APPENDIX S
GEOLOGIC TECHNICAL REPORT

This report was included as Appendix I to the 2001 Ocotillo Power Plant AFC.

Appendix I

Geologic and Foundation Criteria

for the

Application for Certification
Ocotillo Energy Project
Palm Springs, California

prepared by

Geotechnical and Hydraulic Engineering Services
Bechtel Power Corporation
Frederick, Maryland

April 2001

TABLE OF CONTENTS

Section		Page
Cover Sheet		
TABLE OF CONTENTS		I-i
I1.0	INTRODUCTION	I-1
I2.0	SCOPE OF WORK	I-1
I3.0	SITE CONDITIONS	I-1
I4.0	SUBSURFACE INVESTIGATION	I-2
I5.0	FIELD GEOPHYSICAL SURVEY	I-2
I5.1	Seismic Refraction	I-3
I5.2	Downhole Seismic	I-3
I5.3	Electrical Resistivity	I-4
I6.0	LABORATORY TESTING PROGRAM	I-4
I7.0	SITE SUBSURFACE CONDITIONS	I-4
I7.1	Physiography and Geology	I-4
I7.2	Seismology	I-5
I7.3	Stratigraphy	I-5
I7.4	Ground Water	I-5
I7.5	Corrosion Potential and Ground Aggressiveness	I-5
I7.6	Soil Profile Type	I-6
I8.0	ASSESSMENT OF SOIL-RELATED HAZARDS	I-6
I8.1	Liquefaction	I-6
I8.2	Seismically-Induced Settlements	I-6
I8.3	Expansive Soils	I-6
I8.4	Collapsible Soils	I-6
I8.5	Soil Cavities	I-7
I9.0	PRELIMINARY FOUNDATION CONSIDERATIONS	I-7
I9.1	General Foundation Design Criteria	I-7
I9.2	Shallow Foundations	I-7
I10.0	PRELIMINARY EARTHWORK CONSIDERATIONS	I-7
I10.1	Site Preparation and Grading	I-7
I10.2	Temporary Excavations	I-8
I10.3	Permanent Slopes	I-8
I10.4	Backfill Requirements	I-8
I11.0	INSPECTION AND MONITORING	I-8
I12.0	SITE DESIGN CRITERIA	I-9
I12.1	General	I-9
I12.2	Datum	I-9
I13.0	FOUNDATION DESIGN CRITERIA	I-9
I13.1	General	I-9
I13.2	Ground Water Pressures	I-9
I13.3	Factors of Safety	I-9
I13.4	Load Factors and Load Combinations	I-9
I14.0	REFERENCES	I-9

TABLES

I-1 Geotechnical Laboratory Index Testing Summary

FIGURES

I-1 Boring Location Plan
I-2 Subsurface Profile Legend
I-3 Subsurface Profile Section A-A
I-4 Subsurface Profile Section B-B
I-5 Subsurface Profile Section C-C

ATTACHMENTS

I-1 Boring Logs
I-2 Seismic Refraction Survey
I-3 Downhole Seismic Measurements
I-4 Field Electrical Resistivity Survey
I-5 Laboratory Test Results
I-6 Fault Evaluation Report

I1.0 INTRODUCTION

This appendix includes the results of the site Phase 1 subsurface investigation, laboratory testing program and geotechnical assessment for the Ocotillo Power Project to support the Application for Certification (AFC).

This appendix contains a description of the site conditions, field and laboratory testing phases of the investigation, together with the ground water, and foundation related subsurface conditions. Engineering design properties derived from the results of the investigation are discussed. Soil-related hazards addressed include: soil liquefaction, seismically-induced settlements, expansive soils, hydrocompaction (or collapsible soils), and soil cavities. Preliminary foundation and earthwork considerations are addressed based on the results of the site investigation, observations by geotechnical personnel on site and established geotechnical engineering practices.

Information contained in this appendix reflects the codes, standards, criteria and practices generally used in the design and construction of site and foundation engineering systems for the Facility. More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specifications and construction specifications.

I2.0 SCOPE OF WORK

The scope of geotechnical services for the preparation of this appendix included:

- developing a Phase 1 boring location plan and specifications for a field and laboratory investigation,
- selecting a drilling and laboratory testing subcontractor and technically monitoring the work in the field,
- assigning laboratory tests for representative soil samples,
- preparing boring logs,
- evaluating current ground water levels,
- preparing this appendix to include an assessment of soils-related hazards, a summary of foundation and earthwork considerations, and guidelines for inspection and monitoring of geotechnical aspects of construction.

I3.0 SITE CONDITIONS

The site is located north of Interstate Highway 10, about one mile east of the intersection of Dillon Road and Diablo Road, and about 9 miles northwest of the City of Palm Springs, in Riverside County, California. The site is located within the active Wintec electrical generation station consisting of numerous tower-supported windmills and associated support equipment. The surface materials exposed at the site are sands, gravels, and boulders which range in size from six inches to over 18 inches. The area immediately surrounding the site is occupied by either isolated residences or commercial "wind farms" that generate electrical energy by making use of the constantly blowing wind. The site is currently accessed at the southern boundary, via Dillon Road.

The site topography is gently sloping from the north/northwest to the southeast with respect to the plant north shown on Figure I-1. Ground elevations range from about El. 1002 feet due east of the powerblock area to about 920 feet at the southwestern property corner. Surface water, when present, would flow through an intermittent stream channel which also traverses the site from northwest to southeast just to the west of the planned facility development area.

In addition to the numerous windmills operating in the proposed site area, there are several small office trailers, storage trailers, equipment maintenance facilities, stockpiles of new and used wind generating equipment, and a few abandoned cars and trucks on the site. Currently, the property is covered with a few scattered shrubs and cactus plants.

I4.0 SUBSURFACE INVESTIGATION

The site investigation related to the Ocotillo facility has been divided into this investigation (Phase 1) and a Phase 2 investigation that will be developed and implemented to further confirm the subsurface conditions at structure-specific locations. The Phase 1 site investigation borings are shown on the attached boring location plan, Figure I-1. The Phase 1 investigation was designed to provide sufficient information to define the subsurface conditions and determine the foundation requirements to support the AFC. The Phase 1 subsurface investigation described in this appendix was conducted at the site between February 21 and March 3, 2001. The investigation was conducted in accordance with a subsurface investigation specification prepared for this project and followed the American Society for Testing and Materials (ASTM) and other applicable standards.

As shown on Figure I-1, seven soil borings were drilled to obtain soil samples for visual classification and laboratory testing, and to perform in-situ standard penetration tests (SPT). The drilling was performed by Tri-County Drilling of San Diego, California. Technical direction of field operations was provided by a Bechtel Senior Engineering Specialist under the supervision of a Bechtel Geotechnical Engineer. The Senior Engineering Specialist prepared the boring logs and selected representative soil samples for laboratory testing. The Phase 1 field investigation was started on February 23, 2001 and completed on March 3, 2001. The boring logs are provided in Attachment I-1, and subsurface profiles are shown as Figure I-2 through I-5.

Approximately 683 linear feet of soil were drilled at the seven boring locations. The borings ranged in depth from 83.0 feet to 101.5 feet to provide an assessment of the subsurface conditions to depths of interest for foundation design and construction.

The borings were advanced using either a truck-mounted CME-75, CME-85, or CANTERRA drill rig. All borings were drilled using 8-inch hollow-stem flight augers. Two of the borings, B-101 and B-103, were converted to downhole geophysical survey points. After drilling to final depth, 2.5-inch diameter Schedule 40 PVC pipes were inserted into these two boreholes and grouted in place from the bottom of the boring to top of ground to perform the downhole geophysical survey tests. Upon completion of all field investigations, the boreholes were either filled with cement grout (B-101 and B-103) or were backfilled with drill cuttings.

Standard Penetration Test (SPT) soil samples were obtained in accordance with ASTM D 1586 in the borings by driving a 2-inch OD split-barrel sampler 18 inches with a 140-pound hammer falling freely through a distance of 30 inches. The standard penetration resistance value (N-value) is defined as the number of blows required to drive the split-barrel sampler a total distance of 12 inches, the count being started after a penetration of 6 inches. When the sampler could not be driven the required 12 inches, the standard penetration resistance was shown as the number of blows over the inches actually penetrated. Because of the density and granular nature of the soils and the size of the coarse fraction of the recovered samples, a 3-inch OD split-barrel sampler 24 inches in length, was employed to maximize recovery of subsurface samples. Continuous sampling was conducted in B-103 to a depth of 15 feet and at 5-foot intervals thereafter to the bottom of the boring. The remainder of the borings were sampled at 5-foot intervals starting at ground surface and continued to final design depth. Cohesive soils were not encountered in any of the borings and, consequently, no undisturbed samples were collected.

I5.0 FIELD GEOPHYSICAL SURVEY

Geophysical investigation methods were used at the proposed Ocotillo Power Plant site. These studies consisted of seismic refraction measurements along two profiles (RS01-1 and RS01-2), downhole seismic measurements in two borings (B-101 and B-103), and electrical resistivity soundings at two locations (R-1 and R-2). These methods are used to assess the depth and properties of the subsurface layers. The locations of the measurements are shown on Figure I-1 (downhole locations and electrical resistivity tests) and on Attachment I-6, Figure 2 (for seismic refraction line locations). A brief discussion of methods and limitations, as well as of the test results are presented in the next sections.

I5.1 Seismic Refraction

The seismic refraction technique is based on the measurement of the time required for a shockwave to travel from a sourcepoint (shotpoint) to one or more co-linear sensors (geophones). Measurements were obtained using a Geometrics ES1225F seismograph with twelve geophones. The source consisted of multiple sledgehammer blows to a groundplate. Geophones were spaced at 25-foot intervals and were usually in-line with the source. Shotpoints were nominally placed at the center of each line, at each end, and offset 135 ft, 275 ft, and 550 ft, or more, beyond each end. Line segments were generally overlapped to provide continuous profiles. The primary constraint on data quality was wind-induced noise. Sometimes the site geometry limited shotpoint positioning and the subsequent interpretation.

The seismic traveltimes were plotted on time-distance graphs and interpreted using time-term methods (the generalized reciprocal method). The resulting models represent the rock and soils depths and velocities which would account for the measured traveltimes. The models are non-unique but appear to be the most reasonable solutions based on the known geology. Basic assumptions inherent in this geophysical method include the expectation that velocity increases downward, that layers are relatively continuous and thick enough to be individually resolved, and that significant velocity differences are present between the layers of interest. The generally accepted value for depth accuracy is 20%.

The seismic refraction profiles for RS01-1 and RS01-2 are provided in Attachment I-2 along with the raw seismic refraction data plots and a key sheet. Three seismic velocity layers are evident: an upper soil and alluvium layer with average velocities of 1800 fps (feet per second) to 2100 fps, alluvium with average velocities of 2800 fps to 3100 fps, and a lower alluvium with average velocities of 4000 fps to 6700 fps. The surficial layer is normally 10 feet to 30 feet thick and the depth to the third layer usually varies between 40 feet and 100 feet.

Lateral velocity changes appear to vary smoothly, except at two locations on the northeast end of each profile: at stations 11+75 and 15+25 on RS01-1, and at stations 10+00 and 12+50 on RS01-2. These locations also appear to be associated with a localized thickening of the surficial soils. While these lateral velocity changes are similar, in magnitude, to those found elsewhere on the profiles, they differ in that the changes occur over very short distances (tens of feet). This rapid velocity change suggests that somewhat dissimilar materials have been brought up against each other, as would occur due to faulting. The velocity decrease that is often found (due to disrupted materials) at a fault contact is not evident, but normally would not be expected to be measurable in such low velocity materials. The location of these features is north of the proposed development area for the facility.

I5.2 Downhole Seismic

The downhole seismic technique is based on measurement of the time required for seismic waves to travel from the ground surface to a sensor clamped at a known depth in a boring. The sensor consists of a triaxial geophone assembly that is wedged or pneumatically held against the borehole walls. The source consisted of sledgehammer blows to a groundplate. The data were recorded with a Geometrics ES1225F seismograph. Shear waves (S-waves) were produced by striking both ends of a portable horizontal bar partially driven into the ground, and observing the characteristic opposite first motions of this wave. Measurements were made at intervals of five feet. The arrival times are corrected for source-offset effects and plotted on time-depth graphs. Velocities are derived from the slope of the line segments fitted to the data.

Downhole seismic measurements were obtained in borings B-101 and B-103 and are shown in Attachment I-3. Compressional wave velocities in B-101 increase from 1690 fps to 2590 fps at a 20 foot depth and 3070 fps at a 55 foot depth. The shear wave velocity increases from 940 fps to 1400 fps at a 25 foot depth and 1750 feet at a 55 foot depth. In B-103 the compressional wave velocity increases from 2130 fps to 3120 fps at a 55-foot depth. The shear wave velocity increases from 1330 fps to 1580 fps at a 55 foot depth. The data in the upper 55 feet in both borings show a fair degree of variability, so that these velocity measurements represent averages of a number of thinner ubunits. Measurements were obtained to a total depth of 100 feet in both borings.

I5.3 Electrical Resistivity

The electrical resistivity method involves the measurement of the variations in the flow of electrical currents between electrodes inserted into the ground surface. The depth and properties of soil layers can be deduced by the response to increasing the distance between the electrodes. The four-electrode method (Wenner array) was used with spacings starting at two feet and doubling until spacings up to about 128 feet were reached. An L&R MiniRes meter was used and values were plotted and checked for consistency in the field. The resulting data points were fitted to a model curve using published master curves for the Wenner array. This interpretation method assumes that the layers are flat and uniform.

The electrical resistivity measurements obtained at R-1 and R-2 are shown in Attachment I-4. Resistivity values at the first two spacings appear to be depressed due to recent rains affecting the upper one or two feet of soils and were not included in the modeling. Two layer model curves were fitted to the data. Soils resistivity at R-1 decreases from 850000 ohm-cm to 28000 ohm-cm at a depth of 14 feet. At R-2 (next to Boring B-103) soils resistivity decreases from 850000 ohm-cm to 26000 ohm-cm at a depth of 15 feet. The upper layer values appear to correlate with the surficial soils layer in the seismic models. All of the measured values are in the upper range of normal soil values and would be considered to be non-corrosive, from an electrical resistivity standpoint.

I6.0 LABORATORY TESTING PROGRAM

Laboratory tests were performed to determine physical, chemical and engineering characteristics of the subsurface soils. Representative soil material was collected by drive sampling in the borings, grab samples of soil from the bottom of the fault investigation trench (depth 10'), and isolated "undisturbed" samples collected from the walls of the fault investigation trench. These samples were assigned laboratory tests, including: moisture content, grain size analyses, direct shear tests, and collapse tests. The index and soil strength and collapse testing was performed using applicable ASTM Standards or other accepted procedures. Laboratory test results, as they relate to the assessment of soil-related hazards, are discussed in Section I8.0. A summary of laboratory index testing results is attached as Table I-1. The laboratory results are shown in Attachment I-5.

I7.0 SITE SUBSURFACE CONDITIONS

I7.1 Physiography and Geology

The site physiography and geology are discussed in detail in Section 3.3.2 of the AFC and are summarized herein.

The site area is in the Upper Coachella Valley, at the juncture of three distinctive geomorphic provinces, the Transverse Ranges, the Peninsular Ranges, and the Colorado Desert. The San Bernardino Mountains and the Little San Bernardino Mountains are located to the northwest and northeast, respectively. The San Jacinto Mountains are present to the south. The Coachella Valley is the northwest extension of the Colorado Desert and elevations in the valley range from 550 to 2,000 feet. The Banning Fault Zone, part of the San Andreas Fault system, is located immediately to the north of the northern site boundary.

The seven boreholes drilled at the site encountered soils associated with Quaternary Age sediments typical of fluvial and alluvial origin. These sediments consisted of alternating, relatively thin, layers of predominantly fine to coarse-grained sands, gravels, cobbles, and occasional boulders. Occasionally, thin (<18"), locally cemented silty fine sand seams that could be crushed easily with slight pressure were visible in the fault investigation trench and in several borings. The subsurface materials encountered during this Phase I investigation are similar to the material described in the 1994 Pioneer Consultants geotechnical investigation report at the Wintec Energy Generation Farm.

The encountered conditions are as expected based on the geological characterization of the area described in Section 3.3.2 of the AFC. To the depth explored (typically 100 feet), these soils showed little variability from location to location within the site, as would be expected in such an alluvial formation. Boring B-104, terminated at a depth of 83 feet due to auger refusal, was the only boring not extending to the design depth of 100 feet. The sediments encountered in this boring were similar to the material recovered from the other six borings. Other site borings also encountered difficulty advancing at the 80-foot depth but those borings were eventually completed to the 100-foot design depth.

I7.1.1 Structural Geology Site Investigations

The Banning fault zone, part of the San Andreas fault system, diagonally crosses the windfarm property and an extensive trenching investigation was conducted as part of the site investigation to evaluate the potential location (and impact) of this fault. An approximately 1445 foot long by 10 to 15 feet deep fault exploration trench that extended from north of the north limit to the south limit of the proposed powerblock area was completed concurrent with this Phase 1 subsurface site study. A description of this investigation and conclusions regarding its impact on the site are provided in Attachment I-6.

Additionally, geophysical investigations were performed as part of the fault evaluation program. These investigations included the seismic refraction survey discussed in Section I5.1.

I7.2 Seismology

The site seismology is included in Section 3.3.2 of the AFC. The site is located in UBC 1997 Seismic Zone 4.

I7.3 Stratigraphy

Alluvium: Based on a visual examination of the subsurface materials collected during the Phase 1 investigation, the subsurface profile is characterized by essentially one major unconsolidated soil strata. This is an alluvial stream deposit that is locally at least 100 feet thick. Distinct bedding and layering of various sized fractions were encountered in the borings and were visible in the 15-foot deep fault investigation trench that crossed the site from the north of the north limit of the powerblock area to the near the south property boundary. Localized, relatively thin (<1 foot), loosely cemented, silty fine sand seams were encountered in several Phase 1 borings. Occasionally, large cobbles were encountered during advancement of the borings. At the ground surface, rounded rock fragments as large as 18" were visible.

Older Alluvial Deposits: Locally, the Upper Pleistocene age Cabezon Fanglomerate and Ocotillo Conglomerate outcrop at Devers Hill to the northeast of the site. The Cabezon and Ocotillo formations are sandy, poorly-sorted and partially cemented fanglomerates or conglomerates reflected in the materials that form Devers Hill. Based on a visual examination of the recovered soil samples, material representative of these older geologic formations were not identified in the site borings.

Within the split-barrel soil samples that were recovered, there was no discernable evidence of displacement (faulting) in the soil profile.

I7.4 Ground Water

During the site Phase 1 subsurface exploration, which extended to a depth of 100' below ground surface, no moisture was encountered that might reflect the ground water table. No temporary ground water monitoring wells were installed at the site.

I7.5 Corrosion Potential and Ground Aggressiveness

The resistivity test results, shown on Attachment I-4, indicate the site soils to be non-corrosive for buried steel. The sulfate content of the soil will be measured to determine the cement specification for use in below-grade concrete foundations.

I7.6 Soil Profile Type

Based on the 1998 California Building Code (Reference 1), and the results of the shear wave velocity measurements in boreholes B-101 and B-103, the Soil Profile can be classified as a Type S_C (Very Dense Soil Profile).

I8.0 ASSESSMENT OF SOIL-RELATED HAZARDS

I8.1 Liquefaction

Soil liquefaction is a process by which loose, saturated, granular deposits lose a significant portion of their shear strength due to pore water pressure buildup resulting from cyclic loading, such as that caused by an earthquake. Soil liquefaction can lead to foundation bearing failures and excessive settlements when:

- the design ground acceleration is high;
- the water level is relatively shallow; and
- low SPT blow counts are measured in granular deposits (suggesting low soil density).

The results of the site subsurface investigation indicate that the site soils consist of dense sands and gravels with very deep ground water (below 100 foot depth). As a result, there is no potential for liquefaction at this site.

I8.2 Seismically-Induced Settlements

Seismically induced settlements occur when ground shaking causes soil densification. Soils susceptible to seismic densification are generally loose, uncemented, and have low shear strength. Soils below the final site grade will either be naturally dense or compacted under controlled conditions. Thus, the potential for seismically induced settlement at this site can be considered remote.

I8.3 Expansive Soils

Soil expansion is a phenomenon by which clayey soils expand in volume as a result of an increase in moisture content, and shrink in volume upon drying. Expansive soils are usually identified with index tests, such as percentage of clay particles and liquid limit. It is generally accepted that soils with liquid limits larger than about 50 percent, i.e., soils that classify as high plasticity clays (CH) or high plasticity silts (MH), may be susceptible to volume change when subjected to moisture variations.

Laboratory test results for representative soil samples indicated that the upper, near surface soils at the site generally classify as coarse-grained with percent fines lower than 20%. These soils are considered non-swelling and the potential for soil expansion at the site is virtually nil.

I8.4 Collapsible Soils

Soil collapse (hydrocompaction) is a phenomenon that results in relatively rapid settlement of soil deposits due to addition of water. This generally occurs in soils having a loose particle structure cemented together with soluble minerals or with small quantities of clay. Water infiltration into such soils can break down the interparticle cementation, resulting in collapse of the soil structure. Collapsible soils are usually identified with index tests, such as dry density and liquid limit, and consolidation tests where soil collapse potential is measured after inundation under load.

Loosely cemented, silty fine sand similar to that described in Section I7.3 has the potential to be collapsible when subjected to moisture increase. However, based on the data collected during the investigation, this sand is extremely dense and only occurs in localized, thin seams less than 1 foot thick. Therefore, it is concluded that the potential for soil collapse or settlement from inundation at the site is remote.

I8.5 Soil Cavities

Soil cavities are often found in areas underlain by limestone bedrock that is susceptible to water solution. The site is considered to be underlain by sandstone bedrock, which is not known to be water-soluble. Additionally, cavities were not found during the field investigation and are not known to exist in the area. Therefore, the potential for foundation damage due to collapse of soil cavities can be considered remote at this site.

I9.0 PRELIMINARY FOUNDATION CONSIDERATIONS

I9.1 General Foundation Design Criteria

For satisfactory performance, the foundation of any structure must satisfy two independent design criteria. First, it must have an acceptable factor of safety against bearing failure in the foundation soils under maximum design load. Second, settlements during the life of the structure must not be of a magnitude that will cause structural damage, endanger piping connections or impair the operational efficiency of the facility. Selection of the foundation type to satisfy these criteria depends on the nature and magnitude of dead and live loads, the base area of the structure and the settlement tolerances. Where more than one foundation type satisfies these criteria, then cost, scheduling, material availability and local practice will probably influence or determine the final selection of the type of foundation.

A thorough evaluation of the information collected from the SPT borings, laboratory testing, visual observations made during the detailed site investigation, and the previously discussed assessment of soil-related hazards indicate that no adverse foundation-related subsurface and ground water conditions were encountered that would preclude the construction and operation of the proposed plant. Thus, the site can be considered suitable for development of the proposed plant, pursuant to the preliminary foundation and earthwork considerations discussed in this appendix.

I9.2 Shallow Foundations

The generally dense/hard soils encountered throughout the site, as well as the controlled compacted fill to be used to grade the site, are expected to provide adequate allowable bearing pressures for design of shallow foundations for all structures. Shallow foundations can be sized for an allowable bearing pressure of 4,000 psf, which includes a safety factor of at least 3 against bearing failures. Column footings are expected to undergo total settlements of less than 1 inch and differential settlement between neighboring foundations of less than 1/2 inch. Structural mats are expected to undergo total settlements of less than 2 inches and differential settlement between neighboring columns and/or points of load application of less than 1 inch.

Frost depth is estimated to be less than 6 inches at the site (Reference 2). Exterior foundations and foundations in unheated areas should be placed at a depth of at least 1 foot below the ground surface for frost protection. Interior footings in permanently heated areas can be placed at nominal depths. The minimum recommended width is 3 feet for spread footings and 2 feet for wall footings.

The recommended allowable bearing pressure can be increased by 1/3 when transient foundation loads are included. Pressures at the edge of eccentrically loaded foundations can also exceed the recommended allowable value by 1/3, provided the average pressure throughout the footprint of the foundation remains below the recommended allowable value.

I10.0 PRELIMINARY EARTHWORK CONSIDERATIONS

I10.1 Site Preparation and Grading

The site will be graded to about El. 955 feet to provide a flat surface for construction of the facility. After removal of all existing shrubs and debris from the site construction areas, the subgrade preparation should include the complete removal of all vegetation and topsoil. Topsoil can be stockpiled and may be reused in remote areas of the site where no future construction is expected.

All soil surfaces to receive fill should be proofrolled with a heavy vibratory roller or a fully loaded dump truck to detect soft areas. Soft areas will be removed prior to fill placement in accordance with recommendations provided by a geotechnical engineer or his/her representative at the site.

I10.2 Temporary Excavations

It is anticipated that confined temporary excavations at the site will be required during construction for the installation of the circulation water pipes and the cooling tower forebay. All excavations should be sloped in accordance with OSHA requirements. Sheet piling could also be used to support any excavation. The need for internal supports in the excavation will be determined based on the final depth of the excavation.

I10.3 Permanent Slopes

Permanent cut slopes as high as 27 feet and fill slopes as high as 25 feet will be required for site grading. These slopes should be designed to withstand horizontal ground accelerations compatible with the peak ground acceleration for the site. This could result in very flat slopes. Steeper slopes of the order of 3H:1V may require soil reinforcement. Geogrid reinforcement for fill slopes and soil nailing for cut slopes will be considered in these cases.

All cut slopes should be provided with drainage ditches along its top to minimize erosion of slope faces due to surface runoff. Permanent slopes can be protected with native grasses, other vegetation that does not require artificial irrigation, or other appropriate means.

Fill areas will be located on sloped subgrades. Keys at least 6 feet wide at the bottom, sloped at 2H:1V, should be excavated at vertical intervals no greater than 5 feet into stable soils where fills are to be placed on subgrades sloped at 6H:1V or steeper.

I10.4 Backfill Requirements

All fill material must be free of organic matter, debris or clay balls, with a maximum size not exceeding 2 inches. Structural fill must also be well graded and granular. Granular material with similar specifications can be used for pipe bedding, except that the maximum size should not exceed 1/2 inch. Based on the available site grading, it is anticipated that fill material will be available from on-site excavations.

Structural fill should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557 when used for raising the grade throughout the site, below footings or mats, or for rough grading. Fill placed behind retaining structures may be compacted to 90 percent of the maximum dry density as determined by ASTM D 1557. Initially, structural fill should be placed in lifts not exceeding 8 inches loose thickness. Thicker lifts may be used pursuant to approval based on results of field compaction performance. The moisture content of all compacted fill should fall within 3 percentage points of the optimum moisture content measured by ASTM D 1557.

Pipe bedding can be compacted in 12-inch lifts to 90 percent of the maximum dry density as determined by ASTM D 1557. Common fill to be placed in remote and/or unsurfaced areas may be compacted in 12-inch lifts to 85 percent of the maximum dry density as determined by ASTM D 1557.

I11.0 INSPECTION AND MONITORING

A California-registered Geotechnical Engineer or Engineering Geologist should monitor geotechnical aspects of foundation construction and/or installation, and fill placement. At a minimum the Geotechnical Engineer/Engineering Geologist should monitor the following activities:

- All surfaces to receive fill should be inspected prior to fill placement to verify that no pockets of loose/soft or otherwise unsuitable material were left in place and that the subgrade is suitable for structural fill placement.

- All fill placement operations should be monitored by an independent testing agency. Field compaction control testing should be performed regularly and in accordance with the applicable specification to be issued by the Geotechnical Engineer.
- Settlement monitoring of significant foundations and equipment is recommended on at least a quarterly basis during construction and the first year of operation, and then semi-annually for the next two years.

I12.0 SITE DESIGN CRITERIA

I12.1 General

The Facility will be located at a site north of Interstate Highway 10, about one mile east of the intersection of Dillon Road and Diablo Road, and about 9 miles northwest of the City of Palm Springs, in Riverside County, California..

I12.2 Datum

The site grade varies between El. 1002 feet due east of the powerblock area to about 920 feet at the southwestern property corner. Final site grade will be about El. 955 feet.

I13.0 FOUNDATION DESIGN CRITERIA

I13.1 General

Reinforced concrete structures (spread footings, mats and deep foundations) will be designed consistent with Appendix D, Structural Engineering Design Criteria.

Allowable soil bearing pressures for foundation design will be in accordance with this Appendix.

I13.2 Ground Water Pressures

No ground water is anticipated and therefore, no hydrostatic pressures due to ground water or temporary water loads will be considered.

I13.3 Factors of Safety

The factor of safety for structures, tanks and equipment supports with respect to overturning, sliding, and uplift due to wind and buoyancy will be as defined in Appendix D, Structural Engineering Design Criteria.

I13.4 Load Factors and Load Combinations

For reinforced concrete structures and equipment supports, using the strength method, the load factors and load combinations will be in accordance with Appendix D, Structural Engineering Design Criteria.

I14.0 REFERENCES

1. 1998 California Building Code.
2. Department of the Navy (1982). *Soil Mechanics Design Manual 7.1*, Naval Facilities Engineering Command, Alexandria, VA.

Appendix I

Tables

Geotechnical Laboratory Index Testing Summary

Project Name: Ocotillo Power Plant
Project Number: 66-00000023.02 **Task:** 03020
Project Engineer: GL

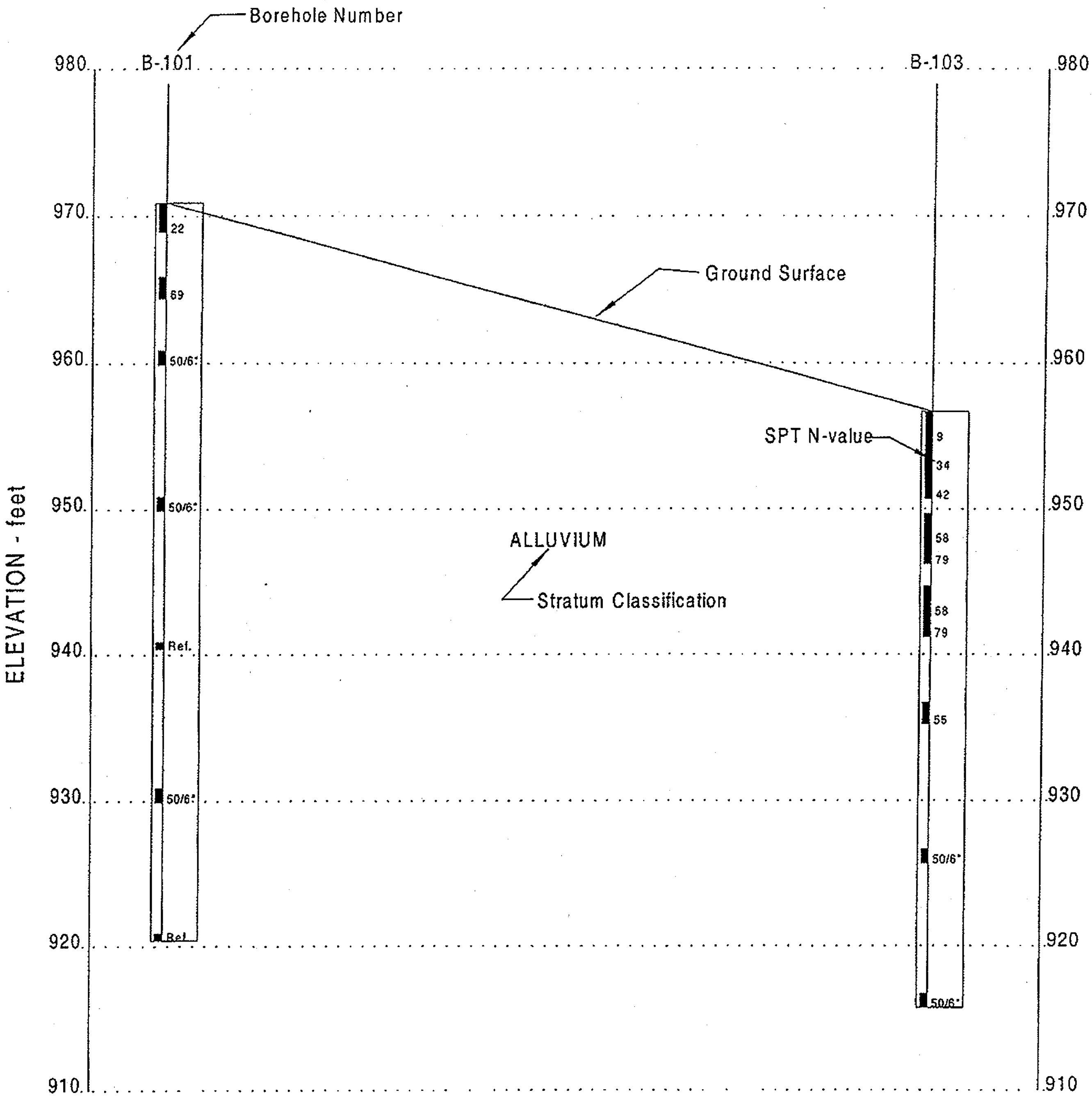
LOCATION				INITIAL CONDITION			INDEX												OTHER TESTS		
							Limits			Gradation				Compaction							
Exploration Number	Sample/ Specimen Number	Depth (ft)	USCS Symbol	Water Content (%)	Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Liquid Limit (%)	Plasticity Index (%)	Liquidity Index	Cobbles (%)	Gravel (%)	Sand (%)	Fines (%)	Test Method	Compaction Proc. A, B, C	Prep. Method: m=moist, d=dry	Max. Dry Unit Weight (pcf)	Opt. Water Content (%)	Expansion Index, EI @ 50% S	Chemical	R-Value
B-101	3	10.0	SW-SM	0.9							9.8	83.7	6.5								
B-101	4	15.0	SM	1.2							8.0	78.4	13.6								
B-101	9	40.0	SM	2.1							11.7	71.2	17.1								
B-101	14	65.0	SM	1.4							6.6	78.3	15.1								
B-101	18	85.0	SW-SM	1.4							18.1	71.1	10.8								
B-103	4	7.0	GW	1.3							54.7	41.6	3.7								
B-103	6	12.0	SM	1.7							25.9	61.0	13.1								
B-103	10	30.0	SW-SM	1.5							18.5	72.0	9.5								
B-103	16	60.0	SW-SM	1.0							7.1	83.2	9.7								
B-103	23	95.0	SM	0.7							11.1	76.0	12.9								
North of site		8.0	SP							4.9	29.4	61.8	3.9	D1557	B	d	126.0	8.0			
Center of site		8.0	SP-SM								26.2	64.0	9.8	D1557	B	m	132.0	7.5			
Sta. 695, west cut		8.0	SM	2.6	109.0	106.2	Direct Shear assigned, not tested due to trimming problems														

Appendix I

Figures

Figure I-1 is included as

Drawing No. CY-0100-00001, Rev. C



NOTES:

Ref. = SPT sample barrel refusal in first 6" of penetration

50/6" = SPT N-value for indicated penetration beyond first 6"

Subsurface data have been obtained at actual boring locations. The stratification shown between borings is based on interpolation of data acquired at the boring locations. Actual stratification between borings may differ from that shown.

0 20 40

HORIZONTAL SCALE - FEET

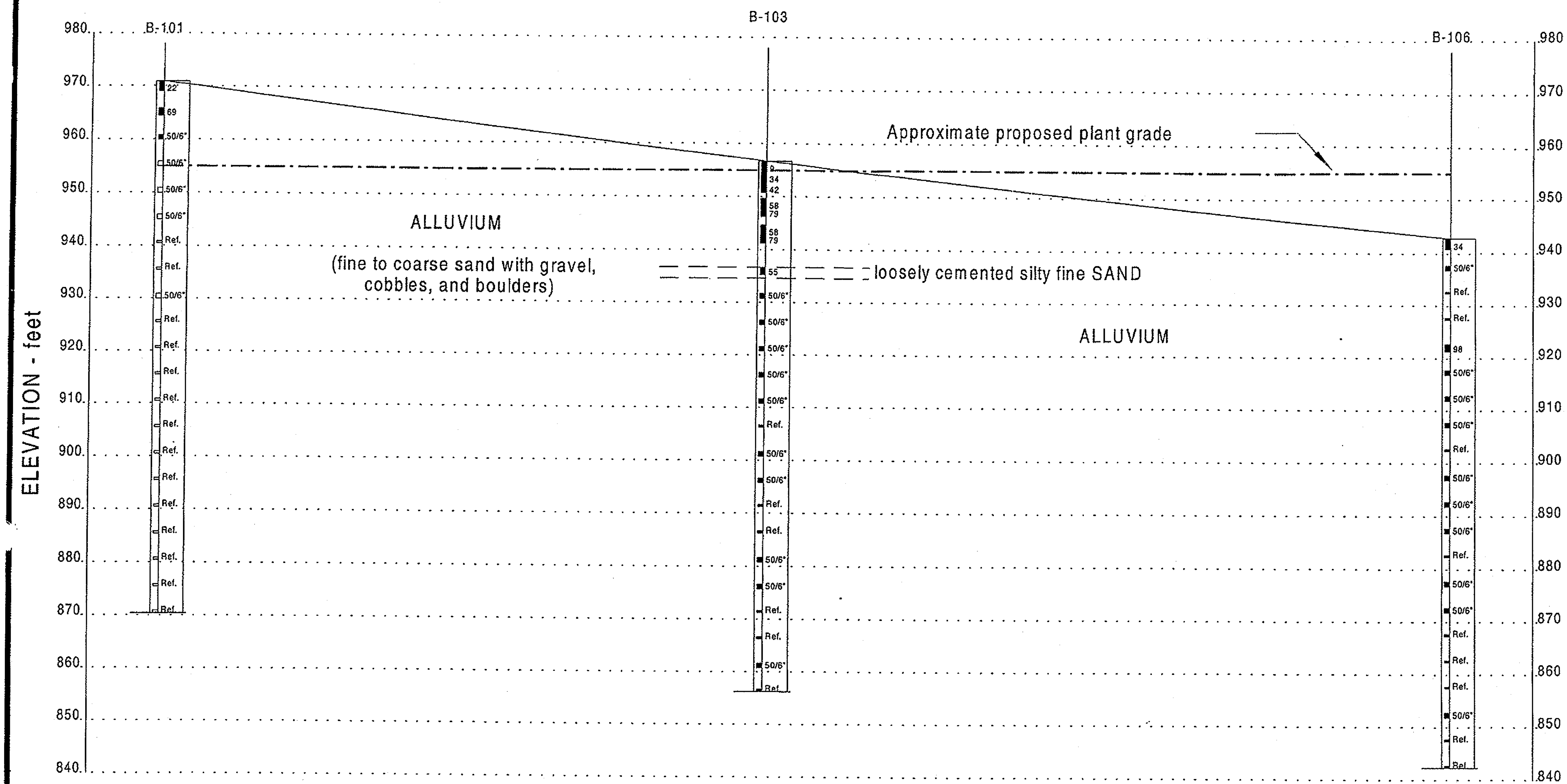
BECHTEL POWER CORPORATION

FREDERICK, MARYLAND

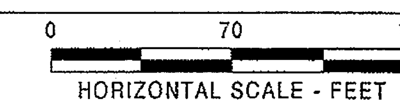
OCOTILLO ENERGY PROJECT

SUBSURFACE PROFILE LEGEND

JOB NO.	DRAWING NO.	REV.
24268-20C	FIGURE I-2	



Vertical Exaggeration = 3.5X



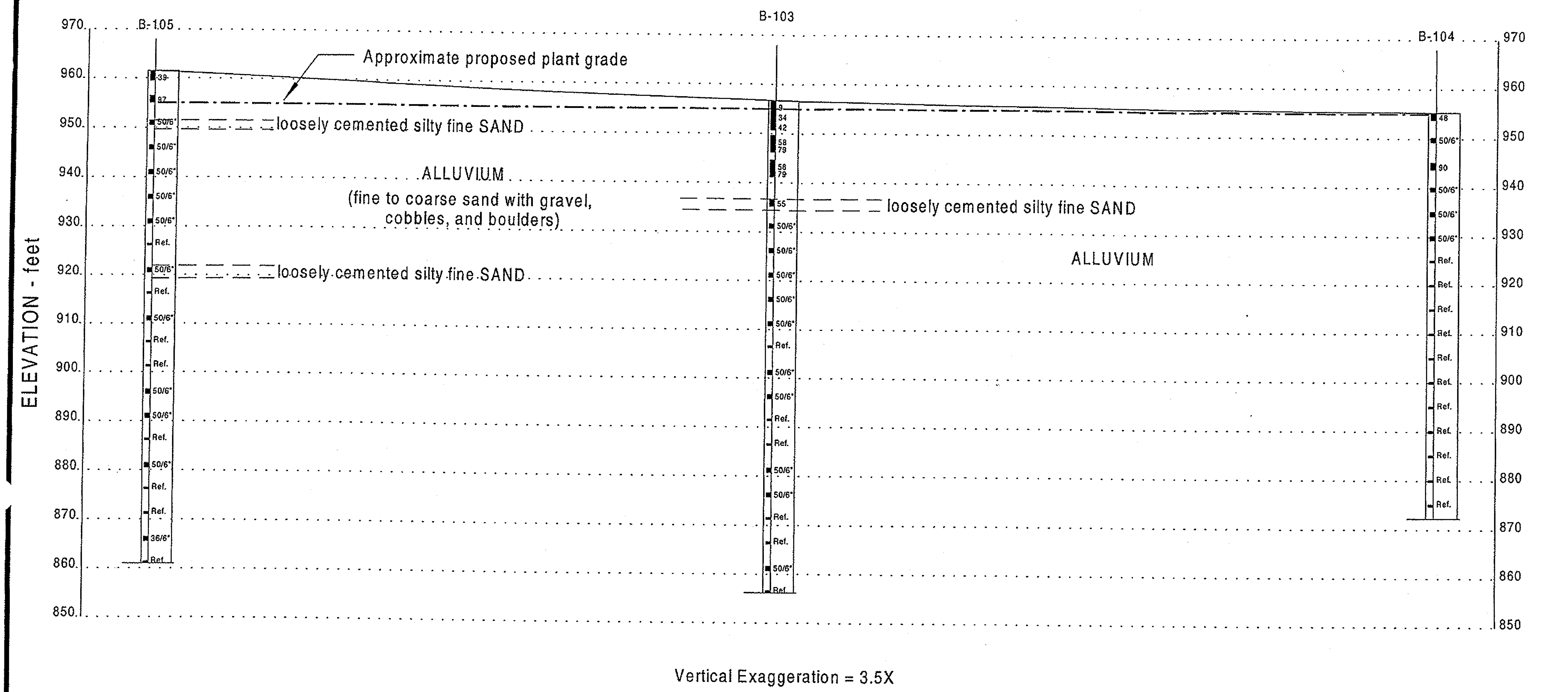
BECHTEL POWER CORPORATION

FREDERICK, MARYLAND

OCOTILLO ENERGY PROJECT

SUBSURFACE PROFILE
SECTION A-A'

JOB NO.	DRAWING NO.	REV.
24268-20C	FIGURE I-3	



0 70 140

HORIZONTAL SCALE - FEET

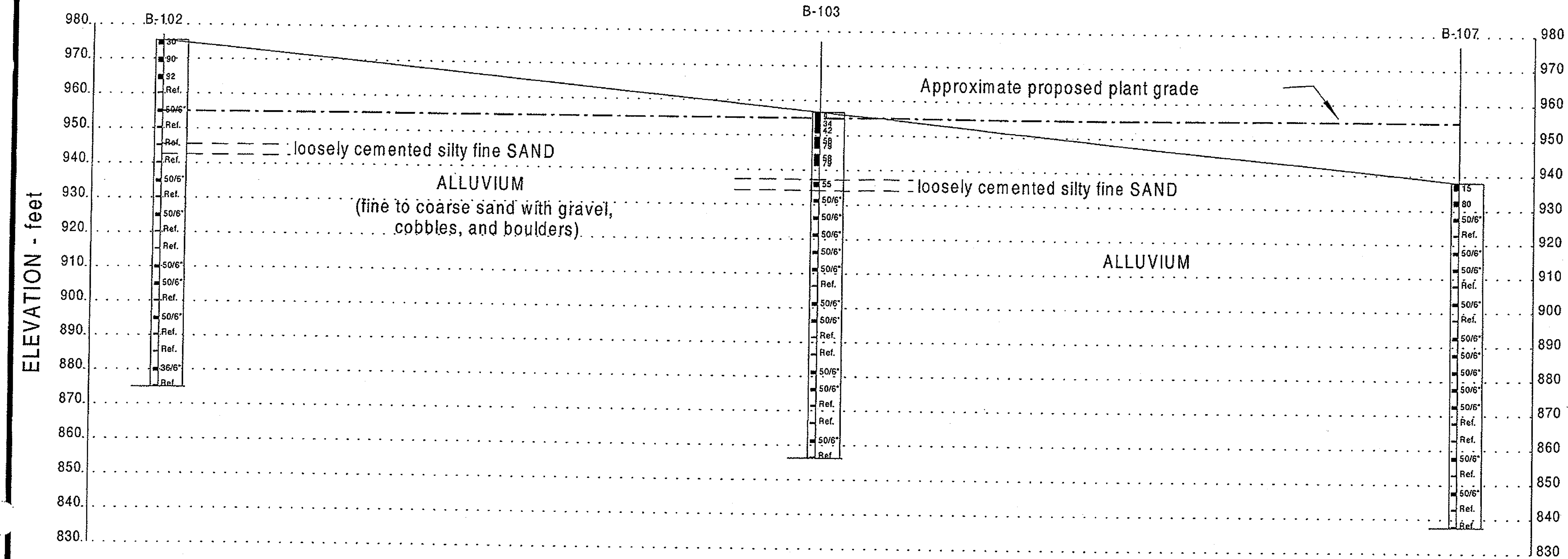
BECHTEL POWER CORPORATION

FREDERICK, MARYLAND

OCOTILLO ENERGY PROJECT

SUBSURFACE PROFILE
SECTION B-B'

JOB NO.	DRAWING NO.	REV.
24268-20C	FIGURE I-4	



Vertical Exaggeration = 2.67X

0 80 160

HORIZONTAL SCALE - FEET

BECHTEL POWER CORPORATION

FREDERICK, MARYLAND

OCOTILLO ENERGY PROJECT

SUBSURFACE PROFILE
SECTION C-C'

JOB NO.	DRAWING NO.	REV.
24268-20C	FIGURE I-5	

Appendix I

Attachment I-1

Boring Logs

BECHTEL

BORING LOG

PROJECT: Ocotillo Energy Project	JOB NO.: 24268-20C	SHEET NO.: 1 OF 2	HOLE NO.: B-101

SITE: Ocotillo, CA.	COORDINATES: N2281429:E6463816	ANGLE FROM HORIZ.: 90°	BEARING:

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN	ROCK	TOTAL DEPTH
2/28/2001	3/3/2001	Tri-County Drilling	CME 75	8"	101	na	101

CORE RECOVERY	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. OF GWT	DEPTH/EL. TOP OF ROCK
na	na	21	na	970.884	Dry	na

SAMPLE HAMMER WEIGHT/FALL: 140 lbs/30"	CASING LEFT IN HOLE: DIA./LENGTH: 2.5"/100'	LOGGED BY: G. LeFevre

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS, USING 3" SAMPLER / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL, WATER RETURN, CHARACTER OF DRILLING
ss 3"			22*	4	11	11	11				1	Medium dense, brown, slightly silty, fine to coarse SAND/	Size of rocks visible
									2.0			pebbles to 2"	at surface range from
													3" to 18"
									5.0				
ss 3"			69*	21	33	36			6.0		2	Same	
									10.0				
ss 3"			50+	19	50+						3	Same	
									15.0				
ss 3"			50+	19	50+				16.0		4	Same	
									20.0				
ss 3"			50+	20	50+				21.0		5	Same	
									25.0				
ss 3"			50 +*	38	50+						6	Same	
									26.5				
									30.0				
ss 3"			50+*	50+							7	Same	
									31.5				
									35.0				
ss 3"			50+*	50+							8	No Recovery	
									36.50				
* N value is for a 3" sampler									40.0				

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER)

SITE Ocotillo

HOLE NO. B-101

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	2 OF 2	B-101

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2281429:E6463816	90°	

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE (cm)	LENGTH CORE RUN	SAMPLE RECOVERY	CORE RECOVERY / SAMPLE BLOWS USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2 cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.8 cm)	4TH 6 INCHES (60.8 cm)	FEET ELEVATION	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL WATER RETURN CHARACTER OF DRILLING
ss 3"				50+*		30	50+				41.5		9	Very dense, brown, slightly silty, fine to coarse SAND	↑
											45.0			with pebbles to 2"	
ss 3"				50+*		50+							10	Same	
											46.5				
											50.0				
ss 3"				50+*		50+					51.5		11	Same	
											55.0				
ss 3"				50+*		50+							12	Same	
											56.5				Drilling slows
											60.0				when encountering
ss 3"				50+*		50+					61.5		13	Same	cobbles/boulders
											65.0				
ss 3"				50+*		50+							14	Same	
											66.5				
											70.0				
ss 3"				50+*		50+					71.5		15	Same	
											75.0				
ss 3"				50+*		50+							16	Same	
											76.50				
											80.0				
ss 3"				50+*		50+							17	Same	
											85.0				
ss 3"				50+*		50+							18	Same	
											86.50				
											90.0				
ss 3"				50+*		50+					91.50		19	Same	
											95.00				
ss 3"				50+*		50+							20	Same	
											96.50				
ss 3"				50+*		50+					100.0				
											101.0		21	Same	↓
														Bottom of Boring 101.0	

* N value is for a 3" sampler

Sample Type (SS = SPLIT SPOON; ST = SHELBY TUBE D = DENNISON ; P = PITCHER; O = OTHER)

SITE Ocotillo

HOLE NO. B-101

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	1 OF 2	B-102

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2281301;E6463373	90°	

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN	ROCK	TOTAL DEPTH
3/2/2001	3/3/2001	Tri-County Drilling	CANTERRA	8"	101	na	101

CORE RECOVERY	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. OF GWT	DEPTH/EL. TOP OF ROCK
na	na	21	na	975.351	Dry	na

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs/30"	na	G. LeFevre

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE	LENGTH CORE RUN	SAMPLE RECOVERY	CORE RECOVERY	SAMPLE BLOWS, USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL WATER RETURN CHARACTER OF DRILLING
ss 3"					30*		8	12	18					1	Medium dense, brown, fine to coarse SAND/	Size of rocks visible
												2.0			pebbles to 2.5", trace silt, rounded rock fragments <2"	at surface range from
																3" to 18"
												5.0				
ss 3"					50+		12	40	50+			6.0		2	Very dense	
												10.0				
ss 3"					50+		28	42	50+					3	Same	
												15.0				
ss 3"					50+		50+					16.0		4	Same	
												20.0				
ss 3"					98*		46	50+				21.0		5	Same	
												25.0				
ss 3"					50 +*		50+							6	Same except rounded pebbles to 1"	
												26.5				
												30.0				
ss 3"					50+*		50+							7	Same with some fine silty sand loosely cemented	
												31.5				
												35.0				
ss 3"					50+*		50+							8	Same with no cementation	
												36.50				
* N value is for a 3" sampler												40.0				

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER)

SITE Ocotillo

HOLE NO. B-102

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	2 OF 2	B-102

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2281301;E6463373	90°	

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE (cm) / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS USING 3" SAMPLER / PERCENT CORE RECOVERY	PENETRATION BLOWS: 1ST 6 INCHES (15.2 cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	FEET ELEVATION	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL, WATER RETURN, CHARACTER OF DRILLING
ss 3"			50+*	37	50+				41.5		9	Very dense, brown, fine to coarse SAND	
									45.0			with rock fragments to 0.5 " (SAND mostly f-m)	
ss 3"			50+*	50+							10	Same except rock fragments to 2.0"	
									46.5				
									50.0				
ss 3"			50+*	33	50+				51.5		11	Same with rounded rock fragments <0.5"	
									55.0				
ss 3"			50+*	50+							12	Same (SAND mostly f-c)	
									56.5				Drilling slows
									60.0				when encountering
ss 3"			50+*	50+					61.5		13	Same except f-m SAND and rounded rock fragments < 1"	cobbles/boulders
									65.0				
ss 3"			50+*	42	50+						14	Same	
									66.5				
									70.0				
ss 3"			50+*	10	50+				71.5		15	Same rounded rock fragments < 0.5"	
									75.0				
ss 3"			50+*	50+							16	Same	
									76.5				
									80.0				
ss 3"			50+*	31	50+				81.5		17	Samewith rounded rock fragments < 1"	
									85.0				
ss 3"			50+*	50+							18	Same	
									86.5				
									90.0				
ss 3"			50+*	50+					91.5		19	Same	
									95.0				
ss 3"			50+*	24	36						20	Same	
									96.5				
ss 3"			50+*	50+					100.0				
									101.0		21	Same	
												Bottom of Boring 101.0	
* N value is for a 3" sampler												This boring consisted of mostly fine to coarse	
												SAND with <2" rounded rock fragments. Occassional larger	
												sized cobbles or boulders were encountered during advance-	
												ment of the boring.	

