ATL, Inc.

CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

DMJM
CAMELBACK RANCH LEVEE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT NO. FCD 95-15
ATL JOB NO. 195039

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GEOTECHNICAL INVESTIGATION

REPORT

DMJM

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CAMELBACK RANCH LEVEE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT NO. FCD 95-15
ATL JOB NO. 195039

Prepared by:

David P. Hayes, P.E.
Executive Vice President

ATL, Inc.
Construction Quality Control
Geotechnical Consultants

September 18, 1996

Mr. Michael Shapiro, P.E.
DMJM
300 W. Clarendon Avenue, Suite 400
Phoenix, Arizona 85013-3499

Re: Geotechnical Investigation Report
Camelback Ranch Levee
Flood Control District of Maricopa County
Contract No. FCD 95-15
ATL Job No. 195039

Dear Mr. Shapiro:

This report presents field and laboratory data, along with recommendations for the construction of a soil-cement embankment levee on the east side of the Agua Fria River and New River between Indian School Road and West Bethany Home Road extended. Field Investigations were completed in four (4) separate mobilizations due to the planting of crops in the Phase II section north of Camelback Road, and the addition of three (3) borings in Agua and New River channels. The final mobilization was completed on August 7th, 1996 and consisted of two (2) additional test pit excavations in the Agua Fria River.

Preliminary soil cement designs were developed for the aggregate excavated from the Agua Fria River, south of Camelback Road and west of the proposed Levee alignment and for the material excavated from the second borrow pit location NE of Camelback Road at the retention basin location. Foundation recommendations, slope stability and a quality analysis of in-situ material are also included in this report.

ATL has appreciated the opportunity to be of service to DMJM on this project. Should any questions arise, please do not hesitate to contact us at your earliest convenience.

Very truly yours,

Registered Professional Engineer
CERTIFICATE NO.
22719
David Preston
Hayes

9/18/96

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GEOTECHNICAL INVESTIGATION

REPORT

DMJM

PROJECT

MARICOPA COUNTY FLOOD CONTROL DISTRICT
CAMELBACK RANCH LEVEE
ATL JOB NO. 195039

1.0 PROJECT DESCRIPTION

The project consists of providing all professional engineering services necessary for the design of a soil cement levee having 1:1 side slopes. The levee shall be constructed along the Agua Fria and New Rivers between Bethany Home Road and Indian School Road.

The levee shall provide SPF protection for properties on the east bank of the rivers from diverted flows being delivered by the construction of the Arizona Canal Diversion Channel (ACDC), as well as flows from the Agua Fria and the New Rivers.

The consultant shall provide the plans and special provisions in two (2) phases. Phase One shall be for the portion south of Camelback Road (see "Exhibit A" of the FCD Scope of Work document for identification of alignment and other related drainage facilities). Phase Two shall be for that portion north of Camelback Road (see "Exhibit B" of the FCD Scope of Work document for identification of alignment and other related drainage facilities). Phase One shall be due in September 1996, completed and ready for advertising and construction. Phase Two shall be complete and ready for advertising and construction in December 1996.

The consultant shall provide all necessary supporting hydraulic analysis, hydrology, geotechnical and structural design required for the construction in December 1996.

The consultant shall provide two options for the design of an outlet for the Agua Fria Freeway at Bethany Home Road and the New River. One shall be a penetration and the other a blockout; the District will select which option, if any, the consultant shall provide.

2.0 GEOLOGIC DESCRIPTION AND LOCATION

The project site lies within the Basin & Range Province that encompasses the Valley and its associated cities. Using the "Plate Tectonics" theory, the desert areas of this province lie in a particularly mobile region. It is theorized that the plates making up this region were part of the earth's crust that was pulled apart rather than pushed together.

In the Basin & Range Province, alluvial fans have developed where streams issue from the mountains, creating "valley fill". The geologic history begins in the Precambrian time. Mountains were formed as crustal plates collided. Later, seas lapped across the area, depositing sedimentary rocks such as sandstone, siltstone and limestone. Rivers formed and eroded the surrounding valley's to produce alternating layers of sands/gravels, and finer silt/clay deposits.

The project is located within Maricopa County and the City of Phoenix. It is bounded on the north by a soil cement levee just north of the Bethany Home Road alignment and on the south by Indian School Road; bounded on the east by 107th Avenue and on the west by the Agua Fria and New Rivers.

3.0 SCOPE OF WORK

ATL's responsibility will be to provide general foundation parameters for the levee, including lateral pressures and slope stability analysis, provide soil-cement mix designs using locally available materials to determine particle size and distribution of channel bed soils, and present foundation parameters for the levee toe-down element.

The following approach was included in ATL's proposal dated December 8, 1995 and adjusted through the course of the project:

A) Field Investigation

Boring Nos. 1 through 16 were drilled along the levee alignment approximately 500 feet apart. Phase I included Boring Nos. 1 through 6, drilled to a depth below grade of twenty-six (26) feet each. Phase II included Boring Nos 7 through 16, drilled to a depth below grade of sixteen (16) feet each.

Sampling consisted of standard Penetration Tests (SPT) at 5-foot depth intervals and ring samples in cohesive material. Bulk samples were also collected for index testing.

Test Pit Nos. 19 and 20 were excavated in the Agua Fria River in the area owned by Johnson Stewart Materials. The material was excavated as a potential borrow source for both Phase I and Phase II. Bulk samples were obtained to determine index properties for use in the soil cement facing as well as in the levee embankment. Both test pits were excavated to a depth of twelve (12) feet.

For Phase II, Test Pit Nos. 17 and 18 were excavated in the area of the proposed detention basin to depths of twelve (12) feet each. Bulk samples were obtained to determine index and quality properties for use in the levee embankment and as an alternate source for soil cement facing.

Five (5) borings/test pits were added after the project progressed; the last two in August, 1996. Boring No. 21 was located in New River; Boring No. 22 was located in the Agua Fria, north of the confluence with New River, where Boring No. 23 was located; Test Pit Nos. 24 and 25 were located in the Agua Fria, south of Camelback Road in the Phase I area. All five (5) test pits/borings excavated to a depth of four (4) feet below existing grade. Sampling was performed in two (2) district layers, one within two feet of the surface and the other four feet below the surface. Samples were analyzed for grain-size distribution and plasticity were used in determining armoring characteristics for sediment transport and scour.

Plate 4 presents boring/test pit locations relative to the levee site.

B) Laboratory Analysis

Upon delivery to the laboratory, soil and aggregate samples were checked by the Project Engineer and laboratory tests assigned. The laboratory testing program consisted of tests designed to present properties of materials planned for use in the levee embankment, as a constituent of soil cement mixes and acceptability as a levee foundaiton.

Published ASTM/AASHTO standards were utilized in conducting the various analysis. Unused material will be stored sixty (60) calendar days after completion of this report.

C) Office Engineering:

Field and laboratory analysis were performed in accordance with ***NAVFAC Design Manual 7.1, Soil Mechanics,*** and ***NAVFAC Design Manual 7.2, Foundations & Earth Structures, May, 1972 with the September, 1986 Change 1 update.***

Using the bulk samples obtained from the streambed and detention pond, ATL developed a soil-cement design using materials from each area. Prior to developing the designs, in-situ aggregate samples were subjected to various physical tests to determine "quality" and suitability for use in soil cement. Mix design curves were produced for each potential borrow source.

From grain curves, D_{50} particle sizes were determined so that scour analysis could be completed by others.

Groundwater movement could be a concern. According to information from the Arizona Department of Environmental Quality (ADEQ) and the Arizona Department of Water Resources (ADWR), a 1982 measurement of a field well in the area showed a ground water elevation 144 feet below the existing ground surface. Measurements from 1986 indicated water depths of 104 feet. Three (3) field wells were measured. This information was used in Section 7.0 of this Report to determine if groundwater intrusion can be expected during the construction of the levee toe-downs.

ADEQ was not aware of planned additional ground water monitoring efforts within the project site, nor of continued readings of existing wells.

4.0 DRILLING AND SAMPLING PROCEDURES

A total of six (6) borings were drilled along the levee alignment in Phase I, and two (2) test pits excavated in the Agua Fria. Ten (10) borings were drilled in Phase II, and two (2) test pits excavated in the detention pond borrow site area. One (1) drilled at the New River - Agua River confluence, one (1) drilled north of confluence in the Agua Fria and two (2) more test pits excavated in the Agua Fria. A total of nineteen (19) borings and six (6) test pits were drilled and excavated for this project

A Mobile B-50 drill rig with an eight (8) inch outside diameter, hollow-stem continuous flight auger was utilized in the drilling operations. A Case 580 Backhoe with a 12-foot extension was used to excavate the test pits.

With the drill rig, SPT values were obtained at five-foot intervals using a split-spoon sampler, penetrating 18 inches in the soil by a 140-pound hammer falling 30 inches in accordance with ASTM D1586 standards.

Bulk samples of the existing native material were selectively sampled from the auger flights and returned to the laboratory for analysis. Each borehole was immediately returned to its original state by backfilling excess cuttings into the borehole.

Test Pit and Boring locations are presented on Plate 4. Edited boring and test pit logs are presented in Appendix A.

5.0 LABORATORY TESTING

Representative bulk samples of the subgrade were collected at each boring and test pit location for soil classification purposes and selected physical property testing.

For this project, in-situ material properties are important relative to hydrological behavior, as well as determining suitability for the materials use in soil cement and embankment. To assist in the determination of the D_{100}, D_{60}, D_{30}, and D_{10}, particle sizes, grain-size distribution curves were constructed for each sample tested. In addition, hydrometer analysis were performed on several samples to determine the silt and clay fractions. Atterberg Limit tests were conducted in order to determine Liquid and Plastic Limits, from which the Plasticity Index was calculated. Where available, In-Situ Moisture Contents were determined for future correlation with other tests. Standard Proctor analysis were completed to determine the relationship between the maximum dry density and optimum moisture content. Consolidation testing indicated minimum swelling when water was added to the sample. Therefore, we concluded that specific controlled swell tests were not required.

In general, the native material encountered in the field investigation process was either a **silty SAND** or a **GRAVEL** with silt and sand. In order to determine the materials behavior under increased loading increments, Consolidation tests

were conducted. Direct Shear tests were also performed to provide parameters that are used in determining lateral forces that potentially will be acting against the soil cement bank protection. Two (2) areas were selected as potential borrow pit sources; one west of the proposed levee alignment and south of Camelback Road (TP19 & TP20), and the other north of Camelback Road and east of the proposed levee alignment in the proposed detention basin area: (TP17 & TP18). The area west of the proposed levee alignment, and south of Camelback Road is owned by Johnson-Stewart Materials District, (JSM), LLC. The Flood Control District of Maricopa County has an agreement with J-SM to be able to use materials within this area for the levee construction. Testing was conducted on these excavated materials in order to answer the following questions:

1. Is the aggregate of suitable quality to meet soil cement requirements?
2. Is the particle-size such that the material can be used directly in the mix?
3. What level of screening will be required? Can a portable pug mill be used?
4. What is the approximate quantity of suitable material available? Can one borrow source be utilized for both phases or will the second borrow pit be required?
5. Is this material suitable to be used for the embankment in the levee?

All laboratory tests were conducted in accordance with ASTM published Standards and are summarized in Appendix B, "Laboratory Test Results". The soil described on the edited boring logs are classified using the Unified Soils Classification System (USCS). The following table summarizes the type and quanity of laboratory tests completed for this project:

TEST	NUMBER OF TESTS PERFORMED
Sieve Analysis	32
Hydrometer Analysis	4
Plasticity Index	32
Moisture Content	23
Soils/Agg Standard Proctor	7
Dry Unit Weight	3
Consolidation	4
Direct Shear	4
L.A. Abrasion	2
Sand Equivalent	2
Clay Lumps	1
Soil Cement Mix Design	2

6.0 SUMMARY OF EXISTING CONDITIONS

6.1 Levee Alignment

ATL's original boring and test pit plan was incorporated in a 2'x 3' plan sheet, and submitted for approval on April 6, 1996. The plan sheet did not include Test Pit Nos. 19 and 20 for the Agua Fria borrow area, but did show Test Pit Nos. 17 and 18 for the Camelback Ranch Detention Area borrow pit. Also excluded from the original boring location plan were Boring Nos. 21 thru 25 located in the New River channel, the Agua Fria channel and at the confluence of the two rivers. These were added later at the request of DMJM, Simons, Li and Associates and approved by the District.

Phase I includes Boring Nos. 1 through 6, located along the proposed levee alignment south of Camelback Road, along with two (2) test pits (TP19 & TP20). Borings were drilled to depths of 25 to 26 feet. Within the first 10-foot strata, the material encountered was a cohesionless **silty SAND (SM)** and a **poorly**

graded SAND (SP). The material was medium dense, with a firm consistency. Boring No. 3 revealed loose material in the top 20 feet, while Boring No. 4 revealed dense material in the same strata. In Boring No. 6, **poorly graded GRAVEL (GP)** was present at depths of 5 to 12 feet.

The next underlying layer was between 13 and 18 feet thick and was more dense and firm than the preceding layer. The material in this layer was a **silty SAND (SM)** and **poorly graded SAND (SP).** The third layer extended to the bottom of the borings and revealed a material change to a **clayey SAND (SC).** This material was hard in firmness and consistency, beginning at a depth of about 20 feet.

The test pits were excavated for the purpose of obtaining material for potential use as the aggregate constituent of the proposed soil-cement stabilization for the new levee and to determine if this material is suitable for use in the levee embankment. The pits were excavated to depths of 4 to 12 feet. A mixture of **poorly graded GRAVEL (GP)** and a **poorly graded SAND (SP)** were encountered throughout each test pit.

Phase II begins north of Camelback Road and encompasses the eastern overbank of the Agua Fria River and the southern overbank of the New River. Specifically, Boring Nos. 7 through 16 were drilled to depths of 15 to 25 feet and Test Pit Nos. 17 and 18 excavated to a depth of 12 feet each.

Except for Boring No. 16, the first layer of material in Boring Nos. 7 through 15 was either a **light brown silty SAND (SM)**, a **brown clayey SAND (SC)** or a combination of **SILT (ML)** and **CLAY (CL)** lenses. The first layer varied in depth from 1 1/2 feet to 10 feet. Boring Nos. 7 and 8 were drilled to depths of 26 feet, while Boring Nos. 9 through 16 were drilled to depths of 16 feet. Boring No. 16 was predominantly a **gray-tan poorly graded SAND (SP)** with gravel and cobbles.

The remaining layers were **SANDS** with varying amounts of silt and clay. Boring No. 14 revealed a 9-foot thick layer of **light brown, sandy silty CLAY (CL-ML).**

In general, the relative density and firmness was similar to that observed in Boring Nos. 1 through 6. Material within the first 10-feet of depth was loose and soft, to moderately firm, (N values of 2 to 10). Thereafter, the material became medium to very dense and very firm to hard.

6.2 Borrow Sites

Both proposed borrow pit sites were investigated for their materials suitability in a soil cement mix and for use in the embankment portion of the new levee. Two (2) test pits were excavated (TP Nos. 19 & 20) and their logs are shown in Appendix A. Each test pit was excavated to a depth of 12 feet. Samples were obtained off the vertical face of the pits. The material in each pit was classified as a **grey - tan, poorly graded SAND (SP)** with gravel and cobbles. While the maximum normal size ranged from 2 to 3 inches, there were some sizes (less than 5%) up to 5 inches in diameter at depths of 8 1/2' to 12'. In Test Pit No. 19, a light coating of clay and silt was detected on the rock surface at depths greater than 8 1/2 feet.

The second borrow pit was located in the SW corner of the proposed Camelback Ranch north of Camelback Road and east of the propose Levee alignment. A detention pond will be excavated as part of Phase II. Material was obtained from Test Pit Nos. 17 and 18. The top 4 to 6 feet was a **brown, sandy silty CLAY (CL-ML)** with over 60% passing the No. 200 screen and a Plasticity Index of 7 (Each Pit).

6.3 Channel Borings

While we were waiting for the crops to be harvested so that Test Pit Nos. 17 & 18, and Boring Nos. 8, 10, 14, 15 and 16 could be drilled or excavated, DMJM, Simons, Li and Associates and the District requested that additional borings be drilled at specific locations; New River, Agua Fria and at the confluence of the two rivers. At each of these locations a sample was obtained in the top 18 inches and a second sample was obtained in the strata 2 foot to 4-foot below grade. Please note that the depth on the boring logs in Appendix A is expressed in inches for Boring Nos. 21 through 23.

Two (2) additional test pits (Nos. 24 and 25) were excavated in the Aqua Fria channel during the middle of August, 1996 using the same criteria as above. These materials were sampled to determine the armoring characteristics for sediment transport analysis by the design team.

The grain-size distribution curves indicate that the top 18 inches is a **gray-tan, poorly graded SAND (SP)** except for Boring No. 21, where a **gray, poorly graded GRAVEL (GP)** was encountered. In all of these borings, the 2 to 4 foot layer consisted of a **brown, poorly graded SAND (SP).**

A light coating of clayey silty was present on the rock at depths of minus 2 feet and greater. The samples processed for sieve analysis/grain-size distribution determination show a nominal maximum aggregate size of 2 1/2 to 7 inches. During drilling, our crew noticed surface cobbles up to 10 inches in diameter. The location of the sample dictated whether or not the largest cobbles were included in the samples.

7.0 DISCUSSIONS AND RECOMMENDATIONS

The sampling of the subsurface materials was performed in May and June, 1996. Groundwater was not encountered during drilling or test pit excavation activities. The research performed by ATL included a review of ADWR Hydrologic Maps. Three wells, labeled C, E and F were located within 7 miles of the site and influenced the "change in groundwater" contours. The project site lies in an area that exhibited an increase in ground water elevation of approximately 40 feet from 1976 to 1982. The irrigation well at location E, 6 miles SE of the site, exhibited an increase to 115' below ground level. The irrigation well at location C, 4 miles NW of the site, decreased 10 feet to 340 feet below grade. Therefore, variances in groundwater levels should not effect the construction of the toe-down element of the levee.

Surface water, however, could effect the project construction sequence, particularly if a flood occurs prior to toe-down excavation, or any other excavation, being backfilled. Therefore, the contractor should be required to

construct temporary diversion dikes around the excavation. We do not anticipated the need for a de-watering system, but one may be required if temporary diversion dikes are not effected. Given the weather cycles in this area, construction should be scheduled during periods of minimum rainfall.

7.1 In-Situ Material Quality

The quality of the materials encountered in the borings/test pits for the levee construction, the borrow sites and the streambeds are addressed separately in the following subsections.

7.1.1 Phase I Levee Construction

The existing grade elevations for Boring Nos. 1 thru 5 were generally at 1017. The existing grade elevation for Boring No. 6 was lower at an elevation of 1012. The material types were similar in all of these borings; either a poorly graded gravel or a poorly graded silty sand. Tested fines content was less than 10%, the material was non-plastic and the maximum nominal aggregate size varied from 3/4 inch to 3 inches. This material, when excavate for both the levee foundation and the toe-down areas, is suitable for use both as structural backfill under the levee embankment and as aggregate filler in the soil cement mix. Specifications for the various backfills are presented in Section 8.0 of this Report an include general non-structural backfill in the toe-down area and structural backfill for the levee embankment construction. Soil cement grading specifications are also presented in Section 8.0 and include physical qualifications along with grading. It should be pointed out to the contractor that some blending might be needed for the soil cement aggregate but that no blending is anticipated for re-use of material from the Phase I area is backfill.

7.1.2 Phase II Levee Construction

This portion of the levee begins north of Camelback Road and the material from this alignment is represented by Boring Nos. 7 thru 16. Grade elevations ranged from 1025 to 1040, increasing from south to north. The material type ranged from a poorly graded silty clay to a poorly graded sand with gravel. From Boring No. 10 to Boring No. 15, the amount of fines encountered exceeded 60%

by weight of total sample. Only the material encountered at Boring Nos. 7 and 8 conformed to the "Select" Specifications (Table 702) of the Maricopa Association of Governments (MAG) 1992 Specifications. Therefore, this material is not recommended for re-use as structural backfill. However, it maybe used as embankment fill in the toe-down excavation areas west of the levee alignment. Section 8.0 provides specification guidelines for the various backfills required for this project and blending of materials throughout Phase II may be performed in order to meet the suggested specifications. If the contractor choses to blend the materials, it is recommended that coarse and fine stock piles be created, grain-size distributions (sieves) performed and blending percentages determined. A pug mill should be used to blend the materials.

7.1.3 Borrow Sites

Potential borrow sites were investigated for each Phase, with Test Pit Nos 19 and 20 representing material in the Agua Fria and Test Pits 17 and 18 representing material in the detention pond area of Phase II. The inital intent was to use the material in the Agua Fria for the soil cement aggregate quantity requirements for both Phase I and Phase II, as well as for the levee embankment. Material available in the excavation for the detention pond in Phase II could then be used to supplement both the soil cement and embankment material needs. Rough estimates indicates that there is in excess of 110,000 cubic yards of material available from the Agua Fria.

Test Pit Nos. 19 and 20 exhibited a 12-foot layer of poorly-graded sand and gravel. Cobbles greater than 3 inches were part of the sampled material. This indications that the contractor will need to screen out the oversize material before using in the the embankment and/or soil cement mix. Otherwise, the quality of the aggregate exceeded that required by MAG Section 702.3 for "Processed Natural Material". The material will initally be used in Phase I and should be mined so that the remainder of this source is avaliable for mining in Phase II.

Phase II includes excavation for a detention pond in the SW corner of the project site, north and east of the Camelback Road Bridge over the Agua Fria

River. DMJM has indicated that the pond will be excavated four (4) feet below existing grade. A drain pipe will be constructed to insure substantial drainage in a 36-hour period. The material in the top 3 feet is a silty lean clay, unsuitable for use as structural backfill. It may, however, be used in the backfill over the toe excavation, if blended with coarser material in order to reduce the percentage fines. The contractor may use the material below the 3 foot cut as structural backfill. If used, the over-excavated area may be backfilled and compacted with the material from the 3 foot cut.

7.1.4 Channel Streambed Material

In order to determine the armoring characteristics for sediment transport analysis by other members of the design team test pits and borings were utilized to sample material in the top 4 feet of the Agua Fria and New Rivers streambed. Test pits were excavated at locations 24 and 25, while borings were drilled at locations 21 thru 23. The material present in the layer from 0 to 1.5 feet was bulk sampled at each location. Additional bulk samples were taken from the 2 to 4 deep layer at each location. A sieve analysis was performed on each sample and a grain-size distribution curve developed so that D_{50} could be determined. Appendix B contains all the laboratory test results.

The D_{50} sizes may be summarized as follows:

Location	Depth	D_{50}
21	0 - 1.5'	8mm
22	0 - 1.5'	2 mm
23	0 - 1.5'	3.8mm
24	0 - 1.5'	29mm
25	0 - 1.5'	68mm
21	2 - 4'	5.8mm
22	2 - 4'	2.9mm
23	2 - 4'	1.2mm
24	2 - 4'	5.5mm
25	2 - 4'	2.2mm

The above data illustrates how the surface material increased in size on the Agua Fria as water traveled downstream (Nos. 22 - 25). This trend was not observed in the lower layers. The New River sample exhibited larger sizes in both layers, relative to the Agua Fria Material.

7.2 Levee and Toe-Down Foundations

7.2.1 Phase I Foundations

The Phase I levee construction begins at the tie-in to the existing soil cement structure at Sta 9+00.00. The new levee will begin at Sta 9+20.20. The new structure will vary in height 4 from 8 feet above existing grade as dictated by the Standard Project Flood (SPF) elevation. The actual toe-down elevation is based on the scour components computed for the SPF and the impact due to potential sand and gravel mining in the Agua Fria.

Boring Nos. 1 thru 6 were drilled along the Phase I levee alignment. Poorly graded sand with silt and some gravel generally comprises the entire 26 feet of boring depth; in various proportions as indicated by the grain-size distribution curves in Appendix B. The SPT data from the boreholes indicates that the in-situ material is very loose to loose. While it's quality is satisfactory, we recommend that four (4) feet of material be over-excavated and recompacted in accordance with the guidelines for levee construction presented in Section 8.0 of this Report. Prior to replacing the excavated material, the resulting subgrade should be proof-rolled so that at least 90% of the ASTM D698 laboratory maximum dry density is obtained. This will vary from 106 pcf to 117 pcf at approximately 10% moisture content. A minimum 10% shrinkage is anticipated during the compaction operation. Using the above procedure, the following parameters were developed for the Phase I levee foundation:

Net Allowable Bearing Capacity	-	**3000psf**
Total Settlement	-	**0.75 inches**
Differential Settlement	-	**0.50 inches**
Coefficient of Sliding Friction	-	**N/A**

The Phase I toe-down will be constructed at a depth determined by the SPF and mining operations. Mining operations for the borrow site are anticipated to begin near Test Pit No.20 and then progress north and from approximately Sta 35+00 to a limit that will be determined by project material requirements.

The bottom of the toe-down excavation for Phase I will be prepared similar to the procedures recommended for the over-excavation of the levee foundation. When the planned elevation is reached, the subgrade should be proof-rolled so that at least 90% of the ASTM D698 laboratory maximum dry density is obtained. This will vary from 115 pcf to 117 pcf at approximately 9.6% moisture content. We expect a shrinkage of approximately 5% during compaction operations.

The slope of the excavation, from the bottom of the over-excavation for the levee foundation to the toe-down elevation, should not be steeper than 1.8H:1.0V. Similar slopes are recommended for the front slope of the same excavation as it extends westward away from the levee.

7.2.2 Phase II Foundations

The Phase II levee construction begins approximately 460 feet east of the existing riprap structure on the north side of the bridge over the Agua Fria at Camelback Road Bridge. The new structure will vary in height 4 from 8 feet above existing grade as dictated by the Standard Project Flood (SPF) elevation. The actual toe-down elevation is based on the scour components computed for the SPF. Mining in New River is not anticipated.

Boring Nos. 7 thru 16 were drilled along the Phase II levee alignment. Silty, sandy clay or sand generally comprises the top 3 feet of material along the alignment. The underlying soil layers consisted of poorly graded silty sands. The SPT data from these boreholes indicates that the in-situ material is very loose in the top 4 feet and loose to medium dense in the next 6 feet. We recommend that the initial four (4) feet of material be over-excavated and recompacted in accordance with the guidelines for levee construction presented in Section 8.0 of this Report. Prior to replacing the excavated material, the resulting subgrade should be proof-rolled so that at least 90% of the ASTM D698 laboratory

maximum dry density is obtained. This will be in the range of 107 pcf at approximately 13.5% moisture content. A minimum 20% shrinkage is anticipated during the compaction operation. Using the above procedure, the following parameters were developed for the Phase II levee foundation:

Net Allowable Bearing Capacity	-	**1800psf**
Total Settlement	-	**1.0 inches**
Differential Settlement	-	**0.75 inches**
Coefficient of Sliding Friction	-	**N/A**

The Phase II toe-down will be constructed at a depth determined by the SPF. The bottom of the toe-down excavation for Phase II will be prepared similar to the procedures recommended for the over-excavation of the levee foundation. When the planned elevation is reached, the subgrade should be proof-rolled so that at least 90% of the ASTM D698 laboratory maximum dry density is obtained. This will be in the range of 120 pcf at approximately 13.2% moisture content. We expect a shrinkage of approximately 15% during compaction operations.

The slope of the excavation, from the bottom of the over-excavation for the levee foundation to the toe-down elevation, should not be steeper than 1.8H:1.0V. Similar slopes are recommended for the front slope of the same excavation as it extends westward away from the levee.

7.3 Levee Embankment

Section 7.2 of this Report presented foundation parameters for the native material. The construction of the embankment requires additional information and analysis which is presented in the following sections, separated for each phase. Tests were conducted to obtain the following on borrow and in-situ material placed in the embankment and compacted to 95% of their maximum dry density at optimum moisture content. In Section 7.2 we have indicated the loss - shrinkage - anticipated in the insitu foundation material at the toe-down area and the levee foundation area. This loss will occur as the result of both proof-rolling and additional compaction due to the movement of construction equipment over the material.

An issue to consider is the effect that earthquakes might have on the embankment. The Western States Seismic Council indicates that earthquakes with shaking intensities can occur in Yuma, in a north trending zone from Flagstaff to Fredonia and northwesterly through Flagstaff and Grand Canyon, merging with the Intermountain Seismic Belt in southern Utah. The Uman region holds the highest probability for damaging earthquakes. Work performed by K.M. Euge in 1992 and Bausch, Brumbaugh, and others in 1994 provide projected acceleration data for Maricopa County. This data indicates that the levee is a 90% non-probability zone. No additional precautions are anticipated for this project. Besides the slopes created during the excavation for the toe-down in both phases, which has been addressed in Section 7.2, the slope of the built-up embankment above ground for both the front and back sides must be evaluated. In addition, the embankment configuration for each phase is different. The construction sequence for each phase will, however, be similar; excavate to the toe with the bottom width sufficient for construction vehicles; compact the bottom area of the excavation; build the toe, construct the embankment and place aggregate base course (ABC) at the top of the levee which will be used as a roadway for maintenance vehicles.

7.3.1 Phase I Embankment

The material used in the embankment for this construction phase will come from the Agua Fria Borrow Site. The material will be placed in accordance with the recommendations contained in Section 8.0 and will conform to the indicated grading specifications. A wet weight of 130 pcf is suggested for use in loading calculations. A shrinkage of 10% is anticipated from excavated quantity to compacted quantity. The recommended construction slopes are:

Above Grade - 1.0H to 1.0V - Front Slope
3.0H to 1.0V - Back Slope

The embankment material for this phase will create a high permeability zone consisting of SP and SM material, adjacent to the soil cement facing. This insures

vertical seepage, with an estimated permeability of 1 x 10^{-2} cm/sec. Therefore uplift pressures will not build up. Using the 100 year-storm data, the design team has determined that no more than 0.4 feet of water will be contained by the levee. Therefore, "rapid drawdown" will not effect the stability of the embankment; the material is not capable of maintaining significant moisture that will create net pore pressures acting in one direction.

Concern for the erosion of embankment material and long term maintenance was voiced by the District. Treatments for the slopes are available; clear lignosufinites, seed mixes and less attractive bituminous sprays.

For the in-situ soils compressing the soil behind the soil cement facing and above the channel bottom, the following lateral forces and weights apply:

Dry Unit Weight	104 pcf
Friction Angle	41°
Equivalent Fluid Pressures	-
Passive	501 pcf
At Rest	36 pcf
Active	22 pcf

7.3.2 Phase II Embankment

The material used in the embankment for this construction phase will come from the Agua Fria Borrow Site. The material will be placed in accordance with the recommendations contained in Section 8.0 and will conform to the indicated grading specifications. A wet weight of 130 pcf is suggested for use in loading calculations. A shrinkage of 10% is anticipated from excavated quantity to compacted quantity. The recommended construction slopes are:

Above Grade - 1.0H to 1.0V - Front Slope
3.0H to 1.0V - Back Slope

The embankment material for this phase will create a high permeability zone consisting of SP and SM material, adjacent to the soil cement facing. This insures vertical seepage, with an estimated permeability of 1 x 10^{-2} cm/sec. Therefore

uplift pressures will not build up. Using 100-year storm data, the design team has determined that no more than 0.4 feet of water will be contained by the levee. Therefore, "rapid drawdown" will not effect the stability of the embankment; the material is not capable of maintaining significant moisture that will create newt pore pressures acting in one direction.

Concern for the erosion of embankment material and long term maintenance was voiced by the District. Treatments for the slopes are available; clear lignosufinites, seed mixes and less attractive bituminous sprays. Phase II will require that the section of the levee adjacent to the proposed detention pond allow for a 15-foot wide road between the top of the basin and the back slope of the levee embankment.

Rapid drawdown is not a factor in this phase for the same reasons as presented above for Phase I.

For the in-situ soils compressing the soil behind the soil cement facing and above the channel bottom, the following lateral forces and weights apply:

Dry Unit Weight	104 pcf
Friction Angle	41°
Equivalent Fluid Pressures	-
Passive	501 pcf
At Rest	36 pcf
Active	22 pcf

7.4 Soil-Cement Mix Designs

7.4.1 Agua Fria Borrow Site

Two (2) test pits (Nos. 19 and 20) were excavated in the Agua Fria to a depth of 12 feet below channel grade. Both excavations revealed **poorly graded SAND (SP)** that is graded sufficiently to use as the "soil" component of the soil cement product. Screening of the plus 2 inch material will be required, however (See Section 8).

The mix design was conducted in order to determine three (3) fundamental requirements for durable soil-cement:

1) Proper Moisture Content
2) Adequate Cement Content for Strength
3) Effects of Grading on Cement Requirements

In order to determine the optimum moisture content, ASTM D558 procedures were used to obtain the following optimum moisture content and maximum dry density:

Maximum Density(Unit Weight) = 122.8 pcf

Optimum Moisture = 8.7%

The Portland Cement Association (PCA) suggests that the average cement content needed for SP materials is 11%. ATL developed a mix design using ASTM D558 procedures with a 10% cement content and in-situ material screened on a 2-inch sieve. The optimum moisture content was determined to be 9.7% (See Appendix B). Using the optimum moisture content, mixtures of soil, water and cement were produced with cement contents varying from 4% to 10% at 2% increments. Material sufficient to mold four (4) specimens at cement, was produced. Specimens were cured for seven (7) days and compressive strength tests performed. The results (average of 3 specimens) are summarized below and in Figure 1.

