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GEOTECHNICAL AND SITE ENGINEERS
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REPORT ON SOIL INVESTIGATION

DESIGNATION: M.C.F.C.D. Roadway Bridge
Arizona Canal Diversion Channel

LOCATION: 35th Avenue @ Arizona Canal
Phoenix, Arizona

CLIENT: Greiner Engineering

PROJECT NO: 64004SS

DATE: August 13, 1984

Registered Professional Engineer (Civil)
CERTIFICATE NO. 11431
JAMES ALAN SPEEDIE
DATE SIGNED 8/13/84
Arizona U.S.A.

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INTRODUCTION

This report presents the results of a subsoil exploration carried out at the site of the proposed bridge for 35th Avenue as it passes over the Arizona Canal Diversion Channel adjacent to the Arizona Canal. The approach roadway at the north end of the bridge will connect to the existing roadway and the intersection with Vogel Avenue; the approach roadway at the south end of the bridge will connect to the existing structure over the Arizona Canal.

Present plans call for the construction of a 130-foot long single-span bridge over the Diversion Channel at a skew of approximately 22 degrees right. The nearly-rectangular concrete-lined channel will have a flow line elevation of 1203± with near vertical side slopes. The bridge deck elevation will be at 1228± feet.

In order to maintain traffic flow during bridge construction, a temporary bridge over the canal will be built to the east of the existing bridge. Since this structure will function as a major traffic facility for a significant period, its design will be approached in the same manner as the permanent bridge. Furthermore, soil conditions at the recommended bearing depth are sufficiently similar that the recommendations presented herein are applicable to both bridges.

As noted on the Soil Boring Location Plan, Plate 1, Borings B-1, B-2 and B-3 were drilled along the alignment of the proposed permanent bridge. Boring B-4 was drilled to confirm the consistency of conditions at the temporary bridge site.

GENERAL SITE AND SOIL CONDITIONS

Site Conditions - The site of the proposed bridge is within the right-of-way of 35th Avenue immediately north of the existing Arizona Canal Bridge in Phoenix, Arizona. Thirty-fifth Avenue at this point consists of six traffic lanes with a landscaped median of varying width. The roadway is asphalt and is bounded by concrete curbs and gutters. Overhead power lines (Salt River Project) located in the right-of-way and should be considered in both design and construction.

General Subsurface Conditions - Subsoil conditions at the site are somewhat variable. The upper 28 to 32 feet consists of loose to dense brown silty sand and interspersed layers of medium stiff brown sandy clay. These strata exhibit a Standard Penetration Test (SPT) of 5 to 30 blows per foot. These materials are generally wet, probably the result of canal leekage, and may well be unstable in excavation.

Underlying the upper sandy and clayey soils is a stratum of very dense brown gravelly sand/sandy gravel to depths of 36 to 39 feet. This layer is non-plastic and contains on an average less than 5 percent fines (material passing the No. 200 sieve). The Standard Penetration Tests (SPT) for this layer is 50 to 100 blows per foot.

The subsoil encountered below the gravelly layer consists uniformly of hard brown sandy clay and very dense brown clayey sand. The Standard Penetration Resistance (SPT) for these lower soils is on the order of 35 to 100 blows per foot.

Although water was added to the boreholes prior to sampling, free groundwater was not encountered in any of the borings and is not known to be shallow in this area. Groundwater, therefore, (other than canal seepage) should not be a factor in design or construction of the proposed bridge.

ANALYSIS AND RECOMMENDATIONS

Analysis - Analysis of the field and laboratory data indicate that the subsoils at the site are favorable for the support of the proposed main bridge on shallow foundations founded on the very dense gravelly sand. Founding on this porous material will minimize any effects of future saturation.

All borings were dry upon completion. Accordingly groundwater should not be a factor during construction. However, due to sand lenses and the proximity of the Canal, seepage could be a nuisance.

Details of the temporary bridge are not known at this time, but it appears reasonable to support this bridge.

Foundation Design - Project documents provided by Greiner Engineering indicate the proposed bottom of the Diversion Channel will be at Elevation 1203. It is our opinion that the proposed structures can be properly supported at Elevation 1196 on the dense gravelly sand encountered at depths of 28 to 32 feet (Elevation 1200 to 1196) utilizing conventional spread footings. Drilled belled caissons are not recommended due to the presence of wet granular overburden material; also, interference of drilling equipment with high-voltage overhead lines should be avoided. Net allowable bearing capacity values for design have been determined, together with settlement estimates, as follows:

Footing Elevation (Ft.)	Design Bearing Capacity (psf)	Estimated Settlements (In.) Total	Differential
±1196	8000	0.6	0.3
	10000	0.8	0.4
	12000	1.0	0.5

Spread footing foundations bearing at depth are not applicable for the temporary bridge if the existing canal is to be undisturbed. Since the looseness of the upper soils makes caissons undesirable, we recommend the use of 40-ton capacity bearing piles (12 HP 53) driven to the bearing stratum at Elevation 1196. Piles should be driven to this capacity on the basis of blow counts determined by the Engineering News Formula, but a minimum depth of Elevation 1200 should be observed.

Lateral Pressures - The upper 25 feet of native soils at this location are relatively loose, and in some areas quite wet (but not saturated), likely the result of canal seepage. For the present non-saturated condition, we recommend that the active lateral earth pressure be simulated by an equivalent fluid pressure of 50 pcf. Care must be taken during design and/or construction of the channel to minimize additional seepage; if seepage were to increase so that a saturated condition were to occur, full hydrostatic and uplift pressures must be added to the design.

