

Bridge over Arizona Canal Diversion Channel and the  
New Arizona Canal Relocation  
59th Avenue, South of Thunderbird Road

**BENSON & GERDIN**  
CONSULTING ENGINEERS

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# BENSON & GERDIN, INC.

CONSULTING ENGINEERS

3150 NORTH SEVENTH STREET

PHOENIX, ARIZONA 85014

PHONE (602) 264-0136

ROGER D. BENSON, P.E.  
ALBERT A. GRIMM, P.E.

FLOOD CONTROL DISTRICT  
RECEIVED  
HAROLD E. GERDIN, P.E.  
MICHAEL E. KENNELLY, P.E.

July 8, 1982

JUL 12 '82

Mr. D. E. Sagramoso, P.E.  
Flood Control District of Maricopa County  
3335 West Durango Street  
Phoenix, AZ 85009

Attention: Mr. Ed Raleigh

Reference: Bridge over Arizona Canal Diversion Channel and the  
New Arizona Canal Relocation  
59th Avenue, South of Thunderbird Road

Dear Sir:

We are submitting copies of the following for your review:

1. Strip map showing existing topography of new bridges and detours
2. Strip map showing ground profiles
3. Geotechnical report
4. Preliminary outline of planning report
5. Preliminary traffic/access study
6. Project schedule
7. Preliminary construction sequence

We are proceeding with Phase II and we will include the final recommendations in the planning report.

Yours very truly,

BENSON & GERDIN, INC.  
CONSULTING ENGINEERS

Michael E. Kennelly, P.E.

MEK: cab

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	ADMIN	SUSP
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REMARKS		

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NEW ARIZONA CANAL RELOCATION  
59TH AVENUE, SOUTH OF THUNDERBIRD ROAD

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References

Appendix A - Soils Report

Appendix B - Preliminary Plan and Profile

PRELIMINARY TRAFFIC/ACCESS STUDY  
BRIDGE OVER ARIZONA CANAL DIVERSION CHANNEL AND THE  
NEW ARIZONA CANAL RELOCATION  
59TH AVENUE, SOUTH OF THUNDERBIRD ROAD

Scope:

To establish the requirements for traffic control and local access during the construction of the project.

Design Traffic Conditions:

Local access to public and private property in the construction area will not be required on this project, however through traffic will be maintained during the construction phase. Access for the S.R.V.W.U.A. facilities will be maintained from the detour to the area of new construction east of 59th Avenue.

Mark Self of the City of Glendale has given us the following information on traffic in the area.

There is a City fire station located 1/4 mile north of Thunderbird Road on 59th Avenue and emergency vehicles would use 59th Avenue to reach the area south of the construction site. The City of Glendale has a service yard at 6210 W. Myrtle and service vehicles use 59th Avenue.

The traffic counts on 59th Avenue are as follows:

Total Daily Traffic (24-hour) 11,619 vehicles

Peak Hour Traffic

<u>Time</u>	<u>Vehicle Count</u>
6-7 AM	448
7-8 AM	1093
8-9 AM	802
9-10 AM	562
3-4 PM	922
4-5 PM	1064
5-6 PM	1149
6-7 PM	949



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Recommendations:

The detours shown on the strip map will maintain one 12-foot lane in each direction. The curves are designed for 30 MPH, but we recommend that the posted limit be 25 MPH.

The capacity of the detour in one direction is determined from the following formulas:

$$N = \frac{5280 V}{S}$$

$$S = V + 20$$

where

N = number of vehicles per hour in one direction

V = velocity in MPH

S = theoretical spacing in feet (AASHTO)

$$S = 25 + 20 = 45$$

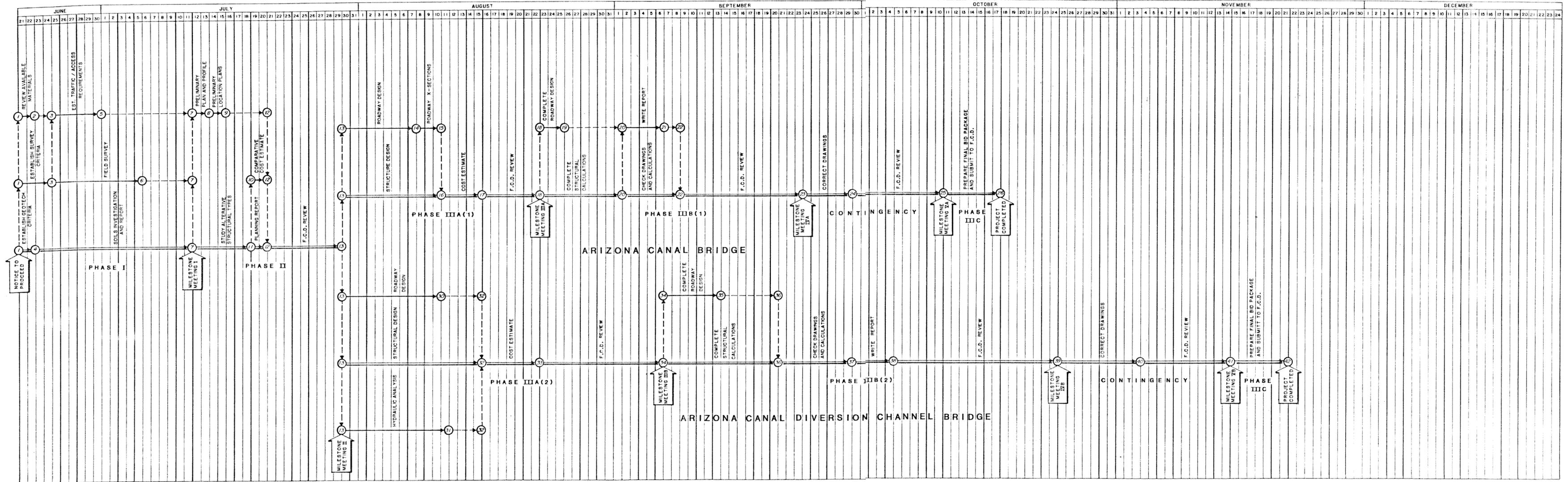
$$N = \frac{5280 \times 25}{45} = 2933 \text{ vehicles/hour}$$

Therefore, the proposed detour should be able to handle any increase in traffic that may occur during the design and construction of the project.