Cement Content (%)	4	6	8	10
Average 7-day Compressive Strength(psi)	130	210	570	940

Based on the Figure 1 graph, a 9% cement content should be sufficient to meet the 7-day strength requirement of 750 psi. In order to insure durability and variations in material, the District recommends that an additional 2% be added. Therefore, ATL anticipates that soil-cement, using material from the Agua Fria source, will require a cement content of 11% by weight of dry aggregate.

It should be noted that the following quality tests were performed on Agua Fria aggregate:

- Absorption
- LA Abrasion
- Sand Equivalent
- Clay Clumps
- Specific Gravity

The tested values exceeded those required in MAG Section 701 for material used in Portland Cement Concrete. The material also conforms to the aggregate grading requirements of the Pima County Flood Control District.

ATL used a Type II, low alkali cement and a City drinking water source. Other water sources may be used, but mortar tests must be conducted in order to insure minimal effect on compressive strength. Even though we chose not to use Fly ash, a Type F pozzolan is acceptable as long as the design proves to be cost effective and meets the strength requirements.

7.4.2 Detention Area Borrow Site

This borrow site is part of Phase II and represents an area that has been selected for the construction of a "Detention" Pond. Two (2) test pits (Nos. 17 & 18) and Boring No. 7 were obtained within the proposed borrow site limits. The initial four (4) feet of depth was primarily a **brown sandy, silty CLAY (CL-ML)**. Boring No. 7 showed only a **dense sandy CLAY** but the test pits revealed thicker lenses. Material layers between 4 and 12 feet consisted of **gray-tan poorly graded SANDS (SP)**. The material between 8 and 12 feet revealed **SAND (SP)** with gravel containing a clayey silt coating.

The development of the soil-cement design was identical to that used for the Aqua Fria material. Fly ash as a pozzolan was not used with the Type II, low alkali cement. The compressive strength results (average of 3 specimens) are summarized below and in Figure 2:

Cement Content (%)	5	7	9	11
Average 7-day Compressive Strength(psi)	480	820	1180	1800

Based on the Figure 2 graph, a 7% cement content should be sufficient to meet the 7-day strength requirement of 750 psi. In order to insure durability and variation in materials, the District recommends that an additional 2% be added. Therefore, ATL anticipates that soil-cement, using material from the detention area source, will require a cement content of 9% by weight of dry aggregate.

8.0 CONSTRUCTION RECOMMENDATIONS

ATL recommends that MAG Standards be used as a guideline for construction specifications. The following sub-sections provide specific references to MAG, as well as containing additional recommendations specific to this project.

8.1 Clearing and Grubbing

Stripping of organic soil, grass, dead crops, etc. will be required prior to stockpiling the subsoil for subsequent use as backfill. Construction methods presented in MAG Sections 201.1 thru 201.4 should be followed. Material is re-usable as the surface layer for the backfill over the toe-down excavation and westward within the over bank limits.

8.2 Structure Excavation and Backfill

In general, Section 206 of MAG should be followed when excavating and backfilling for the levee embankment. The quality of materials used as backfill can vary, depending where and at what depth the backfill is placed. For both phases, backfill has been separated into the following types:

A) Structural backfill for the levee foundation and embankment.

B) Non-structural backfill for the toe-down excavation within 2 feet of the surface.

C) Non-structural backfill for the toe-down excavation placed 2 feet and greater below the surface.

The following material quality specifications are suggested for structural backfill for the material used as structural backfill and embankment in the levee:

Sieve Size	Percent Passing by Weight
2"	100
No. 4	30 - 70
No. 16	20 - 55
No. 50	5 - 35
No. 200	0 - 12

Maximum Plasticity Index = 7

The non-structural backfill used in the toe-down area within 2 feet of final grade, should meet the following requirements:

Sieve Size	Percent Passing by Weight
12"	100
No. 4	30 - 80
No. 200	0 - 60

Maximum Plasticity Index = 15

The non-structural backfill used in the toe-down area from 0 to 2 feet below final grade, should meet the following requirements:

Sieve Size	Percent Passing by Weight
2"	100
No. 4	30 - 80
No. 200	0 - 60

Maximum Plasticity Index = 15

8.2.1 Phase I

Structural backfill for the levee foundation and embankment should be placed in 12-inch compacted layers. Compaction criteria includes compacting to within 95% of the maximum laboratory dry density and within ±2% of the optimum moisture content as determined by ASTM D698. All layers should be placed horizontally and slopes trimmed after placement. Recompaction of subsoil material at the bottom of the excavation using the above criteria should be specified and conform to MAG Section 601.4.

8.2.2 Phase II

Structural backfill for the levee foundation and embankment should be placed in 12-inch compacted layers. Compaction criteria includes compacting to within 95% of the maximum laboratory dry density and within ±2% of the optimum moisture content as determined by ASTM D698. All layers should be placed horizontally and slopes trimmed after placement. Recompaction of subsoil material at the bottom of the excavation using the above criteria should be specified and conform to the requirements of MAG Section 601.4.

The material excavated from the detention pond construction is not suitable for use as structural backfill, but may be used in non-structural backfill areas as indicated above. It also may be used in blends, as along as the blends conform to the indicated grading specifications.

8.3 Soil Cement Placement

This section applies to both phases of construction. There are several acceptable methods of mixing soil-cement; central plant, on-site mixing "table", or mixed-in-place. The central plant or pugmill configuration is preferred for multi-layer applications such as this.

Prior to placing and compacting the soil-cement, the subgrade should be moistened and compacted as specified previously. Haul time should be minimized. Compaction should begin no later than 60 minutes after water is added to the mix. It is recommended that the soil-cement be compacted to an average of 98% and no less than 95% of the maximum density as determined by ASTM D558 or AASHTO T134. Figure 3 illustrates the preferred method of placing the soil-cement armoring, requiring some trimming after partially curing.

Finishing surfaces should be cured using water. Permanently exposed surfaces must be kept moist for seven (7) days. Also note that construction joints will be needed whenever lay down operations are interrupted for over 3 hours.

In developing the mix designs summarized in Section 7.0, the grading of the insitu material was used after scalping off the plus 2 inch aggregate. We recommend that this procedure be followed by the contractor(s) that perform the soil cement placement for each phase. The following gradation specification should be used as a guideline for controlling production and blending of the aggregates used in the soil cement mix:

Sieve	Percent Passing by Weight
2"	100
No. 4	50 - 80
No. 200	0 - 20

The contractor will be responsible for developing a mix design meeting the following strength and unit weight criteria:

7-Day Compressive Strength	750 psi
Minimum Unit Weight	125 pcf
Minimum Cement Content	9%

The narrow working area and high slopes can make construction of the embankment and its soil-cement armoring challenging. One method, appropriate to both Phases, is to use a central plant from which the material is hauled and dumped into a storage bin at the bottom of the embankment. A front end loader can than feed a spreader working from the top of the slope down. Vibratory steel wheel loaders are ideal for compaction of soil-cement made of granular materials.

9.0 ADDITIONAL SERVICES

ATL would welcome the opportunity to provide materials testing services during construction. Our staff of experienced technicians and field engineers can provide competent and reliable testing services.

It has been ATL's pleasure to serve DMJM on this project. ATL has in-house expertise in a variety of geotechnical related areas and the firm looks forward to working with DMJM, Inc. in the near future.

10.0 REFERENCES

1. ***Soil Mechanics, Design Manual 7.01***, Change 1, 9/86
   Naval Facilities Engineering Command
2. ***Foundation and Earth Structures, Design Manual 7.02***
   Change 2, 9/86, Naval Facilities Engineering Command
3. ***Uniform Building Code***, 1991, Part VI, Chapter 29
4. ***"Controlling Floods in the Desert with Soil-Cement"***
   Hansen and Lynch, 6/95
5. ***"Soil-Cement for Facing Slopes and Lining Reservoirs, Channels and Lagoons"***, PCA Concrete Information, 1996
6. ***"Soil-Cement Slope Protection for Embankments: Planning and Design"***, PCA Concrete Information, 1991
7. ***Uniform Standard Specifications for Public Works Construction,***
   =Maricopa Association of Governments, 1992
8. ***Roadside Geology of Arizona***, Holka Chronic, 1995

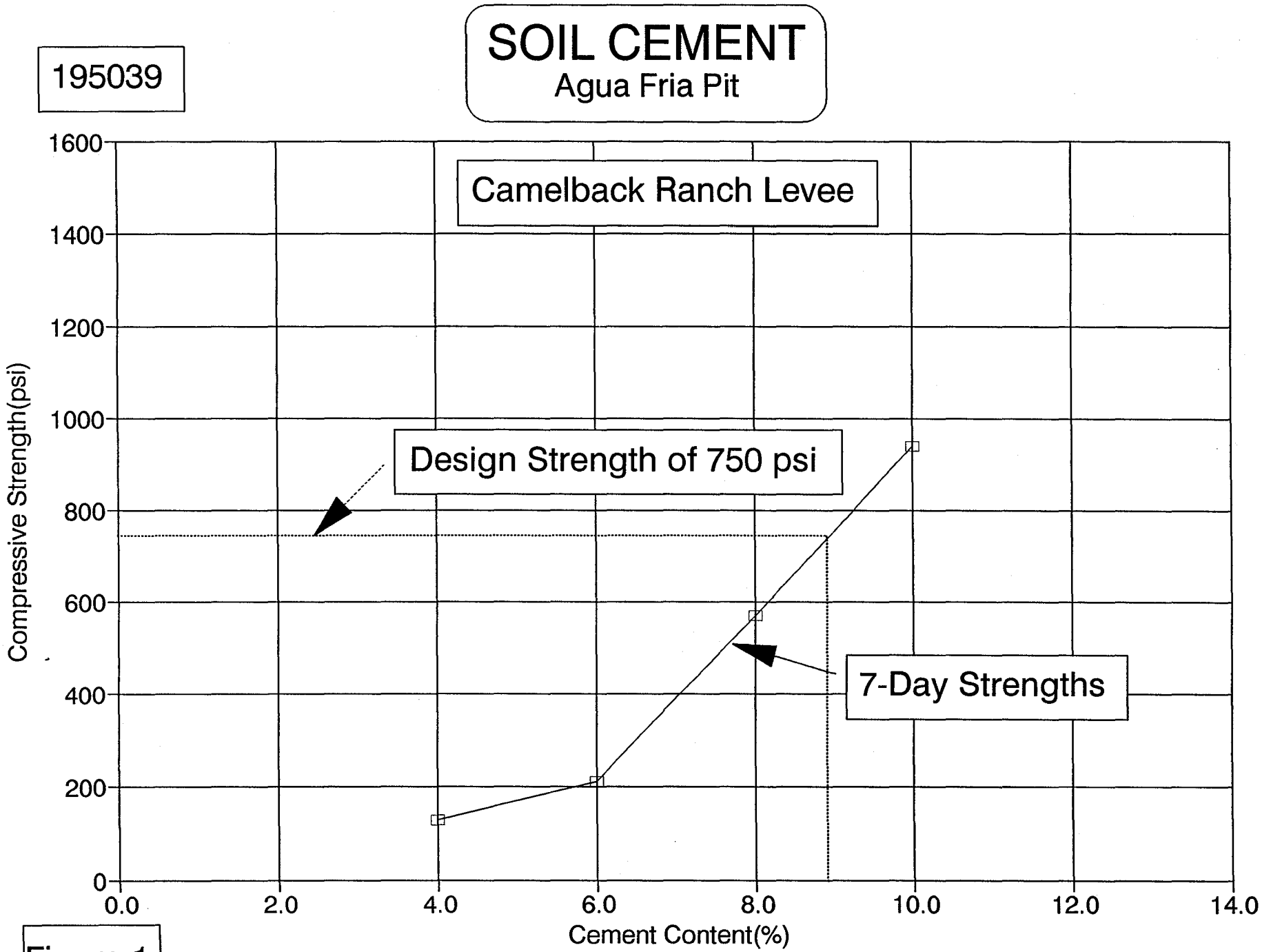

195039
SOIL CEMENT
Agua Fria Pit
Camelback Ranch Levee
Design Strength of 750 psi
7-Day Strengths
Compressive Strength(psi)
Cement Content(%)
1600
1400
1200
1000
800
600
400
200
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

Figure 1

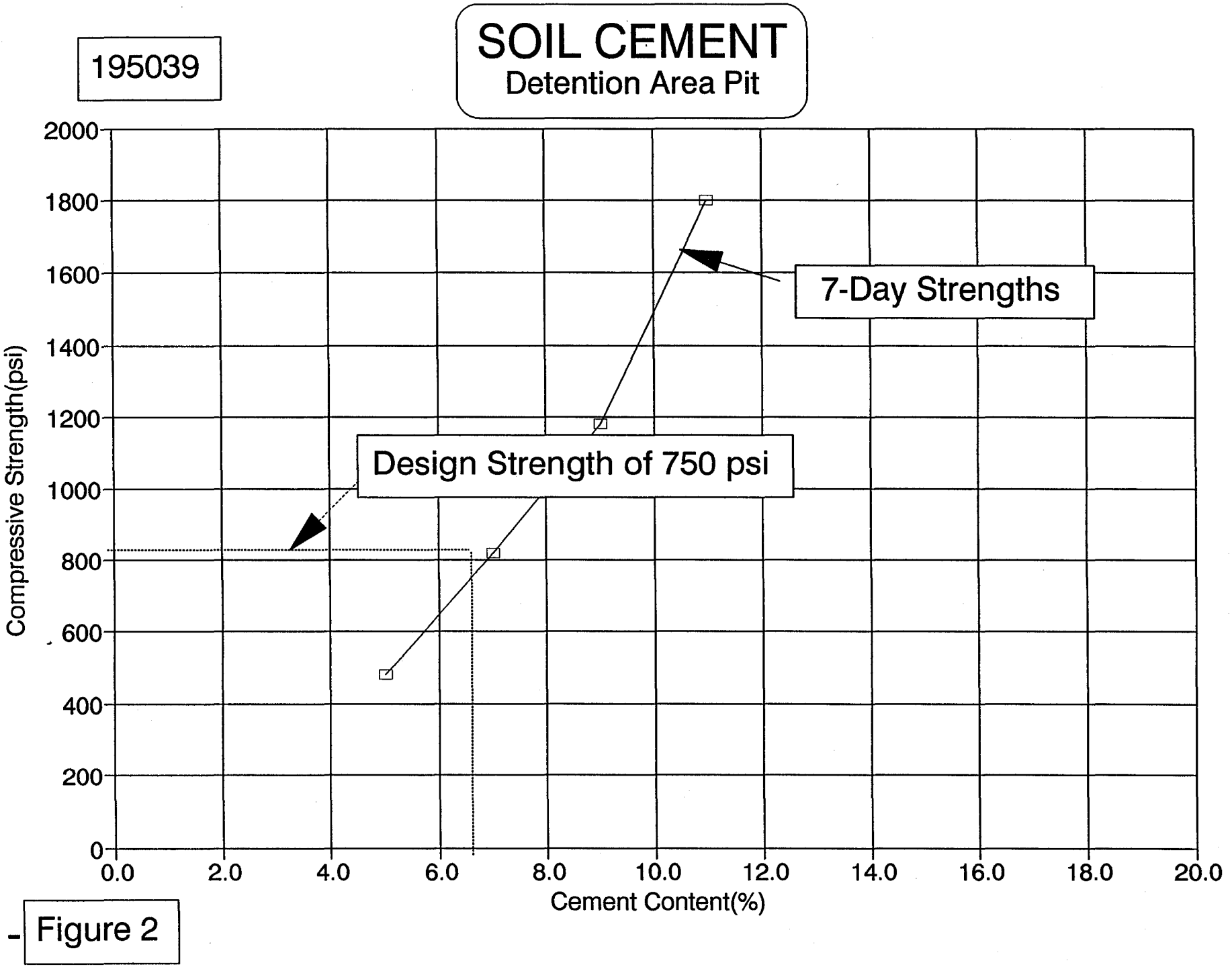

195039
SOIL CEMENT
Detention Area Pit
7-Day Strengths
Design Strength of 750 psi
Compressive Strength(psi)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
Cement Content(%)

Figure 2

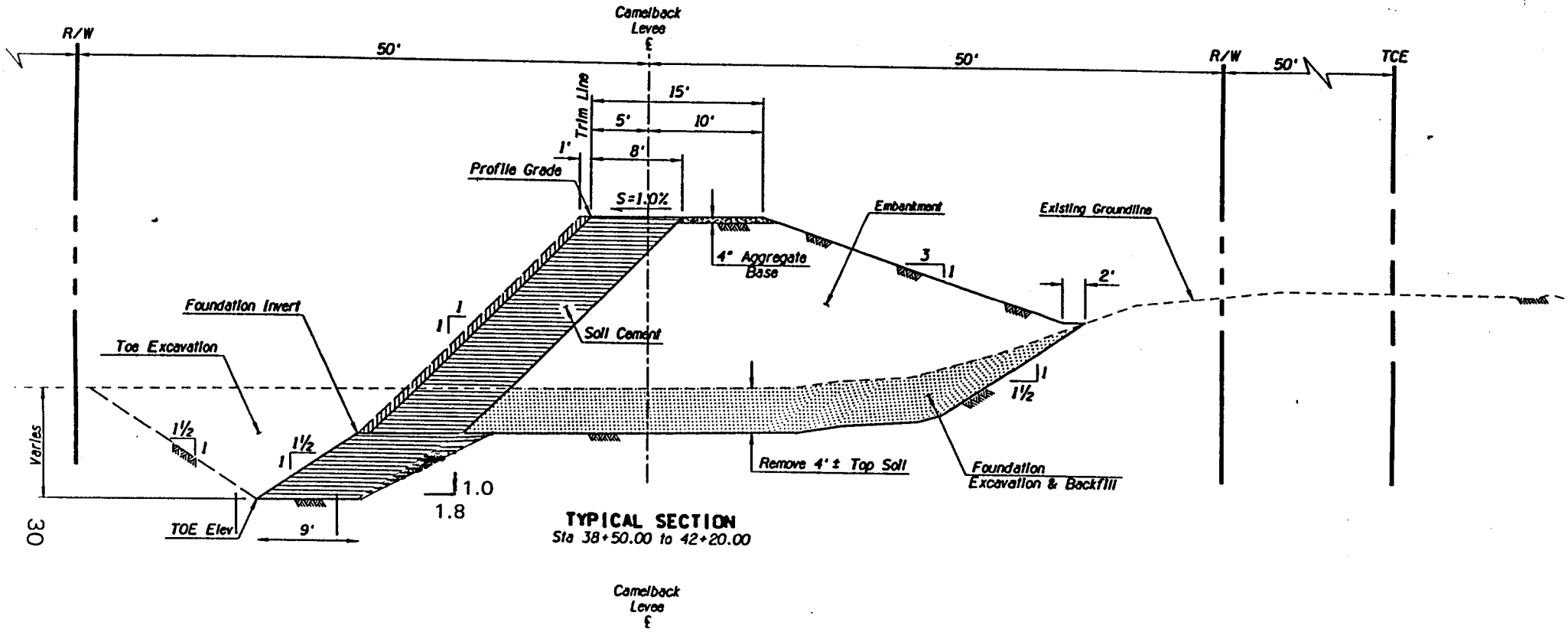

R/W
50'
Camelback Levee
℄
50'
R/W
50'
TCE
15'
5'
10'
1'
Trim Line
8'
Profile Grade
S=1.0%
Embankment
Existing Groundline
4" Aggregate Base
3
1
2'
Foundation Invert
1
1
Soil Cement
Toe Excavation
1½
1
1½
1
1½
1
Varies
30
1.0
1.8
Remove 4'± Top Soil
Foundation Excavation & Backfill
TOE Elev
9'
TYPICAL SECTION
Sta 38+50.00 to 42+20.00
Camelback Levee
℄

FIGURE 3

PLATES

GUIDELINES IN THE USE AND INTERPRETATION

OF THIS GEOTECHNICAL REPORT

ATL Job No. 195039

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

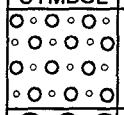
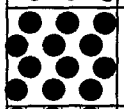
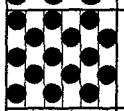
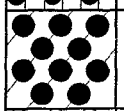
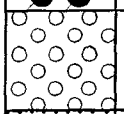
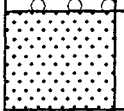
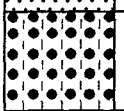
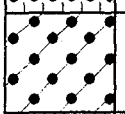
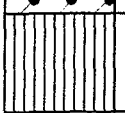
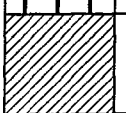
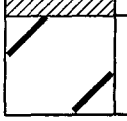
Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.

PLATE 1

SOIL CLASSIFICATION & TERMINOLOGY

GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
	GW	Well graded gravels, gravel - sand mixtures, or sand - gravel - cobble mixtures.
	GP	Poorly graded gravels, gravel - sand mixtures, or sand - gravel - cobble mixtures.
	GM	Silty gravels, gravel - sand - silt mixtures.
	GC	Clayey gravels, gravel - sand - clay mixtures.
	SW	Well graded sands, gravelly sands.
	SP	Poorly graded sands, gravelly sands.
	SM	Silty sands, sand - silt mixtures
	SC	Clayey sands, sand - clay mixtures
	ML	Inorganic silts, clayey silts with slight plasticity
	MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand - gravel mixtures,

N	Relative Density
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium dense
31 - 50	Dense
50	Very dense

2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0 - 4	Very soft	Easily penetrated several inches with fist.
3 - 4	Soft	Easily penetrated several inches with thumb.
5 - 8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9 - 15	Stiff	Readily indented with thumb. but penetrated only with great effort.
16 - 30	Very stiff	Readily indented with thumb-nail.
30 +	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and / or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

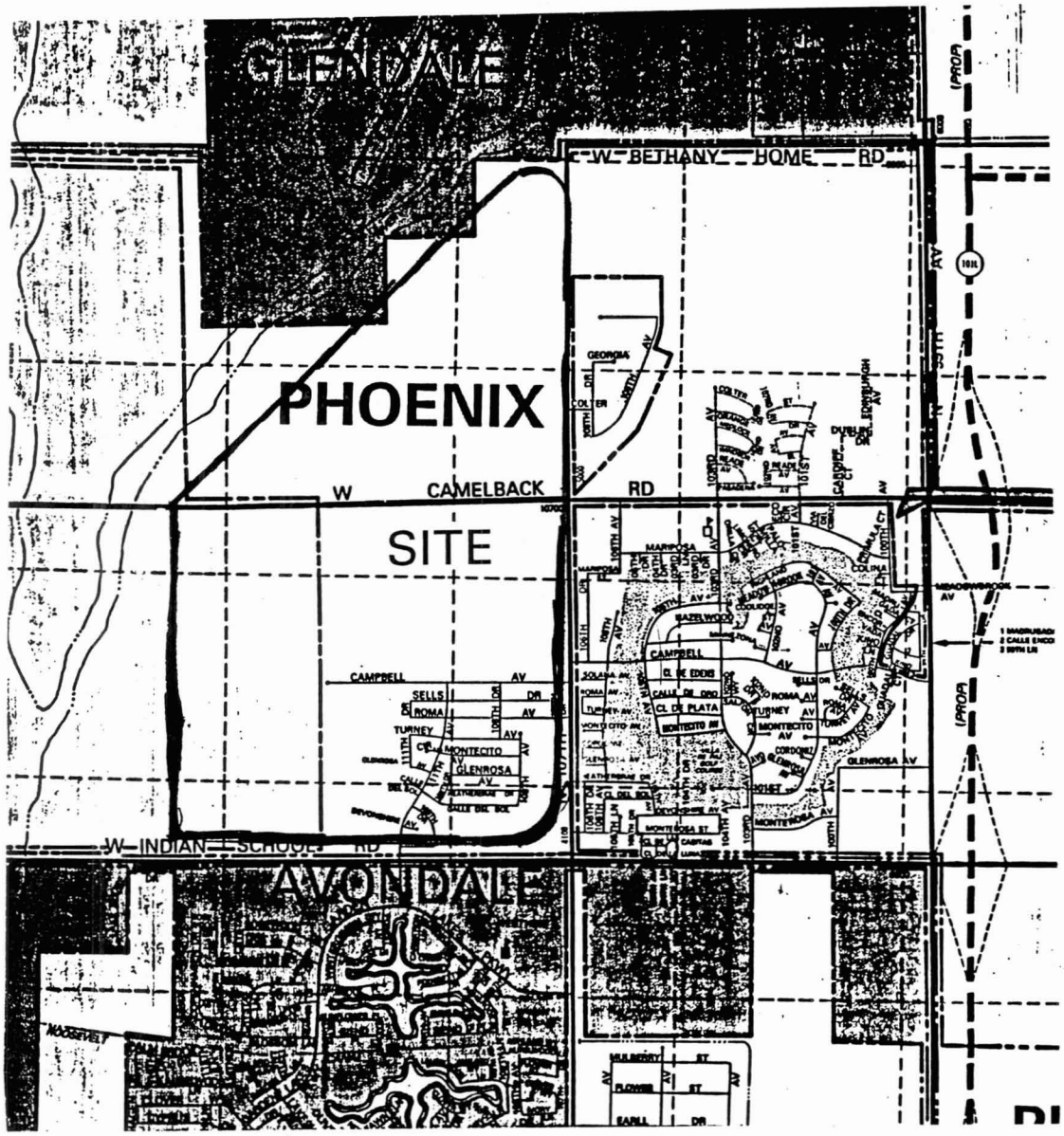
N	Relative Firmness
0 - 4	Very soft
5 - 8	Soft
9 - 15	Moderately firm
16 - 30	Firm
31 - 50	Very firm
50 +	Hard

4. Standard Penetration Tests (SPT) =

DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 inches
Gravel	3 inches to No. 4 sieve
Coarse gravel	3 inches to 3/4 inch
Fine gravel	3/4 inch to No. 4 sieve
Sand	No. 4 sieve to No. 200
Coarse	No. 4 sieve to No. 10
Medium	No. 10 sieve to No. 40
Fine	No. 40 sieve to No. 200
Fines (silt or clay)	Below No. 200 sieve

PLATE 2

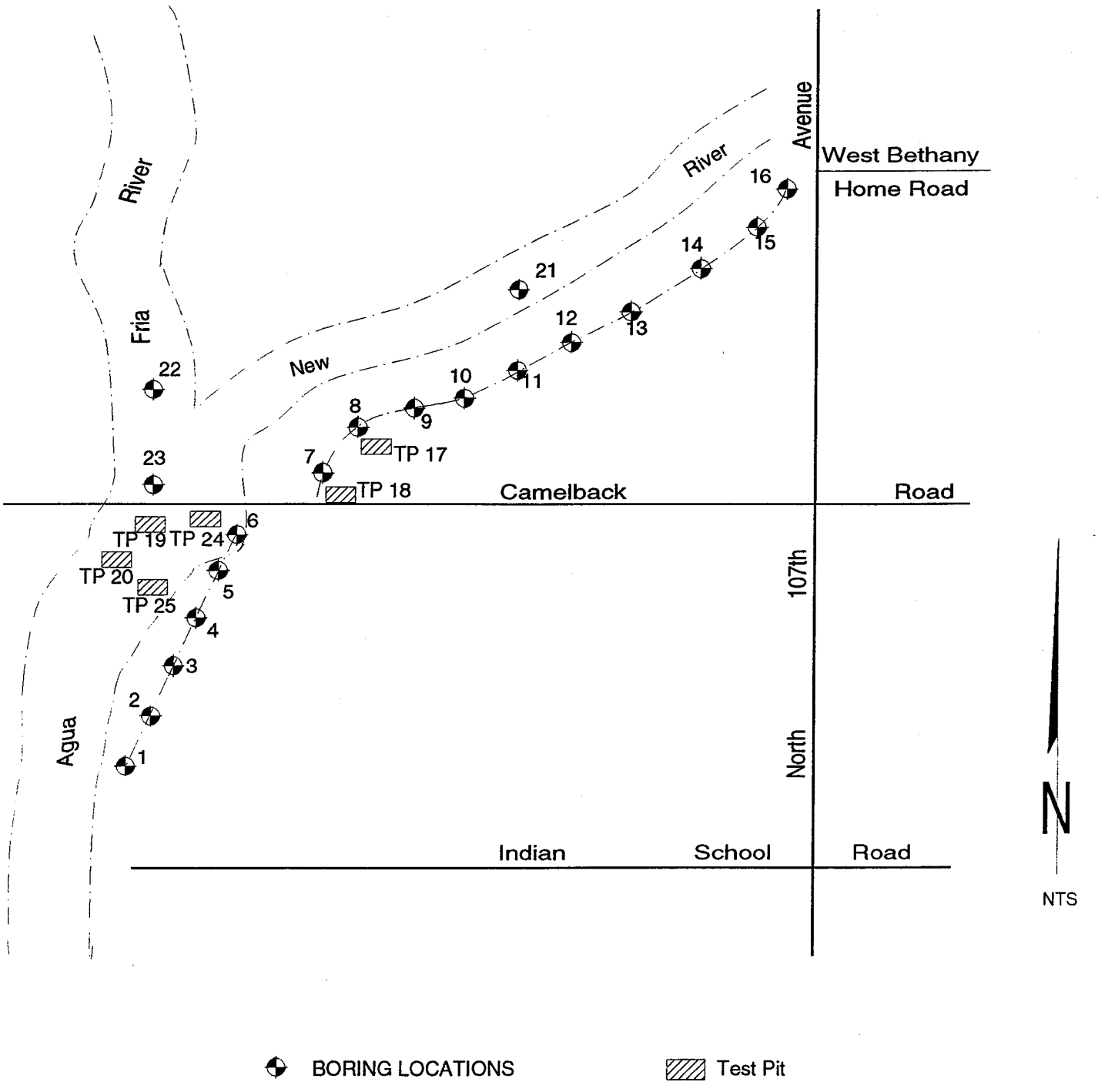


VICINITY MAP

CAMELBACK RANCH LEVEE

ATL JOB NO. 195039

PLATE 3



BORING LOCATIONS

CAMELBACK RANCH LEVEE

ATL JOB NO. 195039

PLATE 4

APPENDIX A

BORING LOGS

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 1

Boring Location: 14 + 26 30' Right, Centerline
Phase I

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/09/96 Elevation of Boring: 1016.5'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		SILT, sand and gravel (Road surfacing)				
		Tan, silty SAND with trace of gravel to 2.5 inch size, Moist				
	5		4			
	10	Light brown, poorly graded SAND (SP-SM) with silt and gravel, Moist	13			
	15		27			
		Light coating of clayey silt				
	20		25			
		Brown, Clayey SAND (SC) and gravel, Moist, Hard drilling, Weakly cemented				
	25		50/4"			
		(Bottom of boring at 26 feet)				

Boring Stopped at 26 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A1

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 2

Boring Location: 19 + 80 14.5' Right Centerline
Phase I

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/09/96 Elevation of Boring: 1017.3'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	Gray-tan, poorly graded silty SAND (SP-SM), with trace of gravel, Damp	14			
	10	Gray-tan, silty SAND (SM) with gravel, Damp	16			
	15		32			
	20	Light brown, clayey SAND (SC) and gravel, Weakly cemented, Damp Hard drilling	50/4"			
	25		50/5"			
		(Bottom of boring at 26 feet)				

Boring Stopped at 26 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A2

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 3

Boring Location: 24 + 50 Centerline
Phase I

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/09/96 Elevation of Boring: 1017.2'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	Light brown, silty SAND (SM), Damp Note: Top 12 inches appears to be disturbed soil. Perhaps backfill from El Paso gas line removal.	4			
	10		5			
	15	Light brown, silty SAND (SM) with gravel, Thin clayey silt coating, Damp	20			
	20	Brown, clayey SAND (SC),with gravel and cobbles, Weakly cemented, Damp, Hard drilling 8 inch auger refusal at 20.5 feet. Changed to 4 inch auger. No recovery from 4 inch auger.	50/2"			
	25	(Bottom of boring at 26 feet)				

Boring Stopped at 26 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A3

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 4

Boring Location: 29 + 50 Centerline

Phase I

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/09/96 Elevation of Boring: 1017.3'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	Gray-tan, poorly graded SAND (SP), Damp	15			
	10	Gray-tan, poorly graded SAND (SP) with gravel, Damp	39			
	15	Light brown, poorly graded GRAVEL (GP) with sand, Clayey silt coating on rock, Damp	14			
	20	Weathered cemented strata	26			
	25	Light brown, clayey SAND (SC) with gravel, Weakly cemented, Damp	34			
		(Bottom of boring at 26.5 feet)				

Boring Stopped at 26.5 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 5

Boring Location: 34 + 50 Centerline
Phase I

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/10/96 Elevation of Boring: 1018.1'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	Gray-tan, silty SAND (SM), Damp, Trace of gravel	10			
	10		90			
	15	Light brown, clayey SAND (SC) with gravel, Damp, Trace of cementation	68			
	20	Poorly graded SAND (SP-SM) with silt and gravel	50/4"			
	25	Weakly cemented	50/3"			
		(Bottom of boring at 26 feet)				