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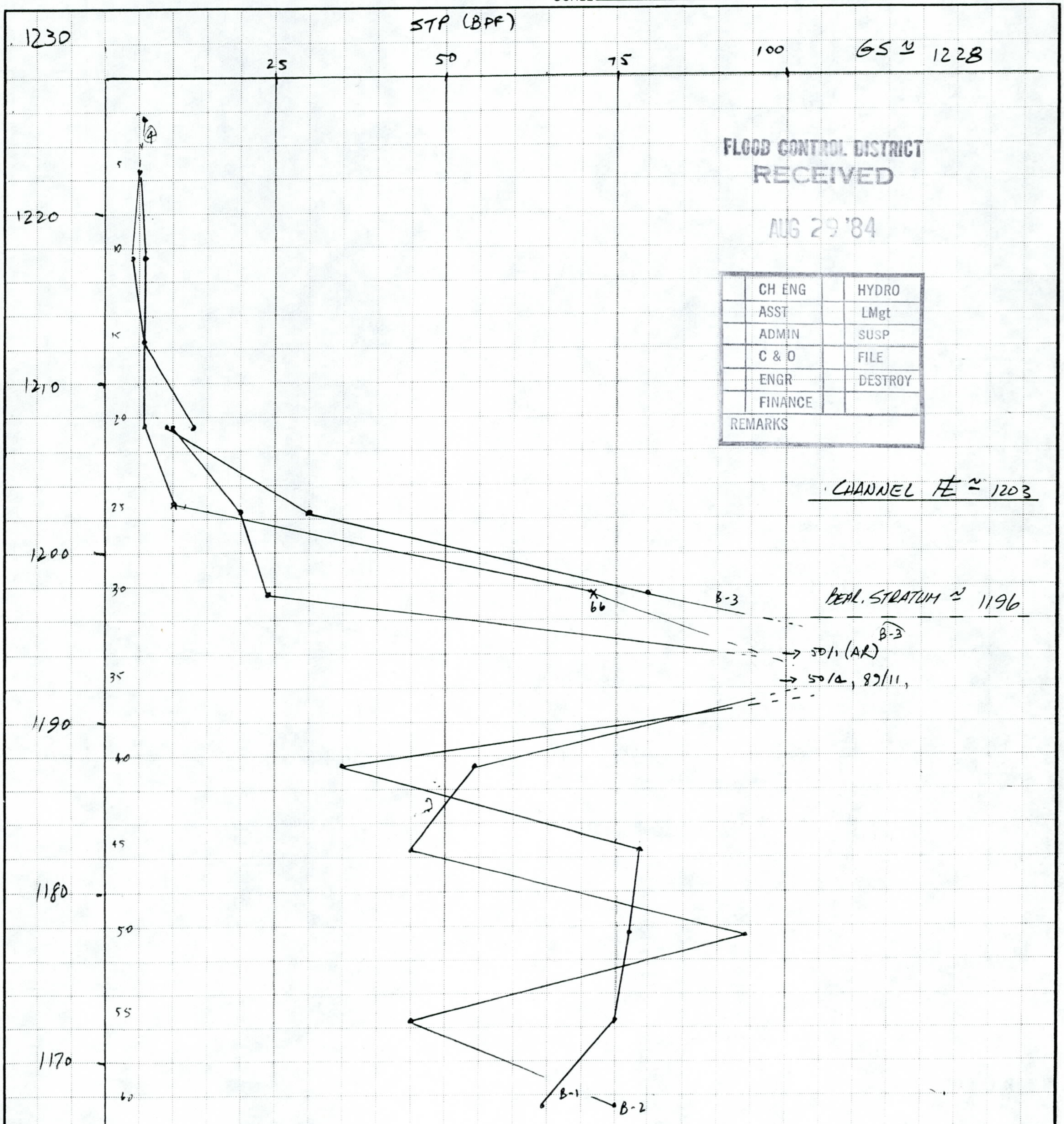
JOB 35 Ave Bridge @ ACDC

SHEET NO. 1 OF 1

CALCULATED BY JAS DATE 7/2

CHECKED BY ______ DATE ______

SCALE ______



X = EXTRAP. N TO 12"
66 = ACTUAL N

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JOB: ACDC/MCFCD BRIDGE 35 Ave — PROJECT NO. 6400455 — SHEET NO. 2
SUBJECT: STABILITY/SETT ANAL. — BY: JAS — DATE: 8/2/84
CHK. BY: JHC — DATE: 8/3/84

IDENTIFY BEARING STRATUM @ ELEV. 1196 (SEE SHT#1)

$N \simeq 45$ @ $d = 45'$ $N' = N \dfrac{50}{(0.9)b + 10}$

$$N' = 45 \frac{50}{(0.9).45 + 10} = 45(.99) \cong 45$$

CONSIDER V. DENSE S&G @ ELEV 1196, SAY $N_{AV} = 50$ bpf.

ESTABLISH DES. PARAMETERS (SEE SH. 3)

$N = 50$ => UPPER PORTION OF "DENSE"

$D_r = 80\%$

$\phi = 34 - 50$

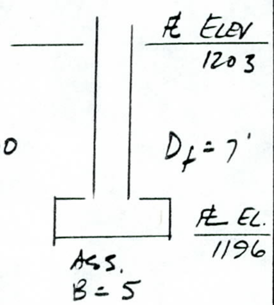
- S&G, N => 50
- CLAY => 34

} SAY $\phi_{GEN} = 40°$

BEAR. CAP.

$$q_{ult} = cN_c^{\,0} + \gamma D_f N_q + \tfrac{1}{2}\gamma B N_\gamma$$

$\phi = 40°$; $N_q = 65$, $N_\gamma = 100$



$$q_{ult} = \overset{59150}{130(7)(65)} + \overset{32500}{\tfrac{1}{2}(130)(5)(100)}$$

$$= 91650$$

$$q_a = \frac{q_{ult}}{FS} = \frac{91650}{3} = 30 \text{ ksf.}$$

SHEET 3

6400+SS

RANGE : 32 - 42'

GENERALIZED DESCRIPTION: T&P pg 107

V.D. Sandy Gravel increasing in cementation & grading to sandy clay.

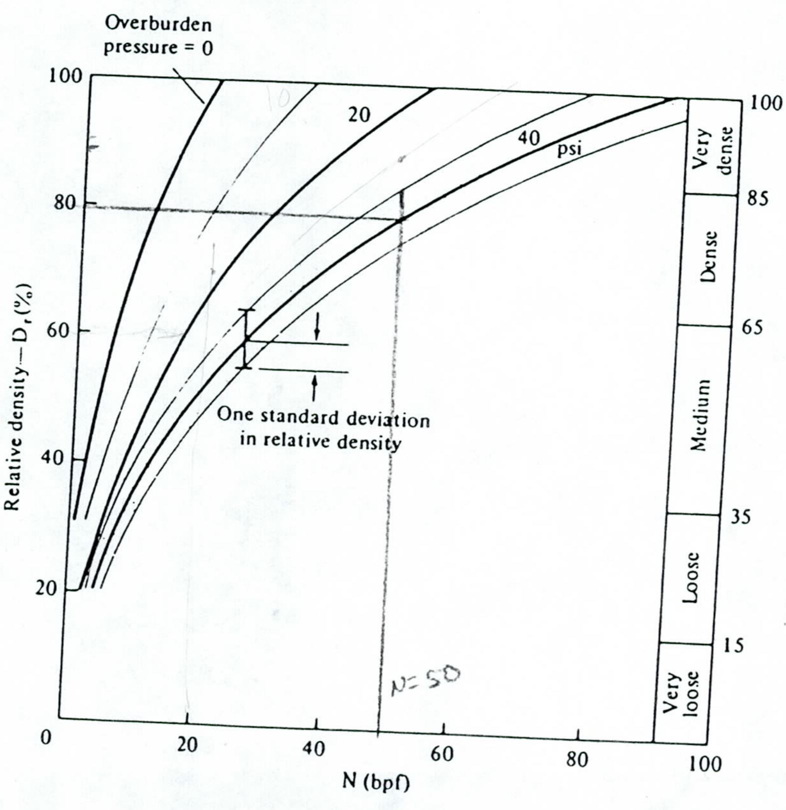
[S&G noted to be well graded and angular to sub-angular]. T&P pg. 341

