GEOTECHNICAL ENGINEERING SERVICES
MC-85 (BUCKEYE ROAD)
FROM 107TH AVENUE TO 75TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA
MCDOT JOB NO. TT345

Kleinfelder Project No.: 129067

December 28, 2012

Prepared for:
Mr. Gant P. Yasanayake, PhD, P.E.
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

Registered Professional Engineer
CERTIFICATE NO.
43838
RAMON
PADILLA
(Civil)
Date Signed 12/28/12
ARIZONA, U.S.A.
Expires 3-31-2015

Ramon Padilla, P.E.
Geotechnical Project Manager

Reviewed By:
Keith H. Dahlen, P.E.
Senior Principal Geotechnical Engineer

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December 28, 2012
Project No.: 129067

Mr. Gant P. Yasanayake, PhD, P.E.
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

SUBJECT: Geotechnical Engineering Services
Proposed Roadway Improvements
MC-85 (Buckeye Road) – From 107th Avenue to 75th Avenue
Maricopa County (Phoenix), Arizona
MCDOT Job No. TT345

Dear Mr. Yasanayake:

This report transmits the findings of our geotechnical evaluation for the proposed MC-85 (Buckeye Road) roadway improvements from 107th Avenue to 75th Avenue in Maricopa County (Phoenix), Arizona. Kleinfelder's services were conducted in general accordance with the scope of services presented in our Proposal No. 126948\TEM12P030R3, dated August 21, 2012. Our work was performed under our existing On-Call Contract No. 2012-034 with Maricopa County Department of Transportation (MCDOT).

We appreciate the opportunity to be of service on this project. If we can be of additional assistance as the design progresses, please do not hesitate to contact us.

Sincerely,
KLEINFELDER WEST, INC.

Registered Professional Engineer
CERTIFICATE NO.
43838
RAMON
PADILLA
(Civil)
Date Signed 12/28/12
ARIZONA, U.S.A.
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Due to the various engineering services Kleinfelder provided for this project, this report was divided into the following sections. A more detailed table of contents is provided at the beginning of each section.

SECTION 1

INTRODUCTION

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1 INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical engineering services for the proposed MC-85 (Buckeye Road) roadway improvements from 107th Avenue to 75th Avenue in Maricopa County (Phoenix), Arizona. The approximate location of the site is shown on the Site Vicinity Map (Figure I-1).

The recommendations contained in this report are subject to the limitations presented in the 'Limitations' section of this report. In addition, as a member of ASFE (The Association of Engineering Firms Practicing the Geosciences), we included a brochure prepared by ASFE in this report. We recommend that all individuals using this report read the limitations along with the accompanying ASFE document.

1.2 PROJECT DESCRIPTION

MC-85 (Buckeye Road) from 107th Avenue to 75th Avenue is planned to be adopted by the City of Phoenix. As part of the adopting process, MC-85 will undergo some construction in order to meet the City of Phoenix roadway specifications. The proposed roadway improvements will include the construction of a continuous 5-lane section with mostly a lowered finished grade and also underground storm-drain improvements.

We understand that a Portland cement concrete pavement (PCCP) roadway was constructed within the MC-85 right-of-way in the 1930s. The PCCP roadway was comprised of adjacent PCCP slabs measuring 6-feet wide by 16-feet in length. The total width of the PCCP roadway at the time it was constructed was approximately 18 feet (consisting of 3 adjacent 6-foot wide slabs). We understand the PCCP roadway was buried at a later date by the construction of a newer asphalt concrete (AC) pavement. Specific information documenting the existing pavement structure (including the buried PCCP) were not available at the time of this report. Based on relatively recent boring/coring log data from other consultants, we understand the depth of the PCCP roadway varies from immediately underneath up to a few feet beneath the AC pavement structure.

Our engineering services included site reconnaissance, review of historical aerial photographs and previous geotechnical reports, subsurface explorations and geophysical surveys, pavement coring, soil sampling, field and laboratory testing, engineering analyses, and preparation of this report. The purposes of our engineering services at the site were to obtain data in an effort to better delineate the extents (widths, lengths and depths) of the buried Portland cement concrete pavement, explore the subsurface conditions for the proposed storm drain line, perform percolation testing for the proposed storm-water retention basins, and consolidate the pavement design information from previous reports.

As part of our engineering services, Kleinfelder reviewed geotechnical and pavement design reports previously prepared by other consultants for the site. These reports were provided to Kleinfelder by MCDOT. These previous reports are included as appendices throughout the different sections of this report. Where appropriate, the data presented in these reports was relied upon and used for the preparation of this report. The following is a list of the reports provided by MCDOT for this project:

- Mactec, Report of Geotechnical Evaluation, MC85 (Buckeye Road), 107th Avenue to 91st Avenue, Maricopa County, Arizona (Mactec Project No. 4975-03-1401, report dated June 17 and revised October 23, 2003).
- DMJM Harris/AECOM, Pavement Design Report, MC 85, 107th Avenue to 91st Avenue, Maricopa County, Arizona (DMJM Harris Project No. 6490.0000, report dated April 25, 2006).
- DMJM Harris/AECOM, Stormwater Detention Basin Percolation Testing and Earthwork Factor Estimates, MC 85 (Buckeye Road), 107th Avenue to 91st Avenue, Maricopa County, Arizona (DMJM Harris Project No. 6490.0000, report dated November 8, 2006).
- Ninyo and Moore (N&M), Geotechnical Evaluation, MC-85 Roadway Improvements, 75th Avenue to 91st Avenue, Maricopa, Arizona (N&M Project No. 601301002, report dated September 28, 2010).

1.3 SITE DESCRIPTION

At the time of our field exploration along MC-85, the site consisted of an AC paved roadway divided into 2 travel lanes each way. The lanes along the site alternated between 5 lanes (2 lanes each way with a center median/turn lane) and 4 lanes (2 lanes each way) with the center median/turn lane transitioning from a full width center turn lane to just a stripe dividing the east and west travel lanes. As previously mentioned, future plans include construction of a continuous 5-lane section across the site.

The site was bounded by private properties. The majority of the properties adjacent to the site along the south consisted of agricultural land; and the properties adjacent to the site along the north consisted of agricultural land, industrial facilities and commercial properties. A dirt and/or gravel shoulder with variable widths was typically observed adjacent to the AC paved roadway where the site was bounded by agricultural land. We observed several concrete-lined irrigation canals adjacent to the edge of the right-of-way along the edge of the agricultural land. In areas of the site bounded by an industrial facility or commercial development, the AC paved roadway generally included improvements of curb, gutter, sidewalk and landscaped areas. The following are pictures of MC-85 (Buckeye Road) taken facing east and west along the south side of the roadway. The pictures were taken near major crossroads (at the end of each mile along the site) starting from the west end of the project.

Picture 1 – Near 107th Ave.; Facing East

Picture 2 – Near 99th Ave.; Facing West

Picture 3 – Near 99th Ave.; Facing East

Picture 4 – Near 91st Ave.; Facing West

Picture 5 – Near 91st Ave.; Facing East

Picture 6 – Near 83rd Ave.; Facing West

Picture 7 – Near 83rd Ave.; Facing East

Picture 8 – Near 75th Ave.; Facing West

1.4 PRIVATE PROPERTY ACCESS

The site of the MC-85 project is approximately 4 miles long, extending west to east from 107th Avenue to 75th Avenue. MCDOT provided to us a list with the contact information of 68 private property owners adjacent to the site. The private properties located adjacent to the site totaled approximately 78 parcels. As directed by MCDOT, Kleinfelder requested access to these private properties by mailing the property owners a letter titled *Roadway Engineering Work, Along MC-85 (Buckeye Road), From 107th Avenue to 75th Avenue, Maricopa County (Phoenix / Tolleson), Arizona* (dated September 24, 2012). We received a response to our letters providing authorization to access approximately 28 parcels. Where requested by the property owners, Kleinfelder coordinated the field work with the property tenants. We did not receive authorization to access the remaining parcels, either by not receiving a response to our letter, or a response was received indicating no authorization to access. Kleinfelder located the work areas along existing right-of-way property or on private properties with authorized access. Some of the proposed work areas were not accessible. Detailed information describing the work Kleinfelder performed is presented in the following sections of this report.

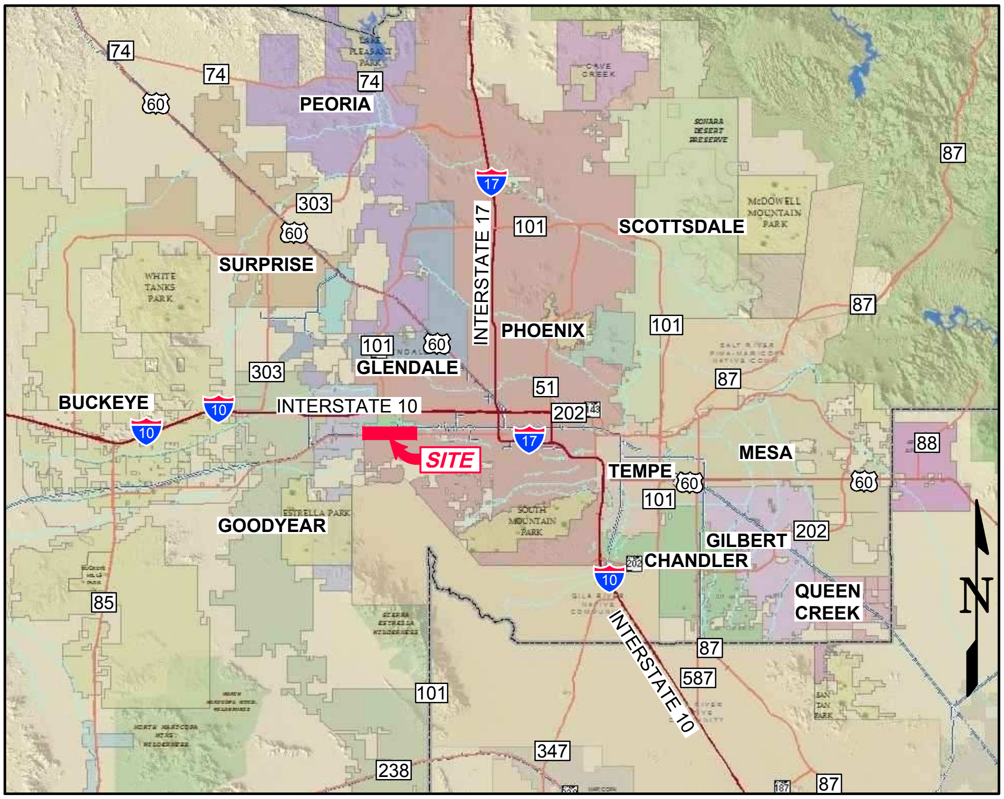
FIGURE

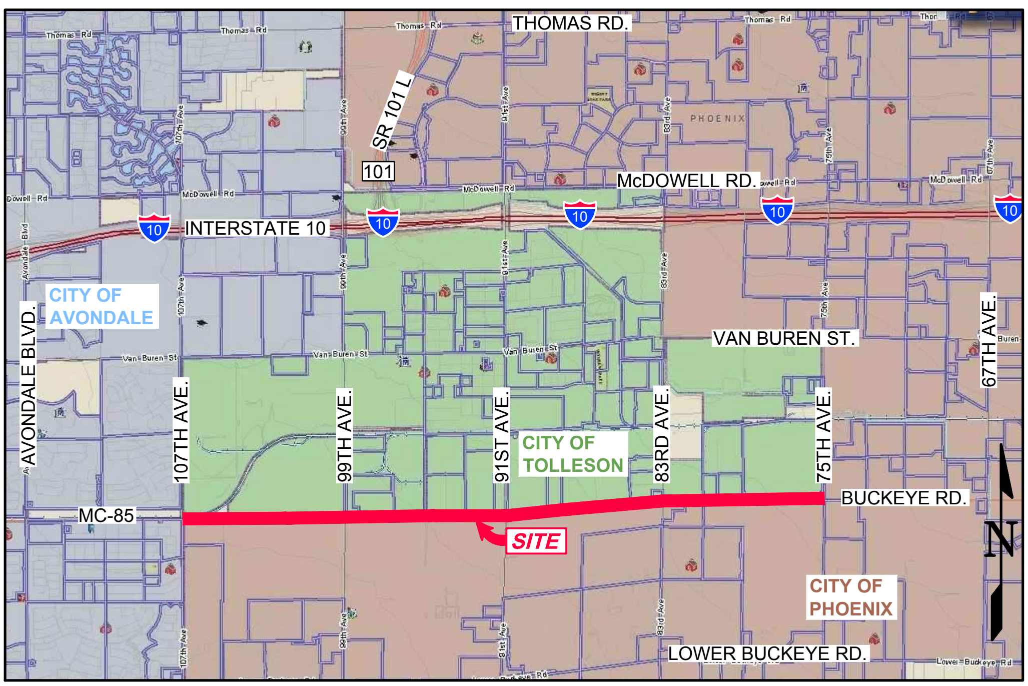
PLOTTED: 15 Nov 2012, 10:31am, dfahrney

CAD FILE: L:\2012\CADD\129067\ LAYOUT: 1

Images: Vicinity1.jpg Images: Vicinity2.jpg

ATTACHED IMAGES:
ATTACHED XREFS:
RIVERSIDE, CA





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VICINITY MAPS

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SITE VICINITY MAP

MC-85 (BUCKEYE ROAD)
FROM 107TH AVENUE TO 75TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

I-1

SECTION 2

HISTORICAL AERIAL PHOTOGRAPH REVIEW

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APPENDIX H-A

2 HISTORICAL AERIAL PHOTOGRAPH REVIEW

2.1 GENERAL

Kleinfelder reviewed aerial photographs as part of our services for the project. The historical aerial photograph review was performed in an effort to identify possible agricultural waste areas that may be within the proposed right-of-way for the project. In addition, the aerial photographs were also reviewed in an effort to aid in locating, where possible, the limits of the Portland cement concrete pavement (PCCP) buried across the site.

2.2 HISTORICAL AERIAL PHOTOGRAPH SOURCES

The sources used by Kleinfelder to obtain aerial photographs of the site were Cooper Aerial Surveys Co. (Cooper Aerial), the United States Department of Agriculture - Farm Service Department - Aerial Photography Field Office (USDA-FSA-APFO), and the Flood Control District of Maricopa County (FCDMC).

The aerial photographs of the site obtained from Cooper Aerial that Kleinfelder observed were dated 1961, 1978, 1984, 1986 and 1999. The aerial photographs of the site obtained from the USDA-FSA-APFO that Kleinfelder observed were dated 1958, 1964 and 1970. The aerial photographs observed from the FCDMC (website) were dated 1937, 1949, 1959, 1969, 1979, 1992-93, 1996-97, 1998-99, 1999-00, 2000-01, 2001-02, 2002-03, 2003-04, 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, and 2009-10. The Maricopa County Assessors Web Site and Google Earth Pro were also used to observe more recent aerial photographs of the site.

2.3 OBSERVATIONS

Selected aerial photographs obtained from the FCDMC website and Google Earth Pro were compiled for each of the 4 miles along the project and are presented in Figures H-1 through H-4. The aerial photographs presented on Figures H-1 through H-4 include red outlines in areas where features were observed to no longer be present on the aerial photograph when compared to an older aerial photograph. At selected areas with a red outline, Borings F1, F2, SD12 and SD13 were drilled to explore the subsurface conditions as part of our field investigation for the proposed storm drain line. Detailed information on these borings is presented in the storm drain line section of this report. At the locations of Borings F1, F2, SD12 and SD13, fill soils underlain by native soil deposits were encountered, and evidence of agricultural waste was not observed. Figures H-5 and H-6 indicate the approximate location of Borings F1, F2, SD12 and SD13, followed by Appendix H-A with the logs for these borings. Based on our observations of the aerial photographs reviewed, agricultural waste areas were not observed adjacent to the proposed right-of-way of the site.

Several of the red outlines marked on Figures H-1 through H-4 were located in areas where it appears relatively small building structures were removed. At these areas, we anticipate (possibly abandoned) features such as underground utility lines and their trenches servicing the previous structures may still be present near the area of the proposed right-of-way. Some of these previous building structures may have also included septic systems.

Due to the low resolution of the older aerial photographs that likely include the Portland Cement Concrete Pavement (PCCP), the PCCP was not clearly identified nor were we able to obtain quantifiable measurements from the aerial photographs to aid with delineating the location of the PCCP at the site.

Our aerial photograph observations are limited to those described in this report and are limited to those observations that were apparent to us. The presence of previous features not depicted or apparent in the aerial photographs is possible.

FIGURES

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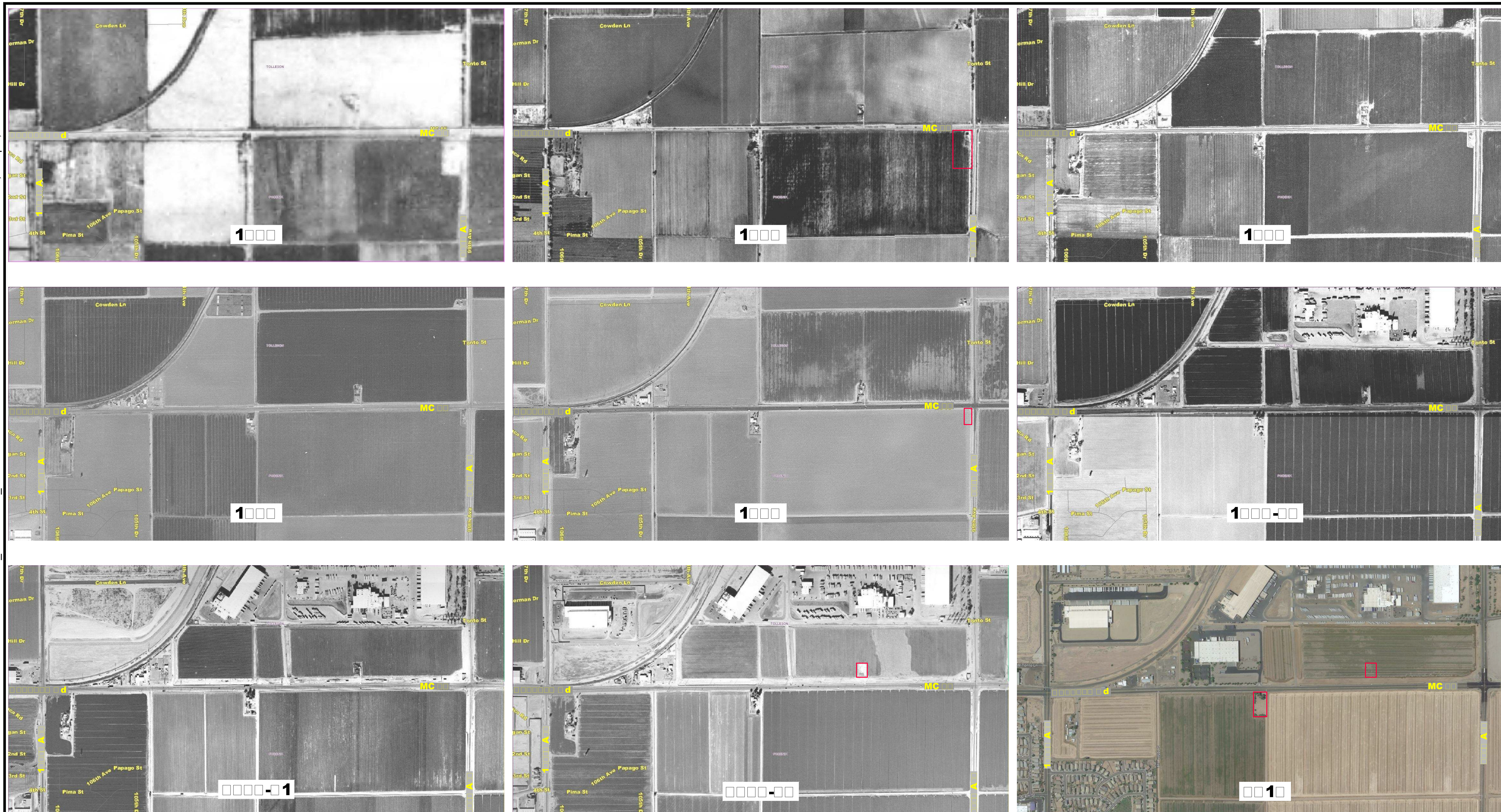
LONG BEACH, CA



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APPROXIMATE AREA WHERE FEATURE(S) OBSERVED IN PREVIOUS PHOTOGRAPH IS NO LONGER PRESENT

SOURCE:
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY WEB SITE (ALL IMAGES EXCEPT 2012).
GOOGLE EARTH PRO, 6/08/12 (2012 IMAGE).

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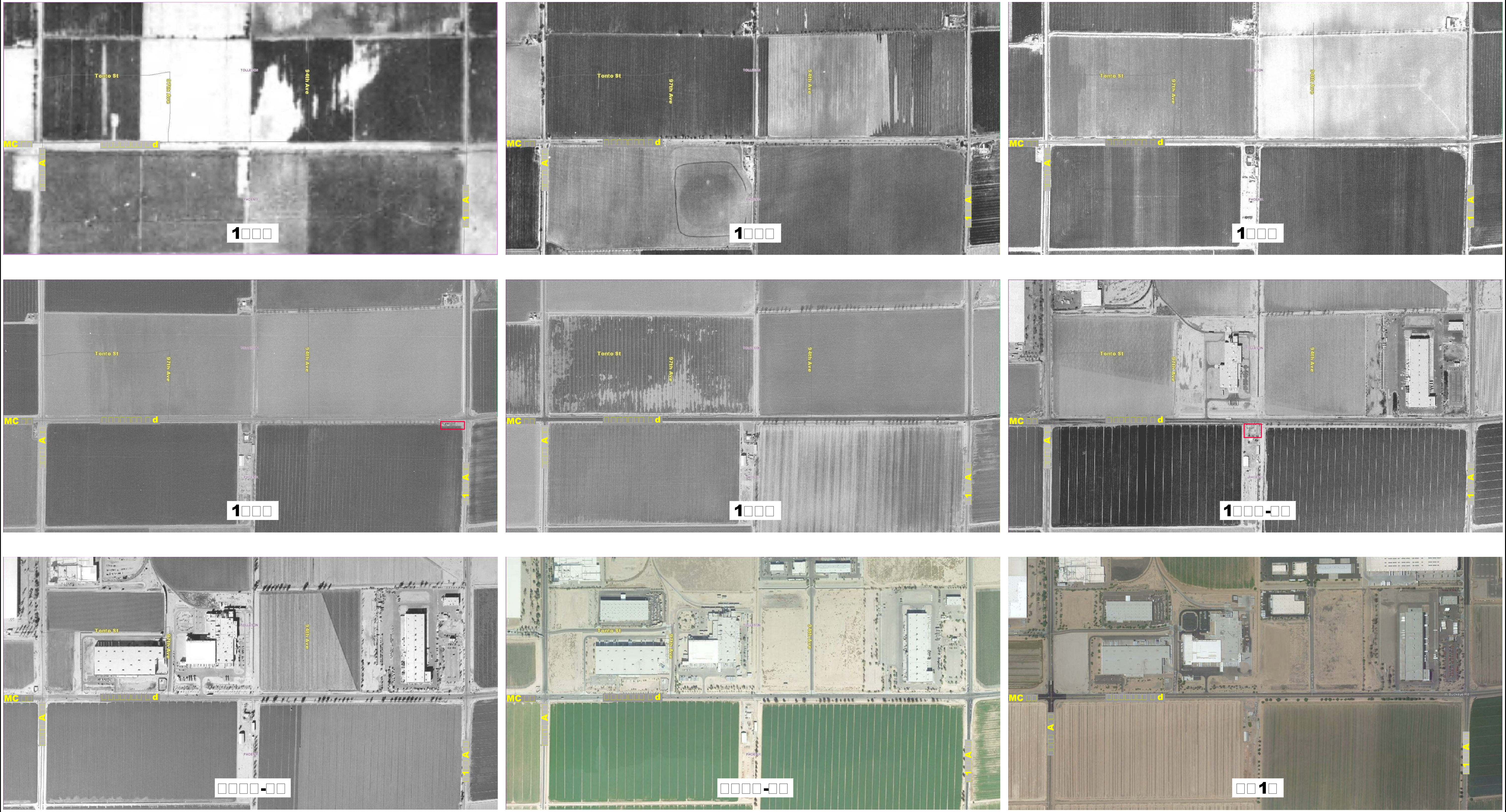
MC-85 (BUCKEYE ROAD)
FROM 107TH TO 99TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE
□-1



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MC-85 (BUCKEYE ROAD)
FROM 99TH AVENUE TO 91ST AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE
□-□

Images: 1937 - 99th to 91st.jpg Images: 1949 - 99th to 91st.jpg Images: 1959 - 99th to 91st.jpg Images: 1969 - 99th to 91st.jpg Images: 1979 - 99th to 91st.jpg Images: 1999-00 - 99th to 91st.j

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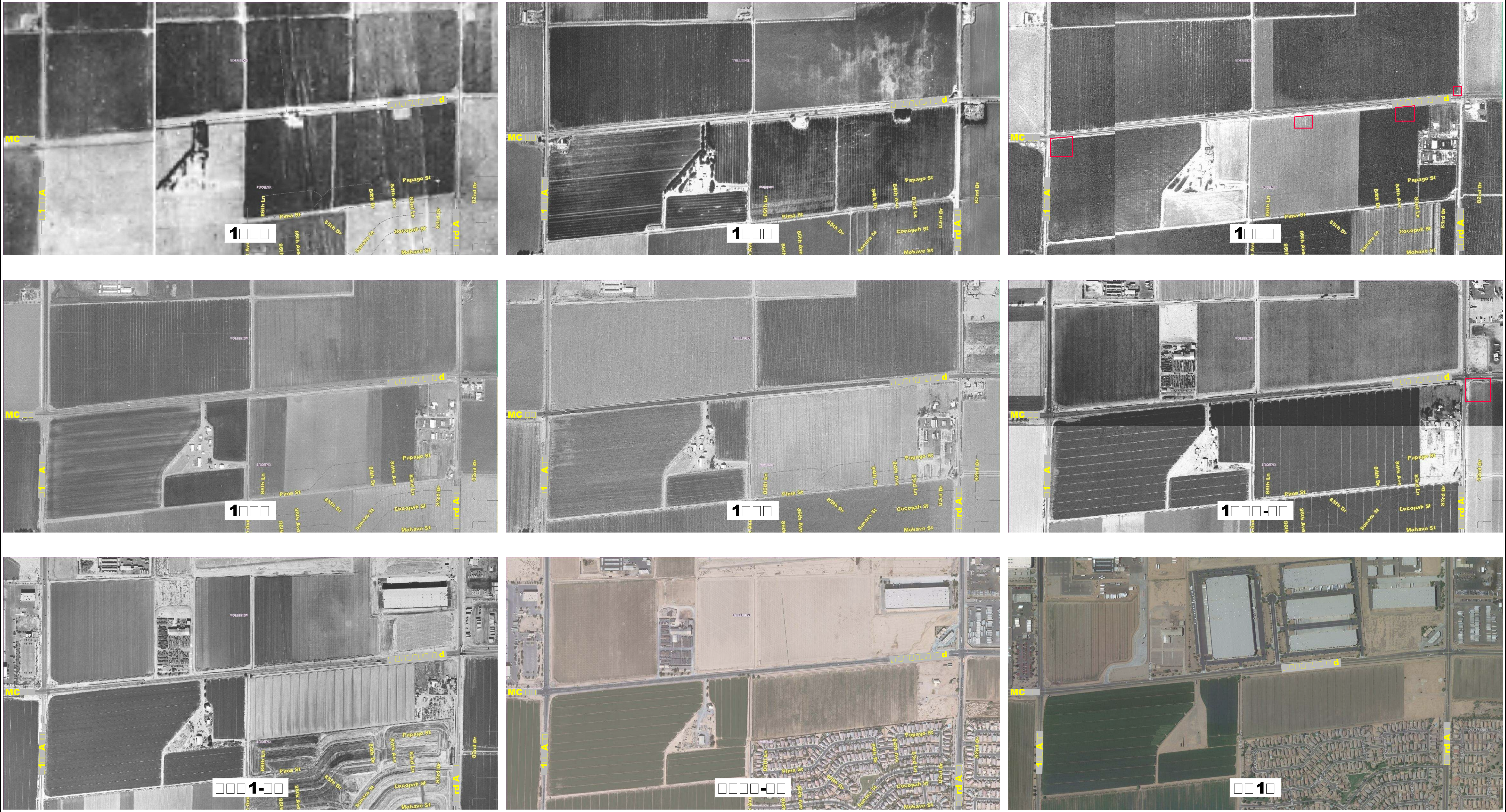

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MC-85 (BUCKEYE ROAD)
FROM 91ST AVENUE TO 83RD AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE
□-□

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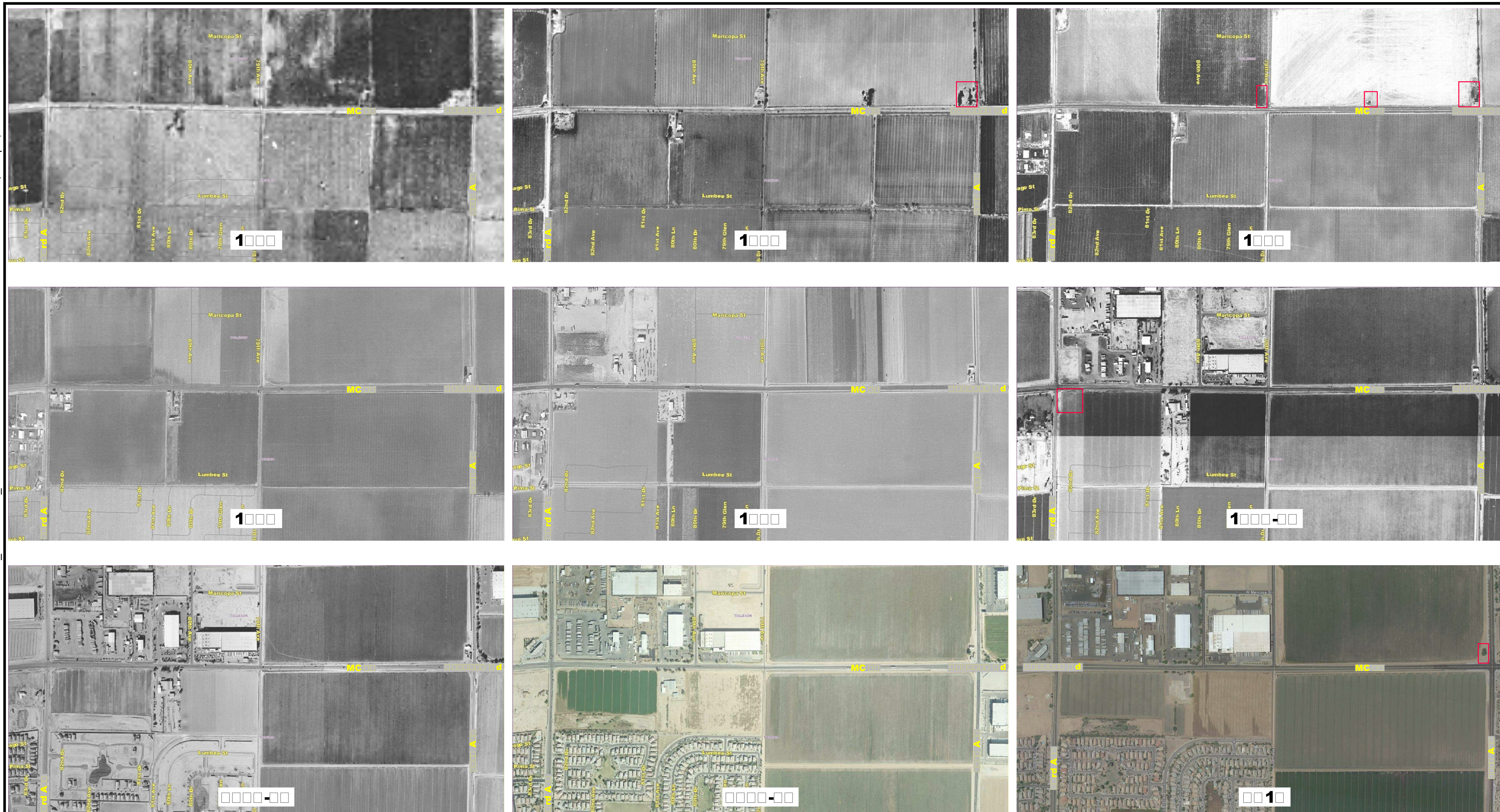

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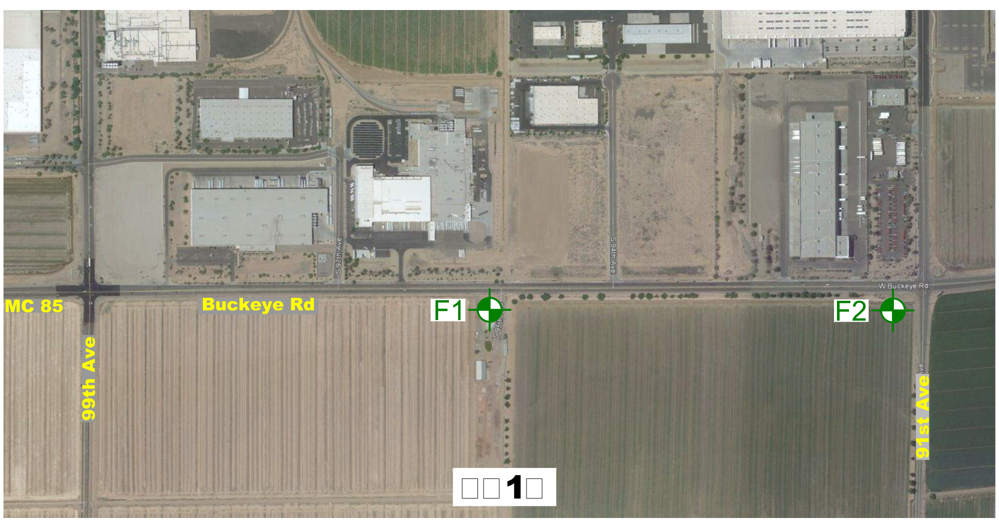
MC-85 (BUCKEYE ROAD)
FROM 83RD AVENUE TO 75TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

□ -□



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APPROXIMATE KLEINFELDER BORING LOCATION

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□1 AN□ □□ MAP

MC-85 (BUCKEYE ROAD)
FROM 99TH AVENUE TO 91ST AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

PLATE

□ -□

Images: 1969 - 99th to 91st.jpg Images: 1999-00 - 99th to 91st.jpg Images: Aerial-Image_1250_6-8-2012_99th-91st.jpg Images: Aerial-Image_1304_6-8-12_99th.jpg

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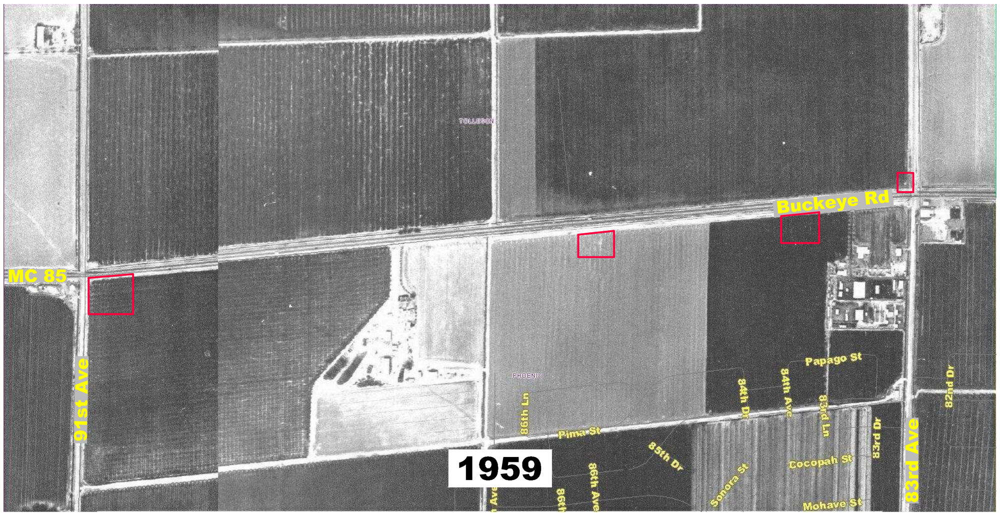

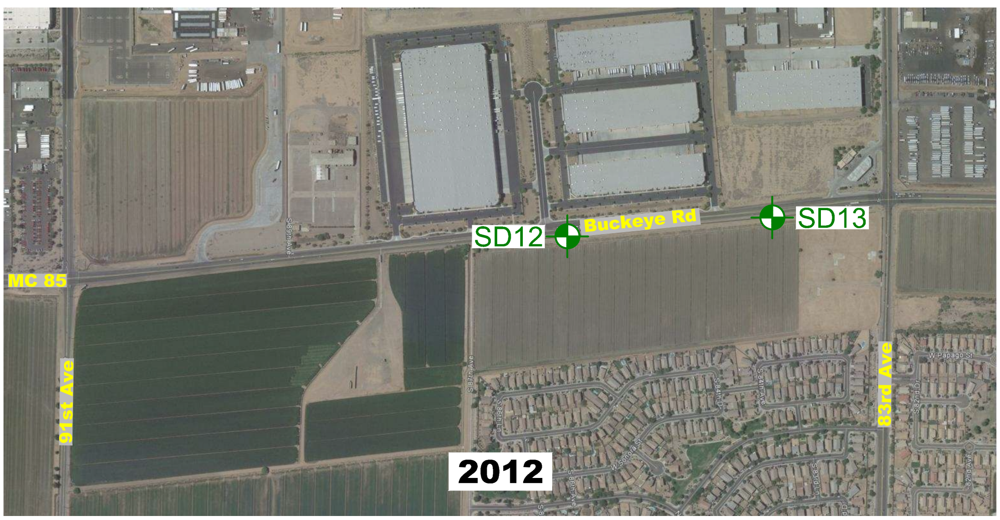

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EXPLANATION

APPROXIMATE KLEINFELDER BORING LOCATION

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PROJECT NO. 129067	BORING LOCATION SD12 AND SD13 MAP		PLATE
DRAWN: 12/2012			H-6
DRAWN BY: MRG			
CHECKED BY: RP	MC-85 (BUCKEYE ROAD) FROM 91ST AVENUE TO 83RD AVENUE MARICOPA COUNTY (PHOENIX), ARIZONA		
FILE NAME: 129067-Fig_H-6.dwg			

APPENDIX H-A

Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LESS THAN 5% PASSING NO. 200 SIEVE	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% PASSING NO. 200 SIEVE	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LESS THAN 5% PASSING NO. 200 SIEVE	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% PASSING NO. 200 SIEVE	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

Note: Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing No. 200 sieve require dual USCS symbols. (See KEY A3 if provided)

GEO-KEY_A1_SOIL 129067 MC-85.GPJ 12/06/12

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Report Date:	Project Number:
December 2012	129067

UNIFIED SOIL CLASSIFICATION SYSTEM

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
H-A1

LOG SYMBOLS

BULK / GRAB SAMPLE

MODIFIED CALIFORNIA SAMPLER
(2 inch inside diameter)

RING (PORTER) SAMPLER
(2-1/2 inch inside diameter)

STANDARD PENETRATION
SPLIT SPOON SAMPLER
(1.4 inch inside diameter)

SHELBY TUBE
(3 inch outside diameter)

HQ-3 SIZE CORE BARREL
(2.4 inch inside diameter)

WATER LEVEL
(level after completion)

WATER LEVEL
(level where first encountered)

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
3. Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.
5. NA = Not Analyzed

GEO-KEY_A2_LOG 129067 MC-85.GPJ 12/06/12

KLEINFELDER
Bright People. Right Solutions.

Report Date:	Project Number:	LOG KEY	PLATE
December 2012	129067	MC-85 (Buckeye Road) From 107th Avenue to 75th Avenue Maricopa County (Phoenix / Tolleson), Arizona	H-A2

Boring Location:	Latitude: 33.4356° Longitude: -112.26408°			Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered			Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic	Elevation (ft):	N/A	Total Depth (ft):	15.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.0 feet — Graded landscaped area, developed parcel
	0			8			49	30	99	77			CL	**LEAN CLAY with SAND:** brown, soft, medium to high plasticity, no cementation, trace gravel, moist, upper roughly 12 inches disturbed by previous grading.
				7										
			2-3-3	3										
				4										
				8										
	5		24/12	10	102	19								Note: brown to light brown, firm, weak cementation, and vesicular below about 5 feet.
				11										
				18										
				20										
			11-13-11											
	10												SM	**SILTY SAND:** brown to light brown, medium dense, non-plastic, no cementation, slightly damp.
			24/12		104	6								Note: trace fine gravel below about 14 feet.
	15													Stopped drilling at 14.0 feet. Stopped sampling at 15.0 feet. No groundwater encountered. Cave-in to 12.0 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

KLEINFELDER
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Report Date: December 2012

Project Number: 129067

LOG OF BORING F1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE H-A3

Boring Location:	Latitude: 33.43561° Longitude: -112.25579°	Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	15.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.5 feet — Graded dirt shoulder - Buckeye Road
				12									FILL	**FILL: CLAYEY SAND:** brown, low plasticity, trace gravel, slightly damp.
				6									CH	**NATIVE: FAT CLAY with SAND:** brown to light brown, moderately firm, high plasticity, weak cementation, trace gravel, damp.
			15/12		95	17								
				5										
				6										
				6										
	5		4-5-5				50	32	99	79				
				6										
				9										
				12										
				14										
			34/12		106	8							CL	**SANDY CLAY:** brown to light brown, very firm, low to medium plasticity, weak cementation, slightly damp.
	10													
			11-11-25											Note: stratified with thin layers of clayey sand below about 14 feet.
	15													
														Stopped drilling at 14.0 feet. Stopped sampling at 15.5 feet. No groundwater encountered in test boring. Cave-in to 11.0 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

KLEINFELDER
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Report Date:	Project Number:
December 2012	129067

LOG OF BORING F2

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
H-A4

Boring Location:	Latitude: 33.43654° Longitude: -112.24486°	Date Started:	11/1/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	11/1/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	5.4

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	Field Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 5.4 feet Graded dirt shoulder - Buckeye Road
							41	26	90	56	Max Dry Dens = 117.8pcf Opt Moist = 13.8% Swell = 3.1% R-value = 5		FILL	**FILL: SANDY LEAN CLAY:** brown and gray, firm, medium plasticity, no cementation, some gravel, slightly damp.
			12-12-12											
	5		50/5											Note: hard at 5 feet.
														Auger refusal at 5.0 feet. Sampler refusal at 5.4 feet. No groundwater encountered in test boring.
	10													
	15													
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

KLEINFELDER
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Report Date:	Project Number:
December 2012	129067

LOG OF BORING SD12

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
H-A5

Boring Location:	Latitude: 33.43694° Longitude: -112.24062°			Date Started:	11/1/2012
Groundwater (ft):	No Groundwater Encountered			Date Completed:	11/1/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic	Elevation (ft):	N/A	Total Depth (ft):	15.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.0 feet — Graded dirt shoulder - Buckeye Road
													FILL	**FILL: SILTY SAND:** brown, non-plastic, slightly damp.
			4-6-3										SC	**NATIVE: CLAYEY SAND:** brown, loose, low plasticity, weak cementation, trace gravel, slightly damp.
							40	23	97	75			CL	**LEAN CLAY with SAND:** light brown, firm, medium plasticity, weak cementation, trace gravel, damp.
	5		16/12		105	15								
			7-10-14										CL-ML	**SANDY, CLAYEY SILT:** light brown, firm, low plasticity, weak cementation, slightly damp.
	10													
													SC	**CLAYEY SAND:** light brown, very dense, low plasticity, weak cementation, damp.
			62/12		103	19								
	15													Stopped drilling at 14.0 feet. Stopped sampling at 15.5 feet. No groundwater encountered in test boring. Cave-in to 10.7 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

KLEINFELDER
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Report Date: December 2012

Project Number: 129067

LOG OF BORING SD13

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

H-A6

SECTION 3

GROUND PENETRATING RADAR SURVEY

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APPENDIX GPR-A

Geological Consultants, Inc. (GCI) report titled *Ground Penetrating Radar Survey, Locate Buried Concrete Pavement Section, MC 85 (Buckeye Road), 75th Avenue to 107th Avenue, Phoenix, Arizona* (GCI Project No. 2012-126, report dated October 17, 2012).

3 GROUND PENETRATING RADAR SURVEY

3.1 GENERAL

Ground penetrating radar (GPR) surveys across the MC-85 roadway were performed throughout the extent of the project. Kleinfelder subcontracted Geological Consultants, Inc. (GCI) to perform the GPR surveys for the project. The GPR surveys across the site were performed in an effort to aid delineating the buried Portland cement concrete pavement (PCCP) at the project. GCI's services for this project are presented in a GPR Survey Report, which is included as Appendix GPR-A in this section.

3.2 GPR FIELD WORK

Prior to the GPR survey field work, Kleinfelder obtained a MCDOT right-of-way permit (Tracking No. TC20120646), and subcontracted Highway Technologies, Inc. (HT) to submit a traffic control plan to MCDOT. The traffic control plan for the GPR survey work was approved by MCDOT on August 31, 2012. The project is surrounded by the cities of Phoenix, Tolleson and Avondale. In order to inform these surroundings municipalities of our GPR survey work, we provided them traffic control information and obtained required right-of-way permits. We notified a MCDOT inspector 24 hours prior to our field work. Traffic control for the project was provided by HT in general accordance with the approved traffic control plan.

The GPR surveys were performed by GCI on September 3rd through the 8th, 2012. The GPR survey work was performed at night between the hours of 8:00P.M. to 5:00A.M. The traffic control, including 4 (off-duty) City of Phoenix police officers, was utilized to reduce traffic to one lane in each direction. The GPR surveys were performed perpendicular to the MC-85 roadway and across the majority of the existing right-of-way. Traffic, if any, was stopped each time the GPR surveys were performed across the roadway travel lanes. Each GPR survey across the roadway was generally performed in approximately 5 minutes or less. Once a GPR survey line was performed across the roadway, the traffic control setup was moved and re-established at the next GPR survey location. A total of 124 GPR survey lines were performed at approximately 200 feet (or less) spacings across the 4 mile long project. Kleinfelder performed periodic site visits during most of the GPR survey shifts and assisted with project and field coordination.

3.3 GPR SUMMARY

The results of the GPR surveys indicate the buried PCCP is present beneath the existing roadway throughout the 4 miles of the project. As indicated in the GPR Survey Report, there appears to either be occasional discontinuities in the buried PCCP or the PCCP may be buried at a depth out of the GPR range. The GPR surveys indicated the width of the PCCP was variable across the project, possibly due to past improvements on the site such as the installation of a southwest gas high pressure line along most of the northern portion of the roadway. The GPR detected anomalies interpreted as the buried PCCP was labeled as an "A" anomaly. Other anomalies interpreted from the GPR along the survey lines were labeled as "B, C or D." GPR surveys were performed at periodic intervals across the site. Continuity of the buried PCCP between GPR survey lines is only assumed. It is possible that conditions could vary between or beyond the data evaluated. A field exploration to core selected GPR anomaly areas was performed by Kleinfelder after the GPR survey work, and detailed information is presented as a separate section of this report (Section 4).

APPENDIX GPR-A

Ground Penetrating Radar Survey Report

Report Prepared for:

Kleinfelder
1335 West Auto Drive
Tempe, AZ 85284

Attention: Mr. Ramon Padilla, P.E.
Geotechnical Project Manager
Kleinfelder Project No. 129067
Kleinfelder Work Order No. 1 (Master Agreement KA12-002)

Report Prepared by:

Geological Consultants Inc.
2333 West Northern Avenue, Suite 1A
Phoenix, Arizona 85021

Registered Geophysicist Registration No. GP-886 Kerry Hennon Date 10/15/12 State of California
EXPIRES 07/31/13

Registered Geologist Certificate No 10338 Kenneth M. Euge Date Signed 10/15/12 Arizona, U.S.A. EXP 09-30-2014

Prepared by:
Kerry Hennon, G.P.

Prepared & Reviewed by:
Kenneth M. Euge, R.G.

GROUND PENETRATING RADAR SURVEY

LOCATE BURIED CONCRETE PAVEMENT SECTION
MC 85 (BUCKEYE ROAD)
75TH AVENUE TO 107TH AVENUE
PHOENIX, ARIZONA

October 17, 2012

GCI Project No. 2012-126

NOTICE

The geophysical survey interpretations, findings, conclusions and recommendations presented in this report are based on (1) available roadway information from unpublished sources available at the time of this study; (2) ground penetrating radar (Radar) geophysical surveys of selected roadway sites; and (3) the analysis and interpretation of the Radar geophysical data gathered along MC 85 between 75th Avenue and 107th Avenue. The services provided by Geological Consultants Inc. (GCI) to Kleinfelder were performed using that degree of care and skill ordinarily exercised under similar circumstances, by reputable members of their profession practicing in the same or similar locality at the time of this study.

It must be recognized that subsurface geologic conditions may vary from place to place and from those found at locations where measurements or surveys are made by the investigator. Opinions regarding the subsurface geological and soil conditions presented in this report are based on the results of this investigation and the interpretation of Radar geophysical data and it may not be possible for others to accurately correlate the geological material, geophysical interpretations, and survey results to test explorations or investigations conducted by others. No warranty or representation, either expressed or implied, is or should be construed regarding geological/geophysical conditions at locations other than those evaluated by the investigator(s) as part of this geophysical site investigation.

This report was prepared by the scope of work outlined in the GCI proposal for geological services dated May 31, 2012 and as authorized through the Master Agreement for Subcontractor Services (No. KA12-002) between Kleinfelder and GCI dated July 20, 2012 and the Kleinfelder Work Order No. 1 dated August 30, 2012 for Kleinfelder Project No. 129067.

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GROUND PENETRATING RADAR SURVEY

LOCATE BURIED CONCRETE PAVEMENT SECTION
MC 85 (BUCKEYE ROAD)
75TH AVENUE TO 107TH AVENUE
PHOENIX, ARIZONA

1.0 INTRODUCTION

This report describes the results of the surface geophysical ground penetrating radar (Radar) surveys conducted at selected locations along MC 85 (Buckeye Road) between 75th Avenue and 107th Avenue in Phoenix, Arizona (Figure 1).

The purpose of the geophysical Radar survey was to provide the necessary geophysical services to complete Radar surveys at selected locations along portions of a four-mile stretch of MC 85 with the purpose to identify buried, old Portland Cement Concrete Pavement (PCCP) sections that were left in place and buried by the subsequent construction of the existing MC 85 roadway. Radar surveys were run perpendicular to the four-lane MC 85 roadway as well as the accessible roadway shoulders

Because of the periodic heavy traffic along MC 85 during the Radar survey, traffic control was used at each Radar profile line location to limit traffic travel to east and westbound inside lines with temporary traffic stoppages during the Radar surveys. The traffic control plan, and its implementation, was designed to minimize to the fullest possible extent, potential impacts to traveling public and the personnel conducting the Radar surveys and to maximize the site safety consideration consistent with the Kleinfelder site-specific health and safety plan.

The Scope of Work performed to accomplish the objectives of this investigation included:

- Mobilization and demobilization of personnel and equipment to and from the job site.

- Prior to undertaking the site work, a task-specific Health and Safety Plan was provided that identified the hospital or medical facility nearest to project area.

- Reports and boring logs from previous geotechnical investigations (DMJM Harris, 2005; MACTEC, 2003; Ninyo & Moore, 2010) were reviewed prior to the Radar survey of the MC 85 alignment to determine the locations where the buried PCCP had been identified.

- Reconnoiter of the site investigation area to assess the general condition of the search area, identify cultural features that could influence the geophysical survey areas, and define the specific work area sequence to minimize roadway traffic lane closure impacts to MC 85.

- A National Geodetic Survey (NGS) monument near MC 85 was selected and the monument was located and occupied to reference the Radar survey profile line GPS location survey.

- Radar survey testing and antenna calibration sites along the MC 85 roadway were coordinated and jointly selected by GCI and Kleinfelder. These test sites focused on area where the buried concrete pavement section had been identified ("tagged") during previous geotechnical investigations. Radar surveys were conducted at fifteen test/calibration sites.

- A total of one hundred-twenty-four (124) Radar survey profiles were completed along MC 85 between 107th Avenue and 75th Avenue, including production, supplemental, and test/calibration profiles. The Radar profile survey lines were located on the average of about 185-feet, on-center. Each Radar profile line start point and the anomalies identified during the Radar survey were marked on the pavement and surveyed for future reference.

- GPS surveying to locate the Radar profiles line was conducted concurrently the Radar survey profiling to locate the identified Radar anomalies.

- Radar and GPS data were processed to interpret and identify the Radar anomalies and to construct the Radar survey profile line and anomaly maps.

- Prepare this report documenting the Radar survey, its finding, interpretations, conclusions, and recommendations.

The Radar and GPS surveys were performed between the hours of 8:00 P.M. and about 5:00 A.M. each day between September 3, 2012 and September 8, 2012. Radar calibrations and testing of selected sites were conducted on September 3, 2012 and the production Radar surveys were conducted on September 4, 2012 through 5:00 A.M. on September 8, 2012. The Radar surveys were conducted by Mr. Kerry Hennon, P.Gp., Principal Geophysicist with Kenneth M. Euge, R.G., Principal Geologist and Project Manager of Geological Consultants Inc. (GCI). Mr. Ramon Padilla, P.E. with Kleinfelder was on the site periodically during the Radar and GPS surveys to facilitate coordination of the work and with the traffic control personnel and the

County. No direct subsurface explorations (bore holes or trenches), materials sampling, nor laboratory testing was performed by GCI as part of this geophysical survey investigation.

2.0 METHODOLOGY AND PROCEDURES

Surface geophysical surveys are the appropriate methodology for rapidly characterizing this site for buried structures that may pose constraints to future roadway and site development if not identified and, if necessary, mitigated. The Radar survey method is used to identify and interpret the location of the reported buried concrete pavement as well as buried debris, backfilled excavations, and public and private utilities that could be encountered along the Radar profile lines. These subsurface features, if present, generally form dielectric contrast relative to the surrounding native in-place soil. The Radar method can detect these physical property contrasts.

2.1 Site Health and Safety

Prior to the start of work, a health and safety meeting with the Kleinfelder GCI personnel, and other site personnel were held to address any identified health and safety issues that could affect the Radar or GPS survey work. Appropriate personal protective equipment, including hard hats, safety vests, and work boots, was used by the personnel conducting the Radar and GPS surveys. The primary health and safety concern identified at this site was traffic flow throughout the Radar survey area along MC 85 from 107th Avenue to 75th Avenue. Another significant safety concern was vehicular traffic entering the work corridor between the major intersection. Where required to minimize the traffic conflicts, the Radar survey works utilized a traffic control plan provided by Kleinfelder that consisted of traffic lane restrictions, flood lights, message board with lighted direction signals, traffic cones, flag-men, and off-duty police officers. During the Radar surveys, the ‘buddy system’ including a flag man and off-duty police were used to provide an awareness to the public of the presence of the Radar survey and the GPS survey crew and for the protection to the Radar/GPS operator and the equipment. No health and safety incidents or ‘near misses’ occurred during the survey.

2.2 Ground Penetrating Radar (Radar)

2.2.1 Ground Penetrating Radar Methodology

Radar can detect objects composed of a variety of materials (metal, concrete, steel, and ceramics). Radar uses high frequency waves to locate three-dimensional changes in the subsurface dielectric properties. Waves transmitted into the ground are partially reflected back to the surface by dielectric contrasts between these objects and the surrounding soil. A steel or fiberglass underground storage tank, for example, should produce a significant cylindrical, high-amplitude, radar anomaly. A buried concrete slab or septic tank would produce a flat-topped, high-amplitude radar anomaly. Small dimension metal objects and utilities produce small-sized, high-amplitude anomalies. Several of these anomalies closely spaced may represent a debris burial pit. A backfilled excavation where tanks may have been removed may cause a discrete change in the regular reflection patterns if the soil backfill has different electrical properties that the native soil.

2.2.2 Ground Penetrating Radar Procedures

Geophysical surveys conducted along MC 85 will conform to ASTM D6432, Standard Guide for Using Surface Ground Penetrating Radar Method for Subsurface Investigation. Radar data were measured with a digital Geophysical Survey Systems, Inc., model SIR-3000 ground penetrating radar unit with a 300-MHz and 400-MHz (1-million cycles/second) antennae. Estimated penetration at this site was to a depth of about five feet below the ground surface. The instrument has been maintained according to the manufactures specifications and it was calibrated at the site prior to the data collection. Almost continuous (about 1-inch intervals) radar data were recorded along the profile lines. Selected drill hole sites where logs reported "tagging" the buried concrete pavement section were used to calibrate the antennae used with the Radar system to determine which antenna was best suited to obtain representative concrete pavement GPR anomaly signatures. Additional Radar tests were also conducted at locations where no buried concrete pavement was tagged in drill hole logs.

Profile line start points were painted along the south side of MC 85 at the edge of the pavement at intervals of 300 feet or less beginning at 107th Avenue and eastward to 75th Avenue. Profile lines were approximately oriented perpendicular to roadway alignment. With the Radar survey profile line spacing and the one-inch radar recording interval, this geometry is adequate for detecting small-dimension pipes, cable, buried debris, backfilled excavations, buried concrete slabs.

Data anomaly locations interpreted as significant buried structures including the old, buried concrete pavement, were paint-marked on the ground as the survey progressed at the site.

2.3 Global Positioning System (GPS)

A Trimble model Ag-114 GPS antenna was connected to the radar antenna to provide accurate tracking of the radar data being recorded. This instrument records data at one-second intervals from as many as twelve available satellites and provides atmospheric corrections from the OMNISTAR satellite. The antenna calculated real-time differential corrections, applied it to the data and then stored the results (North American Datum (NAD) 1983).

The GPS survey was tied to the National Geodetic Survey (NGS, 2006) monument designation 1BB1, PID #AJ3821 that is located approximately 0.6 miles south of the intersection of MC 85 (Buckeye Road) and 91st Avenue. The GPS location data has an estimated uncertainty of ±1-foot. The GPS geodetic coordinates were transformed into the Arizona State Plane-Central Zone for map production using the US Army Corps of Engineers CORPSCON conversion software.

3.0 CONCLUSIONS AND RECOMMENDATIONS

The surface Radar survey along the MC 85 (Buckeye Road) alignment between 107th Avenue and 75th Avenue, (Figures 1) detected several anomalies interpreted to represent the buried Portland cement concrete pavement (Sheets A thru Sheet K). Radar data were recorded along all of the profile lines depicted on Sheet A thru Sheet K. The significant Radar anomalies are depicted in Figure 2.

Based on the results of the site reconnaissance, Radar survey, and data interpretations, the following conclusions are provided. These interpreted data anomalies may require excavation to directly determine the buried structure causing them and their actual depth below existing grades:

- A total of one hundred-twenty-four (124) Radar survey profiles were completed along MC 85 between 107th Avenue and 75th Avenue, including production, supplemental, and test/calibration profiles. The Radar profile survey lines were located on the average of about 185-feet, on-center. Each Radar profile line start point and the anomalies identified during the Radar survey were marked on the pavement and surveyed for future reference.

- Radar detected anomalies interpreted as the buried Portland cement concrete pavement (PCCP) at 104 north oriented profiles between station distances of 1147 feet and 1339+80 feet. Figure 2 upper graph shows a typical radar anomaly interpreted as the PCCP roadway and its burial depth below grade surface (bgs). No roadway anomaly was detected at two profiles (1172+50 feet and 1183 feet) possibly because the PCCP is missing or did not generate a recognizable dielectric contrast with the surrounding soils. Radar anomaly depths ranged between 12 and 29 inches bgs and agreed within ±±3 inches with PCCP encountered in eight borings. Anomalies were detected on 54 profiles east of 1247+42 where five borings did not encounter PCCP.

- The PCCP could either be unusually deep or missing between distances of 1131+66 feet and 1147 feet. MACTAC Boring B11 at 1134+84 feet encountered PCCP at 48 inches bgs. DMJM Boring C3 at 1149+93 feet (1509 feet east of Boring B11) encountered PCCP at 13 inches bgs. Radar detected the PCCP at 1147, 1148+50, and 1149+93 feet in agreement with Boring C3 and also for another 8407 feet eastward to DMJM Boring B16. Radar did not detect roadway anomalies west of Boring B11. Even the lower frequency radar antenna with slightly deeper penetration (about 5 feet) did not detect the PCCP west of 1147 feet. The PCCP may have been removed during previous construction activities west of 1147 feet.

– The interpreted PCCP radar anomalies are generally centered within about 8 feet of the current MC85 center line, except between 1181+50 feet and 1185 feet (350 feet interval) where it deviates about 12 feet southward.

– Two other anomalies (C and D) were detected on many radar profiles as shown in the lower graph (Figure 2). They may represent buried structures or utility lines adjacent to the shoulders of the PCCP roadway.

– Radar survey results, including the profile lines and the geophysical anomaly location information are compiled and plotted on plan sheets prepared in AutoCAD format. These maps uses a geo-referenced calibration point with established X-Y coordinates from an existing NGS benchmark located approximately 0.6 miles south of the MC 85-91st Avenue intersection.

4.0 REFERENCES

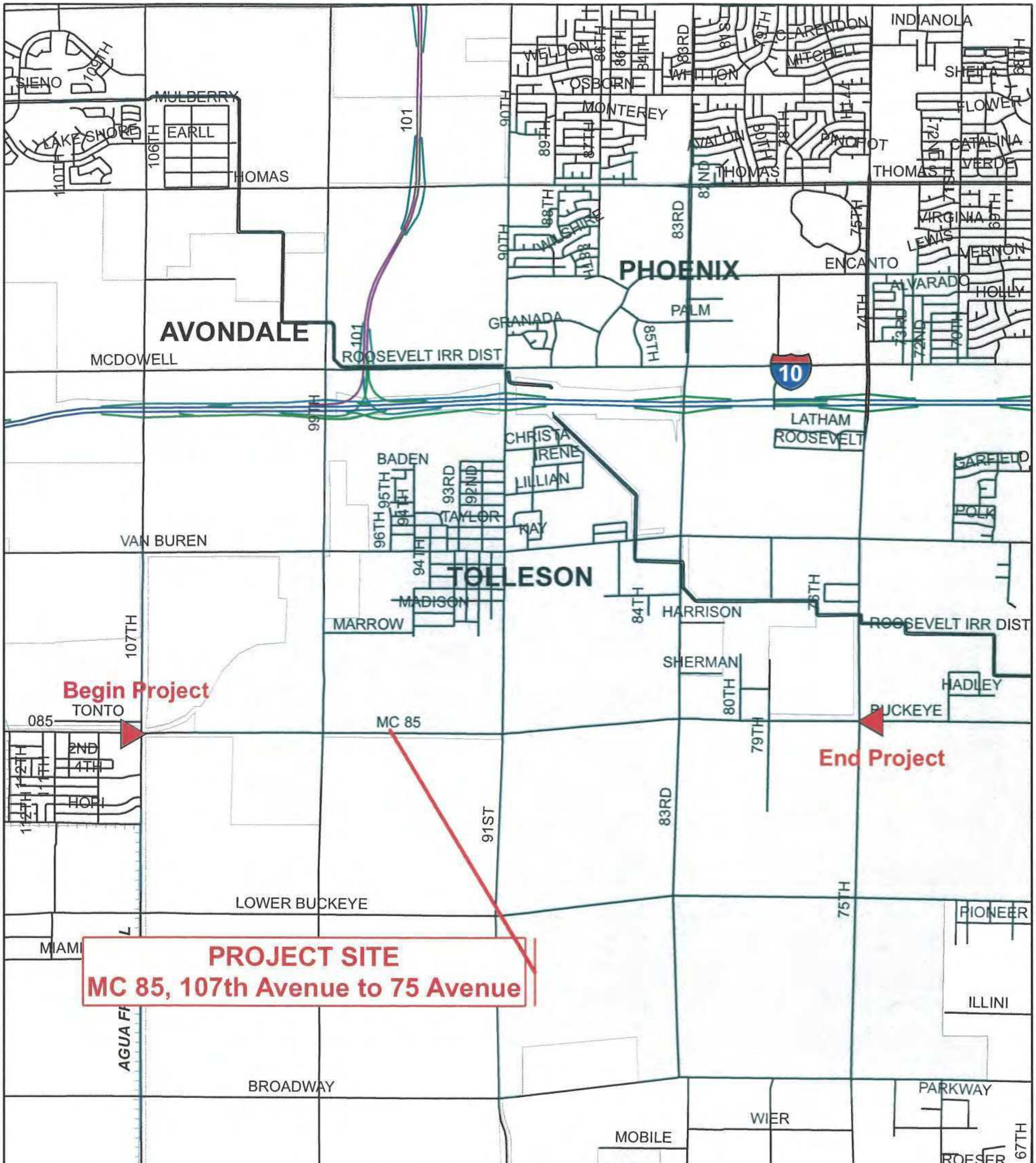
DMJM Harris; 2007; Geotechnical Investigation Report, MC 85 from 107th Avenue to 91st Avenue, Phoenix, AZ.

MACTEC; 2003; Preliminary Geotechnical Investigation, MC 85 - 107th Avenue to 91st Avenue, MACTEC Project 4975-03-1401, June17, 2003, revised October 23, 2003

National Geodetic Survey, 2006; Survey Control Monument Data Sheet, Designation 1BB1, PID AJ3821, USGS Tolleson Quadrangle, Maricopa County, AZ

Ninyo & Moore; 2010; Geotechnical Evaluation, MC 85 Roadway Improvements 75th Avenue to 91st Avenue, Maricopa County, AZ; Ninyo & Moore Project No. 601301002, September 28, 2010.

FIGURES

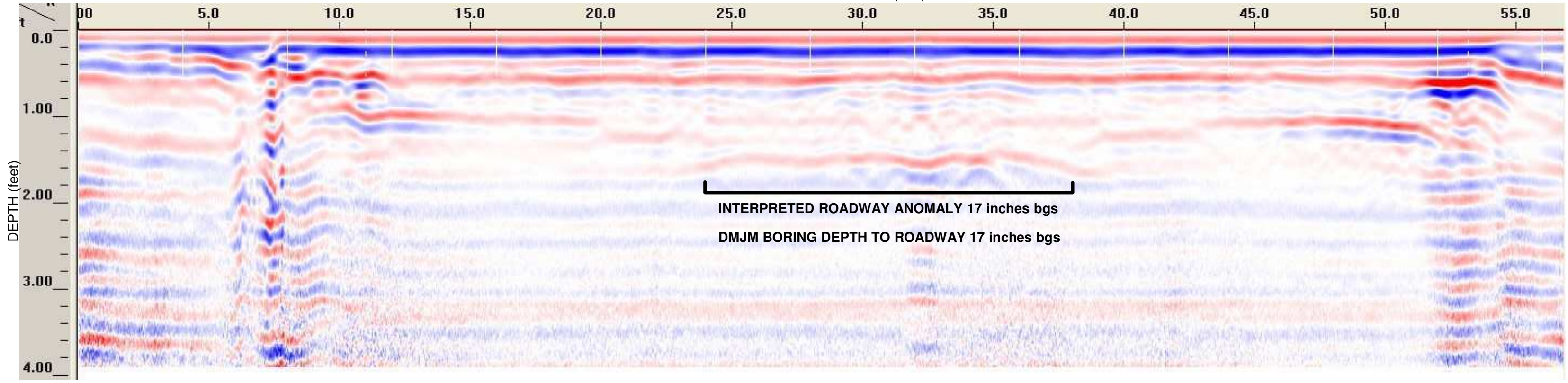


1:48,000

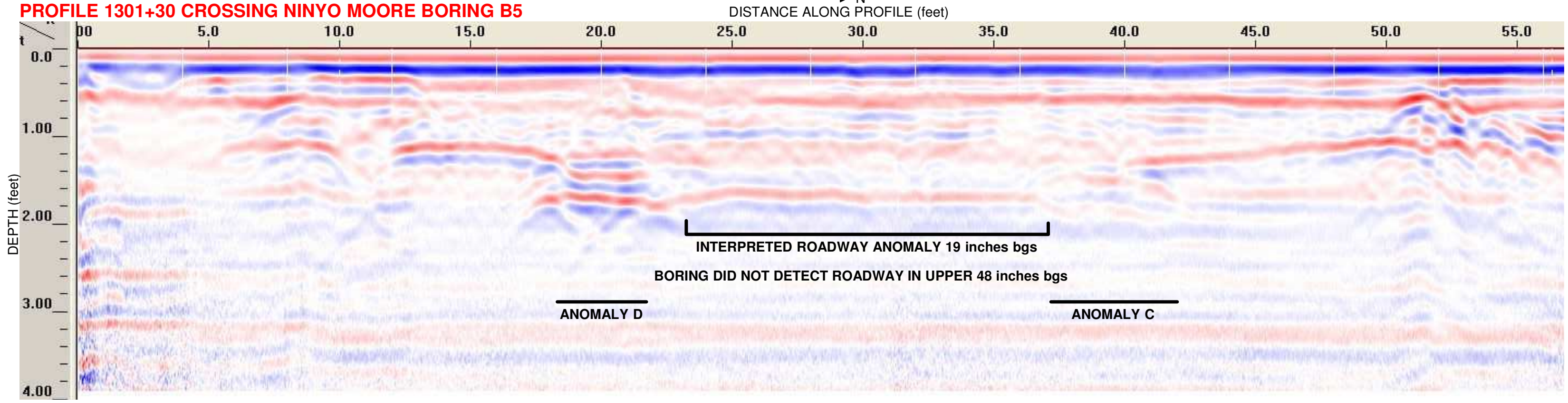
Ground Penetrating Radar Survey
Locate Buried Concrete Pavement Section
MC 85, 75th Avenue to 107th Avenue, Phoenix, AZ.
Figure 1: Location Map

GEOLOGICAL CONSULTANTS INC.
2333 West Northern Ave, Suite 1A
Phoenix, AZ 85021
phone 602-864-1888
fax 602-864-1899

PROFILE 1163+25 CROSSING MACTAC BORING B-8A & DMJM BORING C-5



PROFILE 1301+30 CROSSING NINYO MOORE BORING B5



Refer to Sheets A thru K, GPR Results Map for the location of this example radar data record. Records obtained September 3, 2012.

Ground Penetrating Radar Survey
Locate Buried Concrete Pavement Section
MC 85, 75th Avenue to 107th Avenue, Phoenix, AZ
Example Radar Data Record - Buried Pavement
Figure 2

Geological Consultants Inc.

2333 West Northern Ave. Ste 1A
Phoenix, Arizona 85021
Phone 602-864-1888
Fax 602-864-1899

RADAR SURVEY RESULTS

SHEETS A-1 thru K-1

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Registered Geophysicist Registration No. GP-886 Kerry Hannon Date 10/15/12 State of California EXPIRES 07/31/13

REVISIONS

NO.	BY	DATE	CKD	REMARKS

DES KH
DWN KE
CKD

EXPLANATION:

GPR ANOMALY A: Interpreted Buried Roadway Pavement
d = Depth to PCCP (inches)

C GPR Secondary Anomalies C, or D

P1203+30 GPR Profile w/ Centerline Station (approximate)

WHITE LINE— Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ

107th Avenue to 99st Avenue
Stations 1131+19± to 1150+00

GCI PROJECT NO 2010-126
DATE: October 15, 2012
SHEET A-1
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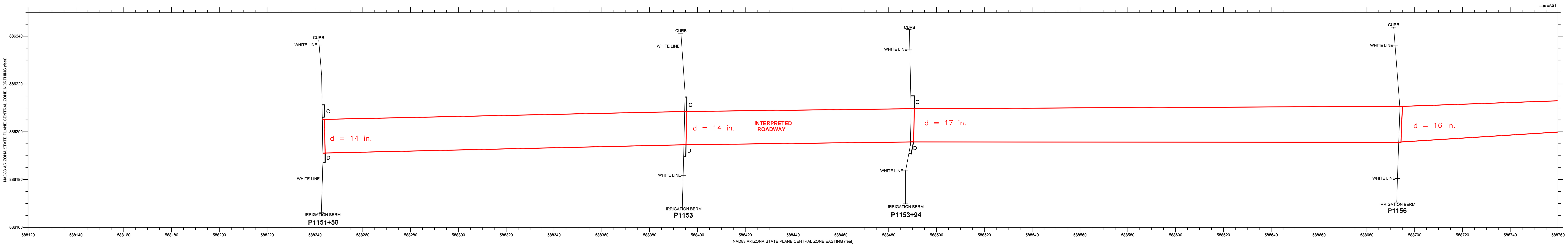

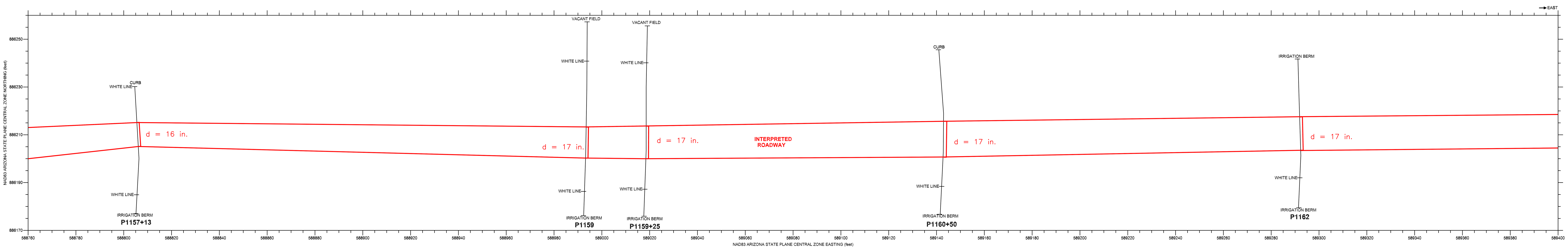

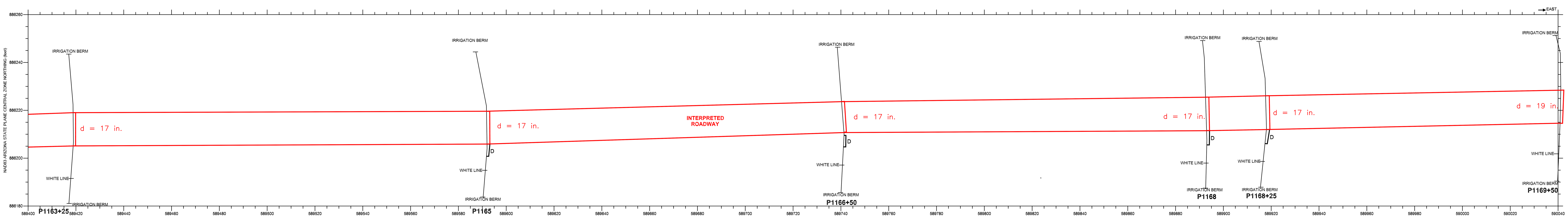

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]c GPR Secondary Anomalies C, or D

P1203+30 GPR Profile w/ Centerline Station (approximate)

WHITE LINE— Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ

107th Avenue to 99st Avenue
Stations 1150+00 to 1169+50±

GCI PROJECT NO 2010-126
DATE: October 15, 2012
SHEET B-1
CAD FILE:

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P1203+30 GPR Profile w/ Centerline Station (approximate)

WHITE LINE— Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ
107th Avenue to 99th Avenue
Stations 1169+50 to 1183+90±
99th Avenue to 91st Avenue
1183+90 to 1188+74±

GCI PROJECT NO 2010-126
DATE: October 15, 2012
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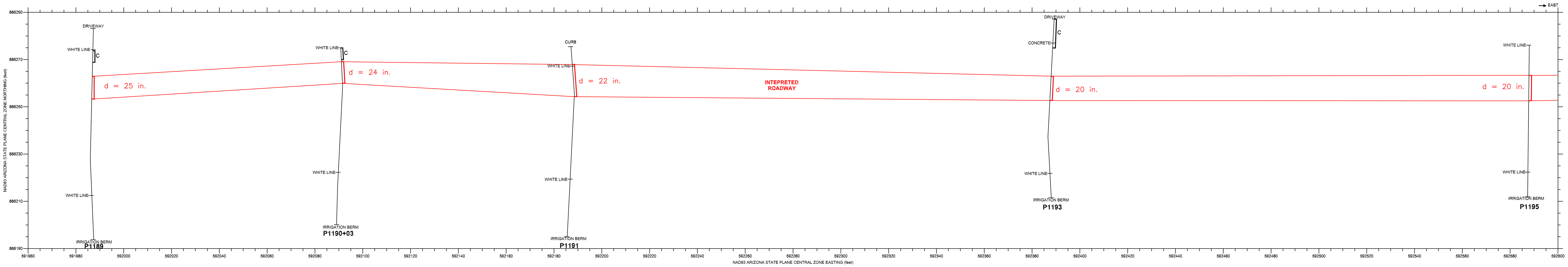

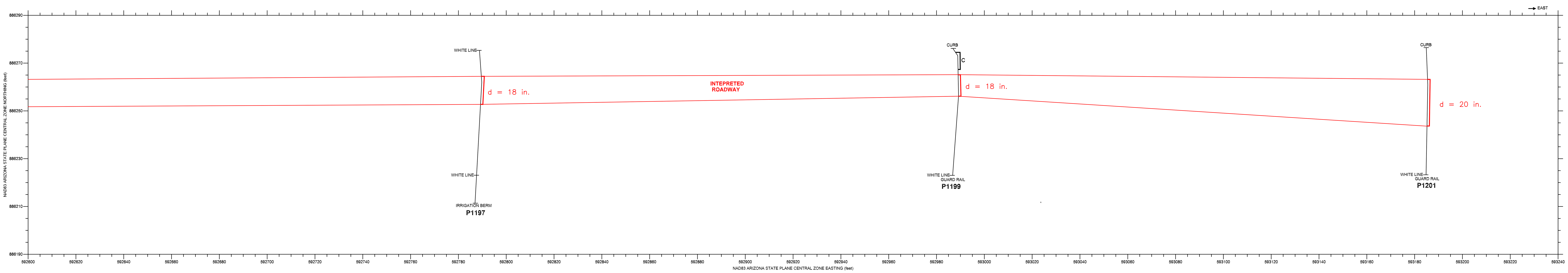

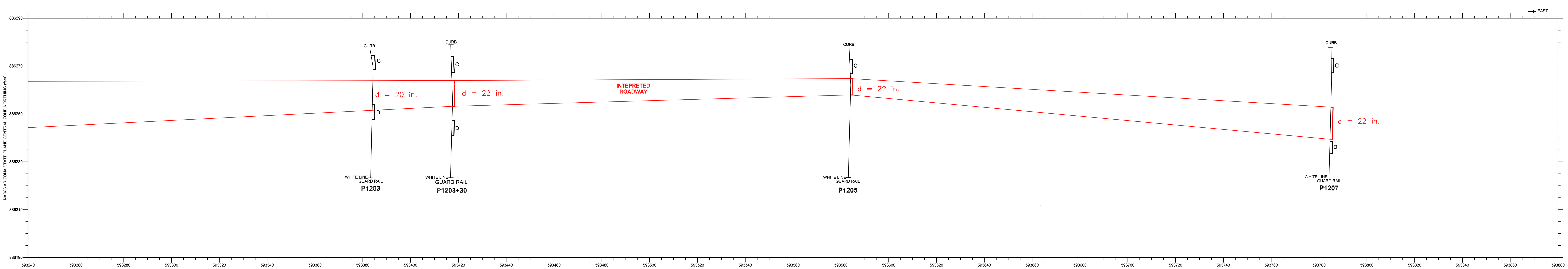

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REVISIONS

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DES KH
DWN KE
CKD

EXPLANATION:

GPR ANOMALY A: Interpreted Buried Roadway Pavement
d = Depth to PCCP (inches)

C GPR Secondary Anomalies C, or D

P1203+30 GPR Profile w/ Centerline Station (approximate)

WHITE LINE— Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ

99th Avenue to 91st Avenue
Stations 1183+90 to 1207+00

GCI PROJECT NO 2010-126
DATE: October 3, 2012
SHEET D-1
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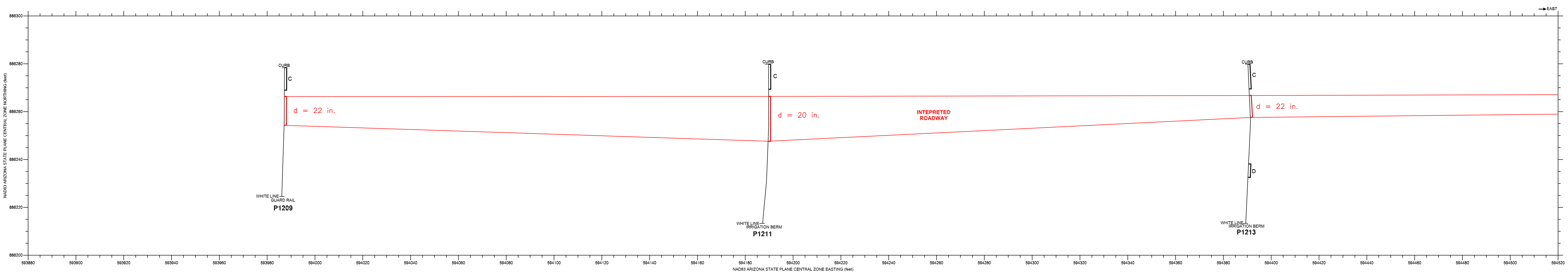

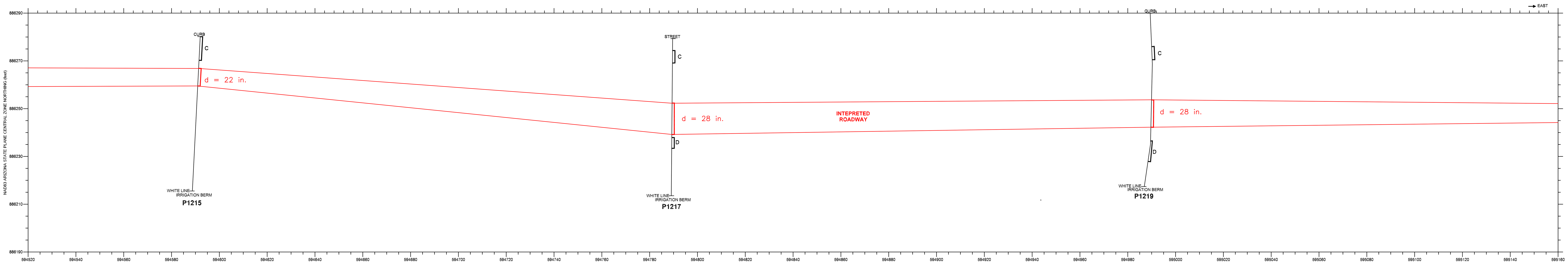

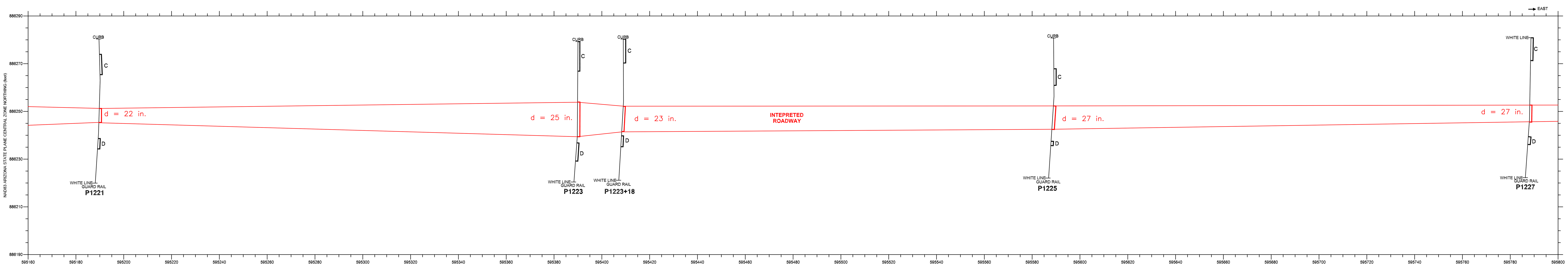

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REVISIONS				
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DWN KE
CKD

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GPR ANOMALY A: Interpreted Buried Roadway Pavement
d = Depth to PCCP (inches)

C GPR Secondary Anomalies C, or D

P1203+30 GPR Profile w/ Centerline Station (approximate)

WHITE LINE— Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ

99th Avenue to 91st Avenue
Stations 1207+00 to 1227+00

GCI PROJECT NO 2010-126
DATE: October 2, 2012
SHEET E-1
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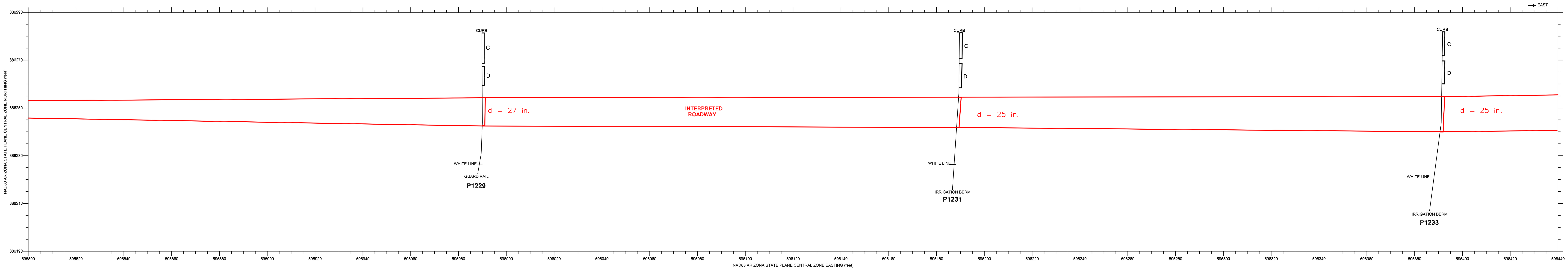

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REVISIONS

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CKD

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P1203+30 GPR Profile w/ Centerline Station (approximate)

WHITE LINE— Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ
99th Avenue to 91st Avenue
Stations 1207+00 to 1236+36±
91st Avenue to 83rd Avenue
1236+36± to 1246+00

GCI PROJECT NO 2010-126

DATE: October 8, 2012

SHEET F-1

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Date 10/15/12
State of California
EXPIRES 07/31/13

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WHITE LINE— Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ
91st Avenue to 83rd Avenue
Stations 1246+00 to 1264+00±

GCI PROJECT NO 2010-126
DATE: October 12, 2012
SHEET G-1
CAD FILE:

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EXPIRES 07/31/13

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d = Depth to PCCP (inches)

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P1203+30 GPR Profile w/ Centerline Station (approximate)

WHITE LINE— Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ
91st Avenue to 83rd Avenue
Stations 1264+00 to 1284+22±

GCI PROJECT NO 2010-126
DATE: October 12, 2012
SHEET H-1
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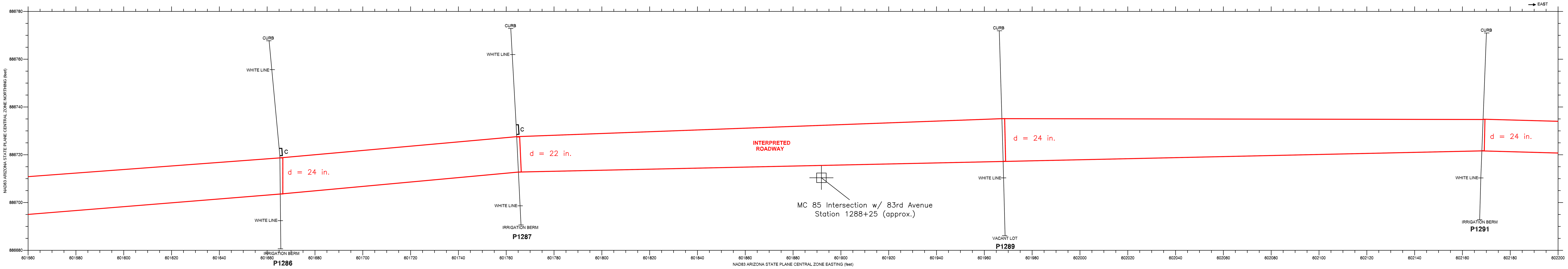

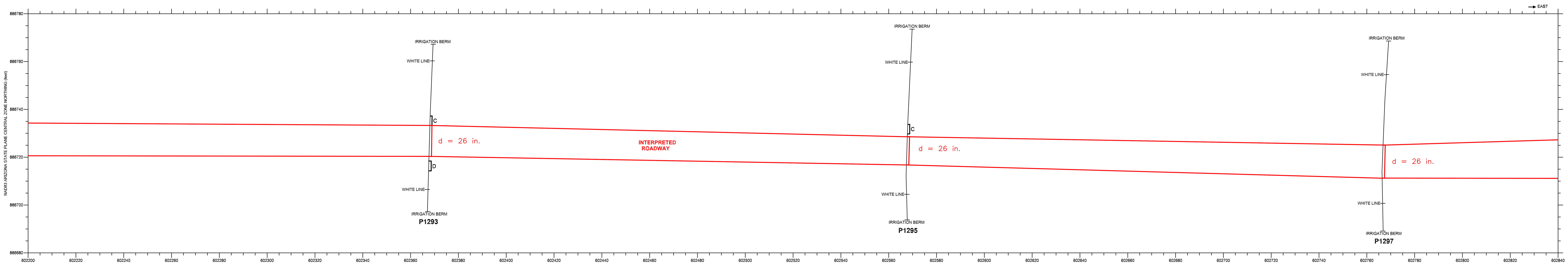

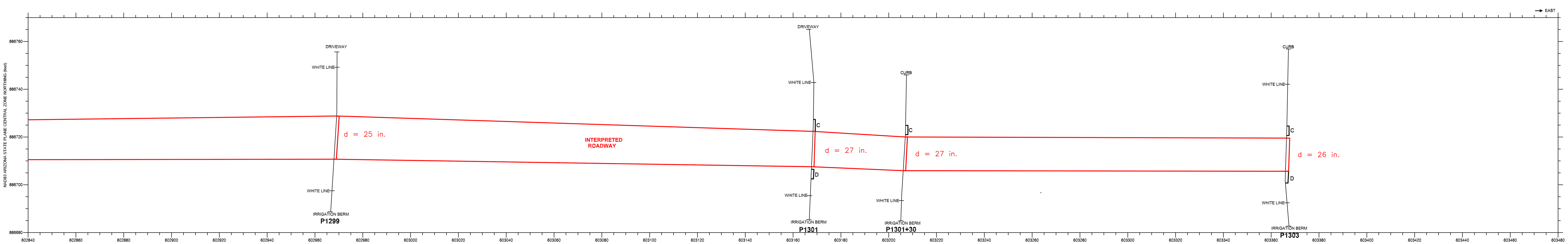

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Registered Geologist GP-886 Kerry Hennon Date 10/15/12 State of California EXPIRES 07/31/13

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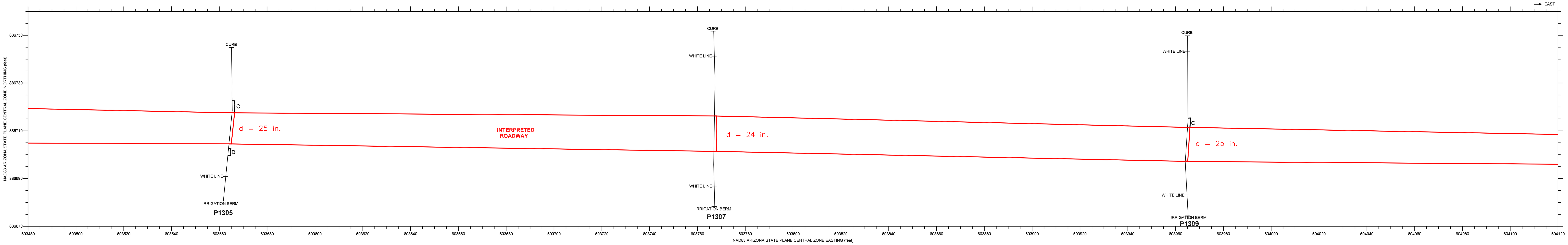
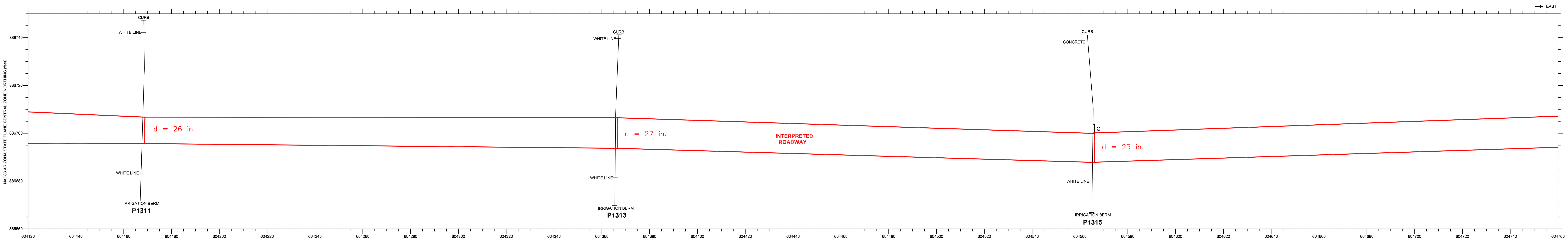
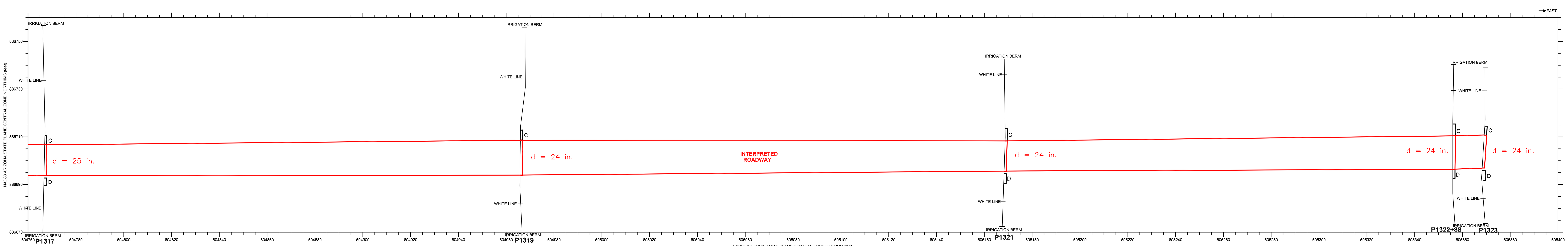
WHITE LINE— Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ
91st Avenue to 83rd Avenue
Stations 1284+22 to 1288+25±
83rd Avenue to 75th Avenue
1288+25± to 1303+00±

GCI PROJECT NO 2010-126
DATE: October 13, 2012
SHEET I-1
CAD FILE:







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Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ
83rd Avenue to 75th Avenue
Stations 1303+00 to 1323+00

GCI PROJECT NO 2010-126
DATE: October 13, 2012
SHEET J-1
CAD FILE:

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P1203+30 GPR Profile w/ Centerline Station (approximate)

WHITE LINE Travel Lane Outside Stripe/Edge of Pavement

Ground Penetrating Radar (GPR) Survey:
Buried Concrete Pavement Search
MC 85 (Buckeye Road), Phoenix, AZ
83rd Avenue to 75th Avenue
Stations 1323+00 to 1340+59 End Project

GCI PROJECT NO 2010-126

DATE: October 14, 2012

SHEET K-1

CAD FILE:

SECTION 4

PAVEMENT CORING EXPLORATION

TABLE OF CONTENTS

FIGURES

APPENDIX C-A

APPENDIX C-B

APPENDIX C-C

4 PAVEMENT CORING EXPLORATION

4.1 GENERAL

Kleinfelder performed coring through the asphalt concrete (AC) pavement at selected ground penetrating radar (GPR) survey areas across the MC-85 roadway in select areas of the project. The coring explorations across the site were performed in an effort to confirm GPR interpreted anomalies of the buried Portland cement concrete pavement (PCCP, “A” anomaly). Kleinfelder also performed coring on the roadway at selected secondary anomaly (“B and C”) areas.

