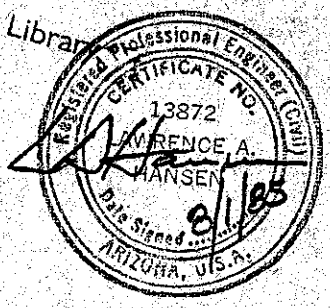
GEOTECHNICAL INVESTIGATION REPORT
Maricopa County Landfill Area
Near Western Avenue & Dysart Road
Avondale, Arizona

FOR CONTRACTORS' REVIEW, FCD 85-32



SHB Job No. E85-91

Consulting Geotechnical Engineers
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SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS

APPLIED SOIL MECHANICS • ENGINEERING GEOLOGY • MATERIALS ENGINEERING • HYDROLOGY

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August 1, 1985

SCS Engineers
4014 Long Beach Boulevard
Long Beach, California 90807-2687

SHB Job No. E85-91

Attention: Mark B. Beizer, P.E.
Project Manager

Re: Maricopa County Landfill Site
Near Western Avenue & Dysart Road
Avondale, Arizona

Gentlemen:

Our Interim Geotechnical Investigation Report addressing the referenced project is herewith submitted. The report includes the results of test drilling, laboratory analysis, preliminary recommendations for earthwork and other elements of the project, and conceptual design features.

Should any questions arise concerning this report, we would be pleased to discuss them with you.

Respectfully submitted,
Sergent, Hauskins & Beckwith Engineers

By _____
Lawrence A. Hansen, Ph.D., P.E.

Registered Professional Engineer (Civil) CERTIFICATE NO. 13872 LAWRENCE A. HANSEN Date Signed 8/1/85 ARIZONA, U.S.A.

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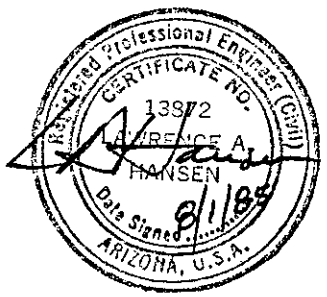
SHB Job No. E85-91



1. INTRODUCTION

This report is submitted pursuant to a geotechnical investigation made by this firm of the site proposed for the Avondale landfill. The landfill will be located near the intersection of Western Avenue and Dysart Road in Avondale, Arizona, adjacent to the Agua Fria River. The objectives of this investigation were to evaluate the physical properties of the soils underlying the site, to provide recommendations for the excavation and earthwork elements of the project, and to provide conceptual designs for the liner elements of the facility. It is our understanding that the information provided in this report may be expanded if it is decided to pursue the project.

2. PROJECT DESCRIPTION

Details of the project were provided by Mark B. Beizer, P.E. and Krishan Saigal, P.E. of SCS Engineers. The site is located adjacent to and west of an existing landfill, which was previously investigated by Sergent, Hauskins & Beckwith (Ref: SHB Job No. E84-220). The landfill is owned and was operated from April, 1979 to October, 1980 by the Maricopa County Highway Department. During its 18 months of operation, the landfill received approximately 250,000 cubic yards of uncompacted municipal solid waste. Apparently no hazardous wastes were deposited at the site. It is understood that the existing landfill will be removed and disposed of at the proposed site investigated as part of the present study.

The purpose of this study is to provide information required to develop a conceptual design of a landfill at the proposed site.

3. INVESTIGATION

3.1 Review of Site Hydrogeology

As part of our investigation, we reviewed a closure study for the existing landfill prepared by SCS Engineers, which detailed hydrogeologic conditions at the disposal site. We also reviewed available governmental reports of water levels, well locations, and effects of flooding in the region of the proposed site. A hydrograph for a section of the Agua Fria River downstream of the site was provided by Simons, Li & Associates, Inc. On their recommendation, the shape of the hydrograph was assumed applicable to the Agua Fria River adjacent to the proposed landfill site.

3.2 Subsurface Exploration

Five exploratory borings were drilled on May 9 and 10, 1985. All of the borings were advanced to auger refusal on sand and gravel, with boring depths varying from 31 to 42 feet below existing grade.

The borings were drilled with a truck-mounted CME-75 drill rig advancing 6 5/8-inch O.D. hollow stem auger. Standard penetration testing and open-end drive sampling were performed at selected intervals in the borings. The

field investigation was supervised by Nicholas J. LaFronz, E.I.T., staff engineer of this firm.

The results of the field investigation are presented in Appendix A, which includes a brief description of drilling and sampling equipment and procedures, a site plan showing the boring locations, and logs of the test borings. Elevations of the ground surface at the boring locations were interpolated from a contour map of the area provided by the Maricopa County Landfill Department.

3.3 Laboratory Analysis

Moisture contents of selected samples were determined. These are shown on the boring logs. Grain-size analysis and Atterberg Limits tests were performed on selected samples. The results of these tests are presented in Appendix B.

4. SITE CONDITIONS & GEOTECHNICAL PROFILE

4.1 Site Conditions

The proposed landfill site is relatively level, exhibiting an elevation difference of about 2 feet. The site appears to have been previously cultivated, but is presently covered with a light to medium growth of grasses and occasional bushes. Unlined irrigation ditches form the northern and southern boundaries of the site. The

surface texture retains evidence of previous discing and furrowing.

4.2 Geotechnical Profile

As indicated by the boring logs, the soils underlying the proposed landfill site are relatively uniform in lateral extent. The soil column can be described as a two-layer system as follows:

A. The upper approximately 6 feet of soil consists of fine grained silts and silty sands that are relatively soft, low in plasticity and moist. In Borings 4 and 5, a 1 to 2-foot thick layer of soft to firm, highly plastic clay was encountered.

B. At depths below 6 feet, moderately firm to hard, clean to silty sands were encountered. This stratum is river alluvium and includes lenses of clean sands and gravels throughout. The materials are typically dense to very dense, and moist to very moist.

It is noted that all exploratory holes caved subsequent to removal of the hollow stem auger.

4.3 Soil Moisture & Groundwater Conditions

Free groundwater was encountered in all of the borings, except Boring 3, at depths varying from 32 to 34 feet. It is noted that Boring 3 extended only to 31 feet and, thus, did not extend to the apparent groundwater level. Moisture contents in the soils above the water table

typically vary from 2 to 11 percent, though a moisture content of 27 was determined for the clay layer in Boring 4.

