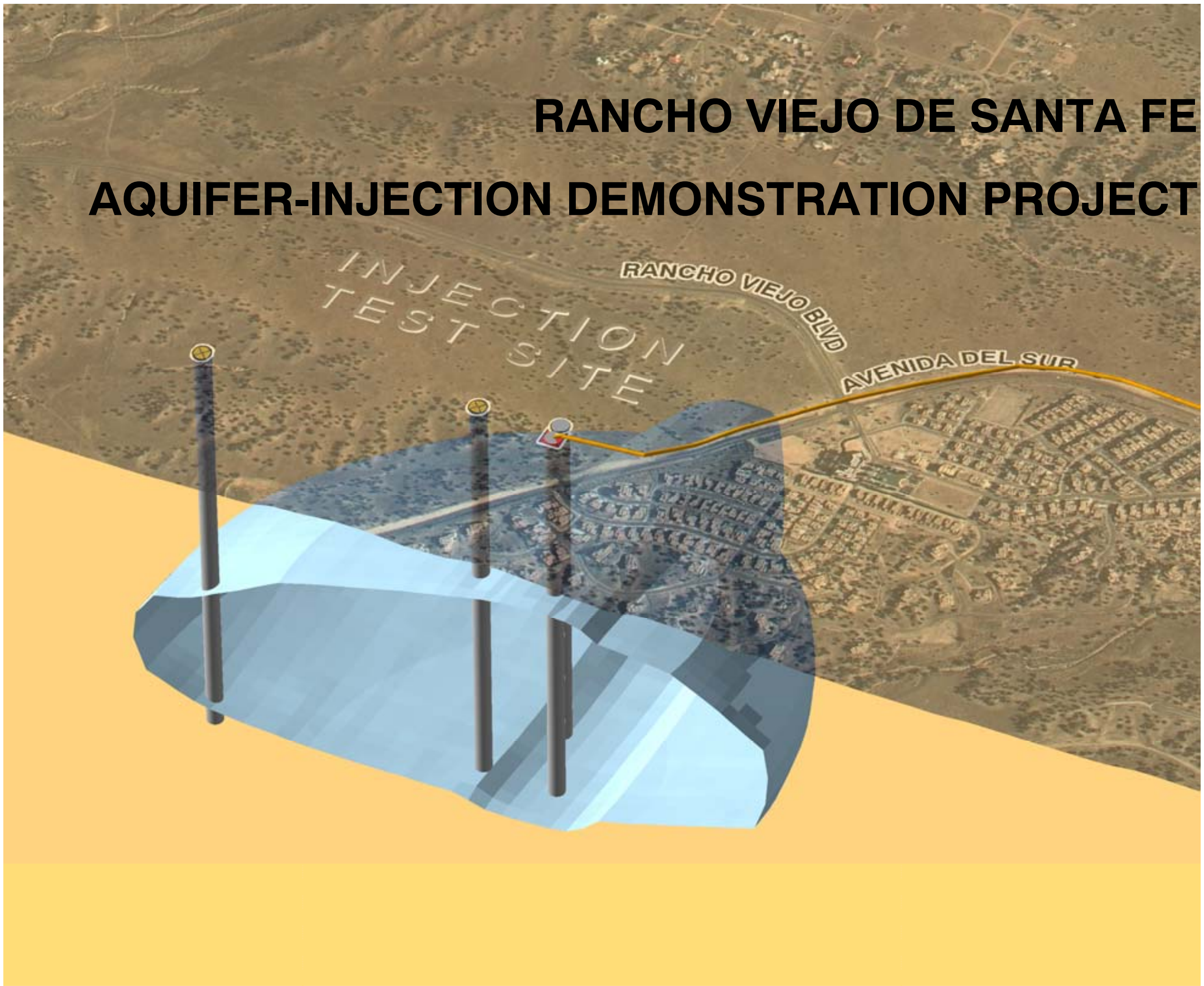
Attachment B

**Prepared for:**
**RANCHO VIEJO DE SANTA FE, INC.**
**55 Cañada del Rancho**
**Santa Fe, NM  87508**

# RANCHO VIEJO DE SANTA FE

# AQUIFER-INJECTION DEMONSTRATION PROJECT



## OCTOBER 2007

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# AQUIFER-INJECTION DEMONSTRATION PROJECT

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# RANCHO VIEJO DE SANTA FE
# AQUIFER-INJECTION DEMONSTRATION PROJECT

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# RANCHO VIEJO DE SANTA FE
# AQUIFER-INJECTION DEMONSTRATION PROJECT

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## SUMMARY

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Rancho Viejo de Santa Fe, Inc. in cooperation with Governor Richardson's Water Innovation Fund, undertook an injection demonstration project in years 2006 and 2007. The project purpose was to demonstrate feasibility of long-term injection of water to the Tesuque Formation through a well.

An injection well and three observation wells were drilled into the Tesuque aquifer in 2006 for the project. Pilot Observation Well A penetrated the basal Bishops Lodge Member of the Tesuque Formation at 1,800 feet. Geophysical logs and cuttings from the four new wells and from an exploratory well drilled in 2001 one-mile east show a regional westward dip of geologic bedding and that a persistent 150-foot-thick clay lies below the water table across the test site. The Community College District pumping well drilled in 2002 is screened below the clay in Tesuque beds correlative with injection and observation wells.

Individual pumping tests of injection and observation wells indicate a non-radial flow response consistent with flow in stacked ribbon-like sand channels bounded by low-permeability deposits. Testing at the pumping well in 2002 indicates near-radial flow with close-in boundaries.

For the injection demonstration, the pumping well was equipped with a pump, control valves, and a flow meter. A three-inch pipeline was installed to convey water one mile west to the injection site. The injection well was equipped with a flow meter,

control valves and a restricting orifice set about 30 feet below static water level to retain-positive pressures in the drop pipe. The pumping and injection wells and eight observation wells and well nests were monitored for response during the test. Wells and piping were sanitized and flushed clean prior to injection. Water quality of the pumping and injection sites are of similar chemistry.

The injection demonstration started on August 29, 2006 and ended on February 27, 2007. Groundwater was extracted at the pumping well and injected at the injection well at an average rate of 50 gallons per minute, a total of about 39 acre feet. Drawdown at the pumping well was 67 feet at the end of the six months. At the injection site, water level buildup in the semi-confined injection zone ranged 85 feet at the injection well to 11 feet at the 2000-foot distant Observation Well C. No aquifer response was seen at water table monitoring points. About one-third of available capacity in the injection well was utilized for the six-month test. After shutdown, water-level recovery was monitored for six months.

The areal influence of six-month injection pressure build-up of about one foot extends to two miles in Tesuque Formation aquifer material consisting of channel sand deposits partially compartmentalized by geologic barrier structures.

The six-month test and six-month recovery response is analyzed with a generalized radial flow calculation and a numeric model. The generalized radial flow calculation utilizes a flow dimension to represent aquifer heterogeneity, variable geometry or boundaries, allowing for substantial geometric deviation from the Theis assumption of two-dimensional radial flow.

Generalized radial flow analysis of injection site buildup and recovery yield a low-flow dimension (n = 1.1 to 1.3) compatible with an aquifer composed of stacked linear channel sands bounded by fine-grained over-bank deposits. At the pumping site the flow dimension indicates nearly radial flow (n = 1.7 to 1.8) with close-in boundaries likely to be mapped faults east and west of the pumping wells.

The numeric model incorporates ribbon-like sand channel features and fault boundaries to simulate the aquifer system with more spatial detail than available in the generalized radial flow calculation. The model simulates the observed head response, confirming that the understanding of the aquifer is reasonable. The model is suitable to adapt for simulating effects of future injection projects that may become of interest to water planners in Santa Fe County.

The injection well and Tesuque aquifer at the test site is capable of accepting 150 gallons per minute (240 acre feet per year) for an extended period with no adverse effects to well efficiency or aquifer performance.

# INTRODUCTION

Rancho Viejo de Santa Fe, Inc. manages water and sewerage operations at a major housing area in the Community College District (CCD) south of Richards Avenue in Santa Fe County, New Mexico. On April 25, 2005, Rancho Viejo authorized Balleau Groundwater, Inc. to provide hydrologic support for an aquifer-injection demonstration project. The purpose of the project was to demonstrate the feasibility of injecting water for an extended period into the Tesuque Formation aquifer through a well. Governor Richardson's Water Innovation Fund contributed part of the funding. The project entailed drilling and constructing an injection well and three observation well/piezometer nests, testing short-term performance of each well, followed by pumping and injecting groundwater for six months with water-level monitoring in ten test and observation wells, and analyzing water-level response with a generalized radial flow (GRF) calculation and a numerical groundwater flow model. This report describes each of these tasks and provides conclusions on the feasibility of injecting water as demonstrated and on the hydrologic nature of the Tesuque Formation aquifer in the demonstration area of response.

The project was approved by New Mexico Office of the State Engineer and Santa Fe County for pumping at CCD production well (CCD-P1) and by New Mexico Environment Department for injecting groundwater into injection well (CCD-I1). Agency approval documents are attached as Appendix A.

## HYDROGEOLOGIC SETTING

The study site is located south of the City of Santa Fe in the CCD of Santa Fe County, New Mexico (Figure 1). The site overlies part of the Santa Fe embayment of the Española structural geologic basin, a shallow, transitional basin between the deeper San Luis Basin to the north and Albuquerque-Belen Basin to the south. The basins are part of the Rio Grande Rift. General geology of the study site and surrounding area is shown in Figure 2.

Numerous studies have been made of the structure and stratigraphy of the Española Basin near Santa Fe (Spiegel and Baldwin, 1963; Kelley, 1978; Hearne, 1985; Koning and Hallett, 2001; Phillips and Grauch, 2004). The major basin-fill unit at the study site is the Tertiary Santa Fe Group, consisting of the Ancha and Tesuque Formations.

The Miocene- to Pliocene-age Tesuque Formation consists of unconsolidated to semi-consolidated sands, silts, clays and minor gravels derived from the Sangre de Cristo Mountains to the east (Spiegel and Baldwin, 1963). Transport and deposition of Tesuque sediments was generally by west-flowing fluvial systems draining to the Rio Grande, but sediment transport at the study site is thought to have been by north-flowing drainages (personal communication, J. Hawley to C. Cook, 2006).

Groundwater below the study site is stored in and moves through sand and gravel beds enclosed in silt and clay of the Tesuque Formation. Thickness of the Tesuque Formation is up to several thousand feet. About 1,600 feet of Tesuque thickness at the injection site was characterized by drilling and logging pilot well CCD-OWA. The Tesuque Formation is overlain by about 200 feet of unsaturated Ancha Formation. The Tesuque Formation forms a wedge in the Santa Fe area that thickens north of the site and pinches out to the south (Koning and Hallett, 2001). Figure 3 shows the elevation of the base of the Tesuque Formation overlying pre-Santa Fe Group formations (Espinaso Formation below the study site) from aeromagnetic data.

Water-level elevations are shown in Figure 4 based on regional water-level data contoured for this study. Groundwater flow below the site is generally west or southwestward from mountain-front recharge at the foot of the Sangre de Cristos to discharge points at La Cienega Springs and the Santa Fe River. Depth to water ranges 250 to 300 feet across the test site. The hydraulic gradient across the site is about 100 feet/mile. Tesuque Formation hydraulic conductivity (K) can range from a few tenths to several feet per day, but the characteristic average range north of Santa Fe is 0.5 to 2 feet/day (Hearne, 1985). Local geologic controls on groundwater flow include depositional pinchout of channel sands, flow across dipping beds, and faults mapped west and east of the pumping well (Figure 2).

## DRILLING AND TESTING

An injection well (CCD-I1) and three observation wells (Observation Well A (CCD-OWA), Observation Well B (CCD-OWB) and Observation Well C (CCD-OWC)) were drilled from January to May 2006 by Rodgers and Co. Inc. for the injection demonstration project. Well locations are shown on Figure 1. Table 1 summarizes well construction for injection, production and outlying monitor-well sites. Figure 5 presents a well cross-sectional diagram. Well completion reports (BGW 2007a, b, c, d) document well drilling, construction and testing. An overview of drilling and testing the four injection-test wells, as well as the CCD pumping and exploratory wells drilled in years 2001 and 2002, is provided below.

In the period 2001 to 2002, Layne Western drilled a pilot exploratory well (CCD-X1) and a pumping well (CCD-P1) for Rancho Viejo about one mile east of the injection well site (Figure 1). Details of well drilling, construction and testing are documented in well completion reports (BGW 2001, 2002). A summary of well construction is provided in Table 1. CCD-X1 was drilled and geophysically logged to 1.500 feet. Subsurface sediments are interpreted as distal piedmont-slope lithofacies (LFA 5 as defined by Hawley and Haase, 1992) derived from the Sangre de Cristo Mountains with lesser amounts of fine-grained basin floor sediments (LFA 3 and 9) (Hawley and Cook, 2003). A correlative 150-foot-thick clay bed is logged above the screened interval at the site. A temporary deep zone and final intermediate zone were tested and found to have local permeability 1.5 to 2.1 ft/day. The exploratory well is completed with an intermediate depth screen and with nested deep and shallow piezometers, all below the 150-foot-thick clay.

Well CCD-P1 was drilled to 1330 feet and completed with a 570-foot-long screen to total depth. A four-day pumping test with one month of recovery indicates transmissivity (T) of local tested formation is 800 $ft^2/d$ (K = 1.4 ft/d) surrounded by low-permeability (T = 150 ft/d ) material at distance. The long-term (several months) recovery trend indicates regional T of 500 $ft^2/d$ (Hawley and Cook, 2003).

The vertical hydraulic gradient between the CCD-P1 screen center and the CCD-X1 shallow piezometer, both below the well-defined clay bed is 0.04 ft/ft downward.

Water-level monitoring at exploration well CCD-X1 and production well CCD-P1 from years 2002 to 2006 (Figure 6) shows generally stable water levels with a slight declining trend at a rate of 0.3 ft/yr. The trend may reflect drawdown from City of Santa Fe wells. The deep piezometer is thought to have clogged perforations, therefore the water-level rise in that piezometer is not considered to reflect aquifer conditions. Background static water-level measurements at the pumping site were stopped in May

2006 prior to airlift testing and redevelopment of the pumping well. For the six-month recharge demonstration test, CCD-P1 was pumped to provide a source of injection water, and the CCD-X1 well nest served as an observation point for adjacent (r = 63 feet) aquifer response.

CCD-OWA was drilled as a pilot well for the injection site by Rodgers and Co. to 1800 feet depth from February 3 to 20, 2006. The borehole penetrated 90 feet of the basal Bishops Lodge member of the Tesuque Formation. Dr. John Hawley of Hawley Geomatters and Dr. Dan Koning of New Mexico Bureau of Geology & Mineral Resources provided logging and interpretation of drill cuttings (Appendix B). Subsurface sediments at CCD-OWA are similar to CCD-X1: sandy, distal piedmont-slope lithofacies (LFA 5) with inter-bedded fine- to coarse-grained basin floor sediments (LFA 3 and 9). Drill cuttings and geophysical logs (Figure 7) indicated several prospective zones of good permeability below a correlative 150-foot clay layer from depths 450 to 600 feet. The correlative 150-foot thick low-resistance clay layer above the screen zone is logged across the site. Three zones below the clay were screened with five-inch diameter slotted casing (Table 1; Figure 5). Two-inch diameter piezometers were installed in the CCD-OWA borehole annulus opposite the deep and intermediate screen settings. Each zone was tested in isolation at about 30 gallons per minute (gpm) for three to four hours. Isolation was accomplished with inflatable packers and by backfilling and sealing previously tested zones. Test-data charts and a summary table of test data and interpretation are included as Appendix C. The testing shows that local Tesuque Formation sand permeability decreases with depth from about 3.8 feet per day (ft/d) in the shallow zone to 0.6 ft/d in the deep zone. The tests also show that pressure change is transmitted between screen zones, apparently through the bentonite seals placed in the wellbore above the backfilled deep and intermediate screens. The vertical gradient below the 150-foot-thick clay at the well is 0.005 ft/ft upward between the shallow and deep screens, although the gradient may be affected by seal leakage.

The geophysical and test data from CCD-OWA and from the exploratory well drilling in year 2001 were used to plan construction of the injection well (CCD-I1). CCD-I1 was drilled to 1320 feet from March 6 to 13, 2006 and geophysically logged. Figure 7 shows the correlation of the distinctive clay and other beds between CCD-X1 and the injection and observation wells. Hawley (2006) (Appendix B) correlates a pebbly sand bed between the pumping and injection sites near the bottom of the CCD-OWA and CCD-X1 boreholes that indicates a regional westward dip of up to three degrees. CCD-I1 screen interval of 590 to 1310 feet was selected to include high-permeability zones tested at CCD-OWA and to correlate with about 300 feet of beds screened by CCD-P1 (Figure 7). The CCD-I1 screen extends about 400 feet above the correlative zone, and the CCD-P1 screen extends about 300 feet below. The well was completed on March 22, 2006 with 12-inch diameter stainless steel wire-wrap screen and with nested shallow and deep two-inch diameter piezometers. Figure 5 shows a schematic of well construction. The vertical hydraulic gradient across the clay bed at CCD-I1 is 0.06 ft/ft upward.

A seven-day pumping test was conducted at CCD-I1 in May 2006 after observation wells CCD-OWB and CCD-OWC were completed. During the test, CCD-OWA, CCD-OWB, and CCD-OWC and CCD-P1 served as observation wells. Charts and a table summarizing test results are included in Appendix C. The test showed that the local aquifer consists of channel sands with K = 1.5 ft/d enclosed by fine-grained deposits of low permeability, as indicated by steep late-time recovery trends. Test data are analyzed by the theoretical curves for flow dimensions reflecting one, two, or three dimensional flow systems corresponding to linear, radial or spherical flow patterns (Walker and Roberts, 2003) and gradations among the three types. The method is discussed in more detail in the "Analysis of Test Data" Section. The flow dimension of the CCD-I1 channel sand is n = 1.1 to 1.3, approximating a linear channel. Response at CCD-P1 about one month after test shutdown indicates a regional transmissivity (T) of

100 $ft^2/d$ and a flow dimension of 2.3. The parameters are compatible with a fault-type boundary between the test and observation wells and induced leakage at late time.

Well CCD-OWB was drilled and logged to 1400 feet from March 28 to April 3, 2006. The well is located 474 feet west of the injection well. Five-inch diameter steel screen with 0.020-inch slots was set 610 to 1330 feet in beds correlative with the CCD-I1 screened interval. A shallow piezometer is installed with perforations about 120 feet below the water table, above the 150-foot-thick clay bed. Vertical gradient across the clay bed at the well is 0.01 ft/ft downward.

CCD-OWB was tested for about four hours at 30 gpm on May 9, 2006. CCD-OWA, CCD-OWC and CCD-I1 were observed for water-level response. Test charts and a summary table are included in Appendix C. Testing shows the well is completed in channel sands with $K = 2.2$ ft/d, enclosed by fine-grain deposits as indicated by steep late-time recovery. Observation well data show a radial-flow response ($n = 2$) compatible with Theis (1935).

CCD-OWC was drilled and logged to 1400 feet depth from April 17 to 22, 2006. The screen interval (680 to 1360 feet) was selected in beds correlative with CCD-I1 and CCD-OWB screens. A two-inch piezometer is installed about 200 feet below the water table, above the clay bed. Vertical gradient across the clay bed at the well is 0.03 ft/ft downward. The downward gradient at wells CCD-OWB and CCD-OWC may result from depressurization of the deeper Tesuque beds by nearby wells, such as the New Mexico State Penitentiary well and the Valle Vista Subdivision Community well, or by pressure built up at the water table from City of Santa Fe sewer effluent. The injection well and CCD-OWA with upward vertical gradients appear to be relatively isolated from these effects due to distance or compartmentalization.

Well CCD-OWC was tested at 36 gpm for four hours on May 11, 2006. Water levels were observed in CCD-I1, CCD-OWA and CCD-OWB, but showed no response to pumping at CCD-OWC. The test data are consistent with an aquifer composed of channel sands with K = 1 ft/d enclosed by fine-grained over bank deposits with one-tenth of the sand permeability, based on steep recovery trends at late time. The slope of drawdown implies a flow dimension of n = 2.3, compatible with leaky radial flow.

Charts and a test summary for all injection and observation single-well tests are attached as Appendix C.

Wells CCD-OWA, CCD-OWB and CCD-OWC are completed with locking steel protective covers set into a concrete pad. The injection well was left without a protective cover to accommodate valves and piping for the recharge demonstration. The wells have been continuously equipped with logging transducers since May 2006 to the present.

## PUMPING AND INJECTION TEST DESIGN

The recharge demonstration test plan was designed for pumping 40 acre feet (AF) of Tesuque Formation groundwater from well CCD-P1 at 50 gallons per minute (gpm) for six months, piping the water one-mile west and injecting into the Tesuque Formation through Well CCD-I1. URS Engineering, Inc. in Phoenix, Arizona designed the pump installation and hydraulic conveyance system to control and transport water to the injection well. Engineering schematics and diagrams of the planned control and conveyance system are attached as Appendix D. The as-built system differs somewhat from the planned schematics. Photographs of the piping and valve installation at the pumping and injection wellheads are in Figures 8 and 9. Photographs of the test installation and the observation wells are in Appendix E.

The pumping well is equipped with a 15-horsepower 70-gpm capacity pump set to 450 feet deep. Discharge rate is controlled to 50 gpm at the pumping wellhead with an adjustable flow control valve (FCV). Well discharge can be directed into the pipeline or, for flushing and cleaning, to waste at a local arroyo by adjusting the setting of two gate valves. A surge/pressure relief valve installed upstream of the gate valves protects the pipeline from overpressure.

Water is conveyed about one mile west to the injection site by a buried three-inch PVC pipe. The pipeline alignment is shown in Figure 10.

At the injection wellhead, a pair of gate valves allows water from the pipeline to be flushed to waste at a nearby arroyo, or to enter the injection well. An adjustable pressure reducing valve (PRV) maintains a constant pressure on the three-inch drop pipe set to 330 feet depth into the injection wellbore. A 0.48-inch diameter orifice installed at the bottom of the drop pipe restricts flow to maintain a full pipe to surface and prevent cascading water and air entrainment in injected water.

Flow at the pumping and injection wells is measured with McCrometer digital flow meters at each wellhead and recorded on dataloggers. Analog pressure gages are installed upstream and downstream of the FCV at the pumping well and the PRV at the injection well. Logging water-level transducers were deployed in the pumping and injection wells, five observation wells and several of the piezometers for monitoring water levels during the injection and recovery periods. Water levels in uninstrumented piezometers and three outlying wells were measured periodically with a well sounder. Observation wells are listed in Table 2 and shown in Figure 10.

Prior to installing the pumping and injection system, Rodgers and Co. chlorinated, swabbed and pumped well CCD-P1 to sterilize and rehabilitate the screen constructed five-years earlier. Rodgers and Co. also brushed and washed down the inside of the injection well casing above static water level to prevent contamination from leftover drilling materials on the wellbore. Rodgers installed the pump, injection drop pipe and valving at both wellheads. Rodgers Plumbing installed the three-inch transmission pipeline. The pipeline was flushed, then filled with chlorinated water for several days for sterilization before the start of injection. Cleaning, flushing and sterilizing the piping was considered part of the test protocol.

## INJECTION DEMONSTRATION

The injection demonstration test started August 29, 2006 and ended February 27, 2007. Prior to start up, the pumping well and pipeline were purged and the control and conveyance system was tested. URS developed a start-up procedure (URS, 2006). Rodgers and Co. operated the pump and the valves. BGW directed the test and monitored wellhead pressure and water flow rates. At start up, water was pumped from CCD-P1 through the pipeline to waste in an arroyo near the injection well until clear and free of air. At 3:00 p.m., the gate valves at the injection wellhead were repositioned to direct water into the injection drop pipe and start the test. The drop pipe filled to surface in two minutes. Rodgers adjusted the FCV and PRV to achieve the target flow rate of 50 gpm. Pressure on the injection drop pipe was 20 psi at start of injection, but was increased to about 50 psi by the end of the six-month test to maintain constant pressure difference across the 0.48-inch orifice. BGW field notes and field sheets with periodic readings of flow, pressure and water levels are attached as Appendix F.

Figure 11 shows pumping and injection flow rates and water levels in the pumping and injection wells. Flow was maintained near the target 50 gpm, except for a few excursions above and below the target early in the test. Small changes in flow rate are reflected in water level response at both wells. We interpret same-time differences in pumping and injection rate to be meter error. Over the test period, the totalizing flow meter indicated that 12.6 million gallons (38.8 AF) of water was pumped and injected at an average rate of 50 gpm. The rate averaged 50.4 gpm for the first three months of the test, and 49.7 gpm for the last three-months, accounting for some late-time flattening of drawdown and build-up trends.

Figures 12 through 15 show hydrographs of water levels during six months of injection and six months of recovery at all monitored wells and piezometers. The pumping well drew down about 67 feet and nearby CCD-X1 about 52 feet at the end of the test (Figure 12). At the injection site (Figure 13), water-level buildup ranged from 83 feet at CCD-I1 to about ten feet at CCD-OWC 2,000 feet distant. CCD-OWA shallow and intermediate screens show identical response. The CCD-OWA deep screen response is probably influenced by leakage through the wellbore seal. Shallow piezometers at CCD-OWB and CCD-OWC (Figure 14) show a rise early in the test a few tenths of a foot, then stabilize. The response is more likely from flow through annular bentonite seal than from groundwater flow through the 150-foot clay aquitard. The shallow piezometer at the injection well, where the annular seal is a more-secure concrete bentonite, shows no response. CCD-X1 shallow piezometer, perforated about 200 feet above the pumping well screen, drew down about 15 feet from vertical leakage through intervening Tesuque beds. Four monitored outlying wells show no observable response to pumping or injection (Figure 15). None showed any effects of shutdown.

The injection well capacity was not fully used (83-foot buildup out of 294 feet available, or 28 percent). Addition available head below land surface implies that 150 gpm could be injected for a multi-year period.

Figure 16 shows distance-buildup relationship among the four wells at the injection site at several times. A low-permeability zone is apparent between wells CCD-OWA (96-foot distance) and CCD-OWB (470-foot distance). We interpret the zone as fine-grained overbank deposits enclosing the more permeable stacked channel sands at CCD-OWA and the injection well.

Displacement of groundwater by six months of injection is calculated to reach about 70 feet from the injection screen, assuming average specific yield of 15 percent. Displacement of formation water into the pumping well screen from six months of withdrawal is about 80 feet in radial extent.

Figure 17 shows water-level elevation and water temperature at the pumping and injection wells. Water temperature is measured by the transducers, set to 430 feet in the pumping well and 335 feet in the injection well. Initial water temperature in the pumping well was about 61°F, but had been raised prior to start of test by system testing, purging and troubleshooting. Temperature in the pumping well increased from 61°F to 69°F as warmer water from up to 1300-feet deep heats cooler shallow water. Injection well water temperature rises from 61°F to 69°F upon injection. Diurnal air temperature fluctuations are reflected in injection temperatures until early October, when insulated enclosures were installed at the pumping and injection wellheads (see photos in Appendix E). At the onset of cooler fall and winter temperatures, injected water temperature begins a steady decline from 68.5°F to about 65.5°F by end of test. The three-degree temperature change caused injected water viscosity to increase by about four percent, thus increasing water-level buildup proportionally (0.04 x 83 ft = ~3 feet) in the wellbore. An increase of about 2.5 feet can be seen in the difference of water-level buildup between the injection well and CCD-OWA (Figure 18). At 96 feet from the injection well, CCD-OWA water levels are not affected by water temperature.

We conclude that the buildup difference is from temperature change and not from loss of screen or formation efficiency.

Figure 18 shows water-level buildup difference in the injection well deep piezometer and the injection screen. The deep piezometer was installed in the gravel pack alongside the screen to observe changes in water-level difference with the injection screen that might signal screen clogging. During the six-month injection phase, the difference in water levels was consistently about 2.7 feet. We conclude that no observable screen clogging occurred as a result of six months of water injection.

Figure 19 shows drawdown difference of CCD-P1 and CCD-X1 intermediate screen. A difference of about 15 feet is maintained for the six-month test, indicating that screen and nearby formation efficiency did not diminish.

Water was sampled from CCD-P1 at the end of the four-day test in 2002, and from CCD-I1 after the May 2006 seven-day test. A repeat sample from CCD-P1 was pulled for analysis on February 26, 2007 prior to shutting down the six-month test. Certificates of Analyses for the three samples are included as Appendix G.

Sampling at the pumping and injection sites from earlier multi-day tests show water quality at the sites is similar. Total dissolved solids (TDS) are 182 and 167 mg/l at the pumping and injection sites. Major ions are present in similar concentrations. Arsenic is the same at 10 parts per billion (ppb).

The CCD-P1 sample from the end of the six-month test showed slightly less TDS (145 mg/l) and substantially lower arsenic (4.9 ppb). The six-months of pumping have tapped into a slightly fresher water source than sampled initially. Water quality had no effect on the injection performance.

# ANALYSIS OF TEST DATA

Six months of pumping and injection response and six months of recovery data are analyzed with GRF calculations and with a numerical model. The GRF calculation employs the formulas developed by Barker (1988) and Walker and Roberts (2003) to characterize aquifer geometry. The parameters resulting from the GRF calculations are used, in conjunction with a geologic and structural conceptual model of the aquifer system, to develop a three-dimensional numerical model with further spatial information. Both methods of test-data analysis are described below.

## Generalized Radial Flow

Barker (1988) developed a GRF model to describe groundwater flow in a fractured rock system. GRF provides type-curves for analysis that are not limited to two-dimensional radial flow (e.g. Theis, 1935). The model employs a non-integer flow dimension ($1 \leq n \leq 3$) that describes the rate at which cross-sectional flow area changes with respect to distance from a source or sink (e.g., a well). Ideally, flow dimension $n = 1$ describes parallel flow inside a one-dimensional prism, $n = 2$ describes concentric two-dimensional radial flow (well function of Theis, 1935), and $n = 3$ is spherical three-dimensional flow to a point. Flow dimensions with values between the idealized integers are conceptualized to contain proportional elements of two or more ideal geometries. The GRF analytical model uses the usual parameters T and S to characterize the well screen zone, then adds a separate parameter of flow dimension to define the curve to be matched to field data, allowing for substantial geometric deviations from the Theis assumption of two-dimensional radial flow. Walker and Roberts (2003) expanded the GRF model concept to apply to general hydrogeologic systems, wherein flow dimension can represent aquifer heterogeneity, variable geometry, or boundaries, with values less than one (a container) and greater than three (an external source). BGW adapted equations (4) through (6) of Walker and Roberts (2003) into a spreadsheet model for matching characteristic GRF curves against test data. The principle of superposition is used to simulate effects of the pumping/injection well pair, and to calculate recovery curves. Figures 20 through 31 show drawdown/buildup and recovery data with matching GRF curves for pumping, injection and observation wells. Table 3 contains a summary of curve-match results. Results are discussed below.

Buildup at the injection well and at CCD-OWA 96 feet distant have comparable GRF late-time curve matches (Figures 20 and 21), with T = 210 and 340 $ft^2/d$, Storativity (S) about 0.0004, and n = 1.3 and 1.1. A GRF curve with T = 1050 $ft^2/d$ matches early CCD-OWA buildup. The flow dimension near one is interpreted to indicate the wells are completed in a linear flow system consisting of stacked linear channel sands bounded by low-permeability overbank deposits. Near-screen effective permeability within the sands is about 1.5 ft/d (1050 $ft^2/d \div 720$ feet), but regional effective permeability is 1/3 to 1/2 ft/d. Pumping at CCD-P1 appears to cause a flattening of the injection build-up trend 10 to 15 days after the start of the test, when the influence of the one-mile separation is seen. The flattening is less than theoretical due to the common interval of pumping well and injection well screen being about one-third the combined screened interval.

Wells CCD-OWB and CCD-OWC response during injection (Figures 22 and 23) matches GRF curves with parameters T = 1050 $ft^2/d$, S = 0.003 and 0.002, and n = 1.2 to 1.3. Flow dimension is consistent with stacked linear channel sands with leaky boundaries. Regional effective T as observed in these outlying wells is three to four times higher than that observed at CCD-OWA, the latter reflecting the low-permeability barrier seen in the distance-relationship between CCD-OWA and CCD-OWB (Figure 16).

Figures 24 and 25 show GRF curve matches to the pumping well and CCD-X1 drawdown. Matching parameters at late-time are T = 185 and 150 $ft^2/d$, S = 0.00065 and 0.0008 and n = 1.7 and 1.8, respectively. Early time data are affected by residual drawdown from pre-test pumping for system testing and troubleshooting. Flow dimensions are somewhat less than radial flow (n = 2), and may reflect a leaky boundary at the fault mapped one-quarter mile west of the wells. Effective permeability is about 1/3 ft/d (185 $ft^2/d \div 530$ ft), similar to that at the injection well. The values of T compare favorably to the four-day pumping late-time drawdown T of 150 $ft^2/d$ in Hawley and Cook (2003). The regional late-time recovery T = 500 $ft^2/d$ in Hawley and Cook (2003) is not apparent in the six-month test data because coalescing pumping and injection cones flatten water levels.

GRF curves matched to recovery data at six wells are shown in Figures 26 through 31, and summarized in Table 3. GRF recovery curves were generated using superimposed curves with common parameters. In most cases, the recovery GRF parameters are similar to those derived for the injection/pumping period. The notable exception is the pumping and exploratory wells, which show a significant reduction in flow dimension (from 1.7/1.8 to 1.4). The change may signal the influence of a more-distant flow boundary, such as the bedrock fault mapped one mile east of the pumping well (Figure 2), or depositional pinchout of the Tesuque at the Santa Fe Embayment margins (Figure 3).

The GRF curve-match parameters are used to help conceptualize the flow system for a three-dimensional numerical groundwater model. The analysis is interpreted to reflect the behavior of separate channel sands with K in the range of one to 2 $ft^2/d$ enclosed by lower K material in the range of one-fifth to one-tenth those values. The sands have lateral dimensions on the scale of hundreds of feet and long dimensions of several miles.

## Numerical Model

A groundwater model was developed to simulate the flow system at the pumping and injection test site with spatial detail not available from the GRF analysis. An illustration of the conceptual hydrogeologic system is in Figure 32. The model is developed with the finite difference MODFLOW packages of Harbaugh and others (2000). Appendix H contains a technical memorandum detailing model conceptualization, construction, calibration and fit to test data. The numerical model provides a framework for further simulation of development scenarios for water injection operations. The key points of the technical memorandum are summarized below.

The model was developed to fit Hawley's geologic concept of stacked, linear, high-permeability sand channels with a north-south orientation enclosed by over bank and other deposits of lower permeability. The GRF curve match for the seven-day CCD-I1 test (Appendix C) and from the six-month injection period show a predominately low-dimension linear flow response of aquifer water levels to a stress, consistent with that geology. The model grid and cross sections are shown in Figures 33 and 34. Regional hydraulic conductivity is simulated at 0.25 to 0.5 feet/day. Linear channel sands are simulated with a north-south trending zone of model cells at K = one-half to one foot/day. Enclosing fine-grain deposits are hundredths of ft/d conductivity. Faults one-quarter mile west and one mile east of the pumping well are included as leaky barriers. Regional dip structure is west and north, compatible with geophysical and lithologic correlations (Figure 7) and aeromagnetic data (Figure 3). Injection and production well screens are simulated in the corresponding layers on a 100-foot layer discretization.

Observed and simulated heads at OWA, OWB, OWC and CCD-X1 are shown in Figures 35 through 38. The model is a reasonable simulation of test results, with simulated head within 5 to 10 percent of observed head and r-squared values over 0.95.

Figure 39 shows the simulated injection and pumping pressure response at several times during the test. An animation of the pressure response can be viewed at http://balleau.com/results.php?category=tools. At the injection site, water first pressurizes the high permeability channel before leaking into surrounding beds. The two cones of production and injection coalesce at 35 to 40 days from start of test. The fault simulated between the pumping and injection sites causes the pumping pressure gradient to steepen westward. The six-month radius of influence of injection reached to about two miles with one foot of buildup in channel sands and in other sediments (Figure 33). The test-response area continued to expand throughout the one year of monitoring.

The flow dimension of the model-simulated response is calculated in Appendix H using the derivative of the simulated pressure change in a method described by Walker and Roberts (2003). The pumping and injection well effects are excluded to avoid that artificial boundary, and to characterize only the aquifer properties. Model-calculated flow dimensions vary, generally increasing through time to reflect heterogeneity and scale-dependent factors built into the model that the analytical GRF curves do not represent. The model response is in the flow dimension range of less than 1.0 to near 3.0, averaging near the analytical values between 1.0 and 2.0. The increasing flow dimension illustrates the evolution from response in channel sands to more three-dimensional volumes of the aquifer space.

# CONCLUSIONS

1. An injection well and three observation well nests were drilled in year 2006 for a recharge demonstration project undertaken cooperatively by Governor Richardson's Water Innovation Fund and Rancho Viejo de Santa Fe, Inc.

2. Drill cuttings and geophysical logs indicate the Tesuque Formation aquifer penetrated by the test wells are correlative, consisting of distal piedmont-slope fluvial sands and gravels interbedded with silt and clay.

3. Pilot Observation Well A penetrated the Bishops Lodge Member base of the Tesuque Formation at 1800 feet.

4. Lithologic and geophysical log correlations among the injection test wells and the associated Community College District exploratory well drilled in year 2001 indicate that beds dip up to three degrees west across the study site.

5. The Community College District pumping well and injection well one-mile apart are screened in correlative Tesuque beds with the pumping well screen extending below and injection screen extending above the common screened interval.

6. Individual pumping tests of injection and observation wells indicate a non-radial flow response. The response is compatible with an aquifer composed of a series of stacked linear channel sands, enclosed by fine-grained deposits.

7. A six-month injection demonstration with one-year monitoring of response, involved withdrawing 50 gallons per minute of groundwater at the pumping well site, piping it one mile west and injecting it to the injection well. A total of 38.8 acre feet was pumped and injected from August 2006 to February 2007.

8. End-of-test water-level buildup ranged from 83 feet at the injection well to 11 feet at the 2000-foot distant observation well. Drawdown at the pumping well was about 67 feet. The shallow water table above a 150-foot thick clay showed no observable response. At the end of the full year of monitoring, water levels were back to two feet residual buildup at the injection well and three feet residual drawdown at the pumping well.

9. No clogging of the injection screen, gravel pack or formation was observed during the six-month test. Effects of injection water temperatures, which alter viscosity, were seen.

10. A clean, sterile, positive-pressure operation free of gas or air contributed to the injection efficiency.

11. Water sampling indicates water quality at the pumping and injection sites is similar. Six months of pumping produced water with lower total dissolved solids and arsenic (about five parts per billion). Water quality had no impact on the injection test.

12. Generalized radial flow calculations to match data show that non-radial flow with leakage characterizes the response at the injection site (flow dimension = 1.1 to 1.3). The pumping site is characterized by nearly radial flow with a close-in boundary (flow dimension = 1.7 to 1.8).

13. Water was displaced 80 feet radially into the pumping well and 70 feet radially from the injection well.

14. The test site flow system is simulated with a numerical model that incorporates linear channel features and fault barriers. The numerical model simulates the observed response. The model is suitable to adaptation for projecting scenarios of future injection project effects.

15. The injection well and Tesuque aquifer at the test site is capable of accepting 150 gallons per minute (240 acre feet per year) for an extended period with no adverse effects to well efficiency or aquifer performance.

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# TABLES

TABLE 1. SUMMARY OF WELL CONSTRUCTION

| Well | Completion Date | X (ft)[1] | Y (ft)[1] | Land Elevation[1] (ft msl) | Total Depth Drilled (ft) | Screen Interval (ft) | Screen Length (ft) | Casing Diameter (in) | Pre-Test Static Water Level[2] (ft) | Water Level Elevation (ft msl) | Vertical Head Difference[3] (ft) | Vertical Gradient (to Screen Centers)[3] (ft/ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CCD-X1 | 21-Dec-01 | 1714736 | 1673013 | 6556.6 | 1500 | 690 - 890 | 200 | 6 | 244.3[4] | 6312.3 | 15.0 | 0.06 |
| Shallow Piezometer | | | | | | 530 - 540 | 10 | 2 | 229.3[4] | 6327.3 | | |
| Deep Piezometer[5] | | | | | | 1137 - 1157 | 20 | 2 | 231.2[4] | 6325.4 | | |
| CCD-P1 | 26-Jan-02 | 1714675 | 1672996 | 6555.4 | 1330 | 740 - 1310 | 570 | 12 | 248.4[4] | 6307.0 | -- | 0.04[6] |
| CCD-I1 | 22-Mar-06 | 1709338 | 1671966 | 6479.9 | 1320 | 590 - 1310 | 720 | 12 | 293.6 | 6186.3 | -20.5 | -0.06 |
| Shallow Piezometer | | | | | | 350 - 370 | 20 | 2.5 | 314.1 | 6165.8 | | |
| Deep Piezometer | | | | | | 690 - 710 | 20 | 2.5 | 294.1 | 6185.8 | | |
| CCD-OWA | 20-Feb-06 | 1709334 | 1672062 | 6482.5 | 1800 | 580 - 620 | 40 | 5 | 294.2 | 6188.3 | -4.7 | -0.005 |
| Intermed. Piezometer | | | | | | 1020 - 1140 | 120 | 2.5 | 293.7 | 6188.8 | | |
| Deep Piezometer | | | | | | 1500 - 1580 | 80 | 2.5 | 289.5 | 6193.0 | | |
| CCD-OWB | 3-Apr-06 | 1708866 | 1672010 | 6473.3 | 1400 | 610 - 1330 | 720 | 5 | 296.3 | 6177.0 | 6.6 | 0.01 |
| Shallow Piezometer | | | | | | 370 - 390 | 20 | 2.5 | 289.7 | 6183.6 | | |
| CCD-OWC | 27-Apr-06 | 1707268 | 1671862 | 6418.0 | 1400 | 680 - 1360 | 680 | 5 | 249.6 | 6168.4 | 15.3 | 0.03 |
| Shallow Piezometer | | | | | | 430 - 450 | 20 | 2.5 | 234.3 | 6183.7 | | |
| La Cienega Well | Unknown | 1725342 | 1674127 | 6787.0 | 230 | Unknown | -- | 4 | 227.4 | 6559.6 | -- | -- |
| El Rancho Well | Unknown | 1713589 | 1670440 | 6538.0 | 230 | Unknown | -- | 4 | 214.0 | 6324.0 | -- | -- |
| Rancho Viejo Obs. Well | Unknown | 1716280 | 1662000 | 6536.0 | 700 | 250 - 700[7] | 310[7] | 4 | 203.3 | 6332.7 | -- | -- |
| SFCC Well | Unknown | 1714799 | 1674217 | 6579.0 | 460 | Unknown | -- | 5 | 238.1[8] | 6340.9 | -- | -- |

[1] Coordinates are New Mexico State Plane Central NAD83 / NGVD 29

[2] Measured August 2006 unless otherwise noted; depth below ground level

[3] Negative number indicates upward gradient

[4] Measured 5/2/2006 before pumping well was airlift tested and developed

[5] Piezometer clogged

[6] CCD-X1 Shallow Piezometer to CCD-P1 vertical gradient

[7] Screened intervals are 250-300, 280-420, 540-610, and 650-700 feet

[8] Measured 9/5/2006, after start of test

## TABLE 2. SUMMARY OF INJECTION DEMONSTRATION TEST AUGUST 2006 TO FEBRUARY 2007, WITH RECOVERY TO SEPTEMBER 2007

| Well | Distance from Pumping Well (ft) | Distance from Injection Well (ft) | Pre-Test Static Water Level[1] (ft) | End-of-Test Depth to Water[2] (ft) | End-of-Test Water Level Change[3] (ft) | End-of-Recovery Depth to Water[4] (ft) | Residual Water Level Change[3] (ft) |
|---|---|---|---|---|---|---|---|
| CCD-X1 | 63 | 5499 | 244.3 [5] | 297.8 | 53.5 | 247.9 | 3.6 |
| Shallow Piezometer | | | 229.3 [5] | 243.9 | 14.6 | 232.7 | 3.4 |
| Deep Piezometer[6] | | | 231.2 [5] | 231.8 | 0.6 | 231.6 | 0.4 |
| CCD-P1 | 0.5 | 5435 | 248.4 [5] | 315.6 | 67.2 | 251.8 | 3.4 |
| CCD-I1 | 5435 | 0.5 | 293.6 | 208.9 | -84.7 | 291.4 | -2.2 |
| Shallow Piezometer | | | 314.1 | 314.2 | 0.1 | 314.3 | 0.2 |
| Deep Piezometer | | | 294.1 | 208.5 | -85.6 | 291.6 | -2.5 |
| CCD-OWA | 5422 | 96 | 294.2 | 219.0 | -75.2 | 291.2 | -3.0 |
| Intermed. Piezometer | | | 293.7 | 218.8 | -74.9 | 290.5 | -3.2 |
| Deep Piezometer | | | 289.5 | 218.4 | -71.1 | 286.5 | -3.0 |
| CCD-OWB | 5892 | 474 | 296.3 | 279.2 | -17.1 | 292.9 | -3.4 |
| Shallow Piezometer | | | 289.7 | 287.4 | -2.3 | 290.3 | 0.6 |
| CCD-OWC | 7493 | 2073 | 249.6 | 238.4 | -11.2 | 247.0 | -2.6 |
| Shallow Piezometer | | | 234.3 | 233.8 | -0.5 | 234.3 | 0.0 |
| La Cienega Well | 10,727 | 16,149 | 227.4 | 225.8 | -1.6 [7] | NM | -- |
| El Rancho Well | 2777 | 4517 | 214.0 | 214.1 | 0.1 [8] | NM | -- |
| Rancho Viejo Obs. Well | 11,112 | 12,146 | 203.3 | 202.7 | -0.6 [9] | NM | -- |
| SFCC Well | 1228 | 5907 | 238.1 [10] | 233.7 [11] | -4.4 [12] | NM | -- |

[1] Below ground level, measured August 2006 unless otherwise noted

[2] Below ground level, measured 2/26/2007 unless otherwise noted

[3] Negative number indicates groundwater buildup

[4] Measured 9/19/2007

[5] Measured 5/2/2006 before pumping well was airlift tested and developed

[6] Piezometer clogged

[7] Recovery from summer pumping

[8] Barometric pressure effect

[9] Affected by nearby windmill well

[10] Measured 9/5/2006, after start of test

[11] Measured 2/20/2007

[12] Recovery from summer pumping

NM = Not measured

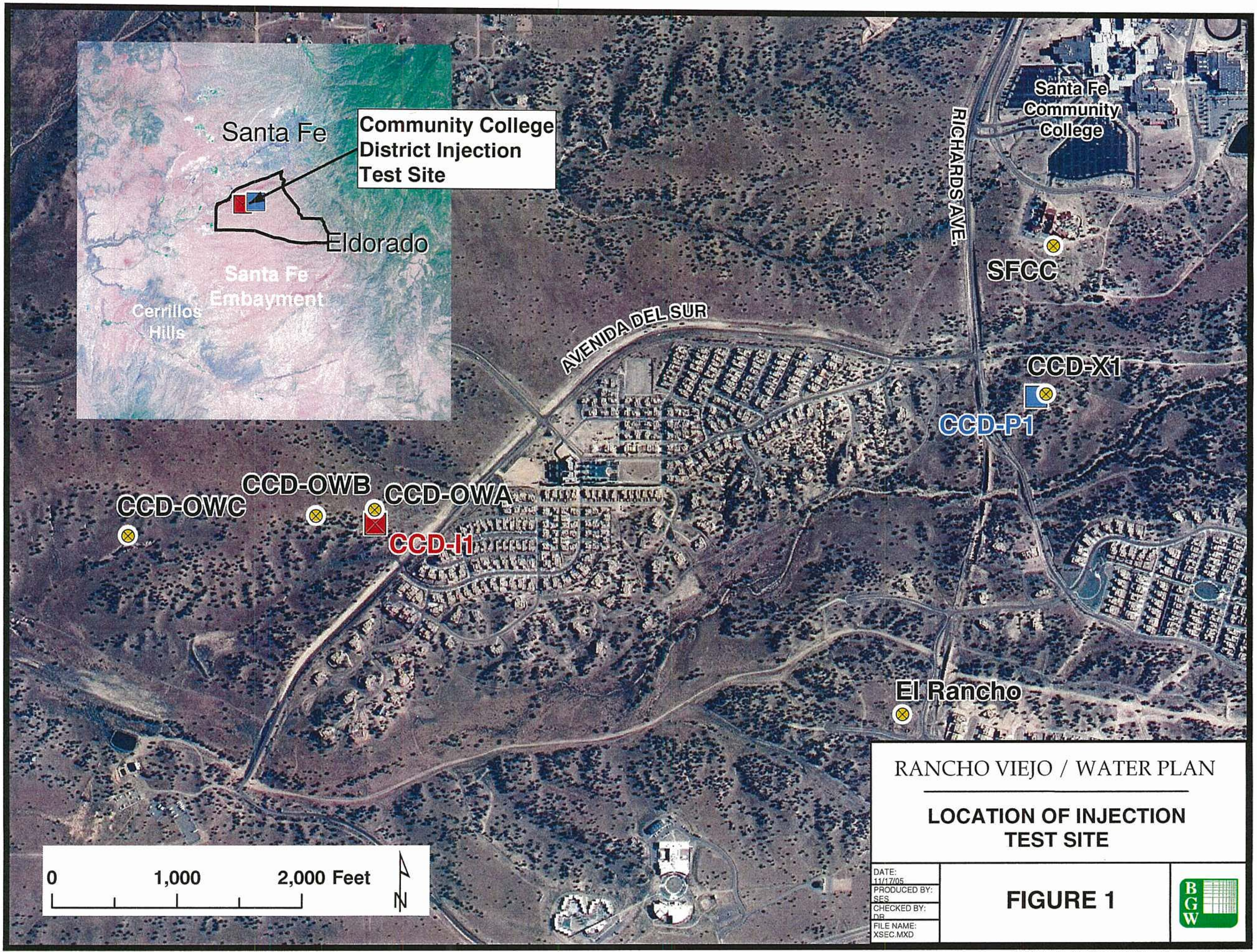
## TABLE 3. RESULTS OF GRF ANALYSES FOR INJECTION/PUMPING AND RECOVERY PERIODS

| Well | Six-month Pumping/Injection | | | Six-month Recovery | | |
|---|---|---|---|---|---|---|
| | Transmissivity ($ft^2$/d) | Storativity | Flow Dimension | Transmissivity ($ft^2$/d) | Storativity | Flow Dimension |
| CCD-I1 | 210 | 0.00035 | 1.3 | 220 | 0.00025 | 1.3 |
| CCD-OWA (intermed.) | 340 | 0.0004 | 1.1 | 270 | 0.00025 | 1.2 |
| CCD-OWB | 1050 | 0.003 | 1.2 | 900 | 0.007 | 1.2 |
| CCD-OWC | 1050 | 0.002 | 1.3 | 860 | 0.005 | 1.3 |
| CCD-P1 | 175 | 0.00065 | 1.7 | 290 | 0.0015 | 1.4 |
| CCD-X1 | 150 | 0.0008 | 1.8 | 300 | 0.0015 | 1.4 |

Analyzed by methods adapted from Walker and Roberts (2003).

GRF analyses summary.xls
Sheet1
CC
11/2/2007

# FIGURES



RANCHO VIEJO / WATER PLAN

**LOCATION OF INJECTION TEST SITE**

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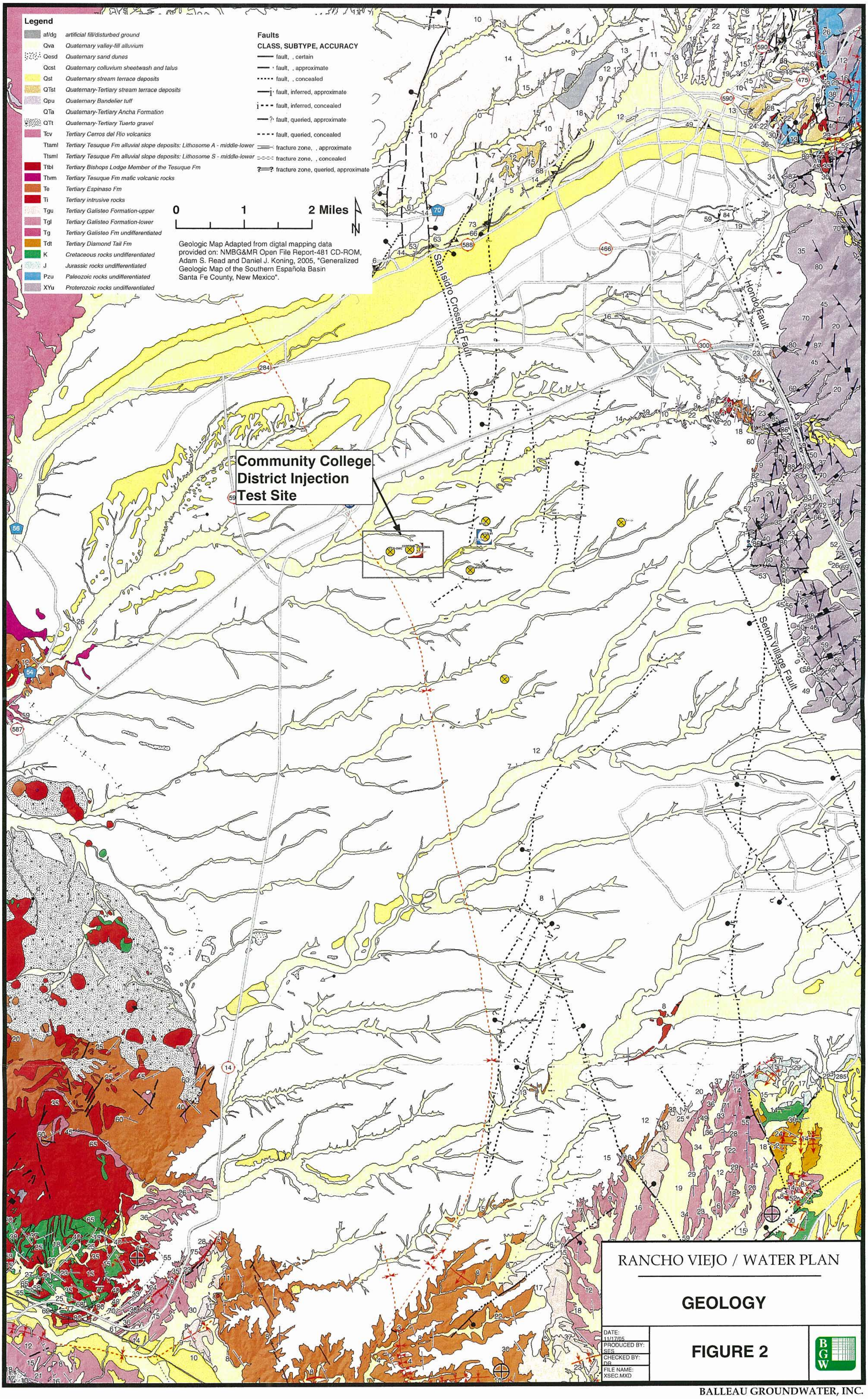
CHECKED BY: DR
FILE NAME: XSEC.MXD

**FIGURE 1**

BALLEAU GROUNDWATER, INC.



Geologic Map Adapted from digtal mapping data provided on: NMBG&MR Open File Report-481 CD-ROM, Adam S. Read and Daniel J. Koning, 2005, "Generalized Geologic Map of the Southern Española Basin Santa Fe County, New Mexico".

RANCHO VIEJO / WATER PLAN

## GEOLOGY

DATE: 11/17/05
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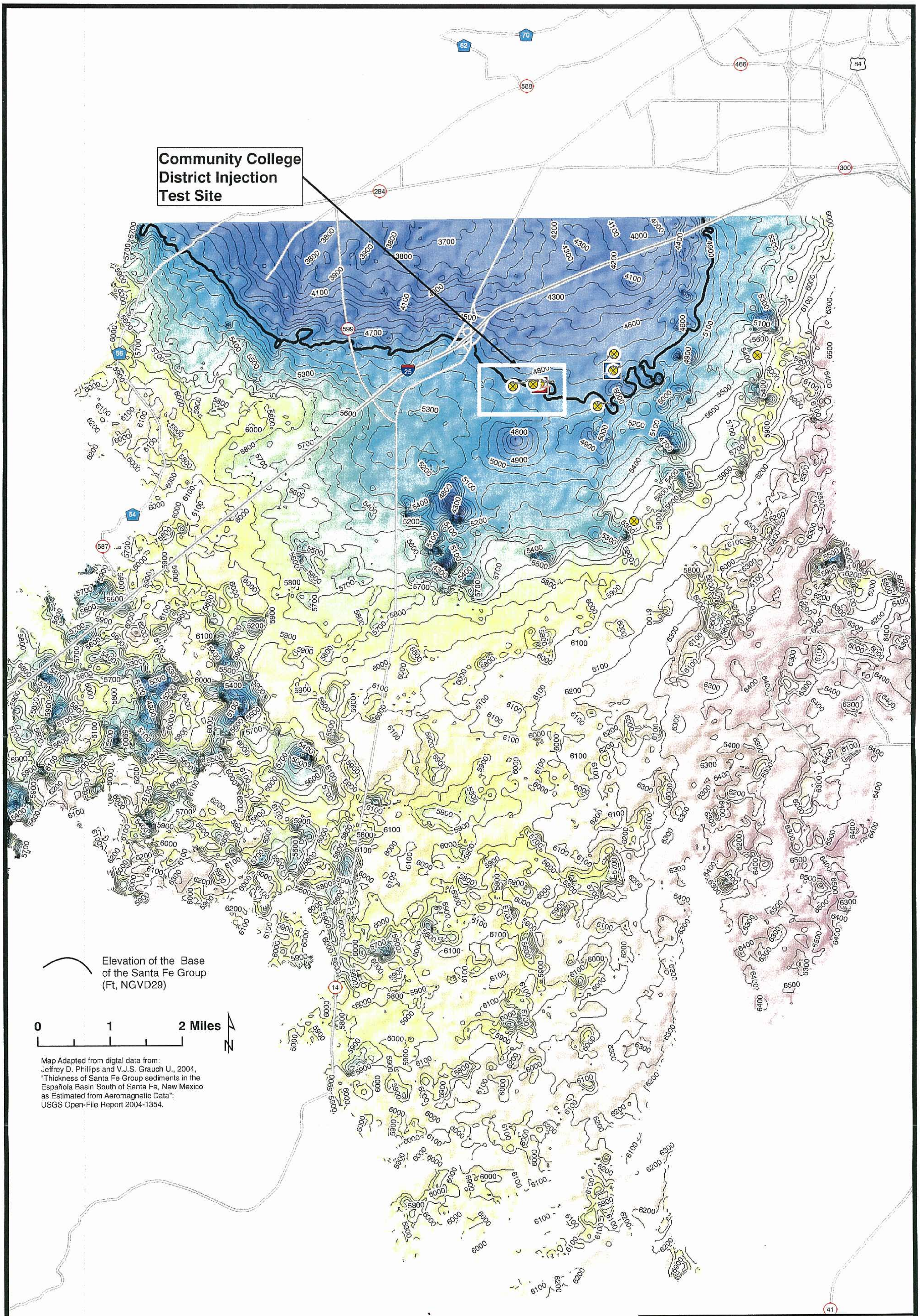
**FIGURE 2**

BGW

BALLEAU GROUNDWATER, INC.



Map Adapted from digtal data from:
Jeffrey D. Phillips and V.J.S. Grauch U., 2004,
"Thickness of Santa Fe Group sediments in the
Española Basin South of Santa Fe, New Mexico
as Estimated from Aeromagnetic Data":
USGS Open-File Report 2004-1354.

RANCHO VIEJO / WATER PLAN

## ELEVATION OF BASE OF TESUQUE FROM AEROMAGNETIC DATA

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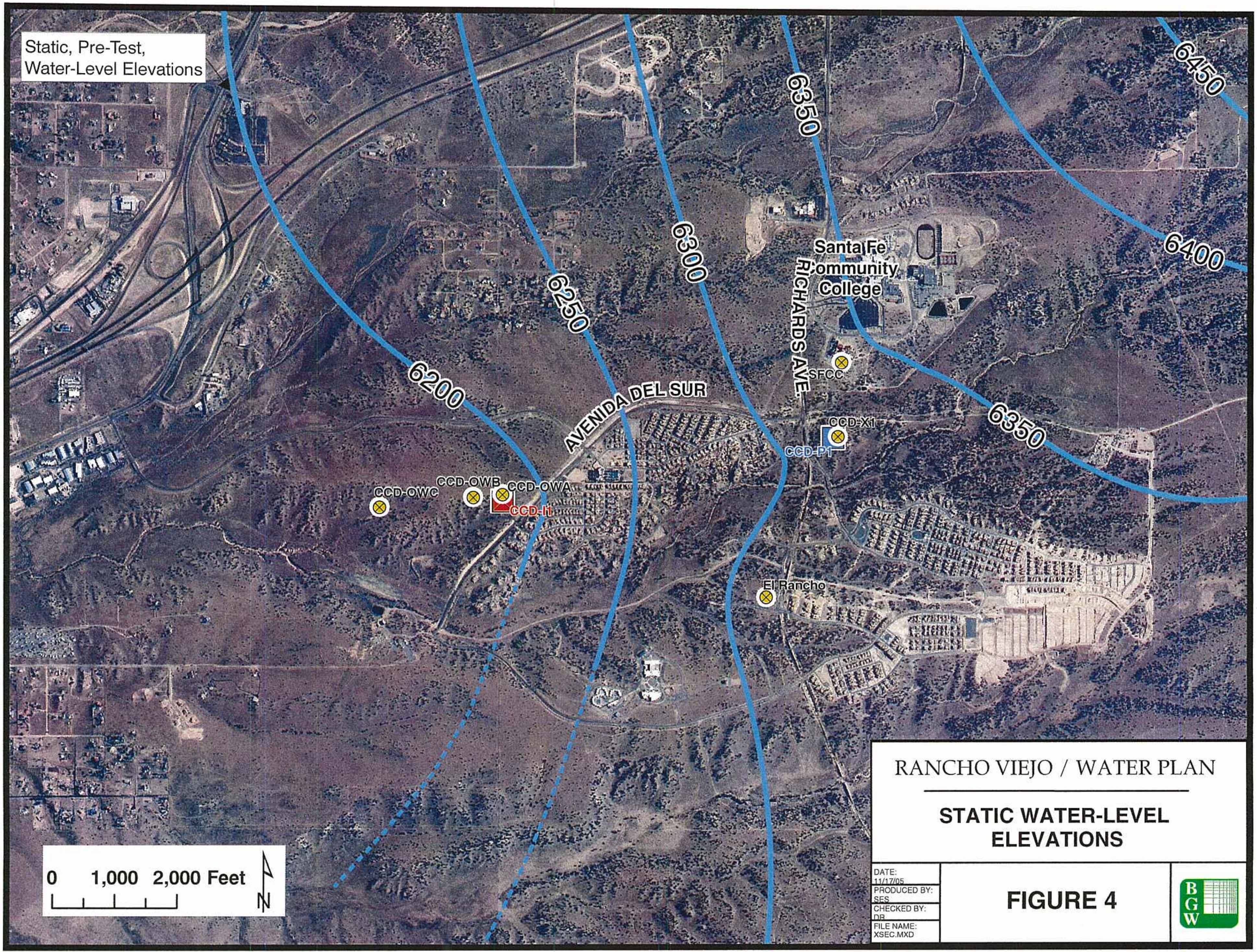
FILE NAME: amag2.MXD

**FIGURE 3**

BGW

BALLEAU GROUNDWATER, INC.



RANCHO VIEJO / WATER PLAN

## STATIC WATER-LEVEL ELEVATIONS

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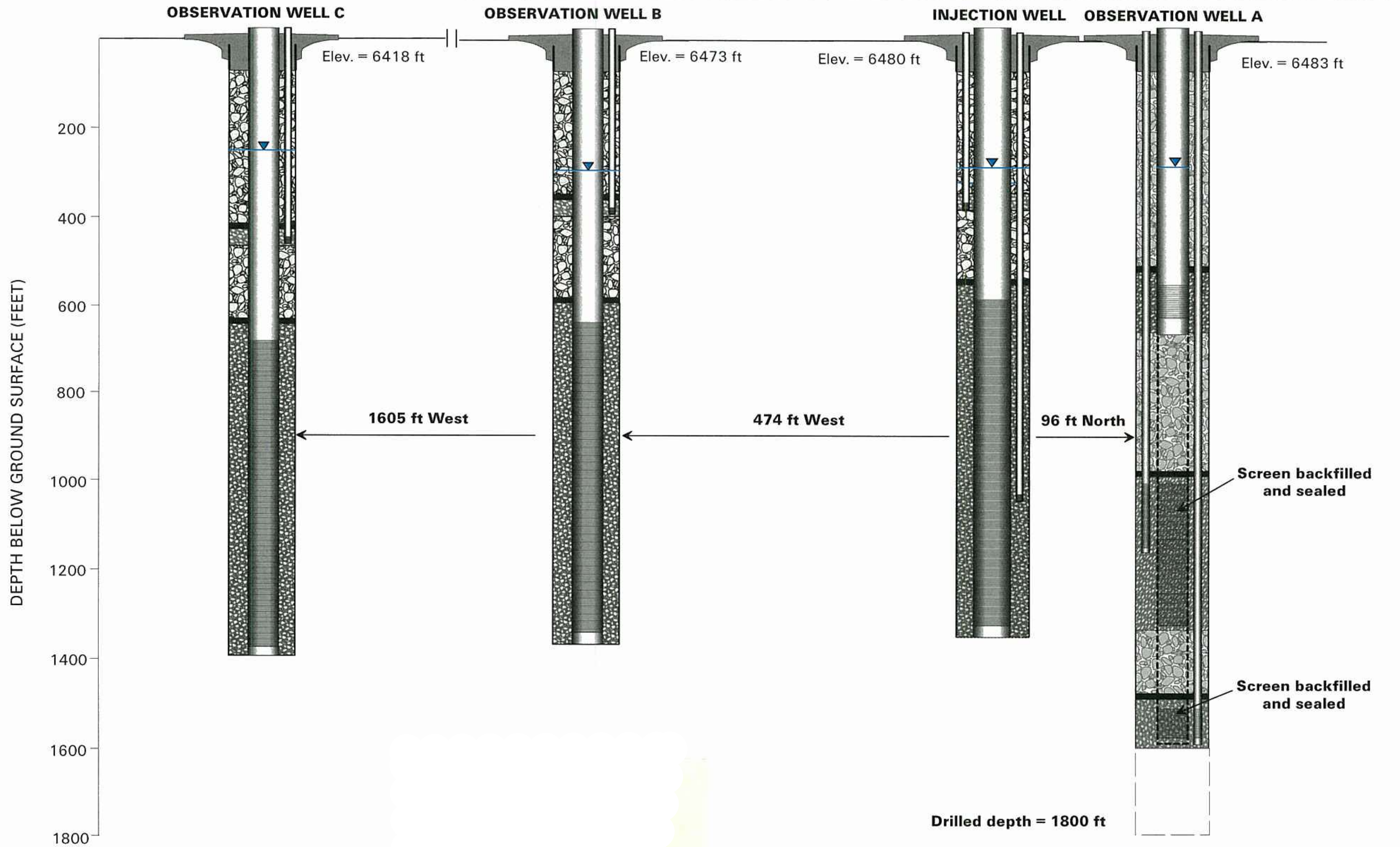
FILE NAME: XSEC.MXD

**FIGURE 4**

BALLEAU GROUNDWATER, INC.



See BGW (2001) and BGW (2002) for CCD-P1 and CCD-X1 schematics

RANCHO VIEJO / WATER PLAN

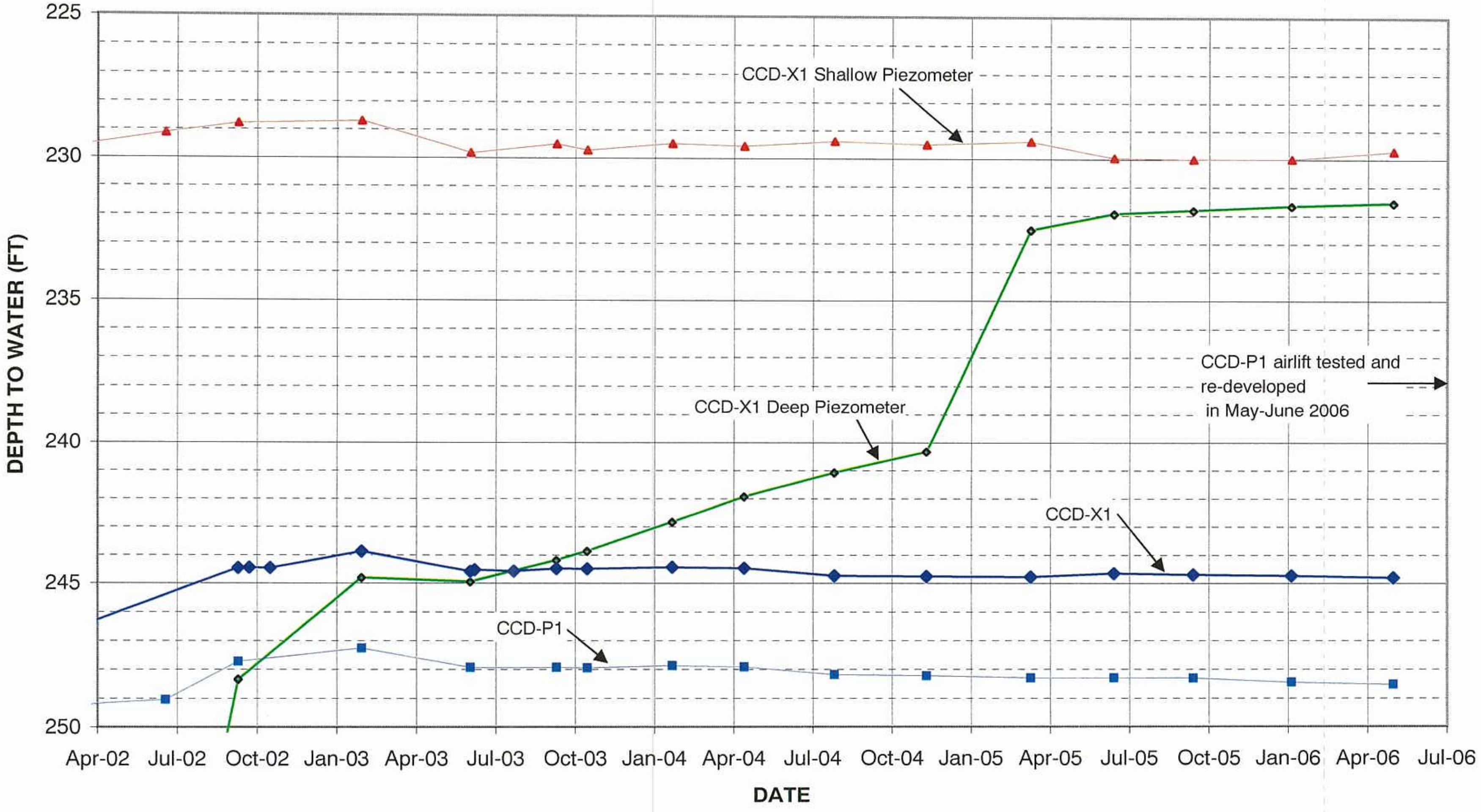
## SCHEMATIC CROSS SECTION OF INJECTION AND OBSERVATION WELLS

Date: 10/29/07
Produced By: CWC
Checked By: WPB
Filename: inj wellfield as built.dsf

**FIGURE 5**

BALLEAU GROUNDWATER, INC.

## FIGURE 6
## COMMUNITY COLLEGE DISTRICT PUMPING WELL SITE PRE-TEST HYDROGRAPHS
## 2002 - 2006



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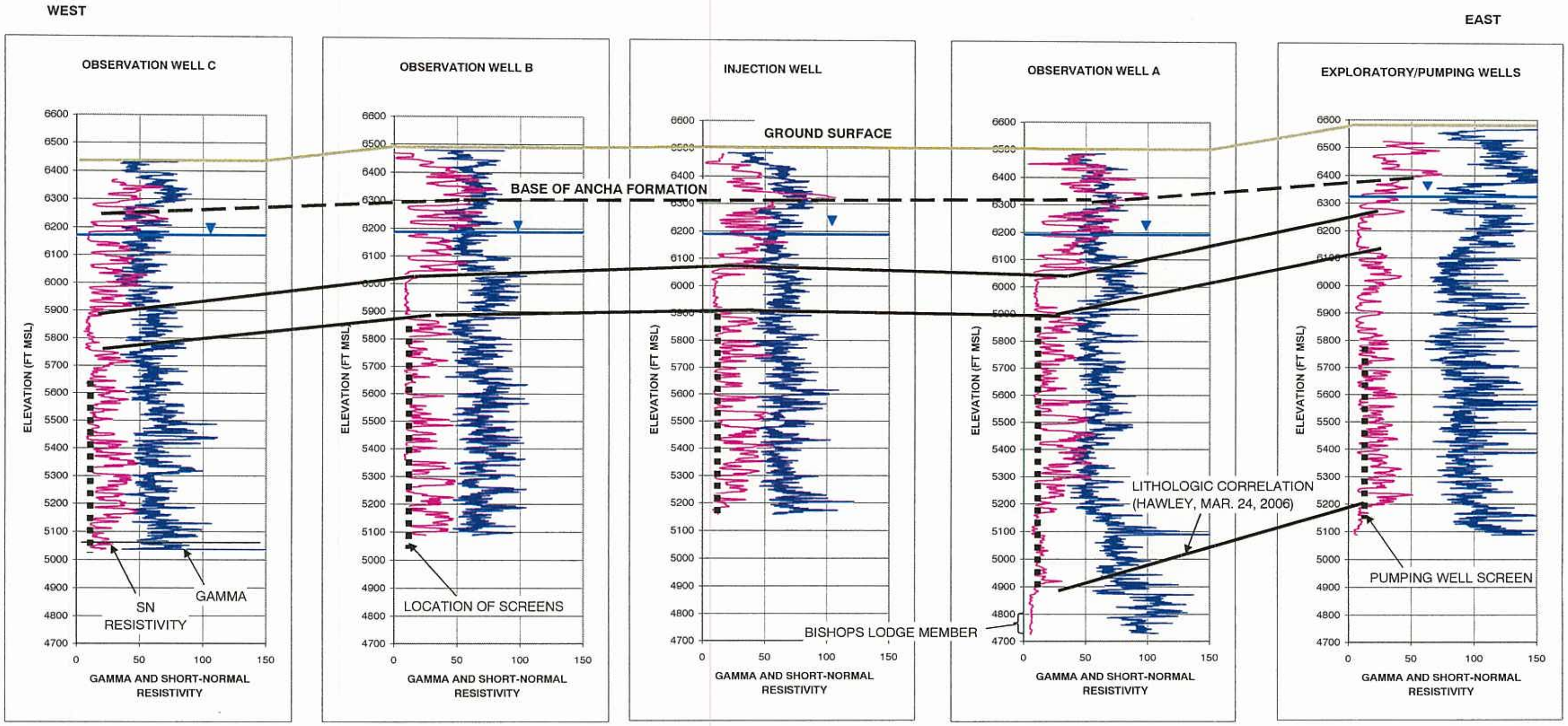
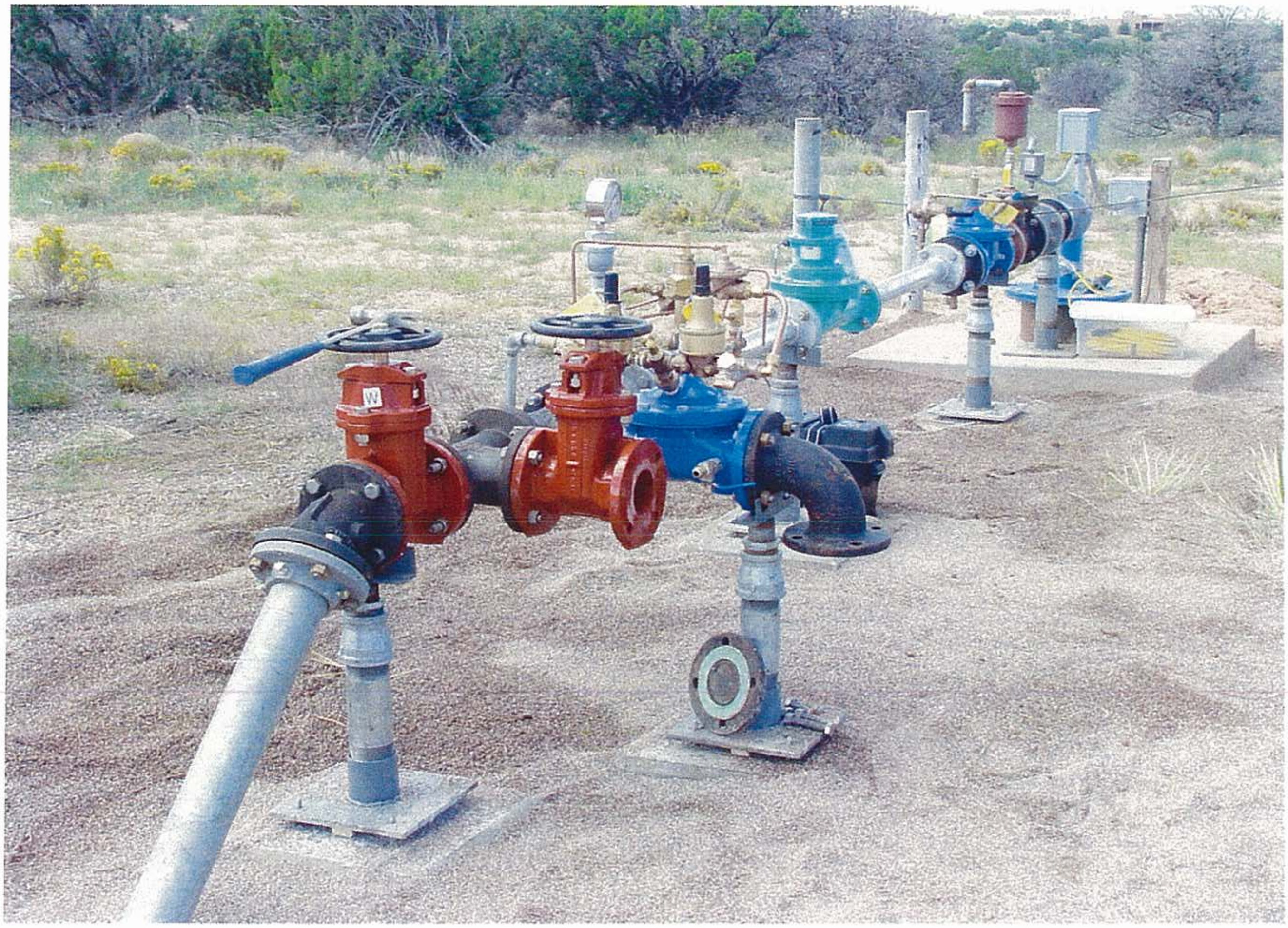
CC
11/1/2007

# FIGURE 7
# BOREHOLE GEOPHYSICS AND CORRELATIONS



InjObsWell_elogs.xls
CHARTS (2)
CC
11/1/2007

# FIGURE 8
# PUMPING WELL TEST SETUP



report_photos.xls
FIG 8
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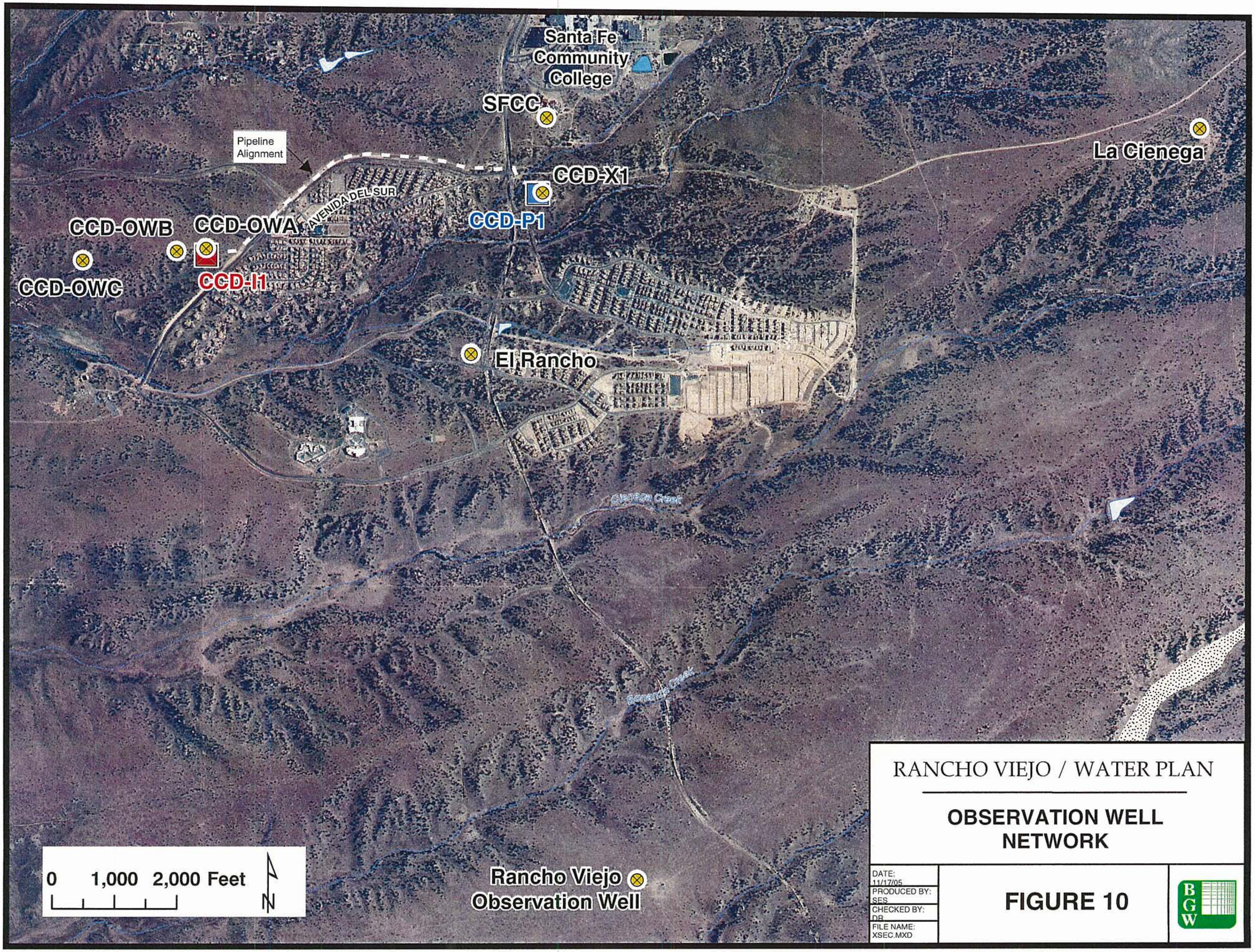
10/31/2007

FIGURE 9
INJECTION WELL TEST SETUP



RANCHO VIEJO / WATER PLAN

## OBSERVATION WELL NETWORK

DATE:
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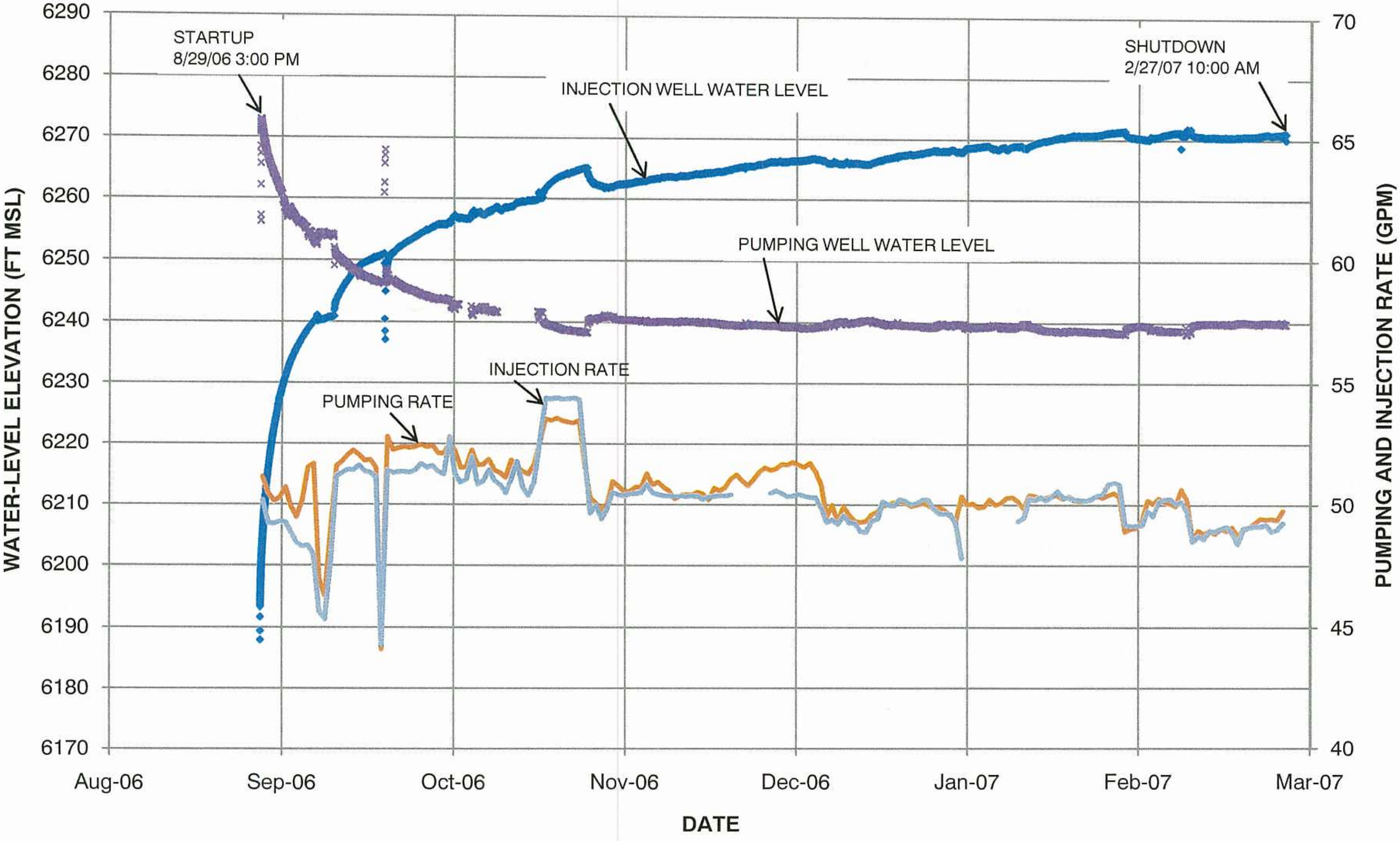
SES
CHECKED BY:
DR
FILE NAME:
XSEC.MXD

**FIGURE 10**

BGW

BALLEAU GROUNDWATER, INC.

## FIGURE 11
## PUMPING AND INJECTION WELL WATER LEVELS AND FLOW RATES



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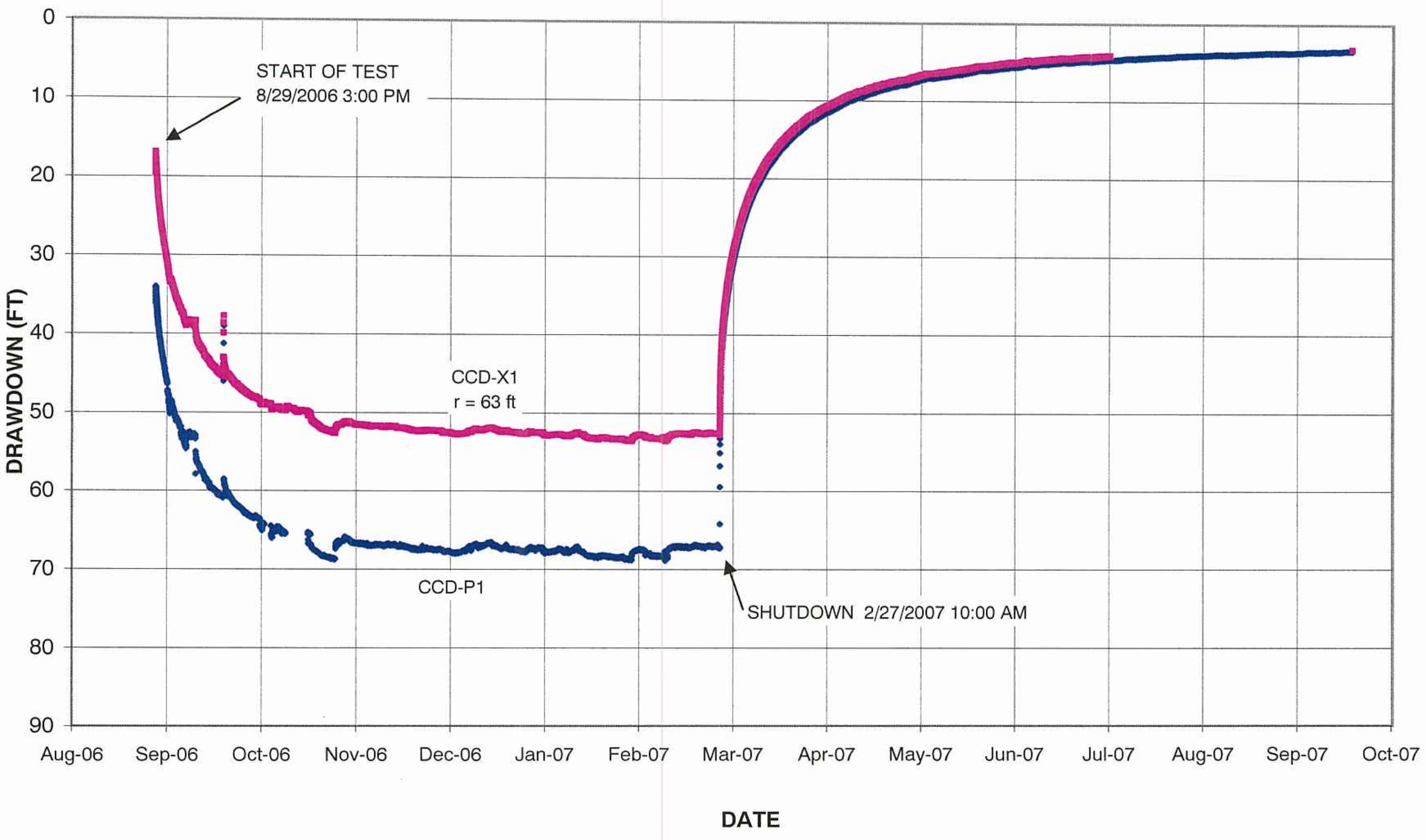
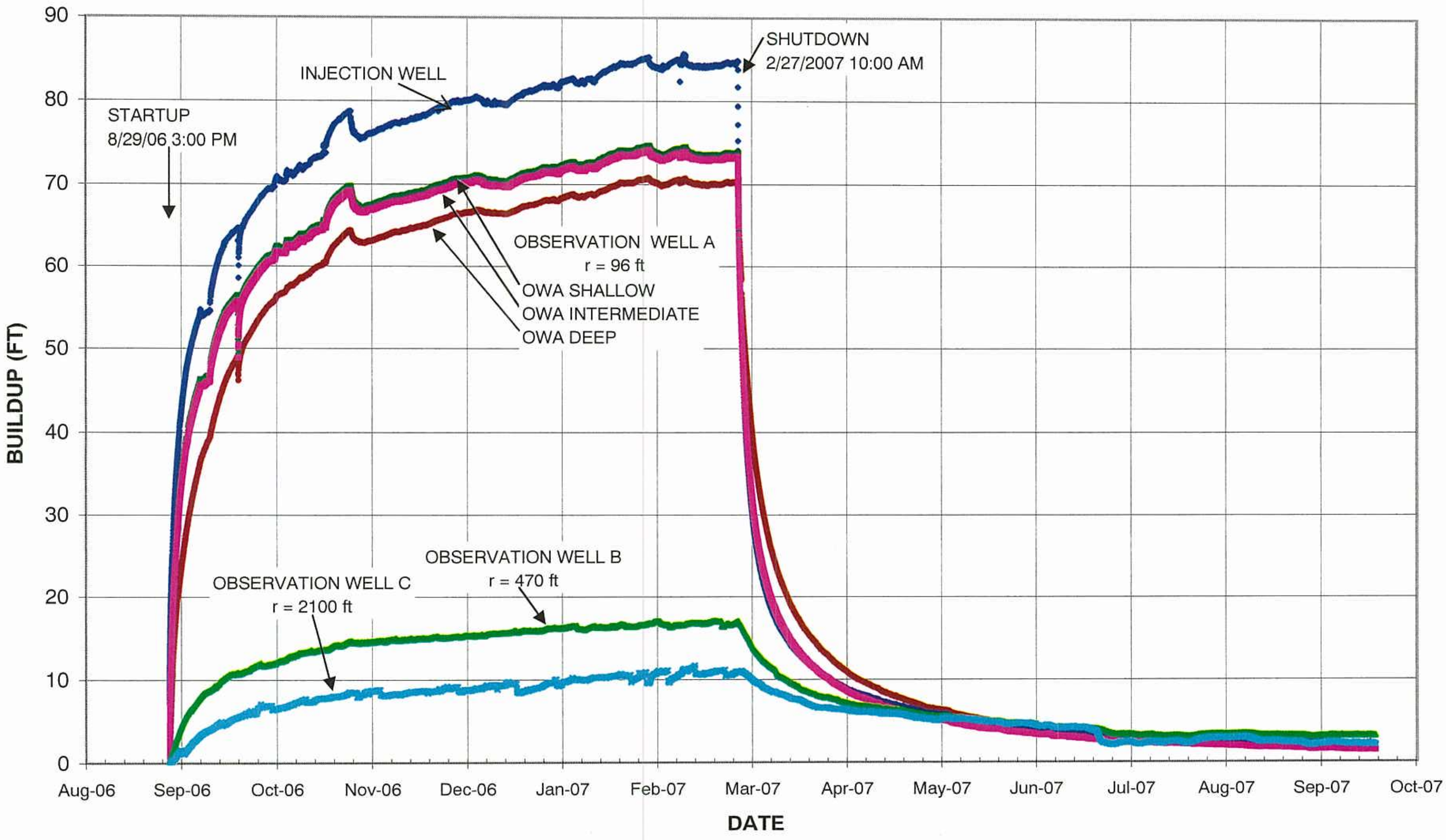
BY
11/2/2007

## FIGURE 12
## PUMPING AND EXPLORATORY WELL DRAWDOWN AND RECOVERY



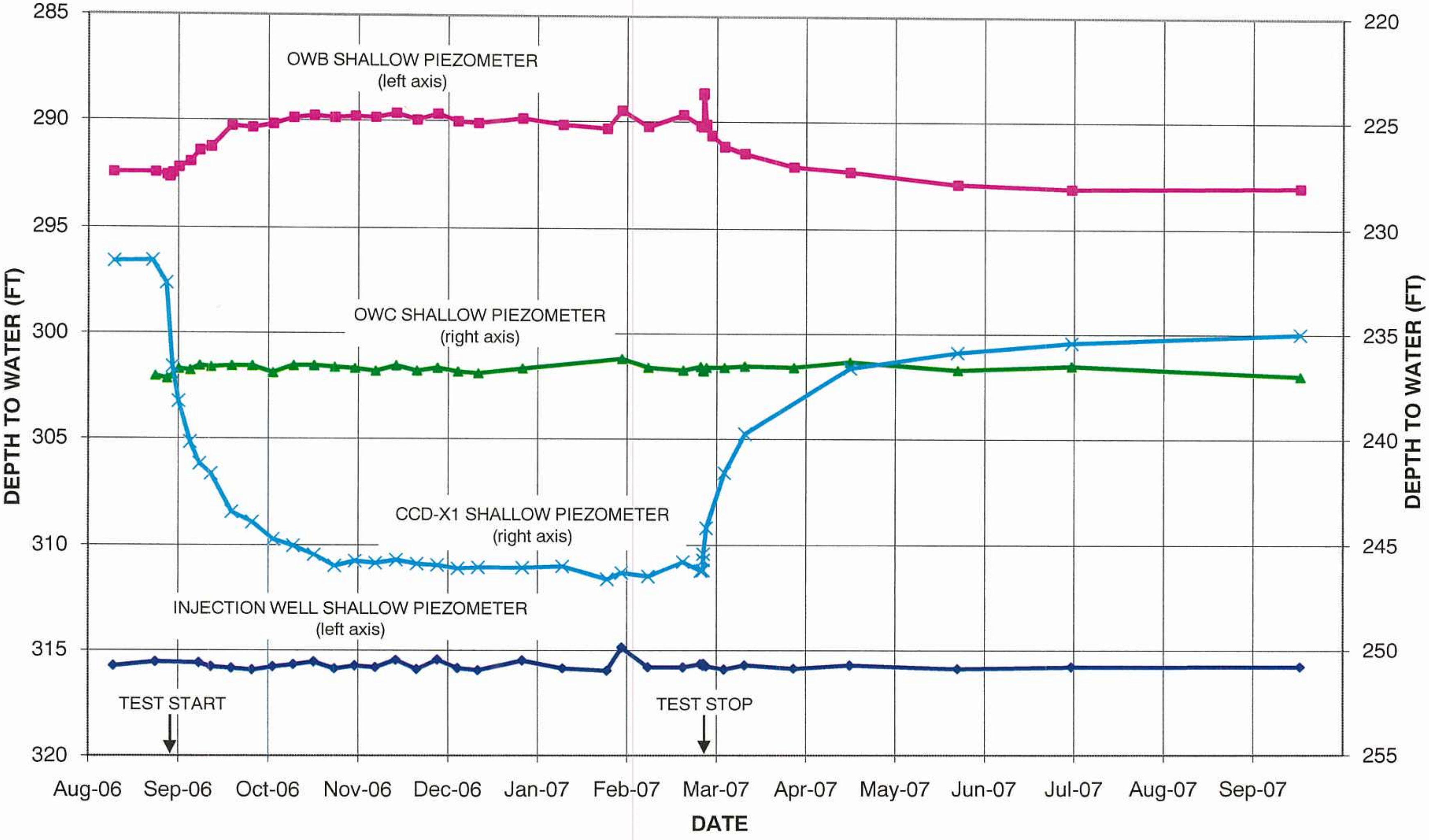
ccdp1.xls
FIG12 ARITH
CC
11/2/2007

## FIGURE 13
## INJECTION AND OBSERVATION WELL WATER-LEVEL BUILDUP AND RECOVERY



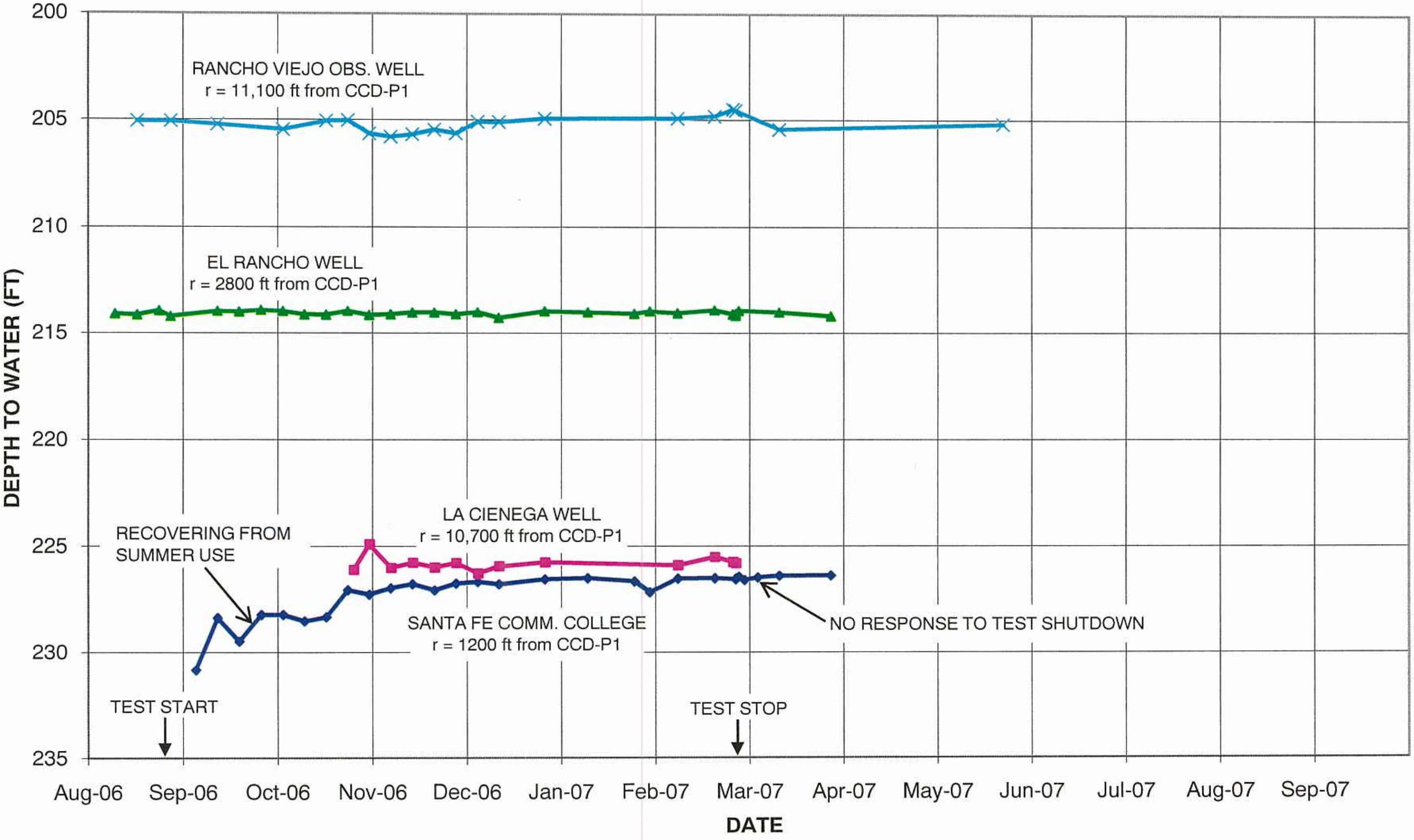
ccdi1.xls
FIG 13 ARITH
CC
11/1/2007

## FIGURE 14
## HYDROGRAPHS OF SHALLOW PIEZOMETERS



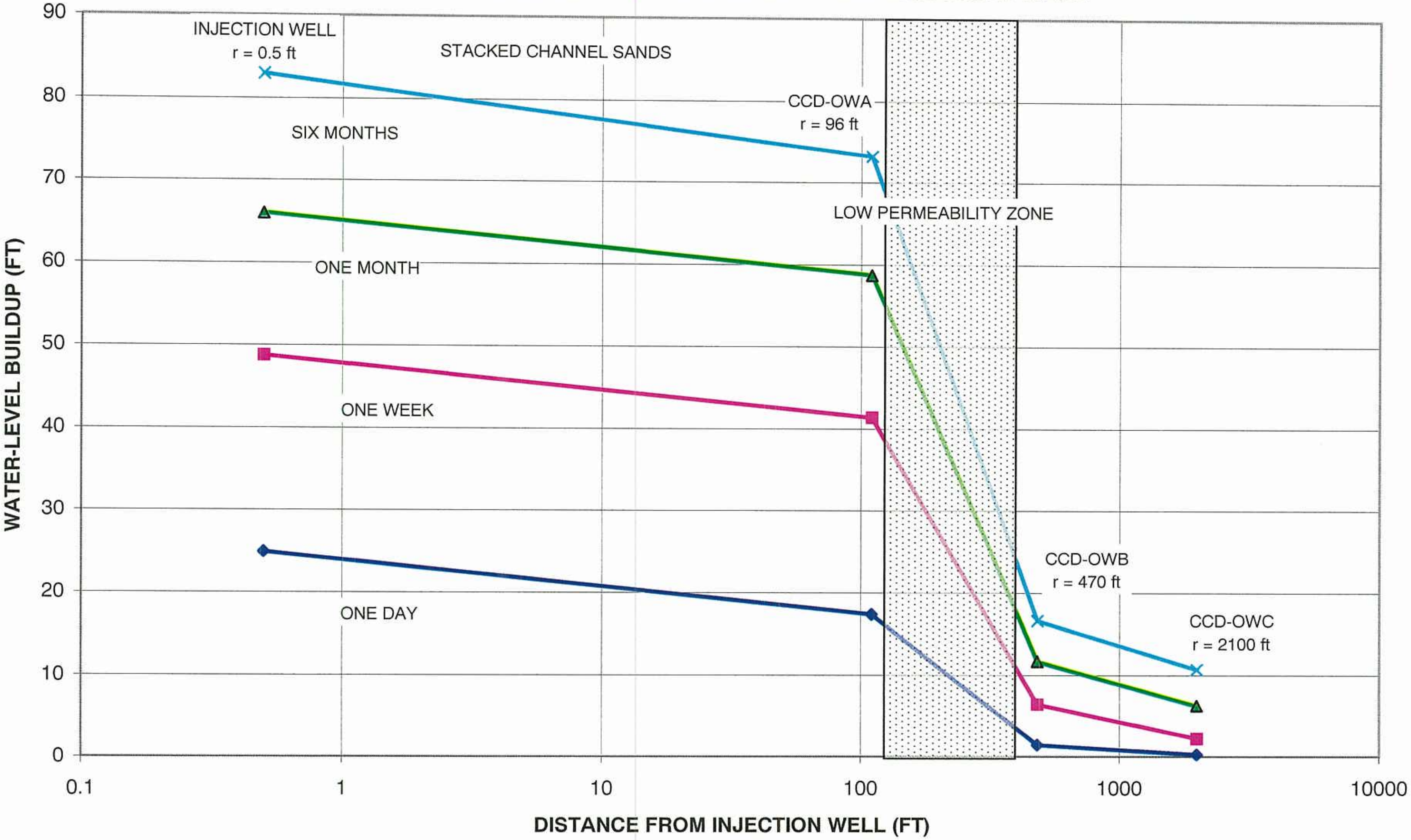
shal piez.xls
OBS WELLS
CC
11/2/2007

## FIGURE 15
## HYDROGRAPHS OF OUTLYING OBSERVATION WELLS



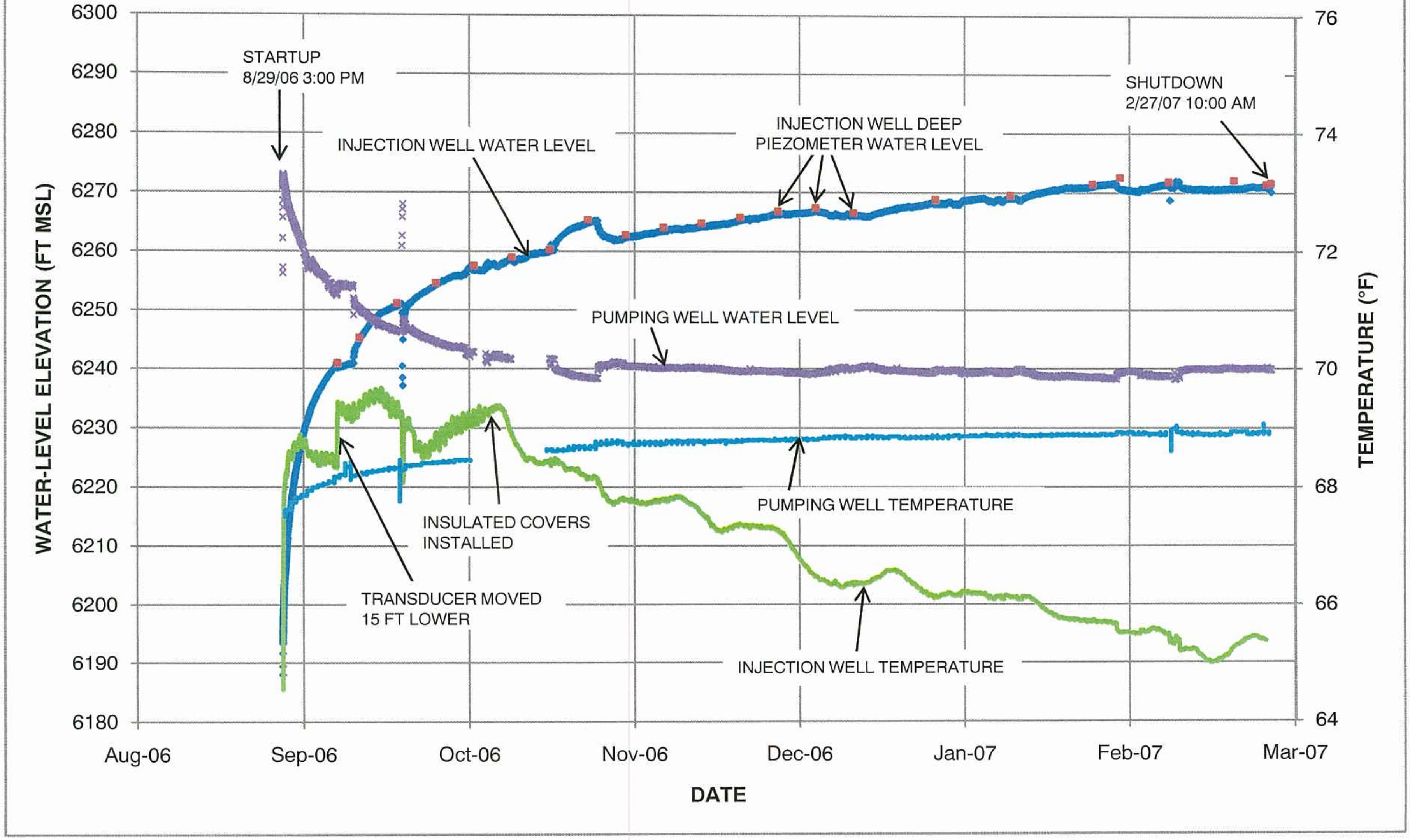
outlying chart_2.xls
OBS WELLS
CC
11/2/2007