In addition, DMJM Harris/AECOM and MACTEC previously performed field explorations across portions of the site and prepared reports summarizing their services. The reports reviewed by Kleinfelder for this portion of the project included:

- *MACTEC Report of (Preliminary) Geotechnical Evaluation, MC85 (Buckeye Road), 107th Avenue to 91st Avenue, Maricopa County, Arizona* (MACTEC Project No. 4975-03-1401, dated June 17, 2003 and revised October 23, 2003).
- *DMJM Harris/AECOM Pavement Design Report, MC 85, 107th Avenue to 91st Avenue, Maricopa County, Arizona* (DMJM Harris Project No. 6490.0000, dated April 25, 2006).

Excerpts of these previous reports regarding the buried Portland cement concrete pavement (PCCP) are included as an appendix to this section. These two previous reports in their entirety are included as an appendix in the subsequent Pavement Structure Design Section of this report.

4.2 SUMMARY OF PREVIOUS PAVEMENT EXPLORATIONS

In 2003, MACTEC performed a preliminary geotechnical exploration on MC-85 (Buckeye Road) from 107th Avenue to 91st Avenue (western 2 miles of the site). MACTEC’s exploration included 12 borings drilled using hollow-stem auger (HSA) with a truck-mounted drill rig and 4 borings drilled with a hand auger. MACTEC’s HSA borings were designated B-1 through B-11 with the exception that B-8 was drilled twice due to auger refusal and the borings were designated B-8A and B-8B. MACTEC’s hand auger borings were designated HA-1 through HA-4. The buried PCCP was noted to have been encountered at the location of MACTEC Boring Nos. B-5, B-8A, B-8B and B-9. The MACTEC Boring Log No. B-11 indicates an approximate

18-inch thick layer of cemented material from approximately 4 to 5.5 feet below the top of pavement, but the notes indicate it was not conclusive to determine if the material was the PCCP.

In 2006, DMJM Harris/AECOM (AECOM) performed a geotechnical exploration also on the western 2 miles of the site, on MC-85 (Buckeye Road) extending from 107th Avenue to 91st Avenue. AECOM's field work included 16 explorations (designated as C1 through C16) using a portable core drill with 6-inch and 3-inch core barrels. The buried PCCP was noted to have been encountered at the location of AECOM Core Nos. C3 through C7, C9, C11, and C13 through C16.

The approximate location of the previous core explorations and borings that encountered the PCCP are shown on Figures C-1 and C-2 included in this section. AECOM prepared a table summarizing their core information and also including MACTEC's boring information (which is presented on Page 8 of the AECOM report). The following is the AECOM summary table:

Table 4.2-1 AECOM Summary Table

MC 85, 107th Avenue to 91st Avenue
Maricopa County, AZ

Pavement Design Report

Table 1 – Summary of Existing MC 85 Pavement Conditions
Based on Preliminary Test Drilling and Final Investigation Pavement Cores

Final Investigation (DMJM Harris, 2005)						Preliminary Investigation (Mactec, 2003)						
Core ID	Station[1]	Offset[1]	AC (in)	AB (in)	PCCP (in)	Bore ID	Station[1]	Offset[1]	AC (in)	AB (in)	PCCP (in)
C1	1136+00	7' Lt	12.1	12.0	-	B-11	1133+80	20' Lt	5.0	19.0	-
C2	1144+00	2.5' Lt	5.0	7.0[2]	-	B-10	1143+70	10' Lt	6.0	12.0	-
C3	1150+00	2.5' Rt	4.0	5.0[2]	7.0	HA-4	1143+65	35' Rt	-	-	-
C4	1156+00	3' Lt	9.0	7.0	6.0	B-9	1152+75	10' Rt	4.0	6.0	12.0
C5	1163+00	2.5'Rt	8.0	9.0	7.0	B-8B	1163+45	5' Lt	5.0	5.0	12.0
C6	1170+00	3' Lt	10.0	9.0	6.0	B-8A	1163+45	5' Lt	5.0	5.0	12.0
C7	1177+00	3' Rt	11.0	11.0	6.0	HA-3	1173+25	25' Rt	-	-	-
C8	1183+00	8' Lt	13.0	13.0	-	B-7	1173+50	20' Rt	5.0	12.0	-
C9	1190+00	2.5' Lt	12.0	12.0	7.0	HA-2	1185+90	45' Lt	-	-	-
C10	1197+00	14' Lt	9.5	26.5	-	B-6	1185+75	30' Lt	3.0	12.0	-
C11	1203+00	6.5' Rt	10.0	14.0	7.0	B-5	1196+00	5' Rt	5.0	25.0	6.0
C12	1209+00	3' Lt	12.0	5.0	-[3]	B-4	1206+30	15' Lt	7.0	11.0	-
C13	1217+00	2.5' Rt	9.0	11.0	7.0	B-3	1216+40	15' Rt	5.0	25.0	-
C14	1220+00	3' Rt	9.0	12.0	6.0	B-2	1225+20	30' Lt	5.0	25.0	-
C15	1227+00	6.5' Rt	8.0	13.0	6.0	HA-1	1233+60	30' Rt	-	-	-
C16	1234+00	3' Rt	12.0	6.0	6.0	B-1	1233+40	15' Rt	3.0	21.0	-

(1): MC 85 Existing Centerline (Section Line)
(2): 4-inch AC encountered underlying AB
(3): Clay soil encountered underlying AB to a depth of 3.2' (38")

4.3 PAVEMENT CORING FIELD EXPLORATION

Prior to the coring field exploration, Kleinfelder marked the core locations, cleared the work areas with the Arizona Blue Stake Center, obtained a MCDOT right-of-way permit (Tracking No. TC20120646), and subcontracted Highway Technologies, Inc. (HT) to submit a traffic control plan to MCDOT. The traffic control plan for the GPR survey work was approved by MCDOT on October 9, 2012 (and re-approved for additional coring on November 29, 2012). We notified a MCDOT inspector 24 hours prior to our field work. Traffic control for the project was provided by HT in general accordance with the approved traffic control plan.

The exploratory cores were performed by Kleinfelder on October 15th through the 20th and on December 3rd through the 6th, 2012. The coring work was performed at night between the hours of 8:00 P.M. to 5:00 A.M. Anomaly areas previously identified by the GPR survey at 17 selected locations were explored by coring through the AC, manually removing the aggregate base course (ABC), coring the underlying PCCP (if present), and hand-augering the underlying subgrade materials. The 17 core explorations performed across the site were designated C1 through C17. The approximate core exploration locations are shown on Figures C-1 through C-4 (Coring Exploration Site Plans).

The coring was performed using a Milwaukee (Cat. No. 4094) drill on an MK-Manta III Stand (Model No. 158644). The AC was cored using a 6-inch diameter core barrel, the ABC was manually removed, and where encountered the PCCP was cored using a 4-inch diameter core barrel. A subgrade sample was generally obtained from the core locations using a 3-inch diameter hand auger. The core holes were backfilled to approximately the bottom elevation of the AC with quick-setting concrete mixed with the previously removed ABC. After sufficient setting of the concrete and ABC, the core hole was backfilled to the surface with (Quality Pavement Repair, QPR) asphalt cold patch. The cold patch materials were placed in approximately 2 inch loose lifts and compacted with a Marshall hammer, and the pavement surface lift was also compacted with an 8-inch square manual tamper.

Picture 1 – Core Exploration at C2

Picture 2 – AC and PCCP Cores Obtained at C4

At the core locations, the AC thicknesses encountered ranged between 5.5 and 14 inches; the ABC thicknesses ranged between 4 and 19 inches, and the lower portion of the ABC generally included oversized rock (cobbles); and where encountered, the PCCP thicknesses ranged between 6 and 7 inches. The following section includes a table providing detailed information on our observations at each core location.

Picture 3 – Core Exploration at C8

Picture 4 – Close-up of Picture 3

Picture 5 – AC and PCCP Cores Obtained at C9. Oversized rock (cobbles) were encountered in the lower portion of the ABC. The top of the PCCP included a roughly ¼-inch thick layer of AC.

4.4 PAVEMENT CORING FIELD EXPLORATION RESULTS

Seventeen pavement core explorations designated C1 through C17 were performed by Kleinfelder across the site. The pavement explorations were cored and hand excavated to depths ranging between 16 and 48 inches below the AC pavement surface. The following table provides a summary of our observations at the core exploration locations.

Table 4.4-1 Kleinfelder Core Results

Core ID	GPR Anomaly and Line	AC Thickness (inches)	ABC Thickness (inches)	PCCP Thickness (inches)	Subgrade Soils (USCS)
C1	“A” / P1150	9.5	4.5	6	Not Sampled
C2	“B” / P1168	9	8	N/E Note 1	Sampled, but not tested
C3	“C” / P1168	9	9	N/E Note 1	Lean Clay with Sand (CL)
C4	“A” / P1207	10	6	6.5	Lean Clay with Sand (CL)
C5	“B” / P1207	10	10	N/E Note 1	Sandy Clay (CL)
C6	“A” / P1242	14	5	7 Note 2, 3	Sampled, but not tested
C7	“A” / P1256	5.5	6	6	Sampled, but not tested
C8	“A” / P1260	6	4	6 Note 2, 3	Sandy Clay (CL)
C9	“A” / P1270	5.5	11	6 Note 2	Lean Clay with Sand (CL)
C10	“A” / P1282	7.5	6	6.5 Note 2	Sampled, but not tested
C11	“C” / P1293	7.5	19	N/E Note 1	Sampled, but not tested
C12	“A” / P1293	11.5	13	N/E Note 1	Sampled, but not tested
C13	“D” / P1293	12	11	N/E Note 1	Sampled, but not tested
C14	“A” / P1297	9	15	N/E Note 1	Sampled, but not tested
C15	“A” / P1307	6	10	6 Note 2, 4	Not Sampled
C16	“A” / P1319	6	11	7	Sampled, but not tested
C17	“A” / P1331	6	17	6	Sampled, but not tested

Note 1 - PCCP not encountered in core exploration.
Note 2 - Top of PCCP core included roughly ¼- to ½-inch thick AC layer.
Note 3 - The PCCP was underlain by approximately 4 inches of ABC.
Note 4 - PCCP encountered, but unable to obtain core - PCCP thickness estimated at 6 inches.

Table 4.4-2 Kleinfelder Core Location Information

Core ID	Approximate Station	Core Location Traffic Lane	Approximate GPS Coordinates (degrees)	
			Latitude	Longitude
C1	1150+00	East-Bound; High-Speed	33.43555	-112.28350
C2	1168+00	East-Bound; Slow-Speed	33.43560	-112.27763
C3	1168+00	West-Bound; Slow-Speed	33.43568	-112.27762
C4	1207+00	Center Turn Lane	33.43573	-112.26484
C5	1207+00	East-Bound; Slow-Speed	33.43570	-112.26484
C6	1242+00	East-Bound; High-Speed	33.43592	-112.25339
C7	1256+00	East-Bound; High-Speed	33.43629	-112.24883
C8	1260+00	East-Bound; High-Speed	33.43639	-112.24751
C9	1270+00	East-Bound; High-Speed	33.43669	-112.24424
C10	1282+00	East-Bound; High-Speed	33.43699	-112.24034
C11	1293+00	West-Bound; Slow-Speed	33.43722	-112.23672
C12	1293+00	West-Bound; High-Speed	33.43717	-112.23672
C13	1293+00	Center Turn Lane	33.43718	-112.23671
C14	1297+00	West-Bound; High-Speed	33.43716	-112.23543
C15	1307+00	East-Bound; High-Speed	33.43710	-112.23212
C16	1319+00	East-Bound; High Speed	33.43707	-112.22820
C17	1331+00	East-Bound; High-Speed	33.43713	-112.22427

4.4.1 SUBGRADE CONDITIONS

A sample of the soils underlying the pavement structure was obtained at the core locations, with the exception of Core Locations C1 and C15. The depth of the subgrade samples ranged from approximately 18 to 48 inches below the finished pavement elevation. We performed laboratory grain size analyses and Atterberg limits testing in order to classify the subgrade soils on the subgrade samples obtained from Core Locations C3, C4, C5, C8 and C9. The results indicated the subgrade soils consisted of lean clay with sand (CL) and sandy lean clay (CL). The results of the laboratory testing performed on the subgrade samples indicated the fines content (percent passing the Sieve No. 200) ranged from approximately 51 to 83 percent and the plastic indices ranged from approximately 17 to 29. The results of laboratory tests are presented on the laboratory test data sheets in Appendix C-A.

4.4.2 PAVEMENT CORING AND GPR COMPARISONS

As previously described in the Ground Penetrating Radar Survey Section, a total of 124 ground penetrating radar (GPR) survey lines were performed at approximate 200 feet (or less) spacings across the 4 mile long project. Seventeen pavement core explorations designated C1 through C17 were performed by Kleinfelder at selected GPR survey lines in an effort to verify the interpreted GPR survey anomalies. The GPR Survey Report designated the interpreted buried PCCP as an “A” anomaly, and 12 pavement core explorations were performed at “A” anomaly areas. With the exception of Core Locations C12 and C14, the coring explorations performed at “A” anomaly GPR survey locations encountered the buried PCCP. The coring explorations performed at secondary GPR survey anomaly areas, designated as “B, C or D” anomalies, did not encounter the buried PCCP. At secondary GPR anomaly areas, oversized rock (cobbles) was generally encountered in the lower portion of the ABC, followed by the subgrade soils. The subgrade soils were excavated with a 3-inch diameter hand-auger to depths of approximately 3 to 4 feet below the finished pavement elevation at select locations. Based on the data obtained in the core explorations and the GPR surveys, it appears that “A” anomalies generally correspond to areas where PCCP is present, and “B, C and D” anomalies correspond to oversized rock in the lower portion of the ABC. A limited number of GPR surveys and core explorations were performed. It is possible that conditions could vary between or beyond the data evaluated.

FIGURES

ATTACHED IMAGES: Images: Aerial-Image_1304_6-8-12_107th.jpg Images: Aerial-Image_1304_6-8-12_83rd.jpg Images: Aerial-Image_1304_6-8-12_91st.jpg Images: Aerial-Image_1304_6-8-12_99th.jpg Images
ATTACHED XREFS:
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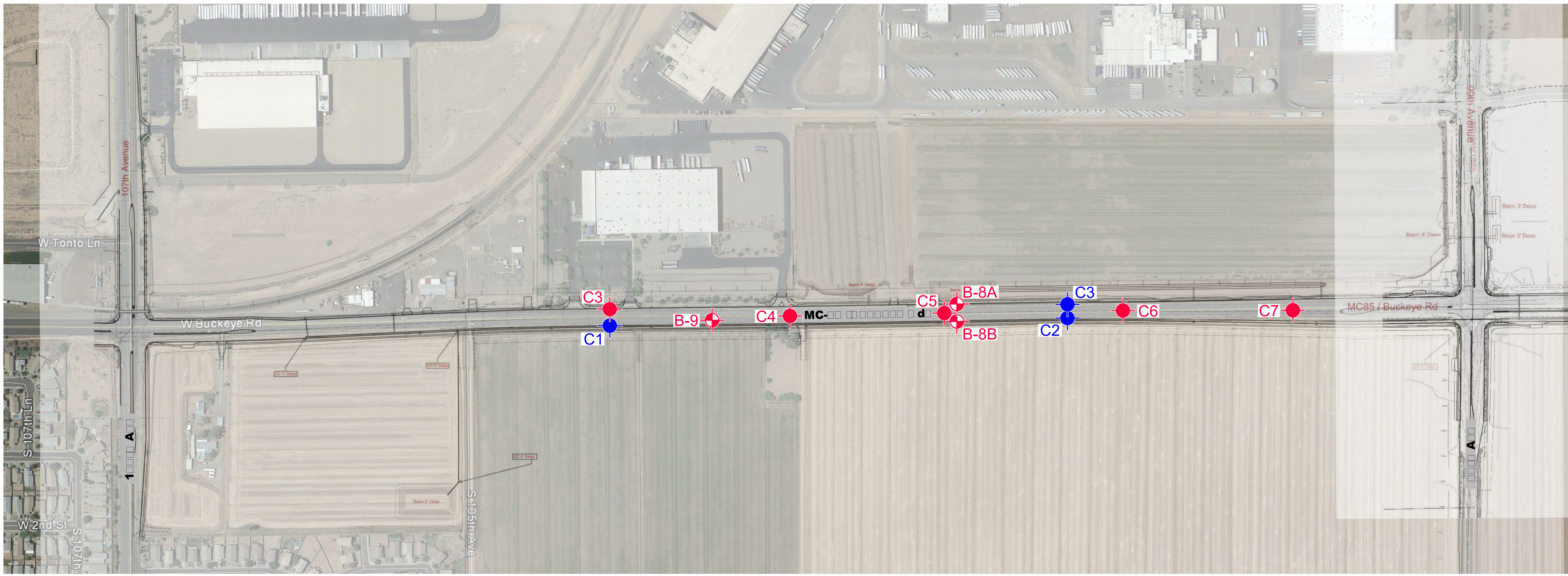

N

0 200 400 800

APPROXIMATE SCALE (feet)

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E□P□ANATI□N

- APPROXIMATE KLEINFELDER CORE LOCATION
- APPROXIMATE PREVIOUS DMJM/AECOM CORE LOCATION
- APPROXIMATE PREVIOUS MACTEC BORING LOCATION

SOURCE: GOOGLE EARTH PRO, 6/08/12.

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PROJECT NO.	129067
DRAWN:	11/2012
DRAWN BY:	MRG
CHECKED BY:	RP
FILE NAME:	129067-FigC-1 to C-4.dwg

C□□IN□ E□P□□□ATI□N SITE P□AN

MC-85 (BUCKEYE ROAD)
FROM 107TH TO 99TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE
C-1

ATTACHED IMAGES: Images: Aerial-Image_1304_6-8-12_107th.jpg Images: Aerial-Image_1304_6-8-12_83rd.jpg Images: Aerial-Image_1304_6-8-12_91st.jpg Images: Aerial-Image_1304_6-8-12_99th.jpg Images
ATTACHED XREFS:
LONG BEACH, CA

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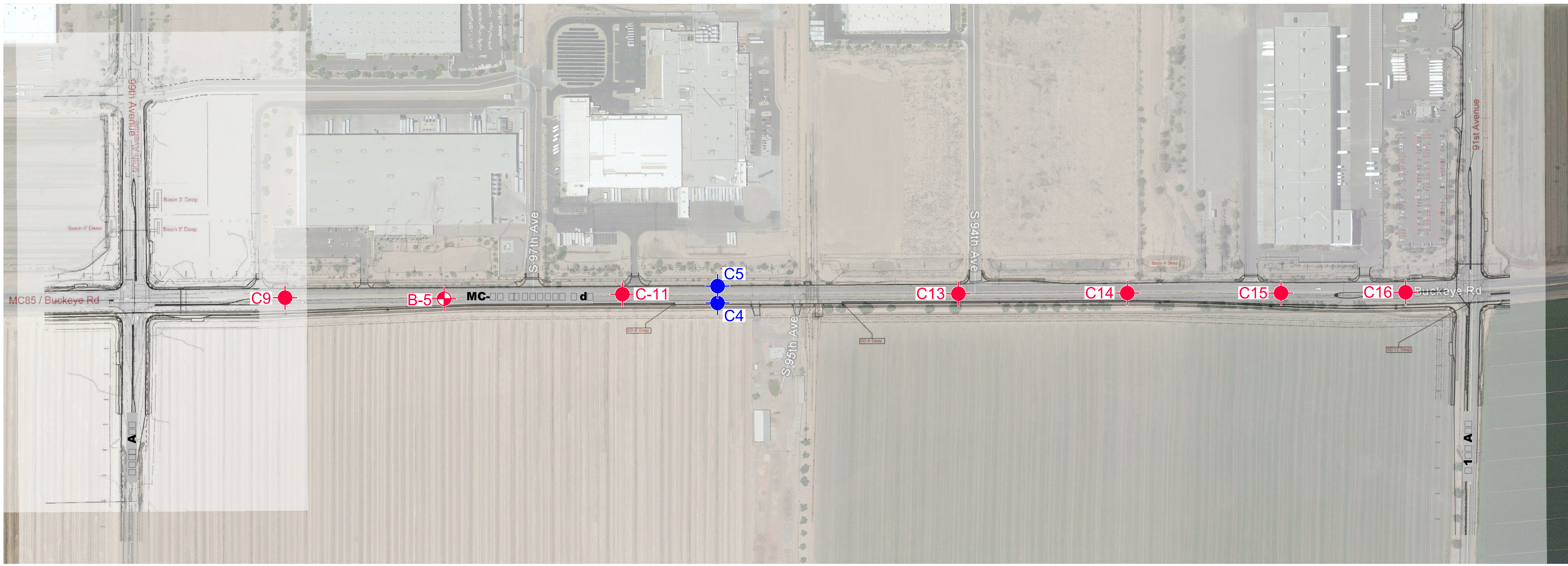

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APPROXIMATE SCALE (feet)

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EXPLANATION

- APPROXIMATE KLEINFELDER CORE LOCATION
- APPROXIMATE PREVIOUS DMJM/AECOM CORE LOCATION
- APPROXIMATE PREVIOUS MACTEC BORING LOCATION

SOURCE: GOOGLE EARTH PRO, 6/08/12.

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CHECKED BY:	RP
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CORING EXPLORATION SITE PLAN

MC-85 (BUCKEYE ROAD)
FROM 99TH TO 91ST AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

C-2

N

0 200 400 800
APPROXIMATE SCALE (feet)

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E□P□ANATI□N

APPROXIMATE KLEINFELDER CORE LOCATION

SOURCE: GOOGLE EARTH PRO, 6/08/12.

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DRAWN BY:	MRG
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FILE NAME:	129067-FigC-1 to C-4.dwg

C□□IN□ E□P□□□ATI□N SITE P□AN

MC-85 (BUCKEYE ROAD)
FROM 91ST AVENUE TO 83RD AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE
C-□

N

0 200 400 800

APPROXIMATE SCALE (feet)

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E□P□ANATI□N

APPROXIMATE KLEINFELDER CORE LOCATION

SOURCE: GOOGLE EARTH PRO, 6/08/12.

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PROJECT NO.	129067
DRAWN:	11/2012
DRAWN BY:	MRG
CHECKED BY:	RP
FILE NAME:	129067-FigC-1 to C-4.dwg

C□□IN□ E□P□□□ATI□N SITE P□AN

MC-85 (BUCKEYE ROAD)
FROM 83RD AVENUE TO 75TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

C-□

APPENDIX C-A

Laboratory Test Results

SAMPLE LOCATION	GRAIN SIZE ANALYSIS				ATTERBERG LIMITS			UNIFIED SOIL CLASSIFICATION (USCS)
	COBBLES (%)	GRAVEL (%)	SAND (%)	FINES (%)	LL	PL	PI	
C3 @ 18-38"	0	2	27	72	35	15	20	LEAN CLAY with SAND (CL)
C4 @ 24-36"	0	1	16	83	42	19	23	LEAN CLAY with SAND (CL)
C5 @ 20-36"	0	1	48	51	47	18	29	SANDY LEAN CLAY (CL)
C8 @ 20-36"	0	0	38	62	32	15	17	SANDY LEAN CLAY (CL)
C9 @ 24-42"	0	1	26	72	35	14	21	LEAN CLAY with SAND (CL)

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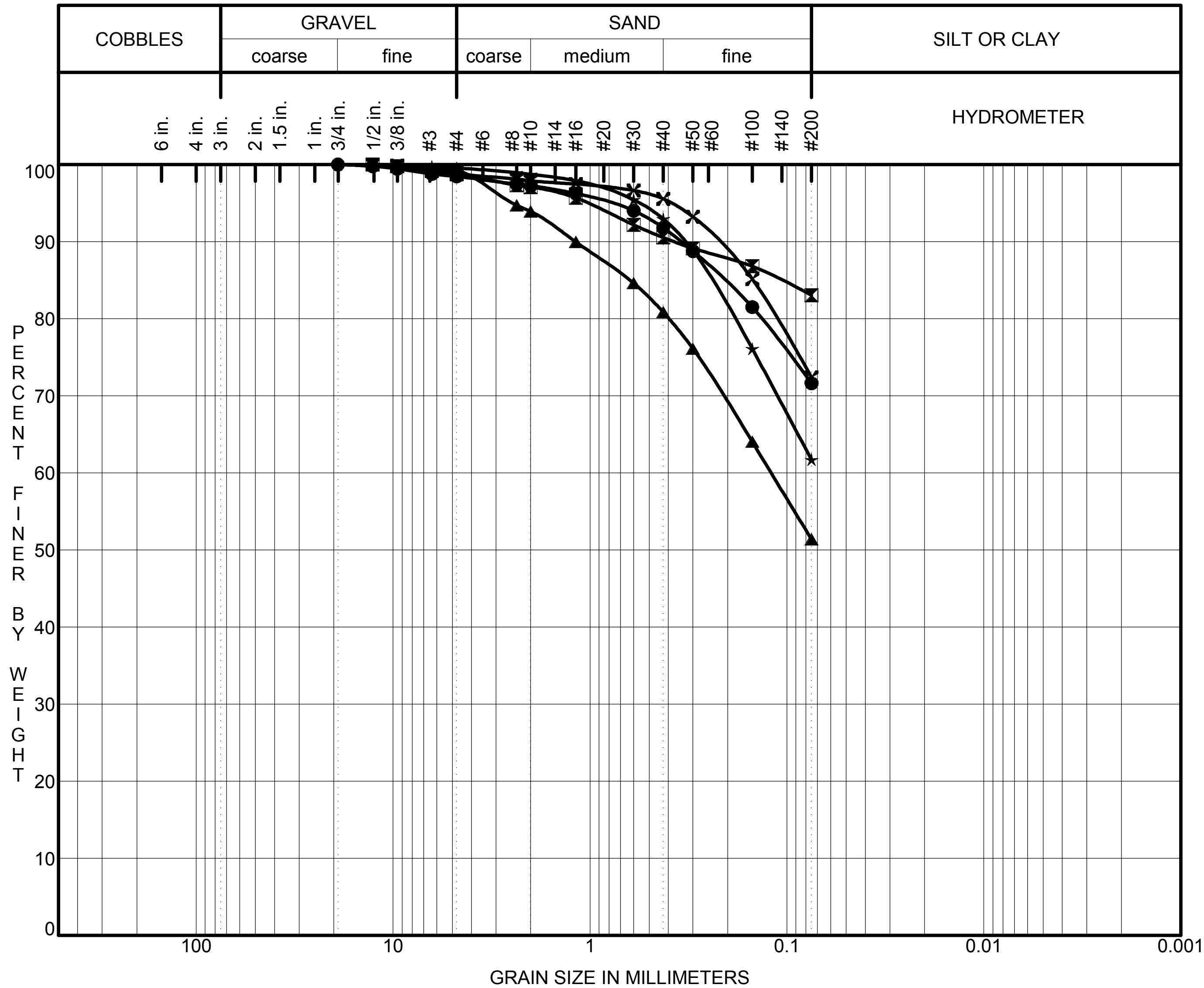
Report Date:	Project Number:
Dec 2012	129067

SUMMARY OF LABORATORY TESTING
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
C-A1



	Source	Depth (ft)	%Cobbles	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	C3	18.0 - 38.0	0	2	27	72				
⧗	C4	24.0 - 36.0	0	1	16	83				
▲	C5	20.0 - 36.0	0	1	48	51		0.1		
★	C8	20.0 - 36.0	0	0	38	62				
✕	C9	24.0 - 42.0	0	1	26	72				

	Source	Depth (ft)	Classification	LL	PL	PI	Cu	Cc
●	C3	18.0 - 38.0	LEAN CLAY with SAND (CL)	35	15	20		
⧗	C4	24.0 - 36.0	LEAN CLAY with SAND (CL)	42	19	23		
▲	C5	20.0 - 36.0	SANDY LEAN CLAY (CL)	47	18	29		
★	C8	20.0 - 36.0	SANDY LEAN CLAY (CL)	32	15	17		
✕	C9	24.0 - 42.0	LEAN CLAY with SAND (CL)	35	14	21		

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Report Date: December 2012

Project Number: 129067

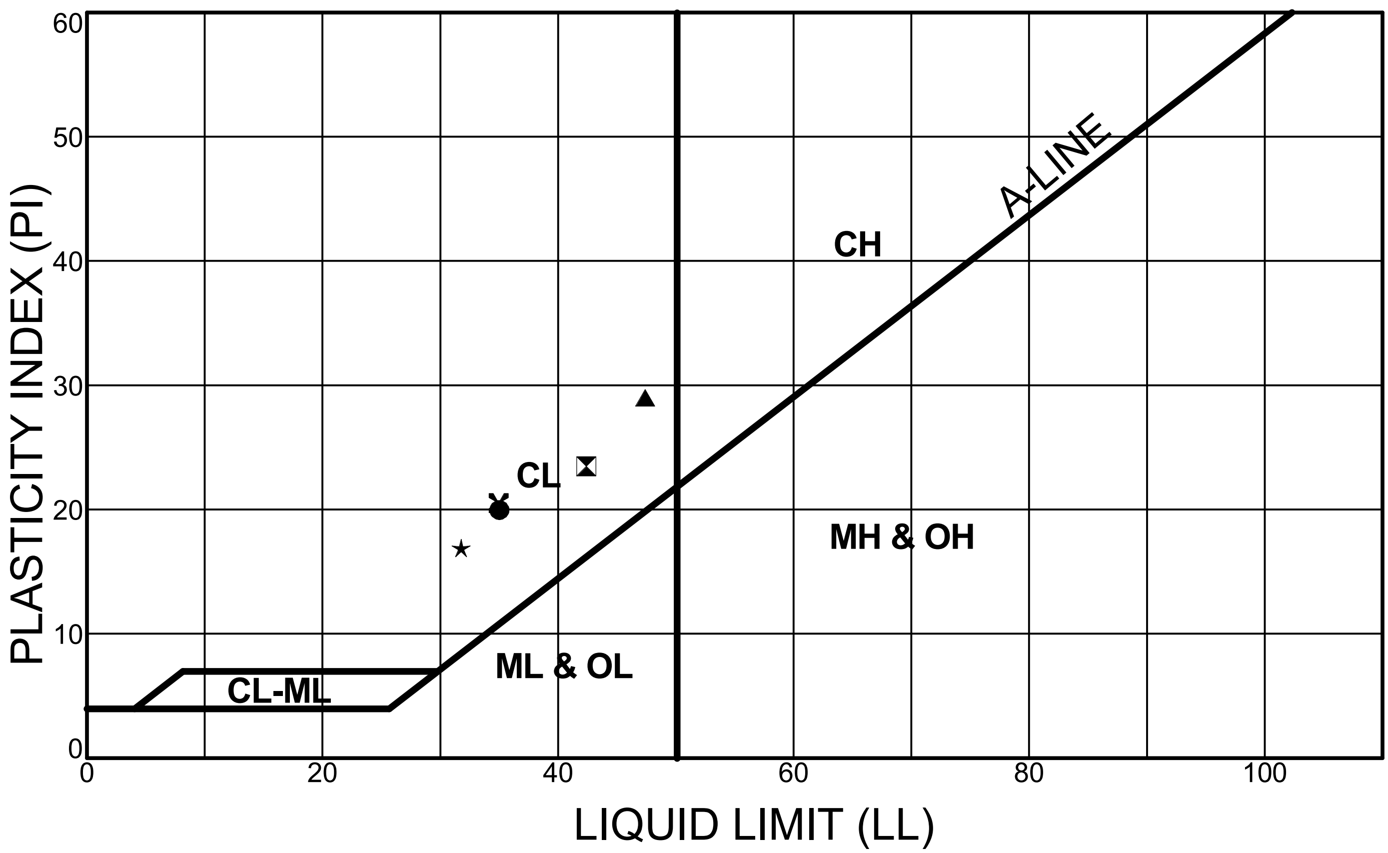
GRAIN SIZE ANALYSES (ASTM C117 and C136)

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

C-A2

123GRAINSIZECOMPLETE 129067 MC-85.GPJ 12/06/12



LEGEND	BORING	DEPTH (ft)	LL	PL	PI
●	C3	18.0 - 38.0	35	15	20
⧗	C4	24.0 - 36.0	42	19	23
▲	C5	20.0 - 36.0	47	18	29
★	C8	20.0 - 36.0	32	15	17
✕	C9	24.0 - 42.0	35	14	21

ATTPLOT 129067 MC-85.GPJ 12/06/12

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Report Date:	Project Number:
December 2012	129067

ATTERBERG LIMITS (ASTM D 4318)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
C-A3

APPENDIX C-B

Excerpts from MACTEC Report

REPORT OF
GEOTECHNICAL EVALUATION

MACTEC Project No. 4975-03-1401

MC85 (BUCKEYE ROAD)

107TH AVENUE TO 91ST AVENUE
MARICOPA COUNTY, ARIZONA
JOB NO. 40069024

Prepared for:

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION
PHOENIX, ARIZONA

Prepared by:

MACTEC ENGINEERING AND CONSULTING, INC.
PHOENIX, ARIZONA

June 17, 2003
Revised October 23, 2003

MACTEC

MACTEC

June 17, 2003

Mr. Joseph A. Phillips, P.E.
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

Subject: **Preliminary Geotechnical Evaluation – Revised October 23, 2003**
MC85 (Buckeye Road)
107th Avenue to 91st Avenue
Maricopa County, Arizona
Job No. 40069024
MCDOT Contract No. CY 2003-03
MACTEC Project No. 4975-03-1401

Dear Mr. Phillips:

MACTEC Engineering and Consulting, Inc. (MACTEC) has completed the preliminary geotechnical evaluation for the proposed reconstruction of MC85 (Buckeye Road) between 107th Avenue and 91st Avenue. This work was performed in general accordance with our proposal for Preliminary Geotechnical Evaluation, dated January 24, 2003. The results of our evaluation, along with the boring location map, laboratory test results, and recommendations are attached.

In addition to the Preliminary Geotechnical Evaluation, the scope of the above referenced work order included review and commentary for the Draft Pavement Design Guide for MCDOT. The results of our review and the associated comments are presented under separate cover.

We at MACTEC are committed to providing quality engineering services combined with client satisfaction in order to achieve a continuing relationship with our clients. We appreciate the opportunity to provide these services for you. If you have any questions regarding any of the other engineering and testing services MACTEC provides, please do not hesitate to contact us.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
34607
JODI
WINNEY
Date Signed 10/23/03
ARIZONA, U.S.A.

Jodi Winney, P.E.
Geotechnical Engineer

Marshall Lew

Marshall Lew, Ph.D.
Senior Principal by adm with permission

JW:ML:adm

(projects\4975\4975-03-1401\deliverables\prelim geotech report revised)

MACTEC Engineering and Consulting
3630 East Wier Avenue • Phoenix, AZ 85040
602-437-0250 • Fax: 602-437-3675

TABLE OF CONTENTS

1.0 PURPOSE

Included in this report are the results of our evaluation of existing pavement subgrade soils that will be used to support the reconstruction of 2 miles of MC85 (Buckeye Road). Consistent with the *Maricopa County Department of Transportation Draft Pavement Design Guide*, this geotechnical evaluation provides preliminary engineering recommendations and information to address the following aspects of this phase of the project:

- Existing site and subgrade soil conditions;
- Geological considerations;
- Groundwater conditions;
- Preliminary percolation rates;
- Excavation conditions for underground utilities;
- Corrosivity to corrugated metal pipe (CMP);
- Earthwork recommendations for pavement subgrade;
- Suitability of site soils as fill;
- Recommended specifications for imported fill;
- Recommended alternative pavement sections; and,
- Discussion of economics for pavement design alternatives.

This report does not address any environmental issues related to the site or the project. If you have any questions concerning environmental aspects of this project please contact us and we can discuss additional services with you.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has been prepared for Maricopa County Department of Transportation for the design of the project described herein. This report has not been prepared for any other parties, and may not contain sufficient information for purposes of other parties. If any of the project information described in Section 2.0 of this report has changed, we should be notified so that we may amend our recommendations as necessary.

2.0 PROJECT INFORMATION

Based on the Corridor Improvement Study dated July 21, 1998, and information you provided, this project consists of the reconstruction of 2 miles of MC85 between 107th Avenue and 91st Avenue. We understand that the preferred improvement level for this roadway is the Full Cost Alternative consisting of a 6-lane asphalt paved divided roadway with a 16 foot wide raised median, as indicated in the Corridor Improvement Study. As part of this project, reconstruction of pavements and other associated improvements will be made at intersections included in the subject segment of MC85. Currently, the roadway consists of a 4 travel lane arterial road with a continuous center turn lane.

We understand that the pavement elevations for this segment of MC85 have not yet been finalized, however it is anticipated that they will be at or slightly above existing pavement elevations. Corrugated metal pipe (CMP) may be utilized to manage flows, although the precise locations of these drainage features have also not yet been determined.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

MACTEC advanced 11 borings to a depth of 10 feet below pavement surface within the left and right travel lanes of both the east and west directions of the existing MC85 alignment. During drilling of these borings, many of the in-place subgrade soils became contaminated with asphalt and aggregate base material when bulk soil sampling was attempted. Therefore, for the purposes of this preliminary evaluation, hand augered subgrade samples were obtained outside the existing asphalt pavement but within the shoulder of MC85. Classification tests performed indicate that the hand auger samples obtained from the shoulder are representative of the types of materials encountered below the paved areas. Preliminary percolation testing was performed within 6 of the drilled boreholes. Results of these tests are presented later in this report.

The approximate locations of these borings are shown on the Boring Location Map attached. The soils encountered at each location were visually classified and recorded on a field log using the Unified Soil Classification System (USCS). Bulk and undisturbed samples of the soils were retrieved for laboratory testing which aided in providing the final soil classifications presented in the boring logs attached in Appendix A.

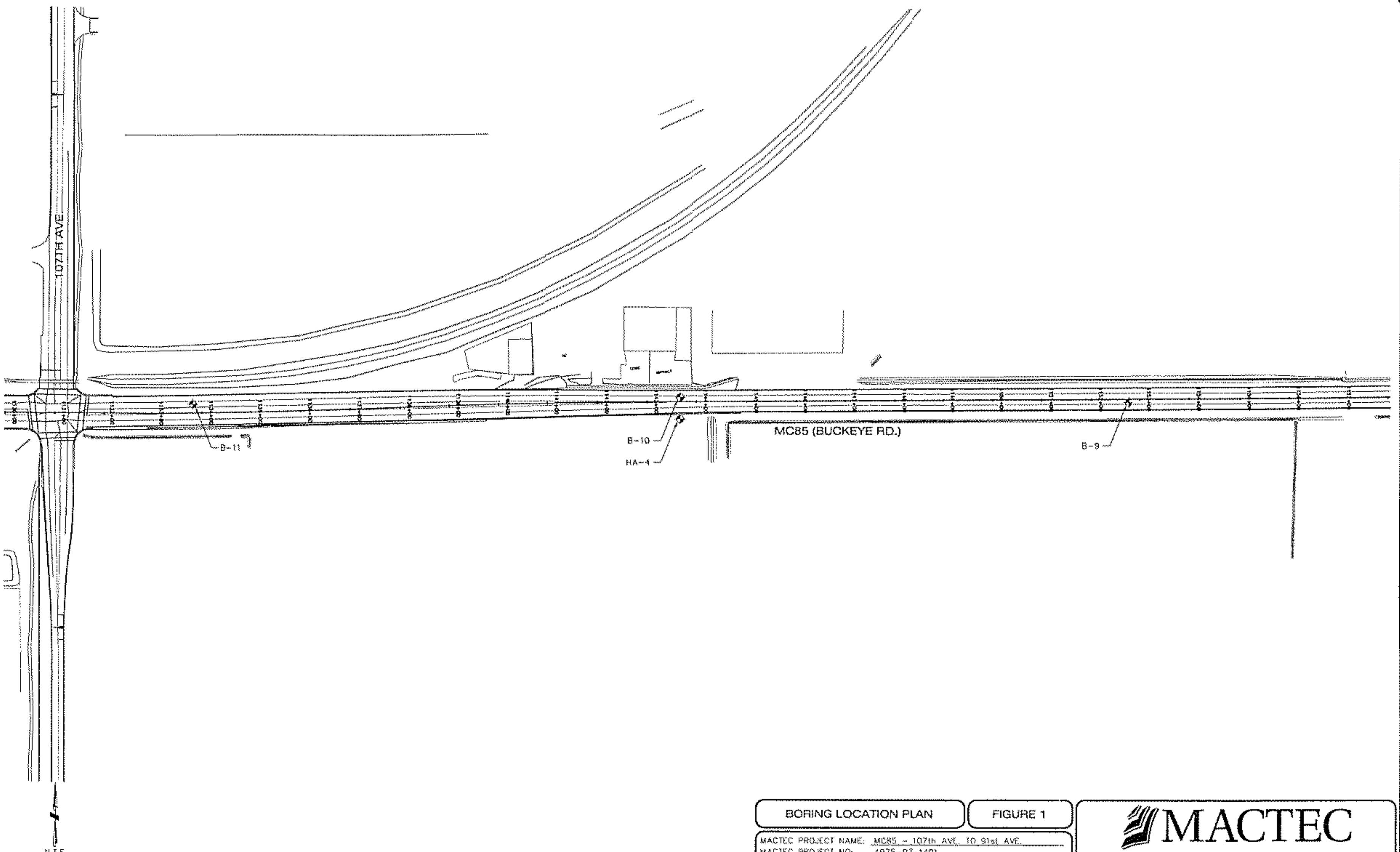
Exposed pavement sections measured within the boring locations indicate that the existing pavement consists of approximately 3 to 7 inches of asphalt concrete pavement, averaging just under 6 inches. Observed aggregate base sections within the borings measured between 11 to 24 inches. The actual pavement section thicknesses measured within the borings are presented on the attached boring logs.

The materials encountered in Borings 8A and 8B indicate the presence of portland cement concrete below the asphalt and aggregate base sections. Refusal to auger drilling was encountered in the first and second attempts at borings in this area. Based on visual inspection of the area near Borings 8A and 8B, concrete associated with either a gated concrete irrigation culvert or underground irrigation/drainage pipes may have been encountered in these borings. A portland cement concrete like material was also encountered in Borings 9 and 11, however these cemented layers did not result in drilling refusal nor was there any visual indication of underground concrete pavement or structures. We were unable to determine or even estimate the lateral extent of these concrete or cemented areas. During the final design, additional field exploration, possibly including potholing, should be scheduled to more precisely determine the extent of this existing concrete section since removal of this concrete may prove costly.

Overall the general condition of the pavement along the subject portion of MC85 was observed to be in a good condition with only minor transverse cracking at the roadway edge and slight intermittent depressions. Alligator cracking along the roadway was observed to a light to moderate degree in the center turn lane, becoming more prominent toward 107th Avenue.

Within the borings, sandy clay soils were encountered from below the asphalt pavement section extending to the full depth of exploration, except in a couple of borings where silty and clayey sand soils were encountered at depth. The soil conditions in the borings ranged from stiff to hard with varying levels of cementation and low to medium plasticity. Surface soils at pavement subgrade level were tested for expansion and exhibited expansion potentials ranging from moderate to high.

FIGURES

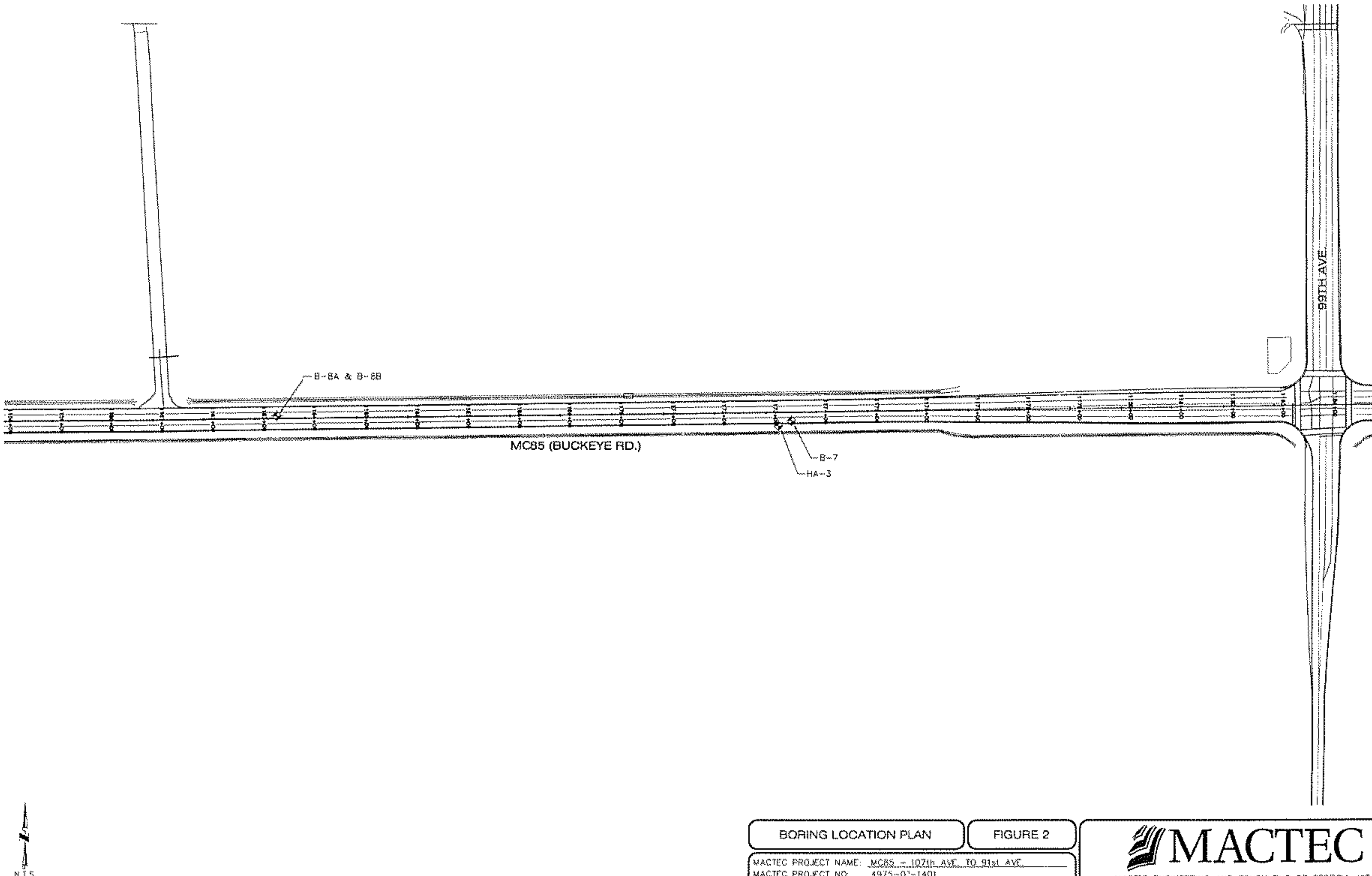


BORING LOCATION PLAN

FIGURE 1

MACTEC PROJECT NAME: MC85 – 107th AVE. TO 91st AVE.
MACTEC PROJECT NO: 4975-03-1401
DATE 05/29/03 E-FILE: DRAWING 4
DRAWN BY. BWT CHECKED BY.

MACTEC
MACTEC ENGINEERING AND CONSULTING OF GEORGIA, INC
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX. (602) 437-3675

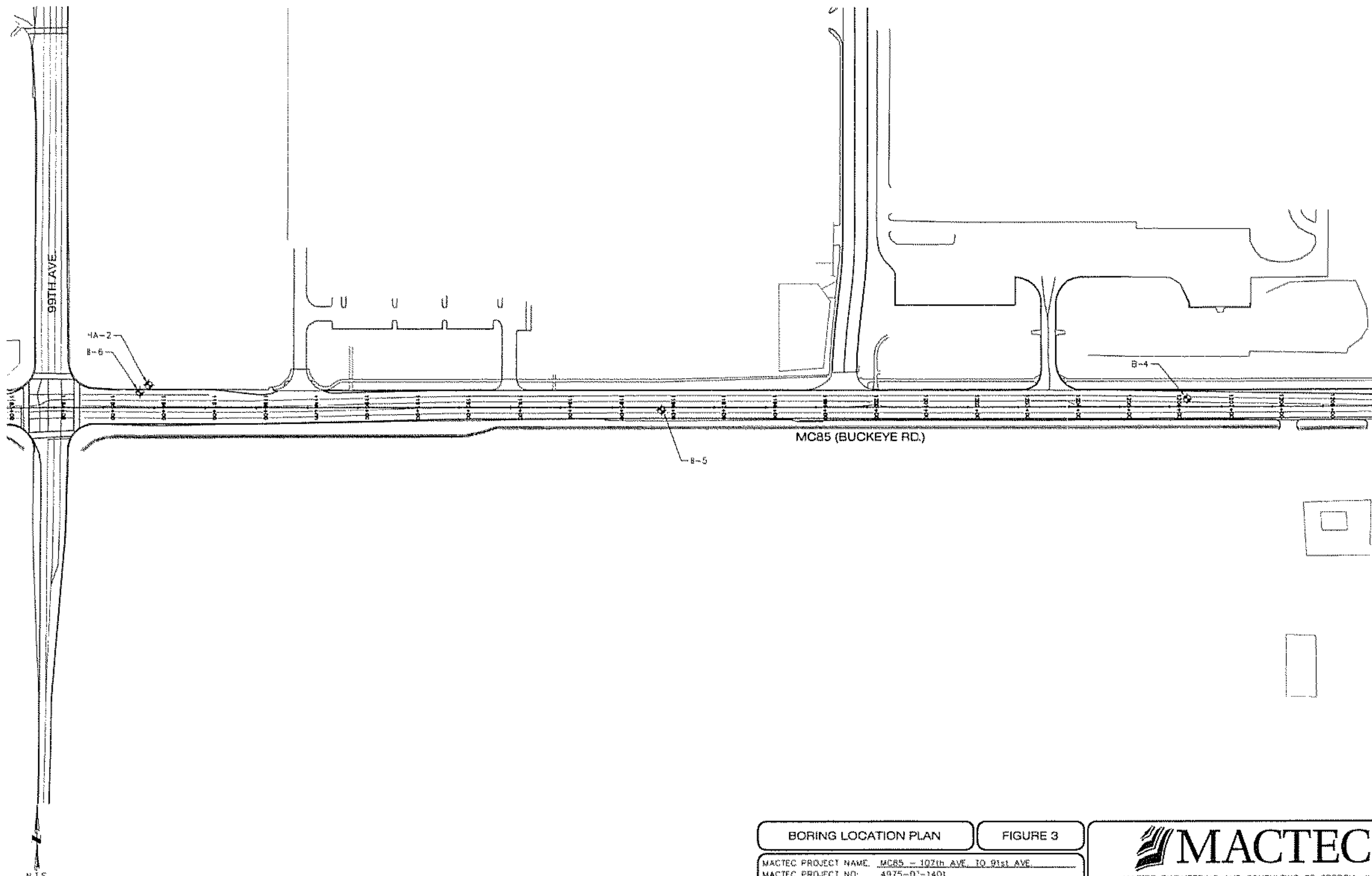


BORING LOCATION PLAN

FIGURE 2

MACTEC PROJECT NAME: MC85 - 107th AVE. TO 91st AVE.
MACTEC PROJECT NO: 4975-03-1401
DATE: 05/29/03 E-FILE: DRAWING 3
DRAWN BY: BWT CHECKED BY:

MACTEC
MACTEC ENGINEERING AND CONSULTING OF GEORGIA, INC.
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX. (602) 437-3675



BORING LOCATION PLAN

FIGURE 3

MACTEC PROJECT NAME: MC85 – 107th AVE. TO 91st AVE.
MACTEC PROJECT NO: 4975-03-1401
DATE: 05/29/03 E-FILE: DRAWING 2
DRAWN BY: BWT CHECKED BY:

MACTEC

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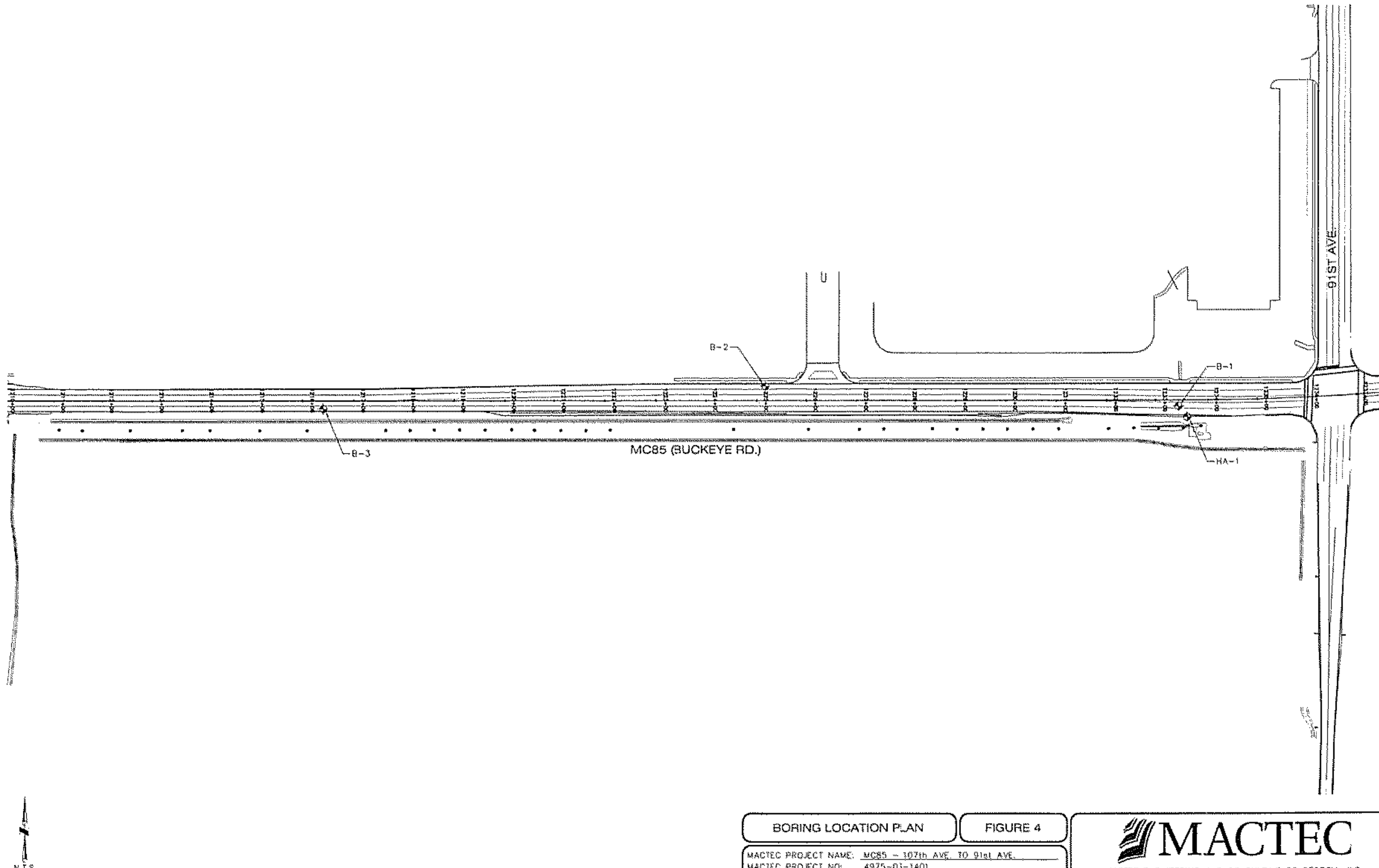
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX: (602) 437-3675



BORING LOCATION PLAN

FIGURE 4

MACTEC PROJECT NAME: MC85 - 107th AVE. TO 91st AVE.
MACTEC PROJECT NO: 4975-03-1401
DATE: 05/29/03 E-FILE: DRAWING 1
DRAWN BY: BWT CHECKED BY:

MACTEC

MACTEC ENGINEERING AND CONSULTING OF GEORGIA, INC.
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX. (602) 437-3675

APPENDICES

APPENDIX A

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")	SPT (bpf)
0	Asphalt: 3" +/- thickness (includes 1" overlay visible at pavement edge)						
	Aggregate base course - (21" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.						
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.						
				UD		18-9-12 (N = 21)	21
5							
	Light cementation visible in soil sample.			UD		17-33-50/5"	100
10							
15	Total depth = 9.9 feet below ground surface.						
	No ground water encountered during drilling.						
	Percolation test performed in borehole after auger removal.						
	Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.						
20							

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" Diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

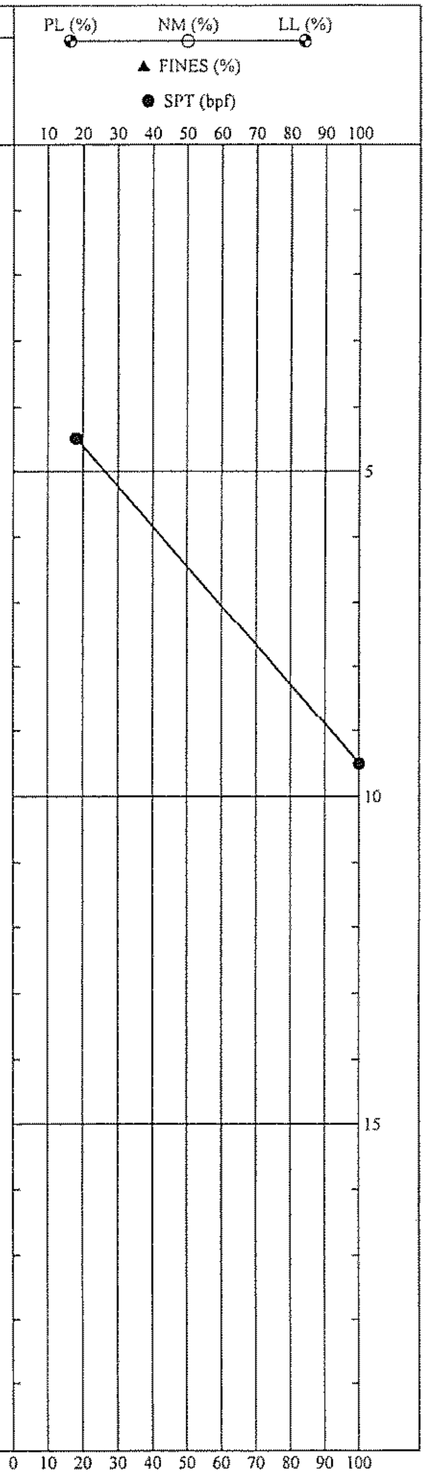
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-1
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Asphalt: 5" +/- thickness			
	Aggregate base course - (25" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.			
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			
		UD		6-8-10 (N = 18)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).			
		UD		29-40-50/5"
10				
15	Total depth = 9.9 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.			
20				



DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

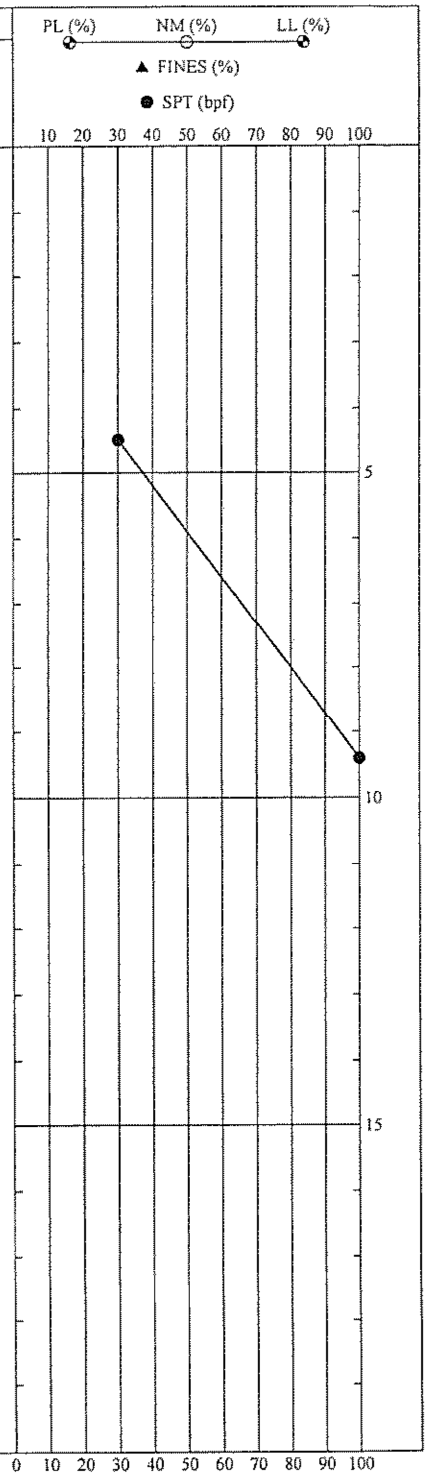
SOIL TEST BORING RECORD

BORING NO.: B-2
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

SOIL TEST BORING RECORD

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Asphalt: 5" +/- thickness			
	Aggregate base course - (25" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.			
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			
		UD		15-14-16 (N = 30)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).			
		UD		29-50/5"
10				
15	Total depth = 9.4 feet below ground surface.			
	No ground water encountered during drilling.			
	Percolation test performed in borehole after auger removal.			
	Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.			
20				



SOIL TEST BORING 3-1101 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

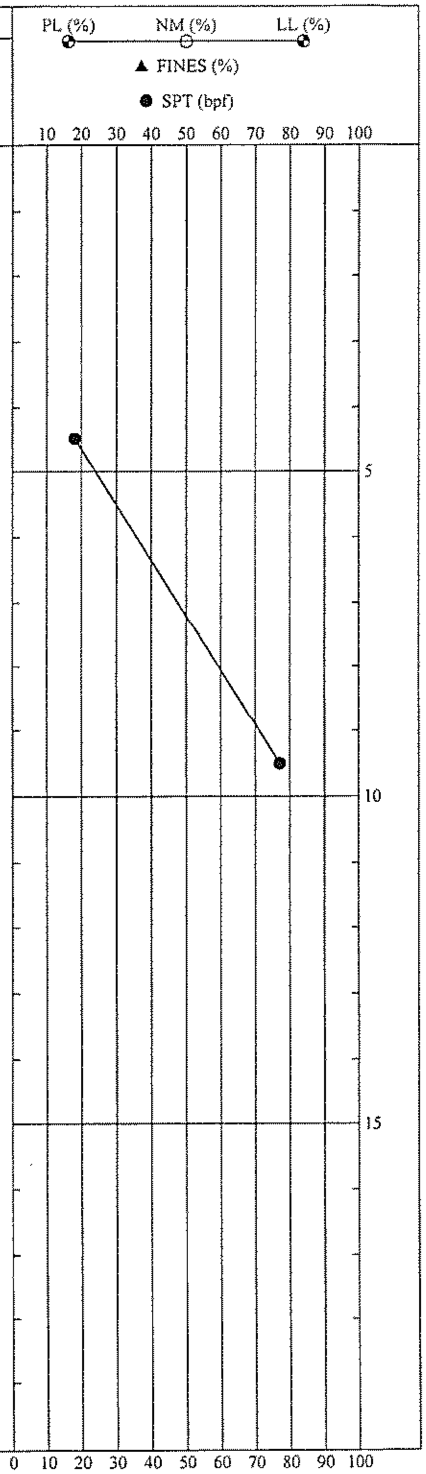
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-3
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	LEGEND	ELEV (ft)	SAMPLES: IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Asphalt: 7" +/- thickness					
	Aggregate base course - (11" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.					
				UD		8-7-11 (N = 18)
5	Light cementation visible in soil sample and cuttings (4' - 8' +/-).					
	Brown, clayey, fine to coarse SAND (SC). Damp. Low plasticity. Light to moderate cementation.			UD		20-27-50 (N = 77)
10						
15	Total depth = 10 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.					
20						



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

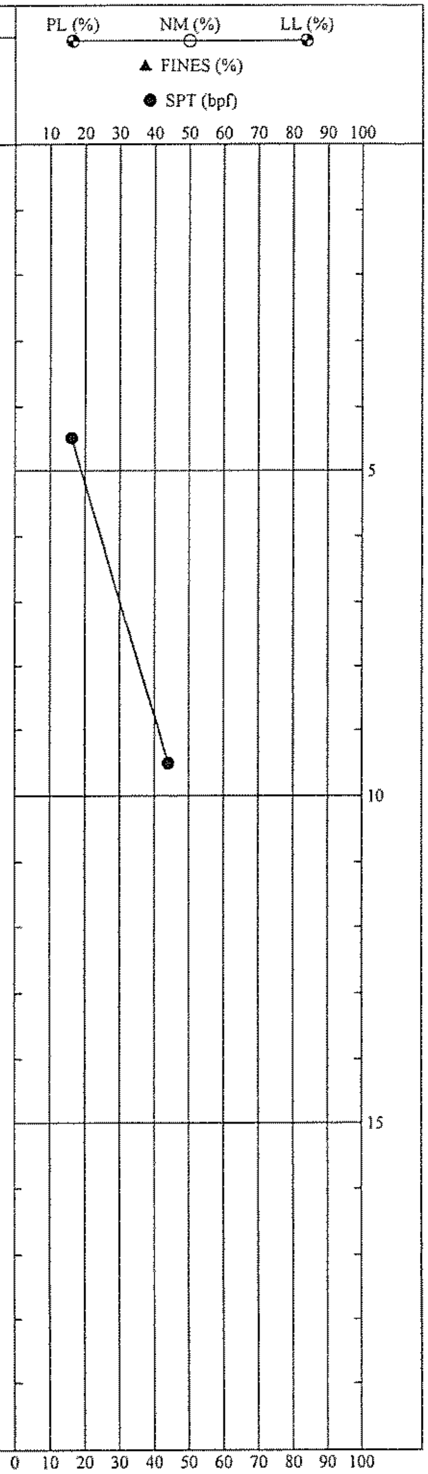
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-4
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Asphalt: 5" +/- thickness					
	Aggregate base course - (25" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface.					
	Approximate 6" +/- of highly cemented material. Hard drilling and audible auger contact with subsurface material during auger advancement. Trace of grey-colored powder in cuttings.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			UD		8-8-8 (N = 16)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).					
				UD		20-22-22 (N = 44)
10						
15	Total depth = 10 feet below ground surface. No ground water encountered during drilling. Percolation test performed in borehole after auger removal. Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.					
20						



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW_GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

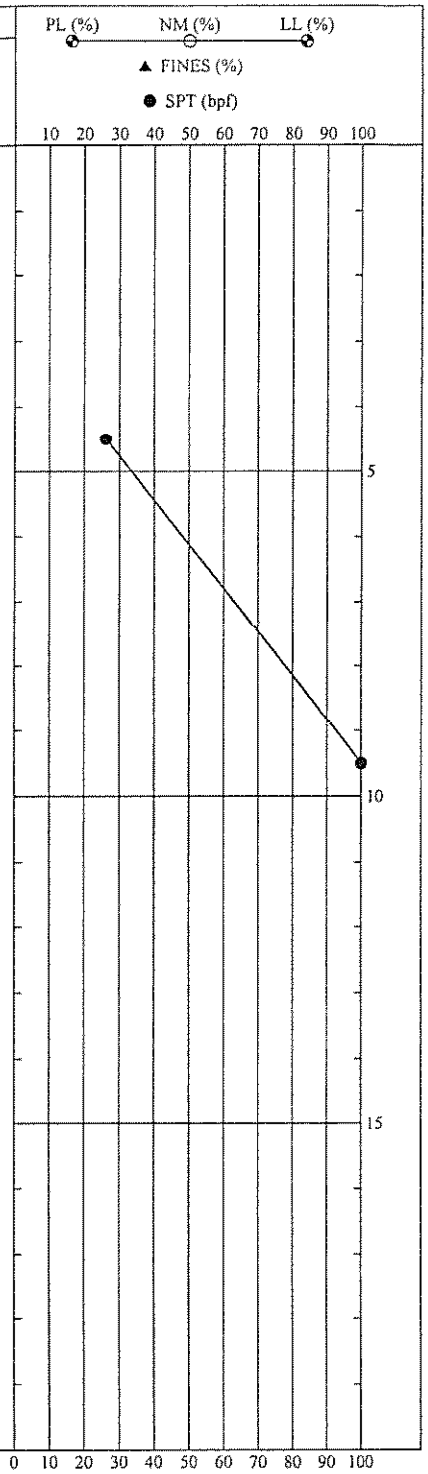
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-5
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	Asphalt: 3" +/- thickness		
	Aggregate base course - (12" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.		
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.		
		UD	11-11-15 (N = 26)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-). Varying silt and fine sand content observed in soil sample and cuttings.		
		UD	16-34-50/5"
10			
15	Total depth = 9.9 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.		
20			



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW_GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

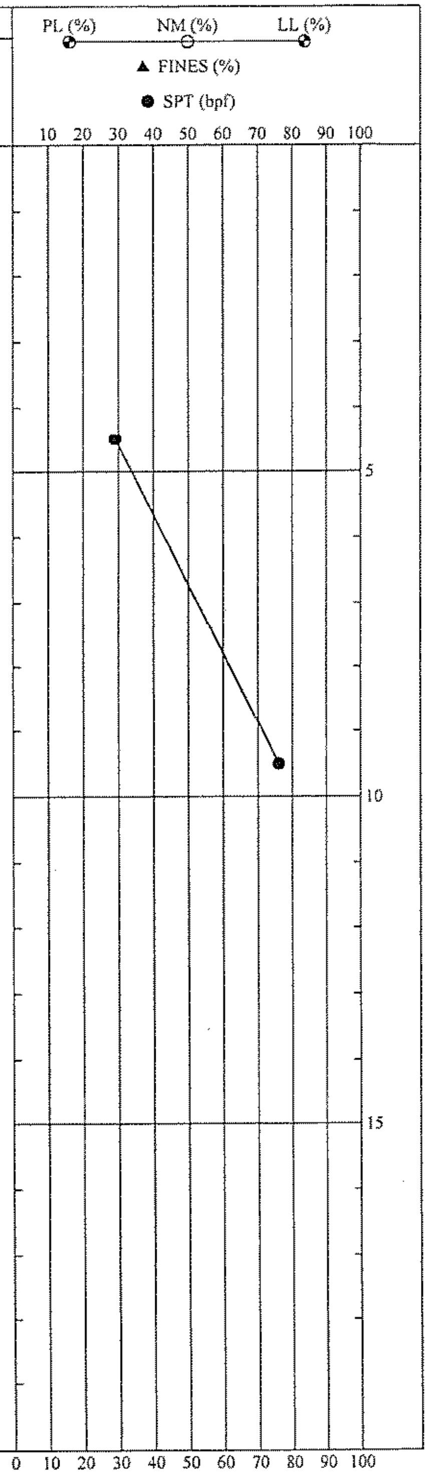
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-6
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Asphalt: 5" +/- thickness (includes 1" overlay visible at pavement edge)			
	Aggregate base course - (12" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.			
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			
		UD		14-14-15 (N = 29)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).			
	Slight increase in fine sand content observed in soil sample.	UD		19-36-40 (N = 76)
10				
15	Total depth = 10 feet below ground surface.			
	No ground water encountered during drilling.			
	Percolation test performed in borehole after auger removal.			
	Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.			
20				



DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

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SOIL TEST BORING RECORD

BORING NO.: B-7
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf)
0	Asphalt: 5" +/- thickness (includes 1" overlay visible at pavement edge)								
	Aggregate base course - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.								
	Approximate 12" +/- of potential concrete or highly cemented material. Audible auger contact with solid surface during auger advancement. Grey-colored powder in cuttings. Boring terminated due to auger refusal								
5									5
10									10
15	Total depth = 1.9 feet below ground surface. Auger refusal on subsurface concrete or cemented material. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.								15
20									

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-8A
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Asphalt: 5" +/- thickness (includes 1" overlay visible at pavement edge)								
	Aggregate base course - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.								
	Approximate 12" +/- of potential concrete or highly cemented material. Audible auger contact with solid surface during auger advancement. Grey-colored powder in cuttings. Boring terminated due to auger refusal.								
5									5
10									10
15	Total depth = 1.9 feet below ground surface. Auger refusal on subsurface concrete or cemented material. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.								15
20									0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

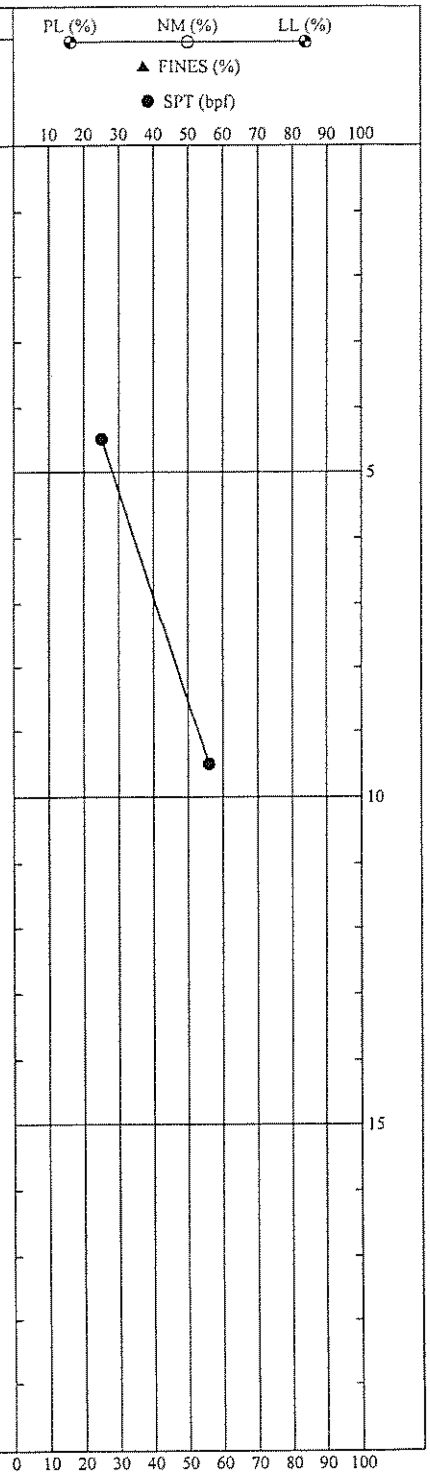
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-8B
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	Asphalt: 4" +/- thickness (includes 1" overlay visible at pavement edge)		
	Aggregate base course - (6" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface.		
	Approximate 12" of highly cemented material. Hard drilling and audible auger contact with subsurface material during auger advancement. Trace of grey-colored powder in cuttings.		
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.		
		UD	8-10-15 (N = 25)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).		
	Light brown color. Slight increase in fine sand content observed in soil sample.	UD	10-22-34 (N = 56)
10			
15	Total depth = 10 feet below ground surface. No ground water encountered during drilling. Percolation test performed in borehole after auger removal. Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.		
20			



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

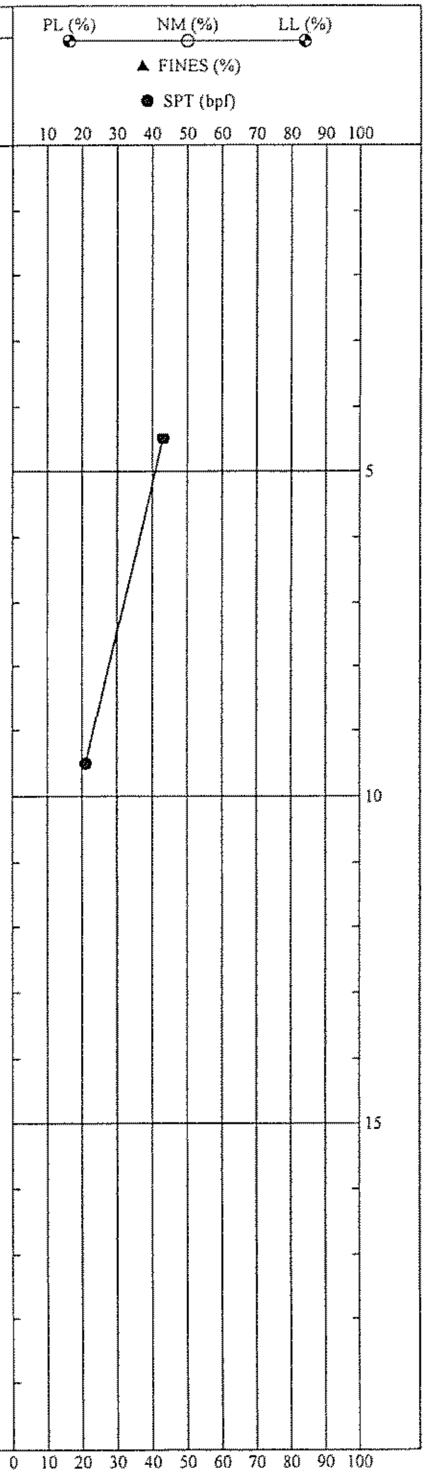
SOIL TEST BORING RECORD

BORING NO.: B-9
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Asphalt: 6" +/- thickness				
	Aggregate base course - (12" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.				
	Brown, silty **CLAY (CL)** little fine sand. Moist. Low to medium plasticity.				
			UD		10-20-23 (N = 43)
5	Light cementation visible in soil sample and cuttings (4' - 8' +/-).				
	Brown, silty fine **SAND (SM)**. Moist. Low to no plasticity.		UD		4-8-13 (N = 21)
10					
15	Total depth = 10 feet below ground surface. No ground water encountered during drilling. Percolation test performed in borehole after auger removal. Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.				
20					



DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

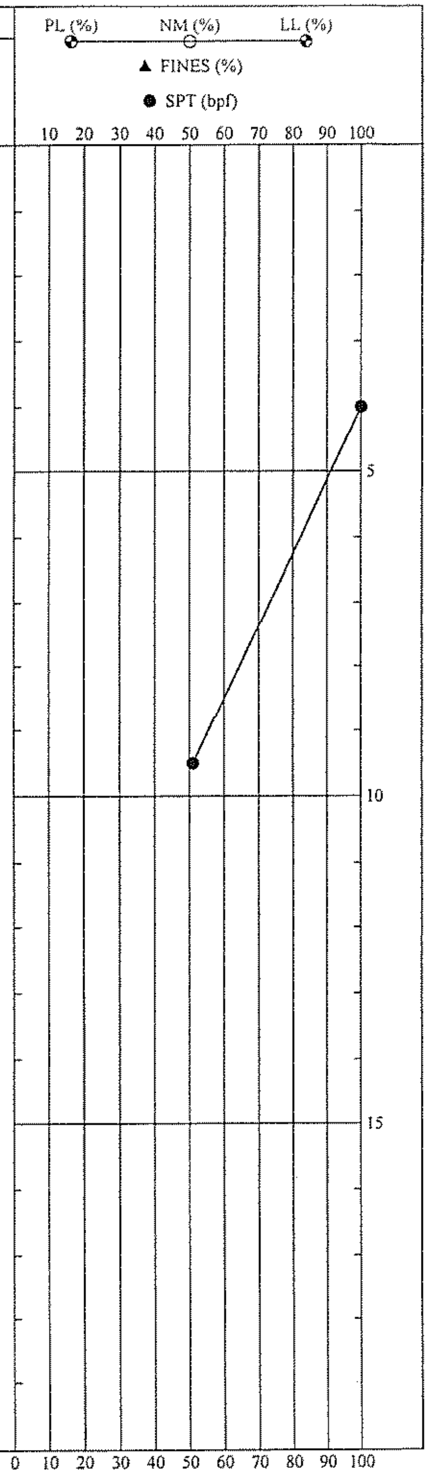
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-10
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	SAMPLES: IDENT	SAMPLES: N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Asphalt: 5" +/- thickness		
	Aggregate base course - (19" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.		
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.	UD	32-50/0"
	Approximate 18" of highly cemented material. Hard drilling and audible auger contact with subsurface material during auger advancement. Gravel in sampler, but no obvious cement residue observed on gravel.		
5	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity. Light cementation.	UD	14-25-26 (N = 51)
10			
15	Total depth = 10 feet below ground surface.		
	No ground water encountered during drilling.		
	Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.		
20			



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE - 107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-11
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			BK			
5							5
10							10
15	Soil boring advanced at a location adjacent to road pavement. Subgrade soil exposed prior to hand auger advancement. Total depth = 3 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling.						15
20							0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	Hand Auger
METHOD:	Manual
HOLE DIA.:	4" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). BK=Disturbed bulk sample collected from hand auger cuttings.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: HA-1
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 20, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			BK			
5							
10							
15	Soil boring advanced at a location adjacent to road pavement. Subgrade soil exposed prior to hand auger advancement. Total depth = 3 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling.						
20							0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1-01 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW_GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	Hand Auger
METHOD:	Manual
HOLE DIA.:	4" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). BK=Disturbed bulk sample collected from hand auger cuttings.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: HA-2
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 20, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"	PL (%) / NM (%) / LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			BK					
5									5
10									10
15	Soil boring advanced at a location adjacent to road pavement. Subgrade soil exposed prior to hand auger advancement. Total depth = 3 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling.								15
20									0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	Hand Auger
METHOD:	Manual
HOLE DIA.:	4" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). BK=Disturbed bulk sample collected from hand auger cuttings.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: HA-3
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 20, 2003
PROJECT NO.: 4975-03-1401.01 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N COUNT 1st 6"	2nd 6"	3rd 6"	PL (%) / NM (%) / LL (%) / ▲ FINES (%) / ● SPT (bpf)
0	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			BK					
5									5
10									10
15	Soil boring advanced at a location adjacent to road pavement. Subgrade soil exposed prior to hand auger advancement. Total depth = 3 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling.								15
20									

DRILLER: EDI
EQUIPMENT: Hand Auger
METHOD: Manual
HOLE DIA.: 4" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). BK=Disturbed bulk sample collected from hand auger cuttings.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: HA-4
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 20, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

APPENDIX C-C

Excerpts from the DMJM Harris/AECOM Report

MC 85, 107TH AVENUE TO 91ST AVENUE
MARICOPA COUNTY, ARIZONA

PAVEMENT DESIGN REPORT

Prepared for:

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

By

DMJM HARRIS | AECOM

2777 E. Camelback Road, Suite 200
Phoenix, AZ 85016

CERTIFICATE NO.
25151
KEITH H.
DAHLEN
Date Signed 4/25/06

April 2006

DMJM HARRIS | AECOM

DMJM Harris
2777 East Camelback Road, Suite 200, Phoenix, AZ 85016
T 602.337.2777 F 602.337.2620 www.dmjmharris.com

April 25, 2006

Mr. Sami Ayoub
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

Re: Pavement Design Report
MC 85 (Buckeye Road), 107th Avenue to 91st Avenue
Maricopa County, Arizona
MCDOT Work Order 69024
DMJM Harris Project No. 6490.0000

Dear Mr. Ayoub:

DMJM Harris is pleased to present this Pavement Design Report to the Maricopa County Department of Transportation (MCDOT) for the above referenced project. This report details our scope of work, and includes the results of our investigation, design and test data obtained as part of the preliminary geotechnical investigation (Mactec, 2003) as well as recommendations for the design of pavements based on life cycle cost analyses of various alternatives for the section of MC 85 (Buckeye Road) between 107th Avenue and 91st Avenue and in Maricopa County, Arizona.

