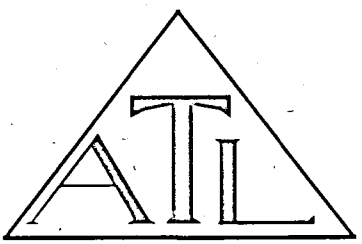
PPM
12/2/97



ATL, INC.

CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

BULLARD WASH - BRIDGES
MC 85 BRIDGE AND BID CANAL OVERCHUTE
GOODYEAR, ARIZONA
ATL JOB NO. 196020-2

BULLARD WASH - BRIDGES
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ATL Job No. 196020-2 November 17, 1997

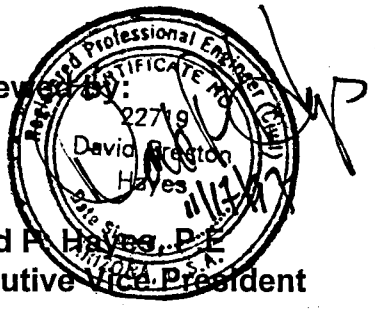
GEOTECHNICAL INVESTIGATION

REPORT FOR

SVERDRUP, CIVIL INC.

PROJECT

BULLARD WASH - BRIDGES
MC 85 BRIDGE AND BID CANAL OVERCHUTE
GOODYEAR, ARIZONA
ATL JOB NO. 196020-2



Reviewed by:

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

Prepared by:

Ammi Osorio
Project Engineer

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

November 17, 1997

Mr. Brad D. Olbert, P.E.
Sverdrup, Civil Inc.
432 N. 44th Street, Suite 250
Phoenix, AZ 85008

Re: Geotechnical Investigation
Bullard Wash - Bridges
MC 85 Bridge and BID Canal Overchute
Goodyear, Arizona
ATL Job No. 196020-2

Dear Mr. Olbert:

This report summarizes the results of a geotechnical investigation conducted at the site of the proposed Bullard Wash - Bridges in Goodyear, Arizona. Presented are the results of the field exploration, laboratory tests, and engineering analysis. ATL's work was performed in accordance with ATL Proposal No. 196020 dated April 17, 1997.

The subsurface soil investigation was performed to provide information necessary for the foundation design for MC-85 Bridge and BID Canal Overchute. The field and laboratory data were used to determine the bearing capacity and settlement of the soil, to provide foundation recommendations, pavement section recommendations and suggest construction material specifications.

ATL has appreciated the opportunity to be of service to Sverdrup, Civil Inc. on this project and looks forward to a continued association on future projects. Should any questions arise, please do not hesitate to contact us at your earliest convenience.

Very truly yours,

Registered Professional Engineer (Civil) CERTIFICATE NO. 22719 David Preston Hayes Date Signed 11/17/97 ARIZONA, U.S.A.

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

DPH/brc

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GEOTECHNICAL INVESTIGATION

REPORT FOR

SVERDRUP, CIVIL INC.

PROJECT

BULLARD WASH - BRIDGES
MC 85 BRIDGE AND BID CANAL OVERCHUTE
GOODYEAR, ARIZONA
ATL JOB NO. 196020-2

1.0 PROJECT DESCRIPTION

The Flood Control District of Maricopa County (FCD) is preparing plans to relocate the Bullard Wash to a location East of Estrella Parkway. As part of the this project, MC-85 Bridge and BID Canal Overchute will be constructed. The bridge roadway shall be approximately 100 feet wide with concrete barrier railings and sidewalks. The abutments and piers of the bridge will be continuous throughout the width of the bridge.

2.0 LOCATION AND SITE DESCRIPTION

The project site is located south of Interstate 10 Freeway (I-10), west of Litchfield Road, and east of Sarival Road. It is situated in a predominantly farm area in Goodyear, Arizona.

The project area is located in the western Salt River Valley, a broad basin filled with alluvium of varying grain-sizes. The fill deposits are composed of a Lower Conglomerate Unit consisting of cemented sand, gravel, silt, and clay but design considerations interested in materials found in the Upper Alluvial Unit, which consist primarily of sands and gravels with clay and silt lenses. Groundwater flows to the northwest, north of Yuma road and to the southwest, south of Yuma Road at depths between 40 and 120 feet below land surface.

3.0 SCOPE OF WORK

As specified in "NAVFAC DM-7.1 and DM-7.2" as well as Flood Control District scope of work Documents, ATL's responsibility was to drill and sample sub-surface material to obtain foundation and pavement design data. Soil borings were drilled on each abutment location. Soil testing will include basic physical properties to characterize the individual soil types along with design parameter tests appropriate for developing bridge foundation systems.

Field and laboratory data were used to produce this report that addresses the following issues:

1) Bridge Foundation Alternatives.
2) Allowable Bearing Capacities.
3) Pavement Section Recommendations.
4) Total and Differential Settlements.
5) Material Recommendations for concrete slabs, Bank Protection, Drilled Caissons and Asphaltic Concrete.
6) Lateral Pressures.

4.0 DRILLING AND SAMPLING PROCEDURES

A total of six (6) borings were drilled. Four (4) of these borings were drilled for the location of the MC 85 Bridge abutments ranging from 32 feet to 75 feet below grade. The other two (2) borings were drilled in the location of BID Canal Overchute to depths of 50 feet below grade. A Mobil B-50 drill rig, using 6-inch and 8-inch outside diameter hollow stem continuous flight augers performed the drilling and sampling of the borings. Standard Penetration Tests (SPT) were performed starting at five (5) feet below grade at 5-foot intervals. For each test, blow counts were recorded at 6-inch intervals over a depth of 18-inches. A 140-pound hammer dropping 30-inches was used to drive the split-spoon sampler that collects the samples in accordance with ASTM Standard D-1586. Ring samples were also obtained in cohesive materials when changes in "N" values or material type was encountered. Bulk samples were obtained continuously off the auger flights as drilling proceeded.

Upon completion, each borehole was backfilled with excess cuttings from each hole. All samples were transported to ATL's Laboratory for analysis. Upon delivery to the laboratory, soil samples were checked by the Project Engineer and the following laboratory tests were assigned:

- Sieve Analysis
- Consolidation / Unit Weight
- Expansion / Swell
- Direct Shear
- Plasticity Index
- Moisture Content
- Standard Proctor

5.0 LABORATORY TESTING

Representative bulk samples of the subgrade were collected at each borehole location for soil classification purposes.

Visual field classifications were supplemented by index tests such as Sieve Analysis and Atterberg Limits on representative samples. Moisture Content tests were performed to determine the amount of water present in the soil at the time of sampling. Percent Swell Tests were performed to determine the expansion tendencies of the

existing materials during water intrusion. In addition, Consolidation Test, Dry Unit Weight Tests and Standard Proctor tests were performed to determine the physical characteristics of the soil relative to consolidation tendencies, maximum dry density and optimum moisture relationships. A Direct Shear Test was performed to determine the friction angle of the in-situ soil.

The following table lists the types and quantities of tests performed to provide the project design information:

TEST	NUMBER OF TEST PERFORMED
Sieve Analysis	11
Atterberg Limit	11
Moisture Content	11
Standard Proctor	2
Consolidation	3
Swell Test	3
Dry Unit Weight	3
Direct Shear	1

All laboratory tests were conducted in accordance with ASTM published procedures. The soils shown on the edited boring logs were classified using the Unified Soils Classifications System (USCS).

6.0 SUMMARY OF EXISTING SUBSURFACE CONDITIONS

The soil encountered at the proposed site can be described as follows:

a) **For Boring No. 1 - MC 85 Bridge**

Top Layer - 8' deep of a **brown, silty, clayey SAND (SC-SM).**

Underlying Layer - 9' deep of a **brown, lean CLAY (CL)** with a 2 ½' layer of a **brown sandy, silty CLAY (CL-ML)** starting at 9 feet below grade.

Bottom Layer - 58' deep of a **gray-tan, poorly graded SAND (SP)** with a 4' layer of a **brown, silty, clayey SAND (SC-SM)** starting at 32 feet below grade.

Fines (Minus #200)	-	56.2% (CL Material)
		4.5% (SP material)
Plasticity Indies	-	7 (CL material)
		NP (SP material)
"N" values	-	16 blows/foot to 45 blows/foot (CL material)
	-	18 blows/foot 19 blows/foot (SP material)

b) **<u>For Boring No. 2 - MC 85 Bridge</u>**

Top Layer	-	9' deep of a **brown, silty, clayey SAND (SC-SM)**
Underlying Layer	-	11½' deep of a **brown, lean CLAY (CL)**
Bottom Layer	-	36' deep of a **gray-tan, silty SAND (SM)** with alternating layers of a **brown, silty, clayey SAND (SC-SM)** and a brown, silty CLAY (CL-ML) .
Fines (Minus #200)	-	46.5% (SC-SM materials)
		80.6% (CL material)
		14.5% (SM material)
Plasticity Indies	-	6 (SC-SM material)
		11 (CL material)
		NP (SM material)
"N" values	-	5 blows/foot to 18 blows/foot (SC-SM material)
	-	19 blows/foot to 29 blows/foot (CL material)
	-	14 blows/foot to 75 blows/foot (SM material)
	-	15 blows/foot (CL-ML material)

c) **<u>Boring No. 3 - MC-85 Bridge</u>**

Top Layer	-	14' of a **brown, silty, SAND (SM)** with gravel.
Underlying Layer	-	11' of a **brown, lean CLAY (CL)**
Bottom Layer	-	12' deep of a **gray-tan, silty SAND (SM)** with gravel.
Fines (Minus #200)	-	88.0% (CL material)

Plasticity Indies - 25 (CL material)

d) **Boring No. 4 - MC-85 Bridge**

Top Layer - 13' of a **brown, silty, SAND (SM)** with gravel.

Second Layer - 9' of a **light brown, silty SAND (SM)**

Third Layer - 4' of a **brown, lean CLAY (CL)**

Fourth Layer - 4 ½' of a **tan, silty SAND (SM)**

Bottom Layer - 1 ½' of a **gray-tan, silty SAND (SM)** with gravel.

Fines (Minus #200) - 38.0% (SM materials)

Plasticity Indies - NP (SM materials)

A Standard Proctor was performed in the laboratory to determine the moisture density relationship of the material. For Boring No. 2, an SC-SM material with depth from 0 to 8' below existing grade, resulted a maximum dry density of 120.6 pcf at an optimum of 12.5. Consolidation tests and Percent Swell tests were performed for Boring No. 1, a CL-ML material, with depth from 12' to 13' below grade and for Boring No. 2, an SM material, with depth from 25' - 26½' below existing grade. The consolidation test for the CL-ML resulted only 3.5% consolidation was observed when a load of 18000 psf was applied. For the SM material, 8% consolidation was observed when the load of 18000 psf was applied. A percent swell of less than one was obtained for the same borings. The in-situ dry unit weights obtained for Boring #2 at depths of 15 to 16 feet below grade and at depths from 25 to 26½ feet below grade, were 118.1 pcf and 91.3 pcf, respectively. A Direct Shear test was performed for Boring No. 2, a CL material, with depth from 15 to 16 feet below grade and obtained an internal friction angle of 51.

e) **Boring No. 5, BID Canal Overchute**

Top Layer - 7½' of a **silty, SAND (SM)**

Bottom Layer - 42.5' of a **gray-tan, poorly graded GRAVEL (GP)**

Fines (Minus #200) - 3.4% to 3.8% (GP material)

Plasticity Indices - NP (GP material)

"N" values - 24 blows/foot to 100+ blows/foot (GP material)

f) **Boring No. 6 - BID Canal Overchute**

Top Layer	-	20½' deep of alternating layers of a **brown, lean CLAY and a brown, sandy SILT (ML)** material.
Bottom Layer	-	30' of a **gray, poorly graded GRAVEL (GP)**
Fines (Minus #200)	-	61.2% to 93.2%
Plasticity Indices	-	NP to 17 (CL material)
"N" values	-	12 blows/foot to 27 blows/foot (CL material)
	-	3 blows/foot (ML material)
	-	29 blows/foot to 100+ blows/foot (GP)

A Standard Proctor analysis was performed for Boring No. 6, a CL material from 0 to 7 feet below grade. The maximum dry density obtained was 101.3 pcf at an optimum moisture content of 22.3%. A Consolidation test, Percent Swell test, and an In-situ Dry Unit Weight test, were performed For Boring No. 5, a GP material, with depth from 20 to 21 ½ feet below grade. The consolidation test indicated that the material consolidated 6% when 18000 psf load was applied. The material did not swell after 24 hours at a 100 psf surcharge. The in-situ dry unit weight result was 96.0 pcf.

7.0 DISCUSSIONS AND RECOMMENDATIONS

Phoenix is in Seismic Zone 1 a. A brief study of the literature indicates that the recurrence interval of major earthquakes are relatively long. In this part of the United States, the sources of damage producing earth quakes are:

1. Transition zone, between the Colorado Plateau and the Basin and Range Physiographic Provinces.
2. Earthquakes originating from the southern extension of the San Andreas fault system in Imperial Valley, California. Maximum ground acceleration generated is 0.1 g.
3. The Verde fault, Big Chino fault, and Safford fault are capable of producing a horizontal ground acceleration of less than 0.08.g.

7.1 Subsurface Soil Data Discussion

The subsoil is represented by Boring Nos. 1 through 4. Lean and sandy-silty clays comprise several layers from the surface to a depth of about 15 feet below grade. The material exists in a medium dense condition, with higher densities in a layer 12 to 17 feet below grade. Laboratory consolidations were less than 3% at loading s of 1.5 tsf.

Ground water was encountered between 33 and 38 feet below grade at the time of drilling on November 3 and September 18, 1997.

7.2 Foundation Design - MC 85 Bridge

The following loading information was provided by Sverdrup for this structure that spans over the proposed new channel:

Support Configuration:

2 Abutments and 2 Piers

Distance between Pier and Abutment	-	28.5'
Distance between Piers	-	35.0'
Bridge Width	-	109'

Reaction Loads:

Pier Dead Load	-	11.3 kips/ft of wall 1 foot thick
Pier Live Load	-	5.2 kips/ft of wall (Excludes Impact Loads)
Abutment Dead Load	-	6.0 kips/ft of wall 1 foot thick
Abutment Live Load	-	3.8 kips/ft of wall

Bridge Pavement:

Continuous Portland Cement Concrete Slab

Allowable Settlement:

Total and Differential Settlements no greater than 0.5 inches.