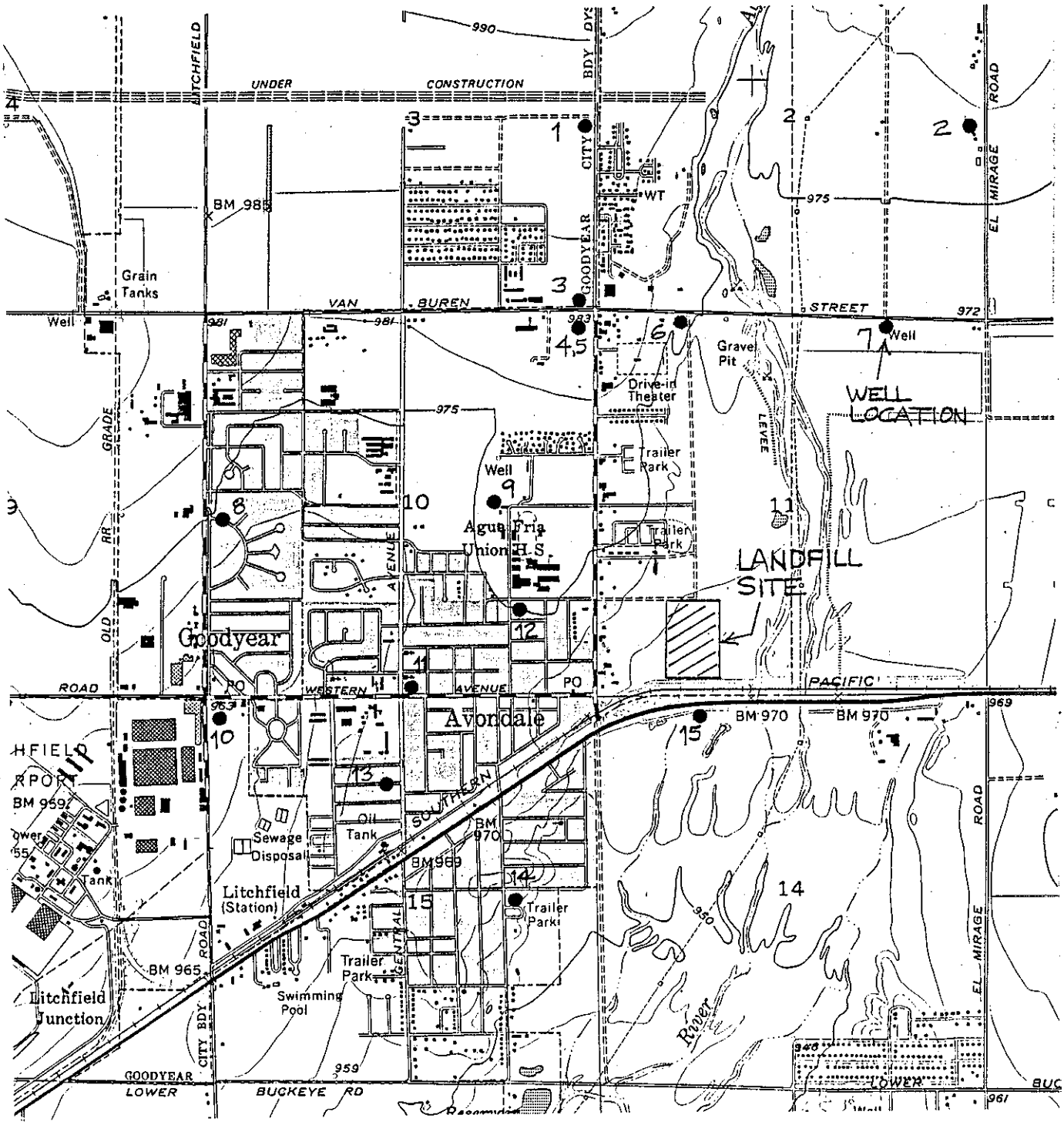
A groundwater contour map prepared by SCS Engineers using 1973* depth-to-water data indicates that, at that time, the depth-to-water beneath the adjacent landfill was about 60 feet, and groundwater movement was to the northwest. To further define the groundwater regime, records for 15 wells, located as shown in Figure 1, were researched from Arizona Department of Water Resources (ADWR) files. Pertinent data from these records are listed in Table 1, including the most recent measured groundwater elevation. This data indicates the groundwater was at elevation 890 to 920 during 1984, compared to the present elevation at the landfill site of 926. An explanation for the apparent rise in the groundwater level between 1982 and 1985 is not available, but it may be related to irrigation or flows in the Agua Fria River.

Declines of the water table are caused by pumping of water primarily for irrigation. Recharge and water level rises are by flooding adjacent to the Agua Fria and Gila Rivers. During a flood, groundwater moves downward forming a mound on the water table, and if the flood is sufficiently long, the mound extends upward to the river. Mann and Rohne (1983) for the floods during

*References are listed at end of report.

FIGURE 1

Landfill Site and Well Locations



Map Basis: Tolleson Quadrangle Arizona - Maricopa County, 7.5 Minute Series, 1957, Photo revised 1982

Maricopa County Landfill Site
Near Western Avenue & Dysart Road
Avondale, Arizona
SHB Job No. E85-91

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TABLE 1

Summary of Well Records

No.	ADWR Ref. No.	Distance from Landfill (miles)	Years of Record	1982 Groundwater Depth (feet)	1982 Groundwater Elevation (feet)
1	3 DAA1	1.3	1962	-	-
2	2 DAA	1.5	1962 & 1982	70	909
3	3 DDD	1.0	-	-	-
4	10 AAA1	0.9	1947-54	-	-
5	10 AAA2	0.9	1956-82	79	903
6	11 BAB	0.8	1982	53	923
7	11 AAB	0.9	1962 & 1982	63	908
8	10 CBB	1.3	1982	85	890
9	10 ACD	0.7	1982	75	901
10	15 ABB2	1.4	-	-	-
11	10 DCC	0.7	1982	63	908
12	10 DBB	0.5	1982	56	919
13	15 BAD	0.9	1982	77	894
14	15 DAB	0.8	1982	57	903
15	14 BAB	0.2	-	-	-

the period February, 1978 to June, 1980 indicate that one well 4 miles west of the site had a rise in the water table of 19 feet, a second 3 miles to the southeast had a rise of 10 feet, and a third 3½ miles to the northeast a rise of 34 feet. As these three are some distance from the Agua Fria River, the water table mound under the proposed landfill site was likely much higher than the pre-flood water table.

5. DISCUSSION, ANALYSES & RECOMMENDATIONS

5.1 Primary Design Factors

The key factors to be considered in developing a landfill at the proposed site include the following:

A. The soils at the site below a depth of approximately 6 feet include relatively clean sands and gravels and silty sands. The in situ moisture content is relatively low, and cementation is not noted; thus, excavation by conventional means is possible. Below depths of 30 feet approximately, depending on the groundwater level at the time of excavation, moist to saturated conditions may be encountered.

B. There does not appear to be a natural soil barrier between the Agua Fria River and the proposed site. Though the proposed dike would prevent surface water from the Standard Project Flood impacting the landfill, subsurface flow below the dike is probable.

5.2 Groundwater Levels During Flood Events

Based on information provided by the Maricopa County

Landfill Department, the stage of the Agua Fria River during the Standard Project Flood is elevation 965. Thus, without placement of the planned dike, the landfill site would become flooded during this event, which has a flow equivalent to approximately 1.5 times the 100-year event. Placement of the dike would prevent surface flooding, but would not prevent subsurface flows. As discussed in Section 4.3, during high stages of extended duration, mounding of groundwater adjacent to the river should be anticipated.

