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January 29, 2002

Flood Control District of Maricopa County
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ATTN: Mr. C. Scott Vogel, P.E.
Senior Project Manager
Planning and Project Management Division

RE: Bethany Home Outfall Channel, Phase II
SR 101L to 83rd Avenue
Contract FCD 2001C053, PCN No. 620 03 32

SUBJECT: Geotechnical Investigation Report, Addendum No. 1
Pedestrian Bridge Structures

Dear Scott:

This addendum to our Geotechnical Investigation Report for Phase II of the Bethany Home Outfall Project, dated August, 2001, is submitted subsequent to additional test drilling and laboratory testing for two planned pedestrian bridge structures. This addendum details our scope of work, and includes the results of our investigation, and provides additional recommendations for the design of foundations, site grading, excavations, and other earthwork related elements for the two bridges.

The details and recommendations presented in this addendum are specific to the proposed pedestrian bridge structures planned as part of this project. Wherever possible, references within the analysis and recommendations section (Section 5) are made to the original report to limit repetition.

1.0 PROJECT UPDATE

The alignment of the proposed flood control channel will pass beneath the existing Salt River Project (SRP) Grand Canal (through box culverts) near the alignment of 87th Avenue and just east of 83rd Avenue. At these two locations, new pedestrian bridges will span the Grand Canal to provide pedestrian access over the canal and maintain continuity to the meandering trail system planned for the landscaped flood control channel. Preliminary information for the bridges indicate 44- to 48-foot long spans, with end reactions of approximately 100 kips.

At both locations, a temporary detour of the Grand Canal will be required during installation of the box culverts to provide uninterrupted flow or irrigation water. Based on the DMJM+HARRIS 60% Submittal, it appears that the excavation required to install

the outfall channel box culvert structure will impact the soils to some extent at the Abutment No. 1 location of the 83rd Avenue Pedestrian Bridge. Depending on the slope of the box culvert excavation, the upper 5 to 10 feet (approximately) of existing soils may be removed and replaced at the location of the planned bridge abutment.

2.0 FIELD & LABORATORY INVESTIGATION

Four test borings were advanced for this additional investigation to depths of approximately 46 feet using a truck-mounted Brainard-Kilman 81HD drill rig and a low-clearance, trailer-mounted, modified LT 10W rig, each advancing 8-inch O.D., hollow-stem auger. Standard Penetration Test (split spoon) and open-end (ring) drive samples were taken at intervals of 5 feet or less within the borings. Bulk samples of auger cuttings were also collected from selected depths for laboratory testing. The soils encountered were visually classified, and logs of borings prepared, by our field engineer. The locations of the test borings are shown on the site plans (Sheets 1 and 2) and are presented with the boring logs in Appendix A.

Laboratory testing was performed by ATL, Inc. on selected samples obtained from the test borings. The tests performed include moisture content, dry density, sieve analysis, Atterberg limits (plasticity index), direct shear, and consolidation. The moisture content and dry density results are presented on the boring logs. The other test results are presented in Appendix B.

3.0 GEOTECHNICAL PROFILE & GROUNDWATER CONDITIONS

3.1 GEOTECHNICAL PROFILE

Typically, the subsurface soils encountered to the full depths explored for this additional investigation consist of fine-grained, silty to sandy clays with layers of clayey sand and lesser amounts of gravelly to silty sand, mostly of low to medium plasticity. The borings advanced at the 87th Avenue pedestrian bridge location encountered fill materials placed to construct the existing Grand Canal banks within the upper two feet, and some gravelly lenses below depths of 37 feet. At the 83rd Avenue pedestrian bridge location, the test borings again encountered gravelly lenses at depth, and Boring 83PB-2 encountered canal bank fill soils within the upper 2 feet. Typically, the soils encountered are uncemented to weakly cemented with calcium carbonate, and are generally moderately firm to firm within the upper five to eight feet, becoming firmer with depth. The majority of the excavations and earthwork anticipated for the pedestrian bridge construction will be completed within the moderately firm to firm near surface clay soils.

3.2 SOIL MOISTURE & GROUNDWATER CONDITIONS

Groundwater was not encountered in any of the test borings. The moisture content of 10 samples tested in the laboratory varied from 3 to 25 percent. The moisture conditions described in the field typically varied from slightly moist to very moist. The close proximity of the test borings to the Grand Canal likely contributed to the elevated

moisture contents within various soil layers. However, the clay soils present near surface also likely provide a natural barrier to significant seepage from the canal.

4.0 SEISMIC CONSIDERATIONS

A peak ground acceleration of 0.026g with a 90 percent probability of non-exceedance in 50 years is indicated in Arizona Department of Transportation (ADOT) report AZ92-344 (Euge, et al, 1992). With respect to seismic design, the above acceleration coefficient would equate to Seismic Performance Category (SPC) A, based on Table 3.4, Division 1A of AASHTO (1996). In accordance with Article 3.5 and Table 3.5.1, Division 1A, of AASHTO (1996), the site soils should be considered as Type II, and the Site Coefficient (S) should be 1.2.

5.0 ANALYSIS & RECOMMENDATIONS

5.1 GENERAL

Single-span pedestrian bridge structures founded just outside the existing Grand Canal bank limits are planned west of the 87th Avenue alignment and east of 83rd Avenue. Based on the materials encountered within the test borings, the lightly loaded pedestrian bridge structures can be supported on either shallow spread-type foundations or on relatively deep, drilled shaft foundations.

It is understood that the structures will most likely be supported on drilled shafts to better accommodate construction sequencing, and to minimize work space requirements. Drilled shafts are considered best suited for use adjacent to canals as they will not be subject to significant movement should the near surface subgrade soils experience substantial increases in moisture due to canal seepage, as compared to shallow foundations. Recommendations for supporting the pedestrian bridges on drilled shafts are presented in Section 5.2.

As discussed in the project update, it is understood that the excavation required for the installation of the outfall channel box culvert east of 83rd Avenue, will likely impact the existing near surface soils at the planned Abutment No. 1 location (on the west side of the Grand Canal). It does not appear that excavations for the temporary detour of the Grand Canal or those required for installation of box culverts, should not impact the soils present at the other three abutment locations. Thus, shallow footings, if utilized, will most likely be founded on either existing embankment fill, on the underlying native site soils, or upon compacted fill. Recommendations for supporting the foundations on spread footings which bear on existing soils or upon properly compacted structural fill (to achieve higher allowable bearing pressures) are presented in Section 5.3. Recommendations for site grading and subgrade preparation for shallow foundations are addressed in Section 5.4.

The soils encountered within the upper 15 to 20 feet typically consist of finer grained cohesive soils. These soils should be stable at economical slopes for temporary and construction excavations, and where cut or properly compacted as fill, should possess

sufficient cohesion for at least moderate resistance to erosion. The native soils are typically non-cemented to weakly cemented with calcium carbonate. Based on the test borings, it does not appear that seepage from the Grand Canal will significantly impact construction in terms of excavations. However, soft, wet zones, may be encountered and will need to be addressed on a localized basis during construction. The resident engineer assigned to the project should coordinate closely with a representative of the geotechnical engineer to deal with such issues. Further recommendations concerning excavations are presented in Section 5.5.

5.2 DRILLED SHAFTS

5.2.1. Vertical Capacity

Drilled shaft capacities for compressive loads were computed using the Beta method for free draining soils recommended by AASHTO, (1996), as presented in the original report. A factor of safety of 2.5 was applied to the ultimate compressive shaft capacities to determine the allowable capacities presented in the design charts. Effective soil unit weights varying from 110 to 125 pounds per cubic foot (pcf) were assumed for the various strata analyzed. Soils present above a depth of 5 feet below the existing bottom of the Grand Canal channel were neglected in terms of developed shaft capacity. The neglected depth is considered justified given the potential for seepage and weakening of the near surface soils adjacent to the canal, and the fact that minimum embedment depths will likely control design given the light loads imposed by the pedestrian bridge structure.

Figures 1 and 2 present the recommended allowable downward capacities of two-foot to four-foot diameter straight, drilled, cast-in-place concrete shafts for the abutments at both of the planned structures. The capacities apply to shafts spaced at least three times the shaft diameter (D), center to center (CTC).