The traffic control will be in accordance with the M.U.T.C.D. as modified by the requirements of M.A.G. and the City of Glendale.

# PROJECT SCHEDULE

## 59th Avenue Bridges Over Arizona Canal And Arizona Canal Diversion Channel



PRELIMINARY CONSTRUCTION SEQUENCE  
BRIDGE OVER ARIZONA CANAL DIVERSION CHANNEL AND THE  
NEW ARIZONA CANAL RELOCATION  
59TH AVENUE, SOUTH OF THUNDERBIRD ROAD

Preliminary Construction Sequence  
Arizona Canal Bridge

1. Build detour around new canal bridge construction site (Detour #1).
2. Construct A.C.D.C. Channel in 59th Avenue (south to north) and use material to construct embankment for roadway south of the new canal bridge.
5. Complete pavement on south approach.
6. Change south end of detour and complete canal and lining east of 59th Avenue.

Preliminary Construction Sequence  
A.C.D.C. Bridge

1. Start construction of A.C.D.C. Bridge from south to north.
2. Water in new canal at end of dry up.
3. Fill and compact existing canal.
4. Realign north end of detour (Detour #2).
5. Complete A.C.D.C. Channel excavation.
6. Complete A.C.D.C. Bridge.
7. Complete roadway pavement.
8. Remove detour pavement (embankment to remain as protective berm on east side of new bridge).



GEOTECHNICAL REPORT

ARIZONA CANAL DIVERSION  
CHANNEL BRIDGES PROJECT  
59th Avenue and  
The Arizona Canal  
Glendale, Arizona

8 July 1982



**WESTERN  
TECHNOLOGIES,  
INC.**

**Phoenix**  
3737 East Broadway Road  
P.O. Box 21387  
Phoenix, Arizona 85036  
(602) 268-1381

**Flagstaff**  
2400 East Huntington Drive  
Flagstaff, Arizona 86001  
(602) 774-8708

**Tucson**  
423 South Olsen Avenue  
Tucson, Arizona 85719  
(602) 624-8894

**Farmington**  
400 South Lorena  
Farmington, New Mexico 87401  
(505) 327-4966

**Las Vegas**  
300 West Boston Avenue  
Las Vegas, Nevada 89102  
(702) 382-7483

**Grand Junction**  
P.O. Box 177  
3224 Highway 6 & 24, No. 3  
Clifton, Colorado 81520  
(303) 434-9873



**WESTERN  
TECHNOLOGIES,  
INC.**

3737 East Broadway Road  
P.O. Box 21387  
Phoenix, Arizona 85036  
(602) 268-1381

Benson & Gerdin  
Consulting Engineers  
3150 North 7th Street  
Phoenix, Arizona 85014

8 July 1982

Attention: Mr. Harold Gerdin

Project: Arizona Canal Diversion Channel  
Bridges Project  
59th Avenue and The Arizona Canal  
Glendale, Arizona

Job No. 2122J085  
Inv. No. 21220142

In accordance with your request, this firm has conducted geotechnical engineering services for the proposed bridges over the Arizona Canal Diversion Channel (ACDC) and the relocated Arizona Canal located along 59th Avenue south of the existing Arizona Canal between Thunderbird Road and Sweetwater Avenue in Glendale, Arizona. The purpose of these services is to provide engineering recommendations relative to the design of foundation elements and procedures relative to earthwork for approach fills.

The ACDC project along 59th Avenue will include the construction of a bridge over the proposed diversion channel, a bridge over the relocated Arizona Canal, relocation of the Arizona Canal, and approach roads. The bridge over the diversion channel will be approximately 620 feet long and 78 feet wide and will have 4 to 8 spans. This structure will be either precast, prestressed concrete girder structure or a box girder structure

with pier loads of 1200 to 2400 kips, respectively. The diversion channel will be an earth-lined trapezoidal section cut approximately 15 to 25 feet into the existing ground surface. The channel will have a 220 foot wide bottom and 6 to 1 (horizontal to vertical) side slopes. The bridge over the relocated Arizona Canal will be approximately 70 feet long and 78 feet wide and will have one or two spans. Pier and abutment loads will be on the order of 300 to 500 kips. The relocated canal will be a concrete-lined trapezoidal section cut into the approach fill on the south side of the diversion channel. The Arizona Canal will be relocated from its present location along the north bridge abutment of the proposed diversion channel to the south side of the diversion channel. The approach fill on the north side of diversion channel will be approximately 150 feet long, while the approach fill on the south side of the channel will be approximately 600 feet long.

Geologic Setting: In general the site is located in the Phoenix Basin in the Basin and Range Physiographic Province. The near surface geologic units at the site are Quaternary-Tertiary Aged interbedded alluvial deposits. The deposits are loose at the surface to very dense at relatively shallow depths. At the time of exploration, the site condition was occupied by a two lane asphaltic concrete paved roadway, a two lane concrete bridge, the Arizona Canal, two irrigation ditches on the west side of the existing roadway and numerous underground and overhead utilities. The existing Arizona Canal was constructed by cutting the channel and placing 3 to 4 feet of fill along the north and south banks of the channel.

