Final Report
Installation of Deep Aquifer Monitoring Wells – DMW-2
Marina Coast Water District
Marina, California

Prepared for

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MACTEC Project No. 4098042052 3.2

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This report, consisting of professional opinions and recommendations, has been made in accordance with generally accepted principles and practices in the field of geology and hydrogeology. The interpretation of geologic conditions within the study area is based on information collected during the construction of dedicated monitoring wells. The locations for the cross-sections were selected to provide a generalized representation of geologic conditions within the study area.

The geologic cross-sections developed for this report are based on information from the wells shown on the cross-section. The geologic information shown between the wells on each cross-section is an interpretation based on professional opinion and may not be an accurate representation of subsurface conditions between wells. Due to changes in geologic conditions with the study area, the information from the geologic cross-sections in this report should not be used as the means for determining site conditions for geographic areas not included in a cross-section.

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EXECUTIVE SUMMARY

This report is the final contractual deliverable of MACTEC summarizing the installation of a monitoring well couplet located on Marina Airport property. The objectives of installing these monitoring wells were to confirm geologic and hydrogeologic conditions of the Deep Aquifer, collect information regarding hydraulic communication within the Deep Aquifer, provide data to evaluate vertical leakage from overlying aquifers, and provide a geochemical reference point from which the intrusion of seawater could be compared in future groundwater samples.

The DMW-2 monitoring well couplet was installed in January 2005 to depths of approximately 1,100 feet and 1,700 feet below ground surface. Groundwater elevation and quality data from these well screens are compared to those from DMW-1 (*USGS, 2002*) and to MCWD Well Nos. 10, 11, and 12 to establish quasi-regional correlation of groundwater flow directions and the potential for seawater intrusion. Vertical gradients at the DMW-2 couplet were also evaluated with groundwater elevations measured four times between January and April 2005.

Data indicate that groundwater quality at the DMW-2 couplet is most similar to MCWD Well Nos. 10 and 11 and, based on the chemical stability of these production wells, seawater intrusion is not occurring. This is in some contrast to the slight landward horizontal gradient measured between DMW-1 and DMW-2 on April 6, 2005, which suggests a potential for future seawater intrusion. Groundwater elevations at DMW-2 consistently indicate a 10-foot upward gradient between the upper and lower screens, suggesting that the upper portion of the Deep Aquifer is stressed more than the lower portion; however, insufficient data exist to confirm this.

Conclusions and recommendations are provided to maximize value of the data collected in this program and to provide a framework within which additional data can be evaluated.

1.0 INTRODUCTION

This report summarizes the drilling and monitoring well installation activities conducted in January 2005 per the contract signed on August 13, 2004, by Marina Coast Water District (District). These activities were conducted at a site near the Marina Municipal Airport (Plate 1). MACTEC Engineering and Consulting, Inc. (MACTEC) conducted a field program including drilling one deep borehole, generating a lithologic log, converting the borehole to a nested monitoring well pair, and developing the monitoring well screens. One well was screened in the Paso Robles Formation and one in the Purisima Formation (Plate 2). Observed lithology, well construction details, and analytical data from ground water samples collected during the program are summarized and described below.

The project background and proposed well installation techniques and well locations are presented in the Work Plan, and Health and Safety Plan (*Technical Memorandum No. 1, Work Plan and Health and Safety Plan, Deep Aquifer Monitoring Well Program, MACTEC, 2004*). Well installation, lithologic logging, geophysical logging, and development were conducted in accordance with the specifications included in the Contract.

In addition to a discussion of the field program activities and findings, this report includes a copy of the well permit (included in Appendix B), lithologic log, geophysical logs, and well development forms as required with Contract specifications.

<u>Objectives/Scope of Work</u>

The objectives of installing this monitoring well were to:

- Confirm geologic and hydrogeologic conditions at the site to depths inclusive of those already penetrated by Deep Aquifer production wells owned by the District, including determining the base of the 400-foot Aquifer;
- Construct a monitoring well that may provide information concerning hydraulic communication within the Deep Aquifer units (e.g., Paso Robles and Purisima Formations);
- Construct a monitoring well from which data could be used to determine the amount of leakage from aquifers (valley fill and Paso Robles) overlying the Deep Aquifers (Paso Robles and Purisima); and
- Provide information concerning the seawater intrusion interface and regional communication with other pumping centers, if any, within the Deep Aquifer.

Long-term objectives include:

- Provide more information to allow further refinement of the safe yield of the Deep Aquifer, including more accurate characterization of recharge rates, transmissivity, and connectivity to the middle and upper aquifers.

- Provide more information to allow a refinement of the Salinas Valley Integrated Ground and Surface water Model (SVIGSM) to be able to address yield and seawater intrusion questions related to aquifer use.

- Provide monitoring of the hydrologic changes within the Deep Aquifer as more production wells in the Deep Aquifer are constructed.

- Allow the District and the Monterey County Water Resources Agency (Agency) to monitor for the occurrence or potential occurrence of seawater intrusion.

The scope of work, as described in the Work Plan (*MACTEC, 2004*) included pre-construction activities including California Environmental Quality Act (CEQA) documentation, obtaining an access agreement well permit, preparation of a Technical Memorandum, and review of available lithologic, geophysical, and groundwater quality data from nearby monitoring wells owned by the U.S. Army. Installation and construction activities associated with DMW-2 included drilling and lithologic logging of a pilot boring, geophysical logging of the pilot hole, and well construction and development followed by chemical testing. Hydrogeologic consultation and analysis, and preparation of this report are activities included in the post-construction phase of the project.

2.0 FIELD PROGRAM

The field program consisted of installing a single borehole with dual completions into Deep Aquifer units using a mud rotary rig, recording lithology from the cuttings, obtaining geophysical logs, installing a nested monitoring well pair, developing each monitoring well screen, and completing the well pair with a secure well vault box. The borehole was drilled to allow completions at 1,000 and 1,700 feet within the targeted aquifers. The well screen lengths were each limited to 50 feet.

Drilling mud samples were collected from the pilot boring during the drilling process; samples were collected approximately every 40 feet within the saturated zone and were field tested for mud viscosity and weight, and for physical parameters, including pH, temperature, and conductivity.

Groundwater samples were collected from the wells after development and submitted to the Agency for laboratory analysis for general mineral content. Groundwater elevations were measured in each monitoring well following the development process.

2.1 Sample Collection and Logging Methods

All samples were logged in the field during drilling activities. Cuttings were logged from grab samples collected off the shale shaker and from samples collected with a fine mesh screen directly from the circulating drilling mud. All sample descriptions include estimates of grain size distribution, and color description using standardized Munsell color charts. Samples that were collected at night or in artificial light were checked for accurate color description during daylight hours.

Shell fragments were noted when they were encountered, but no fossil identification was attempted in the field. Calcite content was estimated by observing for an effervescing reaction using a mild hydrochloric acid solution. Calcite content was checked within 24 hours, while bagged samples were still damp.

Estimates on degree of cementation are based on rate of penetration, measured in minutes per 20 feet, taking into account lithology and what the standard drill rate would be for the particular tri-cone button-bit used on this project.

2.2 Borehole Construction

Prior to drilling and installing the borehole and wells, water well construction permit number 04-08447 was obtained from Monterey County Health Department. Access agreements with the Marina Airport, and a CEQA Notice of Exemption were obtained for the well site. The Monterey County water well construction permit is provided in Appendix B.

Drilling and well construction activities for the Deep Aquifer well began on January 5, 2005 and ended on January 24, 2005. All work was performed using mud rotary drilling equipment owned and operated by WDC Exploration and Wells of Zamora, California.

A permanent steel conductor casing was set 40 foot into surface soil. The pilot borehole was drilled using an 8.25-inch diameter tri-cone button drill bit advanced to 2,025 feet below ground surface (bgs).

All drilling was done under the field oversight of a MACTEC California Professional Geologist and the supervision of the undersigned California Certified Hydrogeologist. The lithologic log was constructed by logging the mud rotary cuttings. Grab samples were collected from the circulating mud and from the shaker table, and were described using the ASTM D 1586-84 classification system. Representative samples of lithology were collected at 20-foot intervals from 500 feet to 2,025 feet bgs; these were stored onsite during drilling and logging for correlation purposes. The lithologic samples were later transported to the Monterey County Water Resources Agency (Agency) offices in care of Mr. Lauran Howard.

Municipal drinking-water-quality water from a hydrant at the Marina Municipal Airport was used for all downhole drilling fluids and for all site clean-up activities. A hydrant meter was obtained from the District to track total volume used for all activities.

Lithologic logs, geophysical logs, and well construction data are presented together on Plate 2. A detailed discussion of lithologic observations at each location is included in Section 3.0.

2.3 Geophysical Logging

The boring was geophysically logged by Welenco Logging Services of Bakersfield and Salinas, California. On January 10, 2005, the 8.5-inch diameter pilot hole was geophysically logged to its total depth of 2,025 feet; logs included: single point, short and long resistivity, bulk natural gamma, spontaneous potential, temperature, deviation, and conductivity as water quality interpreted from SP calculations.

On January 15, 2005, Welenco performed a caliper log on the final borehole which had been reamed to 12.25-inch diameter to a depth of 1,885 feet bgs. The caliper log is used primarily to determine final borehole diameter, and subsequently to calculate the volumes of well materials (sand, bentonite seal, cement) that are added during well construction.

Resistivity (16-normal, 64-normal, and point), natural gamma, spontaneous potential and water quality data derived from the SP log, temperature, caliper, deviation logs, and single point resistivity data are presented in Appendix C.

2.4 Well Construction

Screen interval depths for each monitoring well required interpretation of known lithologic units, lithology encountered, and its correlation with the geophysical logs. The screened interval within each aquifer zone was determined by identifying the thickest section of the coarsest or most permeable material that would most likely act as the primary conduit for regional seawater intrusion. The zones from 1,040 to 1,090 feet and 1,680 to 1,730 feet bgs were identified from the lithologic and geophysical data as favorable for screen intervals based on the apparent thickness of coarse grain formation material and correlation with known production zones in the area.

As illustrated on Plate 3, the 2,025-foot deep 8.5-inch diameter pilot hole was reamed to a 12.25-inch diameter borehole to a depth of 1,885 feet bgs. This depth corresponds to a clayey zone that separated the targeted screen interval from a deeper, less promising water-bearing zone. A bentonite slurry seal of PureGold grout was set as backfill to seal off this zone. The seal was set from 1,771 to 1,885 feet bgs.

The dual monitoring well completion included a deeper 3-inch diameter Schedule 80 PVC casing with a Schedule 80 PVC screen section (0.020-inch slot size) and a 5-foot long silt trap at the bottom. The shallower well completion utilized 2-inch diameter schedule 80 PVC casing with a schedule 80 PVC screen section (0.020-inch slot) and a 10-foot silt trap at the bottom. All PVC well casing (screen and blank) were flush-threaded (tri-lock style) with O-rings. Stainless steel bow-spring centralizers were attached to the casing immediately above and below each well screen and at approximately 40-foot intervals to ground surface to maintain a minimum 2-inch annulus between the well casing and the borehole wall during construction activities.

Monitoring wells were constructed with filter packs consisting of clean, graded, silica #3 sand adjacent to the well screen, and #60 (transition) silica sand placed starting approximately five to ten feet above the screen interval. The sand pack was placed by washing it with fresh water through a 2-inch diameter tremmie pipe set at or just above the screened interval. Details of sand and other annular materials placement are shown graphically in Plate 3.

An intermediate bentonite seal between the two well screens was placed through a 2-inch diameter tremie pipe. This bentonite seal was constructed entirely of PureGold High Solids Bentonite Clay Grout (manufactured by Cetco). The Bentonite was mixed in approximately 200-gallon batches using an M15 model Wilden air diaphragm pump and injected down hole using a duplex piston 4-cylinder pump. When pumping the grout seal, periodically 20 foot sections of tremmie pipe would be removed; care was taken to maintain the grout level higher than the bottom of the tremmie, so as to avoid gaps in seal materials. Bentonite grout was mixed and set during both the day and night shifts to maintain a close approximation to a continuous pour.

A granular bentonite and sand mixture was placed directly above the upper well transition sand, a bentonite and sand mixture was placed. This thin transition seal was constructed of Cetco crumbles (#8 granular pure bentonite) mixed at equal proportions with #60 silica sand and placed by washing with fresh water through the tremmie pipe. This bentonite/sand mix forms a firm surface for tagging (measuring depth of materials) and for setting bentonite grout without washing out the transition sand.

A PureGold Bentonite grout seal was set above the upper screen to approximately 50 feet bgs. The seal materials were mixed and set, using the same equipment and methods as the intermediate seal.

The sanitary seal (the upper 50 feet) of the well pair was constructed of 10-sack sand-cement mix; the mix was provided by RMC, and pumped through WDC's tremmie pipe by Central Coast Concrete Pumping. The sand-cement grout was pumped until all standing water in the borehole was displaced and the sand-cement grout level reached the ground surface. A Monterey County Environmental Health Specialist observed sanitary seal placement activities at the monitoring well.

2.5 Well Development

Each well screen was developed by surging/swabbing of the screen interval followed by air lift methods using threaded tremmie pipe and the air compressor on the mud rotary drill rig. Air lift development activities for the lower well were performed between January 17th and 24th; and for the upper well, on January 20, 2005; and were overseen by a MACTEC geologist. Indicator parameters (pH, temperature, and electrical conductivity[EC]), turbidity, and flow rates were monitored and recorded during development (Appendix D). Well development removes fine-grain solids from the well and borehole wall; development typically continues until turbidity is reduced and the indicator parameters stabilize. All purge water was discharged first to a watertight bin, which acted as a settling reservoir for solids; clear water would then be discharged to the ground, which had been pre-approved by the Marina Airport. Care was taken to avoid erosion at the edge of the tarmac.

DMW-2-Upper was developed by surging the screen interval with a 2-inch diameter swab/surge block attached at the bottom of the tremmie pipe that was used for air lift development. The screen length was surged and then air lifted for approximately 9 hours during which 5,800 gallons of water was removed (approximate discharge rate of 11 gpm) or approximately 37 well volumes. Water quality parameters stabilized at a pH of 8.41 and an electrical conductance (EC) of 1,100 micromhos per centimeter at 26.3 degrees C. Final turbidity was 416 nephelometric turbidity units (NTU). Water was mildly silty, grayish brown, and without significant fines. The total depth of the upper monitoring well was tagged after development at 1,098.2 feet bgs.

DMW-2-Lower had preliminary air lift development performed on January 17 and 18, 2005, after the intermediate seal had been set, but prior to installation of the upper well. This development was conducted to confirm there was no infiltration of fine transition sand through the well screen. In approximately 5 hours, 800 gallons of water were removed by air lifting (approximate discharge rate of 2.6 gpm) and only minor amounts of sand and drilling mud were removed.

On January 19, 2005 five gallons of NuWell™ 220 was added to the well via a tremmie pipe and surged into the screen. NuWell™ 220 is a phosphate-free dispersant polymer that blocks the natural adhesion action of clay agglomerations; it breaks down mud cake, which develops during the mud rotary drilling process.

On January 21 and 24, 2005, the well was air lift developed and 6,180 gallons (11 well volumes) of well water were was removed during approximately 6 hours of purging (approximate discharge rate of 17 gpm). Purged water cleared quickly and was free of sediment with an occasionally faint sulfur odor. Water quality parameters stabilized at a pH of 8.08 and an electrical conductance of 1,150 micromhos per centimeter at 30.3 degrees C, with a final turbidity of 2.52 NTU.

2.6 Surveying and Groundwater Sampling

The monitoring wells have an approximate top of casing elevation of 138.5 feet mean sea level (MSL; National Geodetic Vertical Datum of 1929), as provided by the Monterey County Water Resources Agency. Both well casings are contained in a steel box with top plate that is flush with the pavement. Downhole pressure transducers were placed within each well casing by the District on March 29, 2005.

Ground water samples were collected immediately after development activities. Samples were collected from the air-lift effluent, where it discharged into the settling tank. Two samples were collected from each well in un-preserved plastic bottles and analyzed for general minerals as discussed in Section 3.4. One sample was unfiltered, the other was field filtered using a 0.45 micron disposable filter, silicone tubing and a peristaltic pump. Samples were held on ice and submitted within several hours to Mr. Manuel Saavedra, at the Monterey County Water Resources Agency; analytical results analyses are summarized below.

2.7 Waste Management

Soil cuttings and solids were segregated from drilling mud by the shale shaker and were transported by bin and forklift to a staging area on asphalt at the edge of the airfield. Straw bales were placed around the downslope perimeter of the stockpile area to prevent saturated fines from migrating offsite. Approximately 55 cubic yards of drill cuttings were generated at the well site.

Drilling mud and fluid from the mud rotary rig were combined into watertight bins, which were emptied by a vacuum truck. All drilling fluids and solids were disposed of on the Jefferson Ranch, as non-hazardous waste by Clearwater Environmental Management, Inc. on January 25, 2005. The pavement surface (tarmac) was cleaned of all surface sediment, and restored to its pre-drilling condition.

3.0 LITHOLOGIC AND GROUNDWATER MONITORING RESULTS

This section discusses the lithology observed during drilling activities, and our interpretation of lithology encountered as a basis for well screen selection, ground water elevations, and analytical data from ground water samples.

3.1 Regional Geology Overview

Our interpretation of the stratigraphic units encountered during drilling indicate that the boring penetrated older dune and fluvial valley fill deposits, the Aromas Sand Formation Sands, the Paso Robles Formation, and the Purisima Formation. The deeper granitic basement rocks were not encountered in this boring.

Holocene and Pleistocene Deposits

The Holocene-age older dune sand deposits were encountered from the surface to 110 feet bgs. These deposits are yellowish brown, often poorly graded sands with a minimal silt fines. They comprise the water-bearing sediments of the A-Aquifer/perched zone, and the 180-Foot Aquifer. A significant marine clay that separates dune sand from the underlying 180-Foot Aquifer was encountered from 110 to 130 feet bgs; this unit is a regional aquitard and is referred to as the Salinas Valley Aquitard (SVA).

The Valley Fill deposits include the Salinas Valley Aquitard, a blue grey highly plastic estuarine clay, and fluvial river channel deposits. These sequences were encountered between 110 and 515 feet bgs. The upper part of this unit is typically sandy immediately below the SVA. Below this are coarse gravel and sand sequences interspersed with massive clay units from shallow estuary/marine transgressive sequences. These deposits are generally fining upward, and the upper part of the sequences are often truncated as a result of river gravel scouring. With an increase in depth, the fluvial deposits grade generally lack the thicker, massive clay units encountered at the top of each sequence.

Plio-Pleistocene Age Deposits

Reddish-colored sand units indicative of the Aromas Sand Formation of early Pleistocene age were encountered between 515 and 610 feet bgs. These sand units are fine-grained and silty, and are distinct from other sand unit of eolian and flood plain origin, by their relative abundance of reddish and micaceous oxides. In outcrop, this unit displays cross-bedding and general uniform grain size (*USGS, 1994*). The Aromas Sand lies unconformably on the Paso Robles Formation.

The Paso Robles Formation was encountered between 610 and 850 feet bgs. Plio-Pleistocene in age, the unit sequence represents a combination of braided stream channel and alluvial fan sequences of non-marine origin.

Miocene-Pliocene age Deposits

The Purisima Formation consisting of diatomaceous mudstones and siltstones of Upper Miocene/Pliocene age was encountered from 850 feet to the total depth of the pilot boring. The Purisima is indicative of shallow water marine deposition and does not outcrop south of Santa Cruz. It typically has spheroidal carbonate concretions and is fossiliferous.

3.2 Lithologic Units

Lithologic logs for all Deep Aquifer wells are presented on a lithologic cross-section A-A', Plate 2.

Lithology encountered in the first 500 feet of the pilot hole were consistent with lithologic logs of nearby monitoring wells constructed using sonic drilling techniques owned by the U.S. Army as well as those of production wells owned by the District (*USGS, 2002; Feeney and Rosenberg, 1993*). Plate 2 illustrates lithology at DMW-2 with respect to that of production wells owned by the District. The massive, light yellowish brown older dune sands of the A-Aquifer tended to be fine-grained quartz and feldspar sands. The Salinas Valley Aquitard (SVA) was approximately 20 feet thick at this location, and was first encountered at a depth of 110 feet bgs. Lithologic units below the SVA mark the shallowest aquifers historically relied upon for potable water sources in the area and are discussed below.

180-Foot Aquifer

The upper portion of the 180-Foot Aquifer underlies the SVA and may be unsaturated near the top of this unit. Sediment tends to be fine grained, and lacked river channel and gravel deposits often encountered in the lower portion of the 180-Foot Aquifer. It was encountered from approximately 130 feet to 245 feet bgs.

Several clay units divide the upper and lower portions of the 180-Foot Aquifer: a brownish clay encountered from 250 to 280 feet bgs, indicative of a terrestrial origin; and a grayish clay encountered from 320 to 340 feet bgs indicating an anoxic, marine, or estuarial depositional environment. These are combined into a single correlative unit on the cross-section (Plate 2).

The lower portion of the 180-Foot Aquifer was encountered from 340 to 425 feet bgs, and is composed of generally well-graded sands and silty sands, which are composed partially of quartz, but also derived of light grey mudstone, presumably the Monterey Formation. This portion of the 180-Foot Aquifer is the primary source of potable water to the former Fort Ord community.

400-Foot Aquifer

The 400-Foot Aquifer consists of alluvial and Aeolian deposits, and is entirely terrestrial in origin. The fine-grained, non-calcareous, micaceous Aromas sands are present within this unit, typically these sands display iron-oxidized paleosols, which are difficult, to identify in mud rotary cuttings returns; here they are distinguished by a distinct rust-red color. The Aromas sands likely mark the approximate base of the 400-Foot Aquifer, which extends from approximately 425 to 610 feet bgs.

The base of the 400-Foot Aquifer is also distinguished at this location based on e-log response and lower gamma readings (see Appendix A, DMW-2 Lithologic and Geophysical Log). The lower gamma count could be explained by a relative absence of potassium, commonly in the form feldspar within granitic material, in the eolian silica-sand of the Aromas formation. Potassium is also generally found in relatively high concentrations in clay material, which are also not commonly observed in this unit.

Paso Robles (610 to 850 feet bgs)

This sequence is predominantly fine-grained and micaceous, and is presumed to have originated from a predominantly granitic source. No shells were observed, and traces of calcite were only occasionally observed. Based on oxidation of grains and general color, this unit was deposited under terrestrial conditions.

There are three clay units separated by two small sand zones, a silty sand at 645 to 670 feet and a clayey sand at 775 to 800 feet bgs.

Gamma response in the sand zones is low, and in the clays is generally high, as would be expected as there is a higher amount of potassium ions within the clays.

Upper Paso Robles (850 to 1,250 feet bgs)

This unit is comprised of silty sands and sandy silts, which grade in color from yellowish brown to an olive grey indicative of anoxic conditions. Shell fragments were noted occasionally below about 970 feet bgs. Calcite was present in small amounts through most of the unit. Based on color, fine-grained texture, and presence of shells, this unit appears to have been deposited in partially marine and partially terrestrial conditions, and likely represents a transgressive sequence.

Several notable water-bearing units were encountered, from 915 to 945 feet, 1,020 to 1,085 feet, and 1,170 to 1,205 feet bgs. All three units consist of silty-sand zones separated by thick silt/sandy-silt sequences. The middle unit is significantly thicker, and is therefore more likely to be laterally continuous.

The first of several distinctive marker beds was encountered at 990 feet bgs, and consisted of a well-consolidated, gray (anoxic), clay/mudstone with shell fragments. Drilling rates were high through this unit, but cuttings were notably harder and indicated a greater degree of lithification. An olive grey sandy silt was encountered at 1,040 feet bgs that exhibited a notable color variation in the sand grains, ranging from rust-red to light-green, with no observed shell material and little to no calcite.

This unit is distinguished by a unique gamma signature on the e-log where seven distinct spikes in the gamma readings were observed that do not correspond with clay units as would typically be expected. These gamma spikes correlate with the depth of similar gamma spikes encountered at the USGS DMW-1 location, and appears to be analogous. Spectral analysis of natural gamma at the DMW-1 location at this depth identified the source as primarily uranium and, to a lesser extent, potassium, and it is likely that this is the same source at the DMW-2 location.

Mid-Purisima (1,250 to 1,750 feet bgs)

This unit has a wide variety of textures and grain-size distribution. Colors of the sandy units are entirely in the olive-grey range and several thick clay units were dark bluish-grey in color. Shell fragments were noted within the unit, as well as mild to abundant calcite throughout and thus this unit appears to have been deposited in marine conditions.

Several notable water-bearing units were encountered including a relatively thick, well-graded sand with silty zones from 1,420 to 1,500 feet bgs, a thin silty sand unit from 1,600 to 1,620 feet bgs, and a clean, well-graded sand from 1,685 to 1,735 feet bgs.

Several distinctive marker beds were encountered within this unit. A hard white cemented clay was encountered from 1,285 to 1,325 feet bgs that was white changing to light bluish grey at its base. Calcite was present in abundance throughout the clay. A clean light grey silica sand was encountered at 1,690 to 1,730 feet bgs that was calcite-cemented with trace amounts of mafic mineral within the silica sand. The clean poorly-graded texture and high silica content of this unit were particularly notable.

Drill rates varied widely through this unit and are correlative with calcite concentration as determined from field testing. Drill rates (as measured by advancement of 20-foot sections) slowed to more than 45 minutes/section in three calcite-cemented zones: 1,280 to 1,350 feet bgs, 1,390 to 1,420 feet bgs, and 1,540 to1,750 feet bgs. There were no otherwise observed trends in lithology or e-log response that correspond to these cemented zones.

Lower Purisima (1,750 to 2,025 feet bgs)

This unit is similar to the unit described above as it is grayish in color and has calcite-cementation throughout, indicative of anoxic marine deposits. The notable distinction to this lower unit is the more uniform grain-size distribution. The unit is composed of clay, silt, and fine sand in fairly even proportions. Although grain size varies, there are no clean sands or major confining clay units. The formation appears tight with a cemented zone from 1,830 to 1,960 feet bgs. There were no distinctive marker beds or other unusual features encountered in this unit.

The lower screen of the monitoring well was set in this unit to measure groundwater elevations and quality. During well construction, the unit was partially over-drilled and then grouted to isolate it from the upper water-bearing units.

Selection of screen intervals

As discussed in the Work Plan, each monitoring well screen was not to exceed a length of 50 feet and would penetrate only one lithologic unit (e.g., sand or gravel). Shorter screens would be installed if a lithologic unit at least 50 feet thick was not encountered. A lithologic unit in excess of 50 feet thick is likely to be a laterally continuous subsurface feature across the region.

The upper screen was placed from 1,040 to 1,090 feet bgs within the thickest, and thus most promising, sand sequence within the upper Purisima Formation to target the upper portion of the Deep Aquifer. This screen correlates with the upper screen interval in MCWD Well No. 11, located approximately 5,000 feet west of DMW-2 (as shown on Plate 2).

The lower screen was set from 1,680 to 1,730 feet bgs in the most promising permeable zone of the middle Purisima Formation to target a deeper portion of the Deep Aquifer and correlate with the middle screen placement at MCWD Well No. 12 and the lower screens of MCWD Well No. 11. The lower DMW-2 monitoring well screen will allow collection of data on elevated temperature and potential presence of hydrogen sulfide, which have been associated with the deep water-bearing units in this area.

Copies of lithologic and geophysical data were provided to the District and Agency within 24 hours of completing the borehole. Selection of the screen intervals was agreed upon between the District, Agency, and MACTEC prior to commencement of well construction activities.