The height of the mound is primarily dependent on the time period the flood stage exists. Because the proposed landfill site is adjacent to the Agua Fria River, the possibility that the full impact of a flood stage would be felt was investigated. Based on the 100-year hydrograph provided, the period of significant flow peaks in approximately ten hours and recedes in an additional 20 hours. The total duration of the hydrograph is approximately 100 hours or four days.

A simple flow analysis, considering the landfill will be located approximately 1,000 feet from the Agua Fria River, indicates in excess of 15 days of significant flow would be required to significantly impact the landfill site. Because of the stratigraphy of the soils underlying the site and the barrier to flow created by the dike, direct computation is not possible. However, the lower bound time of 15 days is based on conservative assumptions, and a time in excess of this may be more probable.

Since the duration of peak flow would be much less than the time required for significant subsurface flow to then reach the landfill, it is concluded that the Standard Project Flood would not have a major effect on the landfill. It is likely that, for more severe flood conditions, the water table below the landfill site would rise, but the rise would only be on the order of a few feet. Thus, the bottom of the landfill, planned to be at elevation 930±, would be subject to an uplift pressure on the order of a few hundred pounds per square foot. It would not feel the pressure equivalent to the difference in elevation of flood stage and landfill invert, or 35 feet of water. As important, it is possible that the groundwater level could rise above the landfill invert.

5.3 Design Recommendations - Liner

Considering the need to positively impound any leachate that might develop in the landfill, and the conditions described above, it is recommended that a double liner system be installed. Though the potential for flow in the Agua Fria River to infiltrate the landfill is small, it is recommended that the design include defensive measures against such an occurrence. There is at the site a very high potential for groundwater contamination, and very positive liner, leachate collection, and seepage detection systems are recommended. The design of this system should also consider the potential for uplift pressures acting at its interface with in situ soils. Further, to prevent infiltration of surface

waters, the landfill should be capped with a positive moisture seal and graded to prevent long-term ponding of water.

A conceptual design for the liner system is shown schematically in Figure 2, and a conceptual design for the landfill cap is shown schematically in Figure 3. It is recommended that a double liner incorporating two layers of a geomembrane such as HDPE, CPE, or PVC be used. The double liner system would extend along the bottom and sides of the landfill, providing full encapsulation. The artificial liners would be separated by 24 inches of sand, which would allow collection of any seepage into this layer. The seepage collection system could include a network of PVC pipes leading to a sump drain. A 24-inch layer of sand above the upper liner would accommodate leachate collection, and provide protection for the liner during placement of the waste material in the landfill.

To accommodate placement of the sand and the liners, the site slopes should not exceed 3:1 (horizontal to vertical). The sandy materials required for construction are readily available from the excavation for the landfill. The thicknesses of sand specified would provide protection against damage to the liners, as well as accommodate installation of seepage and leachate collection systems. Should these systems not be installed, it may be possible to lessen the thickness. However, the method of installation and the method of placement of the waste should be carefully considered.

The lower membrane liner could be replaced with a clay liner. However, it does not appear that the silty soils overlying the site would be sufficiently impermeable for this purpose. The layers of high plasticity clay would be acceptable, but there is an insufficient quantity of this material available. Further, to ensure imperviousness, the greater flexibility of a geomembrane would provide a more risk-free barrier. Placement of a clay liner requires less steep slopes (or a greater quantity of material) and protection immediately after placement to prevent drying and cracking. The sand overlying the bottom liner would, of course, provide the degree of protection required.

5.4 Design Recommendations - Cover

Standard design of the landfill cover, as shown in Figure 3, includes a 24-inch layer of foundation material, a 12-inch cap of relatively impervious material (coefficient of permeability of 10^{-6} centimeters per second or less) and a 12-inch layer of native soil. The cover should also be graded and sloped to provide positive surface drainage. Materials for the foundation and cover are available on-site in the upper 6 feet of surficial soils. When the landfill excavation is made, this material could be stockpiled for later use.

The impervious cap could be constructed of finer grained surficial soils such as the silts encountered in Borings 2, 3 and 4. This material would likely have the required degree of imperviousness. Alternatively, the layers of

FIGURE 2

Conceptual Design of Liner System
(Schematic, Not to Scale)

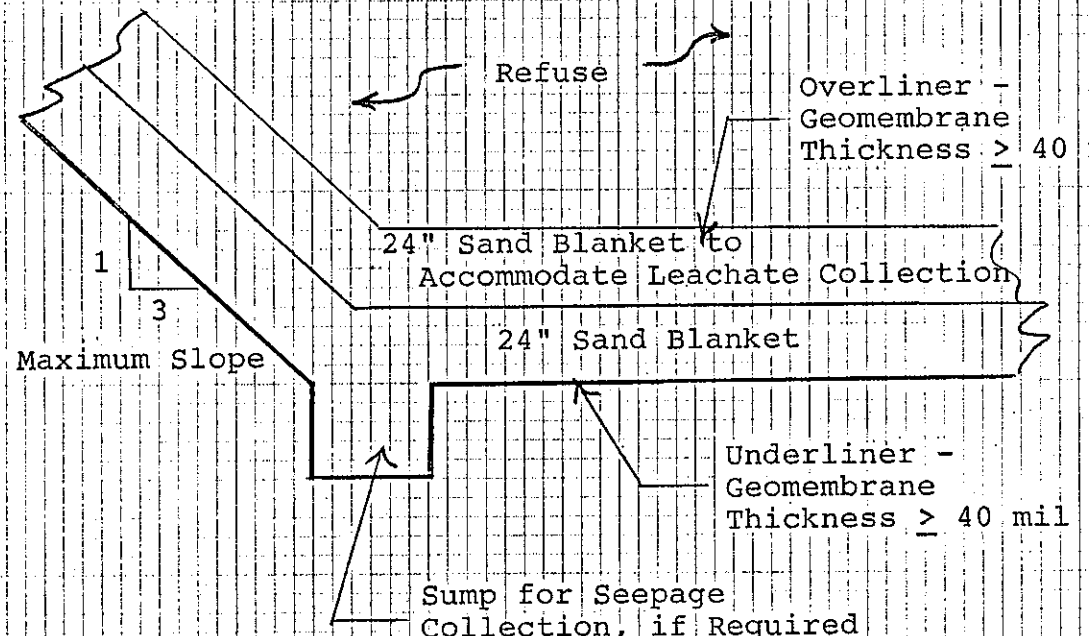
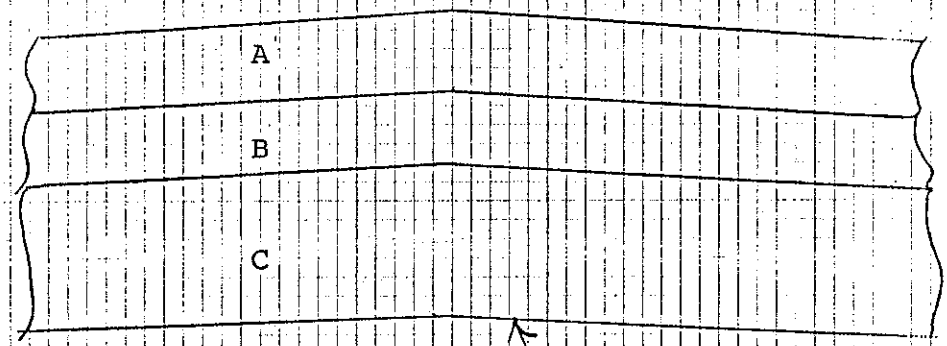


FIGURE 3

Conceptual Design of Landfill Cover
(Schematic, Not to Scale)



Cover Sloped Away From Center to Promote Surface Drainage

Layer	Thickness	Material
A	12"	Protective layer On-site native soils - silts and sandy silts
B	12"	Impervious cap On-site silts possible, local borrow or clay from excavation blended with silts
C	24"	Foundation cover On-site native soils - sands and silty sands

plastic clay encountered in Borings 4 and 5 could be stockpiled and used for this purpose, or blended with other materials to provide a sufficiently impervious material.

