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NQA 06-044

December 7, 2006

U.S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555

Docket No. 50-312
Rancho Seco Nuclear Generating Station
License No. DPR-54
RANCHO SECO HYDROGEOLOGIC REPORT, REVISION 1

Attention: John Hickman

As we discussed during your visit here on November 14, 2006, we are sending you copies of the following documents to facilitate your review of the Rancho Seco License Termination Plan:

1. Hydrogeological Characterization Report, Revision1

2. The draft geotechnical evaluation for the proposed evaporation ponds that were never built.

Members of your staff with questions requiring additional information or clarification may contact me at (916) 732-4843.

Sincerely,

Robert E. Jones
Supervising Quality Engineer

Attachment

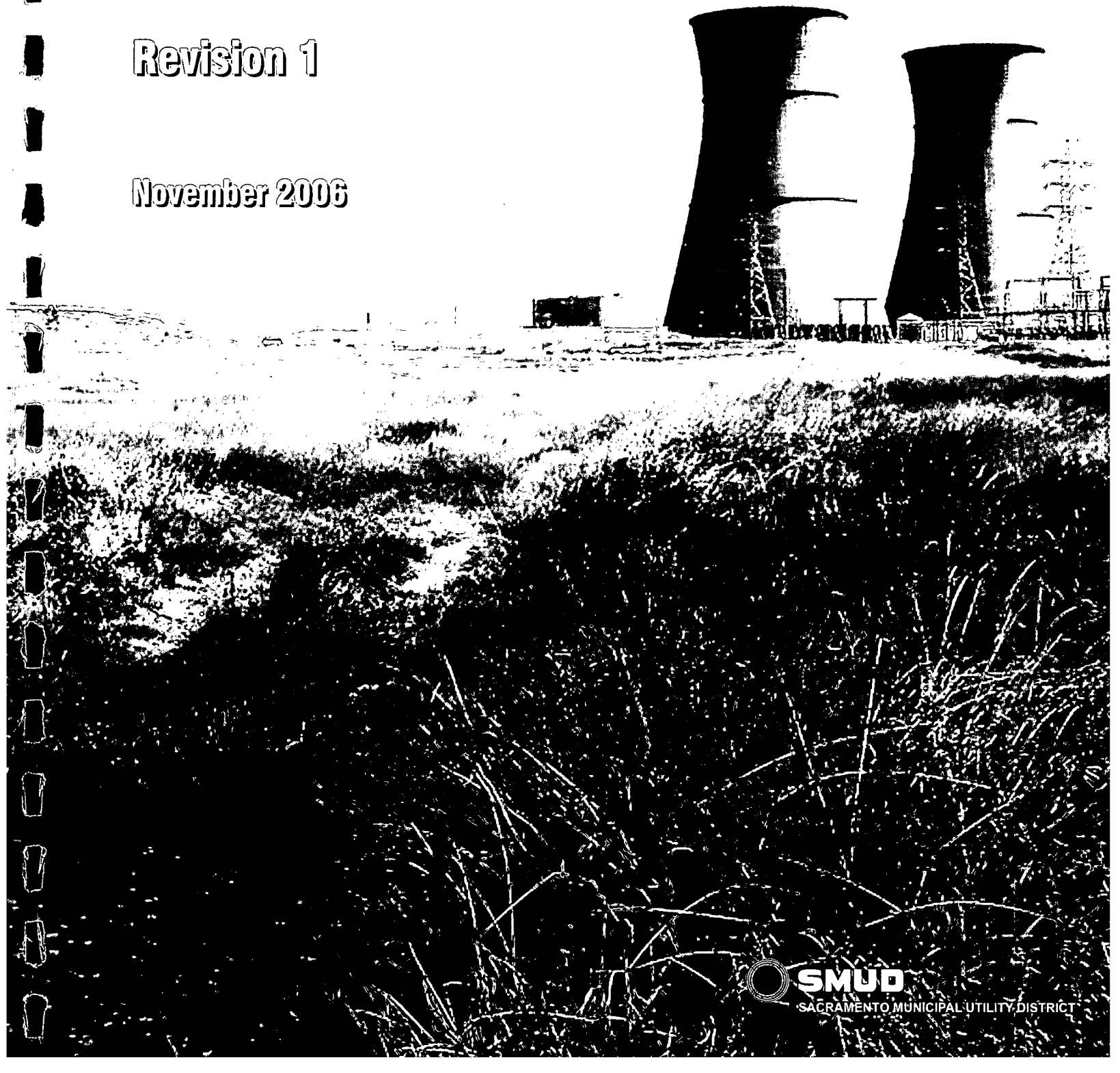
Cc w/ attachment: B.S. Mallett, NRC, Region V

NMSS01

Hydrogeological Characterization of the Rancho Seco Nuclear Generating Station

Revision 1

November 2006



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URS

November 29, 2006

Mr. Einar Ronningen
Rancho Seco Nuclear Generating Station
14440 Twin Cities Road
Herald, California 95638

SUBJECT: Submittal of Hydrogeological Characterization, Revision 1

Dear Mr. Ronningen:

We are pleased to submit with this letter 12 copies of the Hydrogeological Characterization of the Rancho Seco Nuclear Generating Station, Revision 1, revised in response to the request for additional information (RAI) from NRC.

If you have questions concerning this report, please contact Tom Cudzilo (679-2290) or me (679-2247).

Sincerely,

Michael Thomas
Project Manager

URS Corporation
Crown Corporate Center
2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833
Tel: 916.679.2000
Fax: 916.679.2900

Hydrogeological Characterization of the Rancho Seco Nuclear Generating Station

Revision 1

Prepared for:

Rancho Seco Nuclear Generating Station
14440 Twin Cities Road
Herald, California 95638

Prepared by:

URS Corporation
2870 Gateway Oaks Drive, Suite 150
Sacramento, California 95833

November 2006

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bgs	below ground surface
cm/sec	centimeters per second
District	Sacramento Municipal Utility District
meq	milliequivalent(s)
mg/L	milligram(s) per liter
RSNGS	Rancho Seco Nuclear Generating Station
RSPW	Rancho Seco Park Well

This document presents the hydrogeological characterization of the Rancho Seco Nuclear Generating Station (RSNGS). The property is owned and operated by the Sacramento Municipal Utility District (District).

1.1 Purpose

The purpose of the hydrogeological characterization is to determine the site-specific geological, hydrological, and hydrogeological physical parameters required to develop a mathematical site model to calculate soil derived concentration guideline levels for potential radiological contaminants. If the parameters have not been quantified adequately for use in modeling, the characterization identifies uncertainties in the parameter data that should be addressed. The hydrogeological characterization of RSNGS and the mathematical model will support the development of the License Termination Plan for RSNGS. A key component in the development of the model is the conceptual site model.

1.2 Site Description

1.2.1 Location

The RSNGS property, herein called the "site," is in the southeastern part of Sacramento County, California. The site is approximately 25 miles southeast of Sacramento and 26 miles northeast of Stockton, in the central valley of California, between the foothills of the Sierra Nevada Mountains to the east and the Pacific Coast range bordering the Pacific Ocean to the west (Figure 1-1).

1.2.2 Site Description

The nuclear facility consists of an approximately 87-acre fence-enclosed industrial area contained within 2,480 acres of the District-owned and District-controlled property (Figure 1-2). RSNGS had a pressurized water reactor designed and constructed by Bechtel Power Corporation; its nuclear steam supply system, rated at 2,770-megawatt-thermal and 913-megawatt-electric, was provided by Babcock and Wilcox. On the eastern portion of the District-owned property is the Rancho Seco Reservoir created by the damming of an unnamed drainage during construction of RSNGS. The reservoir holds 2,850 acre-feet of water that can be tapped if other water supplies are interrupted. Four groundwater supply wells that produce water as needed were constructed on the site. However, condenser cooling and makeup water for the plant and the reservoir was provided via the Folsom-South Canal, constructed by the Bureau of Reclamation.

1.2.3 Operating History

RSNGS was issued its Title 10 Code of Federal Regulations Part 50 operating license (DPR-54) on August 16, 1974, and attained initial criticality 1 month later, on September 16, 1974. The facility became commercial on April 18, 1975. After approximately 15 years of operation, RSNGS was permanently shut down on June 7, 1989, after passage of a nonbinding referendum by the voters of Sacramento County recommending the District discontinue operation of RSNGS. The reactor was completely defueled on December 8, 1989 (Ref 5.1).

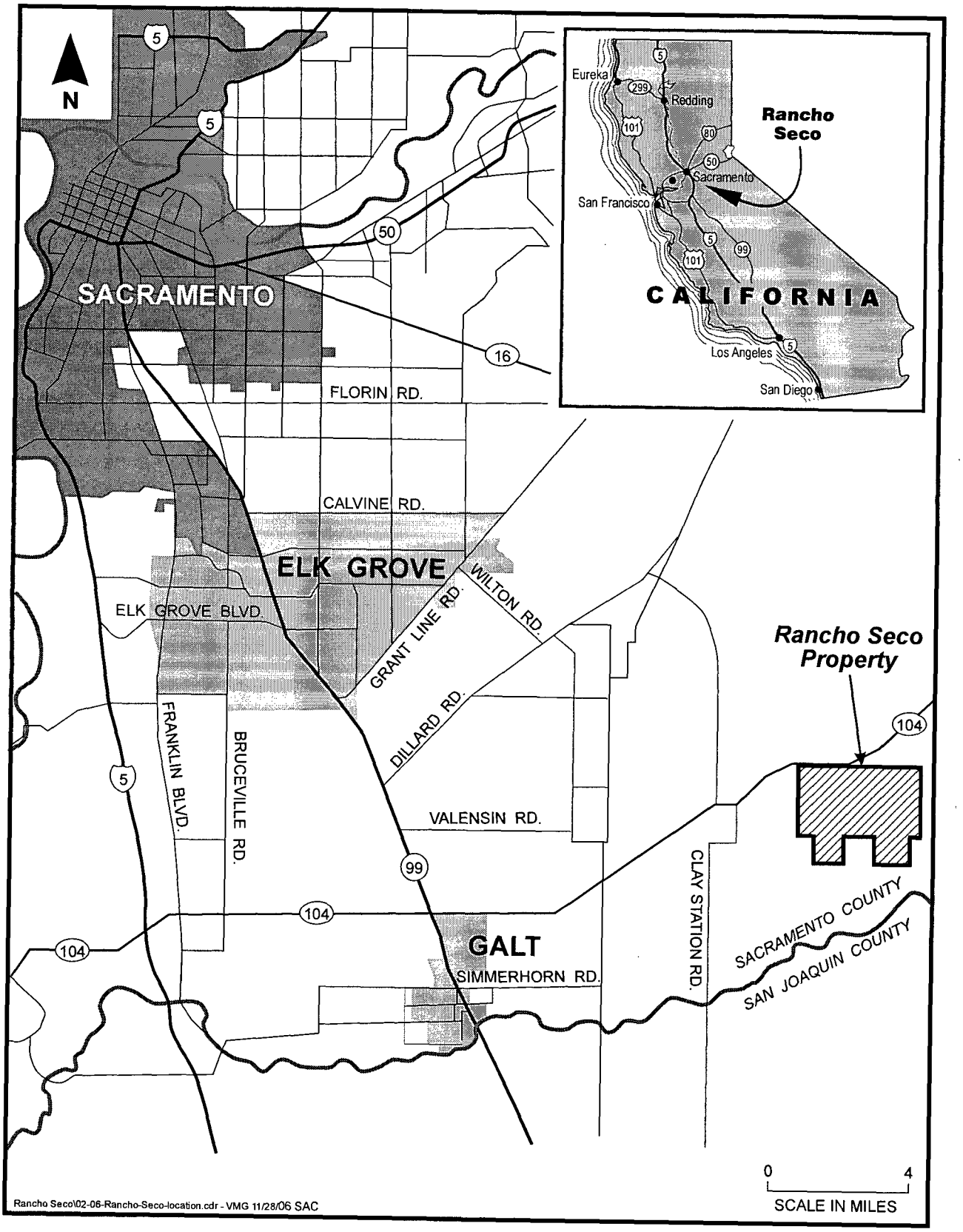

Figure 1-1.
Location of Rancho Seco Nuclear Generating Station

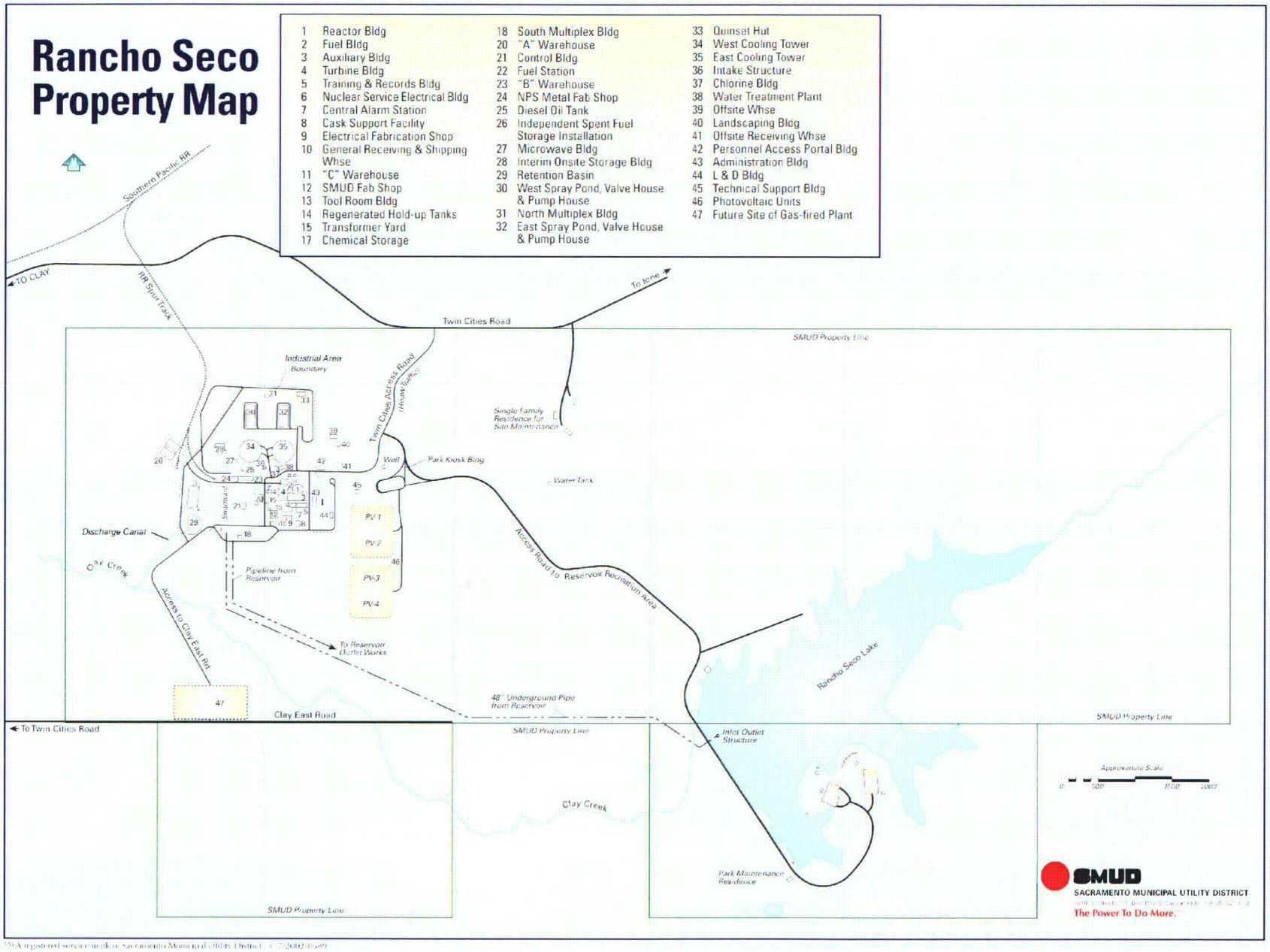

Figure 1-2. Details of Rancho Seco Property Owned by Sacramento Municipal Utility District

1.2.4 Post-Operation Activities

The District formally notified the U.S. Nuclear Regulatory Commission of its intent to permanently shut down the facility, requesting a possession-only license on April 26, 1990. In January 1997, the District's Board approved the Incremental Decommissioning Action Plan. Spent reactor fuel was transferred to the Interim Spent Fuel Storage Installation on the site (Figure 1-2). As of January 2006, the decommissioning project had removed virtually all of the secondary plant systems (with the exception of imbedded or buried piping), including:

- Main Steam;
- Auxiliary Steam;
- Main Feed Water;
- Main Condensate and Makeup;
- Main Circulating Water Pumps;
- Main Turbine and Condenser; and
- Most Support Systems in the Turbine Building.

Within the Auxiliary Building, virtually all systems have been removed. The original Spent Fuel Building dismantling began in October 2002 (Ref 5.1), and the liner plate has been removed.

Within the Reactor Containment Building, significant progress has been made, including the removal of both once-through steam generators, all four reactor coolant pumps and motors, a substantial portion of the reactor coolant system, the reactor building ventilation system, and the support/ electrical/mechanical systems. Significant progress has been made on Reactor Vessel Internals segmentation.

Dismantling activities outside of the facility power block are directed at the removal of temporary buildings and structures and are being carried out in accordance with standard site procedures for the release of potentially contaminated materials and equipment. Final status surveys will be conducted of the "footprint" left from the dismantling of these structures to verify that no residual contamination above the established derived concentration guideline level will remain following license termination (Ref 5.1).

1.2.5 Potential Radiological Contaminant Sources

Most regulated waste from the decommissioning of RSNGS will result from the radiological contamination of plant structures and equipment. The primary source of this contamination was the operation of the facility nuclear reactor and its associated support systems. The radiological inventory of the facility and areas impacted by the release of radionuclides is described in the following paragraphs (Ref 5.1).

Plant systems that were internally contaminated by the operation of RSNGS have been characterized (Ref 5.1).

Evidence indicated that water had leaked from the spent fuel pool within the Spent Fuel Building during reactor operation. Spent fuel pool water was also known to have leaked onto the spent fuel pool cooler pad outside of the Spent Fuel Building. Results of the investigation of soil outside of the Spent Fuel Building in the vicinity of the spent fuel pool cooler pad showed penetration of the soil by liquids from the pool. However, cesium 137 and cobalt 60 concentrations decreased with depth, and 14 feet of soil were scraped and removed, resulting in removal of most of the soil activity. In fall 2004, an investigation was conducted in the soil beneath the spent fuel pool; samples collected below the floor of the pool (down to approximately 25 feet below grade level) had no concentrations indicating penetration of spent fuel pool liquid. Therefore, it is unlikely that contaminated spent fuel pool liquid penetrated to groundwater, which is about 120 feet deeper than the depth sampled.

Outside of the facilities or components mentioned above that had been impacted, several additional areas within the industrial area have been identified as having been impacted radiologically by the operation of the facility (Ref 5.1). These areas have relatively low concentrations of radionuclides; however, several pose a potential threat of migration of radionuclides into soils, surface water, or groundwater dissolved in or carried by liquids. Following are the impacted areas within the industrial area:

- Retention Basins;
- Tank Farm;
- Barrel Farm;
- Regenerant Hold Up Tank areas;
- Storm Drains;
- Oily Water Separator; and
- Turbine Building Drains and Sumps.

1.2.6 New Site Construction

The District has constructed a 30-acre natural-gas-fired power plant on the RSNGS site, approximately 0.5 mile south of the industrial area boundary. Also within the 2,480-acre site are the 560-acre Rancho Seco Reservoir and Recreation Area, a 50-acre solar power (photovoltaic) electrical generating station, and the 0.9-acre, Title 10 Code of Federal Regulations Part 72 licensed Interim Spent Fuel Storage Installation.

1.3 Demography

Land surrounding the site is used in agriculture for grape production, row and silage crops, and cattle grazing. Less than 10 miles west of the site is the City of Galt, which is a rapidly growing community (Figure 1-1). From 1999 to 2025, the population of Galt is expected to grow from 19,000 to 35,500 persons (Ref 5.3). The growth of Galt is important in this characterization because the City of Galt provides water through the operation of six wells distributed throughout the city. As the population increases, more water will be needed, potentially causing more

groundwater removal. Groundwater beneath the site flows west-southwesterly, toward the city of Galt.

1.4 Topography

The elevation of the RSNGS acreage varies from 147 to 195 feet above mean sea level, and drainage along natural gullies varies from 2 to 6 percent. The plant site's rolling terrain is not directly intersected by any streams; however, drainage from higher levels is well defined and intersects with drainage at lower levels. The plant's grade level of approximately 165 feet above mean sea level allows excellent drainage without danger of flooding.

1.5 Meteorology

The climate at the RSNGS site is typical of the Central Valley of California, with hot, dry summers and cool, wet winters. The average annual precipitation estimated for RSNGS is approximately 18 to 19 inches; more than 75 percent occurs between December and March (Ref 5.4). Snow is very rare in Sacramento County; therefore, all of the precipitation is from rain. The average evapotranspiration rate in the Sacramento area is approximately 50 inches per year (Ref 5.5).

In summer, the temperature range may be 35 to 40 degrees Fahrenheit because of cooler marine air that flows through a gap in the Coast Range and across the Sacramento-San Joaquin river delta, lowering the typical 90 to 100+ degrees Fahrenheit daytime highs.

The maximum recorded wind speed in Sacramento County through 1998 was 74 miles per hour. The average wind speed is 6 miles per hour. Tornados are rare in California, averaging five per year; damage from tornados in the state is rarer.

The hydrogeological conceptual model has been developed from all of the surface and subsurface information that has been accumulated for RSNGS. This information consists of surface and subsurface geology, soil parameters, surface and subsurface hydrology, and groundwater-use records.

2.1 Previous Geologic Investigations

2.1.1 Initial Siting Investigation

A soil and foundation investigation program was conducted to establish the suitability of the site and to provide the basic criteria for design of RSNGS. The drilling and sampling program began on June 28, 1967, and was concluded on August 25, 1967. Preceding the drilling and sampling program, a geologic reconnaissance and mapping program was performed by Bechtel geologists in consultation with Roger Rhoades, consultant geologist to Bechtel Corporation. Borings drilled on the RSNGS site included 71 exploratory holes and 1 domestic water supply well (Figure 2-1). The results of the initial siting evaluations are summarized in Section 2.4.7, Wells and Borings, with additional details contained in Appendix 2C, Geology and Seismology, and Appendix 2E, Soils and Foundation Investigation Program, of the District's Unit No. 1 Final Safety Analysis Report (Ref 5.6).

Geophysical logging techniques were employed in DH-23, the deepest geologic boring drilled at the site. These techniques provided a continuous geophysical log of materials with depth between sampling intervals and indicated changes of materials, density, and firmness with depth. Refraction seismograph traverses also were run in the general area of the proposed site using a portable seismic device. The seismic velocities obtained were used to interpret the densities or changes in the properties of subsurface materials with depth.

The entire investigation program was supervised by Bechtel Corporation; the drilling was carried out under a subcontract with Boyles Bros. from Auburn, California, and Myren Drilling of Sacramento, California. Selected soil samples were tested by the Soil Mechanics and Foundation Engineers, Inc., soils laboratory in Palo Alto, California, and supplemented by classification and other testing performed by the District's soils laboratory facility near Placerville, California.

2.1.2 Geotechnical Investigation for Proposed Evaporation Ponds

A geotechnical investigation of a proposed evaporation pond site at RSNGS was performed in summer and fall 1985. The site is located about 0.25 mile southwest of the industrial area, in an area of gently rolling topography underlain by unconsolidated alluvium and poorly consolidated sedimentary rocks. The purpose of the geotechnical investigation was to collect subsurface geologic and soils data for use in evaluating the suitability of the site for the proposed evaporation ponds and to establish a baseline groundwater and soil pore water monitoring system. The ponds were not constructed.

The fieldwork included soil sampling, permeability testing, installation of observation wells and lysimeters, water sampling, and measurement of groundwater levels. Four permeameter holes were drilled for testing permeability of near-surface soils. Four observation wells and two

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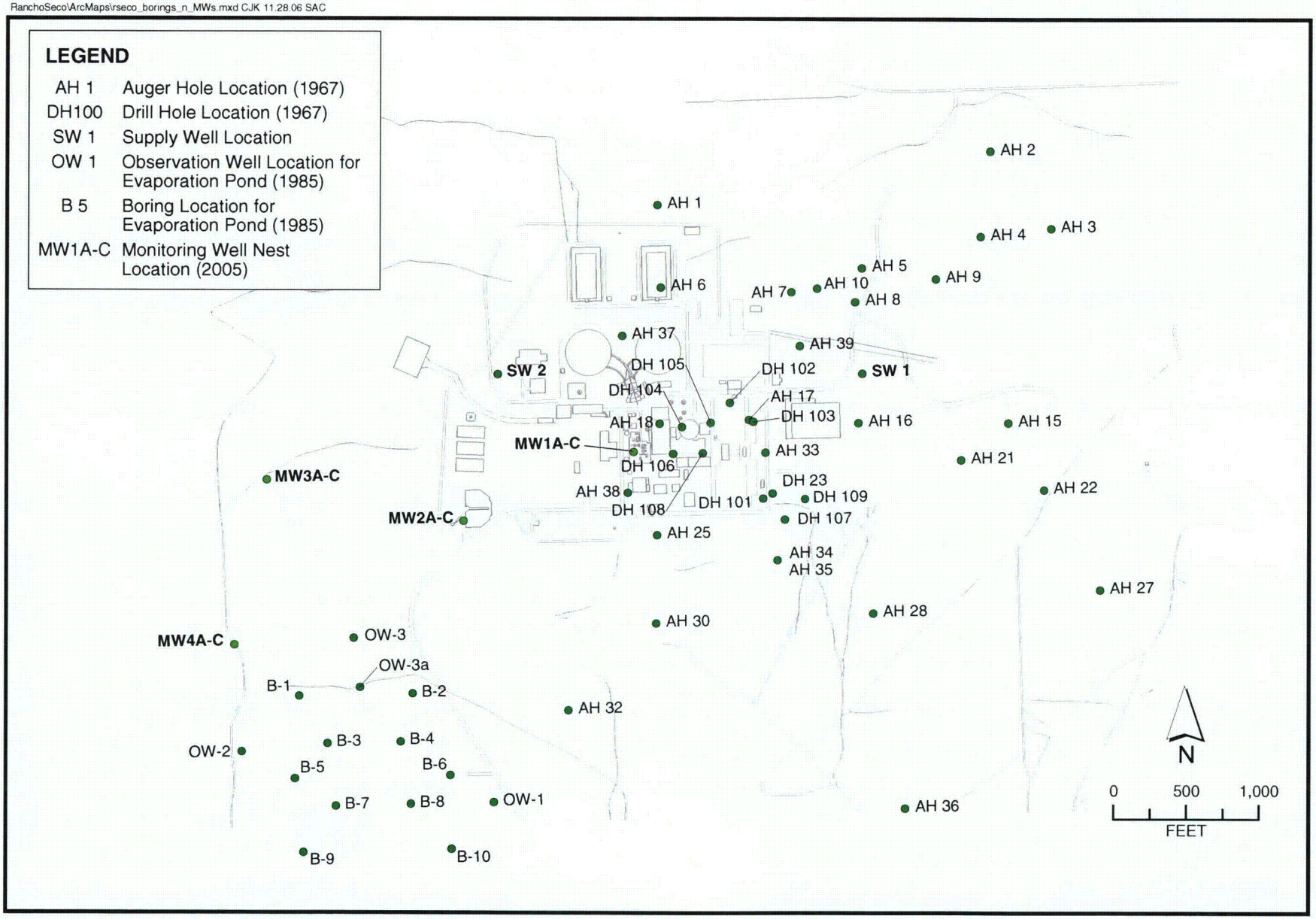


Figure 2-1. Locations of Borings Drilled and Sampled at Rancho Seco NGS

lysimeters were installed. Four test pits were dug for bulk soil samples and 10 soil borings were drilled to collect soils samples for laboratory testing. The water table at this location is at a depth of approximately 150 feet.

Using data from the field program, the effect of a hypothetical pond liner failure on downgradient groundwater quality was analyzed. Based on conservative distribution coefficient assumptions, and considering the effects of adsorption, a travel time of over 20,000 years was calculated for a radiological contaminant to reach the nearest downgradient well 2,200 feet southwest of the evaporation pond site.

A complete description of the geotechnical investigation and its results is contained in *Geotechnical Investigation for Proposed Evaporation Ponds* (Ref. 5.7).

2.1.3 2005 Update Investigation

To reduce uncertainties in the hydrogeological conceptual model, an investigation was undertaken in 2005. The investigation plan was presented to a group of Nuclear Regulatory Commission personnel at their Headquarters in November 2004 to gain preliminary approval of the investigatory approach. At the time that the plan was presented, seven nests of wells were thought to be necessary to fully evaluate hydrogeology and obtain parameters for modeling. However, four nests may be adequate to complete the assessment.

In the investigation, nests of monitoring wells were constructed at four locations between potential sources of contamination (Turbine Building, Spent Fuel Pool, Retention Basin) and the RSNGS property boundary (Figure 2-1). Each nest was intended to have three monitoring wells constructed within one boring. The monitoring wells were constructed such that the well screens were emplaced at three different depths within the boring. Table 2-1 lists the drilling and construction details of each of the well locations. Drilling and construction of wells were permitted by the Environmental Management Department of the County of Sacramento.

The 12-inch-diameter borings were drilled with mud rotary drilling equipment. The subsurface materials being penetrated by the drill were described by the on-site geologist using the drill cuttings brought to the surface by the drilling mud. Drilling logs and construction details are presented in Appendix A. Samples of soil and rock above the water table were collected with split-spoon equipment at three different depths in the borings for MW1 and MW2.

The first boring was drilled into dense sandstone or siltstone at 400 feet below ground surface (bgs). The nature of the rocks penetrated below 320 feet bgs in that boring indicated that vertical migration of any contaminants would be slowed, if not stopped, by the condition of the rock. Subsequent borings were drilled to 300 to 340 feet bgs after penetrating the top of the same dense rock that would impede contaminant migration. After drilling of each boring, the construction of the three monitoring wells in the boring was decided by the on-site geologist in consultation with a California Certified Hydrogeologist. Between the screen intervals in adjacent wells are at least 35 feet of less permeable material than that in the screen interval. After the screen decision was made, the wells were constructed with clean, low-carbon steel casing and screen. Following construction of each well nest, each well in the nest was developed to assure

groundwater would flow into the screen. All of the wells were developed and water flowed into the screen, with the exception of MW1A, the well with the shallowest well screen at location MW1. The shallowest well in each nest is labeled "A;" the "B" and "C" wells are successively deeper in the boring.

Nine months after construction, Well MW1A had not provided any water level information or groundwater samples. The well screen at 160 to 170 feet bgs has been above the groundwater level since the well was completed. During drilling, it was not possible to confirm that groundwater was present at 160 feet bgs because, when drilling with the mud rotary technique, water containing drilling mud is added to the boring during drilling. Little loss of drilling mud occurred while the drill penetrated through the 140 to 170 feet bgs because the material was a plastic clay; therefore, the penetrated material seemed to be water saturated. Previous work at the site and water-level measurements in existing wells indicated that the groundwater surface would be approximately 140 to 150 feet bgs. Groundwater depths in Wells MW1B and MW1C were greater than 182 feet bgs in December 2005. MW1B has sampling equipment stuck in the casing and cannot be sampled. A new well (MW1D) was constructed near the MW1A location in February 2006. The well will be sampled after it is developed.

2.2 Geology and Physical Parameters

Geology. The RSNGS site is located within the Great Valley Geomorphic Province, which is a wide structural trough bounded by the Sierra Nevada on the east and the Coast Range on the west. The surface geology of RSNGS and the city of Galt, California, is shown on Figure 2-2 (Ref 5.8). The youngest alluvial deposits occur farthest west, near the City of Galt and Interstate 5. The deposits exposed at the surface are older as one moves east toward RSNGS.

The stratigraphy of the RSNGS site consists of the following deposits:

- Recent alluvium consisting of stream-deposited gravel, sand, and silt. This material is confined to present drainage courses and ranges in depth from 0 to 5 feet bgs.

- Older alluvium consists of old stream and terrace deposits of gravel, sand, and silt. This material covers the floodplains in the southwestern portion of the site and deposits of well-rounded cobbles, pebbles, and sand derived chiefly from pre-Cretaceous sediments on pediment surfaces. This category includes the equivalents of the Modesto and Riverbank formations. The thickness on site is 0 to 20 feet.

- The Laguna Formation consists of sand, silt, and some gravel; it may or may not contain clay. It is made up of poorly bedded materials of silicic volcanic origin. This formation occurs at the surface across much of the site; its bottom boundary has been encountered at depths of approximately 130 feet bgs.

- The Mehrten Formation consists of fluviatile sandstone, siltstone, and conglomerate composed primarily of andesitic detritus. Locally, it contains horizons of coarse andesitic agglomerate of mudflow origin. This formation is encountered at the surface west of the industrial area and has an approximate thickness of 225 feet beneath the site.

Table 2-1. Construction and Water Elevation Data

Well ID	Northing	Easting	Screen Interval (feet bgs)	Water Use	Groundwater Elevation, December 6, 2005 (feet msl)	Vertical Gradient Between this Well and Shallower Well (ft/ft)	Water Elevation March 2006	Vertical Gradients for March 2006	Water Elevations for June 2006	Vertical Gradients for June 2006
MW1A	1888419.45	6813523.57	160 – 170	Monitoring	NA	—	Dry	NA	Dry	
MW1B	1888419.16	6813522.97	210 – 220	Monitoring	-18.82	NA	Obstruction	NA	Obstruction	
MW1C	1888419.56	6813522.92	290 – 300	Monitoring	-19.33	-0.0064	-19.22		-19.45	
MW1D	NA	NA	200 – 220	Monitoring	NA	NA	-18.74	-0.0056	-18.97	-0.0056
MW2A	1887946.55	6812353.12	200 – 210	Monitoring	-22.54	—	-22.46		-22.78	
MW2B	1887945.27	6812352.87	265 – 275	Monitoring	-22.91	-0.0057	-22.61	-0.0023	-22.87	-0.0014
MW2C	1887946.21	6812353.24	320 – 340	Monitoring	-22.92	-0.0002	-22.65	-0.0007	-22.83	+0.0007
MW3A	1888224.36	6810988.02	200 – 210	Monitoring	-24.56	—	Not accessible		-26.27	
MW3B	1888224.00	6810987.93	265 – 275	Monitoring	-24.62	-0.0009	Not accessible		-26.36	-0.0014
MW3C	1888224.13	6810988.28	310 – 320	Monitoring	-24.71	-0.0020	Not accessible		-26.34	+0.0004
MW4A	1887086.40	6810770.31	195 – 205	Monitoring	-29.02	—	-26.74		-27.04	
MW4B	1887086.44	6810770.72	251 – 261	Monitoring	-29.06	-0.0007	-26.70	+0.0007	-27.01	+0.0005
MW4C	1887086.10	6810770.56	310 – 320	Monitoring	-28.99	+0.0012	-26.67	+0.0005	-27.02	-0.0002
OW-2	1886349.74	6910826.33	168 – 177	Monitoring	-28.7	NA	-27.04	NA	-27.23	NA
OW-3	1887127.52	6811602.60	177 – 187	Monitoring	-26.54	NA	-24.80	NA	-24.90	NA
SW-1	NA	NA	156 – 400	Water supply	NM	NA	NM		NM	
SW-2	NA	NA	254 – 295	Water supply	NM	NA	NM		NM	

NA = not available
NM = not measured

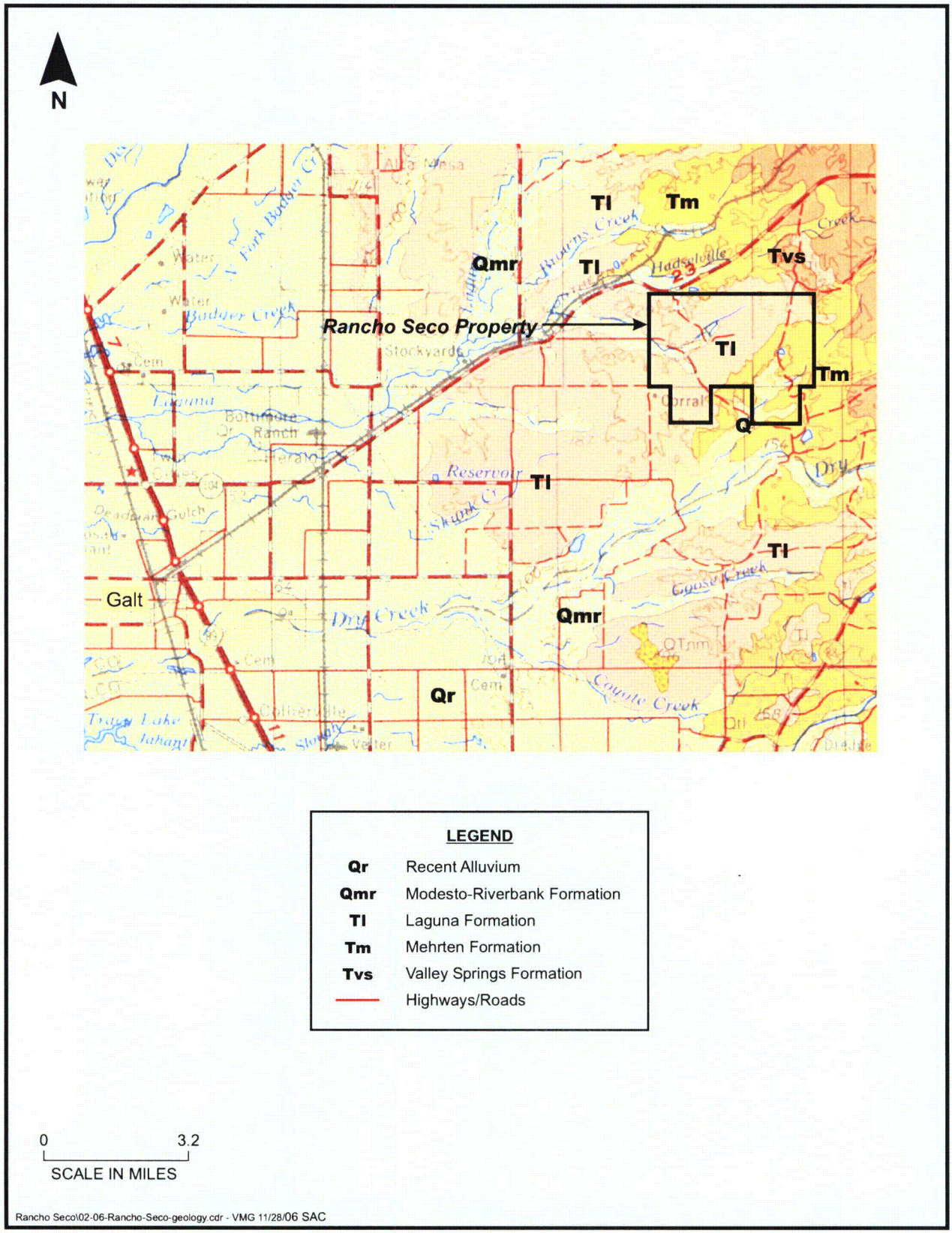


Figure 2-2.
Geologic Map of Area from Rancho Seco to Galt, California

- The Valley Springs Formation consists of pumice and fine siliceous ash, with much greenish-gray clay and some vitreous tuff, glassy quartz sand, and conglomerate. It is commonly well bedded. It derived largely from rhyolithic material thrown out from the high Sierra Nevada. This formation has no surface exposures on the site, and an estimated thickness of 250 feet beneath the site.

- The Ione Formation is composed of clay, sand, sandstone, and conglomerate. It may have a thickness of 200 to 400 feet beneath the site, and it is not exposed anywhere on the District property. Lying beneath the Valley Springs Formation, the Ione Formation is likely to be the deepest sedimentary deposit above the metamorphic basement rocks; however, its depth and thickness are not known because none of the site borings penetrated through the Valley Springs Formation. The approximate depth of the metamorphic basement rocks beneath the site is 2,000 feet bgs.

Borings MW2, MW3, MW4, OW2, and OW3 drilled at RSNGS have penetrated the Older Alluvium, Laguna Formation, and part of the Mehrten Formation. Two borings, DH-23 drilled in 1967 and MW1 drilled in 2005, have penetrated the Older Alluvium, Laguna Formation, Mehrten Formation, and probably hard green siltstone and claystone of the upper part of the Valley Springs Formation.

No faults have been identified within 10 miles of the RSNGS, and the only structure in the sedimentary rocks is identified by gentle westerly dips of 1 to 3 degrees caused by the gradual uplift of the Sierra Nevada relative to the basin receiving the sediments.

Physical Parameters. Several investigations have measured the physical parameters in samples collected from the subsurface of RSNGS. The parameter values will be used in a mathematical model that predicts the subsurface behavior of groundwater and/or contaminants carried by groundwater. The mathematical model translates the hydrogeological conceptual site model into a series of equations that, at a minimum, describe the geometry and dimensionality of the hydrogeological system, the initial and boundary conditions, the time dependence, and the nature of the relevant physical and chemical processes. The model requires that the site geology and hydrology can be described in terms of physical parameters. Subsurface zones used in the model require site-specific values for the parameters as described in the *Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil* [Ref 5.13].

Before the 2005 drilling, sampling and analyses values for 12 parameters or data were considered inadequate. After the 2005-2006 investigation and continuing evaluation, the quantity of parameter and other data was manually increased. In Table 2-2, the RSNGS-specific data for each data need are summarized and compared to the pre-investigation status. The laboratory sheets for the physical parameter measurements are included in Appendix B.

Table 2-2. Physical Property Data Status for RSNGS

Parameter or Data Need	RSNGS Data Availability	Pre-Investigation Adequacy Rating	Range After 2005-2006 Investigation	Post-Investigation Adequacy Rating
Soil dry bulk density	39 measurements	Inadequate; samples from limited area	0.8 to 1.78 grams/cm^3 (To be updated with February 2006 sample results)	Adequate; wider horizontal and vertical distribution
Soil total porosity	15 measurements	Inadequate; samples from one boring	0.35 to 0.55 cm^3/cm^3 (To be updated with February 2006 sample results)	Adequate; wider horizontal and vertical distribution
Effective porosity	No data; calculated from other parameters	Inadequate	0.2 to 0.3 cm^3/cm^3 (To be updated with February 2006 sample results)	Adequate; wider horizontal and vertical distribution
Hydraulic conductivity	8 in unsaturated zone; 23 in saturated zone	Inadequate; no data below 200 feet	Unsaturated: 2.8 x 10^{-7} to 2 x 10^{-4} cm/second Saturated: 4 x 10^{-7} to 2 x 10^{-4} cm/second (To be updated with February 2006 sample results)	Adequate; wider horizontal and vertical distribution
Volumetric water content	71 measurements	Adequate	0.12 to 0.358 cm^3/cm^3	Adequate; wider horizontal and vertical distribution
Soil exponential *b* parameter	No data	In table of accepted model values	Dependent on soil type	Adequate; values from table determined from site soils
Hydraulic gradient - horizontal	No data	Inadequate	0.0022 to 0.0033 feet/foot southwest (12/05)	Adequate; determined from field measurements in new wells
Hydraulic gradient – vertical	No data	Inadequate	Variable 0.0064 downward to 0.0012 upward	Adequate; determined from field measurements in new wells
Water table drop rate	Data from existing subbasin wells	Adequate	10-foot decline/recovery in a year; stable year to year	Adequate
Thickness of uncontaminated, unsaturated zone	No data for contamination; entire zone is 150 feet	Potentially adequate	182 feet at MW1 and 164 to 169 feet at MW2 to MW4 in 12/05.	Adequate
Potentiometric surface maps	No data on site	Inadequate	See Figure 2-7.	Adequate
Groundwater flow paths	No data	Can be estimated with hydraulic gradients	Horizontal and southwesterly	Adequate
Climatic, land use, and recharge impacts	Data available for subbasin	Adequate	See Section 1.0	Adequate

Table 2-2. Continued

Parameter or Data Need	RSNGS Data Availability	Pre-investigation Adequacy Rating	Range After 2005-2006 Investigation	Post-investigation Adequacy Rating
Surface-water impacts on groundwater	No data; groundwater 150 feet below surface	Potentially adequate	See Section 3.0	Adequate
Rate of groundwater movement	Limited data to do calculation	Inadequate for entire aquifer; obtained from hydraulic conductivity and gradient	Unsaturated: 2.7×10^{-9} cm/second to 2×10^{-6} cm/second Saturated: 3.9×10^{-9} to 2×10^{-6} cm/second	Adequate; wider horizontal and vertical distribution.
Rate of contaminant transport	No data	Inadequate; calculated from rate of groundwater movement	Less than groundwater movement; retardation depends on contaminant.	Adequate; wider horizontal and vertical distribution of rate data above.
Radionuclide presence and extent	No data for soil or groundwater	Inadequate	Results reported elsewhere	Assessed elsewhere
K_d Partitioning coefficient	No data	To be derived with probabilistic calculations in the model	No data obtained	To be derived with probabilistic calculations in the model

cm = centimeter(s)
cm^3 = cubic centimeter(s

2.3 Hydrology

Runoff from the site drains into a seasonal unnamed creek, which is tributary to Clay Creek, which empties into Hadselville Creek. Hadselville Creek is a tributary of Laguna Creek South, which flows into the Cosumnes River, which joins the Mokelumne River upstream from its confluence with the San Joaquin River. A portion of the flow in the unnamed creek originates below the dam constructed to create the Rancho Seco Reservoir, approximately 1 mile southeast of the industrial area (Figure 2-3). The remainder of the flow in the creek originates from runoff in the area of its catchment west of the dam and from releases of water from Rancho Seco. Water, most of which is conveyed to the site from the Folsom South Canal, is consistently released to the creek from the RSNGS industrial area at an average rate of 6,000 gallons per minute.

Recharge to the groundwater occurs primarily by the infiltration of surface water along the active channels of streams, such as the Cosumnes River, Dry Creek, and Mokelumne River, and by deep percolation of applied irrigation water (Ref 5.9). Some recharge also occurs from the direct infiltration of precipitation; however, direct infiltration is limited by the relatively low (18-inch) annual rainfall, relatively high (50-inch or more) evapotransporation rate, the moderate to low permeability (0.07 to 0.08 inch per hour) of surface soil, and the deep (greater than 180 feet bgs) water table.

Widening of the unnamed creek occurs at the District's western property boundary in an area where the gradient decreases. Most of the flow into unnamed creek originates from the Folsom South Canal and is discharged from the site in the liquid effluent pathway downstream of the site retention basins. Since the investigation of the RSNGS began in the 1960s, no flooding or inundation from storm runoff has occurred within the site boundaries. The industrial portion of the site would not be flooded during a 100-year storm event (Ref 5.15). The topography of the site and the soil types promote runoff away from site buildings (Figure 2-3). However, seasonal marshes and vernal pools develop west of the industrial area in shallow surface depressions during and after the December through March rainy season.

2.4 Hydrogeology

The RSNGS site is located within the Cosumnes Subbasin of the San Joaquin Valley Groundwater Basin (Ref 5.10). The subbasin consists of the unconsolidated and semi-consolidated sedimentary deposits that may hold groundwater between the Cosumnes River on the north and the Mokelumne River on the south. All of the sedimentary deposits in the Cosumnes Subbasin, and possibly the basement rocks if they are fractured, may contain groundwater. Figure 2-4 is a cross section illustrating the extent of hydrogeologic information with a three-dimensional perspective. Figure 2-5 is a simple fence diagram including data from MW1, MW2, MW3, and MW4 borings. Thirteen borings on the site have penetrated the groundwater; four of those borings were completed as water supply wells, and geologic information was not saved for two of them. Three observation borings, each to a depth of 200 feet bgs, one boring drilled to 602 feet bgs, four 2005 borings, and one 2006 boring for monitoring well nests provide the geologic information about the aquifer.

As shown on Figures 2-4 and 2-5 subsurface deposits beneath RSNGS are dominated by fine-grained deposits of clay and silt with interbedded thin sands and gravels to a depth of approximately 120 to 130 feet bgs; above that depth interval, deposits become more indurated with depth, such that some intervals can be considered claystone and siltstone. Beneath 130 feet, the deposits are siltstone and claystone with thin (10 feet or less) interbedded sandstone and conglomerate (shown in shades of maroon on Figures 2-4 and 2-5); this interval is mostly within the Mehrten Formation. At approximately 290 to 330 feet bgs in all of the deeper borings, drilling became very difficult as the drill penetrated gray to green well-indurated siltstones with thin sandstones and claystones. This change in drilling and lithology of deposits is interpreted as the top of the Valley Springs Formation.

The upper groundwater surface beneath the site now occurs at depths greater than 165 feet bgs (December 2005) in the sediments of the Mehrten Formation. Therefore, groundwater may be present from approximately 165 feet bgs in the Mehrten Formation to perhaps 2,000 feet bgs, where the Ione Formation is in contact with much denser rocks. The sand and gravel zones of these formations yield water readily to wells predominantly west of the facility in the Central Valley. The Mehrten Formation is known for yielding large volumes of water to wells (Ref 5.11) Beneath the site, however, the Mehrten Formation consists predominantly of siltstones and claystones that are likely to have lower hydraulic conductivity values (1×10^{-7} to 1×10^{-4} centimeters per second [cm/sec] from permeability tests [Ref 5.7]) than the typical Mehrten

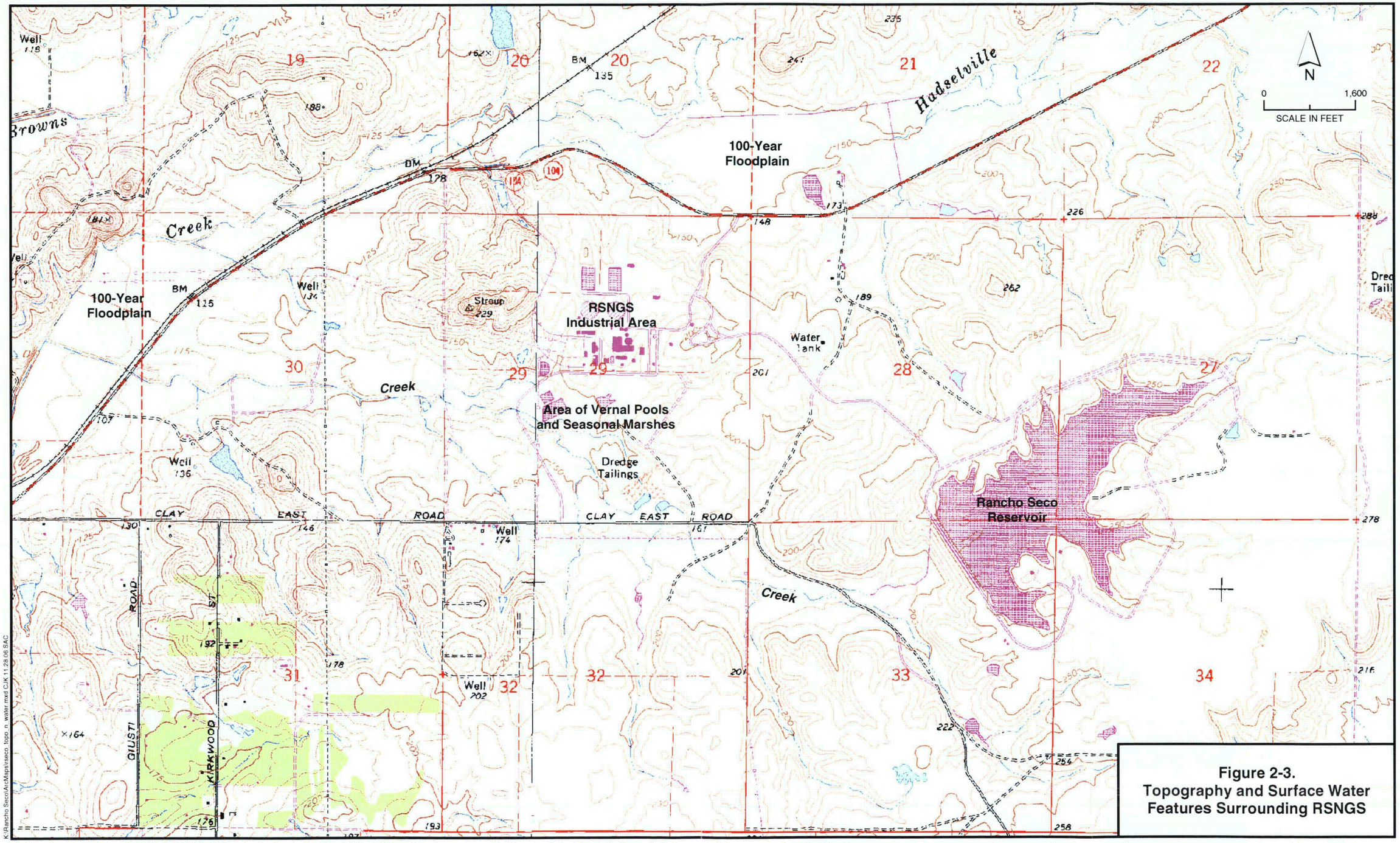
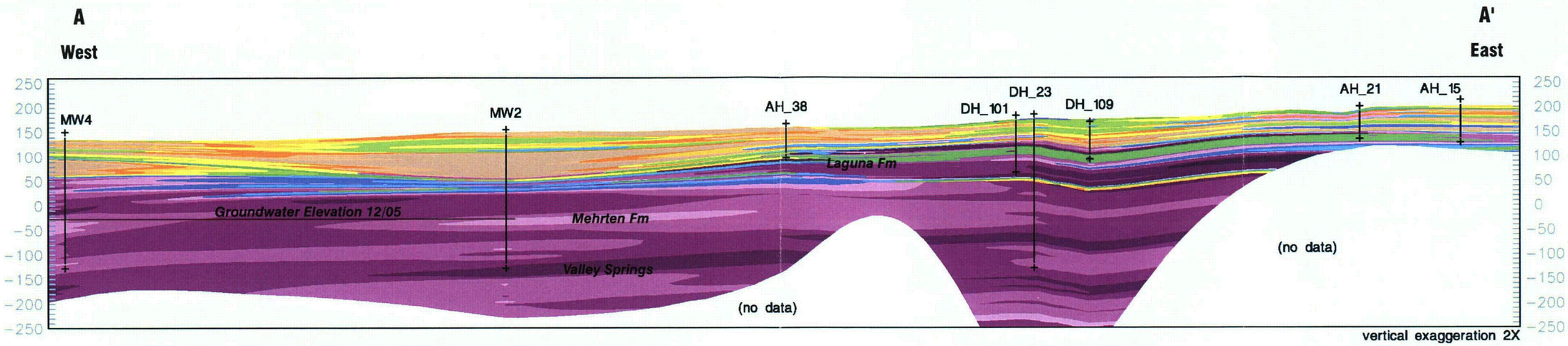
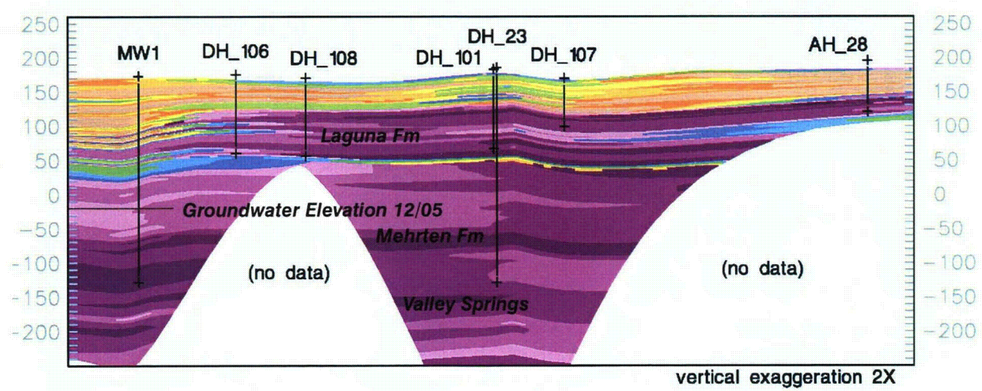


Figure 2-3.
Topography and Surface Water Features Surrounding RSNGS





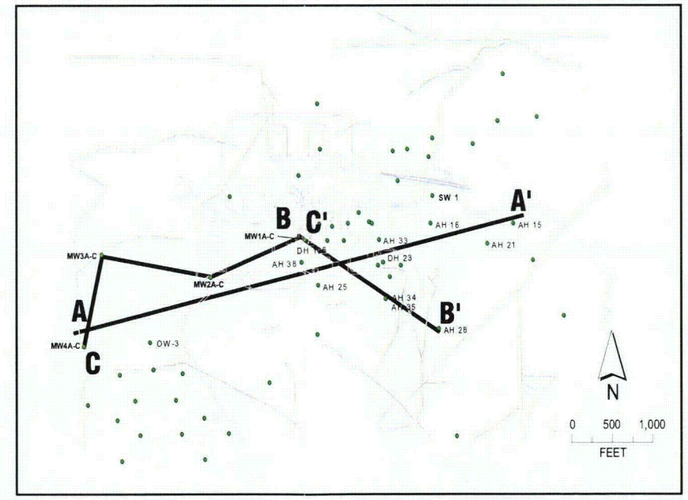


Figure 2-4.
Geologic Cross Sections
Rancho Seco NGS Site

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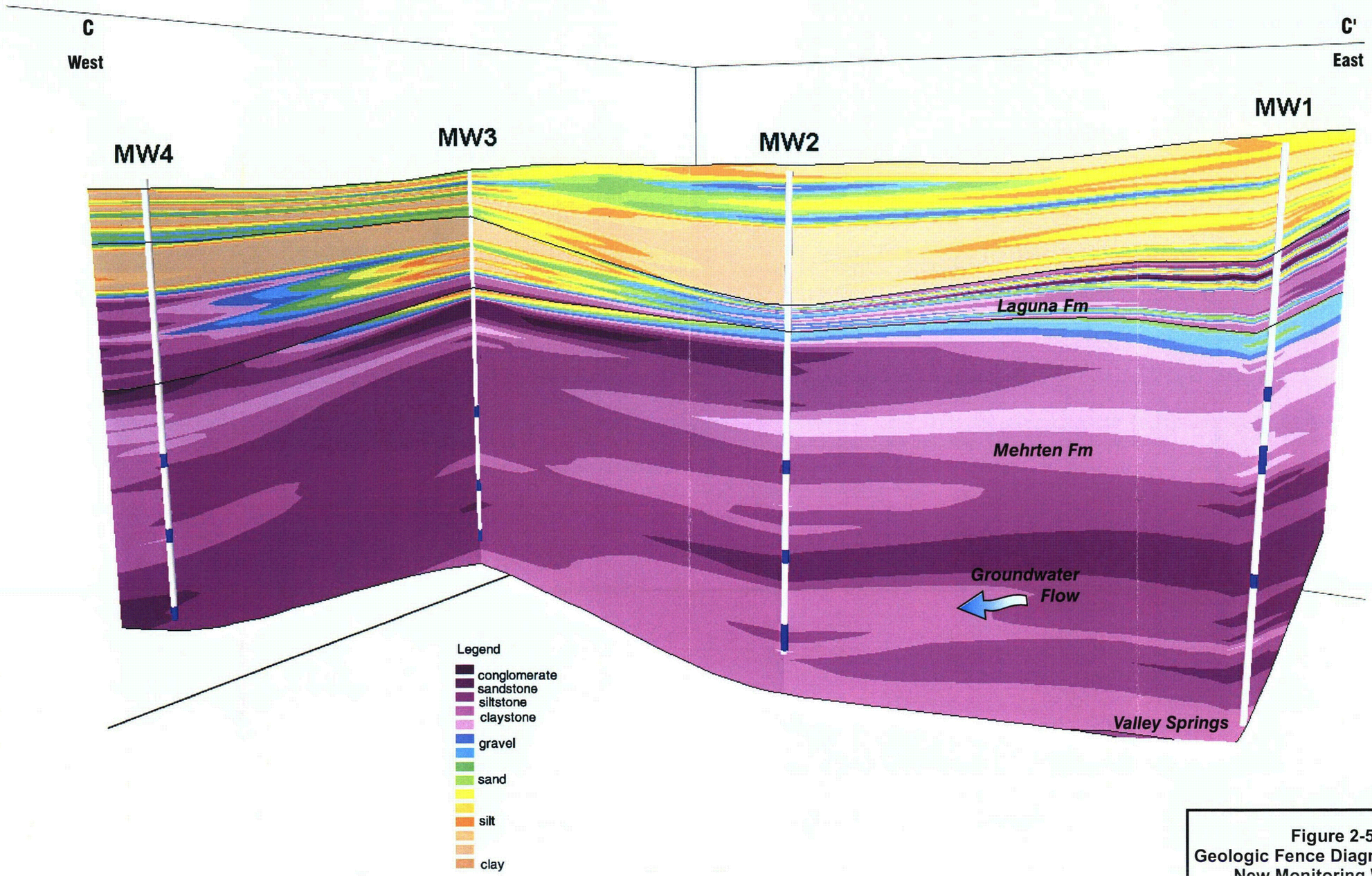

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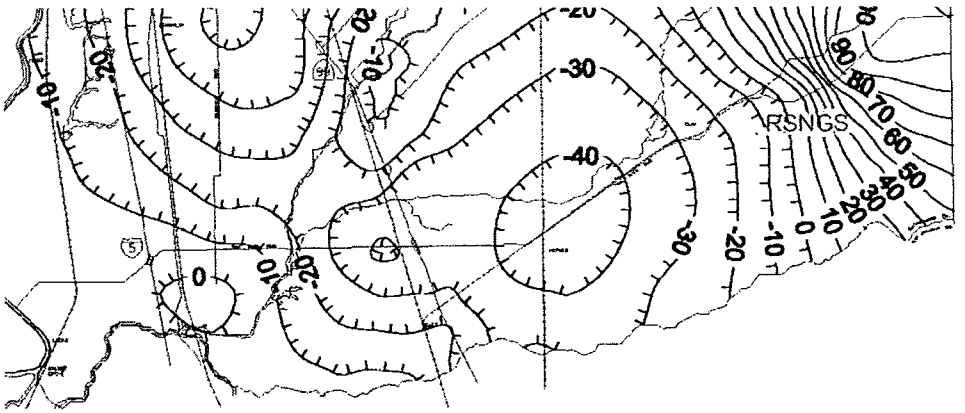
Figure 2-5.
Geologic Fence Diagram Through New Monitoring Wells at Rancho Seco NGS Site

Formation, which is sand/sandstone dominated. The sediments of the Laguna Formation are above the water table and, therefore, do not produce groundwater to wells. However, the hydraulic conductivity range of samples collected in the unsaturated Laguna Formation is 2.8×10^{-7} to 5.8×10^{-4} cm/sec. The Valley Springs and Ione formations are considered small-yield aquifers because of low hydraulic conductivity values caused by claystone and siltstone layers (Ref 5.11).

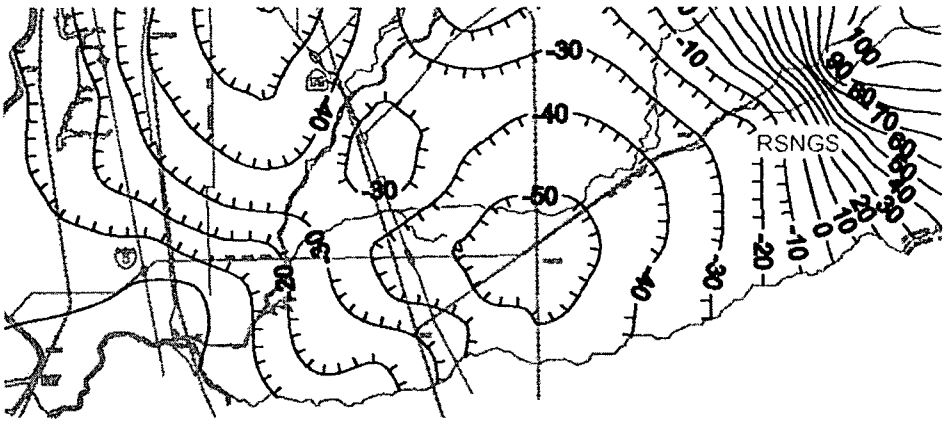
In the Cosumnes Subbasin, groundwater flows to the west from the foothills and the RSNGS area. For at least 40 years (since the initial investigation of the site), a groundwater depression has been caused by the pumping of municipal and agricultural wells in the Galt area. Figure 2-6 shows contours of groundwater elevations in southern Sacramento County (Ref 5.12); the top part of the figure shows contours for Spring 2003, and the bottom part shows contours for Fall 2003; the 2003 maps are the most recent contour maps available from the county. On both figures, a groundwater depression is roughly centered on the town of Herald, which lies between the site and Galt. The depression had an elevation approximately 10 feet lower in Fall 2003 than in Spring 2003. The shape and values of the groundwater elevation contours on the figures indicate that groundwater beneath the site will flow southwesterly toward the depression.

Groundwater levels in the four new well nests suggest that there is one aquifer between the water table and 300 feet bgs, that the horizontal gradient is southwesterly, and the vertical hydraulic gradient is upward. A potentiometric surface map, constructed with data collected in the monitoring wells on December 6, 2005, is shown in Figure 2-7. The contours support the hypothesis of southwesterly gradient beneath RSNGS. The range of hydraulic gradients calculated from potentiometric data for the wells is 0.002 to 0.0033 feet per foot in all depth intervals. Data collected in two subsequent events support the flow direction and gradient. Only one potentiometric surface map was prepared because the data suggest that the horizontal gradients are similar in all depth intervals from 170 to 300 feet bgs (Table 2-1). Horizontal gradients were determined with water level depth information obtained in December 2005. Depth information for all wells was converted to elevation by subtracting the depth from survey elevations of the tops of casing of monitoring wells. Water level elevations from MW1B, MW2B, MW3B, and MW4B were combined with data from OW2 and OW3, wells constructed in 1985, to develop a potentiometric surface map. The well screens in OW2 and OW3 are most similar to those in MW1B, MW2B, MW3B, and MW4B. The potentiometric surface map developed with the water level elevations was used to determine the direction and magnitude of the maximum gradient among the six well locations. It was determined that the water level elevation decreased 4.5 feet over a distance of 1610 feet between potentiometric contours; therefore, 4.5 feet was divided by 1,610 feet, yielding a gradient of 0.0028 foot per foot southwesterly for the B depth interval. Horizontal gradients were roughly estimated from water elevation differences between MW1C and MW3C and between MW1C and MW4C without contours. Those gradients were within the same range as the "B" depth gradients, suggesting horizontal gradients are similar in all depth ranges beneath RSNGS.

Vertical gradients were determined only for the well nests constructed in 2005. Gradients were calculated with water level elevations obtained in December 2005, March 2006, and June 2006 for the following screen interval pairs: MW1B and MW1C, MW2A and MW2B, MW2B and



Groundwater Levels Southern Sacramento County
Spring 2003



Groundwater Levels Southern Sacramento County
Fall 2003

Figure 2-6. Groundwater Elevation Contours Measured in 2003, Southern Sacramento County

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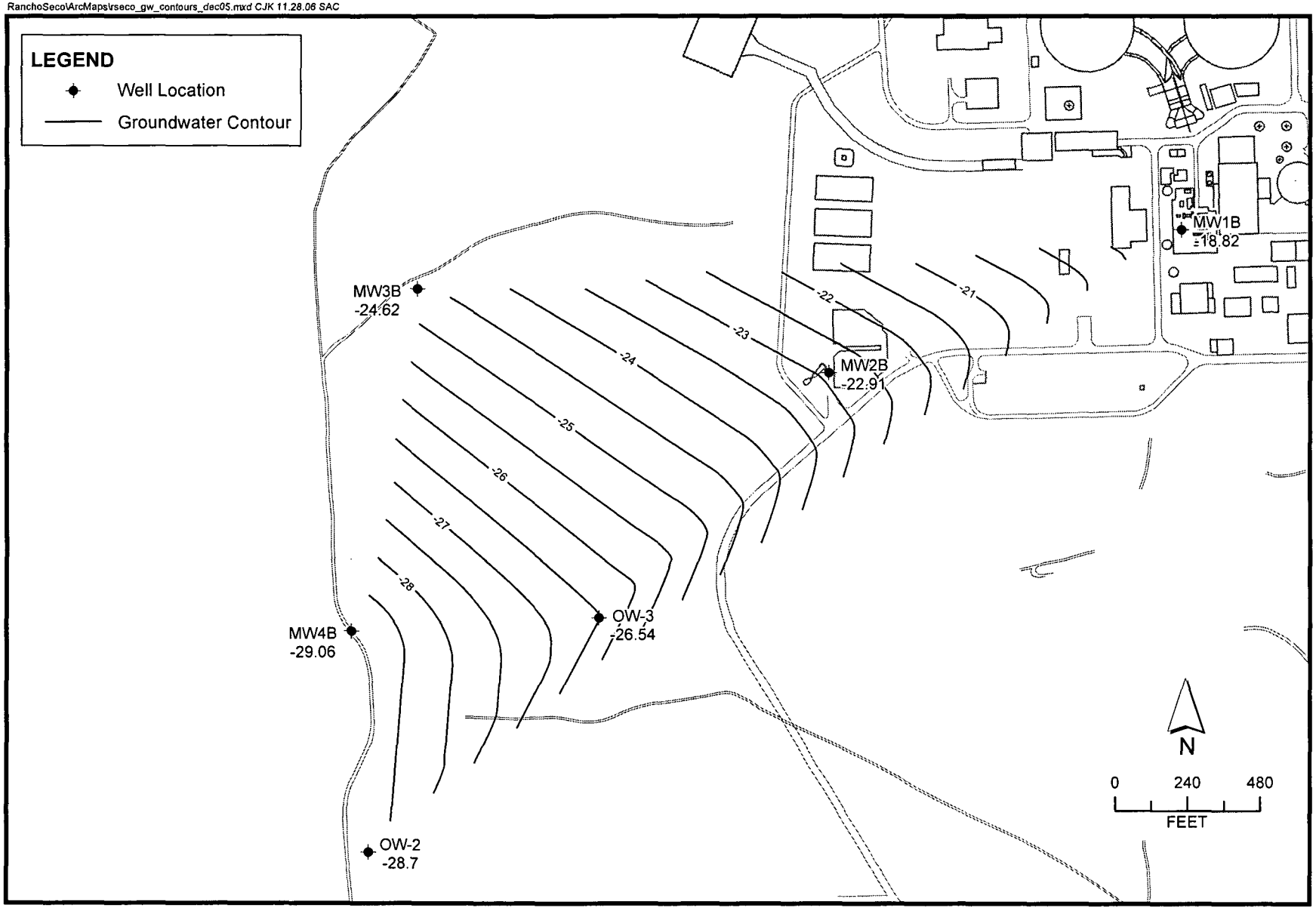

Figure 2-7. Potentiometric Surface Map for Groundwater Beneath RSNGS, December 2005

MW2C, MW3A and MW3B, and MW3B and MW3C. The distance between the center of screens in the well nests were determined from the well construction logs. Then for each pair (for example, MW2A and MW2B) of water level elevations at a well nest, the absolute difference between the higher screen water elevation and the lower screen elevation was divided by the distance between the center of the screens. The result of the calculation is the magnitude of the vertical gradient. If the water elevation for the lower screen had a value less than the elevation for the upper screen, the gradient was designated "downward" and provided with a minus sign. If the elevation for the lower screen was greater than that for the upper screen, the gradient was designated "upward." The vertical gradient calculations for RSNGS well nests varied from 0.0064 foot per foot downward to 0.0012 foot per foot upward across all screen interval pairs. Eight gradients were downward and two upward between "A" and "B" depth interval well screens. Five gradients were downward and four upward between "B" and "C" depth interval well screens. Most well screen pairs did not have consistently upward or downward gradients over the seven-month period that measurements were collected. There is no evident upward or downward influence on gradients caused by the change in season between the first and last measurements. The vertical gradient data calculated for RSNGS well nests indicate that neither an upward or downward gradient prevails in the aquifer.

No pumping tests have been conducted at the site. Hydraulic conductivity values have only been estimated from laboratory hydraulic conductivity tests and in situ packer permeability tests (Ref. 5.7).

With site-specific data obtained in the 2005–2006 investigation and previous investigations, an estimate of the migration speed of a water particle can be made. Assuming the highest hydraulic conductivity measured (2×10^{-4} cm/sec) and a travel distance of 165 feet from a near-surface source to groundwater, a particle would require approximately 80 years to reach groundwater. Once the particle reached groundwater, and again assuming the highest hydraulic conductivity of 2×10^{-4} cm/sec and a distance of 3,100 feet, the travel time to the RSNGS property boundary is estimated at approximately 1,500 years. However, the hydraulic conductivities of some clayey deposits above the groundwater and below the groundwater surface may be only 1/1000th of the value used in the preceding calculations. Therefore, it is likely that migration to groundwater will require more than 80 years and migration to the property boundary will require more than 1,500 years.

Long-term hydrographs for 23 wells in the Cosumnes Subbasin indicate that water levels declined from the mid-1960s until approximately 1980, unless the wells were in the recharge area of the Cosumnes River, which is several miles north of the site. From 1980 until 1986, water levels in most wells recovered as much as 10 feet from pre-1980 levels. Water elevations again decreased approximately 10 to 15 feet during the drought years of 1987 to 1992 and recovered 15 to 20 feet from 1993 to 2003 (Ref 5.10).

Water from the Laguna and Mehrten formations is considered generally good quality in the vicinity of RSNGS. Potable water used on the site comes from one of four site wells. Since 1969, Supply Well 1 has been producing at a rate of 300 gallons per minute, on demand, from the Mehrten Formation from the depth interval of 200 to350 feet bgs (Ref 5.7).

The 2005 investigation of RSNGS was conducted to evaluate hydrology and hydrochemistry that would affect migration of any contaminants migrating in groundwater. Water samples were collected in 10 new wells and 3 water supply wells to evaluate groundwater chemistry and water quality.

3.1 Sampling for General Minerals in Groundwater

Groundwater samples were collected from 10 of the 12 monitoring wells constructed in 2005 and analyzed for a suite of analytes that characterize the natural constituents in groundwater that originate from the atmosphere and from the soluble anions and cations from soil and aquifer material. Well MW1A did not produce sufficient water for a sample and Well MW1B became obstructed with sampling equipment. Sometimes referred to as "general minerals," the analytes in the suite are used to determine differences between groundwater bodies that may be vertically separated. Near-surface groundwater may have a different geochemical composition than deeper groundwater because of constituents dissolved from soil and anthropological sources. In addition to the general mineral constituents, analyses were performed for the total boron because boric acid was added to the water heated by nuclear reactions and would be an indicator that leakage of water from the reactor area reached groundwater.

In addition to the 10 samples from monitoring wells, a sample from one groundwater supply well in the RSNGS industrial area, SW-2; a sample from the supply well, SW-1, just east of the industrial area; and one sample from a well at Rancho Seco Park (RSPW), approximately a mile southeast of the industrial area, were also sampled for the suite of analytes. Results from the two wells located east of the industrial area are representative of "background conditions" because the groundwater moving through those wells has not been affected by any discharges from RSNGS activities. Groundwater at SW-1 and RSPW can be considered unaffected by any contaminants from the RSNGS industrial area because groundwater has been flowing from northeast to southwest for at least 38 years.

Table 3-1 lists the results of the general minerals results for groundwater samples. It is readily evident that borate is not a contaminant in the samples analyzed because it was detected in only one sample, from Well MW2A, at a concentration equal to the reporting limit of 0.05 milligrams per liter (mg/L). Furthermore, the results are notable for the similarity of values among the wells sampled. The only readily identifiable differences in the table are the variations in total iron concentration, higher level of total dissolved solids, presence of detectable concentrations of nitrate nitrogen, and pH 1.5 to 2.1 units lower in Wells SW-1, SW-2, and RSPW than in most of the monitoring well samples. Laboratory sheets for the groundwater analyses are included in Appendix C.

