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REPORT ON GEOTECHNICAL INVESTIGATION

DESIGNATION: Parkwood Basin-Assignment #4

LOCATION: NEC Crismon Rd. & Southern Ave.
Maricopa County, Arizona

A024.904

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REPORT ON GEOTECHNICAL INVESTIGATION

DESIGNATION: Parkwood Basin-Assignment #4

LOCATION: NEC Crismon Rd. & Southern Ave.
Maricopa County, Arizona

CLIENT: Flood Control District of Maricopa County

PROJECT NO: 990194SA

DATE: March 29, 1999

Registered Professional Engineer (Civil)
CERTIFICATE NO. 14388
GREGG ALAN CREASER
Date Signed 3-29-99
ARIZONA, U.S.A.

TABLE OF CONTENTS

PAGE

INTRODUCTION 1

GENERAL SITE AND SOIL CONDITIONS 1
- Site Conditions 1
- General Subsurface Condition 1

ANALYSIS AND RECOMMENDATIONS 1
- Analysis 1
- Site Preparation 2
- Excavation And Temporary Cut Slopes 2
- Foundation Design 2
- Lateral Pressures 3
- Fill And Backfill 3
- Utilities Installation 4

GENERAL 4

APPENDIX

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INTRODUCTION

This report presents the results of a subsoil investigation carried out at the proposed Parkwood Basin located at the northeast corner of Southern Avenue and Crismon Road in Maricopa County, Arizona.

Preliminary information calls for the construction of an 18.5 acre flood control detention basin at the northeast corner of Southern Avenue and Crismon Road. The depth of the basin is on the order of 10 to 12 feet deep. Side slopes are expected to be on the order of 4h:1v to 5h:1v. A drainage-type structure, such as a headwall, is to be located in the southeast corner of the site.

GENERAL SITE AND SOIL CONDITIONS

Site Conditions - The site is bounded on the north by a school, the east by a city park, the west by contiguous vacant land and on the south by Southern Avenue. Vegetation present at the time of investigation includes a few trees, desert brush and grasses and weeds. The site trends to the southeast. A drainage structure is present under Southern Avenue. An earth-lined drainage channel is located on the north side of the site. A large fill pile was present on the northeast corner of the site with smaller debris piles nearby.

General Subsurface Conditions - Subsoil conditions encountered in the borings within the basin area comprise interbedded clayey sand and sand/silty sand to depths of up to 21 feet below grade. No groundwater was encountered during the investigation. The soils were described as being in a "dry" state at the time of investigation based on visual and tactile observation.

Dry densities within the upper 10 feet range from 93 to 115 pcf at 3 to 9 percent moisture content. Compression testing of the upper soils indicates that they are susceptible to additional settlement due to inundation ("hydro-consolidation") under typical foundation loading conditions. The upper clayey soils exhibit volume increase due to wetting of less than 1 percent when slightly undercompacted at optimum moisture content.

ANALYSIS AND RECOMMENDATIONS

Analysis - Excavation for the 10 to 12 foot deep basin is expected to terminate within the clayey sand or sand/silty sand. The sandier units should provide a medium suitable for percolation of storm water. The more clayey units will restrict vertical water movement thereby impeding percolation rates.

Analysis of the field and laboratory data indicates that subsoils at the site are generally favorable for the support of the proposed headwall structure on shallow foundations.

Excavation operations in general should be relatively straightforward using conventional equipment Open-cut excavation for the basin with side slopes of 4h:1v to 5h:1v appears to be feasible. Temporary cut slopes for construction of the headwall should be laid back at 1.5h:1v.

No groundwater was encountered during this investigation. Hence, groundwater is not expected to be a factor during construction.

Site Preparation - The entire area to be occupied by the proposed construction should be stripped of all vegetation, debris, rubble and obviously loose surface soils.

If grading plans require placing structural fill below footing bottom elevation, the exposed grade should be scarified to a depth of 8 inches, moisture conditioned to optimum (± 2 percent) and compacted to at least 95 percent of maximum dry density as determined by ASTM D-698.

Excavation And Temporary Cut Slopes - All excavations must comply with current governmental regulations including the current OSHA Excavation and Trench Safety Standards. Side slopes for open-cut excavation for the headwall structure should be cut back at 1.5h:1v. The slopes should be protected from erosion due to run-off or long term surcharge at the slope crest. Construction equipment, building materials, excavated soil and vehicular traffic should not be allowed within 10 feet or ⅓ the slope height, whichever is greater, from the top of slope. All cut slopes should be observed by the Soils Engineer during excavation. Adjustments to the recommended slopes may be necessary due to wet zones, loose strata and other conditions not observed in the borings. Localized shoring may also be required. Shotcrete or soil stabilizer on the slope face may be useful in preventing erosion due to run-off and/or drying of the slope.