Table 17.1
Representative Values of φ for Sands and Silts

Material	*Degrees* Loose	Dense
Sand, round grains, uniform	27.5	34
Sand, angular grains, well graded	33	45
Sandy gravels	35	50
Silty sand	27–33	30–34
Inorganic silt	27–30	30–35

Table 45.1
Relative Density of Sands according to Results of Standard Penetration Test

No. of Blows N	Relative Density
0–4	Very loose
4–10	Loose
10–30	Medium
30–50	Dense
Over 50	Very dense



GIBBS & HOLTZ, TERZAGHI & PECK

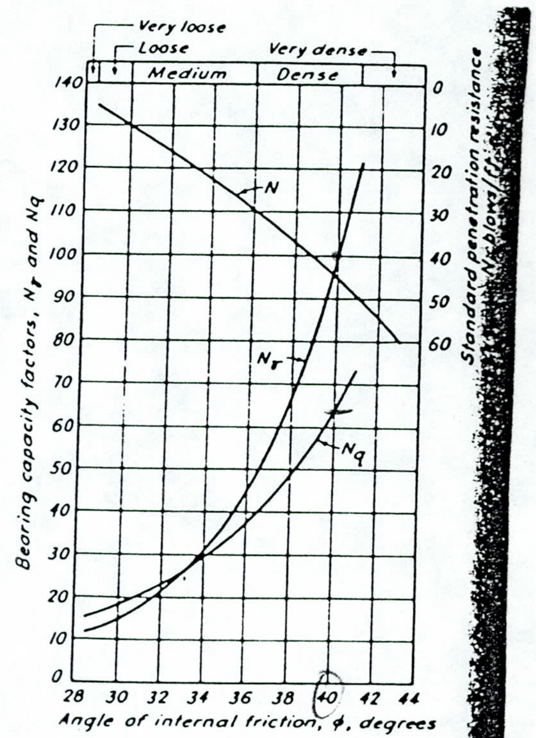


FIGURE 19.5. Curves showing the relationship between bearing-capacity factors and φ, as determined by theory, and rough empirical relationship between bearing capacity factors or φ and values of standard penetration resistance N.

PECK, HANSON & THORNBURN

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JOB ACDC / MCFCD BRIDGE 35 AVE PROJECT NO. 640045S SHEET NO. 4
SUBJECT BY JAS DATE 8/3/84
CHK. BY SAG DATE 8/3/84

CONSIDER SETT.

$$\delta_v = \frac{4 q_a B^2}{K_{v1}(B+1)^2}$$ (SEE NAV DM-7 - ATTACHED)

$$K_{v1} = 225 \text{ T/FT}^3$$

SAY $B = 5'$ $\quad \delta_v = \frac{4 q_a}{225}\left(\frac{5}{6}\right)^2 = .012\, q_a$

FOR $\delta_v = 1'' = 0.083'$

$$q_a = \frac{.083 \text{ FT}}{.012 \text{ FT}^3/\text{T}} = 6.92 \text{ TSF.}$$

SAY 12 ksf.

FOR $q_a = 4$ tsf $\quad \delta_v = .012(4) = = 0.048' = 0.58$

SAY $\delta_v = 0.6''$

LATERAL PRESSURES : UPPER SOILS : $\phi = 26°$ (DUE TO PRES. OF SI & CL)

$$p_A = \gamma \tan^2\left(45 - \frac{26}{2}\right) = 130 \tan^2 (32) = 50.8$$ (.39)

LOWER SOIL (JUST ABOVE S&G @ 1196) : $\phi = 32°$

$$p_p = 130 \tan^2\left(45 + \frac{32}{2}\right) = 423.10$$ Say 400

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JOB: ACDC / MCFCD BRIDGE 35 AVE PROJECT NO. 6400455 SHEET NO. 5
SUBJECT: PILE CAPACITY BY: JAS DATE: 8/3/84
CHK. BY: [illegible] DATE: 8/23/84

SAY BOTTOM OF PILE CAP = ELEV 1223

$\therefore D_f = 1223 - 1196 = 27'$

$q_{ult} = 130(27)(65) + \frac{1}{2}(110)(1)(100) = 233650$ psf (228150) (5500)

FOR FS = 3 $q_a = \frac{233.7}{3} = 77.9$ ksf $= 38.9$ TSF

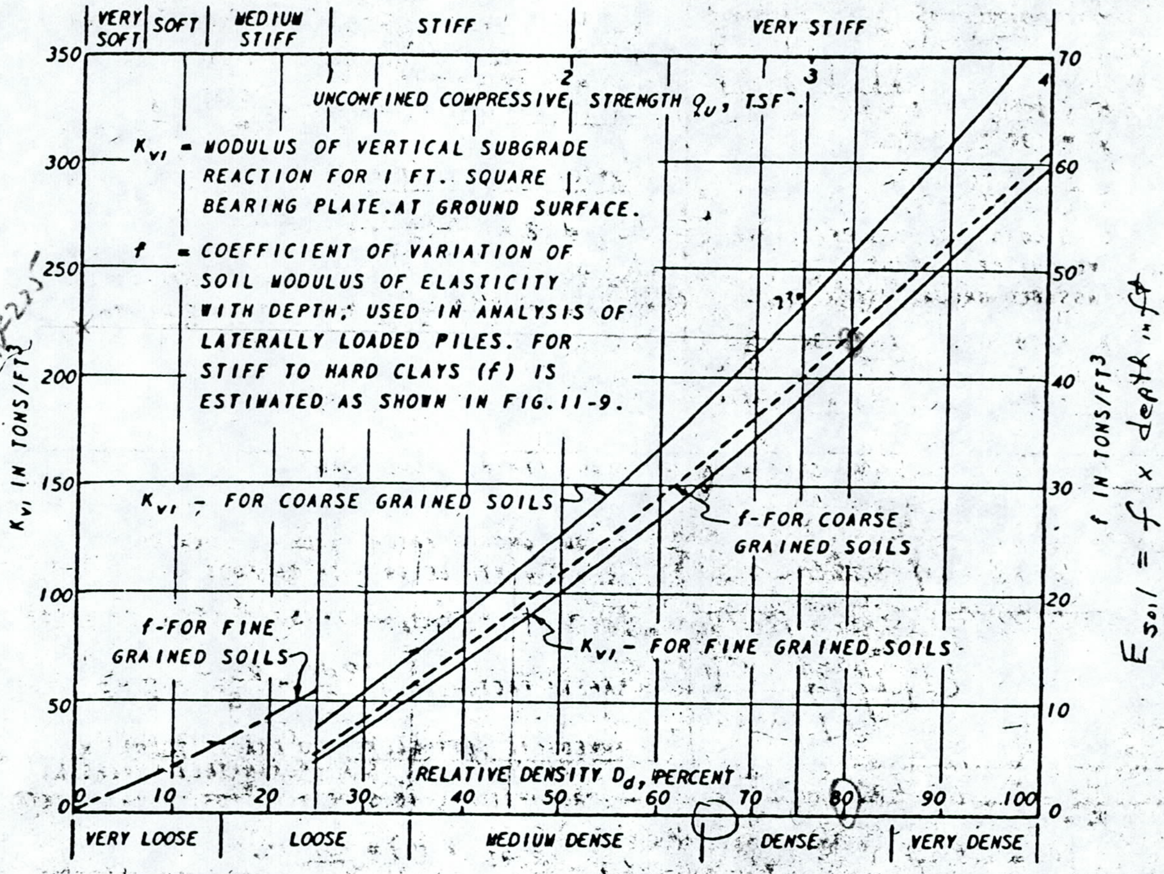
PILE CAPACITY FOR 12" SQ SECTION (12 HP 53)

$P_p = 38.9$ TSF × 1 SF = 38.9 TONS

USE **<u>40 TON</u>** CAPACITY W/ ENGG NEWS FORM.