## FIGURE 16
## WATER-LEVEL BUILDUP VS. DISTANCE FROM INJECTION WELL



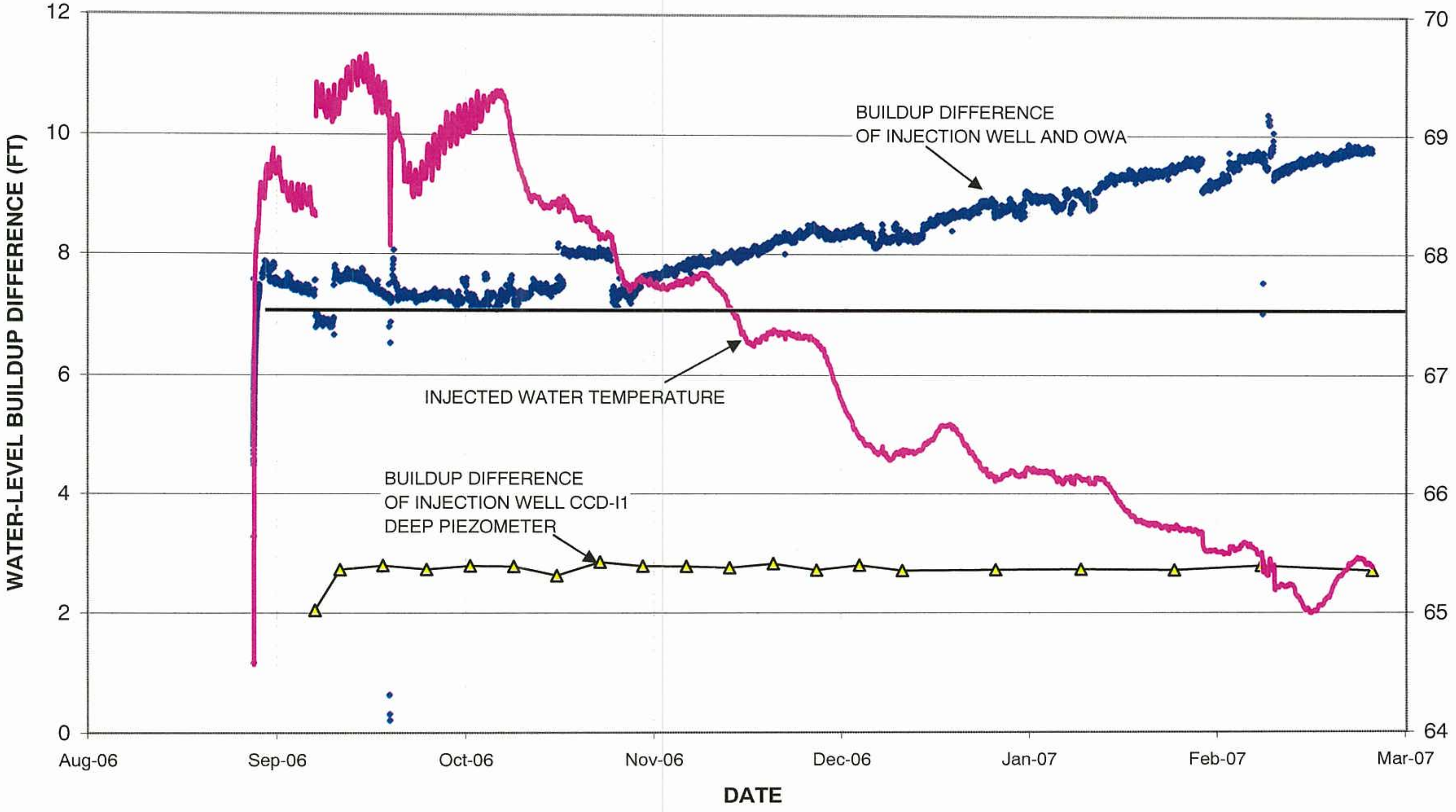
Dist-DD.xls
DIST-BUILDUP
CC
11/1/2007

## FIGURE 17
## PUMPING AND INJECTION WELL WATER LEVELS AND TEMPERATURE



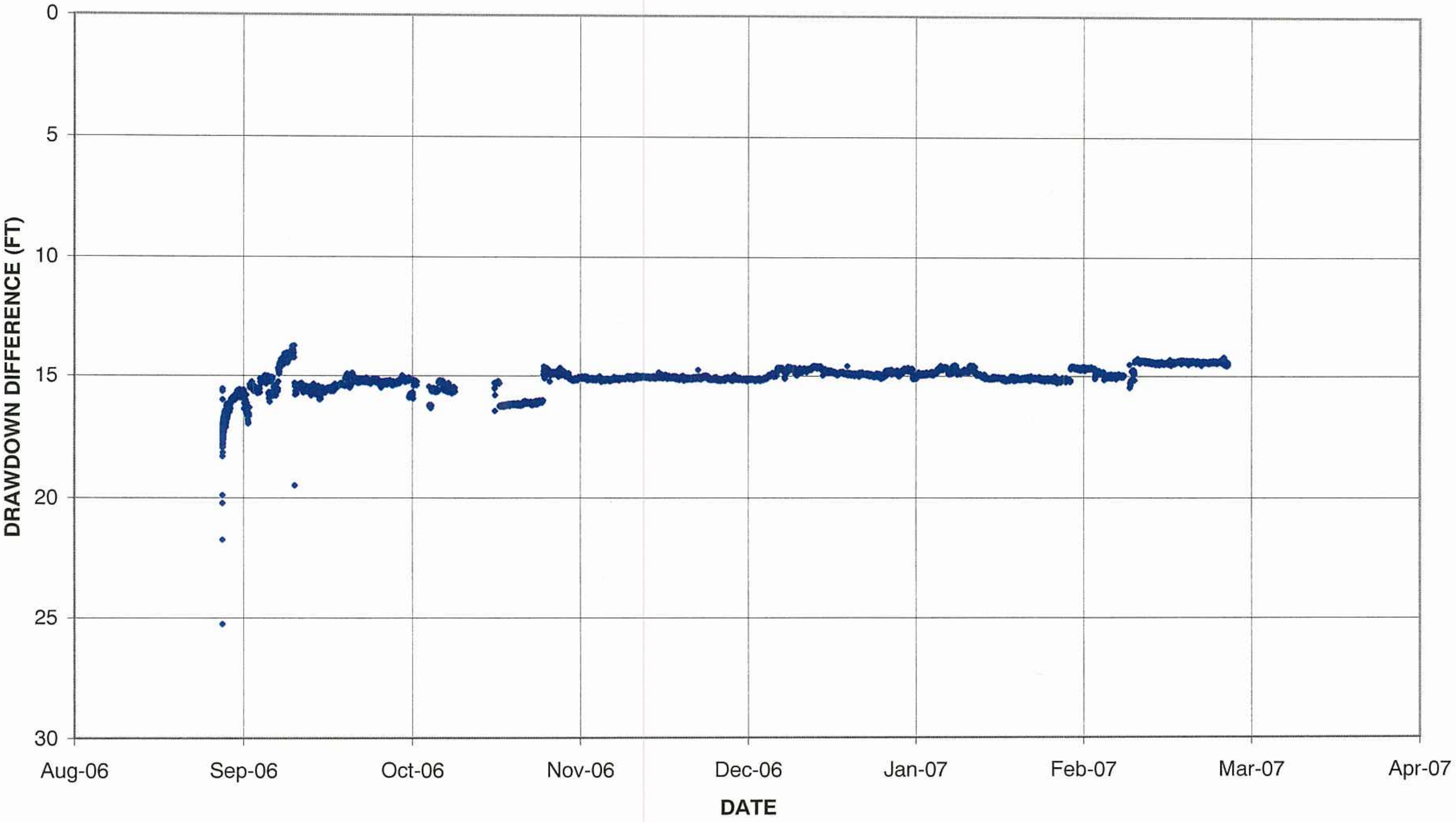
6-Mo Inj Data.xls
BY
11/2/2007

## FIGURE 18
## DIFFERENCE OF WATER-LEVEL BUILDUP IN INJECTION WELL, SHALLOW PIEZOMETER, AND WELL CCD-OWA AND INJECTION WATER TEMPERATURE



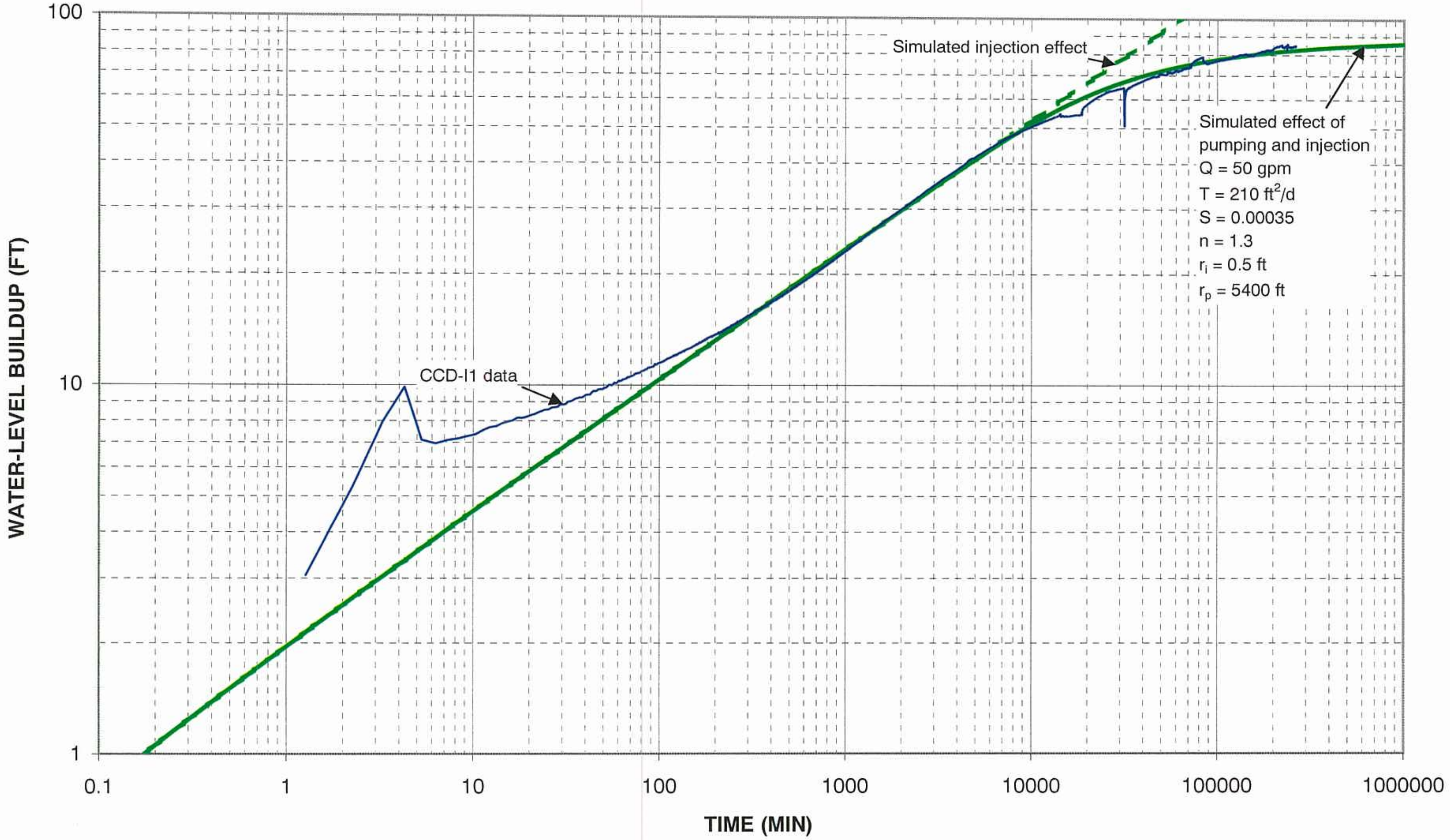
Inj-ObsADifferences.xls
DIFFERENCE
CC
10/31/2007

## FIGURE 19
## DRAWDOWN DIFFERENCE IN PUMPING AND EXPLORATORY WELLS



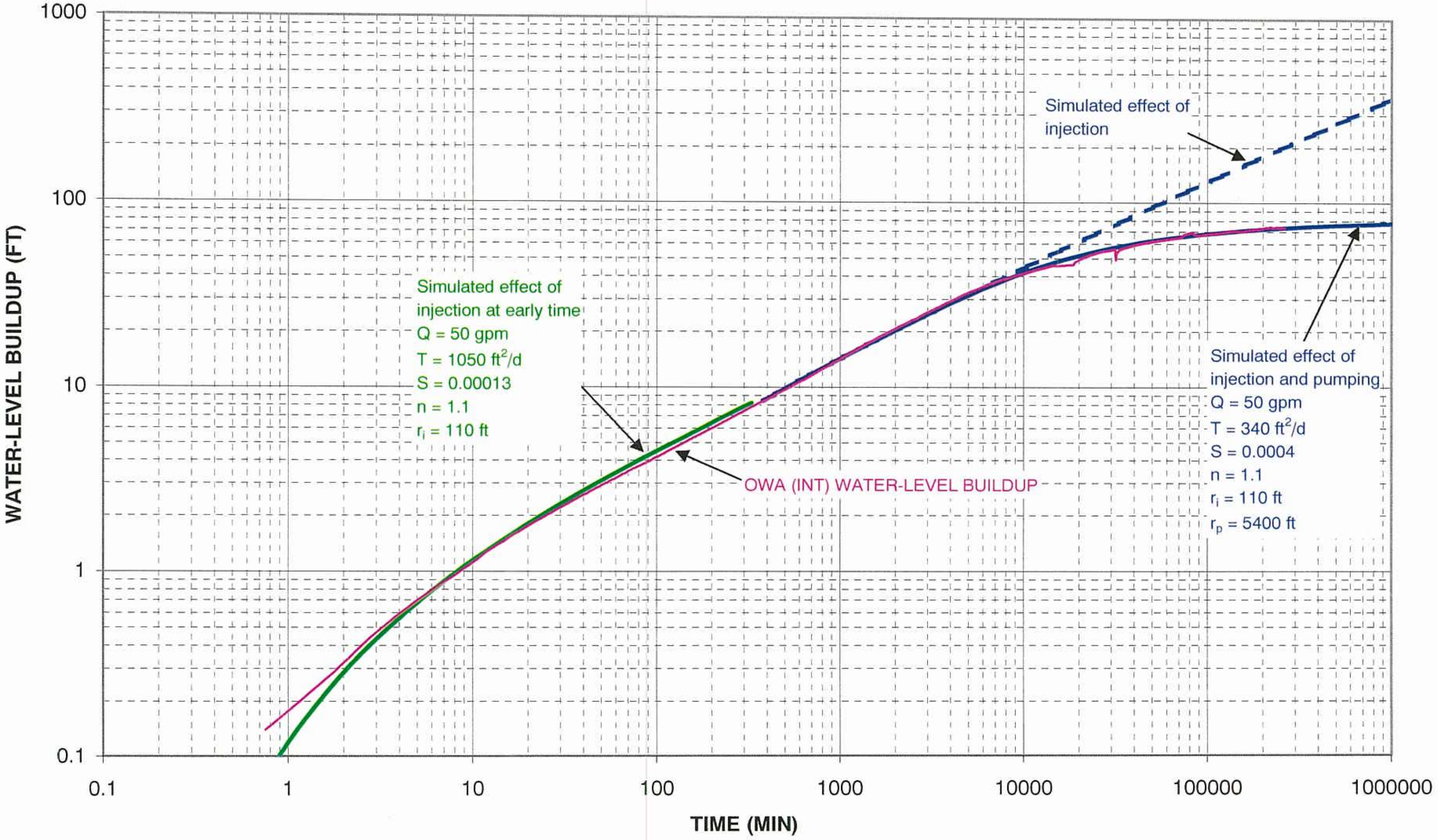
P1-X1Differences.xls
DD DIFF
CC
11/1/2007

## FIGURE 20
## INJECTION WELL WATER-LEVEL BUILDUP AND GRF CURVE MATCH



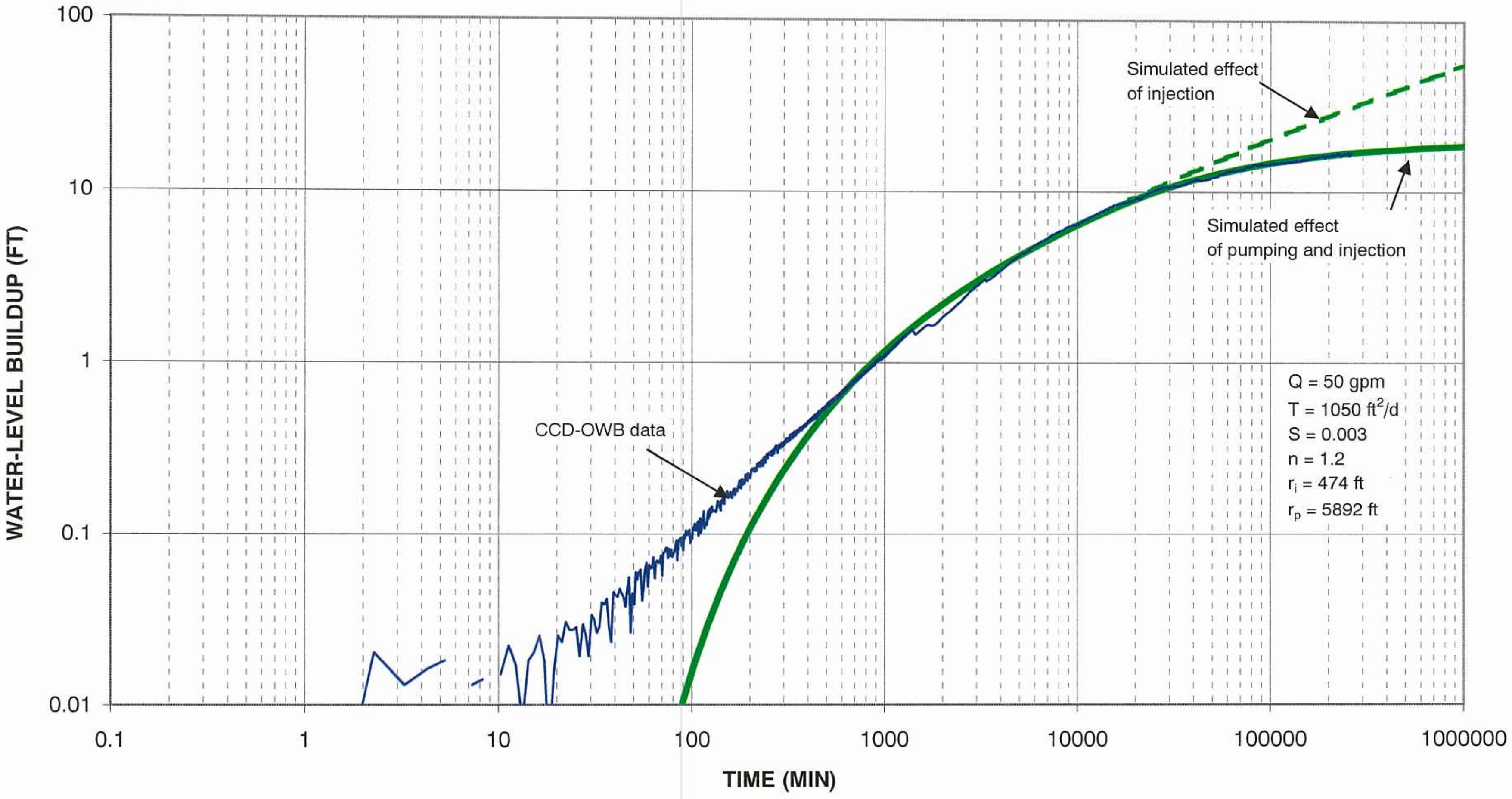
ccdi1.xls
FIG 20 LOG
CC
11/1/2007

## FIGURE 21
## OBSERVATION WELL A WATER-LEVEL BUILDUP AND GRF CURVE MATCH



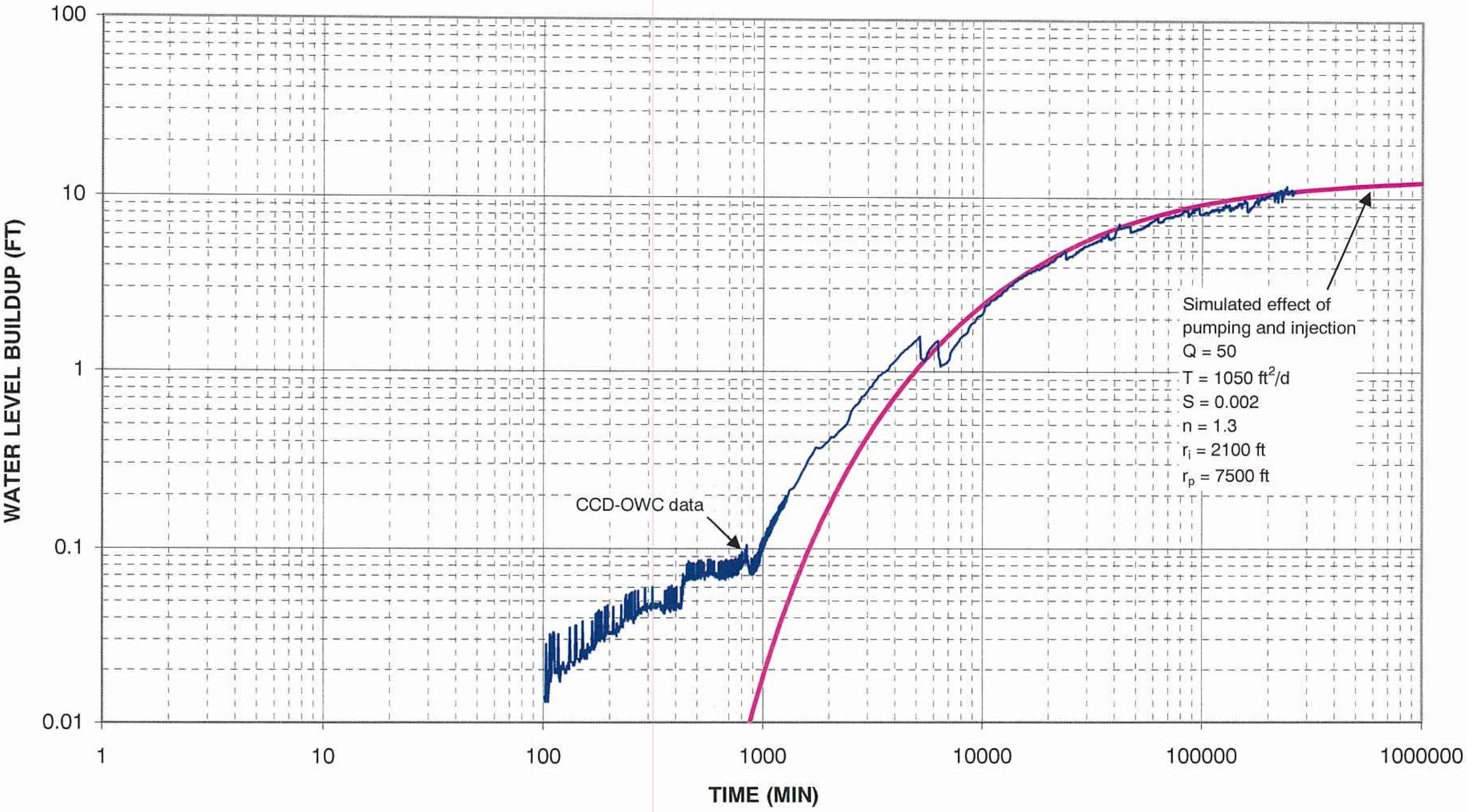
owa.xls
GRF LOG
CC
11/1/2007

## FIGURE 22
## OBSERVATION WELL B WATER-LEVEL BUILDUP AND GRF CURVE MATCH



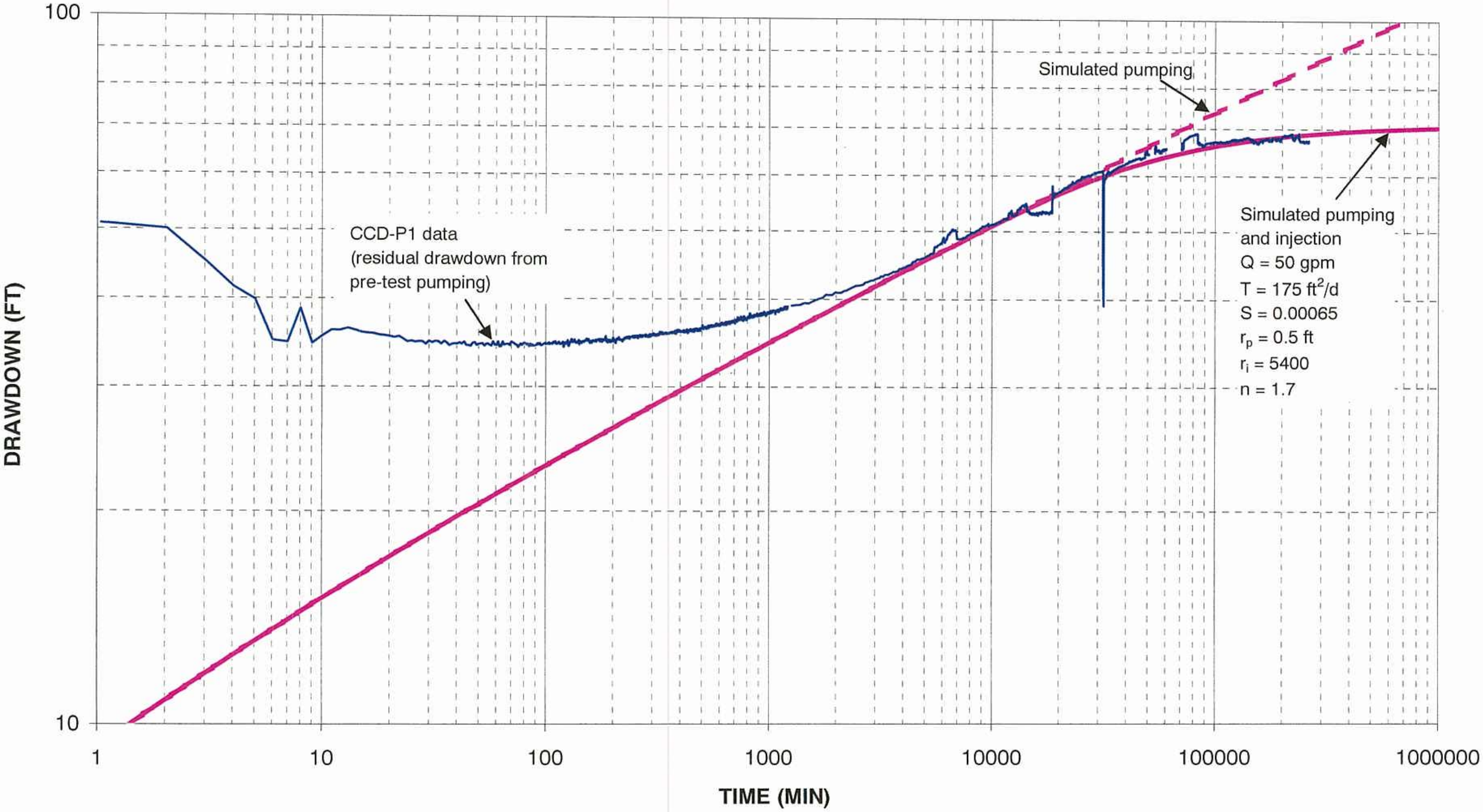
owb.xls
DD LOG
CC
11/1/2007

## FIGURE 23
## OBSERVATION WELL C WATER-LEVEL BUILDUP AND GRF CURVE MATCH



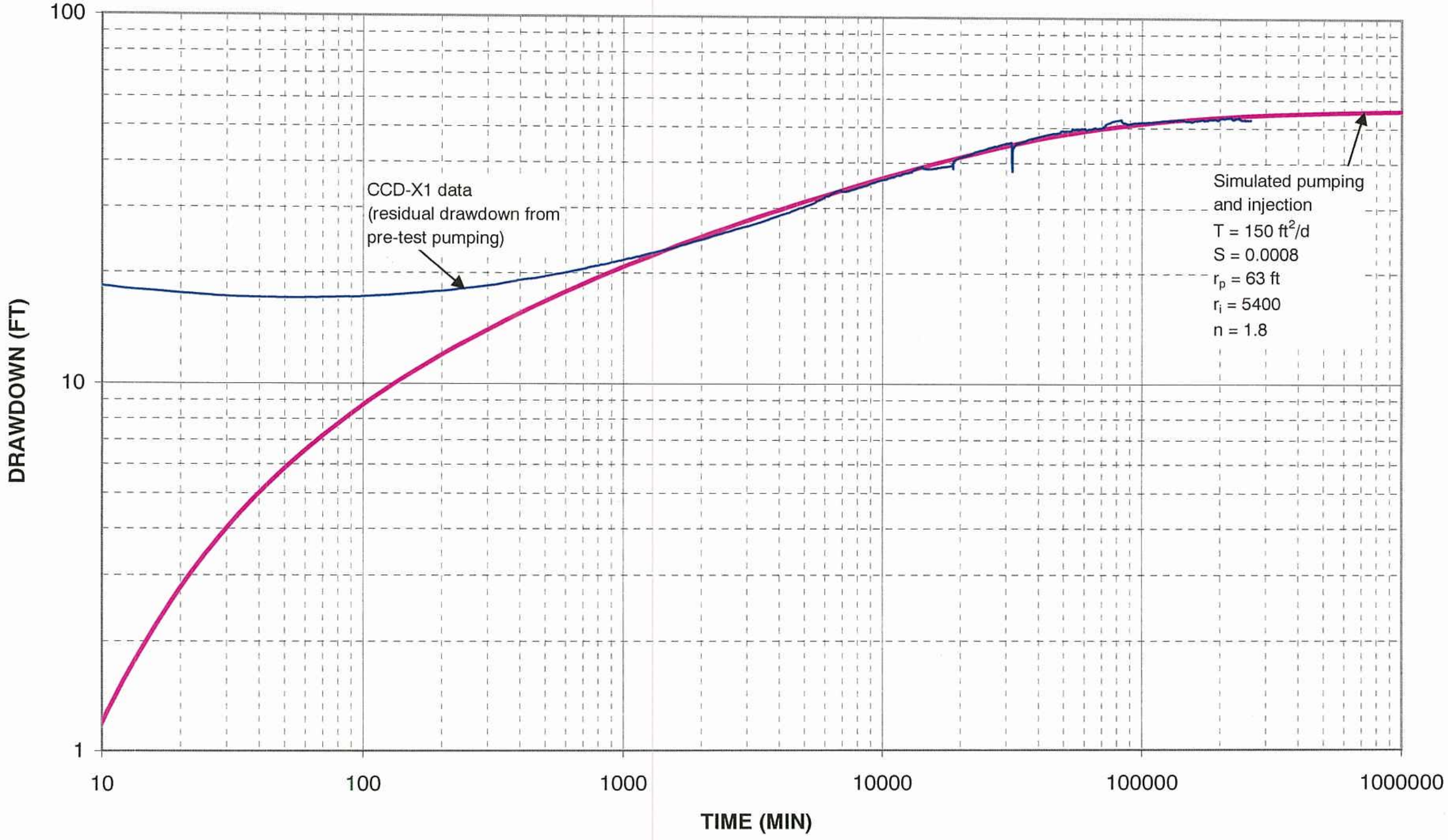
owc.xls
FIG 23 DD LOG
CC
11/1/2007

## FIGURE 24
## CCD-P1 DRAWDOWN AND GRF CURVE MATCH



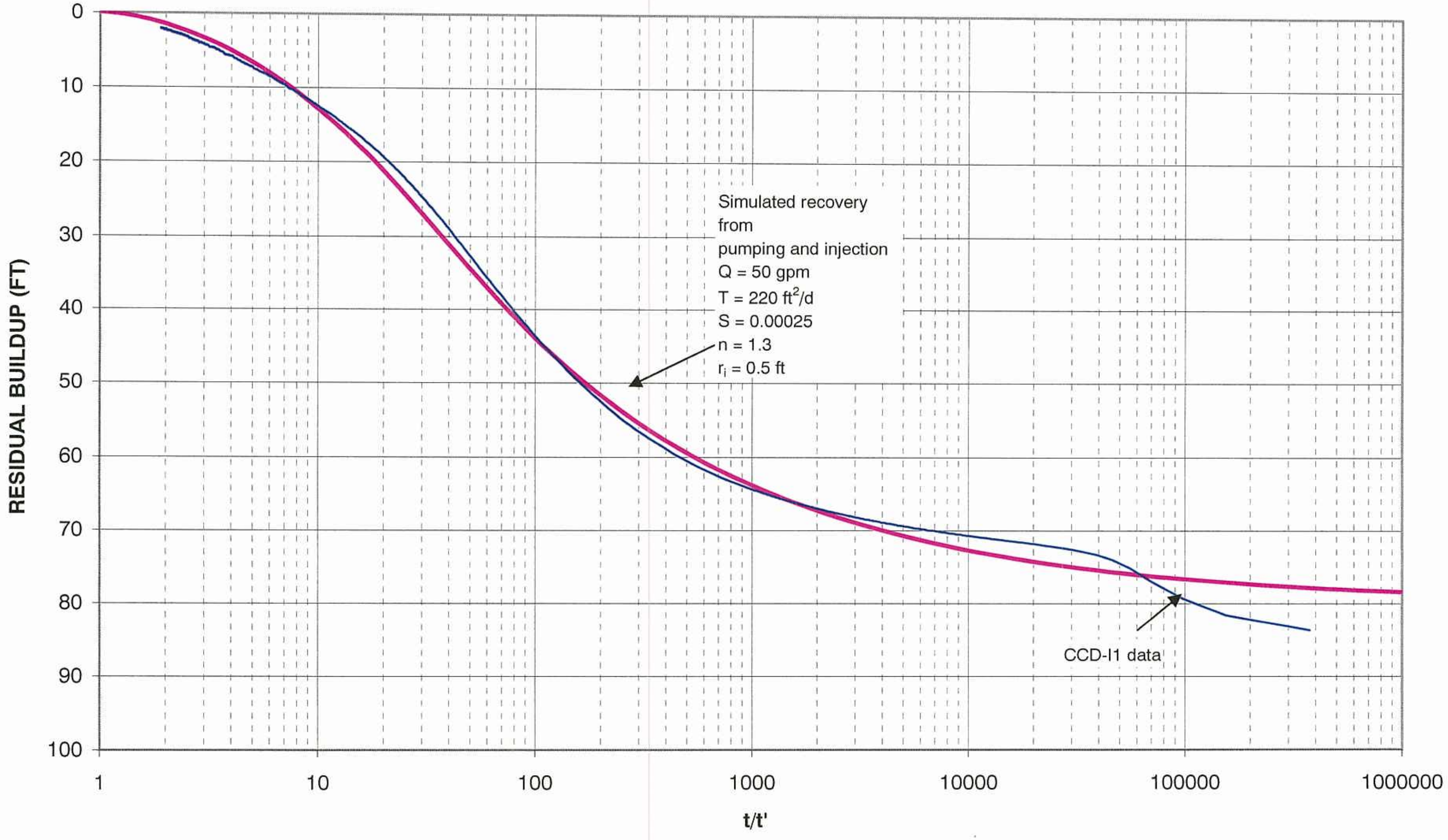
ccdp1.xls
FIG 24 LOGLOG
CC
11/1/2007

## FIGURE 25
## CCD-X1 DRAWDOWN AND GRF CURVE MATCH



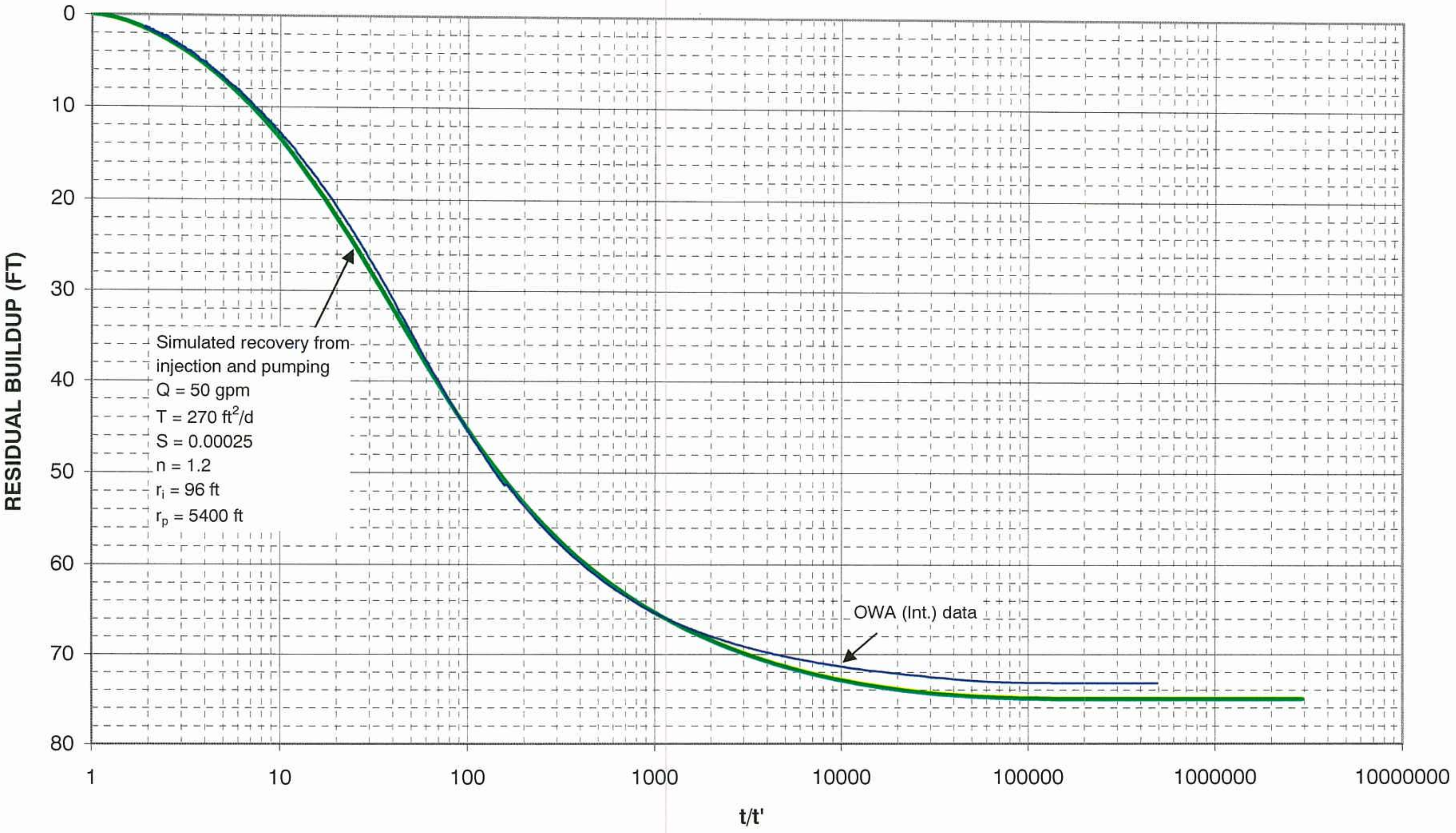
ccdx1.xls
FIG 25 DD LOG
CC
11/1/2007

## FIGURE 26
## INJECTION WELL RECOVERY AND GRF CURVE MATCH



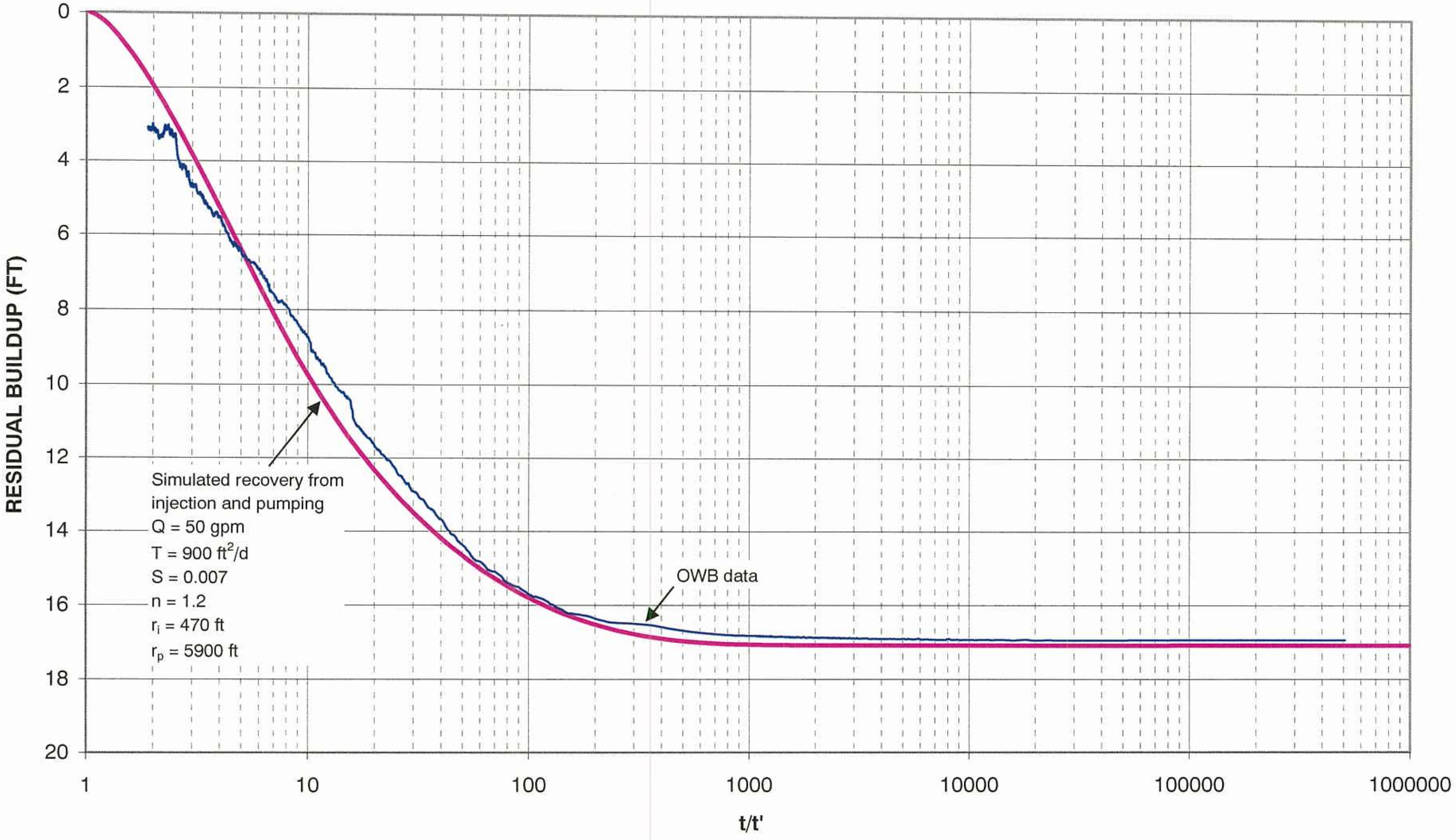
ccdi1.xls
RECOVERY
CC
11/1/2007

## FIGURE 27
## OBSERVATION WELL A RECOVERY AND GRF CURVE MATCH



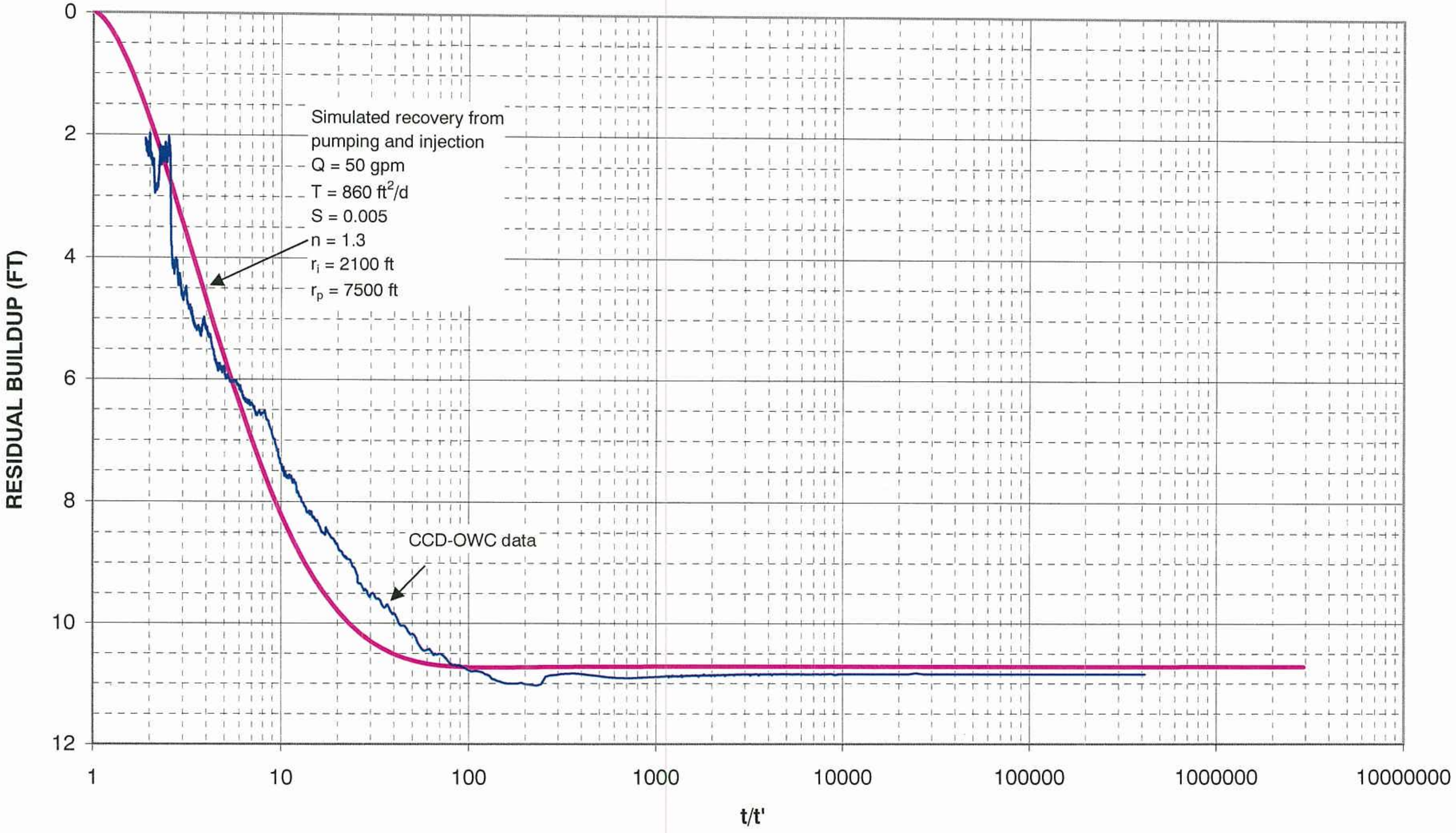
owa.xls
RECOVERY
CC
11/1/2007

## FIGURE 28
## OBSERVATION WELL B RECOVERY AND GRF CURVE MATCH



owb.xls
RECOVERY
CC
11/1/2007

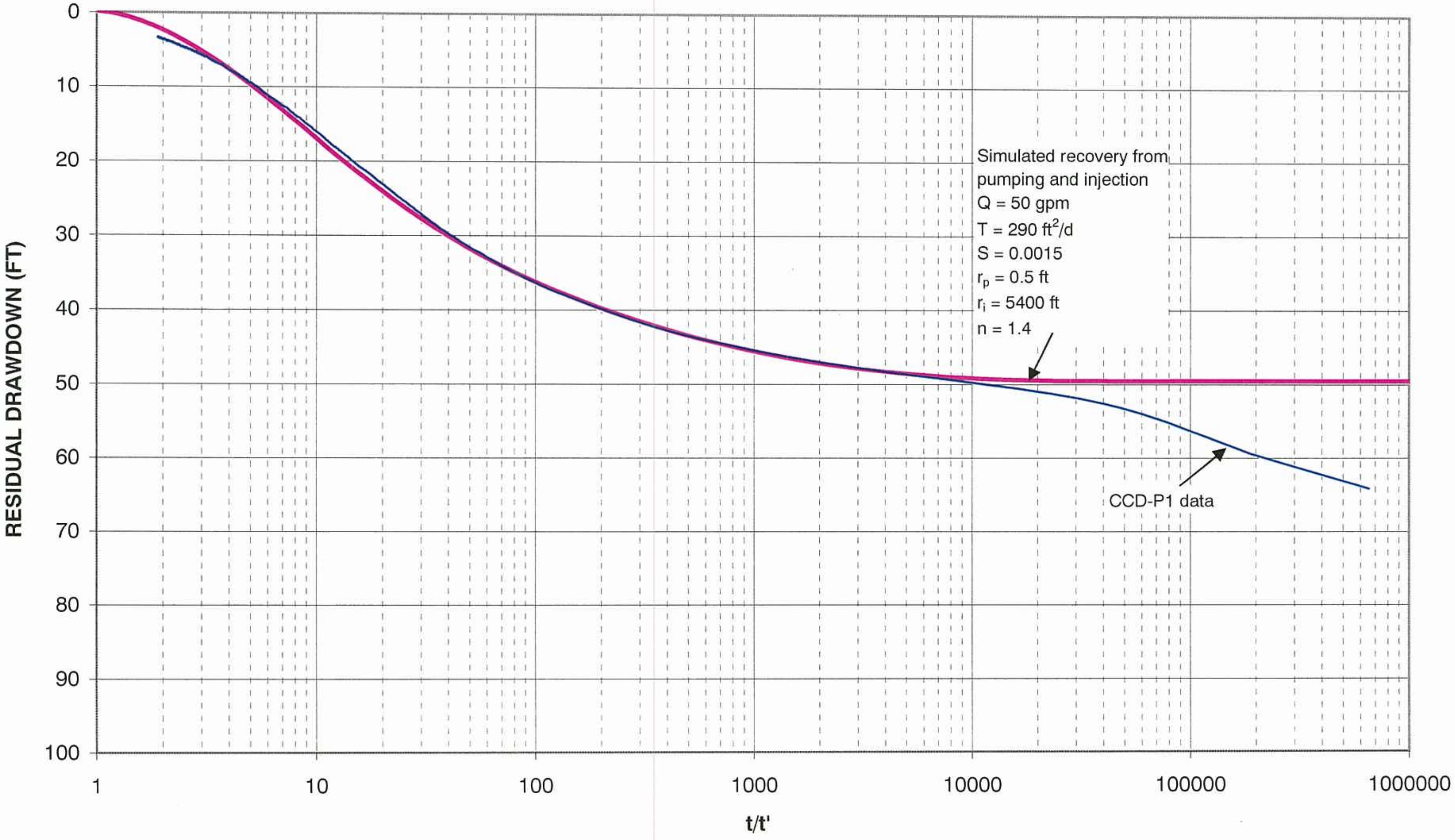
## FIGURE 29
## OBSERVATION WELL C RECOVERY AND GRF CURVE MATCH



Simulated recovery from pumping and injection
Q = 50 gpm
T = 860 $ft^2/d$
S = 0.005
n = 1.3
$r_i$ = 2100 ft
$r_p$ = 7500 ft

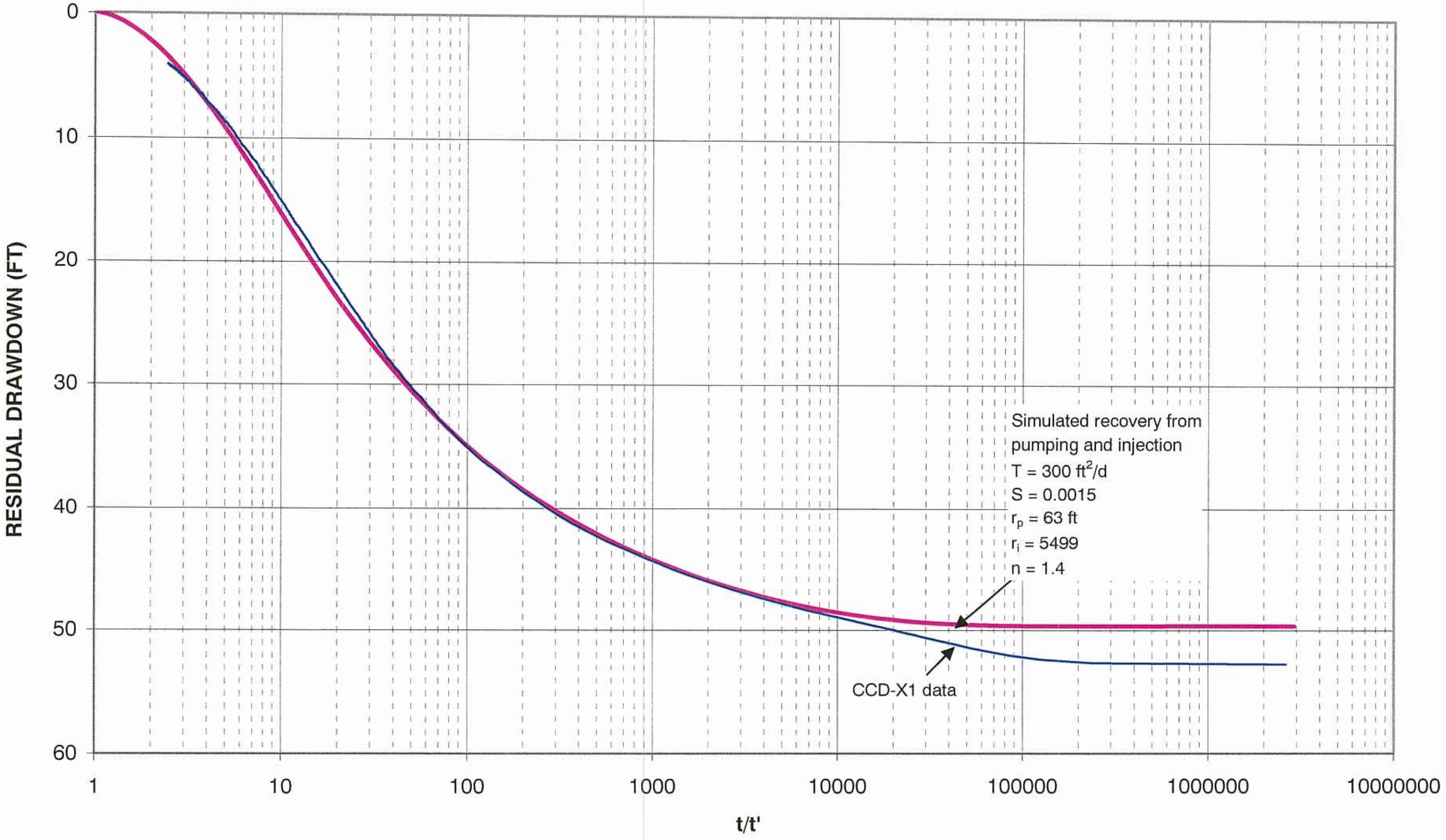
owc.xls
FIG 31 RECOVERY
CC
11/1/2007

## FIGURE 30
## CCD-P1 RECOVERY AND GRF CURVE MATCH



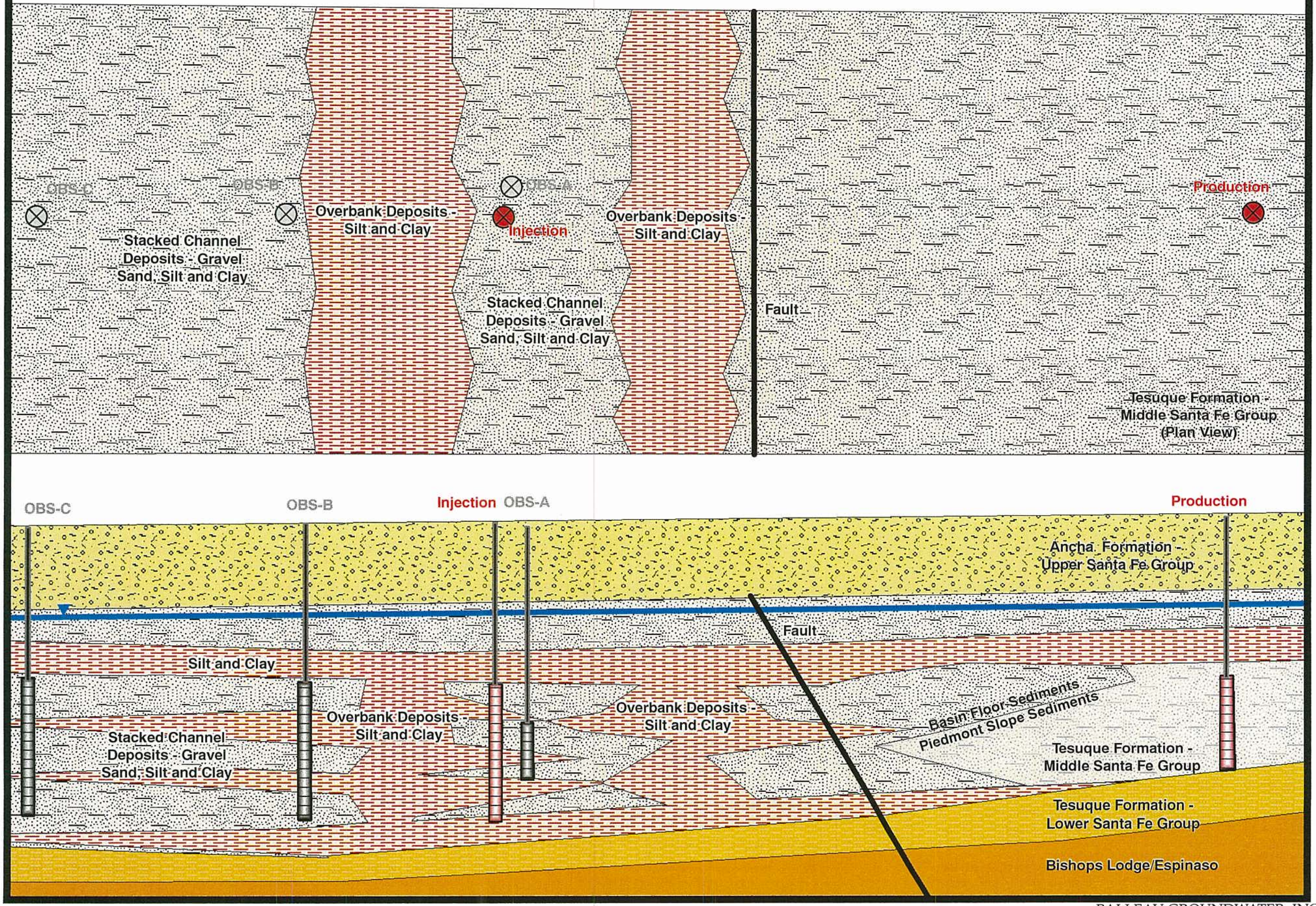
ccdp1.xls
FIG 30 RECOV
CC
11/1/2007

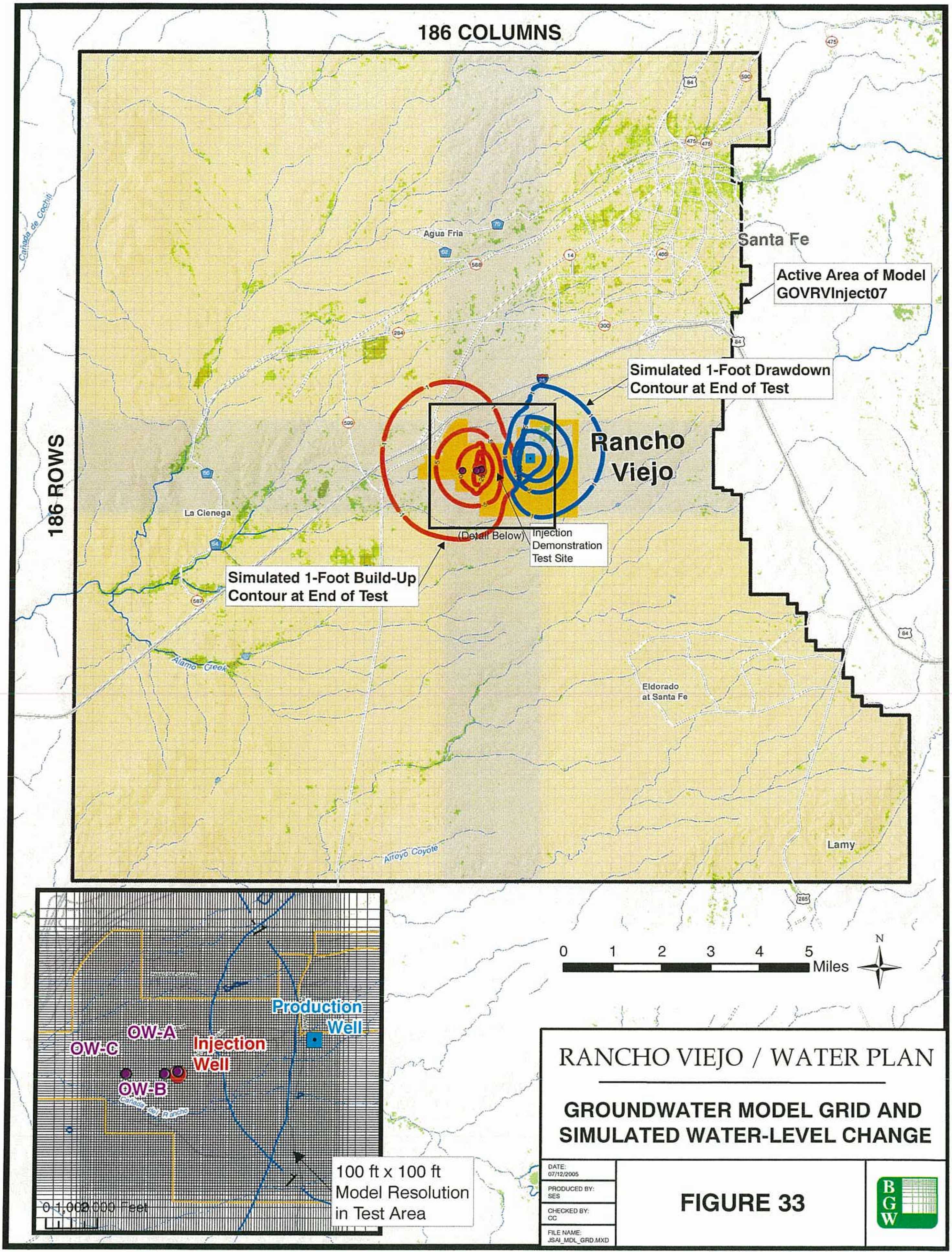
## FIGURE 31
## CCD-X1 RECOVERY AND GRF CURVE MATCH



ccdx1.xls
FIG 31 RECOV
CC
11/1/2007

# FIGURE 32
## GEOLOGIC CONCEPTUAL MODEL





## RANCHO VIEJO / WATER PLAN

## GROUNDWATER MODEL GRID AND SIMULATED WATER-LEVEL CHANGE

DATE: 07/12/2005

PRODUCED BY: SES

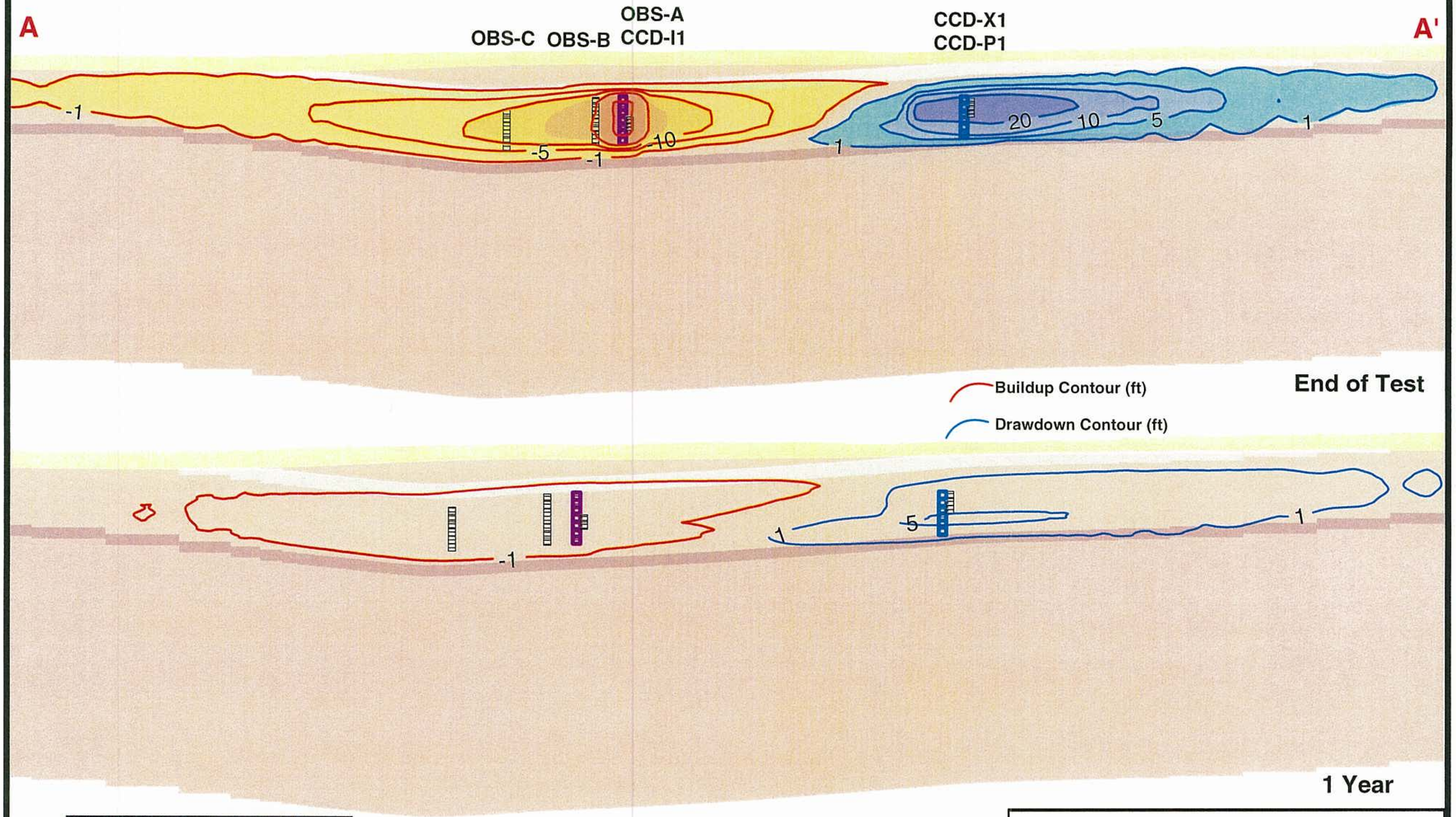
CHECKED BY: CC

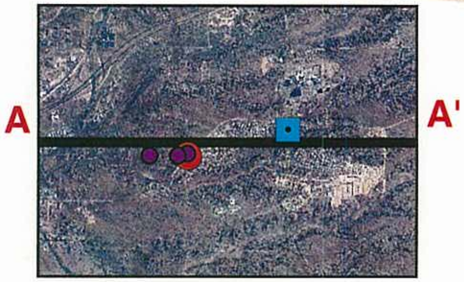
FILE NAME: JSAI_MDL_GRD.MXD

FIGURE 33

BGW

BALLEAU GROUNDWATER, INC.





RANCHO VIEJO / WATER PLAN

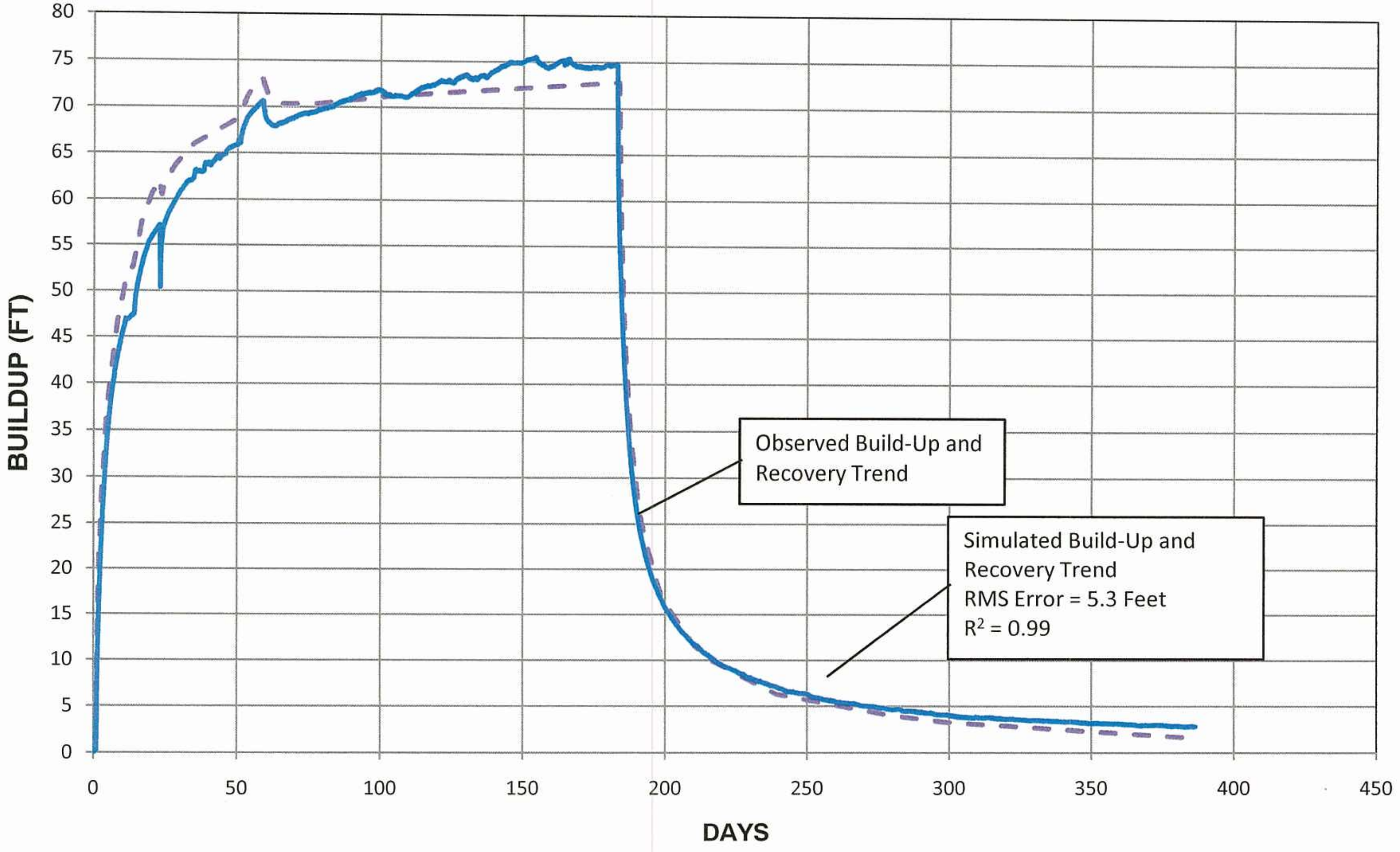
## MODEL CROSS SECTIONS WITH WATER LEVEL CHANGE

DATE: 11/17/05
PRODUCED BY: SES
CHECKED BY: DR
FILE NAME: XSEC.MXD

## FIGURE 34

BALLEAU GROUNDWATER, INC.

## FIGURE 35
## OBSERVED AND SIMULATED BUILD-UP AT CCD-OWA

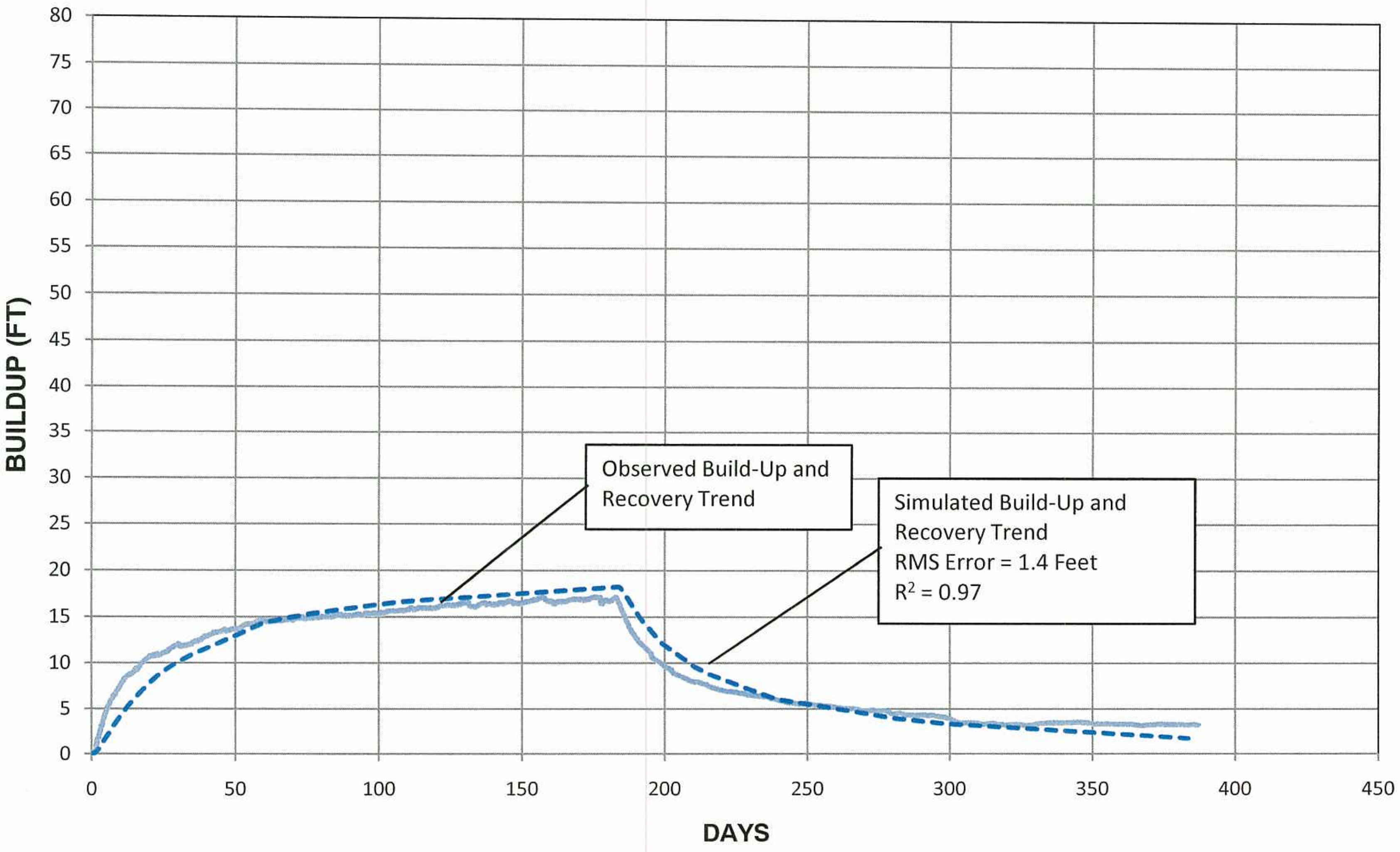


Observed Build-Up and Recovery Trend

Simulated Build-Up and Recovery Trend
RMS Error = 5.3 Feet
$R^2 = 0.99$

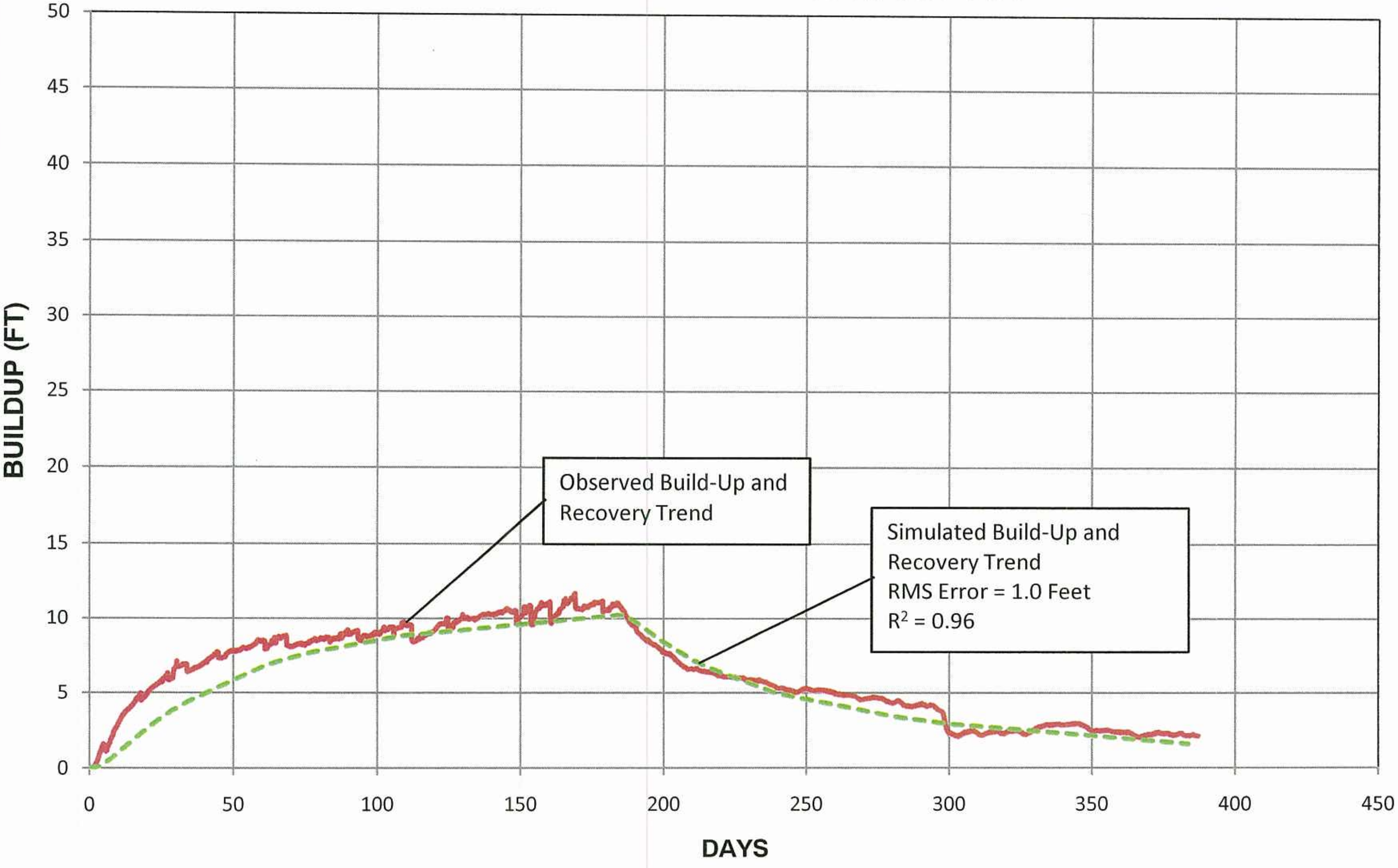
Copy of HRGPHrpt.xlsb
SES
11/5/2007

## FIGURE 36
## OBSERVED AND SIMULATED BUILD-UP AT CCD-OWB



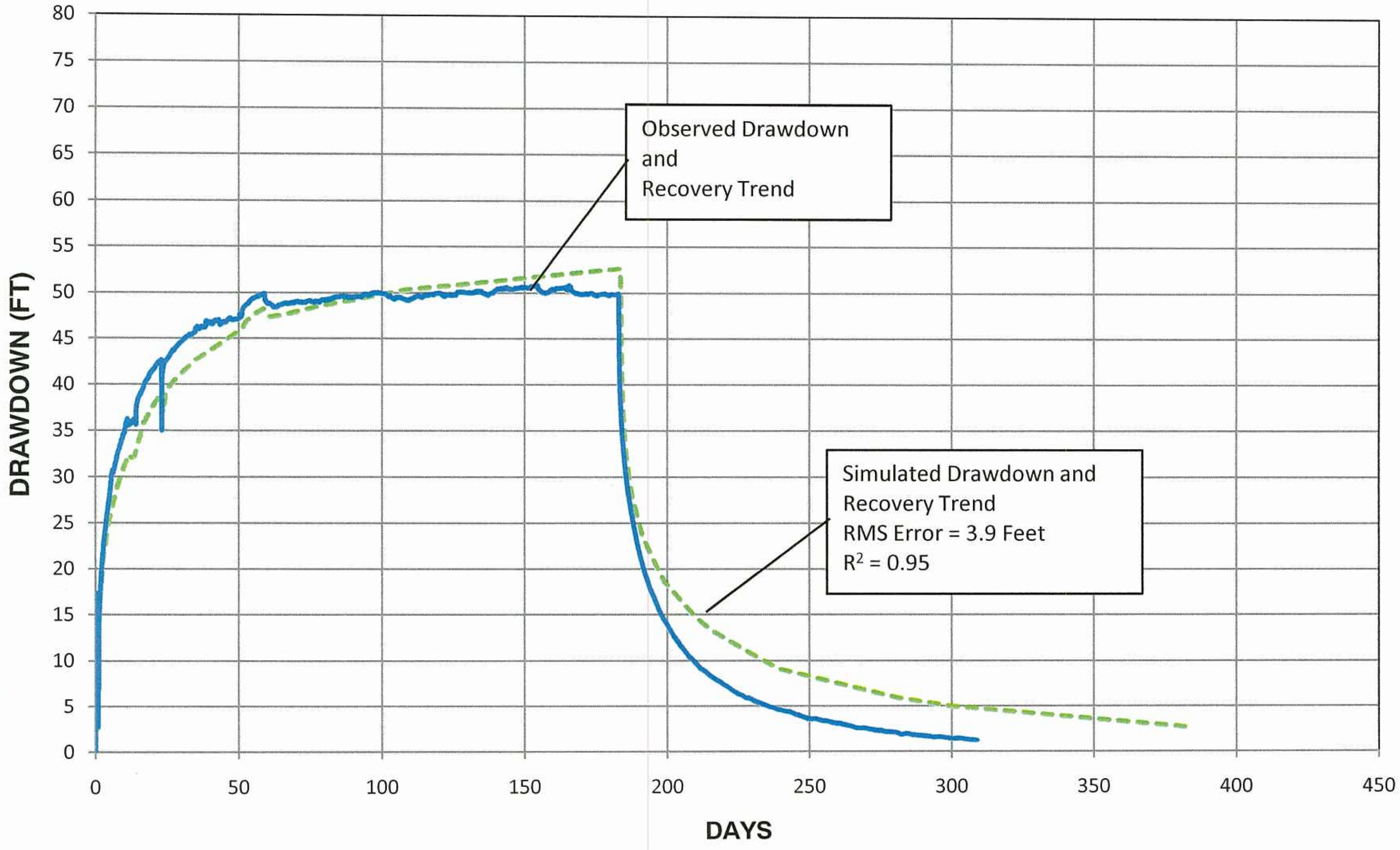
Copy of HRGPHrpt.xlsb
SES
11/5/2007

## FIGURE 37
## OBSERVED AND SIMULATED BUILD-UP AT CCD-OWC

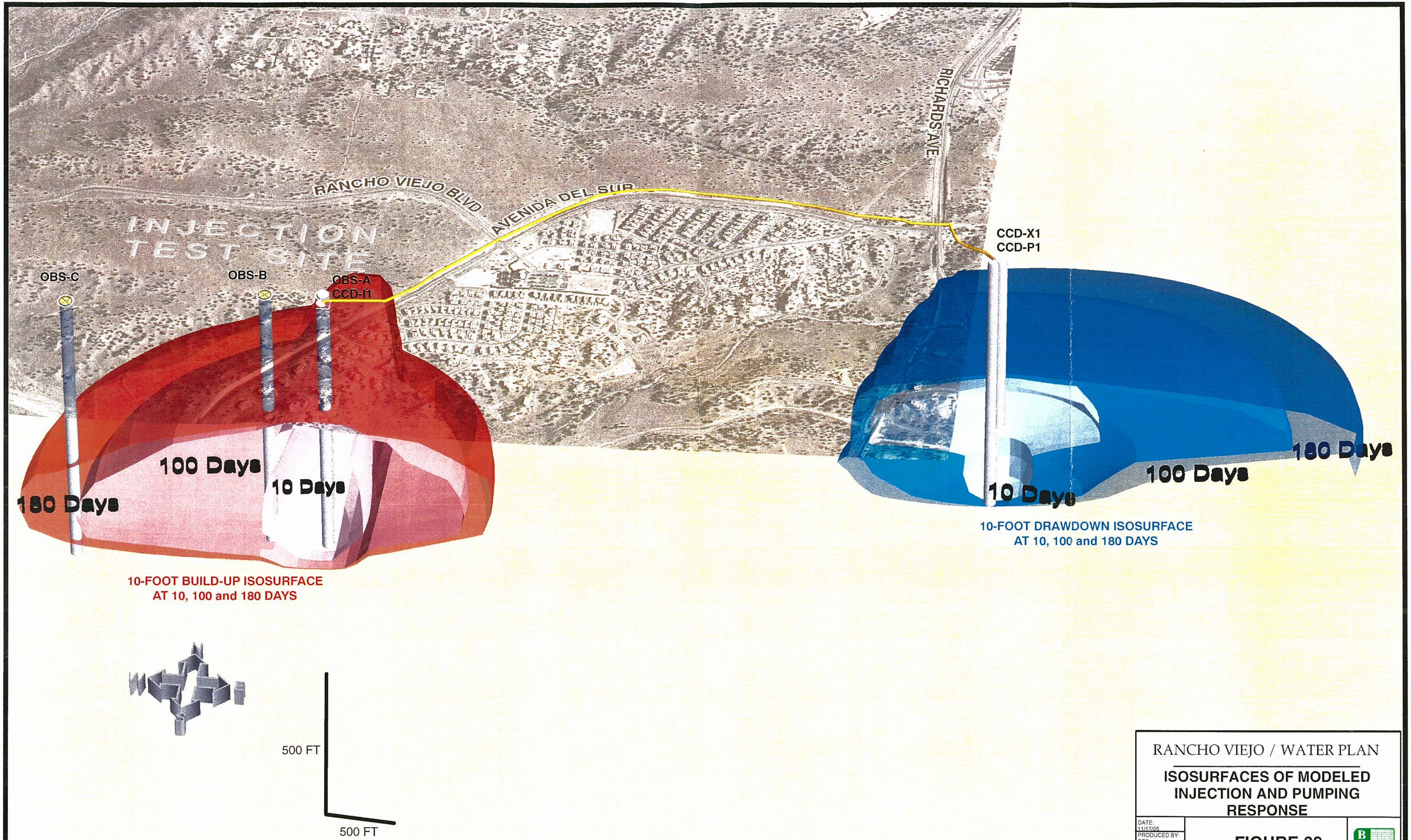


Copy of HRGPHrpt.xlsb
SES
11/5/2007

## FIGURE 38
## OBSERVED AND SIMULATED DRAWDOWN AT CCD-X1



Copy of HRGPHrpt.xlsb
SES
11/5/2007



RANCHO VIEJO / WATER PLAN

**ISOSURFACES OF MODELED INJECTION AND PUMPING RESPONSE**

DATE: 11/17/05
PRODUCED BY: SES
CHECKED BY: DB
FILE NAME: XSEC.MXD

**FIGURE 39**

BALLEAU GROUNDWATER, INC.

# APPENDIX A

# AGENCY APPROVALS

STATE OF NEW MEXICO

OFFICE OF THE STATE ENGINEER

Santa Fe

John R. D'Antonio Jr., P.E.
State Engineer

BATAAN MEMORIAL BUILDING, ROOM 102
SANTA FE, NEW MEXICO 87504-5102
(505) 827-6120
FAX: (505) 827-6682

November 17, 2005

Rancho Viejo de Santa Fe, Inc.
Isaac Pino, P.E., General Manager
P.O. Box 4458
Santa Fe, NM 87502

Re: *Conditional Authorization to Proceed with Temporary Diversion from Well No. RG-38073—Expl. 5*

Dear Mr. Pino:

In our desire to support innovative water related research, which may benefit the public, the Office of the State Engineer ("OSE") is authorizing temporary use of well No. RG-38073—Expl. 5, for diversion of up to forty (40) acre-feet of water, contingent upon the formal withdrawal by Rancho Viejo de Santa Fe, Inc. ("Rancho Viejo") of Application RG-2310, RG-12312, and RG-12313 (Consolidated) into RG-38073—Expl. 5, and further subject to the following specific requirements:

1. Prior to any diversion of water, Rancho Viejo shall obtain appropriate permits as mandated by the New Mexico Environment Department for injection of water into an aquifer.

2. Prior to any diversion of water, Rancho Viejo shall obtain written verification or documentation from Santa Fe County of full compliance with any pertinent County regulations or ordinances governing the diversion of water in the Community College District.

3. Prior to any diversion of water, Rancho Viejo shall provide to the OSE written documentation of compliance with above items numbered 1 and 2.

4. Well No. RG-38073—Expl. 5 shall be equipped with a totalizing meter, installed at the wellhead before any distribution line branch.

5. Prior to any diversion of water, the OSE shall be notified in writing of the make, model, serial number, units, multiplier, and number of free moving dials of the above described totalizing meter.

6. Rancho Viejo shall obtain an exploratory permit from the OSE for the project's injection well and permits for the drilling of all monitor wells, observing all applicable well construction rules and regulations.

7. The injection well shall be equipped with a totalizing meter, which shall be installed at a location and in a manner acceptable to the OSE.

8. Prior to any injection of water, the OSE shall be notified in writing of the make, model, serial number, units, multiplier, and number of free moving dials of the totalizing meter required under item number 7.

9. Prior to any diversion of water under this authorization, well No. RG-38078—Expl. 5, the injection well, and all project observation wells proximal to the diversion and injection wells shall be completed and equipped with continuous recording water level piezometers, installed and operated in a manner acceptable to the OSE.

10. The monitoring well network shall be designed to be capable of measuring all pumping and injection effects in such a manner as to determine any impacts on existing water rights.

11. Prior to any diversion of water, Rancho Viejo shall notify the OSE by Certified Mail of the date of first diversion of water under this authorization.

12. This authorization shall expire on December 31, 2006 or six (6) months from the date of first diversion, as documented above in item number 10, whichever occurs first.

13. Records of the amount of water diverted from well No. RG-38073—Expl. 5, and the amount of water injected into the aquifer shall be submitted to the Santa Fe Office of the State Engineer on or before the 10th day of each month for the preceding calendar month.

14. All water diverted from well No. RG-38073—Expl. 5 shall be injected back into the same hydro-geologic strata from which it was diverted (as documented by means of well samples, geophysical well log and cross sectional data).

15. No water shall be put to beneficial use or consumed under this authorization. If the quantity of water injected is less than the quantity of water diverted, Rancho Viejo shall offset any operational loss or other loss of water in a manner acceptable to the OSE.

16. Copies of all technical data and interpretations developed during this study shall be promptly provided to the OSE.

Please be aware that, although Rancho Viejo is highly encouraged to work with OSE Hydrology Bureau staff in designing its project and conducting the study, by granting this authorization the OSE neither endorses or validates the study or the results obtained there from.

I will anticipate receipt of the required Environment Department and County authorizations, the data for the totalizing meters, as well as the notification of the first day of diversion.

Please contact me if further discussion of this matter is needed. I can be reached at 827-4187.

Sincerely,

John T Romero

John T. Romero, P.E.
Director, Water Resource Allocation Program

cc: John R. D'Antonio, Jr., P.E., New Mexico State Engineer
Jim Sizemore, P.E., Water Right Director
Charles T. DuMars, J.D.
Richard Martinez, DFA-Capital Projects
Richard Rose, P.E., NM Environmental Dept.
Gerald T.E. Gonzalez, Santa Fe County Manager

*State of New Mexico*
***ENVIRONMENT DEPARTMENT***
*Ground Water Quality Bureau*
*Harold Runnels Building*
*1190 St. Francis Drive, P.O. Box 26110*
*Santa Fe, New Mexico 87502-6110*
*Telephone (505) 827-2918*
*Fax (505) 827-2965*

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

COPY

JAN 0 9 2006

**CERTIFIED MAIL - RETURN RECEIPT REQUESTED**

January 4, 2006

Isaac Pino P.E.,
Vice President & General Manager
Rancho Viejo del Santa Fe, Inc.
55 Cañada del Rancho
Santa Fe, NM 87508

**RE: Response to Notice of Intent to Discharge for the Pilot Injection Well, Rancho Viejo Aquifer Recharge Project**

Dear Mr. Pino:

The New Mexico Environment Department (NMED) received a Notice of Intent to discharge for the Rancho Viejo Aquifer Recharge Project Pilot Injection Well on November 30, 2005. The notice satisfies the requirements of Section 20 6 2.1201.B of the New Mexico Water Quality Control Commission (WQCC) Regulations (20.6 2 NMAC). The proposed discharge is located approximately 2 miles south of the City of Santa Fe in Section 29, T16N, R9E, Santa Fe County

**Based on the information provided in your Notice of Intent, NMED has determined that a Discharge Permit is not required as long as the discharge is as described.** The discharge is exempt from the Discharge Permit requirement pursuant to Section 20 6.2 3105 D NMAC because the information provided indicates that the discharge is the result of the transport of water diverted and that the water diverted has not had added to it after the point of diversion any effluent received from a sewerage system and the secretary has not determined that a hazard to public health may result.

The exempt discharge is briefly described as follows:

Up to 50 gallons per minute of Tesuque Formation ground water will be pumped from the Community College District Production Well (CCDP1), piped about 1 mile and returned to the Tesuque Formation through an injection well constructed for the purpose. The total project duration is limited to a six-month period. Injected water is anticipated to have a similar chemical composition to the water of the receiving aquifer. No water contaminants are added to the diverted water and no increase to the weight of water contaminants is anticipated. Measures are taken to prevent chemical changes from occurring during withdrawal, transport and re-injection. Water will be withdrawn and re-injected at correlative stratigraphic intervals. The project will provide a hydrologic assessment of the feasibility of a full-scale aquifer recharge system.

Although a Discharge Permit is not being required for this discharge at this time, you are not relieved of liability should your operation result in actual pollution of surface or ground waters. Further, this decision by NMED does not relieve you of your responsibility to comply with any other applicable federal, state, and/or local laws and regulations, such as zoning requirements, plumbing codes and nuisance ordinances.

If at some time in the future you intend to change the amount, character or location of your discharge, or if observation or monitoring shows that the discharge is not as described in your Notice of Intent or that unforeseen impacts to ground water quality are resulting from your activities, you must file a revised Notice of Intent with the Ground Water Quality Bureau. To this end, NMED requests that information resulting from the project be provided to NMED in a timely manner to verify that ground water impacts are not occurring from the pilot project activities.

If you have any questions, please contact either Robert George, Domestic Waste Team Leader of the Ground Water Pollution Prevention Section at (505) 476-3648 or George Schuman, Program Manager of the Ground Water Pollution Prevention Section, at 505-827-2900.

Sincerely,

George Schuman for W. Olson

William C. Olson, Chief
Ground Water Quality Bureau

WO:RJG/rg

cc: Andy Edmonson, NMED Construction Programs Bureau
John T. Romero, Office of the State Engineer
Cecilia Williams, District Manager, NMED District II
NMED Santa Fe Field Office
NOI File
County File

Harry B Montoya
Commissioner, District 1

Virginia Vigil
Commissioner District 2

Michael D. Anaya
Commissioner, District 3

1852

Paul Campos
Commissioner, District 4

Jack Sullivan
Commissioner, District 5

Gerald T E. González
County Manager

March 1, 2006

Issac Pino, P.E.
General Manager
Rancho Viejo de Santa Fe, Inc
P.O. Box 4458
Santa Fe, NM 87502

Re: Temporary Diversion from well No. RG-38073

Dear Mr. Pino:

You have requested that Santa Fe County address those matters identified in the letter of November 17, 2005 of the State Engineer. You sought the authorization of the Office of the State Engineer to divert an amount of water not to exceed 40 acre-feet Well No. RG-38073. In the response to your request, the Office of the State Engineer, in its letter dated November 17, 2005 specified that "Prior to any diversion of water, Rancho Viejo shall obtain verification or documentation from Santa Fe County of full compliance with any pertinent County regulations or ordinances governing the diversion of water in the Community College District."

Santa Fe County expects that Rancho Viejo will comply with all regulations and ordinances governing the diversion of water in the Community College District. However, since the well is unrelated to a specific development, there does not appear to be any specific requirements that apply to the proposed project.