An alternative would be to treat the finer grained soils with an enzyme additive. This treatment could lessen the required thickness, and produce a more economical design. However, our experience with such additives has not been entirely positive. Questions of long-term stability and protection of soils treated and used as liners (as compared to dust control, road surface stability and other uses) remain to be answered. Use of an additive would require a careful specification of workmanship and product.

REFERENCES

Mann, L.J. and Rohne, P.B., Jr., 1983, Streamflow Losses and Changes in Groundwater Levels along the Salt and Gila Rivers Near Phoenix, Arizona - February 1978 to June 1980, U.S. Geological Survey Water Resources Investigations 83-4043.

SCS Engineers, 1981, Closure Study for the Avondale Landfill, Avondale, Arizona, Report prepared for the U.S. Environmental Protection Agency, July.

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS

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August 22, 1985

SCS Engineers
4014 Long Beach Boulevard
Long Beach, California 90807-2687

SHB Job No. E85-91
Addendum No. 1

Attention: Mark B. Beizer, P.E.
Project Manager

Re: Maricopa County Landfill Site
Near Western Avenue & Dysart Road
Avondale, Arizona

Gentlemen:

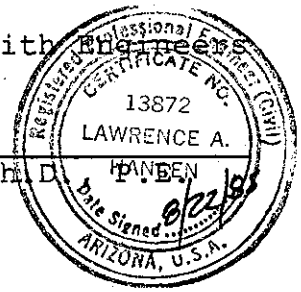
Attached hereto is the result of a permeability test conducted on near-surface, fine grained soils sampled at the above project site. The specimen tested was a composite of soils obtained from depths of $\frac{1}{2}$ foot to 6 feet, remolded to a dry density of 108 pounds per cubic foot at a moisture content of 14 percent. The coefficient of permeability determined is of the order of 4×10^{-7} centimeters per second. Thus, it appears the on-site surficial clayey soils can be used for the impervious cover specified for the landfill. During excavation it should be specified that this layer be stockpiled for this use.

This addendum should be attached to the original report and made a part thereof.

Should any questions arise concerning this addendum, please do not hesitate to contact us.

Respectfully submitted,
Sergent, Hauskins & Beckwith Engineers

By _____
Lawrence A. Hansen, Ph.D., P.E.



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CONSULTING SOIL AND FOUNDATION ENGINEERS
MATERIALS TESTING ENGINEERS

ENGINEERING ANALYSIS • PHYSICAL TESTING • QUALITY CONTROL • FIELD EXPLORATION

REPORT ON LABORATORY TESTS

DATE _____

PROJECT Maricopa County Landfills JOB NO. E85-91

LOCATION Near Avondale, Arizona LAB NO. 5-91-37 thru 41

REMOLDED PERMEABILITY TEST (Pressurized Permeameter)

Sample Combined Samples of Borings #2 @ 0.5-2', #2 @ 4.5'-6', #3 @ 0.5-2', #3 @ 4.5'-6' and #4 @ 0.5-2'

Remolded to Density of ± 108 PCF at 14.0 %

Diameter 3.30 cm Length 6.10 cm Area 8.55 cm^2 Vol. 52.2 cc

W_s 89.99 grms. w_o 14.1 % w_f 23.6 % G_s - V_s - cc

Void Ratio - Dry Density 107.6 PCF Trials 24 days

Pressure (PSI)	Head (inches)	Q (cc)	Time (min.)	K (cm/sec)	K (ft/yr)	Remarks
0	18.1	18.3	11735	4.0×10^{-7}	0.4	Input "Q"
5	152.5	193.8	15977	3.7×10^{-7}	0.4	Input "Q"
	147.0			2.8×10^{-7}	0.3	Exit "Q"
5	156.0	45.8	2508	5.5×10^{-7}	0.6	Input "Q"
	34.0			4.1×10^{-7}	0.4	Exit "Q"

To FCD

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December 30, 1985

SCS Engineers
4014 Long Beach Boulevard
Long Beach, California 90807-2687

SHB Job No. E85-91
Addendum No. 2

Attention: Mark B. Beizer, P.E.
Project Manager

Re: Maricopa County Landfill Site
Near Western Avenue & Dysart Road
Avondale, Arizona

Gentlemen:

Presented herein are the results of the additional field investigation completed for the above referenced project. As discussed with Krishan Saigal, P.E. of SCS Engineers, the original five borings advanced for the project were located outside the boundaries of the final recipient landfill site identified for the project. Thus, it was recommended by all parties concerned that additional borings be advanced within the planned recipient site.

Three borings were drilled on December 18, 1985 at the locations identified on the attached site plan as Borings 6, 7, and 8. All borings were drilled to depths of 40 to 41 feet using a truck-mounted CME-55 drill rig advancing 6 5/8-inch O.D. hollow stem auger. Standard penetration testing was performed at selected intervals in the borings. The field investigation was supervised by Tony J. Freiman, E.I.T., staff engineer of this firm.

Maricopa County Landfill Site
Near Western Avenue & Dysart Road
Avondale, Arizona
SHB Job No. E85-91
Addendum No. 2

A limited laboratory testing program was completed, including determinations of the moisture content, Atterberg Limits, and grain-size distribution of selected samples recovered. Moisture contents are listed on the attached boring logs, and the results of the other tests are listed on a separate attached sheet.

The composite geotechnical profile based on the three additional borings is essentially the same as that described in our original report, except the stratum below a depth of approximately 6 feet appears to contain significantly more gravel-sized particles. The groundwater table at the time of drilling varied from a depth of 31 to 34 feet, corresponding to elevations of 928 to 930, or essentially the same as previously reported.

This addendum should be attached to and made a part of our original report. Should you have any questions concerning the information presented herein, please do not hesitate in contacting us.

Respectfully submitted,
Sergent, Hauskins & Beckwith Engineers

By L D Hansen
Lawrence A. Hansen, Ph.D., P.E.

Registered Professional Engineer (Civil) CERTIFICATE NO. 13872 LAWRENCE A. HANSEN Date Signed 12/30/85 ARIZONA, U.S.A.