We appreciate the opportunity to provide geotechnical services to the MCDOT on this project. Should you have any questions concerning this report, please contact Keith Dahlen of our office at (602) 337-2596.

Sincerely,
DMJM Harris

Francisco J. Garza

Francisco Garza, E.I.T.

Reviewed by:

Keith H. Dahlen

Keith Dahlen, P.E.
Senior Geotechnical Engineer

CERTIFICATE NO.
25151
KEITH H.
DAHLEN
Date Signed 4/25/06
ARIZONA, U.S.A.

cc: 6490.0005 505

TABLE OF CONTENTS

APPENDICES

CERTIFICATE NO.
25151
KEITH H.
DAHLEN
Date Signed 4/25/06

1.0 INTRODUCTION

This Pavement Design Report is submitted subsequent to a subsurface investigation performed by DMJM Harris for the planned widening and improvement of a two-mile segment of MC 85, extending from 107th Avenue to 91st Avenue, and located within Maricopa County, Arizona. The Project Site Vicinity Map is shown in Figure 1. It is our understanding that the existing four-lane roadway with an intermittent center turn lane will be widened to a 6-lane road with a raised median. Given the existing roadway geometry, the majority of new construction will occur along the south side of MC 85 and along the widened edges of the cross-road pavements while reconstruction will take place along the existing MC 85 roadway and portions of the main cross roads to meet new pavement design sections and site profiles. Based on current design plans (DMJM Harris, 2005), the new profile of MC 85 will generally extend from 0 to 2 feet above existing pavement grades, with the low points located at or near the intersections at 107th, 99th and 91st avenue.

2.0 REVIEW OF EXISTING DATA

The pavement design recommendations presented herein are based in part on results from the *Preliminary Report of Geotechnical Evaluation*, (Mactec, Revised October 2003). DMJM Harris has conducted a review of this report and determined that it generally meets the specified MCDOT requirements for final design, relative to the field investigation and laboratory testing.

As-Built Plans were also reviewed as part of this investigation. The primary focus of the review was to determine the location of a 16-foot wide section of Portland cement concrete pavement (PCCP) that is known to underlie a portion of the MC85 asphaltic concrete (AC). MCDOT has considered leaving the PCCP in–place if it does not adversely impact the design or construction of the new MC 85. MCDOT requested that DMJM Harris perform additional coring through the existing MC 85 pavement to better define the location and condition of the existing PCCP.

3.0 PAVEMENT CORE INVESTIGATION

The pavement core investigation was supervised by Ammi Osorio, P.E., and Pancho Garza, E.I.T., of DMJM Harris. A total of sixteen pavement cores (C1 through C16) were advanced to depths ranging from 1.4 feet (17") to 3.2 feet (38") below ground surface using a Milwaukee 480 portable drill with 6-inch and 3-inch bits. The coring equipment is owned and operated by Concrete Coring Company, Inc. The coring was performed through the Asphalt Concrete (AC) layer using a 6-inch drill bit and the underlying PCCP layer, where encountered, using a 3-inch diameter bit. The majority of coring encountered Aggregate Base (AB) materials below the AC layer. Clay soil was encountered below the AB in Core C12. The AB material and clayey materials were excavated using hand tools. The thickness of each pavement layer was measured and the PCCP cores were sampled and stored. After the coring operation, each hole was backfilled with excess cuttings and the AC core replaced with cold patch.

The preliminary investigation (MACTEC, 2003) included advancing a total of eleven test borings to depths of 10 feet along the existing MC 85 alignment. A Site Plan (three sheets), which indicates the DMJM Harris pavement core locations and Mactec test boring locations is included in Appendix A.

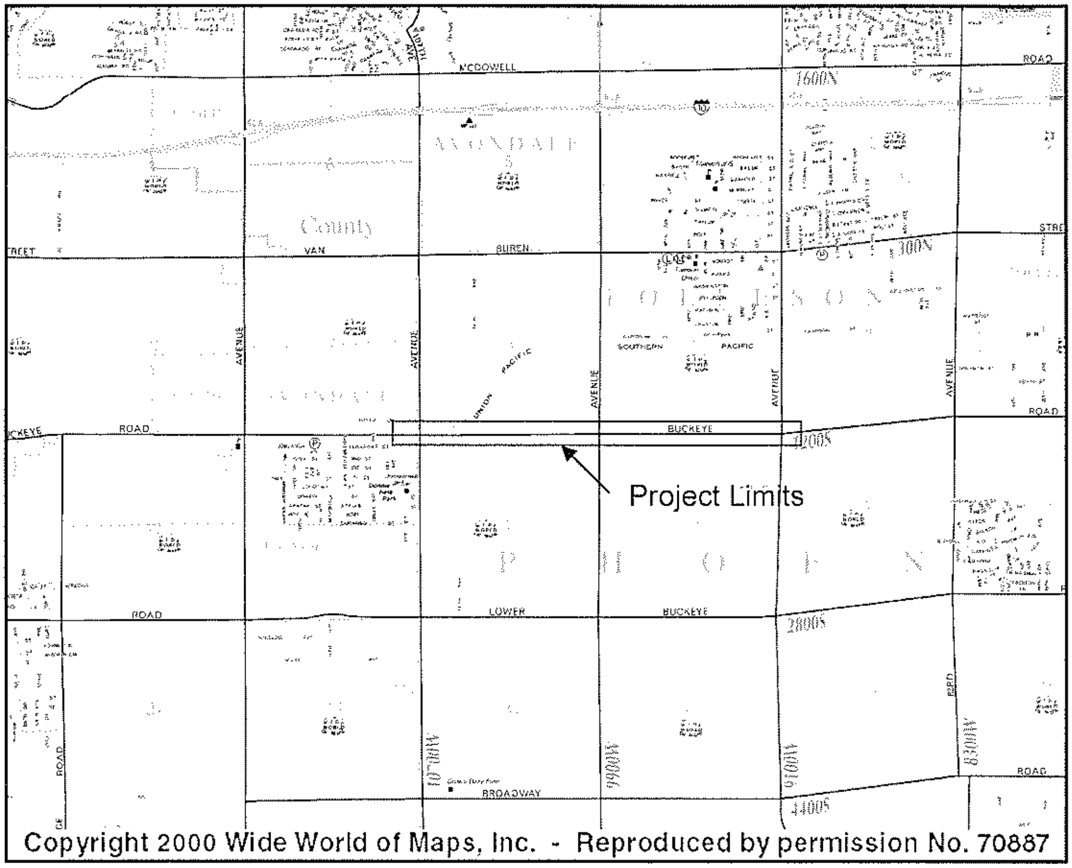


Figure 1: Project Vicinity Map

North

4.0 SITE DESCRIPTION

Development within the vicinity of the MC 85 roadway is a mixture of newer warehouse buildings to the north, and residential use mixed with agricultural farm land to the south. The area has historically been primarily agricultural. The area is generally flat with a gentle regional slope to the southwest. The MC 85 pavement surface is sloped such that drainage is directed toward the shoulders.

Within the project limits, MC 85 (Buckeye Road) consists primarily of two 12-foot wide travel lanes in each direction with 8- to 12-foot wide gravel shoulders and a 12-foot wide center turn lane at various locations. At the time of the field investigation, the existing pavement section appeared to be in fair to good condition. Some light, generally widely spaced cracking was noted and occasional potholes were observed in the roadway.

Major intersections are located at 107th Avenue, 99th Avenue and 91st Avenue within the project limits. Currently, each intersection consists of two lanes in each direction with a left turn lane. Projected traffic data indicates a large increase in traffic volume after the year 2015 due to a planned I-10 reliever to the south of MC 85. The increased traffic volume will result in the 99th Avenue intersection expanding to 3 lanes at the intersection.

5.0 EXISTING MC 85 PAVEMENT SECTION CONDITIONS

The 16-foot wide PCCP section, centered approximately on the existing Section Line, was encountered below the existing roadway in all but five of the core holes (C1, C2, C8, C10 and C12). The field investigation indicated that the AC pavement section varies from 4 inches to 12 inches, with an average depth of 10 inches. The aggregate base (AB) material underlying the AC ranges in thickness from 5 inches to 14 inches. The underlying PCCP ranges in thickness from 6 inches to 7 inches. In Cores C2 and C3, a 4-inch AC layer was encountered under the AB layer. A summary of the pavement sections encountered within the DMJM Harris cores and MACTEC borings is included as Table 1.

Based on the preliminary test borings, the site is generally underlain by finer-grained clayey soils. This medium to highly plastic and moderately expansive material was encountered in all the test borings advanced during the preliminary investigation.

Table 1 – Summary of Existing MC 85 Pavement Conditions
Based on Preliminary Test Drilling and Final Investigation Pavement Cores

Final Investigation (DMJM Harris, 2005)						Preliminary Investigation (Mactec, 2003)					
Core ID	Station(1)	Offset(1)	AC (in)	AB (in)	PCCP (in)	Bore ID	Station(1)	Offset(1)	AC (in)	AB (in)	PCCP (in)
C1	1136+00	7' Lt	12.1	12.0	-	B-11	1133+80	20' Lt	5.0	19.0	-
C2	1144+00	2.5' Lt	5.0	7.0(2)	-	B-10	1143+70	10' Lt	6.0	12.0	-
C3	1150+00	2.5' Rt	4.0	5.0(2)	7.0	HA-4	1143+65	35' Rt	-	-	-
C4	1156+00	3' Lt	9.0	7.0	6.0	B-9	1152+75	10' Rt	4.0	6.0	12.0
C5	1163+00	2.5'Rt	8.0	9.0	7.0	B-8B	1163+45	5' Lt	5.0	5.0	12.0
C6	1170+00	3' Lt	10.0	9.0	6.0	B-8A	1163+45	5' Lt	5.0	5.0	12.0
C7	1177+00	3' Rt	11.0	11.0	6.0	HA-3	1173+25	25' Rt	-	-	-
C8	1183+00	8' Lt	13.0	13.0	-	B-7	1173+50	20' Rt	5.0	12.0	-
C9	1190+00	2.5' Lt	12.0	12.0	7.0	HA-2	1185+90	45' Lt	-	-	-
C10	1197+00	14' Lt	9.5	26.5	-	B-6	1185+75	30' Lt	3.0	12.0	-
C11	1203+00	6.5' Rt	10.0	14.0	7.0	B-5	1196+00	5' Rt	5.0	25.0	6.0
C12	1209+00	3' Lt	12.0	5.0	-(3)	B-4	1206+30	15' Lt	7.0	11.0	-
C13	1217+00	2.5' Rt	9.0	11.0	7.0	B-3	1216+40	15' Rt	5.0	25.0	-
C14	1220+00	3' Rt	9.0	12.0	6.0	B-2	1225+20	30' Lt	5.0	25.0	-
C15	1227+00	6.5' Rt	8.0	13.0	6.0	HA-1	1233+60	30' Rt	-	-	-
C16	1234+00	3' Rt	12.0	6.0	6.0	B-1	1233+40	15' Rt	3.0	21.0	-

(1): MC 85 Existing Centerline (Section Line)
(2): 4-inch AC encountered underlying AB
(3): Clay soil encountered underlying AB to a depth of 3.2' (38")

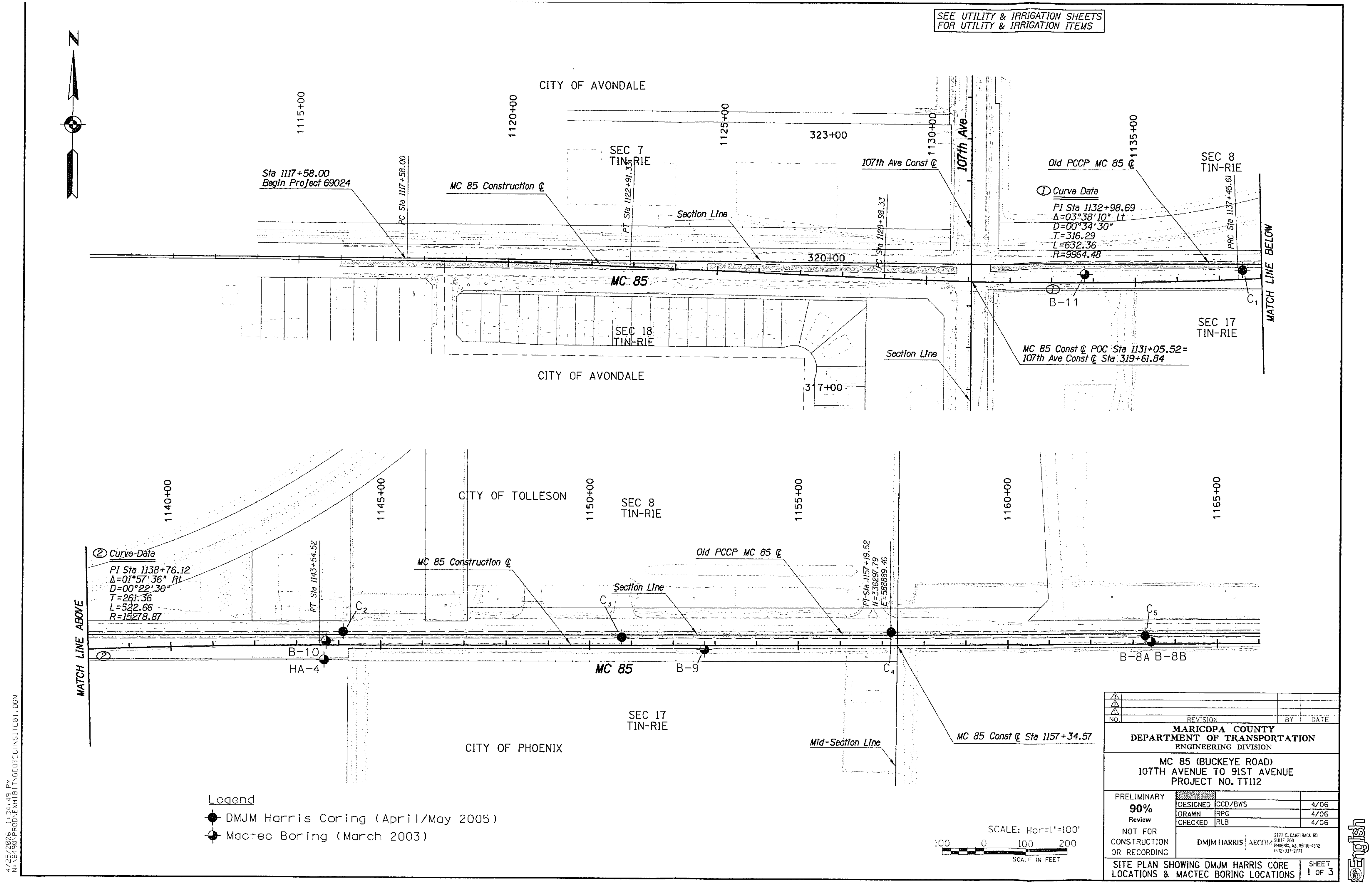
6.0 PAVEMENT SECTION ANALYSIS AND RECOMMENDATIONS

6.1 SUBGRADE MODULUS

The pavement section analysis was performed using the *MCDOT Pavement Design Guide* (2004). This design method utilizes the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures (1993) as the design standard for asphalt pavement structures in Maricopa County. A combination of laboratory correlated R-values and actual R-values are used for the determination of the subgrade modulus.

Laboratory testing for this project was performed by MACTEC (2003). The testing included grain-size analysis, and Atterberg limits testing (plasticity index) for calculation of correlated R-values (in accordance with Table 202.02-3 of ADOT, 1993) and actual R-value tests. Actual R-value tests were performed on four near-surface bulk samples. Grain-size analysis and Atterberg limits (plasticity index) tests, for determination of correlated R-values were performed on near surface samples as well. Based on the average correlated and actual test R-values indicated above and respective standard deviation values of 4.9 and 5.7, a design R_{mean} value of 15.6 is determined. The R_{mean} value, based on Figure 202.02-2, and a Seasonal Variation Factor (SVF) of 1.0 (determined for Phoenix, Arizona from Table 202.02-4), provides the maximum limiting value for resilient modulus (M_r) of 9,830 pounds per square inch (psi).

APPENDIX A – SITE PLAN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N
CITY OF AVONDALE
1115+00
1120+00
1125+00
1130+00
1135+00
323+00
320+00
317+00
SEC 7 T1N-R1E
SEC 8 T1N-R1E
SEC 18 T1N-R1E
SEC 17 T1N-R1E
107th Ave
Sta 1117+58.00 Begin Project 69024
PC Sta 1117+58.00
MC 85 Construction ℄
PT Sta 1122+91.33
Section Line
PC Sta 1128+98.33
107th Ave Const ℄
Old PCCP MC 85 ℄
PRC Sta 1137+45.61
1 Curve Data
PI Sta 1132+98.69
Δ=03°38'10" Lt
D=00°34'30"
T=316.29
L=632.36
R=9964.48
MC 85
B-11
C1
MATCH LINE BELOW
MC 85 Const ℄ POC Sta 1131+05.52= 107th Ave Const ℄ Sta 319+61.84
CITY OF AVONDALE
CITY OF TOLLESON
1140+00
1145+00
1150+00
1155+00
1160+00
1165+00
SEC 8 T1N-R1E
2 Curve Data
PI Sta 1138+76.12
Δ=01°57'36" Rt
D=00°22'30"
T=261.36
L=522.66
R=15278.87
MATCH LINE ABOVE
PT Sta 1143+54.52
C2
MC 85 Construction ℄
C3
Section Line
Old PCCP MC 85 ℄
PI Sta 1157+19.52
N=336297.79
E=588889.46
C5
B-10
HA-4
MC 85
B-9
C4
B-8A B-8B
SEC 17 T1N-R1E
CITY OF PHOENIX
Mid-Section Line
MC 85 Const ℄ Sta 1157+34.57
Legend
DMJM Harris Coring (April/May 2005)
Mactec Boring (March 2003)
SCALE: Hor=1"=100'
100 0 100 200
SCALE IN FEET
NO. REVISION BY DATE
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION
MC 85 (BUCKEYE ROAD) 107TH AVENUE TO 91ST AVENUE PROJECT NO. TT112
PRELIMINARY 90% Review
NOT FOR CONSTRUCTION OR RECORDING
DESIGNED CCD/BWS 4/06
DRAWN RPG 4/06
CHECKED RLB 4/06
DMJM HARRIS AECOM 2777 E. CAMELBACK RD SUITE 200 PHOENIX, AZ 85016-4302 (602) 337-2777
SITE PLAN SHOWING DMJM HARRIS CORE LOCATIONS & MACTEC BORING LOCATIONS
SHEET 1 OF 3
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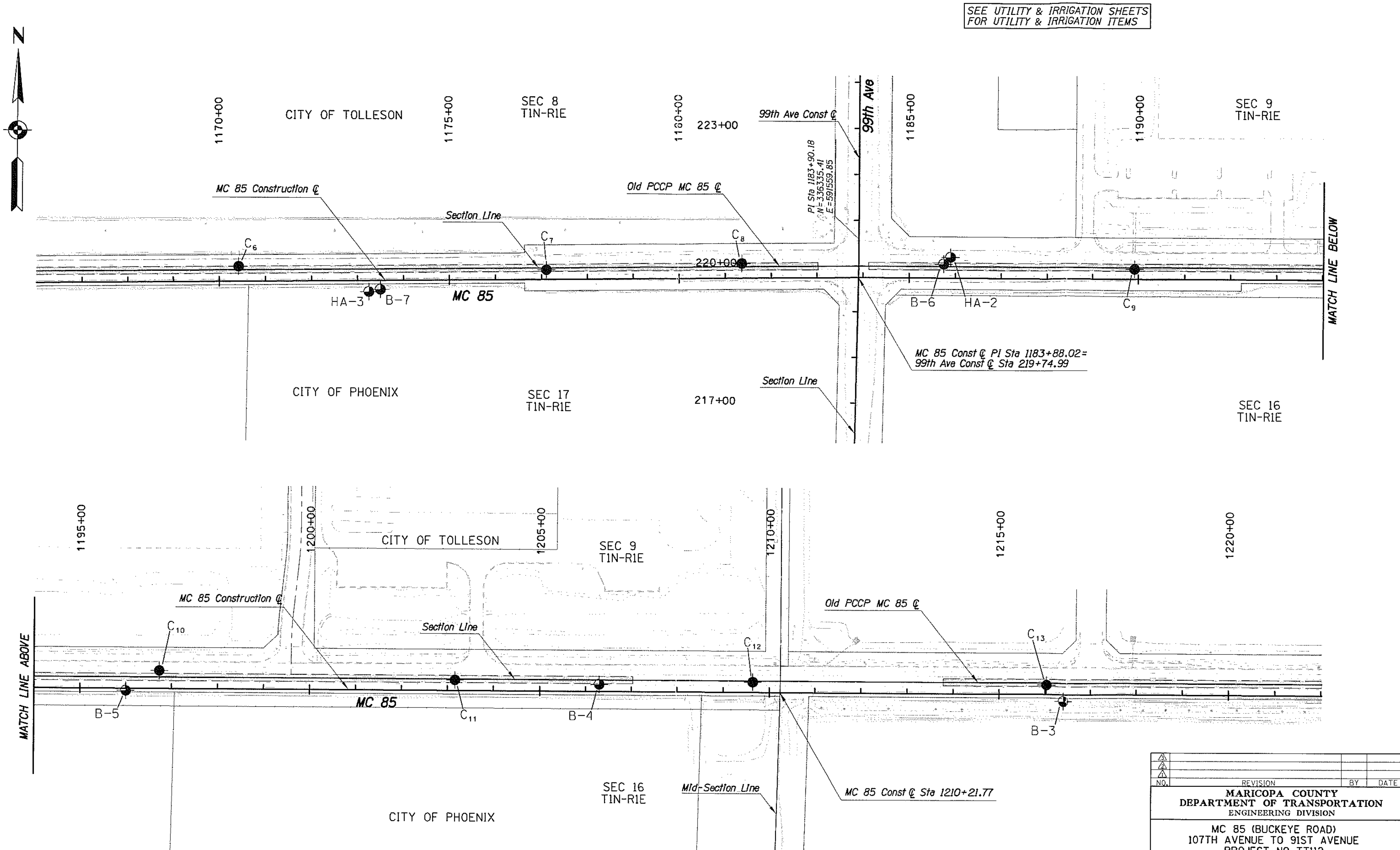
English



Legend

- DMJM Harris Coring (April/May 2005)
- Mactec Boring (March 2003)

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. TT112

PRELIMINARY
90%
Review

NOT FOR CONSTRUCTION OR RECORDING

DESIGNED	CCD/BWS	4/06
DRAWN	RPG	4/06
CHECKED	RLB	4/06

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

SITE PLAN SHOWING DMJM HARRIS CORE LOCATIONS & MACTEC BORING LOCATIONS

SHEET 2 OF 3

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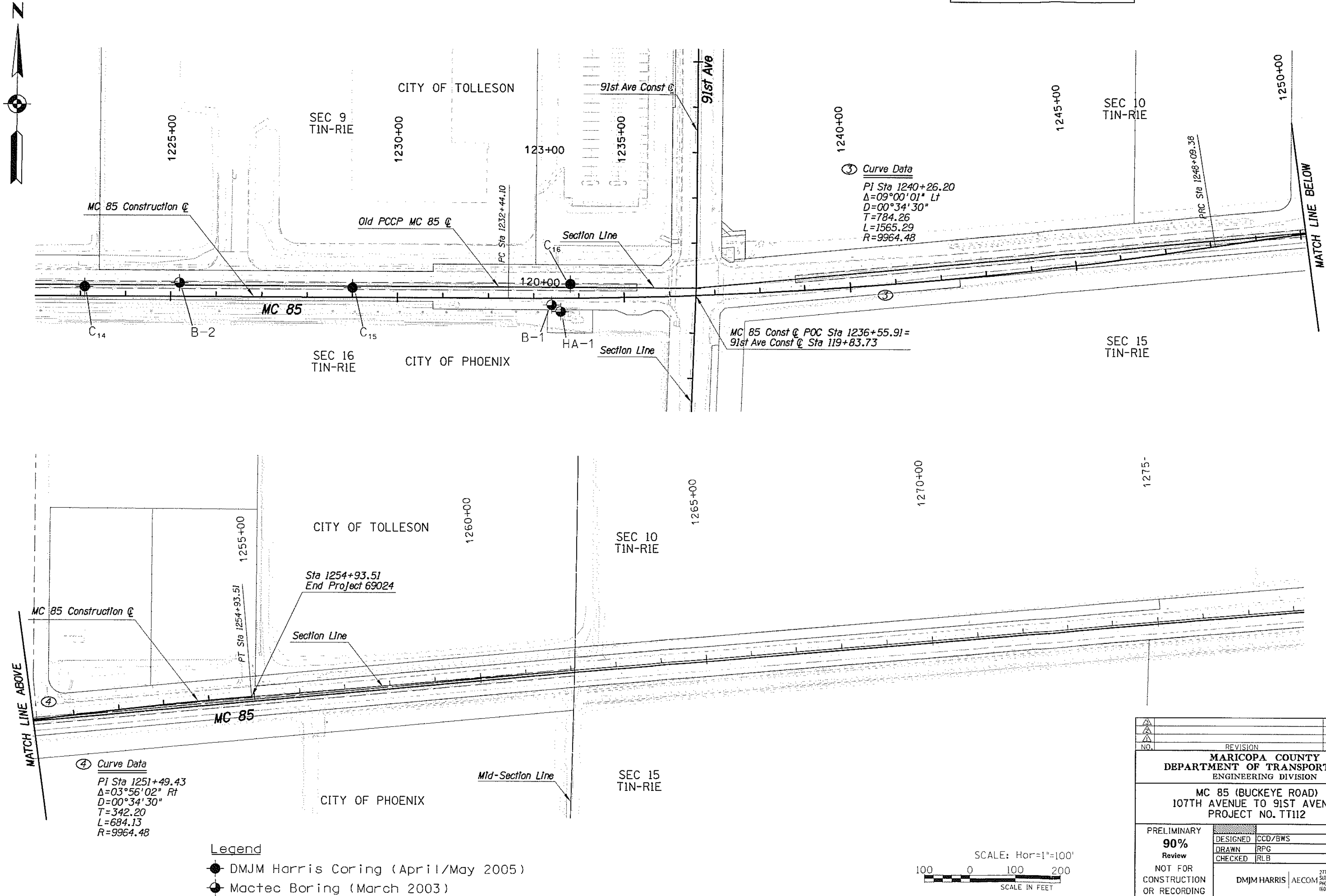
English

SEE UTILITY & IRRIGATION SHEETS
FOR UTILITY & IRRIGATION ITEMS



NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. TT112

PRELIMINARY
90%
Review

NOT FOR CONSTRUCTION OR RECORDING

DESIGNED	CCD/BWS	4/06
DRAWN	RPG	4/06
CHECKED	RLB	4/06

DMJM HARRIS | AECOM 2777 E. CAMELBACK RD SUITE 200 PHOENIX, AZ 85016-4302 (602) 331-2777

SITE PLAN SHOWING DMJM HARRIS CORE LOCATIONS & MACTEC BORING LOCATIONS

SHEET 3 OF 3

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English

SECTION 5

STORM DRAIN EXPLORATION

TABLE OF CONTENTS

5 STORM DRAIN EXPLORATION

5.1 GENERAL

A storm drain line is proposed at the site generally located along the southern portion of the eastbound lanes. The site plans indicate the storm drain line extends along MC-85 at depths ranging from 4 to 12 feet along the southern portion of the roadway alignment. The storm drain line is anticipated to be generally located under future eastbound travel lanes or the eastbound shoulder areas. Kleinfelder performed a geotechnical exploration in general accordance with Section 6.4.5 (Soils Investigation for Storm Drains) of the City of Phoenix Storm (COP) Water Policies and Standards (April 2011). Based on meetings between MCDOT and COP and due to previous work performed at the site, the frequency of the borings for the storm-drain line was reduced to one boring every ¼-mile. The Kleinfelder field exploration included 18 borings to depths generally ranging from approximately 10 to 15 feet with occasional practical refusals at shallower depths. We understand the proposed storm-water line will exclude metal piping; therefore, our field exploration excluded field electrical resistivity testing.

The previous work performed at the site includes the following reports:

- *MACTEC Report of (Preliminary) Geotechnical Evaluation, MC85 (Buckeye Road), 107th Avenue to 91st Avenue, Maricopa County, Arizona* (MACTEC Project No. 4975-03-1401, dated June 17, 2003 and revised October 23, 2003).

- *Ninyo and Moore (N&M), Geotechnical Evaluation, MC-85 Roadway Improvements, 75th Avenue to 91st Avenue, Maricopa, Arizona* (N&M Project No. 601301002, report dated September 28, 2010).

These two previous reports in their entirety are included as an appendix in the subsequent Pavement Structure Design Section of this report. These previous reports include additional information such as subsurface condition descriptions, boring logs, and soil corrosion characteristics. The data in these previous reports should be used to supplement the information presented in this section.

5.2 FIELD EXPLORATION

Prior to our field exploration, Kleinfelder staked the boring locations, cleared work areas with the Arizona Bluestake Center, obtained a MCDOT right-of-way permit (Tracking No. TC20120646), and subcontracted Highway Technologies, Inc. (HT) to submit a traffic control plan to MCDOT for borings located less than 20 feet away from the edge of pavement. The traffic control plan was approved by MCDOT on October 30, 2012. We notified a MCDOT inspector 24 hours prior to our field work. Traffic control for the project was provided by HT in general accordance with the approved traffic control plan.

The exploratory borings were supervised from October 30th to November 1st, 2012 by Rollina Katako, E.I.T. of Kleinfelder. The subsurface soil conditions at the site were explored by drilling a total of 18 borings (designated as SD1 through SD13, SD15 through SD17, and F1 and F2). The borings were drilled along the southern portion of the existing MC-85 alignment, on either the adjacent agricultural land or on the roadway eastbound shoulder. Due to constraints of existing utilities and private property access restrictions, Boring SD14 was excluded from our field work. The approximate locations of the borings are shown on Figures SD-1 through SD-4 (Storm Drain Exploration Site Plans).

The borings were drilled with a truck-mounted D-120 drill-rig and crew supplied by D&S Drilling, Inc. The borings were drilled using 8-inch outer diameter (OD) hollow-stem augers to depths generally ranging from about 10 to 15 feet below the existing ground surface (bgs). As an exception, practical auger refusals were encountered at depths of approximately 5 feet bgs at the location of Borings SD12 and SD15.

During the field exploration, the soils encountered were visually classified, logged, and sampled by Kleinfelder's field engineer. Relatively undisturbed samples of the subsurface materials were obtained using a ring sampler with a 2.42-inch inside diameter (ID) and 3-inch OD. Disturbed samples of soils were obtained using a standard penetration test (SPT) split spoon sampler with a 1.375-inch ID and 2-inch OD. Bulk samples of drill cuttings were also collected at selected depths from the borings. The SPT and ring samplers were driven 18 and 12 inches, respectively, using a hydraulic actuated 140-pound hammer free falling 30 inches. Unless noted otherwise on the boring logs, the sample driving resistance was recorded as number of blows per six inches of penetration. The penetration results are presented on the borings logs adjacent to each sample. The recovered soil samples were removed from the sampler, sealed to reduce moisture loss and submitted to the laboratory. The borings were backfilled with auger cuttings. The logs of the exploratory borings are presented in Appendix SD-A.

5.3 LABORATORY TESTING

Selected laboratory tests were performed on representative samples recovered from the field exploration to support our field classification and to provide information regarding engineering characteristics and properties of the subsurface soils. The laboratory testing program consisted of the following:

Table 5.3-1 Laboratory Testing Program

Laboratory Test	Sample Type	Number of Tests	Purpose of Test
Sieve Analysis (ASTM C136)	Bulk	20	Soil Classification
Atterberg Limits (ASTM D4318)	Bulk	20	Soil Classification
R-Value (ASTM D2844)	Bulk	6	Subgrade Support Characteristics
Standard Proctor (ASTM D698)	Bulk	7	Compaction Characteristics
Remolded Swell (ASTM D4546)	Bulk	7	Expansion Potential of On-Site Soils
Sulfates and Chlorides (Ariz 733/736)	Bulk	34	Soil Corrosion Characteristics
Moisture/Density* (ASTM D2216/D2937)	Ring	22	In-Situ Density and/or Moisture Conditions

* Dry density and moisture content information is presented on the boring logs.

The results of the laboratory tests are presented on the laboratory test data sheets in Appendix SD-B. The laboratory test results are also summarized on the boring logs in Appendix SD-A.

5.4 GENERAL SITE CONDITIONS

5.4.1 SURFACE CONDITIONS

At the time of our field exploration along MC-85, the site consisted of an asphalt concrete (AC) paved roadway divided into 2 travel lanes each way with graded dirt shoulders and occasional developed areas with curb, gutter, sidewalks and landscaping. The lanes along the site alternated between 5 lanes (2 lanes each way with a center median/turn lane) and 4 lanes (2 lanes each way) with the center median/turn lane transitioning from a full width center turn lane to just a stripe dividing the east and west travel lanes. The following are two pictures of MC-85 (Buckeye Road) taken at each end of the site facing east and west along the south side of the roadway.

Picture 1 – Near 107th Ave.; Facing East

Picture 2 – Near 75th Ave.; Facing West

5.4.2 SUBSURFACE CONDITIONS

The subsurface profiles encountered at the boring locations were found to be relatively similar. Individual boring logs with detailed descriptions are presented in Appendix SD-A of this report.

At the location of Borings SD1, SD3 through SD11, SD17, F1 and F2, the surface and/or near surface soils consisted of native deposits of fine-grained soils that included sandy lean clays (CL), lean clay with sand (CL), or (at the location of Boring F2) fat clay (CH). These soils generally exhibited plasticities in the medium to high ranges with relative firmness in the soft to very firm range (generally increasing with depth), and they contained no to weak calcium carbonate cementation (caliche). Beginning at depths ranging from approximately 5 to 13 feet bgs and extending to the final depths of exploration (about 10 to 15.5 feet bgs), the clay soils were generally underlain by deposits of silty sand (SM), clayey sand (SC), silty clayey sand (SC-SM), and sandy silt (ML). These subsurface coarser materials exhibited plasticities in the no to low range with relative densities generally in the loose to medium dense range, and contained no to weak cementation. At the location of Borings SD8 through SD11 and F2, clayey sand (SC) or clayey gravel (GC) fill soils were encountered in the upper roughly 1 to 5 feet bgs.

At the location of SD2, SD13 and SD16, the surface and/or near surface soils consisted of native deposits of clayey sand (SC). These soils exhibited low plasticity, loose relative densities, and contained no to weak cementation. Beginning at depths ranging from approximately 4 to 5 feet bgs and extending to the final depths of exploration (about 10 to 15.5 feet bgs), the clayey sands were underlain by: silty clayey sand (SC-SM) followed by poorly graded sand (SP-SM) at Boring SD2; lean clay (CL) followed by sandy clayey silt (CL-ML) and clayey sand (SC) at Boring SD13; and sandy lean clay (CL) at Boring SD16. These subsurface materials exhibited plasticities in the no to medium range, had relative densities generally in the loose to very dense range (coarse-grained soils), had relative firmness in the soft to firm range (fine-grained soils), and contained no to weak cementation. At the location of Boring SD13, silty sand (SM) fill soils were encountered in the upper roughly 2 feet bgs.

At the location of Borings SD12 and SD15, sandy lean clay (CL) and clayey sand (SC) fill soils were encountered to depths of about 5 feet bgs, where the borings were terminated prematurely due to practical auger refusals on very dense/hard materials. These subsurface fill materials exhibited plasticities in the medium range, had relative firmness in the firm to hard range (fine-grained soils), and had relative densities generally in the medium dense to very dense range (coarse-grained soils).

As previously mentioned, Boring SD14 was not drilled due to constraints of existing utilities and private property access restrictions.

Groundwater was not encountered within the borings to the depths explored. It is possible that variations in groundwater elevations may occur due to seasonal changes, run-off, precipitation, perching, and irrigation and/or construction activities. In general, it is not expected that groundwater would impact construction of this project.

5.5 EXCAVATION CHARACTERISTICS

The following general comments regarding excavation conditions are based on boring data. Based on the subsurface conditions encountered, excavations within the upper roughly 4 to 12 feet bgs should be possible using conventional earth excavating equipment. At the location of Borings SD12 and SD15, practical auger refusal occurred at depths of about 5 feet bgs; therefore, areas across the site may require heavier excavating equipment. We recommend that the earthwork contractor make his own assessment to satisfy himself as to the type of equipment required to excavate through these deposits.

Based on our field observations and test results, temporary excavations in native soils may be cut at an inclination no steeper than 1.5:1 (horizontal:vertical). All excavations should be planned and executed in accordance with current OSHA recommendations for a Type C soil (Federal Register 29 CFR Part 1926) and applicable local governing agency standards and procedures. Slopes may need to be further flattened or shored based on conditions encountered during construction. All parties should understand that safety of construction personnel is the sole responsibility of the Contractor. If trench shoring is used, the Engineer of Record should review shoring designs and soil parameters utilized by the shoring designer.

All construction surcharge loads and traffic loads should be kept a distance equal to the depth of the excavation away from the edge of the trench excavations, unless specifically designed for in the shoring design.

5.6 PRELIMINARY SOIL CORROSION CHARACTERISTICS

Corrosivity levels of selected samples were evaluated by laboratory methods including sulfate and chloride contents. The corrosivity tests were performed by Kleinfelder's subcontracted laboratory, Motzz Laboratories, Inc. (Motzz) of Phoenix, Arizona. Results of laboratory tests performed on selected samples are presented in Appendix SD-B.

Based on the laboratory results, sulfate (SO_4) contents range from 28 to 1,098 ppm (or 0.0028 to 0.1098 percent). According to the 2009 Edition of the IBC, which refers to provisions in the American Concrete Institute (ACI) 318, Sections 4.2 and 4.3, results less than 0.1 percent indicate a negligible level of sulfate exposure; and results between 0.1 and 0.2 percent indicate a moderate level of sulfate exposure. Based on these results, concrete in contact with site soils with similar sulfate concentrations should be formulated to resist a moderate sulfate exposure as defined by ACI 318, which recommends Type II Portland cement. Laboratory test results show chloride contents range from 15 to 512 parts per million (ppm).

We recommend that the results of our laboratory testing be reviewed by a person or firm experienced in corrosion protection designs for the actual construction at the site, and/or by the appropriate pipe or material manufacturer. A corrosion specialist should be consulted if a detailed evaluation is necessary, and/or if corrosion protection recommendations are needed.

The laboratory test results presented in this section are based on limited data obtained from borings sampled at the time of our field exploration. It is possible that conditions could vary between or beyond the data evaluated. These results are general in nature and may not be representative of overall site conditions, particularly the actual backfill conditions.

5.7 PIPE BEDDING

The clay site soils contain a significant amount of fines and are not suitable for use as pipe bedding. Therefore, pipe bedding that may be required at the site will likely consist of imported granular materials. Where pipe bedding is comprised of open graded gravels (e.g., crushed rock, pea gravel or similar), a filter fabric may be required between the bedding and the backfill soils to prevent the migration of fines into the bedding materials. Pipe bedding should meet the specifications of the storm drain pipe manufacturer.

5.8 ENGINEERED FILL

Engineered (compacted) fill used to backfill the storm-drain excavation areas should be inorganic soils (site derived or imported) with equal or better support characteristics than those materials which were encountered by Kleinfelder. The on-site soils encountered at the storm drain borings generally consisted of lean sandy clays and clayey sands with medium plasticities, which are suitable to be used as engineered fill for the storm drain line backfill. On-site soils excavated from the storm drain excavation areas may be used as engineered fill as approved by the geotechnical engineer provided the engineered fill soils are free of vegetation, organics, debris, and contain no rocks or clumps larger than 4 inches nominal diameter.

5.9 SITE GRADING

The following site grading recommendations are intended to provide support for roadway structures overlying the storm drain line at the site. Therefore, the grading activities at the site should be performed under observation and testing directed by the geotechnical engineer.

Trash, debris, vegetation (including roots) and other organics, any existing spread fill, any unstable (soft, loose, disturbed, water softened, etc.) soils, and other deleterious materials should be removed from proposed storm drain areas prior to construction. All areas of excavation should be observed and approved by a representative of the geotechnical engineer after clearing and before any filling operations begin at the site.

The storm drain excavations should extend completely through any existing fill, backfill, disturbed soils, or other unsuitable material. Excavations or irregular terrain should be widened to accommodate compaction equipment and provide a level base for placing fill. The exposed native soils at the base of the excavation should be proof-rolled under the direct supervision of the geotechnical engineer. Following the approval of the geotechnical engineer, the cleared or over-excavated area should be backfilled with approved on-site or imported structural fill soils compacted as recommended in the following section. Fill placed on existing structural fill or natural slopes steeper than 5H:1V should be keyed and benched into the existing slope.

5.10 FILL PLACEMENT AND COMPACTION

Moisture conditioned on-site or imported structural fill materials should be placed in 6 to 8-inch thick loose lifts and compacted to elevate the site to specified finished grade. The materials should be uniform with respect to material type and moisture content. The moisture content should be maintained until covered by the placement of the next lift. Care should be taken to avoid damaging the storm drain pipe during compaction efforts.

In proposed storm drain excavation areas, the lifts of approved on-site or imported engineered fill soils placed at depths greater than 5 feet below finished subgrade should be moisture conditioned within 2 percent of optimum moisture content, and uniformly compacted to a minimum of 100 percent of their maximum dry density as determined by ASTM D698. Engineered fill soils placed within the upper 5 feet below finished subgrade should be moisture conditioned within 2 percentage points from their optimum moisture content, and be uniformly compacted to a minimum of 95 percent of maximum dry density as determined by ASTM D698.

Observation and testing should be performed as necessary in order to meet the project requirements and the recommendations presented in this report.

FIGURES

ATTACHED IMAGES: Images: Aerial-Image_1304_6-8-12_107th.jpg Images: Aerial-Image_1304_6-8-12_83rd.jpg Images: Aerial-Image_1304_6-8-12_91st.jpg Images: Aerial-Image_1304_6-8-12_99th.jpg Images
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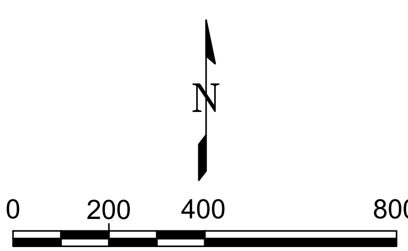

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EXPLANATION

APPROXIMATE KLEINFELDER BORING LOCATION

SOURCE: GOOGLE EARTH PRO, 6/08/12.

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PROJECT NO. 129067	**STORM DRAIN EXPLORATION SITE PLAN**		FIGURE
DRAWN: 11/2012			
DRAWN BY: MRG			**SD-1**
CHECKED BY: RP	MC-85 (BUCKEYE ROAD) FROM 107TH TO 99TH AVENUE MARICOPA COUNTY (PHOENIX), ARIZONA		
FILE NAME: 129067-FigSD-1 to SD-4.dwg			

ATTACHED IMAGES: Images: Aerial-Image_1304_6-8-12_107th.jpg Images: Aerial-Image_1304_6-8-12_83rd.jpg Images: Aerial-Image_1304_6-8-12_91st.jpg Images: Aerial-Image_1304_6-8-12_99th.jpg Images
ATTACHED XREFS:
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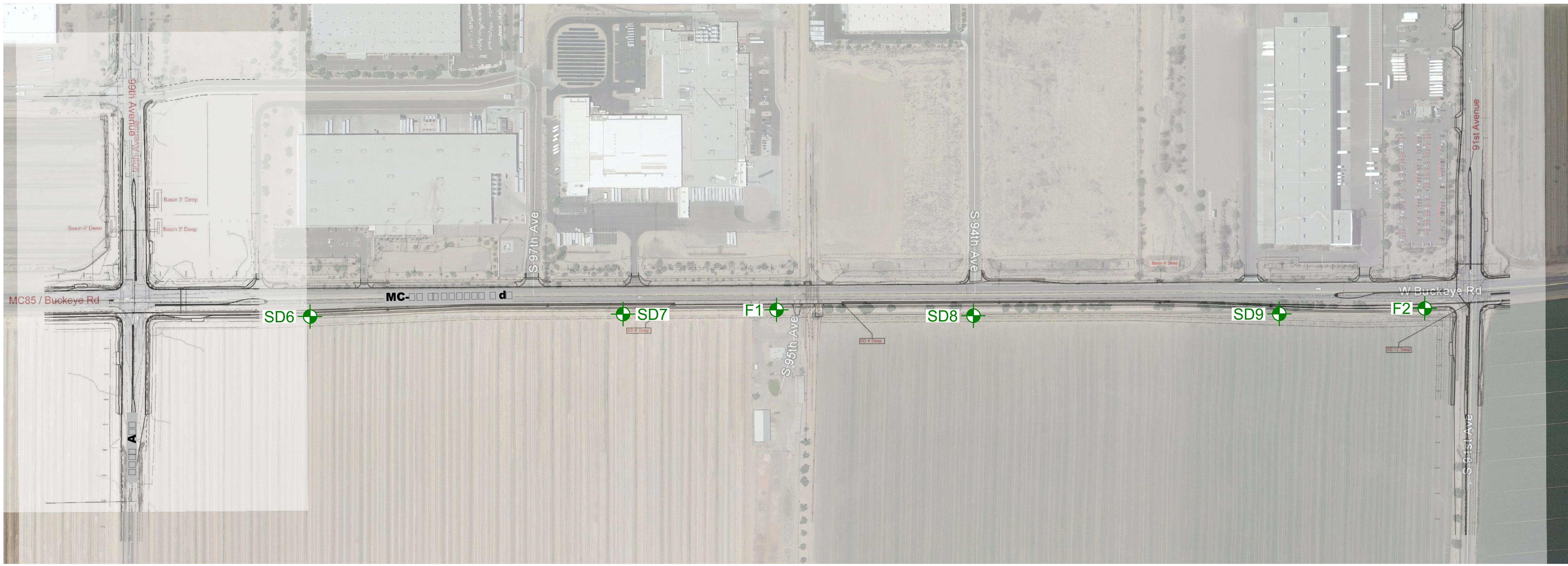

N

0 200 400 800

APPROXIMATE SCALE (feet)

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E□P□ANATI□N

APPROXIMATE KLEINFELDER BORING LOCATION

SOURCE: GOOGLE EARTH PRO, 6/08/12.

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DRAWN:	11/2012
DRAWN BY:	MRG
CHECKED BY:	RP
FILE NAME:	129067-FigSD-1 to SD-4.dwg

ST□□M □□AIN E□P□□□ATI□N SITE P□AN

MC-85 (BUCKEYE ROAD)
FROM 99TH TO 91ST AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

S□-□

ATTACHED IMAGES: Images: Aerial-Image_1304_6-8-12_107th.jpg Images: Aerial-Image_1304_6-8-12_83rd.jpg Images: Aerial-Image_1304_6-8-12_91st.jpg Images: Aerial-Image_1304_6-8-12_99th.jpg Images
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LONG BEACH, CA

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APPROXIMATE SCALE (feet)

EXPLANATION

APPROXIMATE KLEINFELDER BORING LOCATION

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DRAWN BY:	MRG
CHECKED BY:	RP
FILE NAME:	129067-FigSD-1 to SD-4.dwg

STORM DRAIN EXPLORATION SITE PLAN

MC-85 (BUCKEYE ROAD)
FROM 91ST AVENUE TO 83RD AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

SD-3

ATTACHED IMAGES: Images: Aerial-Image_1304_6-8-12_107th.jpg Images: Aerial-Image_1304_6-8-12_83rd.jpg Images: Aerial-Image_1304_6-8-12_91st.jpg Images: Aerial-Image_1304_6-8-12_99th.jpg Images
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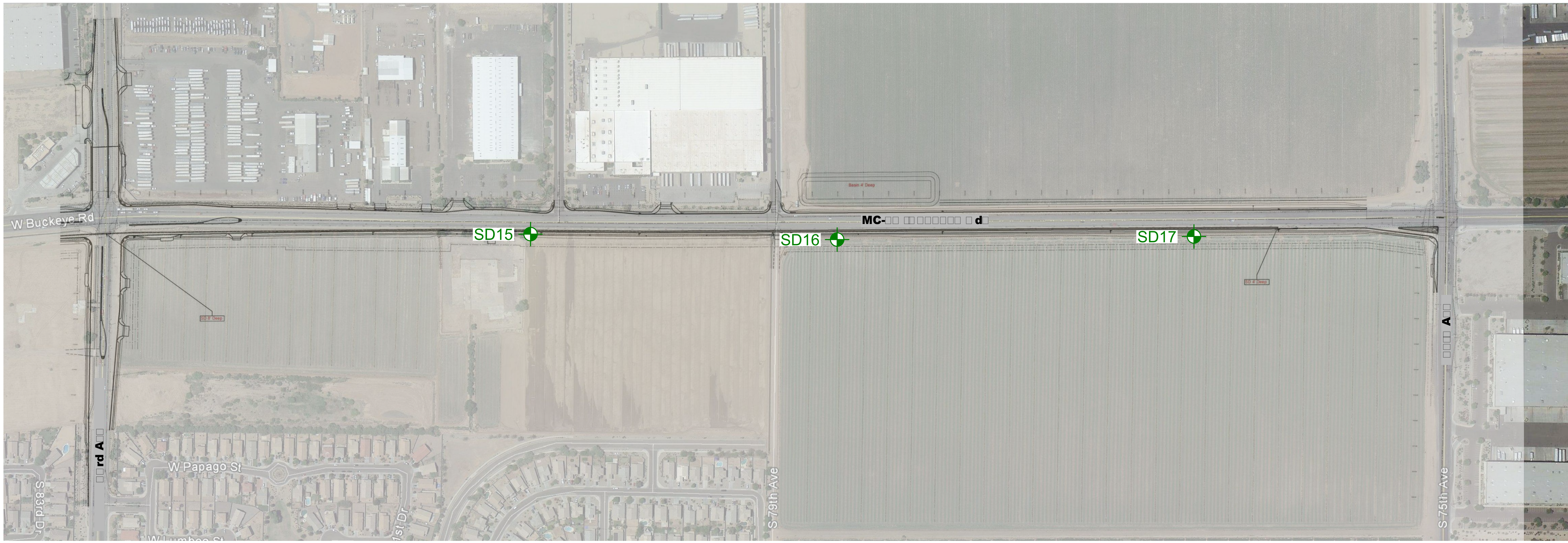

N

0 200 400 800
APPROXIMATE SCALE (feet)

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APPROXIMATE KLEINFELDER BORING LOCATION

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DRAWN BY:	MRG
CHECKED BY:	RP
FILE NAME:	129067-FigSD-1 to SD-4.dwg

ST□□M □□AIN E□P□□□ATI□N SITE P□AN

MC-85 (BUCKEYE ROAD)
FROM 83RD AVENUE TO 75TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

S□-□

APPENDIX SD-A

Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LESS THAN 5% PASSING NO. 200 SIEVE	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% PASSING NO. 200 SIEVE	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LESS THAN 5% PASSING NO. 200 SIEVE	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% PASSING NO. 200 SIEVE	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

Note: Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing No. 200 sieve require dual USCS symbols. (See KEY A3 if provided)

KLEINFELDER Bright People. Right Solutions.		UNIFIED SOIL CLASSIFICATION SYSTEM	PLATE
Report Date: December 2012	Project Number: 129067	MC-85 (Buckeye Road) From 107th Avenue to 75th Avenue Maricopa County (Phoenix / Tolleson), Arizona	A1

LOG SYMBOLS

BULK / GRAB SAMPLE

MODIFIED CALIFORNIA SAMPLER
(2 inch inside diameter)

RING (PORTER) SAMPLER
(2-1/2 inch inside diameter)

STANDARD PENETRATION
SPLIT SPOON SAMPLER
(1.4 inch inside diameter)

SHELBY TUBE
(3 inch outside diameter)

HQ-3 SIZE CORE BARREL
(2.4 inch inside diameter)

WATER LEVEL
(level after completion)

WATER LEVEL
(level where first encountered)

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
3. Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.
5. NA = Not Analyzed

Boring Location:	Latitude: 33.4353° Longitude: -112.28745°	Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	10.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LAB: Insitu Dry Density (pcf)	LAB: Field Moisture Content (%)	LAB: Liquid Limit	LAB: Plasticity Index	LAB: Passing #4 Sieve (%)	LAB: Passing #200 Sieve (%)	LAB: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 10.5 feet — Agricultural field - alfalfa
							39	22	99	68	Max Dry Dens = 113.8pcf Opt Moist = 15.6% Swell = 1.4% R-value = 17 Sulfates = 77 ppm Chlorides = 216 ppm		CL	**SANDY LEAN CLAY:** brown to light brown, firm, medium plasticity, no cementation, trace gravel, damp, upper roughly 12 to 18 inches disturbed by agricultural plowing.
			18/12		109	13								
	5		3-4-4								Sulfates = 75 ppm Chlorides = 96 ppm			Note: soft to moderately firm below about 5 feet.
			4-4-4										SM	**SILTY SAND:** brown, loose, non-plastic, no cementation, slightly damp to damp.
	10													
														Stopped drilling at 9.0 feet. Stopped sampling at 10.5 feet. No groundwater encountered in test boring. Cave-in to 6.0 feet.
	15													
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

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LOG OF BORING SD1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A3

Report Date:	Project Number:
December 2012	129067

Boring Location:	Latitude: 33.43534° Longitude: -112.28551°	Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120
Logged By:	R. Katako		
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger
Hammer Type:	Automatic	Elevation (ft):	N/A
Total Depth (ft):	15.5		

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.5 feet
														Graded dirt shoulder - Buckeye Road
							23	8	97	47			SC	**CLAYEY SAND:** brown to light brown, loose, low plasticity, no cementation, slightly damp to damp, upper roughly 12 inches disturbed by previous grading.
				7										
				6										
			3-3-3											
				7										
				6										
				7										
	5		3-3-3								Sulfates = 207 ppm Chlorides = 129 ppm Sulfates = 156 ppm Chlorides = 201 ppm		SC-SM	**SILTY, CLAYEY SAND:** brown, loose, low plasticity, no cementation, trace gravel, damp.
				6										
				9										
				8										
							26	6	98	32	Sulfates = 81 ppm Chlorides = 54 ppm			
				11										
			25/12		108	8								Note: medium dense and fine to coarse grained below about 9 feet.
	10													
													SP-SM	**POORLY GRADED SAND with SILT:** brown to light brown, medium dense, non-plastic, no cementation, trace gravel, slightly damp to damp.
			7-8-10											
	15													
														Stopped drilling at 14.0 feet. Stopped sampling at 15.5 feet. No groundwater encountered in test boring. Cave-in to 11.0 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

KLEINFELDER
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Report Date: December 2012

Project Number: 129067

LOG OF BORING SD2

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A4

Boring Location:	Latitude: 33.43546° Longitude: -112.28084°	Date Started:	11/1/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	11/1/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120
Logged By:	R. Katako		
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger
Hammer Type:	Automatic	Elevation (ft):	N/A
Total Depth (ft):	10.5		

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 10.5 feet — Agricultural field - cut corn
				8, 9			45	28	98	66			CL	**SANDY LEAN CLAY:** brown to light brown, moderately firm, medium to high plasticity, no cementation, trace gravel, slightly damp, upper roughly 12 to 18 inches disturbed by agricultural plowing.
			4-4-6	13, 14, 15										
	5		29/12	11, 11, 15, 20	111	13					Sulfates = 73 ppm Chlorides = 118 ppm		SC	**CLAYEY SAND:** light brown to tan, medium dense, low plasticity, no to weak cementation, slightly damp, with calcareous veins.
	10		3-4-4										SM	**SILTY SAND:** brown to light brown, loose, non-plastic, no cementation, slightly damp.
	15													
	20													

Stopped drilling at 9.0 feet.
Stopped sampling at 10.5 feet.
No groundwater encountered in test boring.
Cave-in to 7.0 feet.

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Report Date: December 2012

Project Number: 129067

LOG OF BORING SD3

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A5

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

Boring Location:	Latitude: 33.43549° Longitude: -112.27753°			Date Started:	11/1/2012
Groundwater (ft):	No Groundwater Encountered			Date Completed:	11/1/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic	Elevation (ft):	N/A	Total Depth (ft):	14.3

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	Field Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 14.3 feet — Agricultural field - cut corn
				9			44	28	100	82	Max Dry Dens = 104.2pcf Opt Moist = 19.7% Swell = 3.4% R-value < 5		CL	**LEAN CLAY with SAND:** brown, moderately firm, medium plasticity, no cementation, slightly damp to damp, upper roughly 12 to 18 inches disturbed by agricultural plowing.
				8										
			15/12		98	17								
				7										
				8										
				9										
	5		5-8-9								Sulfates = 88 ppm Chlorides = 59 ppm Sulfates = 97 ppm Chlorides = 99 ppm			Note: firm and with calcareous veins below about 5 feet.
				16										
				15										
				16										
				17										
			5-5-6										SC-SM	**SILTY, CLAYEY SAND:** brown to light brown, medium dense, low plasticity, no cementation, slightly damp.
	10													
			50/4			11								Note: brown and gray very dense, and stratified with thin layers of angular fine clayey gravel below about 14 feet.
	15													Stopped drilling at 14.0 feet. Sampler refusal at 14.3 feet. No groundwater encountered in test boring. Cave-in to 10.8 feet.
	20													

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LOG OF BORING SD4

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

Report Date:	Project Number:	PLATE
December 2012	129067	A6

Boring Location:	Latitude: 33.4355° Longitude: -112.27369°	Date Started:	11/1/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	11/1/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	10.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 10.0 feet — Agricultural field - cut corn
				7			46	28	99	72			CL	**LEAN CLAY with SAND:** brown to light brown, moderately firm, medium to high plasticity, no to weak cementation, trace gravel, damp, upper roughly 12 to 18 inches disturbed by agricultural plowing.
				11										
			4-5-5	11										
				12										
				11										
	5		3-3-2	18							Sulfates = 73 ppm Chlorides = 103 ppm		CL	**SANDY CLAY:** brown, soft, medium plasticity, no cementation, slightly damp to damp.
				13										
				16										
				20										
			22/12		104	11							SM	**SILTY SAND:** light brown, medium dense, non-plastic, no cementation, damp.
	10													Stopped drilling at 9.0 feet. Stopped sampling at 10.0 feet. No groundwater encountered in test boring. Cave-in to 7.6 feet.
	15													
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

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LOG OF BORING SD5

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A7

Report Date: December 2012
Project Number: 129067

Boring Location:	Latitude: 33.43556° Longitude: -112.27006°	Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc. — Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 — Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic — Elevation (ft): N/A	Total Depth (ft):	10.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LAB: Insitu Dry Density (pcf)	LAB: Field Moisture Content (%)	LAB: Liquid Limit	LAB: Plasticity Index	LAB: Passing #4 Sieve (%)	LAB: Passing #200 Sieve (%)	LAB: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 10.0 feet — Agricultural field - alfalfa
				10			44	27	100	75			CL	**LEAN CLAY with SAND:** brown, soft, medium plasticity, no cementation, damp, upper roughly 12 to 18 inches disturbed by agricultural plowing.
				6										
			2-2-2	4										
				5										
	5			6										
			3-3-4	6							Sulfates = 69 ppm Chlorides = 134 ppm Sulfates = 71 ppm Chlorides = 140 ppm			
				7										
				9										
				16										
			45/12		104	16							ML	**SANDY SILT:** brown to light brown, dense, non-plastic, no cementation, slightly damp.
	10													Stopped drilling at 9.0 feet. Stopped sampling at 10.0 feet. No groundwater encountered in test boring. Cave-in to 8.0 feet.
	15													
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

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Report Date: December 2012

Project Number: 129067

LOG OF BORING SD6

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A8

Boring Location:	Latitude: 33.4356° Longitude: -112.26602°	Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	10.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 10.5 feet Agricultural field - alfalfa
							44	26	100	85	Sulfates = 153 ppm Chlorides = 222 ppm		CL	**LEAN CLAY with SAND:** brown, soft to moderately firm, medium plasticity, no cementation, moist, upper roughly 12 to 18 inches disturbed by agricultural plowing.
			8/12		92	24								
	5		17/12		100	22					Sulfates = 60 ppm Chlorides = 79 ppm			Note: firm below about 5 feet.
			7-9-13										SC	**CLAYEY SAND:** light brown to tan, medium dense, low plasticity, weak cementation, trace gravel, slightly damp.
	10													
														Stopped drilling at 9.0 feet. Stopped sampling at 10.5 feet. No groundwater encountered in test boring. Cave-in to 6.5 feet.
	15													
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

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Report Date: December 2012

Project Number: 129067

LOG OF BORING SD7

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

A9

Boring Location:	Latitude: 33.4356° Longitude: -112.26408°	Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	15.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.0 feet
														Graded landscaped area, developed parcel
				8			49	30	99	77	Sulfates = 631 ppm Chlorides = 512 ppm		CL	**LEAN CLAY with SAND:** brown, soft, medium to high plasticity, no cementation, trace gravel, moist, upper roughly 12 inches disturbed by previous grading.
				7										
			2-3-3	3										
				4										
				8										
	5		24/12	10	102	19								Note: brown to light brown, firm, weak cementation, and vesicular below about 5 feet.
				11										
				18										
				20										
			11-13-11											
	10												SM	**SILTY SAND:** brown to light brown, medium dense, non-plastic, no cementation, slightly damp.
			24/12		104	6								Note: trace fine gravel below about 14 feet.
	15													Stopped drilling at 14.0 feet. Stopped sampling at 15.0 feet. No groundwater encountered. Cave-in to 12.0 feet.
	20													

GEO_ADOT_EWEL_R 129067 MC-85.GPJ 12/28/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING F1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

A10

Boring Location:	Latitude: 33.43567° Longitude: -112.26157°	Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	10.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	Field Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	USCS Classification	DESCRIPTION 0.0 to 10.5 feet — Graded dirt shoulder - Buckeye Road
			15								FILL	**FILL: CLAYEY SAND:** brown and gray, low plasticity, with gravel, slightly damp, upper roughly 12 inches disturbed by previous grading.
						33	18	85	57	Max Dry Dens = 112.1pcf	CL	
			7							Opt Moist = 14.0%		
		18/12		108	13					Swell = 3.2% R-value = 8		**NATIVE: SANDY LEAN CLAY:** brown, firm, medium plasticity, no cementation, with gravel, damp.
			6									
			7									
			9									
	5	3-6-8								Sulfates = 168 ppm Chlorides = 111 ppm		Note: brown to light brown, moderately firm, and weak cementation below 5 feet.
			12							Sulfates = 166 ppm Chlorides = 178 ppm		
			15									
			15									
			19									
		5-7-7										Note: stratified with thin layers of sandy clay below about 9 feet.
	10											
												Stopped drilling at 9.0 feet. Stopped sampling at 10.5 feet. No groundwater encountered in test boring. Cave-in to 7.5 feet.
	15											
	20											

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Report Date: December 2012

Project Number: 129067

LOG OF BORING SD8

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A11

Boring Location:	Latitude: 33.43561° Longitude: -112.25769°	Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	15.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.0 feet — Graded dirt shoulder - Buckeye Road
													FILL	**FILL: CLAYEY GRAVEL:** brown and gray, low plasticity, with cobbles and gravel, with sand, slightly damp.
			3-4-4				49	32	94	78			CL	**NATIVE: LEAN CLAY with SAND:** brown, soft, medium to high plasticity, no cementation, trace gravel, moist.
	5		13/12		92	22					Sulfates = 413 ppm Chlorides = 348 ppm			Note: brown to light brown, moderately firm, and weak cementation below about 5 feet.
	10		6-9-13								Sulfates = 116 ppm Chlorides = 76 ppm			
			27/12		110	16							SC	**CLAYEY SAND:** brown, medium dense, low plasticity, no to weak cementation, damp.
	15													Stopped drilling at 14.0 feet. Stopped sampling at 15.0 feet. No groundwater encountered in test boring. Cave-in to 11.0 feet.
	20													

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LOG OF BORING SD9

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A12

Report Date: December 2012
Project Number: 129067

Boring Location:	Latitude: 33.43561° Longitude: -112.25579°	Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	15.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	USCS Classification	DESCRIPTION 0.0 to 15.5 feet — Graded dirt shoulder - Buckeye Road
			12								FILL	**FILL: CLAYEY SAND:** brown, low plasticity, trace gravel, slightly damp.
			6								CH	**NATIVE: FAT CLAY with SAND:** brown to light brown, moderately firm, high plasticity, weak cementation, trace gravel, damp.
		15/12		95	17							
			5									
			6									
			6									
	5	4-5-5				50	32	99	79	Sulfates = 60 ppm Chlorides = 57 ppm		
			6									
			9									
			12									
			14									
		34/12		106	8						CL	**SANDY CLAY:** brown to light brown, very firm, low to medium plasticity, weak cementation, slightly damp.
	10											
		11-11-25								Sulfates = 46 ppm Chlorides = 219 ppm		Note: stratified with thin layers of clayey sand below about 14 feet.
	15											
												Stopped drilling at 14.0 feet. Stopped sampling at 15.5 feet. No groundwater encountered in test boring. Cave-in to 11.0 feet.
	20											

GEO_ADOT_EWEL_R 129067 MC-85.GPJ 12/28/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING F2

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
A13

Boring Location:	Latitude: 33.43587° Longitude: -112.25272°	Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	15.5

ELEVATION (ft)	DEPTH (ft)	Sample Interval	Blow Count	Continuous Pen. Bullnose (bpf)	Insitu Dry Density (pcf)	Field Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.5 feet — Graded dirt shoulder - Buckeye Road
				13									FILL	**FILL: CLAYEY SAND:** brown and gray, low plasticity, some gravel, slightly damp.
				17			42	26	96	72	Max Dry Dens = 106.2pcf Opt Moist = 16.4% Swell = 2.9% R-value = 8		CL	**NATIVE: LEAN CLAY with SAND:** brown to light brown, firm, medium plasticity, no cementation, trace gravel, damp.
			10-13-15	20										
				17										
				14										
	5		13-13-17	15							Sulfates = 116 ppm Chlorides = 18 ppm			
				15										
				15										
				12										
			23/12		101	21					Sulfates = 126 ppm Chlorides = 59 ppm			Note: moist and stratified with thin layers of sandy silt (ML) at about 9 feet.
	10													
													SM	**SILTY SAND:** brown to light brown, medium dense, non-plastic, weak cementation, slightly damp to damp.
			7-8-11											
	15													
														Stopped drilling at 14.0 feet. Stopped sampling at 15.5 feet. No groundwater encountered in test boring. Cave-in to 11.0 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

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LOG OF BORING SD10

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
A14

Report Date:	Project Number:
December 2012	129067

Boring Location:	Latitude: 33.43632° Longitude: -112.24815°	Date Started:	11/1/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	11/1/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	15.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.5 feet Graded dirt shoulder - Buckeye Road
	0						28	12	80	34			FILL	**FILL: CLAYEY SAND with GRAVEL:** brown, low plasticity, slightly damp.
	2		9/12		104	15								
	5		7-10-12								Sulfates = 625 ppm Chlorides = 53 ppm		CL	**NATIVE: SANDY CLAY:** brown, firm, medium plasticity, no cementation, trace gravel, slightly damp to damp.
	9		16/12											
	10		8-8-10								Sulfates = 1,098 ppm Chlorides = 191 ppm			
	13												SC	**CLAYEY SAND:** brown to light brown, dense, low plasticity, no cementation, trace gravel, slightly damp to damp.
	14		14-18-30											
	15													
	20													

Stopped drilling at 14.0 feet.
Stopped sampling at 15.5 feet.
No groundwater encountered in test boring.
Cave-in to 5.0 feet.

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING SD11

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
A15

Boring Location:	Latitude: 33.43654° Longitude: -112.24486°	Date Started:	11/1/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	11/1/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	5.4

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 5.4 feet Graded dirt shoulder - Buckeye Road
							41	26	90	56	Max Dry Dens = 117.8pcf Opt Moist = 13.8% Swell = 3.1% R-value = 5		FILL	**FILL: SANDY LEAN CLAY:** brown and gray, firm, medium plasticity, no cementation, some gravel, slightly damp.
			12-12-12											
	5		50/5											Note: hard at 5 feet.
														Auger refusal at 5.0 feet. Sampler refusal at 5.4 feet. No groundwater encountered in test boring.
	10													
	15													
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING SD12

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

A16

Boring Location:	Latitude: 33.43694° Longitude: -112.24062°	Date Started:	11/1/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	11/1/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	15.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.0 feet Graded dirt shoulder - Buckeye Road
													FILL	**FILL: SILTY SAND:** brown, non-plastic, slightly damp.
			4-6-3										SC	**NATIVE: CLAYEY SAND:** brown, loose, low plasticity, weak cementation, trace gravel, slightly damp.
							40	23	97	75			CL	**LEAN CLAY with SAND:** light brown, firm, medium plasticity, weak cementation, trace gravel, damp.
	5		16/12		105	15					Sulfates = 51 ppm Chlorides = 15 ppm			
			7-10-14								Sulfates = 28 ppm Chlorides = 33 ppm		CL-ML	**SANDY, CLAYEY SILT:** light brown, firm, low plasticity, weak cementation, slightly damp.
	10													
													SC	**CLAYEY SAND:** light brown, very dense, low plasticity, weak cementation, damp.
			62/12		103	19								
	15													Stopped drilling at 14.0 feet. Stopped sampling at 15.5 feet. No groundwater encountered in test boring. Cave-in to 10.7 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

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Report Date: December 2012

Project Number: 129067

LOG OF BORING SD13

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A17

Boring Location:	Latitude: 33.43705° Longitude: -112.2328°			Date Started:	11/1/2012
Groundwater (ft):	No Groundwater Encountered			Date Completed:	11/1/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic	Elevation (ft):	N/A	Total Depth (ft):	5.3

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 5.3 feet Graded dirt shoulder - Buckeye Road
				18			29	14	81	38	Max Dry Dens = 122.9pcf Opt Moist = 11.1% Swell = 1.3% Sulfates = 233 ppm Chlorides = 362 ppm		FILL	**FILL: CLAYEY SAND with GRAVEL:** brown and gray, medium dense, medium plasticity, slightly damp.
			15-8-7	13										
				13										
				7										
	5		50/4	6										
				17										Note: very dense with cobbles below about 5 feet.
				20										Auger refusal at 5.0 feet. Sampler refusal at 5.3 feet. No groundwater encountered in test boring.
				21										
				20										
	10													
	15													
	20													

GEO_ADOT_EWEL_R 129067 MC-85.GPJ 12/28/12

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LOG OF BORING SD15

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A18

Report Date:	Project Number:
December 2012	129067

Boring Location:	Latitude: 33.43692° Longitude: -112.22885°	Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	10.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 10.0 feet Agricultural field - alfalfa
	0			4			26	11	99	45	Sulfates = 122 ppm Chlorides = 233 ppm		SC	**CLAYEY SAND:** brown, loose, low plasticity, no cementation, trace gravel, damp, upper roughly 12 to 18 inches disturbed by agricultrual plowing.
				5										
			2-3-3	5										
				7										
				8										
	5		3-3-3	14			33	18	100	64	Sulfates = 138 ppm Chlorides = 366 ppm Sulfates = 164 ppm Chlorides = 459 ppm		CL	**SANDY LEAN CLAY:** brown, soft, medium plasticity, no cementation, slightly damp.
				18										
				19										
				14										
			16/12		100	5								Note: firm and stratified with thin layers of silty sand (SM) below about 9 feet.
	10													Stopped drilling at 9.0 feet. Stopped sampling at 10.0 feet. No groundwater encountered in test boring. Cave-in to 8.5 feet.
	15													
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

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LOG OF BORING SD16

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

Report Date:	Project Number:	PLATE
December 2012	129067	A19

Boring Location:	Latitude: 33.43695° Longitude: -112.22426°	Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120
Logged By:	R. Katako		
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger
Hammer Type:	Automatic	Elevation (ft):	N/A
Total Depth (ft):	10.5		

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 10.5 feet — Agricultural field - alfalfa
	0		2-2-2	3, 3, 3, 5			37	21	100	74	Max Dry Dens = 108.3pcf Opt Moist = 15.3% Swell = 3.5% R-value = 14 Sulfates = 69 ppm Chlorides = 103 ppm Sulfates = 54 ppm Chlorides = 58 ppm		CL	**LEAN CLAY with SAND:** brown, very soft, medium plasticity, no cementation, damp, upper roughly 12 to 18 inches disturbed by agricultural plowing.
	5		19/12	7, 8, 8, 8	98	20					Sulfates = 60 ppm Chlorides = 66 ppm			Note: brown to light brown, firm, medium plasticity, no to weak cementation, and moist below about 5 feet.
	8		3-3-4	14									ML	**SANDY SILT:** brown, loose, no to low plasticity, no cementation, damp, stratified with thin layers of fine sand.
	10													
	15													
	20													

Stopped drilling at 9.0 feet.
Stopped sampling at 10.0 feet.
No groundwater encountered in test boring.
Cave-in to 7.5 feet.