3.3 Groundwater Elevation Data

Groundwater elevations were measured at DMW-2 (upper and lower) by a MACTEC geologist following well development. Pressure transducers were also installed by the District to measure groundwater elevation data on 60 minute intervals on March 29, 2005; however, data will be presented in a deliverable separate from this report. Manual measurements of water level data were again collected at DMW-2 on April 6, 2005 along with measurements from other wells in the region that are screened in the Deep Aquifer (Figure 2). Table 1 provides a summary of water level measurement data for DMW-2

Table 1. DMW-2 Groundwater Elevations

	DMW-2 Upper		DMW-2 Lower	
Measurement Date	Depth to Water (feet)	Elevation (feet MSL)	Depth to Water (feet)	Elevation (feet MSL)
January 20, 2005	160.6	-22.1	Not measured	-
January 24, 2005	160.1	-21.6	148.5	-10.0
January 25, 2005	159.5	-21.0	150.0	-11.5
March 29, 2005 *	157.4	-18.9	148.3	-9.8
April 6, 2005 **	158.9	-20.4	148.3	-9.8

* readings from pressure transducer
** manual readings

The top of casing of the upper and lower DMW-2 monitoring wells is approximately 138.5 feet MSL. Results indicate a consistent upward gradient between the two monitoring wells (i.e., the groundwater elevation in the upper screen is lower than the groundwater elevation in the lower screen). It is notable that a similar upgradient pattern exists at DMW-1 based on data collected on April 6, 2005, when correlating the upper and lower screens of DMW-2 to the #2 and #3 screens of DMW-1, respectively. This upward vertical gradient is interpreted to reflect that the upper portion of the Deep Aquifer is stressed more than is the lower portion of the Deep Aquifer; however, alternative explanations may exist. For example, it is possible that the lower portion of the Deep Aquifer receives more recharge than the upper portion of the Deep Aquifer, although this is unlikely given that local recharge typically originates from overlying sediments (i.e., leakage). Distant recharge areas where the formations comprising the Deep Aquifer are shallow and are recharged directly from infiltrating precipitation are assumed to be relatively equal between the upper and lower portions of this aquifer. Therefore, it is most likely that the upper portion of the Deep Aquifer is stressed more so than the lower portion.

Extrapolated groundwater elevations from nearby monitoring wells owned by the U.S. Army and screened within the lower portion of the 180-Foot Aquifer and upper portion of the 400-Foot Aquifer typically range from -5 to -25 feet MSL in the DMW-2 locality in spring and fall months, respectively (*MACTEC, 2005*). These results indicate a downward gradient between the 400-Foot Aquifer and Deep Aquifer, which is consistent with expected recharge (i.e., leakage) into the Deep Aquifer from overlying aquifers. Continuous groundwater elevation data recorded with pressure transducers at DMW-2 evaluated in conjunction with analysis of pumping patterns from Deep Aquifer production wells and groundwater elevation data from nearby shallower monitoring wells may further illustrate the degree to which leakage is occurring.

MCWD Well No. 11 screens the upper and middle Purisima Formation and Well No.12 screens the middle and lower Purisima Formation. Production from these wells with respect to groundwater elevation data measured at Deep Aquifer monitoring wells (e.g., DMW-1 and DMW-2), may illustrate the three-dimensional radius of influence from the production wells.

Groundwater elevations were measured at MCWD Well No. 12 (March 29, 2005), MCWD Well No. 12, DMW-1, and DMW-2 (April 6, 2005), and previously at the triplet at Fort Ord Well D (March 2, 2004) and evaluated on a quasi-regional scale to assess horizontal gradients in the area in the upper and lower portions of the Deep Aquifer. Results based only on measurements from DMW-1 and DMW-2 indicate a slight landward gradient of 0.00014 feet/foot within the upper portion of the Deep Aquifer, and of 0.00081 feet/foot in the lower portion of the Deep Aquifer; however, it should be noted that groundwater elevation at the #2 screen of DMW-1 was measured at 4.16 feet above sea level, so the meaning of the landward gradient in the lower portion of the Deep Aquifer is not clear.

Groundwater elevations measured at MCWD Well Nos. 11 and 12 were considerably lower and were probably influenced by pumping activity or partial recovery; the pumping schedule prior to the time of measuring groundwater elevation is not known. If proven to be accurate, however, groundwater elevation data from MCWD Well Nos. 11 and 12 would indicate a substantial groundwater depression in this area. While such a depression would occur while pumping was active, the sustained presence of a large cone of depression following pumping activities (e.g., recovery time) could be informative as to the amount and rate of leakage recharging the Deep Aquifer and the long-term sustainability of pumping from this depth.

3.4 Groundwater Quality Data

Water samples were collected immediately after well development. Filtered and non-filtered samples were collected from both monitoring wells. These samples were analyzed for general minerals (e.g., sodium, calcium, magnesium, potassium, alkalinity, chloride, sulfate, nitrate, and conductivity) by the Monterey County Water Resources Agency. Results reflect generally good quality water with minor differences between each monitoring well with concentrations of most constituents being higher in the deeper monitoring well. Calcium, chloride, magnesium, nitrate, pH, potassium, sodium, sulfate, and conductivity concentrations in the upper screen were generally lower than those in the lower screen, as summarized in Table 2:

Table 2. Analytical Sample Results

CONSTITUENT	DMW-2-Upper	DMW-2-Lower
Bicarbonate (HCO_3)	NT	NT
Calcium (Ca)	27	57
Carbonate (CO_3)	NT	NT
Chloride (Cl)	73	139
Fluoride (F) Temp. Depend	NT	NT
Hydroxide (OH)	NT	NT
Magnesium (Mg)	7	6
Nitrate (NO_3)	0	ND
Nitrate (NO_3) Nitrogen	NT	NT
pH (Laboratory; std. units)	8.3	8.1
Potassium (K)	2.7	4.8
Sodium (Na)	110	127
Conductivity (µmho/cm)		
Sulfate (SO_4)	62	59
Total Alkalinity (as $CaCO_3$)	188	211

NT - Not Tested
ND - Not Detected
mg/L - milligrams per liter
concentrations in mg/L except where noted otherwise

This difference is to be expected in part because groundwater at greater depth is typically older and has been in contact with mineral surfaces for longer periods of time than groundwater at shallower depths. The rock-water interaction typically results in higher concentrations of dissolved minerals. Only sulfate was observed at a lower concentration in the deeper monitoring well relative to the shallower, although the difference was negligible.

Groundwater quality data from the USGS DMW-1 monitoring well (*USGS, 2002*), located near the Monterey Bay coastline, MCWD Well Nos. 11 and 12, and Fort Ord D (also known as the

PZ-FO-32 triplet) were compared to and evaluated with those from the DMW-2 upper and lower screens in a Piper diagram (Plate 4). A Piper diagram presents major cation and anion concentration data as proportions of the total ion balance of the sample in a ternary diagram. This graphical approach is useful to illustrate groundwater signatures at individual wells and evaluate whether patterns are apparent geographically or with depth. Analytical data from each well was collected over a significant time period:

- Fort Ord D triplet was sampled in June 1995 (most recent complete inorganic data set);
- MCWD production wells are represented by average concentrations reported in 2001, 2002, and 2003;
- DMW-1 samples were collected in June 2000 (*USGS, 2002*); and
- DMW-2 wells were sampled as part of development in January 2005.

The value of these data, although not collected commensurately, is that they represent depth-specific groundwater quality along the anticipated pathway of groundwater flow toward pumping centers in Salinas Valley. Should seawater intrusion occur or be occurring, a pattern of chloride concentrations or conductivity along this pathway could be indicative of its status with respect to individual production wells.

Data illustrated on Plate 4 indicate that groundwater samples of the Deep Aquifer are generally similar, excepting the calcium-magnesium/chloride signature (similar to that of seawater) at DMW-1, screen #3, and the calcium-bicarbonate signature of the upper Fort Ord D well. Remaining samples all illustrate a sodium/bicarbonate-chloride chemical signature, which is similar to the chemical signature observed in overlying aquifers. The chemical signatures of the DMW-2 upper and lower samples are most similar to those of MCWD Well Nos. 10 and 11. The chemical signatures of DMW-1 (screen #2) and MCWD Well No. 12 are distinguished by a higher sodium/chloride proportion.

The stability of chemical signatures at MCWD production wells in 2001, 2002, and 2003 do not suggest that seawater intrusion is occurring within the Deep Aquifer. The progressive change in water quality associated with seawater intrusion would result in a chemical signature to shift toward the upper-right portion of the central diamond on a Piper diagram. Although data from the three MCWD production wells have remained stable, the potential for seawater intrusion exists and proper basin management and groundwater quality monitoring programs are imperative to prevent future degradation.

4.0 CONCLUSIONS

The following conclusions are made from evaluation of lithologic, geophysical, and analytical data from DMW-2 monitoring wells and comparison of these data to data from DMW-1 and the MCWD Well Nos. 10, 11, and 12.

1. At least two Deep Aquifer lithologic units were encountered in the DMW-2 borehole at depths of approximately 1,100 and 1,700 feet. This is supported by lithologic and geophysical data, and is generally correlative with the DMW-1 and the MCWD production well locations. The upper portion appears to be consistent with the unit that has been referred to as the "900-Foot Aquifer," and the lower portion appears to be consistent with the unit that has been referred to as the "1,500-Foot Aquifer." Both of these aquifers are screened by the MCWD Well Nos. 10, 11, and 12.

2. Groundwater elevations measured at DMW-2 Upper and DMW-2 Lower indicate a consistent upward gradient of approximately 10 feet. Elevations within the overlying 180-Foot and 400-Foot Aquifers measured in December 2004 from a nearby monitoring well owned by the U.S. Army indicate that a downward gradient exists between overlying aquifers and the upper portion of the Deep Aquifer. These gradients represent a potential for downward vertical flow from the overlying aquifers into the upper portion of the Deep Aquifer; however, insufficient data exist at this time to determine whether actual vertical groundwater flow (leakage) may be occurring.

3. Groundwater elevations at DMW-1 and DMW-2 measured on April 6, 2005 indicate a slight landward horizontal gradient of 0.00014 feet/foot within the upper portion of the Deep Aquifer and 0.00081 feet/foot in the lower portion of the Deep Aquifer. The upper portion of the Deep Aquifer at the DMW-1 location was represented by the #3 screen, as this appears to penetrate comparable sediments as the upper screen at DMW-2. The lower screen at DMW-2 is compared to the #2 screen at DMW-1.

4. Analytical results from each monitoring well indicate relatively good quality groundwater with low chloride concentrations and conductivity values in both units. Concentrations were generally higher in the lower portion of the Deep Aquifer and may be indicative of older groundwater resulting from longer periods of rock-water chemical interaction.

5. Susceptibility of future seawater intrusion could not be determined from the single analytical sample from DMW-2, except that results are most consistent with MCWD Well Nos. 10 and 11, which have remained generally stable over time. Groundwater quality from both the upper and lower screens of DMW-2 correlate most closely with MCWD Well Nos. 10 and 11. Little correlation was apparent between analytical data from the DMW-2 lower screen and that of Well No. 12, despite the similar screen depths. Susceptibility to seawater intrusion can be further determined with repeated collection of groundwater samples for analysis of general chemical or stable isotope concentrations and evaluating changes with time. Induction logs conducted at the DMW-1 and DMW-2 monitoring wells could also

potentially indicate the degree of seawater intrusion to depths inclusive of the lower portion of the Deep Aquifer.

6. Aquifer hydraulic parameters of each unit at DMW-2 were not determinable as hydraulic testing was not conducted. However, discharge rates attained during development activities generally indicated relatively high production potential, given the small diameter of each monitoring well. Hydraulic properties of the Deep Aquifer could be further evaluated with aquifer testing either via single-well testing (e.g., slug tests) of each monitoring well or by monitoring drawdown in response to pumping from the MCWD production wells.

5.0 RECOMMENDATIONS

MACTEC recommends that the following tasks be considered by the District to continue to evaluate groundwater resources within the Salinas Valley ground water basin:

1. Measure groundwater elevations and collect groundwater samples from the DMW-1 and DMW-2 monitoring wells on a regular basis to monitor changes in horizontal and vertical gradients and depth-specific groundwater quality over time. The olfactory observation of sulfur from the lower DMW-2 well should also be further investigated, as development samples did not indicate elevated sulfate concentrations. Multiple measurements within hydrologic cycles should be considered as seasonal pumping patterns within the Deep Aquifer exist (i.e., higher-demand summer/fall months versus lower-demand winter/spring months).

2. Compare these results to data collected from the MCWD Well Nos. 10, 11, and 12 and conduct a trend analysis to identify changes that could impact potable water supplies (e.g., changes in horizontal or vertical gradients or chloride concentrations).

3. Compare groundwater elevations and analytical data from the Deep Aquifer monitoring and production wells to those from 180-Foot and 400-Foot Aquifer monitoring wells owned by the U.S. Army to further evaluate the potential for leakage from these overlying aquifers.

4. Install transducers to continuously measure groundwater elevation at the two DMW-2 monitoring wells to evaluate for interference from the MCWD Well Nos. 10, 11, or 12. Groundwater elevation data should be evaluated with respect to the operation (i.e., schedule and pumping rate) of each production well to better identify influence from a particular production well at each monitoring well. Vertical gradients between DMW-2 Upper and DMW-2 Lower should also be evaluated under various pumping scenarios from MCWD production wells.

5. Observable drawdown from DMW-2 monitoring wells in response to regional pumping should be evaluated with respect to pumping from MCWD production wells to calculate, if possible, aquifer properties such as hydraulic conductivity, transmissivity, and storativity. This would require knowledge of pump operation and flow rate of each production well active during the monitoring period. The observation of pumping cycles from other wells in the region could also further illustrate the degree of hydraulic communication within the Deep Aquifer.

6. Conduct single-well aquifer tests (e.g., pneumatic slug tests) at each of the DMW-2 monitoring wells to further estimate aquifer hydraulic properties. Slug test results are typically most representative of aquifer properties very close to the well screen and care should be taken to displace as much water during the test as possible to increase the radius of influence.

7. Collect groundwater samples from MCWD Well Nos. 10, 11, and 12 and from DMW-2 and analyze for stable isotopes of oxygen, hydrogen, and possibly nitrogen to further identify

chemical signatures that could indicate an analytical correlation between the upper and lower portions of the Deep Aquifer and which portion appears to produce most groundwater to the production wells. These results should also be compared to data available from the DMW-1 monitoring wells; however, commensurate samples from DMW-1 would be preferable for correlation purposes.

8. Should discrepancies exist in stable isotope signatures between the Deep Aquifer monitoring and production wells, collect groundwater samples from monitoring wells screened with the lower portion of the 180-Foot and 400-Foot Aquifers to determine if leakage from these overlying aquifers is contributing to groundwater production by the MCWD Deep Aquifer production wells.

9. Periodically conduct an induction log (bulk natural gamma and conductivity) through the lower DMW-1 and DMW-2 monitoring wells to establish baseline geophysical conditions indicative of seawater intrusion status to depths of 1,900 and 1,700 feet, respectively. Establish an induction log monitoring program where induction logs are collected on a regular basis (e.g., five year frequency) to determine changes over time, particularly with respect to conductivity changes associated with advancement of seawater intrusion.

10. In addition to bulk natural gamma, spectral gamma analysis should be considered to further evaluate the source of gamma spikes identified at both the DMW-1 and DMW-2 locations. Naturally radioactive sources such as uranium, potassium, or thorium may be indicative of specific depositional characteristics that may be correlative over large distances and could further characterize the groundwater supplies from the Deep Aquifer. For instance, unconformities associated with uranium-sourced natural gamma could either increase or decrease the likelihood of leakage across the unconformity, depending upon its nature.

11. Survey the top of casing (or equivalent reference point) elevation (relative to the National Geodetic Vertical Datum of 1929) and horizontal coordinates of all wells penetrating the Deep Aquifer, including DMW-1, DMW-2 and MCWD Well Nos. 10, 11, and 12. Future groundwater measurements will then be more accurately comparable to one another and a consistent vertical datum.

12. Proceed with the evaluation of installing a deep aquifer production well in the vicinity of DMW-2 once these recommendations have been followed, and the necessary data collected and evaluated.

6.0 REFERENCES

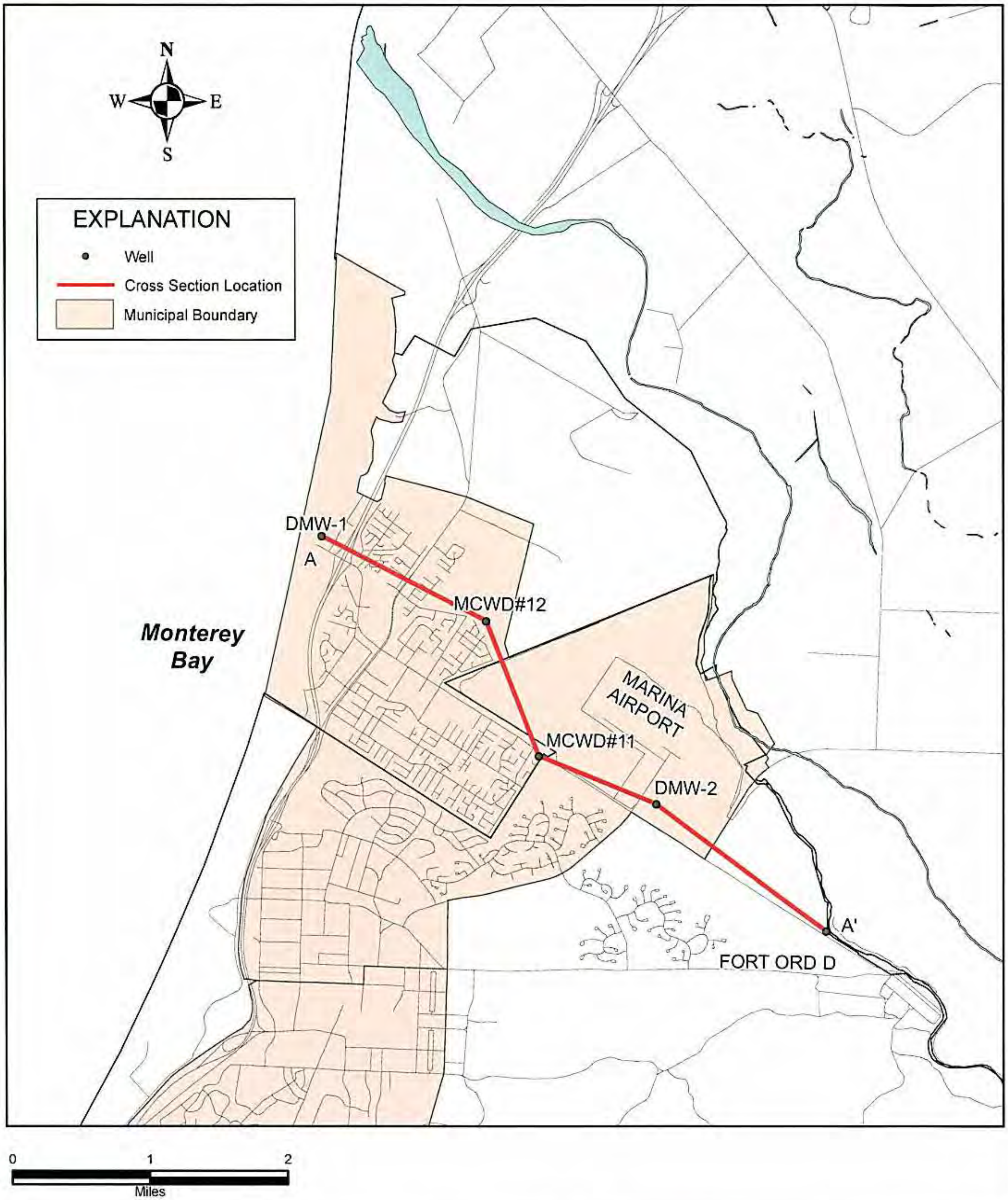
Feeney, Martin, and Lew Rosenberg, 2002. *Technical Memorandum, Deep Aquifer Investigation – Hydrogeologic Data Inventory, Review, Interpretation and Implications*. September 23.

MACTEC Engineering and Consulting, Inc. (MACTEC), 2004. *Technical Memorandum No. 1, Work Plan and Health and Safety Plan, Deep Aquifer Monitoring Well Program*. October 12.

Rosenberg, Lewis, and Joseph C. Clark, 1994. *Final Technical Report, Quaternary Faulting of the Greater Monterey Area, California*. Prepared for US Geological Survey. December.

US Geological Survey (USGS), 2000. *Geohydrology of a Deep-Aquifer Monitoring-Well Site at Marina, Monterey County, California*. Water-Resources Investigations Report 02-4003. Prepared in cooperation with Monterey County Water Resources Agency.

PLATES



P:/4098/042052 - Marina Coast Water District/GIS/Projects/Cross-Section-Location-Map.mxd 3/28/05

MACTEC

Location Plan
Installation of Deep Aquifer Monitoring Wells - DMW-2
Marina Coast Water District
Marina, California

PLATE
1

DRAWN:	PROJECT NO:	CHECKED:	CHECKED DATE:	APPROVED	APPROVED DATE
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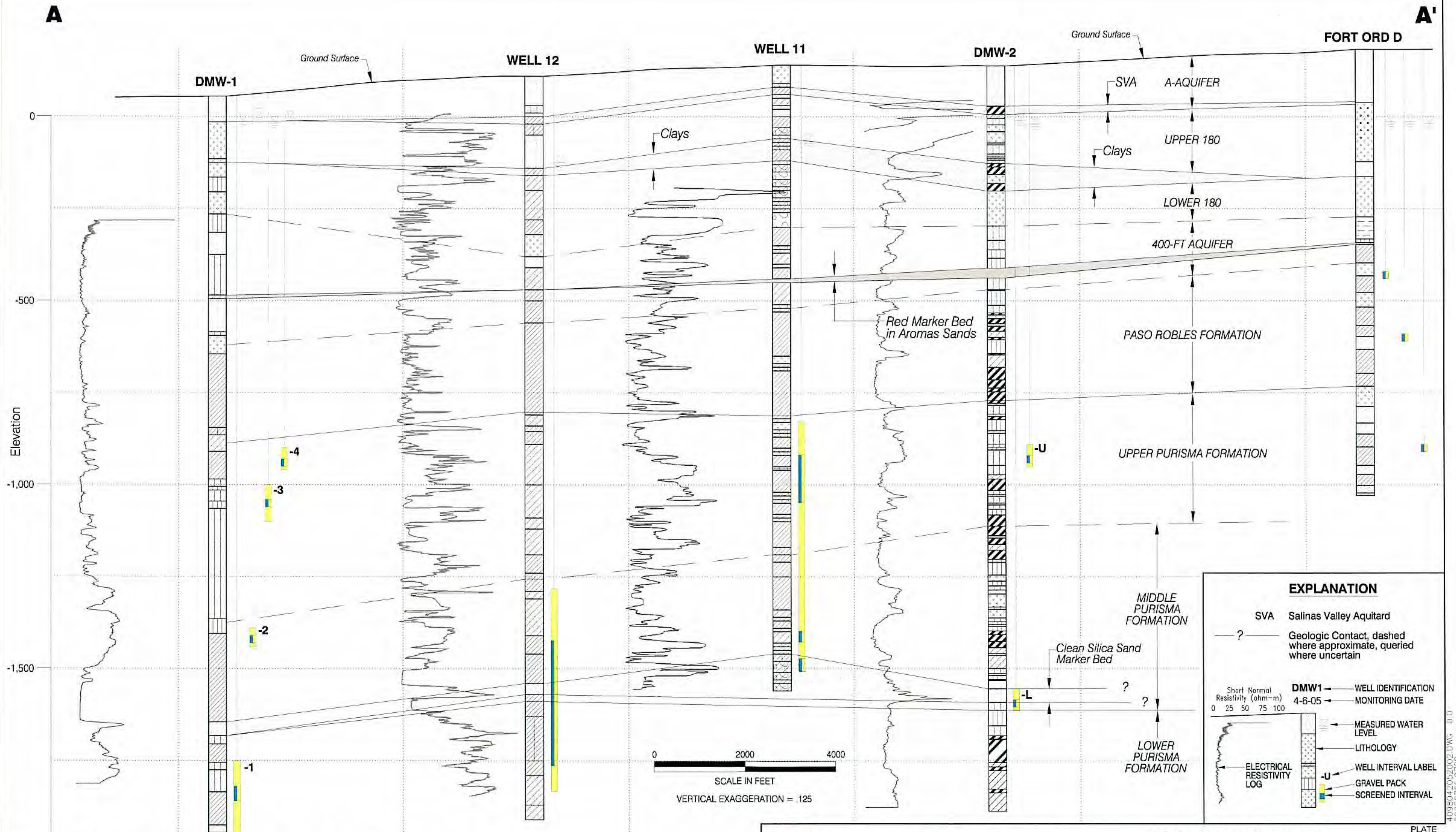

Notes:

1) Depth to water measurements at Well No. 11, DMW-1, and DMW-2 were taken on April 6, 2005. Measurements at Well No. 12 were taken on 3/29/05 by Feeney and Rosenborg. Measurements at Fort Ord Well D were measured on 3/2/04.

2) DMW-1 gravel packs estimated from Figure 3 in USGS, 2002.