Field Explorations and Subsurface Conditions: Twelve test borings were drilled at the locations shown on the accompanying site plan with a CME 75 drill rig using hollow stem auger. In addition, four subgrade samples were obtained from the approach



road area. During test drilling, subsoils were visually examined and sampled at selected intervals. Surface soils in Test Borings 1, 3, 5, 7 and 9 to depths of 2 to 3 feet are roadway approach and canal embankment fill materials. These fills consisted of sand, clay and gravel mixed soils. Along the ACDC bridge alignment soils encountered to the depth of anticipated channel excavation (15 to 25 feet deep) consisted of medium dense to very dense clayey sands, sands, silty sands and gravelly sands with lightly to moderately cemented zones. The soils encountered below the anticipated channel depth are dense to very dense gravelly sands and sands containing a variable percent of silt and clay. Along the relocated Arizona Canal bridge alignment the soils encountered to depths of 19 to 23 feet consist of interbedded sandy clay and clayey sand containing a trace to some gravel and an occasional gravelly sand lens. The underlying material consisted of gravelly sands containing a variable percentage of silt and clay. Test boring depths ranged from 26 to 51 feet below existing grade. No groundwater was encountered in any test boring at the time of exploration.

Laboratory Testing: Laboratory test results indicate that native subsoils at foundation level exhibit relatively low compressibility at natural moisture contents and a very slight tendency to compress additionally under an increased moisture condition. The dense to very dense granular soils exhibit moderate to high shear strength characteristics.

Foundations: Due to the variable nature of bearing soils, and the anticipated grading scheme, foundation alternates consisting of shallow footings bearing upon undisturbed soils, drilled piers designed on either an end bearing or a skin friction basis or a combination of shallow footings and drilled piers appears feasible for support of the structures. Other methods



of support can be evaluated and recommendations presented, if requested.

The recommended allowable bearing capacities apply to dead load plus design live load conditions. A one-third increase in allowable bearing capacity is permissible when considering total loads, including wind or seismic. Recommended minimum width for shallow footings is 36 inches. The recommended minimum diameter for drilled piers is 24 inches. Finish grade references should be considered as lowest adjacent grade as measured at the perimeter of the footings. Lowest adjacent grade should be measured from the bottom of the anticipated scour.

Foundation elements on slopes should have the outside edge of the footings at least 5 feet from the face of slope and should be founded such that an imaginary line extending down at 45 degrees from the perimeter footing edge does not lie above or intersect the slope.

It is recommended that foundation excavations into undisturbed soils be inspected by the geotechnical engineer and deepened if loose or disturbed soils are encountered. If the soil conditions encountered are significantly different than those presented in this report, this firm should be contacted for verification and/or supplemental recommendations.

The following tabulation presents the relationship between foundation depth, allowable bearing capacity and estimated settlements under maximum load conditions for shallow footings and end bearing drilled piers.



Arizona Canal Diversion Channel Bridges  
 Project No. 2122J085

<u>Foundation Depth (Feet) Below Finished Grade</u>	<u>Depth (Feet) Below Existing Grade (min)</u>	<u>Foundation Type</u>	<u>Allowable Bearing Capacity(PSF)</u>	<u>Estimated Settlement (Inches)</u>
2	2	SF	3000*	1/4 - 1/2
10	2	DP	7000*	1/4 - 1/2
5	5	SF	5000*	1/4 - 3/8
10	5	DP	10000*	1/4 - 3/8
3	15	SF	7000	3/4 - 1
10	15	DP	10000	1/4 - 1/2
15	15	DP	15000	< 3/8
10	25	DP	15000	< 1/4
15	25	DP	20000	< 1/4

SF = Shallow footing

DP = Drilled piers

\* Applies to Arizona Canal Bridge only

Drilled piers designed on a skin friction basis should be straight shaft elements which extend at least 20 feet below finished grade. The following tabulation presents the relationship between foundation depth and load capacity for various depths. The total allowable load may be computed by multiplying the load by the diameter of the drilled shaft.



Arizona Canal Diversion Channel Bridges  
 Project No. 2122J085

<u>Depth Below Existing Grade (feet)</u>	<u>Length Below Finished Grade (feet)</u>	<u>Load x Diameter (kips)</u>
0-20	20	14.5
0-25	25	28.0
0-30	30	45.5
0-35	35	66.0
0-40	40	89.5
0-45	45	116.5
0-50	50	147.0
20-40	20	26.5
20-45	25	41.0
20-50	30	59.0
20-55	35	81.0
20-60	40	106.0
20-65	45	134.0
20-70	50	165.0

Estimated settlements for drilled piers designed on a skin friction basis are 3/4 inch or less for maximum concentrated loadings. Little additional settlement is anticipated even if moisture penetrates into soils underlying drilled piers.

It is our opinion that drilling and/or bellling within the near surface and subsoil deposits to depths of 10 to 20 may be readily accomplished with conventional rotary or bucket augers. Significant caving or raveling is not anticipated to these depths unless sand or gravelly sand lenses of substantial thickness are encountered. Some caving or raveling is anticipated and stabilizing techniques (slurry drilling or casing) may be required to maintain open shafts below depths of 10 to 20 feet, and bellling in these soils is not recommended. Foundation concrete quantities will probably somewhat exceed ideal geometric volumes.