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/28/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING SD17

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

A20

APPENDIX SD-B

Laboratory Test Results

SAMPLE LOCATION	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRAIN SIZE ANALYSIS GRAVEL (%)	SAND (%)	FINES (%)	ATTERBERG LIMITS LL	PL	PI	OTHER TESTS(1)	UNIFIED SOIL CLASSIFICATION (USCS)
SD1 @ 0-5'			1	31	68	39	17	22	MDD / OMC = 113.8 / 15.6 S = 1.4 R = 17 SULF = 77 CHLO = 216	SANDY LEAN CLAY (CL)
SD1 @ 2-3'	13.1	109.0								
SD1 @ 5-9'									SULF = 75 CHLO = 96	
SD2 @ 0-5'			3	50	47	23	15	8		CLAYEY SAND (SC)
SD2 @ 5-8'									SULF = 156 CHLO = 201	
SD2 @ 5-6.5'									SULF = 207 CHLO = 129	
SD2 @ 8-13'			2	66	32	26	20	6	SULF = 81 CHLO = 54	SILTY, CLAYEY SAND (SC-SM)
SD2 @ 9-10'	7.9	107.9								
SD3 @ 0-5'			2	32	66	45	17	28		SANDY LEAN CLAY (CL)
SD3 @ 5-9'									SULF = 73 CHLO = 118	
SD3 @ 5-6'	12.7	110.9								
SD4 @ 0-5'			0	17	82	44	16	28	MDD / OMC = 104.2 / 19.7 S = 3.4 R < 5	LEAN CLAY with SAND (CL)
SD4 @ 2-3'	16.9	97.7								
SD4 @ 5-9'									SULF = 97 CHLO = 99	
SD4 @ 5-6.5'									SULF = 88 CHLO = 59	
SD4 @ 14-15'	11.1									
SD5 @ 0-5'			1	28	72	46	18	28		LEAN CLAY with SAND (CL)
SD5 @ 5-9'									SULF = 73 CHLO = 103	
SD5 @ 9-10'	10.8	103.9								

NOTES
(1) MDD / OMC = Maximum Dry Density (pcf) / Optimum Moisture Content (%), as determined by a standard (D698) proctor
S = Swell (%)
R = *R*-value
SULF = Sulfates (ppm)
CHLO = Chlorides (ppm)

KLEINFELDER
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Report Date: Dec 2012
Project Number: 129067

SUMMARY OF LABORATORY TESTING
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B1

SAMPLE LOCATION	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRAIN SIZE ANALYSIS GRAVEL (%)	SAND (%)	FINES (%)	ATTERBERG LIMITS LL	PL	PI	OTHER TESTS[1]	UNIFIED SOIL CLASSIFICATION (USCS)
SD6 @ 0-5'			0	25	75	44	17	27		LEAN CLAY with SAND (CL)
SD6 @ 5-9'									SULF = 71 CHLO = 140	
SD6 @ 5-6.5'									SULF = 69 CHLO = 134	
SD6 @ 9-10'	16.4	104.4								
SD7 @ 0-5'			0	15	85	44	18	26	SULF = 153 CHLO = 222	LEAN CLAY with SAND (CL)
SD7 @ 2-3'	24.3	91.6								
SD7 @ 5-9'									SULF = 60 CHLO = 79	
SD7 @ 5-6'	22.1	99.8								
F1 @ 0-5'			1	22	77	49	19	30	SULF = 631 CHLO = 512	LEAN CLAY with SAND (CL)
F1 @ 5-6'	19.4	102.4								
F1 @ 14-15'	5.7	103.8								
SD8 @ 1-5'			15	28	57	33	15	18	MDD / OMC = 112.1 / 14.0 S = 3.2 R = 8	SANDY LEAN CLAY with GRAVEL (CL)
SD8 @ 2-3'	13.2	107.9								
SD8 @ 5-9'									SULF = 166 CHLO = 178	
SD8 @ 5-6.5'									SULF = 168 CHLO = 111	
SD9 @ 1.5-5'			6	16	78	49	17	32		LEAN CLAY with SAND (CL)
SD9 @ 5-9'									SULF = 413 CHLO = 348	
SD9 @ 5-6'	21.5	91.5								
SD9 @ 9-10.5'									SULF = 116 CHLO = 76	
SD9 @ 14-15'	15.5	110.3								

NOTES

(1) MDD / OMC = Maximum Dry Density (pcf) / Optimum Moisture Content (%), as determined by a standard (D698) proctor
S = Swell (%)
R = *R*-value

SULF = Sulfates (ppm)
CHLO = Chlorides (ppm)

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Report Date: Dec 2012 | Project Number: 129067

SUMMARY OF LABORATORY TESTING
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B1

SAMPLE LOCATION	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRAIN SIZE ANALYSIS GRAVEL (%)	SAND (%)	FINES (%)	ATTERBERG LIMITS LL	PL	PI	OTHER TESTS[1]	UNIFIED SOIL CLASSIFICATION (USCS)
F2 @ 2-3'	17.4	95.4								
F2 @ 5-9'			1	20	79	50	18	32	SULF = 60 CHLO = 57	FAT CLAY with SAND (CH)
F2 @ 9-10'	8.2	105.9								
F2 @ 14-15.5'									SULF = 46 CHLO = 219	
SD10 @ 1-5'			4	24	72	42	16	26	MDD / OMC = 106.2 / 16.4 S = 2.9 R = 8	LEAN CLAY with SAND (CL)
SD10 @ 5-9'									SULF = 116 CHLO = 18	
SD10 @ 9-13'									SULF = 126 CHLO = 59	
SD10 @ 9-10'	20.6	100.8								
SD11 @ 0-5'			20	45	34	28	16	12		CLAYEY SAND with GRAVEL (SC)
SD11 @ 2-3'	14.8	103.6								
SD11 @ 5-9'									SULF = 625 CHLO = 53	
SD11 @ 10-11.5'									SULF = 1,098 CHLO = 191	
SD12 @ 0-4'			10	35	56	41	15	26	MDD / OMC = 117.8 / 13.8 S = 3.1 R = 5	SANDY LEAN CLAY (CL)
SD13 @ 5-9'			3	22	75	40	17	23	SULF = 51 CHLO = 15	LEAN CLAY with SAND (CL)
SD13 @ 5-6'	15.2	105.4								
SD13 @ 9-10.5'									SULF = 28 CHLO = 33	
SD13 @ 14-15'	19.3	102.6								
SD15 @ 0-5'			19	44	38	29	15	14	MDD / OMC = 122.9 / 11.1 S = 1.3 SULF = 233 CHLO = 362	CLAYEY SAND with GRAVEL (SC)

NOTES
(1) MDD / OMC = Maximum Dry Density (pcf) / Optimum Moisture Content (%), as determined by a standard (D698) proctor
S = Swell (%)
R = *R*-value

SULF = Sulfates (ppm)
CHLO = Chlorides (ppm)

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SUMMARY OF LABORATORY TESTING
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B1

SAMPLE LOCATION	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			OTHER TESTS[1]	UNIFIED SOIL CLASSIFICATION (USCS)
			GRAVEL (%)	SAND (%)	FINES (%)	LL	PL	PI		
SD16 @ 0-5'			1	54	45	26	15	11	SULF = 122 CHLO = 233	CLAYEY SAND (SC)
SD16 @ 5-9'			0	36	64	33	15	18	SULF = 164 CHLO = 459	SANDY LEAN CLAY (CL)
SD16 @ 5-6.5'									SULF = 138 CHLO = 366	
SD16 @ 9-10'	5.3	99.8								
SD17 @ 0-5'			0	26	74	37	16	21	MDD / OMC = 108.3 / 15.3 S = 3.5 R = 14 SULF = 69 CHLO = 103	LEAN CLAY with SAND (CL)
SD17 @ 2-3.5'									SULF = 54 CHLO = 58	
SD17 @ 5-8'									SULF = 60 CHLO = 66	
SD17 @ 5-6'	20.1	98.1								

NOTES
(1) MDD / OMC = Maximum Dry Density (pcf) / Optimum Moisture Content (%), as determined by a standard (D698) proctor
S = Swell (%)
R = *R*-value
SULF = Sulfates (ppm)
CHLO = Chlorides (ppm)

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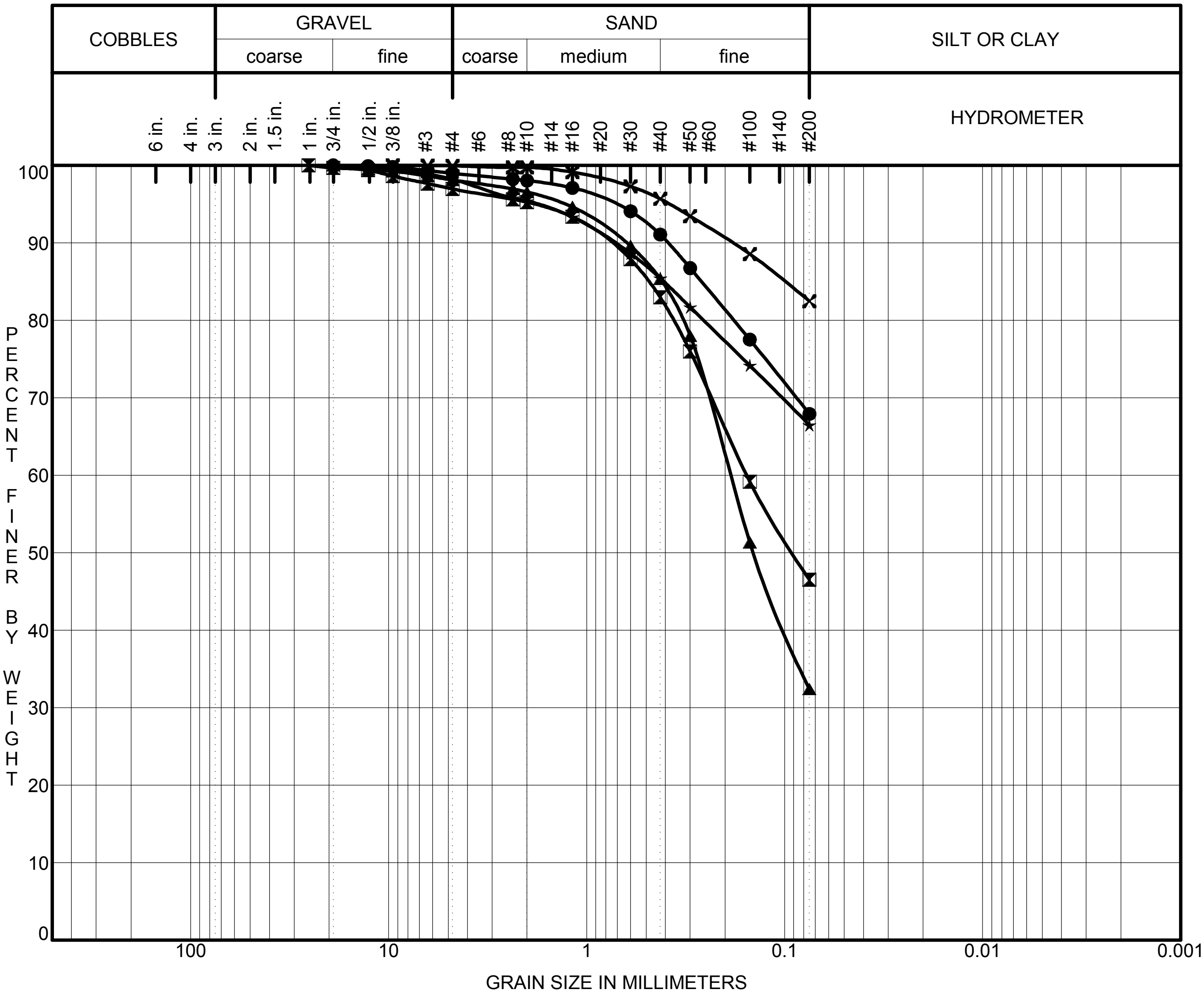
Report Date: Dec 2012
Project Number: 129067

SUMMARY OF LABORATORY TESTING
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B1



	Source	Depth (ft)	%Cobbles	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	SD1	0.0 - 5.0	0	1	31	68				
⧗	SD2	0.0 - 5.0	0	3	50	47		0.2		
▲	SD2	8.0 - 13.0	0	2	66	32		0.2		
★	SD3	0.0 - 5.0	0	2	32	66				
✕	SD4	0.0 - 5.0	0	0	17	82				

	Source	Depth (ft)	Classification	LL	PL	PI	Cu	Cc
●	SD1	0.0 - 5.0	SANDY LEAN CLAY (CL)	39	17	22		
⧗	SD2	0.0 - 5.0	CLAYEY SAND (SC)	23	15	8		
▲	SD2	8.0 - 13.0	SILTY, CLAYEY SAND (SC-SM)	26	20	6		
★	SD3	0.0 - 5.0	SANDY LEAN CLAY (CL)	45	17	28		
✕	SD4	0.0 - 5.0	LEAN CLAY with SAND (CL)	44	16	28		

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Report Date: December 2012

Project Number: 129067

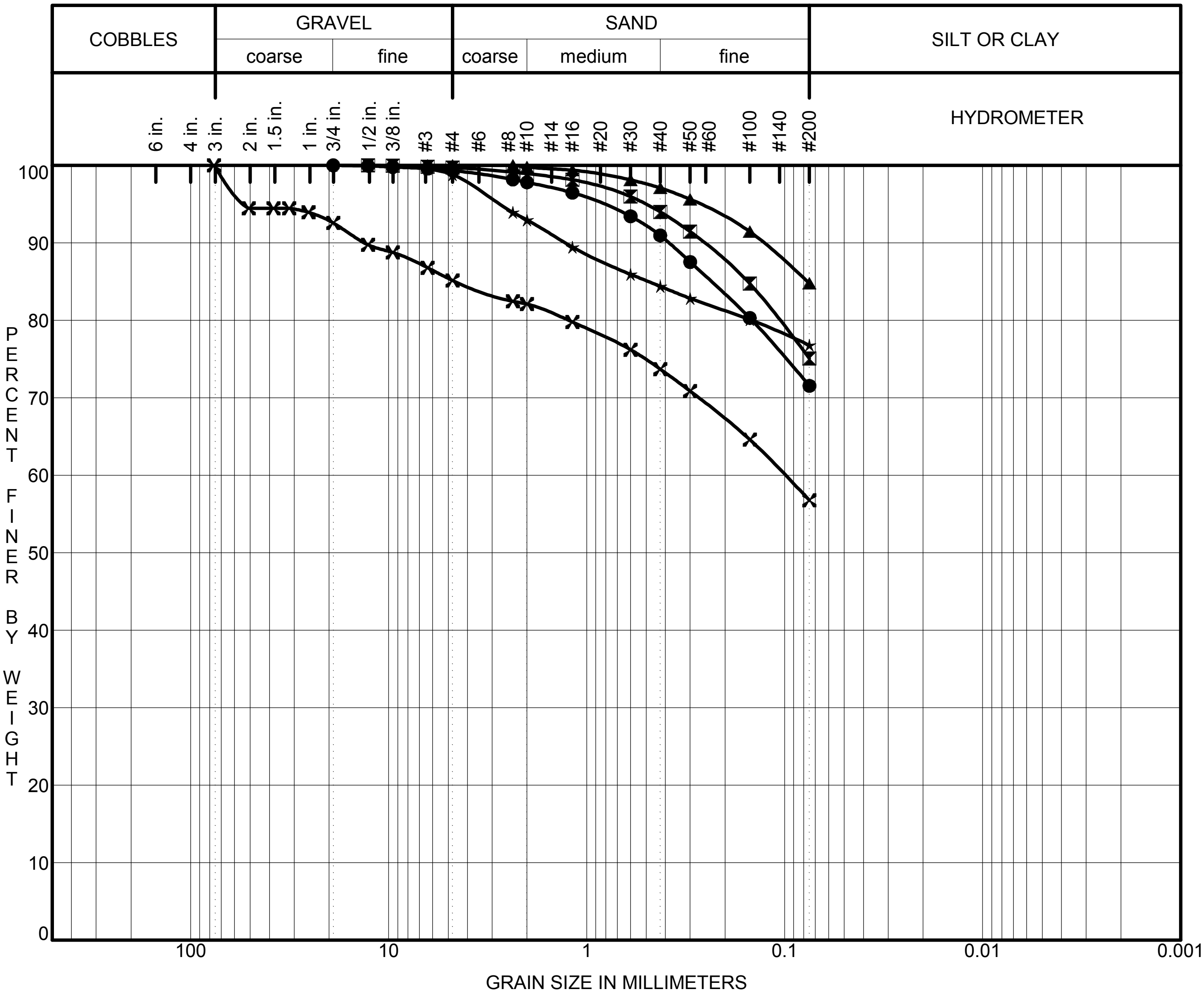
GRAIN SIZE ANALYSES (ASTM C117 and C136)

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B2

123GRAINSIZECOMPLETE 129067 MC-85.GPJ 12/03/12



	Source	Depth (ft)	%Cobbles	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	SD5	0.0 - 5.0	0	1	28	72				
⧗	SD6	0.0 - 5.0	0	0	25	75				
▲	SD7	0.0 - 5.0	0	0	15	85				
★	F1	0.0 - 5.0	0	1	22	77				
✕	SD8	1.0 - 5.0	0	15	28	57		0.1		

	Source	Depth (ft)	Classification	LL	PL	PI	Cu	Cc
●	SD5	0.0 - 5.0	LEAN CLAY with SAND (CL)	46	18	28		
⧗	SD6	0.0 - 5.0	LEAN CLAY with SAND (CL)	44	17	27		
▲	SD7	0.0 - 5.0	LEAN CLAY with SAND (CL)	44	18	26		
★	F1	0.0 - 5.0	LEAN CLAY with SAND (CL)	49	19	30		
✕	SD8	1.0 - 5.0	SANDY LEAN CLAY (CL)	33	15	18		

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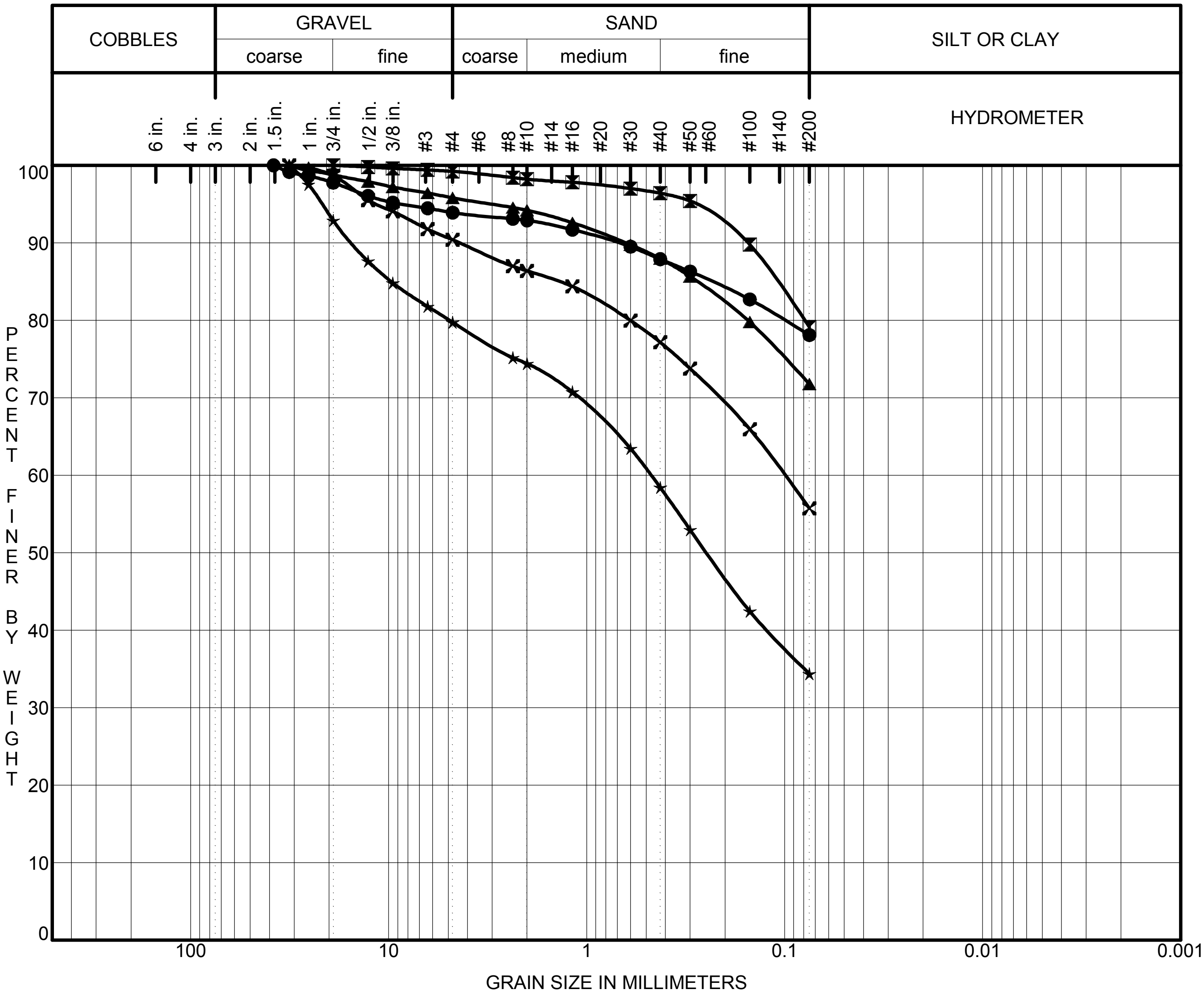
Report Date: December 2012

Project Number: 129067

GRAIN SIZE ANALYSES (ASTM C117 and C136)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B3

123GRAINSIZECOMPLETE 129067 MC-85.GPJ 12/03/12



	Source	Depth (ft)	%Cobbles	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	SD9	1.5 - 5.0	0	6	16	78				
⧗	F2	5.0 - 6.5	0	1	20	79				
▲	SD10	1.0 - 5.0	0	4	24	72				
★	SD11	0.0 - 5.0	0	20	45	34		0.5		
✕	SD12	0.0 - 4.0	0	10	35	56		0.1		

	Source	Depth (ft)	Classification	LL	PL	PI	Cu	Cc
●	SD9	1.5 - 5.0	LEAN CLAY with SAND (CL)	49	17	32		
⧗	F2	5.0 - 6.5	FAT CLAY with SAND (CH)	50	18	32		
▲	SD10	1.0 - 5.0	LEAN CLAY with SAND (CL)	42	16	26		
★	SD11	0.0 - 5.0	CLAYEY SAND with GRAVEL (SC)	28	16	12		
✕	SD12	0.0 - 4.0	SANDY LEAN CLAY (CL)	41	15	26		

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Report Date: December 2012

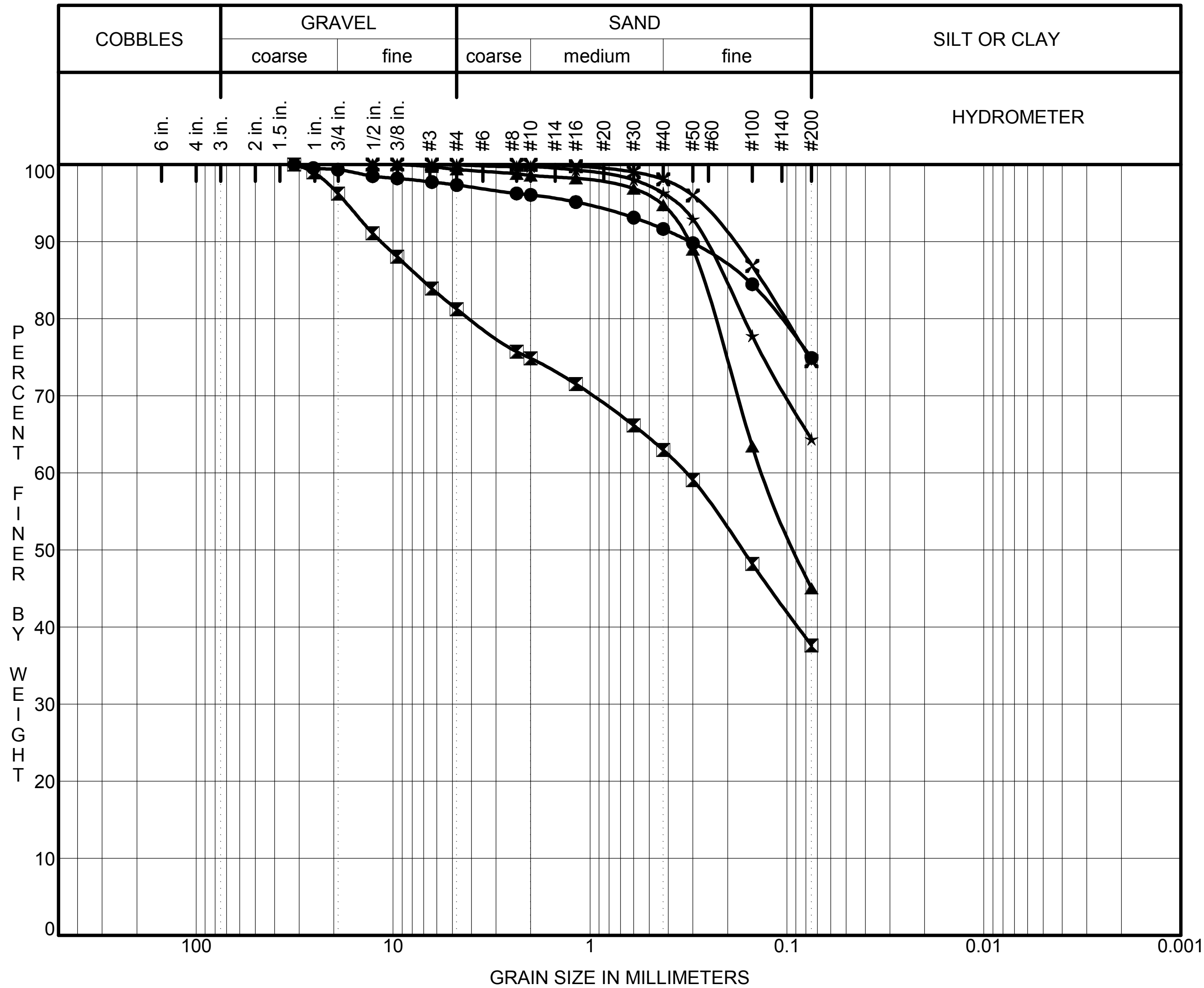
Project Number: 129067

GRAIN SIZE ANALYSES (ASTM C117 and C136)

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B4

123GRAINSIZECOMPLETE 129067 MC-85.GPJ 12/03/12



	Source	Depth (ft)	%Cobbles	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	SD13	4.0 - 9.0	0	3	22	75				
⧗	SD15	0.0 - 5.0	0	19	44	38		0.3		
▲	SD16	0.0 - 5.0	0	1	54	45		0.1		
★	SD16	5.0 - 6.5	0	0	36	64				
✕	SD17	0.0 - 5.0	0	0	26	74				

	Source	Depth (ft)	Classification	LL	PL	PI	Cu	Cc
●	SD13	4.0 - 9.0	LEAN CLAY with SAND (CL)	40	17	23		
⧗	SD15	0.0 - 5.0	CLAYEY SAND with GRAVEL (SC)	29	15	14		
▲	SD16	0.0 - 5.0	CLAYEY SAND (SC)	26	15	11		
★	SD16	5.0 - 6.5	SANDY LEAN CLAY (CL)	33	15	18		
✕	SD17	0.0 - 5.0	LEAN CLAY with SAND (CL)	37	16	21		

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Report Date: December 2012

Project Number: 129067

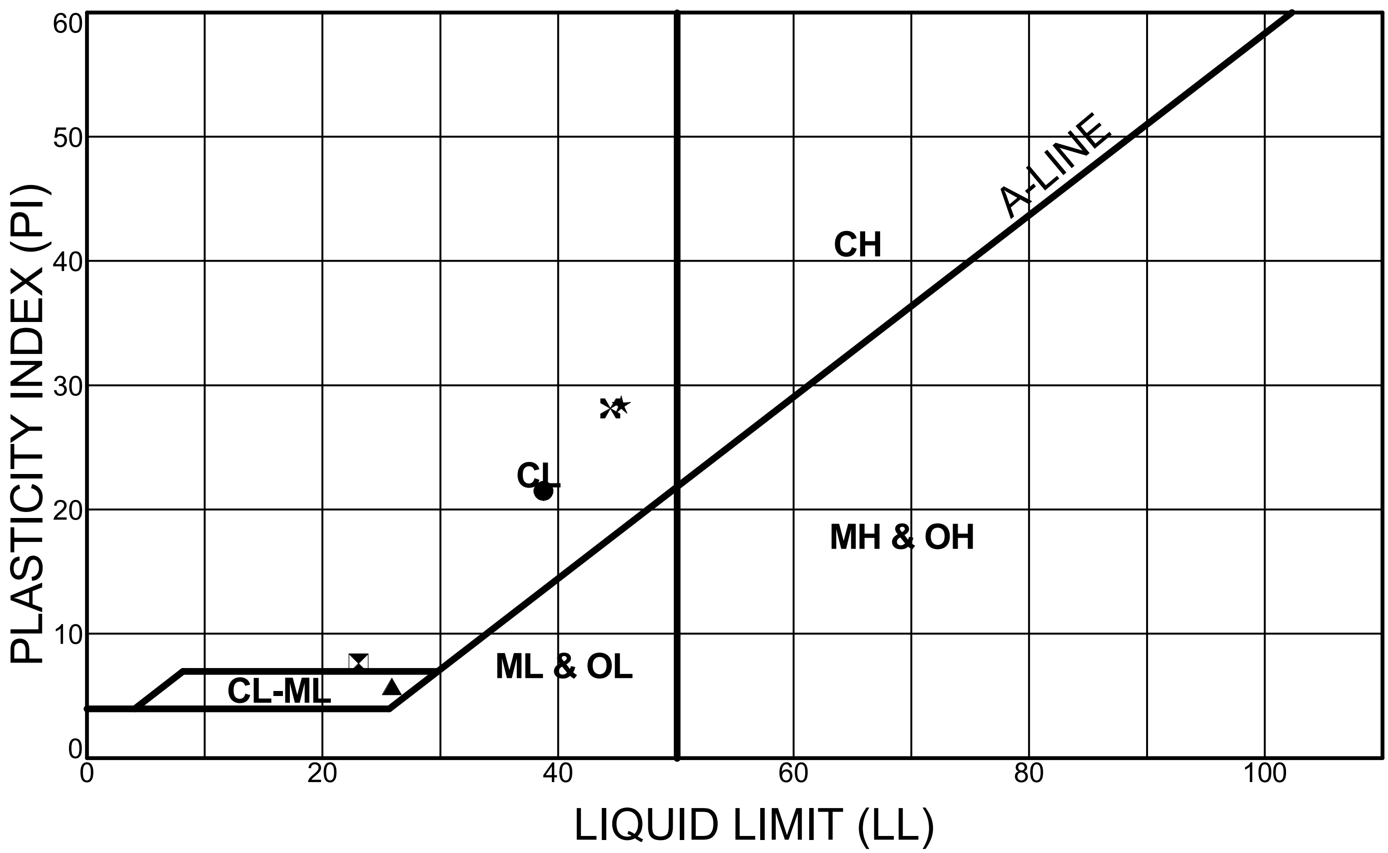
GRAIN SIZE ANALYSES (ASTM C117 and C136)

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B5

123GRAINSIZECOMPLETE 129067 MC-85.GPJ 12/03/12



LEGEND	BORING	DEPTH (ft)	LL	PL	PI
●	SD1	0.0 - 5.0	39	17	22
⧗	SD2	0.0 - 5.0	23	15	8
▲	SD2	8.0 - 13.0	26	20	6
★	SD3	0.0 - 5.0	45	17	28
✕	SD4	0.0 - 5.0	44	16	28

ATTPLOT 129067 MC-85.GPJ 12/03/12

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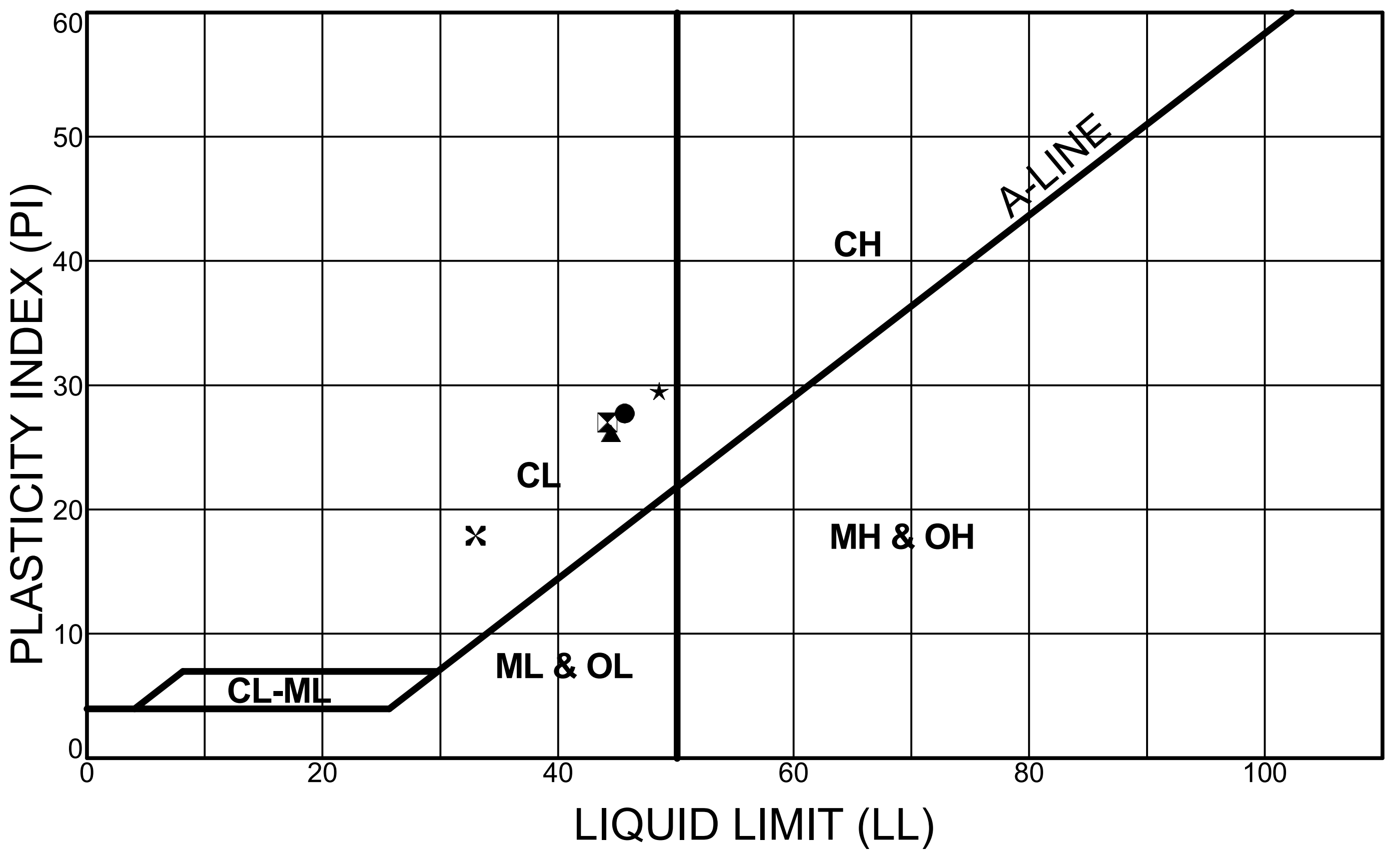
Report Date:	Project Number:
December 2012	129067

ATTERBERG LIMITS (ASTM D 4318)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B6



LEGEND	BORING	DEPTH (ft)	LL	PL	PI
●	SD5	0.0 - 5.0	46	18	28
⧗	SD6	0.0 - 5.0	44	17	27
▲	SD7	0.0 - 5.0	44	18	26
★	F1	0.0 - 5.0	49	19	30
✕	SD8	1.0 - 5.0	33	15	18

ATTPLOT 129067 MC-85.GPJ 12/03/12

KLEINFELDER
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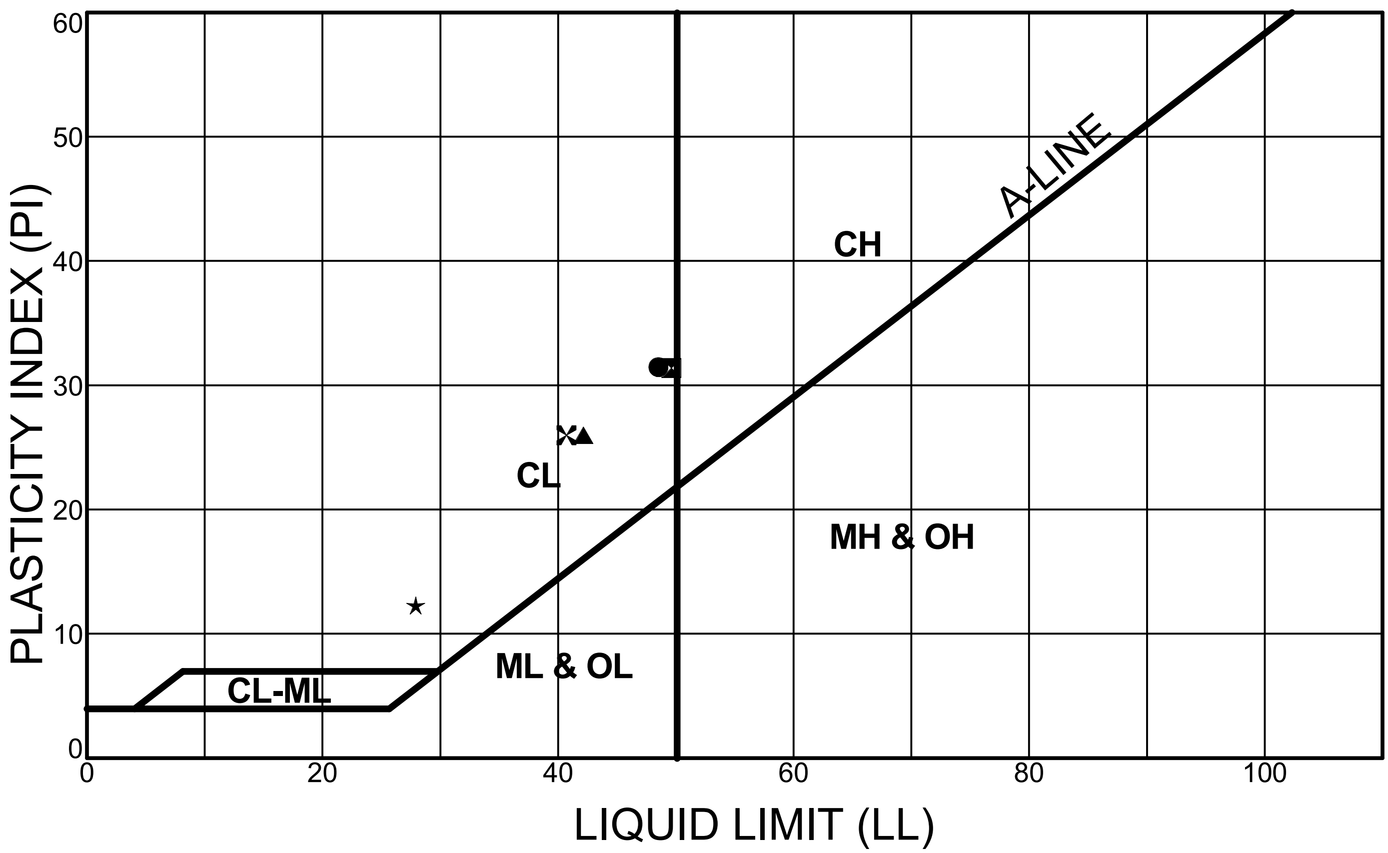
Report Date:	Project Number:
December 2012	129067

ATTERBERG LIMITS (ASTM D 4318)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B7



LEGEND	BORING	DEPTH (ft)	LL	PL	PI
●	SD9	1.5 - 5.0	49	17	32
⧗	F2	5.0 - 6.5	50	18	32
▲	SD10	1.0 - 5.0	42	16	26
★	SD11	0.0 - 5.0	28	16	12
✕	SD12	0.0 - 4.0	41	15	26

ATTPLOT 129067 MC-85.GPJ 12/03/12

KLEINFELDER
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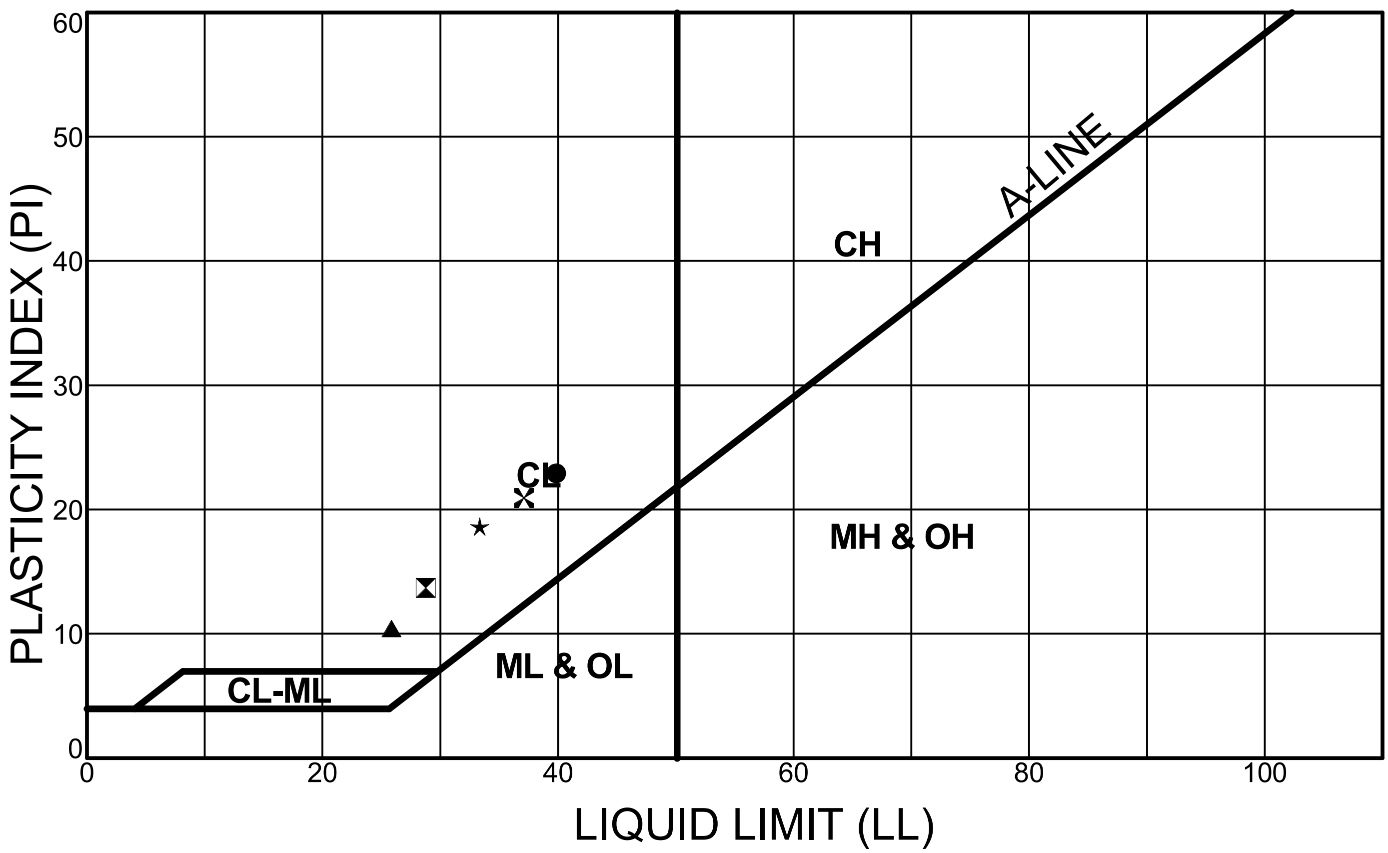
Report Date:	Project Number:
December 2012	129067

ATTERBERG LIMITS (ASTM D 4318)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B8



LEGEND	BORING	DEPTH (ft)	LL	PL	PI
●	SD13	4.0 - 9.0	40	17	23
⧗	SD15	0.0 - 5.0	29	15	14
▲	SD16	0.0 - 5.0	26	15	11
★	SD16	5.0 - 6.5	33	15	18
✕	SD17	0.0 - 5.0	37	16	21

ATTPLOT 129067 MC-85.GPJ 12/03/12

KLEINFELDER
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Report Date:	Project Number:
December 2012	129067

ATTERBERG LIMITS (ASTM D 4318)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

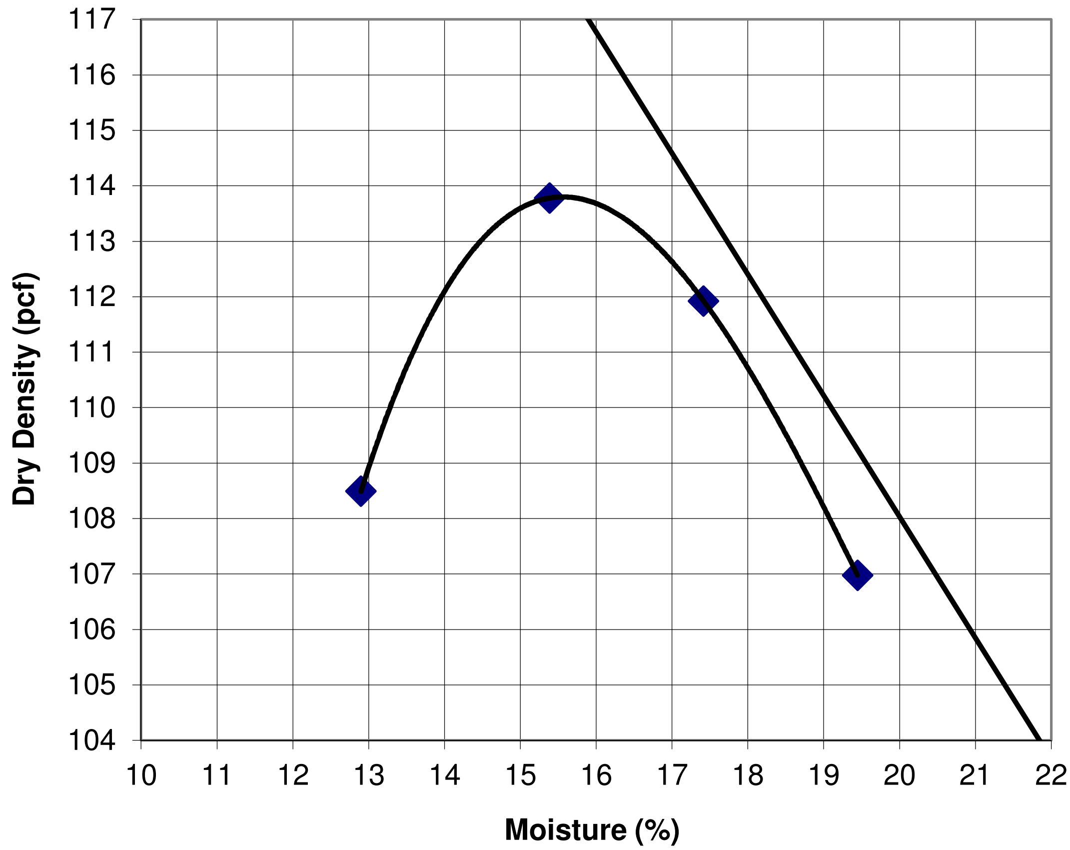
B9

SAMPLE SOURCE: **SD1 @ 0-5'**

USCS: SANDY LEAN CLAY (CL)

Maximum Dry Density: **113.8 pcf**

Optimum Moisture Content: **15.6 %**



The zero air void curve represents an assumed specific gravity of 2.65

KLEINFELDER
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STANDARD PROCTOR (ASTM D698 A)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

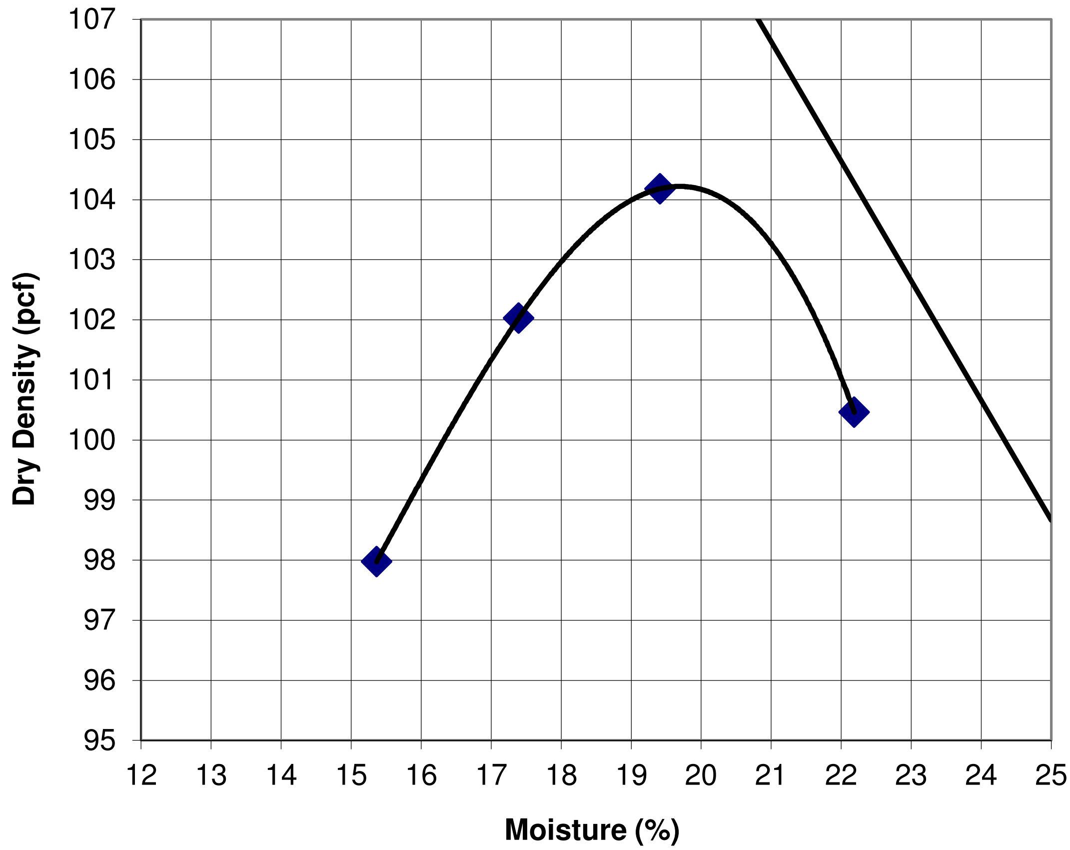
B10

Report Date:	Project Number:
November 2012	129067

12294-36

SAMPLE SOURCE: **SD4 @ 0-5'**
USCS: LEAN CLAY with SAND (CL)

Maximum Dry Density: **104.2 pcf**
Optimum Moisture Content: **19.7 %**



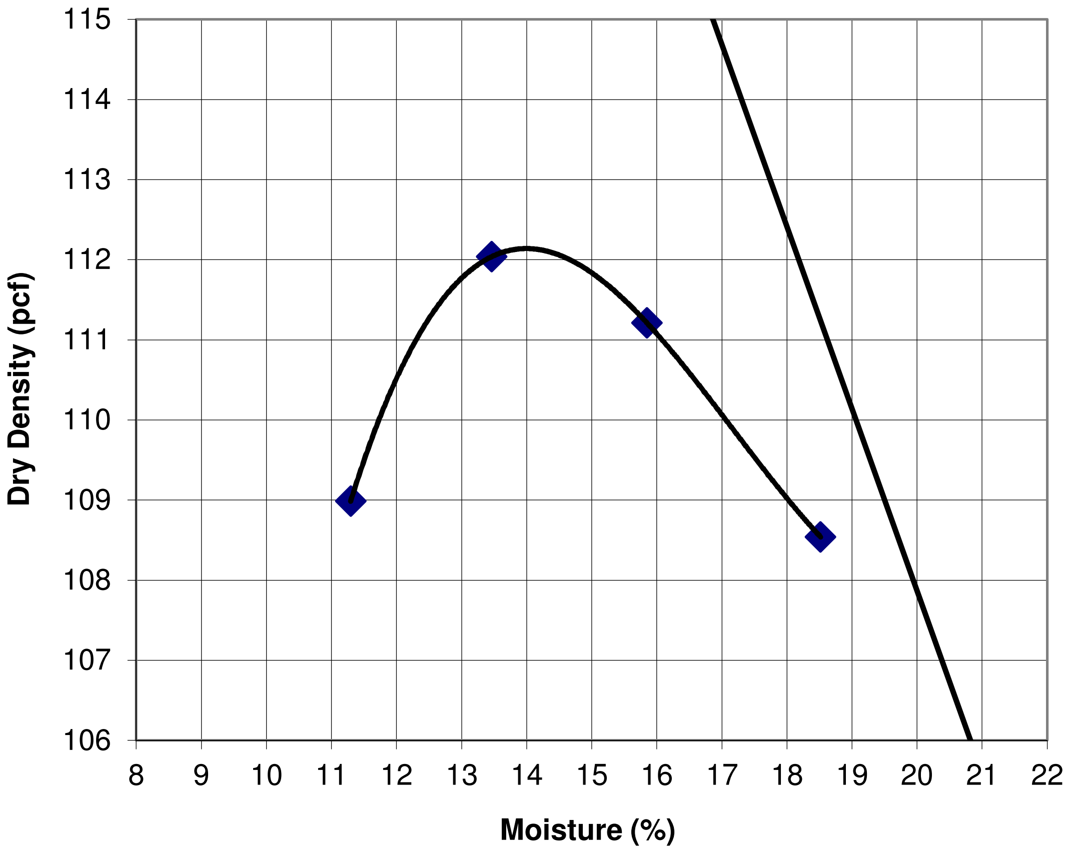
The zero air void curve represents an assumed specific gravity of 2.65

KLEINFELDER Bright People. Right Solutions.	**STANDARD PROCTOR (ASTM D698 A)** MC-85 (Buckeye Road) From 107th Avenue to 75th Avenue Maricopa County (Phoenix / Tolleson), Arizona	PLATE B11
Report Date: November 2012 / Project Number: 129067		

12294-40

SAMPLE SOURCE: **SD8 @ 1-5'**
USCS: SANDY LEAN CLAY with GRAVEL (CL)

Maximum Dry Density:	**112.1 pcf**
Optimum Moisture Content:	**14.0 %**



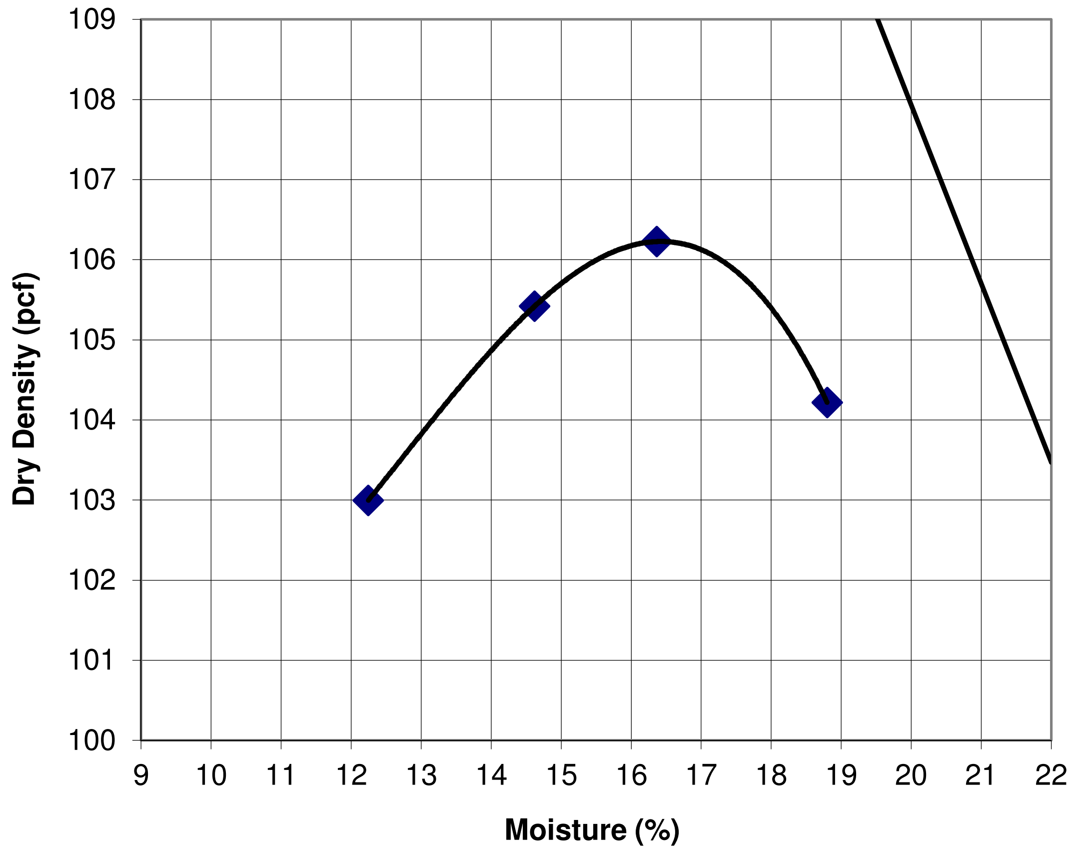
The zero air void curve represents an assumed specific gravity of 2.65

KLEINFELDER Bright People. Right Solutions.		**STANDARD PROCTOR (ASTM D698 A)** MC-85 (Buckeye Road) From 107th Avenue to 75th Avenue Maricopa County (Phoenix / Tolleson), Arizona	PLATE B12
Report Date: November 2012	Project Number: 129067		

12294-45

SAMPLE SOURCE: **SD10 @ 1-5'**
USCS: LEAN CLAY with SAND (CL)

Maximum Dry Density: **106.2 pcf**
Optimum Moisture Content: **16.4 %**



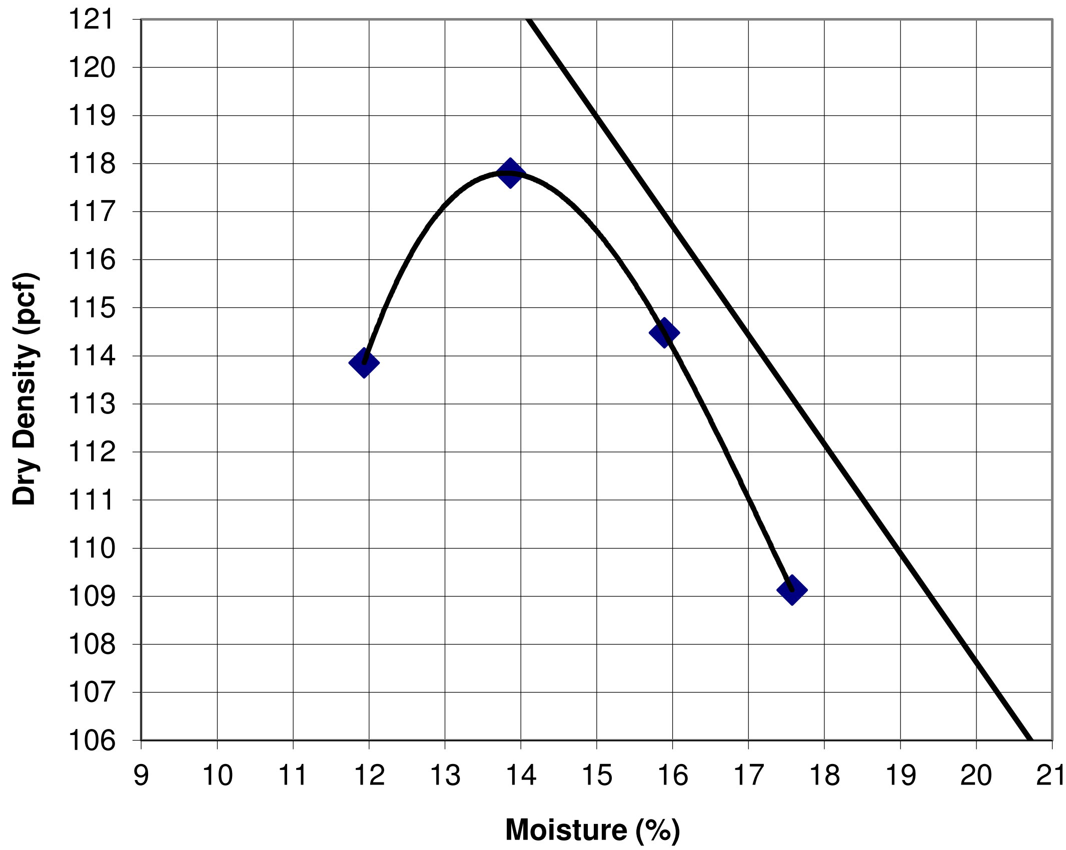
The zero air void curve represents an assumed specific gravity of 2.65

KLEINFELDER Bright People. Right Solutions.		**STANDARD PROCTOR (ASTM D698 A)** MC-85 (Buckeye Road) From 107th Avenue to 75th Avenue Maricopa County (Phoenix / Tolleson), Arizona	PLATE B13
Report Date: November 2012	Project Number: 129067		

12294-48

SAMPLE SOURCE: **SD12 @ 0-4'**
USCS: SANDY LEAN CLAY (CL)

Maximum Dry Density: **117.8 pcf**
Optimum Moisture Content: **13.8 %**



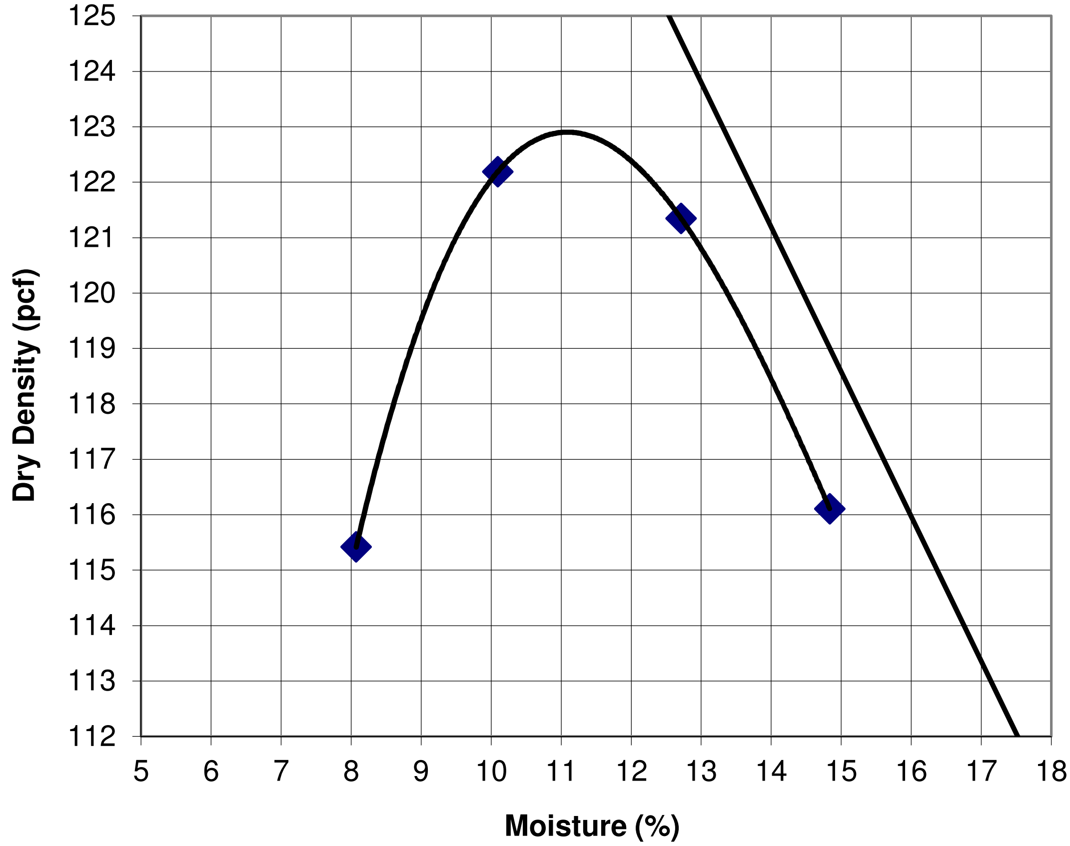
The zero air void curve represents an assumed specific gravity of 2.65

KLEINFELDER *Bright People. Right Solutions.*		**STANDARD PROCTOR (ASTM D698 A)** MC-85 (Buckeye Road) From 107th Avenue to 75th Avenue Maricopa County (Phoenix / Tolleson), Arizona	PLATE B14
Report Date: November 2012	Project Number: 129067		

12294-50

SAMPLE SOURCE: **SD15 @ 0-5'**
USCS: CLAYEY SAND with GRAVEL (SC)

Maximum Dry Density: **122.9 pcf**
Optimum Moisture Content: **11.1 %**



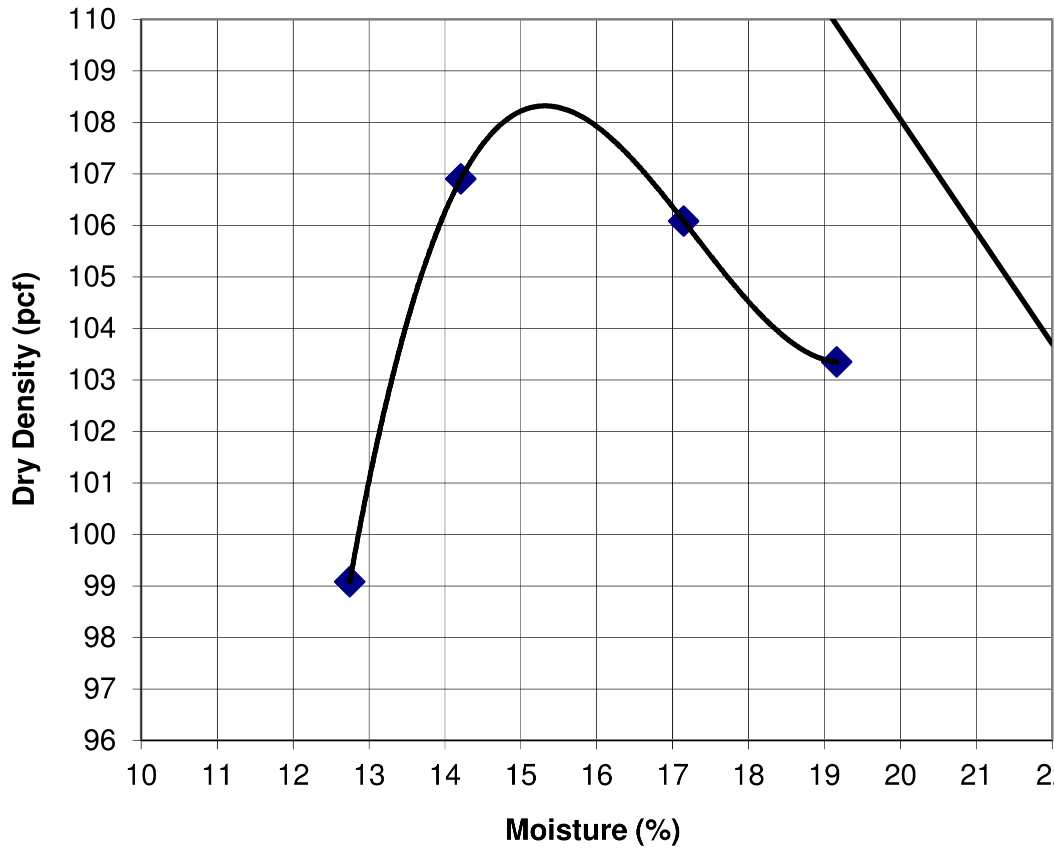
The zero air void curve represents an assumed specific gravity of 2.65

KLEINFELDER Bright People. Right Solutions.		**STANDARD PROCTOR (ASTM D698 A)** MC-85 (Buckeye Road) From 107th Avenue to 75th Avenue Maricopa County (Phoenix / Tolleson), Arizona	PLATE B15
Report Date: November 2012	Project Number: 129067		

12294-52

SAMPLE SOURCE: **SD17 @ 0-5'**
USCS: LEAN CLAY with SAND (CL)

Maximum Dry Density: **108.3 pcf**
Optimum Moisture Content: **15.3 %**



The zero air void curve represents an assumed specific gravity of 2.65

KLEINFELDER Bright People. Right Solutions.	**STANDARD PROCTOR (ASTM D698 A)** MC-85 (Buckeye Road) From 107th Avenue to 75th Avenue Maricopa County (Phoenix / Tolleson), Arizona	PLATE B16
Report Date: November 2012 / Project Number: 129067		

12294-55

SAMPLE SOURCE: **SD1 @ 0-5'**

USCS: SANDY LEAN CLAY (CL)

Moisture Content (%):	12.6
Dry Density (pcf):	108.2
Initial Degree of Saturation (%):	62.8

SPECIFIC GRAVITY: 2.65 (estimated)

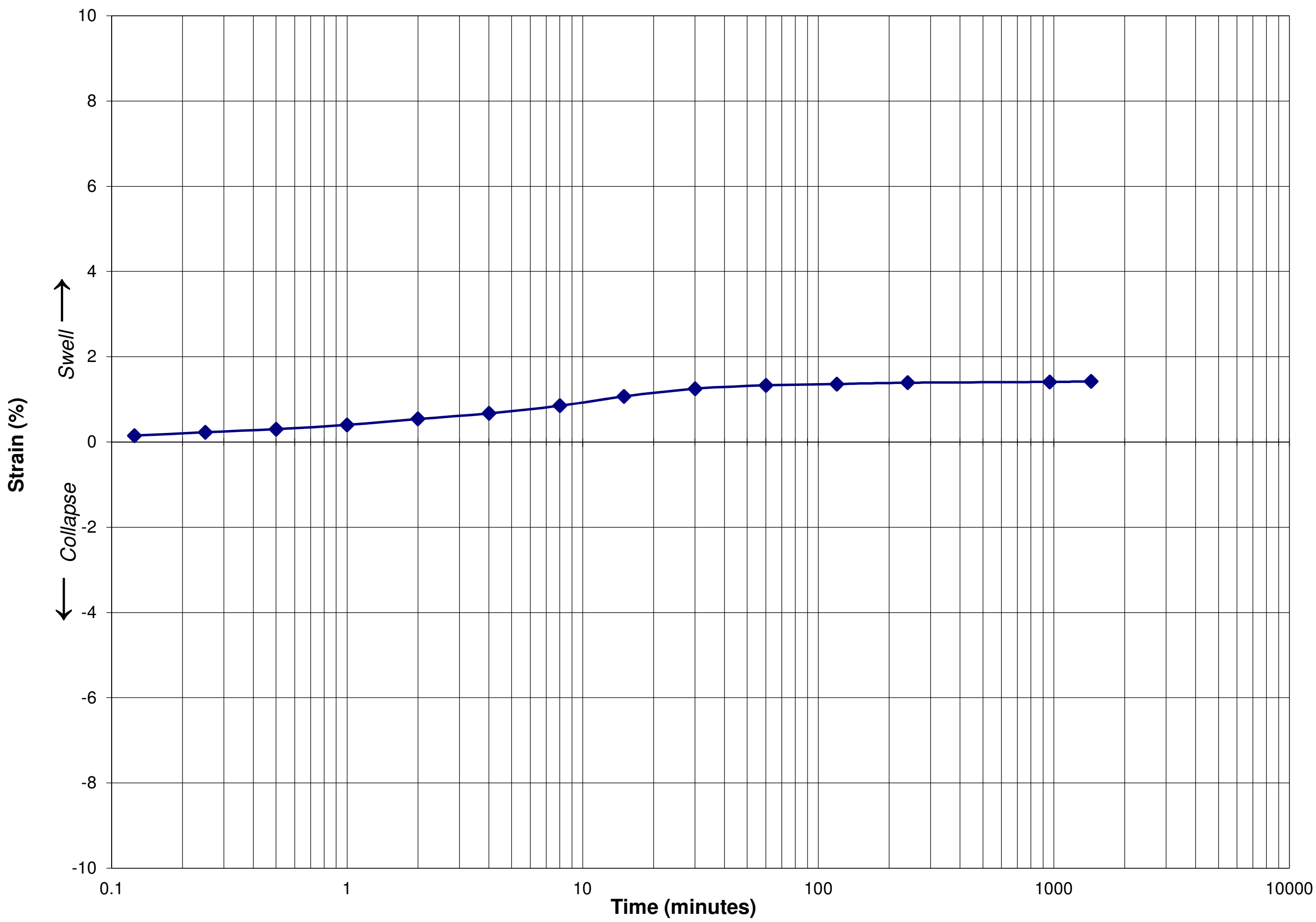
Maximum Dry Density (pcf):	113.8
Optimum Moisture (%):	15.6

APPLIED STRESS: 144 psf

SEATING PRESSURE: 100 psf

TEST PREPARATION: Specimen remolded to approximately 95% of maximum dry density at approximately 3% below optimum moisture, as determined by a standard proctor (ASTM D698).

1.4% Swell



ONE-DIMENSIONAL FREE SWELL (ASTM D 4546)

MC-85 (Buckeye Road)

From 107th Avenue to 75th Avenue

Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B17

KLEINFELDER Bright People. Right Solutions.

Report Date:	Project Number:
November 2012	129067

12294-36

SAMPLE SOURCE: **SD4 @ 0-5'**
USCS: LEAN CLAY with SAND (CL)

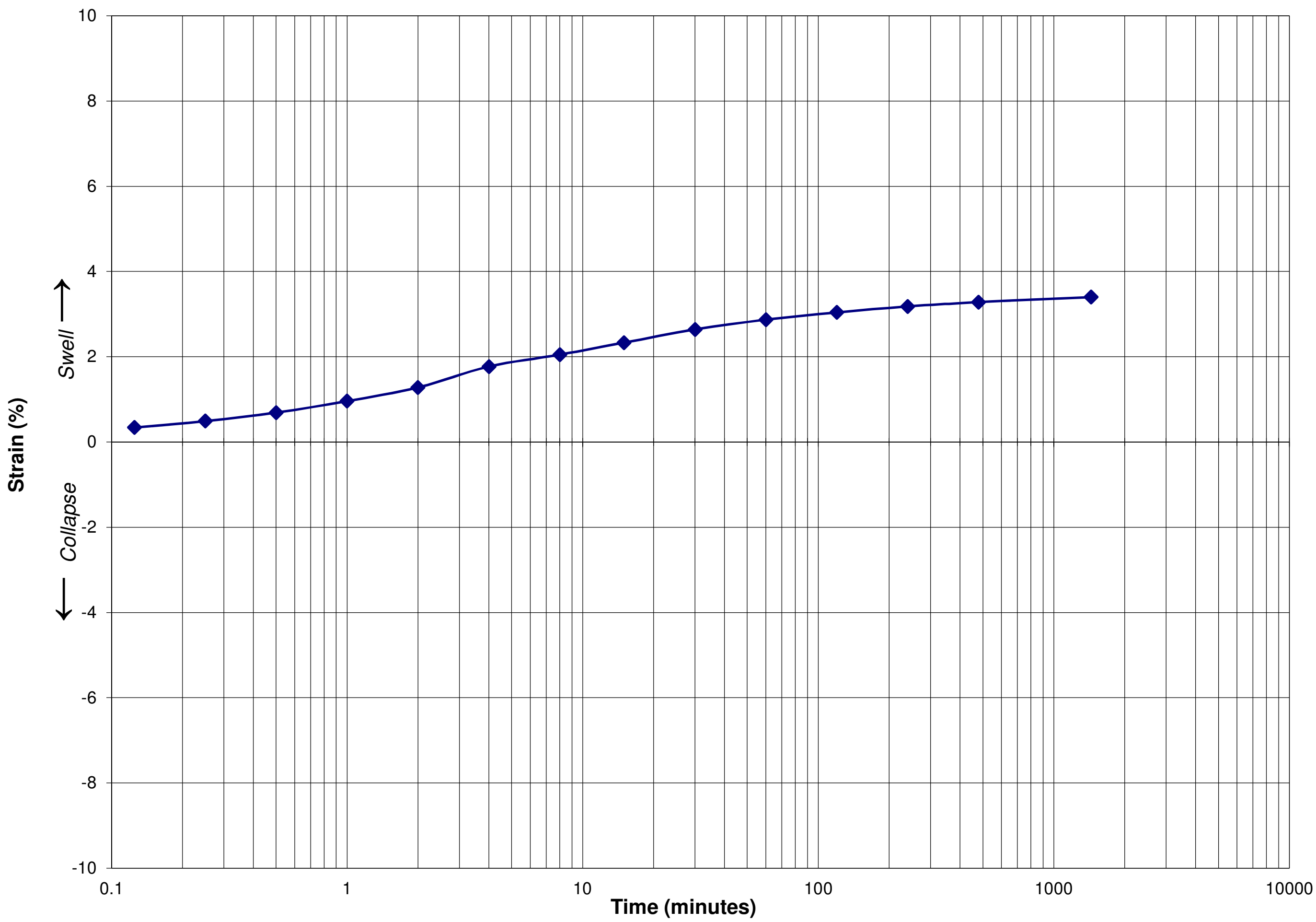
Moisture Content (%):	16.7
Dry Density (pcf):	99.0
Initial Degree of Saturation (%):	65.8

SPECIFIC GRAVITY: 2.65 (estimated)

Maximum Dry Density (pcf):	104.2
Optimum Moisture (%):	19.7

APPLIED STRESS: 144 psf
SEATING PRESSURE: 100 psf
TEST PREPARATION: Specimen remolded to approximately 95% of maximum dry density at approximately 3% below optimum moisture, as determined by a standard proctor (ASTM D698).

3.4% Swell



KLEINFELDER
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Report Date:	Project Number:
November 2012	129067

ONE-DIMENSIONAL FREE SWELL (ASTM D 4546)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B18

12294-40

SAMPLE SOURCE: **SD8 @ 1-5'**

USCS: SANDY LEAN CLAY with GRAVEL (CL)

Moisture Content (%):	11.1
Dry Density (pcf):	106.5
Initial Degree of Saturation (%):	53.0

SPECIFIC GRAVITY: 2.65 (estimated)

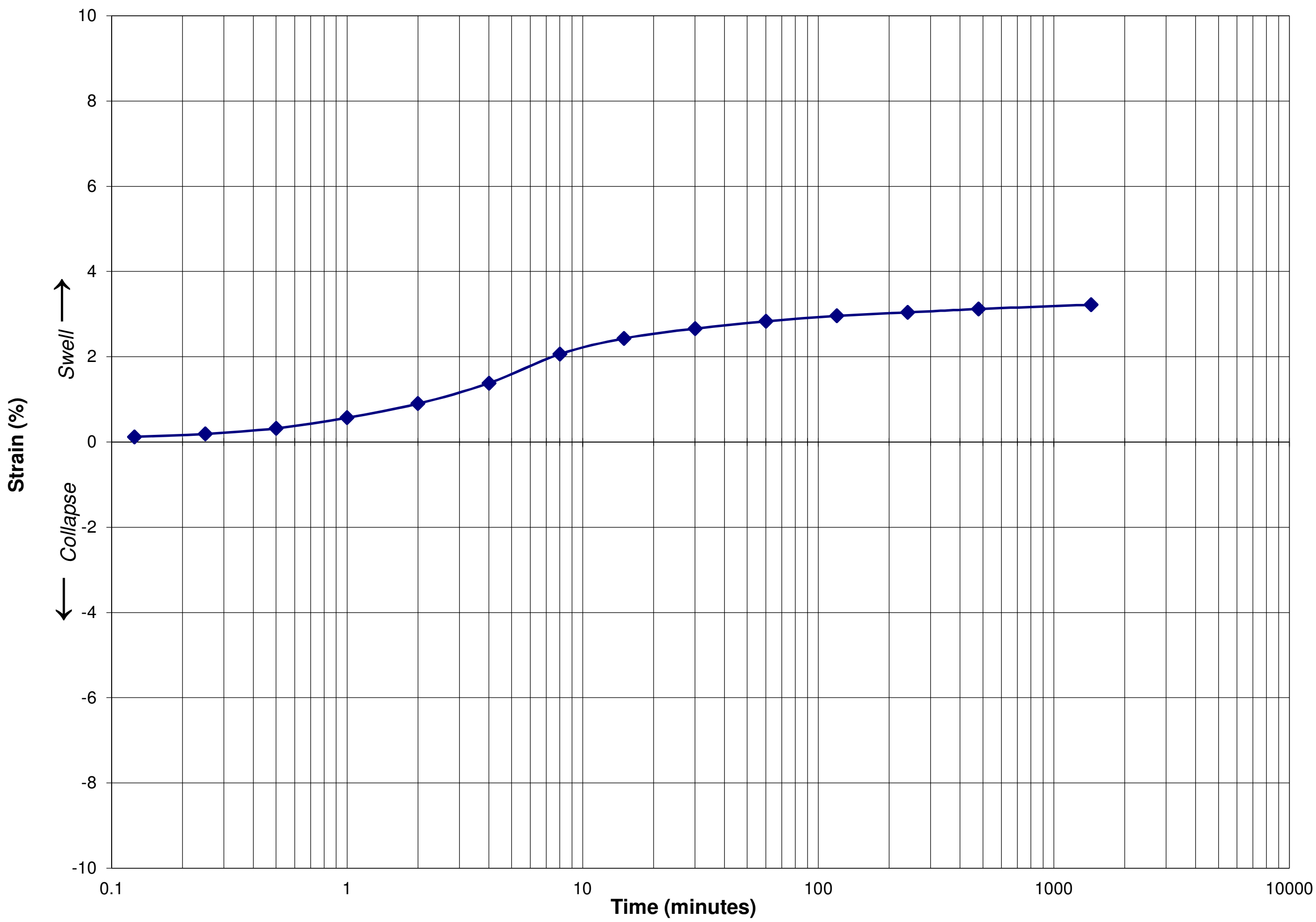
Maximum Dry Density (pcf):	112.1
Optimum Moisture (%):	14.0

APPLIED STRESS: 144 psf

SEATING PRESSURE: 100 psf

TEST PREPARATION: Specimen remolded to approximately 95% of maximum dry density at approximately 3% below optimum moisture, as determined by a standard proctor (ASTM D698).

3.2% Swell



ONE-DIMENSIONAL FREE SWELL (ASTM D 4546)

MC-85 (Buckeye Road)

From 107th Avenue to 75th Avenue

Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B19

KLEINFELDER
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Report Date:	Project Number:
November 2012	129067

12294-45

SAMPLE SOURCE: **SD10 @ 1-5'**
USCS: LEAN CLAY with SAND (CL)

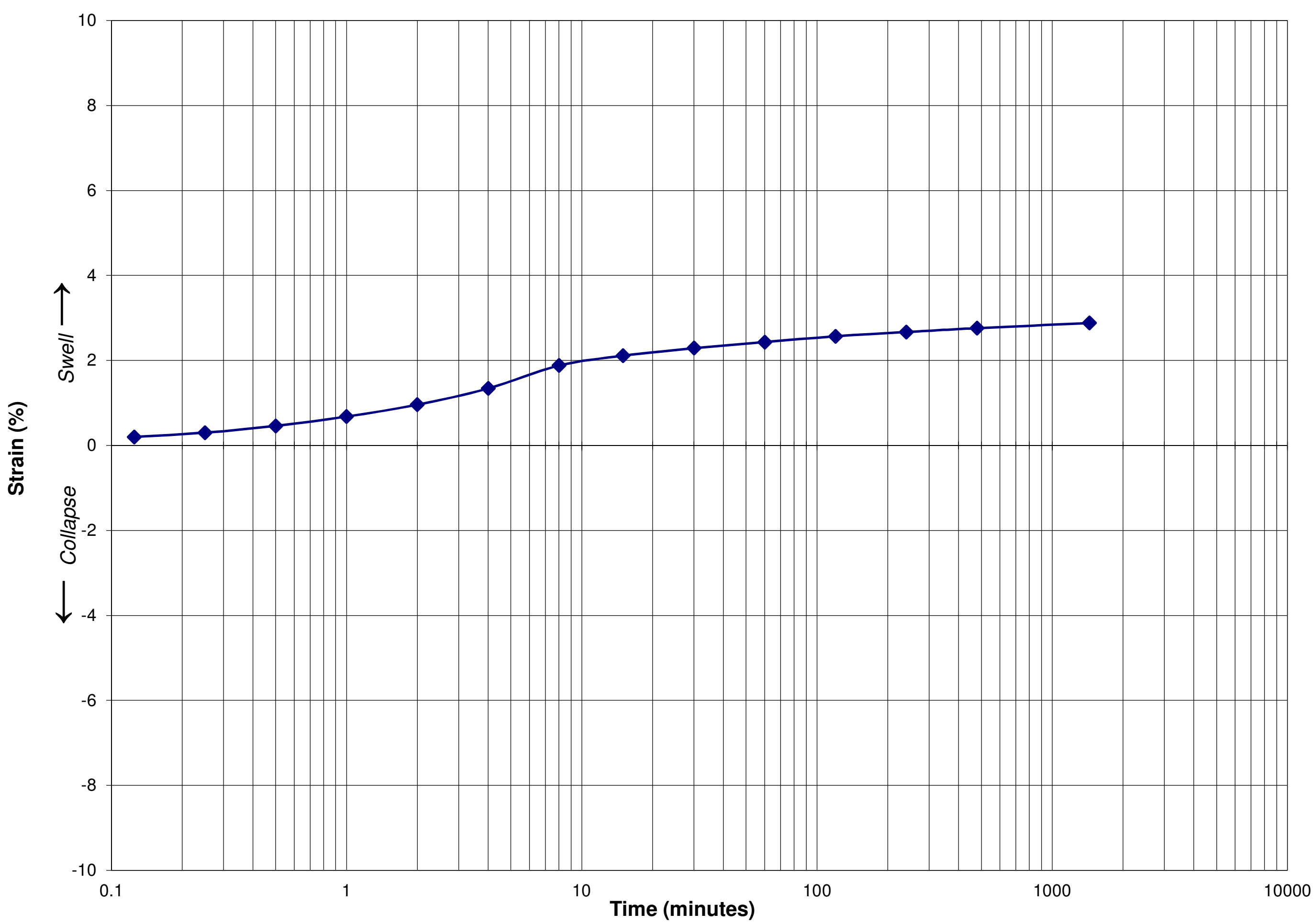
Moisture Content (%):	13.4
Dry Density (pcf):	101.0
Initial Degree of Saturation (%):	55.6

SPECIFIC GRAVITY: 2.65 (estimated)

Maximum Dry Density (pcf):	106.2
Optimum Moisture (%):	16.4

APPLIED STRESS: 144 psf
SEATING PRESSURE: 100 psf
TEST PREPARATION: Specimen remolded to approximately 95% of maximum dry density at approximately 3% below optimum moisture, as determined by a standard proctor (ASTM D698).

2.9% Swell



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ONE-DIMENSIONAL FREE SWELL (ASTM D 4546)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B20

12294-48

SAMPLE SOURCE: **SD12 @ 0-4'**
USCS: SANDY LEAN CLAY (CL)

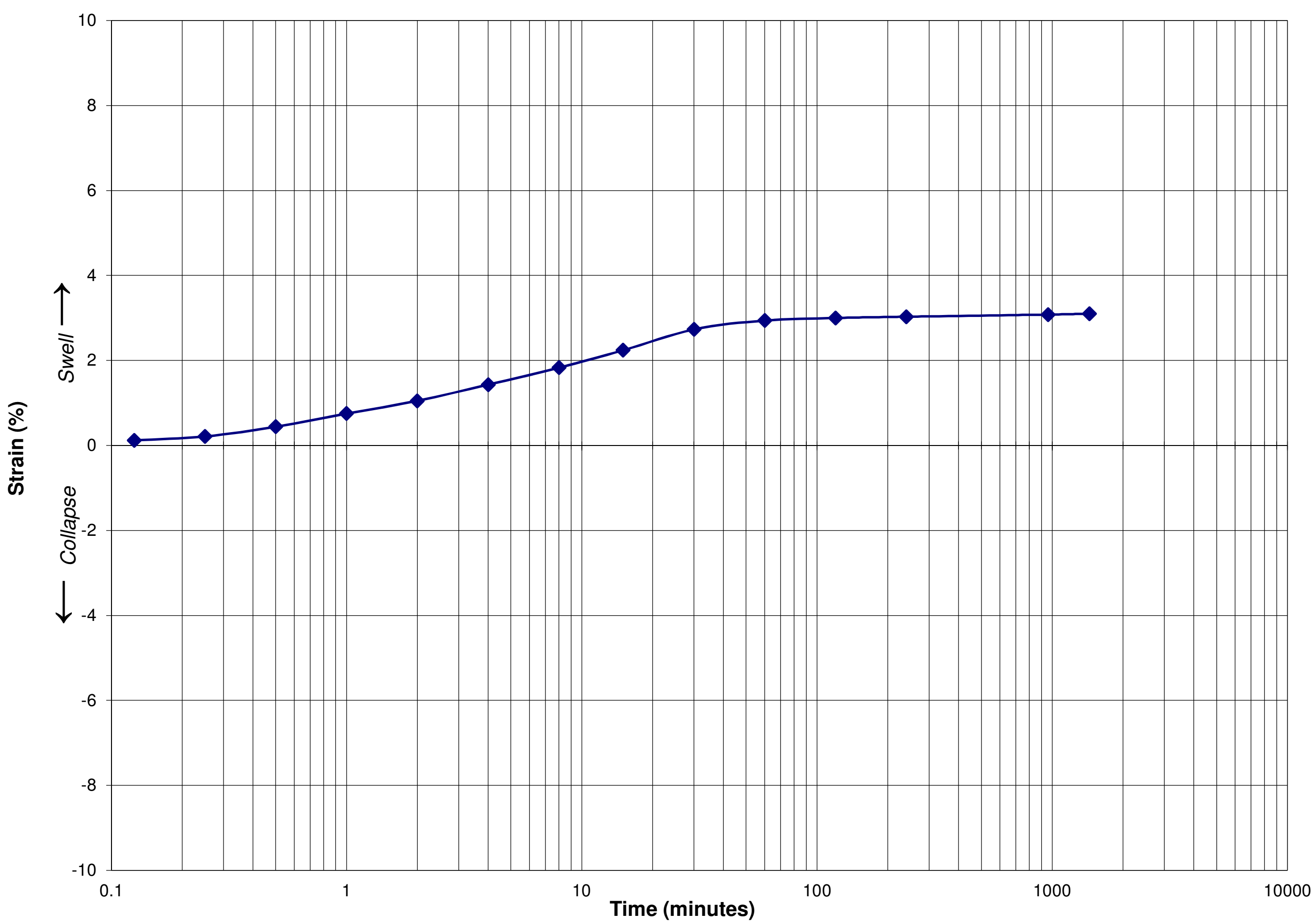
Moisture Content (%):	10.7
Dry Density (pcf):	112.0
Initial Degree of Saturation (%):	59.7

SPECIFIC GRAVITY: 2.65 (estimated)

Maximum Dry Density (pcf):	117.8
Optimum Moisture (%):	13.8

APPLIED STRESS: 144 psf
SEATING PRESSURE: 100 psf
TEST PREPARATION: Specimen remolded to approximately 95% of maximum dry density at approximately 3% below optimum moisture, as determined by a standard proctor (ASTM D698).

3.1% Swell



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ONE-DIMENSIONAL FREE SWELL (ASTM D 4546)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B21

Report Date:	Project Number:
November 2012	129067

12294-50

SAMPLE SOURCE: **SD12 @ 0-4'**
USCS: SANDY LEAN CLAY (CL)

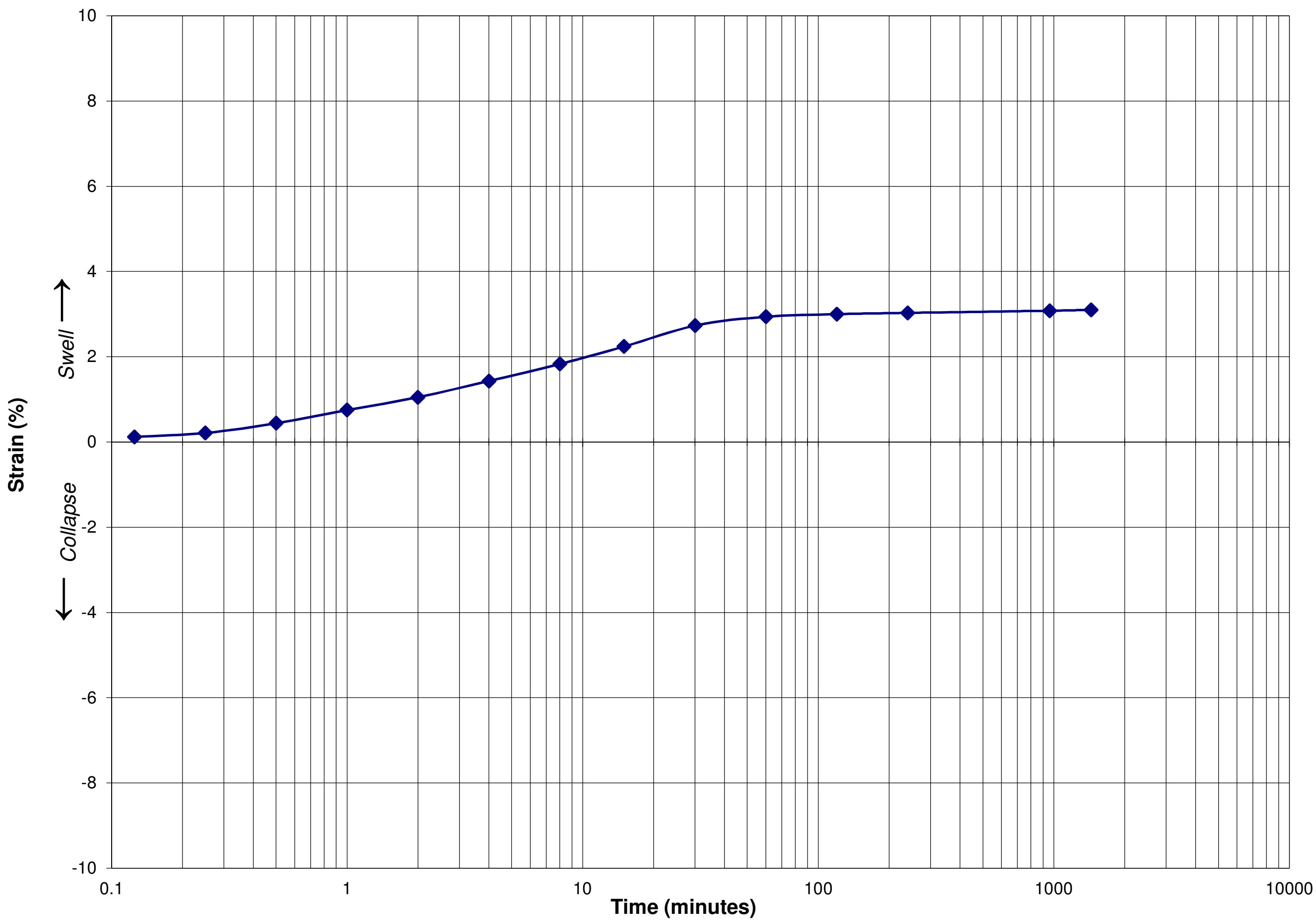
Moisture Content (%):	10.7
Dry Density (pcf):	112.0
Initial Degree of Saturation (%):	59.7

SPECIFIC GRAVITY: 2.65 (estimated)

Maximum Dry Density (pcf):	117.8
Optimum Moisture (%):	13.8

APPLIED STRESS: 144 psf
SEATING PRESSURE: 100 psf
TEST PREPARATION: Specimen remolded to approximately 95% of maximum dry density at approximately 3% below optimum moisture, as determined by a standard proctor (ASTM D698).