The similarity of most parameters among all monitoring well locations and all depths indicate that groundwater is not stratified with large differences in constituent concentrations vertically. Graphical techniques that show the similarity or difference in general mineral concentrations between waters were used to confirm that groundwater up hydraulic gradient from the industrial area, beneath the industrial area, and down hydraulic gradient from the industrial area are the same. Piper and Stiff diagrams were prepared with concentrations of the major cations and anions occurring in groundwater: calcium, magnesium, potassium, sodium, bicarbonate, carbonate, chloride, and sulfate concentrations (Figures 3-1 and 3-2).

In the Piper diagram, each of the 13 well samples is represented by one dot on each of the three diagrams. For this diagram, concentrations of the major cations and anions are converted to meq and totaled. The location of dots representing wells is determined by the percentages of the total that each cation or anion (or a combination such as sodium and potassium) contributes. The close clustering of all the dots representing monitoring well samples as well as the three supply wells indicates that no great difference occurs in the groundwater from 1 mile upgradient to 3,500 feet downgradient of the industrial area. Furthermore, groundwater from 300 feet bgs from the "C" depth monitoring wells is not distinguishable from the groundwater in the "A" and "B" depth wells.

Stiff diagrams use the same meq/L data. However, they are arrayed in a different plot. Stiff diagrams are made for rapid pattern recognition to classify a groundwater and determine similarities from location to location and shallow to greater depths. Figure 3-2 illustrates a series of Stiff diagram plots that further support the similarity of groundwater among all of the wells sampled. These diagrams also indicate that the groundwater beneath District property, including RSNGS, is a sodium-bicarbonate type.

3.2 Data Interpretation

Two wells up hydraulic gradient from the industrial area (SW-1 and RSPW) tap groundwater that has the same composition and similar concentrations of general mineral constituents as groundwater beneath and down hydraulic gradient from the industrial area. Therefore, the two wells can be used as indicators of background quality to compare with any wells that are suspected of being contaminated.

The general mineral constituents at 190 feet bgs in the groundwater beneath RSNGS are essentially the same as at 320 feet bgs. This condition and the upward hydraulic gradient from greater depth to shallower suggests that sampling of most of the "C" depth wells for contaminants will not be necessary because contamination, if any is suspected in the "A" depth wells, is unlikely to migrate downward against the gradient.

Table 3-1. General Minerals Results from Analyses of Groundwater

	Alkalinity, Total (mg/L)	Alkalinity, bicarbonate (mg/L)	Alkalinity, Carbonate (mg/L)	Chloride (mg/L)	Magnesium (mg/L)	Nitrogen, Total Nitrate-N (mg/L)	Sulfate (mg/L)	Iron (mg/L)	Potassium (mg/L)	Boron-Total (mg/L)	Calcium (mg/L)	Hardness (mg/L)	Sodium (mg/L)	Total Dissolved Solids (mg/L)	PH (pH Units)	Cation/Anion Balance (meq)
MW1C	86	57	29	7.1	2	<0.050	<0.50	17	3.86	<0.05	5.9	24	34	126	9.5	2.04/1.92
MW2A	86	86	<5.0	14	3	<0.05	4.2	23	3.34	0.05	4	24	42	151	7.6	2.36/2.2
MW2B	64	64	<5	9.6	4	<0.05	1.4	73	3.46	<0.05	4.7	28	26	101	8.9	1.78/1.58
MW2C	62	36	26	6.7	2	<0.05	<0.05	36	4.03	<0.05	4.7	20	24	88	9.6	1.55/1.43
MW3A	53	42	11	5	<2	<0.05	<0.05	38	2.41	<0.05	3.2	16	20	70	9.3	1.09/1.2
MW3B	49	42	7	4.60	<2.0	<0.05	<0.05	27	2.5	<0.05	3.2	16	18	71	9.3	1.01/1.11
MW3C	49	38	11	3.7	2	<0.05	<0.05	4.65	3.09	<0.05	4	20	16	71	9.3	1.14/1.08
MW4A	49	45	<5	5.6	2	<0.05	1.1	203	2.69	<0.05	4	20	19	69	9	1.26/1.16
MW4B	51	40	11	5.2	<2.0	<0.05	<0.5	5.3	2.97	<0.05	3.2	14	18	72	9.4	1.02/1.17
MW4C	58	51	7	5.7	3	<0.05	<0.05	6.4	3.16	<0.05	4	22	21	81	9.2	1.44/1.32
SW-1	52	52	<5.0	4	3	1.8	3.5	<0.05	3.9	<0.05	3.2	20	22	168	7.7	1.46/1.35
SW-2	55	55	<5	4.1	3	1.8	4.8	<0.05	3.8	<0.05	4.7	24	20	165	7.6	1.45/1/44
RS Park Well	65	65	<5	5.8	5	0.64	1.4	0.24	3.7	<0.05	6.3	35	20	180	7.4	1.69/1/54
Quantitation Limit	5	5	5	1	2	0.05	0.5	0.05	0.05	0.05	3	5	5	10	0.1	
Mean	59.92	51.77	14.57	6.24	2.90	1.41	2.73	39.42	3.30	0.05	4.24	21.77	23.08	108.69	8.75	NC
Standard Deviation	12.85	13.99	9.05	2.81	0.99	0.67	1.63	58.16	0.55	NC	1.01	5.54	7.30	43.18	0.84	NC

meq = milliequivalent(s)
mg/L = milligram(s) per liter
NC = not calculated, too few values

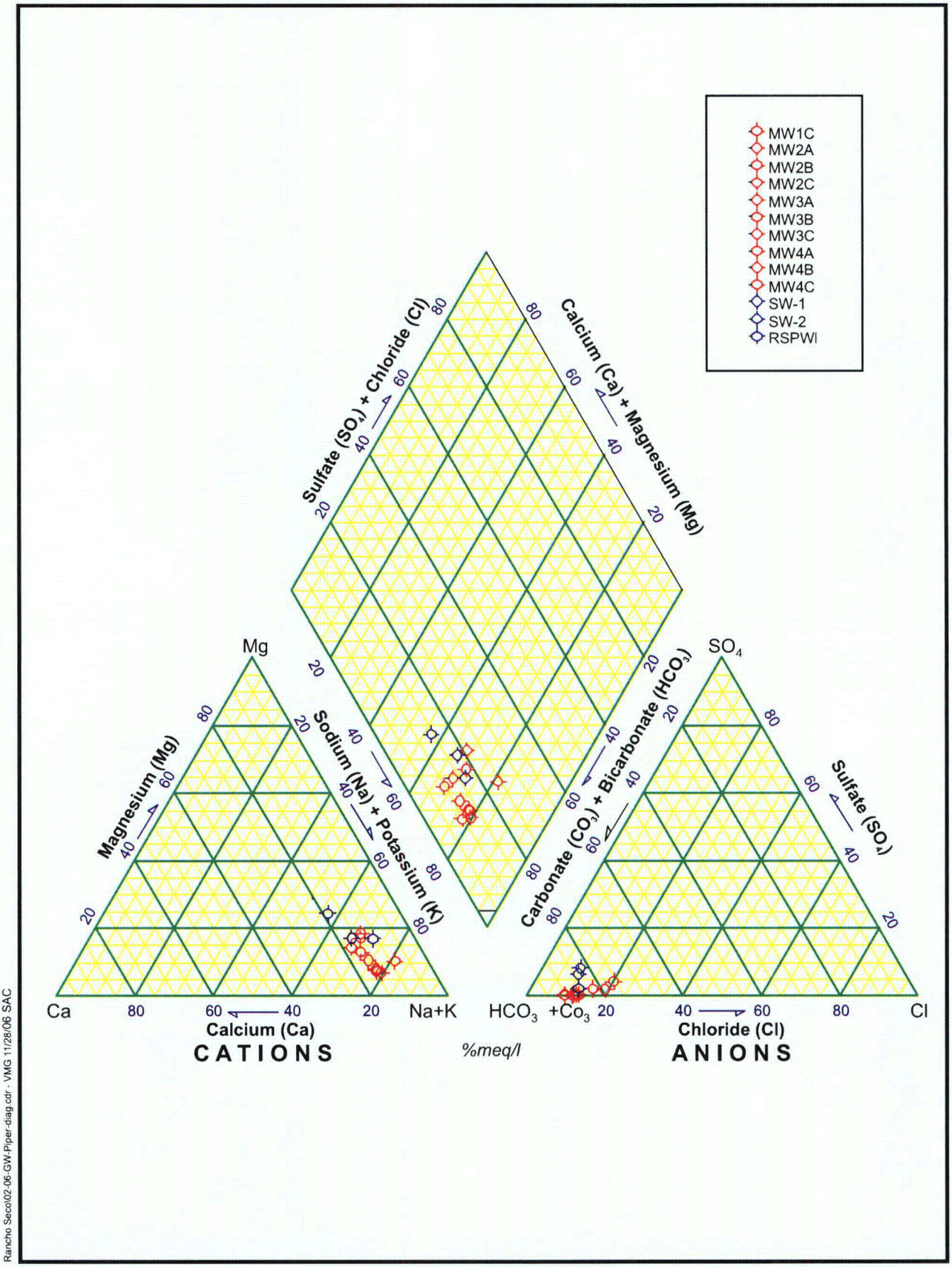

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Figure 3-1. Piper Diagram for Groundwater Concentrations Beneath RSNGS

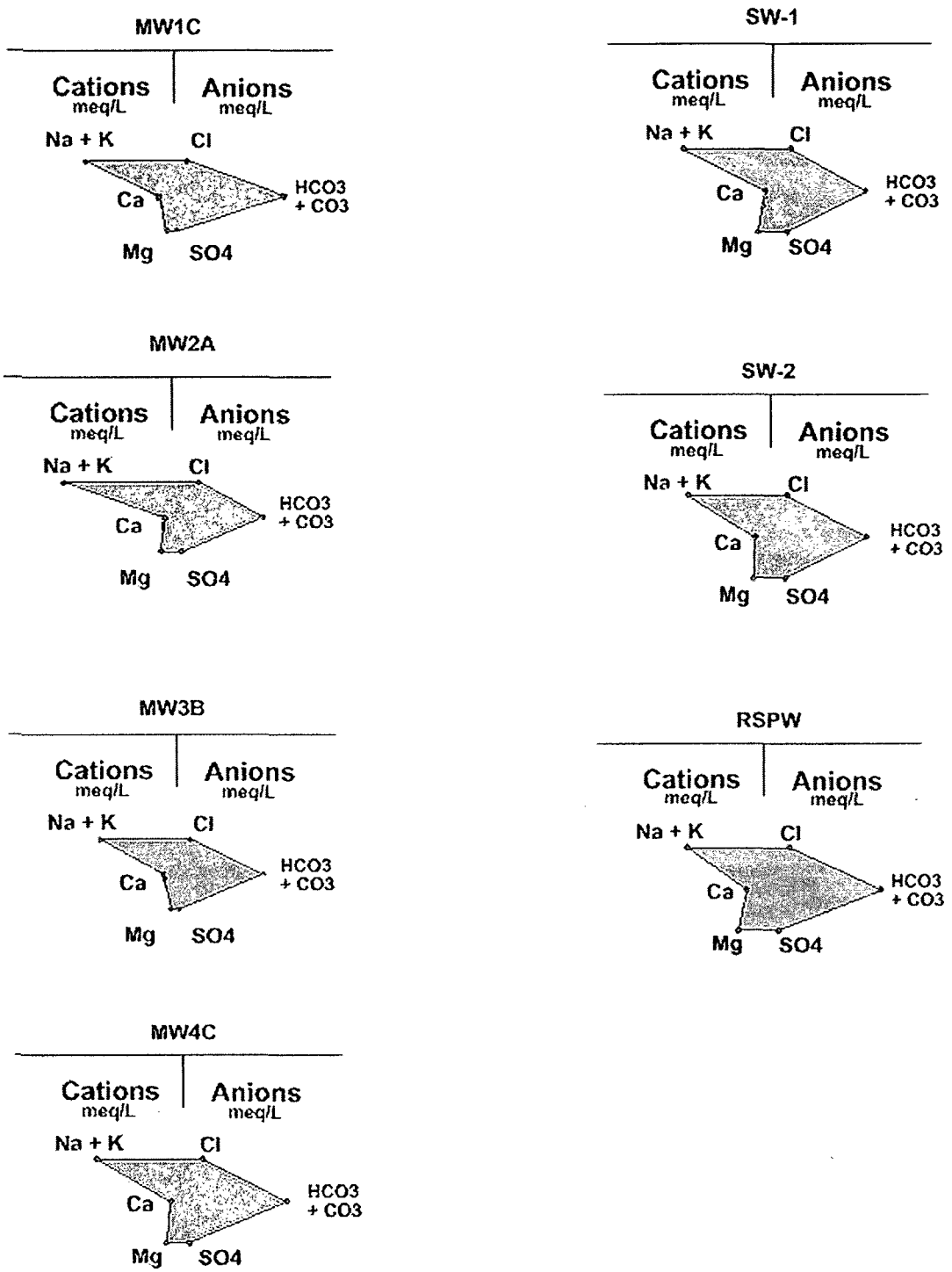

Figure 3-2. Stiff Diagrams of Cation and Anion Concentrations in Groundwater Beneath and Upgradient from RSNGS

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On the basis of the data obtained in previous geologic investigations and in the recent hydrogeological investigation, the hydrogeological conceptual model was updated and conclusions have been developed. From those conclusions, recommendations for additional investigation and sampling are presented.

4.1 Conclusions

The following conclusions have been developed from updating of the conceptual model with data obtained in 2005 and 2006:

- Because groundwater between the depths of 180 and 320 feet bgs has vertical gradient that fluctuates between upward and downward, any contaminants from RSNGS releases are more likely to remain in the shallower zones rather than being drawn to the deepest levels of the aquifer.
- Groundwater in all depth intervals has a southwesterly horizontal gradient.
- Physical parameters measured from subsurface samples indicate diversity in hydrologic conductivity and other parameters needed for mathematical modeling.
- Groundwater from 180 to 320 feet bgs can be classified as sodium bicarbonate type that varies minimally in composition whether samples are collected upgradient, beneath, or downgradient of the RSNGS industrial area.
- MW1D constructed in February 2006 adequately replaces MW1B for monitoring and sampling of groundwater.
- No additional monitoring well locations or soil samples are needed for hydrogeologic characterization unless contamination is discovered in newly constructed monitoring wells.

4.2 Recommendation

The recommendation remaining to further enhance the hydrogeological conceptual model and determine whether contamination from RSNGS activities has reached groundwater is to evaluate results from samples collected at MW1D and other new wells.

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APPENDIX A

2005 Drilling Logs and Well Construction Details

Project: Rancho Seco Nuclear Generation Station

Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW1A, MW1B, MW1C

Drilling Contractor: Water Development	Borehole Diameter: 12-inch	Borehole Name: MW1	Logged By: P. Phillips, S. Plunkett
Drilling Method: Mud Rotary	Dates Drilled: 5/2-5/2005	Well Construction: 5/5/2005	Checked By: Thomas F. Lindsay PG 4473
Drilled by: Randy Criner	Casing Diameter: 2.5-inch	Casing Type: Low Carbon Steel	Slot Size: A- 0.010-inch; B,C- 0.020-inch
Total Depth Drilled: 400-feet	Screen Intervals (ft bgs): A- 160-170'; B- 210-220'; C- 290-300'		Well Development Dates: 6/6/2005
Sampling Method: Grab	Top of Casing Elevations: A- 163.77; B- 163.61; C- 163.43		Ground Surface Elevation: 164.20

A: Northing: 1888419.45 Easting: 6813523.57 B: Northing: 1888419.16 Easting: 6813522.97 C: Northing: 1888419.56 Easting: 6813522.92

Comments: Flat graded pad on AB base.

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical Feet)
		1530		Varigated, sandy, medium pebble to coarse pebble gravel, abundant rock fragments (GP). Schist, chert, milky and clear quartz, biotite, basalt, moderately abundant, light brown (7.5YR 6/4), well indurated schist, possible matrix to gravel.	Flush mount vault box; Wells secured with locking pressure caps; MW1A 2.5-inch inner-diameter (ID) Low Carbon Steel (LCS) blank casing to 160'; MW1B 2.5-inch ID LCS blank casing to 210'; MW1C 2.5-inch ID LCS blank casing to 290'	0, 5, 10
				Varigated mafic very coarse grained sand with abundant pebble gravel, abundant rock fragments (SP).		
X	MW1A			Clayey Sandy Silt. Brownish yellow (10YR 6/6), abundant very coarse grained sand and rock fragments (ML).		15, 20
				Minor increase in pebble gravel.		25
X	MW1B					30
				Moderately abundant varigated rock fragments.		35
					Neat Cement from near ground surface to 152'.	40, 45
				Abundant very fine to very coarse grained sand.		50, 55
				Significant increase in very coarse grained sand.		60, 65

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Log of Monitoring Wells: MW1A, MW1B, MW1C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
						70
				Granular to fine pebble gravel with abundant rock fragments in light brown (7.5YR 6/4) mud, volcanics, siltstone, abundant very fine to very coarse grained sand, angular to rounded, clear and milky quartz, red chert, ultra mafics, plagioclase, greenstone (GW).		75
						80
						85
X	MW1C					90
				Clayey Gravel. Reddish brown (5YR 4/4), abundant silt to very coarse grained sand to medium pebble gravel in silty/sandy clay.		95
				Gravelly, Sandy, Clay. Reddish brown (5YR 4/3), with moderately abundant rock fragments (CL).		100
						105
				Silty Gravel with abundant light pinkish gray (5YR 6/2) silty clay and abundant rock fragments. Gravel subrounded to rounded (GM).		110
						115
						120
				Sandy Clayey Silt/Silty Clay. Reddish gray (5YR 5/2), abundant gravel and rock fragments (CL).		125
						130
				Silt/Clay grading to reddish brown (5YR 5/4).		135
				Continuing change in silt/clay color.		140
				Silty Clay. Brown (7.5YR 5/4), plastic, very minor poorly indurated siltstone (CL).		145
						150

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Log of Monitoring Wells: MW1A, MW1B, MW1C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
155				Increase in siltstone and minor to moderate amounts of well cemented, medium grained sandstone.	Bentonite Seal 152-155' #30 Transition Sand 155-157'	155
160				Significant increase in sandstone and very coarse grained to granular gravel.	MW1A 2.5-inch ID LCS, 0.010-inch Continuous Slot Screen 160-170' #3 Filter Pack Sand 157-171.5'	160
165				Continued presence of gravel and decrease in sandstone.		165
170				Decrease in both gravel and sandstone fragments.		170
175						175
180				Interbeds of increasing sand to granular gravel layers.		180
185					Neat Cement 171.5-203'	185
190						190
195				Marked increase in indurated siltstone.		195
200				Indurated siltstone increases to 20%.		200
205				Silty fine grained sandstone/sandy siltstone increases in abundance.	Bentonite Seal 203-205' #30 Transition Sand 205-207'	205
210				Sandstone. Strong brown (7.5YR 5/6), fragmented, moderately cemented, rounded to subrounded (SS).	MW1B 2.5-inch ID LCS, 0.020-inch Continuous Slot Screen 210-220' #3 Filter Pack Sand 207-221.5'	210
215				Interbeds of moderately indurated siltstone.		215
220						220
225				Continue presence of interbeds (less than 1-inch thick).		225
230						230

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Log of Monitoring Wells: MW1A, MW1B, MW1C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
				Abundant rock fragments.		235, 240
				Abundant siltstone interbeds.		245
				Decrease in siltstone and continued presence of rock fragments in moderately abundant amounts.		250
					Neat Cement 221.5-282'	255
				Very well cemented sandstone clasts and varigated conglomerate granitic gravel interbeds, dark brown (7.5YR 3/2).		260
				Cemented sandstone with minor clasts, dark yellowish brown (10YR 3/4), minor clasts > 0.5-inch, angular to subrounded.		265, 270
				Sand. Minor gravel, dark grayish brown (10YR 4/2), fine to coarse grained sand, moderately to well graded, subangular to subrounded, chert and quartz material, rock fragments (SW).		275, 280
					Bentonite Seal 282-285'	
					#30 Transition Sand 285-287'	285
					MW1C 2.5-inch ID LCS, 0.020-inch Continuous Slot Screen 290-300' #3 Filter Pack Sand 287-301'	290
				Increasing very fine to medium grained sand, gravels decrease.		295, 300
				Olive (5Y 5/3), quartz rich sandstone, subangular to subrounded, fine to medium grained with minor coarse grained sand, and minor gravel (<10%) (SS).		305, 310
				Color change to Dark olive (5Y 4/2), mafic, subrounded to angular, very fine to coarse grained sandstone (probably siltstone or claystone) (SLTST).		315

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Log of Monitoring Wells: MW1A, MW1B, MW1C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
				Siltstone/Claystone. Mafic, very fine to fine grained sand, reddish brown (5YR 4/3), massive, slighty fractured, brittle, indurated (silica rich?). (serpentinite?) (SLTST).		320, 325
				Sandstone. Dark olive (5Y 3/2), very fine to medium grained, subangular to subrounded, competent, silty, larger fragments are brittle (SS).		330, 335
				Sandstone. Dark Olive (5Y 3/2), very fine to medium grained, brittle, angular, clastic material, rock fragments (serpentinite?), competent, minor fractures (SS).		340, 345
				Siltstone. Dark olive (5Y 3/2), content of fines increase, silts and clays, angular to subrounded rock fragments, brittle, clayey siltstone <20% very fine to medium grained sand (SLTST).		350
				Clayey Siltstone. Silt and clay content increases, very little sand, soft.	Boring back-filled with Neat Cement from TD to 301 ft bgs	355, 360, 365, 370, 375, 380
				No Recovery.	Total Depth Drilled 400 feet bgs	385, 390, 395, 400

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Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Well: MW1D

Drilling Contractor: Water Development	Borehole Diameter: 12-inch	Borehole Name: MW1D	Logged By: S. Lookingbill
Drilling Method: ARCH; Mud Rotary	Dates Drilled: 2/15-16/2006	Well Construction: 2/16/2006	Checked By: Thomas E. Gilbert P.G. 17091
Drilled by: Ryan	Casing Diameter: 4-inch	Casing Type: SCH 40 PVC; LCS	Slot Size: 0.020-inch
Total Depth Drilled: 220 feet	Screen Interval (ft bgs): 200-220'	Well Development:	Ground Surface Elevation:
Sampling Method: Grab	Top of Casing Elevation:		Northing: Easting:

Comments: 0-20 ft bgs drilled using Air Rotary Casing Hammer (ARCH); 20-220 ft bgs drilled using Mud Rotary.

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (Vertical Feet)
				Sandy Gravel. Brown, very fine grained sand, gravel to 1-inch diameter, subrounded, trace silt, dry (GP).	Flush mount vault box Well secured with locking pressure cap	0
				Sandy Silt. Brown, non-plastic, damp (ML).	MW1D 4-inch SCH 40 PVC blank casing to 200'	5
				Silty Sand. Brown, very fine to fine grained, partially cemented, damp (SM).		10
				Sandy Silt. Reddish brown, low plasticity, fine grained sand, moist (ML).		15
				Sandy Silt. Brown, non-plastic, fine to coarse grained sand, trace gravel, partially cemented (ML).		20, 25, 30, 35, 40, 45
				Silty Sand. Brown, fine to medium grained sand, partially cemented (SM).	Neat Cement from near ground surface to 193'.	50
	MW1D			Silt. Light reddish brown, non-plastic, partially cemented (ML).		55
				Silty Sand with gravel. Dark brown, mafic subrounded gravel to 0.5-inch (SM).		60
				Silt. Light reddish brown, firm, non-plastic, trace sand (ML).		65

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Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Well: MW1D

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (Vertical feet)
				Sandy Siltstone. Brown, trace subrounded to subangular gravel (SLTST).		75
				Silty Sand with gravel. Grayish brown, 80% coarse grained sand and gravel, gravel is subrounded to angular with quartz, feldspar, and volcanics (SM).		80, 85, 90
				Sandy Siltstone. Light brown, very fine to fine grained sand, cemented (SLTST).		95
				Gravel. Poorly graded, medium grained, subrounded to angular, trace coarse grained sand (GP).		
				Sandy Siltstone. Light reddish brown, fine grained sand, cemented (SLTST).		100
				Silty Sandstone. Grayish brown, fine to coarse grained sand, trace gravel, cemented (SS).		105
				Sand. Gray, very fine to fine grained, poorly graded, dense, cohesive (SP).		110
	MW1E			Consistent grain size throughtout.		115, 120
				Sandy Silt. Brown, hard, very fine grained sand (ML).		125
				Silty Sand. Light brown, coarse grained, subrounded to subangular, loose (SM).		130
				Silt. Reddish brown, hard, partly indurated, trace fine grained sand (ML).		135, 140, 145
				Becomes brown.		150

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Log of Monitoring Well: MW1D

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (Vertical feet)
				Minor clay.		155, 160
				Clayey Silt. Brown, hard, trace very fine grained sand (ML).		165, 170, 175, 180, 185, 190
					Bentonite Seal 193-196' #60 Transition Sand 196-198'	195
				Silty Sand. Grayish brown, medium to coarse grained, subrounded to subangular, non-cohesive, mostly mafic minerals, trace gravel (SM).		200, 205
				Silty Sandstone. Brown, very fine grained, hard, cemented (SS).	MW1D 4-inch Low Carbon Steel, 0.020-inch Continuous Slot Screen 200-220' #3 Filter Pack Sand 198-220'	210
	MW1F					215
					Total Depth Drilled 220 feet bgs	220

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Project: Rancho Seco Nuclear Generation Station

Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW2A, MW2B, MW2C

Drilling Contractor: Water Development	Borehole Diameter: 12-inch	Borehole Name: MW2	Logged By: R. Nommenson
Drilling Method: Mud Rotary	Dates Drilled: 5/16-17/2005	Well Construction: 5/18/2005	Checked By: Thomas Flutsch PG 14473
Drilled by: Randy Criner	Casing Diameter: 2.5-inch	Casing Type: Low Carbon Steel	Slot Size: 0.020-inch
Total Depth Drilled: 333-feet	Screen Intervals (ft bgs): A- 190-200'; B- 255-265'; C- 310-320'		Well Development Dates: 6/7/2005
Sampling Method: Grab	Top of Casing Elevations: A- 145.48; B- 145.28; C- 145.10		Ground Surface Elevation: 146.10

A: Northing: 1887946.55 Easting: 6812353.12 B: Northing: 1887945.27 Easting: 6812352.87 C: Northing: 1887946.21 Easting: 6812353.24

Comments: Asphalt surface approximately 75 feet west of surface water holding ponds.

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical Feet)
				Sandy Gravel. Light brown (7.5YR 6/4), well graded (GW).	Flush mount vault box Wells secured with locking pressure caps MW2A 2.5-inch inner-diameter (ID) Low Carbon Steel (LCS) blank casing to 190' MW2B 2.5-inch ID LCS blank casing to 255' MW2C 2.5-inch ID LCS blank casing to 310'	0, 5
				Sand. Light brown (7.5YR 6/4), coarse grained, gravel, angular fragments, trace clay (SP).		10, 15
				Gravel. Poorly graded, minor sand and clay (GP).		20
☒	MW2A					25
				Clay with trace gravel (CL).		30, 35
					Neat Cement from near ground surface to 183'.	40, 45
☒	MW2B			Gravels increase.		50, 55
						60, 65

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Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW2A, MW2B, MW2C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
				Light brown (7.5YR 6/4), trace gravel. Sand and gravel.		70, 75, 80, 85
				Gravel with coarse grained sand, light brown (7.5YR 6/4) (GW).		90
				Clay with <10% coarse angular gravel fragments (CL).		95
☒	MW2C			Gravel. Reddish brown (5YR 4/4), poorly graded, fine grained, well rounded, minor clay (GP).		100, 105
				Sand. Pinkish gray (5YR 6/2), medium to coarse grained, well graded, cemented, minor clay (SW).		110, 115, 120, 125
				Sandstone. Minor silt and clay, fine grained, brown (7.5YR 5/4), strongly cemented (SS). Medium to coarse grained.		130, 135
				Fine to medium grained, brown (7.5YR 5/4), clayey cemented sand (SS).		140, 145, 150

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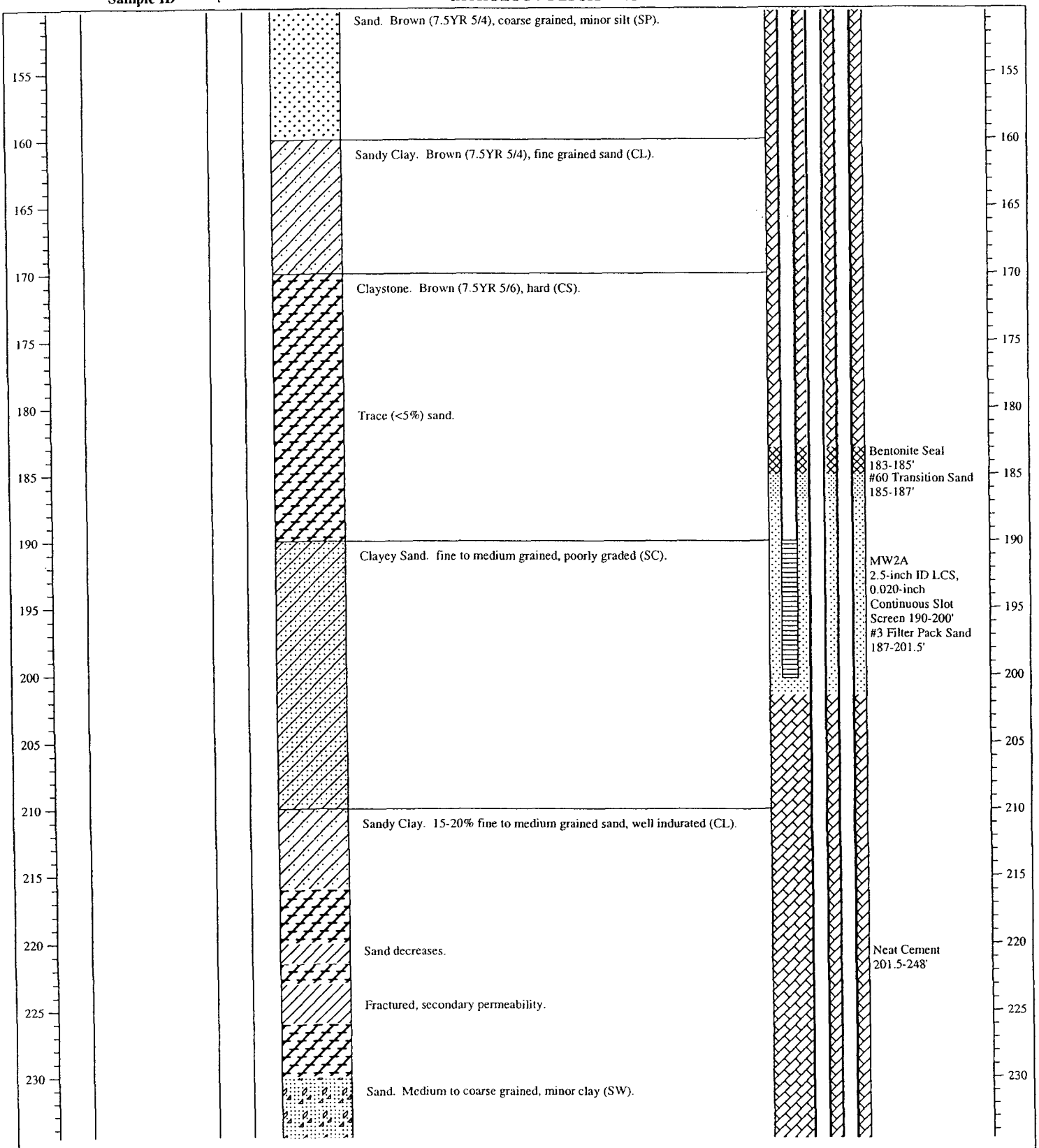
Log of Monitoring Wells: MW2A, MW2B, MW2C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)



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Log of Monitoring Wells: MW2A, MW2B, MW2C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
				Clay. Medium grained sand, angluar (CL).		
				Possibly sandstone (SS).		
				Clayey Sand. Dark brown (7.5YR 3/2), poorly graded, fine to medium grained (SC).	Bentonite Seal 248-250' #60 Transition Sand 250-252' MW2B 2.5-inch ID LCS, 0.020-inch Continuous Slot Screen 255-265' #3 Filter Pack Sand 252-266.5'	
				Sand. Dark grayish brown (10YR 4/2), fine to medium grained, poorly graded, angular, minor clay (SP).		
				Less cemented.		
				Medium grained, angular, dark sand.		
				Minor clay, fine grained sand.		
				Clayey Sand. Medium to coarse grained sand, very angular, 25-40% clay (SC).	Neat Cement 266.5-303'	
				Claystone. Increasing clay content (CS).	Bentonite Seal 303-305' #60 Transition Sand 305-307' MW2C 2.5-inch ID LCS, 0.020-inch Continuous Slot Screen 310-320' #3 Filter Pack Sand 307-321.5'	

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Log of Monitoring Wells: MW2A, MW2B, MW2C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
				No Recovery.	Boring back-filled with Neat Cement from TD to 321.5 ft bgs Total Depth Drilled 333 feet bgs	320 325 330

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Project: Rancho Seco Nuclear Generation Station

Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW3A, MW3B, MW3C

Drilling Contractor: Water Development	Borehole Diameter: 12-inch	Borehole Name: MW3	Logged By: S. Plunkett
Drilling Method: Mud Rotary	Dates Drilled: 6/1/2005	Well Construction: 6/5/2005	Checked By: Thomas C. Cutsafi P.G. #4473
Drilled by: Randy Criner	Casing Diameter: 2.5-inch	Casing Type: Low Carbon Steel	Slot Size: 0.020-inch
Total Depth Drilled: 320-feet	Screen Intervals (ft bgs): A- 200-210'; B- 265-275'; C- 310-320'		Well Development Dates: 6/7/2005
Sampling Method: Grab	Top of Casing Elevations: A- 142.93; B- 142.77; C- 142.56		Ground Surface Elevation: 143.60

A: Northing: 1888224.36 Easting: 6810988.02 B: Northing: 1888224.00 Easting: 6810987.93 C: Northing: 1888224.13 Easting: 6810988.28

Comments:

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical Feet)
				Boring not logged from ground surface to 60 feet bgs.	Flush mount vault box Wells secured with locking pressure caps MW3A 2.5-inch inner-diameter (ID) Low Carbon Steel (LCS) blank casing to 200' MW3B 2.5-inch ID LCS blank casing to 265' MW3C 2.5-inch ID LCS blank casing to 310' Neat Cement from near ground surface to 187'.	0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65
				Silty Clay. Brown (7.5YR 4/4), soft, non-plastic, dry (CL).		

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Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW3A, MW3B, MW3C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
				Silty Clay. Brown (7.5YR 4/2), soft claystone, low plasticity, <15% sand and gravel (CL).		70, 75
				Silty Claystone. Medium plasticity, minor very fine grained sand, claystone (CS).		80, 85, 90
				Sandy Clay. Brown (7.5YR 4/4), low plasticity, minor silt and gravel, very fine grained sand, angular to subrounded, quartz rich (CL).		95
				30% very fine to medium grained sand, coarse content increasing, silty.		100
				Sandstone. Reddish brown (5YR 4/3), competent, indurated, angular to subrounded, quartz rich, silicious, massive (SS).		105, 110
				Content of fines increases to 30% silt.		115
				Silty Sandstone. Strong brown (7.5YR 4/6), very fine to medium grained sand, minor gravel to 10%, poorly graded, angular to subrounded, massive (SS).		120
				Siltstone. Dark reddish gray (5YR 4/2), very fine sandy silt with minor clay and gravel, soft, non-plastic (SLTST).		125, 130, 135
				Silty Sandstone. Coarse content increasing, medium grained sand (SS).		140
				Siltstone. Dark reddish gray (5YR 4/2), fine content increasing, very fine grained sand siltstone, weak, minor clay 25% (SLTST).		145
				Sandstone. Dark reddish brown (5YR 3/3), silty, very fine to coarse grained sand, poorly graded, massive, quartz rich, angular to subrounded (SS).		150

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Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW3A, MW3B, MW3C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
				Sandy Siltstone. Brown (7.5YR 4/4), low plasticity, soft, very fine grained sand, clay (SLTST).	Bentonite Seal 187-195' #60 Transition Sand 195-197' MW3A 2.5-inch ID LCS, 0.020-inch Continuous Slot Screen 200-210' #3 Filter Pack Sand 197-210.5'	155, 160, 165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 225, 230
				Sandy Siltstone. Brown (7.5YR 4/3), 30% very fine to medium grained sand, 60% silt, 10% clay, soft (SLTST).		
				Clayey Siltstone. Brown (7.5YR 4/4), clay content increases, moderate plasticity, 20% sand (SLTST).		
				Sandy Siltstone. Brown (7.5YR 4/3), sand content increases to 25-30%, quartz rich, subangular to subrounded, clayey silt matrix, soft, non-plastic (SLTST).		
				Silty Sandstone. 50-60% very fine to coarse grained sand with minor clay and silt (30%) (SS).	Bentonite Seal 210.5-260'	
				Coarse content increases to 60-70% sand and gravel, 20% silt, 10% clay.		
				Content of silt and clay decreases to trace, massive indurated poorly graded gravel sandstone, subrounded to angular rock fragmetns, quartz rich (SS).		

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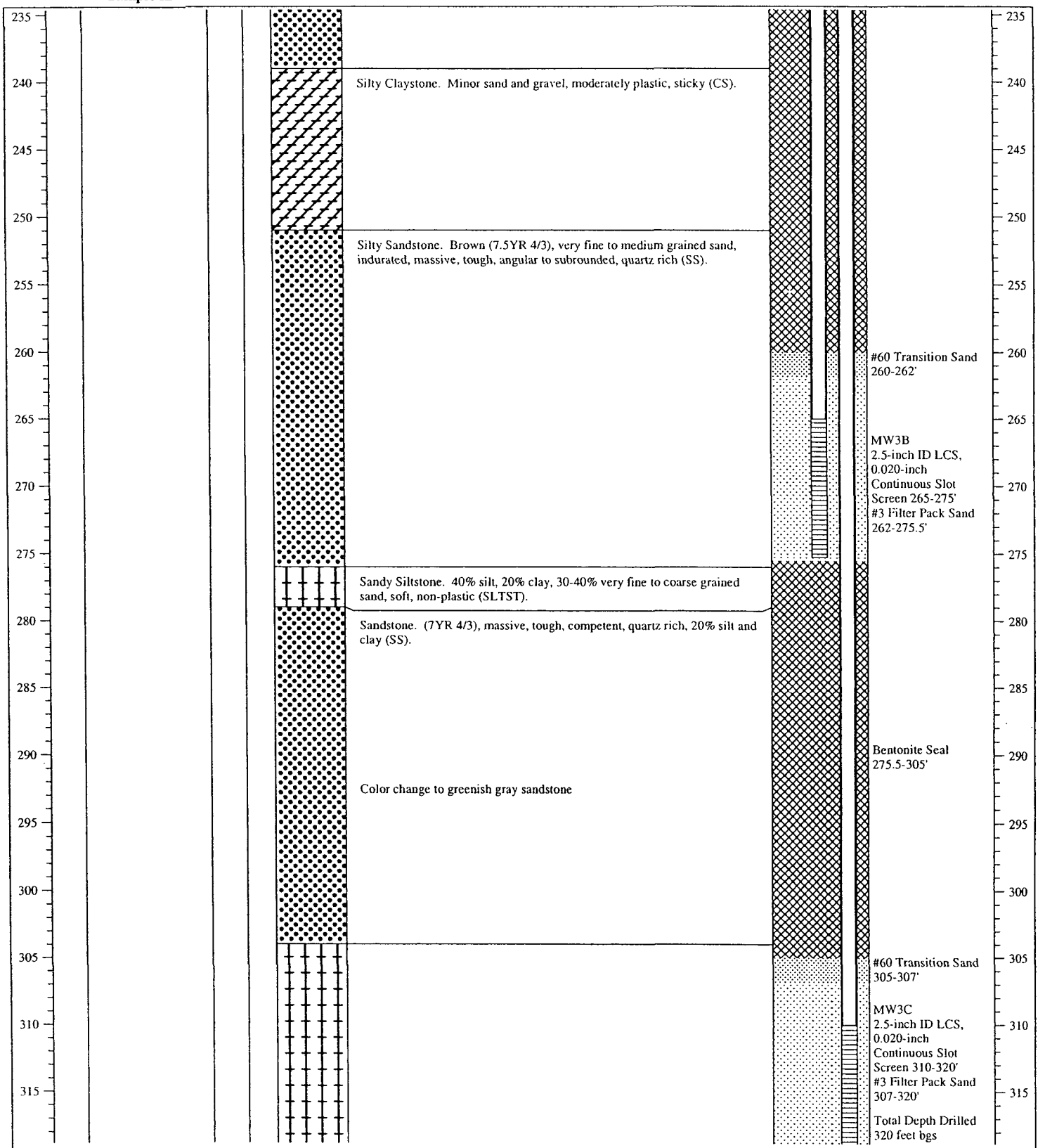
Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW3A, MW3B, MW3C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)



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Project: Rancho Seco Nuclear Generation Station Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612	Log of Monitoring Wells: MW3A, MW3B, MW3C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
320						320

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Project: Rancho Seco Nuclear Generation Station

Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW4A, MW4B, MW4C

Drilling Contractor: Water Development	Borehole Diameter: 12-inch	Borehole Name: MW4	Logged By: S. Plunkett
Drilling Method: Mud Rotary	Dates Drilled: 5/23-24/2005	Well Construction: 6/2/2005	Checked By: [illegible] P.G. /4473
Drilled by: Randy Criner	Casing Diameter: 2.5-inch	Casing Type: Low Carbon Steel	Slot Size: 0.020-inch
Total Depth Drilled: 320-feet	Screen Intervals (ft bgs): A- 195-2'5; B- 251-261'; C- 310-320'		Well Development Dates: 6/9/2005
Sampling Method: Grab	Top of Casing Elevations: A- 140.41; B- 140.21; C- 140.07		Ground Surface Elevation: 140.8

A: Northing: 1887086.40 Easting: 6810770.31 B: Northing: 1887086.44 Easting: 6810770.72 C: Northing: 1887086.10 Easting: 6810770.56

Comments:

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical Feet)
				Gravel. Brown (7.5YR 4/4), angular rock fragments from large boulder, very tough, quartz rich, silicious with minor mafic component, minor clay (GP).	Flush mount vault box Wells secured with locking pressure caps MW4A 2.5-inch inner-diameter (ID) Low Carbon Steel (LCS) blank casing to 195' MW4B 2.5-inch ID LCS blank casing to 251' MW4C 2.5-inch ID LCS blank casing to 310'	0, 5
				Sandy Clay. Brown (7.5YR 5/4), non-plastic, fine to medium grained sand, minor rock fragments, dry (CL).		10
				Gravelly, Sandy, Silty Clay. Light bluish grey (GLEY2 7/5PB) low plasticity, dry (CL).		15
				Silty Sandy Gravel. Olive (5Y 4/3), subangular to subrounded, quartz rich with feldspar (GM).		20
				Gravelly Silty Clay. Reddish brown (5YR 5/3), low plasticity, 30% gravel, slightly moist (CL).		25
				Silty Sandy Gravel. Subangular to subrounded, quartz rich, minor rock fragments. dry (GM).		30
				Gravelly Silt. Reddish brown (5YR 5/4), coarse component decreasing (ML). <20% gravel.		35
				Silty Clay. Soft, low plasticity (CL).	Neat Cement from near ground surface to 185'.	40
				Sandy Gravelly Clay. Reddish brown (5YR 5/4), 25-30% sand and gravel (CL).		45
				Silty Claystone. Soft, low plasticity, <% sand and gravel, slightly moist (CS).		50, 55, 60, 65

URS 2870 Gateway Oaks Dr., Ste 300
Sacramento, CA 95833
916-679-2000

Project: Rancho Seco Nuclear Generation Station

Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW4A, MW4B, MW4C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
70–95				Silty Claystone. Reddish brown (5YR 5/4), soft, low plasticity, <10% sand, minor gravel (CS).		70–95
95–100				Clayey Siltstone. Soft, low plasticity, trace sand, slightly damp (SLTST). Sandy Siltstone. Weak red (2.5YR 5/2), sand content increasing to 25%, subangular to angular clasts, poorly graded (SLTST).		95–100
100–110				Sandy Siltstone. Yellowish red (5YR 4/6), clay and silt content increasing, very fine grained sand 10-15% with minor gravel (SLTST).		100–110
110–120				Sand and gravel content 25-30%, angular to subrounded, coarse.		110–120
120–135				Siltstone. Dark gray (7.5YR 4/1), very fine grained sand 10-15%, trace coarse material (SLTST).		120–135
135–150				Clayey Siltstone. Brown (7.5YR 4/4), soft, non-plastic (SLTST).		135–150

URS
2870 Gateway Oaks Dr., Ste 300
Sacramento, CA 95833
916-679-2000

Project: Rancho Seco Nuclear Generation Station

Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW4A, MW4B, MW4C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
				Sandstone. Very fine to coarse grained sand, quartz rich, massive, poorly graded, angular to subrounded, <10% fines, cemented (SS).		155
				Clayey Siltstone. Brown (7.5YR 4/4), content of fines increased, <5% sand and gravel (SLTST).		160
						165
						170
						175
						180
						185
					Bentonite Seal 185-191'	
						190
					#60 Transition Sand 191-193'	
				Clayey Siltstone. Non-plastic, <5% sand and gravel (SLTST).		195
					MW4A 2.5-inch ID LCS, 0.020-inch Continuous Slot Screen 195-205'	200
				Sandy Clayey Siltstone. Brown (7.5YR 4/4), soft, low plasticity, sand content increasing 10-15%, very fine to medium grained (SLTST).	#3 Filter Pack Sand 193-205.5'	205
						210
				Clayey Siltstone. Reddish brown (5YR 4/3), low plasticity, sand content decreasing <5%, very fine to medium grained, dry (SLTST).		215
				Sandy Siltstone. Minor clay, sand and coarse sand content increased to 20%, poorly graded, subangular to subrounded, quartz (SLTST). Sandy Clayey Siltstone. Medium stiff, tight, medium plasticity, sand content decreasing, <10% sand (SLTST).	Bentonite Seal 205.5-246'	220
						225
						230

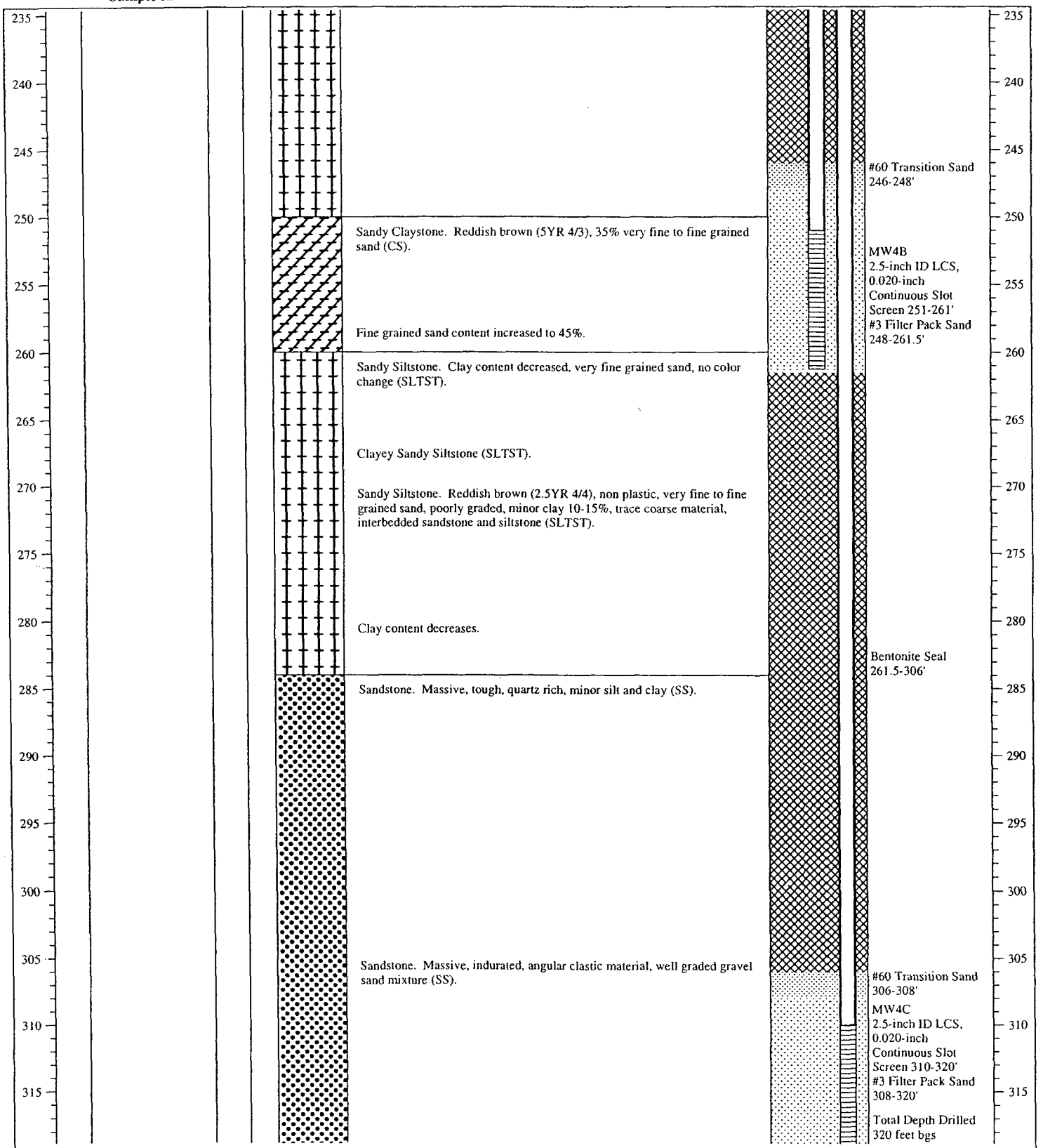
URS
2870 Gateway Oaks Dr., Ste 300
Sacramento, CA 95833
916-679-2000

Project: Rancho Seco Nuclear Generation Station

Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612

Log of Monitoring Wells: MW4A, MW4B, MW4C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)



URS 2870 Gateway Oaks Dr., Ste 300
Sacramento, CA 95833
916-679-2000

Project: Rancho Seco Nuclear Generation Station Location: 14440 Twin Cities Road, Hearld, California 95638 Project: 17325612	Log of Monitoring Wells: MW4A, MW4B, MW4C

Sample Interval	Sample ID	Time	Graphic Log	LITHOLOGY DESCRIPTION	WELL CONSTRUCTION	Depth (vertical feet)
320						320

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916-679-2000

APPENDIX B

2005 Physical Parameter Laboratory Results

08.d

Environmental Geotechnology Laboratory, Inc.

July 13, 2005

URS Corporation
2870 Gateway Oaks, Suite 300
Sacramento, CA 95833

Attn: Mr. Clif Gary

RE: LABORATORY TEST RESULTS/REPORT
Project Name: Hydorlogic Characterization of Rancho Seco
Project No.17325612.30000
EGL Job No.: 05-008-020

Dear Mr. Francis,

We have completed the testing program conducted on samples from the above project. The tests were performed in accordance with testing procedures as follows:

TEST	METHOD
Total Porosity	
Moisture & Density	ASTM D2937
Effective Porosity	
Sandy Soils (less than 15%)	
Other Soils (less than 15%)	
Hydraulic Conductivity	ASTM D5084

Enclosed is the Summary of Laboratory Test Results.

We appreciate the opportunity to provide testing services to URS Corporation. Should you have any questions, please call the undersigned.

Sincerely yours,

Environmental Geotechnology Laboratory, Inc.

Hank Jong, PE, GE
Manager

Enclosure

11819 Goldring Road, Suite A, Arcadia, CA 91006 • Tel.: (626) 263-3588, Fax: (626) 263-3599
E-MAIL: MAIL@EGLAB.COM

SUMMARY OF LABORATORY TEST RESULTS
Specific Gravity, Total Porosity

PROJECT NAME: Hydrologic Characterization of Rancho Seco

EGL JOB NO.: 05-008-020

Job No.: 17325612.30000

CLIENT: URS

DATE: 06-30-05

SUMMARIZED BY: VW

SAMPLE ID	DEPTH NO (ft)	DRY DENSITY ASTM D2937 (pcf)	SPECIFIC GRAVITY ASTM D854	TOTAL POROSITY (%)
MW1-A	15-18.5	100.2	2.772	42.1
MW1-B	30	90.9	2.684	45.8
MW1-C	90	104.4	2.711	38.3
MW2-A	25.5-26.5	77.3	2.734	54.7
MW2-B	50.5	83.7	2.667	49.7
MW2-C	101	82.2	2.636	50.1

SUMMARY OF PERMEABILITY TEST RESULTS

PROJECT NAME: Hydrologic Characterization of Rancho Seco

EGL JOB NO.: 05-008-020

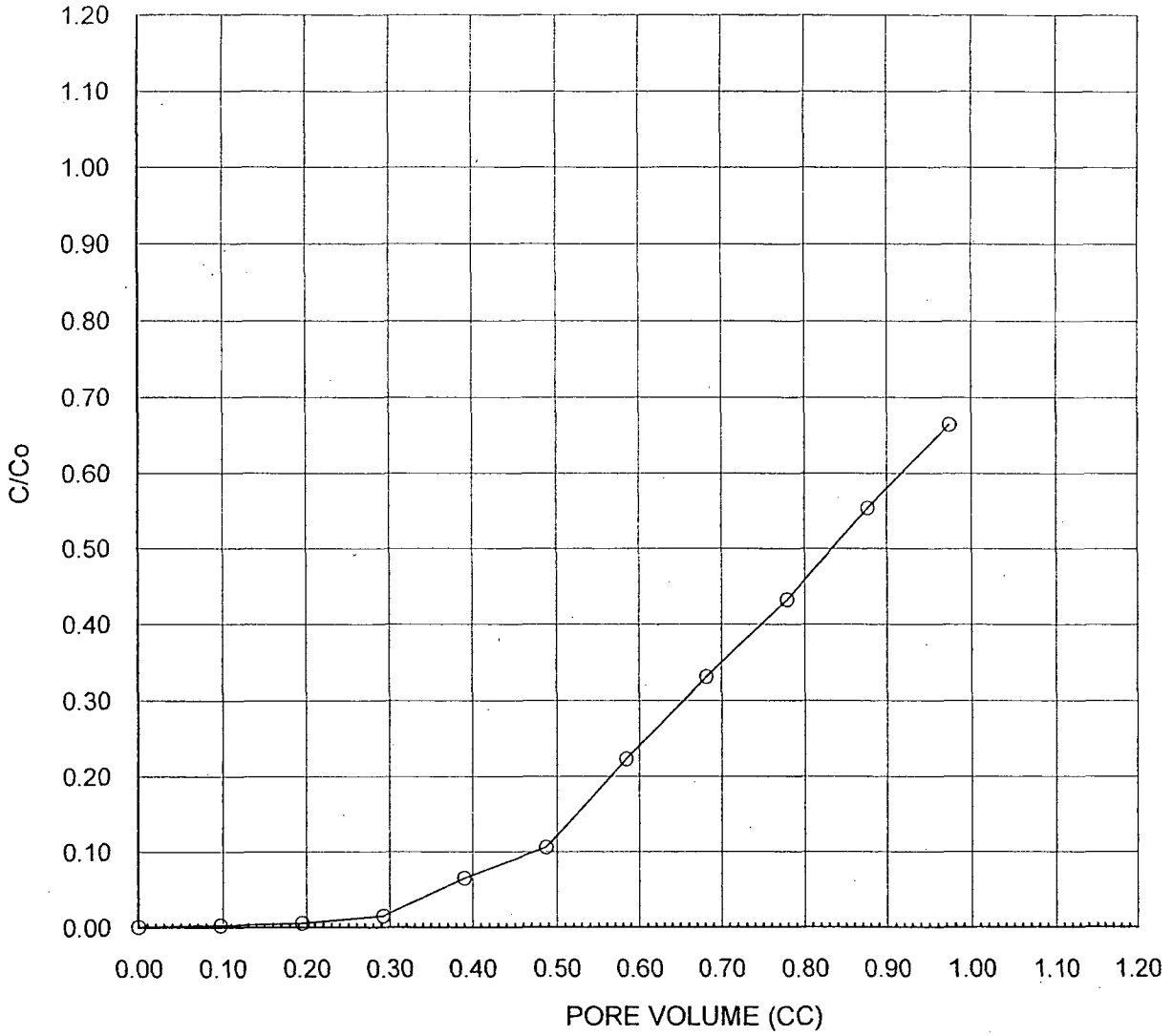
PROJECT NO.: 17325612.30000

CLIENT: URS

DATE: 06-30-05

SUMMARIZED BY: VW

SAMPLE ID	SAMPLE NO	DEPTH (ft)	MOISTURE CONTENT ASTM D2216 (%)	DRY DENSITY ASTM D2937 (pcf)	EFFECTIVE CONFINED PRESSURE (psi)	SATURATED HYDRAULIC CONDUCTIVITY ASTM D5084 (cm/sec)
N/A	MW1-A	15-18.5	12.20	100.2	8.7	5.8E-004
N/A	MW1-B	30	25.80	90.9	15.9	3.5E-006
N/A	MW1-C	90	25.5	104.4	40	7.1E-007
N/A	MW2-A	25.5-26.5	34.5	77.3	12.5	1.4E-004
N/A	MW2-B	50.5	33.7	83.7	26.2	2.8E-007
N/A	MW2-C	101	35.8	82.2	40	3.6E-006



SYMBOL	SAMPLE ID	DEPTH (FT)	SOIL TYPE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	TOTAL POROSITY	EFFECTIVE POROSITY
O	MW1-A	15-18.5	SM	100.2	12.2	0.421	**0.352**

Environmental Geotechnology Laboratory

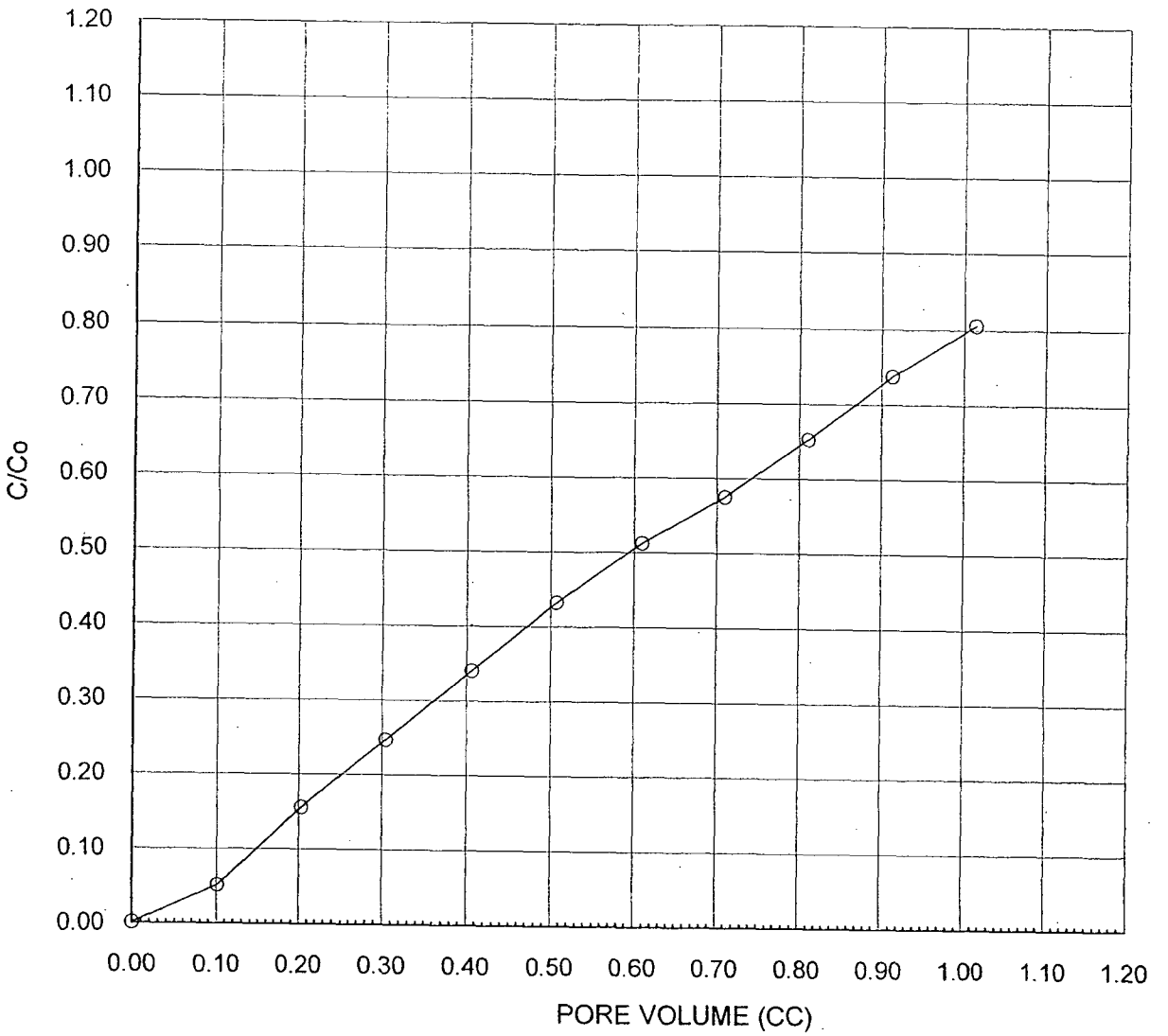
PROJECT NAME: Hydrologic Characterization of Rancho Seco
Client: URS
Job No.: 17325612.30000
EGL Project No.: 05-008-020

BROMIDE BREAKTHROUGH METHOD

(SWRCB)

06/05

FIGURE



SYMBOL	SAMPLE ID	DEPTH (FT)	SOIL TYPE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	TOTAL POROSITY	EFFECTIVE POROSITY
○	MW1-B	30	CL	90.9	25.8	0.458	**0.274**

Environmental Geotechnology Laboratory

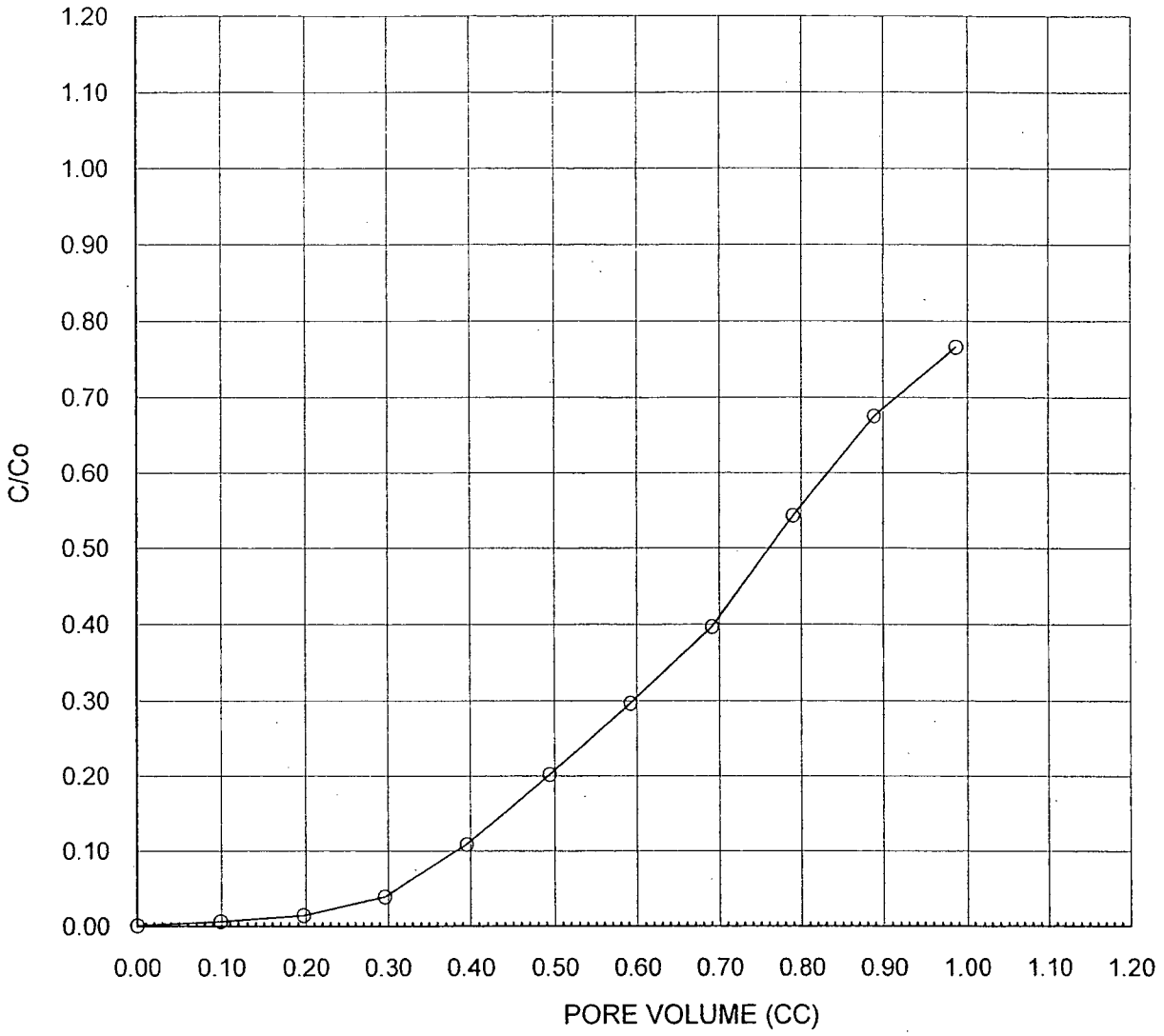
PROJECT NAME: Hydrologic Characterization of Rancho Seco
Client: URS
Job No.: 17325612.30000
EGL Project No.: 05-008-020

BROMIDE BREAKTHROUGH METHOD

(SWRCB)

06/05

FIGURE



SYMBOL	SAMPLE ID	DEPTH (FT)	SOIL TYPE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	TOTAL POROSITY	EFFECTIVE POROSITY
○	MW1-C	90	SM-SC	104.4	25.5	0.383	**0.291**

Environmental Geotechnology Laboratory

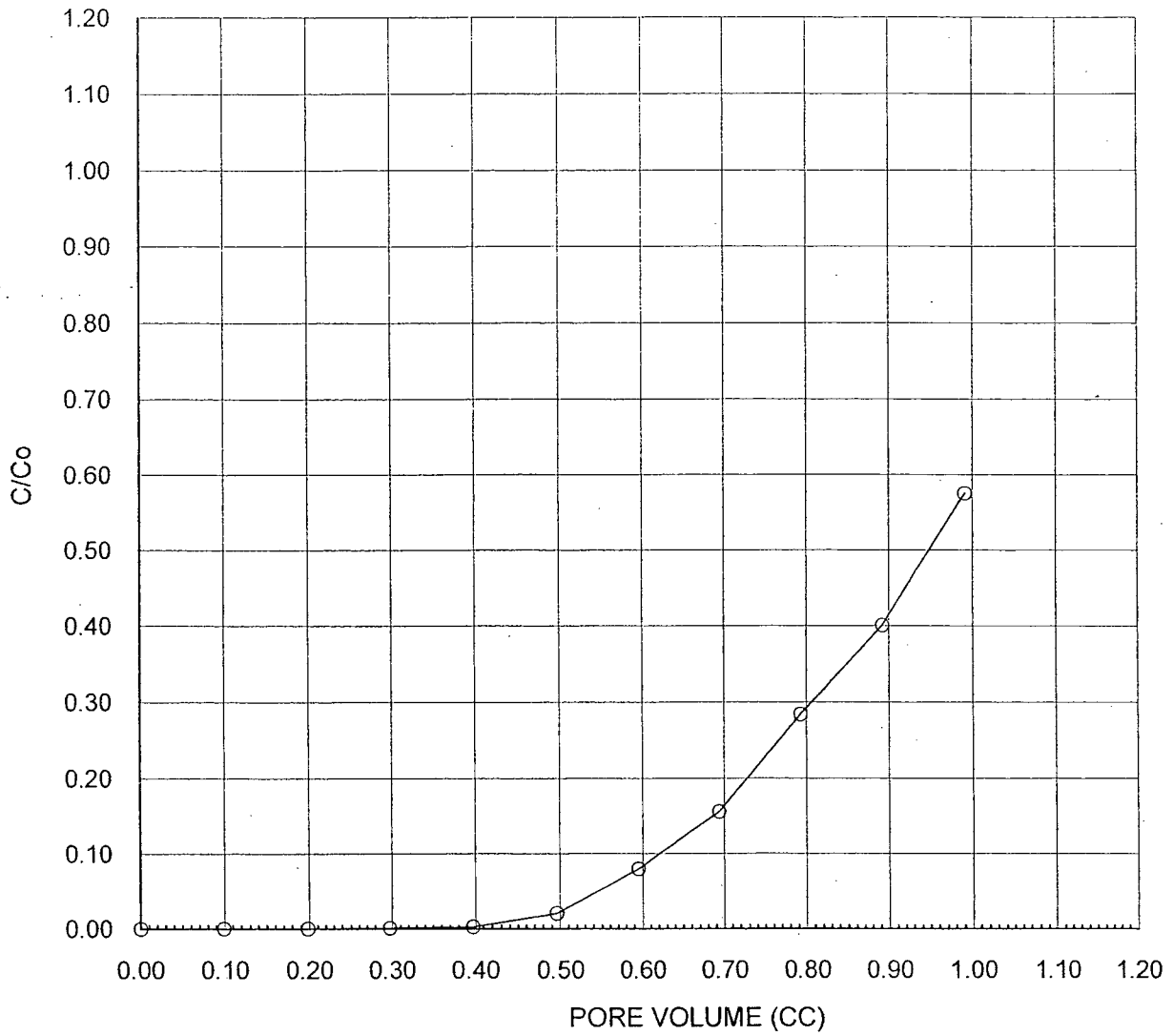
PROJECT NAME: Hydrologic Characterization of Rancho Seco
Client: URS
Job No.: 17325612.30000
EGL Project No.: 05-008-020

BROMIDE BREAKTHROUGH METHOD

(SWRCB)

06/05

FIGURE



SYMBOL	SAMPLE ID	DEPTH (FT)	SOIL TYPE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	TOTAL POROSITY	EFFECTIVE POROSITY
○	MW2-A	25.5-26.5	ML	77.3	34.5	0.547	**0.519**

Environmental Geotechnology Laboratory

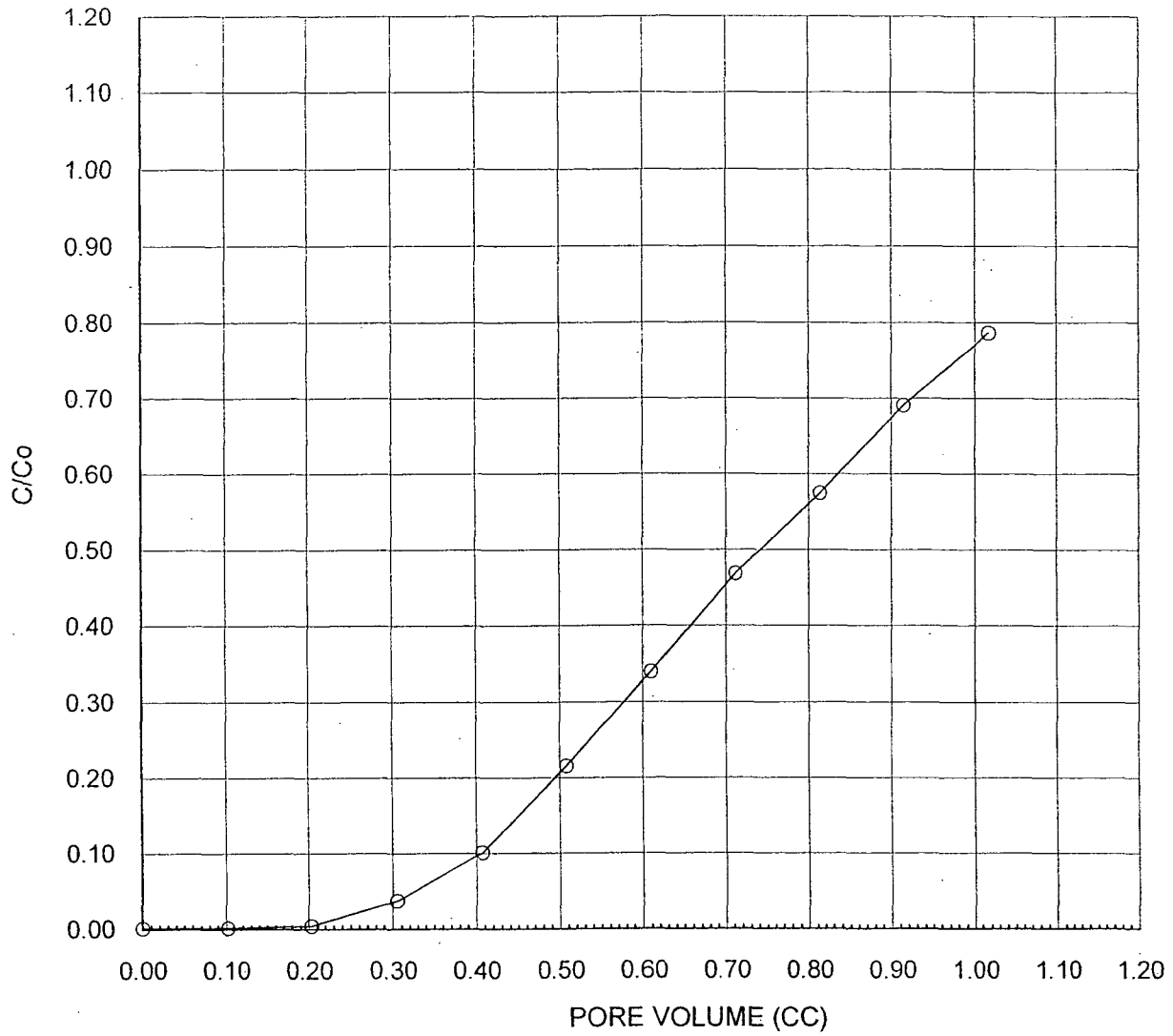
PROJECT NAME: Hydrologic Characterization of Rancho Seco
Client: URS
Job No.: 17325612.30000
EGL Project No.: 05-008-020

BROMIDE BREAKTHROUGH METHOD

(SWRCB)

06/05

FIGURE



SYMBOL	SAMPLE ID	DEPTH (FT)	SOIL TYPE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	TOTAL POROSITY	EFFECTIVE POROSITY
○	MW2-B	50.5	CL	83.7	33.7	0.497	**0.370**

Environmental Geotechnology Laboratory

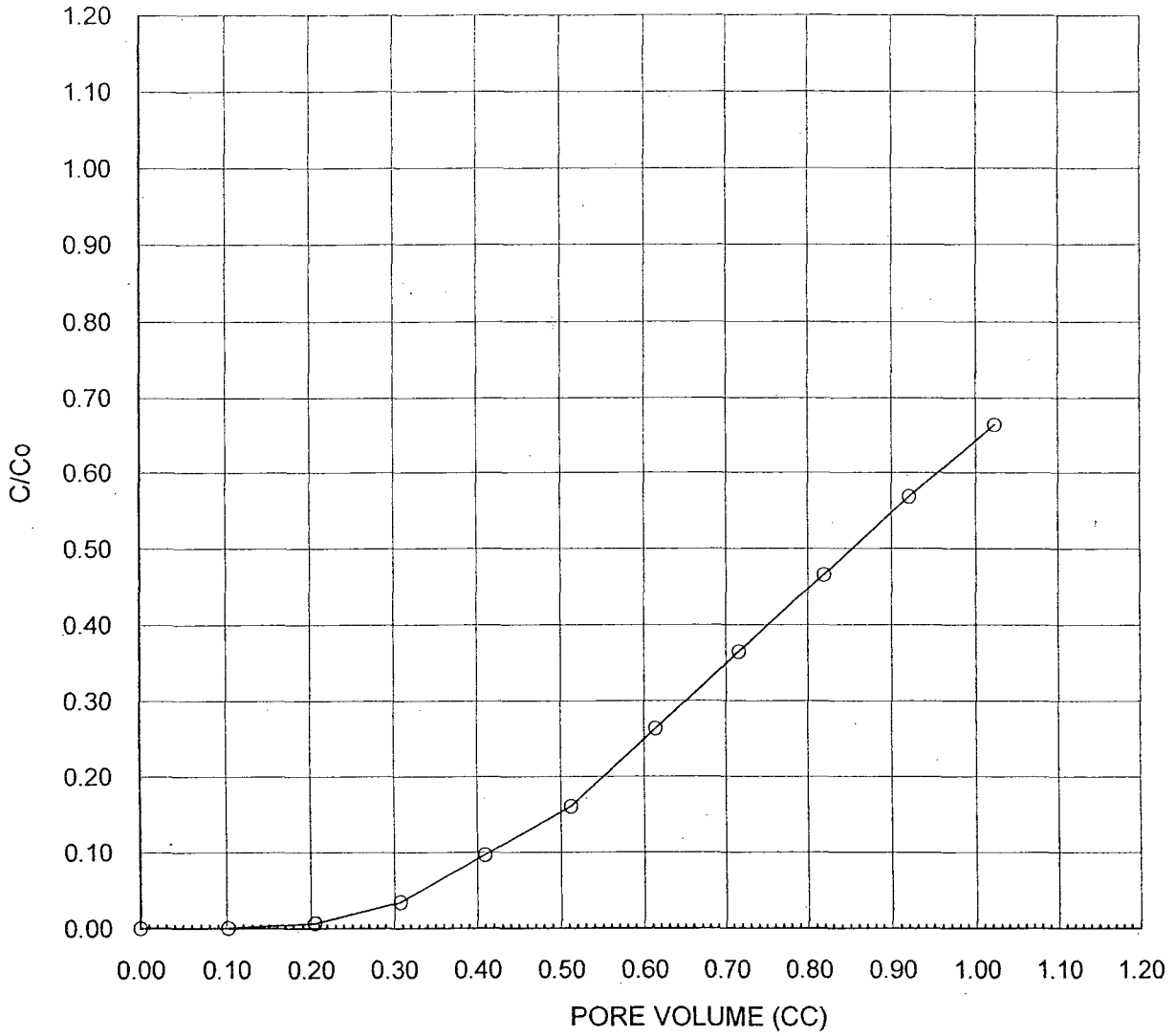
PROJECT NAME: Hydrologic Characterization of Rancho Seco
Client: URS
Job No.: 17325612.30000
EGL Project No.: 05-008-020

BROMIDE BREAKTHROUGH METHOD

(SWRCB)

06/05

FIGURE



SYMBOL	SAMPLE ID	DEPTH (FT)	SOIL TYPE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	TOTAL POROSITY	EFFECTIVE POROSITY
○	MW2-C	101.0	CL-ML	82.2	35.8	0.501	**0.428**

Environmental Geotechnology Laboratory

PROJECT NAME: Hydrologic Characterization of Rancho Seco
Client: URS
Job No.: 17325612.30000
EGL Project No.: 05-008-020

BROMIDE BREAKTHROUGH METHOD

(SWRCB)

06/05

FIGURE

APPENDIX C

2005 Groundwater Sample Laboratory Results

Sierra Foothill Laboratory, Inc.