The weight of the shaft within the bearing zone portion as described above, has been included in the calculations. Due to the general finer-grained nature of the soils encountered within the borings at each bridge site, and the limited amount of gravel which was encountered within the borings, a minimum shaft diameter of two feet is considered acceptable.

Figure 1 - Recommended Allowable Downward Capacity of Drilled Shafts 87th Avenue Pedestrian Bridge

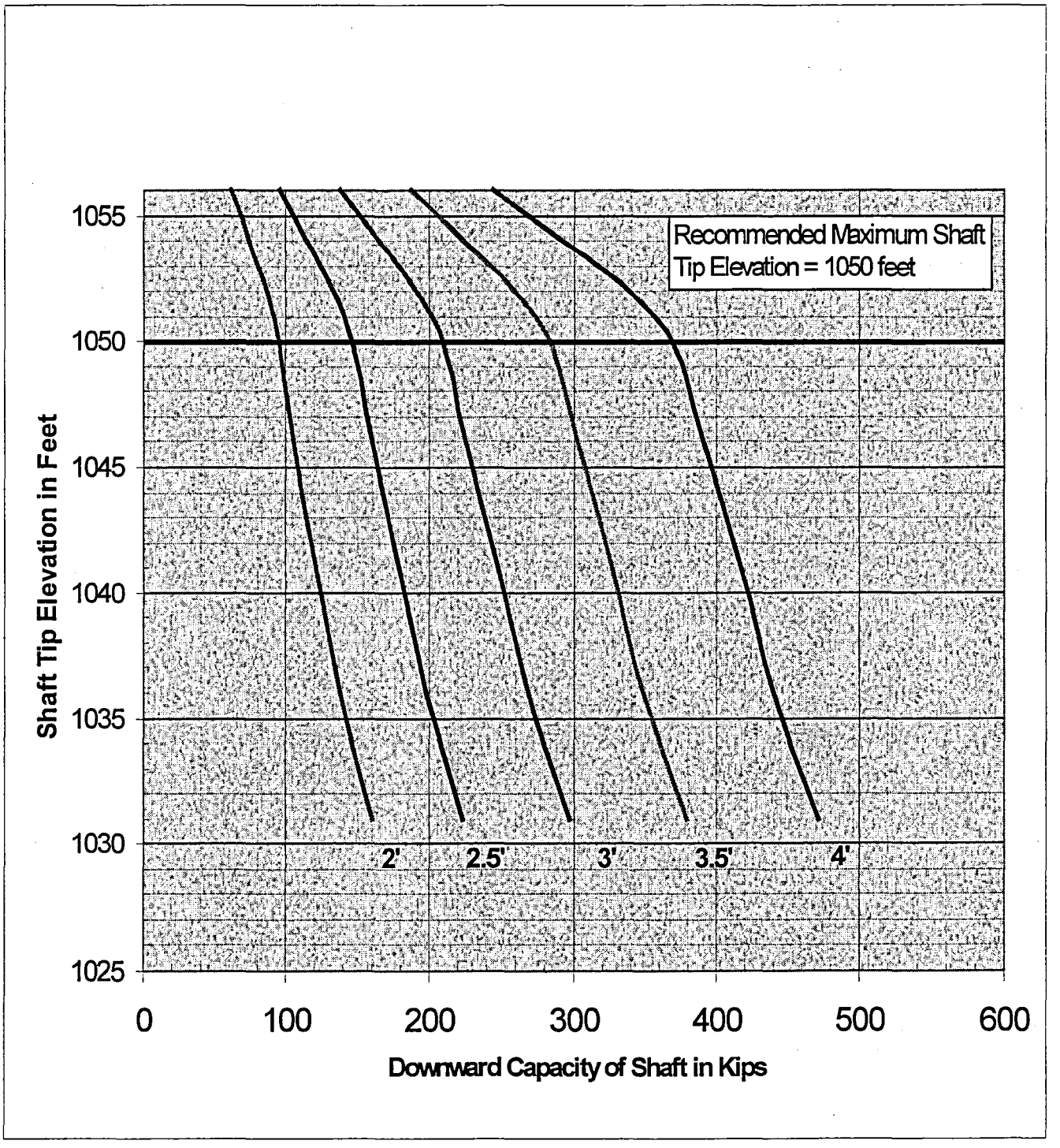
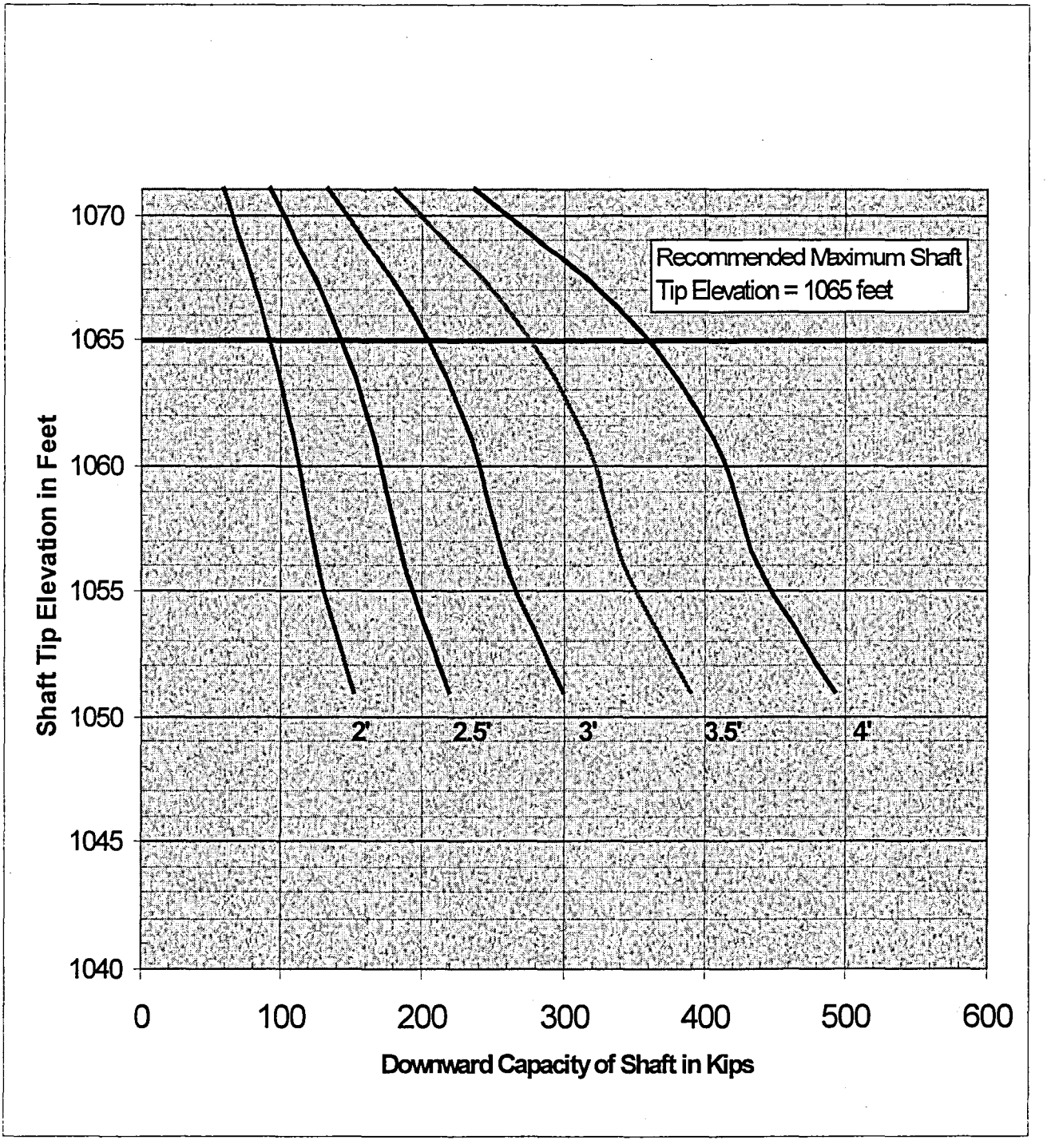


Figure 2 - Recommended Allowable Downward Capacity of Drilled Shafts - 83rd Avenue Pedestrian Bridge



Utilizing methods presented by Reese and Wright (1977), it is estimated that settlements of drilled shafts designed and constructed in accordance with the criteria presented herein for the pedestrian bridge structures will not exceed ¾ inch. In general, it is anticipated that the settlements will be less than ½ inch. Settlements should occur rapidly and be essentially complete following application of the superstructure loads.