Foundation Design - It is recommended that the headwall structure be founded on shallow spread footings bearing on native soil at a minimum depth of 18 inches below lowest, finished exterior grade within 5 feet of the structure. If site preparation is carried out as set forth herein, a recommended safe allowable bearing capacity of 1,500 psf can be utilized for design. This bearing capacity refers to the total of all loads, dead and live, and is a net pressure. It may be increased one-third for wind, seismic or other loads of short duration. These values may be increased by one-third as the allowable toe pressure for retaining walls. All footing excavations should be level and cleaned of all loose or disturbed materials. **Positive drainage away from the proposed building must be maintained at all times.**

Continuous wall footings and isolated rectangular footings should be designed with minimum widths of 16 and 24 inches respectively, regardless of the resultant bearing pressure.

Estimated settlements under design loads are on the order of ½ to ¾-inch, virtually all of which will occur during construction. Post-construction differential settlements will be negligible, under existing and compacted moisture contents. Additional localized settlements of the same magnitude could occur if native supporting soils were to experience a significant increase in moisture content. Positive drainage away from structures **must** be provided to prevent ponding adjacent to perimeter walls.

Continuous footings and stem walls should be reinforced to distribute stresses arising from small differential movements, and long walls should be provided with control joints to accommodate these movements.

Lateral Pressures - The following lateral pressure values may be utilized for the proposed construction:

Active Pressure	
Unrestrained Walls	35 pcf
Restrained Walls	60 pcf
Passive Pressure	
Continuous Footings	350 pcf
Spread Footings or Drilled Piers	400 pcf
Coefficient of Friction (With Passive Pressure)	0.35
Coefficient of Friction (Without Passive Pressure)	0.45

All backfill must be compacted to not less than 95 percent (ASTM D-698) to mobilize these passive values at low strain.

Fill And Backfill - Depending on proposed use and placement, the excavated soils may be suitable for use as engineered fill on other projects. The more clayey soils may not be suitable for fill directly under slabs on grade. The sandy soils would likely be suitable for use as common borrow.

Native soils are considered suitable for use in general onsite grading and as new pipeline trench backfill. The more clayey soils should not be used to backfill over-excavated areas in the basin, particularly where the more sandy soils have been exposed, as they will impede percolation of storm water. The materials to be

removed during excavation of the basin appear suitable for use on off-site projects, particularly the sands/silty sands. The use of more clayey soils may be somewhat limited due to the percentage of fines.

Fill should be placed on subgrade which has been properly prepared and approved by a Soils Engineer. Fill must be wetted and thoroughly mixed to achieve optimum moisture content, ±2 percent. Fill should be placed in horizontal lifts of 8-inch thickness (or as dictated by compaction equipment) and compacted to the percent of maximum dry density per ASTM D-698 set forth as follows:

A.	Building Areas		
	1.	Below footing level	95
B.	Utility Trench Backfill		
	1.	More than 2.0' below finish S/G	90
	2.	Within 2.0' of finish S/G	95
C.	Landscape Areas		
	1.	Miscellaneous fill	90
	2.	Utility trench - more than 1.0' below F/G	85
	3.	Utility trench - within 1.0' of F/G	90

Utilities Installation - Trench excavations for shallow utilities may be accomplished by conventional trenching equipment. Trench walls should stand near-vertical for the short periods of time required to install utilities. Trenches penetrating the sandier deposits may experience sloughing necessitating the cutting back of side slopes and/or shoring. See "Excavation And Temporary Cut Slopes" section of report. Adequate precautions must be taken to protect workmen in accordance with all government regulations.

Backfill of trenches may be carried out with native excavated soils above the utility bedding line. The native clay soils may not be suitable for bedding depending on the type of material being installed. The native soil used for fill material should be moisture-conditioned, placed in 8 inch lifts and mechanically compacted. Water settling is not recommended. Compaction requirements are summarized in the "Fill And Backfill" section of this report.

GENERAL

The scope of this investigation and report does not include regional considerations such as seismic activity and ground fissures resulting from subsidence due to groundwater withdrawal, nor any considerations of hazardous releases or toxic contamination of any type.