255 Scottsville Blvd
PO Box 1268
Jackson, CA 95642

Phone 209/223-2800
Fax 209/223-2747
Email sfl@volcano.net

SMUD

09/01/2005 **08/02/2005 - 09/01/2005**

Sample	Description				Taken		Received	Mail
	Nitrogen, Ammonia-N	<0.50	mg/L	0.50	08/10/2005	KR		
	pH, Lab*	6.9	unit	0.1	08/10/2005	KRS		
583406	**Effluent**				08/11/2005 0745		08/11/2005	08/16/2005
	G WW							
	Parameter	Results	Units	EQL	Analyzed	By		
	Renewal water,chronic tox 3rd ed	by SFL			08/11/2005	SFL		
	Alkalinity, Total	24	mg/L	5.0	08/15/2005	RK		
	Chlorine Residual,Total, Lab*	<0.10	mg/L	0.10	08/11/2005	L&R		
	Oxygen, Dissolved, Lab*	8.5	mg/L	0.1	08/11/2005	L&R		
	Hardness	32	mg/L	5.0	08/12/2005	KR		
	Specific Conductance	56.8	umho/cm	1.00	08/11/2005	RK		
	Nitrogen, Ammonia-N	<0.50	mg/L	0.50	08/15/2005	KR		
	pH, Lab*	7.0	unit	0.1	08/11/2005	RK		
583612	**COMBINED DISCHARGE (PE)**				08/15/2005 0850		08/15/2005	08/22/2005
	G WW 78113							
	Parameter	Results	Units	EQL	Analyzed	By		
	Total Coliform Bacteria, 20 tube	21	#/100ml	2.0	08/15/2005	DS		
583883	**MW1C**				08/17/2005 1010		08/18/2005	08/31/2005
	G W							
	Parameter	Results	Units	EQL	Analyzed	By		
	Cation/Anion Balance	2.04 / 1.92	meq/meq		08/31/2005	DEG		
	Alkalinity, Total	86	mg/L	5.0	08/22/2005	RK		
	Alkalinity, Bicarbonate	57	mg/L	5.0	08/22/2005	RK		
	Alkalinity, Carbonate	29	mg/L	5.0	08/22/2005	RK		
	Chloride	7.1	mg/L	1.0	08/19/2005	KR		
	Magnesium, Calculation	2	mg/L	2.0	08/25/2005	KL		
	Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR		
	Sulfate	<0.50	mg/L	0.50	08/18/2005	KR		
	Iron, FAA	17	mg/L	0.050	08/24/2005	TN		
	Potassium, FAA	3.86	mg/L	0.050	08/25/2005	TN		
	Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ		
	Calcium, Titrimetric	5.9	mg/L	3.0	08/23/2005	KR		
	Hardness	24	mg/L	5.0	08/19/2005	KR		
	Sodium, FAA	34	mg/L	0.10	08/25/2005	TN		
	Solids, Total Dissolved	126	mg/L	10	08/19/2005	MG		
	pH, Lab*	9.5	unit	0.1	08/18/2005	K&R		
583884	**MW2A**				08/17/2005 1155		08/18/2005	08/31/2005
	G WQ							
	Parameter	Results	Units	EQL	Analyzed	By		
	Cation/Anion Balance	2.36 / 2.20	meq/meq		08/31/2005	DEG		
	Alkalinity, Total	86	mg/L	5.0	08/22/2005	RK		
	Alkalinity, Bicarbonate	86	mg/L	5.0	08/22/2005	RK		
	Alkalinity, Carbonate	<5.0	mg/L	5.0	08/22/2005	RK		
	Chloride	14	mg/L	1.0	08/19/2005	KR		
	Magnesium, Calculation	3	mg/L	2.0	08/25/2005	KL		
	Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR		
	Sulfate	4.2	mg/L	0.50	08/18/2005	KR		
	Iron, FAA	23	mg/L	0.050	08/24/2005	TN		
	Potassium, FAA	3.34	mg/L	0.050	08/25/2005	TN		

Sierra Foothill Laboratory, Inc.

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Email sfl@volcano.net

SMUD

09/01/2005 **08/02/2005 - 09/01/2005**

Sample	Description			Taken		Received	Mail
	Boron-total, ICP	0.05	mg/L	0.05	08/23/2005	JQ	
	Calcium, Titrimetric	4.0	mg/L	3.0	08/23/2005	KR	
	Hardness	24	mg/L	5.0	08/19/2005	KR	
	Sodium, FAA	42	mg/L	0.10	08/25/2005	TN	
	Solids, Total Dissolved	151	mg/L	10	08/19/2005	MG	
	pH, Lab*	7.6	unit	0.1	08/18/2005	K&R	

583885 MW2B 08/17/2005 1340 08/18/2005 08/31/2005

G W

Parameter	Results	Units	EQL	Analyzed	By
Cation/Anion Balance	1.78 / 1.58	meq/meq		08/31/2005	DEG
Alkalinity, Total	64	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	64	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	<5.0	mg/L	5.0	08/22/2005	RK
Chloride	9.6	mg/L	1.0	08/19/2005	KR
Magnesium, Calculation	4	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR
Sulfate	1.4	mg/L	0.50	08/18/2005	KR
Iron, FAA	73	mg/L	0.050	08/24/2005	TN
Potassium, FAA	3.46	mg/L	0.050	08/25/2005	TN
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Calcium, Titrimetric	4.7	mg/L	3.0	08/23/2005	KR
Hardness	28	mg/L	5.0	08/19/2005	KR
Sodium, FAA	26	mg/L	0.10	08/25/2005	TN
Solids, Total Dissolved	101	mg/L	10	08/19/2005	MG
pH, Lab*	8.9	unit	0.1	08/18/2005	K&R

583886 MW2C 08/17/2005 1425 08/18/2005 08/31/2005

G W

Parameter	Results	Units	EQL	Analyzed	By
Alkalinity, Total	62	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	36	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	26	mg/L	5.0	08/22/2005	RK
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Cation/Anion Balance	1.55 / 1.43	meq/meq		08/31/2005	DEG
Calcium, Titrimetric	4.7	mg/L	3.0	08/23/2005	KR
Chloride	6.7	mg/L	1.0	08/19/2005	KR
Iron, FAA	36	mg/L	0.050	08/24/2005	TN
Hardness	20	mg/L	5.0	08/19/2005	KR
Potassium, FAA	4.03	mg/L	0.050	08/25/2005	TN
Magnesium, Calculation	2	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR
Sodium, FAA	24	mg/L	0.10	08/25/2005	TN
Sulfate	<0.50	mg/L	0.50	08/18/2005	KR
Solids, Total Dissolved	88	mg/L	10	08/19/2005	MG
pH, Lab*	9.6	unit	0.1	08/18/2005	K&R

583958 MW3A 08/18/2005 0715 08/18/2005 / /

G W

Parameter	Results	Units	EQL	Analyzed	By
Cation/Anion Balance	1.09 / 1.20	meq/meq		08/31/2005	DEG
Alkalinity, Total	53	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	42	mg/L	5.0	08/22/2005	RK

Sierra Foothill Laboratory, Inc.

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Email sfl@volcano.net

SMUD

Sample Description		Taken		Received	Mail
Alkalinity, Carbonate	11	mg/L	5.0	08/22/2005	RK
Chloride	5.0	mg/L	1.0	08/19/2005	KR
Magnesium, Calculation	<2.0	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR
Sulfate	<0.50	mg/L	0.50	08/18/2005	KR
Iron, FAA	38	mg/L	0.050	08/24/2005	TN
Potassium, FAA	2.41	mg/L	0.050	08/25/2005	TN
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Calcium, Titrimetric	3.2	mg/L	3.0	08/23/2005	KR
Hardness	16	mg/L	5.0	08/22/2005	KR
Sodium, FAA	20	mg/L	0.10	08/25/2005	TN
Solids, Total Dissolved	70	mg/L	10	08/19/2005	MG
pH, Lab*	9.3	unit	0.1	08/18/2005	K&R

583959 MW3B 08/18/2005 0750 08/18/2005 / /

G W

Parameter	Results	Units	EQL	Analyzed	By
Cation/Anion Balance	1.01 / 1.11	meq/meq		08/31/2005	DEG
Alkalinity, Total	49	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	42	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	7.0	mg/L	5.0	08/22/2005	RK
Chloride	4.6	mg/L	1.0	08/19/2005	KR
Magnesium, Calculation	<2.0	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR
Sulfate	<0.50	mg/L	0.50	08/18/2005	KR
Iron, FAA	27	mg/L	0.050	08/24/2005	TN
Potassium, FAA	2.50	mg/L	0.050	08/25/2005	TN
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Calcium, Titrimetric	3.2	mg/L	3.0	08/23/2005	KR
Hardness	16	mg/L	5.0	08/22/2005	KR
Sodium, FAA	18	mg/L	0.10	08/25/2005	TN
Solids, Total Dissolved	71	mg/L	10	08/19/2005	MG
pH, Lab*	9.3	unit	0.1	08/18/2005	K&R

583960 MW3C 08/18/2005 0805 08/18/2005 / /

G W

Parameter	Results	Units	EQL	Analyzed	By
Cation/Anion Balance	1.14 / 1.08	meq/meq		08/31/2005	DEG
Alkalinity, Total	49	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	38	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	11	mg/L	5.0	08/22/2005	RK
Chloride	3.7	mg/L	1.0	08/19/2005	KR
Magnesium, Calculation	2	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR
Sulfate	<0.50	mg/L	0.50	08/18/2005	KR
Iron, FAA	4.65	mg/L	0.050	08/24/2005	TN
Potassium, FAA	3.09	mg/L	0.050	08/25/2005	TN
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Calcium, Titrimetric	4.0	mg/L	3.0	08/23/2005	KR
Hardness	20	mg/L	5.0	08/22/2005	KR
Sodium, FAA	16	mg/L	0.10	08/25/2005	TN
Solids, Total Dissolved	71	mg/L	10	08/19/2005	MG

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09/01/2005 **08/02/2005 - 09/01/2005**

Sample	Description		Taken		Received	Mail
	pH, Lab*	9.3	unit	0.1	08/18/2005	K&R

583961 MW4A 08/18/2005 0835 08/18/2005 / /

G W

Parameter	Results	Units	EQL	Analyzed	By
Alkalinity, Total	49	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	45	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	<5.0	mg/L	5.0	08/22/2005	RK
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Cation/Anion Balance	1.26 / 1.16	meq/meq		08/31/2005	DEG
Calcium, Titrimetric	4.0	mg/L	3.0	08/23/2005	KR
Chloride	5.6	mg/L	1.0	08/19/2005	KR
Iron, FAA	203	mg/L	0.050	08/24/2005	TN
Hardness	20	mg/L	5.0	08/22/2005	KR
Potassium, FAA	2.69	mg/L	0.050	08/25/2005	TN
Magnesium, Calculation	2	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR
Sodium, FAA	19	mg/L	0.10	08/25/2005	TN
Sulfate	1.1	mg/L	0.50	08/18/2005	KR
Solids, Total Dissolved	69	mg/L	10	08/19/2005	MG
pH, Lab*	9.0	unit	0.1	08/18/2005	K&R

583962 MW4B 08/18/2005 0925 08/18/2005 / /

G W

Parameter	Results	Units	EQL	Analyzed	By
Alkalinity, Total	51	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	40	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	11	mg/L	5.0	08/22/2005	RK
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Cation/Anion Balance	1.02 / 1.17	meq/meq		08/31/2005	DEG
Calcium, Titrimetric	3.2	mg/L	3.0	08/23/2005	KR
Chloride	5.2	mg/L	1.0	08/19/2005	KR
Iron, FAA	5.3	mg/L	0.050	08/24/2005	TN
Hardness	14	mg/L	5.0	08/22/2005	KR
Potassium, FAA	2.97	mg/L	0.050	08/25/2005	TN
Magnesium, Calculation	<2.0	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR
Sodium, FAA	18	mg/L	0.10	08/25/2005	TN
Sulfate	<0.50	mg/L	0.50	08/18/2005	KR
Solids, Total Dissolved	72	mg/L	10	08/19/2005	MG
pH, Lab*	9.4	unit	0.1	08/18/2005	K&R

583963 MW4C 08/18/2005 0945 08/18/2005 / /

G W

Parameter	Results	Units	EQL	Analyzed	By
Alkalinity, Total	58	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	51	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	7.0	mg/L	5.0	08/22/2005	RK
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Cation/Anion Balance	1.44 / 1.32	meq/meq		08/31/2005	DEG
Calcium, Titrimetric	4.0	mg/L	3.0	08/23/2005	KR
Chloride	5.7	mg/L	1.0	08/19/2005	KR
Iron, FAA	6.4	mg/L	0.050	08/24/2005	TN

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Sample	Description		Taken		Received	Mail
	Hardness	22	mg/L	5.0	08/22/2005	KR
	Potassium, FAA	3.16	mg/L	0.050	08/25/2005	TN
	Magnesium, Calculation	3	mg/L	2.0	08/25/2005	KL
	Nitrogen, Total Nitrate-N	<0.050	mg/L	0.050	08/18/2005	KR
	Sodium, FAA	21	mg/L	0.10	08/25/2005	TN
	Sulfate	<0.50	mg/L	0.50	08/18/2005	KR
	Solids, Total Dissolved	81	mg/L	10	08/19/2005	MG
	pH, Lab*	9.2	unit	0.1	08/18/2005	K&R

583964 SAS 08/18/2005 1125 08/18/2005 / /

G W

Parameter	Results	Units	EQL	Analyzed	By
Alkalinity, Total	55	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	55	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	<5.0	mg/L	5.0	08/22/2005	RK
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Cation/Anion Balance	1.45 / 1.44	meq/meq		08/31/2005	DEG
Calcium, Titrimetric	4.7	mg/L	3.0	08/23/2005	KR
Chloride	4.1	mg/L	1.0	08/19/2005	KR
Iron, FAA	<0.050	mg/L	0.050	08/24/2005	TN
Hardness	24	mg/L	5.0	08/22/2005	KR
Potassium, FAA	3.8	mg/L	0.050	08/19/2005	TN
Magnesium, Calculation	3	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	1.8	mg/L	0.050	08/18/2005	KR
Sodium, FAA	20	mg/L	0.10	08/19/2005	TN
Sulfate	4.8	mg/L	0.50	08/18/2005	KR
Solids, Total Dissolved	165	mg/L	10	08/24/2005	DS
pH, Lab*	7.6	unit	0.1	08/18/2005	K&R

583965 RSP 08/18/2005 1045 08/18/2005 / /

G W

Parameter	Results	Units	EQL	Analyzed	By
Alkalinity, Total	65	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	65	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	<5.0	mg/L	5.0	08/22/2005	RK
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Cation/Anion Balance	1.69 / 1.54	meq/meq		08/31/2005	DEG
Calcium, Titrimetric	6.3	mg/L	3.0	08/23/2005	KR
Chloride	5.8	mg/L	1.0	08/19/2005	KR
Iron, FAA	0.24	mg/L	0.050	08/24/2005	TN
Hardness	35	mg/L	5.0	08/22/2005	KR
Potassium, FAA	3.7	mg/L	0.050	08/19/2005	TN
Magnesium, Calculation	5	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	0.64	mg/L	0.050	08/18/2005	KR
Sodium, FAA	20	mg/L	0.10	08/19/2005	TN
Sulfate	1.4	mg/L	0.50	08/18/2005	KR
Solids, Total Dissolved	180	mg/L	10	08/24/2005	DS
pH, Lab*	7.4	unit	0.1	08/18/2005	K&R

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SMUD

09/01/2005 **08/02/2005 - 09/01/2005**

Sample	Description	Taken	Received	Mail
583966	SITE G W	08/18/2005 1105	08/18/2005	/ /

Parameter	Results	Units	EQL	Analyzed	By
Alkalinity, Total	52	mg/L	5.0	08/22/2005	RK
Alkalinity, Bicarbonate	52	mg/L	5.0	08/22/2005	RK
Alkalinity, Carbonate	<5.0	mg/L	5.0	08/22/2005	RK
Boron-total, ICP	< 0.05	mg/L	0.05	08/23/2005	JQ
Cation/Anion Balance	1.46 / 1.35	meq/meq		08/31/2005	DEG
Calcium, Titrimetric	3.2	mg/L	3.0	08/23/2005	KR
Chloride	4.0	mg/L	1.0	08/19/2005	KR
Iron, FAA	<0.050	mg/L	0.050	08/24/2005	TN
Hardness	20	mg/L	5.0	08/22/2005	KR
Potassium, FAA	3.9	mg/L	0.050	08/19/2005	TN
Magnesium, Calculation	3	mg/L	2.0	08/25/2005	KL
Nitrogen, Total Nitrate-N	1.8	mg/L	0.050	08/18/2005	KR
Sodium, FAA	22	mg/L	0.10	08/19/2005	TN
Sulfate	3.5	mg/L	0.50	08/18/2005	KR
Solids, Total Dissolved	168	mg/L	10	08/24/2005	DS
pH, Lab*	7.7	unit	0.1	08/18/2005	K&R

Sample	Description	Taken	Received	Mail
583967	SITE WELL G W	08/18/2005 1238	08/18/2005	08/26/2005

Parameter	Results	Units	EQL	Analyzed	By
Iron, FAA	<0.050	mg/L	0.050	08/24/2005	TN
Manganese, FAA	0.02	mg/L	0.020	08/24/2005	TN

Sample	Description	Taken	Received	Mail
584212	COMBINED DISCHARGE (PE) G WW	08/23/2005 0725	08/23/2005	08/30/2005

Parameter	Results	Units	EQL	Analyzed	By
Nitrogen, Ammonia-N	<0.50	mg/L	0.50	08/29/2005	KR

Sample	Description	Taken	Received	Mail
584263	COMBINED DISCHARGE (PE) G WW 78125	08/23/2005 0725	08/23/2005	08/31/2005

Parameter	Results	Units	EQL	Analyzed	By
Total Coliform Bacteria, 20 tube	26	#/100ml	2.0	08/23/2005	DS

Sample	Description	Taken	Received	Mail
584811	COMBINED DISCHARGE (PE) G WW 78127	08/30/2005 0800	08/30/2005	/ /

Parameter	Results	Units	EQL	Analyzed	By
Total Coliform Bacteria, 20 tube				/ /	

Sample	Description	Taken	Received	Mail
584830	Inhib Residue G W	08/30/2005 1240	08/31/2005	/ /

Parameter	Results	Units	EQL	Analyzed	By
Inhibitory Residue				/ /	

ENGINEERING REPORTS AND STUDIES
COVER SHEET

Subject: Geotechnical Investigation for Proposed Evaporation Ponds

Control Number: ERPT-C0104

Initiated required follow-up documents [ ] YES [ ] NO [X] NOT REQUIRED

10 CFR 50.59 Determination [ ] Required
[X] Not Required (See DCP/PDQ No. N/A)

Rev. No.	Date	Initial Issue and Revision History	Originator	DGS Approval
1	4-5-89	Added note below	cyp	

Note: Due to duplication of assigned numbers, the document "Seismic Equipment Qualification Record (SQ-074), Gould Pressure Transmitters" has been issued as ERPT-C0095.

PRELIMINARY DRAFT - NOT TO BE USED FOR

DESIGN OR CONSTRUCTION

Report of Geotechnical Investigation for Proposed Evaporation Ponds

Rancho Seco Nuclear Generating Station

Bechtel Job 12334-059

Rev. 0 11/15/85

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Executive Summary

A geotechnical investigation of a proposed evaporation pond site at the Rancho Seco Nuclear Generating Station was performed in the summer and fall of 1985. The proposed evaporation ponds consist of two 11-acre impoundments surrounded by earth embankments which are to be constructed from the near surface soils. The site is located about 1/4 mile southeast of the plant, in an area of gently rolling topography underlain by unconsolidated alluvium and poorly consolidated sedimentary rocks of Pliocene to Holocene age.

The purpose of the geotechnical investigation was to collect subsurface geologic and soils data for use in evaluating suitability of the site for the proposed evaporation ponds, and to establish a baseline ground-water and soil pore water monitoring system. The field work included soil sampling, permeability testing, installation of observation wells and lysimeters, water sampling and measurement of ground-water levels. Four permeameter holes were drilled for testing permeability of near-surface soils. A total of four observation wells and two lysimeters were installed. Four test pits were dug for bulk soil samples and ten soils borings were drilled to collect soils samples for laboratory testing. Water samples were submitted by the Sacramento Municipal Utility District to Morse laboratories for chemical analysis.

Data from the field program were reduced and analyzed to determine geotechnical suitability at the site. Principal conclusions reached are

that the upper sandy soils are suitable for embankment construction, and that the site soils will provide favorable foundation conditions for the proposed project. The water table is at a depth of approximately 150 feet.

Although the pond is being designed with a double liner and leachate collection system, the underlying strata are of moderate to low permeability and would help to protect against ground-water contamination in the unlikely event of liner system failure. Results of permeameter tests provide data on the permeability of soils in the upper ten feet. These values ranged from 1.8×10^{-4} to 6×10^{-6} cm/sec. Packer permeability testing of selected intervals between 22 and 200 feet in the deep boreholes resulted in permeability values ranging from 1.1×10^{-4} to 3.4×10^{-7} cm/sec. Many of the test zones would not accept measurable quantities of water; permeability of these zones is interpreted to be less than 10^{-6} cm/sec. The saturated sand zones beneath the site were estimated to have a permeability of about 1×10^{-3} cm/sec on the basis of observed specific capacities in monitoring wells OW-2 and OW-3.

Using data from the field program, an analysis was performed to evaluate effects of a hypothetical pond liner failure on downgradient ground-water quality. A travel time of over 20,000 years was calculated for Cs-137, considering the effects of adsorption, to reach the nearest downgradient well, located 2200 feet southwest of the evaporated pond site. Cs-137 concentrations would be reduced by radioactive decay to negligible concentrations during this period.

1.0 Introduction

This report documents the procedures used and results obtained from the subsurface investigation and observation well installation program carried out for the proposed evaporation ponds at Rancho Seco Nuclear Generating Station (Figure 1). The program was conducted between July 10 and September 17, 1985. The site of the ponds is located approximately 3000 feet south-southwest of the power block area. Two 11-acre ponds are proposed (Figure 2).

The purpose of the field investigation program was to gather background information on ground water condition by installing observation wells, and to provide subsurface information for use in evaluating the site as the location for evaporation ponds, as well as for designing the pond embankments. The information to be collected included:

- Lithology, thickness, areal extent, continuity and properties of geologic horizons.
- Properties of soils to be used for embankment construction.
- Ground-water data including ground-water levels and gradients, permeabilities and aquifer/aquiclude characteristics.
- Background pore water quality in the unsaturated zone.

2.0 Description of Project

The proposed evaporation ponds consist of two-11-acre impoundments surrounded by earth embankments. The embankments will be constructed from the near-surface soils excavated from the pond areas. To balance cut and fill volumes, it is estimated that approximately 0 to 5 feet of soil will be excavated from the pond bottoms, and approximately 10 to 15-foot-high embankments (inside height) will be constructed. The total volume of earth to be moved is on the order of 150,000 cubic yards.

The ponds will have a double liner with a leachate collection system. The upper or primary liner will be a synthetic one, consisting of high-density polyethylene. The secondary liner, beneath the leachate collection system, will consist either of compacted clay or a synthetic material. Sources for the clay liner material are presently under study.

The ponds will have a permanent monitoring system both in the ground water aquifer and in the unsaturated zone adjacent to the ponds.

The ponds will impound effluent from the plant's condensate polishing demineralizer system and condenser pit sump system. This effluent is expected to consist of generally high-quality water with trace amounts of hydrazine and very low levels of radioactivity. The hydrazine, being highly volatile, is expected to rapidly escape to the atmosphere.

3.0 Scope of Investigations

A total of four ground-water observation wells were installed outside the perimeter of the proposed evaporation ponds. Originally, three wells were planned but inconsistent water levels in well OW-3 necessitated the addition of a fourth. When well OW-3 was initially completed to a depth of 165 feet the water level was approximately 30 feet higher than anticipated. After the well was deepened to 200 feet the water dropped to the expected level, but the apparent presence of a "perched" water table required a fourth observation well. OW-3A was subsequently installed in this "perched" zone but has remained dry at the time of this report.

Two lysimeters were installed outside the perimeter of the ponds to obtain samples of soil pore water from the vadose zone. Water samples from the wells and lysimeters were given to the SMUD laboratory at the plant site for testing for the presence of background radioactivity, metals and general inorganic parameters.

Four permeameter holes were drilled to test permeability of near-surface materials (USBR Des. E-19) and bore hole permeability tests (USBR DES. E-18) were conducted in deeper zones within the observation wells.

Ten test borings to obtain soil samples were drilled to a depth of approximately 30 feet within the limits of the ponds. A summary of all drill holes is given in Table 1. Four test pits were also dug within the ponds to obtain additional bulk soil samples. All soil samples were sent to J. H. Kleinfelder and Associates in Sacramento for testing. The locations of all field borings and trenches are shown in Figure 3.

Drilling, observation well installation, borehole permeability testing, and backhoe pit excavation was performed by J. H. Kleinfelder under the direction of Bechtel. All field operations were supervised by Bechtel geologists, hydrogeologists, or soil engineers. Liaison and coordination assistance was provided by SMUD engineers.

4.0 Geologic and Hydrologic Setting

The discussion of regional and site geology in this report is taken from published literature, previous reports prepared for the Rancho Seco project and results of the subsurface investigations for the evaporation ponds.

The Rancho Seco site is a region of dissected gently-rolling topography with relatively flat stream gradients. The sedimentary formations at, and underlying, the site dip gently westward at approximately one degree. They lap onto the basement rocks which extend to the ground surface in the Sierra foothills to the east of the plant site.

The formation which underlies superficial soil and gravel deposits is the Laguna Formation of Pliocene Age. This formation provides the foundation for most of the major structures at the Rancho Seco site. The Laguna Formation consists primarily of clays, silts and fine silty, clayey sands reflecting a predominantly quiet-water depositional environmental (Figure 4). With the passage of time since the Pliocene these deposits have become consolidated and quite dense. A gravel layer within the Laguna was found in the three observation wells that were cored (Figure 5) and correlates with a similar layer in DH-23 approximately 3000 feet to the northeast of the evaporation ponds. DH-23 was completed in July 1967 as part of the initial site investigation for Rancho Seco.

Ground water in the site region is found at depths generally below 140 feet (elevations of approximately minus five feet) (Figure 6) in the sediments of the Mehrten Formation which underlie the Laguna. The Mehrten is characterized by medium-to-coarse grained olive-gray channel sand and gravel deposits alternating with fine-grained silts, sands, and mudflow deposits.

Ground-water flow in the Rancho Seco area is to the west. West and northwest of the evaporation pond site, water levels are affected by cones of depression around pumping centers, such as at Galt, Herald and Elk Grove (Figure 7). A number of agencies monitor ground-water levels in the area, including SMUD, the U.S. Geological Survey, U.S. Bureau of Reclamation, California Department of Water Resources and Sacramento

County Department of Public Works. Long-term water-level trends are shown on Figure 8, which indicate a general decline in levels from 1949 to 1977, relatively stable levels from 1977 to 1981, and rising water levels since 1981. Locations of wells in the site vicinity are shown on Figure 9.

Recharge to the ground water occurs mainly by infiltration of surface water along the active channels of rivers such as the Consumnes, American and Mokelumne, and by deep percolation of applied irrigation water (California Department of Water Resources, 1974). Some recharge also occurs from direct infiltration of precipitation, but this is limited by the relatively low annual rainfall, and the moderate to low permeability of near surface materials.

The Mehrten and Laguna formations generally contain good quality water in the Rancho Seco area. The water is low in dissolved solids and is a sodium or calcium bicarbonate-type water. Ground water is used extensively for irrigation, domestic and municipal supply; potable water for the Rancho Seco Plant comes from a well at the site.

5.0 Field Investigations

5.1 Geologic Core Holes

Core samples were obtained from three drill holes to obtain a continuous record of subsurface conditions in the vicinity of the evaporation ponds. The first drill hole (OW-2) was cored continuously using a continuous tube sampler from the surface to 110 feet, and an NX core barrel from 110 feet to the completed depth of 200 feet. The continuous tube sampler is essentially a five foot long split spoon sampler that is held stationary inside a hollow stem auger and is advanced slightly ahead of the augers during auger drilling. The sample obtained has a diameter of 2-3/8 inches. The advantage of using this method is that the drilling is done dry and the presence of thin perched water levels is much more easily detected. Below 110 feet excessive depth and harder drilling precluded further use of the augers and the remainder of the hole was cored using a standard 5-foot long NX core barrel. Revert drilling mud was used to hold the hole open during coring. Calcium hypochlorite was used to facilitate breakdown of this organic-type drilling mud following installation of the monitoring wells.

Drill holes OW-1 and OW-3 were cored from 30 to 192 feet and 35 to 165 feet respectively using the NX core barrel with Revert drilling mud. Details of coring operations are included in Appendix A - Boring Logs.

5.2 Borehole Permeability Testing

5.2.1 Packer Permeability Tests (E-18 Method)

Pneumatically inflated single and double NX packers were used to determine permeability of in-place subsurface materials in drill holes OW-1, OW-2 and OW-3. Testing was conducted in accordance with Test Designation E-18 from the Earth Manual, US Department of the Interior, Bureau of Reclamation. The packers were first inflated on the surface using compressed nitrogen to ensure they were operating properly before placing them down the bore hole. Double packers were used to test selected intervals in the bore holes. The spacing between the packers varied from 5.7 to 10.5 feet. In addition, a single packer was used to test longer intervals within the bore hole.

Water pressures were regulated by using a by-pass valve placed upstream of the flow meter. Gauge pressures of 3 psi to 50 psi were used. All pipes used were one-inch galvanized iron. In some cases where water losses were too low to be recorded on the flow meter, the meter was removed from the system and a constant head of water into the pipe was maintained inside the one inch pipe by pouring water from a container of known volume. Results of E-18 testing are discussed in Section 7.0 and summarized in Table 11.

5.2.2 Permeameter Tests (E-19 Method)

Permeability of near surface materials was determined by testing in accordance with Test Designation E-19 from the Earth Manual. Six-inch diameter holes were augered to a depth of approximately 10 feet and then backfilled with #3 Monterey sand.

After the sand was placed and two to three days before starting the E-19 tests, each hole was filled with water to "pre-saturate" the soil. When testing began, the water level was kept constant in the hole by means of a counter-balanced valve. Water was supplied from a 55 gallon drum. The tests varied in length from 72 minutes to over 23 hours. Results of E-19 testing are discussed in Section 7.0 and summarized in Table 3.

5.3 Ground-Water Observation Wells

5.3.1 Construction Details

Each observation well consists of four-inch diameter flush joint Schedule 40 PVC well screen and riser pipe set inside a 7-5/8 inch diameter hole. After the bore hole was completed a minimum of 1000 gallons of clean water was pumped through the drill rods to remove cuttings. The PVC well casing and screen were then set to the required depth and a hose adaptor was

connected to the top of the casing. Clean water was then pumped down inside the casing so that it flowed out through the well screen and returned to the surface. While the water was circulated in this manner, filter sand was slowly poured into the annulus between the well casing and side of the bore hole. After the sand was brought up to approximately two to three feet above the top of the well screen a calcium hypochlorite solution was pumped down the well casing to break down any remaining Revert drilling fluid. With clean water continuing to be pumped down the well casing and recirculating to the surface, 5/8 inch diameter bentonite pellets were dropped down the annulus until a one to two foot thick plug had been placed on top of the filter sand. A weighted measuring tape was used to determine the depth to the top of the filter sand and bentonite plug. The bentonite plug was allowed to set for a minimum of 1-3/4 hours before a 1:1 neat cement grout (with bentonite added to reduce shrinkage) was pumped into the annulus above the plug. The grout was placed through a one-inch diameter tremie pipe that was initially set to a depth ten feet above the bentonite then gradually withdrawn from the hole as the level of grout rose in the annulus. Several days later any grout settlement was topped off and an eight-inch protective steel surface casing was set a minimum of 1.7 feet into the ground. Observation well construction logs are found in Appendix B and a summary is given in Table 2.

5.3.2 Well Development and Testing

Monitoring wells OW-1, OW-2, and OW-3 were developed by air lift pumping, pumping with a submersible pump and bailing. Well OW-3A was dry at the time it was to be developed. Air lift pumping was performed by lowering 2-inch PVC pipe into the well, with 3/4-inch PVC pipe inside the 2-inch PVC pipe. Compressed air was pumped down the 3/4-inch pipe, forcing water and air to come out the 2-inch pipe. Because of the small submergence, potable water was periodically poured into the 4-inch well casing to help surge the screen and bring up sand and silt from the bottom of the well. Air lifting was performed on wells OW-1 and OW-2.

Wells OW-2 and OW-3 were pumped with a submersible pump having a capacity of about 20 to 25 gallons per minute against 175 to 190 feet of head. The wells were alternatively pumped and allowed to recover in order to permit surging in the screened section. More than 1000 gallons were pumped from each well. Pumping was also attempted in OW-1, but the yield was so low that the well was dry before water had filled up the discharge hose.

OW-1, OW-2, and OW-3 were all bailed to remove sand and silt brought into the well by pumping. OW-1 was blocked at about 177 feet (above the screen) and as a result, the water removed was nearly clear. It is planned to develop OW-1 further by

using a bladder pump. This pump has a lower capacity than the submersible pump used on OW-2 and OW-3, and should not dry up the well.

Estimates of the permeability of sands penetrated by the observation wells were obtained by making recovery measurements after bailing (OW-1) and applying the relationship between specific capacity and transmissivity (OW-2 and OW-3).

Permeability at OW-1 was estimated by measuring recovery of water levels following bailing to a dry condition. The method of analysis used in described by S. W. Lohman (1979, p. 29-30). This method is strictly applicable only to confined aquifers of low permeability. Since the sands and sandstones at the site are probably unconfined, at least near the water table, the method provides only a rough estimate of permeability. Furthermore, conductivity of the water removed from OW-1 indicates that development is not complete, so the calculated permeability may be too low.

Permeabilities of the sand zones at OW-2 and OW-3 were estimated using relationships between transmissivity (permeability times saturated aquifer thickness) and specific capacity (pumping rate per foot of drawdown) developed by Theis (1963) and Walton (1970, p. 315). Results of permeability testing are presented in Section 7.2.

5.4 Ground-Water Sampling

Samples of ground water from OW-2 and OW-3 were collected with a bailer in October 8, 1985, after bailing two well volumes from OW-3 and three well volumes from OW-2. Conductivity was monitored during bailing to assess stability of water chemistry before sampling. OW-1 was not sampled at that time because it appeared that fluids from the well were not yet representative of formation water. This was suggested by the fact that water removed from OW-1 at the end of bailing had a specific conductance of 3800 micromhos per centimeter, much higher than the formation water removed from OW-2 and OW-3 during pumping, which had a conductivity of less than 200 micromhos per centimeter. As noted in Section 5.3.2, it is planned to continue development of OW-1 until it can be sampled.

Ground-water samples were placed in clean one-gallon plastic bottles and cooled in an ice chest. They were delivered to SMUD for radionuclide analysis, and shipment to Morse Laboratory in Sacramento for chemical analysis. The results of these analyses are presented in Section 7.6.

5.5 Vadose Zone Pore Water Samplers

Two pressure-vacuum soil water samplers (L-1, L-2) were installed immediately north and south of the evaporation ponds to monitor the migration of any fluids through unsaturated overburden material. The

instruments installed were Soil Moisture Equipment Corporation, Model 1920 lysimeters (Figure 9). They were installed in six-inch diameter holes drilled to a depth of 15 feet using hollow stem augers. A Shelby tube was then pushed into the bottom of the hole through the hollow stem augers to provide a smaller (three-inch) hole in which to set the one and one-half inch diameter lysimeter. A slurry of silica flour and water (approximately one and one-half gallons in L-1 and one gallon in L-2) was then poured down the hole. The tops of the lysimeters were fitted snugly into the belled end of a length of one and one-half inch PVC and lowered through the augers into the three-inch hole. The access tubes from the lysimeter were routed to the surface through the PVC. Five feet of loose sifted soil was then placed on top of the lysimeter and a one to one and one-half foot layer of 5/8 inch bentonite pellets was placed on top of the soil. Approximately two gallons of water was then poured on top of the bentonite. The remaining open portion of the hole was backfilled with more loose sifted soil to within three of five feet of the surface. A permanent protective surface seal will be added later. Figure 10 shows a typical lysimeter installation.

Prior to their installation, each lysimeter was pressure tested, and the porous ceramic tips were saturated with water. After installation was complete, 60 centibars of suction was applied to each lysimeter. The water from the lysimeters was collected on the following day, and suction was again applied. The volume collected at each purging has varied from 1 to 1-5/8 cups per lysimeter. As of October 22, a total

of 1.2 gallons had been removed at each location. This is in excess of the volume used to mix the silica flour slurry in L-2 but does not include any of the water used to expand the bentonite pellet seal (2 gallons). It is not known whether any of this water reached the porous cup. However, it is planned to remove a total of at least 2 gallons from each lysimeter before sampling.

5.6 Soils Borings

Ten borings were drilled within the perimeter of the evaporation ponds to investigate soil properties of near surface materials. The holes were advanced using a 3-1/4 inch ID, 6 inch OD auger and the depth varied from 24 to 29 feet. Standard split-spoon samples were taken at approximately five-foot intervals and undisturbed samples using Shelby tubes and a continuous tube sampler were taken as conditions permitted. The presence of gravel and numerous cobbles generally prevented undisturbed sampling in the first ten feet of the borings. All samples were sent to the J. H. Kleinfelder laboratory in Sacramento for testing and the borings were backfilled with a 1:1 neat cement grout with bentonite added to reduce shrinkage. The boring logs for the soils drilling are included in Appendix A.

5.7 Test Pits

A total of four test pits designated T-1 through T-4 were excavated for the purpose of identifying the soil layering at shallow depths and also for obtaining bulk samples and determining in-place density of soils. The locations of test pits are shown on Figure 3.

The test pits were excavated using a Ford XL 555-A backhoe to depths ranging from 9 to 13 feet below existing ground level. Representative bulk samples of the soil were obtained at varying depths for subsequent laboratory testing. Sample locations are noted on the test pit logs. The in-place density tests were determined at four locations using sand cone equipment. Generally, the soils encountered above the presently proposed final grade of the bottom of the pond were tested. The field density tests were performed by the J. H. Kleinfelder and Associates field technicians. All the test pits were logged and sampled by the Bechtel Soil Engineer. Upon completion of the sampling and logging, all test pits were backfilled with granular site soils and compacted by tamping, using the backhoe. The test logs are presented in Appendix C.

6.0 LABORATORY SOIL TESTING

All laboratory testing of soil was performed by J. H. Kleinfelder and Associates, Sacramento, in accordance with a program developed by Bechtel. The laboratory tests were made in accordance with applicable ASTM Standards or other published procedures. The program included the following tests on undisturbed and recompacted soil specimens:

TEST DESCRIPTION	NUMBER OF TESTS
Laboratory Classification of Soils (ASTM D2487 and D2388)	50
Natural Moisture Content (ASTM D2216)	43
Unit Weight (by volume and weight measurements)	13

TEST DESCRIPTION	NUMBER OF TESTS
Sieve Analysis (ASTM D422)	24
Hydrometer Analysis (ASTM D422)	7
Atterberg Limits (ASTM D4318)	14
Compaction (ASTM D1557)	6
Unconfined Compression (ASTM D2166)	2
Unconsolidated Undrained Triaxial Compression (ASTM D2850)	3
Direct Shear (ASTM D3080)	6
Consolidation (ASTM D2435)	4

The report by J. H. Kleinfelder and Associates describing the procedures of the laboratory testing and the results is presented in Appendix D. The results of all laboratory tests performed are tabulated in the Soil Test Results Summary in Table 3.

7.0 RESULTS OF INVESTIGATIONS

7.1 Soil Types and Distribution

Soil profiles have been made through the proposed evaporation ponds based on the boring data. The profiles are shown on Figure 4.

Three generalized soil strata, all of alluvial origin have been identified from the exploration program. The characteristics of each stratum are described below.

A. Upper Sand Stratum. This stratum consists of 1 to 6 feet of brown, loose to medium clayey sands (SC) with gravels and appreciable amount of fines of medium plasticity. The sands were encountered in the entire evaporation pond area except in a drainage located in the southwest corner of the pond. At the time of field investigations, the drainage was dry. The sands are fine to coarse grained. The amount of gravels in the matrix vary from a few percent to more than 20 percent. Generally, the amount of gravels increases with depth. At a depth of 2 to 3 feet below existing ground level, sands are occasionally weakly to moderately cemented with silty clay. The standard penetration test (SPT) blowcounts, N, of the sand stratum are between 7 and 22, averaging 11 blows per foot.

B. Gravel Stratum. This stratum underlies the upper sand stratum. It consists of 2.5 to 12 feet of brown, medium dense to dense sandy gravels of fine to coarse grain (GC, GW, GP) with 7 to 35 percent fines of high plasticity. Scattered cobbles to 8 inches in diameter were also encountered between 5 and 9 feet depth. This stratum is exposed in the stream in the southwest corner of the pond, where gravels are mostly poorly graded (GP). This is probably due to wash-out of fines and fine sands from the matrix in the rainy season. The standard penetration test blowcounts, N, of the gravels are between 22 and 70 blows per foot, with the average being 44.

C. Interbedded Clay-Silt-Sand Stratum. Underlying the gravel stratum is a thick stratum of interbedded medium to very stiff fine grained soils (CL, CH, ML, MH) and dense clayey sands (SC), which extends to the maximum depth of 29 feet explored.

The fine grained soils are brown to reddish brown in color, and consist of clays and silts of low to high plasticity. The thickness of fine grained soil strata vary from 1.5 to 17 feet. The clay-silt strata exceeding 10 feet in thickness were found on the east side of the pond, particularly in the southwest corner. The standard penetration test blowcounts, N, of the fine grained soils are between 6 and 24 blows per foot, with the average being 13.

The clayey sands are yellowish brown to brown in color, and the fines are of high plasticity. This is based on one gradation test. The thickness of the clayey sand strata varies from 3 to 13 feet. The sands are fine to medium grained with trace to little gravels. The standard penetration test blowcounts, N, of the sand strata are between 9 and 70, averaging 30 blows per foot.

Scattered lenses of dense to very dense sandy gravel were encountered at various depths within the clayey sand strata. Generally, the thickness of these lenses does not exceed 3 feet. However, a 19 foot thick layer of clayey gravels was

encountered in boring B-9 in the southwest corner of the evaporation pond. It is noted that the fine grained soils were not encountered in this boring. The standard penetration test blowcounts, N, of the gravel lenses are high, averaging about 60 blows per foot.

No bedrock was encountered in the borings drilled in the proposed evaporation pond area because of their limited depth.

No ground-water table was encountered in the test borings drilled in the proposed evaporation pond area. However, ground water was encountered in the observation wells, generally below a depth of about 145 feet.

7.2 Soil Properties

The soil properties are summarized in the following table:

Soil Properties	Upper Sand Stratum	Gravel Stratum	Interbedded Clay-Silt-Sand Stratum
Natural Moisture Content (%)	7-11	9-35	20-58
Dry Unit Weight (PCF)	78-83	N/A	60-84
Liquid Limit (%)	28-33	53	61-75
Plasticity Index	10-25	25	26-45
Undrained Shear Strength (KSF)	N/A	N/A	1-4

Soil Properties	Upper Sand Stratum	Gravel Stratus	Interbedded Clay-Silt-Sand Stratum
Drained Shear Strength			
-Cohesion (KSF)	0.4-0.7(1)	N/A	N/A
-Angle of Internal Friction (Degree)	28-33(1)	N/A	N/A
Compression Index		(later)	
Coefficient of Consolidation (Day/Ft^2)			

Note: (1) Recompacted Specimens

A summary plot of standard penetration resistance versus depth is shown on Figure 11. Water content and plasticity are shown versus depth in Figure 12 Plasticity data are also plotted on the plasticity chart, Figure 13.

Gradation plots of the sands, gravels and fine grained soils are shown on Figures 14, 15 and 16, respectively.

Undrained shear strength of the fine grained soils plotted versus depth is shown on Figure 17.

The samples of the upper sandy soils, obtained above the presently proposed bottom of the evaporation pond were recompacted and tested for direct shear. The purpose of the testing was to evaluate these soils as a source of material to construct the pond perimeter and divider embankments. The test data indicate that the upper sandy soils are suitable for use in the embankments (refer to Figure 18 for pond cross-section).

7.3 Grading and Earthwork Recommendations (later)

7.3.1 General (later)

7.3.2 Clearing and Grubbing (later)

7.3.3 Compaction Requirements (later)

7.3.4 Recommended Compaction Methods (later)

7.3.5 Frequency of Testing (later)

7.3.6 Bulking or Shrinkage Factor (later)

7.4 Lithology of Laguna and Mehrten Formations

Geologic cores taken in observation wells OW-1, OW-2 and OW-3 penetrated the entire thickness of the Laguna Formation and extended a maximum of 74.5 feet into the Mehrten Formation (OW-1). The Laguna sediments were encountered at a depth of 10-14 feet and are primarily composed of moderate brown to yellowish brown interbedded fine-grained silty, clayey sands, silts and clay. The materials are well consolidated but essentially uncemented above a depth of approximately 50 feet.

Below 50 feet layers of siltstone and sandstone occur but are generally only weakly to moderately cemented. A 2 to 7 foot thick gravel/conglomerate layer was found 20-36 feet above the base of the Mehrten in the three wells that were cored.

The Mehrten Formation underlies the Laguna beneath the pond site at depths ranging from 117.5 feet (OW-1) to 145.5 feet (OW-2). The Laguna/Mehrten contact in the site area is indicated by the presence of an olive gray fine-to-coarse grained clean sand. This sand varies in thickness from 27.2 feet on the east (OW-1) to 7 feet on the west (OW-2). Below this clean sand the color changes to a moderate brown to yellowish brown and the lithology changes to a series of interbedded silty-clayey sands and silts with occasional lenses of clean sand and gravel.

7.5 Permeability

Methods of field permeability testing are described in Section 5.0. The tests performed provide data on horizontal hydraulic conductivity of the shallow soils at the site (E-19 tests), the slightly cemented sedimentary rocks beneath the site to a depth of 200 feet, and the saturated sand layers between about 150 and 200 depth. The results of these tests are presented in Table 4. The following conclusions have been drawn from the data in Table 4.

- Permeability of near surface (0-10 feet) sediments, as determined from permeameter tests, ranges from 6×10^{-6} cm/sec to about 2×10^{-4} cm/sec. The mean value is 5.5×10^{-5} cm/sec. This indicates that the gravelly and cobbly materials present near the surface over most of the site have a significant clay or silt content and are not highly permeable.

- Borehole packer tests to a depth of 200 feet showed permeability values in th 10^{-7} to 10^{-4} cm/sec range. In many of the tests, flows into the test zone were too low to measure on the available equipment. On the basis of field data for the packer tests, it is expected that these intervals have a permeability of less than about 10^{-6} cm/sec.

- Packer tests and tests in the observation wells indicate that sand zones between about 150 and 200 feet have permeabilities in the range of 10^{-5} to 10^{-3} cm/sec (10 to 1000 ft/yr).

7.6 Water Quality

The ground water in the Mehrten Formation is of good quality, well within the U.S. drinking water standards. It is low in total dissolved solids (<200 ppm) and is soft (<100 ppm total hardness as $CaCO_3$). Table 5 summarizes ground water quality data from

several wells adjacent to the Rancho Seco property and data collected over a period of 5 years from the Rancho Seco onsite domestic well.

The first set of water samples from the evaporation pond ground water monitoring wells were collected and analyzed in October 1985. Results are presented in Table 6. A second set of samples, including soil pore water samples from the two lysimeters will be collected shortly and the results will be included in Table 6.

8.0 EVALUATION OF SITE HYDROGEOLOGY

Ground-water conditions at the site were explored by drilling and sampling to a depth of 200 feet, installing monitoring wells, performing permeability tests, measuring water levels and collecting and analyzing ground-water samples. These investigations showed that the site is underlain by interbedded sediments ranging from clay to clean sand and sandstone. Although thin zones of wet sand were encountered during drilling, the saturated zone is below about 150 feet.

8.1 Ground-Water Levels

Water levels in site observation wells indicate that the water table beneath the site is at a depth of 145 to 155 feet. This corresponds to an elevation of -6 feet at the east edge of the

pond and -9 feet at the west edge of the pond. As determined from Figure 6, flow is toward the west at a gradient of about 0.003 (15 feet per mile).

During the field program, thin, wet zones were noted above the water table at depths as shallow as 20 to 24 feet (soil borings B-6 and B-9), and anomalous water levels were observed in OW-3. Drilling in OW-3 was originally terminated at 1165 feet on August 9, 1985. The drilling rig was then moved from OW-3 to OW-1. Frequent water level measurements in OW-3 were made between August 8 and August 28, when the hole was deepened to 200 feet. When the hole was reentered on August 28, it was found to be open to the original depth of 165 feet. From August 8 to August 13, depth to water was about 86 feet. On August 13, the hole was bailed down to 99 feet and recovered to 87 feet in less than three hours. On August 15, the well was bailed down from 106 to 115 feet. Within six hours it had recovered to 96 feet -- ten feet above the pre-bailing level. Following this bailing, the water level stabilized at a depth of 113 feet for more than a week. The water level recovery after bailing, together with the stabilized level at a depth of 113 feet suggested that the water in the hole was not just drilling fluid, but represented a fluctuating piezometric surface in the vicinity of OW-3. The fact that this water level was 30 feet higher than water levels in OW-1 and OW-2 indicated a possible perched water table. In late August, OW-3 was deepened to 200 feet and completed as a well, open from 173.0 to 192.9. The stabilized water level after

completion was about 145 feet, which is consistent with water levels in OW-1 and OW-2, as well as with levels in nearby water wells. To further investigate the significance of the original higher water level in OW-3, a fourth observation well was installed (OW-3A) adjacent to OW-3. This well is open from 112.0 to 133.1 feet. In less than a week, the water level had fallen to below 133.1 and the well has been dry since that time. There is no ready explanation for this behavior. Possible explanations include: (1) the source of perched water was limited, and became depleted with time; or (2) the anomalous water level was the piezometric level for a confined sand zone between 133.1 and 165 feet; neither OW-3 nor OW-3A is now open to this zone. The geologic log for OW-3 (see Appendix A) indicates that several clean sand and/or gravel zones were encountered in this interval. One thin gravel bed from 139.0 to 140.4 feet was described as wet. On the basis of presently available data, it is not possible to completely explain the water levels in OW-3 before deepening and completion as an observation well. OW-3A should continue to be monitored with the other wells, as a rise in water levels could occur during the winter months.

8.2 Ground-Water Flow

An approximate ground-water seepage velocity (v) through the shallow saturated sands at the site can be calculated for using the relation $v = KI/n$ (Freeze and Cherry, 1979) where K is the average hydraulic conductivity, I is the hydraulic gradient, and n

is the effective or interconnected porosity. Using an average hydraulic conductivity for the sands of 1×10^{-3} cm/sec, an estimated effective porosity of 30% and the observed hydraulic gradient of 0.003, the approximate seepage velocity is 0.028 ft/day or about 10 ft/yr.

8.3 Analysis of Hypothetical Liner Failure

An analysis was performed to evaluate the effects of a hypothetical pond liner failure on the quality of ground water downgradient of the site. The nearest downgradient well is 6/8-30Q1, on the north side of Clay East Road, about 2200 feet west of the west edge of the evaporation ponds. It was assumed that the liner is breached at the end of the pond life, when Cs-137 is expected to be at a concentration of 8.5×10^{-2} µCi/ml as a result of evaporation.

The analysis considered migration of Cs-137 to well 6/8-30Q1 in two stages. The first stage is vertical seepage of pond fluid to the underlying water table. The second stage is horizontal migration in the Mehrten aquifer from the pond site to the well.

Stage 1

For seepage through the unsaturated zone to the water table, the method of Bouwer for vertical movement of a wetting front (1978, p. 254) was used. The appropriate equation is:

$$t = \frac{f}{K_u}\left[L_f - (H_w - h_{cr}) \ln \left(\frac{H_w + L_f - h_{cr}}{H_w - h_{cr}}\right)\right]$$

where:

t = time since start of infiltration

K_u = hydraulic conductivity of wetted zone (unsaturated conductivity)

L_f = depth of wetted front

H_w = depth of water above soil

h_{cr} = critical pressure head of soil for wetting

f = fillable porosity (difference between volumetric water content of soil before and after wetting).

Conservative input values were selected for calculating the time it would take for a wetting front to reach the water table. For K_u (unsaturated conductivity), a value of half the saturated hydraulic conductivity was used (Bouwer, 1978, p. 253). For the material above the water table, a saturated conductivity of 3×10^{-6} cm/sec is believed to be representative, based on packer test results (See Table 4). This gives a value for K_u of 1.5×10^{-6} cm/sec, or 1.55 ft/yr.

L_f is the depth to the wetting front from the bottom of the pond excavation. This depth is variable during seepage from the pond, but would be a minimum of about 144 feet when the front reaches the water table. The height of water above the soil (H_w) was assumed to be seven feet, which is the maximum operating depth of five feet, plus two feet for the clay liner thickness. The average critical pressure head was estimated to be about -100 cm (-3.3 ft), based on typical values for fine-grained soils reported in Bouwer (1978, p. 243).

The fillable porosity is a difficult parameter to estimate, as it would vary considerably from one type of soil to another, and is dependent on the in-place volumetric water content. On the basis of limited soils

tests, a conservative value of ten percent (0.10) was used for the fillable porosity (f).

Using the input data described above, time for a wetting front to reach the ground water is approximately 8 years. However, because of Cs-137 adsorption onto the soils particles as the wetting front moves downward, the time of arrival of radionuclides at the water table will be much longer. Applying a retardation factor of 0.005 (see description of Stage 2 seepage) to the average velocity of the wetting front 144 ft/8 yrs gives an average estimated Cs-137 velocity of 0.09 ft/yr. At this rate it would take 1600 years for Cs-137 to reach the water table. During this period of time, the concentration would be reduced by radioactive decay to less than 10^{-17} μCi/ml.

Stage 2

The method of analysis for migration of Cs-137 in ground water from the pond to the nearest downgradient well is based on the following relationships (Grove, p. 28);

$$U_{ion} = U_{water} R_f$$

$$R_f = \frac{1}{1 + \frac{\rho K_d}{n}}$$

and $C = C_o e^{-\lambda t}$ where:

U_{ion} = velocity of Cs-137

U_{water} = ground-water seepage velocity

R_f = retardation factor

ρ = bulk density

n = porosity

K_d distribution coefficient

C = concentration at time t

C_o = initial concentration

t = travel time

λ = radioactive decay constant

The ground water seepage velocity, U_{water}, is determined by the Darcy relationship:

$$U_{water} = \frac{KI}{n_e}$$, where:

K = hydraulic conductivity

I = hydraulic gradient = .003 ft/ft from Figure 6

n_e = effective porosity, assumed to be .30

A hydraulic conductivity of 2×10^{-3} cm/sec (2069 ft/yr) -- the highest value from field tests (see Table 4) -- was used for calculation of U_{water} = 21 ft/yr.

To determine R_f, a value of 4 g/cc was used for ρ/n, and 50 ml/g was used for the distribution coefficient, K_d. These values are believed to be conservative based on data reported in the literature. Using the described input data, R_f = 0.005, and U_{ion} = 21 ft/day x .005 = 0.11 ft/yr. At this rate of movement, it will take 20,000 years for Cs-137 to travel to well 6/8-30Q1. After this period of time, the calculated

concentration of Cs-137, reduced by radioactive decay, is less than 10^{-99} μCi/ml, nondetectable level. It is well below the MPC (maximum permissible concentration) value of 2×10^{-5} uCi/ml under 10 CFR 20, Appendix B, Table II.

9.0 Ground Water Monitoring Program

To ensure that there is no leakage of effluent from the ponds and to comply with Regional Water Quality Control Board (RWQCB) regulations, the following ground water monitoring program is proposed. Four ground water monitoring wells located at the perimeter of the pond will be monitored on a quarterly basis for the parameters listed in Table 7. In addition, lysimeters or other vadose zone monitoring devices adjacent to the ponds will be sampled quarterly to determine the chemical composition of the soil pore water and ensure that no leachate is escaping into the unsaturated zone. The vadose zone monitoring, however, is not required by the RWQCB for this project. Water samples of the ponds will also be collected monthly and analyzed for the parameters listed in Table 7.

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Tables

Table 1

Drill Hole Summary

Hole No.	Purpose	Surface El (ft)	Depth (ft)	Interval Cored (ft)	No. of Samples	Type of Samples
OW-1	Observation Well	150.0	200	30-192	-	-
OW-2	Observation Well	146.6	200	0-200	-	-
OW-3	Observation Well	137.8	200	35-165	-	-
OW-3A	Observation Well	137.9	138	-	-	-
L-1	Lysimeter	139.8	15.8	-	-	-
L-2	Lysimeter	152.8	17.5	-	-	-
P-1	Permeameter	142.5	10	-	-	-
P-2	Permeameter	142.5	10	-	-	-
P-3	Permeameter	148.4	10	-	-	-
P-4	Permeameter	149.3	10	-	-	-
B-1	Soils Boring	141.3	29	-	10	SS, CTS
B-2	Soils Boring	138.9	29	-	9	SS, CTS
B-3	Soils Boring	143.0	28	-	10	SS, CTS
B-4	Soils Boring	143.8	29	-	10	SS, CTS
B-5	Soils Boring	141.9	24	-	6	SS, CTS
B-6	Soils Boring	148.0	29	-	7	SS, ST
B-7	Soils Boring	143.1	24.4	-	8	SS, CTS, ST
B-8	Soils Boring	148.2	27.2	-	10	SS, CTS
B-9	Soils Boring	150.5	24	-	5	SS, CTS
B-10	Soils Boring	151.8	29	-	9	SS, ST

SS = Split Spoon
CTS = Continuous Tube Sampler
ST = Shelby Tube
} Undisturbed Samples

SOIL TEST RESULTS SUMMARY

JOB NO. 12334-059 PROJECT Rancho Seco FEATURE Evaporation Pond DATE October 1985

HOLE, TEST PIT, OR TRENCH NO.	SAMPLE	DEPTH M FROM	DEPTH M TO	LABORATORY CLASS.	MECHANICAL ANALYSIS GRAVEL (%)	MECHANICAL ANALYSIS SANDS (%)	MECHANICAL ANALYSIS FINES (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	SPECIFIC GRAVITY G	NATURAL WATER CONTENT (%)	NATURAL TOTAL UNIT WEIGHT gm/cc	NATURAL DRY UNIT WEIGHT gm/cc	COMPACTION OPTIMUM WATER (%)	COMPACTION MAX. DRY DENSITY gm/cc	SHEAR DATA TEST	SHEAR DATA INITIAL WATER (%)	SHEAR DATA INITIAL DRY DENSITY gm/cc	SHEAR DATA C KG/CM²	SHEAR DATA φ DEG	PERMEABILITY DRY DENSITY gm/cc	PERMEABILITY K cm/yr	CONSOLIDATION TEST	REMARKS
T-1		1.5		GC	42	35	23	29.8	19.5	10.3		12.4	97.4 **	86.7	12.4	120.8 (2)	***	14.2	111.8	0.7	28				
		3.5		GP-GC	66	27	7																		
(T-1)		7.0										18.8													
		9.0		GC	50	31	19	52.6	27.2	25.4		16.1													
		12.0		GC	38	27	35					15.7													
T-2		0.9	2.0	GC	64	23	13																		
		5.0		CH				75.0	30.0	45.0		36.1			9.0	131.5 (2)									
		7.0		CL								37.6													
		9.0		MH				67.7	33.1	31.6		42.7													
		12.5		MH				62.4	36.0	26.4		25.1													
T-3		1.0		SC	22	45	33	30.2	4.9	25.3		11.0	92.3 **	83.2	11.0	119.9 (2)									
		3.5		SC-CL	15	33	52					11.2	86.6 **	77.9	11.2	124.2 (2)	***	10.7	119.0	0.42	33				
		6.5		SW-SC	33	47	20																		
T-4		1.0		CL(SC)	7	42	51	28.0	18.3	9.7		12.6	123.9 **	110.00	9.0	123.5 (2)									
		2.7		CL(SC)	12	37	51	32.8	15.6	17.2		6.5	100.0 **	93.9	10.4	126.5 (2)									
		5.5		GW-GC	49	40	11																		
		11.0		CL																					

SPECIFIC GRAVITY
(a) = MINUS NO 4
(b) = PLUS NO 4

COMPACTION
(1) = ASTM D698
(2) = ASTM D1557
(3) = 20,000 FT. LBS/CU. FT.
(4) = MAXIMUM - MINIMUM
(5) = OTHER (SEE TEXT)

TRIAXIAL COMPRESSION TESTS
UC UNCONFINED COMPRESSION
UU UNCONSOLIDATED UNDRAINED
CU CONSOLIDATED UNDRAINED (PORE PRESSURE MEASUREMENTS)
CU CONSOLIDATED UNDRAINED
CD CONSOLIDATED DRAINED
CR CYCLIC CONSOLIDATED UNDRAINED (PORE PRESSURE MEASUREMENTS)

OTHERS
* VISUAL CLASSIFICATION
** IN-PLACE DENSITY TEST
*** DIRECT SHEAR TEST ON RECOMPACTED SPECIMENS

TABLE 3

Table 2

Observation Well Summary

Well No.	Surface El (ft)	Total Depth (ft)	Depth to Filter Pack	Depth to Top of Screen	Depth of Bottom of Screen	Depth to Bottom of Sump
OW-1	150.0	7-5/8"ϕ to 193 3"ϕ to 200	167.7	172.7	182.2*	187.8
OW-2	146.6	7-5/8"ϕ to 183 3"ϕ to 200	162.0	168.2	177.2	183.0
OW-3	137.8	7-5/8"ϕ to 193 3"ϕ to 200	173.0	176.8	187.2	192.9
OW-3A	137.9	138.0	112.0	118.2	127.7	133.1

*Unknown blockage in OW-1 at depth of ~ 177 ft.

SOIL TEST RESULTS SUMMARY

JOB NO. 12334-059 PROJECT Rancho Seco FEATURE Evaporation Pond DATE October 1985

HOLE, NO.	SAMPLE	DEPTH FT. FROM	DEPTH FT. TO	LABORATORY CLASS.	MECHANICAL ANALYSIS GRAVEL (%)	MECHANICAL ANALYSIS SANDS (%)	MECHANICAL ANALYSIS FINES (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	SPECIFIC GRAVITY G	NATURAL WATER CONTENT (%)	NATURAL TOTAL UNIT WEIGHT PCF	NATURAL DRY UNIT WEIGHT PCF	COMPACTION OPTIMUM WATER (%)	COMPACTION MAX. DRY DENSITY PCF	SHEAR DATA TEST	SHEAR DATA INITIAL WATER (%)	SHEAR DATA INITIAL DRY DENSITY PCF	SHEAR DATA C KSF	SHEAR DATA Ø DEG	PERMEABILITY DRY DENSITY PCF	PERMEABILITY K FT/YR	CONSOLIDATION TEST	REMARKS
B-1	6	17.5	20	SC	6	62	32					22.7													
B-2	2		7.5	MH				71.3	39.8	31.5							UC	39	80.5	4.1	-			X	
	4	12.5	14	ML								58.1													
	5	15	17.5		0	38	62					41.2													
	8	25	27.5	SM	0	15	85					30.1													
B-3	4	10	11.5	GC								34.8													
	6	15	16.5	MH				67.3	38.5	28.8		41.2													
	7	17.5	20	CL	1	14	85					22.7													
	9	24.5	26	SC								22.4													
B-4	3	7.5	9	CL								30.4													
	5	12.5	14	CL								41.6													
	6	15	17.5	SC	0	55	45					31.9													
	8	22.5	24	SC								28.6													
	10	27.5	29	SC																					
B-5	2	7.5	9	CL								19.5													
	3	10	12.5	CL	0	23	77					31.5													
	6	17.5	19	SP-SC								16.0													
B-6	2	10	12.5	MH	0	13	87	61	28	33		36.1					UU	36.1	83.5	1.45	-			X	3 = 8 psi
	4	15	17.5	ML	0	38	62	50	33	17		50.8					UU	50.8	62.4	2.9	-				3 = 12 psi
	6	22.5	24									47.3													
B-7	1	7.5	9									41.2													
	3	12.5	15									30.2													

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TRIAXIAL COMPRESSION TESTS
UC UNCONFINED COMPRESSION
UU UNCONSOLIDATED UNDRAINED
CU CONSOLIDATED UNDRAINED (PORE PRESSURE MEASUREMENTS)
CU CONSOLIDATED UNDRAINED
CD CONSOLIDATED DRAINED
CR CYCLIC CONSOLIDATED UNDRAINED (PORE PRESSURE MEASUREMENTS)

OTHERS
* VISUAL CLASSIFICATION
** IN-PLACE DENSITY TEST

TABLE 3

ERPT C 0104

SOIL TEST RESULTS SUMMARY

JOB NO. 12334-059 PROJECT Rancho Seco FEATURE Evaporation Pond DATE October 1985

HOLE, NO.	SAMPLE	DEPTH FT. FROM	DEPTH FT. TO	LABORATORY CLASS.	MECHANICAL ANALYSIS GRAVEL (%)	MECHANICAL ANALYSIS SANDS (%)	MECHANICAL ANALYSIS FINES (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	SPECIFIC GRAVITY G	NATURAL WATER CONTENT (%)	NATURAL TOTAL UNIT WEIGHT PCF	NATURAL DRY UNIT WEIGHT PCF	COMPACTION OPTIMUM WATER (%)	COMPACTION MAX. DRY DENSITY PCF	SHEAR DATA TEST	SHEAR DATA INITIAL WATER (%)	SHEAR DATA INITIAL DRY DENSITY PCF	SHEAR DATA C KSF	SHEAR DATA φ DEG	PERMEABILITY DRY DENSITY PCF	PERMEABILITY K FT/YR	CONSOLIDATION TEST	REMARKS
B-7	6	19	21.5	SC	0	61	39					24.8													
B-8	2	5	6									8.1													
	3	10	11.5									27.7													
	6	17.5	20		0	19	81					43.1													
	8	22.5	25									36.9													
B-9	1	5	6.5									18.1													
	4	20	22.5	GC	49	35	16					8.8													
B-10	2	10	11.5									34.8													
	3	12.5	15	MH	70.2	35.8	34.4										UC	40.8	81.5	1.3	-			X	
	5	17.5	20	MH	66	35	31										UU	67.7	60.1	1.0	-			X	3 = 14 psi
	7	22.5	25		0	35	65																		

SPECIFIC GRAVITY
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(b) = PLUS NO. 4

COMPACTION
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(3) = 20,000 FT. LBS/CU. FT.
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TRIAXIAL COMPRESSION TESTS
UC UNCONFINED COMPRESSION
UU UNCONSOLIDATED UNDRAINED
CU CONSOLIDATED UNDRAINED (PORE PRESSURE MEASUREMENTS)
CU CONSOLIDATED UNDRAINED
CD CONSOLIDATED DRAINED
CR CYCLIC CONSOLIDATED UNDRAINED (PORE PRESSURE MEASUREMENTS)

OTHERS
* VISUAL CLASSIFICATION
** IN-PLACE DENSITY TEST

TABLE 3

ERPT C 0104

DRAFT 11/ 07/ 85

Table 4 Field Permeability Test Results

Borehole No.	Interval Tested in Feet	Test Interval Length (Ft)	Test Pressure In Feet of Water	Test Method	Permeability cm/sec
OW-1	53.1-61.0	7.9	-	Couldn't seat packers	
	90.0-99.1	9.1	97.7	Packer-Constant Head	2.3×10^{-6}
	126.8-135.9	9.1	152.4	Packer-Constant Head	No Take
	126.8-135.9	9.1	168.6	Packer-Constant Head	No Take
	126.8-135.9	9.1	191.6	Packer-Constant Head	No Take
	146.8-155.9	9.1	153.2	Packer-Constant Head	2.3×10^{-6}
	166.5-200	33.5	160.6		4.7×10^{-6}
	166.5-200	33.5	175.5		4.0×10^{-5}
	166.5-200	33.5	189.3		5.5×10^{-5}
	166.5-200	33.5	175.5		5.5×10^{-5}
	167.7-187.8	20.1	-	Bailer-Recovery	5×10^{-6}*
OW-2	23.7-191.4	167.7	110.2	Packer-Constant Head	6.9×10^{-7}
	67-79.5	10.5	96.7	Packer-Constant Head	No Take
	69-79.5	10.5	112.8	Packer-Constant Head	No Take
	100-110.5	10.5	128.7	Packer-Constant Head	No Take
	100-110.5	10.5	144.8	Packer-Constant Head	No Take
	100-110.5	10.5	181.6	Packer-Constant Head	No Take
	114-119.7	5.7	178.0	Packer-Constant Head	No Take
	114-119.7	5.7	224.0	Packer-Constant Head	No Take
	114-119.7	5.7	258.5	Packer-Constant Head	No Take
	114.5-156.3	41.8	183.9	Packer-Constant Head	3.1×10^{-6}
	114.5-156.3	41.8	206.9	Packer-Constant Head	3.1×10^{-7}
	114.5-156.3	41.8	241.4	Packer-Constant Head	3.1×10^{-6}

Table 4 Field Permeability Test Results (continued)

Borehole No.	Interval Tested in Feet	Test Interval Length (Ft)	Test Pressure In Feet of Water	Test Method	Permeability cm/sec
OW-2	122.0-127.7	5.7	142.0	Packer-Constant Head	No Take
	122.0-127.7	5.7	165.0	Packer-Constant Head	No Take
	122.0-127.7	5.7	188.0	Packer-Constant Head	No Take
	122.0-127.7	5.7	234.0	Packer-Constant Head	No Take
	136.0-141.7	5.7	152.0	Packer-Constant Head	No Take
	136.0-141.7	5.7	175.0	Packer-Constant Head	No Take
	136.0-141.7	5.7	198.0	Packer-Constant Head	No Take
	136.0-141.7	5.7	232.0	Packer-Constant Head	No Take
	146.0-151.7	5.7	164.0	Packer-Constant Head	No Take
	146.0-151.7	5.7	187.8	Packer-Constant Head	No Take
	146.0-151.7	5.7	210.8	Packer-Constant Head	No Take
	146.0-151.7	5.7	245.3	Packer-Constant Head	No Take
	148.5-159.0	10.5	200.9	Packer-Constant Head	No Take
	148.5-159.0	10.5	235.4	Packer-Constant Head	No Take
	148.5-159.0	10.5	267.6	Packer-Constant Head	No Take
	149.5-160.0	10.5	197.6	Packer-Constant Head	1.1×10^{-4}
	149.5-160.0	10.5	232.1	Packer-Constant Head	2.7×10^{-5}
	151.0-156.7	5.7	176.0	Packer-Constant Head	No Take
	151.0-156.7	5.7	185.2	Packer-Constant Head	No Take
	151.0-156.7	5.7	196.7	Packer-Constant Head	No Take
	151.0-156.7	5.7	219.7	Packer-Constant Head	No Take
	151.5-162.0	10.5	230.1	Couldn't Seat Packers	
	153.0-174.0	21	--	Specific Capacity	2×10^{-3}**

Table 4 Field Permeability Test Results (continued)

Borehole No.	Interval Tested in Feet	Test Interval Length (Ft)	Test Pressure In Feet of Water	Test Method	Permeability cm/sec
OW-2	169.5-180.0	10.5	221.6	Packer-Constant Head	1.6×10^{-5}
	169.5-180.0	10.5	279.1	Packer-Constant Head	1.5×10^{-5}
	184.5-195.0	10.5	274.1	Packer-Constant	1.5×10^{-5}
OW-3	21.8-31.0	9.2	30.2	Packer-Constant Head	2.7×10^{-6}
	47.5-164.0	116.5	115.0	Packer-Constant Head	1.5×10^{-6}
	111.5-164.0	52.5	117.0	Packer-Constant Head	1.2×10^{-6}
	112.5-164.0	51.5	126.9	Packer-Constant Head	No Take
	112.5-164.0	51.5	138.4	Packer-Constant Head	No Take
	112.5-164.0	51.5	152.2	Packer-Constant Head	No Take
	168.0-192.9	24.9	--	Specific Capacity	8×10^{-4}**
P-1	9.25-9.50	9.25	--	Permeameter	1.6×10^{-5}
P-2	0.47-9.50	9.03	--	Permeameter	1.8×10^{-5}
P-3	0.36-9.50	9.14	--	Permeameter	6.0×10^{-6}
P-3	0.25-9.50	9.25	--	Permeameter	1.8×10^{-4}

*Test was conducted prior to completion of well development.
**Permeabilities are for sand zones only.