5.2.2. Lateral Soil Resistance

Lateral soil-structure interaction of single piers can be analyzed using various computer programs including COM624 or LPILE 3.0 Plus, etc., as described in the original report. Table 5.1 presents the recommended soil strength parameters for use in the above referenced programs toward the design of drilled shaft foundations for support of the pedestrian bridge structures.

Table 5.1
Recommended Soil Parameters for Input into Drilled Shaft Lateral Analysis Program

Location	Elevation Range (feet)	Moist Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)	Soil Strain Ratio ϵ_{50}	Lateral Soil Modulus, k (pci)
Pedestrian Bridge	Above 1041	110	0	400	.006	500
Near 87th Avenue	Below 1041	115	30	0	0	200
Pedestrian Bridge	Above 1048	110	0	300	0.007	500
East of 83rd Avenue	Below 1048	120	30	0	0	200

It is recommended that the shafts be modeled assuming stiff clay soils above the ground water table, as the upper portion of the shafts, which will be most influenced by lateral loading, will be supported mainly in finer grained clayey and silty soils. For programs which allow modeling of cohesive and non-cohesive soils within succeeding layers, the input codes for the upper strata given at each bridge location should be modeled as stiff clay. The underlying layer at each location should be modeled as sand.

According to AASHTO Section 4.6.5.6.1.4, drilled shafts in a group may be considered to act individually when the CTC spacing is greater than 2.5D in the direction normal to loading, and greater than 8D in the direction parallel to loading. Should tighter shaft spacings in the direction normal to loading be required, reduction values can be provided. The 60% Submittal indicates the use of two-foot diameter shafts spaced at 13 feet (6.5D) in the direction normal to loading.

5.2.3 Drilled Shaft Construction

Drilled shafts should be constructed in accordance with the Special Provisions for this project. Based on the test borings, it appears that the generally fine grained, clayey

soils present at the 87th Avenue pedestrian bridge location will be well suited to drilling and that concrete overruns due to caving should be minimal (less than 5 percent). Some caving of sandy soils present below about El. 1068 is anticipated for shafts drilled in the near proximity to Test Boring 83PB-1. Specialized stabilization techniques such as casing or slurry to stabilize the excavation are not anticipated to be necessary.

5.3. SHALLOW, SPREAD FOOTING OR MAT-TYPE FOUNDATIONS

5.3.1. Vertical Capacity

Provided that shallow spread footing or mat-type foundations supporting pedestrian bridges at the 87th and 83rd Avenue locations are embedded at a depth of at least 4.0 feet below existing ground, a maximum allowable bearing pressure of 1,500 pounds per square foot (psf) may be utilized for design. The allowable uniform bearing value may be increased by 500 psf for each 1.0 foot of additional structural fill (to a maximum allowable uniform bearing value of 4,000 psf).

The allowable uniform bearing pressure values are based on Section 4.4.7 of AASHTO (1996) using the lower bound averages of SPT values obtained within the test borings, and is contingent upon strict compliance with the subgrade preparation recommendations given in Section 5.4.1 of this addendum.

5.3.2. Passive Lateral Soil Resistance

It is recommended that the passive lateral soil resistance be neglected for soils present within 4 feet of finished adjacent grade. Below a depth of 4 feet, the passive lateral soil resistance against the edges of spread-type footings, wall stems, and other vertical foundation elements, in contact with properly compacted backfill or native soil, may be considered as being equal to the force exerted by a fluid pressure of 300 psf, per foot of depth. A coefficient of friction of 0.40 is recommended for computing the lateral resistance between the base of the spread-type footings and the underlying native or structural fill soils when analyzing lateral loads.

5.4. SITE GRADING

5.4.1 Subgrade Preparation for Shallow Foundations

In general, site grading for the project should be performed in accordance with the current Uniform Standard Specifications for Public Works by the Maricopa Association of Governments (2001), incorporating the following:

The bottom of excavations required for construction of spread- or mat-type footings should be inspected by the Engineer to verify that no loose, soft, wet, or otherwise unacceptable soils are present at the base of the excavation. Additional overexcavation will be necessary if loose, soft, and/or wet zones are present, such that compaction cannot be achieved. Should unsuitable materials be encountered, the materials should

be overexcavated and replaced with either structural backfill or low strength (one sack) sand-cement slurry. Standing water should not be present within the excavation during construction of the foundation.

Upon approval by the Engineer, the exposed surface should be scarified to a minimum depth of eight inches, moisture conditioned as necessary, and compacted to a minimum of 95 percent of the maximum standard Proctor (ASTM D698) density. The excavation may then be refilled with properly compacted structural backfill (maximum compacted lift thickness of 6 inches) as necessary, up to the elevation of the bottom of foundation. The requirements for materials to be used as structural backfill are presented in Section 6.6.5 of the original report.

5.4.2 Granular Wall Backfill

Fill placed within 2 feet (measured horizontally) of all bridge abutment or wing walls, if required, should consist of free draining granular base backfill meeting the requirements given in Section 6.6.6 of the original report.

5.5 EXCAVATIONS

In general, temporary slopes should be excavated in conformance with OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, Subpart P. In accordance with Subpart P, Appendix A, the near surface clayey soils would be considered to be Type "B" soils. For excavations of less than 20 feet in depth, Subpart P, Appendix B indicates a maximum allowable unshored slope of 1H:1V.

Should steeper slopes be required due to proximity to existing structures or for purposes of economy, stability analyses should be performed by a registered geotechnical engineer. Given the predominance of clayey soils, steeper excavation slopes should be feasible, if confirmed through stability analysis.

Flatter excavation slopes may be required in some areas if loose man-made fills or uncemented, relatively clean, sandy to gravelly soils are encountered. Temporary excavations, if performed in such materials, will need to be sloped back no steeper than 1.25H:1V. Significantly steeper slopes likely will require the use of trench shields or shoring. Although groundwater was not encountered within the test borings, moist to very moist conditions were observed from samples collected at various depths within the borings. Should seepage from the adjacent Grand Canal be encountered during construction, slopes within those areas may need to be flattened, and dewatering will be required.

The perimeter of all temporary excavations should be protected against surface water runoff with berms or other measures at the top of the slope. Moderate to severe raveling and erosion of the slopes could occur if impacted by runoff.

6.0 ADDITIONAL SERVICES

The geotechnical investigation for this project was performed based upon the negotiated additional scope of work for this phase of the project. The number of test borings and general locations of the borings were as approved by the Flood Control District of Maricopa County. In general, the borings completed to date appear to provide sufficient information for final design and construction.

Other project elements that may require additional services include stability analyses of excavations, with or without shoring, and handling of seepage issues on an as-needed basis. DMJM+HARRIS would be pleased to provide these additional services at the request of the FCDMC.

7.0 CLOSURE

The recommendations presented in this report addendum are based on a limited number of small diameter test borings, laboratory test data and our general experience in the project area. The subsurface conditions identified are based on the conditions encountered only at the specific test locations at the time of exploration, and it is anticipated that some variance of the subsurface conditions will occur within the footprint of the bridge foundations.

This addendum should be attached to the Geotechnical Investigation Report. If you have any questions, please call Keith Dahlen of our office at 602-337-2596.

Sincerely,
DMJM HARRIS

Chase A. White, E.I.T.

and

Keith H. Dahlen, P.E.
Senior Geotechnical Engineer

Reviewed by:

Mark K. Gilliland, P.E.
Structures Section Manager

Registered Professional Engineer (Civil)
CERTIFICATE NO.
25151
KEITH H.
DAHLEN
Date Signed 1/29/02
ARIZONA, U.S.A.

File: 6888.400.6
Attachments

cc: Dan Sherwood (City of Glendale), JRM, SEO, DBL

APPENDIX A – SITE PLANS & TEST BORING LOGS

SAMPLING & BORING LOG INFORMATION

The material and in-situ moisture descriptions presented on the boring logs are based on visual observation and classification in accordance with the Unified Soil Classification System (USCS), presented on the next page. The field logs were modified, where appropriate, based on laboratory testing of selected samples.