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Lithologic Cross Section A-A'
Installation of Deep Aquifer
Monitoring Wells - DMW-2
Marina Coast Water District
Marina, California

PLATE
2A

DRAWN	JOB NUMBER	CHECKED	CHCK'D DATE	APPROVED	APPRV'D DATE
PCB	4098042052 03	WJF	03/05	MDT	7-7-05

4098042052002.DWG 0.0 20050706.0728

UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D2488-93

MAJOR DIVISIONS			SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS OVER 50% RETAINED ON No.200 SIEVE SIZE	GRAVELS MORE THAN 1/2 OF COARSE FRACTION RETAINED ON No.4 SIEVE SIZE	CLEAN GRAVELS WITH LESS THAN 5% FINES	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GRAVELS WITH OVER 15% FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS MORE THAN 1/2 OF COARSE FRACTION PASSING No.4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 5% FINES	SW	Well-graded sand or gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
		SANDS WITH OVER 15% FINES	SM	Silty sand, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS OVER 50% PASSING No.200 SIEVE SIZE	SILTS & CLAYS LIQUID LIMIT 50% OR LESS		ML	Inorganic silts and sandy or gravelly silts, rock flour
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS LIQUID LIMIT GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays and silty clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils

▯	Geobarrel Core Sampler
◪	SPT Sampler
◨	Modified California Sampler
■	Shelby or Osterberg Sampler
◫	Pitcher Barrel
⊠	Grab or Bulk Sample
▼	G.W. measured after water level stabilizes
▽	G.W. measured during or soon after drilling
Perm	Permeability
Consol	Consolidation
LL	Liquid Limit (%)
PI	Plasticity Index (%)
EI	Expansion Index (%)
Gs	Specific Gravity
MA	Particle Size Analysis
-200=55%	Percent Passing No. 200 Sieve

Shear Strength (psf) — Confining Pressure

	Shear Strength (psf)	(Confining Pressure)	
TxUU (FM) or (S)	3200	(2600)	-Unconsolidated Undrained Triaxial Shear (field moisture or saturated)
TxCU (P)	3200	(2600)	-Consolidated Undrained Triaxial Shear (with or without pore pressure measurement.)
TxCD	3200	(2600)	-Consolidated Drained Triaxial Shear
SSCU (P)	3200	(2600)	-Simple Shear Consolidated Undrained (with or without pore pressure measurement.)
SSCD	3200	(2600)	-Simple Shear Consolidated Drained
DSCD	2700	(2000)	-Consolidated Drained Direct Shear
UC	470		-Unconfined Compression
LVS	700		-Laboratory Vane Shear

KEY TO TEST DATA

Source: ASTM D 2488-93, based on Unified Soil Classification system

SOIL_CLASS_GEOTECH_MACTEC DMW-2_ELOG.GPJ GEOTECH.GDT 7/6/05

MACTEC

Soil Classification Chart and Key to Test Data
Marina Coast Water District
Marina, California

PLATE **2B**

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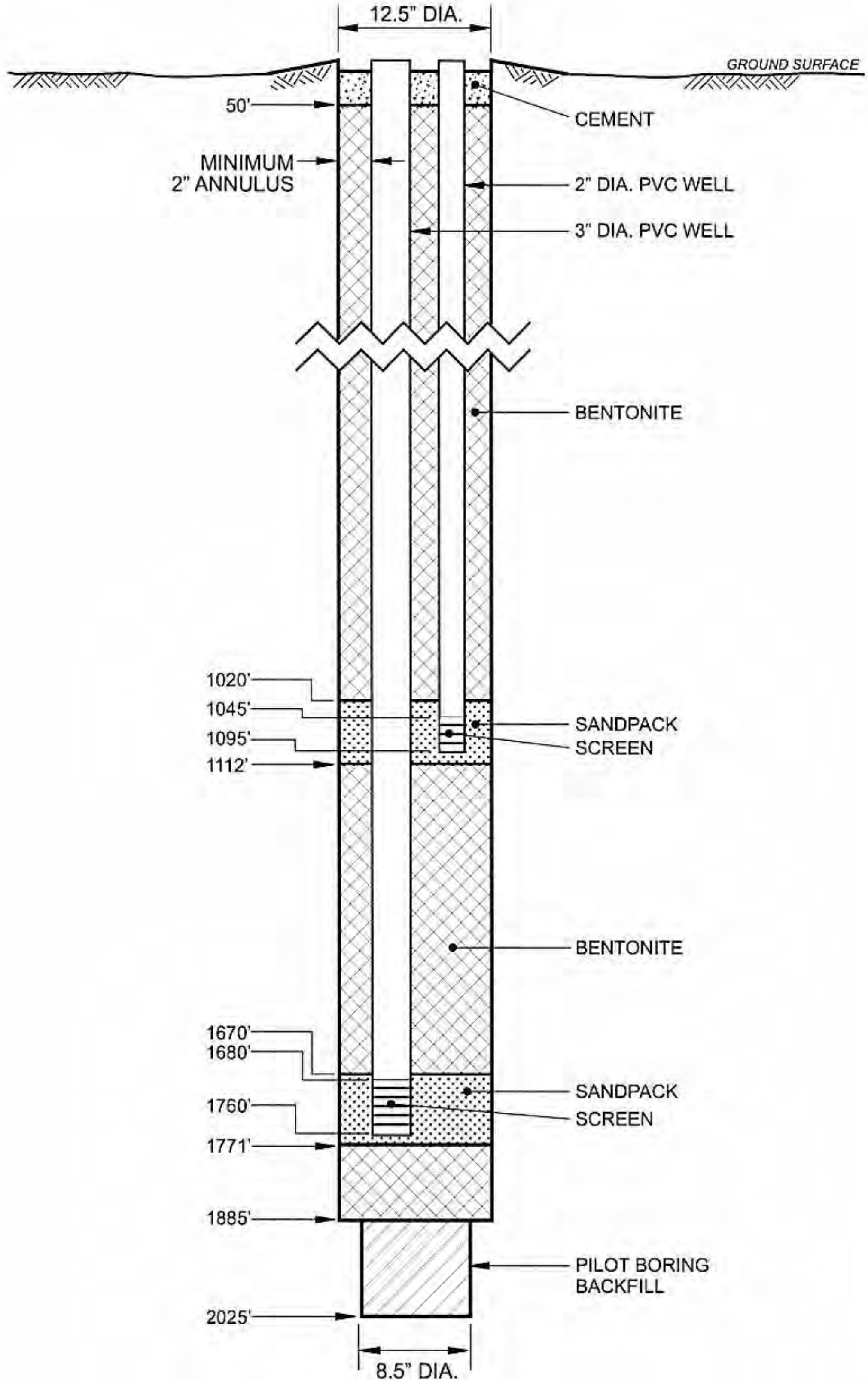


MACTEC

Schematic of DMW-2 Well Construction

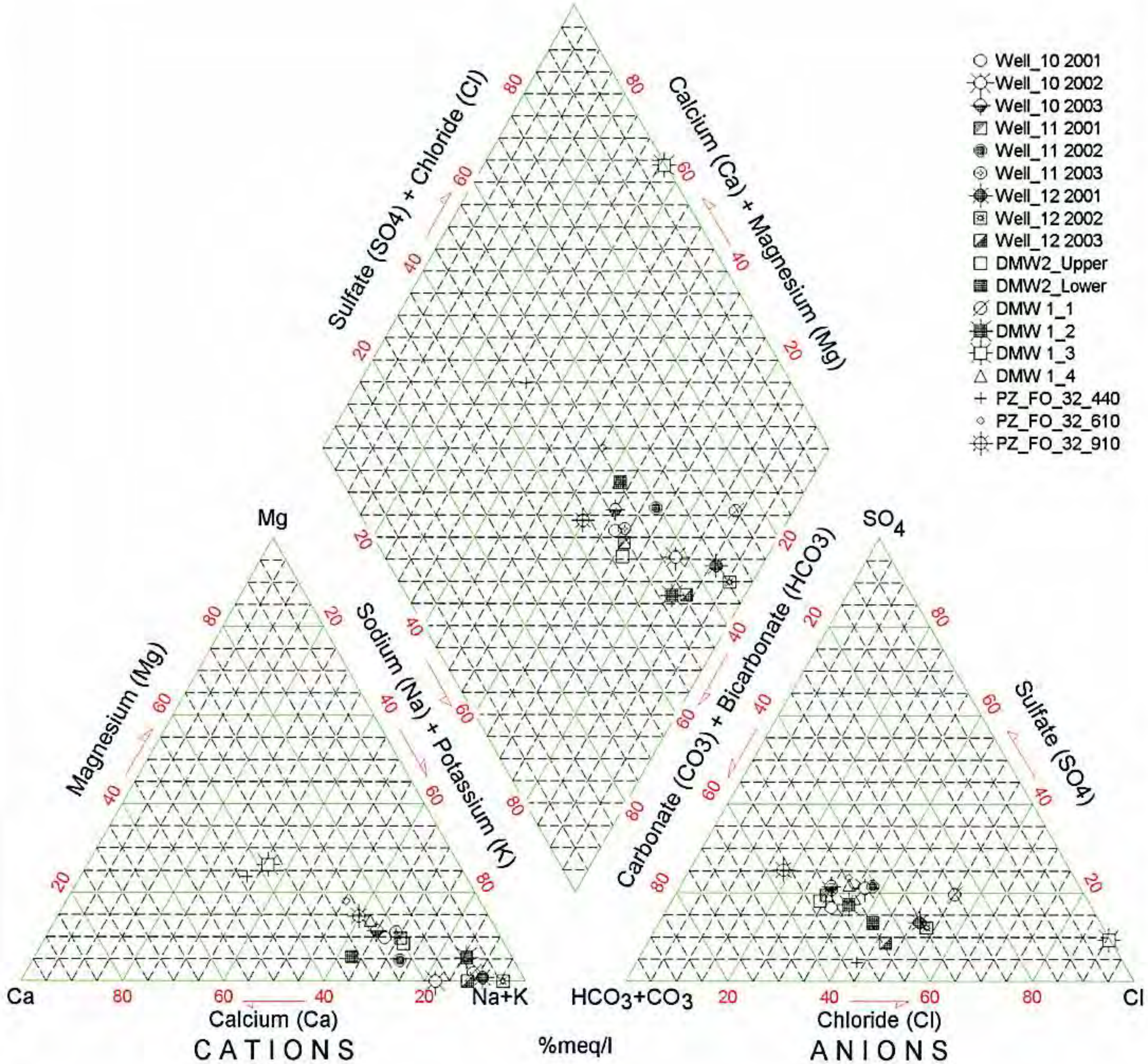
Marina Coast Water District

Marina, California

PLATE

3

DRAWN	JOB NUMBER	CHECKED	CHECKED DATE	APPROVED	APPROVED DATE
CN	4098042052 02	[signature]	05/05	MDT	7-7-05



Geochemical Illustration of Deep Aquifer Wells
Marina Coast Water District
Marina, California

PLATE **4**

MACTEC

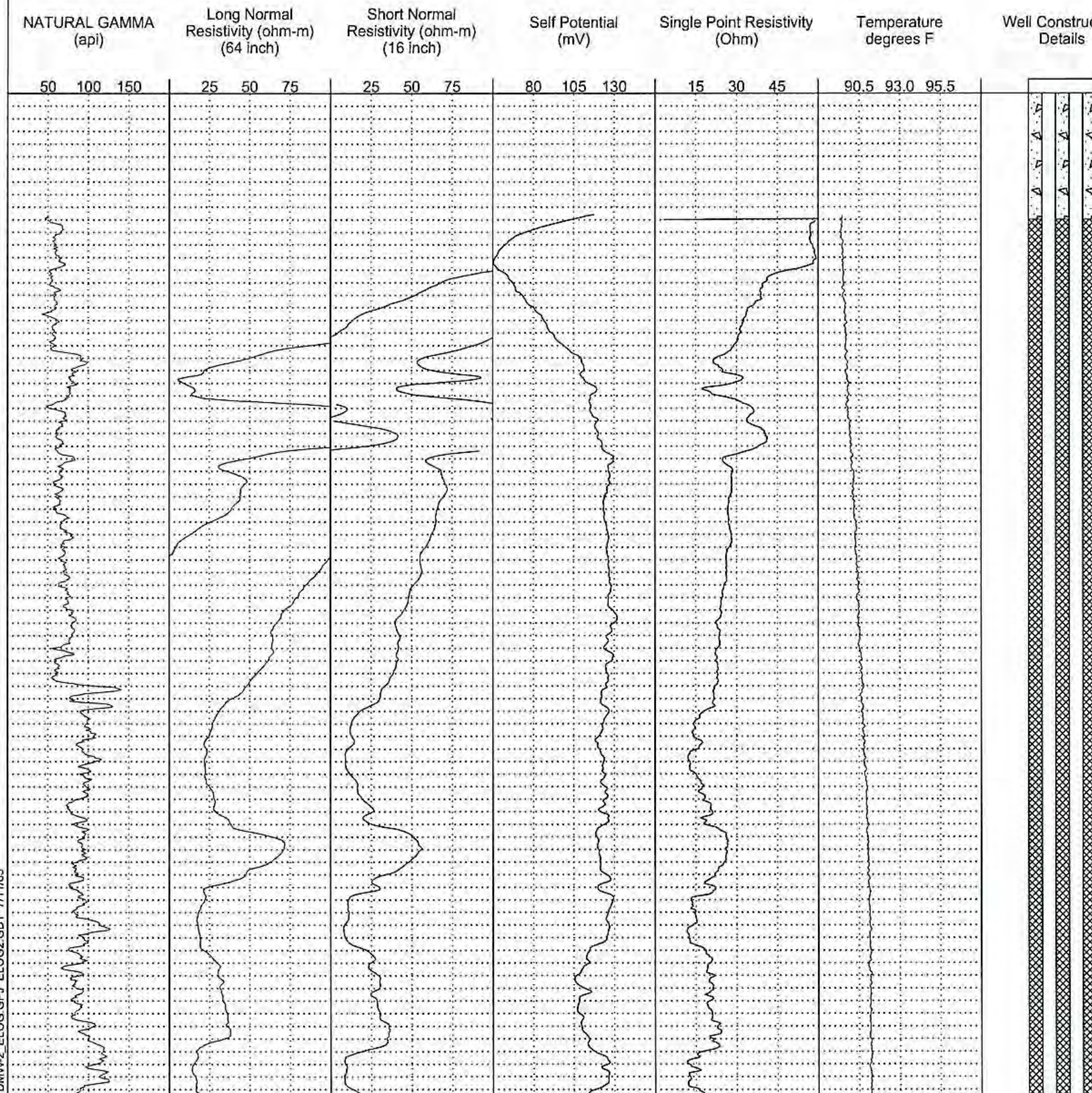
DRAWN	JOB NUMBER	CHECKED	CHECKED DATE	APPROVED	APPROVED DATE
CN	4098042052 1.3	[signature]	05/05	MDT	7-7-05

APPENDIX A

DMW-2 LITHOLOGIC AND GEOPHYSICAL LOG

Induction log collected by Welenco, Inc. on 1/10/2005

Driller: Well Development Corporation
Drilling Method: Mud Rotary
Hole Diameter: 8.5 in. pilot hole
Surface Elevation: ~138.5 ft. MSL Date: 1/5/05
Logged by: AHH Ref. Datum: NGVD 1929



MUD VIS. = 38 sec
WGT. = 8.6 lb.
pH = 8.64
Temp = 15.8°C
EC = 950
Continued drilling on 1/7/2005.

MUD VIS. = 45 sec
WGT. = 8.5 lb.
pH = 6.96
Temp = 13.7°C
EC = 700

MUD VIS. = 40 sec
WGT. = 8.6 lb.
pH = 7.09
Temp = 16.6°C
EC = 900

WGT. = 8.8 lb.

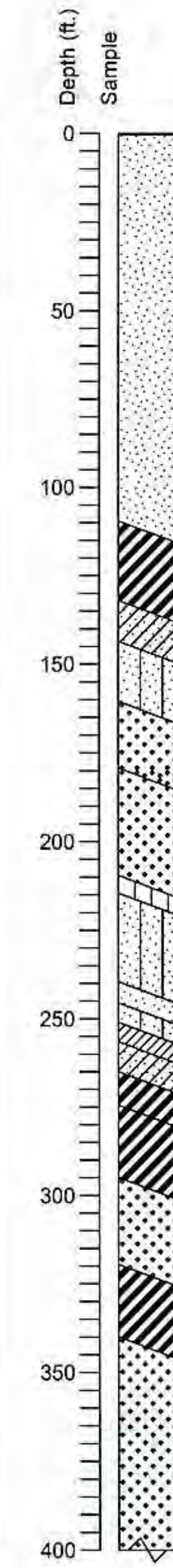
MUD VIS. = 40 sec
WGT. = 8.8 lb.
pH = 7.37
Temp = 18.7°C
EC = 950

MUD VIS. = 39 sec
WGT. = 8.8 lb.
pH = 7.62
Temp = 18.9°C
EC = 1,100

MUD VIS. = 37 sec
WGT. = 9.0 lb.
pH = 7.79
Temp = 20.6°C
EC = 900

MUD VIS. = 37 sec
WGT. = 9.3 lb.
pH = 7.95
Temp = 23.7°C
EC = 1,000

MUD VIS. = 37 sec
WGT. = 8.9 lb.
pH = 8.04



ASPHALT AT SURFACE
LIGHT YELLOWISH BROWN POORLY GRADED SAND (SP) (10YR 6/4) 95% fine sand, 5% fines

@ 95 ft.: Trace black sand, silty fraction ~10%

LIGHT YELLOWISH BROWN FAT CLAY (CH) (2.5Y 6/4) 100% clay, fine, small chips
Mildly silty, 10% silty component, slightly micaceous
100% clay, larger chips
@ 121.5 ft.: Color change to LIGHT OLIVE BROWN (2.5Y 5/4)
LIGHT YELLOWISH BROWN CLAYEY SAND (SC) (10YR 5/4) 60% fine to medium sand, 40% clay/fines as laminations
LIGHT YELLOWISH BROWN SILTY SAND (SM) (2.5Y 6/4) 80% fine to medium sand, 20% silt/fines
LIGHT YELLOWISH BROWN WELL GRADED SAND (SW) (10YR 6/4) 90% fine to coarse sand, 10% fines
LIGHT YELLOWISH BROWN WELL GRADED SAND (SW) (2.5Y 6/3) 100% sand
LIGHT OLIVE BROWN SILT WITH SAND (ML) (2.5Y 5/3) 80% silt, 20% sand
LIGHT OLIVE BROWN SILTY SAND (SM) (2.5Y 5/3) 60-70% fine to very fine sand, 30-40% silt
Angular white grains, non-calcareous
YELLOWISH BROWN POORLY GRADED SAND (SP) (10YR 5/4) 90% fine micaceous sand, 10% silt/fines
YELLOWISH BROWN SILTY SAND (SM) (10YR 5/4) 70% well graded sand, 30% silt/fines
LIGHT YELLOWISH BROWN FAT CLAY WITH SAND (CL) (10YR 5/4) 70% clay, 30% sand
YELLOWISH BROWN CLAYEY SAND (SC) (10YR 4/4) 60% sand, 40% clay fines
LIGHT YELLOWISH BROWN FAT CLAY (CH) (2.5Y 5/4) 90% clay/silt, 10% sand, (micaceous)
LIGHT OLIVE BROWN FAT CLAY (CH) (2.5Y 5/4) 10% clay 10-20% sand
Trace sand in cuttings, clay has silty, micaceous component, ~20% silt
LIGHT OLIVE BROWN WELL GRADED SAND WITH GRAVEL (SW) (2.5Y 4/4) 70% sand, 20% gravel, 10% clay/fines
Gravel is fine rounded to sub-rounded light siltstone (Monterey Fm.)
Increasing gravel content
DARK BLUISH GRAY FAT CLAY (CH) (5B 4/1) 100% clay
LIGHT OLIVE BROWN WELL GRADED SAND WITH GRAVEL (SW) (2.5Y 5/3) 70-80% sand, 20-30% gravel
Gravel is well-rounded to sub-rounded (Monterey Fm.), some

ELOG1 DMW-2_ELOG.GPJ ELOG2.GDT 7/11/05

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DMW-2
Lithologic and Geophysical Log
Deep Aquifer Monitoring Well
Marina Coast Water District
Marina, California

PLATE **A1**

DRAWN	JOB NUMBER	CHECKED	CHCK'D DATE	APPROVED	APPRV'D DATE
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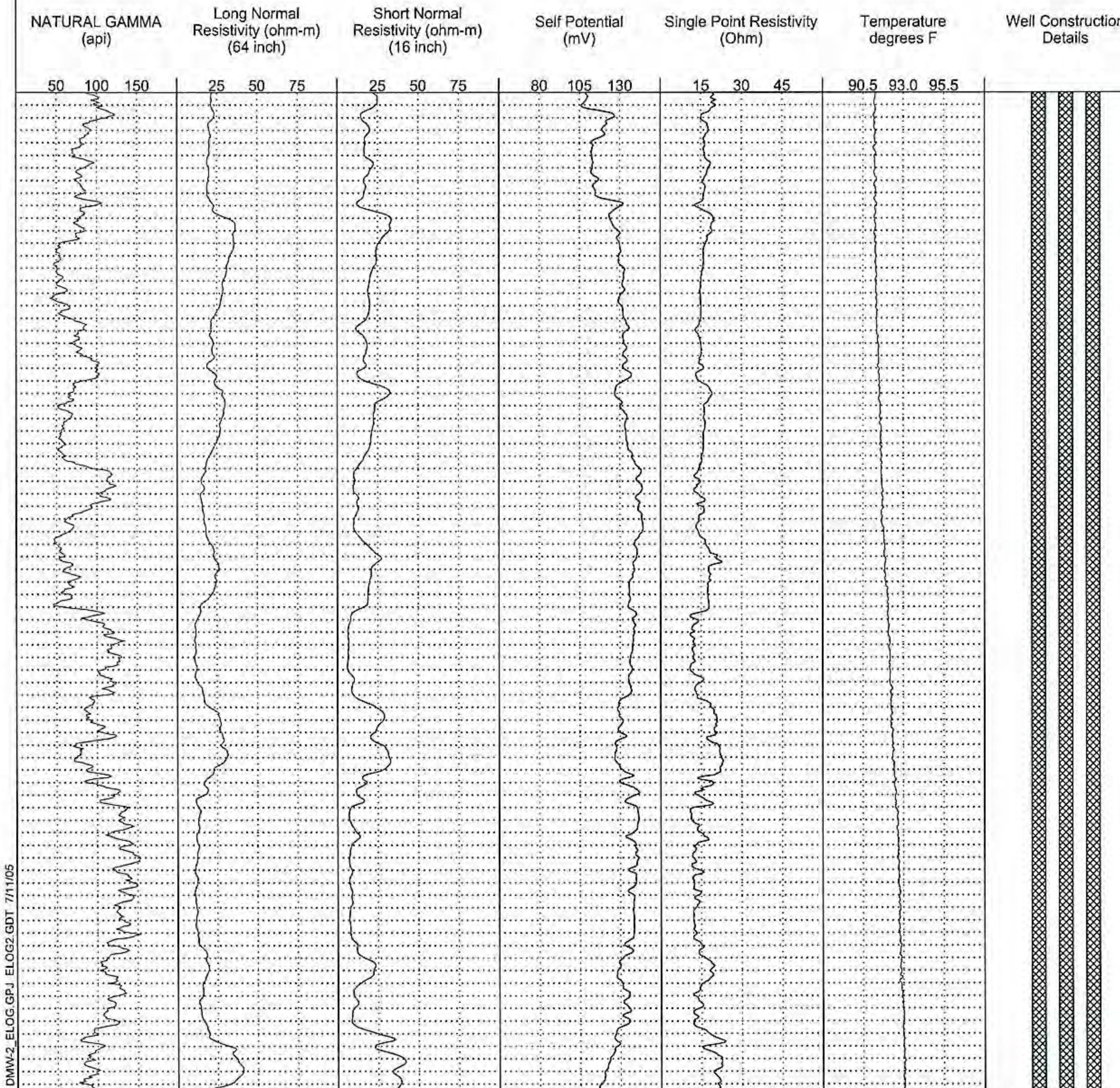
Induction log collected by Welenco, Inc. on 1/10/2005

Driller	Well Development Corporation
Drilling Method	Mud Rotary
Hole Diameter	8.5 in. pilot hole
Surface Elevation	~138.5 ft. MSL
Date	1/5/05
Logged by	AHH
Ref. Datum	NGVD 1929



Temp = 22.7°C
EC = 950

MUD VIS. = 35 sec
WGT. = 8.9 lb.
pH = 8.04
Temp = 24.8°C
EC = 900

MUD VIS. = 34 sec
WGT. = 8.8 lb.
pH = 8.04
Temp = 25.4°C
EC = 1,000

MUD VIS. = 39 sec
WGT. = 9.1 lb.
pH = 8.07
Temp = 25.2°C
EC = 1,000

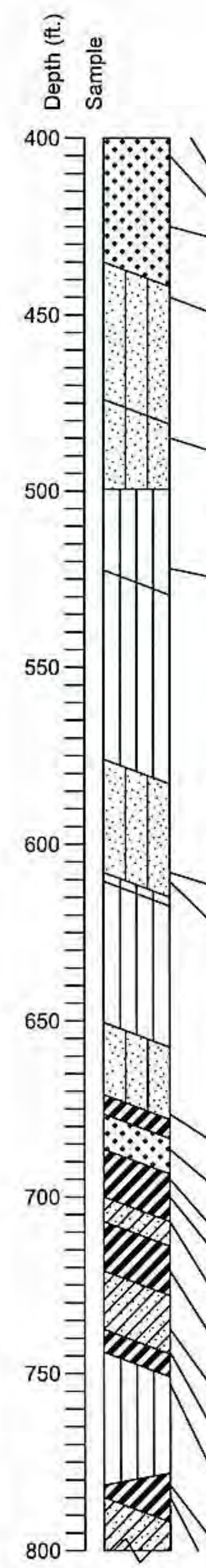
MUD VIS. = 37 sec
WGT. = 9.2 lb.
pH = 8.05
Temp = 25.4°C
EC = 950

MUD VIS. = 40 sec
WGT. = 9.1 lb.
pH = 8.09
Temp = 23.2°C
EC = 950

MUD VIS. = 40 sec
WGT. = 9.0 lb.
pH = 7.85
Temp = 25.4°C
EC = 1,000

MUD VIS. = 37 sec
pH = 7.64
Temp = 28.2°C
EC = 1,000

pH = 7.84
Temp = 29.4°C
EC = 1,000



mica; quartz sand predominates
Finer, little to no gravel
Silty component ~10%
Angular pieces of sand, less silt
75% sand, 20% fine gravel, 5% silt/fines, micaceous

LIGHT OLIVE BROWN SILTY SAND WITH GRAVEL (SM) (2.5Y 5/3) 60% sand, 20% gravel, 20% silt/fines
Monterey Formation and quartz gravel component

OLIVE BROWN SILTY SAND (SM) (2.5Y 4/3) 60% fine sand, 40% silt/fines
Minor amounts of coarse sand (<10%)

OLIVE BROWN SANDY SILT (ML) (2.5Y 4/4) 60% silt, 40% very fine sand, no calcite

Color change to DARK BROWN (7.5YR 4/4), very micaceous
DARK YELLOWISH BROWN SILT WITH SAND (ML) (10YR 4/4) 75% silt, 25% very fine sand, no calcite

YELLOWISH BROWN SILTY SAND (SM) (10YR 4/4) 60% fine to very fine sand, 40% silt, no calcite

Color change to BROWN (10YR 4/3), micaceous, with some medium sand, no calcite
YELLOWISH BROWN SILT (ML) (10YR 4/4) 60% silt, 30% clay, 10% very fine sand
DARK YELLOWISH BROWN SILTY WITH SAND (ML) (10YR 4/4) 70% silt, 20% clay, 10% fine sand, micaceous, no calcite

LIGHT OLIVE BROWN SILTY SAND (SM) (2.5Y 5/4) 60% fine to very fine sand, 40% silt/fines, micaceous, trace calcite

OLIVE BROWN FAT CLAY WITH SAND (CH) (2.5Y 4/3) 80% clay, 20% fine sand
LIGHT YELLOWISH BROWN WELL GRADED SAND (SW) (2.5Y 6/3) 95% sand, 5% fines, micaceous, no calcite
OLIVE BROWN FAT CLAY (CH) (2.5Y 4/3) 90% clay, 10% fine to very fine sand
Finer grained clean sand, micaceous
OLIVE BROWN CLAYEY SAND (SC) (2.5Y 4/3) 60% fine sand, 40% clay, no calcite
OLIVE BROWN FAT CLAY (CH) (2.5Y 4/3) 90% clay, 10% very fine sand
LIGHT OLIVE BROWN CLAYEY SAND (SC) (2.5Y 5/3) 60% fine sand, 40% clay, no calcite, fine clay chips
LIGHT YELLOWISH BROWN FAT CLAY (CH) (2.5Y 6/3) 90% clay, 10% fine sand, no calcite
LIGHT YELLOWISH BROWN SILT (ML) (2.5Y 6/3) 70% silt, 30% clay
Some silty component, micaceous, no calcite