Boring Stopped at 26 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 6

Boring Location: 39 + 50 Centerline

Phase I

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/10/96 Elevation of Boring: 1012.1'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Gray-tan, gravelly SAND (SP), Damp				
	5	*Poorly graded GRAVEL (GP) with sand, Coating of clayey silt on rock, Moist*	32			
	10		34			
		Light brown, clayey SAND (SC) with gravel, Moist, Weakly cemented				
	15		90/10"			
	20	*Clayey silt coating*	41			
	25		50/2"			
		(Bottom of boring at 26 feet)				

Boring Stopped at 26 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 7

Boring Location: 17 + 20 Centerline

Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/10/96 Elevation of Boring: 1025.2

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	Gray-tan, silty SAND (SM) with gravel, Damp				
	Sandy clay lense (CL)				
5	Gray-tan, silty SAND (SM), Moist	11			
	Brown, poorly graded SAND (SP-SM) with silt and gravel, Gravel has silty clay coating				
10		20			
15		41			
20	Occasional cobble	53			
	Trace of cementation				
25		60			
	(Bottom of boring at 26 feet)				

Boring Stopped at 26 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 8

Boring Location: 25 + 11 Centerline
Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 6/17/96 Elevation of Boring: 1026.1'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	Light brown, silty SAND (SM), Moist				
	Brown, sandy CLAY (CL), Very moist				
	Poorly graded SAND (SP-SM) with silt and gravel. Moist				
5		15			
10		44			
15	Gray-tan silty SAND (SM) with gravel, Wet	46			
20	Brown, poorly graded SAND (SP) and gravel and small cobbles, Silty coating on rock, Moist	45			
25		50/5"			
	(Bottom of boring at 25.9 feet)				

Boring Stopped at 25.9 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 9

Boring Location: 31 + 40 Centerline

Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/10/96 Elevation of Boring: 1028.8'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	Gray-tan, poorly graded SAND (SP-SM) with silt and a trace of gravel, Moist	9			
	10		24			
	15	Light brown, SAND (SP) with gravel, Light clayey silt coating on rock, Moist	26			
	20	(Bottom of boring at 16 feet)				
	25					

Boring Stopped at 16 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 10

Boring Location: 38 + 70 Centerline
Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 6/17/96 Elevation of Boring: 1029.3'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	Brown, clayey SAND (SC), Moist				
	Light brown, silty SAND (SM), Moist				
5		8			
10		25			
	Light brown, poorly graded SAND (SP-SM) with a trace of gravel, Moist				
15		46			
	(Bottom of boring at 16 feet)				
20					
25					

Boring Stopped at 16 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 11

Boring Location: 44 + 50 Centerline

Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/10/96 Elevation of Boring: 1032.3'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	Brown clayey SAND (SC), Moist	8			
	10	Gray-tan poorly graded SAND (SP-SM), Moist	64			
	15	Light brown, SAND (SP-SM) with some gravel, Very light coating of clayey silt on the rock, Moist	43			
	20	(Bottom of boring at 16 feet)				
	25					

Boring Stopped at 16 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A11

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 12

Boring Location: 50 + 10 Centerline

Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/09/96 Elevation of Boring: 1033.3'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown, clayey SAND (SC), Moist				
	5	Gray-tan, silty SAND (SM) with gravel, Moist	4			
	10		27			
		Brown, clayey SAND (SC) and gravel, Moist				
	15		63			
		(Bottom of boring at 16 feet)				
	20					
	25					

Boring Stopped at 16 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 13

Boring Location: 57 + 69 Centerline
Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 5/09/96 Elevation of Boring: 1036.1'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown, sandy SILT (ML), Very moist				
	5		4			
	10	Light brown, silty SAND (SM), with gravel, Moist	37			
	15	Light brown, gravelly SAND (SP-SM), Light coating of clayey silt, Moist	16			
		(Bottom of boring at 16 feet)				
	20					
	25					

Boring Stopped at 16 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 14

Boring Location: 64 + 48 Centerline
Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 6/17/96 Elevation of Boring: 1037.8'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Light brown, silty SAND (SM), Moist				
		Brown, clayey SAND (SC), Moist				
	5	Light brown, sandy silty CLAY (CL-ML), Moist	6			
	10		10			
	15	Light brown, silty SAND (SM) with gravel, Damp	19			
		(Bottom of boring at 16 feet)				
	20					
	25					

Boring Stopped at 16 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 15

Boring Location: 71 + 38 Centerline
Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 6/18/96 Elevation of Boring: 1038.4'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown, sandy silty CLAY (CL-ML), Moist				
	5	Light brown, silty SAND (SM), Moist	6			
	10		9			
		Gray-tan, SAND (SP), Moist				
	15	Brown, clayey SAND (SC) with gravel, Moist	50/4"			
		(Bottom of boring at 16 feet)				
	20					
	25					

Boring Stopped at 16 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 16

Boring Location: 77 + 73 Centerline
Phase II

Boring Equipment: Mobile B-50 With 8 - Inch Diameter Hollow Stem Auger

Date of Boring: 6/24/96 Elevation of Boring: 1040.1'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	Gray-tan, poorly graded SAND (SP) with gravel and cobbles, Damp	7			
	10		46			
	15		42			
	20	(Bottom of boring at 16 feet)				
	25					

Boring Stopped at 16 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Test Pit No. 17

Boring Location: 18 + 00 660' Right Centerline
Phase II

Boring Equipment: Case 580 Backhoe

Date of Boring: 6/24/96 Elevation of Boring: 1024.8'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown, sandy silty CLAY (CL-ML) with gravel, Moist				
	5	Gray-tan, SAND (SP) with some gravel with occasional cobbles to 5 inch size, Moist				
	10	Light brown, gravelly SAND (SP) with light clayey silt coating, Moist				
		(Bottom of pit at 12 feet)				
	15					
	20					
	25					

Boring Stopped at 12 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Test Pit No. 18

Boring Location: 77 + 73 Centerline
Phase II

Boring Equipment: Case 580 Backhoe

Date of Boring: 6/24/96 Elevation of Boring: 1040.1'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*Brown, sandy silty CLAY (CL-ML), Moist*				
		Gray-tan, SAND (SP) with some silt, Moist				
	10	*Brown, SAND (SP) with coating of clayey silt, Moist*				
		(Bottom of pit at 12 feet)				
	15					
	20					
	25					

Boring Stopped at 12 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Test Pit No. 19

Pit Location: 38 + 60 470' Left Centerline
Phase I

Boring Equipment: Case 580 Backhoe

Date of Pit: 5/31/96 Elevation of Boring: 1016.9'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	Gray-tan, poorly graded SAND (SP) with gravel and cobbles to 5 inch size, Moist				
	10	Brown, SAND (SP) with gravel and small cobbles, Light coating of clayey silt on rock, Moist				
	15	(Bottom of pit at 12 feet)				
	20					
	25					

Boring Stopped at 12 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Test Pit No. 20

Boring Location: 33 + 00 580' Left Centerline Phase I

Boring Equipment: Case 580 Backhoe

Date of Boring: 5/31/96 Elevation of Boring: 1016.0'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	3	Gray, poorly graded SAND (SP) with gravel, Moist				
	6					
	9	Light brown, poorly graded GRAVEL (GP) with sand to 3" maximum size, Light coating of clayey silt on rock, Very moist				
	12	(Bottom of Test Pit at 12 feet)				
		Note: Maximum size of rock on surface is 9 inch diameter				

Boring Stopped at 12 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A20

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 21

Boring Location: 54 + 00 580' Left Centerline Phase II

Boring Equipment: Hand dug to 18 Inch Depth Mobile B-50 With 8 Inch Diameter Hollow Stem Auger

Date of Boring: 5/22/96 Elevation of Boring: 1026.0'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Inches)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Gray, poorly graded GRAVEL (GP) with sand and small cobbles, Moist				
	12					
	24	Light brown, SAND (SP) with gravel to 3 inch maximum size, Light coating of clayey silt on rock, Very moist				
	36					
	48	(Bottom of boring at 48 inches)				
		Note: Maximum size of rock on surface is 9 inch diameter				

Boring Stopped at 48 Inches Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A21

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 22

Boring Location: 29 + 10 1640' Left Centerline Phase II

Boring Equipment: Hand Dug to 18 Inch Depth Mobile B-50 With 8-Inch Diameter Hollow Stem Auger

Date of Boring: 5/22/96 Elevation of Boring: 1020.2'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Inches)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Gray-tan, poorly graded SAND (GP) with gravel, Maximum size 3 inches, Very small percent above 2 inches, Damp				
	12					
		Gray-tan, poorly graded SAND (SP) with trace of gravel, Moist				
	24					
	36					
	48	(Bottom of boring at 48 inches)				

Boring Stopped at 48 Inches Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. 195039

Boring No. 23

Boring Location: 20 + 10 720 Left Centerline Phase II

Boring Equipment: Hand Dug to 18 inch Depth Mobile B-50 With 8 - inch Diameter Hollow Stem Auger

Date of Boring: 5/22/96 Elevation of Boring: 1017.5'

Driller: J. Cowell Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Inches)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Gray-tan, poorly graded GRAVEL (GP), with gravel with cobbles to 6 inch size, Moist				
	12					
		Gray-tan, poorly graded SAND (SP) with gravel and cobbles to 4 inch maximum size (Very small % of coarse sand and fine gravel) Moist				
	24					
	36					
	48	(Bottom of boring at 48 inches)				
		Note: Maximum size of rock on surface is 10 inches				

Boring Stopped at 48 Inches Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE

ATL Job No. *195039-1*

Test Pit No. *24*

Pit Location: *100' Left Station 41 + 80 Phase I*

Boring Equipment: *Case 580 Backhoe*

Date of Pit: *8/07/96* Elevation of Boring: *1010.6'*

Driller: *Wilstead* Logger: *J. Cowell* Reviewed By: *D. Hayes*

Graphical Log	Depth (Inches)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Gray, Sandy GRAVEL (GP) with Cobbles to 6" Size, Damp				
	10					
	20	*Light Brown Sandy GRAVEL (GP) with Occasional Small Cobbles to 4" Light Clayey Silt Coating*				
	30					
	40					
	50	*(Bottom of Test Pit)*				

Boring Stopped at *48* Inches Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A24

CAMELBACK RANCH LEVEE

ATL Job No. 195039-1

Test Pit No. 25

Pit Location: 285' Left Station 33 + 00 Phase I

Boring Equipment: Case 580 Backhoe

Date of Pit: 8/07/96 Elevation of Boring: 1009.7'

Driller: Wilstead Logger: J. Cowell Reviewed By: D. Hayes

Graphical Log	Depth (Inches)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Gray-Tan, GRAVEL (GP) wiht sand and Cobbles to 6" Max Size, Damp				
	10					
	20	Gray-Tan SAND (SP) with Traces of Fine Gravel to 1" Max Size Few Fines, Damp				
		Gray-Tan, SAND (SP) with Fine Gravel to 1" Max Size, Few Fines, Moist				
	30					
		LIght Brown, SAND (SP) with Silt, Moist				
	40	Light Brown, SAND (SP) with Light Silty Coating Gravel, Moist				
		Light Brown, SAND (SP) with Silt, Moist				
		(Bottom of Test Pit)				
	50					

Boring Stopped at 48 Inches Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A25

APPENDIX B

LABORATORY TEST RESULTS

SUMMARY OF LABORATORY ANALYSIS

PROJECT: DMJM DATE: 6/26/96

LOCATION: Camelback Ranch Levee

MATERIAL: SEE BELOW SAMPLING DATE: 5/09/96

REQUESTED BY: David Hayes ATL JOB NO: 195039

LOG NO.	DEPTH (FT)	MOIST (%)	USCS	LL	PI	SIEVE ANALYSIS - PERCENT PASSING															
						200	100	50	40	16	10	8	4	1/4	3/8	1/2	3/4	1	2	2.5	3
1	10 - 23	3.6	SP-SM	NP	NP	6.4	9	20	28	55	63	63	64	66	70	73	79	81	82	82	100
2	5 1/2 - 6	-	SP-SM	-	-	7.6	23	44	52	80	87	89	92	93	95	96	100				
4	13 - 20	2.3	GP	NP	NP	2.1	2	3	5	14	17	22	22	22	24	26	34	44	88	100	
5	16 - 16 1/2	1.5	SP-SM	NP	NP	5.6	7	13	19	38	46	49	56	59	64	67	75	81	100		
6	5 - 12 1/2	3.5	GP	NP	NP	3.8	9	11	15	31	42	48	50	53	56	60	69	74	91	100	
6	12 1/2 - 19	2.6	SP-SM	NP	NP	6.8	9	17	28	64	74	78	85	87	93	96	100				
7	20-20 1/2	7.0	GP-GM	NP	NP	9.4	12	16	19	36	43	46	54	58	64	71	80	90	100		
8	8 -15	5.0	SP-SM	NP	NP	6.0	8	14	20	44	50	51	57	60	63	67	76	81	100		
9	2 - 11	3.8	SP-SM	NP	NP	6.1	10	24	36	72	82	84	88	90	92	94	97	100			
9	11-15	7.4	SP-SM	NP	NP	6.7	9	19	26	49	54	64	67	68	72	76	82	84	85	85	100
10	1 1/2 - 7	9.2	ML	23	NP	71.1	84	92	95	99	99	100									
12	8 1/2 - 13	6.6	SM	NP	NP	13.1	19	30	37	60	65	66	69	71	73	76	79	80	85	87	100
13	0 - 6 1/2	17.4	ML	25	3	61.1	75	87	90	97	98	98	99	99	99	100					
14	4 1/2-8	12.6	CL-ML	26	5	67.7	81	90	94	98	99	99	100								
15	0 - 3	18.7	CL-ML	28	4	76.6	80	93	95	97	100										
16	3-10	1.5	SP-SM	NP	NP	6.8	10	22	35	79	82	91	96	97	97	97	97	97	100		
17	4-9	3.6	SP	NP	NP	0.8	2	9	17	48	56	59	63	70	71	75	77	81	83	83	90
18	0-3	8.9	CL-ML	30	7	65.4	74	82	87	98	99	100									
19	0 - 8	-	SP	NP	NP	1.5	3	9	17	49	57	59	63	66	70	74	80	84	100		
19	8-12	2.4	SP	NP	NP	2.4	4	10	16	47	63	69	85	88	92	94	96	98	99	100	
20	0 - 8 1/2	-	SP	NP	NP	4.6	8	22	35	66	71	73	76	78	82	85	89	91	100		
20	8-12	2.2	GP	NP	NP	1.0	1	3	4	12	16	18	23	31	37	46	54	68	71	76	89
21	0 - 1 1/2	-	GP	NP	NP	2.7	3	5	8	33	41	43	48	50	54	57	62	67	82	85	91
21	2 - 4	-	GP	NP	NP	2.1	2	3	5	31	42	44	48	52	57	60	66	70	80	83	89
22	0 - 1 1/2	-	SP	NP	NP	1.0	1	1	3	35	52	57	70	74	80	84	90	93	98	100	

SUMMARY OF LABORATORY ANALYSIS

PROJECT: DMJM DATE: 6/26/96

LOCATION: Camelback Ranch Levee

MATERIAL: See Below SAMPLING DATE: 5/09/96

REQUESTED BY: David Hayes ATL JOB NO: 195039

LOG NO.	DEPTH (FT)	MOIST (%)	USCS	LL	PI	SIEVE ANALYSIS - PERCENT PASSING															
						200	100	50	40	16	10	8	4	1/4	3/8	1/2	3/4	1	2	2.5	3
22	2 - 4	-	SP	NP	NP	1.0	3	11	20	48	49	55	60	68	73	81	86	93	97	100	
23	0 - 1.5	-	GP	NP	NP	-	1	1	3	29	41	44	51	61	64	67	72	76	83	86	87
23	2 - 4	-	SP	NP	NP	2.8	4	15	27	52	60	63	71	75	80	83	87	89	93	93	95
24	0 - 1.5	2.0	GP	NP	NP	1.1	2	3	4	15	22	24	28	29	33	31	41	45	60	68	71
24	2 - 4	5.9	GP	NP	NP	2.5	4	8	12	32	39	41	43	46	51	58	65	72	82	89	89
25	0 - 1.5	1.6	GP	NP	NP	1.0	1	1	1	4	5	5	6	8	12	15	21	25	38	45	60
25	2 - 4	6.0	SP	NP	NP	3.6	6	12	17	26	54	55	59	62	67	71	77	80	87	88	88

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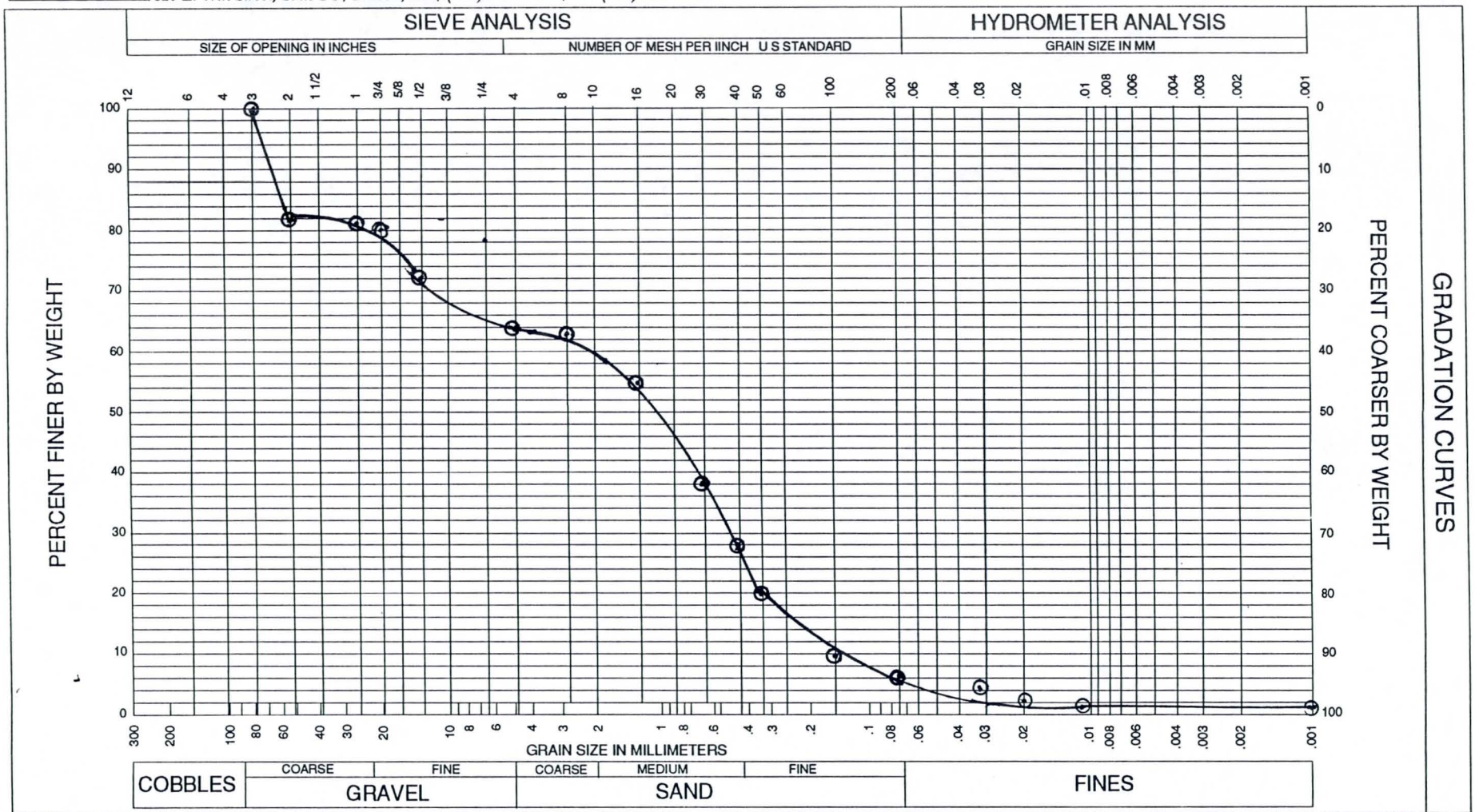
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	1	10 - 23	Poorly graded SAND (SP-SM) with silt and gravel	3.6	NP	NP	NP	

ATL, INC.
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HYDROMETER ANALYSIS
(ASTM D-422)

CLIENT :	DMJM	**DATE RECIVED:**	05/09/96
		JOB NO. :	195039
		LAB. NO. :	96-275
PROJECT :	Camelback Ranch Levee	**SAMPLED BY :**	J. Cowell
MATERIAL SOURCE:	Native	**TESTED BY:**	D. Johnson
MATERIAL TYPE:	Sandy Clay	**SUMMITED BY :**	J.Michael Addington
SAMPLE SOURCE:	Boring #1 Depth: 10' - 23'	**REPORT DATE :**	06/25/96

ELAPSED TIME (MIN)	START TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	(W/SOIL)	CORR. READING	EFFECTIVE DEPTH (CMS)	PARTICLE SIZE (M.M)	PERCENT FINER IN SUSPENSION
0	1:15 pm	24.4	0.01264	1.00375	1.00800	1.00425	14.2	0.034	8.1
2		24.4	0.01264	1.00375	1.00600	1.00225	14.7	0.034	4.3
5		24.4	0.01264	1.00375	1.00500	1.00125	15.0	0.022	2.4
15		24.4	0.01264	1.00375	1.00450	1.00075	15.1	0.013	1.4
30		24.4	0.01264	1.00375	1.00450	1.00075	15.1	0.009	1.4
60		24.4	0.01264	1.00375	1.00450	1.00075	15.1	0.006	1.4
250		26.1	0.12350	1.00375	1.00450	1.00075	15.1	0.030	1.4
1440		24.4	0.01264	1.00375	1.00450	1.00075	15.1	0.001	1.4

WEIGHT OF SAMPLE = 52.12 **(GMS)**

SPECIFIC GRAVITY = 2.742

Percent Of Soil Passing #10 Sieve = 63.29

Remarks:

Reviewed By:

GEOTECH\DMJM\96-275HY

Respectfully Submitted:

J. Michael Addington
Laboratory Supervisor

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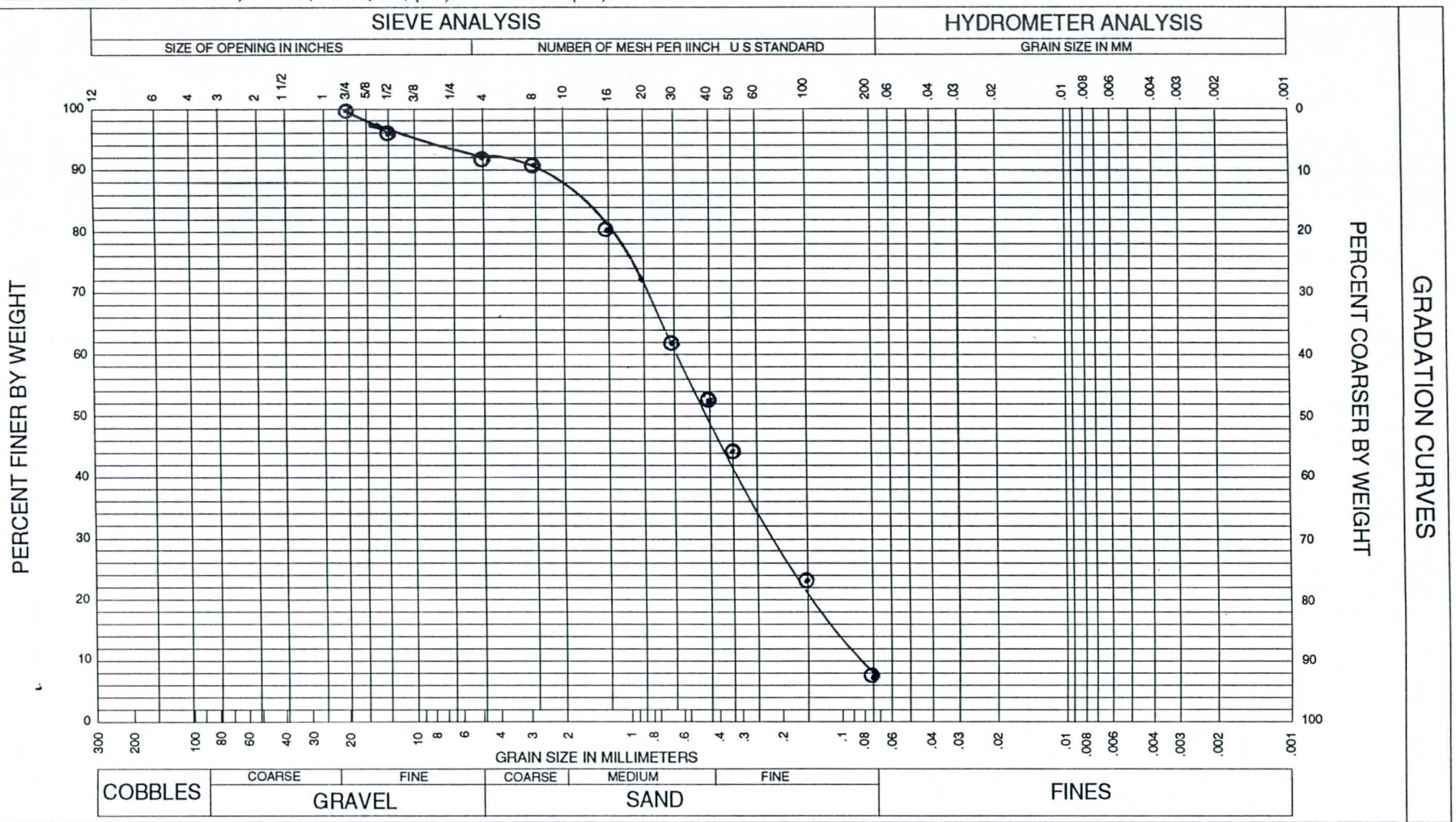
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	2	5 1/2 - 6	Poorly graded SAND (SP- SM) with silt	—	—	—	—	

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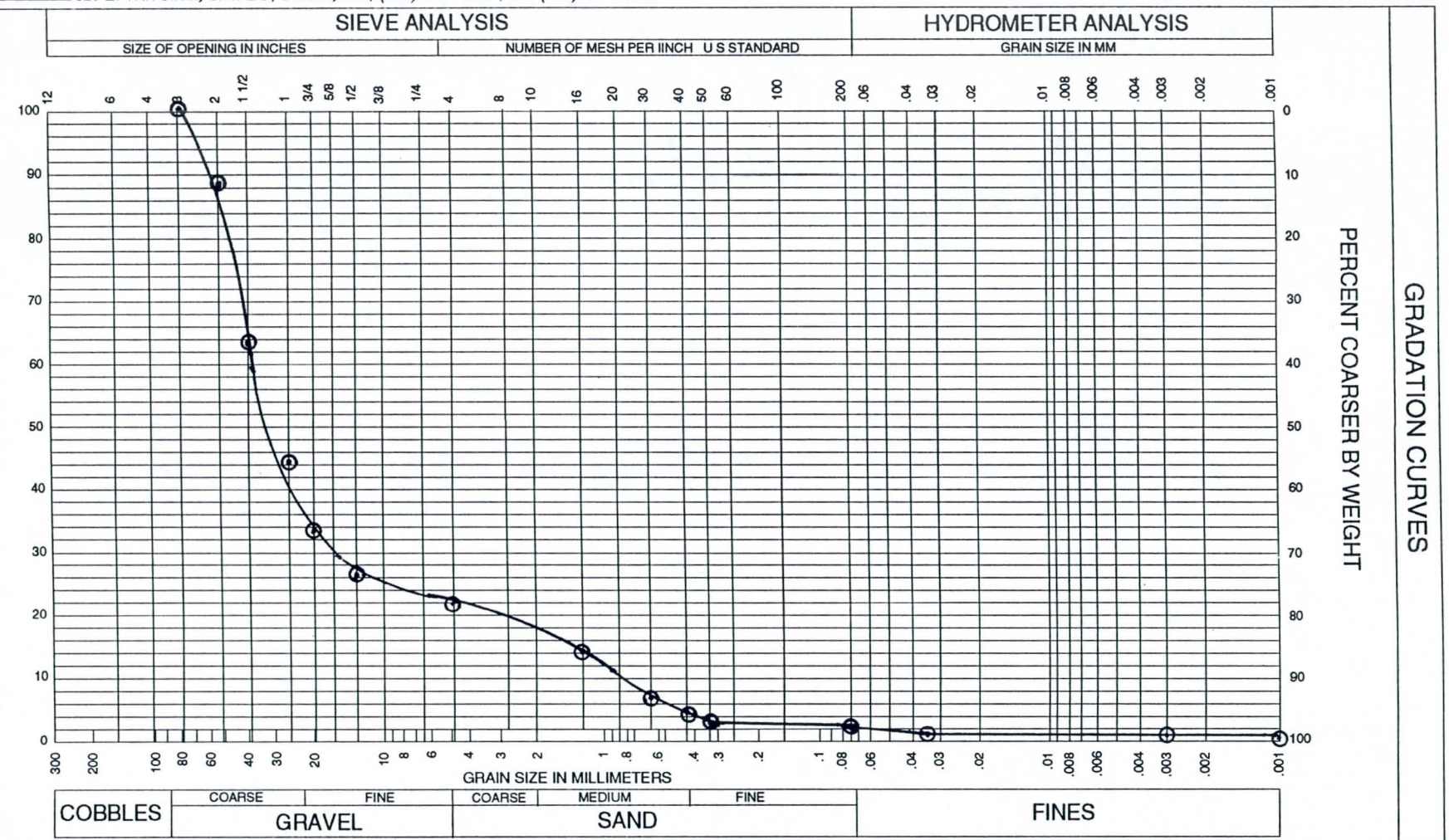
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	4	13 - 20	Poorly graded GRAVEL (GP) with sand	2.3	NP	NP	NP

ATL, INC.
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GEOTECHNICAL CONSULTANTS

HYDROMETER ANALYSIS
(ASTM D-422)

CLIENT :	DMJM	**DATE RECIVED:**	05/09/96
		JOB NO. :	195039
		LAB. NO. :	96-277
PROJECT :	Camelback Ranch Levee	**SAMPLED BY :**	J. Cowell
MATERIAL SOURCE:	Native	**TESTED BY:**	D. Johnson
MATERIAL TYPE:	Sandy Clay	**SUMMITED BY :**	J.Michael Addington
SAMPLE SOURCE:	Boring #4 Depth: 13' - 20'	**REPORT DATE :**	06/25/96

ELAPSED TIME (MIN)	START TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	(W/SOIL)	CORR. READING	EFFECTIVE DEPTH (CMS)	PARTICLE SIZE (M.M)	PERCENT FINER IN SUSPENSION
0	1:35 PM	24.4	0.01301	1.00375	1.00625	1.00250	14.6	0.035	1.3
2		24.4	0.01301	1.00375	1.00600	1.00225	14.7	0.035	1.2
5		24.4	0.01301	1.00375	1.00575	1.00200	14.8	0.022	1.0
15		24.4	0.01301	1.00375	1.00575	1.00200	14.8	0.013	1.0
30		24.4	0.01301	1.00375	1.00575	1.00200	14.8	0.009	1.0
60		24.4	0.01301	1.00375	1.00550	1.00175	14.8	0.006	0.9
250		26.1	0.01272	1.00375	1.00550	1.00175	14.8	0.003	0.9
1440		24.4	0.01301	1.00375	1.00475	1.00100	15.0	0.001	0.5

WEIGHT OF SAMPLE = 53.17 (GMS)

SPECIFIC GRAVITY = 2.638

Percent Of Soil Passing #10 Sieve = 17.20

Remarks:

Reviewed By:

GEOTECH\DMJM\96-277HY

Respectfully Submitted:

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Laboratory Supervisor

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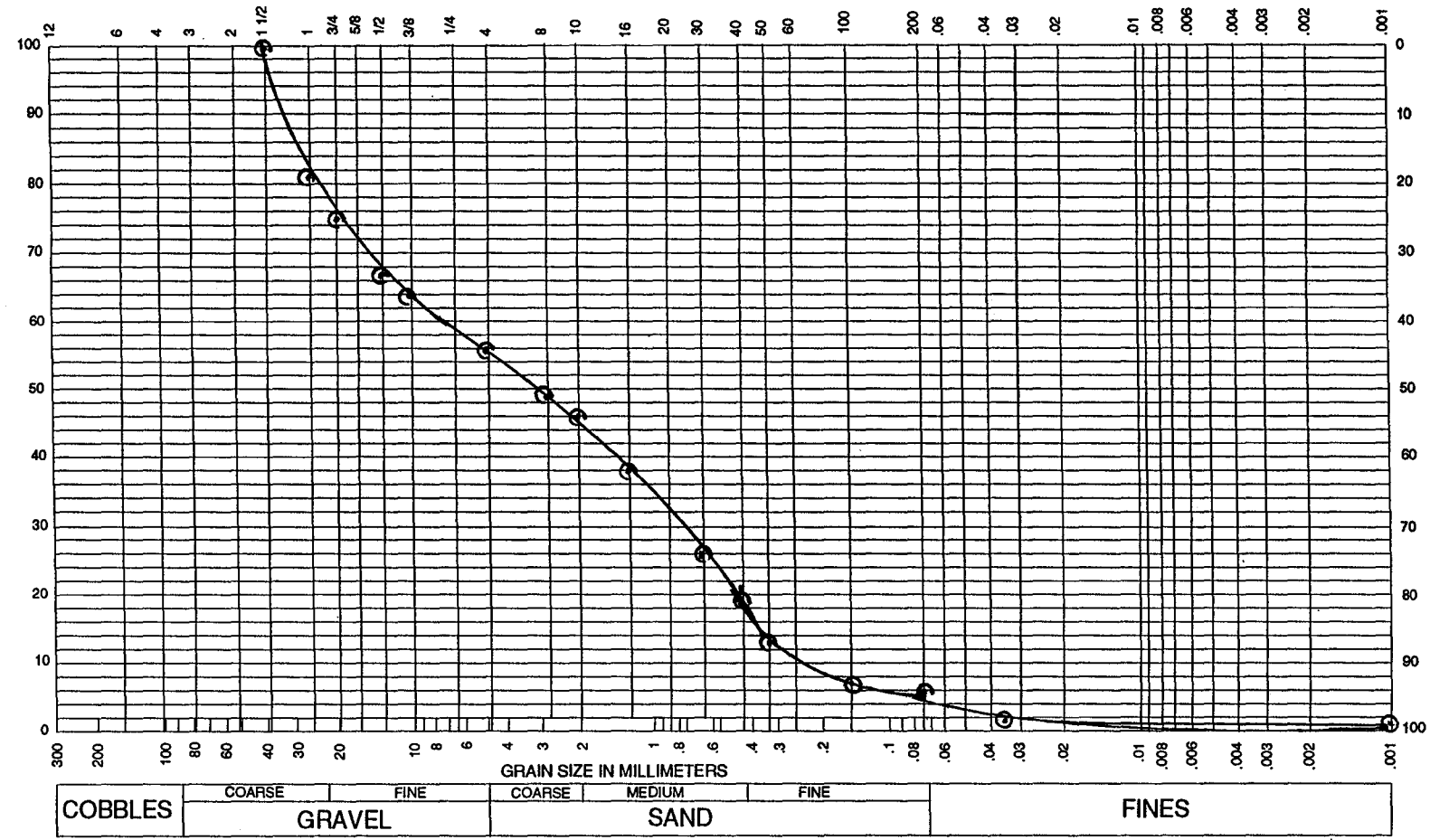
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	5	16 - 16 1/2	Poorly graded SAND (SP-SM) with silt and gravel	1.5	NP	NP	NP

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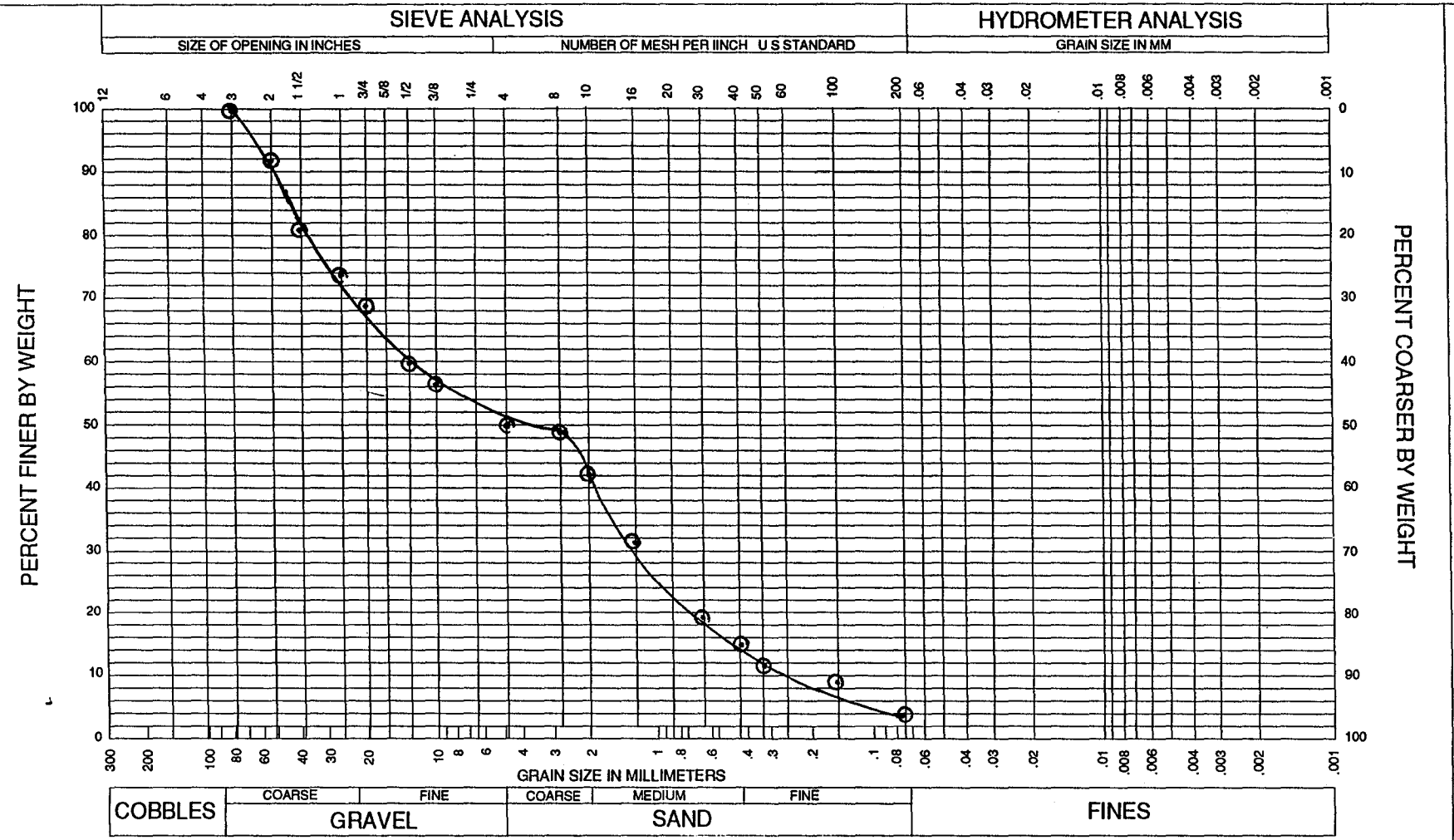
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (FT)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	6	5 - 12 1/2	Poorly graded GRAVEL (GP) with sand	3.5	NP	NP	NP

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

HYDROMETER ANALYSIS
(ASTM D-422)

CLIENT : DMJM

DATE RECIVED: 05/09/96
JOB NO. : 195039
LAB. NO. : 96-280

PROJECT : Camelback Ranch Levee

SAMPLED BY : J. Cowell

MATERIAL SOURCE: Native
MATERIAL TYPE: Sandy Clay
SAMPLE SOURCE: Boring #6 Depth: 5' - 12.5'

TESTED BY: D. Johnson
SUMMITED BY : J.Michael Addington
REPORT DATE : 06/25/96

ELAPSED TIME (MIN)	START TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	(W/SOIL)	CORR. READING	EFFECTIVE DEPTH (CMS)	PARTICLE SIZE (M.M)	PERCENT FINER IN SUSPENSION
0	1:55 pm	24.4	0.01264	1.00375	1.00525	1.00150	14.9	0.035	1.9
2		24.4	0.01264	1.00375	1.00525	1.00150	14.9	0.035	1.9
5		24.4	0.01264	1.00375	1.00525	1.00150	14.9	0.022	1.9
15		24.4	0.01264	1.00375	1.00525	1.00150	14.9	0.013	1.9
30		24.4	0.01264	1.00375	1.00525	1.00150	14.9	0.009	1.9
60		24.4	0.01264	1.00375	1.00500	1.00125	15.0	0.006	1.6
250		26.1	0.01235	1.00375	1.00500	1.00125	15.0	0.003	1.6
1440		24.4	0.01264	1.00375	1.00475	1.00100	15.0	0.001	1.3

WEIGHT OF SAMPLE = 52.88 **(GMS)**

SPECIFIC GRAVITY = 2.745

Percent Of Soil Passing #10 Sieve = 42.20

Remarks:

Reviewed By:

GEOTECH\DMJM\96-280HY

Respectfully Submitted:

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Laboratory Supervisor

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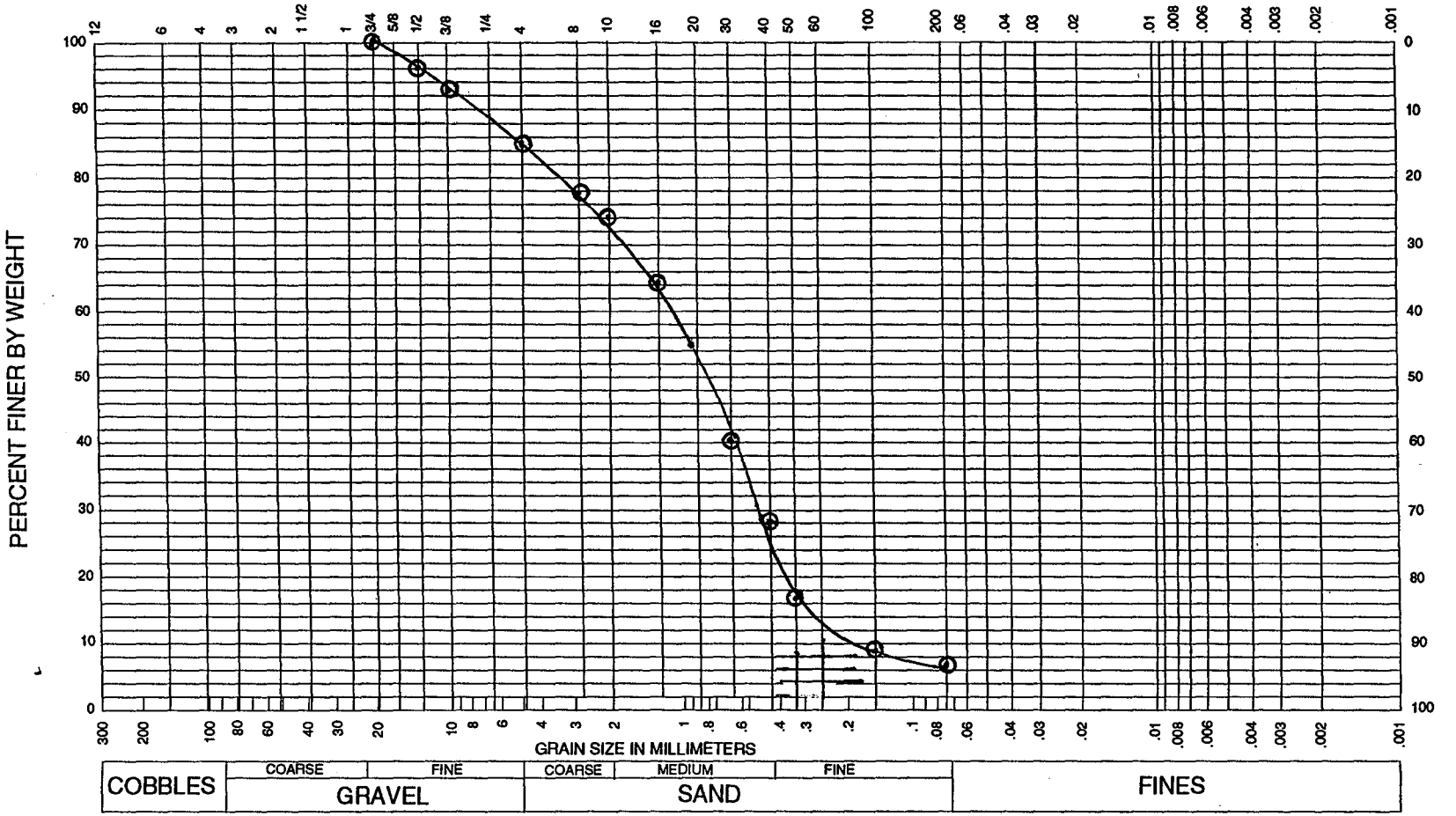
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	6	12 1/2 - 19	Poorly graded SAND (SP-SM) with silt and gravel	2.6	NP	NP	NP	

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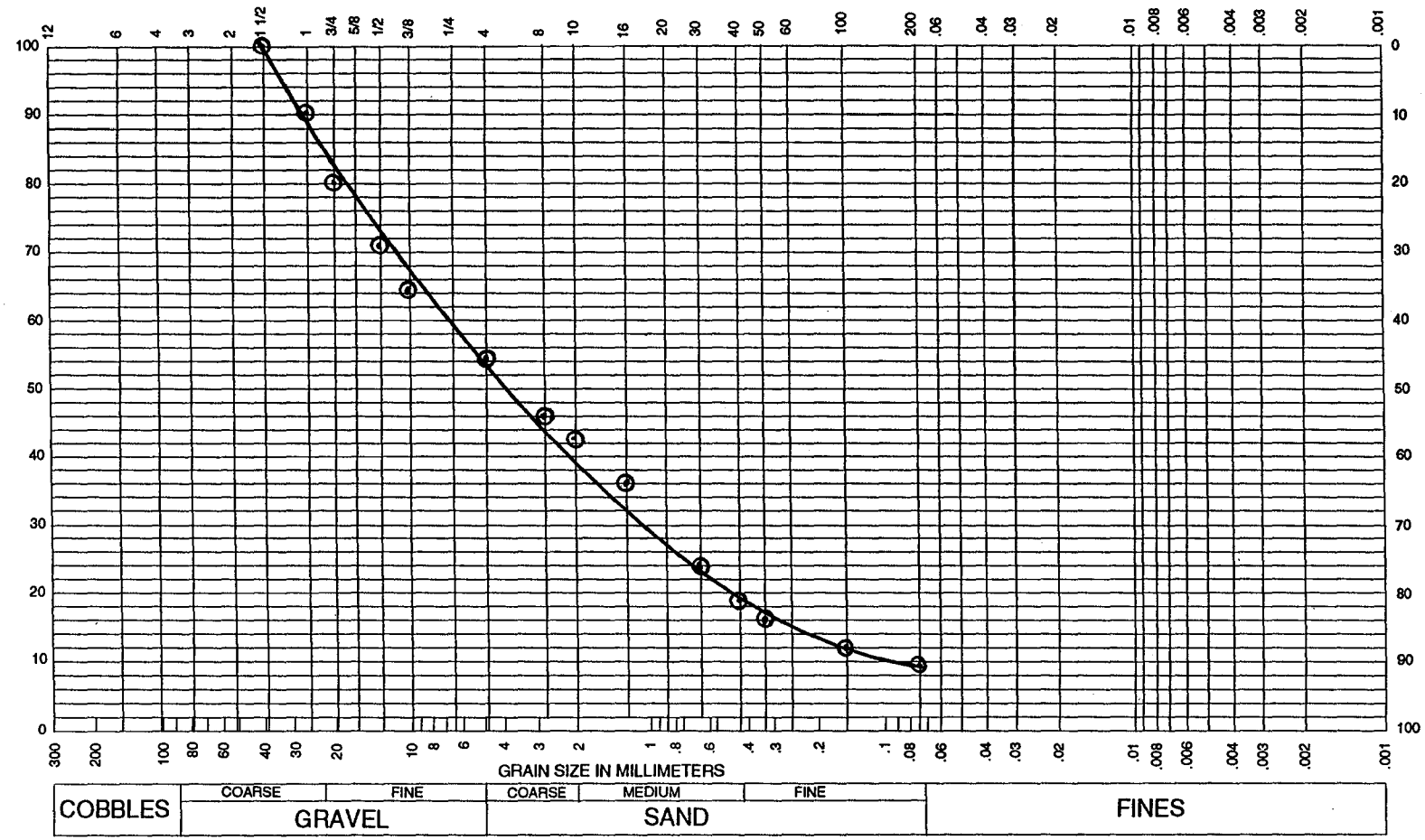
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	7	20-21 1/2	Poorly graded GRAVEL (GP-GM) with silt and sand	7.0	NP	NP	NP

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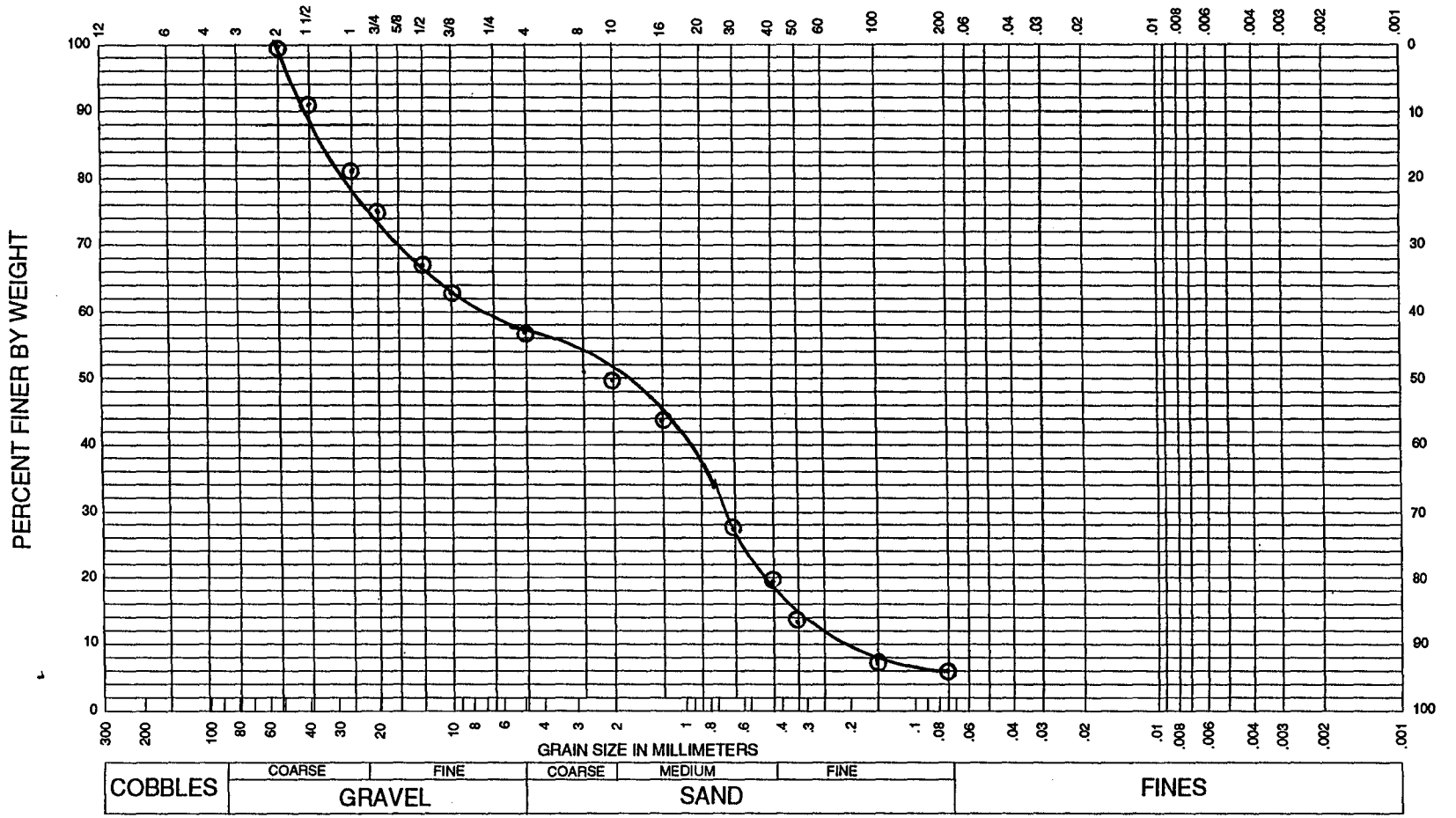
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	8	8 - 15	Poorly graded SAND (SP-SM) with silt and gravel	5.0	NP	NP	NP	

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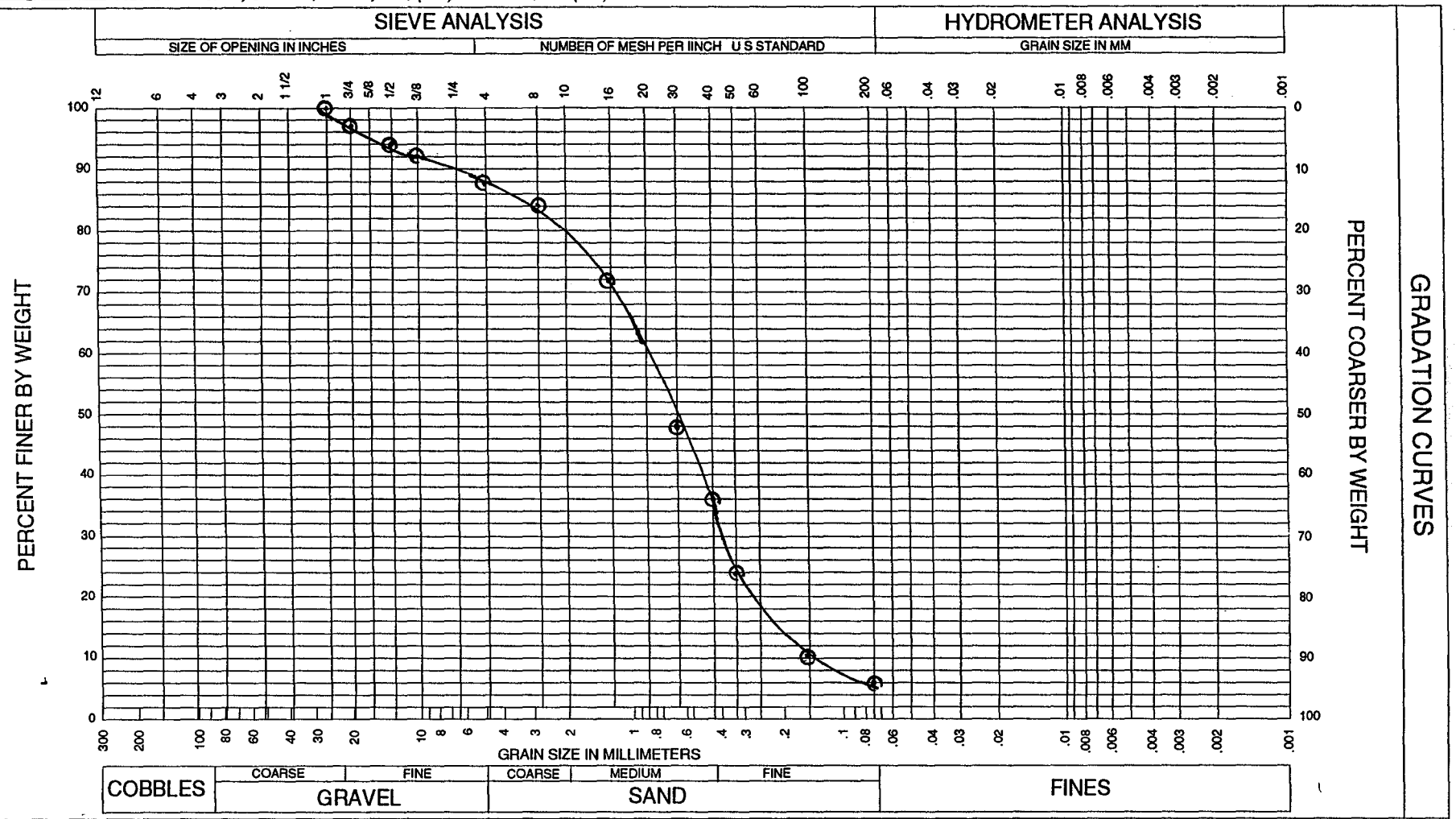
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (FL)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	9	2 - 11	Poorly graded silty SAND (SP-SM)	3.8	NP	NP	NP	

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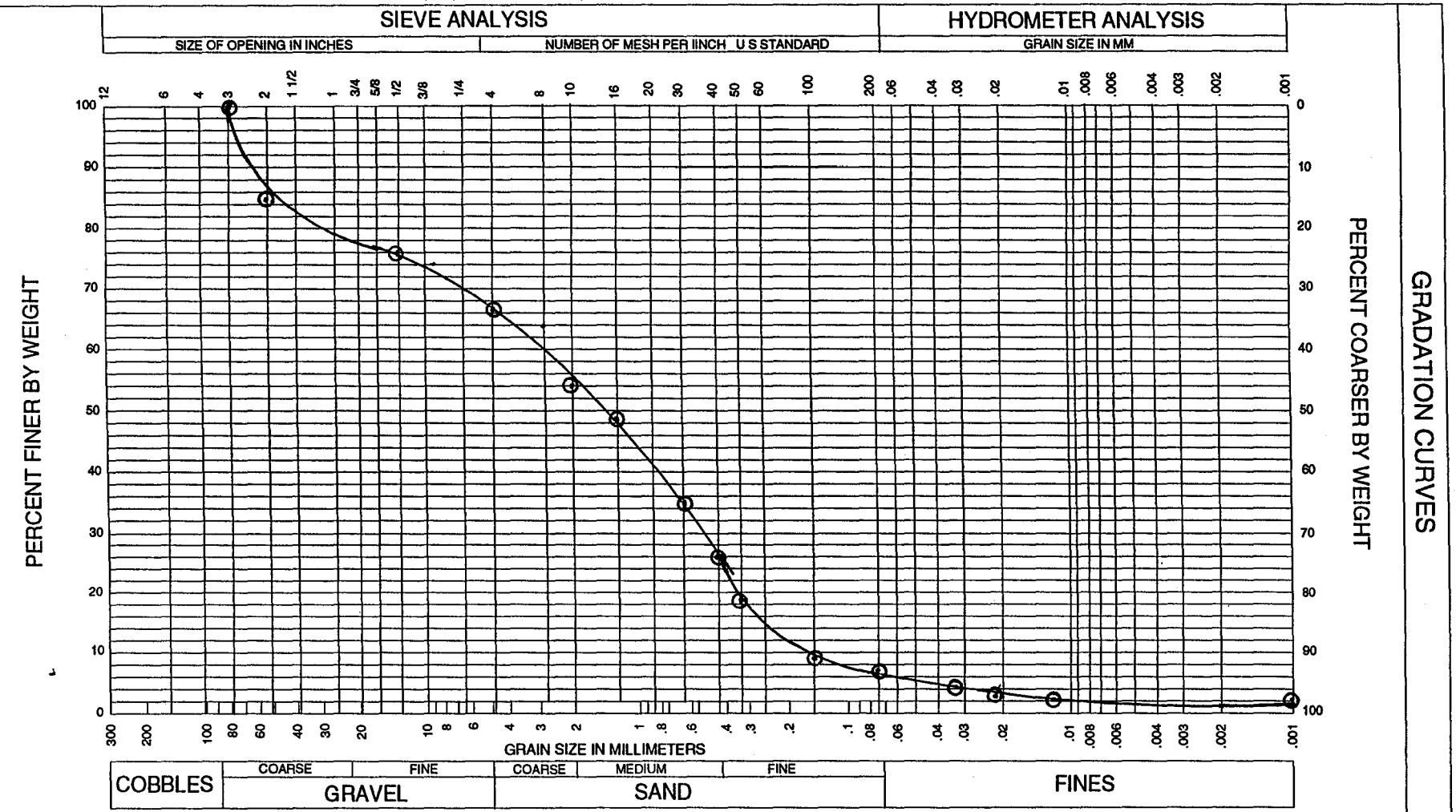
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	9	11- 15	Poorly graded SAND (SP-SM) with silt and gravel	7.4	NP	NP	NP

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

HYDROMETER ANALYSIS
(ASTM D-422)

CLIENT :	DMJM	**DATE RECIVED:**	05/09/96
		JOB NO. :	195039
		LAB. NO. :	96-283
PROJECT :	Camelback Ranch Levee	**SAMPLED BY :**	J. Cowell
MATERIAL SOURCE:	Native	**TESTED BY:**	D. Johnson
MATERIAL TYPE:	Sandy Clay	**SUMMITED BY :**	J.Michael Addington
SAMPLE SOURCE:	Boring #9 Depth: 11' - 15'	**REPORT DATE :**	06/25/96

ELAPSED TIME (MIN)	START TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	(W/SOIL)	CORR. READING	EFFECTIVE DEPTH (CMS)	PARTICLE SIZE (M.M)	PERCENT FINER IN SUSPENSION
0	2:20 PM	24.4	0.01264	1.00375	1.00625	1.00250	14.6	0.034	4.1
2		24.4	0.01264	1.00375	1.00575	1.00200	14.8	0.034	3.3
5		24.4	0.01264	1.00375	1.00575	1.00200	14.8	0.022	3.3
15		24.4	0.01264	1.00375	1.00525	1.00150	14.9	0.013	2.5
30		24.4	0.01264	1.00375	1.00525	1.00150	14.9	0.009	2.5
60		24.4	0.01264	1.00375	1.00525	1.00150	14.9	0.006	2.5
250		26.1	0.01235	1.00375	1.00500	1.00125	15.0	0.003	2.1
1440		24.4	0.01264	1.00375	1.00515	1.00140	14.9	0.001	2.3

WEIGHT OF SAMPLE = 51.05 (GMS)

SPECIFIC GRAVITY = 2.738

Percent Of Soil Passing #10 Sieve = 53.60

Remarks:

Reviewed By:

GEOTECH\DMJM\96-283HY

Respectfully Submitted:

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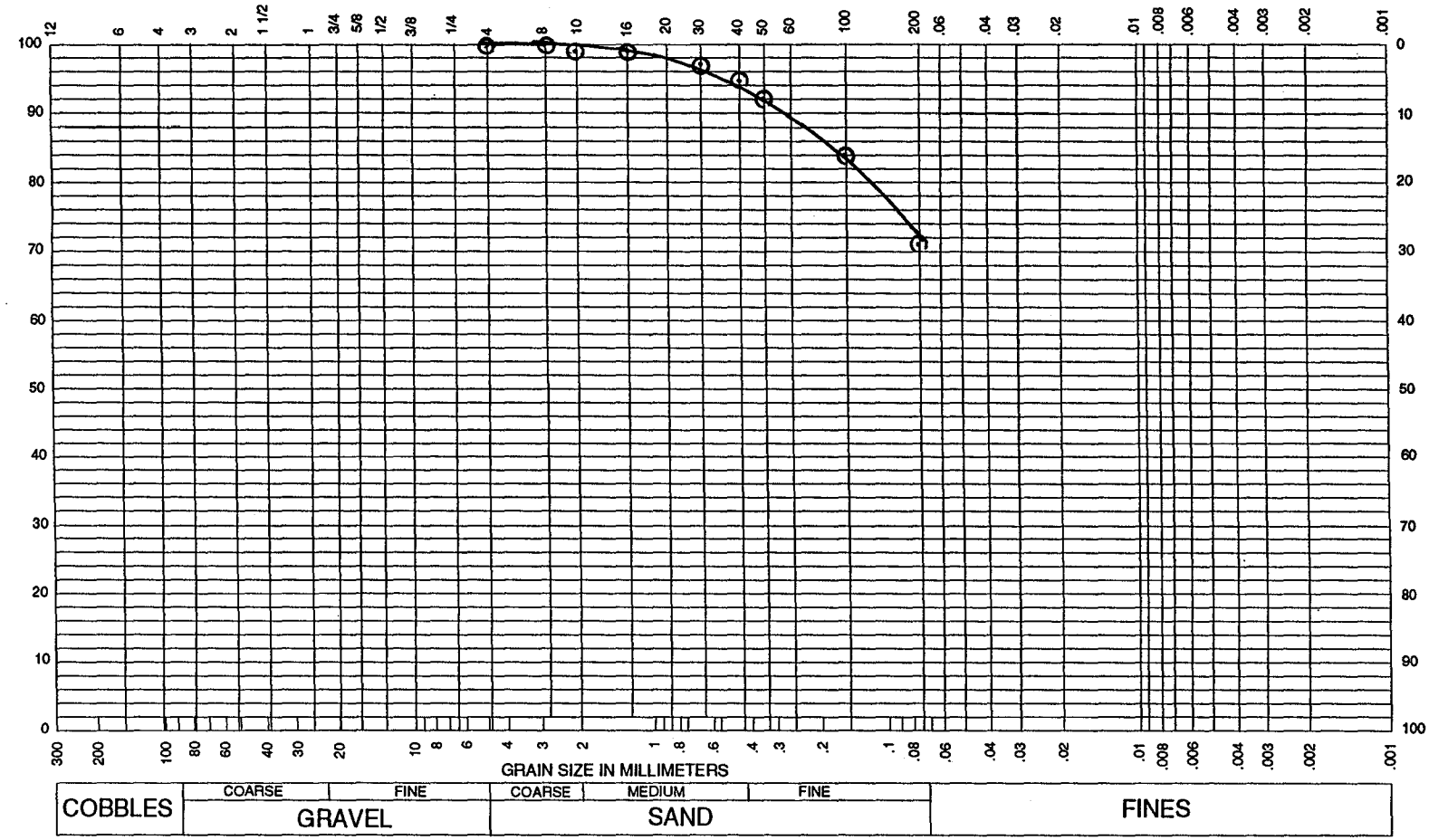
JOB NO. 195039

GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	10	1 1/2 - 7	Sandy SILT (ML)	9.2	NP	23	23

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JOB NO. 195039

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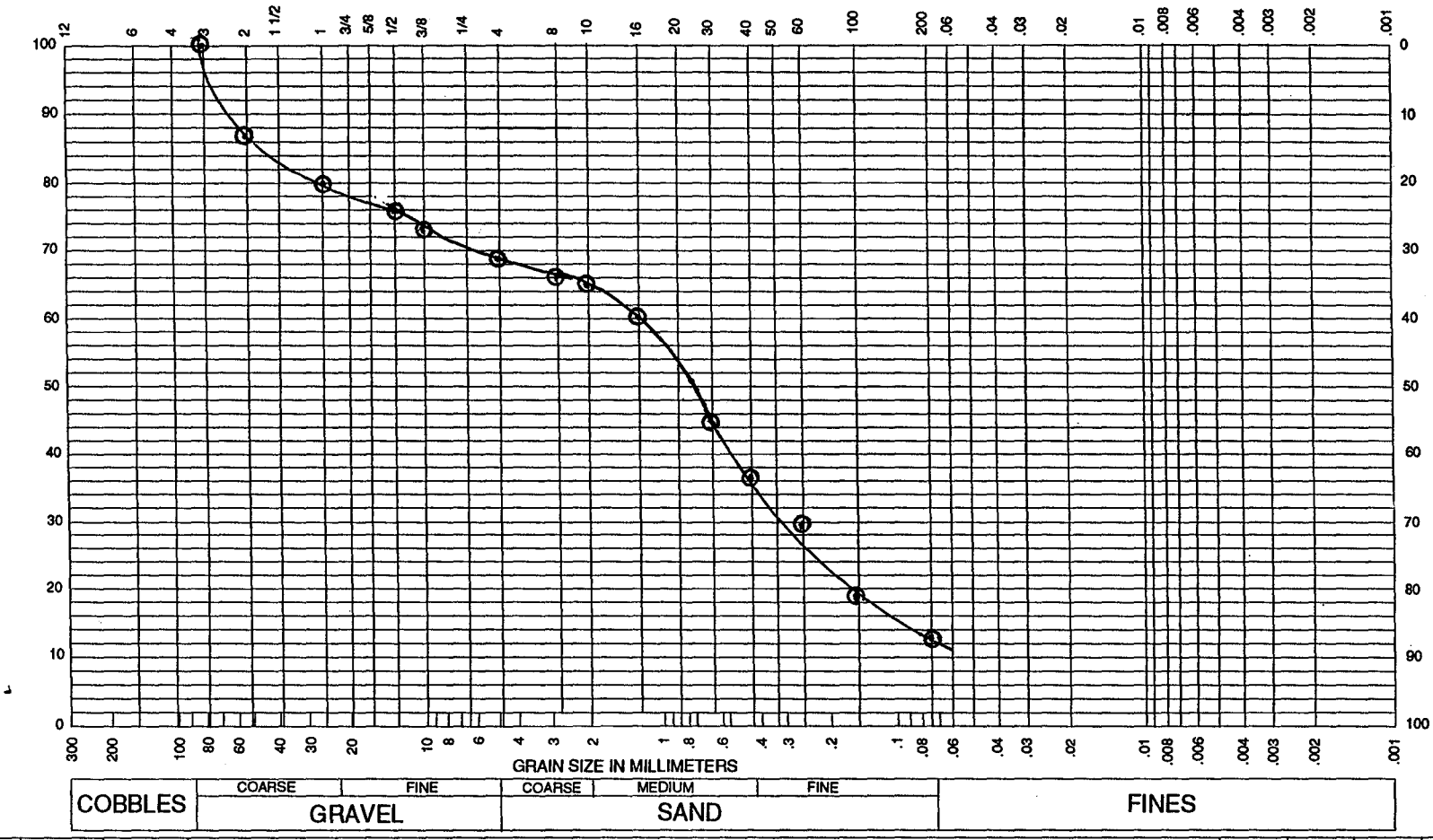

SAMPLE NO.	BORING NO.	DEPTH (Ft)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	12	8 1\2 - 13	Silty sands (SM) w/gravel	6.6	N.P	N.P	N.P

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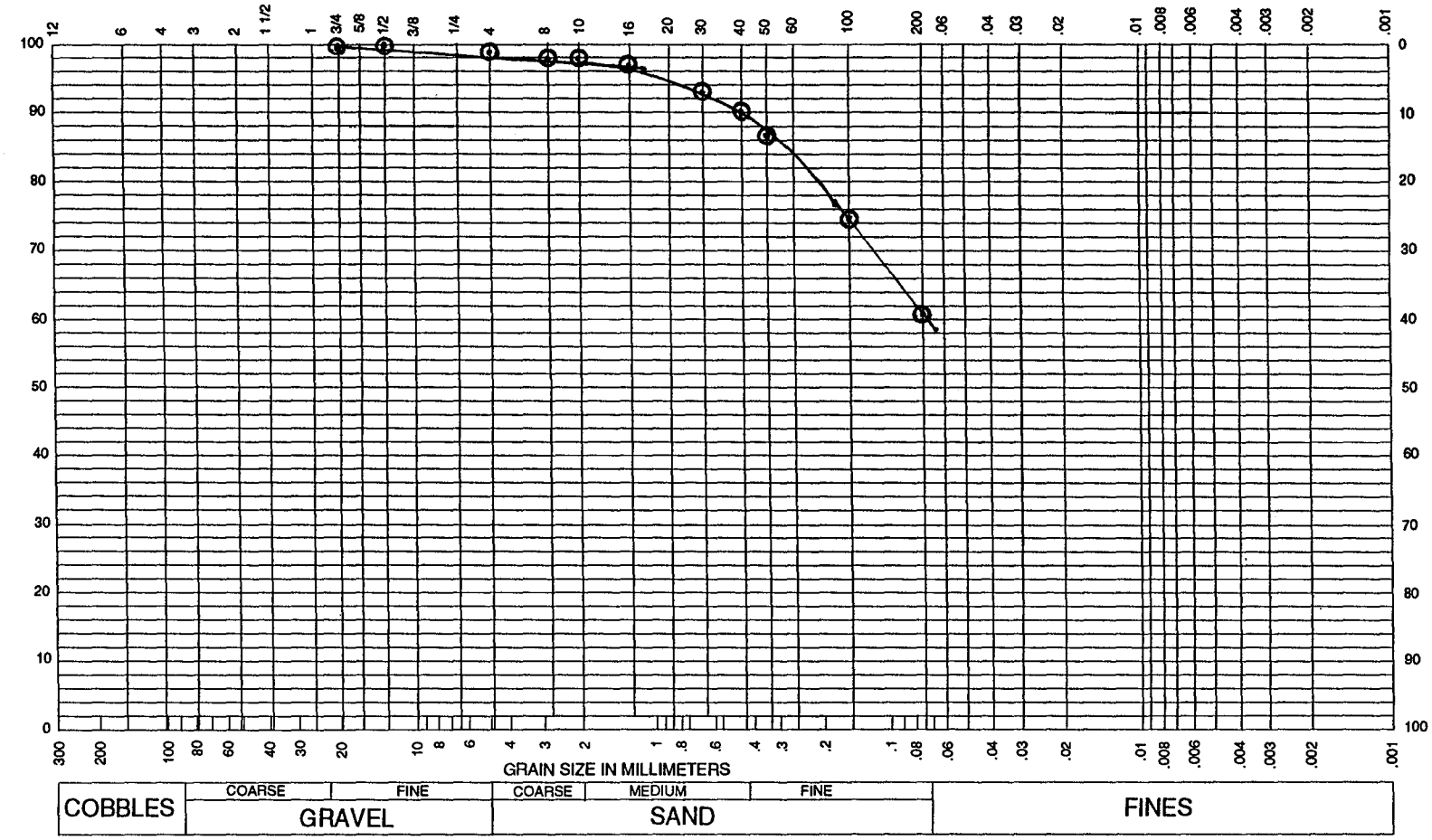

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	13	0 - 6 1\2	Sandy Silt (ML)	17.4	3	25	22	

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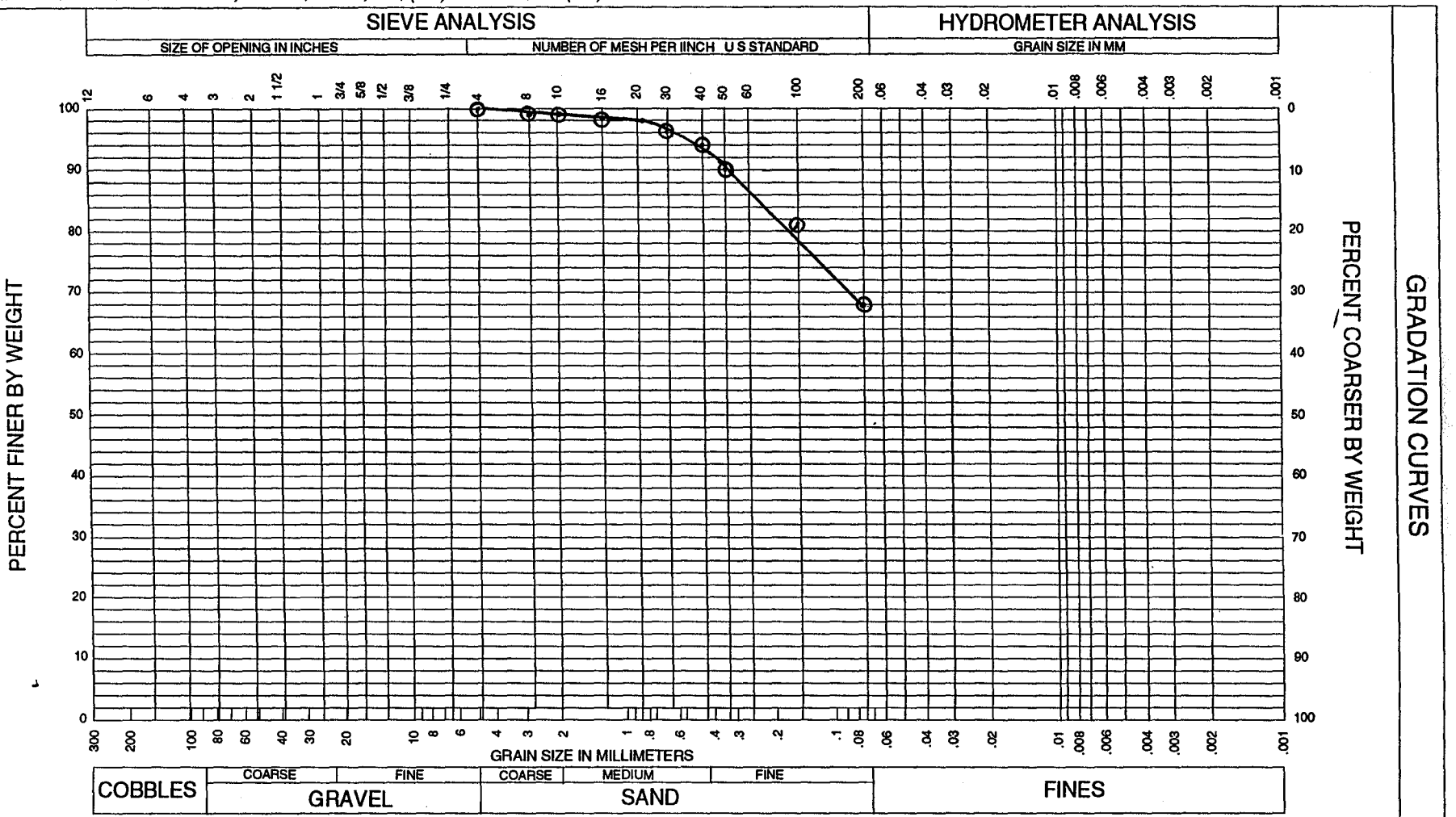

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	14	4 1\2 - 8	Sandy Silty Clay (CL-ML)	12.6	5	26	21	

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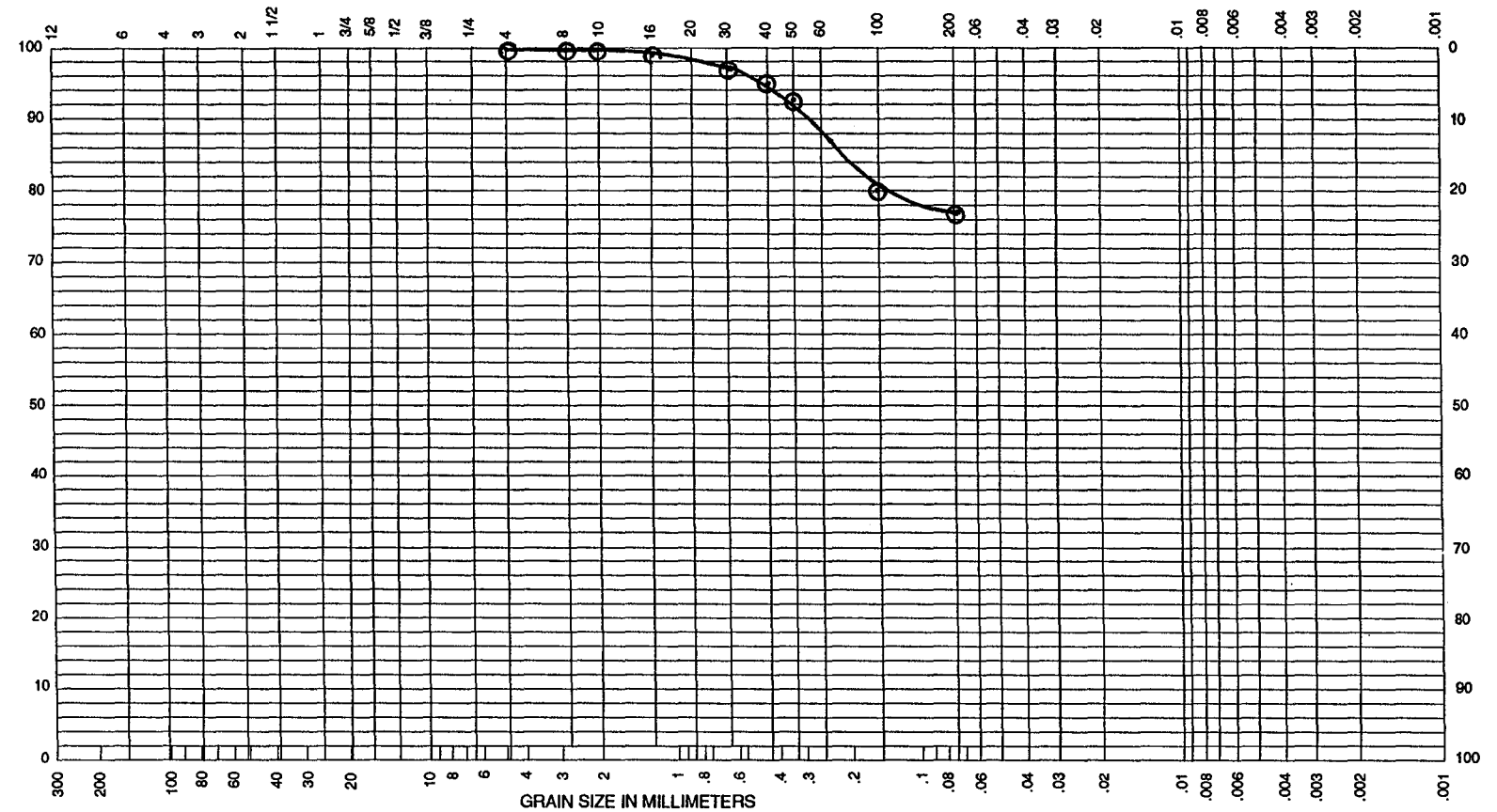

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	15	0 - 3	Sandy silty Clay (CL-ML)	18.7	4	28	24

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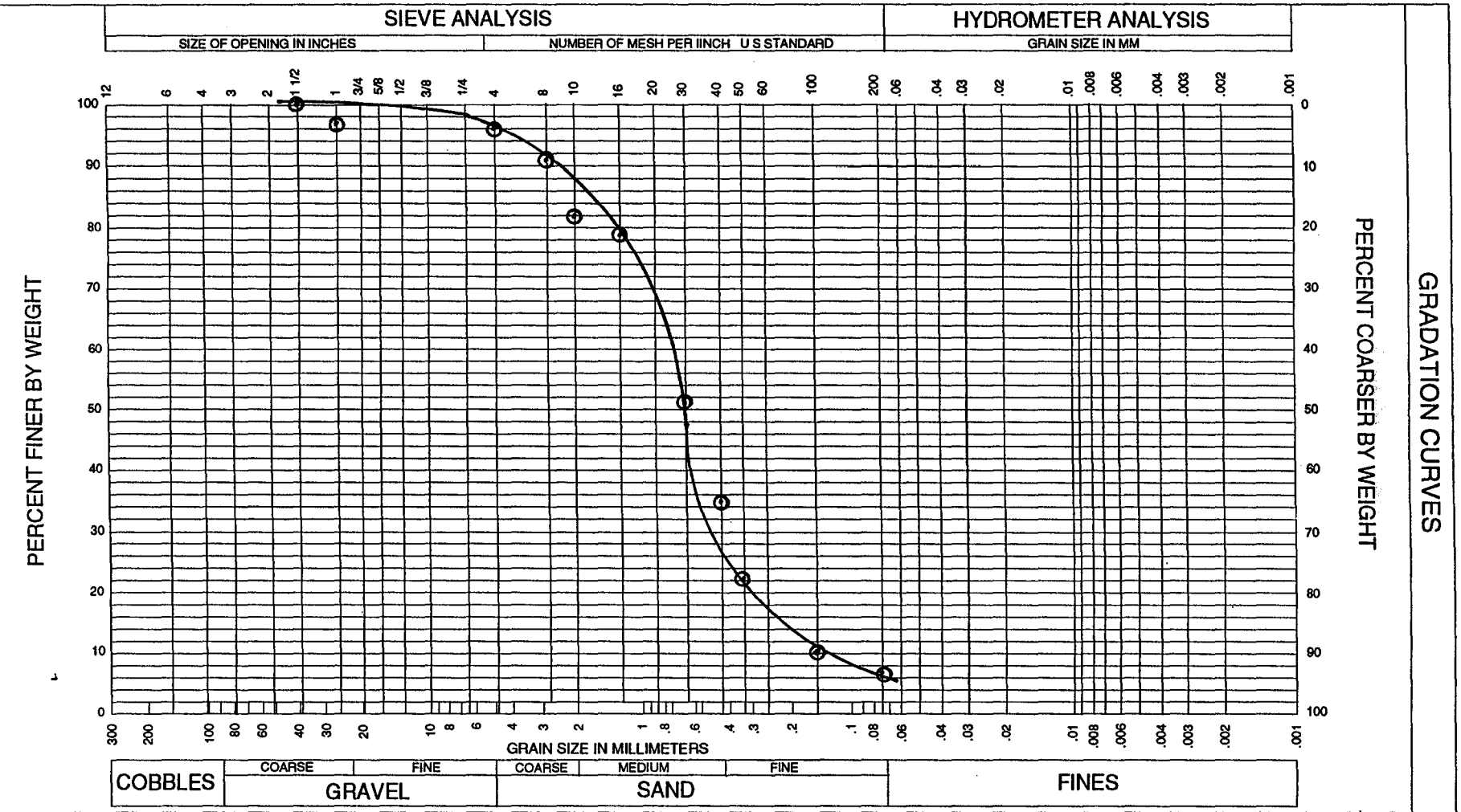

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	16	3-10	Poorly graded SAND (SP-SM) with silt	1.5%	NP	NP	NP	

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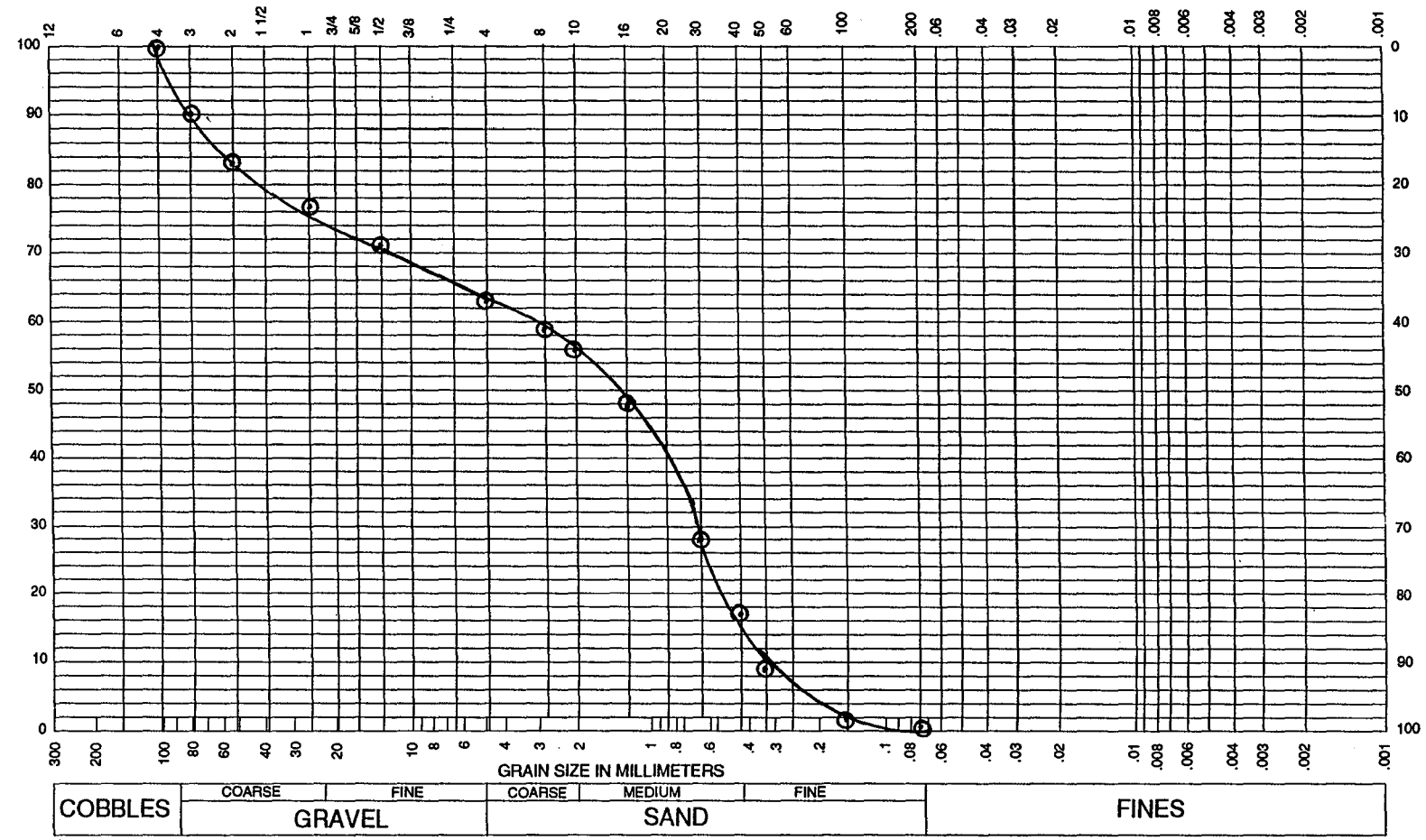

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	Test Pit 17	4-9	Poorly graded SAND (SP) with gravel	3.6	NP	NP	NP

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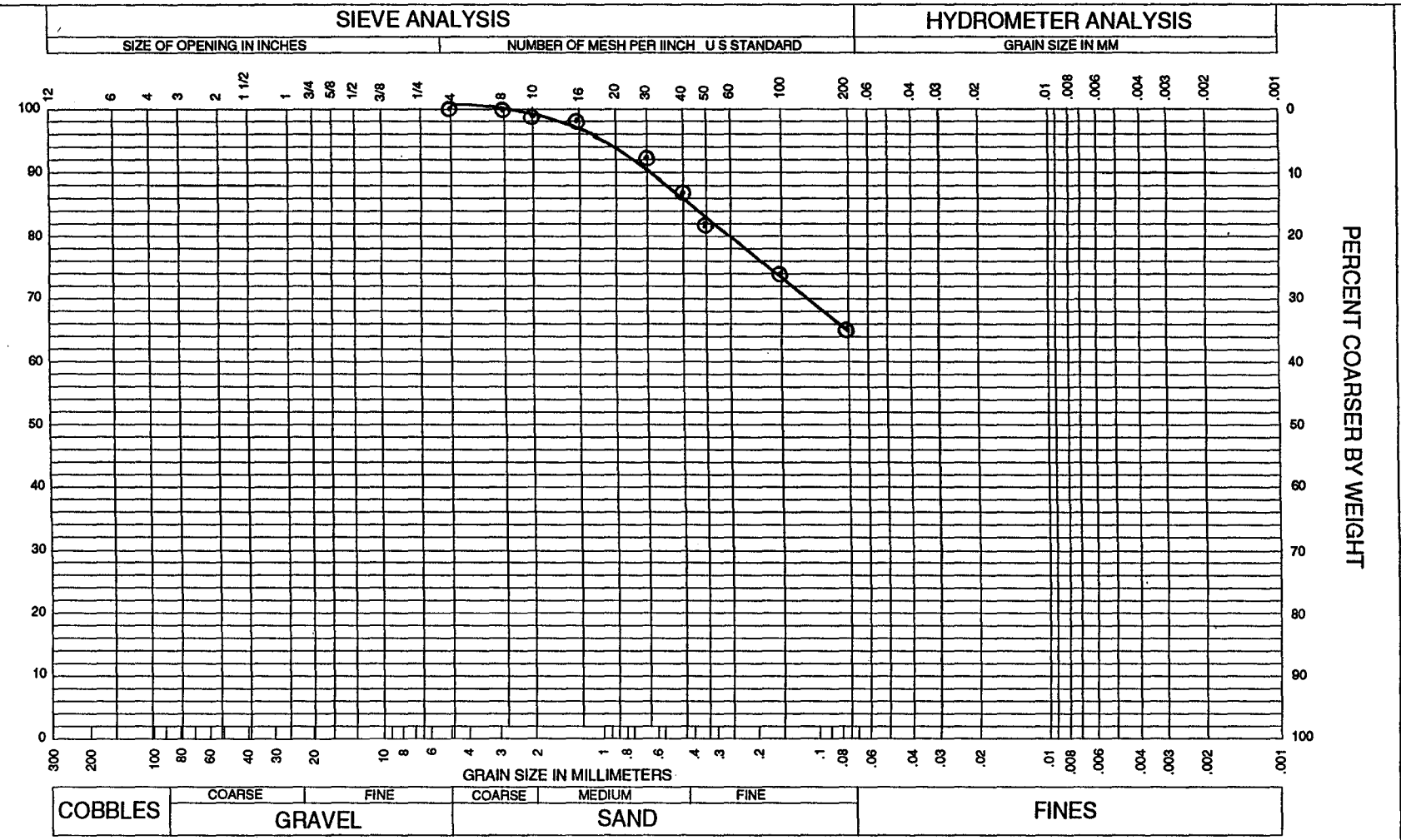

SAMPLE NO.	BORING NO.	DEPTH (Ft)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	Test Pit 18	0-3	Sandy Silty CLAY (CL-ML)	8.9	7	30	23

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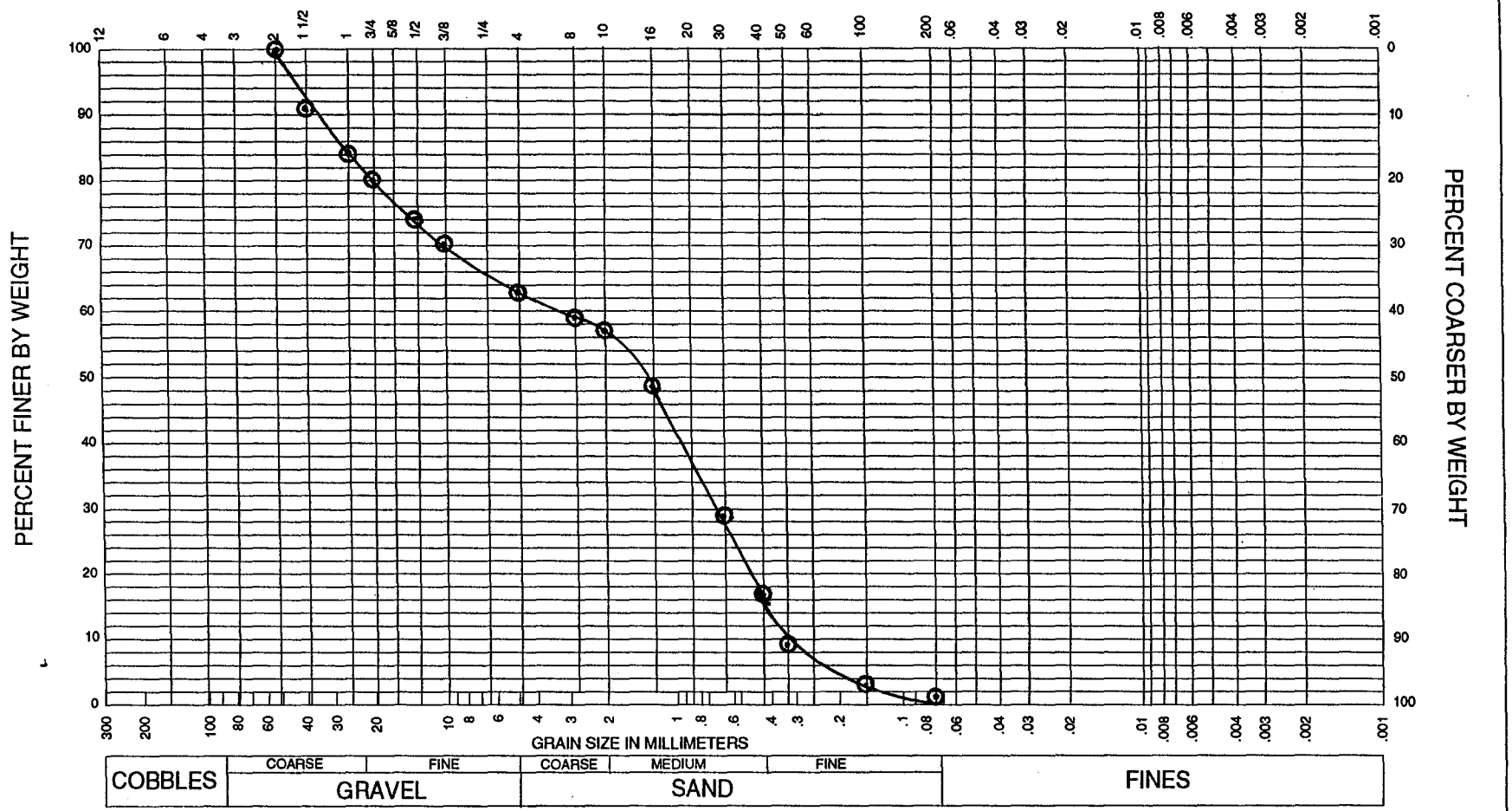

SAMPLE NO.	BORING NO.	DEPTH (Ft)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	Test Pit 19	0 - 8	Poorly graded sand (SP) with gravel	—	NP	NP	NP