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TEST DRILLING EQUIPMENT & PROCEDURES

Drilling Equipment Truck-mounted CME-55 drill rigs powered with 4 or 6 cylinder Ford industrial engines are used in advancing test borings. The 4 cylinder and 6 cylinder engines are capable of delivering about 4,350 and 6,500 foot/pounds torque to the drill spindle, respectively. The spindle is advanced with twin hydraulic rams capable of exerting 12,000 pounds downward force. Drilling through soil or softer rock is performed with 6 1/2 O.D., 3 1/4 I.D. hollow stem auger or 4 1/2 inch continuous flight auger. Carbide insert teeth are normally used on the auger bits so they can often penetrate rock or very strongly cemented soils which require blasting or very heavy equipment for excavation. Where refusal is experienced in auger drilling, the holes are sometimes advanced with tricone gear bits and NX rods using water or air as a drilling fluid. Where auger and tricone gear bits cannot be used to advance the hole due to cobbles or caving conditions, the ODEX (overburden drilling with the eccentric method) is used. A percussion down-the-hole hammer underreams the hole and 5 inch steel casing is introduced into the hole during drilling. The drill bit is eccentric and can be removed from the center of the casing to allow sampling of the material below the bit penetration depth.

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 procedure. In many cases, 2" O.D., 1 3/8" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140 pound 30 inch free fall drop hammer required to advance the samplers in 6 inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2 or 3 inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per foot on the logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587). Where samples of rock are required, they are obtained by NX diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings.

Continuous Penetration Tests Continuous penetration tests are performed by driving a 2" O.D. blunt nosed penetrometer adjacent to or in the bottom of borings. The penetrometer is attached to 1 5/8" O.D. drill rods to provide clearance to minimize side friction so that penetration values are as nearly as possible a measure of end resistance. Penetration values are recorded as the number of blows of a 140 pound 30 inch free fall drop hammer required to advance the penetrometer in one foot increments or less.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487) with appropriate group symbols being shown on the logs.

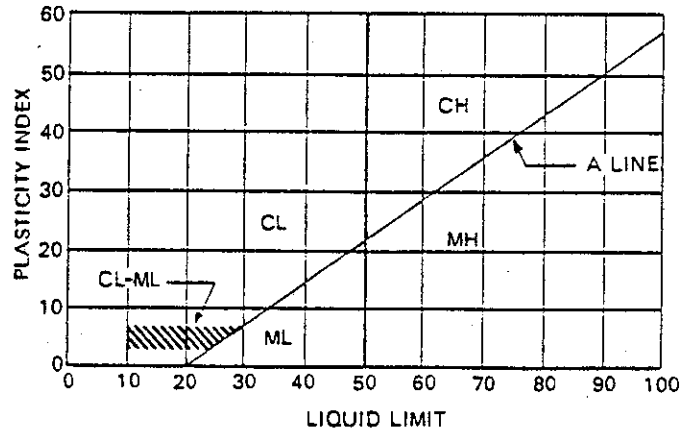
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the Unified Soil Classification system on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" Corp of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-66T.

MAJOR DIVISIONS			GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)		GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
				GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve) — Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve) — Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)		SW	Well graded sands, gravelly sands.
				SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve) — Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
		SANDS WITH FINES (More than 12% passes No. 200 sieve) — Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (Limits plot below "A" line & hatched zone on plasticity chart)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)		ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CLAYS (Limits plot above "A" line & hatched zone on plasticity chart)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)		CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

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.

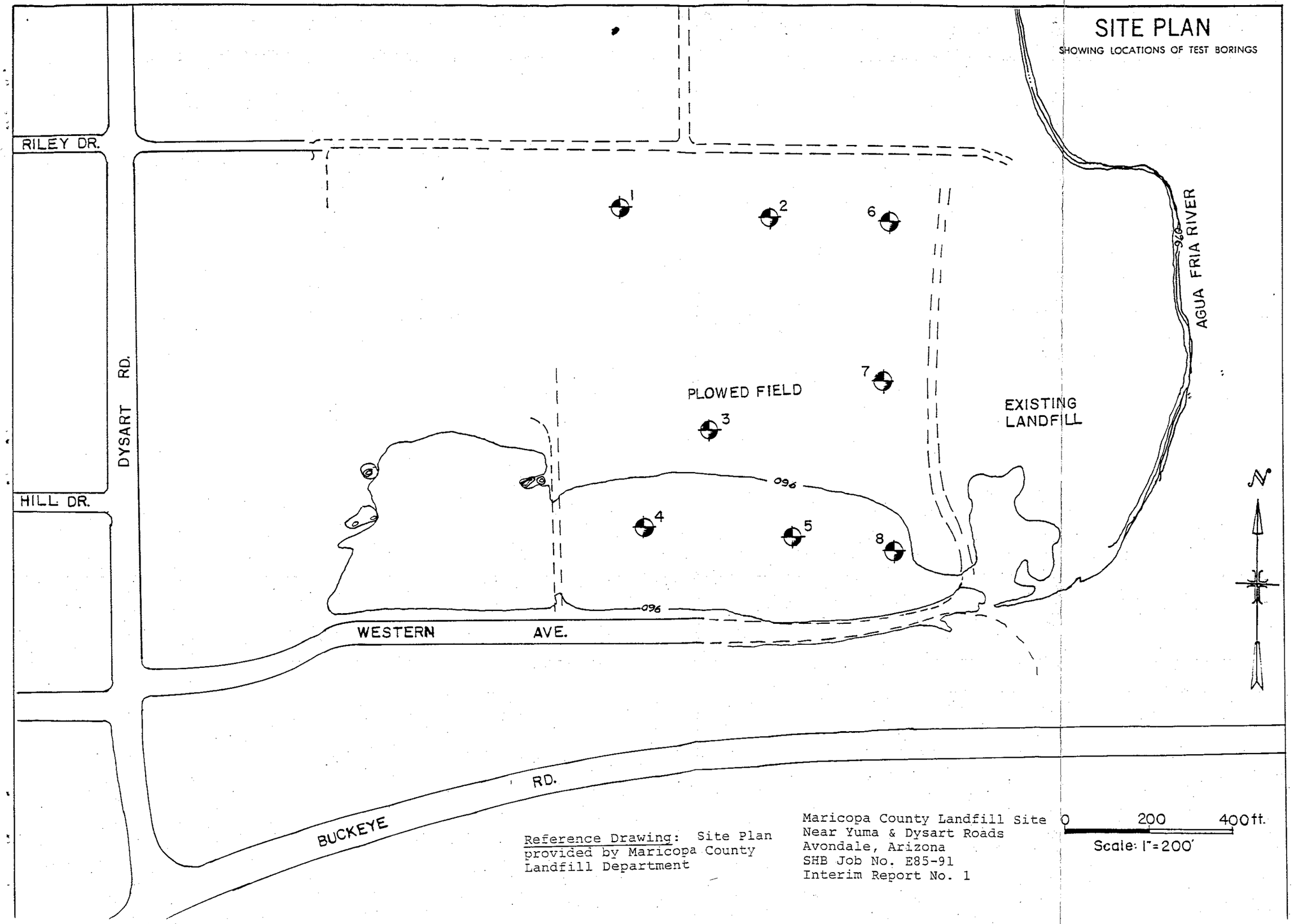
N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
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

SITE PLAN

SHOWING LOCATIONS OF TEST BORINGS



Reference Drawing: Site Plan provided by Maricopa County Landfill Department

Maricopa County Landfill Site
Near Yuma & Dysart Roads
Avondale, Arizona
SHB Job No. E85-91
Interim Report No. 1

0 200 400ft.