Our analysis of data and the recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific sample locations. Our work has been performed in accordance with generally accepted engineering principles and practice; this warranty is in lieu of all other warranties expressed or implied.

We recommend that a representative of the Soils Engineer observe and test the earthwork portions of this project to ensure compliance to project specifications and the field applicability of subsurface conditions which are the basis of the recommendations presented in this report. If any significant changes are made in the scope of work or type of construction that was assumed in this report, we must review such revised conditions to confirm our findings if the conclusions and recommendations presented herein are to apply.

Respectfully submitted,
SPEEDIE & ASSOCIATES, INC.

Registered Professional Engineer (Civil)
CERTIFICATE NO. 30524
PRABHAKAR RUPAL
Date Signed 3-29-99
ARIZONA, U.S.A.

Prabhakar (Peter) Rupal, P.E.

Registered Professional Engineer (Civil)
CERTIFICATE NO. 14388
GREGG ALAN CREASER
Date Signed 3-29-99
ARIZONA, U.S.A.

Gregg A. Creaser, P.E.

APPENDIX

FIELD AND LABORATORY INVESTIGATION

SOIL BORING LOCATION PLAN

SOIL LOG LEGEND

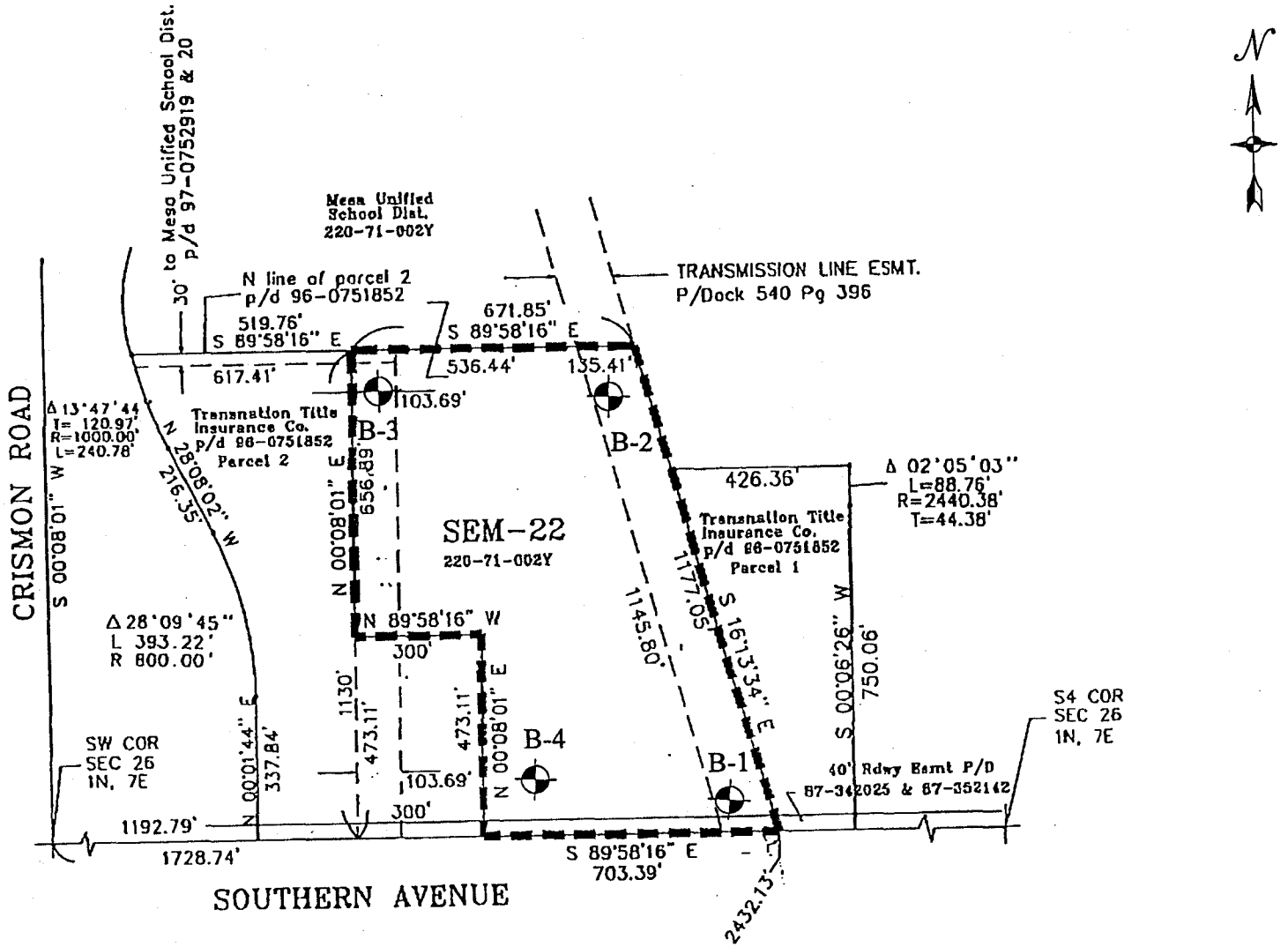
LOG OF TEST BORING

TABULATION OF TEST DATA

FIELD AND LABORATORY INVESTIGATION

On March 8, 1999, soil test borings were drilled at the approximate locations shown on the attached Soil Boring Location Plan. All exploration work was carried out under the full-time supervision of our staff geologist, who recorded subsurface conditions and obtained samples for laboratory testing. The soil borings were advanced with a truck-mounted CME-55 drill rig utilizing 7-inch diameter hollow stem flight augers. Detailed information regarding the borings and samples obtained can be found on an individual Log of Test Boring prepared for each drilling location.

Laboratory testing consisted of moisture content, dry density, grain-size distribution and plasticity (Atterberg Limits) tests for classification and design parameters. All field and laboratory data is presented in this appendix.



Approximate Soil Boring Location