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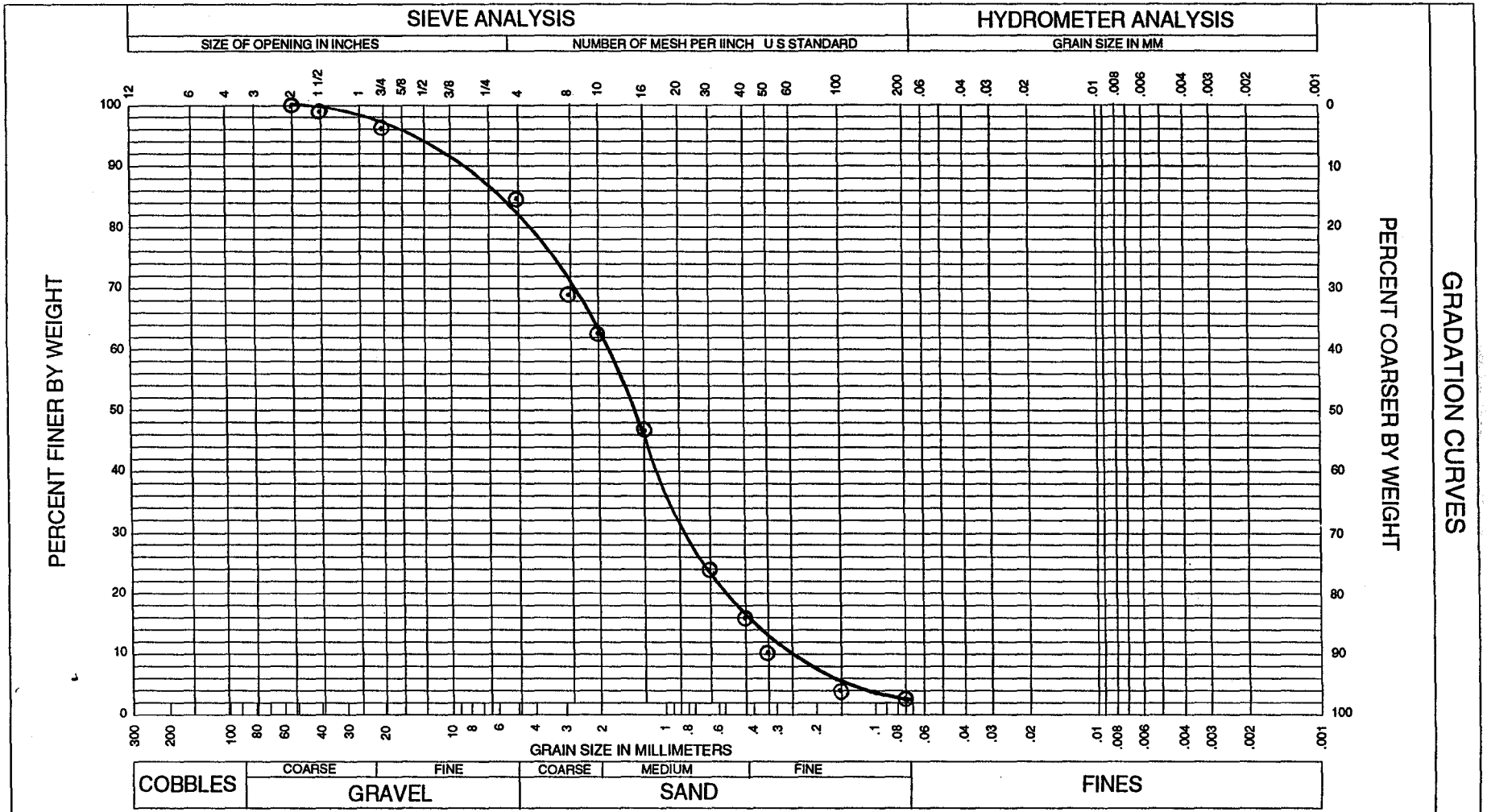

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	19	8-12	Poorly graded SAND (SP) with gravel	2.4	NP	NP	NP	

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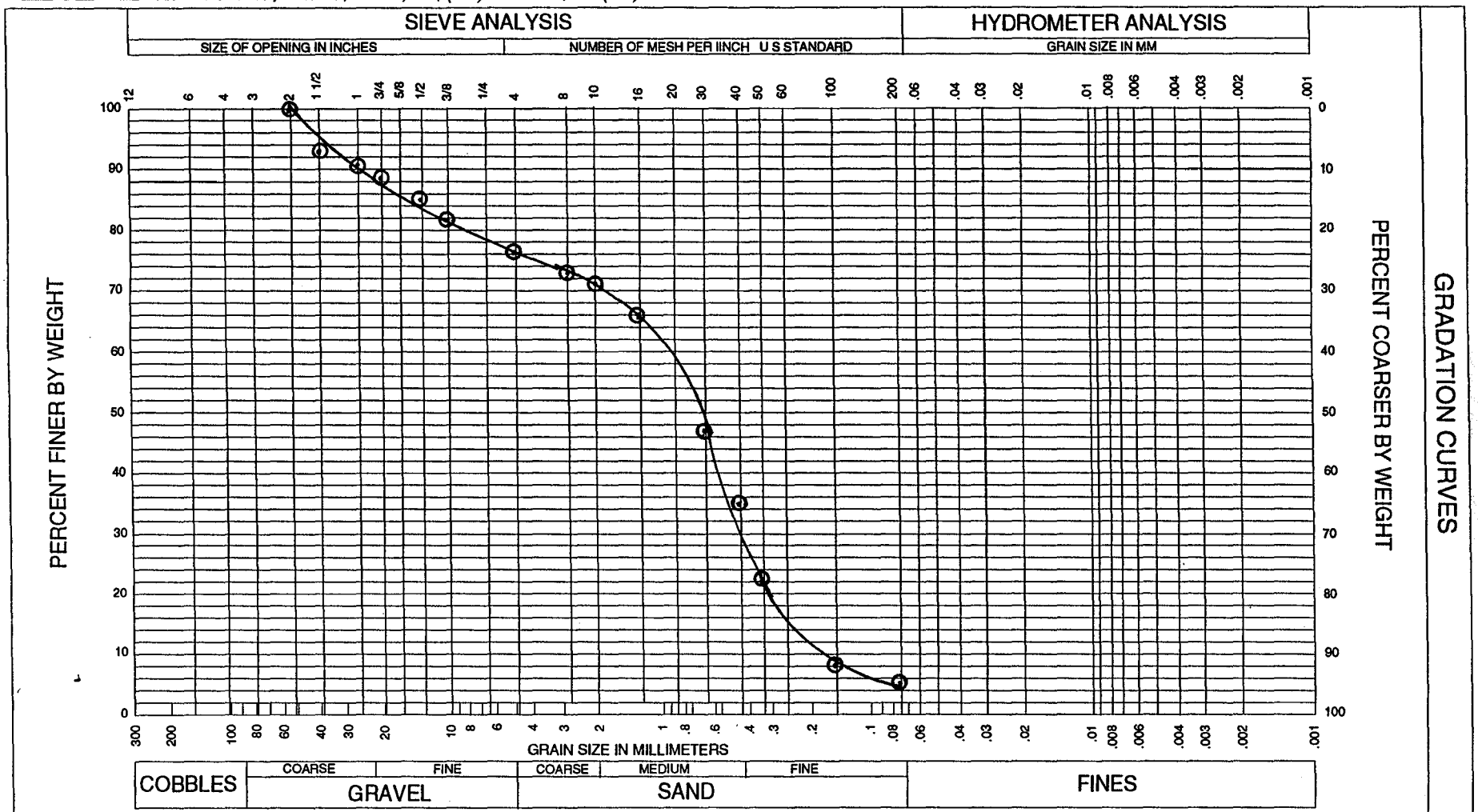
GRADATION CURVES



SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	Test Pit 20	0 - 8 1\2	Poorly graded SAND (SP) with gravel	.....	NP	NP	NP

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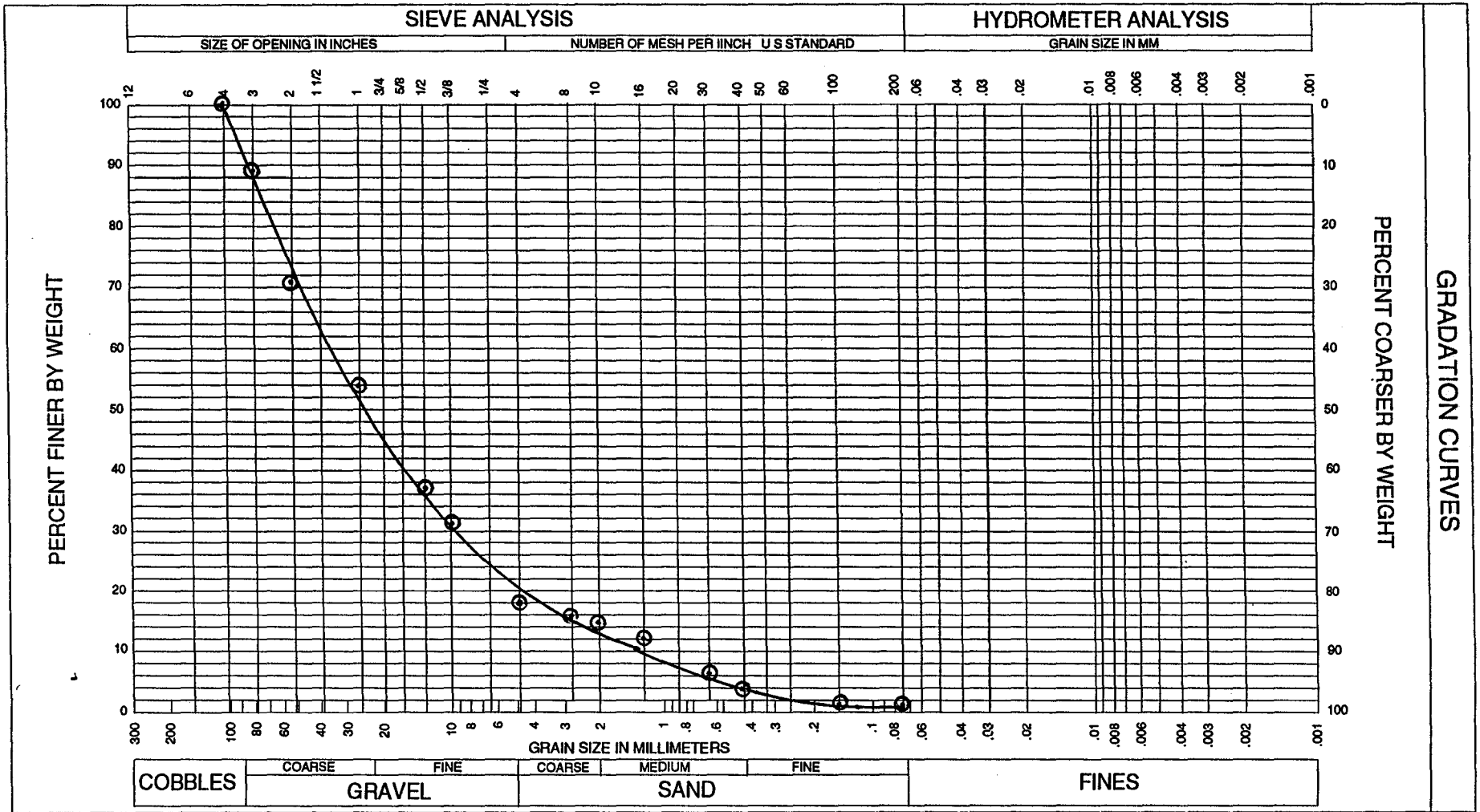

SAMPLE NO.	BORING NO.	DEPTH (FL)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	20	8 1/2-12	Poorly graded GRAVEL (GP)	2.2	NP	NP	NP	

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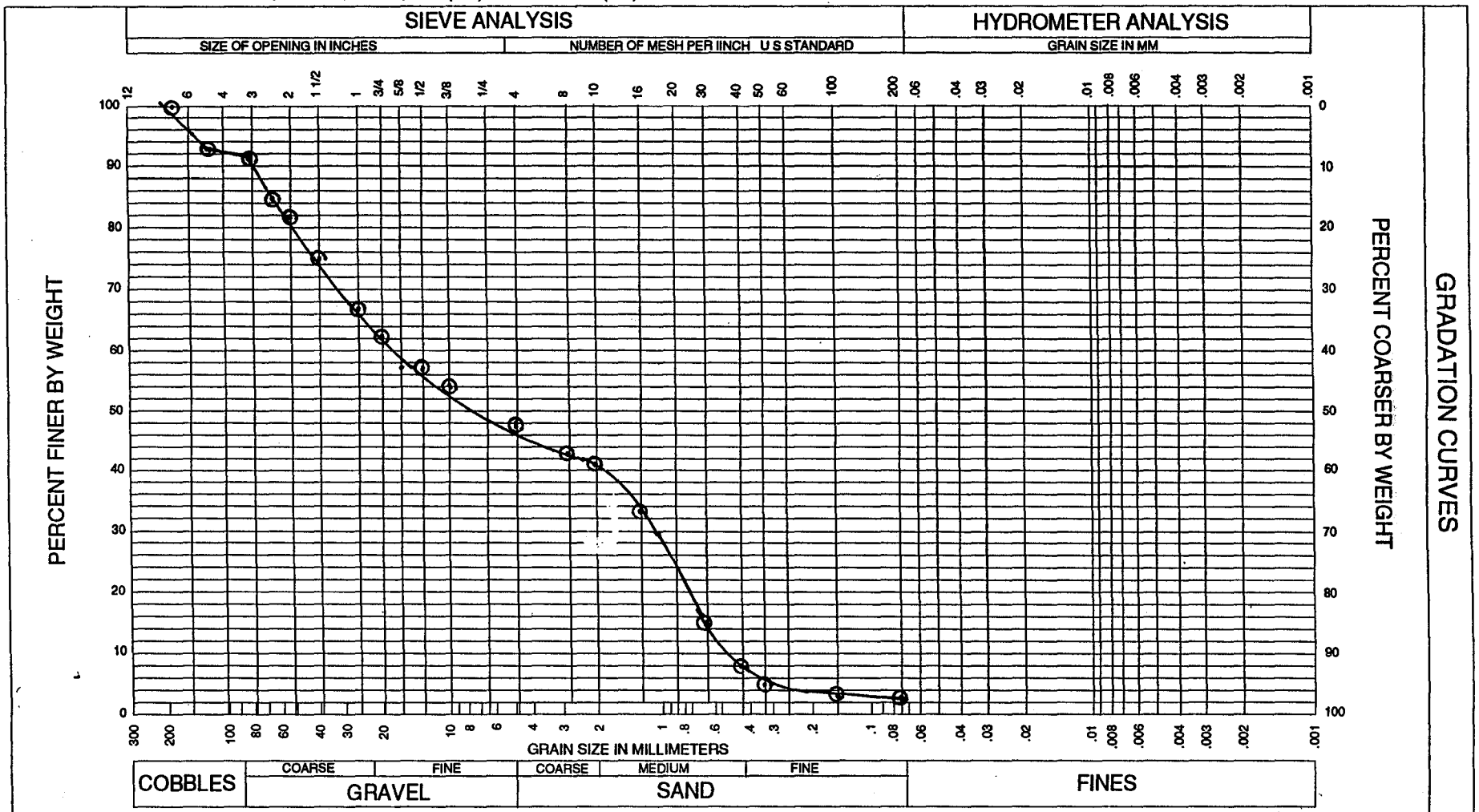

SAMPLE NO.	BORING NO.	DEPTH (FL)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	21	0 - 1 1\2	Poorly graded gravel (GP) with sand	—	NP	NP	NP	

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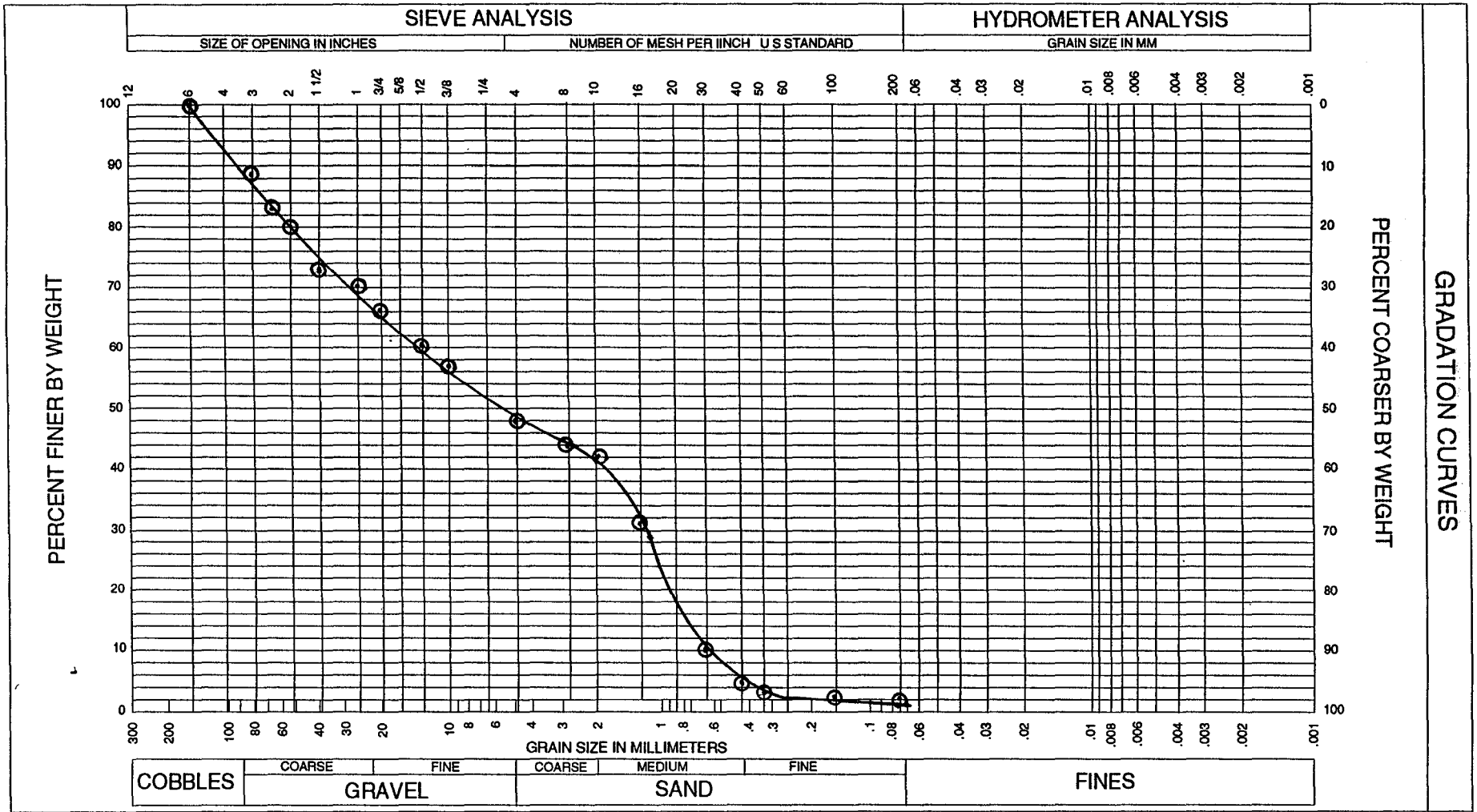

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	21	2 - 4	Poorly graded gravel (GP) with sand	—	NP	NP	NP	

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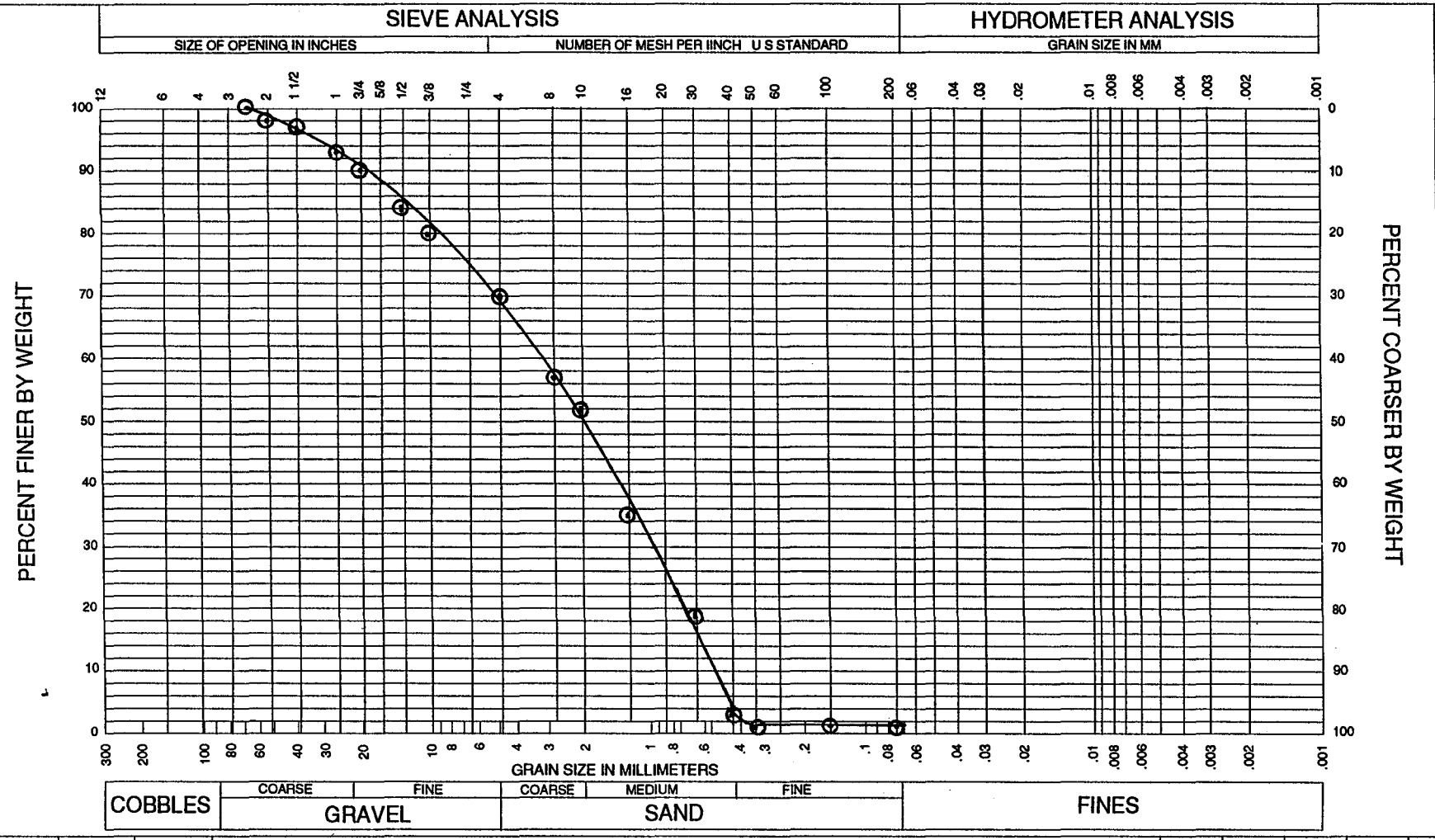

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	22	0 - 1 1\2	Poorly graded sand (GP) with gravel	—	NP	NP	NP	

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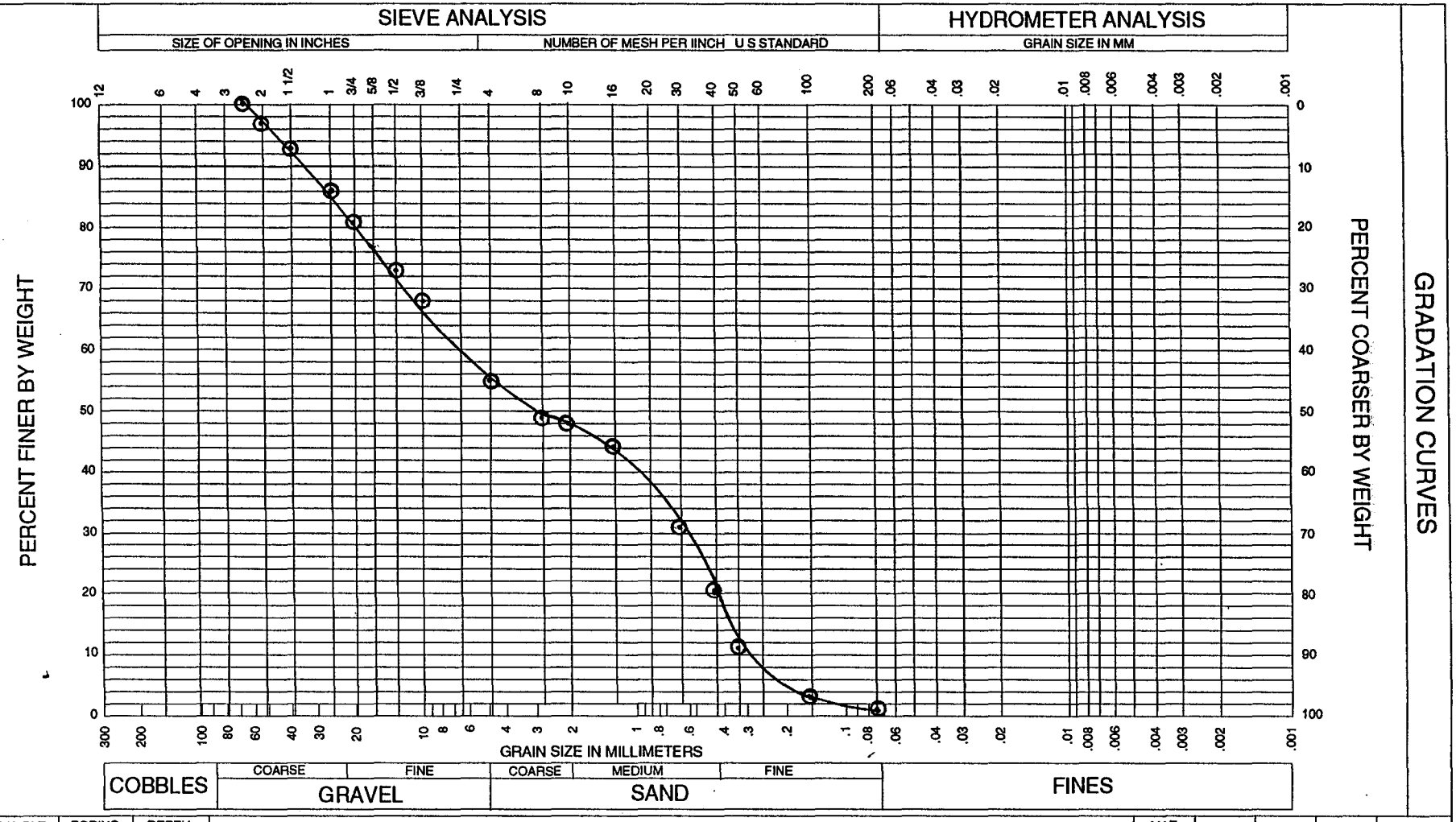

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.
	22	2 - 4	Poorly graded sand (SP) with gravel	—	NP	NP	NP

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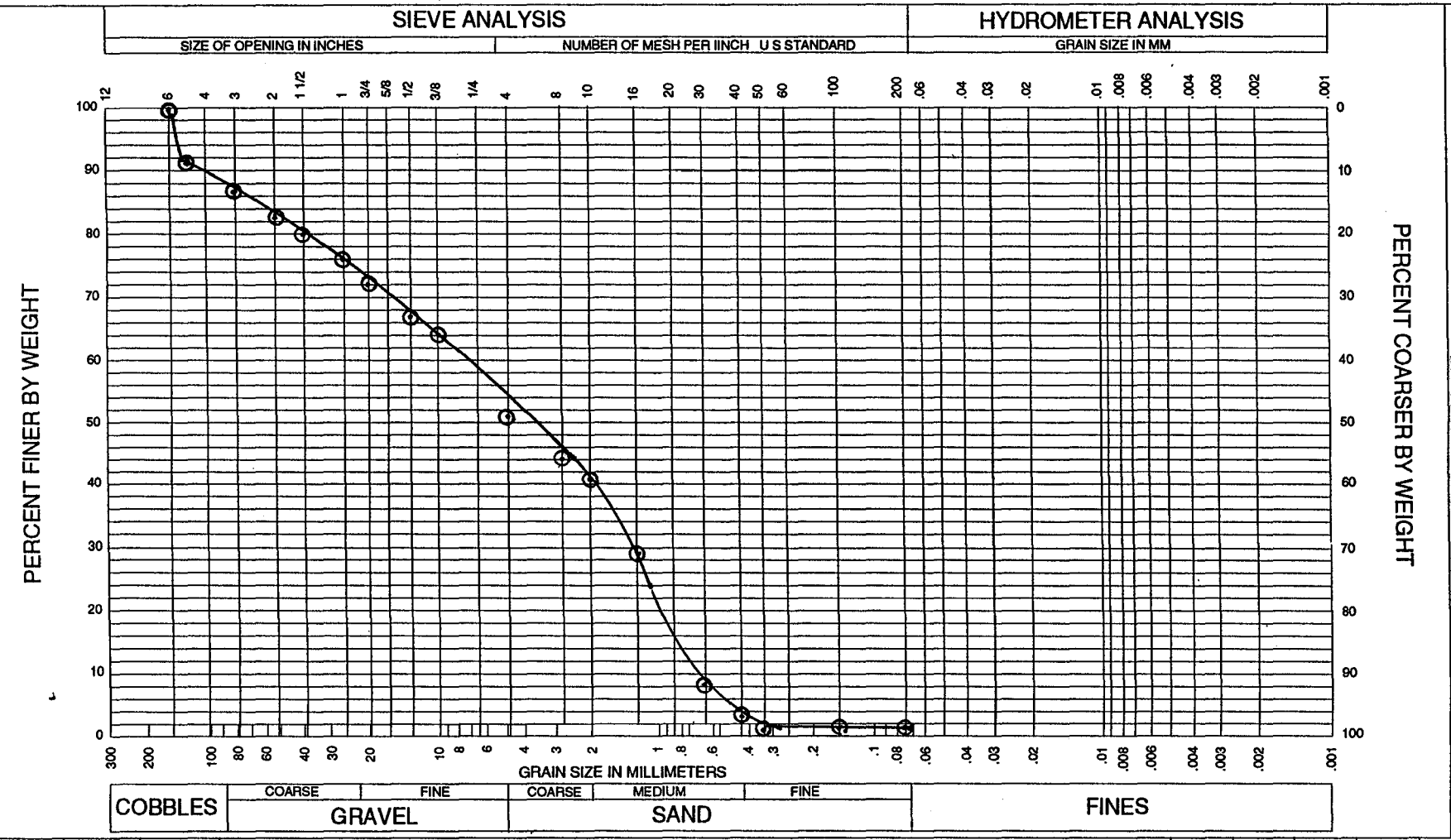

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	23	0 - 1 1/2	Poorly graded gravel (GP) with sand	—	NP	NP	NP	

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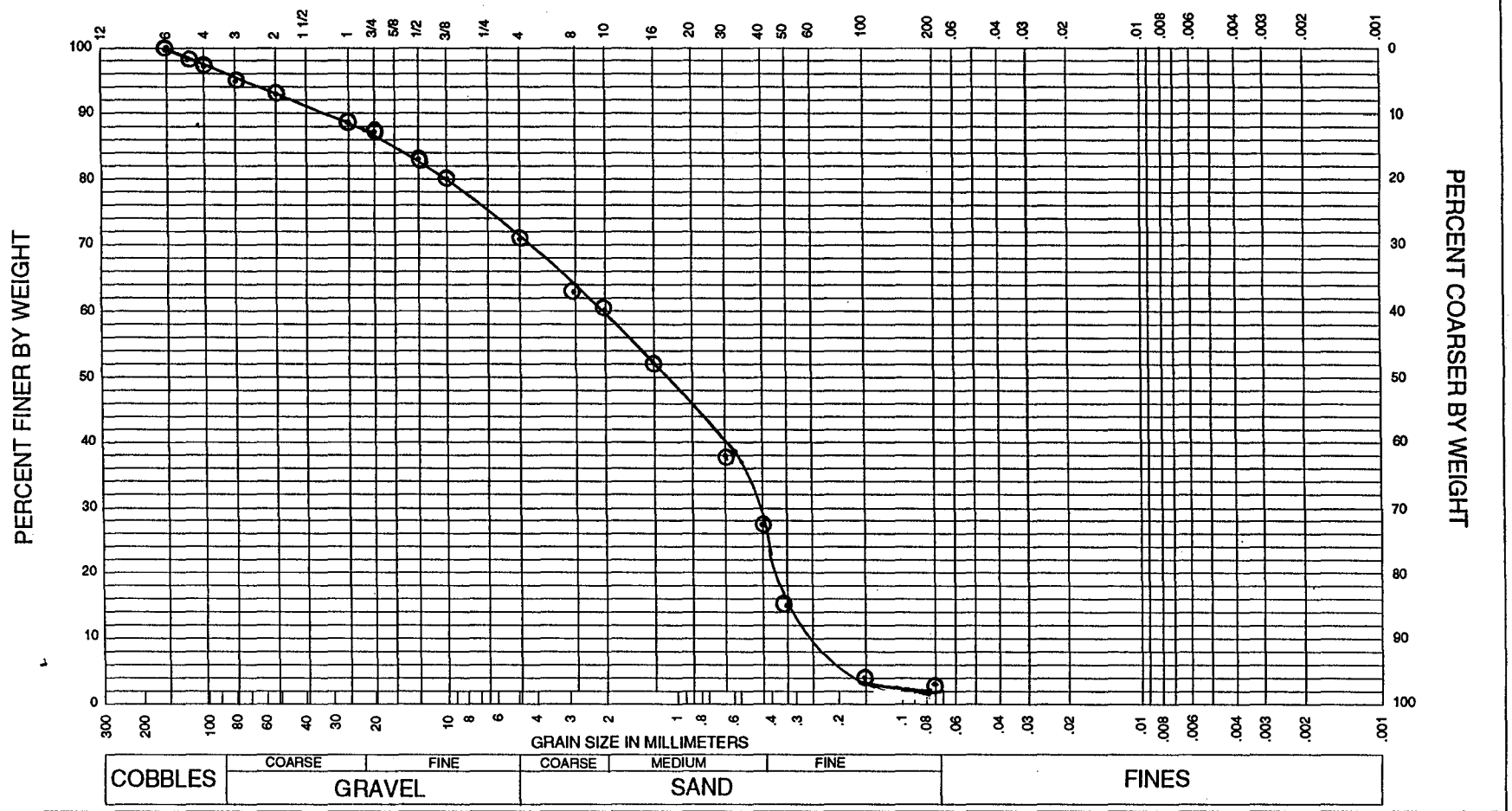

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	23	2 - 4	Poorly graded sand (SP) with gravel	—	NP	NP	NP	