CONSERVATIVE DUE TO:

1. FS ≃ 6 INHERENT IN ENGG. NEWS FORM.
2. NO SKIN FRICTION USED.



DEFINITIONS

δ_v = FOOTING SETTLEMENT
q = FOOTING UNIT LOAD
B = FOOTING WIDTH
L = FOOTING LENGTH
D = DEPTH OF FOOTING BELOW GROUND SURFACE
E_s = MODULUS OF ELASTICITY OF SOIL
C_s = SHAPE COEFFICIENT OF LOADED AREA

FOR COARSE GRAINED SOILS AND VERY SOFT TO MEDIUM STIFF FINE GRAINED SOILS, E_s IS ASSUMED TO INCREASE LINERALLY WITH DEPTH ($E_s = fz$)

FOR STIFF TO HARD CLAYS E_s IS ASSUMED TO BE CONSTANT WITH DEPTH.

COARSE GRAINED SOILS

(MODULUS OF ELASTICITY INCREASING LINERALY WITH DEPTH)

SHALLOW FOOTINGS $D \leq B$

FOR $B \leq 20$FT:

$$\delta_v = \frac{4qB^2}{K_{v1}(B+1)^2} = \frac{4q}{K_{v1}}$$

FOR $B \geq 40$FT:

$$\delta_v = \frac{2qB^2}{K_{v1}(B+1)^2}$$

INTERPOLATE FOR INTERMEDIATE VALUES OF B

DEEP FOUNDATION $D \geq 5B$

FOR $B \leq 20$FT:

$$\delta_v = \frac{2qB^2}{K_{v1}(B+1)^2}$$

NOTES: 1. NON-PLASTIC SILT IS ANALYZED AS COARSE GRAINED SOIL WITH MODULUS OF ELASTICITY INCREASING LINERALLY WITH DEPTH.

2. VALUES OF K_{v1} SHOWN FOR COARSE GRAINED SOILS APPLY TO DRY OR MOIST MATERIAL WITH THE GROUND WATER LEVEL AT A DEPTH OF AT LEAST 1.5B BELOW BASE OF FOOTING. IF GROUND WATER IS AT BASE OF FOOTING USE $K_{v1}/2$ IN COMPUTING SETTLEMENT.

FIGURE 11-8
Immediate Settlement of Isolated Footings on Coarse Grained Soils

Note that bracing will likely be required during excavation, particularly where canal seepage occurs. Parameters for design of this bracing will depend upon construction geometry, sequencing, and other factors.

For resistance of lateral loads, passive pressures for shallow footings (Elevation 1196) may be simulated by an equivalent fluid pressure of 400 pcf for continuous footings and 450 pcf for individual spread footings, together with a sliding friction coefficient of 0.4.

All backfill must be compacted to not less than 95 percent of maximum dry density (ASTM D-698) to mobilize these passive values at low strain. We recommend selectively stockpiling excavated material to use for backfill and entirely preclude the use of plastic clays for this purpose.

Pavement Design - Grading operations should be conducted so that the upper 3.0 feet of the roadway approach embankments be constructed of the more granular subsoils to take advantage of their structural stability. This pavement design is based on the City of Phoenix Standard Detail P-1104, Depth of Base Course for Major Streets; a supplement to the M.A.G. Uniform Standard Details. For design purposes, a value of 50 percent passing the 200 sieve and a plasticity index of 14 percent results in the following minimum design:

Asphaltic Concrete	ABC	Select
4 inches	4 inches	8 inches

All materials should meet the applicable requirements of M.A.G. Uniform Standard Specifications. The asphalt mix design should meet the requirements of M.A.G. designated C-3/4 mix.

All embankment subgrade materials, abutment and wing wall backfill should be compacted to 95 percent maximum dry density as determined by ASTM D-698 (Standard Proctor). Pavement base course materials should be compacted to 100 percent.

Utilities Installation - Trench excavations for utilities may be accomplished by conventional trenching equipment, but excavations will encounter wet sands and gravels subject to sloughing. It is believed that this material may not contain enough fines to enable trench walls to stand near-vertically, even for the short periods of time required to install utilities, so the use of bracing may be expected. If trenches are greater than shoulder-height, precaution must be taken to protect workmen.

Backfill of trenches may be carried out with native excavated material. This material should be moisture conditioned, placed in 8-inch lifts and mechanically compacted. Water settling is not recommended. Compaction should meet the requirements of M.A.G. Uniform Standard Specifications.

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.

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 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

Registered Professional Engineer (Civil) CERTIFICATE NO. 14388 GREGG ALAN CREASER Date Signed 8-13-84 Arizona U.S.A.

Gregg A. Creaser, P.E.

Registered Professional Engineer (Civil) CERTIFICATE NO. 11431 JAMES ALAN SPEEDIE DATE SIGNED 8.13.84 Arizona U.S.A.

