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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
GEOTECHNICAL REPORT FOR PROPOSED EVAPORATION PONDS AT RANCHO SECO

Attention: John Hickman

As you requested, attached is a copy of SMUD calculation ERPT-C0104 "Geotechnical Investigation for Proposed Evaporation Ponds." 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

NMSS01

FSME

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);

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

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

$$\text{and } C = C_0 e^{-\lambda t}$$ 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.

References

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Walton, W. C., 1970, Groundwater resource evaluation: McGraw-Hill Book Co.

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

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, 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/sr	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	120.6 (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		SM-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

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 (%)	SANDS (%)	FINES (%)	ATTERBERG LIMITS LL	PL	PI	SPECIFIC GRAVITY G	NATURAL WATER CONTENT (%)	TOTAL UNIT WEIGHT PCF	DRY UNIT WEIGHT PCF	COMPACTION OPTIMUM WATER (%)	MAX. DRY DENSITY PCF	SHEAR DATA TEST	INITIAL WATER (%)	INITIAL DRY DENSITY PCF	C KSF	φ DEG	PERMEABILITY DRY DENSITY PCF	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	39.6	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													

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

TABLE 3

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	20.2	35.8	34.4										UC	40.8	81.5	8.3	-			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
(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

TABLE 3

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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

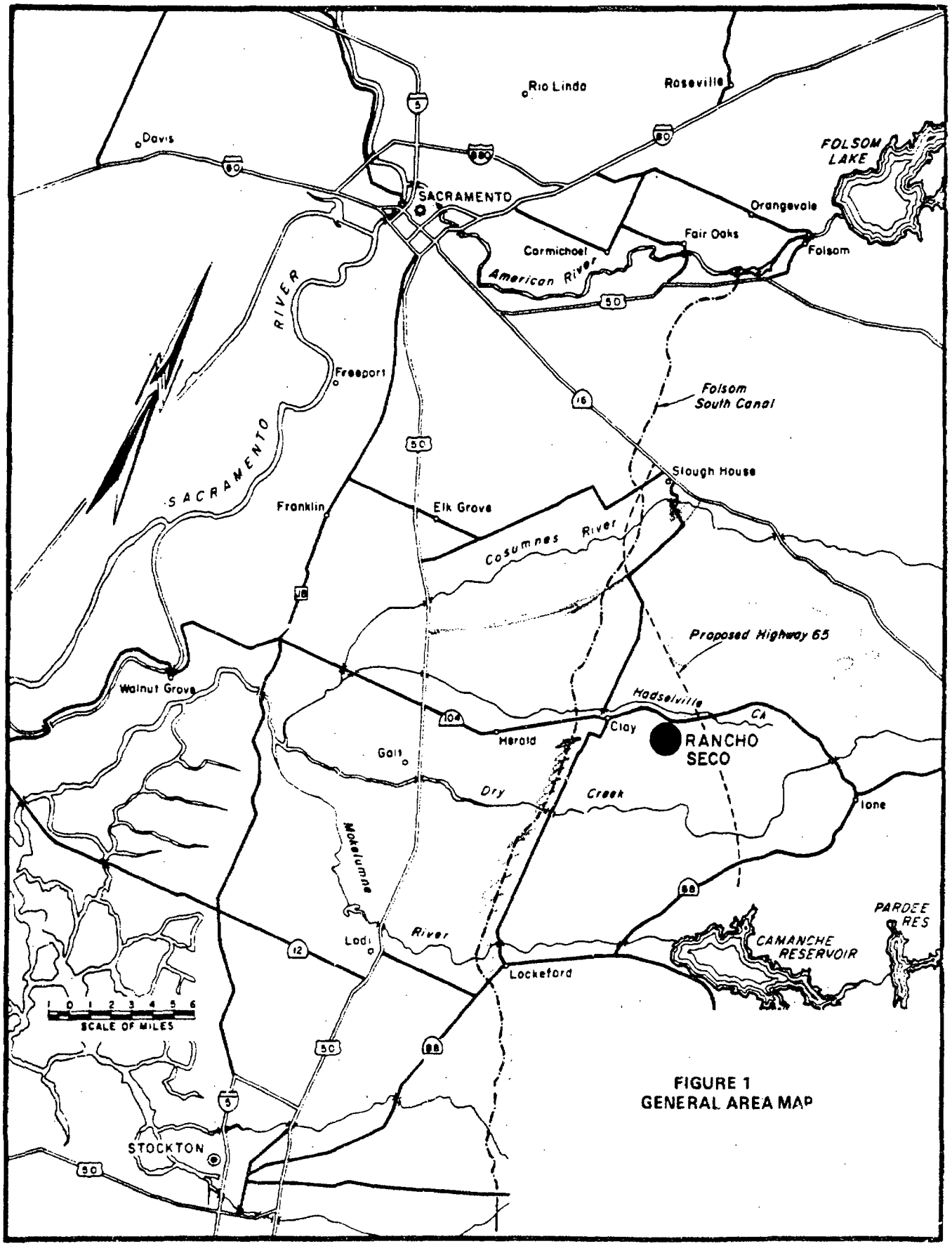


FIGURE 1
GENERAL AREA MAP

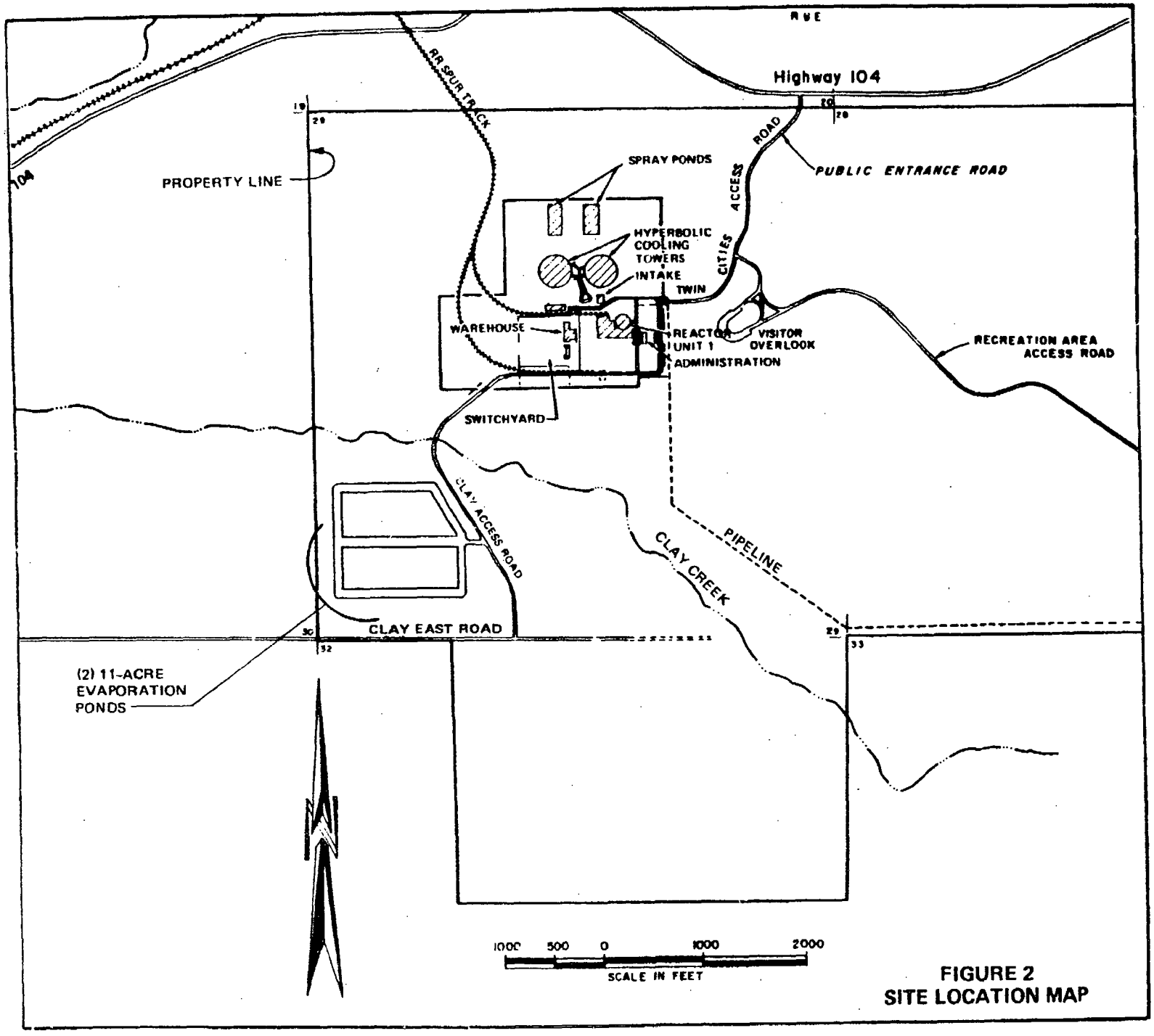


FIGURE 2
SITE LOCATION MAP

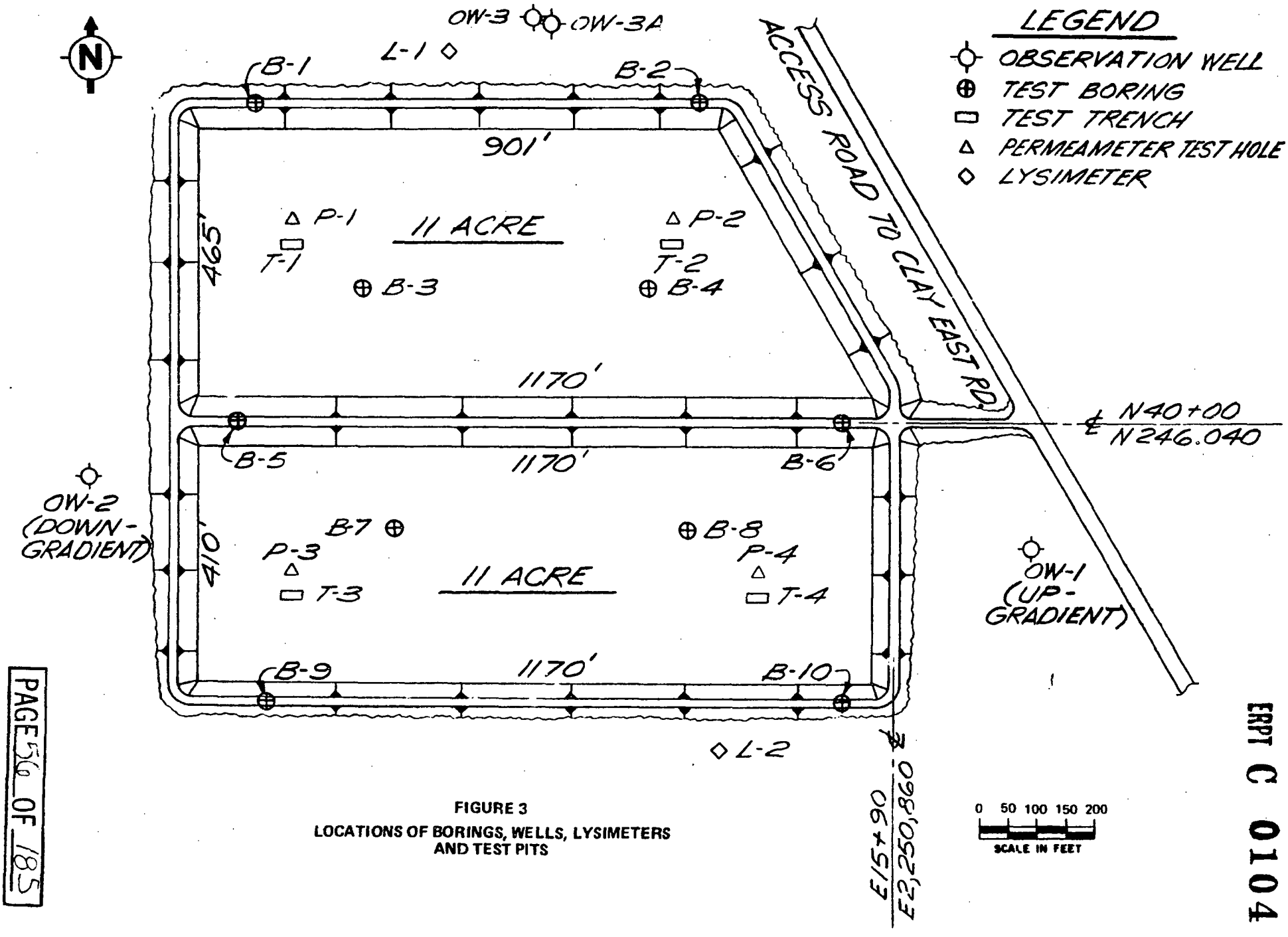


FIGURE 3
LOCATIONS OF BORINGS, WELLS, LYSIMETERS
AND TEST PITS

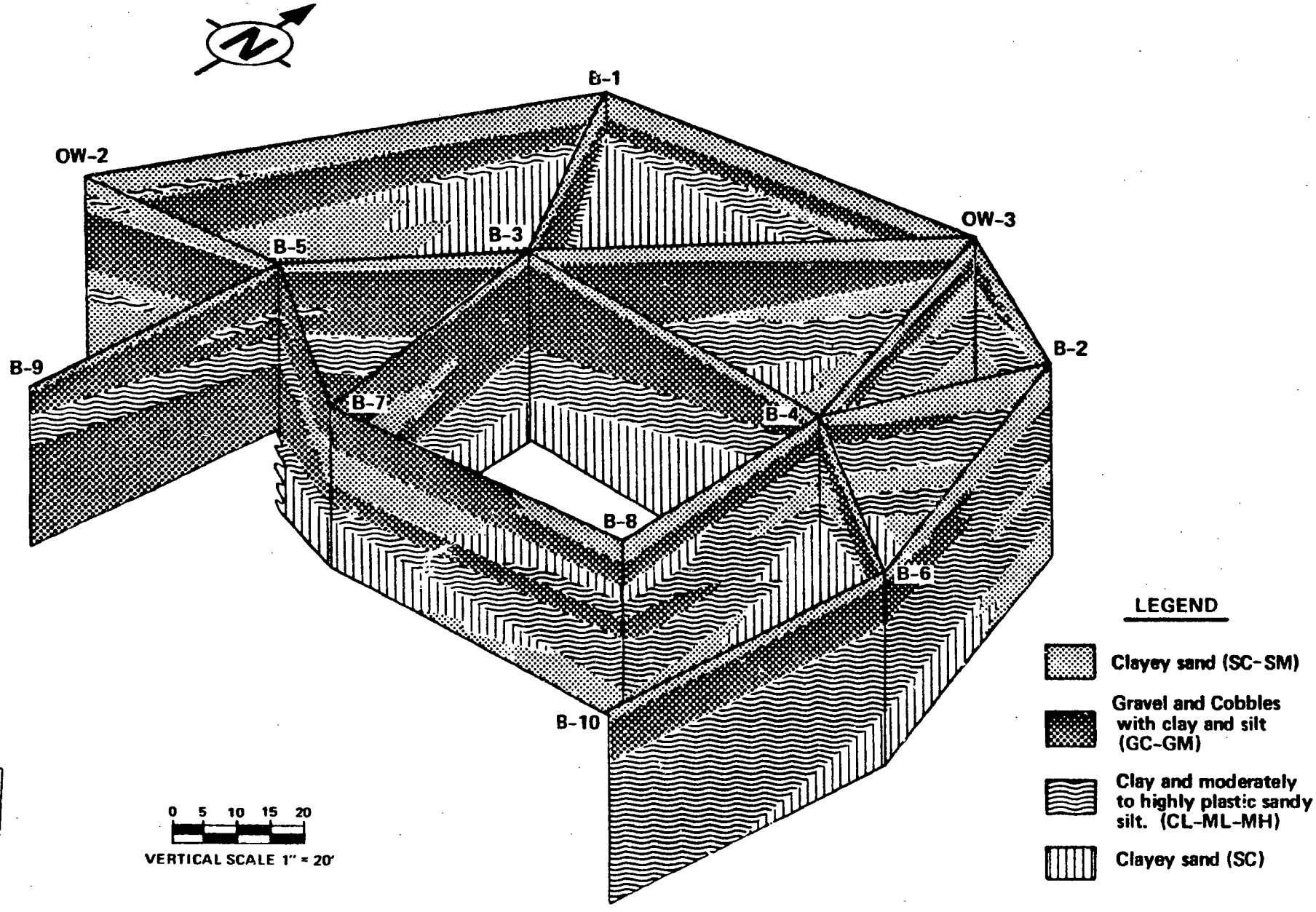


FIGURE 4
FENCE DIAGRAM—SOILS BORINGS

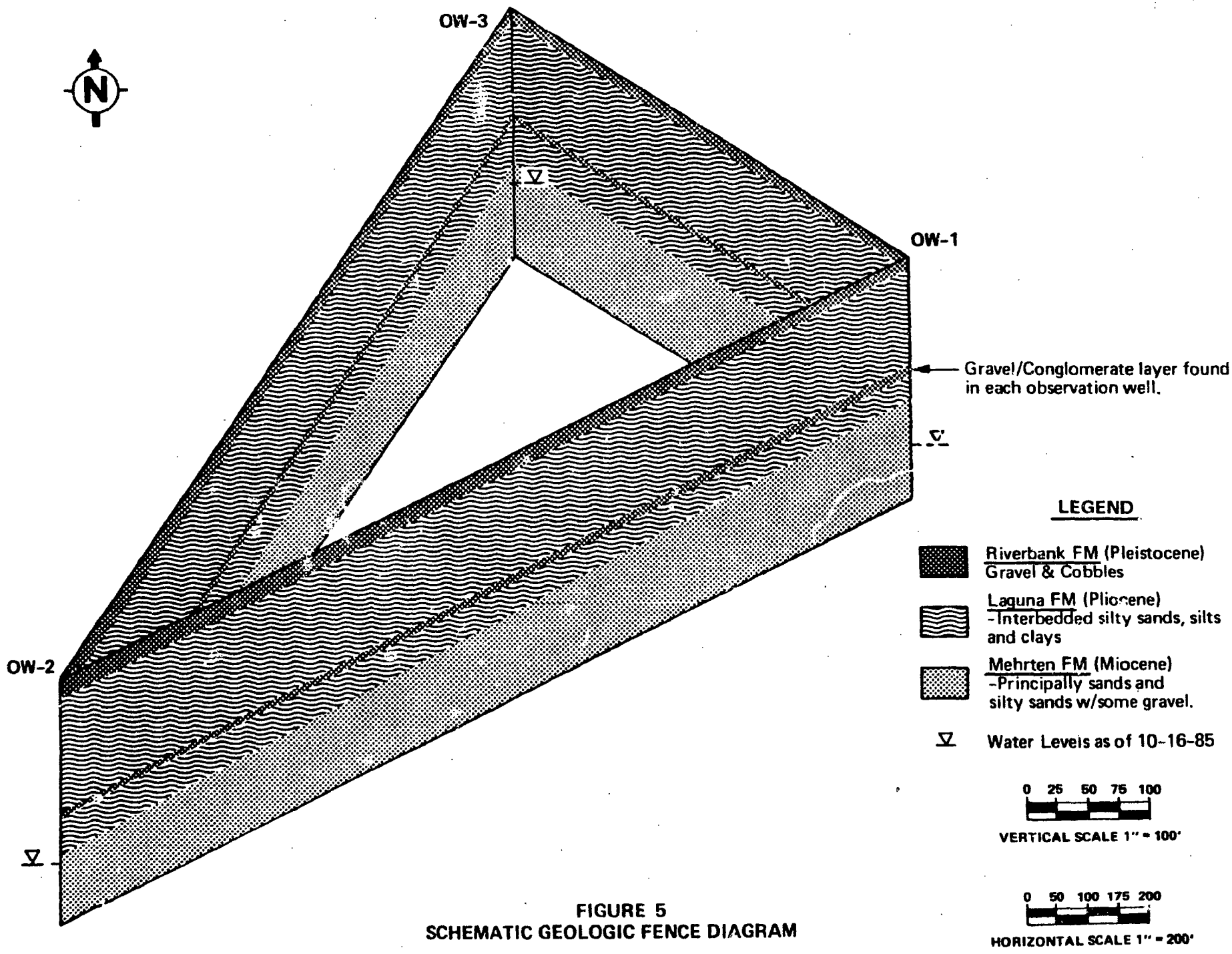


FIGURE 5
SCHEMATIC GEOLOGIC FENCE DIAGRAM

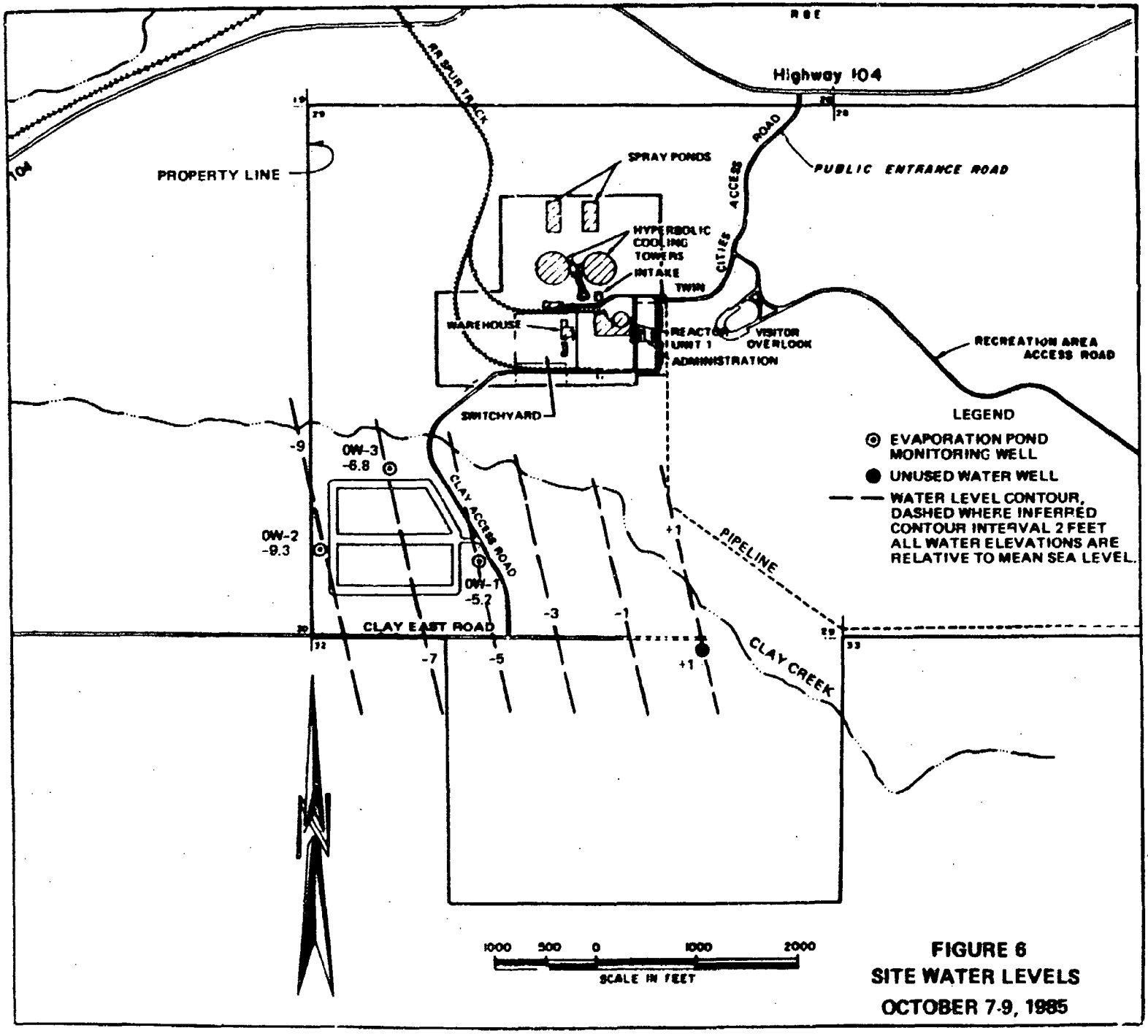
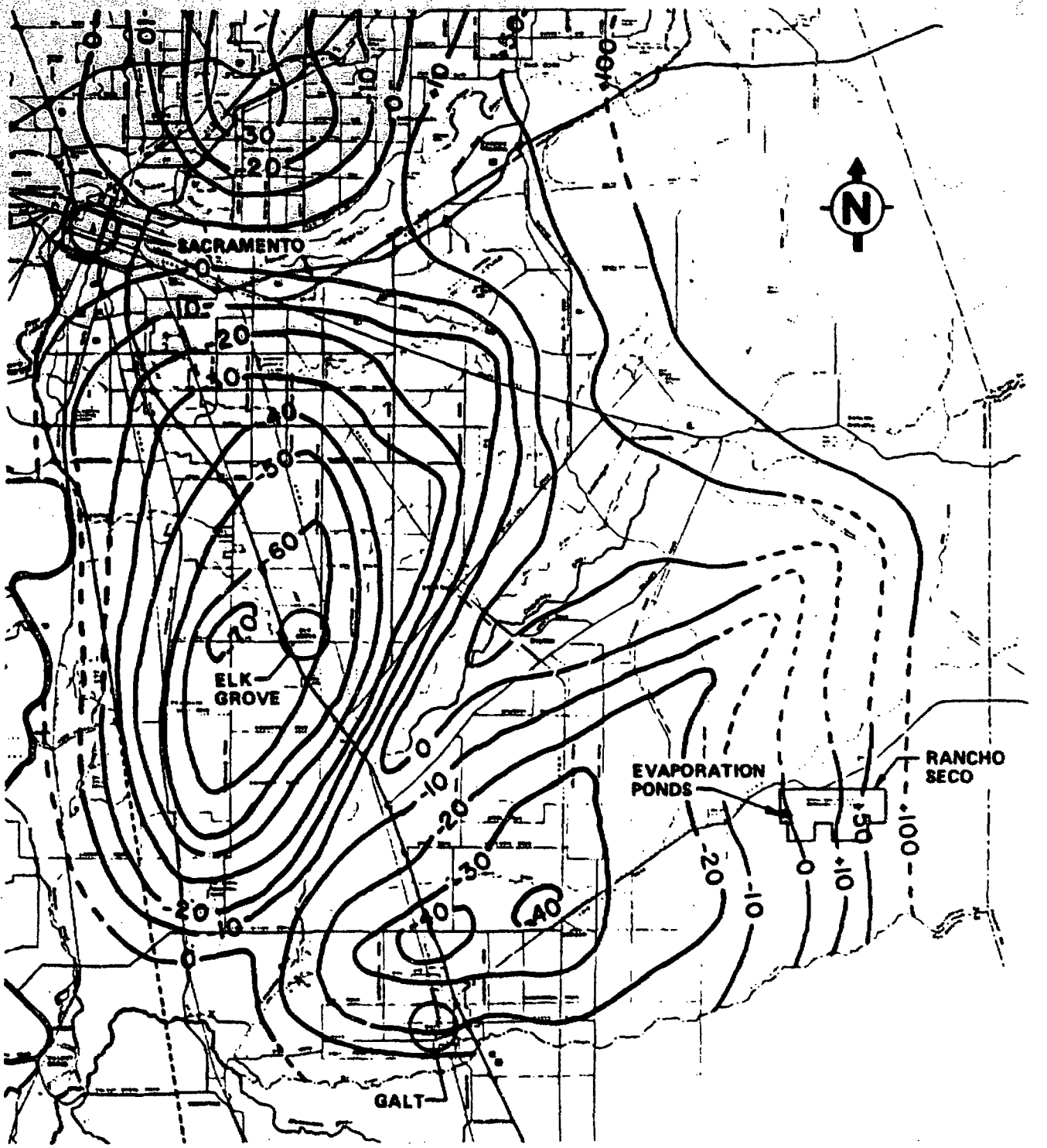
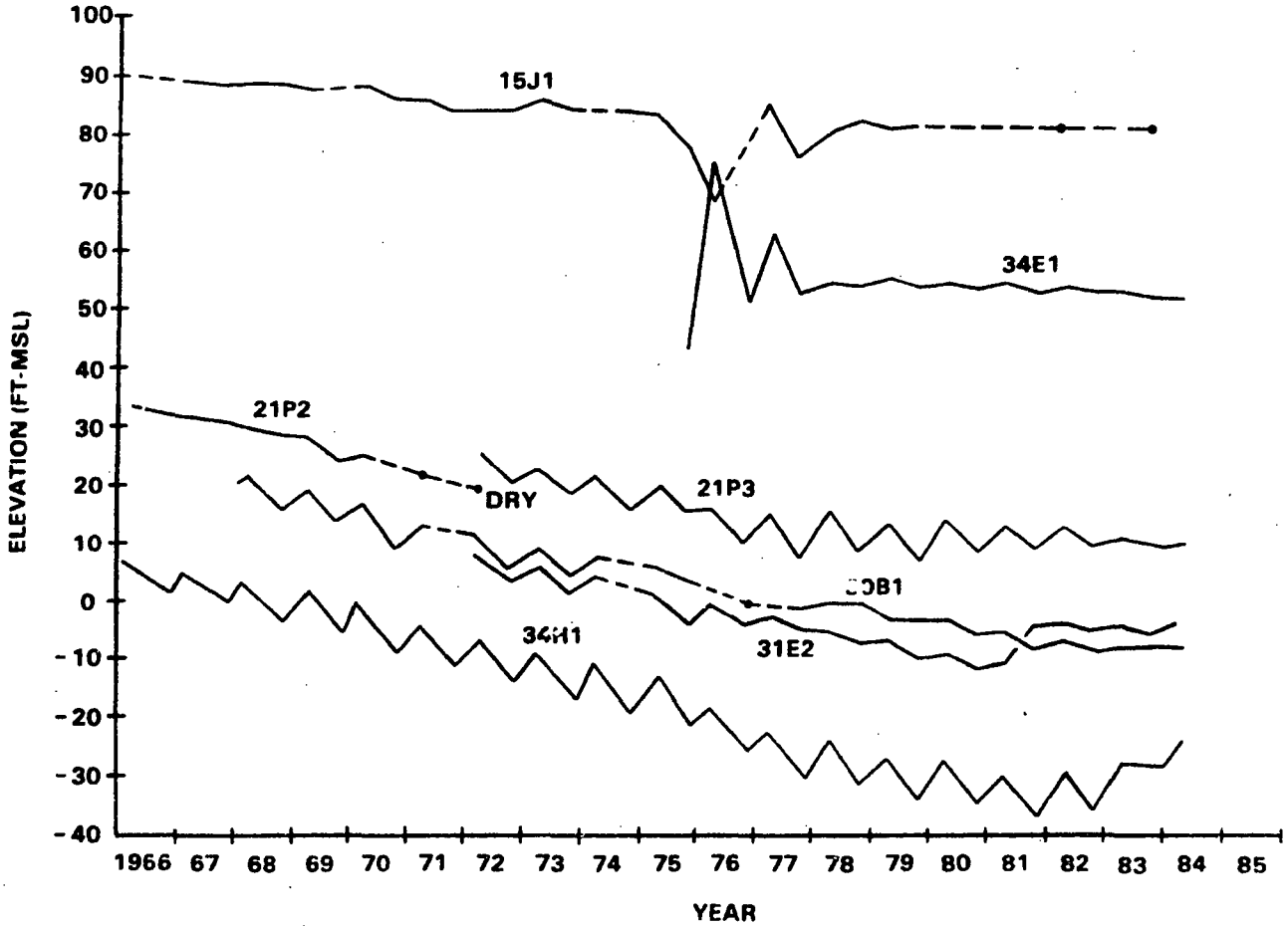