3.1% Swell



KLEINFELDER
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ONE-DIMENSIONAL FREE SWELL (ASTM D 4546)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B21

12294-50

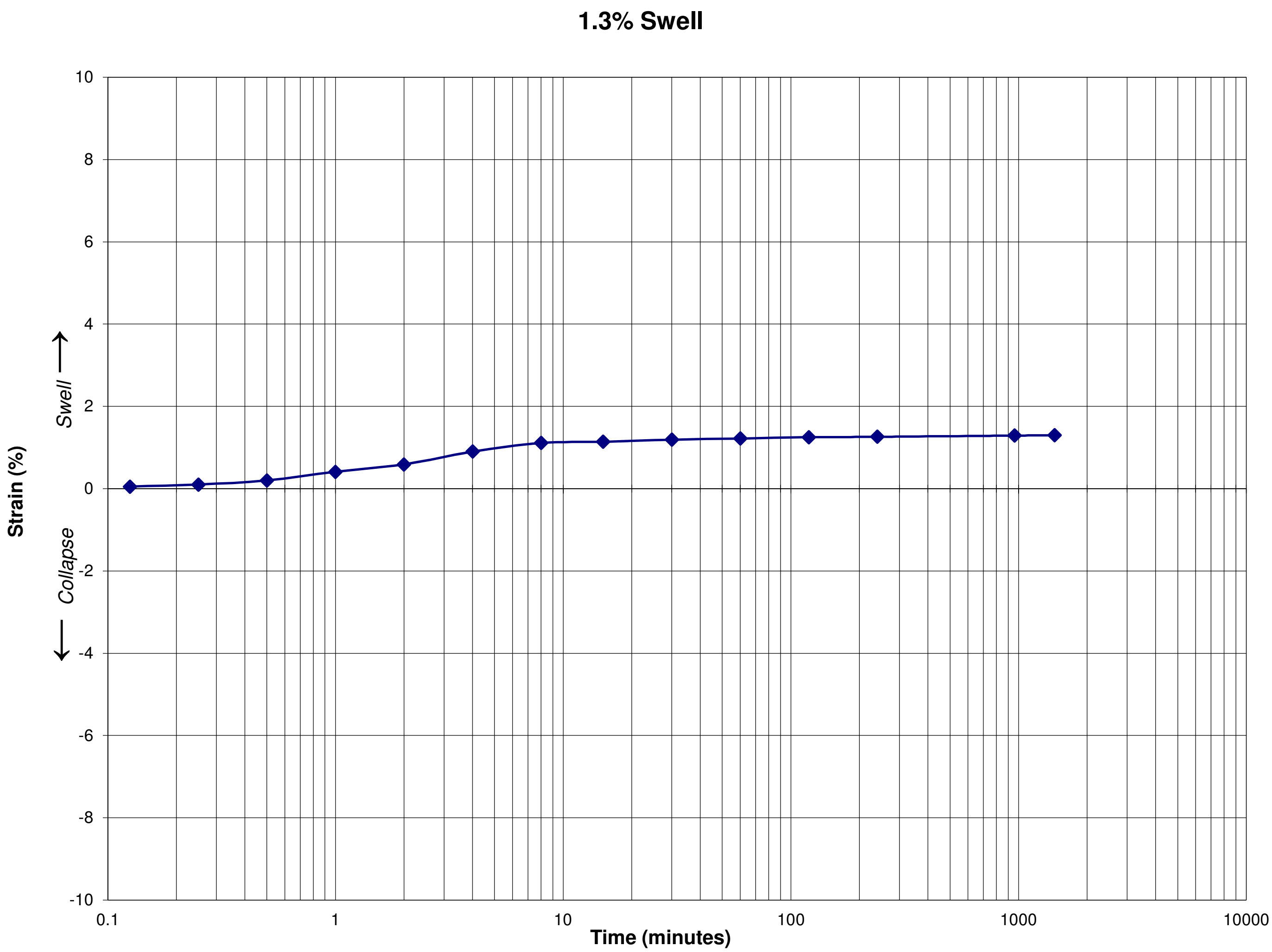
SAMPLE SOURCE: **SD15 @ 0-5'**
USCS: CLAYEY SAND with GRAVEL (SC)

Moisture Content (%):	8.1
Dry Density (pcf):	116.8
Initial Degree of Saturation (%):	51.3

SPECIFIC GRAVITY: 2.65 (estimated)

Maximum Dry Density (pcf):	122.9
Optimum Moisture (%):	11.1

APPLIED STRESS: 144 psf
SEATING PRESSURE: 100 psf
TEST PREPARATION: Specimen remolded to approximately 95% of maximum dry density at approximately 3% below optimum moisture, as determined by a standard proctor (ASTM D698).



KLEINFELDER
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ONE-DIMENSIONAL FREE SWELL (ASTM D 4546)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B22

12294-52

SAMPLE SOURCE: **SD17 @ 0-5'**

USCS: LEAN CLAY with SAND (CL)

Moisture Content (%): 12.3

Dry Density (pcf): 102.8

Initial Degree of Saturation (%): 53.8

SPECIFIC GRAVITY: 2.65 (estimated)

Maximum Dry Density (pcf): 108.3

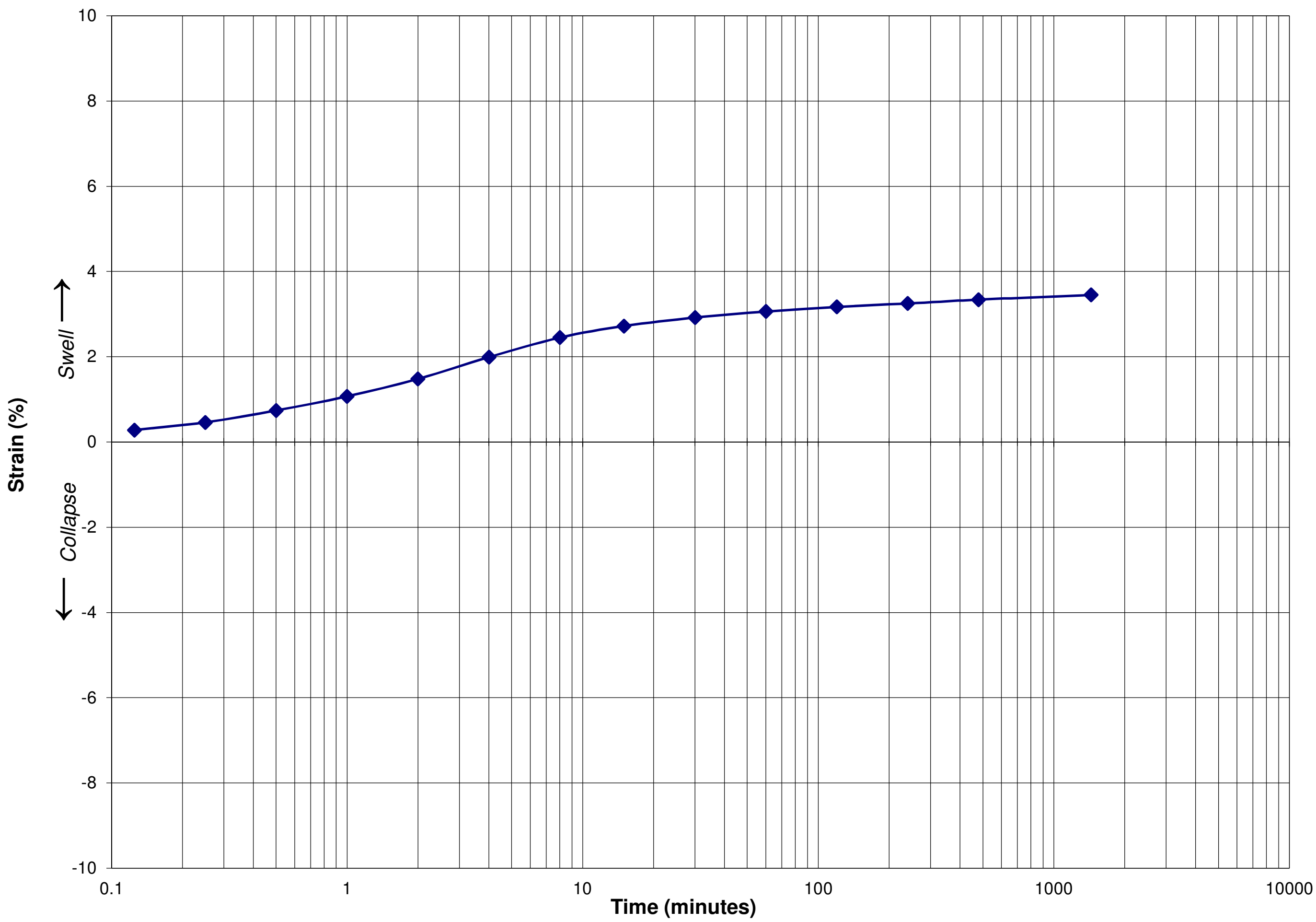
APPLIED STRESS: 144 psf

Optimum Moisture (%): 15.3

SEATING PRESSURE: 100 psf

TEST PREPARATION: Specimen remolded to approximately 95% of maximum dry density at approximately 3% below optimum moisture, as determined by a standard proctor (ASTM D698).

3.5% Swell



KLEINFELDER
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November 2012	129067

ONE-DIMENSIONAL FREE SWELL (ASTM D 4546)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

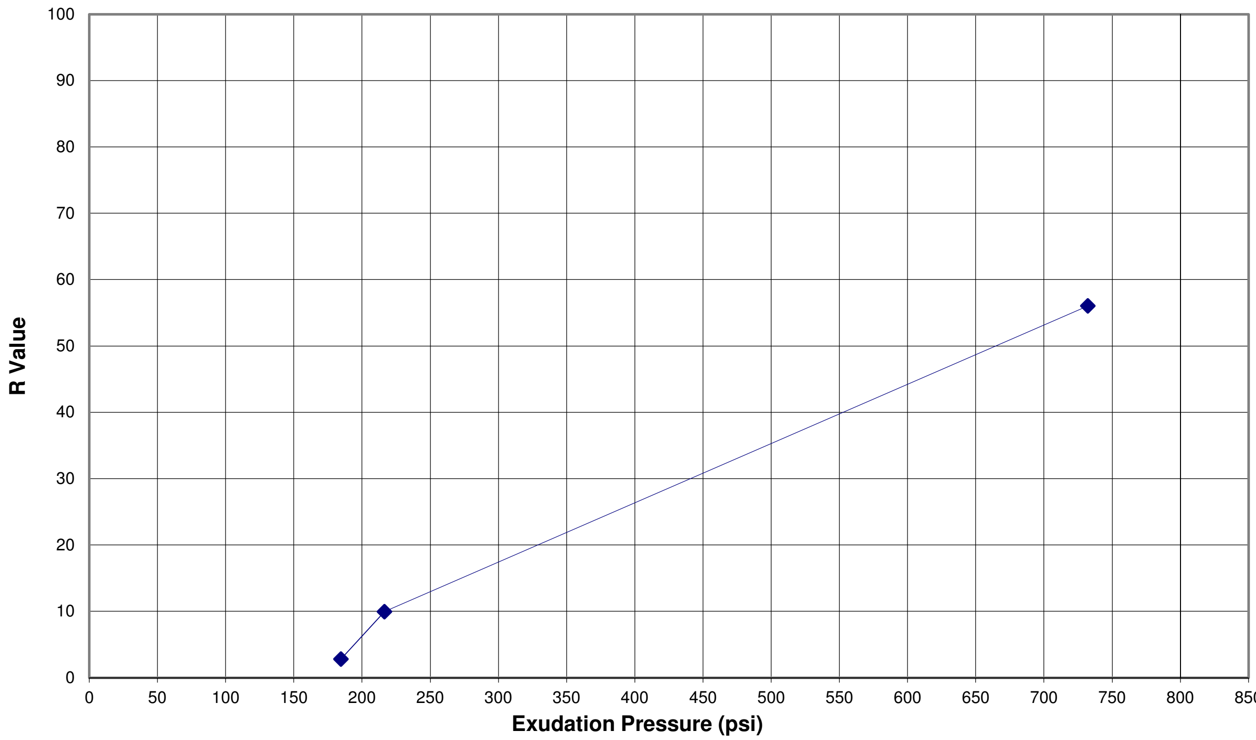
B23

12294-55

SAMPLE SOURCE: **SD1 @ 0-5'**
USCS: SANDY LEAN CLAY (CL)

SPECIMEN	**A**	**B**	**C**
Moisture Content (%)	18.6	15.8	13.0
Compaction Pressure (psi)	*Hand Tamped*	125	350
Specimen Height (in)	2.52	2.52	2.46
Dry Density (pcf)	105.6	110.1	117.8
Horizontal Pressure @ 1000lbs (psi)	64	59	19
Horizontal Pressure @ 2000lbs (psi)	*Exceeded 140*	132	53
Displacement	5.77	4.79	3.96
Expansion Pressure (psi)	0.3	0.0	6.4
Exudation Pressure (psi)	185	216	732
R-Value	3	10	56

Interpolated R-Value at 300 psi = 17



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***R*-VALUE (ASTM D2844)**
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B24

12294-36

SAMPLE SOURCE: **SD4 @ 0-5'**
USCS: LEAN CLAY with SAND (CL)

SPECIMEN	A	B	C
Moisture Content (%)	23.9	26.8	22.0
Compaction Pressure (psi)	*Hand Tamped*	*Hand Tamped*	75
Specimen Height (in)	2.63	2.49	2.54
Dry Density (pcf)	97.6	95.9	100.9
Horizontal Pressure @ 1000lbs (psi)	66	72	60
Horizontal Pressure @ 2000lbs (psi)	*Exceeded 140*	*Exceeded 140*	138
Displacement	5.85	6.19	5.26
Expansion Pressure (psi)	0.3	0.0	6.4
Exudation Pressure (psi)	320	216	732
R- Value	3	3	7

R - VALUE IS LESS THAN 5
SAMPLE EXTRUDED FROM BOTTOM OF MOLD

KLEINFELDER
Bright People. Right Solutions.

Report Date:	Project Number:
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***R*-VALUE (ASTM D2844)**
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B25

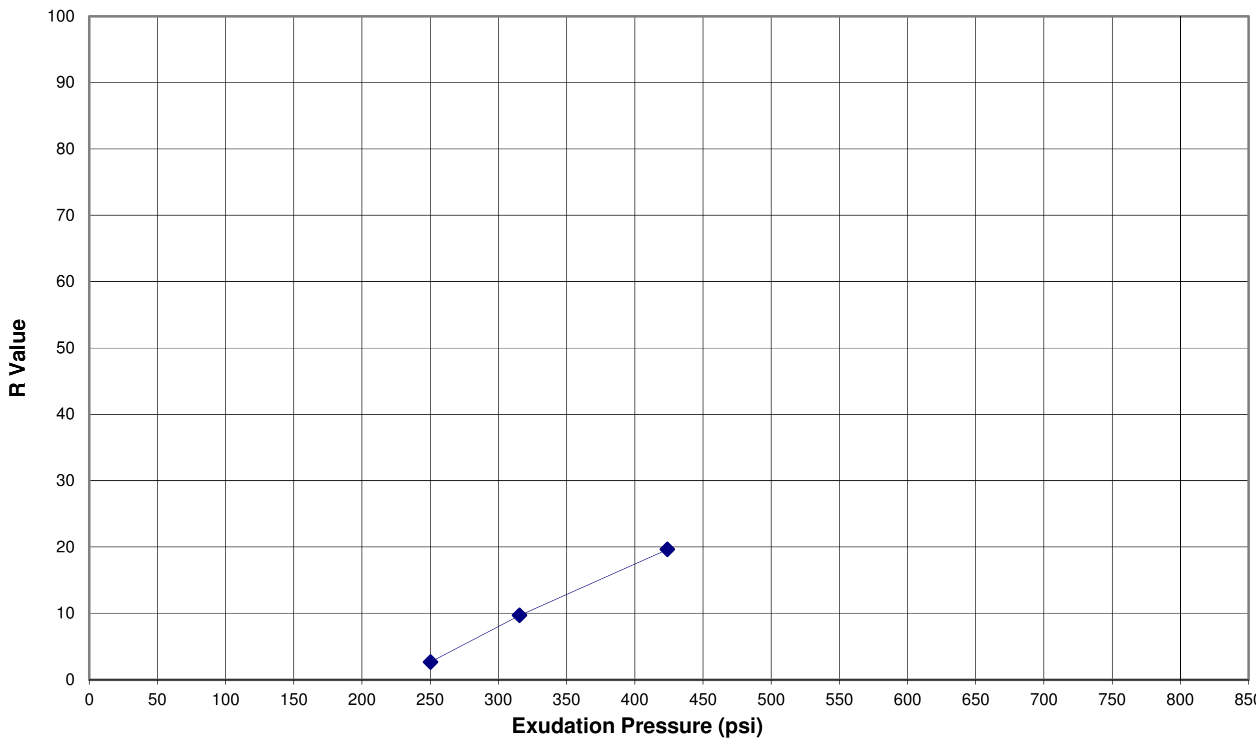
12294-40

SAMPLE SOURCE: **SD8 @ 1-5'**

USCS: SANDY LEAN CLAY with GRAVEL (CL)

SPECIMEN	**A**	**B**	**C**
Moisture Content (%)	16.8	14.1	15.4
Compaction Pressure (psi)	*Hand Tamped*	175	75
Specimen Height (in)	2.47	2.51	2.57
Dry Density (pcf)	113.4	116.6	113.0
Horizontal Pressure @ 1000lbs (psi)	64	44	61
Horizontal Pressure @ 2000lbs (psi)	*Exceeded 140*	114	134
Displacement	6.04	4.13	4.84
Expansion Pressure (psi)	0.0	0.3	0.0
Exudation Pressure (psi)	250	424	316
R-Value	3	20	10

Interpolated R-Value at 300 psi = 8



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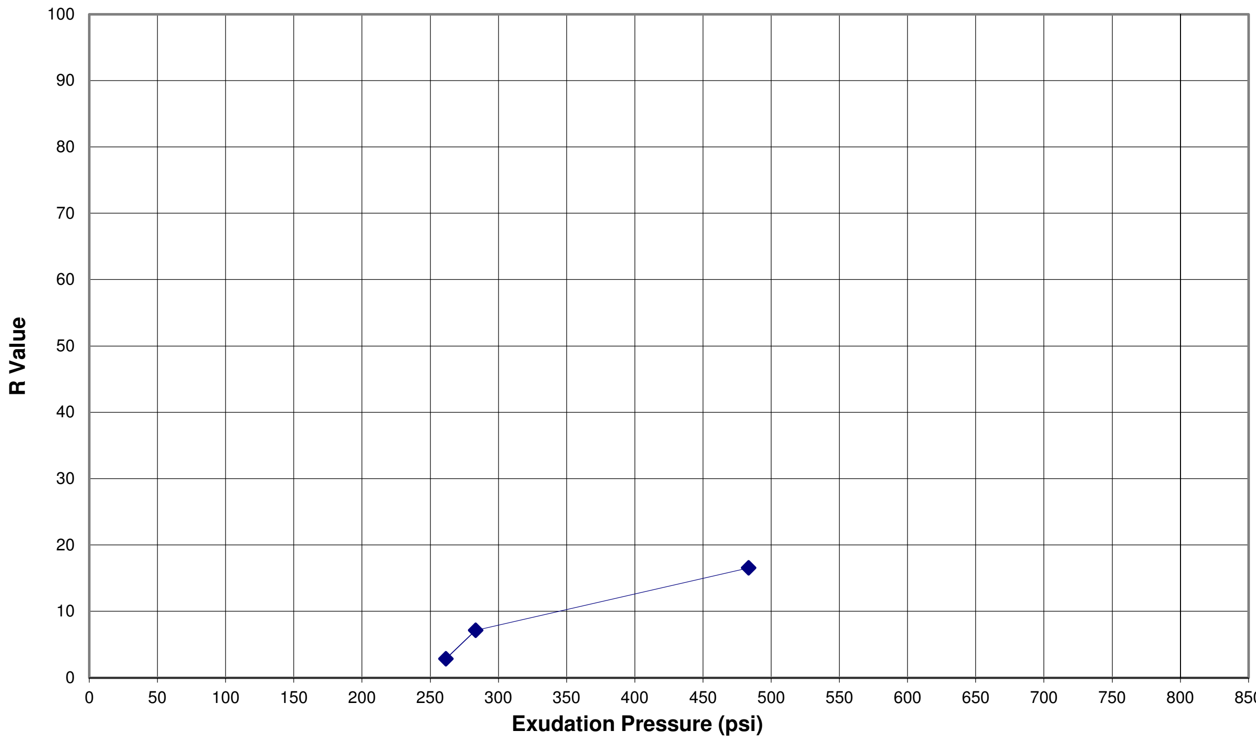
Report Date:	Project Number:	***R*-VALUE (ASTM D2844)** MC-85 (Buckeye Road) From 107th Avenue to 75th Avenue Maricopa County (Phoenix / Tolleson), Arizona	PLATE B26
November 2012	129067		

12294-45

SAMPLE SOURCE: **SD10 @ 1-5'**
USCS: LEAN CLAY with SAND (CL)

SPECIMEN	**A**	**B**	**C**
Moisture Content (%)	19.9	17.2	22.7
Compaction Pressure (psi)	*Hand Tamped*	150	*Hand Tamped*
Specimen Height (in)	2.56	2.46	2.61
Dry Density (pcf)	103.3	109.4	98.3
Horizontal Pressure @ 1000lbs (psi)	62	48	69
Horizontal Pressure @ 2000lbs (psi)	139	118	*Exceeded 140*
Displacement	5.20	4.49	6.30
Expansion Pressure (psi)	0.0	1.6	0.0
Exudation Pressure (psi)	283	483	261
R-Value	7	17	3

Interpolated R-Value at 300 psi = 8



KLEINFELDER
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Report Date:	Project Number:
November 2012	129067

***R*-VALUE (ASTM D2844)**
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B27

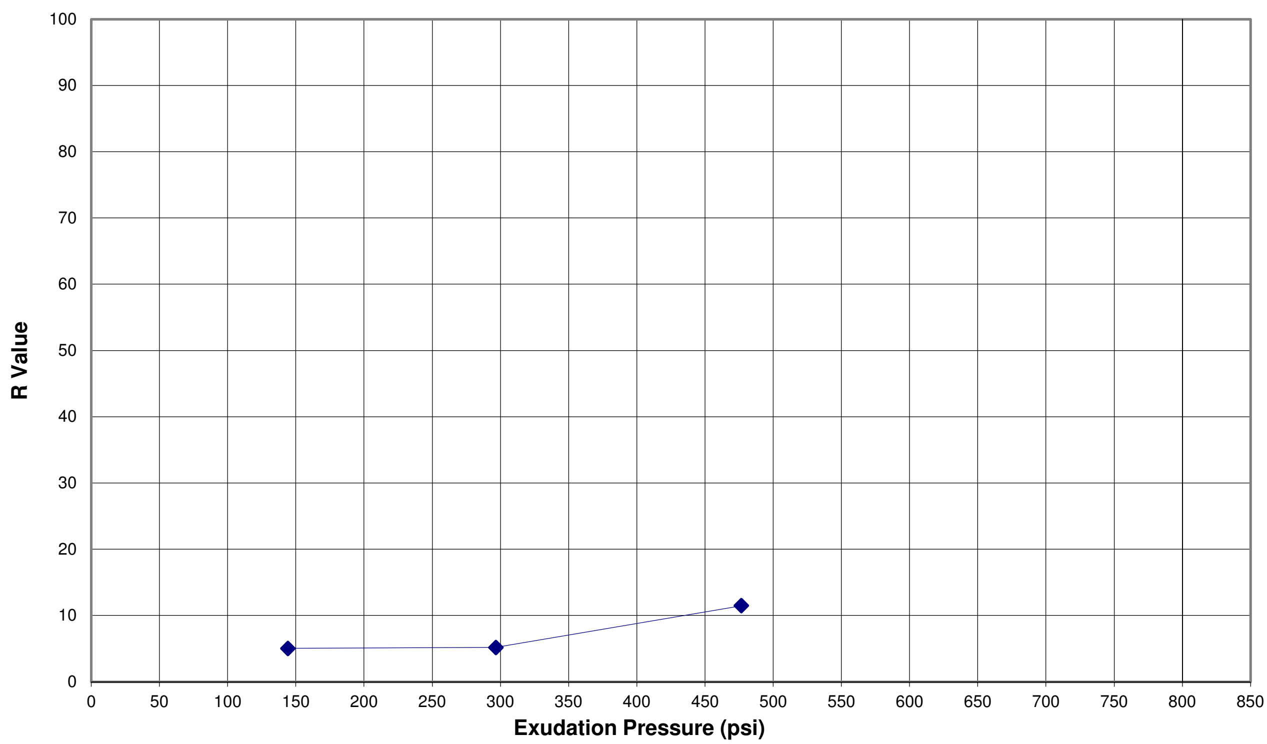
12294-48

SAMPLE SOURCE: **SD12 @ 0-4'**

USCS: SANDY LEAN CLAY (CL)

SPECIMEN	**A**	**B**	**C**
Moisture Content (%)	17.0	19.7	14.3
Compaction Pressure (psi)	*Hand Tamped*	*Hand Tamped*	100
Specimen Height (in)	2.41	2.52	2.38
Dry Density (pcf)	109.8	104.1	116.1
Horizontal Pressure @ 1000lbs (psi)	67	75	54
Horizontal Pressure @ 2000lbs (psi)	*Exceeded 140*	*Exceeded 140*	128
Displacement	5.62	6.36	4.25
Expansion Pressure (psi)	0.0	0.0	0.5
Exudation Pressure (psi)	297	144	477
R-Value	5	5	11

Interpolated R-Value at 300 psi = 5



R-VALUE (ASTM D2844)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B28

KLEINFELDER
Bright People. Right Solutions.

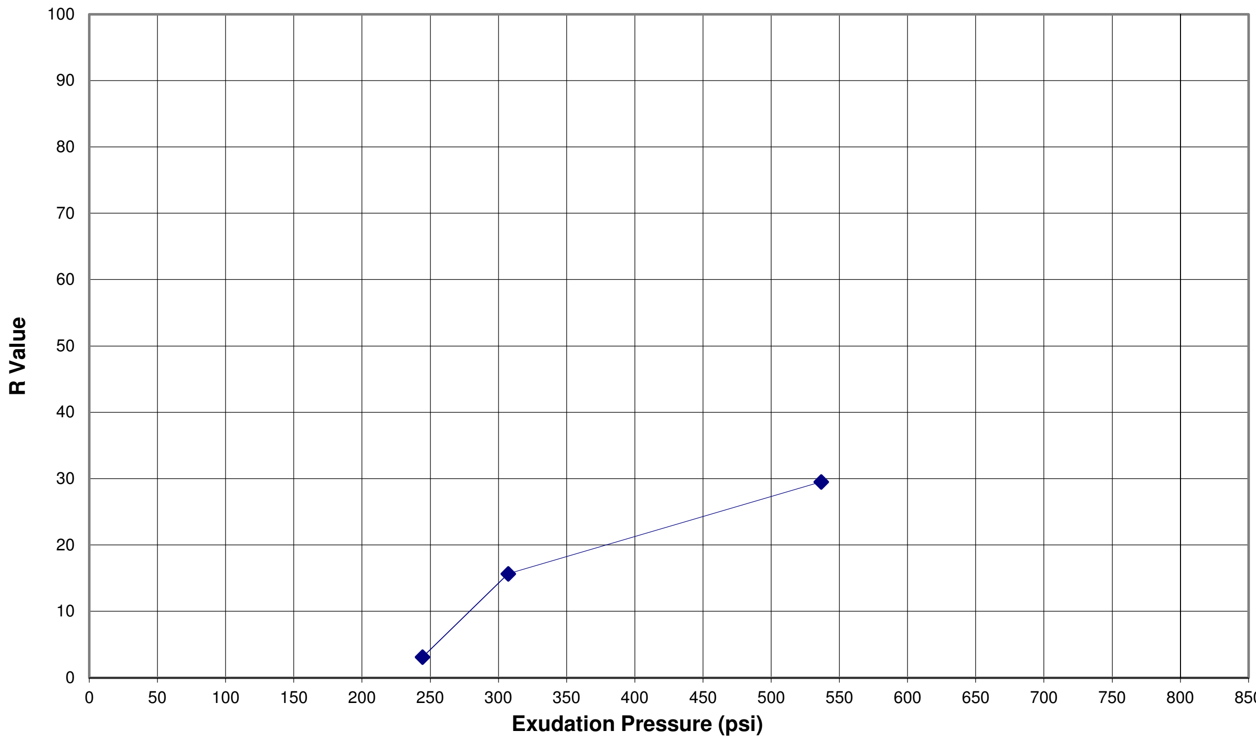
Report Date:	Project Number:
November 2012	129067

12294-50

SAMPLE SOURCE: **SD17 @ 0-5'**
USCS: LEAN CLAY with SAND (CL)

SPECIMEN	A	B	C
Moisture Content (%)	19.7	17.0	15.6
Compaction Pressure (psi)	*Hand Tamped*	150	200
Specimen Height (in)	2.59	2.45	2.48
Dry Density (pcf)	103.5	109.8	113.4
Horizontal Pressure @ 1000lbs (psi)	64	48	37
Horizontal Pressure @ 2000lbs (psi)	*Exceeded 140*	120	99
Displacement	5.70	4.49	3.68
Expansion Pressure (psi)	0.0	1.6	7.6
Exudation Pressure (psi)	244	307	537
R- Value	3	16	30

Interpolated R-Value at 300 psi = 14



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Report Date:	Project Number:
November 2012	129067

_R_-VALUE (ASTM D2844)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B29

12294-55

TEST METHOD:	ARIZ 733**	ARIZ 736**
SAMPLE LOCATION	Sulfates (ppm)	Chlorides (ppm)
SD1 @ 0-5'	77	216
SD1 @ 5-9'	75	96
SD2 @ 5-8'	156	201
SD2 @ 5-6.5'	207	129
SD2 @ 8-13'	81	54
SD3 @ 5-9'	73	118
SD3 @ 5-9' (duplicate)	73	114
SD4 @ 5-9'	97	99
SD4 @ 5-6.5'	88	59
SD5 @ 5-9'	73	103
SD6 @ 5-9'	71	140
SD6 @ 5-6.5'	69	134
SD7 @ 0-5'	153	222
SD7 @ 5-9'	60	79
F1 @ 0-5'	631	512
SD8 @ 5-9'	166	178
SD8 @ 5-6.5'	168	111

*** Testing performed by MotZZ Laboratory, Inc.*

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Report Date: December 2012

Project Number: 129067

ADDITIONAL LABORATORY TESTING
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B30

TEST METHOD:	ARIZ 733**	ARIZ 736**
SAMPLE LOCATION	Sulfates (ppm)	Chlorides (ppm)
SD9 @ 5-9'	413	348
SD9 @ 9-10.5'	116	76
F2 @ 5-9'	60	57
F2 @ 14-15.5'	46	219
SD10 @ 5-9'	116	18
SD10 @ 9-13'	126	59
SD11 @ 5-9'	625	53
SD11 @ 10-11.5'	1,098	191
SD13 @ 5-9'	51	15
SD13 @ 9-10.5'	28	33
SD15 @ 0-5'	233	362
SD16 @ 0-5'	122	233
SD16 @ 5-9'	164	459
SD16 @ 5-6.5'	138	366
SD17 @ 0-5'	69	103
SD17 @ 2-3.5'	54	58
SD17 @ 5-8'	60	66

*** Testing performed by MotZZ Laboratory, Inc.*

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Report Date: December 2012 | Project Number: 129067

ADDITIONAL LABORATORY TESTING
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B30

SECTION 6

PERCOLATION TESTING

TABLE OF CONTENTS

6 PERCOLATION TESTING

6.1 GENERAL

Eleven storm-water retention basins are proposed at multiple locations across the site. The planned depths for the proposed storm-water retention basins will range between 3 and 10 feet. Kleinfelder performed a geotechnical exploration for the proposed storm-water retention basins, which included percolation tests and borings. The geotechnical exploration for the proposed storm-water retention basins at the site was performed in general accordance with the Flood Control District of Maricopa County (FCDMC) requirements (Method 2 of the FCDMC Drainage Design [Hydraulics] Manual, 2010), which we understand also meets the City of Phoenix requirements for storm-water retention basins.

In addition, DMJM Harris/AECOM previously performed percolation tests across portions of the site and prepared a report summarizing their services. The report reviewed by Kleinfelder for this portion of the project was the following:

- *DMJM Harris/AECOM (AECOM) Stormwater Detention Basin Percolation Testing and Earthwork Factor Estimates, MC 85 (Buckeye Road), 107th Avenue to 91st Avenue, Maricopa County, Arizona* (DMJM Harris Project No. 6490.0000, dated November 8, 2006). This previous AECOM report is included as an appendix to this section.

6.2 SUMMARY OF PREVIOUS PERCOLATION TESTING

In 2006, DMJM Harris/AECOM (AECOM) performed percolation testing for proposed storm-water retention basins along MC-85 (Buckeye Road) from 107th Avenue to 91st Avenue (western 2 miles of the site). AECOM's work included 9 percolation tests along the southern portion of the MC-85 alignment. We understand the current design (basin locations, size and depths) of the proposed storm-water retention basins was changed from the design planned at the time AECOM prepared their report.

The approximate location of the previous AECOM percolation tests are shown on Figures P-1 and P-2 included in this section. AECOM prepared a table summarizing their percolation test results, which is presented on Page 8 of the AECOM report). The following table was prepared by AECOM (presented on Page 4 of their report), which summarizes the AECOM percolation test results:

Table 6.2-1 AECOM Percolation Test Results Summary Table

Stormwater Detention Basin Percolation Testing
and Earthwork Factor Estimates
MC 85 (Buckeye Road), 107th Avenue to 91st Avenue
MCDOT Work Order 69024
November 8, 2006
Page 4

Table 2
Percolation Test Results

ID	Station	Offset	Depth (ft)	Stabilized Percolation Rate (min/in)	Stabilized Percolation Rate ($ft^3/hr/ft^2$)
PT1	1133+00	100'R	4.25	25	0.20
PT3*	1143+00	100'R	4.25	32	0.16
PT4	1160+00	90'R	4.25	32	0.16
PT5	1177+00	100'R	4.25	38	0.14
PT6	1186+00	60'R	4.25	24	0.21
PT7	1197+00	60'R	4.25	27	0.19
PT8	1208+00	60'R	4.25	24	0.22
PT9	1219+00	75'R	4.25	52	0.09
PT10	1229+00	70'R	4.25	23	0.21
				Average	0.17

*PT2 was not investigated

6.3 FIELD EXPLORATION

Prior to our field exploration, Kleinfelder staked the boring locations, cleared work areas with the Arizona Bluestake Center, and obtained a MCDOT right-of-way permit (Tracking No. TC20120646). The field work was located at distances greater than 20 feet away from the edge of pavement; therefore, a traffic control plan was not prepared for the percolation test field work. We notified a MCDOT inspector 24 hours prior to our field work.

The exploratory borings and percolation tests for the proposed storm-water retention basins were supervised between October 30th and November 9th, 2012 by Rollina Katako, E.I.T. of Kleinfelder. The basins at the site were numbered from 1 through 11, as shown on the Figures P-1 through P-4 (Percolation Testing Site Plans). Due to constraints of existing utilities and private property access restrictions, the areas for Basin Nos. 4 and 11 were not accessible to perform borings and percolation tests. The approximate locations of the borings and percolation tests for the proposed storm-water retention basins are shown on Figures P-1 through P-4.

We were provided access to the private properties at the location of Basin Nos. 1, 3, 5 and 8; therefore, the borings and percolation tests were performed in the central portion of the proposed storm-water retention basins. We were not provided access to the private properties at the location of Basin Nos. 2, 6, 7, 9 and 10; therefore, the borings and percolation tests were performed along the edge of existing right-of-way and slightly away from the central portion of the proposed basins.

The subsurface soil conditions at the proposed basin sites were explored by drilling a total of 11 borings (designated as B1B1, B2B1, B3B1, B5B1, B5B2, B6B1, B6B2, B7B1, B7B2, B8B1, and B9B1 – the first two characters designate the basin number and the last two characters designate the boring number). The borings were drilled with a truck-mounted D-120 drill-rig and crew supplied by D&S Drilling, Inc. The borings were drilled using 8-inch outer diameter (OD) hollow-stem augers to depths generally ranging from about 15 to 20 feet below the existing ground surface (bgs).

During the field exploration, the soils encountered were visually classified, logged, and sampled by Kleinfelder's field engineer. Relatively undisturbed samples of the subsurface materials were obtained using a ring sampler with a 2.42-inch inside diameter (ID) and 3-inch OD. Disturbed samples of soils were obtained using a standard penetration test (SPT) split spoon sampler with a 1.375-inch ID and 2-inch OD. Bulk samples of drill cuttings were also collected at selected depths from the borings. The SPT and ring samplers were driven 18 and 12 inches, respectively, using a hydraulic actuated 140-pound hammer free falling 30 inches. Unless noted otherwise on the boring logs, the sample driving resistance was recorded as number of blows per six inches of penetration. The penetration results are presented on the borings logs adjacent to each sample. The recovered soil samples were removed from the sampler, sealed to reduce moisture loss and submitted to the laboratory. The borings were backfilled with auger cuttings. The logs of the exploratory borings are presented in Appendix P-A.

6.4 LABORATORY TESTING

Selected laboratory tests were performed on representative samples recovered from the field exploration to support our field classification and to provide information regarding engineering characteristics and properties of the subsurface soils. The laboratory testing program consisted of the following:

Table 6.4-1 Laboratory Testing Program

Laboratory Test	Sample Type	Number of Tests	Purpose of Test
Sieve Analysis (ASTM C136)	Bulk	12	Soil Classification
Atterberg Limits (ASTM D4318)	Bulk	12	Soil Classification
Hydrometer (ASTM D422)	Bulk	3	Silt/Clay Determination
pH and Resistivity (Ariz 236)	Bulk	8	Soil Corrosion Characteristics
Sulfates and Chlorides (Ariz 733/736)	Bulk	8	Soil Corrosion Characteristics

The results of the laboratory tests are presented on the laboratory test data sheets in Appendix P-B. The laboratory test results are also summarized on the boring logs in Appendix P-A.

6.5 GENERAL SITE CONDITIONS

6.5.1 SURFACE CONDITIONS

The proposed storm-water retention basin areas are generally located south and north of the existing MC-85 roadway. The proposed storm-water retention basins are generally located on graded shoulder areas and/or active agricultural land. The following are two pictures of MC-85 (Buckeye Road) taken at each end of the site facing east and west along the south side of the roadway.

Picture 1 – Near 107th Ave.; Facing East

Picture 2 – Near 75th Ave.; Facing West

6.5.2 SUBSURFACE CONDITIONS

The subsurface profiles encountered at the boring locations were found to be relatively similar. Individual boring logs with detailed descriptions are presented in Appendix P-A of this report.

At the boring locations, the surface and/or near surface soils generally consisted of native deposits of fine-grained soils that included sandy fat clays (CH), sandy lean clays (CL), fat clays (CH), and lean clays with sand (CL). These soils typically exhibited plasticities in the medium to high ranges with relative firmness in the soft to very firm range (generally increasing with depth), and they contained no to weak calcium carbonate cementation (caliche). At the location of B5B1, these clay soils extended to the final depth of exploration (approximately 15 feet bgs). With the exception of Boring B5B1, beginning at depths ranging from approximately 6.5 to 13 feet bgs and extending to the final depths of exploration (about 15 to 20.5 feet bgs), the clay soils were generally underlain by deposits of silty sand (SM), poorly graded sand (SP-SM), well graded sand (SW-SM), sandy silt (ML), clayey sand (SC), and sandy clayey silt (CL-ML). These subsurface coarser materials exhibited plasticities in the no to low range with relative densities in the loose to very dense range, had relative firmness in the hard range (fine-grained soils), and contained no to weak cementation. At the location of Borings B2B1, B6B2 and B9B1, silty gravel (GM), clayey sand (SC) or silty sand (SM) fill soils were encountered in the upper roughly 1 to 2 feet bgs.

As previously mentioned, Basin Nos. 4 and 11 were not accessible due to constraints of existing utilities and private property access restrictions; therefore, borings in these proposed storm-water retention basins were not drilled.

Groundwater was not encountered within the borings to the depths explored. It is possible that variations in groundwater elevations may occur due to seasonal changes, run-off, precipitation, perching, and irrigation and/or construction activities. In general, it is not expected that groundwater would impact construction of this project.

6.6 PERCOLATION TEST RESULTS

Eleven storm-water retention basins designated as Basins 1 through 11 are proposed at the site. Dependent upon the size of the proposed basin, 1 to 4 percolation tests were performed at each accessible basin. The percolation tests were designated as listed in the table below. The first two characters of the percolation test number designate the basin number and the last two characters designate the percolation test number for the basin. As part of the field exploration for the storm-water retention basins, borings were generally drilled in the central portion of the basins in an effort to explore the subsurface soil conditions. The approximate locations of the basins, borings and percolation tests are shown on Figures P-1 through P-4.

The percolation test holes were drilled between October 30th and November 9th, 2012 with a 15-inch solid stem auger to depths ranging from approximately 3 to 8 feet bgs. The test holes were manually cleaned and a 12-inch diameter PVC casing was installed in the test hole and the void in the test hole surrounding the outside perimeter of the PVC casing was backfilled with hand-tamped on-site clayey soils in an effort to direct flow to the bottom of the test hole. A gravel layer of approximately 2 inches thick was placed at the bottom of the test hole. The holes were partially filled with water (approximately 2 feet) and allowed to pre-soak for approximately 24 hours. The percolation tests were performed in general accordance with Method 2 of the FCDMC Drainage Design Manual (Hydraulics) to aid in the design of the proposed storm-water retention basins. The percolation tests were performed between October 31st and November 9th, 2012 by filling the percolation test holes with approximately 11 to 12 inches of water and measuring the rate of water drop within each test hole. Multiple water level readings were taken within the percolation test holes, and the holes were refilled with water (as needed) until a stabilized percolation rate was observed.

The following table provides the field measurements of the percolation testing to aid in the design of the proposed storm-water retention basins at the site. The field measurement rates shown in the table below (Table 6.6-1) should be de-rated based on the FCDMC Drainage

Design Manual for a 12-inch diameter test hole. Our scope of work was limited to presenting the field measurements of the percolation tests, and we understand the design of the proposed storm-water retention basins and selection of infiltration rates representative of the site conditions will be performed by others. The designers should be aware that in-situ infiltration testing provides an estimate of short-term infiltration rate that is generally representative of the infiltration rates at a specific location at the site. These tests saturate a very small amount of soil at the test location. The test results presented below may not accurately reflect the effects of interbedded fine-grained sediments and/or changes in hydraulic conductivity within the infiltration media below the tested areas. These tests are limited by the amount of material that they saturate.

Table 6.6-1 Results of Percolation Tests

Basin Number	Percolation Test	Depth of Hole bgs (feet)	Water Depth Range (inches)	Field Measurement Percolation Rate (minutes/inch)*
1	B1P1	7.9	12 to 4	10
	B1P2	8.0	12 to 6	14
2	B2P1	4.0	11 to 5	18
	B2P2	4.0	11 to 5	17
3	B3P1	4.0	12 to 6	33
	B3P2	4.1	11 to 5	23
4	No percolation testing performed due to access constraints.			
5	B5P1	4.0	11 to 5	32
	B5P2	4.0	12 to 5	49
	B5P3	4.0	11 to 5	52
6	B6P1	4.0	12 to 6	20
	B6P2	3.9	12 to 8	114
	B6P3	3.9	11 to 6	28
7	B7P1	3.8	11 to 5	56
	B7P2	3.9	11 to 5	20
	B7P3	3.8	11 to 5	22
	B7P4	4.1	12 to 5	35
8	B8P1	4.0	11 to 6	33
	B8P2	4.0	12 to 6	24
9	B9P1	3.1	12 to 6	72
10	B10P1	3.0	12 to 5	20
11	No percolation testing performed due to access constraints.			

*Note: Percolation rates shown are unfactored.

The field percolation rates measured are based on the soil conditions encountered at the particular locations of the percolation tests. If the soil conditions throughout the basin are different than those encountered, then the actual rates will likely differ, and additional percolation testing including large scale testing may be appropriate to further evaluate the basins.

6.7 EXCAVATION CHARACTERISTICS

The following general comments regarding excavation conditions are based on boring data. Based on the subsurface conditions encountered, excavations within the upper roughly 3 to 8 feet bgs should be possible using conventional earth excavating equipment. We recommend that the earthwork contractor make his own assessment to satisfy himself as to the type of equipment required to excavate through these deposits.

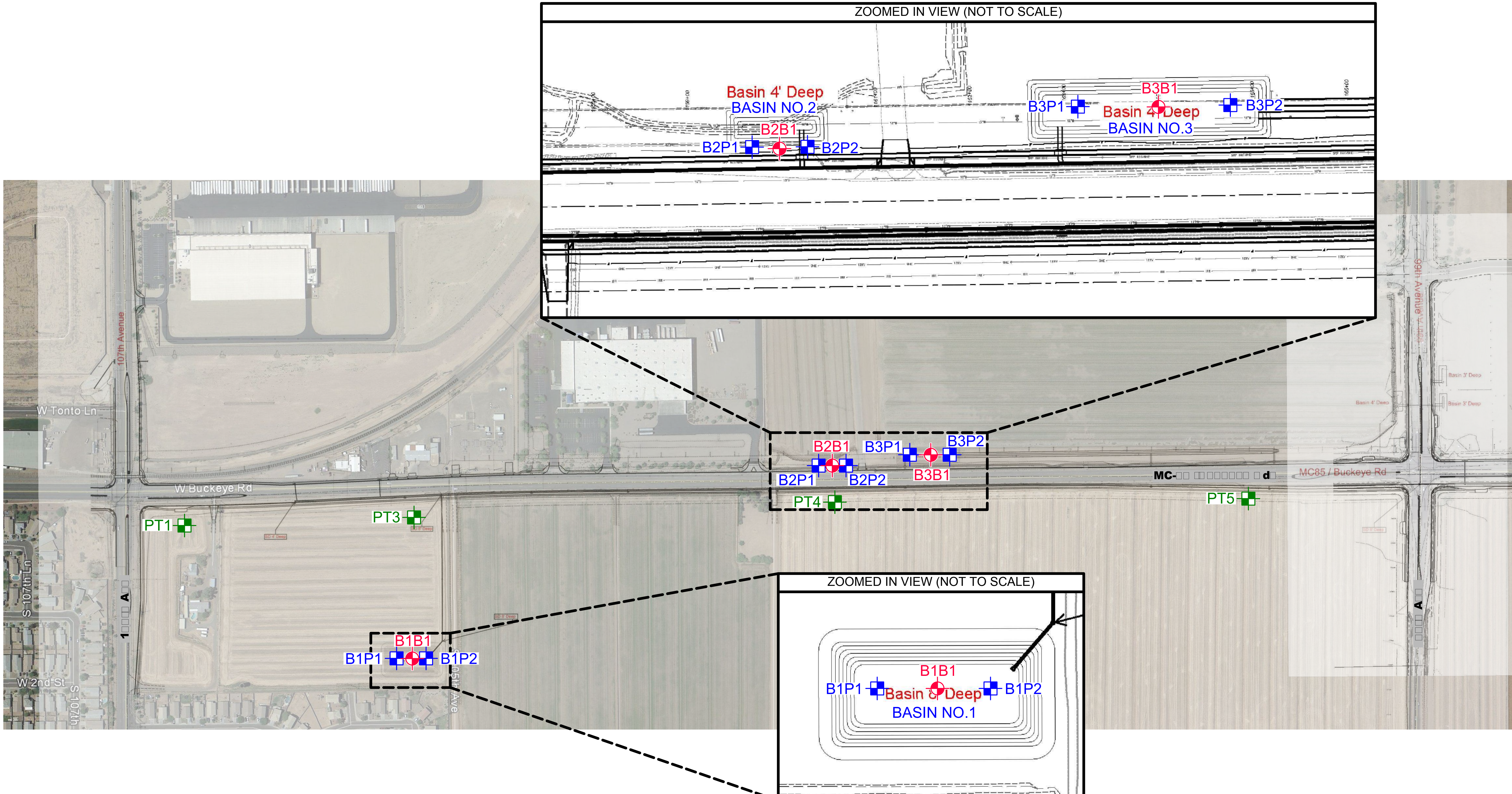
Based on our field observations and test results, temporary excavations in native soils may be cut at an inclination no steeper than 1.5H:1V (horizontal:vertical). All excavations should be planned and executed in accordance with current OSHA recommendations for a Type C soil (Federal Register 29 CFR Part 1926) and applicable local governing agency standards and procedures. Slopes may need to be further flattened or shored based on conditions encountered during construction. All parties should understand that safety of construction personnel is the sole responsibility of the Contractor. If trench shoring is used, the Engineer of Record should review shoring designs and soil parameters utilized by the shoring designer.

All construction surcharge loads and traffic loads should be kept a distance equal to the depth of the excavation away from the edge of the trench excavations, unless specifically designed for in the shoring design.

6.8 PERMANENT SLOPES

We do not anticipate the construction of permanent slopes for the basins to be greater than 10 feet in height, otherwise, Kleinfelder should be notified in order to review the slope details and determine if additional analyses is required. We recommend all cut slopes be constructed at a gradient no steeper than 2.5H:1V. Some erosion on the slopes should be anticipated, especially following storm events. Flatter slopes will be less susceptible to erosion.

FIGURES



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0 200 400 800

APPROXIMATE SCALE (feet)

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EXPLANATION

- APPROXIMATE PERCOLATION TEST LOCATION
- APPROXIMATE KLEINFELDER BORING LOCATION
- APPROXIMATE PREVIOUS DMJM/AECOM PERCOLATION TEST LOCATION

SOURCE: GOOGLE EARTH PRO, 6/08/12.

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FILE NAME:	129067-FigP-1 to P-4.dwg

PERCOLATION TESTING SITE PLAN

MC-85 (BUCKEYE ROAD)
FROM 107TH TO 99TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

P-1

ATTACHED IMAGES: Images: Aerial-Image_1304_6-8-12_107th.jpg Images: Aerial-Image_1304_6-8-12_83rd.jpg Images: Aerial-Image_1304_6-8-12_91st.jpg Images: Aerial-Image_1304_6-8-12_99th.jpg Images
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LONG BEACH, CA

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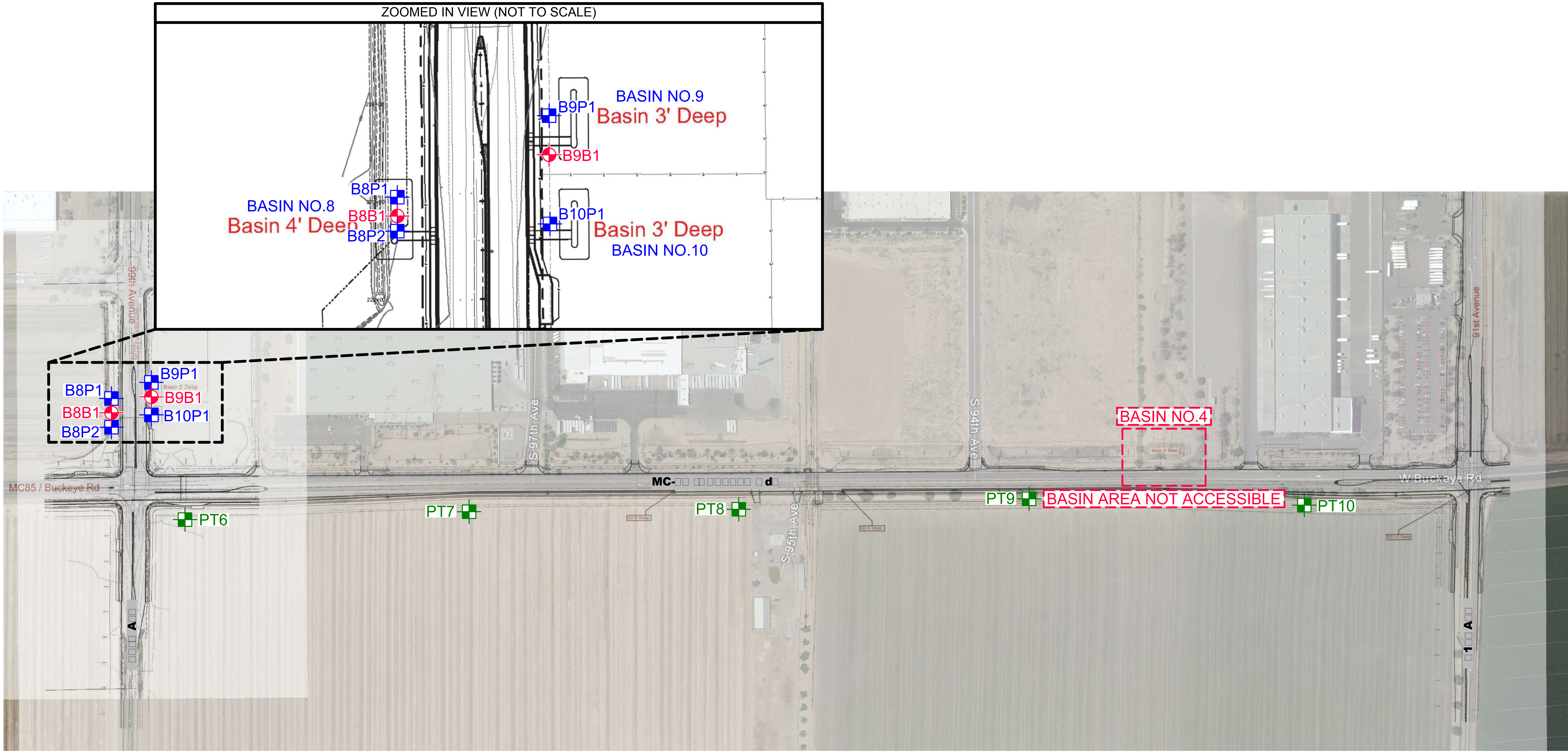

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EXPLANATION

- APPROXIMATE PERCOLATION TEST LOCATION
- APPROXIMATE KLEINFELDER BORING LOCATION
- APPROXIMATE PREVIOUS DMJM/AECOM PERCOLATION TEST LOCATION

SOURCE: GOOGLE EARTH PRO, 6/08/12.

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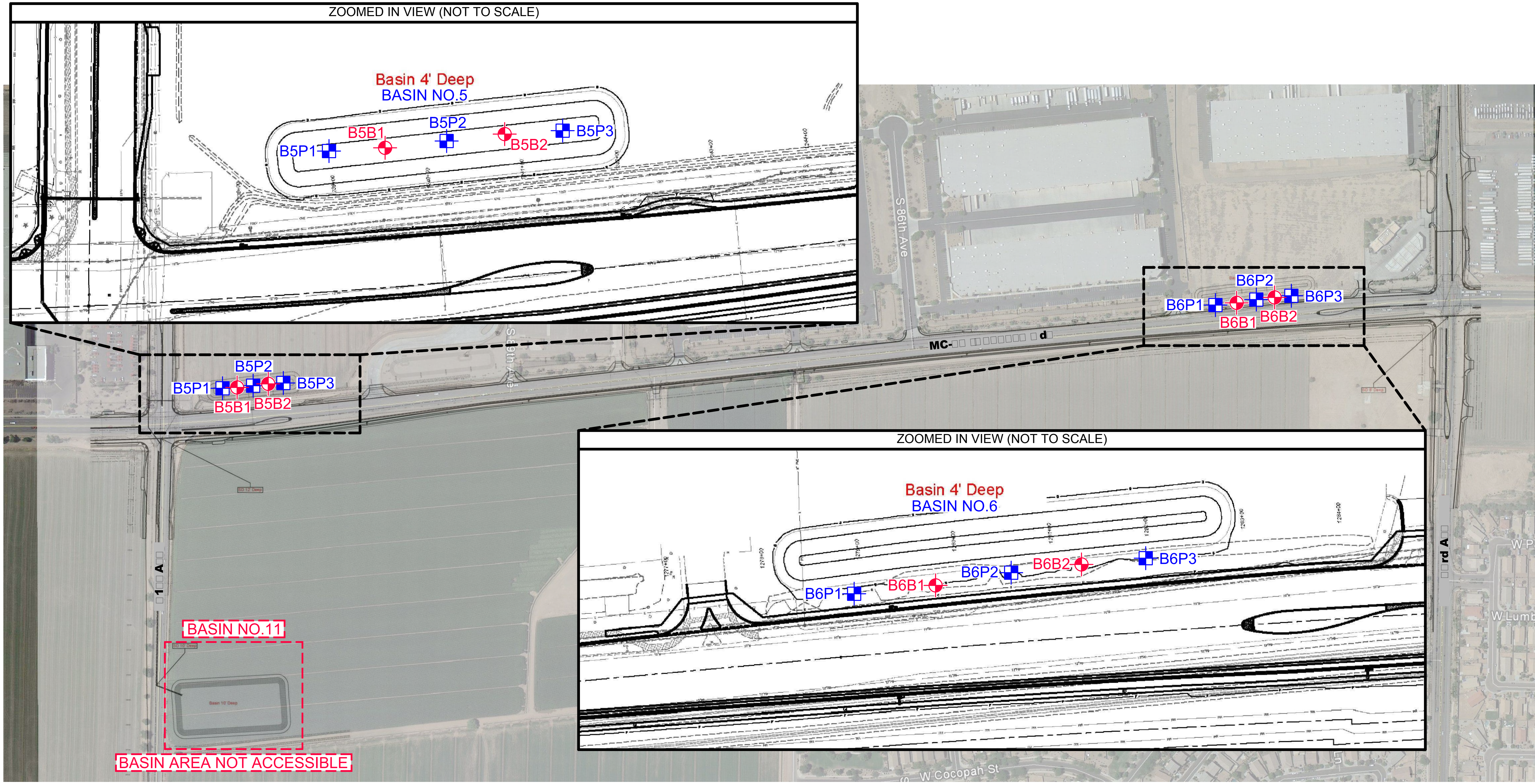
PERCOLATION TESTING SITE PLAN

MC-85 (BUCKEYE ROAD)
FROM 99TH TO 91ST AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

P-2



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APPROXIMATE SCALE (feet)

EXPLANATION

- APPROXIMATE PERCOLATION TEST LOCATION
- APPROXIMATE KLEINFELDER BORING LOCATION

SOURCE: GOOGLE EARTH PRO, 6/08/12.

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PERCOLATION TESTING SITE PLAN

MC-85 (BUCKEYE ROAD)
FROM 91ST AVENUE TO 83RD AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE
P-3

ATTACHED IMAGES: Images: Aerial-Image_1304_6-8-12_107th.jpg Images: Aerial-Image_1304_6-8-12_83rd.jpg Images: Aerial-Image_1304_6-8-12_91st.jpg Images: Aerial-Image_1304_6-8-12_99th.jpg Images
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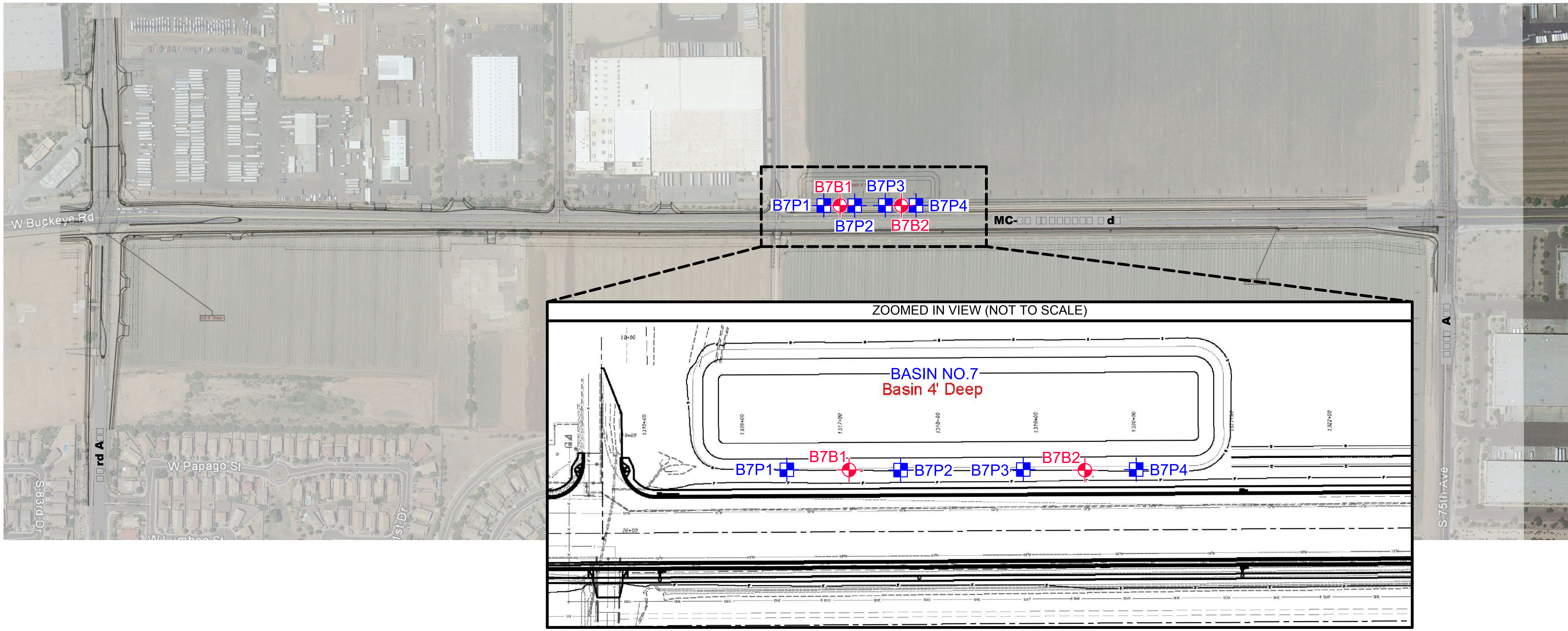

EXPLANATION

APPROXIMATE PERCOLATION TEST LOCATION

APPROXIMATE KLEINFELDER BORING LOCATION

N

0 200 400 800

APPROXIMATE SCALE (feet)

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PERCOLATION TESTING SITE PLAN

MC-85 (BUCKEYE ROAD)
FROM 83RD AVENUE TO 75TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

P-4

APPENDIX P-A

Borings Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LESS THAN 5% PASSING NO. 200 SIEVE	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% PASSING NO. 200 SIEVE	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LESS THAN 5% PASSING NO. 200 SIEVE	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% PASSING NO. 200 SIEVE	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

Note: Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing No. 200 sieve require dual USCS symbols. (See KEY A3 if provided)

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Report Date:	Project Number:
December 2012	129067

UNIFIED SOIL CLASSIFICATION SYSTEM

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

A1

GEO-KEY_A1_SOIL 129067 MC-85.GPJ 12/06/12

LOG SYMBOLS

BULK / GRAB SAMPLE

MODIFIED CALIFORNIA SAMPLER
(2 inch inside diameter)

RING (PORTER) SAMPLER
(2-1/2 inch inside diameter)

STANDARD PENETRATION
SPLIT SPOON SAMPLER
(1.4 inch inside diameter)

SHELBY TUBE
(3 inch outside diameter)

HQ-3 SIZE CORE BARREL
(2.4 inch inside diameter)

WATER LEVEL
(level after completion)

WATER LEVEL
(level where first encountered)

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
3. Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.
5. NA = Not Analyzed

Boring Location:	Latitude: 33.43361° Longitude: -112.28587°	Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	20.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 20.5 feet — Agricultural field - alfalfa
													SC	**CLAYEY SAND:** brown, very loose, low plasticity, no cementation, damp, upper roughly 12 to 18 inches disturbed by agricultural plowing.
			2-1-2											
													CL	**SANDY LEAN CLAY:** brown to light brown, firm, medium plasticity, no to weak cementation, damp.
	5		24/12											
							32	12	98	46	Sulfates = 47 ppm Chlorides = 63 ppm pH = 8.3 Min Resis = 1342 ohms-cm		SC	**CLAYEY SAND:** brown, medium dense, low plasticity, no cementation, trace gravel, damp, stratified with silty sand.
			25/12											
	10													
													SP-SM	**POORLY GRADED SAND, with SILT:** brown to light brown, medium dense, non-plastic, no cementation, trace gravel, damp.
			10-13-15											
	15												GM	**SILTY GRAVEL:** brown and gray, dense, non-plastic, no cementation, damp.
			17-19-17											Note: stratified with thin layers of poorly graded sand, with silt (SP-SM) below about 19 feet.
	20													
														Stopped drilling at 19.0 feet. Stopped sampling at 20.5 feet. No groundwater encountered in test boring. Cave-in to 15.0 feet.

KLEINFELDER
Bright People. Right Solutions.

Report Date:	Project Number:
December 2012	129067

LOG OF BORING B1B1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

A3

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

Boring Location:	Latitude: 33.43578° Longitude: -112.28029°	Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc. — Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 — Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic — Elevation (ft): N/A	Total Depth (ft):	15.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	Insitu Dry Density (pcf)	Field Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	USCS Classification	DESCRIPTION 0.0 to 15.5 feet — Graded dirt shoulder - Buckeye Road
			14								FILL	**FILL: SILTY GRAVEL:** brown and gray, non-plastic, damp.
			9								CH	**SANDY FAT CLAY:** brown, moderately firm, high plasticity, weak cementation, damp.
		3-4-5	7									
			5									
						53	34	100	68	Sulfates = 137 ppm Chlorides = 126 ppm pH = 7.9 Min Resis = 939 ohms-cm		
			9									
	5	31/12	16									Note: light brown, very firm, and weak to moderate cementation below about 5 feet.
			14									
			11								SM	**SILTY SAND:** brown, medium dense, non-plastic, no cementation, trace gravel, damp.
			12									
		5-7-9										
	10											
											SP-SM	**POORLY GRADED SAND, with SILT:** brown to light brown and gray, very dense, non-plastic, no cementation, trace gravel, slightly damp.
		11-25-37										
	15											
	20											

Stopped drilling at 14.0 feet.
Stopped sampling at 15.5 feet.
No groundwater encountered in test boring.
Cave-in to 11.0 feet.

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING B2B1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
A4

Boring Location:	Latitude: 33.43582° Longitude: -112.27896°			Date Started:	10/30/2012
Groundwater (ft):	No Groundwater Encountered			Date Completed:	10/30/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic	Elevation (ft):	N/A	Total Depth (ft):	15.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.5 feet Graded dirt shoulder - Buckeye Road
													CL	**SANDY LEAN CLAY:** brown, soft, medium plasticity, no to weak cementation, damp, upper roughly 12 inches disturbed by previous grading.
			3-3-4											
							44	26	98	56	Sulfates = 115 ppm Chlorides = 249 ppm pH = 7.9 Min Resis = 812 ohms-cm			
	5		5-7-9											Note: light brown, firm, weak to moderate cementation, and trace gravel below about 5 feet.
													SW-SM	**WELL GRADED SAND, with SILT:** brown to light brown, loose, non-plastic, no cementation, some gravel, slightly damp.
			4-4-4				NV	NP	90	9				
	10													
			5-5-7				NV	NP	90	9				Note: medium dense below about 14 feet.
	15													
														Stopped drilling at 14.0 feet. Stopped sampling at 15.5 feet. No groundwater encountered in test boring. Cave-in to 11.0 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING B3B1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

A5

Boring Location:	Latitude: 33.43615° Longitude: -112.25417°	Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	15.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.0 feet Agricultural field - alfalfa
													CH	**FAT CLAY:** brown, soft, high plasticity, no cementation, damp, upper roughly 12 to 18 inches disturbed by agricultural plowing, trace fine roots.
			2-3-3											
							59	41	100	89	Sulfates = 93 ppm Chlorides = 126 ppm pH = 8.0 Min Resis = 738 ohms-cm			
	5		21/12											Note: firm and weak cementation below about 5 feet.
			5-7-10										CL	**SANDY CLAY:** brown and light brown, moderately firm, medium plasticity, weak cementation, damp.
	10													
			20-50/6											Note: brown and tan, hard, moderate cementation, trace caliche nodules, and stratified with thin layers of clayey sand (SC) below about 14 feet.
	15													Stopped drilling at 14.0 feet. Stopped sampling at 15.0 feet. No groundwater encountered in test boring. Cave-in to 12.0 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING B5B1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
A6

Boring Location:	Latitude: 33.43621° Longitude: -112.25376°	Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120
Logged By:	R. Katako		
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger
Hammer Type:	Automatic	Elevation (ft):	N/A
Total Depth (ft):	15.5		

ELEVATION (ft)	DEPTH (ft)	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	Field Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	USCS Classification	DESCRIPTION 0.0 to 15.5 feet — Agricultural field - alfalfa
	0										CH	**FAT CLAY:** brown, very soft, high plasticity, no cementation, damp, upper roughly 12 to 18 inches disturbed by agricultural plowing.
		2-2-2										
						57	38	100	89			
	5	5-7-10										Note: firm and weak cementation below about 5 feet.
		3-4-6									ML	**SANDY SILT:** brown, medium dense, non-plastic, no cementation, damp.
	10											
											SC	**CLAYEY SAND:** brown and light brown, very dense, low plasticity, weak cementation, with caliche nodules, slightly damp.
		40-28-31										
	15											

Stopped drilling at 14.0 feet.
Stopped sampling at 15.5 feet.
No groundwater encountered in test boring.
Cave-in to 12.0 feet.

20

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LOG OF BORING B5B2

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

Report Date:	Project Number:	PLATE
December 2012	129067	A7

Boring Location:	Latitude: 33.43708° Longitude: -112.24107°			Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered			Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic	Elevation (ft):	N/A	Total Depth (ft):	15.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	Field Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	USCS Classification	DESCRIPTION 0.0 to 15.5 feet
												Graded dirt shoulder - Buckeye Road
	0										CL	**SANDY LEAN CLAY:** brown to light brown, soft, medium plasticity, weak cementation, trace gravel, slightly damp, upper roughly 12 inches disturbed by previous grading.
		4-4-3										
						36	19	99	70	Sulfates = 68 ppm Chlorides = 62 ppm pH = 7.9 Min Resis = 671 ohms-cm		
	5	31/12										Note: very firm below about 5 feet.
		7-8-10									ML	**SANDY SILT:** brown to light brown, medium dense, non-plastic, no cementation, slightly damp, stratified with thin layers of lean clay.
	10											
		12-15-17									SC	**CLAYEY SAND:** brown and light brown, dense, low plasticity, no cementation, slightly damp.
	15											
												Stopped drilling at 14.0 feet. Stopped sampling at 15.5 feet. No groundwater encountered in test boring. Cave-in to 10.0 feet.
	20											

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING B6B1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
A8

Boring Location:	Latitude: 33.43713° Longitude: -112.24055°	Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	15.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 15.5 feet: Graded dirt shoulder - Buckeye Road
													FILL	**FILL: CLAYEY SAND:** brown, low plasticity, trace gravel, slightly damp.
													CH	**FAT CLAY:** brown, moderately firm, high plasticity, weak cementation, slightly damp, with calcareous veins.
			13/12											
							50	31	100	89				
	5		11-9-14											Note: firm below about 5 feet.
			7-11-11										CL	**SANDY CLAY:** light brown, firm, low plasticity, weak cementation, slightly damp, with calcareous veins.
	10													
													SM	**SILTY SAND:** brown and gray, medium dense, non-plastic, no cementation, slightly damp.
			17-15-12											
	15													
														Stopped drilling at 14.0 feet. Stopped sampling at 15.5 feet. No groundwater encountered in test boring. Cave-in to 11.0 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING B6B2

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
A9

Boring Location:	Latitude: 33.43729° Longitude: -112.2288°			Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered			Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic	Elevation (ft):	N/A	Total Depth (ft):	20.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	Insitu Dry Density (pcf)	Field Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	USCS Classification	DESCRIPTION 0.0 to 20.5 feet
												Graded dirt shoulder - Buckeye Road
			9								CL	**LEAN CLAY, with SAND:** brown to light brown, soft, medium plasticity, weak cementation, trace gravel, slightly damp, upper roughly 12 inches disturbed by previous grading.
			4									
		2-2-2	3									
			5									
			8									
	5	17/12	8			42	25	100	81	Sulfates = 64 ppm Chlorides = 79 ppm pH = 7.9 Min Resis = 671 ohms-cm		Note: firm below about 5 feet.
			9									
			12									
			21									
		4-5-8									ML	**SANDY SILT:** brown, medium dense, non-plastic, no cementation, stratified with thin layers of silty sand.
	10											
											CL-ML	**SANDY, CLAYEY SILT:** brown to light brown, hard, low plasticity, no to weak cementation, damp, with caliche nodules.
		70/11										
	15											
		7-10-17									CL	**LEAN CLAY, with SAND:** brown to light brown, very firm, low plasticity, weak cementation, slightly damp, stratified with thin layers of silty sand.
	20											

Stopped drilling at 19.0 feet.
Stopped sampling at 20.5 feet.
No groundwater encountered in test boring.
Cave-in to 16.0 feet.

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING B7B1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A10

Boring Location:	Latitude: 33.43724° Longitude: -112.22809°			Date Started:	10/31/2012
Groundwater (ft):	No Groundwater Encountered			Date Completed:	10/31/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic	Elevation (ft):	N/A	Total Depth (ft):	20.5

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 20.5 feet Graded dirt shoulder - Buckeye Road
													CL	**SANDY LEAN CLAY:** brown, soft, low plasticity, no cementation, damp, upper roughly 12 inches disturbed by previous grading.
			2-3-3											
	5		3-4-4				29	13	99	51				Note: moderately firm, trace gravel, and stratified with thin layers of silty sand below about 5 feet.
			7-9-12											Note: firm below about 9 feet.
	10													
													ML	**SANDY SILT:** brown, very dense, non-plastic, no cementation, slighty damp to damp.
			11-22-30											
	15													
			8-11-12											Note: brown and light brown, medium dense, and with caliche nodules below about 19 feet.
	20													
														Stopped drilling at 19.0 feet. Stopped sampling at 20.5 feet. No groundwater encountered in test boring. Cave-in to 16.0 feet.

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

KLEINFELDER
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Report Date: December 2012

Project Number: 129067

LOG OF BORING B7B2

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
A11

Boring Location:	Latitude: 33.43645° Longitude: -112.27268°	Date Started:	11/2/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	11/2/2012
Drilling Company:	D & S Drilling, Inc.	Equipment:	Deidrich D-120
Logged By:	R. Katako		
Hole Diameter (in):	8	Drilling Method:	Hollow Stem Auger
Hammer Type:	Automatic	Elevation (ft):	N/A
Total Depth (ft):	14.8		

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 14.8 feet Graded dirt shoulder - 99th Avenue
				12									CL	**SANDY LEAN CLAY:** brown to light brown, soft, medium plasticity, weak cementation, slightly damp, upper roughly 12 inches disturbed by previous grading.
				5										
			3-4-3	5										
				6										
				8										
	5		22/12	10			43	27	99	63	Sulfates = 244 ppm Chlorides = 579 ppm pH = 7.9 Min Resis = 470 ohms-cm			Note: firm and trace gravel below about 5 feet.
				15										
				19										
				22										
			7-11-17										SC	**CLAYEY SAND:** light brown to light yellow brown, medium dense, low plasticity, no cementation, slightly damp to damp.
	10													
													ML	**SANDY SILT:** brown and light brown, very dense, no to low plasticity, weak cementation, slightly damp, with caliche nodules.
			16-50/3											
	15													Stopped drilling at 14.0 feet. Sampler refusal at 14.7 feet. No groundwater encountered in test boring. Cave-in to 9.7 feet.
	20													

GEO_ADOT_EW/EL_R 129067 MC-85.GPJ 12/06/12

KLEINFELDER
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LOG OF BORING B8B1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE A12

Report Date:	Project Number:
December 2012	129067

Boring Location:	Latitude: 33.43667° Longitude: -112.27218°	Date Started:	11/2/2012
Groundwater (ft):	No Groundwater Encountered	Date Completed:	11/2/2012
Drilling Company:	D & S Drilling, Inc. Equipment: Deidrich D-120	Logged By:	R. Katako
Hole Diameter (in):	8 Drilling Method: Hollow Stem Auger		
Hammer Type:	Automatic Elevation (ft): N/A	Total Depth (ft):	20.4

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Count	FIELD: Continuous Pen. Bullnose (bpf)	LABORATORY: Insitu Dry Density (pcf)	LABORATORY: Field Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION 0.0 to 20.4 feet Graded dirt shoulder - 99th Avenue
													FILL	**SILTY SAND:** light brown, low plasticity, with gravel, slightly damp.
			8-8-7				41	24	99	63	Sulfates = 87 ppm Chlorides = 159 ppm pH = 8.0 Min Resis = 738 ohms-cm		CL	**SANDY LEAN CLAY:** brown, moderately firm, medium plasticity, no cementation, trace gravel, slightly damp to damp.
	5		6-9-10											Note: brown, light brown, gray and firm below about 5 feet.
													SC	**CLAYEY SAND:** brown and light brown, medium dense, low plasticity, weak cementation, slightly damp to damp.
	10		10-14-20											Note: dense below about 9 feet.
	15		50/4											Note: very dense and with caliche nodules below about 14 feet.
	20		23-34-50/5											Note: stratified with thin layers of sandy silt below about 19 feet.
														Stopped drilling at 19.0 feet. Sampler refusal at 20.5 feet. No groundwater encountered in test boring. Cave-in to 13.0 feet.

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Report Date:	Project Number:
December 2012	129067

LOG OF BORING B9B1

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
A13

APPENDIX P-B

Laboratory Test Results

<table>
<tr><th rowspan="3">SAMPLE LOCATION</th><th rowspan="3">NATURAL MOISTURE CONTENT (%)</th><th rowspan="3">NATURAL DRY DENSITY (pcf)</th><th colspan="4">GRAIN SIZE ANALYSIS</th><th colspan="3">ATTERBERG LIMITS</th><th rowspan="3">OTHER TESTS</th><th rowspan="3">UNIFIED SOIL CLASSIFICATION (USCS)</th></tr>
<tr><th rowspan="2">GRAVEL (%)</th><th rowspan="2">SAND (%)</th><th rowspan="2">SILT (%)</th><th rowspan="2">CLAY (%)</th><th>LL</th><th>PL</th><th>PI</th></tr>
<tr></tr>
<tr><td>B1B1 @ 8-13'</td><td></td><td></td><td>2</td><td>51</td><td colspan="2">46</td><td>32</td><td>20</td><td>12</td><td>SULF = 47
CHLO = 63
pH = 8.3
RESIS = 1,342</td><td>CLAYEY SAND (SC)</td></tr>
<tr><td>B2B1 @ 4-8'</td><td></td><td></td><td>0</td><td>32</td><td colspan="2">68</td><td>53</td><td>19</td><td>34</td><td>SULF = 137
CHLO = 126
pH = 7.9
RESIS = 939</td><td>SANDY FAT CLAY (CH)</td></tr>
<tr><td>B3B1 @ 4-8'</td><td></td><td></td><td>2</td><td>42</td><td>25</td><td>31</td><td>44</td><td>18</td><td>26</td><td>SULF = 115
CHLO = 249
pH = 7.9
RESIS = 812</td><td>SANDY LEAN CLAY (CL)</td></tr>
<tr><td>B3B1 @ 9' and B3B1 @ 14'</td><td></td><td></td><td>10</td><td>81</td><td colspan="2">9</td><td>NV</td><td>NP</td><td>NP</td><td></td><td>WELL-GRADED SAND with SILT (SW-SM)</td></tr>
<tr><td>B5B1 @ 4-9'</td><td></td><td></td><td>0</td><td>11</td><td>38</td><td>50</td><td>59</td><td>18</td><td>41</td><td>SULF = 93
CHLO = 126
pH = 8.0
RESIS = 738</td><td>FAT CLAY (CH)</td></tr>
<tr><td>B5B2 @ 4-9'</td><td></td><td></td><td>0</td><td>11</td><td colspan="2">89</td><td>57</td><td>19</td><td>38</td><td></td><td>FAT CLAY (CH)</td></tr>
<tr><td>B6B1 @ 4-9'</td><td></td><td></td><td>1</td><td>30</td><td colspan="2">70</td><td>36</td><td>17</td><td>19</td><td>SULF = 68
CHLO = 62
pH = 7.9
RESIS = 671</td><td>SANDY LEAN CLAY (CL)</td></tr>
<tr><td>B6B2 @ 4-9'</td><td></td><td></td><td>0</td><td>11</td><td>44</td><td>45</td><td>50</td><td>19</td><td>31</td><td></td><td>FAT CLAY (CH)</td></tr>
<tr><td>B7B1 @ 5-9'</td><td></td><td></td><td>0</td><td>19</td><td colspan="2">81</td><td>42</td><td>17</td><td>25</td><td>SULF = 64
CHLO = 79
pH = 7.9
RESIS = 671</td><td>LEAN CLAY with SAND (CL)</td></tr>
<tr><td>B7B2 @ 5-9'</td><td></td><td></td><td>1</td><td>48</td><td colspan="2">51</td><td>29</td><td>16</td><td>13</td><td></td><td>SANDY LEAN CLAY (CL)</td></tr>
<tr><td>B8B1 @ 5-8'</td><td></td><td></td><td>1</td><td>36</td><td colspan="2">63</td><td>43</td><td>16</td><td>27</td><td>SULF = 244
CHLO = 579
pH = 7.9
RESIS = 470</td><td>SANDY LEAN CLAY (CL)</td></tr>
<tr><td>B9B1 @ 2-6.5'</td><td></td><td></td><td>1</td><td>36</td><td colspan="2">63</td><td>41</td><td>17</td><td>24</td><td>SULF = 87
CHLO = 159
pH = 8.0
RESIS = 738</td><td>SANDY LEAN CLAY (CL)</td></tr>
</table>

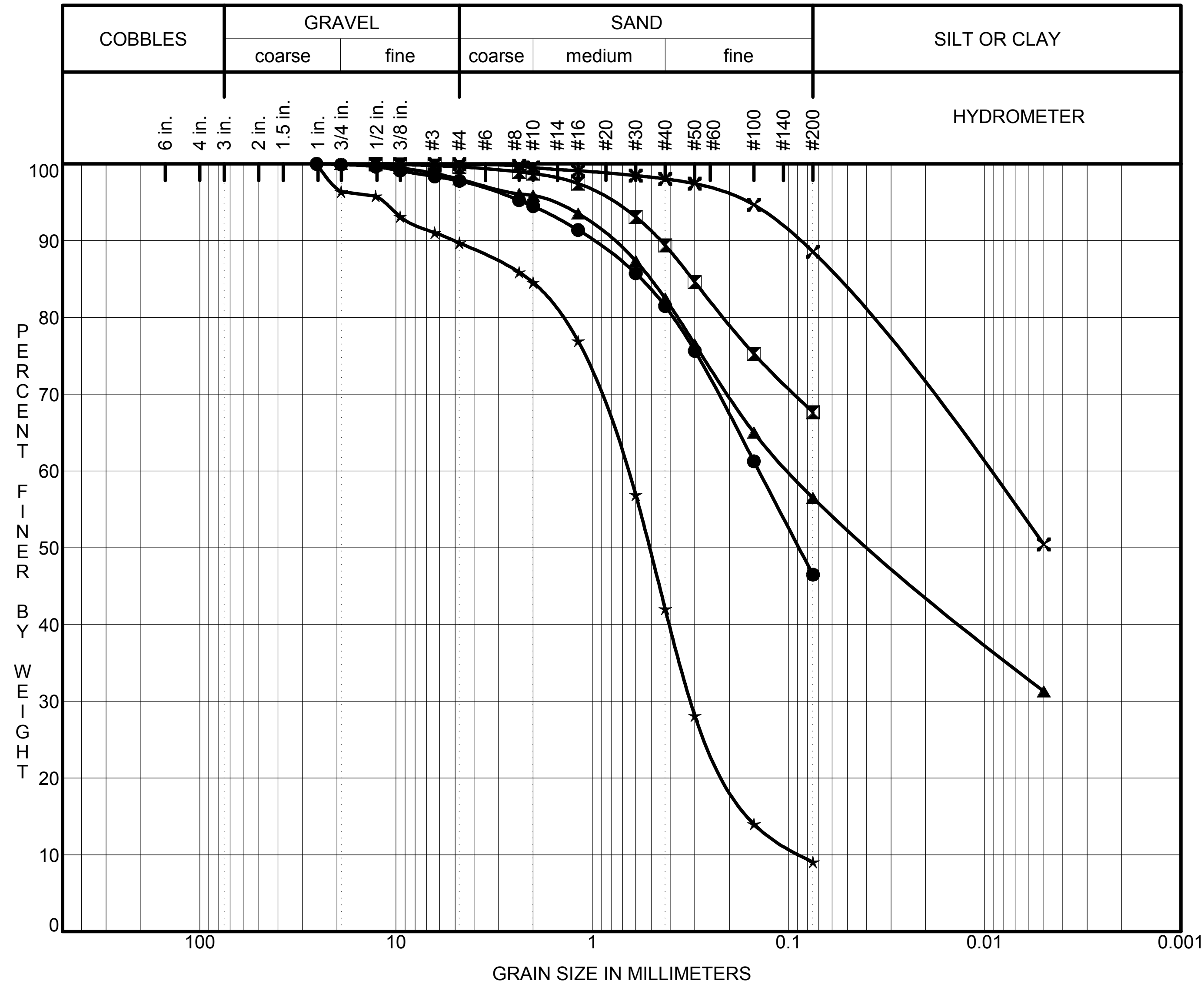
KLEINFELDER
Bright People. Right Solutions.