ELOG1 DMW-2_ELOG.GPJ ELOG2.GDT 7/11/05

MACTEC

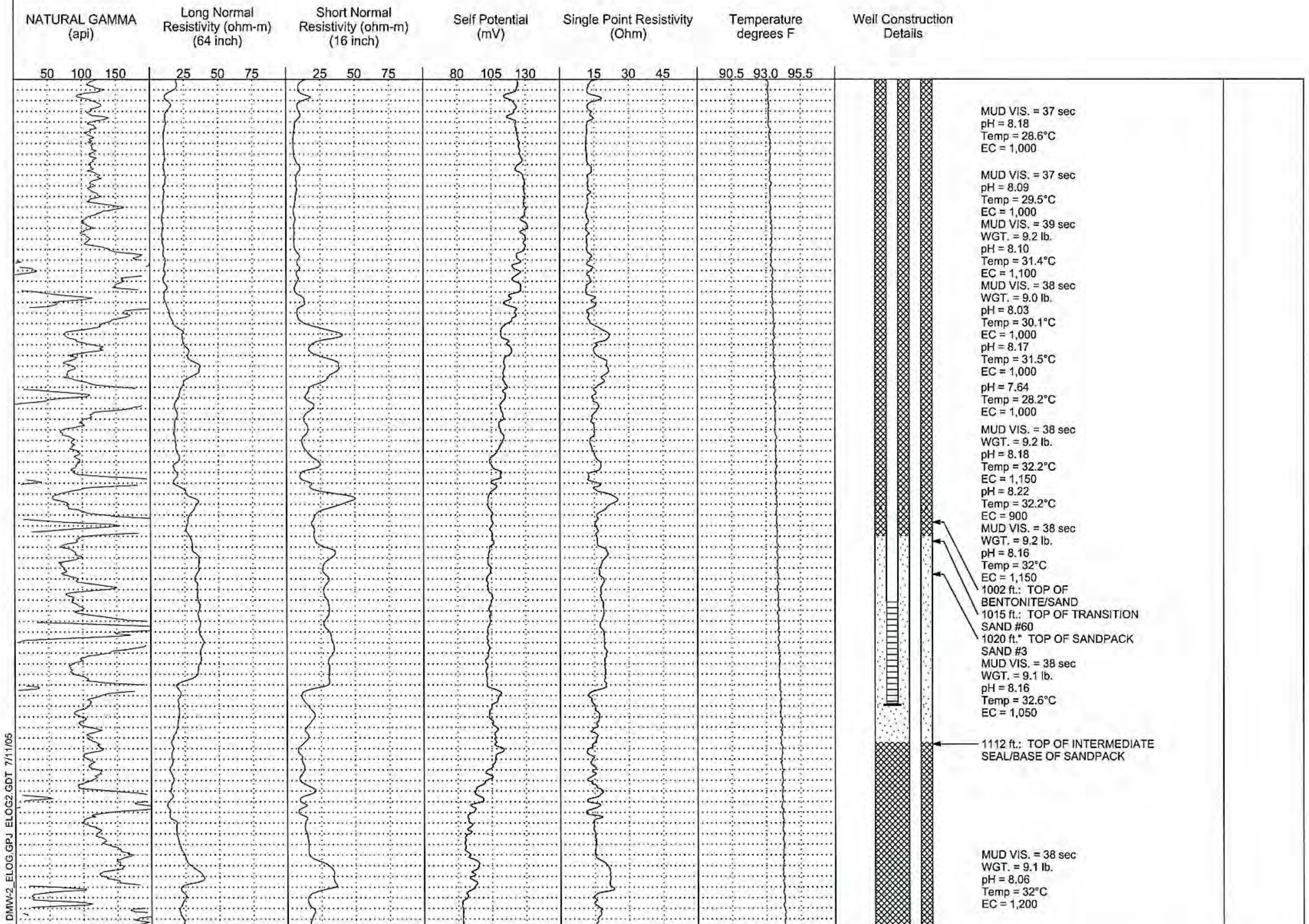
DMW-2
Lithologic and Geophysical Log
Deep Aquifer Monitoring Well
Marina Coast Water District
Marina, California

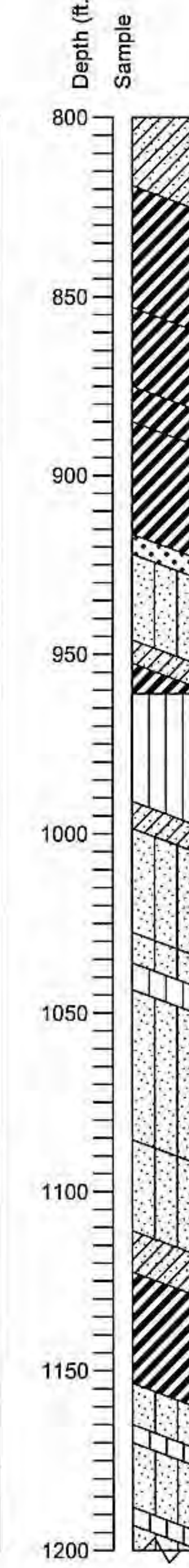
PLATE **A1**

DRAWN	JOB NUMBER	CHECKED	CHCK'D DATE	APPROVED	APPRV'D DATE
CN	4098042052 02		7/05	MAT	7-7-05

Induction log collected by Welenco, Inc. on 1/10/2005

Driller: Well Development Corporation
Drilling Method: Mud Rotary
Hole Diameter: 8.5 in. pilot hole
Surface Elevation: ~138.5 ft. MSL   Date: 1/5/05
Logged by: AHH   Ref. Datum: NGVD 1929





LIGHT YELLOWISH BROWN SANDY FAT CLAY (CH) (2.5Y 6/3) 70% clay, 30% sand

LIGHT YELLOWISH BROWN CLAYEY SAND (SC) (2.5Y 6/3) 70% fine sand, 30% clay/fines, some calcite

LIGHT YELLOWISH BROWN CLAY (CH) (2.5Y 6/3) 90% clay/fines, 10% fine, micaceous sand, trace calcite

LIGHT YELLOWISH BROWN TO GRAY FAT CLAY WITH SAND (CH) (2.5Y 6/3 - 5Y 5/1) Fine, flat chips, 10% very fine sand, trace calcite

GRAY TO LIGHT GRAY CLAY (CH) (5Y 4/1 - 5Y 5/1) 70% clay, 30% silt, no calcite

LIGHT OLIVE GRAY TO OLIVE GRAY CLAY WITH SAND (CH) (5Y 6/2 - 5Y 5/2) 90% clay, 10% fine sand as stringers, no calcite

LIGHT BROWNISH GRAY WELL GRADED SAND (SW) (2.5Y 6/2) 90% sand, 10% silt

LIGHT OLIVE GRAY SILTY SAND (SM) (5Y 6/2) 70-80% fine to medium sand, 20-30% silt/fines, trace calcite

GRAY CLAYEY SAND (SC) (5Y 5/1) 60% sand/fine gravel, 40% clay, bluish clay as thin layers

GRAY FAT CLAY WITH SAND (CH) (5Y 5/1) 80% clay, 20% fine sand

DARK GRAY SILT/CLAY (ML) (5Y 4/1) 70% silt, 30% clay 10-20% mildly calcareous sand, looks like shell fragments, trace calcite

DARK GRAY CLAYEY SAND (SC) (5Y 4/1) 60% sand, 30% clay, 10% light gray mudstone gravel

DARK GRAY SILTY SAND (SM) (5Y 4/1) 80% fine sand, 20% silt, pulverized shell fragments, some calcite

Color change to OLIVE (5Y 5/3)

LIGHT OLIVE BROWN SILTY SAND (SM) (2.5Y 5/3) 70% sand, 30% silt/fines, no calcite

OLIVE GRAY SILT WITH SAND (ML) (5Y 5/2) 80% silt, 20% fine sand, grains of light mudstone, iron oxide and light green oxide colors, no calcite

LIGHT OLIVE GRAY SILTY SAND (SM) (5Y 6/2) 70% well graded sand, 30% silt/fines, some calcite

Color change to LIGHT OLIVE BROWN (2.5Y 5/3) 70% sand, 30% silt/clay as lenses, trace calcite, multi-colored sand

DARK GRAY SILTY SAND WITH CLAY (SM) (5Y 5/1) 60% fine sands, 40% silt/fines

Color change to PALE OLIVE (5Y 6/3), 50% fine sand, 30% silt, 20% clay

Drilling easier for 1-2 ft. increments, sand lenses within silt, trace calcite

PALE OLIVE CLAYEY SAND (SC) (5Y 6/3) 60% fine to very fine sand, 40% clay

Clay content increasing, some calcite

OLIVE GRAY CLAY WITH SAND (CH) (5Y 5/2) 75% clay/fines, 25% sand, some calcite

PALE OLIVE SILTY SAND (SM) (5Y 6/3) 60-70% sand, 30-40% silt, with sandy lenses

PALE OLIVE SILT (ML) (5Y 6/3) 90% silt, 10% very fine sand

ELOG1 DMW-2_ELOG.GPJ ELOG2.GDT 7/11/05

MACTEC

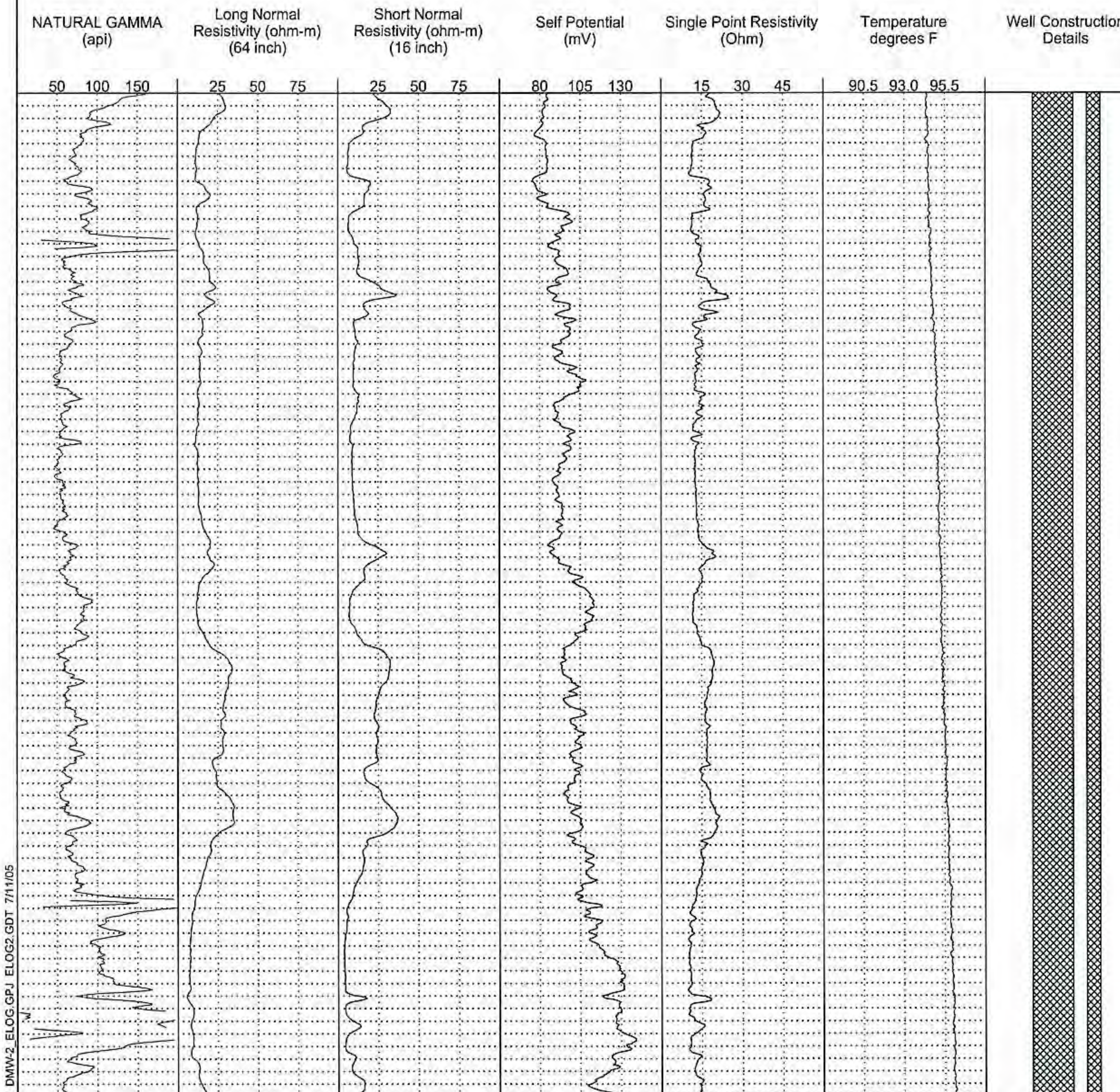
DMW-2
Lithologic and Geophysical Log
Deep Aquifer Monitoring Well
Marina Coast Water District
Marina, California

PLATE **A1**

DRAWN	JOB NUMBER	CHECKED	CHCK'D DATE	APPROVED	APPRV'D DATE
CN	4098042052 02	[signature]	7/05	MDT	7-7-05

Induction log collected by Welenco, Inc. on 1/10/2005

Driller Well Development Corporation
Drilling Method Mud Rotary
Hole Diameter 8.5 in. pilot hole
Surface Elevation ~138.5 ft. MSL Date 1/5/05
Logged by AHH Ref. Datum NGVD 1929



MUD VIS. = 38 sec
WGT. = 9.1 lb.
pH = 8.08
Temp = 32.1°C
EC = 1,050

MUD VIS. = 40 sec
WGT. = 9.2 lb.
pH = 8.27
Temp = 32.7°C
EC = 1,100

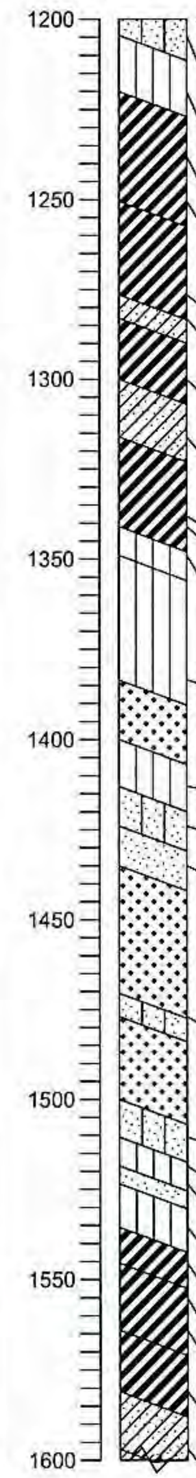
MUD VIS. = 37 sec
WGT. = 9.2 lb.
pH = 8.12
Temp = 33°C
EC = 1,100
MUD VIS. = 32 sec
pH = 7.96
Temp = 33.2°C
EC = 1,200

MUD VIS. = 36 sec
pH = 7.96
Temp = 35.6°C
EC = 1,100
pH = 8.00
Temp = 36.3°C
EC = 1,300

pH = 7.87
Temp = 36°C
EC = 1,100

MUD VIS. = 38 sec
WGT. = 9.1 lb.
pH = 7.85
Temp = 37.6°C
EC = 1,150
pH = 7.83
Temp = 36.3°C
EC = 1,250
MUD VIS. = 38 sec
pH = 7.83
Temp = 36.7°C
EC = 1,200

Depth (ft.) | Sample



DARK GRAY SILTY SAND (SM) (5Y 5/1) 50% fine sand with shell fragments, 30% silt, 20% clay, some calcite
PALE OLIVE SILT (ML) (5Y 6/3) 90% silt, 10% very fine sand
DARK GRAY SILTY SANDS (SM) (5Y 4/1) 60% fine sand, 40% silt/clay, some calcite
DARK GRAY SANDY SILT (ML) (5Y 5/1) 60% silt/clay, 40% fine sand, some shell fragments, some calcite
DARK GRAY FAT CLAY (CH) (5Y 5/1) 70% clay, 30% silt, trace sand, trace calcite
1235 - 1250 ft.: Sand lenses, medium to coarse sand
DARK GRAY SILTY FAT CLAY (CH) (5Y 4/1) 95% clay, 5% sand, some calcite
DARK GRAY CLAYEY SAND (SC) (5Y 4/1) 60% sand, 40% clay/silt
LIGHT GRAY/WHITE CALCITE CEMENTED CLAY (CH) (5Y 6/1) 80% clay, 20% sand
LIGHT BLUE GRAY CLAYEY SAND (SC) (5B 7/1) 60% predominantly carbonate sand grains, angular and broken from drilling, 40% silt/clay, white clay cuttings
GREENISH GRAY FAT CLAY (CH) (5GY 6/1) 70% clay, 30% fine sand; drill rate indicates sand as lenses
Bluish clay cuttings
OLIVE GRAY SANDY SILT (ML) (5Y 5/2) 60% silt, 40% fine, micaceous sand, occasional dark gray coarse sand with shell fragments, abundant calcite
OLIVE GRAY SILT (ML) (5Y 5/2) 90% silt, 10% sand, abundant calcite
GREENISH GRAY WELL GRADED SAND (SW) (5GY 5/1) 100% sand, some calcite
OLIVE GRAY SILT WITH SAND (ML) (5Y 5/2) 80% silt/clay, 20% fine sand, trace calcite
OLIVE GRAY SILTY SAND (SM) (5Y 5/2) 70% well graded sand and fine gravel, 30% silt
OLIVE GRAY POORLY GRADED SAND (SP) (5Y 5/2) 90% fine to medium sand, 10% silt/fines, trace calcite
OLIVE GRAY WELL GRADED SAND (SW) (5Y 5/2) 90% sand, 10% silt, trace calcite

OLIVE GRAY SILTY SAND (2M) 5Y 5/2) 85% sand, 15% silt/fines, trace clay cuttings, some calcite
OLIVE GRAY WELL GRADED SAND (SW) (5Y 5/2) 90% sand, 10% silt, trace calcite
OLIVE GRAY SILTY SAND (SM) (5Y 5/2) 60% fine sand, 40% silt, trace calcite
OLIVE GRAY SANDY SILT (ML) (5Y 5/20 70% silt, 30% sand
LIGHT OLIVE GRAY POORLY GRADED SAND (SP) (5Y 6/2) 90% fine sand, 10% fines, trace calcite
OLIVE GRAY SILT WITH SAND (ML) (5Y 5/2) 90% silt, 10% sand
GRAY CLAY WITH SAND (CH) (5Y 5/1) 80% clay, 20% sand, trace calcite
GREENISH GRAY SILTY FAT CLAY (CH) (5G 5/1) 70% clay, 25% silt, 5% sand, trace calcite
Minor zones with sand
LIGHT OLIVE GRAY SILTY FAT CLAY (CH) (5Y 6/2) 60% clay, 30% silt, 10% sand, with calcite

ELOG1 DMW-2_ELOG.GPJ ELOG2.GDT 7/11/05

MACTEC

DRAWN	JOB NUMBER	CHECKED	CHCK'D DATE	APPROVED	APPRV'D DATE
CN	4098042052 02	MDT	7/05	MDT	7-7-05

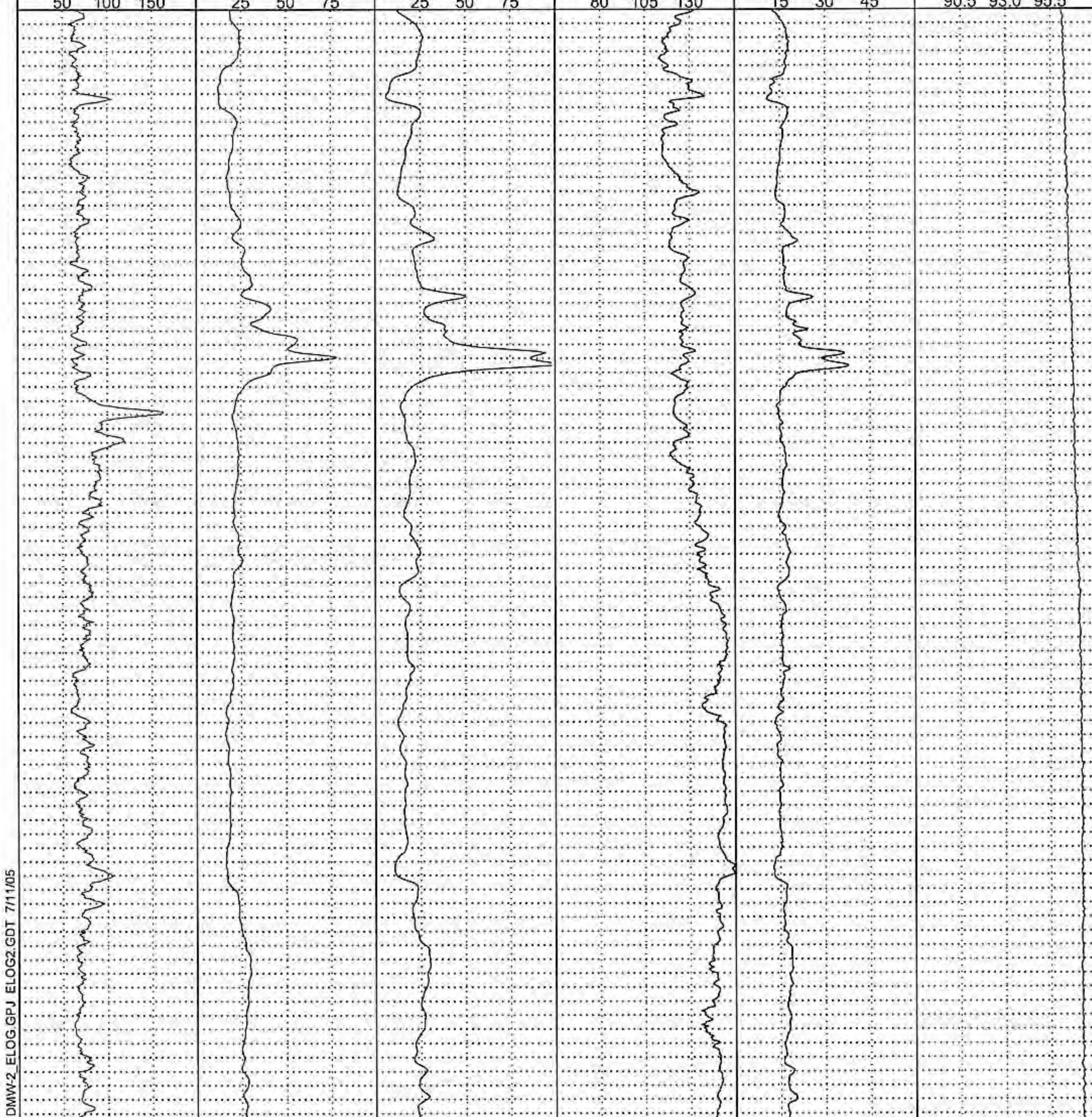
DMW-2
Lithologic and Geophysical Log
Deep Aquifer Monitoring Well
Marina Coast Water District
Marina, California

PLATE
A1

Induction log collected by Welenco, Inc. on 1/10/2005

Driller Well Development Corporation
Drilling Method Mud Rotary
Hole Diameter 8.5 in. pilot hole
Surface Elevation ~138.5 ft. MSL Date 1/5/05
Logged by AHH Ref. Datum NGVD 1929

NATURAL GAMMA (api)	Long Normal Resistivity (ohm-m) (64 inch)	Short Normal Resistivity (ohm-m) (16 inch)	Self Potential (mV)	Single Point Resistivity (Ohm)	Temperature degrees F	Well Construction Details
50 100 150	25 50 75	25 50 75	80 105 130	15 30 45	90.5 93.0 95.5	



MUD VIS. = 38 sec
WGT. = 9.1 lb.
pH = 8.04
Temp = 36.6°C
EC = 1,400

MUD VIS. = 39 sec
WGT. = 9.2 lb.
pH = 7.91
Temp = 37.6°C
EC = 1,500

1680 ft.: TOP TRANSITION SAND #60
1690 ft.: TOP #3 SANDPACK

pH = 7.94
Temp = 36.7°C
EC = 1,400

SILT TRAP

1771 ft.: TOP OF BENTONITE SEAL

pH = 7.96
Temp = 37.1°C

MUD VIS. = 38 sec
WGT. = 9.3 lb.
pH =8.45
Temp = 37.5°C
EC = 1,700
pH = 8.18
Temp = 36.6°C
EC = 1,550

MUD VIS. = 38 sec
pH = 8.27
Temp = 37.1°C
EC = 1,600

8 1/4 in. DIA. BOREHOLE

MUD VIS. = 39 sec
WGT. = 9.2 lb.
pH = 8.22
Temp = 36.6°C
EC = 1,600

Depth (ft.)	Sample	Description
1600		LIGHT OLIVE GRAY CLAYEY SAND (SC) (5Y 6/2) 60% fine sand, 40% clay/fines
		LIGHT OLIVE GRAY SANDY SILTY CLAY (CL) 95Y 6/2) 50% clay, 30% sand, 20% silt, with calcite; drills consistent, any changes in lithology are minor
		LIGHT OLIVE GRAY CLAYEY SAND (SC) (5Y 6/2) 60% fine sand, 40% clay/fines, some calcite
1650		LIGHT OLIVE GRAY SILTY SAND (SM) (5Y 6/2) 70% fine to medium sand, 30% silt, some calcite
		LIGHT OLIVE GRAY CLAYEY SAND (SC) (5Y 6/2) 60% fine sand, 40% clay/fines, some calcite
		LIGHT OLIVE GRAY SILT (ML) (5Y 6/2) 80-90% silt/fines, 10-20% very fine sand, trace calcite
		LIGHT OLIVE BROWN SILTY SAND (SM) (5Y 6/2) 60% sand, 40% silt/fines
1700		LIGHT GRAY POORLY GRADED SAND (SP) (5Y 6/1) 90% medium silica sand, 10% minor amounts of shell fragments, black grains and yellowish brown clay, trace calcite
		LIGHT OLIVE GRAY SILTY SAND (SM) (5Y 6/2) 60-70% fine quartz sand, 30-40% silt; drill rate suggests cementation; white CaCo3 egg-shell-like material
1750		Hard drilling
		Easier drilling from 1735 - 1737 ft.
		LIGHT OLIVE GRAY SANDY SILT (ML) (5Y 6/2) 50-60% silt, 40-50% sand, with calcite grains
		As above, larger grain size distribution, brown clay, some dark grains
1800		LIGHT OLIVE GRAY SILTY SAND (SM) 5Y 6/2) 70% sand, 30% silt/fines, grains of dark gray yellowish brown clay/claystone are more prevalent; quartz sand is fine, ~50% of coarse fraction, some calcite
		LIGHT OLIVE GRAY SANDY CLAY (CH) (5Y 6/2) Soft, 70% clay, 30% sand, clay has silty component with calcite, poor cuttings return
1850		OLIVE GRAY FAT CLAY (CH) (5Y 5/2) 80-90% clay/fines, 10-20% sand, mostly dark gray fine sand with calcite
		Harder, siltier with calcite grains
1900		LIGHT OLIVE GRAY CLAYEY SAND (SC) (5Y 6/2) 60% fine to very fine sand, 40% clay/silt
		LIGHT OLIVE GRAY CLAY WITH SAND (CH) (5Y 6/2) 80-90% clay/fines, 10-20% sand, with calcite grains
		LIGHT OLIVE GRAY CLAYEY SAND (SC) (5Y 6/2) 60% fine to very fine sand, 40% silt/fines
1950		Clayey sand as above, some calcite
		LIGHT OLIVE GRAY CLAY WITH SAND (CH) (5Y 6/2) 80% clay/silt, 20% sand, well-consolidated, hard clay chips
		LIGHT OLIVE GRAY CLAYEY SAND (SC) (5Y 6/2) 60% fine sand, 40% silt/clay, some calcite
2000		

ELOG1 DMW-2_ELOG.GPJ ELOG2.GDT 7/11/05

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DMW-2
Lithologic and Geophysical Log
Deep Aquifer Monitoring Well
Marina Coast Water District
Marina, California

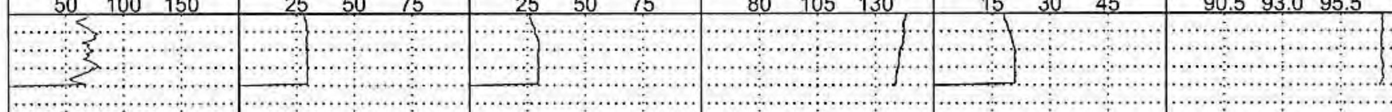
PLATE **A1**

DRAWN	JOB NUMBER	CHECKED	CHCK'D DATE	APPROVED	APPRV'D DATE
CN	4098042052 02	[signature]	7/05	MDT	7-7-05

Induction log collected by Welenco, Inc. on 1/10/2005

Driller Well Development Corporation
Drilling Method Mud Rotary
Hole Diameter 8.5 in. pilot hole
Surface Elevation ~138.5 ft. MSL Date 1/5/05
Logged by AHH Ref. Datum NGVD 1929

NATURAL GAMMA (api)	Long Normal Resistivity (ohm-m) (64 inch)	Short Normal Resistivity (ohm-m) (16 inch)	Self Potential (mV)	Single Point Resistivity (Ohm)	Temperature degrees F	Well Construction Details		Depth (ft.)	Sample	
50 100 150	25 50 75	25 50 75	80 105 130	15 30 45	90.5 93.0 95.5					
							pH = 8.37 Temp = 37.2°C EC = 1,400	2000		Bottom of boring at 2025 feet.