FIGURE 6
SITE WATER LEVELS
OCTOBER 7-9, 1985



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

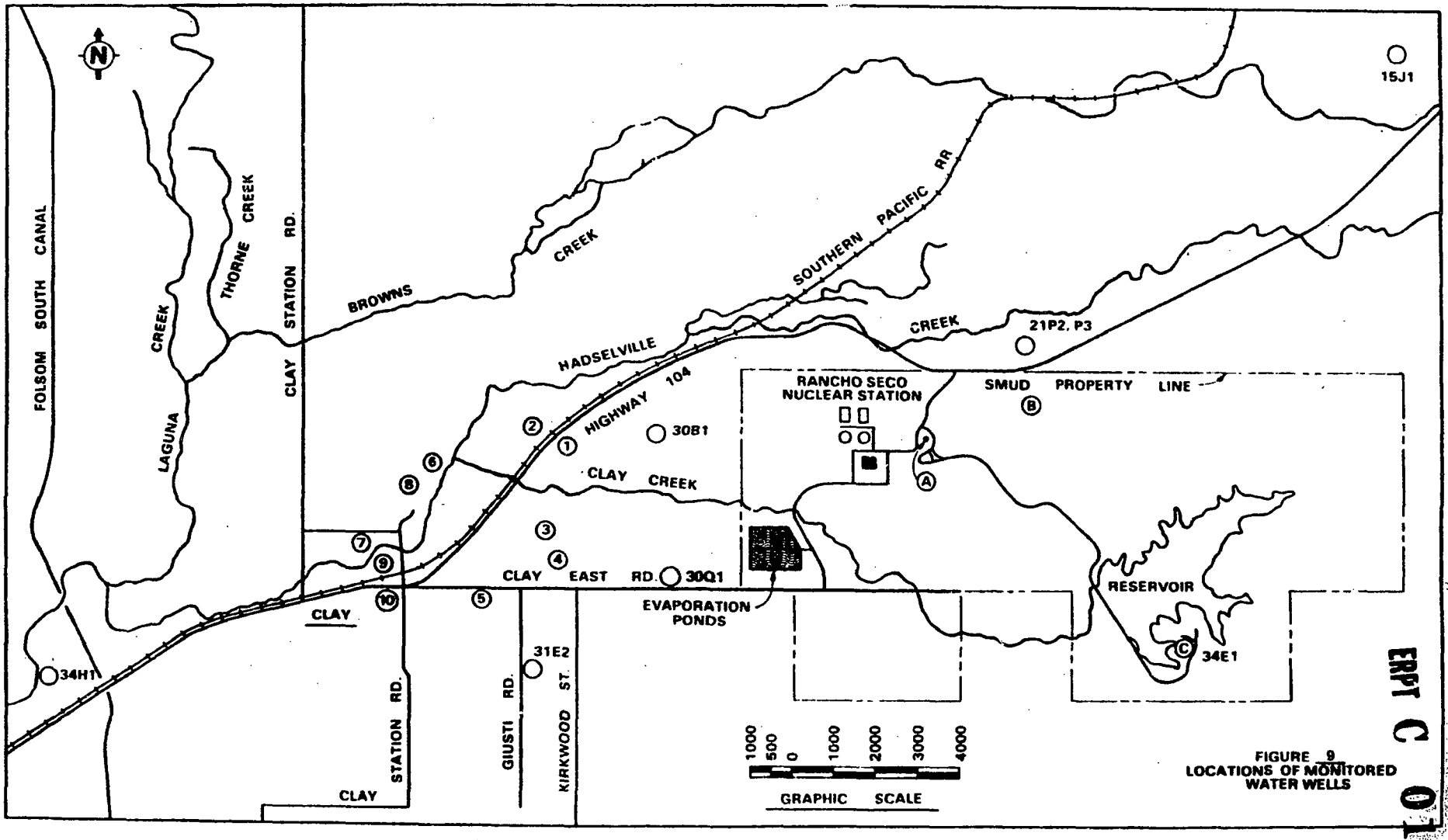


FIGURE 9
LOCATIONS OF MONITORED WATER WELLS

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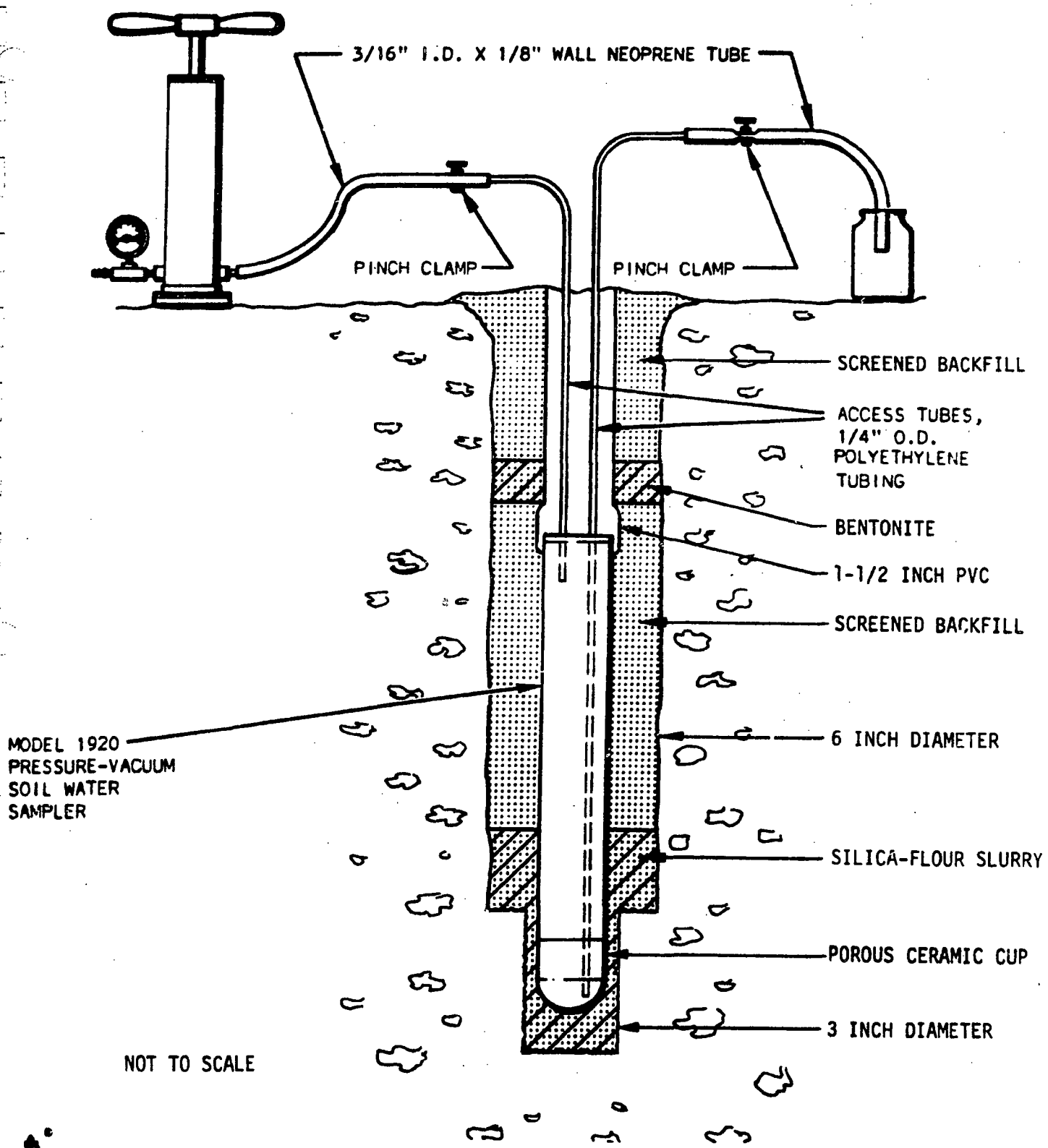
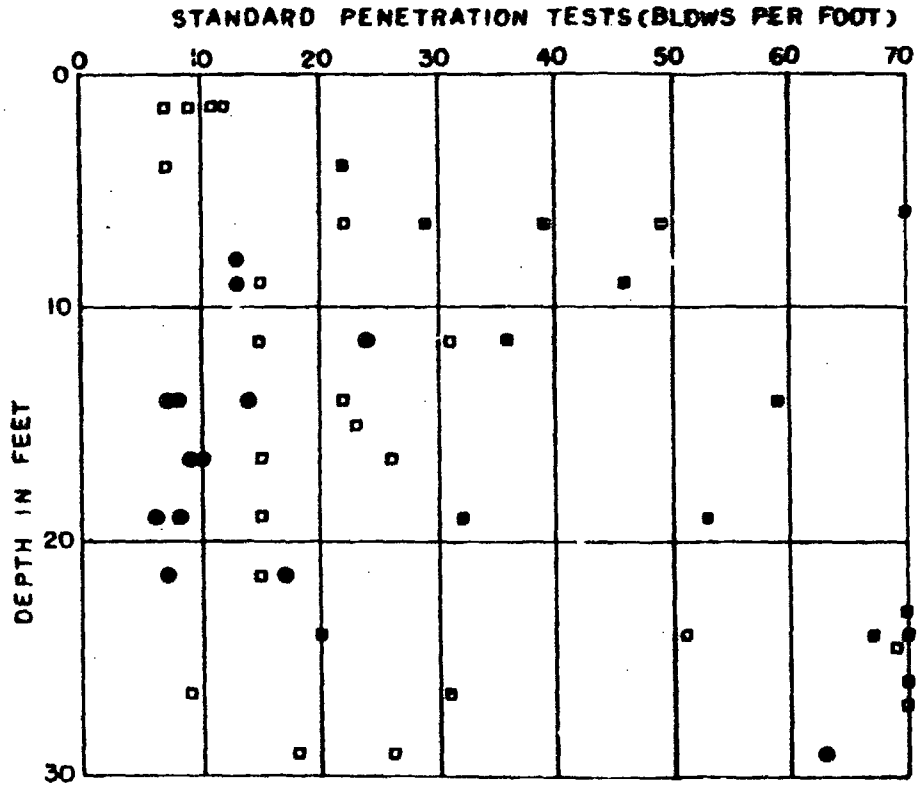


Soilmoisture Equipment Corp. FIGURE TAKEN FROM LITERATURE

FIGURE 10
SCHEMATIC DIAGRAM OF TYPICAL LYSIMETER



LEGEND

- ● CLAYS, SILTS
- ▫ SANDS
- ■ GRAVELS

BECHTEL
SAN FRANCISCO

STANDARD PENETRATION TEST
VERSUS DEPTH

12334 | FIGURE 11

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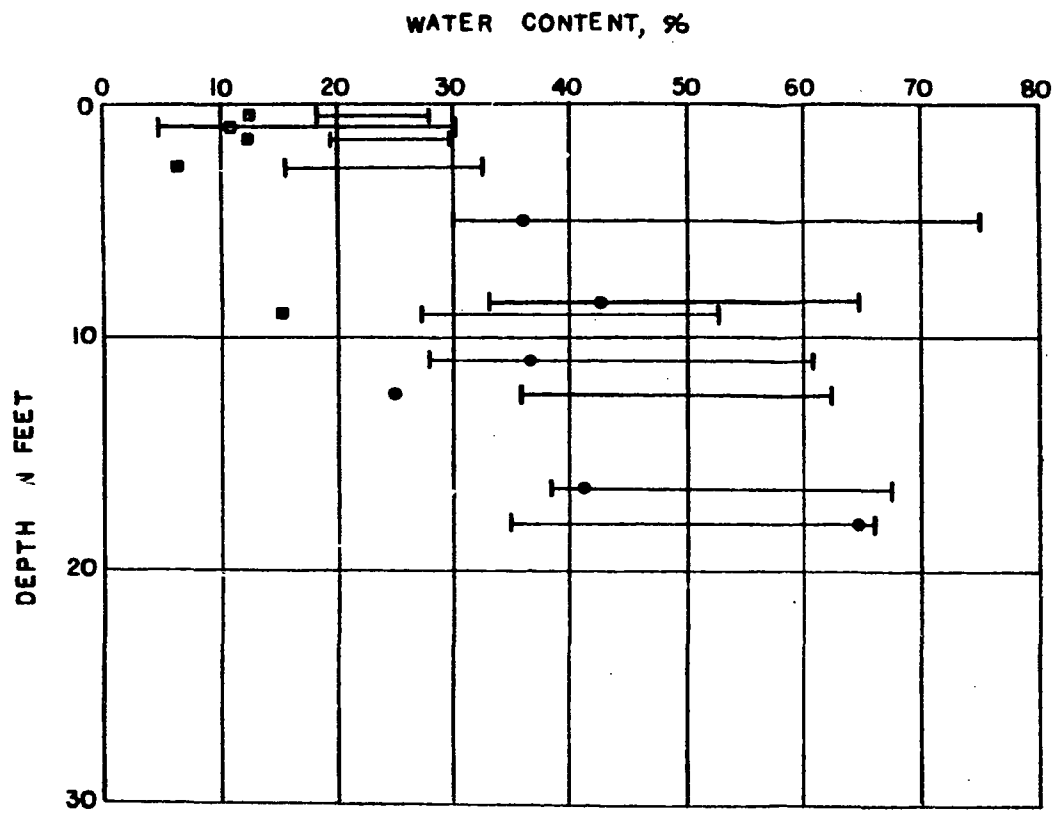

LEGEND

- ● 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 "F" SIZE

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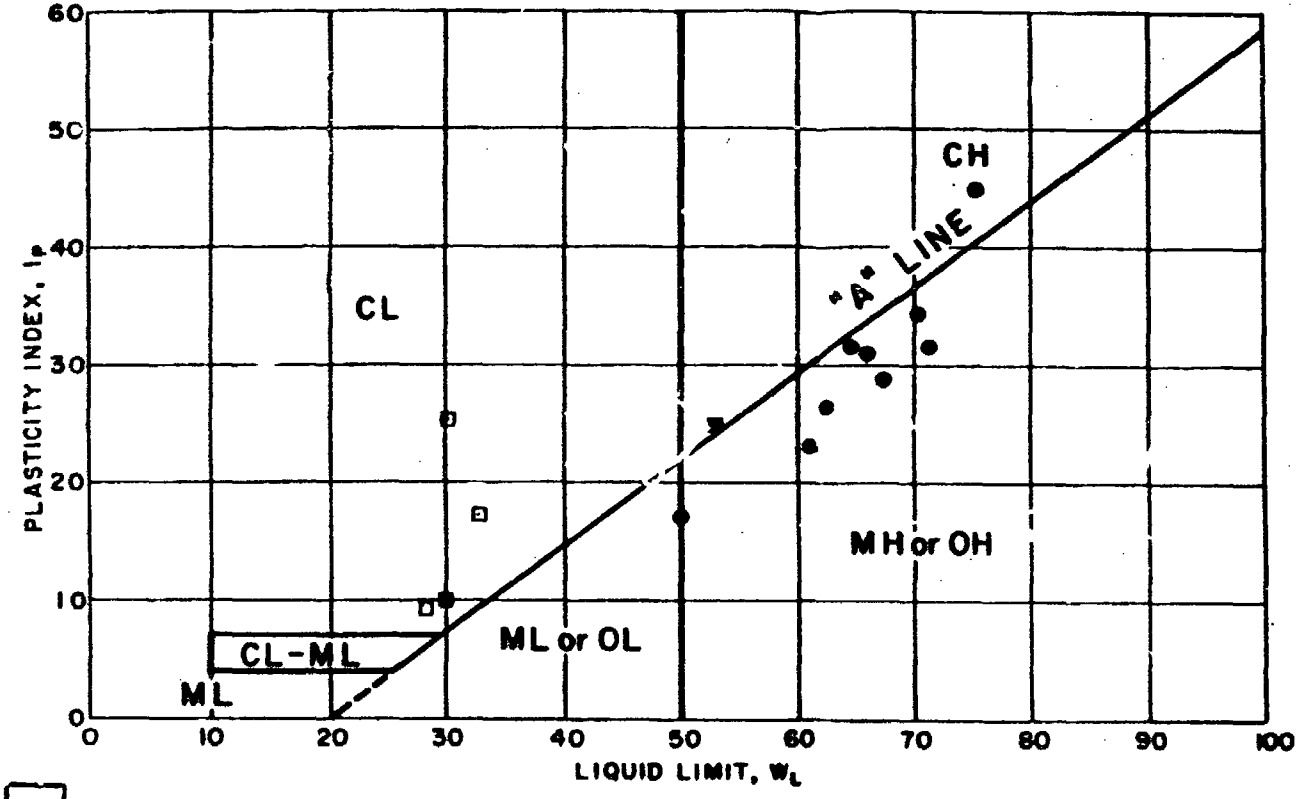
ERPT C 0104



LEGEND

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

BECHTEL
SAN FRANCISCO

PLASTICITY CHART

12334 | FIGURE 13

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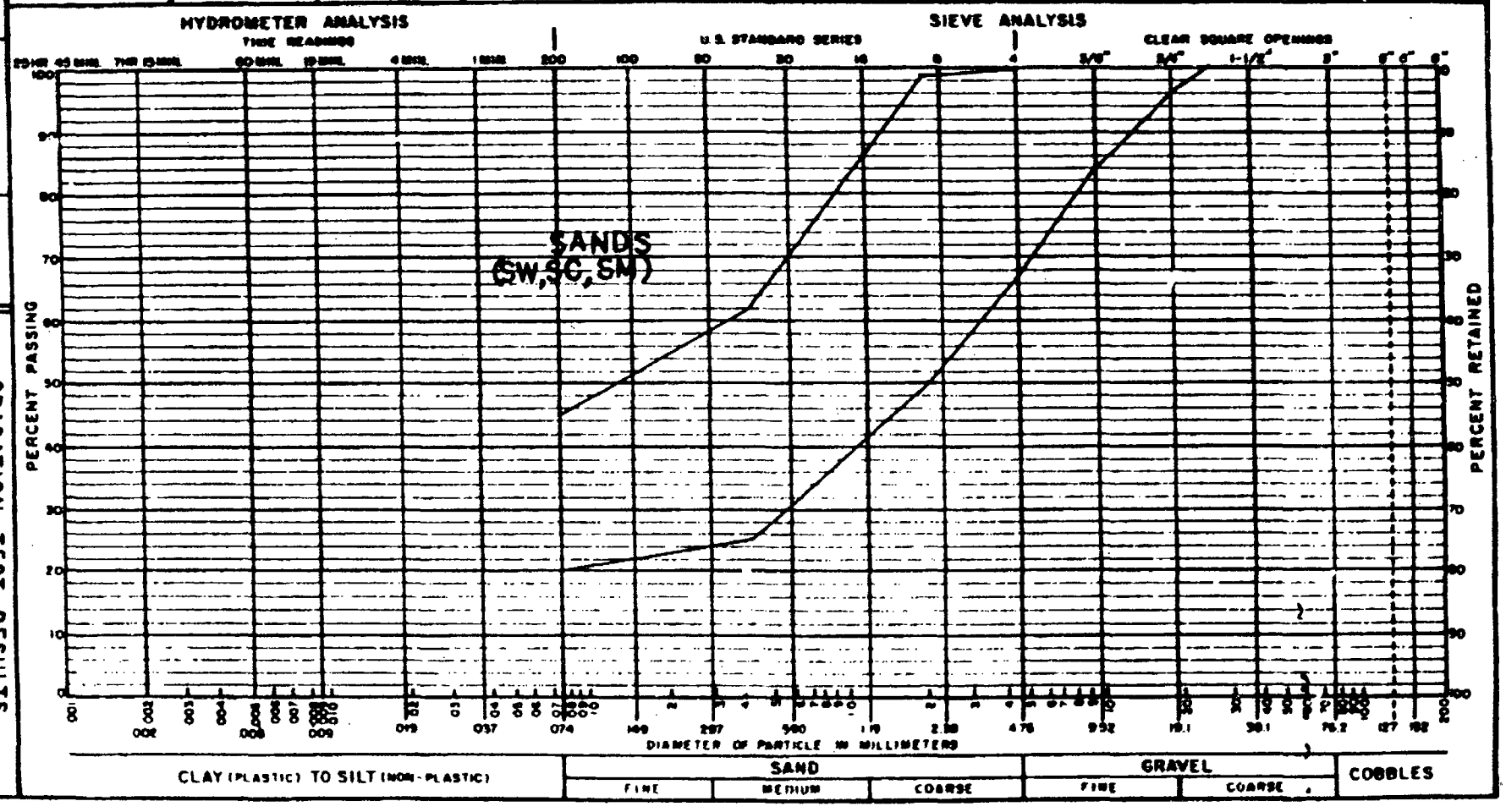
LL										
PL										
PI										
NAT. W/C										
CLASSIF. SYMB.										
SAMPLE NO.										
DEPTH FT										
HOLE NO.										



Hole No. | Tested By | Area | Appr By | Date | Job No. 12334 | File No.

GRADATION TEST RESULTS

FIGURE 14

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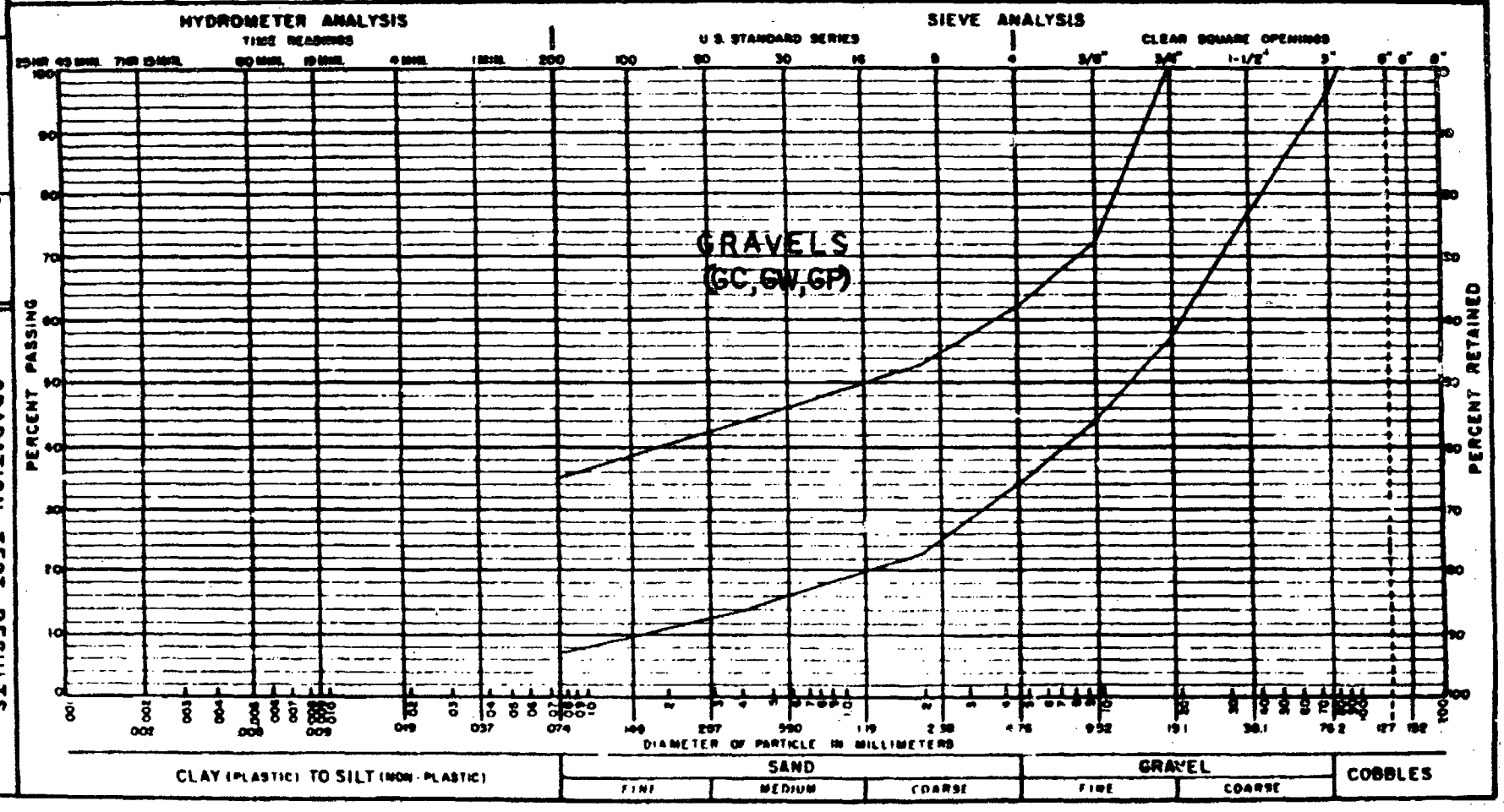
EXPT C 0104

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

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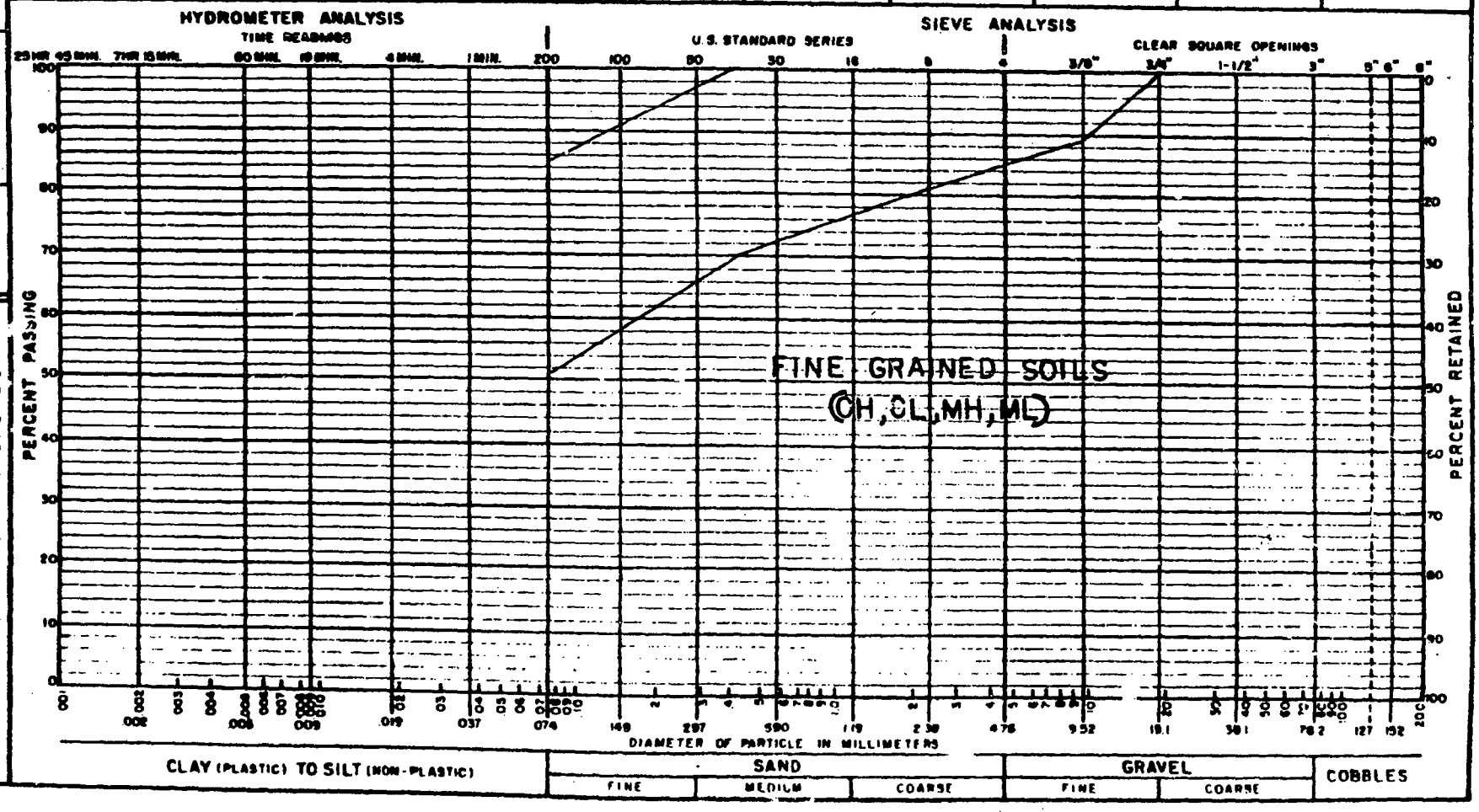
ERPT C 0104

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

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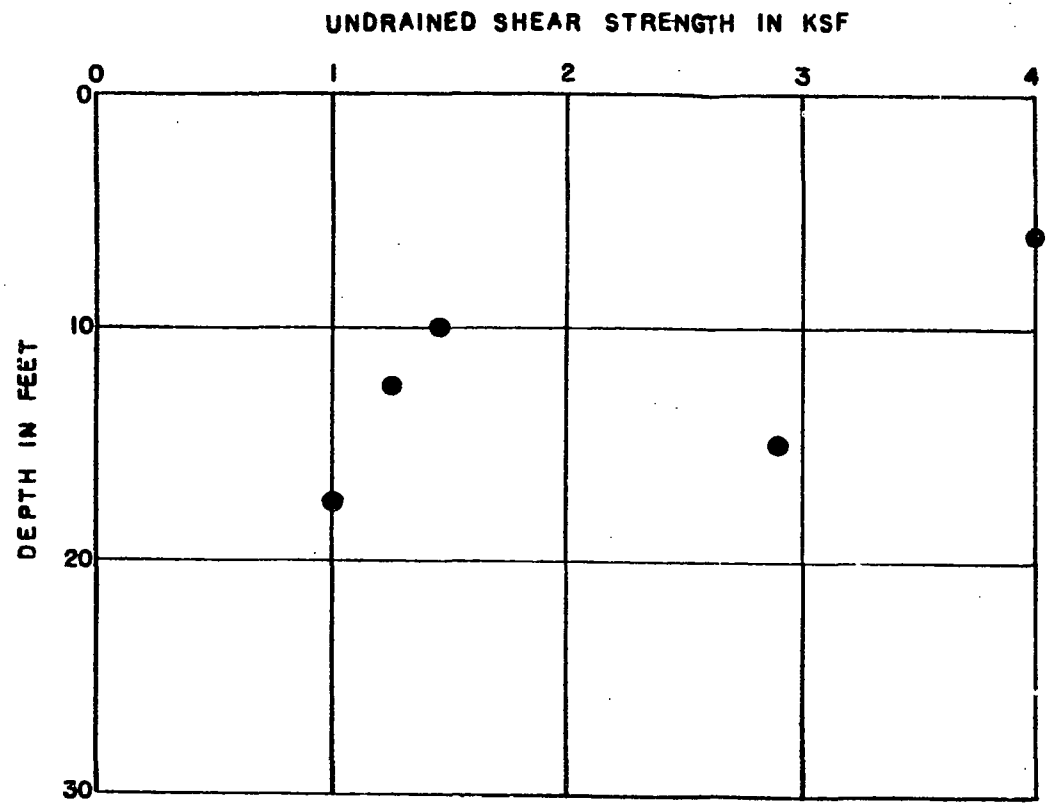
ERPT C 0104

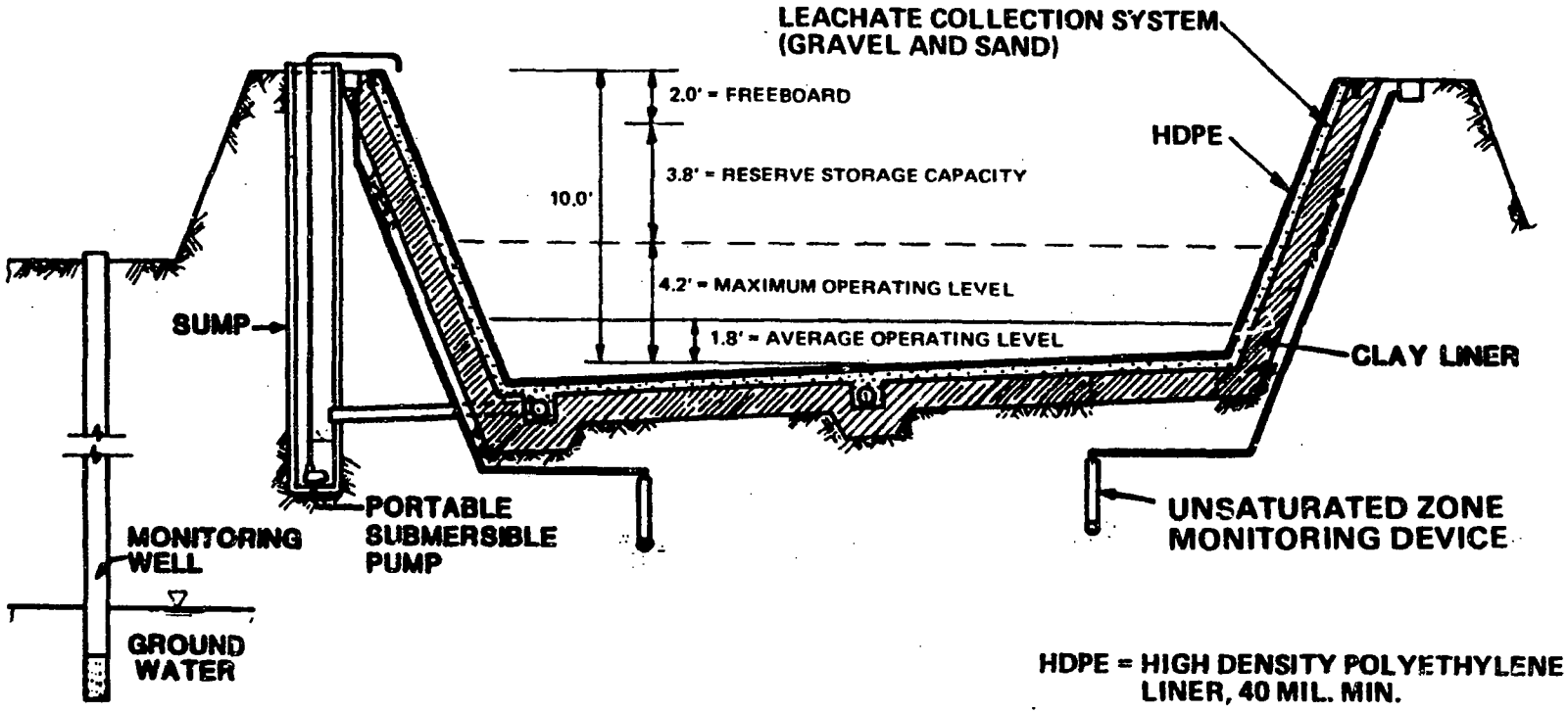


BECHTEL
SAN FRANCISCO

FINE GRAINED SOILS
UNDRAINED SHEAR STRENGTH

12334 | FIGURE 17

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	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
8-8-85	8-15-85	KLEINFELDER	CME-75	4"/3"			200

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
116.7/72	13	N/A	4"PVC=151.2	150.0'	154.92 FT/-4.95 FT 9-18-85	

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	4" PVC SET TO 187.8', SCREEN FROM 172.7'-182.2'	R. NELSON/

Sampler Type and Diameter	Sampler Penetration	Length Cored	Sample Recovery	Core Recovery %	Percent Core Recovery	Water Pressure Tests: Loss in G.P.M.	Pressure P.S.I.	Time in Minutes	Elevation	Depth	Graphic Log	Samples	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 3¾" 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.
									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 / 8-8-85 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; B = BENNISON; 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

Sample Type and Number	Sample Advance Length Core Run	Sample Recovery Core Recovery	Sample Quality "RQD" 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				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.	
							105.8	45			44.2-53.0 Silt (ML)-Pale yellowish brown (10 YR 6/2) grading to moderate brown (5 YR 4/4)@ ~48ft; slightly weathered with slight orange oxidized staining with very thin black manganese stringers; clayey; slight plasticity with trace of very fine sand.	45-50: 12.75 mins 300 psi down 150 psi water 45-47; 250 psi down 50 psi water 47-50 45-47: lost nearly all circulation (~ 25 gpm) mixed more Revert; regained circulation @ 49.
	5.0	3.0	60%					50			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
							97.0 96.5				53.5-55.2 Silt (ML)-Moderate brown (5 YR 4/4); same as 44.2-53.	
	5.0	5.0	100%				94.8	55			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.	55-60: 10 mins 250 psi down 75 psi water
	5.0	3.0	60%					60				60-65: 15.5 mins 250 psi down "0" psi water
	5.0	0.8	16%				84.0	65				65-70: 11 mins 250 psi down 75 psi water -cobble on top of core.
	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.	70-75: 11.5 mins 300 psi down 100 psi water
								75				

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	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	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
NX CORE	5.0	0.4		8%					75				75-80: 28 mins 250 psi down 75-100 psi water 75-81: Cobbles fell in and ground up core
	1.0	0.0		0%					80				80-81: 3.5 mins ~~8-9-85~~ 81 8-12-85 -Set 6 "OD,3¼" ID augers to 9 ft.
	4.0	2.3		58%				69.0				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.	81-85: 10.75 mins 250 psi down "0" psi water
	5.0	0.9		18%					85				85-90: 8 mins 250 psi down "0" psi water Water ways on bit blocked off. Core washed away.
					DOUBLE PACKER 90 - 99.1			60.0	90				90-95: 12.25 mins 250 psi down "0" psi water
	5.0	2.5		50%		CONSTANT HEAD @ +3.1						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.	
	1.0	0.7		70%	.045		7.5		95				95-96: 4.5 mins 250 psi down "0" psi water
	1.0	0.0		0%									96-97: 4 mins 250 psi down 400 psi water 8-12-85 8-13-85 97 WL = 31.6
								52.9				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.	97-102: No time 300 psi down 50-75 psi water
	5.0	4.3		86%					100				102-107: No time 200 psi down 50-75 psi water
	5.0	4.8		96%				46.0	105			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.	107-112: 17.25 mins 200 psi down 50 psi water
	5.0	4.8		96%				42.0	110			108.0-110.8 Sand (SM-SP)-Moderate brown (5 YR 4/6) fine grained with some (15%) silt; few very coarse grains 109.3-110.5; moderately-well consolidated.	
								39.2				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.	112-117: 26.5 mins 200 psi down 50 psi water
	5.0	2.7		54%				37.5	115			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.	