Scale: 1"=200'

PROJECT Maricopa County Landfills

LOG OF TEST BORING NO. 6

JOB NO. E85-91 DATE 12-18-85

RIG TYPE CME-55
BORING TYPE 6½" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								ML	slightly moist moderately firm	SANDY SILT, very fine grained sand, nonplastic, light brown
				S	10					
5				S	10		27	CH	slightly moist moderately firm	SILTY CLAY, trace to some fine grained sand, high plasticity, brown
10				S	14			SP	slightly moist medium dense	SILTY SAND, predominantly fine to medium grained, angular, nonplastic, brown note: trace of coarse grained gravel at 12' to 13' & 18'
				S	24					
20				S	33			GP	slightly moist loosed to dense	GRAVEL, considerable sand, poorly graded, subangular to rounded, nonplastic, brown note: saturated below groundwater table
25				S	12					
30				S	43					
35				S	118					
40				S	50/4"					
45										Stopped auger at 39'6" Sampler refused at 40'4"

GROUND WATER

DEPTH	HOUR	DATE
34'3"	10:25a	12-18

SAMPLE TYPE
A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT Maricopa County Landfills

LOG OF TEST BORING NO. 7

JOB NO. E85-91 DATE 12-18-85

RIG TYPE CME-55
BORING TYPE 6½" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								ML	slightly moist firm	SANDY SILT, very fine grained sand, nonplastic, light brown
				S	28					
5				S	24		13		slightly moist loose to medium dense	SAND, trace of gravel, predominantly fine & medium grained, subangular, nonplastic, light brown to gray
								SP		
10				S	9		3			
15				S	58		2	GP	slightly moist dense to very dense	SILTY GRAVEL, considerable sand, predominantly fine grained, rounded gravel, subangular sand, nonplastic, brown
20				S	18		5	SP	slightly moist medium dense	SILTY SAND, predominantly fine grained, subangular, nonplastic, brown
25				S	41				slightly moist medium dense to dense	SILTY GRAVEL, considerable sand, predominantly fine grained, rounded gravel, subangular sand, nonplastic, brown note: saturated below groundwater table
30				S	53		1	GP		
35				S	22					
40				S	28		11			
45										Stopped auger at 39'6" Stopped sampler at 41'

GROUND WATER

DEPTH	HOUR	DATE
33'	11:45a	12-18

SAMPLE TYPE
A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT Maricopa County Landfills

JOB NO. E85-91 DATE 12-18-85

LOG OF TEST BORING NO. 8

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									dry soft	SANDY SILT, very fine grained sand, nonplastic, light brown
				S	8			ML		
5				S	7				note: 6" layers of fine grained sand at 3' & 4'	
									dry loose to medium dense	SILTY SAND, predominantly fine to medium grained, subangular, nonplastic, light brown
								SP		
10				S	20					
15				S	26			GP	slightly moist medium dense	SILTY GRAVEL, considerable sand, predominantly fine grained, nonplastic, brown
								SP		
20				S	7				slightly moist loose	CLAYEY SAND, predominantly fine to medium grained, nonplastic, reddish brown
									moist dense to very dense	SILTY GRAVEL, considerable sand, predominantly fine to medium grained, nonplastic, brown
25				S	51					
30				S	57			GP	note: saturated below groundwater table	
35				S	52					
40				S	146					
45										Stopped auger at 39'6" Sampler refused at 40'9"

GROUND WATER

DEPTH	HOUR	DATE
31'2"	1:25p	12-18

SAMPLE TYPE

A – Auger cuttings. B – Block sample S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E85-91
W/O 3

HOLE NO	DEPTH	UNIFIED CLASS	L.L.	P.I.	SIEVE ANALYSIS-ACCUM % PASSING												LAB NO
					#200	#100	#50	#40	#30	#16	#10	#8	#4	.25"	.375"	.5"	
					.75"	1"	1.5"	2"	2.5"	3"	3.5"	4"	6"	8"	10"	12"	
6	4.5'-6.0'	CH	68	43	87	95	98	98	99	99	99	99	100				5-91-43
7	9.5'-11'	SP	-	NP	1.8	3	16	38	63	89	94	95	98	98	100		5-91-53
7	14.5'-16'	GP	22	2	4.5	6	8	11	14	29	38	40	48	52	63	68	
					71	82	100										5-91-54
7	19.5'-21'	SP-SM	-	NP	7.9	10	17	33	57	89	95	96	97	97	98	100	5-91-55
7	29.5"-31'	GP	-	NP	2.4	3	4	5	6	7	9	10	13	14	18	18	
					29	52	100										5-91-57

TEST DRILLING EQUIPMENT & PROCEDURES

Drilling Equipment Truck-mounted CME-55 drill rigs powered with 4 or 6 cylinder Ford industrial engines are used in advancing test borings. The 4 cylinder and 6 cylinder engines are capable of delivering about 4,350 and 6,500 foot/pounds torque to the drill spindle, respectively. The spindle is advanced with twin hydraulic rams capable of exerting 12,000 pounds downward force. Drilling through soil or softer rock is performed with 6 1/2 O.D., 3 1/4 I.D. hollow stem auger or 4 1/2 inch continuous flight auger. Carbide insert teeth are normally used on the auger bits so they can often penetrate rock or very strongly cemented soils which require blasting or very heavy equipment for excavation. Where refusal is experienced in auger drilling, the holes are sometimes advanced with tricone gear bits and NX rods using water or air as a drilling fluid. Where auger and tricone gear bits cannot be used to advance the hole due to cobbles or caving conditions, the ODEX (overburden drilling with the eccentric method) is used. A percussion down-the-hole hammer underreams the hole and 5 inch steel casing is introduced into the hole during drilling. The drill bit is eccentric and can be removed from the center of the casing to allow sampling of the material below the bit penetration depth.

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 procedure. In many cases, 2" O.D., 1 3/8" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140 pound 30 inch free fall drop hammer required to advance the samplers in 6 inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2 or 3 inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per foot on the logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587). Where samples of rock are required, they are obtained by NX diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings.

Continuous Penetration Tests Continuous penetration tests are performed by driving a 2" O.D. blunt nosed penetrometer adjacent to or in the bottom of borings. The penetrometer is attached to 1 5/8" O.D. drill rods to provide clearance to minimize side friction so that penetration values are as nearly as possible a measure of end resistance. Penetration values are recorded as the number of blows of a 140 pound 30 inch free fall drop hammer required to advance the penetrometer in one foot increments or less.