James A. Speedie, P.E. August 13, 1984

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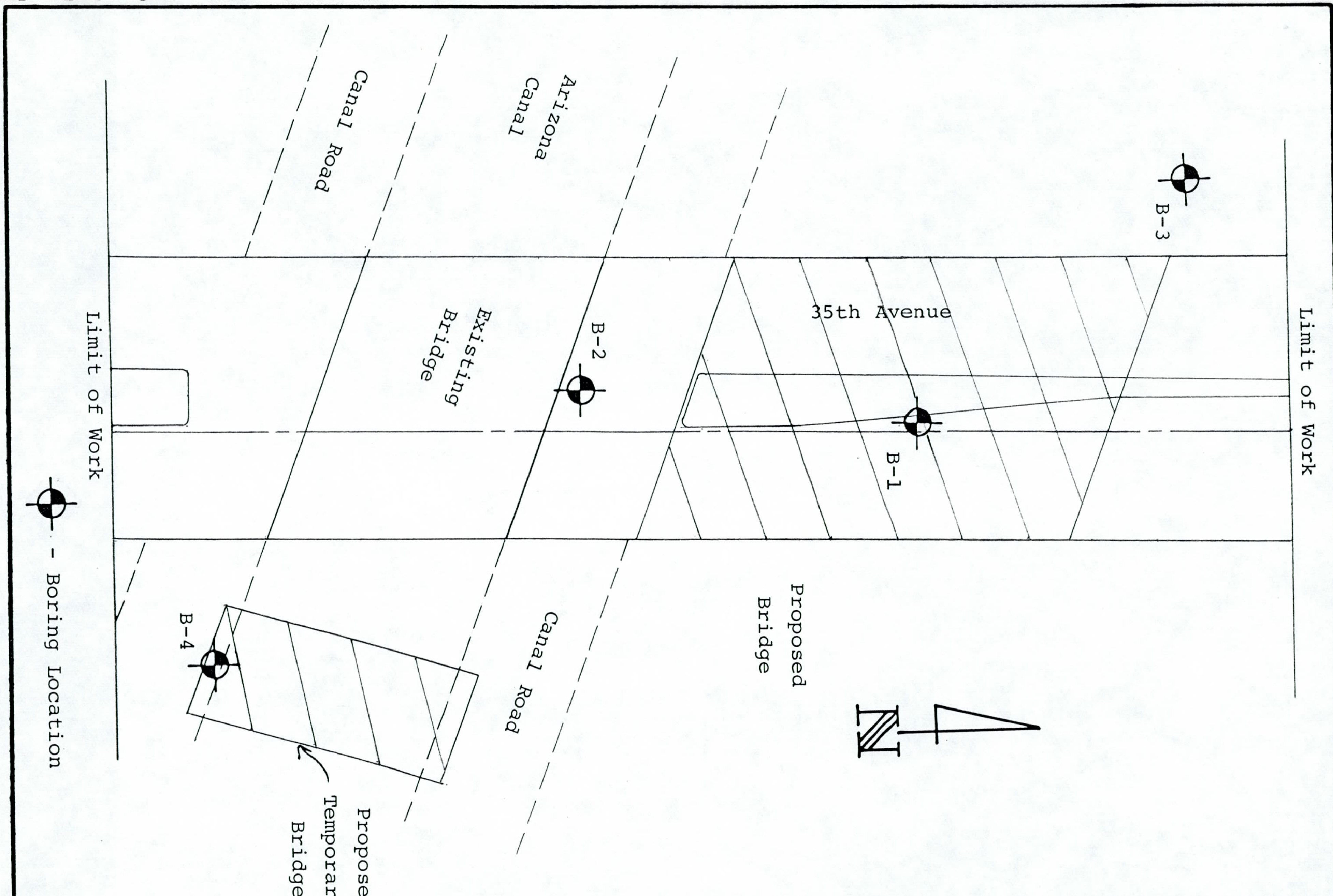
APPENDIX

FIELD AND LABORATORY INVESTIGATION

On July 17, 1984, four soil test borings were drilled at the approximate locations shown on the attached Soil Boring Location Plan, Plate 1. All exploration work was carried out under the full-time supervision of our engineer, who recorded subsurface conditions and obtained samples for laboratory testing. The soil borings were advanced with a truck-mounted Mobile B-41 drill rig utilizing 6.5-inch diameter hollow-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. It is noted that, in our effort to simulate moisture from future seepage, water was added to each hole prior to taking any driven sample.

Laboratory testing consisted of moisture content, dry density, grain-size distribution and plasticity (Atterberg Limits) tests for classification and pavement design parameters. Triaxial shear tests were performed on selected liner samples to determine the in-place shear strength of the subsoils. All field and laboratory data is presented in this Appendix as Figures No. 1 through 6.



SOIL BORING LOCATION PLAN
MCFCD ROADWAY BRIDGE
35TH AVENUE & A.C.D.C.
PHOENIX, ARIZONA

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS
Project No. 64004SS

PLATE 1

SOILS CLASSIFICATION CHART

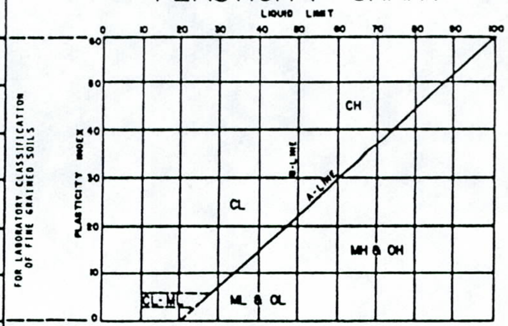
MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVEL WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

GRADATION CHART

MATERIAL SIZE	PARTICLE SIZE			
	LOWER LIMIT		UPPER LIMIT	
	MILLIMETERS	SIEVE SIZE*	MILLIMETERS	SIEVE SIZE *
SAND FINE	.074	#200*	0.42	#40*
SAND MEDIUM	0.42	#40*	2.00	#10*
SAND COARSE	2.00	#10*	4.76	#4*
GRAVEL FINE	4.76	#4*	19.1	3/4"●
GRAVEL COARSE	19.1	3/4"●	76.2	3"●
COBBLES	76.2	3"●	304.8	12"
BOULDERS	304.8	12"●	914.4	36"

*U.S. Standard ●Clear Square Openings

PLASTICITY CHART



CONSISTENCY			RELATIVE DENSITY	
CLAYS & SILTS	BLOWS/FOOT*	STRENGTH ‡	SANDS & GRAVELS	BLOWS/FOOT*
VERY SOFT	0-2	0-¼	VERY LOOSE	0-4
SOFT	2-4	¼-½	LOOSE	4-10
FIRM	4-8	½-1	MEDIUM DENSE	10-30
STIFF	8-16	1-2	DENSE	30-50
VERY STIFF	16-32	2-4	VERY DENSE	OVER 50
HARD	OVER 32	OVER 4		

* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).
‡ Unconfined compressive strength in tons/sq ft. Read from a pocket penetrometer.

SAMPLE DESIGNATION	PENETRATION RESISTANCE SYMBOL	DESCRIPTION
Bag	-	Large Bulk Sample
BS	-	Misc. Grab Sample - Bottle or Bag
AS	-	Auger 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, 1 3/8-inch inside diameter, split spoon sampler into undisturbed soil for three sucessive 6-inch increments of penetration by means of a 140-pound weight falling freely through a distance of 30 inches. The cumulative number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).
LS	●	Liner Sample - Standard Penetration Test-Driving a 2.0-inch outside diameter split spoon, equipped with two, 3-inch long by 1 3/8-inch inside diameter brass liners, seperated by a 1-inch long spacer, into undisturbed soil as above.
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 means of a 140-pound weight falling freely through a distance of 30 inches. The blows required for the 12 inches of penetration are recorded.
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 (Bullnose) - Driving a 2.0-inch outside diameter "Bullnose penetrometer" continuously into undisturbed soil by means of a 140-pound weight falling freely through a distance of 30 inches. The blows for each successive 12-inch increment are recorded.