TABLE 5

GROUND WATER QUALITY OF THE MEHRTEN AQUIFER

Parameters (a)	On Site Domestic Well (b)	Wells in Mehrten Formation (c)
pH	7.22	7.6
Temperature (°C)	19.3	20.9
Conductivity (μmhos/cm)	260	231
Hardness as $CaCO_3$	27	73
Ca	4.7	15
Mg	-	8.6
Na	25	19
K	3.5	2.4
Alkalinity	78	94
SO_4	11	<5.0
Cl	4.5	12.3
F	-	186
SiO_2	45	70
TDS	-	186
Total S	-	-
Total nitrogen	1.3	0.90
NO_3	0.48	-
P	-	0.7
PO_4	5	-
As	<0.01	-
B	0.22	0.12
Cr	<0.02	<0.01
Cu	0.7	<1.0
Fe	0.20	0.02
Zn	<0.1	<0.1
BOD	1.8	-
TOC	3.2	3.3
Color (color units)	8	-
Turbidity (NTU)	2.1	-

(a) All units are mg/l, unless otherwise noted.
(b) Average of 30 samples taken every 2 months from 1980 to 1985.
(c) Average of 17 well samples from Mehrten Formation taken in Sept. 1982.

TABLE 6

GROUND WATER QUALITY IN THE VICINITY
OF THE PROPOSED EVAPORATION PONDS

Parameter	OW-1	OW-2	OW-3	Lysimeter #1	Lysimeter #2
Sodium					
Sulfate					
Nitrate					
Ammonia					
Alkalinity					
TDS					
Plt					
Chloride					
Arsenic					
Barium					
Cadmium					
Lead					
Mercury					
Selenium					
Silver					
Fluoride					
Gross beta (μCi/cc)		<2.90 E-8	<2.79 E-8		
Tritium (μCi/cc)		<3.91 E-6	<3.92 E-6		
Gamma spectrum (μCi/cc)		<LLD*	<LLD		

*LLD = lower limit of detectability

TABLE 7

GROUND WATER MONITORING PROGRAM

Sampling Medium	Number of Samples	Collection Frequency	Parameters Sampled	
Ground water	3	Grab sample collected quarterly	Ground water elevation Temperature pH Conductivity	Group 1
			Sodium Sulfate Nitrate Ammonia Alkalinity TDS pH Chlorine	Group 2
			Arsenic Barium Cadmium Lead Mercury Selenium Silver Fluoride	Group 3
			Gross beta Tritium Gamma spectrum	Group 4
Soil beneath ponds	8 (minimum)	Grab sample collected quarterly	Group 2 and Group 4 listed above	
Pond effluent	1	Grab sample collected monthly	Same as above except ground water elevation	

Figures

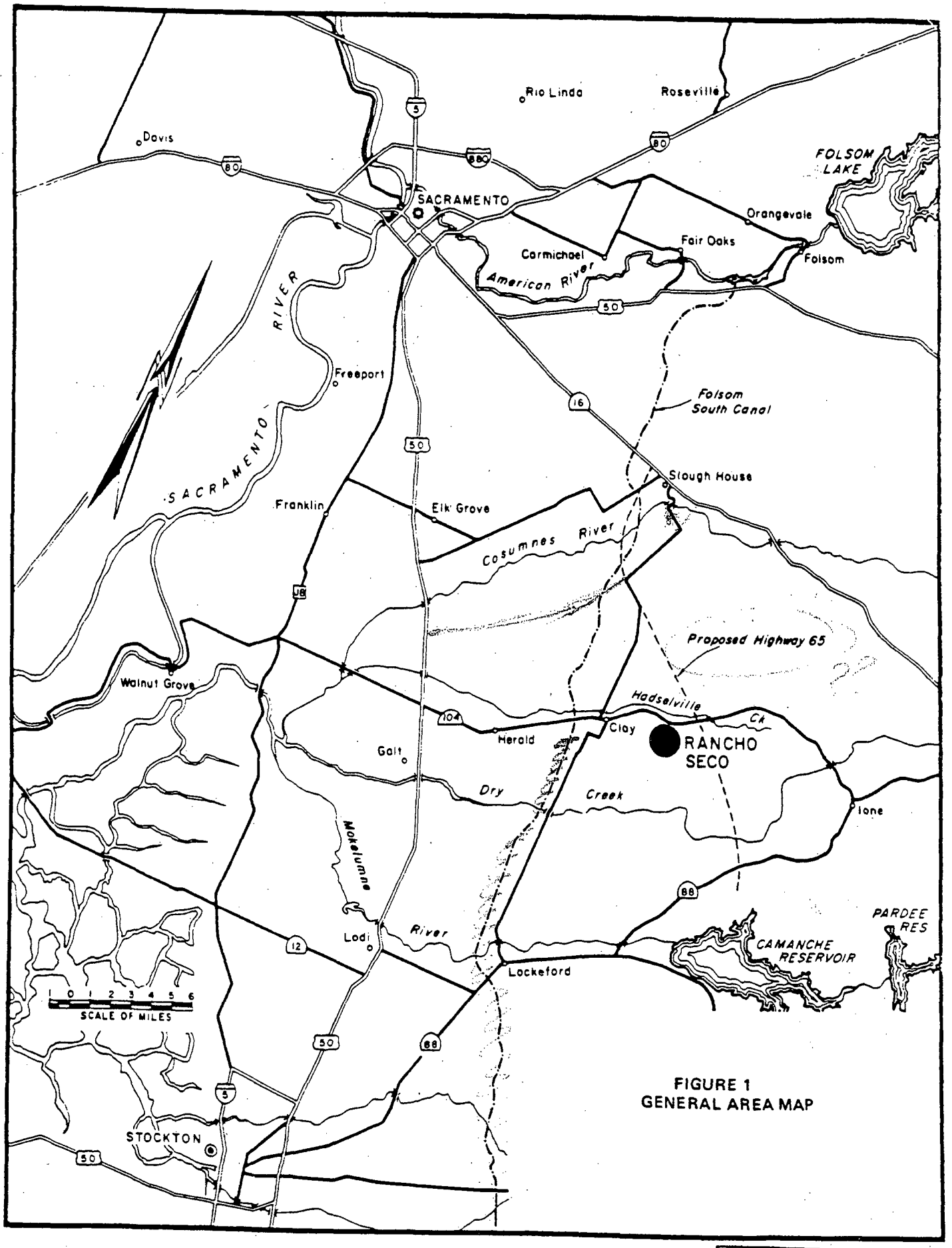

FIGURE 1
GENERAL AREA MAP

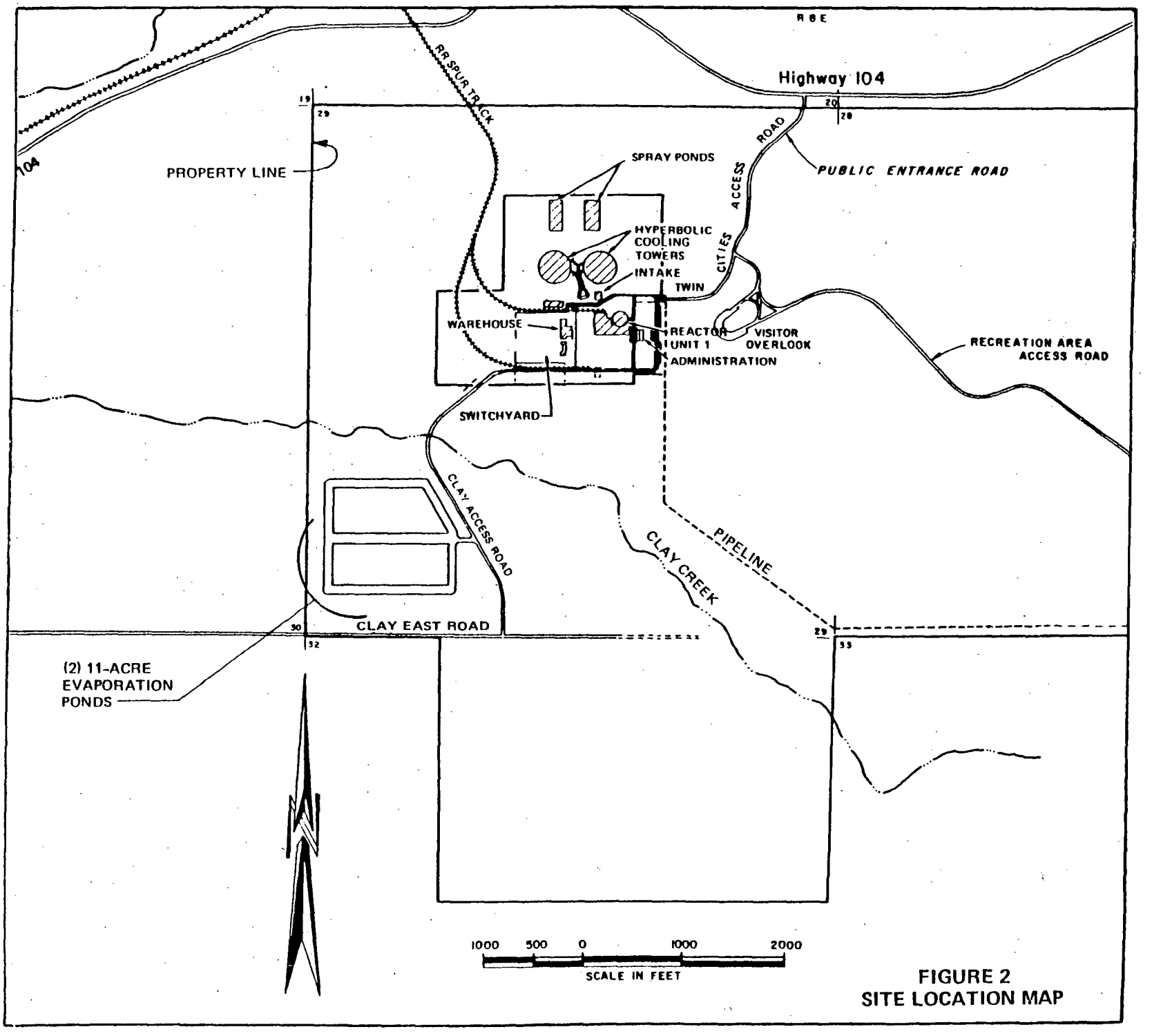

FIGURE 2
SITE LOCATION MAP

ERPT C 0104

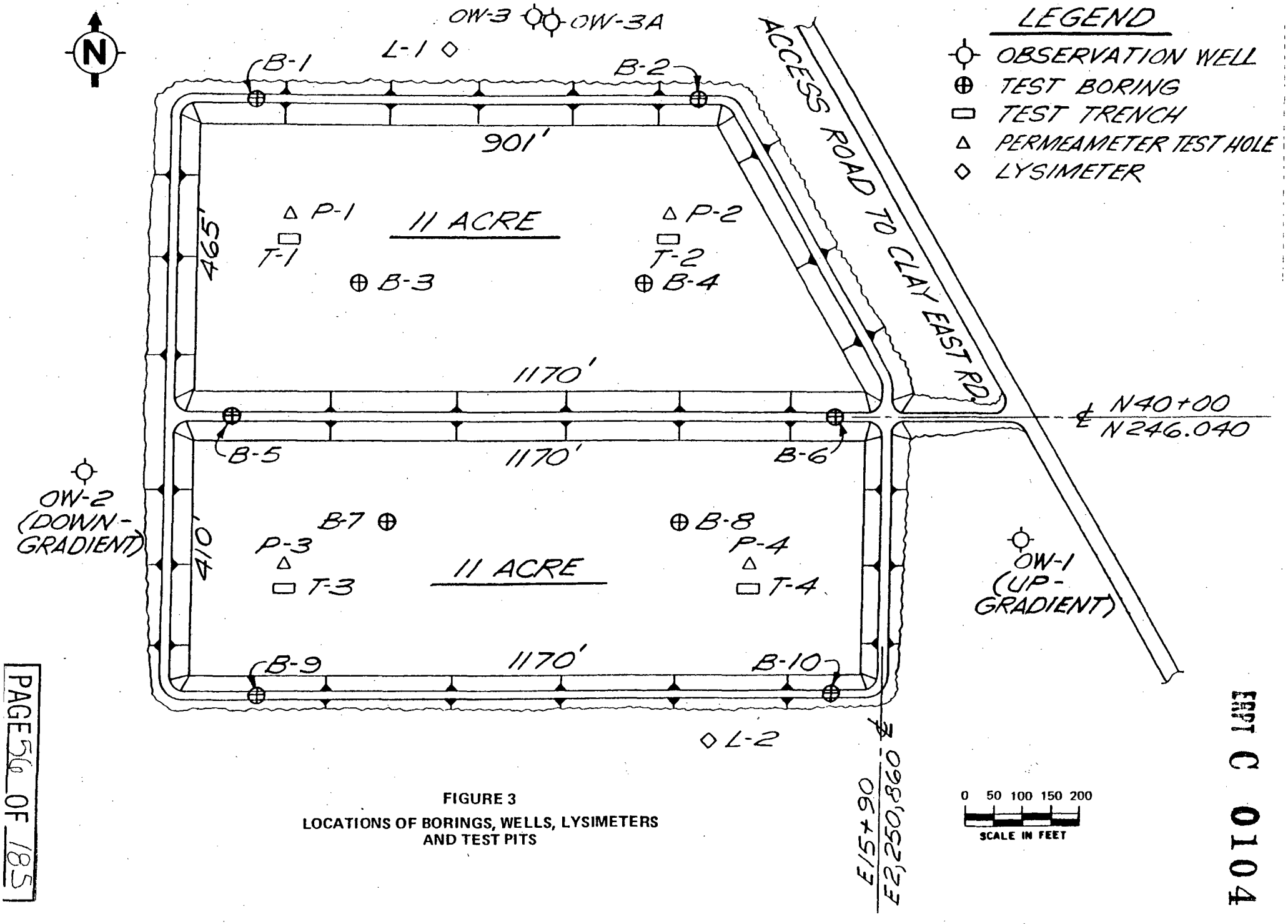

FIGURE 3
LOCATIONS OF BORINGS, WELLS, LYSIMETERS
AND TEST PITS

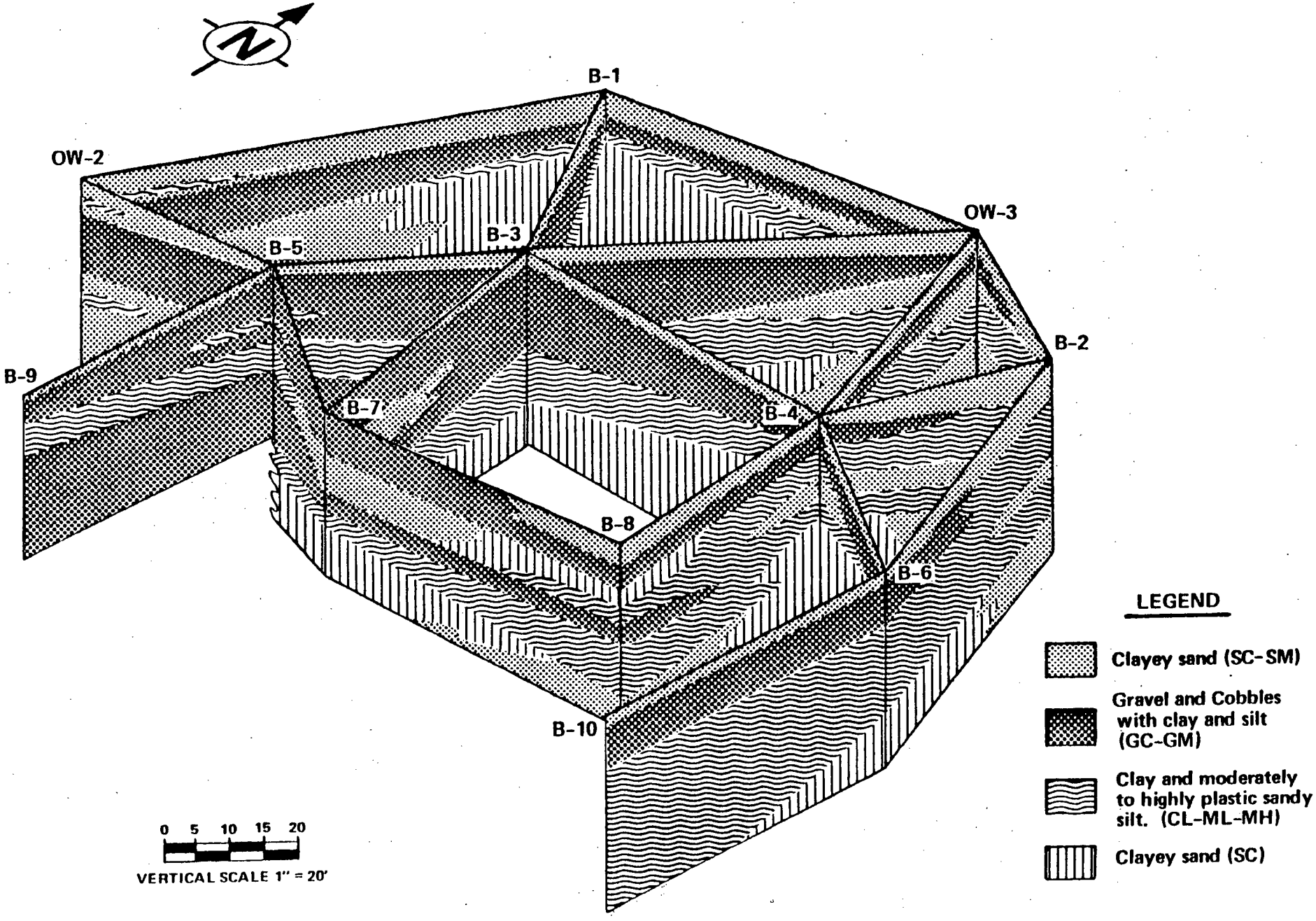

FIGURE 4
FENCE DIAGRAM—SOILS BORINGS

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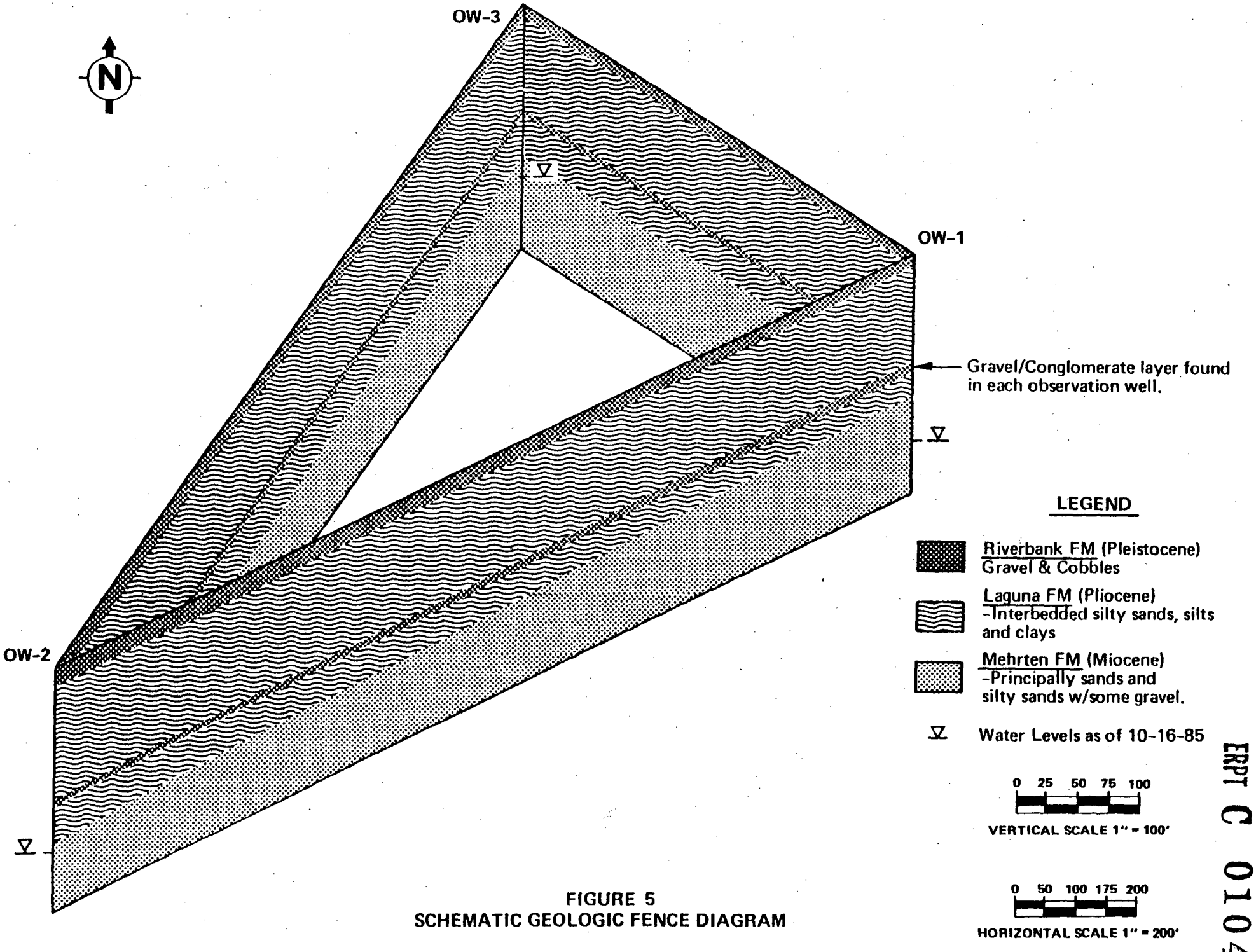

FIGURE 5
SCHEMATIC GEOLOGIC FENCE DIAGRAM

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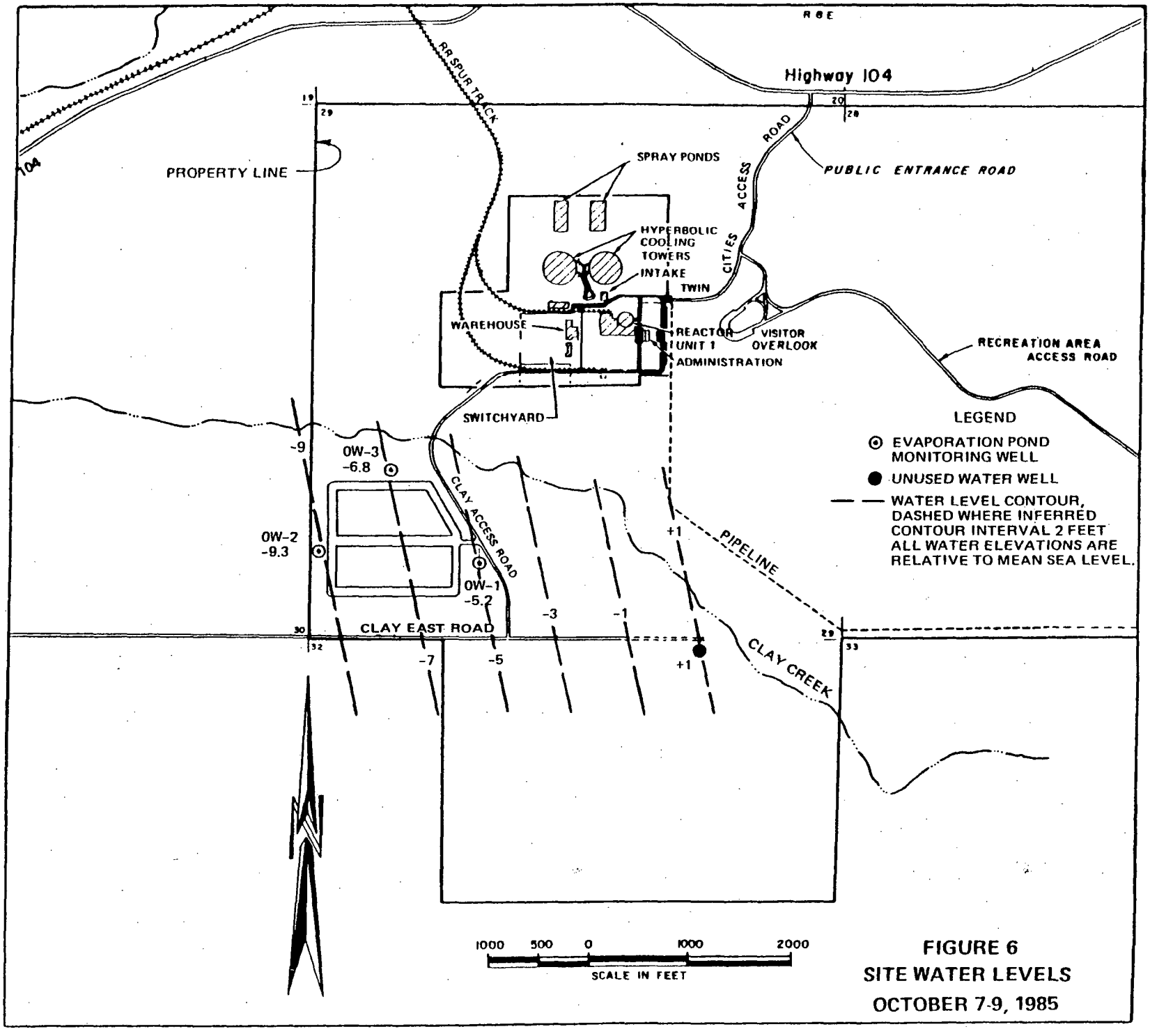
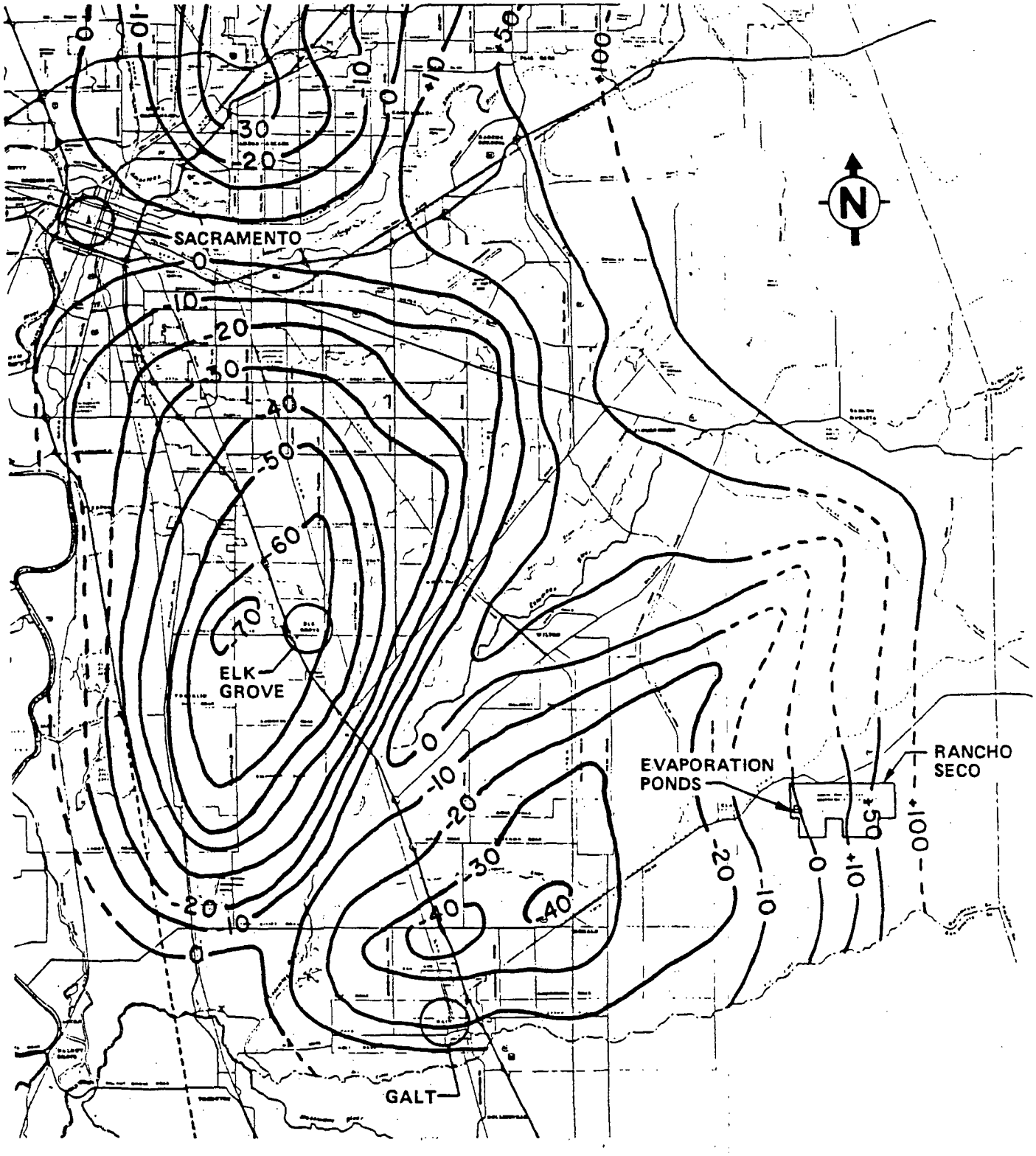


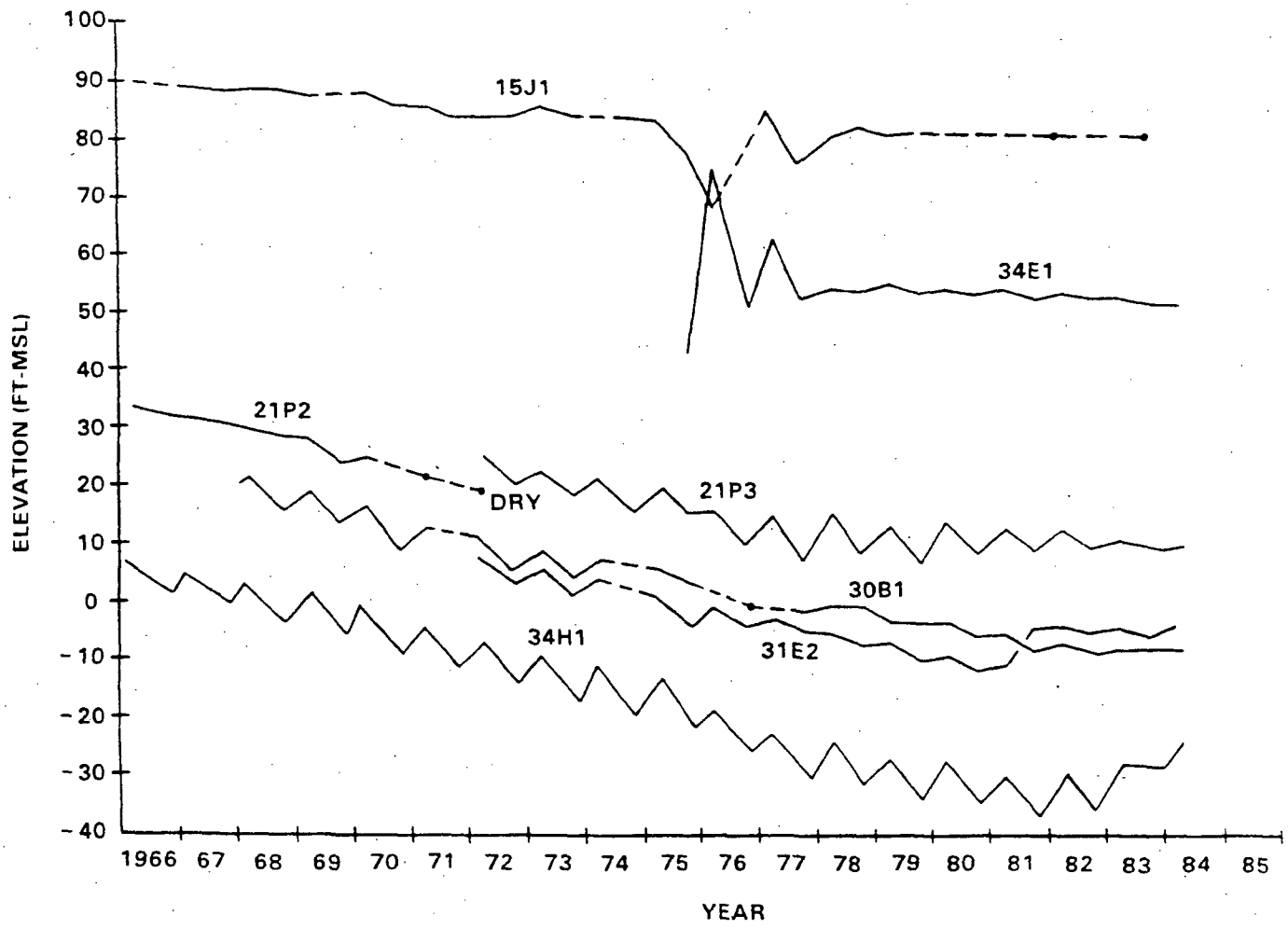
FIGURE 6
SITE WATER LEVELS
OCTOBER 7-9, 1985

ERPT C 0104



SOURCE: COUNTY OF SACRAMENTO
DEPARTMENT OF PUBLIC WORKS
WATER RESOURCES DIVISION

FIGURE 7
REGIONAL WATER LEVEL MAP-SPRING 1985
ELEVATION (FT. MSL)



NOTE: WELL LEVELS ARE RECORDED IN THE SPRING AND FALL. DASHED LINE INDICATES MISSED READINGS.

SOURCE: STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES

FIGURE 8
GROUNDWATER ELEVATION TRENDS IN LOCAL WELLS

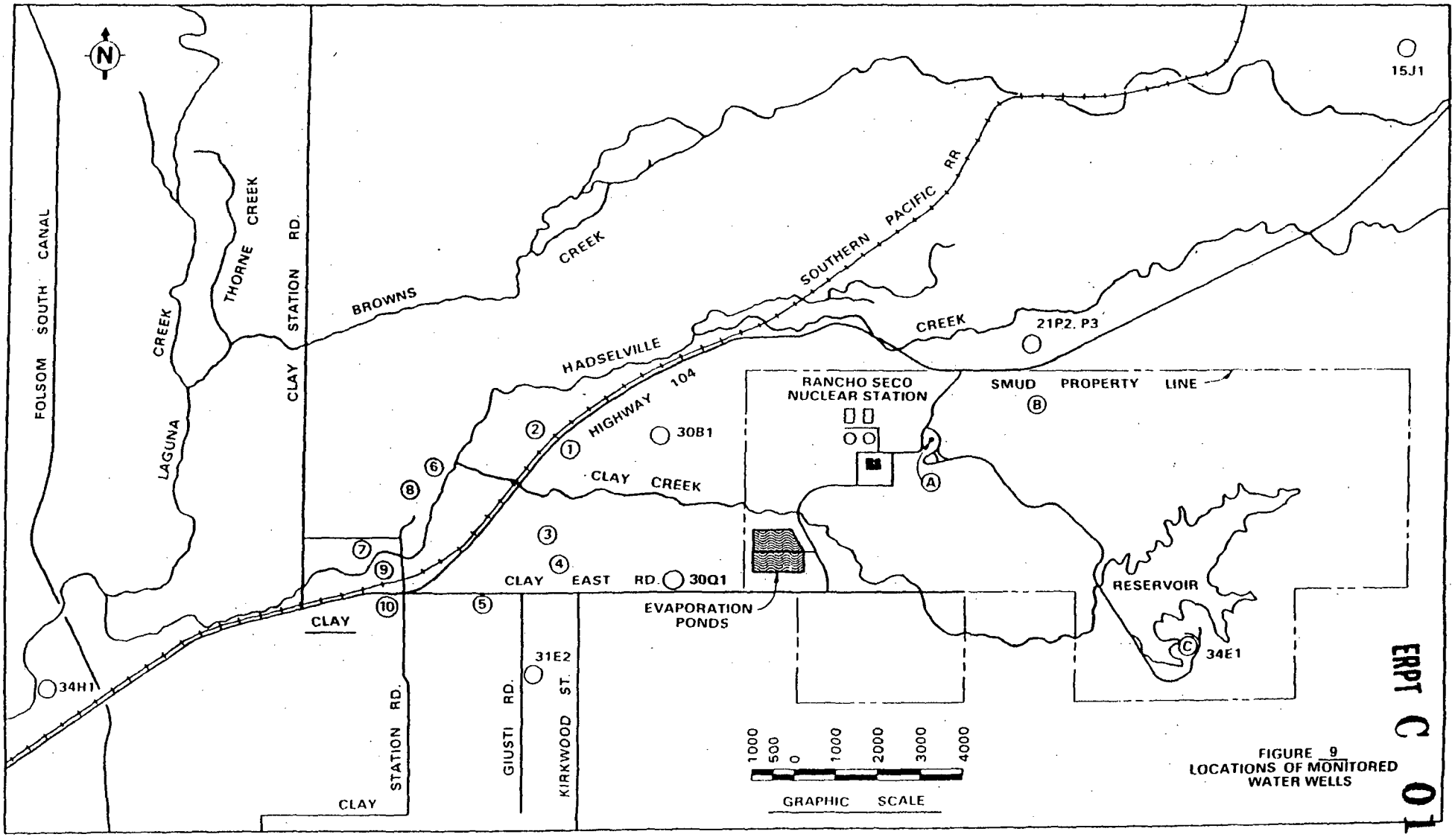


FIGURE 9
LOCATIONS OF MONITORED WATER WELLS

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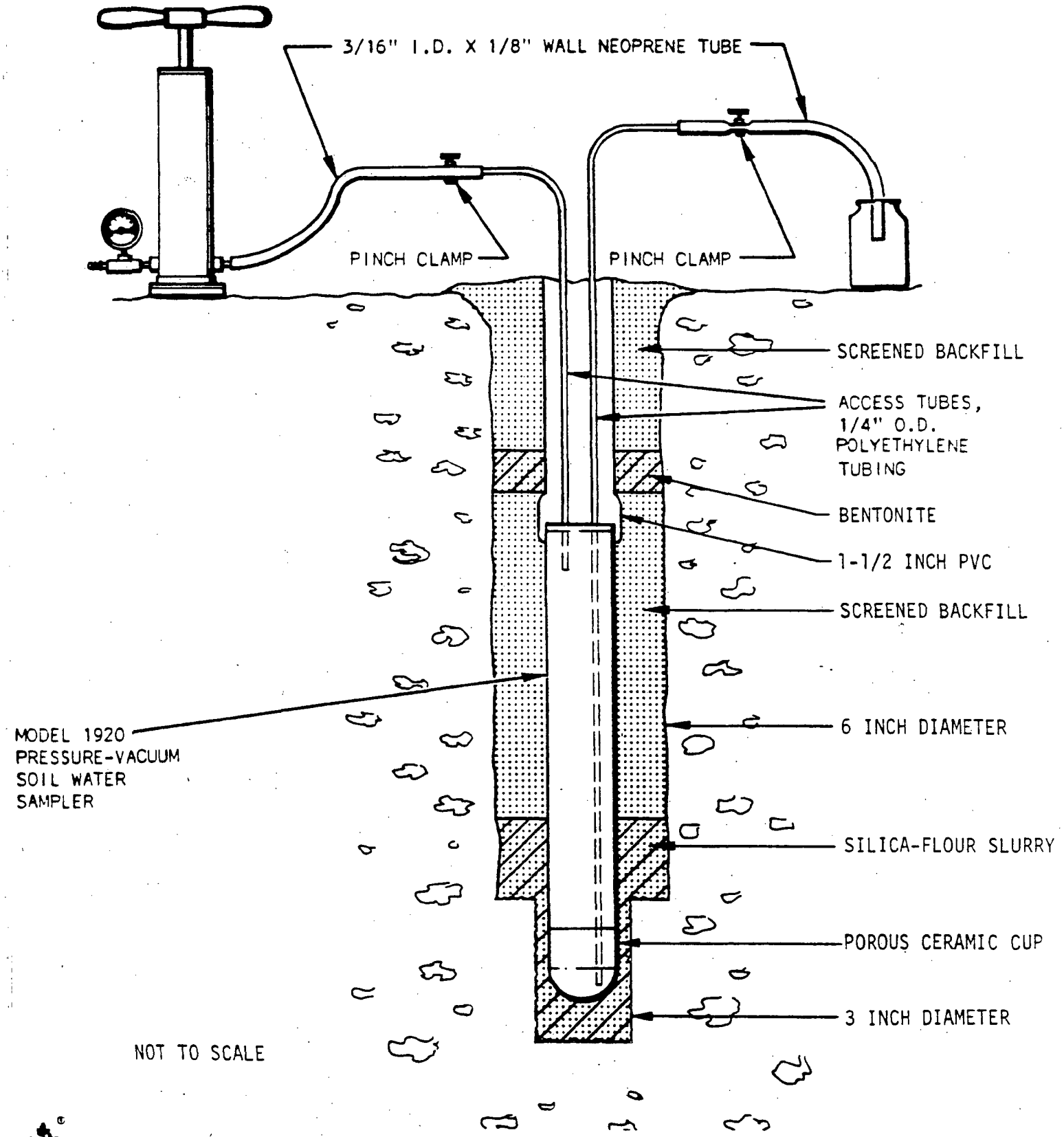
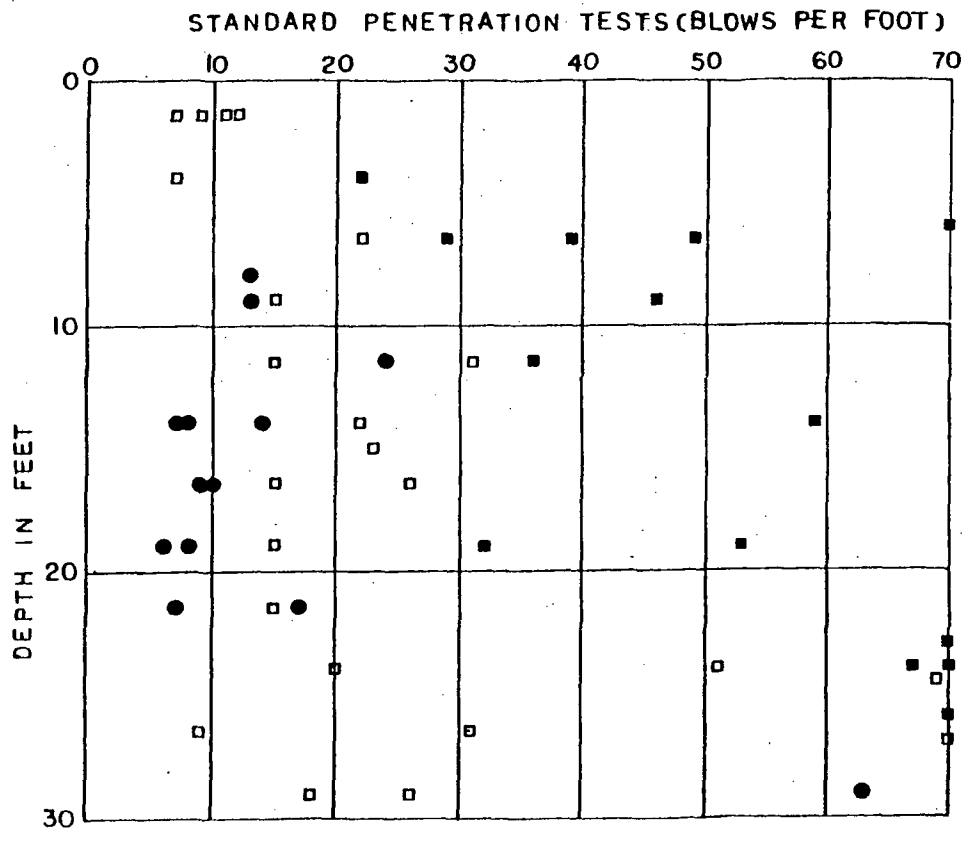


Soilmoisture Equipment Corp. FIGURE TAKEN FROM LITERATURE

FIGURE 10
SCHEMATIC DIAGRAM OF TYPICAL LYSIMETER



LEGEND

- ● CLAYS, SILTS
- ▫ SANDS
- ▪ GRAVELS

△								
△								
△								
No.	DATE	REVISIONS	BY	CHKD	DESIGN DEPT	FINAL	FIELD ENGR	APPR

SCALE | DESIGNED | DRAWN | CHIEF ENGR

BECHTEL
SAN FRANCISCO

STANDARD PENETRATION TEST
VERSUS DEPTH

JOB NO.	DRAWING NO.	REV.
12334	FIGURE 11	

11 x 17 "B" SIZE

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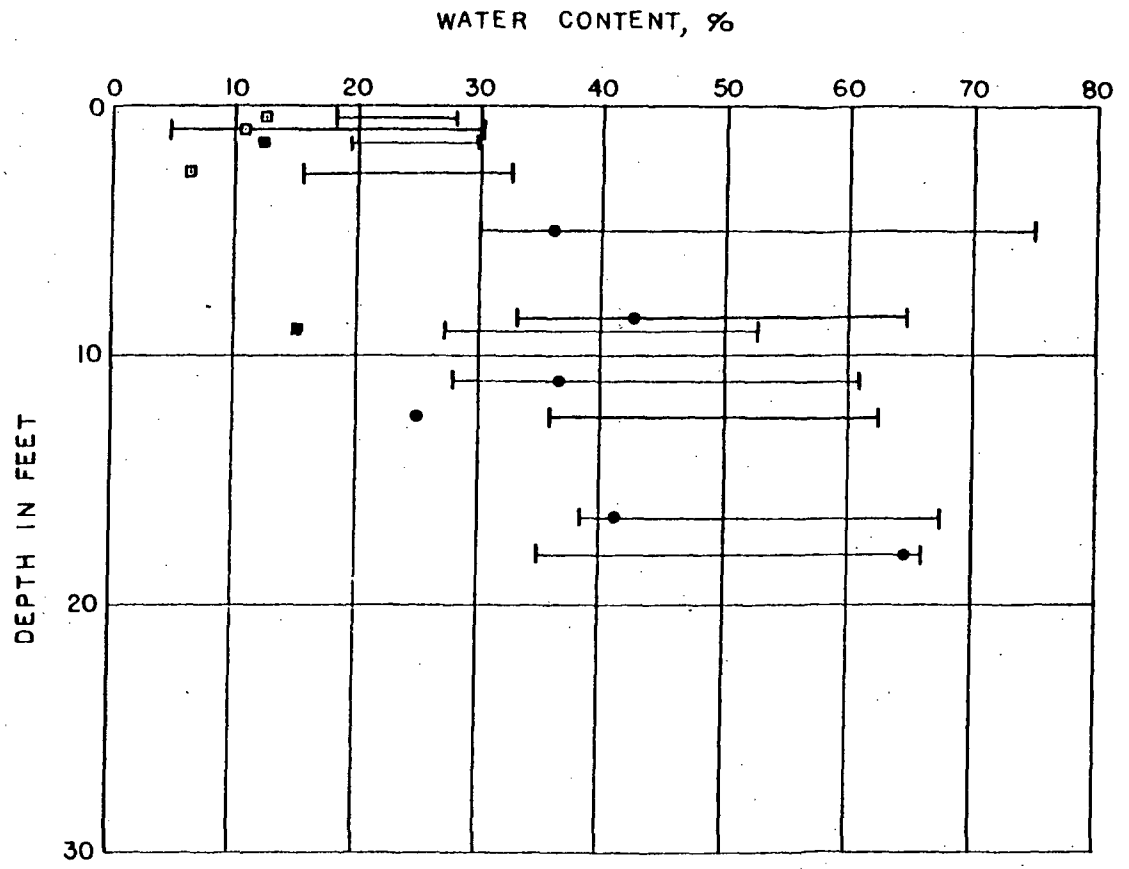


LEGEND

- ● CLAYS, SILTS (CH,MH,CL)
- ▫ SANDS (SC)
- ▪ GRAVELS (GC)

PL W LL

W – MOISTURE CONTENT
PL – PLASTIC LIMIT
LL – LIQUID LIMIT

BECHTEL
SAN FRANCISCO

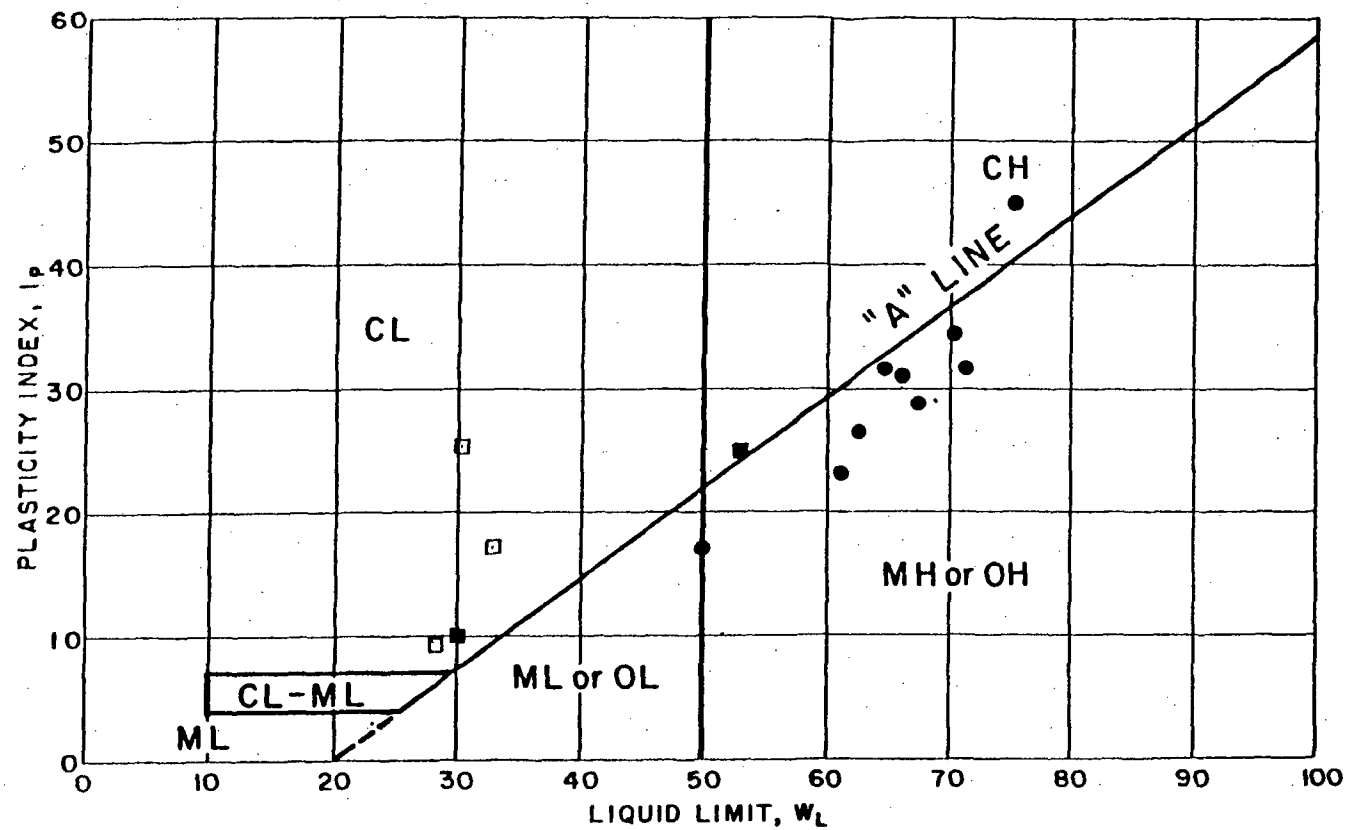
WATER CONTENT/PLASTICITY VERSUS DEPTH

12334 | FIGURE 12

11 x 17 "B" SIZE

PAGE 65 OF 185

ERPT C 0104



LEGEND

- ● FINE GRAINED SOILS (CH, MH CL)
- □ SANDS (SC)
- ■ GRAVELS (GC)

BECHTEL
SAN FRANCISCO

PLASTICITY CHART

12334 | FIGURE 13

11 x 17 "B" SIZE

PAGE 66 OF 185

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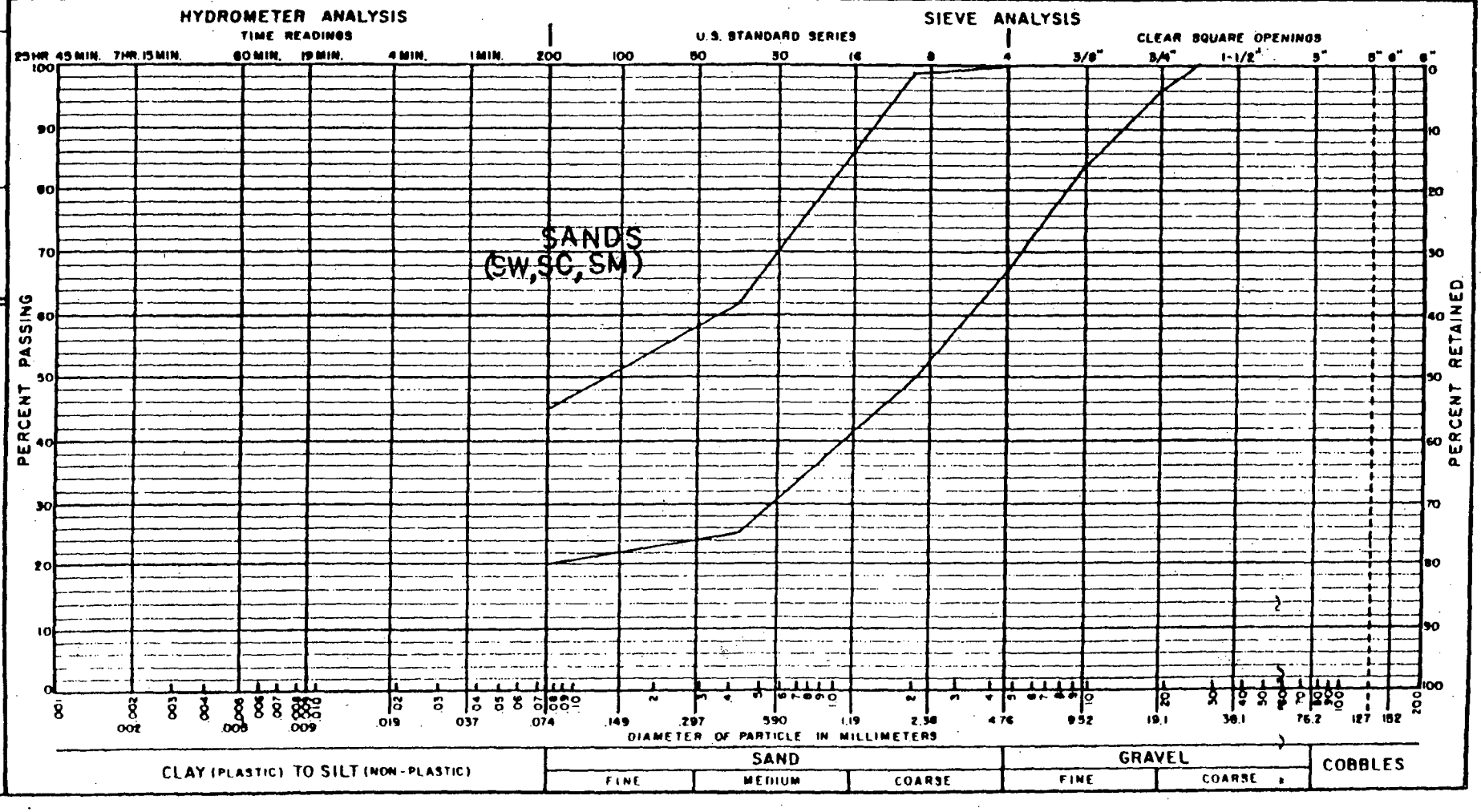
RPI UC 0104

LL									
PL									
PI									
NAT. W/C									
CLASSIF. SYMB.									
SAMPLE NO.									
DEPTH FT.									
HOLE NO.									



Hole No

Tested By

Area

Appr. By

Date

Job No 12334

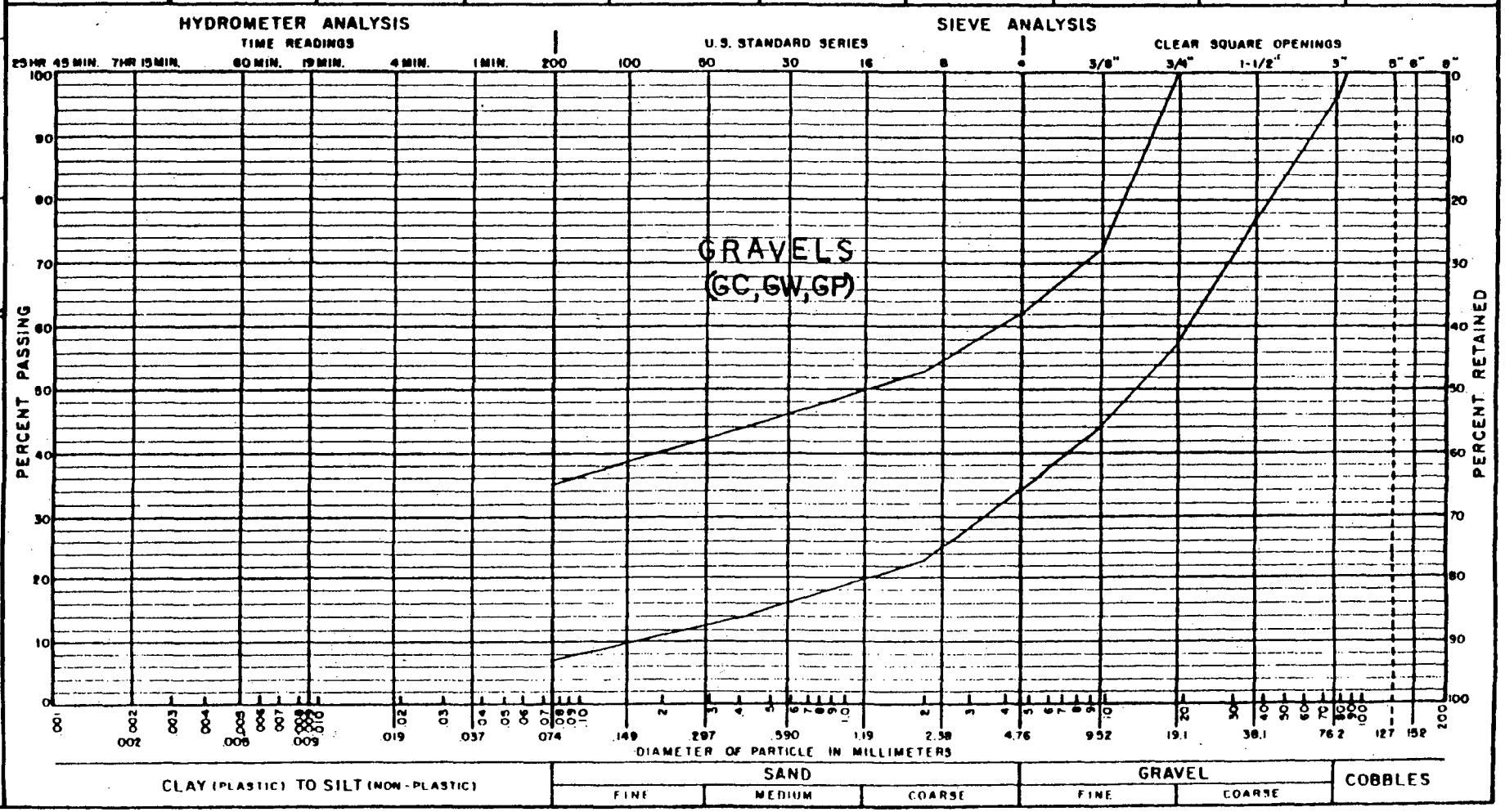
File No

GRADATION TEST RESULTS

FIGURE 14

ERPT C 0104

LL									
PL									
PI									
NAT. W/C									
CLASSIF. SYMB.									
SAMPLE NO.									
DEPTH FT.									
HOLE NO.									



Hole No.

Tested By

Area

Appr. By

Date

Job No. 12334

File No.

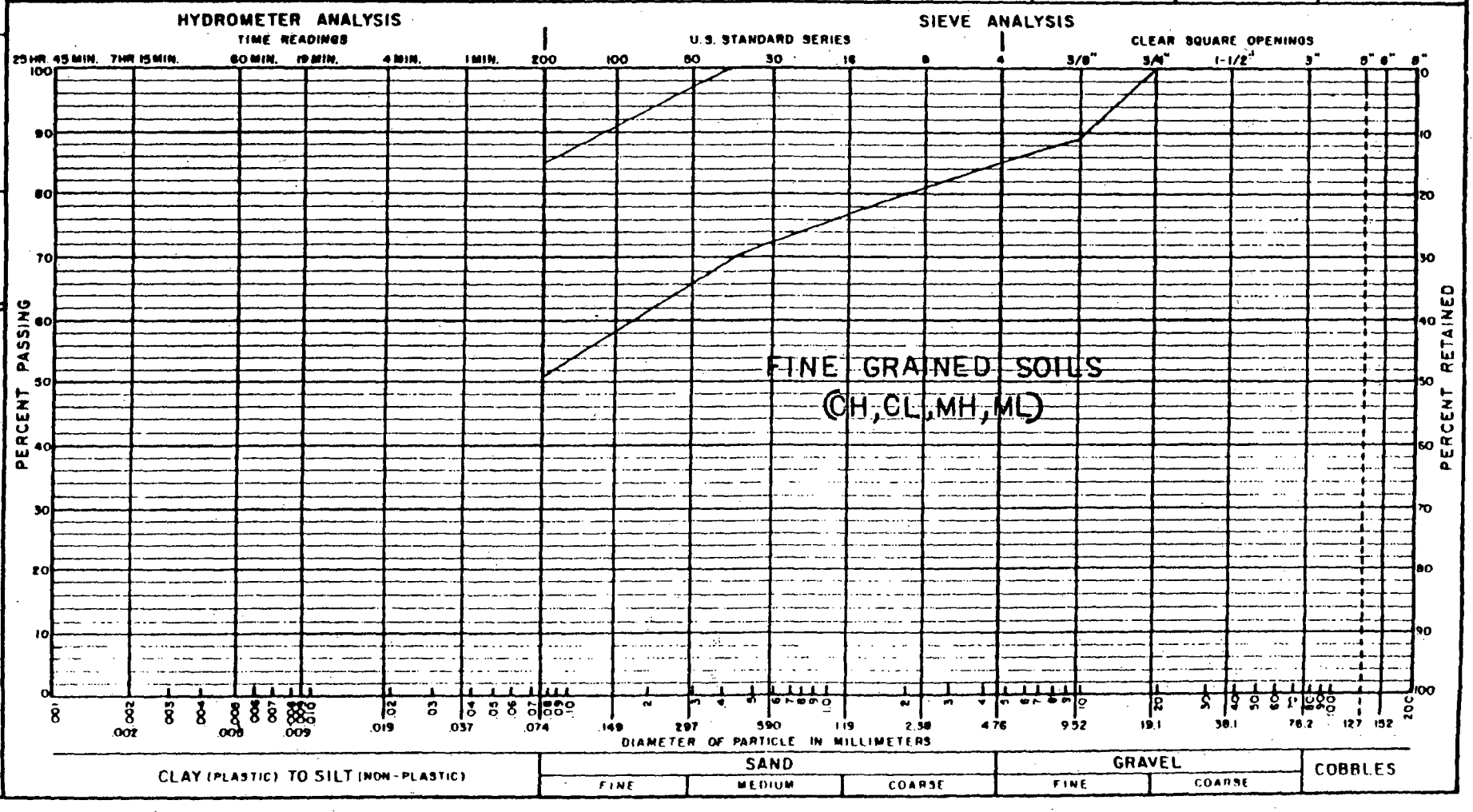
GRADATION TEST RESULTS

FIGURE 15

DACE CO. OF 105

ERPT C 0104

LL									
PL									
PI									
NAT. W/C									
CLASSIF. SYMB.									
SAMPLE NO.									
DEPTH FT.									
HOLE NO.									



Hole No.

Tested By

Area

Appr. By

Date

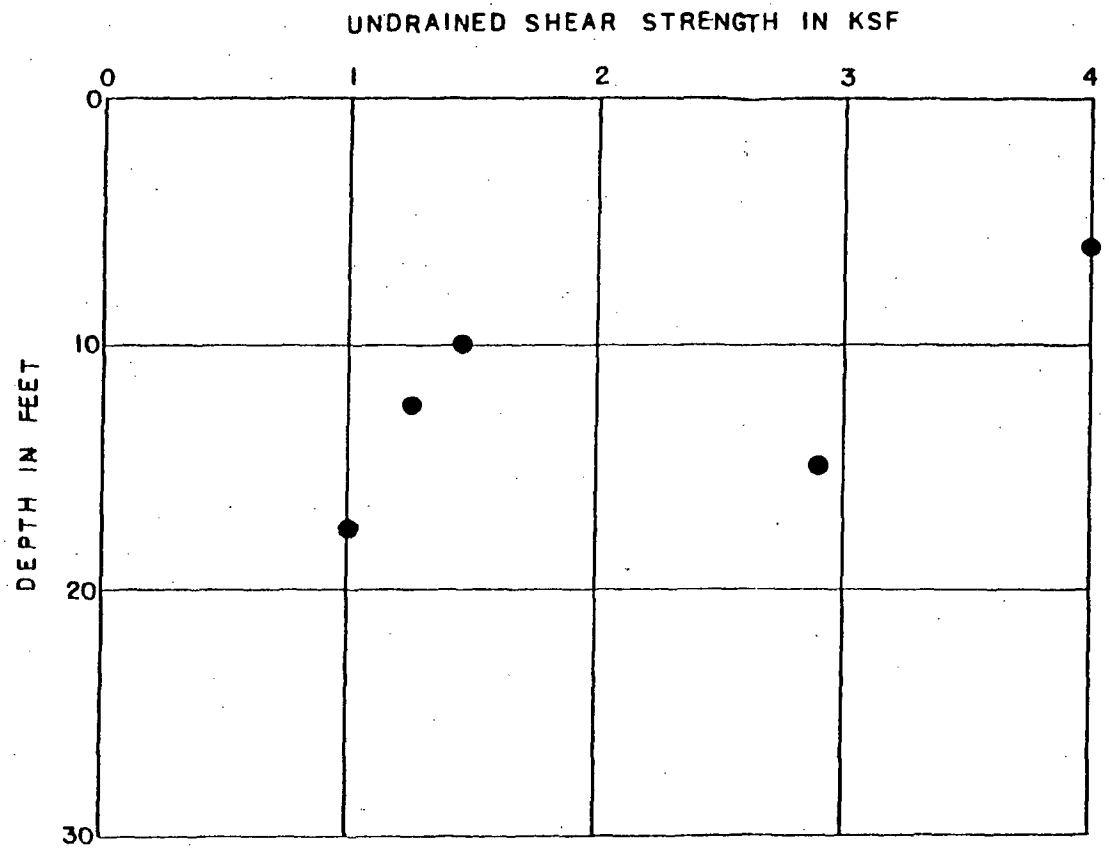
Job No. 12334

File No

GRADATION TEST RESULTS

FIGURE 16

ERPT C 0104



BECHTEL
SAN FRANCISCO

FINE GRAINED SOILS
UNDRAINED SHEAR STRENGTH

JOB NO. 12334

DRAWING NO. FIGURE 17

11 x 17 "B" SIZE

ERPT C 0104

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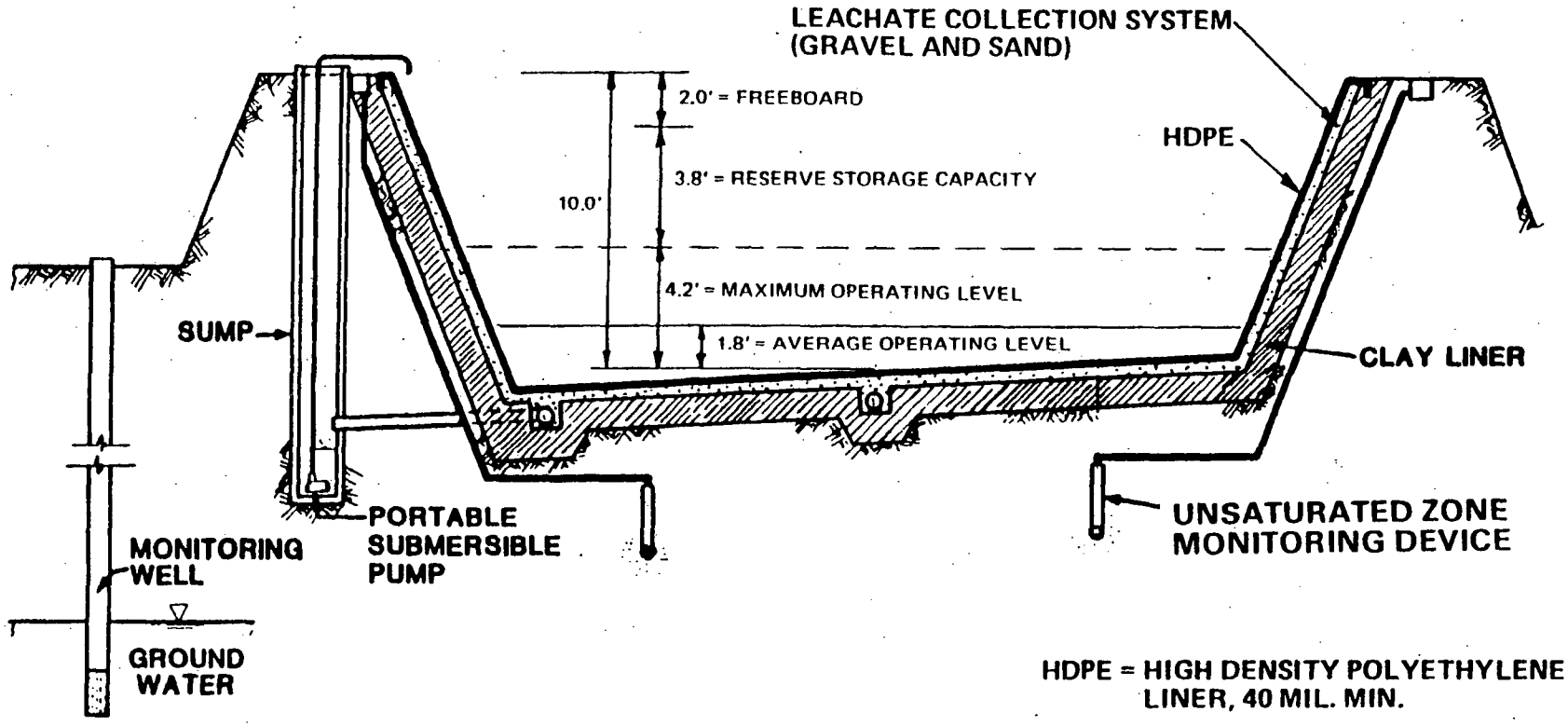
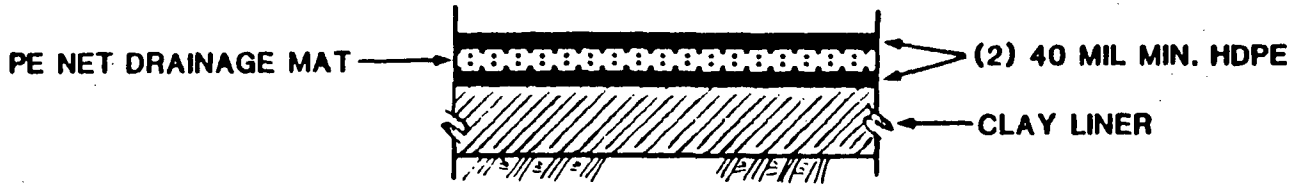
TYPICAL CROSS SECTION OF LINED EVAPORATION POND





POSSIBLE ALTERNATIVE LINER SYSTEM

FIGURE 18

EVAPORATION POND CROSS SECTION

Appendix A - Boring Logs

GEOLOGIC DRILL LOG

PROJECT	RANCHO SECO
JOB NO.	12334
SHEET NO.	1 of 6
HOLE NO.	OW-1
SITE	EVAPORATION PONDS
COORDINATES	N37+81.61 E18+29.77 AS-BUILT
ANGLE FROM HORIZ.	90°
BEARING	—
BEGUN	8-8-85
COMPLETED	8-15-85
DRILLER	KLEINFELDER
DRILL MAKE AND MODEL	CME-75
HOLE SIZE	7 5/8"/3"
OVERBURDEN (FT.)	
ROCK (FT.)	
TOTAL DEPTH	200
CORE RECOVERY (FT./%)	116.7/72
CORE BOXES	13
SAMPLES	N/A
EL. TOP OF CASING	4"PVC=151.2
GROUND EL.	150.0'
DEPTH/EL. GROUND WATER	154.92 FT/-4.95 FT 9-18-85
DEPTH/EL. TOP OF ROCK	
SAMPLE HAMMER WEIGHT/FALL	N/A
CASING LEFT IN HOLE: DIA./LENGTH	4" PVC SET TO 187.8' SCREEN FROM 172.7-182.2'
LOGGED BY:	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
3½"φ DRAG BIT							150.0	0			0.0-10.0 Gravel (GM)- Medium to course, subrounded with large amount (40-50%) fine grained silty light brown (5 YR 5/6) sand; occasional cobbles; trace clay.	Note: Hole drilled to 30 ft using 3½" φ drag bit and Revert; cored from 30-192 ft using nx core barrel and Revert. Drilled from 192-200ft with 3" tri-cone roller bit. -Lithologic description based on visual field methods of cuttings and core.
								5				
							140.0	10			10.0 ~ 15.0 Sand (SM)-Pale yellowish brown (10 YR 6/2) fine-very fine grained with large amount silt; trace clay and gravel.	Riverbank FM / Laguna FM 10 8-8-85 / 8-9-85 12
							135.0	15			15.0~ 20.0 Sand (SM-ML)-Light brown (5 YR 5/6); fine-very fine grained as above but more silt and slight color change.	
							130.0	20			20.0~ 27.0 Sand (SM)-Light brown (5 YR 5/6); fine grained with silt and some very coarse sand.	
								25				
							123.0				27.0~ 43.0 Silt (ML)-Moderate yellowish brown (10 YR 5/4) with some (~ 30%) very fine sand; clayey with slight plasticity; trace of black organics.	Note: Cobble from near surface fell in hole and ground up core from 30-35 ft. Drilling Rates 30-35: 10 mins 100 psi down "0" psi water.
								30				
NX CORE	5.0	0.1	2%					35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO. OW-1

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO | JOB NO. 12334 | SHEET NO. 2 OF 6 | HOLE NO. OW-1

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
NX CORE	5.0	4.0	80%					35				35–40: 5.5 mins 150 psi down "0" psi water
	5.0	2.3	46%					40				40–45: 6.75 mins 300psi down 75 psi water
	5.0	2.4	48%				107.0 / 105.8	45			43.0–44.2 Sand (SM)-Moderate yellowish brown (10 YR 5/4) to dark yellowish brown (10 YR 4/2); fine to very fine grained with large amount (40%) silt.	45–50: 12.75 mins 300 psi down 150 psi water 45–47; 250 psi down 50 psi water 47–50
	5.0	3.0	60%				97.0 / 96.5	50			44.2–53.0 Silt (ML)-Pale yellowish brown (10 YR 6/2) grading to moderate brown (5 YR 4/4)@ ~46ft; slightly weathered with slight orange oxidized staining with very thin black manganese stringers; clayey; slight plasticity with trace of very fine sand.	45–47: lost nearly all circulation (~ 25 gpm) mixed more Revert; regained circulation @ 49.
	5.0	5.0	100%				94.8	55			53.0–53.5 Clay (CL)-Pale red (5 R 6/2) with small amount (20%) very fine silty sand; orange oxidized mottling and black manganese speckling throughout; low plasticity.	50–55: 15.25 mins 250 psi down 50 psi water
	5.0	3.0	60%					60			53.5–55.2 Silt (ML)-Moderate brown (5 YR 4/4); same as 44.2–53.	55–60: 10 mins 250 psi down 75 psi water
	5.0	0.8	16%				84.0	65			55.2~ 66.0 Sand (SM)-Moderate yellowish brown (10 YR 5/4) grading to dark yellowish brown (10 YR 4/2) @ ~ 56.5 ft; fine to very fine grained with some (20–30%) silt; black spots (specks) of manganese and light gray caliche stringers occur randomly; trace mica, 63.4–64 (SM-ML)- more fines.	60–65: 15.5 mins 250 psi down "0" psi water
	5.0	4.7	94%					70			66.0~ 81.0 Siltstone (ML-CL)- Moderate brown (5 YR 4/4); weakly cemented with trace clay; slight to low plasticity; few thin random yellowish gray stringers (caliche) and black manganese speckling.	65–70: 11 mins 250 psi down 75 psi water –cobble on top of core.
								75				70–75: 11.5 mins 300 psi down 100 psi water

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS | HOLE NO. OW-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	3 of 6	OW-1

Sampler Type and Diameter	Sampler Advance	Length Core Run	Sample Recovery	Core Recovery	Sample Blows "N"	Percent Core Recovery	Water Pressure Tests: Loss in G.P.M.	Pressure P.S.I.	Time in Minutes
NX CORE	5.0	0.4		8%					
	1.0	0.0		0%					
	4.0	2.3		58%					
	5.0	0.9		18%					
	5.0	2.5		50%			DOUBLE PACKER 90-99.1	CONSTANT HEAD @ +3.1	
	1.0	0.7		70%			.045		7.5
	1.0	0.0		0%					
	5.0	4.3		86%					
	5.0	4.8		96%					
	5.0	4.8		96%					
	5.0	2.7		54%					

Elevation: 69.0, 60.0, 52.9, 46.0, 42.0, 39.2, 37.5

Depth: 75, 80, 85, 90, 95, 100, 105, 110, 115

Graphic Log / Sample

DESCRIPTION AND CLASSIFICATION

81.0-90.0 Sand (SM-SC)-Moderate brown (5 YR 4/4); very fine grained with large amount (40-50%) clayey silt; trace mica.