The relative density and firmness described on the test boring logs are in general based on standard penetration test (SPT) blows per foot (N) for mostly cohesionless and cohesive soils. 2 inch O.D. SPT samplers are advanced up to 18 inches into undisturbed soils beyond the base of either a hollow stem auger or drill casing. The samplers are driven with a 140 pound hammer and a 30-inch drop. SPT values are recorded on the boring logs for each 6 inch increment of penetration with sampler refusal based on a penetration of less than 6 inches and a blowcount of 50.

Relative Density

Relative density for mostly cohesionless, uncemented sands and sand and gravel mixtures is described based on the following SPT blowcounts:

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium Dense
31-50	Dense
50+	Very Dense

Relative Firmness

Relative Firmness for cohesive and/ or cemented soils including silts, clays and silty to clayey sandy and gravelly soils is described based on the following SPT blowcounts:

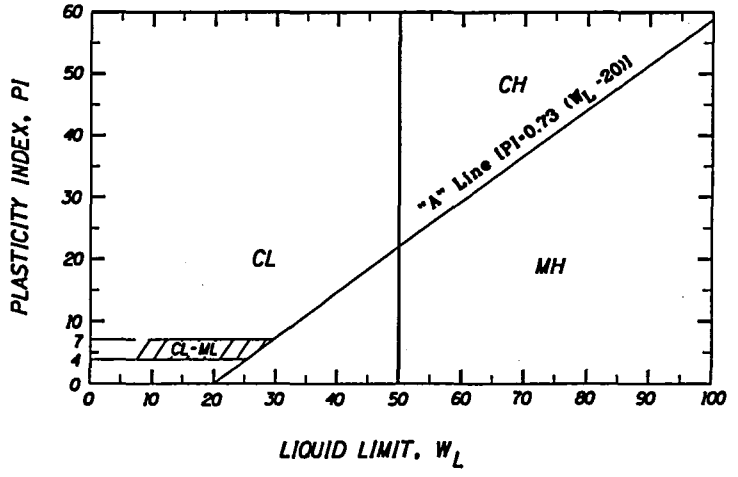
N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-49	Very Firm
50+	Hard

Undisturbed samples of firmer soils, typically present in the southwest, are obtained with 3 inch O.D. samplers lined with 2.42 inch I.D. brass rings. The samplers are advanced up to 12 inches into undisturbed soils beyond the base of either a hollow stem auger or drill casing. The samplers are driven with a 140 pound hammer and a 30-inch drop. The N value blowcounts are recorded on the boring logs for each 6 inch increment of penetration with sampler refusal based on a penetration of less than 12 inches and a blowcount of 100.

UNIFIED SOIL CLASSIFICATION SYSTEM
(ASTM D2487)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests				Group Symbol	Graph Symbol	Group Description
Coarse-Grained Soils (More than 50% Retained on No. 200 Sieve).	Gravels More than 50% of Coarse Fraction Retained on No. 200 Sieve.	Clean Gravels (Less than 5% Fines)		GW		Well Graded Gravels, Gravel-Sand Mixtures or Sand-Gravel-Cobble Mixtures.
				GP		Poorly Graded Gravels, Gravel-Sand Mixtures or Sand-Gravel-Cobble Mixtures.
		Gravels with More than 12% Fines	Fines Classify as ML or MH	GM		Silty Gravels, Gravel-Sand-Silt Mixtures.
			Fines Classify as CL or CH	GC		Clayey Gravels, Gravel-Sand-Clay Mixtures.
	Sands 50% or More of Coarse Fraction Passes No. 4 Sieve.	Clean Sands (Less than 5% Fines)		SW		Well Graded Sands, Gravelly Sands.
				SP		Poorly Graded Sands, Gravelly Sands.
		Sands with More than 12% Fines	Fines Classify as ML or MH	SM		Silty Sands, Sand-Silt Mixtures
			Fines Classify as CL or CH	SC		Clayey Sands, Sand-Clay Mixtures.
Fine-Grained Soils (50% or More Passes the No. 200 Sieve).	Silts and Clays (Liquid Limit Less than 50)		PI > 7 and Plots On Above "A" Line	CL		Inorganic Clays of Low to Medium Plasticity, Gravely Clays, Sandy Clays, Silty Clays, Lean Clays
			PI < 4 or Plots Below "A" Line	ML		Inorganic Silts, Clayey Silts with Slight Plasticity
	Silts and Clays (Liquid Limit 50 or More)		PI Plots On or Above "A" Line	CH		Inorganic Clays of High Plasticity, Fat Clays, Silty and Sandy Clays of High Plasticity
			PI Plots Below "A" Line	MH		Inorganic Silts of High Plasticity, Silty Soils, Elastic Silts

PLASTICITY CHART



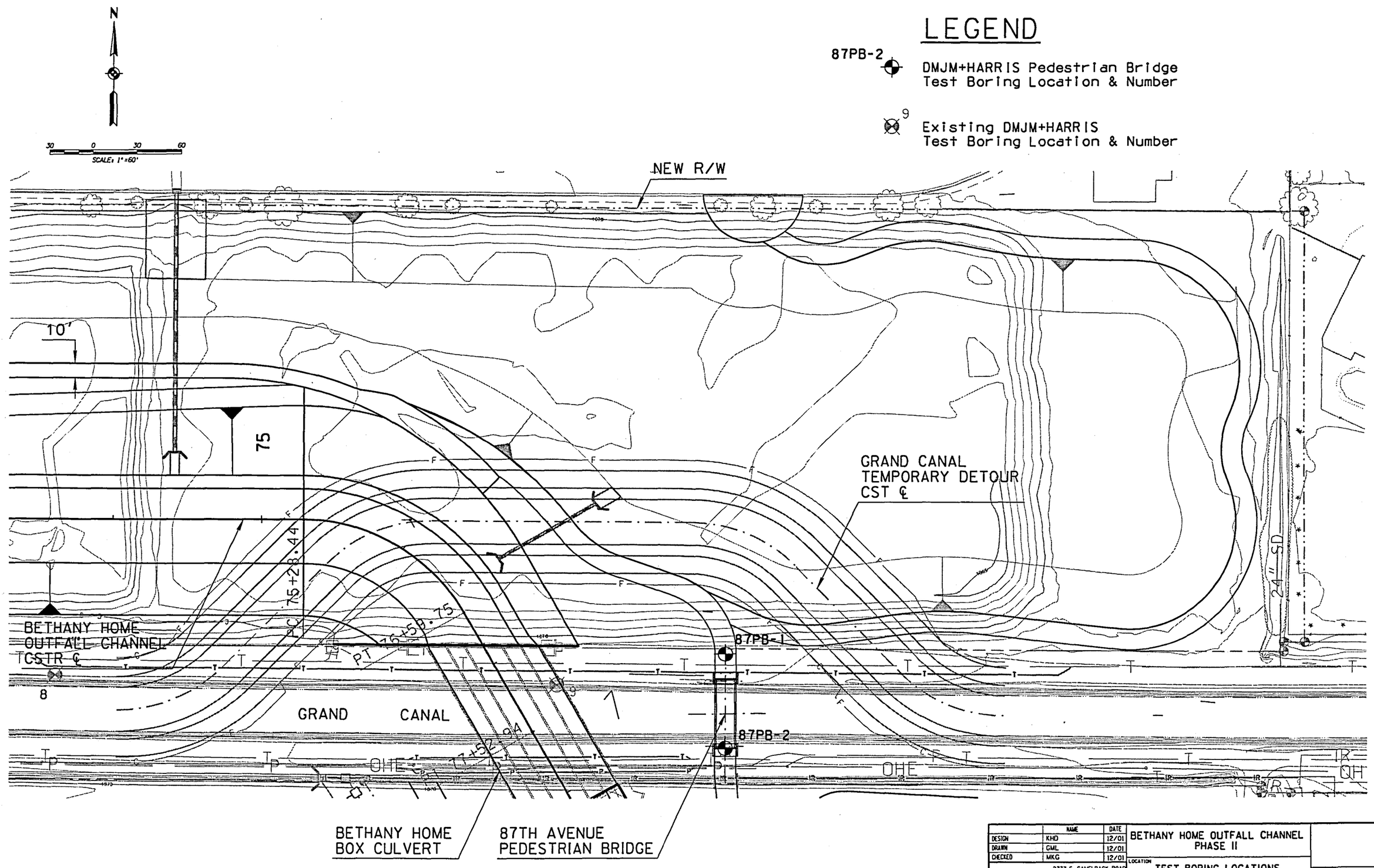
PLASTICITY	
PI=0	Non-Plastic
1≤PI≤7	Low
8≤PI≤25	Medium
PI≥25	High