Approximate Soil Boring Location Plan	
Parkwood Basin NEC Crismon Rd. & Southern Ave. Mesa, Arizona	SPEEDIE AND ASSOCIATES GEOTECHNICAL / ENVIRONMENTAL / MATERIALS ENGINEERS PROJECT NO. 990194SA

SOIL LEGEND

SAMPLE DESIGNATION	DESCRIPTION	
AS	Auger Sample–	A grab sample taken directly from auger flights.
BS	Large Bulk Sample–	A grab sample taken directly from auger flights.
S	Spoon Sample–	Standard Penetration Test (ASTM D–1586) Driving a 2.0 inch outside diameter split spoon sampler into undisturbed soil for three successive 6–inch increments by means of a 140 lb. weight free falling through a distance of 30 inches. The cumulative number of blows for the final 12 inches of penetration is the Standard Penetration Resistance (N).
RS	Ring Sample–	Driving a 3.0 inch outside diameter spoon equipped with a series of 2.42 inside diameter, 1 inch long brass rings, into undisturbed soil for one 12 inch increment by the same means of the Spoon Sample. The blows required for the 12 inches of penetration are recorded.
LS	Liner Sample–	Standard Penetration Test driving a 2.0 inch outside diameter split spoon equipped with two 3 inch long, ⅜ inch inside diameter brass liners, separated by a 1 inch long spacer, into undisturbed soil by the same means of the spoon sample.
ST	Shelby Tube–	A 2.0 inch outside diameter thin–walled tube continuously pushed into undisturbed soil by a rapid motion, without impact or twisting (ASTM D–1587).
–	Continuous Penetration Resistance–	Driving a 2.0 inch outside diameter "Bullnose Penetrometer" continuously into undisturbed soil by the same means of the spoon sample. The blows for each successive 12 inch increment are recorded.

CONSISTENCY			RELATIVE DENSITY	
Clays & Silts	Blows/Foot *	Strength †	Sands & Gravels	Blows/Foot *
Very Soft	0–2	0–0.25	Very Loose	0–4
Soft	2–4	0.25–0.5	Loose	5–10
Firm	5–8	0.5–1.0	Medium Dense	11–30
Stiff	9–15	1–2	Dense	31–50
Very Stiff	16–30	2–4	Very Dense	> 50
Hard	> 30	> 4		

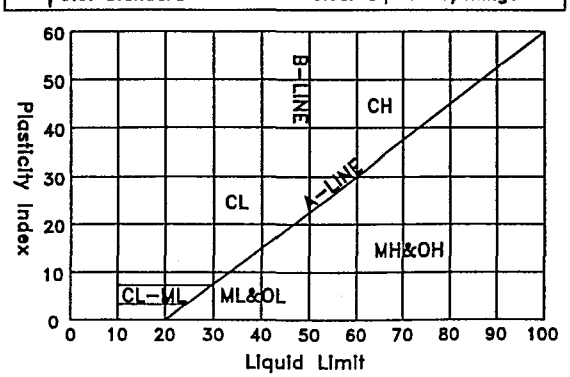
* Number of blows of a 140 lb hammer free falling 30 inches to drive a 2 inch O.D. split spoon sampler (ASTM D–1586)

† Unconfined compressive strength in tons/sq ft. Read from a pocket penetrometer.