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JOB NO. 195039 - 1

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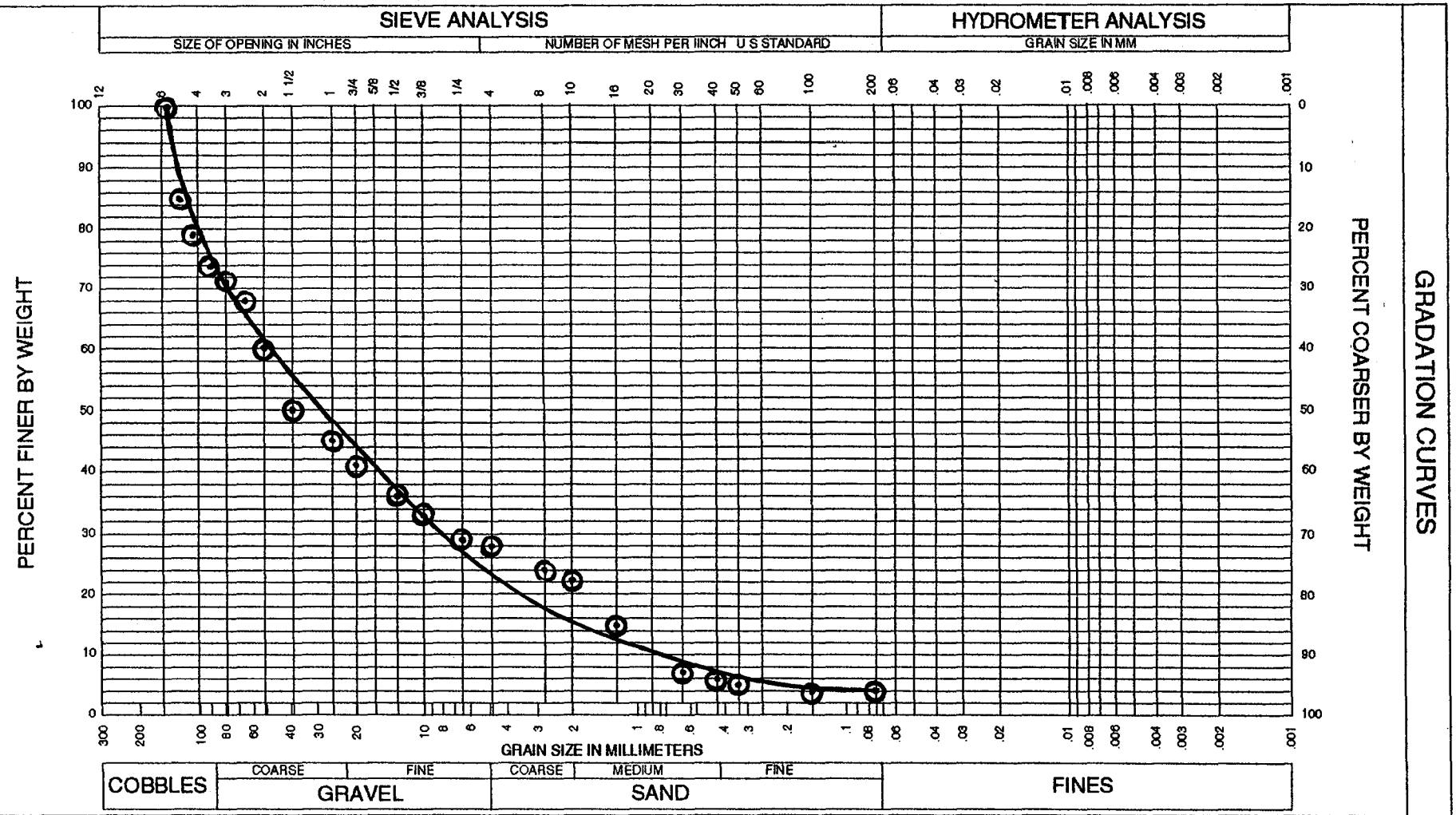

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	24	0-1½	Poorly graded **GRAVEL (GP)** with sand	2.0	NP			

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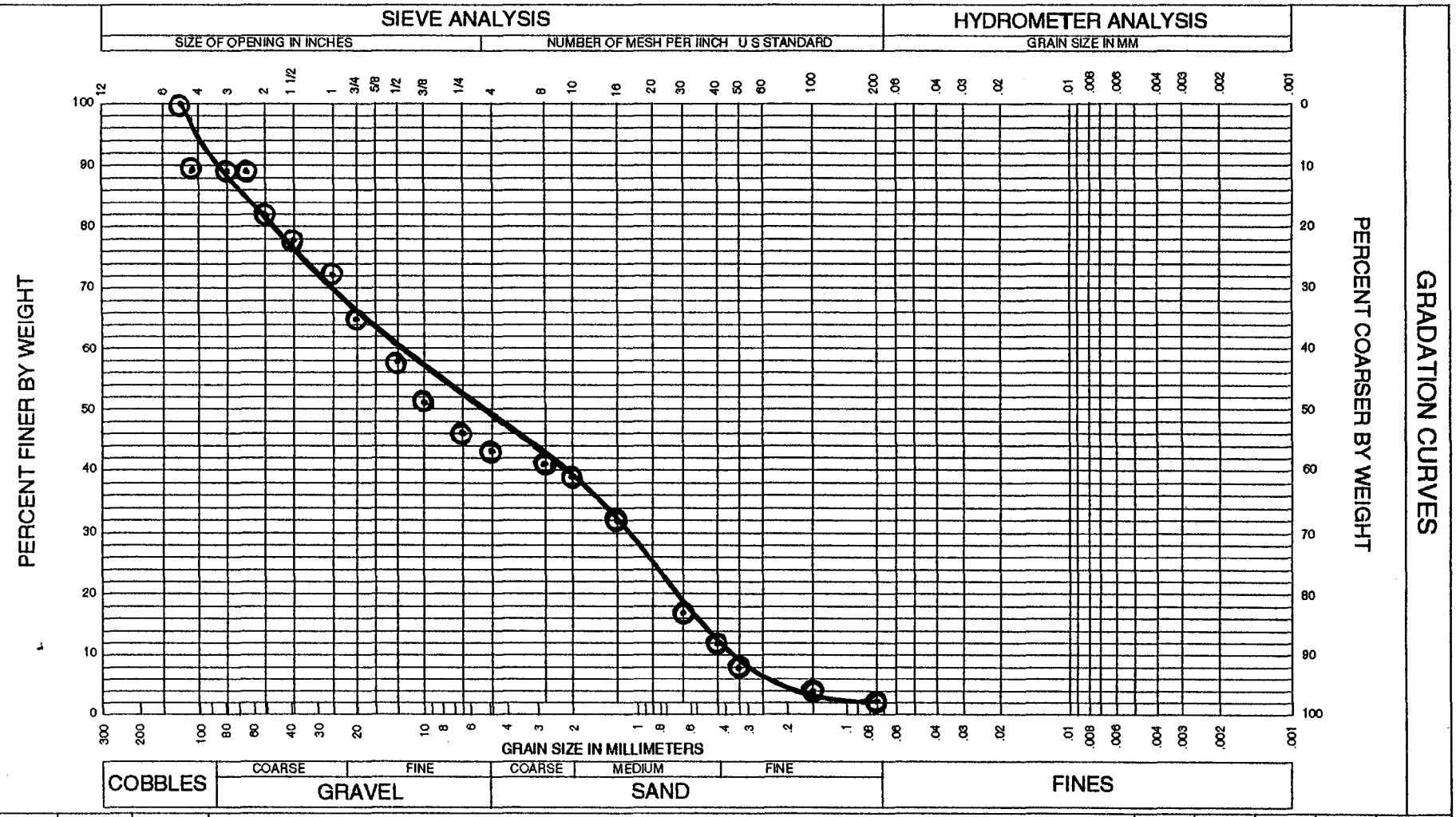

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	24	2-4	Poorly graded **GRAVEL (GP)** with sand	5.9	NP			

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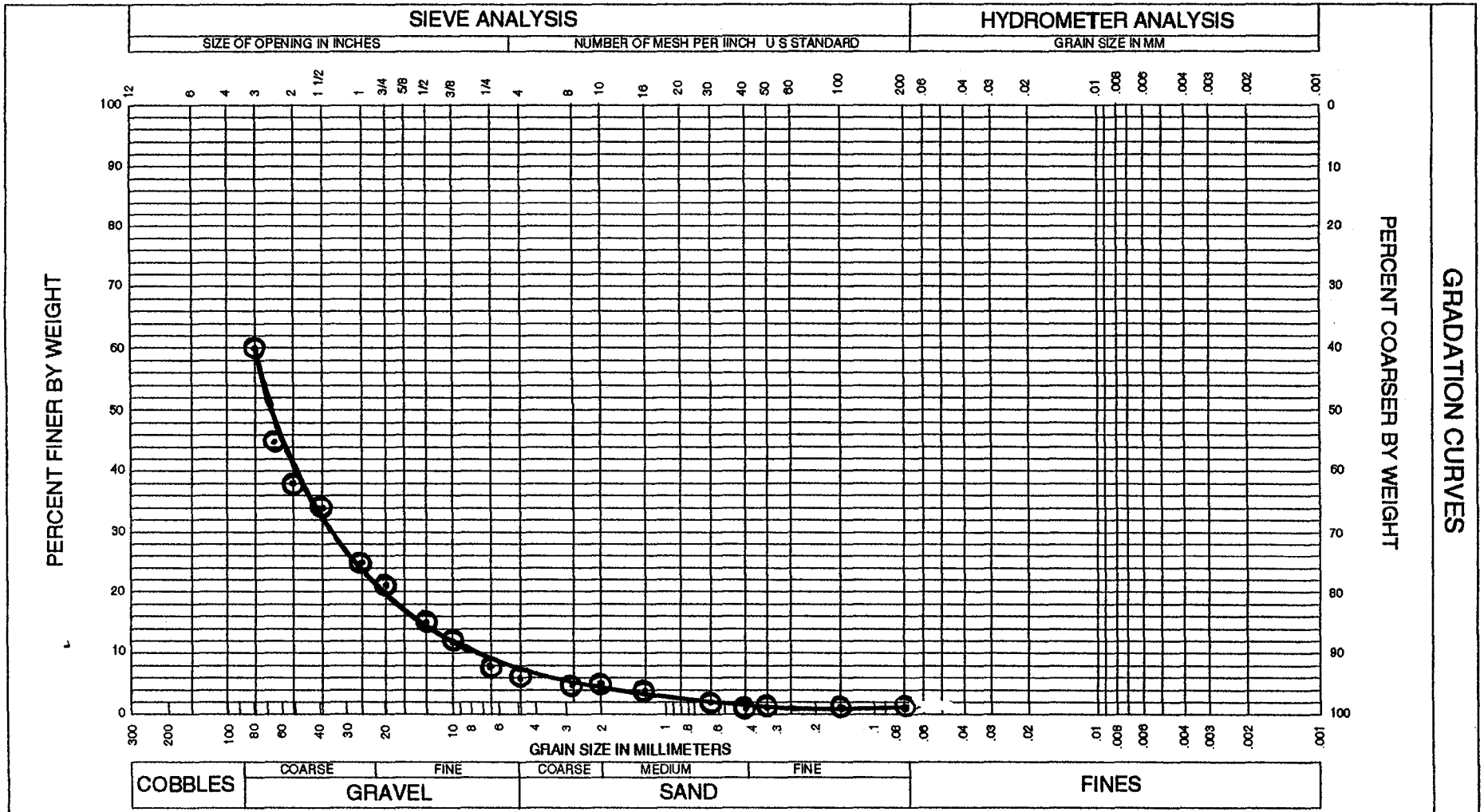

SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	25	0-1½	Poorly graded **GRAVEL (GP)**	1.6	NP			

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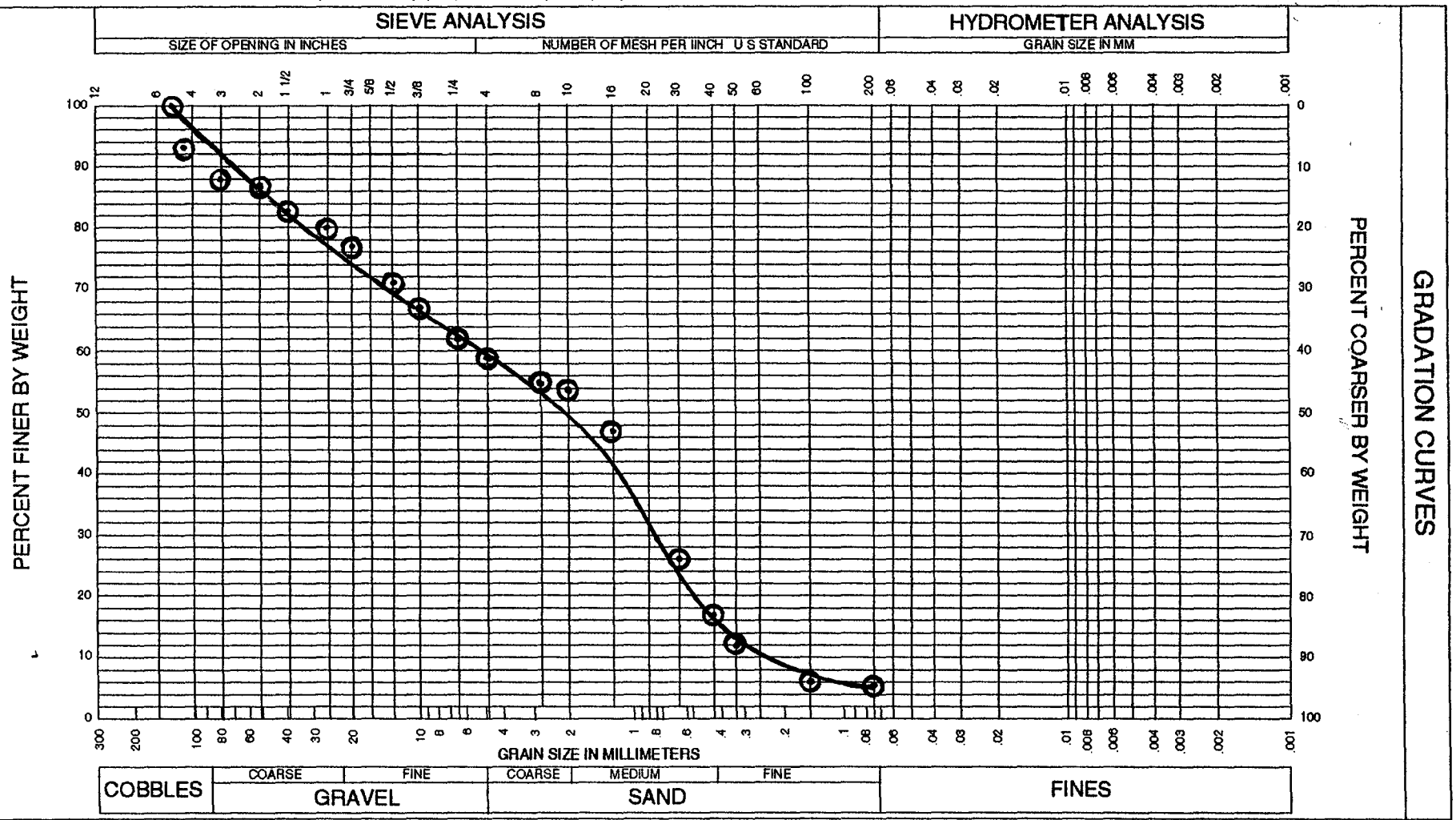


SAMPLE NO.	BORING NO.	DEPTH (Ft.)	CLASSIFICATION	MAT. W.C.	P.I.	L.L.	P.L.	
	25	2-4	Poorly graded **SAND (SP)** with gravel	6.0	NP			

CAMELBACK RANCH LEVEE
ATL JOB No. 195039

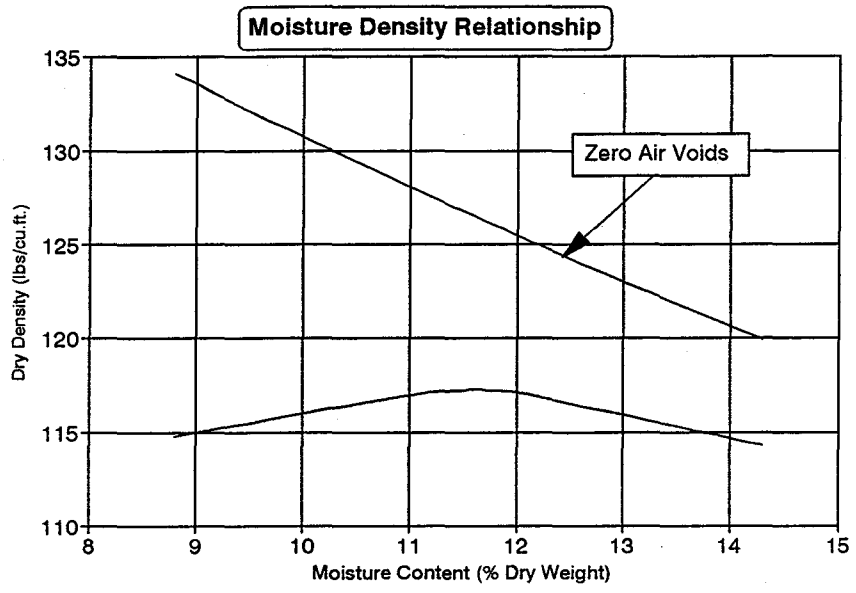
DRY UNIT WEIGHT

Boring No.	Lab No.	Sample Depth (ft)	Dry Unit Wt. (pcf)
2	96-0276	5.0 - 6.5′	101.3
13	96-343	5.0 - 6.5′	101.2
14	96-386	5.0 - 6.5′	106.0

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

Summary of Moisture Density Relationship Tests

Client:	DMJM 300 W. Clarendon Ave., Suite 400 Phoenix, Az. 85013	**Job No.**	195039
		Lab No.	96-424
		Type of Rammer:	Manual
		Test Date:	07/18/96
Project:	Camalback Ranch Levee	**Material Description:**	Silty Clay With Gravel
Test Designation:	ASTM D698		
Test Method:	A		Boring No. 2 3 1/2' - 9'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	114.8	116.6	116.9	114.3
Moisture Content (%)	8.8	10.6	12.2	14.3

Maximum Dry Density (lbs/cu.ft.): **117.2**
Optimum Moisture Content (% of Dry Weight): **11.6**

Maximum Dry Density For Oversize Particles (D4718): N\A
Corrected Moisture Content For Oversized Particles (D4718): N\A

Remarks:

Reviewed By:

Respectfully Submitted:

J. Michael Addington
Laboratory Manager

DMJM\SOILS\96-424

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GLOBE, AZ 85502
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FAX (520) 425-9597

ATL, INC.
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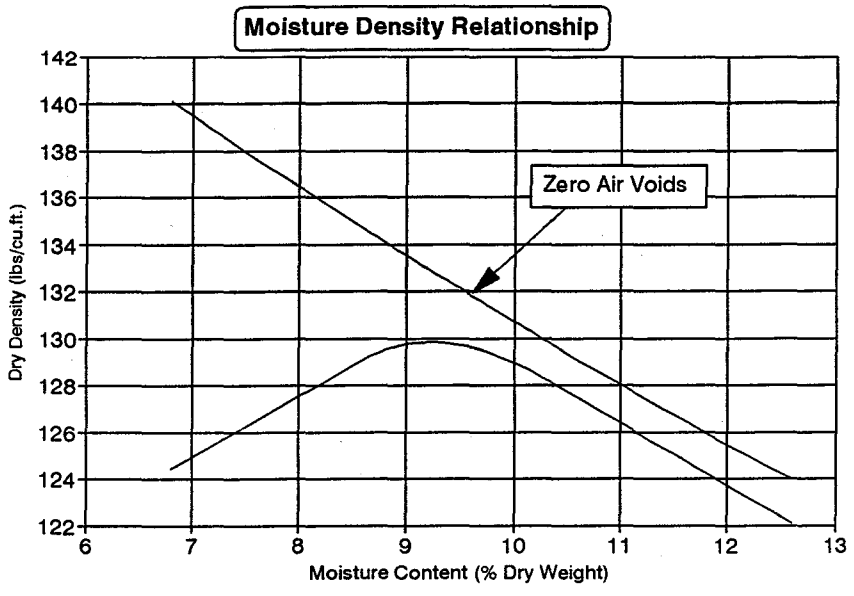
GEOTECHNICAL CONSULTANTS

Summary of Moisture Density Relationship Tests

Client:	DMJM 300 W. Clarendon Ave., Suite 400 Phoenix, Az. 85013	**Job No.**	195039
		Lab No.	96-425
		Type of Rammer:	Manual
		Test Date:	07/19/96
Project:	Camalback Ranch Levee	**Material Description:**	Sandy Gravel With Clay Boring No. 5 11' - 25'
Test Designation:	ASTM D698		
Test Method:	A		



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	124.4	129.1	128.0	122.1
Moisture Content (%)	6.8	8.6	10.4	12.6

Maximum Dry Density (lbs/cu.ft.): **129.9**
Optimum Moisture Content (% of Dry Weight): **9.2**

Maximum Dry Density For Oversize Particles (D4718): N\A
Corrected Moisture Content For Oversized Particles (D4718): N\A

Remarks:

Respectfully Submitted:

Reviewed By:

J. Michael Addington
Laboratory Manager

DMJM\SOILS\96-425

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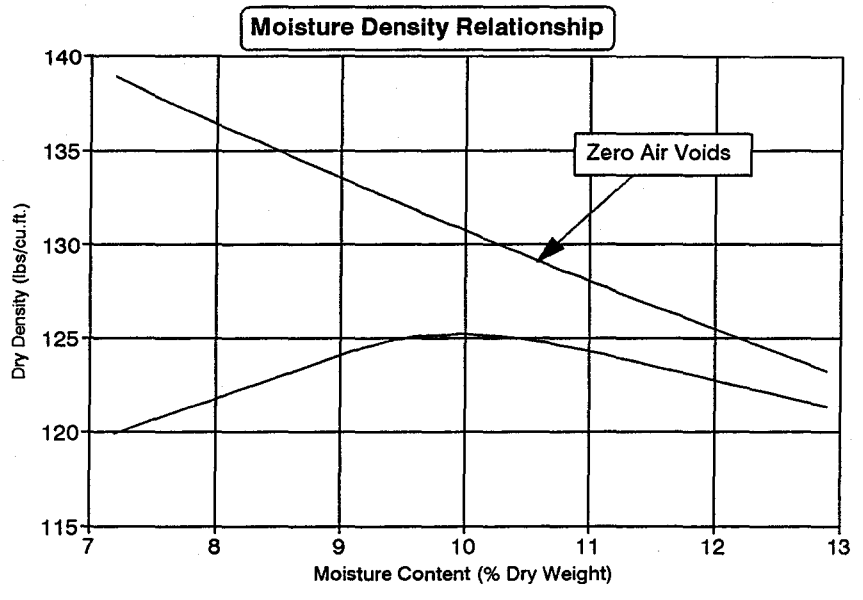
Summary of Moisture Density Relationship Tests

Client:	DMJM 300 W. Clarendon Ave., Suite 400 Phoenix, Az. 85013	**Job No.**	195039
		Lab No.	96-422
		Type of Rammer:	Manual
		Test Date:	07/19/96
Project:	Camalback Ranch Levee	**Material Description:**	Sily Clay With Gr
Test Designation:	ASTM D698		Boring No. 9
Test Method:	A		0' - 2 1/4'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	119.9	124.3	124.0	121.3
Moisture Content (%)	7.2	9.1	11.2	12.9

Maximum Dry Density (lbs/cu.ft.): 125.2
Optimum Moisture Content (% of Dry Weight): 9.9

Maximum Dry Density For Oversize Particles (D4718): N\A
Corrected Moisture Content For Oversized Particles (D4718): N\A

Remarks:

Respectfully Submitted:

Reviewed By:

J. Michael Addington
Laboratory Manager

DMJM\SOILS\96-422

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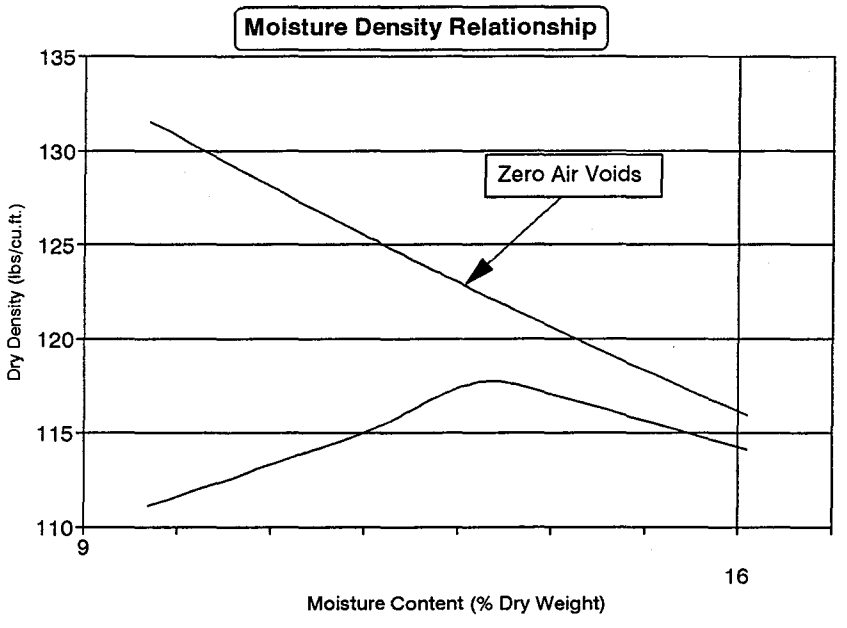
ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

Summary of Moisture Density Relationship Tests

Client:	DMJM	**Job No.**	195039
		Lab No.	96-382
		Type of Rammer:	Hand
		Test Date:	06/04/96
Project:	Camelback Ranch Levee	**Material Description:**	Sandy Silt
Test Designation:	ASTM D-698	**Source Of Sample:**	Bore: #13
Test Method:	A		Depth 0-6.5'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	111.1	115.0	117.6	114.1
Moisture Content (%)	9.7	12.0	13.6	16.1

Maximum Dry Density (lbs/cu.ft.): **117.7**
Optimum Moisture Content (% of Dry Weight): **13.4**

Maximum Dry Density For Oversize Particles (D4718): N\A
Corrected Moisture Content For Oversized Particles (D4718): N\A

Remarks:

Respectfully Submitted:

J. Michael Addington
Laboratory Manager

Reviewed By:

GEOTECH\SOILS\96-342PO

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ATL, INC.
CONSTRUCTION QUALITY CONTROL
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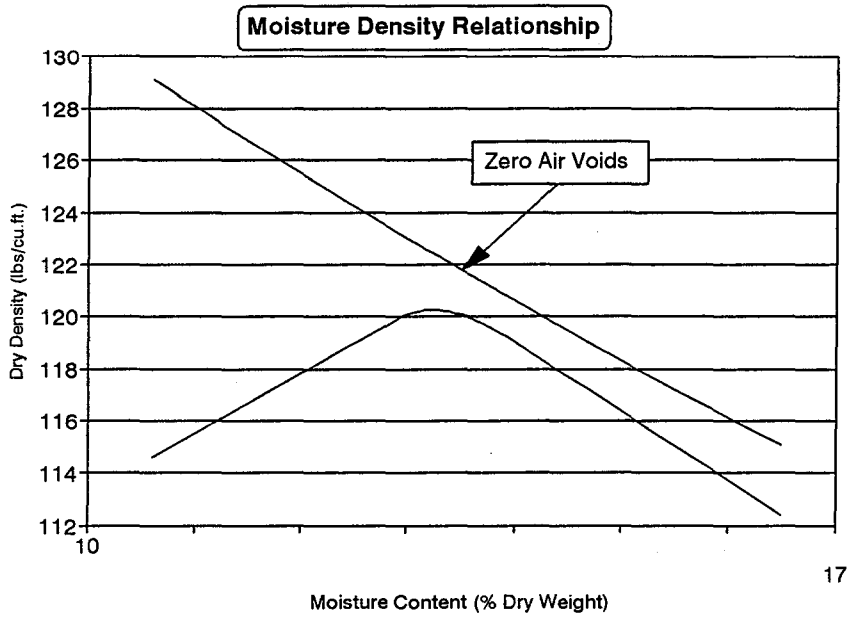
Summary of Moisture Density Relationship Tests

Client:	DMJM	**Job No.**	195039
		Lab No.	96-345
		Type of Rammer:	Hand
		Test Date:	06/20/96
Project:	Camelback Ranch Levee	**Material Description:**	Sandy Silty Clay.
Test Designation:	ASTM D-698		
Test Method:	A	**Source Of Sample:**	Boring #14 Depth: 4.5' - 8.5'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	114.6	119.9	118.5	112.4
Moisture Content (%)	10.6	12.9	14.2	16.5

Maximum Dry Density (lbs/cu.ft.): **120.3**
Optimum Moisture Content (% of Dry Weight): **13.2**

Maximum Dry Density For Oversize Particles (D4718): N\A
Corrected Moisture Content For Oversized Particles (D4718): N\A

Remarks:

Respectfully Submitted:

J. Michael Addington
Laboratory Manager

Reviewed By:

GEOTECH\SOILS\96-345PO

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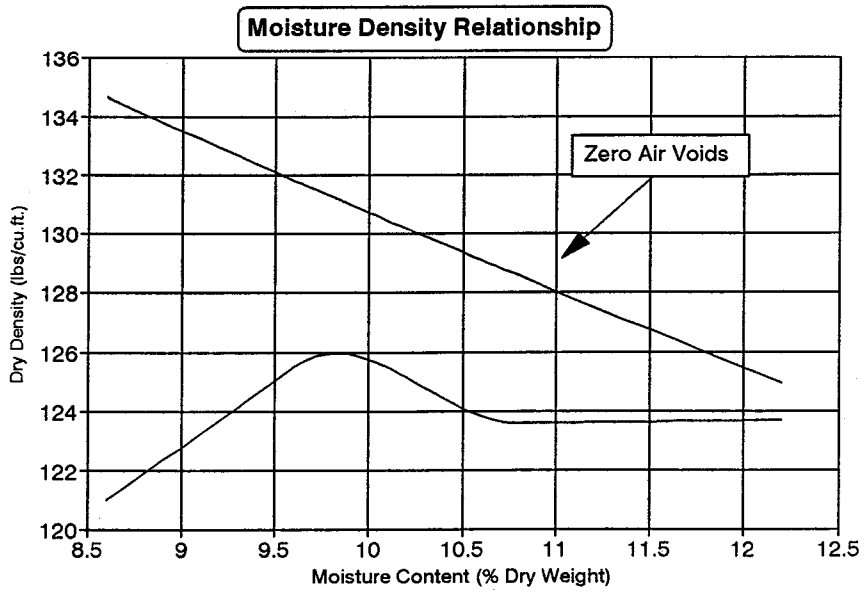
Summary of Moisture Density Relationship Tests

Client:	DMJM 300 W. Clarendon Ave., Suite 400 Phoenix, Az. 85013	**Job No.**	195039
		Lab No.	Lab Mix
		Type of Rammer:	Manual
		Test Date:	07/09/96
Project:	Camalback Ranch Levee	**Material Description:**	Silty Clay With Gravel
Test Designation:	ASTM 558		
Test Method:	B		Boring Nos. 17 & 18 3' - 12 1/2'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	121.0	125.5	123.6	123.7
Moisture Content (%)	8.6	9.6	10.8	12.2

Maximum Dry Density (lbs/cu.ft.): **126.0**
Optimum Moisture Content (% of Dry Weight): **9.8**

Maximum Dry Density For Oversize Particles (D4718): N\A
Corrected Moisture Content For Oversized Particles (D4718): N\A

Remarks:

Respectfully Submitted:

J. Michael Addington
Laboratory Manager

Reviewed By:

DMJM\SOILS\7-9-96LM

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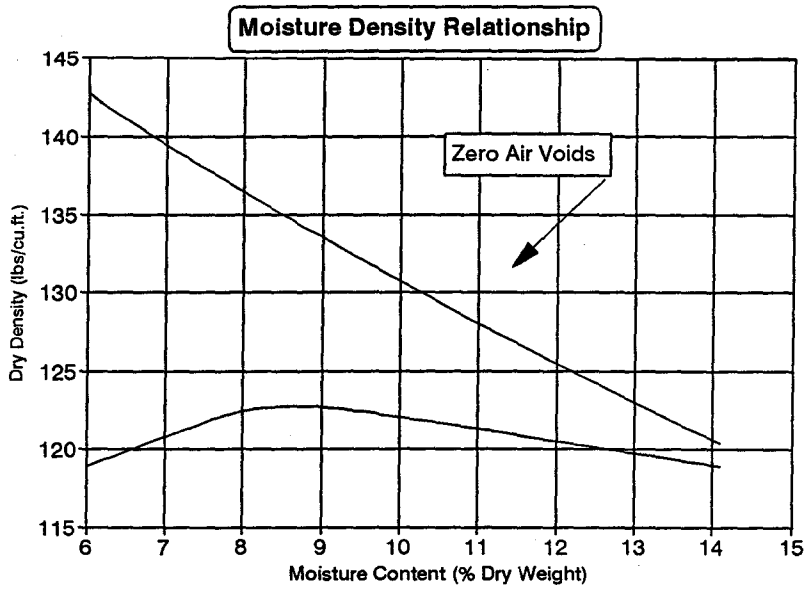
Summary of Moisture Density Relationship Tests

