

SPEEDIE AND ASSOCIATES

GEOTECHNICAL/MATERIALS/SITE ENGINEERS
11029 N. 24TH AVENUE, SUITE 805 • PHOENIX, ARIZONA 85029 • (602) 997-9391

REPORT ON GEOTECHNICAL INVESTIGATION

DESIGNATION: Casandro Wash Storm Drain

LOCATION: Casandro Wash
Wickenburg, Arizona

A343.910

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INTRODUCTION

This report presents the results of a subsoil investigation carried out at the site of a proposed storm drain to be located along the following route: from the southern corner of Navajo St. and Jackson St. southeast along Jackson St., veering to the northeast at the intersection of Jackson St. and Mohave St. continuing to the Mohave St. extension under the Atchison, Topeka, and Santa Fe Railway to a point in Casandro Wash in Wickenburg, Arizona.

It is understood that construction will consist of a storm drain to be located in Mohave Street extension under the railway to a point in Casandro Wash. The invert of the twin 48 inch pipes will be less than 15 feet deep. At this time, corrugated metal pipe (CMP), cast-in-place pipe (IPP) or reinforced concrete pipe (RCP) are being considered as pipe materials. The pipeline will be bored and jacked under the railroad.

GENERAL SITE AND SOIL CONDITIONS

Site Conditions - The site is approximately .75 miles in length. The site commences in a residential area at the corner of Navajo Street and Jackson Street, passes under the Atchison, Topeka, and Santa Fe Railway, and ends in Sol's Wash. The proposed sewer alignment is situated in mainly a residential area. The area between the railway and Sol's Wash is generally occupied by corrals. The vegetation is typical of desert wetlands.

General Subsurface Conditions - Subsoil conditions at the site are somewhat consistent. The upper soils consists of loose clayey sand, medium dense sand and silty sand, and very dense gravelly sand. These are underlain by loose sand, dense clayey sand, and very dense gravelly sand.

Laboratory testing indicates the in-place dry densities are on the order of 94 to 110 pcf. Moisture contents vary from 5 to 7 percent with plasticity indexes ranging from non-plastic (NP) to 13 percent. The soils exhibit a pH of 8 to 8.5 and resistivities of 2580 to 9930 ohms-cm.

Field testing exhibits Standard Penetration Resistance (STP) varying from 8 to 50 plus blows per foot. Refusal was encountered in Boring B-4 just below 6 foot deep. It is thought that this may be a possible sewer line or other unmarked utility, or cobble size rock. All borings were dry upon completion. Groundwater is indicated to be approximately 21 feet at the juncture of Casandro Wash and Sol's Wash and should not be a factor in the design or construction of the storm drain.

ANALYSIS AND RECOMMENDATIONS

Analysis - Due to the nature of the coarser grained soils generally encountered along the route significant disturbances from gravel and occasional cobbles may make neat trenches difficult to achieve. Therefore, cast-in-place pipe may not be feasible. Trench excavations for utilities can be accomplished by conventional trenching equipment. Trench walls may experience some sloughing in coarser grained soils. For trenches greater than shoulder-height, precautions must be taken to protect workmen in accordance with all current governmental regulations. No special recommendations are made if pre-cast reinforced concrete pipe is used except that pipe bedding will be required to prevent point loads due to the presence of cobbles. Based on the ADOT Materials Manual (1989) and resistivity values obtained, galvanized coated steel, aluminum steel coated, aluminum alloy, or bituminous coated CMP may be used.

Boring and jacking operations should be relatively straight forward. However, if should be noted that the presence of cobble may affect the rate of progress.

Utilities Installation - Trench excavations, backfilling and compaction should be carried out under M.A.G. Section 601. Backfill of trenches may be carried out with native excavated material, provided that oversized material is removed in the bedding zone. This material should be moisture-conditioned, placed in 8 inch lifts and mechanically compacted. Water settling is not recommended. Compaction requirements as set forth in Section 601 of M.A.G. Specification should be followed.

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 Soils Engineer monitor the earthwork and foundation 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.

Mark Vanhook / GAC

Mark Vanhook, Geotechnical Technician

GAC



Gregg A. Creaser, P.E.