ANGULARITY
Angular
Subangular
Subrounded
Rounded

MOISTURE
Slightly Moist
Moist
Very Moist
Wet
(Saturated)

SOIL PARTICLE DEFINITIONS

MATERIAL	PARTICLE SIZE RANGE
Boulders	Greater than 12 In.
Cobbles	12 In. to 3 In.
Coarse Gravel	3 In to ¾ In.
Fine Gravel	¾ In. to No. 4 sieve
Coarse Sand	No. 4 Sieve to No. 10 Sieve
Medium Sand	No. 10 Sieve to No. 40 Sieve
Fine Sand	No. 40 Sieve to No. 200 Sieve
Fines (Silt or Clay)	Less than No. 200 Sieve



	NAME	DATE
DESIGN	KHD	12/01
DRAWN	GML	12/01
CHECKED	MKG	12/01

DMJM+HARRIS
AN AECOM COMPANY
2777 E. CAMELBACK ROAD
SUITE 200
PHOENIX, AZ. 85016-4302
(602) 337-2777

BETHANY HOME OUTFALL CHANNEL
PHASE II

LOCATION
TEST BORING LOCATIONS
87TH AVENUE PEDESTRIAN BRIDGE

1 OF 2

NO. | DESCRIPTION OF REVISION | MADE BY | DATE

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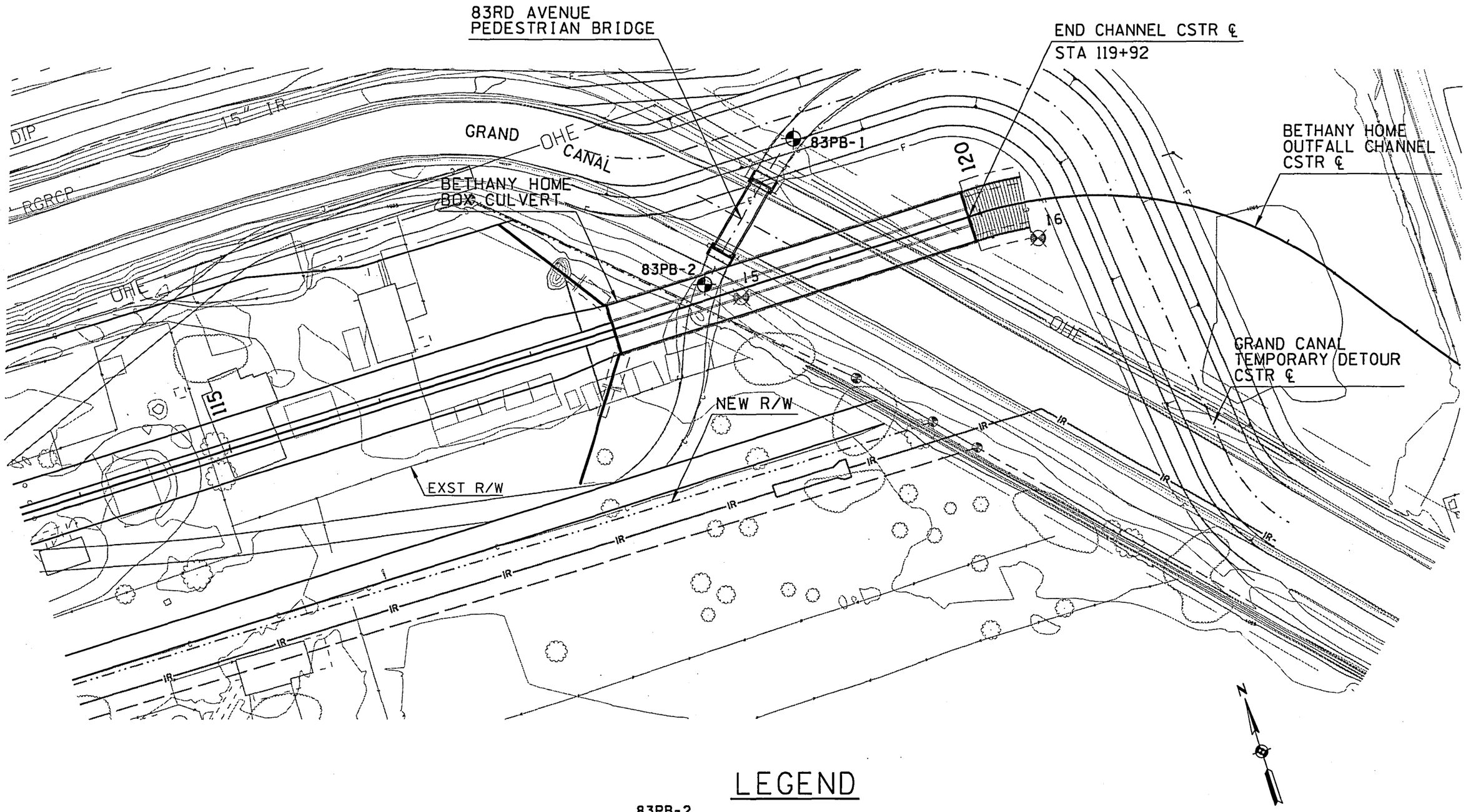

LEGEND

83PB-2 — DMJM+HARRIS Pedestrian Bridge Test Boring Location & Number

15 — Existing DMJM+HARRIS Test Boring Location & Number

	NAME	DATE
DESIGN	KHD	12/01
DRAWN	GML	12/01
CHECKED	MKG	12/01

DMJM+HARRIS AN AECOM COMPANY
2777 E. CAMELBACK ROAD SUITE 200 PHOENIX, AZ. 85016-4302 (602) 337-2777

BETHANY HOME OUTFALL CHANNEL
PHASE II

LOCATION
TEST BORING LOCATIONS
83RD AVENUE PEDESTRIAN BRIDGE

2 OF 2

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Project Name: BHOC Pedestrian Bridges
Location: Glendale, AZ
Project Number: 6888.0060
Logged By: C. White

BORING LOG NO. 87PB-1
Date(s): 11/20/01
Rig & Boring Type: BK 81 HD/8" HSA
Surface Elevation: 1,071.0' ±
Location: Sta 77+69, 140' Lt

Groundwater		
Depth	Hour	Date
None		

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	Dry Density (pcf)	Moisture Content (%)
						CLAYEY SAND TO SILTY SAND (SC-SM) Fine Grained Sand, Low to Medium Plasticity, Light Brown to Brown, Slightly Moist to Moist, Moderately Firm Note: Canal Embankment Fill Note: Surface Cover of Gravel & Asphalt Rubble		
				S(5-7-8)				
1,066.0	5			R(11-20-36)		SANDY CLAY TO CLAYEY SAND (CL-SC) Predominantly Fine Grained Sand, Weak Lime Cementation, Medium Plasticity, Brown, Moist, Moderately Firm to Very Firm	112	14
				A				11
1,061.0	10			R(18-50/6")		SILTY CLAY (CL) Trace to Some Fine Grained Sand, Medium Plasticity, Brown, Hard Note: Very Moist, No Cementation, Very Firm 14.0' to 18.0'	106	14
1,056.0	15			S(10-16-20)		Note: More Fine Grained Sand (Some to Occasional Zones of Weak Lime Cementation, Moist, Hard Below Approx. 18.0'		
1,051.0	20			S(12-32-30)				
1,046.0	25			S(25-36-50/4")				
1,041.0	30			S(50/6")		CLAYEY SAND (SC) Fine Grained Sand, Weak Lime Cementation, Medium Plasticity, Brown, Moist, Hard Note: Gravelly Lens from 33.0' to 33.5'		
1,036.0	35			S(26-30-50/6")		SILTY CLAY (CL) Trace to Some Fine Grained Sand, Weak Lime Cementation, Medium to High Plasticity, Light Brown, Moist, Hard SILTY CLAY TO CLAYEY SAND (CL-SC) Fine Grained Sand, Weak Lime Cementation, Medium Plasticity, Brown, Moist to Very Moist, Very Firm to Hard		
1,031.0	40					Note: Zones of Strong Cementation Below Approx. 42.0'		