90.0-97.1 Gravel (GM-GW)-Fine to coarse, subangular to subrounded with medium-very coarse sand with small amount (5-10%) clayey silt; well graded; weakly cemented.
92.8-93.5: fine-medium silty clayey moderate brown sand with trace fine gravel.

97.1~ 104 Siltstone (ML)-Moderate yellowish brown (10 YR 5/4) to moderate brown (5 YR 4/4) to moderate reddish brown (10 R 4/6); weakly cemented with some (~ 20%) very fine sand with few medium sizes; scattered random black manganese specks and staining, orange oxidized staining and rare caliche stringer; massive gradational contact with below.
98.6-98.65: pale yellowish brown (10 YR 6/2) moderate well cemented seam.

104.0-108.0 Sandstone (SM-SP)-Moderate brown (5 YR 4/4) fine-very fine grained with some (~ 15%) silt; weakly to moderately cemented; rare light yellowish gray (5 Y 9/1) fine sand and black manganese stringers.
106.5-108: large amount (40%) silt; very weakly cemented.

108.0-110.8 Sand (SM-SP)-Moderate brown (5 YR 4/6) fine grained with some (15%) silt; few very coarse grains 109.3-110.8; moderately-well consolidated.

110.8~112.5 Silt (ML-SM)-Moderate brown (5 YR 4/4) with large amount (40-50%) very fine sand; trace mica and black manganese stringers and staining; well consolidated.

112.5-117.5 Clay (CL-CH)-Moderate yellowish brown (10 YR 5/2); some silt; trace (5-10%) very fine sand; medium-high plasticity.

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

75-80: 28 mins 250 psi down 75-100 psi water
75-81: Cobbles fell in and ground up core

80-81: 3.5 mins
8-9-85 / 8-12-85 81
-Set 6 "OD, 3¼" ID augers to 9 ft.
81-85: 10.75 mins 250 psi down "0" psi water

85-90: 8 mins 250 psi down "0" psi water
Water ways on bit blocked off. Core washed away.

90-95: 12.25 mins 250 psi down "0" psi water

95-96: 4.5 mins 250 psi down "0" psi water
96-97: 4 mins 250 psi down 400 psi water
8-12-85 / 8-13-85 97
WL = 31.6
97-102: No time 300 psi down 50-75 psi water

102-107: No time 200 psi down 50-75 psi water

107-112: 17.25 mins 200 psi down 50 psi water

112-117: 26.5 mins 200 psi down 50 psi water

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: OW-1

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	4 of 6	OW-1

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
NX CORE	5.0	4.0	80%				32.5	115, 120			117.5-122.0 Sandstone (SM-SP)-Medium olive gray (5 Y 5/1); fine grained with small amount (10%) silt; moderately cemented with few random yellowish gray (5 Y 8/1) stringers and black manganese spots.	117-122: No time 200 psi down 50 psi water Laguna FM / Mehrten FM 117.5
	5.0	5.0	100%				28.0, 24.8, 23.6	125			122.0-125.2 Sand (SP)-Medium olive gray (5 Y 5/1) fine-medium grained; clean with trace (< 5%) silt; slightly visible thin horizontal bedding apparent below 123 ft. 125.2-126.4 Silt (ML)- Pale brown (5 YR 5/2) changing to pale yellowish brown (10 YR 6/2) @ 125.6 and to medium olive gray (5 Y 5/1) @ 125.9; large amount (40%) of very fine sand; very slight to no plasticity. 126.4-128.5 Sand (SP-SM)-Grayish black (N2) medium grained with interbedded pale yellowish brown (10 Y 6/2) (with random black speckling) and medium olive gray (5 Y 5/1) fine-very fine very silty sand. 127-127.5: coarse grained; dark gray. 127.5-128.5: pale yellowish brown silt.	122-127: 29 mins 200 psi down 50 psi water 127-132: 30 mins 200 psi down 50 psi water
	5.0	5.0	100%	DOUBLE PACKER 126.8-135.9	CONSTANT HEAD @ +3.3	.06 / 16	21.5, 15.4, 14.4, 13.7, 13.0, 11.5	130, 135			128.5-134.6 Sand (SP)-Dark olive gray (5 Y 3/1) to olive gray (5 Y 4/1) fine-medium grained; clean; massive. 130-130.6: thinly interbedded fine grained olive gray and yellowish gray (5 Y 8/1). 132-132.4: Moderate brown (5 YR 4/4) fine clayey silty sand with small amount coarse sand with fine subrounded gravel. 134.3-134.4: orange oxidized zone. 134.6-135.6 Sand (SM)-Medium yellowish brown very fine grained: silty. 135.6-136.3 Sand (SP) Gravel (GP)-Medium yellowish brown (10 YR 5/2) medium-very coarse with large amount fine subrounded gravel (granules). Wet?	~Average water loss while coring today was 2-3 gpm 8-13-85 / 8-14-85 132 WL = 43.8 ~Continued 2-3 gpm water loss. 132-137: 30.5 mins 250-300 psi down "0" psi water
	5.0	4.2	84%				7.6, 5.3	140, 145			136.3-137 Sand (SP)-Pale yellowish brown (10 YR 6/2) to medium yellowish brown (10 YR 5/2) fine-very fine grained; trace of silt and fine soft white subrounded granules. 137.138.5 Sand (SP) Gravel (GP)-Same as 135.6-136.3 but moderately cemented; rare moderate greenish yellow (10 Y 7/4) stained spots. 137.6-137.7 black stained zone. 138.5-142.4 Sandstone (SP)- Light pale yellowish brown (10 YR 7/2) to yellowish olive gray (5 Y 6/2) fine grained with small amount (15%) coarse sizes; moderately cemented becoming weakly cemented @ ~ 141. 142.4-144.7 Sand (SP) Gravel (GP)-Medium yellowish brown (10 YR 5/2) mixed sand and fine gravel; same as 135.6-136.3; same black and orange oxidized staining.	137-142: 31.5 mins 200-250 psi down 50 psi water 142-147: 38 mins 200 psi down 150 psi water
	5.0	4.2	84%				3.0				144.7-147.0 Siltstone (ML)-Yellowish brown (10 YR 5/2) with large amount (40-50%) very fine sand with few medium coarse sizes; slightly vuggy (largest = 0.03 ft max demension); moderately cemented; gradational contact with below.	147-152: 24.5 mins 250 psi down 100 psi water
	5.0	3.8	76%	DOUBLE PACKER 146.8-155.9	CONSTANT HEAD @ +3.2	.77 / 8	-3.0	150, 155			147.0 ~ 153.0 Sandstone (SM)-Moderate yellowish brown (10 YR 5/2); very fine grained with some (~ 20%) silt; moderately cemented becoming weakly cemented below 151; few open pinhole size vesicles; few random black stained specks; trace mica.	152-157: 20.25 mins 250 psi down 100 psi water
	5.0	5.0	100%									

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
EVAPORATION PONDS	OW-1

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	5 of 6	OW-1

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
NX CORE	5.0	4.7		94%					155, 160			153.0 ~ 166.0 Sand (SM-SP) Moderate yellowish brown (10 YR 5/2), very fine grained with small amount (5-10%) silt; trace mica; well consolidated; same as above but slightly cleaner and essentially uncemented.	157-162: 23.5 mins 250 psi down 100 psi water
NX CORE	5.0	5.0		100%					165				162-167: 23 mins 250 psi down 100 psi water
NX CORE	5.0	3.8		76%	SINGLE PACKER 166.5 - 200			-16.0	170			166.0 -173.0 Sand (SP-SM)- Moderate yellowish brown (10 YR 5/2) to dark yellowish brown (10 YR 4/2 with random black speckling); principly fine grained; trace mica and silt; as above but slightly cleaner and coarser grained; occasional weakly cemented zones.	8-14-85 / 8-15-85 167 WL=165 -Continued slight (1-2 gpm) water loss while coring. 167-172: No time 250 psi down 150 psi water
NX CORE	5.0	5.0		100%	2.3 3.9 6.9 5.4 3.7	3.5 10 16 10 3	12 11 5 5 5	-23.0 -26.5	175			173.0-176.5 Sand (SM-SP)-Dark yellowish brown (10 R 4/2) very fine grained with small amount (< 10%) silt; micaceous; well consolidated. 175.2-176: ~ 20-30% clayey silt with orange oxide staining. 176-176.5 :pale yellowish brown (10 YR 6/2) weakly , moderately cemented.	172-177: 37.5 mins 250 psi down 150 psi water
NX CORE	5.0	5.0		100%				-28.4 -29.6	180			176.5-178.4 Sand (SP) Gravel (GP)-Medium gray (N5) medium-coarse sand with large amount fine-medium subrounded gravel from 177.8-178.4; slightly weathered with orange and black oxidized staining. Wet. 178.4-179.6 Sandstone (SM)-Dark yellowish brown (10 YR 4/2); fine-very fine grained with small amount (10 %) clayey silt; moderately cemented.	177-182: 45 mins 250 psi down 150 psi water
NX CORE	5.0	5.0		100%				-31.1				179.6-181.1 Siltstone (ML)-Moderate brown (5 YR 4/4) with random black speckling and staining; small amount (< 10%) fine-very fine sand; weakly-moderately cemented; occasional open pinhole vesicles. 180.5-181.1: wet.	182-187: 37 mins 250 psi down 150 psi water
NX CORE	5.0	4.1		82%				-36.6 -39.7 -40.3	185, 190			181.1-186.6 Sandstone (SM-SP)- Dark yellowish brown (10 R 4/2) with random black specks; very fine grained same as 173-176.5 but moderately cemented. 186.6-189.7 Sand (SP) Gravel (GP)- Dark yellowish brown (10 YR 3/2) medium very coarse sand with large amount (40%) fine-medium subrounded gravel; same as 176.5-178.4 . Wet. 189.7-190.3 Siltstone (ML)- Pale yellowish brown (10 YR 6/2) moderately cemented; slightly weathered with orange oxidized speckling; some (20%) very fine sand; trace clay; slight plasticity; grades to below sand.	187-192: 32 mins 250 psi down 150 psi water
3"TRI-CONE									195			190.3-200.0 Sandstone/Sand (SM-SP)-Moderate yellowish brown (10 YR 5/4) very fine grained with small amount (5-10%) slightly clayey silt; small amount (10%) of medium very coarse subrounded sand scattered throughout;also white (caliche?) granules.	192-200: drilled with 3" roller bit.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: OW-1

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	6 of 6	OW-1

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
3" TRI-CONE							-50.0	195				
								200			BOH = 200.0 FT.	8-16-85 WL = 153.7 8-20-85: reamed to 193 ft with 7 5/8" tri-cone bit. 8-22-85: Observation well installed with 4" pvc set to 187.8 ft with screen from 172.7-182.2 ft. See observation well log for construction details.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: OW-1

H&CE 16-1

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO	JOB NO.: 12334	SHEET NO.: 1 of 6	HOLE NO.: OW-2		
SITE: EVAPORATION PONDS	COORDINATES: N39+20.54 E1+98.53 AS-BUILT	ANGLE FROM HORIZ.: 90°	BEARING: N/A		
BEGUN: 7-11-85	COMPLETED: 8-1-85	DRILLER: KLEINFELDER	DRILL MAKE AND MODEL: CME-75	HOLE SIZE: 7.5"	TOTAL DEPTH: 200FT
CORE RECOVERY (FT./%): 169.7/85	CORE BOXES: 19	SAMPLES: —	EL. TOP OF CASING: 4"PVC=147.85	GROUND EL.: 146.6'	DEPTH/EL. GROUND WATER: 155.61'/-9.01' 9-18-85
SAMPLE HAMMER WEIGHT/FALL: N/A	CASING LEFT IN HOLE: DIA./LENGTH: 4" PVC SET TO 183', SCREEN FROM 168.2'-177.2'	LOGGED BY: R. NELSON			

SAMPLER TYPE AND DIAMETER: CONTINUOUS TUBE SAMPLER - 2 3/8" ID ; 3" OD

SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES
2.5	1.9	76%			
5.0	4.7	94%			
5.0	3.6	72%			
5.0	4.8	96%			
5.0	3.0	60%			
5.0	5.0	100%	SINGLE PACKER 23.7-191.4		
5.0	5.0	100%	.14	CONSTANT HEAD @ +2.6	7 MIN 10 SEC
5.0	5.0	100%			

ELEVATION	DEPTH	DESCRIPTION AND CLASSIFICATION
146.6	0	0.0-3.2 Sand (SM) – Reddish brown, fine to very fine grained with some (~20%) silt, coarse sizes and fine subrounded gravel; slightly damp below ~1 ft.
143.4		3.2-3.8 Clay (CL) – Reddish brown; low to medium plasticity with some (~ 15-20%) fine sand and gravel.
142.8		3.8-4.8 Sand (SM) – As 0-3.2 with large amount fine-medium gravel.
141.8	5	4.8-14.0 Gravel (GC-GM) – Medium to coarse, subrounded with some (~30%) fine sand and clay; numerous cobbles; trace of reddish brown silt.
	10	
132.6		14.0-17.0 Sand (SM) – Light tan-gray; fine to very fine grained with some (10-15%) silt.
	15	
129.6		17.0-18.0 Gravel (GM) – Fine to medium; subrounded with silty sand.
128.6		18.0-21.0 Sand (SM-ML) – Light olive gray; fine to very fine grained with large amount (30-40%) silt; slight plasticity with occasional very thinly interbedded silty clay seams.
	20	
125.6		21.0-28.0 Sand (SM-SC) - Reddish brown, fine to very fine grained with small amount (10-15%) clayey silt; damp.
	25	
118.6		28.0-30.0 Sand (SM-SP) – Moderate brown to light yellowish brown; fine to very fine grained with small amount (<10%) silt; damp.
116.6	30	30.0-36.0 Sand (SM) – Light yellowish brown to reddish brown; very fine grained with some (~20%) clayey silt; damp.
	35	

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

Note: Hole drilled dry from surface to 110 ft. using 5 ft. long continuous tube sampler inside 3-1/4" ID 6" OD hollow stem flight augers. Augers remained in hole to 110 ft. while coring from 110-165 ft. Augers then pulled and hole reamed with 7-1/2" ϕ drag bit from surface to 162 ft.

– Lithologic descriptions based on visual field methods.

Riverbank FM / Laguna FM 14

20-21: saturated zone.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: OW-2

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO | JOB NO.: 12334 | SHEET NO.: 2 of 6 | HOLE NO.: OW-2

CONTINUOUS TUBE SAMPLER - 2 3/8" ID; 3" OD

Sampler Advance Length Core Run	Sample Recovery Core Recovery	Sample Blows "N" / Percent Core Recovery	Water Pressure Tests: Loss in G.P.M.	Pressure P.S.I.	Time in Minutes
5.0	5.0	100%			
5.0	5.0	100%			
5.0	4.3	86%			
5.0	4.0	80%			
5.0	4.1	82%			
5.0	3.5	70%			
5.0	2.9	58%			
5.0	5.0	100%			
5.0	5.0	100%			

Elevation: 110.6, 109.1, 98.1, 96.6, 85.6, 83.6, 81.3, 71.3

Depth: 35, 40, 45, 50, 55, 60, 65, 70, 75

Graphic Log / Sample

Description and Classification

36.0-37.5 Sand (SP-SM) – Moderate brown to yellowish brown; fine to very fine grained with small amount (< 10%) silt; damp.

37.5-48.5 Sand (SM) – Light yellowish brown, very fine grained with some (~20%) silt; black organic staining in thin root tubules throughout; occasional rust and black laminations. 44.5-45.9; 46.3-46.4; 47-47.5; 48.5-48.7; 48.9-50.0: gray fine-medium grained (SP) layers with some orange oxidized staining.

48.5-50.0 Siltstone (ML) – Moderate brown; weakly cemented with some (~30%) very fine sand and black organic streaks and tubules.

50.0-61.0 Sand (SM) – Reddish brown, fine to very fine grained with some (~20%) silt; very dense; very weakly to weakly cemented with random black organic streaks. 55-56: caliche zone (random streaks).

61.0-63.0 Sandstone – Medium gray to brown; fine grained; weakly cemented; friable; trace of caliche.

63.0-65.3 Sand (SP) – Yellowish brown; fine to medium grained; poorly graded; very few fines; weak caliche cementation from 64.5-65.3; 64.7-64.8 reddish brown clay (CL).

65.3-75.3 Siltstone (ML) – Reddish brown; very weakly cemented; clayey with slight plasticity; small amount (10%) very fine sand; random black organic streaks and open pinhole tubules; very slightly damp; grading to sand from 74-75.3.

Notes on: Water Levels, Water Return, Character of Drilling, Etc.

Drilling Rates:

52.5-57.5: 8.5 mins

57.5-62.5: 4.75 mins @ 350 psi

7-11-85 / 7-12-85 62.5

62.5-67.5: 6.75 mins @ 200 psi

67.5-72.5: 6.5 mins @ 150 psi

72.5-77.5: 3 mins (72.5-76 @ 75 psi) (76-77.5 @ 30 psi)

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS | HOLE NO.: OW-2

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	3 of 6	OW-2

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
CONTINUOUS TUBE SAMPLER - 2 3/8" ID, 3" OD	5.0	5.0	100%				71.3 / 70.0	75			75.3-76.6 Sand (SM-SP) — Reddish brown; fine to very fine grained with some (10-15%) silt; trace of black organic streaks.	
	5.0	4.5	90%					80			76.6-85.3 Siltstone (ML) — Reddish brown; same as 65.3-75.3 but moderately cemented, more dense; still with black organic streaks and open pinhole tubules; very slightly damp; gradational contact with below.	77.5-82.5: No time 77.5-79.5 @ 25 psi 79.5-82.5 @ 100 psi 78-78.3: saturated zone. — Unable to get water sample. Augers apparently sealed off; pulled augers up to 77 ft. Waited 10 mins. No water in hole. 82.5-87.0: 8.75 mins. @ 300 psi
	4.5	4.5	100%				61.3	85				
	5.0	4.3	86%					90			85.3-91.0 Siltstone (ML) — Mottled light brown and gray with large amount of very fine sand; weakly to moderately cemented; very little moisture; nearly dry; trace of caliche.	87-92: 5.5 mins @ 300 psi
	3.0	3.0	100%				55.6					92-95: 2.75 mins @ 100 psi
	2.5	2.1	84%					95			91.0-101.4 Sandstone/Sand (SP) — Reddish brown and mottled light yellowish brown (10 YR 4/2) and gray; fine grained with small amount (<10%) silt; very weakly to moderately cemented.	7-12-85 / 7-15-85 95 Dry Hole 95-97.5: 3 mins @ 100 psi 97.5-102.5: 10 mins @ 150 psi
	5.0	4.1	82%					100				
	5.0	4.5	90%				45.2	105			101.4-107.5 Sandstone (SM-SP) — Moderate brown (5 YR 4/4) to light brown (5 YR 5/6); fine to very fine grained with small amount (10-15%) silt; weakly to very weakly cemented with occasional thin (<0.1 ft) uncemented sand lenses; trace of mica; few open pinhole tubules.	102.5-107.5: 10 mins @ 150-200 psi 103.5-104: saturated zone.
	2.5	2.5	100%				39.1				107.5-109.7 Sandstone — Moderate brown (5 YR 4/4) to dark yellowish brown (10 YR 4/2) with small amount of very light gray (N8) mottling; fine to very fine grained with small amount (<10%) silt; moderately cemented, wet.	107.5-110: 10 mins @ 250 psi
NX CORE	5.0	4.9	98%	SINGLE PACKER 114.5-156.3 0 0 0.8	20 30 45	38 9 25	36.9	110			109.7-111.7 Conglomerate/Gravel (GP) — Medium to coarse; subrounded in dark yellowish brown (10 YR 4/2) fine-medium moderately well cemented sandstone matrix.	7-15-85 / 7-16-85 110 Water Level = 103.7 — Average water loss while coring was 5-10 gpm — up around augers most likely. 110-115: 45 mins
							34.9	115			111.7-121.5 Siltstone (ML) — Moderate reddish brown (10 R 4/4) with large amount (40-50%) fine sand; random black (manganese) streaks and very light gray (N8) staining; moderately cemented; 116.7-117: color is dark yellowish brown (10 YR 4/2); 119.1-119.8: medium grained sandstone; moderately well cemented, very gradational contact with below.	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO. OW-2

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	4 of 6	OW-2

Sampler Type and Diameter	Sampler Advance / Length Core Run	Sample Recovery / Core Recovery	Sample Blows "N" / Percent Core Recovery	Water Pressure Tests: Loss in G.P.M.	Pressure P.S.I.	Time in Minutes	Elevation	Depth	Description and Classification	Notes on: Water Levels, Water Return, Character of Drilling, etc.
NX CORE	5.0	5.0	100%	DOUBLE PACKER 114-119.7: 0 / 0 / 0	25 / 45 / 60	5 / 5 / 5		115		– 1 tub (~150 gals) Revert used in initial core run; filled annulus outside augers. Thereafter clear water used for coring. 115-120: 27 mins @ 200 psi (100 psi water) 120-125: 16 mins @ 300 psi (50 psi water)
								120		
							25.1			
	5.0	5.0	100%	DOUBLE PACKER 122-127.7: 0 / 0 / 0 / 0	5 / 15 / 25 / 45	5 / 5 / 5 / 5		125	121.5-132.5 Sandstone (SP-SM) – Moderately reddish brown (10 R 4/4) to moderately brown (5 YR 4/4) with random black and white streaks; same as above siltstone but fine-very fine sand predominates; weakly to moderately cemented; 127.9-128: light brown (5 YR 5/6) layer with fine subrounded gravel.	125-130: 13.5 mins @ 300 psi (125 psi water)
	5.0	5.0	100%							
								130		130-135: 11.5 mins @ 300 psi (110 psi water)
	5.0	4.5	90%				14.1			
								135	132.5-135.6 Siltstone (ML) - Moderate reddish brown (10 R 4/4) with large amount of fine sand; trace (5%) clay; same as 111.7-121.5.	7-16-85 / 7-17-85 135 Water Level N/A
							11.0			
	5.0	5.0	100%	DOUBLE PACKER 136-141.7: 0 / 0 / 0 / 0	5 / 15 / 25 / 40	5 / 5 / 5 / 5			135.6-141.0 Sandstone (SM-SP) - Moderate brown (5 YR 4/4) to moderate reddish brown (10 R 4/4), fine-very fine grained with varying silt content (20-40%); weakly-moderately cemented with black manganese and light gray caliche spots and stringers; few pinhole tubules; 138.7-139.4: well cemented.	135-140: 14 mins 135-138, 139-140 @ 300 psi (50 psi water) 138-139 @ 300 psi (zero water psi)
								140		140-145: 10 mins @ 250 psi (25 psi water)
							5.6			
	5.0	5.0	100%						141.0-145.5 Sand (SP-SM) Moderate yellowish brown (10 YR 5/4) grading to dark yellowish brown (10 YR 4/2) @ 141.5; fine-very fine grained with some black manganese staining; some silt (10-20%) with alternating clean layers; poorly graded; grades to olive gray @ ~144.	145-150: 10 mins @ 250 psi (25-50 psi water)
								145		Laguna FM / Mehrten FM 145.5
							1.1			
	5.0	3.3	66%	DOUBLE PACKER 146-151.7: 0 / 0 / 0 / 0	5 / 15 / 25 / 40	5 / 5 / 5 / 5			145.5-152.5 Sandstone (SP) -- Olive gray (5 Y 4/1) fine-very fine grained; moderately cemented; slightly weathered with small amount of orange iron oxide staining; micaceous; trace (5%) silt; 148-151: interbedded sand; 153-153.2: pale yellowish brown (10 YR 6/2) siltstone; weakly-moderately cemented.	
								150		150-155: 10 mins @ 250 psi (25-50 psi water)
	5.0	3.6	72%	DOUBLE PACKER 151-156.7: 0 / 0 / 0 / 0	6 / 10 / 15 / 25	5 / 5 / 5 / 5	-5.9			
								155	152.5-159.0 Sand (SM-SC) -- Interbedded pale yellowish brown (10YR6/2) (SM-SC): moderately brown (5 YR 4/4) (ML) and olive gray (5 Y 4/1) (SM); fine-very fine grained; poorly graded; damp.	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO. OW-2

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	5 OF 6	OW-2

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG / SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
NX CORE	5.0	4.0	80%				-12.4	155			155-158: saturated zone. (pale yellowish brown) 155-160: 22 mins @ 400 psi (25 psi water)
NX CORE	5.0	4.9	98%				-13.8 -14.7 -15.6 -18.0	160		159.0-160.0 Sand (SP) — Olive gray (5 Y 4/1) fine grained; clean. 160-161.3 Sand (SM-SC) — Moderate brown (5 YR 4/6) fine-very fine grained with small amount (10-15%) clayey silt. 161.3-162.2 Sandstone (SP) — Medium dark gray (N-4); fine-medium grained weakly cemented; clean. 162.2-164.6 Sand (SM-SP) — Moderately yellowish brown (10 YR 5/2): fine-very fine grained with small amount (~10%) silt; 162.2-162.4: moderately cemented siltstone; 164.1-164.6: moderately cemented conglomerate.	160-165: 9 mins @ 250 psi (25-50 psi water)
3" DRAG BIT								165			7-17-85 165 7-31-85 165.7 7-24-85: —Reamed hole with 7.5" drag bit to 162 ft; bit and 25 ft. of NW rod sheared off in hole. Retrieved bit on 7-25-85 and set hollow stem auger back down to 155 ft. On 7-26-85 40 ft. of augers broke off and remained in hole from 115-155 ft. Unable to retrieve so rig moved ~11 ft. NNE and drilled new replacement hole using 3" drag bit to 165.7 ft.* Began coring from 165.7 ft. on 7-31-85.
NX CORE	4.3	3.9	91%					170		164.6-174.1 Sand (SM-SP) — Moderately yellowish brown (10 YR 5/4) fine-very fine grained with some (10-15%) silt; trace mica; very slightly damp; 171.4-171.6: saturated; 172-173.5: weakly cemented; slightly vuggy with open pinhole vesicles - some stained black.	165.7-170: 15.5 mins @ 250 psi (125 psi water) 170-175: 19 mins @ 250 psi (125 psi water) 175-180: 30 mins @ 250 psi (125 psi water) core loss due to inner barrel not set properly.
NX CORE	5.0	5.0	100%				-27.5	175		174.1-179 Sandstone/Siltstone (SM-ML) — Moderate yellowish brown (10 YR 5/4) very fine grained with large amount (30-40%) silt; random open pinholes with black staining; moderately cemented; 174.8-174.9: saturated.	*using Revert 7-31-85
NX CORE	5.0	0.7	14%				-32.4	180		179-187.2 Siltstone (ML) — Yellowish brown (10 YR 5/2) to moderate reddish brown (10 R 4/4) with some (15-20%) very fine sand; very weakly to moderately cemented with occasional well cemented layer (< 0.3 ft. thick); continued presence of black stained open pinhole size open vesicles; random very thin black streaks and staining (manganese); 184.5± - 0.005' caliche layer; 185.5-0.04' may dimension open vug with black coating; runs horizontally thru core.	8-1-85 Water Level = 71.95 180-185: 30 mins @ 250 psi (125 psi water)
NX CORE	5.0	3.2	64%					185			185-190: 23 mins @ 250 psi (150 psi water)
				DOUBLE PACKER 184.5-195	0	50	5				
NX CORE	5.0	4.4	88%				-40.6 -42.0			187.2-188.6 Sand (SM) — Dark yellowish brown (10 YR 4/2); fine grained with some (15%) clayey silt.	
NX CORE	5.0	4.2	84%					190 195		188.6-200.0 Siltstone (ML) — Moderate yellowish brown (10 YR 5/2) to moderate reddish brown (10 R 4/4) same as 179-187.2; trace of clay; slightly more sandy with depth.	190-195: 25 mins @ 400 psi (150 psi water)

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: OW-2

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO | JOB NO.: 12334 | SHEET NO.: 6 of 6 | HOLE NO.: OW-2

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
NX CORE	5.0	1.8	35%					195				195-200: 21 mins @ 350 psi (150 psi water) 8-27-85: Reamed to 183 ft with 7 5/8" tri-cone bit.
							-53.4	200			BOH = 200 ft.	8-28-85: Observation well installed with 4" PVC set to 183 ft with screen from 168.2 -177.2 ft. See observation well log for construction details.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS | HOLE NO.: OW-2

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 OF 6	OW-3

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N47+01.86 E9+63.77 AS-BUILT	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
8-2-85	8-7-85	KLEINFELDER	CME-75	7 5/8"/3"			200 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
119/92	14	N/A	4"PVC=139.0'	137.8'	144.21'/-6.41' 9-18-85	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	SCH 40 4"PVC/194.2'	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
3½" ϕ DRAG BIT							137.8	0			0.0-3.5 Sand (SM)-Moderate brown (5 YR 4/4) to moderate reddish brown (10R 4/6), fine to very fine grained with large amount of silt and fine-medium gravel.	Note: Hole drilled to 35 ft using 3 1/2" ϕ drag bit and Revert. Cored from 35-165 ft using NX core barrel and Revert. -Lithologic description based on visual field methods of cuttings and core. ~ 9 ft: Lost ~ 90% circulation (32-35 gpm) -10 ft regained circulation-ground squirrel hole?
							134.3	5			3.5-6.0 Gravel (GM-GP)-Fine to medium, subrounded in moderate reddish brown (10R 4/6) clayey silty matrix; some medium-coarse sand.	
							131.8				6.0 ~ 10.0 Sand (SM-SC)-Moderate reddish brown (10R 4/6) same as 0-3.5 with only small amount gravel; more clayey.	
							127.8	10			10.0 ~ 15.0 Clay (CL)- Light brown (5 YR 6/4); silty; low plasticity with small amount fine sand.	Riverbank FM / Laguna FM 10
							122.8	15			15.0 ~ 19.0 Sand (SM-SC)-Pale yellowish brown (10 YR 6/2); fine-very fine grained; silty with small amount of clay.	
							118.8	20			19.0-27.0 Sand (SM)-Light brown (5 YR 6/4) to moderate reddish brown (10R 4/6); fine to very fine grained; some medium sand with silt from ~ 22-24.	
				DOUBLE PACKER 21.8-31.0	CONSTANT HEAD @ +3.8			25				
				.03		15	110.8				27.0 ~ 32.0 Silt (ML)-Moderate yellowish brown (10 YR 5/5) with some fine-medium sand.	
								30				
							105.8					
								35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO. OW-3

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO | JOB NO. 12334 | SHEET NO. 2 OF 6 | HOLE NO. OW-3

Sampler Type and Diameter	Sampler Advance Length Core Run	Sample Recovery Core Recovery	Sample Blows "N" Percent Core Recovery	Water Pressure Tests: Loss in G.P.M.	Pressure P.S.I.	Time in Minutes	Elevation	Depth	Graphic Log	Sample	Description and Classification	Notes on: Water Levels, Water Return, Character of Drilling, Etc.
NX CORE	5.0	0.1	2%					35			32.0–43.0 Sand (SM)-Moderate yellowish brown (10 YR 5/4); fine-very fine grained with some (~ 20%) silt. 40.3–40.4 & 40.9–41.1: fine-medium subrounded gravel with medium sand. Wet.	Drilling Rates 35–40: No time 300 psi down "0" psi water cobble blocked core barrel-ground up core.
								40				8-2-85 / 8-5-85 40
	5.0	3.2	64%				94.8				43.0–46.2 Silt (ML)-Moderate yellowish brown (10 YR 5/4) with same (10–15%) very fine sand; slightly weathered with trace of caliche nodules, orange oxidized staining and clay; rare fine sand lenses.	40–45: 16 mins 250 psi down 125 psi water
	5.0	4.8	96%	SINGLE PACKER 47.5–164			91.6	45			46.2–49.4 Sand (SM)-Moderate yellowish brown (10 YR 5/4), fine-very fine grained with large amount (~ 40%) silt; trace clay; micaceous; slightly weathered with orange oxidized and black manganese staining from ~ 47-48; fine grained; gradational contact with above and below.	45–50: 34.5 mins 200 psi down 75-100 psi water
							88.4				49.4–51.0 Silt (ML)-Moderate yellowish brown (10 YR 5/4); same as 43–46.2. 50-50.5 Clay (CL)-Medium brownish gray (5 YR 5/1); silty; low plasticity.	
	5.0	5.0	100%				86.8	50			51.0–53.3 Sand (SM-SC)-Moderate yellowish brown (10 YR 5/4); very fine grained with large amount (40%) silty and clayey silt; slighty weathered with orange oxidized staining and black manganese spots (stains); same as 46.2–49.4 but trace clay and very fine grained.	50–55: 34.5 mins 200 psi down 75 psi water
							84.5				53.3–55.0 Sand (SP-SM)-Moderate to dark yellowish brown (10 YR 5/4–10 YR 4/2) fine-medium grained with trace to small amount (5-10%) silt and very fine sizes; micaceous.	
	5.0	5.0	100%		CONSTANT HEAD @ +3.0		82.8	55			55.0 ~ 58 Siltstone (ML)-Moderate brown (5 YR 4/4); weakly cemented with some (~ 20%) very fine sand; open pinhole size vesicles with black manganese spotting (< 0.01') throughout; gradational contact with underlying sandstone.	55–60: 33 mins 200 psi down 100 psi water
							79.8				58.0–60.0 Sandstone (SM)-Dark yellowish brown (10 YR 4/2) fine-very fine grained with some (20-30%) silt; weakly cemented with few open pinhole vesicles and black manganese spotting.	
				.27		15	77.8	60			60.0–63.5 Siltstone (ML)-Moderate brown (5 YR4/4); same as 55-58; weakly-very weakly cemented.	60–65: 23.5 mins 200 psi down 100 psi water
	5.0	4.7	94%				74.3				63.5–65.0 Sand (SM)-Moderate brown (5 YR 4/4); fine-very fine grained with large amount (30-40%) silt; micaceous with continued black manganese spotting.	
							72.8	65			65.0–67.0 Siltstone (ML)-Moderate brown (5 YR 4/4); same as 55-58.	65–70: 18.25 mins 200 psi down 75 psi water
	5.0	4.2	84%				70.8				67.0–70.2 Sand (SM) -Dark yellowish brown (10 YR 4/2) same as 53.3–55 but slightly more silt.	
							67.6 / 67.2	70			70.2–70.6 Siltstone (ML)-Moderate brown (5 YR 4/4) same as 55-58.	70–75: 45.5 mins 200 psi down 75 psi water
	5.0	4.8	96%								70.6–75.3 Clay (CL)-Pale brown (5 YR 5/2) silty; slight to low plasticity; random manganese specks; occasional slick sides; more silty with trace of very fine sand below 74.	72–74: Wet
							62.5	75				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS | HOLE NO. OW-3

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO | JOB NO.: 12334 | SHEET NO.: 3 of 6 | HOLE NO.: OW-3

NX CORE

Sampler Type and Diameter	Sampler Advance Length Core Run	Sample Recovery Core Recovery	Sample Blows "N"	Percent Core Recovery	Water Pressure Tests: Loss in G.P.M.	Pressure P.S.I.	Time in Minutes
	5.0	4.2		84%			
	5.0	5.0		100%			
	5.0	5.0		100%			
	5.0	4.7		94%			
	5.0	5.0		100%			
	5.0	4.8		96%			
	5.0	4.9		98%			
	5.0	4.3		86%	SINGLE PACKER 111.5-164		

Elevation: 62.5, 56.8, 51.8, 50.8, 50.2, 48.4, 43.0, 39.8, 37.7, 34.5, 25.3, 21.8

Depth: 75, 80, 85, 90, 95, 100, 105, 110, 115

Graphic Log / Sample

Description and Classification

75.3-81.0 Siltstone (ML)-Moderate brown (5 YR 4/4) weakly-moderately cemented with black manganese specks and streaks; trace of fine sand; clayey with slight plasticity; gradational with above clay and underlying sandstone.

81.0-86.0 Sandstone (SM)- Moderate brown (5 YR 4/4) fine-very fine grained; moderately cemented; small amount (10-15%) silt; black manganese "speckling" throughout; pinhole size open vesicles throughout with a few having 0.01 ft max dimension with black and light gray perimeter coating.

86.0-87.0 Sandstone (SM-SP) - Pale yellowish brown (10 YR 6/2) medium coarse grained with trace fine sizes and small amount (5-10%) silt; friable; moderately cemented.

87-87.6 Sandstone (SM)- Same as 81-86.

87.6-89.4 Gravel (GP)-Medium coarse; subrounded in fine-coarse moderately cemented sandstone matrix.

89.4-94.8 Sandstone (SM-SP)-Moderate yellowish brown (10 YR 5/4) medium-coarse grained with few fine sizes and some (10%) silt; black manganese spotting throughout; moderately-well cemented.

94.8-98.0 Siltstone (ML)-Light brown (5 YR 5/6) with trace (5%) very fine sand; black manganese speckling throughout; few pinhole size vesicles, weakly-moderately cemented.
96-96.3: caliche stringers to 0.1 ft thick; gradational contact with underlying sandstone.

98.0-100.1 Sandstone (SM) -Moderate brown (5 YR 4/4) to moderate yellowish brown (10 YR 4/4); very fine grained with large amount (30-40%) silt; weakly-moderately cemented.
98-98.1: yellowish gray (5 Y 7/2) fine-medium silty sand dipping ~ 15°.

100.1-103.3 Sand (SP-SM)- Dark yellowish brown (10 YR 4/2) fine-very fine grained becoming coarser grained from 102-103; trace of silt; very weak to no cementation. ~0.01 ft thick caliche layer dipping ~ 5°.

103.3-112.5 Sandstone (SM)-Moderate brown (5 YR 4/4) fine-very fine grained with some (25-30%) silt; weakly-moderately cemented; random thin (0.05 ft) caliche stringers and black manganese speckling.
106.3: 0.01 ft caliche seam dips ~5°.
106.3-107.6: medium-coarse grained.
108-108.8: very fine grained; silty.
112.2: 0.2 ft caliche layer.

112.5 ~ 116.0 Sand (SM)-Moderate yellowish brown (10 YR 5/2) fine-very fine grained with large amount (~ 40%) silt; weak to no cementation; very few thin light gray caliche stringers; very gradational contact with underlying sand.

Notes on: Water Levels, Water Return, Character of Drilling, Etc.

76-78: Wet
75-80: 30 mins 200 psi down 75 psi water
8-5-85 / 8-6-85 80
80-85: 42 mins 175 psi down 50-75 psi water
85-90: 33.5 mins 200 psi down 75 psi water
90-95: 23 mins 200 psi down 75 psi water
95-100: 40 mins 200 psi down 75 psi water
100-105: 19 mins 200 psi down 75 psi water
105-110: 19 mins 200 psi down 75 psi water
110-115: 25 mins 200 psi down 75 psi water

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: OW-3

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	4 OF 6	OW-3

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
NX CORE	5.0	5.0	100%	SINGLE PACKER 111.5-164 .12	CONSTANT HEAD @ +5.0	17	21.8	115				115-120: 20.5 mins 200 psi down 75 psi water
	5.0	4.8	96%					120			116.0-125.0 Sand (SP) -Dark yellowish brown (10 YR 4/2) grading to moderate olive gray (5 Y 5/1)@ 117.5 to medium dark gray (N4) @~ 119.5; fine-medium grained; poorly graded; clean.	120-125: 26 mins 200 psi down 75 psi water
	5.0	5.0	100%				12.8	125			125.0-128.5 Sand (SP-SW)- Dark gray (N3) medium-very coarse grained with small amount (10%) fine gravel; clean; grades to underlying sand. 127.5-127.6 grayish black fine-medium subrounded gravel.	8-6-85 / 8-7-85 125 Laguna FM / Mehrten FM; 125-130: 25.75 mins 300 psi down 100 psi water
	5.0	5.0	100%				9.3	130			128.5-133 Sand (SP)-Medium olive gray (5 Y 5/1) fine-very fine grained; clean; 132-132.1: silty layer.	130-135: 14.5 mins 300 psi down 75 psi water
	5.0	4.9	98%				4.8	135			133.0-135.5 Sand (SP) -Medium olive gray, (5 Y 5/1)- same as above but fine-medium grained.	135-140: 10 mins 300 psi down 100 psi water
	5.0	5.0	100%				2.3	140			135.5-139.0 Sand (SP-SM)-Medium yellowish brown (10 YR 5/2); fine-medium grained with small amount (10%) subrounded very coarse sizes; trace (5%) silt; well consolidated; portions very weakly cemented.	139-140.4: Appears wet. 140-145: 14 mins 300 psi down 100 psi water
	5.0	5.0	100%				-1.2	145			139.0-140.4 Gravel (GP-GM)- Fine to medium; subrounded in fine medium medium yellowish brown (10 YR 5/2) silty sand matrix.	145-150: 13.25 mins 300 psi down 100 psi water
	5.0	5.0	100%				-2.6	150			140.4~ 152.2 Sand (SM)-Moderate yellowish brown (10 YR 5/4) fine-very fine grained with some (15-20%) silt; slightly finer grained with more (25%) silt below ~ 144; trace mica and black manganese speckling 147.3-147.5: weakly cemented ~ 149 ft: large amount (40-50%) silt gradational contact.	150-155: 19.75 mins 300 psi down 100 psi water
	5.0	5.0	100%				-14.4	155			152.2-155.0 Silt (ML)-Moderate yellowish brown (10 YR 5/4 to moderate brown (5 YR 4/4); very slight plasticity with large amount (40-50%) very fine sand; random black manganese streaks and speckles.	
							-17.2					

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SITE: EVAPORATION PONDS

HOLE NO. OW-3

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO | JOB NO. 12334 | SHEET NO. 5 of 6 | HOLE NO. OW-3

Sampler Type and Diameter	Sampler Advance Length Core Run	Sample Recovery Core Recovery	Sample Blows "N" Percent Core Recovery	Water Pressure Tests: Loss in G.P.M.	Pressure P.S.I.	Time in Minutes	Elevation	Depth	Graphic Log	Sample	Description and Classification	Notes on: Water Levels, Water Return, Character of Drilling, Etc.
NX CORE	5.0	5.0	100%				-17.2	155			155.0-157.8 Siltstone (ML)- As above but weakly-moderately cemented.	155-160: 22 mins 300 psi down 100 psi water
							-20.0				157.8-161.8 Sand (SP)- Dark yellowish brown (10 YR 4/2); fine-medium grained; poorly graded; clean; trace mica 160.4-160.6 & 160.9-161.4 (SM-SC) with black staining.	160-165: 29.5 mins 300 psi down 100 psi water
	5.0	4.9	98%				-24.0	160			161.8~ 168.0 Siltstone (ML) - Pale brown (5 YR 5/2) grading to moderate brown (5 YR 3/4) @~ 164; black manganese speckling throughout; slightly weathered with small amount of orange oxidized staining; random fine open pinhole size vesicles, some with black manganese coating.	8-7-85 / 8-8-85 165 WL = 88.4 8-28-85 WL = 111.95 -Began drilling with 3" tri-cone and clear water. -Lithologic descriptions below 165 based on cuttings and drilling rates.
3" TRI-CONE BIT							-30.2	165			168-173 Sand (SM) Light brown (5 YR 5/6) fine to very fine grained with large amount of silt and clay.	173-175: Drilling rate ~ 7.5 mins/ft.
							-35.7	170			173-175 Sandstone/Siltstone (SM-ML) -Light brown; very fine grained; moderately to well cemented.	8-28-85 / 8-29-85 174
							-37.2	175			175-200 Sand (SM) -Light brown (5 YR 5/6) fine to very fine grained with large amount of silt.	175-200: Drilling rate ~55 secs/ft.
								180				
								185				
								190				
								195				

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SITE: EVAPORATION PONDS

HOLE NO. OW-3

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	6 of 6	OW-3

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
3" TRI-CONE BIT							-62.2	195				8-29-85
								200			BOH = 200 FT.	8-29-85: Reamed to 78 ft. with 7 5/8" tri-cone bit. 8-30-85: Reamed from 78-170 ft. 9-3-85: Reamed from 170-193 ft. and installed observation well with 4" PVC set to 192.9 ft. with screen from 176.8-187.2 ft. See observation well log for construction details.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
EVAPORATION PONDS	OW-3

ERPT C 0104

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 of 1	OW-3A

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N46 + 98.5 E9 + 74.7 *	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-10-85	9-11-85	KLEINFELDER	CME-75	7 5/8"			138 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING *	GROUND EL. *	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	N/A	140.04 FT	137.9 FT	DRY / 9-25-85	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	4" PVC / 135.2 FT	R. NELSON /

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
7 5/8" TRI-CONE BIT							137.9	0			0-6.5 Gravel (GM-GP)-Fine to medium subrounded in reddish brown clayey, silty, sandy matrix. Same as 0-6 FT. in OW-3.	*As-Built Note: Hole drilled using 7 5/8" roller bit and Revert. -Lithologic description based on visual examination of cuttings and comparsion of drilling characteristics with OW-3 located 11.4 FT. WNW of this hole. Significant "marker beds" were correlateable between the two holes. For more detailed descriptions of material between "marker beds" see Geologic Drill Log for OW-3. -Pulled bit @ 18 FT, 53 FT. and 73 FT. to clean clay from water ways. Drilled from 73-138 FT. using 7 5/8" drag bit. 9-10-85: Drilled to 58 FT. 9-11-85: Drilled to 138 FT. 9-12-85: Installed observation well with 4" PVC set to 133.1 FT. with screen from 118.2-127.7 FT. See observation well log for construction details.
							131.4					
							127.9	10			6.5-10 Silty clayey fine sand (SM-SC)	
											10-18 Clay (CL)-Light brown, low plasticity with small amount of fine silty sand. Same as 10-15 FT. in OW-3.	
							119.9	20				
								30			18-51 Interbedded fine sands and silts (SM-ML)	
								40				
							86.9	50			51-52 Clay (CL-CH)-Pale yellowish to medium brownish gray; stiff; medium high plasticity. Same as 50-50.5 FT. in OW-3.	
							85.9					
							68.9	60			52-69 Weakly cemented sandstone/siltstone (SM)	
								70			69-76 Clay (CL)-Pale brown, silty; low plasticity; trace of very fine sand. Same as 70.6-75.3 in OW-3.	
7 5/8" DRAG BIT							61.9					
								80			76-87 Interbedded very fine-fine silty sandstone & siltstones; weakly cemented (SM)	
							50.9					
							48.9	90			87-89 Gravel (GP)-Medium coarse; subrounded with some fine coarse sand. Same as 87.6-89.4 in OW-3.	
								100			89-115 Interbedded silty sands and weakly cemented sandstones and siltstones. (SM)	
								110				
							22.9					
								120			~115-138 Sand (SP-SM)-Dark yellowish brown to medium olive gray fine to medium grained	
								130				
							-0.1	140			BOH = 138 FT.	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
EVAPORATION PONDS	OW-3A

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO	JOB NO.: 12334	SHEET NO.: 1 OF 1	HOLE NO.: L-1		
SITE: EVAPORATION PONDS	COORDINATES: N46+38 E8+20 NOMINAL	ANGLE FROM HORIZ.: 90°	BEARING: —		
BEGUN: 9-13-85	COMPLETED: 9-13-85	DRILLER: KLEINFELDER	DRILL MAKE AND MODEL: CME-75	HOLE SIZE: 6"/3"	OVERBURDEN (FT.):
ROCK (FT.):	TOTAL DEPTH: 15.8 FT				
CORE RECOVERY (FT./%): N/A	CORE BOXES: N/A	SAMPLES: N/A	EL TOP OF CASING: N/A	GROUND EL.: 139.8 FT ±	DEPTH/EL. GROUND WATER: DRY
DEPTH/EL. TOP OF ROCK:					
SAMPLE HAMMER WEIGHT/FALL: N/A	CASING LEFT IN HOLE: DIA./LENGTH: NONE	LOGGED BY: R. NELSON/			

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
6" OD AUGER							139.8	0			0-8 Gravel (GM)-Medium to coarse, subrounded with large amount of light brown (5 YR 5/6) silty sand and cobbles; trace clay.	Note: Hole drilled to 15 FT. with 6" OD 3 1/4" ID auger. Shelby Tube pushed from 15-16.5 FT. but 0.7 FT. of sample remained on bottom so bottom of hole = 15.8 FT. -Soilmoisture Equipment Corp Model 1920 lysimeter set to bottom of hole after first pouring ~1 1/2 gallons of slurry consisting of silica flour and water down hole to fill 3" hole made by Shelby Tube. Loose sifted soil-placed on top of lysimeter to depth of 10 FT.; 5/8" bentonite pellets placed from 8.5-10 FT.; added ~2 gallons water to pellets then backfilled to within ~5 FT. of surface with more loose sifted fill. Tubes from lysimeter routed to surface through 1 1/2" PVC.
								5				
							131.8	10			8-15 Clay (CL-CH)-Light brown (5 YR 5/6) with small amount fine sand; medium-high plasticity.	
ST 3"							124.8 / 124.0	15			15-15.8 Sand (SC)-As above but pricipally clayey sand.	
											BOH = 15.8 FT.	Lithologic discription based on visual examination of auger cuttings.
								20				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: L-1

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 of 1	L-2

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N34+35 E12+90 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-13-85	9-13-85	KLEINFELDER	CME-75	6"/3"			17.5 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	N/A	N/A	152.8 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
6" OD AUGER							152.8	0			0-11 Gravel (GM)-Medium to coarse; subrounded with large amount of light brown (5 YR 5/6) silty sand and cobbles; trace clay.	Note: Hole drilled to 15 FT. with 6" OD 3 1/4" ID auger. Shelby Tube pushed from 15-17.5 FT. -Soilmoisture Equipment Corp Model 1920 lysimeter set to bottom of hole after first pouring ~1 gallon of slurry consisting of silica flour and water down hole to fill 3" hole made by Shelby Tube. Loose sifted soil placed on top of lysimeter to depth of 12 FT.; 5/8" bentonite pellets placed from 11-12 FT.; added ~2 gallons water to pellets then backfilled to within ~5 FT. of surface with more loose sifted fill. Tubes from lysimeter routed to surface through 1 1/2" PVC. -Lithologic description based on visual examination of auger cuttings.
								5				
								10				
							141.8				11-17.5 Sand (SM-SC)-Pale yellowish brown (10 YR 6/2); slighty weathered with orange oxidized staining; very fine grained with large amount clayey silt.	
ST 3"								15				
							135.3				BOH = 17.5 FT.	
								20				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO. L-2

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 OF 1	B-1

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N45+48 E4+80 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-5-85	9-9-85	KLEINFELDER	CME-75	6"			29 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	10	N/A	141.3 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB/30"	BACKFILLED W/ GROUT	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.5	1.2	7-4-3 / 7				141.3	0		1	0-4 Sand (SM)-Grayish orange (10 YR 7/4) very fine grained with large amount (40-50%) silt and fine-medium gravel.	-Hole drilled with 3 1/4" ID 6"OD auger. * CTS=Continuous Tube Sampler
							137.3					
SS 2	1.5	0.6	9-15-14 / 29					5		2	4-6.5 Gravel (GM-GP)-Fine-medium subrounded with fine-very fine silty sand; few cobbles.	
							134.8				6.5-8.0 Clay (CL-SC)-Pale yellowish brown (10 YR 6/2) to moderate brown (5 YR 4/4) with 30-40% fine-medium sand and gravel; low-medium plasticity.	
							133.3					
SS 2"	1.5	1.5	9-6-9 / 15					10		3	8~16 Sand/Gravel (SC, GC)-As above but sand and gravel predominates; with some (15%) cobbles in clay; grades to below.	
CTS* 2¼"ID	2.5	0.4	16%	5-6 KSF NO GOOD; STORED IN JAR						4		
SS 2"	1.5	1.5	8-10-16 / 26					15		5		
							125.3					
CTS 2¼"ID	2.5	0.9	36%	8 KSF						6	16~23 Sand (SC)-Light brown (5 YR 5/6) fine-medium grained with large amount (30-40%) silty clay; low plasticity; trace coarse sizes.	
SS 2"	1.5	1.5	4-6-9 / 15					20		7		
							118.3					
CTS 2¼"ID	2.5	1.5	60%	9+ KSF						8		
SS 2"	1.0	1.0	30-50 / 6"					25		9	23-29 Sand (SM)-Moderate yellowish brown (10 YR 5/4) fine-very fine grained with some orange & black weathered speckling; very dense; trace clay.	
SS 2"	1.5	1.5	15-15-16 / 31									
							112.3			10		
								30			BOH = 29 FT.	
								35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
EVAPORATION PONDS	B-1

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 of 1	B-2

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N45+48 E12+46 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-4-85	9-4-85	KLEINFELDER	CME-75	6"			29 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	9	N/A	138.9 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB / 30"	BACKFILLED W/ GROUT	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.5	0.9	12-6-5 / 11				138.9	0		1	0-6 Sand (SM)-Light brown (5 YR 5/6) very fine grained with large amount (30-40%) of silt and some (20%) fine-medium subrounded gravel; few cobbles; dry.	-Hole drilled with 3 1/4" ID 6"OD auger. * CTS=Continuous Tube Sampler.
* CTS 2¼"ID	2.5	2.5	100%	7 KSF			132.9	5		2		
SS 2"	1.5	1.5	4-5-8 / 13	OUTSIDE OF SPOON DAMP						3	6-11 Silt (MH)-Moderate brown (5 YR 4/4) to pale brown (5 YR 2/2); trace black organics; some (20%) clay low-medium plasticity; damp.	
							127.9	10				
SS 2"	1.5	1.5	3-3-5 / 8							4	11-14 Silt (ML)-Moderate yellowish brown (10 YR 5/4) with some (30%) very fine sand; slightly weathered with trace of orange & black oxidized staining; damp.	
							124.9	15				
CTS 2¼"ID	2.5	1.5	48%	8 KSF			121.9			5	14-17 Sand (SM-ML)-Moderate yellowish brown (10 YR 5/4); very fine grained with large amount (30-40%) silt; trace clay; damp.	
SS 2"	1.5	1.5	3-3-5 / 8							6	17-22 Silt (ML)-Moderate yellowish brown (10 YR 5/4) with black oxidized mottling with some (30%) very fine sand and trace clay and rare fine-medium sand lense; damp (as 11-14).	
								20				
							116.9					
SS 2"	1.5	1.5	3-4-5 / 9							7	22-29.0 Sand (SM-ML)-Moderate brown (5 YR 4/4) with black oxidized (or manganese) mottling; very fine grained with large amount (40%) silt; trace clay.	
								25				
CTS 2¼"ID	2.5	2.0	80%	9+ KSF						8		
SS 2"	1.5	1.5	8-11-15 / 26				109.4			9		
								30			BOH = 29 FT.	
								35				

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SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 of 1	B-3

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N42+30 E6+60 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-5-85	9-5-85	KLEINFELDER	CME-75	6"			28 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	10	N/A	143.0 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB / 30"	BACKFILLED W/ GROUT	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.5	0.8	8-5-4 / 9				143	0	1	0-2 Sand (SM)-Grayish orange (10 YR 7/4), very fine grained with large amount (40%) silt and small amount (10%) gravel.	-Hole drilled with 3 1/4" ID 6"OD auger. * CTS=Continuous Tube Sampler.
							141				
SS 2"	1.5	1.5	20-24-25 / 49					5	2	2-14 Gravel (GC-GM)-Fine-medium subrounded with large amount of sandy, silty clay and cobbles.	
CTS* 2¼"ID	2.5	0.4	16%	RECOVERY TOO SMALL; SAVED IN JAR					3		
SS 2"	1.5	1.4	8-14-22 / 36					10	4		
CTS 2¼"ID	2.5	0.5	20%	SAMPLE DISTURBED; SAVED IN JAR			129		5		
SS 2"	1.5	1.5	6-4-6 / 10					15	6	14-17 Silt (MH)-Light brown (5 YR 5/6) trace of very fine sand; silty; medium plasticity; trace of orange & black oxidized staining.	
							126				
CTS 2¼"ID	2.5	2.3	92%	7 KSF					7	17-22 Clay (CL)-Light brown (5 YR 5/6) silty with large amount (30-40%) fine-medium sand; low plasicity; trace coarse sizes.	
SS 2"	1.5	1.5	3-3-4 / 7					20	8		
							121				
SS 2"	1.5	1.3	30-35-34 / 69					25	9	22-28 Sand (SC)-Moderate yellowish brown (10 YR 4/4) very fine grained with some (20-30%) silty clay becoming slightly cleaner with depth.	
SS 2"	0.5	0.3	56/6"				115		10		
								30		BOH = 28 FT.	
								35			

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
EVAPORATION PONDS	B-3

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 OF 1	B-4

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N42+30 E11+66 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-4-85	9-5-85	KLEINFELDER	CME-75	6"			29 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	10	N/A	143.8 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB/30"	BACKFILLED W/ GROUT	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
CTS* 2½"ID	2.5	0.4	16%				143.8	0		1	0-2 Sand (SM-GM)–Grayish orange (10 YR 7/4) very fine grained with large amount (40-50%) silt and fine-medium gravel.	-Hole drilled with 3 1/4" ID 6" OD auger. * CTS=Continuous Tube Sampler
SS 2"	1.5	0.2	17-11-11 / 22				141.8			2	2-4.5 Gravel (GM)–Fine-medium subrounded with fine-very fine silty sand.	
							139.3	5			4.5-8.8 Clay (CL)–Pale yellowish brown (10 YR 6/2) to moderate brown (5 YR 4/4) with some (20-30%) fine sand, silt and fine-medium gravel; low plasticity.	
SS 2"	1.5	0.8	7-6-7 / 13				135			3		
CTS 2½"ID	2.5	0.6	24%					10		4	8.8-12 Sand (SM)–Moderate yellowish brown (10 YR 4/4) fine-very fine grained with some (~30%) clayey silt; micaceous.	
SS 2"	1.5	1.5	1-3-4 / 7	MOIST			131.8			5	12~15 Clay (CL-CH)–Light brown (5 YR 5/6) trace of very fine sand; silty; medium plasticity; trace orange & black oxidized staining.	9-4-85 / 9-5-85 12.5
CTS 2½"ID	2.5	0.9	36%	5 KSF			128.8	15		6	15~20 Sand (SC)–Light brown (5 YR 5/6) fine-medium grained with large amount (30-40%) silty clay; low plasticity; trace coarse sizes.	
SS 2"	1.5	1.5	4-5-10 / 15							7		
							123.8	20			20-26.5 Sand (SC)–Moderate yellowish brown (10 YR 4/4) very fine grained with some (20-30%) clay; grading to fine grained with small amount (5-10%) silt @ ~ 23.5.	
SS 2"	1.5	1.3	15-20-31 / 51							8		
CTS 2½"ID	2.5	1.1	44%	9+ KSF				25		9		
							117.3				26.5-29 Sand (SC-SP)–Pale yellowish brown (10 YR 6/2) to moderate yellowish brown (10 YR 5/4) fine sandy clay with some thinly interbedded dark gray (N2) medium-coarse clean sand.	
SS 2"	1.5	1.5	17-38-25 / 63	DAMP			114.8			10		
								30			BOH = 29 FT.	
								35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: —

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 of 1	B-5

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N40+00 E4+50 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-6-85	9-6-85	KLEINFELDER	CME-75	6"			24 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	6	N/A	141.9FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB / 30"	BACKFILLED W/ GROUT	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.5	0.8	5-6-6 / 12				141.9	0		1	0-1.5 Sand (SM-GM)-Grayish orange (10 YR 7/4) very fine grained with large amount (40-50%) silt and fine-medium gravel.	-Hole drilled with 3 1/4" ID 6" OD auger.
							140.4				1.5-7.5 Gravel (GM)-Fine-medium subrounded with fine-very fine silty sand and cobbles.	* CTS=Continuous Tube Sampler
								5				
							134.4					
SS 2"	1.5	1.3	6-24-22 / 46				133.7			2	7.5-8.2 Clay (CL)-Pale yellowish brown (10 YR 6/2) fine-very fine grained with some (20%) silty sand.	
											8.2-10.5 Gravel (GM)-Fine-medium; same as 1.5-7.5.	
								10				
CTS* 2¼"ID	2.5	1.4	56%				131.4			3	10.5-15 Clay (CL)-Moderate yellowish brown (10 YR 5/4) to pale yellowish brown (10 YR 6/2) with large amount (40%) very fine silty sand.	
SS 2"	1.5	1.5	5-7-15 / 22							4		
							126.9	15				
CTS 2¼"ID	2.5	1.3	52%	SAMPLE UNUSABLE; PLASTIC LINER MELTED; SAVED IN JAR 9+KSF						5		
SS 2"	1.5	1.5	14-26-27 / 53							6	15-24 Gravel (GM)-Medium coarse subrounded, subrounded with interbedded moderate yellowish brown (10 YR 5/4) fine silty clayey sand.	
								20				
							117.9					
								25			BOH = 24FT.	-Auger refusal @ 24 FT.
								30				
								35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: B-5

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 OF 1	B-6

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N40+00 E15+00 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-6-85	9-6-85	KLEINFELDER	CME-75	6"			29 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	7	N/A	148.0 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB / 30"	BACKFILLED W/ GROUT	R. NELSON /

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.5	0.6	2-5-2 / 7				148.0	0		1	0-2 Sand (SM-GM)-Grayish orange (10 YR 7/4) very fine grained with large amount (40-50%) silt and fine-medium gravel.	-Hole drilled with 3 1/4" ID 6" OD auger.
							146.0					
								5			2-8 Gravel (GM)-Fine-medium subrounded gravel with fine-very grained silty clayey sand; few cobbles.	
							140.0					
ST 2 13/16"	2.5	2.5	100%					10		2	8-15 Clay (CL-SC)-Moderate brown (5 YR 4/4) to moderate reddish brown (10 YR 4/6) with large amount (~40%) fine-very fine sand; low-medium plasticity; gradational to below.	
SS 2"	1.5	1.5	2-6-8 / 14							3		
							133.0	15				
ST 2 13/16"	2.5	1.8	72%							4	15-21 Silt (ML-SM)-Same as above but grades to silt with some (15%) very fine sand; slight plasticity.	
SS 2"	1.5	1.5	2-3-3 / 6							5		
								20				
							127.0					
SS 2"	1.5	1.5	5-7-13 / 20							6	21-29 Sand (SC)-Moderate yellowish brown (10 YR 5/4) fine-very fine grained with large amount (40%) clay; trace silt; damp.	
								25				
SS 2"	1.5	1.5	7-8-10 / 18				113.0			7		
								30			BOH = 29 FT.	
								35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO	JOB NO.: 12334	SHEET NO.: 1 OF 1	HOLE NO.: B-7
SITE: EVAPORATION PONDS	COORDINATES: N38+20 E7+20 NOMINAL	ANGLE FROM HORIZ.: 90°	BEARING: —

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-6-85	9-6-85	KLEINFELDER	CME-75	6"			24.4 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	8	N/A	143.1 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB / 30"	BACKFILLED W/ GROUT	R. NELSON /

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							143.1	0			0-6.5 Gravel (GM)-Fine-medium subrounded with cobbles and fine-very fine silty sand.	-Hole drilled with 3 1/4" ID 6" OD auger. * CTS=Continuous Tube Sampler
								5				
							136.6				6.5-12 Sand (SM)-Moderate yellowish brown (10 YR 5/2) to pale yellowish brown (10 YR 6/2) with some orange & black oxidized staining; fine-very fine grained with some (20-30%) silt; clayey from 6.5-8.	
SS 2"	1.5	1.5	4-6-9 / 15							1		
								10				
SS 2"	1.5	1.5	7-12-19 / 31							2		
							130.1				12-15 Gravel (GC)-Fine-medium subrounded in moderate yellowish brown (10 YR 5/4) silty clayey fine sand.	
CTS* 2¼" ID	2.5	0.9	36%	DISTURBED; SAVED IN JAR						3		
							128.1	15		4	15~17 Silt (ML)-Moderate yellowish brown (10 YR 5/4) with orange and black staining; same as 6.5-12 but silt predominates.	
ST 2 5/8"	1.0	0.8	80%									
SS 2"	1.5	1.5	5-10-13 / 23				126.1			5		
											17-24.4 Sand (SC)-Moderate yellowish brown (10 YR 5/4) fine-very fine grained with large amount (30-40%) clay; trace silt; becoming pale yellowish brown (10 YR 6/2) @ ~ 23.5; moderately cemented with fine gravel.	
CTS 2¼" ID	2.5	1.2	48%	9+ KSF				20		6		
SS 2"	1.4	1.4	12-27-50 / 5"							7		
SS 2"	0.4	0.4	50/5"				118.7			8		-Auger refusal @ 24 FT.
								25			BOH = 24.4 FT.	
								30				
								35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: B-7

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 OF 1	B-8

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N38+20 E12+30 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-5-85	9-5-85	KLEINFELDER	CME-75	6"			27.2 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL TOP OF CASING	GROUND EL. ±	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	10	N/A	148.2 FT	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB / 30"	BACKFILLED W/ GROUT	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.5	1.5	6-5-4 / 9				148.2	0		1	0-3.5 Sand (SM-GM)-Grayish orange (10 YR 7/4) very fine grained with large amount (40-50%) silt and fine-medium gravel.	-Hole drilled with 3 1/4" ID 6" OD auger. * CTS=Continuous Tube Sampler
							144.7				3.5-7.0 Gravel (GC)-Fine-medium subrounded in fine-very fine moderately cemented clayey sand with cobbles and clayey silt.	
SS 2"	1.0	1.0	24-50/6"					5		2		
							141.2				7-9 Sand (SC)-Moderate yellowish brown (10 YR 5/4) fine-medium grained with large amount (40%) silty clay; trace gravel.	
							139.2					
SS 2"	1.5	1.5	7-10-14 / 24					10		3	9-12 Clay (CL)-Pale yellowish brown (10 YR 6/2) to moderate brown (5 YR 4/4) with some (20-30%) fine sand, silt and fine-medium gravel; low plasticity.	
							136.2					
CTS* 2¼" ID	2.5	0.7	28%							4	12-15 Gravel (GC-GM)-Fine-medium subrounded in moderate yellowish brown clayey medium coarse clayey sand matrix.	
							133.2	15				
SS 2"	1.5	1.5	8-7-8 / 15							5	15 ~ 20 Silt (ML)-Moderate yellowish brown (10 YR 5/4) with large amount (40%) very fine grained sand, trace clay; gradational contract with below.	
CTS 2¼" ID	2.5	2.4	96%	6 KSF						6		
							128.2	20				
SS 2"	1.5	1.5	3-7-10 / 17							7	20-23 Silt (ML)-Moderate yellowish brown (10 YR 5/4) with small amount (15%) very fine sand; trace clay; slight plasticity.	
							125.2					
CTS 2¼" ID	2.5	1.8	72%	9+ KSF						8	23-25 Sand (SM)-Moderate yellowish brown as 15-20 but with ~20% clayey silt.	
							123.2	25				
SS 2"	0.8	0.8	31-50/4"							9	25-27.2 Sand (SM)-Moderate yellowish brown (10 YR 4/4) very fine to fine grained with small amount (5-10%) silt.	
SS 2"	0.7	0.7	33-50/2"				121.0			10		
											BOH = 27.2 FT.	
								30				
								35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 OF 1	B-9

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N35+18 E5+00 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-6-85	9-6-85	KLEINFELDER	CME-75	6"			24 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	5	N/A	150.5 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB / 30"	BACKFILLED W/ GROUT	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							150.5	0			0-1 Sand (SM-GM)-Grayish orange (10 YR 7/4) very fine grained with large amount (40-50%) silt and fine-medium gravel.	-Hole drilled with 3 1/4" ID 6" OD auger
							149.5				1-4 Gravel (GM)-Fine-medium subrounded with fine-very fine silty sand; few cobbles.	* CTS=Continuous Tube Sampler
							146.5					
SS 2"	1.5	1.5	12-16-23 / 39					5		1	4-9 Clay (CL)-Moderate yellowish brown (10 YR 5/2) with large amount (40%) fine grained sand and fine gravel.	
							141.5					
								10				
SS 2"	1.5	1.5	12-23-36 / 59							2		
								15			9-24 Gravel (GM-GC)-Fine-coarse with cobbles in dark yellowish brown (10 YR 4/2) sandy silty clay; thinly interbedded fine-coarse sand layers.	
SS 2"	1.5	1.5	3-14-18 / 32							3		
CTS* 2¼" ID	2.5	1.2	48%	9+ KSF DISTURBED; PUT IN JAR				20		4		
SS 2"	1.5	1.5	15-27-40 / 67				126.5			5		-Auger refusal @ 24 FT.
								25			BOH = 24 FT.	
								30				
								35				

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SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
EVAPORATION PONDS	B-9

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 OF 1	B-10

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N35+18 E15+00 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-6-85	9-6-85	KLEINFELDER	CME-75	6"			29 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	9	N/A	151.8 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 LB / 30"	BACKFILLED W/ GROUT	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	1.5	1.0	6-3-4 / 7				151.8	0		1	0-2 Sand (SM-GM)-Grayish-orange (10 YR 7/4) very fine grained with large amount (40-50%) silt and fine-medium gravel.	-Hole drilled with 3 1/4" ID 6" OD auger.
							149.8					
								5			2-8 Gravel/Cobbles (GM)-Fine-medium subrounded with fine-very fine silty sand and numerous cobbles.	
							143.8					
SS 2"	1.5	1.5	4-6-8 / 14					10		2	8-17 Silt (MH)-Light brown (5 YR 5/6) to moderate yellowish brown (10 YR 5/4) with some fine to very fine grained sand and clay; trace of orange and black oxidized staining and clay; gradational with below.	
							139.8					
ST 2 13/16"	2.5	2.0	80%	5 KSF						3		
SS 2"	1.5	1.5	4-4-5 / 9	DAMP				15		4		
							134.8					
ST 2 13/16"	2.5	2.1	84%	4-5 KSF						5	17-22 Silt (ML-CL)-Moderate brown (5 YR 4/4) with small amount (10%) very fine sand; clayey.	
SS 2"	1.5	1.5	2-2-5 / 7	WET				20		6		
							129.8					
ST 2 13/16"	2.5	2.2	88%							7	22-29 Clay (CL)-Moderate yellowish brown (10 YR 5/4) with some orange & black weathered speckling; large smount (40%) fine to very fine grained sand and interbedded pale brown silt; uncemented; damp.	
SS 2"	1.5	1.5	4-6-10 / 16					25		8		
SS 2"	1.5	1.5	2-3-7 / 10				122.8			9		
								30			BOH = 29 FT.	
								35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; B = BUCKET; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO			JOB NO.: 12334	SHEET NO.: 1 of 1	HOLE NO.: P-1
SITE: EVAPORATION PONDS	COORDINATES: N43+50 E5+50 NOMINAL			ANGLE FROM HORIZ.: 90°	BEARING: —
BEGUN: 9-9-85	COMPLETED: 9-9-85	DRILLER: KLEINFELDER	DRILL MAKE AND MODEL: CME-75	HOLE SIZE: 6"	TOTAL DEPTH: 10 FT
CORE RECOVERY (FT./%): N/A	CORE BOXES: N/A	SAMPLES: N/A	EL. TOP OF CASING: N/A	GROUND EL.: 142.5 FT±	DEPTH/EL. GROUND WATER: DRY
SAMPLE HAMMER WEIGHT/FALL: N/A	CASING LEFT IN HOLE: DIA./LENGTH: N/A		LOGGED BY: R. NELSON/		DEPTH/EL. TOP OF ROCK:

Sampler Type and Diameter	Sampler Advance / Length Core Run	Sample Recovery / Core Recovery	Sample Blows "N" / Percent Core Recovery	Water Pressure Tests: Loss in G.P.M.	Pressure P.S.I.	Time in Minutes	Elevation	Depth	Graphic Log	Sample	Description and Classification	Notes on: Water Levels, Water Return, Character of Drilling, Etc.
6" OD AUGER							142.5	0			0-2 Sand (SM)-Grayish orange (10 YR 7/4) very fine grained with large amount of silt and gravel.	-Hole drilled with 3 1/4" ID 6" OD augers -Filled with #3 Monterey sand (from Loadstar) for E-19 test. -Log based on visual examination of auger cuttings.
							140.5				2-6 Gravel (GM)-Fine-medium subrounded with cobbles and fine clayey, silty sand.	
								5				
							136.5				6-8 Clay (CL)-Moderate yellowish brown (5 YR 5/2) with some fine sand, silt and fine gravel.	
							134.5				8-8.5 Gravel (GC)	
							134				8.5-10 Clay (CL-SC)-Same as 6-8 but slightly more sand.	
							132.5	10			BOH = 10 FT.	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: P-1

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO	JOB NO.: 12334	SHEET NO.: 1 OF 1	HOLE NO.: P-2
SITE: EVAPORATION PONDS	COORDINATES: N43+50 E12+05 NOMINAL	ANGLE FROM HORIZ.: 90°	BEARING: —

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-9-85	9-9-85	KLEINFELDER	CME-75	6"			10 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	N/A	N/A	142.5 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	N/A	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
6" OD AUGERS							142.5	0			0-5 Gravel (GM)-Fine-medium subrounded with cobbles and fine clayey silty sand.	-Hole drilled with 3 1/2" ID 6" OD augers. -Filled with #3 Monterey sand (from Loadstar) for E-19 test. -Log based on visual examination of auger cuttings.
							137.5	5			5-10 Clay (CL-CH)-Light brown (5 YR 5/6) with small amount fine sand, medium-light plasticity.	
							132.5				BOH = 10 FT.	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS — HOLE NO.: P-2

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 OF 1	P-3

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N37+45 E5+50 NOMINAL	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-9-85	9-9-85	KLEINFELDER	CME-75	6"			10 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	N/A	N/A	148.4 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	N/A	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
6" OD AUGER							148.4	0			0-8 Gravel (GM-GC)-Fine-medium subrounded in clayey silt/fine sand matrix; few cobbles.	-Hole drilled with 3 1/4" ID 6" OD auger -Filled with #3 Monterey sand (from Loadstar) for E-19 test. -Log based on visual examination of auger cuttings.
								5				
							140.4				8-10 Sand (SM)-Moderate yellowish brown (10 YR 5/2) fine-very fine grained with some (30%) clayey silt.	
							138.4	10			BOH = 10 FT.	