June 30, 1994

APPENDIX

FIELD AND LABORATORY INVESTIGATION

SOIL BORING LOCATION PLAN

SOIL LOG LEGEND

LOG OF TEST BORING

TABULATION OF TEST DATA

CONSOLIDATION DATA

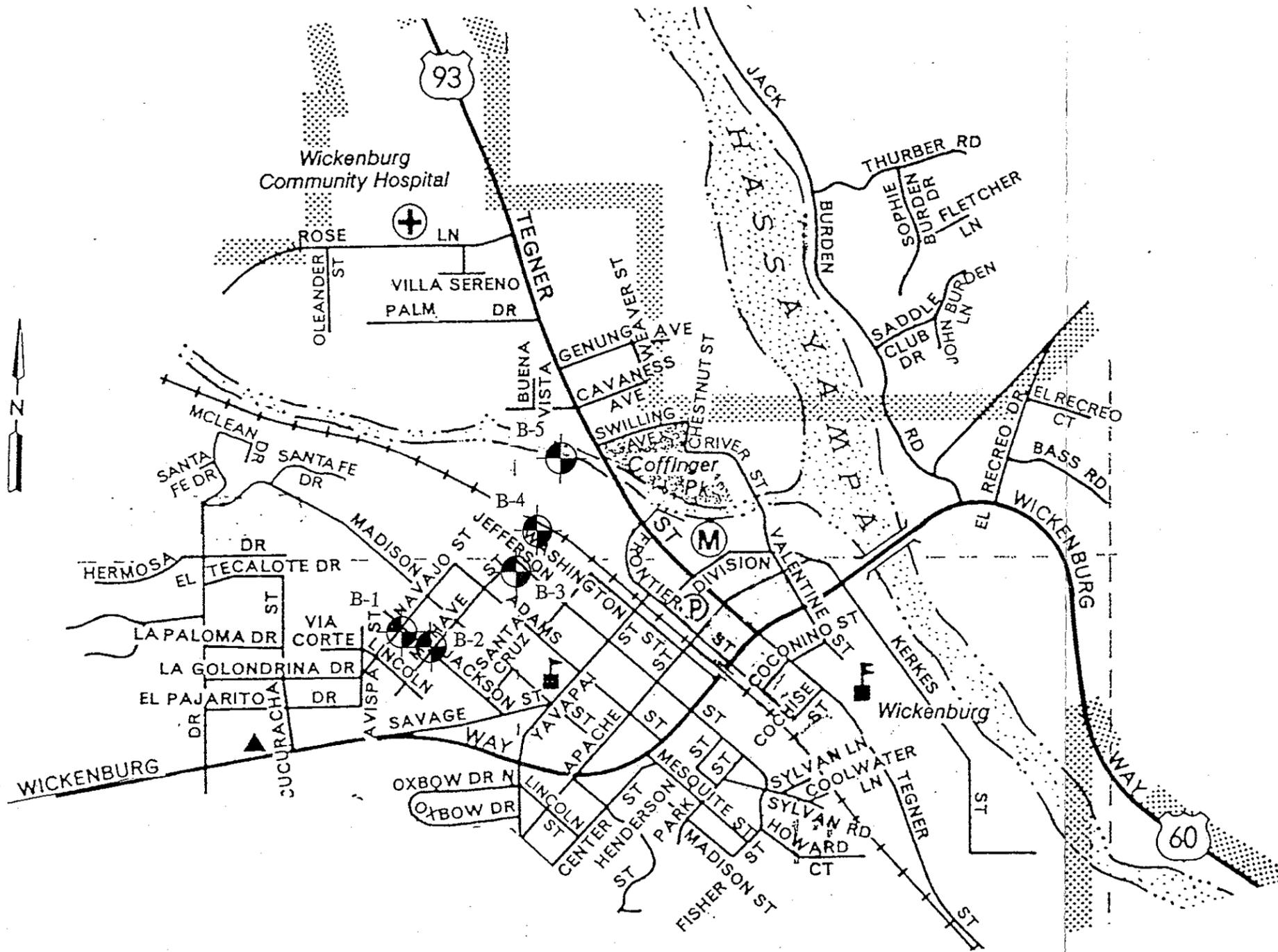
MOISTURE-DENSITY RELATIONS

pH & RESISTIVITY DATA

FIELD AND LABORATORY INVESTIGATION

On June 14, 1994, five 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 engineering technician, 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, pH, resistivity, and plasticity (Atterberg Limits) tests for classification and pavement design parameters. Compression tests were performed on a selected ring sample in order to estimate settlements and determine effects of inundation. All field and laboratory data is presented in this appendix.