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
Coarse Grained Soils More than 50% of material is larger than #200 sieve size	Gravel and Gravelly Soils 50% Coarse Fraction is > #4 Sieve Size	Clean Gravels		GW	Well Graded Gravels
				GP	Poorly Graded Gravels
		Gravels w/ Fines		GM	Silty Gravels
				GC	Clayey Gravels
	Sand and Sandy Soils 50% Coarse Fraction is < #4 Sieve Size	Clean Sands		SW	Well Graded Sands
				SP	Poorly Graded Sands
		Sands w/ Fines		SM	Silty Sand
				SC	Clayey Sand
Fine Grained Soils More than 50% of material is smaller than #200 sieve size	Silts and Clays Liquid Limit is less than 50%			ML	Inorganic Silts, Low P.I.
				CL	Inorganic Clays, Low P.I.
				OL	Organic Silts, High P.I.
	Silts and Clays Liquid Limit is greater than 50%			MH	Inorganic Silts, High P.I.
				CH	Inorganic Clays, High P.I.
				OH	Organic Clays, High P.I.
Highly Organic Soils				PT	Peat and Humus, Highly Organic

MATERIAL SIZE	PARTICLE SIZE			
	Lower Limit		Upper Limit	
	mm	Sieve Size †	mm	Sieve Size †
Sands				
Fine	.075	#200	0.42	#40
Medium	0.42	#40	2.00	#10
Coarse	2.00	#10	4.76	#4
Gravels				
Fine	4.76	#4	191	¾" ∘
Coarse	191	¾" ∘	762	3" ∘
Cobbles	762	3" ∘	304.8	12" ∘
Boulders	304.8	12" ∘	914.4	36" ∘

† U.S. Standard ∘ Clear Square Openings



Rig Type: CME-55
Boring Type: Hollow Stem Auger
Surface Elevation: N/A

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0	Medium Dense Brown CLAYEY SAND (SC-Dry)	RS-1	2.0	8.5	98.9	
3.5	Medium Dense Light Brown CLAYEY SAND (SC-Dry)	S-2	6.0	--	--	
5		S-3	11.0	--	--	
12.0	Medium Dense Brown WELL GRADED SAND (SW-Dry)	S-4	16.0	--	--	
17.0	Very Dense Brown CLAYEY SAND (SC-Dry) with Moderate Calcareous Cementation	S-5	21.0	--	--	85/12"
21.0	End of Boring					
10						
15						
20						
25						
30						

Boring Date: 3-8-99
Field Engineer/Technician: M. Polsky
Driller: R. Wood
Contractor: Heber Mining

Water Level

Depth	Hour	Date
Dry		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B- 1

Parkwood Basin

NEC Crismon Rd. & Southern Ave.

Mesa, Arizona

Project No.: 990194SA

Rig Type: CME-55
Boring Type: Hollow Stem Auger
Surface Elevation: N/A

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0	Medium Dense to Very Dense Brown CLAYEY SAND (SC-Dry) with Weak to Strong Calcareous Cementation	S-1	2.5	--	--	
		BS-2	4.5	--	--	50/4"
5		RS-3	4.8			
	8.0					
	Very Dense Light Brown WELL GRADED SAND (SW-Dry) with Trace Silt	RS-4	9.5	3.1	103.3	60/12"
10						
	13.0					
	Very Dense Light Brown SILTY SAND (SM-Dry) with Trace Gravel and Moderate Calcareous Cementation	S-5	15.3	--	--	50/4"
15						
20	20.0 End of Boring	S-6	21.0	--	--	57/12"
25						
30						

Boring Date: 3-8-99
Field Engineer/Technician: M. Polsky
Driller: R. Wood
Contractor: Heber Mining

Water Level

Depth	Hour	Date
Dry		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B- 2

Parkwood Basin

NEC Crismon Rd. & Southern Ave.