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

SAMPLE 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							115				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
							32.5				Laguna FM / Mehrten FM 117.5	
	5.0	4.0	80%					120			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.	
							28.0				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.	122-127: 29 mins 200 psi down 50 psi water
	5.0	5.0	100%				24.8	125			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.	
							23.6				127-127.5: coarse grained; dark gray. 127.5-128.5: pale yellowish brown silt.	127-132: 30 mins 200 psi down 50 psi water
				DOUBLE PACKER 126.8-135.9								
	5.0	5.0	100%	.06	CONSTANT HEAD @ +3.3	16	21.5				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			130-130.6: thinly interbedded fine grained olive gray and yellowish gray (5 Y 6/1). 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.	-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.
	5.0	5.0	100%								134.6-135.6 Sand (SM)-Medium yellowish brown very fine grained silty.	
							15.4	135			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?	132-137: 30.5 mins 250-300 psi down "0" psi water
							14.4					
							13.7					
							13.0				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.	137-142: 31.5 mins 200-250 psi down 50 psi water
							11.5				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.	
	5.0	4.2	84%					140				
							7.6				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.	142-147: 38 mins 200 psi down 150 psi water
	5.0	4.2	84%				5.3	145			142.4-144.7 Sand (SP) Gravel (GP)-Medium yellowish brown (10 YR 5/2) mixed sand and fine gravel; same as 136.6-136.3; same black and orange oxidized staining.	
							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 dimension); moderately cemented; gradational contact with below.	147-152: 24.5 mins 250 psi down 100 psi water
				DOUBLE PACKER 146.8-155.9								
	5.0	3.8	76%	.77	CONSTANT HEAD @ +3.2	8		150			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
							-3.0					
	5.0	5.0	100%					155				

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

SITE: EVAPORATION PONDS

HOLE NO. OW-1

M&CF 19-1

GEOLOGIC DRILL LOG

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

Sampler Type and Diameter	Sampler Advance Length	Core Recovery	Sample Blows 6"	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%					160–165				162-167: 23 mins 250 psi down 100 psi water
NX CORE	5.0	3.8		76%	SINGLE PACKER 166.5 - 200			-16.0	165–170			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	3.5	12	-23.0	170–175			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%	3.9	10	11	-26.5	175–180			176.5-178.4 Sand (SP) Gravel (GP)-Medium gray (N5) medium-coarse sand with large amount fine-medium subrounded gravel from 17 .5-178.4; slightly weathered with orange and black oxidized staining. Wet.	177-182: 45 mins 250 psi down 150 psi water
NX CORE	5.0	5.0		100%	6.9	16	5	-28.4	180–185			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.	182-187: 37 mins 250 psi down 150 psi water
NX CORE	5.0	5.0		100%	5.4	10	5	-29.6	185–190			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.	
NX CORE	5.0	4.1		82%	3.7	3	5	-31.1	190–195			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.	187-192: 32 mins 250 psi down 150 psi water
3" TRI-CONE								-36.6	195			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.	
								-39.7 -40.8				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.	192-200: drilled with 3" roller bit.
												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.	

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

BORING TYPE AND DIAMETER	BORING METHOD	DRILLING FLUID	CORE DIAMETER	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	193				
									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; B = BENNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS

HOLE NO.: OW-1

H&CF 18-1

GEOLOGIC DRILL LOG

Project	Job No.	Sheet No.	Hole No.
RANCHO SECO	12334	1 of 6	OW-2

Site	Coordinates	Angle from Horiz.	Bearing
EVAPORATION PONDS	N39+20.54 E1+98.53 AS-BUILT	90°	N/A

Begun	Completed	Driller	Drill Make and Model	Hole Size	Overburden (Ft.)	Rock (Ft.)	Total Depth
7-11-85	8-1-85	KLEINFELDER	CME-75	7.5"			200FT

Core Recovery (Ft./%)	Core Boxes	Samples	El. Top of Casing	Ground El.	Depth/El. Ground Water	Depth/El. Top of Rock
169.7/85	19	—	4"PVC=147.85	146.6'	155.61'/-9.01' 9-18-85	

Sample Hammer Weight/Fall	Casing Left in Hole: Dia./Length,	Logged By:
N/A	4" PVC SET TO 183, SCREEN FROM 168.2'-177.2'	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 / Graphic Log / Sample

146.6 — 0

143.4

142.8

141.8 — 5

132.6

10

15

129.6

128.6

20

125.6

25

118.6

116.6 — 30

35

Description and Classification

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.

3.2-3.8 Clay (CL) – Reddish brown; low to medium plasticity with some (~ 15-20%) fine sand and gravel.

3.8-4.8 Sand (SM) – As 0-3.2 with large amount fine-medium gravel.

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.

14.0-17.0 Sand (SM) – Light tan-gray; fine to very fine grained with some (10-15%) silt.

17.0-18.0 Gravel (GM) – Fine to medium; subrounded with silty sand.

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.

21.0-28.0 Sand (SM-SC) - Reddish brown, fine to very fine grained with small amount (10-15%) clayey silt; damp.

28.0-30.0 Sand (SM-SP) – Moderate brown to light yellowish brown; fine to very fine grained with small amount (<10%) silt; damp.

30.0-36.0 Sand (SM) – Light yellowish brown to reddish brown; very fine grained with some (~20%) clayey silt; damp.

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

HACF :9-1

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	Sample Slope "α" / 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.
5.0	5.0	100%					110.6	35	36.0-37.5 Sand (SP-SM) – Moderate brown to yellowish brown; fine to very fine grained with small amount (< 10%) silt; damp.	
5.0	5.0	100%					109.1	40	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.	
5.0	4.3	86%						45		
5.0	4.0	80%					98.1	50	48.5-50.0 Siltstone (ML) – Moderate brown; weakly cemented with some (~30%) very fine sand and black organic streaks and tubules.	Drilling Rates: 52.5-57.5: 3.5 mins
5.0	4.1	82%					96.6	55	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).	57.5-62.5: 4.75 mins @ 350 psi
5.0	3.5	70%						60		
5.0	2.9	58%					85.6	65	61.0-63.0 Sandstone – Medium gray to brown; fine grained; weakly cemented; friable; trace of caliche.	~~7-11-85~~ ~~7-12-85~~ 62.5
							83.6		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).	62.5-67.5: 6.75 mins @ 200 psi
5.0	5.0	100%					81.3	70	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.	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)
5.0	5.0	100%					71.3	75		

SS = SPLIT SPOON; ST = SHELBY TUBE; B = BERNISON; P = PITCHER; O = OTHER

SITE: EVAPORATION PONDS | HOLE NO. OW-2

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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%				55.6	90			86.3-91.0 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%					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.	92-95: 2.75 mins @ 100 psi 7-12-85 / 7-15-85 95 Dry Hole 95-97.5: 3 mins @ 100 psi
	2.5	2.1	84%									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
NIX CORE	5.0	4.9	98%	SINGLE PACKER 114.5-156.3 0 0 0.8	20 30 45	38 9 25	36.9 / 34.9	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
								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

H&CF 19-1

GEOLOGIC DRILL LOG

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

Sample Type and Diameter	Sample Advance	Length Sampled	Sample Recovered	Sample Quality "U" 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%		DOUBLE PACKER 114-119.7 0 0 0	25 45 60	5 5 5		115 120				– 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: 18 mins @ 300 psi (50 psi water)
	5.0	5.0	100%		DOUBLE PACKER 122-127.7 0 0 0 0	5 15 25 45	5 5 5 5	25.1	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%										
	5.0	4.5	90%					14.1	130				130-135: 11.5 mins @ 300 psi (110 psi water)
												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.	
	5.0	5.0	100%		DOUBLE PACKER 136-141.7 0 0 0 0	5 15 25 40	5 5 5 5	11.0	135			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.	7-16-85 7-17-85 135 Water Level N/A 135-140: 14 mins 135-138, 139-140 @ 300 psi (50 psi water) 138-139 @ 300 psi (zero water psi)
	5.0	5.0	100%					5.6	140			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.	140-145: 10 mins @ 250 psi (25 psi water) 145-150: 10 mins @ 250 psi (25-50 psi water)
	5.0	3.3	66%		DOUBLE PACKER 146-151.7 0 0 0 0	5 15 25 40	5 5 5 5	1.1	145 150			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.	Laguna FM / Mehrten FM 145.5 150-155: 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%					155				155-158: saturated zone. (pale yellowish brown) 155-160: 22 mins @ 400 psi (25 psi water)
							-12.4					
							-13.8	160			159.0-160.0 Sand (SP) – Olive gray (5 Y 4/1) fine grained; clean.	160-165: 9 mins @ 250 psi (25-50 psi water)
							-14.7				160-161.3 Sand (SM-SC) – Moderate brown (5 YR 4/6) fine-very fine grained with small amount (10-15%) clayey silt.	
	5.0	4.9	98%				-15.6				161.3-162.2 Sandstone (SP) – Medium dark gray (N-4); fine-medium grained weakly cemented; clean.	
							-18.0	165			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.	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 N[illegible] 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.
3" DRAG BIT												
NX CORE	4.3	3.9	91%								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.	
								170				
	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.	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 no set properly.
	5.0	0.7	14%									
							-32.4					*using Revert 7-31-85
								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± - 0.006' 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%									
				DOUBLE PACKER 184.5-195				185				185-190: 23 mins @ 250 psi (150 psi water)
				0	50	5						
	5.0	4.4	88%				-40.6				187.2-188.6 Sand (SM) – Dark yellowish brown (10 YR 4/2); fine grained with some (15%) clayey silt.	
							-42.0					
								190				190-195: 25 mins @ 400 psi (150 psi water)
	5.0	4.2	84%								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.	
								195				

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	6 of 6	OW-2

SAMPLES TYPE AND NUMBERS	SAMPLES BROKEN LENGTH, CORE DIA.	CORE RECOVERY	SAMPLES BROKEN %	RECEIVED CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M.	WATER PRESSURE TESTS: PRESSURE P.S.I.	WATER PRESSURE TESTS: 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%					-53.4	195				195-200: 21 mins @ 350 psi (150 psi water) 8-27-85: Reamed to 183 ft with 7 5/8" tri-cone bit. 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.
									200			BOH = 200 ft.	

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	Logger by:
N/A	SCH 40 4"PVC/194.2'	R. NELSON/

Sampler Type and Diameter: 3 1/2" φ DRAG BIT

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

DOUBLE PACKER 21.8 - 31.0

Loss in G.P.M.	Pressure P.S.I.	Time in Minutes
.03	CONSTANT HEAD @ +3.8	15

Elevation	Depth	Description and Classification
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.
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	Riverbank FM / Laguna FM 10
		10.0 ~ 15.0 Clay (CL)- Light brown (5 YR 6/4); silty; low plasticity with small amount fine sand.
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.
	25	
110.8		27.0 ~ 32.0 Silt (ML)-Moderate yellowish brown (10 YR 5/5) with some fine-medium sand.
	30	
105.8		
	35	

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?

Notes on: Water levels, water return, character of drilling, etc.

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.: 2 of 6 | HOLE NO.: OW-3

Sampler Type and Number	Sampler Advance	Length Core Run	Sample 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	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 subroundrd gravel with medium sand. Wet.	Drilling Rates 35-40: No time 300 psi down "0" psi water cobble blocked core barrel-ground up core.
	5.0	3.2			64%				94.8	40	43.0-46.2 Silt (ML)-Moderate yellowish brown (10 YR 5/4) with some (10-15%) very fine sand; slightly weathered with trace of caliche nodules, orange oxidized staining and clay; rare fine sand lenses.	8-2-85 8-5-85 40 40-45: 16 mins 250 psi down 125 psi water
	5.0	4.8			96%				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
				SINGLE PACKER 47.5-164					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; slightly 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%				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
				CONSTANT HEAD @ +3.0		.27		15	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.	
	5.0	4.7			94%				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
									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	70		70-75: 45.5 mins 200 psi down 75 psi water
									67.2		70.2-70.8 Siltstone (ML)-Moderate brown (5 YR 4/4) same as 55-58.	
	5.0	4.8			96%						70.8-75.3 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

Sampler Type and Diameter	Sampler Advance Length Core Run	Sample Recovery Core Recovery	Sample Blows 6"	Percent Core Recovery	Water Pressure Tests: Loss in G.P.M.	Pressure P.S.I.	Time in Minutes
NX CORE	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	Depth	Description and Classification	Notes on: Water Levels, Water Return, Character of Drilling, Etc.
62.5	75	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.	76-78: Wet 75-80: 30 mins 200 psi down 75 psi water
56.8	80	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.	8-5-85 / 8-6-85 80 80-85: 42 mins 175 psi down 50-75 psi water
51.8	85	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.	85-90: 33.5 mins 200 psi down 75 psi water
50.8 50.2		87-87.6 Sandstone (SM)- Same as 81-86.	
48.4		87.6-89.4 Gravel (GP)-Medium coarse; subrounded in fine-coarse moderately cemented sandstone matrix.	
	90	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.	90-95: 23 mins 200 psi down 75 psi water
48.0	95	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.	95-100: 40 mins 200 psi down 75 psi water
39.8		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°.	100-105: 19 mins 200 psi down 75 psi water
37.7	100	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°.	
34.5	105	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.	105-110: 19 mins 200 psi down 75 psi water 110-115: 25 mins 200 psi down 75 psi water
25.3	110	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.	
21.8	115		

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	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				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	135			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.
	5.0	5.0	100%				-1.2	140			139.0-140.4 Gravel (GP-GM)- Fine to medium, subrounded in fine medium medium yellowish brown (10 YR 5/2) silty sand matrix.	140-145: 14 mins 300 psi down 100 psi water
	5.0	5.0	100%				-2.6	145			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.	145-150: 13.25 mins 300 psi down 100 psi water
	5.0	5.0	100%				-14.4	150				150-155: 19.75 mins 300 psi down 100 psi water
							-17.2	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	

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. 5 OF 6 | HOLE NO. OW-3

Sampler Type and Diameter	Sampler Advance Length Core Run	Sample Recovery Core Recovery	Sample Blows 6"	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 / 8-29-85 174 175-200: Drilling rate ~55 secs/ft.
								-37.2	175			175-200 Sand (SM) -Light brown (5 YR 5/6) fine to very fine grained with large amount of silt.	
									180				
									185				
									190				
									195				

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

SAMPLE NO.	BLOWS PER 6 INCHES	DRILLING TIME PER 6 INCHES	DRILLING RATE	DRILLING FLUID	CORE RECOVERY	SAMPLE TYPE	PERCENT CORE RECOVERY	WATER PRESSURE TESTS: LOSS OR GAIN	WATER PRESSURE TESTS: PRESSURE P.S.I.	WATER PRESSURE TESTS: TIME IN MINUTES	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
5 TR. CONCRETE												193				
											-62.2	200				8-29-85
															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: EVAPORATION PONDS

HOLE NO. OW-3

M&CF 19-1

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 6" / 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 comparison 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; B = BENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
EVAPORATION PONDS	OW-3A

H&CF 19-1

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 PLANES "a"	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: RANCHO SECO	JOB NO.: 12334	SHEET NO.: 1 of 1	HOLE NO.: L-2
SITE: EVAPORATION PONDS	COORDINATES: N34+35 E12+90 NOMINAL	ANGLE FROM HORIZ.: 90°	BEARING: —

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/

SAMPLES TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH OR 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 ~6 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); slightly 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; B = DENNISON; P = PITCHER; O = OTHER

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

14&CF 19-1

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO	JOB NO.: 12334	SHEET NO.: 1 - 1	HOLE NO.: B-1
SITE: EVAPORATION PONDS	COORDINATES: N45+48 E4+80 NOMINAL	ANGLE FROM HORIZ.: 90°	BEARING: —

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 DRIVING LENGTH CODE	SAMPLE RECOVERY CODE	SAMPLE BLOWS 6" - 6" - 6" / 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.	
STS 2¾" ID	2.5	0.4	16%	5-6 KSF NO GOOD; STOPED IN JAR						4		
SS 2"	1.5	1.5	8-10-16 / 26				125.3	15		5		
STS 2¾" 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					
STS 2¾" 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: EVAPORATION PONDS | HOLE NO.: 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* 2"ID	2.5	2.5	100%	7 KSF			132.9	5		2		
SS 2"	1.5	1.5	4-3-8 / 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.	
								10				
							127.9				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	
SS 2"	1.5	1.5	3-3-5 / 8							4		
							124.9	15			14-17 Sand (SM-ML)-Moderate yellowish brown (10 YR 5/4); very fine grained with large amount (30-40%) silt; trace clay; damp.	
CTS 2"ID	2.5	1.5	48%	8 KSF						5		
							121.9					
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	8-4-5 / 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 2"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.: B-2

MACF 15-1

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO	JOB NO.: 12334	SHEET NO.: 1 OF 1	HOLE NO.: B-3
SITE: EVAPORATION PONDS	COORDINATES: N42+30 E6+60 NOMINAL	ANGLE FROM HORIZ.: 90°	BEARING: —

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	GRAPHIC LOG	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.
					141					* CTS=Continuous Tube Sampler.
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	0.5	56/6"		115			10		
									BOH = 28 FT	
						30				
						35				

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

SITE: EVAPORATION PONDS | HOLE NO.: 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	18~20 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	4-6-10 / 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		
								25				
CTS 2½"ID	2.5	1.1	44%	9+KSF						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.: B-4

H&CF 19-1

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				
SS 2"	1.5	1.3	6-24-22 / 46				134.4 / 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* 24"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 24"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 sub rounded 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 = O.H.

Site: EVAPORATION PONDS

Hole No.: B-5

H&CF 19-1

BECHTEL

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					
								10			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.	
ST 2 3/4"	2.5	2.5	100%							2		
SS 2"	1.5	1.5	2-6-8 / 14							3		
							133.0	15				
ST 2 3/4"	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				119.0			7		
								30			BOH = 29 FT.	
								35				

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

SITE: EVAPORATION PONDS

HOLE NO.: B-6

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
RANCHO SECO	12334	1 of 1	B-7

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N38+20 E7+20 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"			24.4 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	4-4-9 / 15							1		
SS 2"	1.5	1.5	7-12-19 / 31					10		2		
CTS* 2 1/2"	2.5	0.9	36%	DISTURBED; SAVED IN JAR			130.1				12-15 Gravel (GC)-Fine-medium subrounded in moderate yellowish brown (10 YR 5/4) silty clayey fine sand.	
ST 2 1/2"	1.0	0.8	80%							3		
SS 2"	1.5	1.5	5-10-13 / 23				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.	
							126.1			5		
CTS* 2 1/2"	2.5	1.2	48%	9" KSF				20		6	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.	
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				

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SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; F = FITCHER; O = OTHER

SITE	HOLE NO.
EVAPORATION PONDS	E-7

H&CF 19-1

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"			27.2FT

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	148.2FT	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					
SS 2"	1.0	1.0	24-50/6"					5		2	3.5-7.0 Gravel (GC)-Fine-medium subrounded in fine-very fine moderately cemented clayey sand with cobbles and clayey silt.	
							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				

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

SITE	HOLE NO.
EVAPORATION PONDS	B-8

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO	JOB NO.: 12334	SHEET NO.: 1 of 1	HOLE NO.: B-9
SITE: EVAPORATION PONDS	COORDINATES: N35+18 E5+00 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 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	150.5FT ±	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	5				
SS 2"	1.5	1.5	12-16-23 / 39							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	12-28-32 / 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* 24" ID	2.5	1.2	48%	9+ KSF				20		4		
				DISTURBED; PUT IN JAR								
SS 2"	1.5	1.5	15-27-40 / 67				126.5			5		-Auger refusal @ 24 FT.
											BOH = 24 FT	
								25				
								30				
								35				

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

SITE: EVAPORATION PONDS

HOLE NO.: B-9

H&CF 19-1

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				2-8 Gravel/Cobbles (GM)-Fine-medium subrounded with fine-very fine silty sand and numerous cobbles.	
								5				
							143.8					
								10				
SS 2"	1.5	1.5	4-6-8 / 14							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 3/16"	2.5	2.0	80%	5 KSF						3		
								15				
SS 2"	1.5	1.5	4-4-5 / 9	DAMP						4		
							134.8					
ST 2 3/16"	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.	
								20				
SS 2"	1.5	1.5	2-2-5 / 7	WET						6		
							129.8					
ST 2 3/16"	2.5	2.2	88%							7	22-29 Clay (CL)-Moderate yellowish brown (10 YR 5/4) with some orange & black weathered speckling; large amount (40%) fine to very fine grained sand and interbedded pale brown silt; uncemented; damp.	
								25				
SS 2"	1.5	1.5	4-6-10 / 16							8		
SS 2"	1.5	1.5	2-3-7 / 10							9		
							122.8					
								30			BOH = 29 FT.	
								35				

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

SITE	HOLE NO.
EVAPORATION PONDS	B-10

M&CF 19-1

GEOLOGIC DRILL LOG

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

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N43+50 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	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 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 8" 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.	

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

SITE	HOLE NO.
EVAPORATION PONDS	P-1

H&CF 19-1

GEOLOGIC DRILL LOG

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

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N43+50 E12+05 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	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.	

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

SITE	HOLE NO.
EVAPORATION PONDS	P-2

H&CF 19-1

GEOLOGIC DRILL LOG

PROJECT: RANCHO SECO	JOB NO: 12334	SHEET NO. 1 of 1	HOLE NO. P-3
SITE: EVAPORATION PONDS	COORDINATES: N37+45 E5+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	148.4 FT	DRY	

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

SAMPLE TYPE AND NUMBER	SAMPLE # ADVANCE LENGTH TOOK OUT	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS 6" / 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: EVAPORATION PONDS

HOLE NO. P-3

H&CF 19-1

GEOLOGIC DRILL LOG

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

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
EVAPORATION PONDS	N37+45 E13+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	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 Loaostar) 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.	

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

SITE	HOLE NO.
EVAPORATION PONDS	P-4

H&CF 19-1

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

ELEV. – TOP OF SURFACE CASING: 151.42'

ELEV. – TOP OF RISER CASING: 151.21'

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.

	DEPTH (FT)	ELEV. (FT)
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

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.

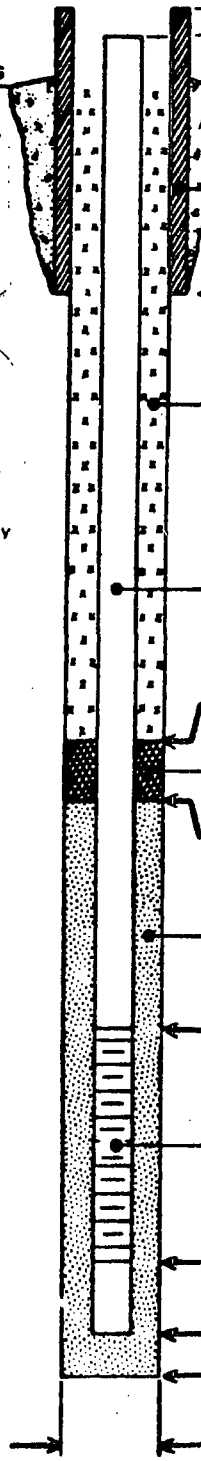
* Reamed to 193 ft: 3" hole to 200 ft.

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	177.2	-30.6
BOTTOM OF SUMP	183.0	-36.4
BOTTOM OF HOLE	183.0*	-36.4

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

Bottom of filter pad ← Cuttings from 176-183

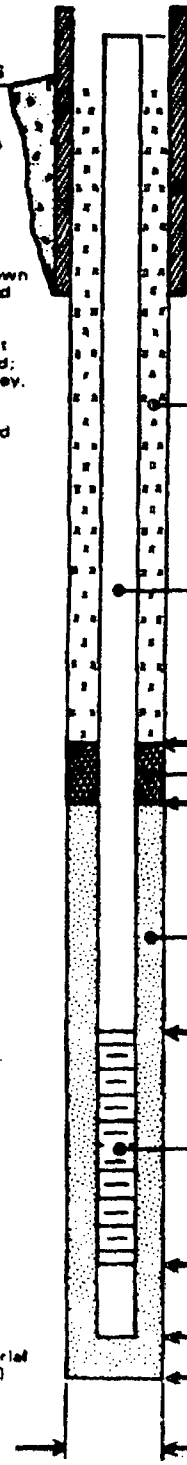
HOLE DIA: 7 5/8 INCHES

-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		



	DEPTH (FT)	ELEV. (FT)
ELEV. – TOP OF SURFACE CASING: 139.37		
ELEV. – TOP OF RISER CASING: 139.04		
GROUND SURFACE		137.8
BOTTOM OF SURFACE CASING	2.4	135.4
TOP OF SEAL	171.0	-33.2
TOP OF FILTER PACK	173.0	-35.2
TOP OF SCREEN	176.8	-39.0
BOTTOM OF SCREEN	187.2	-49.4
BOTTOM OF SUMP	192.9	-55.1
BOTTOM OF HOLE	193.0*	-55.0

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.

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 INCHES
TYPE: MFR 6 VERT ROWS OF SLOTS

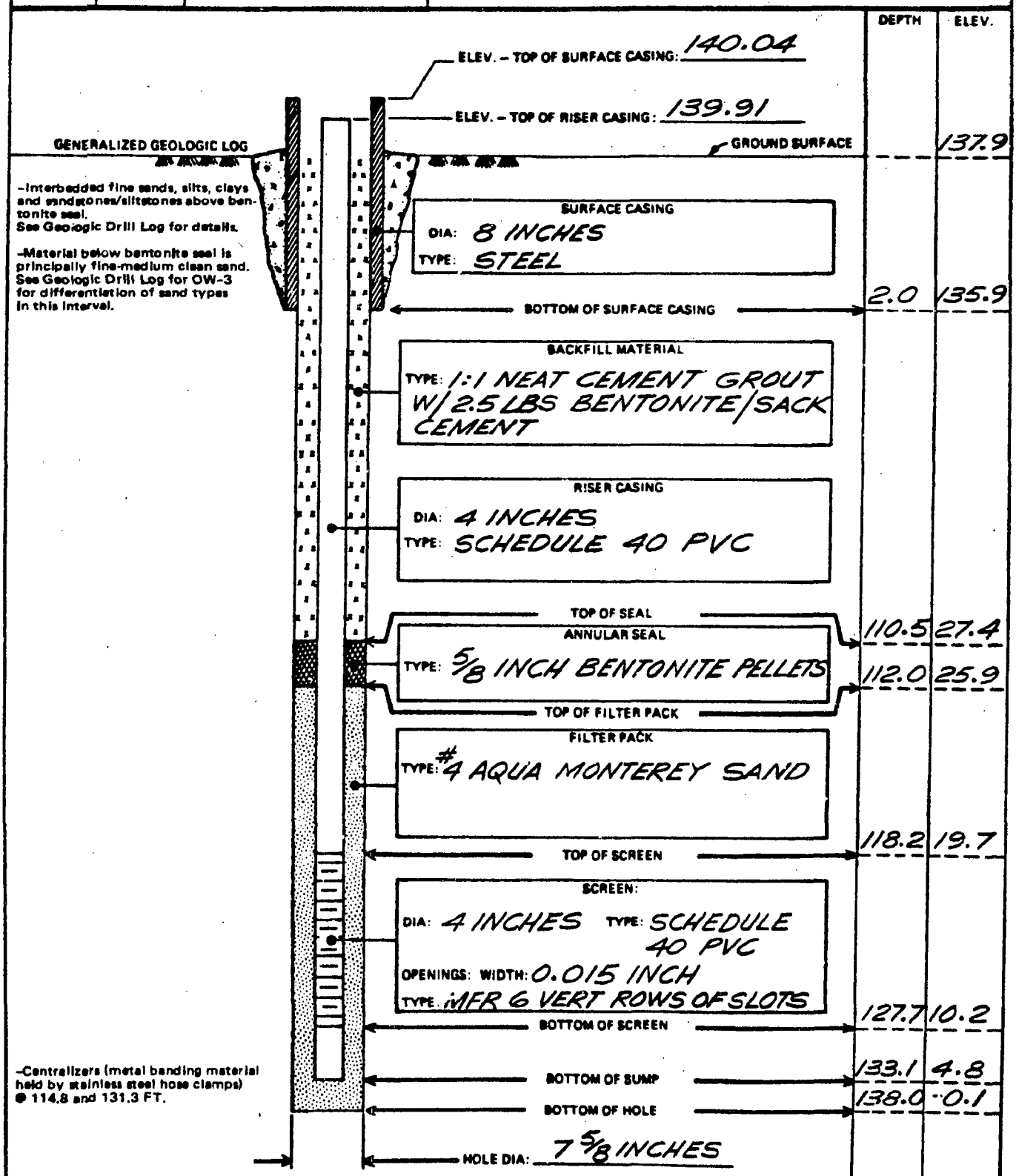
HOLE DIA: 7 5/8 INCHES

-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		



Appendix C - Test Pit Logs

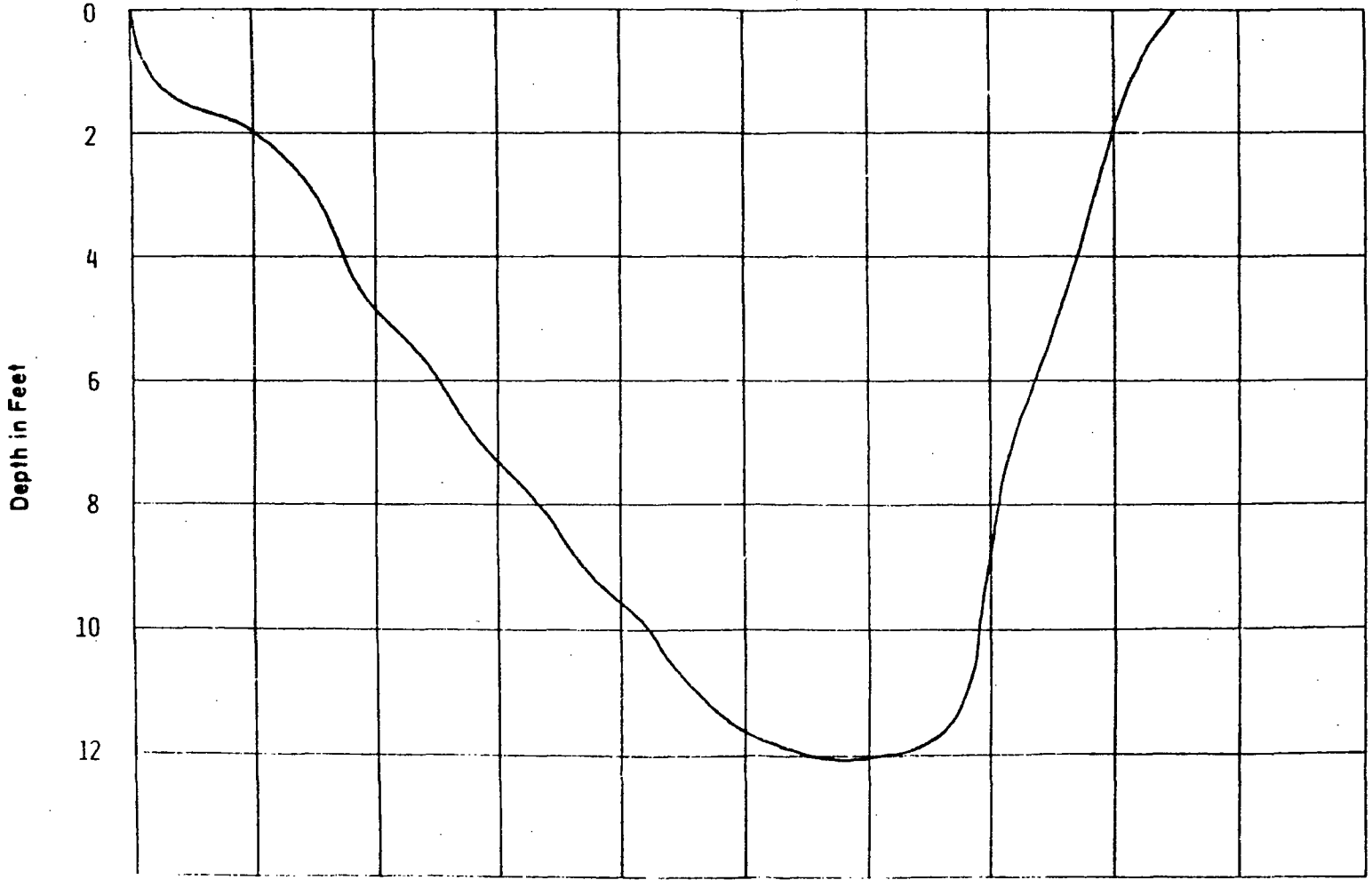
TEST PIT LOG

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



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.	

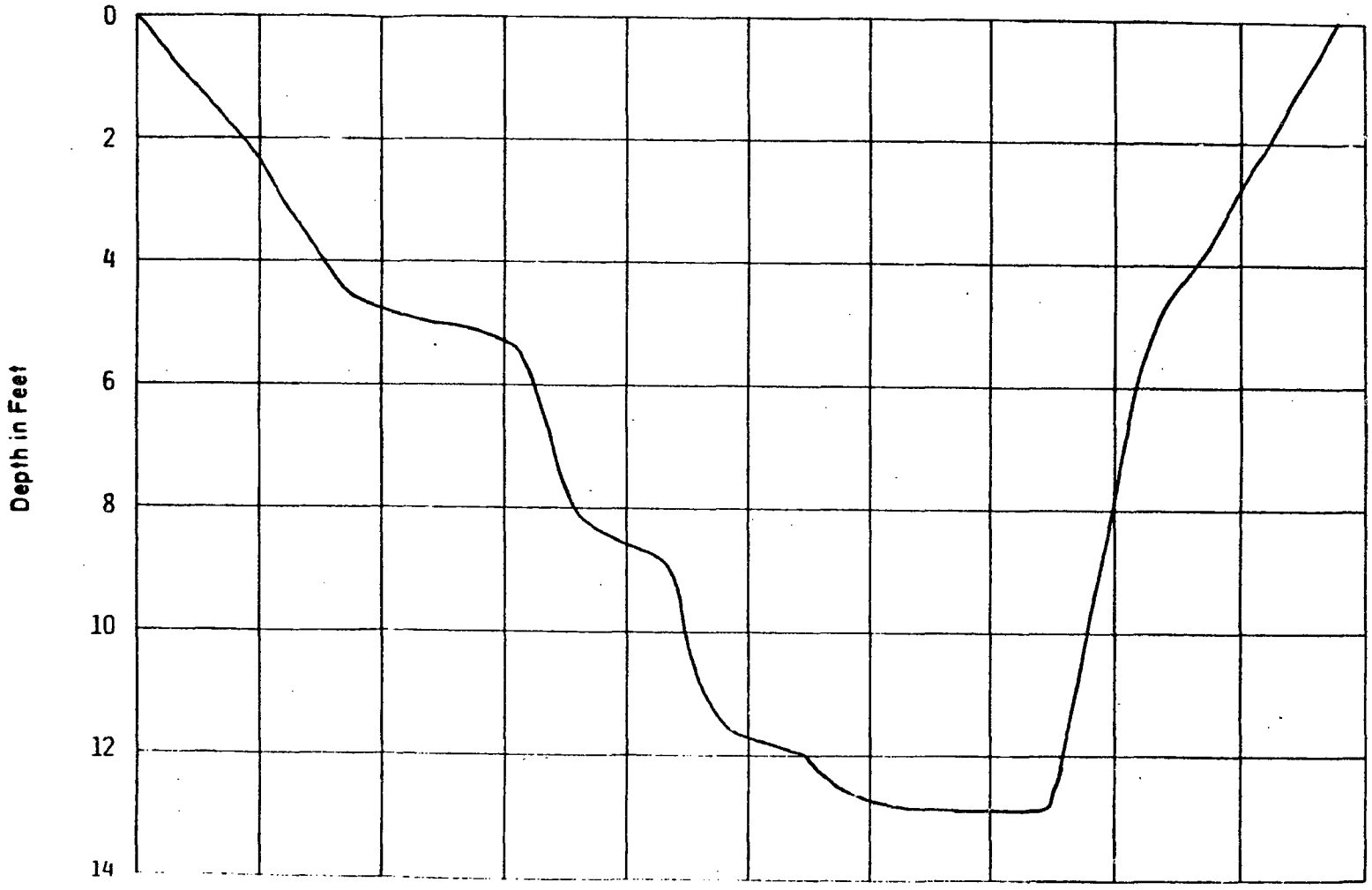
TEST PIT LOG

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



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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.	