Sincerely,

Dolores I. Vigil
Land Use Administrator

Copy: County Manager
County Attorney
Utilities Resources Director

102 Grant Avenue • P.O. Box 276 • Santa Fe, New Mexico 87504-0276 • 505-986-6225 • FAX: 505-986-6389

REC'D AUG 29 2006

**STATE OF NEW MEXICO**
**OFFICE OF THE STATE ENGINEER**
**Santa Fe**

John R. D'Antonio Jr., P.E.
State Engineer

BATAAN MEMORIAL BUILDING, ROOM 102
SANTA FE, NEW MEXICO 87504-5102
(505) 827-6120
FAX: (505) 827-6682

August 28, 2006

Rancho Viejo de Santa Fe, Inc.
Isaac Pino, P.E., General Manager
P.O. Box 4458
Santa Fe, NM 87502

Re: Authorization to Change Completion Date for Injection of Water Diverted from Well No. RG-38073—Expl. 5

Dear Mr. Pino:

In our continued desire to support innovative water related research, the Office of the State Engineer (OSE) is authorizing the Change in the completion date for the injection of water diverted from well No. RG-38073—Expl. 5. The expiration date for this authorization shall now be February 28, 2007. The original requirements in our Conditional Authorization issued on November 17, 2005 must still be met.

Please contact me if further discussion of this matter is needed. I can be reached at 827-4187.

Sincerely,

John T Romero

John T. Romero, P.E.
Director, Water Resource Allocation Program

cc: John R. D'Antonio, Jr., P.E., New Mexico State Engineer
Jim Sizemore, P.E., Water Right Director
Charles T. DuMars, LRPA
Richard Martinez, DFA-Capital Projects
Andy Edmondson, NM Environmental Dept.
Gerald T.E. Gonzalez, Santa Fe County Manager

Jtr

# APPENDIX B

# HAWLEY GEOLOGY REPORT CCD-OWA

# BOREHOLE-SAMPLE AND GEOPHYSICAL LOGS FROM COLLEGE DISTRICT EXPLORATORY WELL CDX1, SANTA FE COUNTY, NM—INCLUDING SUMMARY OF HYDROGEOLOGIC INTERPRETATIONS

John W. Hawley, Ph.D., HAWLEY GEOMATTERS hgeomatters@qwest.net

The following log of drill cuttings from the 1,802-ft Pilot Hole for Rancho Viejo Observation-Well OB-A, in the Española Basin southwest of Santa Fe; and preliminary interpretations of basin-fill hydrogeology in the well-site area were made during and shortly after drilling operations in February and March,2006. Except for a thin Quaternary erosion-surface veneer in the uppermost part of the borehole (~5-10ft), all deposits penetrated by the test well are correlated with the Oligocene to Lower Pleistocene Santa Fe Group (SFG)—Tesuque and Ancha Formations as defined by Brewster Baldwin (*in* Spiegel and Baldwin 1993, p. 38-64). *Note that the 'upper" Santa Fe-Ancha Formation has recently been "redefined" by Koning and others (2002); but at test-well sites in the Rancho Viejo study area, the Ancha Fm conforms to both original and current lithostratigraphic concepts. Johnson and others (2004) have also extended Tesuque Fm-Lithosome mapping-unit concepts of Cavazza (1986) and Koning (2004) into the southern Española Basin (**Appendix**, p. 49-51).*

The bulk of SFG sediments in the study area (including the College District Exploratory [CDX1] Well site) are here interpreted as sandy, distal piedmont-slope lithofacies derived from the adjacent Santa Fe Range (southern Sangre de Cristos); and interbedded fine- to coarse-grained basin-floor sediments. These deposits are here classified according to two major systems of stratigraphic nomenclature: 1) Upper Neogene Santa Fe Group lithostratigraphic units: upper Santa Fe-Ancha Fm, and middle to lower Santa Fe-Tesuque Formation—"main body" and Bishop Lodge Mbr; and 2) informal lithofacies-assemblage (***LFA***) and hydrostratigraphic (**HSU**) subdivisions of the Santa Fe Group (**Fig. 1, Tables A-D**; Hawley and Kernodle, 2000). Major Tesuque Fm lithosomes S, and E?) are also tentatively identified. A lithologic description of drill cuttings (**Table A**, p. 4-24) is followed by summaries of major lithofacies, stratigraphic, and hydrogeologic interpretations (**Tables B and C**, p. 25-34, 35-45). **Table D** (p. 46) is a chart that summarizes the distribution of major hydrostratigraphic units, lithofacies assemblages, and Tesuque Fm lithosomes. **Selected References** are listed on p. 47 and 48.

Sample logging was done in cooperation with Casey Cook and Peter Balleau of Balleau Groundwater. Rodgers Brothers Drilling Company drilled the test well using the reverse-rotary method. Borehole geophysical logging (incl: natural Gamma, SP, short-normal and dual-induction resistivity, neutron, and caliper) was done by Welenco following drilling completion (2/13/06). Drill cuttings were collected at 10-ft intervals from the land surface to 1,800 ft. Sample logging involved use of standard field-Identification procedures developed by the USDA-Natural Resource Conservation Service (NRCS) and other Federal agencies for their geological engineering and soil mapping programs (NRCS, 1996, National Soil Survey Handbook, 430-VI-NSSH).

Prior drilling experience in the area indicates that the basin fill is unconsolidated to moderately consolidated. Therefore, systems of classification developed in soil mechanics and soil surveys (i.e. Unified-ASTM) will be used in this investigation along with standard geological field descriptions. Bulk lithologic properties (incl. texture, color, grain-size grading, mineralogy, and secondary carbonate content) are estimated visually, manually, and with dilute HCl. "Visual" procedures include use of a hand-lens and binocular microscope where needed. Supplemental interpretations of vertical distribution of major textural classes (e.g. fine-grained vs. sand to fine gravel zones) are based on borehole geophysics and other drilling records. However, detailed analyses involving combined use of binocular and petrographic microscopy have not been done; so identification of fine-grained igneous and sedimentary rocks is definitely at a provisional level.

It is also important to note that drill cuttings from rotary-drilling methods represent only an approximation of the in-place lithologic character of the units penetrated by the drill bit. This is due to the mixing of cuttings and some loss of fine-grained material (clay, silt and fine sand) as the drilling fluid circulates through the borehole and mud pit. Comparison of borehole samples and geophysical logs, however, indicates that the reverse-rotary method used in this particular drilling operation produced a suite of samples that are representative of general subsurface conditions at the site. Because geophysical logging shows that there is some lag in drill-cutting return (usually <20ft), reported lithologic-unit depth ranges are adjusted to an estimated "true depth" in Tables 2 and 3. Descriptions of sampled intervals include all or part of the following information on drill-cutting properties:

1. Dominant textural class(es)[1]
2. Dominant moist color[s] [2]
3. Grain-size distribution by major textural class[3]
4. Grading of sand grains and fine (pebble) gravel clasts[4]
5. Grain and clast angularity/roundness (angular, subangular, subrounded, rounded)
6. Dominant grain and clast composition
7. Carbonates: calcareous/noncalcareous–effervescence in dilute HCl; and secondary carbonate morphologies[5]
8. Other classifications: **Unified-ASTM**, *USDA-NRCS*

**Footnotes:**

[1] For standard geological notation (see[3])

[2] Munsell Color (2000)

[3] Major textural classes

a. Mud/fines: silt-clay mixtures (<0.062mm [w/clay <0.004mm]). Note that the sand/silt break varies from 0.05mm (USDA) to 0.074mm (ASTM)
b. Sand (0.062 to 2mm): very fine (vf sd)-0.062 to 0.125mm, fine (f sd)-0.125 to 0.25mm, medium (m sd)-0.25 to 0.5mm, coarse (c sd)-0.5 to 1mm, very coarse (vc sd)-1 to 2mm. Note that sand the sand/fine gravel break varies from 2mm (USDA) to 4.75mm (ASTM)
c. Gravel [Pebbles](2 to 64mm): very fine ( vf gvl)-2 to 4mm, fine (f gvl)-4 to 8mm, medium (m gvl)-8 to 16, coarse (c gvl)-16 to 32mm, very coarse (vc gvl)-32-64mm. Note: Cobbles [cobble gravel]-64 to 256mm,and boulders [boulder gravel]->256mm

[4] Well graded (poorly sorted)=large range of size classes, poorly graded (well sorted)=small range of size classes. Note that "moderately" may be used to indicate intermediate levels of grading (sorting)

[5] e=effervescent – bubbles readily observed, es=strongly effervescent – bubbles form a low foam, ev=violently effervescent – thick foam "jumps up"

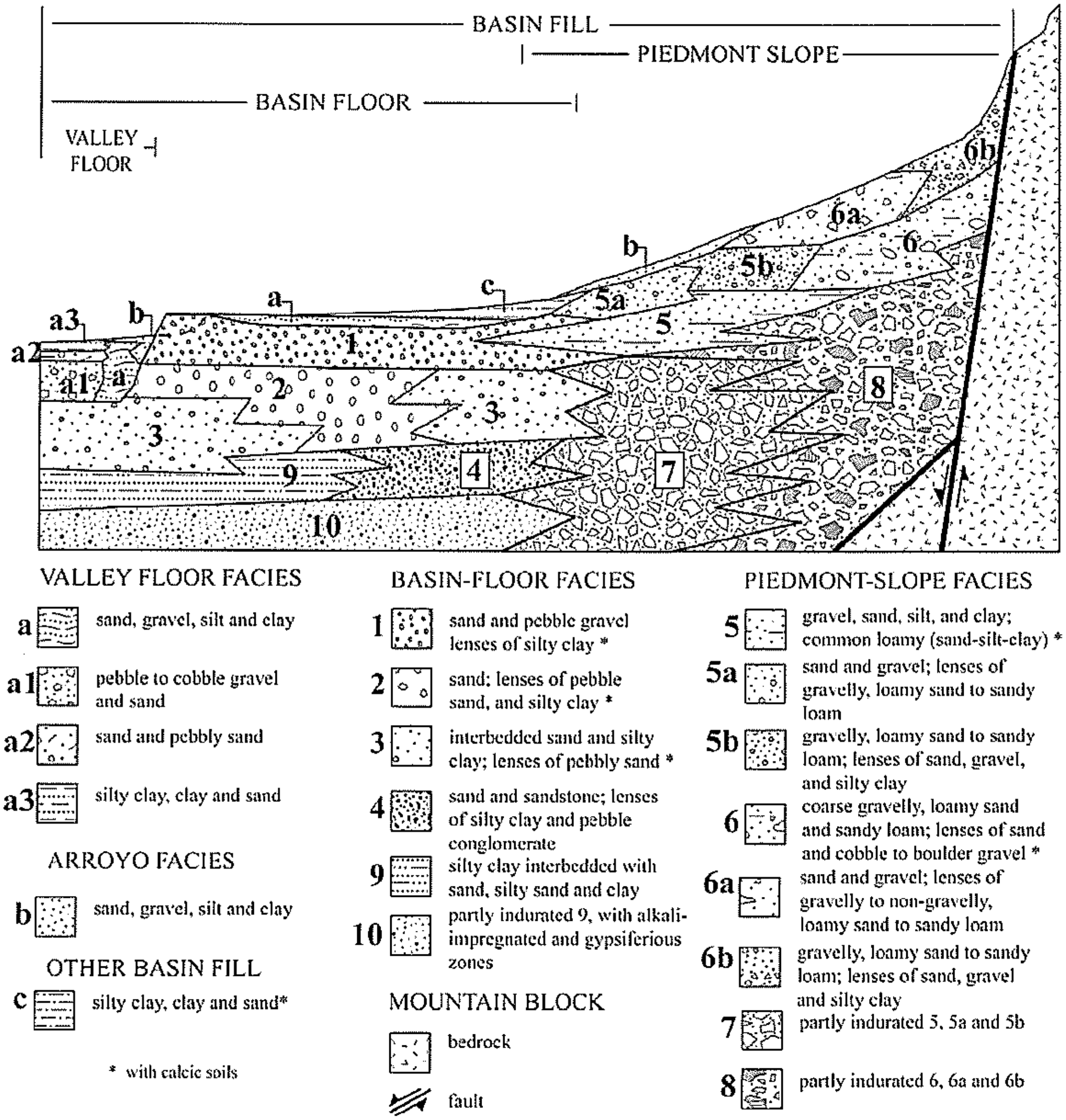


Figure 1. Schematic distribution pattern of major lithofacies assemblages (Tables 1 to 3) in Santa Fe Group basin fill and post-Santa Fe valley fills of the Rio Grande rift region. From Hawley and Kernodle (2000)

## TABLE A. DETAILED LITHOLOGIC LOG OF PILOT HOLE FOR OBSERVATION WELL OB-A (RANCHO VIEJO) BASED ON VISUAL ANALYSES OF DRILL CUTTINGS

**Well Name:** OB-A
**Location:** T16N, R9E, Section 29.111
**Lat/Long:** 35°35'43" N, 106°01'05" W
**State Plane Coordinates (est.):** X=1709332 (569100) Y=1672077 (1671600)
**Elevation:** 6,475ft asl
**Total Depth:** 1,802 ft
**Completed:** 2/12/2006
**Geophysical Logging (to 1,760 ft):** 2/13/2006

### Description and Classification of Drill Cuttings

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 0-10 | Pebbly sand, slightly silty and poorly sorted. Dark reddish gray to reddish brown (5YR4/2-3). Sand (vf-vc), with 10% vf-m pebble gravel and 10% silt. Well graded, angular to subangular sand grains and gravel clasts. Arkosic mineralogy (quartz, K-feldspar, granite/pegmatite lithics; w/ one weathered micaceous gneiss pbl (derived from local Pre-Cambrian terrane). Calcareous (e-es). **SW**, *Sand.* |

**Note: Top (?) of Upper Santa Fe-Ancha Fm (Pliocene-Early Pleistocene) within 5-10 ft of land surface. Cuttings to 40ft from auger borehole for surface casing.**

| | |
|---|---|
| 10-20 | Silty sand, poorly sorted. Reddish brown (5YR4/4). 70-75% sand (vf-vc), 25-30% silt, and <2% pebbles (**pbls**)(vf-m). Well graded, angular to subrounded sand grains and gravel clasts. Arkosic grain/clast mineralogy (as above), w/common K-mica flakes, one m pbl-granite, and f pbl-brown chert. Calcareous (e-es). **SM**, *Sandy loam.* |
| 20-30 | Sandy pebble gravel, poorly sorted. Reddish brown (5YR4/3). 60% pbls (vf-vc), 35% sand (vf-vc), and 5% silt. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above), w/ mica flakes and 64mm subrounded granite pbl. Noncalcareous. **GW**, *Sandy fine gravel.* |
| 30-40 | Silty sand, poorly sorted. Reddish brown (5YR4/4). 70-75% sand (vf-vc), 20-25% silt , and 5% pbls (vf-c). Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above), w/few m-c pbls of gray to black siliceous ss and conglomeratic ss. Noncalcareous. **SM**, *loamy sand.* |

## Description and Classification of Drill Cuttings

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 40-50 | Very fine pebbly sand, poorly sorted. Reddish brown (5YR5/3). 85-90 % sand (vf-vc), with 10-15% pbls (vf-f). Well graded, angular to subrounded grains and clasts. Arkosic- micaceous mineralogy (as above). Noncalcareous. **SW**, *Sand.* Remarks: Start reverse-rotary drilling with water drilling fluid. |
| 50-60 | Silty sand, poorly sorted. Reddish brown (5YR4-5/3). 75-80% sand (vf-vc), 20-25% silt, and trace vf-f pbls. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above), w/common mica flakes. Noncalcareous. **SM**, *Loamy sand.* |
| 60-70 | Very fine pebbly sand, poorly sorted. Reddish brown (5YR5/3). Sand (vf-vc), with vf-f pbls (10-15%). Well graded, angular to subrounded grains and clasts. Arkosic- micaceous mineralogy (as above). Noncalcareous. **SW**, *Sand.* |
| 70-80 | Silty sand—dominant, w/ interbedded(?) very fine sandy silt. Sand: dark brown (7.5YR3/2); silt: brown (7.5YR5/3). 85-90% sand (vf-vc), 10-15% silt, and few vf-f pbls. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above). Calcareous (e-es). **SW-SM**, *Sand-loamy sand.* Remarks: Possible buried soil in upper part of interval. |
| 80-90 | Pebbly sand, slightly silty and poorly sorted. Reddish brown (5YR4-5/3). 80% sand (vf-vc), 10% silt, and 10% vf-m pbls. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above), w/common mica flakes. Calcareous (e). **SW**, *Sand.* |
| 90-100 | Silty to sandy clay. Reddish gray (5YR5/2). 60% silt-clay (**fine-fraction, fines, mud**), 35% sand (vf-vc), and 5% pbls (vf-m). Well graded, angular to subrounded grains and clasts. Arkosic mineralogy (as above). Calcareous (ev). **SC,** *Sandy loam-sandy clay loam.* |
| 100-110 | Pebbly sand, poorly sorted, w/ minor interbedded(?) silty to sandy clay (as above, 90-100). Reddish brown (5YR4-5/3). 80-85% sand (vf-vc), 10% pbls (vf-m), and 5-10% fines. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above). Calcareous (es-ev), with trace (mostly pink, 2.5-5YR7/3) soft carbonate segregations (*can*). **SW**, *Sand* and minor **SC**, *Sandy clay loam.* |
| 110-120 | Slightly silty sand, poorly sorted. Reddish brown (5YR5/3), with some reddish gray (5YR5/2) silty zones. 80-85% sand (vf-vc), 10-15% fines, and 5-10% pbls (vf-f). Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above). Very calcareous (ev), with trace pink *can* as above. **SW,** *Sand.* |

## Description and Classification of Drill Cuttings

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 120-130 | Sandy pebble gravel, poorly to moderately sorted. Reddish brown (5YR5/3-4). 60% pbls (vf-m) and 40% sand (f-vc). Moderately to well graded, angular to subrounded grains and clasts; clast max: 15mm. Arkosic grain/clast mineralogy (as above). Noncalcareous. **GW**, *Sandy fine gravel.* |
| 130-140 | Pebbly sand, slightly silty and poorly sorted. Reddish brown (5YR5/3-4). 60% sand (vf-vc), 30% pbls (vf-m), and 10% fines. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above). Calcareous fine fraction w/ trace *can.* **SW-GW**, *Sand to very fine gravelly sand.* |
| 140-150 | Pebbly sand, slightly silty and poorly sorted. Reddish brown (5YR5/3-4). 70% sand (vf-vc), 25-30% pbls (vf-f), and <5% fines. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above). Calcareous fine fraction. **SW-GW**, *Sand to very fine gravelly sand.* |
| 150-160 | Pebble gravel and sand, poorly sorted. Reddish brown (5YR5/4). 50% pbls (vf-m) and 50% sand (f-vc). Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above) w/ trace diorite. Noncalcareous. **GW-SW**, *Sandy fine gravel* and *very fine gravelly sand.* |
| 160-170 | Pebble gravel and sand, as above (150-170). |
| 170-180 | Pebbly sand, poorly sorted. Reddish brown (5YR5/4). 65% sand (vf-vc) and 35% pbls (vf-m). Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above). Noncalcareous. **SW-GW**, *Sand to very fine gravelly sand.* |
| 180-190 | Sandy pebble gravel, poorly sorted. Reddish brown (5YR5/3-4). 60% pbls (vf-m) and 40% sand (vf-vc). Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above), w/ trace dark quartzite. Noncalcareous. **GW**, *Sandy fine gravel.* |
| 190-200 | Pebbly sand, poorly sorted. Reddish brown (5YR5/3-4). 60% sand (vf-vc) and 40% pbls (vf-m). Well graded, angular to subrounded grains and clasts; clast max: 13mm. Arkosic grain/clast mineralogy (as above), w/ some quartzite and diorite. Noncalcareous. **SW-GW**, *Sand to very fine gravelly sand.* |
| 200-210 | Pebbly sand, poorly sorted. Reddish brown (5YR5/3). 65% sand (vf-vc) and 35% pbls (vf-m). Well graded, angular to subrounded grains and clasts; clast max: 16mm. Arkosic grain/clast mineralogy (as above). Noncalcareous. **SW-GW**, *Sand to very fine gravelly sand.* |

## Description and Classification of Drill Cuttings

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 210-220 | Pebble gravel and sand, poorly sorted. Reddish brown (5YR5/4). 50% pbls (vf-m) and 50% sand (f-vc). Well graded, angular to subrounded grains and clasts; clast max: 10mm. Arkosic grain/clast mineralogy (as above), w/ quartzite and diorite. Noncalcareous. **GW-SW**, *Sandy fine gravel* and *very fine gravelly sand.* |
| 220-230 | Coarse pebble gravel, poorly to moderately sorted. Reddish brown (5YR5/3). 75% pbls (vf-vc) and 40% sand (f-vc). Moderately to well graded, angular to subrounded grains and clasts; clast max: 45mm. Arkosic grain/clast mineralogy (as above), with gneiss, diorite, and quartzite. Noncalcareous. **GW**, *Fine gravel.* |

**Note: Contact of Upper Santa Fe-Ancha Fm on Middle Santa Fe-Tesuque Fm at ~215ft is inferred from "drillograph" records, borehole geophysics, and major texture-mineralogy shift in drill cuttings. Driller noted very coarse gravel ("boulders") at about 205ft and a shift to much faster bit penetration at 213ft.**

| | |
|---|---|
| 230-240 | Silty clay to clay. Reddish brown (2.5YR4/4). 80 fines, >18% sand (vf-c), <2% pbls (vf). Arkosic grain/clast mineralogy (as above). Very calcareous (es-ev). **CL**, *Clay to clay loam.* |
| 240-250 | Silty clay to clay. Reddish brown (2.5YR4/3-4). 80% fines and 20% sand (vf-c), and trace vf pbls. Arkosic grain/clast mineralogy (as above). Very calcareous (es-ev), w/ few pink (5YR7/3) *can.* **CL**, *Clay to clay loam.* |
| 250-260 | Silty clay to clay, as above (230-250), with trace vf-f pbls. Clasts include quartz, K-feldspar, granite, and quartzite. |
| 260-270 | Pebble gravel and sand, poorly sorted. Brown (7.5YR5/3) to reddish brown (5YR5/4). 50% pbls (vf-m) and 50% sand (f-vc). Well graded, w/ angular to rounded grains and angular to subrounded clasts; clast max: 15mm. Arkosic grain/clast mineralogy (quartz, K-feldspar, K-mica, and granite/gneiss lithics) w/ few Pz ss, siltstone (**slts**), and gray chert. Noncalcareous. **GW-SW**, *Sandy very fine gravel* and *very fine gravelly sand.*<br>Remarks: Interpreted as Lithosome S of the Tesuque Fm (Johnson et al., 2004; Koning and Hallett, 2001 [2006 update]). |
| 270-280 | Silty clay to clay—dominant, with interbedded(?) pebble gravel and sand as above (260-270). Fines: Reddish brown (2.5YR4/4); 80% silty clay and 20% sand (vf-c), <2% pbls (vf). Arkosic grain/clast mineralogy (as above). Noncalcareous to very calcareous (es). **CL** and **GW-SW**, *Clay to clay loam* and *very fine gravel* to *fine gravelly sand.* |

## Description and Classification of Drill Cuttings

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 280-290 | Sandy to silty clay. Reddish brown (5YR5/3). 70 fines, >28% sand (vf-c), <2% pbls (vf-m); clast max: 10mm. Arkosic grain/clast mineralogy (as above), including weathered gneiss; w/ trace light-gray chert. Noncalcareous to very calcareous (es). **SC-CL**, *Sandy clay loam to clay.* |
| 290-300 | Silty clay to clay. Reddish brown (2.5YR4/4). 80 % fines, 20% sand (vf-c), and trace vf pbls. Arkosic grain/clast mineralogy (as above). Very calcareous (es-ev), w/ few pink *can.* **CL**, *Clay Loam to clay.* |
| 300-310 | Coarse pebbly sand, slightly silty and poorly sorted. Reddish brown to light reddish brown (5YR5-6/3). 50% sand (vf-vc), 40% pbls (vf-c), and 10% fines. Well graded, grain/clast angularity/rounding as above (260-270); clast max: 30mm. Arkosic grain/clast mineralogy (as above); w/ trace quartzite. Calcareous fine fraction w/ trace *can.* **SW-GW**, *Fine gravelly sand.* |
| 310-320 | Pebbly sand as above (300-310, 260-270) dominant, with some interbedded(?) silty to sandy clay. Fines: reddish brown (2.5YR4/4). 50% fines, 35% sand (vf-vc), and 5% pbls (vf-m); clast max: 15mm. Arkosic mineralogy (as above), w/ trace black chert (Pz). Calcareous (e-ev). **SW-GW**, *Fine gravelly sand* ; w/ **SC**, *Sandy clay loam.* |
| 320-330 | Fine pebbly sand, poorly sorted. Reddish brown (5YR5/3). 80-85% sand (vf-vc), 15% pbls (vf-f), and <5% fines. Well graded, grain/clast angularity/rounding as above (260-270); clast max: 30mm. Arkosic grain/clast mineralogy (as above); w/ trace black and gray chert (Pz). Non- to slightly calcareous (e). **SW**, Very *fine gravelly sand.* |
| 330-340 | Fine sandy to silty clay. Reddish brown (5YR5/4&2.5YR4/4). 75% fines, 25% sand (vf-c), and trace vf pbls. Arkosic grain/clast mineralogy (as above). Slightly to very calcareous (e-ev). **SC-CL**, *Clay loam to clay.* |
| 340-350 | Interbedded(?) fine pebbly sand and silty clay to clay as above (320-340). |
| 350-360 | Interbedded(?) fine pebbly sand and silty clay to clay as above (320-340), w/ fine-grained zones dominant (~67%). |
| 360-370 | Sandy to silty clay, with few thin sandy zones (like 320-330). Reddish brown (5YR5/4&2.5YR4/4). 60% fines, 40% sand (vf-c), and trace vf-f pbls. Arkosic grain/clast mineralogy (as above). Very calcareous (es-ev), w/ few light yellowish brown (10YR6/3) high-carbonate zones. **SC**, *Sandy loam* to *sandy clay loam.* |
| 370-380 | Interbedded(?) fine pebbly sand and silty clay to clay as above (320-350). |

## Description and Classification of Drill Cuttings

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 380-390 | Sandy to silty clay. Reddish brown (5YR5/3). 60% fines, 40% sand (vf-c), and trace vf-f pbls. Arkosic grain/clast mineralogy (as above). Calcareous (ev). **SC**, *Sandy loam* to *sandy clay loam.* |
| 390-400 | Fine to medium pebbly sand, poorly sorted. Reddish brown (5YR5/3). 75% sand (vf-vc), 20% pbls (vf-f), and <5% fines. Well graded, grain/clast angularity/rounding as above (260-270); clast max: 30mm. Arkosic grain/clast mineralogy (as above); w/ highly weathered gneiss fragment, and trace coarse ss and black chert (Pz). Non- to slightly calcareous (e). **SW**, *Fine gravelly sand.* |
| 400-410 | Silty clay. Reddish brown (2.5YR4/4-5). 80% fines and 20% sand (vf-c), and trace vf-f pbls. Arkosic grain/clast mineralogy (as above). Very calcareous (ev), w/ pink (5YR7/3) *can.* **CL**, *Clay to clay loam.* |
| 410-420 | Clay to silty clay. Weak red to reddish brown (10R4/3-2.5YR4/4). 90% fines and 10% sand (vf-c), and trace vf-f pbls. Arkosic grain/clast mineralogy (as above), w/ trace Pz? slts and light reddish brown to pink (2.5YR6-7/3) limestone (**ls**) fragments. Very calcareous (ev), w/ pink *can.* **CL**, *Clay.* Remarks: Some "**ls**" fragments here and below could be indurated carbonate segregations (*cam*). |
| 420-430 | Silty clay, as above (400-410). |
| 430-440 | Sand, poorly to moderately sorted, with interbedded(?) silty clay, as above (400-430). Sand: reddish brown (5YR5/3) and fines: 5YR4/4). 85-90% sand (vf-vc), <5% pbls (vf-m), and 10% fines. Well to moderately graded, grain/clast angularity/rounding as above (260+); clast max: 13mm. Arkosic grain/clast mineralogy (as above); w/ trace quartzite. Non- to very calcareous (ev). **SW**, *Sand*; with **CL**, *Clay loam to clay.* |
| 440-450 | Clay to silty clay. Reddish brown (2.5-5YR5/4), with trace weak red (10R4/3). 90% fines and 10% sand (vf-c), w/ trace vf-f pbls. Arkosic grain/clast mineralogy (as above), w/ trace slts (Pz?). Non- to slightly calcareous (e). **CL**, *Clay.* |
| 450-460 | Clay to silty clay, as above (440-450), with slightly more (5-10%) very fine sandy silt. |
| 460-470 | Fine sandy to silty clay. Reddish brown (2.5-5YR5/4), with trace weak red (10R4/3). 70% fines, 30% sand (vf-f), and trace vf-f pbls. Arkosic grain/clast mineralogy (as above), w/weathered calcareous ss (Pz?). Very calcareous (es-ev), w/ pink *can.* **SC-CL**, *Clay loam to clay.* |
| 470-480 | Fine sandy to silty clay. Light reddish brown (2.5-5YR6/3). Texture, mineralogy, and secondary carbonates as above (460-470). |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 480-490 | Clay to silty clay. Variegated: Pale red to reddish brown (10R-2.5YR4-5/4), and light reddish brown (2.5YR6/4). 85-90% fines, 10-15% sand (vf-f), and trace vf-f pbls. Arkosic grain mineralogy (as above), w/ trace ls (Pz?). Very calcareous (es-ev), w/ pink *can* and zones of black Mn-oxide (**MnO**) dendrites. **CL**, *Clay.* Remarks: See 410-420; lighter values indicate slight increase in silt and vf sand. |
| 490-500 | Clay to silty clay. Reddish brown (2.5-5YR5/4), with trace weak red (10R4/3). 90% fines and 10% sand (vf-c), and trace vf-f pbls. Arkosic grain/clast mineralogy (as above), w/ trace slts (Pz?). Non-to slightly calcareous (e). **CL**, *Clay.* |
| 500-510 | Clay to silty clay, as above (490-500). |
| 510-520 | Fine sandy to silty clay. Reddish brown (2.5-5YR5/4). 70% fines, 30% sand (vf-f), and trace vf pbls. Arkosic grain mineralogy (as above), w/ weathered calcareous ss (Pz?). Very calcareous (ev), w/ pink *can.* **SC-CL**, *Clay loam to clay.* |
| 520-530 | Clay to silty clay, as above (480-490); variegated. |
| 530-540 | Clay to silty clay, as above (480-490, 520-530). Variegated: Pale red to reddish brown (10R-2.5YR5/4), and reddish brown (5YR5/3). 80-90% fines, 10-20% sand (vf-f), and trace vf pbls. Arkosic grain mineralogy (as above). Very calcareous (ev), w/ pink *can.* **CL**, *Clay loam to clay.* |
| 540-550 | Clay to silty clay. Reddish brown (2.5YR4/4), with trace weak red (10R4/3). 90% fines and 10% sand (vf-c), and trace vf-f pbls. Arkosic grain/clast mineralogy (as above), w/ trace ss (Pz?). Very calcareous (ev). **CL**, *Clay.* |
| 550-560 | Silty clay to clay—dominant, with interbedded(?) silty vf-m sand. Reddish brown (2.5YR4-5/4 & 5YR5/3). 80-90% fines, 10-20% sand (vf-f), and trace vf pbls. Arkosic grain mineralogy (as above). Very calcareous (ev), w/ pink *can.* **CL** and **SW**, *Clay* and *fine sand.* |
| 560-570 | Clay to silty clay, as above (540-550), with trace vf-m pbls. Arkosic grain/clast mineralogy (as above), w/ trace ls (Pz?). Very calcareous (ev), w/ pink *can.* **CL**, *Clay.* |
| 570-580 | Clay to silty clay, as above (540-550, 560-570); with few thin beds(?) of soft silty ss and fine sand. Sand and ss: Light reddish brown (2.5YR6/3), Very calcareous (ev), w/ pink *can.* **CL** w/minor **SM**, *Clay w/minor loamy sand.* |
| 580-590 | Clay to silty clay, with some sand/ss beds, as above (570-580). Trace (~1%) vf –f pebbles of weathered calcareous ss. |
| 590-600 | Fine sandy to silty clay. Reddish brown (5YR5/3). 70% fines, 30% sand (vf-f), and trace (<1%) vf pbls. Arkosic grain mineralogy (as above), w/ trace chert (Pz?).Calcareous (e-es), w/ pink *can.* **SC-CL**, *Clay loam to clay.* |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| **600-610** | Sandy clay. Reddish brown (5YR5/4). 45% fines, 55% sand (vf-vc), and <1% pbls (vf-m). Well graded, w/ angular to rounded sand grains and angular to subrounded pebble clasts. Arkosic grain/clast mineralogy, w/ trace quartzite. Very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy clay loam.* Remarks: **Uppermost sample selected for sieve analysis**, with representative sample-splits taken at about 50-ft intervals btw 600 and 1,610ft. |
| 610-620 | Muddy sand, poorly sorted—dominant; with interbedded(?) sandy-silty clay. Reddish brown (2.5-5YR4/4, 5YR5/3). 65% sand (vf-vc), <35% fines, and <1% pbls (vf-m). Well graded sands; grain/clast angularity/rounding as above (600-610). Arkosic grain/clast mineralogy, w/ trace chert?(Pz) and quartzite. Very calcareous (ev), w/ pink *can.* **SM**, *Sandy loam.* Remarks: Some K-feldspar pebbles highly weathered and cleave readily. |
| 620-630 | Fine sandy to silty clay. Reddish brown (5YR4/4-5/3). 70% fines, <30% sand (vf-f), and 1-2% pbls (vf-m); clast max: 15mm. Arkosic grain mineralogy (as above), w/ quartzite, weathered gneiss, and white (10YR8/1) chert (Pz?). Very calcareous (ev), w/ pink *can.* **SC-CL**, *Clay loam to clay.* |
| 630-640 | Silty sand, poorly sorted—dominant; with interbedded(?) sandy-silty clay, as above (610-620). |
| 640-650 | Clay to silty clay. Reddish brown (2.5YR4/3). 90% fines and 10% sand (vf-c), and trace vf pbls. Arkosic grain/clast mineralogy. Very calcareous (ev). **CL**, *Clay.* |
| **650-660** | Muddy sand to sandy clay. Reddish brown (2.5YR4/4 & 5YR5/3). 40% fines, 55-60% sand (vf-vc), and <5% pbls (vf-f). Well graded sands, grain/clast angularity/rounding as above (600-610). Arkosic grain/clast mineralogy, w/ trace chert and weathered calcareous ss (Pz). Very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy loam to sandy clay loam.* Remarks: **Sieve analysis of representative sample-split.** |
| 660-670 | Silty to sandy clay, as above (650-660); no chert noted in coarsest-size fraction. |
| 670-680 | Muddy sand, poorly sorted—dominant; with interbedded(?) sandy-silty clay. Reddish brown (2.5-5YR4/4, 5YR5/3). 65% sand (vf-vc), <35% fines, and <1% pbls (vf-m); clast max: 12mm. Well graded sands; grain/clast angularity/rounding as above (600-670). Arkosic grain/clast mineralogy, w/ trace chert?(Pz) and quartzite. Very calcareous (ev), w/ pink *can.* **SM**, *Sandy loam.* |
| 680-690 | Clay to silty clay. Reddish brown (2.5YR4/3). 90% fines, 10% sand (vf-c), and trace vf-f pbls. Arkosic grain/clast mineralogy. Very calcareous (ev). **CL**, *Clay.* Remarks: Like 640-650. |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 690-700 | Muddy sand to sandy clay. Reddish brown (2.5YR4/4 & 5YR5/3). 55-60% sand (vf-vc), 40% fines, and <5% pbls (vf-f). Well graded sands, grain/clast angularity/rounding as above (600-610). Arkosic grain/clast mineralogy, w/ trace chert and weathered calcareous ss (Pz). Very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy clay loam.* |
| **700-710** | Muddy sand, with interbedded(?) sandy and silty clay. Reddish brown (2.5YR4/4 & 5YR5/3). 55-60% sand (vf-vc), 40% fines, and <5% pbls (vf-f) in sieved sample. Well graded sands, grain/clast angularity/rounding as above (650-660). Arkosic grain/clast mineralogy, w/ trace chert (Pz) and quartzite. Very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy loam to sandy clay loam; and* **SC-CL,** *Sandy clay to clay.* Remarks: **Coarser fraction of sampled-interval selected for sieve analysis.** |
| 710-720 | Sandy clay, with interbedded(?) silty clay, as above (700-710); w/ trace ls (Pz?). |
| 720-730 | Clay to silty clay. Reddish brown (2.5YR4/3). 85% fines, 15% sand (vf-c), and trace vf pbls. Arkosic grain/clast mineralogy. Very calcareous (ev). **CL**, *Clay.* Remarks: Like 640-650, 680-690. |
| 730-740 | Silty sand, as below (740-740). 75-80% sand (vf-vc), 20% fines, and <3% pbls (vf-f). Arkosic mineralogy, w/ trace ss (Pz?). |
| **740-750** | Muddy sand, moderately sorted. Sand: reddish brown (5YR5/3); fines: reddish brown (2.5YR4/3-5/4). 79% sand (vf-vc), 15% fines, and 6% pbls (vf-f). Moderately graded sands, grain/clast angularity/rounding as above (700-710). Arkosic grain/clast mineralogy, w/ trace chert (Pz) and quartzite. Very calcareous (ev), w/ pink *can.* Remarks: **Sieve analysis of representative sample-split.** |
| 750-760 | Clay to silty clay. Reddish brown (2.5YR4/3). 90% fines, 10% sand (vf-c), and trace vf pbls. Arkosic grain/clast mineralogy. Very calcareous (ev), w/ pink *can.* **CL**, *Clay.* Remarks: Like 640-650, 680-690, 720-730. |
| 760-770 | Clay to silty clay, as above (750-760), with no pbls. |
| 770-780 | Clay to silty clay. Reddish brown (2.5YR4/3). 85% fines, 15% sand (vf-c), and trace vf-f pbls. Arkosic grain/clast mineralogy; w/ trace ls (Pz?). Very calcareous (ev). **CL**, *Clay.* Remarks: Like 640-650, 680-690, 720-730, 750-770. |
| 780-790 | Fine sandy to silty clay. Reddish brown (5YR4/4-5/3). 70% fines, <30% sand (vf-f), and trace vf pbls. Arkosic grain mineralogy (as above) ; w/ trace ls (Pz?). Very calcareous (ev), w/ pink *can.* **SC-CL**, *Clay loam to clay.* |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 790-800 | Muddy sand, poorly sorted. Reddish brown (2.5-5YR5/3). <75% sand (vf-vc), 25% fines, and 1% pbls (vf-f). Well graded sands, grain/clast angularity/rounding as above (740-750). Arkosic grain/clast mineralogy, w/ trace dark quartzite. Very calcareous (ev), w/ pink *can*. |
| **800-810** | Muddy sand, moderately sorted; with interbedded(?) silty clay. Sand: reddish brown (5YR5/3), fines (2.5YR4/4-5YR5/3). 60% sand (vf-vc), 35% fines, and 5% pbls (vf-f) in sieved sample. Moderately graded sands, w/ grain/clast angularity/rounding as above (740-750). Arkosic grain/clast mineralogy, w/ trace ls, ss, chert, and quartzite. Very calcareous (ev), w/ pink *can*. **SM-SC**, *Sandy clay loam to loam.* Remarks: **Coarser fraction of sampled-interval selected for sieve analysis.** |
| 810-820 | Clay to silty clay. Reddish brown (2.5YR4/3). 85% fines and 15% sand (vf-c). Arkosic grain mineralogy. Very calcareous (ev). **CL**, *Clay.* Remarks: Like 640-650, 680-690, 720-730, 750-780. |
| 820-830 | Clay to silty clay, as above (810-820); interbedded with silty sand, as above (800-810). |
| 830-840 | Silty clay (dominant) with some interbedded(?) silty sand, as above (800-830), and 1-2% vf-f pebbles. Fines: Reddish brown (2.5YR4/4); sand: reddish brown (5YR5/3). Very calcareous (es-ev), w/ pink *can*. |
| **840-850** | Silty to fine sandy clay, with few silty sand beds. Variegated: Reddish brown (5YR4/4-5/3) and light brown to pink (7.5YR6-7/3). 66% fines, 32% sand (vf-vc), and 2% pbls (vf-f). Arkosic grain mineralogy (as above); w/ trace ls (Pz?). Very calcareous (ev), w/ pink *can*. **SC-CL**, *Clay loam to clay.* Remarks: **Sieve analysis of representative sample-split.** |
| 850-860 | Fine sandy to silty clay. Reddish brown (5YR5/3). 75% fines, 25% sand (vf-f), and trace(?) vf pbls. Arkosic grain mineralogy (as above). Very calcareous (ev), w/ pink *can*. **SC-CL**, *Clay loam to clay.* |
| 860-870 | Fine to very coarse sand (~60%); with interbedded silty to sandy clay, as above (850-860) . Reddish brown: Sand (5YR5/3); fines (2.5YR4-5/4). 5% pebbles (vf-m). Well graded sands, w/ grain/clast angularity/rounding as above (800-810). Arkosic grain/clast mineralogy, w/ trace weathered gneiss and ls (Pz?). Very calcareous (ev), w/ pink *can*. **SW**, *Sand* and SC-SL, *Sandy clay-clay loam.* |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 870-880 | Silty clay—dominant; with some interbedded(?) silty (vf) sand, as above (800-840), and no(?) pebbles. Fines: Reddish brown (2.5YR4-5/4); sand: reddish brown (5YR5/3). Very calcareous (ev), w/ few pink *can.* **CL** w/ **SM**, *clay w/Sandy clay loam to loam.* |
| 880-890 | Fine sandy to silty clay. Reddish brown (2.5-5YR5/4). 75% fines, 25% sand (vf-f), and no(?) pebbles. Arkosic grain mineralogy (as above). Very calcareous (ev), w/ pink *can.* **SC-CL**, *Clay loam to clay.* |
| 890-900 | Clay to silty clay. Reddish brown (2.5-5YR5/4). 80% fines and 20% sand (vf-m). Arkosic grain mineralogy. Very calcareous (ev). **CL-ML**, *Clay to clay loam.* |
| 900-910 | Silty clay, as above (880-900—dominant; with some interbedded(?) silty sand, as above (730-750), and no(?) pebbles. Fines: Reddish brown (2.5YR4-5/4); sand: reddish brown (5YR5/3). Very calcareous (ev), w/ few pink *can.* |
| **910-920** | Fine to medium pebbly sand, well to moderately sorted. Pinkish gray (7.5YR6/2). 73% sand (f-vc), 24% pbls (vf-m), and 3% fines. Moderately to well graded, with angular to subrounded grains and clasts; clast max: 13mm. Arkosic grain/clast mineralogy (as above); w/ trace slts and coarse ss (Pz). Sand: Non calcareous; fines very calcareous (ev). **SW**, *Fine gravelly sand.* Remarks: **Sieve analysis of representative sample-split.** Upper beds of medium to coarse grained part of Lithosome S (910-1320)? |

**Note: In samples below 910 ft, well-rounded sand grains only present in trace amounts or absent, and indicate possible shift to zone of intertonguing of distal piedmont and marginal basin-floor facies (e.g. *LFA*'s *5* & *2-3-9*; Tesuque Lithosomes A and S).**

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 920-930 | Clay to silty clay. Reddish brown (2.5YR4/4). 85% fines, 15% sand (vf-m), and trace vf-f pbls. Arkosic grain/clast mineralogy. Very calcareous (es-ev). **CL**, *Clay.* |
| 930-940 | Silty clay, as above (920-930), interbedded with fine to coarse sand. Fines: Reddish brown (2.5YR4-5/4) and light reddish brown (2.5-5YR6/3; sand: reddish brown (5YR5/3). Trace vf-f pbls; arkosic, w/ ls (Pz?). Very calcareous (ev), w/ few pink *can.* **CL**, *Clay* and **SW**, *sand.* |
| 940-950 | Sandy to silty clay; with minor interbedded sand, as above (930-940). Fines: Reddish brown (2.5YR4-5/4). 65% fines, 35% sand (vf-m), Very calcareous (ev), w/ few pink *can.* **CL-SC**, *clay loam to sandy clay.* |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 950-960 | Fine sandy to silty clay. Reddish brown (2.5-5YR5/4). 70% fines, 30% sand (vf-f), and trace vf pebbles. Arkosic grain mineralogy (as above). Very calcareous (ev). **SC-CL**, *Clay loam to sandy clay.* |
| **960-970** | Fine pebbly, medium to very coarse sand, well sorted. Reddish brown (5YR5/3); w/ minor fines: Reddish brown (2.5YR4-5/3). 82% Sand (f-vc), 15% pbls (vf-f), and 3% fines. Poorly graded, grain/clast angularity/rounding as above (from 910 ft). Arkosic grain/clast mineralogy (as above); w/ trace slts, fine to coarse ss (Fe-MnO cement), and black chert (Pz). Sand: Non calcareous; fines very calcareous (ev). **SP**, *Fine gravelly sand.*<br>Remarks: **Sieve analysis of representative sample-split.** |
| 970-980 | Fine to medium pebbly sand, well to moderately sorted. Reddish brown (5YR5/3); w/ minor fines: Reddish brown (2.5YR4-5/3).. >75% sand (f-vc), 20% pbls (vf-c), and <5% fines. Moderately to well graded, grain/clast angularity/rounding as above (from 260ft); clast max: 25mm. Arkosic grain/clast mineralogy (as above); w/ trace marlstone and brown chert (Pz). Sand: Non calcareous; fines very calcareous (ev). **SP-SW**, *Fine gravelly sand.* |
| 980-990 | Fine to medium pebbly sand, as above (960-980); without coarse pebbles and Pz chert. **SP-SW**, *Fine gravelly sand.* |
| 990-1000 | Clay to silty clay—dominant; with minor interbedded(?) fine sand. Reddish brown (2.5YR4/3-5YR5/3). 85% fines, 15% sand (vf-f), and trace vf-f pbls. Arkosic grain/clast mineralogy. Very calcareous (ev), w/ pink *can.* **CL**, *Clay.* |
| 1000-1010 | Clay to silty clay. Reddish brown (2.5YR4/4), and weak red to reddish brown (10R-2.5YR4/3). 80-90% fines and 10-20% sand (vf-f). Arkosic grain/clast mineralogy. Very calcareous (ev), w/ pink *can.* **CL**, *Clay to clay loam*; with minor **SW**, *sand.* |
| 1010-1020 | Silty clay. Reddish brown (2.5YR4/4). 70-80% fines, 20-30% sand (vf-c), and trace vf-m pbls. Arkosic grain/clast mineralogy, w/ trace ss (cemented zone fragment?). Very calcareous (ev), w/ pink *can.* **SC-CL**, *Sandy clay to clay loam.* |
| **1020-1030** | Pebbly, medium to very coarse sand, well sorted. Reddish brown (5YR5/4); fines: weak red (10R4/3). 75% Sand (m-vc), 25% pbls (vf-m), and trace fines; clast max: 10mm. Poorly graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above); w/ trace slts, ss, ls, and gray "banded" chert (Pz). Sand: Noncalcareous; fines very calcareous (ev). **SP**, *Fine gravelly sand.*<br>Remarks: **Sieve analysis of representative sample-split.** |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1030-1040 | Pebbly, medium to very coarse sand, as above (1020-1030); clast max: 15mm. |
| 1040-1050 | Pebbly, medium to very coarse sand, as above (1020-1040); with minor interbedded(?) silty clay. Fines: Weak red to reddish brown (10R-2.5YR4/4). Clast max: 20mm. Arkosic grain/clast mineralogy (as above); w/ trace sandy ls and chert (Pz). Sand: Non calcareous; fines very calcareous (ev). **SP**, *Fine gravelly sand, with minor* **CL**, *Clay loam to clay.* |
| 1050-1060 | Clay to silty clay. Weak red to reddish brown (10R-2.5YR4/4). 80-90% fines, 10-20% sand (vf-vc), and trace vf pbls. Arkosic grain/clast mineralogy. Very calcareous (ev), w/ pink *can.* **CL**, *Clay to clay loam.* |
| 1060-1070 | Clay to silty clay, as above (1050-1060). Reddish brown (2.5YR4/3). 90% fines, 10% sand (vf-c), and trace vf pbls. **CL**, *Clay.* |
| **1070-1080** | Pebbly, medium to very coarse sand, well to moderately sorted. Reddish brown (5YR5/4); fines: Weak red (10R4/3). 73% Sand (m-vc), 25% pbls (vf-m), and 2% fines; clast max: 15mm. Poorly to moderately graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above); w/ trace f-c ss and chert (Pz). Sand: Noncalcareous; sparry-calcite cement on some pebbles; fines very calcareous (ev). **SP**, *Fine gravelly sand.*<br>Remarks: **Sieve analysis of representative sample-split.** |
| 1080-1090 | Pebbly, fine to very coarse sand, moderately to well sorted; with some interbedded pebble gravel. Reddish brown (5YR5/4); fines: Weak red (10R4/3). 63% Sand (f-vc), 35% pbls (vf-vc), and 2% fines; clast max: 15mm. Moderately to poorly graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above); w/ fragment of very coarse, rounded pbl of "purple" metaquarzite. Sand: Noncalcareous; fines very calcareous (ev). **SP**, *Gravelly sand*; with(?) **GP**, *Sandy gravel*. |
| 1090-1100 | Pebbly sand, as above (1070-1080), well sorted. Reddish brown (5YR5/4). 75% Sand (m-vc), 25% pbls (vf-c). Poorly graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above); w/ fragment of coarse, rounded pbl of metaquarzite. Noncalcareous. **SP**, *Gravelly sand.* |
| 1100-1110 | Pebbly, medium to very coarse sand, well sorted. Reddish brown (5YR5/4); fines: Reddish brown and pinkish gray (2.5YR4/4 & 6YR6/2). 76% Sand (f-vc), 23% pbls (vf-c), and 2% fines; clast max: 20mm. Poorly graded. Angularity/roundness and grain/clast mineralogy, as above and below (910+); w/ trace gray and brown chert (Pz). Sand: Noncalcareous; sparry-calcite cement on some pebbles; fines very calcareous (es-ev). **SP**, *Fine gravelly sand.* |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| **1110-1120** | Pebbly, medium to very coarse sand, well to moderately sorted. Reddish brown (5YR5/4); fines: Weak red (10R4/3). 76% Sand (m-vc), 22% pbls (vf-m), and 2% fines; clast max: 15mm. Poorly to moderately graded. Angularity/roundness and grain/clast mineralogy, as above; w/ trace f-c ss and chert (Pz). Sand: Noncalcareous; fines calcareous (e-es). **SP**, *Fine gravelly sand.* Remarks: **Sieve analysis of representative sample-split.** |
| 1120-1130 | Sandy, fine to coarse pebble gravel, well sorted. Reddish brown (5YR5/4). 50% pbls (vf-c), 50% sand (f-vc) and trace fines (as above); clast max: 20mm. Poorly graded. Angularity/roundness and grain/clast mineralogy, as above; w/ trace ss and chert (Pz), and white “marlstone.” Sand: Noncalcareous; fines calcareous (e-es). **GP-SP**, *Sandy very fine gravel* and *very fine gravelly sand.* |
| 1130-1140 | Pebbly, fine to very coarse sand, well sorted. Reddish brown (5YR5/4); fines: Reddish brown (2.5-5YR5/4). 70% Sand (f-vc), 30% pbls (vf-c), and trace fines; clast max: 25mm. Poorly graded. Angularity/roundness and grain/clast mineralogy, as above and (910+). Sand: Noncalcareous; fines calcareous (e-es). **SP**, *Fine gravelly sand.* |
| 1140-1150 | Silty clay to clay; with minor pebbly sand, as above (1130-1140). Fines: weak red to reddish brown (10R-2.5YR4/3). 80% fines, 20% sand (vf-f), and trace vf-f pbls. Arkosic grain/clast mineralogy. Very calcareous (ev), w/ pink *can*. **CL**, *Clay loam to clay.* |
| 1150-1160 | Interbedded(?) pebbly sand and silty clay, as above (1130-1140 & 1140-1150). **SP**, *Fine gravelly sand* and **CL**, *Clay loam to clay.* |
| **1160-1170** | Pebbly coarse sand, well sorted; with interbedded(?) silty clay; as above (1130-1160). Coarse fraction: 58% sand (m-vc) and 42% pbls (vf-c) in sieved sample; clast max: 25mm. Poorly graded, w/ grain/clast angularity/rounding as above (910+). Arkosic grain/clast mineralogy, w/ trace siliceous ss, chalcedony, and gray and brown chert (Pz). Noncalcareous to very calcareous (ev), w/ pink *can*, and sparry-calcite cement on some pebbles. **SP**, *Fine gravelly sand* and **CL**, *Clay loam to clay.* Remarks: **Coarser fraction of sampled-interval selected for sieve analysis.** |
| 1170-1180 | Interbedded(?) pebbly sand and silty clay, as above (1130-1140 & 1140-1150); with about 10% f pebbles. **SP**, *Very Fine gravelly sand* and **CL**, *Clay loam to clay.* |
| 1180-1190 | Sandy, fine to coarse pebble gravel, well sorted. Reddish brown (5YR5/4). 50% pbls (vf-c), 50% sand (m-vc). Poorly graded. Angularity/roundness and arkosic grain/clast mineralogy, as above. Noncalcareous. **GP-SP**, *Sandy very fine gravel* and *very fine gravelly sand.* |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1190-1200 | Sandy, fine to coarse pebble gravel, as above (1180-1190), **over**: sandy to silty clay. Reddish brown (2.5YR4/3). 60% fines, 40% sand (vf-vc), and trace vf-f pbls. Arkosic grain/clast mineralogy; w/ fragment of vc pebble (gneiss). Sand: Noncalcareous; fines very calcareous (ev), w/ pink *can.* **GP-SP**, *Sandy very fine gravel* and *very fine gravelly sand,* over: **SC-CL**, *Sandy clay to Clay loam.* |
| 1200-1210 | Sandy to silty clay. Reddish brown (2.5YR4-5/4) and pale red (10R5/4). 60% fines, 40% sand (vf-vc), and trace vf-f pbls; clast max: 8mm. Arkosic grain/clast mineralogy, as above. Very calcareous (ev), w/ pink *can.* **SC-CL**, *Sandy clay to clay loam.* |
| **1210-1220** | Muddy sand; with minor interbedded(?) fine to coarse sand. Fines: Weak red (10R4/3) and reddish brown (2.5YR5/3-4); sand: reddish brown (5YR4-5/4). 60% sand (vf-vc [<10% vc]), 40% fines, and trace vf pbls. Arkosic grain/clast mineralogy. Very calcareous (ev). **SM-SC**, *Sandy loam to sandy clay loam.* Remarks: **Sieve analysis of representative sample-split.** |
| 1220-1230 | Interbedded(?) silty clay and sand. Fines: Reddish brown (10R-2.5YR4/3). Sand: Reddish brown (5YR5/4). Fines: 40-60% silty clay and 40-60% sand (vf-m). Sand: 85% (vf-vc), w/ 10% vf-c pbls and 5% fines; moderately to poorly graded; angularity/roundness and arkosic grain/clast mineralogy (as above); w/ fragment of coarse, rounded pbl of metaquarzite. Fines very calcareous (ev), w/ pink *can.* **SW-SP**, *Sand* and **SM-SC**, *Sandy loam to sandy clay loam.* |
| 1230-1240 | Interbedded(?) sand and silty clay, as above (1220-1230)—sand dominant |
| 1240-1250 | Fine to medium pebbly sand, well sorted. Reddish brown (5YR5/4), with minor reddish brown (10R-2.5YR4/3) fines. >80% sand (vf-vc), 15% pbls (vf-m), and <5% fines. Poorly graded w/ grain/clast angularity/rounding as above (910+). Arkosic grain/clast mineralogy. Noncalcareous. **SP**, *Very fine gravelly sand.* |
| **1250-1260** | Pebbly, medium to very coarse sand, moderately sorted. Sand: Reddish brown (5YR5/4); fines: reddish brown (10R4-5/3). 78% Sand (f-vc), 13% pbls (vf-m), and 10% fines. Moderately graded. Angularity/roundness and grain/clast mineralogy, as above (1,070+); w/ trace slts and chert (Pz), and quartzite. Sand: Noncalcareous; sparry-calcite cement on some pebbles; fines very calcareous (ev). **SW-SP**, *Fine gravelly sand.* Remarks: **Sieve analysis of representative sample-split.** |
| 1260-1270 | Silty clay and clay. Reddish brown (2.5YR4/3-4), and weak red (10R4/4). 75-85% fines, 15-25% sand (vf-f), and trace(?) vf pbls. Arkosic grain mineralogy. Calcareous (e-es). **CL**, *Clay to clay loam.* |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1270-1280 | Sandy to silty clay; with minor interbedded(?) sand (like 1250-1260). Fines: reddish brown (2.5YR5/4) and pale red (10R5/4). 60% fines, 40% sand (vf-vc), and trace vf-f pbls; clast max: 8mm. Arkosic grain/clast mineralogy, as above. Very calcareous (ev), w/ pink *can.* **SC-CL**, *Sandy clay to clay loam*; w/ minor **SW**, *sand.* |
| 1280-1290 | Clay and silty clay. Weak red to reddish brown (10R-2.5YR4/3-4). 85% fines, 15% sand (vf-f), and trace(?) vf pbls. Very calcareous (ev), w/ pink *can.* **CL**, *Clay.* |
| 1290-1300 | Clay and silty clay, as above (1280-1290). |
| **1300-1310** | Pebbly, medium to very coarse sand, moderately to well sorted. Sand: Reddish brown (5YR5/4); fines: reddish brown (10R4-5/3). 83% Sand (vf-vc), 7% pbls (vf-m), and 10% fines. Moderately poorly graded. Angularity/roundness and grain/clast mineralogy, as above (910+); w/ trace ss and chert (Pz), and quartzite (pC). Sand: Noncalcareous; sparry-calcite cement on some pebbles; fines very calcareous (ev). **SW-SP**, *Fine gravelly sand.* Remarks: **Sieve analysis of representative sample-split**. Basal part of ~400-ft thick, coarsest-grained subunit of the Tesuque Fm "main body" (Lithosome S of Johnson et al., 2004?). |
| 1310-1320 | Muddy sand, moderately to well sorted; with minor interbedded(?) silty clay. Sand: reddish brown (5YR5/4), fines (2.5YR4/4). 75% sand (vf-m), 25% fines, and trace pbls (vf). Moderately to poorly graded sands, w/ grain/clast angularity/rounding as above (910+). Arkosic grain mineralogy. Very calcareous (ev), w/ pink *can.* **SM**, *Sandy loam-loamy sand.* |
| 1320-1330 | Clay and silty clay. Reddish brown (2.5YR4/4). 85% fines, 15% sand (vf-f), and trace(?) vf pbls. Very calcareous (ev), w/ pinkish gray (7.5YR6/2) *can.* **CL**, *Clay.* |
| 1330-1340 | Silty clay. Reddish brown (5YR5/3 & 2.5-5YR4/4). 75% fines, 25% sand (vf-f), and trace(?) vf pbls. Very calcareous (ev), w/ pinkish gray *can.* **SC-CL**, *Clay loam to clay.* |
| 1340-1350 | Sandy to silty clay. Reddish brown (2.5YR5/3). 55% fines and 45% sand (vf-vc). Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pink *can.* **SC-SM**, *Sandy clay loam to clay loam.* |
| **1350-1360** | Sandy to silty clay, as above (1340-1350). Reddish brown (2.5YR5/3). 55% fines and 45% sand (vf-c, w/ trace vc). Arkosic grain mineralogy, and with w/ grain/clast angularity/rounding as above (910+). Very calcareous (ev), w/ pink *can.* **SC-SM**, *Sandy clay loam to clay loam.* Remarks: **Sieve analysis of representative sample-split.** |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1360-1370 | Clay and silty clay. Reddish brown (2.5-5YR4/4). 85% fines, 15% sand (vf-f), and trace(?) vf pbls. Very calcareous (ev), w/ pinkish gray (7.5YR6/2) *can.* **CL**, *Clay.* Remarks: With few light gray (2.5-5YR7/1) "reduction zones" |
| 1370-1380 | Clay and silty clay, as above (1360-1370). |
| 1380-1390 | Clay and silty clay, as above (1360-1380); with minor interbedded fine sand. |
| 1390-1400 | Clay and silty clay, as above (1360-1380); with few cutting fragments of micaceous silty very fine sand (light gray, 5Y7/1). |
| **1400-1410** | Sandy clay; with few very fine to medium pebbles. Variegated: Reddish gray to brown (5-7.5YR5/2) and reddish brown (2.5YR5/3 & 4/3). 52% sand (vf-c), 45% fines, and 3% vf-f pbls. Arkosic grain mineralogy, as above; w/ few weathered intermediate volcanics (?). Very calcareous (ev). **SM-SC**, *Sandy clay loam.* Remarks: **Sieve analysis of representative sample-split.** |
| 1410-1420 | Sandy to silty clay. Reddish brown (2.5YR4/3), with some pinkish gray (5YR6/2) high-carbonate zones. 60% fines, 40% sand (vf-vc), and trace vf-m pbls. Arkosic grain/clast mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SC**, *Sandy clay to clay loam.* |
| 1420-1430 | Very fine sandy to silty clay. Reddish brown (2.5YR4/3), with some pinkish gray (5YR6/2) high-carbonate zones. 70% fines and 30% sand (vf-vc). Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SC**, *Clay loam to clay.* |
| 1430-1440 | Sandy clay; with few very fine to medium pebbles. Dark reddish gray to reddish gray (5YR4-5/2). 50% sand (vf-f) and 50% fines. Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SM-SC**, *Sandy clay loam.* |
| 1440-1450 | Muddy fine sand. Reddish brown (2.5YR5/3-4) with some pinkish gray (5YR6/2) high-carbonate zones, and minor weak red (10R4/3) "bodies." 60% sand (vf-m), 40% fines, and trace vf pbls. Arkosic grain/clast mineralogy. Very calcareous (ev). **SM-SC**, *Sandy loam to sandy clay loam.* |
| **1450-1460** | Sandy clay. Reddish brown (5YR4/3) dominant, with reddish gray to reddish brown (5YR5/2-3). 52% sand (vf-vc), 45% fines, and 3% pbls (vf-f). Grain/clast angularity/rounding and arkosic mineralogy as above (910+); with trace gray chert. Very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy clay loam.* Remarks: **Sieve analysis of representative sample-split.** |
| 1460-1470 | Sandy clay, as above (1450-1460). |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1470-1480 | Silty clay. Reddish brown (2.5-5YR4/3), with some pinkish gray (5YR6/2) high-carbonate zones. 70% fines, 30% sand (vf-m) and trace vf-f pbls. Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SC**, *Clay loam to clay.* |
| 1480-1490 | Silty clay, as above (1470-1480); with trace ls or indurated carbonate nodules (**cam**). |
| 1490-1500 | Sandy to silty clay. Brown (7.5YR5/2), with some pinkish gray (7.5YR6/2) high-carbonate zones. 60% fines and 40% sand (vf-m). Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SC-CL**, *Sandy clay to clay loam.* |
| 1500-1510 | Sandy to silty clay, as above (1490-1500). Brown (7.5YR4/3), with minor pinkish gray (7.5YR6/2) high-carbonate zones and *can.* |
| 1510-1520 | Sandy to silty clay, as above (1490-1510). Reddish brown to brown (5-7.5YR5/2), with minor pinkish gray (7.5YR6/2) high-carbonate zones and *can.* |

**Note: Distinct shift from reddish (2.5-5YR) to brownish (7.5YR) hues in 1,490 to 1,520-ft drill cuttings.**

| | |
|---|---|
| 1520-1530 | Interbedded(?) sandy to silty clay and sand. Reddish brown (5YR5/3). Fines: 50% silty clay and 50% sand (vf-m). Sand: 85-90% (vf-vc), w/ <5% vf-c pbls and 10% fines; clast max 30mm. Moderately graded; angularity/roundness and arkosic grain/clast mineralogy (as above); w/ coarse quartzite pbl and f pbl of gray chert (Pz). Fines very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy loam to sandy clay loam* and **SW-SP**, *Sand.* |
| **1530-1540** | Pebbly, silty fine to coarse sand, moderately sorted. Sand: Reddish brown to brown (5-7.5YR5/3); fines: reddish brown (5YR5/3). 70% Sand (f-vc), 15% pbls (vf-m), and 15% fines. Moderately graded. Angularity/roundness and grain/clast mineralogy, as above (910+); w/ trace gray and black chert (Pz), and one pale yellow (2.5Y8/2) slts fragment. Fines very calcareous (ev). **SW-SP**, *Fine gravelly sand to loamy sand.* Remarks: **Sieve analysis of representative sample-split.** |
| 1540-1550 | Sandy to silty clay. Reddish brown (5YR5/3), with some brown to dark grayish brown (7.5-10YR4/2) zones. 60% fines, 40% sand (vf-m), and trace vf pbls. Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SC**, *Sandy clay to clay loam.* |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1550-1560 | Sandy to silty clay—dominant; with interbedded(?) silty sand. Brown to dark grayish brown (7.5-10YR4/2). Fines: 50% silty clay and 50% sand (vf-m). Sand: 80% (vf-vc), 20% fines, and trace w/ vf-f pbls. Moderately graded; angularity/roundness and arkosic grain/clast mineralogy (as above); w/ coarse quartzite pbl and f pbl of gray chert (Pz). Fines very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy loam to sandy clay loam*, with **SM-SW**, *Loamy sand and sand.* |
| **1560-1570** | Pebbly coarse sand, well sorted; with interbedded(?) silty clay. Sand: Reddish brown (5YR5/3); fines: Reddish brown (2.5-5YR4-5/3). Coarse fraction: 62% sand (m-vc) and 33% pbls (vf-c) in sieved sample. Poorly graded, w/ grain/clast angularity/rounding as above (910+). Arkosic grain/clast mineralogy, w/ trace ss, and gray and black chert (Pz). Fines very calcareous (ev). **SP**, *Fine gravelly sand* and **SC-CL**, *Clay loam to clay.* Remarks: **Coarser fraction of sampled-interval selected for sieve analysis.** |

**Note: Pebbly sands in the 1530-40 and 1560-70 ft sample intervals mark the basal coarse-grained (alluvial-channel) facies in the Middle Santa Fe hydrostratigraphic unit (HSU MSF, *LFA's 3 and 5a[?]*) and Tesuque Fm-Lithosome S.**

| | |
|---|---|
| 1570-1580 | Silty clay to clay. Reddish brown (2.5YR4/3)—dominant, with dark reddish gray (5YR4/2). 80% fines, 20% sand (vf-f), and trace(?) vf – f pbls, as above (1560-1570). Very calcareous (ev), w/ pink *can.* **CL-ML**, *Clay to clay loam.* |
| 1580-1590 | Very fine sandy to silty clay. Dark reddish gray (5YR4/2). 70% fines, 30% sand (vf-m) and trace vf-f pbls, as above (1560-1570). Very calcareous (ev), w/ pinkish gray *can.* **SC-CL**, *Clay loam to clay.* |
| 1590-1600 | Very fine sandy to silty clay, as above (1580-1590). Reddish brown (5YR4/3) and brown (7.5YR4/3). |
| **1600-1610** | Fine sandy to silty clay. Reddish brown (2.5YR4-5/3). 65% fines, 35% sand (vf-m, w/ minor c-vc). Arkosic grain mineralogy, as above. Very calcareous (ev). **SC-CL**, *Sandy clay to clay loam.* Remarks: **Sieve analysis of representative sample-split.** |

**Note: Better consolidation (compaction) in drill cuttings below 1,600-1,610 ft, and shift from sands and silty clays to *soft* sandstones to mudstones.**

| | |
|---|---|
| 1610-1620 | Clay to silty clay. Reddish brown to weak red (2.5YR-10R4/4), with some light gray (5Y7/1) "reduction zones." 90% fines and 10% sand (vf-f). Very calcareous (ev). **CL**, *Clay.* |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1620-1630 | Clay to silty clay, as above (1610-1620—weak red); interbedded(?) with very fine sandy clay (reddish brown—2.5YR5/3). Sandy clay: 75% fines and 25% sand (vf). Very calcareous (ev). **CL**, *Clay* and **SC**, *Clay loam.* |
| 1630-1640 | Clay to silty clay. Reddish brown (2.5YR4-5/4). 85-90% fines and 10-15% sand (vf). Very calcareous (ev), w/ *can*. **CL**, *Clay.* Remarks: With few "reduction zones," as above (1610-1630). |
| 1640-1650 | Clay to silty clay, as above (1630-1640, reddish brown (2.5YR4/4). |
| 1650-1660 | Clay to silty clay. Reddish brown to red (2.5YR4/4-6) and weak red (10R4/4). 90% fines and 10% sand (vf-f, w/ trace m-c). Very calcareous (es). **CL**, *Clay.* Remarks: With few "reduction zones," as above (1610-1650), and "MnO dendrites." |
| 1660-1670 | Clay to silty clay, as above (1630-1650, reddish brown (2.5YR4/4), with minor interbedded(?) silty fine to very fine sand. Sand: Weak red (2.5YR5/2), 85% (vf-f); fines: 15%. |
| 1670-1680 | Clay to silty clay. Weak red to reddish brown (10R-2.5YR4/3). 90% fines and 10% sand (vf-f). Very calcareous (es-ev). **CL**, *Clay.* Remarks: With trace "reduction zones," as above (1610-1670). |
| 1680-1690 | Clay to silty clay, as above (1670-1680 |
| 1690-1700 | Clay to silty clay, as above (1670-1680 |
| 1700-1710 | Silty clay to clay. Weak red to reddish brown (10R-2.5YR4/3). 80% fines and 20% sand (vf-f). Very calcareous (ev) , w/ trace pink (10R8/3-4) *can*. **CL**, *Clay to clay loam.* |

**Note: Near contact of main body of the Tesuque Fm (Lithosome S) on Tesuque-Lithosome E of Johnson and others (2004). The latter grayish brown unit (upper Oligocene?), with intermediate to basaltic-volcanic clasts, is correlative with the Tesuque-Bishops Lodge Mbr (Smith,2000) and basal Santa Fe Gp deposits derived from volcanic rocks of the Cerrillos Hills area (including the Espinaso Fm and Cieneguilla Limburgite [basanite] of Disbow and Stoll (1957) and Sun and Baldwin (1958).**

| | |
|---|---|
| 1710-1720 | Pebbly sandy mudstone and silty fine sandstone (soft). Dark gray to dark grayish brown (10YR4/1-2) dominant, with some gray to grayish brown (10YR5/1-2), and minor reddish brown (5YR5/3). 45% fines, 45% sand (vf-c), and 10% pbls (vf-m). Well graded, w/ angular to subrounded grains and clasts. Mixed grain/clast mineralogy, including intermediate-basaltic volcanics, volcaniclastic slts and ss, quartz, K-feldspar, and arkosic lithics. Very calcareous (es-ev), w/ trace light gray (10YR7/1) "zones"/ segregations (*can*), and sparry calcite cement on some pebbles. |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1720-1730 | Fine sandy mudstone (soft), as above (1710-1720). Dark gray to dark grayish brown (10YR4/1-2). 50% fines and 50% sand (vf-c), with trace vf-f pbls. |
| 1730-1740 | Fine sandy mudstone (soft), as above (1720-1730). Dark grayish brown to brown (10YR4/2-3), with minor reddish brown (5YR4/3). |
| 1740-1750 | Fine sandy mudstone (soft), as above (1720-1740). Dark grayish brown to brown (10YR4/2-3), with minor reddish brown (5YR4/3). |
| 1750-1760 | Fine sandy mudstone (soft), as above (1720-1750). Dark gray to grayish brown (10YR4-5/1-2), with minor reddish brown to brown (5-7.5YR4/3). Trace(?) vf-f pebbles. |

**Note: Bottom of geophysical-logged interval at about 1,760ft.**

| | |
|---|---|
| 1760-1770 | Fine sandy mudstone (soft), as above (1720-1760). Brown to dark grayish brown (7.5-10YR4/2), with some gray (10YR6/1) very calcareous "zones." |
| 1770-1780 | Coarse sandstone to conglomeratic (vf pbly) sandstone (hard to soft). Gray (10YR5/1). Mixed intermediate-volcanic and arkosic lithic types and minerals; w/ coarse fragments (25mm max) of gray volcaniclastic(?) ss. Non- to slightly calcareous (e). |
| 1780-1790 | Silty sandstone to fine sandy mudstone (soft), with hard volcaniclastic(?) sandstone fragments, as above (1770-1780), and trace vf-f pbls. Brown to gray (7.5YR4/2 to 10YR5/1), with minor gray (7.5YR5/1) and reddish brown (5YR4/3). Mixed arkosic-volcanic grains and clasts as above (1710-1780). Non- to very calcareous (e-ev). |
| 1790-1800 | Fine sandy mudstone and silty sandstone (soft to hard). Gray (7.5-10YR5/1) and dark gray (10YR4/1). Trace of vf-f pbls of intermediate to basaltic volcanics. Very calcareous (es-ev). |

**Note: Bottom of Hole at 1,802ft (elev. ~4,673 asl).**

# TABLE B. INTERPRETIVE LITHOLOGIC LOG BASED ON COMPARTIVE ANALYSES OF DRILL CUTTINGS AND BOREHOLE GEOPHYSICS IN PILOT HOLE FOR OBSERVATION WELL OB-A, RANCHO VIEJO

**Well Name:** OB-A Pilot Hole
**Location):** T16N, R9E, Section 29.111
**Lat/Long:** 35°35'43" N, 106°01'05" W
**State Plane Coordinates (est.):** X=569100 (1709332) Y=1671600 (1672077)
**Elevation:** 6,475ft asl
**Total Depth:** 1,802 ft
**Geophysical Logging:** to 1,760 ft

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 0-20 | Pebbly sand to silty sand, poorly sorted. Dark reddish gray to reddish brown (5YR4/2-4). Sand (vf-vc), with 10% vf-m pebble (**pbl**) gravel in upper 10ft and 25-30% silt in lower 10ft. Well graded, angular to subangular sand grains and gravel clasts. Arkosic mineralogy (quartz, K-feldspar, K-mica, and granite-gneiss/pegmatite lithics—derived from local Pre-Cambrian terrane); w/ one f pbl of brown chert noted (Pz-derived). Calcareous (e-es). **SW-SM**, *Sand to sandy loam.* |

**Note: Top (?) of Upper Santa Fe-Ancha Fm (Pliocene-Early Pleistocene) within 5-10 ft of land surface. Upper Santa Fe Hydrostratigraphic Unit (HSU) USF1, *Lithofacies Assemblage (LFA) 5b***

| | |
|---|---|
| 20-30 | Sandy pebble gravel, poorly sorted. Reddish brown (5YR4/3). 60% pbls (vf-vc), 35% sand (vf-vc), and 5% silt. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above), w/ mica flakes and 64mm subrounded granite pbl. Noncalcareous. **GW**, *Sandy fine gravel.* **HSU-USF1, *LFA5a*** |
| 30-67 | Fine pebbly sand, poorly sorted, *fining upward* into silty sand in upper 10 ft; and with interbedded silty fine to coarse sand from 50-60 ft. Reddish brown (5YR4-5/3-4). 10-15% pbls (vf-f) in 40-50 and 60-67 ft intervals; and 25-30% silt and 5% pbls in silty sand layer. Well graded, angular to subrounded grains and clasts. Arkosic-micaceous mineralogy (as above). Noncalcareous. **SW**, *Sand* and **SM**, *Loamy sand* . **HSU-USF1, *LFA5*** |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 67-80 | Pebbly sand, slightly silty and poorly sorted, *fining upward* into silty sand, w/ some interbedded(?) very fine sandy silt. Reddish brown (5YR4-5/3) to dark brown and brown (7.5YR3/2-5/3). 80-90% sand (vf-vc), 10-15% silt, and up to 10% vf-m pbls. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above), w/common mica flakes. Calcareous (e-es). **SM**, *Loamy sand //* **SW**, *Sand.* Remarks: Possible buried soil in upper 5 ft. **HSU-USF1,** ***LFA5*** |
| 80-100 | Pebbly sand, poorly sorted, *fining upward* into silty to sandy clay. Reddish brown (5YR4-5/3) to reddish gray (5YR5/2). 80-85% sand (vf-vc) and 5-10% pbls (vf-m) in basal part, and 60% silt-clay fraction (**fines**) in upper 10 ft. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above). Calcareous (es-ev), with trace (mostly pink, 2.5-5YR7/3) soft carbonate segregations (*can*). **SM-SC**, *Sandy loam-sandy clay loam //* **SW**, *Sand.* **HSU-USF1,** ***LFA5*** |
| 100-130 | Sandy pebble gravel, poorly to moderately sorted, *fining upward* into poorly sorted silty sand. Reddish brown (5YR5/3-4), with some reddish gray (5YR5/2) silty zones. 60% pbls (vf-m) and 40% sand (f-vc) in basal part; and 80-85% sand (vf-vc) and 10-15% fines in upper 10 ft. Moderately to well graded, angular to subrounded grains and clasts; clast max: 15mm. Arkosic grain/clast mineralogy (as above). Very calcareous (ev), with trace pink *can* in upper part. **SW-SM**, *Sand to loamy sand //* **GW**, *Sandy fine gravel* to. **HSU-USF1,** ***LFA5*** |
| 130-205 | Pebbly sand, clean to slightly silty and poorly sorted; with interbedded pebble gravel and sand from 130-165, 175-185 and 195-205 ft. Reddish brown (5YR5/3-4). 40-70% sand (vf-vc), 30-60% pbls (vf-m), and up to10% fines. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy, w/ minor dark quartzite and diorite). Calcareous fine fraction w/ trace *can*. **SW-GW**, *Sand to very fine gravelly sand*; with interbedded **GW-SW**, *Sandy fine gravel* and *very fine gravelly sand.* **HSU-USF1,** ***LFA5a*** |
| 205-213 | Coarse pebble gravel, poorly to moderately sorted. Reddish brown (5YR5/3). 75% pbls (vf-vc) and 40% sand (f-vc). Moderately to well graded, angular to subrounded grains and clasts; clast max: 45mm. Arkosic grain/clast mineralogy (as above), with gneiss, diorite, and quartzite. Noncalcareous. **GW**, *Fine gravel.* **HSU-USF1,** ***LFA5a*** |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
|  | **Contact of Upper Santa Fe-Ancha Fm on "Lower" Santa Fe-Tesuque Fm, and top of Middle Santa Fe Hydrostratigraphic Unit (HSU) MSF2, *Lithofacies Assemblage (LFA) 3*at ~213 ft. Depth inferred from "drillograph" records, borehole geophysics, and major texture-mineralogy shift in drill cuttings. Driller noted very coarse gravel ("boulders") at about 205ft and a shift to much faster bit penetration at 213 ft.** |
| 215-240 | Pebble gravel and sand, poorly sorted (230-240 ft), *fining upward* into silty clay to clay. Fine fraction: reddish brown (2.5YR4/4); 80 fines, >18% sand (vf-c), <2% pbls (vf). Coarse fraction: brown (7.5YR5/3) to reddish brown (5YR5/4); 50% pbls (vf-m) and 50% sand (f-vc). Well graded, w/ angular to rounded grains and angular to subrounded clasts; clast max: 15mm. Arkosic grain/clast mineralogy (quartz, K-feldspar, K-mica, and granite/gneiss lithics) w/ few Pz ss, siltstone (**slts**), and gray chert. Noncalcareous sand and gvl, and very calcareous (es-ev) fines. **CL-ML**, *Clay to clay loam //* **GW-SW**, *Sandy very fine gravel* and *very fine gravelly sand.* Remarks: Interpreted as Lithosome S of the Tesuque Fm (Johnson et al., 2004; Koning and Hallett, 2001 [2006 update]). **HSU-MSF2, *LFA3*** |
| 240-300 | Silty clay to clay—dominant (240-60, 280-300), with pebble gravel and sand from 260 to 280 ft, as above (230-240). Fines: reddish brown (2.5-5YR4/4-5/3); 70-80% silty clay and 20-30% sand (vf-c), <2% pbls (vf). Arkosic grain/clast mineralogy, as above, including weathered gneiss and/ trace light-gray chert. Slightly to very calcareous (e-ev), w/ few pink *can.* **CL- SC,** *Clay to clay loam and sandy clay loam.* **HSU-MSF2, *LFA3*** |
| 300-365 | Coarse pebbly sand—dominant, slightly silty and poorly sorted, with minor interbedded sandy clay in lower 35 ft. Reddish brown to light reddish brown (5YR5-6/3). 50-85% sand (vf-vc) and 15-40% pbls (vf-c). Sandy clay: reddish brown (2.5YR4/4). 50% fines, 35% sand (vf-vc), and 5% pbls (vf-m) Well graded, grain/clast angularity/rounding as above (230+); clast max: 30mm. Arkosic grain/clast mineralogy (as above); w/ weathered gneiss and trace quartzite and gray to black chert (Pz). Calcareous fine fraction w/ trace *can.* **SW-GW,** *Fine gravelly sand.* Fine fraction: Reddish brown (2.5-5YR4/4-5/3); 70-80% silty clay and 20-30% sand (vf-c), <2% pbls (vf). Calcareous fine fraction (e-ev), w/ trace *can.* **SW-GW,** *Fine gravelly sand, w/ minor* **CL-SC,** *Clay to clay loam and sandy clay loam.* **HSU-MSF2, *LFA1-2*** |

**Note: Water table and capillary fringe in 300 to 310-ft interval.**

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 365-400 | Fine to medium pebbly sand, poorly sorted (380-400 ft), *fining upward* into fine sandy to silty clay. Fine fraction: reddish brown (2.5YR4/4). Coarse fraction: reddish brown (5YR5/3-4); 75% sand (vf-vc), 20% pbls (vf-c), and <5% fines; well graded, grain/clast angularity/rounding as above (230+). Arkosic grain/clast mineralogy (as above); w/ highly weathered gneiss fragment, and trace coarse ss and black chert (Pz). Calcareous fine fraction (e-ev), w/ trace *can*. Sand: Non- to slightly calcareous (e). **SC-CL**, *Clay loam to clay* // **SW**, *Fine gravelly sand.* **HSU-MSF2, *LFA3*** |
| 400-420 | Sand, poorly to moderately sorted (410-420ft), *fining upward* into clay to silty clay. Fine fraction: weak red to reddish brown (10R4/3-2.5-5YR4/4-5); 80-90% fines and 10-20% sand (vf-c), and trace vf-f pbls. Sand: reddish brown (5YR5/3); 85-90% sand (vf-vc), 10% fines, and <5% pbls (vf-m). Well to moderately graded, grain/clast angularity/rounding as above (230+); clast max: 13mm. Arkosic grain/clast mineralogy (as above); w/ trace quartzite, and slts and light reddish brown to pink (2.5YR6-7/3) limestone (**ls**) fragments (Pz?). Calcareous fine fraction (e-ev), w/ trace *can.* Sand: Non- to slightly calcareous (e). **CL**, *Clay loam to clay* // **SW**, *Sand.* Remarks: Some "**ls**" fragments here and below could be indurated carbonate segregations (*cam*). **HSU-MSF2, *LFA3*** |
| 420-455 | Fine sandy to silty clay grading(?) upward into clay. Reddish brown to light reddish brown (2.5-5YR5/4-6/3), with trace weak red (10R4/3). 70-90% fines, 10-30% sand (vf-f), and trace vf-f pbls. Arkosic grain/clast mineralogy (as above), w/ trace slts and weathered calcareous ss (Pz?). Slightly to very calcareous (e-ev), w/ pink *can.* **SC-CL**, *Clay loam to clay.* **HSU-MSF2, *LFA3,9*** |
| 455-555 | Clay to silty clay—dominant; with some interbedded fine sandy clay and silty fine sand in 510-520, 550-560, and 570-600. Mostly reddish brown (2.5-5YR5/4); with variegated zones in uppermost and mid-part of interval: pale red to reddish brown (10R-2.5YR4-5/3-4), and light reddish brown (2.5YR6/4). 80-90% fines, 10-20% sand (vf-f), and trace vf-f pbls. Arkosic grain mineralogy (as above), w/ trace ls, slts, ss and chert (Pz?). Very to slightly calcareous (ev-e), w/ pink *can* and some black Mn-oxide (**MnO**) dendrites. **CL**, *Clay*, w/ some **SM&SC**, *loamy sand & sandy clay loam.* **HSU-MSF2, *LFA9*** |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 555-595 | Sandy and silty clay—dominant, interbedded with silty sand. Fine-grained beds: reddish brown (2.5-5YR4/3-5/4); 70-90% fines, 10-30% sand (vf-c), and trace vf pbls. Sands: reddish brown (2.5YR4/4 & 5YR5/3). 55-65% sand (vf-vc), 35-45% fines, and <5% pbls (vf-f); well graded, w/ angular to rounded sand grains and angular to subrounded pebble clasts; and arkosic grain/clast mineralogy, w/ trace quartzite and chert (Pz). Very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy loam to sandy clay loam; and* **SC-CL**, *Sandy clay to clay.* **HSU-MSF2, *LFA3,9*** |
| 595-655 | Silty sand—dominant, poorly sorted, interbedded with sandy to silty clay, as above (555-595). **SM-SC**, *Sandy loam to sandy clay loam; and* **SC-CL**, *Sandy clay to clay.* **HSU-MSF2, *LFA3*** |
| 555-695 | Sandy to silty clay—dominant, interbedded with silty sand, as above (555-595). **SM-SC**, *Sandy loam to sandy clay loam; and* **SC-CL**, *Sandy clay to clay.* Remarks: Some K-feldspar, gneiss and ss pebbles are highly weathered and split readily. **HSU-MSF2, *LFA9,3*** |
| 695-760 | Silty sand—dominant, moderately to poorly sorted, interbedded with sandy to silty clay, as above (555-595). Sand: reddish brown (5YR5/3); 70-80% sand (vf-vc), <20% fines, and <10% pbls (vf-f). Fine fraction: reddish brown (2.5YR4/3-5/4); 70-90% fines, 10-30% sand (vf-c), and trace vf-f pbls. Moderately to well graded sands, grain/clast angularity/rounding as above (600-730). Arkosic grain/clast mineralogy, w/ trace quartzite, ss, and chert (Pz). Fines: very calcareous (ev), w/ pink *can.* **SM**, *Sandy loam; and* **SC-CL**, *Sandy clay to clay.* **HSU-MSF2, *LFA3*** |
| 760-870 | Clay to silty clay—dominant; with some interbedded sandy clay and silty sand, and basal sand “zone” (855-874). Clays: reddish brown (2.5YR4/4-5YR5/3); 80-90% fines, 10-20% sand (vf-c). Silty sands: reddish brown (2.5-5YR5/3); 60-75% sand (vf-vc), 25-35% fines, and 1-5% pbls (vf-f). Basal sand: 90% sand, 5% pebbles (vf-m), and 5%fines; moderately to well graded, w/ angular to rounded sand grains and angular to subrounded pebble clasts; arkosic grain/clast mineralogy, w/ trace quartzite, ls, ss, and chert. Very calcareous (ev), w/ pink *can.* **SC-CL**, *Clay loam to clay*, with **SC-SM**, *Sandy clay loam to loam,* and basal **SW**, *Sand.* Remarks: Variegated silty to sandy clay in 840-850 ft sample interval: Reddish brown (5YR4/4-5/3) and light brown to pink (7.5YR6-7/3). **HSU-MSF2, *LFA9,3*** |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 870-905 | Fine sandy to silty clay—dominant; with minor interbedded(?) silty fine sand, as above. Fines: reddish brown (2.5-5YR4-5/4); sand: reddish brown (5YR5/3). 75-80% fines and 20-25% sand (vf-f), and no(?) pebbles. Arkosic grain mineralogy. Very calcareous (ev), w/ few pink *can.* **SC-CL,** *clay loam to clay,* w/ **SM**, *Sandy clay loam to loam.* **HSU-MSF2, *LFA9*** |
| 905-1016 | Fine to medium pebbly sand, well to poorly sorted; interbedded with Fine sandy clay to clay. Sands: pinkish gray (7.5YR6/2); 70-85% sand (f-vc), 15-25% pbls (vf-m), and <5% fines. Clays: reddish brown (2.5-5YR4-5/4); 65-90% fines and 10-35% sand (vf-m), with trace vf-f pbls. Sands: poorly to well graded; clast max: 13mm; with angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (quartz, K-feldspar, and granite/gneiss lithics), w/ trace marlstone, slts, ls, ss (Fe-MnO cement), and black and brown chert (Pz). Sand: Non calcareous; fines very calcareous (ev). **SP-SW**, *Fine gravelly sand* and **SC-CL**, *Clay loam, fine sandy clay and clay.* Remarks: Uppermost part of ~400-ft coarsest-grained subunit of the Tesuque Fm-"main body" (Lithosome S of Johnson et al., 2004). **HSU-MSF2, *LFA3*** |

**Note: In samples of sands below 905 ft, well-rounded sand grains are present in only trace amounts or absent, and indicate possible shift to zone of intertonguing of distal piedmont and marginal basin-floor facies (e.g. *LFA*'s *5* & *2-3-9*) of Tesuque Lithosome S).**

| | |
|---|---|
| 1016-1055 | Pebbly, medium to very coarse sand, well sorted; minor interbedded(?) silty clay in lower 10ft . Reddish brown (5YR5/4). 75% sand (m-vc) and 25% pbls (vf-m); fines: weak red to reddish brown (10R4/3-4 to 2.5YR4/4). Poorly graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy, w/ trace slts, ss, ls, and gray "banded" chert (Pz). Sand: Noncalcareous; fines very calcareous (ev). **SP**, *Fine gravelly sand*, with *minor CL*, *Clay loam to clay.* **HSU-MSF2, *LFA1-2*** |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1055-1080 | Pebbly sand, well to moderately sorted (1070-1080), *fining upward* into clay to silty clay. Fine fraction: weak red to reddish brown (10R-2.5YR4/3-4); 80-90% fines, 10-20% sand (vf-vc), and trace vf pbls. Coarse fraction: reddish brown (5YR5/4); 73% Sand (m-vc), 25% pbls (vf-m), and 2% fines; clast max: 15mm. Poorly to moderately graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above); w/ trace f-c ss and chert (Pz), and sparry-calcite cement on some pebbles; Fines very calcareous (ev), w/ pink *can*. **CL**, *Clay to clay loam //* **SP**, *Fine gravelly sand.* **HSU-MSF2, *LFA3*** |
| 1080-1140 | Pebbly, medium to very coarse sand, well to moderately sorted; with some interbedded sandy pebble gravel. Sands: reddish brown (5YR5/4); fines: weak red (10R4/3). 65-80% sand (m-vc), 20-35% pbls (vf-c), and 1-2% fines. Poorly to moderately graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above); w/ trace white "marlstone," ss and chert (Pz), and few fragments of rounded, coarse pbls of metaquarzite. Noncalcareous to very calcareous (ev), w/ sparry-calcite cement on some pebbles. **SP**, *Fine gravelly sand*, with some **GP**, *Sandy gravel.* **HSU-MSF2, *LFA1-2*** |
| 1140-1200 | Pebbly sand to sandy pebble gravel, well sorted (1160-1200), *fining upward* into sandy to silty clay and clay; with some small-scale interbedding of sandy clay and sand. Fine fraction: weak red to reddish brown (10R-2.5YR4/3); 60-80% fines, 20-40% sand (vf-f), and trace vf-f pbls. Coarse fraction: reddish brown (5YR5/4); 50-60% sand (m-vc) and 40-50% pbls (vf-vc); poorly graded, w/ grain/clast angularity/rounding and arkosic mineralogy, as above (905+); w/ trace siliceous ss, chalcedony, and gray and brown chert (Pz), and fragment of vc gneiss pebble. Noncalcareous to very calcareous (ev), w/ pink *can*, and sparry-calcite cement on some pebbles. **CL**, *Clay loam to clay //* **SP**, *Fine gravelly sand.* **HSU-MSF2, *LFA3,2*** |
| 1200-1265 | Pebbly sand, moderately to well sorted, with some interbedded silty to clayey (**muddy**) sand (1215-1260); fining upward into sandy to silty clay. Fine fraction: weak to pale red (10R4/3-5/4) and reddish brown (2.5YR4-5/3-4). Sand: reddish brown (5YR5/4); 75-85% Sand (f-vc), 10-15% pbls (vf-m), and <10% fines. Moderately to poorly graded. Angularity/roundness and grain/clast mineralogy, as above (910+); w/ trace slts and chert (Pz), and fragment of coarse, rounded pbl of metaquarzite. Sand: Noncalcareous; sparry-calcite cement on some pebbles; fines very calcareous (ev) w/ pink *can*. **SW-SP**, *Fine gravelly sand.* **HSU-MSF2, *LFA3*** |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1265-1320 | Pebbly sand, moderately to well sorted (1300-1320), *fining upward* into silty clay and clay, with minor interbedded sand. Clays: reddish brown (2.5YR4/3-4) and weak and pale red to reddish brown (10R-2.5YR4-5/3-4), sandy clay: reddish brown (2.5YR5/4). Sand: reddish brown (5YR5/4); 80-85% sand (vf-vc), 5-10% pbls (vf-m), and 10% fines. Moderately poorly graded. Angularity/roundness and grain/clast mineralogy, as above (910+); w/ trace ss and chert (Pz), and quartzite (pC). Sand: Noncalcareous; sparry-calcite cement on some pebbles; fines very calcareous (ev). **CL-SC**, *Clay to sandy clay loam* // **SW-SP**, *Fine gravelly sand.* Remarks: Basal part of ~400-ft thick, coarsest-grained subunit of the Tesuque Fm "main body" (Lithosome S of Johnson et al., 2004?). **HSU-MSF2, *LFA3,9*** |
| 1320-1395 | Clay and silty clay—dominant , with minor interbedded silty sand and sandy clay. Clays: reddish brown (2.5-5YR4/4 and 5YR5/3-4); 55-85% fines, 15-45% sand (vf-m), and trace c-vc sand and vf pbls. Sand: reddish brown (5YR5/4); 75% sand (vf-m), 25% fines, and trace pbls (vf).; with w/ grain angularity/rounding and mineralogy as above (910+). Very calcareous (ev), w/ pinkish gray (7.5YR6/2) *can.* **SC-CL**, *Sandy clay loam to clay*, with minor **SM**, *Sandy clay loam.* Remarks: With few light gray (2.5-5YR7/1) "reduction zones," and fragments of micaceous silty very fine sand (light gray, 5Y7/1). **HSU-MSF2, *LFA9*** |
| 1395-1475 | Sandy to silty clay—dominant , with some interbedded silty to clayey (**muddy**) fine sand. Clays: reddish brown (2.5-5YR4-5/3)—dominant, with variegated zones: reddish gray to brown (5-7.5YR5/2) and reddish brown (as above). 30-60% sand (vf-c), 40-70% fines, and <5% vf-m pbls. Sand: reddish brown (2.5YR5/3-4), and minor weak red (10R4/3) "bodies;" 60% sand (vf-m), 40% fines, and trace vf pbls. Arkosic grain/clast mineralogy; grain/clast angularity/rounding and arkosic mineralogy as above (910+); with trace gray chert and weathered intermediate volcanics(?). Very calcareous (ev), w/ pinkish gray (5YR6/2) high-carbonate "zones" and *can.* **SC**, *Sandy clay loam to clay*, and **SM**, *sandy loam to sandy loam.* **HSU-MSF2, *LFA9,3*** |
| 1475-1510 | Sandy to silty clay. Brown (7.5YR4/3-5/2)--dominant, with some pinkish gray (7.5YR6/2) high-carbonate zones, and minor reddish brown (5YR5/2) in lower 10 ft. 60% fines and 40% sand (vf-m). Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SC-CL**, *Sandy clay to clay loam.* Remarks: Distinct shift from reddish (2.5-5YR) to brownish (7.5YR) hues in 1,490 to 1,520-ft drill cuttings. **HSU-MSF2, *LFA9*** |

## Description and Classification of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1510-1575 | Sandy to silty clay with few sand layers (1510-30, 1540-60); interbedded with well to moderately sorted pebbly sand and sand (1530-40, 1560-75). Fine fraction: reddish brown (5YR5/3); 50% silty clay and 50% sand (vf-m). Coarse fraction: reddish brown to brown (5-7.5YR5/3); 60-85% (vf-vc), 15-35% vf-c pbls and 5-15% fines; clast max 30mm. Moderately graded; angularity/roundness and arkosic grain/clast mineralogy, as above (910+); w/ trace ss, slts, gray and black chert (Pz), and coarse quartzite pbls. Fines very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy loam to sandy clay loam* and **SP-SW**, *Sand and fine gravelly sand.* **HSU-MSF2, *LFA3,9*** |

**Note 1: Pebbly sands in the 1530-40 and 1560-70 ft sample intervals mark the basal coarse-grained (alluvial-channel) facies in Tesuque Fm-Lithosome S, and the (*provisional*) base of the Middle Santa Fe hydrostratigraphic unit (HSU MSF, *LFA's 3 and 5[?]*). Dominantly fine-grained basin fill between 1,575 and 1,685 ft in the OB-A pilot hole, and underlying beds of Lithosome S (1,685-1,743 ft) are here placed in an (informal) Lower Santa Fe hydrostratigraphic unit (HSU LSF).**
**Note 2: Better consolidation (compaction) in drill cuttings below 1,600-ft sample interval, and shift from sands and silty clays to *soft* sandstones to mudstones.**

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1575-1615 | Fine sandy to silty clay. Reddish brown (2.5YR4-5/3)—dominant, with dark reddish gray (5YR4/2) and brown (7.5YR4/3). 65-80% fines, 20-35% sand (vf-m, w/ minor c-vc). Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SC-CL**, *Sandy clay to clay loam.* **HSU-LSF, *LFA9,3*** |
| 1615-1685 | Clay to silty clay—dominant, with some interbedded very fine sandy clay. Weak red to reddish brown (10R-2.5YR4/3)—dominant; with variegated "zones:" reddish brown to weak red and red (2.5YR4-5/3-4 to 10R4/4 and 2.5YR4/6), and some light gray (5Y7/1) "reduction zones" and black MnO "dendrites." 80-90% fines and 10-20% sand (vf-f). Very calcareous (ev), w/ trace pink (10R8/3-4) *can.* **CL-SC**, *Clay, w/ sandy clay.* **HSU-LSF, *LFA9*** |

**Note: Near contact of main body of the Tesuque Fm (Lithosome S) on Tesuque-Lithosome E of Johnson and others (2004) at 1,685 ft. The latter grayish brown unit (upper Oligocene?), with intermediate to basaltic volcanic clasts, is correlative with the Tesuque-Bishops Lodge Mbr (Smith,2000) and basal Santa Fe Gp deposits derived from volcanic rocks of the Cerrillos Hills area (including the Espinaso Fm and Cieneguilla Limburgite [basanite] of Disbow and Stoll (1957) and Sun and Baldwin (1958). This interpretation is based on visual analysis of drill cuttings and information from borehole geophysical logs (primarily resistivity, conductivity, and gamma ray).**

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1685-1695 | Pebbly sandy mudstone and silty fine sandstone (soft). Dark gray to dark grayish brown (10YR4/1-2) dominant, with some gray to grayish brown (10YR5/1-2), and minor reddish brown (5YR5/3). 45% fines, 45% sand (vf-c), and 10% pbls (vf-m). Well graded, w/ angular to subrounded grains and clasts. Mixed grain/clast mineralogy (andesite-latite porphyry, basalt(?), volcaniclastic slts and ss, quartz, K-feldspar, and arkosic lithics. Very calcareous (es-ev), w/ trace light gray (10YR7/1) "zones"/ segregations (*can*), and sparry calcite cement on some pebbles. **HSU-LSF, *LFA9*(R)** |
| 1695-1743 | Fine sandy mudstone (soft), as above (1710-1720 sample interval). Dark gray to dark grayish brown and brown (10YR4-5/1-3); with brown to dark grayish brown (7.5-10YR4/2) beds. 50% fines and 50% sand (vf-c), with trace vf-f pbls. Very calcareous (es-ev), w/ *can* and light gray (10YR6-7/1) "zones" in lower 10 ft.<br>Remarks: Bottom of geophysical-logging interval at about 1,760ft.<br>**HSU-LSF, *LFA9*** |

**Note: Drilling records show major shift to harder material and slower drilling at about 1,743 ft (probably hard sandstones in 1770-1780 sample interval). Unit penetrated below 1,743 ft here interpreted as either basal Tesuque Fm—Bishops Lodge Mbr or pre-Santa Fe Gp volcaniclastic bedrock correlative with the upper Espinaso Fm and/or the Cieneguilla "basanite."**

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1743-1800 | Coarse sandstone to conglomeratic (vf pbly) sandstone (hard to soft), and fine sandy mudstone and silty sandstone (soft and hard). Gray to brown (10YR5/1 to 7.5YR4/2-5/1) and dark gray (10YR4/1), with minor reddish brown (5YR4/3). Mixed intermediate-volcanic to basaltic, and arkosic lithic types and minerals; w/ coarse fragments (25mm max) of gray volcaniclastic(?) ss. Non- to very calcareous (e-ev). **HSU-LSF(?), *LFA9*(R)** |

# TABLE C. SUMMARY OF HYDROSTRATIGRAPHIC AND LITHOFACIES INTERPRETATIONS BASED ON COMPARTIVE ANALYSES OF DRILL CUTTINGS AND BOREHOLE GEOPHYSICS IN THE OB-A PILOT HOLE, RANCHO VIEJO

**Well Name:** OB-A Pilot Hole
**Location):** T16N, R9E, Section 29.111; **Lat/Long:** 35°35'43" N, 106°01'05" W
**State Plane Coordinates (est.):** X=569100 (1709332) Y=1671600 (1672077)
**Elevation:** 6,475ft asl
**Total Depth:** 1,802 ft
**Geophysical Logging:** to 1,760 ft

## Description and Interpretation of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 0-20 | Pebbly sand to silty sand, poorly sorted. Dark reddish gray to reddish brown (5YR4/2-4). Sand (vf-vc), with 10% vf-m pebble (**pbl**) gravel in upper 10ft and 25-30% silt in lower 10ft. Well graded, angular to subangular sand grains and gravel clasts. Arkosic mineralogy (quartz, K-feldspar, K-mica, and granite-gneiss/pegmatite lithics—derived from local Pre-Cambrian terrane); w/ one f pbl of brown chert noted (Pz-derived). Calcareous (e-es). **SW-SM**, *Sand to sandy loam.* |

**Note: Top (?) of Upper Santa Fe-Ancha Fm (Pliocene-Early Pleistocene) within 5-10 ft of land surface. Upper Santa Fe Hydrostratigraphic Unit (HSU) USF1, *Lithofacies Assemblage (LFA) 5b***

| | |
|---|---|
| 20-30 | Sandy pebble gravel, poorly sorted. Reddish brown (5YR4/3). 60% pbls (vf-vc), 35% sand (vf-vc), and 5% silt. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above), w/ mica flakes and 64mm subrounded granite pbl. Noncalcareous. **GW**, *Sandy fine gravel.* **HSU-USF1, *LFA5a*** |
| 30-67 | Fine pebbly sand, poorly sorted, *fining upward* into silty sand in upper 10 ft; and with interbedded silty fine to coarse sand from 50-60 ft. Reddish brown (5YR4-5/3-4). 10-15% pbls (vf-f) in 40-50 and 60-67 ft intervals; and 25-30% silt and 5% pbls in silty sand layer. Well graded, angular to subrounded grains and clasts. Arkosic-micaceous mineralogy (as above). Noncalcareous. **SW**, *Sand* and **SM,** *Loamy sand* . **HSU-USF1, *LFA5*** |