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	1 OF 2	B-103

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2281025;E6463806	90°	

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN	ROCK	TOTAL DEPTH
2/23/2001	2/24/2001	Tri-County Drilling	CME 75	8 "	101.5	na	101.5

CORE RECOVERY	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. OF GWT	DEPTH/EL. TOP OF ROCK
na	na	24*	na	956.651	Dry	na

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs/30"	2.5"/100'	G. LeFevre

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE	LENGTH CORE RUN	SAMPLE RECOVERY	CORE RECOVERY *SAMPLE BLOWS, USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL WATER RETURN CHARACTER OF DRILLING
ss 3"				9*		2	3	6	16				1	Loose, brown, slightly silty, fine to coarse SAND/ pebbles	Sampling continuous
											2.0			to 1"	from 0 to 16 '; every
ss 3"				34*		12	16	18	25				2	Same except dense	5' thereafter, starting
											4.0				at 20'
ss 3"				42*		6	15	27	39				3	Same	Rocks at surface up
											6.0				to 18".
											7.0				↑
ss 3"				58*		14	28	30	34				4	Same except pebbles to 2"	
											9.0				
ss 3"				79*		13	35	44					5	No recovery, very difficult advance	
											11.0				
											12.0				
ss 3"				58*		14	26	32	42				6	Very dense, brown, slightly silty, fine to coarse SAND,	Drilling difficult,
											14.0			pebbles to 1"	due to presence of
ss 3"				79*		7	36	43					7	No recovery - sharp sound when using hammer	cobbles/boulders
											16.0				
											16.0				
											20.0				
ss 3"				55*		14	34	21					8	Very dense, brown, slightly silty, fine to coarsre SAND/	
											21.5			pebbles to 1.5", localized cemented fines	
											25.0				
ss 3"				50 +*		24	50+						9	Same except no pebbles but little recovery	
											26.50				
											30.0				
ss 3"				50+*		41	50+						10	Same as 9	
											31.50				
											35.0				
ss 3"				50+*		29	50+						11	Same as 9	
											36.50				
* N value is for a 3" sampler											40.0				↓

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER)

SITE Ocotillo

HOLE NO. B-103

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	2 OF 2	B-103

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
Ocotillo, California	N2281025;E6463806	90°	

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE (cm)	LENGTH CORE RUN	SAMPLE RECOVERY	CORE RECOVERY / SAMPLE BLOWS USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2 cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	FEET ELEVATION	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL WATER RETURN CHARACTER OF DRILLING
ss 3"				50+*		40	50+				41.5		12	Very dense, brown, slightly silty, fine to coarse SAND	
											45.0			with pebbles to 1.5 "	
ss 3"				50+*		30	50+						13	Same	
											46.5				
											50.0				
ss 3"				50+*		50+					51.5		14	Same	
											55.0				
ss 3"				50+*		39	50+						15	Same with pebbles to 0.5"	
											56.5				Drilling slows
											60.0				when encountering
ss 3"				50+*		13	50+				61.5		16	Same as 15	cobbles/boulders
											65.0				
ss 3"				50+*		50+							17	Same as 15	
											66.5				
											70.0				
ss 3"				50+*		50+					71.5		18	Same as 15	
											75.0				
ss 3"				50+*		18	50+						19	Same as 15	
											76.50				
											80.0				
ss 3"				50+*		14	50+				81.5		20	Same as 15	
											85.0				
ss 3"				50+*		50+							21	Same as 15	
											86.50				
											90.0				
ss 3"				50+*		50+					91.50		22	Same as 15	
											95.00				
ss 3"				50+*		35	50+						23	Same as 15	
											96.50				
ss 3"				50+*		50+					100.0			No recovery	
											101.0			Bottom of Boring	

* N value is for a 3" sampler

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER)

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	2 OF 2	B-104

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2281185;E6464256	90°	

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE (cm) / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS USING 3" SAMPLER / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2 cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	FEET ELEVATION	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL WATER RETURN CHARACTER OF DRILLING
ss 3"			50+*	50+					41.5		9	Very dense, brown, fine to coarse SAND	Drilling slows
									45.0			with rock fragments < 2"	when encountering
ss 3"			50+*	50+							10	Same	cobbles/boulders
									46.5				
									50.0				
ss 3"			50+*	50+					51.5		11	Same	
									55.0				
ss 3"			50+*	50+							12	Same	
									56.5				
									60.0				
ss 3"			50+*	50+					61.5		13	Same	
									65.0				
ss 3"			50+*	50+							14	Same	
									66.5				
									70.0				
ss 3"			50+*	50+					71.5		15	Same	
									75.0				
ss 3"			50+*	50+							16	Same	
									76.5				
									80.0				Cobble Zone
ss 3"			50+*	50+					81.5		17	Same	76 - 83'
									83.0			Bottom of Boring 83.0 where auger refusal was met.	
												The sand portion of this boring consisted mostly of fine to	
* N value is for a 3" sampler												medium sized grains with a minority being coarse grained.	
												The material encountered is an alluvium having occasional	
												lenses or beds of cobbles and boulders which were encount-	
												ered during advancement of the boring.	

Sample Type (SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER) | SITE Ocotillo | HOLE NO. B-104

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	1 OF 2	B-104

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2281185;E6464256	90°	

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN	ROCK	TOTAL DEPTH
3/3/2001	3/3/2001	Tri-County Drilling	CANTERRA	8"	83	na	83

CORE RECOVERY	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. OF GWT	DEPTH/EL. TOP OF ROCK
na	na	17		955.287	Dry	na

SAMPLE HAMMER WEIGHT\FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs/30"	na	G. LeFevre

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE	LENGTH CORE RUN	SAMPLE RECOVERY	CORE RECOVERY / *SAMPLE BLOWS, USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS: 1ST 6 INCHES (15.2cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	ELEVATION (METERS)	DEPTH (METERS)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL, WATER RETURN, CHARACTER OF DRILLING
ss 3"				48*		7	17	31					1	Dense, brown, fine to coarse SAND/ rounded rock frag-	Size of rocks visible
											2.0			ments < 2"	at surface range from
															3" to 18"
											5.0				
ss 3"				50+		45	50+				6.0		2	Same	
											10.0				
ss 3"				50+		20	40	50+					3	Same	
											15.0				
ss 3"				50+		30	50+				16.0		4	Same	
											20.0				
ss 3"				50+*		35	50+				21.0		5	Same	
											25.0				
ss 3"				50 +*		44	50+						6	Same	
											26.5				
											30.0				
ss 3"				50+*		50+							7	Same	
											31.5				
											35.0				
ss 3"				50+*		50+							8	Same	
											36.50				
											40.0				

* N value is for a 3" sampler

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER)

SITE Ocotillo

HOLE NO. B-104

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	2 OF 2	B-105

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2280941;E6463365	90°	

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE (cm) / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS: 1ST 6 INCHES (15.2 cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	(FEET) ELEVATION	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL, WATER RETURN, CHARACTER OF DRILLING
ss 3"			50+*		37	50+				41.5			Very dense, brown, fine to coarse SAND	Rock fragments
										45.0			with rounded rock fragments < 2", locally cemented.	at surface up to
ss 3"			50+*		50+							10	Same	18"s.
										46.5				
										50.0				
ss 3"			50+*		33	50+				51.5		11	Same/ no cementing	
										55.0				
ss 3"			50+*		50+							12	Same	
										56.5				Drilling slows
										60.0				when encountering
ss 3"			50+*		50+					61.5		13	Same	cobbles/boulders
										65.0				
ss 3"			50+*		42	50+						14	Same	
										66.5				
										70.0				
ss 3"			50+*		10	50+				71.5		15	Same	
										75.0				
ss 3"			50+*		50+							16	Same/ very little recovery	
										76.5				
										80.0				
ss 3"			50+*		31	50+				81.5		17	No recovery	
										85.0				
ss 3"			50+*		50+							18	No recovery except 2" gravel fragment	
										86.5				
										90.0				
ss 3"			50+*		50+					91.5		19	Same/ little recovery	
										95.0				
ss 3"			50+*		24	36						20	Same/ little recovery	
										96.5				Rods chattering
ss 3"			50+*		50+					100.0				for 2'
										101.0		21	Same/ little recovery	
													Bottom of Boring 101.0	
* N value is for a 3" sampler													This boring consisted of mostly fine to coarse SAND with <2" rounded rock fragments. Occassional larger sized cobbles or boulders were encountered during advancement of the boring.	

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	1 OF 2	B-105

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2280941;E6463365	90°	

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN	ROCK	TOTAL DEPTH
3/2/2001	3/2/2001	Tri-County Drilling	CME-85	8"	101	na	101

CORE RECOVERY	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. OF GWT	DEPTH/EL. TOP OF ROCK
na	na	21	na	961.527	Dry	na

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs/30"	na	G. LeFevre

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE	LENGTH CORE RUN	SAMPLE RECOVERY	CORE RECOVERY	SAMPLE BLOWS, USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL, WATER RETURN, CHARACTER OF DRILLING
ss 3"					39*		11	17	22	34				1	Dense, brown, fine to coarse SAND/ rounded rock frag-	Size of rocks visible
												2.0			ments < 2"	at surface range from
																3" to 18"
												5.0				
ss 3"					50+*		14	47	50+			6.0		2	Same/very dense	
																Rods chattering
																(cobble zone)
												10.0				
ss 3"					50+*		27	50+						3	Same/ fine sand is locally cemented-breaks down with	
															slight pressure.	
												15.0				
ss 3"					50+*		12	50+				16.0		4	Same/ no cementation	
																Rods chattering
																(cobble zone)
												20.0				
ss 3"					50+*		16	50+				21.0		5	Same	
												25.0				
ss 3"					50 +*		15	50+						6	Same	
												26.5				
												30.0				
ss 3"					50+*		40	50+						7	Same	
												31.5				
												35.0				
ss 3"					50+*		50+							8	Same	
												36.50				
												40.0				

* N value is for a 3" sampler

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER)

SITE Ocotillo

HOLE NO. B-105

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	1 OF 2	B-106

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2280566;E6463783	90°	

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN	ROCK	TOTAL DEPTH
3/1/2001	3/2/2001	Tri-County Drilling	CME 75	8"	101	na	101

CORE RECOVERY	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. OF GWT	DEPTH/EL. TOP OF ROCK
na	na	21	na	942.820	Dry	na

SAMPLE HAMMER WEIGHT\FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs/30"	na	G. LeFevre

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE	LENGTH CORE RUN	SAMPLE RECOVERY	CORE RECOVERY	SAMPLE BLOWS, USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL, WATER RETURN, CHARACTER OF DRILLING
ss 3"					34*		5	16	18	30				1	Dense, brown, fine to coarse SAND/	Size of rocks visible
												2.0			pebbles to 2.5", trace silt+Q20	at surface range from
																3" to 18"
												5.0				Drill chattering
ss 3"					50+		39	50+				6.0		2	Very dense	
												10.0				Drill chattering
ss 3"					50+		50+							3	Same	
												15.0				
ss 3"					50+		50+					16.0		4	Same	
																Drill chattering
												20.0				
ss 3"					98*		14	48	50+			21.0		5	Same except SAND is mostly fime to medium with minor	
															portion being coarse and pebbles to 0.5"	
												25.0				
ss 3"					50 +*		26	50+						6	Same except pebbles to 2"	
												26.5				
												30.0				
ss 3"					50+*		39	50+						7	Same	
												31.5				
												35.0				
ss 3"					50+*		42	50+						8	Same	
												36.50				
												40.0				

* N value is for a 3" sampler

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER)

SITE Ocotillo

HOLE NO. B-106

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	2 OF 2	B-106

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2280566;E6463783	90°	

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE (cm) / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS USING 3" SAMPLER / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2 cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	(FEET) ELEVATION	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL WATER RETURN CHARACTER OF DRILLING
ss 3"			50+*	50+					41.5		9	Very dense, brown, fine to coarse SAND	
									45.0			with rock fragments to 0.5 " (SAND mostly f-m)	
ss 3"			50+*	44	50+						10	Same except rock fragments to 2.0"	
									46.5				
									50.0				
ss 3"			50+*	42	50+				51.5		11	Same	
									55.0				
ss 3"			50+*	29	50+						12	Same (SAND mostly f-c)	
									56.5				Drilling slows
									60.0				when encountering
ss 3"			50+*	50+					61.5		13	Same except f-m SAND	cobbles/boulders
									65.0				
ss 3"			50+*	48	50+						14	Same except f-m SAND	
									66.5				
									70.0				
ss 3"			50+*	15	50+				71.5		15	Same except f-c SAND	
									75.0				
ss 3"			50+*	50+							16	Same	
									76.5				
									80.0				
ss 3"			50+*	50+					81.5		17	Same	
									85.0				
ss 3"			50+*	50+							18	Same	
									86.5				
									90.0				
ss 3"			50+*	36	50*				91.5		19	Same	
									95.0				
ss 3"			50+*	50+							20	Same	
									96.5				
ss 3"			50+*	50+					100.0				
									101.0		21	Same	
												Bottom of Boring 101.0	

* N value is for a 3" sampler

This boring consisted of mostly fine to medium and fine to coarse SAND with <2" rounded rock fragments. Occassional larger sized cobbles or boulders were encountered during advancement of the boring.

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE D = DENNISON ; P = PITCHER; O = OTHER)

SITE Ocotillo

HOLE NO. B-106

BORING LOG

PROJECT: Ocotillo Energy Project		JOB NO.: 24268-20C		SHEET NO.: 1 OF 2	HOLE NO.: B-107
SITE: Ocotillo, California	COORDINATES: N2280798;E6464254			ANGLE FROM HORIZ.: 90°	BEARING:
BEGUN: 3/2/2001	COMPLETED: 3/3/2001	DRILLER: Tri-County Drilling	DRILL MAKE AND MODEL: CME-85	HOLE SIZE: 8"	OVERBURDEN: 101
ROCK: na	TOTAL DEPTH: 101	CORE RECOVERY: na	CORE BOXES: na	SAMPLES: 21	EL. TOP OF CASING: na
GROUND EL.: 938.057	DEPTH/EL. OF GWT: Dry	DEPTH/EL. TOP OF ROCK: na	SAMPLE HAMMER WEIGHT/FALL: 140 lbs/30"	CASING LEFT IN HOLE: DIA./LENGTH: na	LOGGED BY: G. LeFevre

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE	LENGTH CORE RUN	SAMPLE RECOVERY	CORE RECOVERY / SAMPLE BLOWS, USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.6 cm)	4TH 6 INCHES (60.8 cm)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL WATER RETURN CHARACTER OF DRILLING
ss 3"				15		4	7	8	11				1	Medium dense, brown, fine to coarse SAND/ rounded	Size of rocks visible
											2.0			rock fragments < 2"	at surface range from
															3" to 18"
											5.0				Occasional slowing
ss 3"				80		22	37	43			6.0		2	Same	of drilling because
															of cobble/boulder
															zones.
											10.0				
ss 3"				50+		32	50+						3	Same	
											15.0				
ss 3"				50+		50+					16.0		4	Same	
											20.0				
ss 3"				50+*		36	50+				21.0		5	Same	
											25.0				
ss 3"				50 +*		44	50+						6	Same	
											26.5				
											30.0				
ss 3"				50+*		50+							7	Same	
											31.5				
											35.0				
ss 3"				50+*		39	50+						8	Same	
											36.50				
* N value is for a 3" sampler															
											40.0				

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER)

SITE Ocotillo

HOLE NO. B-107

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Ocotillo Energy Project	24268-20C	2 OF 2	B-107

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Ocotillo, California	N2280798;E6464254	90°	

SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE (cm)	LENGTH CORE RUN	SAMPLE RECOVERY	CORE RECOVERY / SAMPLE BLOWS USING 3" SAMPLER	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6 INCHES (15.2 cm)	2ND 6 INCHES (30.4 cm)	3RD 6 INCHES (45.8 cm)	4TH 6 INCHES (60.8 cm)	(FEET) ELEVATION	DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVEL WATER RETURN CHARACTER OF DRILLING
ss 3"				50+*		50+					41.5		9	Very dense, brown, fine to coarse SAND	Rock fragments
											45.0			with rounded rock fragments < 2".	at surface up to
ss 3"				50+*		37	50+						10	Same	18"s.
											46.5				
											50.0				
ss 3"				50+*		28	50+				51.5		11	Same	
											55.0				
ss 3"				50+*		22	50+						12	Same	
											56.5				Drilling slows
											60.0				when encountering
ss 3"				50+*		25	50+				61.5		13	Same	cobbles/boulders
											65.0				
ss 3"				50+*		22	50+						14	Same	
											66.5				
											70.0				
ss 3"				50+*		50+					71.5		15	Same	
											75.0				
ss 3"				50+*		50+							16	Same	
											76.5				
											80.0				
ss 3"				50+*		13	50+				81.5		17	Same	
											85.0				
ss 3"				50+*		50+							18	Same	
											86.5				
											90.0				
ss 3"				50+*		30	50+				91.5		19	Same	
											95.0				
ss 3"				50+*		50+							20	Same	
											96.5				Rods chattering
ss 3"				50+*		50+					100.0				for 2'
											101.0		21	Same	
														Bottom of Boring 101.0	
* N value is for a 3" sampler														This boring consisted of mostly fine to coarse SAND	
														with <2" rounded rock fragments. Occassional larger	
														sized cobbles or boulders were encountered during advance-	
														ment of the boring.	

Sample Type (SS = SPLIT SPOON: ST = SHELBY TUBE D=DENNISON; P=PITCHER; O=OTHER)

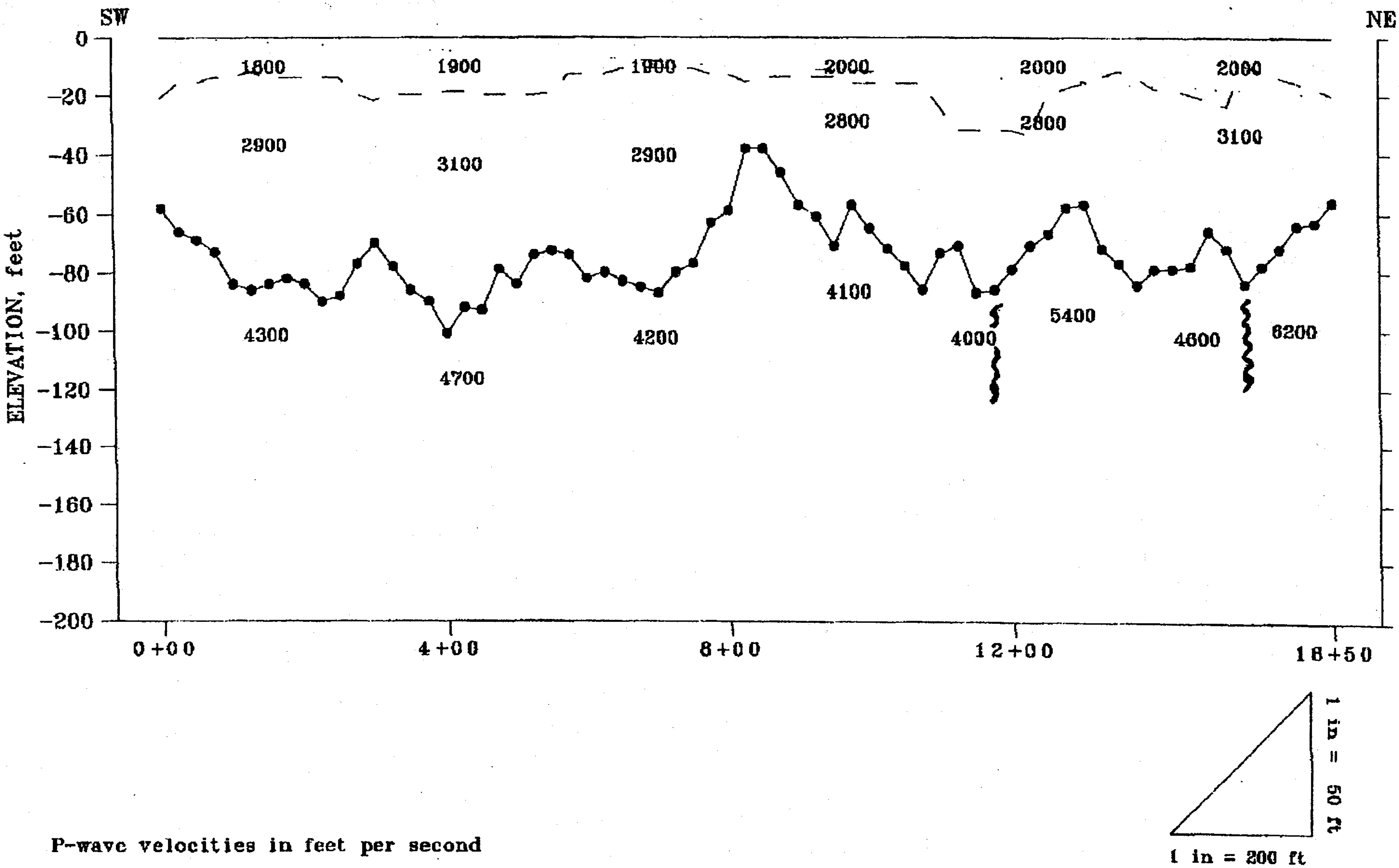
SITE Ocotillo

HOLE NO. B-107

Appendix I

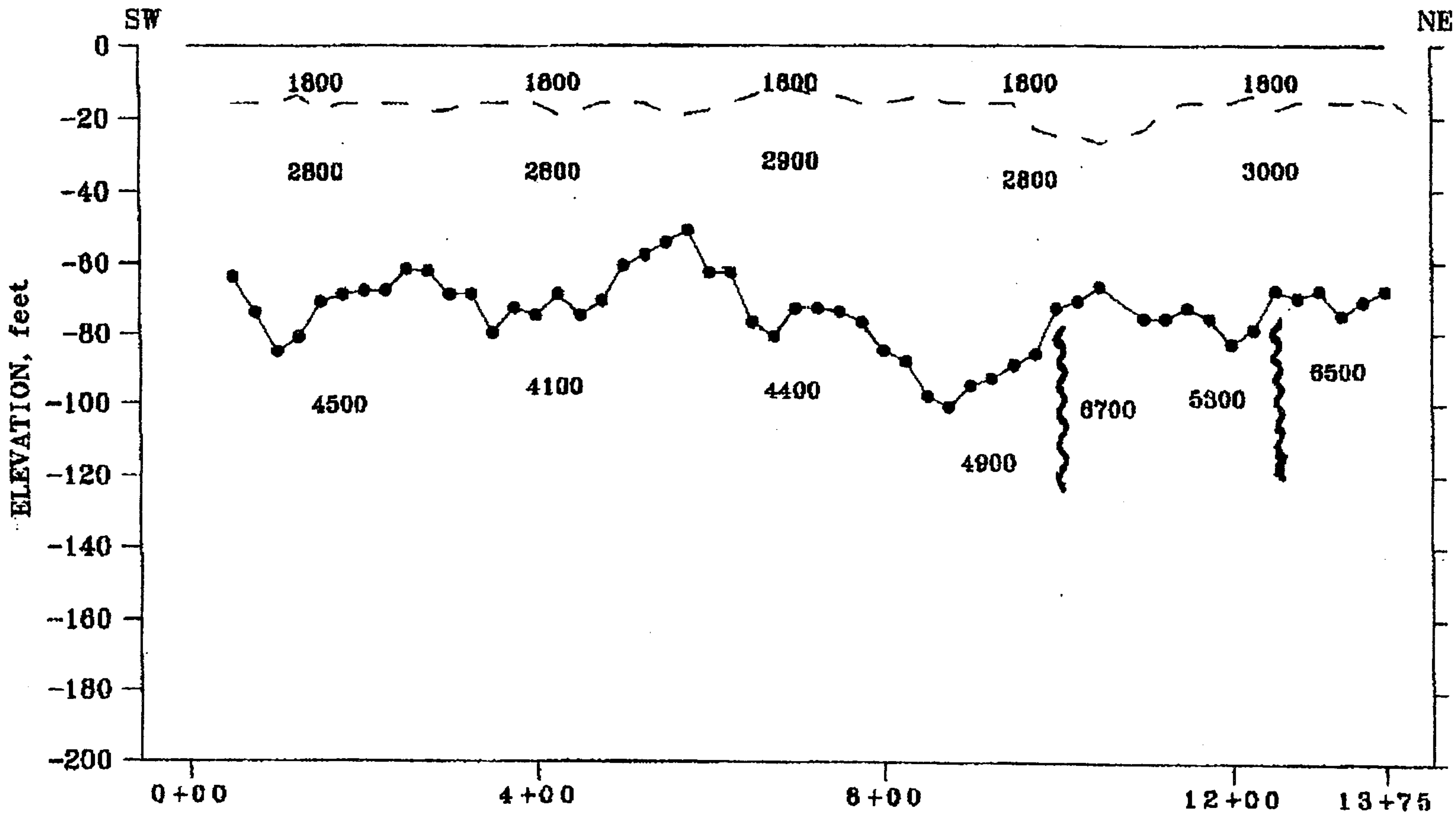
Attachment I-2

Seismic Refraction Survey

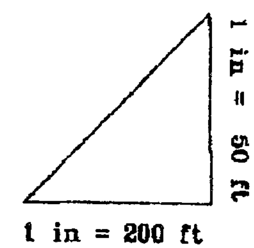


SEISMIC REFRACTION PROFILE RS01-1

Project No.:	Date: 2-16-01	Project: OCOTILLO POWER PLANT	Fig.



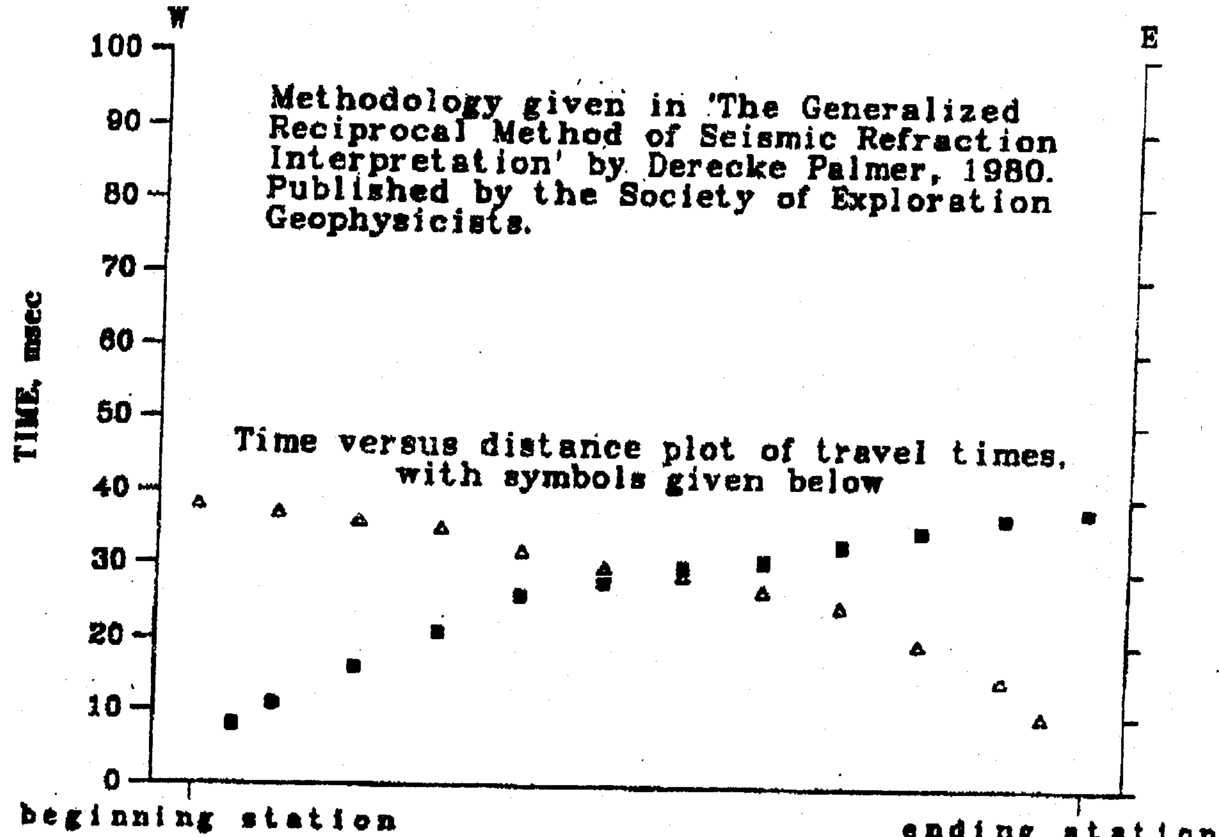
P-wave velocities in feet per second



SEISMIC REFRACTION PROFILE RS01-2

Project No.:	Date: 2-16-01	Project: OCOTILLO POWER PLANT	Fig.

KEY TO SYMBOLS AND NOTATION USED ON SEISMIC REFRACTION DATA SHEETS



Geophone Spacing = Distance between adjacent geophones (ft)

Arrival Time, msec ▲ ■ ● △ □ — Travel times of arrivals from a shot to a geophone, with corresponding symbols (msec)

t_{ab}= Reciprocal time, end-to-end travel time (msec)
XY = Geophone analysis separation distance (ft)
t_a= Travel times of refracted arrivals from end shot (msec)
t_b= Travel times of refracted arrivals from reversed shot (msec)
$\frac{1}{2}\Delta t$= Velocity analysis function, plotted above travel times on time-distance plot (msec)
t_g= Time depth, $(t_a+t_b-t_{ab})/2$ (msec)
t_e= Delay times due to thin surface layer ($\frac{1}{2}$ time intercept at shotpoints) with z_e depth and v_e velocity (msec)

---

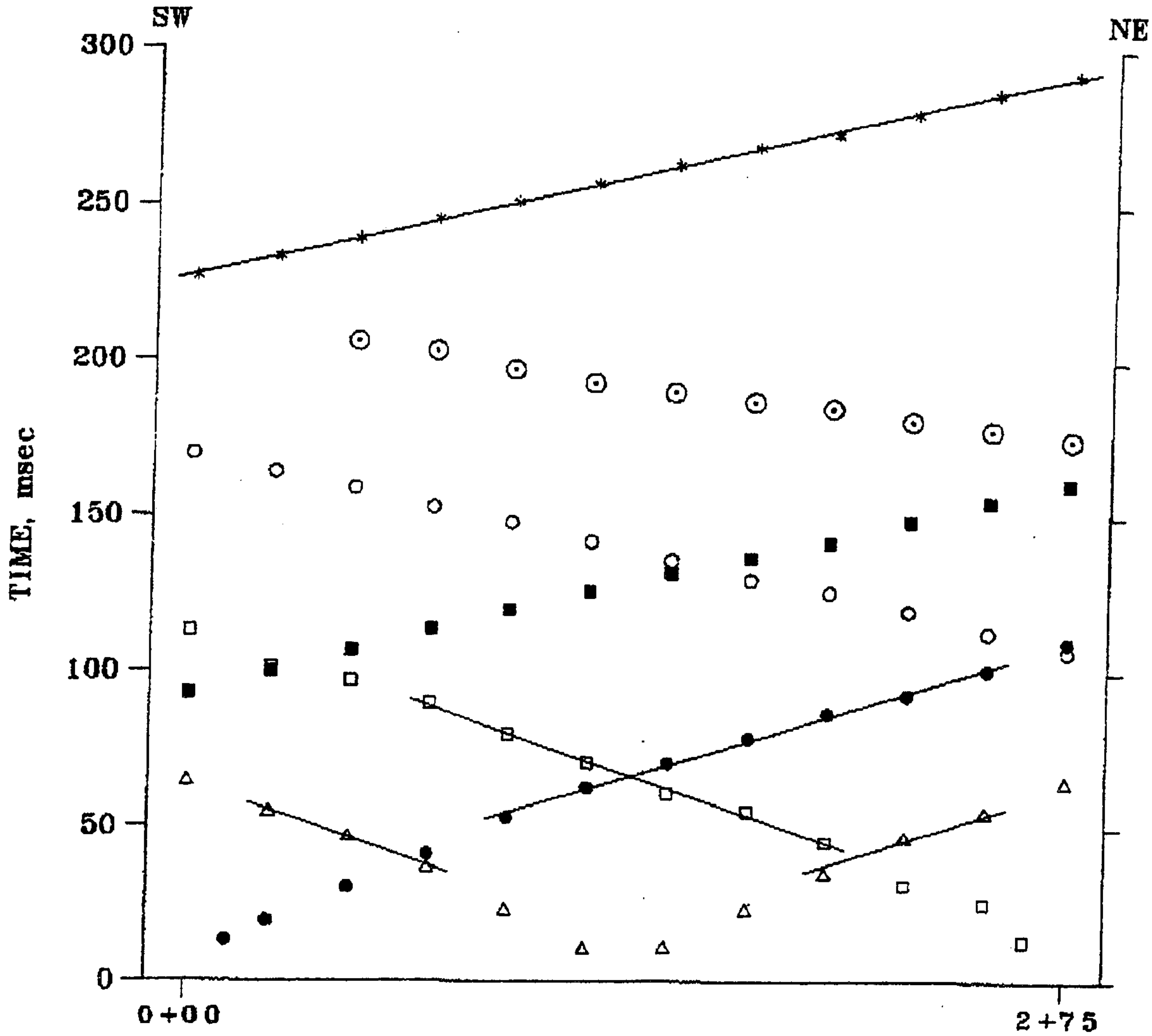
z_i= z_{i+1}= Calculated depth to the i^{th} layer, assumed normal to the surface, (t_g-t_e) x Velocity Function (ft)

v_i= v_{i+1}= v_{i+2}= Velocity of the i^{th} layer from the Velocity Function or the inverse slope of the raw data (ft/sec)

(i) values inferred from other data (see text)

[Line Number]

Project No.:	Date:	Project:	Fig.



Geophone spacing = 25 ft

Arrival Time, msec												
▲												
■	93	100	107	114	120	126	132	137	142	149	155	161
●	13	19	30	41	53	63	71	79	87	93	101	110
△	65	55	47	37	23	11	11	23	35	47	55	65
□	113	101	97	90	80	71	61	55	45	31	25	13
○	170	164	159	153	148	142	136	130	126	120	113	107
⊙			206	203	197	193	190	187	185	181	178	175

t_{ab} = 111 msec; XY = 0

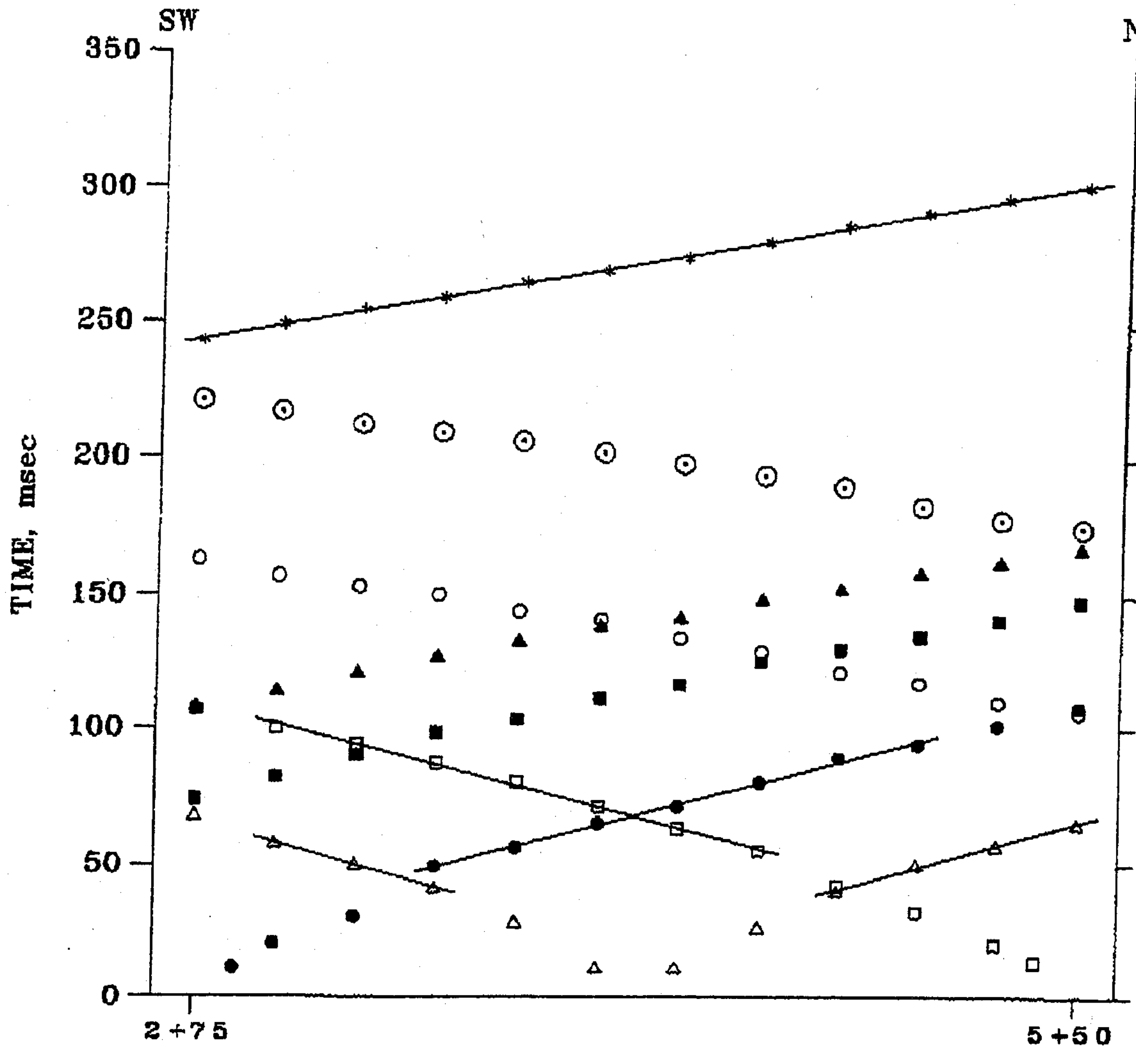
t_a=	42	49	56	63	69	75	81	86	91	98	104	110
t_b=	113	107	102	96	91	85	79	73	69	63	56	50
* ½Δt=	−35½	−29	−23	−16½	−11	−5	1	6½	11	17½	24	30
t_g=	22	22½	23½	24	24½	24½	24½	24	24½	25	24½	24½
t_c=	12	9	9	8	8	7	8	8	8	8	8	9

z_0=	22	16	16	14	14	13	14	14	14	14	14	16	ft
z_1=	58	66	69	74	84	87	84	82	84	91	88	86	ft

v_0= 1800 fps
v_1= 3180 2780 3000 2820 fps
v_2= 4260 fps

RS01-1

Project No.:	Date: 2-16-01	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

Arrival Time, msec												
▲	108	114	121	127	133	139	142	149	153	159	163	168
■	74	82	90	98	103	111	116	125	130	135	141	148
●	11	20	30	49	56	65	71	80	89	94	101	108
△	68	58	50	41	28	11	11	26	40	50	57	65
□	107	100	94	87	80	71	63	55	42	32	20	13
○	163	157	153	150	144	141	134	129	121	117	110	106
⊙	221	217	212	209	206	202	198	194	190	183	178	175

t_{ab} = 108 msec; XY = 0

t_a=	48	54	61	67	73	79	82	89	93	99	103	108
t_b=	107	101	97	94	88	85	78	73	65	61	54	50
* ½Δt=	−29½	−23½	−18	−13½	−7½	−3	2	8	14	19	24½	29
t_g=	23½	23½	25	26½	26½	28	26	27	25	26	24½	25
t_c=	13	12	11	11	11	10	10	11	11	11	11	13
z_0=	25	23	21	21	21	19	19	21	21	21	21	25 ft
z_1=	68	71	79	87	91	101	92	94	80	84	75	73 ft

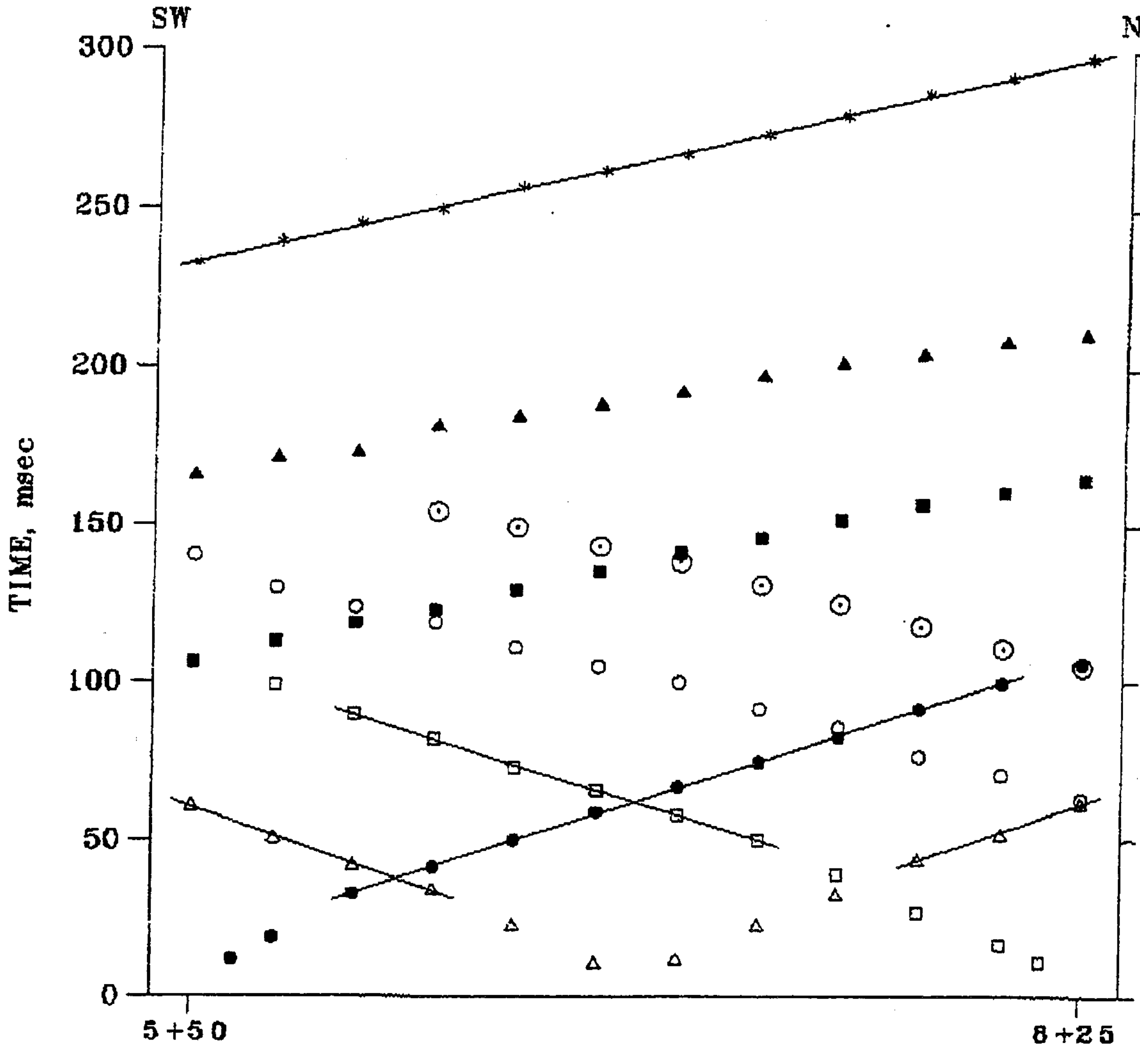
v_0= 1900 fps

v_1= 3240 2940 3050 3290 fps

v_2= 4690 fps

RS01-1

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

Arrival Time, msec												
▲	166	172	174	182	185	189	193	198	202	205	209	211
■	106	113	119	123	129	135	141	146	152	157	161	165
●	12	19	33	41	50	59	67	75	83	92	100	106
△	61	51	42	34	23	11	12	23	33	44	52	62
□	106	99	90	82	73	66	58	50	39	27	17	11
○	140	130	124	119	111	105	100	92	86	77	71	63
⊙				154	149	143	138	131	125	118	111	105

t_{ab}= 106 msec; XY = 0

t_a=	47	54	60	64	70	76	82	87	93	98	102	106
t_b=	106	99	93	88	80	75	70	62	56	47	41	33
* $\frac{1}{2}\Delta t$=	−29½	−22½	−16½	−12	−5	0½	6	12½	18½	25½	30½	36½
t_g=	23½	23½	23½	23	22	22½	23	21½	21½	19½	18½	16½
t_c=	8	7	7	7	6	6	6	6	6	7	7	9

z_0=	15	13	13	13	11	11	11	11	11	13	13	17	ft
z_1=	73	75	83	81	83	85	88	81	77	63	59	45	ft