The bearing surface of drilled foundation elements designed on an end-bearing basis must be cleaned prior to concrete placement. Adequacy of cleaning and verification of pier configuration should be established by inspection of drilled elements. Drilled piers designed on a skin friction basis should be machine cleaned. Applicable safety codes require casing for personnel protection during cleaning and inspection.

Design Consideration for Lateral Loads: Drilled piers resist lateral load (horizontal loads or moments) by deflecting until the necessary reaction in the surrounding soil is mobilized. Behavior of the foundation under such loading conditions depends essentially on the relative stiffnesses of the pier and the soil. The allowable lateral soil resistance acting on the drilled pier sections are 2.0 KSF/ft for piers extending 0 to 20 feet below existing grade and 4.5 KSF/ft for piers extending below 20 feet.

As an alternate the following lateral subgrade modulus may be used:

<u>Material</u>	<u>Lateral Subgrade Modulus (pounds/cu.in.)</u>
Undisturbed Granular Soils	65
Granular Fill (min. 95% ASTM D1557)	65
Granular Fill (85% to 90% ASTM D1557)	24

The recommended design factors to assess lateral earth pressures against shallow footings and abutments are presented in the following tabulation:



Equivalent active soil pressure:	
Undisturbed -----	30 psf/ft.
Compacted granular soils:	
Lateral Pressures (yielding structure) -	30 psf/ft.
Lateral Pressures (rigid structure) ---	55 psf/ft.
Equivalent passive soil pressure:	
Compacted granular or in-situ granular soils:	
Shallow continuous footings -----	350 psf/ft.
Coefficient of base friction -----	0.30*

\*The coefficient of base friction may be used in conjunction with passive pressures.

All backfill against the bridge abutments should consist of free draining granular material. Backfill should be placed in horizontal lifts consistent with the maximum material size and type of compaction equipment in use and to a minimum of 95% of the maximum density at an optimum moisture content plus or minus 3% as determined in accordance with ASTM D1557. Compaction equipment should be maintained at least 2 feet from the walls to minimize the possibility of developing excessive stresses.

Lateral movements of bridge deck which are transmitted to the abutment as the result of thermal expansion will result in passive resistance equal to or greater than those presented above. The development of passive resistance at the interface between fill zone and abutments may be reduced by the installation of a resilient material (preferred), or alternately styrofoam or corrugated cardboard filler. This material should be installed along all vertical faces of the abutment.



Roadways and Approach Fills Site Preparation: The following procedure is recommended for placement and compaction of fill and approach fill zones in roadway areas.

1. Completely remove all loose soil, vegetation, any roadside debris and existing structures within proposed fill areas.
2. Depressions, ditches and the existing canal should be cleaned of all loose or wet soils and widened to accommodate compaction equipment and sloping areas should be benched to provide a level surface for fill placement.
3. Scarify, moisten or dry as required, all exposed subgrade surface to a minimum depth of 8 inches.
4. Place required fill in compacted horizontal lifts to subbase level. Soils obtained during site grading or comparable soils borrowed from adjacent sites which are free of vegetation and debris may be utilized in approach and roadway fills. All fills should be placed and compacted in lifts consistent with type of compaction equipment in use to achieve uniform density. Compaction should be to a minimum of 95% of the maximum density as determined in accordance with ASTM D1557 within a moisture content range of plus or minus 3% of optimum.

Stability of Cut and Fill Slopes: It is anticipated that the compacted fill materials will consist of on-site soils. As such, the recommended side slopes for fill are as follows:



Fill Slopes

Above high water level ---- 1-1/2 to 1 (horizontal to vertical)

Below high water level ---- 2-1/2 to 1 (horizontal to vertical)

Cut Slopes

<u>Material Type</u>	<u>Cut Slope (Horizontal to Vertical)</u>
Alluvial Soils	1-1/2 to 1

Approach Fill Settlements: For approach fills of 5 to 10 feet in height, a total settlement of approximately 1 to 1-1/2 inches is expected which will be comprised of settlement of the approach fill itself and compression of the underlying foundation materials due to the weight of the approach fill.

Temporary Excavations for Spread Foundations: Excavations for shallow foundations through the alluvial soils should be possible with conventional excavation equipment. Due to the granular nature of the alluvial subsoils, caving and/or sloughing is anticipated for temporary construction slopes. Therefore, excavations for shallow footings at pier locations will require shoring and bracing to provide protection for personnel. If shoring and bracing is not utilized, trench slopes should be cut to an approximate 1-1/4 to 1 slope (horizontal to vertical). Flatter slopes may be required where clean poorly graded sand and gravel lenses or seams are encountered.

Pavement Design: Pavement design for 59th Avenue should be based on the minus No. 200 sieve analysis and plasticity index (attached).



Arizona Canal Diversion Channel Bridges  
Project No. 2122J085

If you should have any questions regarding the contents of this report, or if we may be of additional service to you in any way, please do not hesitate to contact us.

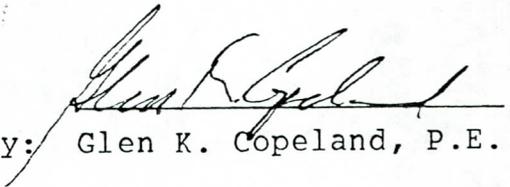
Sincerely yours,  
WESTERN TECHNOLOGIES, INC.  
Geotechnical Services



Kenneth L. Ricker, P.E.

/kb

copies to: Addressee (5)



Reviewed by: Glen K. Copeland, P.E.