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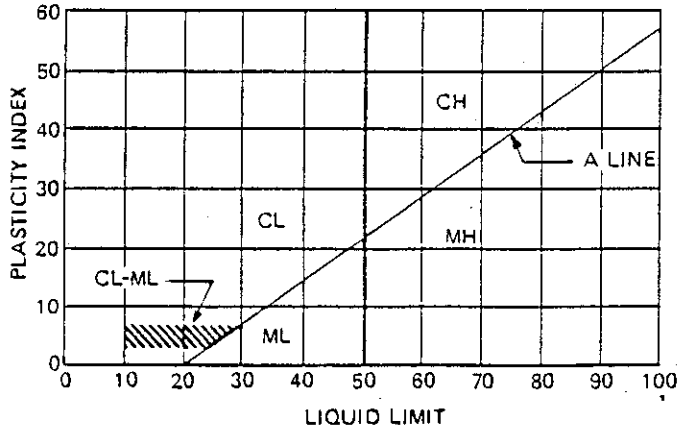
Soils are visually classified by the Unified Soil Classification system on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" Corp of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-66T.

MAJOR DIVISIONS			GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)		GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
				GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve) — Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve) — Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)		SW	Well graded sands, gravelly sands.
				SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve) — Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
		SANDS WITH FINES (More than 12% passes No. 200 sieve) — Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (Limits plot below "A" line & hatched zone on plasticity chart)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)		ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CLAYS (Limits plot above "A" line & hatched zone on plasticity chart)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)		CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

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.

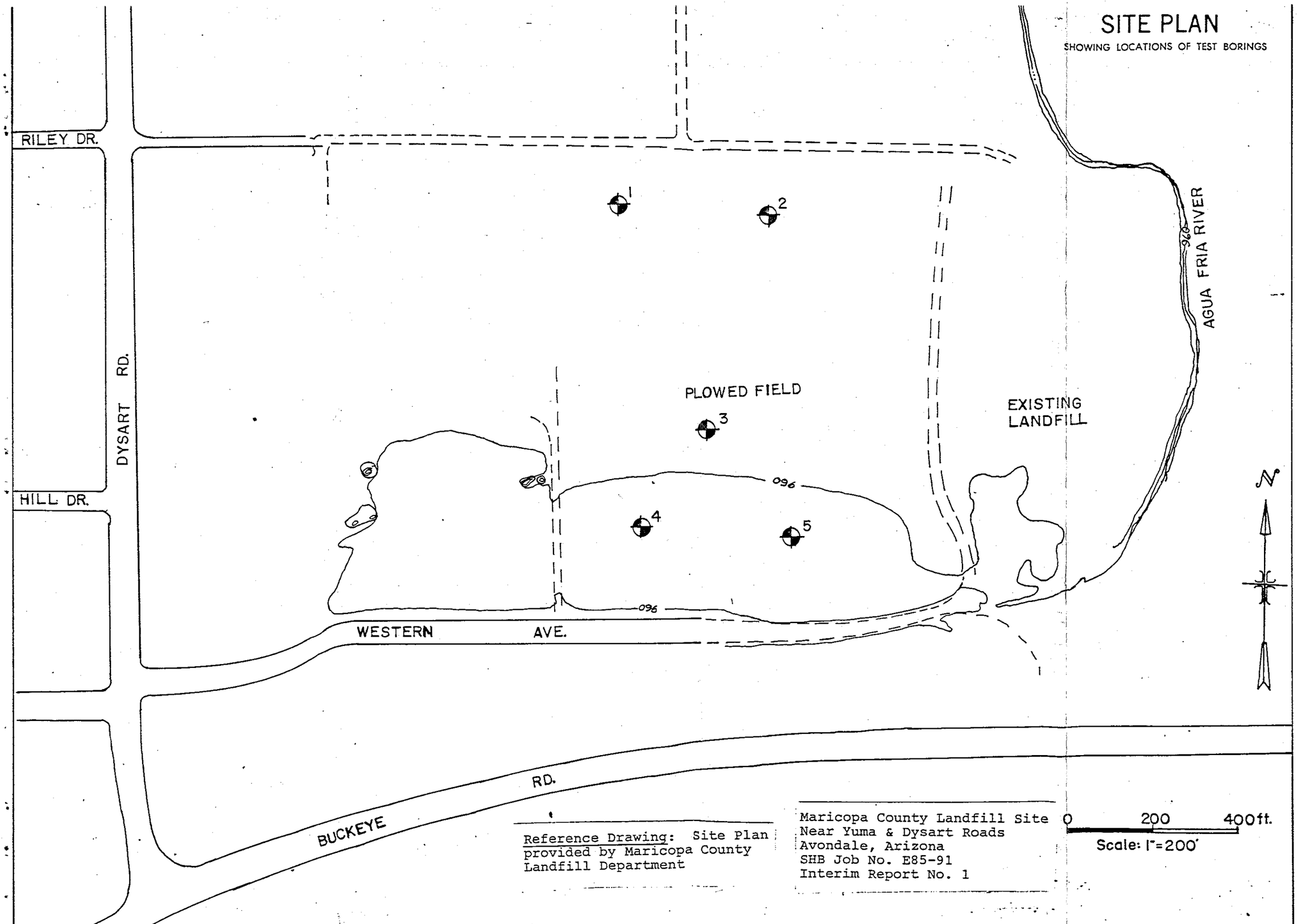
N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
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

SITE PLAN

SHOWING LOCATIONS OF TEST BORINGS



Reference Drawing: Site Plan provided by Maricopa County Landfill Department

Maricopa County Landfill Site
Near Yuma & Dysart Roads
Avondale, Arizona
SHB Job No. E85-91
Interim Report No. 1

0 200 400ft.

Scale: 1"=200'

PROJECT Maricopa County Landfills

JOB NO. E85-91 DATE 5-9-85

LOG OF TEST BORING NO. 1

RIG TYPE CME-75

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 961.4'

DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	9			SM	slightly moist to moist very soft to soft	SILTY SAND, predominantly fine grained, subrounded, nonplastic, brown note: small amount of silt below 2' note: trace of gravel, slightly coarser grained sand at 5'
5			X	S	8					
10			X	S	14			SP-SM	moist moderately firm to hard	GRAVELLY SAND, small amount of silt, gap graded, angular to subangular, lenticular, nonplastic, brown note: well graded below 8' note: trace to small amount of orangish brown silt below 15' note: very weakly lime cemented at 21' note: coarse grained subrounded gravel, trace of cobbles below 21'
15			X	S	52					
20			X	S	60		5			
25			=	S	50/3" (no recovery)					
30			X	S	37			SP & GP	moist to very moist dense to very dense	SAND, considerable gravel, small amount of cobbles, trace of silt, poorly graded, subangular to subrounded, nonplastic, brown
35			X	S	43		7			
40										Auger refused at 39'

GROUND WATER

DEPTH	HOUR	DATE
33'	10:00a	5-9
34'	2:30p	5-10

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS
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PROJECT Maricopa County Landfills