## Description and Interpretation of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 67-80 | Pebbly sand, slightly silty and poorly sorted, *fining upward* into silty sand, w/ some interbedded(?) very fine sandy silt. Reddish brown (5YR4-5/3) to dark brown and brown (7.5YR3/2-5/3). 80-90% sand (vf-vc), 10-15% silt, and up to 10% vf-m pbls. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above), w/common mica flakes. Calcareous (e-es). **SM**, *Loamy sand* // **SW**, *Sand.* Remarks: Possible buried soil in upper 5 ft. **HSU-USF1,** ***LFA5*** |
| 80-100 | Pebbly sand, poorly sorted, *fining upward* into silty to sandy clay. Reddish brown (5YR4-5/3) to reddish gray (5YR5/2). 80-85% sand (vf-vc) and 5-10% pbls (vf-m) in basal part, and 60% silt-clay fraction (**fines**) in upper 10 ft. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above). Calcareous (es-ev), with trace (mostly pink, 2.5-5YR7/3) soft carbonate segregations (*can*). **SM-SC**, *Sandy loam-sandy clay loam* // **SW**, *Sand.* **HSU-USF1,** ***LFA5*** |
| 100-130 | Sandy pebble gravel, poorly to moderately sorted, *fining upward* into poorly sorted silty sand. Reddish brown (5YR5/3-4), with some reddish gray (5YR5/2) silty zones. 60% pbls (vf-m) and 40% sand (f-vc) in basal part; and 80-85% sand (vf-vc) and 10-15% fines in upper 10 ft. Moderately to well graded, angular to subrounded grains and clasts; clast max: 15mm. Arkosic grain/clast mineralogy (as above). Very calcareous (ev), with trace pink *can* in upper part. **SW-SM**, *Sand to loamy sand* // **GW**, *Sandy fine gravel* to. **HSU-USF1,** ***LFA5*** |
| 130-205 | Pebbly sand, clean to slightly silty and poorly sorted; with interbedded pebble gravel and sand from 130-165, 175-185 and 195-205 ft. Reddish brown (5YR5/3-4). 40-70% sand (vf-vc), 30-60% pbls (vf-m), and up to10% fines. Well graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy, w/ minor dark quartzite and diorite). Calcareous fine fraction w/ trace *can*. **SW-GW**, *Sand to very fine gravelly sand*; with interbedded **GW-SW**, *Sandy fine gravel* and *very fine gravelly sand.* **HSU-USF1,** ***LFA5a*** |
| 205-213 | Coarse pebble gravel, poorly to moderately sorted. Reddish brown (5YR5/3). 75% pbls (vf-vc) and 40% sand (f-vc). Moderately to well graded, angular to subrounded grains and clasts; clast max: 45mm. Arkosic grain/clast mineralogy (as above), with gneiss, diorite, and quartzite. Noncalcareous. **GW**, *Fine gravel.* **HSU-USF1,** ***LFA5a*** |

## Description and Interpretation of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|

**Note: Contact of Upper Santa Fe-Ancha Fm on “Lower” Santa Fe-Tesuque Fm, and top of Middle Santa Fe Hydrostratigraphic Unit (HSU) MSF2, *Lithofacies Assemblage (LFA) 3*at ~213 ft. Depth inferred from “drillograph” records, borehole geophysics, and major texture-mineralogy shift in drill cuttings. Driller noted very coarse gravel (“boulders”) at about 205ft and a shift to much faster bit penetration at 213 ft.**

| | |
|---|---|
| 215-240 | Pebble gravel and sand, poorly sorted (230-240 ft), *fining upward* into silty clay to clay. Fine fraction: reddish brown (2.5YR4/4); 80 fines, >18% sand (vf-c), <2% pbls (vf). Coarse fraction: brown (7.5YR5/3) to reddish brown (5YR5/4); 50% pbls (vf-m) and 50% sand (f-vc). Well graded, w/ angular to rounded grains and angular to subrounded clasts; clast max: 15mm. Arkosic grain/clast mineralogy (quartz, K-feldspar, K-mica, and granite/gneiss lithics) w/ few Pz ss, siltstone (**slts**), and gray chert. Noncalcareous sand and gvl, and very calcareous (es-ev) fines. **CL-ML**, *Clay to clay loam //* **GW-SW**, *Sandy very fine gravel* and *very fine gravelly sand.* Remarks: Interpreted as Lithosome S of the Tesuque Fm (Johnson et al., 2004; Koning and Hallett, 2001 [2006 update]). **HSU-MSF2, *LFA3*** |
| 240-300 | Silty clay to clay—dominant (240-60, 280-300), with pebble gravel and sand from 260 to 280 ft, as above (230-240). Fines: reddish brown (2.5-5YR4/4-5/3); 70-80% silty clay and 20-30% sand (vf-c), <2% pbls (vf). Arkosic grain/clast mineralogy, as above, including weathered gneiss and/ trace light-gray chert. Slightly to very calcareous (e-ev), w/ few pink *can.* **CL- SC,** *Clay to clay loam and sandy clay loam.* **HSU-MSF2, *LFA3*** |
| 300-365 | Coarse pebbly sand—dominant, slightly silty and poorly sorted, with minor interbedded sandy clay in lower 35 ft. Reddish brown to light reddish brown (5YR5-6/3). 50-85% sand (vf-vc) and 15-40% pbls (vf-c). Sandy clay: reddish brown (2.5YR4/4). 50% fines, 35% sand (vf-vc), and 5% pbls (vf-m) Well graded, grain/clast angularity/rounding as above (230+); clast max: 30mm. Arkosic grain/clast mineralogy (as above); w/ weathered gneiss and trace quartzite and gray to black chert (Pz). Calcareous fine fraction w/ trace *can.* **SW-GW,** *Fine gravelly sand.* Fine fraction: Reddish brown (2.5-5YR4/4-5/3); 70-80% silty clay and 20-30% sand (vf-c), <2% pbls (vf). Calcareous fine fraction (e-ev), w/ trace *can.* **SW-GW,** *Fine gravelly sand, w/ minor* **CL-SC,** *Clay to clay loam and sandy clay loam.* **HSU-MSF2, *LFA1-2*** |

**Note: Water table and capillary fringe in 300 to 310-ft interval.**

## Description and Interpretation of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 365-400 | Fine to medium pebbly sand, poorly sorted (380-400 ft), *fining upward* into fine sandy to silty clay. Fine fraction: reddish brown (2.5YR4/4). Coarse fraction: reddish brown (5YR5/3-4); 75% sand (vf-vc), 20% pbls (vf-c), and <5% fines; well graded, grain/clast angularity/rounding as above (230+). Arkosic grain/clast mineralogy (as above); w/ highly weathered gneiss fragment, and trace coarse ss and black chert (Pz). Calcareous fine fraction (e-ev), w/ trace *can*. Sand: Non- to slightly calcareous (e). **SC-CL**, *Clay loam to clay* // **SW**, *Fine gravelly sand.* **HSU-MSF2, *LFA3*** |
| 400-420 | Sand, poorly to moderately sorted (410-420ft), *fining upward* into clay to silty clay. Fine fraction: weak red to reddish brown (10R4/3-2.5-5YR4/4-5); 80-90% fines and 10-20% sand (vf-c), and trace vf-f pbls. Sand: reddish brown (5YR5/3); 85-90% sand (vf-vc), 10% fines, and <5% pbls (vf-m). Well to moderately graded, grain/clast angularity/rounding as above (230+); clast max: 13mm. Arkosic grain/clast mineralogy (as above); w/ trace quartzite, and slts and light reddish brown to pink (2.5YR6-7/3) limestone (**ls**) fragments (Pz?). Calcareous fine fraction (e-ev), w/ trace *can*. Sand: Non- to slightly calcareous (e). **CL**, *Clay loam to clay* // **SW**, *Sand.* Remarks: Some "**ls**" fragments here and below could be indurated carbonate segregations (*cam*). **HSU-MSF2, *LFA3*** |
| 420-455 | Fine sandy to silty clay grading(?) upward into clay. Reddish brown to light reddish brown (2.5-5YR5/4-6/3), with trace weak red (10R4/3). 70-90% fines, 10-30% sand (vf-f), and trace vf-f pbls. Arkosic grain/clast mineralogy (as above), w/ trace slts and weathered calcareous ss (Pz?). Slightly to very calcareous (e-ev), w/ pink *can*. **SC-CL**, *Clay loam to clay.* **HSU-MSF2, *LFA3,9*** |
| 455-555 | Clay to silty clay—dominant; with some interbedded fine sandy clay and silty fine sand in 510-520, 550-560, and 570-600. Mostly reddish brown (2.5-5YR5/4); with variegated zones in uppermost and mid-part of interval: pale red to reddish brown (10R-2.5YR4-5/3-4), and light reddish brown (2.5YR6/4). 80-90% fines, 10-20% sand (vf-f), and trace vf-f pbls. Arkosic grain mineralogy (as above), w/ trace ls, slts, ss and chert (Pz?). Very to slightly calcareous (ev-e), w/ pink *can* and some black Mn-oxide (**MnO**) dendrites. **CL**, *Clay*, w/ some **SM&SC**, *loamy sand & sandy clay loam.* **HSU-MSF2, *LFA9*** |

## Description and Interpretation of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 555-595 | Sandy and silty clay—dominant, interbedded with silty sand. Fine-grained beds: reddish brown (2.5-5YR4/3-5/4); 70-90% fines, 10-30% sand (vf-c), and trace vf pbls. Sands: reddish brown (2.5YR4/4 & 5YR5/3). 55-65% sand (vf-vc), 35-45% fines, and <5% pbls (vf-f); well graded, w/ angular to rounded sand grains and angular to subrounded pebble clasts; and arkosic grain/clast mineralogy, w/ trace quartzite and chert (Pz). Very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy loam to sandy clay loam; and* **SC-CL,** *Sandy clay to clay.* **HSU-MSF2, *LFA3,9*** |
| 595-655 | Silty sand—dominant, poorly sorted, interbedded with sandy to silty clay, as above (555-595). **SM-SC**, *Sandy loam to sandy clay loam; and* **SC-CL,** *Sandy clay to clay.* **HSU-MSF2, *LFA3*** |
| 555-695 | Sandy to silty clay—dominant, interbedded with silty sand, as above (555-595). **SM-SC**, *Sandy loam to sandy clay loam; and* **SC-CL,** *Sandy clay to clay.* Remarks: Some K-feldspar, gneiss and ss pebbles are highly weathered and split readily. **HSU-MSF2, *LFA9,3*** |
| 695-760 | Silty sand—dominant, moderately to poorly sorted, interbedded with sandy to silty clay, as above (555-595). Sand: reddish brown (5YR5/3); 70-80% sand (vf-vc), <20% fines, and <10% pbls (vf-f). Fine fraction: reddish brown (2.5YR4/3-5/4); 70-90% fines, 10-30% sand (vf-c), and trace vf-f pbls. Moderately to well graded sands, grain/clast angularity/rounding as above (600-730). Arkosic grain/clast mineralogy, w/ trace quartzite, ss, and chert (Pz). Fines: very calcareous (ev), w/ pink *can.* **SM**, *Sandy loam; and* **SC-CL,** *Sandy clay to clay.* **HSU-MSF2, *LFA3*** |
| 760-870 | Clay to silty clay—dominant; with some interbedded sandy clay and silty sand, and basal sand "zone" (855-874). Clays: reddish brown (2.5YR4/4-5YR5/3); 80-90% fines, 10-20% sand (vf-c). Silty sands: reddish brown (2.5-5YR5/3); 60-75% sand (vf-vc), 25-35% fines, and 1-5% pbls (vf-f). Basal sand: 90% sand, 5% pebbles (vf-m), and 5%fines; moderately to well graded, w/ angular to rounded sand grains and angular to subrounded pebble clasts; arkosic grain/clast mineralogy, w/ trace quartzite, ls, ss, and chert. Very calcareous (ev), w/ pink *can.* **SC-CL**, *Clay loam to clay*, with **SC-SM**, *Sandy clay loam to loam,* and basal **SW**, *Sand.*<br>Remarks: Variegated silty to sandy clay in 840-850 ft sample interval: Reddish brown (5YR4/4-5/3) and light brown to pink (7.5YR6-7/3). **HSU-MSF2, *LFA9,3*** |

## Description and Interpretation of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 870-905 | Fine sandy to silty clay—dominant; with minor interbedded(?) silty fine sand, as above. Fines: reddish brown (2.5-5YR4-5/4); sand: reddish brown (5YR5/3). 75-80% fines and 20-25% sand (vf-f), and no(?) pebbles. Arkosic grain mineralogy. Very calcareous (ev), w/ few pink *can.* **SC-CL,** *clay loam to clay,* w/ **SM**, *Sandy clay loam to loam.* **HSU-MSF2, *LFA9*** |
| 905-1016 | Fine to medium pebbly sand, well to poorly sorted; interbedded with Fine sandy clay to clay. Sands: pinkish gray (7.5YR6/2); 70-85% sand (f-vc), 15-25% pbls (vf-m), and <5% fines. Clays: reddish brown (2.5-5YR4-5/4); 65-90% fines and 10-35% sand (vf-m), with trace vf-f pbls. Sands: poorly to well graded; clast max: 13mm; with angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (quartz, K-feldspar, and granite/gneiss lithics), w/ trace marlstone, slts, ls, ss (Fe-MnO cement), and black and brown chert (Pz). Sand: Non calcareous; fines very calcareous (ev). **SP-SW**, *Fine gravelly sand* and **SC-CL**, *Clay loam, fine sandy clay and clay.* Remarks: Uppermost part of ~400-ft coarsest-grained subunit of the Tesuque Fm-"main body" (Lithosome S of Johnson et al., 2004). **HSU-MSF2, *LFA3*** |

**Note: In samples of sands below 905 ft, well-rounded sand grains are present in only trace amounts or absent, and indicate possible shift to zone of intertonguing of distal piedmont and marginal basin-floor facies (e.g. *LFA*'s *5* & *2-3-9*) of Tesuque Lithosome S).**

| | |
|---|---|
| 1016-1055 | Pebbly, medium to very coarse sand, well sorted; minor interbedded(?) silty clay in lower 10ft . Reddish brown (5YR5/4). 75% sand (m-vc) and 25% pbls (vf-m); fines: weak red to reddish brown (10R4/3-4 to 2.5YR4/4). Poorly graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy, w/ trace slts, ss, ls, and gray "banded" chert (Pz). Sand: Noncalcareous; fines very calcareous (ev). **SP**, *Fine gravelly sand,* with *minor CL, Clay loam to clay.* **HSU-MSF2, *LFA1-2*** |

## Description and Interpretation of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1055-1080 | Pebbly sand, well to moderately sorted (1070-1080), *fining upward* into clay to silty clay. Fine fraction: weak red to reddish brown (10R-2.5YR4/3-4); 80-90% fines, 10-20% sand (vf-vc), and trace vf pbls. Coarse fraction: reddish brown (5YR5/4); 73% Sand (m-vc), 25% pbls (vf-m), and 2% fines; clast max: 15mm. Poorly to moderately graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above); w/ trace f-c ss and chert (Pz), and sparry-calcite cement on some pebbles; Fines very calcareous (ev), w/ pink *can.* **CL**, *Clay to clay loam //* **SP**, *Fine gravelly sand.* **HSU-MSF2, *LFA3*** |
| 1080-1140 | Pebbly, medium to very coarse sand, well to moderately sorted; with some interbedded sandy pebble gravel. Sands: reddish brown (5YR5/4); fines: weak red (10R4/3). 65-80% sand (m-vc), 20-35% pbls (vf-c), and 1-2% fines. Poorly to moderately graded, angular to subrounded grains and clasts. Arkosic grain/clast mineralogy (as above); w/ trace white "marlstone," ss and chert (Pz), and few fragments of rounded, coarse pbls of metaquarzite. Noncalcareous to very calcareous (ev), w/ sparry-calcite cement on some pebbles. **SP**, *Fine gravelly sand*, with some **GP**, *Sandy gravel.* **HSU-MSF2, *LFA1-2*** |
| 1140-1200 | Pebbly sand to sandy pebble gravel, well sorted (1160-1200), *fining upward* into sandy to silty clay and clay; with some small-scale interbedding of sandy clay and sand. Fine fraction: weak red to reddish brown (10R-2.5YR4/3); 60-80% fines, 20-40% sand (vf-f), and trace vf-f pbls. Coarse fraction: reddish brown (5YR5/4); 50-60% sand (m-vc) and 40-50% pbls (vf-vc); poorly graded, w/ grain/clast angularity/rounding and arkosic mineralogy, as above (905+); w/ trace siliceous ss, chalcedony, and gray and brown chert (Pz), and fragment of vc gneiss pebble. Noncalcareous to very calcareous (ev), w/ pink *can*, and sparry-calcite cement on some pebbles. **CL**, *Clay loam to clay //* **SP**, *Fine gravelly sand.* **HSU-MSF2, *LFA3,2*** |
| 1200-1265 | Pebbly sand, moderately to well sorted, with some interbedded silty to clayey (**muddy**) sand (1215-1260); fining upward into sandy to silty clay. Fine fraction: weak to pale red (10R4/3-5/4) and reddish brown (2.5YR4-5/3-4). Sand: reddish brown (5YR5/4); 75-85% Sand (f-vc), 10-15% pbls (vf-m), and <10% fines. Moderately to poorly graded. Angularity/roundness and grain/clast mineralogy, as above (910+); w/ trace slts and chert (Pz), and fragment of coarse, rounded pbl of metaquarzite. Sand: Noncalcareous; sparry-calcite cement on some pebbles; fines very calcareous (ev) w/ pink *can.* **SW-SP**, *Fine gravelly sand.* **HSU-MSF2, *LFA3*** |

## Description and Interpretation of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1265-1320 | Pebbly sand, moderately to well sorted (1300-1320), *fining upward* into silty clay and clay, with minor interbedded sand. Clays: reddish brown (2.5YR4/3-4) and weak and pale red to reddish brown (10R-2.5YR4-5/3-4), sandy clay: reddish brown (2.5YR5/4). Sand: reddish brown (5YR5/4); 80-85% sand (vf-vc), 5-10% pbls (vf-m), and 10% fines. Moderately poorly graded. Angularity/roundness and grain/clast mineralogy, as above (910+); w/ trace ss and chert (Pz), and quartzite (pC). Sand: Noncalcareous; sparry-calcite cement on some pebbles; fines very calcareous (ev). **CL-SC**, *Clay to sandy clay loam* // **SW-SP**, *Fine gravelly sand.* Remarks: Basal part of ~400-ft thick, coarsest-grained subunit of the Tesuque Fm "main body" (Lithosome S of Johnson et al., 2004?). **HSU-MSF2, *LFA3,9*** |
| 1320-1395 | Clay and silty clay—dominant , with minor interbedded silty sand and sandy clay. Clays: reddish brown (2.5-5YR4/4 and 5YR5/3-4); 55-85% fines, 15-45% sand (vf-m), and trace c-vc sand and vf pbls. Sand: reddish brown (5YR5/4); 75% sand (vf-m), 25% fines, and trace pbls (vf).; with w/ grain angularity/rounding and mineralogy as above (910+). Very calcareous (ev), w/ pinkish gray (7.5YR6/2) *can.* **SC-CL**, *Sandy clay loam to clay*, with minor **SM**, *Sandy clay loam.* Remarks: With few light gray (2.5-5YR7/1) "reduction zones," and fragments of micaceous silty very fine sand (light gray, 5Y7/1). **HSU-MSF2, *LFA9*** |
| 1395-1475 | Sandy to silty clay—dominant , with some interbedded silty to clayey (**muddy**) fine sand. Clays: reddish brown (2.5-5YR4-5/3)—dominant, with variegated zones: reddish gray to brown (5-7.5YR5/2) and reddish brown (as above). 30-60% sand (vf-c), 40-70% fines, and <5% vf-m pbls. Sand: reddish brown (2.5YR5/3-4), and minor weak red (10R4/3) "bodies;" 60% sand (vf-m), 40% fines, and trace vf pbls. Arkosic grain/clast mineralogy; grain/clast angularity/rounding and arkosic mineralogy as above (910+); with trace gray chert and weathered intermediate volcanics(?). Very calcareous (ev), w/ pinkish gray (5YR6/2) high-carbonate "zones" and *can.* **SC**, *Sandy clay loam to clay*, and **SM**, *sandy loam to sandy loam.* **HSU-MSF2, *LFA9,3*** |
| 1475-1510 | Sandy to silty clay. Brown (7.5YR4/3-5/2)--dominant, with some pinkish gray (7.5YR6/2) high-carbonate zones, and minor reddish brown (5YR5/2) in lower 10 ft. 60% fines and 40% sand (vf-m). Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SC-CL**, *Sandy clay to clay loam.* Remarks: Distinct shift from reddish (2.5-5YR) to brownish (7.5YR) hues in 1,490 to 1,520-ft drill cuttings. **HSU-MSF2, *LFA9*** |

## Description and Interpretation of Major Lithologic Units

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1510-1575 | Sandy to silty clay with few sand layers (1510-30, 1540-60); interbedded with well to moderately sorted pebbly sand and sand (1530-40, 1560-75). Fine fraction: reddish brown (5YR5/3); 50% silty clay and 50% sand (vf-m). Coarse fraction: reddish brown to brown (5-7.5YR5/3); 60-85% (vf-vc), 15-35% vf-c pbls and 5-15% fines; clast max 30mm. Moderately graded; angularity/roundness and arkosic grain/clast mineralogy, as above (910+); w/ trace ss, slts, gray and black chert (Pz), and coarse quartzite pbls. Fines very calcareous (ev), w/ pink *can.* **SM-SC**, *Sandy loam to sandy clay loam* and **SP-SW**, *Sand and fine gravelly sand.* **HSU-MSF2, *LFA3,9*** |

**Note 1: Pebbly sands in the 1530-40 and 1560-70 ft sample intervals mark the basal coarse-grained (alluvial-channel) facies in Tesuque Fm-Lithosome S, and the (*provisional*) base of the Middle Santa Fe hydrostratigraphic unit (HSU MSF, *LFA's 3 and 5[?]*). Dominantly fine-grained basin fill between 1,575 and 1,685 ft in the OB-A pilot hole, and underlying beds of Lithosome S (1,685-1,743 ft) are here placed in an (informal) Lower Santa Fe hydrostratigraphic unit (HSU LSF).**

**Note 2: Better consolidation (compaction) in drill cuttings below 1,600-ft sample interval, and shift from sands and silty clays to *soft* sandstones to mudstones.**

| | |
|---|---|
| 1575-1615 | Fine sandy to silty clay. Reddish brown (2.5YR4-5/3)—dominant, with dark reddish gray (5YR4/2) and brown (7.5YR4/3). 65-80% fines, 20-35% sand (vf-m, w/ minor c-vc). Arkosic grain mineralogy, as above. Very calcareous (ev), w/ pinkish gray *can.* **SC-CL**, *Sandy clay to clay loam.* **HSU-LSF, *LFA9,3*** |
| 1615-1685 | Clay to silty clay—dominant, with some interbedded very fine sandy clay. Weak red to reddish brown (10R-2.5YR4/3)—dominant; with variegated "zones:" reddish brown to weak red and red (2.5YR4-5/3-4 to 10R4/4 and 2.5YR4/6), and some light gray (5Y7/1) "reduction zones" and black MnO "dendrites." 80-90% fines and 10-20% sand (vf-f). Very calcareous (ev), w/ trace pink (10R8/3-4) *can.* **CL-SC**, *Clay, w/ sandy clay.* **HSU-LSF, *LFA9*** |

## Description and Interpretation of Major Lithologic Units

**Note: Near contact of main body of the Tesuque Fm (Lithosome S) on Tesuque-Lithosome E of Johnson and others (2004) at 1,685 ft. The latter grayish brown unit (upper Oligocene?), with intermediate to basaltic volcanic clasts, is correlative with the Tesuque-Bishops Lodge Mbr (Smith,2000) and basal Santa Fe Gp deposits derived from volcanic rocks of the Cerrillos Hills area (including the Espinaso Fm and Cieneguilla Limburgite [basanite] of Disbow and Stoll (1957) and Sun and Baldwin (1958). This interpretation is based on visual analysis of drill cuttings and information from borehole geophysical logs (primarily resistivity, conductivity, and gamma ray).**

| Depth (ft) | Description, Classification, and Remarks |
|---|---|
| 1685-1695 | Pebbly sandy mudstone and silty fine sandstone (soft). Dark gray to dark grayish brown (10YR4/1-2) dominant, with some gray to grayish brown (10YR5/1-2), and minor reddish brown (5YR5/3). 45% fines, 45% sand (vf-c), and 10% pbls (vf-m). Well graded, w/ angular to subrounded grains and clasts. Mixed grain/clast mineralogy (andesite-latite porphyry, basalt(?), volcaniclastic slts and ss, quartz, K-feldspar, and arkosic lithics. Very calcareous (es-ev), w/ trace light gray (10YR7/1) "zones"/ segregations (*can*), and sparry calcite cement on some pebbles. **HSU-LSF, *LFA9*(R)** |
| 1695-1743 | Fine sandy mudstone (soft), as above (1710-1720 sample interval). Dark gray to dark grayish brown and brown (10YR4-5/1-3); with brown to dark grayish brown (7.5-10YR4/2) beds. 50% fines and 50% sand (vf-c), with trace vf-f pbls. Very calcareous (es-ev), w/ *can* and light gray (10YR6-7/1) "zones" in lower 10 ft.<br>Remarks: Bottom of geophysical-logging interval at about 1,760ft.<br>**HSU-LSF, *LFA9*** |

**Note: Drilling records show major shift to harder material and slower drilling at about 1,743 ft (probably hard sandstones in 1770-1780 sample interval). Unit penetrated below 1,743 ft here interpreted as either basal Tesuque Fm—Bishops Lodge Mbr or pre-Santa Fe Gp volcaniclastic bedrock correlative with the upper Espinaso Fm and/or the Cieneguilla "basanite."**

| | |
|---|---|
| 1743-1800 | Coarse sandstone to conglomeratic (vf pbly) sandstone (hard to soft), and fine sandy mudstone and silty sandstone (soft and hard). Gray to brown (10YR5/1 to 7.5YR4/2-5/1) and dark gray (10YR4/1), with minor reddish brown (5YR4/3). Mixed intermediate-volcanic to basaltic, and arkosic lithic types and minerals; w/ coarse fragments (25mm max) of gray volcaniclastic(?) ss. Non- to very calcareous (e-ev). Remarks: Bottom of hole at 1,802 ft. **HSU-LSF, *LFA9*(?)** |

## PRELIMINARY NOTES ON CCX1 AND OB-A CORRELATIONS (3/24/2006):

**1**. The lowermost part of the main body of the Tesuque Fm occurs at a depths of ~ 1,500ft in CCX1 (elev. 4,970ft asl) and 1,700ft (elev. 4,775ft asl) in OB-A, respectively, as inferred from both borehole geophysics and drill cutting analysis.

**2**. Pebbly sands in the 1530-1570ft interval in OB-A (elev. 4945-4,905ft asl) mark the basal coarse-grained (alluvial-channel) facies in the Middle Santa Fe hydrostratigraphic unit (**HSU MSF**, ***LFA's 5a*** and ***3***) and Tesuque Fm-Lithosomes A & S (see **Appendix**). This zone appears to correlate with the basal arkosic sand sequence penetrated in CCX1 between about 1,330-1,380ft (elev 5,220-5,170ft asl). This also indicates that the "average" westward dip of the lower Tesuque Fm is only about 2 to 3° (3.5-5%) in this part of the basin (**which agrees with current interpretations by USGS geophysicists and NMBGMR geologists**).

**3**. A maximum westward dip of about 2 to 3° in the main body of the Tesuque Fm between the CCX1 and OB-A well sites definitely indicates that the major aquifer zones screened in these wells (~900 to 1,300ft in OB-A, and 740 to 1,300ft in CCX1) are interconnected. This is corroborated by correlations of thick clayey zones encountered in both wells (e.g. 310-425ft and 600-720ft in CCX1, with 455-555ft and 760-905ft in OB-A).

**4.** The possible hydraulic effects of a small (down-to-the-east, N-trending) fault identified in USGS aeromagnetic surveys between the two well sites has not been evaluated in this phase of the study.

# TABLE D. DISTRIBUTION OF MAJOR LITHOFACIES ASSEMBLAGES AND HYDROSTRATIGRAPHIC UNITS IN THE OB-A PILOT HOLE, RANCHO VIEJO— SUMMARY OF HYDROGEOLOGIC NTERPRETATIONS FOR MODEL DEVELOPMENT (FIG. 1, TABLES 1 to 3)

**Well Name:** OB-A Pilot Hole (Rancho Viejo Project)
**Location:** T16N, R9E, Section 29.111; **Lat/Long:** 35°35'43" N, 106°01'05" W
**State Plane Coordinates (est.):** X=569100 (1709332) Y=1671600 (1672077)
**Elevation:** 6,475ft asl
**Total Depth:** 1,802 ft

| Depth (feet) | Elevation (top, ft) | Lithofacies Assemblage/ Tesuque Fm Lithosome | Hydrostratigraphic Unit |
|---|---|---|---|
| 0-10 | 6,475 | **b/*5*** | ***PA/* USF1** |
| 10-142 | 6,465 | ***5,5a*** | **USF1** |
| 142-213 | 6,333 | ***5a*** | **USF1** |
| 213-280 | 6,262 | ***3/S*** | **MSF2** |
| 280-300 | 6,195 | ***9/S*** | **MSF2** |
| 300-365 | 6,175 | ***1-2/S*** | **MSF2** |
| 365-455 | 6,110 | ***3/S*** | **MSF2** |
| 455-555 | 6,020 | ***9/S*** | **MSF2** |
| 555-760 | 5,920 | ***3/S*** | **MSF2** |
| 760-870 | 5,715 | ***9,3/S*** | **MSF2** |
| 870-905 | 5,605 | ***9/S*** | **MSF2** |
| 905-1016 | 5,570 | ***3/S*** | **MSF2** |
| 1016-1140 | 5,459 | ***1-3/S*** | **MSF2** |
| 1140-1265 | 5,335 | ***3/S*** | **MSF2** |
| 1265-1320 | 5,210 | ***3,9/S*** | **MSF2** |
| 1320-1395 | 5,155 | ***9/S*** | **MSF2** |
| 1395-1475 | 5,080 | ***9,3/S*** | **MSF2** |
| 1475-1510 | 5,000 | ***9/S*** | **MSF2** |
| 1510-1575 | 4,965 | ***3,9/S*** | **MSF2** |
| 1575-1615 | 4,900 | ***9,3/S*** | **LSF** |
| 1615-1685 | 4,860 | ***9/S*** | **LSF** |
| 1685-1743 | 4,790 | ****9/Ttbl-E?*** | **LSF** |
| 1743-1802 | 4,732 | ****9/Ttbl-E?*** | **LSF** |
| Bottom of Hole | 4,673 | | |

****Ttbl-E?*** Probably Bishop Lodge Mbr, or possibly Lithosome E of the "lower" Tesuque Fm. See **Appendix** (p. 49-51).

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## APPENDIX: TESUQUE FORMATION LITHOSOME CLASSIFICATION

### Lithosomes A and B (Cavazza, 1986; Koning, 2004)

#### Lithosome A

Lithosome A units are associated with piedmont-slope alluvial depositional environments of the Tesuque Fm along the western base of the Southern Sangre de Cristo Mountains (Santa Fe Range). "These units are characterized by medium to thick, tabular to broadly lenticular beds of silty sandstone interbedded with various proportions of coarser channel deposits of pebbly sandstone, sandstone, and pebble conglomerate. The gravel of lithosome A is generally dominated by granite, with subordinate quartzite, and the sand fraction has abundant pinkish potassium feldspar. Lithosome A is further subdivided according to texture. Finer units (silty very-fine to medium sandstone and siltstone with less than 5-7% coarser sand and gravel channel deposits) are interpreted to generally represent the distal alluvial slope. Coarser units, composed of slightly muddy very-fine to very-coarse sandstone with greater than 5-7% gravelly sand channel deposits, are interpreted to generally represent the medial and proximal alluvial slope (Koning, 2004, p. 103)."
**Comment by JWH:** In the Rancho Viejo study area (CCX and Injection Well sites), distal piedmont slopes form the primary depositional environments of Tesuque Fm—Lithosome A. *Main-body* and *lower* Tesuque deposits associated with these units correspond to the ***Lithofacies Assemblages (LFAs) 5, 5a, & 5b,*** and *informal* **Hydrostratigraphic Units (HSUs) MSF1 and LSF[1]** used herein (see Fig. 1 and Table 1; Hawley and Kernodle, 2000; Hawley and Cook, 2003).

#### Lithosome B (Not Present in Southern Española Basin)

Lithosome B units are associated with basin-floor fluvial depositional environments of the Tesuque Fm near the axis of an early-stage northern Española Basin (including the "old" Buckman well field and area to the north. These units "are characterized by siltstone, claystone [mudstones], and fine sandstone floodplain deposits interbedded with subordinate, relatively broad channel deposits of sandstone and conglomerate (Koning, 2004, p. 103)." In the northern and central parts of the basin, Cavazza (1986) and Koning note that gravel-clast composition is "hetereolithic," and includes clasts derived from Tertiary volcanic, Paleozoic sedimentary, and Proterozoic granitic/metamorphic source terranes to the north and northeast (e.g. Peñasco embayment and southern San Luis Basin).

## Lithosomes S and E (Koning, 2006)

### Lithosome S

The basin-floor—distal piedmont-slope equivalent of Lithosome B In the Rancho Viejo study area is now designated **Lithosome S** (see Koning 2006 [below], Johnson et al. 2005); and most, if not all of these *main-body* Tesuque deposits are derived from an ancestral southern Santa Fe Range source area that was dominated by basement-granitic/metamorphic bedrock units, with relatively small areas of exposed Paleozoic sedimentary units and Oligocene volcanics.

**Comment by JWH:** In the Rancho Viejo study area, inferred depositional environments represented by Lithosome S include both fluvial-channels and broad floodplains located near the southern end of basin. *Main-body* Tesuque deposits associated with these environments correspond to the ***Lithofacies Assemblages (LFAs) 2, 3, & 9,*** and *informal* **Hydrostratigraphic Units (HSUs) MSF2 and LSF[2]** used herein (see Fig. 1 and Table 1; Hawley and Kernodle, 2000; Hawley and Cook, 2003).

### Lithosome E

A relatively thin, volcanic-derived and volcaniclastic **basal-Tesuque** unit is now designated **Lithosome E** by Koning (2006) and Johnson and others (2004). It is generally correlative with the Tesuque-Bishops Lodge Mbr of Spiegel and Baldwin (1963), and it is transitional westward with the uppermost parts of the Espinaso Fm (volcanics) and Cieneguilla Limburgite (basanite) of Disbrow and Stoll (1957) and Sun and Baldwin (1958).

### Lithosome AS Complex (My informal unit that may be useful for detailed correlation of facies units in the Rancho Viejo [CDX and OB-A pilot hole] area—not used in this report)

Stacked units associated with shifting depositional environments in inferred areas of piedmont-toeslope/basin-floor transition. In the Rancho Viejo-CCX-Well study area, the **Lithosome AS Complex** includes *main-body* Tesuque deposits corresponding to the ***Lithofacies Assemblages (LFAs) 3,5 & 5,3***, and *informal* **Hydrostratigraphic Units (HSUs) MSF and LSF** used herein (see Fig. 1 and Table 1; Hawley and Kernodle, 2000; Hawley and Cook, 2003).

## Selections from E-mail communications from Dan J. Koning on February 27and March 26, 2006 on: Lithosomes in the Southern Española Basin.

### February 26, 12:52 PM:

<u>Lithosome B</u> is associated with a south-sloping basin floor facies and a provenance of the Peñasco embayment and San Luis basin. It has a composition of mixed Paleozoic + felsic-intermediate volcanic + granitic detritus (the latter increases to the south). I have not found lithosome B anywhere near

Santa Fe; the furthest south I see it is in the old Buckman well field north of the new city wells.

Lithosome S is [primarily] arkosic pebbly sand and sand, but there [are] more than trace amounts of yellowish Paleozoic sandstone + limestone grains + Proterozoic quartzite grains (including a dark, cherty grain). Also, generally there are intercalated mudstone beds in lithosome S, although we have found places, such as at the fairgrounds, where such mudstone beds are relatively minor. Lithosome S was deposited by an ancestral Santa Fe River on a piedmont slope; and back in Miocene-time, the upper reaches of this river extended eastwards across the Picuris-Pecos fault. In this area, piedmont-slope sediment of lithosome A, [which] lacks Paleozoic sedimentary + Proterozoic quartzite detritus, seems to be of relatively narrow extent south of lithosome S. It seems that granitic hills south of the ancestral Santa Fe River were not sufficiently [high] or of wide extent as to produce much lithosome A sediment south of the river on the piedmont slope.

Recently, I have designated Lithosome E for Oligocene-Miocene volcaniclastic sediment derived from erosion of paleo-highlands that ringed the south, southwestern, and western part of the Santa Fe embayment. The recent Jail well went through this lithosome at ~550-1214 ft, and I see it in many Nuclear Dynamic wells west of the Rancho Viejo well(s). LIthosome E consists of sand, muddy sand, and muddy pebbly sand; and the composition of the volcanics is mixed basalt + latite (because of erosion of both the Cieneguilla basanite and the Espinaso Fm). Perhaps what you called Espinaso Fm is really lithosome E. The basalts usually are a dark gray to black color and olivine is usually seen; the color of the latite is generally a lighter gray.

**March 27, 8:13 AM:**
I looked at the boxed cuttings from this well late last week. I also stopped by the ABQ office to look at the 1710-1800 ft interval with Sean's petrographic scope. I changed my interpretation of this interval: After looking at these cuttings in detail, I would call it Bishop's Lodge Member of Tesuque Fm (equivalent to upper Espinaso Fm). The cuttings are more tuffaceous than the lithosome E, are composed predominately of dacite clasts (only one clast/grain that might be basalt), are relatively consolidated, and the upper contact seems more sharp than gradational. Usually, [the] upper lithosome E has muddy beds near its gradational top, but that is not the case here. Do the down-hole geophysical logs show a sharp contact or muddy interbeds in the 1710-1800 ft interval? Also, do the gamma ray curves indicate any ash beds in the upper or middle part of the hole?

. . . . Having an Espinaso Fm-Bishop's Lodge Mbr interpretation for 1710-1800 ft interval is going to require that I change my cross-section again! I'll forward you a copy when I'm done with the revision.

Thanks a lot for letting me look at the samples!

# APPENDIX C

# INJECTION AND OBSERVATION WELL TEST SUMMARIES

TABLE G1. OBSERVATION WELL A TEST SUMMARY (SINGLE-DRILL HOLE, MULTIPLE-SCREEN SETTINGS)

| Tested Zone | Test Date | Screen Setting of Tested Interval (ft below ground) | Pre-Test Water Level[4] (ft below ground) | Tested Rate (gpm) | Test Duration (hr) | Packer Depth (ft below ground) | Test Zone Drawdown (ft) | Observation Zone Drawdown (ft) | | | Local Test Zone Properties[8] | | | Recovery Period (hours) | Late-Time Recovery Transmissivity[9] ($ft^2/d$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Above Packer[5] | Intermediate Piezometer[6] | Deep Piezometer[7] | Transmissivity ($ft^2/d$) | Test Zone Thickness (Screen Length) (ft) | Hydraulic Conductivity (ft/d) | | |
| Deep[1] | 3/1/2006 | 1500 to 1580 | 280.95 | 28 | 3.8 | 1391 | 137.4 | 1.26 | -- | -- | 48 | 80 | 0.6 | 19 | 30 |
| Intermediate[2] | 3/6/2006 | 1020 to 1300 | 290.11 | 43 | 3.3 | 706 | 18.3 | 0.36 | -- | 7.9 | 126 | 180 | 0.7 | 10 | 40 |
| Shallow[3] | 3/8/2006 | 580 to 620 | 284.49 | 30 | 4.1 | None | 27.7 | -- | 17.0 | 4.3 | 150 | 40 | 3.8 | 113 | 8 |

[1] Deep zone isolated with inflatable wellbore packer set at 1391 feet below ground.

[2] Before intermediate zone test, deep zone screen backfilled with gravel and sealed with 20-foot thick bentonite plug. Intermediate zone isolated with inflatable wellbore packer set at 706 feet below ground.

[3] Before shallow zone test, intermediate zone screen backfilled with gravel and sealed with 20-foot thick bentonite plug.

[4] Pre-test water levels were recovering from previous tests and from wellbore sealing operations. The pre-test and post-test hydraulic head in the deep zone is higher than intermediate and shallow zones. The pre-test head in the shallow zone is higher than the intermediate zone head, but recovers to about one foot lower. Final gradient is upward from deep to shallow zone.

[5] Change in water level above packer during deep and intermediate zone tests is interpreted as leakage around packer. No leakage through annular bentonite seals is indicated.

[6] Response at intermediate piezometer during shallow zone test may be from movement and bypass of bentonite plug inside casing.

[7] Response at deep piezometer during intermediate and shallow zone tests may be from movement and bypass of bentonite plugs inside casing.

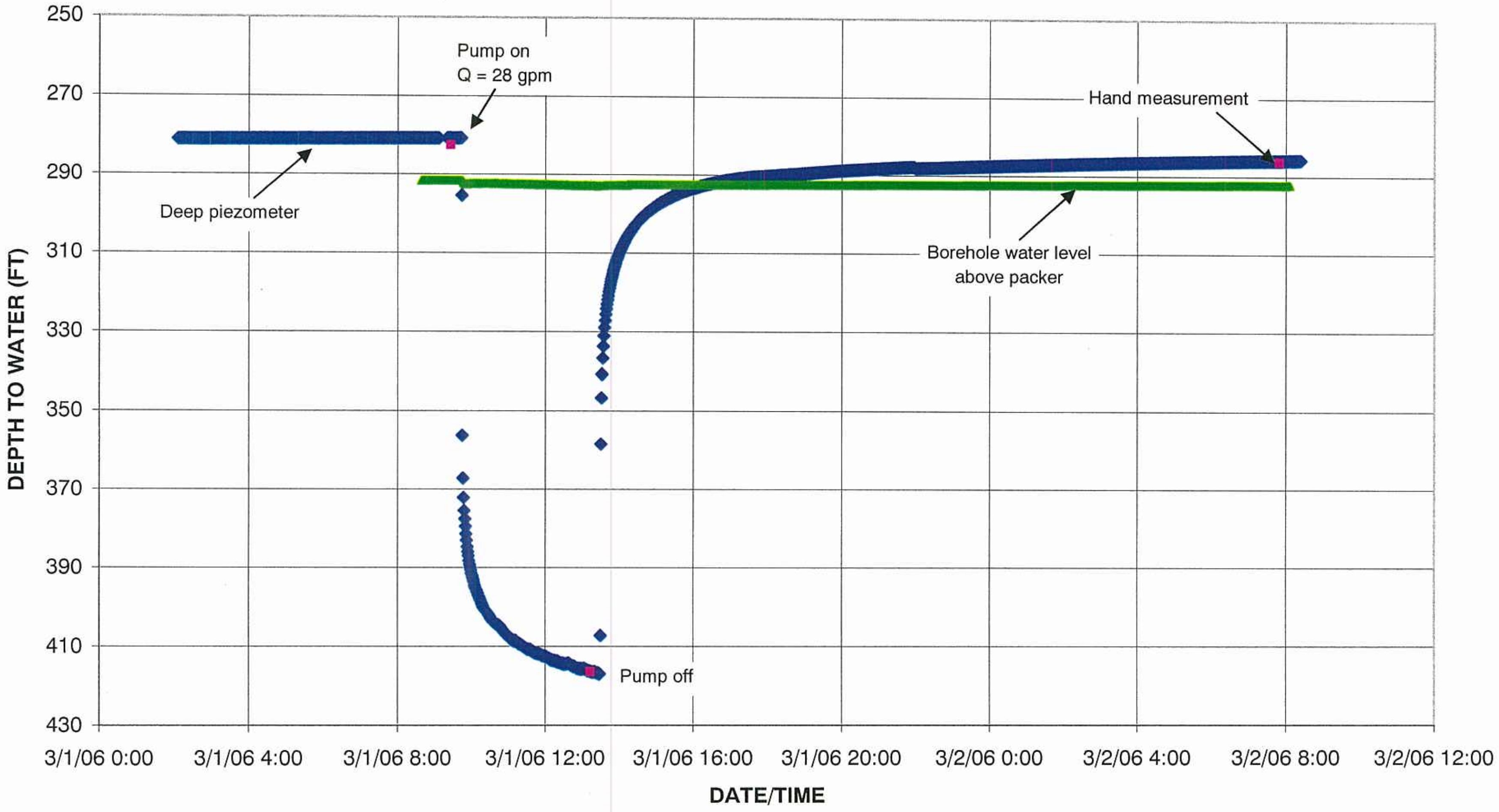
[8] Local test zones in screened sands are tested radii of influence, ranging 400 to 800 feet.

[9] Barrier boundaries of fine-grained sediment enclosing channel sands are indicated by late-time recovery transmissivity at intermediate and shallow zones.

Conclusions: Hydraulic conductivity of screened sands decreases with depth from several feet per day at 600 feet to several tenths of a foot per day at 1500 feet. Fine-grained sediments enclosing channel sands are one-half to one-tenth of the hydraulic conductivity of the sands. Vertical hydraulic gradient is upward.

SL
obs well a test sum.xls

# FIGURE G1
# CCD-OWA DEEP ZONE TEST
# TEST HYDROGRAPH



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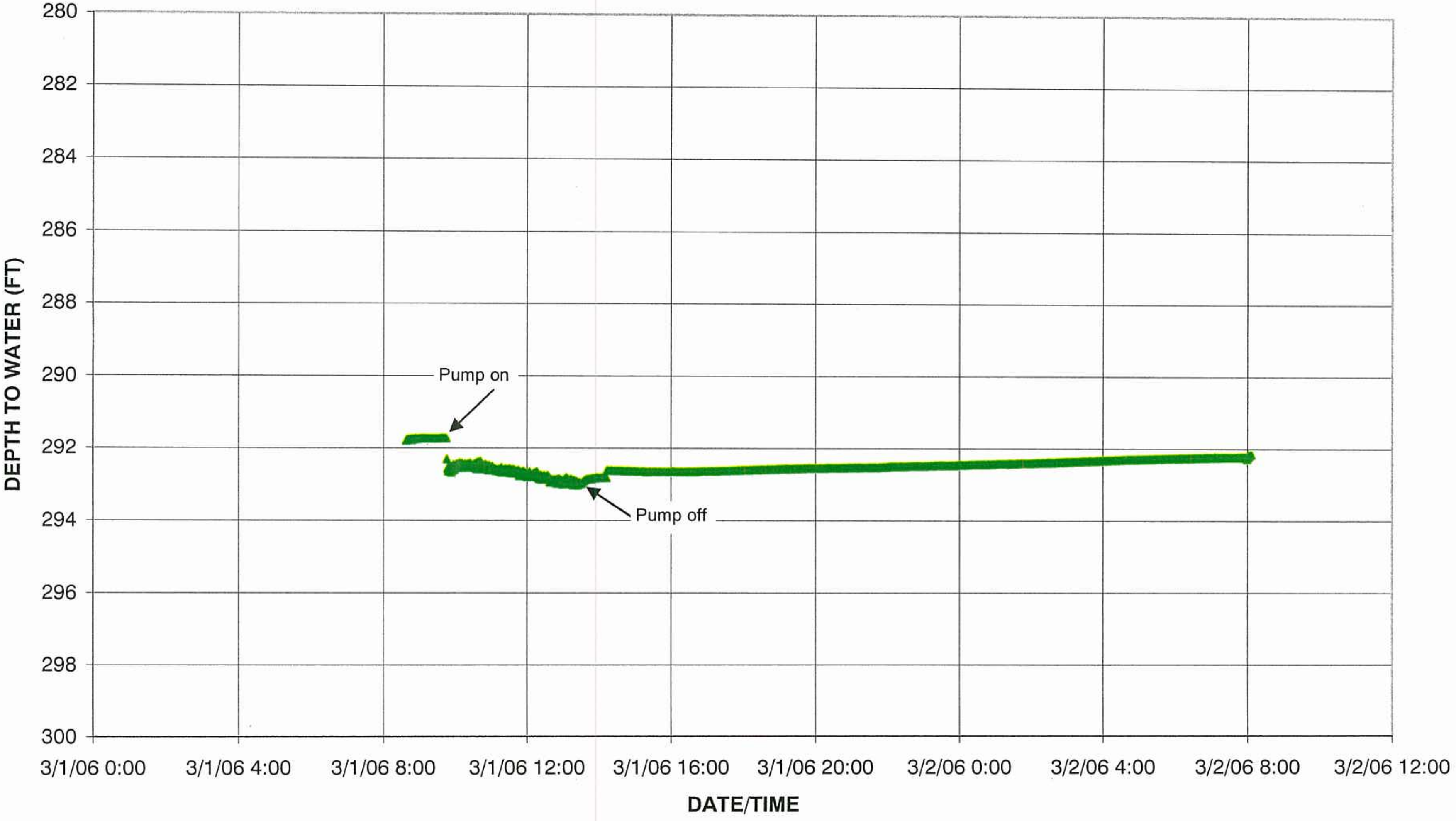
4/9/2007

# FIGURE G2
## CCD-OWA DEEP ZONE TEST
## RESPONSE IN WELLBORE ABOVE PACKER



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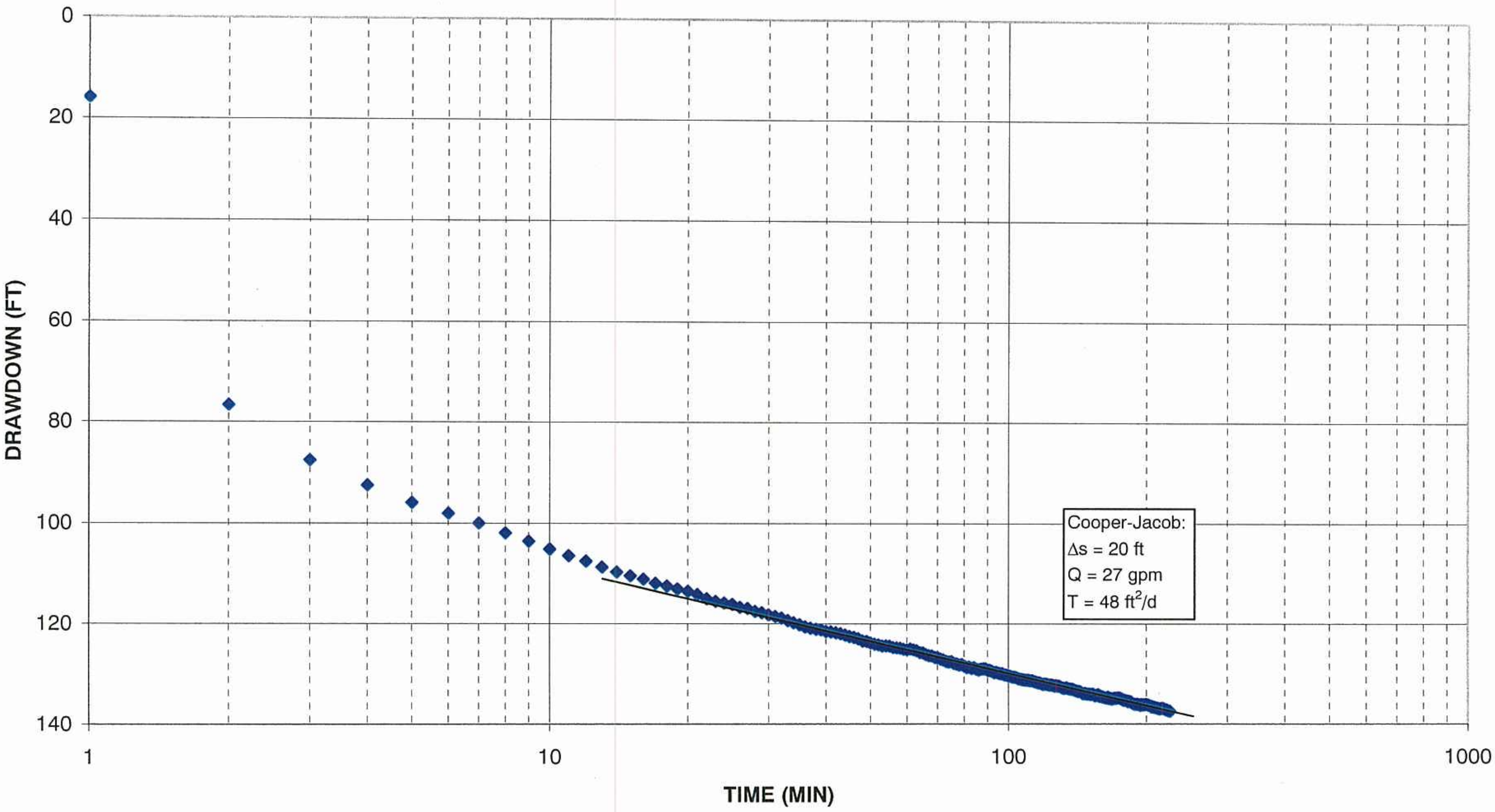
## FIGURE G3
## CCD-OWA DEEP ZONE TEST
## DRAWDOWN AT DEEP PIEZOMETER



Cooper-Jacob:
$\Delta s$ = 20 ft
Q = 27 gpm
T = 48 $ft^2$/d

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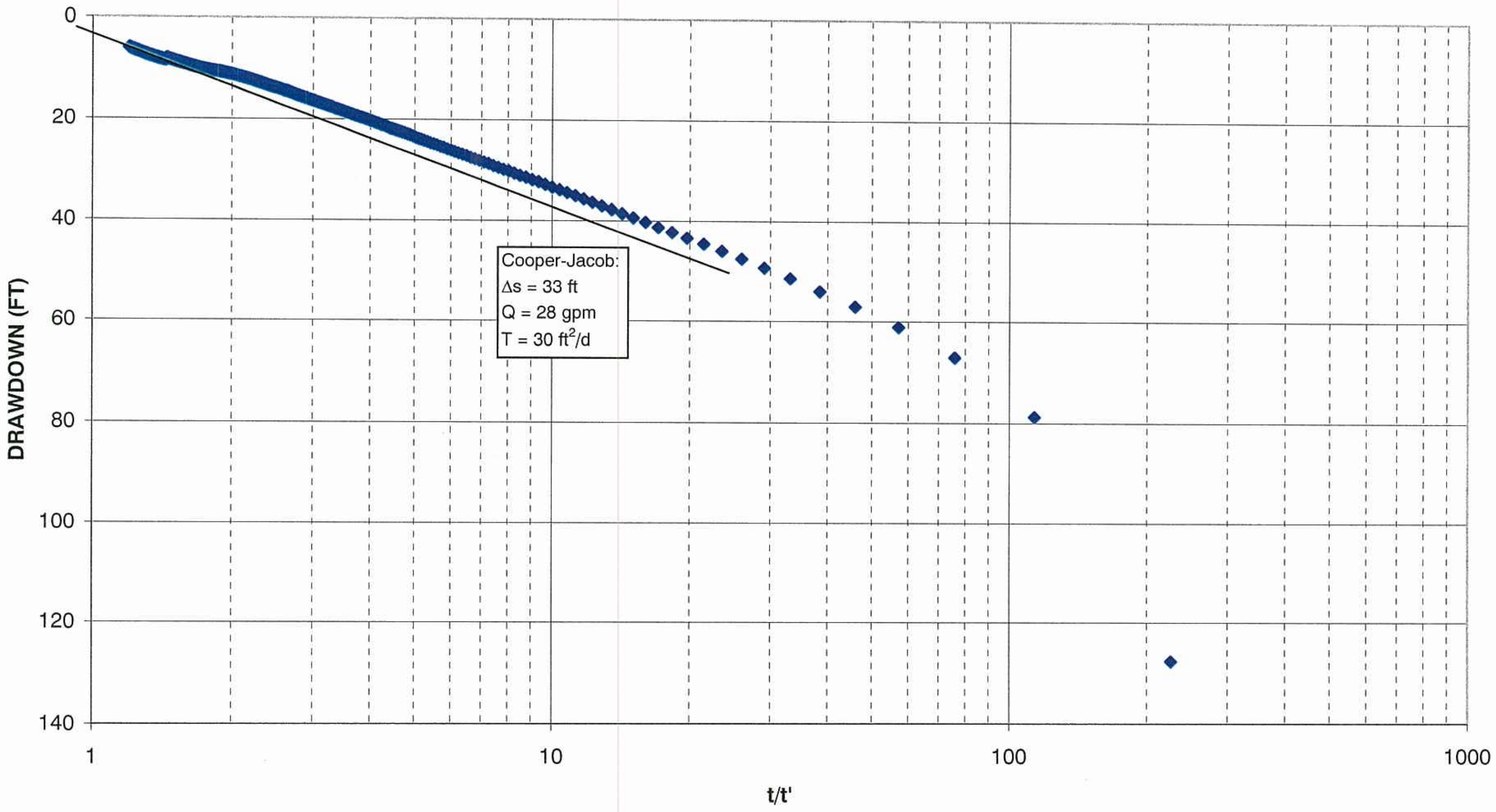
DD LOG
CC
4/9/2007

## FIGURE G4
## CCD-OWA DEEP ZONE TEST
## RECOVERY AT DEEP PIEZOMETER



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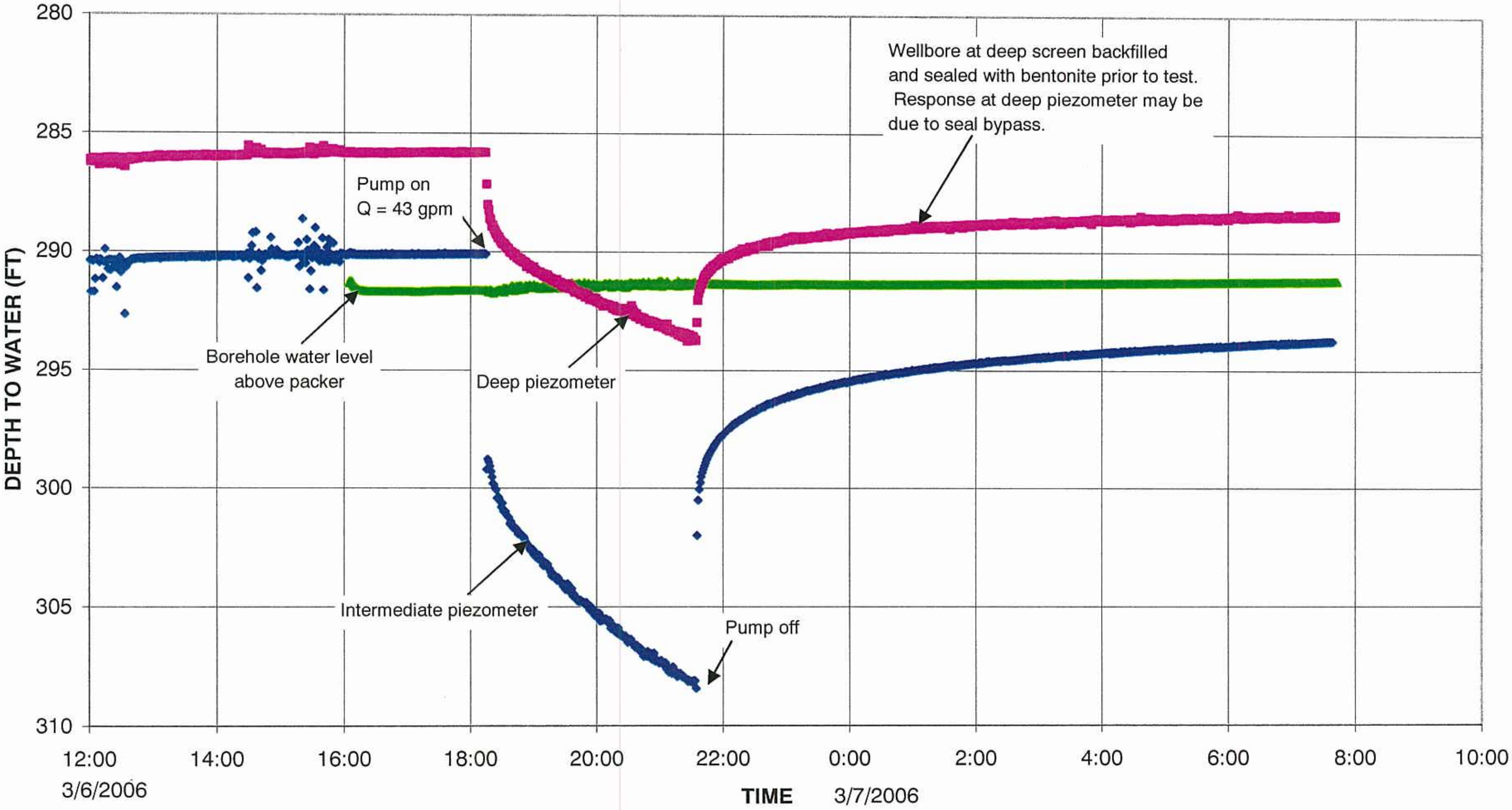
## FIGURE G5
## CCD-OWA INTERMEDIATE ZONE TEST
## TEST HYDROGRAPH



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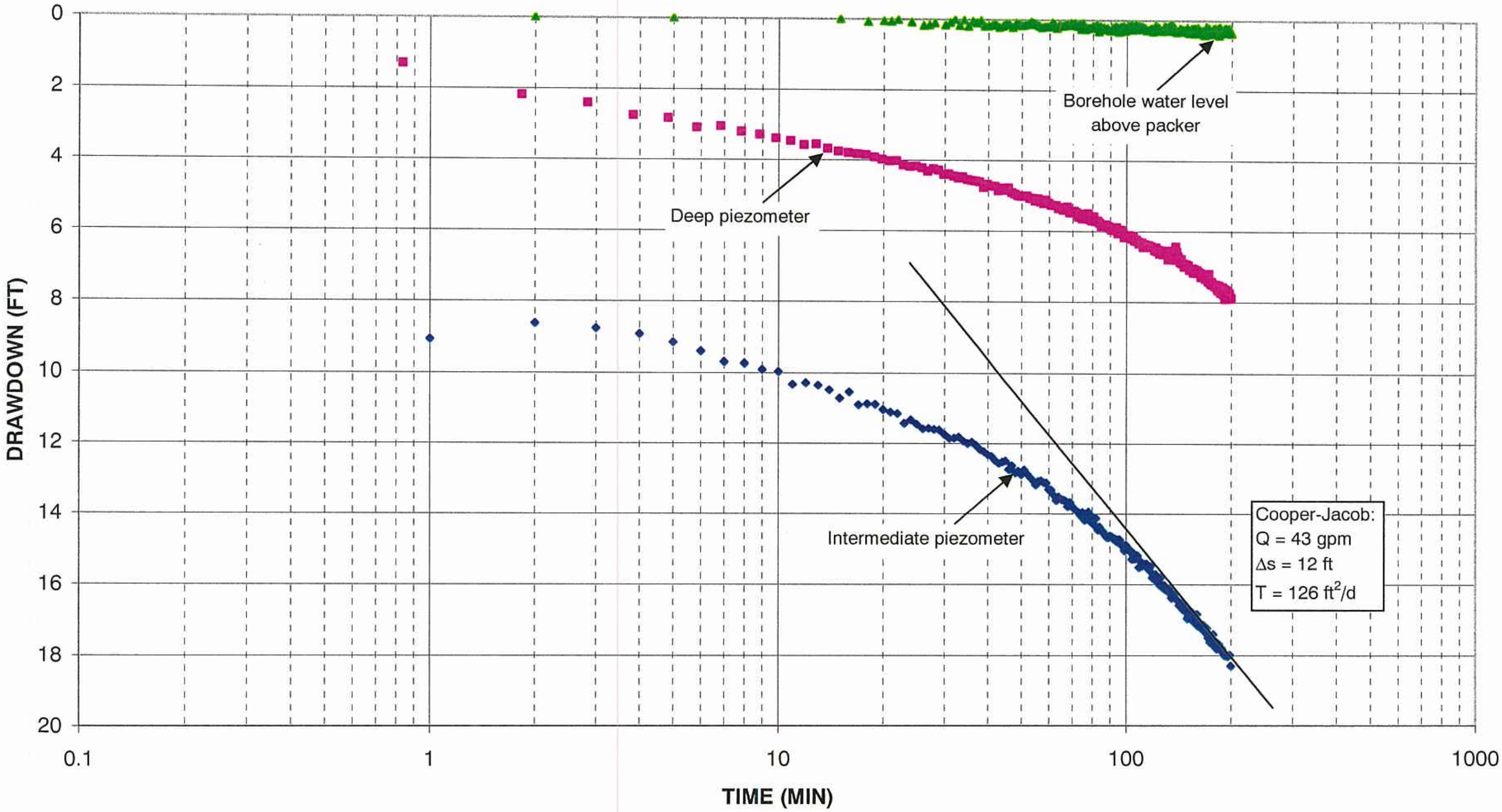
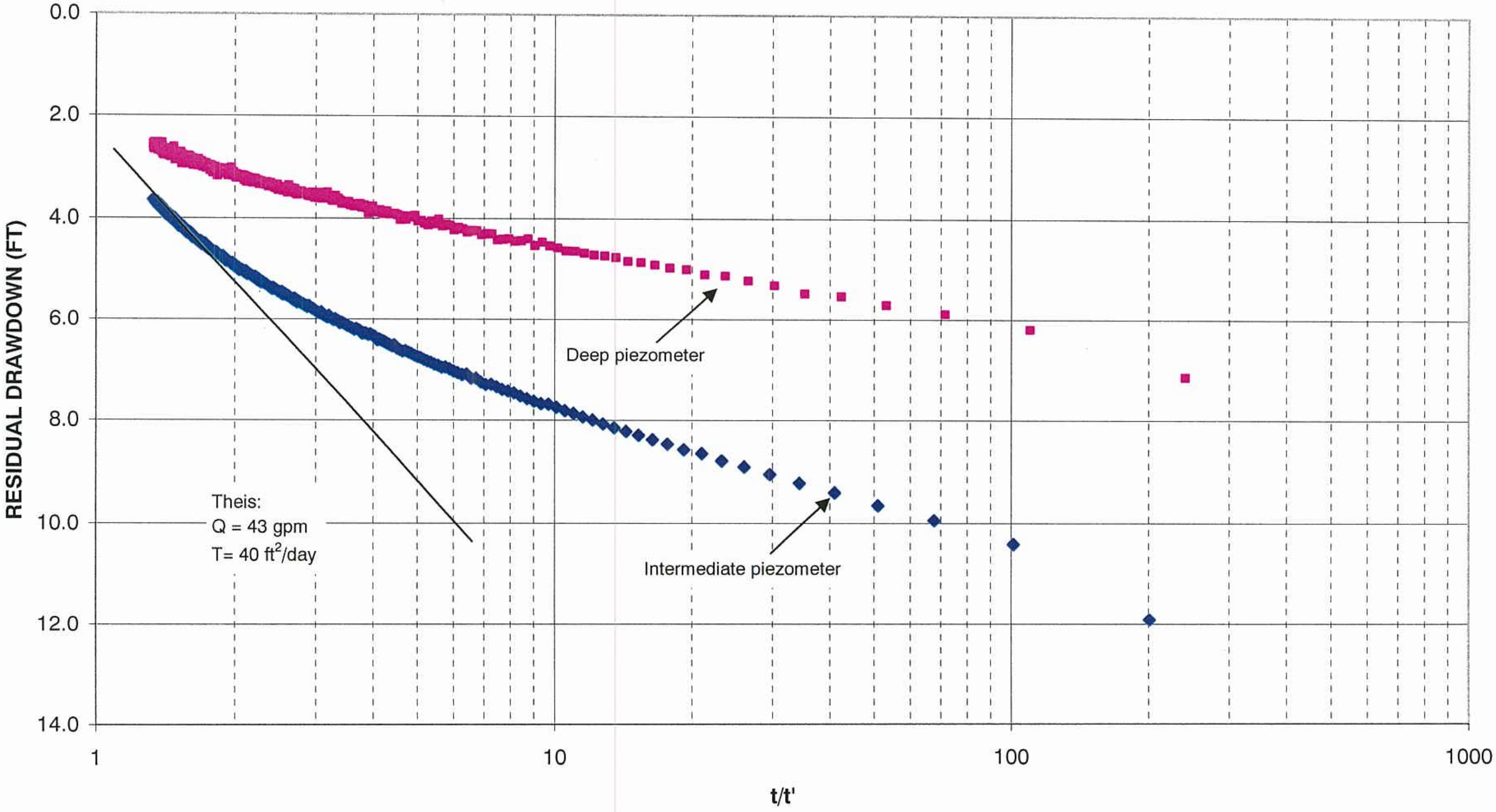
TEST HGRAPH
CC
4/16/2007

## FIGURE G6
## CCD-OWA INTERMEDIATE ZONE TEST
## DRAWDOWN IN DEEP AND INTERMEDIATE PIEZOMETERS AND ABOVE PACKER



owa int.xls
SEMILOG DD
CC
4/16/2007

## FIGURE G7
## CCD-OWA INTERMEDIATE ZONE TEST RECOVERY



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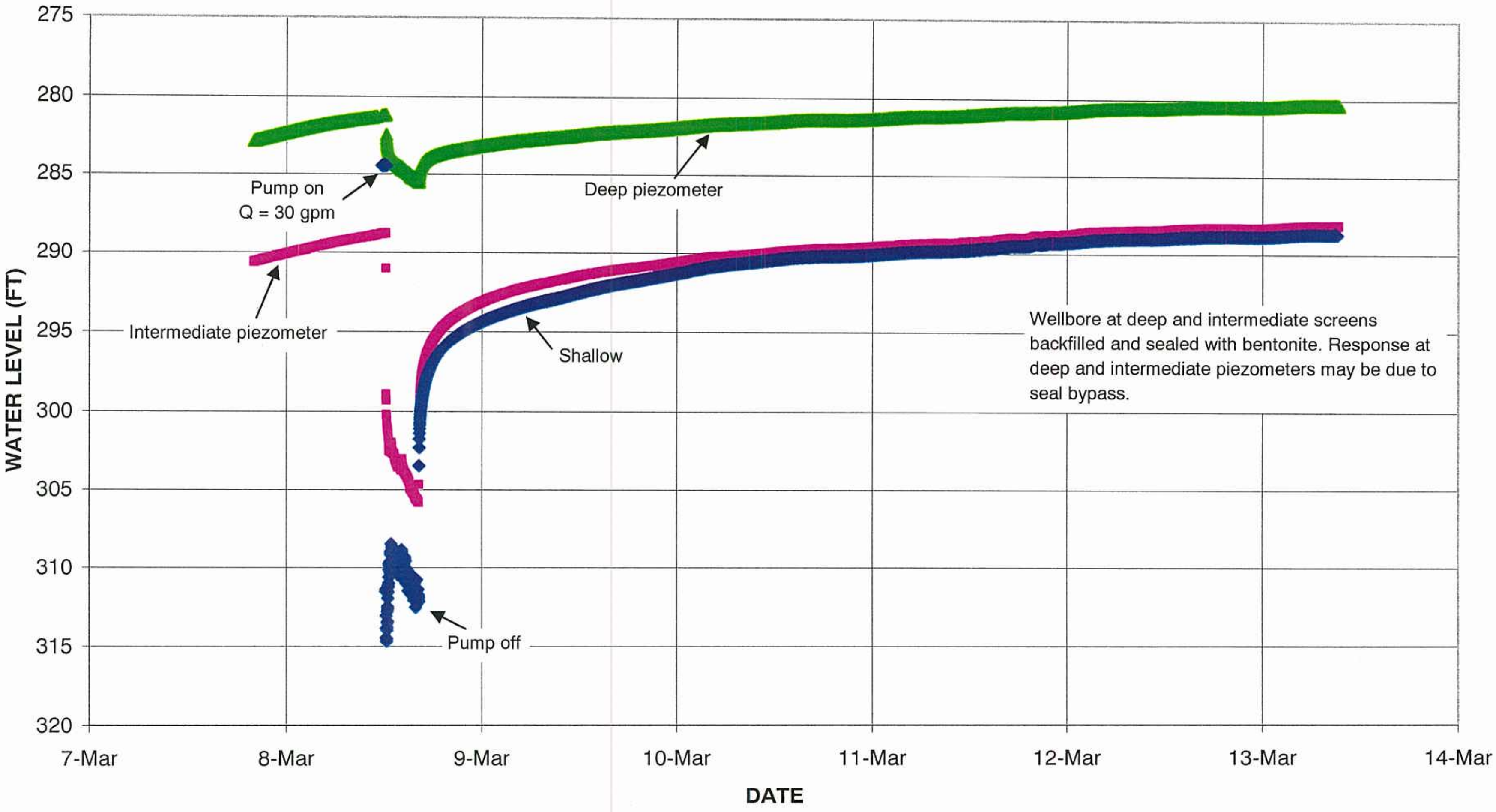
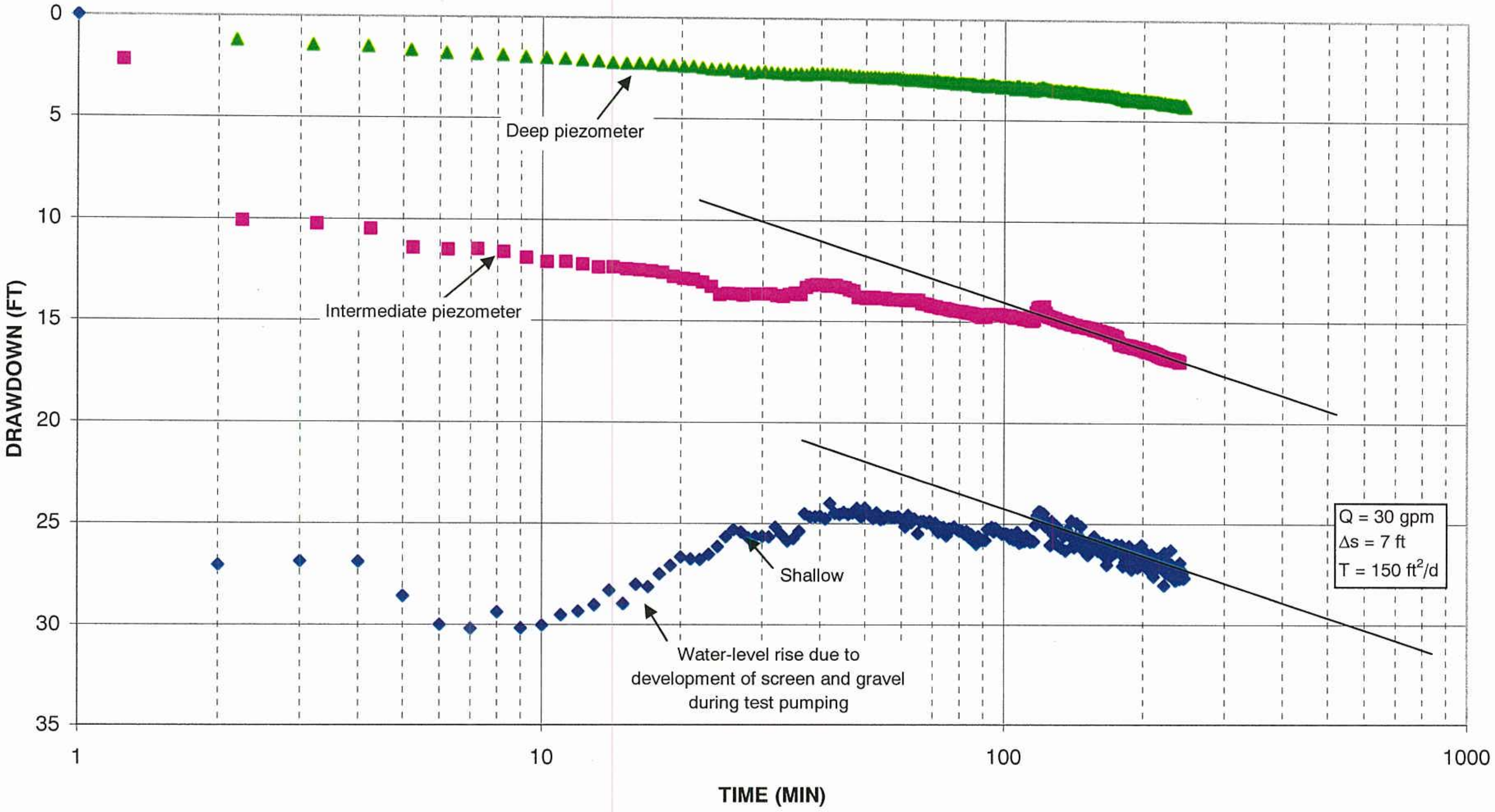
## FIGURE G8
## CCD-OWA SHALLOW ZONE TEST
## TEST HYDROGRAPH



Wellbore at deep and intermediate screens backfilled and sealed with bentonite. Response at deep and intermediate piezometers may be due to seal bypass.

owa shallow.xls
ARITH
CC
4/16/2007

## FIGURE G9
## CCD-OWA SHALLOW ZONE TEST
## DRAWDOWN AT DEEP AND INTERMEDIATE PIEZOMETERS AND AT SHALLOW 5-INCH SCREEN



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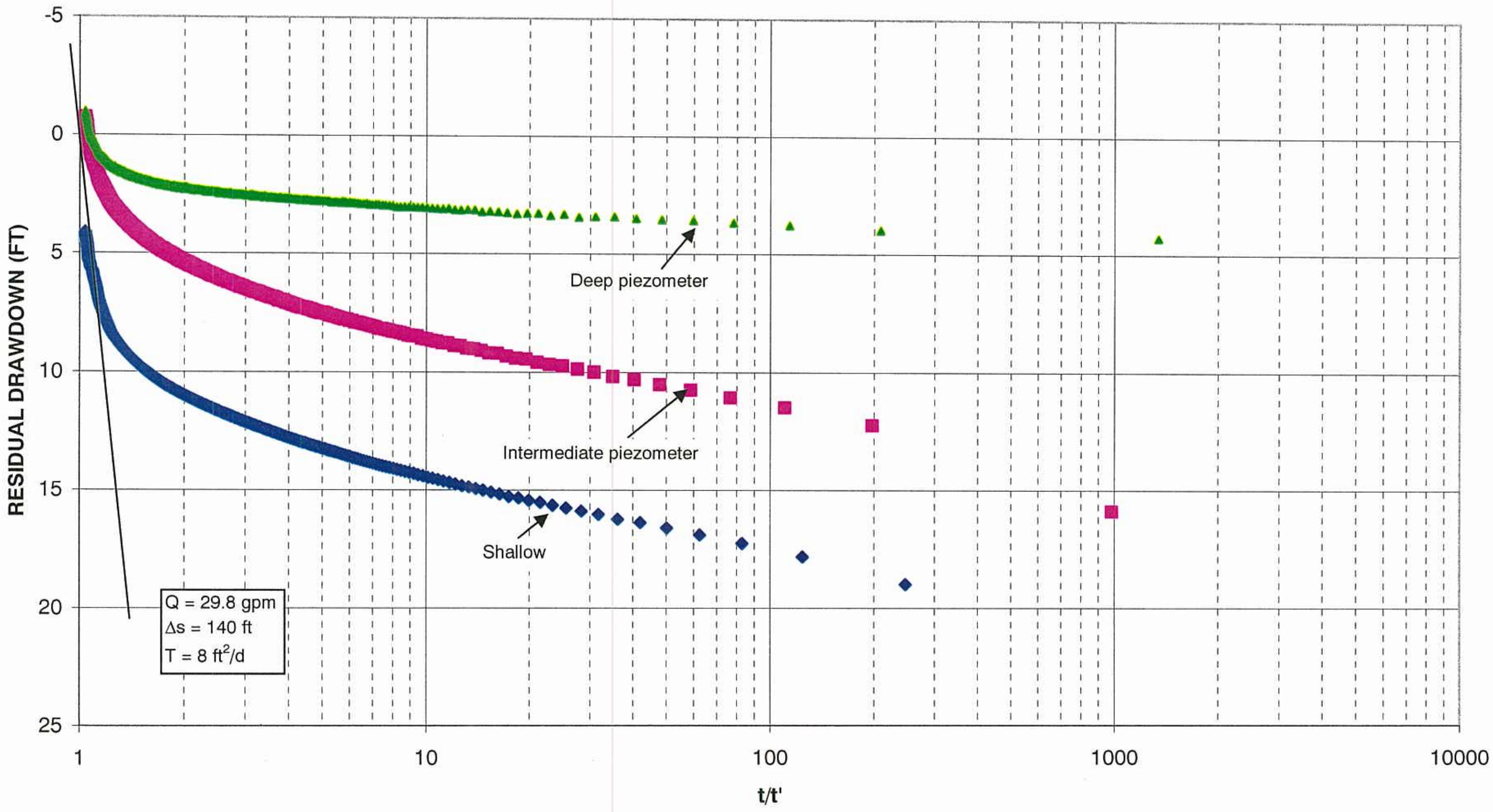
4/9/2007

## FIGURE G10
## CCD-OWA SHALLOW ZONE TEST
## RECOVERY



owa shallow.xls
RECOV
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4/9/2007

TABLE F1. SUMMARY OF CCD-I1 PUMPING TEST

| Well | Purpose | Distance from Test Well (ft) | Pre-Test Water Level (ft below ground) | End of Test Drawdown (ft) | Tested Parameters[2,3] | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | T (ft$^2$/d) | S | n | Late-time Recovery T (ft$^2$/d) |
| Injection Well | Test Well[1] | -- | 297.2 | 175.7 | 1100 | $2.5\text{x}10^{-5}$ | 1.3 | 73 |
| OWA Shallow | Observation | 110 | 297.7 | 92.2 | -- | -- | -- | 70 |
| OWA Intermediate | Observation | 110 | 297.5 | 147.1 | 1100 | 0.00013 | 1.1 | 70 |
| OWA Deep | Observation | 110 | 294.9 | 78.0 | -- | -- | -- | 70 |
| OWB | Observation | 482 | 302.0 | 22.2[5] | 1100 | 0.003 | 1.3 | 155 |
| OWC | Observation | 1985 | 260.3 | 3.5[5] | 1100 | 0.005 | 1.3 | 390 |
| CCD-P1 | Observation | 5400 | 250.1 | 0.5 | 100 | 0.0015 | 2.6 | -- |

[1] Tested at 200 gpm for 7 days from May 15-27, 2006.

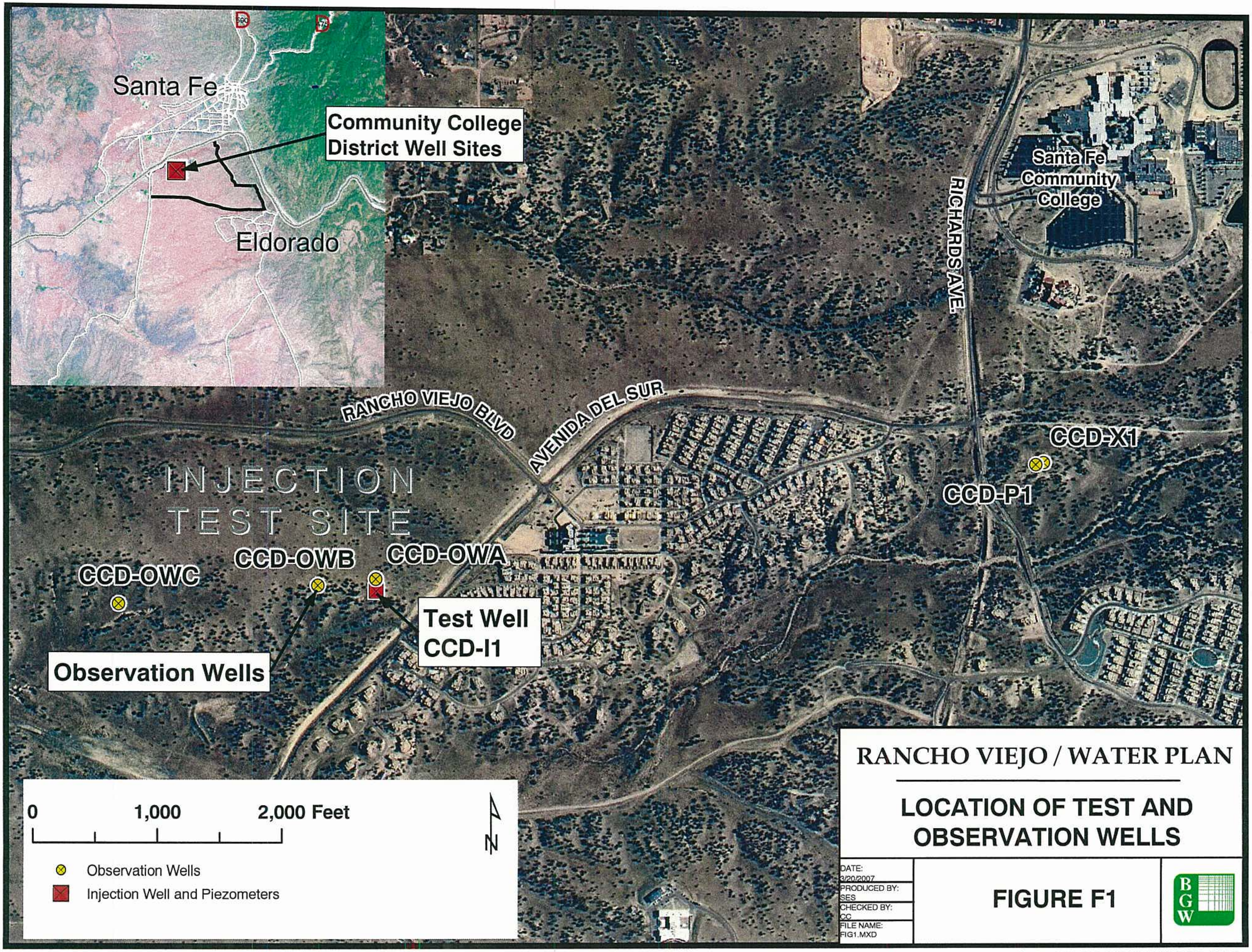
[2] Drawdown analyzed with methods of Walker, D.D., and R.M. Roberts, 2003, Flow dimensions corresponding to hydrogeologic conditions in Water Resources Research, Vol. 39, No. 12, p. 1329.

[3] Recovery analyzed with methods of Theis C.V., 1935, The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage: American Geophysical Union, Volume 16, pp. 519-524.

[4] Hydraulic conductivity (k) of test zone = T/screen length = 1100/720 = 1.5 ft/d.

[5] Corrected for background water level rise.

<u>Conclusion:</u> Tested aquifer consists of channel sands (k = 1.5 ft/d) enclosed by fine-grained over bank deposits with less permeability (based on recovery). Flow dimension of enclosing boundary is n = 1.1 to 1.3 (approximating a linear channel). Response at CCD-P1 one mile distant was observed 35 days after test start. Matching parameters T = 100 ft$^2$/d and n = 2.3 is compatible with a boundary between the test and observation wells and induced leakage at late time over a distance of 5,400 feet.



RANCHO VIEJO / WATER PLAN

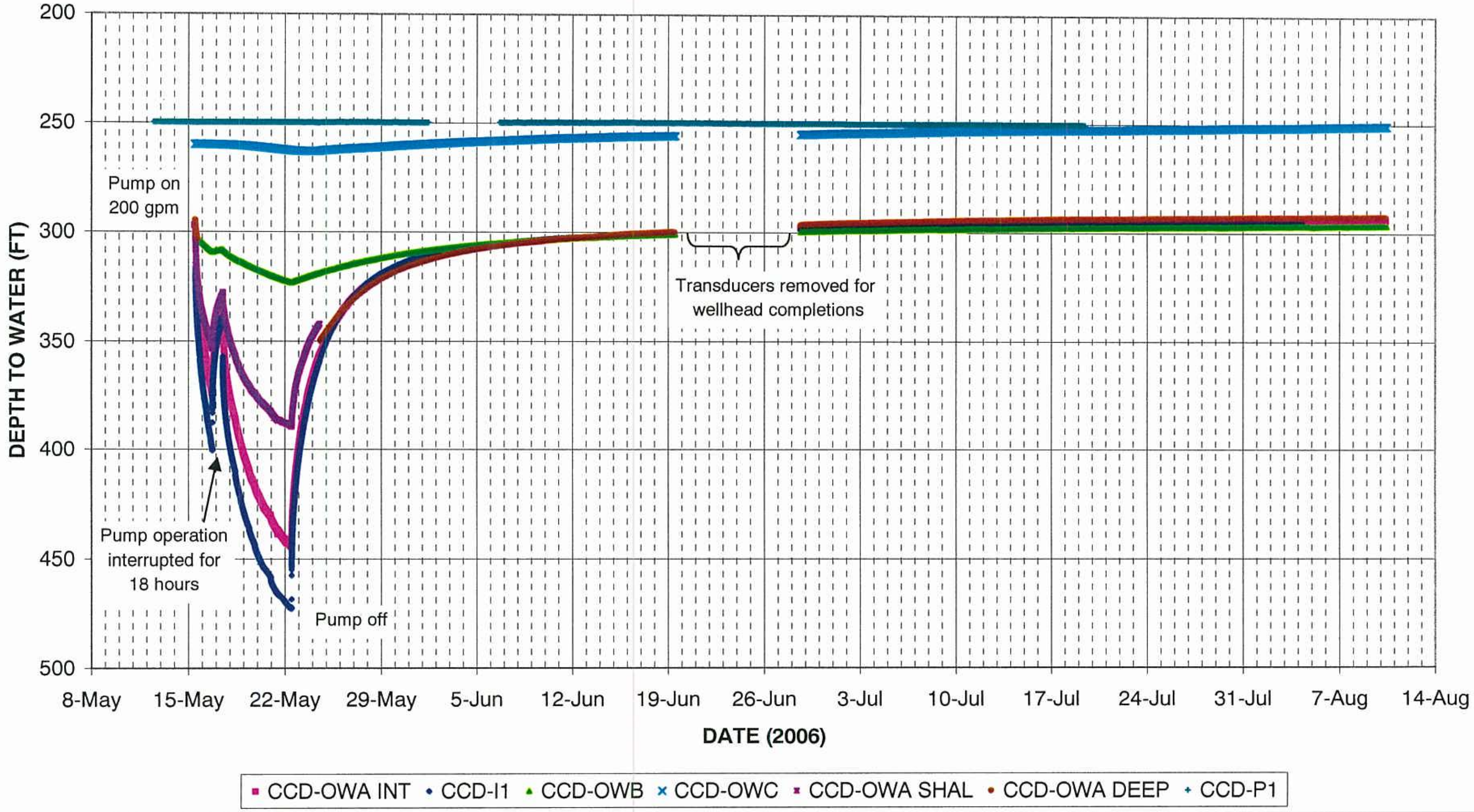
LOCATION OF TEST AND OBSERVATION WELLS

DATE: 3/20/2007
PRODUCED BY: SES
CHECKED BY: CC
FILE NAME: FIG1.MXD

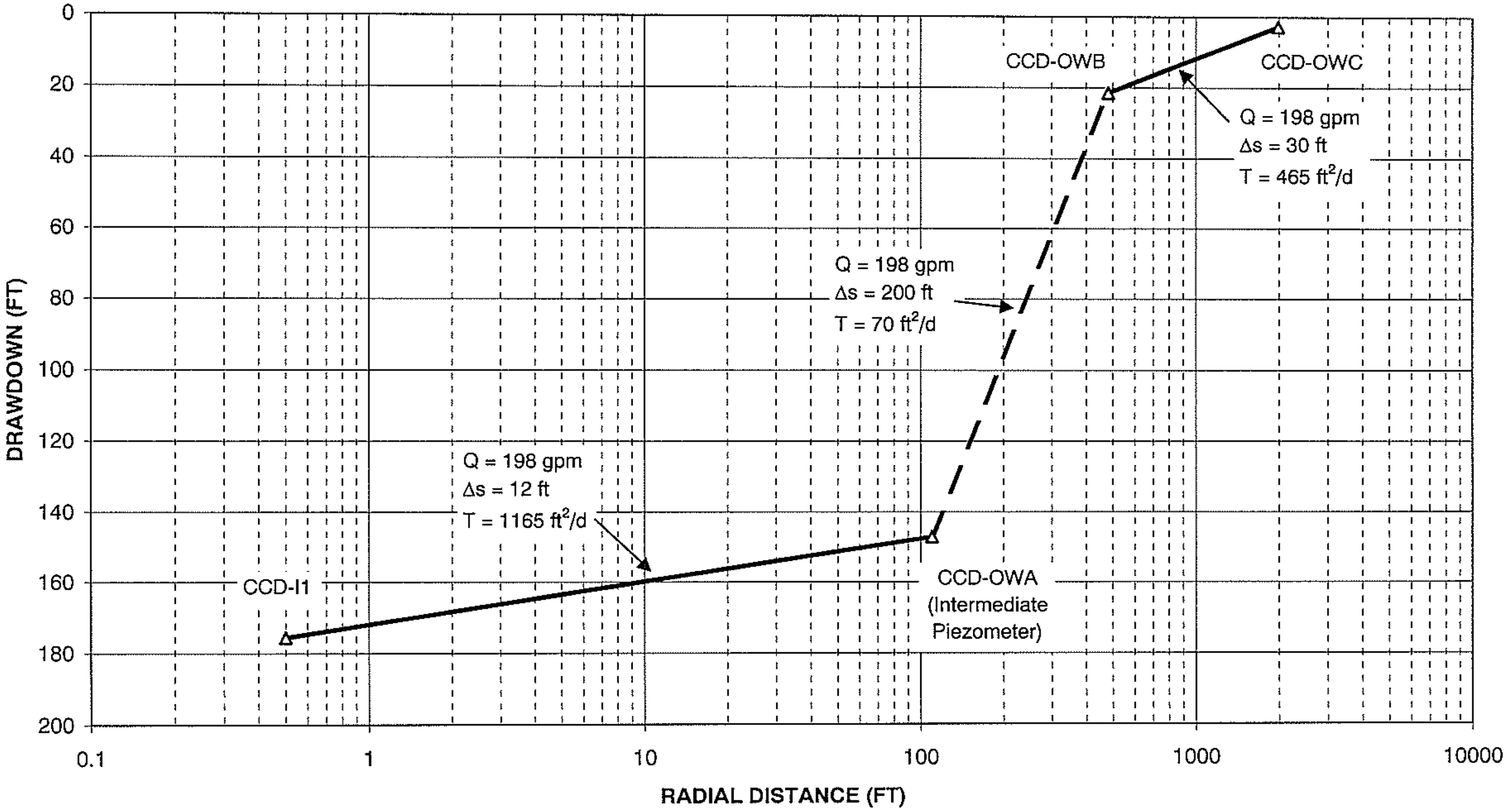
FIGURE F1

BALLEAU GROUNDWATER, INC.