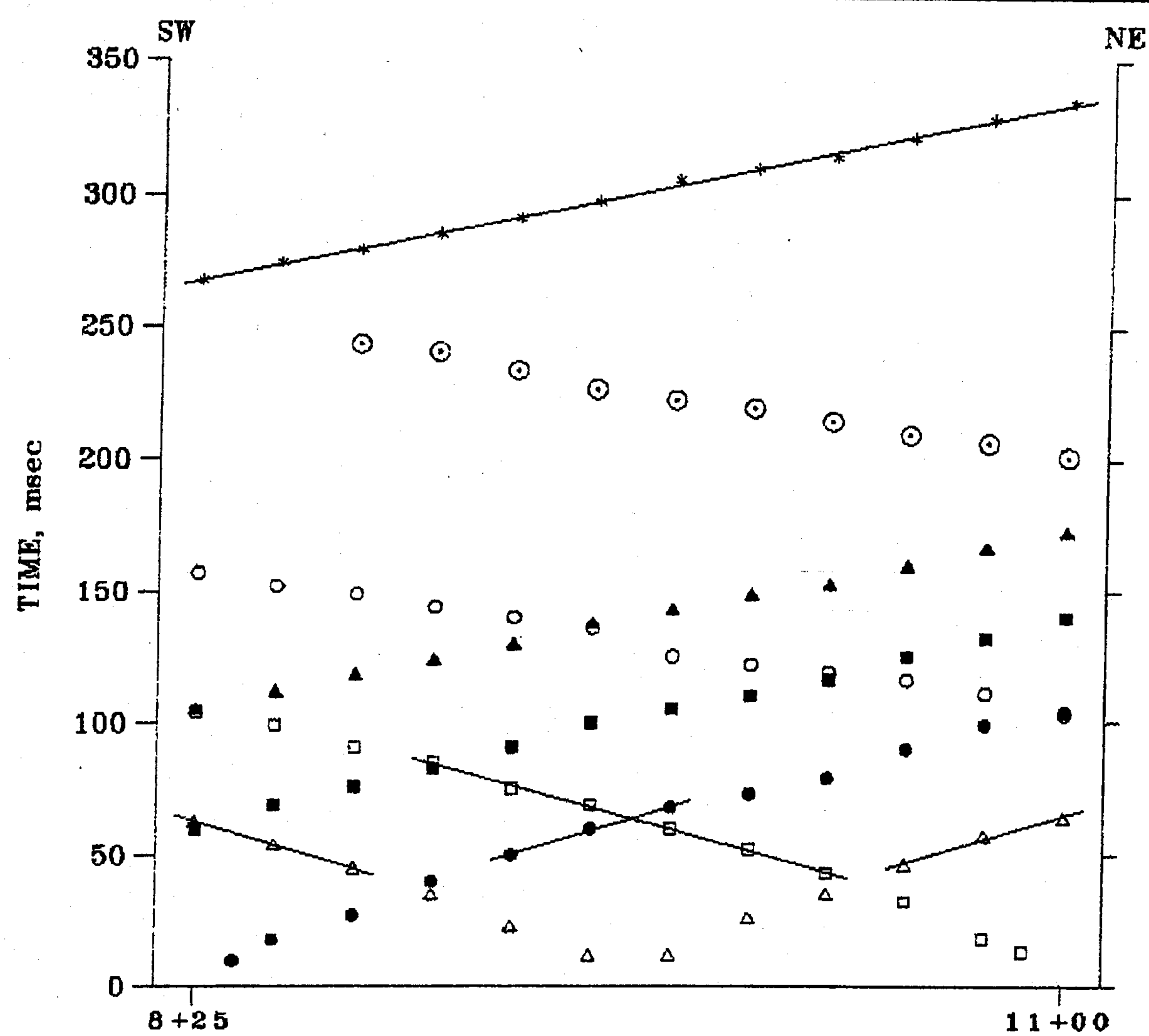
v_0= 1900 fps

v_1= 2980 2780 2780 3140 fps

v_2= 4190 fps

RS01-1

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

Arrival Time, msec

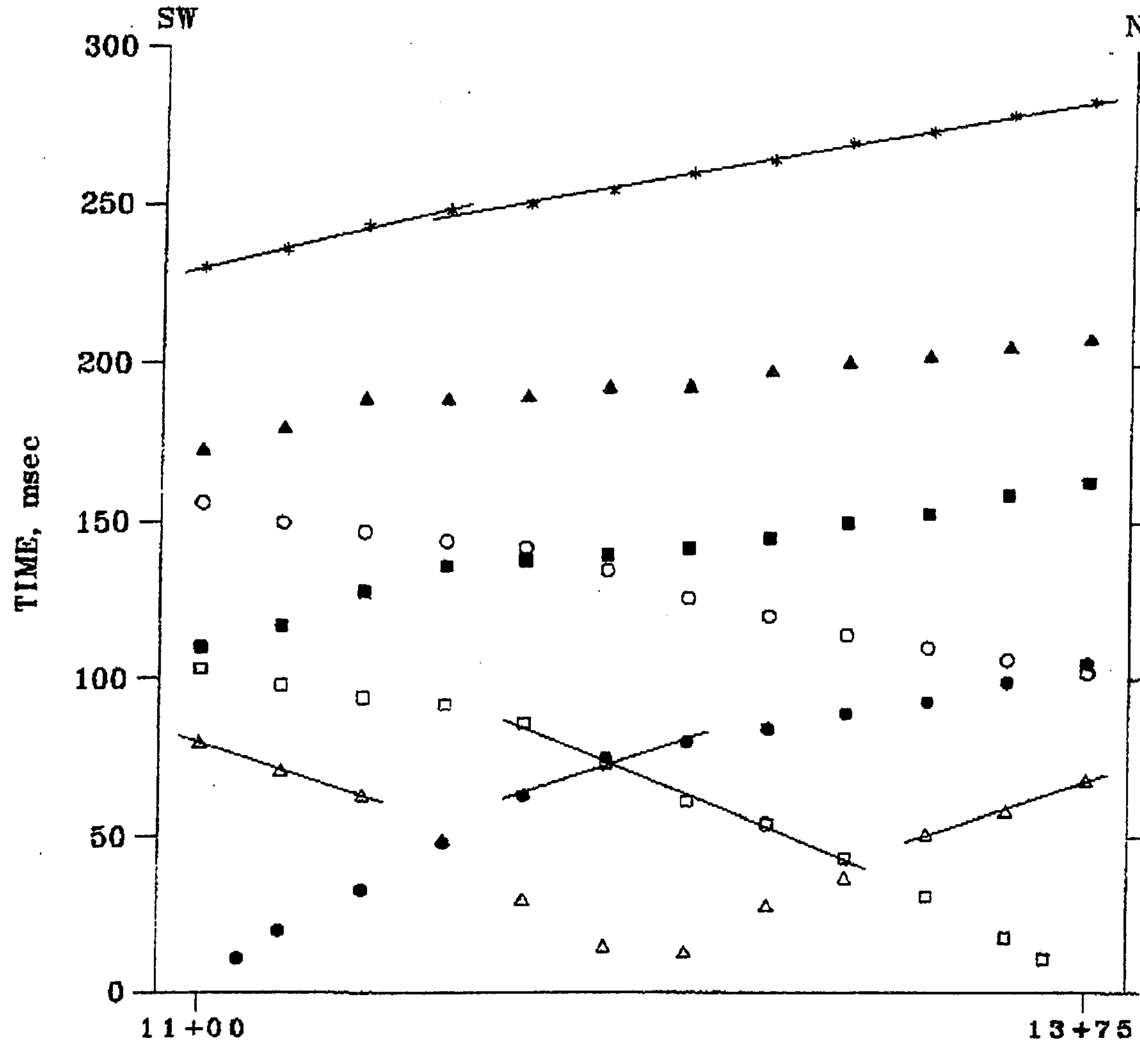
▲	105	112	118	124	130	138	143	149	153	160	167	173
■	60	69	76	83	91	100	105	110	116	125	132	140
●	10	18	27	40	50	60	68	73	79	90	99	104
△	63	54	45	35	23	12	12	26	35	46	57	64
□	104	99	91	85	75	69	60	52	43	32	18	13
○	157	152	149	144	140	136	125	122	119	116	111	103
⊙			243	240	233	226	222	219	214	209	206	201

t_{ab} = 104 msec; XY = 0

t_a =	23	32	39	46	54	63	68	73	79	90	99	104	
t_b =	104	99	96	91	87	83	72	69	66	63	58	50	
* ½Δt =	-40½	-33½	-28½	-22½	-16½	-10	-2	2	6½	13½	20½	27	
t_g =	11½	13½	15½	16½	18½	21	18	19	20½	24½	26½	25	
t_c =	7	7	7	7	7	7	8	8	8	8	8	9	
z_0 =	14	14	14	14	14	14	16	16	16	16	16	18	ft
z_1 =	31	38	46	57	61	71	57	65	72	78	86	78	ft
v_0 =						2000							fps
v_1 =		2780			2780			2780			3040		fps
v_2 =						4130							fps

RS01-1

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

Arrival Time, msec

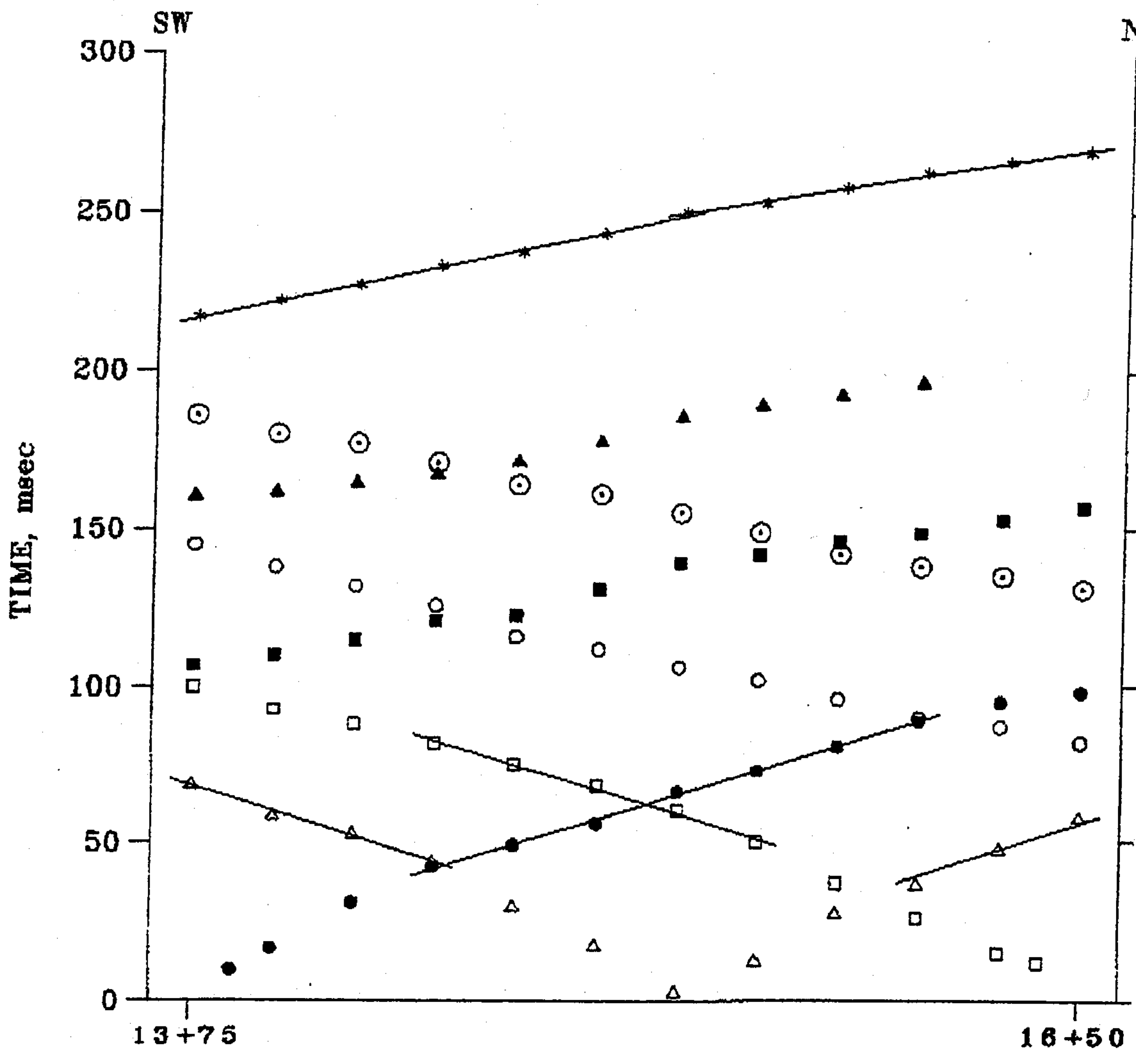
▲	173	180	189	189	190	193	193	198	201	203	206	209
■	110	117	128	136	138	140	142	145	150	153	159	163
●	11	20	33	48	63	75	80	84	89	93	99	105
△	80	71	63	49	30	15	13	28	37	51	58	68
□	103	98	94	92	86	73	61	54	43	31	18	11
○	156	150	147	144	142	135	126	120	114	110	106	102
⊙												

t_{ab}= 104 msec; XY = 0

t_a=	49	56	67	75	77	79	81	84	89	93	99	105	
t_b=	103	98	94	92	90	83	74	68	62	58	54	50	
* ½Δt=	-27	-21	-13½	-8½	-6½	-2	3½	8	13½	17½	22½	27½	
t_g=	24	25	28½	31½	31½	29	25½	24	23½	23½	24½	25½	
t_c=	15	16	16	16	16	17	10	9	8	7	6	5	
z_0=	30	32	32	32	32	34	20	18	16	14	12	10	ft
z_1=	69	71	87	86	79	71	67	58	57	72	77	82	ft
v_0=						2000							fps
v_1=		2940			2940			2940		2380			fps
v_2=				3970				5360					fps

RS01-1

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

Arrival Time, msec

▲	161	162	165	168	172	178	186	190	193	197		
■	107	110	115	121	123	131	139	142	146	149	153	157
●	10	17	31	42	49	56	66	73	81	89	95	98
△	69	59	53	44	30	18	3	13	28	37	48	58
□	100	93	88	82	75	68	60	50	37	26	15	12
○	145	138	132	126	116	112	106	102	96	90	87	82
⊙	186	180	177	171	164	161	155	149	142	138	135	131

t_{ab}= 99 msec; XY = 0

t_a=	50	53	58	64	66	74	82	85	89	92	96	98	
t_b=	100	93	88	82	75	71	65	62	56	50	47	42	
* $\frac{1}{2}\Delta t$=	-25	-20	-15	-9	-4½	1½	8½	11½	16½	21	24½	28	
t_g=	25½	23½	23½	23½	21	23	24	24	23	21½	22	20½	
t_c=	9	9	9	10	11	12	5	6	7	8	9	10	
z_0=	18	18	18	20	22	24	10	12	14	16	18	20	ft
z_1=	87	79	79	78	66	72	84	78	72	64	63	56	ft

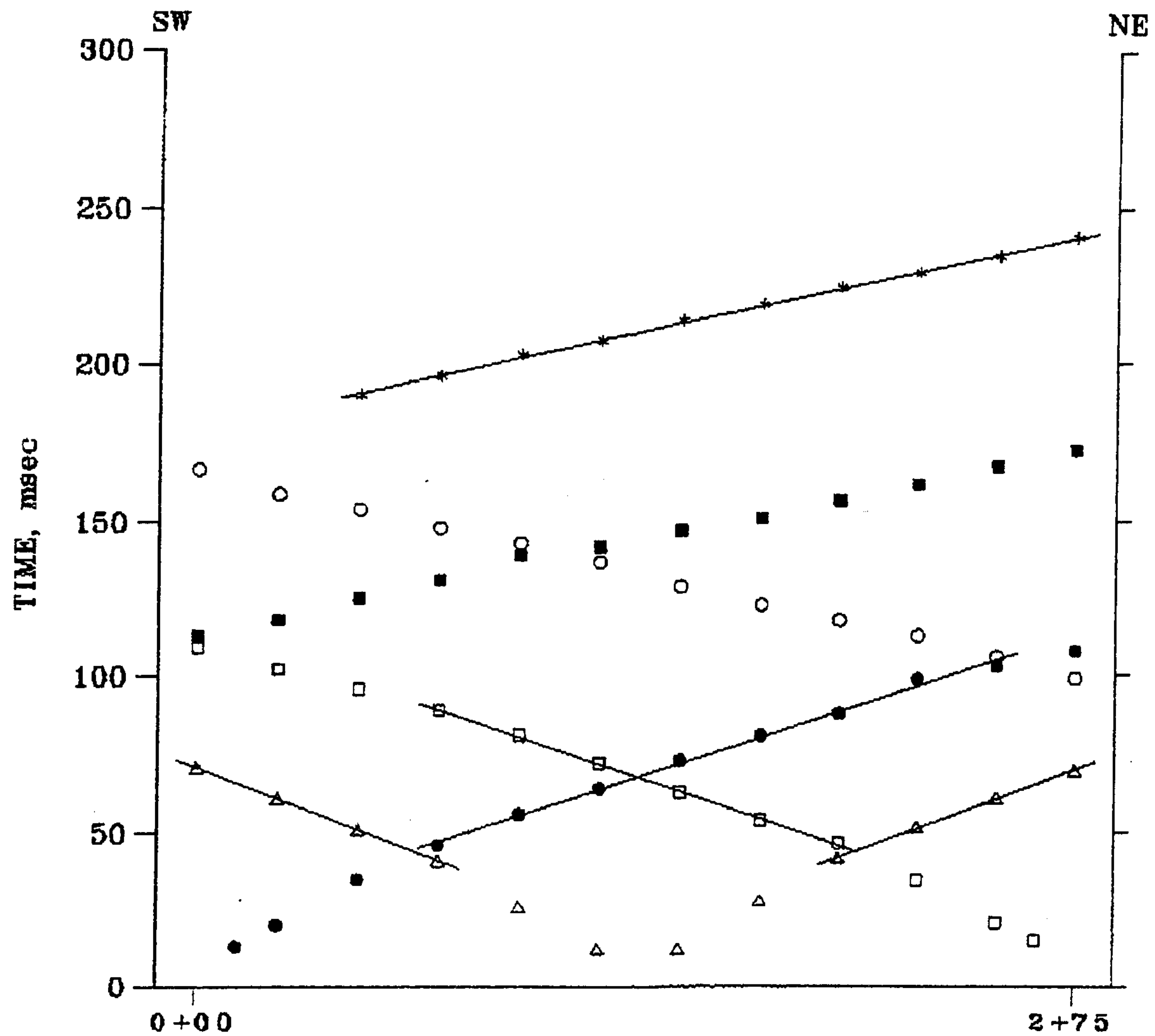
v_0= 2000 fps

v_1= 3150 3090 3000 3160 fps

v_2= 4550 6210 fps

RS01-1

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

Arrival Time, msec												
▲												
■	113	118	125	131	139	142	147	151	157	162	168	173
●	13	20	35	46	56	64	73	81	88	99	103	108
△	71	61	51	41	26	12	12	28	42	52	61	70
□	109	102	96	89	81	72	63	54	47	35	21	15
○	167	159	154	148	143	137	129	123	118	113	106	99
⊙												

t_{ab} = 108 msec; XY = 0

t_a=			62	68	76	79	84	88	94	99	103	108	
t_b=	109	102	96	90	85	79	71	65	60	55	48	41	
* $\frac{1}{2}\Delta t$=			−17	−11	−4½	0	6½	11½	17	22	27½	33½	
t_g=			25	25	26½	25	23½	22½	23	23	21½	20½	
t_c=	11	9	9	9	9	8	10	9	9	9	9	10	
z_0=			16	16	16	14	18	16	16	16	16	18	ft
z_1=			64	74	85	82	71	70	69	68	62	53	ft

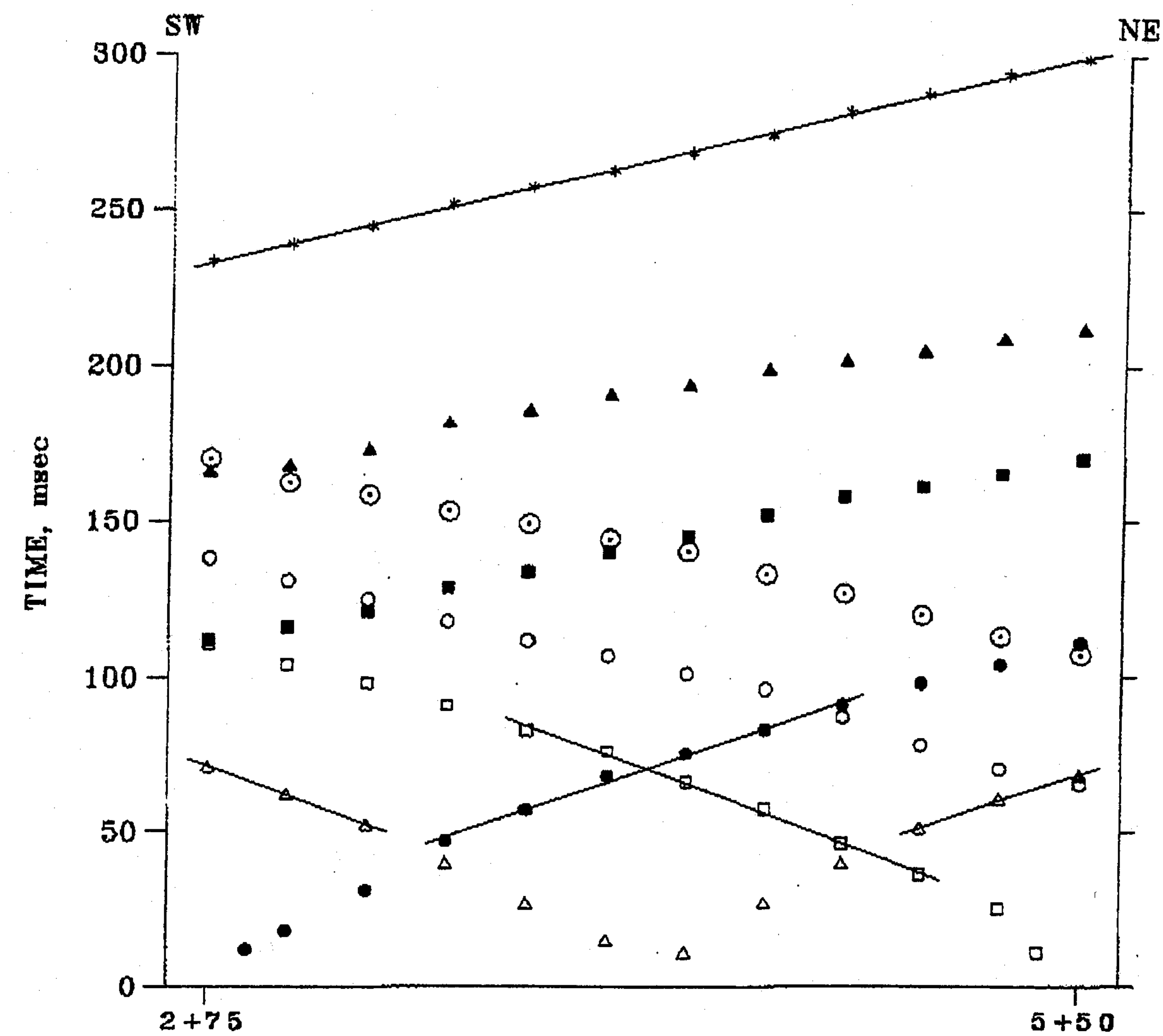
v_0= 1800 fps

v_1= 3030 2500 2690 2920 fps

v_2= 4520 fps

RS01-2

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

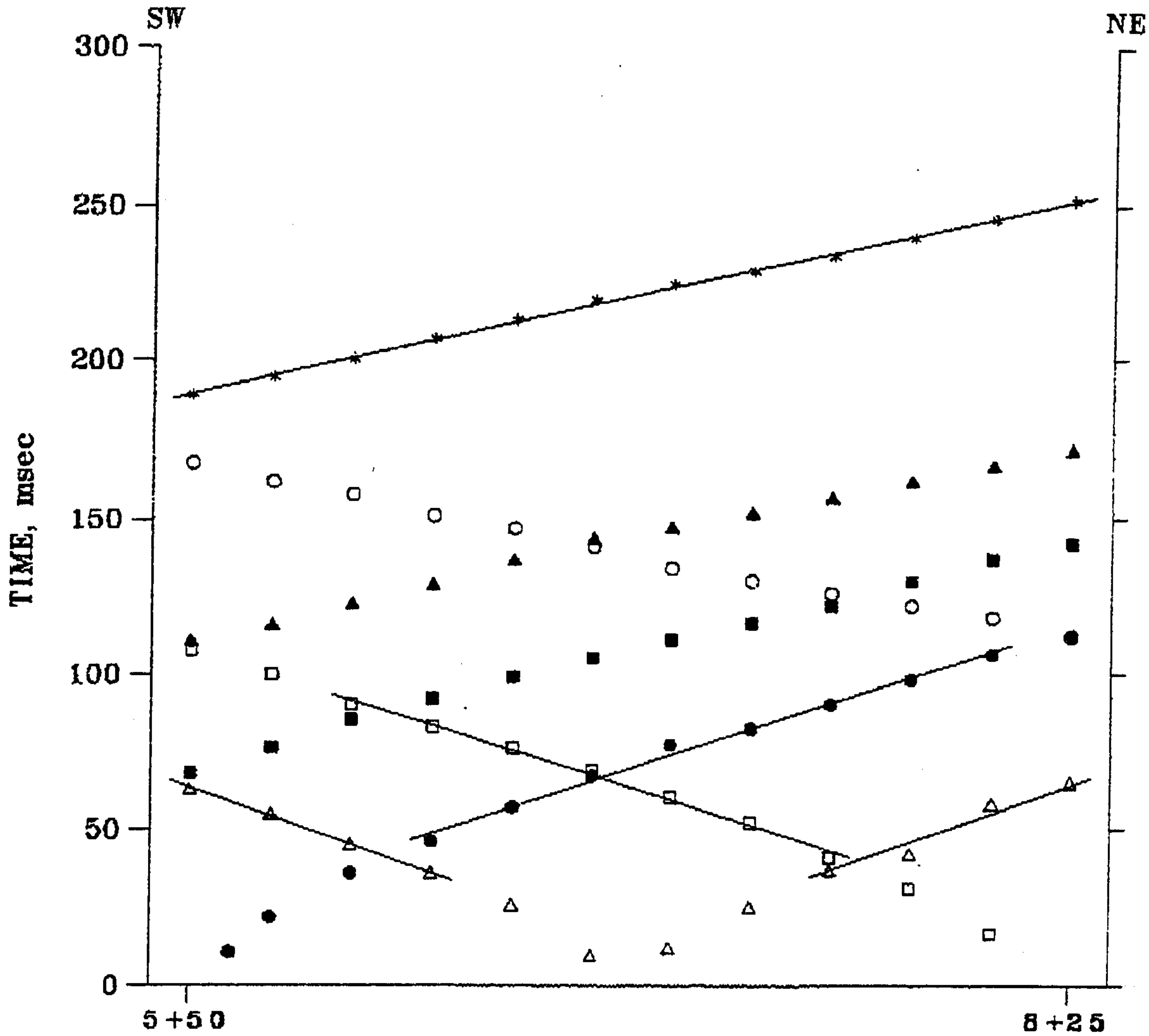
Arrival Time, msec												
▲	166	168	173	182	186	191	194	199	202	205	209	212
■	112	116	121	129	134	140	145	152	158	161	165	170
●	12	18	31	47	57	68	75	83	91	98	104	111
△	71	62	52	40	27	15	11	27	40	51	60	68
□	111	104	98	91	83	76	66	57	46	36	25	11
○	138	131	125	118	112	107	101	96	87	78	70	65
⊙	170	162	158	153	149	144	140	133	127	120	113	107

t_{ab} = 111 msec; XY = 0

t_a=	53	57	62	70	75	81	86	93	99	102	106	111	
t_b=	111	104	98	91	85	80	74	69	60	51	43	38	
* ½Δt=	-29	-23½	-18	-10½	-5	0½	6	12	19½	25½	31½	36½	
t_g=	26½	25	24½	25	24½	25	24½	25½	24	21	19	19	
t_c=	11	10	9	9	9	9	11	10	9	9	9	9	
z_0=	20	18	16	16	16	16	20	18	16	16	16	16	ft
z_1=	73	69	69	80	73	75	69	75	71	61	58	58	ft
v_0=						1800							fps
v_1=		2870			2630			2940			2620		fps
v_2=						4140							fps

RS01-2

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

Arrival Time, msec												
▲	111	116	123	129	137	144	147	152	157	162	167	172
■	68	76	85	92	99	105	111	116	122	130	137	142
●	11	22	36	46	57	67	77	82	90	98	106	112
△	63	55	45	36	26	10	12	25	37	42	58	65
□	108	100	90	83	76	69	60	52	41	31	17	
○	168	162	158	151	147	141	134	130	126	122	118	112
⊙												

t_{ab} = 110 msec; XY = 0

t_a=	43	48	55	61	69	76	79	84	90	98	106	112	
t_b=	108	102	98	91	87	81	74	70	66	62	58	52	
* $\frac{1}{2}\Delta t$=	−32½	−27	−21½	−15	−9	−2½	2½	7	12	18	24	30	
t_g=	20½	20	21½	21	23	23½	21½	22	23	25	27	27	
t_c=	12	11	10	9	8	7	7	8	8	9	9	10	
z_0=	22	20	18	16	14	13	13	14	14	16	16	18	ft
z_1=	51	51	63	64	78	82	74	73	74	77	85	79	ft

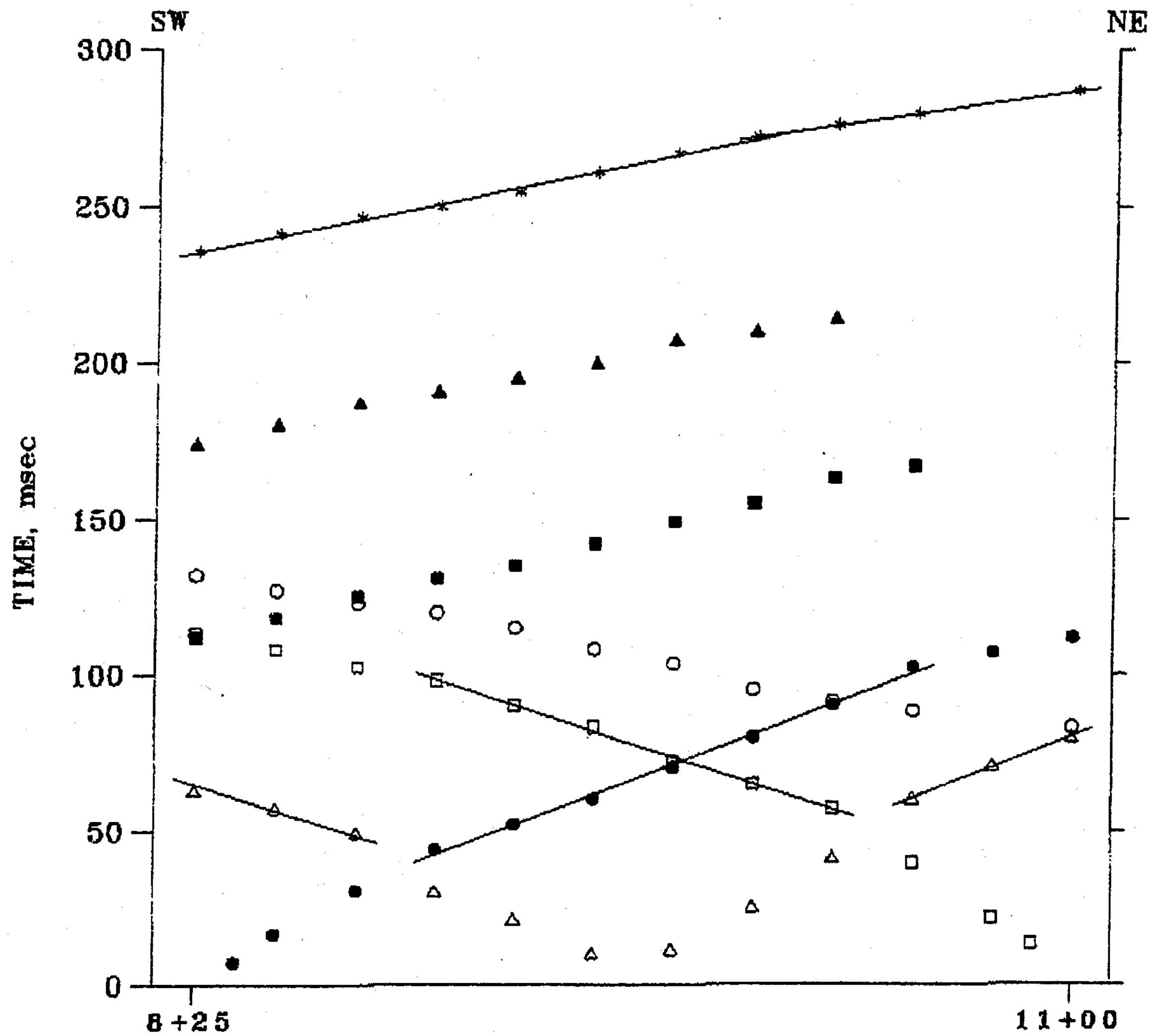
v_0= 1800 fps

v_1= 3000 2750 2800 3110 fps

v_2= 4440 fps

RS01-2

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

Arrival Time, msec

▲	174	180	187	191	195	200	207	210	214			
■	112	118	125	131	135	142	149	155	163	167		
●	7	16	30	44	52	60	70	80	90	102	107	112
△	63	57	49	30	21	10	11	25	41	60	71	80
□	113	108	102	98	90	83	72	65	57	39	21	13
○	132	127	123	120	115	108	103	95	91	88		83
⊙												

t_{ab}= 112 msec; XY = 0

t_a=	58	64	71	75	79	84	91	94	98	102	107	112
t_b=	113	108	104	101	96	89	84	76	72	69		64
* ½Δt=	-27½	-22	-16½	-13	-8½	-2½	3½	9	13	16½		24
t_g=	29½	30	31½	32	31½	30½	31½	29	29	29½		32
t_c=	7	8	9	9	9	9	13	14	14	15	15	16

z_0=	13	14	16	16	16	16	23	25	25	27		29	ft
z_1=	98	98	102	95	93	90	87	73	71	67		72	ft

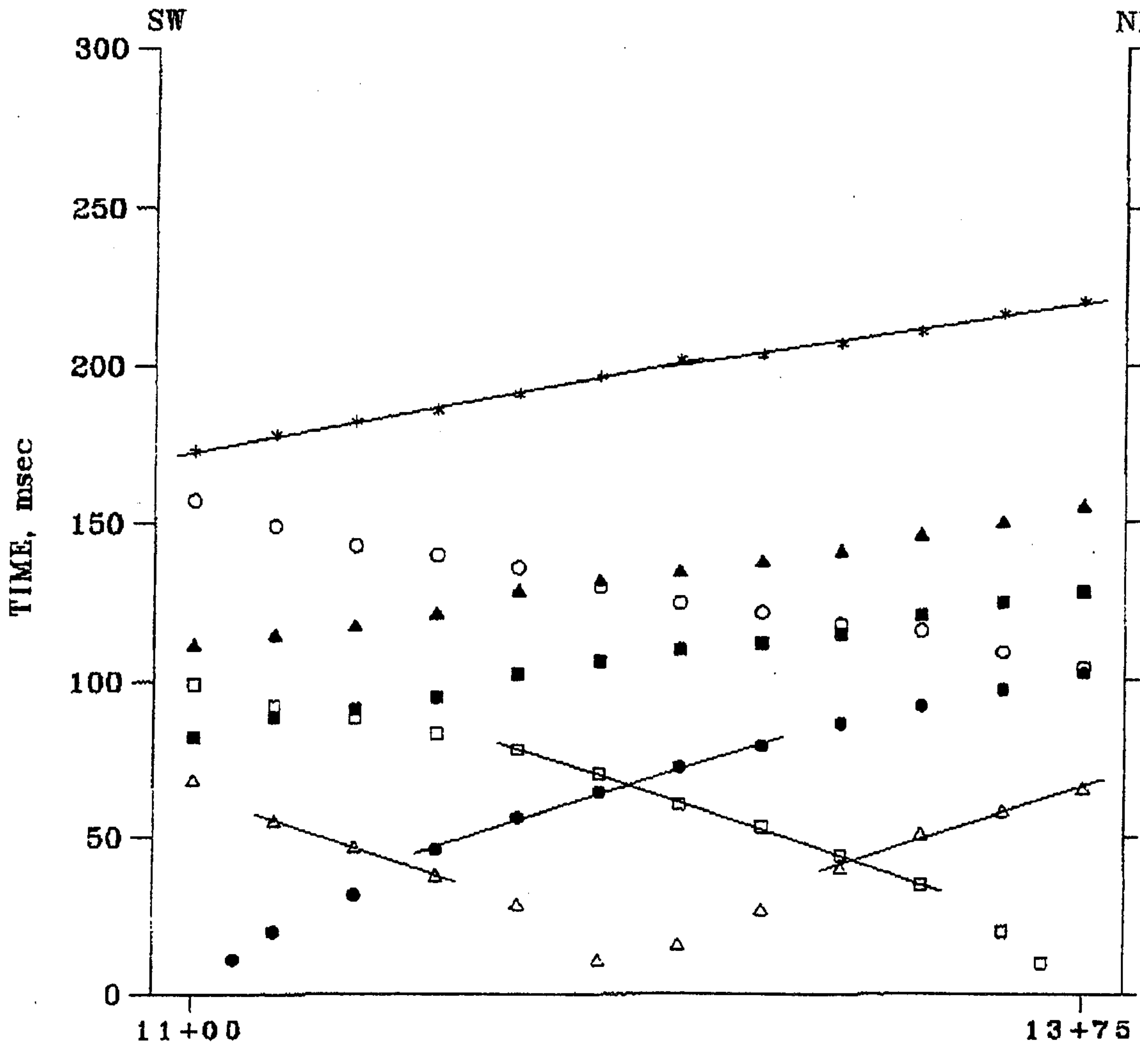
v_0= 1800 fps

v_1= 2590 3000 2500 3010 fps

v_2= 4890 6700 fps

RS01-2

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.



Geophone spacing = 25 ft

Arrival Time, msec

▲	112	115	118	122	129	132	135	138	141	146	150	155
■	82	88	91	95	102	106	110	112	115	121	125	128
●	11	20	32	46	56	64	72	79	86	92	97	102
△	68	55	47	38	29	11	16	27	40	51	58	65
□	99	92	86	83	78	70	60	53	44	35	20	10
○	157	149	143	140	136	130	125	122	118	116	109	104
⊙												

t_{ab}= 101 msec; XY = 0

	t_a=	59	62	65	69	76	80	84	86	89	95	99	102
	t_b=	99	92	86	83	80	73	66	65	61	59	52	47
*	½Δt=	-20	-15	-10½	-7	-2	3½	9	10½	14	18	23½	27½
	t_g=	28½	26½	25	25½	27½	26	24½	25	24½	26½	25	24
	t_c=	11	10	9	9	9	8	10	9	9	9	9	9

z_0=	20	18	16	16	16	14	18	16	16	16	16	16	ft
z_1=	82	76	73	76	83	80	68	70	68	75	72	68	ft

v_0= 1800 fps

v_1= 3050 2940 3050 2920 fps

v_2= 5280 6460 fps

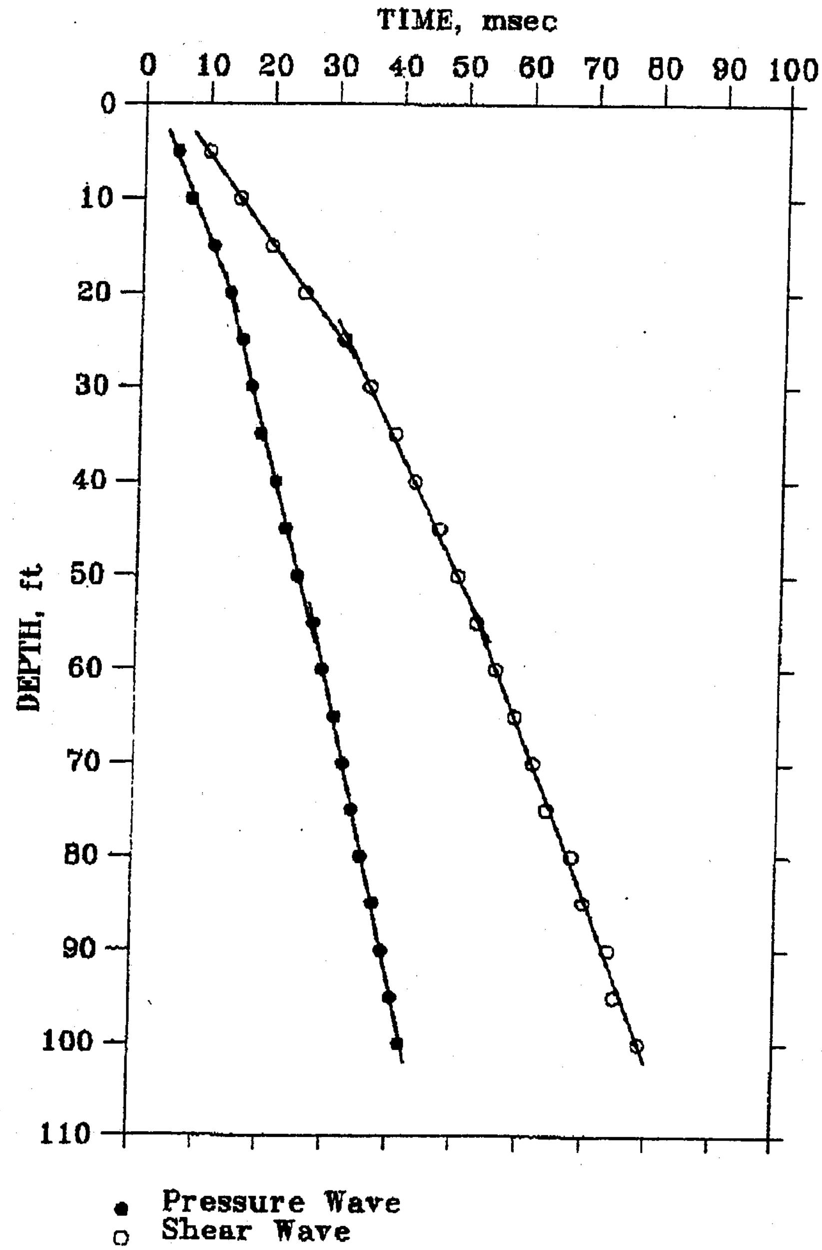
RS01-2

Project No.:	Date:	Project: OCOTILLO POWER PLANT	Fig.

Appendix I

Attachment I-3

Downhole Seismic Measurements



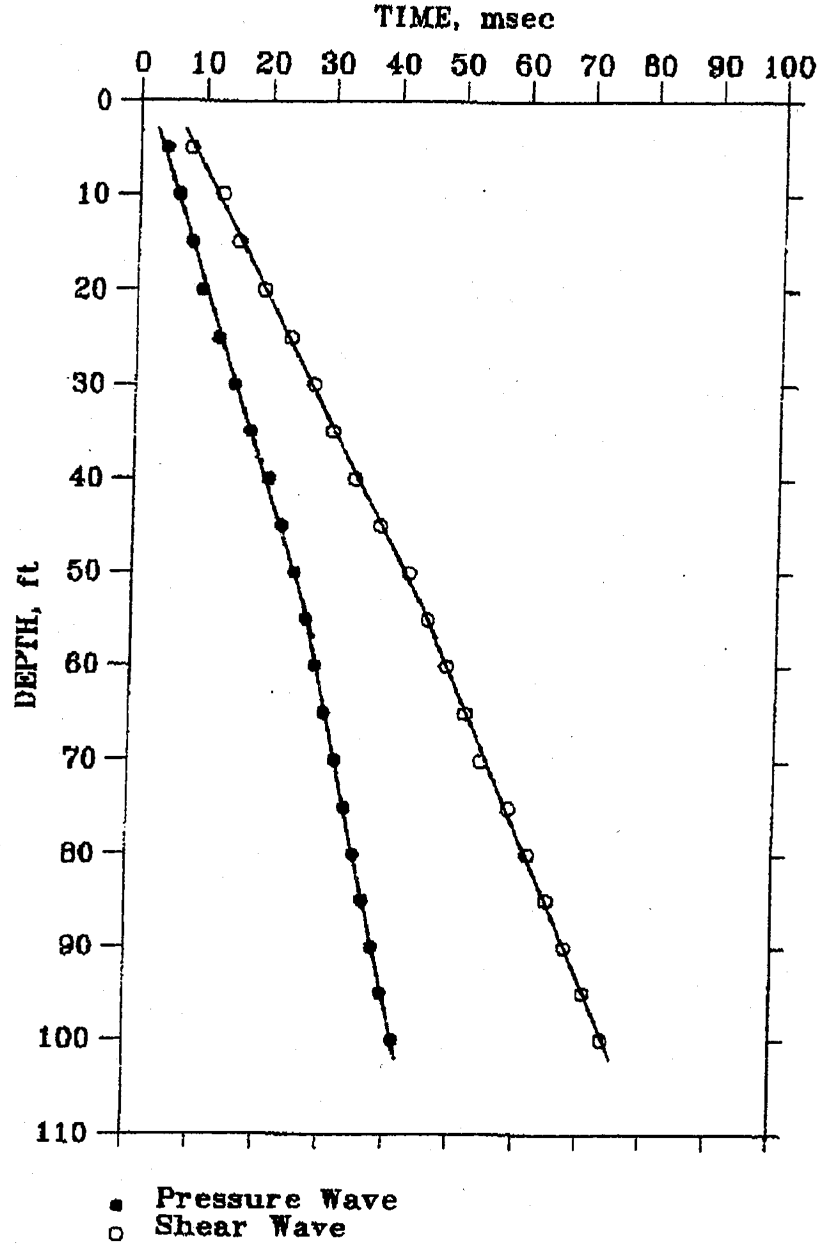
z	P	S
5.0	7.0	14.0
10.0	8.0	16.5
15.0	11.5	21.0
20.0	14.0	26.0
25.0	16.0	32.0
30.0	17.5	36.0
35.0	19.0	40.0
40.0	21.5	43.0
45.0	23.0	47.0
50.0	25.0	50.0
55.0	27.5	53.0
60.0	29.0	56.0
65.0	31.0	59.0
70.0	32.5	62.0
75.0	34.0	64.0
80.0	35.5	68.0
85.0	37.5	70.0
90.0	39.0	74.0
95.0	40.5	75.0
100.0	42.0	79.0

Source Offset = 5.0 ft

Depth (ft): $V_{P\text{-WAVE}}$ (fps):	5- 20 1690	20- 55 2590	55-100 3070			
Depth (ft): $V_{S\text{-WAVE}}$ (fps):	5- 25 940	25- 55 1400	55-100 1750			

B-101

Project No.:	Date: 3-2-01	Project: OCOTILLO POWER PLANT	Fig.



z	P	S
5.0	7.0	13.5
10.0	7.5	15.5
15.0	9.0	17.0
20.0	10.5	20.5
25.0	13.0	24.5
30.0	15.5	28.0
35.0	18.0	31.0
40.0	21.0	34.5
45.0	23.0	38.5
50.0	25.0	43.0
55.0	27.0	46.0
60.0	28.5	49.0
65.0	30.0	52.0
70.0	32.0	54.5
75.0	33.5	59.0
80.0	35.0	62.0
85.0	36.5	65.0
90.0	38.0	68.0
95.0	39.5	71.0
100.0	41.5	74.0

Source Offset = 7.0 ft

Depth (ft): $V_{P\text{-WAVE}}$ (fps):	5- 55 2130	55-100 3120				
Depth (ft): $V_{S\text{-WAVE}}$ (fps):	5- 55 1330	55-100 1580				

B-103

Project No.:	Date: 3-2-01	Project: OCOTILLO POWER PLANT	Fig.

Appendix I

Attachment I-4

Field Electrical Resistivity Survey

RESISTIVITY SURVEY LOG

DATE: 3-2-01 **LOCATION:** R-1, North-South **BY:** RLM

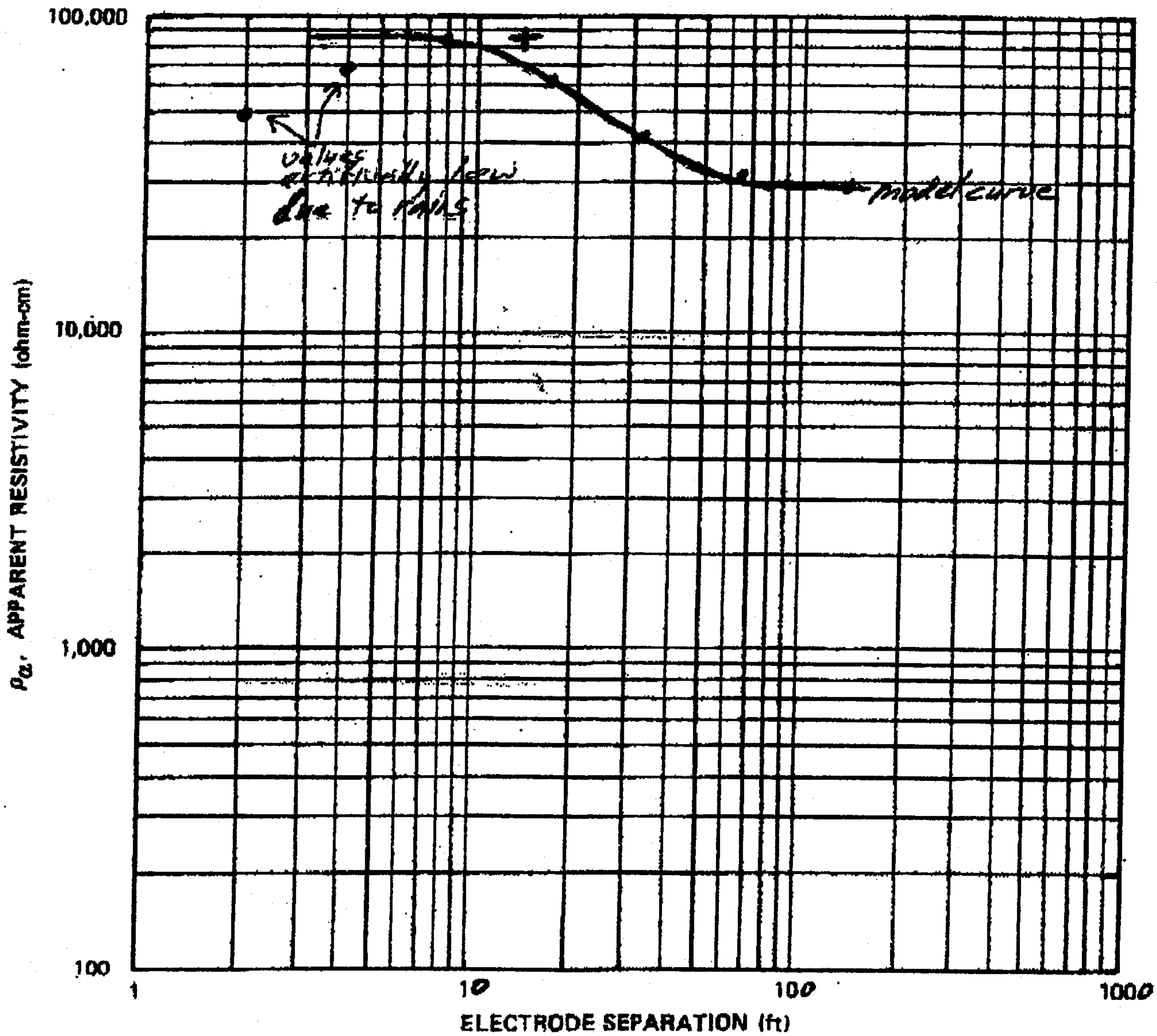
Surface Soils Type and Moisture: Moist, Sandy, Recent Rains affecting surface values

Four Electrode Method: C_1 P_1 P_2 C_2 (← a → ← a → ← a →)

$\rho_a = 191.5\ aR$

a = spacing (ft) R = reading (ohms) ρ_a = Apparent Resistivity (ohm-cm)

a:	2	4	8	16	32	64	128
R:	129	87	55	20	6.7	2.6	1.2
ρ_a:	49k	67k	84k	61k	41k	32k	29k



Project: Project No.	RESISTIVITY MEASUREMENT: R-1	Fig.