Report Date: Nov 2012

Project Number: 129067

SUMMARY OF LABORATORY TESTING
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B1



	Source	Depth (ft)	%Cobbles	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	B1B1	8.0 - 13.0	0	2	51	46		0.1		
⧗	B2B1	4.0 - 8.0	0	0	32	68				
▲	B3B1	4.0 - 8.0	0	2	42	25	31	0.1		
★	B3B1	9.0 - 15.5	0	10	81	9		0.7	0.3	0.1
✕	B5B1	4.0 - 9.0	0	0	11	38	50	0.0		

	Source	Depth (ft)	Classification	LL	PL	PI	Cu	Cc
●	B1B1	8.0 - 13.0	CLAYEY SAND (SC)	32	20	12		
⧗	B2B1	4.0 - 8.0	SANDY FAT CLAY (CH)	53	19	34		
▲	B3B1	4.0 - 8.0	SANDY LEAN CLAY (CL)	44	18	26		
★	B3B1	9.0 - 15.5	WELL-GRADED SAND with SILT (SW-SM)	NP	NP	NP	7.8	1.74
✕	B5B1	4.0 - 9.0	FAT CLAY (CH)	59	18	41		

123GRAINSIZECOMPLETE 129067 MC-85.GPJ 11/27/12

KLEINFELDER
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Report Date: November 2012

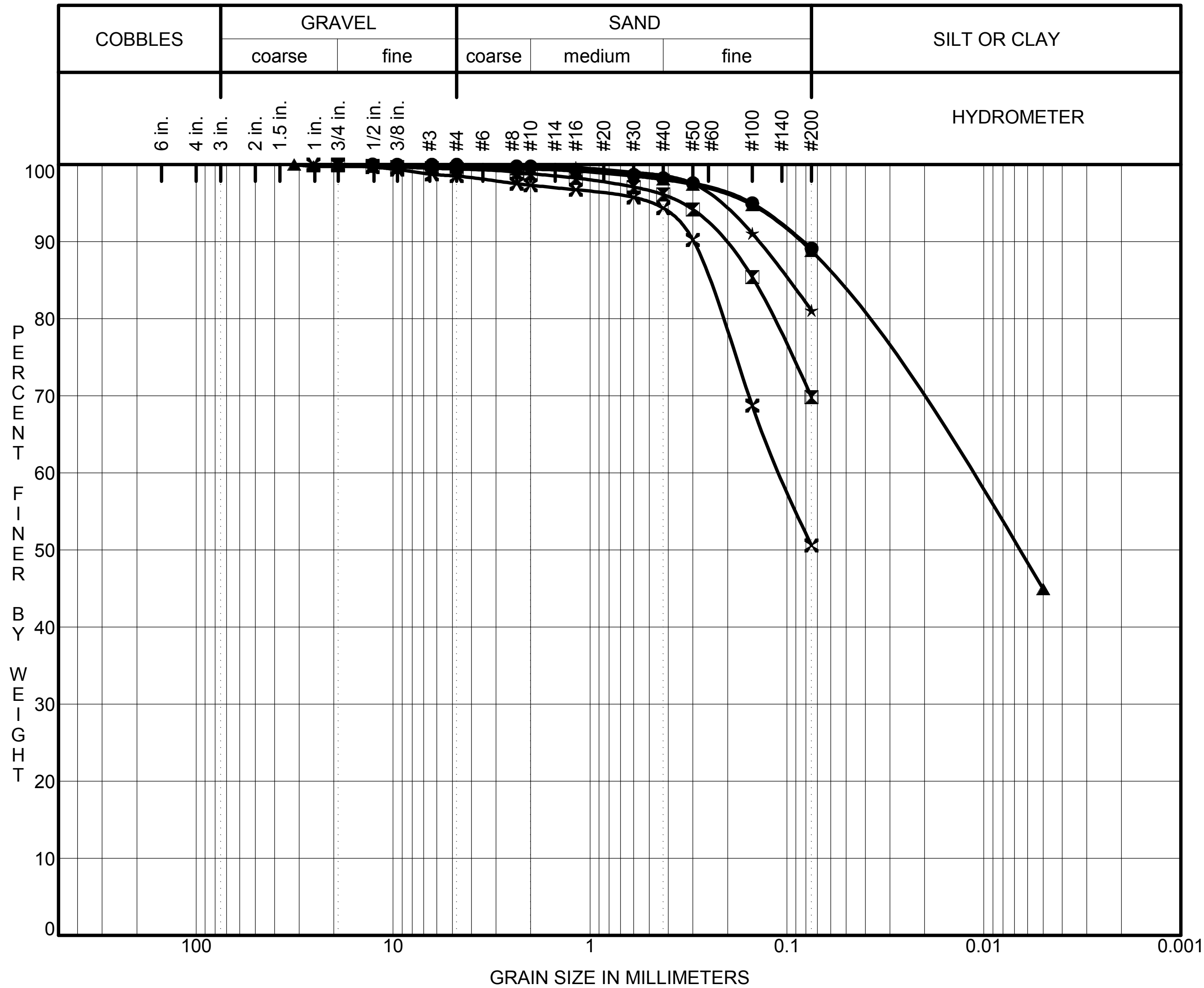
Project Number: 129067

GRAIN SIZE ANALYSES (ASTM C117 and C136)

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B2



	Source	Depth (ft)	%Cobbles	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	B5B2	4.0 - 9.0	0	0	11	89				
⧗	B6B1	4.0 - 9.0	0	1	30	70				
▲	B6B2	4.0 - 9.0	0	0	11	44	45	0.0		
★	B7B1	5.0 - 9.0	0	0	19	81				
✖	B7B2	5.0 - 9.0	0	1	48	51		0.1		

	Source	Depth (ft)	Classification	LL	PL	PI	Cu	Cc
●	B5B2	4.0 - 9.0	FAT CLAY (CH)	57	19	38		
⧗	B6B1	4.0 - 9.0	SANDY LEAN CLAY (CL)	36	17	19		
▲	B6B2	4.0 - 9.0	FAT CLAY (CH)	50	19	31		
★	B7B1	5.0 - 9.0	LEAN CLAY with SAND (CL)	42	17	25		
✖	B7B2	5.0 - 9.0	SANDY LEAN CLAY (CL)	29	16	13		

123GRAINSIZECOMPLETE 129067 MC-85.GPJ 12/05/12

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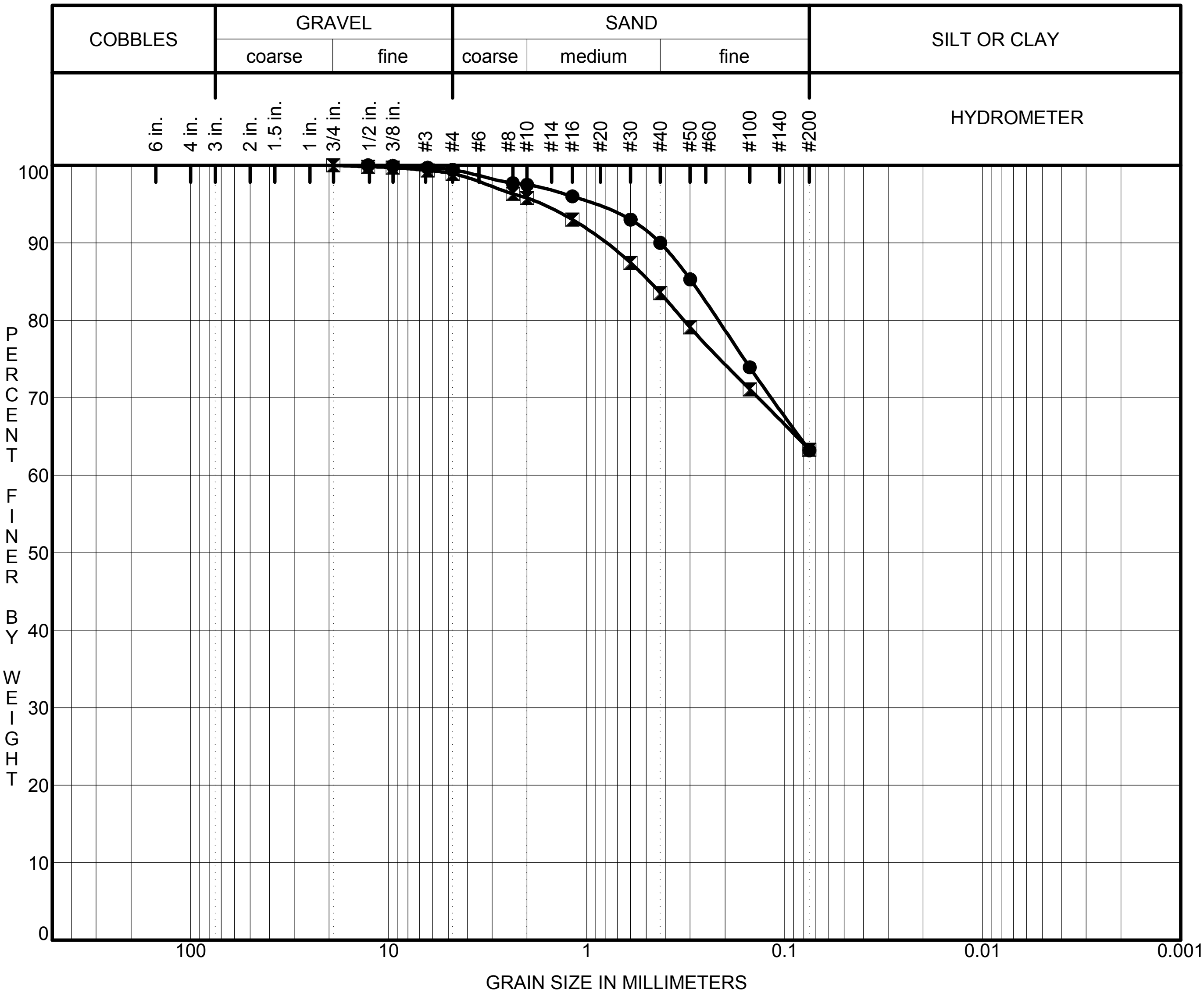
GRAIN SIZE ANALYSES (ASTM C117 and C136)

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B3

Report Date:	Project Number:
December 2012	129067



	Source	Depth (ft)	%Cobbles	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	B8B1	5.0 - 8.0	0	1	36	63				
⧗	B9B1	2.0 - 6.5	0	1	36	63				

	Source	Depth (ft)	Classification	LL	PL	PI	Cu	Cc
●	B8B1	5.0 - 8.0	SANDY LEAN CLAY (CL)	43	16	27		
⧗	B9B1	2.0 - 6.5	SANDY LEAN CLAY (CL)	41	17	24		

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Report Date: December 2012

Project Number: 129067

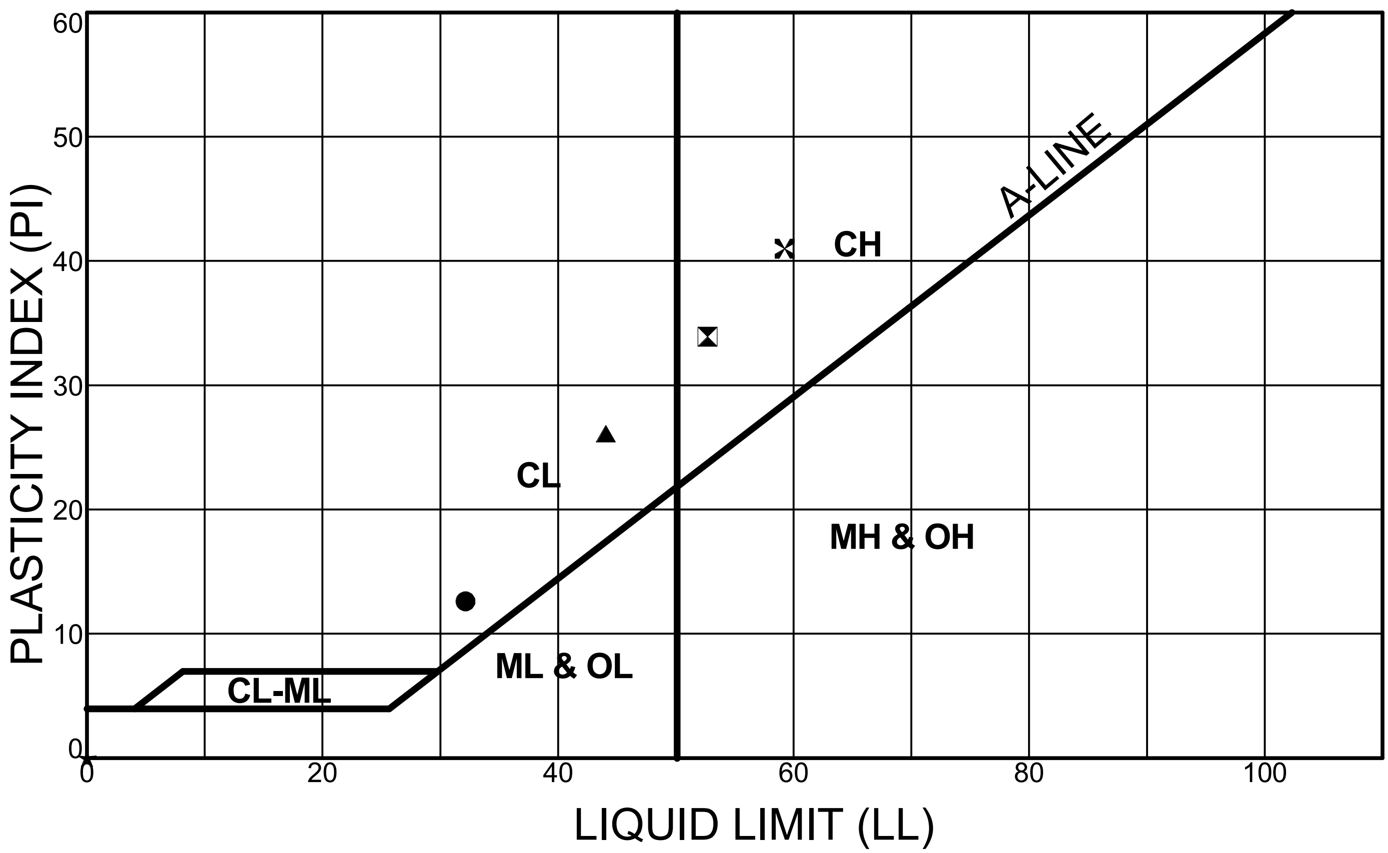
GRAIN SIZE ANALYSES (ASTM C117 and C136)

MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B4

123GRAINSIZECOMPLETE 129067 MC-85.GPJ 12/05/12



LEGEND	BORING	DEPTH (ft)	LL	PL	PI
●	B1B1	8.0 - 13.0	32	20	12
⧗	B2B1	4.0 - 8.0	53	19	34
▲	B3B1	4.0 - 8.0	44	18	26
★	B3B1	9.0 - 15.5	NP	NP	NP
✕	B5B1	4.0 - 9.0	59	18	41

ATTPLOT 129607 MC-85.GPJ 11/27/12

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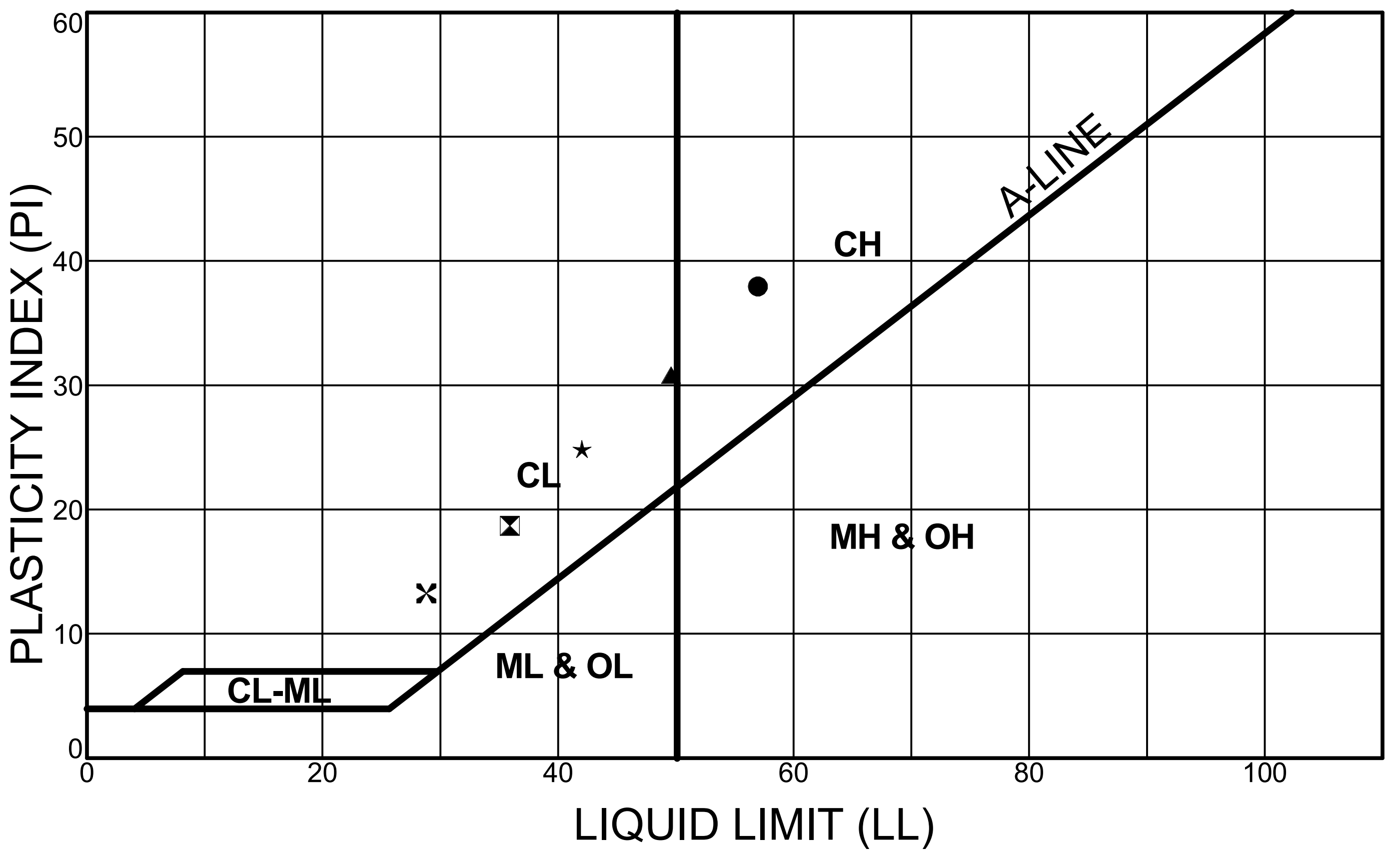
Report Date:	Project Number:
November 2012	129067

ATTERBERG LIMITS (ASTM D 4318)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B5



LEGEND	BORING	DEPTH (ft)	LL	PL	PI
●	B5B2	4.0 - 9.0	57	19	38
⧗	B6B1	4.0 - 9.0	36	17	19
▲	B6B2	4.0 - 9.0	50	19	31
★	B7B1	5.0 - 9.0	42	17	25
✕	B7B2	5.0 - 9.0	29	16	13

ATTPLOT 129067 MC-85.GPJ 12/05/12

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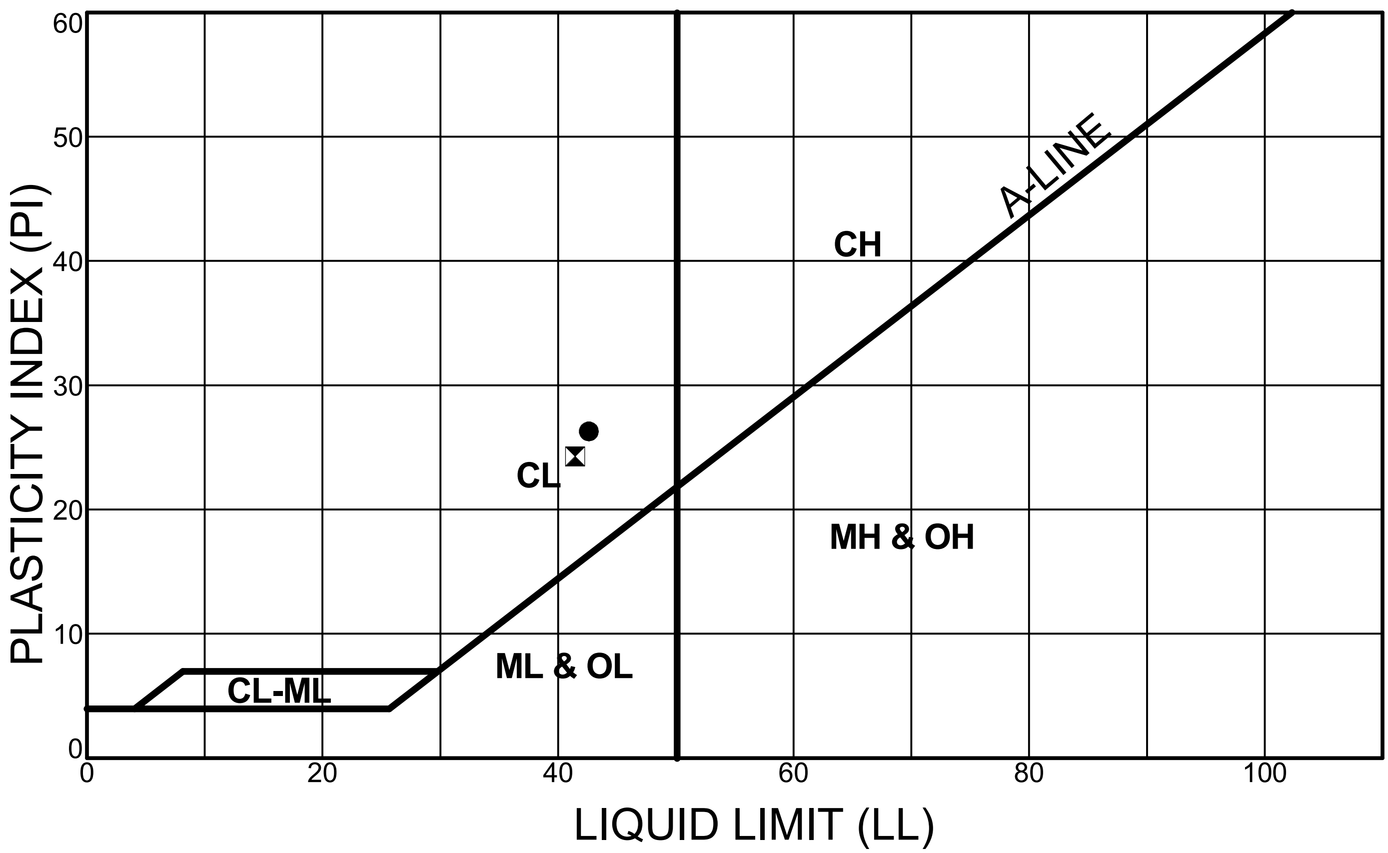
Report Date:	Project Number:
December 2012	129067

ATTERBERG LIMITS (ASTM D 4318)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B6



LEGEND	BORING	DEPTH (ft)	LL	PL	PI
●	B8B1	5.0 - 8.0	43	16	27
⧗	B9B1	2.0 - 6.5	41	17	24

ATTPLOT 129067 MC-85.GPJ 12/05/12

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Report Date:	Project Number:
December 2012	129067

ATTERBERG LIMITS (ASTM D 4318)
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE
B7

TEST METHOD:	ARIZ 236b	ARIZ 236b	ARIZ 733**	ARIZ 736**
SAMPLE LOCATION	**pH**	**Minimum Resistivity (ohm-cm)**	**Sulfates (ppm)**	**Chlorides (ppm)**
B1B1 @ 8-13'	8.3	1,342	47	63
B2B1 @ 4-8'	7.9	939	137	126
B3B1 @ 4-8'	7.9	812	115	249
B5B1 @ 4-9'	8.0	738	93	126
B6B1 @ 4-9'	7.9	671	68	62
B7B1 @ 5-9'	7.9	671	64	79
B8B1 @ 5-8'	7.9	470	244	579
B9B1 @ 2-6.5'	8.0	738	87	159

*** Testing performed by MotZZ Laboratory, Inc.*

KLEINFELDER
Bright People. Right Solutions.

Report Date: November 2012

Project Number: 129067

ADDITIONAL LABORATORY TESTING
MC-85 (Buckeye Road)
From 107th Avenue to 75th Avenue
Maricopa County (Phoenix / Tolleson), Arizona

PLATE

B8

APPENDIX P-C

DMJM Harris/AECOM Report

DMJM Harris
2777 East Camelback Road, Suite 200, Phoenix, AZ 85016
T 602.337.2777 F 602.337.2620 www.dmjmharris.com

November 8, 2006

Mr. Sami Ayoub
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, AZ 85009

Re: Stormwater Detention Basin Percolation Testing
and Earthwork Factor Estimates
MC 85 (Buckeye Road), 107th Avenue to 91st Avenue
Maricopa County, Arizona
MCDOT Work Order 69024
DMJM Harris Project No. 6490.0000

Dear Mr. Ayoub:

This letter presents the results of stormwater detention basin percolation testing that was performed for the above referenced project. Also included are the results of in-place density testing and laboratory classification and moisture-density testing for the development of project excavation earthwork factors.

1.0 INVESTIGATION

The field investigation included the excavation of nine backhoe test pits, each dug to a depth of four feet, using a CAT 416C backhoe with a 24-inch bucket. The backhoe is owned and operated by 4-J's Excavating, of Phoenix. In-situ nuclear gauge density tests were performed at depths of 1.0, 2.0, 3.0 and 4.0 feet within the pits by AMEC Earth and Environmental, Inc., (AMEC), as directed by DMJM Harris, using a Troxler 3440 nuclear moisture-density gauge. Falling head percolation tests were also performed within the bottom of each of the test pits by DMJM Harris. All field activities were supervised by Pancho Garza, E.I.T. of DMJM Harris.

The backhoe pit/percolation test locations were selected to be within the general limits of proposed detention basins for this project, and also on properties for which temporary entries could be obtained. Each of the test sites was located within agricultural farm land to the south side of existing MC 85. The attached site plans (six sheets) indicate the locations of the backhoe pit/percolation test locations. Also attached are logs of the test pits.

Laboratory testing was performed by AMEC on selected bulk samples that were obtained from the test pit excavations. The tests performed include sieve analysis and Atterberg limits (plasticity index), moisture content, standard Proctor (ASTM D698; Moisture-Density Relationship) and remolded one-dimensional swell. The results of all laboratory tests are attached. The swell tests utilized samples that were remolded to approximately 95 percent of the Proctor density of the particular material in order to determine potential post construction movement due to excess moisture.

2.0 RESULTS OF TESTING & DISCUSSION

In general, the soils encountered within the pits are soft to firm, medium to high plasticity, clayey sand to sandy clay (SC to CL/CH), extending to the full depth of investigation. The soils vary from uncemented to weakly cemented with calcium carbonate (lime). The in-situ moisture contents of tested samples varied from about 10 to 25 percent and the excavated soils were visually described as moist to very moist. Table 1 presents a summary of the results of in-situ and laboratory testing for test pits PT1 through PT10.

2.1 EARTHWORK ESTIMATES

The in-situ nuclear gauge density readings were compared with the corresponding 95 percent value Proctor density in order to obtain data for use in estimation of earthwork factors. Based on the available data, there is a large variation in earthwork factors; ranging from nearly 11 percent shrink to 17 percent swell. The generally high swell values appear to be based on the high in-situ moisture contents. Most of the clay soils tested would need to be dried prior to use, as their in-situ moistures are above the optimum values needed for compaction. Both Test Pits PT1 and PT3 were excavated in a fallow field that had not been watered for some time. This area yielded the majority of shrink while a recently watered field, which included Test Pit PT9, produced the maximum estimated swells. Also, the fact that the clayey soils contain higher percentages of sand in the vicinity of Test Pits PT1 and PT3 (west end of project), would also tend to allow the soils to drain more quickly and thus have a greater capacity to loose volume (shrink) when compacted.

shrink and swell factors are related only to dry density

Based on the results, and our experience with similar soil conditions, it is anticipated that the soft to firm, generally moist to very moist, near-surface clay soils will typically vary from 0 to 5 percent swell when excavated and re-used for compacted fill on this project. It should be noted that considerable drying may be needed to get the excavated soils to at or near optimum moisture. Also, the majority of these soils will not meet the borrow acceptance criteria (R value = 30) that was recommended in the Pavement Design Report (DMJM Harris, April 2006). The correlated R-values of the nine samples tested from Test Pits PT1 through PT10 vary from 10 to 39 with a mean value of 16. Only one of the samples (Test Pit PT3) would actually meet the acceptance criteria. Based on this data, it appears that the all or the majority of soils that are excavated from within the detention basin areas (unless adequately modified by mixing with sand, lime or cement), should be wasted from the project.

2.2 POTENTIAL SWELL

One dimensional swell tests were performed on four remolded samples of clayey soils obtained from the test pits. The samples were remolded to 95 percent of the associated standard Proctor density and optimum moisture to approximate post-construction conditions. In general, the results indicate low swell percentages ranging from 0 to 2 percent. It is possible that additional swell might be observed in the field if the compacted soils are placed dry of optimum moisture, and are subsequently inundated with moisture. Testing of the swell potential of remolded soils assuming in-situ density and moisture properties was not performed. However, based on the summary of information provided in Table 1, it appears that the in-situ moisture contents are typically slightly below to well above optimum and thus large volume gains from the in-situ to optimum (or plus optimum) condition would not be anticipated.

2.3 PERCOLATION TESTS

In-situ percolation testing was performed in general accordance with the City of Chandler Standard Detail C-109 (2002 including revisions 2006). This method measures the time needed to drain a volume of water over a given area of soil. The recorded stabilized percolation rates ranged from 0.09 to 0.22 $ft^3/hr/ft^2$ and were fairly consistent throughout the two-mile segment. Table 2 presents a summary of the percolation tests completed for this investigation.

Table 1
Results of Soil Testing

ID	Depth Range (Feet)	% Passing -200 Sieve	USCS	Plasticity Index	In-Situ Moisture Content (%)	In-situ Wet Density (pcf) @ Depth	Optimum Moisture Content (%)	95% Standard Proctor Density (pcf)	% Shrink/ Swell (+/-)
PT1	1.0 – 4.0	74	CH	32	13.7	110.3 @ -1' 119.4 @ -2' 126.5 @ -3' 122.6 @ -4'	12.6	113.1	-2.5 +5.5 +11.8 +8.3
PT3*	1.0 – 4.0	46	SC	8	9.7	104.1 @ -1' 106.8 @ -2' 109.4 @ -3' 111.1 @ -4'	12.6	113.1	-8.0 -5.6 -3.3 -1.8
PT4	1.0 – 4.0	57	CL	18	13.5	91.3 @ -1' 107.3 @ -2' 108.0 @ -3' 96.7 @ -4'	18.0	102.3	-10.8 +4.9 +5.5 -5.4
PT5	1.0 – 4.0	60	CH	30	19.1	105.6 @ -1' 107.5 @ -2' 107.6 @ -3' 107.7 @ -4'	18.0	102.3	+3.2 +5.1 +7.5 +5.3
PT6	1.0 – 4.0	66	CH	34	20.4	106.0 @ -1' 104.4 @ -2' 110.1 @ -3' 111.5 @ -4'	16.0	104.7	+1.4 -0.2 +5.2 +6.5
PT7	1.0 – 4.0	72	CL	25	16.3	111.5 @ -1' 107.4 @ -2' 104.0 @ -3' 111.4 @ -4'	16.0	104.7	+6.5 +2.6 -0.7 +6.4
PT8	1.0 – 4.0	82	CL	24	20.4	106.6 @ -1' 111.9 @ -2' 119.8 @ -3' 115.0 @ -4'	16.0	104.7	+1.8 +6.9 +10.6 +9.9
PT9	1.0 – 4.0	78	CL	21	21.7	117.6 @ -1' 111.2 @ -2' 120.1 @ -3' 118.5 @ -4'	17.3	102.4	+14.9 +8.6 +17.3 +15.7
PT10	1.0 – 4.0	88	CL	25	24.5	117.9 @ -1' 111.2 @ -2' 107.0 @ -3' 106.4 @ -4'	17.3	102.4	+15.1 +8.6 +4.5 +3.9

*PT2 was not investigated

Table 2
Percolation Test Results

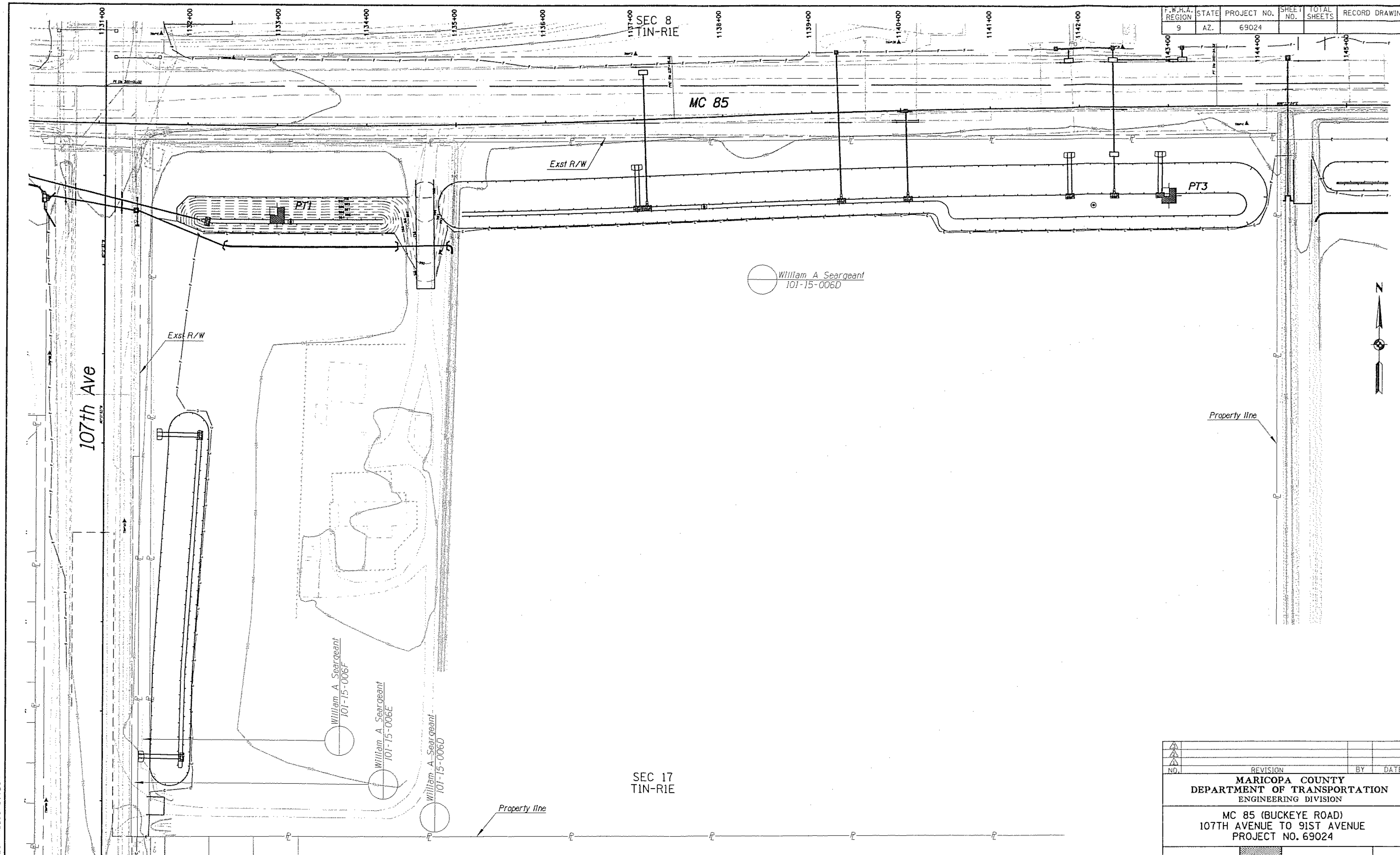
ID	Station	Offset	Depth (ft)	Stabilized Percolation Rate (min/in)	Stabilized Percolation Rate ($ft^3/hr/ft^2$)
PT1	1133+00	100'R	4.25	25	0.20
PT3*	1143+00	100'R	4.25	32	0.16
PT4	1160+00	90'R	4.25	32	0.16
PT5	1177+00	100'R	4.25	38	0.14
PT6	1186+00	60'R	4.25	24	0.21
PT7	1197+00	60'R	4.25	27	0.19
PT8	1208+00	60'R	4.25	24	0.22
PT9	1219+00	75'R	4.25	52	0.09
PT10	1229+00	70'R	4.25	23	0.21
				Average	0.17

*PT2 was not investigated

The percolation test results need to be interpreted within the proper context as part of a complete drainage study. Other factors to consider when designing drainage features include, but are not limited to: anticipated volume and depth of water, drainage area characteristics, subsurface soils, and depth to groundwater. For this project, it is recommended that a safety factor of 2.0 be applied to the average tested percolation rate of 0.17 $ft^3/hr/ft^2$, resulting in a design value of 0.085 $ft^3/hr/ft^2$.

As the majority of soils present within the upper 8 to 10 feet along the project alignment contain high percentages (more than 50 percent) of minus No. 200 fines, the potential for adequate, long-term surface infiltration would appear to be low. Drywells may be required in combination with the basins in order to meet the surface infiltration requirements mandated by the City of Phoenix. The City of Phoenix requires that all surface basins retain water for no more than 36 hours. Based on discussions with local drywell installers, the permeable soils needed to provide adequate surface drainage are at depths which typically exceed 25 feet and that the drywells themselves, will need to be on the order of 50 feet in depth, if required. It is further understood that a typical inflow rate of 0.25 cubic feet per second (cfs) is used for drywells previously installed in the near vicinity of this project. For design, a slightly conservative value of 0.20 cfs is recommended. This value will need to be confirmed and/or adjusted by testing of an actual drywell during construction.

F.W.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	69024			



LEGEND

DMJM Harris Percolation Test Location

50 0 50 100
SCALE IN FEET

NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. 69024

DESIGNED	PG	10/06
DRAWN	JTN	10/06
CHECKED	KHD	10/06

NOT FOR CONSTRUCTION OR RECORDING

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

PERCOLATION TEST LOCATIONS

SHEET 1 OF 6

TRACS NO.

11/8/2006 10:21:52 AM
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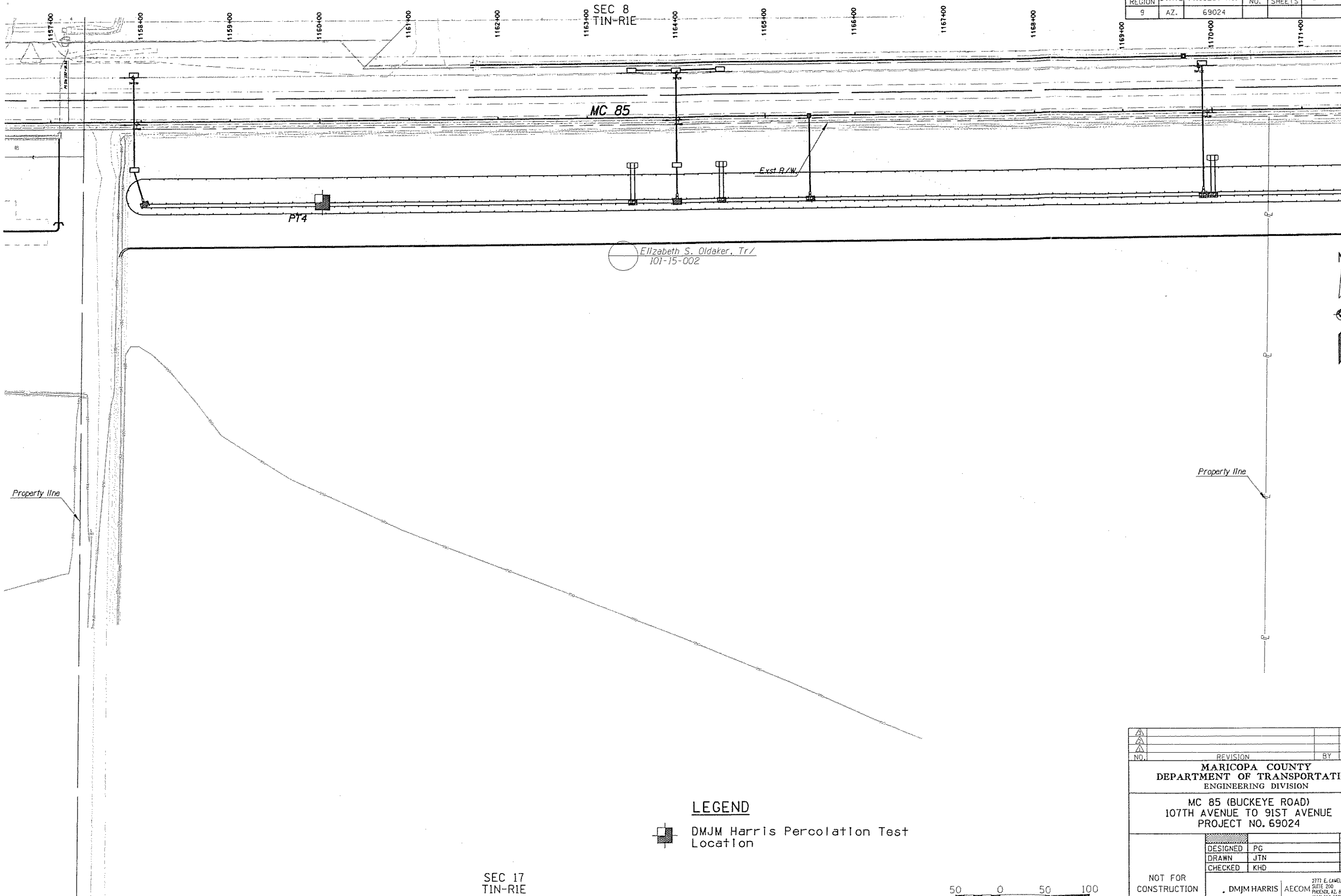
English

F.W.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	69024			



LEGEND

DMJM Harris Percolation Test Location

NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. 69024

DESIGNED	PG	10/06
DRAWN	JTN	10/06
CHECKED	KHD	10/06

NOT FOR CONSTRUCTION OR RECORDING

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

PERCOLATION TEST LOCATIONS

SHEET 2 OF 6

TRACS NO.

11/8/2006 10:23:20 AM
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English

F.W.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
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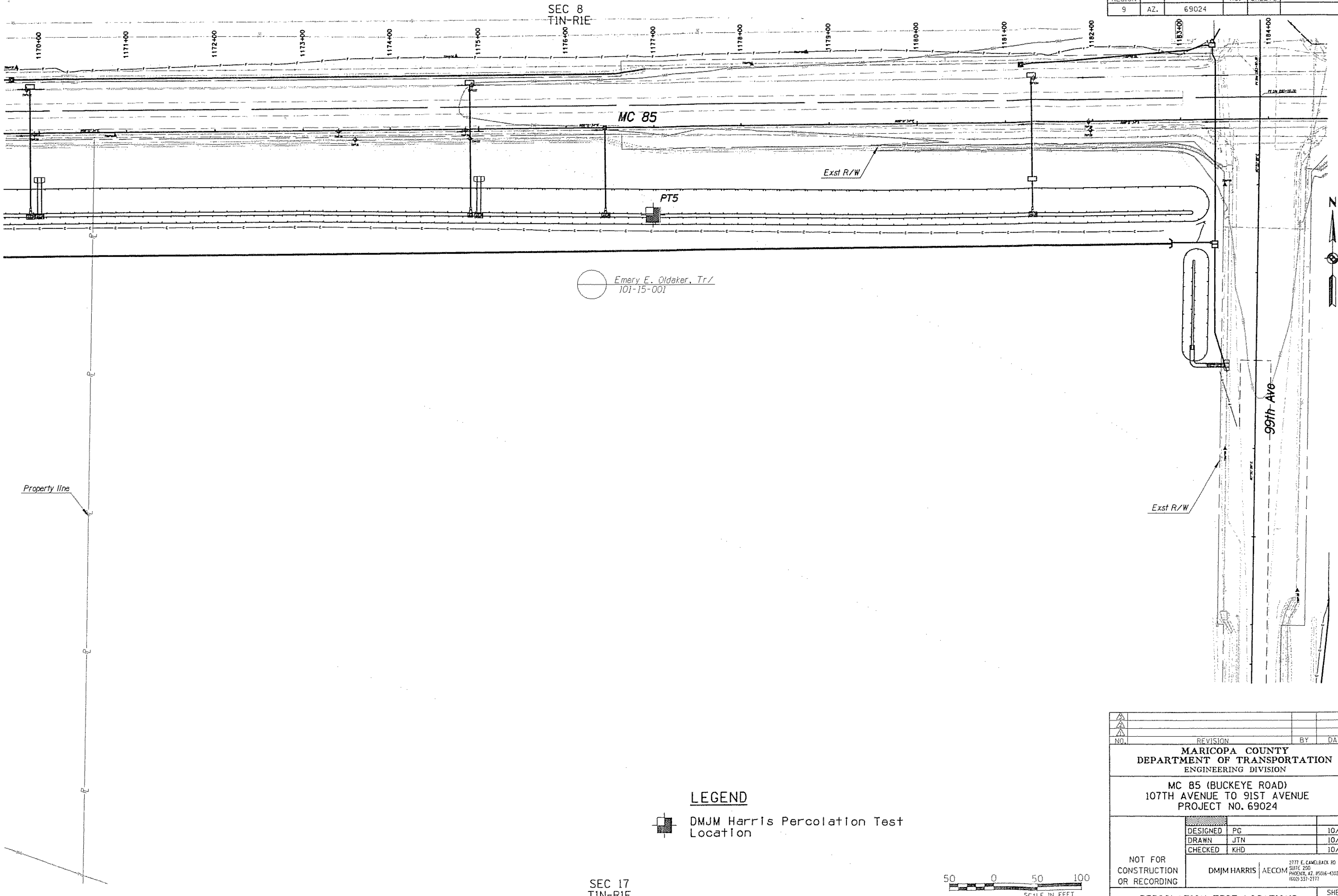


LEGEND

DMJM Harris Percolation Test Location

NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. 69024

DESIGNED	PG	10/06
DRAWN	JTN	10/06
CHECKED	KHD	10/06

NOT FOR CONSTRUCTION OR RECORDING

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

PERCOLATION TEST LOCATIONS

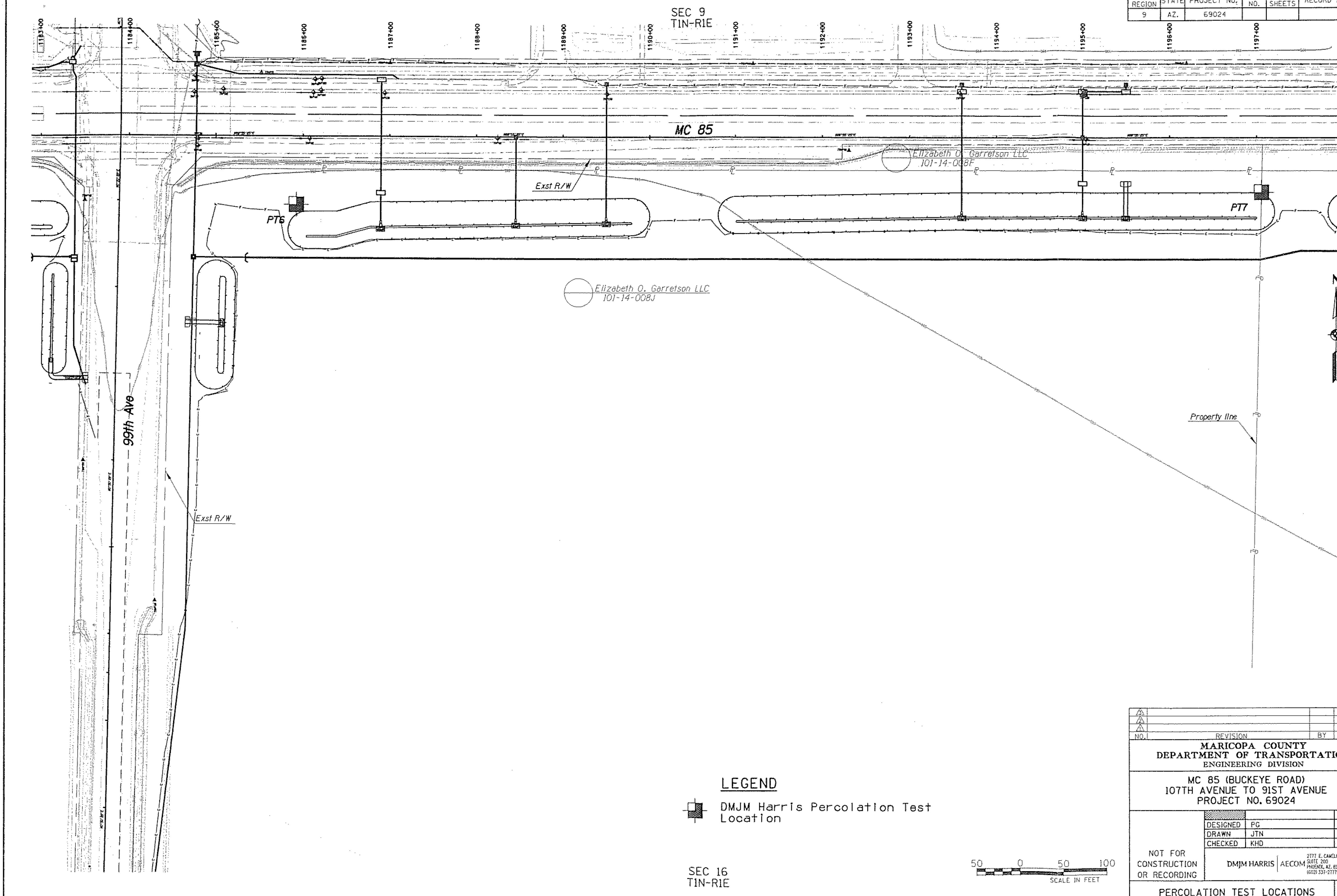
SHEET 3 OF 6

TRACS NO.

11/8/2006 10:23:56 AM
N:\6490\PROD\GEOTECH\MC85SP03.DGN

English

F.W.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	69024			



NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. 69024

DESIGNED	PG	10/06
DRAWN	JTN	10/06
CHECKED	KHD	10/06

NOT FOR CONSTRUCTION OR RECORDING

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

PERCOLATION TEST LOCATIONS

SHEET 4 OF 6

TRACS NO.

11/8/2006 10:25:16 AM
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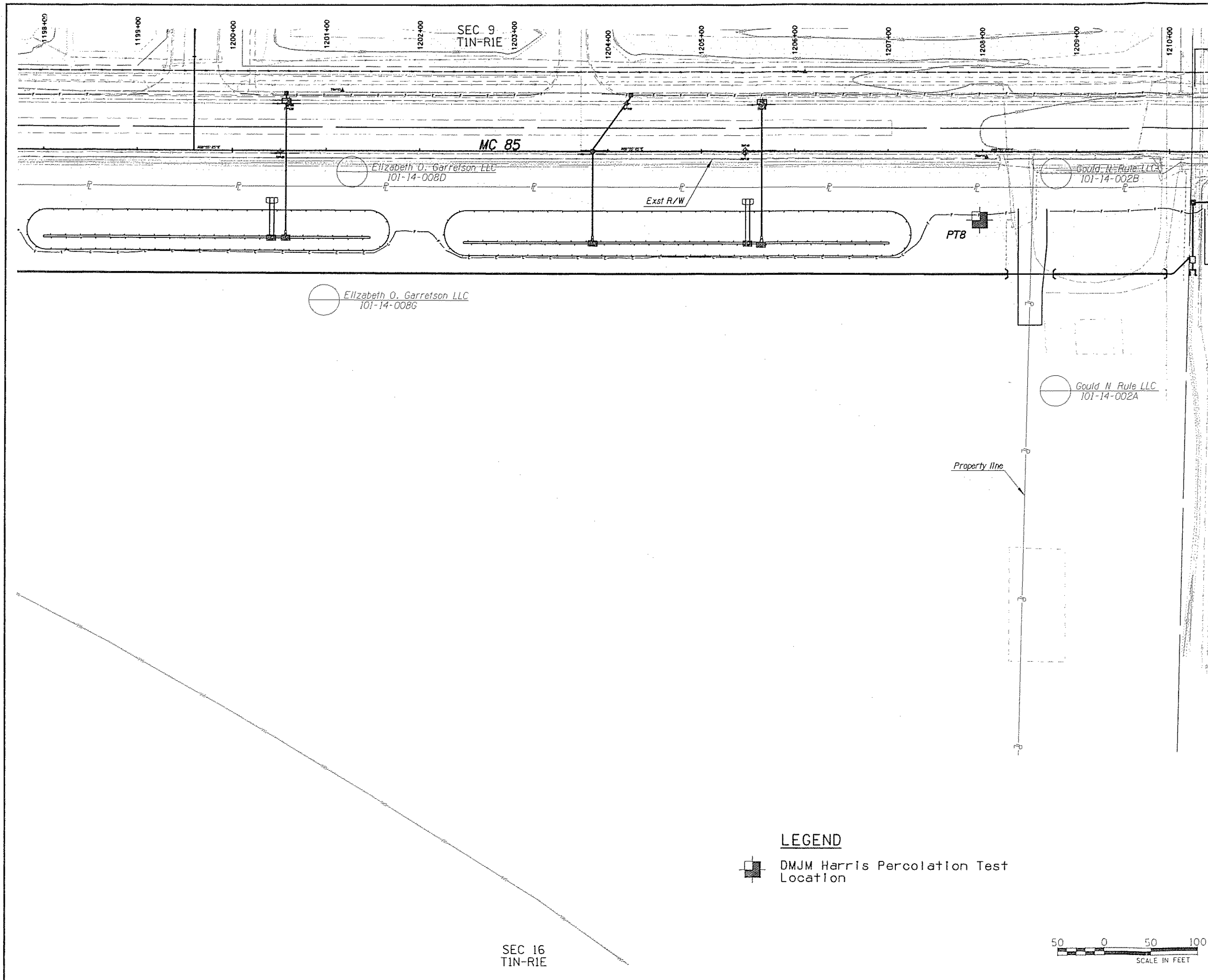
English

F.W.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	69024			



LEGEND

DMJM Harris Percolation Test Location

NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. 69024

DESIGNED	PG	10/06
DRAWN	JTN	10/06
CHECKED	KHD	10/06

NOT FOR CONSTRUCTION OR RECORDING

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

PERCOLATION TEST LOCATIONS

SHEET 5 OF 6

TRACS NO.

11/8/2006 10:25:54 AM
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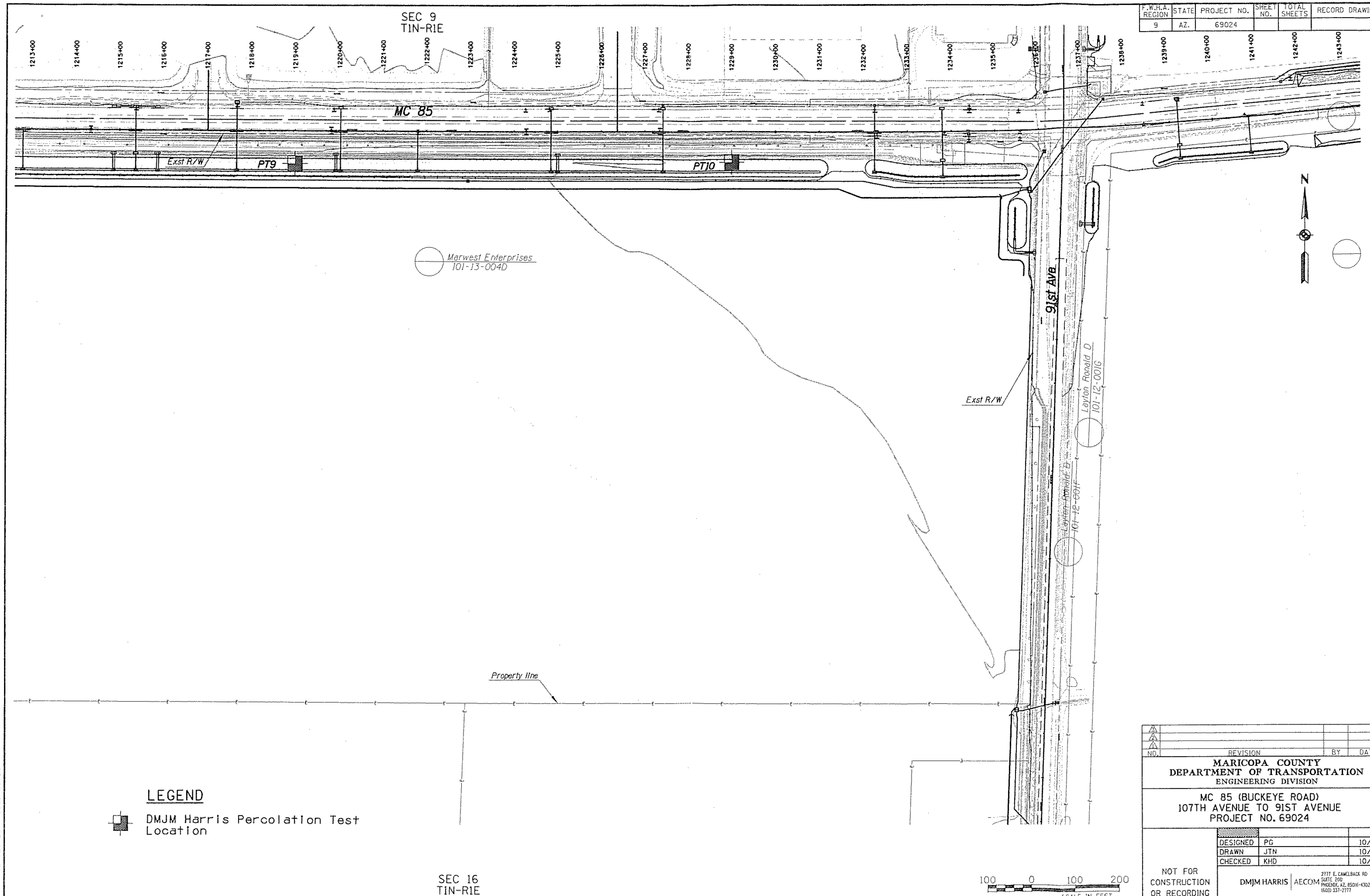
F.W.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	69024			



LEGEND

DMJM Harris Percolation Test Location

NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. 69024

DESIGNED	PG		10/06
DRAWN	JTN		10/06
CHECKED	KHD		10/06

NOT FOR CONSTRUCTION OR RECORDING

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

PERCOLATION TEST LOCATIONS

SHEET 6 OF 6

TRACS NO.

11/8/2006 10:27:06 AM
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English

Project Name: MC85, 107th Ave to 91st Ave
Location: Maricopa County, Arizona
Project Number: 6490.0000
Logged By: P. Garza

Groundwater		
Depth	Hour	Date
None	N/A	N/A

TEST PIT NO. PT3

Date(s): 07/10/2006
Backhoe/Trackhoe Type: CAT 416C w/ 24" Bucket
Surface Elevation: 990.0' ±
Location: Sta 1143+00, 100' Rt MC85 Cst ℄

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 (%)
				D		SANDY CLAY (CL) Trace Fine Subangular Gravel, Fine Sand, Weakly Lime Cemented, Medium Plasticity, Brown, Slightly Moist, Firm		10
						CLAYEY SAND (SC) Trace Fine Subangular Gravel, Predominantly Fine Sand, Weakly Lime Cemented, Medium Plasticity, Brown, Moist, Firm. Note: $CaCo_3$ Staining Present		
985.0	5					STOPPED EXCAVATION @ 4.0'		
980.0	10							
	15							
	20							
	25							
	30							
	35							
	40							

Sample Type
D-DISTURBED BULK SAMPLE

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

Project Name: MC85, 107th Ave to 91st Ave
Location: Maricopa County, Arizona
Project Number: 6490.0000
Logged By: P. Garza

Groundwater		
Depth	Hour	Date
None	N/A	N/A

TEST PIT NO. PT4

Date(s): 08/31/2006
Backhoe/Trackhoe Type: CAT 416C w/ 24" Bucket
Surface Elevation: 990.0' ±
Location: Sta 1160+00, 90'Rt MC85 Cst ℄

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 (%)
				D		SANDY CLAY (CL) Predominantly Fine Sand, Weakly Lime Cemented, Medium Plasticity, Brown, Moist, Very Soft to Soft. Note: Recently Harvested Alfalfa Field		14
985.0	5					STOPPED EXCAVATION @ 4.0'		
980.0	10							
	15							
	20							
	25							
	30							
	35							
	40							

Sample Type
D-DISTURBED BULK SAMPLE

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

Project Name: MC85, 107th Ave to 91st Ave
Location: Maricopa County, Arizona
Project Number: 6490.0000
Logged By: P. Garza

Groundwater		
Depth	Hour	Date
None	N/A	N/A

TEST PIT NO. PT5

Date(s): 08/31/2006
Backhoe/Trackhoe Type: CAT 416C w/ 24" Bucket
Surface Elevation: 993.0' ±
Location: Sta 1177+00, 100' Rt MC85 Cst ℄

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 (%)
				D		SANDY CLAY (CH) Predominantly Fine Sand, Weakly Lime Cemented, High Plasticity, Brown, Very Moist, Moderately Firm Note: Recently Harvested Alfalfa Field		19
988.0	5					STOPPED EXCAVATION @ 4.0'		
983.0	10							
	15							
	20							
	25							
	30							
	35							
	40							

Sample Type
D-DISTURBED BULK SAMPLE

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

Project Name: MC85, 107th Ave to 91st Ave
Location: Maricopa County, Arizona
Project Number: 6490.0000
Logged By: P. Garza

Groundwater		
Depth	Hour	Date
None	N/A	N/A

TEST PIT NO. PT6

Date(s): 08/31/2006
Backhoe/Trackhoe Type: CAT 416C w/ 24" Bucket
Surface Elevation: 995.0' ±
Location: Sta 1186+00, 60' Rt MC85 Cst ℄

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 (%)
				D		SANDY CLAY (CH) Predominantly Fine Sand, Weakly Lime Cemented, High Plasticity, Brown, Very Moist, Moderately Firm		20
990.0	5					STOPPED EXCAVATION @ 4.0'		
985.0	10							
	15							
	20							
	25							
	30							
	35							
	40							

Sample Type
D-DISTURBED BULK SAMPLE

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

Project Name: MC85, 107th Ave to 91st Ave
Location: Maricopa County, Arizona
Project Number: 6490.0000
Logged By: P. Garza

Groundwater		
Depth	Hour	Date
None	N/A	N/A

TEST PIT NO. PT7

Date(s): 08/31/2006
Backhoe/Trackhoe Type: CAT 416C w/ 24" Bucket
Surface Elevation: 996.5' ±
Location: Sta 1197+00, 60' Rt MC85 Cst ℄

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 (%)
				D		SANDY CLAY (CL) Predominantly Fine Sand, Weakly Lime Cemented, Medium Plasticity, Brown, Moist, Moderately Firm		16
						STOPPED EXCAVATION @ 4.0'		
991.5	5							
986.5	10							
	15							
	20							
	25							
	30							
	35							
	40							

Sample Type
D-DISTURBED BULK SAMPLE

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

Project Name: MC85, 107th Ave to 91st Ave
Location: Maricopa County, Arizona
Project Number: 6490.0000
Logged By: P. Garza

Groundwater		
Depth	Hour	Date
None	N/A	N/A

TEST PIT NO. PT8
Date(s): 08/31/2006
Backhoe/Trackhoe Type: CAT 416C w/ 24" Bucket
Surface Elevation: 998.0' ±
Location: Sta 1208+00, 60' Rt MC85 Cst ℄

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	Dry Density (pcf)	Moisture Content (%)
				D		CLAY (CL) Some Fine Sand, Weakly Lime Cemented, Medium Plasticity, Brown, Very Moist, Moderately Firm		20
993.0	5					STOPPED EXCAVATION @ 4.0'		
988.0	10							
	15							
	20							
	25							
	30							
	35							
	40							

Sample Type
D-DISTURBED BULK SAMPLE

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

Project Name: MC85, 107th Ave to 91st Ave
Location: Maricopa County, Arizona
Project Number: 6490.0000
Logged By: P. Garza

PT9

Groundwater		
Depth	Hour	Date
None	N/A	N/A

Date(s): 07/10/2006
Backhoe/Trackhoe Type: CAT 416C w/ 24" Bucket
Surface Elevation: 999.0' ±
Location: Sta 1219+00, 80' Rt MC85 Cst ℄

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 (%)
				D		SANDY CLAY (CL) Fine Sand, Weakly Lime Cemented, Medium Plasticity, Dark Brown, Very Moist to Wet, Soft Note: Recently Watered Barley Field		22
994.0	5					STOPPED EXCAVATION @ 4.0'		
989.0	10							
	15							
	20							
	25							
	30							
	35							
	40							

Sample Type
D-DISTURBED BULK SAMPLE

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

Project Name: MC85, 107th Ave to 91st Ave
Location: Maricopa County, Arizona
Project Number: 6490.0000
Logged By: P. Garza

Groundwater		
Depth	Hour	Date
None	N/A	N/A

TEST PIT NO. PT10

Date(s): 07/10/2006
Backhoe/Trackhoe Type: CAT 416C w/ 24" Bucket
Surface Elevation: 998.0' ±
Location: Sta 1229+00, 75' Rt MC85 Cst ℄

Elev (ft)	Depth (ft)	Penetration Rate (Min./Ft)	Sample Interval	Sample Type & (Blowcounts)	Graphical Log	MATERIAL CLASSIFICATION & USCS	Dry Density (pcf)	Moisture Content (%)
				D		SANDY CLAY (CL) Fine Sand, Weakly Lime Cemented, Medium Plasticity, Dark Brown, Very Moist to Wet, Soft Note: Recently Watered Barley Field		25
993.0	5					STOPPED EXCAVATION @ 4.0'		
988.0	10							
	15							
	20							
	25							
	30							
	35							
	40							

Sample Type
D-DISTURBED BULK SAMPLE

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

amec

PROJECT: MC85, 107th Avenue and 91st Avenue 6490.0000
LOCATION: Maricopa County
SAMPLE SOURCE: SEE BELOW

JOB NO: 6-119-000566
WORK ORDER NO: 2
DATE ASSIGNED: 9/6/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

PERCENT PASSING BY WEIGHT

PI P200

Location & Depth	USCS	LL	PI	Silt or Clay	SAND								GRAVEL									COBBLES	Lab #
					Fine			Medium			Coarse		Fine				Coarse						
				#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	
PT4 @ 1.0-4.0'	CL	36	18	57	69	81	87	91	97	99	99	99	100	100	100	100	100	100	100	100	100	100	5
PT5 @ 1.0-4.0'	CH	52	30	60	69	80	85	89	95	98	98	99	100	100	100	100	100	100	100	100	100	100	6
PT6 @ 1.0-4.0'	CH	58	34	66	76	85	89	92	96	98	99	100	100	100	100	100	100	100	100	100	100	100	7
PT7 @ 1.0-4.0'	CL	48	25	72	81	89	92	95	98	99	100	100	100	100	100	100	100	100	100	100	100	100	8
PT8 @ 1.0-4.0'	CL	44	24	82	88	92	94	96	98	99	100	100	100	100	100	100	100	100	100	100	100	100	9

AASHTO R18

REVIEWED BY

amec

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	JOB NO:	6-119-000566
LOCATION:	Maricopa County	WORK ORDER NO:	1
MATERIAL:	Native Soil	LAB NO:	1
SAMPLE SOURCE:	PT1 @ 1.0-4.0'	DATE SAMPLED:	7/13/06

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)
DETERMINING PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (AASHTO T89 & T90)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6in.	100
4in.	100
3in.	100
2in.	100
1 1/2in.	100
1 1/4in.	100
1in.	100
3/4in.	100
1/2in.	100
3/8in.	100
1/4in.	100
#4	100
#8	99
#10	99
#16	98
#30	95
#40	93
#50	89
#100	81
#200	74

ATTERBERG LIMITS

LL:	51
PL:	19
PI:	32
USCS:	CH

AASHTO R18

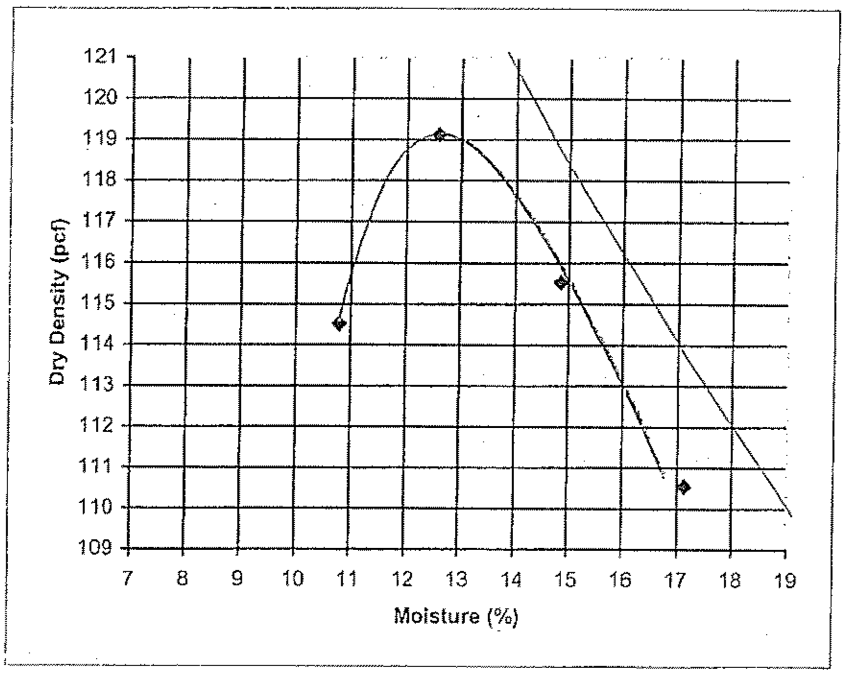
REVIEWED BY g

amec

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	**JOB NO:**	6-119-000566
LOCATION:	Maricopa County	**WORK ORDER NO:**	1
MATERIAL:	Native Soil	**LAB NO:**	2
SAMPLE SOURCE:	PT3 @ 1.0-4.0'	**DATE SAMPLED:**	7/13/06

LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING
STANDARD EFFORTS (12,400ft-lb-ft/cu.ft) (ASTMD698A)
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)
DETERMINING PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (AASHTO T89 & T90)

MAXIMUM DRY DENSITY (pcf):	119.1
OPTIMUM MOISTURE (%):	12.6



SIEVE SIZE	PERCENT PASSING
6"	100
4"	100
3"	100
2"	100
1 1/2"	100
1 1/4"	100
1"	100
3/4"	100
1/2"	100
3/8"	99
1/4"	97
#4	97
#8	95
#10	95
#16	93
#30	88
#40	84
#50	77
#100	60
#200	46

ATTERBERG LIMITS

LL:	26
PL:	18
PI:	8
USCS:	SC

NOTE: THE ZERO AIR VOIDS CURVE REPRESENTS A SPECIFIC GRAVITY OF: 2.651 ASSUMED.

THIS IS A SUMMARIZED REPORT OF THE REFERENCED PROCEDURES AND DOES NOT INCLUDE ALL REPORTING REQUIREMENTS. ADDITIONAL DATA CAN BE PROVIDED AT CLIENT'S REQUEST.

AAP AASHTO R18

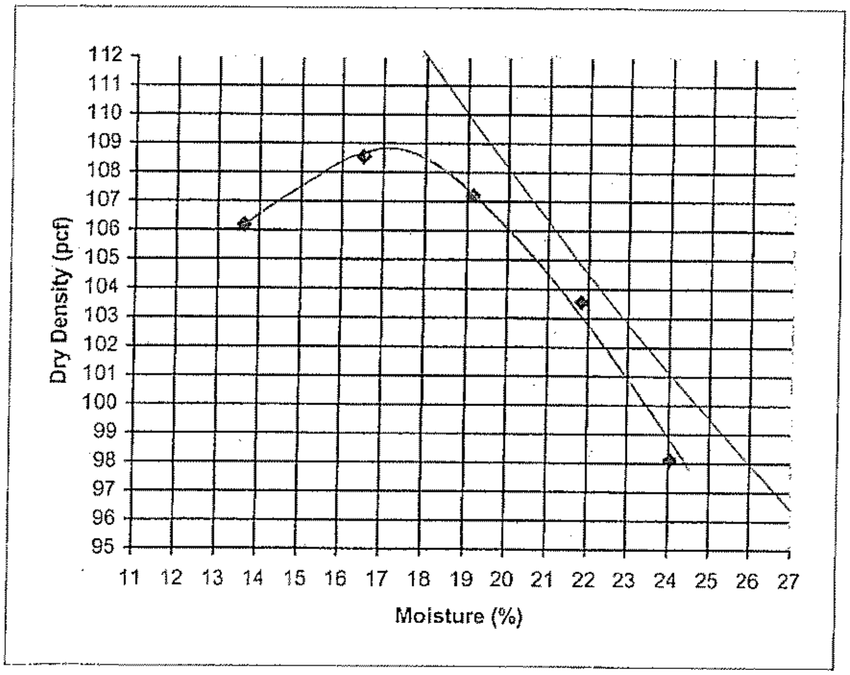
REVIEWED BY

amec

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	JOB NO:	6-119-000566
LOCATION:	Maricopa County	WORK ORDER NO:	1
MATERIAL:	Native Soil	LAB NO:	3
SAMPLE SOURCE:	PT9 @ 1.0-4.0'	DATE SAMPLED:	7/13/06

LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING STANDARD EFFORTS (12,400ft-lb-ft/cu.ft) (ASTMD698A)
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)
DETERMINING PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (AASHTO T89 & T90)

MAXIMUM DRY DENSITY (pcf):	107.8
OPTIMUM MOISTURE (%):	17.3



SIEVE SIZE	PERCENT PASSING
6"	100
4"	100
3"	100
2"	100
1 1/2"	100
1 1/4"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
1/4"	100
#4	100
#8	100
#10	100
#16	100
#30	98
#40	97
#50	95
#100	88
#200	78

ATTERBERG LIMITS

LL:	42
PL:	21
PI:	21
USCS:	CL

NOTE: THE ZERO AIR VOIDS CURVE REPRESENTS A SPECIFIC GRAVITY OF: 2.651 ASSUMED.

THIS IS A SUMMARIZED REPORT OF THE REFERENCED PROCEDURES AND DOES NOT INCLUDE ALL REPORTING REQUIREMENTS. ADDITIONAL DATA CAN BE PROVIDED AT CLIENT'S REQUEST.

AASHTO R18

REVIEWED BY

amec

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	JOB NO:	6-119-000566
LOCATION:	Maricopa County	WORK ORDER NO:	1
MATERIAL:	Native Soil	LAB NO:	4
SAMPLE SOURCE:	PT10 @ 1.0-4.0'	DATE SAMPLED:	7/13/06

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)
DETERMINING PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (AASHTO T89 & T90)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6in.	100
4in.	100
3in.	100
2in.	100
1 1/2in.	100
1 1/4in.	100
1in.	100
3/4in.	100
1/2in.	100
3/8in.	100
1/4in.	100
#4	100
#8	99
#10	99
#16	99
#30	99
#40	98
#50	97
#100	93
#200	88

ATTERBERG LIMITS

LL:	48
PL:	23
PI:	25
USCS:	CL

AASHTO R18

REVIEWED BY ____________________

amec

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	**JOB NO:**	6-119-000566
LOCATION:	Maricopa County, Arizona	**WORK ORDER NO:**	1
MATERIAL:	See Below	**LAB NO:**	See Below
SAMPLE SOURCE:	See Below	**DATE ASSIGNED:**	7/13/06

MOISTURE CONTENT OF SOIL (ASTM D2216)

LAB #	BORING & DEPTH	WET WT. (gram)	DRY WT. (gram)	MOISTURE CONTENT
1	PT1 @ 1.0-4.0'	1830.8	1610.5	13.7%
2	PT3 @ 1.0-4.0'	913.4	832.3	9.7%
3	PT9 @ 1.0-4.0'	1229.3	1010.0	21.7%
4	PT10 @ 1.0-4.0'	1365.3	1097.0	24.5%

AAP® AASHTO R18

REVIEWED BY [signature]

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	**JOB NO:**	6-119-000566
LOCATION:	Maricopa County	**WORK ORDER NO:**	2
MATERIAL:	Native Soil	**LAB NO:**	See Below
SAMPLE SOURCE:	See Below	**DATE ASSIGNED:**	9/6/06

MOISTURE CONTENT OF SOIL (ASTM D2216)

LAB #	BORING & DEPTH	WET WT. (gram)	DRY WT. (gram)	MOISTURE CONTENT
5	PT4 @ 1.0-4.0'	990.5	872.7	13.5%
6	PT5 @ 1.0-4.0'	940.8	789.9	19.1%
7	PT6 @ 1.0-4.0'	1594.3	1324.2	20.4%
8	PT7 @ 1.0-4.0'	911.5	783.6	16.3%
9	PT8 @ 1.0-4.0'	1385.5	1151.2	20.4%

AASHTO R18

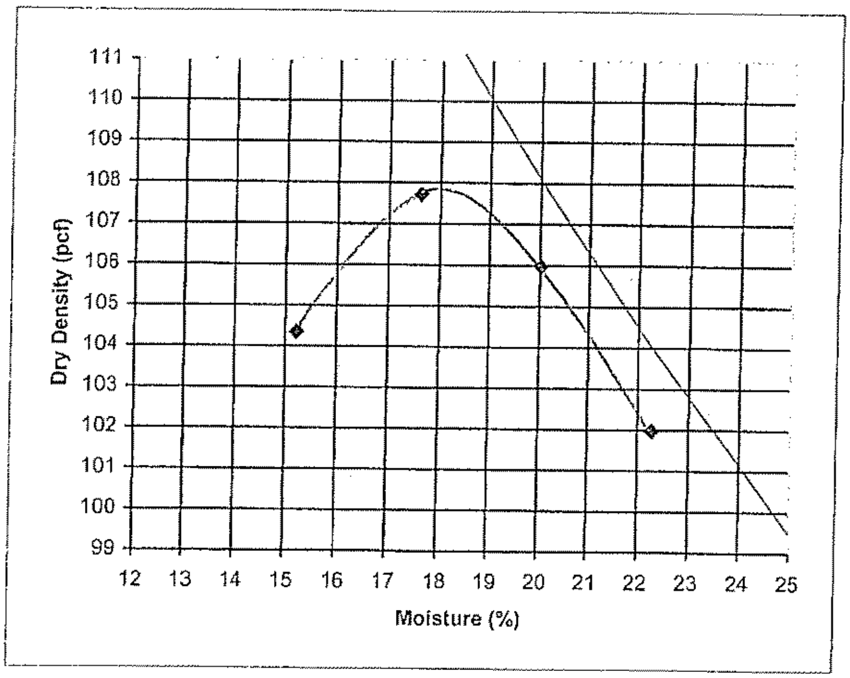
REVIEWED BY

amec

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	JOB NO:	6-119-000566
LOCATION:	Maricopa County	WORK ORDER NO:	2
MATERIAL:	Native Soil	LAB NO:	6
SAMPLE SOURCE:	PT5 @ 1.0-4.0'	DATE SAMPLED:	9/6/06

LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING STANDARD EFFORTS (12,400ft-lb-ft/cu.ft) (ASTMD698A)
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)
DETERMINING PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (AASHTO T89 & T90)

MAXIMUM DRY DENSITY (pcf):	107.7
OPTIMUM MOISTURE (%):	18.0



SIEVE SIZE	PERCENT PASSING
6"	100
4"	100
3"	100
2"	100
1 1/2"	100
1 1/4"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
1/4"	100
#4	99
#8	98
#10	98
#16	95
#30	89
#40	85
#50	80
#100	69
#200	60

ATTERBERG LIMITS

LL:	52
PL:	22
PI:	30
USCS:	CH

NOTE: THE ZERO AIR VOIDS CURVE REPRESENTS A SPECIFIC GRAVITY OF: 2.651 ASSUMED.

THIS IS A SUMMARIZED REPORT OF THE REFERENCED PROCEDURES AND DOES NOT INCLUDE ALL REPORTING REQUIREMENTS. ADDITIONAL DATA CAN BE PROVIDED AT CLIENT'S REQUEST.

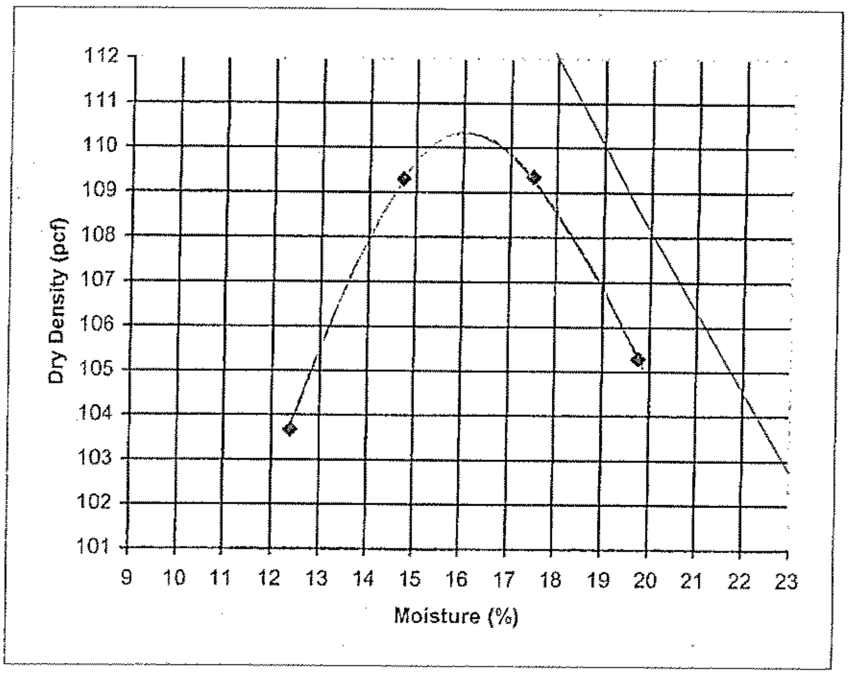
AASHTO R18

REVIEWED BY CJ

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	JOB NO:	6-119-000566
LOCATION:	Maricopa County	WORK ORDER NO:	2
MATERIAL:	Native Soil	LAB NO:	8
SAMPLE SOURCE:	PT7 @ 1.0-4.0'	DATE SAMPLED:	9/6/06

LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING STANDARD EFFORTS (12,400ft-lb-ft/cu.ft) (ASTMD698A)
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)
DETERMINING PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (AASHTO T89 & T90)

MAXIMUM DRY DENSITY (pcf): 110.2
OPTIMUM MOISTURE (%): 16.0



SIEVE SIZE	PERCENT PASSING
6"	100
4"	100
3"	100
2"	100
1 1/2"	100
1 1/4"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
1/4"	100
#4	100
#8	100
#10	99
#16	98
#30	95
#40	92
#50	89
#100	81
#200	72

ATTERBERG LIMITS

LL:	48
PL:	23
PI:	25
USCS:	CL

NOTE: THE ZERO AIR VOIDS CURVE REPRESENTS A SPECIFIC GRAVITY OF: 2.651 ASSUMED.

THIS IS A SUMMARIZED REPORT OF THE REFERENCED PROCEDURES AND DOES NOT INCLUDE ALL REPORTING REQUIREMENTS. ADDITIONAL DATA CAN BE PROVIDED AT CLIENT'S REQUEST.