Client:	DMJM	**Job No.**	195039
		Lab No.	96-393
		Type of Rammer:	Manual
		Test Date:	06/25/96
Project:	Camelback Ranch Levee	**Material Description:**	Poorly graded SAND
Test Designation:	ASTM D558		
Test Method:	B	**Test Location:**	Test Pits 19 & 20 Depth 0 to 8'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	118.9	121.9	122.0	118.9
Moisture Content (%)	6.0	7.6	10.1	14.1

Maximum Dry Density (lbs/cu.ft.): **122.8**
Optimum Moisture Content (% of Dry Weight): **8.7**

Maximum Dry Density For Oversize Particles (D4718): N\A
Corrected Moisture Content For Oversized Particles (D4718): N\A

Remarks:

Respectfully Submitted:

Reviewed By:

J. Michael Addington
Laboratory Manager

MSTRFORM\PROCFORM\1

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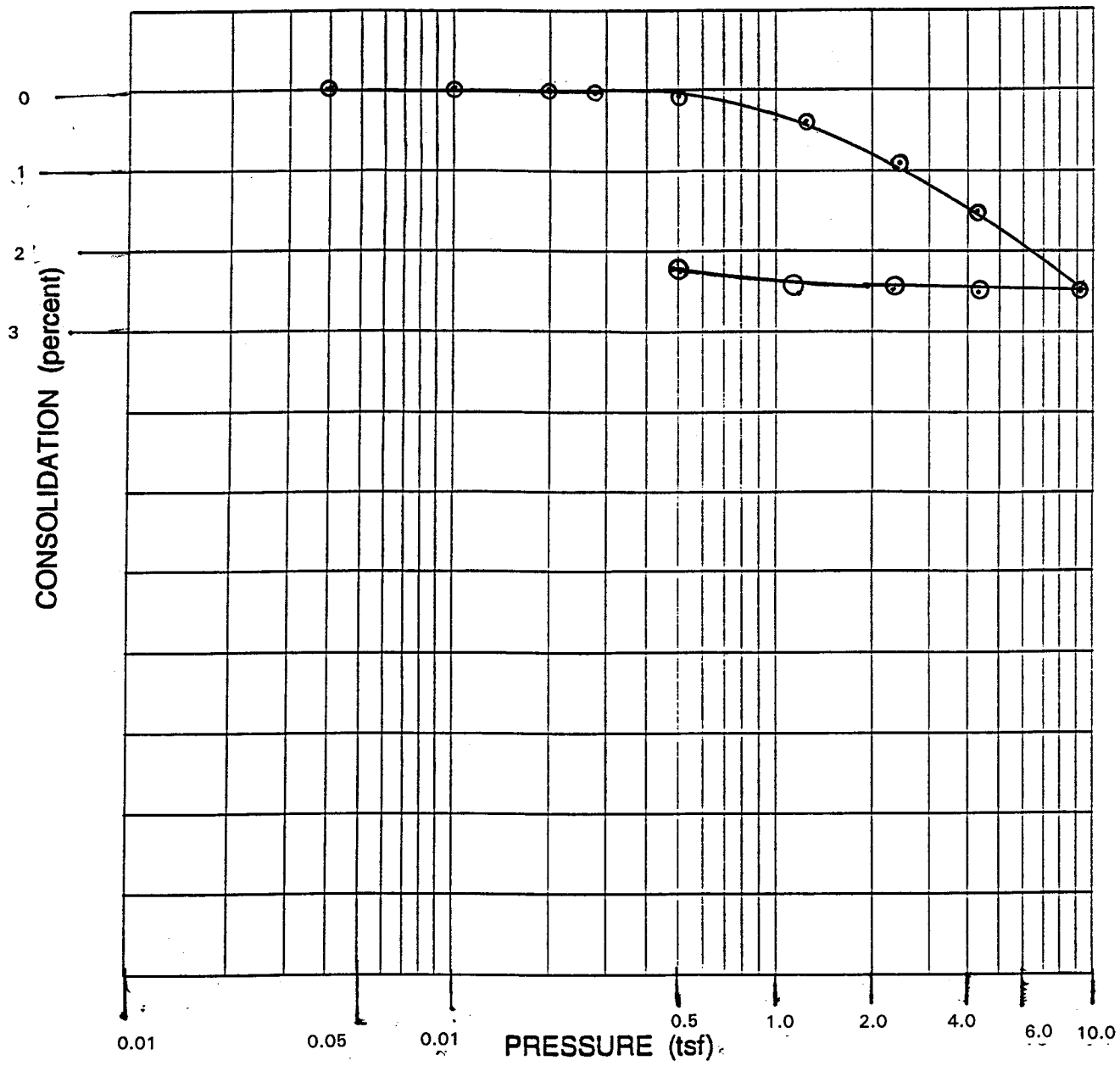


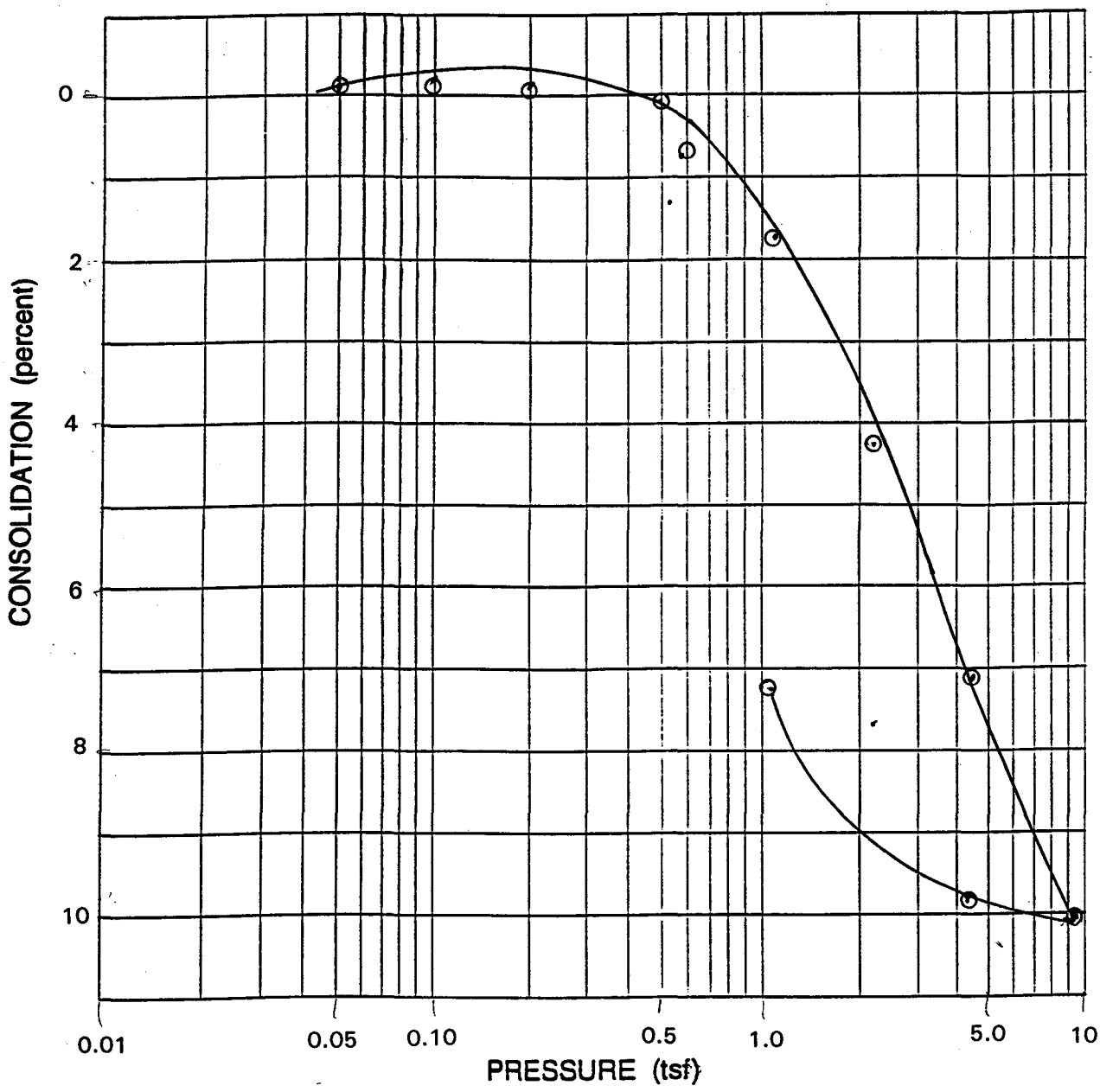
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%) Before	Moisture Content (%) After	Dry Density (pcf)
	5	16 - 16.5	Silty sand (SP-SM)	NP	NP	6.9	21.6	105.3

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 195039

Date 5/20/96



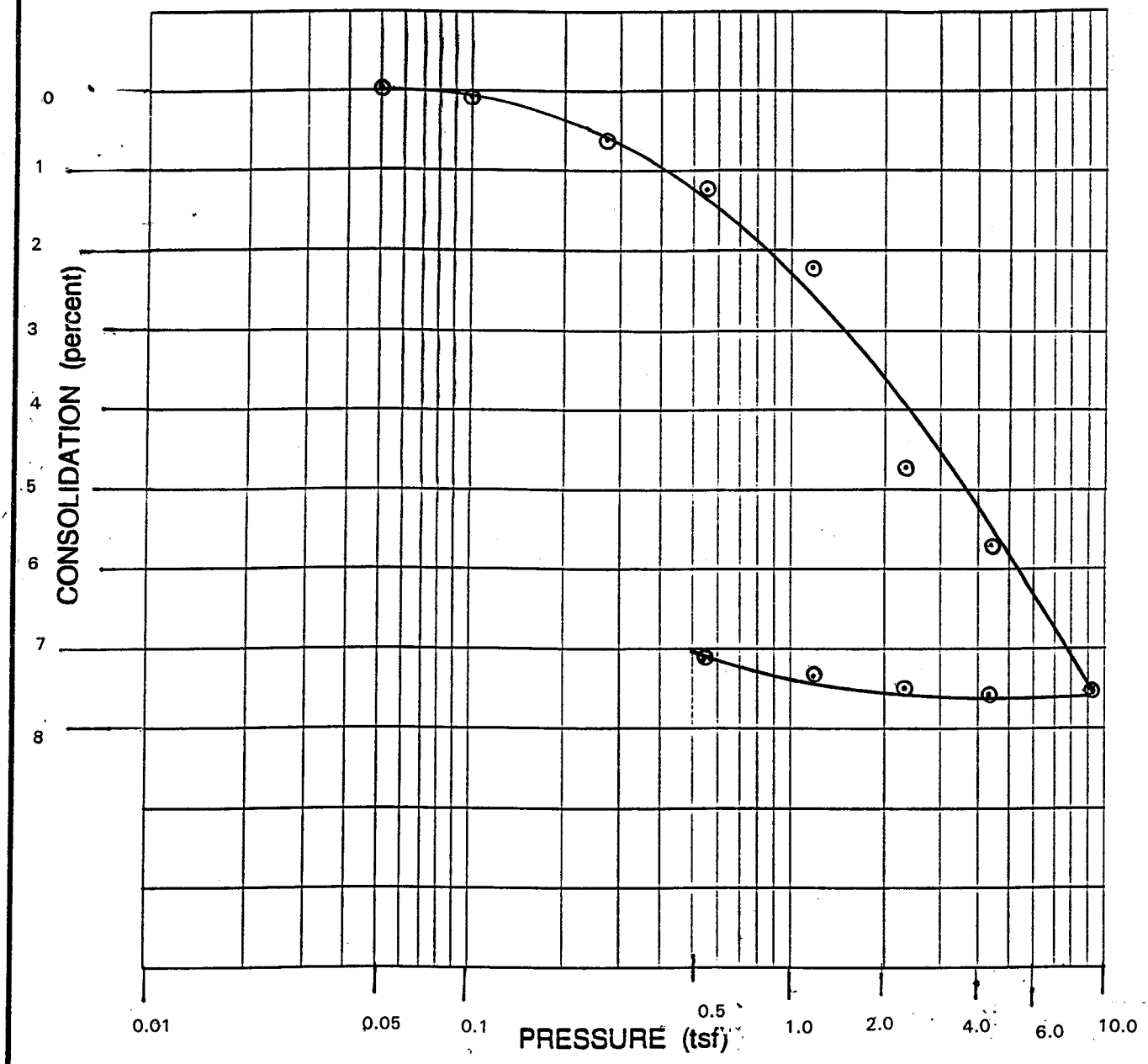
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%) Before	Moisture Content (%) After	Dry Density (pcf)
	6	3 1/2 -5	Light Brown Sandy Lean CLAY (CL)	36	19	17.6		113.2

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 195039

Date 6/17/96



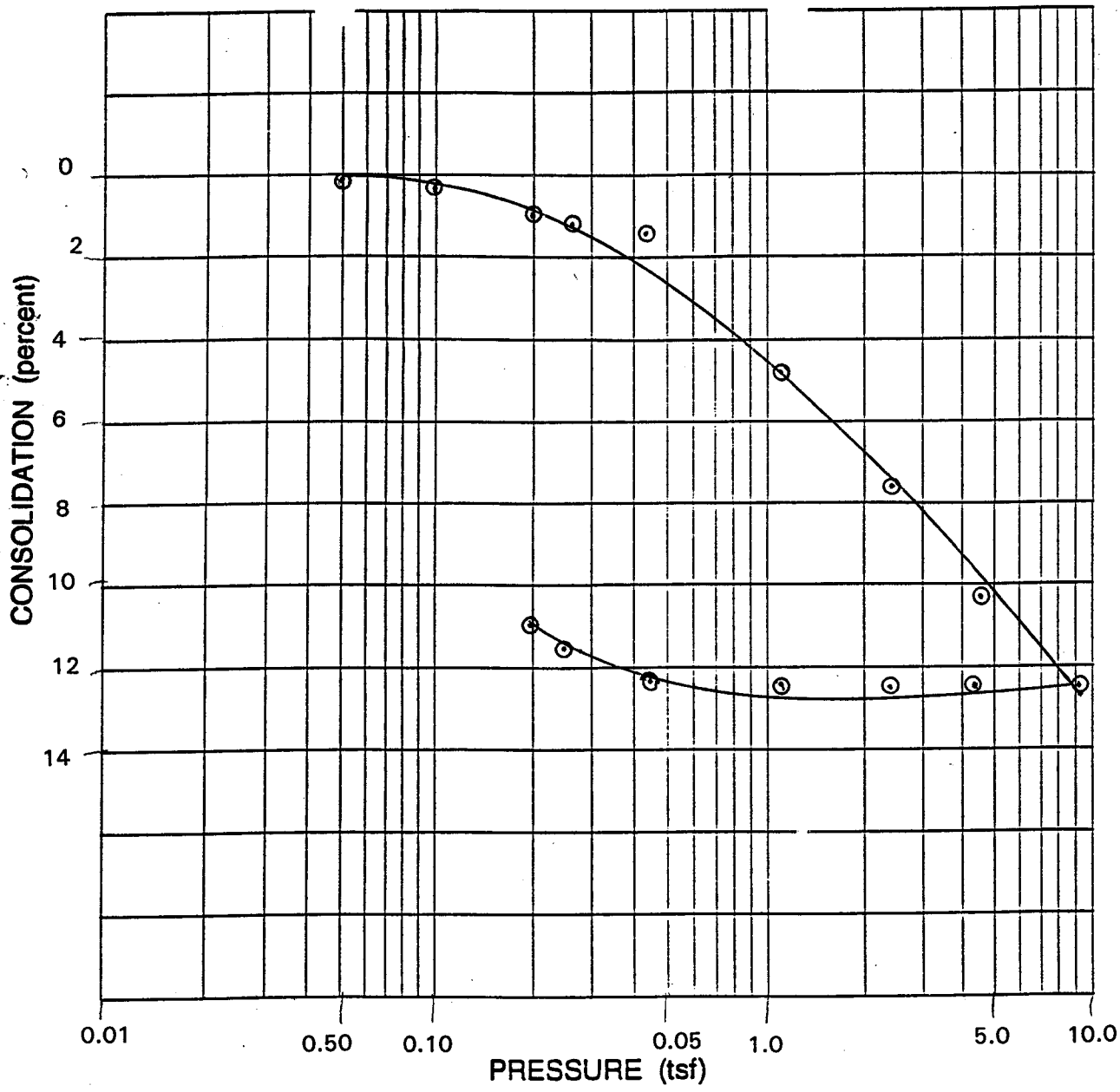
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%) Before	Moisture Content (%) After	Dry Density (pcf)
	9	1.5 - 2	SP - SM	NP	NP	12.8	27.5	103.8

ATL

CONSOLIDATION TEST DATA

Project No. 195039

Date 5/20/96

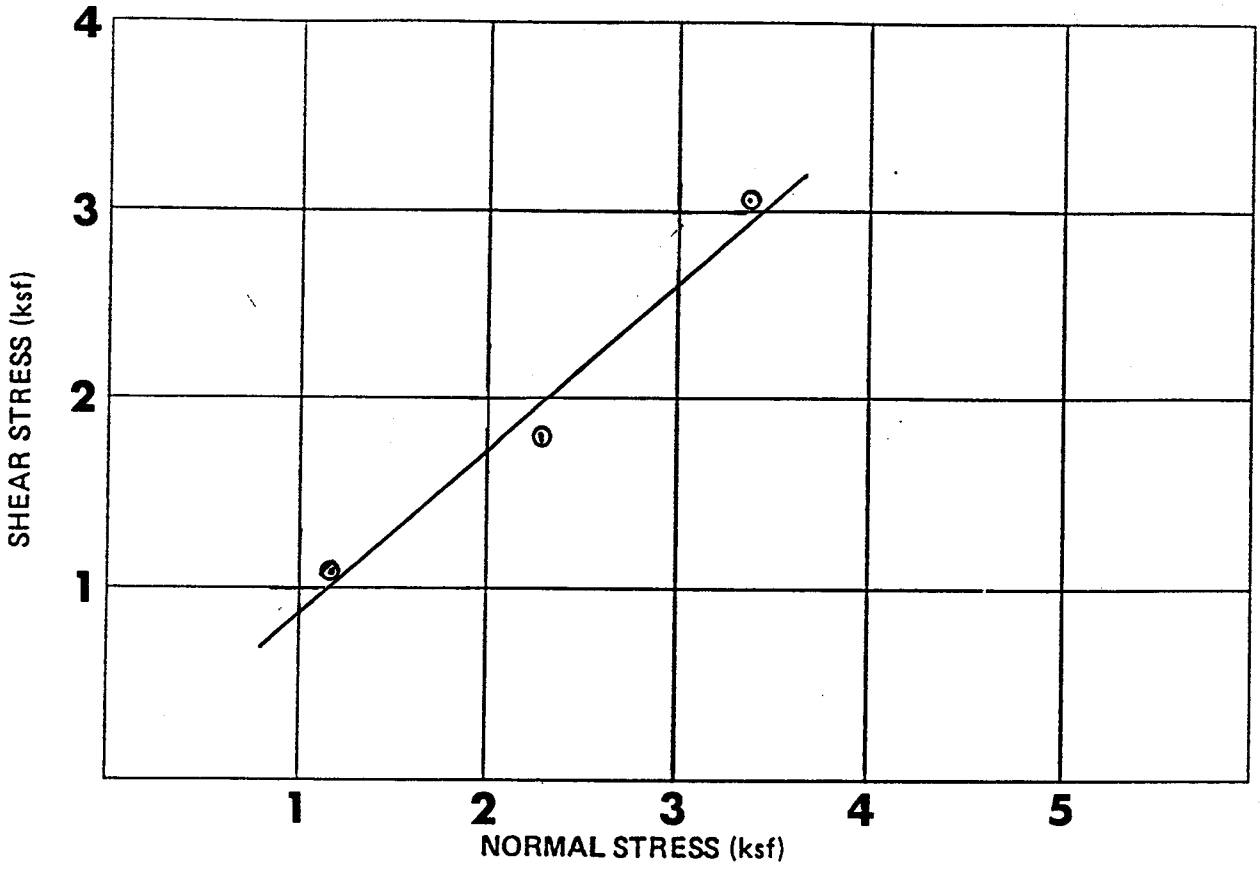


Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%) Before	Moisture Content (%) After	Dry Density (pcf)
	14	5-6 1/2	Brown Sandy Silty CLAY (CL-ML)	26	21	13.1	34.4	108.6

CONSOLIDATION TEST DATA

Project No. 195039

Date 7/1/96



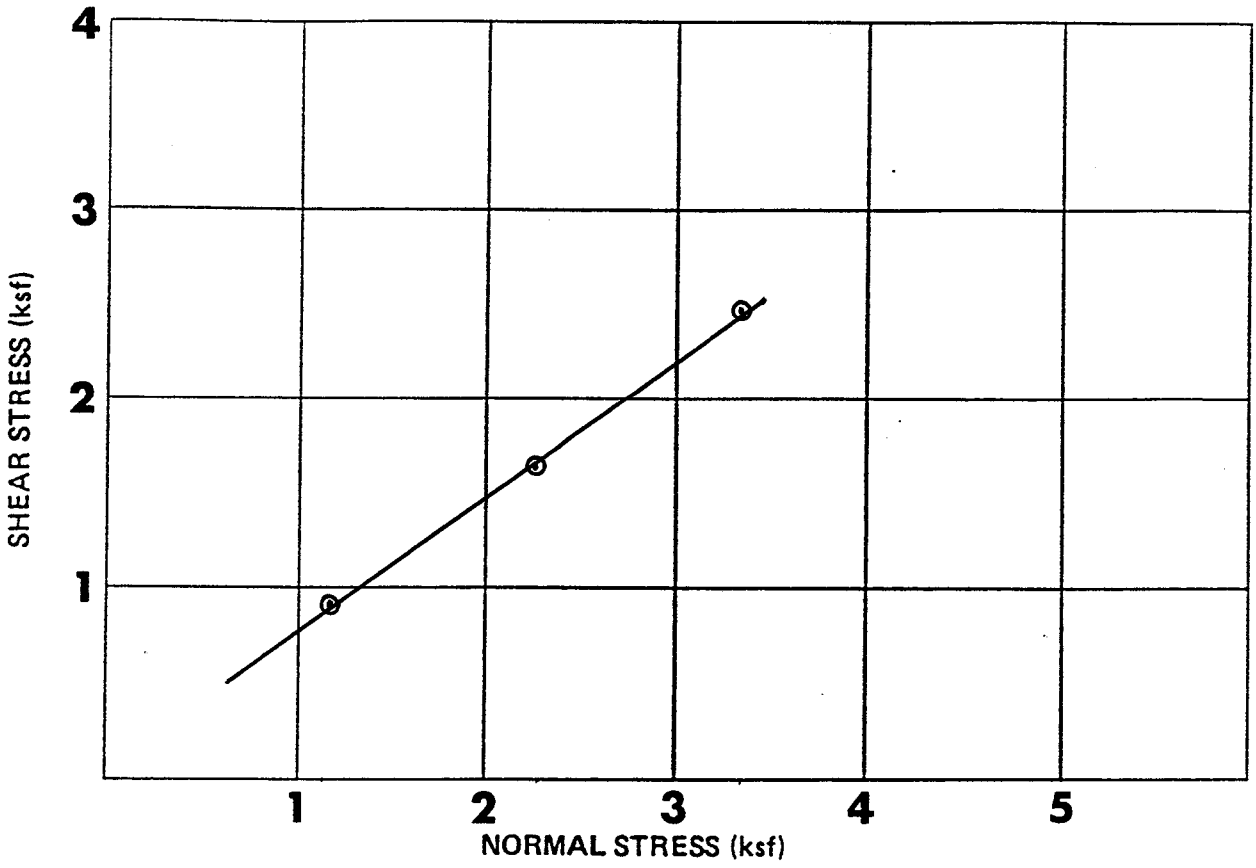
Boring or Test Pit No.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
5	11' - 25'	(SP-SM)	Poorly graded SAND with silt	0	41°	9.4	103.9

DIRECT SHEAR TEST DATA

JOB NO. 195039

ATL TESTING LABORATORIES

PLATE



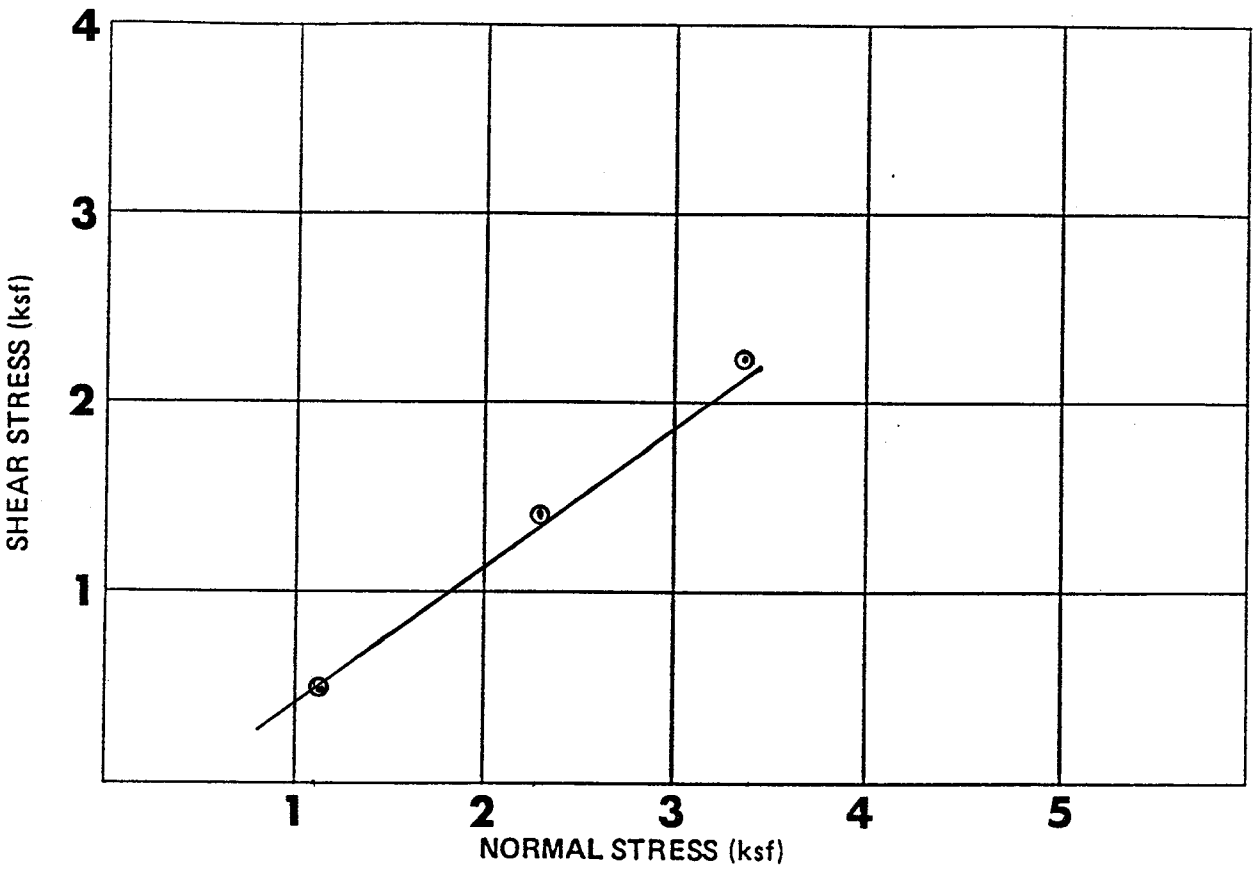
Boring or Test Pit No.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
9	1.5' - 2'	SP-SM	Poorly graded SAND with silt	0	36°	9.7	103.4

DIRECT SHEAR TEST DATA

JOB NO. 195039

ATL TESTING LABORATORIES

PLATE



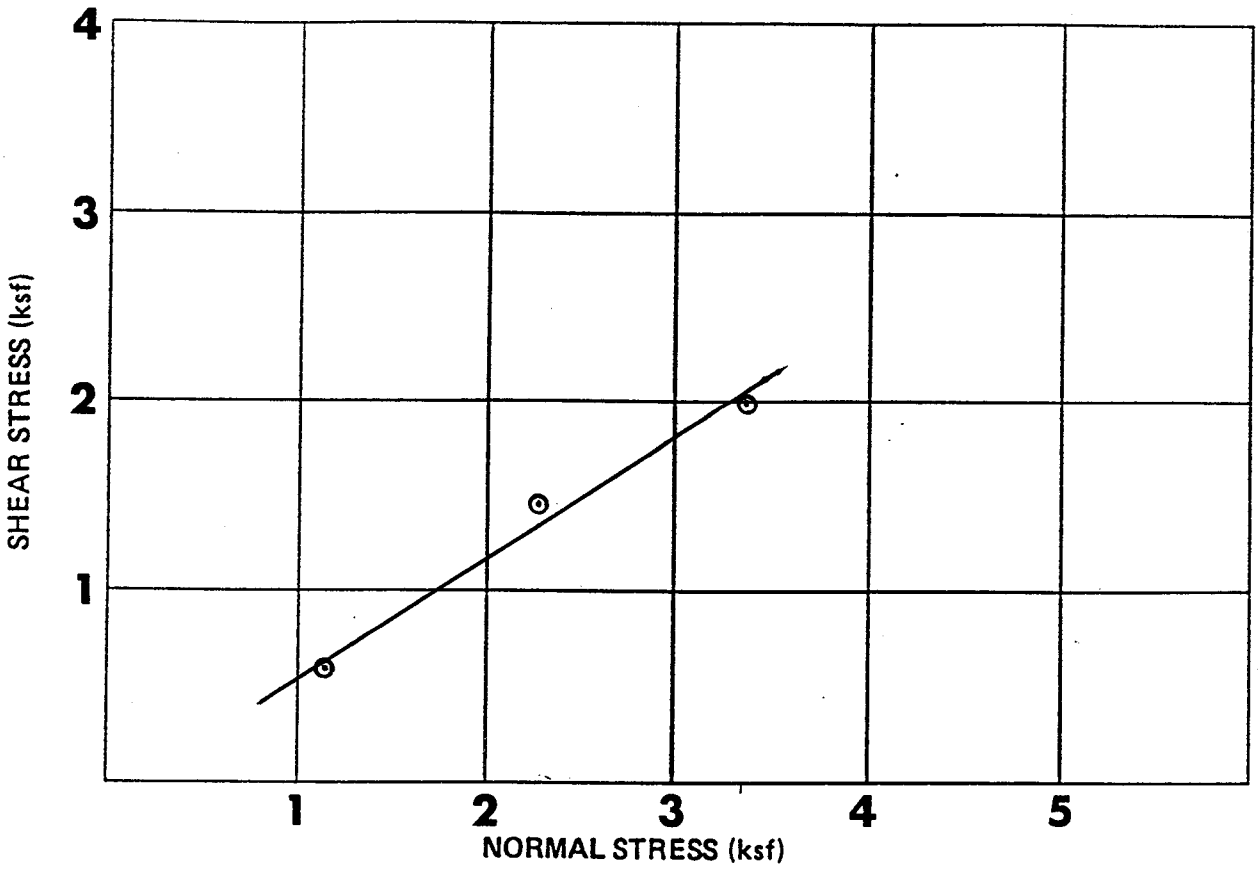
Boring or Test Pit No.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
13	5 - 6 1/2	ML	Sandy SILT	0	36°	21.4	101.8

DIRECT SHEAR TEST DATA

JOB NO. 195039

ATL TESTING LABORATORIES

PLATE



Boring or Test Pit No.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
14	5 - 6 1/2	CL-ML	Sandy Silty CLAY	0	33°	12.9	90.5

DIRECT SHEAR TEST DATA

JOB NO. 195039

ATL TESTING LABORATORIES

PLATE

PHYSICAL PROPERTIES
CAMELBACK RANCH LEVEE
ATL JOB No. 195039

A) Los Angles Abrasion (AASHTO T96)

	T.P. 19	T.P. 20
Method:	B	A
No. of Spheres:	11	11
Loss After 100 Revolutions	4.0%	5.6%
Loss After 500 Revolutions	21.0%	23.0%

B) Sand Equivalent (ASTM D-2419)

TP	Reading 1	Reading2	Reading 3
19	88	88	90
	Average 89		
20	76	78	75
	Average 77		

C) Specific Gravity and Absorption (ASTM C127 & C128)

Combined Sample TP 19 & TP 20

	Bulk Oven Dry	Bulk SSD	Apparent	Absorption
Coarse Aggregate	2.595	2.633	2.697	1.40%
Fine Aggregate	2.517	2.561	2.632	1.74%

D) Clay Lumps and Friable Particles (ASTM C142)

Combined Sample TP 19 & TP 20 = 2.2%