RESISTIVITY SURVEY LOG
(B-103)

DATE: 3-2-01 LOCATION: R-2, East-West BY: RCM

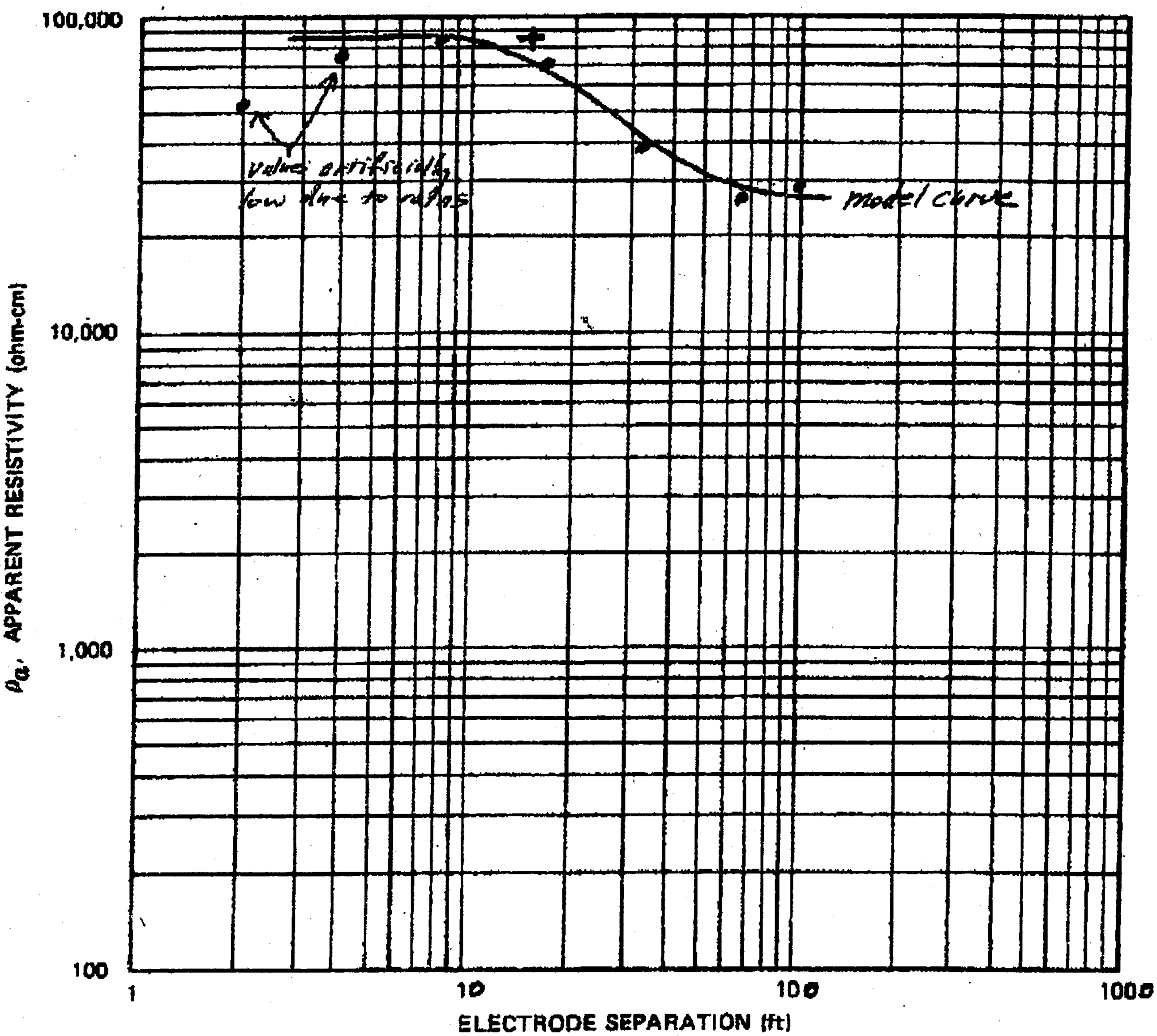
Surface Soils Type and Moisture: Moist, sandy, recent rains affect upper values

Four Electrode Method: C_1 P_1 P_2 C_2 (spacing a – a – a)

ρ_a = 191.5 aR

a = spacing (ft) R = reading (ohms) ρ_a = Apparent Resistivity (ohm-cm)

a:	2	4	8	16	32	64	100
R:	136	98	55	23	6.1	2.1	1.9
ρ_a:	52k	75k	84k	70k	37k	26k	29k



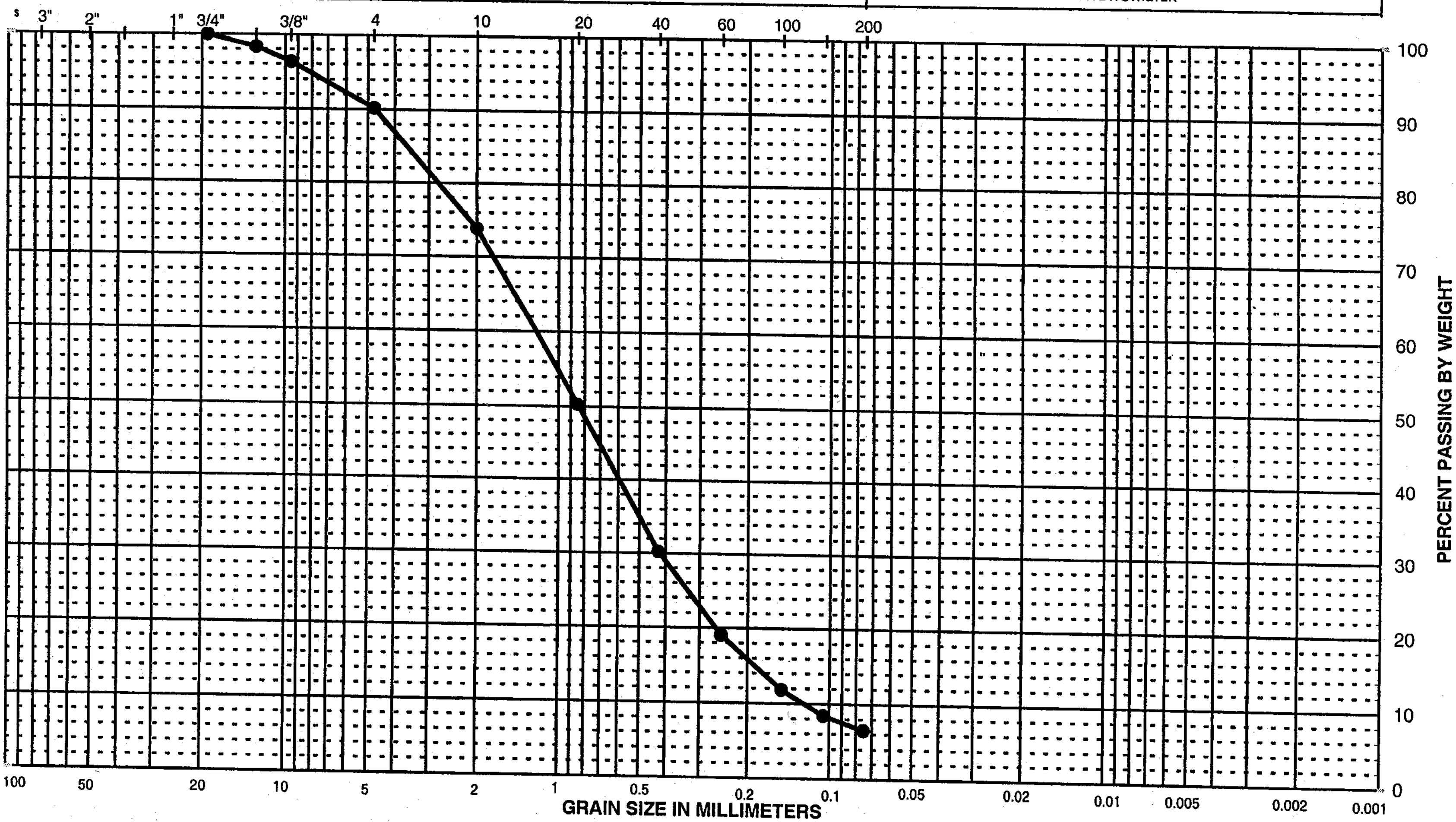
Project: Project No.	RESISTIVITY MEASUREMENT: R-2	Fig.

Appendix I

Attachment I-5

Laboratory Test Results

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	
1"	25.4	
3/4"	19.05	100.0
1/2"	12.70	98.3
3/8"	9.53	96.3
#4	4.75	90.2
#10	2.00	73.8
#20	0.850	50.3
#40	0.425	30.2
#60	0.250	19.0
#100	0.150	11.8
#140	0.105	8.4
#200	0.075	6.5
Hydrometer Analysis		

% Cobbles	
% Gravel	9.8
% Sand	83.7
% Fines	6.5
D_{60}	1.3
D_{30}	0.43
D_{10}	0.13
C_u	10.0
C_c	1.1

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-101	3	10.0	●	0.9				Brown well-graded Sand with silt (SW-SM)

PROJECT NAME: Ocotillo Power Plant

PROJECT NUMBER: 66-00000023.20

PARTICLE-SIZE DISTRIBUTION CURVES

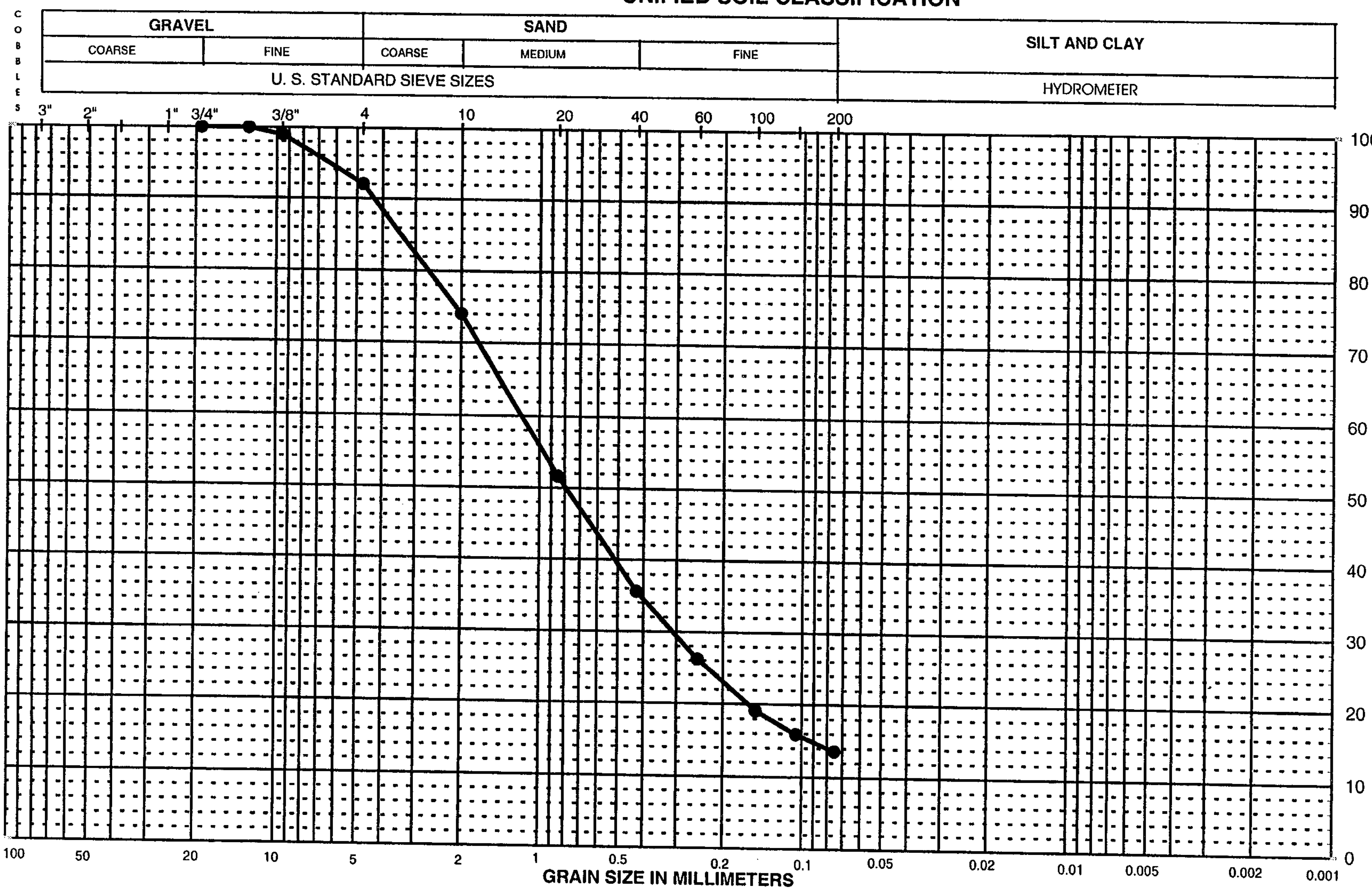
Figure:

(SNA) sieve only (04/2000)

saop10103

URS

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	
1"	25.4	
3/4"	19.05	100.0
1/2"	12.70	100.0
3/8"	9.53	99.0
#4	4.75	92.0
#10	2.00	74.0
#20	0.850	51.6
#40	0.425	35.6
#60	0.250	26.2
#100	0.150	19.1
#140	0.105	15.9
#200	0.075	13.6
Hydrometer Analysis		

% Cobbles	
% Gravel	8.0
% Sand	78.4
% Fines	13.6
D_{60}	
D_{30}	
D_{10}	
C_u	
C_c	

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-101	4	15.0	●	1.2				Brown silty Sand (SM)

PROJECT NAME: Ocotillo Power Plant
PROJECT NUMBER: 66-00000023.20

PARTICLE-SIZE DISTRIBUTION CURVES

Figure:

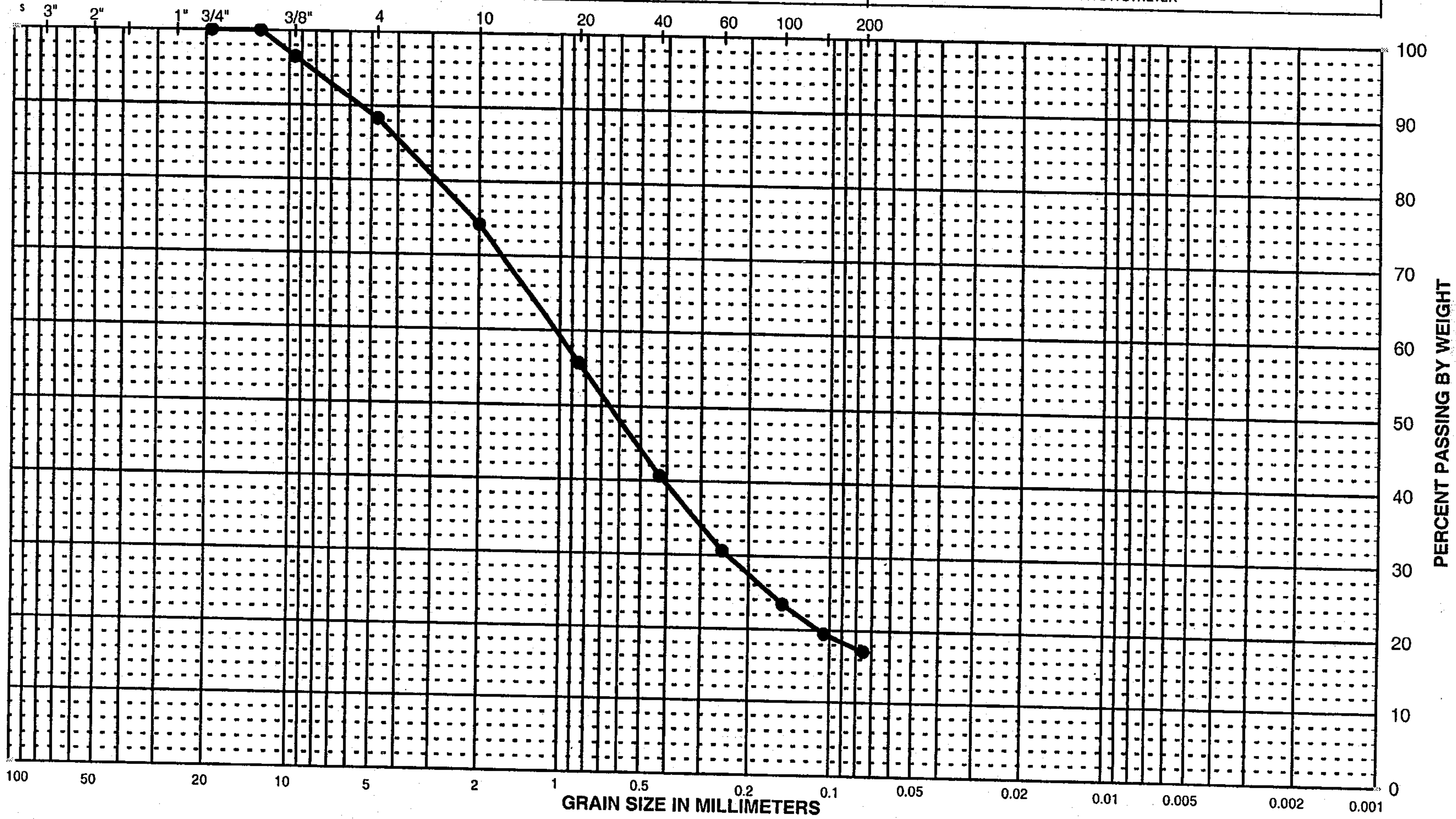
(SNA) sieve only (04/2000)

saop10104

URS

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
	U. S. STANDARD SIEVE SIZES					HYDROMETER



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	
1"	25.4	
3/4"	19.05	100.0
1/2"	12.70	100.0
3/8"	9.53	96.5
#4	4.75	88.3
#10	2.00	74.2
#20	0.850	55.7
#40	0.425	40.6
#60	0.250	30.6
#100	0.150	23.4
#140	0.105	19.5
#200	0.075	17.1
Hydrometer Analysis		

% Cobbles	
% Gravel	11.7
% Sand	71.2
% Fines	17.1
D_{60}	
D_{30}	
D_{10}	
C_u	
C_c	

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-101	9	40.0	●	2.1				Brown silty Sand (SM)

PROJECT NAME: Ocotillo Power Plant

PROJECT NUMBER: 66-00000023.20

PARTICLE-SIZE DISTRIBUTION CURVES

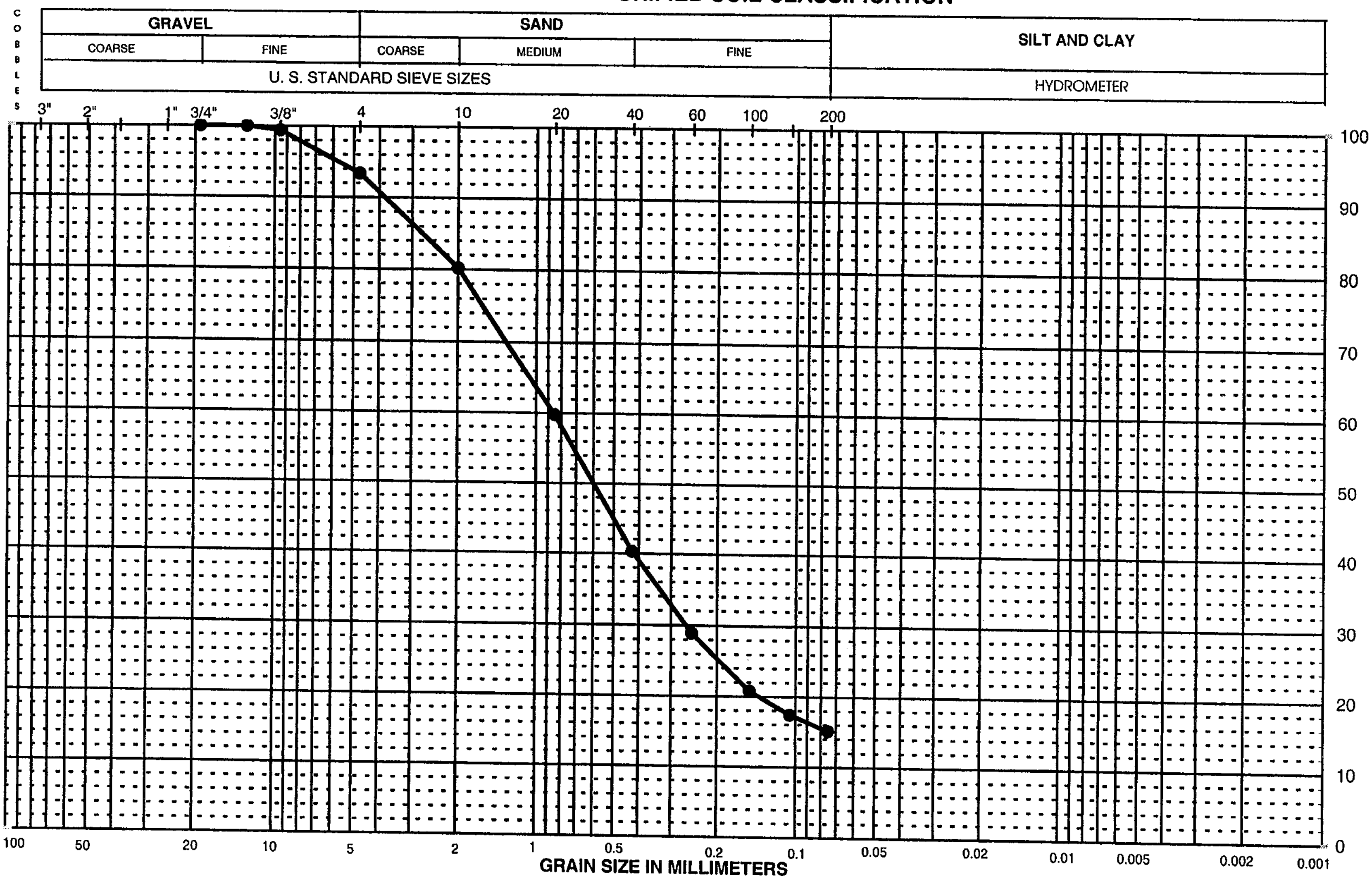
Figure:

(SNA) sieve only (04/2000)

saop10109

URS

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	
1"	25.4	
3/4"	19.05	100.0
1/2"	12.70	100.0
3/8"	9.53	99.4
#4	4.75	93.4
#10	2.00	80.2
#20	0.850	59.8
#40	0.425	40.3
#60	0.250	28.9
#100	0.150	20.8
#140	0.105	17.4
#200	0.075	15.1
Hydrometer Analysis		

% Cobbles	
% Gravel	6.6
% Sand	78.3
% Fines	15.1
D_{60}	
D_{30}	
D_{10}	
C_u	
C_c	

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-101	14	65.0	●	1.4				Brown silty Sand (SM)

PROJECT NAME: Ocotillo Power Plant

PROJECT NUMBER: 66-00000023.20

PARTICLE-SIZE DISTRIBUTION CURVES

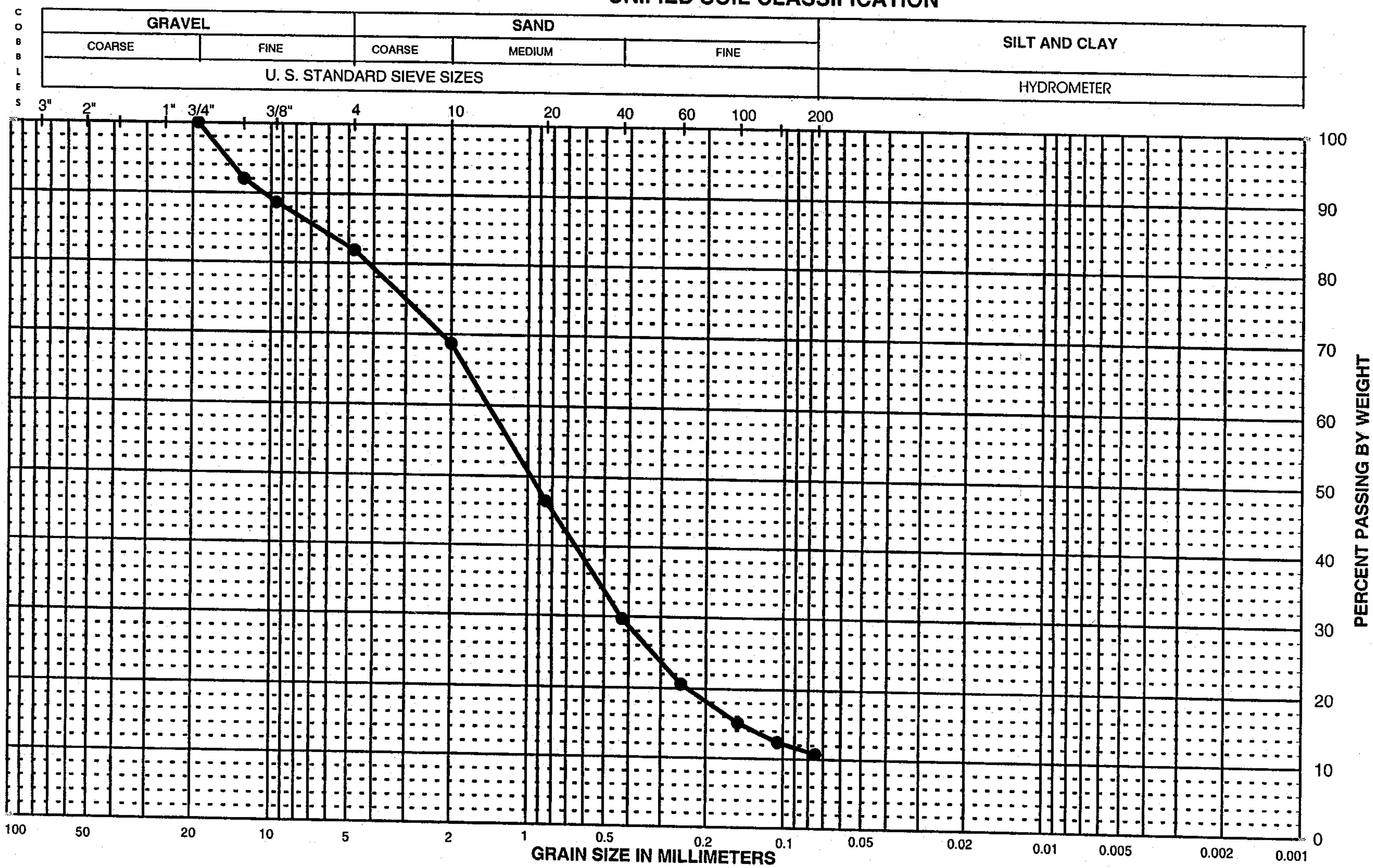
Figure:

(SNA) sieve only (04/2000)

saop10114

URS

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	
1"	25.4	
3/4"	19.05	100.0
1/2"	12.70	92.0
3/8"	9.53	88.7
#4	4.75	81.9
#10	2.00	68.7
#20	0.850	46.5
#40	0.425	29.7
#60	0.250	20.6
#100	0.150	15.1
#140	0.105	12.4
#200	0.075	10.8
Hydrometer Analysis		

% Cobbles	
% Gravel	18.1
% Sand	71.1
% Fines	10.8
D_{60}	1.6
D_{30}	0.45
D_{10}	0.065
C_u	24.6
C_c	1.9

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-101	18	85.0	●	1.4				**Brown well-graded Sand with silt and gravel (SW-SM)**

PROJECT NAME: **Ocotillo Power Plant**

PROJECT NUMBER: **66-00000023.20**

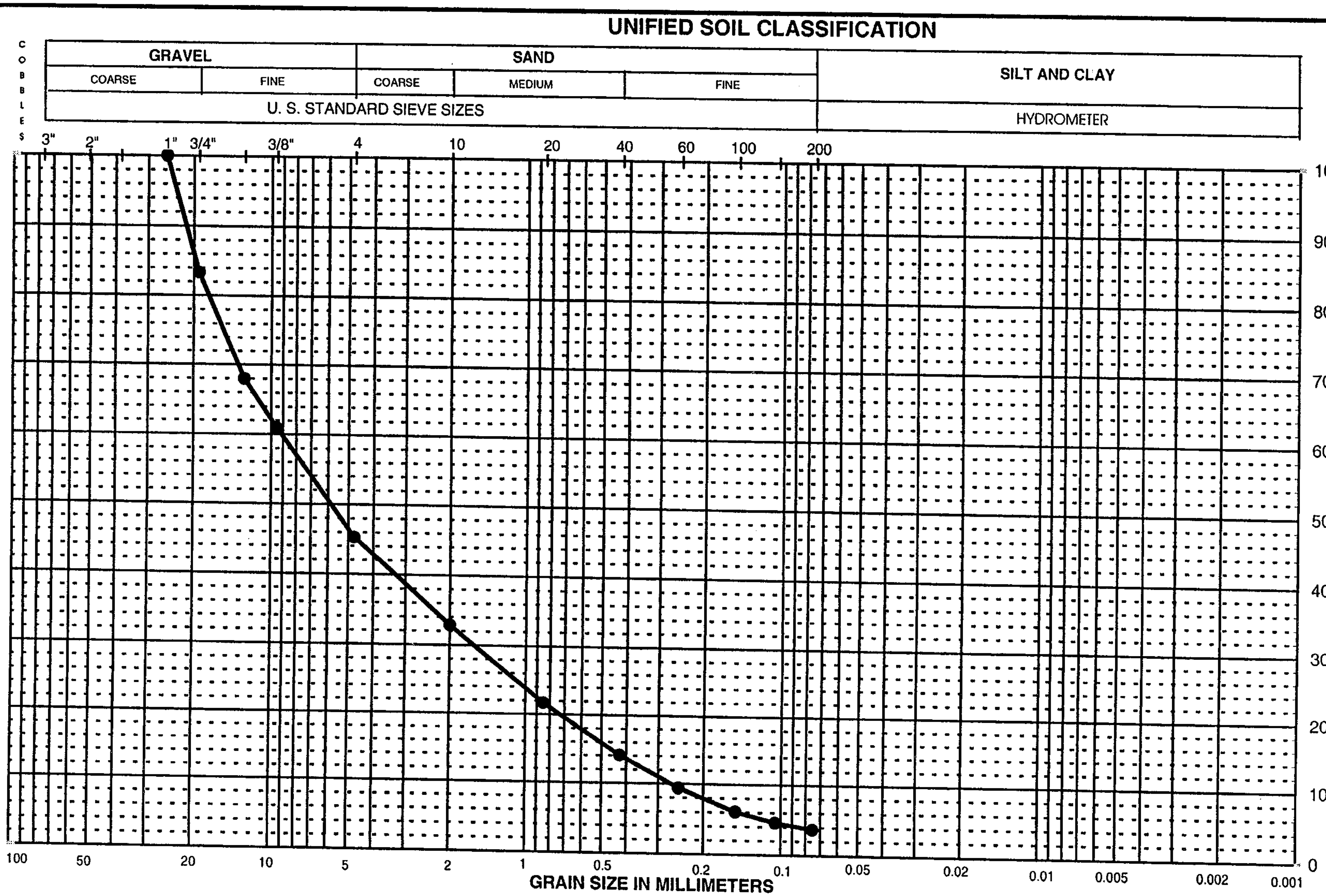
PARTICLE-SIZE DISTRIBUTION CURVES

Figure:

(SNA) sieve only (04/2000)

saop10118

URS



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	
1"	25.4	100.0
3/4"	19.05	83.3
1/2"	12.70	68.0
3/8"	9.53	61.0
#4	4.75	45.3
#10	2.00	32.9
#20	0.850	21.7
#40	0.425	14.1
#60	0.250	9.4
#100	0.150	6.1
#140	0.105	4.6
#200	0.075	3.7
Hydrometer Analysis		

% Cobbles	
% Gravel	54.7
% Sand	41.6
% Fines	3.7
D_{60}	9.2
D_{30}	1.7
D_{10}	0.28
C_u	32.9
C_c	1.1

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-103	4	7.0	●	1.3				Brown well-graded Gravel with sand (GW)

PROJECT NAME: Ocotillo Power Plant
PROJECT NUMBER: 66-00000023.20

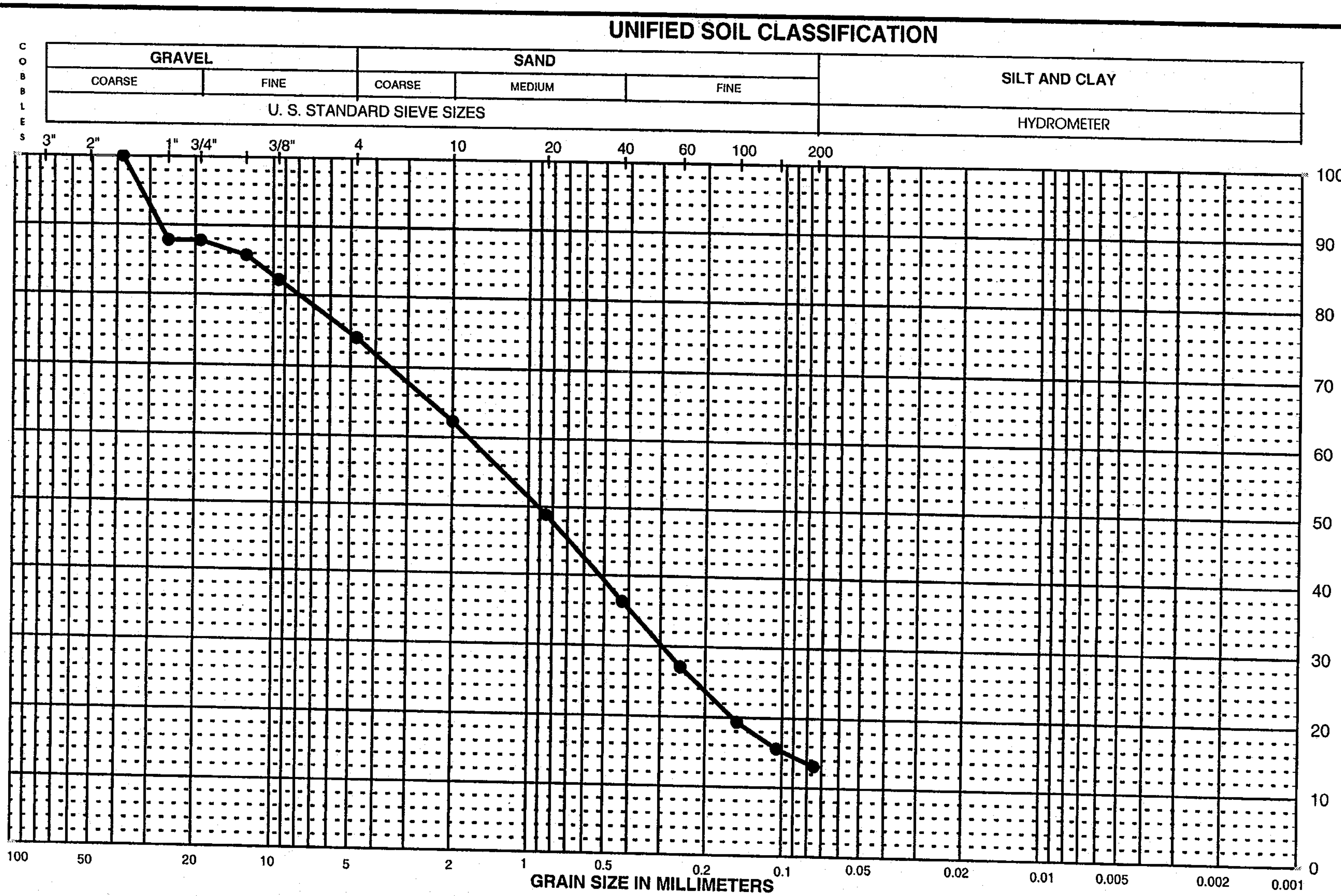
PARTICLE-SIZE DISTRIBUTION CURVES

Figure:

(SNA) sieve only (04/2000)

saop10304

URS



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	100.0
1"	25.4	87.8
3/4"	19.05	87.8
1/2"	12.70	85.7
3/8"	9.53	82.2
#4	4.75	74.1
#10	2.00	62.3
#20	0.850	48.8
#40	0.425	36.3
#60	0.250	27.1
#100	0.150	19.3
#140	0.105	15.6
#200	0.075	13.1
Hydrometer Analysis		

% Cobbles	
% Gravel	25.9
% Sand	61.0
% Fines	13.1
D_{60}	
D_{30}	
D_{10}	
C_u	
C_c	

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-103	6	12.0	●	1.7				Brown silty Sand with gravel (SM)

PROJECT NAME: Ocotillo Power Plant

PROJECT NUMBER: 66-00000023.20

PARTICLE-SIZE DISTRIBUTION CURVES

Figure:

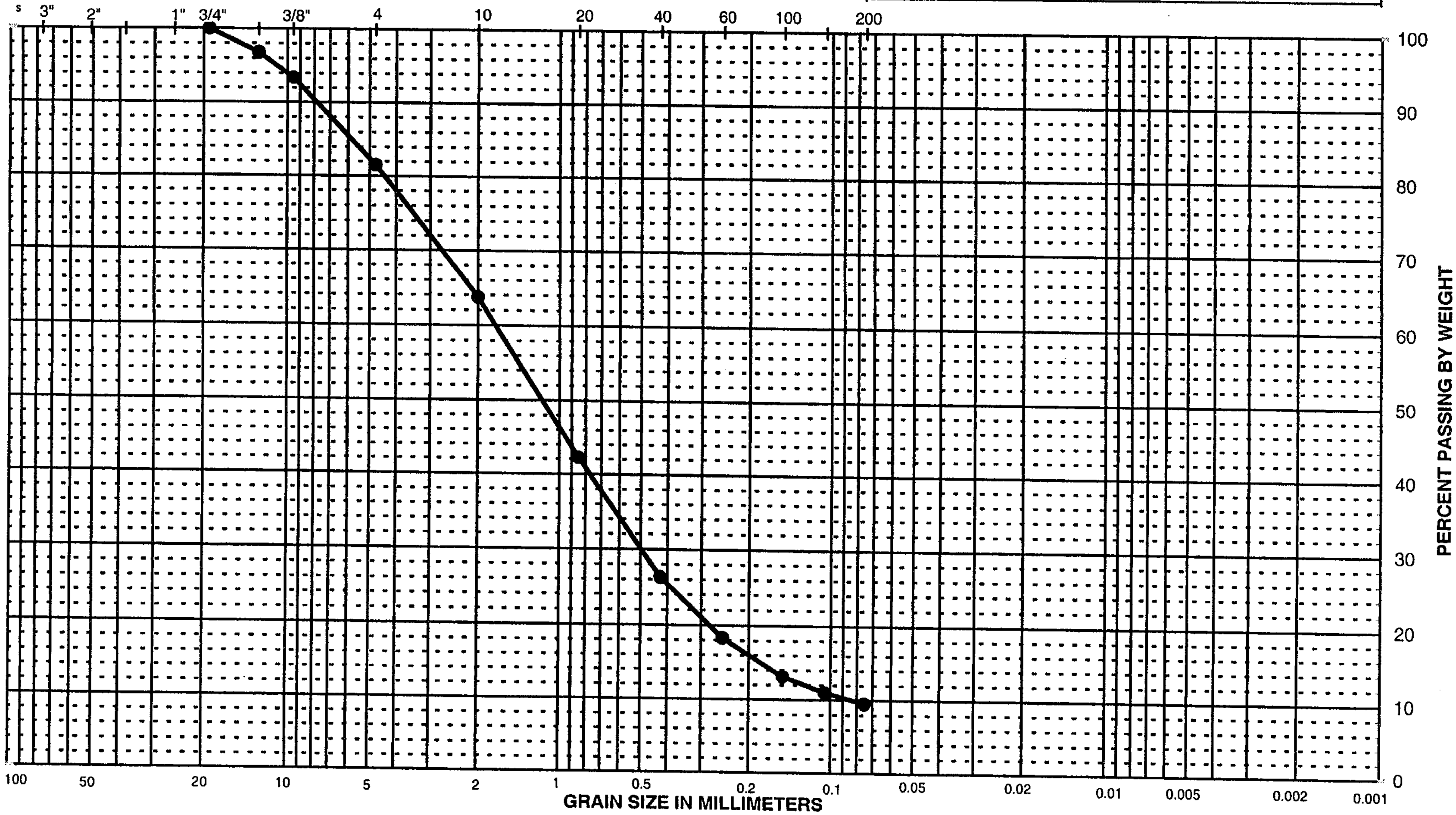
(SNA) sieve only (04/2000)

saop10306

URS

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
	U. S. STANDARD SIEVE SIZES					HYDROMETER



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	
1"	25.4	
3/4"	19.05	100.0
1/2"	12.70	96.8
3/8"	9.53	93.4
#4	4.75	81.5
#10	2.00	63.7
#20	0.850	42.2
#40	0.425	26.3
#60	0.250	18.3
#100	0.150	13.1
#140	0.105	11.0
#200	0.075	9.5
Hydrometer Analysis		

% Cobbles	
% Gravel	18.5
% Sand	72.0
% Fines	9.5
D_{60}	1.8
D_{30}	0.5
D_{10}	0.08
C_u	22.5
C_c	1.7

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-103	10	30.0	●	1.5				Brown well-graded Sand with silt and gravel (SW-SM)

PROJECT NAME: Ocotillo Power Plant

PROJECT NUMBER: 66-00000023.20

PARTICLE-SIZE DISTRIBUTION CURVES

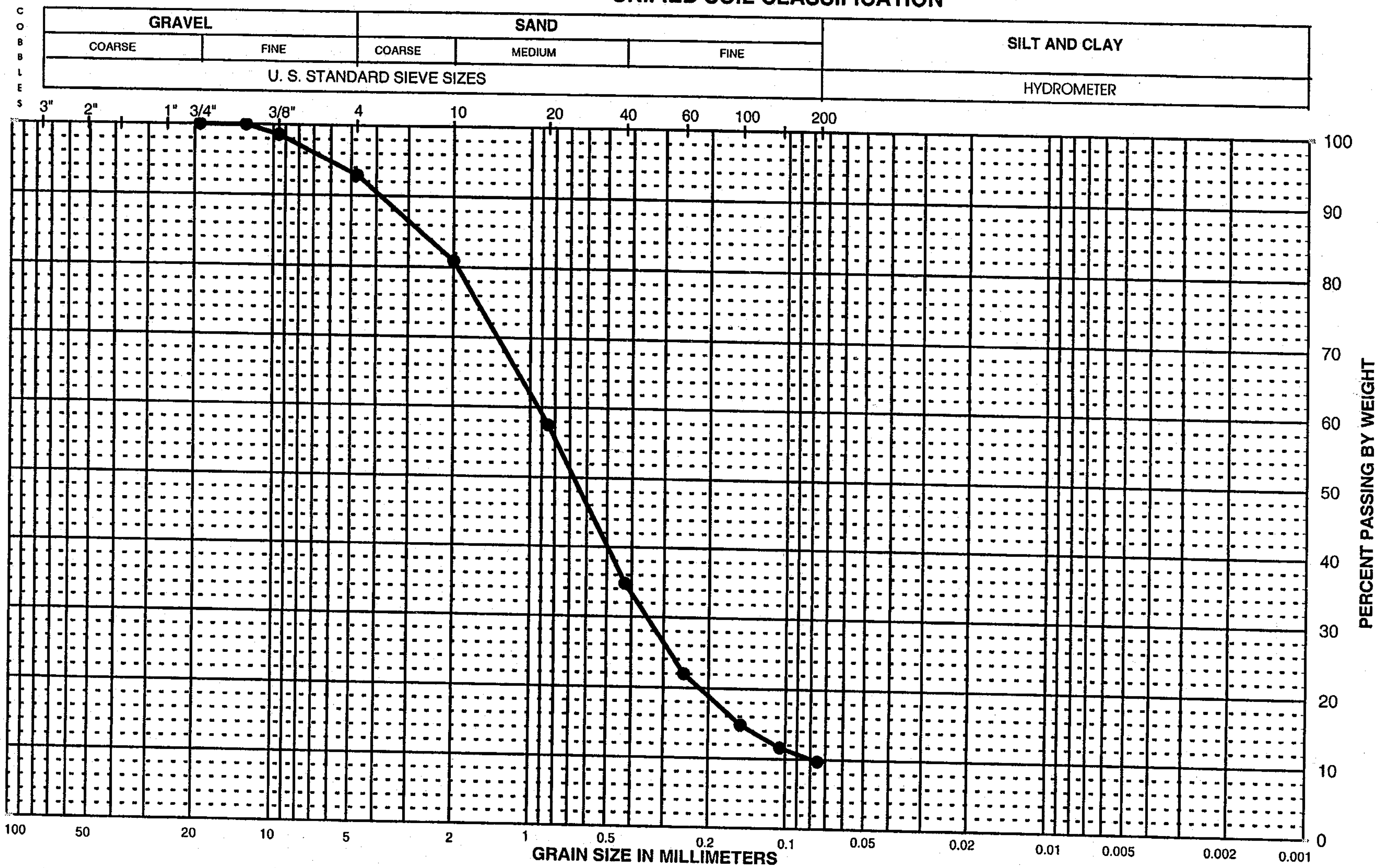
Figure:

(SNA) sieve only (04/2000)

saop10310

URS

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	
1"	25.4	
3/4"	19.05	100.0
1/2"	12.70	100.0
3/8"	9.53	98.6
#4	4.75	92.9
#10	2.00	80.9
#20	0.850	57.5
#40	0.425	34.8
#60	0.250	22.0
#100	0.150	14.8
#140	0.105	11.6
#200	0.075	9.7
Hydrometer Analysis		

% Cobbles	
% Gravel	7.1
% Sand	83.2
% Fines	9.7
D_{60}	0.95
D_{30}	0.35
D_{10}	0.08
C_u	11.9
C_c	1.6

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-103	16	60.0	●	1.0				Brown well-graded Sand with silt (SW-SM)

PROJECT NAME: **Ocotillo Power Plant**

PROJECT NUMBER: **66-00000023.20**

PARTICLE-SIZE DISTRIBUTION CURVES

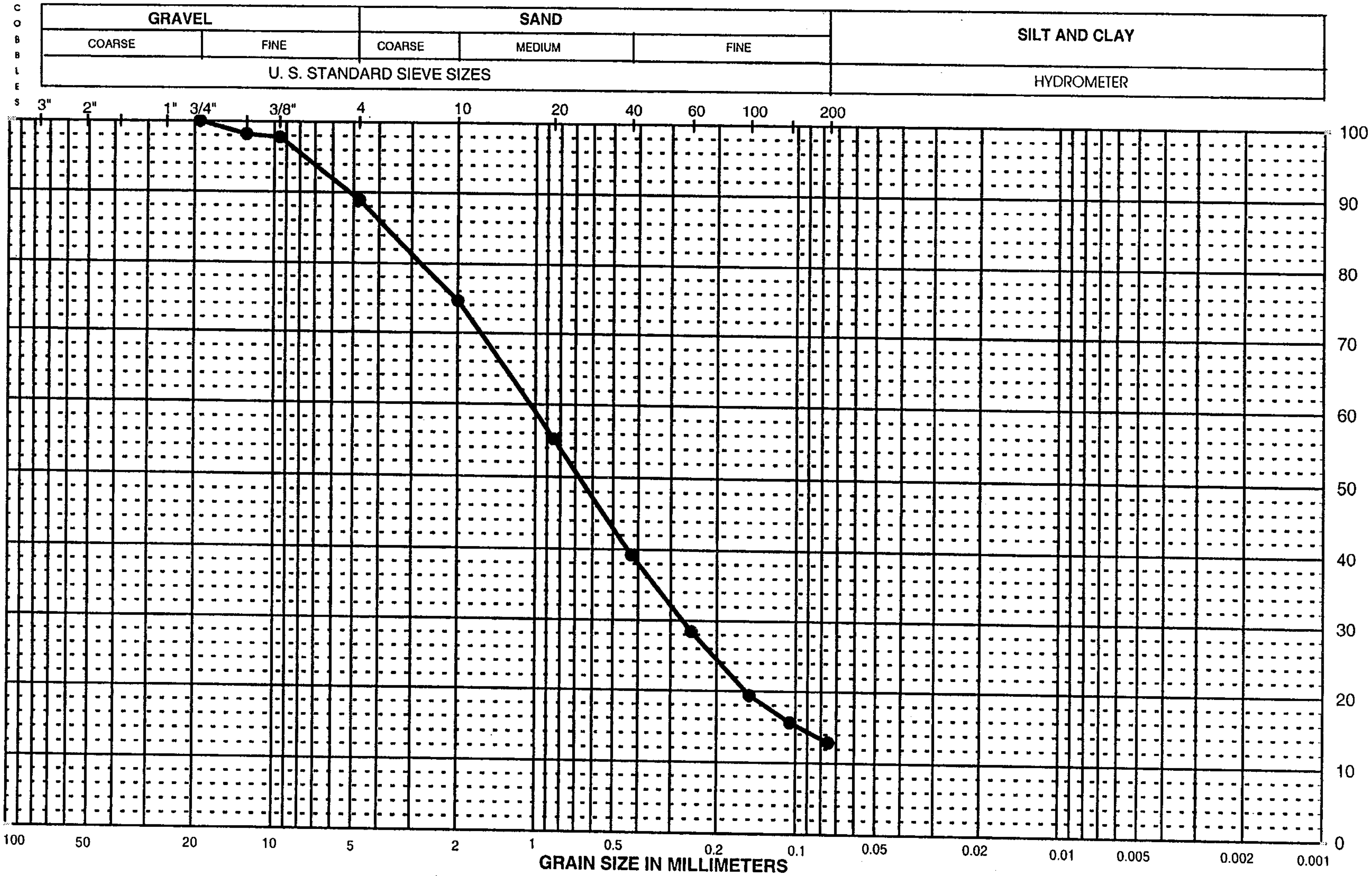
Figure:

(SNA) sieve only (04/2000)

saop10316

URS

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	76.2	
2"	50.8	
1 1/2"	38.1	
1"	25.4	
3/4"	19.05	100.0
1/2"	12.70	98.2
3/8"	9.53	97.8
#4	4.75	88.9
#10	2.00	74.6
#20	0.850	55.2
#40	0.425	39.2
#60	0.250	28.4
#100	0.150	19.4
#140	0.105	15.6
#200	0.075	12.9
Hydrometer Analysis		

% Cobbles	
% Gravel	11.1
% Sand	76.0
% Fines	12.9
D_{60}	
D_{30}	
D_{10}	
C_u	
C_c	

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
B-103	23	95.0	●	0.7				Brown silty Sand (SM)