Design Parameters

If a spread footing is constructed, then the excavated material may be used as backfill behind the abutments to within 3 feet of the surface. The following data is relative to equivalent fluid pressures created by this fill on the abutment wall:

Angle of Internal Friction	-	34°
Active Pressure	-	33 psf
Passive Pressure	-	407 psf

At Rest Pressure	-	51 psf
Average Unit Weight	-	115 pcf
Coefficient of Cohesion	-	120 psi

It is our understanding that the abutments and the piers will be constructed of concrete in a continuous wall for the entire bridge width of 109 feet.

Therefore, the following values were determined for this structure, with the bottom of the concrete foundation 15 feet below grade, but as a minimum, below the channel bottom elevation.

Piers

Allowable Bearing Capacity	-	3900 psf maximum
Maximum Settlement	-	0.47 inches
Footing Width	-	11 feet minimum
Founding Soil	-	Re-compacted Native

Abutments

Allowable Bearing Capacity	-	3900 psf maximum
Maximum Settlement	-	0.44 inches
Footing Width	-	11 feet minimum
Founding Soil	-	Re-compacted Native

7.3 Foundation Design - Over-Chute Bridge

The north bank of the Buckeye Irrigation District (BID) canal is approximately 4000 feet south of the MC 85 bridge. While the soil lenses are similar, the measured water table elevation at the time of drilling was higher.

The purpose of the over-chute is to transport the water collected by the new Bullard Wash Channel over the existing BID canal. In order to accomplish this goal and to also maintain service access to the BID, the design will include the following:

- Transition from a natural channel bottom and gabion side slopes to a concrete section as the channel approaches the BID from the north.
- Either a pre-cast or constructed-in-place concrete aqueduct section that will span the BID.

- The construction of a box culvert south of the BID to allow the Bullard Wash Channel to flow under a new service road that will be constructed to maintain access to the BID.

There are several types of foundations that may be utilized to support the abutments used to support the channel over-chute structure. A shallow spread footing or mat foundation is a consideration. However, good practice dictates that the footings or pier tips be founded below the invert of the BID Canal. Due to the presence of clay and silt lenses in the area of Boring No. 6 at depths of up to 20.5 feet below grade, it is more advisable to construct drilled caissons to a tip depth of approximately 21 feet below grade. We considered "belled" caissons with a bottom at approximately 15 feet below grade, but in the vicinity of Boring No. 5, the soil layer at that depth consisted of a poorly graded gravel. This material would not maintain the bell shape and would probably "slough" during construction. Therefore, the following parameters are provided for 3-foot diameter piers:

Allowable Bearing Capacity	-	6000 psf maximum
Maximum Settlement	-	0.45 inches
Pile Diameter	-	4 feet
Founding Soil	-	20 feet Below Grade Sand and Gravel
N value	-	24 blows/ft
Minimum Embedment	-	9 feet
Friction Angle Between Pile and Soil	-	30°
K_{HT}	-	0.5
K_{HC}	-	1.0
N_q	-	72
Soil Density Above Water	-	110 pcf Clay 125 pcf Gravel
Soil Density Below Water	-	63 pcf Gravel
Pile Spacing	-	3 Pile Diameters, center-to-center
Assumed Load Per Pile	-	100 Kips

8.0 GENERAL CONSTRUCTION RECOMMENDATIONS

The following sections provide suggested recommendations for the various materials that will be used in the construction of the two (2) bridges.. In general, the standard specifications available from the Maricopa Association of Governments (MAG) will be referenced and in some cases, re-stated. For a few cases, a change in the standard specifications will be suggested and the change presented for insertion in the contract special provisions.

8.1 Embankment

On-site sources of material will be used to construct the berms proposed for the Over-chute structure and ramps to the existing BID service road. Standard proctor tests (ASTM D 698) will be required on this material to insure that 95% compaction, at a moisture content within 2% of optimum, is achieved during construction. Only mechanical compaction methods may be utilized; no water settling will be permitted.

8.2 Borrow

If off-site borrow is required to complete the construction of the embankment, it should conform to the following requirements of MAG 702, Type B.

8.3 Portland Cement Concrete

Two (2) types of portland cement concrete (pcc) are proposed for this project. The concrete for the piles should be equivalent to a MAG Class AA, minimum 4000 psi 28-day compressive strength. The contractor should use a super-plasticizer during placement to produce a "flowable" mix that will consolidate completely with minimum use of vibrators. Flyash substitution should not be allowed. A mix design must be submitted for approval prior to use on this project. The mix design should show 3-day breaks, as well as 7 and 28-day breaks.

A standard MAG Class B concrete may be used for miscellaneous concrete construction. No additives are required but may be used for the contractor's convenience. A mix design for this concrete must also be submitted for approval prior to use on the project.

8.4 Pipe Bedding

If drain pipes are to be constructed ,the native subgrade must be compacted to 100% of a standard proctor maximum dry density, within 2% of the optimum moisture content. Twelve (12) inches of bedding material, conforming to the following specification should be compacted to the same requirement as the subgrade.

Sieve Size	Percent Passing
1½"	100
1"	90 - 100
No. 8	35 - 80
No. 200	0 - 8

Plasticity Index ≤ 8
$6.0 \leq pH \leq 9.0$
Resistivity ≥ 2000 ohms/cm^3

9.0 ADDITIONAL SERVICES

It is recommended that the Geotechnical Engineer, ATL, be retained to provide a general review of final design plans and specifications in order to confirm that site preparation and foundation construction recommendations have been interpreted and implemented as intended by the design. In the event that any changes of the proposed project are planned, the conclusions and recommendations contained in this report should be reviewed and the report modified or supplemented as necessary.

The Geotechnical Engineer may also be retained to provide testing services during excavation, grading, and bridge substructure construction phases of the work. Construction testing, including field and laboratory evaluation of backfill and concrete for caisson construction should be performed by a competent, certified laboratory to determine whether applicable project requirements have been met. ATL, Inc. is highly qualified to provide these additional services.

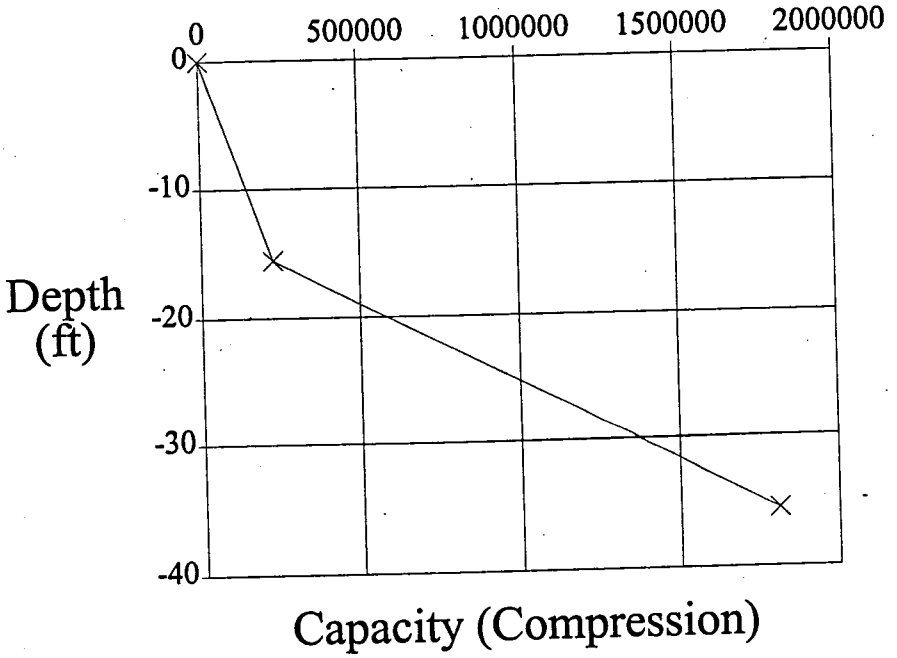
The analyses and recommendations in this report are based in part upon data obtained from the field exploration. The nature and extent of variations beyond the location of test borings may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of this report.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers

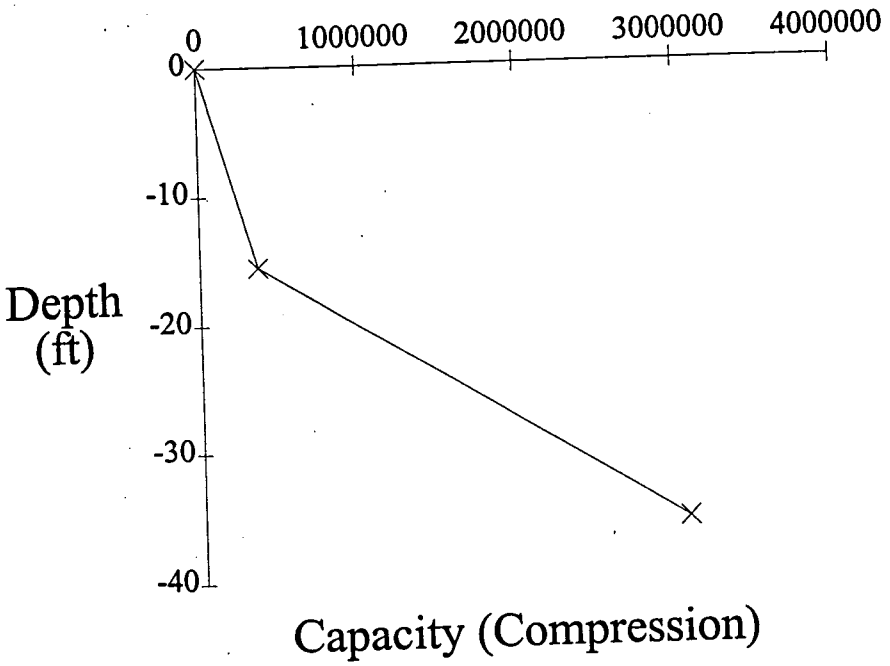
practicing in this or similar localities. No warranty, express or implied, is made. We prepared the report as an aid in design of the proposed project. This report must draw his own conclusions regarding site conditions and specific construction techniques to be used on this project.

This report is for the exclusive purpose of providing geotechnical engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken.

Pile Capacity (Comp.) vs. Depth,3' Dia



Pile Capacity (Comp.) vs. Depth, 4' Dia



PLATES

GUIDELINES IN THE USE AND INTERPRETATION

OF THIS GEOTECHNICAL REPORT

ATL Job No.196020-2

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.

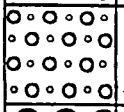
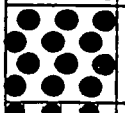
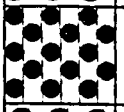
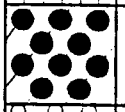
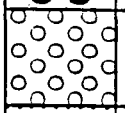
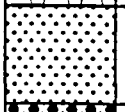
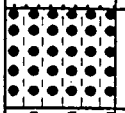
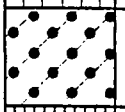
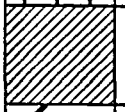
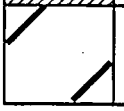
The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change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

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 thumbnail.
30 +	Hard	Indented only with difficulty by thumbnail.

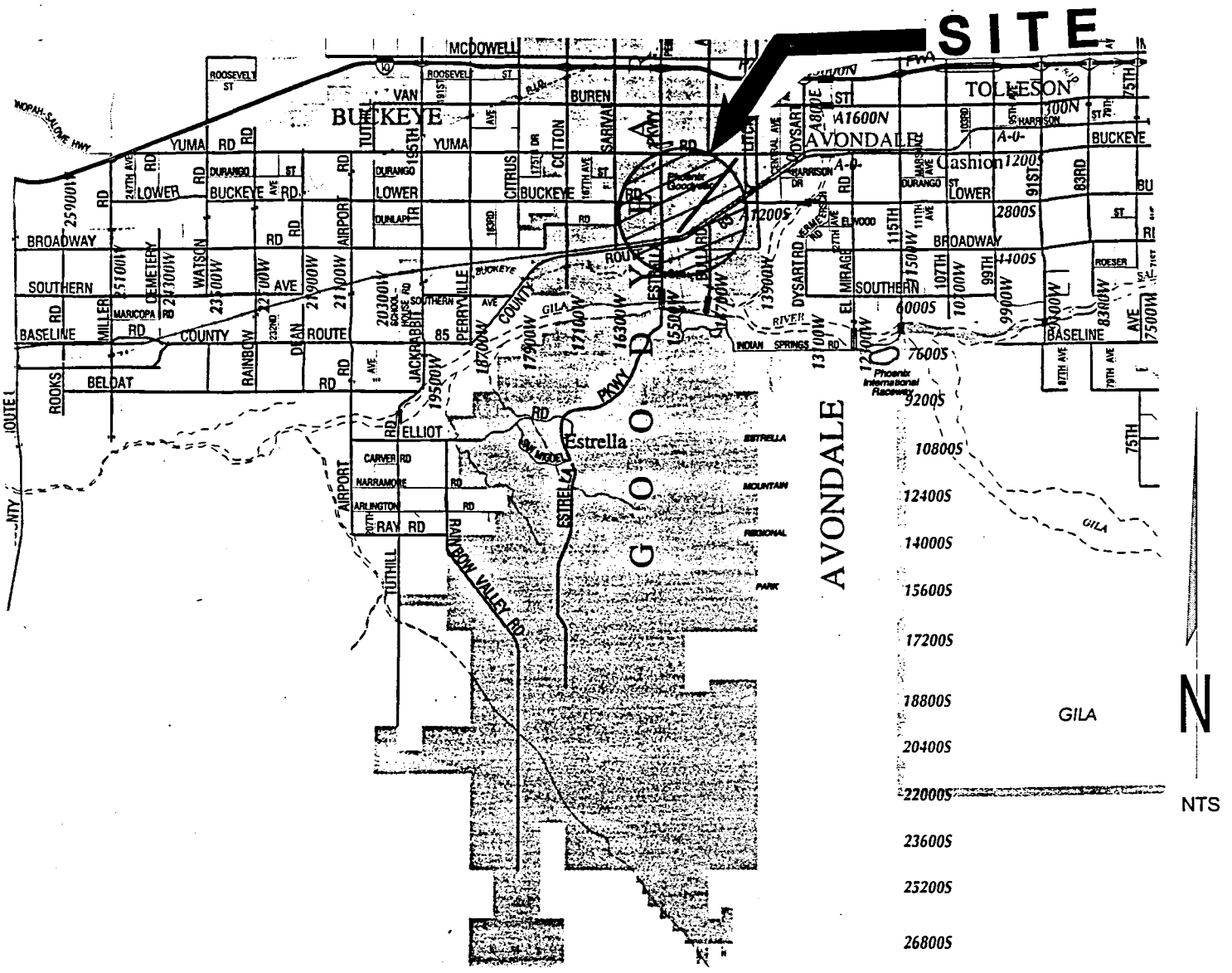
3. Relative Firmness. Terms for description of partially saturated and / or cemented soils which commonly occur in the Southwest including clays, cemented granular materials silts and silty and clayey granular soils.