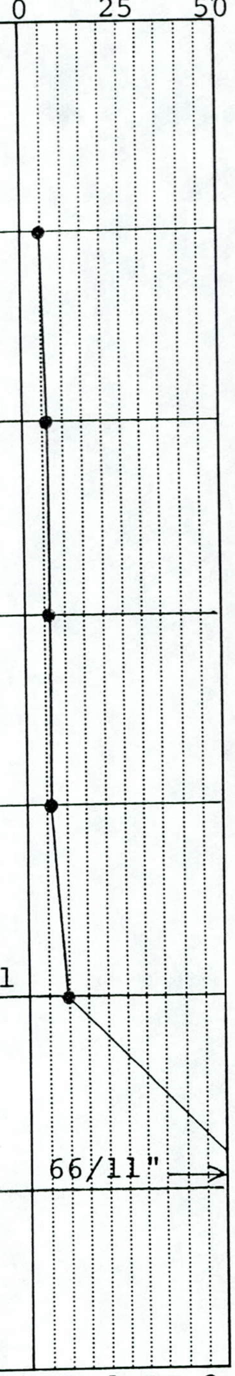
NOTE: The stratification lines shown on the Logs of Test Borings and/or Test Pit represent the approximate boundary between soil types, and the transition may be gradual.

SOIL LOG LEGEND

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS

GROUND SURFACE ELEVATION: N/A

SOIL DESCRIPTION	Depth	SAMPLE NUMBER	ELEVATION OF SAMPLE TIP *	NATURAL WATER CONTENT (%)	IN-PLACE DRY DENSITY (P.C.F.)	STANDARD PENETRATION NUMBER (N) BLOWS PER FOOT
Loose Light Brown GRAVELLY SAND (SM - Dry). Some Silt. Fill.	1.0'					
Loose Brown SAND (SP - Dry). Trace Of Silt. Trace Of Gravel.	5.5'	S-1	5.5	-	-	
Medium Stiff Brown SILTY CLAY (CL - Moist). Trace Of Sand.	13.0'	S-2	10.5	-	-	
Medium Stiff Brown SANDY SILT (ML - Moist).	17.5'	S-3	15.5	-	-	
Loose Brown SAND (SP/SM - Wet). Trace To Some Silt. Trace Of Gravel.	28.0'	S-4	20.5	8.2	-	
		LS-5	25.0	12.4	125.1	
Very Dense Brown GRAVELLY SAND (SW - Wet). Trace Of Silt.	31.0'	S-6	30.5	10.9	-	66/11" →



ELEVATION (FEET)

CONTINUED ON NEXT SHEET

* Sample Depth

BORING STARTED: 07-17-84
BORING COMPLETED: 07-17-84
FIELD ENGINEER/TECHNICIAN: R. Schooler
DRILLER: D. Ulses
CONTRACTOR: Heber Mining

WATER LEVEL IN HOLE AT Dry
NUMBERS OF HOURS AFTER COMPLETION:

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS

LOG OF TEST BORING NUMBER B-1

MCFCD ROADWAY BRIDGE
35TH AVENUE &
ARIZONA CANAL DIVERSION CHANNEL
PHOENIX, ARIZONA

APPROVED: JAS | DATE: 08-08-84
PROJECT NO: 64004SS | FIGURE NO: 1a

GROUND SURFACE ELEVATION: N/A

SOIL DESCRIPTION	SAMPLE NUMBER	ELEVATION OF SAMPLE TIP *	NATURAL WATER CONTENT (%)	IN-PLACE DRY DENSITY (P.C.F.)	STANDARD PENETRATION NUMBER (N) BLOWS PER FOOT (0 – 25 – 50)
Very Dense Brown GRAVELLY SAND (SW - Wet). Trace Of Silt. 34.0'					
Very Dense Brown SANDY GRAVEL (GW - Moist). Trace Of Clay. 36.0'	S-7	35.5	9.2	-	50/4" →
Hard Light Brown SANDY CLAY (CL - Moist). 43.0'	S-8	40.5	-	-	
Very Dense Light Brown SAND (SP - Dry). Trace Of Gravel. Trace Of Silt. Moderately Cemented. 49.5'	S-9	45.5	-	-	78/12" →
Very Dense Brown CLAYEY SAND (SC - Moist). Trace Of Gravel. 53.5'	S-10	50.5	-	-	77/12" →
Hard Brown SILTY CLAY (CL - Dry). Some Sand. 60.5'	S-11	55.5	-	-	75/12" →
	S-12	60.5	-	-	64/12" →
END OF BORING					

ELEVATION (FEET)

* Sample Depth

SHEET 2 OF 2

BORING STARTED: 07-17-84
BORING COMPLETED: 07-17-84
FIELD ENGINEER/TECHNICIAN: R. Schooler
DRILLER: D. Ulses
CONTRACTOR: Heber Mining

WATER LEVEL IN HOLE AT Dry
NUMBERS OF HOURS AFTER COMPLETION:

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS

LOG OF TEST BORING NUMBER B-1

MCFCD ROADWAY BRIDGE
35TH AVENUE &
ARIZONA CANAL DIVERSION CHANNEL
PHOENIX, ARIZONA

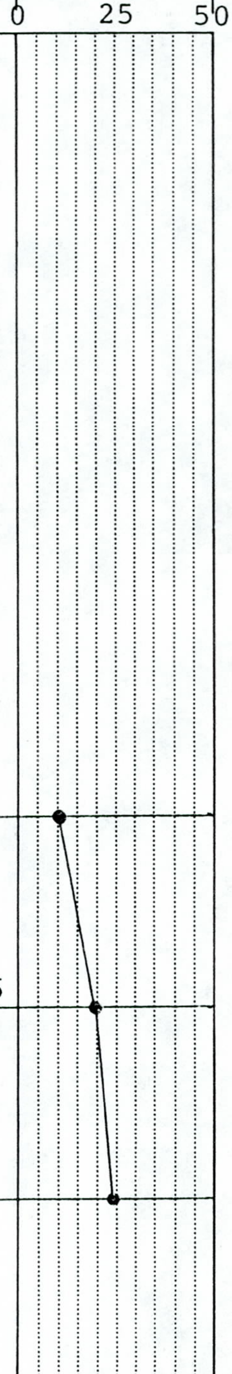
APPROVED: JLS DATE: 08-08-84
PROJECT NO: 64004SS FIGURE NO: 1b

ELEVATION (FEET)

GROUND SURFACE ELEVATION: N/A

SOIL DESCRIPTION	SAMPLE NUMBER	* ELEVATION OF SAMPLE TIP	NATURAL WATER CONTENT (%)	IN-PLACE DRY DENSITY (P.C.F.)
1" Asphalt On 11" Of Concrete On 12" Of A.B.C. 2.0'				
Loose Brown SILTY SAND (SM - Dry). 4.5'				
Medium Stiff Brown SANDY CLAY (CL - Moist). 7.5'				
Loose Brown SILTY SAND (SM - Dry). Some Gravel. 9.5'				
Very Stiff Brown SANDY CLAY (CL - Moist). 19.0'				
Medium Dense Brown SILTY SAND (SM/SW - Moist). Trace To Some Gravel. 31.0'	S-1	20.5	7.4	-
	LS-2	25.5	11.1	131.6
	S-3	30.5	12.4	-
CONTINUED ON NEXT SHEET				