ELOG1 DMW-2_ELOG.GPJ ELOG2.GDT 7/11/05

MACTEC

DMW-2
Lithologic and Geophysical Log
Deep Aquifer Monitoring Well
Marina Coast Water District
Marina, California

PLATE A1

DRAWN	JOB NUMBER	CHECKED	CHCK'D DATE	APPROVED	APPRV'D DATE
CN	4098042052 02	[signature]	7/05	MDT	7-7-05

APPENDIX B

WELL PERMIT

MONTEREY COUNTY

DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
1270 Natividad Road
Salinas, CA 93906
(831) 755-4507

WATER WELL CONSTRUCTION PERMIT

WELL PERMIT NO. #04-08447

ISSUED: 10-19-04
EXPIRES: 10-19-05

SITE LOCATION: 3200 Imjin Road
RECEIPT: 230650
TYPE: Monitoring Only
APN: not given
OWNER: Marina Coast Water Dist.
ADDRESS: 11 Reservation Rd.
CITY: Marina, CA 93933
PHONE: (831) 384-6131
DRILLING CONTRACTOR: Mactec
LICENSE: 283326

ISSUED BY: E. Karu

CONDITIONS OF APPROVAL:

1. The well shall be at least 100 feet from any septic tank; any portion of any leach field or animal enclosure; 50 feet from any sewer main, line or lateral; and 150 feet from any seepage pit. If type of absorption field is unknown, the distance shall be 150 feet.

2. Location of the well shall not prevent the installation, relocation or expansion of the septic system on any adjoining lot.

3. Notify the Monterey County Health Department, Division of Environmental Health (MCHD, DEH) prior to moving on site.

4. Water well permit shall be kept on site at all times while work is in progress.

5. Notify the MCHD, DEH 24 hours prior to the time you expect to place any seal.

6. An electric log shall be performed and it shall be reviewed by the MCHD, DEH in consultation with the appropriate water management agency, before the well is sealed. A written water quality report and interpretation shall be provided by the construction firm indicating the best location(s) for sealing off poor quality water.

7. Surface construction features of the completed well shall be in accordance with *Bulletin 74-81* (including all supplements), *Water Well Standards: State of California*.

END

MONTEREY COUNTY HEALTH DEPARTMENT
DIVISION OF ENVIRONMENTAL HEALTH – HAZARDOUS MATERIALS BRANCH

APPLICATION TO CONSTRUCT OR DESTROY MONITORING WELL OR SOIL BORING – on its way

One application per Monitoring Well

Date of Application: 9/27/04 Receipt Number: ________ APN: ________ Well # A MW

Monitoring Well Fee: ~~$285~~ ea. [X]-Construction water levels [ ]-Abandonment/Destruction Soil Boring Fee: $95. per site # of S. B. ________

Physical Address of site: 3200 IMJIN RD. MARINA, CA 93933

Site contact person: ANNA HENKE Phone: (415) 328 - 0684

Owner: MCWD	Consultant MACTEC	Driller: WDC
Address: 11 RESERVATION RD.	Address: 600 GRAND AVE SUITE 300	Address: P.O.B. 141. CO. RD. 93B
City: MARINA	City: OAKLAND	City: ZAMORA
State: CA Zip: 93933	State: CA Zip: 95610	State: CA Zip: 95698
Phone: (831) 384-6131	Phone: (510) 451-1001	Phone: (800) 873 3073

A C-57 License is required by law. C-57 283326 Date of estimated work: Start: OCT 11, 04 Finish: OCT. 30, 04

A map showing the following data must accompany this application: 1- The property lines, distances of the proposed well/soil boring to the property lines, other wells or borings on the property and adjacent properties. 2 - The location of the proposed well/soil borings must be marked at the site by a surveyor's stake with the words "proposed well/soil boring". 3- A work plan and site safety plan must also accompany well and soil boring applications.

REASON FOR INSTALLATION – DESTRUCTION OF MONITORING WELL: ________

TYPE OF WELL OR BORING
- [X] Ground Water Monitoring
- [ ] Vapor Extraction
- [ ] Vadose Zone
- [ ] Piezometer
- [ ] Soil Boring/Core Sampling
- [ ] Cathodic Protection Well
- [ ] Other ________

PROPOSED SPECIFICATIONS
- Depth (ft) 1500, 1900
- Diameter (in) 3"
- Width seal (in) 2-2.5"
- Depth perforations
  - 1500-1550'
  - 1900-1950'

CASING
- (Single)/Double
- Material PVC
- Type of joint THREADED
- Gravel Pack (ft) @ 70'
- Filter pack (ft)

DRILLING METHOD
- [X] Rotary MUD
- [ ] Cable
- [ ] Dug
- [ ] Other ________

Location of well Seals: (ft) CEMENT SEAL 0-50
BENTONITE SEALS 50-1480, 1570-1880

Existing Wells on property: Check one

Condition of other wells on property	Indicate intentions for use of replaced well
[X]-In use MONITORING WELLS	[ ]-To be abandoned
[ ]-Inactive	[ ]-To supplement new well
[ ]-Abandoned	[ ]-To be LEFT inactive
	[ ]-Irrigation (AG)

[ ] - WELL DESTRUCTION [ ] - SOIL BORING DESTRUCTION

Submit well log with the application and a site plan. Depth of well/boring (ft) ________ Depth of proposed seal(s) (ft) ________
Materials to be used: ________
Location of screens or perforations: ________
Cleaning of well required: ________

I hereby agree to comply with all laws and regulations of the County of Monterey and the State of California pertaining to well/soil boring construction and destruction. I will contact the Monterey County Health Department before I commence the work. After completion of the work, I will furnish the Monterey County Health Department a log signed and stamped by a certified professional. A certified professional will also directly supervise all drilling operations. I hereby agree that I will not commence work until I have a valid permit and that I will notify the Monterey County Health Department if I change the location of the well/boring site. I hereby agree to pay all fees at the time of application and any subsequent fees that may accrue.

04-08447

IN0843541

Rec 230650

All legal representatives must be obtained before a permit is issued.

Property Owner: [signature] MCWD 582-2646

Drilling Contractor: [signature] for WDC

[signature]
Circle one: (Registered Geologist) Civil Engineer
Print Name: A H HENKE
Certification Number: 7070

Environmental Health Offices

Salinas	Monterey/Peninsula Area	King City/South County of Monterey
1270 Natividad Rd., Room 301	1200 Aguajito Rd.	620 Broadway, Ste. N
Salinas, CA 93906	Monterey, CA 93940	King City, CA 93930
(831) 755-4511	(831) 647-7654	(831) 385-8350

Revised 6/03

for Marina Coast Wtr. Dist.

APPENDIX C

WELENCO GEOPHYSICAL LOGS

welenco

5201 Woodmere Drive, Bakersfield, CA 93313-- www.welenco.com--(800) 445-9914

ELECTRIC - GAMMA RAY - TEMPERATURE LOG

FILING NO.

COMPANY MACTEC

WELL Deep Aquifer Test Well #1

FIELD Marina Airport

STATE California COUNTY Monterey

LOCATION:

OTHER SERVICES: Directional

JOB NO. 39482

SEC: ____ TWP: ____ RGE: ____ LONG.: ____ LAT.: ____

Permanent Datum: Ground Level, Elev. ____ Ft. Elev.: K.B. U/K Ft.

Log Measured From: Ground Level, 0 Ft. Above Perm. Datum D.F. U/K Ft.

Drilling Measured From: Ground Level G.L. ____ Ft.

Run No.	One	Two	Three	Four
Date	Jan. 10, 2005			
Depth-Driller	2023 Ft	Ft	Ft	Ft
Depth-Logger	2020 Ft	Ft	Ft	Ft
Top Logged Interval	40 Ft	Ft	Ft	Ft
Btm. Logged Interval	2020 Ft	Ft	Ft	Ft
Casing-Driller	12.25 In @ 40 Ft	In @ Ft	In @ Ft	In @ Ft
Casing-Logger	12.25 In @ 40 Ft	In @ Ft	In @ Ft	In @ Ft
Bit Size	8.5 In	In	In	In
Time On Bottom	07:40			
Type Fluid In Hole	Bentonite			
Density / Viscosity	n/a / n/a			
pH / Fluid Loss	n/a / n/a ml	ml	ml	ml
Source of Sample	Shaker			
Rm @ Measured Temp.	5.88 @ 75 °F	@ °F	@ °F	@ °F
Rmf @ Measured Temp.	6.3 @ 75 °F	@ °F	@ °F	@ °F
Rmc @ Measured Temp.	n/a @ °F	@ °F	@ °F	@ °F
Source Rmf / Rmc	Meas			
Rm @ BHT	n/a @ °F	@ °F	@ °F	@ °F
Time Since Circulation	5 hr Hr	Hr	Hr	Hr
Max. Rec. Temp.	97.4 °F	°F	°F	°F
Van No. / Location	L-23 / Bfld			
Recorded By	M. Sharpless			
Witnessed By	A. Henke			

Miscellaneous Information

Drilled By: WDC Exploration & Wells

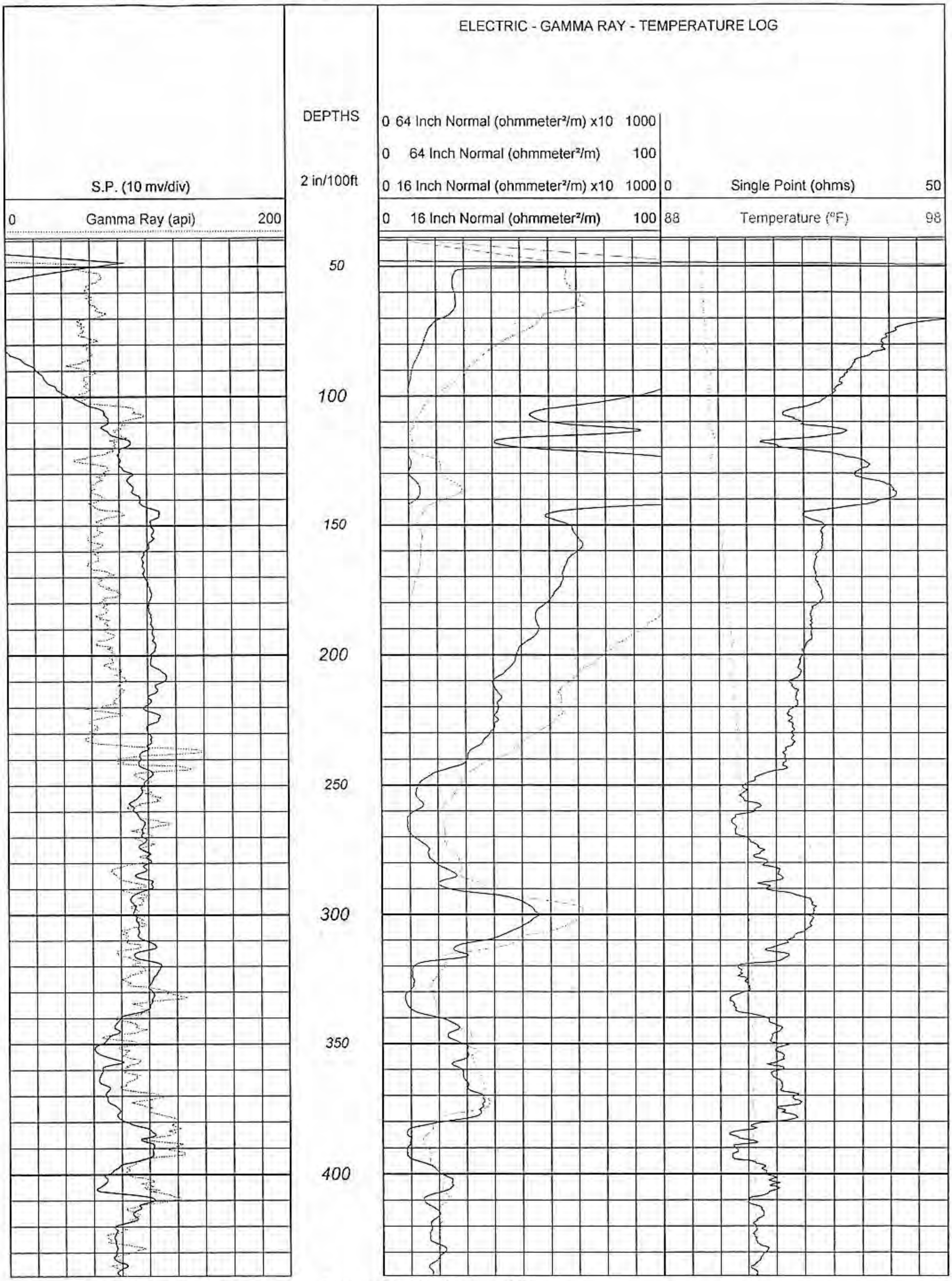
SP Calculations For Water Quality

LOG DEPTHS	S.P.	Rwe	Rw RANGE Ohmeters2/M		E.C. RANGE MicroSiemens		TDS RANGE ppm	
			NaCl	NaHCo3	NaCl	NaHCo3	NaCl	NaHCo3

Class I (Excellent to Good)	Class II (Good to Injurious)	Class III (Injurious to Poor)
Less than 700 ppm	700-2000 ppm	More than 2000 ppm

NOTICE

MACTEC Deep Aquifer Test Well #1 Jan 10, 2005

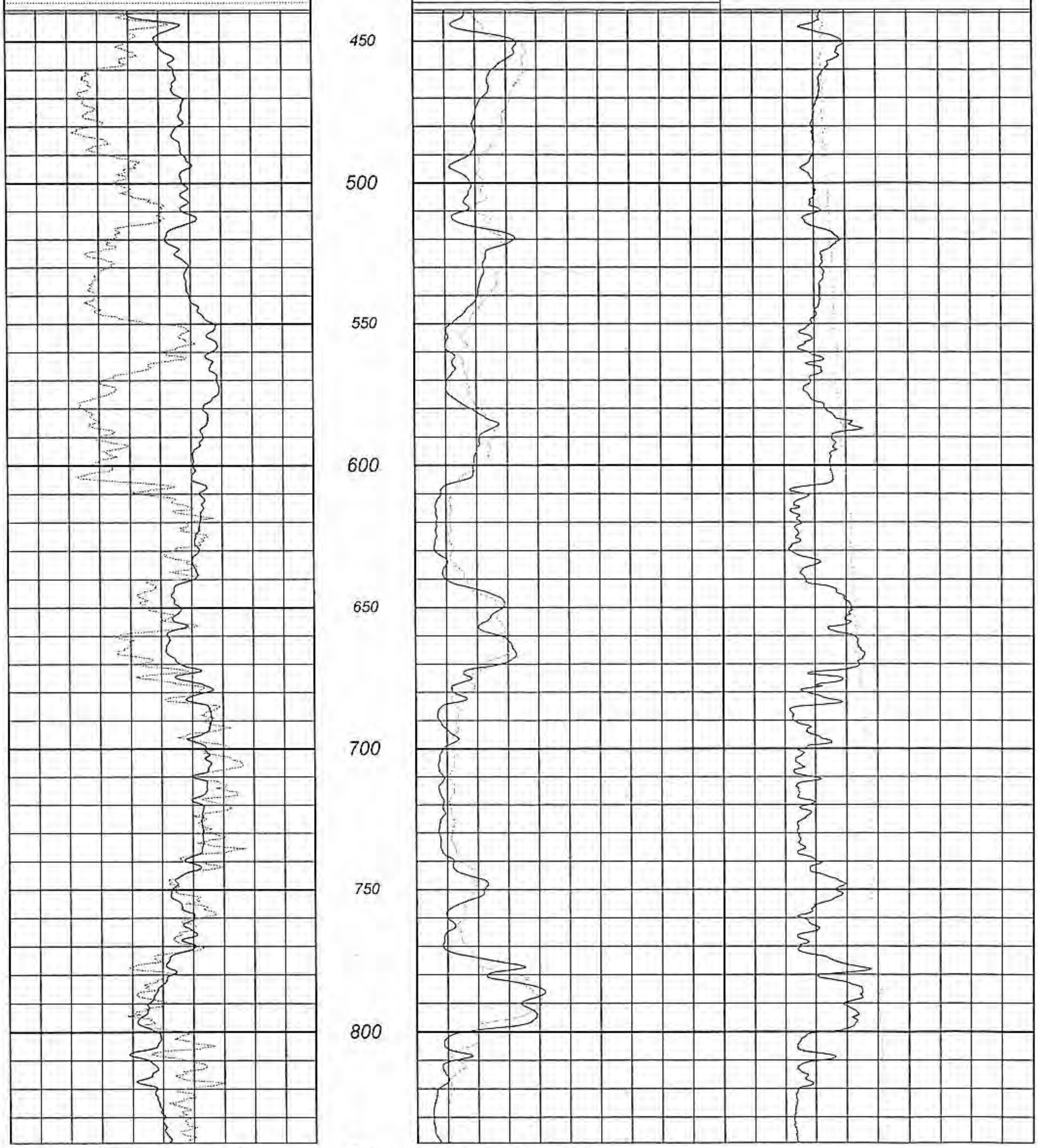


Log Page No. 1 of 5 Pages

Page Length: 39 - 439 Feet (400 Feet)

ELECTRIC - GAMMA RAY - TEMPERATURE LOG

S.P. (10 mv/div)	DEPTHS	0 64 Inch Normal (ohmmeter²/m) x10 1000	
		0 64 Inch Normal (ohmmeter²/m) 100	
S.P. (10 mv/div)	2 in/100ft	0 16 Inch Normal (ohmmeter²/m) x10 1000	0 Single Point (ohms) 50
0 Gamma Ray (api) 200		0 16 Inch Normal (ohmmeter²/m) 100	88 Temperature (°F) 98



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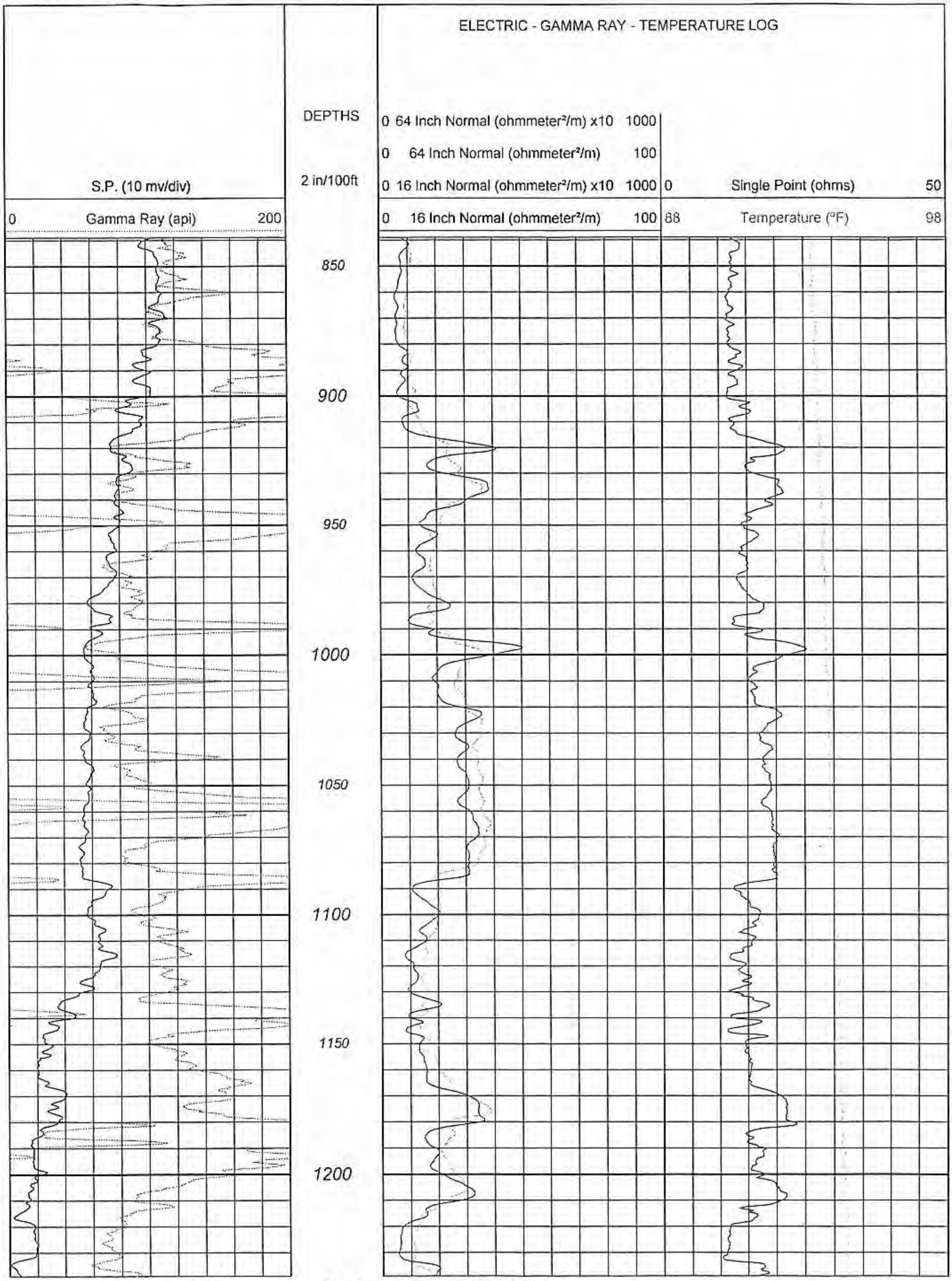

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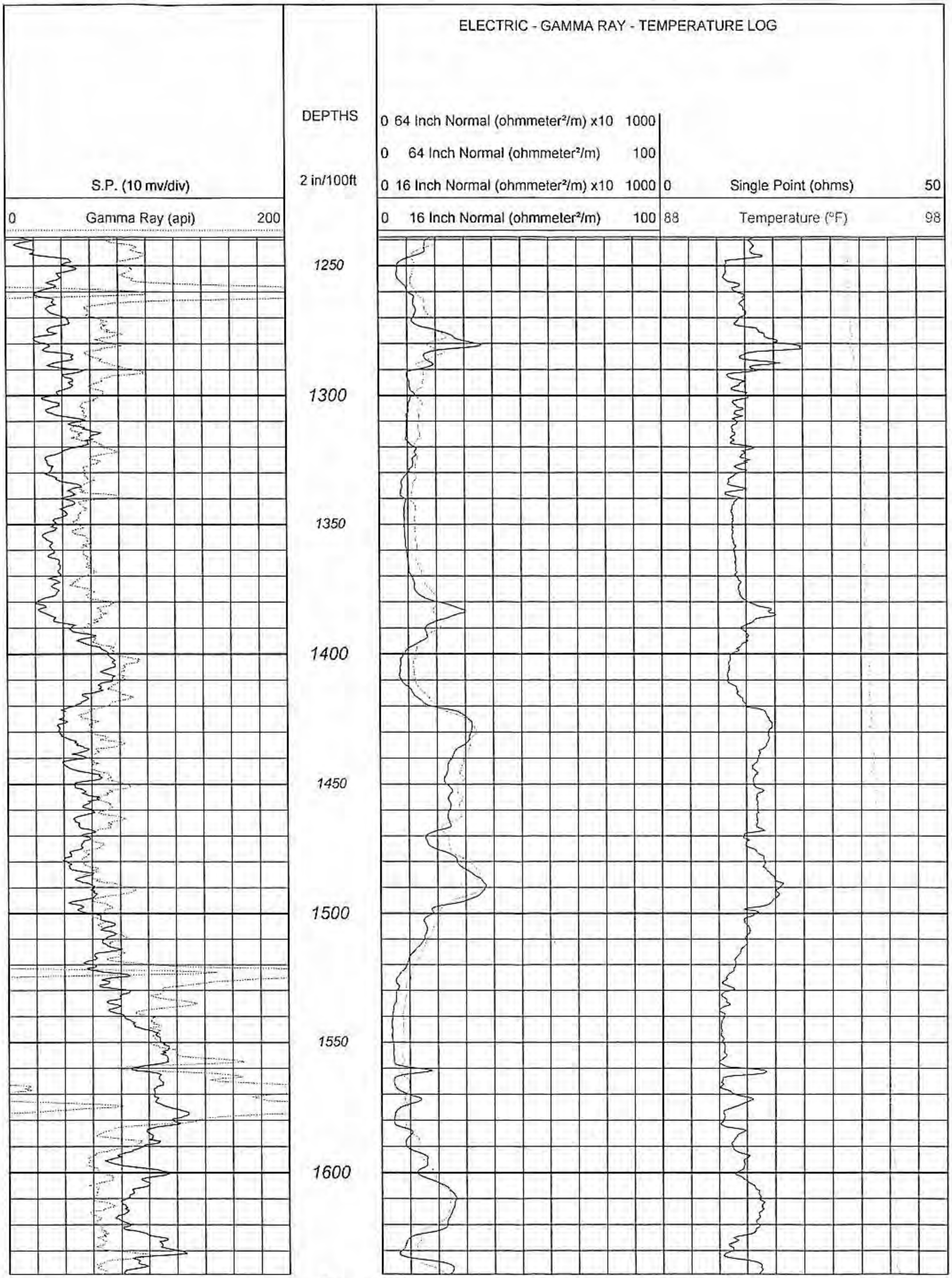


Log Page No. 4 of 5 Pages

Page Length: 1239 - 1639 Feet (400 Feet)

ELECTRIC - GAMMA RAY - TEMPERATURE LOG

DEPTHS

2 in/100ft

0 64 Inch Normal (ohmmeter²/m) x10 1000

0 64 Inch Normal (ohmmeter²/m) 100

0 16 Inch Normal (ohmmeter²/m) x10 1000

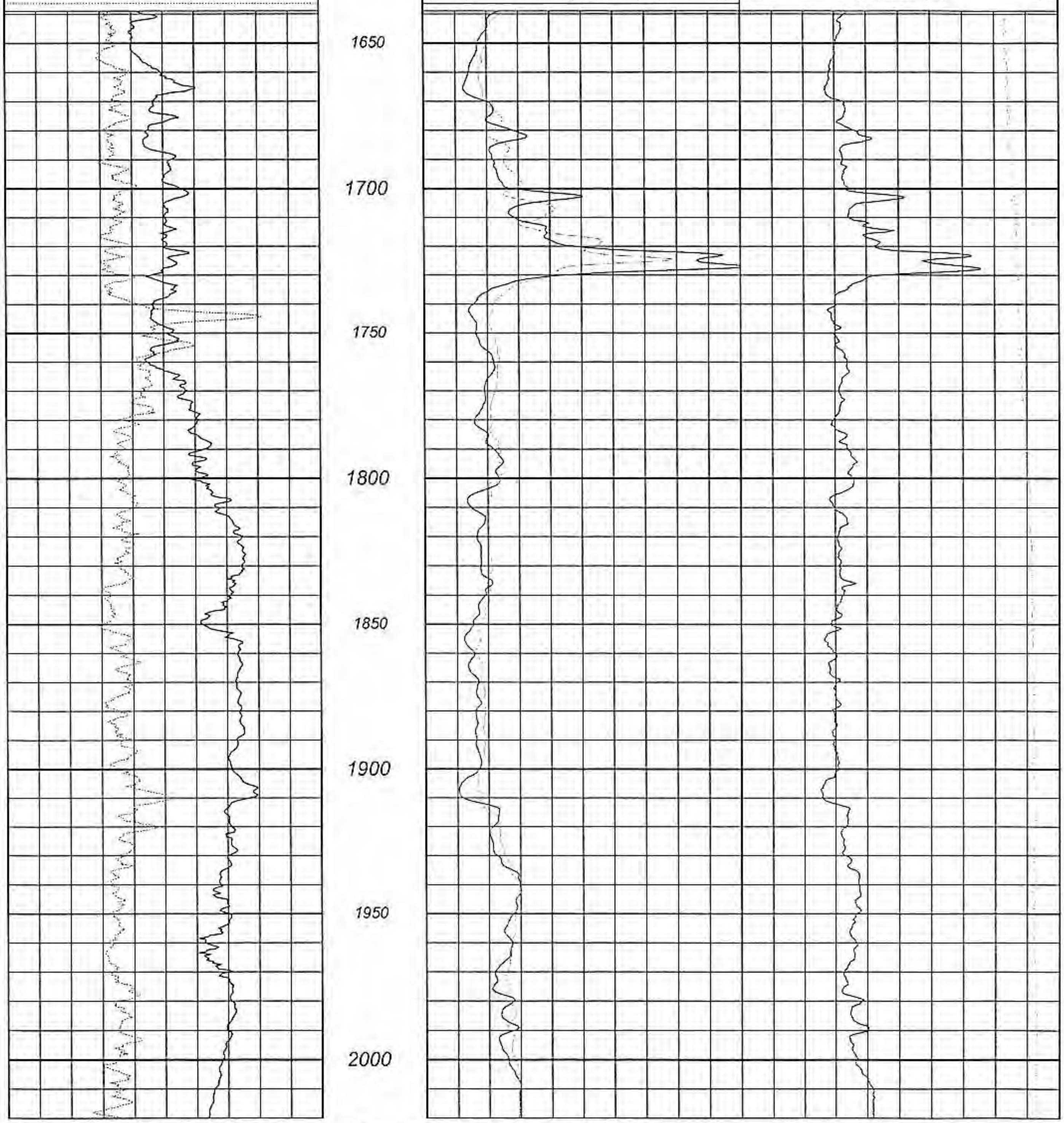
0 16 Inch Normal (ohmmeter²/m) 100

S.P. (10 mv/div)

0 Gamma Ray (api) 200

0 Single Point (ohms) 50

88 Temperature (°F) 98



Page Length: 1639 - 2020 Feet (381 Feet)

welenco

5201 Woodmere Drive, Bakersfield, CA 93313-- www.welenco.com--(800) 445-9914

3-ARM CALIPER LOG

FILING NO.