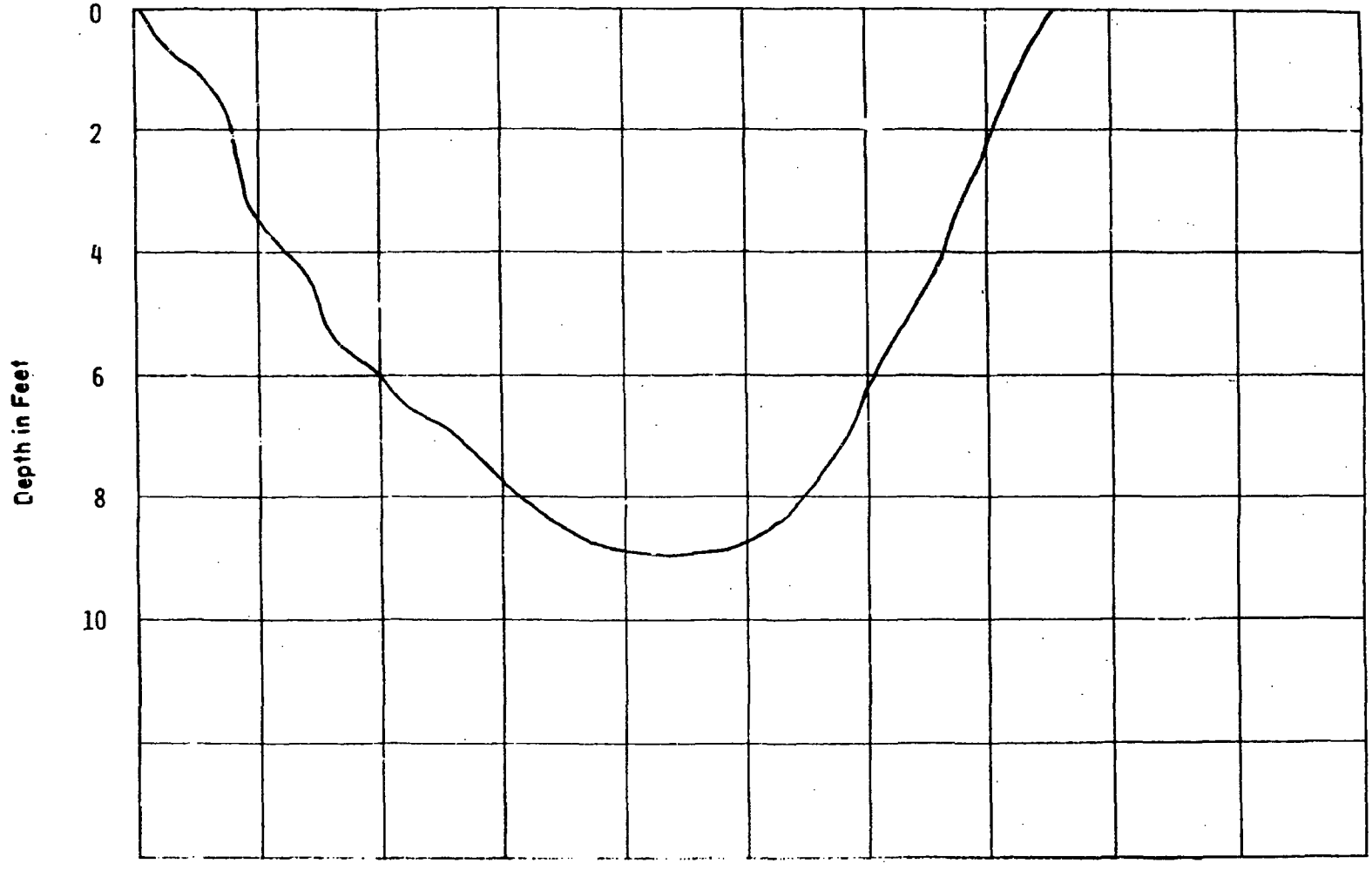
TEST PIT LOG

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



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.	

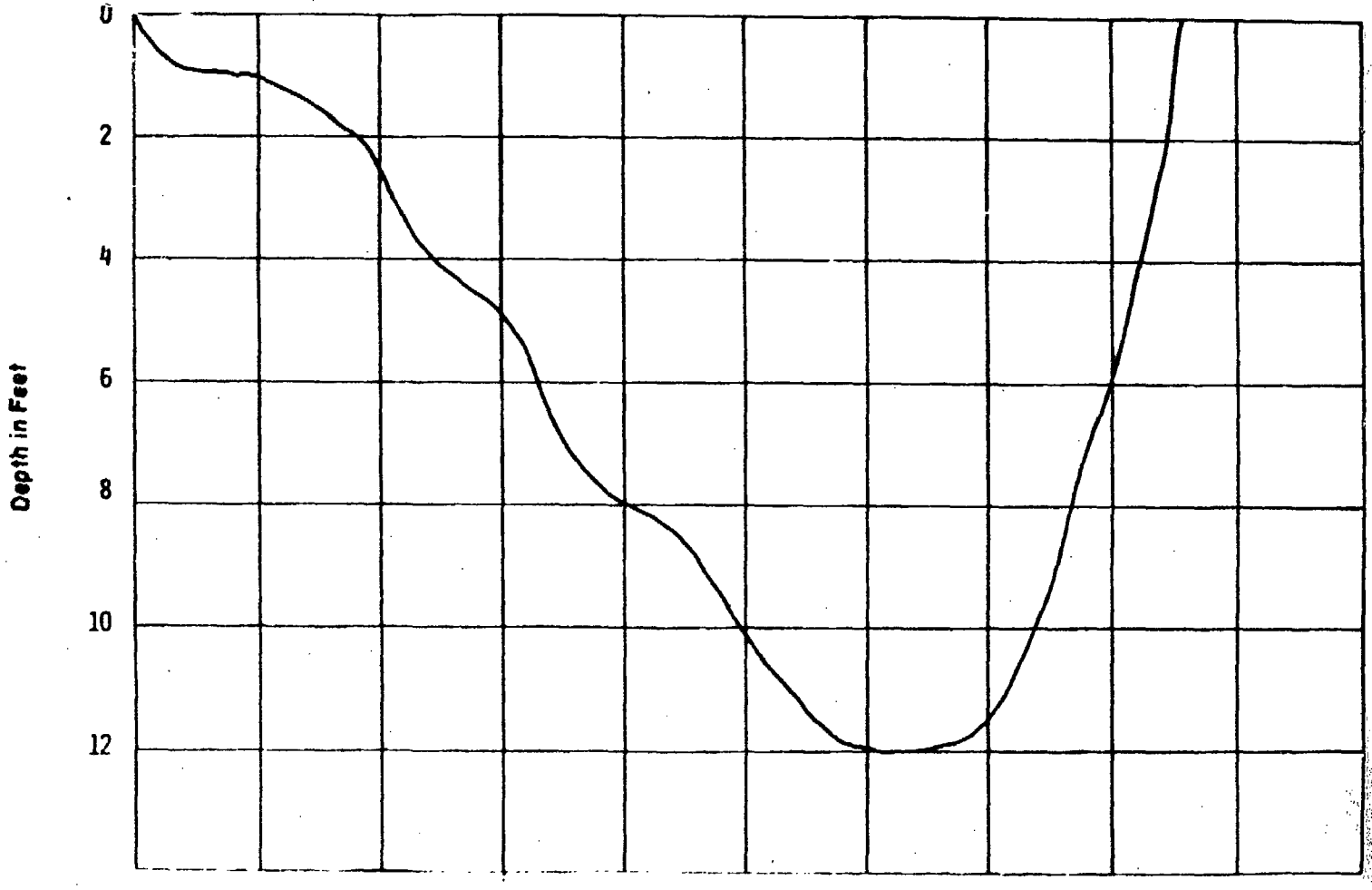
TEST PIT LOG

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



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.	

Appendix D

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

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)

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

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

PROJECT NO. A-2676-1

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

GRAIN SIZE DISTRIBUTION

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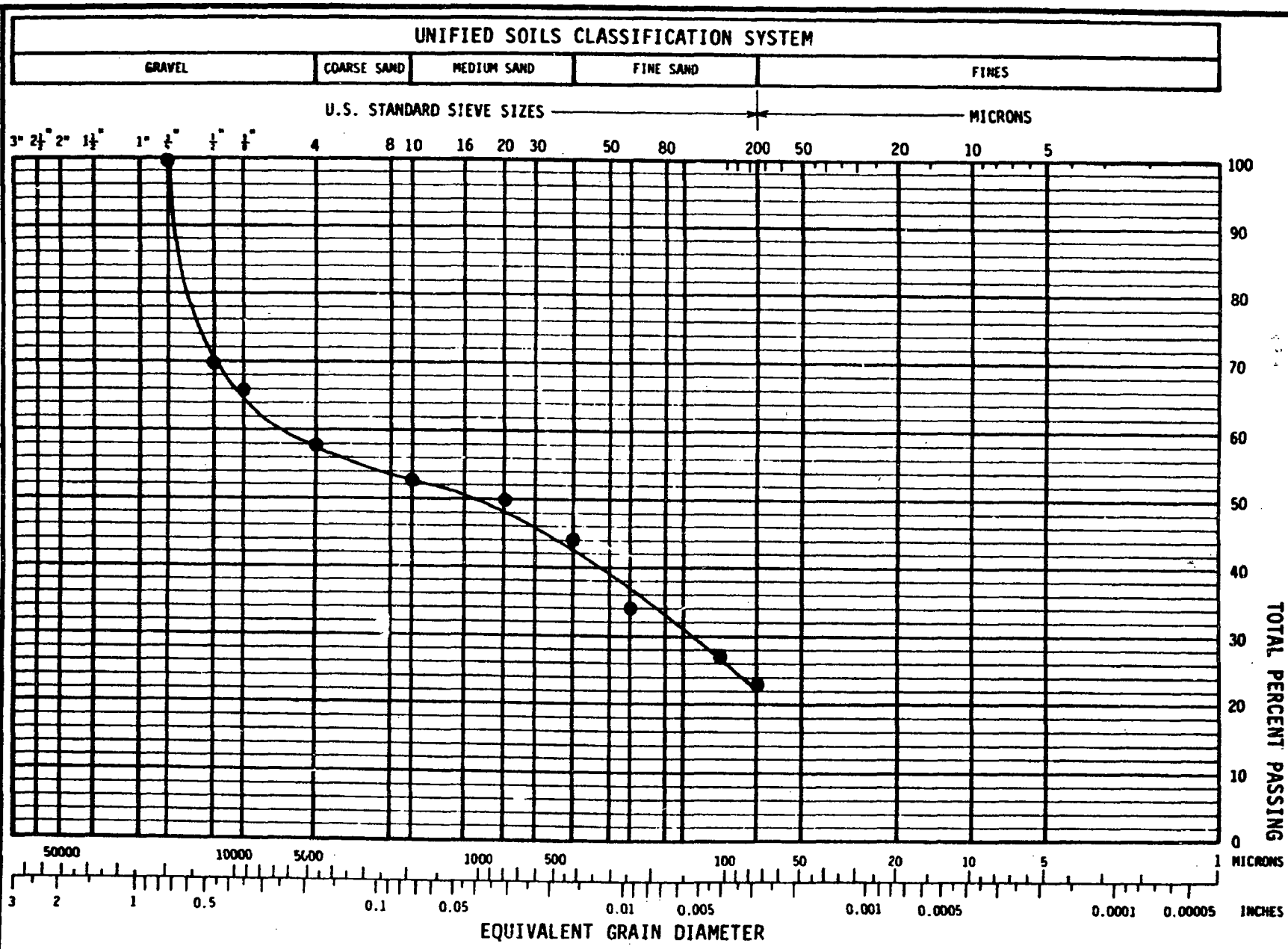

Test Pit No.

T-1 @ 1.5 Ft.

PLATE

ERPT C 0104

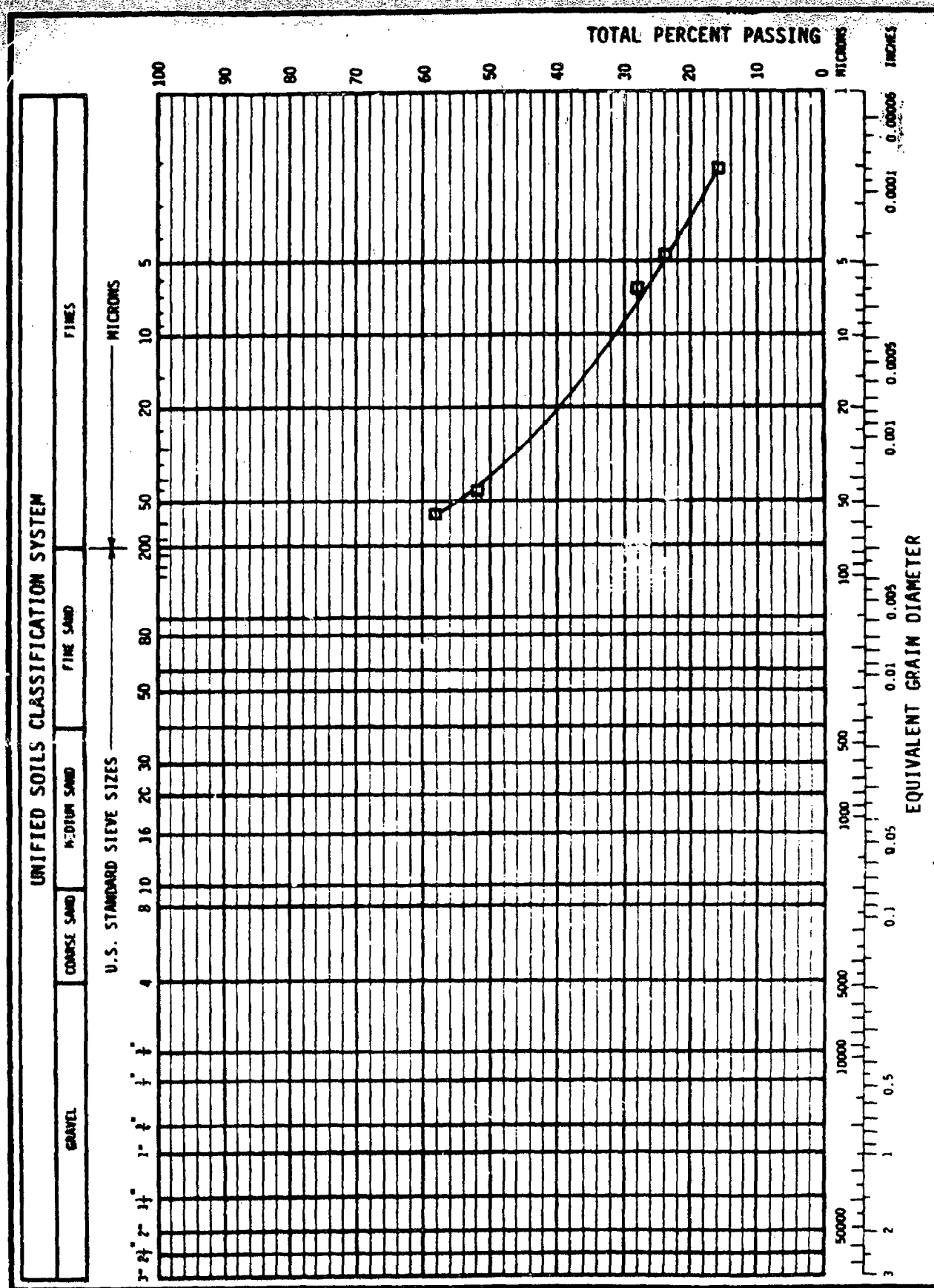

EXHIBIT C 0104

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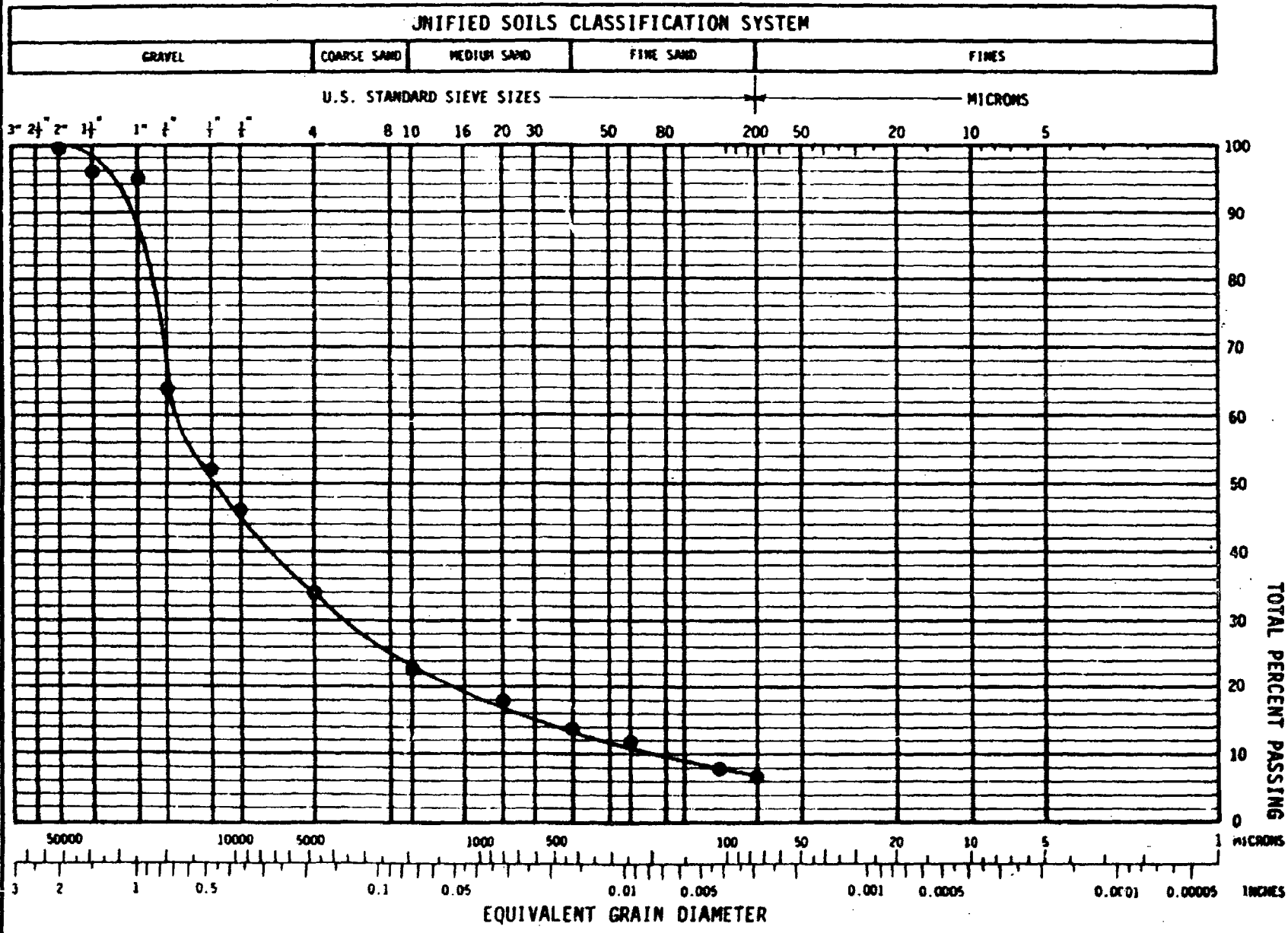
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING

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

GRAIN SIZE DISTRIBUTION

PLATE

PROJECT NO. A-2676-1



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
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GRAIN SIZE DISTRIBUTION

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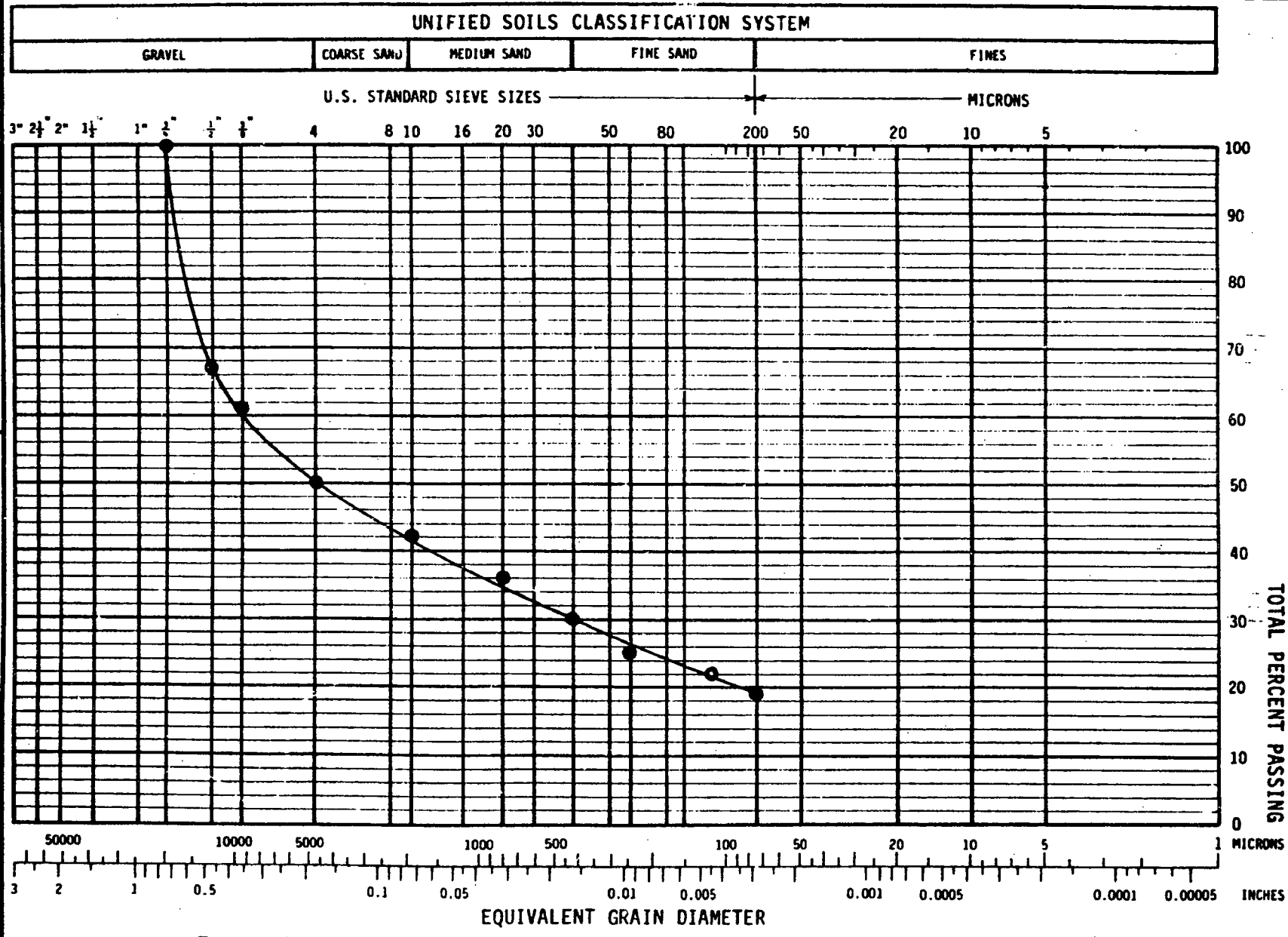
PROJECT NO. A-2676-1

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

GRAIN SIZE DISTRIBUTION

PLATE



Test Pit No.
T-1 @ 9.0 Ft.

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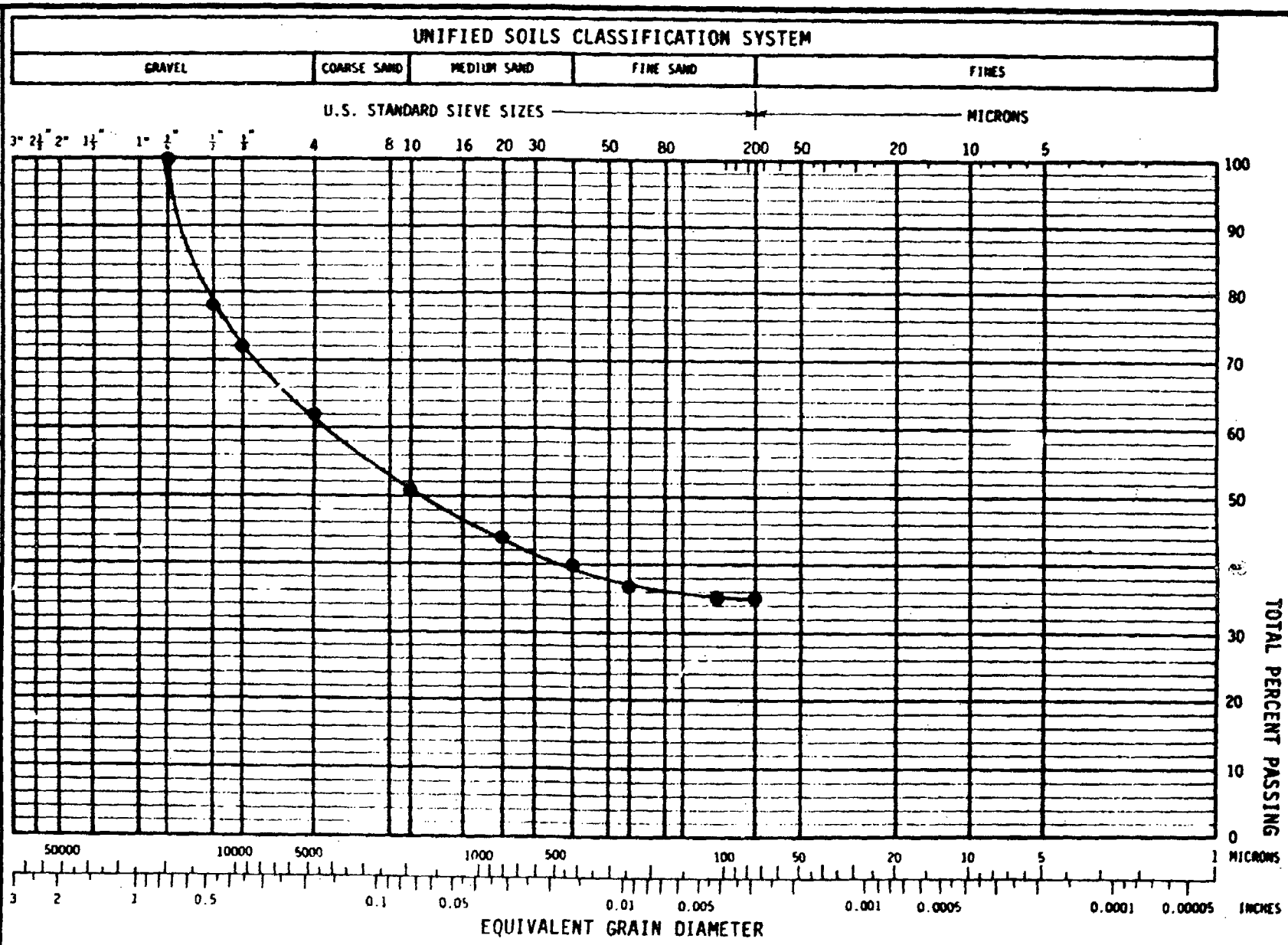

Test Pit No.
T-1 @ 12.0 feet

J.H. KLEINFELDER & ASSOCIATES
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PROJECT NO. [illegible]

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

GRAIN SIZE DISTRIBUTION

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PROJECT NO. A- 2276-1

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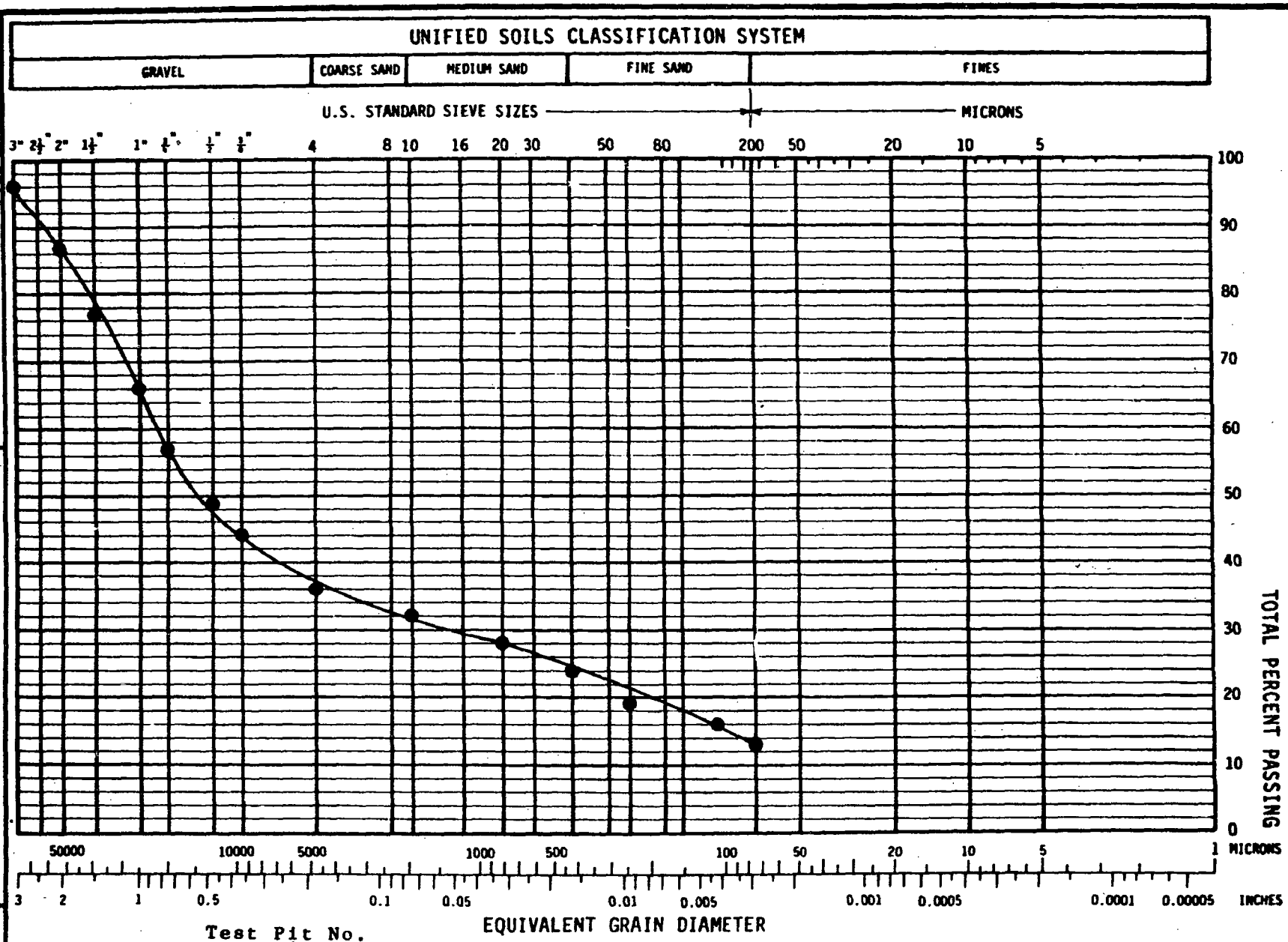
Evaporation Pond, SMUD Task 059
Rancho Seco Nuclear Generating
Station, Unit 1

GRAIN SIZE DISTRIBUTION

PLATE



Test Pit No.
T-2 @ 0.9 Ft.

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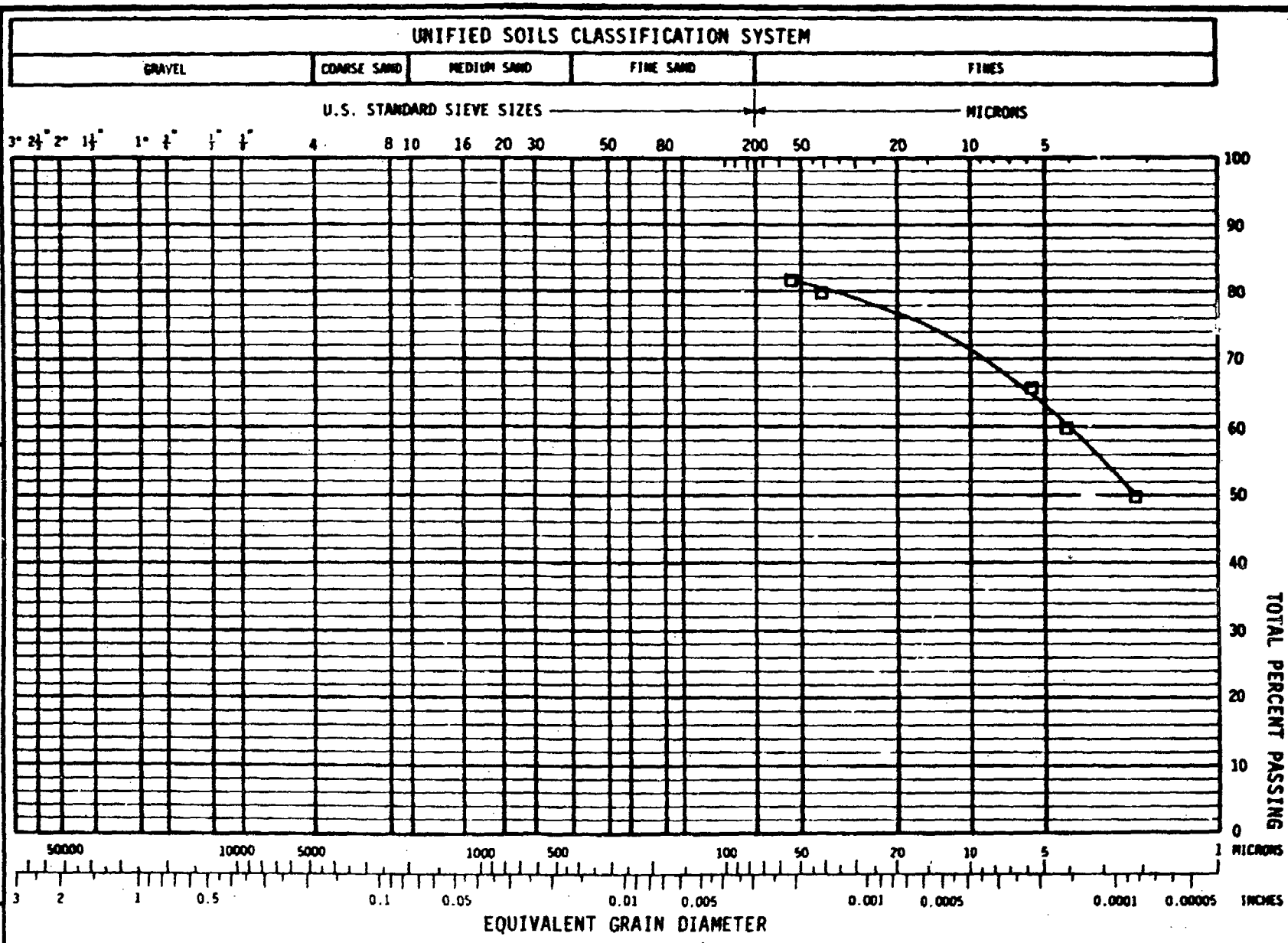

Test Pit No.