Mesa, Arizona

Project No.: 990194SA

Rig Type: CME-55
Boring Type: Hollow Stem Auger
Surface Elevation: N/A

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0–25–50)
0	Medium Dense to Very Dense Brown SILTY SAND (SM-Dry) with Trace Gravel	RS-1	2.0	6.2	92.8	
5		S-2	6.0	--	--	
10		S-3	11.0	--	--	
15		S-4	16.0	--	--	86/12"
20	20.0 End of Boring	S-5	20.0	--	--	50/6"
25						
30						

Boring Date: 3-8-99
Field Engineer/Technician: M. Polsky
Driller: R. Wood
Contractor: Heber Mining

Water Level

Depth	Hour	Date
Dry		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B- 3

Parkwood Basin

NEC Crismon Rd. & Southern Ave.

Mesa, Arizona

Project No.: 990194SA

Rig Type: CME-55
Boring Type: Hollow Stem Auger
Surface Elevation: N/A

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0	Dense Brown SILTY SAND (SM-Dry)	RS-1	2.0	--	--	
5	with Trace Gravel	RS-2	5.5	3.3	114.9	
10	Very Dense Brown SILTY SAND (SM-Dry)	S-3	11.0	--	--	51/12"
13.5	Hard Brown SANDY SILT (ML-Dry) with Moderate Calcareous Cementation	S-4	16.0	--	--	50/6"
17.0	Very Dense Light Brown SILTY SAND (SM-Dry) with Trace Gravel and Moderate Calcareous Cementation	S-5	21.0	--	--	82/12"
21.0	End of Boring					
15, 20, 25, 30						

Boring Date: 3-8-99
Field Engineer/Technician: M. Polsky
Driller: R. Wood
Contractor: Heber Mining

Water Level

Depth	Hour	Date
Dry		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B- 4

Parkwood Basin

NEC Crismon Rd. & Southern Ave.

Mesa, Arizona

Project No.: 990194SA

TABULATION OF TEST DATA

SOIL BORING or TEST PIT NUMBER	SAMPLE NUMBER	SAMPLE TYPE	DEPTH OF SAMPLE TIP	NATURAL WATER CONTENT (Percent of Dry Weight)	IN-PLACE DRY DENSITY (Pounds Per Cubic Foot)	PARTICLE SIZE DISTRIBUTION (Percent Finer)					ATTERBERG LIMITS			UNIFIED SOIL CLASSIFICATION	SPECIMEN DESCRIPTION
						#200 SIEVE	#40 SIEVE	#10 SIEVE	#4 SIEVE	3" SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
B- 1	RS-1	RS	2.0	8.5	98.9	46.1	70	88	96	100	28	17	11	SC	CLAYEY SAND
B- 1	S-4	SPT	16.0	--	--	8.8	25	64	85	100	NP	NP	NP	SW-SM	WELL GRADED SAND with SILT and GRAVEL
B- 2	BS-2	BS	4.5	--	--	22.9	42	72	88	100	50	24	26	SC	CLAYEY SAND
B- 2	RS-4	RS	9.5	3.1	103.3										
B- 3	RS-1	RS	2.0	6.2	92.8	42.6	68	89	95	100	12	18	NP	SM	SILTY SAND
B- 3	S-3	SPT	11.0	--	--	14.0	34	79	93	100	NP	NP	NP	SM	SILTY SAND
B- 4	RS-2	RS	5.5	3.3	114.9	22.2	40	71	83	100	NP	NP	NP	SM	SILTY SAND with GRAVEL
B- 4	S-3	SPT	11.0	--	--	23.2	42	73	91	100	25	21	4	SM	SILTY SAND

Sieve analysis results do not include material greater than 3". Refer to the actual boring logs for the possibility of cobble and boulder sized materials.

Parkwood Basin
NEC Crismon Rd. & Southern Ave.
Mesa, Arizona
Project No. 990194SA