Sample Type
S-Split Spoon
R-Ring Sampler
A-Drill Cuttings

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

Project Name: BHOC Pedestrian Bridges
Location: Glendale, AZ
Project Number: 6888.0060
Logged By: C. White

Groundwater		
Depth	Hour	Date
None		

BORING LOG NO. 87PB-1
Date(s): 11/20/01
Rig & Boring Type: BK 81 HD/8" HSA
Surface Elevation: 1,071.0' ±
Location: Sta 77+69, 140' Lt

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	LABORATORY ANALYSIS: Dry Density (pcf)	LABORATORY ANALYSIS: Moisture Content (%)
				S(14-16-25)		SILTY CLAY TO CLAYEY SAND (CL-SC) Cont'd...		
						Note: Zones of Strong Cementation Below Approx. 42'		
1,026.0	45			S(16-20-38)				
						STOPPED DRILLING @ 45'-0" SAMPLER REFUSED @ 46'-6"		
1,021.0	50							
	55							
	60							
	65							
	70							
	75							
	80							

Sample Type
S-Split Spoon
R-Ring Sampler
A-Drill Cuttings

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

Project Name: BHOC Pedestrian Bridges
Location: Glendale, AZ
Project Number: 6888.0060
Logged By: C. White

Groundwater		
Depth	Hour	Date
None		

BORING LOG NO. 87PB-2
Date(s): 11/19/01
Rig & Boring Type: LT 10 W/8" HSA
Surface Elevation: 1,071.0' ±
Location: Sta 78+15, 108' Lt

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	Dry Density (pcf)	Moisture Content (%)
				A		SANDY CLAY (CL) Some Gravel (on Surface), Some Sand & Silt, Medium Plasticity, Brown, Slightly Moist to Moist, Firm		8
				S(8-9-20)		Note: Canal Embankment Fill		
1,066.0	5			R(25)		SANDY CLAY (CL) Some Silt, Predominantly Fine Grained Sand, Medium Plasticity, Brown, Moist to Very Moist, Firm		
						SANDY CLAY TO CLAYEY SAND (CL-SC) Trace of Fine Subangular Gravel, Predominantly Fine Grained Sand, Medium Plasticity, Light Brown, Moist, Firm Note: Some Fine Gravel Sized Nodules of Strong Lime Cementation	107	16
1,061.0	10			S(25-50/6")		SILTY TO CLAYEY SAND (SM-SC) Predominantly Fine Grained Sand, Low Plasticity, Brown, Slightly Moist to Very Moist, Very Firm to Hard Note: Weak Lime Cementation From 8.0' to 12.0'		
1,056.0	15			R(20)				
1,051.0	20			S(12-30-50/6")		SILTY CLAY (CL) Trace to Fine Grained Sand, Some to Considerable Silt, Medium Plasticity, Brown, Moist to Very Moist, Very Firm to Hard Note: Moderate to Strong Lime Cementation Below Approx. 28.5'		25
1,046.0	25			S(20-50/5")				
1,041.0	30			S(50/2")				
1,036.0	35			S(50/6")		SILTY TO CLAYEY SAND (SM-SC) Predominantly Fine Grained Sand, Zones of Weak to Moderate Lime Cementation, Low Plasticity, Brown, Moist to Very Moist, Very Dense to Hard Note: Gravelly Lens @ 37.0' to 37.5'		
1,031.0	40							

Sample Type
S-Split Spoon
R-Ring Sampler
A-Drill Cuttings

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

Project Name: BHOC Pedestrian Bridges
Location: Glendale, AZ
Project Number: 6888.0060
Logged By: C. White

Groundwater		
Depth	Hour	Date
None		

BORING LOG NO. 87PB-2
Date(s): 11/19/01
Rig & Boring Type: LT 10 W/8" HSA
Surface Elevation: 1,071.0' ±
Location: Sta 78+15, 108' Lt

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	LABORATORY ANALYSIS: Dry Density (pcf)	LABORATORY ANALYSIS: Moisture Content (%)
				S(20-30-50/6")		SILTY TO CLAYEY SAND (SM-SC) Cont'd...		
1,026.0	45			S(12-28-30)				
						STOPPED DRILLING @ 45'-0" SAMPLER REFUSED @ 46'-6"		
1,021.0	50							
	55							
	60							
	65							
	70							
	75							
	80							

Sample Type
S-Split Spoon
R-Ring Sampler
A-Drill Cuttings

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

Project Name: BHOC Pedestrian Bridges
Location: Glendale, AZ
Project Number: 6888.0060
Logged By: C. White

Groundwater		
Depth	Hour	Date
None		

BORING LOG NO. 83PB-1
Date(s): 11/20/01
Rig & Boring Type: BK 81 HD/8" HSA
Surface Elevation: 1,085.5±
Location: Sta 119+03, 80' Lt

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	Dry Density (pcf)	Moisture Content (%)
				S(10-12-18)		SANDY CLAY TO CLAYEY SAND (CL-SC) Some Silt, Fine Grained Sand, Medium Plasticity, Light Brown, Moist, Firm		
1,080.5	5			S(17-50/5")		Note: Tan, Weak to Moderate Lime Cementation, Slightly Moist, Hard From 4.5' to 8.0'		
				A				
1,075.5	10			S(9-14-21)		CLAYEY SAND (SC) Some Silt, Trace of Fine Gravel, Well-Graded Sand, Low to Medium Plasticity, Brown, Moist, Very Firm		8
1,070.5	15			Not Recorded				
1,065.5	20			S(15-18-21)		SAND (SP) Some Fine Subangular Gravel, Trace of Silt and Clay, Predominantly Medium Grained Subangular Sand, Non Plastic, Light Brown, Moist, Dense		3
1,060.5	25			S(27-50/6")		CLAYEY SILT TO SILTY CLAY (ML-CL) Some Fine Grained Sand, Medium Plasticity, Brown, Very Moist, Hard		
1,055.5	30			S(50/6")		SANDY CLAY (CL) Some Silt, Fine Grained Sand, Weak Lime Cementation, Medium Plasticity, Light Brown to Brown, Moist, Hard		
1,050.5	35			S(50/5")		SAND (SP-SC) Considerable Predominantly Fine Grained Gravel, Trace of Clay, Predominantly Fine & Medium Grained Subangular Sand, Non Plastic, Light Brown, Moist, Dense		
						Note: Grades to Some Fine Angular Gravel Below Approx. 39.5'		
1,045.5	40							

Sample Type
S-Split Spoon
R-Ring Sampler
A-Drill Cuttings

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

Project Name: BHOC Pedestrian Bridges
Location: Glendale, AZ
Project Number: 6888.0060
Logged By: C. White

Groundwater		
Depth	Hour	Date
None		

BORING LOG NO. 83PB-1
Date(s): 11/20/01
Rig & Boring Type: BK 81 HD/8" HSA
Surface Elevation: 1,085.5±
Location: Sta 119+03, 80' Lt

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	LABORATORY ANALYSIS: Dry Density (pcf)	LABORATORY ANALYSIS: Moisture Content (%)
				S(25-29-40)		SAND (SP-SC) Cont'd...		
1,040.5	45			S(26-28-32)				
						STOPPED DRILLING @ 45'-0" SAMPLER REFUSED @ 46'-6"		
1,035.5	50							
	55							
	60							
	65							
	70							
	75							
	80							

Sample Type
S-Split Spoon
R-Ring Sampler
A-Drill Cuttings

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

Project Name: BHOC Pedestrian Bridges
Location: Glendale, AZ
Project Number: 6888.0060
Logged By: C. White