PROJECT NAME: Ocotillo Power Plant
PROJECT NUMBER: 66-00000023.20

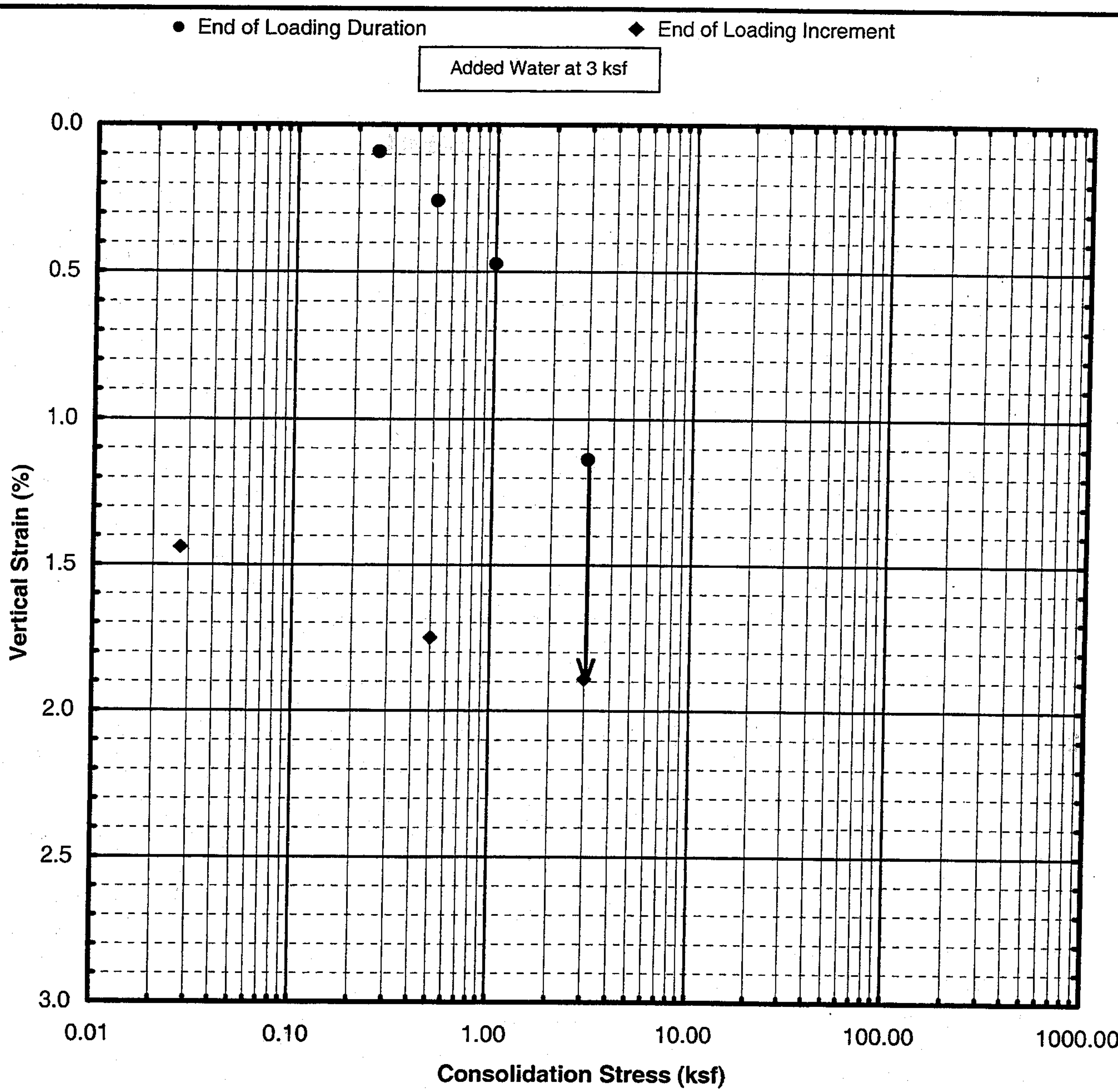
PARTICLE-SIZE DISTRIBUTION CURVES

Figure:

(SNA) sieve only (04/2000)

saop10323

URS



Exploration No.: sta 835 Sample No.: west cut Depth (ft.): 8.0

Description/ Classification: Brown silty Sand (SM)

	Water Content, %	Total Unit Weight, pcf	Dry Unit Weight, pcf	Void Ratio	Saturation %	Height inches	Diameter inches	Specific Gravity	Liquid Limit	Plasticity Index
Initial:	8.6	120.3	110.8	0.52	44.6	0.994	1.932	2.70		
Final:	16.4	130.6	112.2	0.50	88.6	0.981		assumed		

Project Name: Ocotillo Power Plant
Project Number: 66-00000023.02

CONSOLIDATION TEST
Figure:

One-Dimensional Consolidation, Swell Test
ASTM D 2435, D 4546

Project Number:	66-00000023.02	Task Number:	03020	Exploration No.	sta 835
Project Name:	Ocotillo Power Plant	Assignment Number:		Sample No:	west cut
Project Engineer:	GL	Test Number:	OD000032	Depth (ft)	8.0
		Load Increment Duration:	t 90 + l hr dry, 1 day wet		

Specimen Description: Brown silty Sand (SM)

Specimen Analysis						Initial Trim	Initial Spec.	Final
Mass of Container and Wet Specimen M1 (g)							91.99	194.23
Mass of Container and Dry Specimen, M2 (g)							84.73	180.83
Mass of Container, M3 (g)							x	99.05
Water Content, w (%)							**8.57**	**16.39**
Mass of Wet Specimen, M4 (g)						91.99		98.61
Mass of Dry Specimen, M5 (g)						84.73		84.73
Nominal		Measured	X	Specimen Height, H (in)		0.994		0.981
Nominal	X	Measured		Specimen Diameter, D (in)		1.932		1.932
Area of Specimen, A (in^2)						2.932		2.932
Volume of Specimen, V (cc)						47.75		47.13
Assumed	X	Measured		Specific Gravity, Gs		2.70		2.70
Wet Unit Weight, WUW (pcf)						**120.3**		**130.6**
Dry Unit Weight, DUW (pcf)						**110.8**		**112.2**
Degree of Saturation, S (%)						**44.6**		**88.6**

Consolidation Stress (ksf)	Dial Reading (inch) Initial Dial = 0.2000		Apparatus Compressibility Correction (inch)	Vertical Strain (%)	
	End of Load Duration	End of Load Increment		End of Load Duration	End of Load Increment
0.13	0.1999	0.1999	0.0000	0.01	0.01
0.25	0.1990	0.1990	0.0001	0.09	0.09
0.50	0.1972	0.1970	0.0003	0.26	0.27
1.0	0.1947	0.1947	0.0006	0.47	0.47
3.0	0.1872	0.1797	0.0015	1.14	1.89
0.5		0.1819	0.0007		1.75
0.03		0.1854	0.0003		1.44

w = ((M1 - M2) / (M2 - M3)) * 100,   M4(initial) = M5(initial) * (1 + (w(initial) / 100)).
M4 (final) is measured,   M5(final) = M5(final),   M5(final) = M4(final) / (1+ (w(final) / 100))
WUW = (M4,g) / (V,cm^3) * (62.43, lb/ft^3),   DUW = WUW / (1 + (w / 100)),   S = (DUW * w * Gs) / ((Gs * Unit Weight of Water) - DUW).
Strain (%) = (Dial Reading - Initial Dial Reading - Apparatus Compressibility) * 100 / Initial Specimen Height.
Unit Weight of Water (20 C) = 62.32 pcf or 0.9982 g/cm^3,   Initial Void Ratio (eo) = (Gs * w) / S,   Strain for Saturation = ((eo - ((Gs * w) / 98)) *100) / (1 + eo)

Initial Void Ratio = 0.52

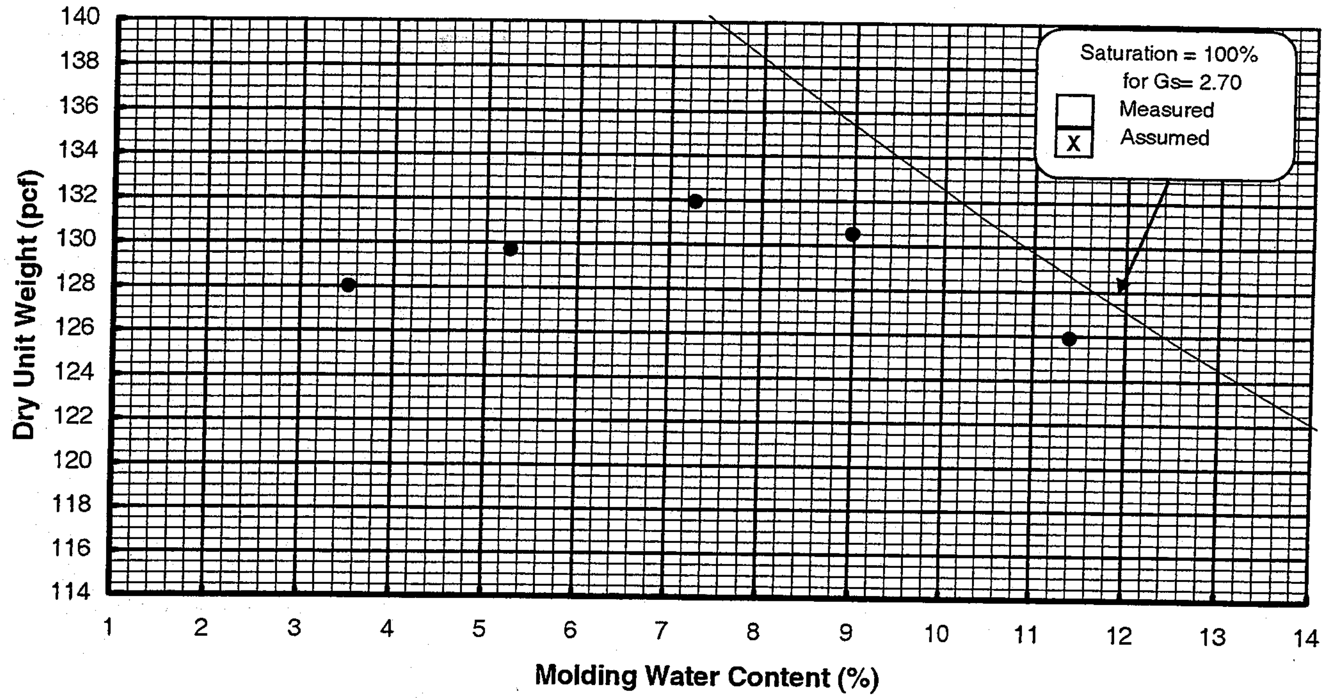
Strain for Saturation at 3 ksf loading (%) = 0.75

Tested by: TJO   Date: 2/12/2001

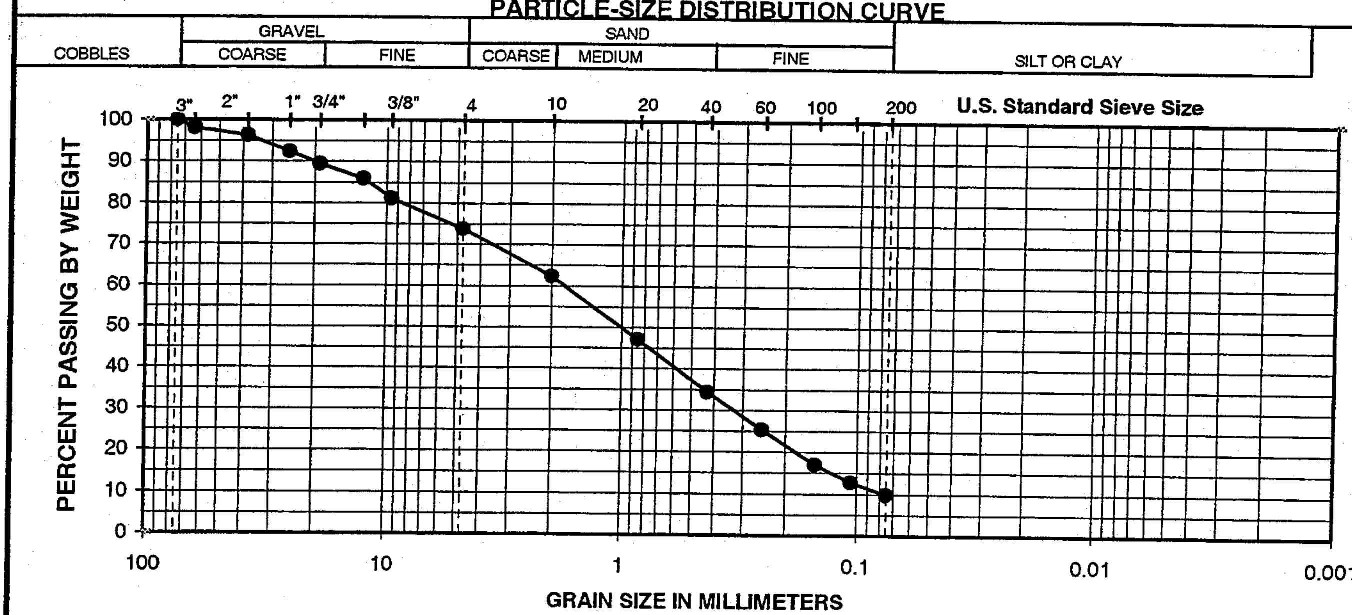
COMPACTION CURVE

Test Method: ● ASTM D 1557 ■ ASTM D 698 ◆ CA-DWR: S-10 ❍ Other Effort

Compaction Procedure: **B** Specimen Preparation Method: **Moist**



PARTICLE-SIZE DISTRIBUTION CURVE



NOTATION: ● Representative of entire sample ◆ Representative of compacted specimen ■ Representative of compacted specimen and entire sample

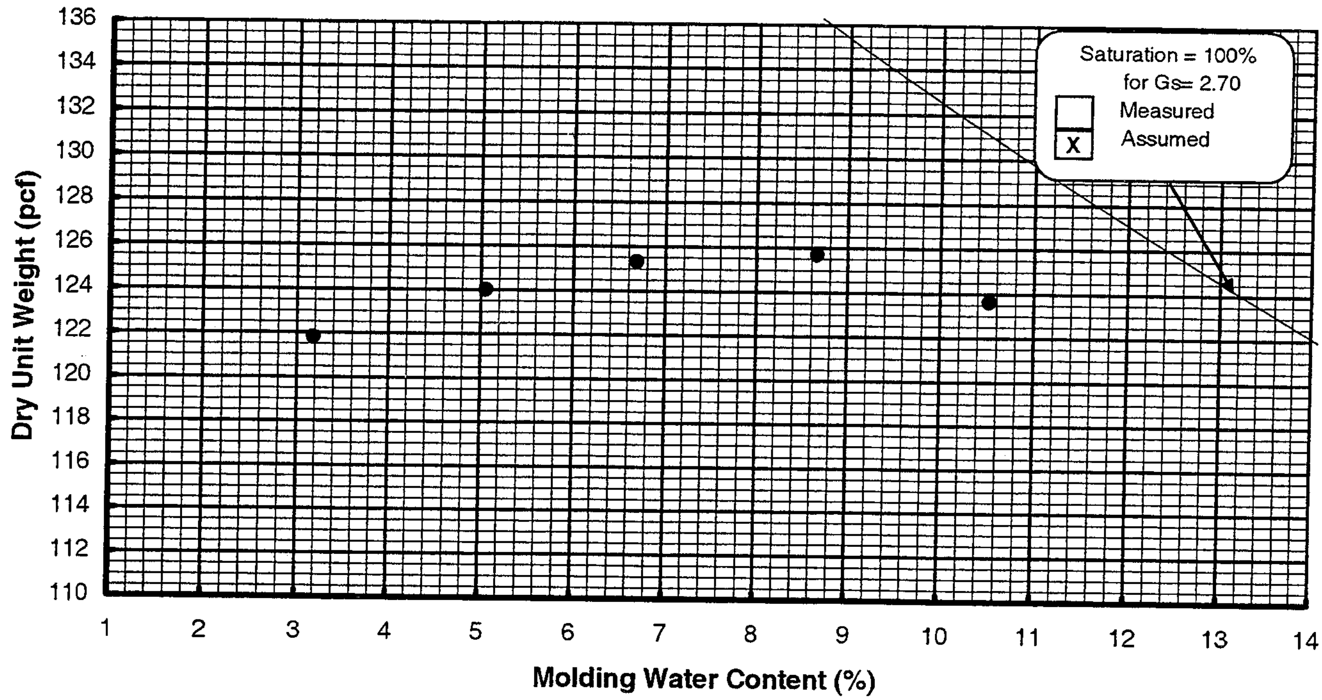
Exploration No.	Sample No.	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	LL	PI	Description and/or Classification
B-101~ B-103		8.0	7.5	132.0	NT	NT	Light brown poorly graded Sand with silt and gravel (SP-SM)

PROJECT NAME: Ocotillo Power Plant **PROJECT NUMBER: 66-00000023.02**	**COMPACTION AND INDEX PROPERTY DATA**	**FIGURE No.**

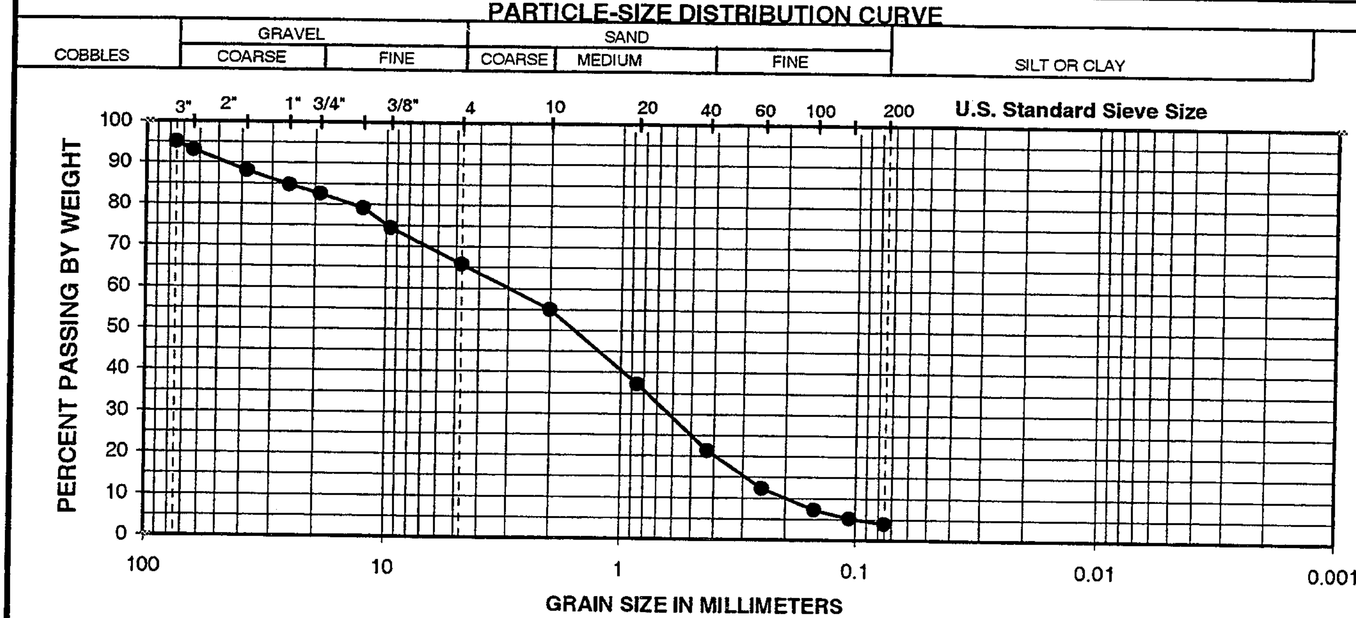
COMPACTION CURVE

Test Method: ● ASTM D 1557 ■ ASTM D 698 ◆ CA-DWR: S-10 ❍ Other Effort

Compaction Procedure: **B** Specimen Preparation Method: **Dry**



PARTICLE-SIZE DISTRIBUTION CURVE



NOTATION: ● Representative of entire sample ◆ Representative of compacted specimen ■ Representative of compacted specimen and entire sample

Exploration No.	Sample No.	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	LL	PI	Description and/or Classification
50 ft N. of B-101		8.0	8.0	126.0	NT	NT	Brown poorly graded Sand with gravel (SP)

PROJECT NAME: Ocotillo Power Plant **PROJECT NUMBER: 66-00000023.02**	**COMPACTION AND INDEX PROPERTY DATA**	**FIGURE No.**

Appendix I

Attachment I-6

Fault Evaluation Report

Mr. Lloyd Young
Mr. Charles Worthington
Bechtel Geotechnical & Hydraulic Engineering Services
5275 Westview Drive
Frederick, MD 21703

SUBJECT **SURFACE FAULT RUPTURE HAZARD INVESTIGATION FOR THE PROPOSED OCOTILLO POWER PLANT, PALM SPRINGS, CALIFORNIA**

Gentleman:

URS is herein providing the results of our surface fault rupture hazard investigation for the proposed Ocotillo Power Plant, located in Palm Springs, California. The investigation was conducted as part of the Application For Certification (AFC) Phase Geotechnical Investigation for InterGen North America (INA). Information obtained from the investigation is in support of the geologic hazards section of the AFC to be submitted to the California Energy Commission (CEC) for licensing of the Ocotillo Power Plant. Bechtel is the primary consultant for the AFC Phase Geotechnical Investigation, and is preparing the geologic hazards section of the AFC. URS supplied support services to Bechtel as detailed within the Statement of Work (SOW) dated February 12, 2001. This report presents the findings of the seismic refraction survey and fault trenching tasks presented in the SOW.

1.0 EXCUTIVE SUMMARY

A fault rupture hazard investigation was completed for the proposed Ocotillo Power Plant site in North Palm Springs, Riverside County, California (Figure 1). As part of the fault rupture hazard investigation, URS completed 3,025 feet of seismic refraction surveys along two parallel north-south profiles, and excavated a 1,435-foot long exploratory trench across the site. The purpose of these investigations was to fulfill the requirements for the AFC licensing process and the Alquist-Priolo Earthquake Fault Zone Act. In addition, the potential for surface fault rupture beneath planned structures located outside the Alquist-Priolo Earthquake Fault Zone boundaries was evaluated in order to minimize the possibility of discovering active faults during site construction.

The location of geophysical anomalies, interpreted as possible faults, was recognized on both the geophysical refraction profiles. The location of these potential faults are consistent with fault traces mapped by the California Division of Mines and Geology (CDMG) (1980), located north of the proposed power plant (Figure 2). The trench log shows that several faults were logged between trench stations 90 and 215, with the main zone of faulting occurring between Stations 143 and 180. This approximately 125 foot-wide zone of deformation

corresponds with the middle of the three splays that were mapped by CDMG (1980). To the south of station 215, the trench exposed horizontal to gently south dipping alluvial deposits with no indication of faulting.

Previous trenching conducted by others in 1981, and the mapping by CDMG, as well as the geophysical and trenching studies completed during this investigation indicate that the surface rupture potential associated with the Banning fault is confined to the area north of the proposed power plant.

2.0 BACKGROUND

INA is proposing to construct a 900 megawatt natural gas fired power plant (Ocotillo Energy Facility) on 30 acres of land within a 160 acre parcel that is located in the southeast ¼ of the northwest ¼ of Section 9 within Township 3S, and Range 4E. The property is approximately 1.5 miles west of the town of North Palm Springs (Figure 1). An active splay of the San Andreas fault, known as the Banning fault, crosses along a northwest trend, through the 160 acre parcel, immediately to the north of the 30 acre site. As shown on Figure 2, the Banning fault consists of three fault splays as mapped by the CDMG (1980), within the160 acre parcel. An approximately 1,000 foot-wide zone centered on the Banning fault has been delineated as an Earthquake Fault Zone under the Alquist-Priolo (A-P) Earthquake Fault Zoning Act[1]. As shown on Figure 2, a portion of the proposed plant footprint encroaches into the A-P Earthquake Fault Zone.

As part of the fault rupture hazard investigation, URS completed 3,025 feet of seismic refraction surveys along two parallel north-south profiles, and excavated a 1,435-foot long exploratory trench across the site. The purpose of these investigations was to fulfill the requirements for the AFC licensing process and the Alquist-Priolo Act, and to minimize the possibility of discovering faults during site construction by evaluating the potential for surface fault rupture beneath planned structures.

2.1 Previous Trenching

Trenching was also completed on the site, for a project unrelated to the Ocotillo Power Plant, by Rasmussen in 1981(Kahle et al., 1987). Rasmussen's trench is approximately located on Figure 2. This trench encountered a zone of deformation consisting of faulting and folding that corresponds to the middle splay of the fault as mapped by CDMG (1980). Rasmussen's trench also encountered several closely spaced shallow north dipping faults to the south of this zone, near the south end of the trench, as shown on Figure 2.

---

[1] The Alquist-Priolo Earthquake Fault Zoning Act was signed into state law in December of 1972. The purpose of the law is to prohibit the location of most structures for human occupancy across the trace of active faults.

3.0 SITE INVESTIGATIONS - METHODOLOGY

3.1 Seismic Refraction Survey

Prior to trenching, seismic refraction measurements were gathered along two profiles, RS01-1 and RS01-2. These profiles were run parallel to each other along north-south transects across the site, as shown on Figure 2. Both profiles crossed the entire mapped fault zone and the proposed power plant footprint. RS01-1 was 1,650 feet long, and RS01-2 was 1375 feet long. The reference stationing along the two profiles is from the south to north. The profile locations are shown on Figure 2, and profiles RS01-1 and RS01-2 are presented within Attachment A.

The seismic refraction technique is based on the measurement of the time required for a shockwave to travel from a sourcepoint (shotpoint) to one or more co-linear sensors (geophones). Measurements were obtained using a Geometrics ES1225F seismograph with twelve geophones. The source consisted of multiple sledgehammer blows to a groundplate. Geophones were spaced at 25-foot intervals and were usually in-line with the source. Shotpoints were nominally placed at the center of each line, at each end, and offset 135 ft, 275 ft, and 550 ft, or more, beyond each end. Line segments were generally overlapped to provide continuous profiles. The primary constraint on data quality was wind-induced noise. Sometimes the site geometry limited shotpoint positioning and the subsequent interpretation.

The seismic travel-times were plotted on time-distance graphs and interpreted using time-term methods (the generalized reciprocal method), the time-distance graphs are presented in Attachment A of this document. The resulting seismic refraction profiles represent the depths and velocities of various subsurface alluvial materials that would account for the measured travel-times (Attachment A). The seismic refraction profiles are non-unique but appear to be the most reasonable solutions based on the known geology. Basic assumptions inherent in this geophysical method include the expectation that velocity increases downward, that layers are relatively continuous and thick enough to be individually resolved, and that significant velocity differences are present between the layers of interest. The generally accepted value for depth accuracy is 20%. Geologic interpretations of the seismic refraction profiles are discussed in Section 4.1.

3.2 Trenching

Prior to any trench excavations Underground Service Alert, of Southern California, was notified to obtain clearance from the representative utility companies in the area. In addition, a site walk was conducted with the property owners' representative to identify utilities or other restrictions associated with trench excavations. A trench location was selected along an existing north-south oriented dirt road. The location was selected considering optimal orientation for identifying the Banning and any associated splay faults, as well as avoiding existing utilities and native vegetation. The property owners' representative indicated that a high voltage electric line existed across the southern portion of the proposed trench, however the exact location was unknown. Spectrum Geophysics Corporation of San Fernando, California, examined the area of the trench location for underground utilities. Spectrum located the high voltage electric line near the south end of the property. Consequently the trench excavation was terminated on either side of the electric line, resulting in a 30 foot-long unexcavated area, as shown on Figure 2.

Excavation of the trench took place between February 26 and March 2, 2001. The equipment used for excavation included an 892 John Deere excavator with a 39-inch bucket and a JCB 1550B backhoe with a 24-inch bucket. In addition, a Caterpillar 980B rubber tire loader was used to stockpile excavation spoils away from the trench sides.

The trench design was planned in the field based on existing ground conditions, logistical constraints due to existing structures and utilities, and in accordance with OSHA regulations. Trench station locations were established at five-foot intervals beginning with Station 0 at the north and continuing south to Station 1435. An initial plan to shore the trench with aluminum hydraulic shores proved impractical due to the loose nature of coarse-grained sediments. The sediments spalled upon excavation, producing trench sidewalls that were too wide to be shored. In an attempt to minimize trench width, the JCB 1550B backhoe with a 24-inch bucket was mobilized to continue the excavation. Initial efforts to minimize the trench width were successful and hydraulic shoring was placed between stations 220 to 260. South of station 260 spalling of the sediments continued and further attempts of placing hydraulic shoring were unsuccessful. Instead, the remaining trench was excavated with the 892 excavator and benched in 4- to 5-foot intervals. The trench was excavated to provide adequate exposures of well-bedded alluvium, and where practical, to extend down to or close to proposed foundation elevation. However, the excavation design utilizing the benching method required a wider surface area. This placed limitations on the total depth that the trench could be excavated in order to avoid encroachment with surrounding easements and structures. The majority of the trench was excavated to an approximate depth of 10 feet below the existing ground surface. Between stations 670 and 880 the trench was excavated to approximately 15 feet below ground surface. This deeper section of the trench corresponds to an area where the two most northern turbines were proposed to be located.

Subsequent to the trench excavation, the east wall of the trench was prepared for logging. Due to the coarse-grained nature of the sediments (sands and gravels), and the natural cleaning of the walls provided by prevailing winds, minimal brushing and scraping was needed to clean the trench walls. Excavating equipment typically left up to one foot of debris (excavation spoil) on the benches between the upper and lower trench walls. Except in critical areas, such as across the main fault zone, the debris was not cleared from the benches. Reference lines were constructed to aid trench logging. Reference lines consisted of a horizontal string that was attached to the trench wall by large nails and/or rebar. A line (bubble) level was used to check the horizontality of the string lines. Tape was attached to the string at 5-foot intervals and marked for horizontal control. The trench reference line was surveyed by the Keith Companies, Palm Desert, California. The Keith Companies also established ground control for surface contours that were established by an aerial survey in

December 2000 conducted by Air Survey of Dulles Virginia. Following completion of the grid lines, manual trench logging was conducted on 10 grid paper at a horizontal and vertical scale of 1-inch = 5-feet. Trench wall features were measured in relation to the reference line with a tape measure. The physical characteristics of the alluvial material were visually identified based on the classifications outlined in the U.S. Bureau of Reclamation (1998) Engineering Geology Field Manual. Soil colors were classified with a Munsel Soil Color Chart (1992). In addition to the trench log, which is presented here as Figure 3, the trench was photographed and video taped. The original photographs and videotape have been saved in the project file, and a copy has been provided to Bechtel.

The trench perimeters, the crest and toe of each bench face, and the bottom of the trench were surveyed at 20-foot intervals prior to backfilling the trench. On March 16, March 19, and March 20, 2001, materials were back-filled in approximately 2-5 foot lifts, watered, and wheel rolled for compaction. This method of compaction was requested by the property owner as an effort to minimize settlement under the maintenance road that was re-established over the excavation site. In the future, the trench fill will need to be re-excavated and properly compacted during construction of the power plant.

4.0 RESULTS OF INVESTIGATION

4.1 Seismic Refraction

The seismic refraction profiles for RS01-1 and RS01-2 are shown in Attatchment 2. Three seismic velocity layers are interpreted: an upper alluvium layer with average velocities of 1,800 fps (feet per second) to 2,100 fps, alluvium with average velocities of 2,800 fps to 3,100 fps, and lower alluvium with average velocities of 4,000 fps to 6,700 fps. The upper layer ranged from 10 feet to 30 feet thick, and the depth to the third layer usually varies between 40 feet and 100 feet.

Lateral velocity changes appear to vary smoothly, except at two locations on the northeast end of each profile: at stations 11+75 and 15+25 on RS01-1, and at stations 10+00 and 12+50 on RS01-2. These locations also appear to be associated with a localized thickening of the surficial soils. While these lateral velocity changes are similar, in magnitude to those found elsewhere on the profiles, they differ in that the changes occur over very short distances (tens of feet). This rapid velocity change over a short lateral distance suggests that somewhat dissimilar materials have been juxtaposed, as would occur due to faulting. The smooth velocity changes recorded over the remainder of the profiles indicate that the alluvial sequence is not faulted.

4.2 Trenching

As shown on Figure 2, the trench extends along a north-south alignment through the footprint of the proposed power plant, and continues to approximately 400 feet north of the footprint. The trench was extended beyond the footprint to cross the southern most two of the three

Banning fault splays that were mapped by CDMG (1980). The trench crossed the mapped locations of these faults in order to confirm the fault location, and if present, demonstrate that faulting could be recognized in the coarse-grained alluvium that underlies the site.

The trench exposed several faults between stations 90 and 215, with the main zone of faulting occurring between Stations 143 and 180 (Figure 3 and 4). Between stations 60 and 185 the alluvium is folded. Anticlinal hinge zones occur at stations 100 and 156 and a synclinal hinge zone occurs at station 111 (Figure 3, sheets 3 and 4). Collectively these faults and the folding comprise a zone of deformation approximately 125 feet-wide that corresponds with the middle of the three splays that were mapped by CDMG (1980), as shown on Figure 2. To the south of station 215, the trench exposed horizontal to gently south dipping alluvial deposits with no indication of faulting.

As shown on the trench log (Figure 3), the trench exposed an alluvial fan depositional sequence consisting of interlayered silty-sand, sand, and gravel. Soil profiles are superimposed on the alluvium, and vary in their degree of development. The soil profiles were used to differentiate two distinct depositional sequences of alluvium. An older alluvium, that contains two moderately well developed soil profiles, was exposed from the north end of the trench, south to about station 1002, and at the very bottom of the trench from about stations 1100 to 1208. This older alluvium has been incised by a sequence of channels that have been backfilled with younger alluvial deposits. This younger alluvium was observed from about station 620 to the south end of the trench.

The older alluvial deposits exposed in the northern portions of the fault trench include a moderately well developed surface soil profile north and south of the fault zone and a similarly developed buried soil profile to the south of the fault zone (Figure 3 and Figure 6). The characterization of the soil profile as "moderately well developed" refers primarily to the relative strength of development of the argillic (clay enriched B) horizon. The diagnostic characteristics of the argillic horizon include thickness, color, and clay film development. The argillic horizon noted was approximately 30cm in thickness, has a reddish brown color (7.5YR 4/4), and has common, moderately thick and many thin clay films.

By comparison to described argillic horizons in established soil chronosequences in similar geologic settings, an age estimate for the site soils can be made. McFadden and Weldon (1987) described a soil chronosequence in primarily coarse alluvial deposits in Cajon Pass, and Hatch (1987) described a sequence of soils in similar alluvial fan deposits in northern Baja California (Valle Agua Blanca). By comparison, the upper soil exposed in the trench would compare with soils estimated to be on the order of 15 to 20 thousand years old in these other areas. Based on this comparison to other dated soils, the deposits in the older alluvium (that contain two moderately well developed argillic horizons are estimated to be on the order of at least 30,000 to 40,000 years old, and were assigned a late Pleistocene age. These deposits are likely to be somewhat older than 30,000 to 40,000 years since the surface soil characterized here is on a geomorphic surface that is actively being degraded. The episodic movement and uplift from faulting has created a slight warping or doming of the fan surface. Erosion of the uplifted surface tends to minimize the thickness and development of the soil profile in the location described.

The younger alluvial depositional sequence exposed in the southern portion of the trench appears much younger than the late Pleistocene age deposits of the older alluvium. Fan processes are still actively modifying this lower geomorphic surface. Deposition and braided channel formation and subsequent erosion are both occurring on this active surface. At least two weakly developed soils are present within these younger fan deposits, both characterized by A/C profiles[2] with no apparent development of an argillic B-horizon. This weak level of soil development indicates an age of only a few thousand years. Based on geomorphology and soil development, we estimate that the younger alluvial deposits are of late Holocene age.

Inherent to the accumulation of an alluvial depositional sequence are periods or episodes of erosion. Erosional contacts are produced by the cutting and scour of water through previously deposited alluvium, resulting in discordant contacts between depositional sequences and tabular to lensoidal channel deposits. The margins of channel deposits are typically low to high angle erosional surfaces that flatten and are continuous with a channel bottom. Sediments on either side of this erosional contact typically do not match, as they are the consequence of two separate depositional events. In some circumstances channel margins can be mistaken for a fault because they occur as a low to high angle contact with dissimilar depositional layers on either side of the surface. Distinguishing between questionable channel margins and faults was typically accomplished by locally hand digging the trench deeper to demonstrate that the channel margin flattens and continues into a channel bottom. In all but one case a channel bottom and continuous layering below the channel could be exposed to verify the questionable channel margin's origin as an erosional/depositional feature. In one case, at about station 215, a north-dipping feature was tentatively identified as either a fault or a channel margin. The orientation of this feature is N62°W, 23°NE, approximately parallel to the trend of the Banning fault, and thereby suggesting it may be a fault. Despite efforts to hand dig the trench deeper, unequivocal evidence regarding its origin (i.e. exposure of a channel bottom, or definitive offset of stratigraphy) was not exposed. As such, this feature was tentatively interpreted to be a fault and therefore it is considered the southern most fault splay observed in the trench excavation.

Overall the alluvium exposed in the trenches was well stratified. Depositional contacts, and individual layers within a depositional sequence, such as sand lenses and beds, silt laminations, pebble layers, and stone lines, could be mapped as continuous features over horizontal distances of various lengths (Figure 6). These features, where unbroken or undeformed, provide geologic evidence that faulting had not occurred since their deposition.

---

[2] A/C soils profile is characterized by the presence of an A-Horizon and a C-Horizon. An A-horizon is an accumulation of organic matter mixed with a mineral fraction, with a higher relative percentage of the latter. A C-Horizon lacks properties of A and B-Horizons, but includes materials in various stages of weathering.

In this way, overlapping continuous features were mapped along the length of the trench to document the absence of faulting south of trench station 215.

5.0 DISCUSSION OF RESULTS

The trenching study and the seismic refraction surveys identified several faults in the immediate vicinity of the mapped trace of the Banning fault. No faults were found in the trench within the area of the proposed power plant. As exposed in the trench, the distance from the southern most interpreted fault, and the northern limits of the plant site is approximately 235 feet.

There is a good spatial correlation between the trend of the northernmost fault indicated on RS01-1 and RS01-2; and the northern splay of the Banning fault, as mapped by CDMG (1980). However, confirmation of this correlation was beyond the scope of this study.

The faulting and folding observed in the trench between stations 60 and 215 corresponds well with the middle mapped trace of the Banning fault as mapped by CDMG (1980), as well as the northern most fault logged in the Rasmussen trench (Kahle et al., 1987). This zone of faulting and folding within the trench might also correspond with the southern of two faults indicated on the seismic refraction lines.

The southern splay of the Banning fault, as mapped by CDMG (1980) terminates in the vicinity of the trench. However no evidence of faulting was found in the trench exposures at the mapped intersection of this southern splay with the trench. The southernmost faults interpreted on RS01-1 and RS01-2 appear to correlate with the middle and/or the southern fault splays as mapped by CDMG. The above data indicate that the southern splay either terminates or merges with the middle splay east of the fault trench.

The projections of the faults logged within the southern portion of the Rasmussen trench, were also not observed within the trench exposure. In this area, the Banning fault is mapped as a compressional left-step by CDMG (1980). Faulting within a compressional step can be a complex system of short-discontinuous fault segments. As such, direct correlation of all fault segments between trenches may not be possible.

Based on relative soil profile development, the older alluvium is estimated to be late Pleistocene in age, and deposited at least 30,000 to 40,000 years before present, and the younger alluvium is considered to be a late Holocene deposit, deposited a few thousand years before present. These relationships indicate that if faults are present beneath the unfaulted older alluvium that was exposed in the trench between stations 215 and 1002, and between stations 1100 and 1208, then they must have been inactive for at least 30,000 to 40,000 years, and therefore are pre-Holocene in age. The late Holocene deposits exclusively exposed in the trench between stations 1002 and 1100, between stations 1208 and 1270, and between stations 1305 and 1440 showed no evidence of faulting. Based on the currently available trench data, Holocene age faulting could potentially exist beneath the exposed younger alluvium. However, these areas where the absence of Holocene faulting cannot be unequivocally determined are well outside the Alquist–Priolo Earthquake Fault Zone. Lacking evidence to suggest otherwise, the potential for finding splays of the Banning fault at this distance from the main fault zone is considered remote.

In summary, the previous trenching by Rasmussen, and the mapping by CDMG, as well as the geophysical and trenching studies completed during this investigation indicate that the surface rupture potential associated with the Banning fault is confined to the area north of the proposed power plant.

6.0 CONDITIONS

This report presents professional interpretations and judgements for the project based on a review of the available information and on our geologic and geophysical investigation. In view of the general geology of the area, the possibility of different conditions elsewhere on the site cannot be discounted. We do not guarantee the performance of the project in any respect, only that our geologic work and judgements rendered meet the standard of care in our profession at this time.

7.0 CLOSURE

We appreciate the opportunity to be of assistance to INA and Bechtel on the Ocotillo Power Project. If you have any questions regarding this report, please call at your convenience.

Very truly yours,

URS CORPRATION

Garry Lay, P.E.
Project Manager

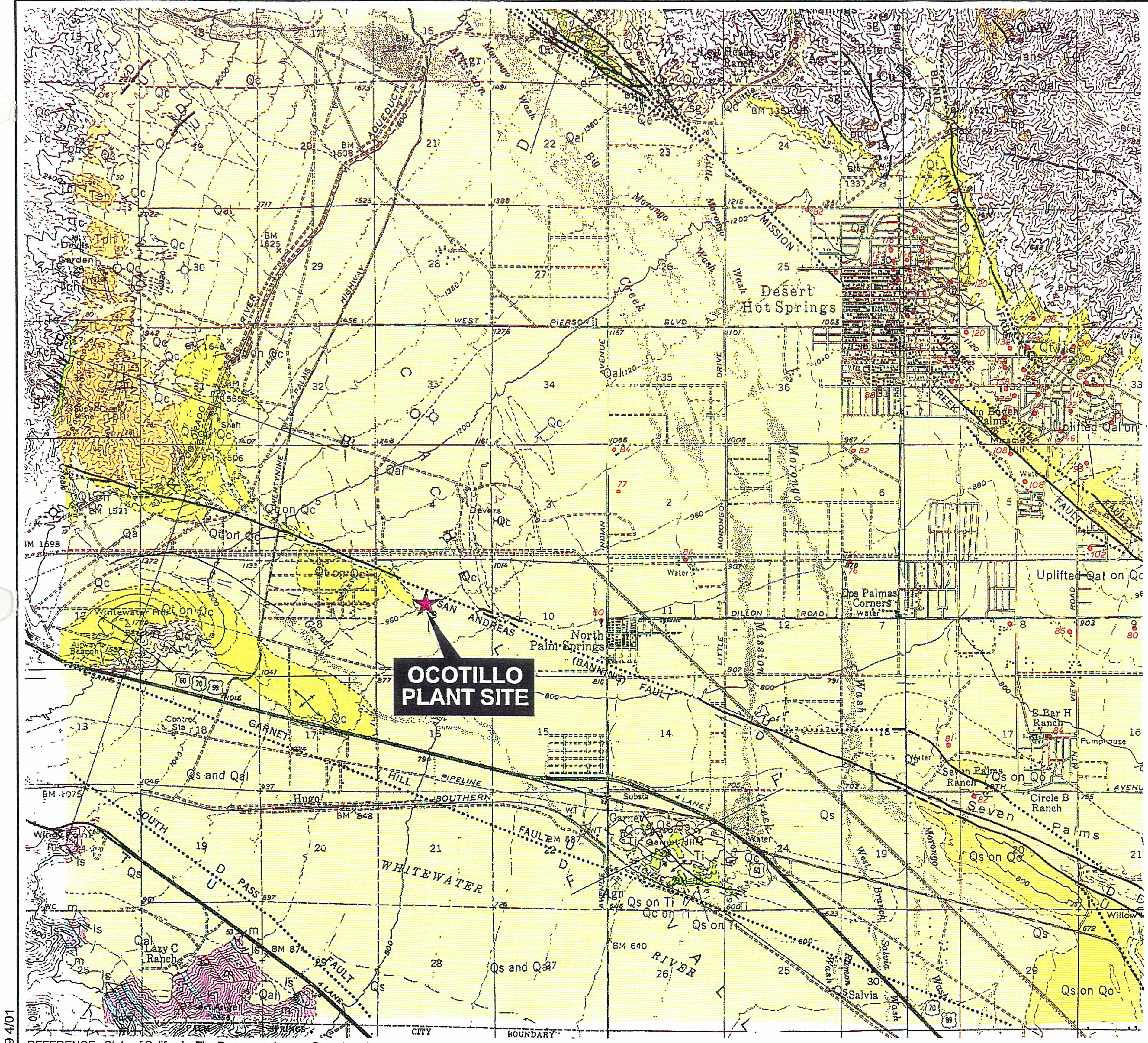
Martin Siem, R.G.
Task Manager

Chris Goetz, C.E.G.
Project Geologist

cc Mr. Robert Hren

ATTACHMENTS

Figure 1- Area Geology
Figure 2- Site Map
Figure 3- Trench Log (Sheets 1 through 22)
Figure 4- Banning Fault Zone
Figure 5- Argillic Soil Horizons
Figure 6- Examples of Layered Stratigraphy
Attachment A- Seismic Refraction Data
Attachment B- References



REFERENCE: State of California, The Resources Agency, Department of Conservation, Division of Mines and Geology, Desert Hot Springs Area, Riverside County, California, 1968, Special Report 94 by R.J. Proctor

N

0 1 2
Scale in Miles

EXPLANATION

QUATERNARY

Recent

Qs — Superficial Sand
Mainly blowsand; few dunes

Qal — Alluvium

Upper Pleistocene

Qt — Terrace Deposits
Thin orange mantle of gravels

Qc / ss Qo — Cabezon Fanglomerate and Ocotillo Conglomerate
Sandy ill-sorted lightbrown conglomerate: ss=resistant sandstone beds

TERTIARY

Middle Pliocene To Lower Pleistocene

cg Tph Tpc b Tps — Painted Hill and Palm Springs Formations, Canebrake Conglomerate
Tph, Tpc=sandy well rounded conglomerate, Tps=siltstone; cg=resistant conglomerate bed; b-olivine basalt

Lower Pliocene

Ti — Imperial Formation
Marine sandstone and shale, fossiliferous

Upper Miocene(?)

Tcb Tc Ts — Coachella Fanglomerate and Split Mountain Formation
Red-brown conglomerate and coarse sandstone: Tcb-olivine basalt; Ts=(shown in sections only)

MAINLY PRE-MESOZOIC

m ls — Metamorphic Rocks of the San Jacinto Mountains
Mica shist, gneiss and dikes; ls=recrystallized limestone large aplite dikes and sills shown in red

bp c sg di xe gm — San Gorgonio Complex (Chuckwalla Complex)
Mainly contorted migmatitic gneisses; c=Cactus Granite of Vaughn (gm=quartz monzonite; di=dioritic porphyry; bp=basic plutonic rocks (gabbroic). xe=xenolith breccia; large aplite dikes shown in red

SYMBOLS

Contact
(Dashed where approximately located, gradational or inferred)

U D
Fault, showing dip
(Dashed where approximately located; queried where uncertain; U, Upthrown side; D, downthrown side)

Concealed fault

Fault, showing relative movement

A T
Fault plane in section
(A=away; T=toward)

Strike and dip of beds

Strike and dip of foliation

Axis of syncline

Axis of anticline

Anticline showing direction of plunge

Abandoned oil well site

Landslump
(on Whitewater Hill)

Mine or quarry
Agr-aggregate
Au-gold
Cu-copper
St-building stone
W-tungsten

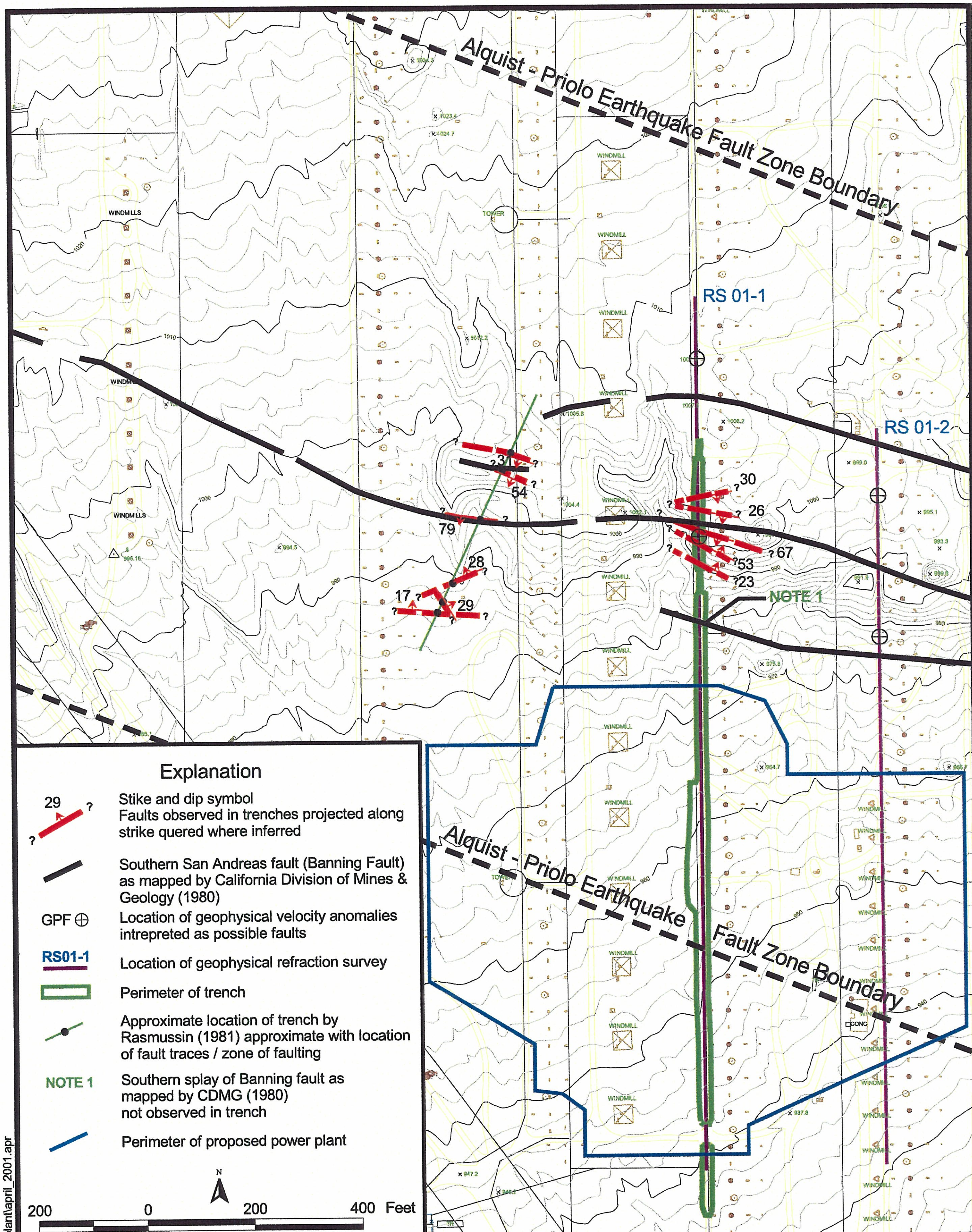
Water well and water temperature (°F.)