## DEFINITION OF TERMINOLOGY

ALLOWABLE SOIL BEARING CAPACITY ALLOWABLE FOUNDATION PRESSURE	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
BACKFILL	A specified material placed and compacted in a confined area.
BASE COURSE	A layer of specified material placed on a subgrade or subbase.
BASE COURSE GRADE	Top of base course.
BENCH	A horizontal surface in a sloped deposit.
CAISSON	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
CONCRETE SLABS-ON-GRADE	A concrete surface layer cast directly upon a base, subbase or subgrade.
CRUSHED ROCK BASE COURSE	A base course composed of crushed rock of a specified gradation.
DIFFERENTIAL SETTLEMENT	Unequal settlement between or within foundation elements of a structure.
ENGINEERED FILL	Specified material placed and compacted to specified density and/or moisture conditions under observation of a representative of a soil engineer.
EXISTING FILL	Materials deposited through the action of man prior to exploration of the site.
EXISTING GRADE	The ground surface at the time of field exploration.
EXPANSIVE POTENTIAL	The potential of a soil to expand (increase in volume) due to the absorption of moisture.
FILL	Materials deposited by the action of man.
FINISHED GRADE	The final grade created as a part of the project.
GRAVEL BASE COURSE	A base course composed of naturally occurring gravel with a specified gradation.
HEAVE	Upward movement.
NATIVE GRADE	The naturally occurring ground surface.
NATIVE SOIL	Naturally occurring on-site soil.
ROCK	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
SAND AND GRAVEL BASE	A base course of sand and gravel of a specified gradation.
SAND BASE COURSE	A base course composed primarily of sand of a specified gradation.
SCARIFY	To mechanically loosen soil or break down existing soil structure.
SETTLEMENT	Downward movement.
SOIL	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
STRIP	To remove from present location.
SUBBASE	A layer of specified material placed to form a layer between the subgrade and base course.
SUBBASE GRADE	Top of subbase.
SUBGRADE	Prepared native soil surface.





Type of Material Subsoils

Job No. 2122J085

Source of Material As noted below

Test Procedure ASTM D422, D423, D424, C114D

Tested/Calc. By MA Date 7/2/82

Reviewed By KR Date 7/7/82

Hole No.	Location	Depth	Classification		LL	PI	Sieve Analysis - Accum % Passing												Lab No./I.D.					
			AASHTO	Unified			200	100	40	16	10	4	¼	¼	¼	1	1½	2		3				
A	Sta 30+00	0-1½'		SC	28	13	41	*																
B	Sta 32+00	0-1½'		CL	31	13	59	*																
C	Sta 44+00	0-1½'		SC	33	14	40	*																
D	Sta 46+00	0-½'		CL	33	15	54	*																
3	See site plan	25-26½'		SC	29	8	16	19	31	56	64	72	83	90	100									
7	See site plan	20-21'		SM	27	5	12	13	30	61	74	88	90	92	100									

\*Minus No. 200 Sieve determination only

## SOIL CLASSIFICATION AND LEGEND

### COARSE-GRAINED SOIL

MORE THAN 50% LARGER THAN 200 SIEVE SIZE

Symbol	Letter	DESCRIPTION	MAJOR DIVISIONS
	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% - 200 FINES	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size.
	GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% - 200 FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% - 200 FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% - 200 FINES	
	SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% - 200 FINES	SANDS More than half of coarse fraction is smaller than No. 4 sieve size.
	SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% - 200 FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES MORE THAN 12% - 200 FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES MORE THAN 12% - 200 FINES	

### FINE-GRAINED SOIL

MORE THAN 50% SMALLER THAN 200 SIEVE SIZE

Symbol	Letter	DESCRIPTION	MAJOR DIVISIONS
	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	SILTS AND CLAYS Liquid limit less than 50
	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
	OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	SILTS AND CLAYS Liquid limit greater than 50
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

NOTE — Soils with 5 to 12 percent minus 200 fines should be classified with dual symbols

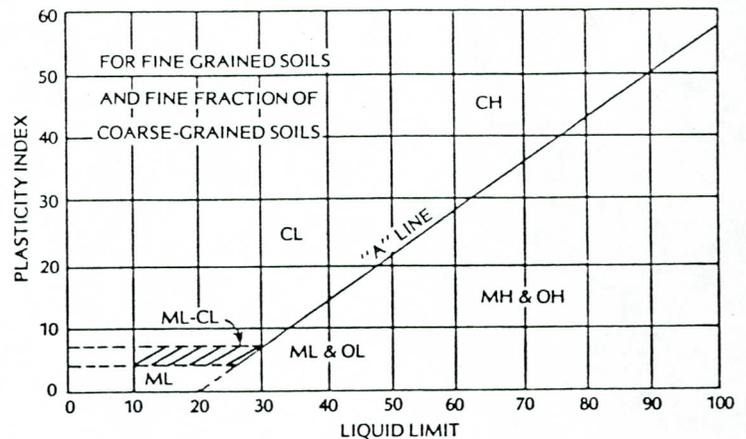
### SOIL FRACTIONS

Component	Size Range
Boulders	Above 12 in.
Cobbles	3 in. to 12 in.
Gravel	3 in. to No. 4 sieve
Coarse Gravel	3 in. to 1/4 in.
Fine Gravel	1/4 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

**Soil Classification:** ASTM D2487

Classification is visual unless accompanied by mechanical analysis and Atterberg limits. Percentage shown on log denotes visual approximation  $\pm 5\%$ .