COMPANY MACTEC

WELL Deep Aquifer Test Well #1

FIELD Marina Airport

STATE California COUNTY Monterey

LOCATION:
Marina Airport

OTHER SERVICES:
None

JOB NO.
39482

SEC: ____ TWP: ____ RGE: ____ LONG.: ____ LAT.: ____

Permanent Datum: Ground Level , Elev. ____ Ft. Elev.: K.B. U/K Ft.

Log Measured From: Ground Level , 0 Ft. Above Perm. Datum D.F. U/K Ft.

Drilling Measured From: Ground Level G.L. ____ Ft.

Date	Jan. 15, 2005			
Type Of Log	Caliper			
Run No.	One	Two	Three	Four
Depth-Driller	1885 Ft	Ft	Ft	Ft
Depth-Logger	1883 Ft	Ft	Ft	Ft
Top Logged Interval	0 Ft	Ft	Ft	Ft
Btm. Logged Interval	1882 Ft	Ft	Ft	Ft
Type Fluid In Hole	Bentonite			
Fluid Level	Full Ft	Ft	Ft	Ft
Max Temp	97.4 °F	°F	°F	°F
Operating Rig Time	1.25 hr Hr	Hr	Hr	Hr
Van No. / Location	L-22 / Sns			
Recorded By	M. Sharpless			
Witnessed By	A. Henke			

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	TYPE	FROM	TO
1	12.25 In	40 Ft	1885 Ft	12.38 In	Drive	0 Ft	40 Ft
2	In	Ft	Ft	In		Ft	Ft
3	In	Ft	Ft	In		Ft	Ft

Miscellaneous Information

Remarks:

Drilled By: WDC Exploration & Wells

Perforated Intervals:

Line Speed:

Borehole Volume Calculations:

Other Information:

NOTICE

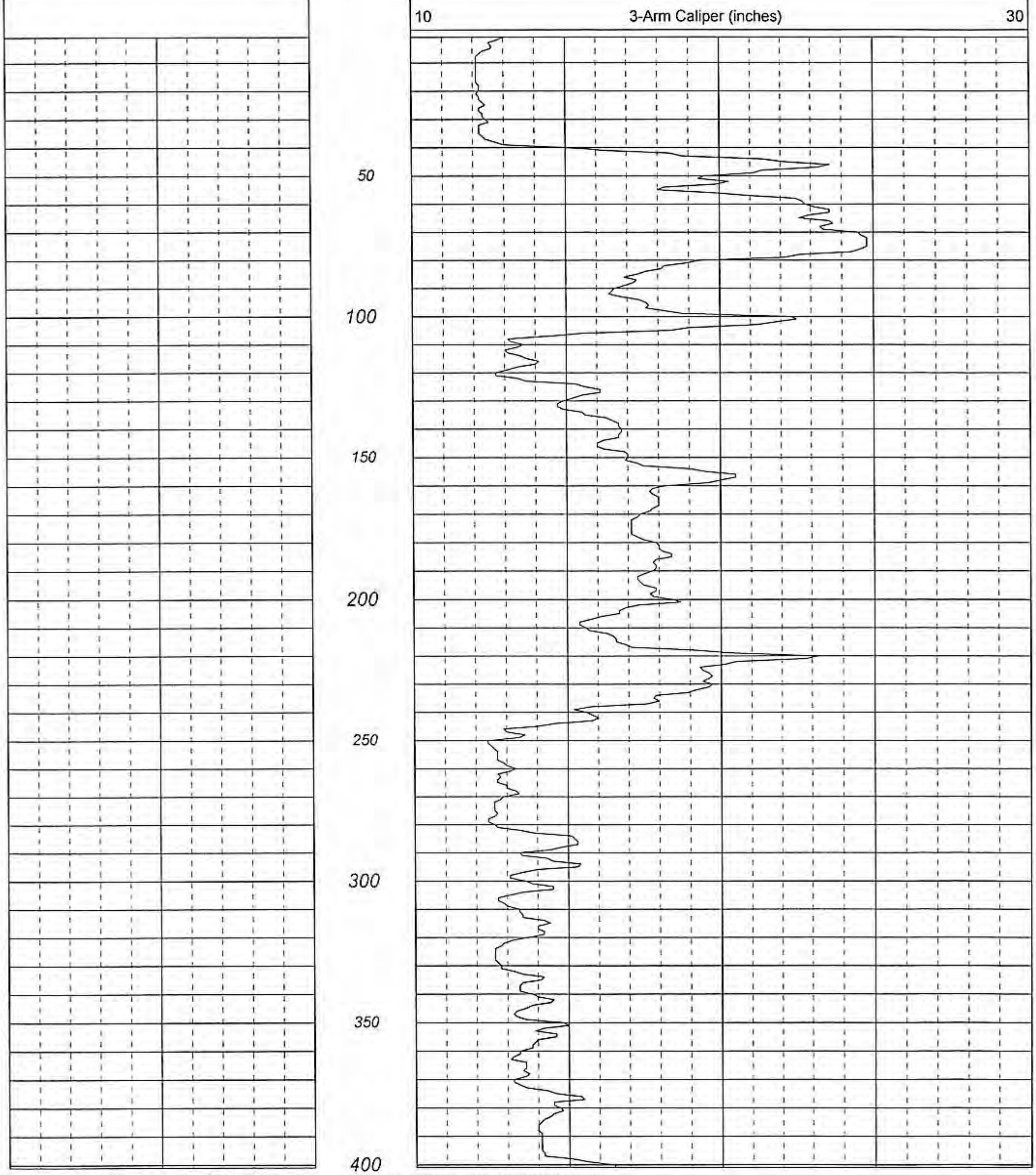
All Interpretations are opinions based on inferences from electrical and other measurements and we do not guarantee the accuracy or correctness of any verbal or written interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

welenco, inc. January 15, 2005

3-ARM CALIPER LOG

DEPTHS

2 in/100ft



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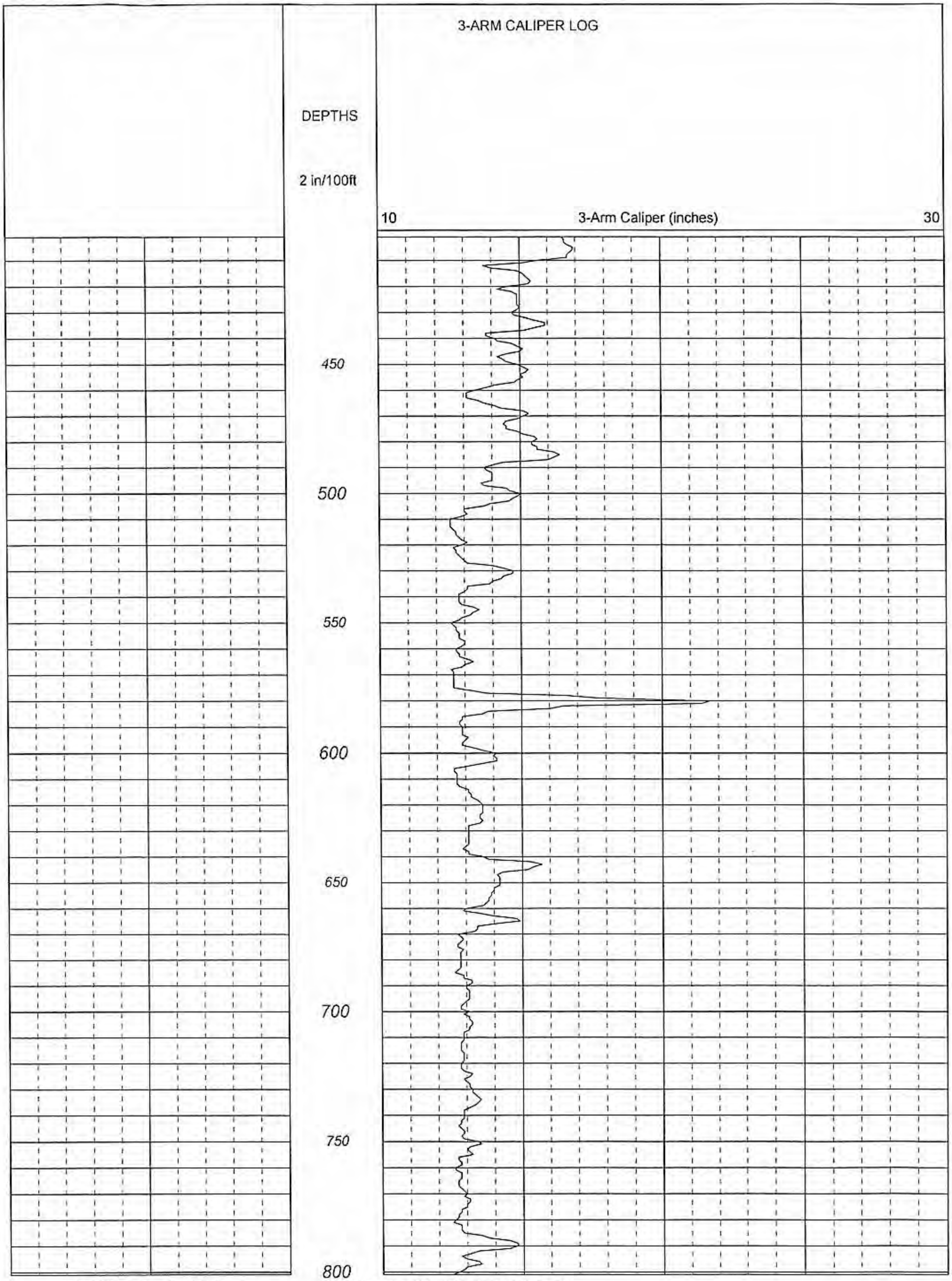

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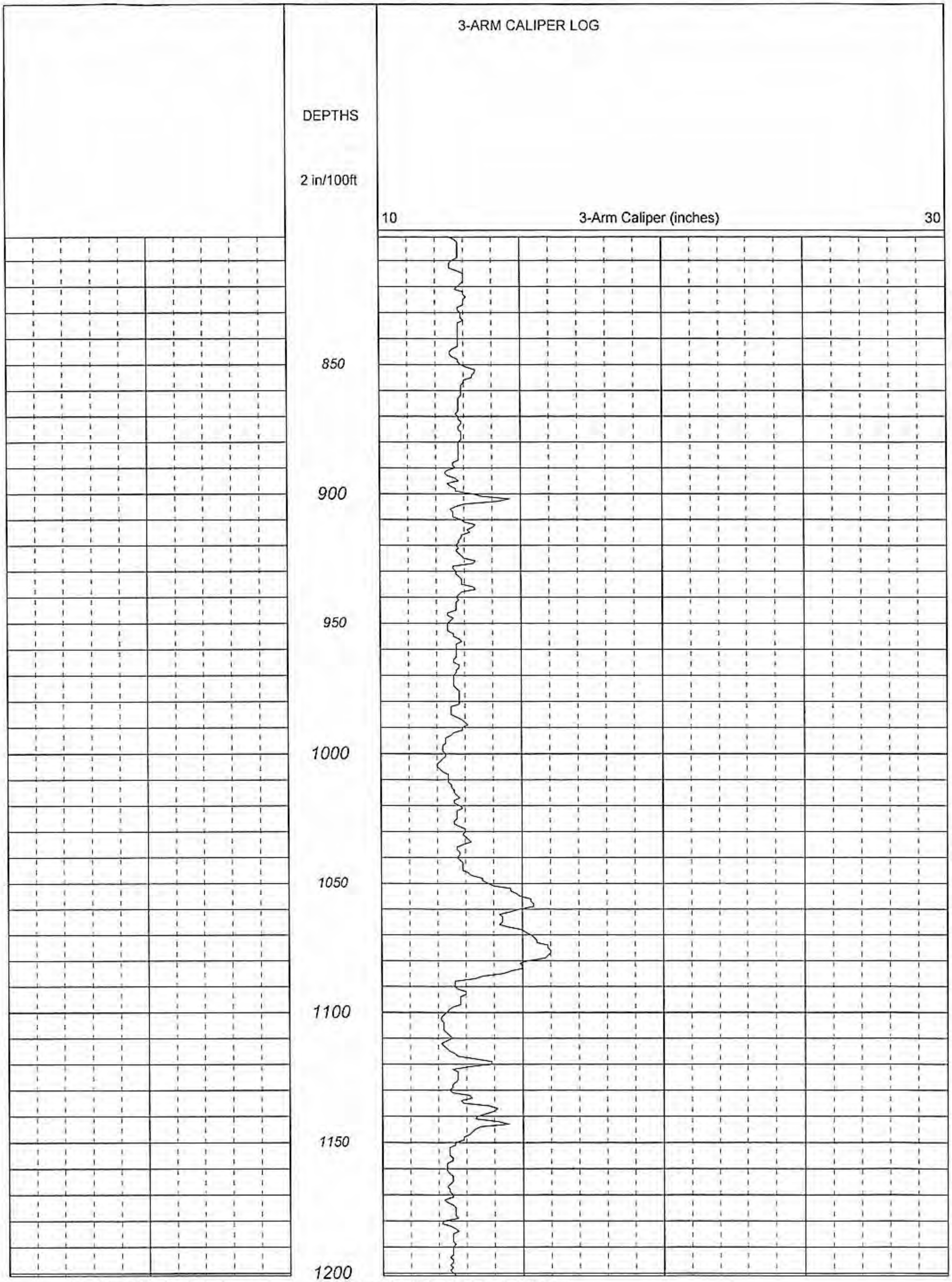

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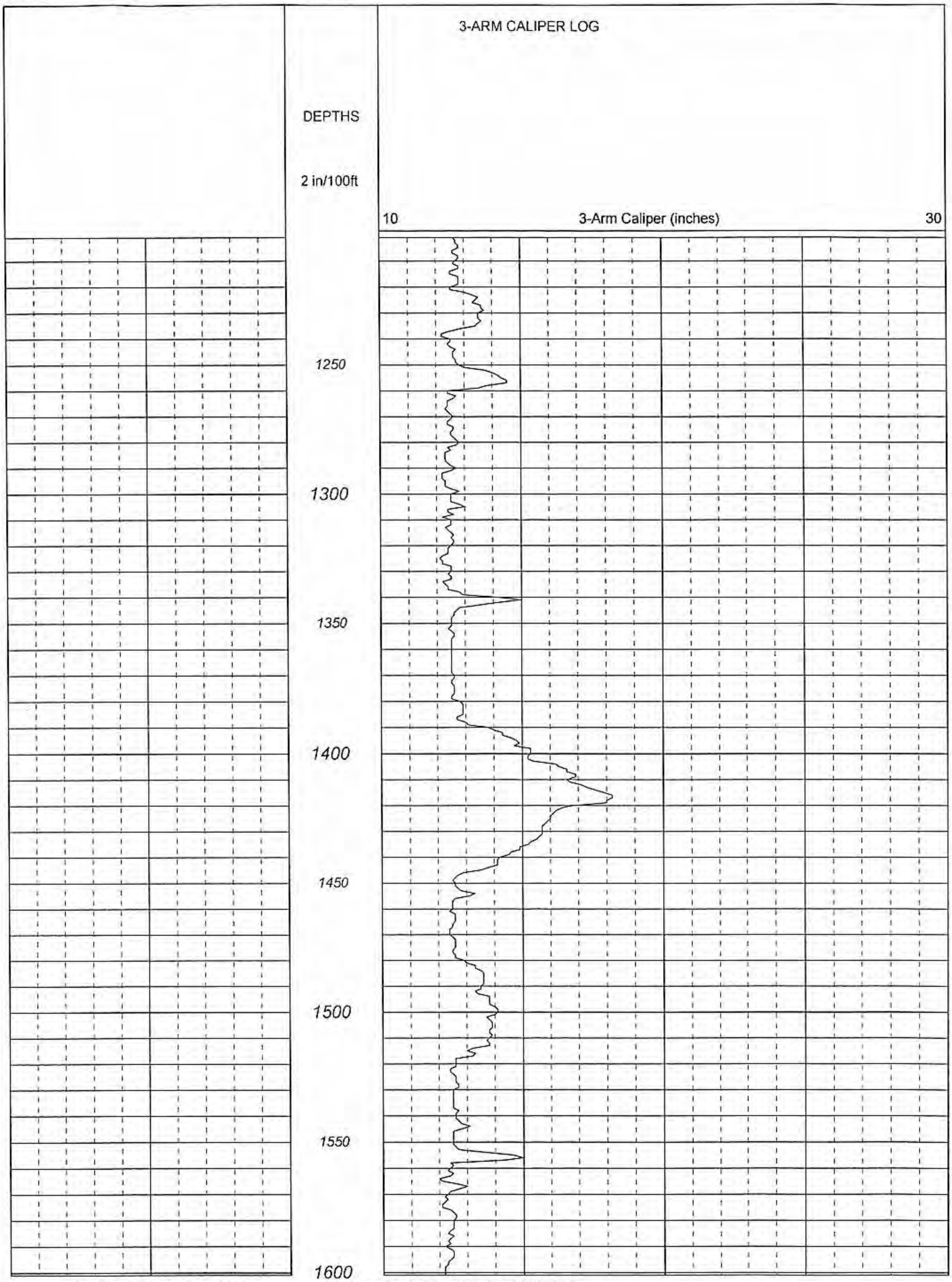

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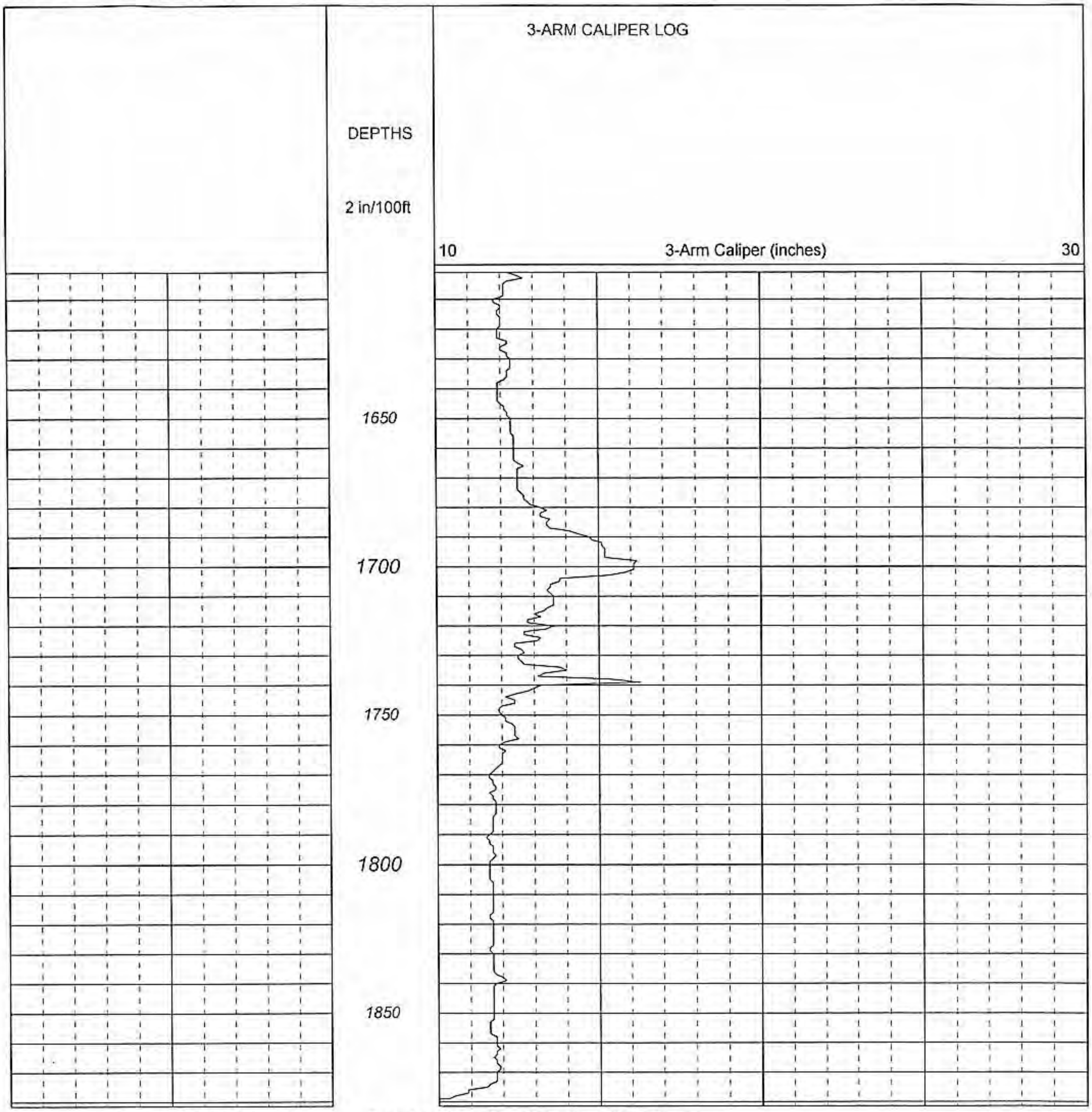


Page Length: 1601 - 1881.5 Feet (280.5 Feet)

Drift-Pac™

Wellbore DRIFT Interpretation Package

Prepared Especially For

MACTEC

Deep Aquifer Test Well #1

January 10, 2005

welenco

Drift-Pac | **Wellbore Drift Interpretation** | **welenco**

Company	MACTEC	**County**	Monterey
Well Number	Deep Aquifer Test Well #1	**Date of Survey**	January 10, 2005
Field	Marina	**Recorded By**	Mark F. Sharpless
Equipment No.	L-23 **Job Number** 39482	**welenco Office**	Salinas
Location	Marina Airport		
Remarks		**Tool Type**	Compass
Drift Calculation Method	Balanced Tangential Method	**Dogleg Calculation Method**	

State C

Magnetic Declination Used

Witness A. Henke

Tool Number 4348

Measured Information			Closure Calculations				Rectangular Coordinates				Dogleg Severity	
Measured Depth, Feet	Inclination, Degrees From Vertical	Azimuth, Degrees, True	Course Deviation, Feet	True Vertical Depth, Feet	Drift Distance, Feet	Drift Bearing Degrees, True	Latitude, Feet	Departure, Feet	Total Latitude, Feet	Total Departure, Feet	Dogleg Severity, Degs/20 Feet	Dogleg Severity, Degs/100 Feet
0.00	0.00	166	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
50.00	0.18	155	0.08	49.99	0.08	155.00	-0.07	0.03	-0.07	0.03		
100.00	0.29	206	0.19	99.98	0.26	178.30	-0.18	-0.02	-0.25	0.01		
150.00	0.29	236	0.24	149.97	0.46	199.10	-0.18	-0.16	-0.43	-0.15		
200.00	0.20	161	0.17	199.96	0.63	201.20	-0.15	-0.08	-0.58	-0.23		
250.00	0.35	165	0.24	249.95	0.83	191.30	-0.23	0.07	-0.81	-0.16		
300.00	0.23	77	0.19	299.94	0.94	181.40	-0.12	0.14	-0.93	-0.02		
350.00	0.26	28	0.19	349.93	0.82	170.80	0.12	0.15	-0.81	0.13		
400.00	0.35	338	0.24	399.92	0.58	167.50	0.24	0.00	-0.57	0.13		
450.00	0.33	337	0.30	449.91	0.30	176.80	0.27	-0.11	-0.30	0.02		
500.00	0.20	329	0.23	499.90	0.12	221.20	0.21	-0.10	-0.09	-0.08		
550.00	0.23	106	0.07	549.89	0.05	213.60	0.05	0.05	-0.04	-0.03		
600.00	0.07	237	0.08	599.88	0.09	154.10	-0.04	0.07	-0.08	0.04		
650.00	0.22	156	0.11	649.87	0.19	163.80	-0.10	0.01	-0.18	0.05		
700.00	0.42	112	0.26	699.86	0.42	142.40	-0.16	0.21	-0.34	0.26		
750.00	0.59	356	0.24	749.85	0.44	110.20	0.19	0.15	-0.15	0.41		
800.00	0.53	324	0.47	799.84	0.39	41.10	0.44	-0.15	0.29	0.26		
850.00	0.15	265	0.27	849.83	0.48	7.10	0.18	-0.20	0.47	0.06		
900.00	0.17	274	0.14	899.82	0.48	350.40	0.00	-0.14	0.47	-0.08		
950.00	0.24	351	0.14	949.81	0.60	343.60	0.11	-0.09	0.58	-0.17		
1,000.00	0.70	344	0.41	999.80	1.01	344.50	0.40	-0.10	0.98	-0.27		
1,050.00	0.36	289	0.42	1,049.79	1.42	339.20	0.34	-0.23	1.32	-0.50		
1,100.00	0.25	16	0.20	1,099.78	1.60	337.30	0.16	-0.12	1.48	-0.62		
1,150.00	0.50	320	0.29	1,149.77	1.90	337.40	0.27	-0.11	1.75	-0.73		
1,200.00	0.42	346	0.39	1,199.76	2.29	336.40	0.34	-0.18	2.09	-0.91		
1,250.00	0.17	243	0.18	1,249.75	2.46	335.50	0.14	-0.11	2.23	-1.02		
1,300.00	0.31	301	0.19	1,299.74	2.57	332.10	0.04	-0.18	2.27	-1.20		
1,350.00	0.29	256	0.24	1,349.73	2.72	328.10	0.04	-0.24	2.31	-1.44		