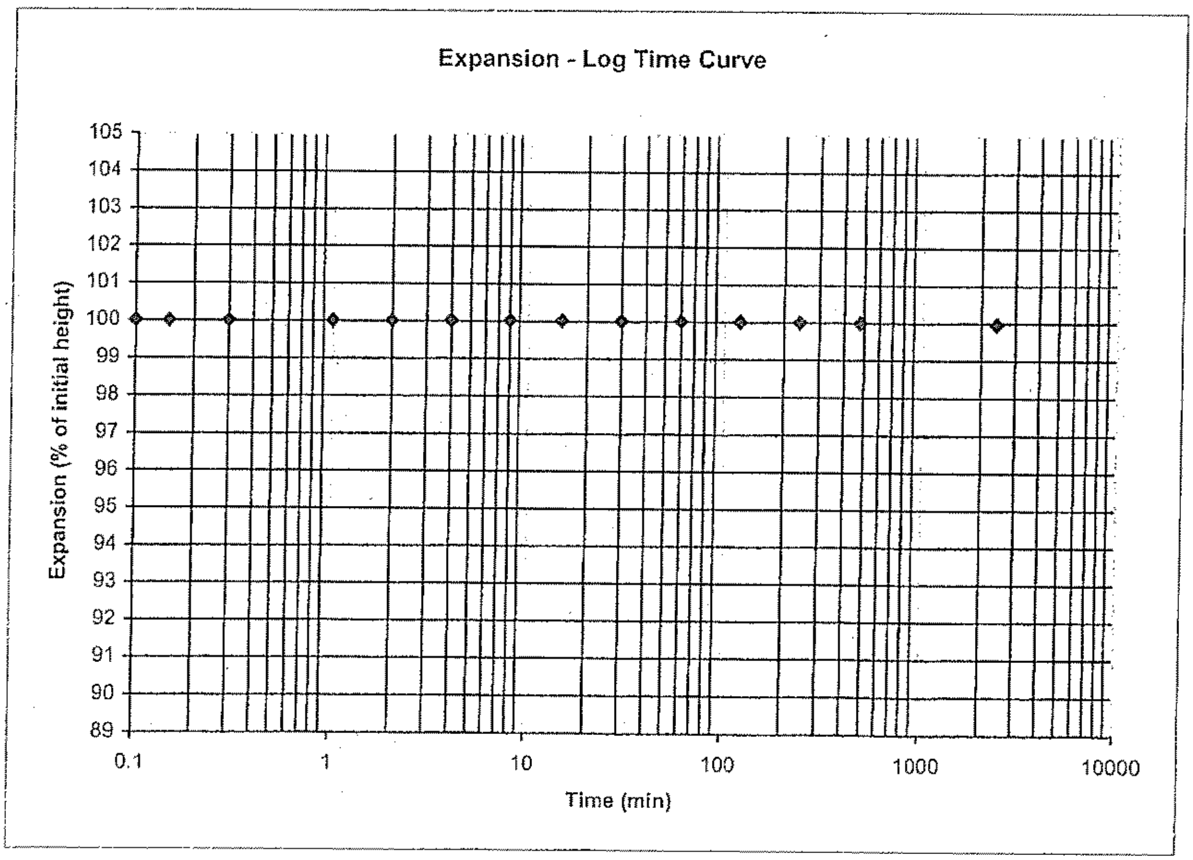
AASHTO R18

REVIEWED BY

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	JOB NO:	6-119-000566
LOCATION:	Maricopa County	WORK ORDER NO:	1
MATERIAL:	Native Soil	LAB NO:	2
SAMPLE SOURCE:	PT3 @ 1.0-4.0'	DATE SAMPLED:	7/12/06
SAMPLE PREP:	Remolded to 95% max dry density and optimum moisture Max dry density D698A 119.1 pcf @ 12.6 opt. moisture		

ONE DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS (ASTM D-4546)

INITIAL DRY DENSITY	113.4 pcf
FINAL DRY DENSITY	113.4 pcf
INITIAL MOISTURE CONTENT	12.6%
FINAL MOISTURE CONTENT	17.3%
MOIST. PICK-UP (% DRY WT.)	4.7%
MOIST. PICK-UP (% IN. VOL.)	8.6%
SWELL (% INITIAL HT.)	0.0%
TYPE OF WATER USED	TAP WATER

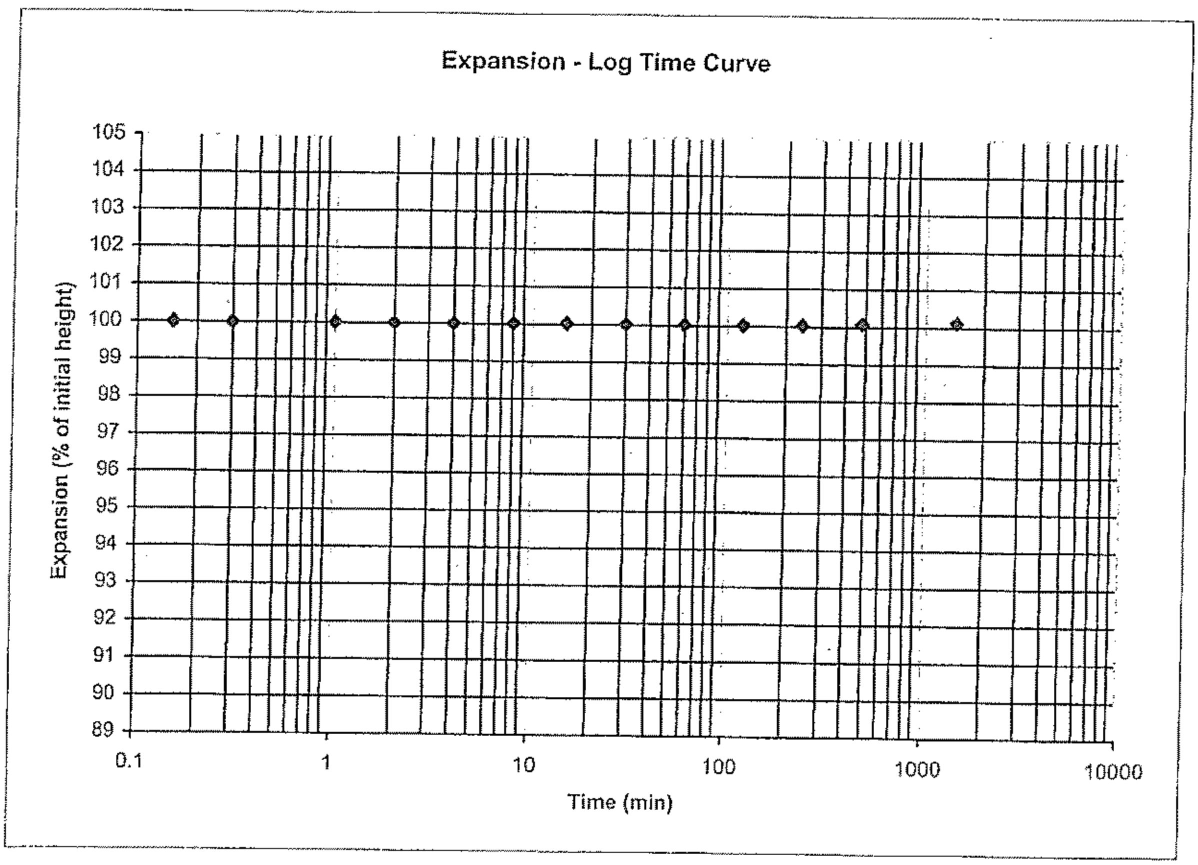


REVIEWED BY CY

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	JOB NO:	6-119-000566
LOCATION:	Maricopa County	WORK ORDER NO:	2
MATERIAL:	Native Soil	LAB NO:	6
SAMPLE SOURCE:	PT5 @ 1.0-4.0'	ASSIGNED DATE:	9/6/06
SAMPLE PREP:	Remolded to 95% max dry density and optimum moisture Max dry density D698A 107.7 pcf @ 18.0 opt. moisture		

ONE DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS (ASTM D-4546)

INITIAL DRY DENSITY	104.0 pcf
FINAL DRY DENSITY	103.9 pcf
INITIAL MOISTURE CONTENT	16.2%
FINAL MOISTURE CONTENT	25.6%
MOIST. PICK-UP (% DRY WT.)	9.4%
MOIST. PICK-UP (% IN. VOL.)	15.8%
SWELL (% INITIAL HT.)	0.1%
TYPE OF WATER USED	TAP WATER

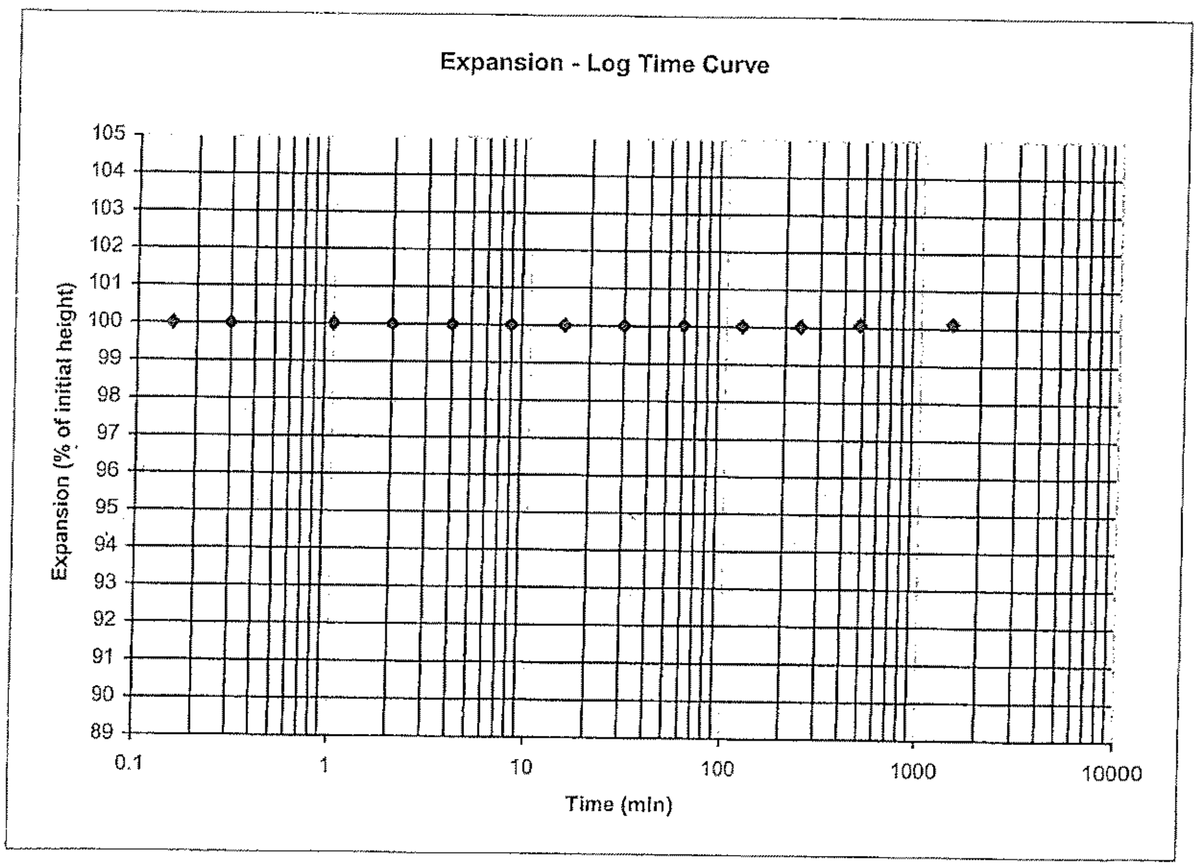


REVIEWED BY [signature]

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	JOB NO:	6-119-000566
LOCATION:	Maricopa County	WORK ORDER NO:	2
MATERIAL:	Native Soil	LAB NO:	8
SAMPLE SOURCE:	PT7 @ 1.0-4.0'	ASSIGNED DATE:	9/6/06
SAMPLE PREP:	Remolded to 95% max dry density and optimum moisture Max dry density D698A 110.2 pcf @ 16.0 opt. moisture		

ONE DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS (ASTM D-4546)

INITIAL DRY DENSITY	105.8 pcf
FINAL DRY DENSITY	105.7 pcf
INITIAL MOISTURE CONTENT	15.0%
FINAL MOISTURE CONTENT	21.4%
MOIST. PICK-UP (% DRY WT.)	6.4%
MOIST. PICK-UP (% IN. VOL.)	10.9%
SWELL (% INITIAL HT.)	0.1%
TYPE OF WATER USED	TAP WATER

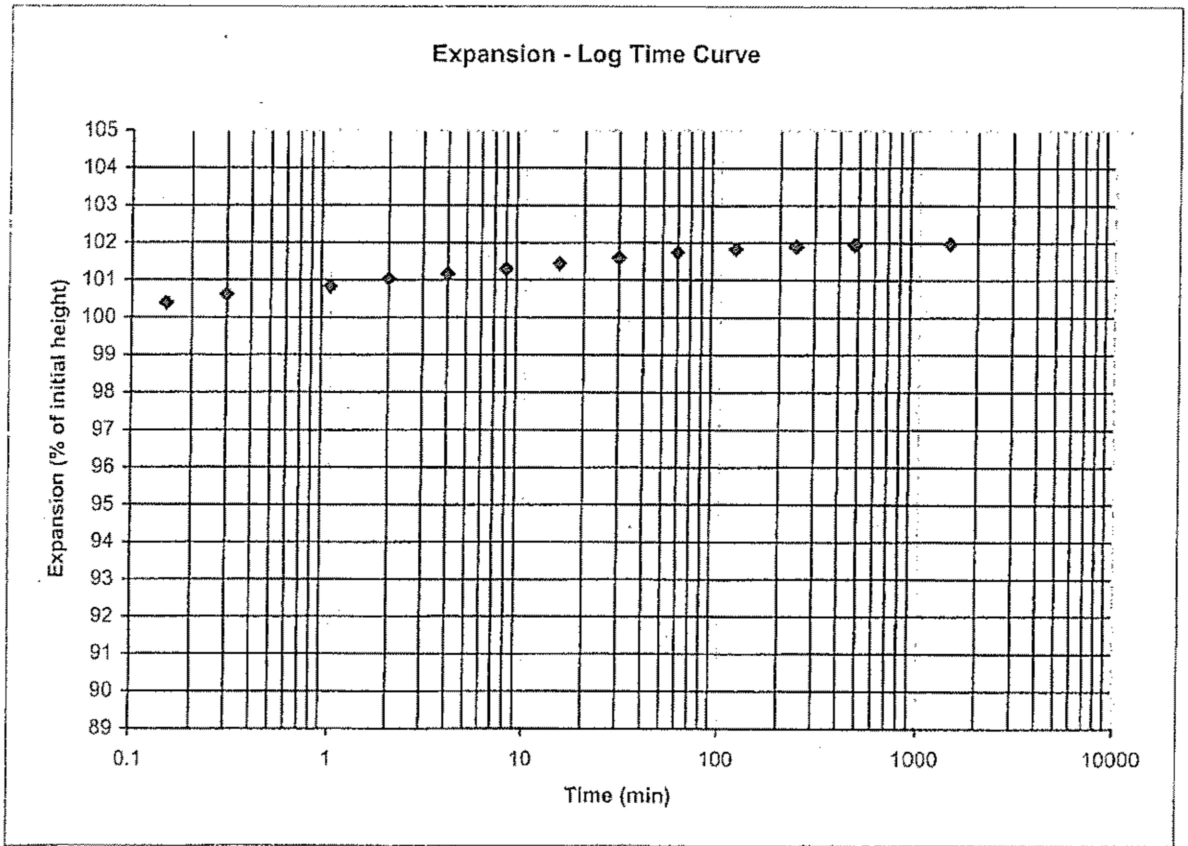


REVIEWED BY

PROJECT:	MC85, 107th Avenue and 91st Avenue 6490.0000	**JOB NO:**	6-119-000566
LOCATION:	Maricopa County	**WORK ORDER NO:**	1
MATERIAL:	Native Soil	**LAB NO:**	3
SAMPLE SOURCE:	PT9 @ 1.0-4.0'	**DATE SAMPLED:**	7/12/06
SAMPLE PREP:	Remolded to 95% max dry density and optimum moisture Max dry density D698A 107.8 pcf @ 17.3 opt. moisture	**LOAD:**	

ONE DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS (ASTM D-4546)

INITIAL DRY DENSITY	102.0 pcf
FINAL DRY DENSITY	100.0 pcf
INITIAL MOISTURE CONTENT	17.9%
FINAL MOISTURE CONTENT	24.2%
MOIST. PICK-UP (% DRY WT.)	6.3%
MOIST. PICK-UP (% IN. VOL.)	10.3%
SWELL (% INITIAL HT.)	2.0%
TYPE OF WATER USED	TAP WATER



REVIEWED BY CY

SECTION 7

PAVEMENT STRUCTURE DESIGN

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- City of Phoenix pavement section approval letter titled *MC-85 Buckeye Road from 91st Avenue to 107th Avenue, STX2011X3* (letter dated July 14th, 2011).
- City of Phoenix pavement section approval letter titled *MC-85 Buckeye Road from 75th Avenue to 91st Avenue, STX2011X1* (letter dated July 14th, 2011).

APPENDIX PAV-B

MACTEC Engineering and Consulting, Inc. report titled *Rerport of Geotechnical Evaluation, MC-85 (Buckeye Road), 107th Avenue to 91st Avenue, Maricopa County, Arizona, Job No. 40069024* (MACTEC Project No. 4975-03-1401, report dated June 17, 2003, and revised October 23, 2003).

APPENDIX PAV-C

DMJM Harris/AECOM report titled *Pavement Design Report, MC-85, 107th Avenue to 91st Avenue, Maricopa County, Arizona* (DMJM Harris Project No. 6490.0000, report dated April 25, 2006).

APPENDIX PAV-D

Ninyo and Moore report titled *Geotechnical Evaluation, MC-85 Roadway Improvements, 75th Avenue to 91st Avenue, Maricopa County, Arizona* (Ninyo and Moore Project No. 601301002, report dated September 28, 2010).

7 PAVEMENT STRUCTURE DESIGN

7.1 GENERAL

The proposed MC-85 (Buckeye Road) roadway improvements will extend from 107th Avenue to 75th Avenue in Maricopa County (Phoenix), Arizona. The approximate location of the site is shown on the Site Vicinity Map (Figure PAV-1).

At the time of our field exploration along MC-85, the site consisted of an asphalt (AC) paved roadway divided into 2 travel lanes each way. The lanes along the site alternated between 5 lanes (2 lanes each way with a center median/turn lane) and 4 lanes (2 lanes each way) with the center median/turn lane transitioning from a full width center turn lane to just a stripe dividing the east and west travel lanes. We understand the planned roadway improvements will include construction of a continuous 5-lane section across the site.

The pavement structure design for the project was previously performed by other consultants, and these designs are summarized in this report section. Based on the pavement structure designs previously performed, the City of Phoenix approved a pavement section for the site. This report section summarizes the proposed pavement structure design for the project.

7.2 PREVIOUS PAVEMENT STRUCTURE DESIGN

Previous geotechnical reports were prepared for the project, and these previous reports included pavement structure design recommendations for the site. The following are the previous pavement structure design reports provided by MCDOT for this project:

- MACTEC, Report of Geotechnical Evaluation, MC85 (Buckeye Road), 107th Avenue to 91st Avenue, Maricopa County, Arizona (Mactec Project No. 4975-03-1401, report dated June 17 and revised October 23, 2003).
- DMJM Harris/AECOM, Pavement Design Report, MC 85, 107th Avenue to 91st Avenue, Maricopa County, Arizona (DMJM Harris Project No. 6490.0000, report dated April 25, 2006).
- Ninyo and Moore (N&M), Geotechnical Evaluation, MC-85 Roadway Improvements, 75th Avenue to 91st Avenue, Maricopa, Arizona (N&M Project No. 601301002, report dated September 28, 2010).

These 3 pavement structure design reports listed above are included as an appendix in this section.

7.2.1 SUMMARY OF MACTEC REPORT

The MACTEC report was a preliminary geotechnical evaluation for the proposed reconstruction for the western roughly 2 miles of the MC-85 project, from 107th Avenue to 91st Avenue. MACTEC advanced 11 borings across the site to evaluate the subsurface conditions. MACTEC determined a mean R-value of 17 for the project, and a resilient modulus (M_r) of the subgrade soil of 10,369 pounds per square inch (psi). The MACTEC report indicated design equivalent single axle loads (ESALs) ranging from 9,500,000 to 5,000,000, which resulted in design structural numbers ranging from 4.46 to 4.07. MACTEC presented various pavement section alternatives that included a combination of different thicknesses of asphalt rubber (AR), asphalt concrete (AC), aggregate base (AB), lime stabilized subbase (LSS), imported fill subgrade, and existing aggregate subbase. The MACTEC report is included in Appendix PAV-B.

7.2.2 SUMMARY OF DMJM HARRIS/AECOM REPORT

The DMJM Harris/AECOM (AECOM) report was a geotechnical evaluation for the western roughly 2 miles of the MC-85 project, from 107th Avenue to 91st Avenue. The AECOM report relied upon the previous MACTEC report and presented final pavement design recommendations. AECOM advanced 16 pavement exploration cores across the site to evaluate the subsurface conditions. AECOM determined a mean R-value of 15.6 for the project, and a M_r of the subgrade soil of 9,830 psi. The AECOM report indicated design ESALs ranging from 11,724,000 to 9,377,000, which resulted in design structural numbers ranging from 4.08 to 3.86. AECOM presented various pavement section alternatives that included a combination of different thicknesses of AR, AC, AB, LSS, and imported fill subgrade. The AECOM report is included in Appendix PAV-C.

7.2.3 SUMMARY OF NINYO AND MOORE REPORT

The Ninyo and Moore (N&M) report was a geotechnical evaluation for the eastern roughly 2 miles of the MC-85 project, from 91st Avenue to 75th Avenue. The N&M report relied upon data from a previous report prepared by Terracon as part of a final design concept report (DCR). N&M advanced 11 pavement exploration cores across the site to evaluate the subsurface conditions. N&M determined an average R-value of 20 for the project, and a M_r of the subgrade soil of 13,000 psi. The N&M report indicated design ESALs of 15,000,000, which resulted in design structural numbers of 4.42. N&M presented various pavement section alternatives that included a combination of different thicknesses of AR, AC, AB, and LSS. The N&M report is included in Appendix PAV-D.

7.3 CITY OF PHOENIX APPROVED PAVEMENT STRUCTURE SECTION

Based on the previous pavement structure design reports prepared for the site, the City of Phoenix (COP) approved a pavement section for the project. The approved COP pavement sections were approved in the following engineering letters:

- City of Phoenix pavement section approval letter titled *MC-85 Buckeye Road from 91st Avenue to 107th Avenue, STX2011X3* (letter dated July 14th, 2011).
- City of Phoenix pavement section approval letter titled *MC-85 Buckeye Road from 75th Avenue to 91st Avenue, STX2011X1* (letter dated July 14th, 2011).

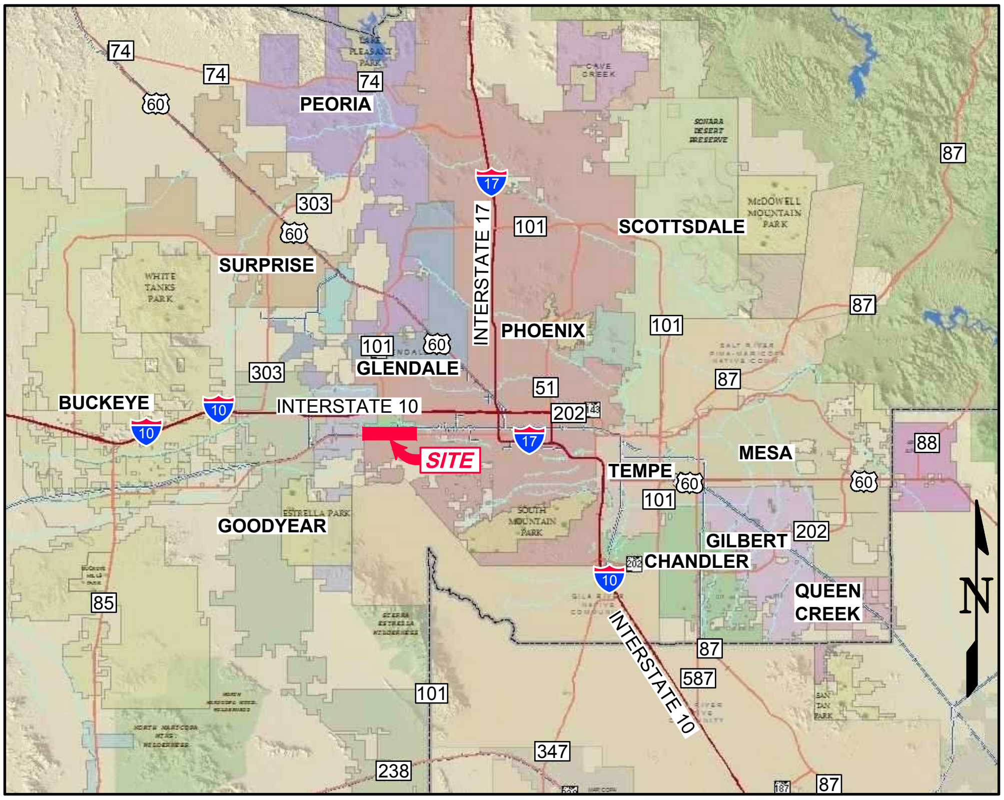
The parameters used in the COP pavement section approval letter for the western 2 miles of the MC-85 project (from 107th Avenue to 91st Avenue) included a design ESAL of 12,955,000, a design M_r of 10,000 psi, and the resulting structural number was 4.3. The parameters used in the COP pavement structural section approval letter for the eastern 2 miles of the MC-85 project (from 91st Avenue to 75th Avenue) included a design ESAL of 13,550,000, a design M_r of 10,158 psi, and the resulting structural number was also 4.3. The resulting structural number was the same for the east and west 2 miles of the MC-85 project; therefore, the same new pavement section was recommended for both 2 mile segments of the project. The COP pavement section approval letters are included in Appendix PAV-A. The following table summarizes the COP approved pavement section for the project.

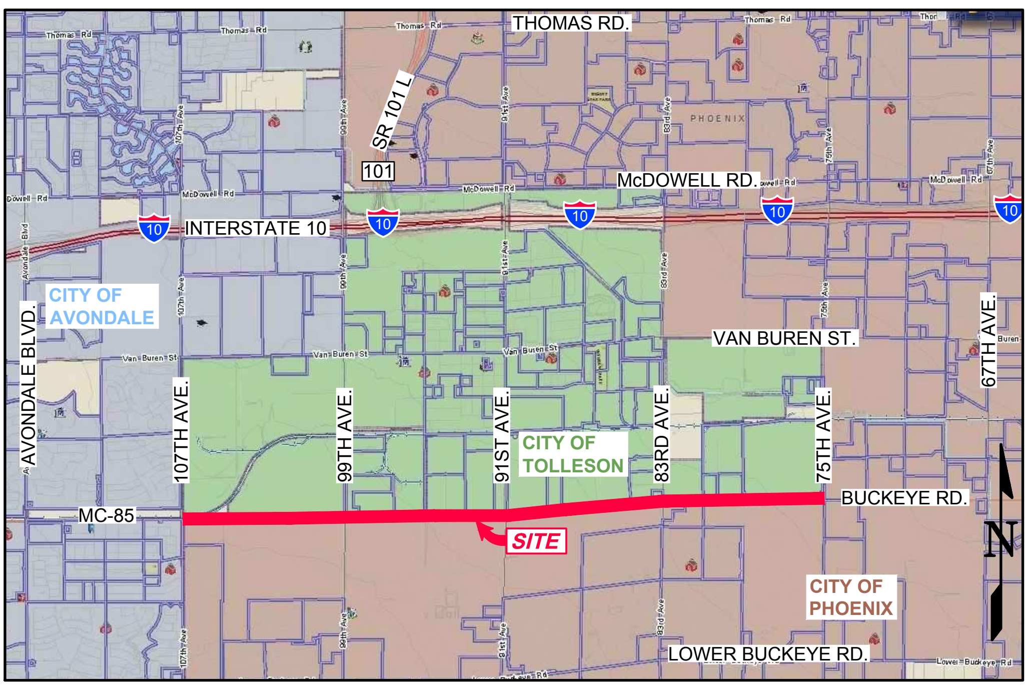
Table 7.3-1 COP Approved New Pavement Structure Thicknesses

Roadway Section	Asphaltic Concrete *	Aggregate Base Course	Lime Stabilized Subbase
MC-85 (Buckeye Road) from 107th Avenue to 75th Avenue	7 inches	6 inches	8 inches

* Asphaltic concrete pavement should be placed in three lifts: two base courses, 3-inch and 2½-inch thick with A1½ mix at 4.3% oil; and a surface course, 1½-inch thick with D ½ mix at 5.1% oil.

FIGURE





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VICINITY MAPS

NOT TO SCALE

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PROJECT NO.	129067
DRAWN:	12/2012
DRAWN BY:	DMF
CHECKED BY:	RP
FILE NAME:	129067_F1.dwg

SITE VICINITY MAP

MC-85 (BUCKEYE ROAD)
FROM 107TH AVENUE TO 75TH AVENUE
MARICOPA COUNTY (PHOENIX), ARIZONA

FIGURE

PAV-1

PLOTTED: 07 Dec 2012, 8:22am, dfahrney
CAD FILE: L:\2012\CADD\129067\ LAYOUT: 1
Images: Vicinity1.jpg Images: Vicinity2.jpg
ATTACHED IMAGES:
ATTACHED XREFS:
RIVERSIDE, CA

APPENDIX PAV-A

City of Phoenix Pavement Section Approval Letter

City of Phoenix

To: Chris Kowalsky
Civil Engineer II,
Planning, Design and Programming

Date: July 14th 2011

From: Equbalali Charania, P.E., Ph.D
Engineering Supervisor, Materials Lab

Subject: MC- 85 Buckeye Road from 91st Avenue to 107th Avenue, STX2011X3

Introduction:

The project involves Paving and Storm Drain improvements for MC-85 Buckeye Road from 91st Avenue to 107th Avenue.

Geotechnical investigations were performed by MACTEC (project number 4975-03-140, dated 6/17/2003) and by DMJM Harris (project number 64900000, dated 4/25/2006). Geotechnical reports were prepared by both MACTEC and DMJM.

Investigations showed that the thickness of the existing pavement on Buckeye Road from 91st Avenue to 107th Avenue varied between 3.0-inch to 12.0-inch asphaltic concrete on 5-inches to 26 ½ -inch aggregate base course. In some areas, concrete was encountered and the thickness of concrete varied from 6-inch to 12-inch.

Asphaltic Concrete pavement on Lower Buckeye Road is in fair to poor condition, with longitudinal and transverse cracks, patches and some potholes.

Pavement Recommendations:

The pavement was designed according to the new AASHTO (1993) design procedure. The following parameters were used in the design:

20 Year, ESAL	12,955,000
Lane Distribution Factor	0.75
Design MR (PSI)	10,000
Overall Standard Deviation	0.4
Reliability	95%
Design Serviceability Loss	2.5
Drainage Factor	1.0
The Resulting Structural Number	4.3

a) Pavement Structure for new pavement

On the basis of the above investigations, soil test results and field inspection, the following pavement structure is recommended for new pavement;

7 inch asphaltic concrete and 6-inch ABC on 8-inch lime stabilized subbase.

Asphaltic concrete pavement should be placed in three lifts, two base courses, 3–inch and 2 ½ inch thick with A 1 ½ mix at 4.3% oil and a surface course, 1 ½ -inch thick with D ½ mix at 5.1% oil.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
19668
EQUBALALI H.
CHARANIA
Date Signed 7/14/11
ARIZONA, U.S.A.
Expires 06/30/2014

Equbalali Charania, P.E., Ph.D
Engineering Supervisor

REPORT OF GEOTECHNICAL EVALUATION

MACTEC Project No. 4975-03-1401

MC85 (BUCKEYE ROAD)

107TH AVENUE TO 91ST AVENUE
MARICOPA COUNTY, ARIZONA
JOB NO. 40069024

Prepared for:

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION
PHOENIX, ARIZONA

Prepared by:

MACTEC ENGINEERING AND CONSULTING, INC.
PHOENIX, ARIZONA

June 17, 2003
Revised October 23, 2003

MACTEC

DMJM HARRIS | AECOM

DMJM Harris
2777 East Camelback Road, Suite 200, Phoenix, AZ 85016
T 602.337.2777 F 602 337.2620 www.dmjmharris.com

April 25, 2006

Mr. Sami Ayoub
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

Re: Pavement Design Report
MC 85 (Buckeye Road), 107th Avenue to 91st Avenue
Maricopa County, Arizona
MCDOT Work Order 69024
DMJM Harris Project No. 6490.0000

Dear Mr. Ayoub:

DMJM Harris is pleased to present this Pavement Design Report to the Maricopa County Department of Transportation (MCDOT) for the above referenced project. This report details our scope of work, and includes the results of our investigation, design and test data obtained as part of the preliminary geotechnical investigation (Mactec, 2003) as well as recommendations for the design of pavements based on life cycle cost analyses of various alternatives for the section of MC 85 (Buckeye Road) between 107th Avenue and 91st Avenue and in Maricopa County, Arizona.

We appreciate the opportunity to provide geotechnical services to the MCDOT on this project. Should you have any questions concerning this report, please contact Keith Dahlen of our office at (602) 337-2596.

Sincerely,
DMJM Harris

Francisco J. Garza

Francisco Garza, E.I.T.

Reviewed by:

Keith H. Dahlen

Keith Dahlen, P.E.
Senior Geotechnical Engineer

Registered Professional Engineer
Certificate No. 25151
KEITH H. DAHLEN
Date Signed 4/25/06
Arizona, U.S.A.

cc: 6490.0005 505

City of Phoenix

To: Chris Kowalsky
Civil Engineer II,
Planning, Design and Programming

Date: July 14th 2011

From: Equbalali Charania, P.E., Ph.D
Engineering Supervisor, Materials Lab

Subject: MC- 85 Buckeye Road from 75th Avenue to 91st Avenue, STX2011X1

Introduction:

The project involves Paving and Storm Drain improvements for MC-85 Buckeye Road from 75th Avenue to 91st Avenue.

Geotechnical investigations were performed by Ninyo and Moore (N&M project number 601301002). Geotechnical report was prepared by Ninyo and Moore in 9/28/2010 and the their report included results of investigations carried out by Terracon (project number 65035025 dated 5/14/2003).

Investigations showed that the thickness of the existing pavement on Buckeye Road from 75th Avenue to 91st Avenue varied between 6.0-inch to 9.0-inch asphaltic concrete on 5-inches to 12-inch aggregate base course.

Asphaltic Concrete pavement on Lower Buckeye Road is in fair to poor condition, with longitudinal and transverse cracks, patches and some potholes.

Pavement Recommendations:

The pavement was designed according to the new AASHTO (1993) design procedure. The following parameters were used in the design:

20 Year, ESAL	13,550,000
Lane Distribution Factor	0.75
Design MR (PSI)	10,158
Overall Standard Deviation	0.4
Reliability	95%
Design Serviceability Loss	2.5
Drainage Factor	1.0
The Resulting Structural Number	4.3

a) Pavement Structure for new pavement

On the basis of the above investigations, soil test results and field inspection, the following pavement structure is recommended for new pavement;

7 inch asphaltic concrete and 6-inch ABC on 8-inch lime stabilized subbase.

Asphaltic concrete pavement should be placed in three lifts, two base courses, 3–inch and 2 ½ inch thick with A 1 ½ mix at 4.3% oil and a surface course, 1 ½ -inch thick with D ½ mix at 5.1% oil.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
19668
EQUBALALI H.
CHARANIA
Date Signed 7/14/11
ARIZONA, U.S.A.

Expires 06/30/2014

Equbalali Charania, P.E., Ph.D
Engineering Supervisor

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

September 28, 2010
Project No. 601301002

Mr. John Shi
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

Subject: Geotechnical Evaluation
MC-85 Roadway Improvements
75th Avenue to 91st Avenue
Maricopa County, Arizona

Dear Mr. Shi:

In accordance with your authorization, we have performed a geotechnical evaluation for the above-referenced project in Maricopa County, Arizona. This report presents our geotechnical findings, conclusions, and recommendations for the design and construction of the subject project.

We appreciate the opportunity to be of service to you during this phase of the project. If you have any questions or comments regarding this report, please call.

Sincerely,
NINYO & MOORE

Marek J. Kasztalski, P.E., P.M.P., LEED A.P.
Senior Geotechnical Engineer

Steven D. Nowaczyk, P.E.
Principal Engineer

Registered Professional Engineer (Civil) Certificate No. 34935 Steven D. Nowaczyk Date Signed 9.28.10 Arizona U.S.A.

EXPIRES 6/30/12

SV/MJK/SDN/tns

Distribution: (3) Addressee (3 hard copy & via e-mail)

495-3617

APPENDIX PAV-B

MACTEC Engineering and Consulting, Inc. Report

REPORT OF
GEOTECHNICAL EVALUATION

MACTEC Project No. 4975-03-1401

MC85 (BUCKEYE ROAD)

107TH AVENUE TO 91ST AVENUE
MARICOPA COUNTY, ARIZONA
JOB NO. 40069024

Prepared for:

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION
PHOENIX, ARIZONA

Prepared by:

MACTEC ENGINEERING AND CONSULTING, INC.
PHOENIX, ARIZONA

June 17, 2003
Revised October 23, 2003

MACTEC

MACTEC

June 17, 2003

Mr. Joseph A. Phillips, P.E.
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

Subject: **Preliminary Geotechnical Evaluation – Revised October 23, 2003**
MC85 (Buckeye Road)
107th Avenue to 91st Avenue
Maricopa County, Arizona
Job No. 40069024
MCDOT Contract No. CY 2003-03
MACTEC Project No. 4975-03-1401

Dear Mr. Phillips:

MACTEC Engineering and Consulting, Inc. (MACTEC) has completed the preliminary geotechnical evaluation for the proposed reconstruction of MC85 (Buckeye Road) between 107th Avenue and 91st Avenue. This work was performed in general accordance with our proposal for Preliminary Geotechnical Evaluation, dated January 24, 2003. The results of our evaluation, along with the boring location map, laboratory test results, and recommendations are attached.

In addition to the Preliminary Geotechnical Evaluation, the scope of the above referenced work order included review and commentary for the Draft Pavement Design Guide for MCDOT. The results of our review and the associated comments are presented under separate cover.

We at MACTEC are committed to providing quality engineering services combined with client satisfaction in order to achieve a continuing relationship with our clients. We appreciate the opportunity to provide these services for you. If you have any questions regarding any of the other engineering and testing services MACTEC provides, please do not hesitate to contact us.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
34607
JODI
WINNEY
Date Signed 10/23/03
ARIZONA, U.S.A.

Jodi Winney

Jodi Winney, P.E.
Geotechnical Engineer

Marshall Lew

Marshall Lew, Ph.D.
Senior Principal
by ADM with permission

JW:ML:adm

(projects\4975\4975-03-1401\deliverables\prelim geotech report revised)

TABLE OF CONTENTS

1.0 PURPOSE

Included in this report are the results of our evaluation of existing pavement subgrade soils that will be used to support the reconstruction of 2 miles of MC85 (Buckeye Road). Consistent with the *Maricopa County Department of Transportation Draft Pavement Design Guide*, this geotechnical evaluation provides preliminary engineering recommendations and information to address the following aspects of this phase of the project:

- Existing site and subgrade soil conditions;
- Geological considerations;
- Groundwater conditions;
- Preliminary percolation rates;
- Excavation conditions for underground utilities;
- Corrosivity to corrugated metal pipe (CMP);
- Earthwork recommendations for pavement subgrade;
- Suitability of site soils as fill;
- Recommended specifications for imported fill;
- Recommended alternative pavement sections; and,
- Discussion of economics for pavement design alternatives.

This report does not address any environmental issues related to the site or the project. If you have any questions concerning environmental aspects of this project please contact us and we can discuss additional services with you.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has been prepared for Maricopa County Department of Transportation for the design of the project described herein. This report has not been prepared for any other parties, and may not contain sufficient information for purposes of other parties. If any of the project information described in Section 2.0 of this report has changed, we should be notified so that we may amend our recommendations as necessary.

2.0 PROJECT INFORMATION

Based on the Corridor Improvement Study dated July 21, 1998, and information you provided, this project consists of the reconstruction of 2 miles of MC85 between 107th Avenue and 91st Avenue. We understand that the preferred improvement level for this roadway is the Full Cost Alternative consisting of a 6-lane asphalt paved divided roadway with a 16 foot wide raised median, as indicated in the Corridor Improvement Study. As part of this project, reconstruction of pavements and other associated improvements will be made at intersections included in the subject segment of MC85. Currently, the roadway consists of a 4 travel lane arterial road with a continuous center turn lane.

We understand that the pavement elevations for this segment of MC85 have not yet been finalized, however it is anticipated that they will be at or slightly above existing pavement elevations. Corrugated metal pipe (CMP) may be utilized to manage flows, although the precise locations of these drainage features have also not yet been determined.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

MACTEC advanced 11 borings to a depth of 10 feet below pavement surface within the left and right travel lanes of both the east and west directions of the existing MC85 alignment. During drilling of these borings, many of the in-place subgrade soils became contaminated with asphalt and aggregate base material when bulk soil sampling was attempted. Therefore, for the purposes of this preliminary evaluation, hand augered subgrade samples were obtained outside the existing asphalt pavement but within the shoulder of MC85. Classification tests performed indicate that the hand auger samples obtained from the shoulder are representative of the types of materials encountered below the paved areas. Preliminary percolation testing was performed within 6 of the drilled boreholes. Results of these tests are presented later in this report.

The approximate locations of these borings are shown on the Boring Location Map attached. The soils encountered at each location were visually classified and recorded on a field log using the Unified Soil Classification System (USCS). Bulk and undisturbed samples of the soils were retrieved for laboratory testing which aided in providing the final soil classifications presented in the boring logs attached in Appendix A.

Exposed pavement sections measured within the boring locations indicate that the existing pavement consists of approximately 3 to 7 inches of asphalt concrete pavement, averaging just under 6 inches. Observed aggregate base sections within the borings measured between 11 to 24 inches. The actual pavement section thicknesses measured within the borings are presented on the attached boring logs.

The materials encountered in Borings 8A and 8B indicate the presence of portland cement concrete below the asphalt and aggregate base sections. Refusal to auger drilling was encountered in the first and second attempts at borings in this area. Based on visual inspection of the area near Borings 8A and 8B, concrete associated with either a gated concrete irrigation culvert or underground irrigation/drainage pipes may have been encountered in these borings. A portland cement concrete like material was also encountered in Borings 9 and 11, however these cemented layers did not result in drilling refusal nor was there any visual indication of underground concrete pavement or structures. We were unable to determine or even estimate the lateral extent of these concrete or cemented areas. During the final design, additional field exploration, possibly including potholing, should be scheduled to more precisely determine the extent of this existing concrete section since removal of this concrete may prove costly.

Overall the general condition of the pavement along the subject portion of MC85 was observed to be in a good condition with only minor transverse cracking at the roadway edge and slight intermittent depressions. Alligator cracking along the roadway was observed to a light to moderate degree in the center turn lane, becoming more prominent toward 107th Avenue.

Within the borings, sandy clay soils were encountered from below the asphalt pavement section extending to the full depth of exploration, except in a couple of borings where silty and clayey sand soils were encountered at depth. The soil conditions in the borings ranged from stiff to hard with varying levels of cementation and low to medium plasticity. Surface soils at pavement subgrade level were tested for expansion and exhibited expansion potentials ranging from moderate to high.

3.2 SITE CONDITIONS AND GEOLOGIC HAZARDS

At the time our field exploration was performed, the surrounding areas around the roadway alignment typically consisted of relatively flat agriculturally developed land to the south and light to moderate industrial developments to the north. Several intersecting roadways ranging from unpaved private drives to connecting collector or arterial roads exist along the subject portion of MC85. Vegetation consisted of young crops, and within some areas a sparse growth of desert trees, brush and grasses.

Area surface topography is interpreted to consist of a gentle slope toward the southwest (USGS, *Tolleson, Arizona Quadrangle,* 7.5-minute [topographic] series dated 1957, photorevised 1982). Surface water generated on the roadway flows as sheet flow to the north or south shoulders. Runoff water is either allowed to flow into open irrigation canals paralleling the roadway, is captured by intentional or unintentional small earth berms along the open irrigation canals, or is captured by curb and gutters constructed along developed properties.

A 1988 Flood Insurance Rate Map (Panel Number 04013C2095 D, effective April 15, 1988) reveals that the existing alignment was reported to be within the 500-year flood boundary. The Maricopa County Flood Control district website indicates that the area north of the railroad tracks located at the very west end of the alignment at 107th Avenue is adjacent to a known flood plain and is regulated.

No ground-water was encountered within any of the borings during our field exploration. Ground-water levels in the area will fluctuate, but were reported at about 60 feet below the ground surface in 1992 (Arizona Department of Water Resources Hydrologic Map Series Report No. 27, 1995).

According to the 1997 Uniform Building Code, the project area lies within Seismic Zone 1 corresponding to a Seismic Zone Factor (Z) of 0.075. As presented in Tables 16-J and 16-Q the seismic coefficients C_a and C_v for soil conditions at the site classified as S_D are 0.12 and 0.18, respectively.

3.3 LABORATORY TESTING

For evaluation of the subgrade soils for preliminary pavement section design, laboratory tests were performed on the representative samples obtained during our field exploration. The following tests were performed in general accordance with the applicable ASTM test methods:

- Plasticity Index
- Sieve Analysis
- R-Value
- pH and Minimum Resistivity
- In-situ Moisture and Density
- Moisture-Density Relationship
- Expansion Potential

The results of these tests are presented in the Summary of Laboratory Testing Tables 1, 2, and 3 included in Appendix B.

3.4 FIELD TESTING

Preliminary percolation testing was performed in six of the eight-inch diameter borings advanced along the MC85 alignment for the purpose of understanding the range of percolation rates that may be encountered once drainage feature locations are determined. The method for determining the preliminary percolation rates presented below consisted of advancing the boring to the full exploration depth of 10 feet, cleaning the hole using the auger flights, and filling the hole with water for a short pre-soak period on the order of one-half to two hours. After this pre-soak period and one to two refillings as needed, the drop rate of the water within the hole was recorded through direct measurement.

The rates measured should only be taken as rough estimates for preliminary design. Final rates should be determined using applicable Maricopa County and/or ADEQ guidelines.

Boring No.	Depth of Boring (feet)	Preliminary Percolation Rate* (min/inch)
1	9.9	3
3	9.4	4
5	10	2
7	10	9
9	10	1
10	10	9

*Rounded to the nearest minute

The rates reported may be faster than the rates determined during the final report due to side seepage and the short pre-soak period associated with this preliminary phase of testing.

4.0 DESIGN AND RECOMMENDATIONS

4.1 MODULUS OF RESILIENCY

In accordance with the *Maricopa County Department of Transportation Draft Pavement Design Guide* (Design Guide) the sieve and plasticity values were utilized to determine correlated R-values for use in developing the mean R-value. The correlated R-values are presented in Summary of Laboratory Testing Table 1. Based on the standard deviations of both the laboratory tested R-values and the correlated R-values, the average R-values did not require adjusting.

Also in accordance with the Design Guide, the mean R-value for the soils at this project was determined to be 17 using the following formula:

$$\mathbf{R_{mean} = (2*N_t * R_t * \delta_c^2 + N_c*R_c*\delta_t^2)/(2*N_t*\delta_c^2 + N_c*\delta_t^2)}$$

Where

N_t = number of tested R-values
R_t = average tested R-values
δ_t = standard deviation of the tested R-values
N_c = number of correlated R-values
R_c = average correlated R-value
δ_c = standard deviation of the correlated R-values

Considering a mean R-value of 17 and a seasonal variation factor (SVF) of 1.0 for the project area, the resilient modulus (M_r) of the subgrade soil was determined to be 10,369 pounds per square inch (psi) as determined by the following formula from the Design Guide:

$$\mathbf{M_r = (1815 + 225*R_{mean} + 2.4*R_{mean}^2)/(0.6*SVF^{0.6})}$$

It is this resilient modulus value that will be utilized in conjunction with traffic loading to determine the necessary structural number for the proposed roadway.

4.2 TRAFFIC LOAD ANALYSIS

For the purposes of pavement design, Maricopa County Department of Transportation provided both a Corridor Improvement Study and the MAG traffic projections for years 2010 and 2020. A combination of values from the information provided were used to develop the initial and final Equivalent Single Axle Loads (ESAL) for years 2003 and 2023, the analysis period of this report.

MC85 Design Traffic Load

The improvement section of MC85 that is the subject of this report was divided into two sections which exhibit similar 2020 traffic loading in terms of Average Daily Trips (ADT) as projected by MAG. After the two sections were established, the ADT provided within each of the sections were averaged to provide a design ADT for use in determining pavement material thicknesses. The two sections consisted of the portions of MC85 from 91st Avenue to the 103rd Avenue alignment at 30,000 ADT, and from the 103rd Avenue alignment to 107th Avenue at 23,000 ADT. Design truck percentages were determined for each of these sections of MC85 in a similar fashion and were based on information provided by Inca Engineers for 2003 truck counts. We understand that the percentage of trucks along the subject portion of MC85 are not expected to increase; therefore, for the purposes of this report, truck percentages are assigned a zero percent growth over the analysis period.

These averaged 2020 ADT volumes, along with the 1997 traffic counts provided in the Corridor Improvement Study were utilized to determine an approximate compounded growth rate for MC85 of 5.8% between 91st Avenue and 103rd Avenue, and 4% between 103rd Avenue and 107th Avenue.

These rates shall be used for pavement design and analysis purposes of this report only, and should not be used for future traffic projections.

Utilizing these calculated growth rates, the 2020 ADT volumes were back calculated to determine initial traffic volumes for 2003 and extrapolated to determine the final traffic volumes for 2023 for the two sections of MC85. Initial and final traffic volumes for the intersecting roadways at MC85 were also determined using similar methods assuming a single growth rate of 5.8% overall. These values are summarized below:

Roadway Section	1997 ADT[1]	2020 ADT[2]	Growth Rate[3]	2023 ADT
MC85 – 91st Ave. to 99th Ave	9,000	30,000	5.4%	35,326
MC85 – 99th Ave to 103rd Ave	8,200	30,000	5.8%	35,517
MC85 – 103rd Ave to 107th Ave	8,200	23,000	4.0%	25,872
91st Avenue	Not Provided	13,000	5.8%[4]	15,396
99th Avenue	Not Provided	17,000	5.8%[4]	20,133
107th Avenue	Not Provided	13,000	5.8%[4]	15,396

[1]Direct data from Corridor Improvement Study
[2]Averaged MAG projected ADT
[3]Estimated growth rate calculated based on 1997 and 2020 ADT data
[4]Estimated growth rate calculated based on 2010 and 2020 ADT data

Using the traffic volumes and growth rates presented above, the ESAL's and Structural numbers for the sections of MC85 and intersecting roadways were calculated using the following design parameters:

Performance Period (years)	20
Number of lanes in the Design Direction (MC85)	3
Percent of All Trucks in the Design Lane (MC85)	70%
Number of lanes in the Design Direction (Intersecting Roads)	2
Percent of All Trucks in the Design Lane (Intersecting Roads)	90%
Percent Trucks in the Design Direction	100%
Average Initial Truck Factor (provided by MCDOT)	1.2
Annual Truck Factor Growth Rate	0%
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95%
Overall Standard Deviation	0.45

Roadway Section	2003 ADT	Growth Rate	Truck Percentage	18 Kip ESALs	Structural Number
MC85 – 91st Ave. to 99th Ave	12,270	5.4%	14%	10,615,225	4.54
MC85 – 99th Ave to 103rd Ave	11,505	5.8%	9%	6,430,830	4.22
MC85 – 103rd Ave to 107th Ave	11,808	4.0%	7%	5,138,823	4.08
91st Avenue	4,985	5.8%	10%	3,975,346	3.93
99th Avenue	6,519	5.8%	18%	9,308,194	4.45
107th Avenue	4,985	5.8%	5%	2,011,273	3.55

In review of the structural numbers and design ESAL above for the roadway sections, and after considering the feasibility of multiple pavement section designs, it was apparent that the sections above could be grouped into two levels of pavement loading. In evaluation of the data presented previously, we propose that certain portions of the improvement area be considered within the same pavement loading level and be combined or averaged as follows for pavement section design:

Design No.	Roadway Section	Design ESAL	Design Structural Number
Design 1	MC85–91st Ave. to 99th Ave	9,500,000	4.46
	MC85–99th Ave to 103rd Ave		
	99th Avenue		
Design 2	MC85–103rd Ave to 107th Ave	5,000,000	4.07
	91st Avenue		
	107th Avenue		

Some consideration may be given to using Design 2 for any improvements to 99th Avenue south of the MC85 intersection since it is apparent from the MAG projections provided that traffic volumes south of MC85 are much less at approximately 4000 ADT in 2020. Certainly, ease of construction may be considered when making this decision.

4.3 PAVEMENT SECTION DESIGN

The subgrade soils along the MC85 alignment are considered to be poor quality soils for pavement support due to their high fines content, plasticity and moderately high expansion potential. Therefore, alternative pavement section designs have been provided to determine the most economic section combination or soil remediation option for achieving the structural numbers required.

In accordance with the AASHTO method for layered thickness design, and based on the above design parameters, pavement section alternatives for each of the pavement loading levels were determined as presented below. As requested by Maricopa County Department of Transportation, the upper portion of the asphalt concrete section required was replaced by a 1.5 inch section of asphalt rubber overlay using a replacement ratio of approximately 1.5 to 1, or a structural coefficient of 0.61. Structural coefficients of 0.42, 0.12, and 0.16 were utilized for asphalt concrete, aggregate base course, and lime stabilized soil subgrade, respectively. More detailed section thicknesses and material properties are available for review in the pavement analysis data sheets attached in Appendix C.

Alternative 1 – Full Depth Asphalt over Native Subgrade		
Pavement Section	**Design 1 (inches)** MC85 – 91st Ave to 103rd Ave, and Intersecting 99th Ave SN 4.46	**Design 2 (inches)** MC85 – 103rd Ave to 107th Ave, and Intersecting 91st and 107th Aves. SN 4.07
Asphalt Rubber Surface	1.5	1.5
Asphalt Concrete	8.5	7.5
Native Subgrade	--	--

Alternative 2 – AC and AB over Native Subgrade		
Pavement Section	**Design 1 (inches)** MC85 – 91st Ave to 103rd Ave, and Intersecting 99th Ave SN 4.46	**Design 2 (inches)** MC85 – 103rd Ave to 107th Ave, and Intersecting 91st and 107th Aves. SN 4.07
Asphalt Rubber Overlay	1.5	1.5
Asphalt Concrete	5	4.5
Aggregate Base	12	11
Native Subgrade	--	--

Alternative 3 – AC and AB over Lime Stabilized Subbase		
Pavement Section	**Design 1 (inches)** MC85 – 91st Ave to 103rd Ave, and Intersecting 99th Ave SN 4.46	**Design 2 (inches)** MC85 – 103rd Ave to 107th Ave, and Intersecting 91st and 107th Aves. SN 4.07
Asphalt Rubber Surface	1.5	1.5
Asphalt Concrete	5	4
Aggregate Base	4	4
Lime Stabilized Subbase	12	12

Alternative 4 – AC and AB over Imported Fill Subgrade*		
Pavement Section	**Design 1 (inches)** MC85 – 91st Ave to 103rd Ave, and Intersecting 99th Ave SN 3.5	**Design 2 (inches)** MC85 – 103rd Ave to 107th Ave, and Intersecting 91st and 107th Aves. SN 3.17
Asphalt Rubber Overlay	1.5	1.5
Asphalt Concrete	5	4.5
Aggregate Base	4	4
24" Imported Fill Subgrade*	24	24

*For the pavement sections presented above, the imported fill must meet the quality specifications presented in the Earthwork and Materials section of this report.

Alternative 5 – AC over Existing AB and Undisturbed Subgrade*		
Pavement Section	**Design 1 (inches)** MC85 – 91st Ave to 103rd Ave, and Intersecting 99th Ave SN 4.46	**Design 2 (inches)** MC85 – 103rd Ave to 107th Ave, and Intersecting 91st and 107th Aves. SN 4.07
Asphalt Rubber Overlay	1.5	1.5
Asphalt Concrete	5	4
Aggregate Base	4	4
Existing Aggregate Subbase*	11	11
Undisturbed Subgrade	--	--

*Existing aggregate srbbase section assumes that the in-place material meets or exceeds compaction requirements in its present state. In-place density testing should be performed to verify this condition.

If Alternative 5 is chosen for this project, construction of the two new outside lanes must be accomplished in a manner that will allow positive drainage beneath the pavement sections. Therefore, it is recommended that the aggregate base layer of the new outside lanes be at least as deep as the existing aggregate base layer that is left in place in Alternative 5.

A reduced structural coefficient of 0.10 was used in design to represent the existing aggregate base subbase. Alternative 5 assumes that there will be sufficient existing aggregate base in place after removal of asphalt pavement to allow for the minimum aggregate base section indicated above. The actual depths should be verified either in the final geotechnical report for this project or during construction, or both to ensure that the minimum section requirements are met. In areas where insufficient base exists, either pulverized asphalt concrete or additional aggregate base shall be added.

Structural coefficients of 0.42 and 0.12 represent high quality plant mix asphalt and Maricopa Association of Governments (MAG) quality aggregate base course, respectively. A structural coefficient of 0.12 was also used for both recycled or existing aggregate base and pulverized asphalt concrete used as base material.

The lime stabilized subbase structural coefficient of 0.16 assumes the addition of a minimum of 5% quicklime by weight to the native subgrade soils. Please be aware that this minimum amount may not be enough to limit the expansion potential of the native subgrade soils, especially if subgrade soils are mixed and stabilized in place. Therefore, a more precise determination of the required amount of lime and mixing guidelines should be determined by a lime-mix design provided in the final report or by the Contractor prior to placement. The actual amount of lime required to sufficiently limit the expansion of the native soils may prove to be costly and should be evaluated further.

The pavement section thickness represents values that have been adjusted to the nearest ½ inch for asphalt and the nearest inch for aggregate base and lime stabilized subbase. In determining the final sections, consideration was also given to practicality of paving operations, minimum MCDOT section thicknesses for the roadway classification, and the minimum and maximum compacted lift thicknesses of asphalt concrete allowed by MAG.

The 20-year pavement design life is based on the premise that normal maintenance of the pavement is performed. This may include crack sealing, slurry sealing, and/or chip sealing as deemed necessary by a pavement management plan.

4.4 OPINION OF COSTS

The five alternatives presented were evaluated based on their construction and material costs to estimate the most economic pavement section for each traffic loading level of this project. For the purposes of this preliminary report, only those items which differ based on the pavement section design chosen have been provided for cost analysis. Therefore, unavoidable costs such as removal of the existing pavement section and prime coat application have not been included in this analysis.

Roadway lengths associated with the two Design portions, along with the existing and new roadway widths, were used to determine the estimated section volumes. Unit prices from the Pavement Design Guide and the ADOT Construction Cost 1999 manual were used to develop the tables pertaining our opinions of cost are presented below:

Design 1 - Alternative 1 - Full Depth Asphalt Over Native Subgrade

Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	5,875	ton	$45.00	$264,375
Asphalt Concrete (3/4" Mix at 147 pcf)	8.5	33,290	ton	$30.00	$998,700
Tack Coat (0.1 gal/sq yd)	--	39	ton	$115.00	$4,485
Apply Tack Coat	--	30	hour	$110.00	$3,300
Removal of Existing AC and AB for Soil Prep	20	1,126,400	sq yd/in	$0.70	$788,480
Roadway Excavation*	12	25,227	cu yd	$2.00	$50,454
				Total Cost	$2,109,794

*Represents the depth of subgrade preparation below pavement sections

Design 2 - Alternative 1 - Full Depth Asphalt Over Native Subgrade

Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	1,958	ton	$45.00	$88,110
Asphalt Concrete (3/4" Mix at 147 pcf)	7.5	9,791	ton	$30.00	$293,730
Tack Coat (0.1 gal/sq yd)	--	39	ton	$115.00	$4,485
Apply Tack Coat	--	30	hour	$110.00	$3,300
Removal of Existing AC and AB for Soil Prep	20	375,467	sq yd/in	$0.70	$262,827
Roadway Excavation*	12	8,409	cu yd	$2.00	$16,818
				Total Cost	$669,270

*Represents the depth of subgrade preparation below pavement sections

Design 1 - Alternative 2 - AC and AB Over Native Subgrade					
Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	5,875	ton	$45.00	$264,375
Asphalt Concrete (3/4" Mix at 147 pcf)	5	19,582	ton	$30.00	$587,460
Tack Coat (0.1 gal/sq yd)	--	26	ton	$115.00	$2,990
Apply Tack Coat	--	20	hour	$110.00	$2,200
Aggregate Base (Class 2)	12	45,976	ton	$7.50	$344,817
Removal of Existing AC and AB for Soil Prep	20	1,126,400	sq yd/in	$0.70	$788,480
Pulverization of Existing AC	4	225,280	sq yd/in	$0.46	$103,629
Reduction of AB by using Recycled AC	4	15,325	Ton	-$7.50	-$114,939
Roadway Excavation*	12	25,227	cu yd	$2.00	$50,454
				Total Cost	$2,029,466

*Represents the depth of subgrade preparation below pavement sections

Design 2 - Alternative 2 - AC and AB Over Native Subgrade					
Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	1,958	ton	$45.00	$88,110
Asphalt Concrete (3/4" Mix at 147 pcf)	4.5	5,875	ton	$30.00	$176,250
Tack Coat (0.1 gal/sq yd)	--	26	ton	$115.00	$2,990
Apply Tack Coat	--	20	hour	$110.00	$2,200
Aggregate Base (Class 2)	11	14,048	ton	$7.50	$105,361
Removal of Existing AC and AB for Soil Prep	20	375,467	sq yd/in	$0.70	$262,827
Pulverization of Existing AC	4	75,093	sq yd/in	$0.46	$34,543
Reduction of AB by using Recycled AC	4	5,108	Ton	-$7.50	-$38,310
Roadway Excavation*	12	8409	cu yd	$2.00	$16,818
				Total Cost	$650,789

*Represents the depth of subgrade preparation below pavement sections

Design 1 - Alternative 3 - AC and AB Over Lime Stabilized Subgrade					
Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	5,875	ton	$45.00	$264,375
Asphalt Concrete (3/4" Mix at 147 pcf)	5	19,582	ton	$30.00	$587,460
Tack Coat (0.1 gal/sq yd)	--	26	ton	$115.00	$2,990
Apply Tack Coat	--	20	hour	$110.00	$2,200
Aggregate Base (Class 2)	4	15,325	ton	$7.50	$114,939
Removal of Existing AC and AB for Soil Prep	20	1,126,400	sq yd/in	$0.70	$788,480
Pulverization of Existing AC	4	225,280	sq yd/in	$0.46	$103,629
Reduction of AB by using Recycled AC	4	15,325	Ton	-$7.50	-$114,938
Roadway Excavation*	0	0	cu yd	$2.00	$0
5% Lime Stabilized Soil	12	908,160	sq yd/in	$0.39	$354,182
				Total Cost	$2,103,318

*Assumes that the native soil will be stabilized in place

Design 2 - Alternative 3 - AC and AB Over Lime Stabilized Subgrade					
Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	1,958	ton	$45.00	$88,110
Asphalt Concrete (3/4" Mix at 147 pcf)	4	5,222	ton	$30.00	$156,660
Tack Coat (0.1 gal/sq yd)	--	26	ton	$115.00	$2,990
Apply Tack Coat	--	20	hour	$110.00	$2,200
Aggregate Base (Class 2)	4	5,108	ton	$7.50	$38,313
Removal of Existing AC and AB for Soil Prep	20	375,467	sq yd/in	$0.70	$262,827
Pulverization of Existing AC	4	75,093	sq yd/in	$0.46	$34,543
Reduction of AB by using Recycled AC	4	5,108	Ton	-$7.50	-$38,310
Roadway Excavation*	0	0	cu yd	$2.00	$0
5% Lime Stabilized Soil	12	302,720	sq yd/in	$0.39	$118,061
				Total Cost	$665,394

*Assumes that the native soil will be stabilized in place

Design 1 - Alternative 4 - AC and AB Over Imported Fill Subgrade					
Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	5,875	ton	$45.00	$264,375
Asphalt Concrete (3/4" Mix at 147 pcf)	5	19,582	ton	$30.00	$587,460
Tack Coat (0.1 gal/sq yd)	--	26	ton	$115.00	$2,990
Apply Tack Coat	--	20	hour	$110.00	$2,200
Aggregate Base (Class 2)	4	15,325	ton	$7.50	$114,939
Removal of Existing AC and AB for Soil Prep	20	1,126,400	sq yd/in	$0.70	$788,480
Pulverization of Existing AC	4	225,280	sq yd/in	$0.46	$103,629
Reduction of AB by using Recycled AC	4	15,325	Ton	-$7.50	-$114,938
Roadway Excavation*	24	50,453	cu yd	$2.00	$100,907
Imported Fill Subgrade (Borrow)	24	50,453	cu yd	$2.75	$138,747
				Total Cost	$1,988,789

*Represents the depth of removal and disposal of native soils

Design 2 - Alternative 4 - AC and AB Over Imported Fill Subgrade					
Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	1,958	ton	$45.00	$88,110
Asphalt Concrete (3/4" Mix at 147 pcf)	4.5	5,875	ton	$30.00	$176,250
Tack Coat (0.1 gal/sq yd)	--	26	ton	$115.00	$2,990
Apply Tack Coat	--	20	hour	$110.00	$2,200
Aggregate Base (Class 2)	4	5,108	ton	$7.50	$38,313
Removal of Existing AC and AB for Soil Prep	20	375,467	sq yd/in	$0.70	$262,827
Pulverization of Existing AC	4	75,093	sq yd/in	$0.46	$34,543
Reduction of AB by using Recycled AC	4	5,108	Ton	-$7.50	-$38,310
Roadway Excavation*	24	16,818	cu yd	$2.00	$33,636
Imported Fill Subgrade (Borrow)	24	16,818	cu yd	$2.75	$46,249
				Total Cost	$646,808

*Represents the depth of removal and disposal of native soils

Design 1 - Alternative 5 - AC Over Existing AB					
Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	5,875	Ton	$45.00	$264,375
Asphalt Concrete (3/4" Mix at 147 pcf)	5	19,582	Ton	$30.00	$587,460
Tack Coat (0.1 gal/sq yd)	--	39	Ton	$115.00	$4,485
Apply Tack Coat	--	30	Hour	$110.00	$3,300
Aggregate Base (Class 2) Existing Lanes	4	11,405	Ton	$7.50	$85,536
Aggregate Base (Class 2) New Outside Lanes	15	14,702	Ton	$7.50	$110,261
Existing Aggregate Subbase	11	42,144	Ton	$0.00	$0
Removal of Existing AC	6	337,920	sq yd/in	$0.70	$236,544
Roadway Excavation	0	0	cu yd	$2.00	$0
				Total Cost	$1,291,961

*Represents the depth of subgrade preparation below pavement sections

Design 2 - Alternative 5 - AC Over Existing AB					
Work Item	Section Thickness (in)	Quantity	Unit of Measure	Unit Price ($)	Cost
Asphalt Rubber (138 pcf)	1.5	1,958	Ton	$45.00	$88,110
Asphalt Concrete (3/4" Mix at 147 pcf)	4	5,222	Ton	$30.00	$156,660
Tack Coat (0.1 gal/sq yd)	--	26	Ton	$115.00	$2,990
Apply Tack Coat	--	20	Hour	$110.00	$2,200
Aggregate Base (Class 2) Existing Lanes	4	3,802	Ton	$7.50	$28,512
Aggregate Base (Class 2) New Outside Lanes	15	4,901	Ton	$7.50	$36,754
Existing Aggregate Subbase	12	15,325	Ton	$0.00	$0
Removal of Existing AC	6	151,360	sq yd/in	$0.70	$105,952
Roadway Excavation*	0	0	cu yd	$2.00	$0
				Total Cost	$421,178

*Represents the depth of subgrade preparation below pavement sections

Items required for pavement construction which have not been included here should be considered either in the final geotechnical evaluation or prior to selection of an alternative. The construction items and unit rates presented in the opinion of cost tables above represent anticipated procedures and estimated unit costs. The following assumptions have been made in preparation of the opinion of costs:

- The unit cost for Roadway Excavation includes both scarification or removal of the native subgrade, then recompaction to the required density and moisture;
- The unit cost for lime stabilization assumes that the subgrade will be stabilized in place;
- The maximum amount of recycled asphalt pavement materials available results in a section equaling approximately 4 inches across the length of MC 85.

If any of the work items are incomplete or the associated unit rates are not accurate, we should be notified immediately so that appropriate changes can be made prior to final design.

Based on the opinion of cost analysis above which does not consider the associated pavement management/life-cycle costs or the cost of changing the alignment grade, Alternative 5 – Asphalt Concrete over Existing Aggregate Base represents the most economic alternative for construction of both portions of the 2 mile section of MC85.

4.5 DRAINAGE

The proposed pavement should be constructed in a way that will prevent ponding of water on or directly adjoining paved surfaces. Ponding of water will decrease the expected life of the proposed pavement potentially causing subgrade expansion, cracking, and deterioration. In accordance with the MCDOT Roadway Design Manual, the proposed roadway should be constructed with a cross slope of 0.02 foot per foot downward from the high centerline to allow for proper drainage.

4.6 CORROSIVITY

We understand that corrugated metal pipe drainage features may be utilized to manage water flow near the roadway. For suitability of existing soils around the drainage features, pH and minimum resistivity testing was performed on representative samples along the alignment. The results are presented in Table 1 Summary of Laboratory Testing. The pH and resistivity of the surface soils tested indicate that the soil's potential for attack ranges from moderately corrosive to corrosive on corrugated metal pipe.

5.0 EARTHWORK AND MATERIALS

5.1 EARTHWORK RECOMMENDATIONS

The subject portion of MC85 and the intersecting roadways should be stripped of existing pavement sections, vegetation, structures, and any other deleterious materials. The removal of such items should be performed in a manner that will result in exposed surfaces free of mounds and depressions. If removal of these items results in the shallow excavation of site soils below new pavement areas, the soils should be replaced with approved fill using proper compaction as indicated below.

Exposed subgrade below pavement sections (including lime stabilized soil), channel profiles, or fill areas should be removed and recompacted to a minimum depth of 12 inches. Fill material should be uniformly placed in uncompacted lifts not exceeding 8 inches. Materials shall be compacted to the following densities and moistures:

	ASTM D698	Moisture Spec.
Native Site Soils		
Below Pavement Areas	95% Min	Optimum to +3%
Below Site Concrete (not within upper 2 feet)	90% Max	Optimum to +3%
Imported Fill Material		
Below Pavement Areas	95% Min	+/- 2%
Below Site Concrete	95% Min	+/- 2%
Existing Aggregate Base Subbase	95% Min	+/- 2%
Aggregate Base Course	100% Min	+/- 2%
Landscape Areas	90% Min	+/- 2%

Based on the soil conditions encountered, it is anticipated that conventional excavation equipment would be suitable for shallow utility excavations. For shallow utility excavations, site clay and silt soils can be considered Type B soils when applying the OSHA regulations. This corresponds to a maximum recommended slope inclination of 1:1 (horizontal to vertical) for depths up to 4 feet below site grades. All other site soils shall be considered Type C soils corresponding to a maximum slope inclination of 1.5:1.

5.2 MATERIALS

Clean on-site native soils, or approved imported soil, may be used as fill material below pavement areas in accordance with the pavement section alternative chosen. Site soil that is tested to be non-plastic or approved imported soil, may be used as engineered fill material below site concrete. All other site soils should not be used within the upper 2 feet below site concrete due to the expansion potential of the native soils.

Imported fill to be used as subgrade soils within the upper 24 inches below pavement sections shall fall within the acceptable range presented on the Construction Control R-Value Chart attached. Imported fill soils to be placed as subgrade or engineered fill should also conform to the following criteria:

Particle Size (ASTM C136)	Percent Finer by Weight
6"	100
2"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	50 or less*
Expansion Potential	1.5% or less**

*Or fall within the acceptable range on the Construction Control R-value Chart for pavement subgrade.
**When remolded to 95% of ASTM D698 and 3 percent below optimum, and tested under a 100 psf surcharge while inundated with water.

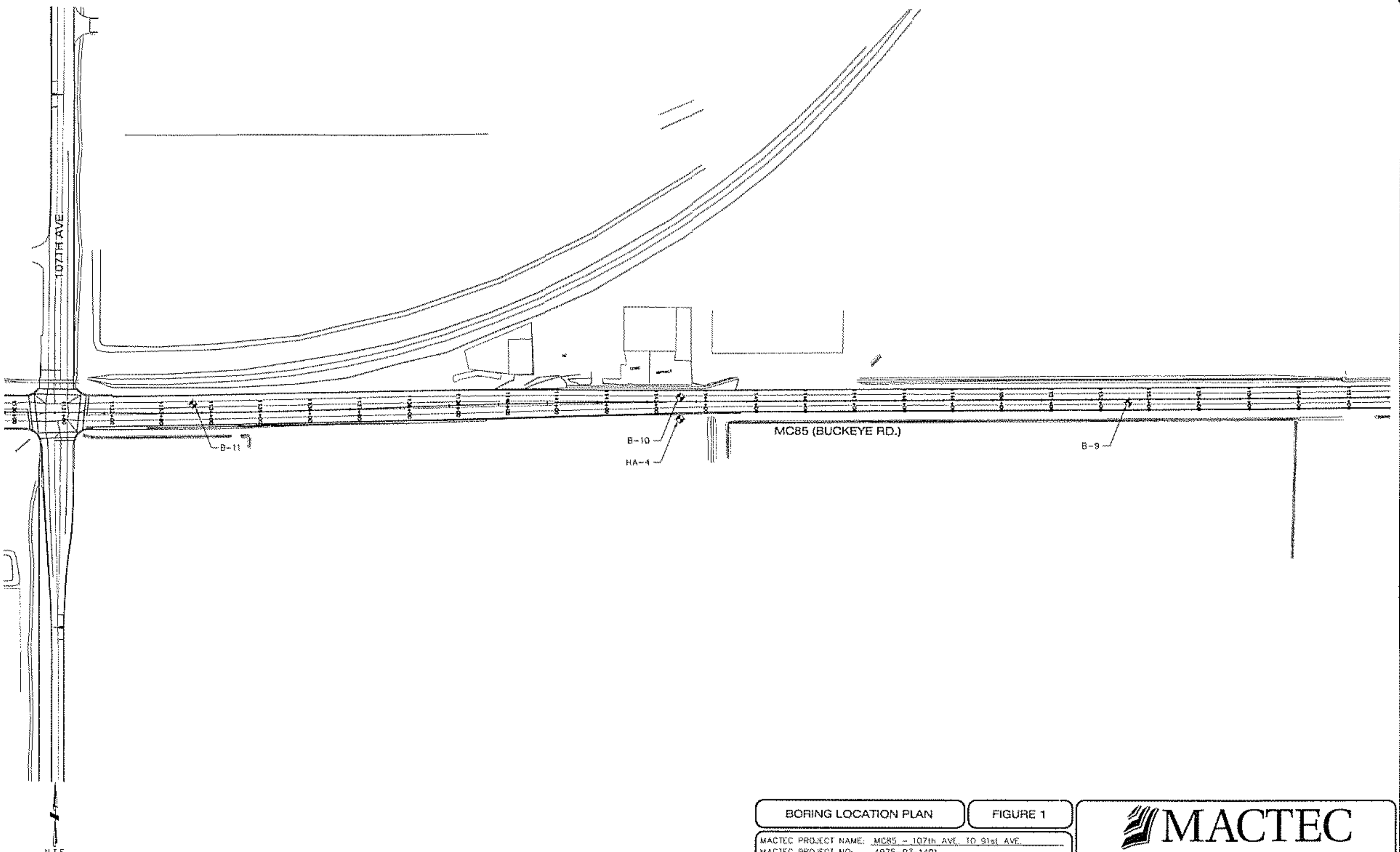
Asphalt rubber overlay should be open graded rubberized asphalt conforming to Section 325 of the MAG Specifications. Structural asphalt concrete should consist of dense-graded, plant-mix asphalt concrete. The asphalt concrete should conform to MAG specifications for Asphalt Concrete Type A19mm for heavy traffic. Imported base course materials should conform to MAG specifications.

6.0 BASIS FOR RECOMMENDATIONS

The recommendations provided in this report are preliminary and are based on our understanding of the project described herein and on our interpretation of the data collected during the subsurface exploration. These preliminary recommendations apply to the specific project discussed in this report. A final geotechnical evaluation report and pavement design must be completed prior to the start of final design or construction operations. As the project progresses, any changes in project scope, traffic or site conditions, or site grades should be clearly identified in the final pavement design report.

Regardless of the thoroughness of the geotechnical exploration, there is always a possibility that conditions between the test borings will be different than those encountered in the test borings, or that soil conditions may change subsequent to our investigation. Therefore, a final subsurface evaluation must be performed and an experienced geotechnical engineer or qualified technical representative should monitor the earthwork and subgrade construction to confirm that the soil conditions encountered in the field conform to those described in this report.

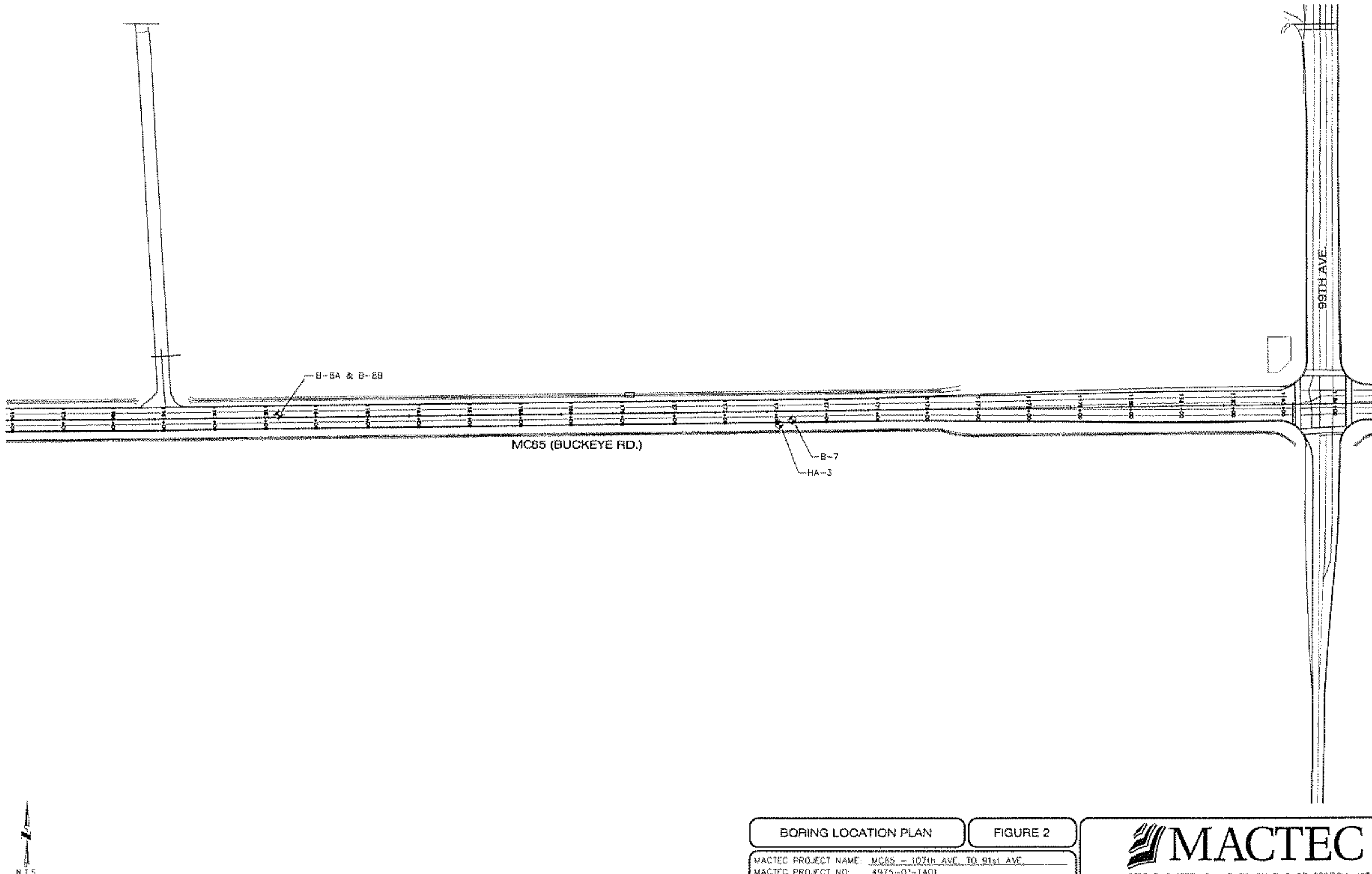
FIGURES



BORING LOCATION PLAN	FIGURE 1

MACTEC PROJECT NAME: MC85 – 107th AVE. TO 91st AVE.
MACTEC PROJECT NO: 4975-03-1401
DATE 05/29/03 E-FILE: DRAWING 4
DRAWN BY. BWT CHECKED BY.