### PLASTICITY CHART



### LEGEND OF BORING OPERATIONS

ST - Sample Type

R = 2.42" I.D. ring sampler, driven with 140 pound hammer with 30" free fall; RF = more than 100 blows

N = 2.0 inch O.D. split barrel sampler (ASTM D1586), driven with 140 pound hammer with 30" free fall; RF = more than 100 blows

C = 2.0 inch O.D. bullnose, driven with 140 pound hammer with 30" free fall; RF = more than 100 blows

T = Thin wall tube sampler, either pushed into the soil or driven with 140 pound hammer with 30" free fall

G = Grab sample from cuttings or spoil

B = Block sample

DD - dry density  
 MC - moisture content  
 RF - refusal  
 NR - no recovery  
 P - pushed  
 HSA - hollow stem auger  
 SSA - solid stem auger  
 RW - rotary wash  
 CNX - NX-size diamond coring  
 CBX - BX-size diamond coring  
 CHQ - HQ-size diamond coring  
 RK - bedrock  
 RA - rotary air  
 RAF - rotary air with foam

Note: The data presented on the following log of boring sheet(s) represents conditions at the location on the date the field work was performed and should not be inferred to represent other locations or dates. Such data have been obtained exclusively for design purposes and should not be construed as part of the construction plans or as defining construction technique.



LOG OF BORING

Test Boring No. 1

Sta 41+96 L 30'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 17.8

Datum:

Type/Size Boring: 7" HSA

Rig Type: CME75

Date: 6/25/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	MC (%)	Description
-					<u>SANDY CLAY</u> ; Brown (CL), <u>Fill</u> , Below Plastic Limit, Firm
5	31	S			<u>SANDY CLAY</u> ; Brown (CL), At to Above Plastic Limit, Firm to Stiff, Lightly Cemented
10					<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense, Lightly to Moderately Cemented
	28	R	113.6	2.7	<u>SAND</u> ; Trace to some Gravel, Brown (SP), Slightly Damp, Medium Dense
15					
	52	S			<u>SILTY SAND</u> ; Brown (SM), Slightly Damp, Dense
20					
	50/8"	R	110.2	15.9	<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
25					
	50/5"	S			
30					

(continued)



LOG OF BORING

Test Boring No. 1 (Continued)

Project No: 2122J085

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	Description
<u>31</u>	92/8"	S		<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
—				
<u>35</u>	50/4"	S		
—				
<u>40</u>	50/6"	S		
—				
<u>45</u>	94/11"	S		
—				
<u>50</u>	50/6"	S		
Stopped at 51'				
<u>55</u>				
—				
<u>60</u>				
—				
<u>65</u>				



LOG OF BORING

Test Boring No. 2

Sta 40+48 R 46'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 14.2

Datum:

Type/Size Boring: 7" HSA

Rig Type: CME75

Date: 6/23/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	ST	DD (pcf)	MC (%)	Description
-					<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense, Lightly to Moderately Cemented
-					
-					
<u>5</u>					
-					
<u>10</u>					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					<u>SILTY SAND</u> ; Trace to some Gravel, Brown (SM), Slightly Damp, Dense to very Dense
-					
<u>15</u>	41	R	118.0	6.6	
-					
<u>20</u>	50/8"	R	NR		
-					
-					
<u>25</u>	56	S			
-					
<u>30</u>					

(continued)



LOG OF BORING

Test Boring No. 2 (Continued)

Project No: 2122J085

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	Description
<u>31</u>	50/6"	R		<u>SILTY SAND</u> ; Trace to some Gravel, Brown (SM), Slightly Damp, Dense to very Dense
-				
<u>35</u>				
-	72	S		
-				
<u>40</u>				
-	50/5"	R		
-				
<u>45</u>				
-	99/11"	S		
-				
<u>50</u>	50/2"	S NR		
Stopped at 50'				
-				
<u>55</u>				
-				
<u>60</u>				
-				
<u>65</u>				



LOG OF BORING

Test Boring No. 3

Sta 40+23 L 11'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 18.6

Datum:

Type/Size Boring: 7"HSA

Rig Type: CME 75

Date: 6/28/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	(%)	Description
-					<u>SANDY GRAVEL</u> ; Some Silty, Brown (GP/GW), <u>Fill</u> (Aggregate Base Material), Dense
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), <u>Fill</u> , Slightly Damp, Dense to very Dense
<u>5</u>					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
-					
<u>10</u>					
-					
-					
<u>15</u>					
-					
-					
<u>20</u>					
-					
-					
<u>25</u>	79	S			<u>SILTY SAND</u> ; Trace to some Gravel, Brown (SM), Slightly Damp, Dense to very Dense
-					
-					
<u>30</u>					

(continued)



LOG OF BORING

Test Boring No. 3 (Continued)

Project No: 2122J085

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	MC (%)	Description
<u>31</u>	50/6"	R			<u>SILTY SAND</u> ; Trace to some Gravel, Brown (SM), Slightly Damp, Dense to very Dense
-					Dense to very Dense
<u>35</u>	50/2"	S	NR		<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
<u>40</u>	50/2"	R	NR		
-					
<u>45</u>	50/6"	S			
-					
<u>50</u>	50/2"	S			
Stopped at 50'					
<u>55</u>					
-					
<u>60</u>					
-					
<u>65</u>					



LOG OF BORING

Test Boring No. 4

Sta 39+03 R 44'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 14.3

Datum:

Type/Size Boring: 7"HSA

Rig Type: CME 75

Date: 6/23/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	(%)	Description
-					<u>CLAYEY SAND</u> ; Trace to some Gravel,
-					Brown (SC), Slightly Damp, Medium Dense
-					to Dense, Lightly to Moderately Cemented
5					<u>GRAVELLY SAND</u> ; Trace to some Clay and
-					Silt, Brown (SP/SW), Slightly Damp,
-					Dense to very Dense
10					
-					
-					
15					
-					
-					
20					
-					
-					<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown
-					(SC) Slightly Damp, Medium Dense to Dense,
25					<u>Lightly to Moderately Cemented</u>
-	50/6"	R	107.9	7.9	<u>SILTY SAND</u> ; Trace to some Gravel, Brown
-					(SM), Slightly Damp, Dense to very Dense
30					(continued)