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



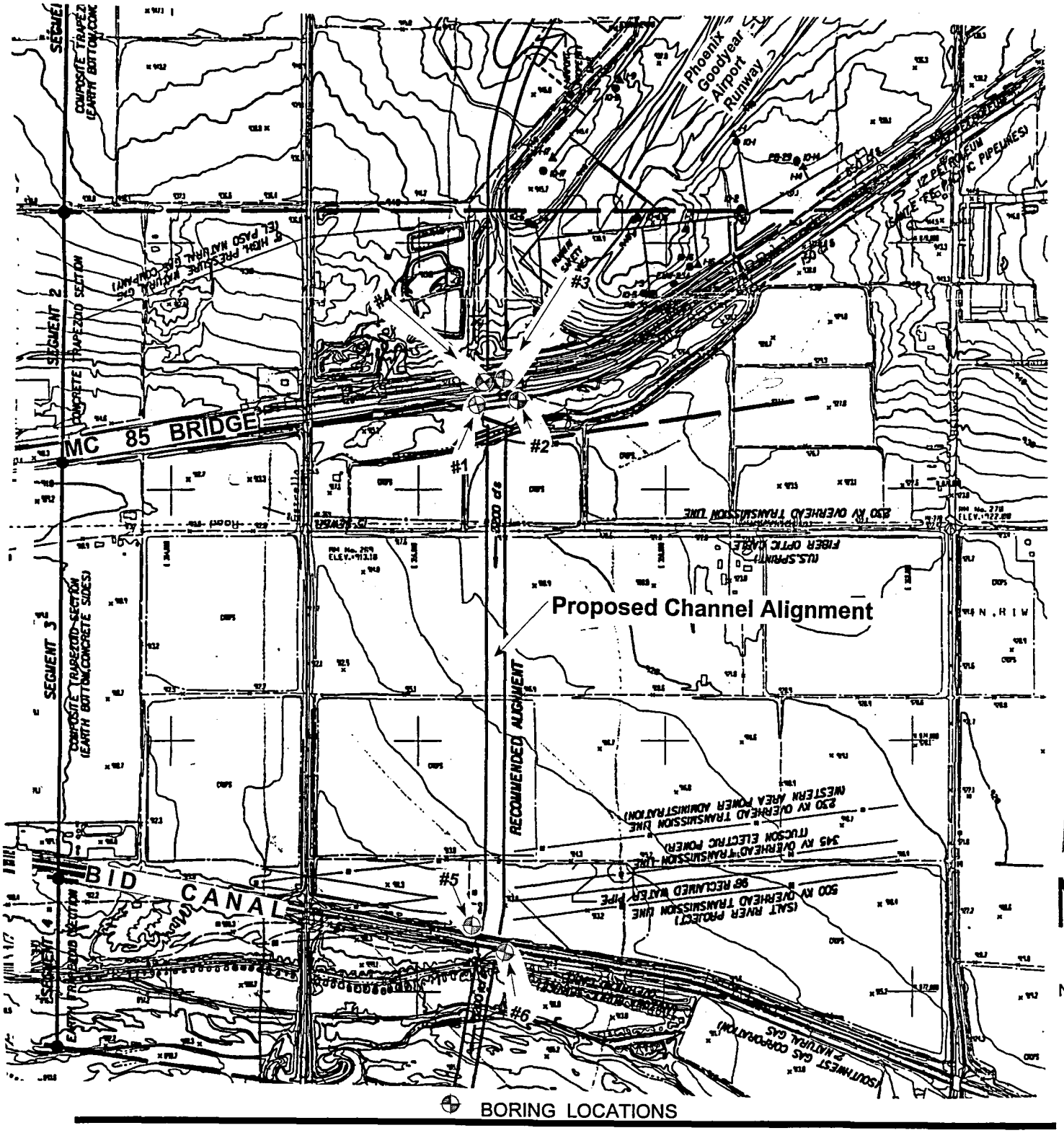
VICINITY MAP

BULLARD WASH - BRIDGES

Goodyear, Arizona

ATL JOB NO. 196020-2

PLATE 3



BORING LOCATIONS

BULLARD WASH - BRIDGES

Goodyear, Arizona

ATL JOB NO. 196020-2

PLATE 4

APPENDIX A

BORING LOGS

BULLARD WASH - MC 85 BRIDGE
Goodyear, Arizona

ATL Job No. 196020-2

Boring No.: 1

Boring Location: *46 feet Left Channel centerline Sta 73+42*

Boring Equipment: *Mobile B-50 with 8 - Inch diameter hollow stem auger*

Date of Boring: *9-18-97* **Elevation of Boring:** *921.0*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
		Brown, silty, clayey, SAND(SC-SM), Moist				
		Brown, lean CLAY(CL), Moist				
		Brown, sandy, silty CLAY(CL-ML), Moist	*16*	*60*	*56.2*	*7*
	15	*Brown, lean CLAY(CL)*	*45*			
		Gray-tan, poorly graded SAND(SP), Moist	*19*			
			18		*4.5*	*NP*
	30		*18*			
		Brown silty, clayey SAND(SC-SM), Moist *Note: change to 4" dia auger*				
		Gray-Tan, poorly graded SAND (SP), wet *Water at 38.3'* ▽				
	45					
	60					
	75	*(Bottom of Boring at 75 feet)*				

Boring Stopped at 75 Feet below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	38.3		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A1

BULLARD WASH - MC 85 BRIDGE
Goodyear, Arizona

ATL Job No. 196020-2

Boring No.: 2

Boring Location: *Sta 73+43, 50 feet right of channel centerline*

Boring Equipment: *Mobile B-50 with 8 - Inch diameter hollow stem auger*

Date of Boring: *9-17-97* **Elevation of Boring:** *921.0*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	Brown, silty, clayey SAND(SC-SM), Moist			*46.5*	*6*
			18		
	Brown, lean CLAY(CL), Moist	*18*			
		19			
15					
	Moist increase to very moist	*29*	*44*	*80.6*	*11*
	Gray-tan, silty SAND(SM), Moist	*18*		*14.5*	*NP*
			24		
		15			
30		*16*			
	Brown, silty, clayey SAND(SC-SM), Moist				
	Brown silty CLAY(CL-ML), very moist	*15*			
	Water at 38.3' ▽				
	Gray-Tan, silty SAND (SM)				
	Brown, silty, clayey SAND(SC-SM),	*5*			
	Gray-Tan, silty SAND(SM)				
45		*14*			
		17			
		75			
	(Bottom of Boring at 56 ½ feet)				
60					
75					

Boring Stopped at 56 ½ Feet below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A2

BULLARD WASH - MC 85 BRIDGE
Goodyear, Arizona

ATL Job No. 196020-2

Boring No.: 3

Boring Location: *17 ½ feet Rt.(East) of Channel centerline Sta 74+00*

Boring Equipment: *Mobile B-50 with 8 - Inch diameter hollow stem auger*

Date of Boring: *11/3/97* **Elevation of Boring:** *921.5*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
		Brown, silty SAND(SM) with gravel, Moist	7			
			17	27		
	15	*Brown, lean CLAY(CL), Moist*	28			
				47		
			14		88.0	25
			16			
		Gray-tan, silty SAND(SM) with trace of gravel, Moist,				
	30		18			
		Water at 33.3'				
			14			
		(Bottom of Boring at 37 feet)				
	45					
	60					
	75					

Boring Stopped at 37 Feet below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	33.3		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A3

BULLARD WASH - MC 85 BRIDGE
Goodyear, Arizona

ATL Job No. *196020-2*

Boring No.: 4

Boring Location: *17 ½ feet Lt.(West) of Channel centerline Sta 73+99*

Boring Equipment: *Mobile B-50 with 8 - Inch diameter hollow stem auger*

Date of Boring: *11/3/97* **Elevation of Boring:** *921.5* **Driller:** *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
		Brown, silty SAND(SM) with gravel, Moist				
			8			
			19			
	15	*Light brown, silty SAND(SM), damp*	*36*		*38.0*	*NP*
			18			
		Brown, lean CLAY (CL), Moist				
			17			
		Tan, silty SAND(SM), damp				
	30	*Gray-tan, silty SAND(SM) with some gravel, Moist*	*20*			
		(Bottom of Boring at 32 feet)				
	45					
	60					
	75					

Boring Stopped at 32 Feet below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

BULLARD WASH - BID CANAL OVERCHUTE
Goodyear, Arizona

ATL Job No. 196020-2

Boring No.: 5

Boring Location: Channel Sta 30+60, 40 feet Left centerline North Bank BID Canal

Boring Equipment: Mobile B-50 with 8 - Inch diameter hollow stem auger

Date of Boring: 9-18-97 **Elevation of Boring:** 913.0 **Driller:** J. Cowell **Logger:** J. Cowell **Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
		Brown, silty SAND(SM), interbeded with gray-tan siltySAND (SM)	12			
	10	Gray-Tan, poorly graded GRAVEL(GP)		25		
			24		3.8	NP
		Trace of gravel				
		with gravel , Moist	24			
	20			19	3.4	NP
		Water at 22.3'	25			
			50 / 5"			
	30		39			
			11			
	40		33			
		Increasing % of gravel				
	50	(Bottom of Boring at 50 feet)				

913
2
1
89

Boring Stopped at 50 Feet below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	22.3'		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A5

BULLARD WASH - BID CANAL OVERCHUTE
Goodyear, Arizona

ATL Job No. 196020-2

Boring No.: 6

Boring Location: Channel Sta 29+60, 40 feet Right centerline North Bank BID Canal

Boring Equipment: Mobile B-50 with 6 - Inch diameter hollow stem auger

Date of Boring: 9-19-97 **Elevation of Boring:** 910.0 **Driller:** J. Cowell **Logger:** J. Cowell **Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
		Brown, lean CLAY(CL), Moist			93.2	17
			27			
		Gray-Tan sandy SILT(ML), Moist				
	10					
			12		61.2	NP
		Brown, lean CLAY(CL), Wet				
		Gray-Tan sandy SILT(ML), Moist				
			3			
		Brown, lean CLAY(CL), Wet				
	20		30			
		Gray, poorly graded GRAVEL(GP) Water at 22.35'				
			18			
	30					
			66			
			29			
	40		47			
			38			
		With gravel				
	50		50/6"			
		(Bottom of Boring at 50 ½ feet)				

Boring Stopped at 50 ½ Feet below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	22.3'		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

APPENDIX B
LABORATORY TEST RESULTS

SUMMARY OF LABORATORY ANALYSIS

CLIENT: SVERDRUP CIVIL, INC. DATE: 10/10/97

PROJECT: BULLARD WASH - MC 85 BRIDGE AND BID CANAL OVERCHUTE

LOCATION: GOODYEAR, ARIZONA

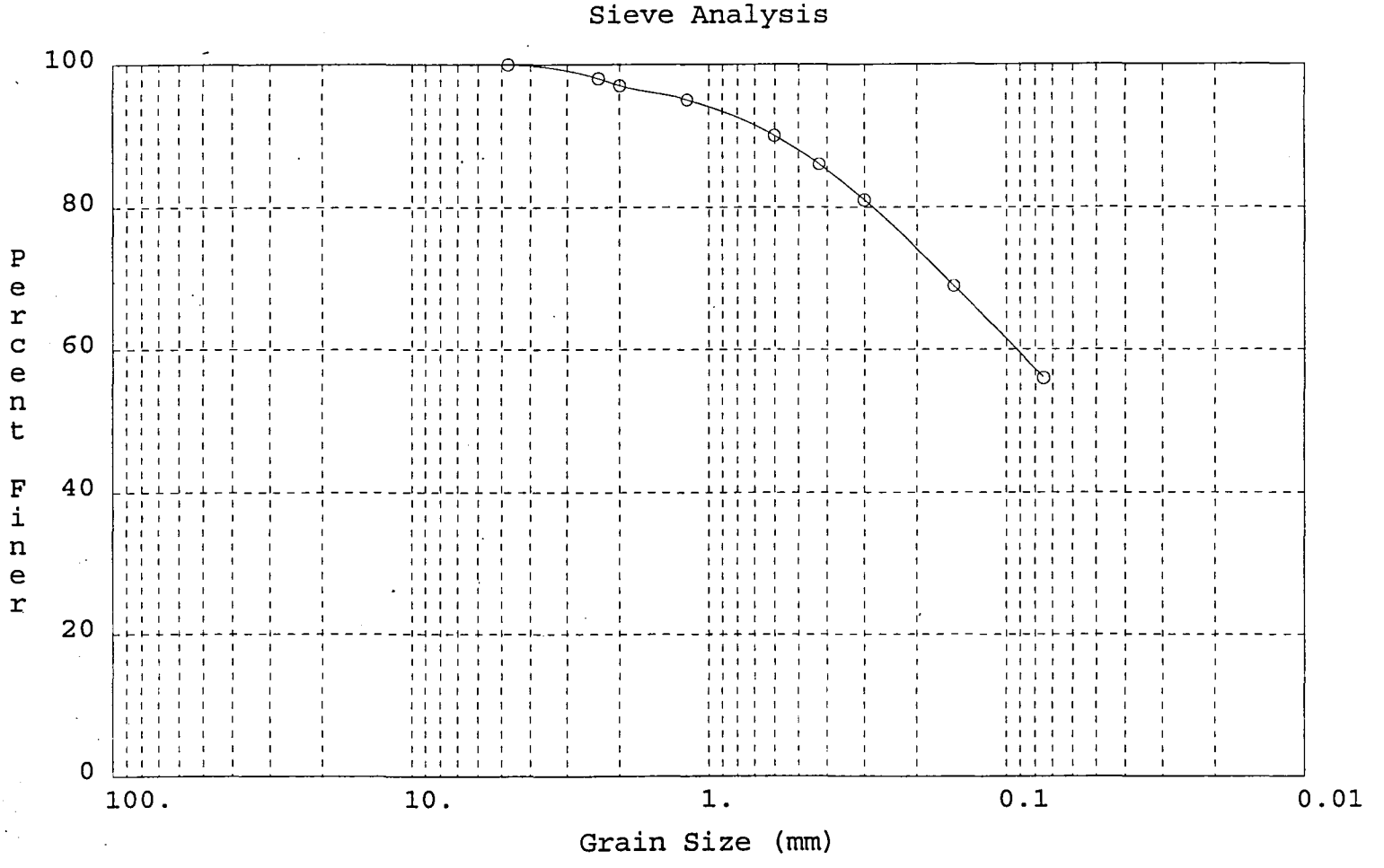
MATERIAL: See Below SAMPLING DATE: 09/18/97