Groundwater		
Depth	Hour	Date
None		

BORING LOG NO. 83PB-2
Date(s): 11/20/01
Rig & Boring Type: BK 81 HD/8" HSA
Surface Elevation: 1,087.0±
Location: Sta 118+20, 9' Lt

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	LABORATORY ANALYSIS Dry Density (pcf)	LABORATORY ANALYSIS Moisture Content (%)
						CLAYEY SAND TO SILTY SAND (SC-SM) Fine Grained Sand, Low Plasticity, Brown, Slightly Moist, Moderately Firm		
				S(4-5-5)		Note: Canal Bank Fill		
1,082.0	5			R(4-6-15)		SANDY CLAY TO CLAYEY SAND (CL-SC) Some Silt, Predominantly Fine Grained Sand, Weak Lime Cementation, Medium Plasticity, Light Brown to Brown, Moist to Very Moist, Moderately Firm to Very Firm	100	13
1,077.0	10			R(14-20-24)		Note: Increase In Medium & Coarse Grained Sand Below 12'	109	13
1,072.0	15			S(15-18-23)				
1,067.0	20			S(7-8-10)		SILTY CLAY (CL) Trace of Fine Grained Sand, Medium Plasticity, Brown, Very Moist, Firm		
1,062.0	25			S(6-8-19)				
1,057.0	30			S(18-28-36)		SANDY CLAY (CL) Some Silt, Predominantly Fine Grained Sand, Weak Lime Cementation, Medium Plasticity, Brown, Moist, Hard		
						Note: Interbedded w/ Occasional Thin Lenses of Fine Grained Clayey Sand		
1,052.0	35			S(50/5")				
						CLAYEY SAND (SC) Predominantly Fine Grained Sand, Low to Medium Plasticity, Brown, Moist, Dense		
1,047.0	40							

Sample Type
S-Split Spoon
R-Ring Sampler
A-Drill Cuttings

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

Project Name: BHOC Pedestrian Bridges
Location: Glendale, AZ
Project Number: 6888.0060
Logged By: C. White

Groundwater		
Depth	Hour	Date
None		

BORING LOG NO. 83PB-2
Date(s): 11/20/01
Rig & Boring Type: BK 81 HD/8" HSA
Surface Elevation: 1,087.0±
Location: Sta 118+20, 9' Lt

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	LABORATORY ANALYSIS: Dry Density (pcf)	LABORATORY ANALYSIS: Moisture Content (%)
				S(16-31-31)		CLAYEY SAND (SC) Cont'd...		
						Note: Grades w/ PG (Predominantly Fine) Subrounded to Rounded Gravel Below Approx. 43', Very Dense		
1,042.0	45			S(33-50/6")				
						STOPPED DRILLING @ 45'-0" SAMPLER REFUSED @ 46'-0"		
1,037.0	50							
	55							
	60							
	65							
	70							
	75							
	80							

Sample Type
S-Split Spoon
R-Ring Sampler
A-Drill Cuttings

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

APPENDIX B – LABORATORY TEST DATA

ATL

SUMMARY OF LABORATORY ANALYSIS

CLIENT: DMJM - HARRIS DATE: 12/04/01

PROJECT: BETHANY HOME ROAD OUTFALL CHANNEL - PEDESTRIAN BRIDGES

LOCATION: GLENDALE, ARIZONA

MATERIAL: See Below SAMPLING DATE: 11/27/01

REQUESTED BY: AMMI OSORIO ATL JOB NO: 199027-1

BORING No.	DEPTH (Feet)	IN-SITU Moist %	USCS	LL	PI	SIEVE ANALYSIS - PERCENT PASSING #200	#100	#50	#40	#30	#16	#10	#4	3/8"	3/4"	1.5"	3.0"
83 PB - 1	7.5 - 9.5	7.6	SC	45	22	44.4	51	58	61	65	71	77	88	96	98	100	-
83 PB - 1	20.0 - 21.5	3.2	SW - SM	-	NP	5.2	8	15	23	32	53	67	81	87	94	100	-
83 PB - 2	5.5 - 6.5	12.8	CL	36	16	50.7	62	72	75	78	81	84	91	98	100	-	-
83 PB - 2	10.5-11.5	12.5	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-
87 PB - 1	5.5 - 6.5	14.1	CL	36	17	54.5	66	78	81	84	87	89	92	98	100	-	-
87 PB - 1	8.0 - 10.0	11.3	CL	39	19	52.3	64	77	82	86	90	93	98	100	-	-	-
87 PB - 1	10.0-11.0	13.8	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-
87 PB - 2	0.0 - 2.5	7.5	CL	29	11	59.9	67	75	78	81	86	89	93	95	100	-	-
87 PB - 2	5.0 - 6.0	16.3	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-
87 PB - 2	20.0 - 21.5	25.0	CL	45	21	86.7	95	98	99	100	-	-	-	-	-	-	-

DMJM - HARRIS
BETHANY HOME OUTFALL CHANNEL - PEDESTRIAN BRIDGES
GLENDALE, ARIZONA
ATL JOB NO. 199027-01

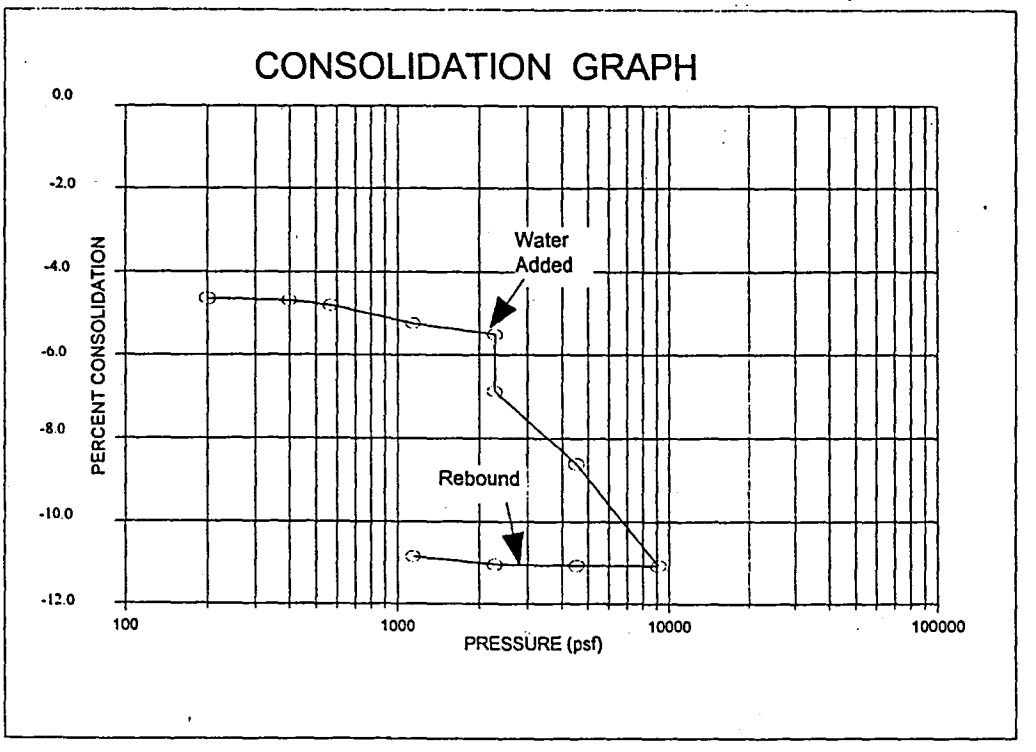
DRY UNIT WEIGHT

Boring No.	Sample Depth (ft)	Dry Density (pcf)	Moisture Content (%)
83PB-2	5.5 - 6.5	100.2	12.8
87PB-1	5.5 - 6.5	111.5	14.1

CONSOLIDATION TEST
(ASTM D-2435)

Client:	DMJM-HARRIS	**Lab No.:**	01-1598
Project Name :	BHOC-Pedestrian Bridge	**Test Date:**	12/14/01
Project No. :	199027-01	**Sample Location:**	Boring No.: 83PB-2
Initial Reading:	0.2000		Depth:10.5'-11.5'
Dry Density:	108.6 pcf	**Soil Description:**	Brown, CL
Moisture Content:	Before: 12.5% After: 22.5%		