AREA GEOLOGY
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 1
Date: APRIL 2001	

URS

L:/Ocot...ig 1.fh9 4/01



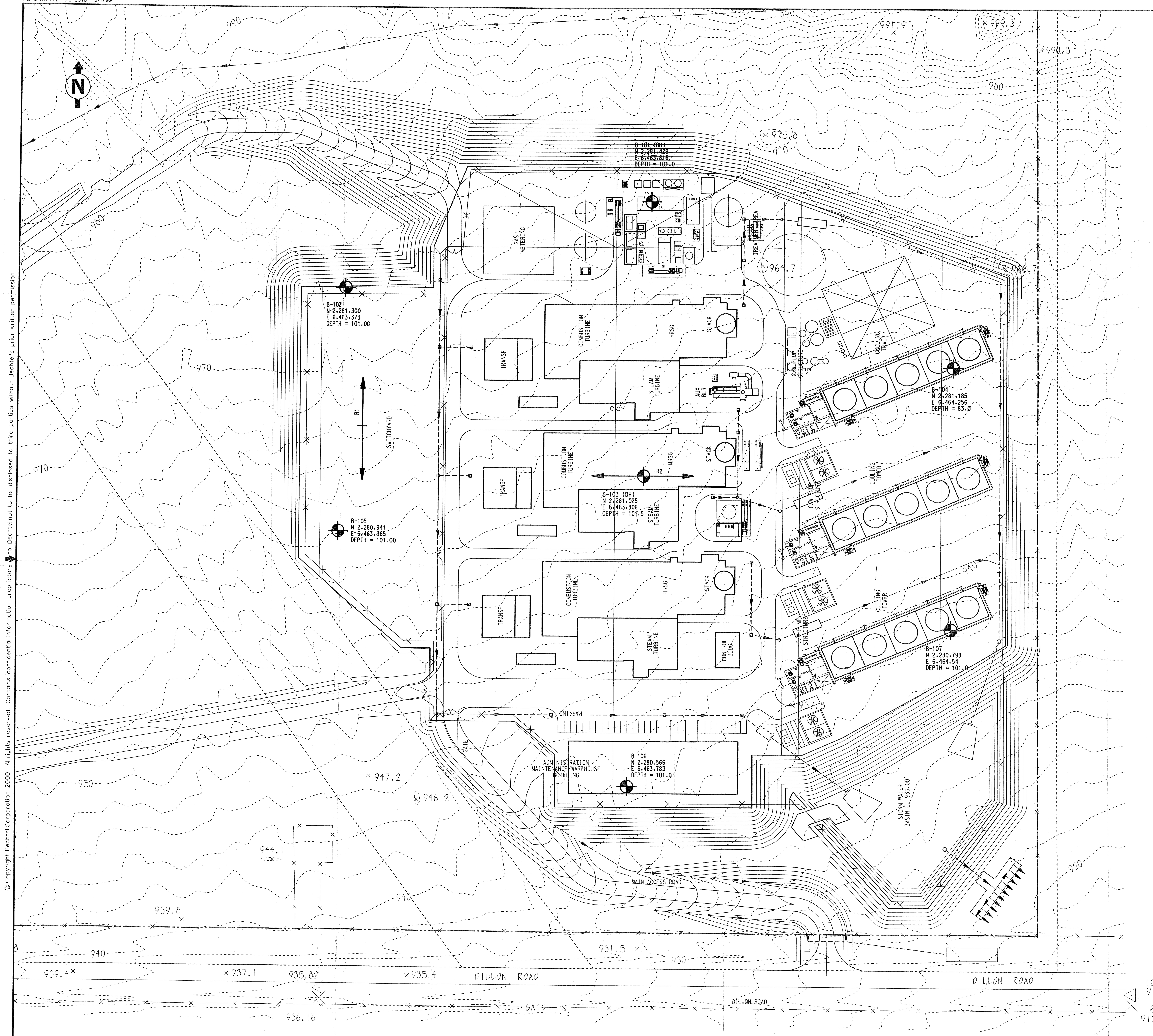
Site Map

Project No: 66-00000023.02	Date: April 2001	Ocotillo Energy Plant	Figure: 2

URS

g:\Ocotillopowerplantapril_2001.apr

FORMATS.CEL AC-ESTD 3/1/99



LEGEND:

BORING

RESISTIVITY LINE

(DH) DOWN HOLE SEISMIC TESTING

R1 AND R2 RESISTIVITY LINES HAVE THE FOLLOWING SPACINGS IN FEET:
0.5, 1, 2.5, 5, 10, 20, 30, 50, 100

NO.	DATE	REVISIONS	BY	CHK	DES SUPV.	ENGR.	PROJ ENGR	APPR
	/ /							
	/ /							
	/ /							
C	4/11/01	REVISED SEISMIC TEST TYPE AND LOCATION	JJM	[illegible]		[illegible]	[illegible]	
B	03/21/01	AS-BUILT FOR PHASE 1	JJM	RW	-	NM	CW	
A	02/14/01	ISSUED FOR USE	JJM	RW	-	NM	CW	

SCALE 1" = 50' | DATE 02/13/01 | DESIGNED | DRAWN JJM | CHIEF ENGR.

BECHTEL
FREDERICK, MARYLAND

OCOTILLO ENERGY PROJECT
INTERGEN NORTH AMERICA, L.P.

SUBSURFACE
INVESTIGATION PROGRAM

JOB NO.	DRAWING NO.	REV.
24268-20A	CY-0100-00001	C

34"X44"E SIZE

LEGEND

COARSE GRAVEL - clasts that pass a 3" sieve but are retained on a No. 4 (4.75 mm.) sieve. Coarse gravels commonly contain some cobble (3" to 12") size clasts, and occasional boulder (greater than 12") size clasts.

FINE GRAVEL - clasts that will pass a ¾" sieve and be retained on the No. 4 sieve (4.75 mm.)

SAND - grains that will pass No. 4 (4.75 mm.) sieve and be retained on the 200 sieve (0.075 mm.)

SAND WITH FINES - mostly comprised of sand with a substantial component of fines (silt and/or clay) that pass the 200 sieve (0.075 mm.)

INTERLAYERED AND LAMINATED SAND & GRAVEL - statigraphic unit that consists of an alternating sequence of fine gravel and medium to coarse laminated sand with minor silt. Locally cross bedded.

DEBRIS - the disturbed soil material left from the excavation process on intermediate benches within the trench.

CONTACT - the boundary between differentiated depositional units of variable grain size. Contacts are depicted as a solid line where clear, and as a dashed and queried line where uncertain or inferred.

SOIL HORIZON BOUNDARY - typically a gradational boundary between differentiated soils that are the result of pedogenic (soil forming) processes. Soil Horizon Boundaries are depicted as discontinuous and queried in areas where they are uncertain or inferred.

fus FINING UPWARD SEQUENCE - a graded stratigraphic sequence that is characterized by grain sizes that fine upward.

cus COARSENING UPWARD SEQUENCE - a reverse graded stratigraphic sequence that is characterized by grain sizes that coarsen upward.

STONE LINE - a distinct but thin layer of gravel size clasts.

LAMINATION - a fine layering, less than 1 cm in thickness, defined by the alternation of material which differs one from the other in grain size.

CALICHE HORIZON - stratigraphic layer impregnated with caliche.

ROOT CASTS - a linear shaped accumulation of calcium carbonate that concentrates within the soil adjacent to the root of a plant.

FAULT - a fracture or fracture zone along which there has been displacements of the sides relative to one another parallel to the fracture. Faults are depicted as solid lines where clear, and as dashed and queried lines where uncertain or inferred.

HOLOCENE AGE ALLUVIUM shown with white background
and
PLEISTOCENE AGE ALLUVIUM shown with light gray background

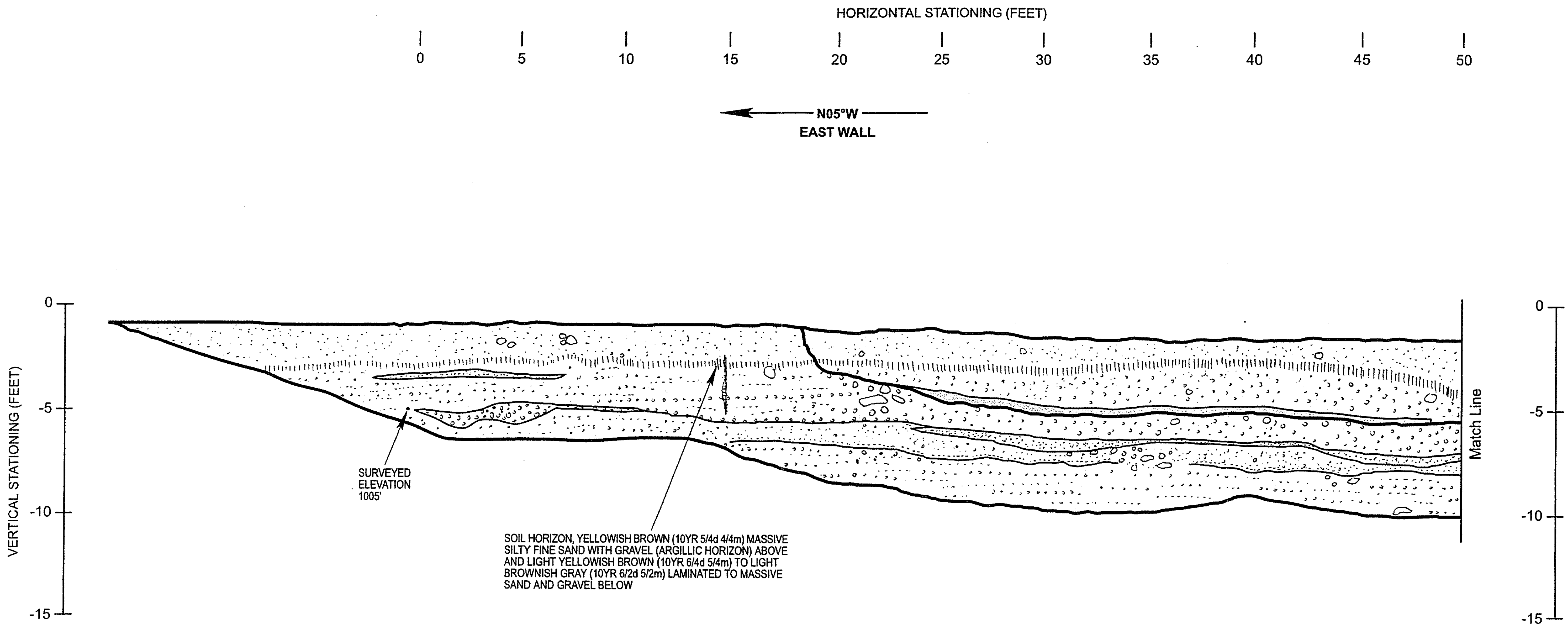
TRENCH - top, bottom and intermediate benches.

Note: Stratigraphic units delineated on the trench log were based on a visual inspection. Visual-manual procedures for classification of soils according to ASTM Designation D2488 were not employed. As such, the description of the units within the trench should not be relied upon for engineering purposes.

TRENCH LOG OCOTILLO ENERGY PROJECT	
Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 1 of 22

URS

L:/Ocotillo/cross section 1.fh9 3/01



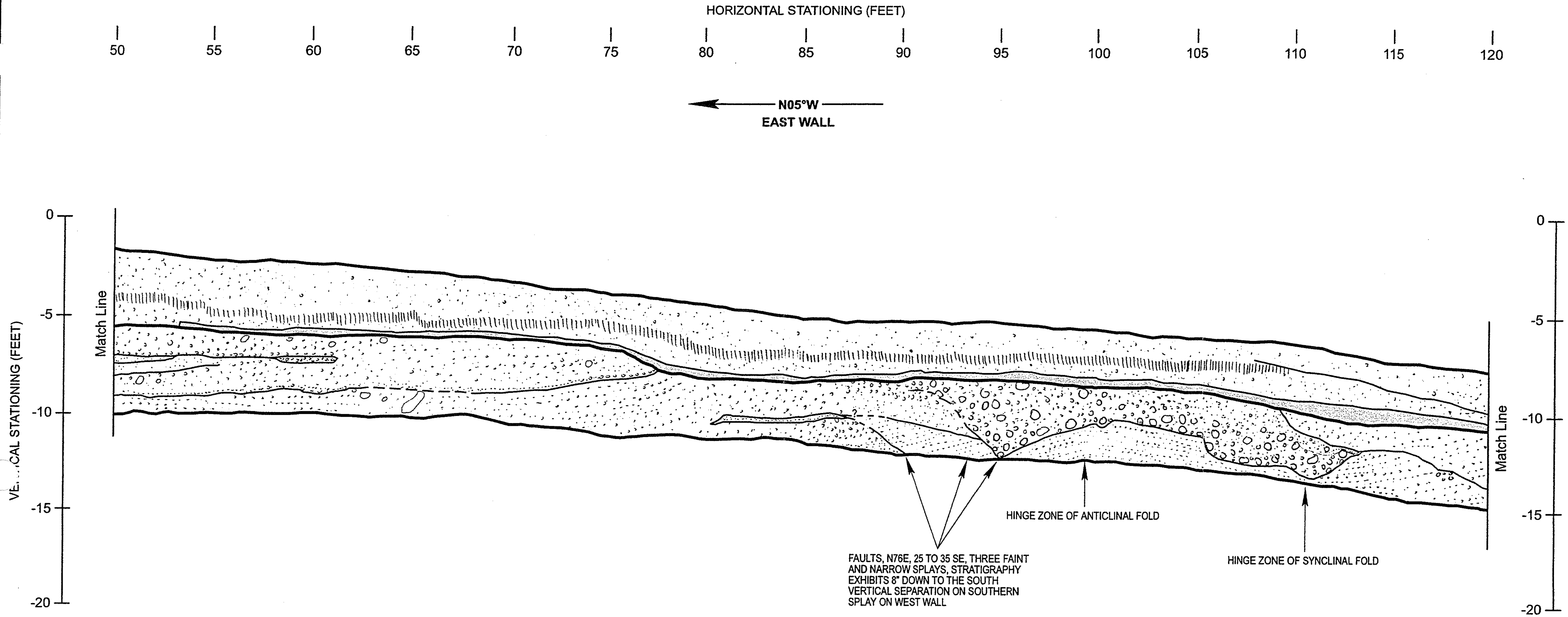
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 2 of 22

URS

L:/Ocotillo/cross-section 1.fh9 3/01



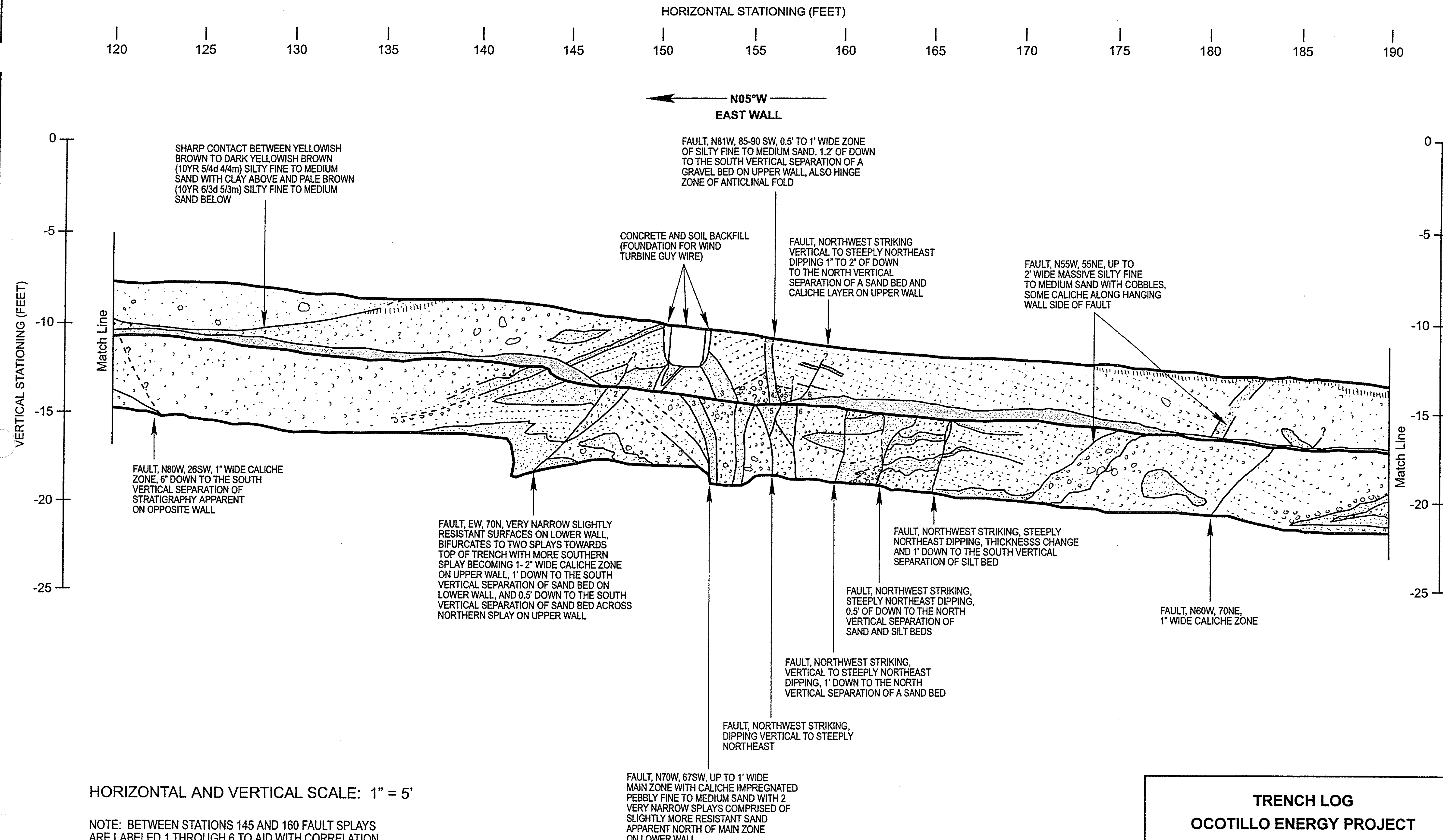
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 3 of 22

URS

L:/Ocotillo/cross-section 1.fh9



HORIZONTAL AND VERTICAL SCALE: 1" = 5'

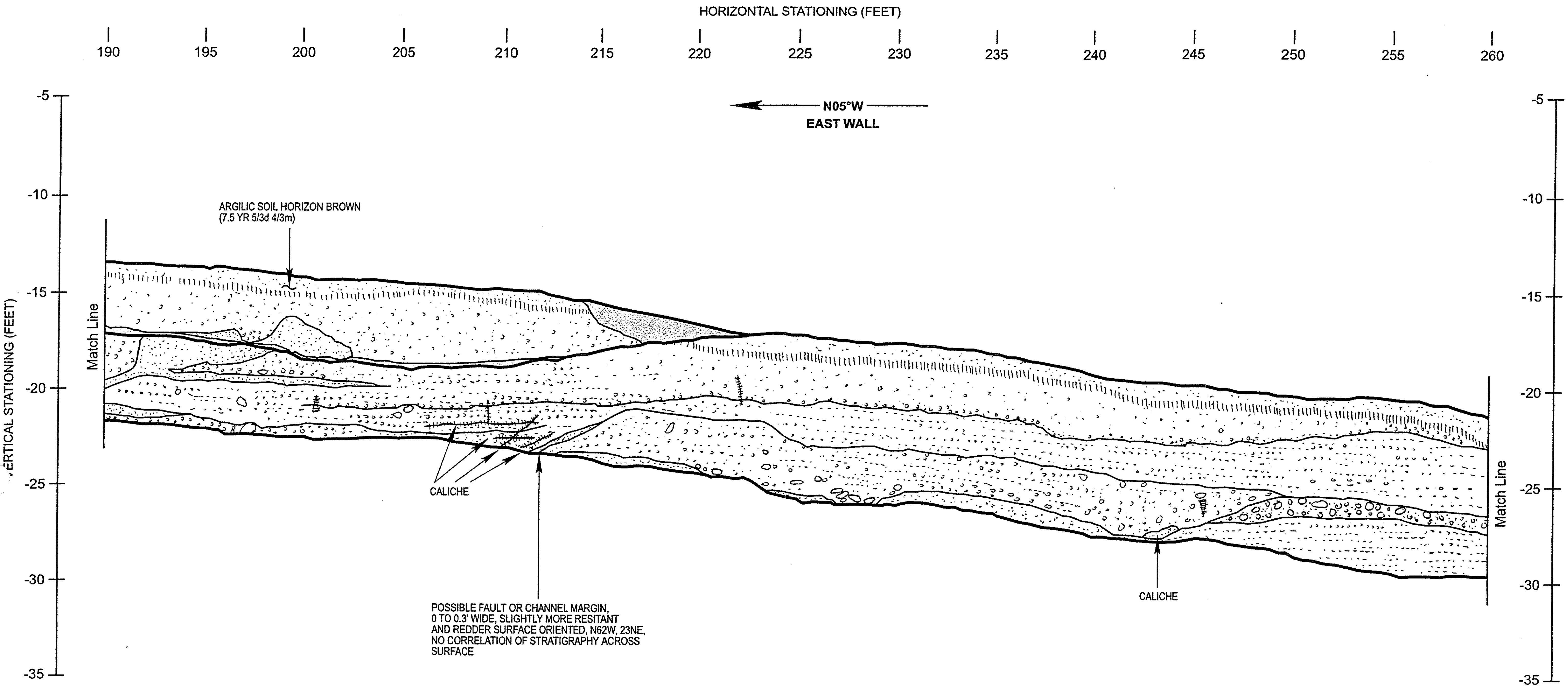
NOTE: BETWEEN STATIONS 145 AND 160 FAULT SPLAYS ARE LABELED 1 THROUGH 6 TO AID WITH CORRELATION OF FAULTS ACROSS BENCH FROM TOP OF LOWER WALL TO BASE OF UPPER WALL

L:/Ocotillo/cross section 1.fh9 3/01

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 4 of 22

URS



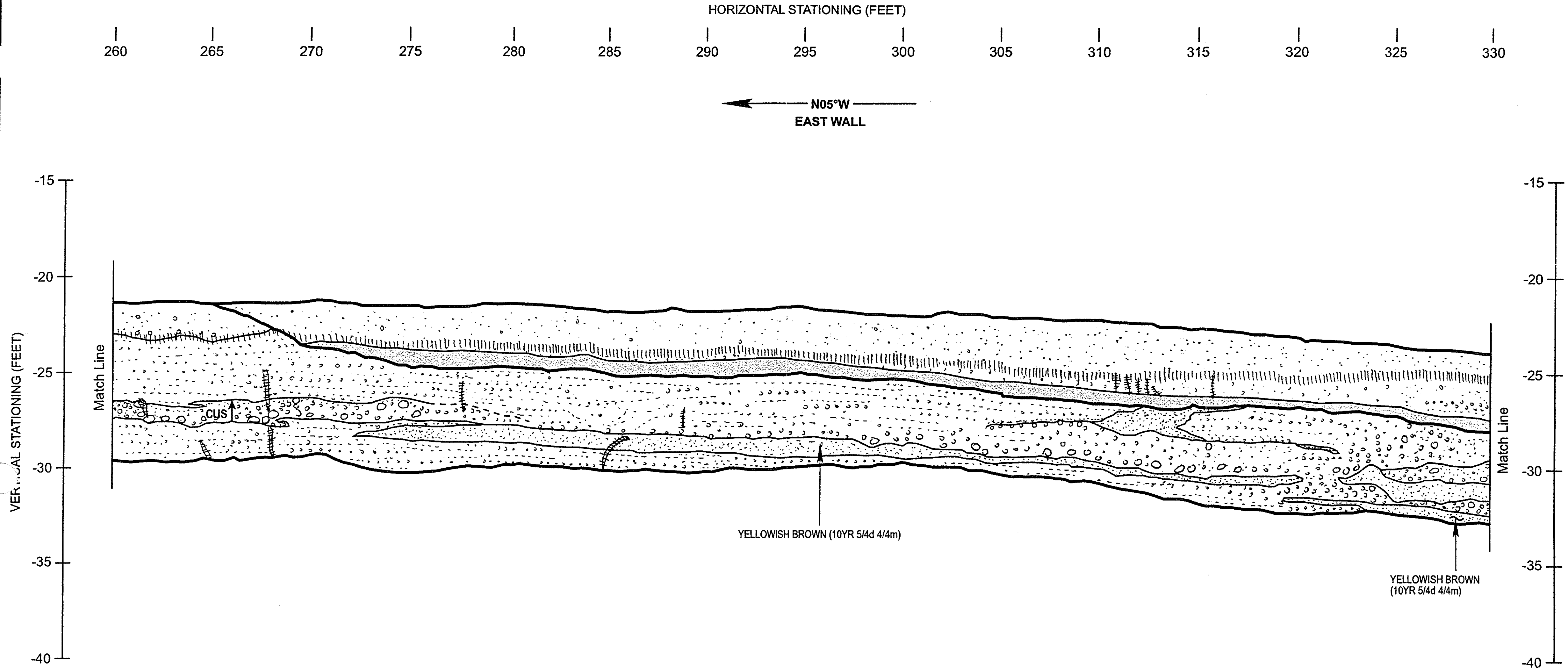
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 5 of 22

URS

L:/Ocotillo/cross-section 1.fh9 3/01

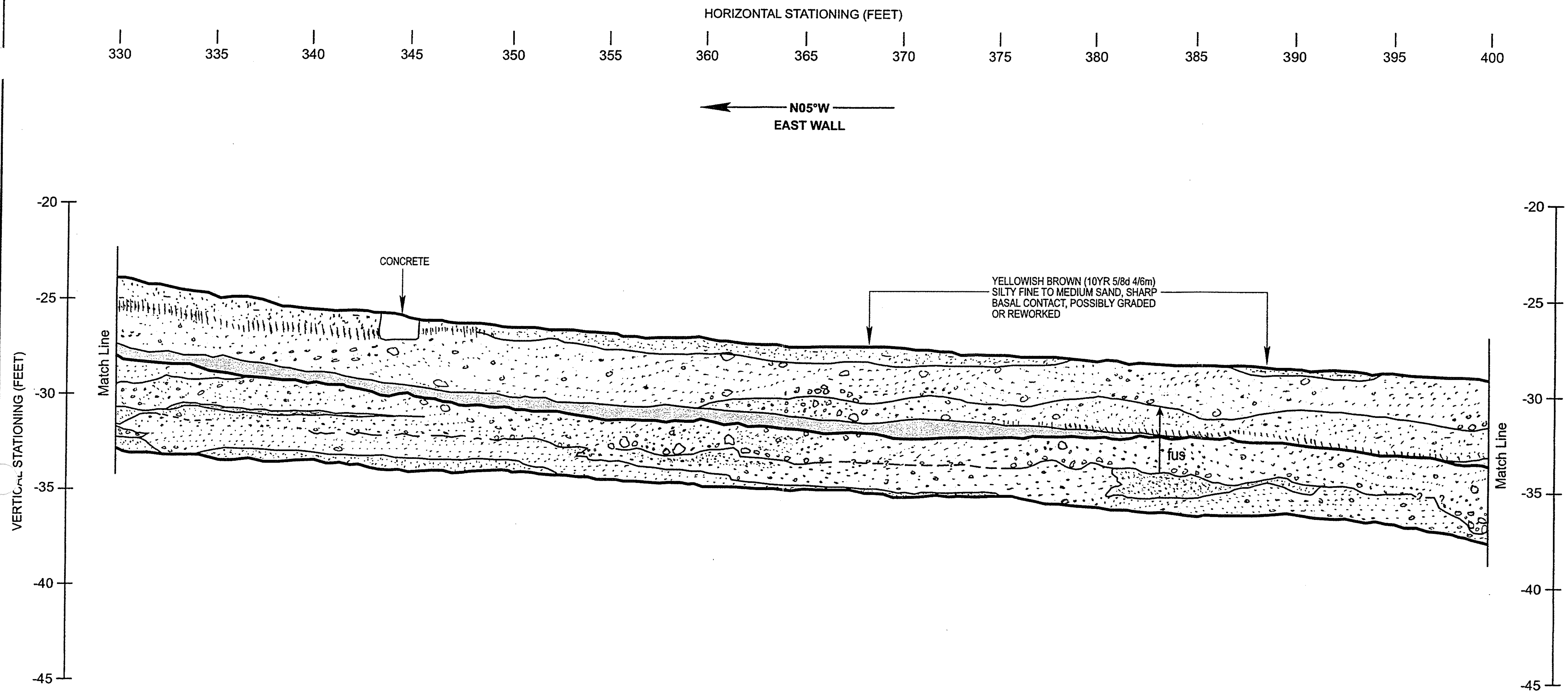


HORIZONTAL AND VERTICAL SCALE: 1" = 5'

L:/Ocotillo/cross section 1.fh9 3/01

TRENCH LOG OCOTILLO ENERGY PROJECT	
Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 6 of 22

URS



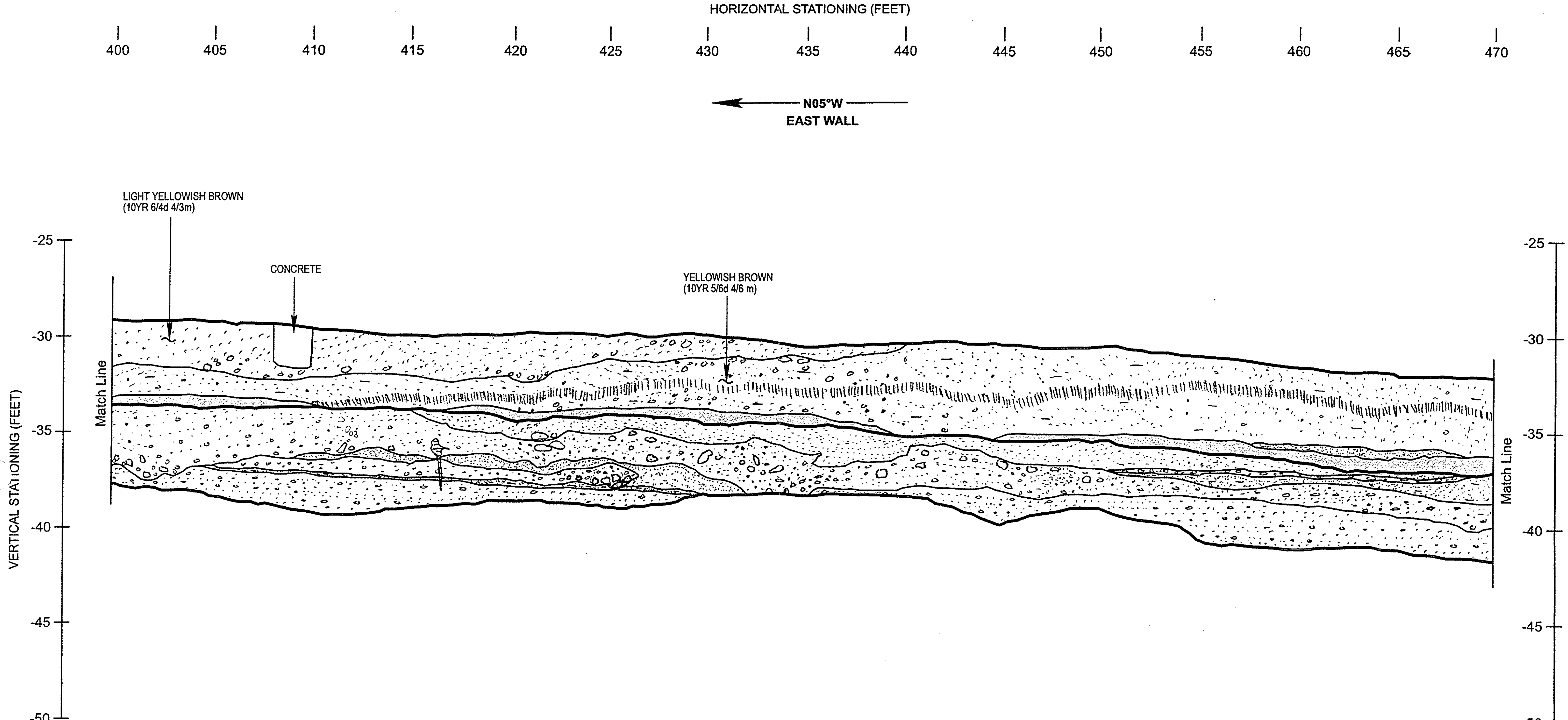
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

L:/Ocotillo/cross section 1.fh9 3/01

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 7 of 22

URS



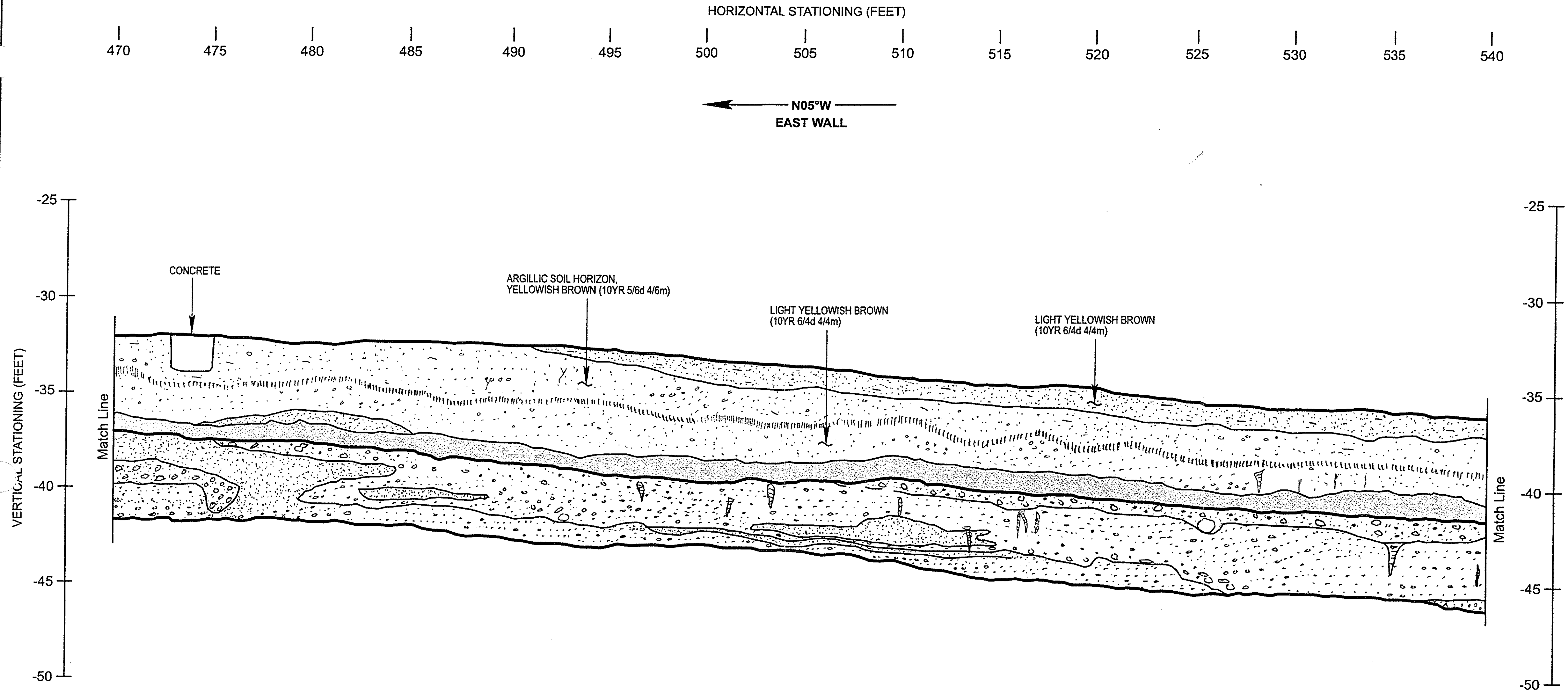
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

L:/Ocotillo/cro...ction 1.fh9 3/01

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 8 of 22

URS

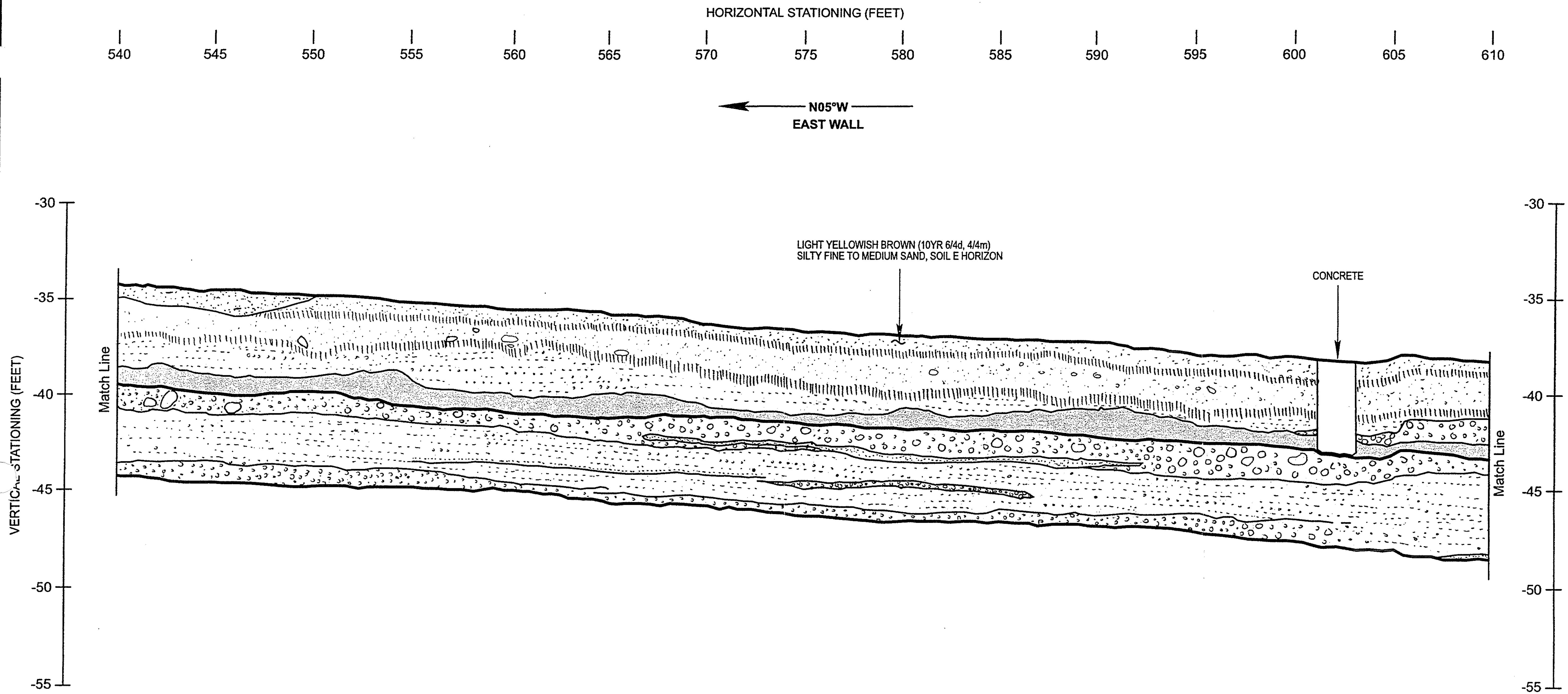


HORIZONTAL AND VERTICAL SCALE: 1" = 5'

L:/Ocotillo/cross-section 1.fh9 3/01

TRENCH LOG OCOTILLO ENERGY PROJECT	
Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 9 of 22

URS



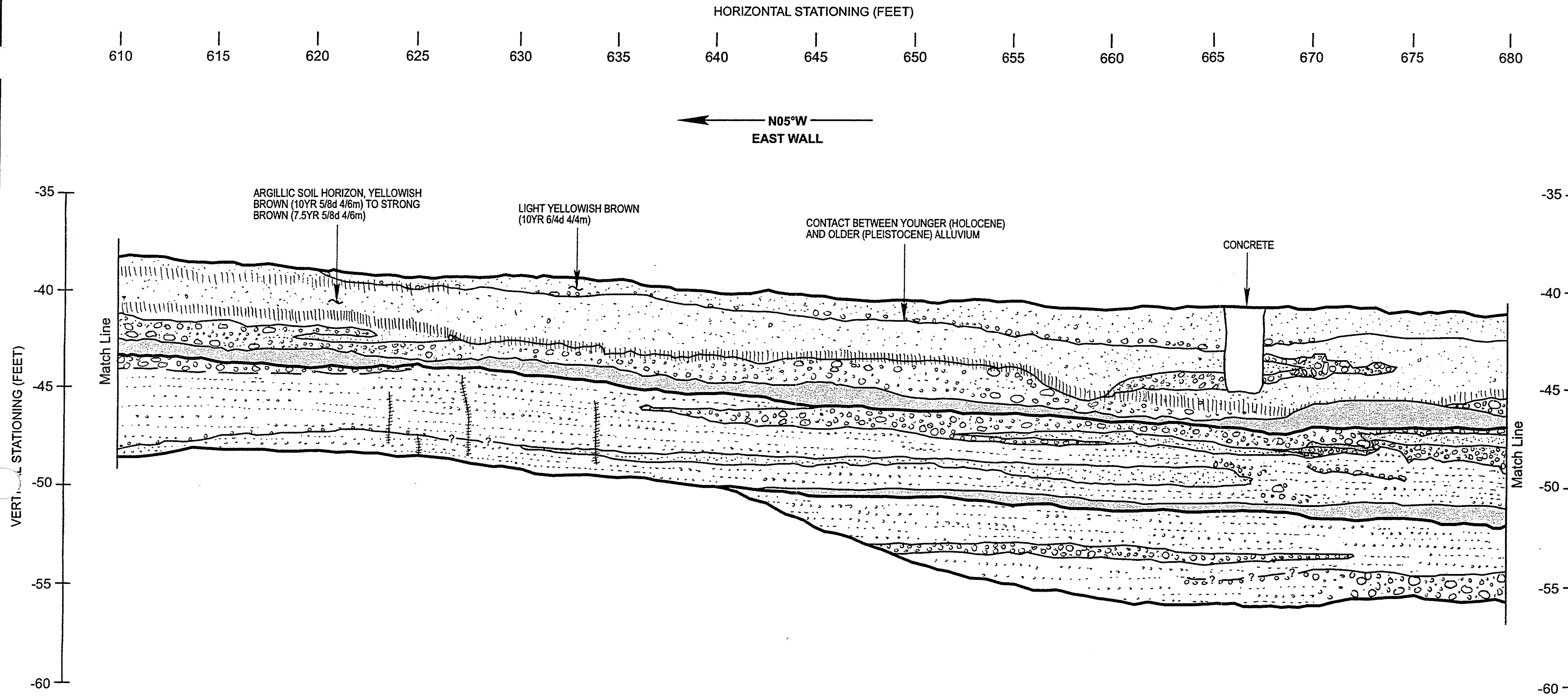
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

L:/Ocotillo/cross section 1.fh9 3/01

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 10 of 22

URS



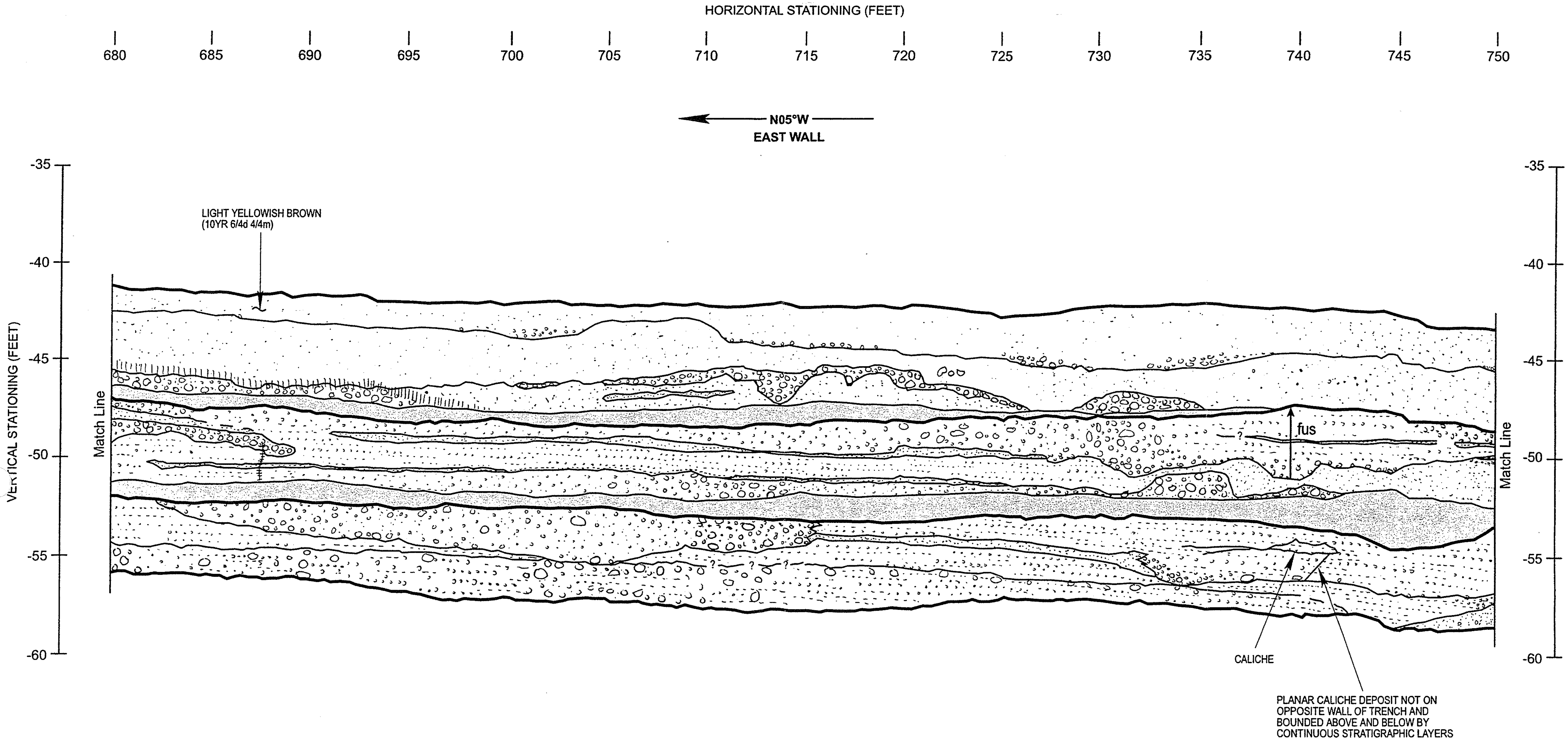
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: MARCH 2001	Sheet 11 of 22

URS

L:/Ocotillo/cross section 1.fh9 3/01



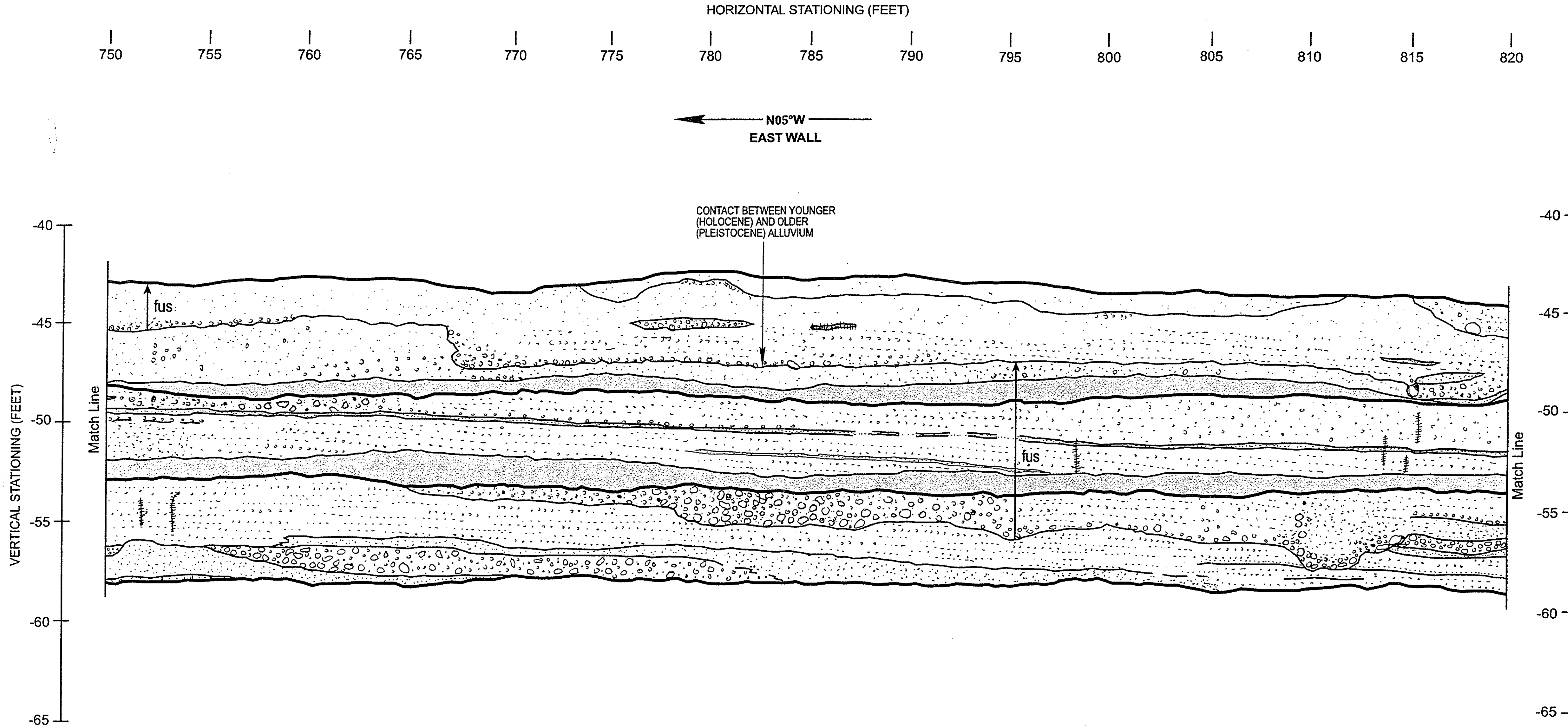
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 12 of 22