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SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
EVAPORATION PONDS	P-3

M&CF 10-1

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO	JOB NO.: 12334	SHEET NO.: 1 of 1	HOLE NO.: P-4
SITE: EVAPORATION PONDS	COORDINATES: N37+45 E13+50 NOMINAL	ANGLE FROM HORIZ.: 90°	BEARING: —

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
9-9-85	9-9-85	KLEINFELDER	CME-75	6"			10 FT

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
N/A	N/A	N/A	N/A	149.3 FT ±	DRY	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	N/A	R. NELSON/

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
6"OD AUGERS							149.3	0			0-8 Gravel (GM)-Fine-medium subrounded with cobbles and fine clayey, silty sand.	-Hole drilled with 3 1/2" ID 6"OD auger. -Filled with #3 Monterey sand (from Loadstar) for E-19 test. -Log based on visual examination of auger cuttings.
								5				
							141.3				8-10 Clay (CL-SC)-Moderate brown (5 YR 4/4) with some fine sand; medium plasticity.	
							139.3	10			BOH = 10 FT.	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: P-4

Appendix B - Observation Well Completion Reports

OBSERVATION WELL

PROJECT	WELL NO.
RANCHO SECO	OW-1

JOB NO.	SITE	COORDINATES
12334	EVAPORATION PONDS	N37+81.61 E18+29.77

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
8-21-85	8-22-85	R. NELSON	TOP OF 4" PVC RISER

	DEPTH (FT)	ELEV (FT)
ELEV. – TOP OF SURFACE CASING: 151.42'		
ELEV. – TOP OF RISER CASING: 151.21'		
GROUND SURFACE		150.0
BOTTOM OF SURFACE CASING	2.55	147.45
TOP OF SEAL	165.2	-15.2
TOP OF FILTER PACK	167.7	-17.7
TOP OF SCREEN	172.7	-22.7
BOTTOM OF SCREEN	182.2	-32.2
BOTTOM OF SUMP	187.8	-37.8
BOTTOM OF HOLE	193.0*	-43.0

GENERALIZED GEOLOGIC LOG

Interbedded fine sand; silty sands and sandstone/siltstone above bentonite seal. See geologic drill log for details.

Material below seal as follows:

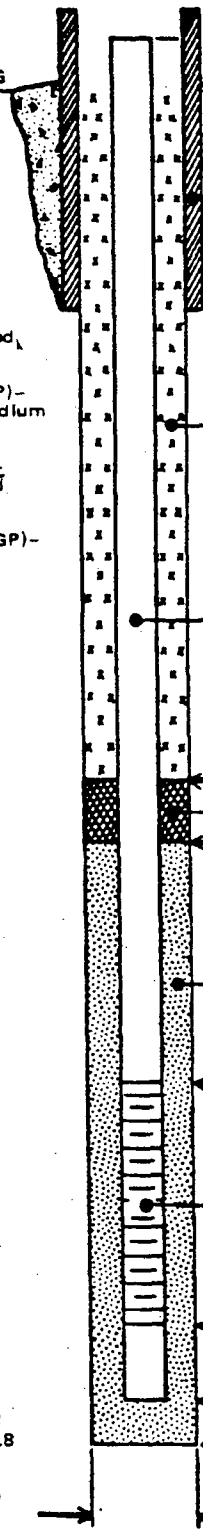
166-176.5 Sand (SP-SM)- Moderate yellowish brown principly fine grained with trace of silt; occasional weakly cemented zones.

176.5-178.4 Sand (SP) Gravel (GP)- Medium-coarse sand with fine-medium subrounded gravel

178.4-186.6 Sandstone/Siltstone- Interbedded fine-very fine grained sandstone and siltstone

186.6-189.7 Sand (SP) Gravel (GP)- Same as 176.5-178.4

189.7 ff Interbedded very fine sandstone/siltstone.



SURFACE CASING
DIA: 8 INCHES
TYPE: STEEL

BACKFILL MATERIAL
TYPE: 1:1 NEAT CEMENT GROUT WITH 2.5 LBS BENTONITE/SACK CEMENT

RISER CASING
DIA: 4 INCHES
TYPE: SCHEDULE 40 PVC

ANNULAR SEAL
TYPE: 5/8 INCH BENTONITE PELLETS

FILTER PACK
TYPE: #4 AQUA MONTEREY SAND

SCREEN:
DIA: 4 INCHES TYPE: SCHEDULE 40 PVC
OPENINGS: WIDTH: 0.015 INCHES
TYPE: MFR 5 VERT ROWS OF SLOTS

HOLE DIA: 7 5/8 INCHES

-Centralizers (Metal banding material held by stainless steel hose clamps) @ 170.7 and 185.8 ft.

* Reamed to 193 ft: 3" hole to 200 ft.

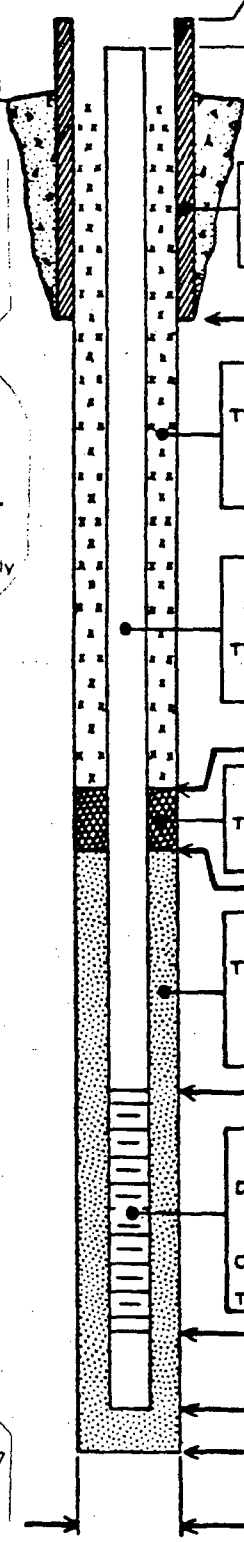
ERPT C 0104

OBSERVATION WELL

PROJECT	WELL NO.
RANCHO SECO	OW-2

JOB NO.	SITE	COORDINATES
12334	EVAPORATION PONDS	N39+20.54 E1+98.53

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
8-27-85	8-28-85	R. NELSON	TOP OF 4" PVC



	DEPTH (FT)	ELEV (FT)
ELEV. – TOP OF SURFACE CASING: 148.67±		
ELEV. – TOP OF RISER CASING: 147.85±		
GROUND SURFACE		146.6
BOTTOM OF SURFACE CASING	1.7	144.9
TOP OF SEAL	160.5	-13.9
TOP OF FILTER PACK	162.0	-15.4
TOP OF SCREEN	168.2	-21.6
BOTTOM OF SCREEN	176.0 / 177.2	-29.4 / -30.6
BOTTOM OF SUMP	183.0	-36.4
BOTTOM OF HOLE	183.0*	-36.4

Bottom of filterpad ← Cuttings from 176-183

GENERALIZED GEOLOGIC LOG

Interbedded fine sands silty sands and sandstone/siltstones above bentonite seal. See geologic drill log for details.

Material below seal as follows:

161.3-162.2 Sandstone (SP)- Medium dark gray (N-4), fine-medium grained; weakly cemented; clean.

162.2-174.1 Sand (SM-SP) - Moderate yellowish brown (10 YR 5/2, 5/4) fine-very fine grained with small amount (10-15%) silt.

174.1-187.2 Sandstone/Siltstone (SM-ML)-Moderate yellowish brown (10 YR 5/2) to moderate reddish brown (10 R 4/4) with very fine grained sand; very weakly moderately cemented.

SURFACE CASING
DIA: 8 INCHES
TYPE: STEEL

BACKFILL MATERIAL
TYPE: 1.1 NEAT CEMENT GROUT WITH 2.5 LBS BENTONITE/SACK CEMENT

RISER CASING
DIA: 4 INCHES
TYPE: SCHEDULE 40 PVC

ANNULAR SEAL
TYPE: 5/8 INCH BENTONITE PELLETS

FILTER PACK
TYPE: #4 AQUA MONTEREY SAND

SCREEN:
DIA: 4 INCHES TYPE: SCHEDULE 40 PVC
OPENINGS: WIDTH: 0.015 INCHES
TYPE: MFR 6 VERT ROWS OF SLOTS

HOLE DIA: 7 5/8 INCHES

-Centralizers (Metal banding material held by stainless steel hose clamps) @ 165.6 and 180.7 ft.

*Reamed to 183 ft; 3" hole to 200 ft.

OBSERVATION WELL

PROJECT: RANCHO SECO		WELL NO.: OW-3
JOB NO.: 12334	SITE: EVAPORATION PONDS	COORDINATES: N47+01.86 E9+63.77
BEGUN: 9-3-85 / COMPLETED: 9-4-85	PREPARED BY: R. NELSON	REFERENCE POINT FOR MEASUREMENTS: TOP OF 4" PVC RISER

GENERALIZED GEOLOGIC LOG

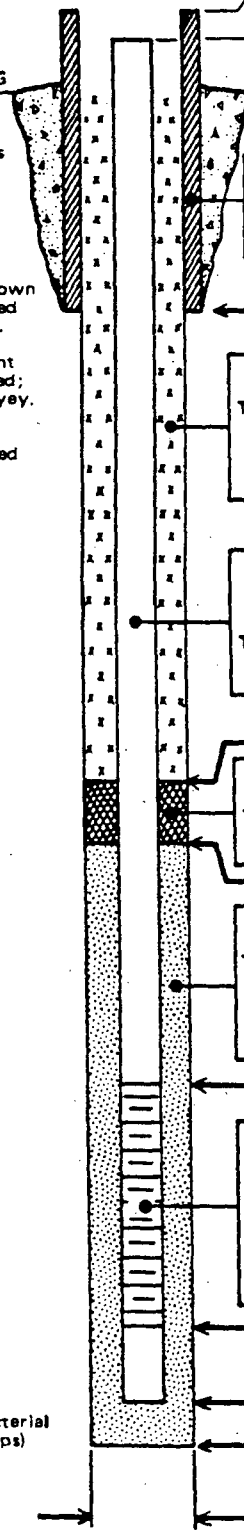
Interbedded fine sands, silty sands and sandstone/siltstone above bentonite seal. See geologic drill log for details.

Material below seal as follows:

168-173 Sand (SM-CL)- Light brown (5 YR 5/6) fine to very fine grained with large amount of silt and clay.

173-175 Sandstone/Siltstone Light brown (5 YR 5/6) very fine grained; moderately to well cemented; clayey.

175-200 Sand (SM)-Light brown (5 YR 5/6) fine to very fine grained with large amount of silt.



	DEPTH (FT)	ELEV. (FT)
ELEV. – TOP OF SURFACE CASING: 139.37		
ELEV. – TOP OF RISER CASING: 139.04		
GROUND SURFACE		137.8
SURFACE CASING — DIA: 8 INCHES; TYPE: STEEL		
BOTTOM OF SURFACE CASING	2.4	135.4
BACKFILL MATERIAL — TYPE: 1:1 NEAT CEMENT GROUT W/ 2.5 LBS BENTONITE/SACK CEMENT		
RISER CASING — DIA: 4 INCHES; TYPE: SCHEDULE 40 PVC		
TOP OF SEAL	171.0	-33.2
ANNULAR SEAL — TYPE: 5/8 INCH BENTONITE PELLETS		
TOP OF FILTER PACK	173.0	-35.2
FILTER PACK — TYPE: #4 AQUA MONTEREY SAND		
TOP OF SCREEN	176.8	-39.0
SCREEN: DIA: 4 INCHES; TYPE: SCHEDULE 40 PVC; OPENINGS: WIDTH: 0.015 INCHES; TYPE: MFR 6 VERT ROWS OF SLOTS		
BOTTOM OF SCREEN	187.2	-49.4
BOTTOM OF SUMP	192.9	-55.1
BOTTOM OF HOLE	193.0*	-55.0
HOLE DIA: 7 5/8 INCHES		

-Centralizers (Metal banding material held by stainless steel hose clamps) @ 168.6 and 190.7 ft.

*Reamed to 193 ft; 3" hole to 200 ft.

OBSERVATION WELL

PROJECT: RANCHO SECO			WELL NO.: OW-3A
JOB NO.: 12334	SITE: EVAPORATION PONDS	COORDINATES: N46+98.5 E9+74.7 AS-BUILT	
BEGUN: 9-12-85	COMPLETED: 9-12-85	PREPARED BY: R. NELSON	REFERENCE POINT FOR MEASUREMENTS: TOP OF 4" PVC RISER

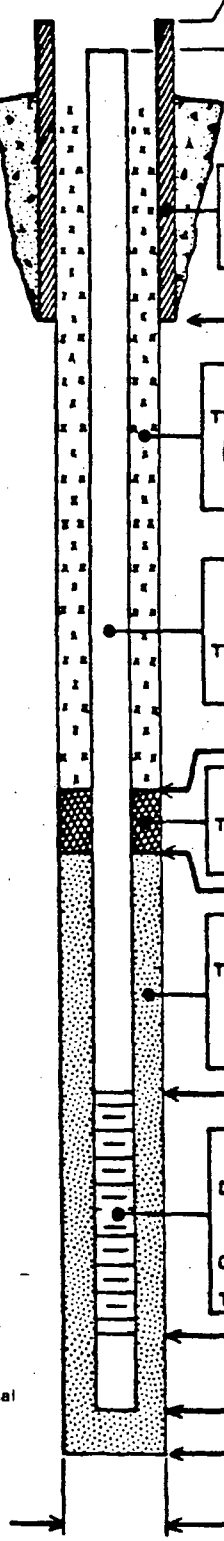
ELEV. – TOP OF SURFACE CASING: 140.04

ELEV. – TOP OF RISER CASING: 139.91

GENERALIZED GEOLOGIC LOG

–Interbedded fine sands, silts, clays and sandstones/siltstones above bentonite seal.
See Geologic Drill Log for details.

–Material below bentonite seal is principally fine-medium clean sand.
See Geologic Drill Log for OW-3 for differentiation of sand types in this interval.



	DEPTH	ELEV.
GROUND SURFACE		137.9
BOTTOM OF SURFACE CASING	2.0	135.9
TOP OF SEAL	110.5	27.4
TOP OF FILTER PACK	112.0	25.9
TOP OF SCREEN	118.2	19.7
BOTTOM OF SCREEN	127.7	10.2
BOTTOM OF SUMP	133.1	4.8
BOTTOM OF HOLE	138.0	-0.1

SURFACE CASING
DIA: 8 INCHES
TYPE: STEEL

BACKFILL MATERIAL
TYPE: 1:1 NEAT CEMENT GROUT W/ 2.5 LBS BENTONITE/SACK CEMENT

RISER CASING
DIA: 4 INCHES
TYPE: SCHEDULE 40 PVC

ANNULAR SEAL
TYPE: 5/8 INCH BENTONITE PELLETS

FILTER PACK
TYPE: #4 AQUA MONTEREY SAND

SCREEN:
DIA: 4 INCHES TYPE: SCHEDULE 40 PVC
OPENINGS: WIDTH: 0.015 INCH
TYPE: MFR 6 VERT ROWS OF SLOTS

–Centralizers (metal banding material held by stainless steel hose clamps) @ 114.8 and 131.3 FT.

HOLE DIA: 7 5/8 INCHES

Appendix C - Test Pit Logs

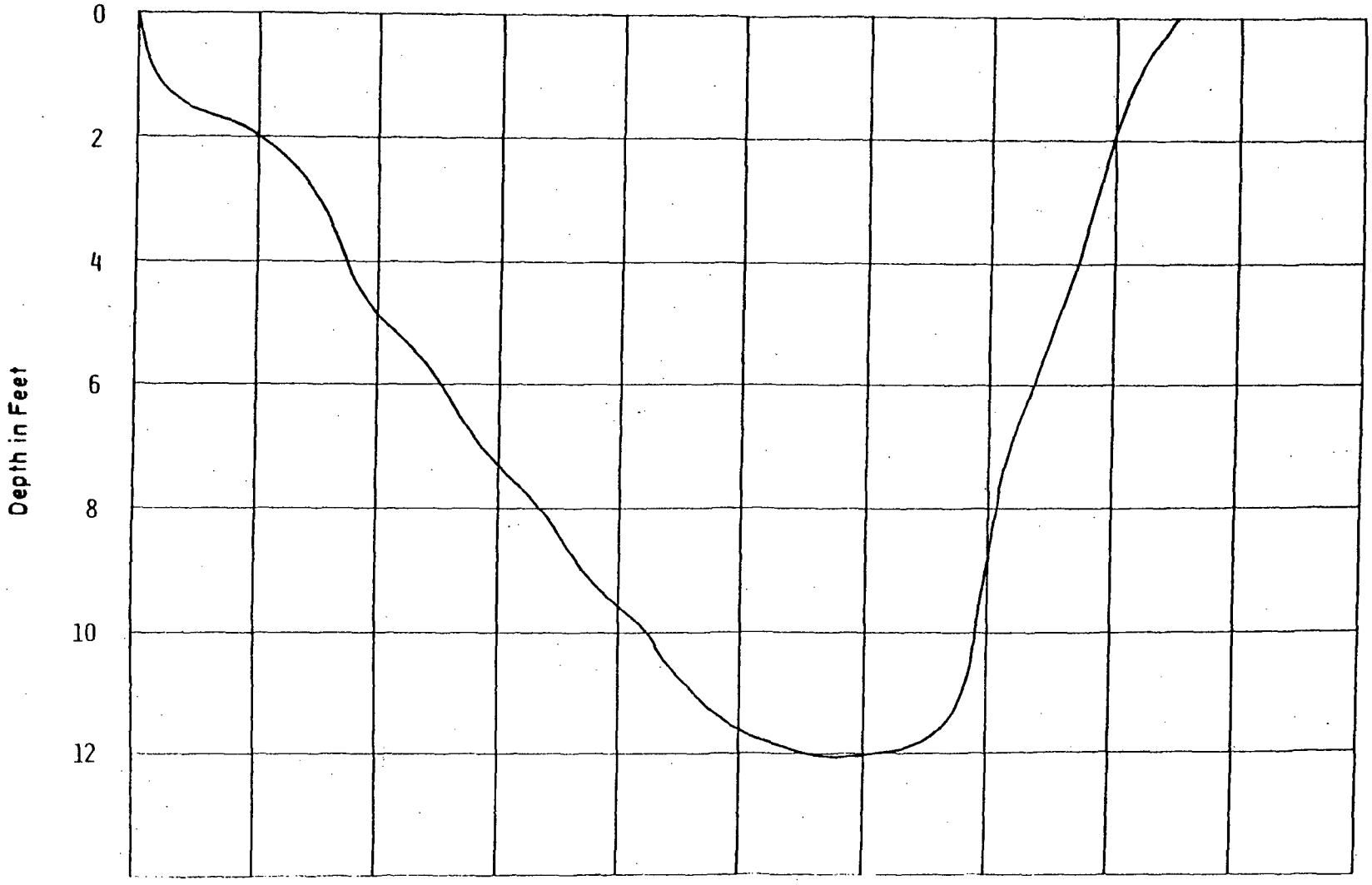
TEST PIT LOG

Project RANCHO SECO-EVAPORATION POND Job No. 12334-059 **TEST PIT NO.** T-1

Ground El. 142.4 FT. Location N 43+ 10, E 5 + 50

Depth of Pit 12.0 FT

Date Excavated SEPTEMBER 5, 1985 Method of Excavation BACKHOE FORD XL 555-A



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Depth Feet	Sample Type and Number	Symbol	Description	Remarks
2.3	1		MEDIUM DENSE BROWN CLAYEY SANDY GRAVEL. FINE GRAIN. DAMP (GC)	
6.6	2		MEDIUM DENSE BROWN GRAVEL. FINE TO COARSE GRAIN. SOME SAND. TRACE OF CLAY. MOIST. (GP-GC)	
12.0	3, 4		DENSE BROWN CLAYEY SANDY GRAVEL. FINE TO COARSE GRAIN. HIGHLY PLASTIC FINES. MOIST. (GC).	
	5		BOTTOM OF PIT AT EL. 130.4 FT. NO GROUND WATER WAS ENCOUNTERED DURING EXCAVATION.	

EBT C 0104

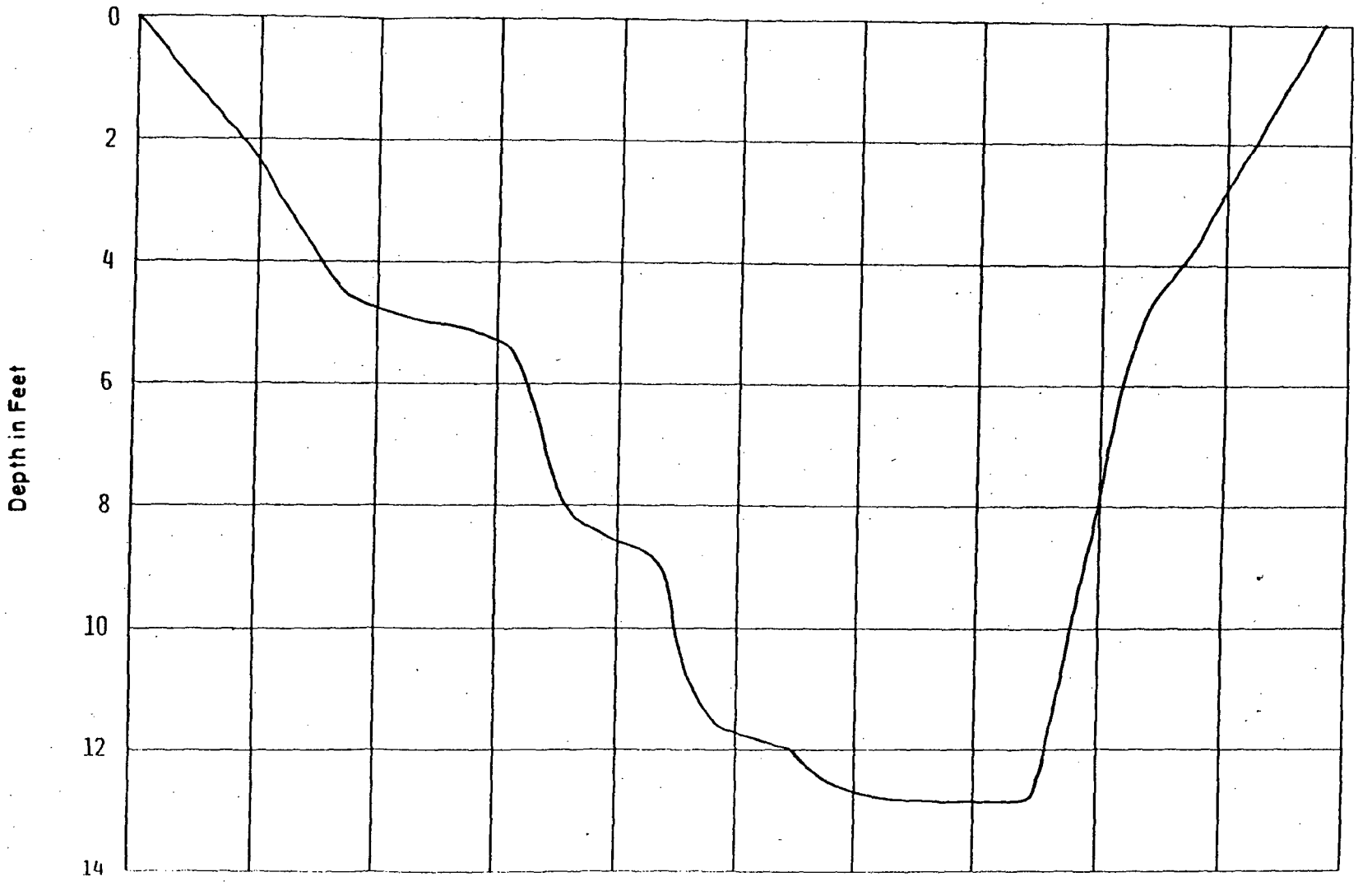
TEST PIT LOG

Project RANCHO SECO-EVAPORATION POND Job No. 12334-059 **TEST PIT NO.** T-2

Ground El. 143.7 FT. Location N 43+10; E 12+05

Depth of Pit 13.0 FT.

Date Excavated SEPTEMBER 6, 1985 Method of Excavation BACKHOE FORD XL 555-A



ERPT C 0104

Depth Feet	Sample Type and Number	Symbol	Description	Remarks
4.6	①		LOOSE TO MEDIUM DENSE BROWN CLAYEY GRAVEL. FINE TO COARSE GRAIN. SOME FINE TO COARSE SAND. DAMP TO MOIST. (GC).	
8.5	② ③		STIFF BROWN TO REDISH BROWN SILTY CLAY. MOIST (CL-CH).	Q_P = 1.75TSF @ 5 FEET Q_P = 2.75TSF @ 7 FEET
13.0	④ ⑤		VERY STIFF REDISH BROWN CLAYEY SILT. TRACE OF FINE SAND. MOIST. (MH).	Q_P = 3.40TSF @ 9 FEET
			BOTTOM OF PIT AT EL. 130.7 FT. NO GROUND WATER WAS ENCOUNTERED DURING EXCAVATION.	

ERPT C 0104

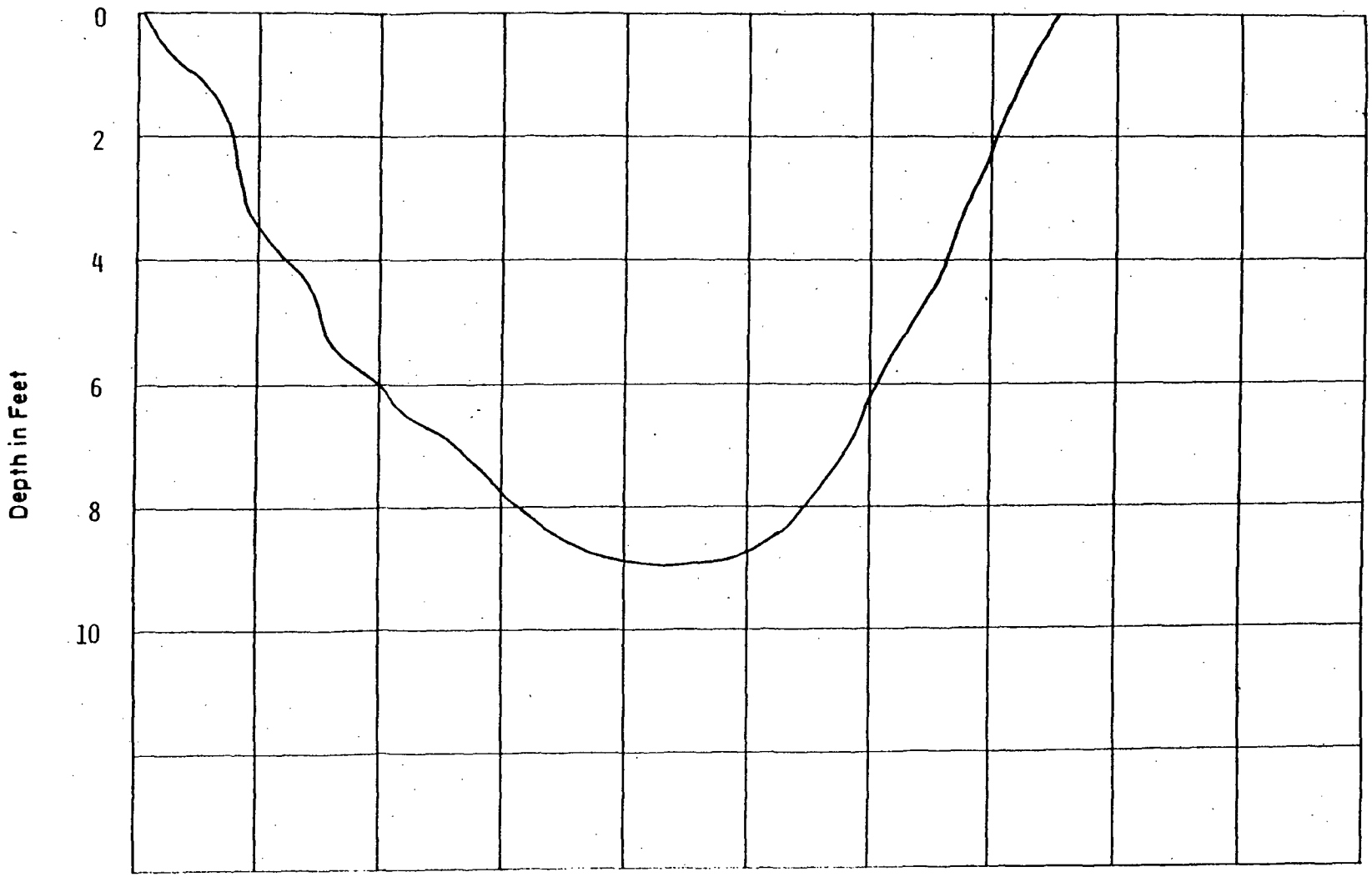
TEST PIT LOG

Project RANCHO SECO - EVAPORATION POND Job No. 12334-059 **TEST PIT NO.** T-3

Ground El. 149.7 FT. Location N37+05; E 5+50

Depth of Pit 9.0'

Date Excavated SEPTEMBER 5, 1985 Method of Excavation BACKHOE FORD XL 555-A



ERPI C 0104

Depth Feet	Sample Type and Number	Symbol	Description	Remarks
2.5	①		MEDIUM DENSE BROWN CLAYEY SAND. LITTLE GRAVEL. DAMP. (SC)	
5.0	②		MEDIUM DENSE TO DENSE BROWN CLAYEY SAND. OCCASIONALLY CEMENTED WITH CLAY. LITTLE GRAVEL. DAMP. (SC-CL)	
9.0	③		DENSE TO VERY DENSE GRAY GRAVELLY-CLAYEY SAND. FINE TO COARSE GRAIN. FEW COBBLES TO 8 INCHES IN DIAMETER. (SW-SC)	HARD DIGGING AT A DEPTH OF 5 AND 9 FEET.
			BOTTOM OF PIT AT EL. 140.7 FT. NO GROUND WATER WAS ENCOUNTERED DURING EXCAVATION.	

ERPT C 0104

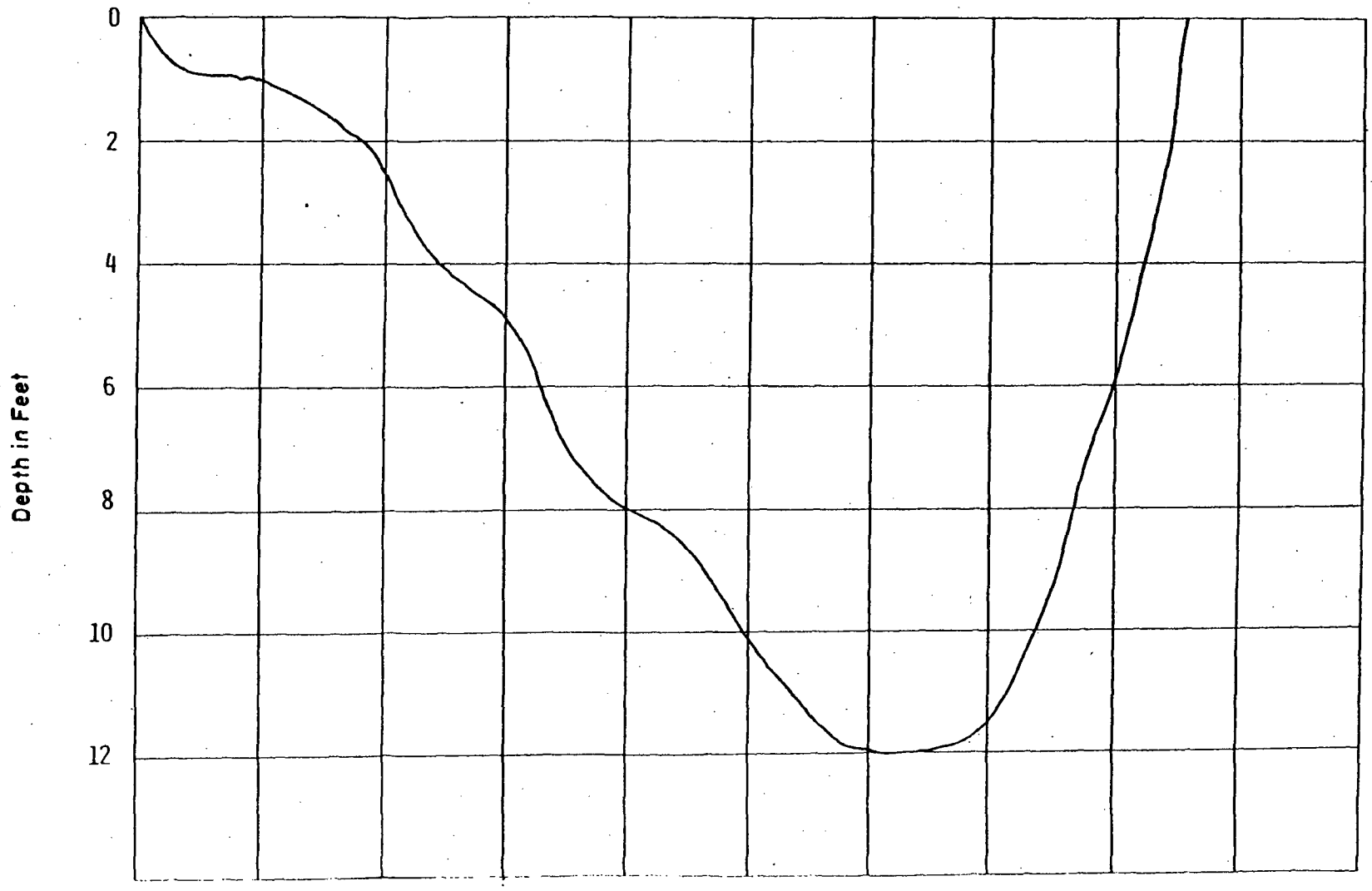
TEST PIT LOG

Project RANCHO SECO-EVAPORATION POND Job No. 12334-059 **TEST PIT NO.** T-4

Ground El. 149.7 FT. Location N37+05; E 13 + 50

Depth of Pit 12.0 FT.

Date Excavated SEPTEMBER 6, 1985 Method of Excavation BACKHOE FORD XL 555-A



ERPI C 0104

Depth Feet	Sample Type and Number	Symbol	Description	Remarks
4.0	① ②		LOOSE TO MEDIUM DENSE BROWN CLAYEY SAND WITH SIGNIFICANT AMOUNT OF CLAY. FINE TO COARSE GRAIN. TRACE OF GRAVEL. DAMP. (SC-CL)	
8.3	③		MEDIUM DENSE TO DENSE DARK BROWN SANDY GRAVEL. LITTLE CLAY. MOIST. (GW-GC).	HARD DIGGING AT A DEPTH OF 6 FEET.
12.0	④		VERY STIFF BROWN TO REDISH BROWN SILTY CLAY. TRACE OF FINE SAND. MOIST (CL).	Q_p = 3TSF @ 9 FEET Q_p = 3.5TSF @ 11 FEET
			BOTTOM OF PIT AT EL. 137.7 FT. NO GROUND WATER WAS ENCOUNTERED DURING EXCAVATION.	

ERPT C-0104

Appendix D

ERPT C 0104

J. H. KLEINFELDER & ASSOCIATES

RANCHO SECO NUCLEAR
GENERATING STATION
UNIT 1, SMUD TASK 059
EVAPORATION POND

LABORATORY TESTING OF SOILS

FILE: C.I. 03.08
JHKA PROJECT NO. A-2676-1

November 12, 1985

J. H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING
LAND & WATER RESOURCES
9795 BUSINESS PARK DRIVE, SUITE A
SACRAMENTO, CA 95827-1794
(916) 366-1701

ERPT C 0104

November 12, 1985
A-2676-1

Bechtel Power Corporation
P.O.Box 60860-Terminal Annex
Los Angeles, California 90060

Attention: Mr. D.B. Wood
Project Manager
Western Power Division

Subject: RANCHO SECO NUCLEAR GENERATING STATION, UNIT # 1
BECHTEL JOB 12334, SMUD TASK 059
EVAPORATION POND, LABORATORY TESTING OF SOILS
FILE: C.I. 03.08
JHKA PROJECT NO. A-2676-1

Gentlemen:

This is to report the results of laboratory soil testing performed by our firm in connection with the above referenced project. The testing program was performed as requested by Bechtel Power Corporation in letter No. BVL-876 dated October 2, 1985. All tests were performed in general conformance with ASTM procedures. The types of tests, ASTM designations, and number of each test performed are provided in Table No. 1. The laboratory test results are presented in the accompanying appendices, divided according to test types.

All tests were performed on samples tagged and identified by Bechtel personnel as received in our laboratory. However, one particular bulk sample identified as T-4 at 9.0 feet, was not located in our laboratory and was therefore not a part of the testing program. Data and computation sheets for all tests have been retained in our records and are available for review at your convenience.

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding test procedures, or the results provided herein, please do not hesitate to contact our office.

Sincerely,

J.H. KLEINFELDER AND ASSOCIATES

Robert L. Ehlers

Robert L. Ehlers
Operations Manager

TABLE NO. 1

Summary of Laboratory Tests

Type of Test	ASTM Designation	Appendix Presenting Test Results	Number of Tests Performed
Soil Classification	D-2487, D-2488	A	50
Moisture Content	D-2216	B	39
Dry Unit Weight	D-2937	C	8
Grain Size Distribution	D-422	D	30 (24 sieve analyses 6 hydrometers)
Atterberg Limit	D-4318	E	14
Compaction Test	D-1557	F	6
Triaxial Compression	D-2850	G	3
Unconfined Compression	D-2166	H	2
Direct Shear	D-3080	I	2
Consolidation	D-2435	J	4

Boring	Depth	Soil Description
B-1	17.5 - 20.0'	Clayey SAND, fine to coarse grain, brown (SC)
B-2	6.0 - 7.5'	Clayey SILT, elastic, reddish brown (MH)
B-2	12.5 - 14.0'	Clayey SILT, brown (ML)
B-2	15.0 - 17.5'	Clayey SILT, with fine sand, brown (ML)
B-2	25.0 - 27.5'	Silty CLAY, with fine sand, brown (CL)
B-3	10.0 - 11.5'	Clayey GRAVEL (3/4" Max., subrounded) with medium to fine grain sand, brown (GC)
B-3	15.0 - 16.5'	Clayey SILT, elastic, brown (MH)
B-3	17.5 - 20.0'	Sandy CLAY, fine grain, brown (CL)
B-3	24.5 - 26.0'	Clayey SAND, medium to fine grain, brown (SC)
B-4	7.5 - 9.0'	Silty CLAY, with fine gravel (1/2" Max., subangular) trace of medium to fine grain sand, brown, (CL)
B-4	12.5 - 14.0'	Silty CLAY, brown (CL)
B-4	15.0 - 17.5'	Clayey SAND, fine to coarse grain, brown (SC)
B-4	22.5 - 24.0'	Clayey SAND, fine grain, brown (SC)
B-4	27.5 - 29.0'	Clayey SAND, medium grain, brown (SC)
B-5	7.5 - 9.0'	Silty CLAY, with fine grain sand, trace of fine gravel, brown (CL)
B-5	10.0 - 12.5'	Sandy CLAY, fine grain, brown (CL)
B-5	17.5 - 19.0'	SAND, fine grain, trace silty clay and fine gravel, brown (SP-SC)

Boring	Depth	Soil Description
B-6	10.0 - 12.5'	Silty CLAY, with little fine sand, brown (CH)
B-6	15 - 17.5'	Clayey SILT, elastic, reddish brown (MH)
B-6	22.5 - 24.0'	Clayey SAND, fine to medium grain, brown, (SC)
B-7	7.5 - 9.0'	Silty CLAY, with fine to medium sand, brown (CL)
B-7	12.5' - 15.0'	Clayey GRAVEL (1/2" Max., subangular), with fine to coarse grain sand, brown (GC)
B-7	19.0 - 21.5'	Clayey SAND, fine to coarse grain, brown (SC)
B-8	5.0 - 6.0'	Clayey GRAVEL (1/2" Max. subangular), with fine to coarse sand, brown (GC)
B-8	10.0 - 11.5'	Silty CLAY, brown (CL)
B-8	17.5 - 20.0'	Sandy CLAY, fine grain sand, brown (CL)
B-8	22.5 - 25.0'	Clayey SILT, trace fine sand, brown (ML)
B-9	5.0 - 6.5'	Silty CLAY, with trace fine sand, brown (CL)
B-9	20.0 - 22.5'	Clayey SAND, fine to coarse grain, with fine gravel, brown (SC)
B-10	10.0 - 11.5'	Clayey SILT, trace fine sand, elastic, brown with white speckles (MH)
B-10	12.5 - 15.0'	Clayey SILT, elastic, reddish brown (MH)
B-10	17.5 - 20.0'	Clayey SILT, elastic reddish brown (MH)
B-10	22.5 - 25.0'	Sandy CLAY, with silt, brown (CL)

J. H. KLEINFELDER & ASSOCIATES

Test Pit	Depth	Soil Description
T-1	1.5'	Clayey GRAVEL ,fine grain, with fine to coarse sand, brown (GC)
T-1	3.5'	GRAVEL, poorly graded, fine to coarse grain (1 1/2" Max., subangular) with fine to coarse sand and clay (GP-GC)
T-1	7.0'	Clayey GRAVEL, fine to coarse grain,(1 in. Max., subangular) with coarse sand and little clay, brown (GC)
T-1	9.0'	Clayey GRAVEL, fine grain (3/4" Max., subangular) highly plastic fines, with fine to coarse sand, brown (GC)
T-1	12.0'	Clayey GRAVEL, fine grain (3/4" Max. subangular), highly plastic fines with fine to coarse sand, brown (GC)
T-2	0.9	Clayey GRAVEL, fine to coarse grain, with fine to coarse sand, 4% cobbles, brown (GC)
T-2	5.0'	Clayey GRAVEL, fine to coarse grain, with fine to coarse sand, brown (GC)
T-2	7.0'	Silty CLAY, reddish brown (CL)
T-2	9.0'	Clayey SILT, elastic, reddish brown (MH)
T-2	12.5'	Clayey SILT, trace fine sand, elastic, reddish brown (MH)
T-3	1.0'	Clayey SAND, fine to coarse grain, with fine gravel, brown (SC)
T-3	3.5'	Sandy CLAY, fine to coarse grain, with fine gravel, brown (CL)
T-3	6.5'	SAND, well graded with fine gravel and clay, brown (SW-SC)

Test Pit	Depth	Soil Description
T-4	1.0'	Sandy CLAY, fine to coarse grain, trace fine gravel, brown (CL)
T-4	2.7'	Silty CLAY, with fine to coarse sand, trace fine gravel, brown (CL)
T-4	5.5'	GRAVEL, fine grain, with clay and fine to coarse sand (GW-GC)
T-4	11.0'	Silty CLAY, trace fine sand, brown (CL)

MOISTURE CONTENT

Test Pit No. T-1

Depth(ft)	% Moisture
1.5	6.4
7.0	18.8
9.0	16.1
12.0	15.7

Test Pit No. T-2

Depth(ft)	% Moisture
5.0	36.1
7.0	37.6
9.0	42.7
12.5	25.1

Test Pit No. T-3

Depth(ft)	% Moisture
1.0	12.5
3.5	9.8

Test Pit No. T-4

Depth(ft)	% Moisture
9.0	46.8

MOISTURE CONTENT

Boring: B-1

Depth(ft)	% Moisture
17.5-20.0	22.7

Boring: B-2

Depth(ft)	% Moisture
12.5-14.0	58.1
15.0-17.5	41.2
25.0-27.5	30.1

Boring: B-3

Depth(ft)	% Moisture
10.0-11.5	18.0
15.0-16.5	27.7
17.5-20.0	30.4
24.5-26.0	22.4

Boring: B-4

Depth(ft)	% Moisture
7.5-9.0	30.4
12.5-14.0	41.6
15.0-17.5	31.9
22.5-24.0	28.6
27.5-29.0	21.0

Boring: B-5

Depth(ft)	% Moisture
7.5-9.0	19.5
10.0-12.5	31.5
17.5-19.0	16.0

MOISTURE CONTENT

Boring: B-6

Depth(ft)	% Moisture
22.5-24.0	47.3

Boring: B-7

Depth(ft)	% Moisture
7.5-9.0	21.2
12.5-15.0	30.2
19.0-21.5	24.8

Boring: B-8

Depth(ft)	% Moisture
5.0-6.0	8.1
10.0-11.5	27.7
17.5-20.0	43.1
22.5-25.0	36.9

Boring: B-9

Depth(ft)	% Moisture
5.0-6.0	18.1
20.0-22.5	8.8

Boring: B-10

Depth(ft)	% Moisture
10.0-11.5	34.8
22.5-25.0	53.1

DRY UNIT WEIGHTS

BORING: B-2

Depth(ft.)	Dry Unit Weight(pcf)
15.0-17.5	70.9
25.0-27.5	90.3

BORING: B-3

Depth(ft.)	Dry Unit Weight(pcf)
17.5-20.0	80.1

BORING: B-4

Depth(ft.)	Dry Unit Weight(pcf)
15.0-17.5	81.1

BORING: B-5

Depth(ft.)	Dry Unit Weight(pcf)
10.0-12.5	83.4

BORING: B-6

Depth(ft.)	Dry Unit Weight(pcf)
17.5-20.0	83.0
22.5-25.0	84.8

BORING: B-10

Depth(ft.)	Dry Unit Weight(pcf)
22.5-25.0	77.3

SIEVE ANALYSIS

Test Pit	T-1				T-2
Depth:	1.5'	3.5'	9.0'	12.0'	0.9'
Sieve Size	% Passing				
3 1/2"	100	100	100	100	100
3"	100	100	100	100	96
2"	100	100	100	100	87
1 1/2"	100	96	100	100	77
1"	100	95	100	100	66
3/4"	100	64	100	100	57
1/2"	70	52	67	78	49
3/8"	66	46	61	72	44
No. 4	58	34	50	62	36
No. 10	53	23	42	51	32
No. 20	50	18	36	44	28
No. 40	44	14	30	40	24
No. 60	34	12	25	37	19
No. 140	27	8	22	35	16
No. 200	23	7	19	35	13

SIEVE ANALYSIS

Test Pit		T-3	
Depth:	1.0'	3.5'	6.5'
Sieve Size		% Passing	
3"	100	100	100
2"	100	100	100
1 1/2"	99	100	100
1"	95	100	100
3/4"	92	100	96
1/2"	89	91	91
3/8"	86	89	84
No. 4	78	85	67
No. 10	61	80	50
No. 20	55	75	36
No. 40	49	70	25
No. 60	43	63	19
No. 140	37	57	12
No. 200	33	52	10

SIEVE ANALYSIS

Test Pit	T-4		
Depth:	1.0'	2.7'	5.5'

Sieve Analysis	% Passing		
3/4"	100	100	100
1/2"	97	93	70
3/8"	96	92	64
No. 4	93	88	51
No. 10	89	84	38
No. 20	85	78	29
No. 40	77	73	22
No. 60	67	64	18
No. 140	55	59	12
No. 200	51	51	11

SIEVE ANLAYSIS

Boring	B-1	B-2	
Depth	17.5 - 20'	15 - 17.5'	25 - 27.5
Sieve Size	**% Passing**		
3/8"	100	100	100
No. 4	94	100	100
No. 10	84	99	100
No. 20	70	98	99
No. 40	50	94	99
No. 60	42	86	94
No. 140	34	64	87
No. 200	32	62	85

SIEVE ANALYSIS

Boring	B-3	B-4	B-5	B-6
Depth:	17.5 - 20'	15 - 17.5'	10 - 12.5'	10 - 12.5'
Sieve Size		**% Passing**		
3/8"	100	100	100	100
No. 4	99	100	100	100
No. 10	98	98	100	100
No. 20	98	82	100	---
No. 40	97	61	100	95
No. 60	95	55	99	91
No. 140	86	47	84	---
No. 200	85	45	77	87

Boring	B-6	B-7	B-8	B-9
Depth	15 - 17.5'	19 - 21.5'	17.5 - 20'	20 - 22.5'
Sieve Size		**% Passing**		
3/4"	100	100	100	100
1/2"	100	100	100	67
3/8"	100	100	100	63
No. 4	100	100	100	51
No. 10	100	99	100	40
No. 20	---	88	99	32
No. 40	90	62	96	24
No. 60	84	52	93	20
No. 140	---	42	84	17
No. 200	62	39	81	16

SIEVE ANALYSIS

Boring	B-10	B-10
Depth:	17.5 - 20'	22.5 - 25'

Sieve Size	% Passing	
3/4"	100	100
1/2"	100	100
3/8"	100	100
No. 4	100	100
No. 10	100	100
No. 20	---	99
No. 40	98	93
No. 60	96	91
No. 100	92	---
No. 140	---	66
No. 200	87	65

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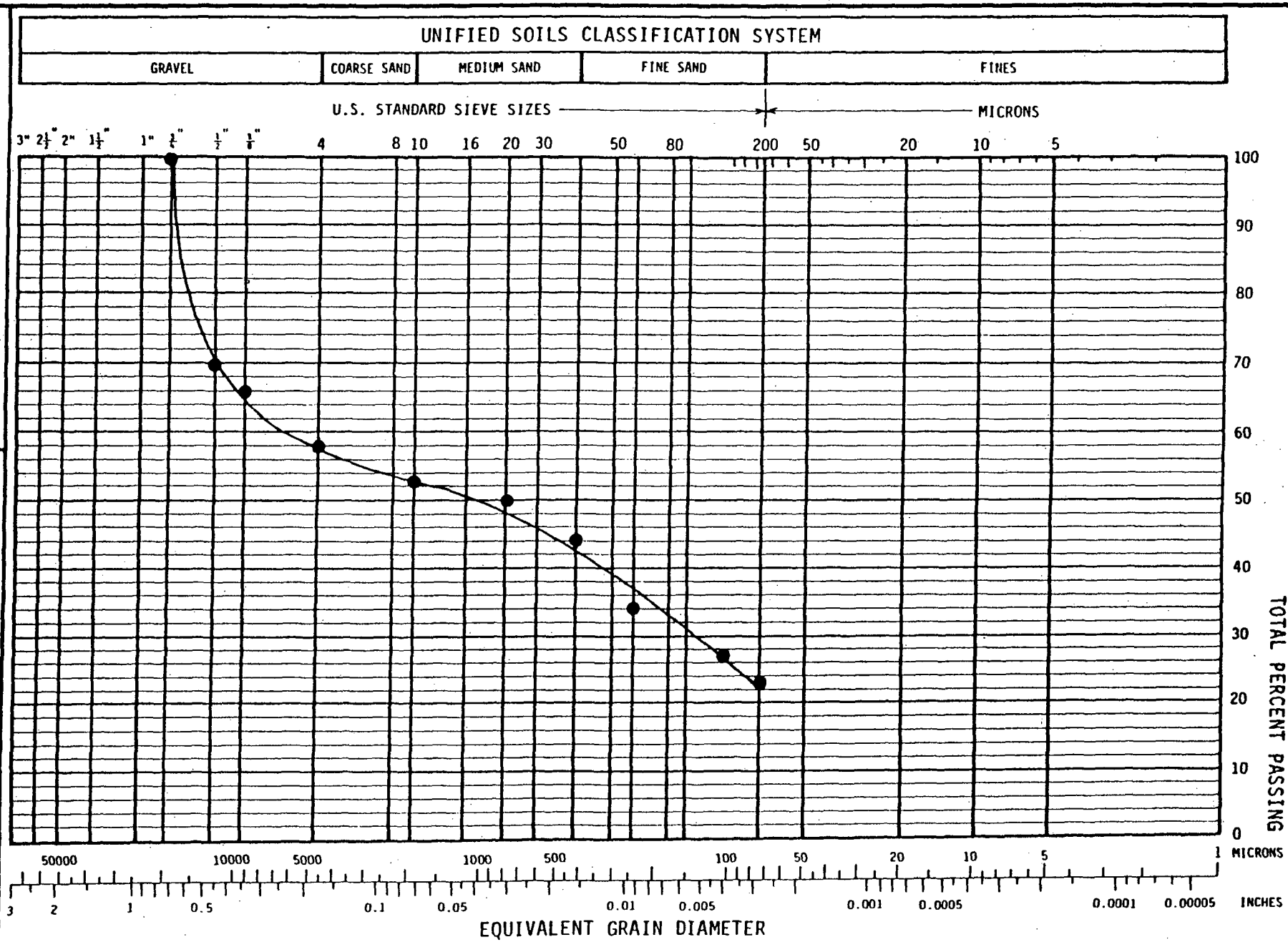
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING

PROJECT NO. A-7676-1

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION



Test Pit No.
T-1 @ 1.5 Ft.

PLATE

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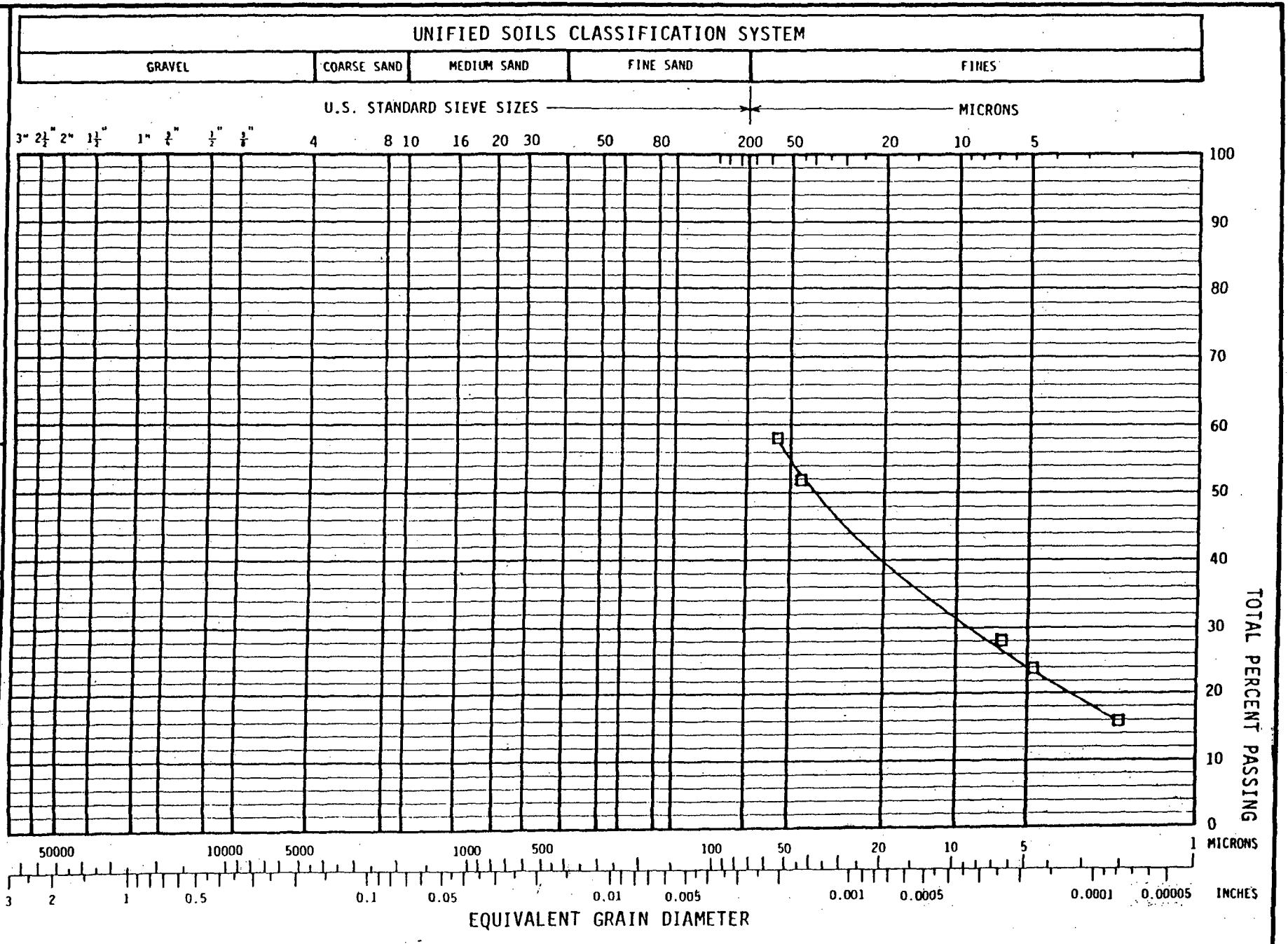
A-2676-1

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating
Station, Unit 1

GRAIN SIZE DISTRIBUTION



Test Pit No.
T-1 @ 1.5 Ft.

PLATE

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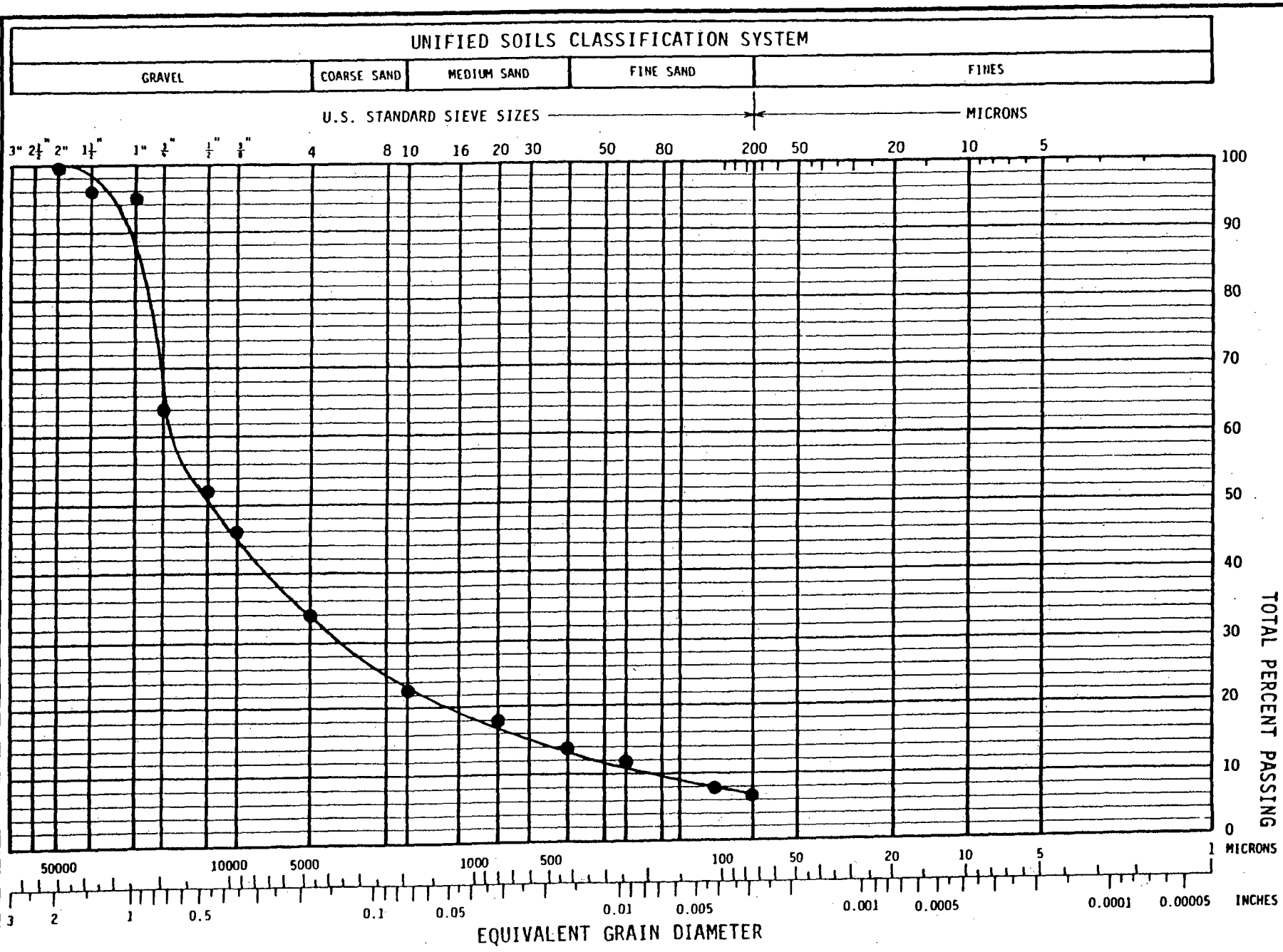

Test Pit No.
T-1 @ 3.5 Ft.

ERPT C 0104

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PROJECT NO. A-2676-1

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION

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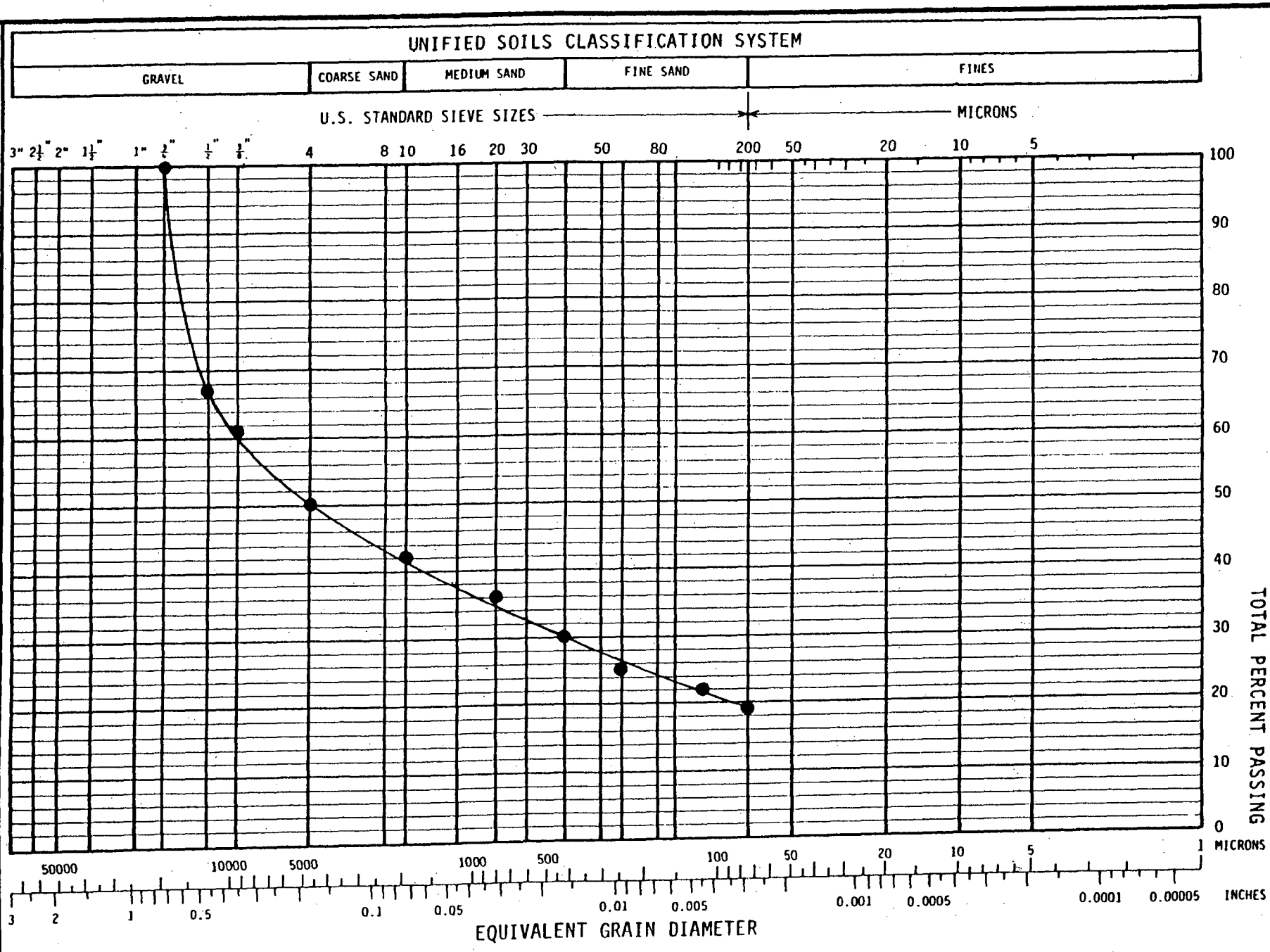
PROJECT NO. A-2676-1

Evaporation pond, SMUD Task 059
Rancho Seco Nuclear Generating
Station, Unit 1

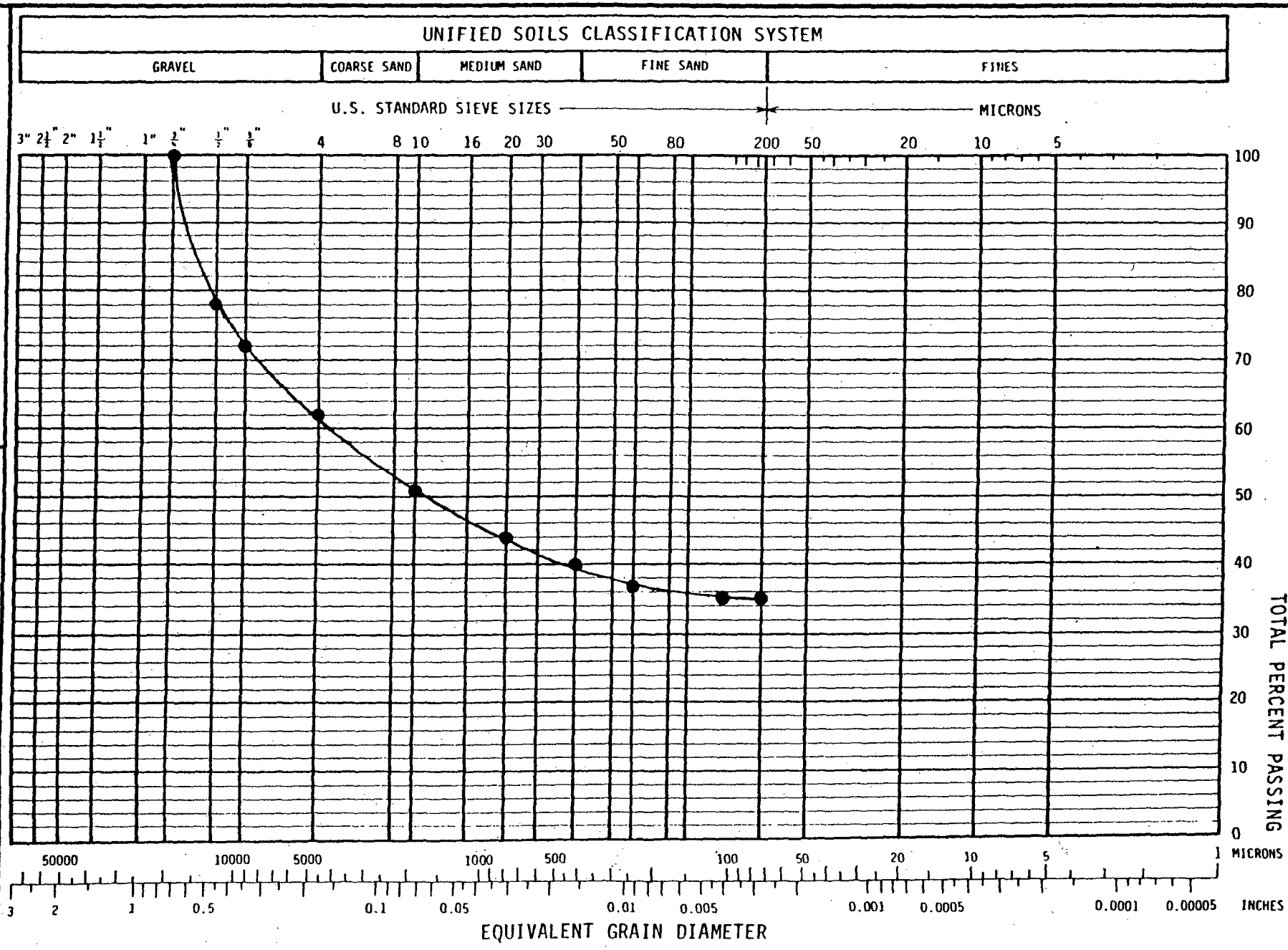
GRAIN SIZE DISTRIBUTION



Test Pit No.
T-1 @ 9.0 Ft.

PLATE

ERPT C 0104



Test Pit No.
T-1 @ 12.0 feet

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PROJECT NO. A 2276

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station Unit 1

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PROJECT NO. A- 2276 1

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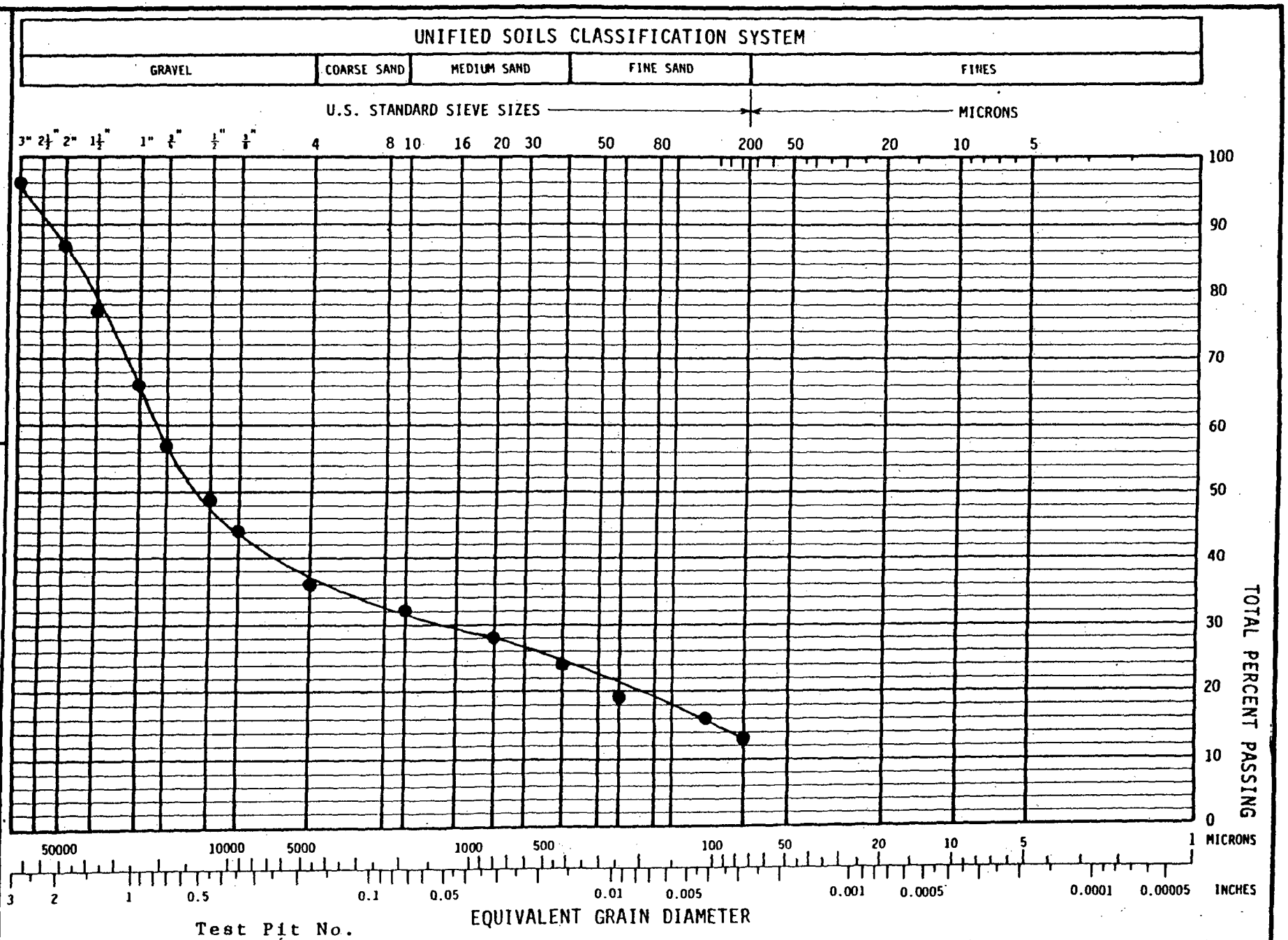
Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION



Test Pit No.

T-2 @ 0.9 Ft.