## FIGURE F2
## INJECTION WELL SEVEN-DAY PUMPING TEST TEST AND OBSERVATION WELL HYDROGRAPHS



# FIGURE F3
# INJECTION WELL SEVEN-DAY PUMPING TEST
# DISTANCE-DRAWDOWN AT END OF TEST



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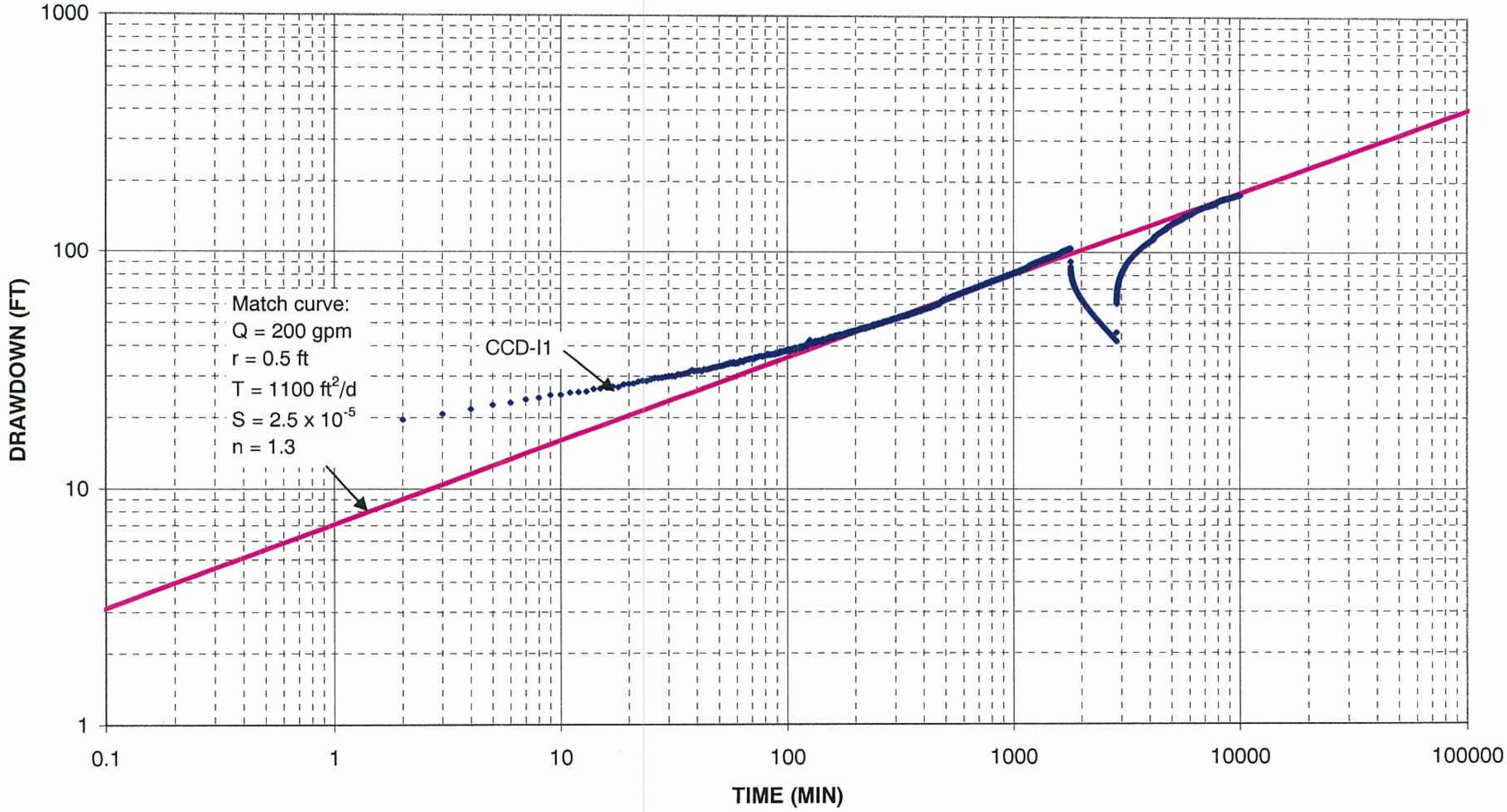
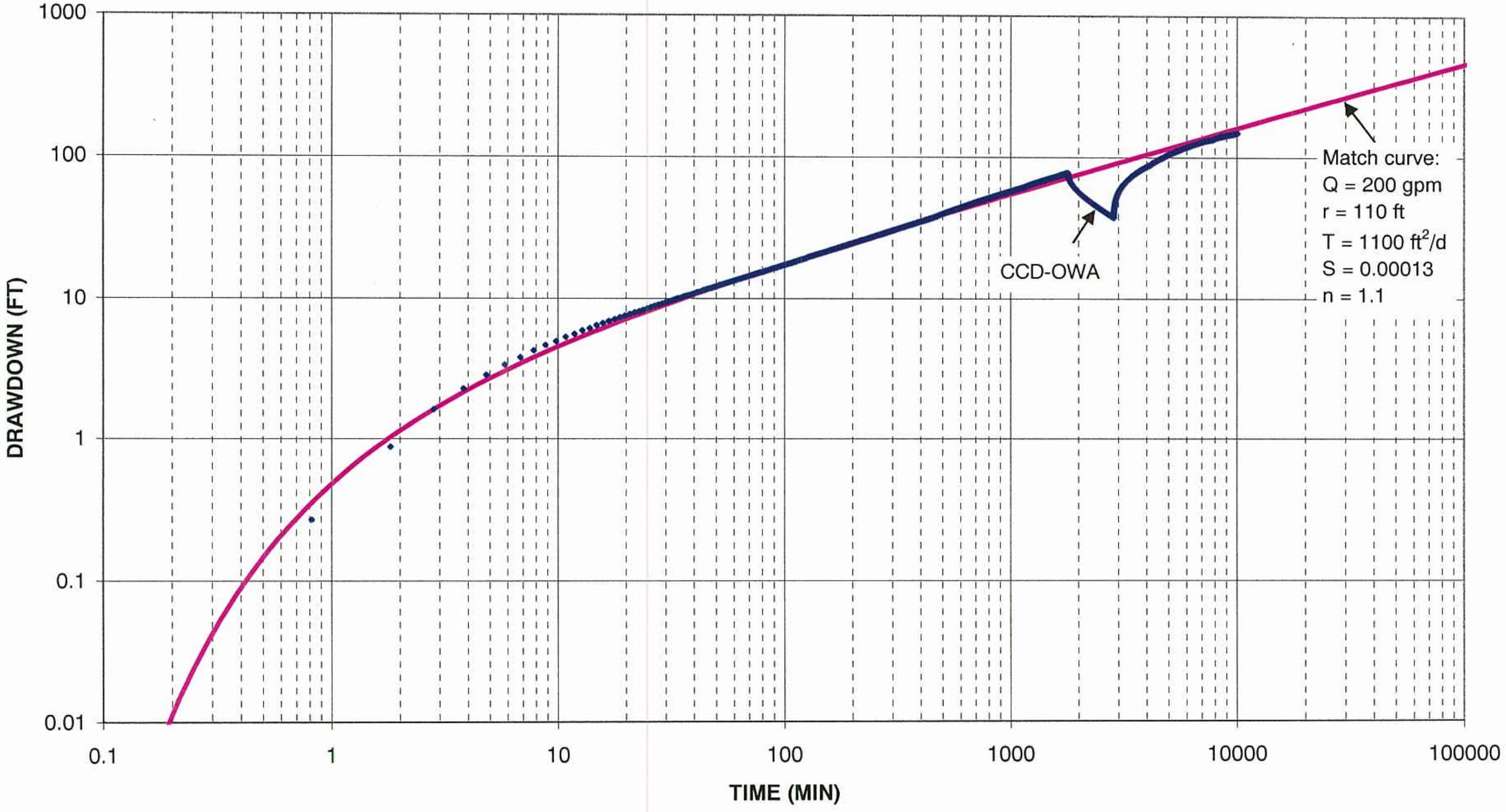
DD VS DIST
CC
9/28/2007

## FIGURE F4
## INJECTION WELL SEVEN-DAY PUMPING TEST
## TEST WELL DRAWDOWN



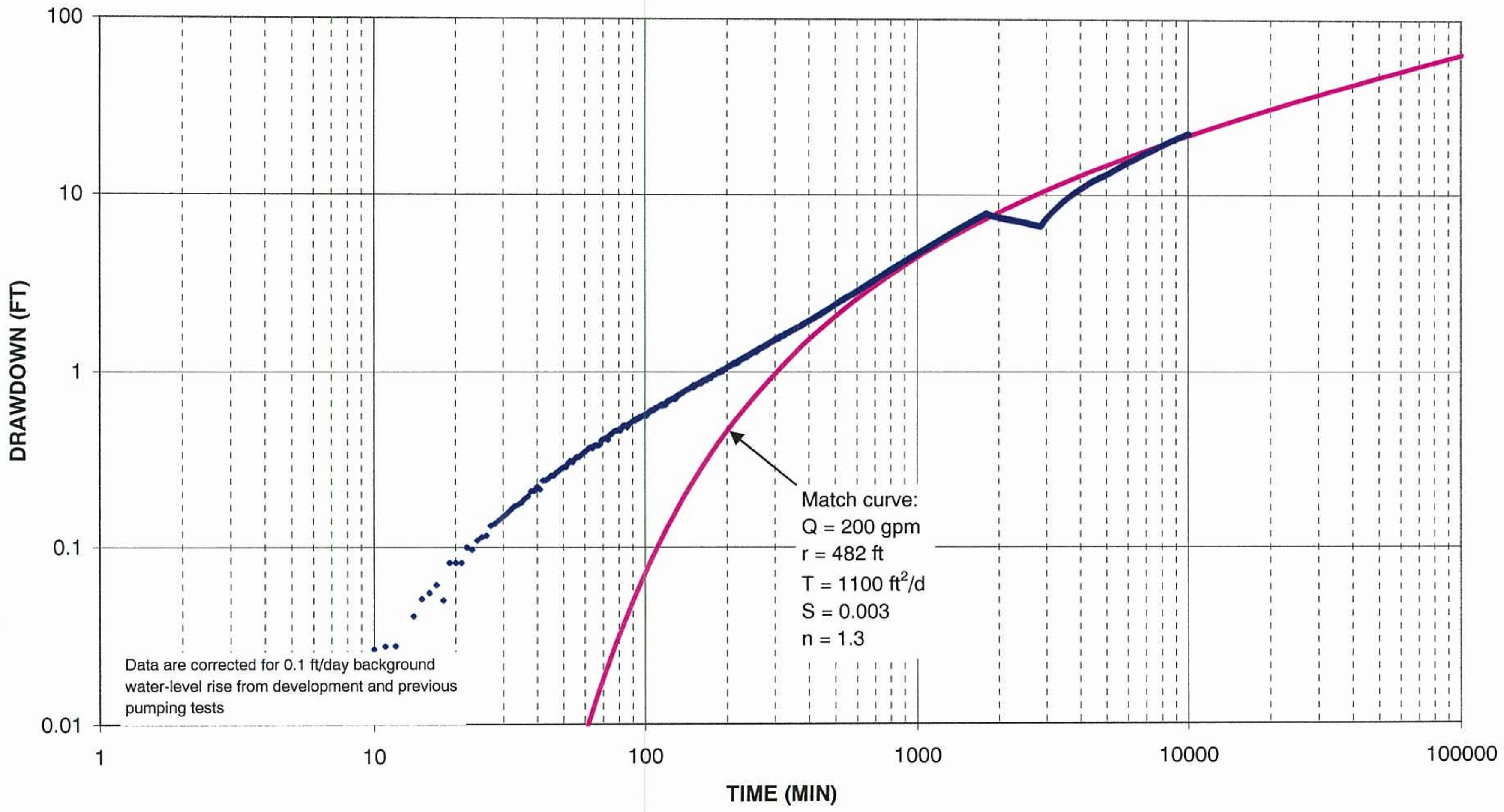
InjWell.xls
DD LOG
CC
9/28/2007

## FIGURE F5
## INJECTION WELL SEVEN-DAY PUMPING TEST
## OW-A INTERMEDIATE PIEZOMETER DRAWDOWN



OW-A.xls
INT DD LOG
CC
9/28/2007

# FIGURE F6
## INJECTION WELL SEVEN-DAY PUMPING TEST
## OW-B DRAWDOWN

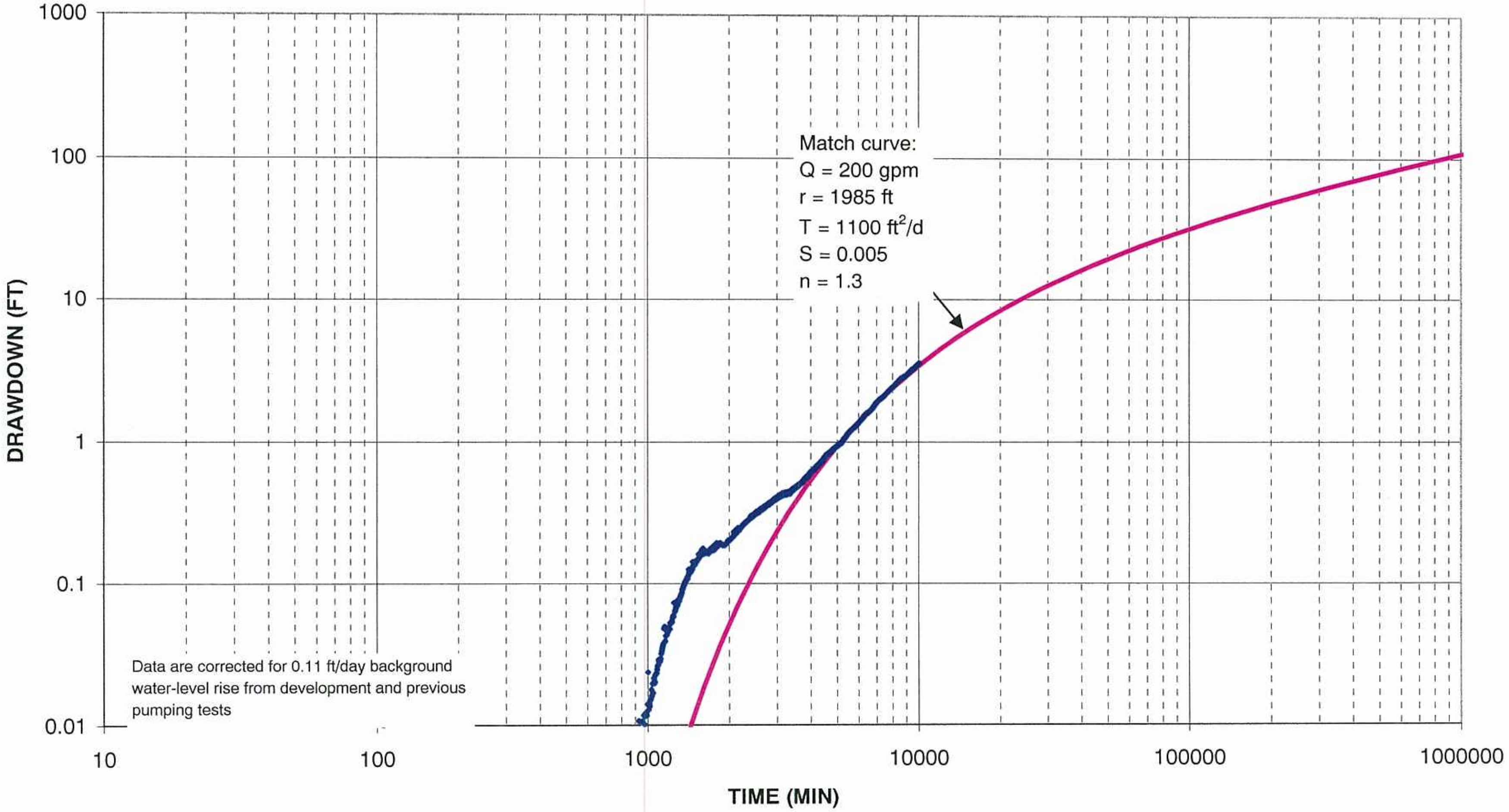


Match curve:
Q = 200 gpm
r = 482 ft
T = 1100 $ft^2/d$
S = 0.003
n = 1.3

Data are corrected for 0.1 ft/day background water-level rise from development and previous pumping tests

OW-B.xls
DD LOG
CC
9/28/2007

# FIGURE F7
# INJECTION WELL SEVEN-DAY PUMPING TEST
# OW-C DRAWDOWN

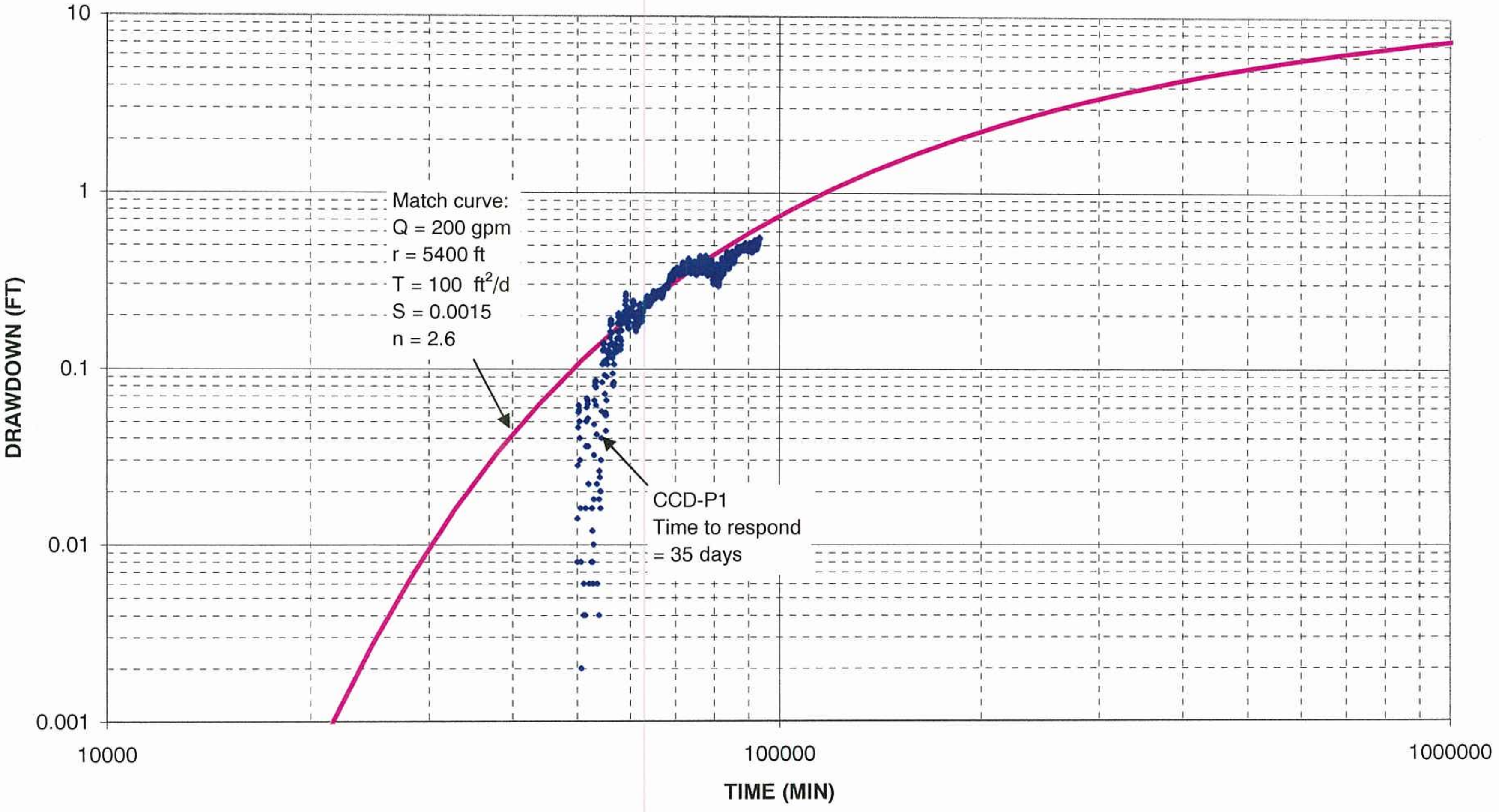


Match curve:
Q = 200 gpm
r = 1985 ft
T = 1100 ft$^2$/d
S = 0.005
n = 1.3

Data are corrected for 0.11 ft/day background water-level rise from development and previous pumping tests

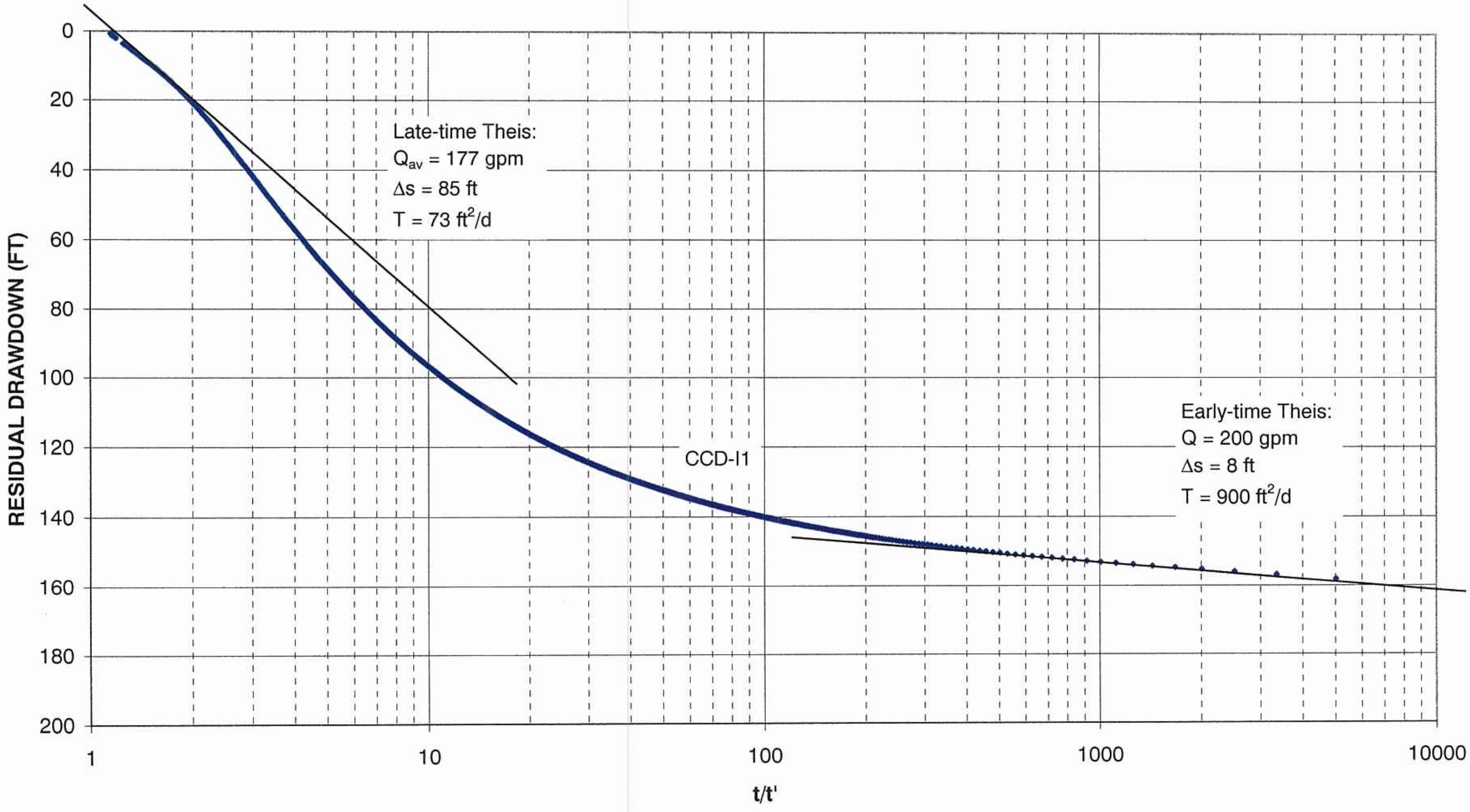
OW-C.xls
DD LOG
CC
9/28/2007

## FIGURE F8
## INJECTION WELL SEVEN-DAY PUMPING TEST
## CCD-P1 DRAWDOWN



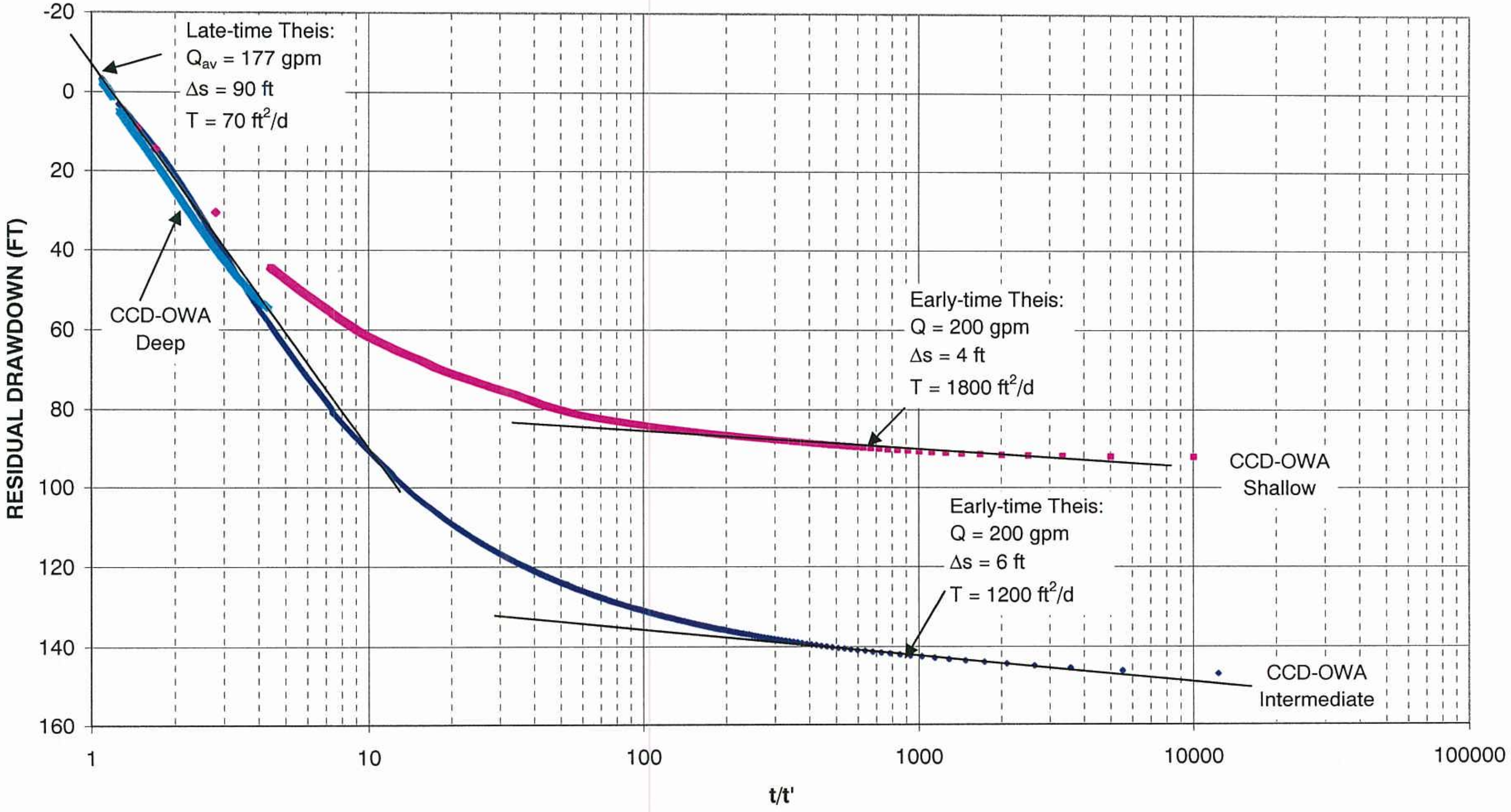
ccdp1 response to inj Qtest.xls
LOG
CC
9/28/2007

# FIGURE F9
# INJECTION WELL SEVEN-DAY PUMPING TEST
# TEST WELL RECOVERY



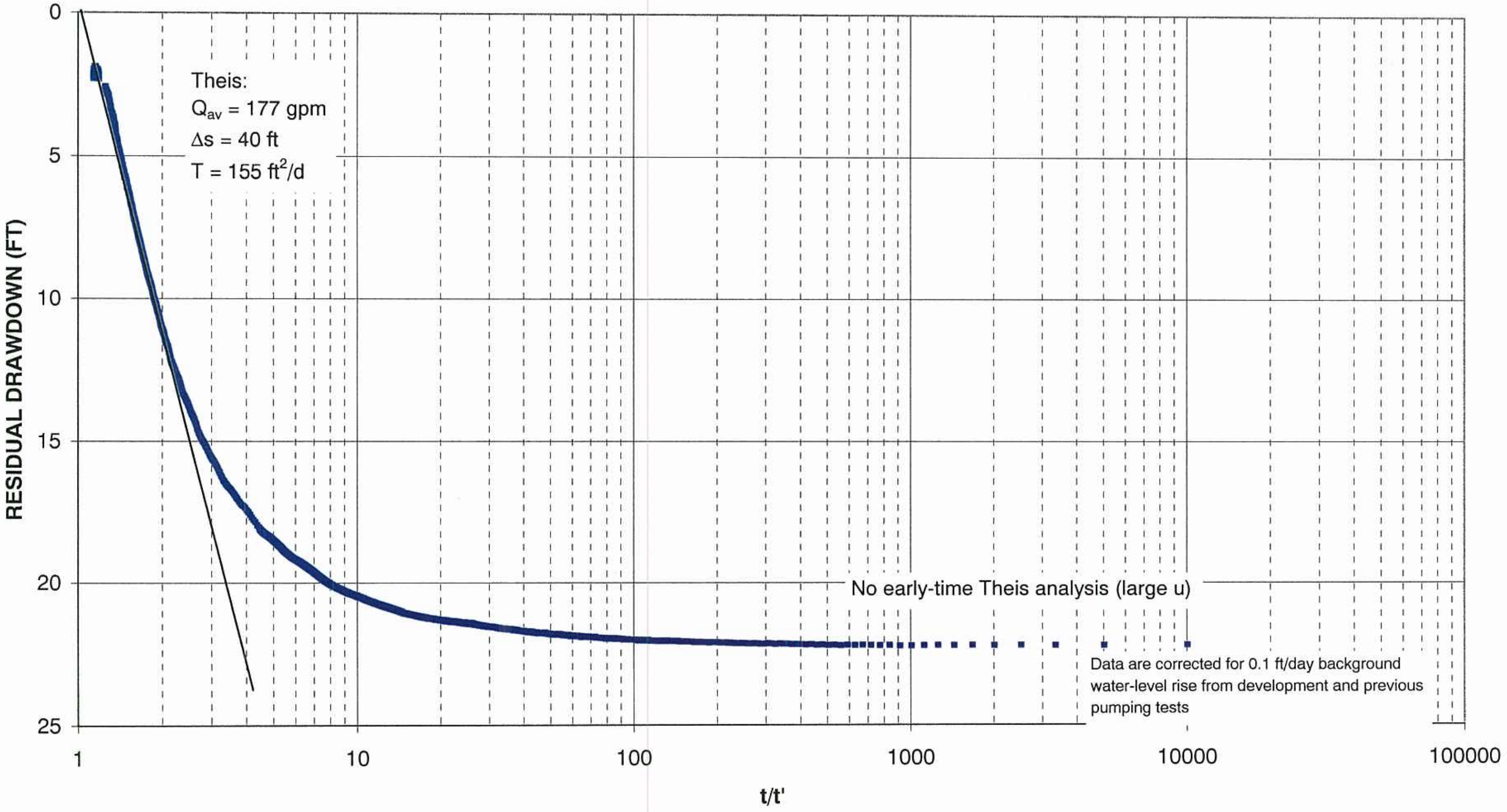
InjWell.xls
RECOV
CC
9/28/2007

## FIGURE F10
## INJECTION WELL SEVEN-DAY PUMPING TEST
## OW-A RECOVERY



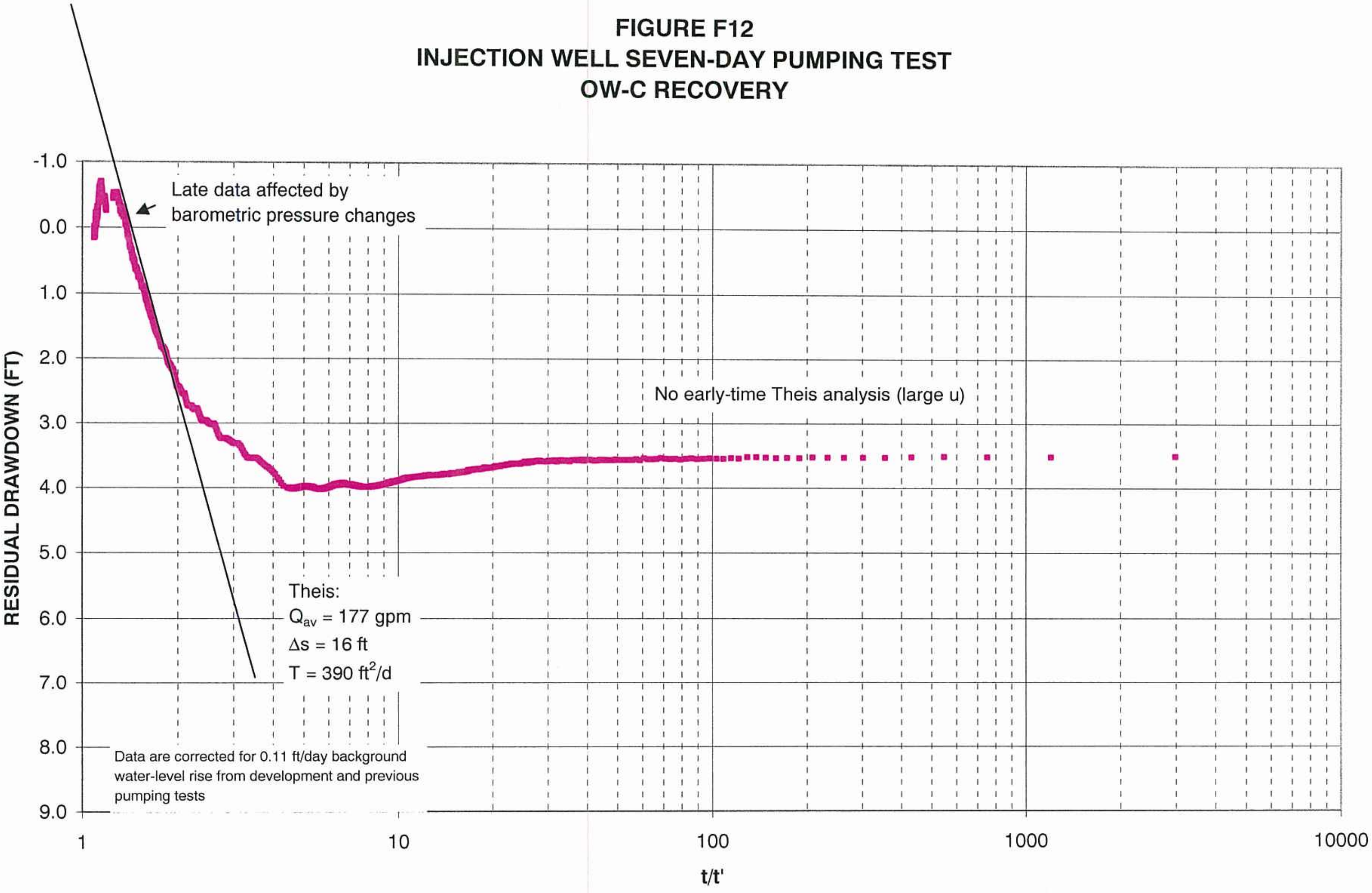
OW-A.xls
RECOV
CC
9/28/2007

## FIGURE F11
## INJECTION WELL SEVEN-DAY PUMPING TEST
## OW-B RECOVERY



OW-B.xls
RECOV
CC
9/28/2007

## FIGURE F12
## INJECTION WELL SEVEN-DAY PUMPING TEST
## OW-C RECOVERY



OW-C.xls
RECOV
CC
9/28/2007

## TABLE F1. SUMMARY OF CCD-OWB PUMPING TEST

| Well | Purpose | Distance from Test Well (ft) | Pre-Test Water Level (ft below ground) | End of Test Drawdown (ft) | Tested Parameters[2,3] | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | T ($ft^2/d$) | S | n | Late Time Recovery T ($ft^2/d$) |
| OWB | Test Well[1] | -- | 300.7 | 14.5 | 1600[4] | 0.0013 | 2.0 | 30 |
| OWA Shallow | Observation | 473 | 298.6 | 0.33 | 1600 | 0.0013 | -- | 590 |
| OWA Intermediate | Observation | 473 | 267.5 | 0.27 | 1600 | 0.0016 | 2.0 | 590 |
| OWA Deep | Observation | 473 | 292.0 | 0 | -- | -- | -- | -- |
| Injection Well | Observation | 483 | 296.8 | 0.17 | 2000 | 0.002 | 2.0 | -- |
| OWC | Observation | 1513 | 259.7 | 0.02 | 3000 | 0.0009 | 2.0 | -- |

[1] Tested at 30 gpm for 4.4 hours on May 9, 2006.

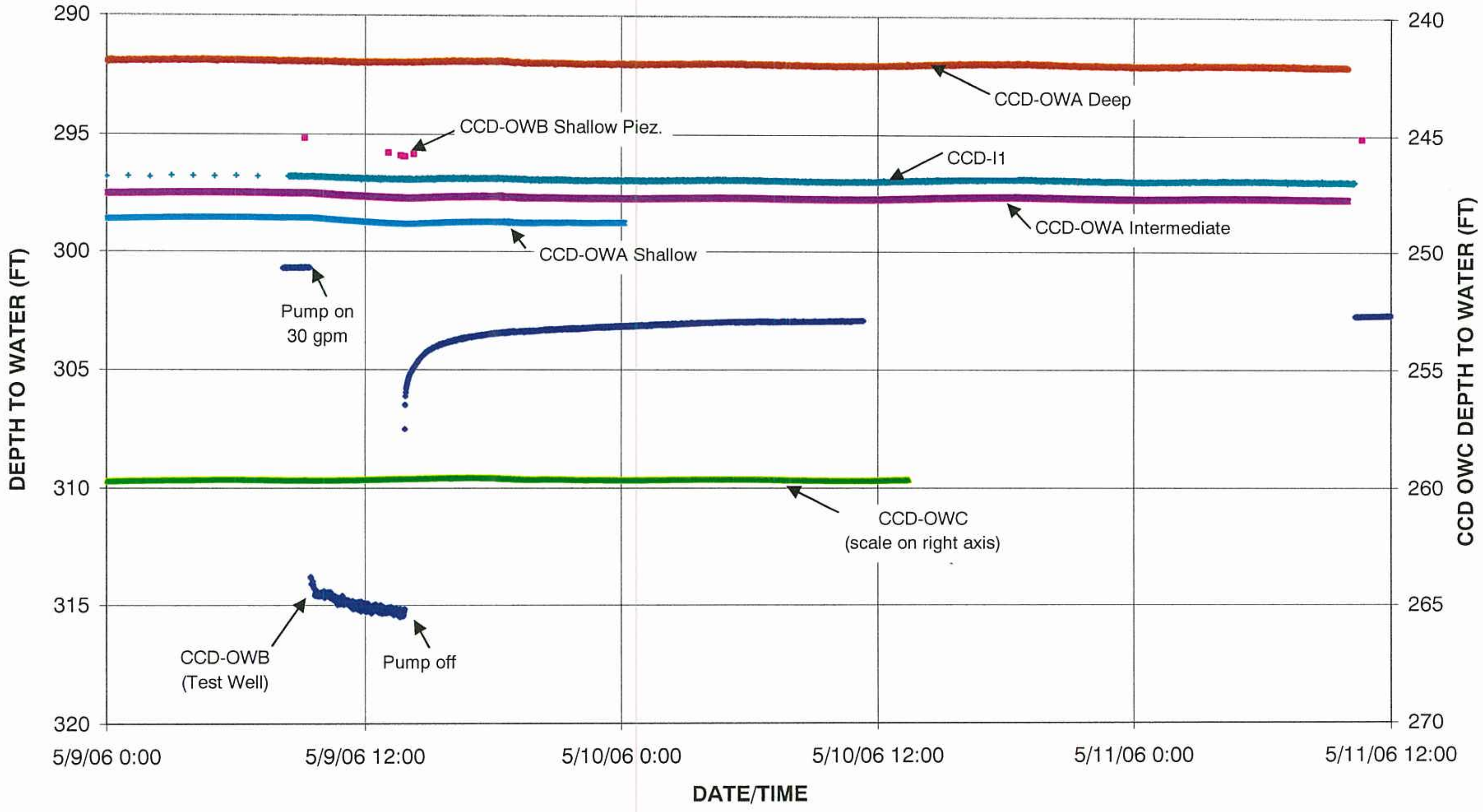
[2] Drawdown analyzed by methods of Walker, D.D., and R.M. Roberts, 2003, Flow dimensions corresponding to hydrogeologic conditions in Water Resources Research, Vol. 39,

[3] Drawdown and recovery analyzed by methods of Theis C.V., 1935, The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage: American Geophysical Union, Volume 16, pp. 519-524.

[4] Hydraulic conductivity (k) of test zone = T/screen length = 1600/720 = 2.2 ft/d.

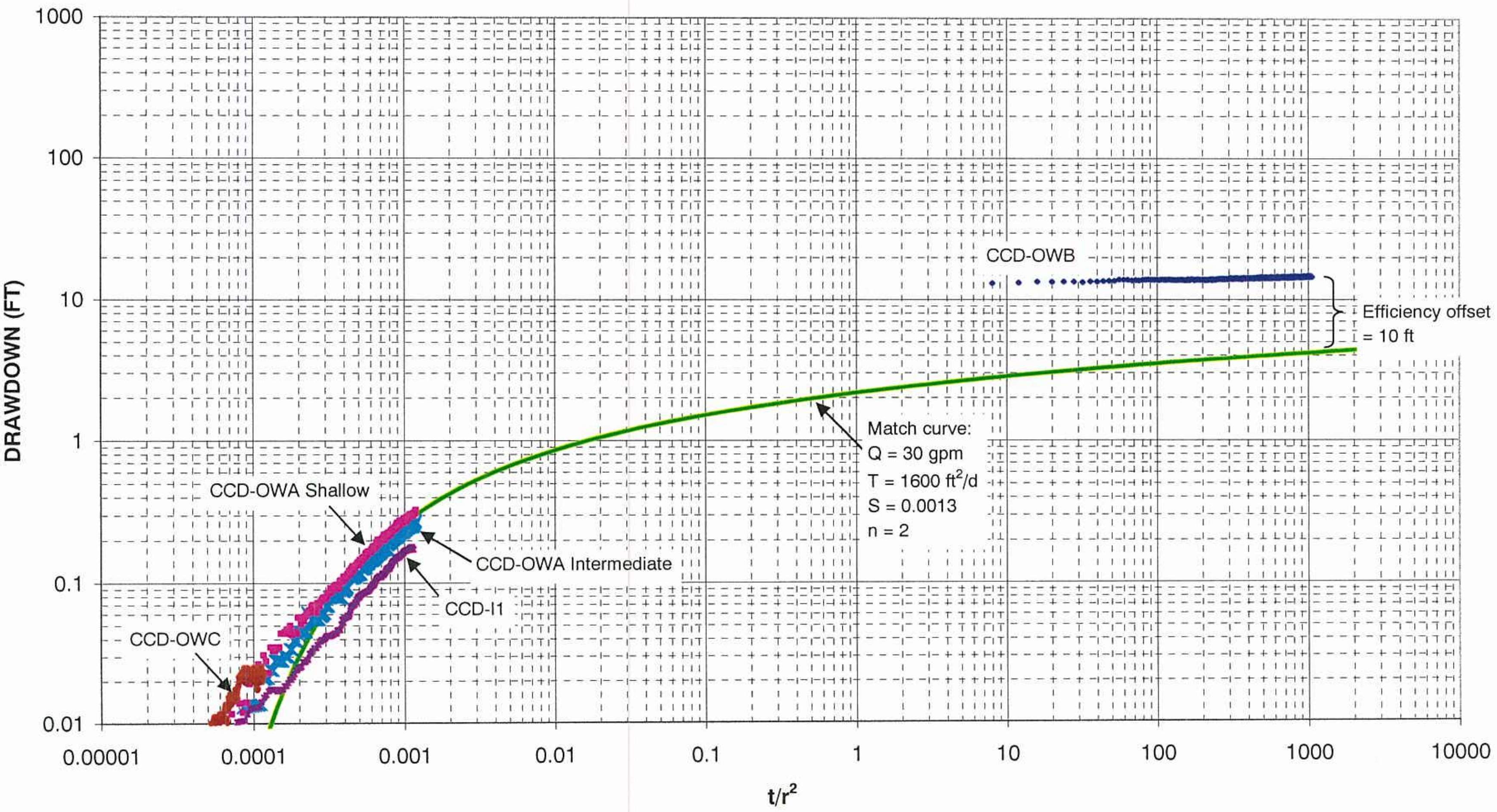
<u>Conclusion:</u> Tested aquifer consists of channel sands (k = 2.2 ft/d) enclosed by fine-grained over bank deposits with less permeability as indicated by late-time recovery data. Flow dimension (n) of 2.0 at observation wells indicates radial flow response compatible with Theis (1935).

## FIGURE F1
## CCD-OWB PUMPING TEST
## TEST HYDROGRAPH



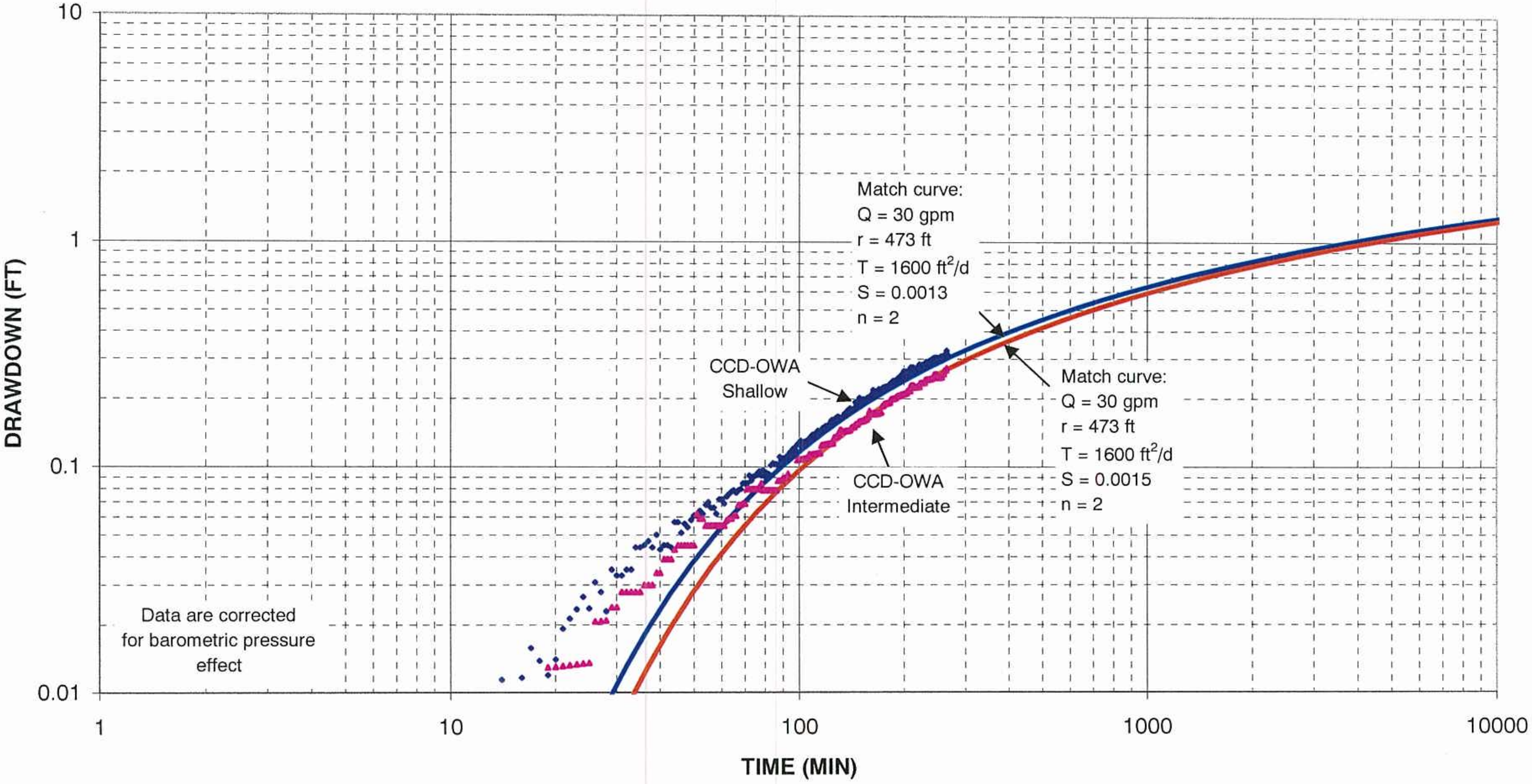
CCD-OWB.xls
ARITH
CC
9/18/2007

# FIGURE F2
## CCD-OWB PUMPING TEST
## TIME-DISTANCE DRAWDOWN



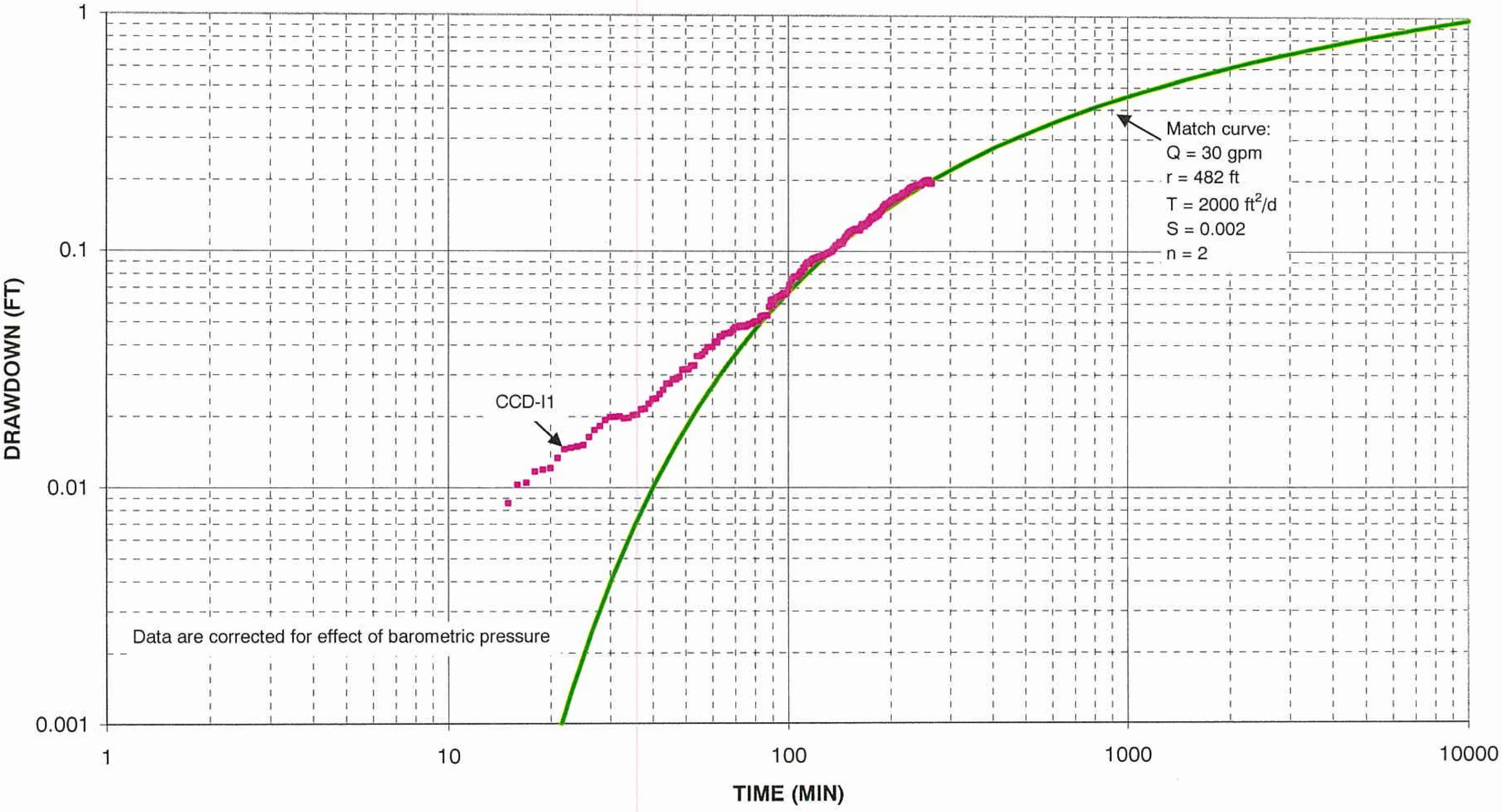
CCD-OWB.xls
T OVR R SQ
CC
9/18/2007

## FIGURE F3
## CCD-OWB PUMPING TEST
## DRAWDOWN AT OBSERVATION WELL CCD-OWA



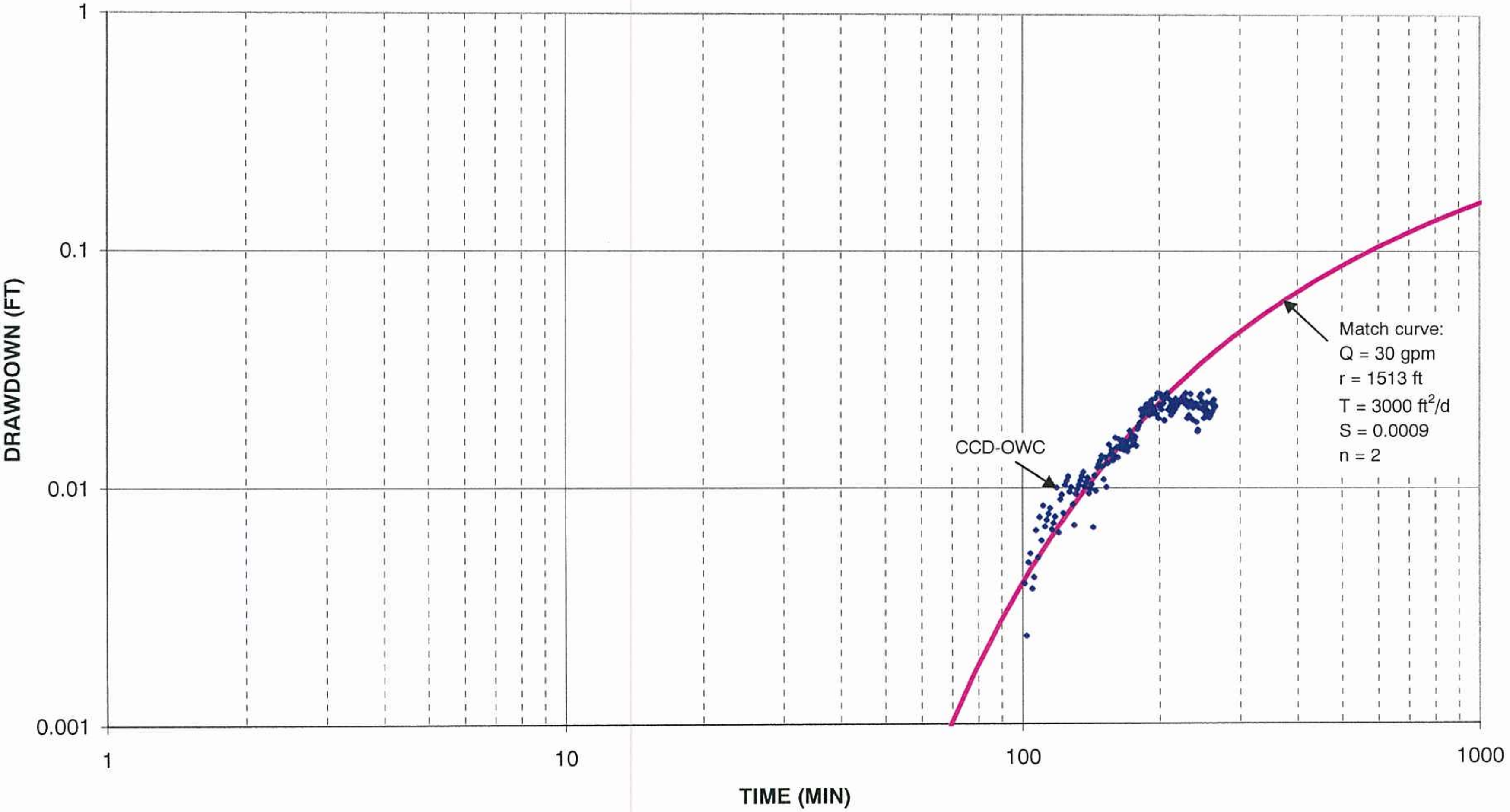
OW-A.xls
DD LOG
CC
9/18/2007

## FIGURE F4
## CCD-OWB PUMPING TEST
## DRAWDOWN AT OBSERVATION WELL CCD-I1



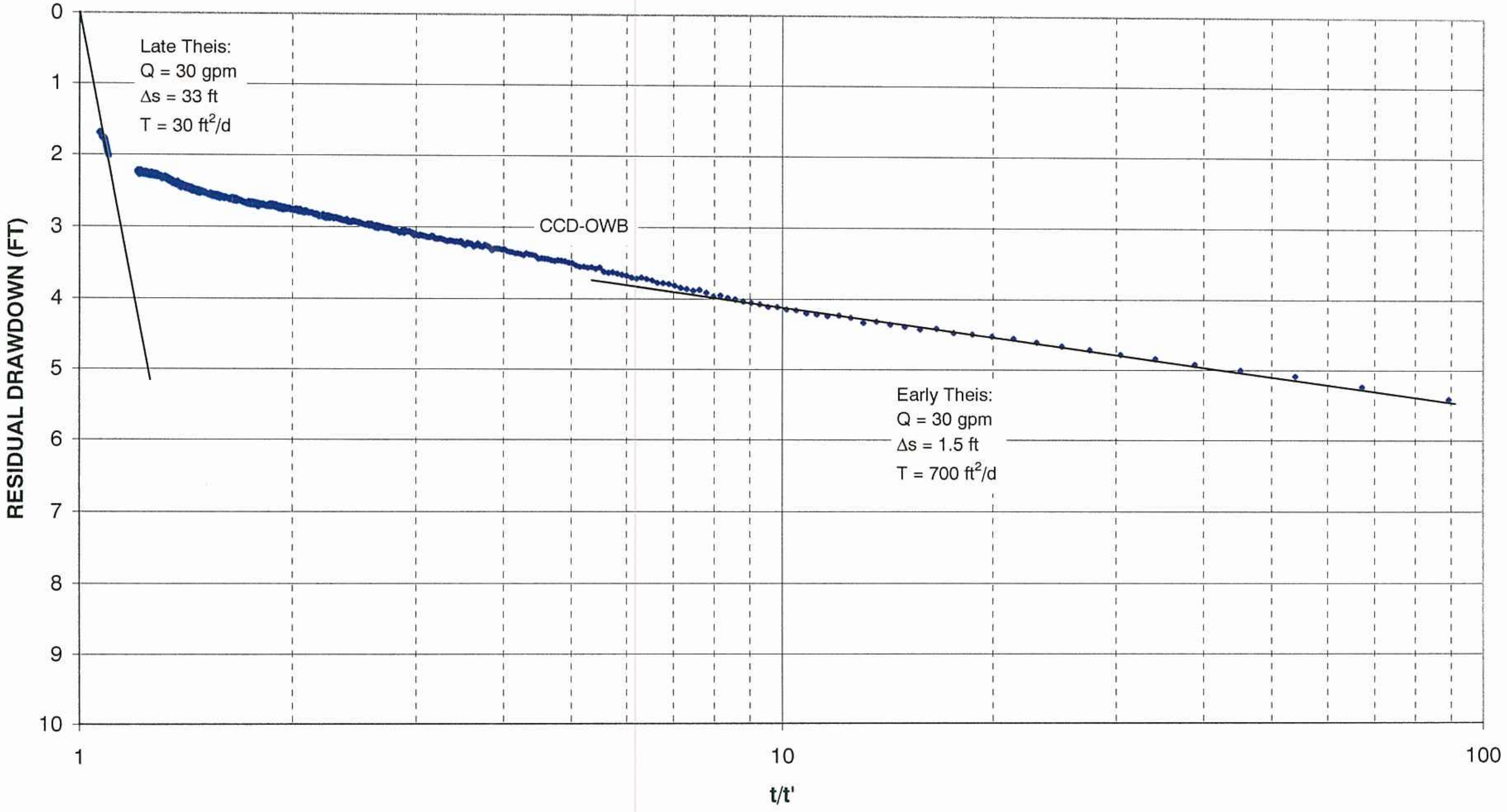
inj well during owb test.xls
DD LOG
CC
9/18/2007

# FIGURE F5
# CCD-OWB PUMPING TEST
# DRAWDOWN AT OBSERVATION WELL CCD-OWC



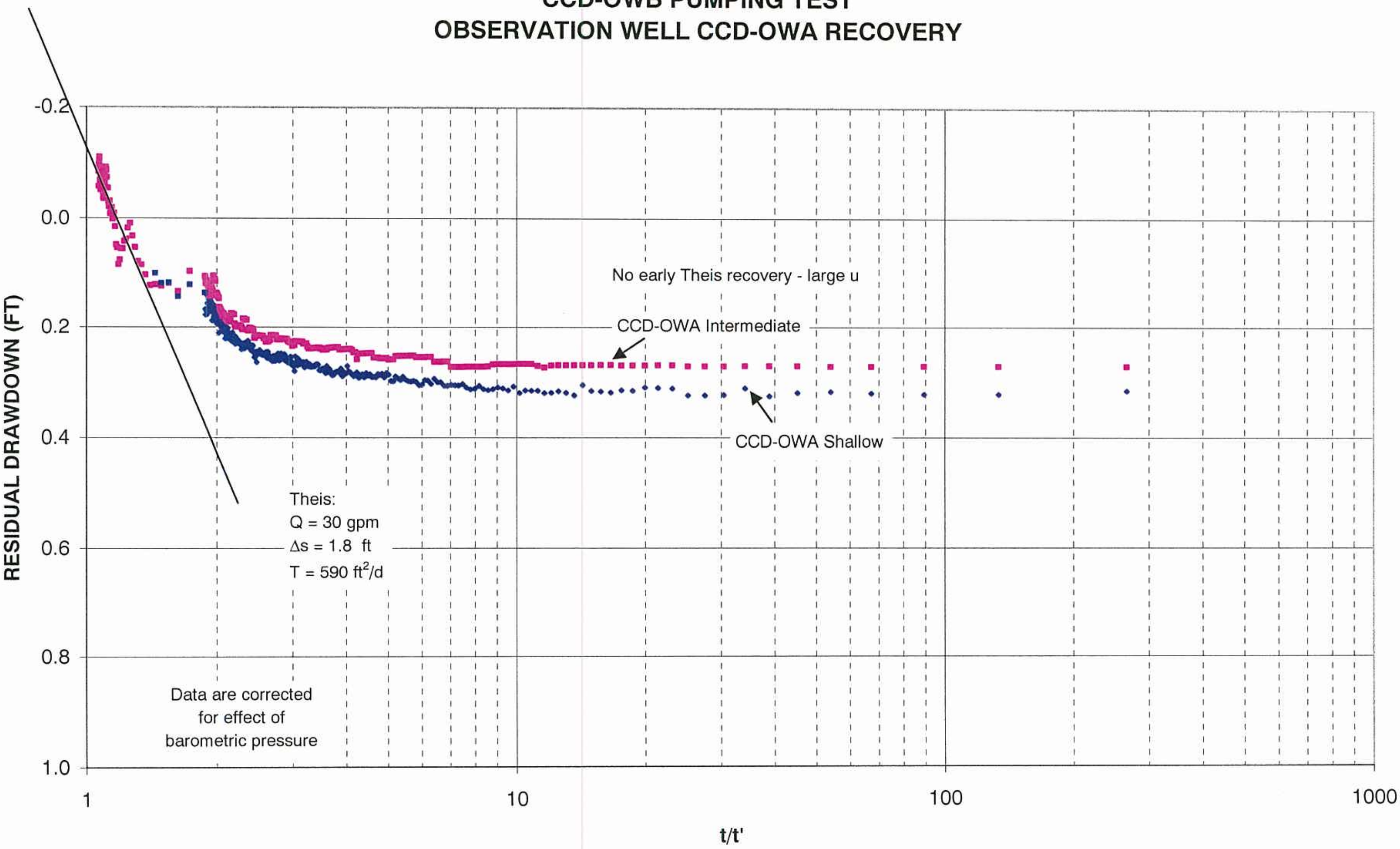
OW-C during owb test.xls
DD LOG
CC
9/18/2007

## FIGURE F6
## CCD-OWB PUMPING TEST
## TEST WELL CCD-OWB RECOVERY



CCD-OWB.xls
RECOV
CC
9/18/2007

## FIGURE F7
## CCD-OWB PUMPING TEST
## OBSERVATION WELL CCD-OWA RECOVERY



OW-A.xls
RECOV
CC
9/18/2007

## TABLE F1. SUMMARY OF CCD-OWC PUMPING TEST

| Well | Purpose | Distance from Test Well (ft) | Pre-Test Water Level (ft below ground) | End of Test Drawdown (ft) | Tested Parameters[2,3] | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | T ($ft^2$/d) | S | n | Late Time T ($ft^2$/d) |
| OWC | Test Well[1] | -- | 259.61 | 14.82 | 635[5] | 0.0001 | 2.3 | 55 |
| OWB | Observation[4] | 1513 | 302.20 | 0 | -- | -- | -- | -- |

[1] Tested at 36 gpm for 4 hours on May 11, 2006.

[2] Drawdown analyzed by methods of Walker, D.D., and R.M. Roberts, 2003, Flow dimensions corresponding to hydrogeologic conditions in Water Resources Research, Vol. 39, No. 12, p. 1329.

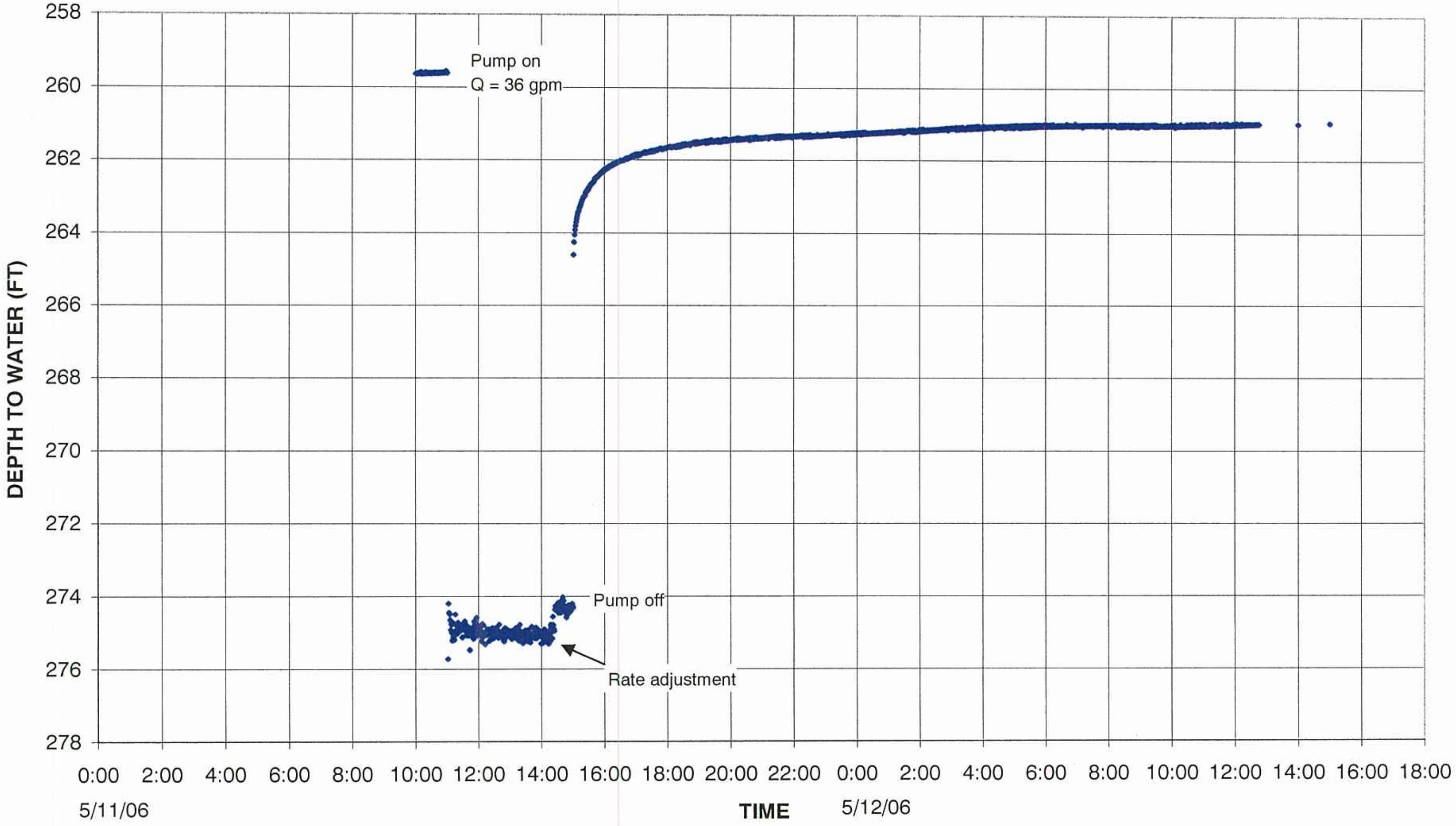
[3] Recovery analyzed by methods of Theis C.V., 1935, The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage: American Geophysical Union, Volume 16, pp. 519-524.

[4] CCD-I1 and OWA also were instrumented during test. No response was observed.

[5] Hydraulic conductivity (k) of test zone = T/screen length = 635/680 = ~1 ft/d.

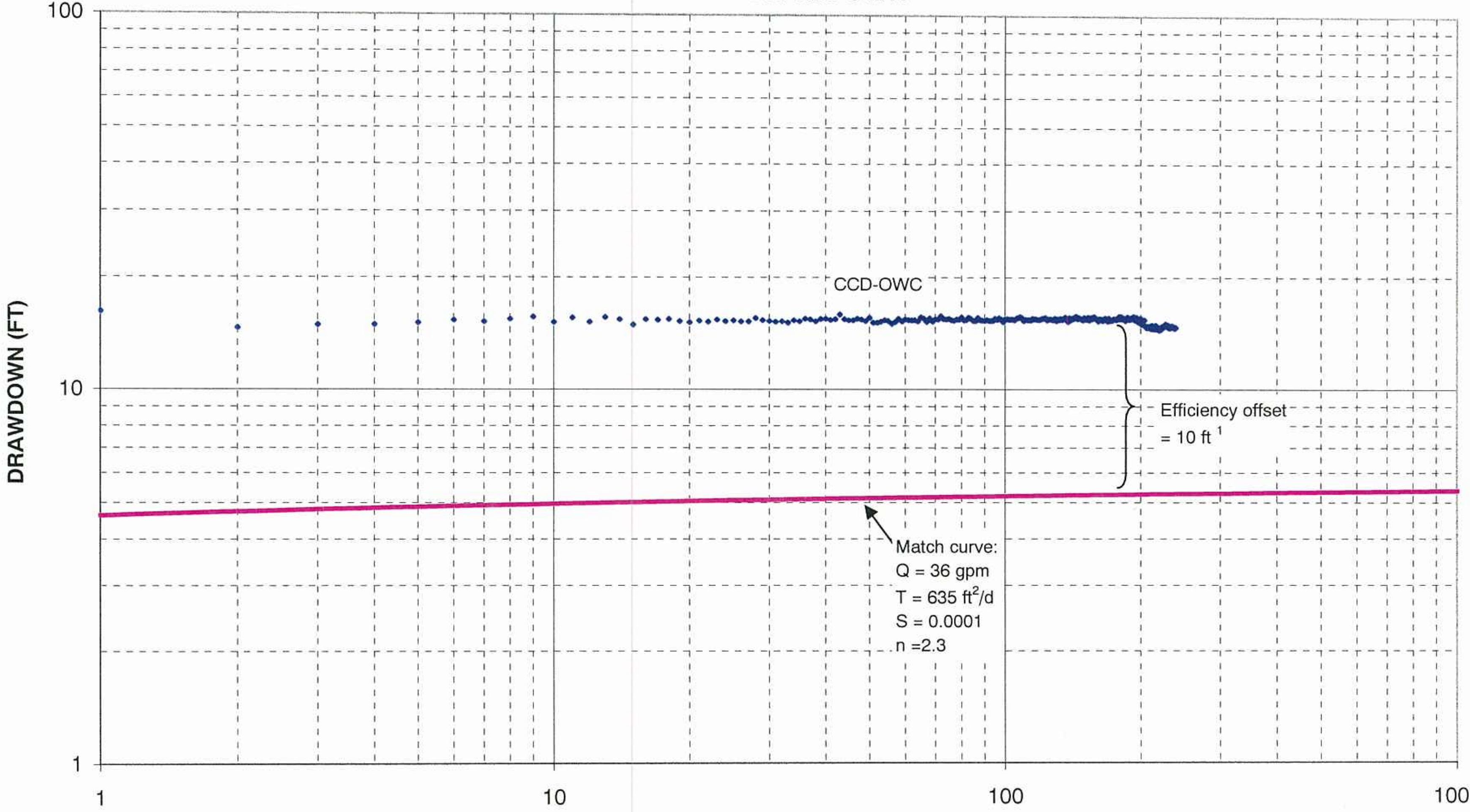
Conclusion: Tested aquifer consists of channel sands (k = ~1 ft/d) enclosed by fine-grained over bank deposits at about 1/10 permeability based on late-time recovery. Flow dimension (n) of channel sands is 2.3 (leaky radial flow).

## FIGURE F1
## CCD-OWC PUMPING TEST
## TEST HYDROGRAPH



CCD-OWC.xls
ARITH
CC
9/18/2007

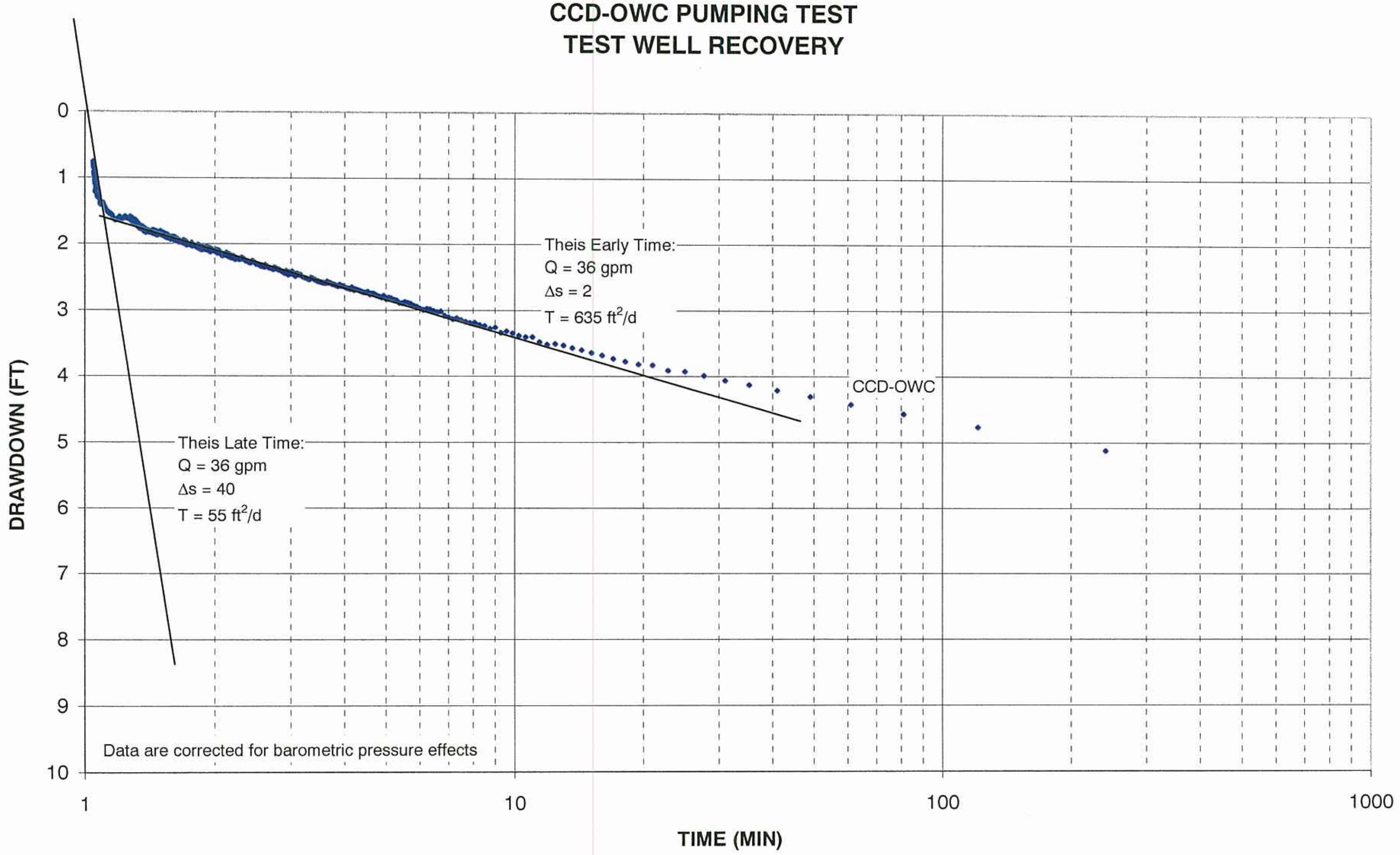
## FIGURE F2
## CCD-OWC PUMPING TEST
## TEST WELL DRAWDOWN



[1] Based on offset from drawdown match curve at T = 635 $ft^2$/d, which is same T as early recovery Theis match.

CCD-OWC.xls
DD LOG
CC
9/18/2007

## FIGURE F3
## CCD-OWC PUMPING TEST
## TEST WELL RECOVERY



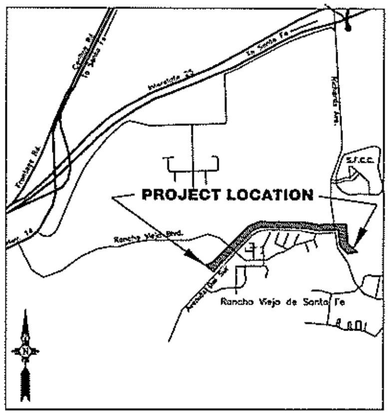
CCD-OWC.xls
RECOV
CC
9/18/2007

# APPENDIX D

# SCHEMATICS OF INJECTION SYSTEM

# RANCHO VIEJO DE SANTA FE
# AQUIFER STORAGE & RECOVERY PROJECT

RANCHO VIEJO



**VICINITY MAP**

NOT TO SCALE

## GENERAL NOTES:

1. ALL WORK DETAILED ON THE PROJECT TO BE PERFORMED UNDER THIS CONTRACT SHALL, EXCEPT AS OTHERWISE STATED OR PROVIDED FOR HEREIN, BE CONSTRUCTED IN ACCORDANCE WITH THE NEW MEXICO PUBLIC WORKS STANDARD SPECIFICATIONS, 1987 EDITION.
2. CONTRACTOR SHALL NOTIFY THE OWNER'S REPRESENTATIVE NOT LESS THAN SEVEN (7) DAYS PRIOR TO STARTING WORK IN ORDER THAT THE OWNER'S REPRESENTATIVE MAY TAKE NECESSARY MEASURES TO ENSURE THE PRESERVATION OF SURVEY MONUMENTS. CONTRACTOR SHALL NOT DISTURB PERMANENT SURVEY MONUMENTS WITHOUT THE CONSENT OF THE OWNER'S REPRESENTATIVE AND SHALL BEAR THE EXPENSE OF REPLACING ANY THAT MAY BE DISTURBED WITHOUT PERMISSION. REPLACEMENT SHALL BE DONE ONLY BY OWNER'S REPRESENTATIVE. WHEN A CHANGE IS MADE IN ANY ROADWAY IN WHICH A PERMANENT SURVEY MONUMENT IS LOCATED, CONTRACTOR SHALL, AT HIS OWN EXPENSE, ADJUST THE MONUMENT COVER TO THE NEW GRADE UNLESS OTHERWISE SPECIFIED.
3. ALL EXISTING UTILITIES SHOWN HERE WERE OBTAINED AS ACCURATELY AS POSSIBLE FROM RECORD DRAWINGS AND SURFACE INDICATIONS. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO PROTECT, MAINTAIN IN SERVICE, AND VERIFY EXACT LOCATIONS OF ALL AFFECTED UTILITIES DURING CONSTRUCTION OF THIS PROJECT.
4. THE CONTRACTOR SHALL NOTIFY ALL UTILITY COMPANIES WHEN WORKING NEAR THEIR SYSTEMS. TWO DAYS PRIOR TO ANY EXCAVATION, CONTRACTOR MUST CONTACT NEW MEXICO ONE-CALL SYSTEM (1-800-321-ALERT(2537)) FOR LOCATION OF EXISTING UTILITIES.
5. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL EXCAVATE AND VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL OBSTRUCTIONS. SHOULD A CONFLICT EXIST, THE CONTRACTOR SHALL NOTIFY THE PROJECT MANAGER SO THAT THE CONFLICT CAN BE RESOLVED WITH MINIMUM AMOUNT OF DELAY.
6. ACCESS TO LOCAL BUSINESS AND RESIDENCES SHALL BE KEPT OPEN AT ALL TIMES. TEMPORARY ACCESS CLOSURES, IF REQUIRED, SHALL BE SCHEDULED AT LEAST TWENTY-FOUR (24) HOURS IN ADVANCE WITH PROPERTY OWNER AND APPROVED BY THE PROJECT MANGER.
7. THE CONTRACTOR SHALL DISPOSE OF ALL UNSUITABLE MATERIAL IN AN ENVIRONMENTALLY ACCEPTABLE MANNER AT A LOCATION ACCEPTABLE TO THE PROJECT MANGER. THERE WILL BE NO DIRECT COMPENSATION FOR THIS WORK.
8. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE TO LANDSCAPING AND IRRIGATION SYSTEMS WITHIN WORK AREA NOT COVERED IN THE PLANS.
9. CONTRACTOR IS RESPONSIBLE FOR SUPPORTING ANY EXISTING UTILITIES EXPOSED DURING REQUIRED EXCAVATIONS.

## INDEX TO DRAWINGS

| SHEET NO. | DRAWING NO. | DESCRIPTION |
|---|---|---|
| 1 | G-1 | TITLE SHEET |
| 2 | G-2 | QUANTITY SHEET |
| 3 | C-1 | PLAN |
| 4 | C-2 | PROFILE |
| 5 | C-3 | PIPELINE ROAD CROSSING RANCHO VIEJO BLVD. |
| 6 | C-4 | PIPELINE ROAD CROSSING RICHARDS AVE. AT AVE. DEL SUR |
| 7 | P-1 | LEGENDS AND SCHEDULES PROCESS FLOW DIAGRAM |
| 8 | M-1 | PRODUCTION AND INJECTION WELL PIPING PLANS |
| 9 | M-2 | MECHANICAL DETAILS |

UTILITY COMPANY CONTACTS

PNM -SANTA FE
GAS AND ELECTRIC
STEVE ALGAR (505) 473-3234
P.O. BOX 1268
SANTA FE, NM 87504

QWEST LOCAL NETWORK NORTH
COMCAST CABLE-SANTA FE
TIM NIX (505) 280-3448
GREAT PLAINS LOCATING SERVICE
4401 ANAHEIM AVE.
ALBUQUERQUE, NM 87113

SANTA FE COUNTY WATER RESOURCES DEPT.
205 MONTEZUMA AVE.
SANTA FE, NM 87501
OFFICE: (505) 992-9870
AFTER HOURS EMERGENCY NUMBER: (505) 885-6623

| NO. | DATE | REV. BY | DESCRIPTION |
|---|---|---|---|

REVISIONS ( OR CHANGE NOTICES )

DESIGN MAB/PCF DATE APRIL 2005
DRAWN TA/JDL DATE APRIL 2005
APPROVAL MSH DATE APRIL 2006
ENGINEER PCF DATE APRIL 2006

RANCHO VIEJO DE SANTA FE
AQUIFER STORAGE & RECOVERY PROJECT

COVER SHEET AND GENERAL NOTES

**URS**

SHEET NO. 1 OF 9
DRAWING NO. G-1

## QUANTITIES–WELLHEAD PIPING SYSTEM AND CONSTRUCTION

| A. Civil Work – 3–inch transmission line | Unit | QUANTITIES |
|---|---|---|
| 3–inch Pipe, plain end, including all fittings, trench, and backfill | Linear Feet | 7400 |
| Bore and jack steel casing for roadway crossings, including carrier pipe spacers | Linear Feet | 190 |
| Excavation, Backfill and Compaction for Insertion and Receiving Pits | CY | 250 |
| Trail removal and replacement | SY | 15 |
| Remove and Replace existing fencing | Linear Feet | 160 |
| | | |
| B. Well Head and Piping Installation | | |
| Submersible Well Pump | Lump Sum | 1 |
| Aboveground Piping, Valve and Appurtenances | Lump Sum | 1 |
| 2.5–inch Galvanized Steel Pipe, schedule 40 | Linear Foot | 400 |
| 2.5–inch Black Iron weld neck flange, class 150# | Each | 12 |
| 3–inch Galvanized Steel Pipe, schedule 40 | Linear Foot | 360 |
| 3–inch Black Iron weld neck flange, class 150# | Each | 20 |
| Heat Tracer Wire | Linear Foot | 105 |
| Pipe wrap and insulation | Linear Foot | 60 |
| Pipe Supports, stanchions | Lump Sum | 9 |
| Security Fence – 6–foot high chain link, embedded in ground | Lump Sum | 1 |

| NO. | DATE | REV. BY | DESCRIPTION |
|---|---|---|---|

REVISIONS ( OR CHANGE NOTICES )

RANCHO VIEJO DE SANTA FE
AQUIFER STORAGE & RECOVERY PROJECT

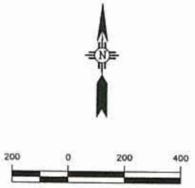
APPROVAL MSH
DATE APRIL 2006
ENGINEER PCF
DATE APRIL 2006
DESIGN MAB/PCF
DATE APRIL 2006
DRAWN TA/JDL
DATE APRIL 2006

QUANTITY SHEET

URS

SHEET NO. 2 OF 9

DRAWING NO. G–2



## GENERAL NOTES

1. PROJECT COORDINATES ARE MODIFIED NM STATE PLANE, CENTRAL ZONE, NAD 83, NAVD 88.
2. PIPELINE SHALL BE HYDROSTATICALLY TESTED AND DISINFECTED AS PER THE SPECIFICATIONS.
3. IF THIS IS NOT 24"X36", THEN IT IS A REDUCED PLOT. USE GRAPHIC SCALE ACCORDINGLY.

## KEY NOTES

① PROPOSED INJECTION WELL.

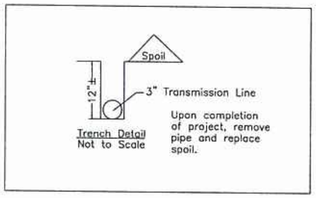
② EXISTING PRODUCTION WELL.

③ 60' OFFSET TYPICAL. MAY VARY FOR PRESERVATION OF VEGETATION AND EXISTING SURFACE FEATURES.

④ CONSTRUCT STEEL CASING REQUIRED FOR CROSSING. SEE PIPELINE ROAD CROSSING SHEETS.

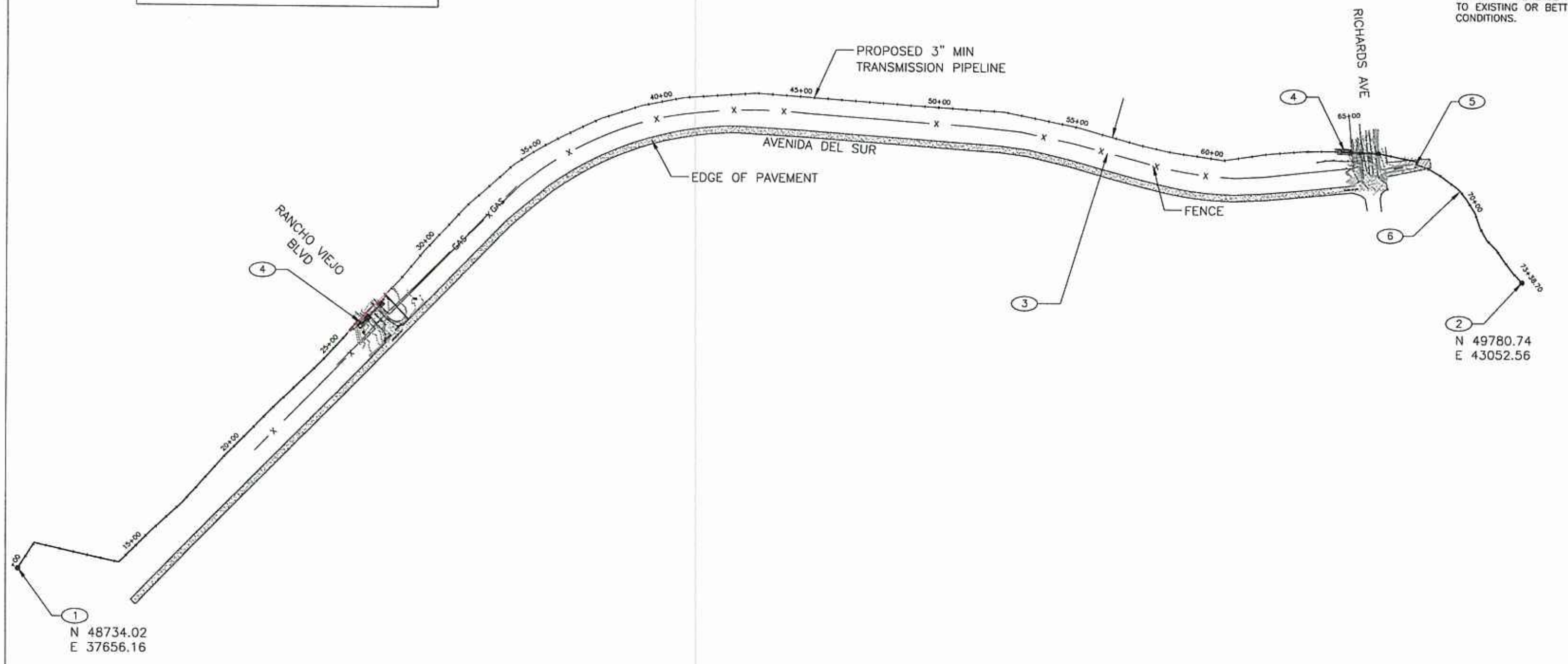
⑤ SANTA FE COUNTY TRAIL. CONSTRUCT BURIED CROSSING REPLACE TRAIL TO EXISTING OR BETTER CONDITIONS. SEE PIPELINE ROAD CROSSING SHEETS.

⑥ DIRT ROAD. CONSTRUCT BURIED CROSSING. REPLACE ROAD SURFACE TO EXISTING OR BETTER CONDITIONS.



Trench Detail
Not to Scale

Upon completion of project, remove pipe and replace spoil.



| NO. | DATE | REV. BY | DESCRIPTION |
|---|---|---|---|
| | | | |

REVISIONS ( OR CHANGE NOTICES )

DESIGN MAB/PCF DATE APRIL 2006
DRAWN TA/JDL DATE APRIL 2006
APPROVAL MSH DATE APRIL 2006
ENGINEER PCF DATE APRIL 2006

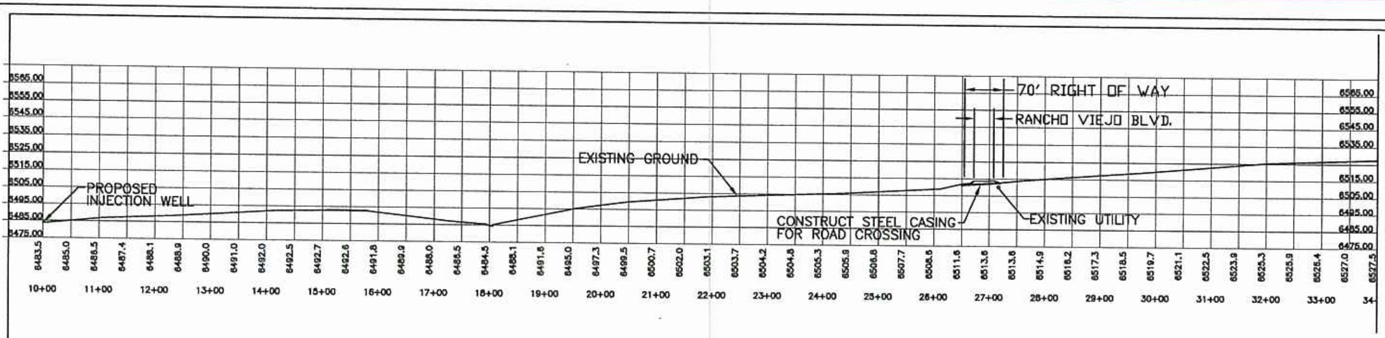
RANCHO VIEJO DE SANTA FE
AQUIFER STORAGE & RECOVERY PROJECT

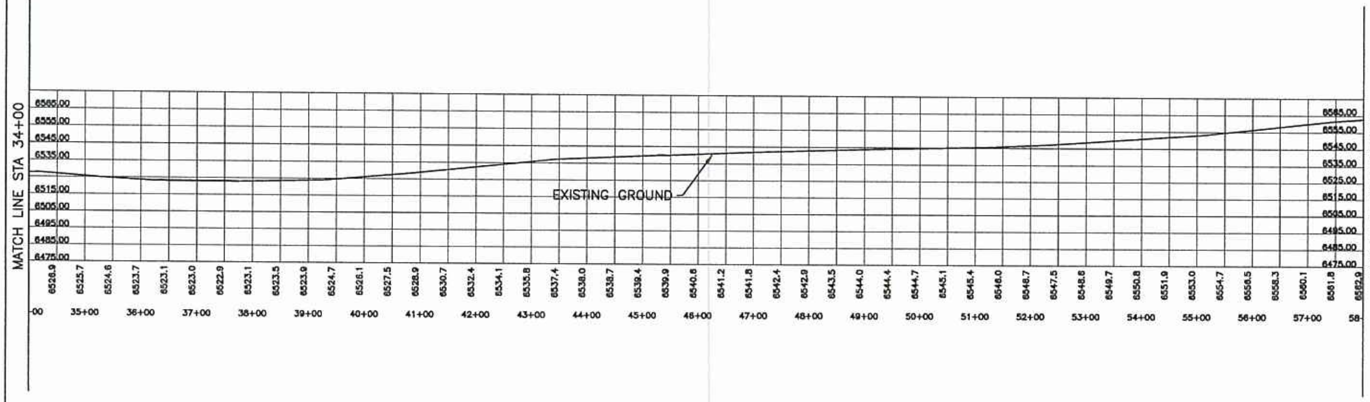
TEMPORARY TRANSMISSION PIPELINE PLAN VIEW

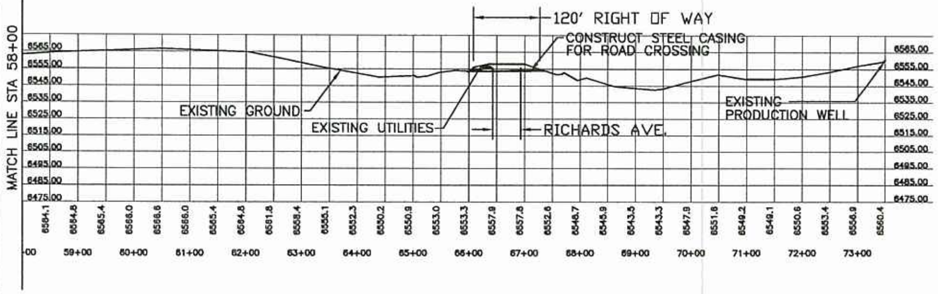
URS

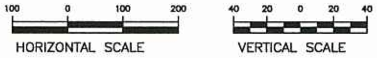
SHEET NO. 3 OF 9

DRAWING NO. C-1









## GENERAL NOTES

1. UTILITY LOCATIONS SHOWN HERE ARE APPROXIMATE AND SHALL BE VERIFIED PRIOR TO ANY EARTHWORK, EXCAVATION OR BORING. CONTRACTOR SHALL POTHOLE ALL UTILITIES TO VERIFY HORIZONTAL AND VERTICAL LOCATION WITH SUFFICIENT DETAIL TO AVOID CONTACT DURING EARTHWORK, EXCAVATION OR BORING OPERATIONS. ANY UTILITIES EXPOSED DURING CONSTRUCTION SHALL BE SUPPORTED AND PROTECTED TO THE SATISFACTION OF THE UTILITY OWNER.

2. IF THIS IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

| NO. | DATE | REV. BY | DESCRIPTION |
|---|---|---|---|
| | | | REVISIONS ( OR CHANGE NOTICES ) |

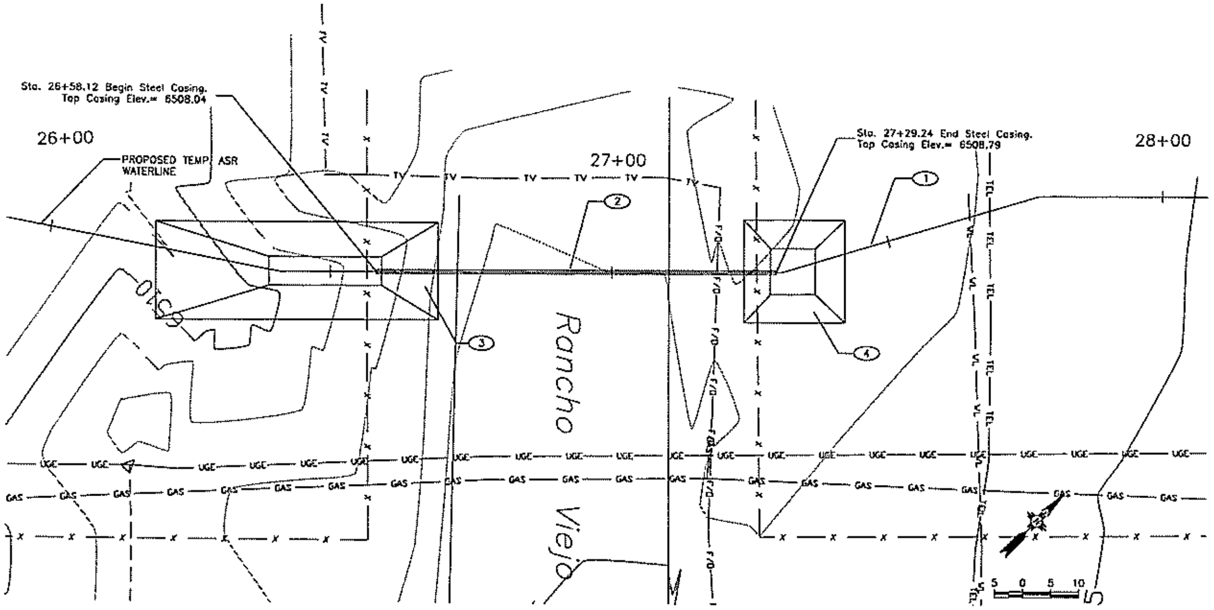
RANCHO VIEJO DE SANTA FE
AQUIFER STORAGE & RECOVERY PROJECT

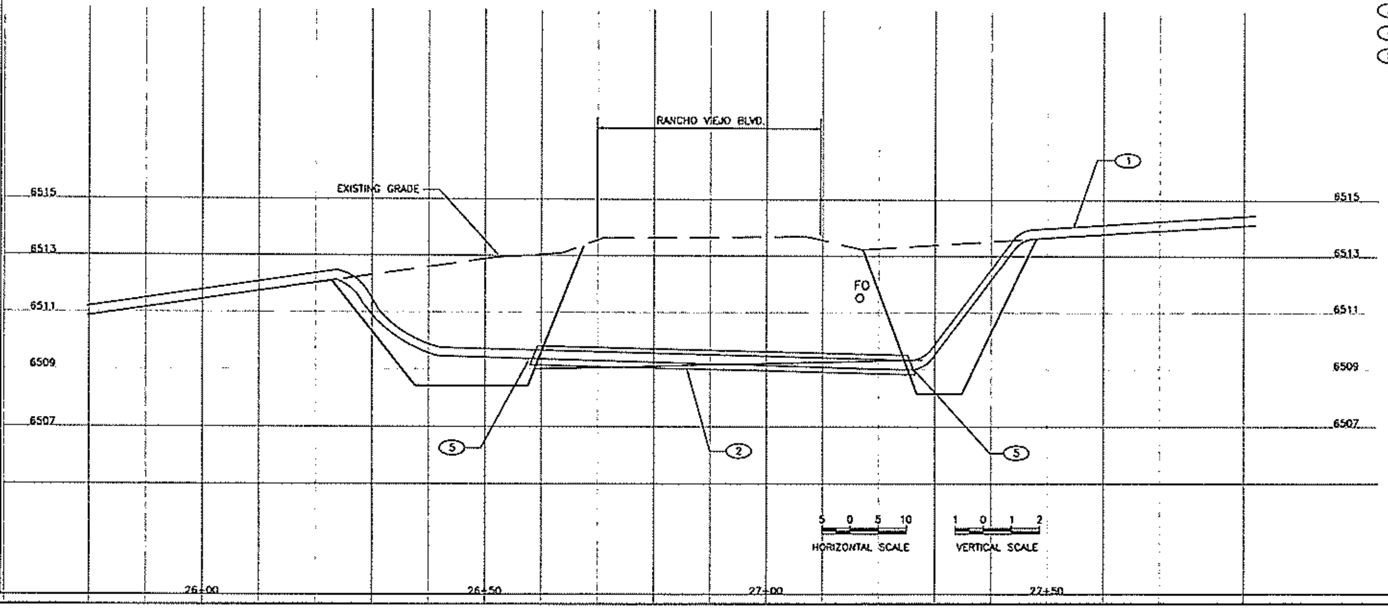
TEMPORARY TRANSMISSION PIPELINE PROFILE

DESIGN MAB/PCF DATE APRIL 2008
DRAWN TA/JDL DATE APRIL 2008
APPROVAL MSH DATE APRIL 2008
ENGINEER PCF DATE APRIL 2008

URS

SHEET NO. 4 OF 9
DRAWING NO. C-2





## GENERAL NOTES

1. UTILITY LOCATIONS SHOWN HERE ARE APPROXIMATE AND SHALL BE VERIFIED PRIOR TO ANY EARTHWORK, EXCAVATION OR BORING. CONTRACTOR SHALL POTHOLE ALL UTILITIES TO VERIFY HORIZONTAL AND VERTICAL LOCATION WITH SUFFICIENT DETAIL TO AVOID CONTACT DURING EARTHWORK, EXCAVATION OR BORING OPERATIONS.
ANY UTILITIES EXPOSED DURING CONSTRUCTION SHALL BE SUPPORTED AND PROTECTED TO THE SATISFACTION OF THE UTILITY OWNER.

2. IF ANY CONFLICT IS ENCOUNTERED OR FORESEEN, NOTIFY THE ENGINEER FOR ADJUSTMENT TO THE BORING LOCATION.

3. INSERTION AND RECEIVING PITS SHALL BE EXCAVATED AND SHORED ACCORDING TO OSHA STANDARDS TO PROVIDE A SAFE WORKING ENVIRONMENT. EDGE OF PITS SHALL BE NO CLOSER THEN 2' FROM ANY PAVED SURFACE.

4. A MINIMUM 4' BURY TO TOP OF STEEL CASING SHALL BE MAINTAINED.

5. REMOVE AND REPLACE FENCING AS NECESSARY FOR BORING AND PIPE INSTALLATION, AS GOOD OR BETTER AS EXISTING.

6. IF THIS IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

## KEY NOTES

① 3" CARRIER PIPE
② STEEL CASING, BORED AND JACKED INTO PLACE
③ INSERTION PIT
④ RECEIVING PIT
⑤ SUPPORT CARRIER PIPE THROUGH CASING WITH MANUFACTURED SPACERS. FOR INSTALLATION AND SPACING FOLLOW MANUFACTURER'S RECOMMENDATIONS. SEAL END OF CASING WITH EXPANDABLE ANNULAR SPACE SEAL, FLEXIBLE RUBBER SEAL, OR APPROVED EQUAL

## LEGEND

| | |
|---|---|
| —UGE—UGE— | ELECTRIC |
| —GAS—GAS— | NATURAL GAS |
| —TV—TV— | CABLE |
| —VL—VL— | WATER LINE |
| —F/O—F/O— | TELEPHONE |
| ▨ | EXISTING ROADWAY |
| △ | TRANSFORMER |

| NO. | DATE | REV. BY | DESCRIPTION |
|---|---|---|---|
| | | | |

REVISIONS ( OR CHANGE NOTICES )

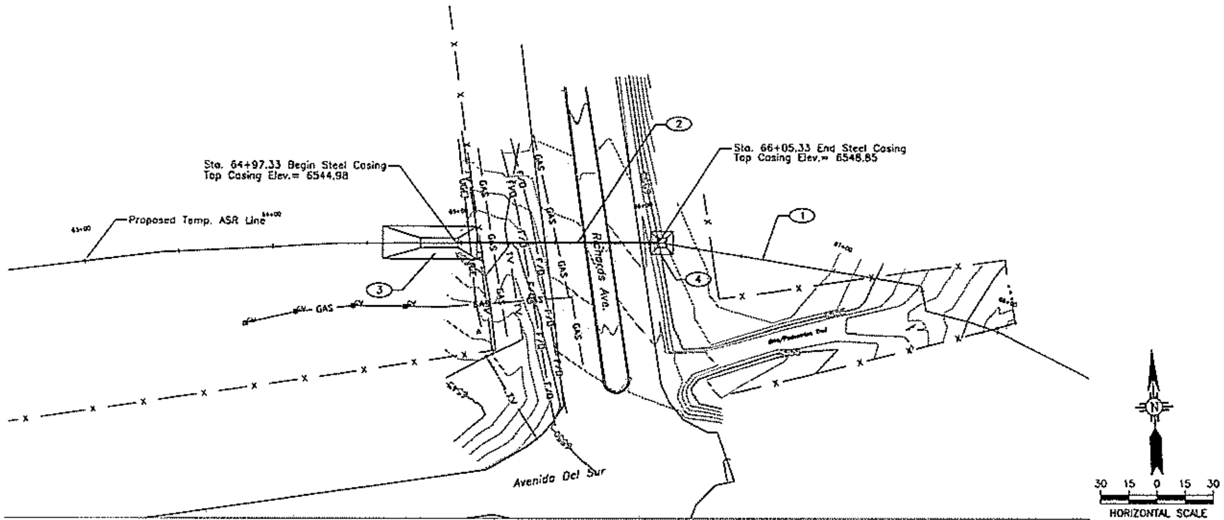
RANCHO VIEJO DE SANTA FE
AQUIFER STORAGE & RECOVERY PROJECT

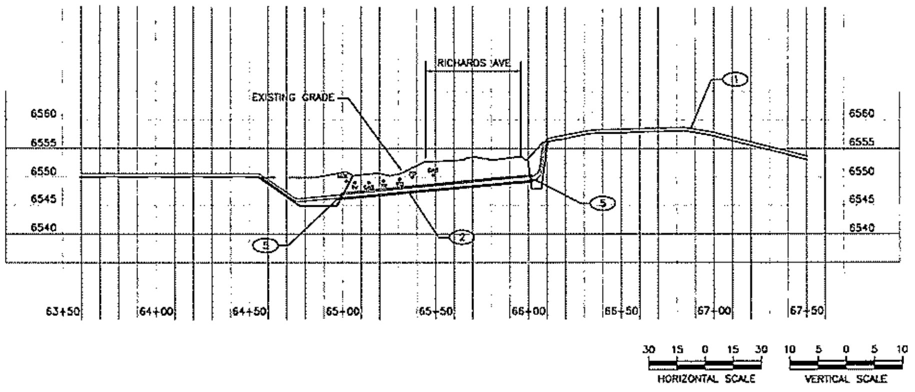
PIPELINE ROAD CROSSING RANCHO VIEJO BLVD
AT AVIENDA DEL SUR

APPROVAL DATE MSH APRIL 2006
ENGINEER DATE PCF APRIL 2006
DESIGN DATE MAB/PCF APRIL 2006
DRAWN DATE TA/JDL APRIL 2006

URS

SHEET NO. 5 OF 9
DRAWING NO. C-3





## GENERAL NOTES

1. UTILITY LOCATIONS SHOWN HERE ARE APPROXIMATE AND SHALL BE VERIFIED PRIOR TO ANY EARTHWORK, EXCAVATION OR BORING. CONTRACTOR SHALL POTHOLE ALL UTILITIES TO VERIFY HORIZONTAL AND VERTICAL LOCATION WITH SUFFICIENT DETAIL TO AVOID CONTACT DURING EARTHWORK, EXCAVATION OR BORING OPERATIONS. ANY UTILITIES EXPOSED DURING CONSTRUCTION SHALL BE SUPPORTED AND PROTECTED TO THE SATISFACTION OF THE UTILITY OWNER.

2. IF ANY CONFLICT IS ENCOUNTERED OR FORESEEN, NOTIFY THE ENGINEER FOR ADJUSTMENT TO THE BORING LOCATION.

3. INSERTION AND RECEIVING PITS SHALL BE EXCAVATED AND SHORED ACCORDING TO OSHA STANDARDS TO PROVIDE A SAFE WORKING ENVIRONMENT. EDGE OF PITS SHALL BE NO CLOSER THEN 2' FROM ANY PAVED SURFACE.