 Approximate Soil Boring Location

SOIL BORING LOCATION PLAN	
Casandro Wash Storm Drain Wickenburg, Arizona	SPEEDIE AND ASSOCIATES <small>GEOTECHNICAL / MATERIALS / SITE ENGINEERS</small> PROJECT NO. 940175SA

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 inch 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, 1 1/4 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 3.0 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.

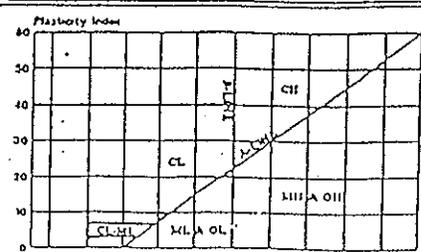
CONSISTENCY			RELATIVE DENSITY	
Clays & Silts	Blows/Foot *	Strength †	Sands and Gravels	Blows/Foot *
Very Soft	0-2	0-1/4	Very Loose	0-4
Soft	2-4	1/4-1/2	Loose	5-10
Firm	5-8	1/2-1	Medium Dense	11-30
Stiff	9-15	1-2	Dense	31-50
Very Stiff	16-30	2-4	Very Dense	> 50
Hard	> 30	> 4		

* Number of blows of a 140 lb hammer free falling 30 inches to drive a 2 inch O.D. split spoon sampler (ASTM D-1588)
 † 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	Clean Gravels	GW	Well Graded Gravels
	50% Coarse Fraction is > #4 Sieve Size	Gravels w/Fines	GP	Poorly Graded Gravels
			GM	Silty Gravels
		GC	Clayey Gravels	
	Sand and Sandy Soils	Clean Sands	SW	Well Graded Sands
	50% Coarse Fraction is < #4 Sieve Size	Sands w/Fines	SP	Poorly Graded Sands
SM			Silty Sand	
		SC	Clayey Sand	
Fine Grained Soils More than 50% of material is smaller than #200 sieve size	Silt and Clays		ML	Inorganic Silts, Low Plasticity
	Liquid limit is less than 50%		CL	Inorganic Clays, Low Plasticity
	Liquid limit is greater than 50%		OL	Organic Silts, High Plasticity
	Silt and Clays		MH	Inorganic Silts, High Plasticity
	Liquid limit is greater than 50%		CH	Inorganic Clays, High Plasticity
OH		OH	Organic Clays, High Plasticity	
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	3" *
Coarse	191	3" *	762	24" *
Cobbles	762	24" *	3048	120" *
Boulders	3048	120" *	9144	360" *

† U.S. Standard * Clear Square Openings



Depth (feet)
0
5
10
15
20
25

Graphic Log
 Rig Type: CME-55
 Boring Type: Hollow Stem Auger
 Surface Elevation: N/A
 Visual Classification

Medium to Very Dense Light Brown
 CLAYEY SAND (SC-Dry to Moist)
 with Little Gravel

6.0
 Boring Terminated Due to Possible
 Sewer Line

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
RS-1	1.7	--	--	50/8"
S-2	6.0	--	--	

Boring Date: 6-14-94
 Field Engineer/Technician: M. Vanhook
 Driller: D. Burgmeier
 Contractor: Heber Mining

Water Level		
Depth	Hour	Date

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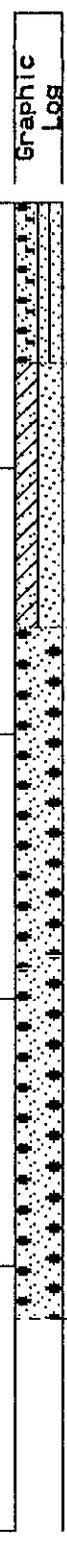
Log of Test Boring Number: B- 1