LOG OF BORING

Test Boring No. 4 (Continued)

Project No: 2122J085

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	MC (%)	Description
<u>31</u>	85/11"	S			<u>SILTY SAND</u> ; Trace to some Gravel, Brown (SM), Slightly Damp, Dense to very Dense
-					
<u>35</u>					
-	50/2"	R			
-					
<u>40</u>					
-	50/4"	S			
-					
<u>45</u>					
-	50/3"	S			
-					
<u>50</u>	50/6"	R	102.6	18.2	
Stopped at 51'					
<u>55</u>					
-					
<u>60</u>					
-					
<u>65</u>					



LOG OF BORING

Test Boring No. 5

Sta 38+75 L 11'

Project: 59th Avenue Bridge over ACDC Project No: 2122J085

Elevation: 16.8 Datum:

Type/Size Boring: 7"HSA Rig Type: CME 75 Date: 6/28/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	(%)	Description
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, <u>Fill</u> , Brown (SP/SW), Slightly Damp, Dense to very Dense
-					<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense, Lightly to Moderately Cemented
<u>5</u>					<u>GRAVELLY SAND</u> ; Traces to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense, Lightly to Moderately Cemented
<u>10</u>					
-					
-					
<u>15</u>					
-					<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense, Lightly to Moderately Cemented
<u>20</u>	74	S			
-					
-					
<u>25</u>	50/5"	S			
-					
-					
<u>30</u>					

(continued)



LOG OF BORING

Test Boring No. 5 (Continued)

Project No: 2122J085

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	(%)	Description
<u>31</u>	50/5"	S			<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
-					
<u>35</u>					
-	50/4"	S			
-					
-					
<u>40</u>					
-	50/4"	S			
-					
-					
<u>45</u>					
-	50/5'	S			
-					
-					
<u>50</u>	50/6"	S			
-					
-					
-					
<u>55</u>					
-					
-					
-					
<u>60</u>					
-					
-					
-					
<u>65</u>					

Stopped at 51'



LOG OF BORING

Test Boring No. 6

Sta 37+53 R 44'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 13.4

Datum:

Type/Size Boring: 7"HSA

Rig Type: CME 75

Date: 6/24/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	MC (%)	Description
-					<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown
-					(SC), Slightly Damp, Medium Dense to
-					Dense, Lightly to Moderately Cemented
<u>5</u>					
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and
-					Silt, Brown (SP/SW), Slightly Damp,
-					Dense to very Dense
<u>10</u>					
-					<u>CLAYEY SAND</u> ; Brown (SC), Slightly Damp,
-					Medium Dense, Lightly to Moderately Dense
<u>15</u>					
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and
-					Silt, Brown (SP/SW), Slightly Damp,
-					Dense to very Dense
<u>20</u>					
-	50/4"	R	126.2	5.8	
-					
<u>25</u>					
-	71	S			
-					
<u>30</u>					

(continued)



LOG OF BORING

Test Boring No. 6 (Continued)

Project No: 2122J085

Depth (ft)	Blows/ Foot	ST	DD (pcf)	MC (%)	Description
<u>31</u>	83/10"	S			<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
<u>35</u>	50/4"	R			
-					
<u>40</u>	32	S			
-					
<u>45</u>	50/6"	R	115.2	6.2	
-					
<u>50</u>	80/9"	S			
Stopped at 51'					
<u>55</u>					
-					
<u>60</u>					
-					
<u>65</u>					



LOG OF BORING

Test Boring No. 7

Sta 37+27 L 11'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 14.8

Datum:

Type/Size Boring: 7"HSA

Rig Type: CME 75

Date: 6/28/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	MC (%)	Description
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, <u>Fill</u> , Brown (SP/SW), Slightly Damp, Dense to very Dense
-					<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense Lightly to Moderately Cemented
5					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
-					
10					
-					
-					
15					
-					
-					
20	50/10"	R			<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense Lightly to Moderately Cemented
-					
-					
25	50/6"	R	118.1	15.1	
-					
-					
30					(continued)



LOG OF BORING

Test Boring No. 7 (Continued)

Project No: 2122J085

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	MC (%)	Description
<u>31</u>	40	R	113.7	12.5	<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
<u>35</u>	50/9"	R	114.2	10.8	
-					
<u>40</u>	50/5"	R	121.5	6.9	
-					
<u>45</u>	50/4"	R			
-					
<u>50</u>	50/5"	R	100.9	24.3	<u>SILTY SAND</u> ; Trace to some Gravel, Brown (SM), Slightly Damp, Dense to very Dense
-					
-					Stopped at 51'
<u>55</u>					
-					
<u>60</u>					
-					
<u>65</u>					



LOG OF BORING

Test Boring No. 8

Sta 36+07 R 44'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 12.2

Datum:

Type/Size Boring: 7"HSA

Rig Type: CME 75

Date: 6/24/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	ST	DD (pcf)	MC (%)	Description
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
-					
-					
5					
-					<u>SILTY SAND</u> ; Trace to some Gravel, Brown (SM), Slightly Damp, Dense to very Dense
-					
-					
-					
10	82/11"	S			
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
-					
-					
15	50/7"	R	93.2	23.2	
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
-					
-					
20	50/5"	S			
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
-					
-					
25	50/5"	S			
-					(continued)
-					
30					