4. A MINIMUM OF A 4' BURY TO TOP OF CASING SHALL BE MAINTAINED.

5. REMOVE AND REPLACE FENCING AS NECESSARY FOR BORING AND PIPE INSTALLATION, AS GOOD OR BETTER AS EXISTING.

6. IF THIS IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

## KEY NOTES

① 3" MIN CARRIER PIPE

② STEEL CASING, BORED AND JACKED INTO PLACE

③ INSERTION PIT

④ RECEIVING PIT

⑤ SUPPORT CARRIER PIPE THROUGH CASING WITH MANUFACTURED SPACERS. FOR INSTALLATION AND SPACING FOLLOW MANUFACTURER'S RECOMMENDATIONS. SEAL END OF CASING WITH EXPANDABLE ANNULAR SPACE SEAL, FLEXIBLE RUBBER SEAL, OR APPROVED EQUAL

## LEGEND

| | |
|---|---|
| —— UGE —— | ELECTRIC |
| —— GAS —— | NATURAL GAS |
| —— TV —— | CABLE |
| —— WL —— | WATER LINE |
| —— F/O —— | TELEPHONE |
| ▨ | EXISTING ROADWAY |
| △ | TRANSFORMER |

| NO. | DATE | REV. BY | DESCRIPTION |
|---|---|---|---|
| | | | REVISIONS ( OR CHANGE NOTICES ) |

RANCHO VIEJO DE SANTA FE
AQUIFER STORAGE & RECOVERY PROJECT

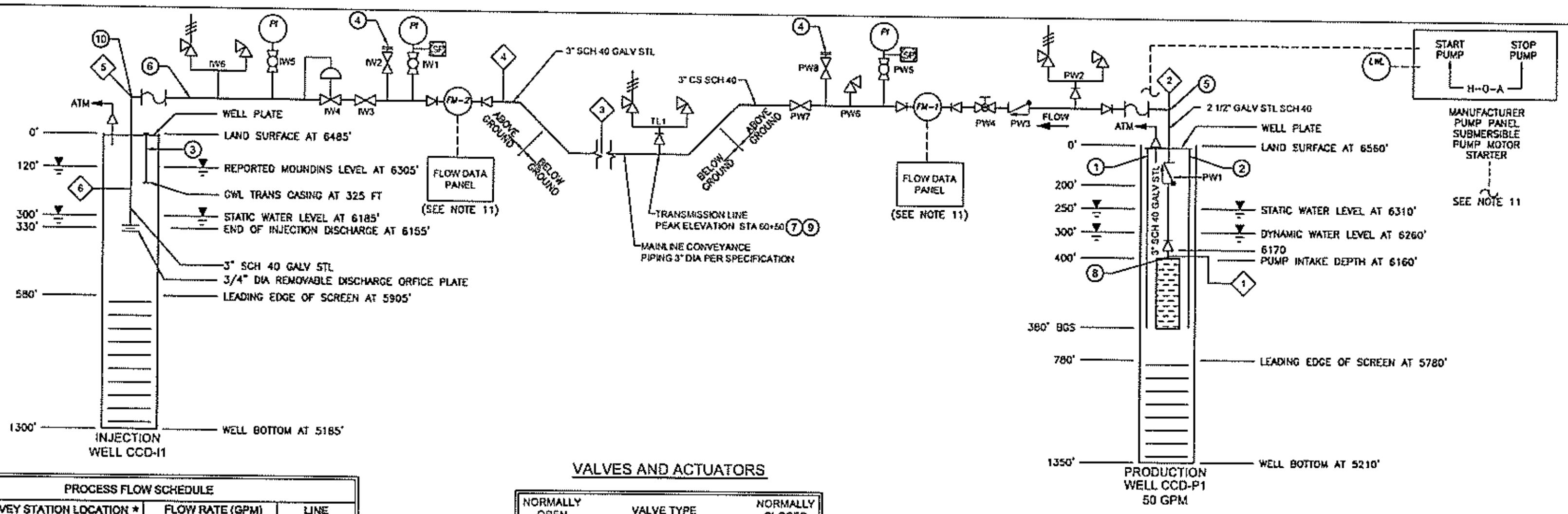
PIPELINE ROAD CROSSING RICHARDS AVE
AT AVIENDA DEL SUR

| | | | |
|---|---|---|---|
| APPROVAL DATE | MSH APRIL 2006 | DESIGN DATE | MAB/PCF APRIL 2006 |
| ENGINEER DATE | PCF APRIL 2006 | DRAWN DATE | TA/JDL APRIL 2006 |

URS

SHEET NO. 6 OF 9

DRAWING NO. C-4



| PROCESS FLOW SCHEDULE | | | |
|---|---|---|---|
| FLOW STREAM | SURVEY STATION LOCATION * | FLOW RATE (GPM) | LINE PRESSURE (PSI) ** |
| | | OPERATING | |
| 1 | STA 73 + 50 | 50 | 245 |
| 2 | STA 73 + 50 | 50 | 65 |
| 3 | STA 60 + 50 | 50 | 55 |
| 4 | STA 10 + 00 | 50 | 57 |
| 5 | STA 10 + 00 | 50 | 25 |
| 8 | STA 10 + 00 | 50 | 19 |

* STATIONING BASED ON PIPELINE ALIGNMENT. STATIONS ARE APPROXIMATE.

** OPERATIONS PRESSURES SHOWN ARE APPROXIMATE AND MAY VARY BASED ON ACTUAL SYSTEM OPERATION.

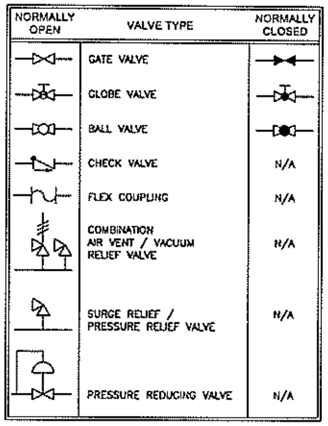
| VALVE SCHEDULE | | | | |
|---|---|---|---|---|
| VALVE IDENTIFICATION | VALVE TYPE | FLOW STREAM | DIAMETER (INCHES) | OPERATING PRESSURE (PSI) * |
| PW1 | SPRING LOADED CHECK VALVE | 1 | 2 1/2 | 245 |
| PW2 | AIR VACUUM VALVE | 2 | 1/2 | 65 |
| PW3 | GLOBE CHECK VALVE | 2 | 3 | 65 |
| PW4 | FLOW CONTROL VALVE | 2 | 3 | 65 |
| PW5 | BALL VALVE | 2 | 1/2 | 65 |
| PW6 | SURGE / PRESSURE RELIEF VALVE | 2 | 3 | 65 |
| PW7 | GATE VALVE | 2 | 3 | 65 |
| PW8 | GATE VALVE | 2 | 3 | 65 |
| TL1 | COMBINATION AIR VALVE | 3 | 1 | 55 |
| IW1 | BALL VALVE | 4 | 1/2 | 57 |
| IW2 | GATE VALVE | 4 | 3 | 57 |
| IW3 | GATE VALVE | 4 | 3 | 57 |
| IW4 | PRESSURE REDUCING VALVE | 4 | 3 | 57 |
| IW5 | BALL VALVE | 4 | 1/2 | 25 |
| IW6 | AIR VACUUM VALVE | 5 | 1/2 | 25 |

* OPERATING PRESSURES SHOWN ARE APPROXIMATE AND MAY VARY BASED ON ACTUAL SYSTEM OPERATION.

| FLOW METER SCHEDULE | | | | |
|---|---|---|---|---|
| METER IDENTIFICATION | TYPE | SIZE (IN) | MINIMUM FLOW (GPM) | TOTALIZER |
| FM-1 | McCROMETER ML-08-D PROPELLER TYPE | 2" | 35 | US GALLONS |
| FM-2 | McCROMETER ML-08-D PROPELLER TYPE | 2" | 35 | US GALLONS |

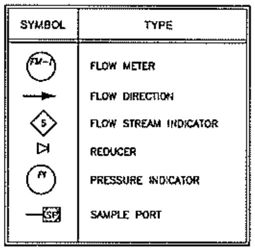
| PUMP SCHEDULE | | | | |
|---|---|---|---|---|
| PUMP IDENTIFICATION | PUMP FUNCTION/PERFORMANCE | PUMP TYPE | PUMP (HP) | PERFORMANCE DATA |
| P-1 | PRODUCTION WELL CCPP1 PUMP DEDICATED WELL PUMP | SUBMERSIBLE | 15 | GOLDS MODEL 70L15 50 GPM @ 575 FT HEAD |

## VALVES AND ACTUATORS



| NORMALLY OPEN | VALVE TYPE | NORMALLY CLOSED |
|---|---|---|
| | GATE VALVE | |
| | GLOBE VALVE | |
| | BALL VALVE | |
| | CHECK VALVE | N/A |
| | FLEX COUPLING | N/A |
| | COMBINATION AIR VENT / VACUUM RELIEF VALVE | N/A |
| | SURGE RELIEF / PRESSURE RELIEF VALVE | N/A |
| | PRESSURE REDUCING VALVE | N/A |

## PIPE SPECIALTIES



| SYMBOL | TYPE |
|---|---|
| FM-1 | FLOW METER |
| | FLOW DIRECTION |
| 5 | FLOW STREAM INDICATOR |
| | REDUCER |
| PI | PRESSURE INDICATOR |
| SP | SAMPLE PORT |

KEY NOTES:

① PRODUCTION WELL LOW WATER LEVEL TRANSDUCER CASING. CASING SHALL BE 1 ½ INCH SCH 80 PVC AND INSTALLED BELOW GROUND SURFACE TO ELEV 6185.

② PRODUCTION WELL – GROUNDWATER LEVEL TRANSDUCER CASING (SOUNDING TUBE). CASING SHALL BE 1 ½ INCH SCH 80 PVC AND INSTALLED BELOW GROUND SURFACE TO ELEVATION 6180.

③ INJECTION WELL – GROUNDWATER LEVEL TRANSDUCER CASING. (SOUNDING TUBE) 1 ½ INCH SCH 80 PVC SET AT 325 FEET BGS.

④ PUMP TO WASTE BYPASS LINE.

⑤ ABOVE GROUND ALIGNMENT FOR THE PRODUCTION WELL WELLHEAD PIPING SHALL BE INSTALLED TO PIPE CENTERLINE ELEV 6562.5 FT.

⑥ ABOVE GROUND ALIGNMENT FOR THE INJECTION WELL WELLHEAD PIPING SHALL BE INSTALLED TO PIPE CENTERLINE ELEV 6487.5 FT.

⑦ MAINLINE TRANSMISSION SHOWN AS REFERENCE TO THE CONVEYANCE SYSTEM ONLY. THE MAINLINE TRANSMISSION INCREASES IN ELEV FROM THE LOCATION OF THE PRODUCTION WELL AT PIPE ALIGNMENT ELEV 6562.6 FT TO A PIPE ALIGNMENT ELEV OF 6570 AT STATION 60+50. LINE DECREASES IN ELEV TOWARDS THE INJECTION WELL LOCATED AT A PIPE ALIGNMENT ELEVATION OF APPROXIMATELY 6487.5 FT.

⑧ PROVIDE DIELECTRIC FITTING AT PUMP DISCHARGE TRANSITION TO GALV STEEL.

⑨ CONTRACTOR SHALL INSTALL A COMBINATION AIR RELIEF VALVE AT TRANSMISSION LINE STATION 65+50 ELEVATION 6570± 1 FT AS APPROVED BY THE ENGINEER. VALVE SHALL BE SIMILAR OR APPROVED TO APCO WILLIAMETTE MODEL NO. 143C, CL 250 CI WITH NSF APPROVED EPOXY COATING.

⑩ MODIFIED WELL SEAL RISER FOR DOWN PIPE ACCESSIBILITY.

## PROCESS FLOW DIAGRAM ABBREVIATIONS

| | |
|---|---|
| ATM | ATMOSPHERIC |
| AVV | AIR VENT/VACUUM RELIEF VALVE |
| BA | BALL VALVE |
| BGS | BELOW GROUND SURFACE |
| CONC | CONCENTRIC REDUCER |
| CRV | COMBINATION PRESSURE/RELIEF VALVE |
| CS | CARBON STEEL |
| CV | CHECK VALVE |
| ECC | ECCENTRIC REDUCER |
| ELEV | ELEVATION |
| FM | FLOW METER |
| FT | FEET |
| GALV | GALVANIZED |
| GPM | GALLONS PER MINUTE |
| GBV | GLOBE VALVE |
| GR | GRADE |
| GV | GATE VALVE |
| GWL | GROUNDWATER LEVEL |
| HP | HORSE POWER |
| LWL | LOW WATER LEVEL |
| NC | NORMALLY CLOSED |
| PI | PRESSURE INDICATOR |
| PRV | PRESSURE REDUCING VALVE |
| PVC | POLYVINYL CHLORIDE |
| Q | FLOW DIRECTION |
| RED | REDUCER |
| S | SAMPLE PORT |
| SCH | SCHEDULE |
| SS | STAINLESS STEEL |
| SDR | STANDARD DIMENSION RATIO |
| SRV | SURGE-PRESSURE RELIEF VALVE |
| STL | STEEL |
| TDH | TOTAL DYNAMIC HEAD |
| TRANS | TRANSDUCER |
| TYP | TYPICAL |

PROCESS FLOW NOTES:

1. PROCESS FLOW IS NOT TO SCALE, AND MAY NOT SHOW ALL FITTINGS, AND INFRASTRUCTURE FOR A COMPLETE INSTALLATION.
2. WELL DETAILS AND WATER LEVEL DATA PROVIDED BY BALLEAU GROUNDWATER INC.
3. STATIC WATER LEVEL AND DYNAMIC WATER LEVEL SHOWN FOR THE PRODUCTION WELL IS BASED ON A WELL DRAWDOWN OF 50 FEET AT A DISCHARGE FLOWRATE OF 50 GPM.
4. STATIC WATER LEVEL AND MOUNDING WATER LEVEL SHOWN FOR THE INJECTION WELL BASED ON AN ANTICIPATED WELL INJECTION FLOW RATE OF 50 GPM AT 12 PSI.
5. ALL BELOW GRADE PIPING SHALL BE 3-INCH DIAMETER PLAIN END SCHEDULE 80 PVC TYPE 1.
6. ALL ABOVE GROUND PIPING SHALL BE SCH 40 HOT DIPPED GALV ASTM A53 B TO THE DIAMETERS SPECIFIED.
7. PRODUCTION WELL CCDP1 AND THE INJECTION WELL ARE EXISTING. CONTRACTOR TO FURNISH AND INSTALL PUMP, COLUMN PIPE, INJECTION WELL DISCHARGE PIPE, WELL HEAD PIPING/APPERTUNANCES/FITTINGS, AND MAIN LINE CONVEYANCE PIPING.
8. THE CONTRACTOR IS NOTIFIED THAT THE WORK INVOLVES INSTALLATION OF A GROUNDWATER PUMP SUPPLY AND INJECTION SYSTEM. GROUNDWATER ASSOCIATED WITH THE AQUIFER SHALL BE CONSIDERED DRINKING WATER QUALITY AND ALL MATERIALS, PIPING AND COMPONENTS FURNISHED AND INSTALLED BY THE CONTRACTOR SHALL CONFORM TO NATIONAL SANITATION FOUNDATION STANDARDS 60 AND 61 AS ADOPTED BY THE STATE OF NEW MEXICO.
9. ALL ABOVE GROUND REDUCERS SHALL BE ECCENTRIC.
10. ALL FITTINGS SHALL BE FLANGED AS SHOWN ON DWG M-1.
11. ELECTRICAL DESIGN SHALL BE PROVIDED BY OTHERS. PROCESS FLOW SHOWS MANUFACTURER PUMP PANEL AND LOW WATER CONDITION INTERFACE FOR PROCESS CLARIFICATION ONLY.

| NO. | DATE | REV. BY | DESCRIPTION |
|---|---|---|---|
| REVISIONS ( OR CHANGE NOTICES ) | | | |

RANCHO VIEJO DE SANTA FE
AQUIFER STORAGE & RECOVERY PROJECT

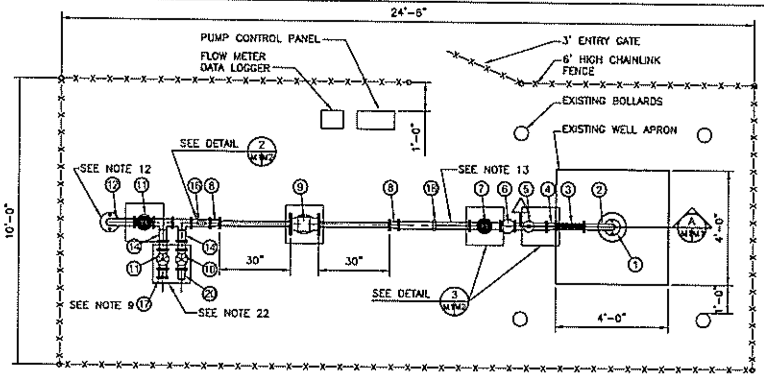
LEGEND AND SCHEDULES
PROCESS FLOW DIAGRAM

| | | | |
|---|---|---|---|
| APPROVAL | MSH | DESIGN | MAB |
| DATE | APRIL 2006 | DATE | APRIL 2006 |
| ENGINEER | PCF | DRAWN | RJW \ KLP |
| DATE | APRIL 2006 | DATE | APRIL 2006 |

URS

SHEET NO. 7 OF 9

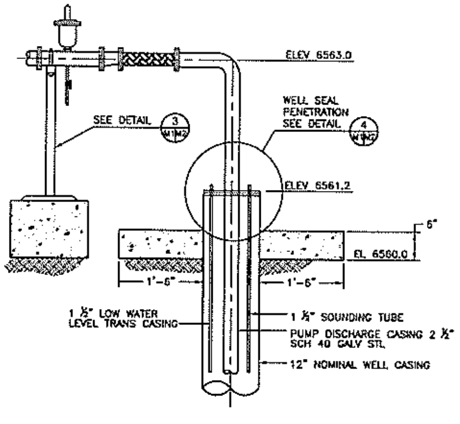
DRAWING NO. P-1



PRODUCTION WELL PIPING

PLAN

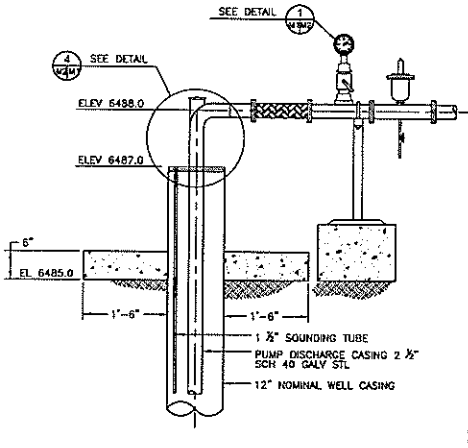
SCALE IN FEET



PRODUCTION WELL (PARTIAL SECTION)

SECTION A M1/M1

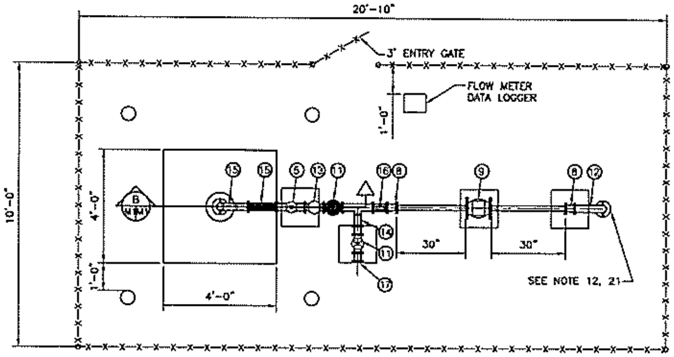
SCALE IN FEET



INJECTION WELL (PARTIAL SECTION)

SECTION B M1/M1

SCALE IN FEET



INJECTION WELL

PLAN

SCALE IN FEET

| MECHANICAL SCHEDULE | | | | |
|---|---|---|---|---|
| COMPONENT ID | DESCRIPTION | DIA | CONNECTION | MATERIAL/ MODEL NO. |
| 1 | SILENT CHECK VALVE – GLOBE TYPE | 2.5 | SC | CAST IRON ASTM A126 GR. B-250 LB CL/APCO WILLIAMETTE MODEL 653 |
| 2 | MODIFIED LONG RADIUS ELBOW | 2.5 | W X FL | GALVANIZED SCH. 40 STEEL- MORILL INDUSTRIES 15955 MODIFIED |
| 3 | FLEXIBLE COUPLING | 2.5 X 12 | FL X FL | STAINLESS STEEL TYPE 304, SCH. 40 |
| 4 | ECCENTRIC RED. | 2.5 X 3 | FL X W | GALVANIZED, SCH. 40 STEEL, ASTM A53 GR. B |
| 5 | AIR VACUUM VALVE | ½ | SC | CAST IRON ASTM A126 GR. B-250 LB CL/APCO WILLIAMETTE MODEL 141 |
| 6 | SILENT CHECK VALVE – GLOBE TYPE | 3 | FL X FL | CAST IRON ASTM A126 GR. B-250 LB CL |
| 7 | FLOW CONTROL VALVE | 3 | FL X FL | CLA VALVE MODEL 40G-01KC, CL 150 LB DI |
| 8 | ECCENTRIC RED. | 2.5 X 3 | W X W | GALV. STEEL - SCH 40 ASTM A53 GR. B |
| 9 | FLOW METER | 2 | FL X FL | McCROMETER ML-08 D |
| 10 | PRESSURE RELIEF VALVE/SURGE ANTICIPATOR | 2 ½ | FL X FL | CLA VALVE MODEL 52G-03KC, 150 LB CL DI |
| 11 | GATE VALVE | 3 | FL X FL | MUELLER A-2360, CL 125 CI |
| 12 | 45 DEGREE ELBOW | 3 | FL X FL | SS TYPE 304 SCH 40 |
| 13 | PRESSURE REDUCING VALVE | 3 | FL X FL | CLA VALVE MODEL 90G-01ASKC, CL 150 LB DI |
| 14 | TEE | 3 | FL X FL | SS TYPE 304 SCH 40 |
| 15 | FLEXIBLE COUPLING | 3 X 11 | FL X FL | SS TYPE 304 SCH 40 |
| 16 | PRESSURE GAUGE/SAMPLE PORT ASSEMBLY | SEE DETAIL 2, DWG. M2 | SC, FL | SS TYPE 304 |
| 17 | BLIND FLANGE | 3 | FL | GALV STEEL, CL 150 LB SCH 40 ASTM A53 GR. B |
| 18 | FLOW CONTROL VALVE ORFICE | 3 | FL | SS- CLASS 150 LB (MANUFACTURER PROVIDED ORIFICE FOR FLOW CONTROL VALVE) |
| 19 | SPRING LOADED CHECK VALVE | 3 | SC | GALV. STEEL SCH 40- ASTM A53 GR. B |
| 20 | 90 DEG. ELBOW | 3 | FL | GALV. STEEL SCH 40- ASTM A53 GR. B |

NOTES:

1. ALL FLANGES SHALL BE COMPATABLE
2. DIELECTRIC FLANGE KITS SHALL BE INSTALLED WHERE FITINGS FABRICATED OF DISIMILAR METALS ARE INSTALLED.
3. DIMENSIONS SHOWN ON EACH PLAN ARE APPROXIMATE AND MAY NOT REFLECT THE EXACT SIZE AND DIMENSIONS OF COMPONENTS.
4. ORIFICE PLATE FOR THE FLOW CONTROL VALVE SHALL BE PLACED AT LEAST 5 PIPE DIAMETERS DOWNSTREAM OF THE CONTROL VALVE.
5. SPRING LOADED CHECK VALVE SHALL BE INSTALLED ON THE PUMP DISCHARGE PIPE AT A VERTICAL LOCATION 200 FEET ALONG THE DISCHARGE.
6. UNLESS OTHERWISE SPECIFIED, CONTRACTOR SHALL MAINTAIN ALL SPACING REQUIREMENTS FOR VALVES AND FITTINGS AS RECOMMENDED BY THE MANUFACTURER.
7. ALL COMPONENTS, VALVES, FITTINGS, PIPING, APPERTUNACES, SEALANTS AND FLANGES SHALL BE IN CONFORMANCE WITH NSF 60 AND 61 AS REQUIRED BY THE STATE OF NEW MEXICO.
8. FENCING SHALL BE INSTALLED PER SPECIFICATION 02830.
9. BLIND FLANGES SHALL BE INSTALLED ON EACH PUMP TO WASTE VALVE DISCHARGE AS SHOWN.
10. ALL CONTROL TYPE VALVES SHALL BE HYDRAULICALLY OPERATED.
11. PUMP CONTROL AND FLOW METER DATA LOGGER PANEL SHALL BE INSTALLED AND SUPPORTED WITH GALVANIZED STEEL UNISTRUT FRAMING. FRAMING SHALL BE INSTALLED WITH EMBEDDED POSTS AND SHALL BE CAPABLE OF SUPPORTING THE DEAD WEIGHT AND DYNAMIC LOADING OF THE PANEL. UNLESS SPECIFIED OTHERWISE, TOP OF PANEL HEIGHT SHALL NOT EXCEED 5 FEET ABOVE GROUND SURFACE.
12. UNDERGROUND TRANSITION SHALL BE INSTALLED WITH 45 DEGREE ELBOWS AND STRAIGHT PIPE AS REQUIRED TO ACHIEVE A TOP OF PIPE CROWN DEPTH OF 36-INCHES. PIPING SHALL BE WRAPPED WITH 20-MIL PVC TAPE, DOUBLE WRAPPED AROUND CIRCUMFERENCE OF PIPE AND FITTINGS. WRAP SHALL BEGIN AT 6-INCHES ABOVE GROUND SURFACE. CONNECTION TO THE MAINLINE CONVEYANCE PIPE SHALL BE MADE WITH RESTRAINED JOINTS AS DIRECTED BY THE ENGINEER.
13. ABOVEGROUND PIPING SHALL BE DRESSED WITH HEAT TRACE AND COVERED WITH MANUFACTURER APPROVED PIPE INSULATION PER THE PROJECT SPECIFICATIONS.
14. PIPE SUPPORTS AND STANCHIONS SHALL BE FIELD FIT AS REQUIRED TO ADEQUATELY SUPPORT PIPING AND VALVES IN CONFORMANCE WITH THE PROJECT SPECIFICATIONS.
15. CONCRETE WELLHEAD APRONS, BOLLARDS AND WELLS IS EXISTING.
16. CONTRACTOR SHALL INSTALL PIPING ALIGNMENT TO THE SECTION ELEVATIONS AS SHOWN.
17. PRIOR TO EXCAVATION OR CONDUCTING SITE WORK THE CONTRACTOR SHALL CONTACT NEW MEXICO ONE CALL AND MAINTAIN A VALID UTILITY LOCATE CASE FILE AT THE SITE FOR THE PROJECT AT ALL TIMES. CONTRACTOR SHALL COMPLY WITH NEW MEXICO ONE CALL AS PER CHAPTER 62, ARTICLE 14, NMSA 1978.
18. CONTRACTOR IS NOTIFIED THAT ALL COMPONENTS AND MATERIALS INSTALLED AND/OR USED IN THE WATER DISTRIBUTION SYSTEM SHALL COMPLY WITH NSF 60 AND 61.
19. ELECTRICAL DESIGN SHALL BE PROVIDED BY OTHERS.
20. PIPING, VALVES, PUMP AND APPERTUNANCES SHALL BE INSTALLED IN CONFORMANCE WITH THE PROJECT SPECIFICATIONS.

| NO. | DATE | REV. BY | REVISIONS ( OR CHANGE NOTICES ) | DESCRIPTION |
|---|---|---|---|---|

DESIGN MAB DATE APRIL 2006
DRAWN RJW \ KLP DATE APRIL 2006
APPROVAL MSH DATE APRIL 2006
ENGINEER PCF DATE APRIL 2006

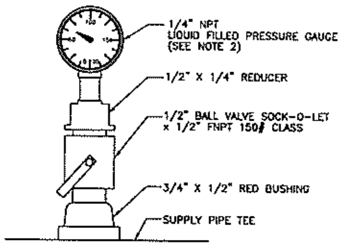
RANCHO VIEJO DE SANTA FE
AQUIFER STORAGE & RECOVERY PROJECT

PRODUCTION AND INJECTION WELL PIPING PLANS

URS

SHEET NO. 8 OF 9

DRAWING NO. M-1



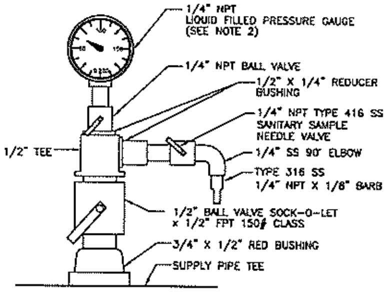
TYPICAL PRESSURE GAUGE ASSEMBLY

DETAIL 1 M2
NOT TO SCALE

GAUGE/SAMPLE PORT NOTES:

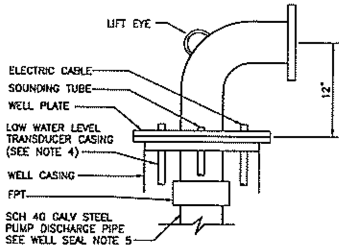
1. SEE DIVISION 15 FOR PIPING SPECIALTIES.

2. ALL FITTINGS USED SHALL BE INTERNALLY COATED WITH AN NSF 61 APPROVED COATING.



TYPICAL PRESSURE GAUGE/SAMPLE PORT ASSEMBLY

DETAIL 2 M2
NOT TO SCALE



GALVANIZED STEEL WELL SEAL

DETAIL 4 M-2
NOT TO SCALE

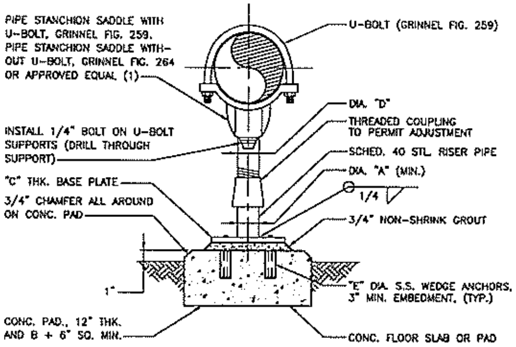
WELL SEAL NOTES:

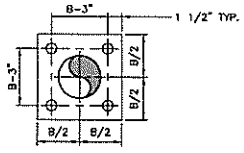
1. WELL SEAL SHALL BE COMPRESSION TYPE EQUIVALENT OR APPROVED EQUAL TO MORRILL INDUSTRIES MODEL NG 1595-GALVANIZED STEEL.

2. LIFT EYE SHALL BE CAPABLE OF SUPPORTING WELL PLATE AND FITTINGS ALL LOADS, INCLUDING PIPING, WATER, PUMP, MOTOR AND ASSOCIATED SAFETY AND ELECTRIC CABLES.

3. CASING PROVIDED ONLY FOR PRODUCTION WELL ONLY.

4. PRODUCTION WELL: WELL HEAD PLATE SHALL BE EQUIPED TO RECIEVE A 2 ½" DIA PUMP DISCHARGE PIPE AND OUTFLOW.
INJECTION WELL: WELL HEAD PLATE SHALL BE EQUIPPED TO ACCOMODATE A 3" DIA INFLOW AND DISCHARGE





BASE PLATE

| TYPE | PIPE SIZE | A | B | C | D(2) | E |
|---|---|---|---|---|---|---|
| PS-1<br>OR<br>PS-2 | 2 1/2", 3", 3 1/2" | 2 1/2" | 9" | 3/8" | 1 1/2" | 3/8" |
| | 4", 6" | 3" | 10" | 3/8" | 2 1/2" | 3/8" |
| | 8", 10", 12" | 3" | 10" | 1/2" | 2 1/2" | 1/2" |
| PS-2 | 14", 16" | 4" | 12" | 5/8" | 3" | 1/2" |
| | 18", 20" | 6" | 14" | 3/4" | 3 1/2" | 1/2" |
| | 24", 30", 36" | 6" | 14" | 3/4" | 4" | 1/2" |

PIPE SUPPORT NOTES:

1. WHERE LOCATED UNDER FLANGE OR VALVE USE PS2 SUPPORT WITH SADDLE RADIUS TO MATCH FLANGE OR VALVE BODY.

2. FOR PS1 U-BOLT SUPPORTS USE DIMENSION "A" IN LIEU OF "D".

TYPICAL PIPE SUPPORT

DETAIL 3 M-2
NOT TO SCALE

| NO. | DATE | REV. BY | DESCRIPTION |
|---|---|---|---|
| | | | REVISIONS ( OR CHANGE NOTICES ) |

RANCHO VIEJO DE SANTA FE
AQUIFER STORAGE & RECOVERY PROJECT

MECHANICAL DETAILS

APPROVAL MSH DATE APRIL 2006
ENGINEER PCF DATE APRIL 2006
DESIGN MAB DATE APRIL 2006
DRAWN RJW \ KLP DATE APRIL 2006

URS

SHEET NO. 9 OF 9
DRAWING NO. M-2

# APPENDIX E

# PHOTOGRAPHS

## WATER PLAN

| PHOTO | DESCRIPTION |
|---|---|
| DSC02341.JPG | Pumping Well |
| DSC02344.JPG | Flow Control Valve |
| DSC02345.JPG | Pumping Well Flow Meter |
| DSC02346.JPG | Surge Relief Valve |
| DSC02349.JPG | Injection Well |
| DSC02350.JPG | Pressure Reducing Valve |
| DSC02498.JPG | Inject Wellhead with Insulation |
| DSC02499.JPG | Insulation Close-up |
| DSC02501.JPG | Insulation Close-up |
| DSC02502.JPG | CCD-OWA |
| DSC02504.JPG | CCD-OWB |
| DSC02506.JPG | CCD-OWC |
| DSC02517.JPG | Santa Fe Community College Well |
| DSC02520.JPG | Rancho Viejo Observation Well |
| DSC02337.JPG | El Rancho Well |
| DSC02338.JPG | La Cienega Well |

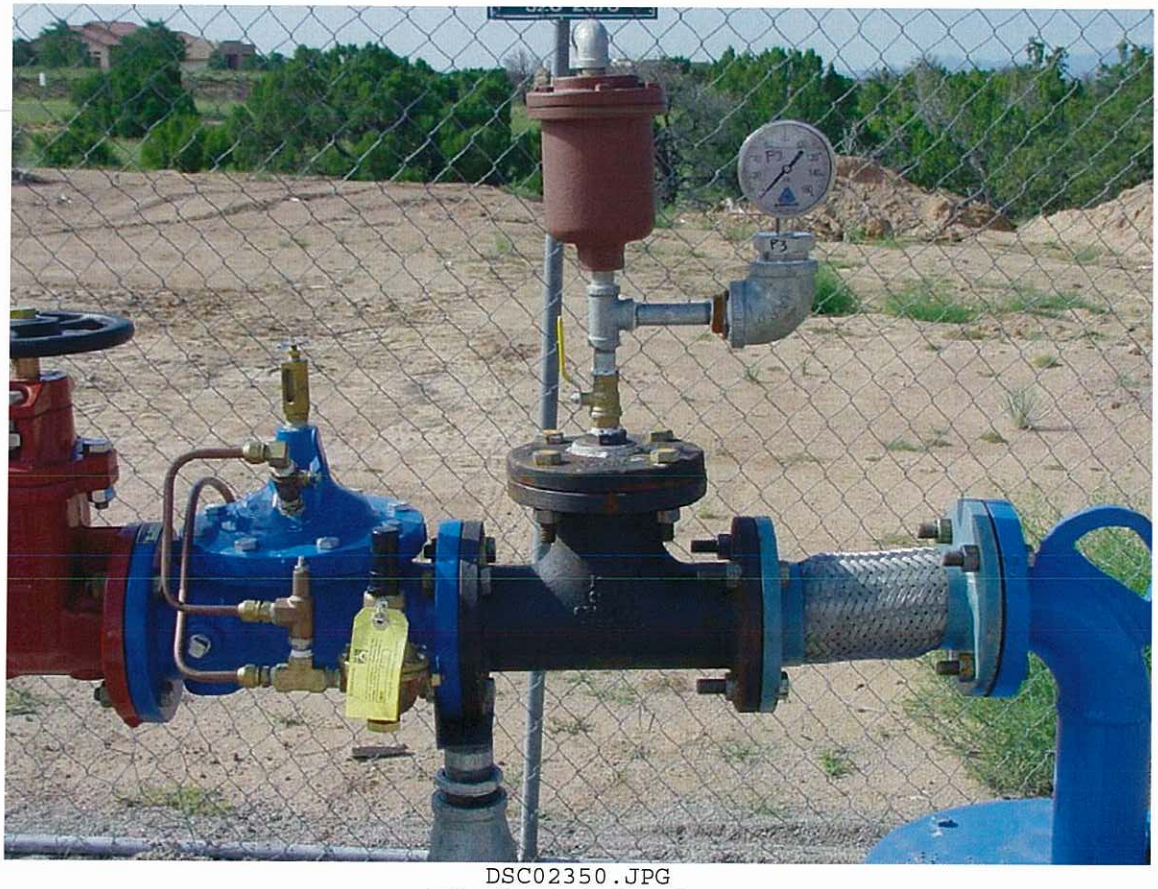
DSC02341.JPG
8/28/2006 10:56:28 AM

DSC02344.JPG
8/28/2006 10:57:43 AM

DSC02345.JPG
8/28/2006 10:58:05 AM

DSC02346.JPG
8/28/2006 10:58:38 AM

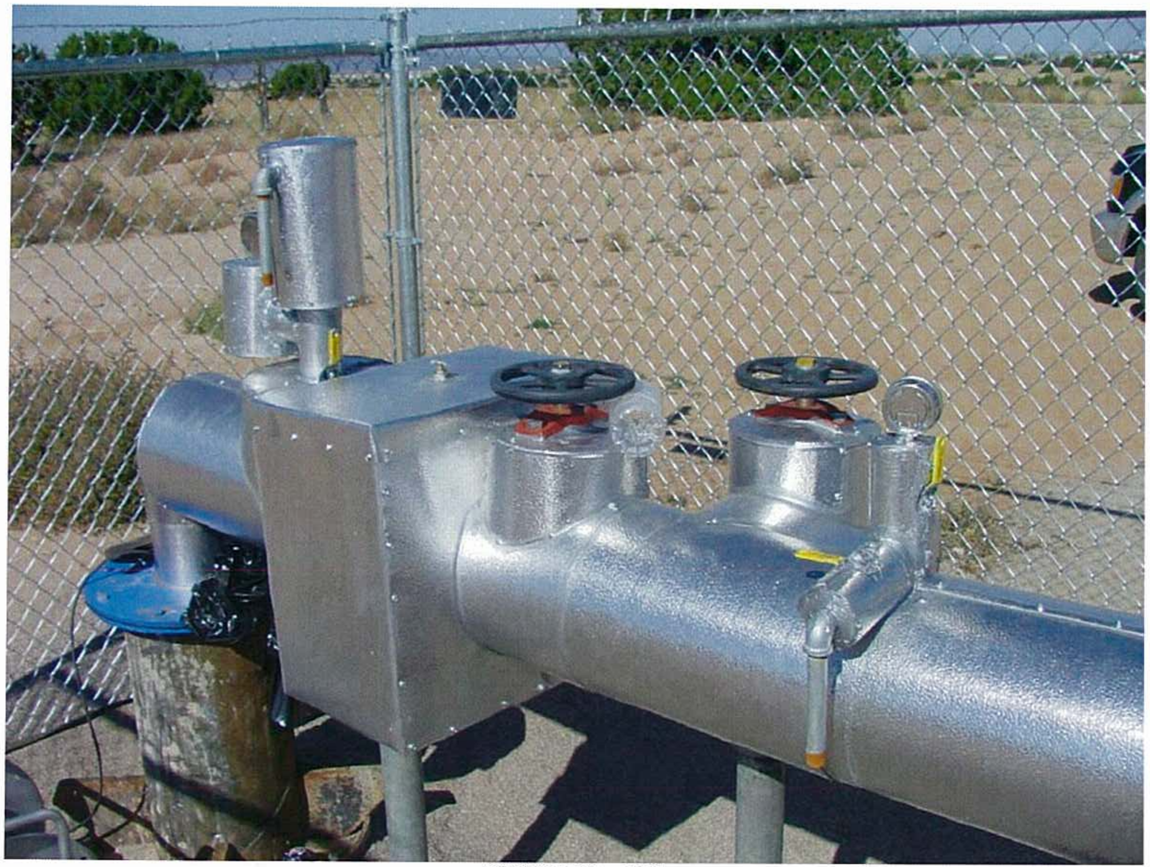
DSC02349.JPG
8/29/2006 9:51:16 AM



DSC02350.JPG
8/29/2006 9:51:46 AM

DSC02498.JPG
10/31/2006 11:56:29 AM

DSC02499.JPG
10/31/2006 11:56:53 AM



DSC02501.JPG
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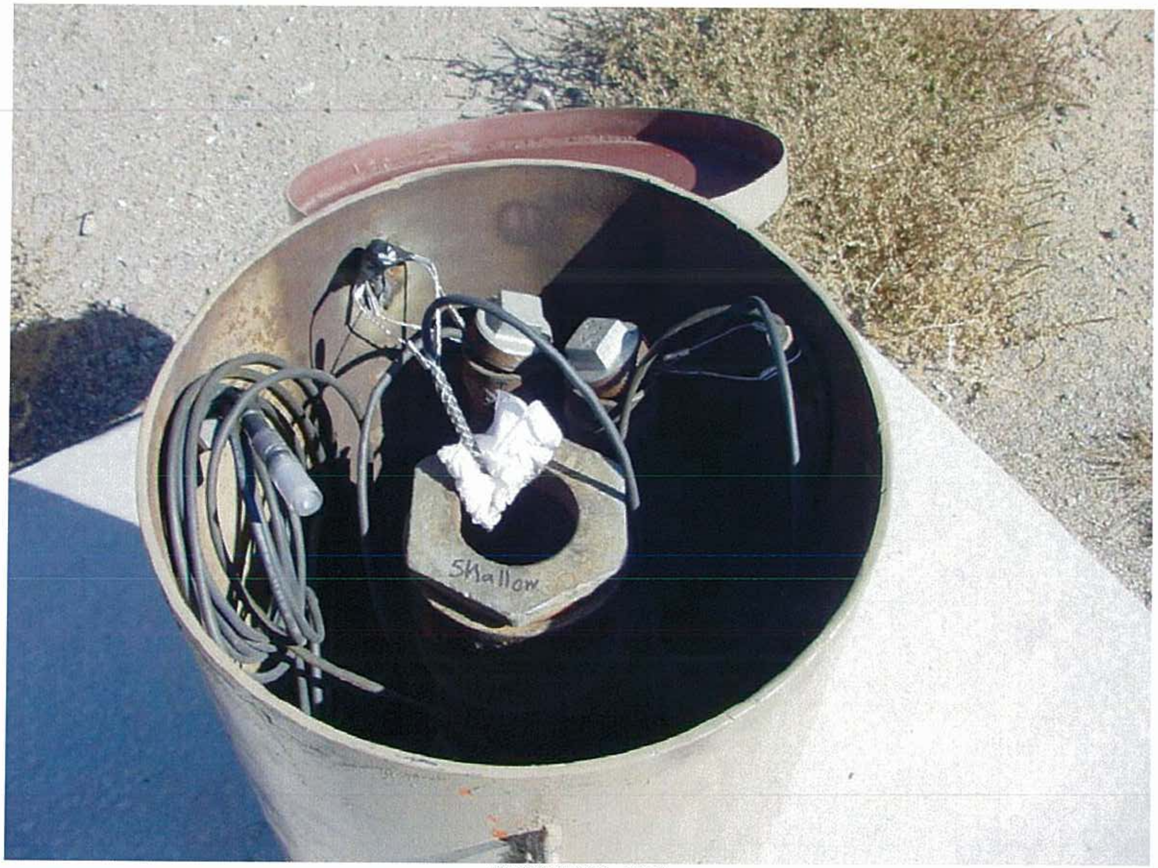
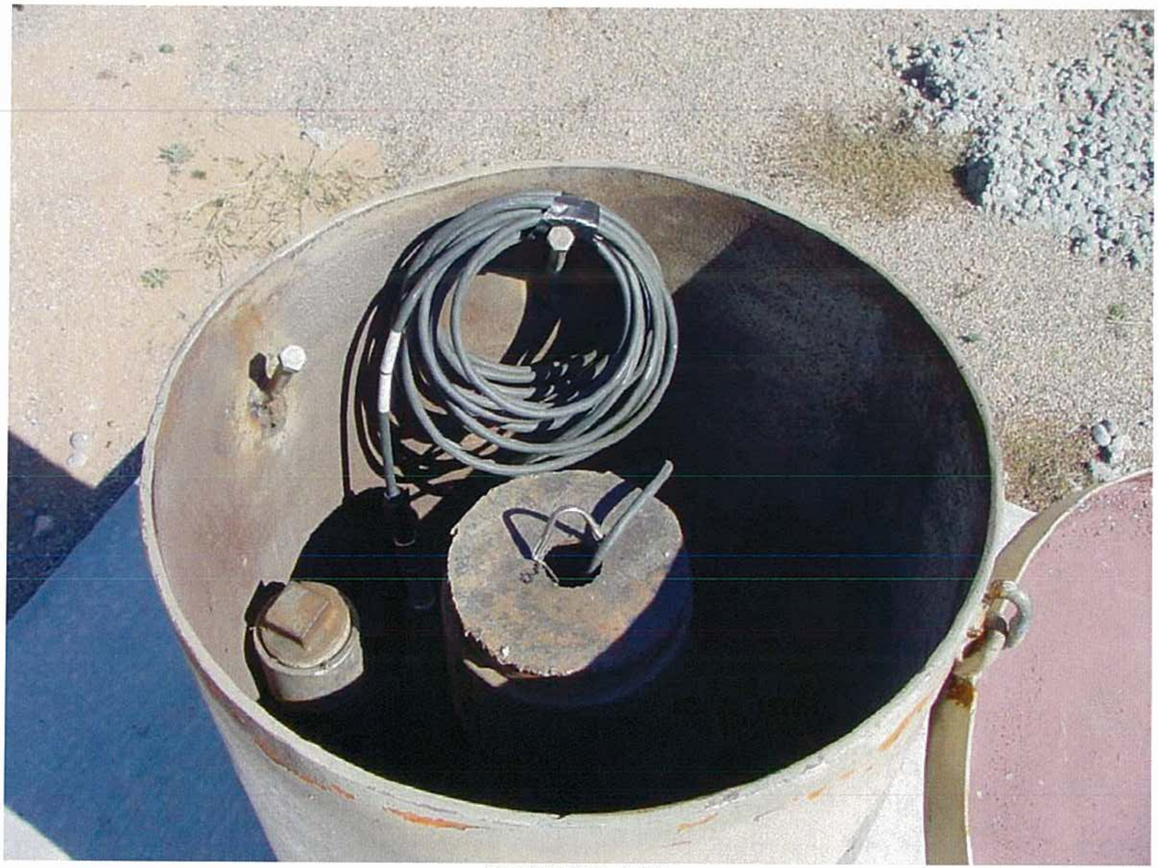


DSC02502.JPG
10/31/2006 12:33:25 PM

DSC02504.JPG
10/31/2006 12:36:09 PM



DSC02506.JPG
10/31/2006 12:52:23 PM

DSC02517.JPG
10/31/2006 2:28:10 PM

DSC02520.JPG
10/31/2006 2:54:35 PM

DSC02337.JPG
8/10/2006 11:45:12 AM

DSC02338.JPG
8/10/2006 4:51:53 PM

# APPENDIX F

# FIELD NOTES AND SHEETS

Rancho Viejo

~~Apr~~ May 2006 - Aug 2006

Peninsular

FIELD BOOK
50% RAG
64 PAGE
FB 3N2

5/26/06 CWC onsite 0745
Inj. wellfield
Download recovery data
Check water levels

offsite 0855

---

6/1/06 mtg w/ Comm. Sullivan
Sullivan's well Lujan - Driller
4/3/98
~~400~~ 420 ft deep RG 69393
serves 4 houses
300-400 screen
4½ inch csg
DTW 335 (well record)
10-12 gpm
on trib. to Arroyo Hondo
old stock dam

air in water
pump "shuts" off
started when inj well
drilling began

1200 gal tank
2 pressure tanks

DTW 382.5 ft d/w, just below
top of screen.
pressure → 56 psi
pump came on for ~ 1 min.

6/1/06 CWC onsite
Inj wellfield
Downloading data, measuring
water levels

6/6/06 CWC onsite 1415
Inj wellfield
Downloading data
Delivered package to Jon Paul.
set xducer in CCDP1

offsite 1500

6/19/06 CWC and Mick B.

Onsite 11:00

pulling transducers for Rodgers to complete wellheads

| Solinst<br>2000 VG | Tape | cumul. |
|---|---|---|
| 0 - 100 | 100.20 | .2 |
| 100 - 200 | 100.15 | .35 |
| 200 - 300 | 100.15 | .50 |
| 300 - 400 | 100.60 | 1.10 |

Offsite 13:15

[redacted]

6/21/06 measured w/ Jeff watson.

New data on Inj wellfield

OWA shall 2.58' above top Surf csg
Deep (South) 2.62' " "
Int (north) 2.55' " "

OWB 2.92 ft top surf csg to
top protective csg
5 inch — 0.36 = 2.56
piez — 0.39 = 2.51

OWC 2.50 above top Surf csg
piez 2.21 above " "
~~75~~
[illegible]

Inj well not cut down yet

6/28/06 CWC onsite 1400
CCD Injection Wellfield

Re-installing transducers.

Can't remove cap from OW-C
~~dee~~ shallow piez - let
Seth know

offsite 1625

8/10/06 CWC onsite 0830
Setting transducers in
Inj well, OW-A shallow,
CCD-X1 and RV Obs well.
Checking access to LaCienega
and El Rancho wells.
Inspecting pipeline and
valving installation.

☐ Arrange for wellhead elev.
survey

Injection well - eductor pipe
installed. Piezometers cut to
final height.

CCD-I1
M.P. height above surf csg
Inj well sounding tube 2.01 ft
shal ~~deep~~ piez 1.04 ft
deep ~~shal~~ piez 0.68 ft

☒ tape ~~sha~~ OW A shallow kellum
☒ tarp over inj well xducer reel
☒ tape over inj well sounder hole
☐ Remind J Watson → Obs C
lid & piez cap

El Rancho Well
213.85 11:38 am Solinst 300
access for transducer and
m scope available (need pliers
and wrench to remove plug)
brake on windmill not set,
breeze or wind can activate
pump
☐ set brake on windmill
Transducer S/N 316 failed
RV obs well
nearby windmill operating
205.10 ft 15:20 toc
w/ Powers 1000'

Getting to RV obs well

S. on Richards from Rodeo Rd.

wind through ~~[illegible]~~ Rancho Viejo

~~23137 SR~~ houses. Just before

AIAI entrance, turn left on

Amer Indian Arts Inst.

rough dirt road. At fence,

turn left. At RR grade

turn right. Go to windmill.

RV obs well is NW of windmill

~ 150 ft

☑ La Cienega well

227.37 toc 16:45 solinst 300

well operating

no transducer access

☐ Contact McKinley → when

shutdown wells?

offsite 1700

---

8/17/06 CWC onsite 10:10

CCD-Pl

213.90 (1440)

offsite 1630

Rancho Viejo
Aug 2006 —

Peninsular

FIELD BOOK
50% RAG
64 PAGE

FB 3N2

8/23/06 CWC onsite 13:45

CCD-P1

pump has power

All ~~ast~~ valves installed

No pressure switch yet

pipe supports not yet in place.

Transducers set to 1 min

Pump Started ~ 14:52

ccw less flow } FCV
cw more flow } FCV

before FCV

| psi | Q |
|---|---|
| 35 | 113 |
| 180 | 70 |

Offsite 1645 mi 110

---

8/24/06 CWC onsite 10:10

Flushing pipeline

Testing flowmeter.

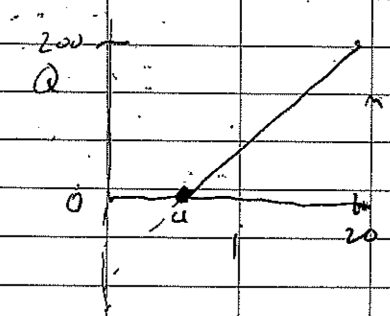
Kerry, Jason and ______

from Rodgers assisting

Flowmeter

0 gpm @ 4 ma
200 gpm @ 20 ma

$Q = 12.5 i - 50$



$m = \frac{200}{16} = 12.5$

$b =$

Time for water to travel from CCD-P1 to CCD-I1 16 min

Inj flowmeter was stuck - opened up body and cleared blockage, works ok

Dataloggers reading and storing flowmeter data.

Using 2 12 V batteries to power flow meter; need 110 VAc power and trasformer to 24 VDC for 6-mo test.

During pipeline purge
CCDP1 flow 100 gpm { 70 psi upstream, 25 psi downstream of FCV
CCDF1 flow 99 gpm → 0 psi (gate valves open)

pipeline purged from ~ 1215 to 2:45, chlorine added to CCD-P1 about 2:45
CCDP1 shut off @ 3:30

offsite 17:15

mi → 120

| | | |
|---|---|---|
| | Kerry (Rodgers) | 280-3733 |
| | Jason (Rodgers plumbing) | 203-6122 |
| SFCC | Ann Probst | 428-1340 |
| | Henry McKinley | 471-4321 |
| SFCC | Frank Joy | 428-1225 |
| | Jeff Watson | 280-0867 |
| | Jon Paul Romero | 780-0376 |
| | Frank Joy cell | 690-6509 |
| | Rancho Viejo | 982 6921 |
| | Sean @ McCrometer | (951) 652-6811 |
| 7/3/07 | Tech Support<br>office | (505) 428-1670 |

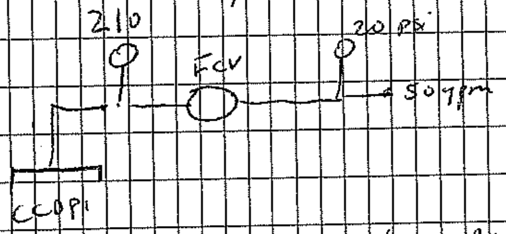
8/25 phoncon w/ Jeff W.

- concrete pads/pipe stands are in
- pressure switch is in office
  → will be installed Mon a.m.
- fencing → 2 or 3 weeks away?
  temp. fencing up next week
- 110 VAC power for both wellheads
  - ok for CCD-P1
  - issue for CCD-I1

---

8/28/06 CWC onsite 0820
CCDP1
Starting 6-mo test today

FCV - set to 51 gpm w/
~~no downs~~ 20 psi downstream,
upstream pressure is 210 psi



at CCDP1
Surge relief valve needs inflow line from system + not installed

290 + 70 = 360 ft

Orifice at inj well

300 ft head → ~48 gpm

277 ft head ~46 gpm

323 ft 50 gpm

experation @

startup → 23 ft head ~ 10 psi

at inj wellhead

CCD-P1 wellhead:

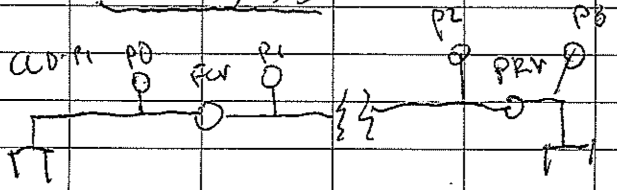
downstream pressure gage wrong — replaced. Now indicating ~50 psi during pipeline purge

(8 psi @ CCD-I1)

Starting head @ inj well

18.25 ft

Pressure gauges



6 mo inj start 15:25

15:28 51 gpm → 12 psi P2

15 24 49 gpm

1538 45 gpm 16 psi P2

1555 stopped flow to inj well w/ gate valves

30 min @ ~ 45-50 gpm

∴ 1500 gal injected

pressure testing line overnight

offsite 1705

(110 mi)

8/29/06 CWC onsite 0930

Jeff W and

Greg B here

Pipeline passed pressure check — removed pressurized @ 100 psi overnight

Draining pipeline @ inj well

(Started ~ 9:15)

water is clear during drainage from pipeline

Elevations

| | | | |
|---|---|---|---|
| 6 ft | CCD P1 | 6560 | |
| | Inj | 6483 | > 83 ft |
| | air valve | 6566 | ≈ 36 psi |

pipeline drained out ~ 0950

pump on 100 gpm ~ 0955

NOTE: PRESSURE GAGES STICK → TAP BEFORE READING

water arrived ~ 1005 clear, air

10:10 clear, air

10:12: air out

steady 100 gpm

water cloudy

10:30 water cloudy

Drop pipe dia 2.5 inch

$r = 0.104$ ft

$A = 0.034$ ft$^2$

$300$ ft $\times .034 = 10$ ft$^3 \times 7.48 \frac{\text{gal}}{\text{ft}^3}$

$V = 76$ gal

@ $\phi = 3$ inch → $V \approx 110$ gal

PRV @ CCD-P1

Turn CW to increase downstream pressure

Turn CCW to increase

range 2-30 psi ~3 psi/rev

pre-set @ 10 psi d.s. pressure

speed adj - CW to make valve close slower

Start ≈ 11:00

| | P0 | P1 | P2 | P3 | F1 | F2 |
|---|---|---|---|---|---|---|
| 1050 | 80 | 55 | 0 | 0 | 100 | 100 |

10:52 M1 = 66000, M2 37700 } 100 gpm } *estimate @ 11:00*

| time | P0 | P1 | P2 | P3 | F1 | F2 |
|---|---|---|---|---|---|---|
| 1102 | | 100 ↳ dumping | 84 | 8 | 92 | 43 |
| 1105 | adjust flow @ CCD P1 pump shut off | | | | | |
| 1110 | 220 | 70 | 42 | 18 | 50 | 47 |

water clear

Adjust PRV to read 30 psi
~~dow~~ @ P3 @ ~11:15

| | P0 | P1 | F1 | P2 | P3 | F2 |
|---|---|---|---|---|---|---|
| 1117 | 220 | 52 | 55gpm | 47 | 31 | 49 |

FCV was stuck, Kerry
fixed @ ~ 11 30

| | | | | | | |
|---|---|---|---|---|---|---|
| 1132 | 220 | 38 | ~~49~~ 50 | 74 | 31 | 49 |

→ 7 ft head ~~ed~~ rise
water clear

| | | | | | | |
|---|---|---|---|---|---|---|
| 1145 | 220 | 38 | 51 | 74 | 30 | 49 |

1210 shutting down → FCV
failing,
m1 = 71500
M2 = 42400

1405 opened valve
@ inj well
pump on
purging well / line for inject
startup

## — START 6-Mo TEST —

1500 Initiating injection
vacuum on air relief
10 psi on P2
2 min for
drop pipe to fill

| | P0 | P1 | F1 | P2 | P3 | F2 |
|---|---|---|---|---|---|---|
| 1505 | ~220 | 20 | 50 | 26 | 20 | 50 |

FCV @ CCØI opened

| | | | | | | |
|---|---|---|---|---|---|---|
| 1514 | 215 | 70 | 54 | 50 | 29 | 51 |

Backed adj of PRV to P3 = 25
NO Δ in flow

| | | | | | | |
|---|---|---|---|---|---|---|
| 1529 | 220 | 85 | 51 | 75 | 25 | 51 |

☑ Rodgers → replace P2
drill hole for air relief
in CCΔ-I1

| | | | | | | |
|---|---|---|---|---|---|---|
| 1544 | 215 | 65 | 51 | 70 | 25 | 51 |

Need:
- hole in CCΔ-11 csg
- locks for fence / gate
- 24V DC power (loggers)

Offsite 1600

mi 120

8/30/06 CWC Onsite 10:45
6-mo Inj test
underway

10:50 Inj well
F2 50 gpm
P2 56 psi
P3 24 psi
water → clear - bubbles?

1105 Prod well
P0 215 psi
P1 36 psi
F1 51-52 gpm
water clear, fine bubbles
NO evidence of surge
valve release

CCDP1 Drawdown = ~40 ft
CCDX1 " = ~22 ft

use to calculate back pretest totalizer
11:30 F1 totalizer = 140900
11 50 F2 totalize = 110900

Set CCDP1 CCDX1 transducers to
log 1 hr
Set F1 datalogger to log half hour

Note - fence builders on site - using some water from sample port to mix concrete -

El Rancho xducer OK
Did ~~get~~ not check RV obs well

Inj well mounding = 25 ft

1205 F2 = 50
P2 = 63
P3 = 24
Set F2 logger to ½ hour
Set CCD-F1 & obs well
xducers to 1 hr

offsite 1245

---

Jason 14:30 8/31/06
P0 215 psi
P1 62 psi
F1 ~~flow~~ 49-50 gpm
P2 71 psi
P3 22 psi
F2 49 gpm

9/1/06

Henry McKinley
will shut down La Cienega
well in early Oct

9/1/06 CWC onsite 11:30

CCD-P1

P0 215 psi
P1 64 psi
F1 48 ~~[illegible]~~ -49 gpm (fluctuating briefly to 50 gpm)

water clear, bubble free
no evidence of surge valve discharge

F1 totalizer 287200

CCDP1 drawdown ~ 45 ft

Flow Datalogger battery 25.92 V

CCD-I1

F2 49 GPM
P2 74 psi
P3 24 psi

Buildup in CCD-I1 39 ft
water clear, no bubbles

Flow logger battery 25.87 V

- ☐ measure all WL
- ☐ Call Frank Joy SFCC → check well
- ☐ fix Solinst 500
- office ☐ Plot inj well temp
- ☐ RV obs well
- ☑ El Rancho well

RV Obs well
Cows knocked over transducer cable reel.
Transducer & cable ok

El Rancho well
transducer and cable ok

14:50 CCD-P1
P0 215 psi
F1 48-49 gpm
P1 53 psi

1500 Air relief near Richards/Avenida del Sur is wet, wet soil below ~~[illegible]~~ set into "manhole".

15:05 CCD-I1

48 to

F2 49 gpm

P2 60 psi

P3 24 psi

15:07 Increased P3 to 28 psi w/ PRV.

F2 stable @ 49 gpm

P2 dropped to 54 psi

15:15 CCD-P1

F1 49 gpm ~~steady~~ 48-50 fluctuating

P1 36 psi

P0 215 psi

1605 CCD-P1

F1 49-51 gpm

P1 40 psi

P0 215 psi

water "fizzy" but clear

1612 CCD-I1

P2 47-48 psi

P3 28 psi

F2 49 gpm

water fizzy, but clear

---

offsite 1620

9/5/06 Tues

CWC onsite 09:30

CCD-I1

P2 75 psi

P3 28 psi

F2 48 gpm tot = 529600

water clear — no bubbles, no color

CCD-I1 buildup 50 ft

CCD-P1 09:50

P0 210-215

P1 65-66

F1 50 gpm (fluct. to 49)

Surge relief has discharged water "fizzy".

CCD-P1 drawdown ~ 50 ft

10:05 second sample - water clear, no "fizz"

10:05 totalizer 572400

Flow logger bat 25.5V

Rodgers i Co observations

Saturday 9/2/06 11:00

P0 210

P1 100

F1 51 gpm 356800 gal

Surge valve discharging (trickle)

P2 100 +

P3 30

F2 49 323000 gal

~~Monday 9/4/06~~

Tues 9/5/06 06:30

P0 210

P1 100

P2 100 +

P3 29 - 30 psi

surge valve trickling

CCD-P1 13:00

P0 210 - 215 psi

P1 65 psi

F1 48 - 49 gpm

230.87 ft 13:15

SFCC well

"SFCC Grounds Supervisor"

Manuel Gomez

→ 670 - 3218

[ Gilbert

920 - 6777 cell ]

I left Solinst 300 in SFCC well for future measurements

CCD-I1 13:25

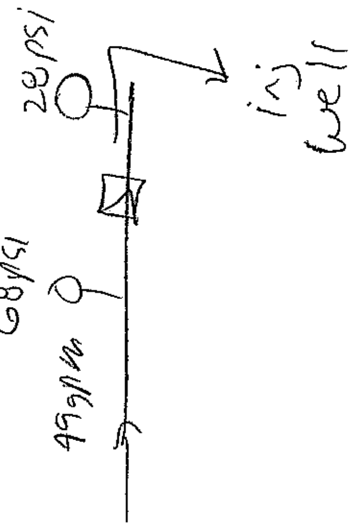
F2 48 - 49 gpm

P2 72 psi

P3 28 psi

offsite 13:30

WTB Observations



Sunday 5pm
Sept 3 2006

9/8/06 CWC Onsite 0935

CCD-I1

F2 48 GPM 740600 gal
P2 >100 psi
P3 28 psi
Water clear, no fizz

- ☒ roll sol?mer 500
- ☒ meas. all water levels
- ☐ STCC – contact, measure
- ☐ daily check sheet
- ☒ lower CCD I1 xducer to >330
- ☒ Δ PRV spring

CCD-P1 09:55

P0 210 psi
P1 100 psi
F1 53 gpm 791900 gal
Surge valve dumping
~3 gpm

CCDI-1

10:04 changed PRV setting to 32 psi
(one full turn CW)
F2 → 49 gpm

P2 still >100 psi

10:06 1 turn ccw PRV
P2 to 35 psi
F2 → 49 gpm
1 more turn
P2 to 38 psi
F2 to 50 gpm
P1 still >100 psi

CCD-I1 buildup ~ 54 ft

mtg w/ JP Romero
- ☐ enclosures?
- ☐ solar pwr ← Phil → solar
- ☐ Jeff - 1:00
- ☐ PRV spring
- ☐ Frost

→ Thermostat + solar
→ JP ok pressure xducer

- ☐ check budget; redo
- ☐ send charts

Jason and Marcus
on site ~ 1245
Adjusted FCV ~ 1/4 turn ccw
to reduce flow
(was flowing near 55 gpm
when Jason got on site)
13:00
P0 210 fluctuating
P1 56
F1 52-53 gpm

1302 3/4 turn ccw on FCV
F1 → 50-49 gpm
P0 → 210
P1 → 36 psi dropped
to ~ 20 psi in couple
of minutes

1315 CCD-I1
P2 29
P3 22
F2 47

Jason swapping spring in PRV
to red (15-75 psi)
No problems

1330

PO 210 - 212 psi
P1 19 psi
F1 51 gpm

14:45
PO 210 psi
P1 8 psi
F1 45 gpm

increase flow @ FCV to 48 - 49 gpm
(turned about 1/2 turn)

1500 Pressure building
F1 jumped to 53 gpm
with no adjustment
P1 up to 20

CCD-P1
303.82 sol500
127.11 xducer
x3093

1510 - 1/2 turn CCW
at FCV, F1 → 50 gpm

P1 → 22psi

---

15:30 PO = 210
P1 = 20 psi
F1 = 50 - 51 gpm
15:50 same as above
16:10 F2 48 gpm
P2 30 psi CCD-I1
P3 24 psi
water clear, no fizz

1650 CCD-I1
P2 30 psi
P3 24 psi
F2 47 gpm

1637 CCD-P1
PO :210
P1 20 psi
F1 57 gpm

Conclusion:
FCV is operating wrong
and/or flow meter F1
is operating wrong

off site 17:15

9/11/06

Jason had to shut down
this morning to troubleshoot.
~~F1 - 51 steady~~
~~F2 - 50 steady~~

~~backflushed no color~~
re-oriented orifice so sensing port
is on side instead of on
bottom

Flushed system as before
now operating at ~50 gpm

F1 - 51 gpm steady
F2 - 50 gpm steady

9/12/06 CWC ; Mick B
Onsite 10:20

F1 51 gpm 1072300 gal
P0 210 psi
P1 43 psi
water fizzy
Flow logger battery 25.01V

11:30
F2 51 gpm 1016200 gal
P2 51 psi
P3 44 psi
water slightly fizzy

air in sight gage of
PRV - cleared out w/
valve. Did not affect
settings
Flow logger battery 25.02V

Comm College 228.40
(SFCC) 13:15

13:50 CCD-F1
F2 50-51 gpm
P2 48 psi
P3 45 psi

Offsite 1400

SFCC 15:07 229.80

9/12 phoncon w/ Jeff W.

- Insulating sleeves should be done mid-next week
- B Electric → 110V power @ CCD-P1 end of week
- CCD-X1 - 12V system for heat tape is better for solar power.

RV, inj
8am 9-13-06

F2 = 51 gpm
1,080,800

P2 = 51 psi us
P3 = 46 " ds

9/24

R.V. SFcc: 230
1558 - 17.5
212.5

10/4/06 CWC onsite 1620

CCD P1 wellfield

- Δ Prod well flowmeter batteries
- meas Prod well WL
- Check CCD X1 xducer
- " RV OW "

P0 209 psi
P1 46-47 psi
F1 < ~~50~~ 51 gpm 2737700

DTW 51.420 ft CCDP1
@ 16:40

CCD-X1 Transducer ok - communicated w/ newer cable (note - could not engage connector ~~cable~~ fully on Xducer cable side)

RV obs well
transducer ok

- needs new dessicant cap
- CCDX1 Xducer needs new batteries

10/10/06 R.U.
SFCC
15 28 228.54
10/24 230.
1455- 2.91

---

10/26/06 CWC onsite 10:30.
CCD-P1 site
w/ Kerry from Rodgers

PO - ~~closed~~ [illegible]
P1 - 72 psi
F1 - 53gpm 4379800

Kerry adjusting rate w/
FCV ~ ½ turn
~ 10:45
P1 48 psi
F1 49-50 gpm

La Genega well
Kerry rotated well to improve access
DTW 225.50 top plate
Powers 500
hangs up a little @ ~100 ft

Kerry can jack well, move
over a little to eliminate
the catching point. need
to get Rancher's
permission first.

11:20 F1 = 50-51 gpm
P1 = 46 psi
PO = 105 psi

CCD - E1
F2 = 50 gpm
P2 54 psi
P3 47 psi

offsite 11:40

10/27/06
Mike - Duran Plumbing -
F1 - 50 gpm
F2 - 49 gpm

10/31
SFCC well
1327 227.30

11/14/06
RVSFCC Well
226.81 @ 1253

12/27/06 CWC Onsite 0930
Rancho Viejo
measuring water levels, downloading
transducers: Injection test
going ~ 4½ months.
No field visit last week
due to weather.

E/Rancho 214.00 ft

SFCC 226.59

offsite 15:45

226.69 - CFCC @ 1412

---

1/10/07 CWC Onsite 0730
Rancho Viejo pumping/
injection wellfields
- measuring water levels
- downloading transducers &
loggers.

SFCC
225ft notebook
2 lengths
+

CCWP1 24.11 ✓
9906200 gal
318.12 @ 8:10

OWB 282.74 10:40 226.54
piez 290.19 10:45

Offsite 12:00
mi 110

2/26/07 CWC and MB

Onsite 11:30

Prepping for shutdown tomorrow

1350 RV obs 204' -

=

on Powers 500 ft er

windmill brake

engaged

samples pulled @

CCDP1 @ ~1330

CCDP1

Conductivity 19° 225 umhos/cm

offsite 1500

---

2/27/07

CWC & MB

Onsite 0830

Injection 6-mo

test shutdown

today

10:00 inject flowmeter

1268460

OWB sh piez

288.71 @ 10:21

Ron Detmore

690-5247

Final flowmeter (pumping)

1336160

RV obs 203.97 ft toc

@ 11:29 (Powers)

windmill brake engaged

OWB sh piez

288.66 @ 1156

offsite 15:30

2/28/07

El Rancho 213.97 @ 11:49

CC 12:25 226.47

3/2/07

CWC onsite 0740

~~offsite~~ measuring WL's

downloading xducers

offsite 0850

115 mi

3/6/07 CWC onsite 15:30

CCD wells

offsite 100 mi

1645

3/13/07 CWC onsite 1400

CCD wellfield

- ☒ meas WL's
- ☒ reset xducers to 4 hrs
- ☒ move deep OW x to RV obs

offsite ~~1641~~ 1645

120 mi

3/30/07 CWC onsite 0900

Dawson survey (Dennis)

surveying wellhead XY and

elevation.

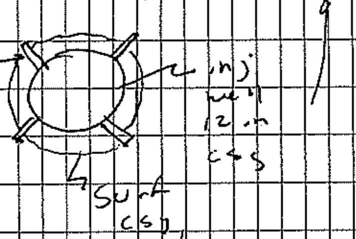
inj wellhead not

completed - surveying

~~N side top of surf csg~~

top of fin on NW

side



NOTE: Transducer

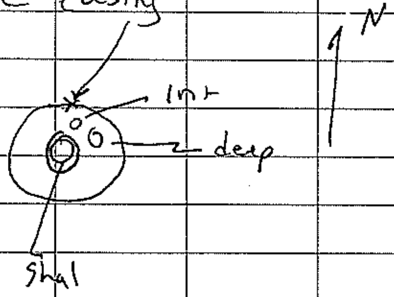
time is not

adjusted for DST

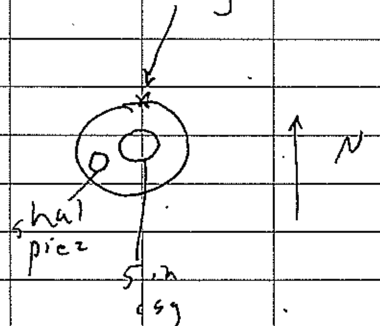
(1 hr earlier than

actual time)

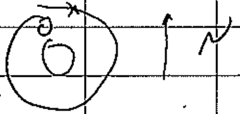
CCD-OW
~~Obs~~ A survey pt
N. side top of
protective casing



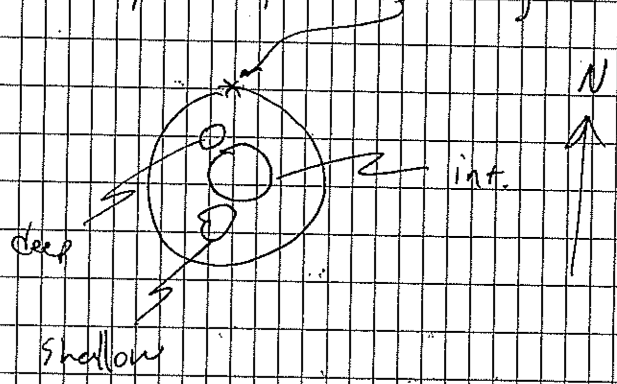
CCD-OWB . survey pt
N. side top of
protective csg



CCD-OWC survey pt
N side top of
protective csg

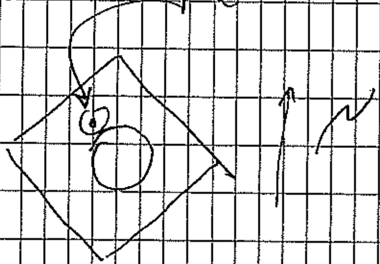


CCD-X1
Survey pt ~~top~~ N side
top of protective csg



| | | | |
|---|---|---|---|
| X1 | S | 237.60 | 1.570 |
| X1 | D | 234.17 | |

CCD-P1
NW side of
well csg on
concrete pad

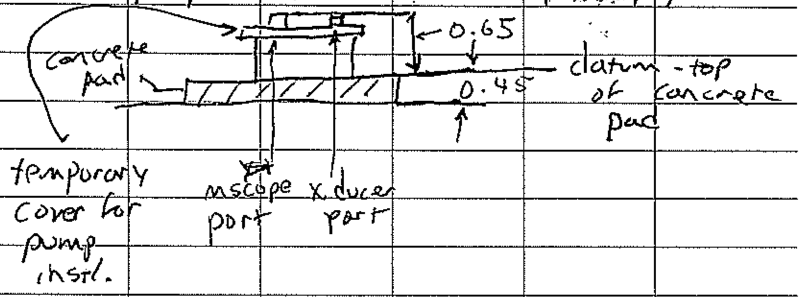


SFCC 226.41 11:06

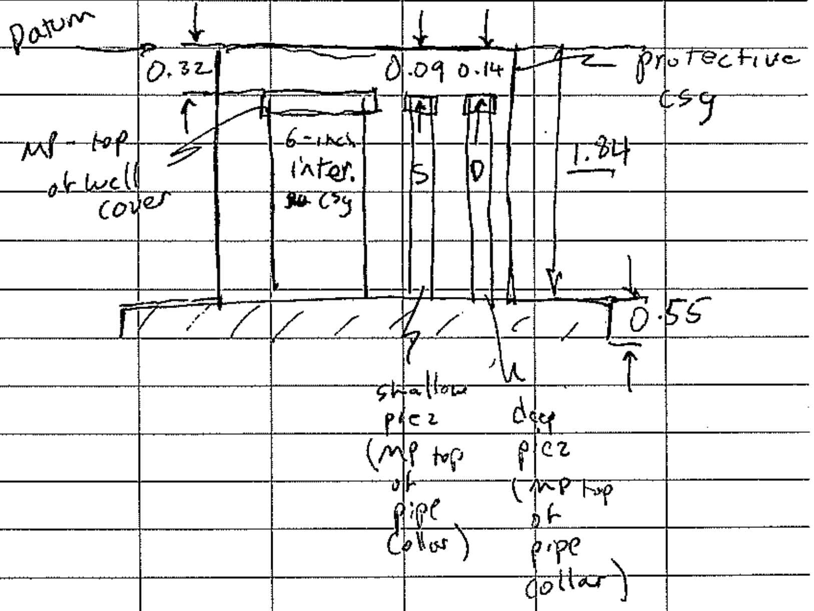
3/30/07

# M.P. Offsets from Datum (all units = ft)

## CCD-P1 (Temporary configuration w/ pump installation for 6-mo. test)



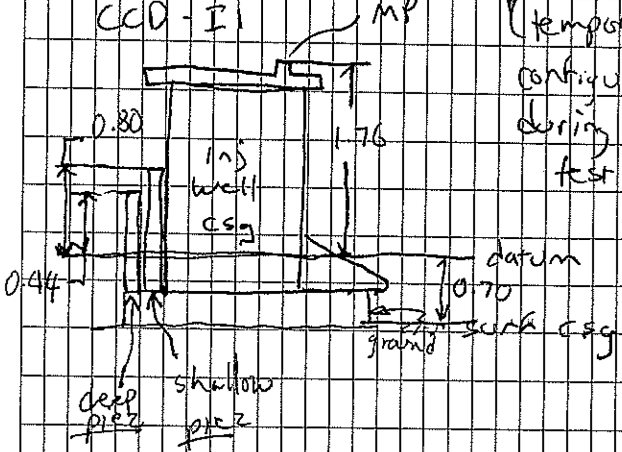
## CCD-X1 (permanent configuration)



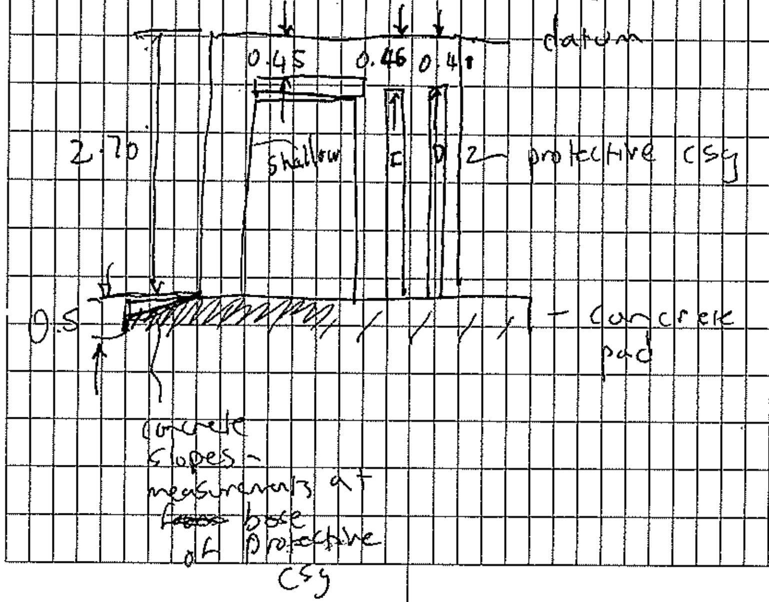
## CCD-I1

(no concrete pad)

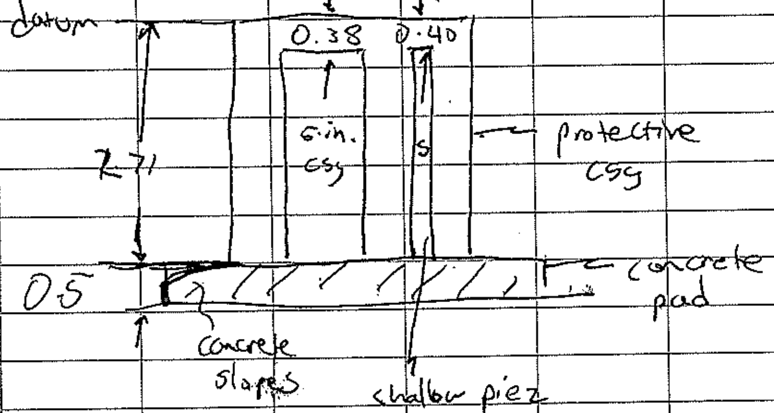
(temporary configuration during 6-mo test)



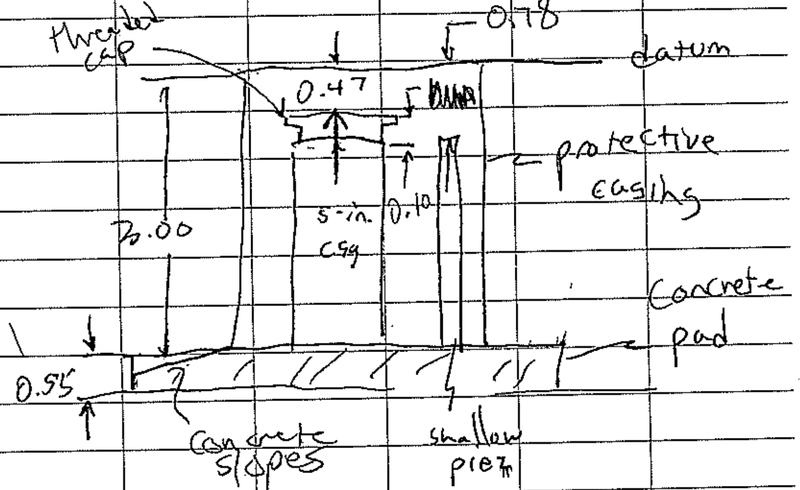
## CCD-OWA (permanent configuration)



CCD-OW B (Permanent Configuration)



CCD-OWC (Permanent Config.)



Offsite

13:30

4/18/07 CWC onsite 1350

Inj test + recovery measurements / downloads

SFCe well ______ ft

Could not open lock - Combo change?

Grass looks watered, soil damp.

Well probably in use.

Solinst 500

CCD-7I

|  |  |  |
|---|---|---|
| shallow | 315.73 ft | 1600 |
| deep | 288.02 ft | 1605 |

Changed all clocks to daylight savings (1 hr forward)

| | | |
|---|---|---|
| OWA shal | 289.03 ft | 16:10 |
| OWB shallow piez | 292.35 | 1620 |
| OWC sh piez | 236.36 | 1630 |
| CCDX1 sh piez | 236.65 | 1650 |
| CCDX1 deep piez | 234.15 | 1655 |

Offsite 1700

Viejo

- All WL's
- pull RV obs xducer, ✓ set in CCD-P1 ✓
- pull BGW xducers, return ✓ to office
- Get 300' solinst SFCC λ

5/25/07 CWC onsite 0900

Checking water levels, downloading transducers.

CCD-P1 256.41 ft @ 10:00

pulling BGW xducer

El Rancho well - brake off, pumping. No more observations.

offsite 13:30

mi 120

7/3/07

1115 - BGW on-site (Mick & Bill) at injection well

1330 - Downloaded all x-ducers and measured water levels. Never could get hold of Frank Joy, left 2nd message.

1345 - Called Manual Gomez (SFCC Grounds Sup.) left message. No answer on the number for Gilbert.

1350 - BGW off-site

* Frank Joy returned call @ 1425. He said that Manuel Gomez should be the contact for access, and we can always call the office for help--- 505-428-1670

670-3218

---

9/19/07

1350 - BJ on-site to download xducers and measure fluid levels. Called Manuel Gomez (SFCC), he will come to unlock SFCC well.

1410 - Retreived 300' Solinst.

1600 - Measured fluid levels and collected xducer data. BGW off-site

Replaced dessicant at injection well

COPY 06/0888

FILE

# FAX FROM

# RICH DURAN PLUMBING AND HEATING , INC.

17 B PASEO DEL ~~OSO~~
SANTA FE ,NM 87506
505-992-0306
505-992-0253 FAX

DATE 9-28-06

NUMBER OF PAGES [illegible] 4

TO [illegible] Valleau Ground water

FROM Rich Duran P&H 412-1284-

RE [illegible] Rancho Viejo Wells

MESSAGE

OCT-1

# Rancho Viejo Pump and Inject System Daily Check List

| Date | Time | Pumping Well | | | | | Injection Well | | | | | Comments | Initials |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P0 | P1 | F1 (gpm) | F1 (gal) | Water Quality | P2 | P3 | F2 (gpm) | F2 (gal) | Water Quality | | |
| 10-21-06 | 7:47 | 210 | 75 | 53 | 3984700 | Fizzy | 80 | 71 | 54 | 3878600 | Clear✓ | | |
| 10-21-06 | 5:15 | 210 | 75 | 53 | 4015800 | Fizzy | 80 | 71 | 54 | 3928500 | Clear✓ | | |
| 10-22-06 | 8:30 | 210 | 76 | 53 | 4064900 | Fizzy | 80 | 78 | 54 | 3978400 | Fizzy | | |
| 10-22-06 | 4:00 | 210 | 74 | 53 | 4088400 | Fizzy | 79 | 72 | 54 | 4002700 | Clear✓ | | |
| 10-23-06 | | | | | | | | | | | | | |
| 10-23-06 | 4:30 | 200 | 75 | 53 | 4167700 | Fizzy | 79 | 71 | 54 | 4084200 | clear | | |
| 10-24-06 | | | | | | | | | | | | | |
| 10-24-06 | 4:00 | 200 | 72 | 53/54 | 4249200 | Fizzy | 79 | 71 | 54 | 4159800 | clear | | |
| 10-25-06 | 7:30 | 200 | 72 | 53/52 | 4297800 | Fizzy | 79 | 71 | 54 | 4212400 | clear✓ | | |
| 10-25-06 | 4:00 | 200 | 72 | 53 | 4319800 | Fizzy | 79 | 71 | 54 | 4238300 | Fizzy to clear | | |
| 10-26-06 | 7:30 | 200 | 72 | 53 | 4370500 | Fizzy | 79 | 70 | 54 | 4290200 | clear✓ | | |
| 10-26 | 4:30 | 210 | 49 | 50 | 4396400 | Fizzy to clear | 54 | 49 | 50 | 4314400 | clear | | |
| 10-27-06 | 7:30 | 210 | 40 | 50 | 4414500 | Fizzy to clear | 49 | 40 | 49 | 4363800 | clear✓ | | |
| | | | | | | | | | | | | | |
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Normal Ranges
- F1 and F2 - 49 to 51 gpm
- P0 - 200 to 215 psi
- P1 and P2 - 30 to 90 psi
- P3 - 30 to 70 psi

Emergency Contacts
- Jon Paul Romero work (505) 983-6921 cell (505) 780-0376
- Jeff Watson work (505) 877-1030 cell (505) 280-0867
- Casey Cook work (505) 247-2000 cell (505) 252-0150

## Rancho Viejo Pump and Inject System Daily Check List

FAX

| Date | Time | Pumping Well | | | | | Injection Well | | | | | Comments | Initials |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P0 | P1 | F1 (gpm) | F1 (gal) | Water Quality | P2 | P3 | F2 (gpm) | F2 (gal) | Water Quality | | |
| 10-6-06 | 8:15 | 210 | 50 | 52 | 2861900 | Fizzy to Clear | 56 | 50 | 51 | 2781400 | Clear | | |
| 10-6-06 | 7:26 | 210 | 51 | 52 | 2896900 | Clear | 60 | 51 | 51 | 2816100 | Clear | | HL |
| 10-7-06 | 8:50 | 210 | 51 | 52 | 2939100 | Fizzy to clear | 60 | 52 | 51 | 2857600 | Clear | No (PO) Gauge ~~found~~ | |
| 10-7-06 | 4:00 | 210 | 43 | 50/51 | 2959600 | Fizzy to clear | 51 | 45 | 50 | 2877900 | Clear | | |
| 10-8-06 | 8:30 | 208 | 44 | 51 | 3012900 | " " | 52 | 46 | 50 | 2929360 | Clear | ~~F1 GPM Changes from 50 to 51 GPM~~ | |
| 10-8-06 | 4:15 | 209 | 52 | 51/52 | 3035800 | " " | 58 | 52 | 51 | 2952100 | Clear | | |
| 10-9-06 | 7:00 | 210 | 50 | 51/50 | 3088500 | " " | 56 | 50 | 50/51 | 3005100 | Clear | F2 GPM Changes from 50 to 51 GPM | |
| 10-9-06 | 5:00 | 210 | 53 | 51 | 3113800 | " " | 60 | 54 | 51 | 3029500 | Fizzy to clear | | |
| 10-10-06 | 7:40 | 210 | 53 | 51 | 3159400 | " " | 61 | 54 | 51 | 3075200 | clear | | |
| 10-10-06 | 5:20 | 210 | 43 | 50 | 3189800 | " " | 58 | 41 | 50 | 3105300 | clear | | |
| 10-11-06 | 7:30 | 210 | 43 | 50 | 3232800 | " " | 51 | 41 | 50 | 3140000 | Fizzy to clear | | |
| 10-11-06 | 6:45 | 210 | 50 | 51 | 3267900 | " " | 58 | 50 | 51 | 3182000 | Clear | | |
| 10-12-06 | 8:15 | 210 | 48 | 51 | 3309000 | " " | 53 | 49 | 50 | 3223500 | clear | | |
| 10-12-06 | 6:30 | 210 | 48 | 50 | 3340900 | " " | 53 | 49 | 50 | 3254400 | clear | | |
| 10-13-06 | 10:00 | 210 | 51 | 51/52 | 3393900 | " " | 59 | 51 | 51 | 3306900 | clear | | |
| 10-13-06 | 6:30 | 210 | 51 | 51/52 | 3415100 | " " | 60 | 53 | 51 | 3328000 | clear | | |
| 10-14-06 | 7:00 | 210 | 51 | 51 | 3454100 | " " | 60 | 51 | 51 | 3366600 | Clear | | |
| 10-14-06 | 4:00 | 210 | 51 | 51 | 3486600 | " " | 59 | 50 | 51 | 3394800 | Clear | | |
| 10-15-06 | 8:30 | 209 | 48 | 51 | 3533800 | " " | ~~48~~ | ~~56~~ | ~~50~~ | ~~3445700~~ | ~~clear~~ | | |
| ~~10~~ | | | | | | | 56 | 48 | 50 | 3445700 | Fizzy to clear | | |
| 10 15 06 | 4:30 | 208 | 50 | 51 | 3556700 | " " | 55 | 49 | 50 | 4368400 | " " | | BG |
| 10 16 06 | 9:30 | 209 | 48 | 51 | 3610300 | " " | 54 | 49 | 51 | 3522800 | " " | | BG |
| 10-16-06 | 5:20 | 210 | 48 | 51 | 3637800 | " " | 54 | 47 | 51 | 3550400 | " " | | |
| 10-17-06 | 8:30 | 210 | 47 | 51 | 3680800 | " " | 55 | 49 | 50 | 3591900 | " " | | |
| 10-17-06 | 5:30 | 210 | 50 | 52 | 3710700 | " " | 82 | 47 | 50 | 3620900 | " " | (Spike to 82 PSI) Called and | |
| 10-18-06 | 8:00 | 210 | 50 | 52 | 3754500 | " " | 58 | 50 | 50 | 3669700 | clear | talk with Jeff. | |
| 10-18-06 | 6:16 | 209 | 75 | 53 | 3787200 | Fizzy | 80 | 71 | 54 | 3696500 | Fizzy | Spike P2 & P3 GPM at 54 spike on P1 | |
| 10-19-06 | 7:30 | 209 | 75 | 53 | 3824600 | Fizzy | 80 | 71 | 54 | 3740700 | Fizzy | | |
| 10-19-06 | 6:21 | 204 | 75 | 53 | 3862000 | Fizzy | 79 | 71 | 54 | 3773500 | Fizzy | | |
| 10-20-06 | 9:15 | 209 | 75 | 53 | 3912900 | Fizzy | 80 | 71 | 54 | 3825100 | Fizzy | | |
| 10-20-06 | 5:55 | 209 | 75 | 53 | 3963800 | Fizzy | 80 | 71 | 54 | 3877100 | Fizzy | | |

Normal Ranges
- F1 and F2 - 49 to 51 gpm
- P0 - 200 to 215 psi
- P1 and P2 - 30 to 90 psi
- P3 - 30 to 70 psi

Emergency Contacts
- Jon Paul Romero work (505) 883-6921 cell (505) 780-0376
- Jeff Watson work (505) 877-1030 cell (505) 280-0857
- Casey Cook work (505) 247-2000 cell (505) 252-0150

Rancho Viejo Pump and Inject System Daily Check List

Fax:

| Date | Time | Pumping Well | | | | | Injection Well | | | | | Comments | Initials |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P0 | P1 | F1 (gpm) | F1 (gal) | Water Quality | P2 | P3 | F2 (gpm) | F2 (gal) | Water Quality | | |
| 9-21-06 | 8:40 | 209 | 54 | 53 | 1706600 | Fizzy to Clear | 60 | 54 | 52 | 1664800 | Clear | | |
| 9-21-06 | 8:08 | 210 | 45 | 51 | 1768700 | Fizzy To Clear | 54 | 49 | 50 | 1700800 | Fizzy | | RO |
| 9-22-06 | 8:04 | 210 | 48 | 52 | 1806100 | Fizzy | 54 | 49 | 51 | 1738500 | Fizzy | | RO |
| 9-22-06 | 6:38 | 210 | 50 | 52 | 1839000 | Fizzy to clear | 58 | 50 | 51 | 1770900 | Fizzy to Clear | | ML |
| 9-23-06 | 7:45 | 210 | 50 | 52 | 1886900 | Fizzy | 55 | 50 | 51 | 1811200 | Fizzy to clear | | ML |
| 9-23-06 | 4:15 | 210 | 49 | 52 | 1909400 | Fizzy | 55 | 50 | 51 | 1835100 | Fizzy to Clear | | ML |
| 9-24-06 | 1:55 | 209 | 48 | 51 | 1975400 | Clear | 55 | 50 | 51 | 190500 | Fizzy To Clear | | ML |
| 9-24-06 | 7:20 | 209 | 50 | 52 | 1992400 | Clear | 56 | 56 | 51 | 1921600 | Clear | | ML |
| 9-25-06 | 7:37 | 209 | 50 | 52 | 2031100 | Fizzy to Clear | 58 | 50 | 51 | 1959700 | Clear | | ML |
| 9-25-06 | 7:54 | 209 | 47 | 52 | 2070100 | Clear | 56 | 50 | 51 | 1997200 | Clear | | ML |
| 9-26-06 | 7:43 | 209 | 50 | 52 | 2106900 | Fizzy to Clear | 58 | 51 | 51 | 2034900 | Clear | | ML |
| 9-26-06 | 6:25 | 209 | 51 | 52/53 | 2140500 | Fizzy | 59 | 52 | 51/52 | 2067100 | Clear | Meter Changes From 52 To 53 GPM | ML |
| 9-27-06 | 7:29 | 210 | 51 | 52/53 | 2182[illegible]00 | Fizzy to Clear | 60 | 51 | 51/52 | 2113800 | Clear | " " " 51 TO 52 GPM | ML |
| 9-27-06 | 7:45 | 210 | 51 | 52 | 2221500 | Fizzy | 58 | 49 | 51 | 2146900 | Clear | | ML |
| 9-28-06 | 8:34 | 210 | 51 | 52 | 2261500 | Fizzy to Clear | 59 | 51 | 51 | 2188800 | Clear | | ML |
| 9-28-06 | 6:38 | 209 | 51 | 52 | 2292900 | Fizzy to Clear | 59 | 51 | 51 | 2217300 | Clear | | ML |
| 9-2[illegible]-06 | 8:00 | 210 | 51 | 52 | 2335100 | Fizzy to Clear | 59 | 51 | 51 | 2259200 | Clear | | ML |
| 9-29-06 | 7:21 | 209 | 51 | 52 | 2371400 | Fizzy to Clear | 59 | 51 | 51 | 2291000 | Clear | | ML |
| 9-30-06 | 8:47 | 210 | 50 | 52 | 2412900 | Fizzy to Clear | 56 | 50 | 51 | 2335800 | Clear | | ML |
| 9-30-06 | 4:36 | 209 | 49 | 51 | 2437700 | Fizzy to Clear | 52 | 49 | 51 | 2360200 | Clear | | ML |
| 10-1-06 | 7:22 | 209 | 49 | 52 | 2484200 | Fizzy to Clear | 55 | 50 | 51 | 2409300 | Clear | | ML |
| 10-1-06 | | 207 | 48 | 52 | 2516800 | Fizzy to Clear | 55 | 50 | 51 | 2438100 | Clear | | ML |
| 10-2-06 | 7:54 | 209 | 67 | 53 | 2560700 | Fizzy to Clear | 70 | 62 | 53 | 2481800 | Clear | | ML |
| 10-2-06 | 6:40 | 208 | 65 | 53 | 2594800 | Fizzy to Clear | 66 | 60 | 55 | 2515500 | Clear | GPM Spike To 55 GPM- | ML |
| 10-3-06 | 7:39 | 209 | 51 | 52 | 2635700 | Fizzy | 59 | 51 | 51 | 2556900 | Clear | | ML |
| 10-3-06 | 4:45 | 209 | 42 | 51 | 2663700 | Fizzy to Clear | 51 | 49 | 50 | 2584400 | Clear | | ML |
| 10-4-06 | 7:43 | 210 | 50 | 52 | 2711000 | Clear | 58 | 50 | 51 | 2631200 | Clear | | ML |
| 10-4-06 | 6:28 | 210 | 48 | 51 | 2744600 | Fizzy to Clear | 55 | 50 | 51 | 2669700 | Clear | | ML |
| 10-5-06 | 8:02 | 210 | 48 | 51 | 2786300 | Fizzy to Clear | 53 | 49 | 50 | 2705600 | Clear | | ML |
| 10-5-06 | 7 | 210 | 46 | 51 | 2815100 | Fizzy to Clear | 52 | 49 | 50 | 2734200 | Clear | | ML |

Normal Ranges
F1 and F2' - 49 to 51 gpm
P0 - 200 to 215 psi
P1 and P2' - 30 to 90 psi
P3 - 30 to 70 psi

Emergency Contacts
Jon Paul Romero work (505) 983-6921 cell (505) 780-0376
Jeff Watson work (505) 877-1030 cell (505) 280-0867
Casey Cook work (505) 247-2000 cell (505) 252-0150

# Field Checklists

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| Date: 9/19/06 | Observed | by: | MICK |
| | | Time | Observation |
| Production Well | CCD-Prod 1: | | |
| | Flow-1 GPM: | 10:56 | fluctuation bet. 51 & 52 every 3-4 secs |
| | Flow-1 Total: | 10:56 | 1599500 gal |
| | Pressure-0 | 10:57 | 209 psi |
| | Pressure-1 | 10:59 | 44 psi |
| | Battery VDC | | 24.40 |
| | Seal Batt. Box | | ✓ |
| | Water Quality | | fizzy / Clear |
| | Laptop ELOG | | ✓ |
| | Download to handheld (old cable) | | ✓ |
| | | | |
| | CCD-Expl 1: | 12:35 | 243.49 Shallow |
| | Piezometer water levels (2) | 12:39 | 233.45 Deep |
| | Download to handheld (old cable) | | ✓ |
| | | | |
| Injection Well | | | |
| | Air purged | 11:37 | ✓ |
| | Flow-2 GPM: | 11:40 | 51 gpm |
| | Flow-2 Total: | " | 1537300 gal |
| | Pressure-2 | | 51 psi |
| | Pressure-3 | | 46 psi |
| | Battery VDC | | 24.46 |
| | Seal Batt. Box | | ✓ |
| | Water Quality | | Fizzy / Clear |
| | Laptop ELOG | | ✓ |
| | Downloads to handheld (P5) | | ✓ |
| | Piezometer water levels (2) ~~[illegible]~~ | 11:52 | 230.00 Deep |
| | ~~Deep~~ | 11:55 | 315.98 Shallow |
| Observation Well | OW-A: | | |
| | Download to handheld (P5) (3) | | ✓ |
| | OW-B: | | |
| | Download | | ✓ |
| | Piezometer water level | 14:07 | 190.3 |
| | OW-C: | | |
| | Download ✓ | 14.18 | 236.59 |
| | Piezometer water level | | |
| | | | |
| El Rancho Well | | | |
| | Piezometer water level | 12:54 | 214.03 |
| | | | |
| SFCC Well | | | |
| | Piezometer water level | 13:27 | 229.50 |
| | | | |
| La Cienega Well | (Future) | | |

purge on prod. well?
↳ ~~unable to connect handheld~~,

# FIELD CHECKLIST:
# RANCHO VIEJO WELLFIELD

| Date: 9/26/06 | Observed by: MiLK | | |
|---|---|---|---|
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| | Flow-1 GPM: | 1354 | 52 gpm |
| | Flow-1 Total: | " | 2126400 gal |
| | Pressure-0 | 1355 | 206 psi |
| | Pressure-1 | " | 49 psi |
| | Battery VDC | 1353 | 23.90 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | slightly fizzy |
| | Laptop ELOG | 1351 | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1409 | 243.96 |
| | **Deep:** | 1407 | 233.45 |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| **Injection Well** | | | |
| | Air purged | ✓ | |
| | Flow-2 GPM: | 1250 | 51 gpm |
| | Flow-2 Total: | 1250 | 2049800 gal |
| | Pressure-2 | 1249 | 56 psi |
| | Pressure-3 | 1249 | 51 psi |
| | Battery VDC | 1246 | 22.89 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | tiny bubbles / Fizzy |
| | Laptop ELOG | 1242 | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 1301 | 315.96 |
| | **Deep:** | 1257 | 226.50 |
| | | | |
| **Observation Wells** | | | |
| | **OBS Well:** | | |
| | Download to handheld (P5) | ✓ | 205.51 @1449 w/ sounder |
| | **OW-A:** | | ↳ changed x-ducer |
| | Download to handheld (P5) (3) | ✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1319 | 290.38 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1327 | 236.59 |
| | | | |
| **El Rancho Well** | | | |
| | Piezometer water level | 1425 | 213.95 |
| | | | |
| **SFCC Well** | | | |
| | Piezometer water level | 1558 | 212.50 |

# FIELD CHECKLIST:
# RANCHO VIEJO WELLFIELD

| **Date:** 10/3/06 | **Observed by:** M'CK | **Time** | **Observation** |
|---|---|---|---|
| **Production Well** | **CCD-Prod 1:** | | |
| | Flow-1 GPM: | | 52 gpm |
| | Flow-1 Total: | | 2656200 |
| | Pressure-0 | 1410 | 205 psi |
| | Pressure-1 | | 49-50 psi |
| | Battery VDC | 14:13 | 23.16 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | ✓ | fizzy / lots of bubbles. |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | | Changed batt on X-ducer<br>↳ pulled x-ducer |
| | **CCD-Expl 1:** 1555 295.80 | → 1530 | 313.90 |
| | Piezometer water levels (2) **Shallow:** | 1539 | 244.76 |
| | **Deep:** | 1541 | 233.61 |
| | Download to handheld (old cable, P4) | | |
| **Injection Well** | | | |
| | Air purged | ✓ | |
| | Flow-2 GPM: | | 51 gpm |
| | Flow-2 Total: | | 2574400 |
| | Pressure-2 | 13:24 | 57 psi |
| | Pressure-3 | " | 52 psi |
| | Battery VDC | ✓ | changed batt. |
| | Seal Batt. Box | ✓ | |
| | Water Quality | ✓ | slightly fizzy |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 1330 | 315.81 |
| | **Deep:** | 1335 | 233.63 |
| **Observation Wells** | | | |
| | **OBS Well:** | | |
| | Download to handheld (P5) | 1634 | 205.49 |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1352 | 290.21 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1359 | 256.92 |
| **El Rancho Well** | | | |
| | Piezometer water level | 1612 | 214.0 |
| **SFCC Well** | | | |
| | Piezometer water level | 1702 | 228.25 needs tape measure |

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 10/10/06 | **Observed by:** Mick | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| | Flow-1 GPM: | 11:42 | 51-52 mostly 52, slight fluctuation |
| | Flow-1 Total: | | 3171800 |
| | Pressure-0 | | 206 |
| | Pressure-1 | | 53 psi |
| | Battery VDC | | 25.43 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | set repaired x-ducer few bubbs / clear |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 13:03 | 245.05 |
| | **Deep:** | 12:59 | 233.54 |
| | Download to handheld (old cable, P4) | ✓ | changed batts in x-ducer, reset. |
| **Injection Well** | | | |
| | Air purged | | |
| | Flow-2 GPM: | 13:36 | 50 gpm |
| | Flow-2 Total: | | 3093100 |
| | Pressure-2 | | 54 psi |
| | Pressure-3 | | 48 psi |
| | Battery VDC | | 24.76 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | fizzy |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 14:01 | 315.70 |
| | **Deep:** | 13:52 | 222.14 |
| **Observation Wells** | | | |
| | **OBS Well:** | | |
| | Download to handheld (P5) | ✓ | |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 14:22 | 289.91 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 14:32 | 236.57 |
| **El Rancho Well** | | | |
| | Piezometer water level | 15:16 | 214.16 |
| **SFCC Well** | | | |
| | Piezometer water level | 15:28 | 228.55 |