PLATE

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PROJECT NO. A-2676-1

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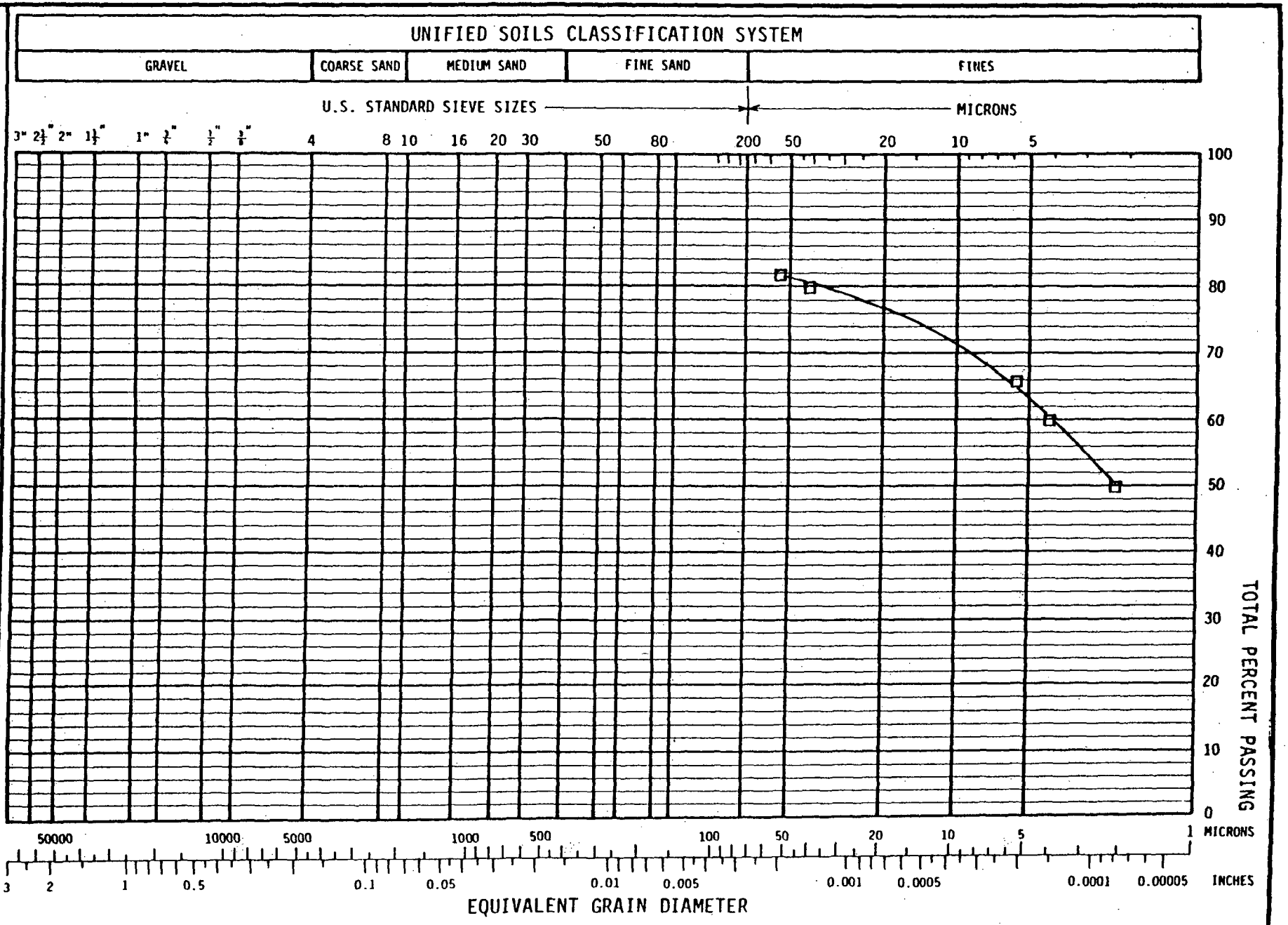
Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating
Station Unit 1

GRAIN SIZE DISTRIBUTION



Test Pit No.

T-2 @ 5 Ft.

PLATE

ERPT C 0104

PROJECT NO. [illegible]

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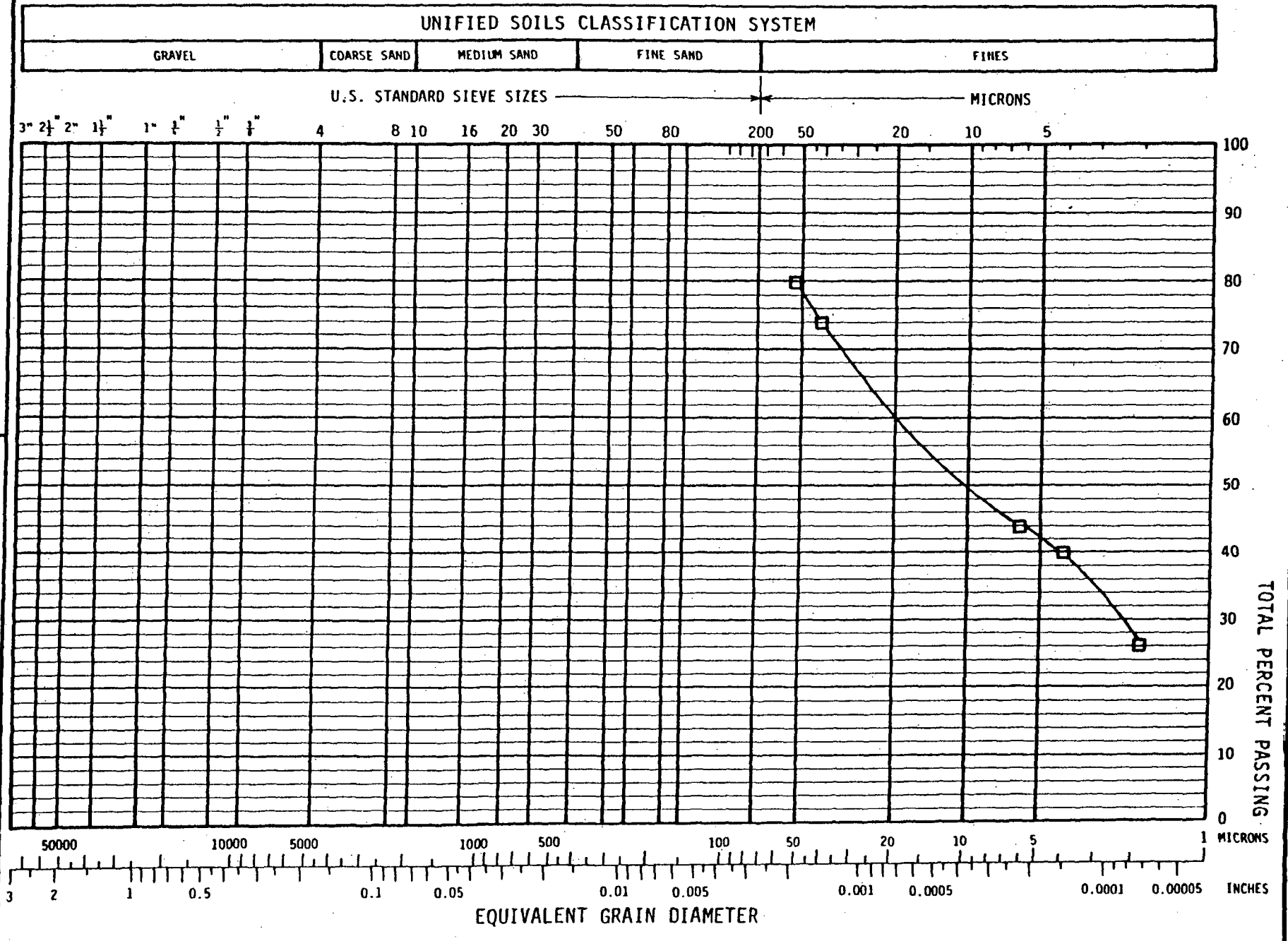
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station Unit #1

GRAIN SIZE DISTRIBUTION



Test Pit No.
T-2 @ 12.5 Ft.

PLATE

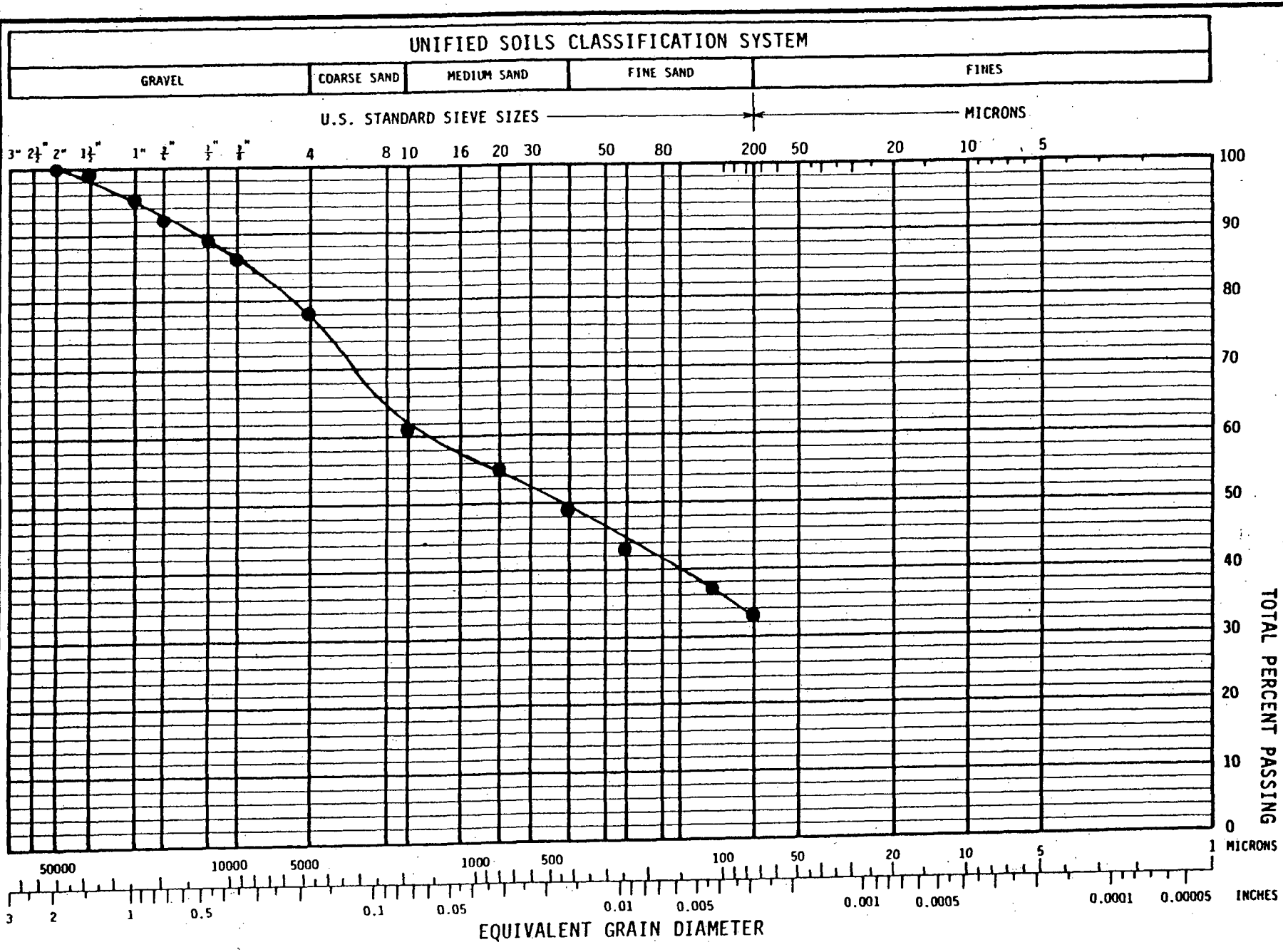
ERPT C 0104

PROJECT NO. A-2676-1

J.H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION

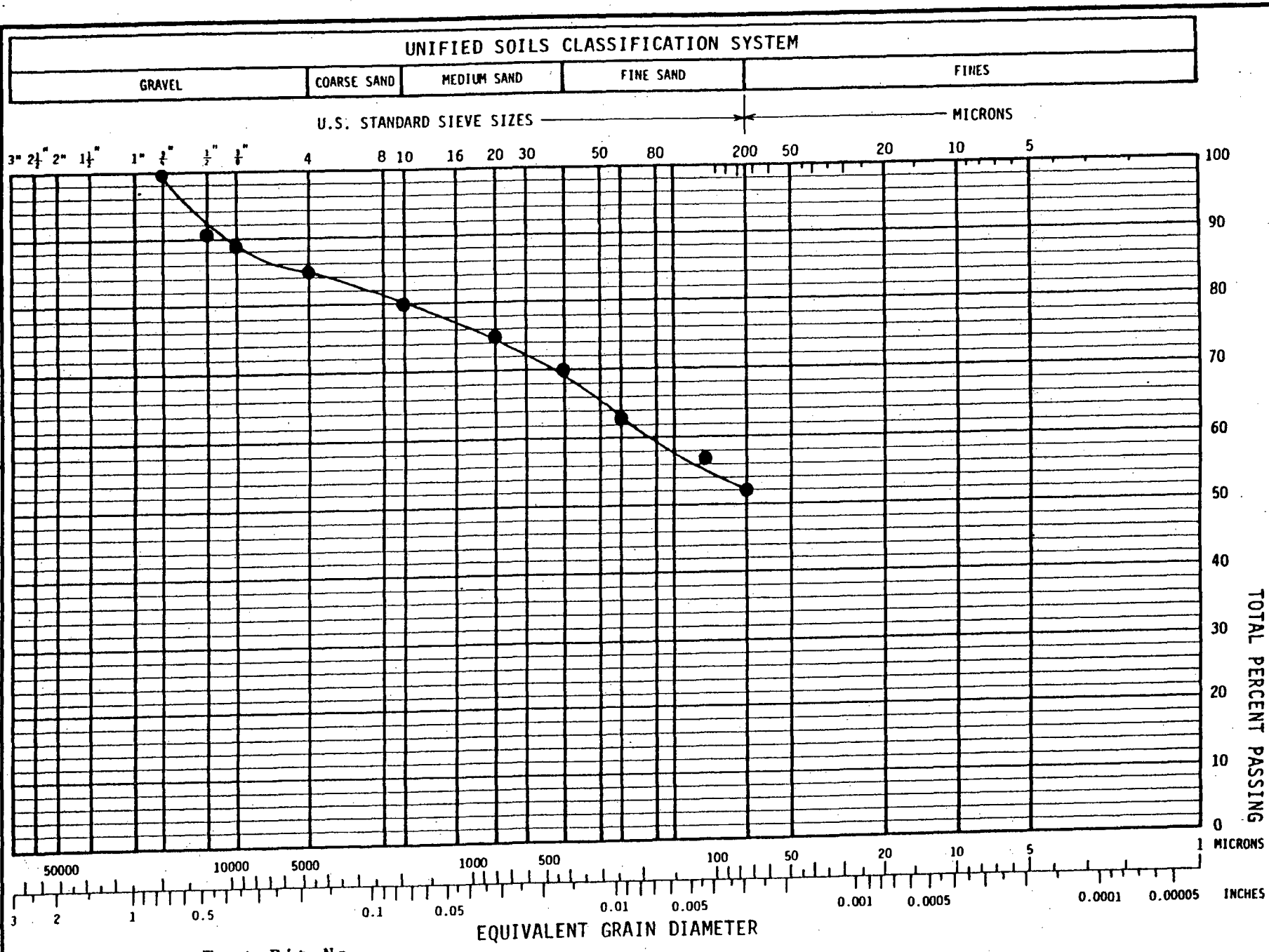


Test Pit No.

T-3 @ 1.0 Ft.

PLATE

ERPT C 0104



Test Pit No.

T-3 @ 3.5 Ft.

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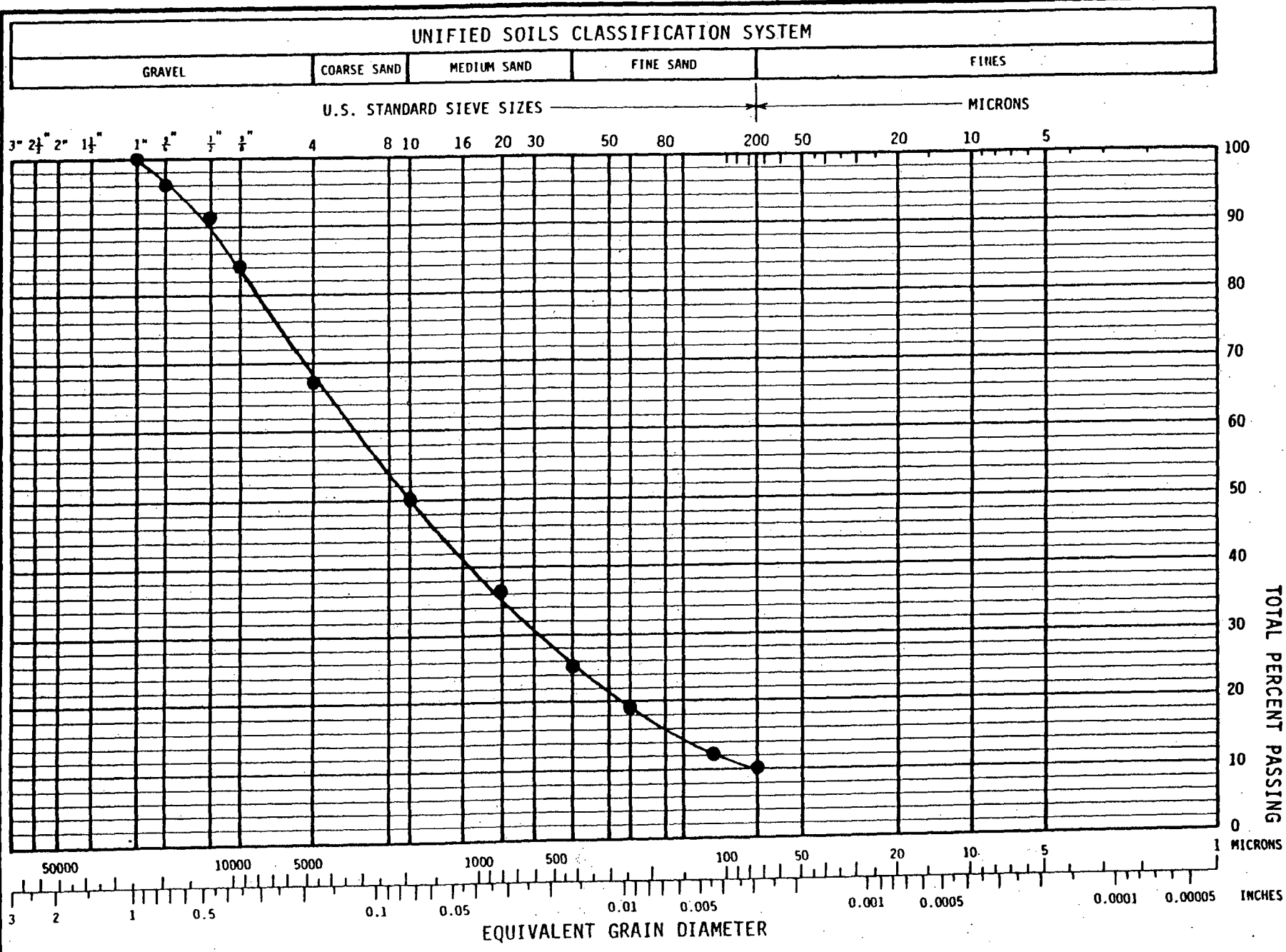
PROJECT NO. A-2676-1

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION

PLATE



Test Pit No.

T-3 @ 6.5 Ft.

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PROJECT NO. A-2676-1

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION

PLATE

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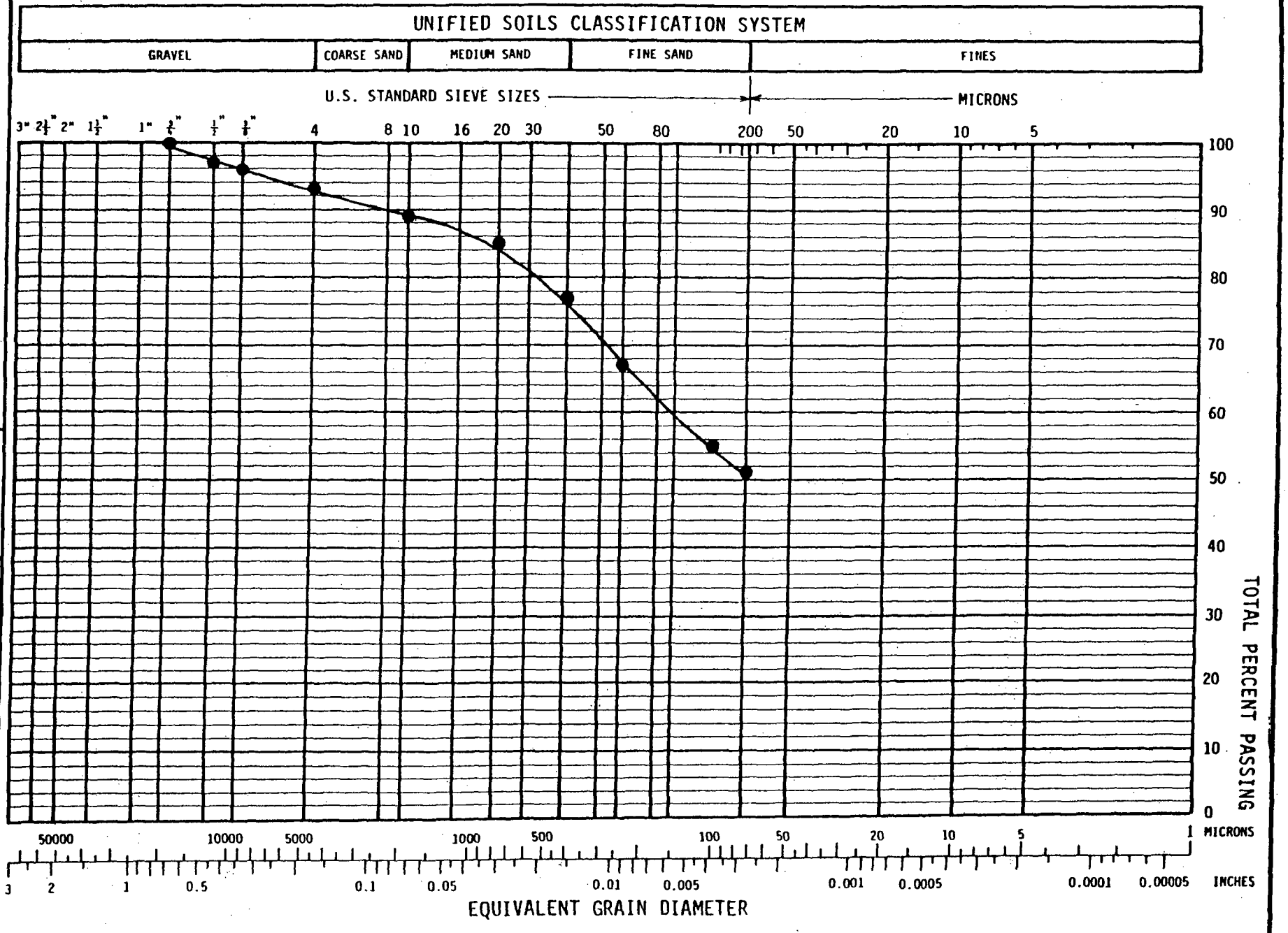

Test Pit No.
T-4 @ 1.0 Ft.

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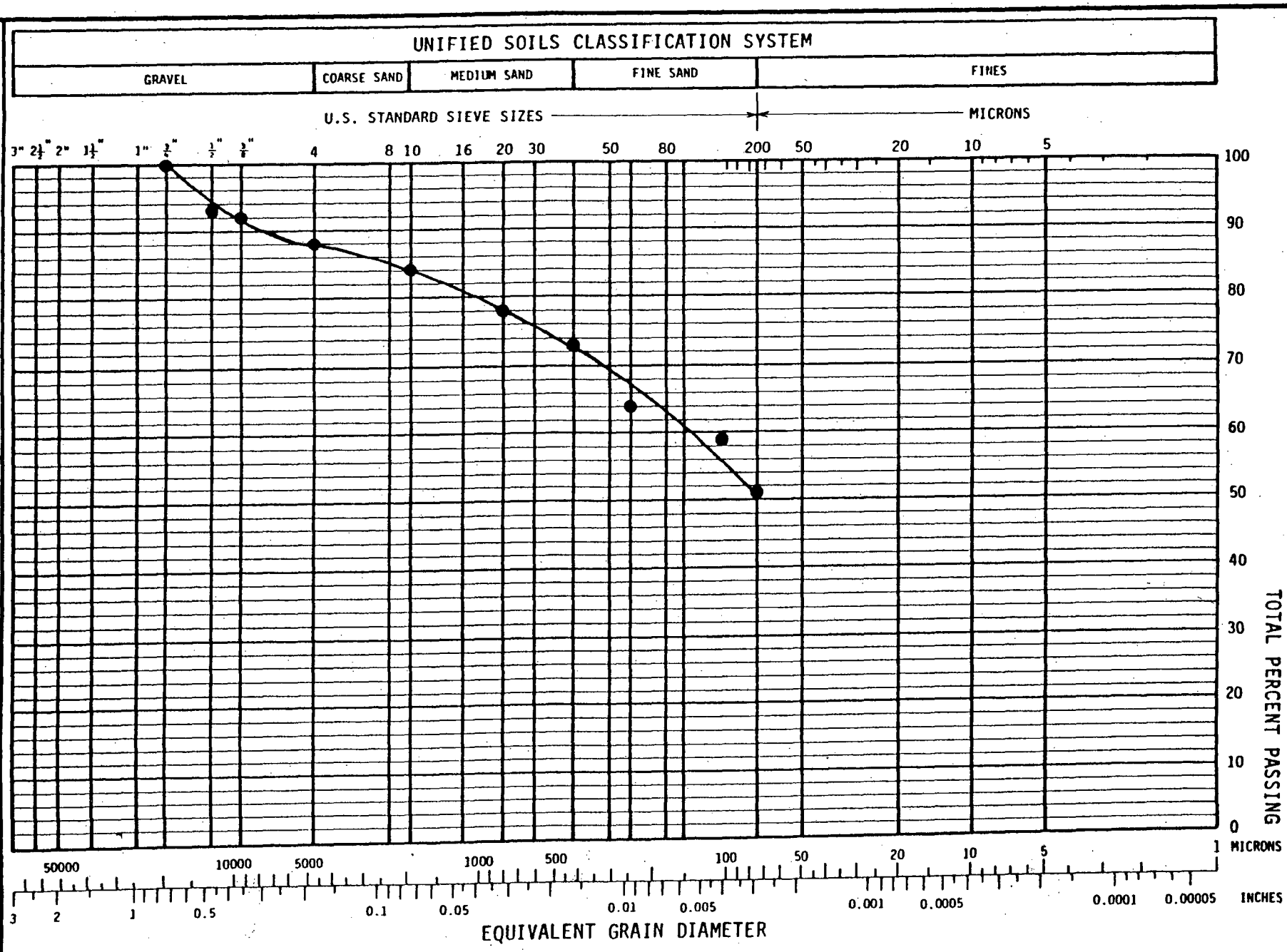
PROJECT NO. A-2676-1

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION

PLATE



Test Pit No.
T-4 @ 2.7 Ft.

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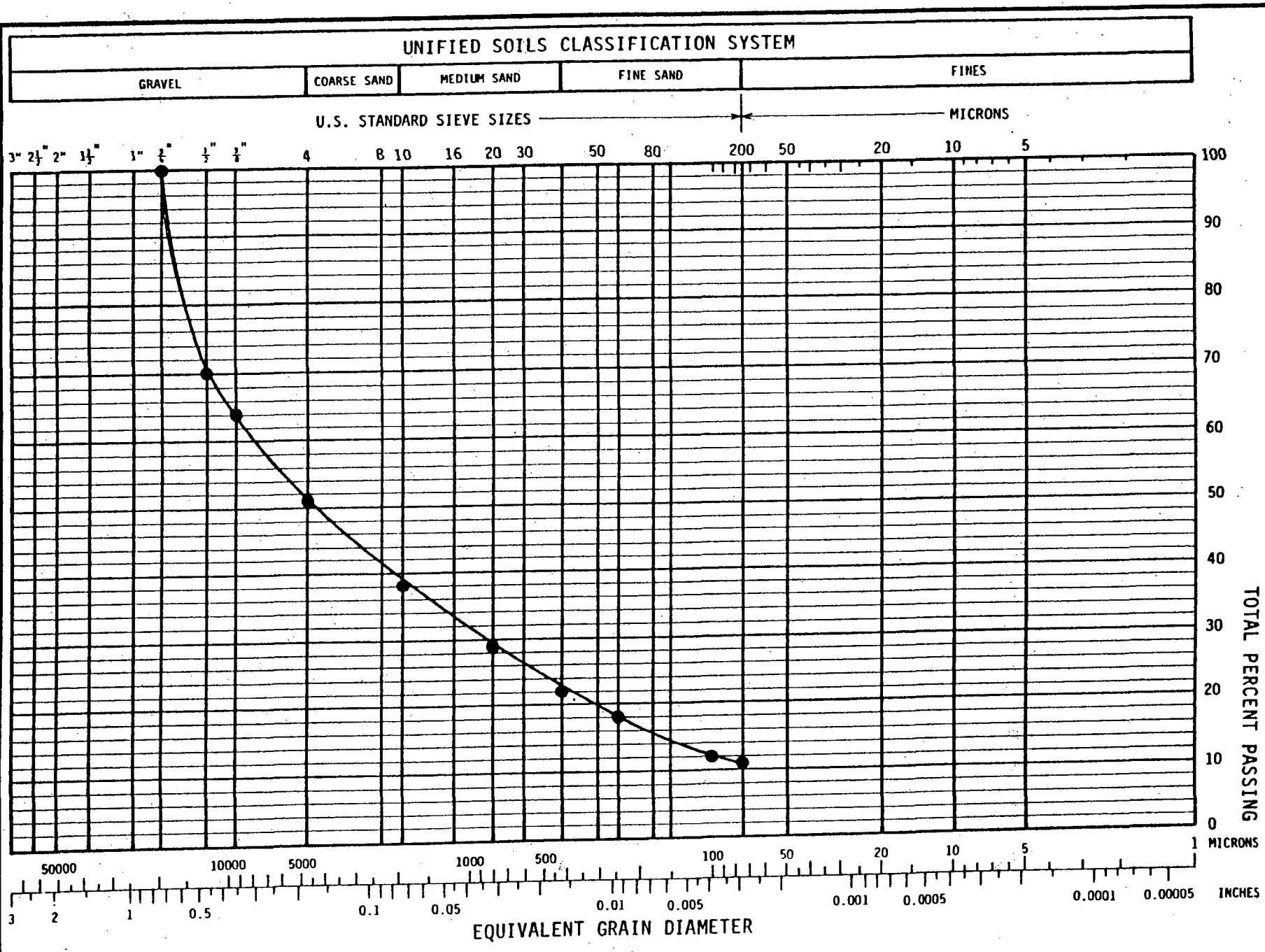
GRAIN SIZE DISTRIBUTION

PLATE



Test Pit No.
T-4 @ 5.5 Ft.

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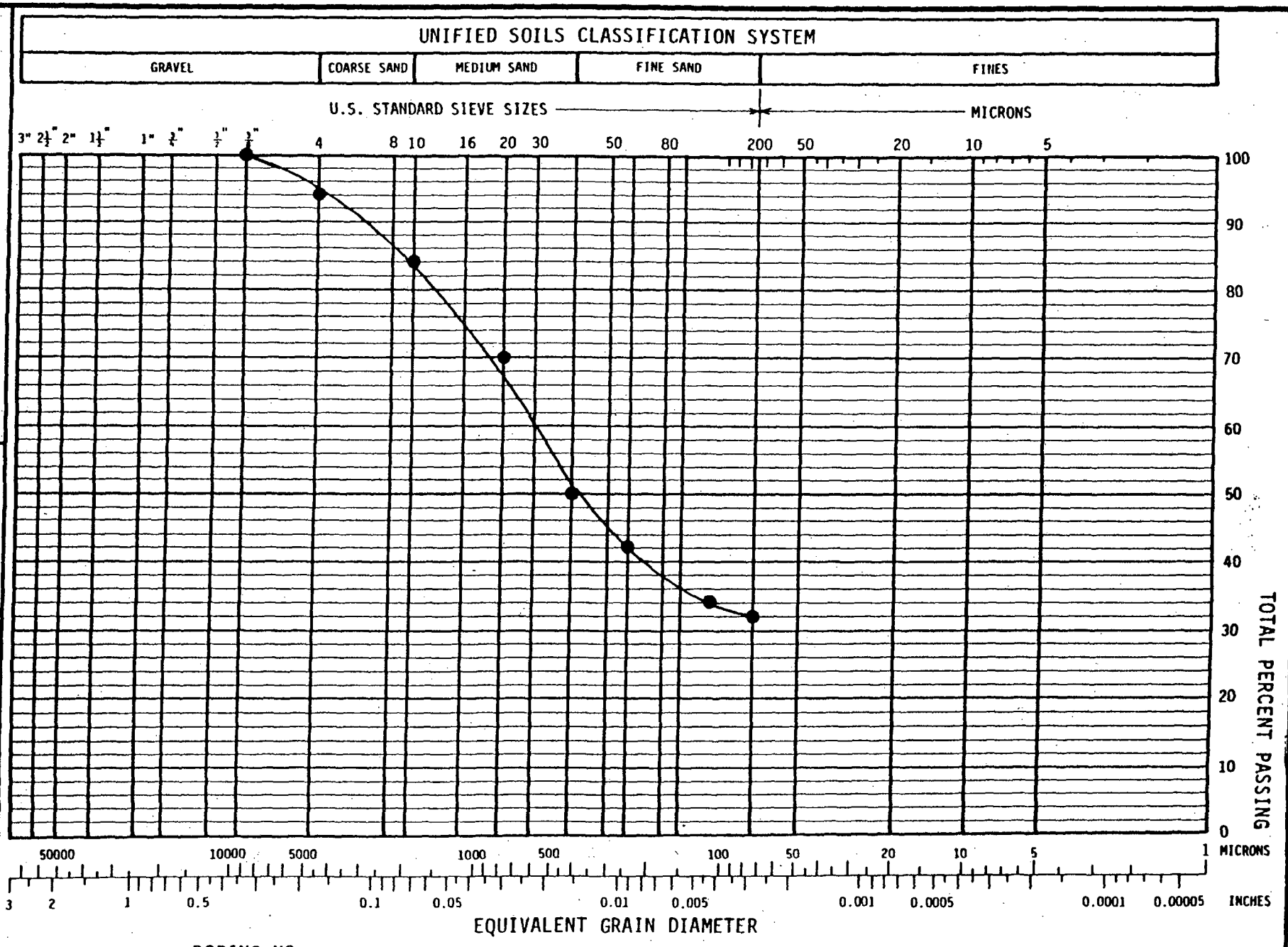
GRAIN SIZE DISTRIBUTION

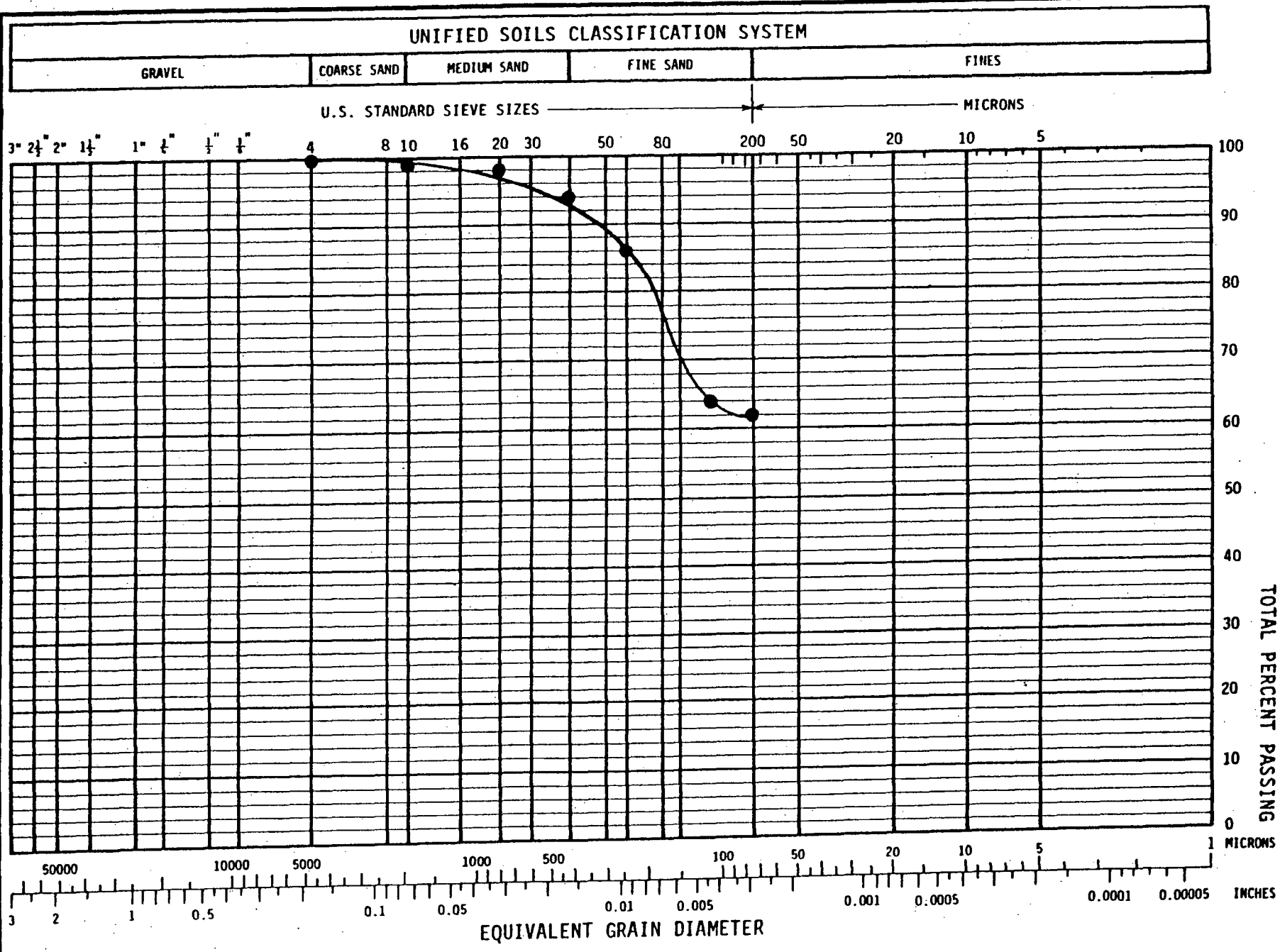
PLATE



BORING NO.

B-1 @ 17.5 to 20 Ft.

ERPT C 0104



BORING NO.

B-2 @ 15 to 17.5 Ft.

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GRAIN SIZE DISTRIBUTION

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PROJECT NO. A-2676-1

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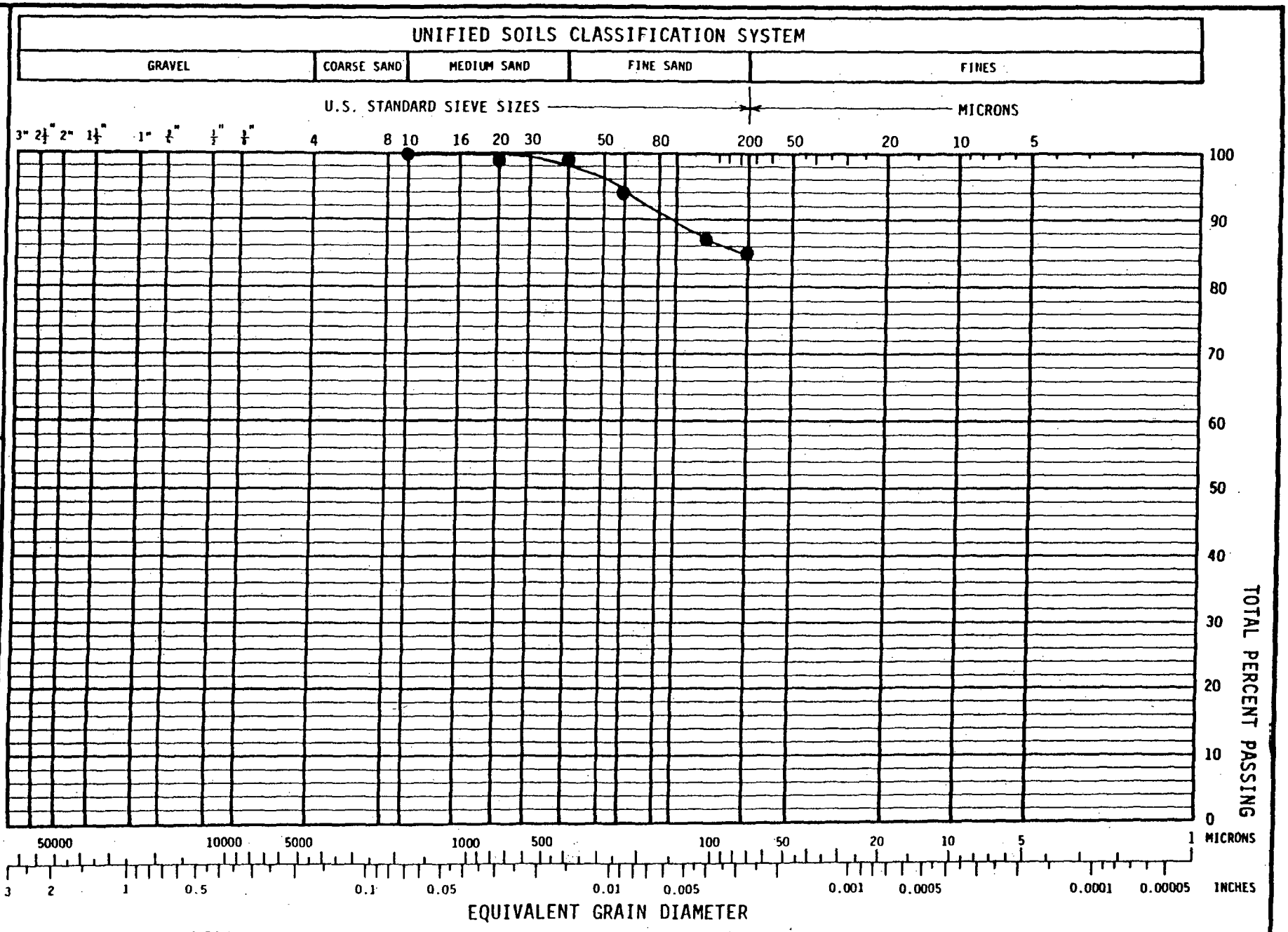
Rancho Seco Nuclear Generating Station Unit 1

GRAIN SIZE DISTRIBUTION



BORING NO.

B-2 @ 25 to 27.5 Ft.

PLATE

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PROJECT NO.

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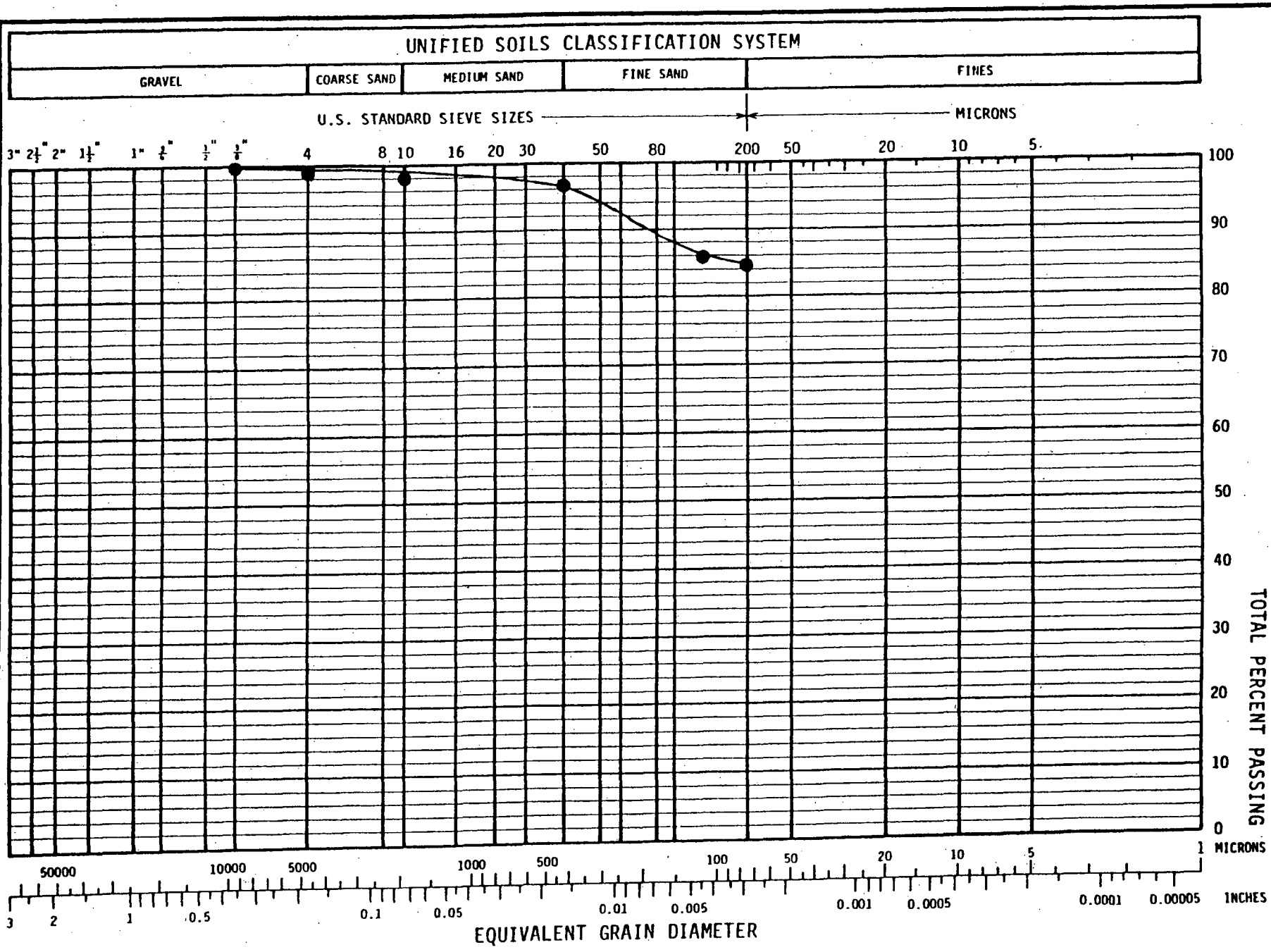
Rancho Seco Nuclear Generating Station

GRAIN SIZE DISTRIBUTION



BORING NO.

B-3 @ 17.5 to 20 Ft.

PLATE

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PROJECT NO. A-2676-1

Evaporation Pond, SMUD Task 059
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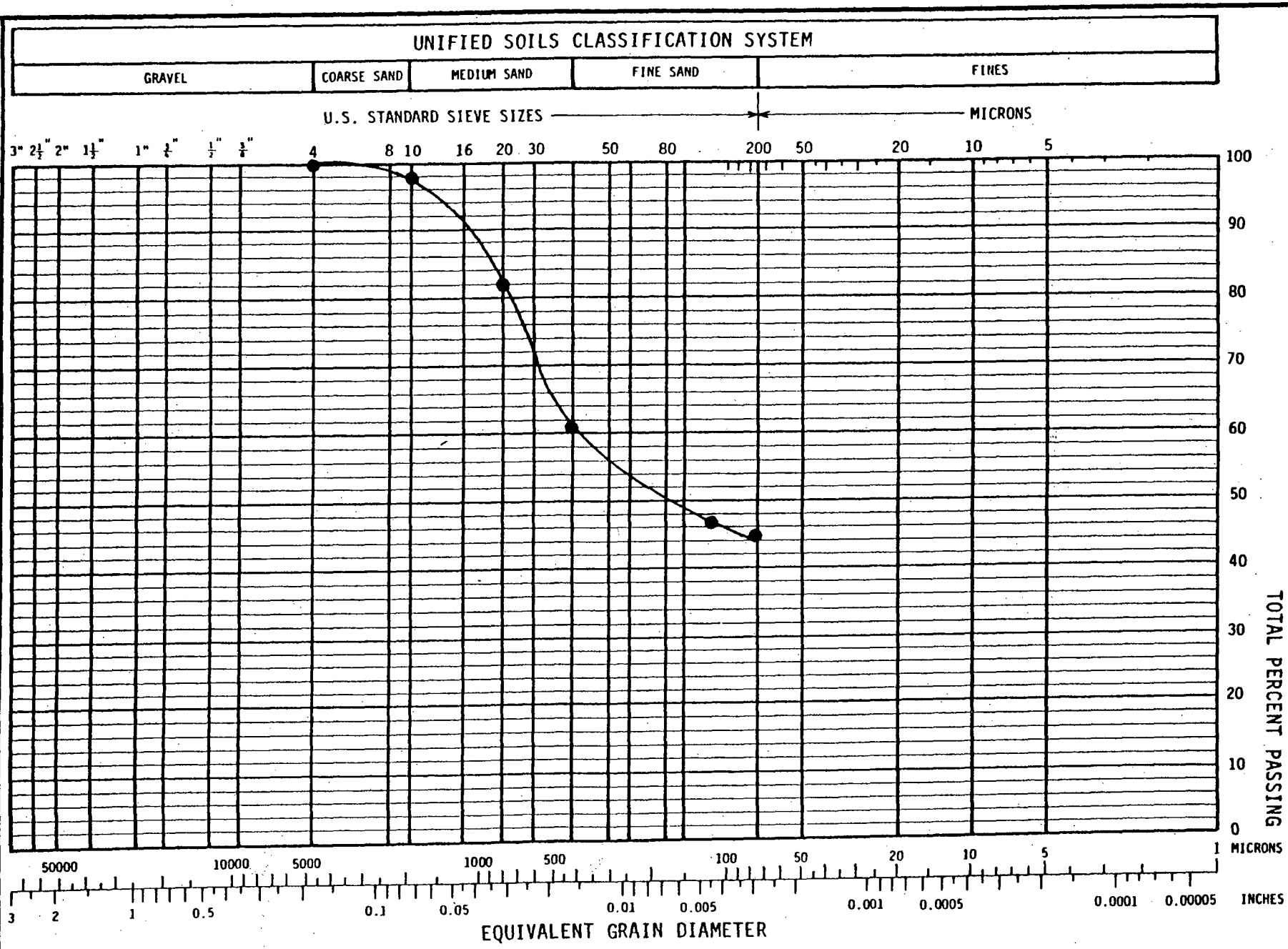
GRAIN SIZE DISTRIBUTION

PLATE



BORING NO.

B-4 15 to 17.5 Ft.

ERPT C 0104

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PROJECT NO. A-2676-1

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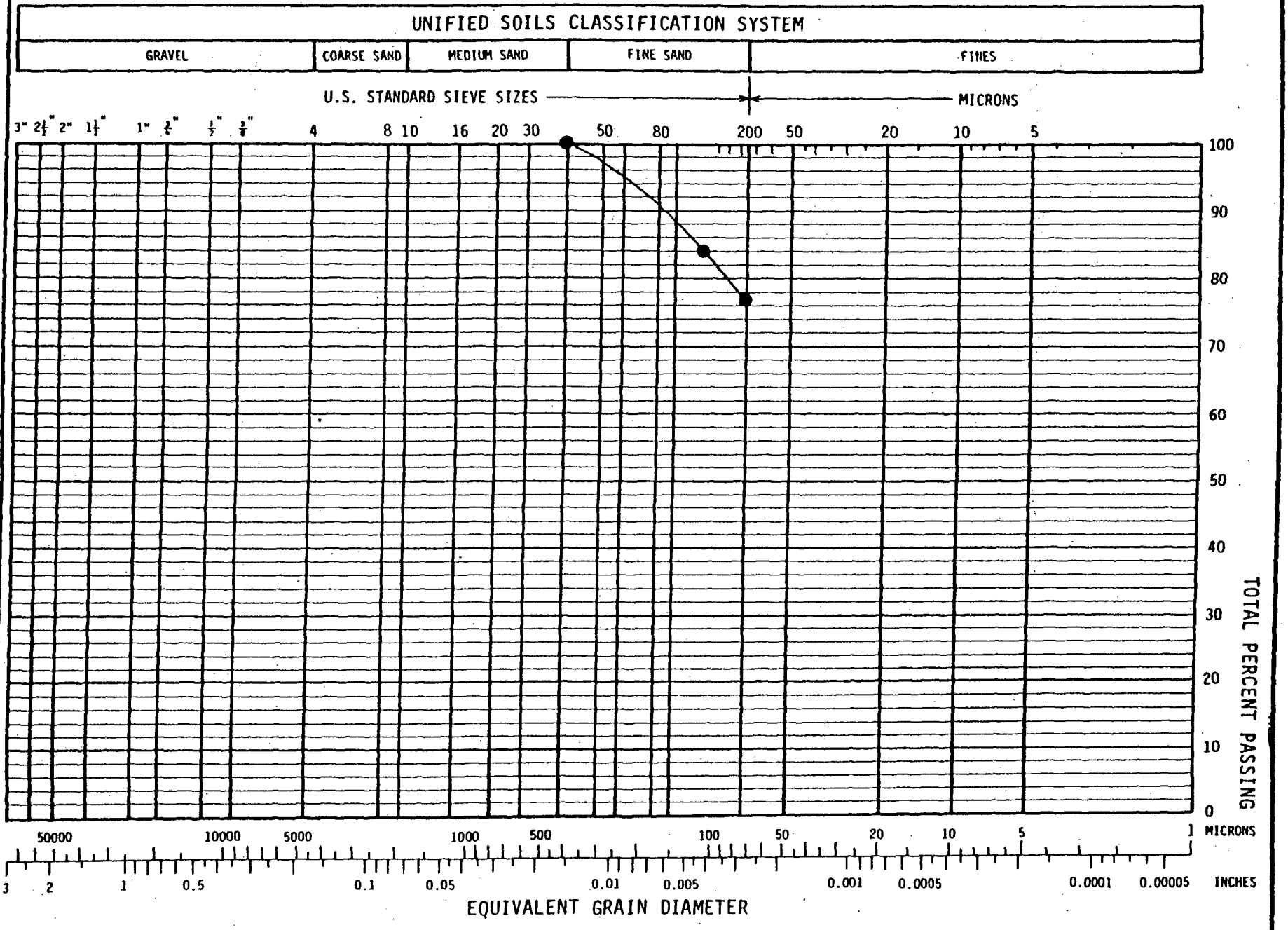
GRAIN SIZE DISTRIBUTION



Boring No.
B-5 @ 10 to 12.5 Ft.

PLATE

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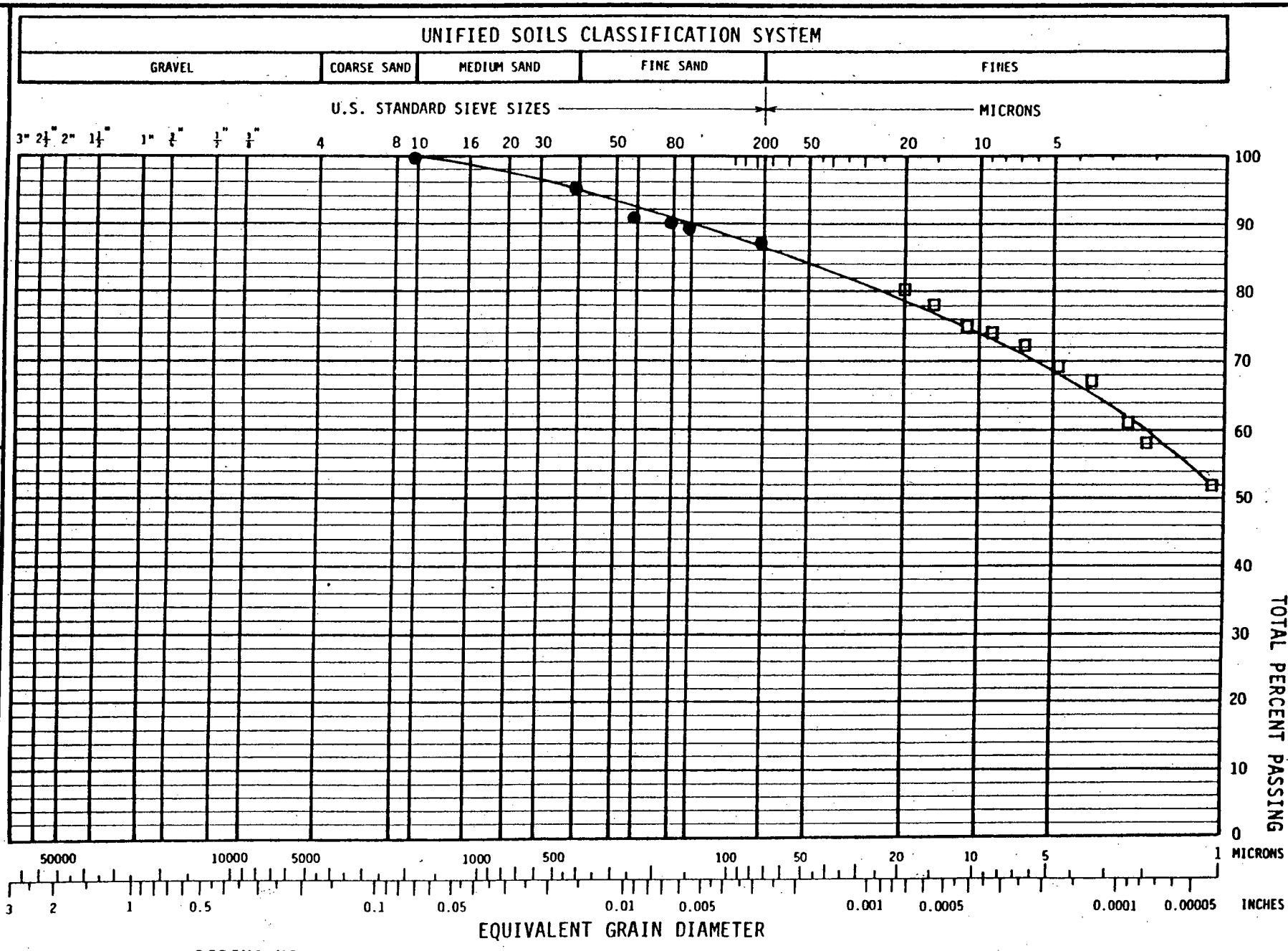
GRAIN SIZE DISTRIBUTION

PLATE

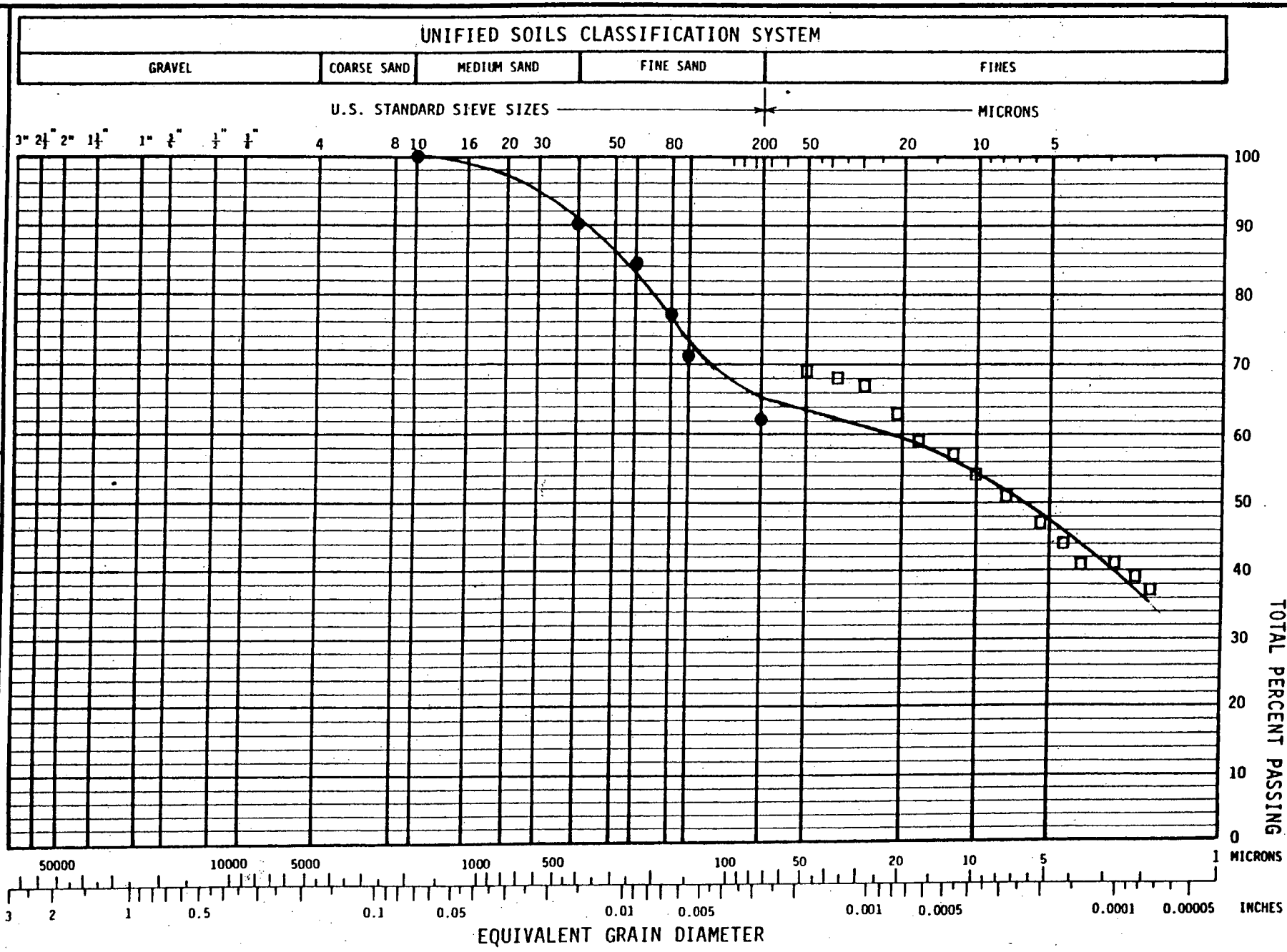


BORING NO.

B-6 @ 10 to 12.5 Ft.

● Sieve Analysis
□ Hydrometer Analysis

ERPT C 0104



BORING NO.

B-6 @ 15 to 17.5 Ft.

● Sieve Analysis

□ Hydrometer Analysis

ERPT C 0104

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Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION

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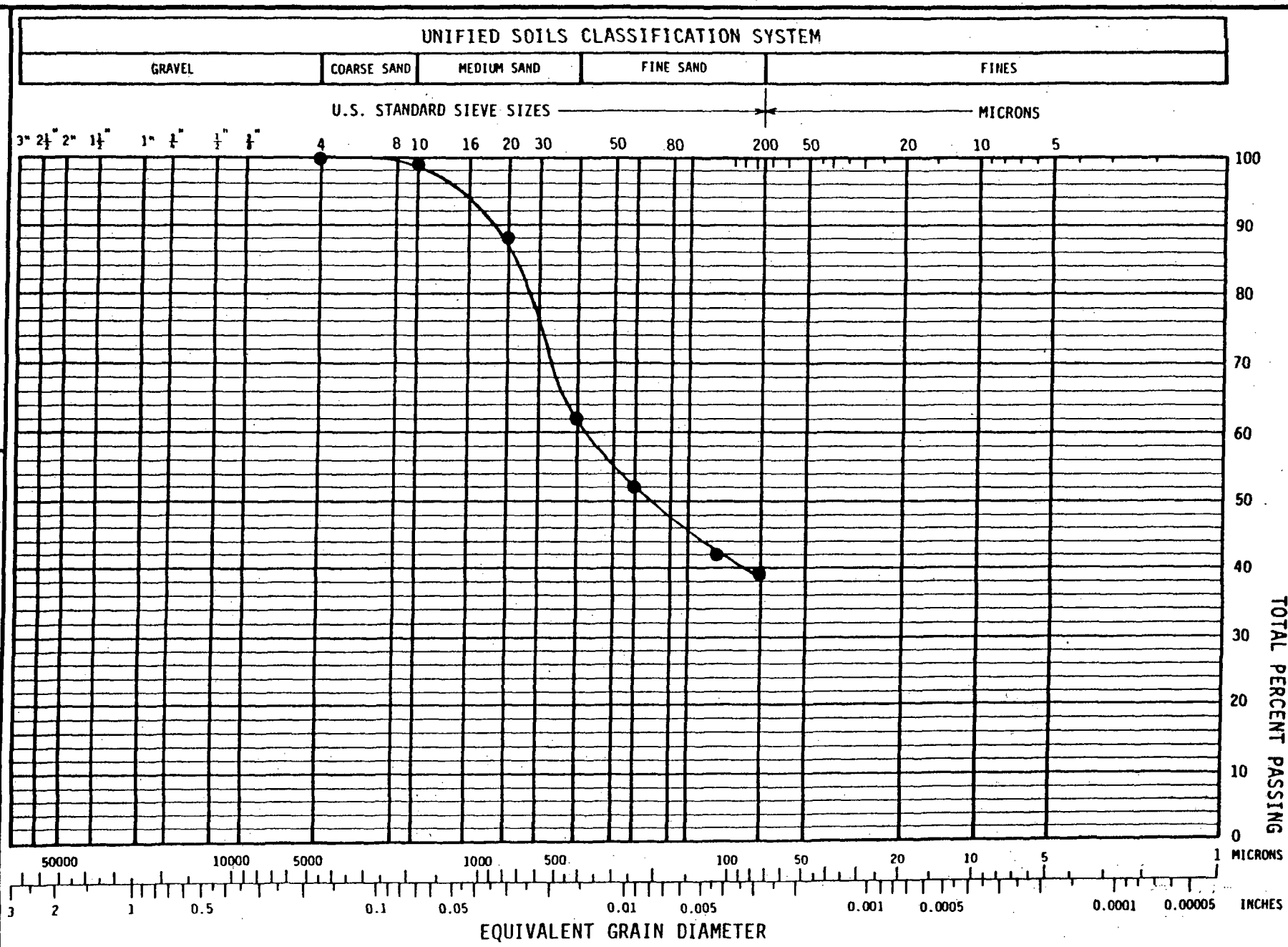
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION



BORING NO.

B-7 @ 19 to 21.5 Ft.

PLATE

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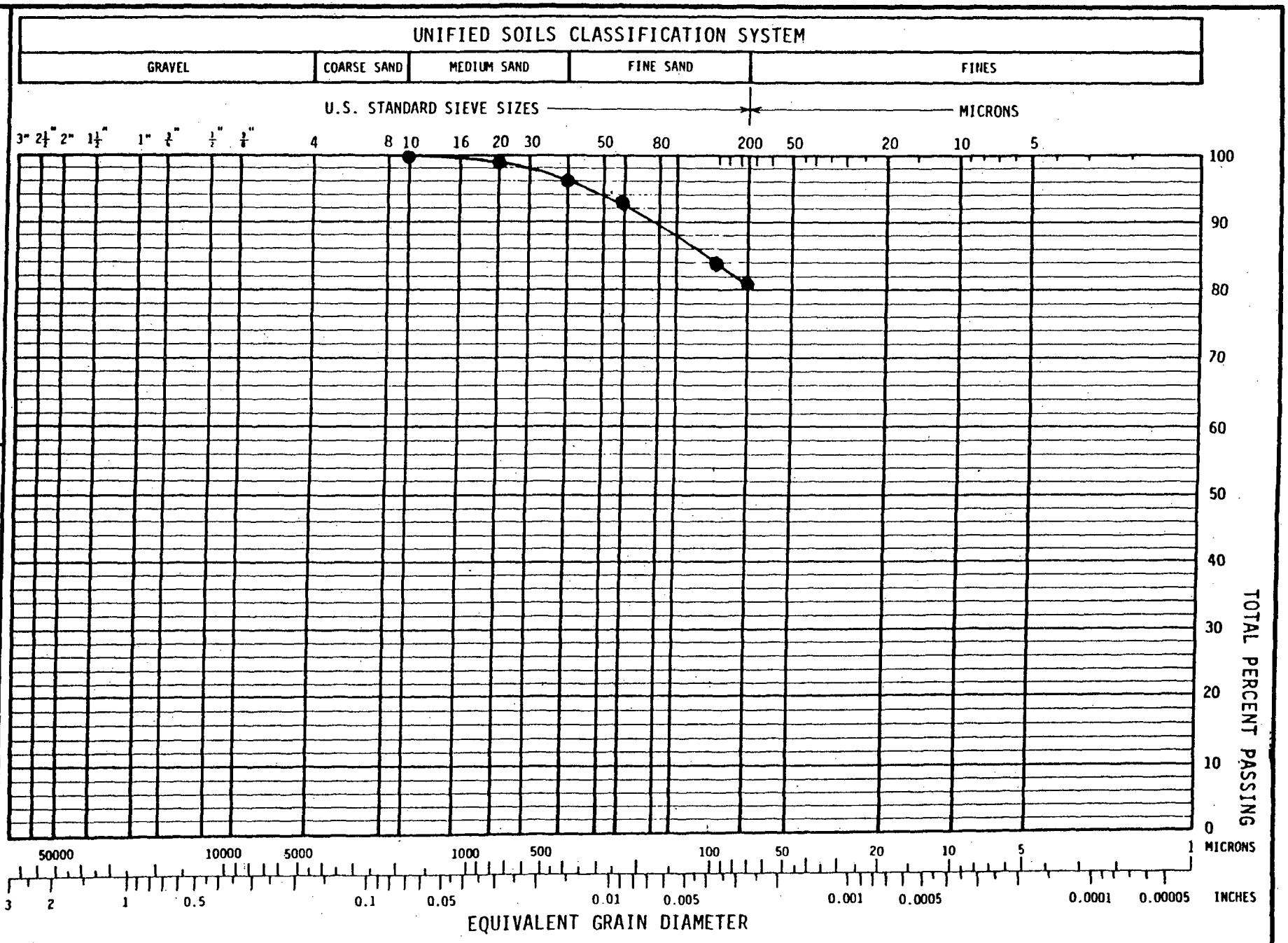
PROJECT NO. A-2676-1

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION



BORING NO.

B-8 @ 17.5 to 20 feet

PLATE

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PROJECT NO. A-2676-1

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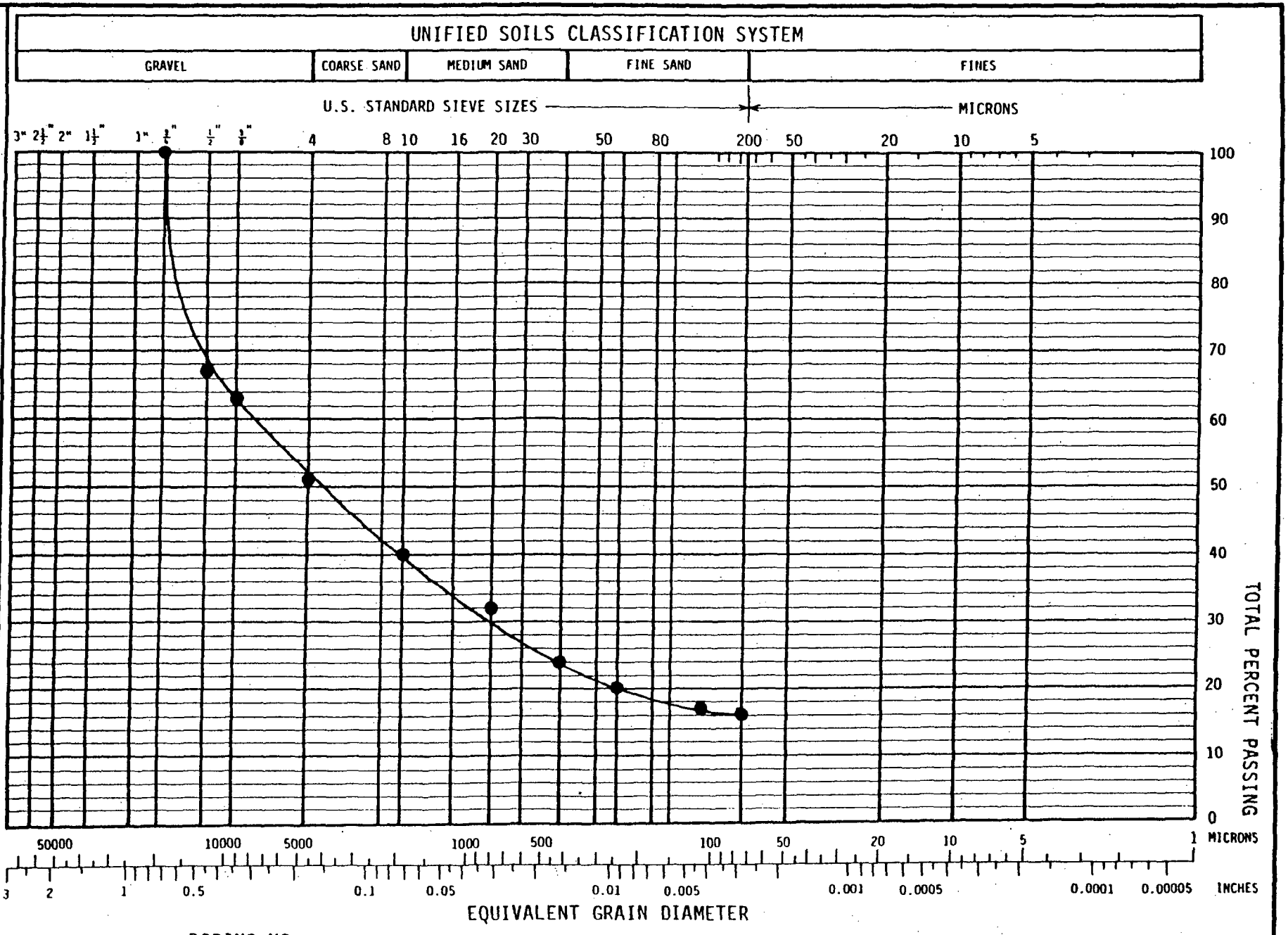
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION



BORING NO.
B-9 @ 20 to 22.5 Ft.

PLATE

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PROJECT NO. A 0676 1

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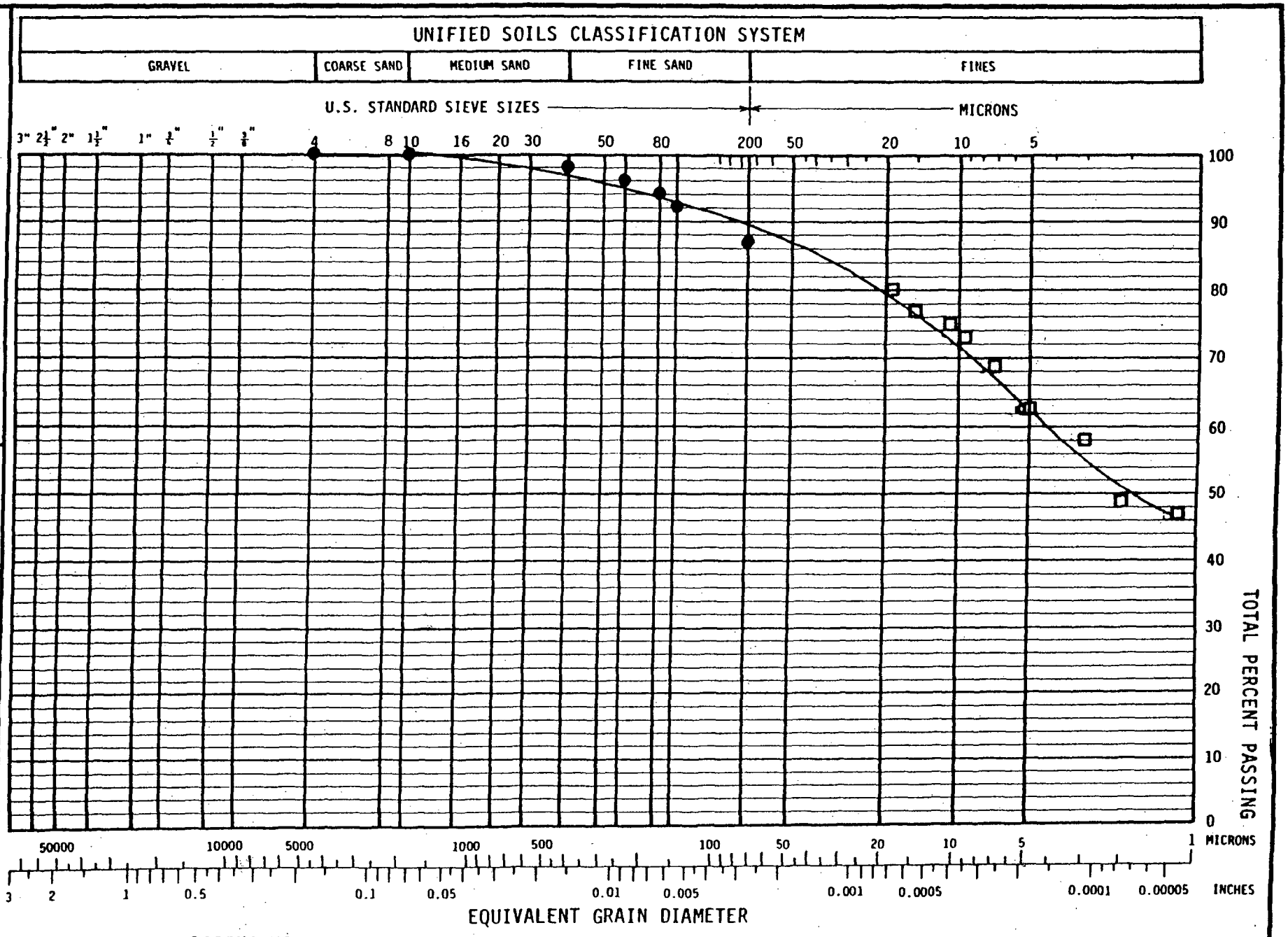
Rancho Seco Nuclear Generating
Station Unit 1

GRAIN SIZE DISTRIBUTION



BORING NO.