JOB NO. E85-91 DATE 5-9-85

LOG OF TEST BORING NO. 2

RIG TYPE CME-75

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 961.6'

DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			☒	S	7		8		slightly moist	SANDY SILT, nonplastic, brown
								ML	soft to moderately firm	
5			☒	S	14					
									slightly moist to very moist	SAND, trace to small amount of silt, predominantly medium grained, angular to subangular, lenticular, nonplastic, brown
10			☒	S	32				very firm to hard	
15			☒	S	71		5			note: some gravel, small amount of silt below 13'
										note: lenses of sand & gravelly sand throughout
20			☒	S	62			SP-SM		note: trace to small amount of cobbles below 25'
25			☒	S	72		4			
30			☒	S	71					
35			☒	S	34					
										Stopped auger at 34'6" Stopped sampler at 36'
40										Hole caved to 13'6"

GROUND WATER

DEPTH	HOUR	DATE
34'	2:00p	5-9

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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PROJECT Maricopa County Landfills

JOB NO. E85-91 DATE 5-9-85

LOG OF TEST BORING NO. 3

RIG TYPE CME-75

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 959.8'

DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									moist soft to moderately firm	SANDY SILT, nonplastic, brown note: dark brown silty clay lens from 4' - 5', high plasticity, firm
				S	10		10	ML		
5				S	12					
10				S	11		2		slightly moist to very moist loose to very dense	SAND, considerable gravel, trace of silt, predominantly medium grained, angular to subrounded, lenticular, nonplastic, brown note: trace to small amount of orangish brown silt below 14' note: lenses of sand & gravelly sand throughout note: trace of cobbles below 27'
15				S	36					
								SP		
20				S	48					
25				S	77					
30				S	50/3" (no recovery)					
35										Auger refused at 31' Hole caved to 12'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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PROJECT Maricopa County Landfills

JOB NO. E85-91 DATE 5-10-85

LOG OF TEST BORING NO. 4

RIG TYPE CME-75

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 959.5'

DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	7			ML	slightly moist very soft to soft	SANDY SILT, nonplastic, brown
								SP		
5				S	12		27	CH	moist loose	SAND, trace of silt, very fine grained, sub-angular to rounded, nonplastic, brown
10				S	9				very moist soft to moderately firm	SILTY CLAY, trace of fine grained sand, high plasticity, dark brown
15				S	55				slightly moist to very moist moderately firm to hard	SAND, trace of fine grained gravel & silt, predominantly fine to medium grained, angular to subrounded, lenticular, nonplastic, light brown to brown note: small amount of silt below 15', considerable gravel from 15' - 17' note: lenses of sand & gravelly sand throughout note: clean sand lens at 19'6" - 20'6", gravelly sand lens below 20'6" note: trace to small amount of cobbles below 22' note: some cobbles below 25' note: trace of gravel at 40'
20				S	15			SP-SM		
25				S	50/2" (no recovery)					
30				S	21		3			
35				S	31					
40				S	22		23			
45										Auger refused at 42' Hole caved to 13'

GROUND WATER

DEPTH	HOUR	DATE
34'	10:00a	5-10

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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JOB NO. E85-91 DATE 5-10-85

LOG OF TEST BORING NO. 5

RIG TYPE CME-75

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 959.2'

DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	15			SM	slightly moist very soft to moderately firm	SILTY SAND, predominantly very fine grained, subangular to subrounded, nonplastic, brown
5			X	S	24			CH	very moist firm	SILTY CLAY, trace of fine grained sand, medium plasticity, dark brown
10			X	S	15			SP-SM	slightly moist to moist moderately firm to very firm	SAND, trace to considerable gravel, trace to small amount of cobbles & silt, predominantly fine to medium grained, angular to subrounded, lenticular, nonplastic, brown to reddish brown note: some orangish brown silt at 15'
15			X	S	31		8			
20			X	S	15		11	SC		
25			X	S	24				moist moderately firm	CLAYEY SAND, trace of fine grained gravel, predominantly fine to medium grained, angular to subrounded, low plasticity, brown
30			X	S	2(no recovery)			SP-SM	moist to very moist moderately firm to hard	SAND, trace to considerable gravel, trace to small amount of cobbles & silt, predominantly fine to medium grained, angular to subrounded, lenticular, nonplastic, brown to reddish brown
35			X	S	68					
40										Auger refused at 39' Hole caved to 23'

GROUND WATER

DEPTH	HOUR	DATE
32'	1:00p	5-10

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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TABULATION OF TEST RESULTS

Job No. E85-91

HOLE NO	DEPTH	UNIFIED CLASS	L.L.	P.I.	SIEVE ANALYSIS-ACCUM % PASSING												LAB NO
					#200 .75"	#100 1"	#50 1.5"	#40 2"	#30 2.5"	#16 3"	#10 3.5"	#8 4"	#4 6"	.25" 8"	.375" 10"	.5" 12"	
1	19.5'-21'	SP-SM	21	NP	7.2 82	11 100	18	29	39	53	60	62	69	72	78	82	5-91-5
1	34.5'-36'	GP-GM	*NA	-	5.6 67	7 89	10 100	13	17	28	33	35	42	45	51	58	5-91-7
2	0.5'-2'	ML	28	NP	79	99	99	100									5-91-8
2	14.5'-16'	SW-SM	24	NP	10 88	12 88	16 100	20	25	39	49	53	64	70	79	84	5-91-11
2	24.5'-26'	SP	-	NP	4.4 85	7 100	12	23	29	63	68	69	72	74	77	79	5-91-13
3	0.5'-2'	ML	29	NP	79	95	99										5-91-16
3	9.5'-11'		NA	-	2.9 91	5 100	11	18	29	56	67	70	78	81	84	87	5-91-18
4	4.5'-6'	CH	75	48	98	99	100										5-91-23
4	29.5'-31'	SP	-	NP	3.9 89	8 100	12	26	43	62	68	70	74	75	81	85	5-91-27
4	39.5'-41'	SP-SM	-	NP	7.4	14	41	69	84	94	96	98	99	99	100		5-91-29
5	14.5'-16'	SM	26	NP	13 93	19 100	35	51	66	83	87	88	89	89	90	93	5-91-33
5	19.5'-21'	SC	32	14	30	35	43	52	67	86	91	92	95	96	97	100	5-91-34

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E85-91

HOLE NO	DEPTH	MOISTURE CONTENT	LAB NO
1	19.5'-21'	5 %	5-91-5
1	34.5'-36'	6.6 %	5-91-7
2	0.5'-2'	7.8 %	5-91-8
2	14.5'-16'	4.5 %	5-91-11
2	24.5'-26'	3.6 %	5-91-13
3	0.5'-2'	9.8 %	5-91-16
3	9.5'-11'	1.9 %	5-91-18
4	4.5'-6'	27.1 %	5-91-23
4	29.5'-31'	3.2 %	5-91-27
4	39.5'-41'	23.4 %	5-91-29
5	14.5'-16'	8.2 %	5-91-33
5	19.5'-21'	10.6 %	5-91-34