Casandro Wash Storm Drain

Wickenburg, Arizona

Project No.: 940175SA

Depth (feet)
0
5
10
15
20
25



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

Dense Light Brown SAND/SILTY SAND (SW/SM-Dry to Moist) with Some Gravel

Loose Light Brown SAND/CLAYEY SAND (SP/SC-Dry) with Trace Gravel; Very Stratified

Medium Dense to Dense Light to Reddish Brown GRAVELLY SAND (SP/SW-Dry to Moist) with Trace Clay, and with Cobbles from 11.0' to 11.5'

End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
RS-1	2.0	6.9	110.3	
BS-6	3.0	--	--	
S-2	6.0	--	--	
S-3	11.0	--	--	
S-4	16.0	--	--	
S-5	21.0	--	--	

Boring Date: 6-14-94
 Field Engineer/Technician: M. Vanhook
 Driller: D. Burgmeier
 Contractor: Heber Mining

Water Level		
Depth	Hour	Date

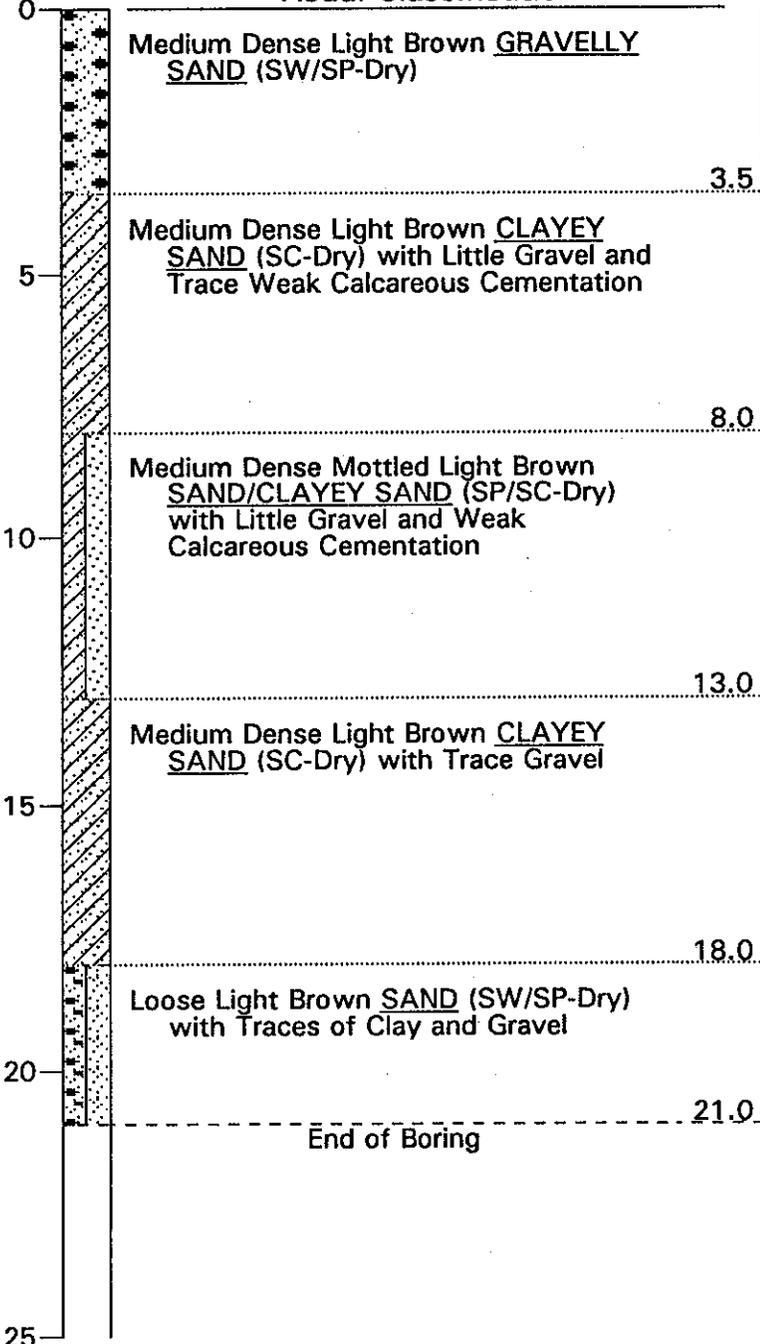
SPEEDIE AND ASSOCIATES
 Log of Test Boring Number: B- 2
 Casandro Wash Storm Drain
 Wickenburg, Arizona
 Project No.: 940175SA