# FIELD CHECKLIST:
# RANCHO VIEJO WELLFIELD

| **Date:** 10/17/06 | **Observed by:** Mick | | |
|---|---|---|---|
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| | Flow-1 GPM: | 1343 | 50-51 gpm |
| | Flow-1 Total: | " | 3696800 |
| | Pressure-0 | | 206 |
| | Pressure-1 | | 48 |
| | Battery VDC | 1346 | 24.91 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | ✓ | |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✗ | started new test @ 1400 |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | | |
| | **Deep:** | | |
| | Download to handheld (old cable, P4) | | |
| **Injection Well** | | | |
| | Air purged | | |
| | Flow-2 GPM: | 12:32 | 50 |
| | Flow-2 Total: | " | 3603860 |
| | Pressure-2 | " | 55 psi |
| | Pressure-3 | " | 49 psi |
| | Battery VDC | 12:34 | 24.19 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | ✓ | fizzy, tiny bubbles |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | 222.66 @ 12:43 sol 500 |
| | Piezometer water levels (2) Deep ~~**Shallow:**~~ | 12:47 | 220.81 |
| | Shallow ~~**Deep:**~~ | 1250 | 315.57 |
| **Observation Wells** | | | |
| | **OBS Well:** | | |
| | Download to handheld (P5) | ✓ | |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | ✓ | |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | ✓ | |
| **El Rancho Well** | | | |
| | Piezometer water level | | |
| **SFCC Well** | | | |
| | Piezometer water level | | |

# FIELD CHECKLIST:
# RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 10/24 | **Observed by:** MICK | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| | Flow-1 GPM: | | 53 |
| | Flow-1 Total: | | 4235900 |
| | Pressure-0 | | 199 |
| | Pressure-1 | | 72 |
| | Battery VDC | | 24.32 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | ✓ | clear, few tiny bubbles |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1357 | 246.02 |
| | **Deep:** | 1401 | 233.60 |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| **Injection Well** | | | |
| | Air purged | | ✓ |
| | Flow-2 GPM: | | 54 |
| | Flow-2 Total: | | 4150300 |
| | Pressure-2 | | 77 psi |
| | Pressure-3 | | 70 " |
| | Battery VDC | | 22.47 25.55 re-read |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | Clear, No Bubbles |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | | |
| | Piezometer water levels (2) **Shallow:** | 1244 | 815.90 |
| | **Deep:** | 1239 | 215.81 |
| | | | |
| **Observation Wells** | | | |
| | **OBS Well:** + hand measure | 14:35 | 205.05 |
| | Download to handheld (P5) | ✓ | |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1331 | 289.90 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1339 | 236.64 |
| | | | |
| **El Rancho Well** | | | |
| | Piezometer water level | 1419 | 213.99 |
| | | | |
| **SFCC Well** | | | |
| | Piezometer water level | | |

Pete
301 2973

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD

| **Date:** 10/31 | **Observed by:** Mick | **Time** | **Observation** |
|---|---|---|---|
| **Production Well** | **CCD-Prod 1:** | | |
| | Flow-1 GPM: | | 51 gpm |
| | Flow-1 Total: | | ~~4662800~~ 4748600 |
| | Pressure-0 | | 206 psi |
| | Pressure-1 | | 47 psi |
| | Battery VDC | | 23.78 changed batt. |
| | Seal Batt. Box | ✓ | |
| | Water Quality | ✓ | fizzy, lots of bubbles |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1221 | 245.78 |
| | **Deep:** | 1217 | 233.61 |
| | Download to handheld (old cable, P4) | ✓ | |
| **Injection Well** | | | |
| | Air purged | | |
| | Flow-2 GPM: | | 51 gpm |
| | Flow-2 Total: | | 4662800 |
| | Pressure-2 | | 54 psi |
| | Pressure-3 | | 48 psi |
| | Battery VDC | 11:02 | 24.92 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | ✓ | fizzy, lots of tiny bubbles. |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 11:14 | 315.76 |
| | **Deep:** | 11:18 | 218.32 |
| **Observation Wells** | | | |
| | **OBS Well:** [redacted] | 1356 | 205.67 |
| | Download to handheld (P5) | ✓ | |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 11:36 | 289.83 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 11:43 | 236.70 |
| **El Rancho Well** | | | |
| | Piezometer water level | 1337 | 214.18 |
| **SFCC Well** | | | |
| | Piezometer water level | 1327 | 227.30 |
| La Cienega | Piezometer level | 1309 | 224.29 |

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 11/7 | **Observed by:** Mick | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| | Flow-1 GPM: | | 50 |
| | Flow-1 Total: | | 5264700 |
| | Pressure-0 | | 206 |
| | Pressure-1 | | 48 |
| | Battery VDC | 1255 | 24.88 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | clear, few tiny particles. |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1302 | 245.88 |
| | **Deep:** | 1305 | 233.63 |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| **Injection Well** | | | |
| | Flow-2 GPM: | | 50 |
| | Flow-2 Total: | | 5175200 |
| | Pressure-2 | | 55 |
| | Pressure-3 | | 48 |
| | Battery VDC | 1100 | 24.32 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | fizzy, tiny bubs |
| | Laptop ELOG | | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 1121 | 315.84 |
| | **Deep:** | 1118 | 217.12 |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | 1202 | 205.82 pulled x-ducer |
| | Download to handheld (P5) | ✓ | |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1136 | 289.88 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1142 | 236.83 |
| **El Rancho Well** | | | |
| | Piezometer water level | 1225 | 214.15 |
| **SFCC Well** | | | |
| | Piezometer water level | 1235 | 227.0 |
| **La Cienega Well** | | | |
| | Piezometer water level | 1320 | 225.41 |

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD

| **Date:** 11/14/06 | **Observed by:** MICK | | |
|---|---|---|---|
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | Inside Max: 82.5 |
| | Flow-1 GPM: | | 50 MIN: 55.5 |
| | Flow-1 Total: | | 57742 Out MAX: 76.8 |
| | Pressure-0 | | 206 MIN: 22.2 |
| | Pressure-1 | | 47 |
| | Battery VDC | | no meter |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | Fizzy, lots of tiny bubbles |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1244 | 245,73 |
| | **Deep:** | 1242 | 233.67 |
| | Download to handheld (old cable, P4) | ✓ | |
| | | Inside: | MAX: 76.4 |
| **Injection Well** | | | MIN: 46.7 |
| | Flow-2 GPM: | | 50 gpm |
| | Flow-2 Total: | | 5685200 |
| | Pressure-2 | | 54 psi |
| | Pressure-3 | | 47 psi |
| | Battery VDC | | no meter |
| | Seal Batt. Box | ✓ | |
| | Water Quality | ✓ | Fizzy, lots of tiny bubbles |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) ✓ **Shallow:** | 11 17 | 315.49 |
| | **Deep:** | 11 21 | 216.37 |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | | |
| | ~~Download to handheld (P5)~~ Piezometer W.L. | 12 02 | 205,71 [illegible] 50/500 |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 11 36 | 289.68 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 11 44 | 236.56 |
| **El Rancho Well** | | | |
| | Piezometer water level | 1218 | 214.06 |
| **SFCC Well** | | | |
| | Piezometer water level | 1253 | 226.81 |
| **La Cienega Well** | | | |
| | Piezometer water level | 14:14 | 225.16 Powers 1000' |

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD

| Date: 11/21/06 | Observed by: Mick | | |
|---|---|---|---|
| | | Time | Observation |
| **Production Well** | **CCD-Prod 1:** | | |
| | Flow-1 GPM: | | 51 gpm |
| | Flow-1 Total: | | 6294600 gal |
| | Pressure-0 | | 206 psi |
| | Pressure-1 | | 49 psi |
| | Battery VDC | | 22.27 |
| | Seal Batt. Box | | ✓ |
| | Water Quality | | fizzy, bubbles |
| | Laptop ELOG | | ✓ |
| | Download to handheld (old cable, P4) | | ✓ |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1544 | 245.91 |
| | **Deep:** | 1542 | 233.69 |
| | Download to handheld (old cable, P4) | | ✓ |
| | | | |
| **Injection Well** | | | |
| | Flow-2 GPM: | | 50 gpm |
| Temp | Flow-2 Total: | | 6202700 gal |
| inside MAX: 71.4 | Pressure-2 | | 56 psi |
| Min: 47.8 | Pressure-3 | | 49 - 50 psi |
| | Battery VDC | | 23.04, changed, 25.52 |
| out MAX: 85.2 | Seal Batt. Box | | ✓ |
| MIN: — | Water Quality | | fizzy, bubbles |
| | Laptop ELOG | | ✓ |
| | Downloads to handheld (P5) | | ✓ |
| | Piezometer water levels (2) **Shallow:** | 1344 | 315.93 |
| | **Deep:** | 1342 | 215.34 |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | | |
| | ~~Download to handheld (P5)~~ W.L. | 1500 | 205.49 |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | | ✓✓✓ |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1404 | 289.99 |
| | **OW-C:** | | |
| | Download | | ✓ |
| | Piezometer water level | 1411 | 236.81 |
| **El Rancho Well** | | | |
| | Piezometer water level | 1516 | 214.06 |
| **SFCC Well** | | | |
| | Piezometer water level | 1610 | ~~233.10~~ 227.10 |
| **La Cienega Well** | | | |
| | Piezometer water level | 1557 | 225.39 |

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD

| Date: 11/28/06 | Observed by: Mick | | |
|---|---|---|---|
| | | Time | Observation |
| **Production Well** | **CCD-Prod 1:** | | |
| Inside Max: 70.8 | Flow-1 GPM: | | 51 |
| Min. 51.6 | Flow-1 Total: | | 6809900 |
| | Pressure-0 | | 206 |
| | Pressure-1 | | 48 |
| | Battery VDC | | 20.15 - replaced to 25.31 |
| | Seal Batt. Box | | ✓ |
| | Water Quality | | fizzy, tiny bubbles |
| | Laptop ELOG | | ✓ |
| | Download to handheld (old cable, P4) | | ✓ |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1521 | 245.98 |
| | **Deep:** | 1524 | 233.74 |
| | Download to handheld (old cable, P4) | | ✓ |
| | | | |
| **Injection Well** | | | |
| Inside Max: 71.2 | Flow-2 GPM: | | 50 |
| Min. 49.6 | Flow-2 Total: | | 6714300 |
| | Pressure-2 | | 56 psi |
| | Pressure-3 | | 48 psi |
| | Battery VDC | | 25.50 ⊖ cable unplugged - re-attached |
| | Seal Batt. Box | | ✓ |
| | Water Quality | | fizzy, lots of bubbles |
| | Laptop ELOG | | ✓ |
| | Downloads to handheld (P5) | | ✓ |
| | Piezometer water levels (2) **Shallow:** | 1400 | 315.47 |
| | **Deep:** | 1358 | 214.30 |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | | |
| | ~~Download to handheld (P5)~~ W.L.: | 14:34 | 205.66 |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | | ✓✓✓ |
| | **OW-B:** | | |
| | Download | | ✓ |
| | Piezometer water level | 1413 | 289.71 |
| | **OW-C:** | | |
| | Download | | ✓ |
| | Piezometer water level | 1420 | 236.67 |
| **El Rancho Well** | | | |
| | Piezometer water level | 1452 | 214.14 |
| **SFCC Well** | | | |
| | Piezometer water level | 1547 | 226.78 |
| **La Cienega Well** | | | |
| | Piezometer water level | 1536 | 225.17 |

## FIELD CHECKLIST:
## RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 12/5/06 | **Observed by:** MCK | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| Inside Max: 67.8 | Flow-1 GPM: | 9 | 51 |
| Inside Min: 45.1 | Flow-1 Total: | | 73280 |
| Outside Max: 80.2 | Pressure-0 | | 206 |
| Outside Min: -4.3 | Pressure-1 | | 49 |
| | Battery VDC | | 24.39 |
| | Seal Batt. Box | ✓ | ~~24.39~~ |
| | Water Quality | | Fizzy, lots of tiny bubbles |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1401 | 246.14 |
| | **Deep:** | 1404 | 233.89 |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| **Injection Well** | | | |
| Inside Max: 63.5 | Flow-2 GPM: | | 50 |
| Inside Min: 31.9 | Flow-2 Total: | | 7223200 |
| Outside Max: 74.3 | Pressure-2 | | 58 |
| Outside Min: 2 | Pressure-3 | | 50 |
| | Battery VDC | | 24.67 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | | 315.88 @ 12:42PM |
| | **Deep:** | | 213.69 @ 12:40PM |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** Windmill? | | Vane is closed |
| | Piezometer water level | 1623 | 205.12 |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1257 | 290.06 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1303 | 236.85 |
| **El Rancho Well** | | | |
| | Piezometer water level | 1636 | 214.04 |
| **SFCC Well** | | | |
| | Piezometer water level | 1706 | 226.71 |
| **La Cienega Well** | | 1654 | 225.47 |
| | Piezometer water level | | |

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 12/12/06 | **Observed by:** Mick | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| Inside Max: 70.1 | Flow-1 GPM: | | 49 |
| Inside Min: 60.1 | Flow-1 Total: | | 7833300 |
| Outside Max: | Pressure-0 | | 206 |
| Outside Min: | Pressure-1 | | 41 |
| | Battery VDC | | 23.76 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | | |
| | **Deep:** | | |
| | Download to handheld (old cable, P4) | | |
| | | | |
| **Injection Well** | | | |
| Inside Max: 72.5 | Flow-2 GPM: | | 49 |
| Inside Min: 53.4 | Flow-2 Total: | | 7720800 |
| Outside Max: | Pressure-2 | | 49 |
| Outside Min: | Pressure-3 | | 42 |
| | Battery VDC | | [illegible] 24.09 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 1128 | 315.10 |
| | **Deep:** | 1124 | 214.55 |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | | |
| | Piezometer water level | 1228 | 205.13 |
| | **OW-A:** | ✓ | |
| | Download to handheld (P5) (3) | ✓// | |
| | **OW-B:** | ✓ | |
| | Download | ✓ | |
| | Piezometer water level | ✓ | |
| | **OW-C:** | ✓ | |
| | Download | ✓ | |
| | Piezometer water level | ✓ | |
| **El Rancho Well** | | | |
| | Piezometer water level | 1243 | 214.31 |
| **SFCC Well** | | | |
| | Piezometer water level | | |
| **La Cienega Well** | | | |
| | Piezometer water level | | |

# FIELD CHECKLIST:
# RANCHO VIEJO WELLFIELD

| **Date:** 12/27/06 | **Observed by:** CWC | | |
|---|---|---|---|
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| Inside Max: | Flow-1 GPM: | | 49 - 50 gpm |
| Inside Min: | Flow-1 Total: | | 8919300 |
| Outside Max: | Pressure-0 | 1526 | 210 psi |
| Outside Min: | Pressure-1 | | 46 psi |
| | Battery VDC | | 22.12 changed → 25.43 |
| | Seal Batt. Box | | ✓ |
| | Water Quality | | clear |
| | Laptop ELOG | | ✓ |
| | Download to handheld (old cable, P4) | | ✓ |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1518 | 246.10 |
| | **Deep:** | 1522 | 235.18 |
| | Download to handheld (old cable, P4) | | ✓ |
| | | | |
| **Injection Well** | | | |
| Inside Max: no | Flow-2 GPM: 50 | | 50 |
| Inside Min: screw- | Flow-2 Total: 88073 | | 8807300 |
| Outside Max: driver | Pressure-2 53 psi | | 53 |
| Outside Min: | Pressure-3 | | 47 |
| | Battery VDC | | 22.85 (needs charge) |
| | Seal Batt. Box | | ✓ |
| | Water Quality | | — |
| | Laptop ELOG | | ✓ |
| | Downloads to handheld (P5) | | ✓ |
| | Piezometer water levels (2) **Shallow:** | ~~8~~14:34 | 315.51 |
| | **Deep:** | 14:32 | 212.30 e |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | | |
| | Piezometer water level | | ✓ |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | | ✓ ✓ ✓ |
| | **OW-B:** | | |
| | Download | | ✓ |
| | Piezometer water level | 14:55 | 289.90 |
| | **OW-C:** | | |
| | Download | | |
| | Piezometer water level | 15:04 | 236.70 |
| **El Rancho Well** | | | |
| | Piezometer water level | | ✓ |
| **SFCC Well** | | | |
| | Piezometer water level | | ✓ |
| **La Cienega Well** | | | |
| | Piezometer water level | | ✓ |

Note: Logger times are 1 hr off → daylight saving time

# FIELD CHECKLIST:
# RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 1/10/07 | **Observed by:** CWC | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | 8:10 | 9906200 |
| Inside Max: | Flow-1 GPM: | 50 | |
| Inside Min: | Flow-1 Total: | | 9906200 gal 8:00 |
| Outside Max: | Pressure-0 | 220 | |
| Outside Min: | Pressure-1 | 46 | |
| | Battery VDC | 24.1 | |
| | Seal Batt. Box | ✓ | |
| | Water Quality | – | |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | 7:40 | 300.29 |
| | Piezometer water levels (2) **Shallow:** | 7:35 | 246.04 |
| | **Deep:** | 7:37 | 234.00 |
| | Download to handheld (old cable, P4) | 7 30 | ✓ |
| | | | |
| **Injection Well** | | 0956 | 213.52 |
| Inside Max: 6 | Flow-2 GPM: } was not reading; | | ~~Not reading~~ 49-50 |
| Inside Min: 50° | Flow-2 Total: reset by removing 3V external battery | 11:30 | 9240000 |
| Outside Max: | Pressure-2 | | 54 psi |
| Outside Min: 25° | Pressure-3 | 0930 | 47 psi 26.01V |
| | Battery VDC | | replaced (battery was dead) |
| | Seal Batt. Box | | ✓ |
| | Water Quality | | |
| | Laptop ELOG | | ✓ |
| | Downloads to handheld (P5) | | ✓ |
| | Piezometer water levels (2) **Shallow:** | 0942 | 315.89 |
| | **Deep:** | 0946 | 211.59 |
| | | | |
| **Observation Wells** | | | shal 222.87 10:22 |
| | **Rancho Viejo QBS Well:** Too much | | Int 222.76 10:30 |
| | Piezometer water level snow | | Deep 222.63 10:25 |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | 10 40 | 282.74 |
| | Download | ✓ | |
| | Piezometer water level | 10:45 | 290.19 |
| | **OW-C:** | | |
| | Download | | |
| | Piezometer water level | | |
| **El Rancho Well** | | 11.00 | 214.05 |
| | Piezometer water level | | |
| **SFCC Well** | | 9:00 | 226.54 |
| | Piezometer water level | | |
| **La Cienega Well** | | | too much Snow to |
| | Piezometer water level | | drive to site |

957 652 6811

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 1/25/07 | **Observed by:** | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| Inside Max: 71.9 | Flow-1 GPM: | | 50 |
| Inside Min: 57.5 | Flow-1 Total: | | 11013000 |
| Outside Max: | Pressure-0 | | 206 |
| Outside Min: | Pressure-1 | | 50 |
| | Battery VDC | ✓ | |
| | Seal Batt. Box | ✓ | changed batt |
| | Water Quality | | |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) ~~**Shallow:**~~ | 1356 | 234.02 Deep |
| | ~~**Deep:**~~ | 1400 | 246.65 shallow |
| | Download to handheld (old cable, P4) | ✓ | solinst reel broken |
| | | | |
| **Injection Well** | | | |
| Inside Max: 77.3 | Flow-2 GPM: 51 | | |
| Inside Min: 44 | Flow-2 Total: 10335100 | | |
| Outside Max: | Pressure-2 58 | | |
| Outside Min: | Pressure-3 51 | | |
| | Battery VDC | | 24.80 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | ✓ | |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | 12:49 | 211.42 |
| | Piezometer water levels (2) **Shallow:** | 12:51 | 316.00 |
| | **Deep:** | 12:54 | 209.63 |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | | TOO MUCH SNOW |
| | Piezometer water level | | |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1314 | 290.36 |
| | **OW-C:** | | |
| | Download | | |
| | Piezometer water level | TOO | MUCH SNOW |
| **El Rancho Well** | | | |
| | Piezometer water level | 1324 | 214.12 |
| **SFCC Well** | | | |
| | Piezometer water level | 1412 | 226.69 |
| **La Cienega Well** | | | |
| | Piezometer water level | TOO | MUCH SNOW |

# FIELD CHECKLIST:
# RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 1/30/07 | **Observed by:** MICK | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | 49 |
| Inside Max: 69.9 | Flow-1 GPM: | | 11372700 349 |
| Inside Min: 59.5 | Flow-1 Total: | | — |
| Outside Max: | Pressure-0 | | 209 |
| Outside Min: | Pressure-1 | | 40 |
| | Battery VDC | | 24.94 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1305 | 245.65 Powers 500' |
| | **Deep:** | 1209 | 233.16 " |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| **Injection Well** | | | |
| Inside Max: 70.5 | Flow-2 GPM: | | 49 |
| Inside Min: 48.2 | Flow-2 Total: | | 10704300 32.8 AF |
| Outside Max: | Pressure-2 | | 49 |
| Outside Min: | Pressure-3 | | 42 |
| | Battery VDC | | 24.35 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | | |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 1358 | 313.98 Powers 500' |
| | **Deep:** | 1349 | 207.93 " |
| | | | → +0.6 correction = 208.53 |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | ✗ | |
| | Piezometer water level | | |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1420 | 288.70 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1430 | 235.55 |
| **El Rancho Well** | | | |
| | Piezometer water level | 1330 | 213.37 |
| **SFCC Well** | | | |
| | Piezometer water level | 1320 | 226.55 |
| **La Cienega Well** | | ✗ | |
| | Piezometer water level | | |

FIELD CHECKLIST:
RANCHO VIEJO WELLFIELD 1437: 307.98

| | | | |
|---|---|---|---|
| **Date:** 2/8 | **Observed by:** Mick | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** Flow1 | | 49 |
| Inside Max: 73.4 | ~~Flow-1 GPM:~~ Flow1 Tot. | | 12025500 |
| Inside Min: 56.6 | ~~Flow-1 Total.~~ Piez. | 1609 | 328.36 |
| Outside Max: | Pressure-0 | | 206 |
| Outside Min: | Pressure-1 | | 48 |
| | Battery VDC | | 24.46 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | — | |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | changed x-ducer batt, reset test |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1416 | 246.51 |
| | **Deep:** | 1415 | 234.11 |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| **Injection Well** | | | |
| Inside Max: 81.3 | Flow-2 GPM: | | 50 |
| Inside Min: 46.7 | Flow-2 Total: | | 11348700 |
| Outside Max: | Pressure-2 | | 55 |
| Outside Min: | Pressure-3 | | 49 |
| | Battery VDC | | 23.74, changed batt |
| | Seal Batt. Box | ✓ | |
| | Water Quality | — | |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 1321 | 315.93 |
| | **Deep:** | 1319 | 209.20 |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | | |
| | Piezometer water level | 1516 | 204.94 |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1345 | 290.27 |
| | **OW-C:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1336 | 236.64 |
| **El Rancho Well** | | | |
| | Piezometer water level | 1437 | 214.08 |
| **SFCC Well** | | | |
| | Piezometer water level | 1648 | 226.55 |
| **La Cienega Well** | | | |
| | Piezometer water level | 1635 | 225.48 |

# FIELD CHECKLIST:
# RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 2/20 | **Observed by:** Mick | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| Inside Max: 72.6 | Flow-1 GPM: | | 50 |
| Inside Min: 56.8 | Flow-1 Total: | | 12869000 |
| Outside Max: | Pressure-0 | | 209 |
| Outside Min: | Pressure-1 | | 46 |
| | Battery VDC | | 23.76 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | — | |
| | Laptop ELOG | ✓ | |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | 1218 | 245.81 |
| | **Deep:** | 1221 | 234.22 |
| | Download to handheld (old cable, P4) | ✓ | |
| | | | |
| **Injection Well** | | | |
| Inside Max: 76.4 | Flow-2 GPM: | | 50 |
| Inside Min: 48.6 | Flow-2 Total: | | 12193800 |
| Outside Max: | Pressure-2 | | 54 |
| Outside Min: | Pressure-3 | | 48 |
| | Battery VDC | | 24.46 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | —✓ | |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 1333 | 315.83 |
| | **Deep:** | 1336 | 208.99 |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | | |
| | Piezometer water level | 1422 | 204.84 |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | ✓✓✓ | |
| | **OW-B:** | | |
| | Download | ✓ | |
| | Piezometer water level | 1351 | 289.70 |
| | **OW-C:** | | |
| | Download | 1401 | 236.76 |
| | Piezometer water level | ✓ | |
| **El Rancho Well** | | | |
| | Piezometer water level | 1449 | 213.94 |
| **SFCC Well** | | | |
| | Piezometer water level | 1521 | 226.54 |
| **La Cienega Well** | | | |
| | Piezometer water level | 1500 | 225.54 |

# FIELD CHECKLIST:
# RANCHO VIEJO WELLFIELD

| | | | |
|---|---|---|---|
| **Date:** 2/26/07 | **Observed by:** Mick | | |
| | | **Time** | **Observation** |
| **Production Well** | **CCD-Prod 1:** | | |
| Inside Max: | Flow-1 GPM: | | 48-49 |
| Inside Min: | Flow-1 Total: | | 13302000 |
| Outside Max: | Pressure-0 | | 210 |
| Outside Min: | Pressure-1 | | 40 |
| | Battery VDC | | |
| | Seal Batt. Box | ✓ | 22.94 |
| | Water Quality | – | |
| | Laptop ELOG | | |
| | Download to handheld (old cable, P4) | | |
| | | | |
| | **CCD-Expl 1:** | | |
| | Piezometer water levels (2) **Shallow:** | | |
| | **Deep:** | | |
| | Download to handheld (old cable, P4) | | |
| | | | |
| **Injection Well** | | | |
| Inside Max: | Flow-2 GPM: | | 49 |
| Inside Min: | Flow-2 Total: | | 12617800 |
| Outside Max: | Pressure-2 | | 49 |
| Outside Min: | Pressure-3 | | 44 |
| | Battery VDC | | 22.72 |
| | Seal Batt. Box | ✓ | |
| | Water Quality | – | |
| | Laptop ELOG | ✓ | |
| | Downloads to handheld (P5) | ✓ | |
| | Piezometer water levels (2) **Shallow:** | 1129 | 315.68 |
| | **Deep:** | 1126 | 209.67 |
| | | | |
| **Observation Wells** | | | |
| | **Rancho Viejo OBS Well:** | | |
| | Piezometer water level | | |
| | **OW-A:** | | |
| | Download to handheld (P5) (3) | | |
| | **OW-B:** | | |
| | Download | | |
| | Piezometer water level | | |
| | **OW-C:** | | |
| | Download | | |
| | Piezometer water level | | |
| **El Rancho Well** | | | |
| | Piezometer water level | | |
| **SFCC Well** | | | |
| | Piezometer water level | | |
| **La Cienega Well** | | | |
| | Piezometer water level | | |

3/2/07 CWL onsite CCD wells 0740
using Solinst 500 sounder

| | | DTW | Time |
|---|---|---|---|
| CCD-I1 | sh piez | 315.80 | 0749 |
| | deep piez | 258.21 | 0746 |
| CCD OWB | sh piez | 290.67 | 0802 |
| OWC | sh piez | 236.95 | 0809 |
| CCD-X1 | sh piez | 243.80 | 0827 |
| | deep piez | 243.18 | 0830 |
| SFCC | | 226.62 | 0838 |
| El Rancho | | 214.27 | 0845 |

Injection / Observation
Well Test Records

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. Inj well 12inch csg
Location ________
Collected By ________

Rate Control ________
Measuring Point top meas tube,
Pump Intake (ft.) 2.01 ft above surf csg

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t¹ | t/t¹ | |
| 8 | 10/06 | | | | | correction | | | | well csg cut down, inj. eqpr installed |
| 09 | 08 | | | | 296.55 | +0.5 = 297.05 | | | | powers 1000 |
| 8 | 24/06 | | | | | | | → | | setting transducer S/N 103747 |
| 14 | 05 | | | | 296.08 | powers 1000 | | 296.58 | | (300 psi) to ~~[illegible]~~ ft<br>315.00 |
| 9 | 8 | | | | | | | | | |
| 10 | 51 | | | | 241.75 | sol 500 | | | | sol 500 |
| 13 | 30 | | | | | | | | | lowered transducer ~ 20 ft to |
| | | | | | | | | | | get below drop pipe for |
| 9 | 8 | | | | | | | | | better temperature sensing. |
| 14 | 00 | | | | 242.10 | Sol 500 | | | | |
| 10 | 17/06 | | | | | | | | | |
| | 1243 | | | | 222 | 66 sol | 500 | | | |
| | | | | | | | | | | |
| 12/1 | 2/06 | | | | | | | | | |
| 12 | 10 | | | | 216 | 51 | | | | |
| 1/10 | /07 | | | | | | | | | |
| 09 | 50 | | | | 213 | 52 | | | | |
| 1/2 | 5/07 | | | | | | | | | |
| 12 | 49 | | | | 211 | 42 | | | | |
| 2/2 | 6/07 | | | | | | | | | |
| 11 | 34 | | | | 211 | 37 | | | | final meter 12684600 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. Inj well shallow piez
Location ________
Collected By ________

Rate Control ________
Measuring Point +0c
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ/rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 6 | /28 | /06 | | | | | | | | |
| 15 | 20' | | 317 | 44 | + 0.5 | = 317. | 94 | | | w/ Powers 1000' |
| | | | | | | | | | | casing not cut yet |
| 8/ | 10/ | 06 | | | | | | | | csg cut down - 1.04ft above |
| 9 | 12 | | 315 | 27 | + 0.5 | 315. | 77 | | | surf csg |
| 8/ | 24/ | 06 | | | | | | | | |
| 16 | 14 | | 315 | 08 + | 0.5 | 315. | 58 | | | powers1000 |
| | | | | | | | | | | transducer S/N 103826 |
| 9 | /8 | | | | | | | | | (rental) set to 351 78 ft |
| 10 | 55 | | 315 | 62 | | | | | | sol 500 |
| 9 | /12/ | 06 | | | | | | | | pulled X-ducer |
| | 11 | 00 | | | | | | | | |
| | 13 | 51 | 315 | 81 | | | | | | sol 500 |
| | | | | | | | | | | |
| 9/ | 19/06 | | | | | | | | | |
| 11 | 55 | | 315 | 88 | | | | | | " |
| 9/2 | 6/06 | | | | | | | | | |
| 13 | 01 | | 315 | 96 | | | | | | " |
| 10/3 | /06 | | | | | | | | | |
| 13 | 30 | | 315 | 81 | | | | | | " |
| 10/10 | /06 | | | | | | | | | |
| 14 | 01 | | 315 | 70 | | | | | | " |
| 10/ | 17/06 | | | | | | | | | |
| 12 | 50 | | 315 | 57 | | | | | | |
| 10/2 | 4/06 | | | | | | | | | |
| 12 | 44 | | 315 | 90 | | | | | | |
| 10/31 | /06 | | | | | | | | | |
| 11 | 14 | | 315 | 76 | | | | | | |
| 11/0 | 7/06 | | | | | | | | | |
| 11 | ~~05~~ | 21 | 315 | 84 | | | | | | |
| | 11/14 | /06 | | | | | | | | |
| | 11 | 17 | 315 | 49 | | | | | | |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ______
Drawdown/Recovery _
Step 1-2-3-4
Tape, [✓ M-scope], airline Sol inst 560
Start Time ______
Starting Rate ______
Static at Start ______

Well ID. Faj Well Shallow Piez
Location ______
Collected By ______

Rate Control ______
Measuring Point TOC
Pump Intake (ft.) ______

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 11/21/06 | | | | | | | | | | |
| 13 | 44 | | 315 | 93 | | | | | | |
| 11/28/06 | | | | | | | | | | |
| 14 | 00 | | 315 | 47 | | | | | | |
| 12/5/06 | | | | | | | | | | |
| 12 | 42 | | 315 | 88 | | | | | | |
| 12/12/06 | | | | | | | | | | |
| 11 | 28 | | 315 | 98 | | | | | | |
| 12/27/06 | | | | | | | | | | |
| 14 | 34 | | 315 | 51 | | | | | | |
| 1/10/07 | | | | | | | | | | |
| 09 | 42 | | 315 | 89 | | | | | | |
| | | | | | | | | | | |
| 1/24/07 | | | | | | | | | | |
| 12 | 51 | | 316 | 00 | | | | | | |
| 1/30/07 | | | | | | | | | | |
| 13 | 58 | | 314 | 04 | | | | | | |
| 2/8/07 | | | | | | | | | | |
| 13 | 21 | | 315 | 83 | | | | | | |
| 2/12/07 | | | | | | | | | | |
| 13 | 33 | | 315 | 83 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 11 | 29 | | 315 | 68 | | | | | | |
| 2/27/07 | | | | | | | | | | |
| 8 | 37 | | 315 | 75 | | | | | | |
| 10 | 03 | | 315 | 74 | | | | | | |
| 11 | 51 | | 315 | 71 | | | | | | |
| 13 | 30 | | 315 | 66 | | | | | | |
| 2/28/07 | | 1114 | 315 | 79 | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | 315 | 93 | | | | | | |

/6/07 14:26

3/13/07 14:06 315.73 ~~373.35~~

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ______
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ______
Starting Rate ______
Static at Start ______

Deep Piez

Well ID. Injection Well
Location EV
Collected By CWC

Rate Control ______
Measuring Point ______
Pump Intake (ft.) ______

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 6/28/06 | | | | | | | | | | Set transducer S/N 103797 (300 psi) |
| 14 | 15 | | | | | Correction | | | | to 531.72 ft |
| 15 | 14 | | 301 | 22 | → 301.72 | | | | | w/ Powers 1000' |
| | | | | | | | | | | xducer 230.0 |
| | | | | | | | | | | Casing not cut yet |
| 8/10/06 | | | | | | | | | | csg cut to 0.68 above surf csg |
| 09 | 18 | | 295 | 22 | + 0.5 | 295.72 | | | | transducer pulled by |
| 8/24 | | | | | | | | | | Rodgers : Cox ~ 8/1 |
| 16 | 09 | | 294 | 78 | +0.5 | 295.28 | | | | Installed rental transducer |
| 9/8/06 | | | | | | | | | | S/N 103186 to 300.44 ft |
| 13 | 28 | | 240 | 22 | Sol 500 | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 9/12/06 | | | | | | | | | | |
| ~ | 11:00 | | | | | | | | | pulled x-ducer |
| 13 | 46 | | ~~235~~ | 90 | | | | | | |
| 9/19/06 | | | | | | | | | | |
| 11 | 52 | | 230 | 00 | | | | | | Sol 500 |
| 9/26/06 | | | | | | | | | | |
| 12 | 57 | | 226 | 50 | | | | | | " |
| 10/3/06 | | | 2 | | | | | | | |
| 13 | 35 | | 2~~1~~3 | 63 | | | | | | " |
| 10/10/06 | | | | | | | | | | |
| 13 | 52 | | 222 | 14 | | | | | | " |
| 10/17/06 | | | | | | | | | | |
| 12 | 47 | | 220 | 87 | | | | | | " |
| 10/24/06 | | | | | | | | | | |
| 12 | 39 | | 215 | 81 | | | | | | |
| 10/31/06 | | | | | | | | | | |
| 11 | 18 | | 218 | 32 | | | | | | |
| | 11/07/06 | | [illegible] | | | | | | | |
| | 11 18 | | 217 | 12 | | | | | | |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Deep Piez

Well ID. Injection Well
Location RV
Collected By MB

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 11/14/06 | | | | | | | | | | |
| 11 | 21 | | 216 | 37 | | | | | | Solinst 500' |
| 11/21/06 | | | | | | | | | | |
| 13 | 47 | | 215 | 34 | | | | | | ″ |
| 11/28/06 | | | | | | | | | | |
| 13 | 58 | | 214 | 30 | | | | | | |
| 12/5/06 | | | | | | | | | | |
| 12 | 40 | | 213 | 69 | | | | | | |
| 12/12/06 | | | | | | | | | | |
| 11 | 24 | | 214 | 55 | | | | | | |
| 12/27/06 | | | | | | | | | | |
| 14 | 32 | | 212 | 30 | | | | | | |
| | | | | | | | | | | |
| 1/10/07 | | | | | | | | | | |
| 09 | 46 | | 211 | 59 | | | | | | |
| 1/25/07 | | | | | | | | | | |
| 12 | 54 | | 209 | 63 | | | | | | |
| 1/30/07 | | | | | | | | | | |
| 13 | 49 | | 208 | 53 | | | | | | |
| 2/8/07 | | | | | | | | | | |
| 13 | 19 | | 209 | 20 | | | | | | |
| 2/20/07 | | | | | | | | | | |
| 13 | 36 | | 208 | 98 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 11 | 26 | | 209 | 67 | | | | | | |
| 2/27/07 | | | | | | | | | | |
| 8 | 34 | | 209 | 40 | | | | | | Shutdown @ 10:00 |
| 10 | 04 | 30 | 219 | 19 | | | | | | |
| 11 | 49 | | 227 | 06 | | | | | | |
| 3 | 28 | | 229 | 27 | | | | | | |
| /28/07 | | | | | | | | | | |
| 11 | 16 | | 243 | 78 | | | | | | |

3/6/07
16:13 272.05

3/13/07 16:12 273.35

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW A shallow
Location RV
Collected By ________

Rate Control ________
Measuring Point toc → 2.58 ft
Pump Intake (ft.) above surf csg

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time t | t¹ | t/t¹ | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| | 6/28/ | 06 | | | | | | | | |
| 15 | 35 | | 300 | 51 | +0.5 | = 301.01 | | | | Powers 1000 |
| 8 | /10/ | 06 | | | | | | | | |
| 10 | 30 | | 296 | 98 | +0.5 = | 297.48 | | | | Set transducer S/N 107472 (100 psi) to 350[illegible].16 ft |
| 8 | 24 | | | | | | | | | |
| 14 | 52 | | 296 | 45 | → 2 | 96.95 | | | | P1000 |
| 9 | /8/06 | | | | | | | | | |
| 13 | 40 | | 249 | 29 | 501 520 | | | | | |
| 10/ | 17/06 | | | | | | | | | |
| 13 | 02 | | 230 | 39 | " | | | | | |
| 12/ | 12/06 | | | | | | | | | |
| | 1/41 | | 225 | 07 | | | | | | |
| | | | | | | | | | | |
| 1/10/07 | | | | | | | | | | |
| 16 | 22 | | 222 | 87 | | | | | | |
| 2/20/07 | | | | | | | | | | |
| 11 | 42 | | 221 | 71 | | | | | | |
| 3 | /13/07 | | | | | | | | | |
| 14 | 42 | | 279 | 26 | | | | | | pulling xducer to put in RV Obs well |

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW-4 (Intermed
Location RV
Collected By ________

Rate Control ________
Measuring Point toc → 2.55 ft above top surf csg
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time t | $t^1$ | $t/t^1$ | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 6 | /28/ | 06 | | | | | | | | set transducer S/N 104002 100 psi. |
| 16 | 30 | | | | | | | | | to 350.86 ft toc |
| 13 | 38 | | 300 | 17 | = 300.67 | | | | | w/ Powers 1000" |
| | | | | | | | | | | educer 50.19 |
| 8 | /24/ | 06 | | | | | | | | 348.31 above top surf csg |
| 15 | 60 | | 295 | 92 | = 296.42 | | | | | Powers 1000 |
| 9 | /8 | | | | | | | | | |
| 13 | 43 | | 249 | 30 | Sol 500 | | | | | |
| 10 | /17/06 | | | | | | | | | |
| 13 | 06 | | 230 | 35 | " | | | | | |
| 12/ | 12/06 | | | | | | | | | |
| | 1146 | | 225 | 00 | | | | | | |
| 1/10 | /07 | | | | | | | | | |
| 10 | 30 | | 222 | 76 | | | | | | |
| 2/2 | /07 | | | | | | | | | |
| 11 | 46 | | 221 | 53 | | | | | | |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. Obs A deep
Location ________
Collected By ________

Rate Control ________
Measuring Point toc → 2.62 ft
Pump Intake (ft.) above surf csg

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 6/ | 28/ | 06 | | | | | | | | |
| 14 | 35 | | | | | | | | | set xducer s/N 104001 |
| 15 | 42 | | 296 | 20 | | corrected<br>296.70 | | | | to 485.75 ft (100 psi) |
| | | | | | | | | | | w/1000' powers |
| 8/ | 24 | | | | | | | | | xducer 189.05 |
| 14 | 56 | | 291 | 78 | + .5 : | 292.28 | | | | |
| 9 | /8 | | | | | | | | | 483.13 below ~~above~~ |
| 13 | 46 | | 254 | 72 | 501 | 568 | | | | moved transducer surf csy |
| | | | | | | | | | | up abour 10 ft @ |
| | | | | | | | | | | 13:55 |
| 10/ | 17/06 | | | | | | | | | |
| | 1308 | | 231. | 12 | " | | | | | |
| | | | | | | | | | | |
| 12/12/06 | | | 224 | 91 | | | | | | |
| 1 | 44 | | | | | | | | | |
| 1/10/07 | | | | | | | | | | |
| 10 | 25 | | 222 | 63 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 11 | 45 | | 221 | 19 | | | | | | |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW-B
Location ________
Collected By ________

Rate Control ________
Measuring Point toc - 2.56 ft above surf csg
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 6 | /28 | /06 | | | | | | | | |
| 14 | 45 | | | | | | | | | xducer 104000 set (100 psi) |
| | | | | | | | | | | to 345.29 ft |
| | | | | | | | | | | xducer 42.77 ft |
| 15 | 52 | | 302 | 02 | = (302.52) | | | | | w/ Powers 1000' |
| | | | | | | | | | | 342.73 ft |
| | | | | | | | | | | - below surf csg |
| 8/ | 24/06 | | | | | | | | | |
| 15 | 15 | | 298 | 60 | → 299.10 | | | | | Powers 1000 |
| 9/ | 8 | | | | | | | | | |
| 16 | 40 | | 290 | 77 | | | | | | sd 500 |
| 10/ | 17/06 | | | | | | | | | |
| 13 | 17 | | 285 | 30 | | | | | | Sol 500 |
| 12/ | 12/06 | | 283 | 41 | | | | | | |
| 11 | 51 | | | | | | | | | |
| ~~12~~ | ~~/25/06~~ | | | | | | | | | |
| ~~14~~ | ~~55~~ | | ~~289~~ | ~~90~~ | | | | | | |
| 1/10/07 | | | | | | | | | | |
| 10 | 40 | | 282 | 74 | | | | | | |
| 2/2,/07 | | | | | | | | | | |
| 12 | 41 | | 282 | 04 | | | | | | |

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ______
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ______
Starting Rate ______
Static at Start ______

Well ID. OWB shallow piez
Location ______
Collected By ______

Rate Control ______
Measuring Point TOC → 2.51
Pump Intake (ft.) TC above surf csg

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 6 | /28/ | 06 | | | | | | | | |
| 15 | 55' | | 292 | 98 | →293.48 | | | | | powers 1000' |
| 8 | /10/06 | | | | | | | | | |
| 10 | 58 | | 291 | 97 | 292.47 | | | | | " " |
| 8 | /24 | | | | | | | | | |
| 15 | 19 | | 291 | 97 | 292.47 | | | | | " " |
| 8/ | 28 | | | | | | | | | |
| 14 | 18 | | 292 | 09 | 292.59 | | | | | " " |
| 8 | /29 | | | | | | | | | |
| 11 | 29 | | 292 | 19 | 292.69 | | | | | " " |
| 14 | 49 | | 292 | 13 | 292.63 | | | | | |
| 15 | 58 | | 292 | 10 | 292.60 | | | | | " " |
| | 8/ | 30 | | | | | | | | |
| 12 | 27 | | 292 | 00 | 292.50 | | | | | " " |
| | 9/ | 1/06 | | | | | | | | " |
| 13 | 44 | | 291 | 74 | | | | | | |
| 9 | /5/ | /06 | | | | | | | | |
| 11 | 48 | | 291 | 46 | | | | | | " |
| 9 | /8/06 | | | | | | | | | |
| 16 | 38 | | 290 | 95 | → 291.45 | | | | | " 291.37 w/ Sols |
| 9 | /12 | | | | | | | | | |
| 13 | 40 | | 291 | 28 | | | | | | Sol, inst 500 |
| 9/ | 19/06 | | | | | | | | | |
| 14 | 07 | | 290 | 30 | | | | | | " |
| 9/ | 26/06 | | | | | | | | | |
| 13 | 19 | | 290 | 38 | | | | | | " |
| 10/3/ | /06 | | | | | | | | | |
| 13 | 52 | | 290 | 21 | | | | | | " |
| 10/10/ | 06 | | | | | | | | | |
| 14 | 22 | | 289 | 91 | | | | | | " |
| | 10/17 | 1321 | 289 | 81 | | | | | | " |
| | | | | | | | | | | |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW-B shallow piez
Location ________
Collected By ________

Rate Control ________
Measuring Point toc + 2,51
Pump Intake (ft.) above surf csg

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 10/24/06 | | | | | | | | | | |
| 13 | 31 | | 289 | 90 | | | | | | |
| 10/31/06 | | | | | | | | | | |
| 11 | 36 | | 289 | 83 | | | | | | |
| 11/07/06 | | | | | | | | | | |
| 11 | 36 | | 289 | 88 | | | | | | |
| 11/14/06 | | | | | | | | | | |
| 11 | 36 | | 289 | 68 | | | | | | |
| 11/21/06 | | | | | | | | | | |
| 14 | 04 | | 289 | 99 | | | | | | |
| 11/28/06 | | | | | | | | | | |
| 14 | 13 | | 289 | 71 | | | | | | |
| | 12/5/06 | | | | | | | | | |
| 12 | 57 | | 290 | 06 | | | | | | |
| 12/12/06 | | | | | | | | | | |
| 11 | 55 | | 290 | 14 | | | | | | |
| 12/27/06 | | | | | | | | | | |
| 14 | 55 | | 289 | 90 | | | | | | |
| 1/10/07 | | | | | | | | | | |
| 10 | 45 | | 290 | 19 | | | | | | |
| 1/25/07 | | | | | | | | | | |
| 13 | 14 | | 290 | 36 | | | | | | |
| 1/30/07 | | | | | | | | | | |
| 14 | 20 | | 288 | 70 | | | | | | |
| 2/8/07 | | | | | | | | | | |
| 13 | 45 | | 290 | 27 | | | | | | |
| 2/20/07 | | | | | | | | | | |
| 13 | 51 | | 289 | 70 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 12 | 41 | | 290 | 22 | | | | | | |
| | | 2/27 | | | | | | | | |
| | 0845 | | 290 | 26 | Sz/MSL 500 | | | | | |

0848 288.72 Powers 500

154

/

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW 3 Shallow piez
Location ________
Collected By ________

Rate Control ________
Measuring Point toc 2 51
Pump Intake (ft.) abv concrete pad

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 2 | 27/0 | 7 | | | | | | | | |
| 10 | 08 | | 288 | 73 | | | | | | Powers 500 |
| A | 56 | | 288 | 68 | | | | | | ↓ |
| 10 | 21 | | 288 | 71 | | | | | | |
| 13 | 38 | | 288 | 70 | | | | | | |
| 14 | 10 | | 288 | 67 | | | | | | |
| 15 | 06 | | 288 | 65 | | | | | | |
| 2/28 | 07 | | | | | | | | | |
| 11 | 35 | | 290 | 15 | | | | | | Solinst 500 |
| 3/2 | 07 | | | | | | | | | |
| 8 | 02 | | 290 | 67 | | | | | | " |
| 3 | 6/07 | | | | | | | | | |
| | 1620 | | 291 | 18 | | | | | | |
| 3 | 13/07 | | | | | | | | | |
| 14 | 30 | | 291 | 50 | | | | | | |
| | | | | | | | | | | |
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BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW-C
Location ________
Collected By ________

Rate Control ________
Measuring Point toc = 2.50 above
Pump Intake (ft.) top surf csg

| Clock Time (24hrs) | | | Hold Unit | + <br> − | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 6/ | 28/ | 06 | | | | | | | | |
| 15 | 00 | | | | | | | | | set xducer S/N 103998 (30 psi) |
| | | | | | | | | | | to 325.47 ft toc |
| | | | | | | | | | | xducer 67.75 |
| 16 | 08 | | 257 | 30 | +0.42 = | ~~AA~~ 257.72 | | | | powers 1000' |
| 8/ | 24 | | | | | | | | | = 323 |
| 15 | 38 | | 252 | 12 | +0.42 = | 252.54 | | | | powers 1000 |
| 9/ | 8/06 | | | | | | | | | |
| 10 | 27 | | 248 | 70 | | | | | | 50/500 |
| 10/ | 17/06 | | | | | | | | | |
| 13 | 36 | | 244 | 39 | | | | | | 〃 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 12/ | 12/06 | | | | | | | | | |
| 12 | 04 | | 242 | 96 | | | | | | |
| 2/ | 26/07 | | | | | | | | | |
| 12 | 52 | | 241 | 34 | | | | | | |

BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. GWC Shallow Piez
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 6 | /28/ | 06 | | | | | | | | Can't measure - cap not accessible |
| | | | | | connection | | | | | to wrench |
| 8/ | 24/ | 06 | | | ↓ | 237.07 | | | | |
| 15 | 40 | | 236 | 57 | + ~~.18~~ | ~~236.75~~ | | | | powers 1000 |
| 8 | 28 | | | | 0.5 | 237.20 | | | | |
| 14 | 32 | | 236 | 70 | ~~.18~~ 0.5 | ~~236.88~~ | | | | " |
| 8/ | 30 | | | | | | | | | |
| 12 | 17 | | 236 | 85 | .18 | 237.03 | | | | solinst 300 |
| 9 | /1 | | | | | | | | | |
| 13 | 33 | | 236 | 74 | | | | | | " |
| 9 | /5 | | | | | | | | | |
| 11 | 42 | | 236 | 60 | | | | | | " |
| | 9/8 | | | | | | | | | |
| 16 | 30 | | 236 | 58 | | | | | | sol 500 |
| 9 | /12 | | | | | | | | | |
| 13 | 26 | | 236 | 64 | | | | | | sol 500 |
| 9/ | 19/06 | | | | | | | | | |
| 14 | 18 | | 236 | 59 | | | | | | " |
| 9/ | 26/06 | | | | | | | | | |
| 13 | 27 | | 236 | 59 | | | | | | " |
| 10/3 | /06 | | | | | | | | | |
| 13 | 59 | | 236 | 92 | | | | | | " |
| 10/10 | /06 | | | | | | | | | |
| 14 | 32 | | 236 | 57 | | | | | | " |
| 10/17 | /06 | | | | | | | | | |
| 13 | 33 | | 236 | 57 | | | | | | " |
| 10/2 | 4/06 | | | | | | | | | |
| 13 | 39 | | 236 | 64 | | | | | | |
| 10/31 | /06 | | | | | | | | | |
| 11 | 43 | | 236 | 70 | | | | | | |
| | 11/7/06 | | | | | | | | | |
| | 11 42 | | 236 | 83 | | | | | | |

BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW-C Shallow Piez
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 11/14/06 | | | | | | | | | | |
| 11 | 44 | | 236 | 56 | | | | | | |
| 11/21/06 | | | | | | | | | | |
| 14 | 11 | | 236 | 81 | | | | | | |
| 11/28/06 | | | | | | | | | | |
| 14 | 20 | | 236 | 67 | | | | | | |
| 12/5/06 | | | | | | | | | | |
| 13 | 03 | | 236 | 85 | | | | | | |
| 12/ | 12/06 | | 236 | 93 | | | | | | |
| 12 | 02 | | | | | | | | | |
| 12/27/06 | | | | | | | | | | |
| 15 | 04 | | 236 | 70 | | | | | | |
| | | | | | | | | | | |
| 1/30/07 | | | | | | | | | | |
| 14 | 30 | | 235 | 55 | | | | | | |
| 2/8/07 | | | | | | | | | | |
| 13 | 36 | | 236 | 64 | | | | | | |
| 2/20/07 | | | | | | | | | | |
| 14 | 01 | | 236 | 76 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 12 | 50 | | 236 | 59 | | | | | | |
| 2/ | 27 | | | | | | | | | |
| 08 | 56 | | 236 | 77 | | | | | | |
| 10 | 12 | | 236 | 77 | | | | | | |
| 11 | 56 | | 236 | 77 | | | | | | |
| 13 | 36 | | 236 | 80 | | | | | | |
| 2/28/07 | | | | | | | | | | |
| 11 | 36 | | 236 | 63 | | | | | | |
| | | | | | | | | | | |
| 3/6/07 | | | | | | | | | | |
| | 1633 | | 236 | 63 | | | | | | |
| | 3/13/07 | | | | | | | | | |
| | 14:21 | | 236 | 56 | | | | | | |

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Production / Exploratory
Well Test Records

# AQUIFER/WELL TEST RECORD

257.31

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. CCD-P1
Location RV
Collected By ________

Rate Control ________
Measuring Point east meas tube
Pump Intake (ft.) ≈0.71 ft above concrete pad

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 8/17/06 | | | | | | | | | | |
| 10 | 35 | | 250 | +1.36 | 248.64 | +0.28 | | | | solinst 300 (needs correction) |
| 8/23/06 | | | | | | | | | | |
| 14 | 08 | | | | 248.68 | + 28 : 248.96 | | | | set transducer s/N 7137 |
| | | | | | | | | | | (100 psi) to 430.22 ft |
| | | | | | | | | | | 181.28 + 248.96 |
| 8/28/06 | | | | | | | | | | |
| 08 | 55 | | | | 257.31 | +.28 = | | | | sol 300 |
| 9/1/06 | | | | | | | | | | |
| 12 | :10 | | | | 294.85 | | | | | " |
| 9/18/06 | | | | | | | | | | |
| 15 | 05 | | | | 303 | 82 | sol | 500 | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 10/3/06 | | | | | | | | | | |
| 15 | 30 | | | | 313 | 90 | sol | 500 | | changed batt on x-ducer, pulled x-ducer |
| 10/4/06 | | | | | | | | | | |
| 16 | 40 | | | | 314 | .20 | sol | 500 | | |
| 10/5/06 | | | | | | | | | | |
| 17 | 55 | | | | 31.4 | .10 | sol | 500 | | installed rental x-ducer. |
| 10/16/06 | | | | | | | | | | set repaired x-ducer |
| 10/17/06 | | | | | | | | | | started new test |
| 14 | 06 | | | | 315 | 45 | sol | 500 | | |
| 12/12/06 | | | | | | | | | | |
| 13 | 18 | | | | 317 | 29 | | | | |
| ~~1/10/07~~ | | | | | | | | | | |
| ~~08~~ | ~~10~~ | | | | | | | | | |
| 2/8/07 | | | | | | | | | | |
| 16 | 09 | | | | 328 | 36 | | | pulled | x-ducer, changed batt, reset on 2/9, |
| 2/26/07 | | | | | | | | | | |
| 14 | 04 | | | | 317 | 54 | | | | |
| | | | | | | | | | | |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. CCD-X1 (5inch)
Location ________
Collected By ________

Rate Control ________
Measuring Point toc
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time t | t¹ | t/t¹ | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 8 | 10/06 | | | | | | | | | |
| 16 | 00 | | 246 | 09 + | .28 = 246.37 | | | | | Solinsr 300 |
| 8 | 23 | | | | | | | | | Set transducer 7303 (100 psi) |
| 14 | 39 | | 246 | 07 | ⟷ 246.35 | | | | | 10 ~ ~~300~~ ft |
| 8 | 28 | | | | | | | | | 338.97 |
| 08 | 42 | | 249 | 46 | 249.74 | | | | | sol 300 |
| 9 | 1/06 | | | | | | | | | |
| 12 | 00 | | 275 | 34 | | | | | | sol 300 |
| 9 | 18 | | | | | | | | | |
| 15 | 29 | | 285 | 31 | | | | | | Sol 500 |
| 10/3/06 | | | | | | | | | | |
| 15 | 55 | | 295 | 80 | | | | | | " |
| | | | | | | | | | | |
| 10/10/06 | | | | | | | | | | changed batt in x-ducer. |
| 10/17/06 | | | | | | | | | | |
| 14 | 27 | | 297 | 22 | | | | | | Sol 500 |
| 12/12/06 | | | | | | | | | | |
| 13 | 31 | | 299 | 56 | | | | | | |
| 1/10/07 | | | | | | | | | | |
| 07 | 40 | | 300 | 29 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 14 | 10 | | 299 | 90 | | | | | | |
| 2 | 27/07 | | | | | | | | | moved transducer up ~ 20 ft |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. CCD-71 Shal Piez
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 8/8/00 | | | | | | corrected | | | | |
| 16 | 15 | | 231 | 37 | +0.28 | 231.65 | | | | solinst 300 |
| 8 | /23 | | | | | | | | | |
| 14 | 41 | | 231 | 33 | | 231 61 | | | | ″ |
| 8 | /28 | | | | | | | | | |
| 08 | 46 | | 232 | 40 | | 232 68 | | | | ″ |
| 8 | /30 | | | | | | | | | |
| 11 | 13 | | 236 | 34 | | 236.62 | | | | ″ |
| 9 | /1/06 | | | | | | | | | |
| 12 | 06 | | 238 | 00 | | 238.28 | | | | ″ |
| 9 | /5/06 | | | | | | | | | |
| 10 | 41 | | 239 | 92 | | 240.20 | | | | ″ |
| | 9/8 | | | | | | | | | |
| 15 | 23 | | 241 | 20 | | | | | | sol 500 |
| 9/ | 12/06 | | | | | | | | | |
| 10 | 41 | | 241 | 68 | | | | | | ″ |
| 9/ | 19/06 | | | | | | | | | |
| 12 | 35 | | 243 | 49 | | | | | | ″ |
| 9/26 | /06 | | | | | | | | | |
| 14 | 09 | | 243 | 96 | | | | | | ″ |
| 10/3 | /06 | | | | | | | | | |
| 15 | 39 | | 244 | 76 | | | | | | ″ |
| 10/ | 10/06 | | | | | | | | | |
| 13 | 03 | | 245 | 05 | | | | | | ″ |
| 10/17 | /06 | | | | | | | | | |
| 14 | 22 | | 245 | 48 | | | | | | ″ |
| 10/24 | /06 | | | | | | | | | |
| 13 | 57 | | 246 | 02 | | | | | | |
| 10/31 | /06 | | | | | | | | | |
| 12 | 21 | | 245 | 78 | | | | | | |
| 11/07/06 | | | | | | | | | | |
| | 1302 | | 245 | 88 | | | | | | |

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ______
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ______
Starting Rate ______
Static at Start ______

Well ID. CCD-X1 Shal Piez
Location ______
Collected By ______

Rate Control ______
Measuring Point ______
Pump Intake (ft.) ______

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 11/14/06 | | | | | | | | | | |
| 12 | 44 | | 245 | 73 | | | | | | solinst 500' |
| 11/21/06 | | | | | | | | | | |
| 15 | 44 | | 245 | 91 | | | | | | 〃 |
| 11/28/06 | | | | | | | | | | |
| 15 | 21 | | 245 | 98 | | | | | | |
| 12/5/06 | | | | | | | | | | |
| 14 | 01 | | 246 | 14 | | | | | | |
| 12/12/06 | | | | | | | | | | |
| 13 | 29 | | 246 | 09 | | | | | | |
| 12/27/06 | | | | | | | | | | |
| 15 | :18 | | 246 | 10 | | | | | | 〃 |
| | | | | | | | | | | |
| 1/16/07 | | | | | | | | | | |
| 07 | 35 | | 246 | 04 | | | | | | |
| 1/25/07 | | | | | | | | | | |
| 14 | 00 | | 246 | 65 | | | | | | |
| 1/30/07 | | | | | | | | | | |
| 13 | 05 | | 245 | 65 | | | | | | |
| 2/8/07 | | | | | | | | | | |
| 14 | 16 | | 246 | 51 | | | | | | |
| 2/20/07 | | | | | | | | | | |
| 12 | 19 | | 245 | 81 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 14 | 11 | | 246 | 24 | | | | | | |
| 2/27/07 | | | | | | | | | | |
| 9 | 35 | | 246 | 22 | | | | | | |
| 10 | 54 | | 245 | 73 | | | | | | |
| 12 | 44 | | 245 | 43 | | | | | | |
| /28/07 | | | | | | | | | | |
| 12 | 08 | | 244 | 21 | | | | | | |
| | | | | | | | | | | |

3/6/07
1543 241 60
3/13/07
1610 239.77

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BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ______
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ______
Starting Rate ______
Static at Start ______

Well ID. CCD-X1 Deep Piez
Location ______
Collected By ______

Rate Control ______
Measuring Point ______
Pump Intake (ft.) ______

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 8/10/06 | | | | | | Corrected | | | | |
| 16 | 20 | | 233 | 27 | + 0.28 | 233.55 | | | | Solinst 300 |
| 8/23 | | | | | | | | | | |
| 16 | 44 | | 233 | 15 | | 233.43 | | | | " |
| 8/28 | | | | | | | | | | |
| 08 | 48 | | 233 | 25 | | 233.53 | | | | " |
| 8/30 | | | | | | | | | | |
| 11 | 19 | | 233 | 26 | | 233.54 | | | | " |
| 9/1/06 | | | | | | | | | | |
| 12 | 03 | | 233 | 27 | | 233.55 | | | | " |
| 9/5/06 | | | | | | | | | | |
| 10 | 45 | | 233 | 26 | | 233.54 | | | | " |
| 9/8 | | | | | | | | | | |
| 15 | 26 | | 233 | 39 | | | | | | sol 500 |
| 9/12/06 | | | | | | | | | | |
| 10 | 43 | | 233 | 39 | | | | | | " |
| 9/19/06 | | | | | | | | | | |
| 12 | 39 | | 233 | 45 | | | | | | " |
| 9/26/06 | | | | | | | | | | |
| 14 | 07 | | 233 | 45 | | | | | | " |
| 10/3/06 | | | | | | | | | | |
| 15 | 41 | | 233 | 61 | | | | | | " |
| 10/10/06 | | | | | | | | | | |
| 12 | 59 | | 233 | 54 | | | | | | " |
| 10/17/06 | | | | | | | | | | |
| 14 | 25 | | 233 | 58 | | | | | | |
| 10/24/06 | | | | | | | | | | |
| 14 | 01 | | 233 | 60 | | | | | | |
| 10/31/06 | | | | | | | | | | |
| 1217 | | | 233 | 61 | | | | | | |
| 11/7/06 | | | | | | | | | | |
| | 1305 | | 233 | 63 | | | | | | |

BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. CCD-X1 Deep Pier
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 11/14/06 | | | | | | | | | | |
| 12 | 42 | | 233 | 67 | | | | | | solinst 500' |
| 11/21/06 | | | | | | | | | | |
| 15 | 42 | | 233 | 69 | | | | | | |
| 11/28/06 | | | | | | | | | | |
| 15 | 24 | | 233 | 74 | | | | | | |
| 12/5/06 | | | | | | | | | | |
| 14 | 04 | | 233 | 89 | | | | | | |
| 12/12/06 | | | | | | | | | | |
| 13 | 27 | | 233 | 91 | | | | | | |
| 12/27 | | | | | | | | | | |
| 13:22 | | | 233 | 98 | | | | | | |
| | | | | | | | | | | |
| 1/10/07 | | | | | | | | | | |
| 07 | 37 | | 234 | 00 | | | | | | |
| 1/25/07 | | | | | | | | | | |
| 13 | 56 | | 234 | 02 | | | | | | |
| 1/30/07 | | | | | | | | | | |
| 13 | 08 | | 233 | 16 | | | | | | |
| 2/8/07 | | | | | | | | | | |
| 14 | 15 | | 234 | 11 | | | | | | |
| 2/20/07 | | | | | | | | | | |
| 12 | 21 | | 234 | 22 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 14 | 12 | | 234 | 08 | | | | | | |
| 2/27/07 | | | | | | | | | | |
| 9 | 33 | | 234 | 09 | | | | | | |
| 2/27/07 | | | | | | | | | | |
| 10 | 51 | | 234 | 11 | | | | | | |
| 12 | 47 | | 234 | 11 | | | | | | |
| 2/28/07 | | | | | | | | | | |
| | 05 | | 234 | 17 | | | | | | |

12/6/07
15:46 234.15
3/13/07
16:12 234.20

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BALLEAU GROUNDWATER, INC.

Outlying Observation
Well Test Records

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. El Rancho Well
Location RV
Collected By ________

Rate Control ________
Measuring Point top cover plate
Pump Intake (ft.) ~ flush w/ ground level

| Clock Time (24hrs) Hr | Min | Sec | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time t | t¹ | t/t¹ | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 10 | 06 | | | | | | | | |
| 11 | 38 | | 213 | 85 | | | | | | |
| 8 | 17 | 06 | | | | | | | | |
| 14 | 40 | | 213 | 90 | | | | | | sol.nsr 300 |
| 8 | 24 | | | | | | | | | |
| 17 | 00 | | 213 | 70 ~~+ 28 = 213.98~~ | | | | | | " |
| 8 | 28 | | | | | | | | | set transducer S/N 106606 |
| 09 | 35 | | 213 | 97 | | | | | | (rental) to ~~231.84~~ 232.12 ft |
| 9 | 12 | | | | | | | | | |
| 12 | 54 | | 214. | 00 | | | | | | sol 500 pulled transducer |
| 9 | 19 | 06 | | | | | | | | |
| 12 | 54 | | 214 | 03 | | | | | | " |
| | | | | | | | | | | |
| 9 | 26 | 06 | | | | | | | | |
| 14 | 25 | | 213 | 95 | | | | | | " |
| 10 | 3 | 06 | | | | | | | | |
| 16 | 12 | | 214 | 00 | | | | | | sol 500 |
| 10 | 10 | 06 | | | | | | | | |
| 15 | 16 | | 214 | 16 | | | | | | " |
| 10 | 17 | 06 | | | | | | | | |
| 14 | 38 | | 214 | 17 | | | | | | " |
| 10 | 24 | 06 | | | | | | | | |
| 14 | 19 | | 213 | 99 | | | | | | " |
| 10 | 31 | 06 | | | | | | | | |
| 13 | 37 | | 214 | 18 | | | | | | " |
| 11 | 07 | 06 | | | | | | | | |
| 12 | 25 | | 214 | 15 | | | | | | " |
| 11 | 14 | 06 | | | | | | | | |
| 12 | 18 | | 214 | 06 | | | | | | |
| 11 | 21 | 06 | | | | | | | | |
| 15 | 16 | | 214 | 06 | | | | | | |
| | | | | | | | | | | |

BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ______
Drawdown/Recovery
Step 1-2-3-4
Tape, M-scope, airline
Start Time ______
Starting Rate ______
Static at Start ______

Well ID. El Rancho Well
Location R.V.
Collected By ______

Rate Control ______
Measuring Point top cover plate
Pump Intake (ft.) Flush w/ground lvl

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | $t^1$ | $t/t^1$ | |
| 11/28/06 | | | | | | | | | | |
| 14 | 52 | | 214 | 14 | | | | | | |
| 12/5/06 | | | | | | | | | | |
| 16 | 36 | | 214 | 04 | | | | | | |
| 12/12/06 | | | | | | | | | | |
| 12 | 43 | | 214 | 31 | | | | | | |
| 12/27/06 | | | | | | | | | | |
| 10 | 30 | | 214 | 00 | | | | | | vane open - I closed it and |
| 1/10/07 | | | | | | | | | | wired it down |
| 11 | 00 | | 214 | 05 | | | | | | vane closed |
| 1/25/07 | | | | | | | | | | |
| 13 | 24 | | 214 | 12 | | | | | | |
| | | | | | | | | | | |
| 2/8/07 | | | | | | | | | | |
| 14 | 37 | | 214 | 08 | | | | | | |
| 2/20/07 | | | | | | | | | | |
| 14 | 49 | | 213 | 94 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 13 | 25 | | 214 | 13 | | | | | | |
| 2/27/07 | | | | | | | | | | |
| 10 | 36 | | 214 | 20 | | | | | | |
| 13 | 17 | | 214 | 11 | | | | | | |
| 2/28/07 | | | | | | | | | | |
| 11 | 49 | | 213 | 97 | | | | | | |
| 3/6/07 | | | | | | | | | | |
| | | | 214 | 10 | | | | | | |
| 3/13/07 | | | | | | | | | | |
| 15 | 50 | | 214 | 04 | | | | | | Windmill turning - small |
| | | | | | | | | | | amount of water coming out |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date __________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time __________
Starting Rate __________
Static at Start __________

Well ID. SFCC well
Location SFCC
Collected By __________

Rate Control __________
Measuring Point __________
Pump Intake (ft.) __________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time t | $t^1$ | $t/t^1$ | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| 9 | /15 | | | | | | | | | |
| 13 | 15 | | | | 230 | 87 | | | | |
| | | | | | | | | | | |
| 9/ | 17 | | | | | | | | | |
| 13 | 15 | | | | 228. | 40 | | | | |
| 9/ | 19/06 | | | | | | | | | |
| 13 | 27 | | | | 229 | 50 | | | | |
| 9/ | 26/06 | | | | | | | | | |
| 15 | 58 | | | | 228 | 25 | | | | |
| 10/3 | /06 | | | | | | | | | |
| 17 | 02 | | | | 229 | 25 | | | | |
| 10/1 | 0/06 | | | | | | | | | |
| | 15:28 | | | | 228 | 55 | | | | |
| 10/1 | 7/06 | | | | | | | | | |
| 15 | 38 | | | | 228 | 36 | | | | |
| 10/2 | 4/06 | | | | | | | | | |
| 14 | 55 | | | | 227 | 09 | | | | |
| 10/31 | /06 | | | | | | | | | |
| 13 | 27 | | | | 227 | 30 | | | | |
| 11/07 | /06 | | | | | | | | | |
| 12 | 35 | | | | 227 | 00 | | | | |
| 11/14 | /06 | | | | | | | | | |
| 12 | 53 | | | | 226 | 81 | | | | |
| 11/2 | 1/06 | | | | | | | | | |
| 16 | 10 | | | | 227 | 10 | | | | |
| 11/28 | /06 | | | | | | | | | |
| 15 | 47 | | | | 226 | 78 | | | | |
| 12/5 | /06 | | | | | | | | | |
| 17 | 06 | | | | 226 | 71 | | | | |
| 12/1 | 2/06 | | | | | | | | | |
| 14 | 12 | | | | 226 | 82 | | | | |
| | | | | | | | | | | |

12/27/06 226 59
11:30

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1/10/07 9:00 226.54

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. SFCC Well
Location SFCC
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 1/25/07 | | | | | | | | | | |
| 14 | 12 | | 226 | 69 | | | | | | |
| 1/30/07 | | | | | | | | | | |
| 13 | 20 | | 226 | 55 | | | | | | |
| 2/8/07 | | | | | | | | | | |
| 16 | 48 | | 226 | 55 | | | | | | |
| 2/20/07 | | | | | | | | | | |
| 15 | 21 | | 226 | 54 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 13 | 34 | | 226 | 54 | | | | | | |
| 2/27/07 | | | | | | | | | | |
| 11 | 00 | | 226 | 59 | | | | | | |
| | | | | | | | | | | |
| 12 | 55 | | 226 | 56 | | | | | | |
| 15 | 23 | | 226 | 55 | | | | | | |
| 2/28/07 | | | ~~226~~ | ~~47~~ | | | | | | |
| 12 | 25 | | 226 | 47 | | | | | | |
| 3/2/07 | | | 226 | 62 | | | | | | |
| 8 | 38 | | | | | | | | | |
| 3/6/07 | | | | | | | | | | |
| 15 | 35 | | 226 | 50 | | | | | | |
| 3/13/07 | | | | | | | | | | |
| 16 | 26 | | 226 | 42 | | | | | | |
| | | | | | | | | | | |
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BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. Rancho V. Obs Well
Location RV
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 8 | /10/06 | | | | | | | | | |
| 15 | 20 | | 205 | 10 | | | | | | ~~Solinst 300~~ Powers 1000 |
| 8/ | 17/06 | | | | | | | | | |
| 14 | 30 | | 205 | 10 | | | | | | Solinst 300 |
| | | | +30 | 2 | | | | | | set xducer s/N 106615 30psi |
| 8 | 28 | | 235 | 20 | | | | | | (rental) to 235.30 ft. |
| 10 | 04 | | 205 | 10 | | | | | | Solinst 300 |
| 9 | /12 | | | | | | | | | |
| 12 | 10 | | 205 | 25 | | | | | | Sol 500 |
| 10/3 | /06 | | | | | | | | | |
| 16 | 34 | | 205 | 49 | | | | | | |
| 10/ | 17/06 | | | | | | | | | |
| | 1456 | | 205 | 08 | | | | | | Sol 500 |
| 10/2 | 4/06 | | | | | | | | | |
| 14 | 35 | | 205 | 05 | | | | | | " |
| 10/ | 31/06 | | | | | | | | | |
| 13 | 56 | | 205 | 67 | | | | | | " |
| 11/0 | 7/06 | | | | | | | | | |
| 12 | 02 | | 205 | 82 | | | | | | " Pulled x-ducer |
| 11/1 | 4/06 | | | | | | | | | |
| 12 | 02 | | 205 | 71 | | | | | | |
| 11/21 | /06 | | | | | | | | | |
| 15 | 00 | | 205 | 49 | | | | | | |
| 11/28 | /06 | | | | | | | | | |
| 14 | 34 | | 205 | 66 | | | | | | |
| 12/5 | /06 | | | | | | | | | |
| 16 | 23 | | 205 | 20 | | | | | | Vane on windmill is closed |
| 12/12 | /06 | | | | | | | | | |
| 12 | 28 | | 205 | 13 | | | | | | |
| 12/ | 27 | | | | | | | | | |
| 10 | 00 | | 204 | 97 | | | | | | Vane closed |
| | | | | | | | | | | |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. Rancho Viejo Obs Well
Location R.V.
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 2/8 | /07 | | | | | | | | | |
| 14 | 16 | | 204 | 94 | | | | | | |
| 2/26 | /07 | | | | | | | | | |
| 14 | 22 | | 204 | 84 | | 0.60 = 204.52 | | | | |
| 2/26 | /07 | | | | | | | | | |
| 13 | 50 | | 203 | 92 | x — | powers 500' | | | | |
| 2 | /27/07 | | | | | | | | | |
| 11 | 29 | | 203 | 97 | | " | " | | | |
| 3 | /13/07 | | | | | | | | | |
| 15 | 16 | | 205 | 45 | | Solinst | | | | windmill operating |
| | | | | | | | | | | setting xducer s/n 107472 (100psi) |
| | | | | | | | | | | to ~350 ft |

BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. La Cienega
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 10/24/06 | | | | | | | | | | |
| 1130 | | | 225 | 50 | | | | | | Powers 500 |
| 10/31/06 | | | | | | | | | | |
| 13 | 09 | | 224 | 29 | | | | | | " |
| 11/07/06 | | | | | | | | | | |
| 13 | 20 | | 225 | 41 | | | | | | " |
| 11/14/06 | | | | | | | | | | |
| 14 | 14 | | 225 | 16 | | | | | | " |
| 11/21/06 | | | | | | | | | | |
| 15 | 57 | | 225 | 39 | | | | | | " |
| 11/28/06 | | | | | | | | | | |
| 15 | 36 | | 225 | 17 | | | | | | powers 1000 |
| | | | | | | | | | | |
| 12/4/06 | | | | | | | | | | |
| 16 | 54 | | 225 | 67 | | | | | | Pow 500 |
| 12/12/06 | | | | | | | | | | |
| 13 | 50 | | 225 | 33 | | | | | | pow 500 |
| 12/~~26~~ 27/06 | | | | | | | | | | [illegible] |
| 11 | 00 | | 225 | 79 | | | | | | ~~Powers~~ 500 vane closed |
| 2/8/07 | | | | | | | | | | |
| 15 | 24 | | 225 | 93 | | | | | | |
| 2/20/07 | | | | | | | | | | |
| 15 | 06 | | 225 | 54 | | | | | | |
| 2/26/07 | | | | | | | | | | |
| 13 | 47 | | 225 | 78 | | | | | | |
| 2/27/07 | | | | | | | | | | |
| 11 | 12 | | 225 | 84 | | | | | | ~~Can't get~~ |
| | | | | | | | | | | 3/12/07 can't get lock open |
| | | | | | | | | | | -changed combo? |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. ~~La Cienega well~~ CCD-P1
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time | | Hold Unit | + - | Depth to Water | Drawdown or Recovery. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | t | t' | t/t' | |
| 5/25/07 | | | | | | | | | |
| 10 | 00 | 256. | 41 | ← water level moving | | | | | pulling BGW xducer |
| | | | | up and down with | | | | | Setting RV xducer |
| | | | | wind gusts (?) | | | | | s/N |
| | | | | | | | | | ~ 350 ft |
| 7/3/07 | | | | | | | | | |
| 12 | 35 | 254 | 80 | | | | | | |
| 12 | 38 | 254 | 79 | | | | | | piezometer? |

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-~~4~~
Tape, [✓ ~~M~~-scope,] airline Solmst 500 unless noted otherwise
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. Inj well Shal Piez
Location ________
Collected By ________

Rate Control ________
Measuring Point toc
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t¹ | t/t¹ | |
| 3/ | 3/07 | | 315 | 73 | | | | | | |
| 14 | 06 | | | | | | | | | |
| 3/ | 30/07 | | | | | | | | | |
| 09 | 25 | | 315 | 89 | | | | | | |
| 7 | 5/25/07 | | | | | | | | | |
| 12: | 46 | | 315 | 90 | | | | | | |
| 3/07/11 | 20 | | 315 | 81 | | | | | | |
| 15 | 00 | | 315 | 80 | | | | | | 9/19/07 |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, [✓ M/scope], airline    Solinst 500
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. Inj Well Deep Piez
Location ________
Collected By ________

Rate Control ________
Measuring Point toc
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | |
| /13/07 | | | | | | | | | | |
| 4 | 12 | | 273 | 35 | | | | | | |
| 3/20/07 | | | | | | | | | | |
| 09 | 35 | | 285 | 34 | | | | | | |
| 5/25/07 | | | | | | | | | | |
| 12 | 50 | | 290 | 48 | | | | | | |
| 7/3/07 | | | ~~29~~ | ~~73~~ | | | | | | |
| 1 | 24 | | 291 | 73 | | | | | | |
| 1 | 32 | | 293 | 04 | | | | | | inj well 12" casing |
| | 03 | | 292 | 73 | | | | | | 9/19/07 |
| | | | | | | | | | | |

BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, [✓ M-scope], airline solinst 500
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW-A Shallow ~~CED P1~~
Location ________
Collected By ________

Rate Control ________
Measuring Point ~~[illegible] tube~~
Pump Intake (ft.) ________ 0.71 ~~ft above [illegible] pad~~

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time t | t' | t/t' | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | | | | Note - transducer was ~~moved~~ |
| 3/30/07 | | | | | | | | | | removed on mar. 13 |
| 0 | 945 | | 286 | 00 | | | | | | |
| 5/25/07 | | | | | | | | | | |
| 12 | 56 | | 291 | 70 | | | | | | |
| 7/3/07 | | | | | | | | | | |
| 11 | 49 | | 292 | 98 | | | | | | Shallow |
| 11 | 46 | | 288 | 55 | | | | | | OWA deep piezometer |
| 11 | 52 | | 292 | 60 | | | | | | OWA intermediate |
| 15 | 20 | | 293 | 97 | | | | | | 9/19/07 |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery
Step 1-2-3-4
Tape, [✓ M-scope,] airline Solinst 500
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW-13 Shal Piez
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | t | $t^1$ | $t/t^1$ | |
| Hr | Min | Sec | | | | | | | | |
| 3/30/07 | | | | | | | | | | |
| 09 | 55 | | 292 | 12 | | | | | | |
| 5/25/07 | | | | | | | | | | |
| 13 | 05 | | 292 | 94 | | | | | | |
| 7/3/07 | | | | | | | | | | |
| 12 | 01 | | 293 | 14 | | | | | | |
| 12 | 04 | | 295 | 60 | | | | | | 5" casing |
| 15 | 50 | | 293 | 07 | | | | | | 9/19/07 |

BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, [✓ M-scope], airline Solinst 500
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. OW-C Shal Piez
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 3/30/07 | | | | | | | | | | |
| 10 | 15 | | 236.62 | | | | | | | |
| 5/25/07 | | | | | | | | | | |
| 13 | 12 | | 236 | 74 | | | | | | |
| 7/3/07 | | | | | | | | | | |
| 12 | 10 | | 236 | 54 | | | | | | shal piez |
| 12 | 12 | | 249 | 89 | | | | | | 5" casing |
| ~~14~~ | ~~40~~ | | ~~233~~ | ~~81~~ | | | | | | ~~9/19/07~~ BP (CCD-X1 Deep level) |
| 15 | 38 | | 237 | 02 | | | | | | 9/19/07 |

BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery
Step 1-2-3-4
Tape, [✓ M-scope], airline Solinst 500
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. CCD-Y1 Shallow Piez
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | $t^1$ | $t/t^1$ | |
| 3/30/07 | | | | | | | | | | |
| 10 | 50 | | 237 | 80 | | | | | | |
| 5/25/07 | | | | | | | | | | |
| 10 | 25 | | 235 | 90 | | | | | | |
| 7/3/07 | | | | | | | | | | |
| ~~12~~ | ~~46~~ | | ~~251~~ | ~~25~~ BY | | | | | | 5" depth, moved measurement to correct sheet |
| 12 | 49 | | 235 | 44 | | | | | | Shallow piez |
| 14 | 38 | | 235 | 03 | | | | | | 9/19/07 |

BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery _
Step 1-2-3-4
Tape, M-scope, airline
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. CCD-X1 main csg
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 5/25/07 | 10 | :20 | 252 | 61 | | | | | | |
| 7/5/07 | | | | | | | | | | |
| 12 | 46 | | 251 | 25 | | | | | | |
| 14 | 35 | | 249 | 99 | | | | | | 9/19/07 |

BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, [✓ M-scope], airline 50/msl
500
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. CCD-X1 Deep Piez
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | $t'$ | $t/t'$ | |
| 3/30/07 | | | | | | | | | | |
| 10 | 52 | | 234 | 17 | | | | | | |
| 7/3/07 | | | | | | | | | | |
| 12 | 51 | | 233 | 99 | | | | | | |
| 14 | 40 | | 233 | 81 | | | | | | 9/19/07 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
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BALLEAU GROUNDWATER, INC.

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# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery _
Step 1-2-3-4
Tape, [✓ M-scope], airline Solinst 300
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. SFCC Well
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + − | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 3/ | 30/07 | | | | | | | | | |
| 1: | 06 | | 226 | 41 | | | | | | |
| / | 3/07 | | | | | | | | | |
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BALLEAU GROUNDWATER, INC.

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ________
Drawdown/Recovery_
Step 1-2-3-4
Tape, [✓ M-scope], airline Solinst 500
Start Time ________
Starting Rate ________
Static at Start ________

Well ID. El Rancho Well
Location ________
Collected By ________

Rate Control ________
Measuring Point ________
Pump Intake (ft.) ________

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 3/30/07 | | | | | | | | | | |
| 11 | 20 | | 214 | 22 | | | | | | windmill turning, small amount of |
| | | | | | | | | | | water produced |
| 7/3/07 | | | | | | | | | | |
| 12 | 24 | | 214 | 11 | | | | | | |

# AQUIFER/WELL TEST RECORD

BGW Sheet __ of __
Test Date ______
Drawdown/Recovery
Step 1-2-3-4
Tape, M-scope, airline
Start Time ______
Starting Rate ______
Static at Start ______

Well ID. RV Obs Well
Location ______
Collected By ______

Rate Control ______
Measuring Point ______
Pump Intake (ft.) ______

| Clock Time (24hrs) | | | Hold Unit | + – | DTW | DD or Recov. | Elapsed Time | | | Remarks: static, start, end, Δ rate, sample, etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hr | Min | Sec | | | | | t | t' | t/t' | |
| 09 | 20 | (5/25/07) | 205 | 20 | | | | | | windmill off; pulling xducer |
| | | | | | | | | | | setting 205.20 + 146.57 |
| | | | | | | | | | | = 351.77 ft |

BALLEAU GROUNDWATER, INC.

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# APPENDIX G

# WATER ANALYSES

**ASSAIGAI
ANALYTICAL
LABORATORIES, INC.**
4301 Masthead NE • Albuquerque, New Mexico 87109 • (505) 345-8964 • FAX (505) 345-7259
3332 Wedgewood, Ste. N • El Paso, Texas 79925 • (915) 593-6000 • FAX (915) 593-7820
127 Eastgate Drive, 212-C • Los Alamos, New Mexico 87544 • (505) 662-2558

**BALLEAU GROUNDWATER**
attn: **CASEY COOK**
**901 RIO GRANDE BLVD NW SUITE F-242**
**ALBUQUERQUE NM 87104**

| Explanation of codes | |
|---|---|
| **B** | *Analyte Detected in Method Blank* |
| **E** | *Result is Estimated* |
| **H** | *Analyzed Out of Hold Time* |
| **N** | *Tentatively Identified Compound* |
| **S** | *Subcontracted* |
| **1-9** | *See Footnote* |

STANDARD

***Assaigai Analytical Laboratories, Inc.***

# *Certificate of Analysis*

*All samples are reported on an "as received" basis, unless otherwise noted (i.e. - Dry Weight).*

Client: **BALLEAU GROUNDWATER**
Project: **RANCHO VIEJO**
Order: **0702694** **BAL01** Receipt: **02-26-07**

*William P. Biava: President of Assaigai Analytical Laboratories, Inc.*

Sample: ***CCDP1*** Collected: *02-26-07 14:30:00* By: *CC*
Matrix:

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0702694-0001A** | | **EPA 120.1 Specific Conductance** | | | | | By: | MJN | | |
| WCOND-07-007 | WC.2007.538.4 | 10-34-4 | Conductivity | 230 | umhos/cm | 1 | 1 | | 03-07-07 | 03-07-07 |
| **0702694-0001A** | | **EPA 150.1 pH, Electrometric** | | | | | By: | RKA | | |
| WPH07027 | WC.2007.488.1 | 10-29-7 | pH | 8.20 | units | 1 | 0.1 | | 02-27-07 | 02-27-07 |
| WPH07027 | WC.2007.488.1 | | sample temperature @ | 12.7 | deg C | 1 | 0 | | 02-27-07 | 02-27-07 |
| **0702694-0001A** | | **EPA 160.1 Total Dissolved Solids** | | | | | By: | MJN | | |
| WTDS-07-018 | WC.2007.479.15 | 10-33-3 | Total Dissolved Solids | 145 | mg/L | 1 | 10 | | 02-28-07 | 03-01-07 |
| **0702694-0001A** | | **EPA 300.0 Anions by IC** | | | | | By: | JJK | | |
| W07154 | WC.2007.494.7 | 16887-00-6 | Chloride | 1.52 | mg/L | 5 | 0.05 | | 02-27-07 | 02-27-07 |
| W07154 | WC.2007.494.7 | 16984-48-8 | Fluoride | ND | mg/L | 5 | 0.05 | | 02-27-07 | 02-27-07 |
| W07154 | WC.2007.494.7 | 14797-65-0 | Nitrate, as N | 0.645 | mg/L | 5 | 0.05 | | 02-27-07 | 02-27-07 |
| W07154 | WC.2007.494.7 | 14797-55-8 | Nitrite, as N | ND | mg/L | 5 | 0.05 | | 02-27-07 | 02-27-07 |
| W07154 | WC.2007.494.7 | 14808-79-8 | Sulfate | 11.8 | mg/L | 5 | 0.05 | | 02-27-07 | 02-27-07 |
| **0702694-0001A** | | **EPA 310.1 Alkalinity, Titrimetic** | | | | | By: | RKA | | |
| WALK07016 | WC.2007.505.10 | T-005 | Alkalinity, Total | 108 | mg/L | 1 | 2 | | 03-05-07 | 03-05-07 |
| **0702694-0001A** | | **SM 2330B** | | | | | By: | JPM | | |
| LANGL | WC.2007.695.1 | | Langlier Saturation Index | 0.11 | % | 1 | 0 | | 03-22-07 | 03-22-07 |
| **0702694-0001B** | | **EPA 4.1.3/200.7 ICP** | | | | | By: | AZC | | |
| M07248 | MT.2007.413.39 | 7440-70-2 | Calcium | 22.5 | mg/L | 10 | 0.5 | | 03-12-07 | 03-13-07 |
| M07202 | MT.2007.348.22 | 7439-95-4 | Magnesium | 1.43 | mg/L | 1 | 0.5 | | 03-01-07 | 03-02-07 |
| M07248 | MT.2007.447.46 | 7440-09-7 | Potassium | 1.44 | mg/L | 1 | 0.5 | 1 | 03-12-07 | 03-19-07 |
| M07202 | MT.2007.348.27 | 7440-23-5 | Sodium | 27.8 | mg/L | 10 | 0.5 | | 03-01-07 | 03-02-07 |

**Assaigai Analytical Laboratories, Inc.**

# Certificate of Analysis

*All samples are reported on an "as received" basis, unless otherwise noted (i.e. - Dry Weight).*

Client: **BALLEAU GROUNDWATER**
Project: **RANCHO VIEJO**
Order: **0702694** **BAL01** Receipt: **02-26-07**

Sample: ***CCDP1*** Collected: *02-26-07 14:30:00* By: *CC*
Matrix:

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0702694-0001B** | | **EPA 11.2.2/200.8 Metals by ICP-MS** | | | | | By: | DPA | | |
| M07198 | MT.2007.369.27 | 7440-38-2 | Arsenic | 0.0049 | mg/L | 1 | 0.001 | | 03-01-07 | 03-06-07 |
| **0702694-0001B** | | **SM 2340B** | | | | | By: | JPM | | |
| HARD | MT.2007.477.1 | | Hardness, as CaCO3 | 62 | mg/L | 1 | 0 | | 03-23-07 | 03-23-07 |
| **0702694-0001C** | | **SW846 5030B/8260B Purgeable VOCs by GC/MS** | | | | | By: | EJB | | |
| V07120 | XG.2007.291.12 | 67-66-3 | Chloroform | ND | ug/L | 1 | 1 | | 02-27-07 | 02-27-07 |

*Unless otherwise noted, all samples were received in acceptable condition and all sampling was performed by client or client representative. Sample result of ND indicates Not Detected, ie result is less than the sample specific Detection Limit. Sample specific Detection Limit is determined by multiplying the sample Dilution Factor by the listed Reporting Detection Limit. All results relate only to the items tested. Any miscellaneous workorder information or foonotes will appear below.*

*Analytical results are not corrected for method blank or field blank contamination.*

1 The LCS is outside QC criteria at 116.8 percent for K. This should be taken into account when reviewing the data.

ASSAIGAI
ANALYTICAL
LABORATORIES, INC.
4301 Masthead NE, Ste. A • Albuquerque, New Mexico 87109 • (505) 345-8964 • FAX (505) 345-7259
3332 Wedgewood, Ste. N • El Paso, Texas 79925 • (915) 593-6000 • FAX (915) 593-7820
127 Eastgate Drive, 212-C • Los Alamos, New Mexico 87544 • (505) 662-2558

| Explanation of codes | |
|---|---|
| B | *Analyte Detected in Method Blank* |
| E | *Result is Estimated* |
| H | *Analyzed Out of Hold Time* |
| N | *Tentatively Identified Compound* |
| S | *Subcontracted* |
| 1-9 | *See Footnote* |

**BALLEAU GROUNDWATER**
attn: **CASEY COOK**
**901 RIO GRANDE BLVD NW SUITE F-242**
**ALBUQUERQUE NM 87104**

STANDAI

*Assaigai Analytical Laboratories, Inc.*

# *Certificate of Analysis*

*All samples are reported on an "as received" basis, unless otherwise noted (i.e. - Dry Weight).*

Client: BALLEAU GROUNDWATER
Project: INJECTION WELL
Order: 0605465 BAL01 Receipt: 05-19-06

*William P. Biava: President of Assaigai Analytical Laboratories, Inc.*

Sample: *RV CCD-I1* Collected: *05-19-06 10:30:00* By: *CC*
Matrix: *DW*

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0605465-0001A** | | **EPA 150.1 pH, Electrometric** | | | | | By: | NJL | | |
| WPH06076 | WC.2006.1254.1 | 10-29-7 | pH | 8.36 | units | 1 | 0.1 | | 05-19-06 | 05-19 |
| WPH06076 | WC.2006.1254.1 | | sample temperature @ | 18.8 | deg C | 1 | 0 | | 05-19-06 | 05-19 |
| **0605465-0001A** | | **EPA 160.1 Total Dissolved Solids** | | | | | By: | MJN | | |
| WTDS-06-056 | WC.2006.1301.11 | 10-33-3 | Total Dissolved Solids | 167 | mg/L | 1 | 10 | | 05-24-06 | 05-25 |
| **0605465-0001A** | | **EPA 180.1 Turbidity, Nephelometric** | | | | | By: | MJN | | |
| WTURB-06-040 | WC.2006.1237.2 | 10-08-02 | Turbidity | 0.59 | NTU | 1 | 0.3 | | 05-19-06 | 05-19 |
| **0605465-0001A** | | **EPA 300.0 Anions by IC** | | | | | By: | JTK | | |
| W06378 | WC.2006.1265.4 | 16887-00-6 | Chloride | 1.65 | mg/L | 5 | 0.05 | | 05-19-06 | 05-19 |
| W06378 | WC.2006.1265.4 | 16984-48-8 | Fluoride | ND | mg/L | 5 | 0.05 | | 05-19-06 | 05-19 |
| W06378 | WC.2006.1265.4 | 14797-65-0 | Nitrate, as N | 0.260 | mg/L | 5 | 0.05 | | 05-19-06 | 05-19 |
| W06378 | WC.2006.1265.4 | 14797-55-8 | Nitrite, as N | ND | mg/L | 5 | 0.05 | | 05-19-06 | 05-19 |
| W06378 | WC.2006.1265.4 | 14808-79-8 | Sulfate | 13.1 | mg/L | 5 | 0.05 | | 05-19-06 | 05-19 |
| **0605465-0001A** | | **EPA 310.1 Alkalinity, Titrimetic** | | | | | By: | NJL | | |
| WALK06023 | WC.2006.1328.2 | 71-52-3 | Alkalinity, Bicarbonate | 112 | mg/L | 1 | 2 | | 05-30-06 | 05-30 |
| WALK06023 | WC.2006.1328.2 | 3812-32-6 | Alkalinity, Carbonate | ND | mg/L | 1 | 2 | | 05-30-06 | 05-30 |
| WALK06023 | WC.2006.1328.2 | T-005 | Alkalinity, Total | 112 | mg/L | 1 | 2 | | 05-30-06 | 05-30 |
| **0605465-0001A** | | **SM 2120B** | | | | | By: | MJN | | |
| WCOLOR-06-029 | WC.2006.1239.2 | | Color | ND | APHA | 1 | 5 | | 05-19-06 | 05-19 |
| **0605465-0001A** | | **SM 2330B** | | | | | By: | JPM | | |
| LANGL | WC.2006.1529.1 | | Langlier Saturation Index | 0.14 | % | 1 | 0 | | 06-23-06 | 06-23 |

# *Certificate of Analysis*

*All samples are reported on an "as received" basis, unless otherwise noted (i.e. - Dry Weight).*

Client: **BALLEAU GROUNDWATER**
Project: **INJECTION WELL**
Order: **0605465** **BAL01** Receipt: **05-19-06**

---

Sample: *RV CCD-I1* Collected: *05-19-06 10:30:00* By: *CC*
Matrix: *DW*

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| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0605465-0001B** | | EPA 4.1.3/200 series AA-FL | | | | | By: | DPA | | |
| M06550 | MT.2006.1007.19 | 7440-23-5 | Sodium | 44.8 | mg/L | 10 | 1 | | 05-24-06 | 06-0 |
| **0605465-0001B** | | EPA 4.1.3/200.7 ICP | | | | | By: | TGA | | |
| M06538 | MT.2006.952.37 | 7440-70-2 | Calcium | 13.4 | mg/L | 1 | 0.5 | | 05-23-06 | 05-2 |
| M06538 | MT.2006.952.37 | 7439-95-4 | Magnesium | 1.33 | mg/L | 1 | 0.5 | | 05-23-06 | 05-2 |
| **0605465-0001B** | | EPA 11.2.2/200.8 Metals by ICP-MS | | | | | By: | BAS | | |
| M06550 | MT.2006.958.24 | 7429-90-5 | Aluminum | 0.0160 | mg/L | 1 | 0.01 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.999.11 | 7440-36-0 | Antimony | ND | mg/L | 1 | 0.005 | | 05-24-06 | 06-0 |
| M06550 | MT.2006.958.24 | 7440-38-2 | Arsenic | 0.0101 | mg/L | 1 | 0.001 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.1006.20 | 7440-39-3 | Barium | 0.116 | mg/L | 1 | 0.0005 | | 05-24-06 | 06-0 |
| M06550 | MT.2006.1006.20 | 7440-41-7 | Beryllium | ND | mg/L | 1 | 0.0005 | | 05-24-06 | 06-0 |
| M06550 | MT.2006.958.24 | 7440-43-9 | Cadmium | ND | mg/L | 1 | 0.0005 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.958.24 | 7440-47-3 | Chromium | 0.0042 | mg/L | 1 | 0.001 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.958.24 | 7440-50-8 | Copper | 0.0057 | mg/L | 1 | 0.001 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.958.24 | 7439-89-6 | Iron | ND | mg/L | 1 | 0.01 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.980.23 | 7439-92-1 | Lead | 0.0011 | mg/L | 1 | 0.0005 | | 05-24-06 | 05-3 |
| M06550 | MT.2006.958.24 | 7439-96-5 | Manganese | 0.0029 | mg/L | 1 | 0.0005 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.958.24 | 7440-02-0 | Nickel | 0.0005 | mg/L | 1 | 0.0005 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.958.24 | 7782-49-2 | Selenium | ND | mg/L | 1 | 0.005 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.958.24 | 7440-22-4 | Silver | ND | mg/L | 1 | 0.0005 | | 05-24-06 | 05-2 |
| M06550 | MT.2006.995.36 | 7440-28-0 | Thallium | ND | mg/L | 1 | 0.0005 | | 05-24-06 | 05-3 |
| M06550 | MT.2006.1006.20 | 7440-61-1 | Uranium | 0.0027 | mg/L | 1 | 0.0005 | | 05-24-06 | 06-0 |
| M06550 | MT.2006.1006.20 | 7440-66-6 | Zinc | 0.0110 | mg/L | 1 | 0.005 | | 05-24-06 | 06-0 |
| **0605465-0001B** | | EPA 245.1 Mercury by CVAA | | | | | By: | BAS | | |
| M06569 | MT.2006.992.34 | 7439-97-6 | Mercury | ND | ug/L | 1 | 0.2 | | 05-31-06 | 05-3 |
| **0605465-0001B** | | SM 2340B | | | | | By: | JPM | | |
| M06538 | MT.2006.1122.1 | | Hardness, as CaCO3 | 39 | mg/L | 1 | 0 | | 06-22-06 | 06-2 |
| **0605465-0001C** | | EPA 100.2 | | | | | By: | JM | | |
| QTM137003 | SB.2006.241.1 | | Amphibole Asbestos | ND | MFL | 1 | 0.123 | S | 05-24-06 | 05-2 |
| QTM137003 | SB.2006.241.1 | | Chrysotile Asbestos | ND | MFL | 1 | 0.123 | S | 05-24-06 | 05-2 |
| **0605465-0001D** | | EPA 900 | | | | | By: | TS | | |
| ARS10600989 | SB.2006.217.3 | | Gross Alpha | 2.0619+/-<br>0.7532 | pCi/L | 1 | 0 | S | 06-04-06 | 06-0 |
| ARS10600989 | SB.2006.217.3 | | Gross Beta | 2.1625+/-<br>0.6321 | pCi/L | 1 | 0 | S | 06-04-06 | 06-0 |
| **0605465-0001D** | | EPA 903 | | | | | By: | KP | | |
| ARS010600989 | SB.2006.247.2 | | Radium-226 | -0.0003+/-<br>0.0003 | pCi/L | 1 | 0 | S | 05-30-06 | 05-3 |
| **0605465-0001D** | | EPA 904 | | | | | By: | KP | | |
| ARS10600989 | SB.2006.246.2 | | Radium-228 | 0.2400+/-<br>0.3600 | pCi/L | 1 | 0 | S | 05-30-06 | 05-3 |

# Certificate of Analysis

*All samples are reported on an "as received" basis, unless otherwise noted (i.e. - Dry Weight).*

Client: **BALLEAU GROUNDWATER**
Project: **INJECTION WELL**
Order: **0605465** **BAL01** Receipt: **05-19-06**

Sample: *RV CCD-I1* Collected: *05-19-06 10:30:00* By: *CC*
Matrix: *DW*

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0605465-0001E** | | | **Glyphosate by EPA 547** | | | | By: | CAS | | |
| CASK0604160 | SB.2006.226.1 | | Glyphosate | ND | ug/L | 1 | 6 | S | 05-30-06 | 05- |
| **0605465-0001F** | | | **EPA 140.1 Threshold Odor** | | | | By: | MJN | | |
| WODOR-06-029 | WC.2006.1238.2 | | Odor | No detectable odor | TON | 1 | 1 | | 05-19-06 | 05- |
| **0605465-0001G** | | | **Haloacetic Acids by EPA 552.2** | | | | By: | CAS | | |
| CASK0604160 | SB.2006.231.1 | | Bromoacetic Acid | ND | ug/L | 1 | 1 | S | 05-30-06 | 05- |
| CASK0604160 | SB.2006.231.1 | | Chloroacetic Acid | ND | ug/L | 1 | 2 | S | 05-30-06 | 05- |
| CASK0604160 | SB.2006.231.1 | | Dibromoacetic Acid | ND | ug/L | 1 | 1 | S | 05-30-06 | 05- |
| CASK0604160 | SB.2006.231.1 | | Dichloroacetic Acid | ND | ug/L | 1 | 1 | S | 05-30-06 | 05- |
| CASK0604160 | SB.2006.231.1 | | Trichloroacetic Acid | ND | ug/L | 1 | 1 | S | 05-30-06 | 05- |
| **0605465-0001H** | | | **Chlorinated Acids by EPA 515.4** | | | | By: | CAS | | |
| CASK0604160 | SB.2006.222.1 | | 2,4,5-TP (Silvex) | ND | ug/L | 1 | 0.05 | S | 05-24-06 | 05-2 |
| CASK0604160 | SB.2006.222.1 | | 2,4-D | ND | ug/L | 1 | 0.1 | S | 05-24-06 | 05-2 |
| CASK0604160 | SB.2006.222.1 | | Dalapon | ND | ug/L | 1 | 0.54 | S | 05-24-06 | 05-2 |
| CASK0604160 | SB.2006.222.1 | | Dinoseb | ND | ug/L | 1 | 0.2 | S | 05-24-06 | 05-2 |
| CASK0604160 | SB.2006.222.1 | | Pentachlorophenol | ND | ug/L | 1 | 0.04 | S | 05-24-06 | 05-2 |
| CASK0604160 | SB.2006.222.1 | | Picloram | ND | ug/L | 1 | 0.1 | S | 05-24-06 | 05-2 |
| **0605465-0001H** | | | **EPA 335.4** | | | | By: | CAS | | |
| CASK0604160 | SB.2006.228.1 | | Cyanide, Total | ND | mg/L | 1 | 0.01 | S | 05-26-06 | 05-2 |
| **0605465-0001I** | | | **Endothall by EPA 548.1** | | | | By: | CAS | | |
| CASK0604160 | SB.2006.227.1 | | Endothall | ND | ug/L | 1 | 5 | S | 05-23-06 | 05-2 |
| **0605465-0001J** | | | **ASTM D2330-88** | | | | By: | ECC | | |
| W06397 | WC.2006.1314.4 | | Surfactants | 0.14 | mg/L | 1 | 0.03 | | 05-26-06 | 05-2 |
| **0605465-0001K** | | | **Pesticides/PCBs by EPA 508.1** | | | | By: | CAS | | |
| CASK0604160 | SB.2006.232.1 | | Aroclor 1016 | ND | ug/L | 1 | 0.05 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Aroclor 1221 | ND | ug/L | 1 | 0.099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Aroclor 1232 | ND | ug/L | 1 | 0.099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Aroclor 1242 | ND | ug/L | 1 | 0.099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Aroclor 1248 | ND | ug/L | 1 | 0.099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Aroclor 1254 | ND | ug/L | 1 | 0.099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Aroclor 1260 | ND | ug/L | 1 | 0.099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Chlordane | ND | ug/L | 1 | 0.099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Endrin | ND | ug/L | 1 | 0.0099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | gamma-BHC (Lindane) | ND | ug/L | 1 | 0.0099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Heptachlor | ND | ug/L | 1 | 0.0099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Heptachlor Epoxide | ND | ug/L | 1 | 0.0099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Methoxychlor | ND | ug/L | 1 | 0.0099 | S | 06-02-06 | 06-0 |
| CASK0604160 | SB.2006.232.1 | | Toxaphene | ND | ug/L | 1 | 0.099 | S | 06-02-06 | 06-0 |
| **0605465-0001L** | | | **EPA Method 525.2** | | | | By: | CAS | | |
| CASK0604160 | SB.2006.224.1 | | Alachlor | ND | ug/L | 1 | 0.71 | S | 06-02-06 | 06-1 |

# Certificate of Analysis

*All samples are reported on an "as received" basis, unless otherwise noted (i.e. - Dry Weight).*

Client: BALLEAU GROUNDWATER
Project: INJECTION WELL
Order: 0605465 BAL01 Receipt: 05-19-06

Sample: *RV CCD-I1* Collected: *05-19-06 10:30:00* By: *CC*
Matrix: *DW*

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0605465-0001L** | | **EPA Method 525.2** | | | | | By: | CAS | | |
| CASK0604160 | SB.2006.224.1 | | Atrazine | ND | ug/L | 1 | 0.99 | S | 06-02-06 | 06-1 |
| CASK0604160 | SB.2006.224.1 | | Benzo(a)pyrene | ND | ug/L | 1 | 0.02 | S | 06-02-06 | 06-1 |
| CASK0604160 | SB.2006.224.1 | | Bis(2-ethylhexyl) Adipate | ND | ug/L | 1 | 0.5 | S | 06-02-06 | 06-1 |
| CASK0604160 | SB.2006.224.1 | | Bis(2-ethylhexyl) Phthalate | ND | ug/L | 1 | 0.5 | S | 06-02-06 | 06-1 |
| CASK0604160 | SB.2006.224.1 | | Hexachlorobenzene | ND | ug/L | 1 | 0.5 | S | 06-02-06 | 06-1 |
| CASK0604160 | SB.2006.224.1 | | Hexacholorocyclopentadiene | ND | ug/L | 1 | 0.099 | S | 06-02-06 | 06-1 |
| CASK0604160 | SB.2006.224.1 | | Simazine | ND | ug/L | 1 | 0.5 | S | 06-02-06 | 06-1 |
| **0605465-0001M** | | **Method 1613b** | | | | | By: | CAS | | |
| CASK0604160 | SB.2006.267.1 | | 2, 3, 7, 8-TCDD | ND | pg/L | 1 | 0.152 | S | 06-20-06 | 06-2 |
| **0605465-0001N** | | **Diquat by EPA 549.2** | | | | | By: | CAS | | |
| CASK0604160 | SB.2006.229.1 | | Diquat | ND | ug/L | 1 | 0.4 | S | 05-23-06 | 06-0 |
| **0605465-0001O** | | **EPA 531.1** | | | | | By: | CAS | | |
| CASK0604160 | SB.2006.225.1 | | Aldicarb | ND | ug/L | 1 | 0.5 | S | 05-23-06 | 05-2 |
| CASK0604160 | SB.2006.225.1 | | Aldicarb Sulfone | ND | ug/L | 1 | 0.5 | S | 05-23-06 | 05-2 |
| CASK0604160 | SB.2006.225.1 | | Aldicarb Sulfoxide | ND | ug/L | 1 | 0.5 | S | 05-23-06 | 05-2 |
| CASK0604160 | SB.2006.225.1 | | Carbofuran | ND | ug/L | 1 | 0.5 | S | 05-23-06 | 05-2 |
| CASK0604160 | SB.2006.225.1 | | Oxamyl | ND | ug/L | 1 | 0.5 | S | 05-23-06 | 05-2 |
| **0605465-0001P** | | **EPA 524 PURGEABLE VOCs by GC/MS** | | | | | By: | CAS | | |
| CASK0604160 | XG.2006.818.1 | | 1,1 Dichloroethane (SPCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,1 Dichloroethene (CCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,1,1 Trichloroethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,1,1,2 Tetrachloroethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,1,2 Trichloroethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,1,2,2 Tetrachloroethane (SPCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,1-Dichloropropene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,2 Dibromoethane (EDB) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,2 Dichlorobenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,2 Dichloroethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,2 Dichloropropane (CCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,2,3 Trichloropropane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,2,3-Trichlorobenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,2,4-Trichlorobenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,2,4-Trimethylbenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,2-Dibromo-3-chloropropane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,3 Dichlorobenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,3,5-Trimethylbenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,3-Dichloropropane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 1,4 Dichlorobenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 2,2-Dichloropropane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 2-Chlorotoluene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |
| CASK0604160 | XG.2006.818.1 | | 4-Chlorotoluene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05-2 |

# Certificate of Analysis

*All samples are reported on an "as received" basis, unless otherwise noted (i.e. - Dry Weight).*

Client: **BALLEAU GROUNDWATER**
Project: **INJECTION WELL**
Order: **0605465** **BAL01** Receipt: **05-19-06**

Sample: *RV CCD-I1* Collected: *05-19-06 10:30:00* By: *CC*
Matrix: *DW*

**0605465-0001P** EPA 524 PURGEABLE VOCs by GC/MS By: CAS

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| CASK0604160 | XG.2006.818.1 | | Benzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Bromobenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Bromochloromethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Bromodichloromethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Bromoform (SPCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Bromomethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Carbon tetrachloride | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Chlorobenzene (SPCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Chlorodibromomethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Chloroethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Chloroform (CCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Chloromethane (SPCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | cis-1,2 Dichloroethene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | cis-1,3 Dichloropropene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Dibromomethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Ethylbenzene (CCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Hexachlorobutadiene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Isopropylbenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Methyl tert-Butyl Ether | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Methylene chloride | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Naphthalene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | n-Butylbenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | n-Propylbenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | O-Xylene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | P/M Xylenes | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | p-Isopropyltoluene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | sec-ButylBenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Styrene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | T-1,2 Dichloroethene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | t-1,3 Dichloropropene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | tert-Butylbenzene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Tetrachlorethene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Toluene (CCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Trichloroethene | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Trichlorofluoromethane | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |
| CASK0604160 | XG.2006.818.1 | | Vinyl chloride (CCC) | ND | ug/L | 1 | 0.5 | | 05-26-06 | 05- |

**0605465-0001Q** EPA 504 EDB/DBCP by GC/ECD By: W/RLG

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| S06276 | XG.2006.626.12 | 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | ug/L | 1 | 0.025 | | 05-22-06 | 05- |
| S06276 | XG.2006.626.12 | 106-93-4 | 1,2-Dibromoethane, EDB | ND | ug/L | 1 | 0.025 | | 05-22-06 | 05- |

# Certificate of Analysis

*All samples are reported on an "as received" basis, unless otherwise noted (i.e. - Dry Weight).*

Client: **BALLEAU GROUNDWATER**
Project: **INJECTION WELL**
Order: **0605465** **BAL01** Receipt: **05-19-06**

*Unless otherwise noted, all samples were received in acceptable condition and all sampling was performed by client or client representative. Sample result of ND indicates Not Detected, ie result is less than the sample specific Detection Limit. Sample specific Detection Limit is determined by multiplying the sample Dilution Factor by the listed Reporting Detection Limit. All results relate only to the items tested. Any miscellaneous workorder information or foonotes will appear below.*

*Analytical results are not corrected for method blank or field blank contamination.*

MEMO: The analysis for gross alpha, gross beta, radium-226 and radium-228 was subcontracted to American Radiation Services.
The analysis for asbestos was subcontracted to Quantem Laboratories.
The analysis for EPA 547, EPA 552.2, EPA 515.4, EPA 335.4, EPA 548.1, EPA 508.1, EPA 525.2, EPA 1613, EPA 549.2, EPA 531.1, EPA 524.2 and EPA 504 was subcontracted to Columbia Analytical Services.