T-2 @ 5 Ft.

ERPT C 0104

J.H. KLEINFELDER & ASSOCIATES
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PROJECT NO. A-2676-1

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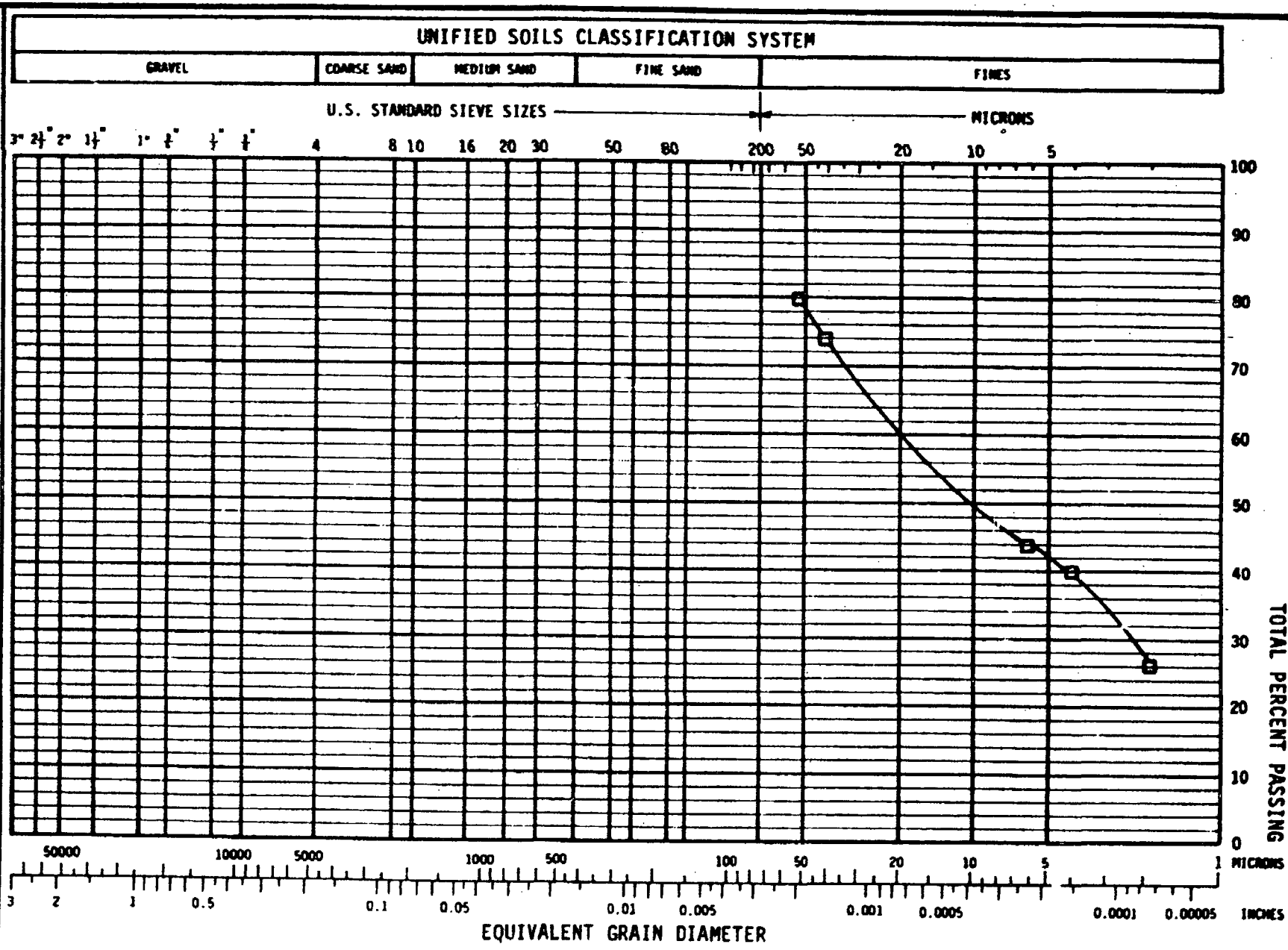
PROJECT NO.

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

GRAIN SIZE DISTRIBUTION

PLATE



Test Pit No.
T-2 @ 12.5 Ft.

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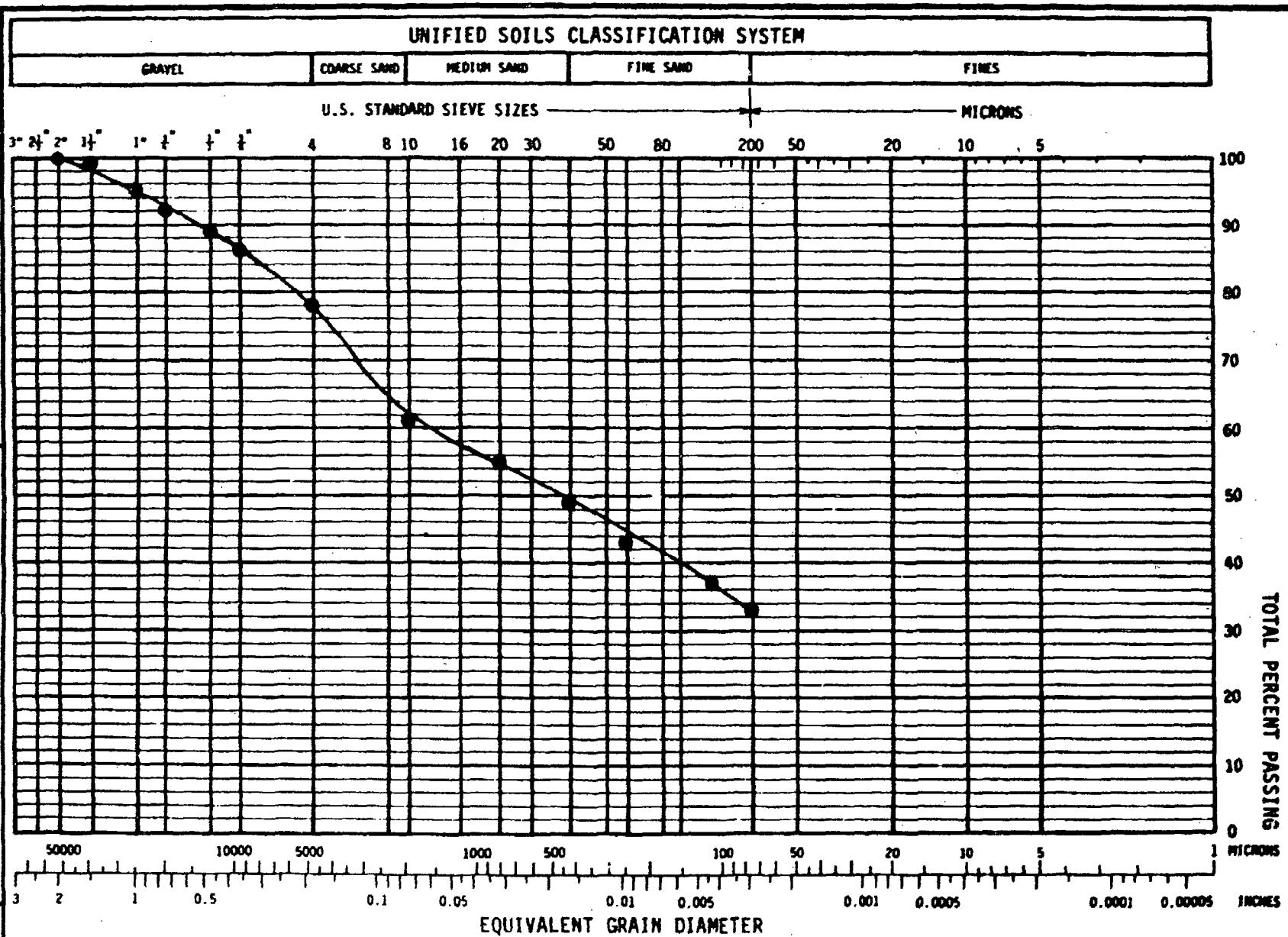
PROJECT NO. 4-2676-1

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

GRAIN SIZE DISTRIBUTION

PLATE



Test Pit No.
T-3 @ 1.0 Ft.

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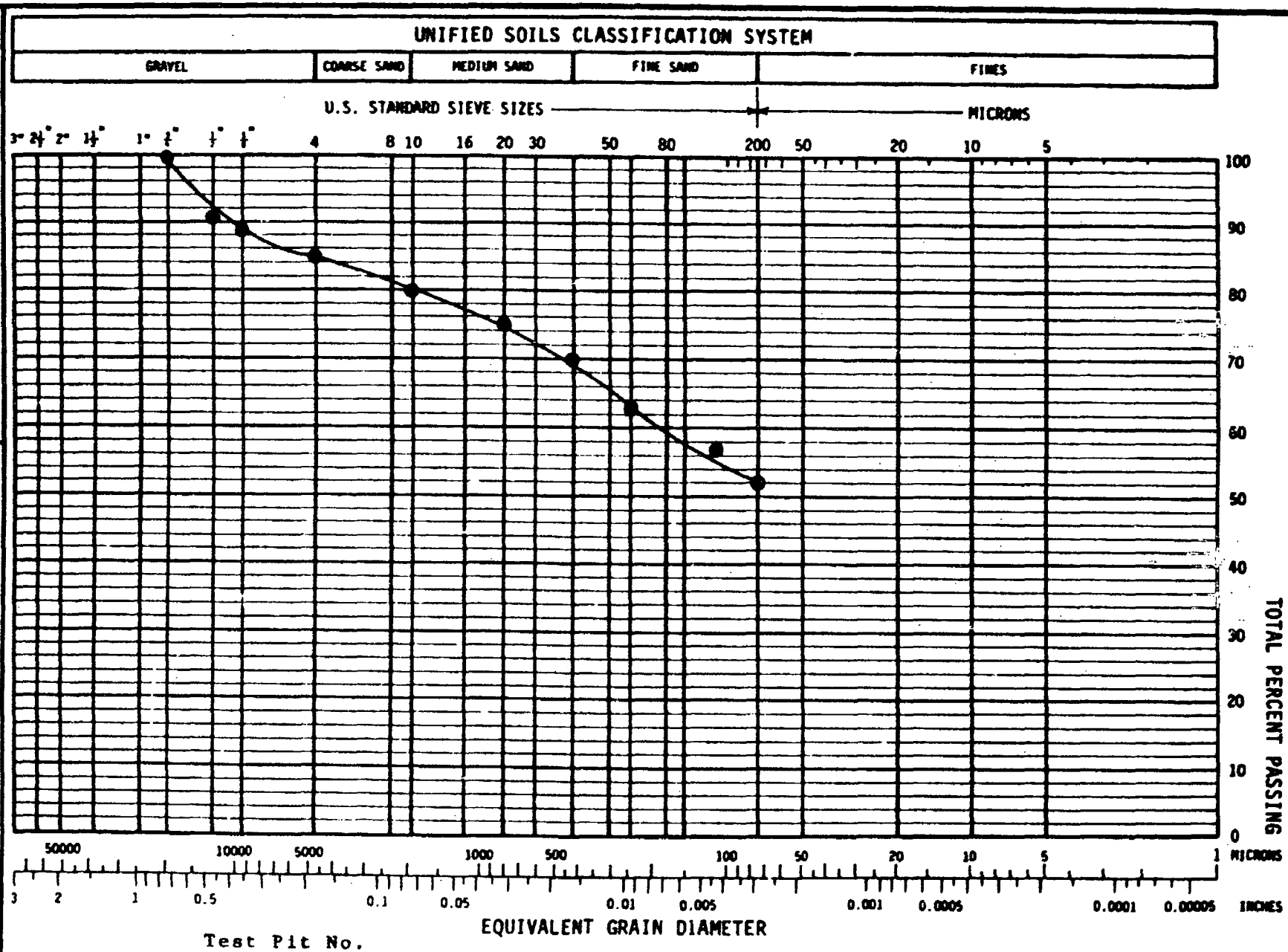

Test Pit No.

T-3 @ 3.5 Ft.

J.H. KLEINFELDER & ASSOCIATES
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PROJECT NO. A-2676-1

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Station, Unit 1

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

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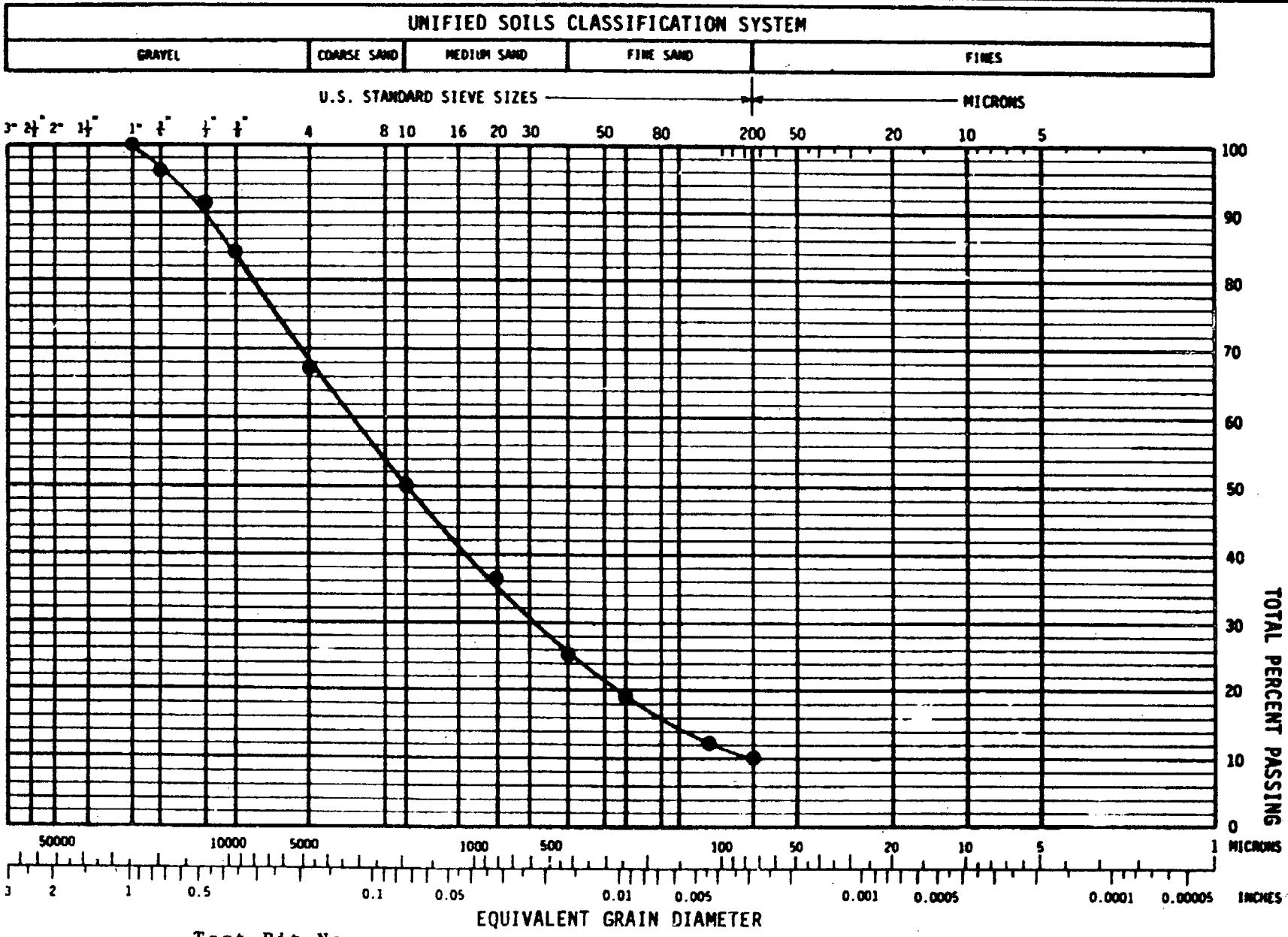
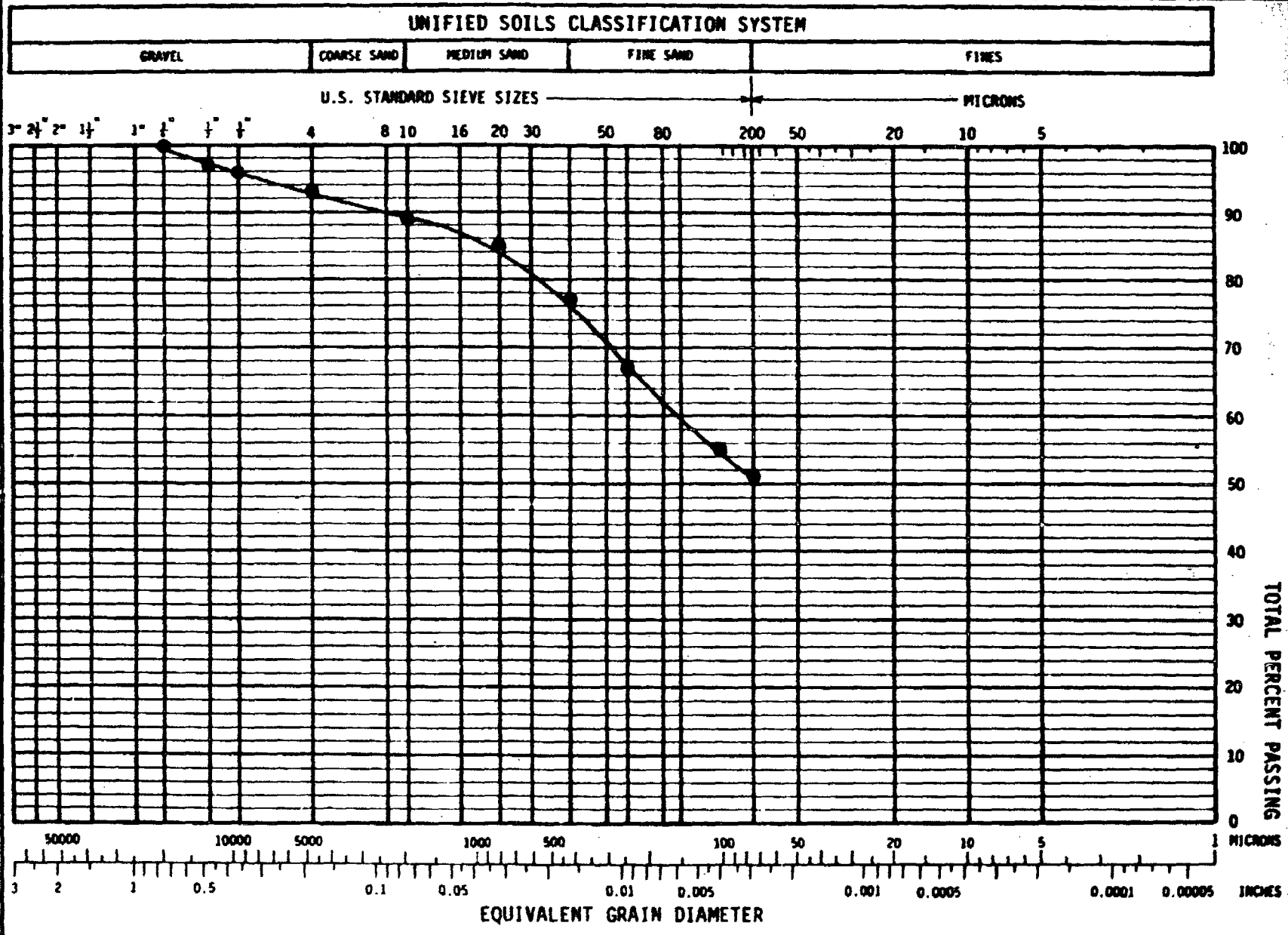


Test Pit No.

T-3 @ 6.5 Ft.

PLATE

ERPT C 0104



Test Pit No.
T-4 @ 1.0 Ft.

ERPT C 0104

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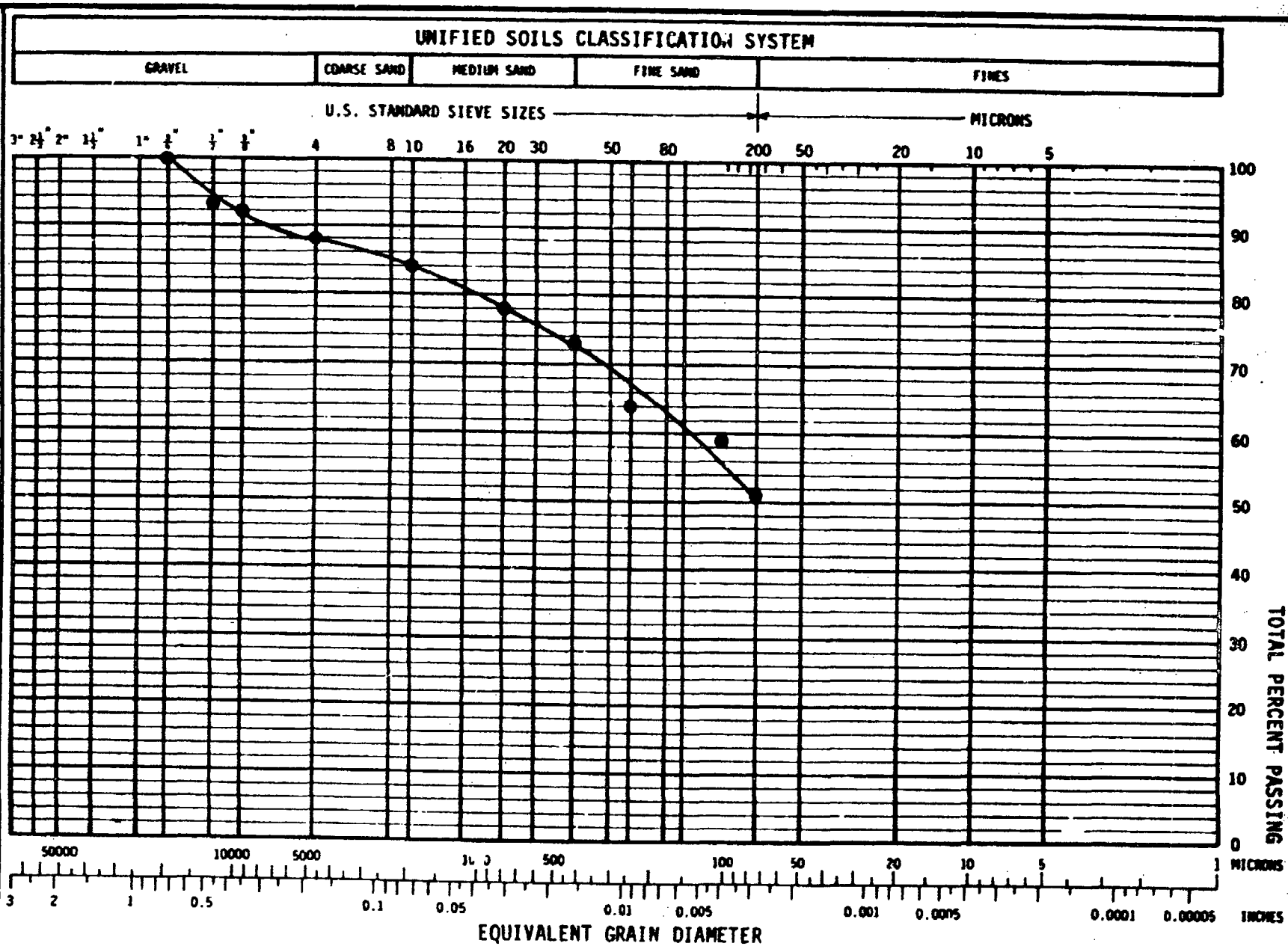
GRAIN SIZE DISTRIBUTION

PLATE



Test Pit No.
T-4 @ 2.7 Ft.

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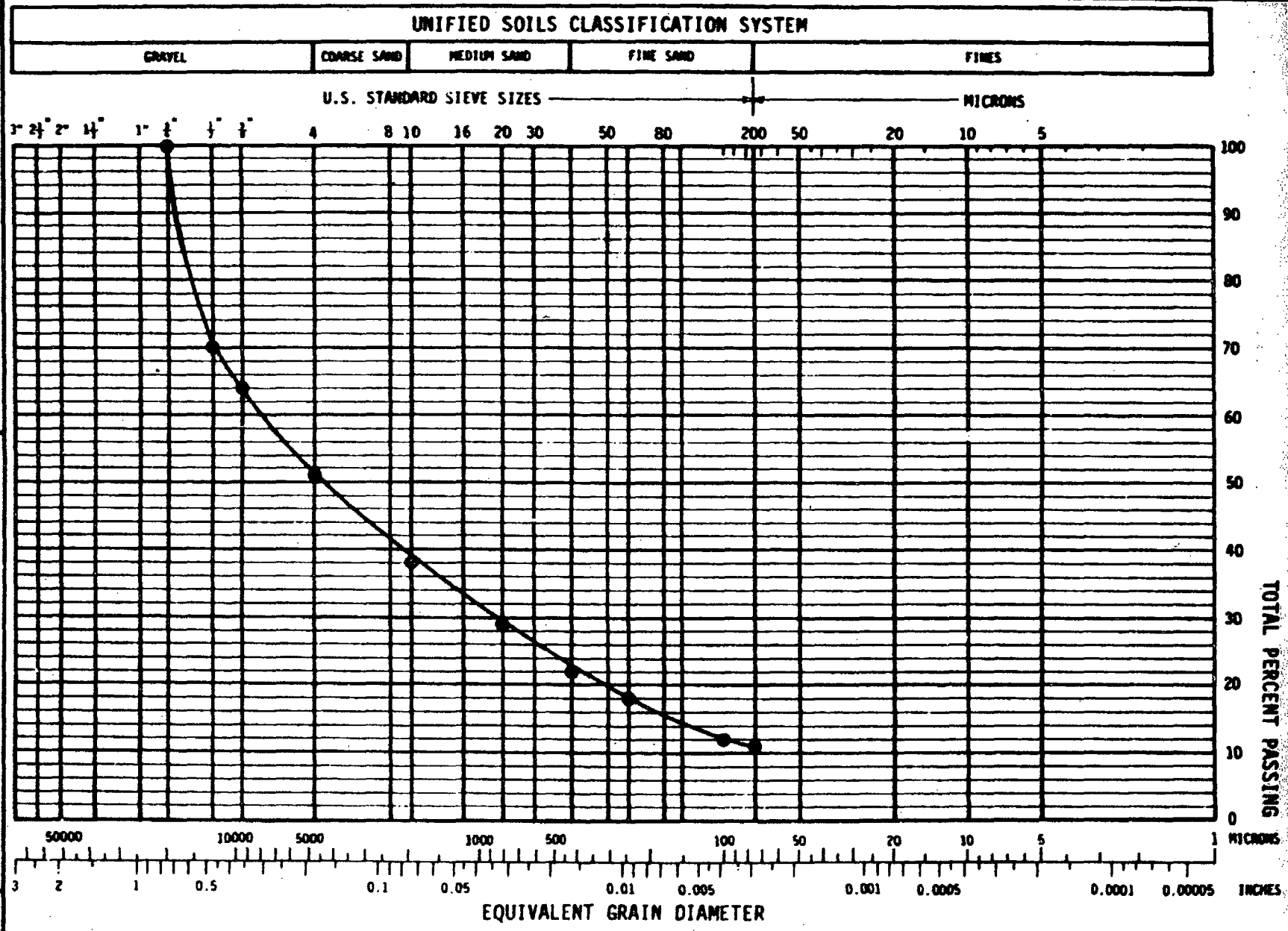

Test Pit No.
T-4 @ 5.5 Ft.

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GRAIN SIZE DISTRIBUTION

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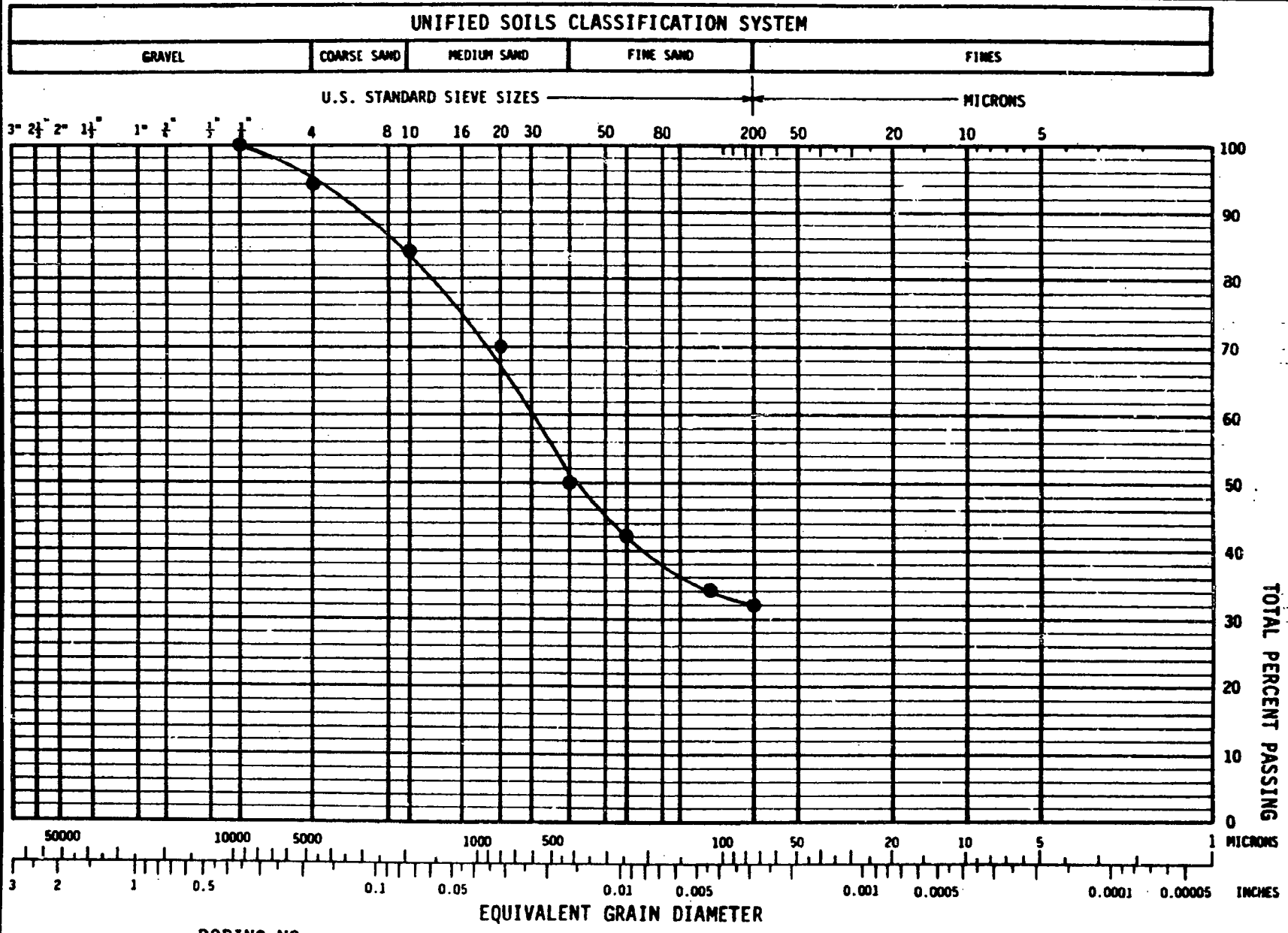

BORING NO.

B-1 @ 17.5 to 20 Ft.

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PROJECT NO. A-2676 -1

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GRAIN SIZE DISTRIBUTION

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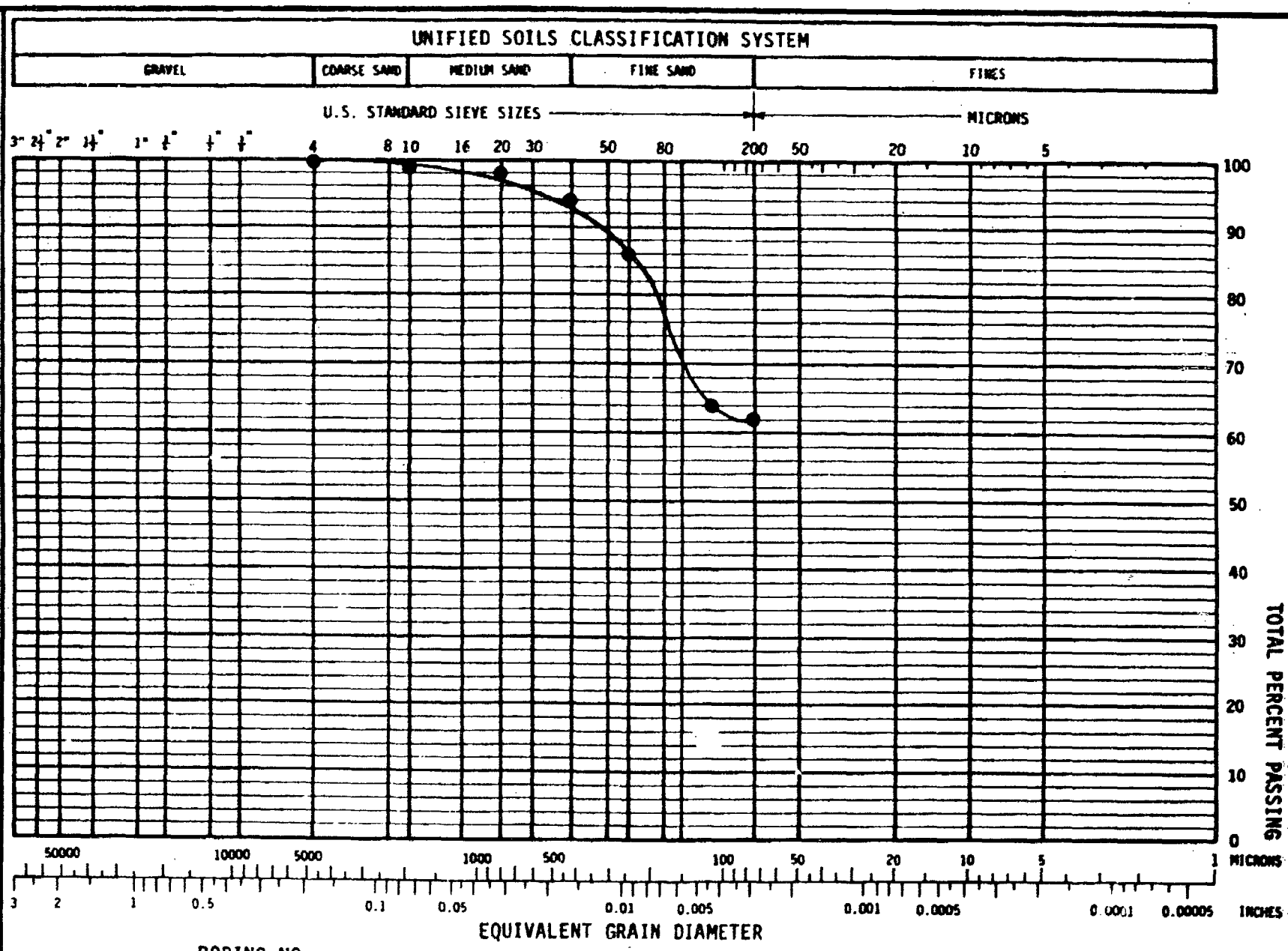

BORING NO.