Depth (feet)

Graphic Log

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

Visual Classification



Medium Dense Light Brown GRAVELLY SAND (SW/SP-Dry)

Medium Dense Light Brown CLAYEY SAND (SC-Dry) with Little Gravel and Trace Weak Calcareous Cementation

Medium Dense Mottled Light Brown SAND/CLAYEY SAND (SP/SC-Dry) with Little Gravel and Weak Calcareous Cementation

Medium Dense Light Brown CLAYEY SAND (SC-Dry) with Trace Gravel

Loose Light Brown SAND (SW/SP-Dry) with Traces of Clay and Gravel

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
S-1	2.5	--	--	
RS-2	5.5	5.4	94.0	
S-3	11.0	--	--	
S-4	16.0	--	--	
S-5	21.0	--	--	

Boring Date: 6-14-94
 Field Engineer/Technician: M. Vanhook
 Driller: D. Burgmeier
 Contractor: Heber Mining

Water Level		
Depth	Hour	Date

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Log of Test Boring Number: B- 3

Casandro Wash Storm Drain

Wickenburg, Arizona

Project No.: 940175SA

Depth (feet)

Graphic Log
 Rig Type: **CME-55**
 Boring Type: **Hollow Stem Auger**
 Surface Elevation: **N/A**
 Visual Classification

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
---------------	-----------------	---------------------------	-------------------------------	---------------------------------------

0
5
10
15
20
25

Very Dense Brown GRAVELLY SAND (SW/SP-Dry)
 3.0
 Dense Brown CLAYEY GRAVEL (GC-Dry to Moist) and Sand
 6.0
 Auger Refusal on Cobbles or Possible Unmarked Utility Line

RS-1	1.6	--	--	50/7"
S-2	6.0	--	--	

Boring Date: **6-14-94**
 Field Engineer/Technician: **M. Vanhook**
 Driller: **D. Burgmeier**
 Contractor: **Heber Mining**

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Log of Test Boring Number: **B- 4**