TVD in Feet 2,019.59 **Final Closure Distance in Feet** 9.16 **Final Closure Bearing in Degrees** 343.10

Measured Information			Closure Calculations				Rectangular Coordinates				Dogleg Severity	
Measured Depth, Feet	Inclination, Degrees From Vertical	Azimuth, Degrees, True	Course Deviation, Feet	True Vertical Depth, Feet	Drift Distance, Feet	Drift Bearing Degrees, True	Latitude, Feet	Departure, Feet	Total Latitude, Feet	Total Departure, Feet	Dogleg Severity, Degs/20 Feet	Dogleg Severity, Degs/100 Feet
1,400.00	0.33	337	0.21	1,399.72	2.90	326.10	0.10	-0.18	2.41	-1.62		
1,450.00	0.36	303	0.29	1,449.71	3.19	325.50	0.22	-0.19	2.63	-1.81		
1,500.00	0.45	22	0.27	1,499.70	3.45	327.20	0.27	-0.06	2.90	-1.87		
1,550.00	0.24	323	0.27	1,549.69	3.67	329.60	0.27	0.01	3.17	-1.86		
1,600.00	0.49	7	0.30	1,599.68	3.95	331.30	0.30	-0.04	3.47	-1.90		
1,650.00	0.67	13	0.51	1,649.67	4.36	335.50	0.50	0.09	3.97	-1.81		
1,700.00	0.34	317	0.39	1,699.66	4.74	337.10	0.39	-0.04	4.36	-1.85		
1,750.00	1.16	20	0.59	1,749.65	5.25	340.20	0.58	0.07	4.94	-1.78		
1,800.00	1.01	356	0.93	1,799.64	6.08	344.40	0.92	0.14	5.86	-1.64		
1,850.00	0.69	324	0.71	1,849.63	6.80	344.20	0.68	-0.21	6.54	-1.85		
1,900.00	1.08	7	0.72	1,899.62	7.51	344.80	0.71	-0.12	7.25	-1.97		
1,950.00	0.88	318	0.78	1,949.61	8.29	344.80	0.75	-0.20	8.00	-2.17		
2,000.00	0.68	333	0.67	1,999.60	8.93	343.30	0.55	-0.39	8.55	-2.56		
2,020.00	0.70	335	0.24	2,019.59	9.16	343.10	0.22	-0.11	8.77	-2.67		

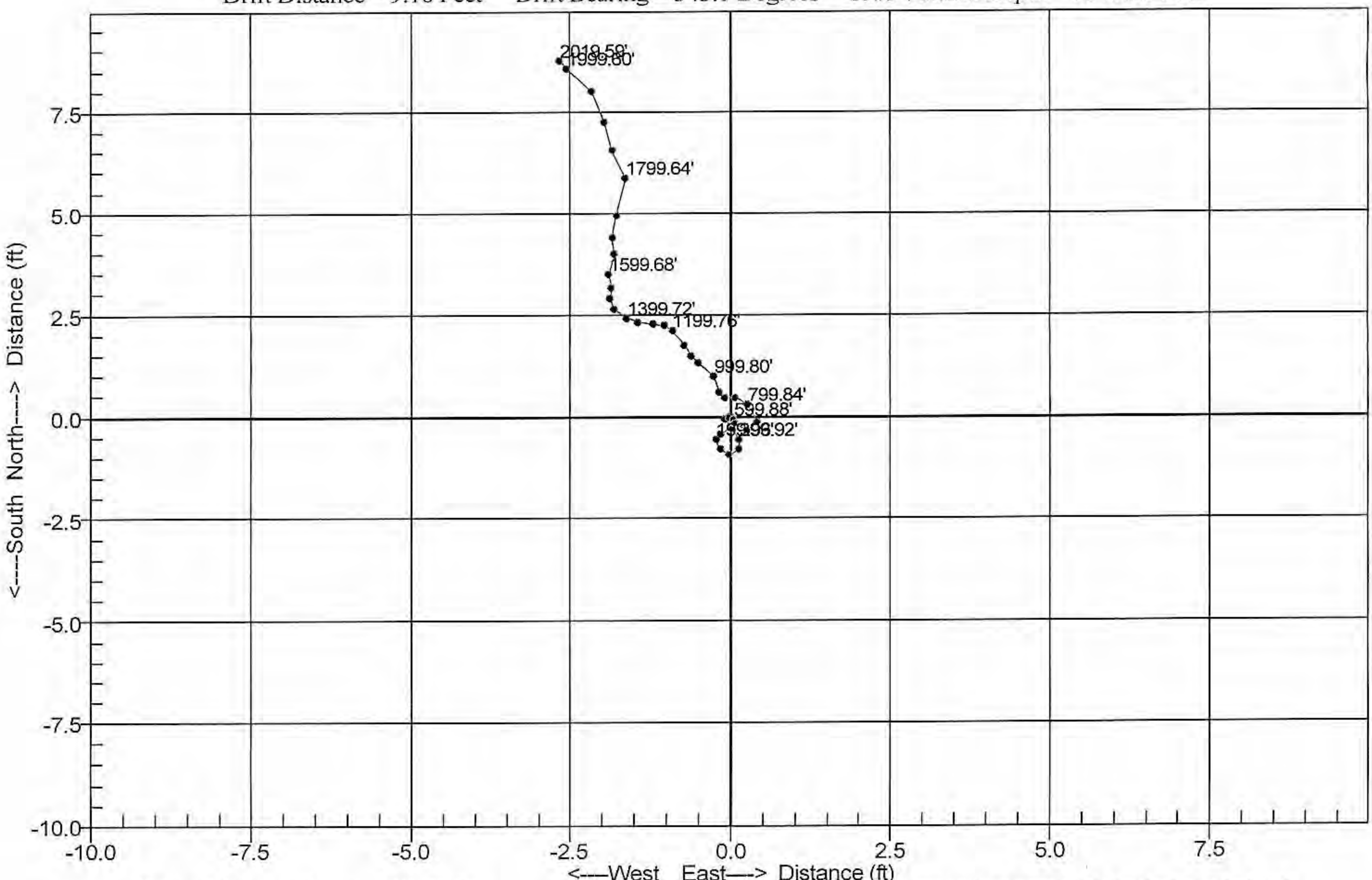
TVD in Feet 2,019.59 **Final Closure Distance in Feet** 9.16 **Final Closure Bearing in Degrees** 343.10

MACTEC

Deep Aquifer Test Well #1

Drift-Pac Plan View

Drift Distance = 9.16 Feet   Drift Bearing = 343.1 Degrees   True Vertical Depth = 2019.59 Feet



Date of Survey: January 10, 2005

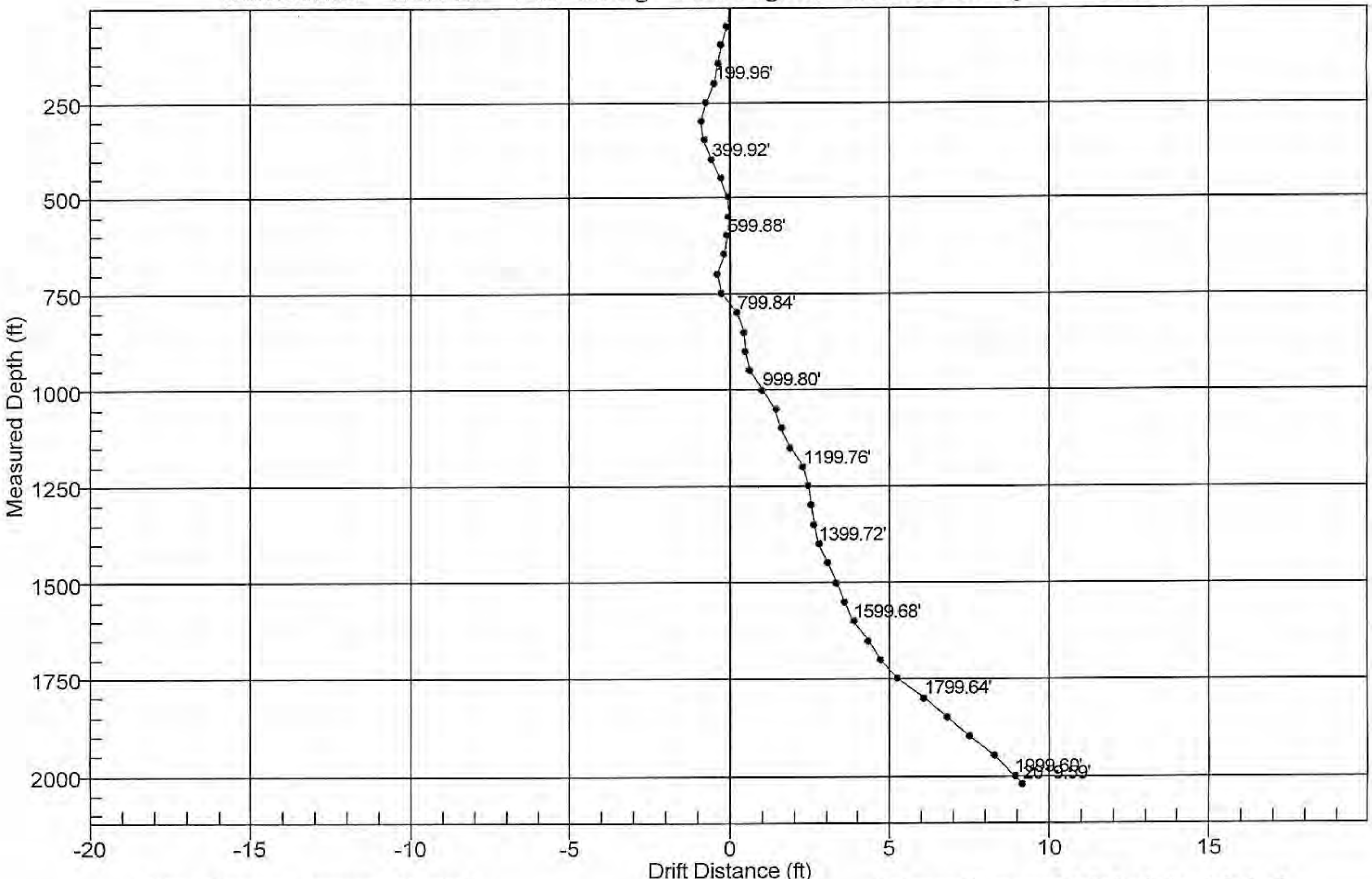
Balanced Tangential Calculation Method

Welenco, Inc. (800) 445-9914

MACTEC

Deep Aquifer Test Well #1
Drift-Pac Plane of Drift View

Drift Distance = 9.16 Feet   Drift Bearing = 343.1 Degrees   True Vertical Depth = 2019.59 Feet



Date of Survey: January 10, 2005

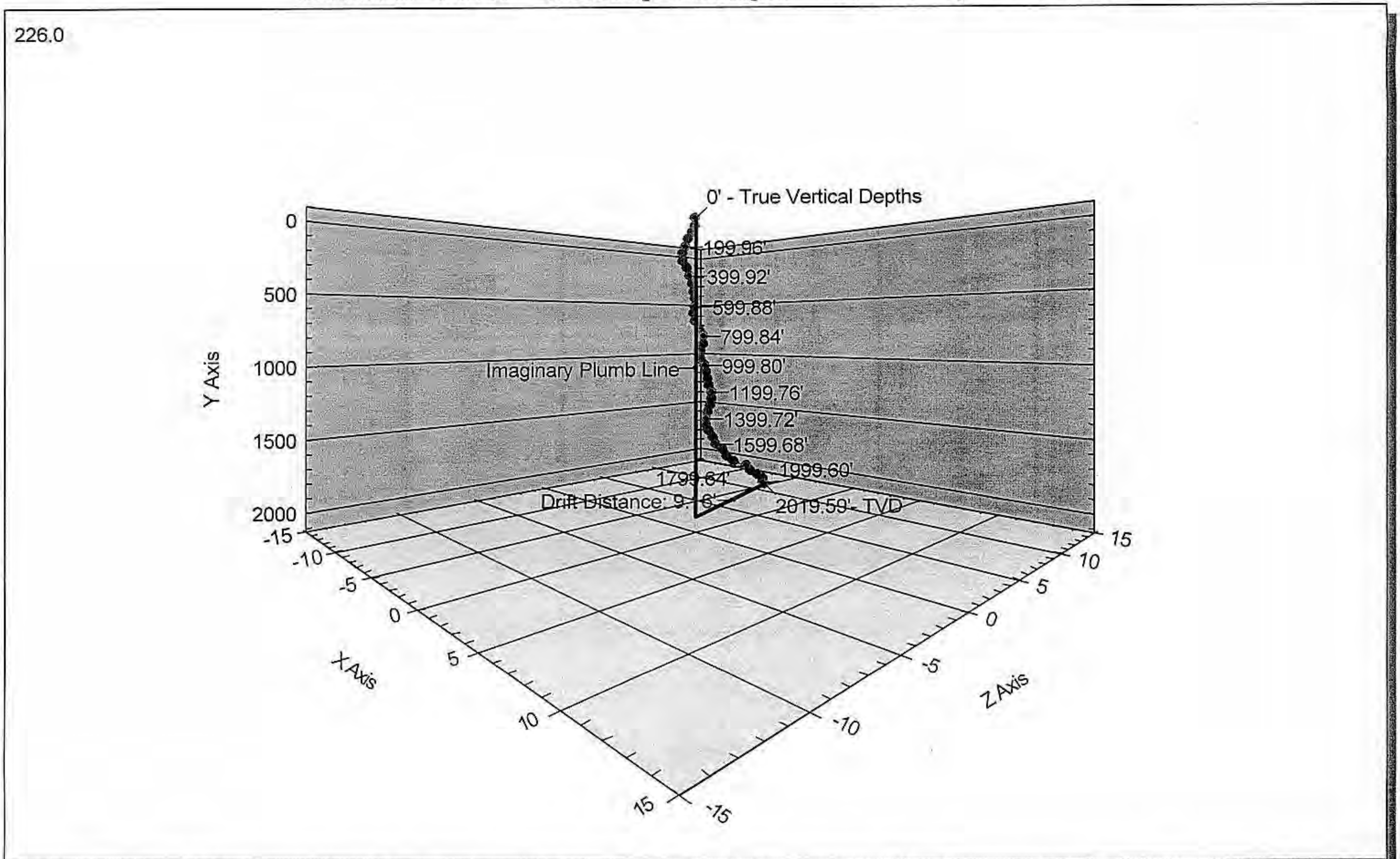
Balanced Tangential Calculation Method

Welenco, Inc. (800) 445-9914

MACTEC

Deep Aquifer Test Well #1
Drift-Pac 3D Projection View

Drift Distance = 9.16 Feet   Drift Bearing = 343.1 Degrees   True Vertical Depth = 2019.59 Feet



Date of Survey: January 10, 2005

Balanced Tangential Calculation Method

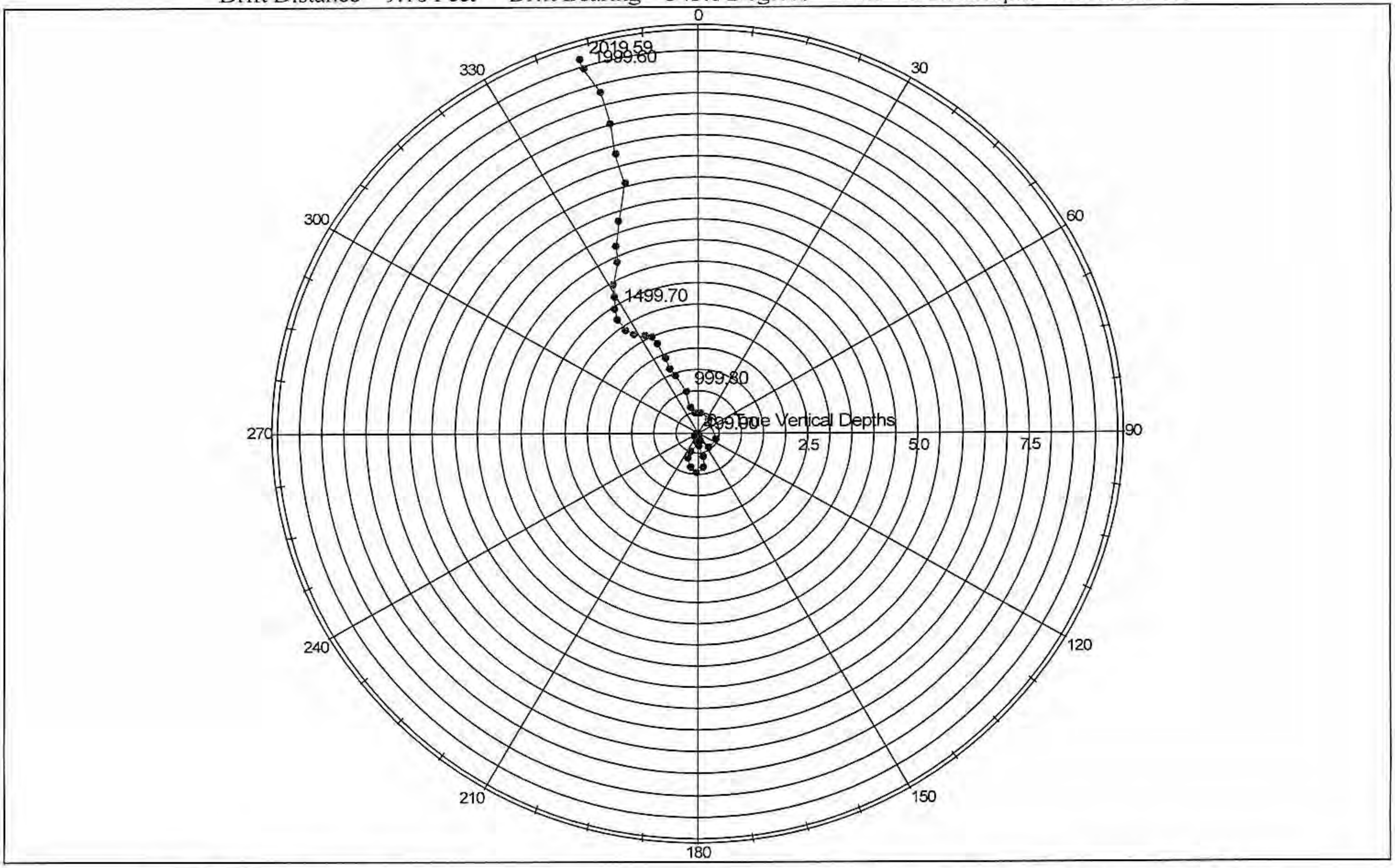
Welenco, Inc. (800) 445-9914

MACTEC

Deep Aquifer Test Well #1

Drift-Pac Polar View

Drift Distance = 9.16 Feet   Drift Bearing = 343.1 Degrees   True Vertical Depth = 2019.59 Feet



Date of Survey: January 10, 2005   Balanced Tangential Calculation Method

Welenco, Inc. (800) 445-9914

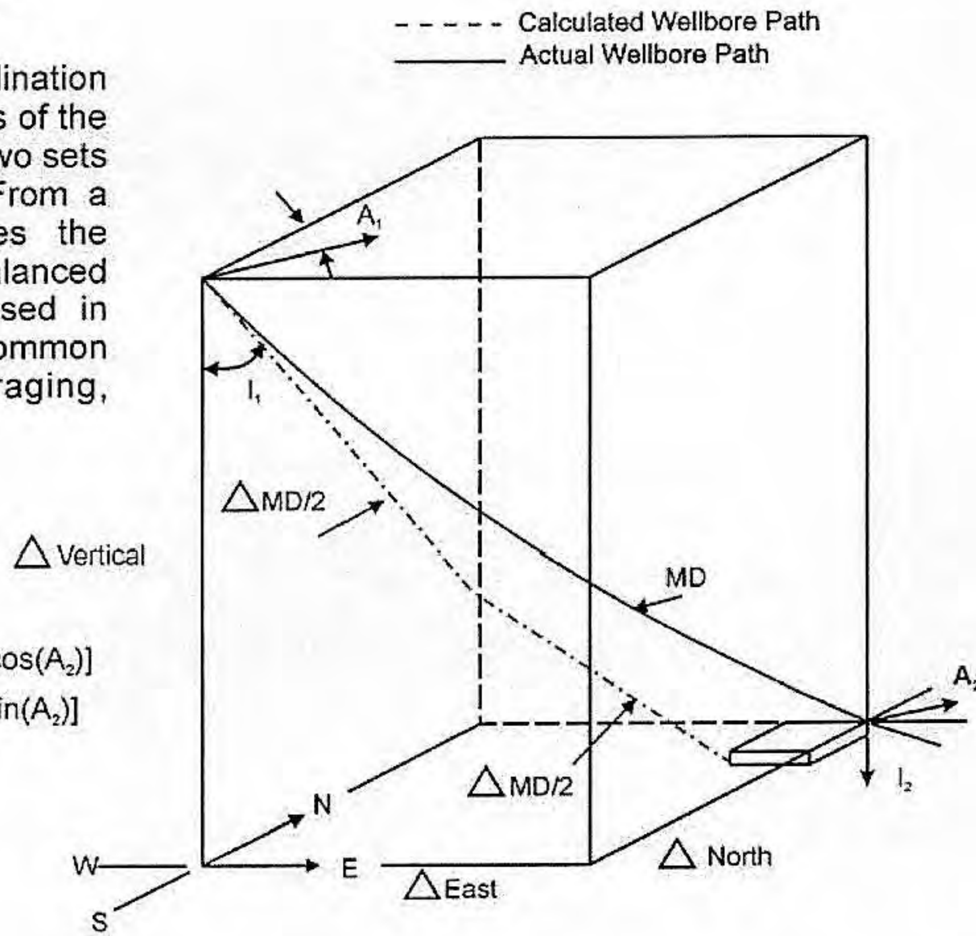
Balanced Tangential Method

The Balanced Tangential Method uses the inclination and direction angles at the upper and lower ends of the course length in a manner so as to balance the two sets of measured angles over a course length. From a theoretical standpoint, this method combines the trigonometric functions to provide the average balanced inclination and direction angles, which are used in standard computational procedures. Other common names for this method are Vector Averaging, Acceleration, and Trapezoidal.

$\Delta \text{North} = [\Delta MD/2] \times [\sin(I_1) \times \cos(A_1) + \sin(I_2) \times \cos(A_2)]$

$\Delta \text{East} = [\Delta MD/2] \times [\sin(I_1) \times \sin(A_1) + \sin(I_2) \times \sin(A_2)]$

$\Delta \text{Vertical} = [\Delta MD/2] \times [\cos(I_2) + \cos(I_1)]$



APPENDIX D

MONITORING WELL DEVELOPMENT LOGS

Well Development Form

Project: MCWD

Well No. PMW - 2 - LOWER

Personnel: A H HENKE

Date: 1/17/05 – 1/18/05

WDC – MUD RIG AIR LIFT DEV.

3" ϕ TD 1735.3 WL ~ 149' 1 VOL = 582 GAL. S.I. 1681 – 1730

Time	Depth to Water (ft)	Gallons Removed	Turbidity (Ntu)	pH	Temp °C	E.C.	Recovery Rate inches/min	Recovery Rate gpm	Observations
1/17/05 1600	TRIP IN 600' OF 2" ϕ TREMMIE PIPE								
1810	BEGIN AIR LIFT DEVELOPMENT – NO WATER LEVEL								
1820	NA	200G	>1000	7.88	27.8	1750			DRILLING MUD. NO SAND
1830		500G	>1000	8.03	26.6	1500			NO SAND
1840		600G – EMPTY BIN – LIGHT GREY SAND AT BOTTOM.							NO #60
1905		600G	>1000	8.06	25.5	1450			SOME FINE, LT. GREY SAND
1910		750G	>1000	8.17	27.9	1550			
1925		1000G	>1000	8.21	29.3	1600			SOME LIGHT BROWN FLOCULES
1930		1200G	>1000	8.22	30.2	1550			
1/18/05 0030		2800G	70.7	8.67	18.5	900			SOME FINE SAND. GREY + LT. BROWN
		PULL TREMMIE							COARSER THAN #60
0650		TAG T.D. AT 1733.7' BGS ≃ 2' OF SEDS IN BOTTOM.							
0900		BAIL SAMPLE OFF BOTTOM: DRILL MUD, LT BRN FINE SAND (LOOKS LIKE #60), BENTONITE LUMPS, AND PIPE DOPE (FROM TREMMIE THREADS)							

B18848-CP

Well Development Form

Project: MCWD

Personnel: AHH, WDC

Well No. DMW-2 - LOWER

Date: 1/19/05 - 1/24/05

3" ϕ

Time	Depth to Water (ft)	Gallons Removed	Turbidity (Ntu)	pH	Temp °C	E.C.	Recovery Rate inches/min	Recovery Rate gpm	Observations
1/19/05 2200	NA	ADD 5 GAL NUWEL220 - 3" SURGE BLOCK - FLUSH TREMMIE WITH 300G FRESH WATER. SURGE SEVERAL TIMES.							
1/21/05 0900		i	>1000	8.01	18.0	3000			AIR LIFT. SILTY YELLOW BRN. 1 VOL ~ 600 GAL.
0930		500G	>1000	8.27	24.5	2000			SOME FINE WHITE SAND.
1025		1420G	388	7.77	28.7	1100			FLOATING FLOCULES SOME RUST COLOUR.
1100		1930G	23.1	8.16	29.9	1000			CLEAR. SLIGHT SULFUR ODOR
1130		2550G	58.5	8.20	30.1	950			
1200		3050	18.5	8.20	29.5	1000			NO SULFUR ODOR
1230		3580	11.4	8.26	29.9	1000			
1300		4080	17.6	8.25	30.0	1000			END DEVELOPMENT FOR DAY.
1/24/05 1015		4080	18.1	8.04	22.2	1000			
1045		4680	16.6	7.93	28.6	1250			MILD SULFUR ODOR
1115		5280	6.65	7.93	28.7	1150			

Well Development Form

Project: MCWD

Personnel: A H HENKE, WDC

Well No. PMW-2 - LOWER

Date: 1/24/05 - 1/25/05

3" ϕ

Time	Depth to Water (ft)	Gallons Removed	Turbidity (Ntu)	pH	Temp °C	E.C.	Recovery Rate inches/min	Recovery Rate gpm	Observations
1/24/05 1145	NA	5580	3.51	7.92	28.2	1100			
1200		6180	2.52	8.08	30.3	1150			
1205		SAMPLE							
1210		TRIP OUT TREMMIE PIPE							
1250	148.5' BGS								
1/25/05 1230	150.0' BGS								
1555		T.D. 1737.9							

B18848-CP

1/1

Well Development Form

Project: MCWD

Well No. DMW-2-UPPER

Personnel: A H HENKE

Date: 1/20/05

WDC [illegible] RIG - AIR LIFT.