B-10 to 17.5 to 20 Ft.

● Sieve Analysis

□ Hydrometer Analysis

PLATE

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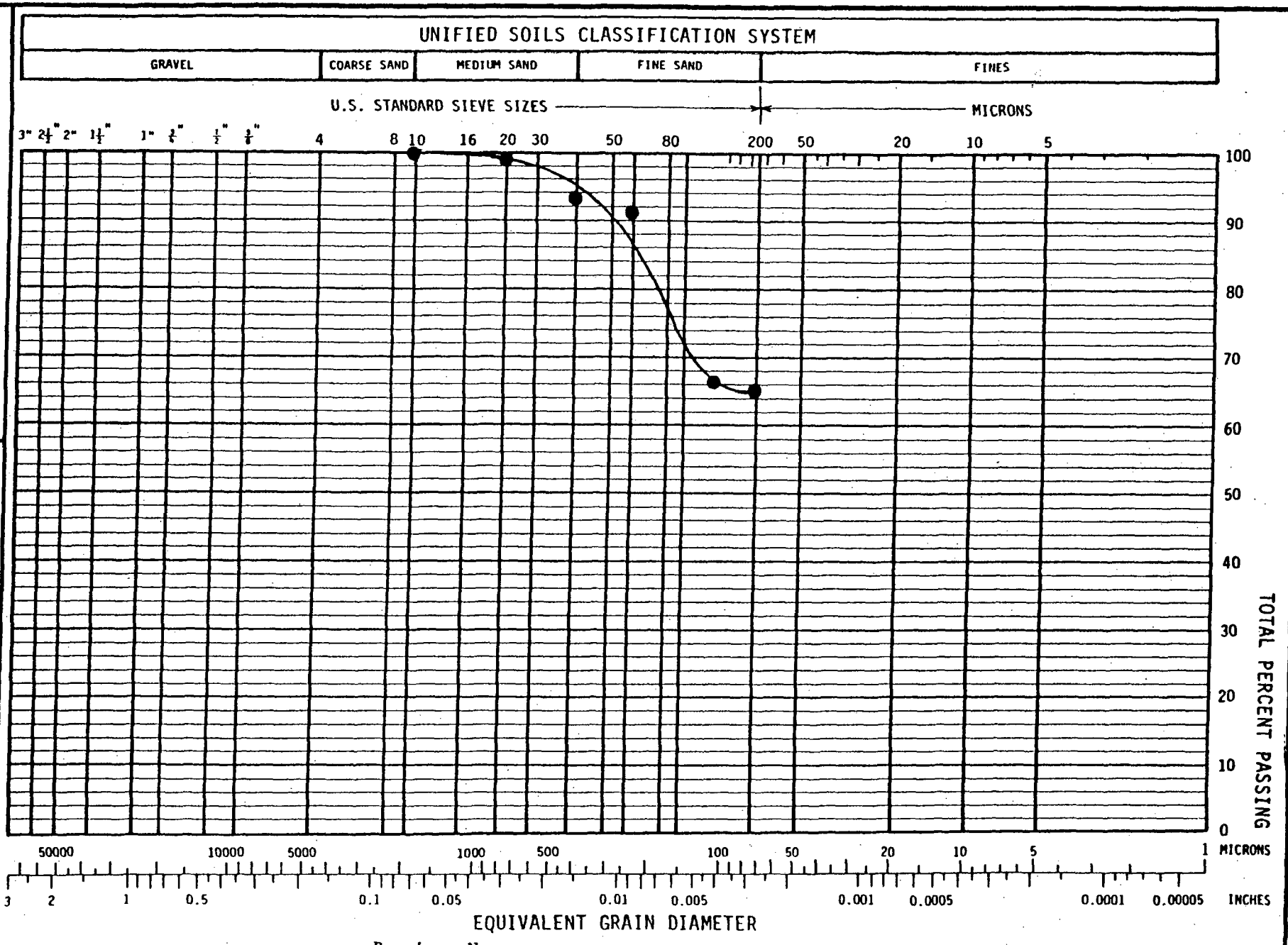
PROJECT NO. A-2676-1

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION



Boring No.
B-10 @ 22.5 to 25 Ft.

PLATE

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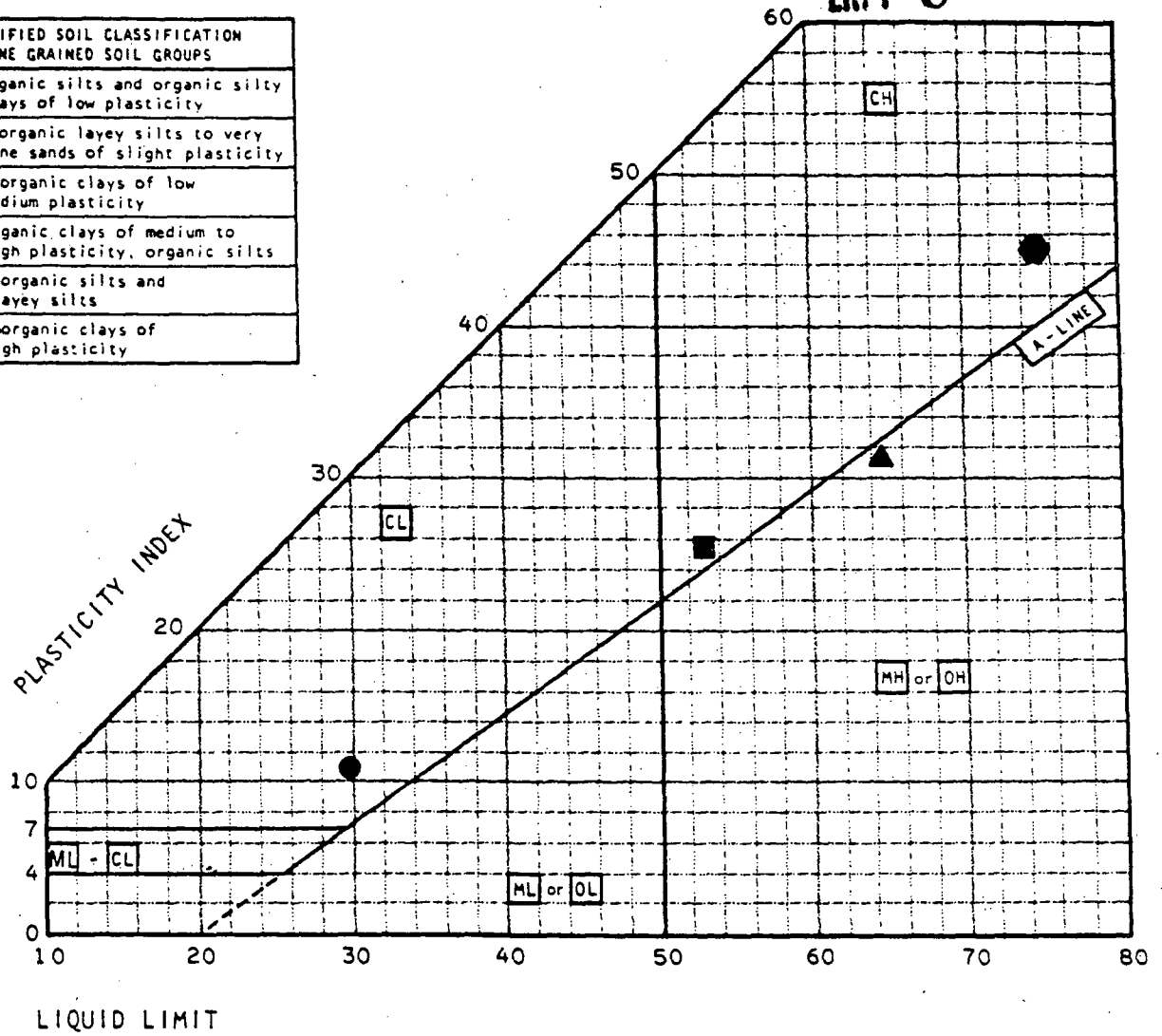
GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
OL	Organic silts and organic silty clays of low plasticity
ML	Inorganic layey silts to very fine sands of slight plasticity
CL	Inorganic clays of low medium plasticity
OH	Organic clays of medium to high plasticity, organic silts
MH	Inorganic silts and clayey silts
CH	Inorganic clays of high plasticity



TEST SYMBOL	Test Pit No.	Depth (ft)	LIQUID LIMIT	PLASTICITY INDEX	CLASSIFICATION
●	T-1	1.5	29.8	10.3	Clayey Gravel (GC)
■	T-1	9.0	52.6	25.4	Clayey Gravel (GC)
⬢	T-2	5.0	75.0	45.0	Silty Clay (CH)
▲	T-2	9.0	64.7	31.6	Clayey Silt (MH)

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Rancho Seco Nuclear Generating Station, Unit 1

PLASTICITY CHART

PLATE

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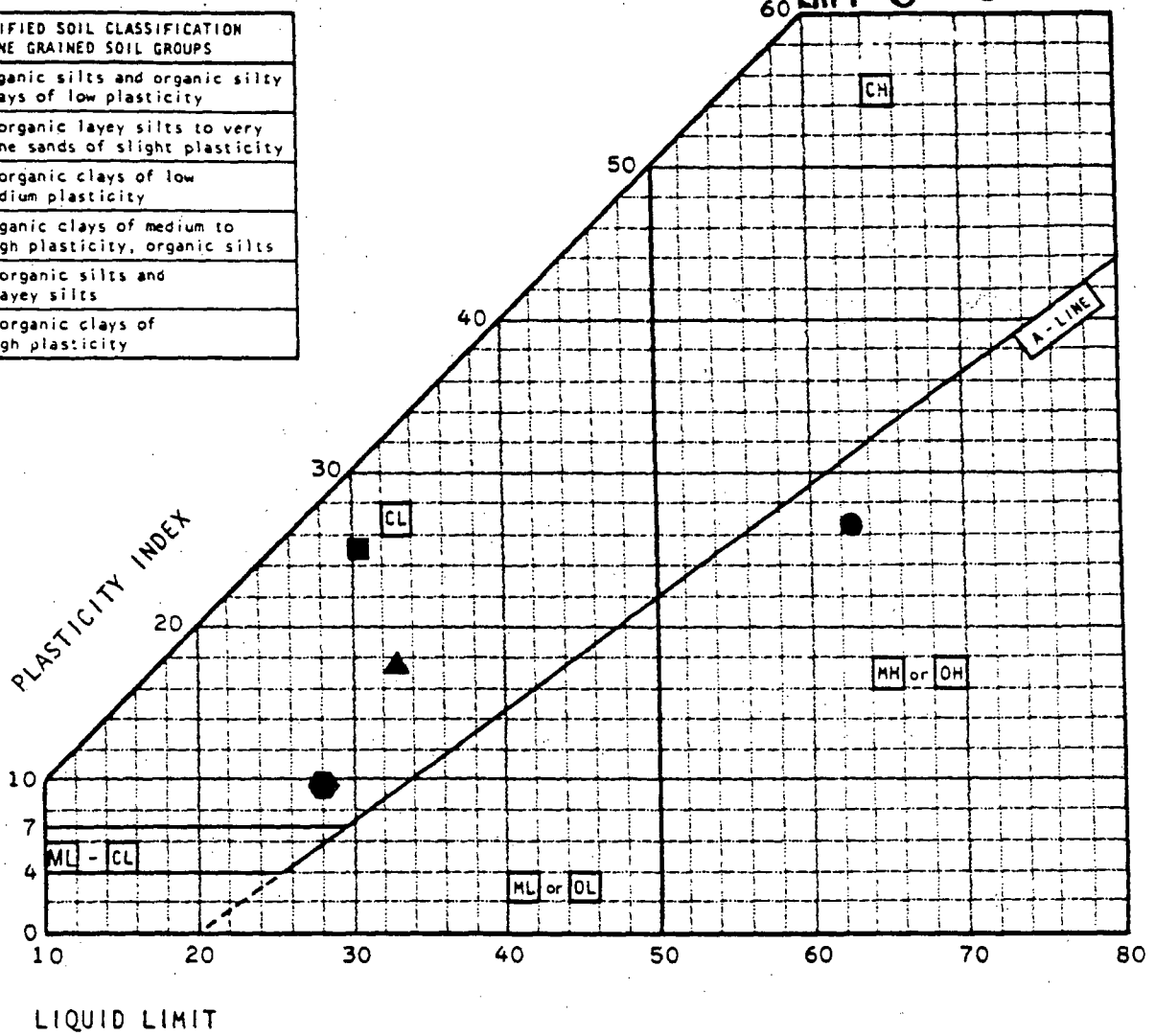

TEST SYMBOL	Test Pit No.	Depth (ft)	LIQUID LIMIT	PLASTICITY INDEX	CLASSIFICATION
●	T-2	12.5	62.4	26.4	Clayey Silt (MH)
■	T-3	1.0	30.2	25.3	Clayey Sand (SC)
⬢	T-4	1.0	28.0	9.7	Sandy Clay (CL)
▲	T-4	2.7	32.8	17.2	Silty Clay (CL)

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Rancho Seco Nuclear Generating Station, Unit 1

PLASTICITY CHART

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ERPT C 0104

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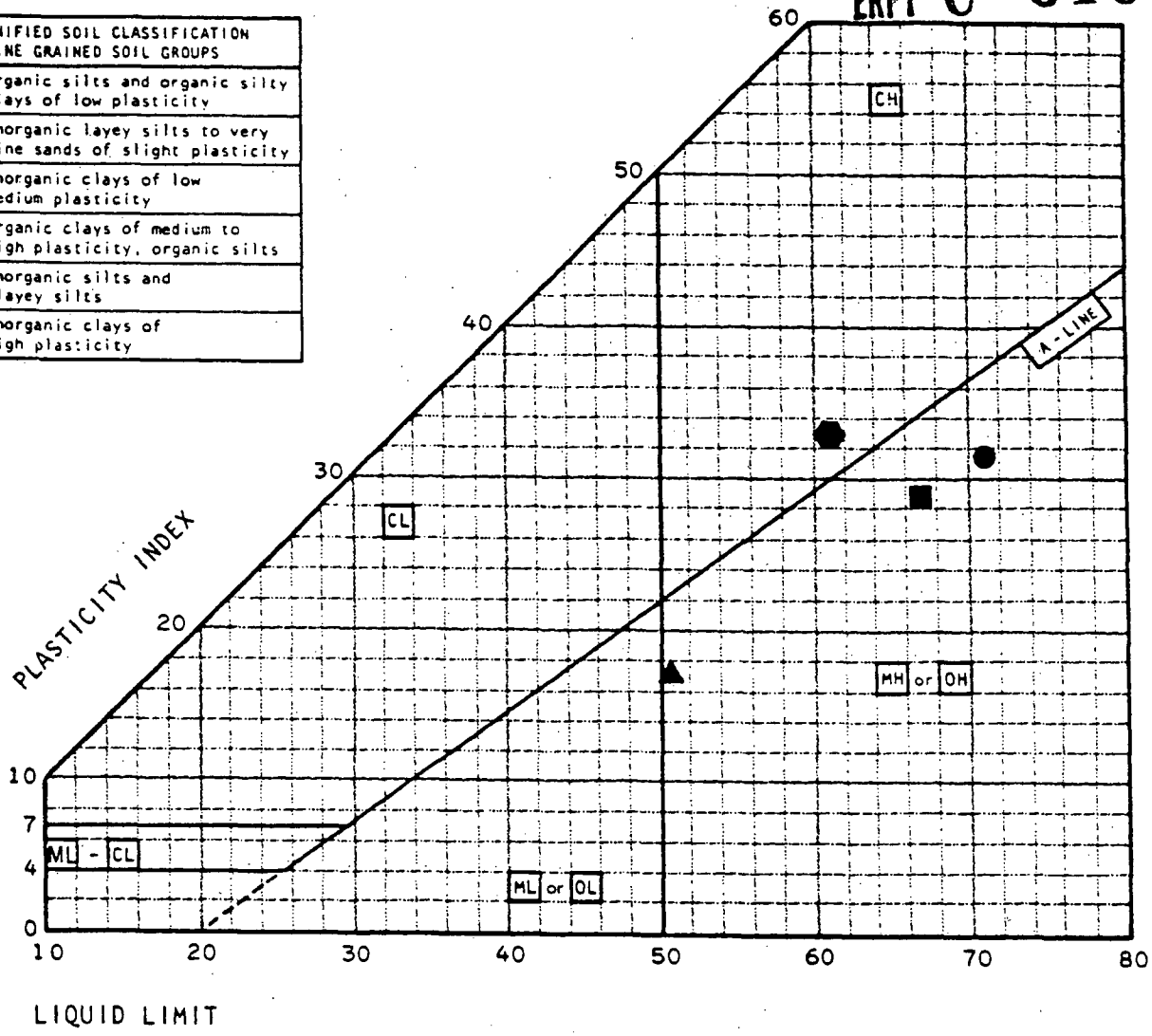

TEST SYMBOL	BORING NO.	Depth (ft)	LIQUID LIMIT	PLASTICITY INDEX	CLASSIFICATION
●	B-2	6-7.5	71.3	31.5	Clayey Silt
■	B-3	15-16.5	67.3	28.8	Clayey Silt (MH)
⬢	B-6	10-12.5	61.0	33 .0	Silty Clay (CH)
▲	B-6	15-17.5	50.2	17.2	Clayey Silt (MH)

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Rancho Seco Nuclear Generating Station, Unit 1

PLASTICITY CHART

PLATE

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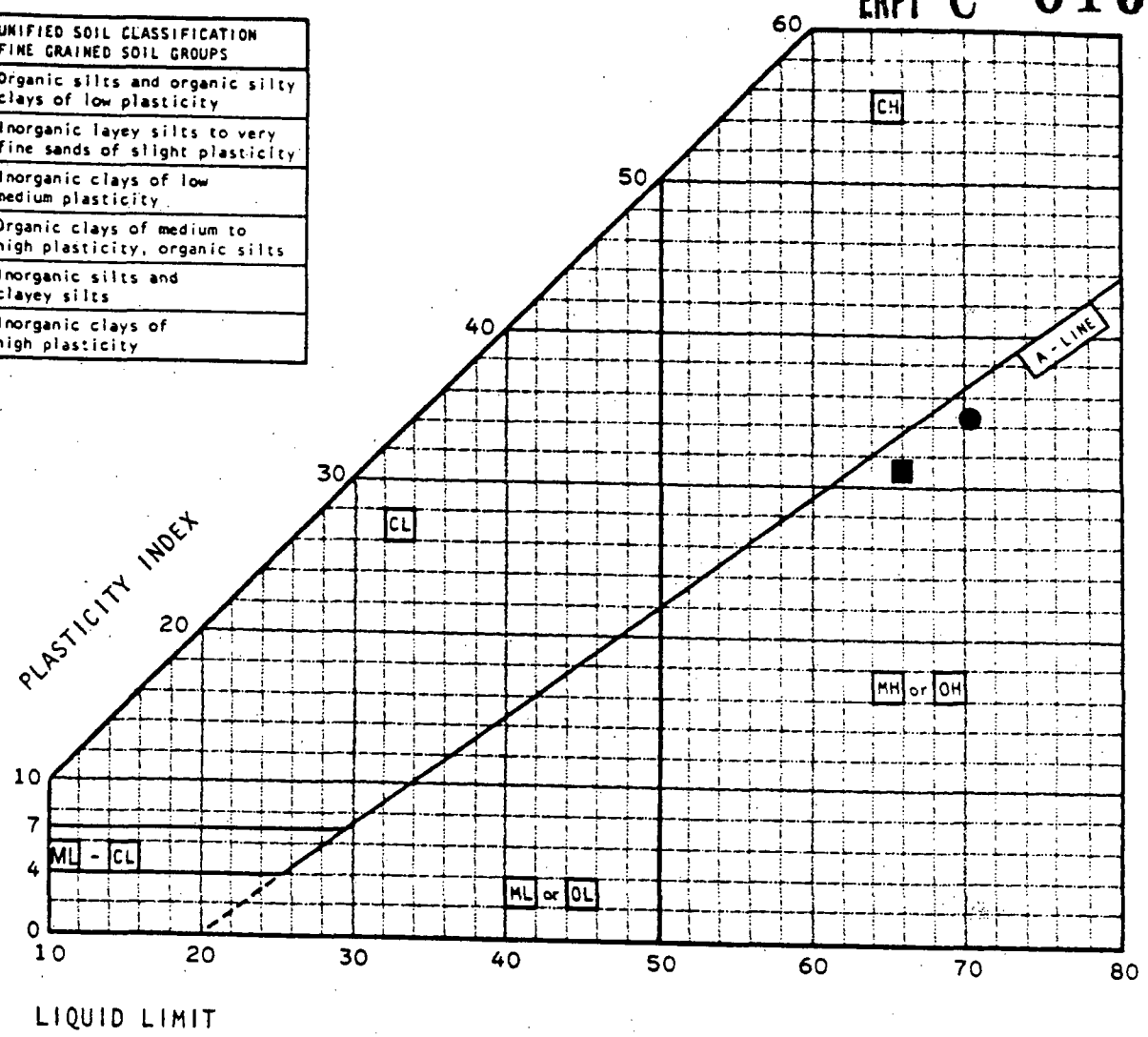

TEST SYMBOL	BORING NO.	Depth (ft)	LIQUID LIMIT	PLASTICITY INDEX	CLASSIFICATION
●	B-10	12.5-15	70.2	34.3	Clayey Silt (MH)
■	B-10	17.5-20	66.0	31.0	Clayey Silt (MH)

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Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

PLASTICITY CHART

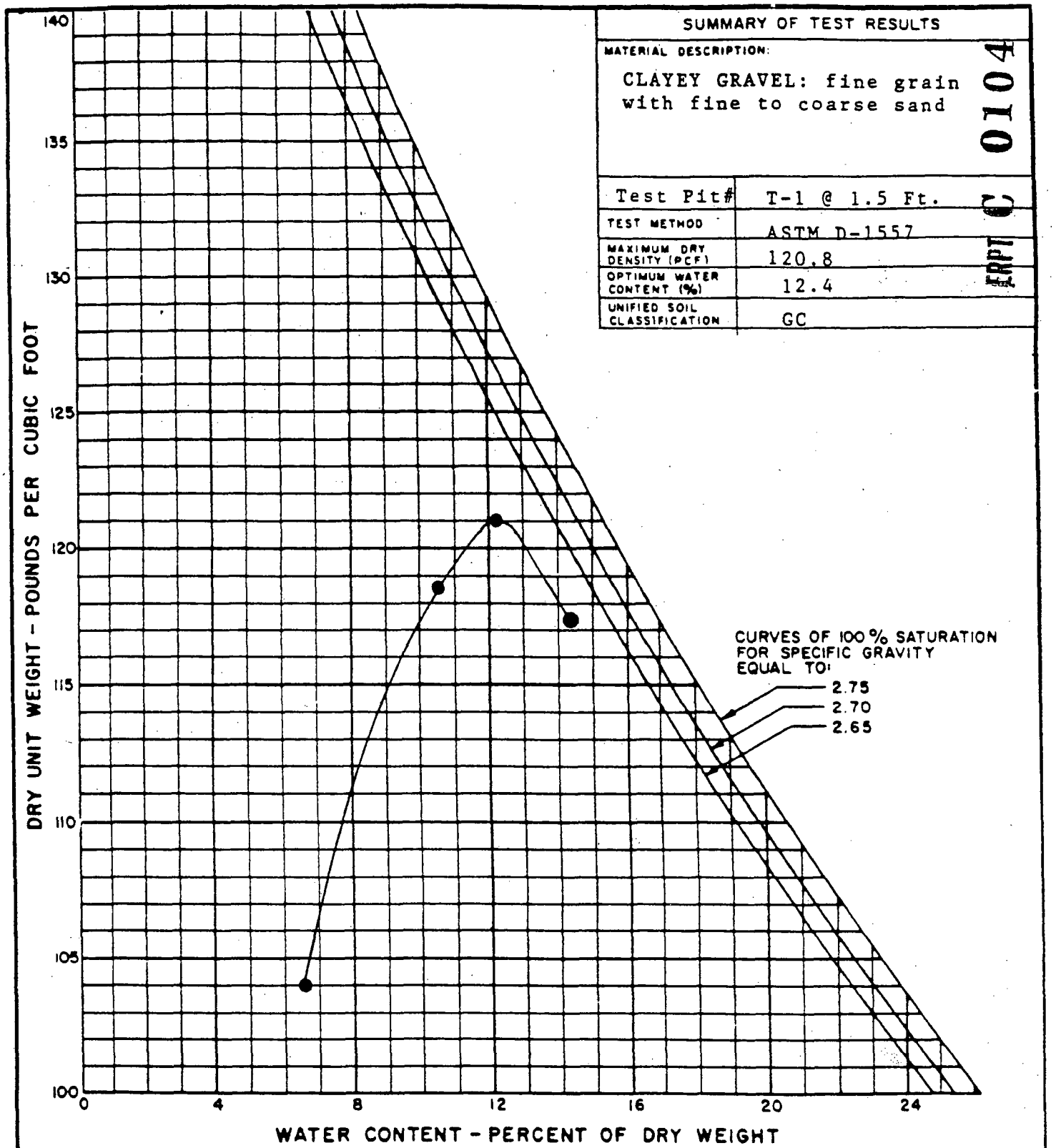
PLATE

COMPACTION TESTS

Test: ASTM 1557

Test Pit	T-1	T-2	T-3
Depth:	1.5'	5.0'	1.0'
Maximum Density	120.8 lbs.	131.5 lbs.	119.9 lbs.
Optimum Moisture	12.4%	9.0%	11.0%

Test Pit	T-3	T-4	T-4
Depth	3.5'	1.0'	2.7'
Maximum Density	124.2 lbs.	123.5 lbs	126.5 lbs.
Optimum Moisture	11.2 %	9.0%	10.4%



SUMMARY OF TEST RESULTS

MATERIAL DESCRIPTION:

CLAYEY GRAVEL: fine grain with fine to coarse sand

Test Pit#	T-1 @ 1.5 Ft.
TEST METHOD	ASTM D-1557
MAXIMUM DRY DENSITY (PCF)	120.8
OPTIMUM WATER CONTENT (%)	12.4
UNIFIED SOIL CLASSIFICATION	GC

0104

RPT C

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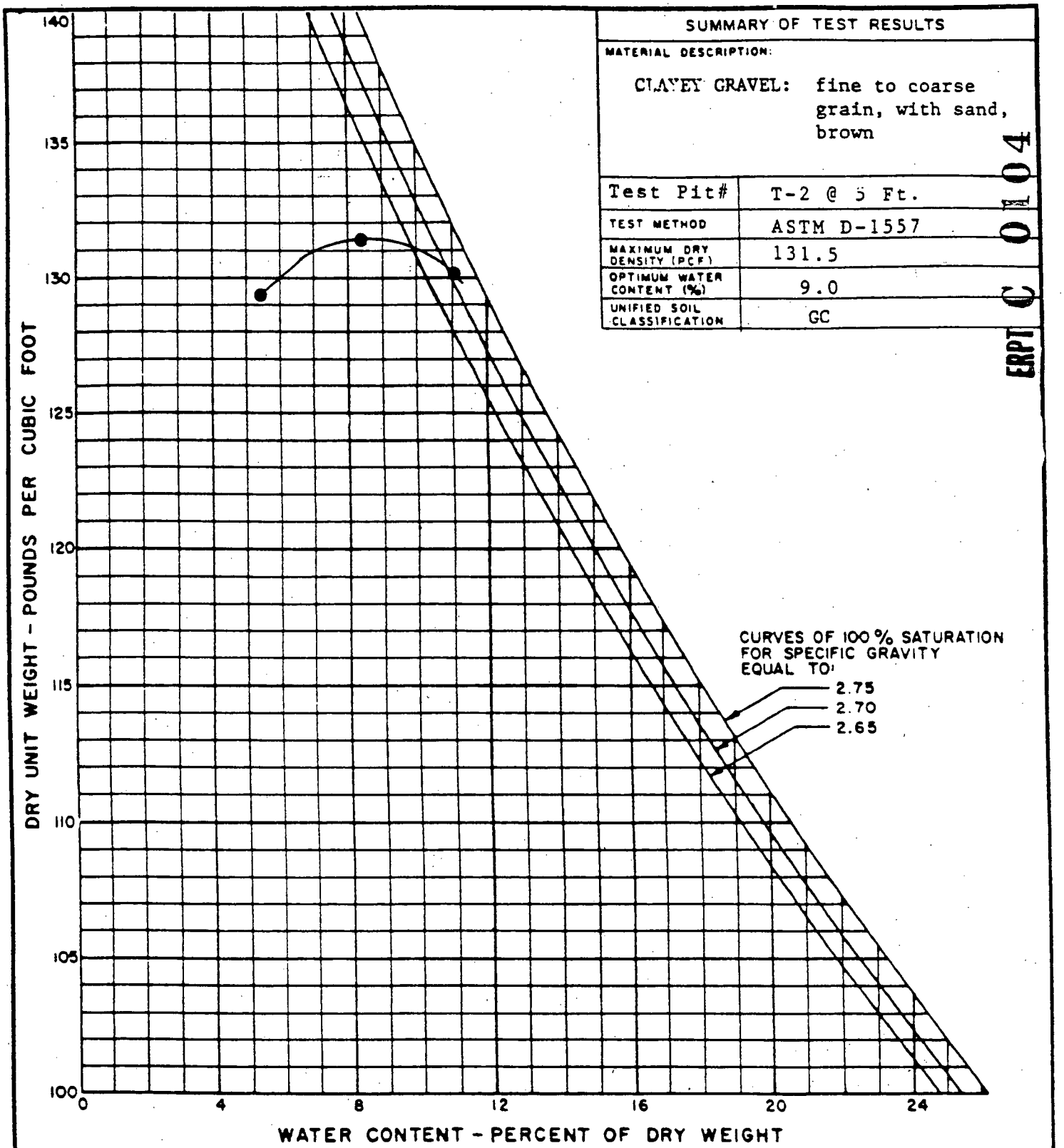
Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

PREPARED BY: DATE

CHECKED BY: DATE

COMPACTION DIAGRAM

PROJECT NO. A-2676-1 PLATE NO.



SUMMARY OF TEST RESULTS

MATERIAL DESCRIPTION:

CLAYEY GRAVEL: fine to coarse grain, with sand, brown

Test Pit#	T-2 @ 5 Ft.
TEST METHOD	ASTM D-1557
MAXIMUM DRY DENSITY (PCF)	131.5
OPTIMUM WATER CONTENT (%)	9.0
UNIFIED SOIL CLASSIFICATION	GC

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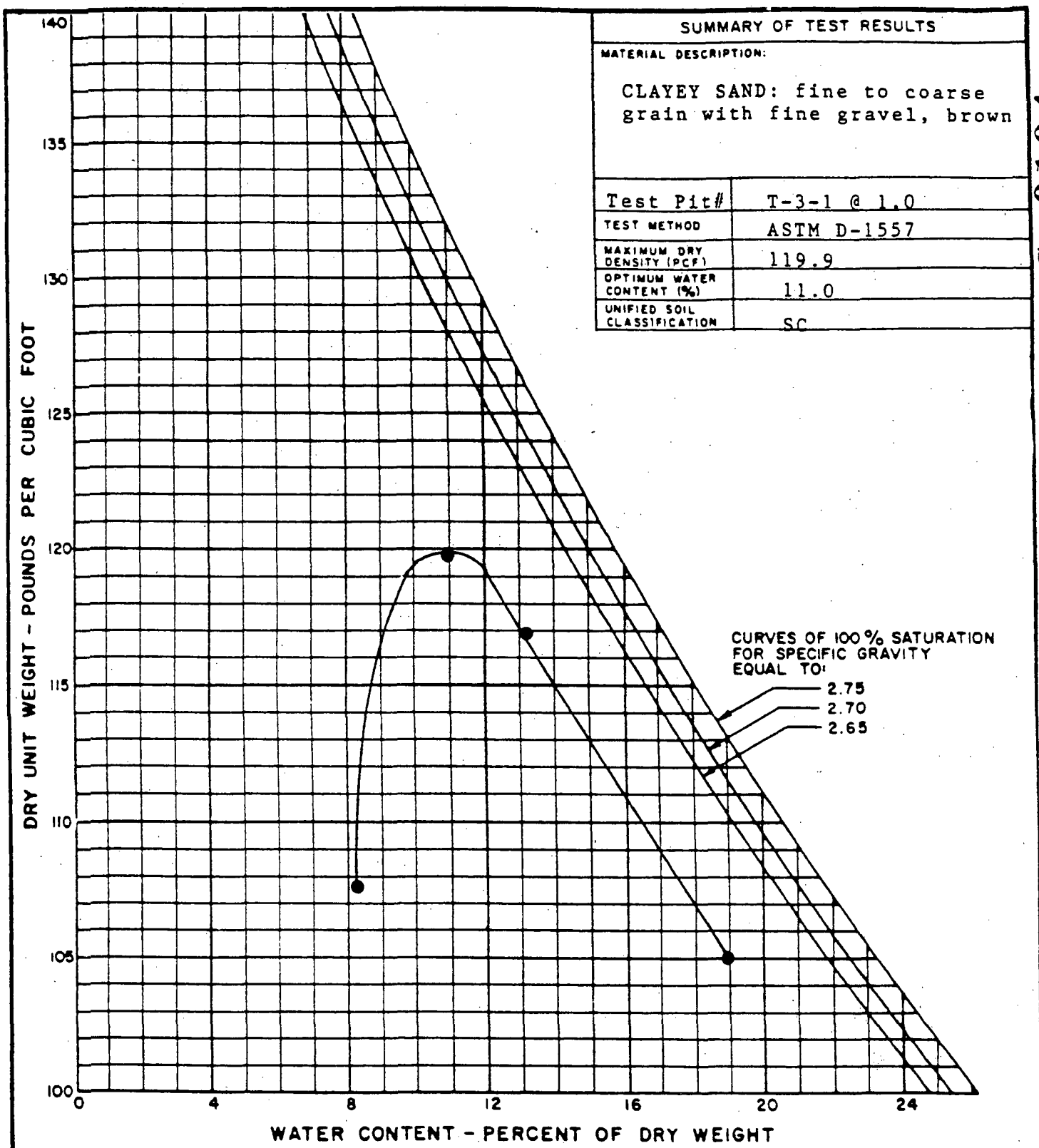
Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

PREPARED BY: DATE:

CHECKED BY: DATE:

COMPACTION DIAGRAM

PROJECT NO. A-2676-1 PLATE NO.



SUMMARY OF TEST RESULTS

MATERIAL DESCRIPTION:

CLAYEY SAND: fine to coarse grain with fine gravel, brown

Test Pit#	T-3-1 @ 1.0
TEST METHOD	ASTM D-1557
MAXIMUM DRY DENSITY (PCF)	119.9
OPTIMUM WATER CONTENT (%)	11.0
UNIFIED SOIL CLASSIFICATION	SC

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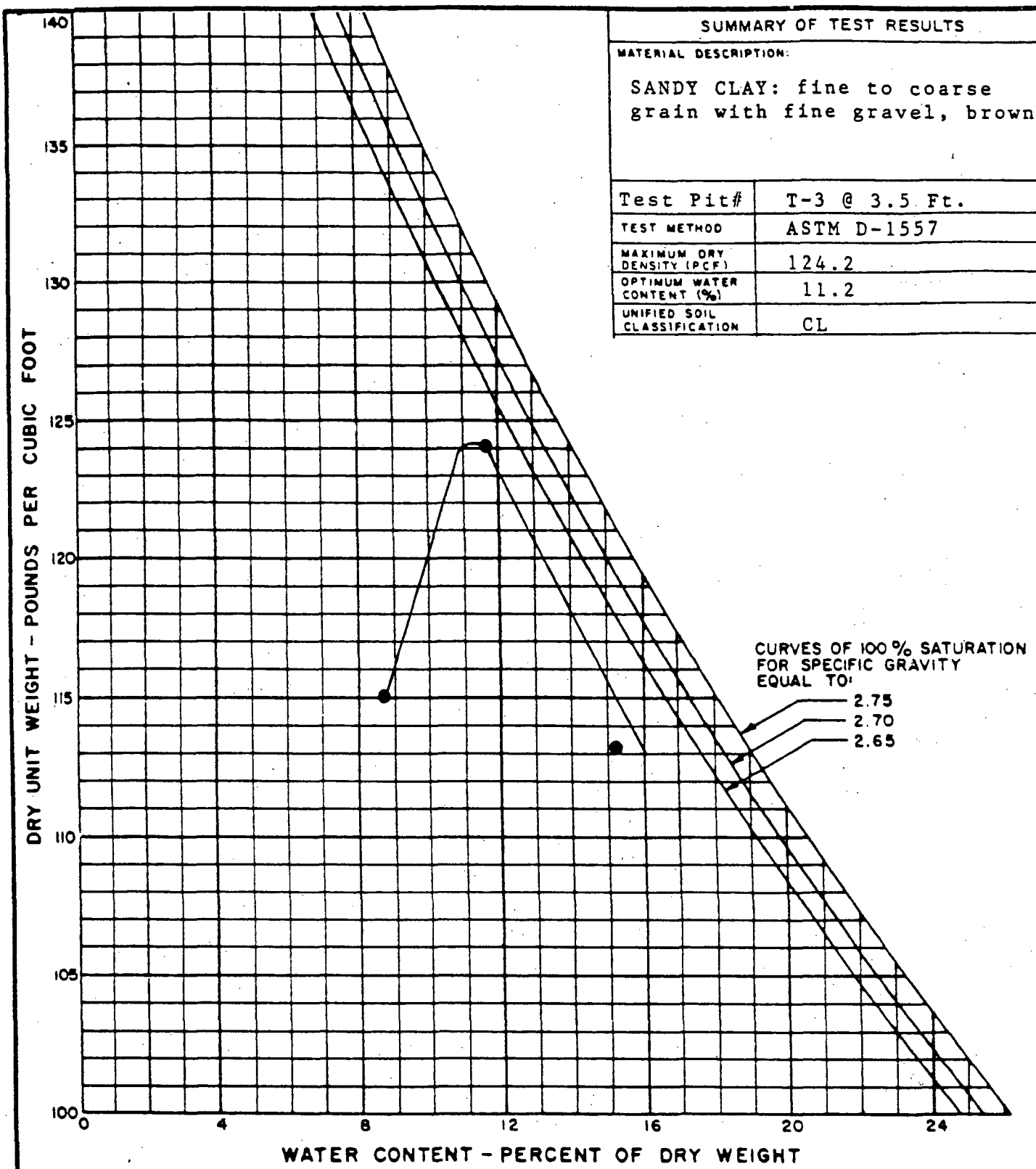
Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

PREPARED BY: DATE

CHECKED BY: DATE

COMPACTION DIAGRAM

PROJECT NO. A-2676-1 PLATE NO.



SUMMARY OF TEST RESULTS	
MATERIAL DESCRIPTION: SANDY CLAY: fine to coarse grain with fine gravel, brown	
Test Pit#	T-3 @ 3.5 Ft.
TEST METHOD	ASTM D-1557
MAXIMUM DRY DENSITY (PCF)	124.2
OPTIMUM WATER CONTENT (%)	11.2
UNIFIED SOIL CLASSIFICATION	CL

ERPT C 0104

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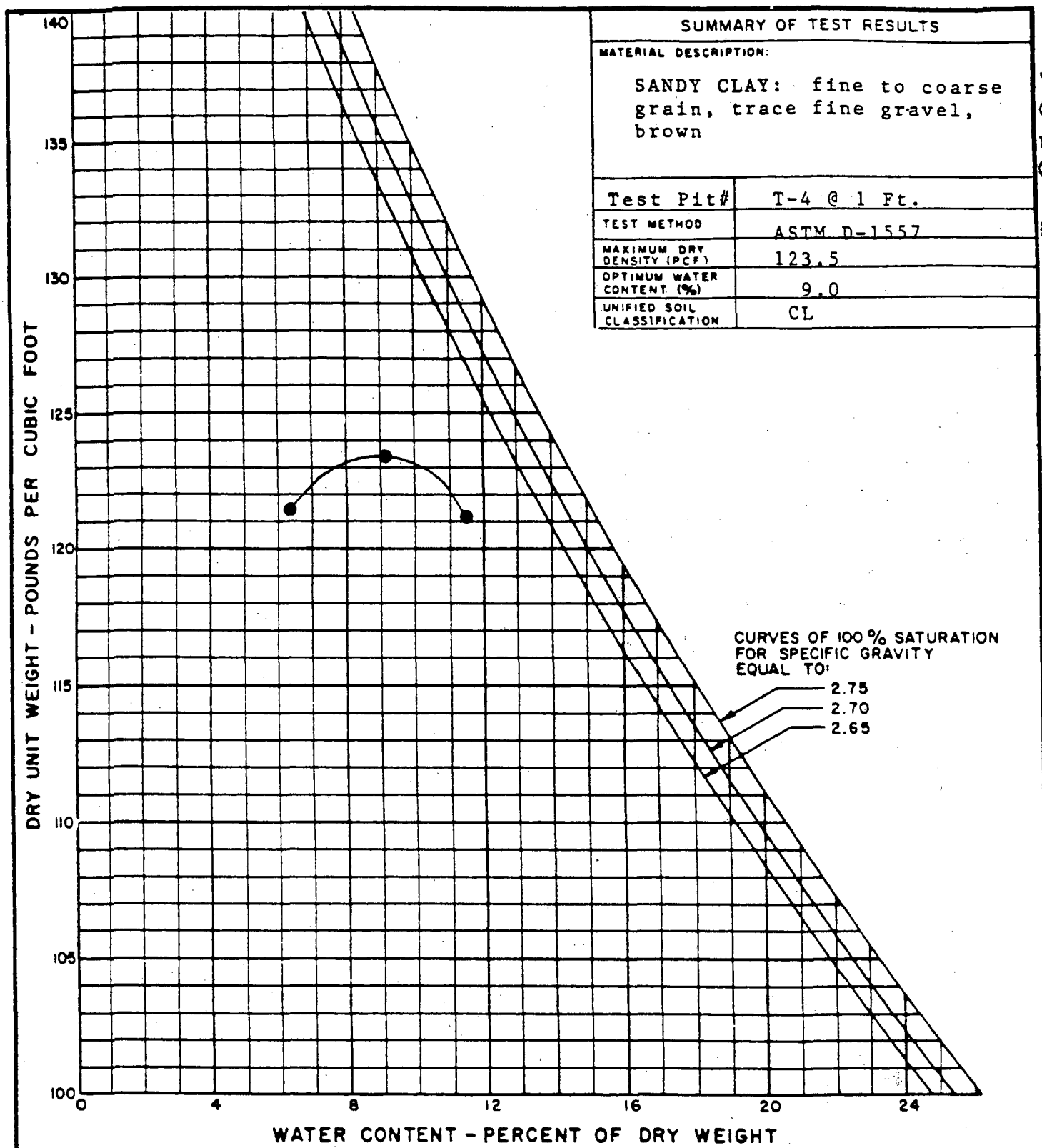
Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

PREPARED BY: DATE

CHECKED BY: DATE

COMPACTION DIAGRAM

PROJECT NO. A-2676-1 PLATE NO.



SUMMARY OF TEST RESULTS

MATERIAL DESCRIPTION:

SANDY CLAY: fine to coarse grain, trace fine gravel, brown

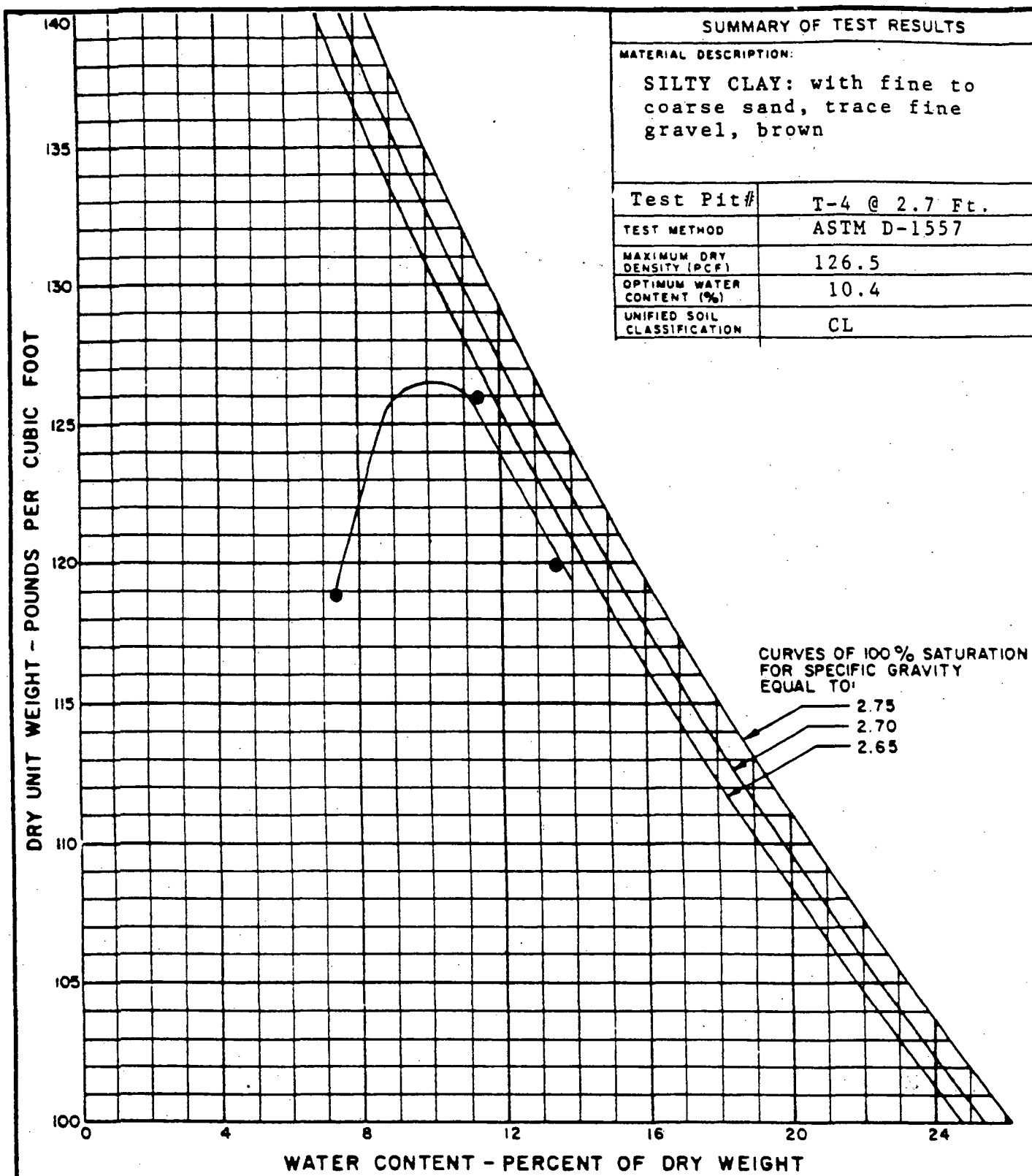
Test Pit#	T-4 @ 1 Ft.
TEST METHOD	ASTM D-1557
MAXIMUM DRY DENSITY (PCF)	123.5
OPTIMUM WATER CONTENT (%)	9.0
UNIFIED SOIL CLASSIFICATION	CL

ERPT C 0104

J. H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS ENGINEERING LABORATORIES

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

PREPARED BY:	DATE	COMPACTION DIAGRAM	
CHECKED BY	DATE	PROJECT NO. A-2676-1	PLATE NO.



SUMMARY OF TEST RESULTS

MATERIAL DESCRIPTION:

SILTY CLAY: with fine to coarse sand, trace fine gravel, brown

Test Pit#	T-4 @ 2.7 Ft.
TEST METHOD	ASTM D-1557
MAXIMUM DRY DENSITY (PCF)	126.5
OPTIMUM WATER CONTENT (%)	10.4
UNIFIED SOIL CLASSIFICATION	CL

ERPI C 0104

J. H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS ENGINEERING LABORATORIES

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

PREPARED BY: DATE

CHECKED BY: DATE

COMPACTION DIAGRAM

PROJECT NO. A-2676-1 PLATE NO.

A-2676-1

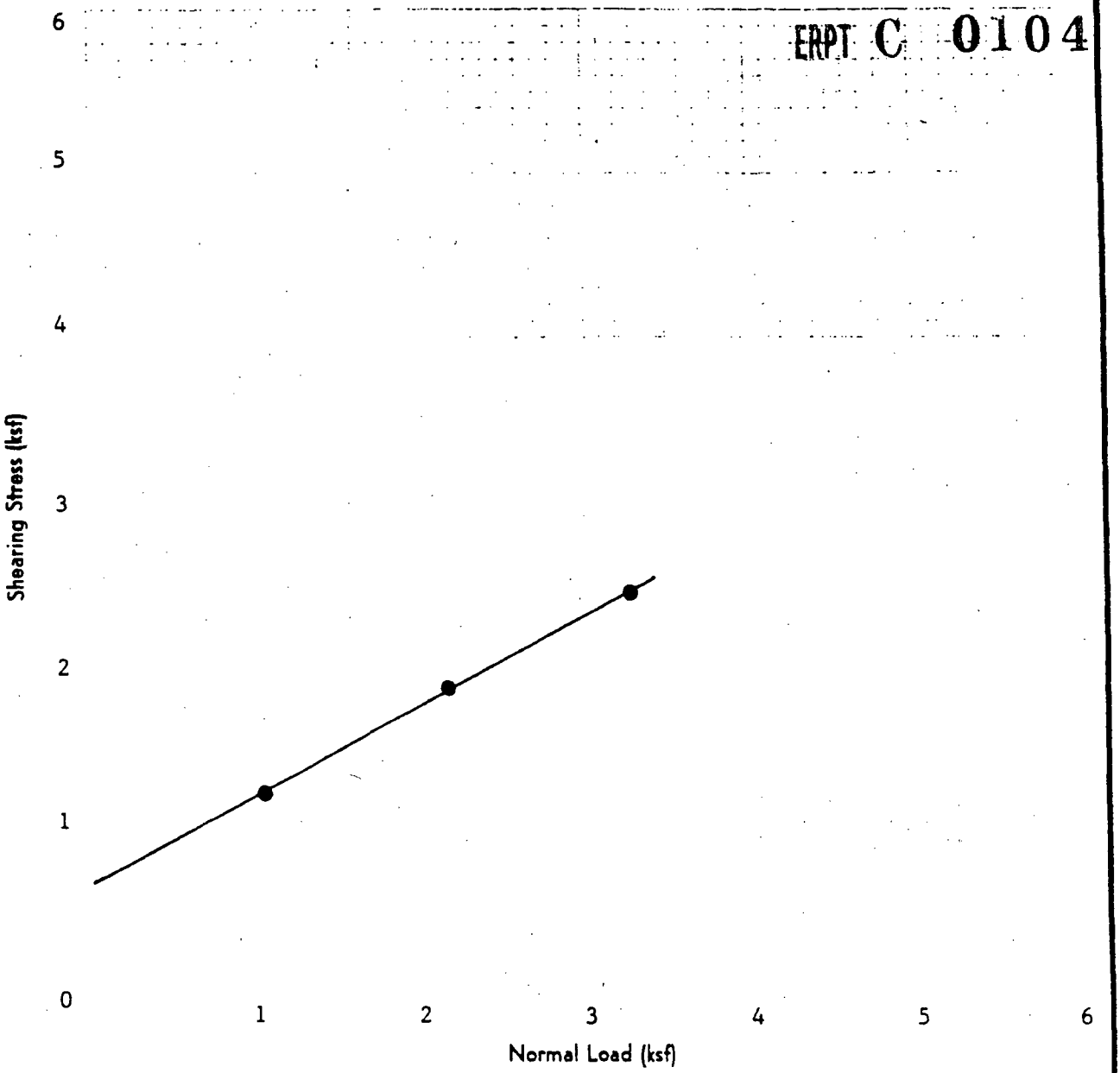
TRIAXIAL COMPRESSION

UNCONSOLIDATED-UNDRAINED

Boring	B-6	B-6	B-10
Depth (ft)	10-12½	15-17½	17½-20
(PSI)	8	12	14
Shear Stress (PSF)	1400	2900	1000
Dry Density (PCF)	83.5	62.4	60.1
Moisture (%)	36.1	50.8	64.7

UNCONFINED COMPRESSION

Boring:	B-2	B-10
Depth :	6'-7.5'	12.5'-15'
Moisture Content:	39%	40.8%
Unit Weight Wet :	111.9 lb.	114.7 lb.
Unit Weight Dry :	80.5 lb.	81.5 lb.
T.S.F. :	4.13	1.34



Test Pit T-1

Depth 1.5'

Sample Description brown fine Sandy SILT with aggregate

Special Loading Conditions

Initial Dry Density-pcf 111.8

Initial Water Content-% 14.2

Cohesion-ksf 0.70

Angle of Internal Friction

Ø= 28°

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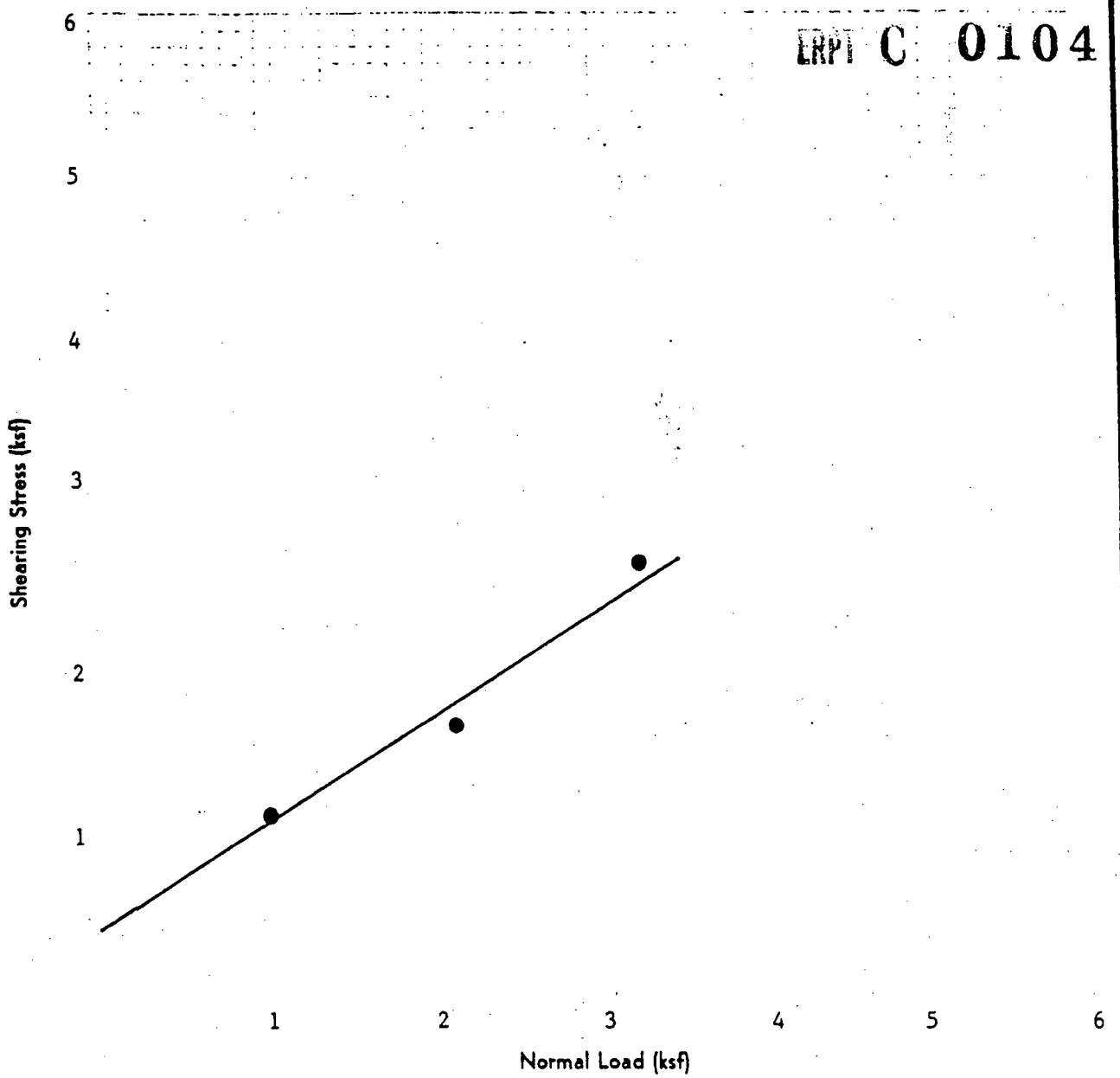
GEOTECHNICAL CONSULTANTS — MATERIALS TESTING

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

PREPARED BY:	DATE:	DIRECT SHEAR TEST	
CHECKED BY:	DATE:	PROJECT NO. A-2676-1	PLATE NO.



Test Pit T-3
Depth 3.5
Sample Description Brown SILT with aggregate
Special Loading Conditions

Initial Dry Density-pcf 119.0
Initial Water Content-% 10.7
Cohesion-ksf 0.42
Angle of Internal Friction
Ø= 33°

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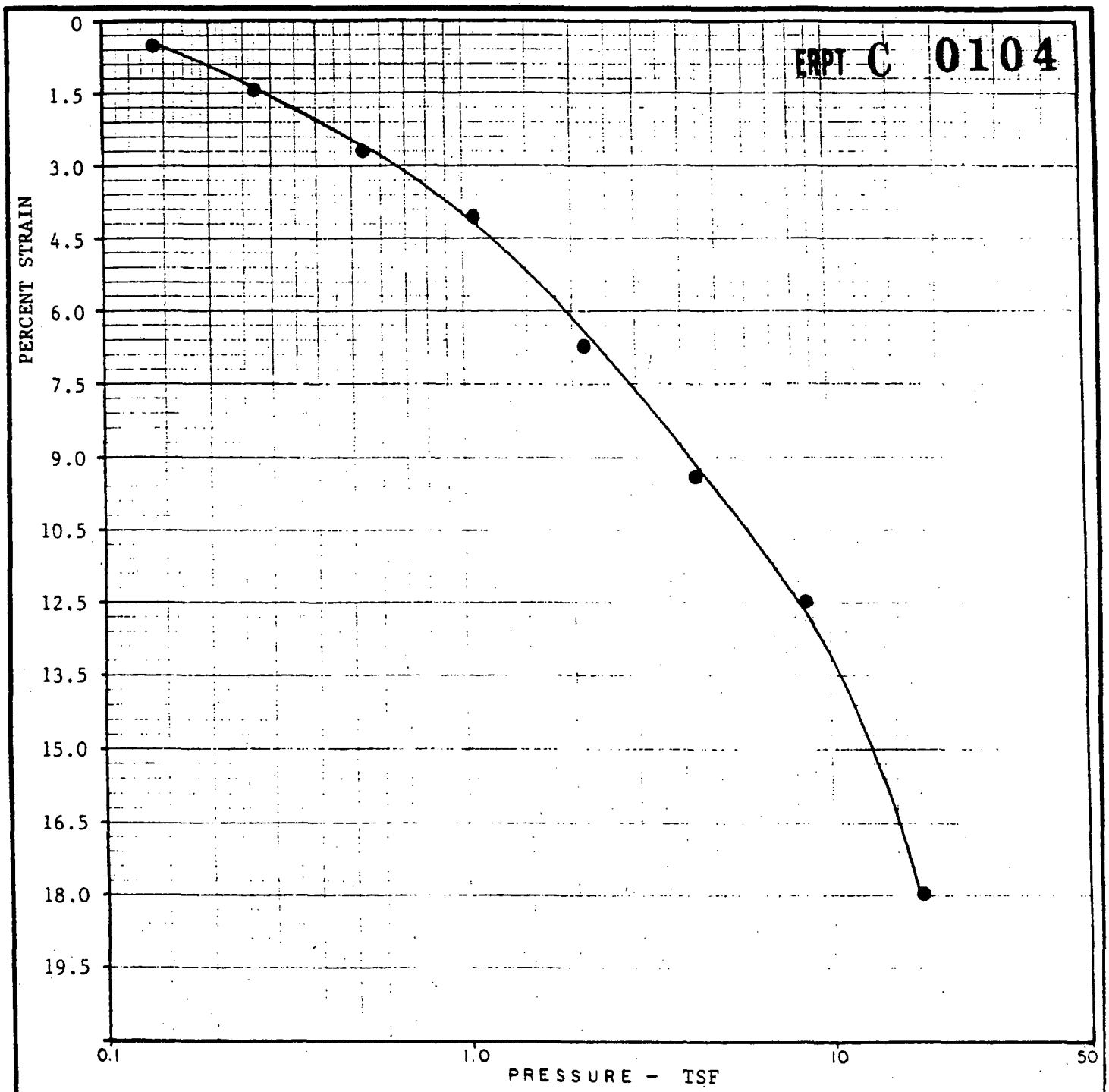
GEOTECHNICAL CONSULTANTS — MATERIALS TESTING

Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating Station, Unit 1

PREPARED BY:	DATE:	DIRECT SHEAR TEST	
CHECKED BY:	DATE:	PROJECT NO. A-2676-1	PLATE NO.



BORING NO. B-1

DEPTH 5-7.5 Ft.

SAMPLE DESCRIPTION reddish-brown Clayey SILT

	INITIAL	FINAL
DRY DENSITY - PCF	78.7	78.7
WATER CONTENT - %	26.5	27.7

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Evaporation Pond, SMUD Task 059
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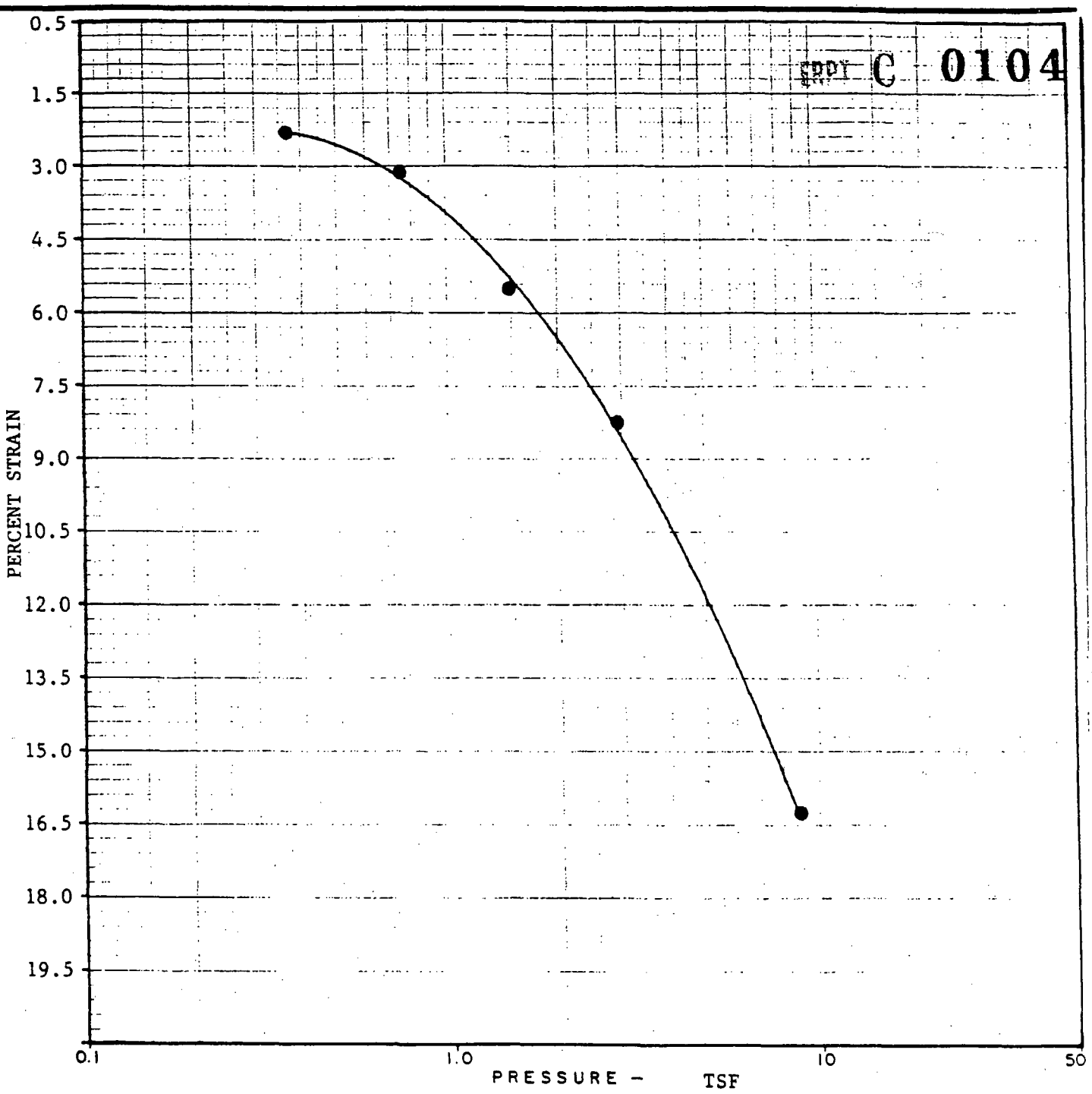
CHECKED BY: DATE:

CONSOLIDATION TEST DATA

PROJECT NO. A-2676-1 PLATE NO.



BORING NO. B-6

DEPTH 10-12.5 Ft.

SAMPLE DESCRIPTION brown Silty CLAY

	INITIAL	FINAL
DRY DENSITY - PCF	82.0	82.0
WATER CONTENT - %	34.5	35.7

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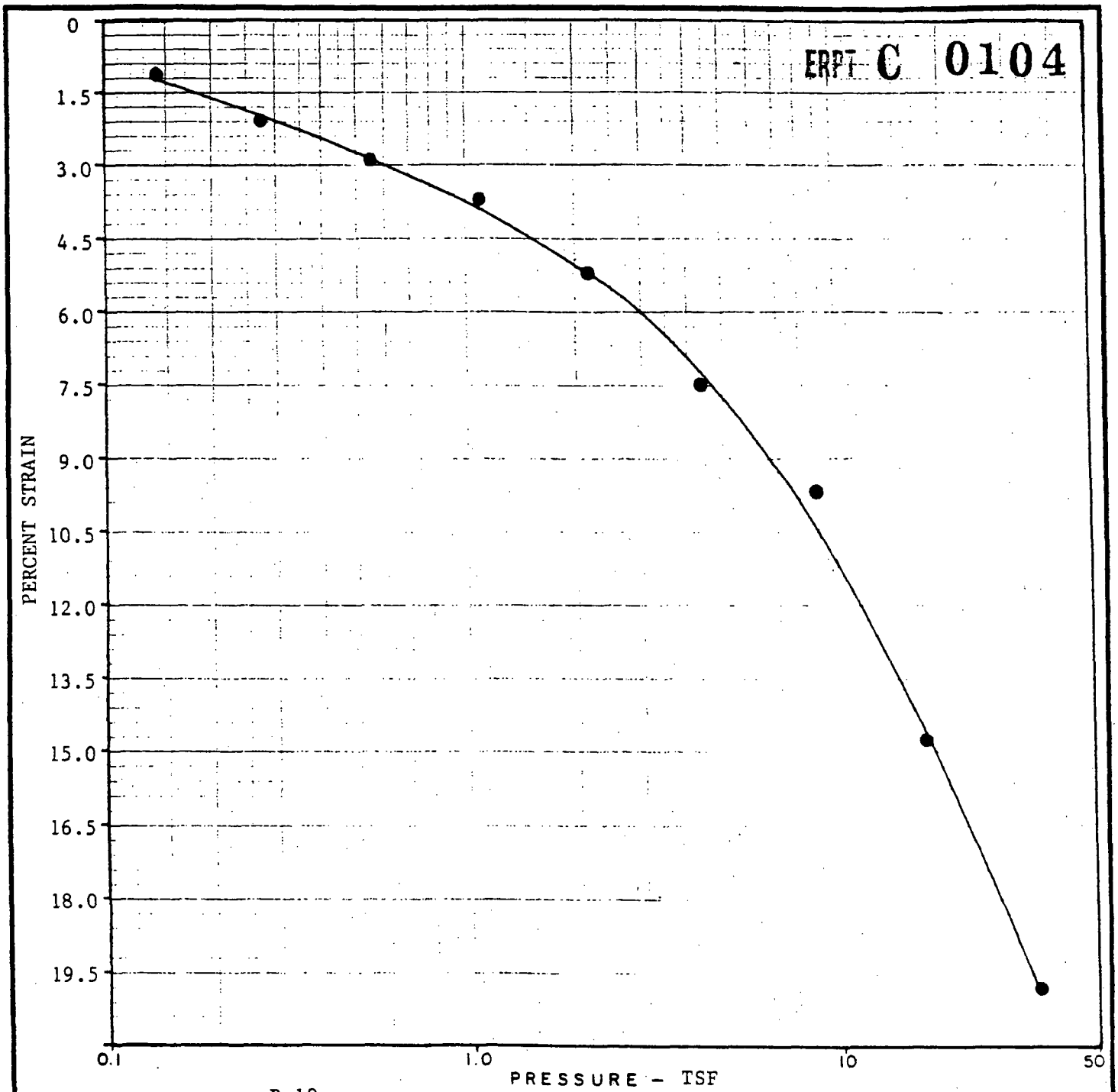
CHECKED BY: DATE:

CONSOLIDATION TEST DATA

PROJECT NO. A-2676-1 | PLATE NO.



BORING NO. B-10

DEPTH 12.5 - 15.0 Ft.

SAMPLE DESCRIPTION brown-CLAY

	INITIAL	FINAL
DRY DENSITY - PCF	72.2	72.2
WATER CONTENT - %	41.2	35.4

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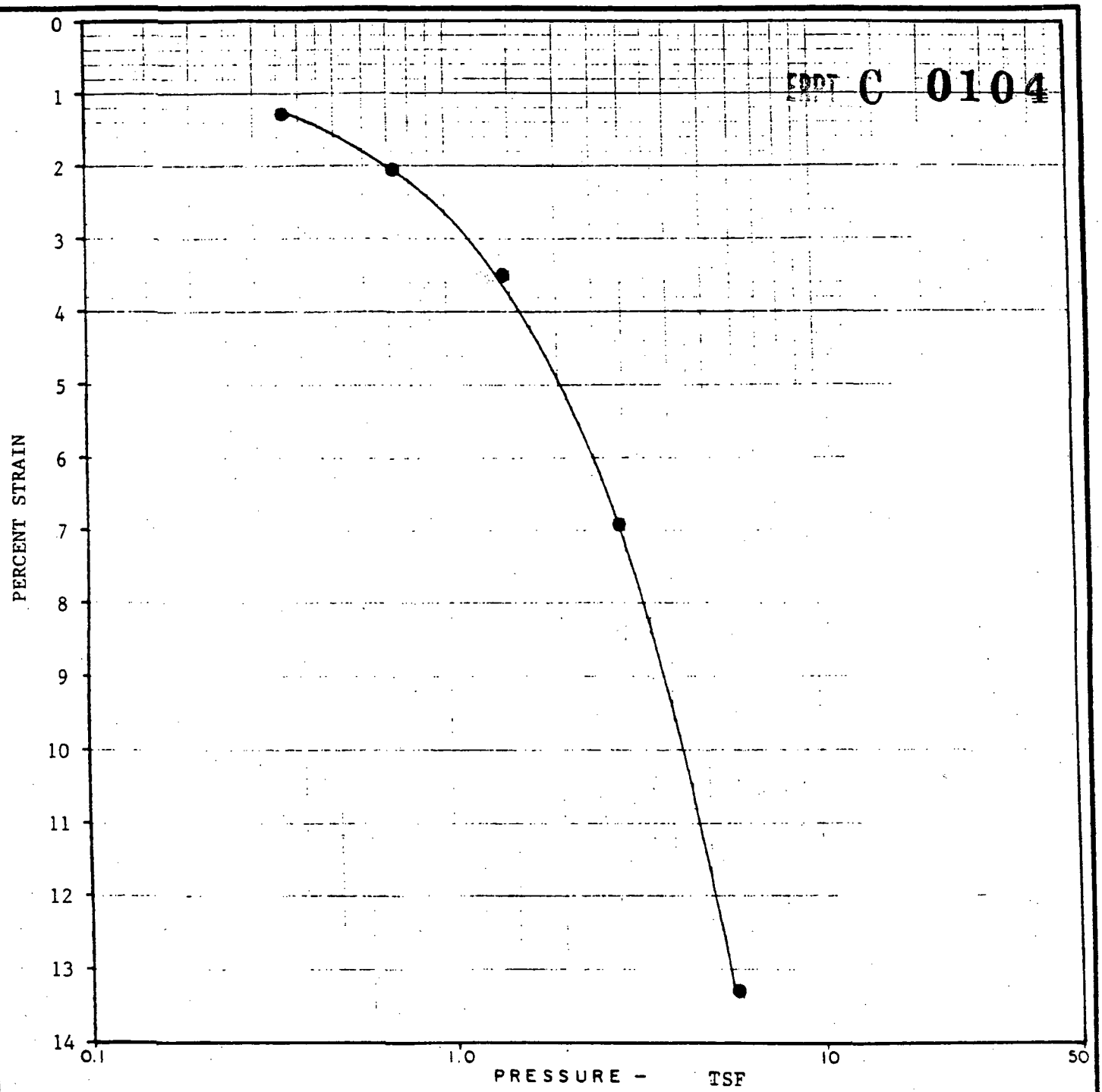
CONSOLIDATION TEST DATA

PROJECT NO. A-2676-1 PLATE NO.



BORING NO. B-10

DEPTH 17.5-20 Ft.

SAMPLE DESCRIPTION reddish-brown Clayey SILT

	INITIAL	FINAL
DRY DENSITY - PCF	77.0	77.0
WATER CONTENT - %	31.8	38.9

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PREPARED BY: DATE:

CHECKED BY: DATE:

CONSOLIDATION TEST DATA

PROJECT NO. A-2676-1 | PLATE NO.