Casandro Wash Storm Drain

Wickenburg, Arizona

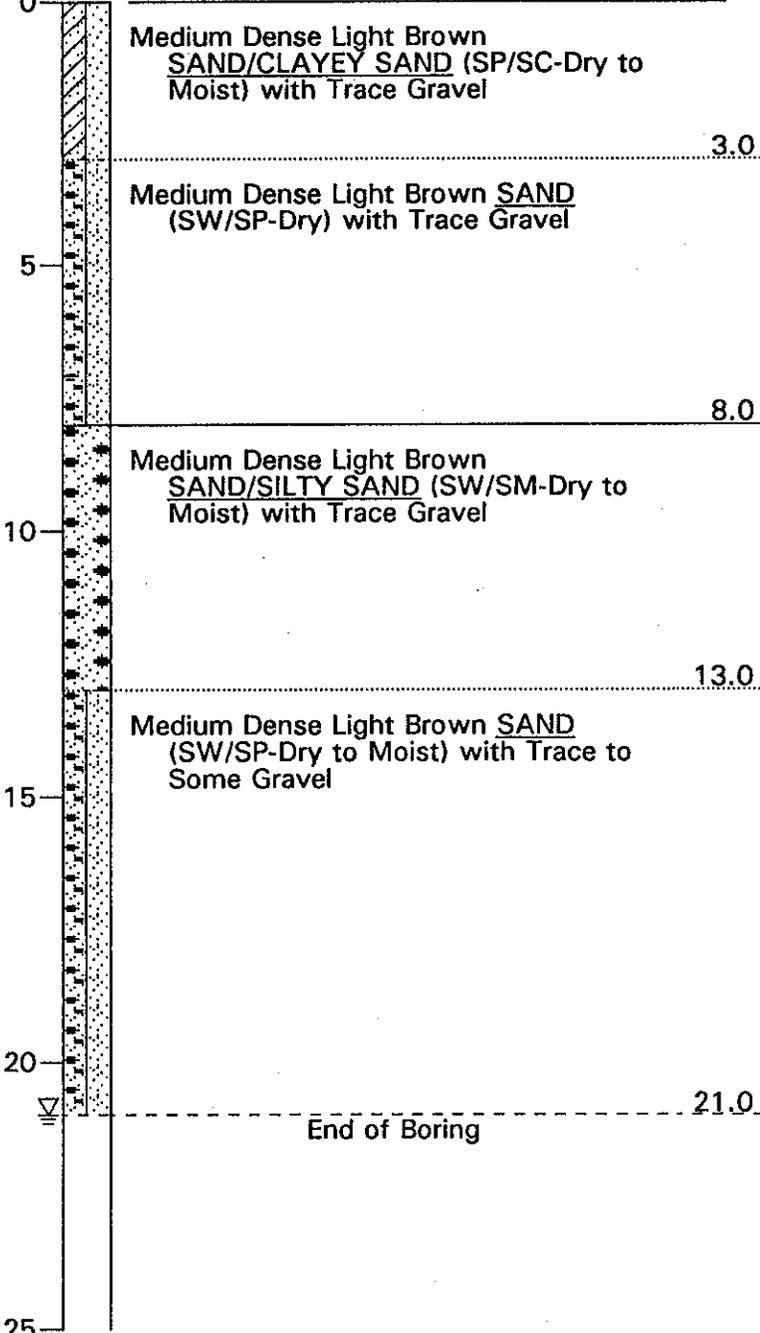
Project No.: **940175SA**

Water Level		
Depth	Hour	Date

Depth (feet)

Graphic Log
 Rig Type: CME-55
 Boring Type: Hollow Stem Auger
 Surface Elevation: N/A
 Visual Classification

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
---------------	-----------------	---------------------------	-------------------------------	---------------------------------------



S-1	2.5	--	--	
S-2	6.0	--	--	
S-3	11.0	--	--	
S-4	16.0	--	--	
S-5	21.0	--	--	

Boring Date: 6-14-94
 Field Engineer/Technician: M. Vanhook
 Driller: D. Burgmeier
 Contractor: Heber Mining

Water Level		
Depth	Hour	Date
21.0		6/14/94

SPEEDIE AND ASSOCIATES
 Log of Test Boring Number: B- 5
 Casandro Wash Storm Drain
 Wickenburg, Arizona
 Project No.: 940175SA