**ASSAIGAI ANALYTICAL LABORATORIES, INC.**
7300 Jefferson, NE • Albuquerque, New Mexico 87109 • (505) 345-8964 • FAX (505) 345-7259
3332 Wedgewood Dr., Suite N • El Paso, Texas 79925 • (915) 593-6000 • FAX (915) 593-7820
127 Eastgate Drive, 212-C • Los Alamos, New Mexico 87544 • (505) 662-255[illegible]

**Explanation of codes**

| | |
|---|---|
| B | analyte detected in Method Blank |
| E | result is estimated |
| H | analyzed out of hold time |
| N | tentatively identified compound |
| S | subcontracted |
| 1-9 | see footnote |

**BALLEAU GROUNDWATER**
attn: **CASEY COOK**
**901 RIO GRANDE BLVD NW STE F242**
**ALBUQUERQUE NM 87104**

STANDARD

*Assaigai Analytical Laboratories, Inc.*

# Certificate of Analysis

Client: **BALLEAU GROUNDWATER**
Project: **RANCHO VIEJO**
Order: **0202126 RAN03** Receipt: **01-23-02**

*William P. Bravo: President of Assaigai Analytical Laboratories, Inc.*

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 13:00:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0202126-01A** | | **EPA 900** | | | | | By: | KP | | |
| ARS020183 | TT.2002.547.1 | | Gross Alpha | 3.22+/-0.48 | pCi/L | 1 | 0.83 | S | 02-14-02 | 02-14-02 |
| ARS020183 | TT.2002.547.1 | | Gross Beta | 1.43+/-0.53 | pCi/L | 1 | 1.44 | S | 02-14-02 | 02-14-02 |

*Unless otherwise noted, all samples were received in acceptable condition and all sampling was performed by client or client representative. Sample result of ND indicates Not Detected, ie result is less than the sample specific Detection Limit. Sample specific Detection Limit is determined by multiplying the sample Dilution Factor by the listed Reporting Detection Limit. All results relate only to the items tested. Any miscellaneous workorder information or footnotes will appear below.*

**ASSAIGAI ANALYTICAL LABORATORIES, INC.**
7300 Jefferson, NE • Albuquerque, New Mexico 87109 • (505) 345-8964 • FAX (505) 345-7259
3332 Wedgewood Dr., Suite N • El Paso, Texas 79925 • (915) 593-6000 • FAX (915) 593-7820
127 Eastgate Drive, 212-C • Los Alamos, New Mexico 87544 • (505) 662-2558

**Explanation of codes**

| | |
|---|---|
| B | analyte detected in Method Blank |
| E | result is estimated |
| H | analyzed out of hold time |
| N | tentatively identified compound |
| S | subcontracted |
| 1-9 | see footnote |

**BALLEAU GROUNDWATER**
attn: **CASEY COOK**
**901 RIO GRANDE BLVD NW STE F242**
**ALBUQUERQUE NM 87104**

STANDARD

*Assaigai Analytical Laboratories, Inc.*

# *Certificate of Analysis*

Client: **BALLEAU GROUNDWATER**
Project:
Order: **0201283** **RAN03** Receipt: **01-23-02**

William P. Bivey: President of Assaigai Analytical Laboratories, Inc.

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:12:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-01A** | | **SM-9223B** | | | | | By: | NL | | |
| BT0220 | TT.2002.251.3 | | E. coli, MMO/MUG | Absent | N/A | 1 | 0 | | 01-24-02 | 01-25-02 |
| BT0220 | TT.2002.251.3 | | Total Coliform, MMO/MUG | Present | N/A | 1 | 0 | | 01-24-02 | 01-25-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:14:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-02A** | | **SM-9223B** | | | | | By: | NL | | |
| BT0220 | TT.2002.251.4 | | E. coli, MMO/MUG | Absent | N/A | 1 | 0 | | 01-24-02 | 01-25-02 |
| BT0220 | TT.2002.251.4 | | Total Coliform, MMO/MUG | Absent | N/A | 1 | 0 | | 01-24-02 | 01-25-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:25:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-03A** | | **EPA 524.2** | | | | | By: | EHL | | |
| EHL698255 | TT.2002.507.1 | | Bromodichloromethane | ND | ug / L | 1 | 0.5 | S | 01-26-02 | 01-26-02 |
| EHL698255 | TT.2002.507.1 | | Bromoform | ND | ug / L | 1 | 0.5 | S | 01-26-02 | 01-26-02 |
| EHL698255 | TT.2002.507.1 | | Chloroform | 0.8 | ug / L | 1 | 0.5 | S | 01-26-02 | 01-26-02 |
| EHL698256 | TT.2002.507.1 | | Dibromochloromethane | ND | ug / L | 1 | 0.5 | S | 01-26-02 | 01-26-02 |

Assaigai Analytical Laboratories, Inc.

# Certificate of Analysis

Client: **BALLEAU GROUNDWATER**
Project:
Order: **0201283** **RAN03** Receipt: **01-23-02**

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:50:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 0201283-04A | | EPA 515.1 | | | | | By: | EHL | | |
| EHL698256 | TT.2002.514.1 | | 2,4,5-TP (Silvex) | ND | ug / L | 1 | 0.1 | S | 01-29-02 | 01-30-02 |
| EHL698256 | TT.2002.514.1 | | 2,4-D | ND | ug / L | 1 | 0.1 | S | 01-29-02 | 01-30-02 |
| EHL698256 | TT.2002.514.1 | | Dalapon | ND | ug / L | 1 | 1 | S | 01-29-02 | 01-30-02 |
| EHL698256 | TT.2002.514.1 | | Dicamba | ND | ug / L | 1 | 0.1 | S | 01-29-02 | 01-30-02 |
| EHL698256 | TT.2002.514.1 | | Dinoseb | ND | ug / L | 1 | 0.1 | S | 01-29-02 | 01-30-02 |
| EHL698256 | TT.2002.514.1 | | Pentachlorophenol | ND | ug / L | 1 | 0.04 | S | 01-29-02 | 01-30-02 |
| EHL698256 | TT.2002.514.1 | | Picloram (Tordon) | ND | ug / L | 1 | 0.1 | S | 01-29-02 | 01-30-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:20:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 0201283-05A | | EPA 548.1 | | | | | By: | EHL | | |
| EHL698257 | TT.2002.516.1 | | Endothall | ND | ug / L | 1 | 9 | S | 01-29-02 | 01-31-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:30:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 0201283-06A | | EPA 547 | | | | | By: | EHL | | |
| EHL698258 | TT.2002.517.1 | | Glyphosate (Round-up) | ND | ug / L | 1 | 6 | S | 01-28-02 | 01-30-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:15:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 0201283-07A | | EPA 524.2 | | | | | By: | EHL | | |
| EHL698259 | TT.2002.508.1 | | 1,1,1,2-Tetrachloroethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,1,1-Trichloroethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,1,2,2-Tetrachloroethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,1,2-Trichloroethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,1-Dichloroethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,1-Dichloroethylene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,1-Dichloropropylene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,2,3-Trichlorobenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,2,3-Trichloropropane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,2,4-Trichlorobenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,2,4-Trimethylbenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |

**Assaigai Analytical Laboratories, Inc.**

# Certificate of Analysis

Client: **BALLEAU GROUNDWATER**
Project:
Order: **0201283** **RAN03** Receipt: **01-23-02**

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:15:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-07A** | | **EPA 524.2** | | | | | By: | EHL | | |
| EHL698259 | TT.2002.508.1 | | 1,2-Dibromo-3-Chloropropane | ND | ug / L | 1 | 0.2 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,2-Dibromoethane(EDB) | ND | ug / L | 1 | 0.2 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,2-Dichlorobenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,2-Dichloroethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,2-Dichloropropane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,3,5-Trimethylbenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,3-Dichlorobenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,3-Dichloropropane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 1,4-Dichlorobenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 2,2-Dichloropropane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 2-Chlorotoluene (o-) | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 4-Chlorotoluene (p-) | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | 4-Isopropyltoluene (p-) | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Benzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Bromobenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Bromochloromethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Bromodichloromethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Bromoform | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Bromomethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Carbon tetrachloride | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Chlorobenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Chloroethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Chloroform | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Chloromethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | cis-1,2-Dichloroethylene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | cis-1,3-Dichloropropylene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Dibromochloromethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Dibromomethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Dichlorodifluoromethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Dichloromethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Ethylbenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Hexachlorobutadiene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Isopropylbenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Methyl-t-butyl ether (MTBE) | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Naphthalene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | n-Butylbenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | n-Propylbenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | sec-Butylbenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Styrene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | tert-Butylbenzene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Tetrachloroethylene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Toluene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Total Xylenes | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |

**Assaigai Analytical Laboratories, Inc.**

# Certificate of Analysis

Client: **BALLEAU GROUNDWATER**
Project:
Order: **0201283** **RAN03** Receipt: **01-23-02**

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:15:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-07A** | | **EPA 524.2** | | | | | By: | EHL | | |
| EHL698259 | TT.2002.508.1 | | trans-1,2-Dichloroethylene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | trans-1,3-Dichloropropylene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Trichloroethylene | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Trichlorofluoromethane | ND | ug / L | 1 | 0.5 | S | 01-28-02 | 01-28-02 |
| EHL698259 | TT.2002.508.1 | | Vinyl chloride | ND | ug / L | 1 | 0.2 | S | 01-28-02 | 01-28-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:49:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-08A** | | **EPA 505** | | | | | By: | EHL | | |
| EHL698260 | TT.2002.513.1 | | Aroclor 1016 | ND | ug / L | 1 | 0.08 | S | 01-29-02 | 01-30-02 |
| EHL698260 | TT.2002.513.1 | | Aroclor 1221 | ND | ug / L | 1 | 2 | S | 01-29-02 | 01-30-02 |
| EHL698260 | TT.2002.513.1 | | Aroclor 1232 | ND | ug / L | 1 | 0.5 | S | 01-29-02 | 01-30-02 |
| EHL698260 | TT.2002.513.1 | | Aroclor 1242 | ND | ug / L | 1 | 0.3 | S | 01-29-02 | 01-30-02 |
| EHL698260 | TT.2002.513.1 | | Aroclor 1248 | ND | ug / L | 1 | 0.1 | S | 01-29-02 | 01-30-02 |
| EHL698260 | TT.2002.513.1 | | Aroclor 1254 | ND | ug / L | 1 | 0.1 | S | 01-29-02 | 01-30-02 |
| EHL698260 | TT.2002.513.1 | | Aroclor 1260 | ND | ug / L | 1 | 0.2 | S | 01-29-02 | 01-30-02 |
| EHL698260 | TT.2002.513.1 | | Chlordane | ND | ug / L | 1 | 0.1 | S | 01-29-02 | 01-30-02 |
| EHL698260 | TT.2002.513.1 | | Toxaphene | ND | ug / L | 1 | 1 | S | 01-29-02 | 01-30-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:22:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-09A** | | **EPA 531.1** | | | | | By: | EHL | | |
| EHL698261 | TT.2002.511.1 | | 3-Hydroxycarbofuran | ND | ug / L | 1 | 0.5 | S | 01-30-02 | 02-02-02 |
| EHL698261 | TT.2002.511.1 | | Aldicarb | ND | ug / L | 1 | 0.5 | S | 01-30-02 | 02-02-02 |
| EHL698261 | TT.2002.511.1 | | Aldicarb Sulfone | ND | ug / L | 1 | 0.7 | S | 01-30-02 | 02-02-02 |
| EHL698261 | TT.2002.511.1 | | Aldicarb Sulfoxide | ND | ug / L | 1 | 0.5 | S | 01-30-02 | 02-02-02 |
| EHL698261 | TT.2002.511.1 | | Carbaryl | ND | ug / L | 1 | 0.5 | S | 01-30-02 | 02-02-02 |
| EHL698261 | TT.2002.511.1 | | Carbofuran | ND | ug / L | 1 | 0.9 | S | 01-30-02 | 02-02-02 |
| EHL698261 | TT.2002.511.1 | | Methomyl | ND | ug / L | 1 | 0.5 | S | 01-30-02 | 02-02-02 |
| EHL698261 | TT.2002.511.1 | | Oxamyl (Vydate) | ND | ug / L | 1 | 1 | S | 01-30-02 | 02-02-02 |

*Assaigai Analytical Laboratories, Inc.*

# Certificate of Analysis

Client: **BALLEAU GROUNDWATER**
Project:
Order: **0201283** **RAN03** Receipt: **01-23-02**

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:00:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-10A** | | **1613B** | | | | | By: | TLI | | |
| TLI58461 | TT.2002.424.2 | | 2,3,7,8-TCDD | ND | pg / L | 1 | 3 | S | 01-30-02 | 02-04-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:00:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-11A** | | **EPA 525.2** | | | | | By: | EHL | | |
| EHL698262 | TT.2002.510.1 | | Alachlor (Lasso) | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Aldrin | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | alpha-Chlordane | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Atrazine | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Benzo(a)pyrene | ND | ug / L | 1 | 0.02 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Butachlor | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Di(2-ethylhexyl)adipate | ND | ug / L | 1 | 0.6 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Di(2-ethylhexyl)phthalate | ND | ug / L | 1 | 0.6 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Dieldrin | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Endrin | ND | ug / L | 1 | 0.01 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | gamma-Chlordane | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Heptachlor | ND | ug / L | 1 | 0.04 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Heptachlor epoxide | ND | ug / L | 1 | 0.02 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Hexachlorobenzene | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Hexachlorocyclopentadiene | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Lindane (gamma-BHC) | ND | ug / L | 1 | 0.02 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Methoxychlor | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Metolachlor (Dual) | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Metribuzin (Bencor) | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Propachlor | ND | ug / L | 1 | 0.1 | S | 01-28-02 | 02-04-02 |
| EHL698262 | TT.2002.510.1 | | Simazine | ND | ug / L | 1 | 0.07 | S | 01-28-02 | 02-04-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:55:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-12A** | | **EPA 335.4** | | | | | By: | EHL | | |
| EHL698263. | TT.2002.509.1 | | Cyanide | ND | mg / L | 1 | 0.02 | S | 02-01-02 | 02-01-02 |

# *Certificate of Analysis*

**Client:** **BALLEAU GROUNDWATER**
**Project:**
**Order:** **0201283** **RAN03** **Receipt:** **01-23-02**

**Sample:** ***CDPROD1/ RANCHO VIEJO*** **Collected:** *01-23-02 12:55:00* **By:** *CWC*
**Matrix:** ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-13A** | | **EPA 549.2** | | | | | By: | EHL | | |
| EHL698264 | TT.2002.515.1 | | Diquat | ND | ug / L | 1 | 0.4 | S | 01-28-02 | 01-28-02 |

**Sample:** ***CDPROD1/ RANCHO VIEJO*** **Collected:** *01-23-02 12:56:00* **By:** *CWC*
**Matrix:** ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-14A** | | **EPA 425.1** | | | | | By: | ROE | | |
| W026 | MW.2002.128.3 | | Surfactants | ND | mg / L | 1 | 0.03 | | 01-29-02 | 01-29-02 |

**Sample:** ***CDPROD1/ RANCHO VIEJO*** **Collected:** *01-23-02 12:56:00* **By:** *CWC*
**Matrix:** ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-15A** | | **EPA 100.2** | | | | | By: | JM | | |
| QL2010TA076617 | TT.2002.412.1 | | Amphibole | ND | MFL | 1 | 0.151 | S | 01-30-02 | 01-30-02 |
| QL2010TA076617 | TT.2002.412.1 | | Chrysotile | ND | MFL | 1 | 0.151 | S | 01-30-02 | 01-30-02 |
| QL2010TA076617 | TT.2002.412.1 | | Total Asbestos Fibers >= 10 um | ND | MFL | 1 | 0.051 | S | 01-30-02 | 01-30-02 |

**Sample:** ***CDPROD1/ RANCHO VIEJO*** **Collected:** *01-23-02 12:56:00* **By:** *CWC*
**Matrix:** ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-16A** | | **EPA 200.8 ICP-MS** | | | | | By: | CJ | | |
| M0287 | MW.2002.188.30 | 7429-90-5 | Aluminum | 0.014 | mg / L | 1 | 0.01 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7440-36-0 | Antimony | ND | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7440-38-2 | Arsenic | 0.010 | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7440-39-3 | Barium | 0.117 | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.210.4 | 7440-41-7 | Beryllium | ND | mg / L | 1 | 0.001 | | 01-25-02 | 02-12-02 |
| M0287 | MW.2002.188.30 | 7440-43-9 | Cadmium | ND | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7440-47-3 | Chromium | 0.005 | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7440-50-8 | Copper | 0.004 | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7439-89-6 | Iron | 0.070 | mg / L | 1 | 0.01 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7439-92-1 | Lead | ND | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7439-96-5 | Manganese | 0.005 | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7440-02-0 | Nickel | ND | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7782-49-2 | Selenium | ND | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7440-22-4 | Silver | ND | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |
| M0287 | MW.2002.188.30 | 7440-28-0 | Thallium | ND | mg / L | 1 | 0.001 | | 01-25-02 | 02-11-02 |

STANDARD

**Assaigai Analytical Laboratories, Inc.**

# Certificate of Analysis

Client: **BALLEAU GROUNDWATER**
Project:
Order: **0201283** **RAN03** Receipt: **01-23-02**

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:55:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-16A** | | **EPA 200.8 ICP-MS** | | | | | By: | CJ | | |
| M0287 | MW.2002.188.30 | 7440-66-6 | Zinc | 0.011 | mg / L | 1 | 0.005 | B | 01-25-02 | 02-11-02 |
| **0201283-16A** | | **EPA 245.1 CVAA** | | | | | By: | je | | |
| M02106 | MW.2002.136.25 | 7439-97-6 | Mercury | ND | mg / L | 1 | 0.0002 | | 01-30-02 | 01-30-02 |
| **0201283-16A** | | **EPA 4.1.3/200.7 ICP** | | | | | By: | SKD | | |
| M0288 | MW.2002.125.49 | 7440-70-2 | Calcium | 11.0 | mg / L | 1 | 0.4 | | 01-25-02 | 01-28-02 |
| M0288 | MW.2002.125.49 | 7439-95-4 | Magnesium | 0.8 | mg / L | 1 | 0.1 | | 01-25-02 | 01-28-02 |
| M0288 | MW.2002.125.49 | 7440-23-5 | Sodium | 49.7 | mg / L | 1 | 0.2 | | 01-25-02 | 01-28-02 |
| **0201283-16A** | | **SM 2340B** | | | | | By: | MAJ | | |
| HARD | TT.2002.352.1 | | Hardness, as CaCO3 | 31 | mg / L | 1 | 0 | | 02-06-02 | 02-06-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:10:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-18A** | | **EPA 140.1** | | | | | By: | DH | | |
| OD021 | TT.2002.243.2 | | Odor | No Odor Observed | TON | 1 | 1 | | 01-24-02 | 01-24-02 |

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:58:00* By: *CWC*
Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-19A** | | **EPA 150.1** | | | | | By: | DH | | |
| WPH027 | TT.2002.244.1 | | pH | 8.7 | units | 1 | 0.1 | | 01-24-02 | 01-24-02 |
| **0201283-19A** | | **EPA 160.1** | | | | | By: | NL | | |
| TD026 | TT.2002.278.3 | | Total Dissolved Solids | 182 | mg / L | 1 | 10 | | 01-25-02 | 01-25-02 |
| **0201283-19A** | | **EPA 180.1** | | | | | By: | DH | | |
| TU023 | TT.2002.240.2 | | Turbidity | 1.0 | NTU | 1 | 0.3 | | 01-24-02 | 01-24-02 |
| **0201283-19A** | | **EPA 300.0** | | | | | By: | SEF | | |
| W0228 | MW.2002.131.35 | 16887-00-6 | Chloride | 2.64 | mg / L | 10 | 0.05 | | 01-24-02 | 01-25-02 |
| W0228 | MW.2002.131.35 | 16984-48-8 | Fluoride | ND | mg / L | 10 | 0.05 | | 01-24-02 | 01-25-02 |
| W0228 | MW.2002.131.35 | 14797-65-0 | Nitrate, as N | ND | mg / L | 10 | 0.05 | | 01-24-02 | 01-25-02 |
| W0228 | MW.2002.131.35 | 14797-55-8 | Nitrite, as N | ND | mg / L | 10 | 0.05 | | 01-24-02 | 01-25-02 |
| W0228 | MW.2002.131.35 | | Sulfate | 12.2 | mg / L | 10 | 0.05 | | 01-24-02 | 01-25-02 |
| **0201283-19A** | | **EPA 310.1** | | | | | By: | DH | | |
| ALK023 | TT.2002.344.2 | | Alkalinity, Total | 113 | mg / L | 1 | 2 | | 02-05-02 | 02-05-02 |

**Assaigai Analytical Laboratories, Inc.**

# Certificate of Analysis

Client: **BALLEAU GROUNDWATER**

Project:

Order: **0201283** **RAN03** Receipt: **01-23-02**

Sample: ***CDPROD1/ RANCHO VIEJO*** Collected: *01-23-02 12:58:00* By: *CWC*

Matrix: ***AQ***

| QC Group | Run Sequence | CAS # | Analyte | Result | Units | Dilution Factor | Detection Limit | Code | Prep Date | Run Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **0201283-19A** | | **SM 2120B** | | | | | By: | DH | | |
| COL022 | TT.2002.242.2 | | Color | ND | APHA | 1 | 5 | | 01-24-02 | 01-24-02 |
| **0201283-19A** | | **SM 2330B** | | | | | By: | MAJ | | |
| LANG | TT.2002.353.1 | | Langlier Saturation Index | 0.25 | N/A | 1 | 0 | | 02-06-02 | 02-06-02 |

*Unless otherwise noted, all samples were received in acceptable condition and all sampling was performed by client or client representative. Sample result of ND indicates Not Detected, ie result is less than the sample specific Detection Limit. Sample specific Detection Limit is determined by multiplying the sample Dilution Factor by the listed Reporting Detection Limit. All results relate only to the items tested. Any miscellaneous workorder information or footnotes will appear below.*

# APPENDIX H

## BALLEAU GROUNDWATER, INC. TECHNICAL MEMORANDUM SIMULATION OF A ONE YEAR AQUIFER WITHDRAWAL AND INJECTION TEST SOUTH OF SANTA FE, NEW MEXICO

# TECHNICAL MEMORANDUM

**To File** RANCHO VIEJO/WATER PLAN

November 6, 2007

**From** Dave M. Romero and Steven E. Silver

**Subject** SIMULATION OF A ONE-YEAR AQUIFER WITHDRAWAL AND INJECTION TEST SOUTH OF SANTA FE, NEW MEXICO

## Introduction

On behalf of Rancho Viejo de Santa Fe, Inc. (Rancho Viejo), Balleau Groundwater, Inc. (BGW) designed, monitored and interpreted an aquifer-recharge demonstration project in Santa Fe County, New Mexico. The project is part of and is partly funded by Governor Richardson's Water Innovation Fund. The work involved investigating the six-month feasibility of injecting water into the Tesuque Formation aquifer by withdrawing 50 gallons per minute (gpm) from a production well and routing the water one mile away to an injection well. During the six-month test and subsequent six months of recovery, water levels were monitored at the production well site, at the injection well site and at several deep and shallow outlying wells. This technical memorandum describes a hydrogeologic model of the observed water-level response during the one-year monitoring period (August 2006 to September 2007). The project location is south of Interstate 25 near the end of Richards Avenue in the Santa Fe Embayment of the Española Basin (Kelley, 1978), as shown on Figure 1.

### Purpose and Scope

This injection work was done on the joint behalf of Governor Richardson's Water Innovation Fund and Rancho Viejo to provide information on the feasibility of injecting water into the Tesuque Formation aquifer for an extended period in which the potential for well clogging could be tested, and the aquifer response could be examined. The model is nominated GOVRVInject07. The model files are available at the BGW website (http://balleau.com/results.php?category=tools). This memorandum describes a numerical model of the groundwater flow system that integrates available MODFLOW-2000 (Harbaugh and others, 2000) modeling techniques and geohydrologic data with data and results from previous studies. The objectives of the model are to (1) integrate the geohydrologic structure of the Santa Fe Embayment to better understand how the structure affects water-level response to groundwater withdrawal and injection, (2) simulate the observed water-level changes during the test, and (3) provide a modeling tool that describes a structure and parameterization of the hydrology of the Tesuque Formation aquifer at a local and sub-regional scale for use in long-term projections of water injection operations.

## Previous Work

Hearne (1980) developed a model of the same aquifer to simulate a multi-well, multi-layer aquifer test conducted at the Pueblo of Tesuque. His three-dimensional digital model was calibrated using data from the aquifer test. The orientation of the Hearne model layers incorporated the dipping-bed structure of the Tesuque Formation and local-scale features identified from geophysical log data. The model area was within the Pojoaque River Basin approximately 12 miles north of the groundwater injection demonstration site described herein. That model was based on the program code developed by Posson and others (1980). Hearne's aquifer-test model result was used in later regional modeling and has been converted to the MODFLOW program.

Others have studied and analyzed the hydrogeology of the Santa Fe Embayment area of the Española Basin (Hearne and Koopman, 1974; Hearne, 1985; McAda and Wasiolek, 1988; Frenzel, 1995; Core, 1996; BGW, 1997; John Shomaker & Associates, 1998; Keating and others, 1998; and Keating and others, 2003). Each of those studies focused on different areas of the Española Basin, but captured the geohydrology on a regional scale.

The analysis herein takes an approach similar to that of Hearne (1980 and 1985) for multi-well pump-test analysis, in that it incorporates the regional dipping bed structure of the Tesuque Formation while taking into account local-scale features derived from interpretation of geophysical data and lithologic logs in the wells drilled for the injection test, and others in the area. The model uses the latest capabilities of the U.S. Geological Survey (USGS) model MODFLOW-2000 (Harbaugh and others, 2000).

## Hydrologic Setting

Major tributaries of the local surface water system include the Santa Fe River and its Arroyo Hondo, La Cienega and Bonanza Creek tributaries, all of which flow intermittently from the mountain front until reaching an area near La Cienega where water-table springs perennially provide flow. The Santa Fe River then flows generally west toward the Rio Grande at Cochiti Reservoir. The water-bearing formations of the Santa Fe Embayment area include the Tesuque and Ancha Formations of the Santa Fe Group and alluvial units adjacent to perennial streams and springs (Spiegel and Baldwin, 1963, p. 38). The primary water-bearing unit is the Tesuque Formation with a thickness of about 2,000 feet at the test site in comparison to a few hundred feet of saturated where Ancha Formation and tens of feet of saturated alluvium. Along perennial streams there are tens of feet of saturated alluvium. The deeper units represented in the model are principally Espinaso and Galisteo Formations.

The springs in the La Cienega area act as a drain that discharges groundwater from the aquifer system. Groundwater generally moves southwest toward the springs and eventually toward the Rio Grande. The bedding structure and hydraulic properties of the Tesuque Formation affect the direction of groundwater flow and the hydraulic gradient of the groundwater system. The Tesuque Formation consists of inter-bedded deposits of sediments with contrasting permeability. The beds have a dip that creates a preferential pathway for groundwater flow; the ability of the formation to transmit water parallel to the beds is much greater than its ability to transmit water across the beds (Hearne, 1980). That condition creates steep hydraulic gradients in the Tesuque Formation (50 to more than 100 feet per mile) where the movement of water is across, rather than parallel to, the dipping beds (Spiegel and Baldwin, 1963, pgs. 131-132).

In the area of Agua Fria, there is a flattening of head gradient that has been mapped by Spiegel and Baldwin (1963, Plate 6) and by Johnson and others (2004, Plate 5). That flattening is consistent with the movement of water parallel to, rather than across, the dipping geologic beds as the strike of the beds wraps around the Santa Fe Embayment as mapped by Kelley (1978) and by Grauch and Bankey (2003) at the structural base of the Santa Fe Group. Subcrop of an identifiable clay sequence and fault structure also contribute to the hydraulic-gradient pattern.

The pumping and injection wells used during the one-year test are completed in the lower 1,400 feet of the Tesuque Formation aquifer. The hydrologic properties and structure of the lower Tesuque Formation aquifer are, therefore, expected to be the dominant factor that influences water-level response during the test. The field test program is described in BGW (2001 and 2002) and BGW (2007 a, b, c and d). Field conditions provide the rate, response and well geometries for the simulation described herein.

## Model Development

The model is used for analyzing data collected during the six-month injection test plus six-month recovery phase. Four components are developed: (1) a hydrogeologic framework, (2) a spatial grid, (3), a test pre-condition and (4) matching of observed data to the model response. Each of these components is described below.

### Hydrogeologic Framework

We compiled data to provide information for the construction of a three-dimensional hydrogeologic unit solids model. The solids model provides a framework for specifying hydrologic parameter zones within the groundwater flow model and provides a basis for using the Hydrogeologic Unit Flow (HUF) Package that works with MODFLOW-2000 (Anderman and Hill, 2003).

The first step involved compiling data from Johnson and others (2004), Phillips (2004), Read and others (2004) and Sawyer and Minor (2006) to define the elevation of the Base of the Santa Fe Group (BSFG). The areas between data points were then interpolated to create a surface representative of the BSFG. This surface provided datum upon which shallower hydrogeologic units are constructed.

This model was constructed based on cross sections by Read and others (2004) and lithologic interpretations by Hawley (2006).[1] Above the BSFG, the solid model includes Hawley's lower (LSF), middle (MSF) and upper (USF) Santa Fe Group. Johnson and others (2004) provided a contour map of the base of the Ancha Formation (USF). We then used the land surface to define the top of the solids model above the BSFG. Along the southern edge of the Santa Fe Embayment, we used data from Grant (1998) to define the Tesuque subcrop extent beneath the Ancha Formation (USF).

At the injection test site, the solids model was defined by local structure interpreted by Hawley (2006) and Hawley and Cook (2003) based on test site drilling program data. The middle Santa Fe Group is divided into 13 separate units to capture the hydrostratigraphic unit interpretation as described below.

Below the BSFG, we constructed a hydrogeologic unit representing pre-Santa Fe Group bedrock units. We defined the unit to be about 3,250 feet thick representing basement rock including Espinaso Formation, Galisteo Formation, and Mesozoic and Paleozoic rock units near the Sangre de Cristo and Cerrillos uplifts. Volcanic rocks are also represented where they outcrop near Cerillos and the Caja del Rio.

## Spatial Grid

The groundwater system is represented by a grid with 40 layers, 186 rows and 186 columns. The grid covers an area of 245-square miles and ranges in thickness from 3,000- to 8,500-feet thick. As shown on Figure 1, the model grid is oriented north. In plan view, the model grid is constructed out of cells that vary in size from squares 100 feet on a side (in the area where groundwater levels are influenced by the test) to cells constructed from squares 1,000 feet long on a side. Model grid cells are 100 feet thick in the areas where water levels are influenced by the one-year test.

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[1] Dr. John Hawley of Hawley Geomatters, Inc. interpreted lithologic samples from the wells at the production and injection sites and characterized the geology of the test site (Hawley, 2006; Hawley and Cook, 2003).

The layer structure follows the idea of a dipping grid conceived by Hearne (1985). Hearne's grid represented the Tesuque Formation by incorporating geologic dip in the model grid layers. The grid developed for the model herein incorporates the dip as defined by the previously described BSFG. The grid was constructed based on this surface so that its layer structure would approximate the geologic dip of bedding (Figure 2).

### Pre-Test Condition

The one-year injection test took place under years 2006 and 2007 conditions of the hydrologic system. The current hydrologic condition in the model area is one that has been altered from a natural setting by groundwater development over the past 60 years or so. The model is set up to account for current conditions so that the pre-test setting is suitable for simulation of the one-year period. Simulation of the pre-test setting integrates a specification of observed groundwater heads and specified aquifer properties.

We developed a current water-level map to specify observed heads on the boundary of the model grid in the regional groundwater system and along arroyo and aquifer channels where groundwater flux is expected to occur. During a steady-state simulation, the specified heads produce a net inflow to the aquifer wherever recharge is required to maintain observed groundwater levels and a net outflow wherever groundwater discharge is required to maintain observed groundwater levels. Areally distributed recharge is included. This flow is converted into a specified flow and the steady-state model is rerun.

The result is a distribution of regional model-area recharge and discharge at boundary rates that integrate specified aquifer parameters with water levels observed in the field. Aquifer parameters for this run are adapted from Hearne (1985). The resulting net model flows are shown on Figure 1.

The specified flow points on Figure 1 translate to recharge along arroyo axes, the mountain front, and the Santa Fe River at a rate of 17,500 acre feet per year (AFY) or 71 AF/square mile. That rate is compatible with Anderholm (1994) who estimates 80 to 107 AF/square mile for the Santa Fe area. Groundwater flow from the model area into the Middle

Rio Grande Basin is 8,200 which is compatible with McAda and Barroll (2002, Figure 10) who estimate about 10,000 AFY. These results indicate that the simulated pre-test condition provides a match to observed water levels while groundwater flow is within the range of estimates published by others.

## Model Calibration

Model specification requires an understanding of the geohydrologic parameters and processes that affect the flow system. Our concept of the local-scale details regarding groundwater flow through the Tesuque Formation is related to flow dimension derived from test analysis and to genesis of the Tesuque Formation as described by Dr. John Hawley (personal communication, Fall 2006). Dr. Hawley describes sediments to have been deposited by flow from the south to the north within the Santa Fe Embayment. Flow from south to north is expected to create channel sands within finer over-bank deposits. Deposition of Tesuque Formation sediments then buries the coarse sands to form stacked paleo-stream channels inter-bedded within the fine-grained sediments. The surface flow is expected to have meandered so that the beds of coarse sand occur at a different horizontal location and elevation consistent with Tesuque Formation deposition at a later time. The resulting sediments would be composed of inter-bedded layers of gravel, sand, silt and clay, with a general south to north axial trend of buried paleo-stream channels.

The occurrence of channeled gravels in Tesuque Formation sediments is further described by Daniel J. Koning (Johnson and others, 2004, Appendix B, pg. 3). *"In the Tesuque Formation, there is an abundance of tabular (locally broadly lenticular), very thin to thick beds of silty to clayey sand (and minor sandy silt) that generally lack channel margins. These are in addition to overbank deposits of mud, silt, and very fine- to fine-grained sand that are most common in the distal alluvial slope. Unmistakable channel deposits of fine to very coarse sand and gravel (having both ribbon and sheet geometry) are scoured into this finer sediment..."*

This local-scale axial channel description of the Tesuque Formation aquifer is further supported by analysis of the one-year test data with generalized radial flow (GRF) analytical method (Walker and Roberts, 2003) that takes into account one-dimensional flow paths, which are conceptually compatible with ribbon-style axial channels. The analysis of water-level response indicates a localized flow dimension that is representative of preferential flow through linear channels, rather than the Theis condition of entirely radial flow (BGW, 2007).

Geophysical log data at the test site indicate the presence of a persistent low-permeability clay layer with a thickness of about 150 feet stratigraphically above the zone of injection and production as shown on Figure 3. This clay layer is present above the production and injection well completions and is expected to cap the water-level response associated with the one-year test. That clay feature was added to the model.

With these factors in mind, the calibration approach involved initial Tesuque Formation aquifer properties based on Hearne (1985): Hydraulic conductivity (K) = 1.0 feet per day, Specific Storage (Ss) = 2 x $10^{-6}$ per foot and horizontal to vertical anisotropy of 1:300. Hearne (1985) chose these properties because they represent the middle of a plausible range of values estimated from aquifer testing and from his analysis of vertical gradients. With those parameters, this model was found to under-predict the observed injection test field response. We then added some ribbon-channel, sand lens and fault feature detail to the well areas. Model parameter and sensitivity analysis was performed with the MODFLOW parameter estimation process (Hill and others, 2000). After ten iterations of altering channel features and localized properties, we arrived at a set of calibrated values as shown on Figure 4. Calibrated parameters are compatible with those calculated from the field test program described in BGW (2001; 2002 and BGW 2007 a, b, c and d). The specific zonation of features is fitted to the resolution of the field response data. The general zones of outlying trends should be understood to lump other unresolved sand, clay and structural features.

The model is intended to be further adjusted where other features or scenarios are of interest, including longer-term water injection operations.

## Model Comparison with Observed Data

The production and injection wells are situated about one mile apart. At the injection well site, monitoring wells are set up at distances of about 100 feet (CCD-OWA Intermediate), 500 feet (CCD-OWB) and 2,000 feet (CCD-OWC) from the injection well and at the production site (see Figures 2 and 3 for model screen zones). The simulated and observed water-level responses from the one-year test are shown on Figures 5 through 8. The simulated curve fit to observed data and statistics are posted on each chart. They range from one foot root mean squared (RMS) error to five feet RMS error, or about ten percent of buildup and drawdown across the site. Correlation coefficients are all greater than 0.95. Less than 0.5 feet of buildup is simulated at shallow piezometers, similar to the observed response. Drawdown is observed at the CCD-X1 shallow piezometer as in the injection test (BGW, 2007).

Figure 9 contours show maximum (180 day) test buildup and drawdown contours. The horizontal anisotropy caused by the axial channel trend at the injection site is visible in the buildup contour. The build up and drawdown contours overlap because of non-contiguous screen zones between the pumping and injection sites. Faults to the west of the pumping site act as a barrier to drawdown. At 180 days 6.8 square miles of aquifer has build up greater than one foot and 3.9-square miles of aquifer has drawdown greater than one foot. Residual drawdown and buildup after about six months of recovery is shown on Figure 10. Cross sections with buildup and drawdown at six months and one year are shown on Figure 11.

GRF calculations used to match test data (BGW, 2007) show that non-radial flow with leakage characterizes the response at the injection site. The slope of the pressure derivative of a modeled aquifer response curve can be related to the apparent GRF flow dimension as described in Walker and Roberts (2003). The resulting numeric flow dimension can represent aquifer heterogeneity, variable geometry, or boundaries with values less than one (a container) and greater than three (an external source). Ideally, flow dimension n = 1 describes parallel flow inside a one-dimensional prism, n = 2 describes concentric two-dimensional radial flow (well function of Theis, 1935), and n = 3 is spherical three-dimensional flow to a point. Flow dimensions with values between the idealized integers are considered to contain elements of various geometries.

Figures 12 through 14 display the calculated flow dimensions and the associated build up from constant injection of 50 gpm for 180 days. At CCD-OWA a low-flow dimension is indicated for less than one day, before a radial then increasingly leaky response persists to 180 days. The average flow dimension for CCD-OWA is 2.3. High (>2.5) flow dimensions are interpreted to result from periodic transmissivity (Walker and Roberts, 2003) zones within the model area. Flow dimensions less than two indicate that less than radial flow regime persists at CCD-OWB and CCD-OWC for about 100 days before near radial then leaky responses predominate. CCD-OWB has an average flow dimension of 1.7 and CCD-OWC has an average flow dimension of 1.5.

## Conclusions

1. The model (GOVRVInject07) incorporates the three-dimensional hydrogeologic structure of the Tesuque Formation aquifer. The model is capable of simulating the water-level response caused by the one-year injection test and response, and can be adapted to project the response area of future water-injection operations.
2. The model analysis supports the concept of axial paleo-stream channels inter-bedded in the Tesuque Formation sediments which improves local-scale model performance. Calibrated parameters are compatible with those calculated from the aquifer-recharge demonstration project field program data.
3. The model is calibrated to reasonably match observed data at four piezometers and the water table.

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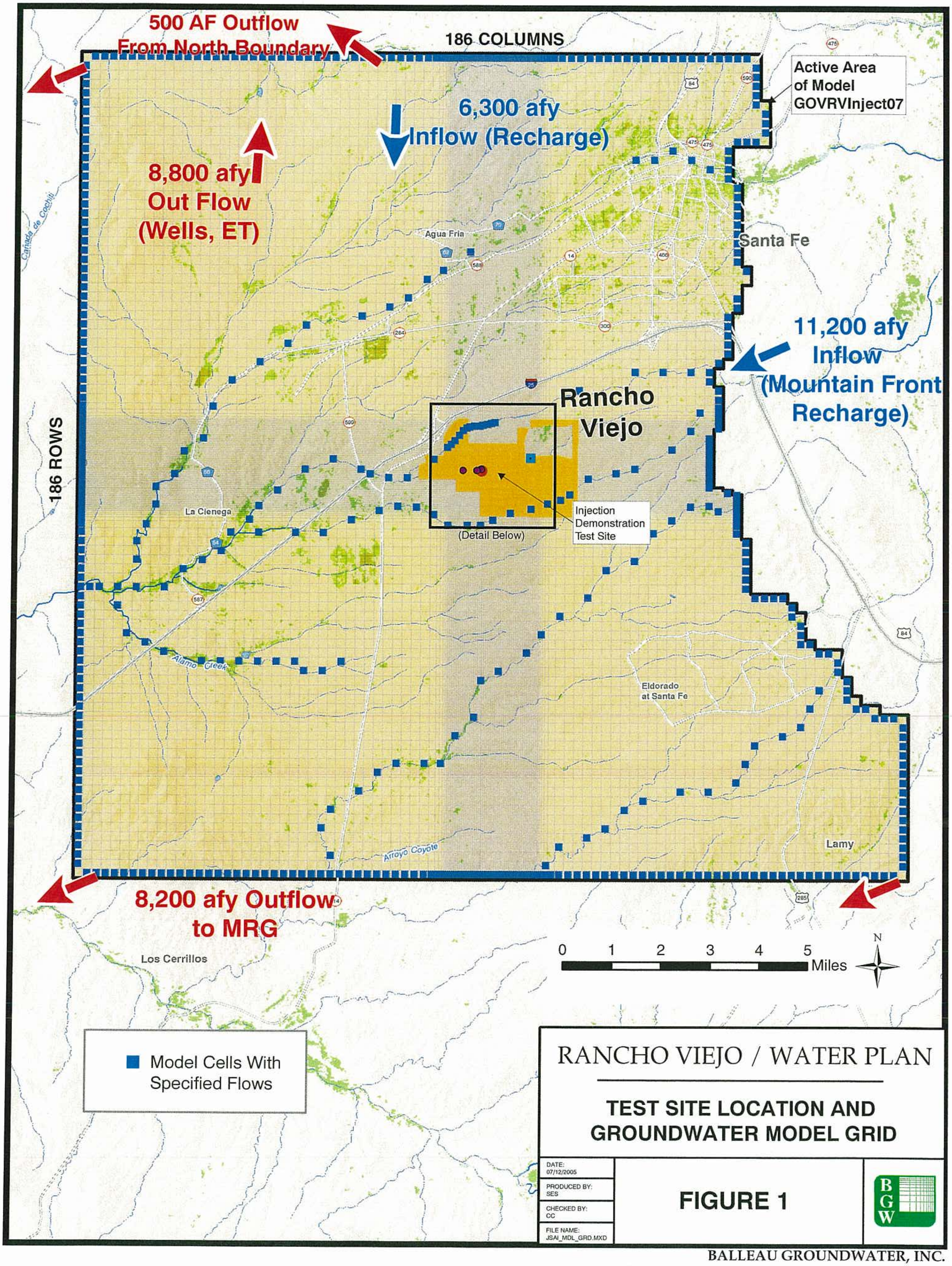
Attachments: Figures (14)



RANCHO VIEJO / WATER PLAN

**TEST SITE LOCATION AND GROUNDWATER MODEL GRID**

DATE:
07/12/2005

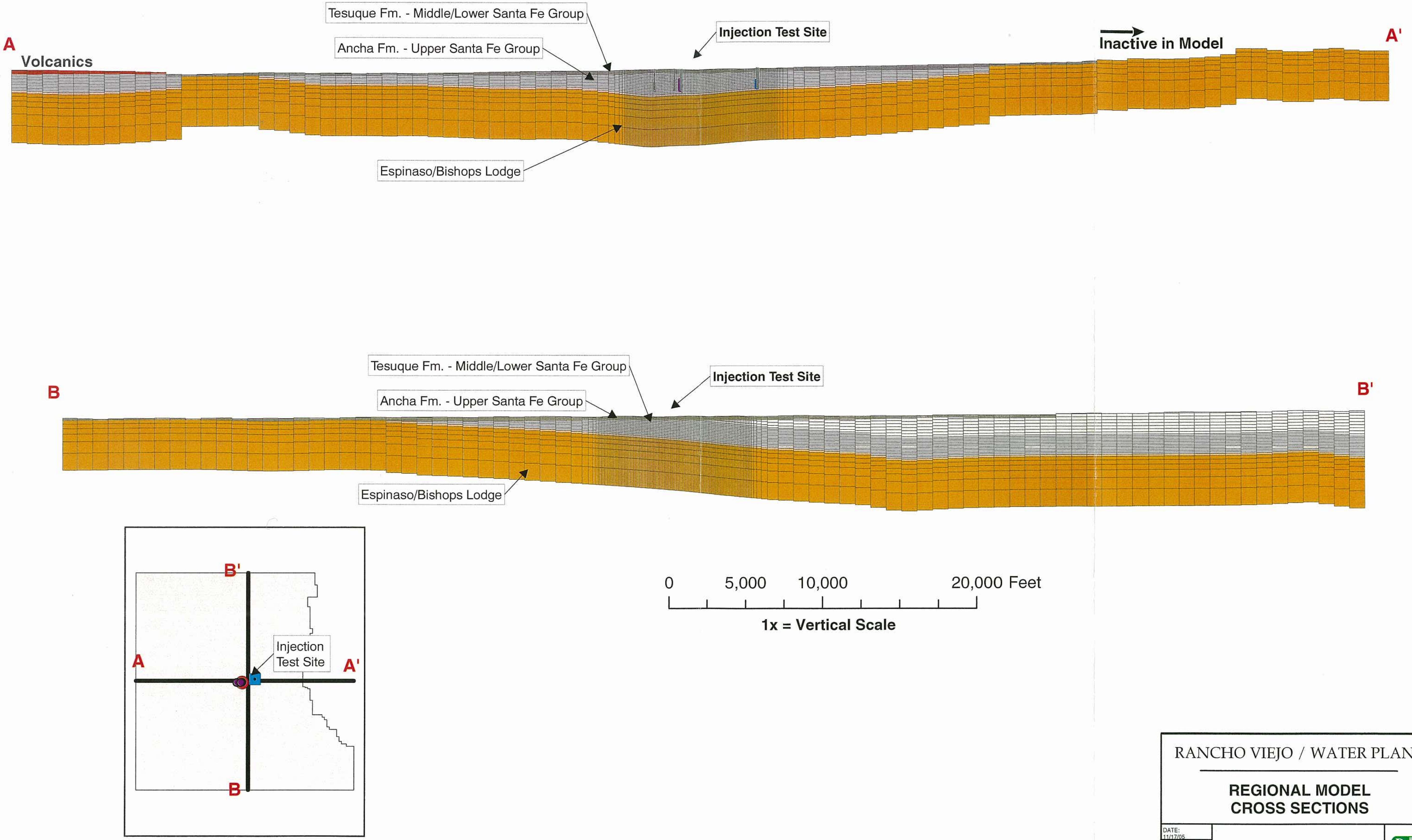
PRODUCED BY:
SES

CHECKED BY:
CC

FILE NAME:
JSAI_MDL_GRD.MXD

**FIGURE 1**

BALLEAU GROUNDWATER, INC.



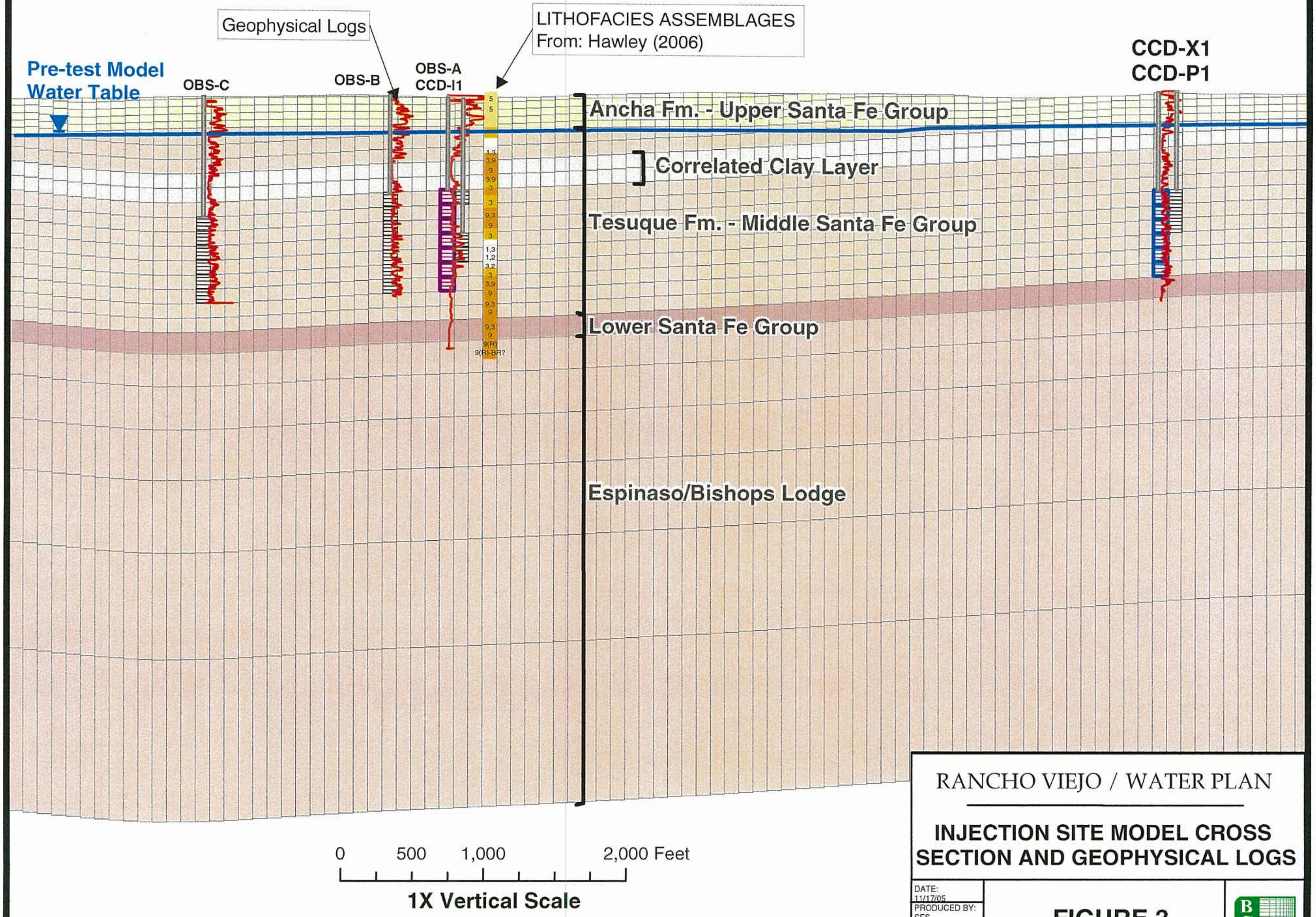
RANCHO VIEJO / WATER PLAN

## REGIONAL MODEL CROSS SECTIONS

DATE:
11/17/05
PRODUCED BY:
SES
CHECKED BY:
DR
FILE NAME:
XSEC.MXD

## FIGURE 2

BALLEAU GROUNDWATER, INC.



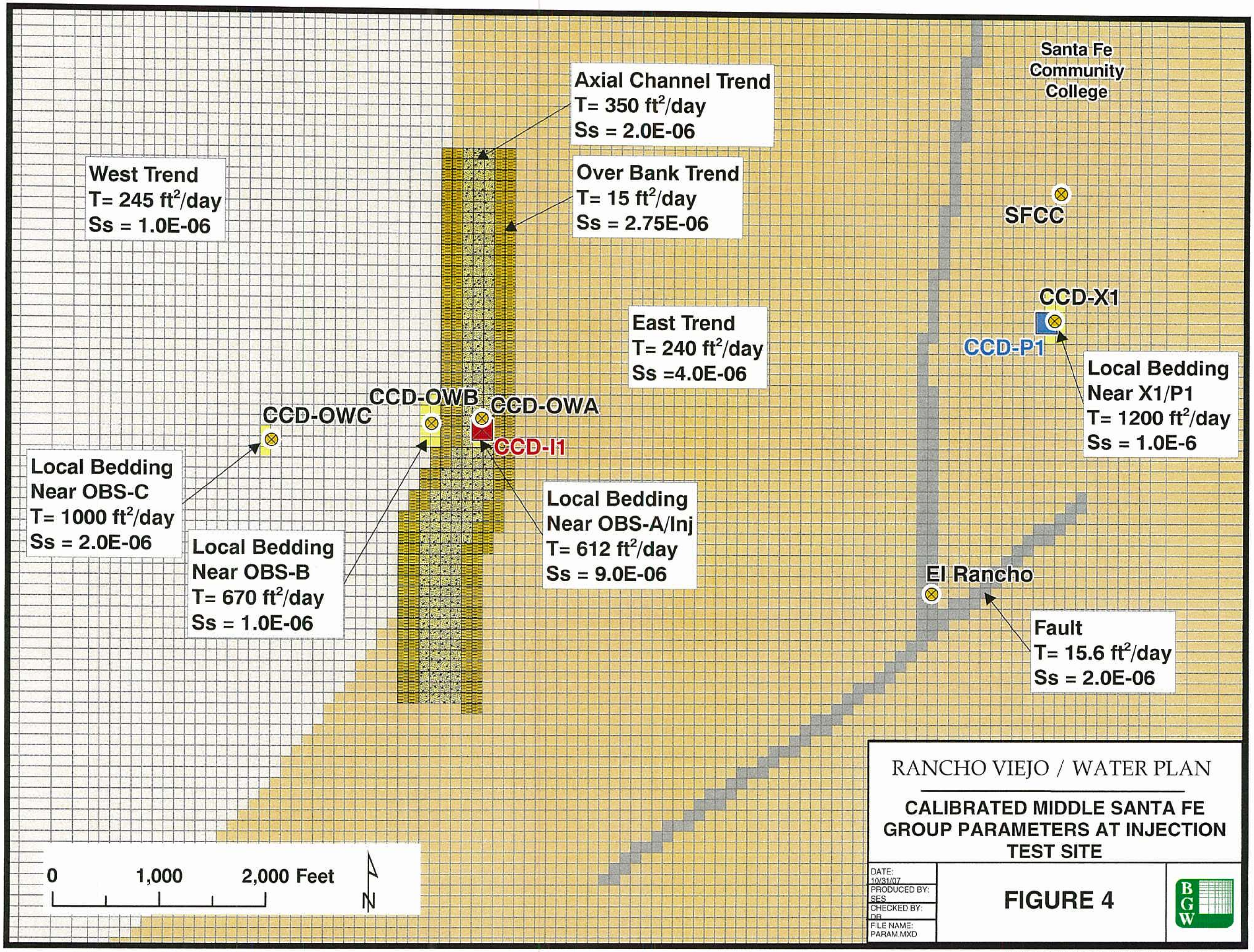
RANCHO VIEJO / WATER PLAN

## INJECTION SITE MODEL CROSS SECTION AND GEOPHYSICAL LOGS

DATE: 11/17/05
PRODUCED BY: SES
CHECKED BY: DR
FILE NAME: XSEC.MXD

**FIGURE 3**

BALLEAU GROUNDWATER, INC.



RANCHO VIEJO / WATER PLAN

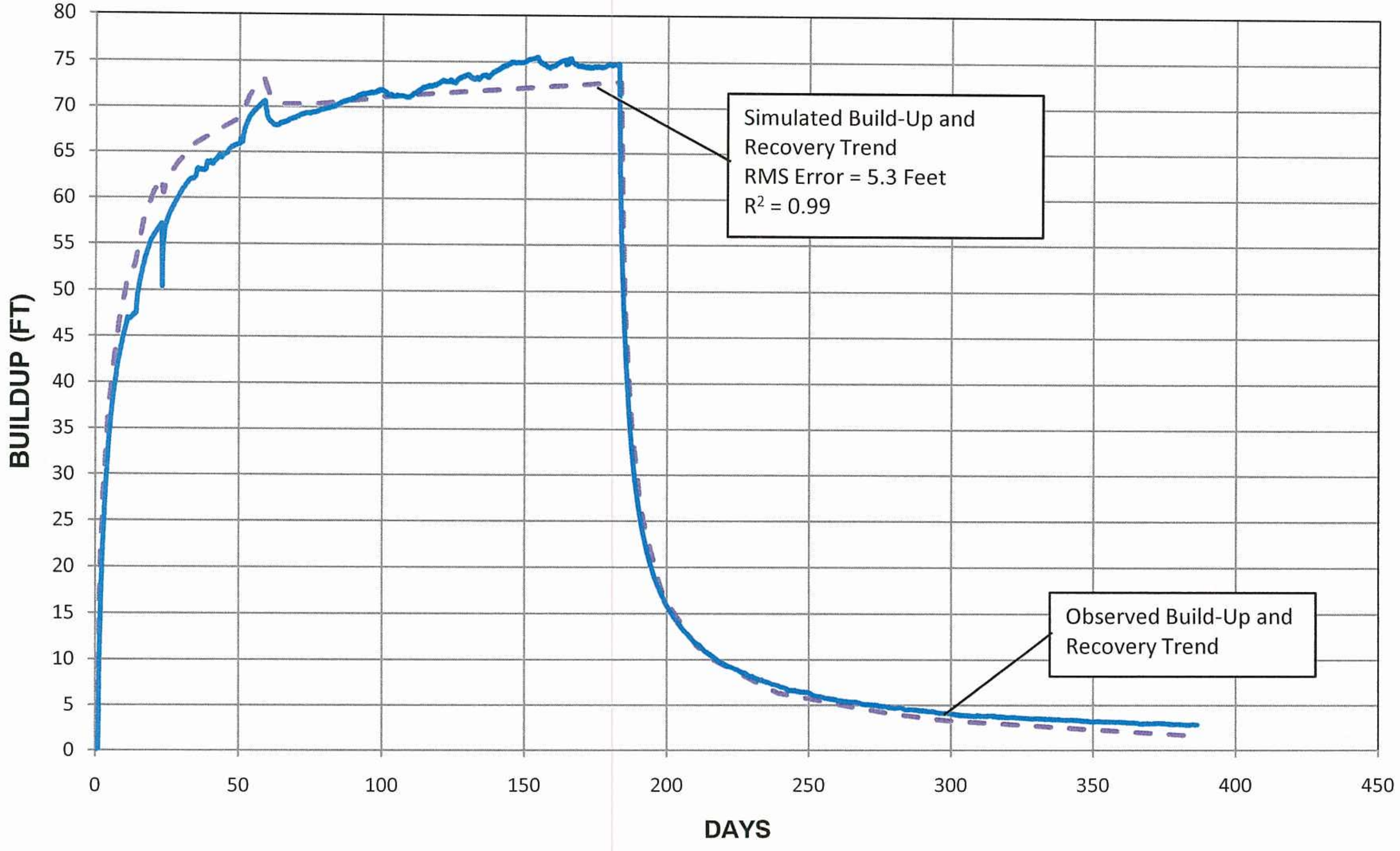
## CALIBRATED MIDDLE SANTA FE GROUP PARAMETERS AT INJECTION TEST SITE

DATE:
10/31/07
PRODUCED BY:
SES
CHECKED BY:
DR
FILE NAME:
PARAM.MXD

**FIGURE 4**

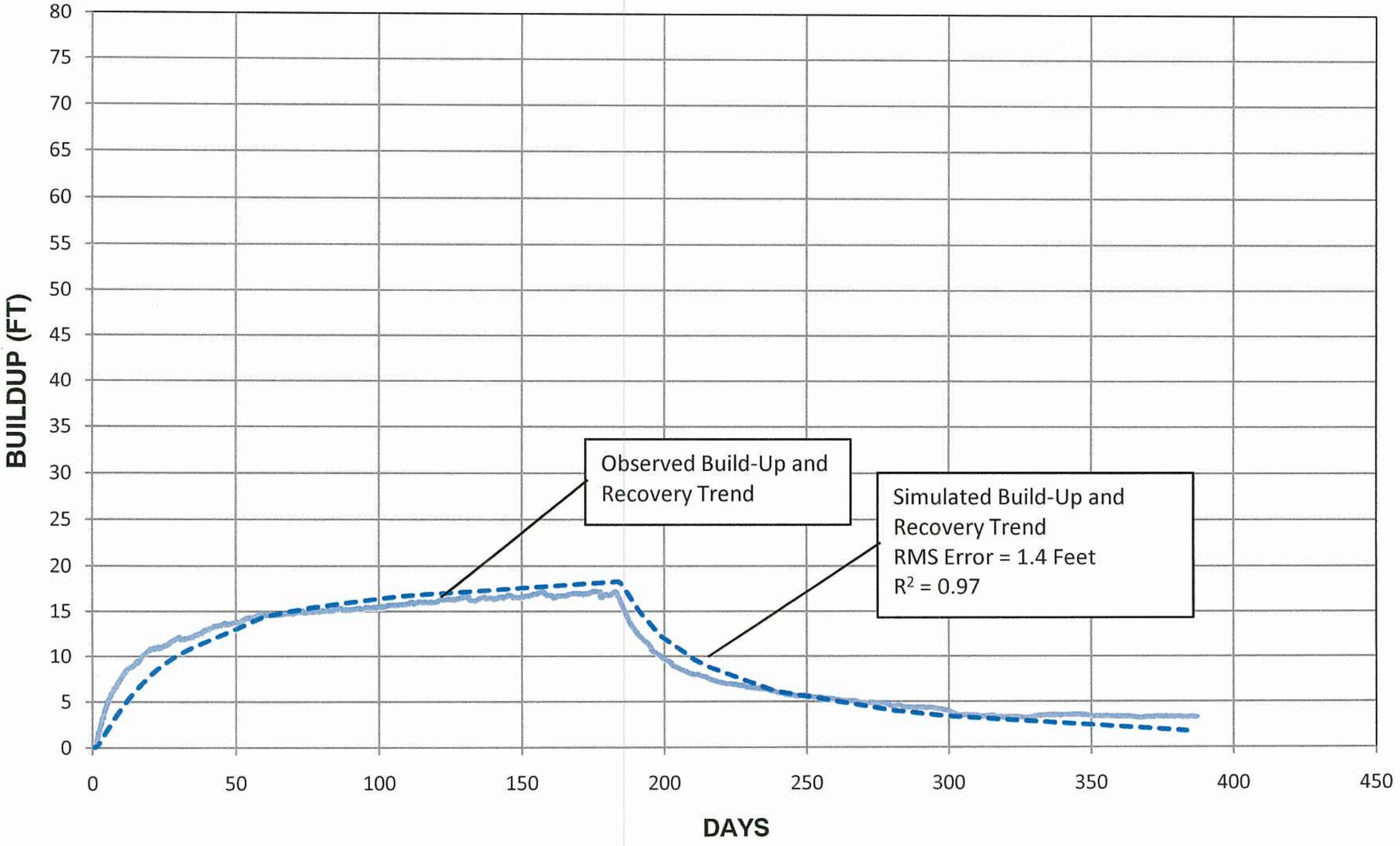
BALLEAU GROUNDWATER, INC.

## FIGURE 5
## OBSERVED AND SIMULATED BUILD-UP AT CCD-OWA



HRGPHmemo.xlsb
SES
11/5/2007

## FIGURE 6
## OBSERVED AND SIMULATED BUILD-UP AT CCD-OWB

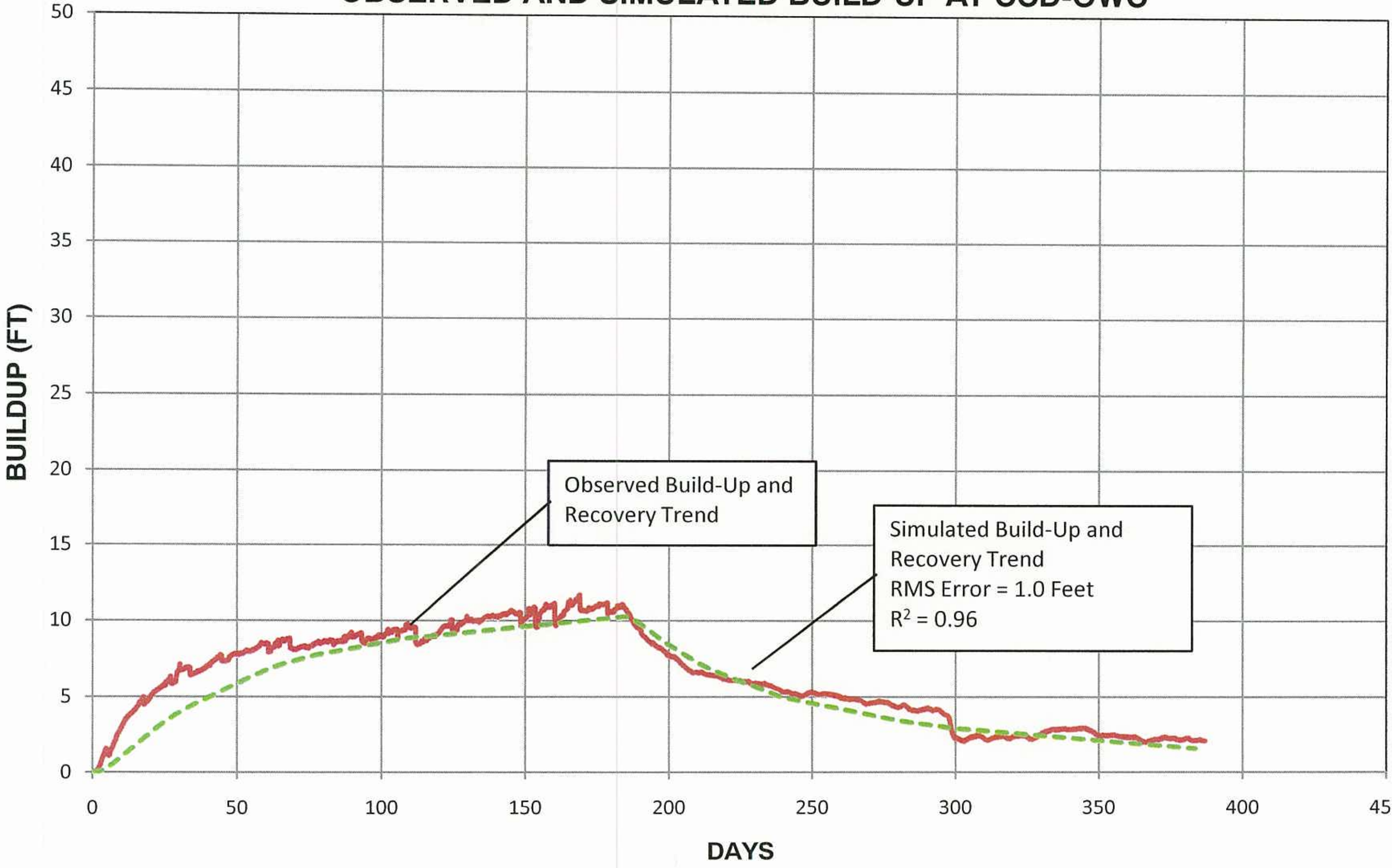


Observed Build-Up and Recovery Trend

Simulated Build-Up and Recovery Trend
RMS Error = 1.4 Feet
$R^2 = 0.97$

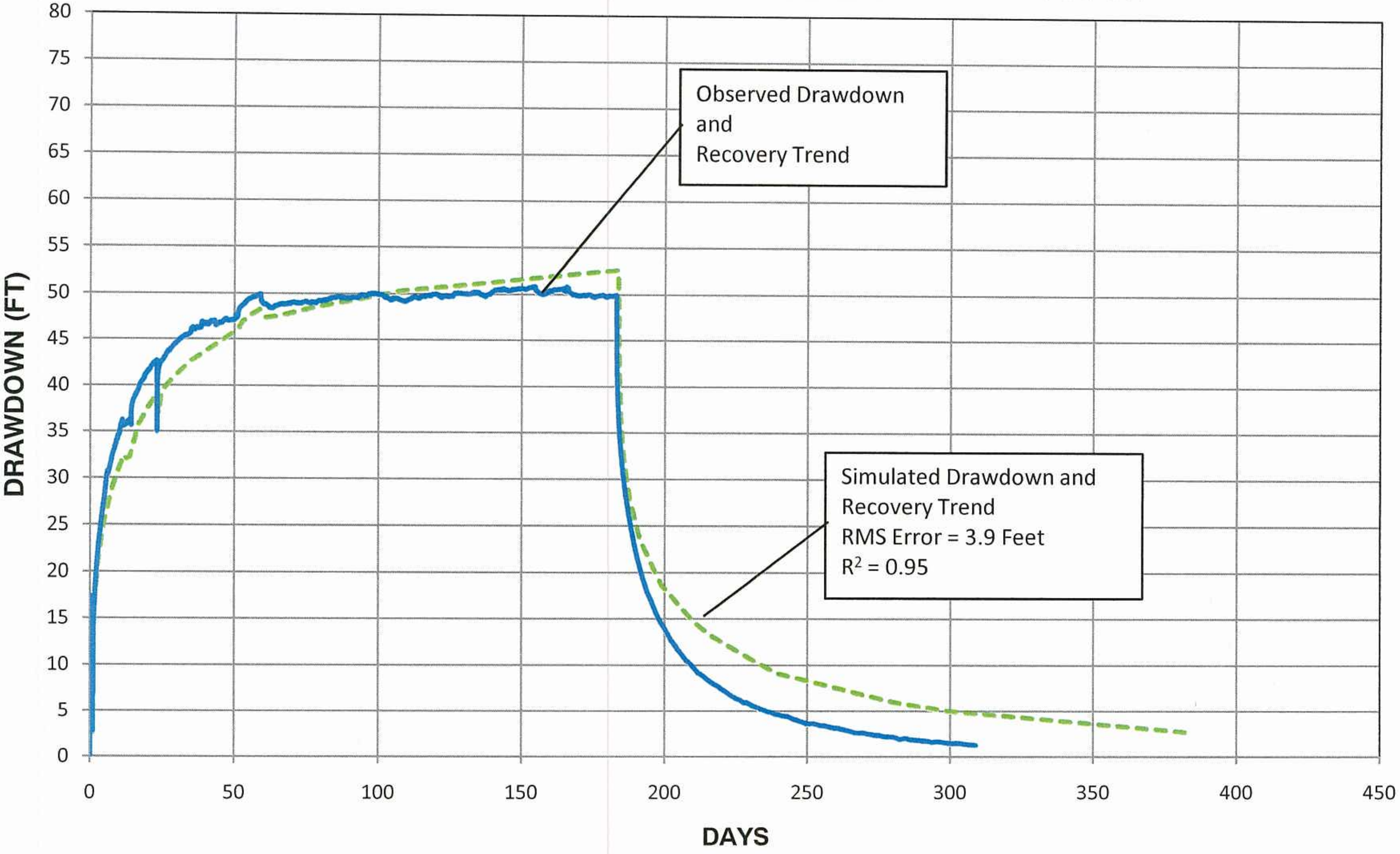
HRGPHmemo.xlsb
SES
11/5/2007

## FIGURE 7
## OBSERVED AND SIMULATED BUILD-UP AT CCD-OWC

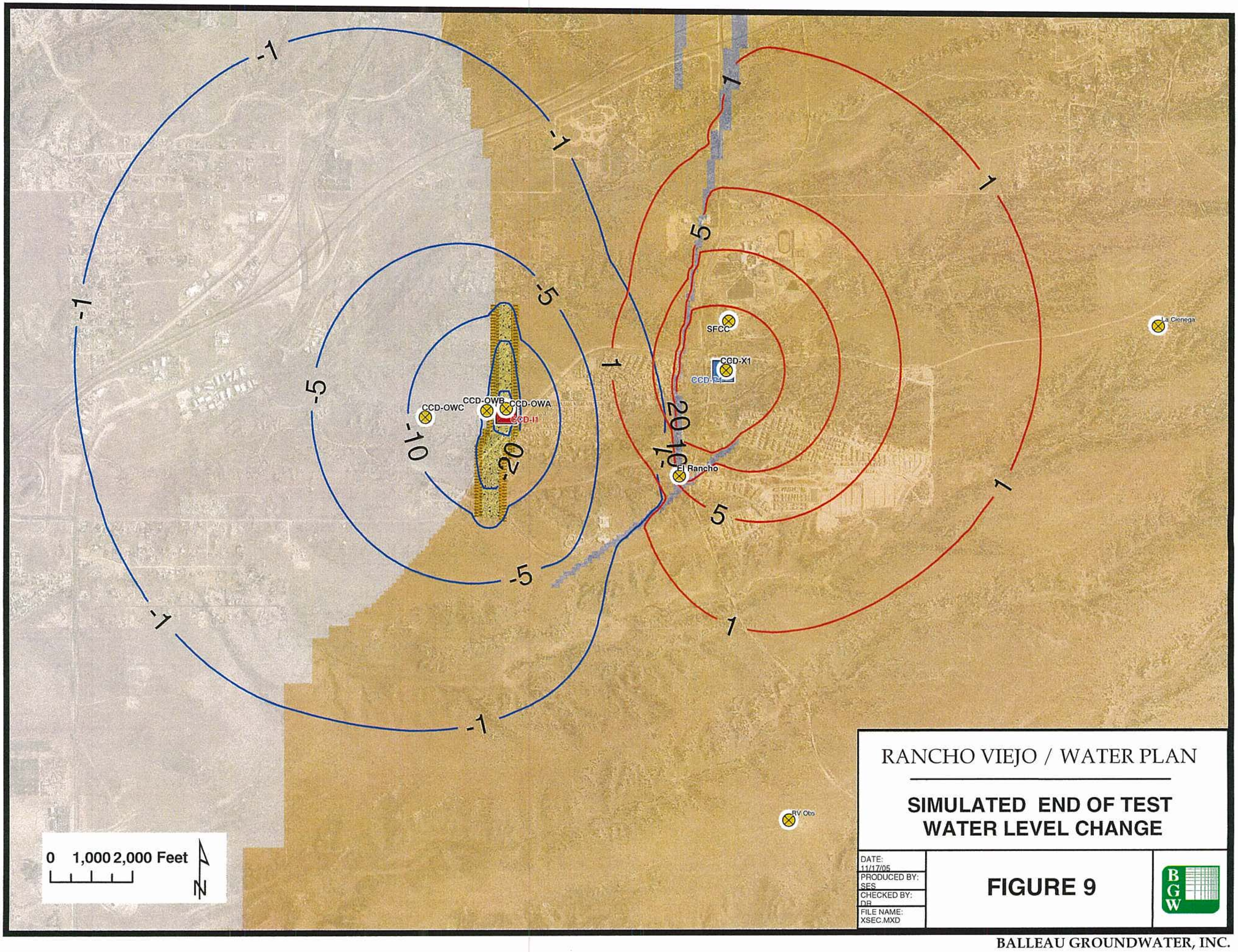


HRGPHmemo.xlsb
SES
11/5/2007

# FIGURE 8
# OBSERVED AND SIMULATED DRAWDOWN AT CCD-X1



HRGPHmemo.xlsb
SES
11/5/2007



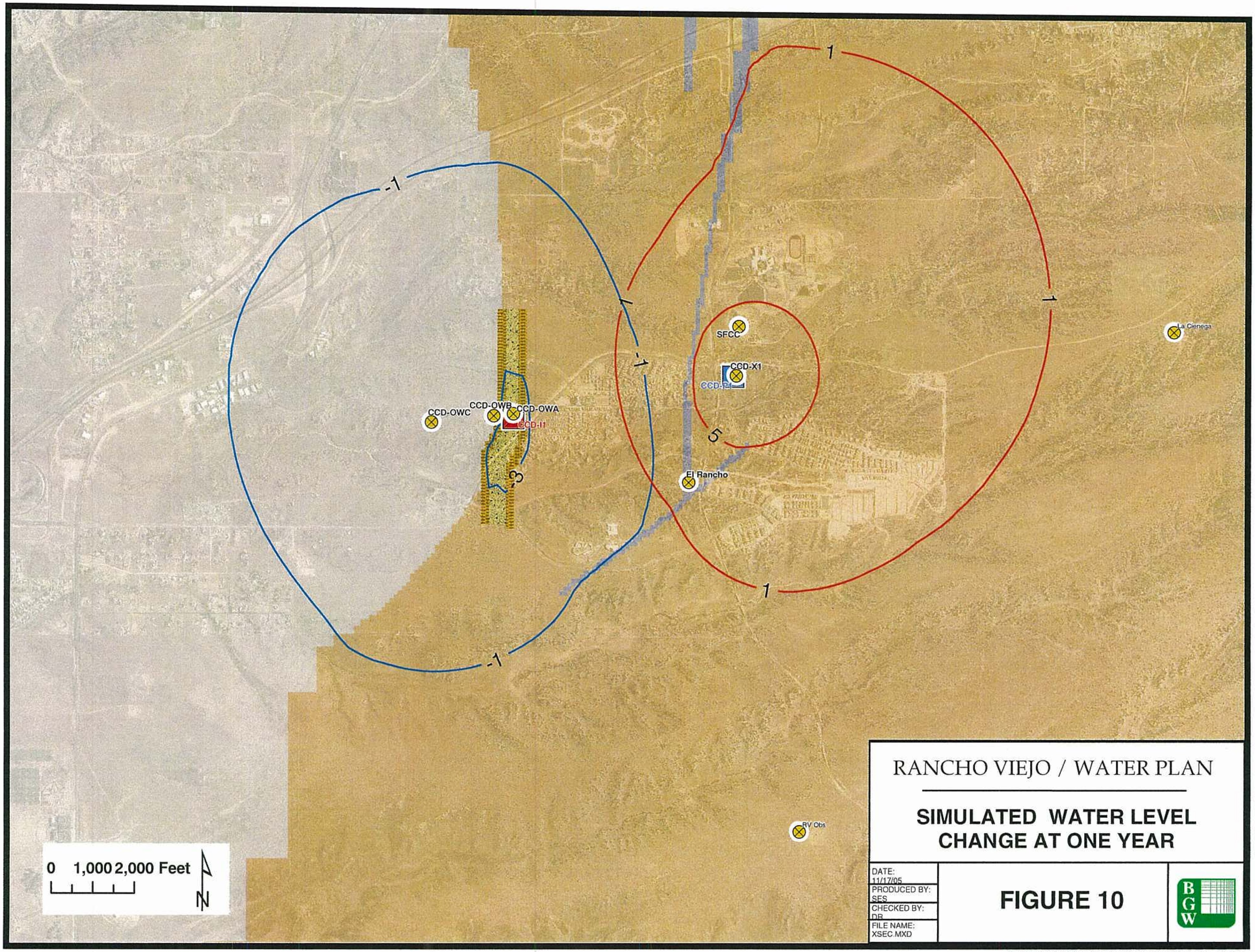
RANCHO VIEJO / WATER PLAN

## SIMULATED END OF TEST WATER LEVEL CHANGE

DATE:
11/17/05
PRODUCED BY:
SES
CHECKED BY:
DR
FILE NAME:
XSEC.MXD

**FIGURE 9**

BALLEAU GROUNDWATER, INC.



RANCHO VIEJO / WATER PLAN

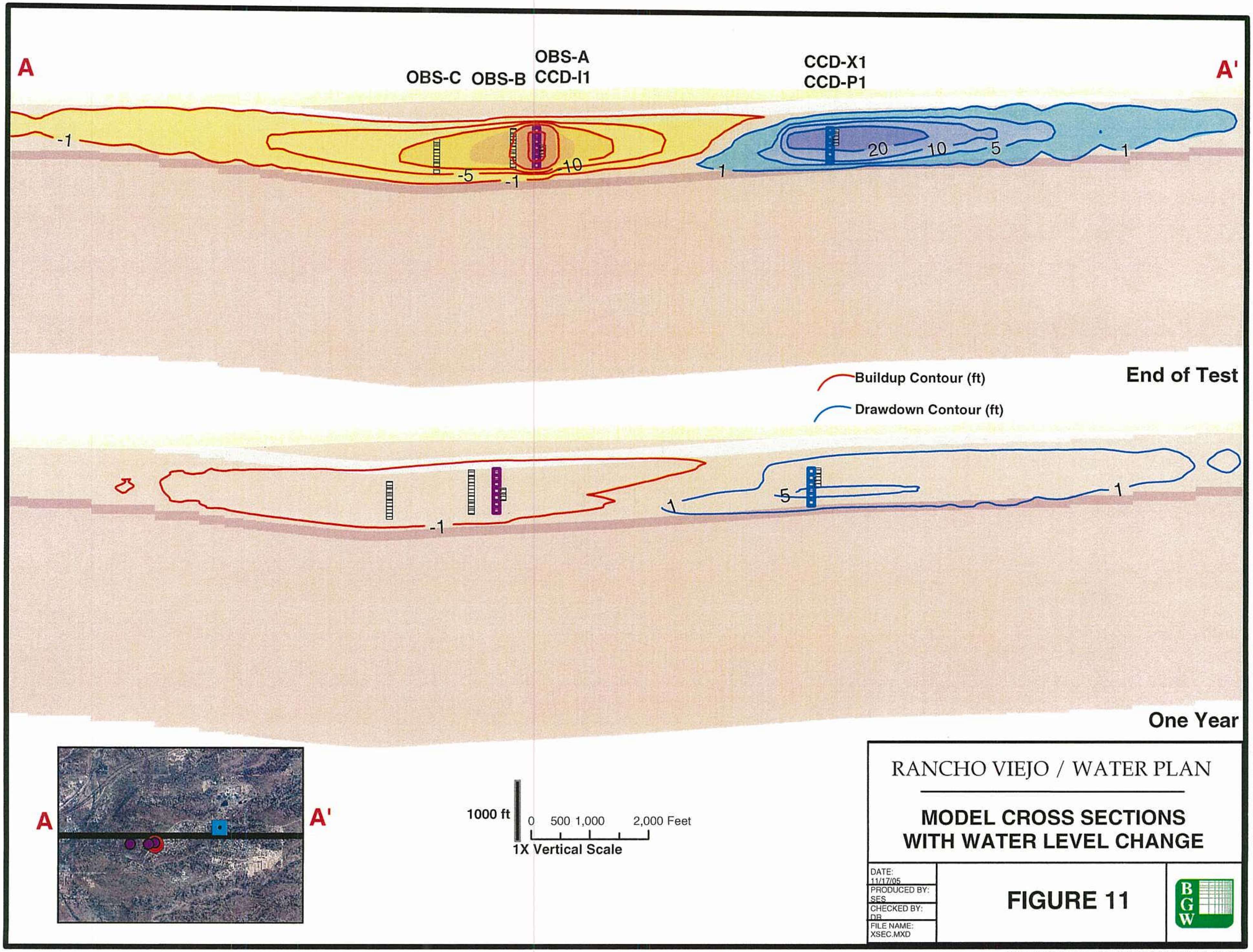
**SIMULATED WATER LEVEL CHANGE AT ONE YEAR**

DATE: 11/17/05
PRODUCED BY: SES
CHECKED BY: DR
FILE NAME: XSEC.MXD

**FIGURE 10**

BGW

BALLEAU GROUNDWATER, INC.



RANCHO VIEJO / WATER PLAN

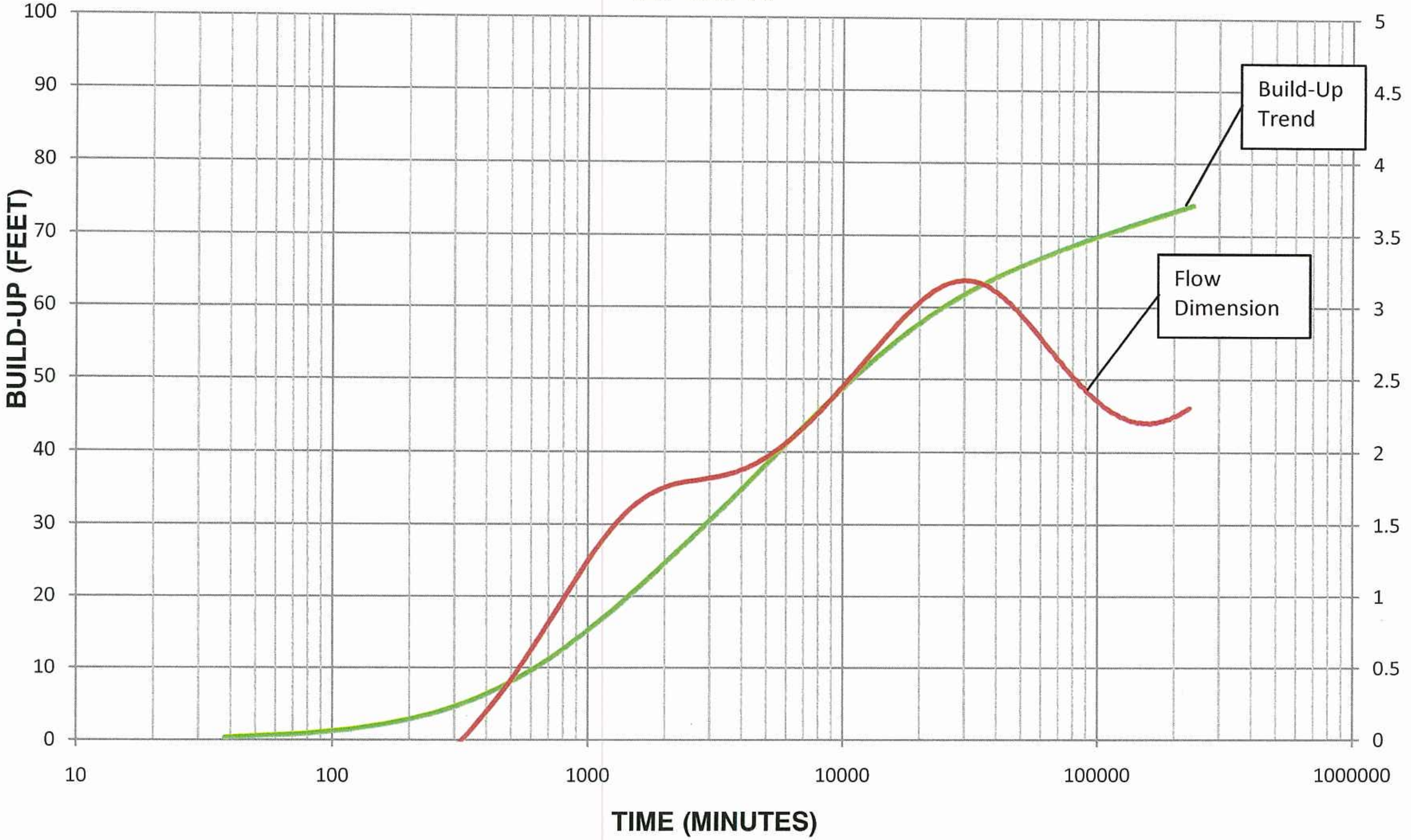
## MODEL CROSS SECTIONS WITH WATER LEVEL CHANGE

DATE: 11/17/05
PRODUCED BY: SES
CHECKED BY: DR
FILE NAME: XSEC.MXD

**FIGURE 11**

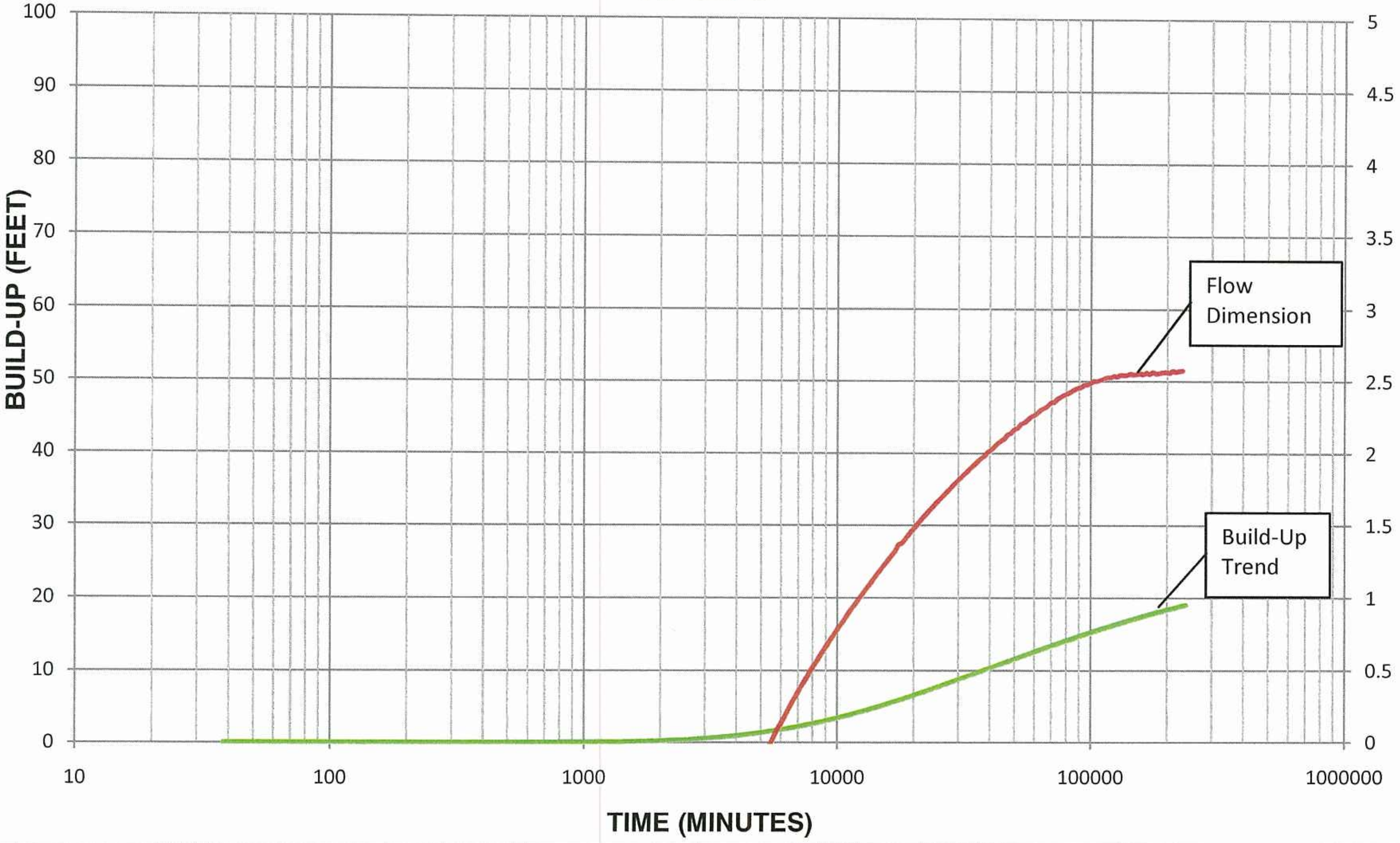
BALLEAU GROUNDWATER, INC.

## FIGURE 12
## APPARENT FLOW DIMENSIONS FOR INJECTION TEST SIMULATION AT OW-A



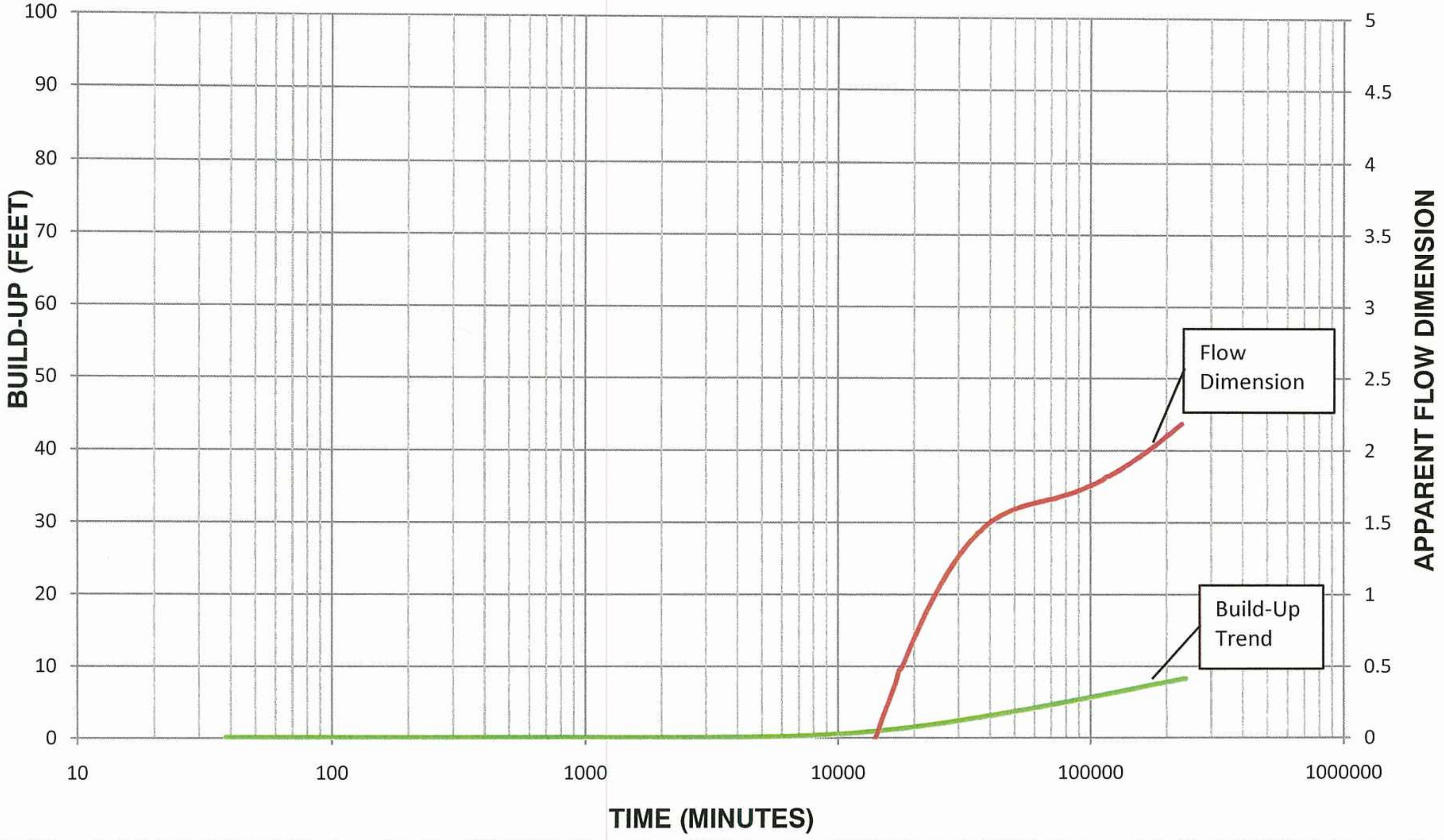
FlowD2.xls
SES
11/5/2007

# FIGURE 13
## APPARENT FLOW DIMENSIONS FOR INJECTION TEST SIMULATION AT OW-B



FlowD2.xls
SES
11/5/2007

## FIGURE 14
## APPARENT FLOW DIMENSIONS FOR INJECTION TEST SIMULATION AT OW-C



FlowD2.xls
SES
11/5/2007