B-2 @ 15 to 17.5 Ft.

J H KLEINFELDER & ASSOCIATES
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GRAIN SIZE DISTRIBUTION

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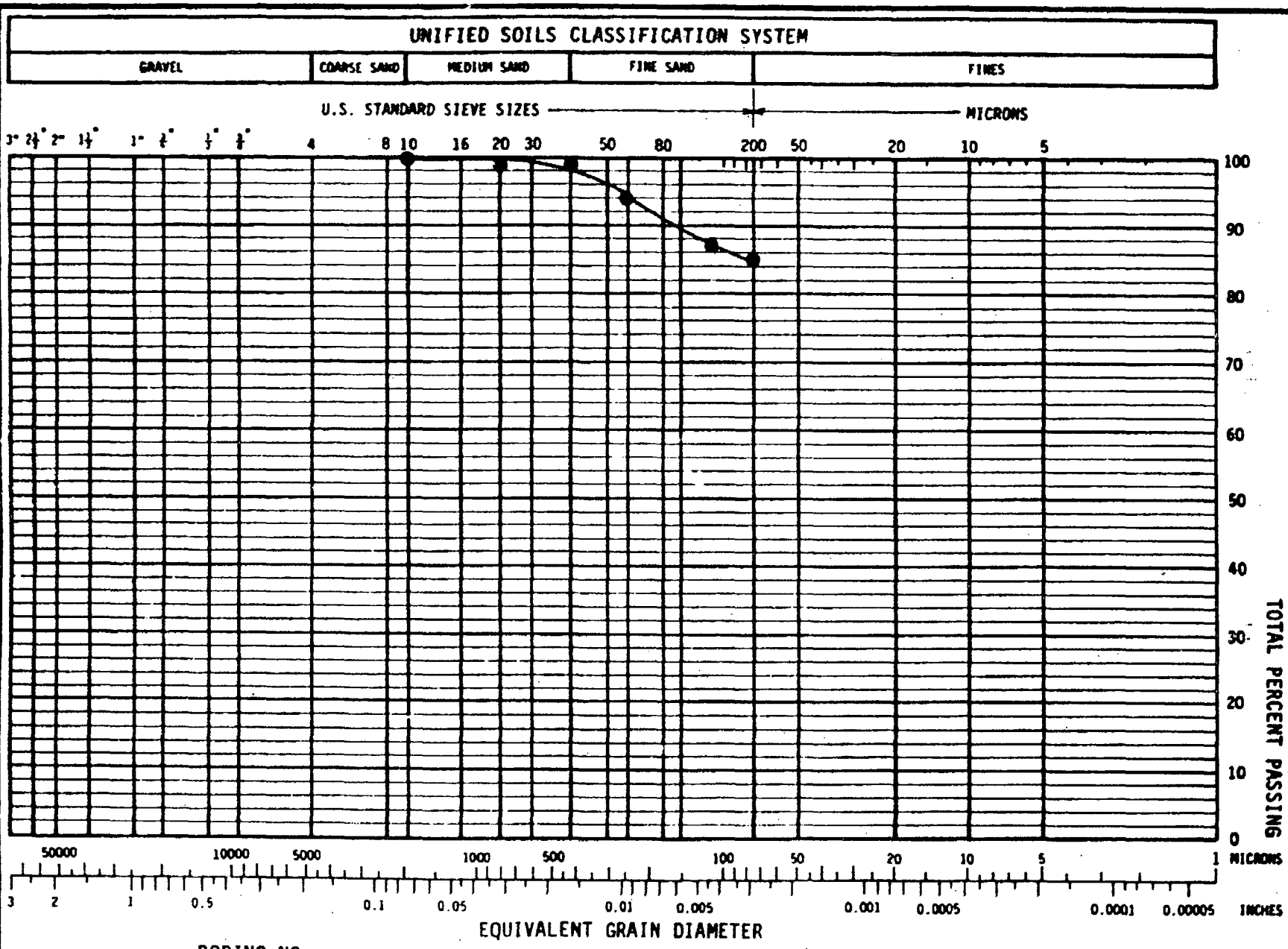

BORING NO.

B-2 @ 25 to 27.5 Ft.

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GRAIN SIZE DISTRIBUTION

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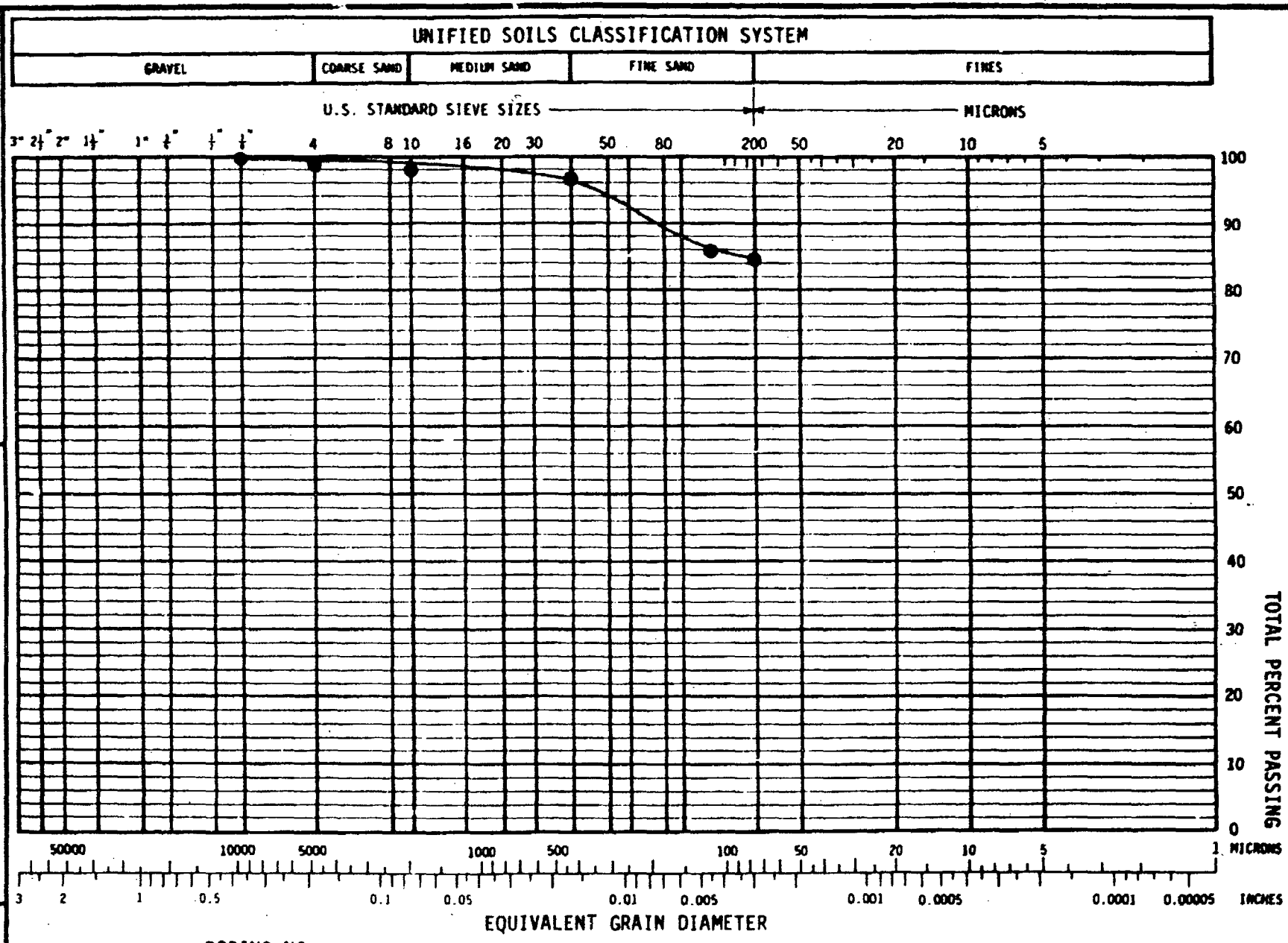

BORING NO.

B-3 @ 17.5 to 20 Ft.

ERPT C 0104

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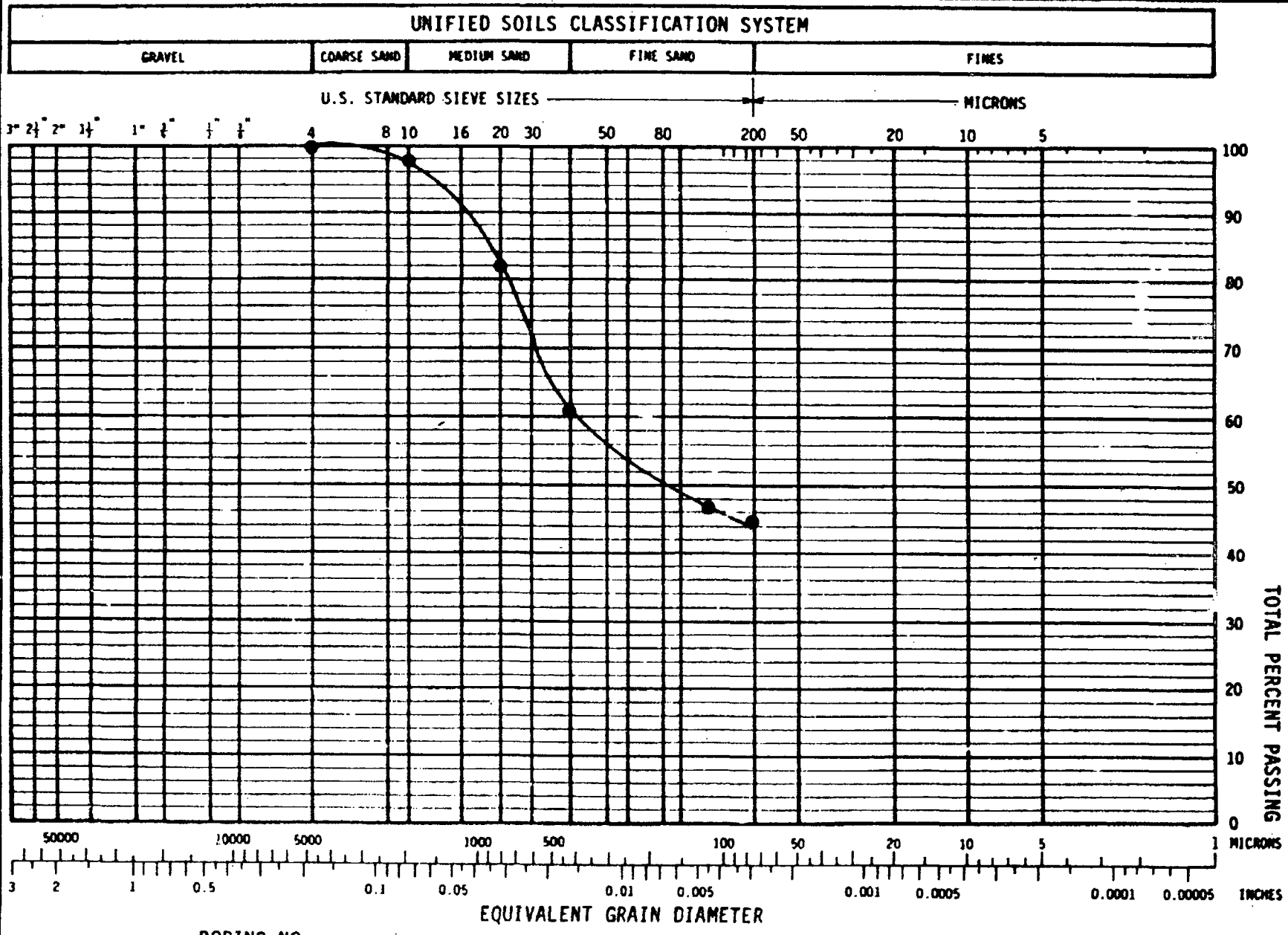
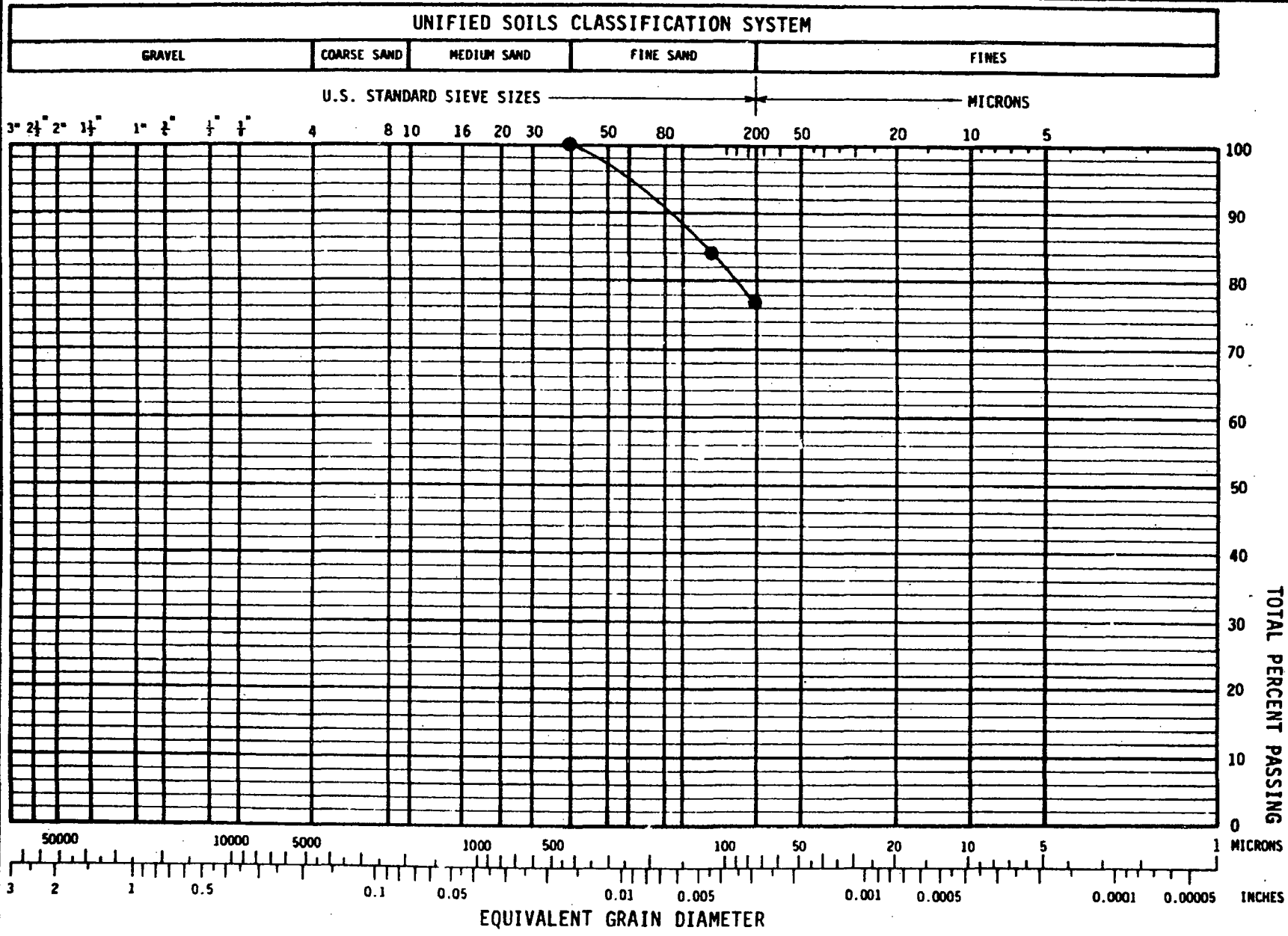


BORING NO.

B-4 15 to 17.5 Ft.

ERPI C 0104



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

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Rancho Seco Nuclear Generating Station, Unit 1

GRAIN SIZE DISTRIBUTION

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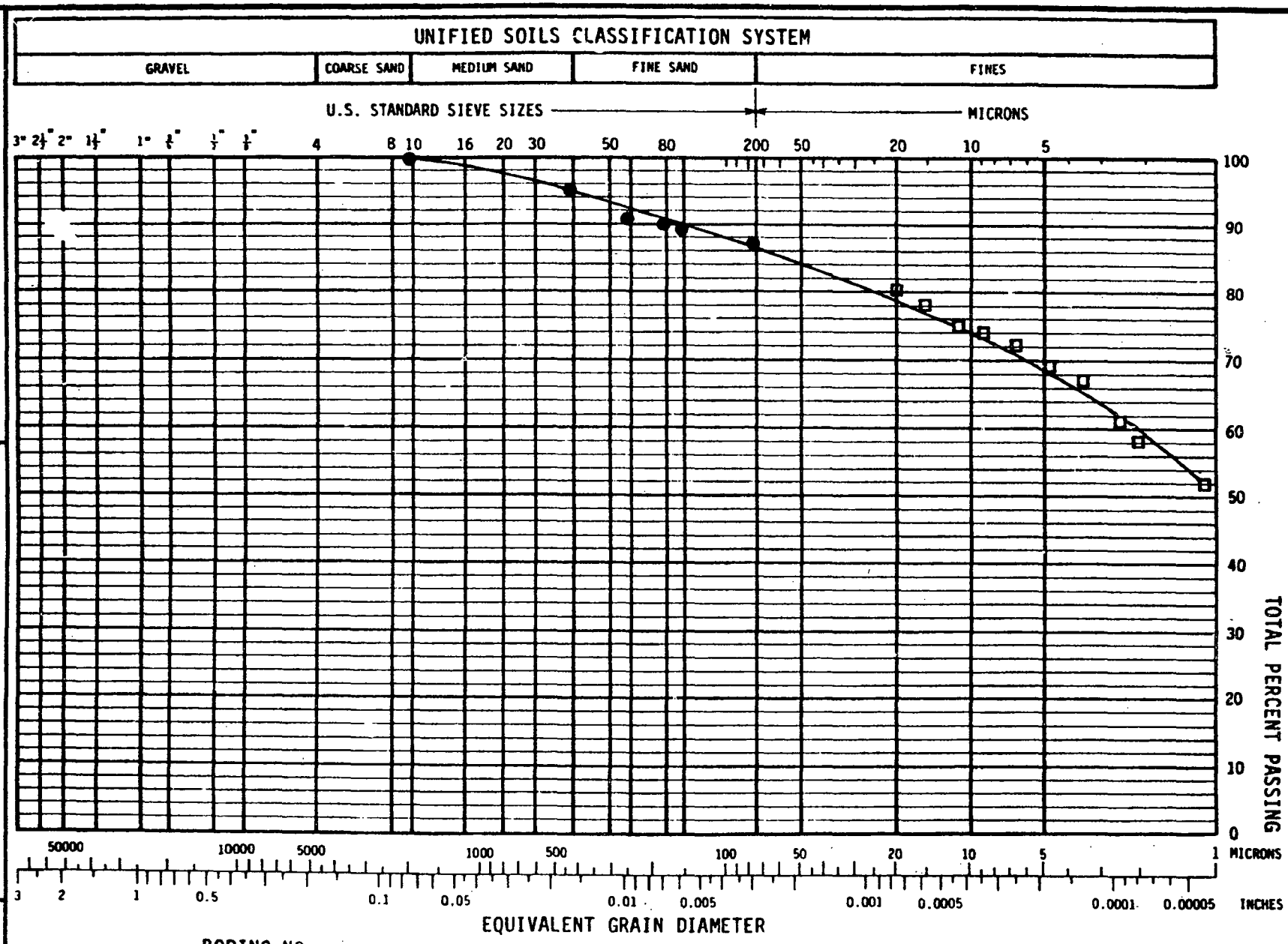
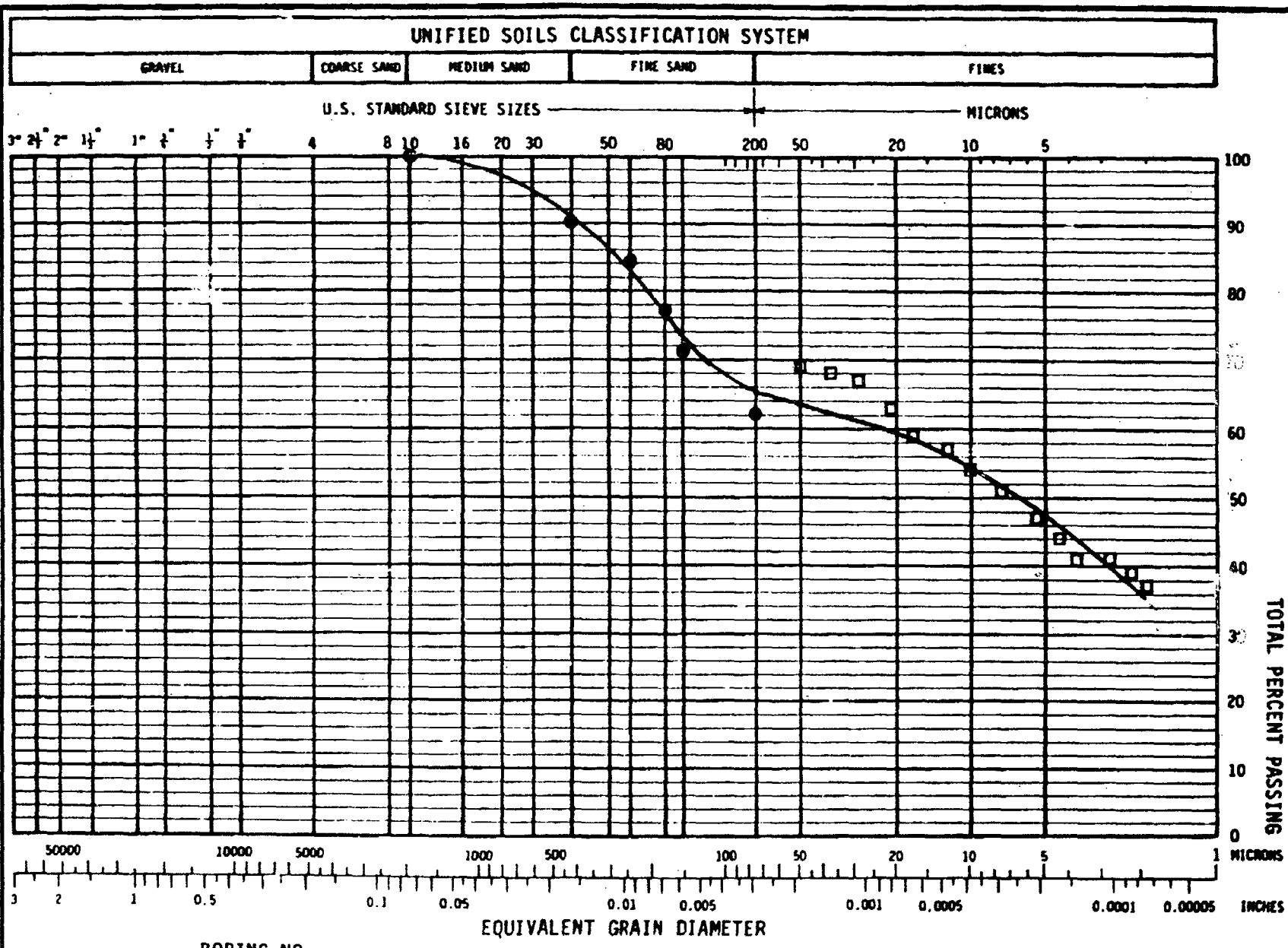


BORING NO.

B-6 @ 10 to 12.5 Ft.

● Sieve Analysis
□ Hydrometer Analysis

ERPI C 0104



BORING NO.

B-6 @ 15 to 17.5 Ft.

● Sieve Analysis

□ Hydrometer Analysis

ERPT C 0104

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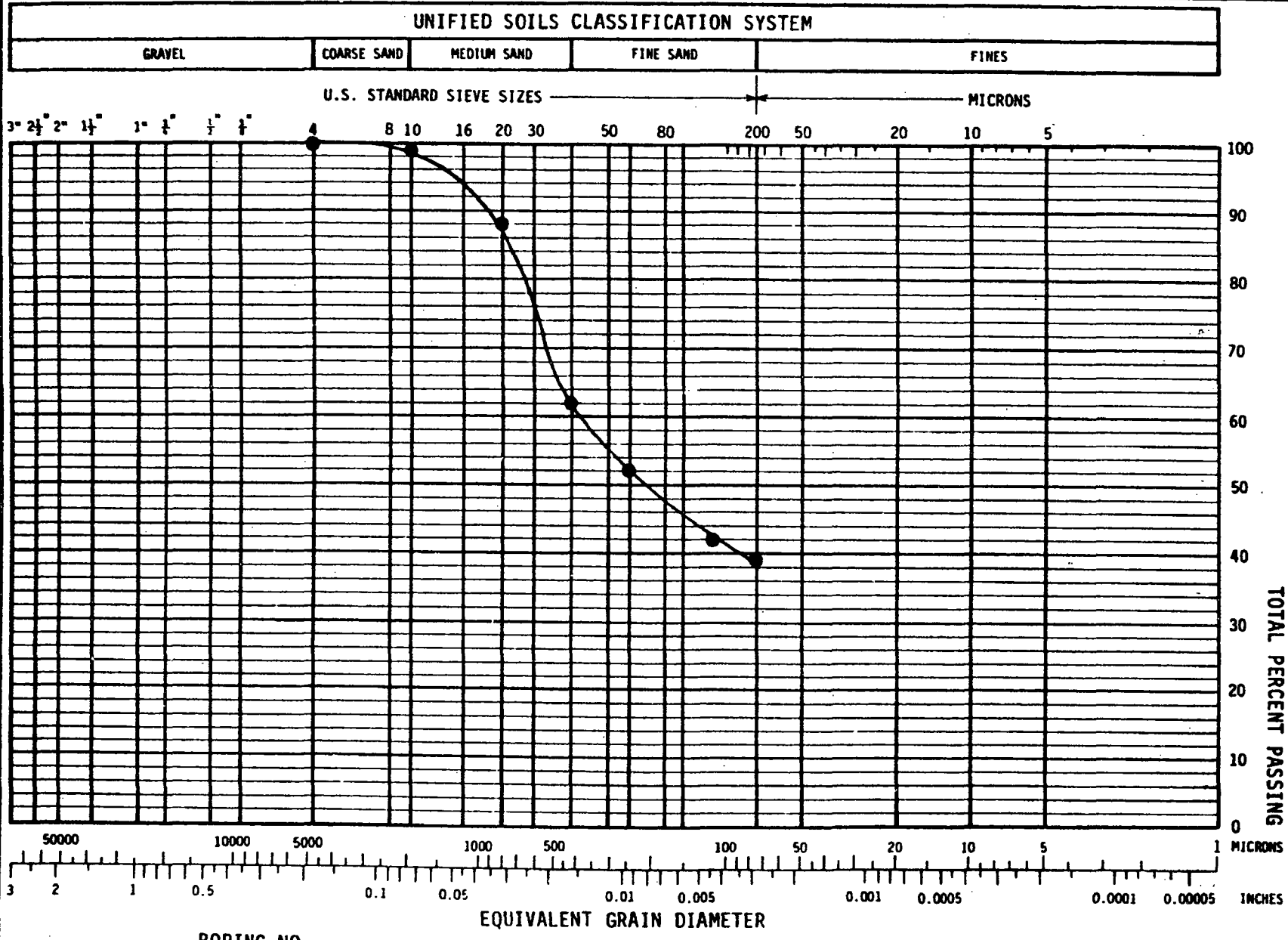
GRAIN SIZE DISTRIBUTION



BORING NO.

B-7 @ 19 to 21.5 Ft.

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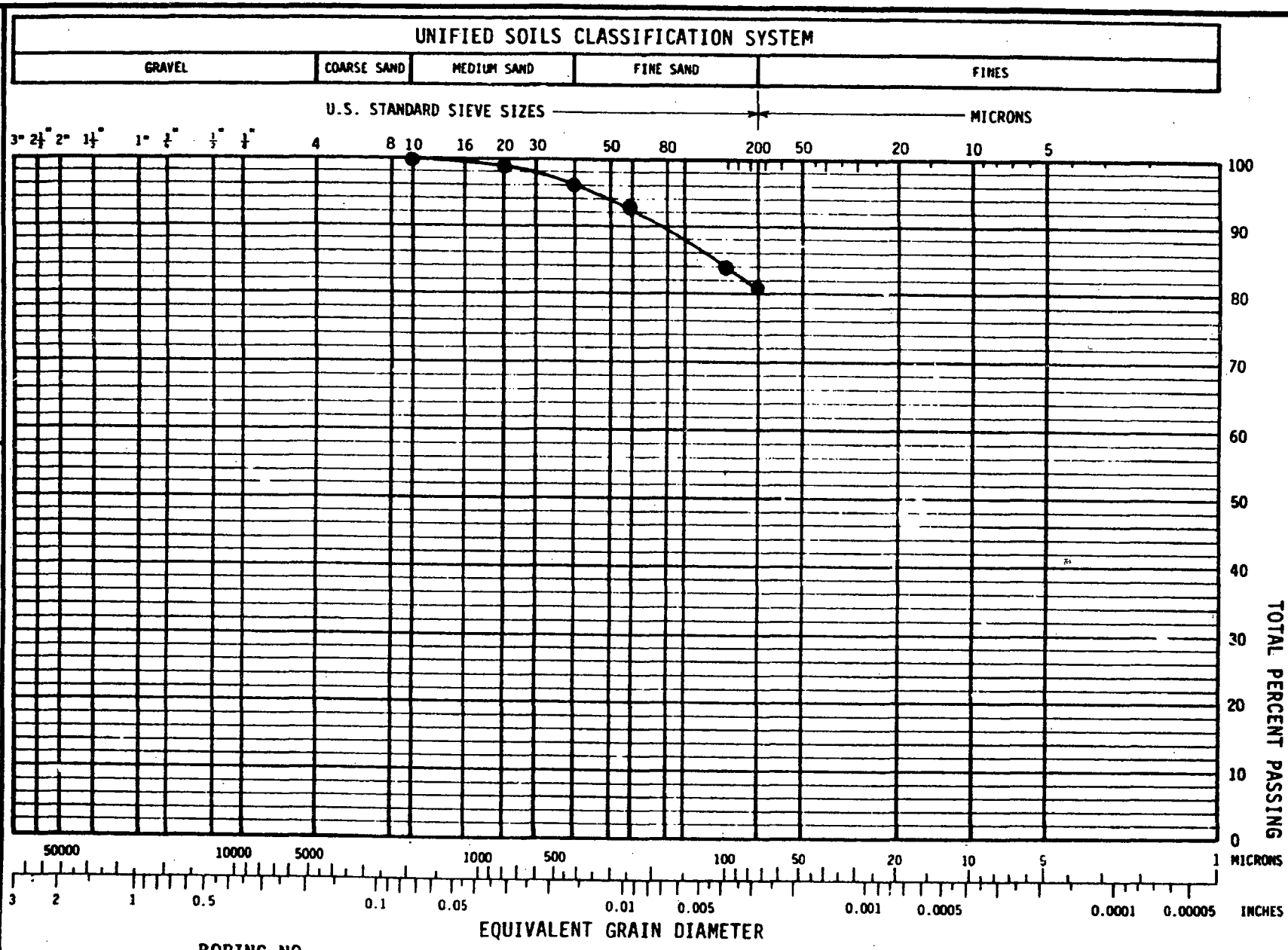

BORING NO.