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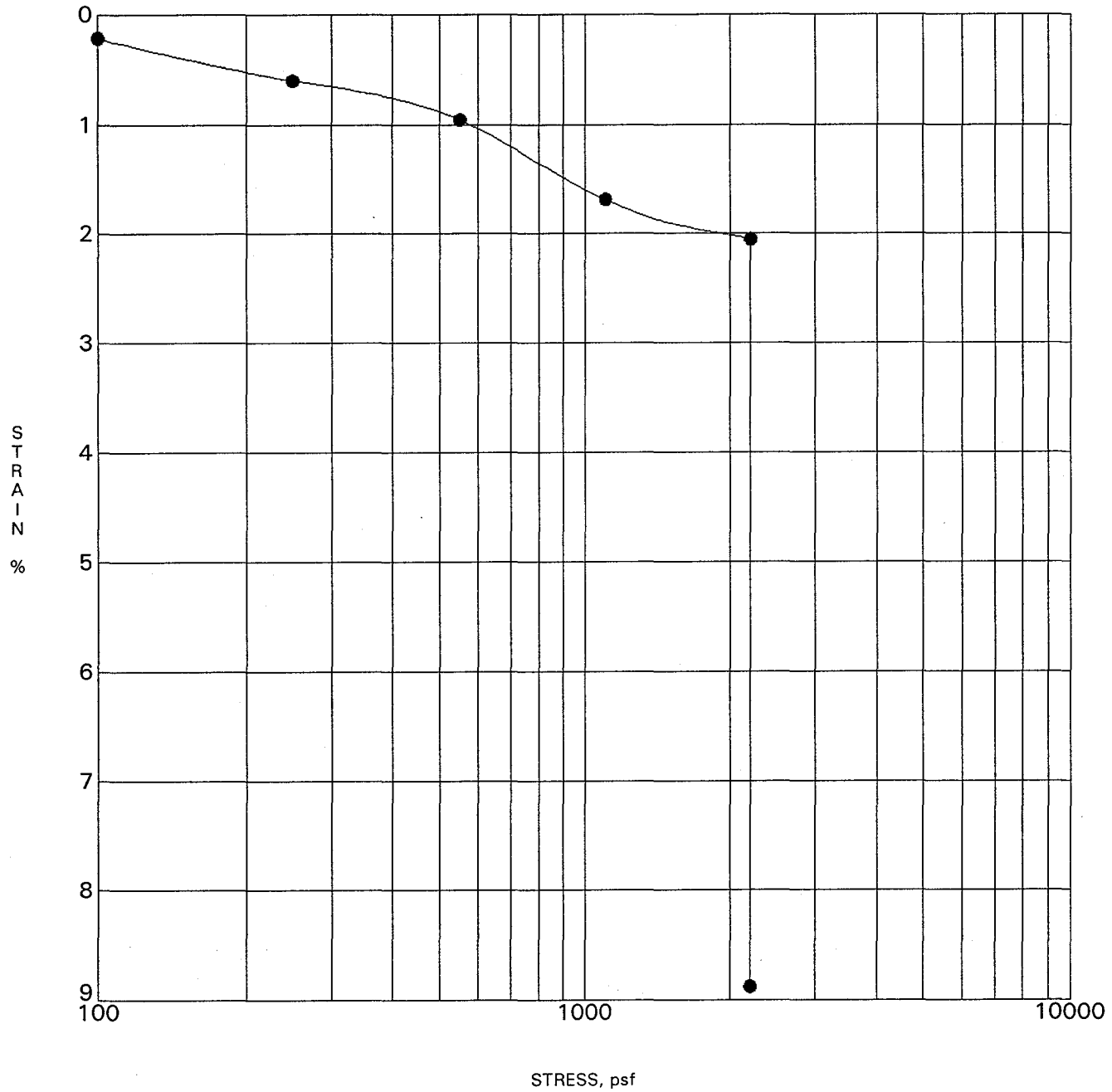
CONSOLIDATION TEST



BORING B- 1

SAMPLE No. RS-1

Sample inundated at end of test at 2200 psf

PROJECT	Parkwood Basin - NEC Crismon Rd. & Southern Ave.	JOB NO.	990194SA
		DATE	3/8/99