REQUESTED BY: David Hayes ATL JOB NO: 196020-2

BORING No.	DEPTH (FT)	MOIST (%)	USCS	LL	PI	SIEVE ANALYSIS - PERCENT PASSING											
						200	100	50	40	30	16	10	4	3/8	1.5	3	2
1	9 - 11 ½	11.8	CL - ML	26	7	56.2	69	81	86	90	95	97	100	-	-	-	-
1	30 - 31 ½	4.0	SP	-	NP	4.4	8	26	40	61	83	87	88	90	93	100	-
2	0 - 8	8.3	SC - SM	25	6	46.5	56	70	76	81	86	88	91	93	94	100	-
2	15 - 16	20.1	CL	33	11	80.6	85	89	91	93	96	98	100	-	-	-	-
2	25 - 26 ½	7.7	SM	-	NP	14.5	28	56	74	92	99	100	-	-	-	-	-
5	11 ½ - 13	6.0	GP	-	NP	3.8	10	54	81	94	98	99	100	-	-	-	-
5	20 - 25	13.3	GP	-	NP	3.4	5	13	23	38	56	60	62	69	86	96	100
6	0 - 7	8.2	CL	40	17	93.2	96	98	99	99	100	-	-	-	-	-	-
6	15 - 16 ½	26.3	ML	-	NP	61.3	85	98	99	100	-	-	-	-	-	-	-
3	21 ½ - 23	19.5	CL	49	25	88.0	90	91	92	93	94	96	98	100	-	-	-
4	15 - 16 ½	11.0	SM	-	NP	38.0	49	70	78	84	92	95	98	100	-	-	-

Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, MC 85 Bridge
Date = 9/24/97
Tested By = M. Blalock
Boring Number = 1
Depth = 9' - 11 1/2'
Sample Number = 97-0768
Description = Brown, sandy, silty CLAY(CL-ML)
Dry Sample Weight (g) = 1000

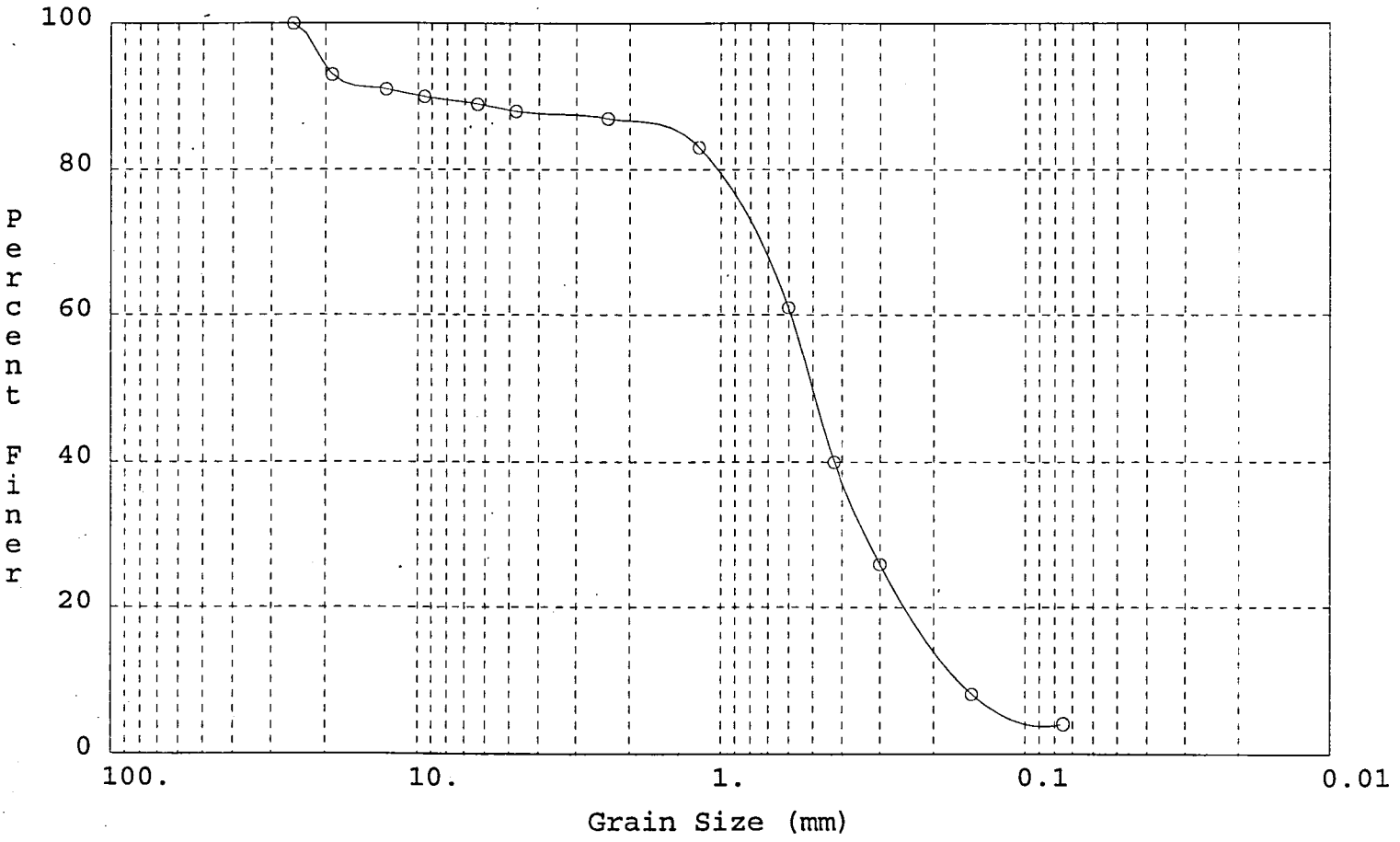
SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#4	4.750	0.00	0.00	0.00	100.00
#8	2.360	20.00	2.00	2.00	98.00
#10	2.000	10.00	1.00	3.00	97.00
#16	1.180	20.00	2.00	5.00	95.00
#30	0.600	50.00	5.00	10.00	90.00
#40	0.425	40.00	4.00	14.00	86.00
#50	0.300	50.00	5.00	19.00	81.00
#100	0.150	120.00	12.00	31.00	69.00
#200	0.075	130.00	13.00	44.00	56.00
Pan	0.000	0.00	0.00	44.00	56.00



Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, MC 85 Bridge
Date = 9/24/97
Tested By = M. Blalock
Boring Number = 1
Depth = 30' - 31 1/2'
Sample Number = 97-0769
Description = Gray-tan, Poorly graded SAND(SP)
Dry Sample Weight (g) = 1000

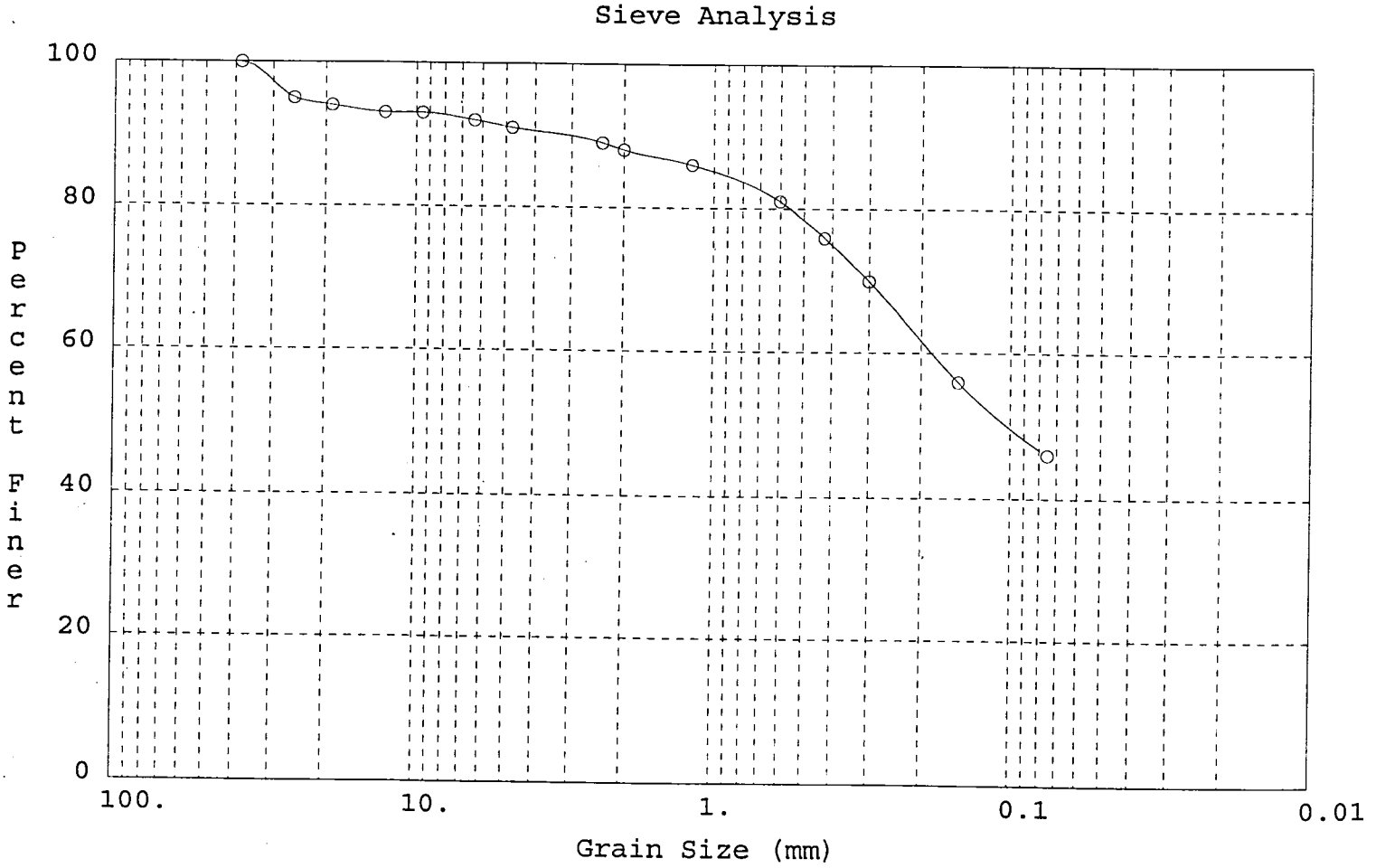
SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
1"	25.400	0.00	0.00	0.00	100.00
3/4"	19.050	70.00	7.00	7.00	93.00
1/2"	12.700	20.00	2.00	9.00	91.00
3/8"	9.500	10.00	1.00	10.00	90.00
1/4"	6.350	10.00	1.00	11.00	89.00
#4	4.750	10.00	1.00	12.00	88.00
#8	2.360	10.00	1.00	13.00	87.00
#16	1.180	40.00	4.00	17.00	83.00
#30	0.600	220.00	22.00	39.00	61.00
#40	0.425	210.00	21.00	60.00	40.00
#50	0.300	140.00	14.00	74.00	26.00
#100	0.150	180.00	18.00	92.00	8.00
#200	0.075	40.00	4.00	96.00	4.00
pan	0.000	0.00	0.00	96.00	4.00