B-8 @ 17.5 to 20 feet

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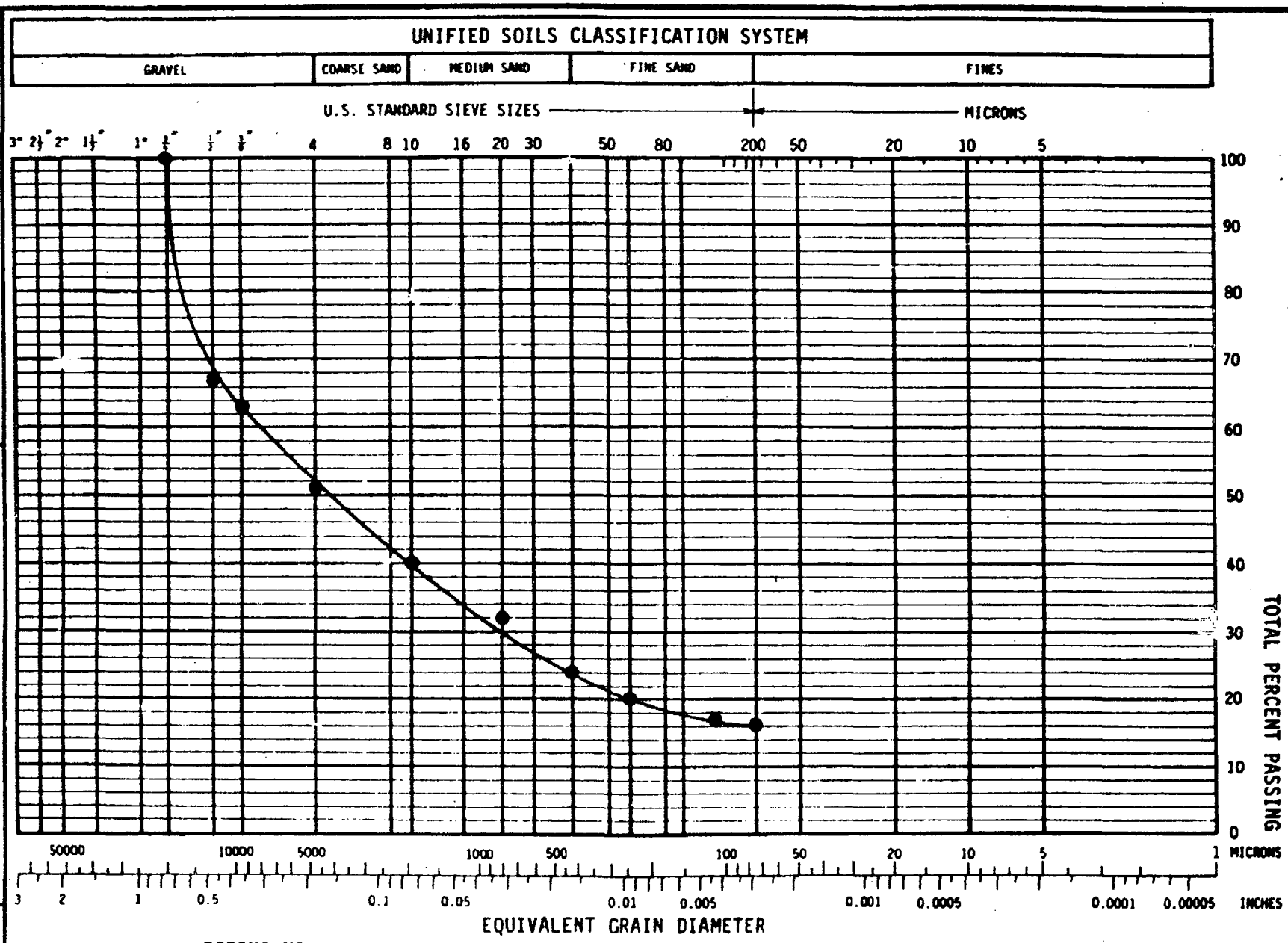
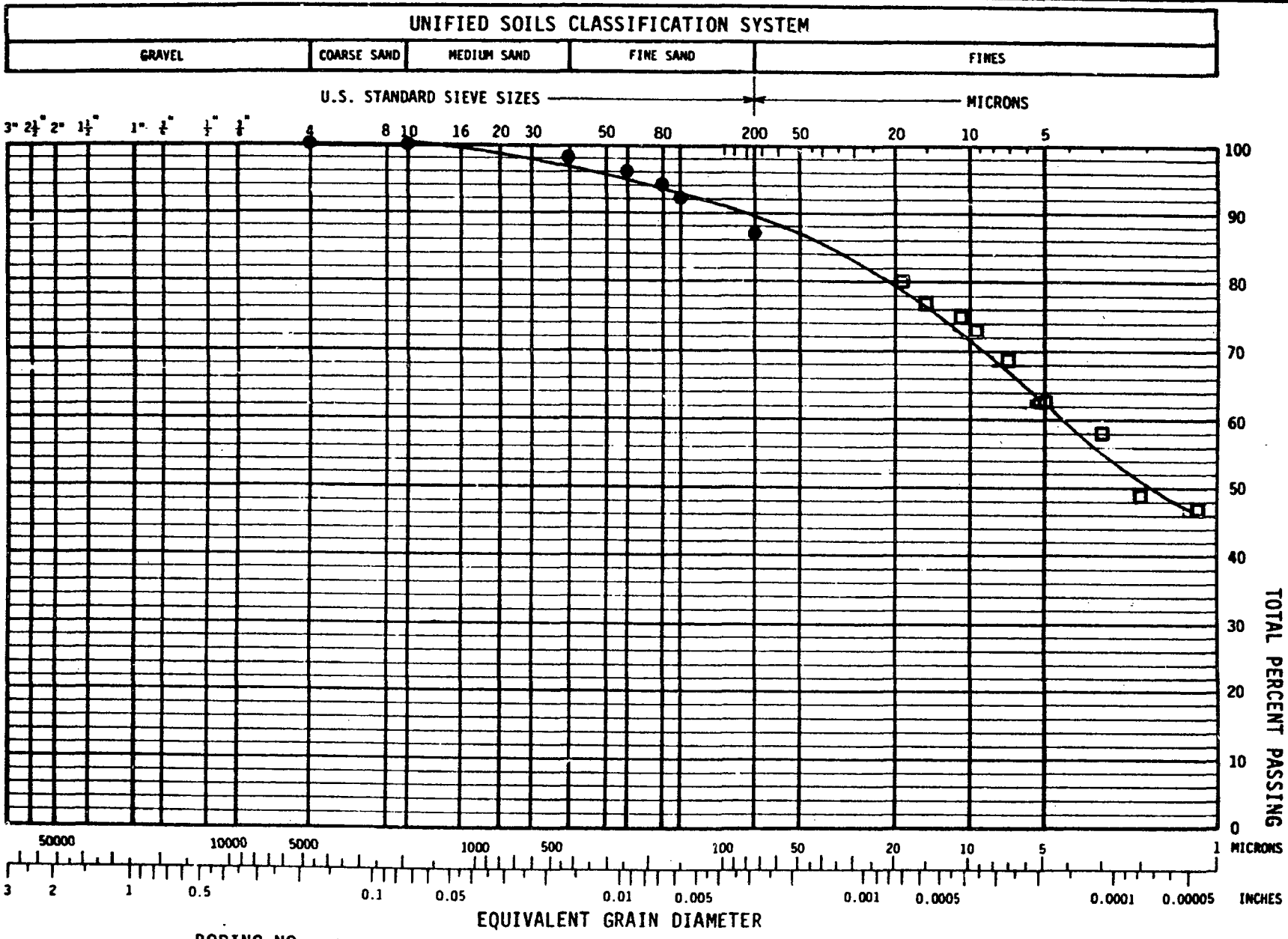


BORING NO.
B-9 @ 20 to 22.5 Ft.

PLATE

ERPT C 0104



BORING NO.

B-10 to 17.5 to 20 Ft.

● Sieve Analysis

□ Hydrometer Analysis

ERPT C 0104

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PROJECT NO. A 9676-1

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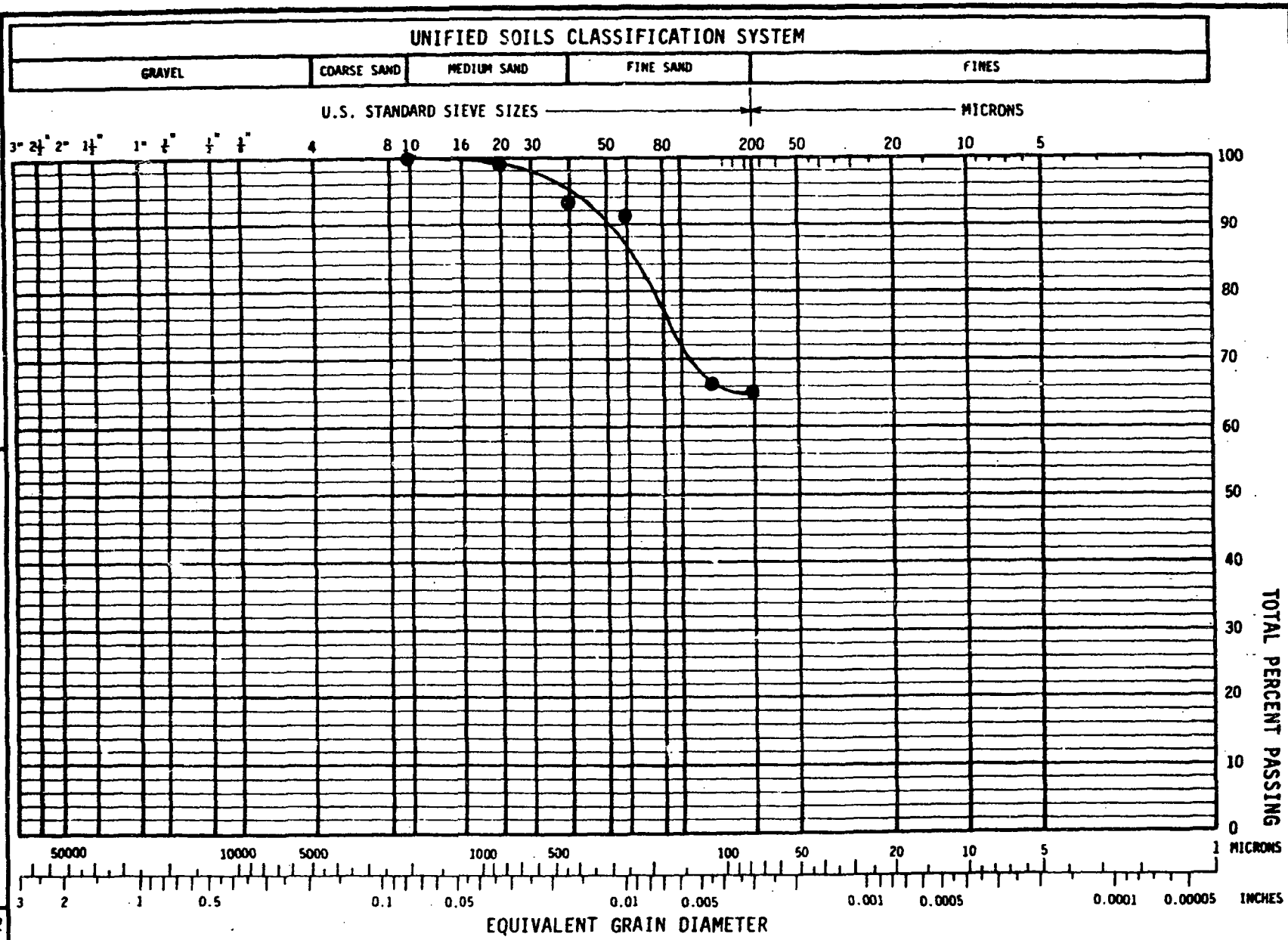
Station, Unit 1

GRAIN SIZE DISTRIBUTION

PLATE



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

ERPT C 0104

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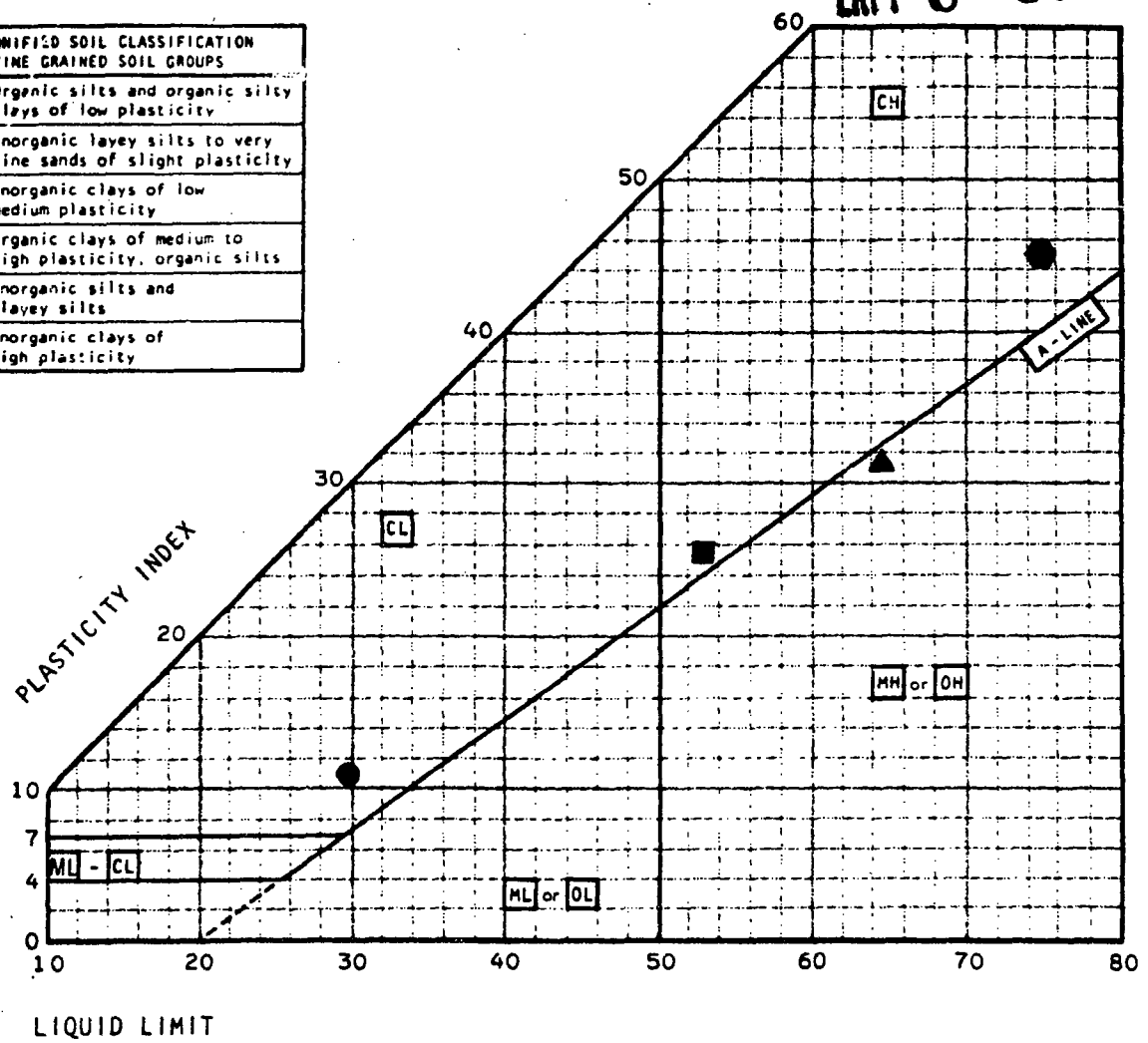
GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
OL	Organic silts and organic silty clays of low plasticity
ML	Inorganic layey silts to very fine sands of slight plasticity
CL	Inorganic clays of low medium plasticity
OH	Organic clays of medium to high plasticity, organic silts
MH	Inorganic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

PLATE

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
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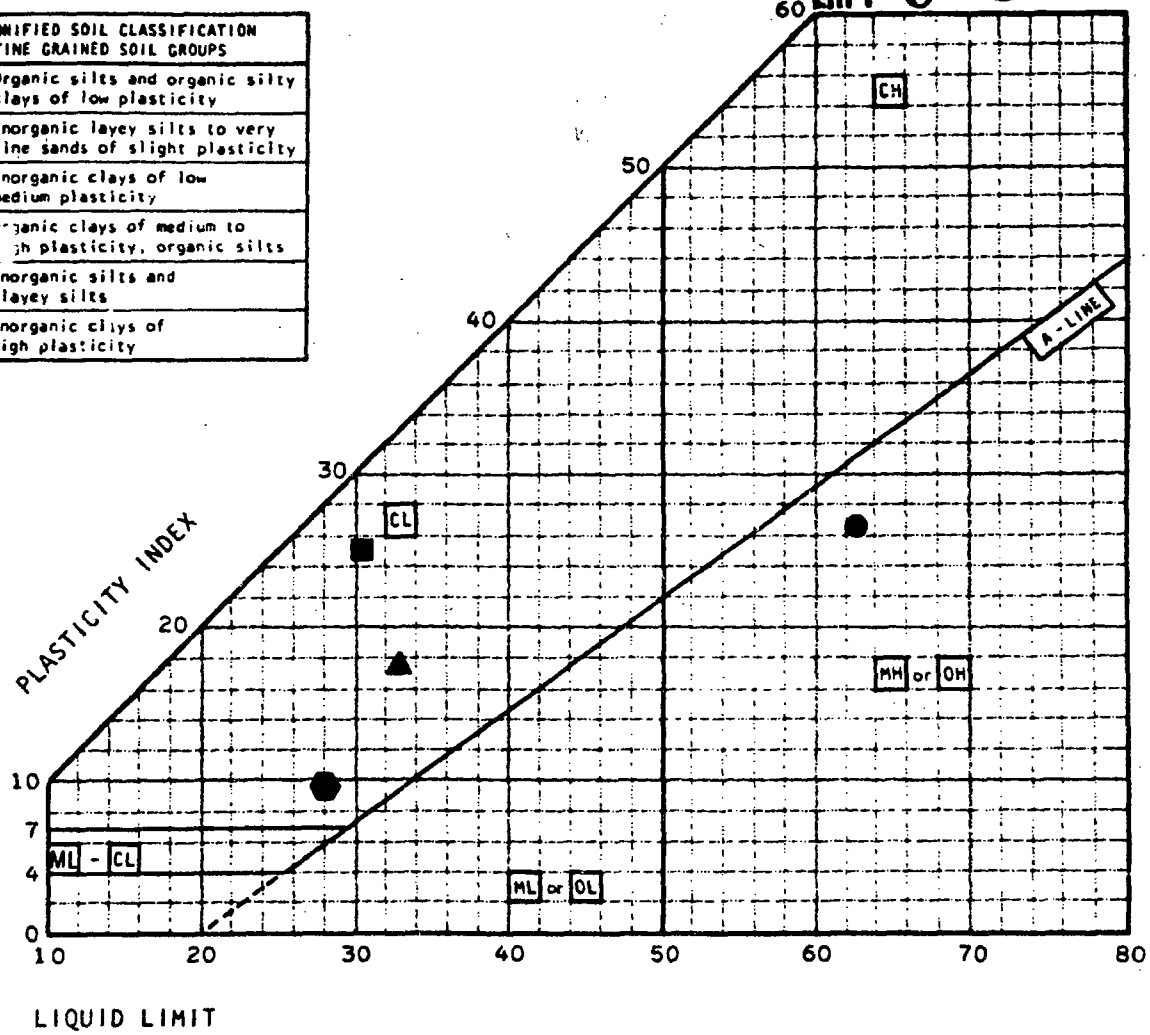
CH	Inorganic clays of high plasticity



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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PLASTICITY CHART

PLATE

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
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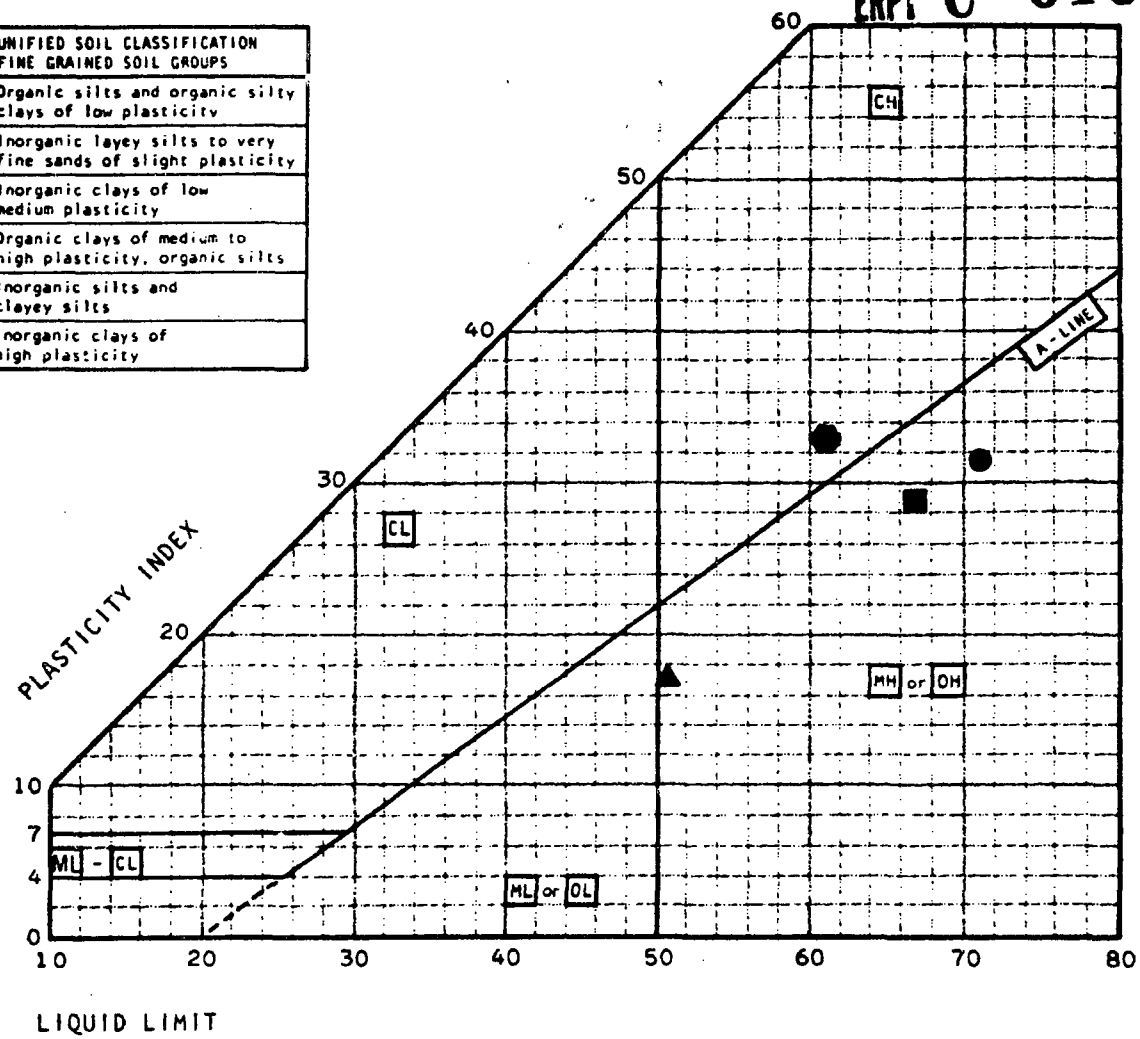
OH	Organic clays of medium to high plasticity, organic silts
MH	Inorganic silts and clayey silts
CH	Inorganic clays of high plasticity



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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PLASTICITY CHART

PLATE

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
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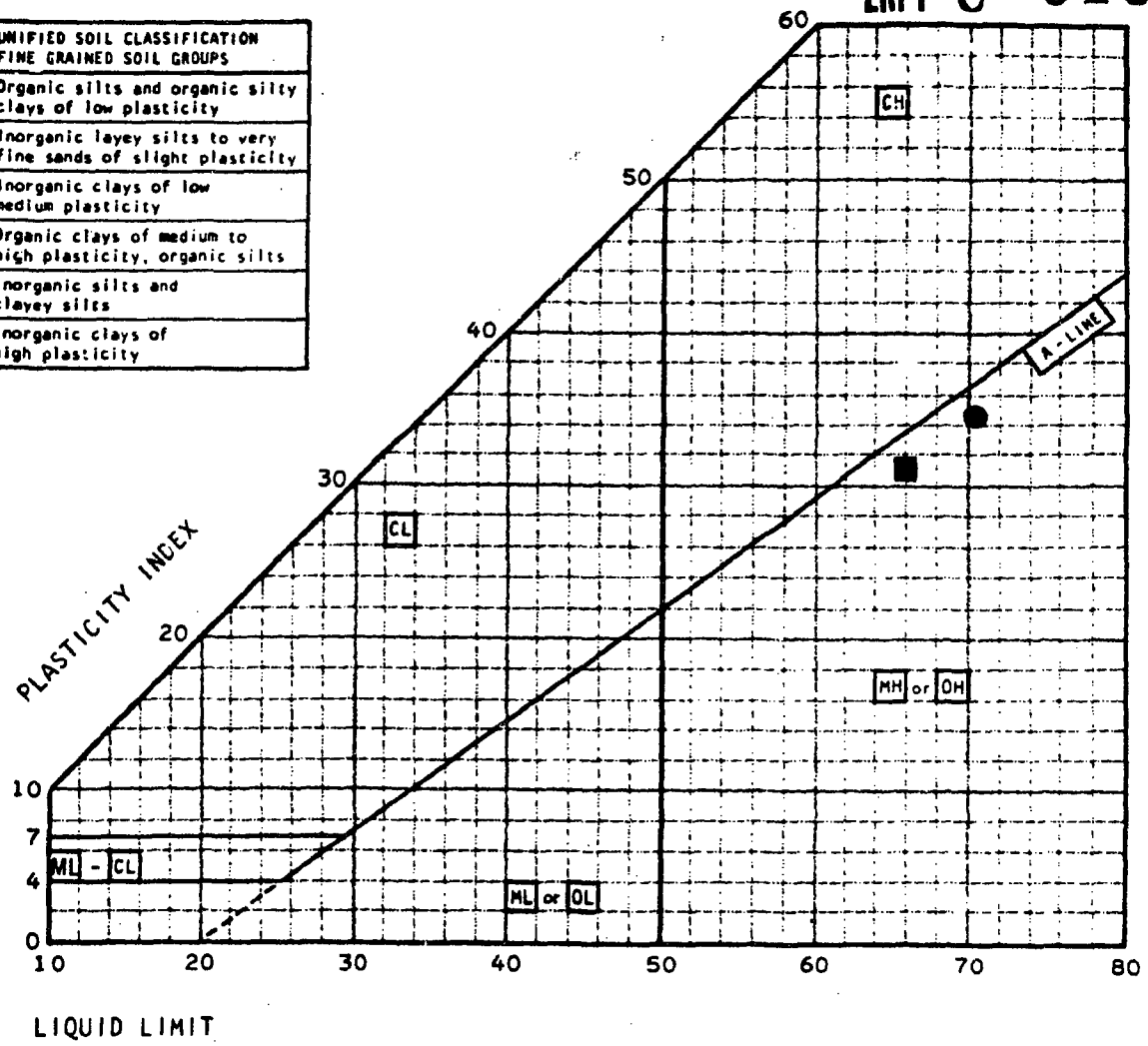
MH	Inorganic silts and clayey silts
CH	Inorganic clays of high plasticity



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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PROJECT NO. A2676-1

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

PLASTICITY CHART

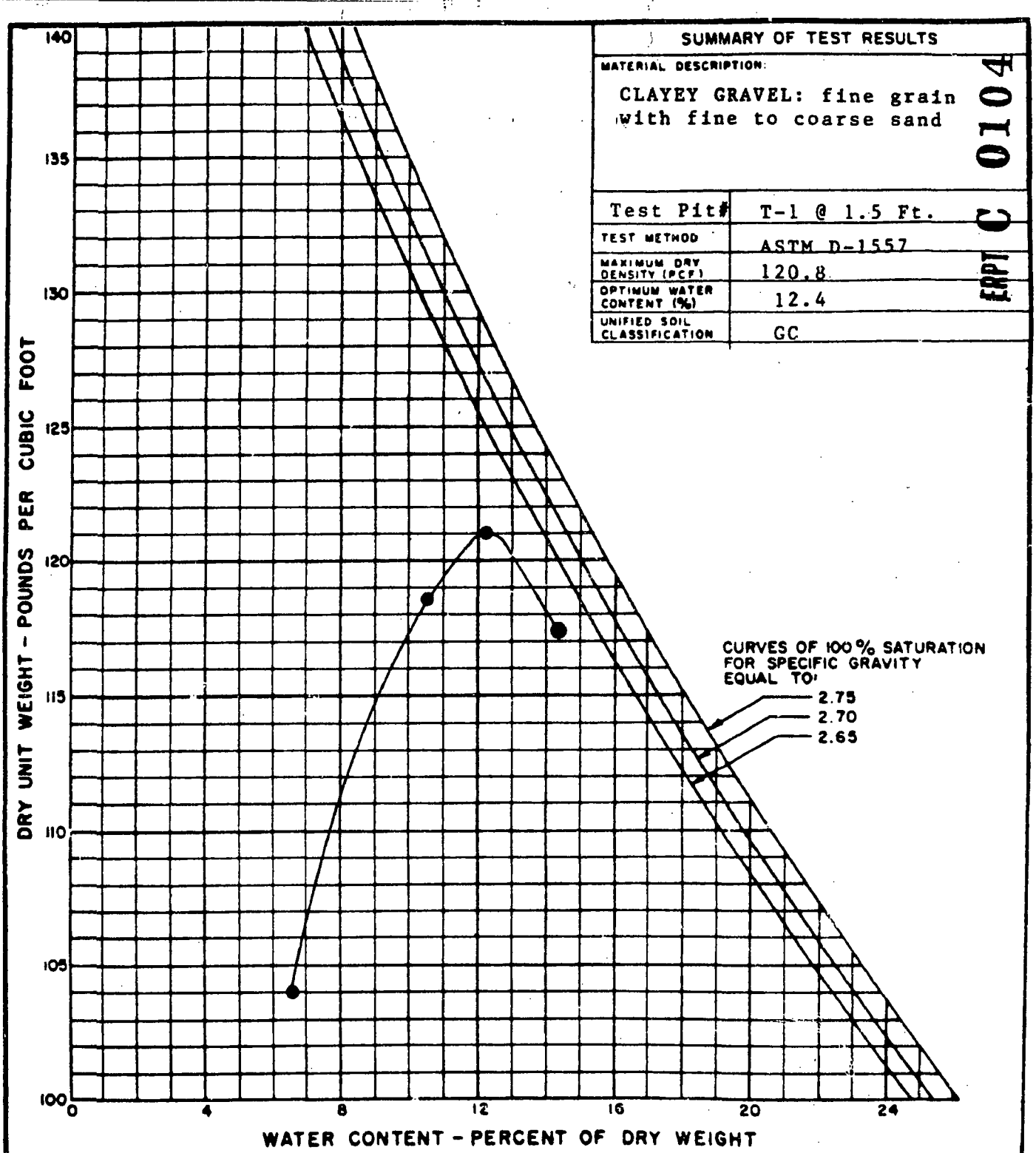
PLATE

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 Mo sture	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

ERPT C 0104

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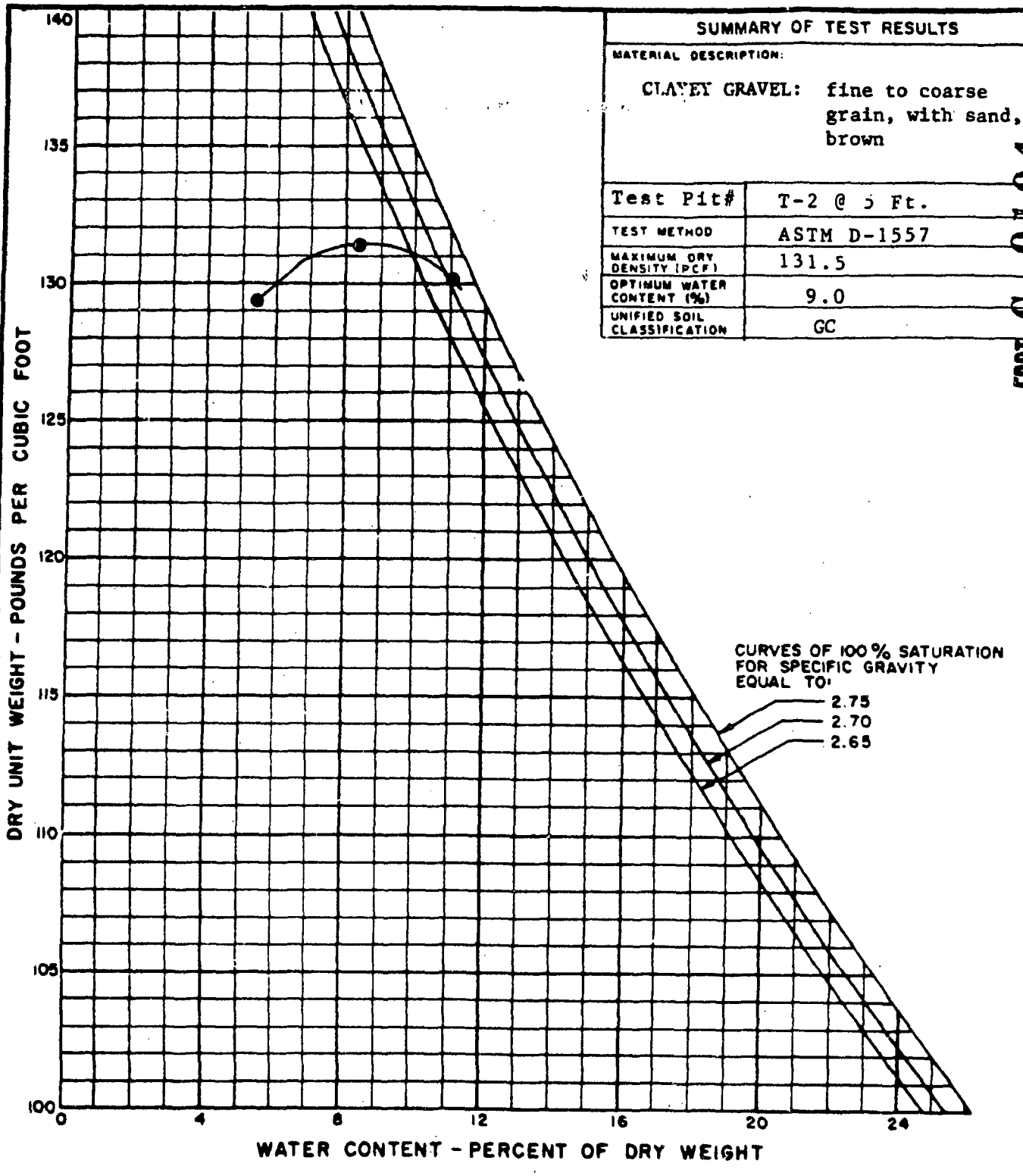
Rancho Seco Nuclear Generating Station, Unit 1

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



SUMMARY OF TEST RESULTS

MATERIAL DESCRIPTION:

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

ERPT C 0104

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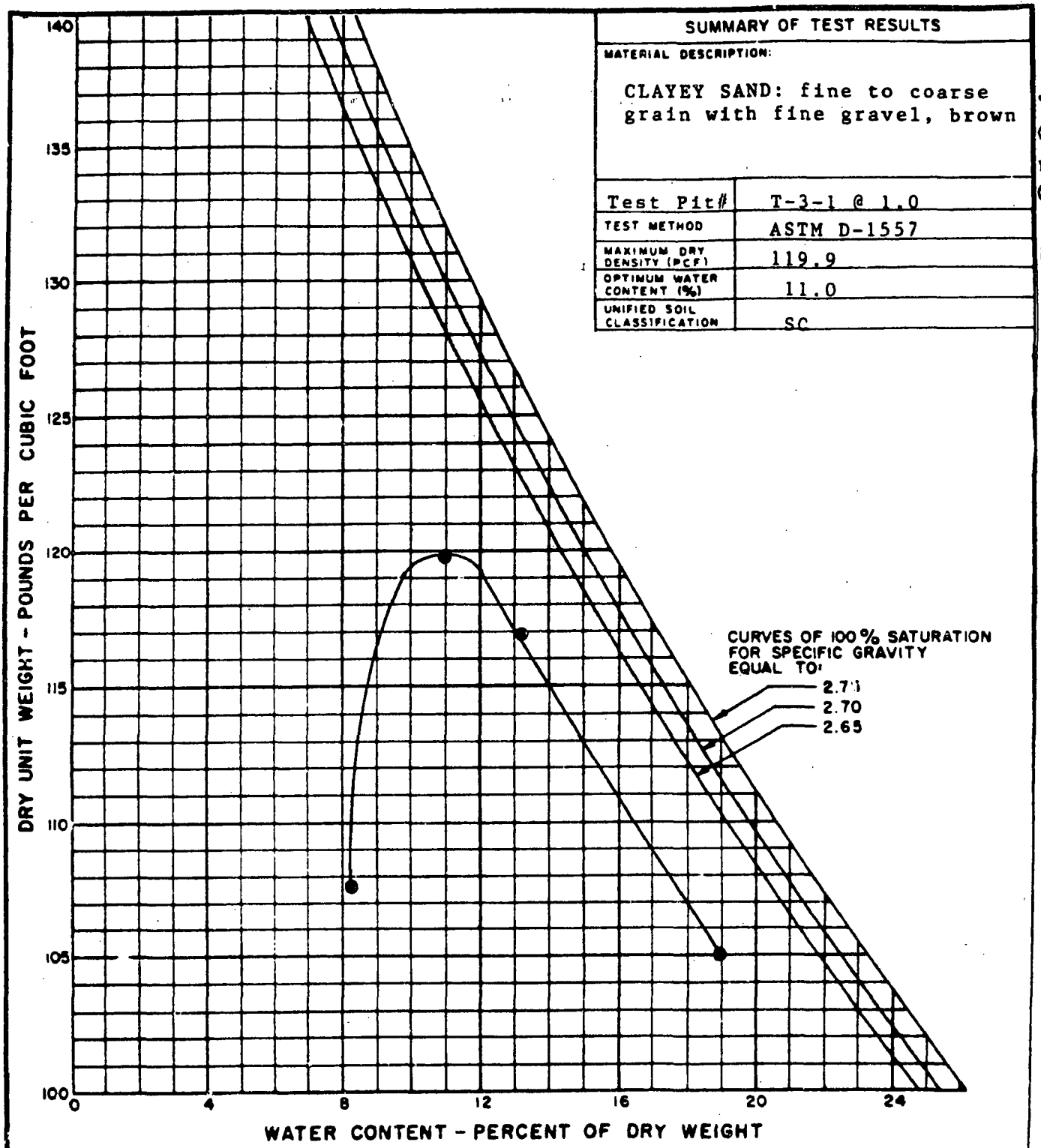
Rancho Seco Nuclear Generating Station, Unit 1