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MOISTURE-DENSITY RELATIONS

PROJECT: Parkwood Basin PROJECT NO.: 990194SA

LOCATION: NEC Crismon Rd. & Southern Ave. DATE: 3/8/99

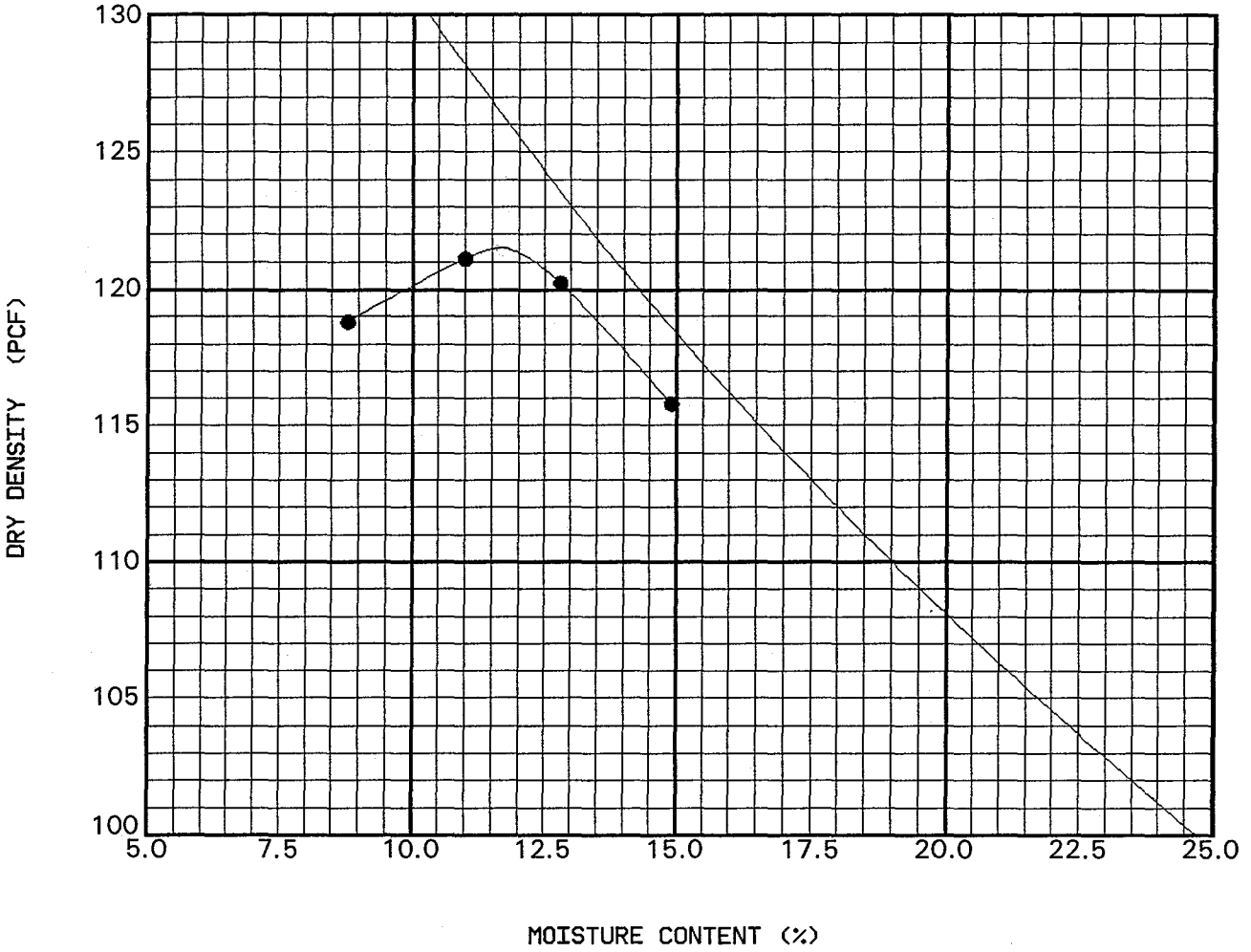
BORING NO.: B- 2 SAMPLE NO.: BS-2' SAMPLE DEPTH: 4.50

METHOD OF COMPACTION: ASTM D698A

LIQUID LIMIT: 50 PLASTIC LIMIT: 24 PLASTICITY INDEX: 25

CLASSIFICATION: SC ASTM SOIL DESCRIPTION: CLAYEY SAND

MAXIMUM DRY DENSITY: 121.5 PCF OPTIMUM MOISTURE CONTENT: 11.7 %



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SWELL TEST DATA

BORING or TEST PIT No.	SAMPLE DEPTH, ft	REMOLDED DRY DENSITY (pcf)	INITIAL MOISTURE (%)	PERCENT COMPACTION	INITIAL DEGREE of SATURATION (%)	FINAL DEGREE of SATURATION (%)	TOTAL SWELL (%)
B- 2 BS-2	4.5	113.6	11.7	93.5	68.2	86.1	0.2

PERCENT COMPACTION BASED ON A MAXIMUM DRY DENSITY OF 121.5 pcf @ 11.7 % MOISTURE

Parkwood Basin
NEC Crismon Rd. & Southern Ave.
Mesa, Arizona
Project No. 990194SA

SPEEDIE AND ASSOCIATES