2" ∅ T.D. 1100.4, WL ~150 . 1 VOL = 155 GAL.

S.I. 1040 - 1090

Time	Depth to Water (ft)	Gallons Removed	Turbidity (Ntu)	pH	Temp °C	E.C.	Recovery Rate inches/min	Recovery Rate gpm	Observations
1/20/05 0100	RUN IN 2" SURGE BLOCK/SWAB TO 1100 - SWAB 20 TIMES.								VENT HOLE FOR AIRLIFT AT 504' BGS
0400	BEGIN AIR LIFT DEVELOPMENT - NO WATER LEVELS								TREMMIE INTAKE AT 1092' BGS.
0800		~~BIN~~ — 1800 GAL	~~>1000~~ 117	~~8.18~~ 7.40	~~19.5~~ 19.5	~~900~~ 700			AVE. 7.5 GPM PURGE
0830	SURGE SCREEN INTERVAL. PULL TREMMIE. BOTTOM AT ~ 1045								
~1000	NA	~2000 G	>1000	8.35	25.6	650			~17 GPM.
~1110		3200 G	484	8.30	26.1	550			SILTY GREY BROWN
1215		4050 G ~~4500 GAL~~	455	8.41	26.7	650			
1250		4500 G	485	8.41	26.2	1100			
1330		5020 G	408	8.43	26.5	1100			
1430		5800 G	416	8.41	26.3	1100			~37 VOL REMOVED
1430		COLLECT SAMPLE							
1630	160.6 BGS TAG T.D. 1098.2' BGS								
1/24/05 1250	160.1 BGS								
1/25/05 1230	159.5' BGS								

B18848-CP

APPENDIX E

STATE WELL COMPLETION REPORTS

ORIGINAL
File with DWR

Page 1 of 1

Owner's Well No. MCWD DMW-2

Date Work Began Jan 6, 2005, Ended Jan. 25 2005

Local Permit Agency Monterey County, Dept of Health

Permit No. 04-08447 Permit Date 10/19/04

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 737000

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Mud Rotary FLUID Potable water

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
	see attached geologic log.

TOTAL DEPTH OF BORING 2025 (Feet)

TOTAL DEPTH OF COMPLETED WELL 1760 (Feet)

WELL OWNER

Name Marina Coast Water District

Mailing Address 11 Reservation Road

Marina CA 93933

CITY STATE ZIP

WELL LOCATION

Address 3200 Imjin Road

City Marina

County Monterey

APN Book ___ Page ___ Parcel ___

Township 14 S Range R2E Section NA.

Latitude 36 40 24 NORTH (DEG. MIN. SEC.) Longitude 121 45 40 WEST (DEG. MIN. SEC.)

LOCATION SKETCH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial

MONITORING X
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ~100 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 160.1 U/148.5 L (Ft.) & DATE MEASURED Jan 24, 2005

ESTIMATED YIELD * N/A (GPM) & TEST TYPE N/A.

TEST LENGTH N/A (Hrs.) TOTAL DRAWDOWN N/A. (Ft.)

Note: U - Upper well, L - Lower well

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 to 40				✓		Steel	16	5/8	—
0 to 1045		✓				PVC	2-in	sch 80	—
1045 to 1095			✓			PVC	2-in	sch 80	0.20
0 to 1680		✓				PVC	3-in	sch 80	—
1680 to 1760			✓			PVC	3-in	sch 80	0.20

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 to 50	✓			11-sack mix
50 to 1045		✓		Pure Gold
1045 to 1112			✓	#3 w/ #60 TS
1112 to 1680		✓		Pure Gold
1680 to 1771			✓	#3 w/ #60 TS
1771 to 1885		✓		Pure Gold

ATTACHMENTS (✓)

X Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME WDC Exploration
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

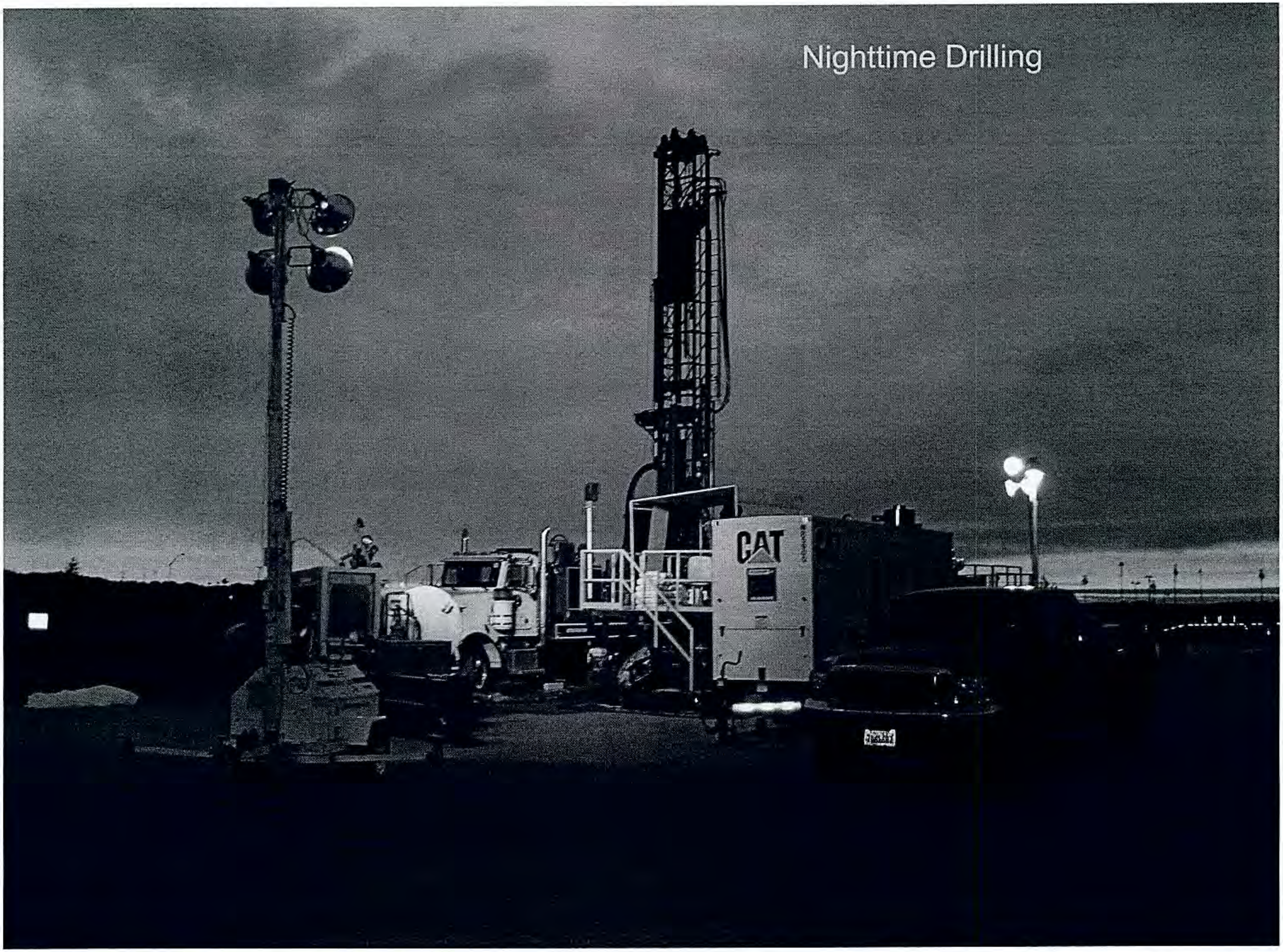
ADDRESS P.O. Box 1141 Zamora CA 95698
CITY STATE ZIP

Signed Jim Whitley 4-18-05 283326
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

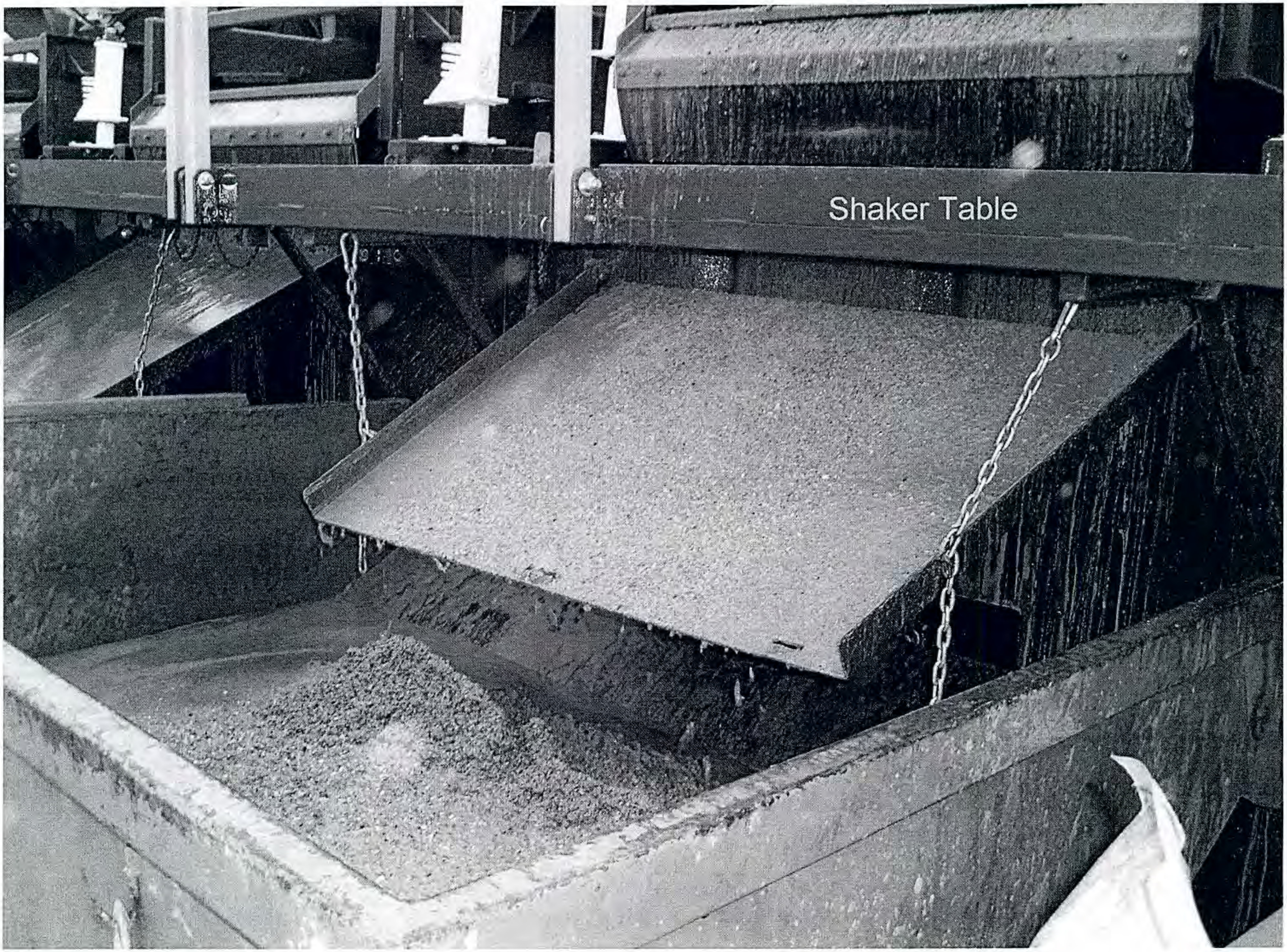
APPENDIX F

DRILLING ACTIVITY PHOTOS

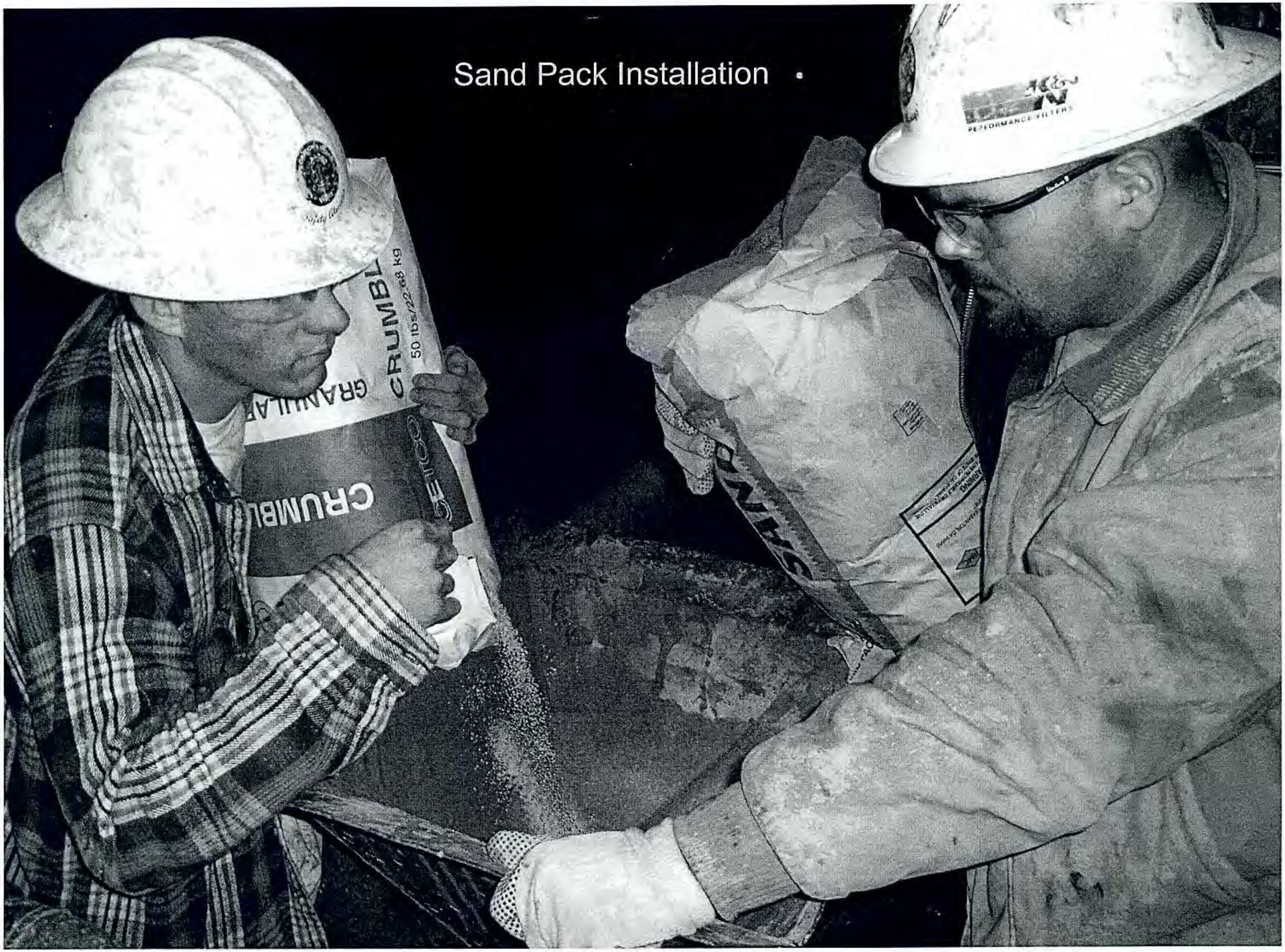

Setting Up the Drilling Rig



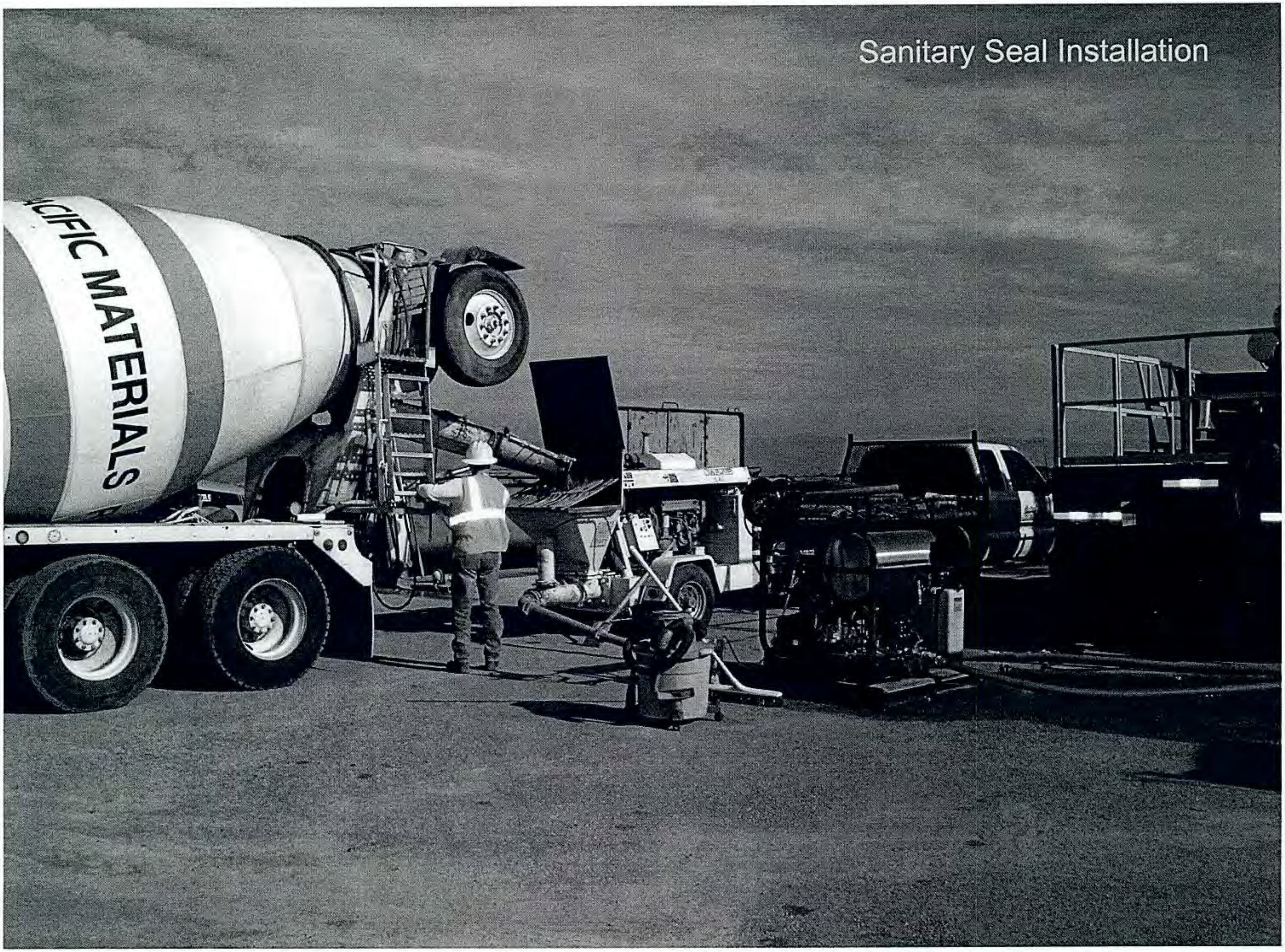
Nighttime Drilling


Shaker Table

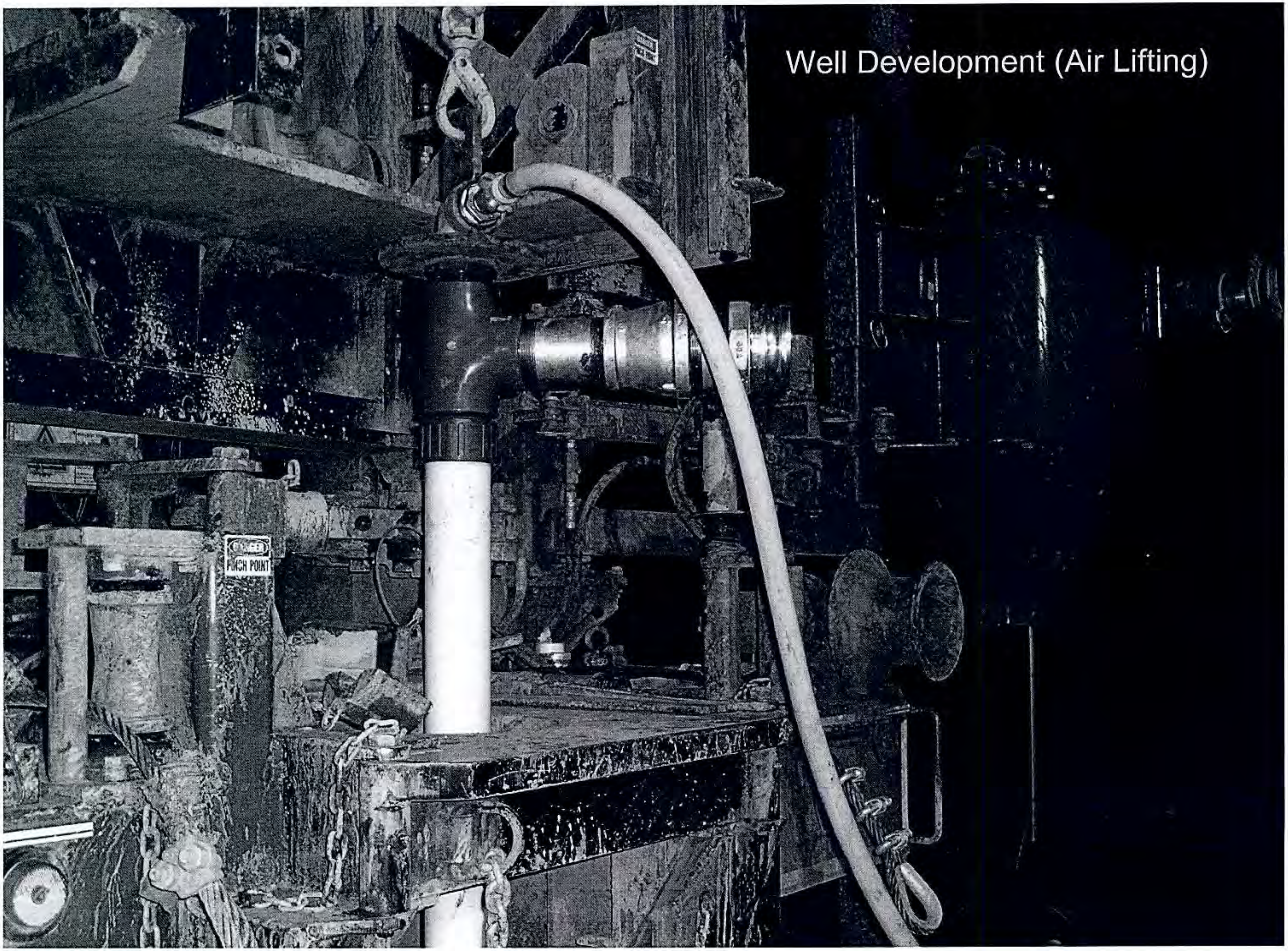

PVC Well Assembly



Sand Pack Installation

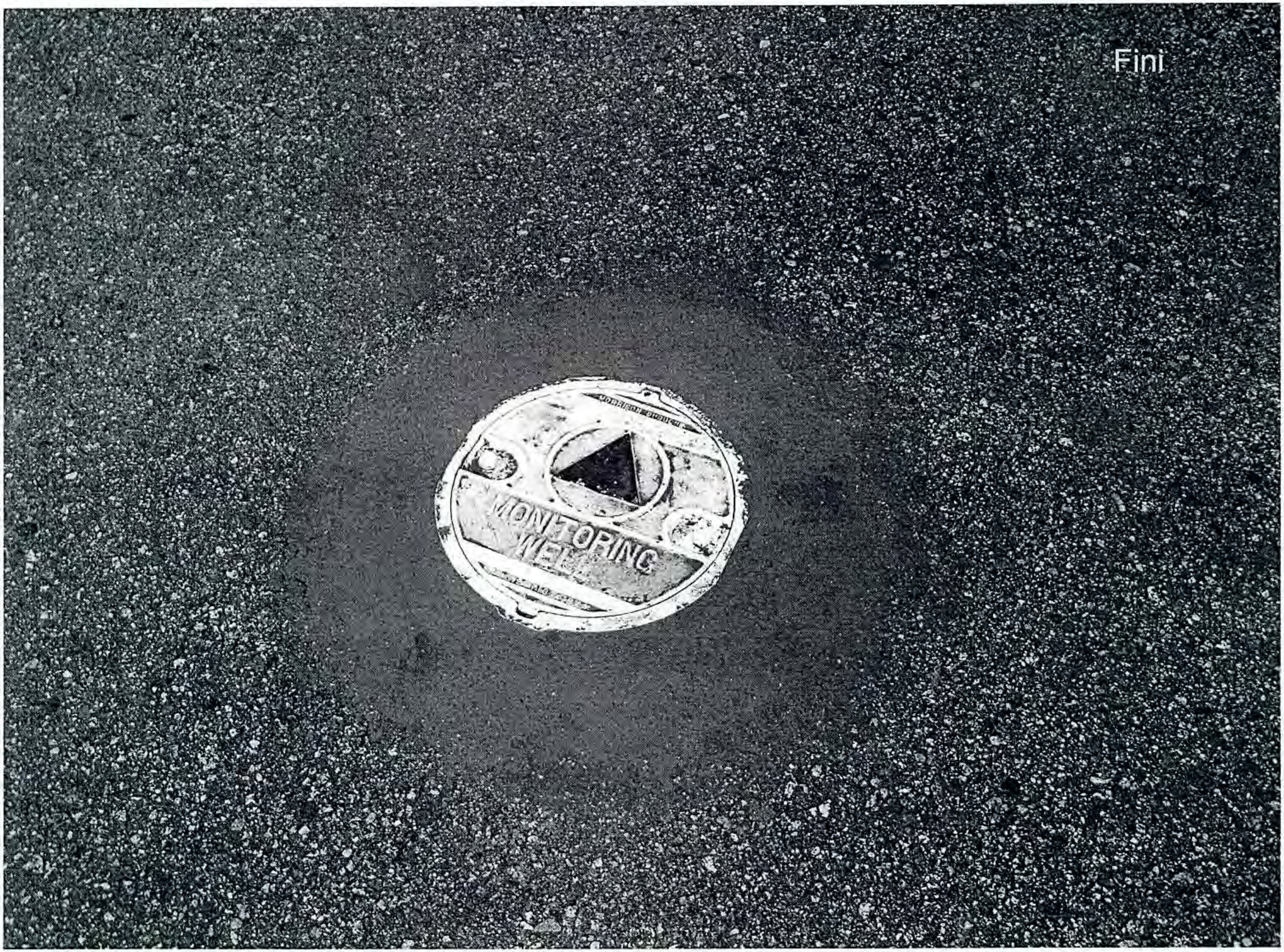


Sanitary Seal Installation



Well Development (Air Lifting)


Well Completion


Fini
MONITORING

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Final Report
Installation of Deep Aquifer Monitoring Wells – DMW-2
Marina Coast Water District
Marina, California

July 7, 2005

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Quality Control Reviewer

William Godwin, CEG
Senior Engineering Geologist

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