URS

L:/Ocotillo/cross-section 1.fh9 3/01



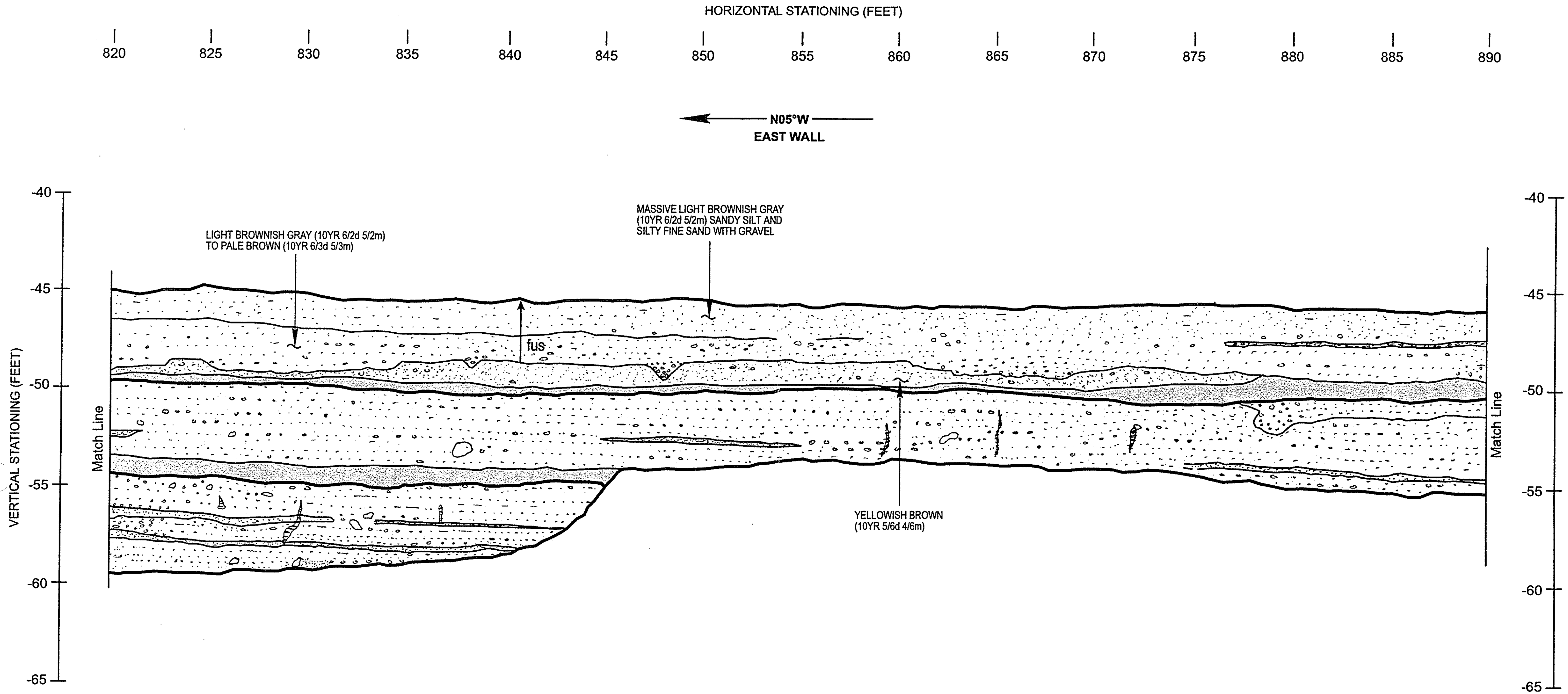
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 13 of 22

URS

L:/Ocotillo/cr...ection 1.fh9 3/01

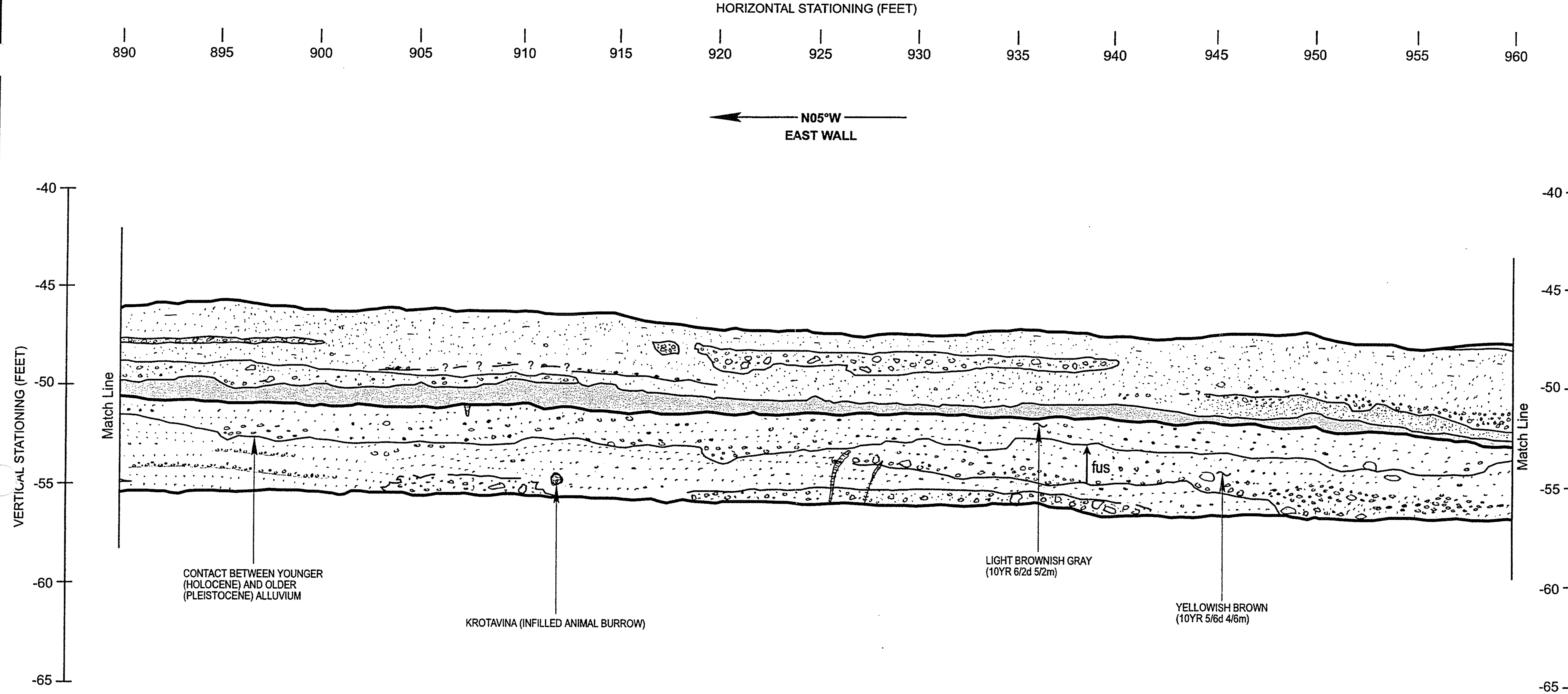


L:/Ocotillo/cross-section 1.fh9 3/01

HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG OCOTILLO ENERGY PROJECT	
Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 14 of 22

URS



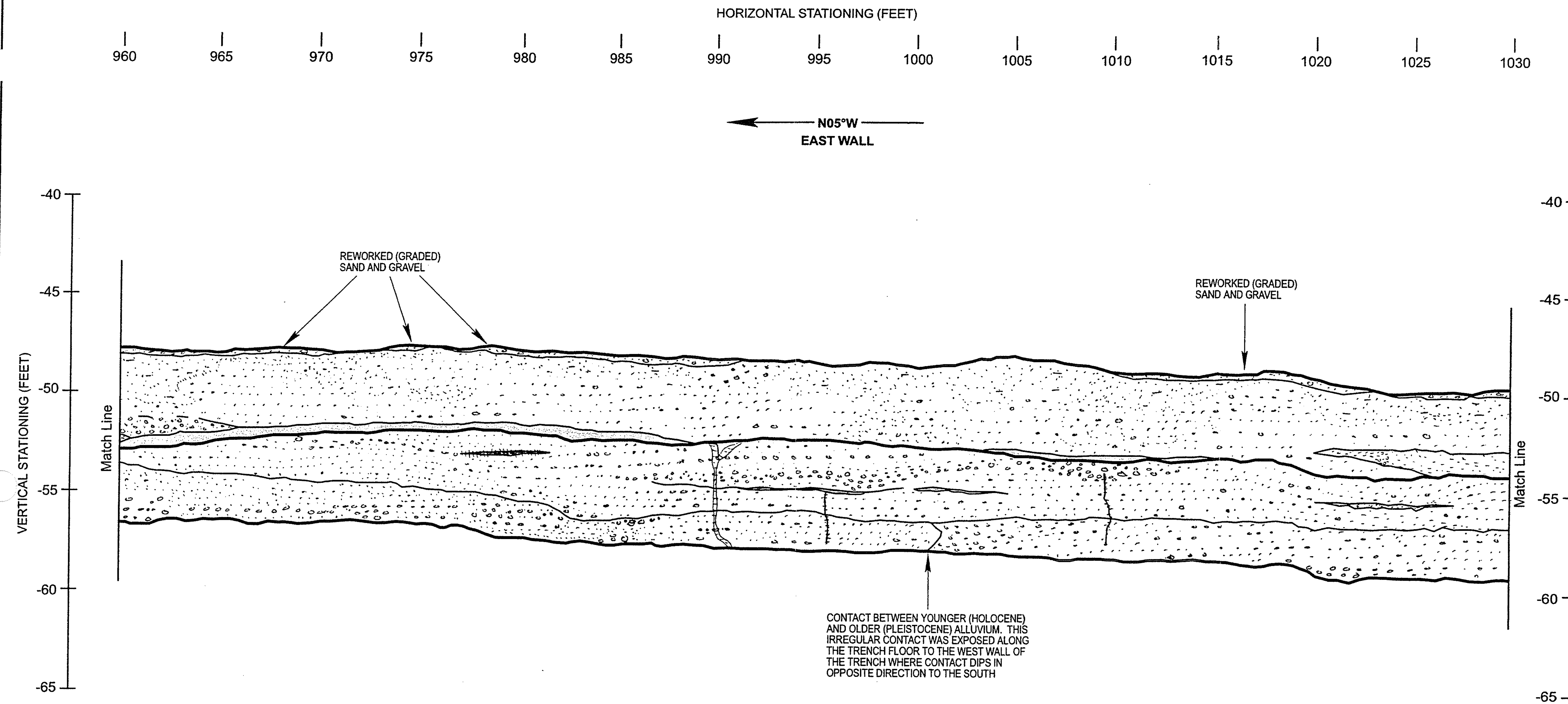
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 15 of 22

URS

L:/Ocotillo/cross section 1.fh9 3/01



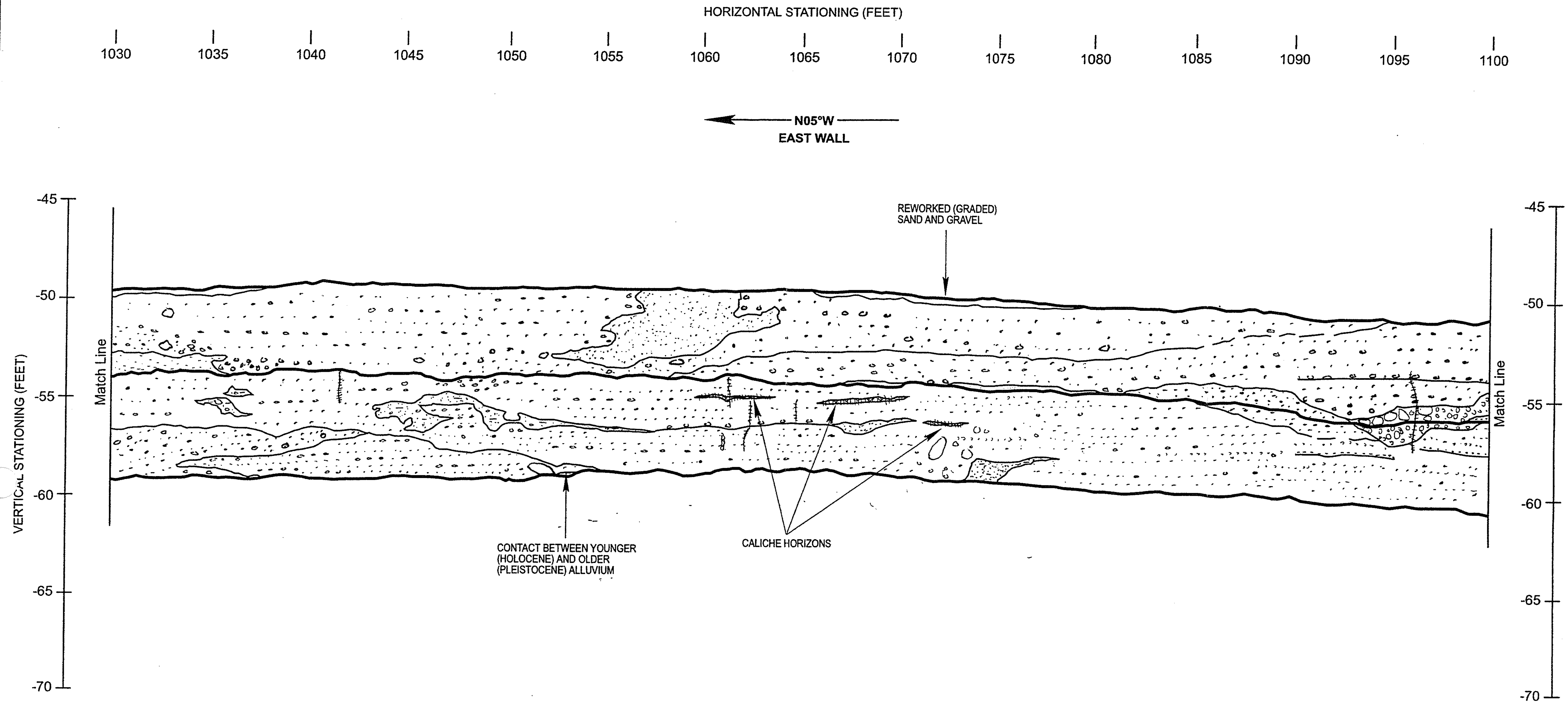
L:/Ocotillo/cross-section 1.fh9 3/01

HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 16 of 22

URS

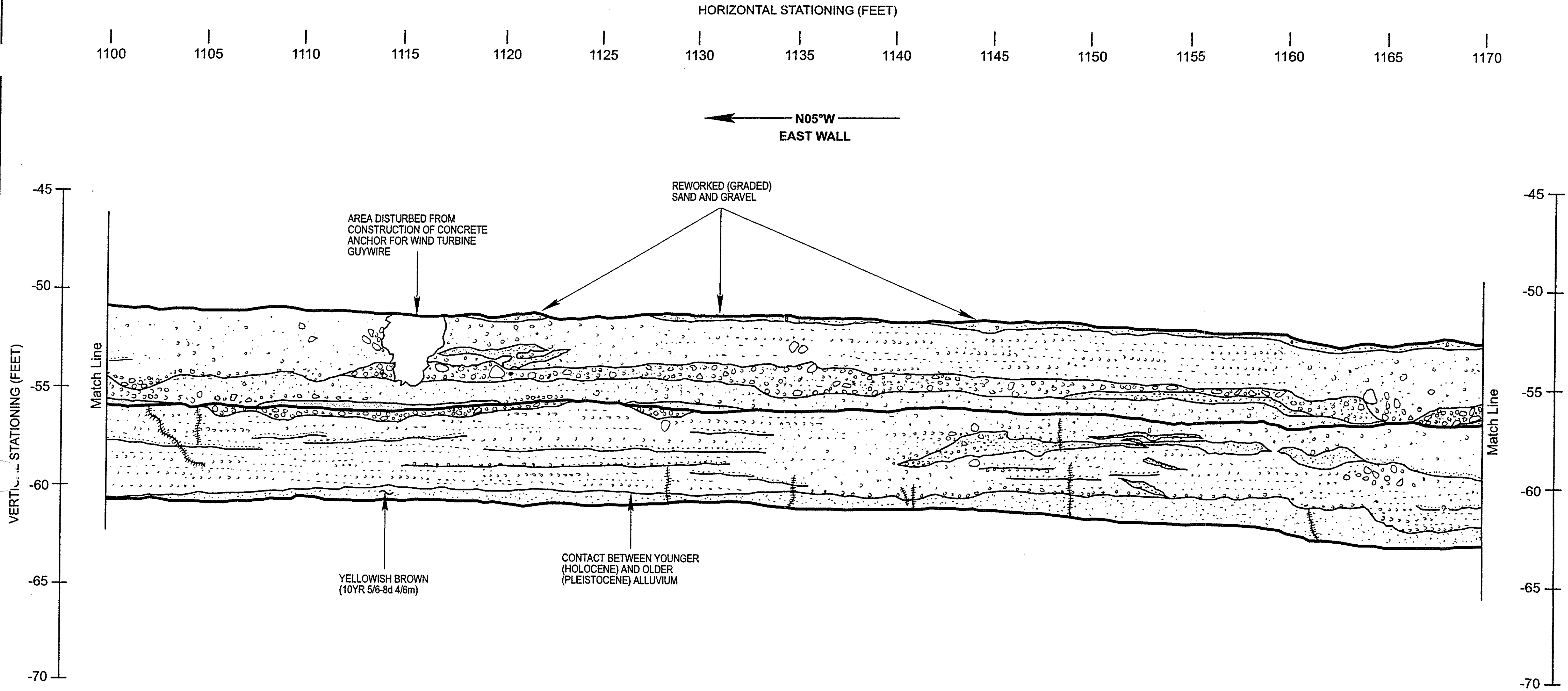


HORIZONTAL AND VERTICAL SCALE: 1" = 5'

L:/Ocotillo/cross section 1.fh9 3/01

TRENCH LOG OCOTILLO ENERGY PROJECT	
Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 17 of 22

URS



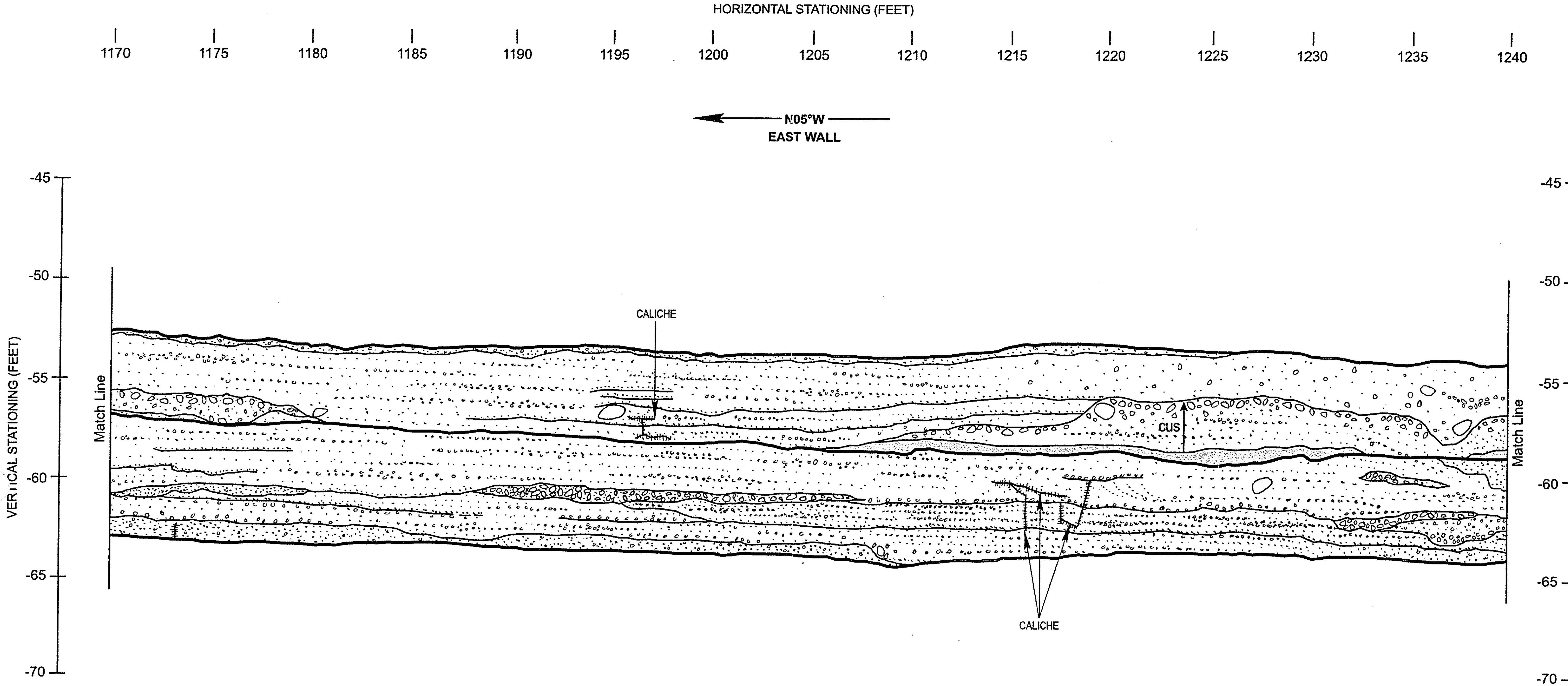
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 18 of 22

URS

L:/Ocotillo/cross section 1.fh9 3/01

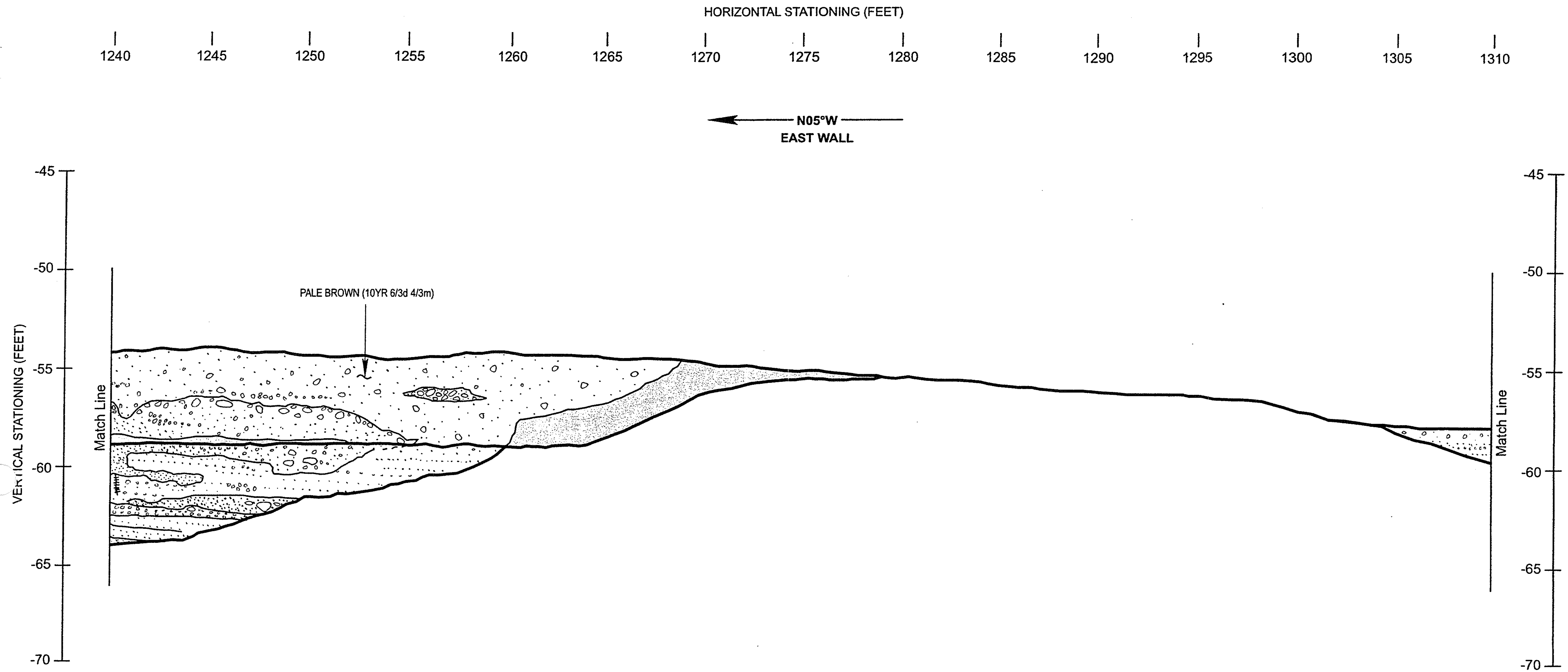


HORIZONTAL AND VERTICAL SCALE: 1" = 5'

TRENCH LOG OCOTILLO ENERGY PROJECT	
Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 19 of 22

URS

L:/Ocotillo/cross section 1.fh9 3/01



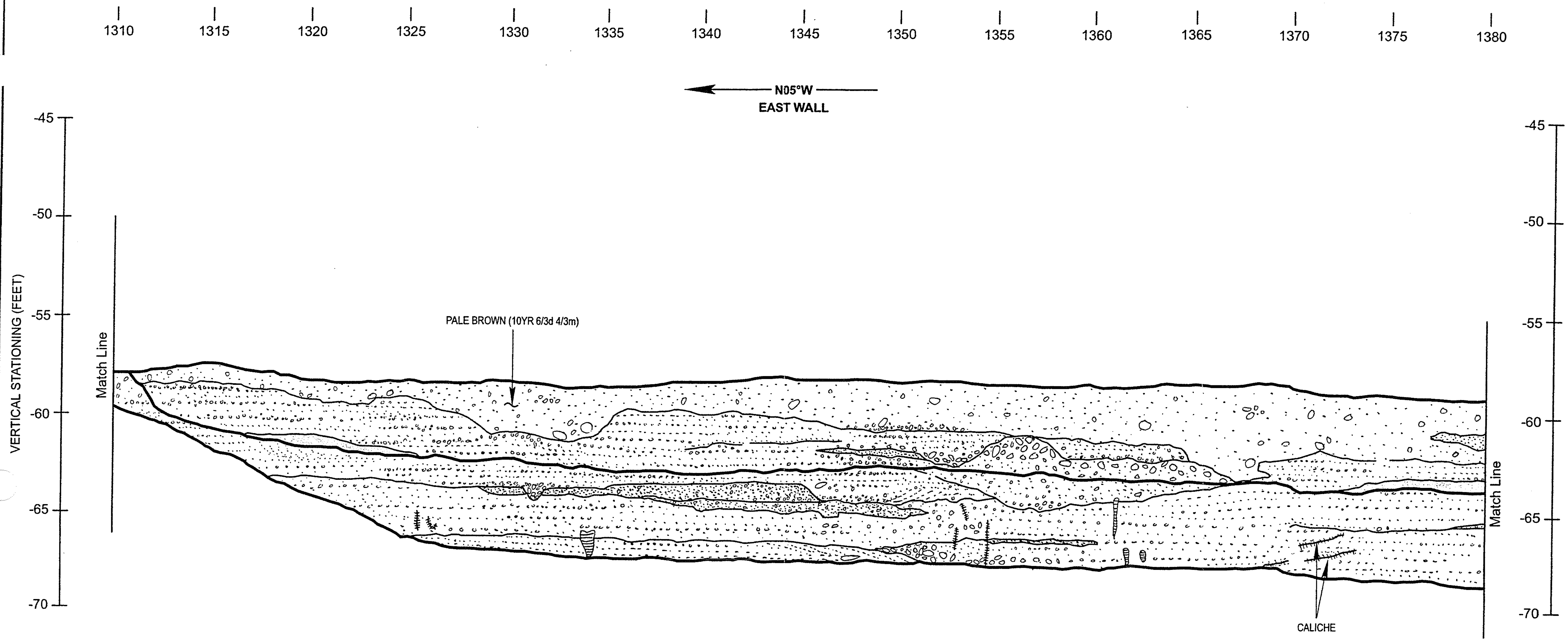
HORIZONTAL AND VERTICAL SCALE: 1" = 5'

NOTE: BREAK IN TRENCH DUE TO PRESENCE OF A BURIED HIGH VOLTAGE ELECTRIC LINE NEAR STATION 1290. EXCAVATION WAS SET BACK APPROXIMATELY 10 FEET ON EITHER SIDE OF ELECTRIC LINE.

L:/Ocotillo/cross section 1.fh9 3/01

TRENCH LOG OCOTILLO ENERGY PROJECT	
Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 20 of 22

URS

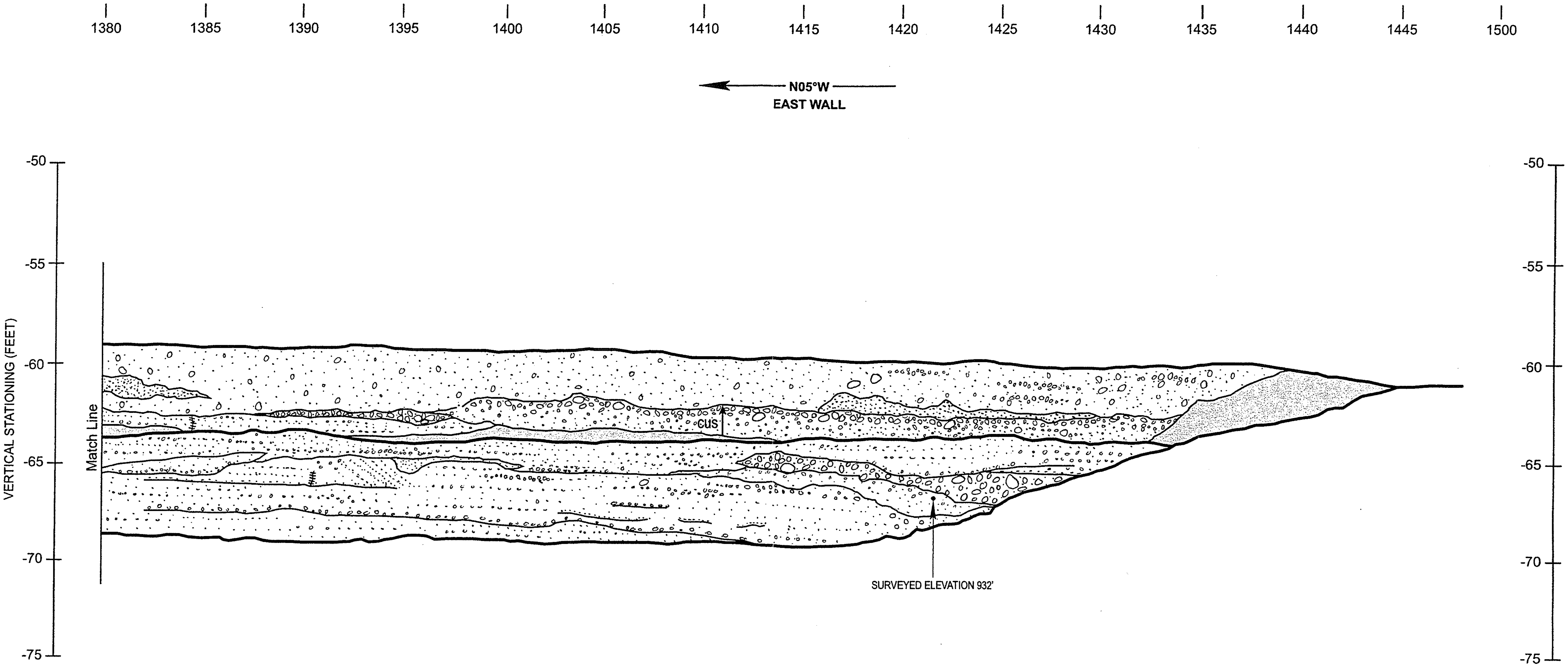


HORIZONTAL AND VERTICAL SCALE: 1" = 5'

L:/Ocotillo/cross-section 1.fh9 3/01

TRENCH LOG OCOTILLO ENERGY PROJECT	
Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 21 of 22

URS



HORIZONTAL AND VERTICAL SCALE: 1" = 5'

L:/Ocotillo/cross section 1.fh9 3/01

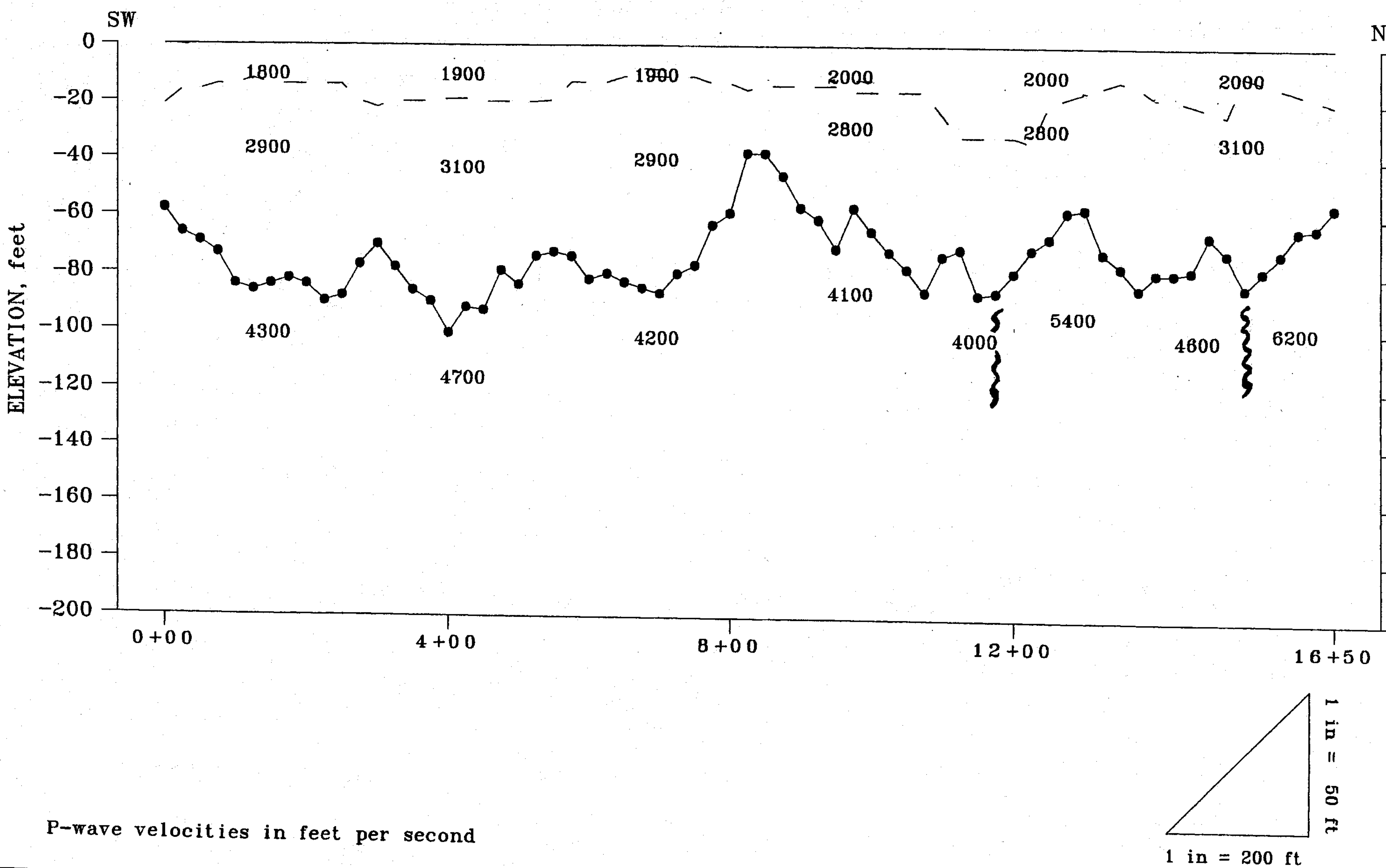
TRENCH LOG
OCOTILLO ENERGY PROJECT

Project No.: 6600000023.02	Figure 3
Date: APRIL 2001	Sheet 22 of 22

URS

ATTACHMENT A

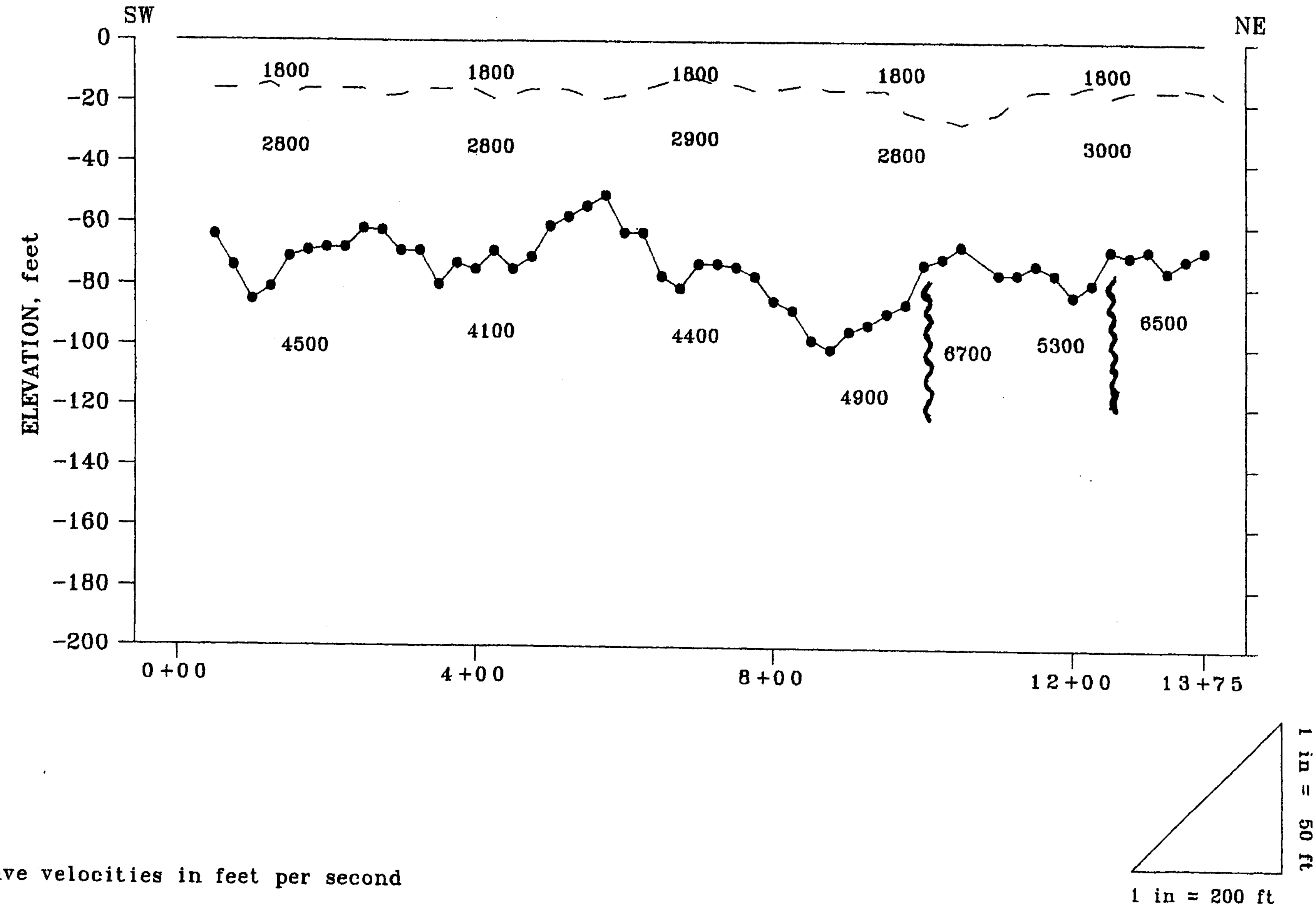
SEISMIC REFRACTION DATA



P-wave velocities in feet per second

SEISMIC REFRACTION PROFILE RS01-1

Project No.:	Date: 2-16-01	Project: OCOTILLO ENERGY PROJECT	Att. 1a

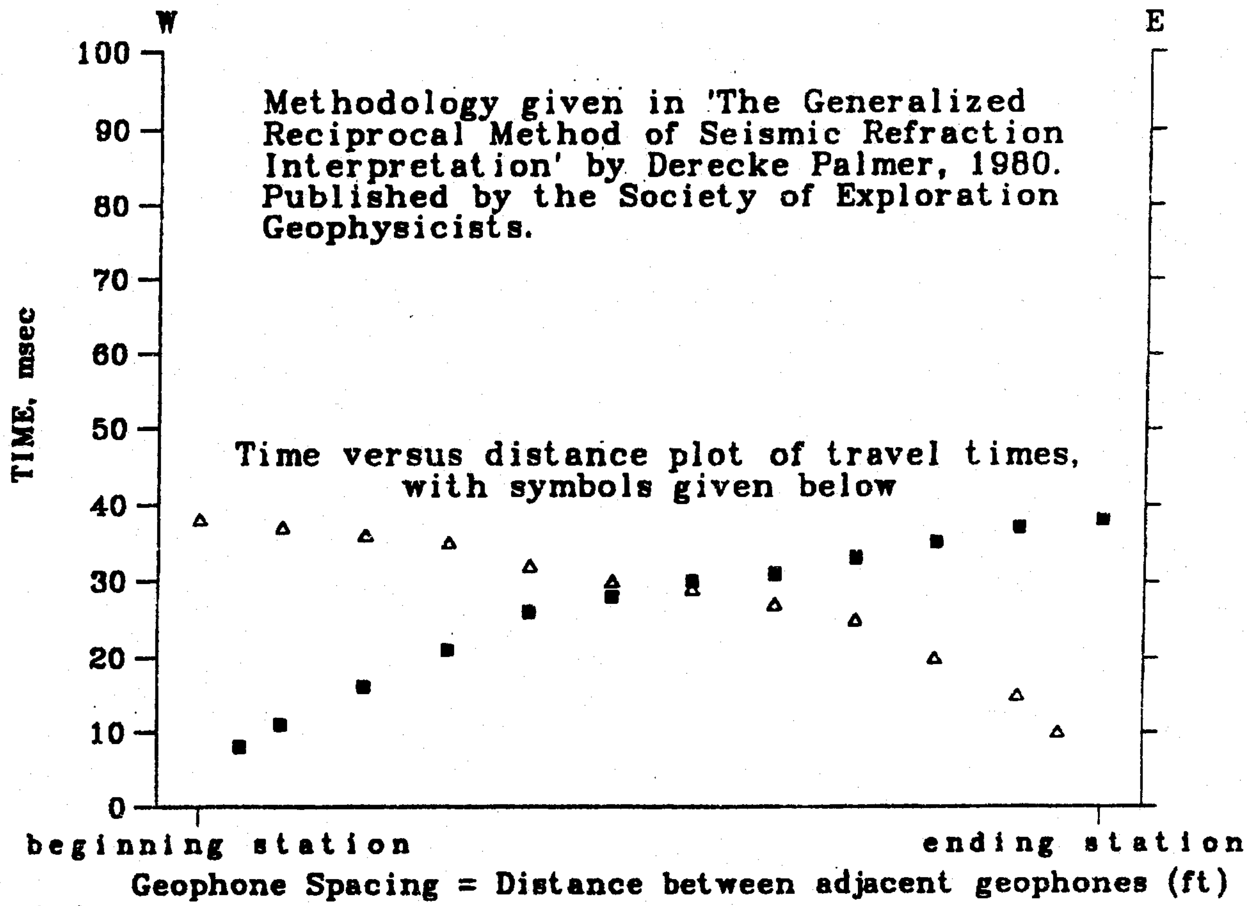


P-wave velocities in feet per second

SEISMIC REFRACTION PROFILE RS01-2

Project No.:	Date: 2-16-01	Project: OCOTILLO ENERGY PROJECT	Att. 1b

KEY TO SYMBOLS AND NOTATION USED ON SEISMIC REFRACTION DATA SHEETS



Arrival Time, msec ▲ ■ ● △ □ — Travel times of arrivals from a shot to a geophone, with corresponding symbols (msec)

t_{ab} = Reciprocal time, end-to-end travel time (msec)
XY = Geophone analysis separation distance (ft)
t_a = Travel times of refracted arrivals from end shot (msec)
t_b = Travel times of refracted arrivals from reversed shot (msec)
* $\frac{1}{2}\Delta t$ = Velocity analysis function, plotted above travel times on time-distance plot (msec)
t_g = Time depth, $(t_a+t_b-t_{ab})/2$ (msec)
t_c = Delay times due to thin surface layer ($\frac{1}{2}$ time intercept at shotpoints) with z_0 depth and v_0 velocity (msec)

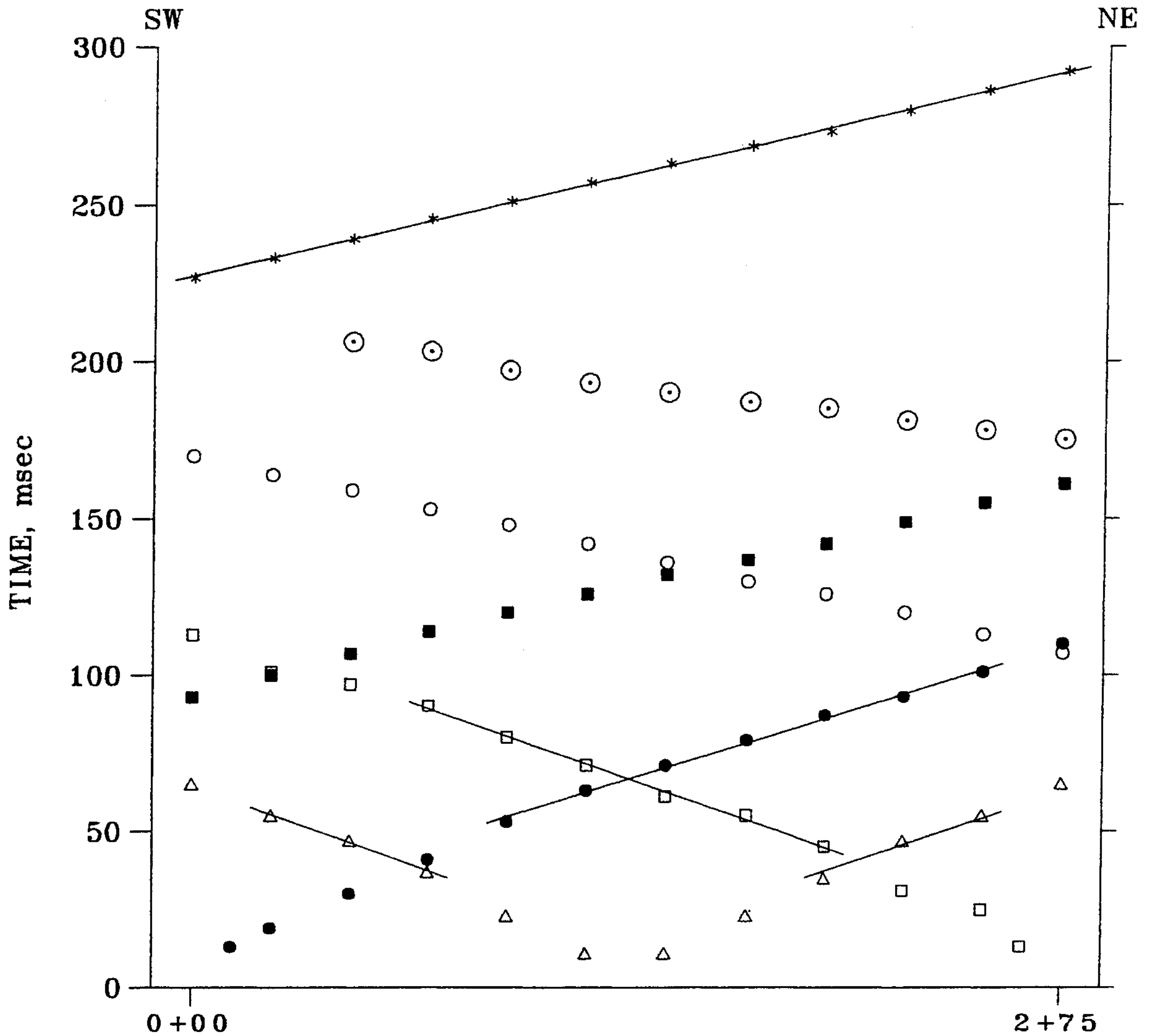
---

z_i =
z_{i+1} = Calculated depth to the i^{th} layer, assumed normal to the surface, (t_g-t_c) x Velocity Function (ft)

v_i =
v_{i+1} =
v_{i+2} = Velocity of the i^{th} layer from the Velocity Function or the inverse slope of the raw data (ft/sec)

(i) values inferred from other data (see text)