LOG OF BORING

Test Boring No. 8 (Continued)

Project No: 2122J085

Depth (ft)	Blows/ Foot	DD ST (pcf)	MC (%)	Description
<u>31</u>	50/3"	S		<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-				
-				
<u>35</u>				
-	50/4"	R		
-				
-				
<u>40</u>				
-	92/11"	S		
-				
-				
<u>45</u>				
-	50/5"	R	116.5	5.7
-				
-				
<u>50</u>	74	S		
Stopped at 51'				
-				
-				
<u>55</u>				
-				
-				
<u>60</u>				
-				
-				
<u>65</u>				



LOG OF BORING

Test Boring No. 9

Sta 35+77 L 12'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 13.0

Datum:

Type/Size Boring: 7"HSA

Rig Type: CME 75

Date: 6/28/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	DD ST	MC (pcf) (%)	Description
-				<u>GRAVELLY SAND</u> ; Trace to some Clay and
-				Silt, <u>Fill</u> , Brown (SP/SW), Slightly Damp,
-				Dense to very Dense
-				<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown
5				(SC), Slightly Damp, Medium Dense to
	18	S		Dense, Lightly to Moderately Cemented
-				<u>GRAVELLY SAND</u> ; Trace to some Clay and
-				Silt, Brown (SP/SW), Slightly Damp,
-				Dense to very Dense
10				
	80/10"	S		
-				
-				
15				
	109	S		
-				
-				
20				
	71	S		
-				
-				
25				
	82	S		
-				
-				
30				

(continued)



LOG OF BORING

Test Boring No. 9 (Continued)

Project No: 2122J085

Depth (ft)	Blows/ Foot	DD ST	MC (%)	Description
<u>31</u>	98/8"	S		<u>GRAVELLY SAND</u> ; Trace to some Clay and Silt, Brown (SP/SW)
-				
-				
<u>35</u>				
-	50/5"	S	NR	
-				
-				
<u>40</u>				
-	79	S		
-				
-				
<u>45</u>				
-	89/11"	S		
-				
-				
<u>50</u>	90/8"	S		
-				
-				
-				
<u>55</u>				
-				
-				
<u>60</u>				
-				
-				
<u>65</u>				

Stopped at 51'



LOG OF BORING

Test Boring No. 10

Sta 34+77 L 29'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 12.1

Datum:

Type/Size Boring: 7"HSA

Rig Type: CME 75

Date: 6/25/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	MC (%)	Description
-					<u>SANDY CLAY</u> ; Brown (CL), At to Above
-					Plastic Limit, Firm to Stiff, Lightly
-					Cemented
<u>5</u>					
-	22	S			
-					<u>GRAVELLY SAND</u> ; Trace to some Clay and
-					Silt, Brown (SP/SW), Slightly Damp,
<u>10</u>					Dense to very Dense
-	50/6"	R	86.3	16.3	<u>SANDY CLAY</u> ; Brown (CL), At to Above
-					Plastic Limit, Firm to Stiff, Lightly
-					Cemented
<u>15</u>					
-	69/11"	S			
-					
<u>20</u>					
-	50/10"	R			
-					
<u>25</u>					<u>GRAVELLY SAND</u> ; Trace to some Clay and
-	78	S			Silt, Brown (SP/SW), Slightly Damp,
-					Dense to very Dense
-					
-					Stopped at 26'
<u>30</u>					



LOG OF BORING

Test Boring No. 11

Sta 33+93 R 43'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 10.2

Datum:

Type/Size Boring: 7"HSA

Rig Type: CME 75

Date: 6/25/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	DD ST	MC (pcf)	MC (%)	Description
-	36	R			<u>SANDY CLAY</u> ; Brown (CL), At to Above Plastic Limit, Firm to Stiff, Lightly Cemented
5	16	S			<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense Lightly to Moderately Cemented
10	50/10"	R	96.4	19.7	<u>SANDY CLAY</u> ; Brown (CL), at to Above Plastic Limit, Firm to Stiff, Lightly Cemented
15	71	S			
20	50/4"	R			<u>GRAVELLY SAND</u> : Trace to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
25	77/10"	S			
-					Stopped at 26'
30					



LOG OF BORING

Test Boring No. 12

Sta 34+12 L 30'

Project: 59th Avenue Bridge over ACDC

Project No: 2122J085

Elevation: 11.4

Datum:

Type/Size Boring: 7"HSA

Rig Type: CME 75

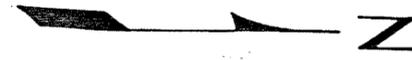
Date: 6/25/82

Groundwater Conditions: No Groundwater

Depth (ft)	Blows/ Foot	ST	DD (pcf)	MC (%)	Description
-	27	S			<u>SANDY CLAY</u> ; Brown (CL), at to Above Plastic Limit, Firm to Stiff, Lightly Cemented
5	33	R	105.5	12.4	<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense Lightly to Moderately Cemented
10	97/11"	S			<u>GRAVELLY SAND</u> ; Traces to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					<u>CLAYEY SAND</u> ; Trace to some Gravel, Brown (SC), Slightly Damp, Medium Dense to Dense Lightly to Moderately Cemented
15	50/8"	R			
20	58	S			
25	50	R	120.4	8.4	<u>GRAVELLY SAND</u> ; Traces to some Clay and Silt, Brown (SP/SW), Slightly Damp, Dense to very Dense
-					
30					Stopped at 26'



Arizona Canal Diversion Channel Bridges  
Project No. 2122J085



Not to Scale