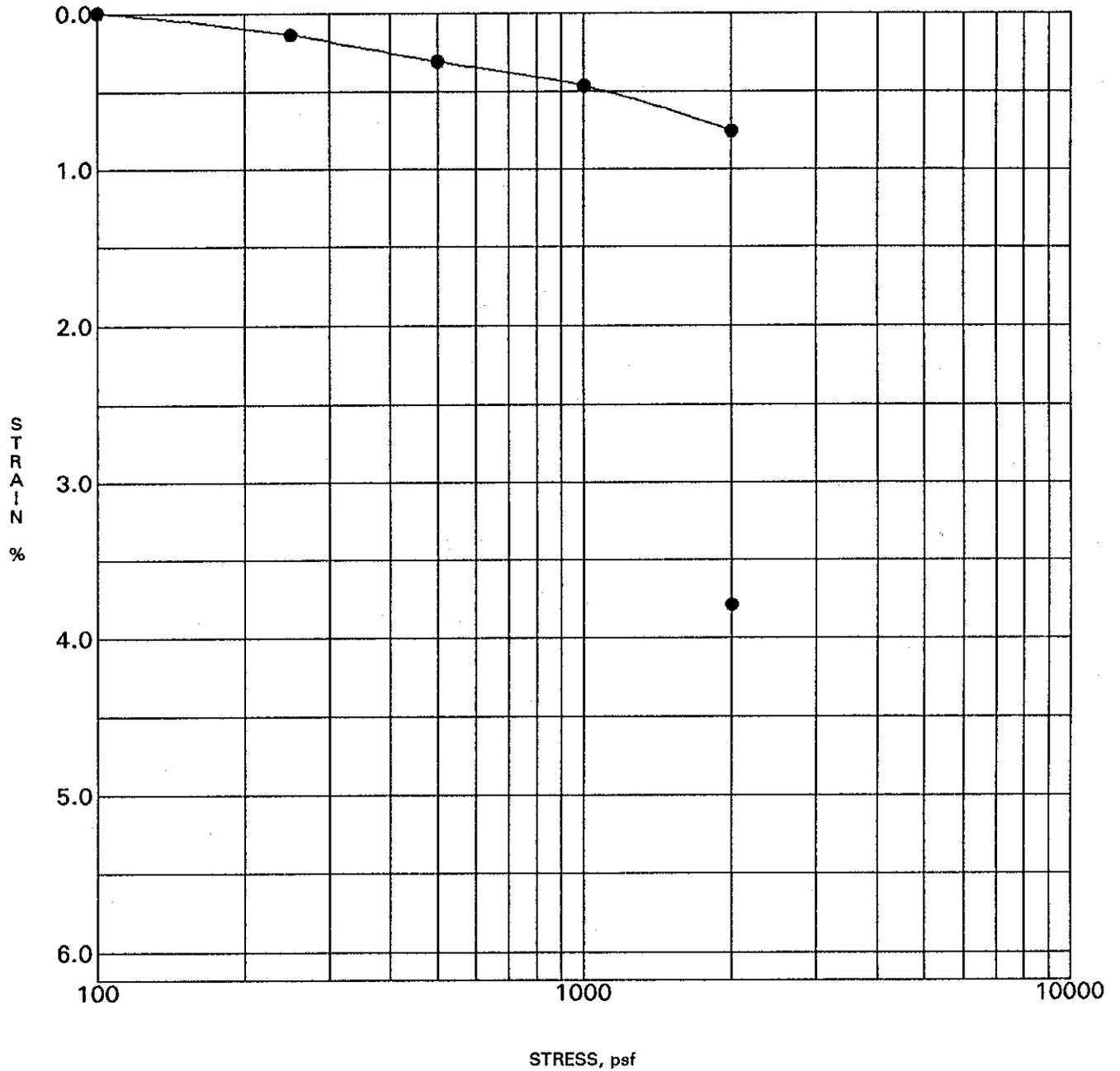
TABULATION OF TEST DATA

PROJECT: Casandro Wash Storm Drain -

NUMBER: 940175SA

Test Sample Boring Number	Depth (feet)	Water Content %	Dry Density (pcf)	<#200 Sieve %	<#40 Sieve %	<#10 Sieve %	<#4 Sieve %	<3" Sieve %	Liquid Limit %	Plastic Limit %	Plasticity Index %	ASTM Classification
B- 1	6.0	--	--	13	26	58	80	100	28	15	13	SC
B- 2	2.0	6.9	110.3									
B- 2	3.0	--	--	8	20	53	73	100	NP	NP	NP	SW-SM
B- 3	5.5	5.4	94.0	37	51	70	85	100	29	18	10	SC
B- 4	6.0	--	--	13	24	46	56	100	28	15	13	GC
B- 5	11.0	--	--	6	21	81	94	100	NP	NP	NP	SW-SM

CONSOLIDATION TEST



BORING B-3

DEPTH 5.50

Sample inundated at end of test at 2000 psf

PROJECT Casandro Wash Storm Drain -

JOB NO. 940175SA
DATE 6/14/94

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MOISTURE-DENSITY RELATIONS

PROJECT: Casandro Wash Storm Drain

PROJECT NO.: 940175SA DATE: 6/14/94

LOCATION:

BORING NO.: B- 2

SAMPLE NO.: BS-6

SAMPLE DEPTH: 3.00

METHOD OF COMPACTION: ASTM D698A

LIQUID LIMIT: NP

PLASTIC LIMIT: NP

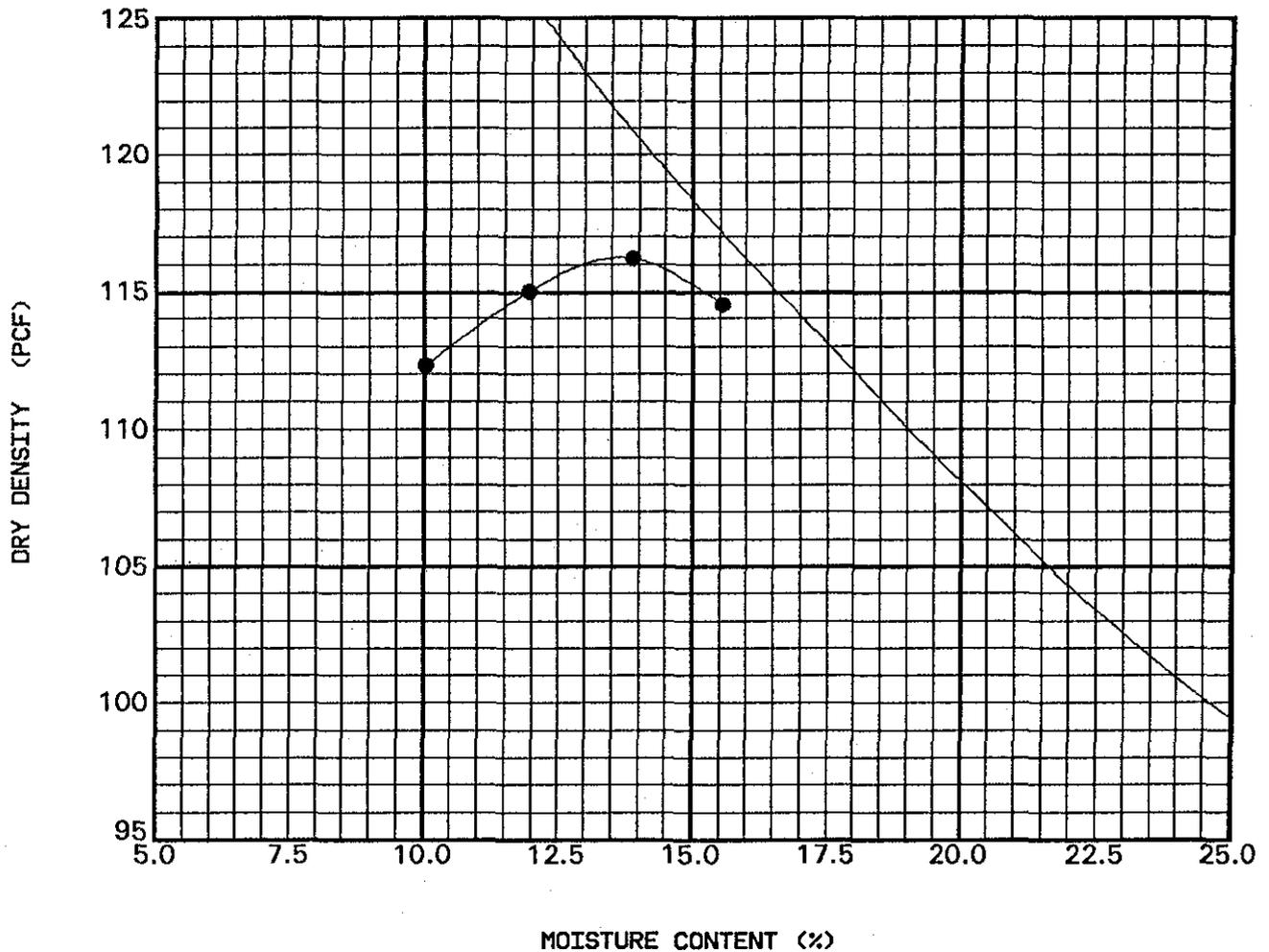
PLASTICITY INDEX: NP

CLASSIFICATION: SW-SM

ASTM SOIL DESCRIPTION: WELL GRADED SAND with SILT and GRAVEL

MAXIMUM DRY DENSITY: 116.3 PCF

OPTIMUM MOISTURE CONTENT: 14.4 %



Project: Casandro Wash Storm Drain
Wickenburg, Arizona

Project No.: 940175SA

pH & RESISTIVITY DATA

BORING NO.	DEPTH, ft.	pH	RESISTIVITY (ohm-cm)
B-2	11-21	8.2	2,648
B-3	3-16	8.2	2,582
B-5	3-21	8.4	9,930