[Line Number]			
Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1c



Geophone spacing = 25 ft

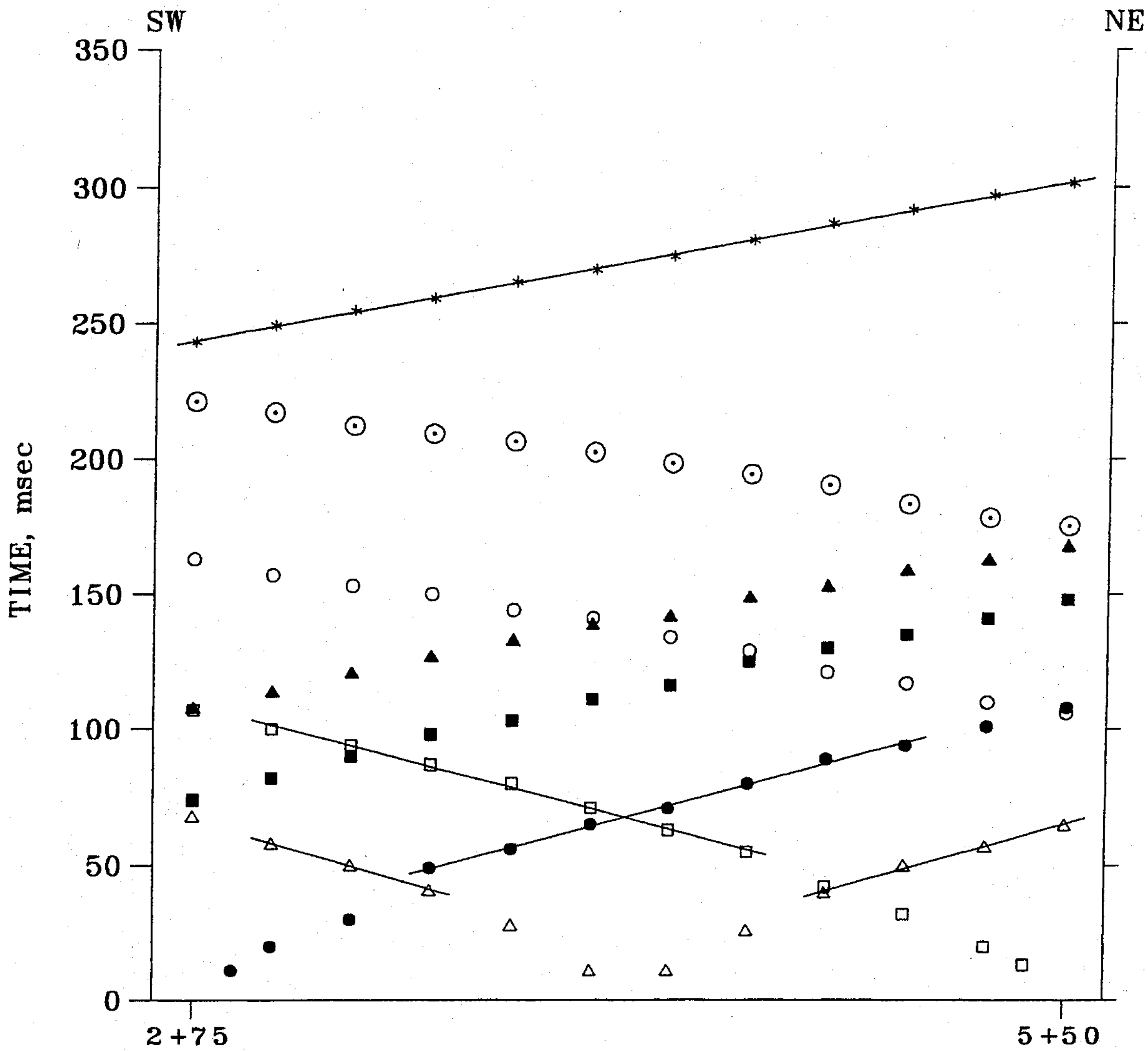
Arrival Time, msec													
▲													
■	93	100	107	114	120	126	132	137	142	149	155	161	
●	13	19	30	41	53	63	71	79	87	93	101	110	
△	65	55	47	37	23	11	11	23	35	47	55	65	
□	113	101	97	90	80	71	61	55	45	31	25	13	
○	170	164	159	153	148	142	136	130	126	120	113	107	
⊙			206	203	197	193	190	187	185	181	178	175	

t_{ab}= 111 msec; XY = 0

t_a=	42	49	56	63	69	75	81	86	91	98	104	110	
t_b=	113	107	102	96	91	85	79	73	69	63	56	50	
* $\frac{1}{2}\Delta t$=	−35½	−29	−23	−16½	−11	−5	1	6½	11	17½	24	30	
t_g=	22	22½	23½	24	24½	24½	24½	24	24½	25	24½	24½	
t_c=	12	9	9	8	8	7	8	8	8	8	8	9	
z_0=	22	16	16	14	14	13	14	14	14	14	14	16	ft
z_1=	58	66	69	74	84	87	84	82	84	91	88	86	ft
v_0=						1800							fps
v_1=		3180			2780			3000		2820			fps
v_2=						4260							fps

RS01-1

Project No.:	Date: 2-16-01	Project: OCOTILLO ENERGY PROJECT	Att. 1d



Geophone spacing = 25 ft

Arrival Time, msec												
▲	108	114	121	127	133	139	142	149	153	159	163	168
■	74	82	90	98	103	111	116	125	130	135	141	148
●	11	20	30	49	56	65	71	80	89	94	101	108
△	68	58	50	41	28	11	11	26	40	50	57	65
□	107	100	94	87	80	71	63	55	42	32	20	13
○	163	157	153	150	144	141	134	129	121	117	110	106
⊙	221	217	212	209	206	202	198	194	190	183	178	175

t_{ab} = 108 msec; XY = 0

t_a=	48	54	61	67	73	79	82	89	93	99	103	108
t_b=	107	101	97	94	88	85	78	73	65	61	54	50
* ½Δt=	−29½	−23½	−18	−13½	−7½	−3	2	8	14	19	24½	29
t_g=	23½	23½	25	26½	26½	28	26	27	25	26	24½	25
t_c=	13	12	11	11	11	10	10	11	11	11	11	13
z_0=	25	23	21	21	21	19	19	21	21	21	21	25 ft
z_1=	68	71	79	87	91	101	92	94	80	84	75	73 ft

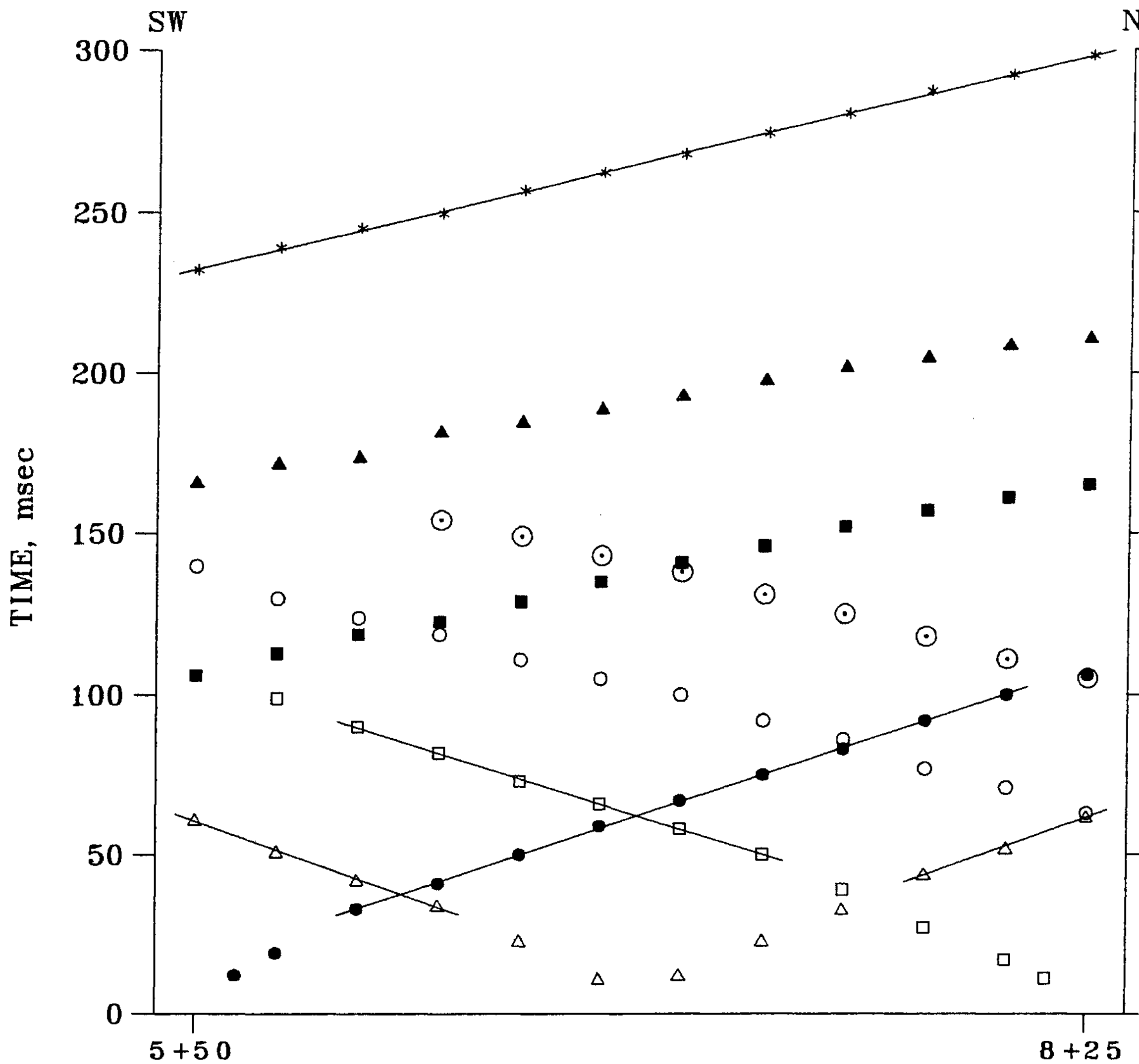
v_0= 1900 fps

v_1= 3240 2940 3050 3290 fps

v_2= 4690 fps

RS01-1

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1e



Geophone spacing = 25 ft

Arrival Time, msec

▲	166	172	174	182	185	189	193	198	202	205	209	211
■	106	113	119	123	129	135	141	146	152	157	161	165
●	12	19	33	41	50	59	67	75	83	92	100	106
△	61	51	42	34	23	11	12	23	33	44	52	62
□	106	99	90	82	73	66	58	50	39	27	17	11
○	140	130	124	119	111	105	100	92	86	77	71	63
⊙				154	149	143	138	131	125	118	111	105

t_{ab}= 106 msec; XY = 0

t_a=	47	54	60	64	70	76	82	87	93	98	102	106
t_b=	106	99	93	88	80	75	70	62	56	47	41	33
* ½Δt=	−29½	−22½	−16½	−12	−5	0½	6	12½	18½	25½	30½	36½
t_g=	23½	23½	23½	23	22	22½	23	21½	21½	19½	18½	16½
t_c=	8	7	7	7	6	6	6	6	6	7	7	9

z_0=	15	13	13	13	11	11	11	11	11	13	13	17	ft
z_1=	73	75	83	81	83	85	88	81	77	63	59	45	ft

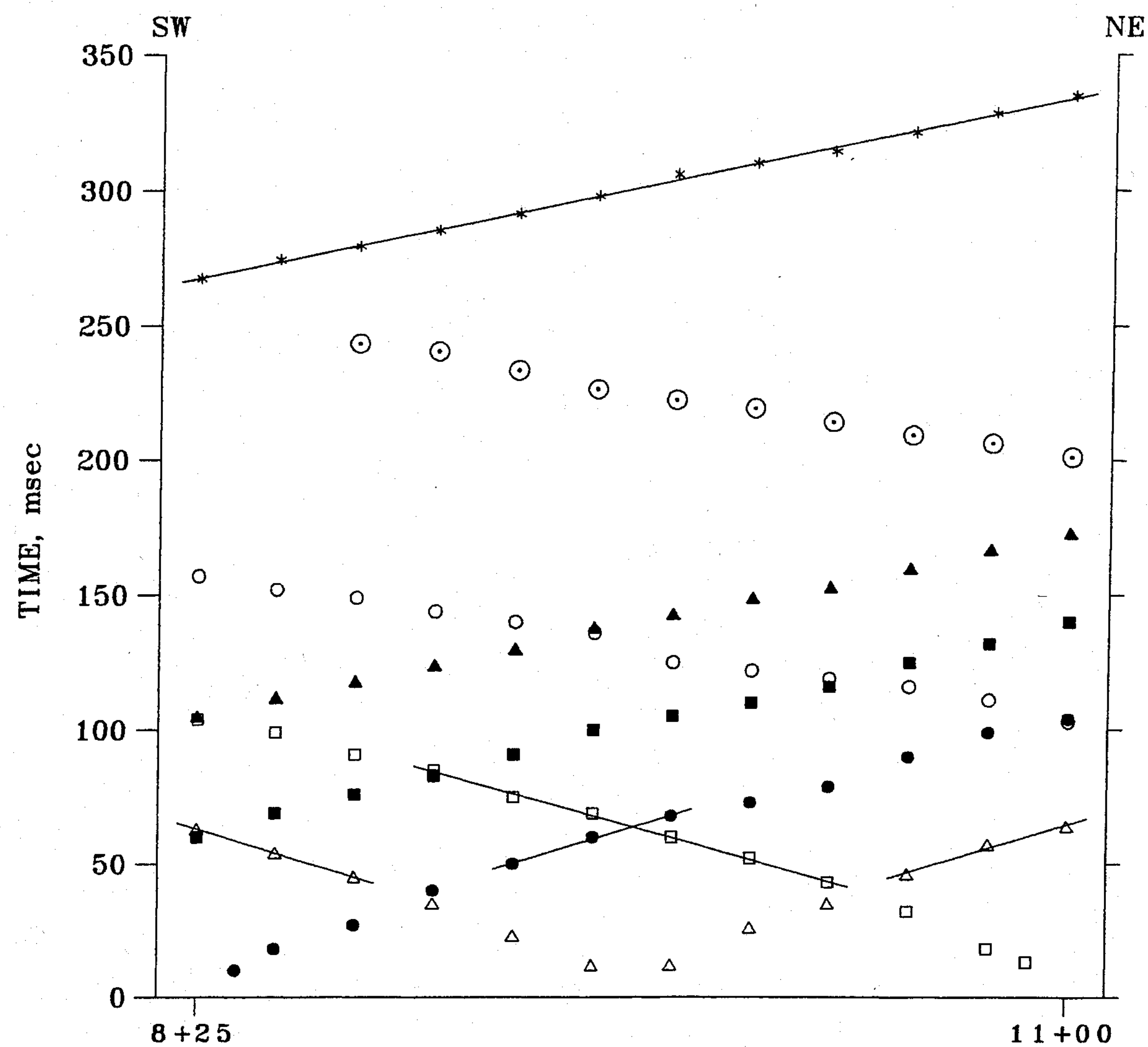
v_0= 1900 fps

v_1= 2980 2780 2780 3140 fps

v_2= 4190 fps

RS01-1

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1f



Geophone spacing = 25 ft

Arrival Time, msec												
▲	105	112	118	124	130	138	143	149	153	160	167	173
■	60	69	76	83	91	100	105	110	116	125	132	140
●	10	18	27	40	50	60	68	73	79	90	99	104
△	63	54	45	35	23	12	12	26	35	46	57	64
□	104	99	91	85	75	69	60	52	43	32	18	13
○	157	152	149	144	140	136	125	122	119	116	111	103
⊙			243	240	233	226	222	219	214	209	206	201

t_{ab}= 104 msec; XY = 0

t_a=	23	32	39	46	54	63	68	73	79	90	99	104
t_b=	104	99	96	91	87	83	72	69	66	63	58	50
* ½Δt=	-40½	-33½	-28½	-22½	-16½	-10	-2	2	6½	13½	20½	27
t_g=	11½	13½	15½	16½	18½	21	18	19	20½	24½	26½	25
t_c=	7	7	7	7	7	7	8	8	8	8	8	9

z_0=	14	14	14	14	14	14	16	16	16	16	16	18	ft
z_1=	31	38	46	57	61	71	57	65	72	78	86	78	ft

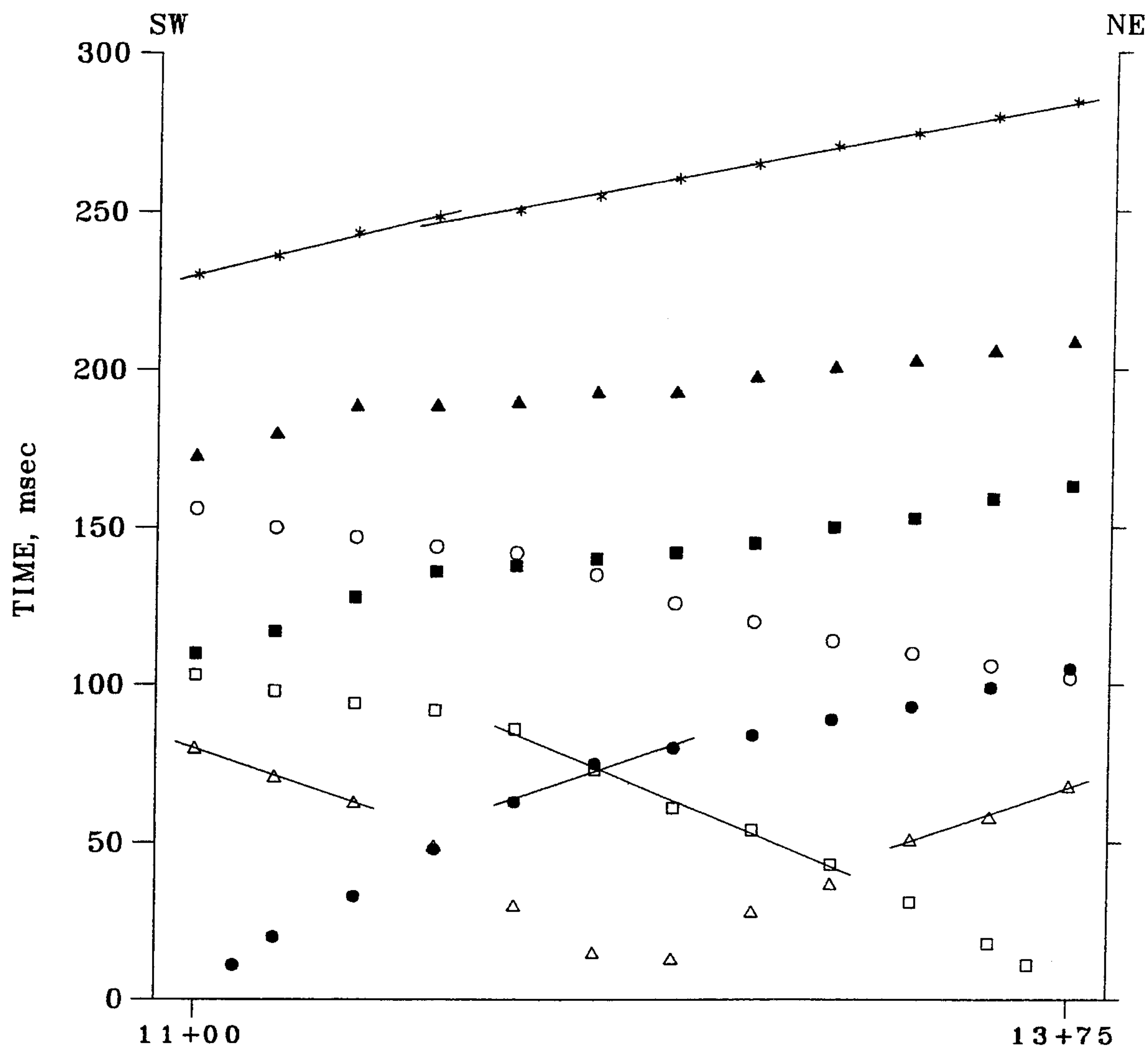
v_0= 2000 fps

v_1= 2780 2780 2780 3040 fps

v_2= 4130 fps

RS01-1

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1g



Geophone spacing = 25 ft

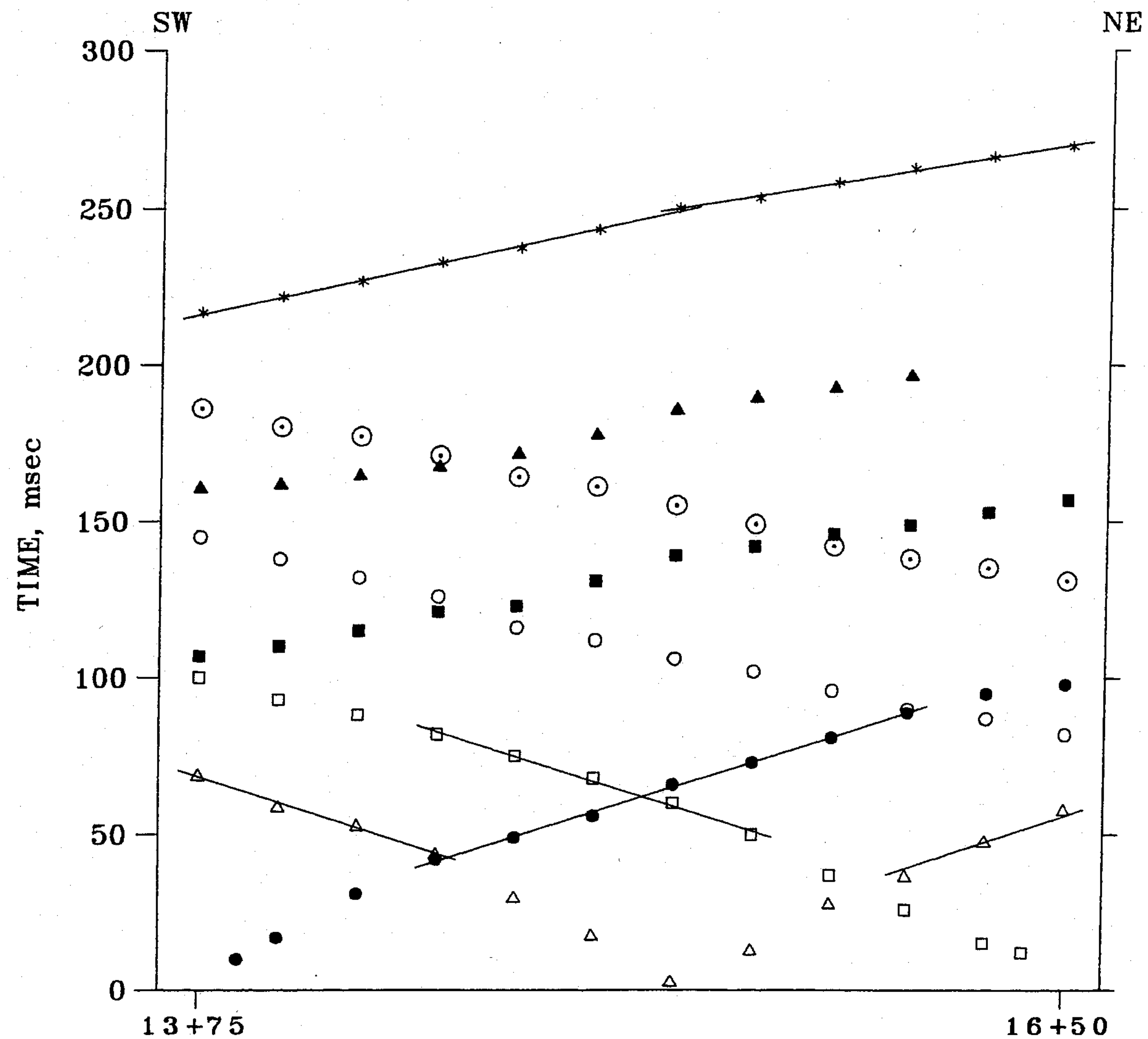
Arrival Time, msec													
▲	173	180	189	189	190	193	193	198	201	203	206	209	
■	110	117	128	136	138	140	142	145	150	153	159	163	
●	11	20	33	48	63	75	80	84	89	93	99	105	
△	80	71	63	49	30	15	13	28	37	51	58	68	
□	103	98	94	92	86	73	61	54	43	31	18	11	
○	156	150	147	144	142	135	126	120	114	110	106	102	
⊙													

t_{ab} = 104 msec; XY = 0

t_a=	49	56	67	75	77	79	81	84	89	93	99	105	
t_b=	103	98	94	92	90	83	74	68	62	58	54	50	
* ½Δt=	−27	−21	−13½	−8½	−6½	−2	3½	8	13½	17½	22½	27½	
t_g=	24	25	28½	31½	31½	29	25½	24	23½	23½	24½	25½	
t_c=	15	16	16	16	16	17	10	9	8	7	6	5	
z_0=	30	32	32	32	32	34	20	18	16	14	12	10	ft
z_1=	69	71	87	86	79	71	67	58	57	72	77	82	ft
v_0=						2000							fps
v_1=		2940			2940			2940		2380			fps
v_2=				3970				5360					fps

RS01-1

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1h



Geophone spacing = 25 ft

Arrival Time, msec												
▲	161	162	165	168	172	178	186	190	193	197		
■	107	110	115	121	123	131	139	142	146	149	153	157
●	10	17	31	42	49	56	66	73	81	89	95	98
△	69	59	53	44	30	18	3	13	28	37	48	58
□	100	93	88	82	75	68	60	50	37	26	15	12
○	145	138	132	126	116	112	106	102	96	90	87	82
⊙	186	180	177	171	164	161	155	149	142	138	135	131

t_{ab} = 99 msec; XY = 0

t_a =	50	53	58	64	66	74	82	85	89	92	96	98
t_b =	100	93	88	82	75	71	65	62	56	50	47	42
* ½Δt =	−25	−20	−15	−9	−4½	1½	8½	11½	16½	21	24½	28
t_g =	25½	23½	23½	23½	21	23	24	24	23	21½	22	20½
t_c =	9	9	9	10	11	12	5	6	7	8	9	10
z_0 =	18	18	18	20	22	24	10	12	14	16	18	20 ft
z_1 =	87	79	79	78	66	72	84	78	72	64	63	56 ft

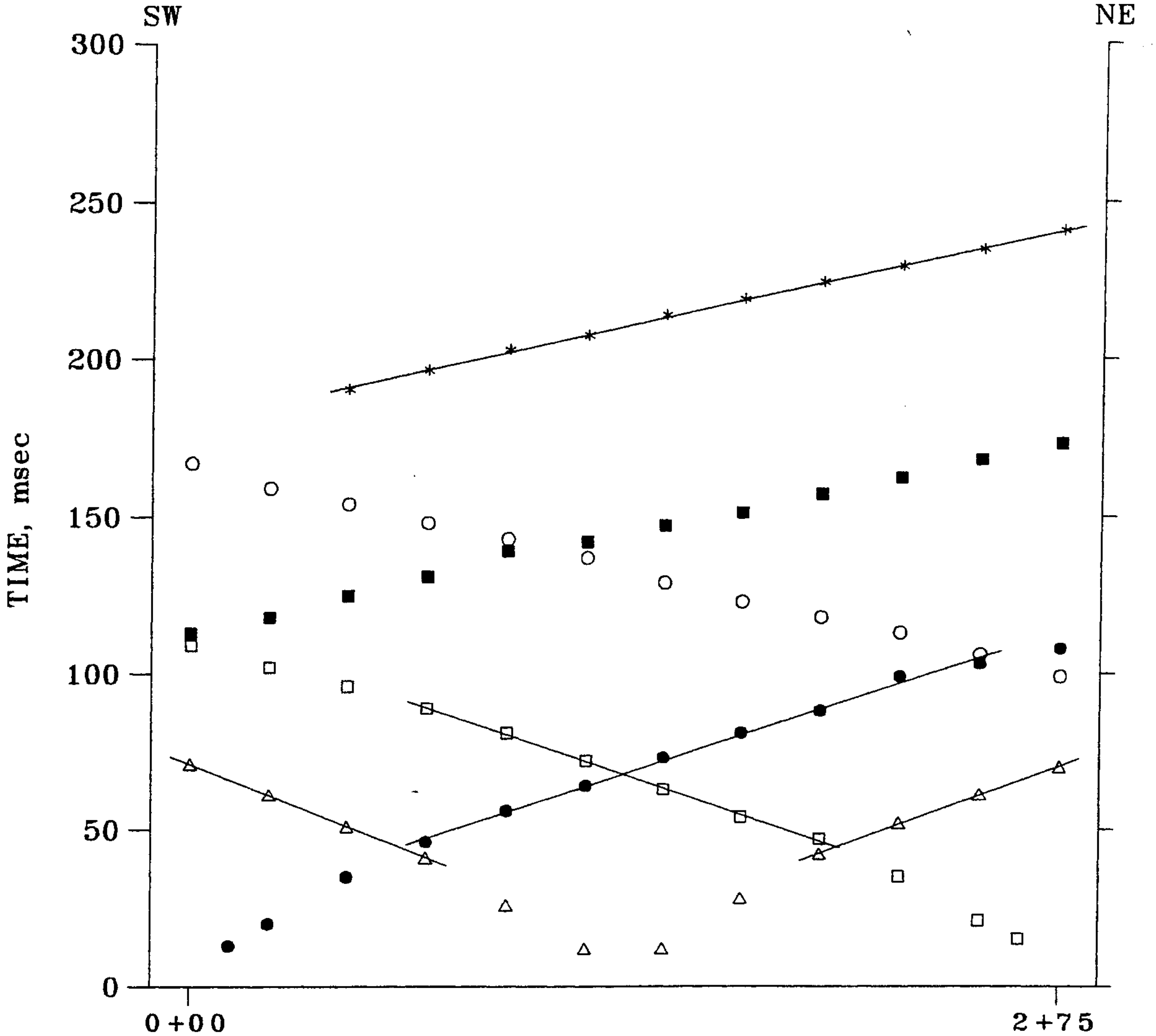
v_0 = 2000 fps

v_1 = 3150 3090 3000 3160 fps

v_2 = 4550 6210 fps

RS01-1

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1i



Geophone spacing = 25 ft

Arrival Time, msec												
▲												
■	113	118	125	131	139	142	147	151	157	162	168	173
●	13	20	35	46	56	64	73	81	88	99	103	108
△	71	61	51	41	26	12	12	28	42	52	61	70
□	109	102	96	89	81	72	63	54	47	35	21	15
○	167	159	154	148	143	137	129	123	118	113	106	99
⊙												

t_{ab}= 108 msec; XY = 0

t_a=			62	68	76	79	84	88	94	99	103	108	
t_b=	109	102	96	90	85	79	71	65	60	55	48	41	
* $\frac{1}{2}\Delta t$=			−17	−11	−4½	0	6½	11½	17	22	27½	33½	
t_g=			25	25	26½	25	23½	22½	23	23	21½	20½	
t_c=	11	9	9	9	9	8	10	9	9	9	9	10	
z_0=			16	16	16	14	18	16	16	16	16	18	ft
z_1=			64	74	85	82	71	70	69	68	62	53	ft

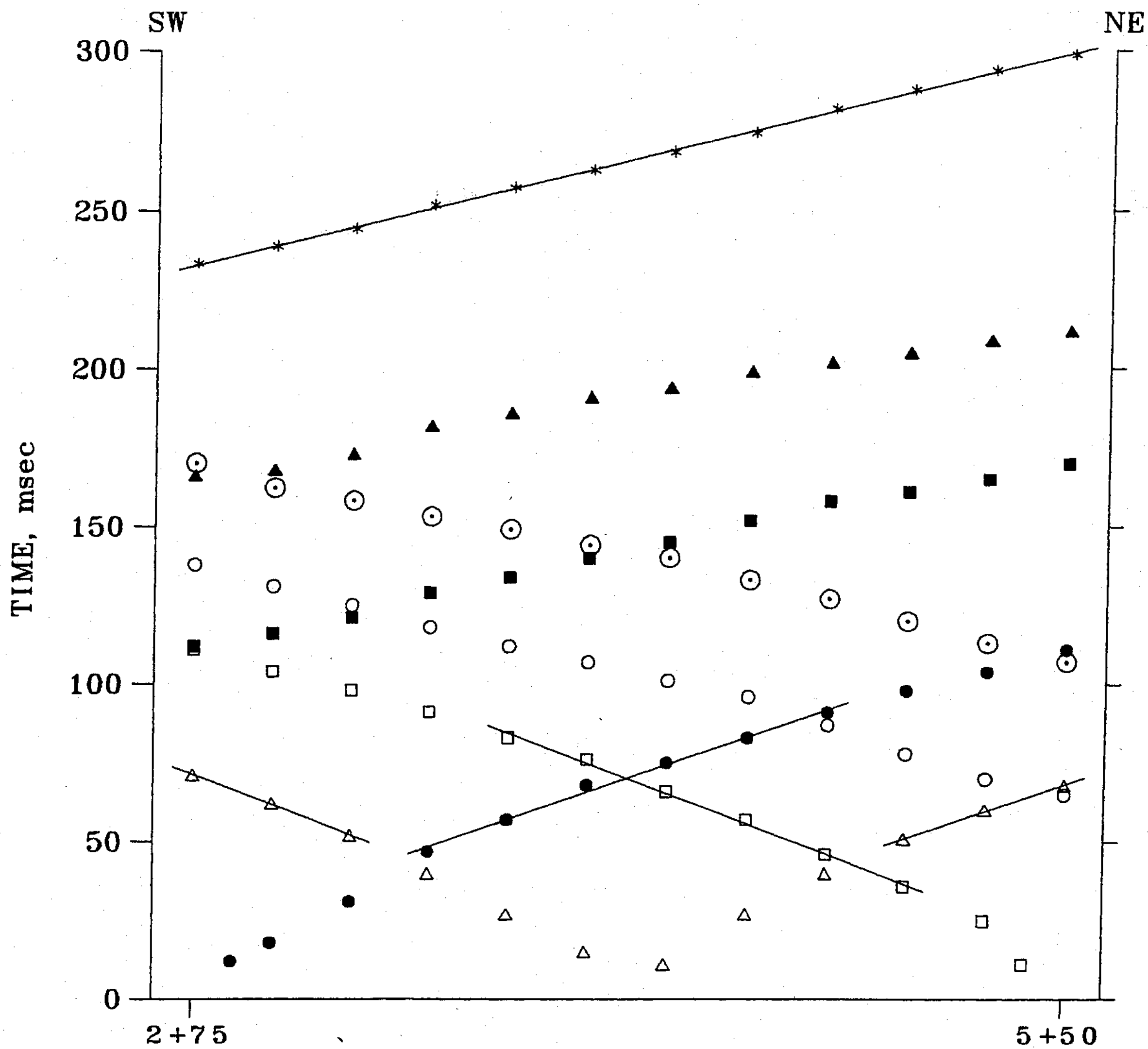
v_0= 1800 fps

v_1= 3030 2500 2690 2920 fps

v_2= 4520 fps

RS01-2

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1j

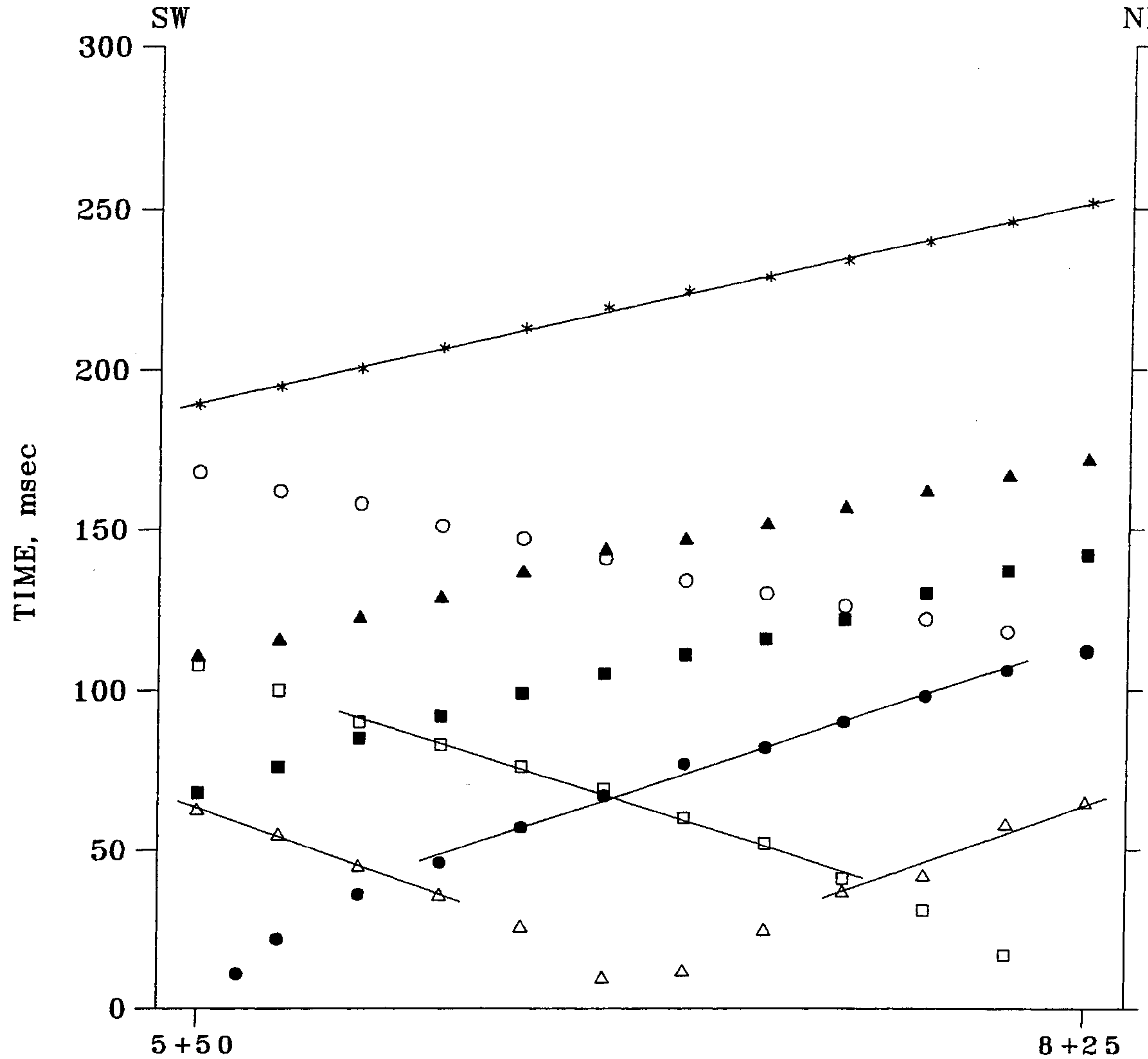


Geophone spacing = 25 ft

Arrival Time, msec													
▲	166	168	173	182	186	191	194	199	202	205	209	212	
■	112	116	121	129	134	140	145	152	158	161	165	170	
●	12	18	31	47	57	68	75	83	91	98	104	111	
△	71	62	52	40	27	15	11	27	40	51	60	68	
□	111	104	98	91	83	76	66	57	46	36	25	11	
○	138	131	125	118	112	107	101	96	87	78	70	65	
⊙	170	162	158	153	149	144	140	133	127	120	113	107	
t_{ab}= 111 msec; XY = 0													
t_a=	53	57	62	70	75	81	86	93	99	102	106	111	
t_b=	111	104	98	91	85	80	74	69	60	51	43	38	
* $\frac{1}{2}\Delta t$=	−29	−23½	−18	−10½	−5	0½	6	12	19½	25½	31½	36½	
t_g=	26½	25	24½	25	24½	25	24½	25½	24	21	19	19	
t_c=	11	10	9	9	9	9	11	10	9	9	9	9	
z_0=	20	18	16	16	16	16	20	18	16	16	16	16	ft
z_1=	73	69	69	80	73	75	69	75	71	61	58	58	ft
v_0=						1800							fps
v_1=		2870			2630			2940		2620			fps
v_2=						4140							fps

RS01-2

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1k



Geophone spacing = 25 ft

Arrival Time, msec												
▲	111	116	123	129	137	144	147	152	157	162	167	172
■	68	76	85	92	99	105	111	116	122	130	137	142
●	11	22	36	46	57	67	77	82	90	98	106	112
△	63	55	45	36	26	10	12	25	37	42	58	65
□	108	100	90	83	76	69	60	52	41	31	17	
○	168	162	158	151	147	141	134	130	126	122	118	112
⊙												

t_{ab} = 110 msec; XY = 0

t_a=	43	48	55	61	69	76	79	84	90	98	106	112	
t_b=	108	102	98	91	87	81	74	70	66	62	58	52	
* ½△t=	−32½	−27	−21½	−15	−9	−2½	2½	7	12	18	24	30	
t_g=	20½	20	21½	21	23	23½	21½	22	23	25	27	27	
t_c=	12	11	10	9	8	7	7	8	8	9	9	10	
z_0=	22	20	18	16	14	13	13	14	14	16	16	18	ft
z_1=	51	51	63	64	78	82	74	73	74	77	85	79	ft

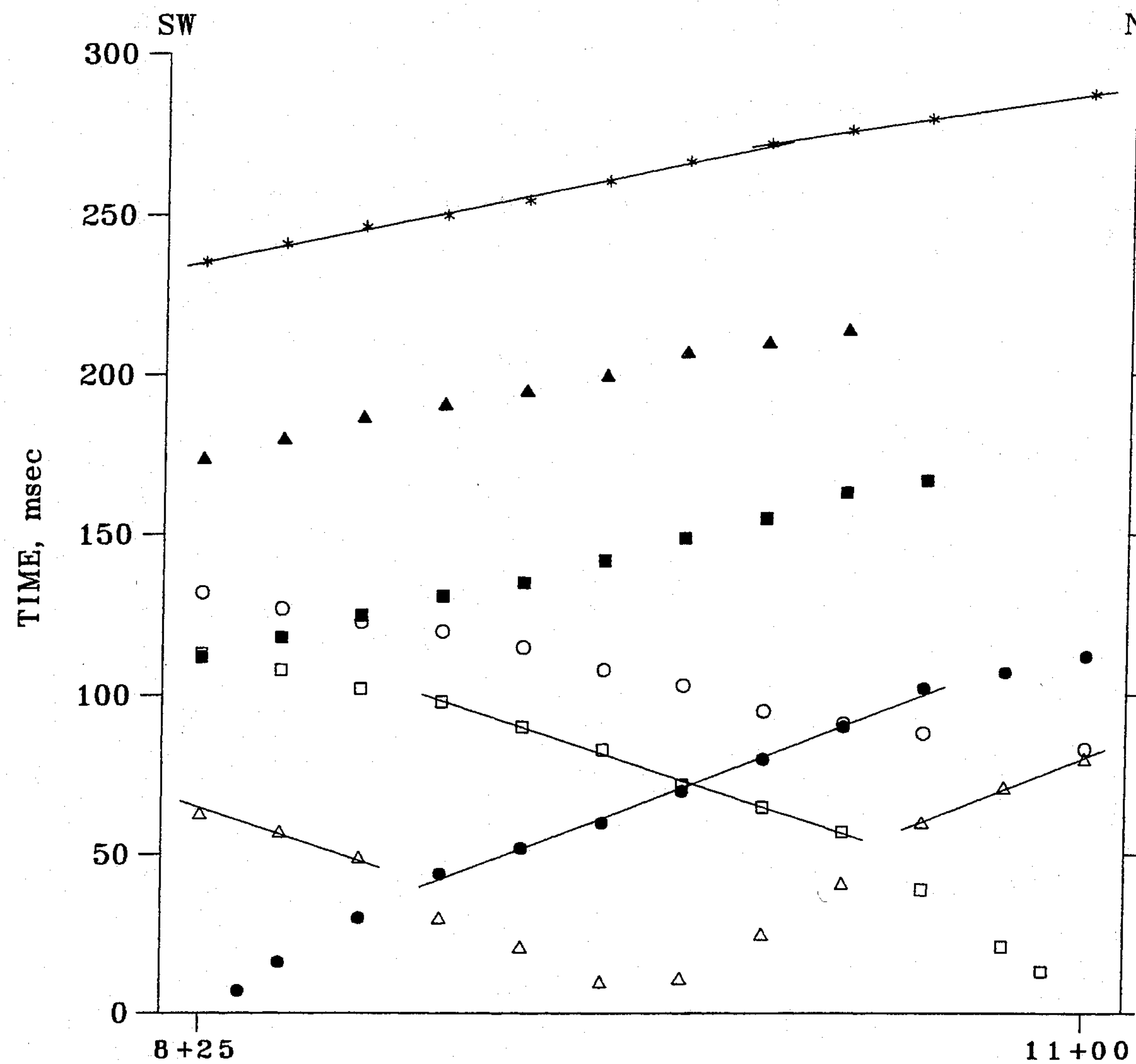
v_0= 1800 fps

v_1= 3000 2750 2800 3110 fps

v_2= 4440 fps

RS01-2

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1I



Geophone spacing = 25 ft

Arrival Time, msec

▲	174	180	187	191	195	200	207	210	214			
■	112	118	125	131	135	142	149	155	163	167		
●	7	16	30	44	52	60	70	80	90	102	107	112
△	63	57	49	30	21	10	11	25	41	60	71	80
□	113	108	102	98	90	83	72	65	57	39	21	13
○	132	127	123	120	115	108	103	95	91	88		83
⊙												

t_{ab} = 112 msec; XY = 0

t_a=	58	64	71	75	79	84	91	94	98	102	107	112	
t_b=	113	108	104	101	96	89	84	76	72	69		64	
* $\frac{1}{2}\Delta t$=	-27½	-22	-16½	-13	-8½	-2½	3½	9	13	16½		24	
t_g=	29½	30	31½	32	31½	30½	31½	29	29	29½		32	
t_c=	7	8	9	9	9	9	13	14	14	15	15	16	
z_0=	13	14	16	16	16	16	23	25	25	27		29	ft
z_1=	98	98	102	95	93	90	87	73	71	67		72	ft

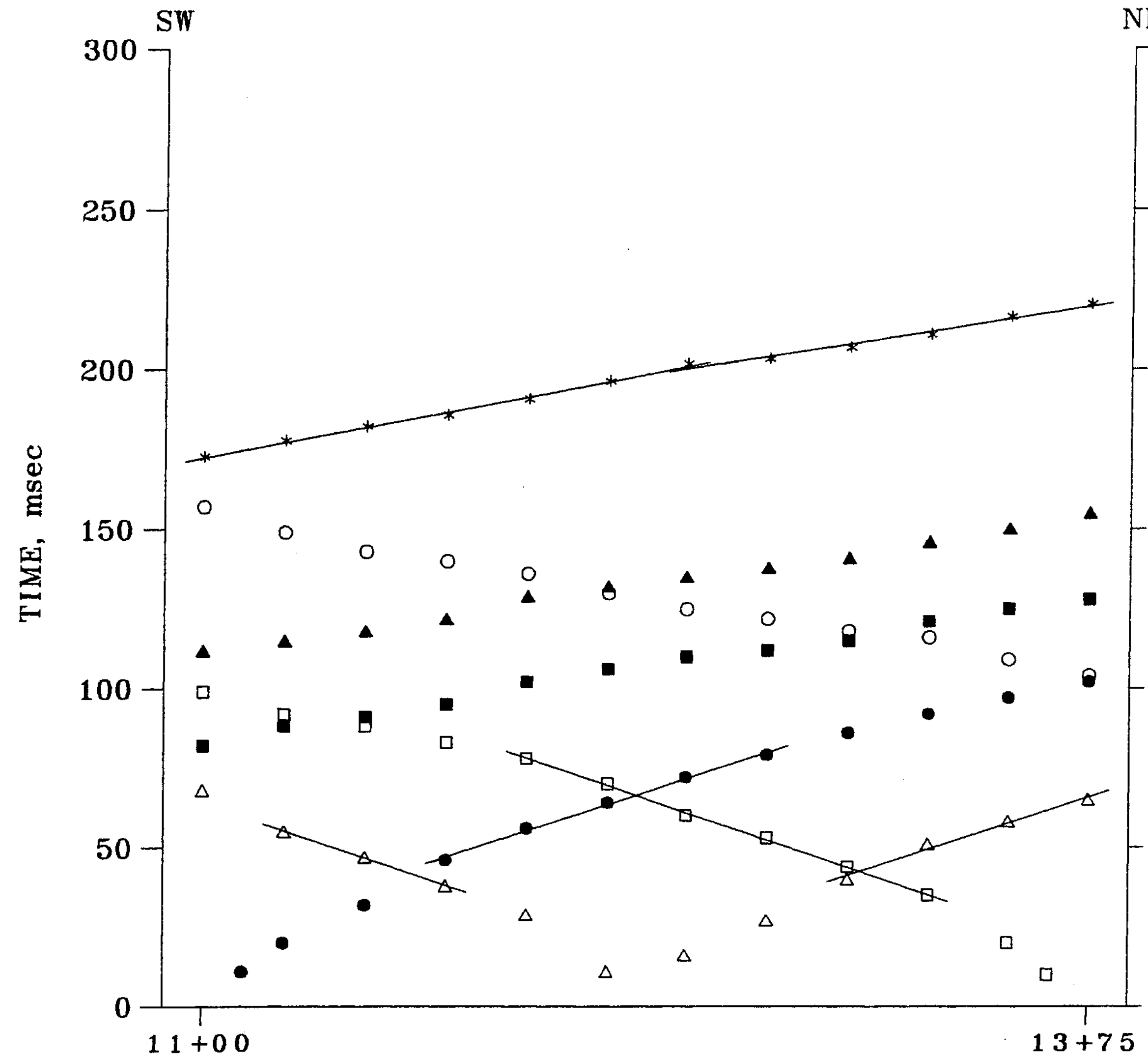
v_0= 1800 fps

v_1= 2590 3000 2500 3010 fps

v_2= 4890 6700 fps

RS01-2

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1m



Geophone spacing = 25 ft

Arrival Time, msec

▲	112	115	118	122	129	132	135	138	141	146	150	155
■	82	88	91	95	102	106	110	112	115	121	125	128
●	11	20	32	46	56	64	72	79	86	92	97	102
△	68	55	47	38	29	11	16	27	40	51	58	65
□	99	92	88	83	78	70	60	53	44	35	20	10
○	157	149	143	140	136	130	125	122	118	116	109	104
⊙												

t_{ab}= 101 msec; XY = 0

t_a=	59	62	65	69	76	80	84	86	89	95	99	102
t_b=	99	92	86	83	80	73	66	65	61	59	52	47
* ½Δt=	−20	−15	−10½	−7	−2	3½	9	10½	14	18	23½	27½
t_g=	28½	26½	25	25½	27½	26	24½	25	24½	26½	25	24
t_c=	11	10	9	9	9	8	10	9	9	9	9	9

z_0=	20	18	16	16	16	14	18	16	16	16	16	16	ft
z_1=	82	76	73	76	83	80	68	70	68	75	72	68	ft

v_0= 1800 fps

v_1= 3050 2940 3050 2920 fps

v_2= 5280 6460 fps

RS01-2

Project No.:	Date:	Project: OCOTILLO ENERGY PROJECT	Att. 1n

ATTACHMENT B (REFERENCES)

California Division of Mines and Geology, 1980, State of California Special Studies Zones, Desert Hot Springs Quadrangle, Revised Official Map, Effective January 1, 1980, Scale 1:24,000

Hatch M.E., 1987, Neotectonics of the Agua Blanca Fault, Valle Agua Blanca, Baja California Mexico, Masters Thesis San Diego State University.

Kahle J.E., Hart E.W., Borchart G, Manson, M.W., 1987, California Division of Mines and Geology Fault Evaluation Report-185, Surface Rupture Associated with the North Palm Springs Earthquake of July 8, 1986—Banning and Related Faults, Riverside County, 15 p. 7 figs.

Mcfadden L.D. and Weldon R.J., 1987, Rates and Processes of soil development on Quaternary terraces in Cajon Pass, California, Geological Society of America Bulletin, Vol. 98, pp. 280-293

Munsell Soil Color Chart (1992), Macbeth Division of Loomorgan Instruments Corporation, New Windsor, NY, 10 p.

Procter, R., 1968, Geology of the Desert Hot Springs-Upper Coachella Valley Area, California, California Division of Mines and Geology, Special Report 94, 50 p.

United States Bureau of Reclamation, 1998, Engineering Geology Field Manual, Second Edition, Vol. 1, 478 p.