Sieve Analysis



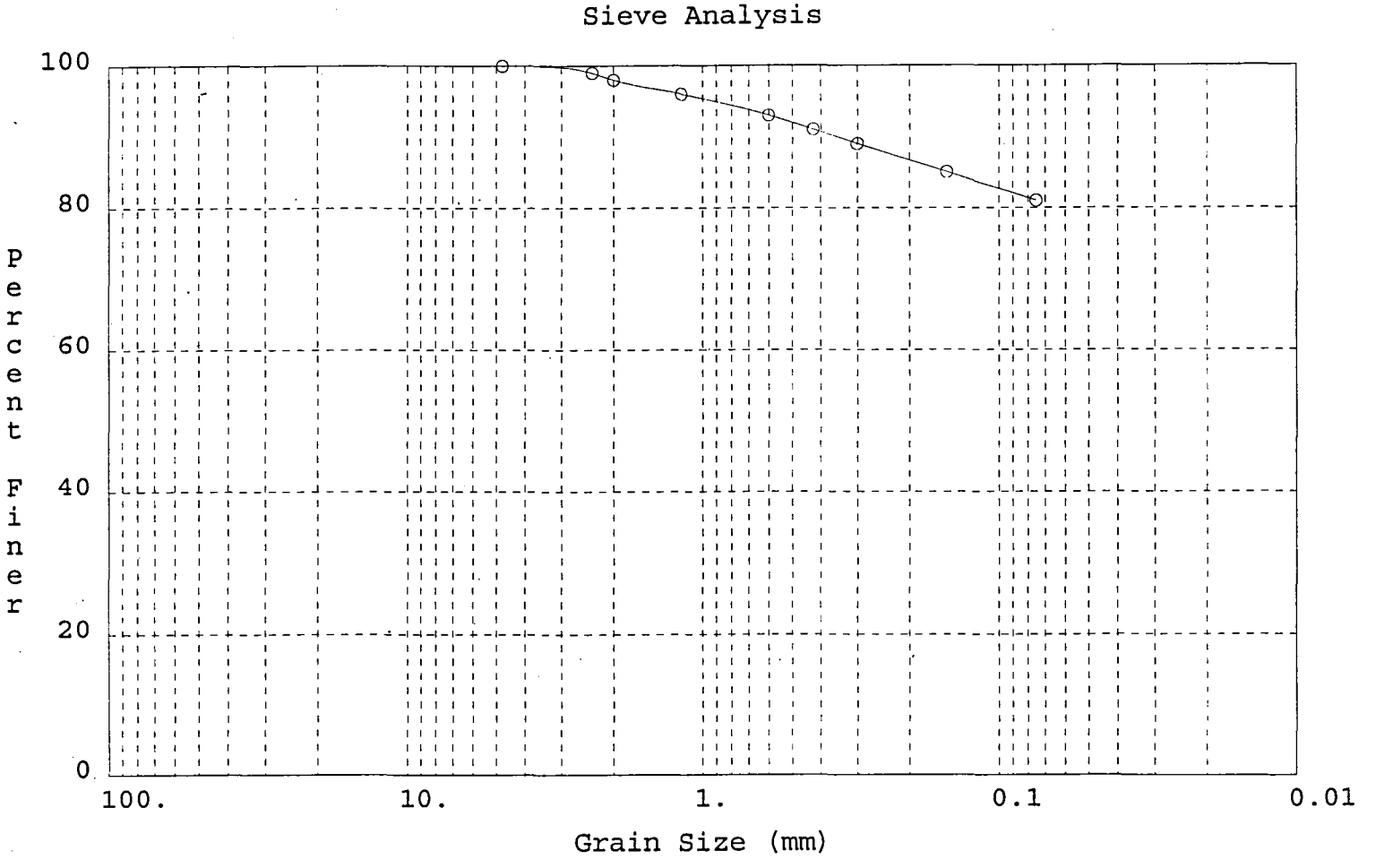
Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, MC 85 Bridge
Date = 9/24/97
Tested By = M. Blalock
Boring Number = 2
Depth = 0 - 8'
Sample Number = 97-0771
Description = Brown, silty, clayey SAND(SC-SM)
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
1 1/2"	38.100	0.00	0.00	0.00	100.00
1"	25.400	50.00	5.00	5.00	95.00
3/4"	19.050	10.00	1.00	6.00	94.00
1/2"	12.700	10.00	1.00	7.00	93.00
3/8"	9.500	0.00	0.00	7.00	93.00
1/4"	6.350	10.00	1.00	8.00	92.00
#4	4.750	10.00	1.00	9.00	91.00
#8	2.360	20.00	2.00	11.00	89.00
#10	2.000	10.00	1.00	12.00	88.00
#16	1.180	20.00	2.00	14.00	86.00
#30	0.600	50.00	5.00	19.00	81.00
#40	0.425	50.00	5.00	24.00	76.00
#50	0.300	60.00	6.00	30.00	70.00
#100	0.150	140.00	14.00	44.00	56.00
#200	0.075	100.00	10.00	54.00	46.00
Pan	0.000	0.00	0.00	54.00	46.00



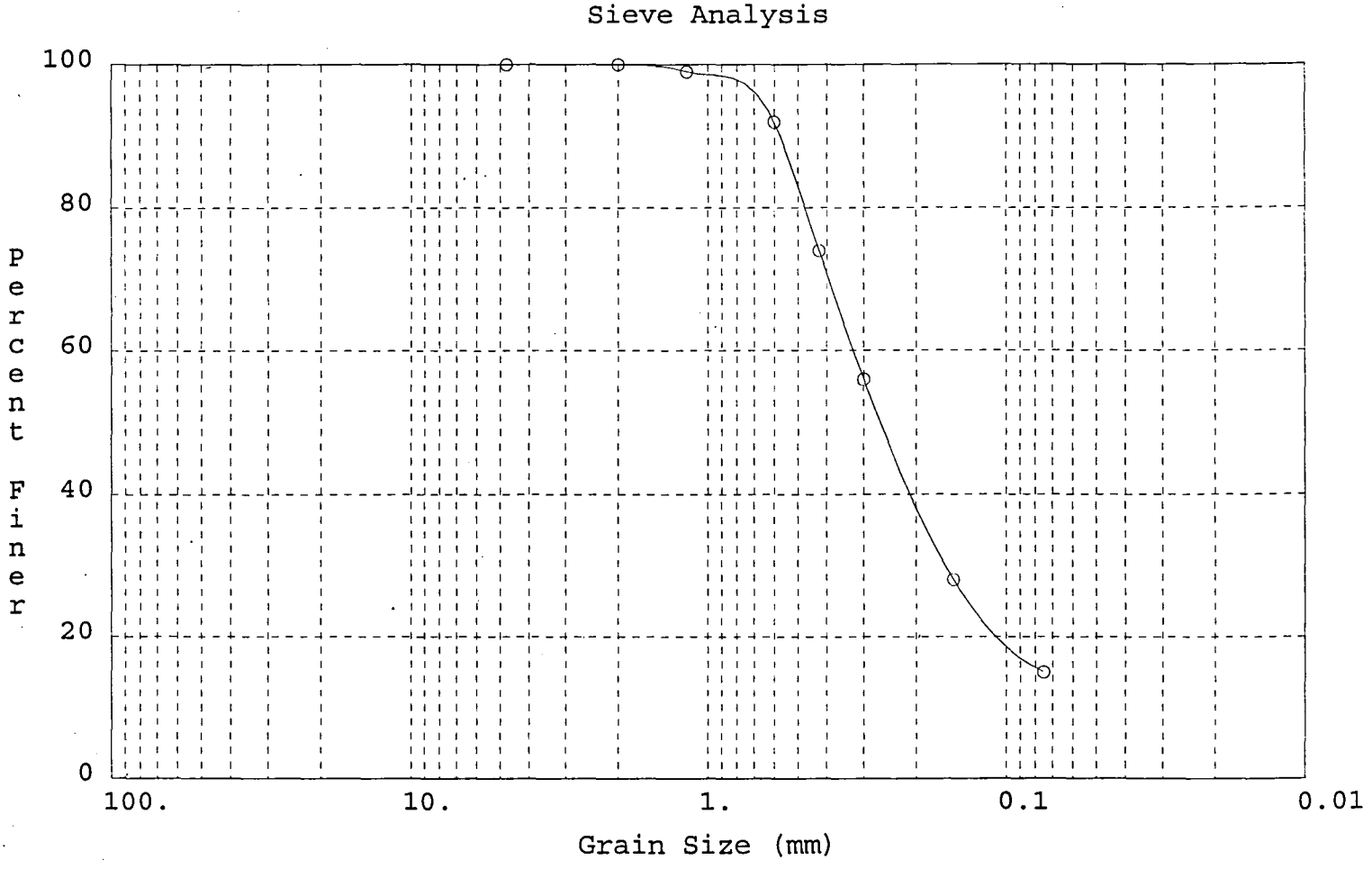
Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, MC 85 Bridge
Date = 9/24/97
Tested By = D. Johnson
Boring Number = 2
Depth = 15' - 16'
Sample Number = 97-0772
Description = Brown, lean CLAY(CL)
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#4	4.750	0.00	0.00	0.00	100.00
#8	2.360	10.00	1.00	1.00	99.00
#10	2.000	10.00	1.00	2.00	98.00
#16	1.180	20.00	2.00	4.00	96.00
#30	0.600	30.00	3.00	7.00	93.00
#40	0.425	20.00	2.00	9.00	91.00
#50	0.300	20.00	2.00	11.00	89.00
#100	0.150	40.00	4.00	15.00	85.00
#200	0.075	40.00	4.00	19.00	81.00
Pan	0.000	0.00	0.00	19.00	81.00



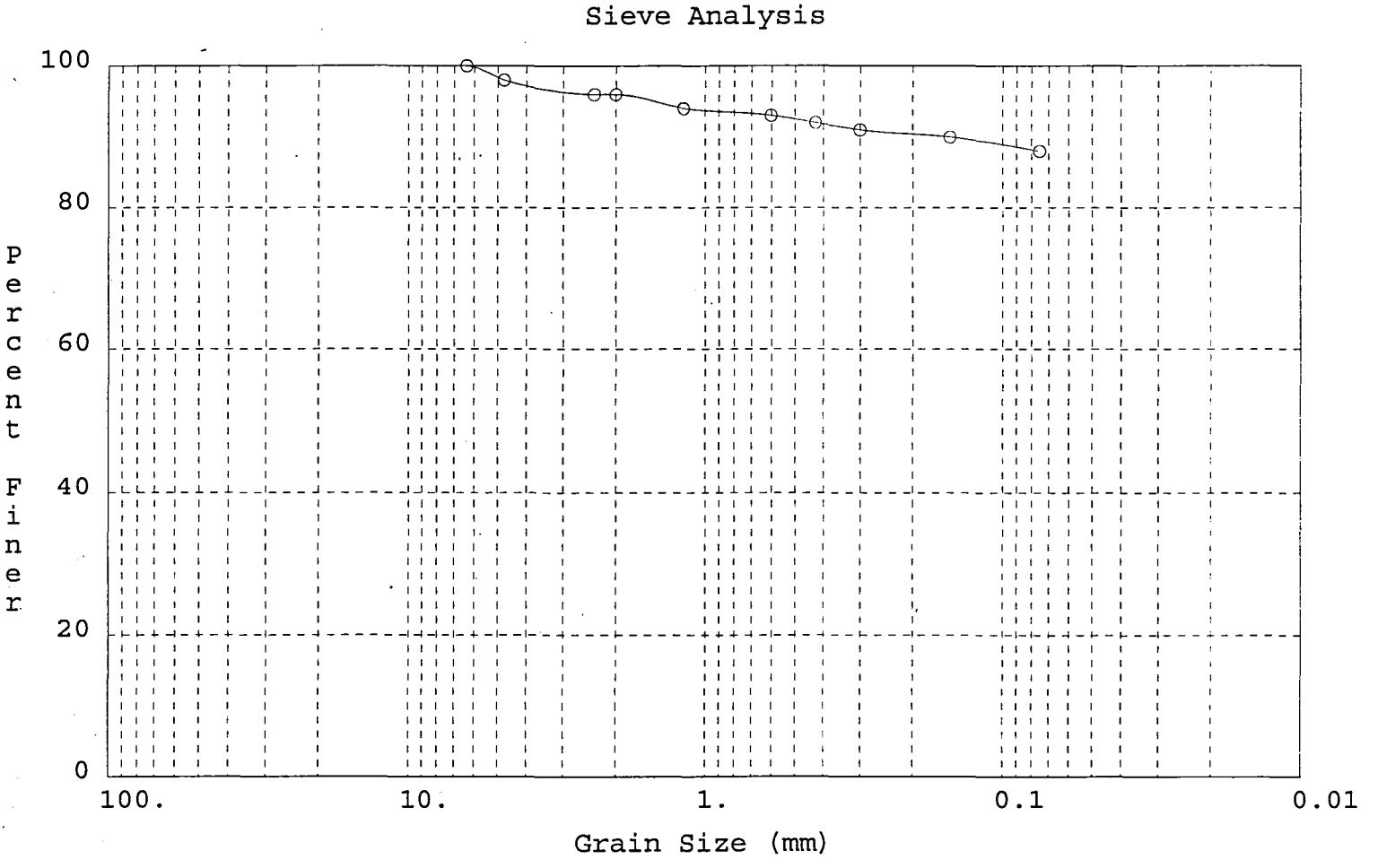
Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, MC 85 Bridge
Date = 9/23/97
Tested By = D. Johnson
Boring Number = 2
Depth = 25' - 26 1/2'
Sample Number = 97-0774
Description = Gray-tan, silty SAND(SM)
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#4	4.750	0.00	0.00	0.00	100.00
#10	2.000	0.00	0.00	0.00	100.00
#16	1.180	10.00	1.00	1.00	99.00
#30	0.600	70.00	7.00	8.00	92.00
#40	0.425	180.00	18.00	26.00	74.00
#50	0.300	180.00	18.00	44.00	56.00
#100	0.150	280.00	28.00	72.00	28.00
#200	0.075	130.00	13.00	85.00	15.00
Pan	0.000	0.00	0.00	85.00	15.00



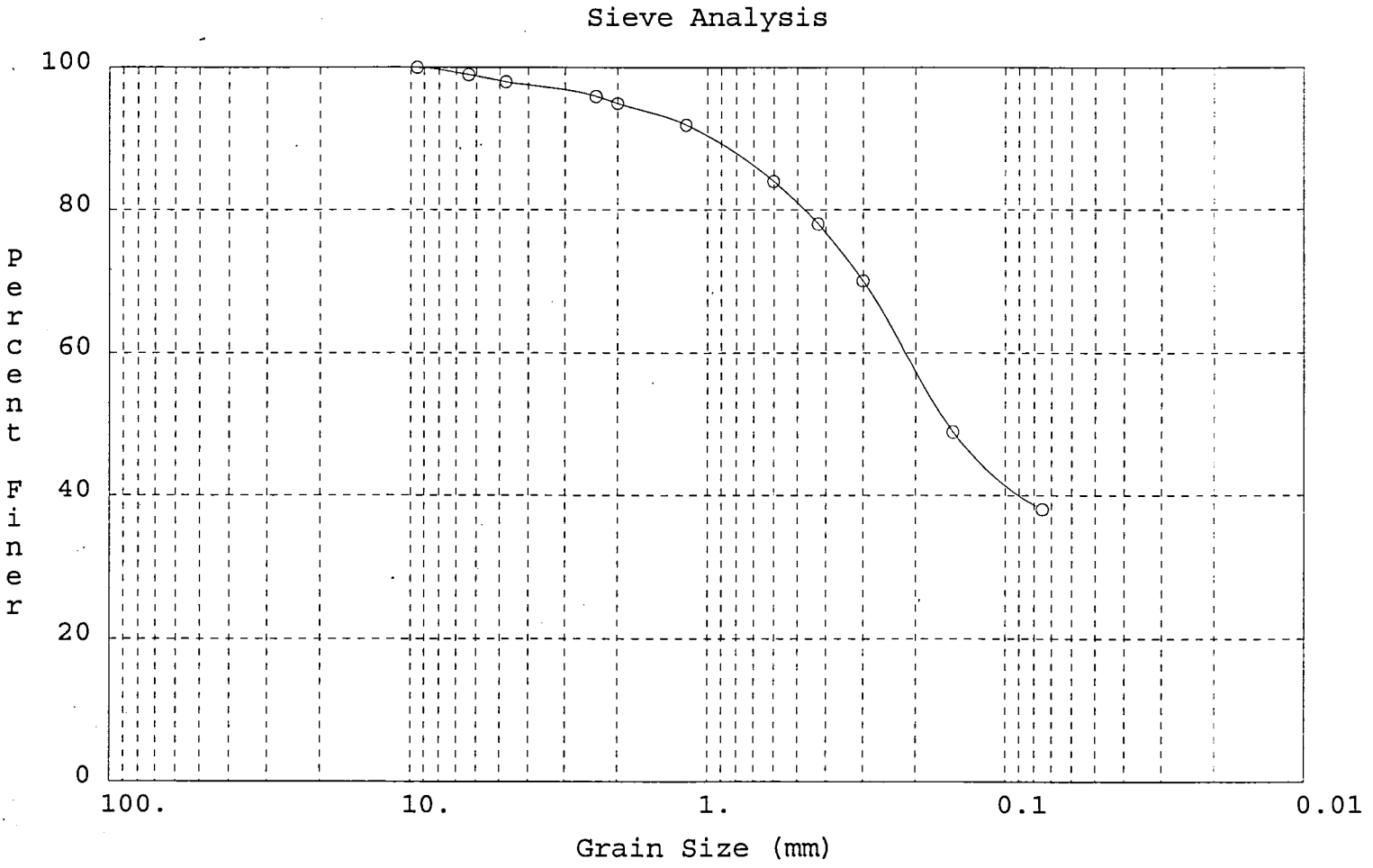
Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, MC 85 Bridge
Date = 11/04/97
Tested By = D. Johnson
Boring Number = 3
Depth = 21 1/2' - 23'
Sample Number = 97-0955
Description = Brown, lean CLAY(CL)
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
1/4"	6.350	0.00	0.00	0.00	100.00
#4	4.750	20.00	2.00	2.00	98.00
#8	2.360	20.00	2.00	4.00	96.00
#10	2.000	0.00	0.00	4.00	96.00
#16	1.180	20.00	2.00	6.00	94.00
#30	0.600	10.00	1.00	7.00	93.00
#40	0.425	10.00	1.00	8.00	92.00
#50	0.300	10.00	1.00	9.00	91.00
#100	0.150	10.00	1.00	10.00	90.00
#200	0.075	20.00	2.00	12.00	88.00
Pan	0.000	0.00	0.00	12.00	88.00