STANDARD PENETRATION NUMBER (N) BLOWS PER FOOT



* Sample Depth

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS

LOG OF TEST BORING NUMBER B-2

MCFCD ROADWAY BRIDGE
35TH AVENUE &
ARIZONA CANAL DIVERSION CHANNEL
PHOENIX, ARIZONA

APPROVED: JAS
DATE: 08-08-84
PROJECT NO: 64004SS
FIGURE NO: 2a

BORING STARTED: 07-18-84
BORING COMPLETED: 07-18-84
FIELD ENGINEER/TECHNICIAN: R. Schooler
DRILLER: D. Ulses
CONTRACTOR: Heber Mining

WATER LEVEL IN HOLE AT Dry

NUMBERS OF HOURS AFTER COMPLETION:

GROUND SURFACE ELEVATION: N/A

ELEVATION (FEET)

SOIL DESCRIPTION	Depth
Medium Dense Brown SILTY SAND (SM/SW - Moist). Trace To Some Gravel.	32.0'
Very Dense Brown SANDY GRAVEL (GW - Moist). Trace Of Silt.	39.0'
Hard Light Brown SANDY CLAY (CL - Moist). Slightly Cemented.	48.0'
Hard Brown CLAY (CL - Moist). Some Sand. Trace Of Gravel.	60.5'
END OF BORING	

* Sample Depth

SAMPLE NUMBER	ELEVATION OF SAMPLE TIP *	NATURAL WATER CONTENT (%)	IN-PLACE DRY DENSITY (P.C.F.)	STANDARD PENETRATION NUMBER (N) BLOWS PER FOOT (0 – 25 – 50)
S-4	35.5	10.1	-	89/11" →
S-5	40.5	-	-	54/12" →
S-6	45.5	-	-	
S-7	50.5	-	-	94/12" →
S-8	55.5	-	-	
S-9	60.5	-	-	75/12" →

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS

LOG OF TEST BORING NUMBER B-2

MCFCD ROADWAY BRIDGE
35TH AVENUE &
ARIZONA CANAL DIVERSION CHANNEL
PHOENIX, ARIZONA

APPROVED: JAS	DATE: 08-08-84
PROJECT NO: 64004SS	FIGURE NO: 2b

BORING STARTED: 07-18-84
BORING COMPLETED: 07-18-84
FIELD ENGINEER/TECHNICIAN: R. Schooler
DRILLER: D. Ulses
CONTRACTOR: Heber Mining

WATER LEVEL IN HOLE AT Dry
NUMBERS OF HOURS AFTER COMPLETION:

GROUND SURFACE ELEVATION: N/A

ELEVATION (FEET)

SOIL DESCRIPTION	Depth
Loose Brown SAND (SP - Dry). Trace Of Silt. Trace Of Gravel.	4.0'
Medium Stiff Brown SILTY CLAY (CL - Moist). Trace Of Sand.	10.0'
Medium Stiff Brown SANDY SILT (ML - Moist).	15.0'
Medium Stiff Brown SANDY CLAY (CL - Moist). Trace Of Gravel.	20.0'
Loose To Dense Brown SAND (SW - Moist). Some Gravel. Some Silt.	28.0'
Very Dense Brown SANDY GRAVEL (GW - Moist). Trace Of Silt. Some Cobbles.	35.0'

SAMPLE NUMBER	ELEVATION OF SAMPLE TIP *	NATURAL WATER CONTENT (%)	IN-PLACE DRY DENSITY (P.C.F.)	STANDARD PENETRATION NUMBER (N) BLOWS PER FOOT (0 – 25 – 50)
S-1	20.5	-	-	
S-2	25.5	10.7	-	
S-3	30.5	10.3	-	80/12" →
S-4	34.0	-	-	50/1" →

END OF BORING - Auger Refusal On Cobbles

* Sample Depth

BORING STARTED: 07-18-84
BORING COMPLETED: 07-18-84
FIELD ENGINEER/TECHNICIAN: R. Schooler
DRILLER: D. Ulses
CONTRACTOR: Heber Mining

WATER LEVEL IN HOLE AT Dry

NUMBERS OF HOURS AFTER COMPLETION:

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS

LOG OF TEST BORING NUMBER B-3

MCFCD ROADWAY BRIDGE
35TH AVENUE &
ARIZONA CANAL DIVERSION CHANNEL
PHOENIX, ARIZONA

APPROVED: JAS | DATE: 08-08-84

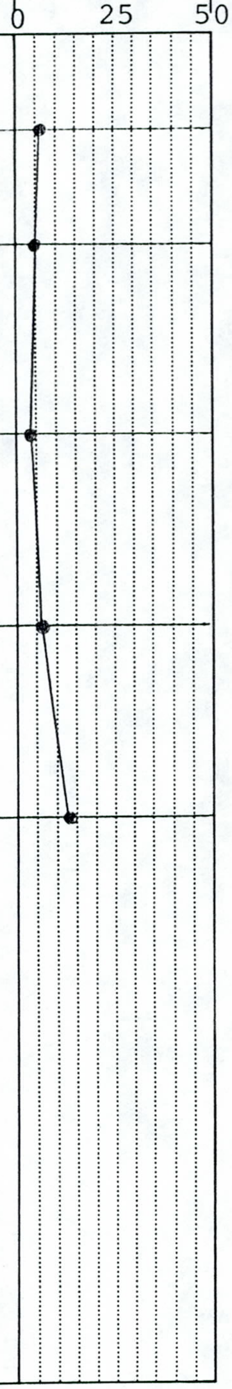
PROJECT NO: 64004SS | FIGURE NO: 3

GROUND SURFACE ELEVATION: N/A

ELEVATION (FEET)

SOIL DESCRIPTION	Depth	SAMPLE NUMBER	ELEVATION OF SAMPLE TIP *	NATURAL WATER CONTENT (%)	IN-PLACE DRY DENSITY (P.C.F.)
Loose Brown SILTY SAND (SM - Moist). Trace Of Gravel.	4.0'	S-1	2.5	11.5	-
Soft To Medium Stiff Brown CLAY (CL - Wet). Some Sand.	12.0'	S-2	5.5	26.5	-
		S-3	10.5	29.1	-
Medium Stiff Brown SANDY SILT (ML - Wet).	17.5'	S-4	15.5	16.2	-
Medium Dense Brown GRAVELLY SAND (SM - Moist). Some Silt.	20.5'	S-5	20.5	9.6	-
END OF BORING					

STANDARD PENETRATION NUMBER (N)
BLOWS PER FOOT



* Sample Depth

BORING STARTED: 07-17-84
BORING COMPLETED: 07-17-84
FIELD ENGINEER/TECHNICIAN: R. Schooler
DRILLER: D. Ulses
CONTRACTOR: Heber Mining

WATER LEVEL IN HOLE AT Dry
NUMBERS OF HOURS AFTER COMPLETION:

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS

LOG OF TEST BORING NUMBER B-4

MCFCD ROADWAY BRIDGE
35TH AVENUE &
ARIZONA CANAL DIVERSION CHANNEL
PHOENIX, ARIZONA

APPROVED: JAS	DATE: 08-08-84
PROJECT NO: 64004SS	FIGURE NO: 4

TABULATION OF TEST DATA

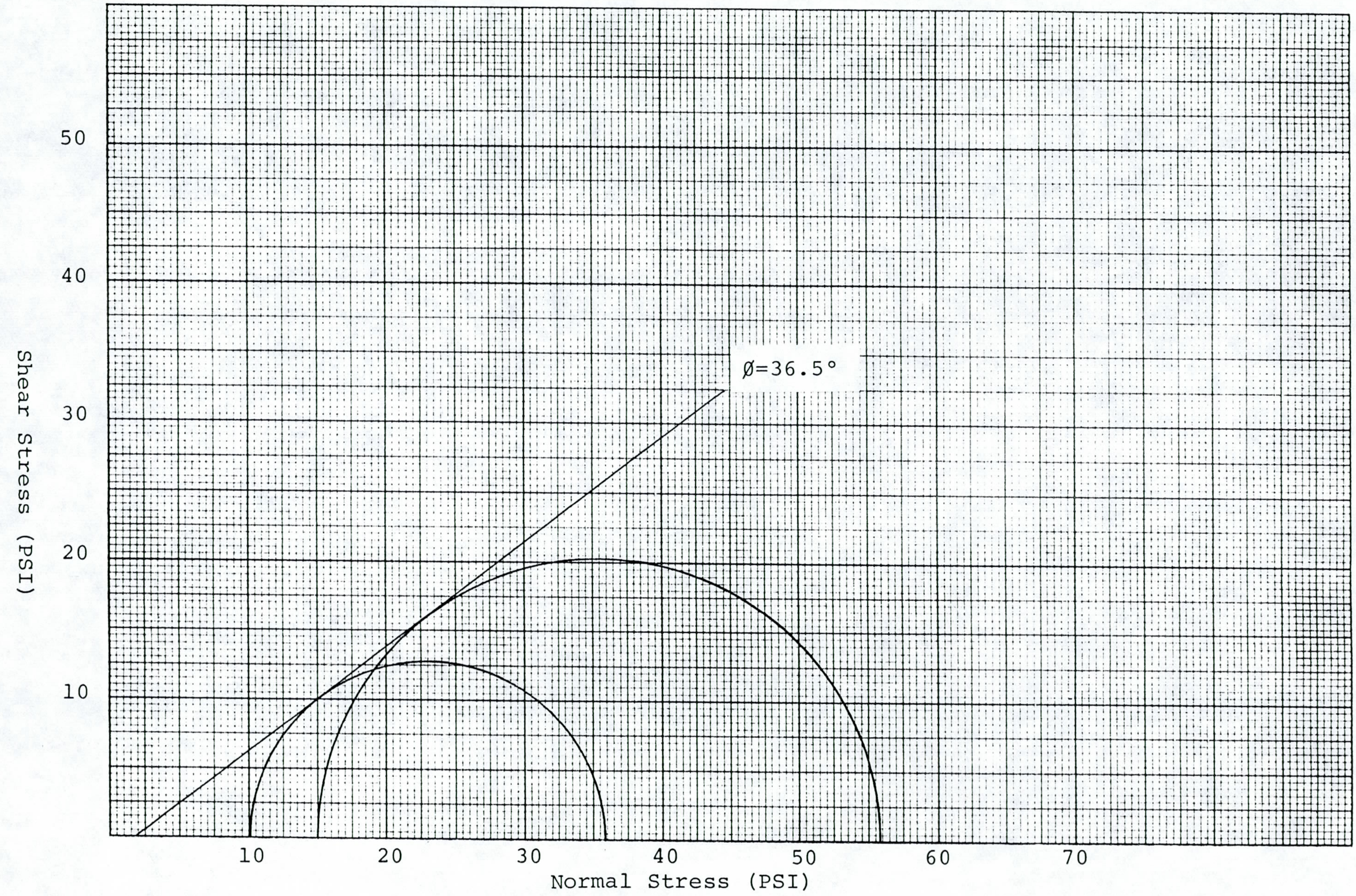
Test Boring or Test Pit Number	Sample Number	Depth of Sample Tip	Elevation of Sample Tip	Natural Water Content (Percent of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Particle Size Distribution: Colloids (Percent)	Clay (Percent)	Silt (Percent)	Fine Sand (Percent)	Medium Sand (Percent)	Coarse Sand (Percent)	Gravel (Percent)	Atterberg Limits: Liquid Limit (Percent)	Plastic Limit (Percent)	Plasticity Index (Percent)	Unified Soil Classification	Cohesion - One-Half of Unconfined Compressive Strength (PSF)	
B-1	S-4	20.5	-	8.2	-	←	2	→	42	50	5	1	-	-	-	SP	-	
B-1	LS-5	25.0	-	12.4	125.1	←	25	→	33	38	4	0	-	-	NP	SM	-	
B-1	S-6	30.5	-	10.9	-	←	2	→	7	31	19	41	-	-	-	SW	-	
B-1	S-7	35.5	-	9.2	-	←	1	→	10	16	13	60	-	-	-	GW	-	
B-2	S-1	20.5	-	7.4	-	←	18	→	34	35	11	2	-	-	NP	SM	-	
B-2	LS-2	25.5	-	11.1	131.6	←	28	→	30	23	13	6	-	-	NP	SM	-	
B-2	S-3	30.5	-	12.4	-	←	2	→	19	41	18	20	-	-	-	SW	-	
B-2	S-4	35.5	-	10.1	-	←	3	→	6	19	12	60	-	-	-	GW	-	
B-3	S-2	25.5	-	10.7	-	←	12	→	16	37	17	18	-	-	NP	SW	-	
B-3	S-3	30.5	-	10.3	-	←	3	→	10	15	12	60	-	-	-	GW	-	
B-4	S-1	2.5	-	11.1	-	←	48	→	35	10	6	1	-	-	NP	SM	-	
B-4	S-2	5.5	-	25.6	-	←	82	→	13	3	2	0	27	18	9	CL	-	
B-4	S-3	10.5	-	29.1	-	←	88	→	12	0	0	0	27	17	10	CL	-	
B-4	S-4	15.5	-	16.2	-	←	56	→	41	3	0	0	-	-	NP	ML	-	
B-4	S-5	20.5	-	9.6	-	←	22	→	21	12	9	36	-	-	NP	SM	-	

PROJECT NO. 64004SS

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS

SHEET 1 OF 1

FIGURE NO. 5



TRIAXIAL SHEAR TEST DATA
PROPOSED BRIDGE STRUCTURE
35TH AVE. & ACDC CANAL
PHOENIX, ARIZONA

SPEEDIE & ASSOCIATES
GEOTECHNICAL AND SITE ENGINEERS
Project No. 64004SS

FIGURE NO. 6