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

ERPT C 0104

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Rancho Seco Nuclear Generating Station, Unit 1

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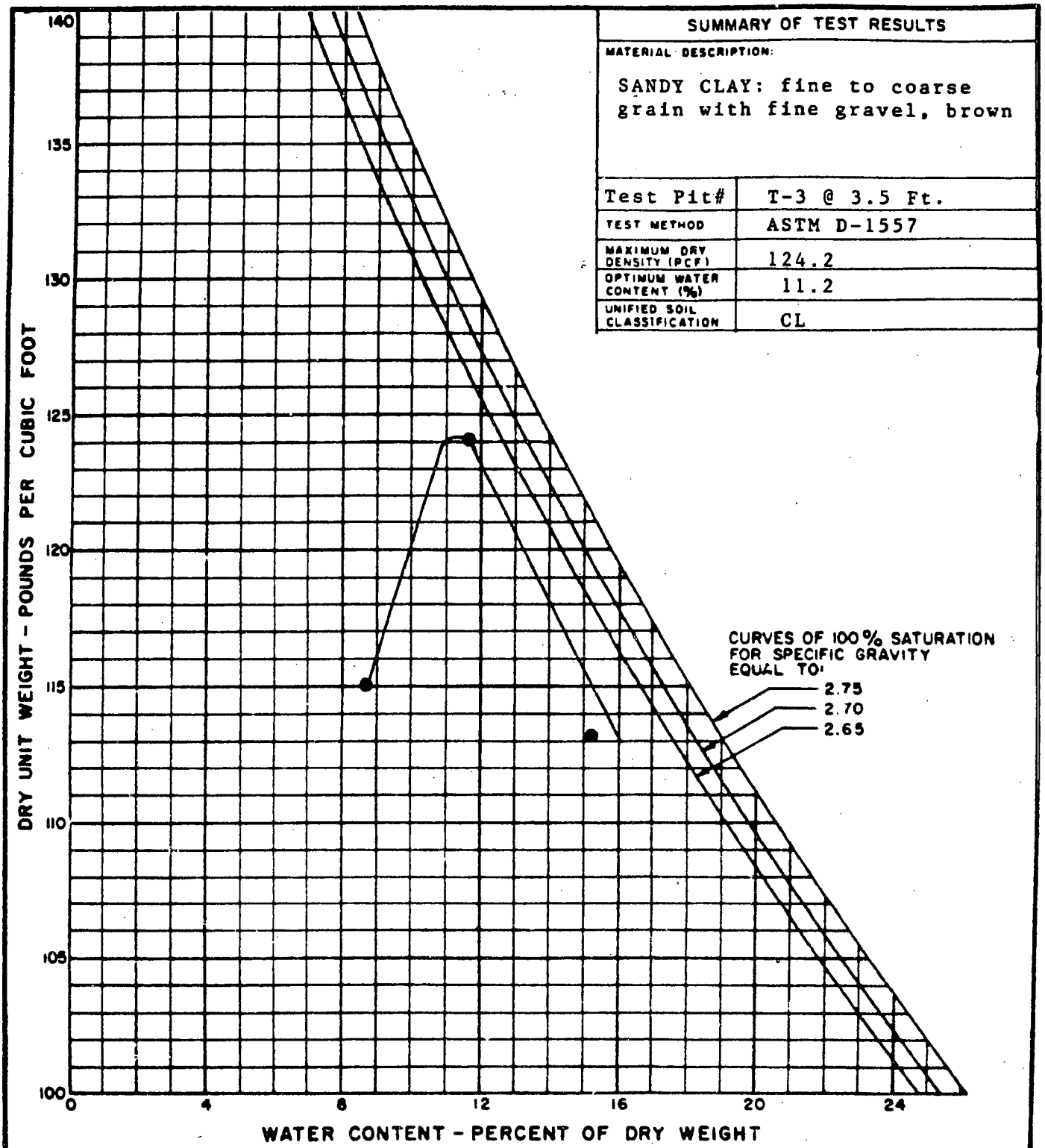
COMPACTION DIAGRAM

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

ERPI C 0104

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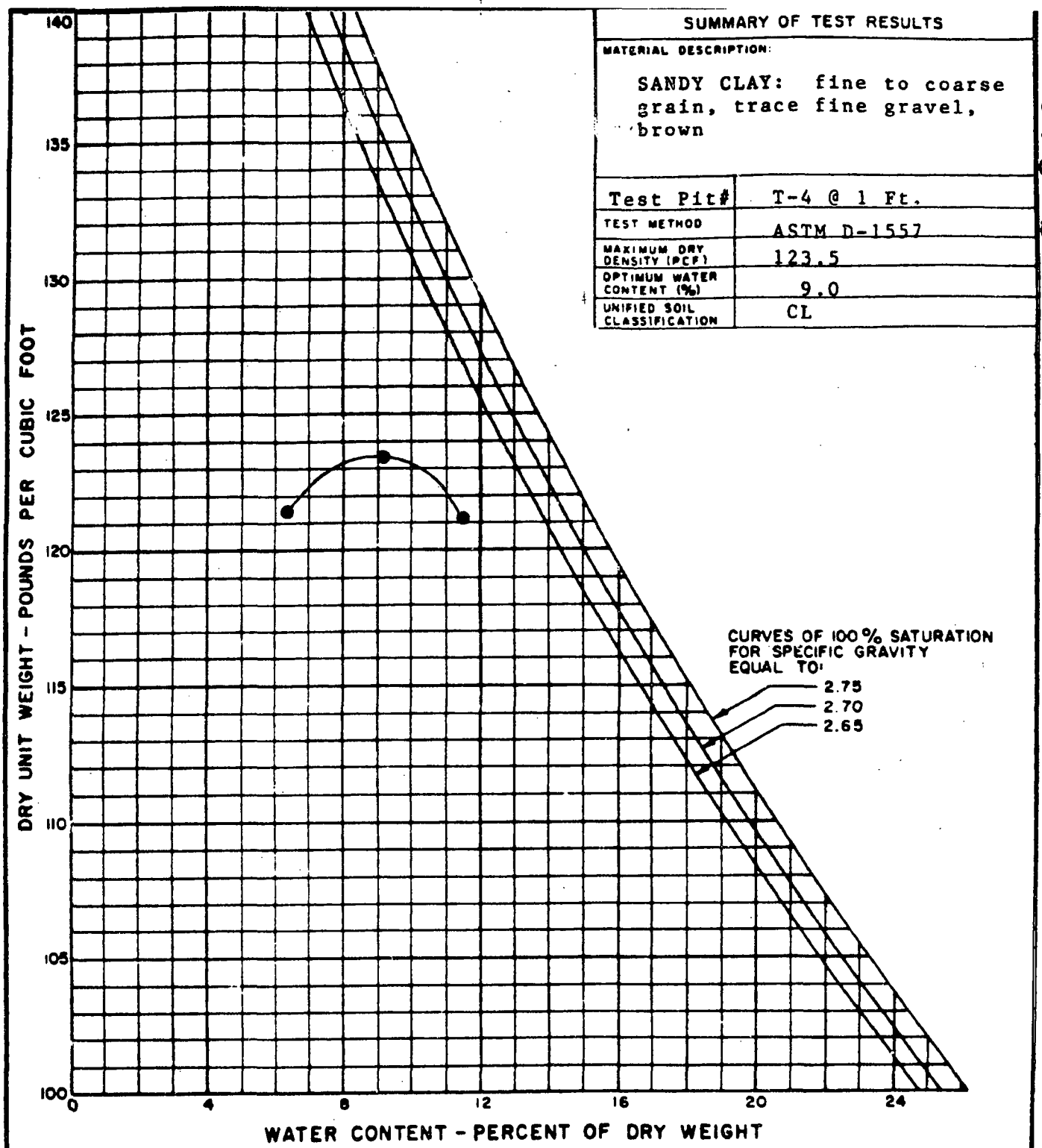
COMPACTION DIAGRAM

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

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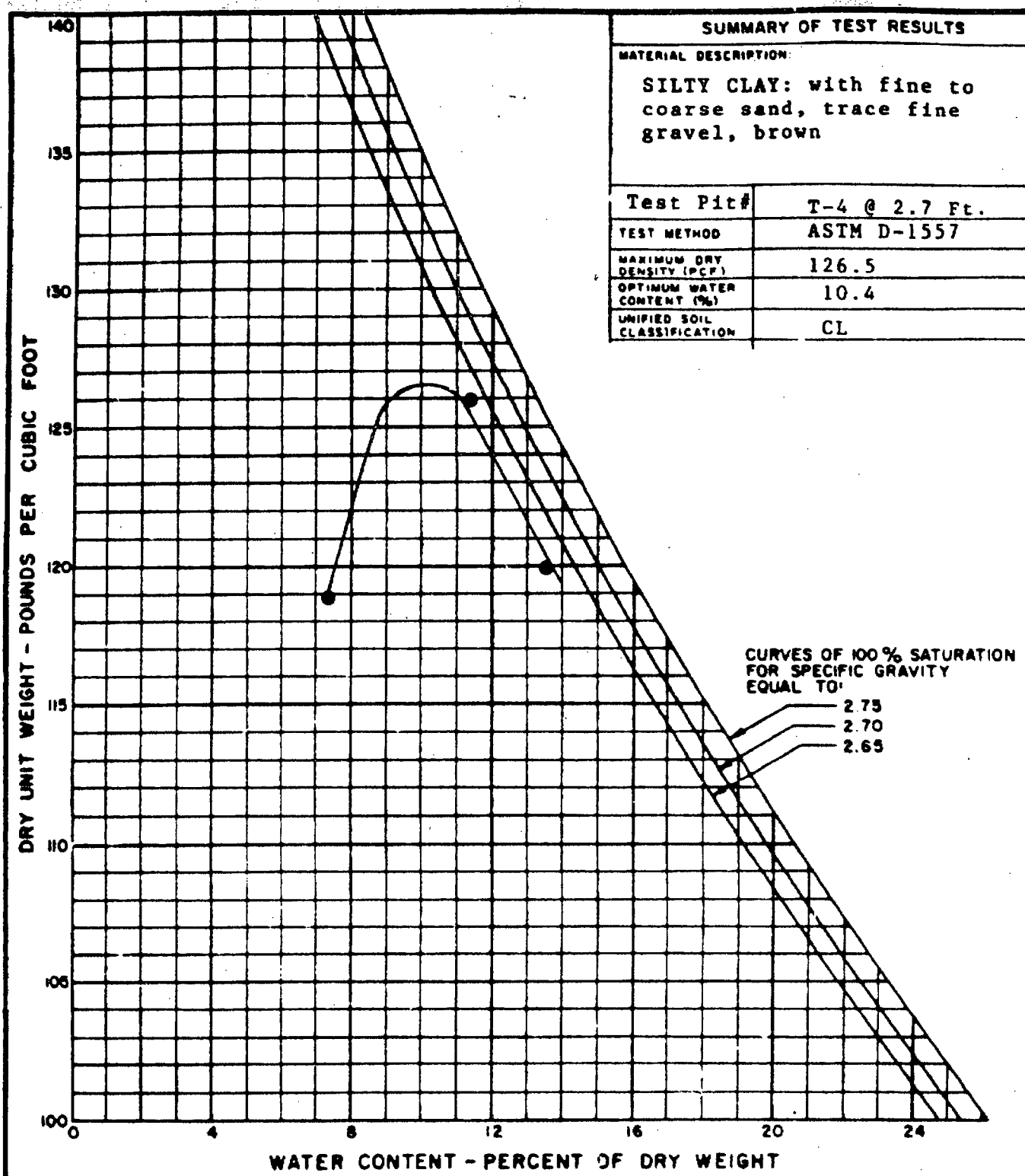
PREPARED BY:	DATE	COMPACTION DIAGRAM	
CHECKED BY	DATE	PROJECT NO. A-2676-1	PLATE NO.



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

1010 C 1M

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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

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

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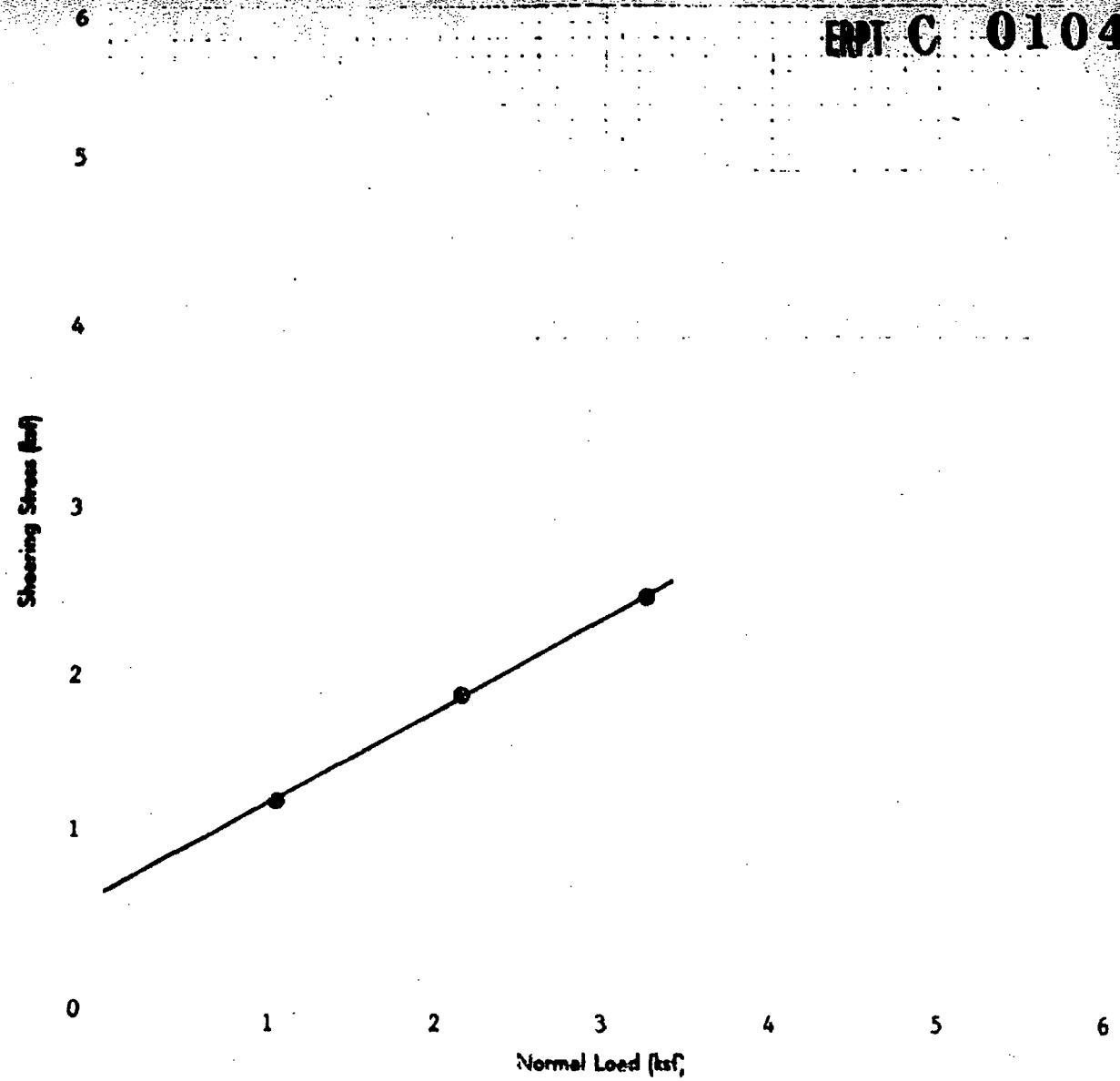
UNCONFINED COMPRESSION

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

ϕ= 29°

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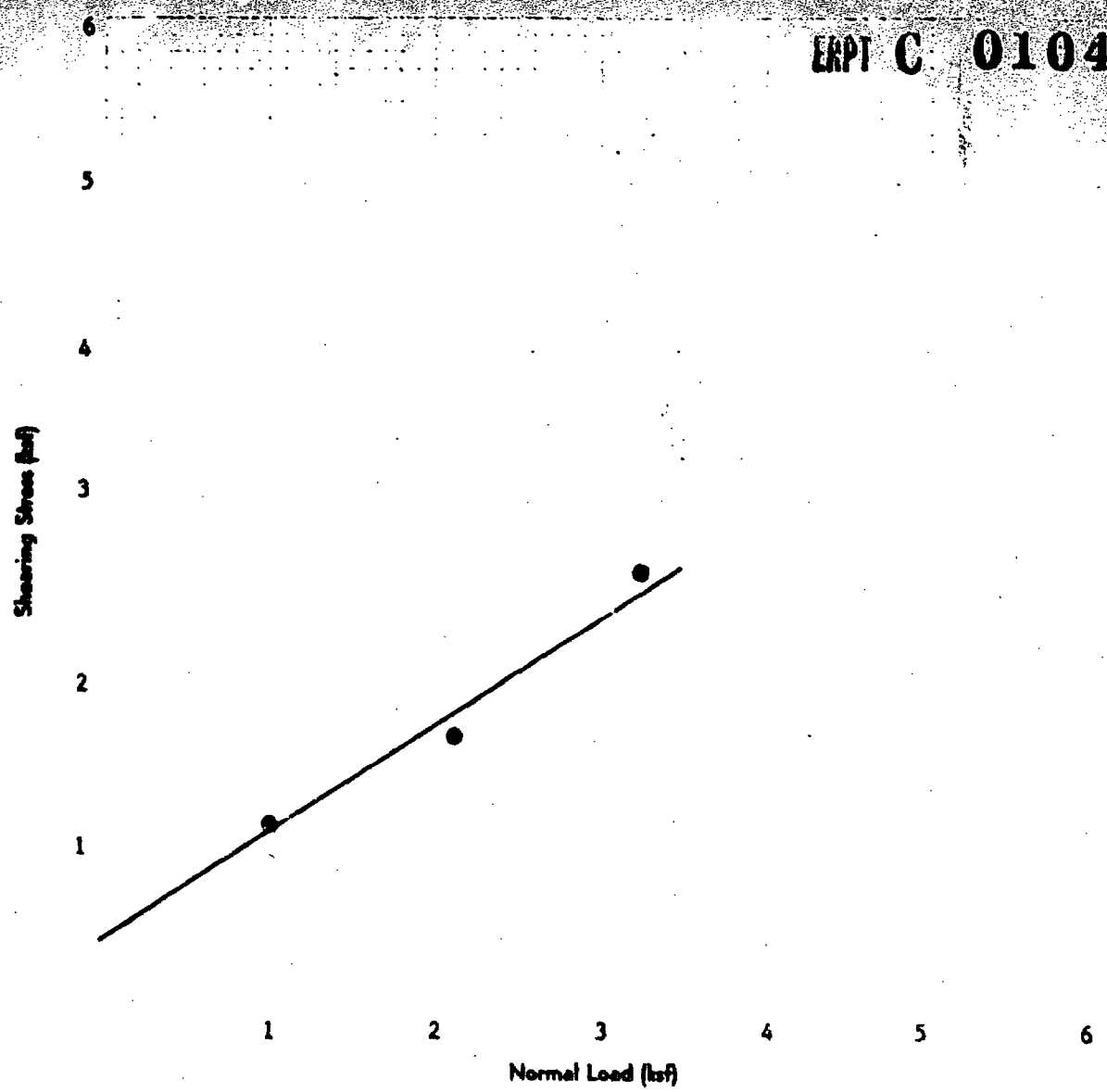
PREPARED BY:	DATE:	DIRECT SHEAR TEST	
CHECKED BY:	DATE:	PROJECT NO. Am2676-1	PLATE NO.



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
ϕ= 33°

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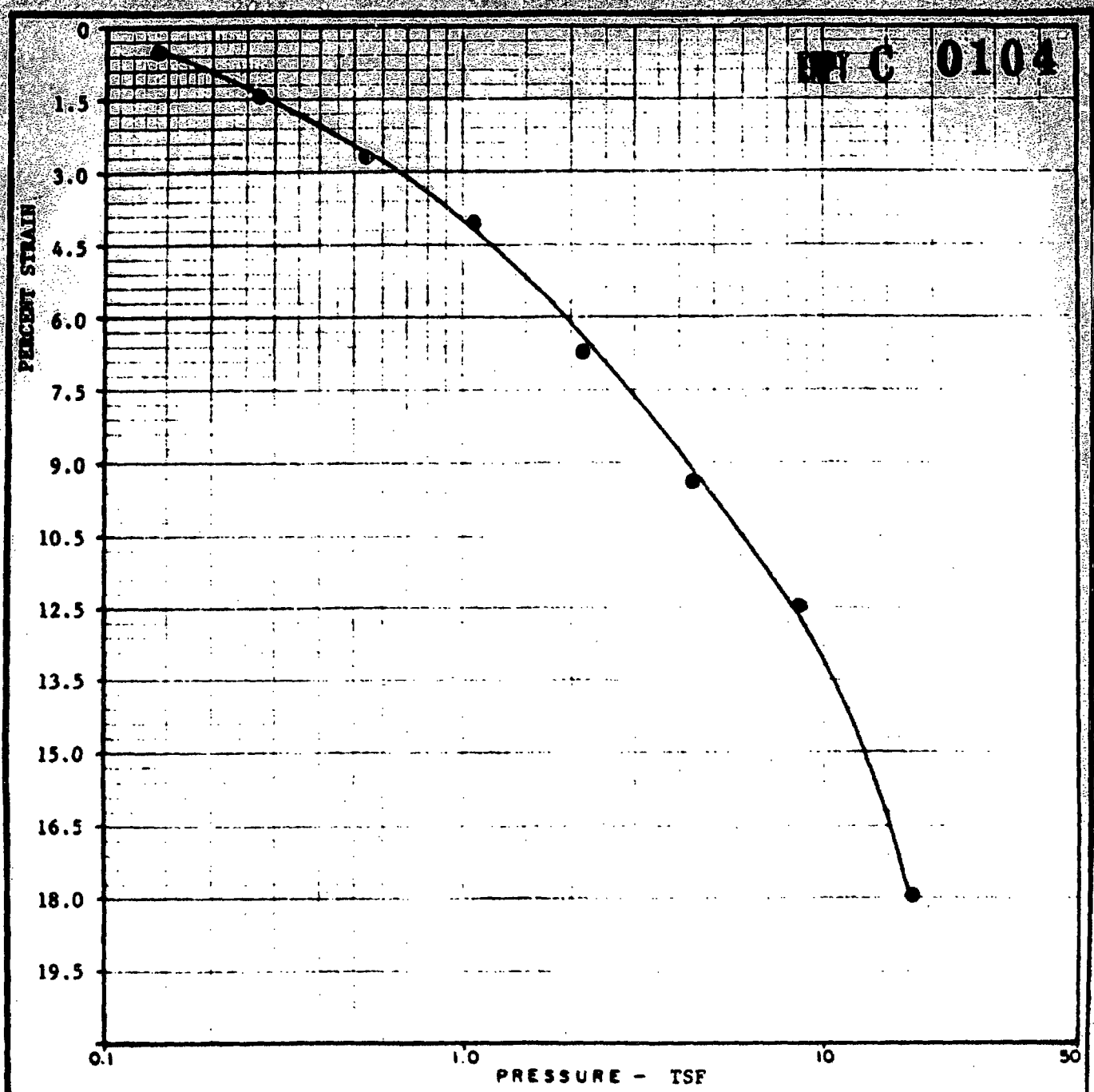
PREPARED BY:	DATE:	DIRECT SHEAR TEST	
CHECKED BY:	DATE:	PROJECT NO. A-2676-1	PLATE NO.



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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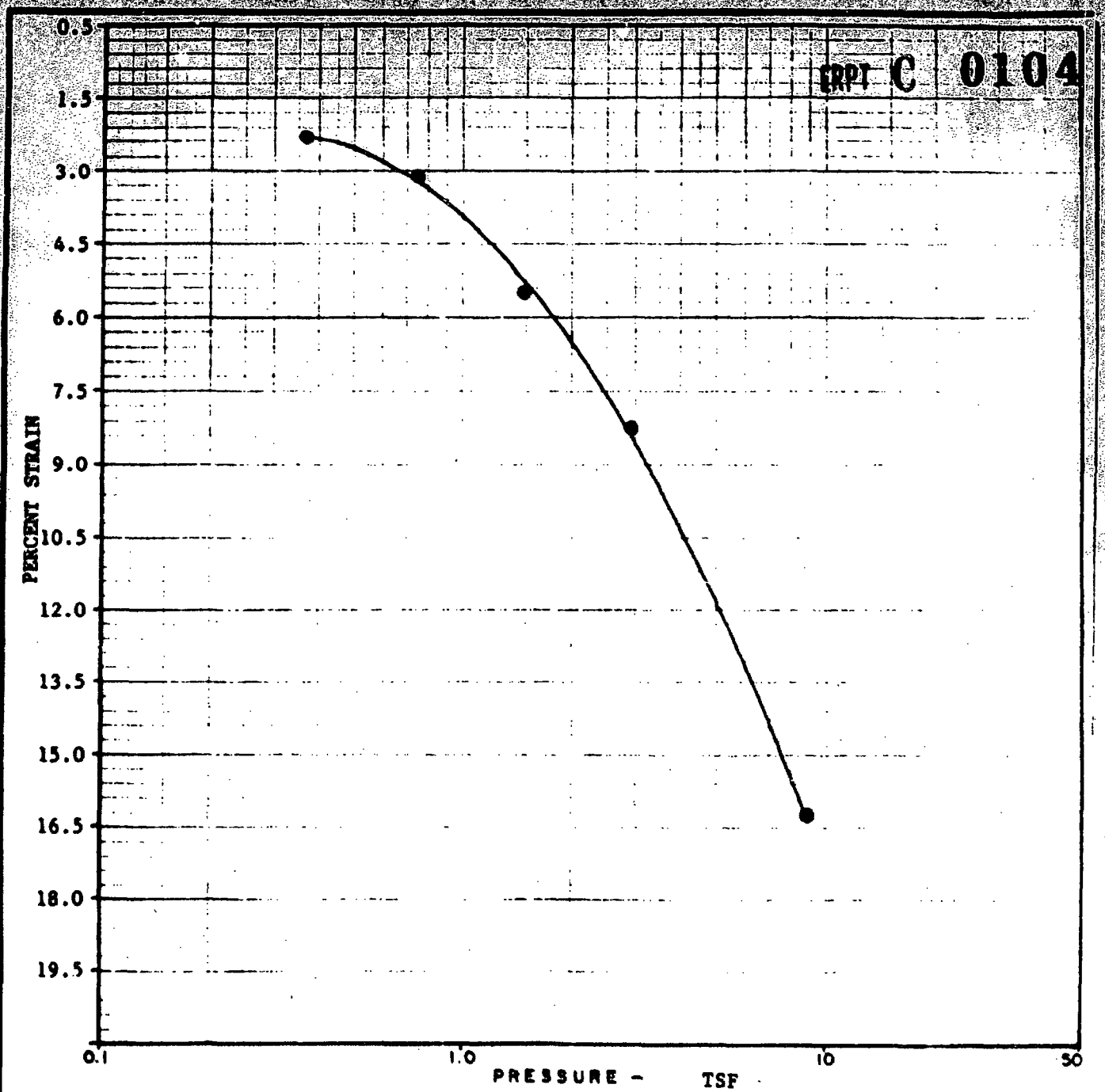
CONSOLIDATION TEST DATA

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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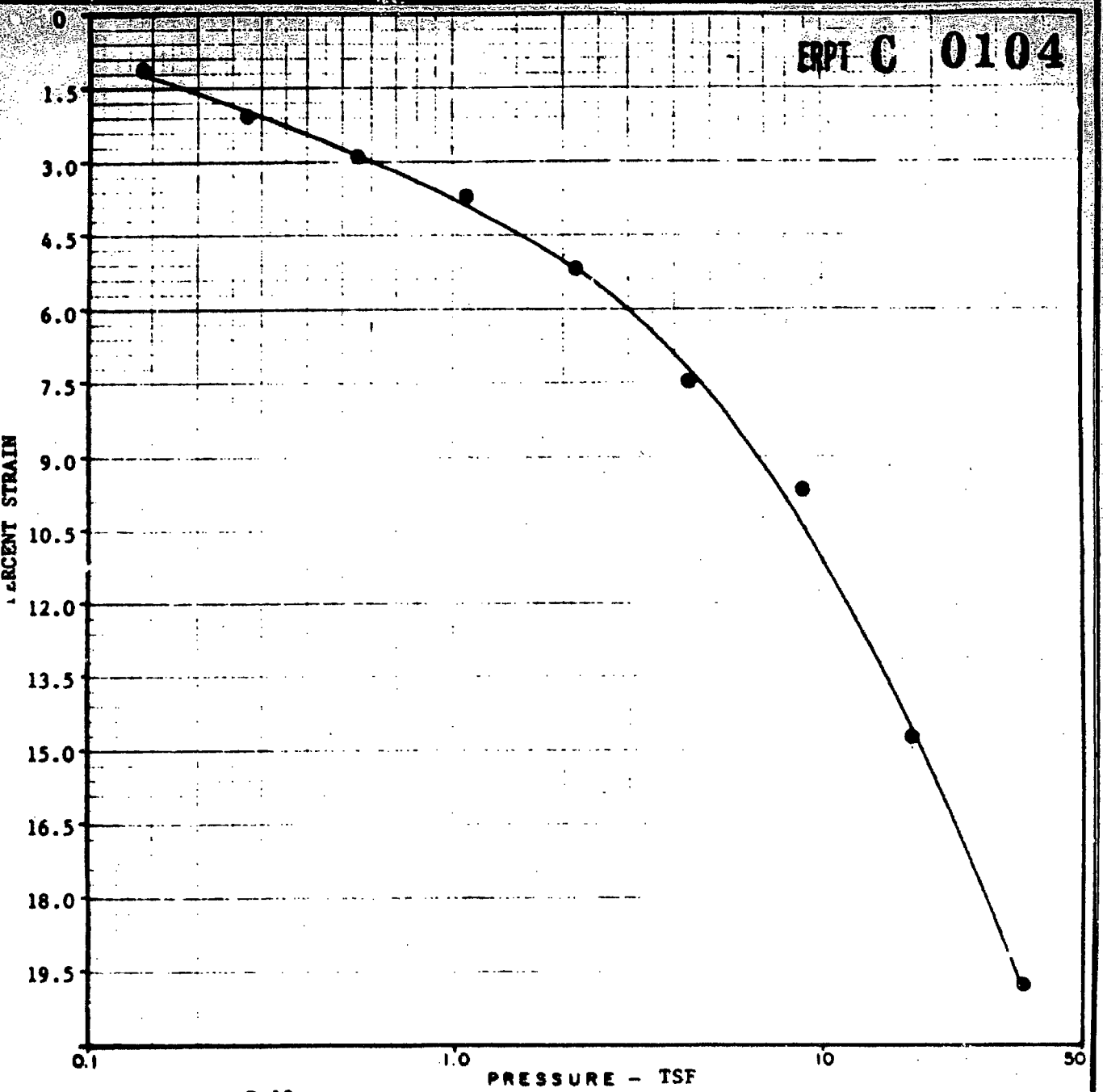
PREPARED BY:	DATE	CONSOLIDATION TEST DATA
CHECKED BY:	DATE	PROJECT NO. A-2676-1 / PLATE NO.



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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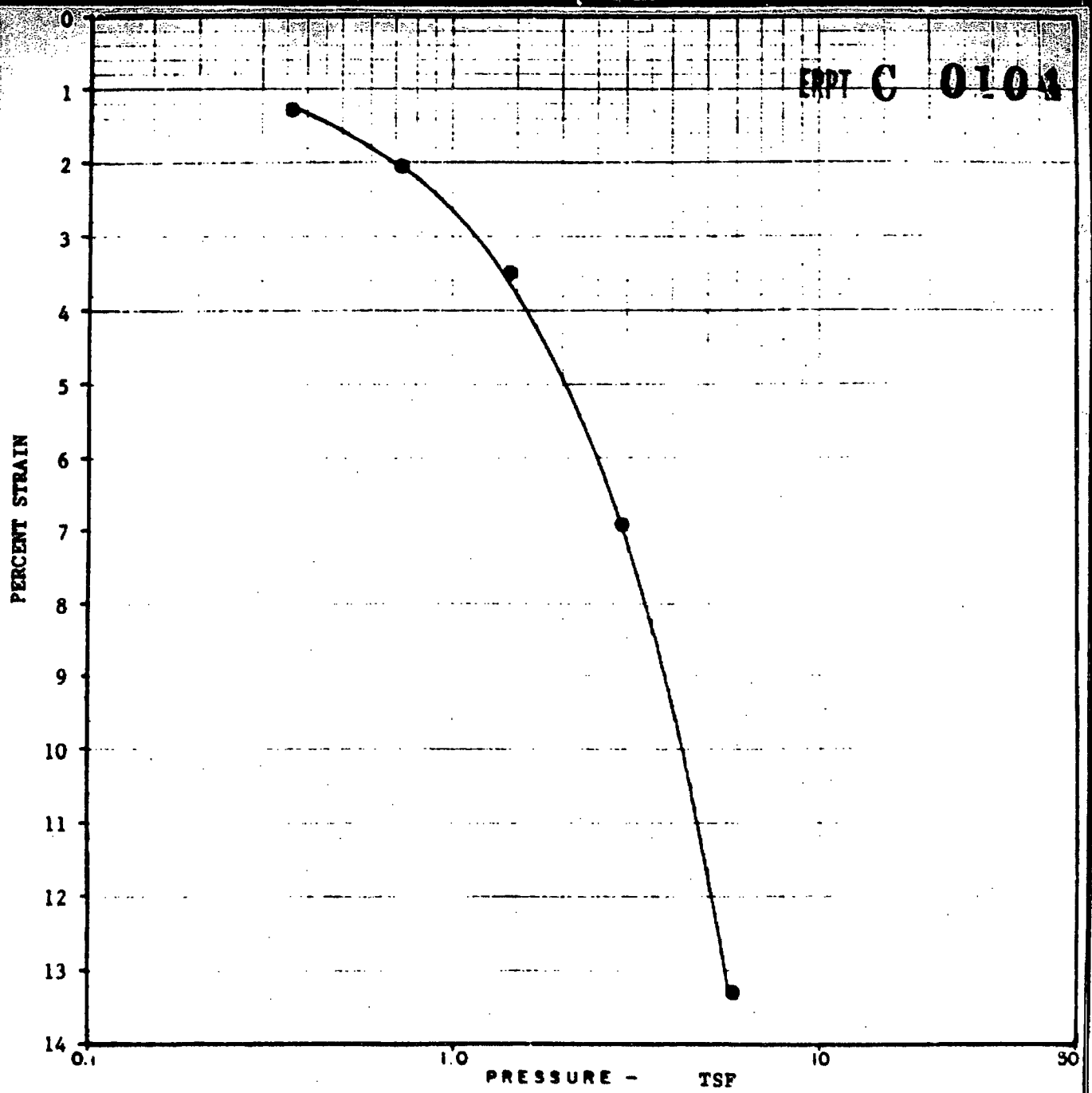
CONSOLIDATION TEST DATA

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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CONSOLIDATION TEST DATA

PROJECT NO. A-2676-1 PLATE NO.