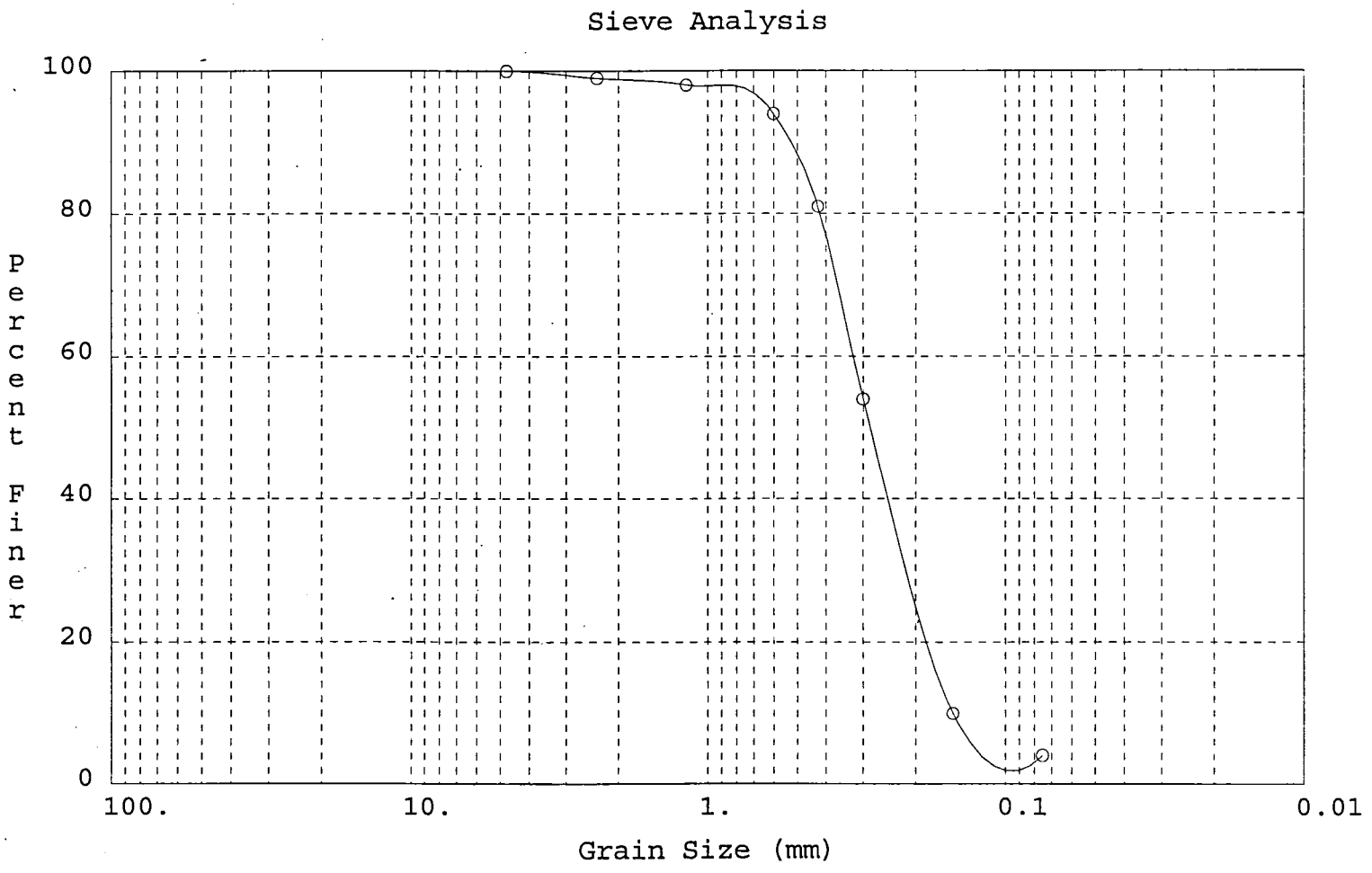
Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, MC 85 Bridge
Date = 11/04/97
Tested By = M. Blalock
Boring Number = 4
Depth = 15' - 16 1/2'
Sample Number = 97-0956
Description = Brown, silty SAND(SM)
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3/8"	9.500	0.00	0.00	0.00	100.00
1/4"	6.350	10.00	1.00	1.00	99.00
#4	4.750	10.00	1.00	2.00	98.00
#8	2.360	20.00	2.00	4.00	96.00
#10	2.000	10.00	1.00	5.00	95.00
#16	1.180	30.00	3.00	8.00	92.00
#30	0.600	80.00	8.00	16.00	84.00
#40	0.425	60.00	6.00	22.00	78.00
#50	0.300	80.00	8.00	30.00	70.00
#100	0.150	210.00	21.00	51.00	49.00
#200	0.075	110.00	11.00	62.00	38.00
Pan	0.000	0.00	0.00	62.00	38.00



Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, BID Canal Overchute
Date = 9/24/97
Tested By = M. Blalock
Boring Number = 5
Depth = 11 1/2' - 13'
Sample Number = 97-0773
Description = Gray-tan, Poorly graded GRAVEL(GP)
Dry Sample Weight (g) = 1000

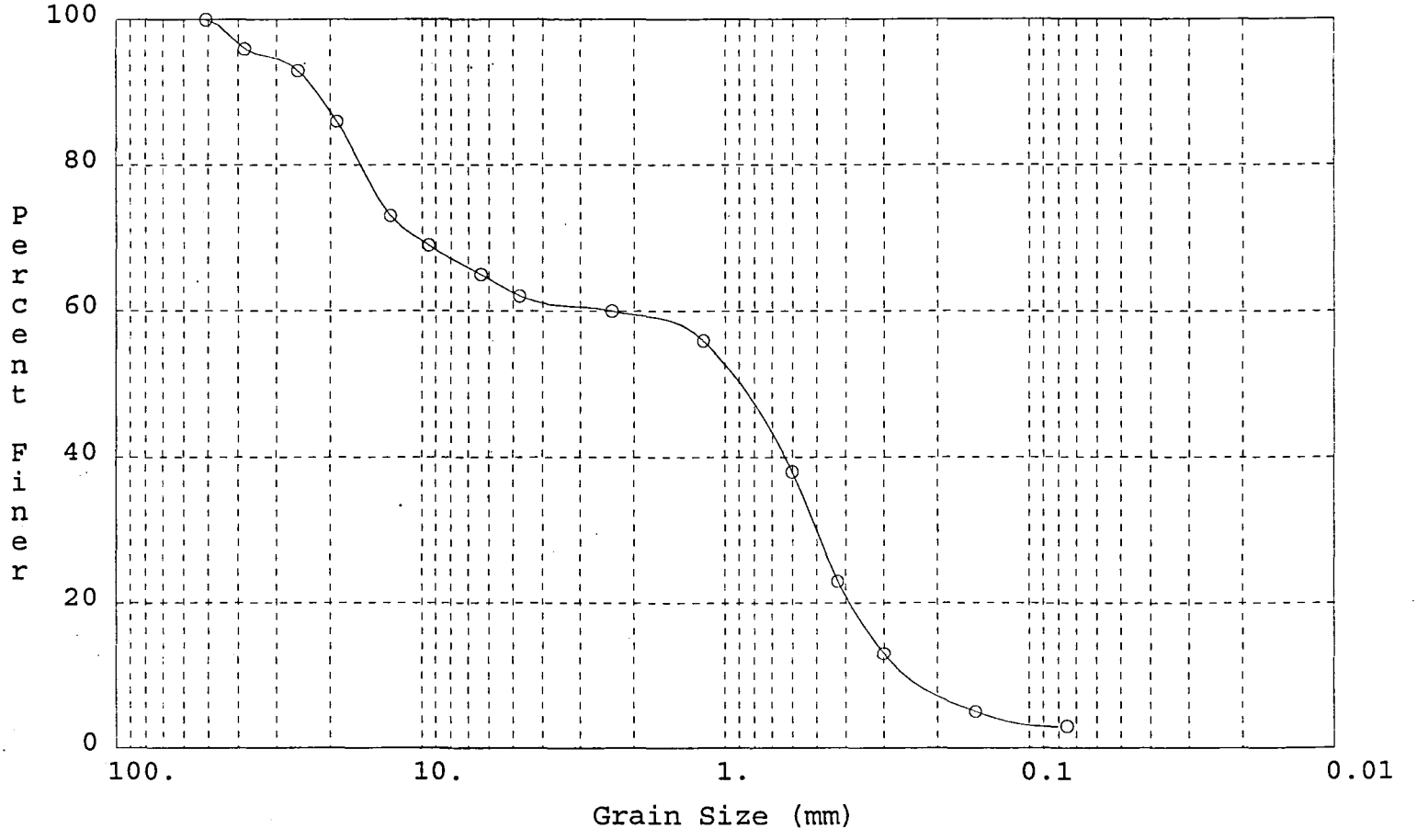
SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#4	4.750	0.00	0.00	0.00	100.00
#8	2.360	10.00	1.00	1.00	99.00
#16	1.180	10.00	1.00	2.00	98.00
#30	0.600	40.00	4.00	6.00	94.00
#40	0.425	130.00	13.00	19.00	81.00
#50	0.300	270.00	27.00	46.00	54.00
#100	0.150	440.00	44.00	90.00	10.00
#200	0.075	60.00	6.00	96.00	4.00
Pan	0.000	0.00	0.00	96.00	4.00



Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, BID Canal Overchute
Date = 9/24/97
Tested By = D. Johnson
Boring Number = 5
Depth = 20' - 25'
Sample Number = 97-0781
Description = Gray, poorly graded GRAVEL(GP)
Dry Sample Weight (g) = 1000

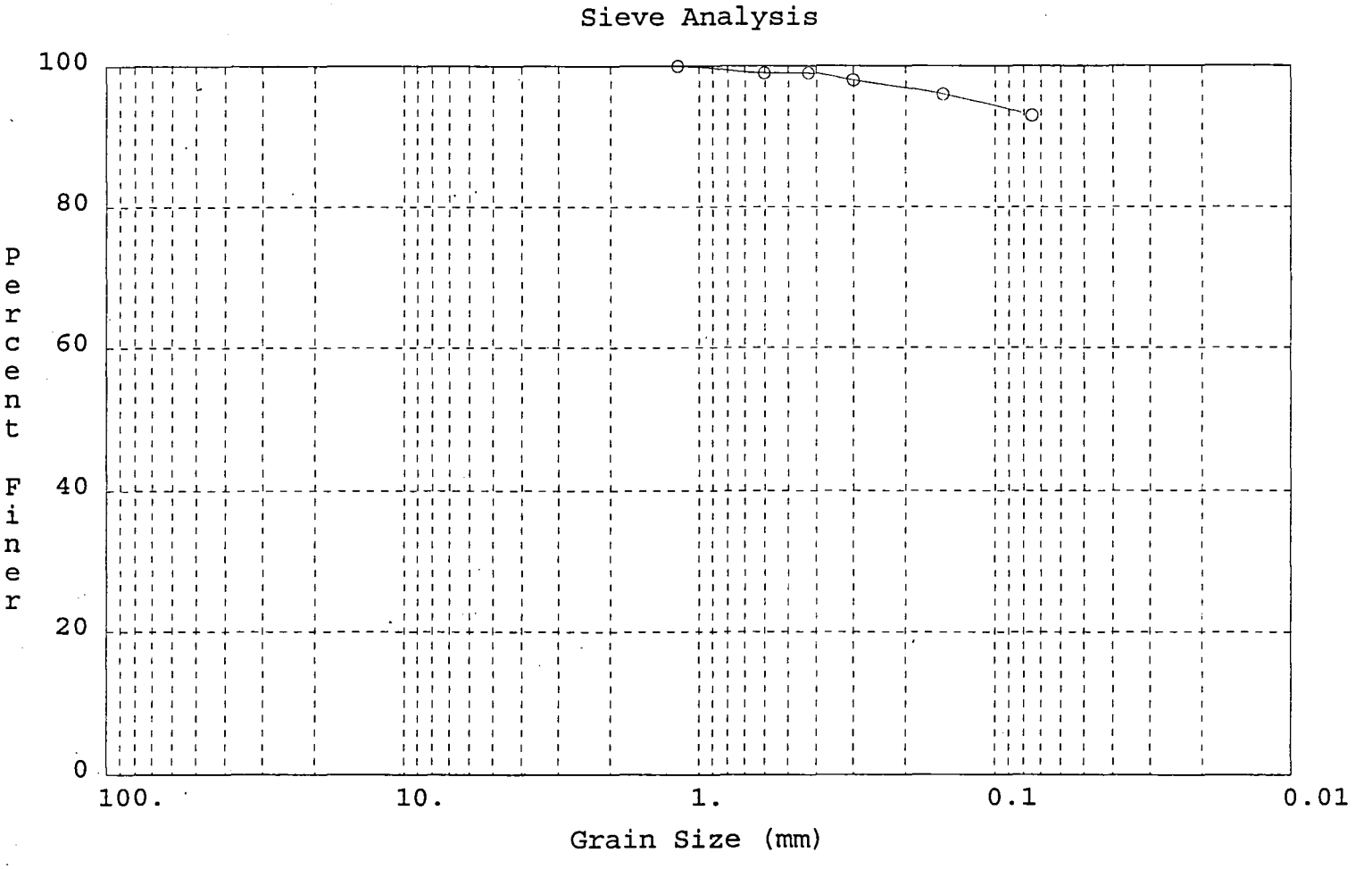
SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
2"	50.800	0.00	0.00	0.00	100.00
1 1/2"	38.100	40.00	4.00	4.00	96.00
1"	25.400	30.00	3.00	7.00	93.00
3/4"	19.050	70.00	7.00	14.00	86.00
1/2"	12.700	130.00	13.00	27.00	73.00
3/8"	9.500	40.00	4.00	31.00	69.00
1/4"	6.350	40.00	4.00	35.00	65.00
#4	4.750	30.00	3.00	38.00	62.00
#8	2.360	20.00	2.00	40.00	60.00
#16	1.180	40.00	4.00	44.00	56.00
#30	0.600	180.00	18.00	62.00	38.00
#40	0.425	150.00	15.00	77.00	23.00
#50	0.300	100.00	10.00	87.00	13.00
#100	0.150	80.00	8.00	95.00	5.00
#200	0.075	20.00	2.00	97.00	3.00
pan	0.000	0.00	0.00	97.00	3.00