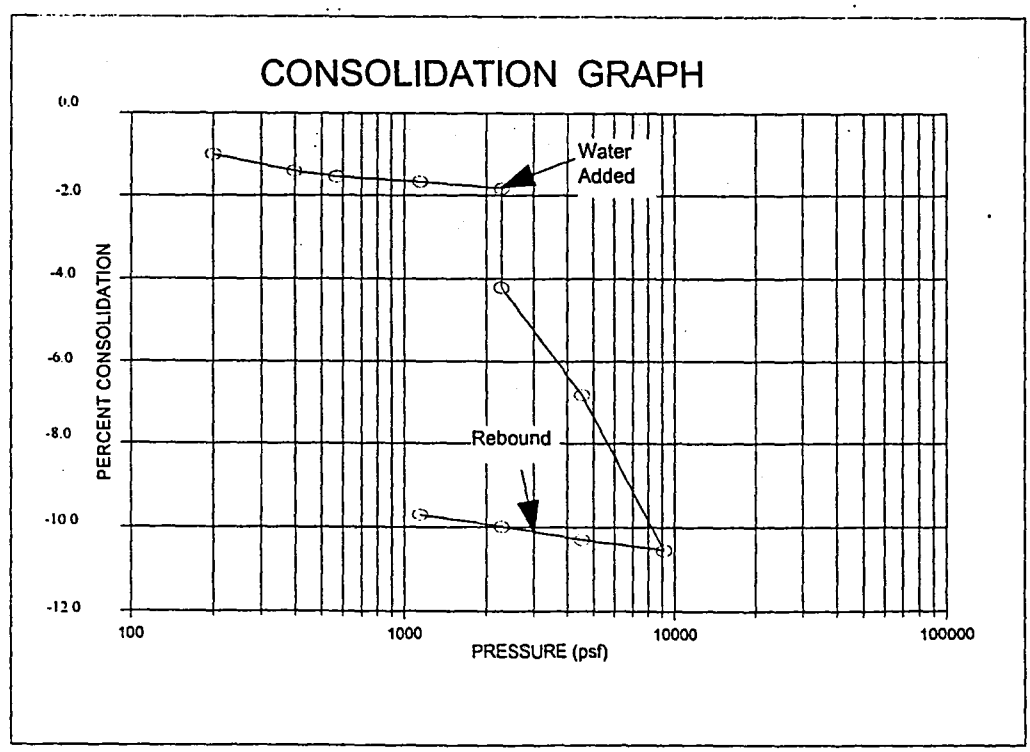
LOAD (tsf)	LOAD (psf)	DIAL READING	PERCENT CONSOLIDATION
0.05	100	0.2168	-1.68
0.10	200	0.2464	-4.64
0.20	400	0.2468	-4.68
0.29	570	0.2480	-4.80
0.57	1140	0.2524	-5.24
1.14	2280	0.2551	-5.51
1.14	2280	0.2688	-6.88
2.28	4560	0.2861	-8.61
4.56	9120	0.3108	-11.08
2.28	4560	0.3107	-11.07
1.14	2280	0.3105	-11.05
0.57	1140	0.3086	-10.86

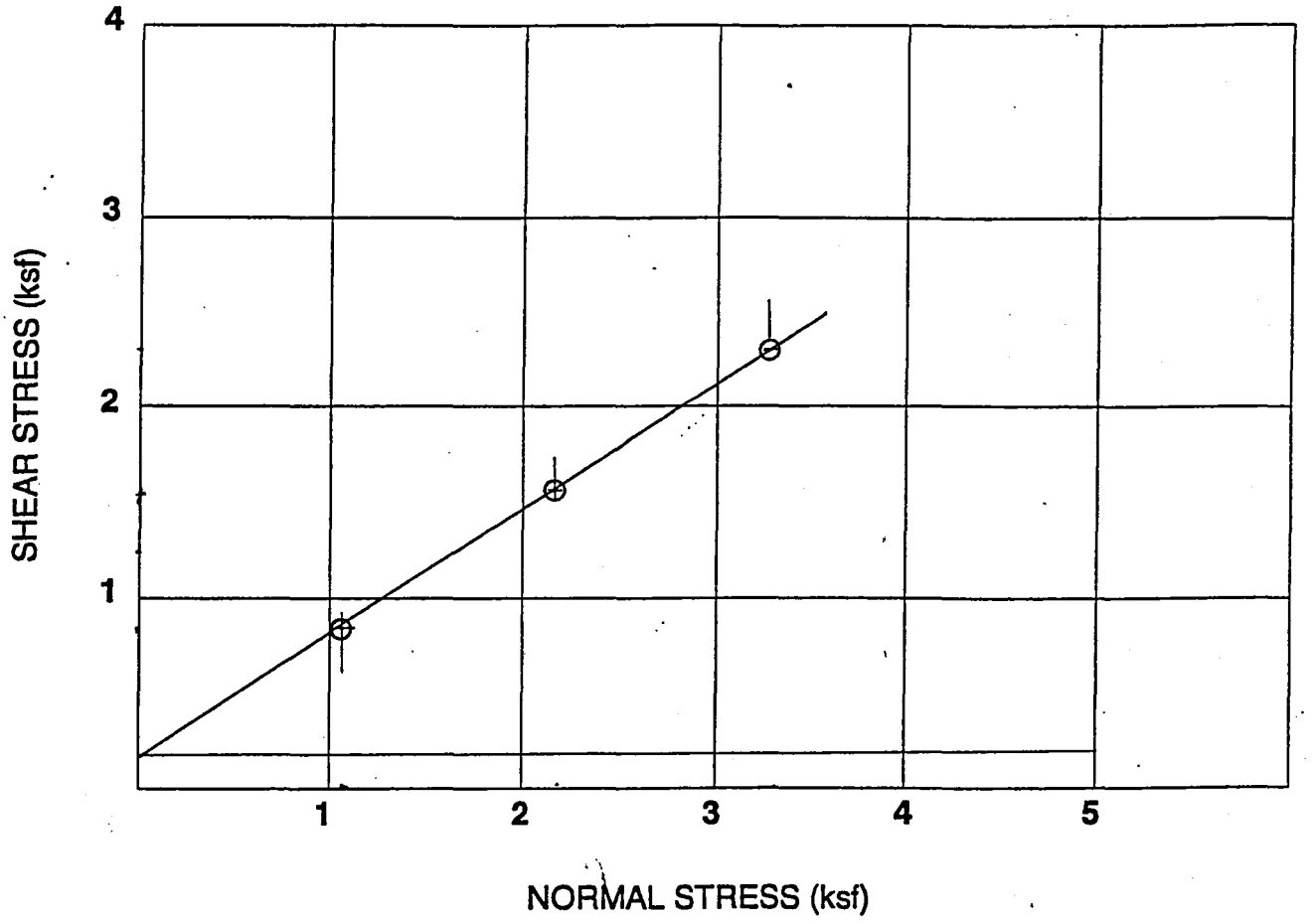


CONSOLIDATION TEST
(ASTM D-2435)

Client:	DMJM-HARRIS	**Lab No.:**	01-1603
Project Name :	BHOC-Pedestrian Bridge	**Test Date:**	12/14/01
Project No. :	199027-01	**Sample Location:**	Boring No.: 87PB-2
Initial Reading:	0.2000		Depth:5.0'-6.0'
Dry Density:	107.2 pcf	**Soil Description:**	Brown, CL
Moisture Content:	Before: 16.3% After: 20.9%		

LOAD (tsf)	LOAD (psf)	DIAL READING	PERCENT CONSOLIDATION
0.05	100	0.2065	-0.65
0.10	200	0.2100	-1.00
0.20	400	0.2141	-1.41
0.29	570	0.2154	-1.54
0.57	1140	0.2166	-1.66
1.14	2280	0.2183	-1.83
1.14	2280	0.2421	-4.21
2.28	4560	0.2681	-6.81
4.56	9120	0.3054	-10.54
2.28	4560	0.3030	-10.30
1.14	2280	0.2999	-9.99
0.57	1140	0.2970	-9.70





Boring or Test Pit no.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
87PB-1	10-11	CL	Sandy Lean Clay (CL)	0.25	32	13.8	105.5

DIRECT SHEAR TEST DATA

JOB NO. 199027-01

ATL INC.