Sieve Analysis



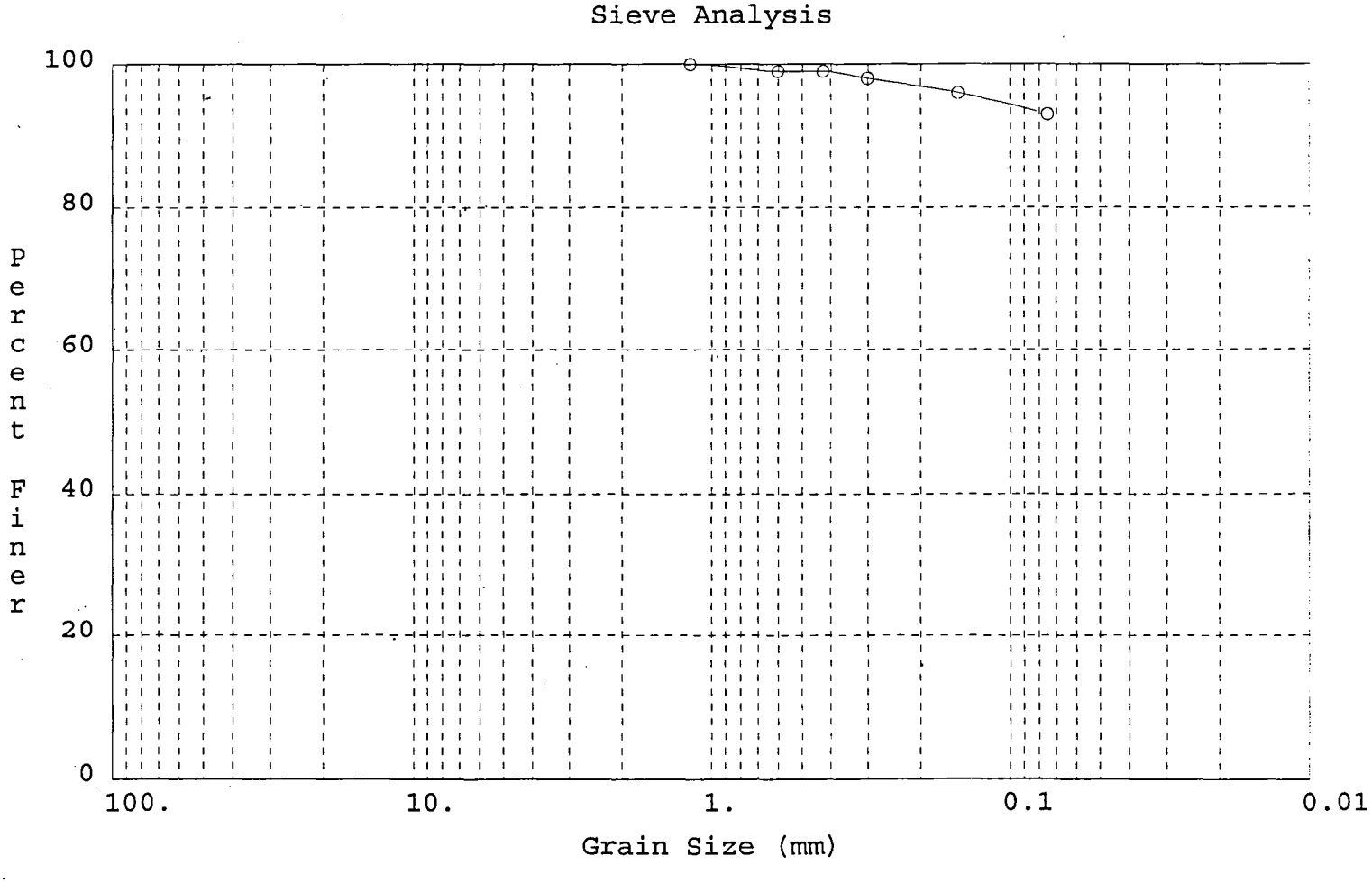
Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, BID Canal Overchute
Date = 9/24/97
Tested By = M. Blalock
Boring Number = 6
Depth = 15' - 16 1/2'
Sample Number = 97-0775
Description = Brown, sandy SILT(ML)
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#16	1.180	0.00	0.00	0.00	100.00
#30	0.600	0.00	0.00	0.00	100.00
#40	0.425	10.00	1.00	1.00	99.00
#50	0.300	10.00	1.00	2.00	98.00
#100	0.150	130.00	13.00	15.00	85.00
#200	0.075	240.00	24.00	39.00	61.00
Pan	0.000	0.00	0.00	39.00	61.00



Project Number = 196020-2 Client: Sverdrup Civil, Inc.
Location = Bullard Wash, BID Canal Overchute
Date = 9/24/97
Tested By = M. Blalock
Boring Number = 6
Depth = 0 - 7'
Sample Number = 97-0776
Description = Brown, lean CLAY(CL)
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#16	1.180	0.00	0.00	0.00	100.00
#30	0.600	10.00	1.00	1.00	99.00
#40	0.425	0.00	0.00	1.00	99.00
#50	0.300	10.00	1.00	2.00	98.00
#100	0.150	20.00	2.00	4.00	96.00
#200	0.075	30.00	3.00	7.00	93.00
Pan	0.000	0.00	0.00	7.00	93.00



BULLARD WASH - MC 85 BRIDGE AND BID CANAL OVERCHUTE
TUCSON, ARIZONA
ATL JOB NO. 196020-2

IN-SITU DRY UNIT WEIGHT

Boring No.	Depth (ft)	USCS	Dry Unit Weight (pcf)
2	15 - 16	CL	118.1
2	25 - 26 ½	SM	98.3
5	20 - 21 ½	GP	96.0

BULLARD WASH - MC 85 BRIDGE AND BID CANAL OVERCHUTE
TUCSON, ARIZONA
ATL JOB NO. 196020-2

PERCENT SWELL TEST
(Surcharge = 100psf)

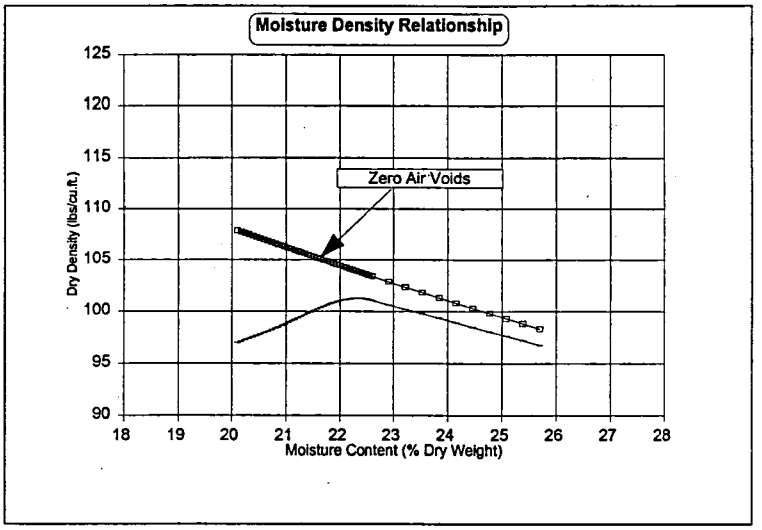
Boring No.	Sample Depth (ft)	USCS	Percent Swell	Dry Density (pcf)	Saturation Moisture (%)
1	12 - 13	CL - ML	0.35	102.6	25.3
*2	25 - 26 ½	SM	0	92.1	29.2
*5	20 - 21 ½	GP	0	89.9	24.4

*Note: Consolidation takes place after 24 hours of testing.

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

Summary of Moisture Density Relationship Tests

Client:	Sverdrup Civil Inc. 432 N. 44th Street, Ste 250 Phoenix, Arizona 85008	**Job No.** **Lab No.** **Type of Rammer:** **Test Date:**	197020-2 97-0776 Manual 09/24/97
Project:	Bullard wash - BID Canal Overchute		
Test Designation:	ASTM D-698	Material description:	lean CLAY(CL)
Test Method:	A	Sample Source:	Boring No.: 6 Depth: 0 - 7'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	97.0	98.4	101.1	96.8
Moisture Content (%)	20.1	20.8	22.6	25.7

Maximum Dry Density (lbs/cu.ft.): **101.3**
Optimum Moisture Content (% of Dry Weight): **22.3**

Remarks:

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

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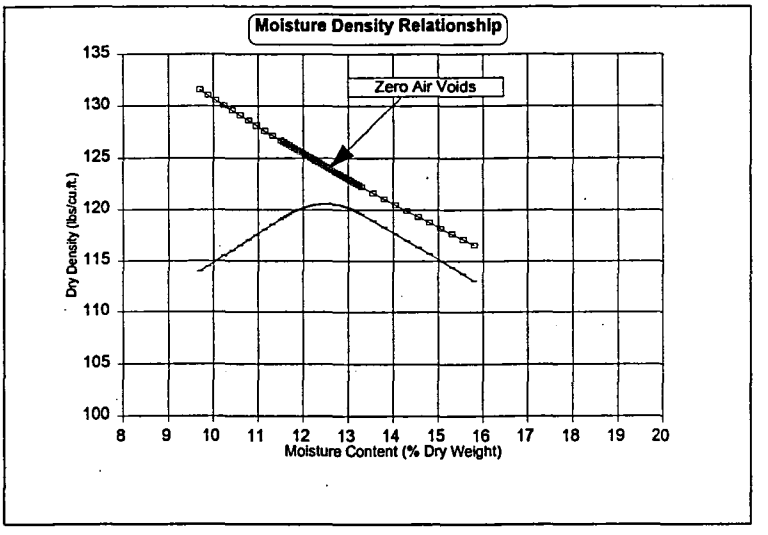
ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

Summary of Moisture Density Relationship Tests

Client:	Sverdrup Civil Inc. 432 N. 44th Street, Ste 250 Phoenix, Arizona 85008	**Job No.**	197020-2
		Lab No.	97-0771
		Type of Rammer:	Manual
		Test Date:	09/25/97
Project:	Bullard wash - MC 85 Bridge		
Test Designation:	ASTM D-698	Material description:	silty,clayey SAND(SC-SM)
Test Method:	A	Sample Source:	Boring No.:2 Depth: 0 - 8'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	114.0	119.1	119.6	113.1
Moisture Content (%)	9.7	11.5	13.3	15.8

Maximum Dry Density (lbs/cu.ft.): **120.6**
Optimum Moisture Content (% of Dry Weight): **12.5**

Remarks:

Reviewed By:
Input By: AO

Respectfully Submitted:
Robert Rivera
Laboratory Supervisor

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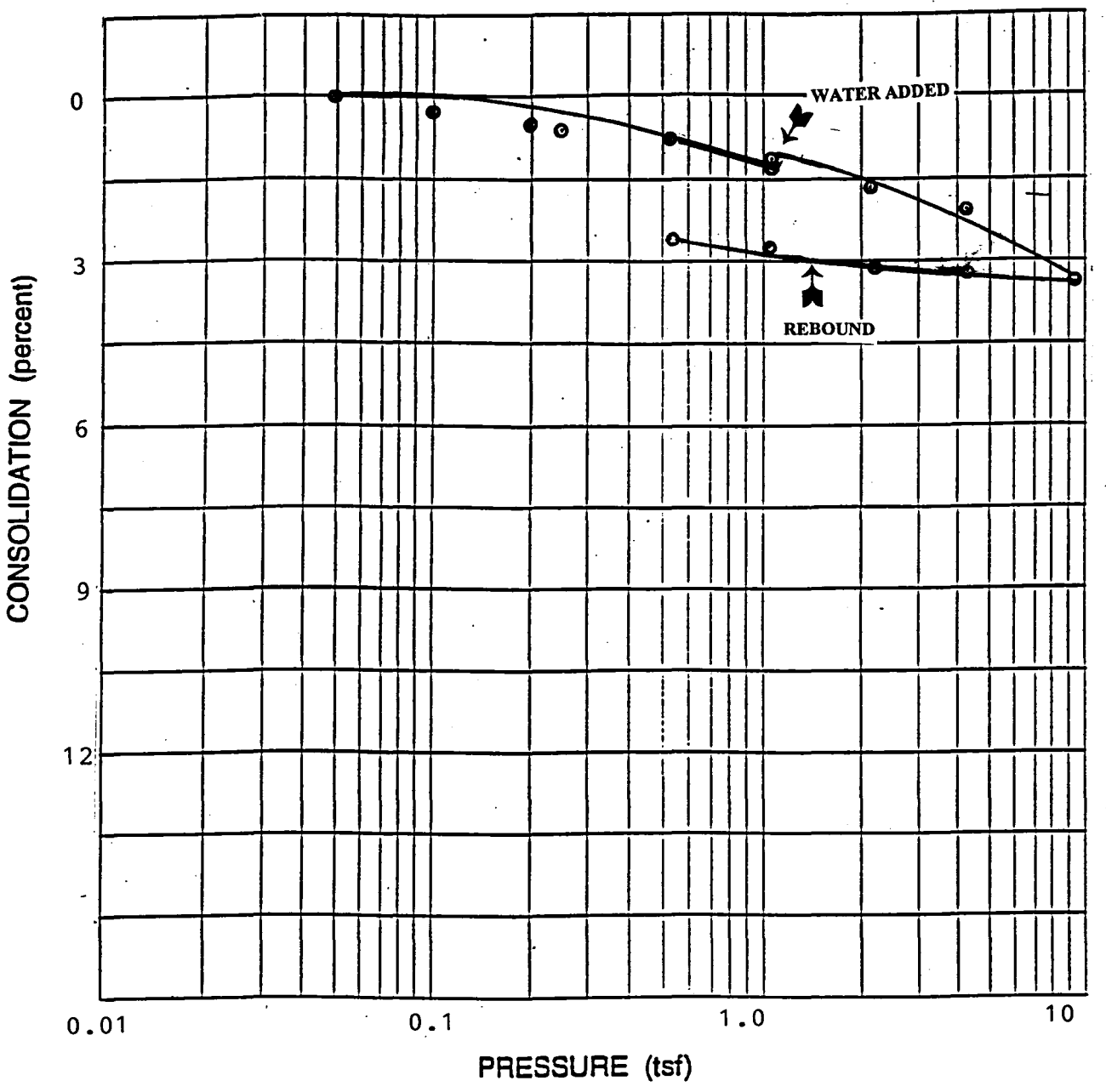
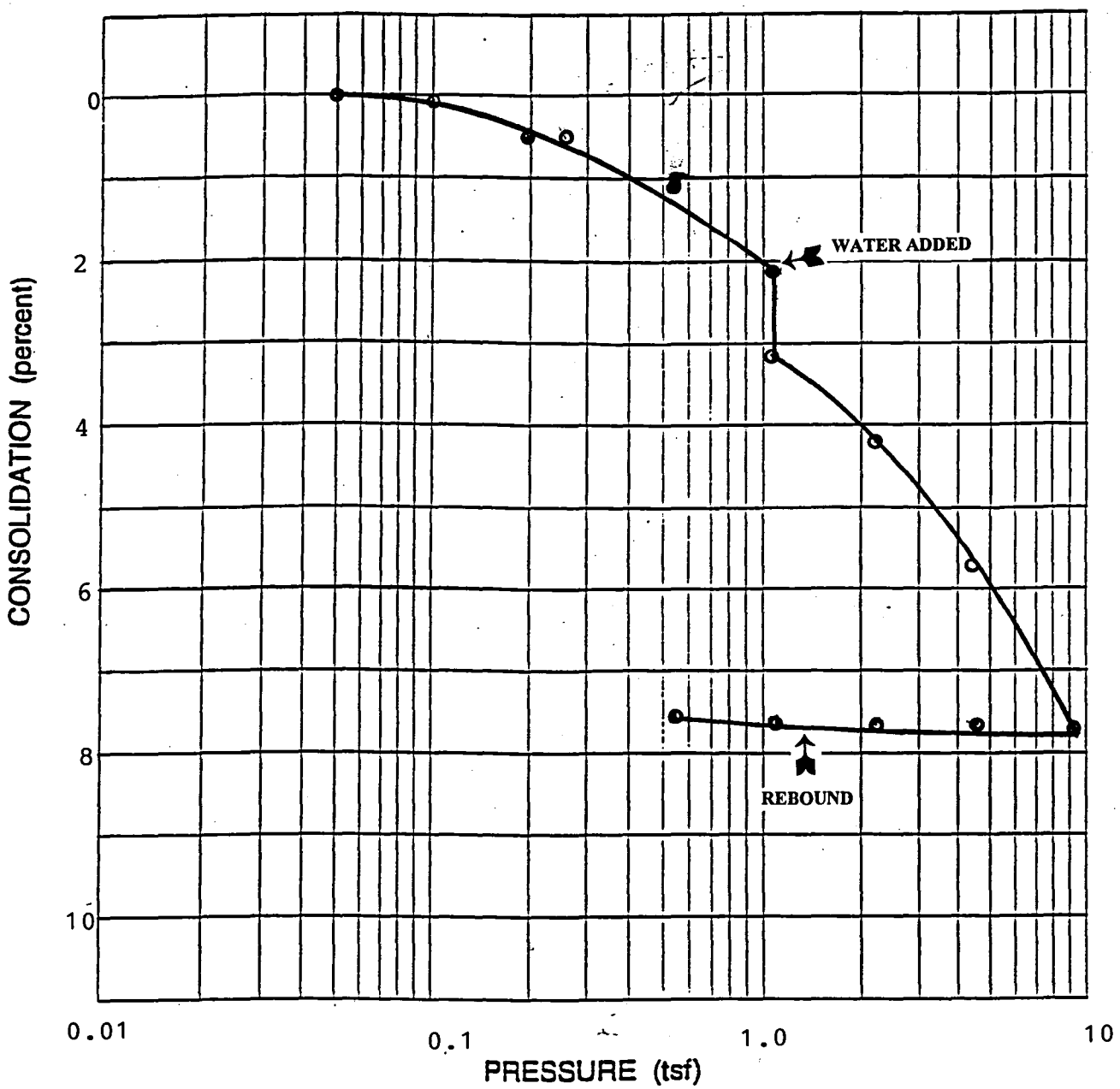


Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%) Before	Moisture Content (%) After	Dry Density (pcf)
	1	12 - 13	Brown, sandy, silty CLAY (CL-ML)	-	-	15.5	19.5	112.5

CONSOLIDATION TEST DATA

Project No. 196020-2

Date 9/22/97



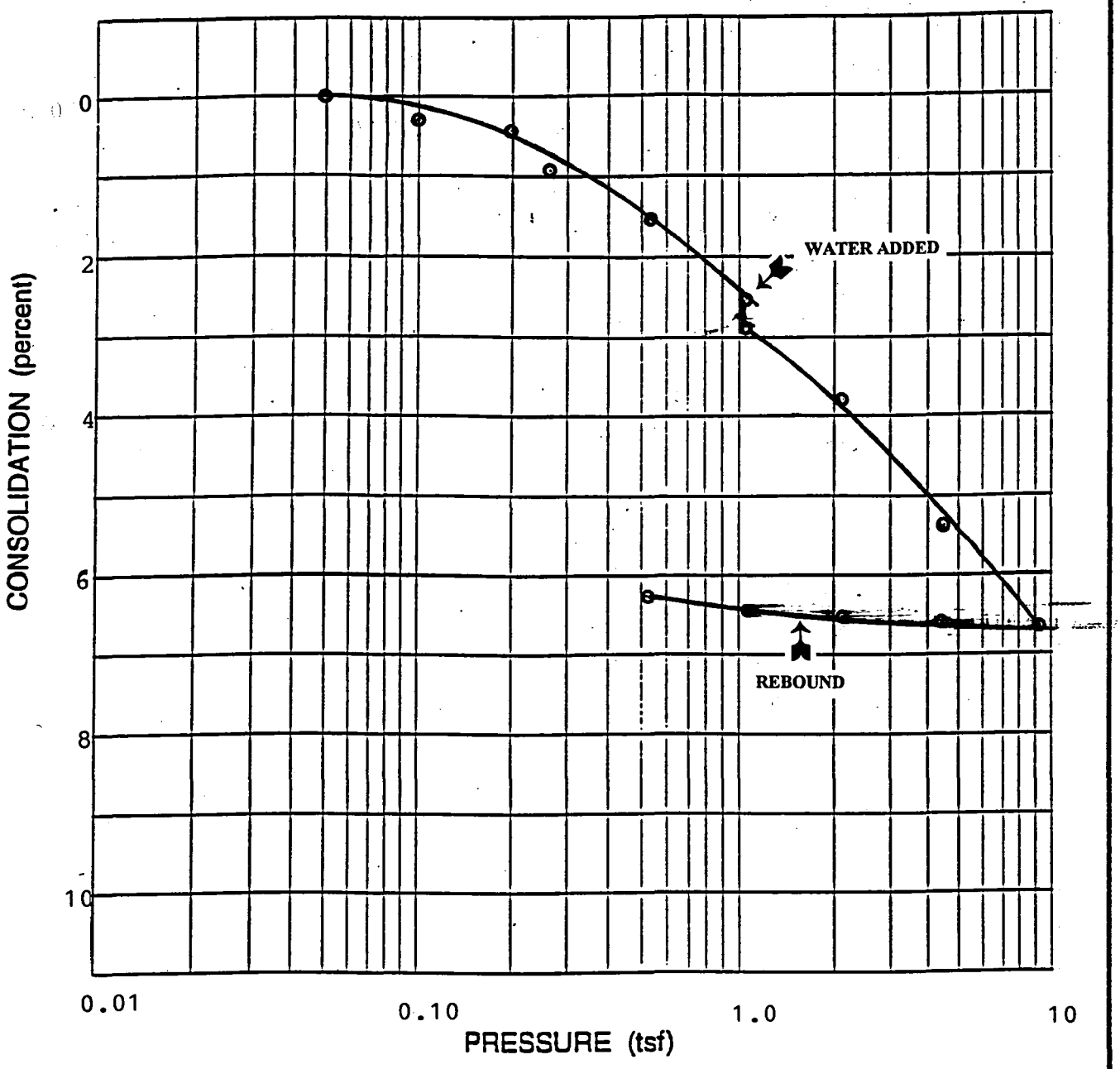
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%) Before	Moisture Content (%) After	Dry Density (pcf)
	2	25'-26½	Gray-tan, silty SAND (SM)	-	NP	6.1	36.8	92.7

CONSOLIDATION TEST DATA

Project No. 196020-2

Date 10/10/97

ATL INC.



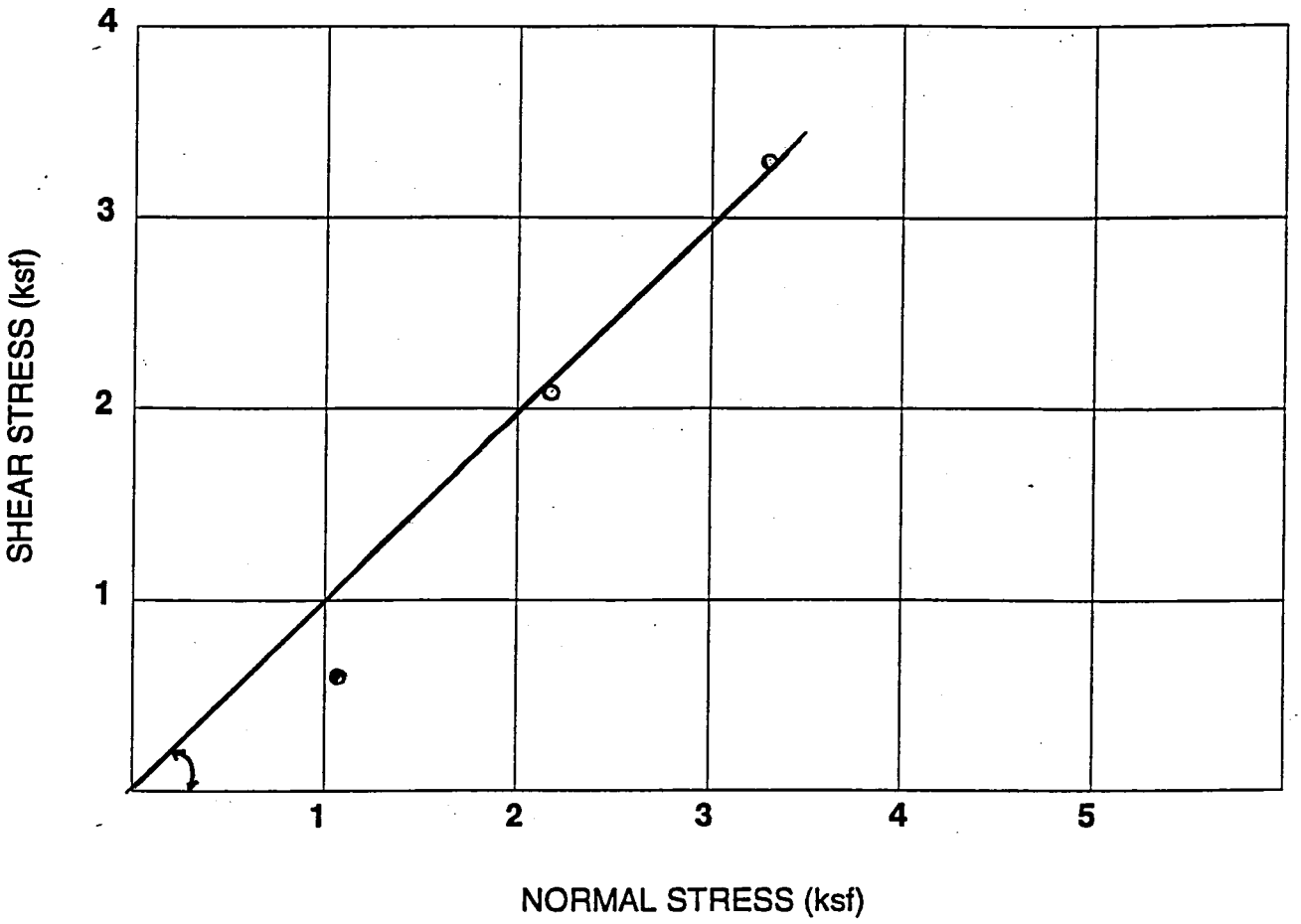
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%) Before	Moisture Content (%) After	Dry Density (pcf)
	5	20-21½	Gray-tan, Poorly graded GRAVEL (GP)	--	NP	70	27.1	89.5

CONSOLIDATION TEST DATA

Project No. 196020-2

Date 10/10/97

ATL INC.



Boring or Test Pit no.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
2	15-16	CL	Brown, lean CLAY		45	16.9	107.5

DIRECT SHEAR TEST DATA

JOB NO. 196020-2