MACTEC
MACTEC ENGINEERING AND CONSULTING OF GEORGIA, INC
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX. (602) 437-3675



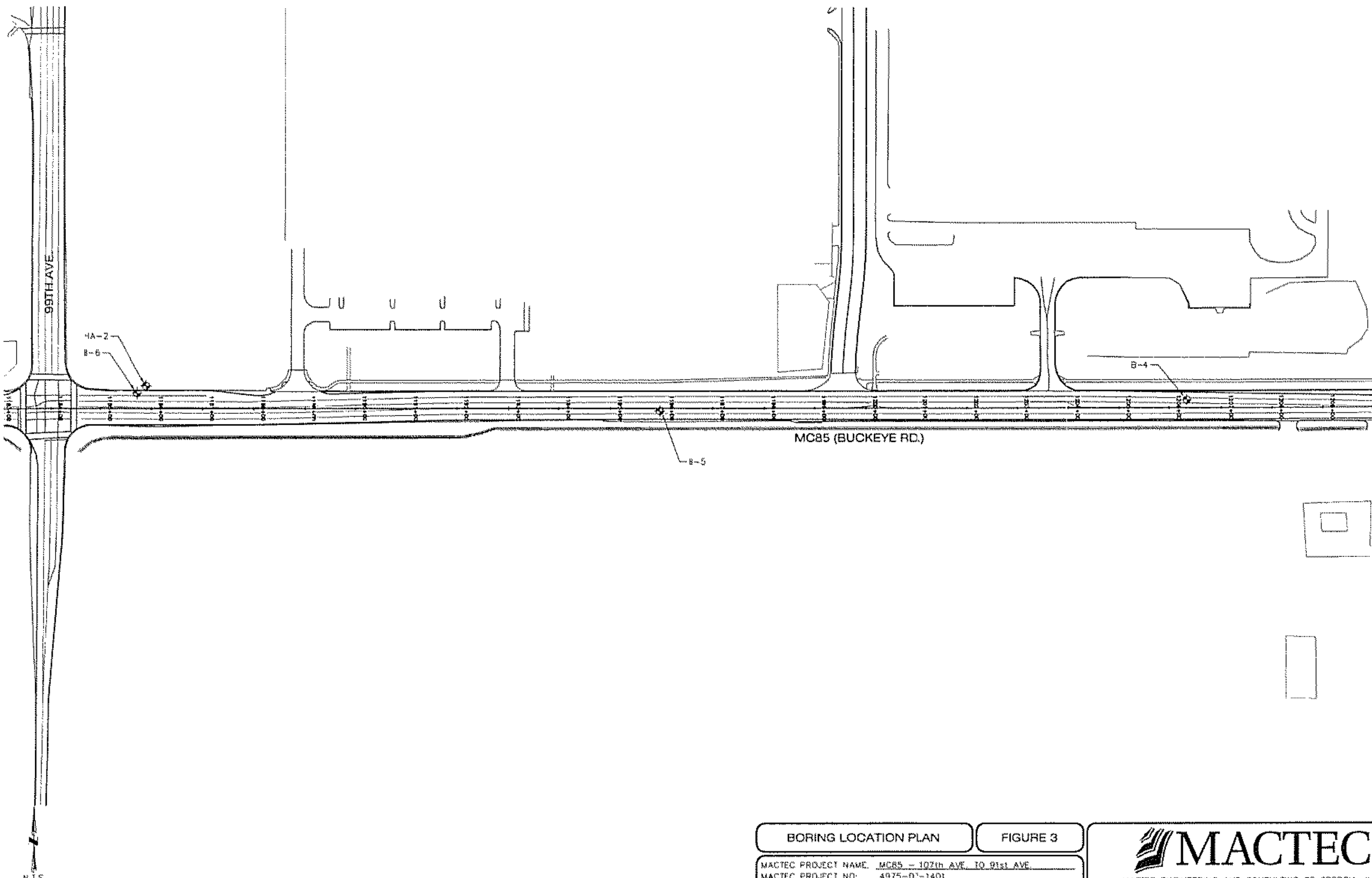
BORING LOCATION PLAN

FIGURE 2

MACTEC PROJECT NAME: MC85 - 107th AVE. TO 91st AVE.
MACTEC PROJECT NO: 4975-03-1401
DATE: 05/29/03 E-FILE: DRAWING 3
DRAWN BY: BWT CHECKED BY:

MACTEC

MACTEC ENGINEERING AND CONSULTING OF GEORGIA, INC.
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX. (602) 437-3675



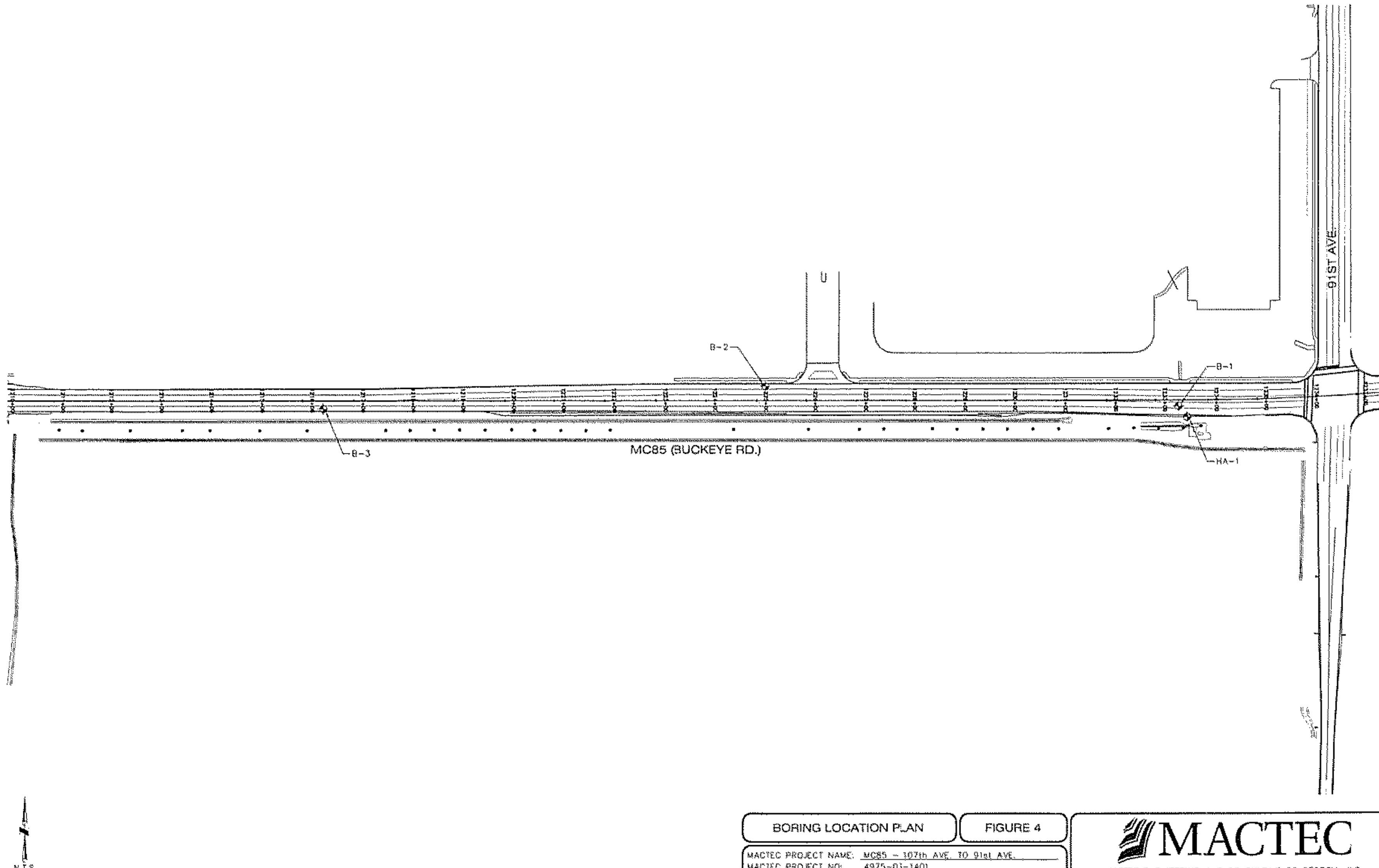
BORING LOCATION PLAN

FIGURE 3

MACTEC PROJECT NAME: MC85 - 107th AVE. TO 91st AVE.
MACTEC PROJECT NO: 4975-03-1401
DATE: 05/29/03 E-FILE: DRAWING 2
DRAWN BY: BWT CHECKED BY:

MACTEC

MACTEC ENGINEERING AND CONSULTING OF GEORGIA, INC.
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX: (602) 437-3675



BORING LOCATION PLAN

FIGURE 4

MACTEC PROJECT NAME:	MC85 – 107th AVE. TO 91st AVE.
MACTEC PROJECT NO:	4975-03-1401
DATE: 05/29/03	E-FILE: DRAWING 1
DRAWN BY: BWT	CHECKED BY:

MACTEC

MACTEC ENGINEERING AND CONSULTING OF GEORGIA, INC.
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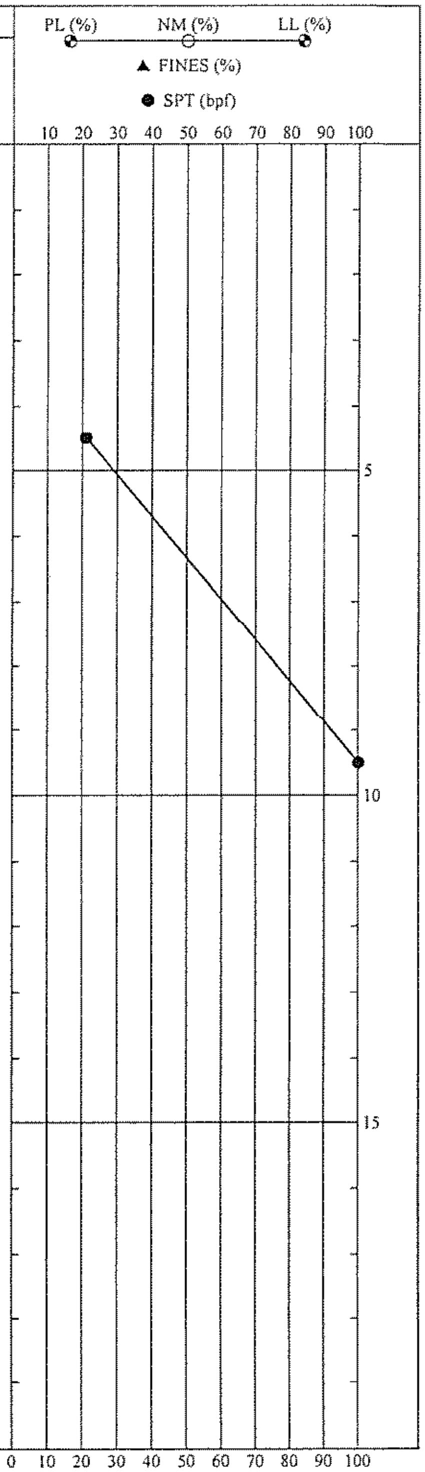
PHONE: (602) 437-0250 FAX. (602) 437-3675

APPENDICES

APPENDIX A

SOIL TEST BORING RECORD

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Asphalt: 3" +/- thickness (includes 1" overlay visible at pavement edge)					
	Aggregate base course - (21" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.					
5				UD		18-9-12 (N = 21)
	Light cementation visible in soil sample.			UD		17-33-50/5"
10						
15	Total depth = 9.9 feet below ground surface.					
	No ground water encountered during drilling.					
	Percolation test performed in borehole after auger removal.					
	Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.					
20						



DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

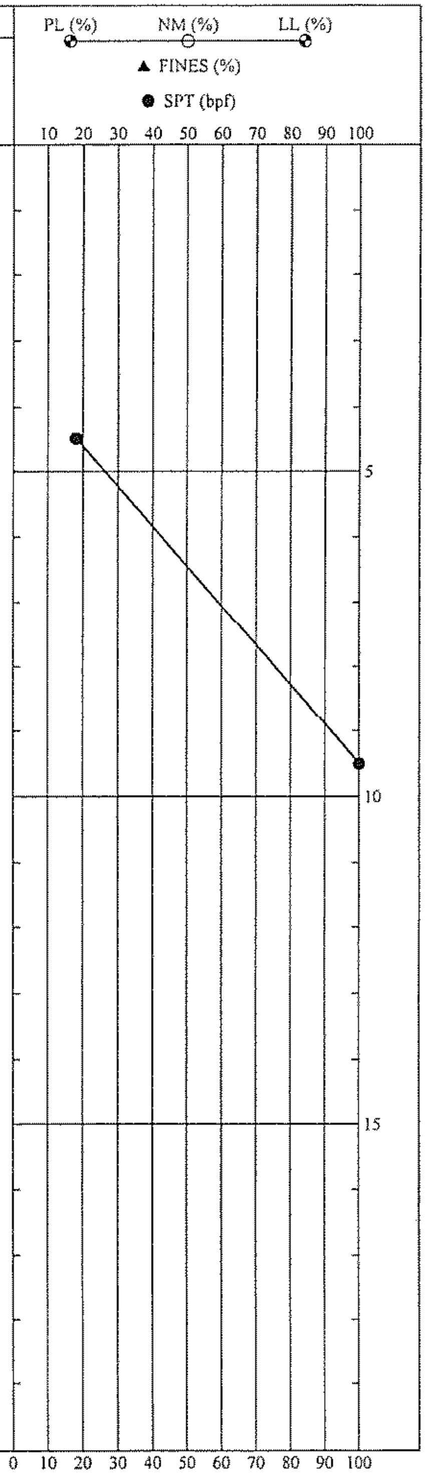
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-1
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Asphalt: 5" +/- thickness				
	Aggregate base course - (25" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.				
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.		UD		6-8-10 (N = 18)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).				
			UD		29-40-50/5"
10					
15	Total depth = 9.9 feet below ground surface.				
	No ground water encountered during drilling.				
	Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.				
20					



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW_GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

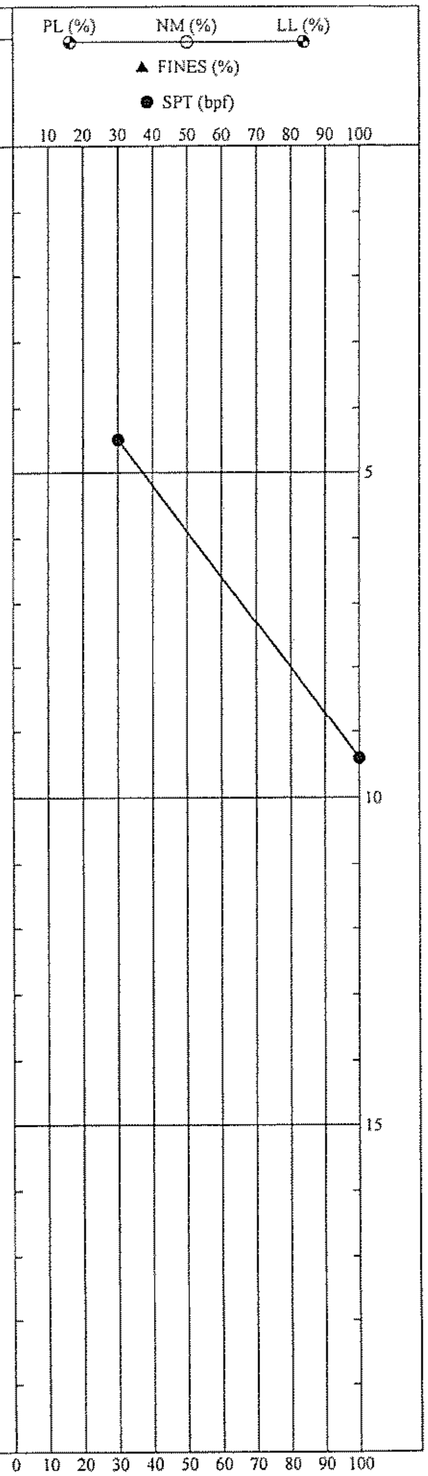
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-2
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
0	Asphalt: 5" +/- thickness					
	Aggregate base course - (25" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.					
				UD		15-14-16 (N = 30)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).					
				UD		29-50/5"
10						
15	Total depth = 9.4 feet below ground surface. No ground water encountered during drilling. Percolation test performed in borehole after auger removal. Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.					
20						



SOIL TEST BORING 3-1101 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

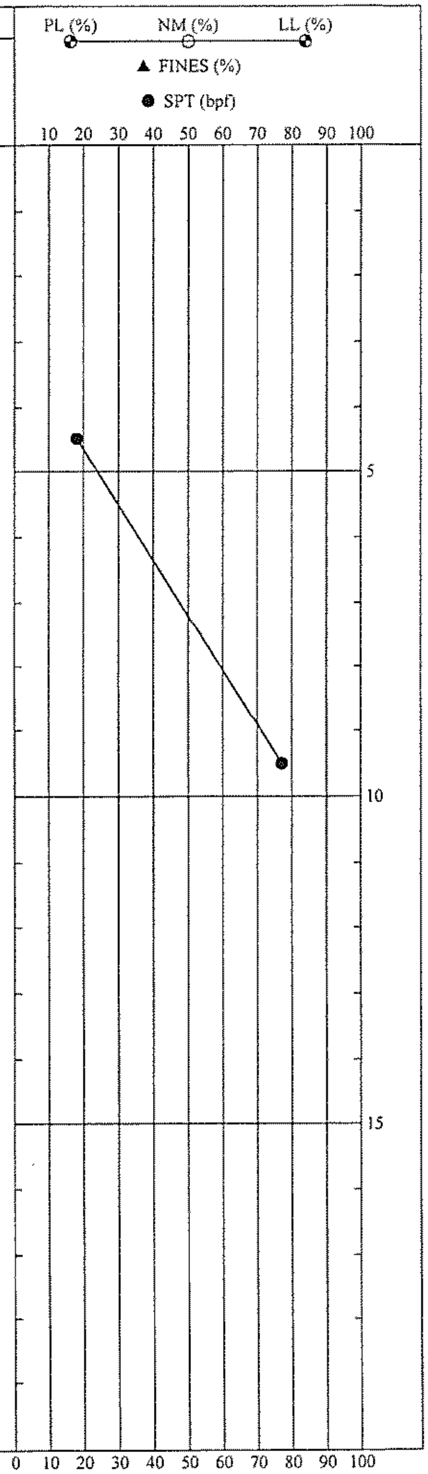
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-3
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
0	Asphalt: 7" +/- thickness					
	Aggregate base course - (11" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.					
				UD		8-7-11 (N = 18)
5	Light cementation visible in soil sample and cuttings (4' - 8' +/-).					
	Brown, clayey, fine to coarse SAND (SC). Damp. Low plasticity. Light to moderate cementation.			UD		20-27-50 (N = 77)
10						
15	Total depth = 10 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.					
20						



DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

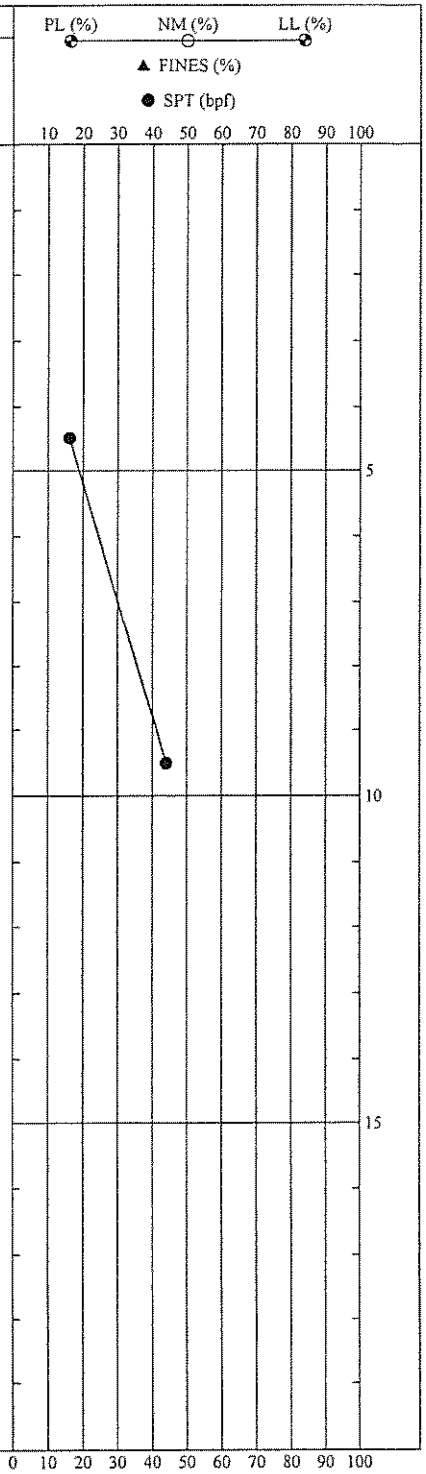
SOIL TEST BORING RECORD

BORING NO.: B-4
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01 **PAGE 1 OF 1**

MACTEC

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Asphalt: 5" +/- thickness					
	Aggregate base course - (25" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface.					
	Approximate 6" +/- of highly cemented material. Hard drilling and audible auger contact with subsurface material during auger advancement. Trace of grey-colored powder in cuttings.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			UD		8-8-8 (N = 16)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).					
				UD		20-22-22 (N = 44)
10						
15	Total depth = 10 feet below ground surface.					
	No ground water encountered during drilling.					
	Percolation test performed in borehole after auger removal.					
	Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.					
20						



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW_GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

SOIL TEST BORING RECORD

BORING NO.:	B-5
PROJECT:	Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:	
DRILLED:	March 13, 2003
PROJECT NO.:	4975-03-1401.01

PAGE 1 OF 1

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.)	IDENT	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Asphalt: 3" +/- thickness		
	Aggregate base course - (12" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.		
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.		
		UD	11-11-15 (N = 26)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-). Varying silt and fine sand content observed in soil sample and cuttings.		
		UD	16-34-50/5"
10			
15	Total depth = 9.9 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.		
20			

Chart legend: PL (%) NM (%) LL (%); ▲ FINES (%); ● SPT (bpf); scale 0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

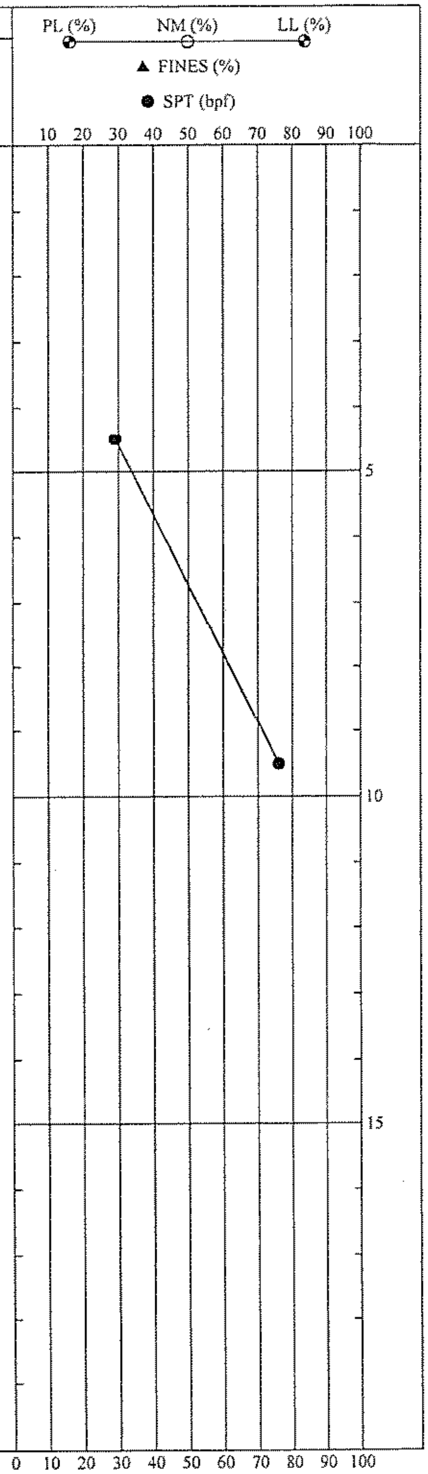
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-6
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Asphalt: 5" +/- thickness (includes 1" overlay visible at pavement edge)					
	Aggregate base course - (12" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.					
				UD		14-14-15 (N = 29)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).					
	Slight increase in fine sand content observed in soil sample.			UD		19-36-40 (N = 76)
10						
15	Total depth = 10 feet below ground surface. No ground water encountered during drilling. Percolation test performed in borehole after auger removal. Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.					
20						



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE - 107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-7
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Asphalt: 5" +/- thickness (includes 1" overlay visible at pavement edge) Aggregate base course - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth. Approximate 12" +/- of potential concrete or highly cemented material. Audible auger contact with solid surface during auger advancement. Grey-colored powder in cuttings. Boring terminated due to auger refusal						
5							5
10							10
15	Total depth = 1.9 feet below ground surface. Auger refusal on subsurface concrete or cemented material. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.						15
20							0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-8A
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Asphalt: 5" +/- thickness (includes 1" overlay visible at pavement edge)								
	Aggregate base course - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.								
	Approximate 12" +/- of potential concrete or highly cemented material. Audible auger contact with solid surface during auger advancement. Grey-colored powder in cuttings. Boring terminated due to auger refusal.								
5									5
10									10
15	Total depth = 1.9 feet below ground surface. Auger refusal on subsurface concrete or cemented material. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.								15
20									0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-8B
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
0	Asphalt: 4" +/- thickness (includes 1" overlay visible at pavement edge)					
	Aggregate base course - (6" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface.					
	Approximate 12" of highly cemented material. Hard drilling and audible auger contact with subsurface material during auger advancement. Trace of grey-colored powder in cuttings.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.					
				UD		8-10-15 (N = 25)
5	Light cementation visible in soil sample and cuttings (4' - 9' +/-).					
	Light brown color. Slight increase in fine sand content observed in soil sample.			UD		10-22-34 (N = 56)
10						
15	Total depth = 10 feet below ground surface. No ground water encountered during drilling. Percolation test performed in borehole after auger removal. Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.					
20						

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100
0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: CME-75
METHOD: hollow stem auger
HOLE DIA.: 8" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

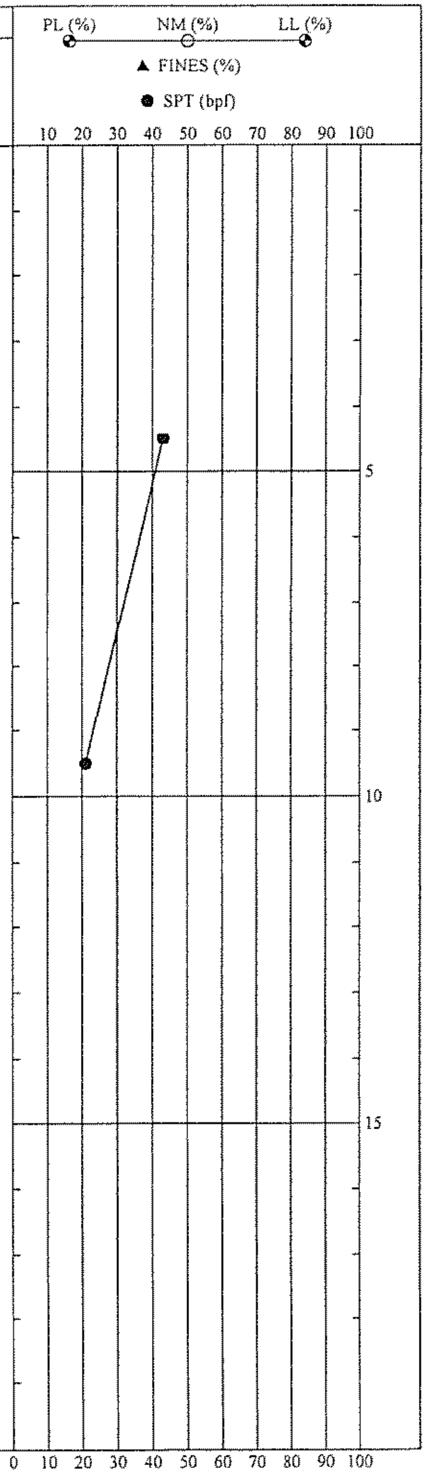
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-9
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Asphalt: 6" +/- thickness					
	Aggregate base course - (12" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.					
				UD		10-20-23 (N = 43)
5	Light cementation visible in soil sample and cuttings (4' - 8' +/-).					
	Brown, silty fine SAND (SM). Moist. Low to no plasticity.			UD		4-8-13 (N = 21)
10						
15	Total depth = 10 feet below ground surface. No ground water encountered during drilling. Percolation test performed in borehole after auger removal. Borehole backfilled with soil cuttings after test. Borehole capped with asphalt cold patch.					
20						



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE - 107AVE AND BUCKEYE.GPJ LAW_GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

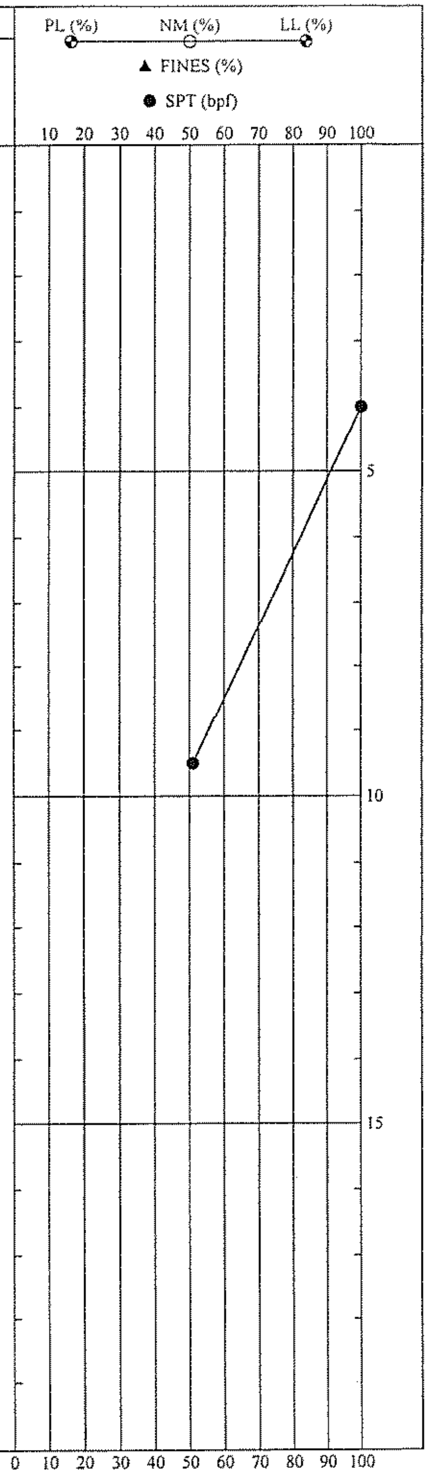
SOIL TEST BORING RECORD

BORING NO.: B-10
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

PAGE 1 OF 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Asphalt: 5" +/- thickness					
	Aggregate base course - (19" +/- thickness) - gravelly sand, little fine-grained soil at asphalt interface. Slight increase in fine-grained soil with depth.					
	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			UD		32-50/0"
	Approximate 18" of highly cemented material. Hard drilling and audible auger contact with subsurface material during auger advancement. Gravel in sampler, but no obvious cement residue observed on gravel.					
5	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity. Light cementation.			UD		14-25-26 (N = 51)
10						
15	Total depth = 10 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling. Borehole capped with asphalt cold patch.					
20						



SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE - 107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	CME-75
METHOD:	hollow stem auger
HOLE DIA.:	8" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). UD=Undisturbed sample collected by driving 2.5"-diameter ring sampler using 140-lb hammer free-falling 30" (ASTM D 1586).

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: B-11
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 13, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			BK			
5							5
10							10
15	Soil boring advanced at a location adjacent to road pavement. Subgrade soil exposed prior to hand auger advancement. Total depth = 3 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling.						15
20							0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	Hand Auger
METHOD:	Manual
HOLE DIA.:	4" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). BK=Disturbed bulk sample collected from hand auger cuttings.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: HA-1
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 20, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			BK			
5							5
10							10
15	Soil boring advanced at a location adjacent to road pavement. Subgrade soil exposed prior to hand auger advancement. Total depth = 3 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling.						15
20							0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW_GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	Hand Auger
METHOD:	Manual
HOLE DIA.:	4" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). BK=Disturbed bulk sample collected from hand auger cuttings.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: HA-2
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 20, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"	PL (%) / NM (%) / LL (%); ▲ FINES (%); ● SPT (bpf)
0	Brown, silty <u>CLAY (CL)</u> little fine sand. Moist. Low to medium plasticity.			BK					
5									
10									
15	Soil boring advanced at a location adjacent to road pavement. Subgrade soil exposed prior to hand auger advancement. Total depth = 3 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling.								
20									

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER:	EDI
EQUIPMENT:	Hand Auger
METHOD:	Manual
HOLE DIA.:	4" diam.
REMARKS:	Soil classification per Unified Soil Classification System (USCS). BK=Disturbed bulk sample collected from hand auger cuttings.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: HA-3
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 20, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N COUNT 1st 6"	2nd 6"	3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf)
0	Brown, silty CLAY (CL) little fine sand. Moist. Low to medium plasticity.			BK					
5									
10									
15	Soil boring advanced at a location adjacent to road pavement. Subgrade soil exposed prior to hand auger advancement. Total depth = 3 feet below ground surface. No ground water encountered during drilling. Borehole backfilled with soil cuttings after sampling.								
20									

Scale: 0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING 3-1401 MCDOT 85 - 91AVE -107AVE AND BUCKEYE.GPJ LAW GIBB.GDT 4/23/03

DRILLER: EDI
EQUIPMENT: Hand Auger
METHOD: Manual
HOLE DIA.: 4" diam.
REMARKS: Soil classification per Unified Soil Classification System (USCS). BK=Disturbed bulk sample collected from hand auger cuttings.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: HA-4
PROJECT: Arizona 85 (Buckeye Rd.), 91st to 107th Ave.
LOCATION:
DRILLED: March 20, 2003
PROJECT NO.: 4975-03-1401.01

MACTEC

APPENDIX B

SUMMARY OF LABORATORY TESTING

TABLE 1
MC85 - 107th Ave to 91st Ave
MACTEC Project No. 4975-03-1401

Boring No.	Sample Depth (ft)	MACTEC Lab No.	USCS*	Sieve Analysis (% Passing) 3/4"	No. 4	No. 16	No. 40	No. 100	No. 200	Liquid Limit	Plasticity Index	Actual/ Laboratory Tested R-values (at 300 psi)	Correlated R-values	Notes
1	4-5	30931	CL	100	100	100	69	62	53.8	30	16		24	
2	4-5	30934	CL	100	100	100	98	93	88.0	40	20		16	
3	4-5	30937	CL	100	100	100	91	71	57.4	46	27		16	
4	4-5	30940	CL	100	100	100	98	96	93.0	47	22		15	
5	4-5	30943	CL	100	100	99	94	85	75.9	32	16		20	
6	4-5	30946	CL	100	100	99	95	85	76.9	49	29		13	
7	4-5	30949	CL	100	99	98	94	86	77.6	39	24		15	
9	4-5	30951	CL	100	100	99	94	86	79.2	48	30		13	
10	4-5	30954	CL	100	100	98	92	78	68.9	37	23		17	
HA1	0-3	30992	CL	100	95	94	91	83	72.0	36	19	7	19	
HA2	0-3	30993	CL	95	83	78	70	61	55.2	37	19	9	21	
HA3	0-3	30994	CL	96	95	93	88	80	72.4	36	19	7	18	
HA4	0-3	30995	CL	100	98	96	88	70	61.1	30	15	19	24	
												Actual	Correlated	
											Total Number of Values:	4	13	
											Average R-value:	11	18	
											Standard Deviation:	5.7	3.6	
											Adjusted Average R-Value:	11	18	
											SVF=	1.0		
											Rmean=	17		
											M_R=	10,369		

HA indicates these bulk samples were obtained using a hand auger.
*Unified Soil Classification System
1. Minus #200 wash only
2. Visual Classification

SUMMARY OF LABORATORY TESTING

TABLE 2

MC85 - 107th Ave to 91st Ave

MACTEC Project No. 4975-03-1401

Boring No.	Sample Depth (ft)	MACTEC Lab No.	USCS*	Remolded Moisture Content (%)	Remolded Density (pcf)	Moisture-Density Relationship Opt. Moist. (%)	Moisture-Density Relationship Max. Density (pcf)	Expansion (%)	Sulfur Content (ppm)	Chloride Content (ppm)	Minimum Resistivity (ohm-cm)	pH	Notes
3	4-5	30937	CL	12.6	106			10.0					2
HA1	0-3	30992	CL								1470	8.4	
HA3	0-3	30994	CL	12.0	107			5.4			930	8.0	1,2

HA indicates these bulk samples were obtained using a hand auger.

*Unified Soil Classification System

1. Ariz Test Methods 733 and 736.
2. Remolded at approximately 95% of ASTM D698A and 3% below optimum and loaded with a 100 psf surcharge.

SUMMARY OF LABORATORY TESTING

TABLE 3

MC85 - 107th Ave to 91st Ave

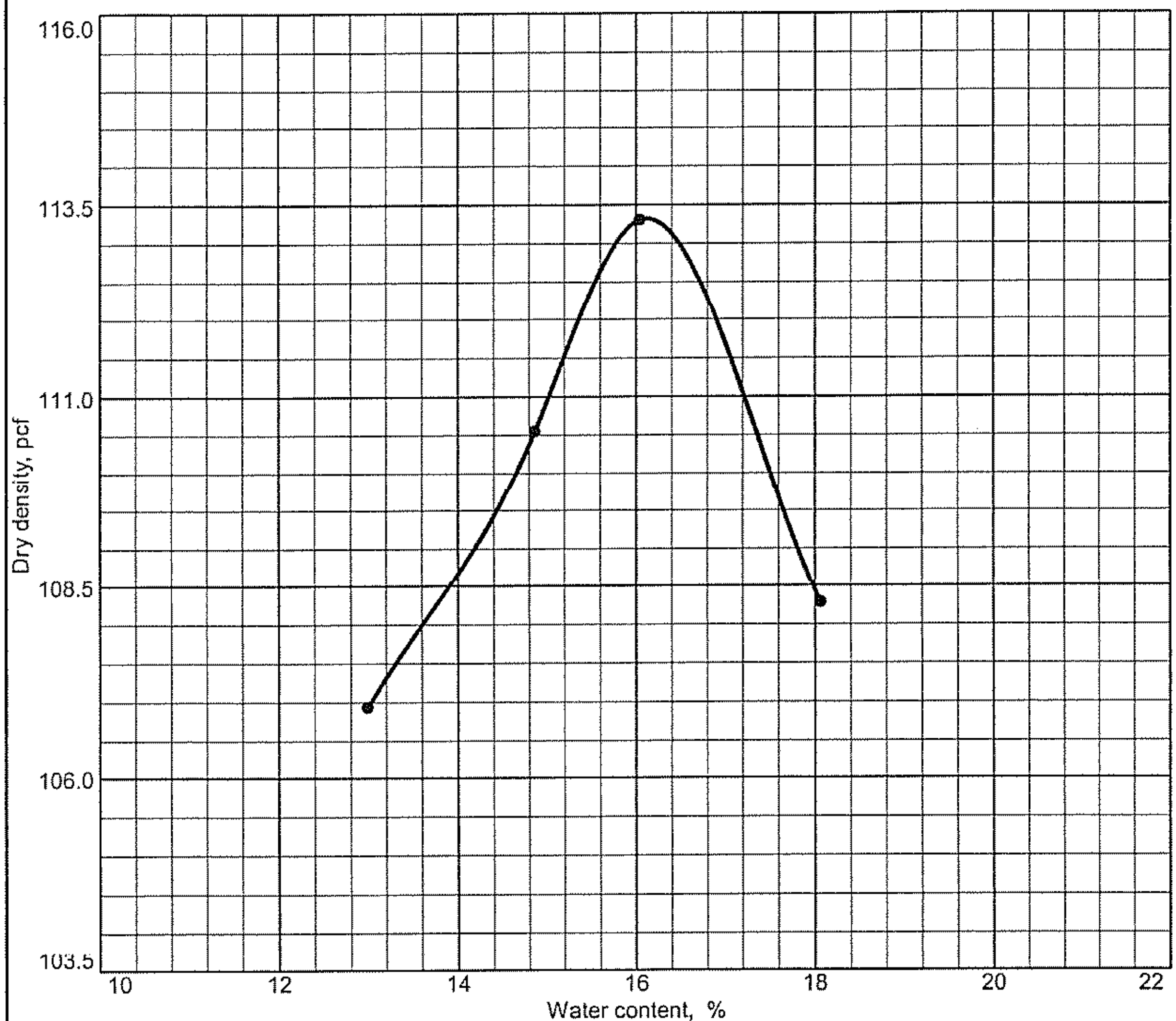
MACTEC Project No. 4975-03-1401

Boring No.	Sample Depth (ft)	MACTEC Lab No.	USCS*	In-situ Moisture Content (%)	In-situ Density (pcf)	Notes
1	4-5	30931	CL	20.1	102.7	
2	4-5	30934	CL	20.7	104.4	
2	9-10	30935	CL	17.1	113.2	2
3	4-5	30937	CL	13.6	122.4	
4	4-5	30940	CL	28.0	94.9	
4	9-10	30941	SC	10.3	123	2
5	4-5	30943	CL	14.3	112.3	
5	9-10	30944	CL	16.1	113.3	2
6	4-5	30946	CL	17.3	107.5	
6	9-10	30947	CL	14.9	117.6	2
7	9-10	30950	CL	16.4	118.5	2
9	4-5	30951	CL	16.0	111	
9	9-10	30952	CL	16.8	115	2
10	4-5	30954	CL	11.2	123.1	
10	9-10	30955	SM	16.3	115.8	2
11	9-10	30958	CL	12.1	125	2

*Unified Soil Classification System

1. Minus #200 wash only
2. Visual Classification

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 113.3 pcf Optimum moisture = 16.1 %	Native HA-1

Project No. 03-1401.01 **Client:** Maricopa County Department of Transportation

Project: MC-85 107th Ave to 91st Ave

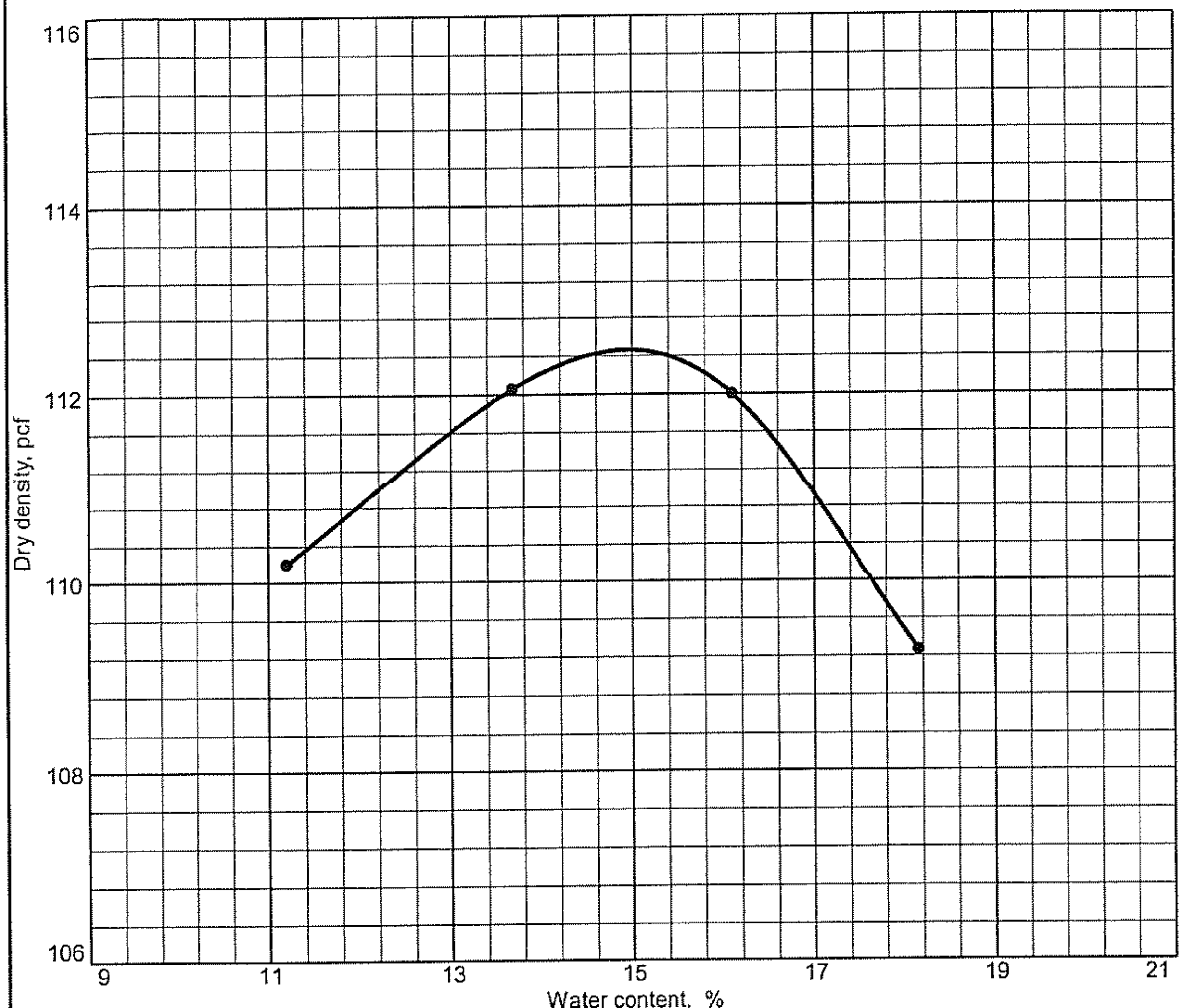
● **Source:** Native **Sample No.:** 30992

Remarks:

Sample Date: 3/25/03

Plate

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 112.5 pcf Optimum moisture = 15.0 %	Native HA-3

Project No. 03-1401.01 **Client:** Maricopa County Department of Transportation
Project: MC-85 107th Ave to 91st Ave

● **Source:** Native **Sample No.:** 30994

Remarks:
Sample Date: 3/25/03

06

Plate

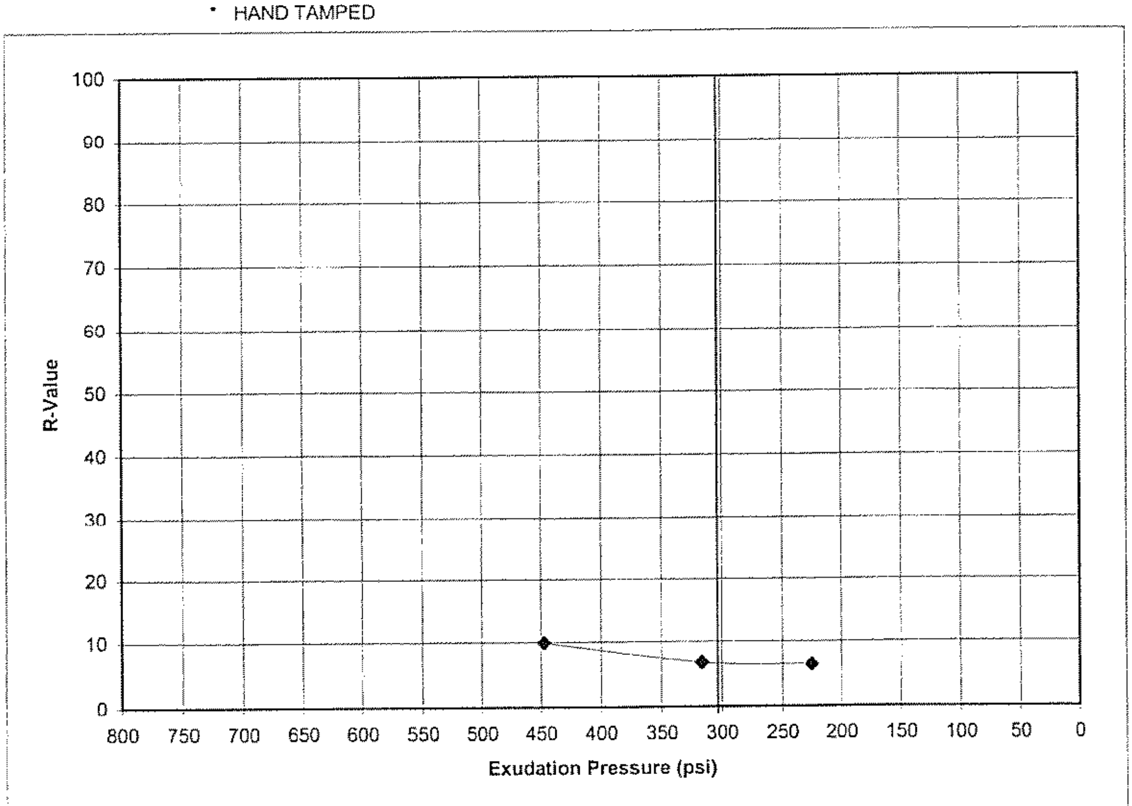
amec

PROJECT:	03-1401	JOB NO:	2-119-000224
LOCATION:	BUCKEYE ROAD	WORK ORDER NO:	6
MATERIAL:	NATIVE	LAB NO:	7
SAMPLE SOURCE:	30992	DATE SAMPLED:	03/27/03

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	A	B	C
Moisture Content	21.3%	19.5%	17.7%
Compaction Pressure (psi)	*	*	75
Specimen Height (inches)	2.58	2.44	2.40
Dry Density (pcf)	103.5	107.2	110.5
Horiz. Pres. @ 1000lbs (psi)	68.0	64.0	58.0
Horiz. Pres. @ 2000lbs (psi)	140.0	140.0	133.0
Displacement	5.63	4.62	4.16
Expansion Pressure (psi)	0.0	0.3	0.7
Exudation Pressure (psi)	225	316	447
R Value	6	7	10

* HAND TAMPED



R Value at 300 PSI = 7

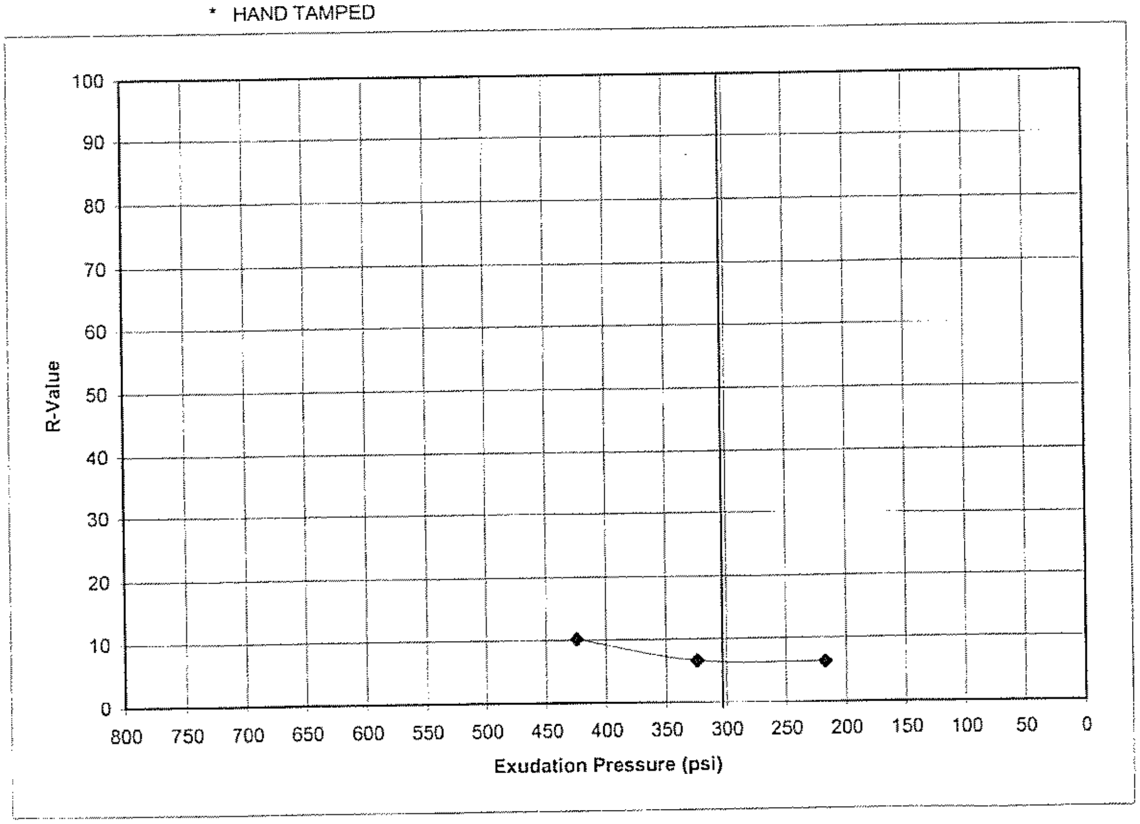
REVIEWED BY

PROJECT:	03-1401	JOB NO:	2-119-000224
LOCATION:	BUCKEYE ROAD	WORK ORDER NO:	6
MATERIAL:	NATIVE	LAB NO:	8
SAMPLE SOURCE:	30994	DATE SAMPLED:	03/27/03

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	A	B	C
Moisture Content	20.8%	19.0%	17.2%
Compaction Pressure (psi)	*	*	75
Specimen Height (inches)	2.50	2.43	2.41
Dry Density (pcf)	104.5	108.9	112.2
Horiz. Pres. @ 1000lbs (psi)	68.0	63.0	58.0
Horiz. Pres. @ 2000lbs (psi)	140.0	140.0	133.0
Displacement	5.29	4.66	4.11
Expansion Pressure (psi)	0.0	0.0	0.1
Exudation Pressure (psi)	217	324	424
R Value	6	7	10

* HAND TAMPED



R Value at 300 PSI = 7

REVIEWED BY

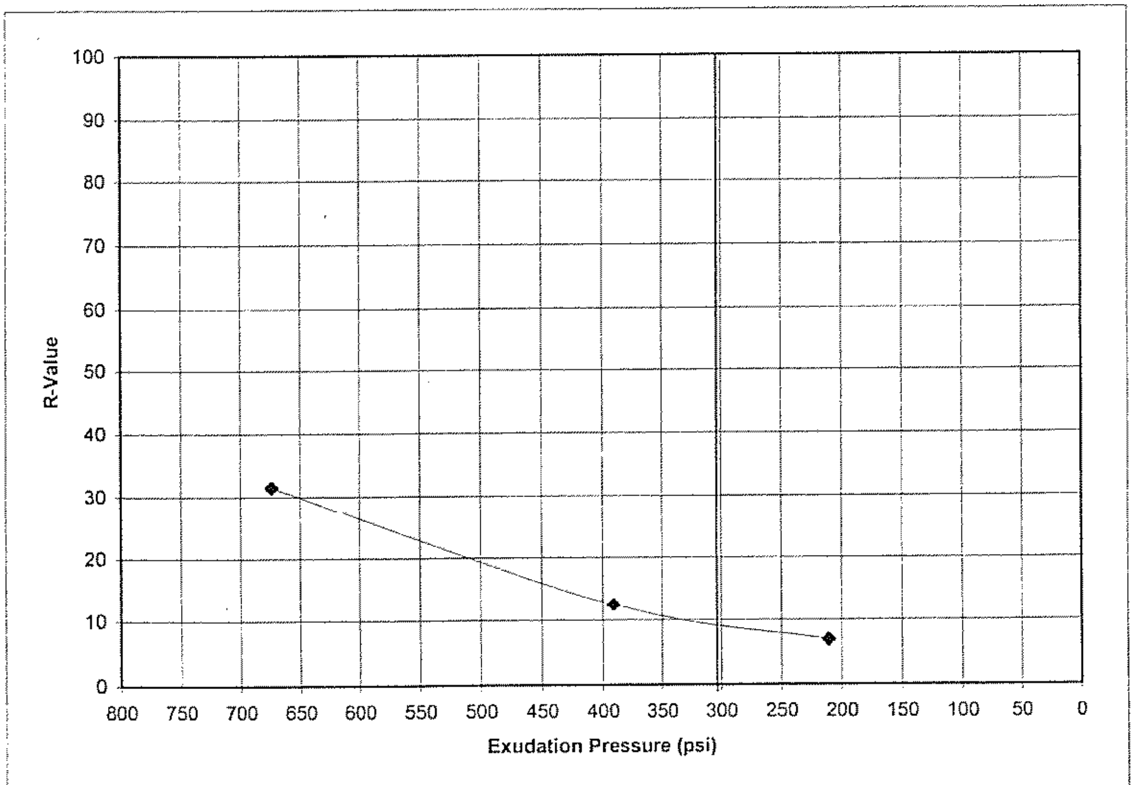
amec

PROJECT:	03-1401	JOB NO:	2-119-000224
LOCATION:	BUCKEYE ROAD	WORK ORDER NO:	6
MATERIAL:	NATIVE	LAB NO:	9
SAMPLE SOURCE:	30993	DATE SAMPLED:	03/27/03

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	A	B	C
Moisture Content	19.6%	15.9%	14.0%
Compaction Pressure (psi)	*	75	175
Specimen Height (inches)	2.57	2.53	2.44
Dry Density (pcf)	107.9	116.6	121.8
Horiz. Pres. @ 1000lbs (psi)	67.0	54.0	36.0
Horiz. Pres. @ 2000lbs (psi)	140.0	129.0	97.0
Displacement	5.13	4.21	3.33
Expansion Pressure (psi)	0.0	0.1	5.0
Exudation Pressure (psi)	211	391	674
R Value	7	12	31

* HAND TAMPED



R Value at 300 PSI = 9

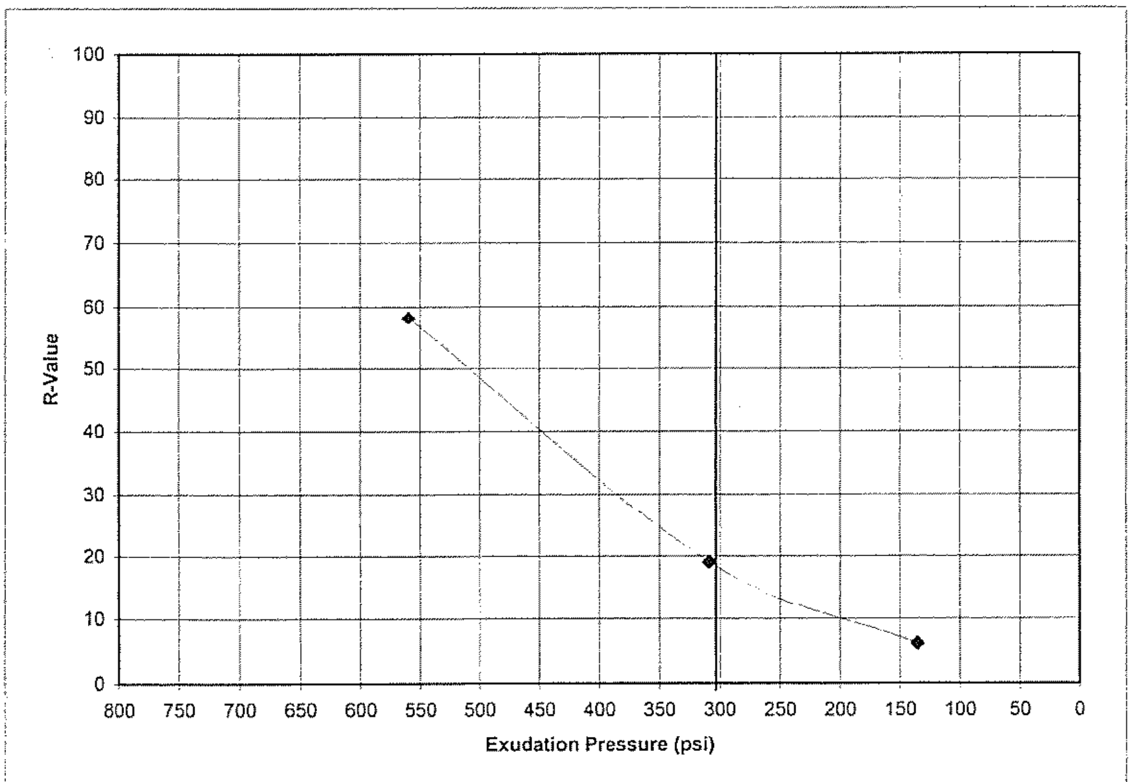
REVIEWED BY

PROJECT:	03-1401	**JOB NO:**	2-119-000224
LOCATION:	BUCKEYE ROAD	**WORK ORDER NO:**	6
MATERIAL:	NATIVE	**LAB NO:**	10
SAMPLE SOURCE:	30995	**DATE SAMPLED:**	03/27/03

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	A	B	C
Moisture Content	19.4%	15.7%	13.8%
Compaction Pressure (psi)	*	75	350
Specimen Height (inches)	2.61	2.56	2.48
Dry Density (pcf)	108.1	116.1	120.8
Horiz. Pres. @ 1000lbs (psi)	67.0	48.0	20.0
Horiz. Pres. @ 2000lbs (psi)	140.0	116.0	51.0
Displacement	6.07	4.26	3.85
Expansion Pressure (psi)	0.0	0.4	7.9
Exudation Pressure (psi)	136	309	560
R Value	6	19	58

* HAND TAMPED



R Value at 300 PSI = 19

REVIEWED BY C. M.

APPENDIX C

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Mactec, Inc.

Flexible Structural Design Module

MC85 from 91st to 99th Avenues, 12270 ADT, 5.4% growth, 14% trucks.

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	10,615,225
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.54 in

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	12,270
Number of Lanes in Design Direction	3
Percent of All Trucks in Design Lane	70 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	- %
Average Initial Truck Factor (ESALs/truck)	-
Annual Truck Factor Growth Rate	- %
Annual Truck Volume Growth Rate	- %
Growth	Compound
Total Calculated Cumulative ESALs	~~13,552,411 *~~

~~*Note: This value is not represented by the inputs or an error occurred in calculation.~~

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	12,270
Number of Lanes in Design Direction	3
Percent of All Trucks in Design Lane	70 %
Percent Trucks in Design Direction	100 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	86	5.4	0.0008	0	74,461
2	14	0	1.2	0	10,540,764

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
Total	100	-	-	-	10,615,225

Growth	Compound
Total Calculated Cumulative ESALs	10,615,225

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Mactec, Inc.

Flexible Structural Design Module

MC85 - 99th to 103rd Avenues , 11505 ADT, 5.8% growth, 9% trucks.

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	6,430,830
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.22 in

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	11,505
Number of Lanes in Design Direction	3
Percent of All Trucks in Design Lane	70 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	- %
Average Initial Truck Factor (ESALs/truck)	-
Annual Truck Factor Growth Rate	- %
Annual Truck Volume Growth Rate	- %
Growth	Simple
Total Calculated Cumulative ESALs	- *

*Note: This value is not represented by the inputs or an error occurred in calculation.

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	11,505
Number of Lanes in Design Direction	3
Percent of All Trucks in Design Lane	70 %
Percent Trucks in Design Direction	100 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	91	5.8	0.0008	0	77,101
2	9	0	1.2	0	6,353,728

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
Total	100	-	-	-	6,430,830

Growth	Compound
Total Calculated Cumulative ESALs	6,430,830

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Computer Software Product
Mactec, Inc.

Flexible Structural Design Module

MC85 from 103rd to 107th Avenues, 11808 ADT, 4.0% growth, 7% trucks.

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,138,823
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.08 in

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	11,808
Number of Lanes in Design Direction	3
Percent of All Trucks in Design Lane	70 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	- %
Average Initial Truck Factor (ESALs/truck)	-
Annual Truck Factor Growth Rate	- %
Annual Truck Volume Growth Rate	- %
Growth	Simple
Total Calculated Cumulative ESALs	- *

*Note: This value is not represented by the inputs or an error occurred in calculation.

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	11,808
Number of Lanes in Design Direction	3
Percent of All Trucks in Design Lane	70 %
Percent Trucks in Design Direction	100 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	93	4	0.0008	0	66,886
2	7	0	1.2	0	5,071,937

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
Total	100	-	-	-	5,138,823

Growth	Compound
Total Calculated Cumulative ESALs	5,138,823

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Mactec, Inc.

Flexible Structural Design Module

91st Avenue - 4985 ADT, 5.8% growth, 10% trucks.

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	3,975,346
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	3.93 in

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	4,985
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	- %
Average Initial Truck Factor (ESALs/truck)	-
Annual Truck Factor Growth Rate	- %
Annual Truck Volume Growth Rate	- %
Growth	Simple
Total Calculated Cumulative ESALs	- *

*Note: This value is not represented by the inputs or an error occurred in calculation.

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	4,985
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	100 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	90	5.8	0.0008	0	42,480
2	10	0	1.2	0	3,932,866

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
Total	100	-	-	-	3,975,346

Growth Compound

Total Calculated Cumulative ESALs 3,975,346

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Mactec, Inc.

Flexible Structural Design Module

99th Avenue - 6519 ADT, 5.8% growth, 18% trucks.

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	9,308,194
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.45 in

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	6,519
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	- %
Average Initial Truck Factor (ESALs/truck)	-
Annual Truck Factor Growth Rate	- %
Annual Truck Volume Growth Rate	- %
Growth	Simple
Total Calculated Cumulative ESALs	- *

*Note: This value is not represented by the inputs or an error occurred in calculation.

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	6,519
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	100 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	82	5.8	0.0008	0	50,614
2	18	0	1.2	0	9,257,580

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
Total	100	-	-	-	9,308,194

Growth	Compound
Total Calculated Cumulative ESALs	9,308,194

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Mactec, Inc.

Flexible Structural Design Module

107th Avenue - 4985 ADT, 5.8% growth, 5% trucks.

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	2,011,273
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	3.55 in

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	4,985
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	100 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	- %
Average Initial Truck Factor (ESALs/truck)	-
Annual Truck Factor Growth Rate	- %
Annual Truck Volume Growth Rate	- %
Growth	Simple
Total Calculated Cumulative ESALs	- *

*Note: This value is not represented by the inputs or an error occurred in calculation.

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	4,985
Number of Lanes in Design Direction	2
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	100 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	95	5.8	0.0008	0	44,840
2	5	0	1.2	0	1,966,433

Why?

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
Total	100	-	-	-	2,011,273

Growth	Compound
Total Calculated Cumulative ESALs	2,011,273

DESIGN 1

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Mactec, Inc.

Flexible Structural Design Module

MC85 - 91st Avenue to 103rd Avenue, and Intersecting 99th Avenue

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	9,500,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.46 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	8.5	43	3.57
Total	-	-	-	10.00	-	4.48

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	8.44	3.54
Total	-	-	-	-	-	-	-	9.94	4.46

Optimized Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Cost (sq yd/in)	Min Thick (Di)(in)	Max Thick (in)	Width (ft)	Optimum Thick (in)	Calculated SN (in)	Calculated Cost (sq yd)
Total	-	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Mactec, Inc.

Flexible Structural Design Module

MC85 · 91st Avenue to 103rd Avenue, and Intersecting 99th Avenue

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	9,500,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.46 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	5	43	2.10
3	Aggregate Base Course	0.12	1	12	-	1.44
Total	-	-	-	18.50	-	4.46

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	4.90	2.06
3	Aggregate Base Course	0.12	1	-	-	33,000	43	12.38	1.49
Total	-	-	-	-	-	-	-	18.78	4.46

Optimized Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Cost (sq yd/in)	Min Thick (Di)(in)	Max Thick (in)	Width (ft)	Optimum Thick (in)	Calculated SN (in)	Calculated Cost (sq yd)	
Total	-	-	-	-	-	-	-	-	-		-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Flexible Structural Design Module

MC85 - 91st Avenue to 103rd Avenue, and Intersecting 99th Avenue

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	9,500,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.46 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	5	43	2.10
3	Aggregate Base Course	0.12	1	4	43	0.48
4	Lime Stabilized Subgrade	0.16	1	12	43	1.92
Total	-	-	-	22.50	-	5.42

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	4.90	2.06
3	Aggregate Base Course	0.12	1	4	-	33,000	43	4.00	0.48
4	Lime Stabilized Subgr...	0.16	1	12	-	47,500	43	12.00	1.92
Total	-	-	-	-	-	-	-	22.40	5.37

Optimized Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Cost (sq yd/in)	Min Thick (Di)(in)	Max Thick (in)	Width (ft)	Optimum Thick (in)	Calculated SN (in)	Calculated Cost (sq yd)
Total	-	-	-	-	-	-	-	-	-	-

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Computer Software Product
Mactec, Inc.

Flexible Structural Design Module

MC85 - 91st Avenue to 103rd Avenue, and Intersecting 99th Avenue

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	9,500,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	21,000 psi
Stage Construction	1
Calculated Design Structural Number	3.50 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	5	43	2.10
3	Aggregate Base Course	0.12	1	4	43	0.48
Total	-	-	-	10.50	-	3.50

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	4.90	2.06
3	Aggregate Base Course	0.12	1	-	-	33,000	43	4.38	0.53
Total	-	-	-	-	-	-	-	10.78	3.50

Optimized Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Cost (sq yd/in)	Min Thick (Di)(in)	Max Thick (in)	Width (ft)	Optimum Thick (in)	Calculated SN (in)	Calculated Cost (sq yd)
Total	-	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Mactec, Inc.

Flexible Structural Design Module

Deisgn 1, using a reduced Resilient Modulus for undisturbed subgrade.

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	9,500,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.46 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	5	43	2.10
3	Aggregate Base Course	0.12	1	4	43	0.48
4	Existing AB Subbase	0.1	1	11	43	1.10
Total	-	-	-	21.50	-	4.60

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	4.90	2.06
3	Aggregate Base Course	0.12	1	-	-	33,000	43	2.40	0.29
4	Existing AB Subbase	0.1	1	12	-	26,000	43	12.00	1.20
Total	-	-	-	-	-	-	-	20.81	4.46

DESIGN 2

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Mactec, Inc.

Flexible Structural Design Module

MC85 - 103rd Ave to 107th Ave, Intersecting 91st Ave and 107th Ave

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,000,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.07 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	7.5	43	3.15
Total	-	-	-	9.00	-	4.06

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	7.51	3.16
Total	-	-	-	-	-	-	-	9.01	4.07

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Mactec, Inc.

Flexible Structural Design Module

MC85 - 103rd Ave to 107th Ave, Intersecting 91st Ave and 107th Ave

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,000,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.07 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	4.5	43	1.89
3	Aggregate Base Course	0.12	1	11	43	1.32
Total	-	-	-	17.00	-	4.13

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	4.22	1.77
3	Aggregate Base Course	0.12	1	-	-	33,000	43	11.51	1.38
Total	-	-	-	-	-	-	-	17.24	4.07

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Mactec, Inc.

Flexible Structural Design Module

MC85 - 103rd Ave to 107th Ave, Intersecting 91st Ave and 107th Ave

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,000,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.07 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	4	43	1.68
3	Aggregate Base Course	0.12	1	4	43	0.48
4	Lime Stabilized Subgrade	0.16	1	12	43	1.92
Total	-	-	-	21.50	-	4.99

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	4.22	1.77
3	Aggregate Base Course	0.12	1	4	-	33,000	43	4.00	0.48
4	Lime Stabilized Subgr...	0.16	1	12	-	47,500	43	12.00	1.92
Total	-	-	-	-	-	-	-	21.72	5.09

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Mactec, Inc.

Flexible Structural Design Module

MC85 - 103rd Ave to 107th Ave, Intersecting 91st Ave and 107th Ave

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,000,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	21,000 psi
Stage Construction	1
Calculated Design Structural Number	3.17 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	4.5	43	1.89
3	Aggregate Base Course	0.12	1	4	43	0.48
Total	-	-	-	10.00	-	3.28

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	4.22	1.77
3	Aggregate Base Course	0.12	1	-	-	33,000	43	4.01	0.48
Total	-	-	-	-	-	-	-	9.74	3.17

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Mactec, Inc.

Flexible Structural Design Module

Deisgn 2, using a reduced Resilient Modulus for undisturbed subgrade.

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,000,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	10,369 psi
Stage Construction	1
Calculated Design Structural Number	4.07 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	43	0.92
2	Asphalt Concrete	0.42	1	4	43	1.68
3	Aggregate Base Course	0.12	1	4	43	0.48
4	Existing AB Subbase	0.1	1	11	43	1.10
Total	-	-	-	20.50	-	4.18

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
1	Asphalt Rubber	0.61	1	1.5	-	400,000	43	1.50	0.92
2	Asphalt Concrete	0.42	1	-	-	400,000	43	4.22	1.77
3	Aggregate Base Course	0.12	1	-	-	33,000	43	2.05	0.25
4	Existing AB Subbase	0.1	1	12	-	26,000	43	12.00	1.20
Total	-	-	-	-	-	-	-	19.77	4.13

APPENDIX PAV-C

DMJM Harris/AECOM Report

MC 85, 107^{TH} AVENUE TO 91^{ST} AVENUE
MARICOPA COUNTY, ARIZONA

PAVEMENT DESIGN REPORT

Prepared for:

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

By

DMJM HARRIS | AECOM

2777 E. Camelback Road, Suite 200
Phoenix, AZ 85016

CERTIFICATE NO.
25151
KEITH H.
DAHLEN
Date Signed 4/25/06

April 2006

DMJM HARRIS | AECOM

DMJM Harris
2777 East Camelback Road, Suite 200, Phoenix, AZ 85016
T 602.337.2777 F 602.337.2620 www.dmjmharris.com

April 25, 2006

Mr. Sami Ayoub
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

Re: Pavement Design Report
MC 85 (Buckeye Road), 107th Avenue to 91st Avenue
Maricopa County, Arizona
MCDOT Work Order 69024
DMJM Harris Project No. 6490.0000

Dear Mr. Ayoub:

DMJM Harris is pleased to present this Pavement Design Report to the Maricopa County Department of Transportation (MCDOT) for the above referenced project. This report details our scope of work, and includes the results of our investigation, design and test data obtained as part of the preliminary geotechnical investigation (Mactec, 2003) as well as recommendations for the design of pavements based on life cycle cost analyses of various alternatives for the section of MC 85 (Buckeye Road) between 107th Avenue and 91st Avenue and in Maricopa County, Arizona.

We appreciate the opportunity to provide geotechnical services to the MCDOT on this project. Should you have any questions concerning this report, please contact Keith Dahlen of our office at (602) 337-2596.

Sincerely,
DMJM Harris

Francisco J. Garza

Francisco Garza, E.I.T.

Reviewed by:

Registered Professional Engineer, Certificate No. 25151, Keith H. Dahlen, Date Signed 4/25/06, Arizona, U.S.A.

Keith Dahlen, P.E.
Senior Geotechnical Engineer

cc: 6490.0005 505

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APPENDICES

1.0 INTRODUCTION

This Pavement Design Report is submitted subsequent to a subsurface investigation performed by DMJM Harris for the planned widening and improvement of a two-mile segment of MC 85, extending from 107th Avenue to 91st Avenue, and located within Maricopa County, Arizona. The Project Site Vicinity Map is shown in Figure 1. It is our understanding that the existing four-lane roadway with an intermittent center turn lane will be widened to a 6-lane road with a raised median. Given the existing roadway geometry, the majority of new construction will occur along the south side of MC 85 and along the widened edges of the cross-road pavements while reconstruction will take place along the existing MC 85 roadway and portions of the main cross roads to meet new pavement design sections and site profiles. Based on current design plans (DMJM Harris, 2005), the new profile of MC 85 will generally extend from 0 to 2 feet above existing pavement grades, with the low points located at or near the intersections at 107th, 99th and 91st avenue.

2.0 REVIEW OF EXISTING DATA

The pavement design recommendations presented herein are based in part on results from the *Preliminary Report of Geotechnical Evaluation*, (Mactec, Revised October 2003). DMJM Harris has conducted a review of this report and determined that it generally meets the specified MCDOT requirements for final design, relative to the field investigation and laboratory testing.

As-Built Plans were also reviewed as part of this investigation. The primary focus of the review was to determine the location of a 16-foot wide section of Portland cement concrete pavement (PCCP) that is known to underlie a portion of the MC85 asphaltic concrete (AC). MCDOT has considered leaving the PCCP in–place if it does not adversely impact the design or construction of the new MC 85. MCDOT requested that DMJM Harris perform additional coring through the existing MC 85 pavement to better define the location and condition of the existing PCCP.

3.0 PAVEMENT CORE INVESTIGATION

The pavement core investigation was supervised by Ammi Osorio, P.E., and Pancho Garza, E.I.T., of DMJM Harris. A total of sixteen pavement cores (C1 through C16) were advanced to depths ranging from 1.4 feet (17") to 3.2 feet (38") below ground surface using a Milwaukee 480 portable drill with 6-inch and 3-inch bits. The coring equipment is owned and operated by Concrete Coring Company, Inc. The coring was performed through the Asphalt Concrete (AC) layer using a 6-inch drill bit and the underlying PCCP layer, where encountered, using a 3-inch diameter bit. The majority of coring encountered Aggregate Base (AB) materials below the AC layer. Clay soil was encountered below the AB in Core C12. The AB material and clayey materials were excavated using hand tools. The thickness of each pavement layer was measured and the PCCP cores were sampled and stored. After the coring operation, each hole was backfilled with excess cuttings and the AC core replaced with cold patch.

The preliminary investigation (MACTEC, 2003) included advancing a total of eleven test borings to depths of 10 feet along the existing MC 85 alignment. A Site Plan (three sheets), which indicates the DMJM Harris pavement core locations and Mactec test boring locations is included in Appendix A.

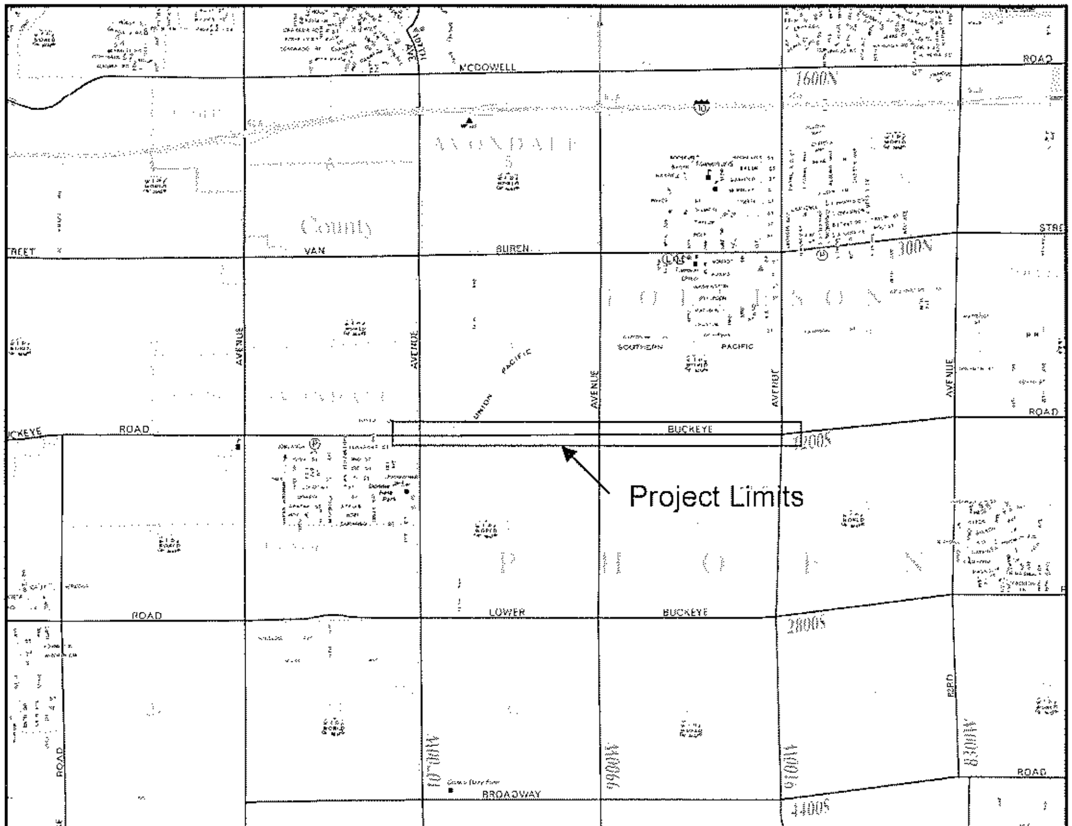


Figure 1: Project Vicinity Map

North

4.0 SITE DESCRIPTION

Development within the vicinity of the MC 85 roadway is a mixture of newer warehouse buildings to the north, and residential use mixed with agricultural farm land to the south. The area has historically been primarily agricultural. The area is generally flat with a gentle regional slope to the southwest. The MC 85 pavement surface is sloped such that drainage is directed toward the shoulders.

Within the project limits, MC 85 (Buckeye Road) consists primarily of two 12-foot wide travel lanes in each direction with 8- to 12-foot wide gravel shoulders and a 12-foot wide center turn lane at various locations. At the time of the field investigation, the existing pavement section appeared to be in fair to good condition. Some light, generally widely spaced cracking was noted and occasional potholes were observed in the roadway.

Major intersections are located at 107th Avenue, 99th Avenue and 91st Avenue within the project limits. Currently, each intersection consists of two lanes in each direction with a left turn lane. Projected traffic data indicates a large increase in traffic volume after the year 2015 due to a planned I-10 reliever to the south of MC 85. The increased traffic volume will result in the 99th Avenue intersection expanding to 3 lanes at the intersection.

5.0 EXISTING MC 85 PAVEMENT SECTION CONDITIONS

The 16-foot wide PCCP section, centered approximately on the existing Section Line, was encountered below the existing roadway in all but five of the core holes (C1, C2, C8, C10 and C12). The field investigation indicated that the AC pavement section varies from 4 inches to 12 inches, with an average depth of 10 inches. The aggregate base (AB) material underlying the AC ranges in thickness from 5 inches to 14 inches. The underlying PCCP ranges in thickness from 6 inches to 7 inches. In Cores C2 and C3, a 4-inch AC layer was encountered under the AB layer. A summary of the pavement sections encountered within the DMJM Harris cores and MACTEC borings is included as Table 1.

Based on the preliminary test borings, the site is generally underlain by finer-grained clayey soils. This medium to highly plastic and moderately expansive material was encountered in all the test borings advanced during the preliminary investigation.

Table 1 – Summary of Existing MC 85 Pavement Conditions Based on Preliminary Test Drilling and Final Investigation Pavement Cores

Final Investigation (DMJM Harris, 2005)						Preliminary Investigation (Mactec, 2003)					
Core ID	Station(1)	Offset(1)	AC (in)	AB (in)	PCCP (in)	Bore ID	Station(1)	Offset(1)	AC (in)	AB (in)	PCCP (in)
C1	1136+00	7' Lt	12.1	12.0	-	B-11	1133+80	20' Lt	5.0	19.0	-
C2	1144+00	2.5' Lt	5.0	7.0(2)	-	B-10	1143+70	10' Lt	6.0	12.0	-
C3	1150+00	2.5' Rt	4.0	5.0(2)	7.0	HA-4	1143+65	35' Rt	-	-	-
C4	1156+00	3' Lt	9.0	7.0	6.0	B-9	1152+75	10' Rt	4.0	6.0	12.0
C5	1163+00	2.5'Rt	8.0	9.0	7.0	B-8B	1163+45	5' Lt	5.0	5.0	12.0
C6	1170+00	3' Lt	10.0	9.0	6.0	B-8A	1163+45	5' Lt	5.0	5.0	12.0
C7	1177+00	3' Rt	11.0	11.0	6.0	HA-3	1173+25	25' Rt	-	-	-
C8	1183+00	8' Lt	13.0	13.0	-	B-7	1173+50	20' Rt	5.0	12.0	-
C9	1190+00	2.5' Lt	12.0	12.0	7.0	HA-2	1185+90	45' Lt	-	-	-
C10	1197+00	14' Lt	9.5	26.5	-	B-6	1185+75	30' Lt	3.0	12.0	-
C11	1203+00	6.5' Rt	10.0	14.0	7.0	B-5	1196+00	5' Rt	5.0	25.0	6.0
C12	1209+00	3' Lt	12.0	5.0	-(3)	B-4	1206+30	15' Lt	7.0	11.0	-
C13	1217+00	2.5' Rt	9.0	11.0	7.0	B-3	1216+40	15' Rt	5.0	25.0	-
C14	1220+00	3' Rt	9.0	12.0	6.0	B-2	1225+20	30' Lt	5.0	25.0	-
C15	1227+00	6.5' Rt	8.0	13.0	6.0	HA-1	1233+60	30' Rt	-	-	-
C16	1234+00	3' Rt	12.0	6.0	6.0	B-1	1233+40	15' Rt	3.0	21.0	-

(1): MC 85 Existing Centerline (Section Line)
(2): 4-inch AC encountered underlying AB
(3): Clay soil encountered underlying AB to a depth of 3.2' (38")

6.0 PAVEMENT SECTION ANALYSIS AND RECOMMENDATIONS

6.1 SUBGRADE MODULUS

The pavement section analysis was performed using the *MCDOT Pavement Design Guide* (2004). This design method utilizes the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures (1993) as the design standard for asphalt pavement structures in Maricopa County. A combination of laboratory correlated R-values and actual R-values are used for the determination of the subgrade modulus.

Laboratory testing for this project was performed by MACTEC (2003). The testing included grain-size analysis, and Atterberg limits testing (plasticity index) for calculation of correlated R-values (in accordance with Table 202.02-3 of ADOT, 1993) and actual R-value tests. Actual R-value tests were performed on four near-surface bulk samples. Grain-size analysis and Atterberg limits (plasticity index) tests, for determination of correlated R-values were performed on near surface samples as well. Based on the average correlated and actual test R-values indicated above and respective standard deviation values of 4.9 and 5.7, a design R_{mean} value of 15.6 is determined. The R_{mean} value, based on Figure 202.02-2, and a Seasonal Variation Factor (SVF) of 1.0 (determined for Phoenix, Arizona from Table 202.02-4), provides the maximum limiting value for resilient modulus (M_r) of 9,830 pounds per square inch (psi).

6.2 TRAFFIC LOADINGS

The existing and projected Average Daily Traffic (ADT) loadings were provided by the Maricopa Association of Governments (MAG), and the MC 85 Corridor Study (DMJM Harris, 2005). Total one-way equivalent single axle loadings were calculated as follows:

Roadway Section	Existing One-Way ADT	Annual Growth Rate (%)	Truck (%)	Flexible Total One-Way 18 Kip ESAL
MC 85 – 107th Ave. to 91st Ave.	18,000(1)	2.25	17	11,724,000
91st Avenue	10,000(2)	5.5	17	11,721,000
99th Avenue	8,000(3)	7.0	17	11,025,000
107th Avenue	8,000(3)	5.5	17	9,377,000

(1): 2005 ADT, (2): 2003 ADT, (3): 2004 ADT

The growth rates were calculated by taking the current traffic data and determining the appropriate growth rate to meet 20-year traffic projections. The MC 85 growth rate projection is lower than the anticipated growth rate for the north-south arterials. 99th Avenue is anticipated to experience the highest growth. These variations can be attributed to the planned addition of a freeway traffic reliever to the south of MC 85. In general for the region, the north and southbound traffic volumes are expected to increase more than the east and west traffic volume along MC 85.

6.3 STRUCTURAL NUMBER

The drainage coefficient of 1.0 was selected, from MCDOT (2004) Table 10.2.6, utilizing a "roadway designed with concrete curbs and drop inlet' designation. The mean resilient modulus was utilized in conjunction with the traffic data to develop 18-kip Equivalent Single Axle Loads (ESALs). The following parameters for an arterial road were used for the pavement section analysis:

Seasonal Variation Factor (Phoenix)	1.0
Drainage Coefficient (Fair)	1.0
Performance Period (years)	20
Number of Lanes in Design Direction (MC85)	3
Percent of All Truck in the Design Lane (MC85)	70
Number of Lanes in the Design Direction (Intersections)	2
Percent of All Trucks in the Design Lane (Intersections)	90
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95%
Overall Standard Deviation	0.45

The outcome of the input values resulted in the following:

Roadway Section	Design 18-Kip ESALs	Design Structural Number
MC 85 –107th to 91st Ave including 91st Ave, 99th Ave & 107th Ave intersections – New Construction	11,724,000	4.08
MC 85 – 107th to 91st Ave including 91st Ave, 99th Ave & 107th Ave intersections – Reconstruction	11,724,000	3.86

6.4 PAVEMENT SECTION DESIGN

The pavement section design utilizes the maximum calculated 18-kip ESAL for all segments of the roadway including the intersections. While the 107th Avenue intersection has the lowest ESAL count, it does not warrant including that intersection as a separate design as the drop in anticipated ESALs is not significant. By using a single ESAL loading for the intersections, a single pavement section can be utilized. However, it may be necessary to utilize various pavement sections for certain areas of the project.

6.4.1 Widening of MC 85

The medium to high plasticity (low R-value) clay subgrade soils exhibit potential for expansion or settlement upon wetting and drying, and are not considered adequate for roadway support without some type of modification. Thus, no alternatives were studied that would leave the unaltered soil in-place directly below the new pavement section. The two options considered for subgrade treatment are to treat the in-place clayey material (upper 12 inches) with lime or to overexcavate the soils to a minimum depth of 2.0 feet and replace with AB or good quality imported fill.

If overexcavation is chosen as the construction method it is recommended that the existing medium to high plasticity soils, which are exposed beneath the pavement section, be overexcavated to a depth of 2.0 feet below the finished pavement subgrade elevation, and be replaced with materials meeting a recommended minimum construction control R-value of 30. An alternative to overexcavation, would be the placement of a geogrid and high survivability separation fabric beneath the pavement section aggregate base. It may be preferable to leave any existing lower quality soils in-place and cover with geogrid to limit the depth of excavation. This option would be limited to those in-place soils that when tested would have a correlated R-value of at least 20 (within 10 of the construction control R-value of 30). Any soils with correlated R-values of less than 20 should be overexcavated and replaced, as discussed above.

As a minimum, existing soils within all areas to receive embankment, pavements, and general fill should be scarified to a minimum depth of 8 inches, moisture-conditioned to within plus or minus two percent of the optimum moisture content, and be compacted to a minimum of 95 percent of standard Proctor (ASTM D698) density. It is recommended that a representative of the geotechnical engineer inspect the exposed surfaces of overexcavations prior to placement of fill to verify suitable bearing conditions. All placement and compaction of subgrade materials should be in general accordance with Section 203 of the MAG Specifications (1998 includes updates through 2005).

Lime can be incorporated to stabilize fine-grained soil, typically soils with a minimum of 25% passing the #200 sieve and a plasticity index greater than 10, either employed as a subgrade or subbase to create a layer with structural value in the pavement system. Subgrade stabilization usually involves in-place "road mixing," and generally requires adding 3 to 6 percent lime by weight of the dry soil. The on-site clayey soils based on laboratory results have an expansion potential between 5.4% and 10.0%. This soil (in accordance with Table 10.2.8 of MCDOT, 2004) requires a stabilized depth of 12 inches. The actual lime percentage should be determined by following the test protocol for a mixture design. All placement of lime slurry should be in general accordance with Section 309 of the MAG Specifications (1998 includes updates through 2005).

In accordance with the AASHTO method for layered thickness design, and based on the given design parameters, the following eight alternatives listed herein were developed. Structural coefficients of 0.61, 0.42, 0.12, and 0.16 were used for asphalt rubber (AR), AC, AB, and lime stabilized soil subgrade. The detailed calculations for determined section thicknesses are attached. Alternatives 1 through 4 present the new construction options for the widening of MC85 utilizing AR. Alternatives 5 through 8 present new construction options for the widening of MC85 utilizing a combination of 12.5 mm and 19 mm Strategic Highway Research Program (SHRP) AC mixes.

Alternative 1 – AR over AC over AB over Imported Fill Subgrade*

Material	New Construction/Widening MC 85- 107thAvenue to 91st Avenue , SN = 4.08 (inches)
Asphalt-Rubber	1.5
Asphalt Concrete	5.0
Aggregate Base	10.0
Borrow Excavation (Imported)*	24.0

* See Appendix C for subgrade requirements

Alternative 2 – AR over AC over AB over Lime Stabilized Subgrade

Material	New Construction/Widening MC 85- 107thAvenue to 91st Avenue, SN = 4.08 (inches)
Asphalt-Rubber	1.5
Asphalt Concrete	3.5
Aggregate Base	6.0
Lime Slurry Stabilization Subbase (5%)	12.0

Alternative 3 – AR over AC over Imported Fill Subgrade*

Material	New Construction/Widening MC 85- 107thAvenue to 91st Avenue, SN = 4.08 (inches)
Asphalt-Rubber	1.5
Asphalt Concrete	8.0
Borrow Excavation (Imported) *	24.0

* See Appendix C for subgrade requirements

Alternative 4 – AR over AC over Lime Stabilized Subgrade	
Material	**New Construction/Widening MC 85- 107thAvenue to 91st Avenue, SN = 4.08 (inches)**
Asphalt-Rubber	1.5
Asphalt Concrete	5.0
Lime Slurry Stabilization Subbase (5%)	12.0

Alternative 5 – AC over AB over Imported Fill Subgrade*	
Material	**New Construction/Widening MC 85- 107thAvenue to 91st Avenue, SN = 4.08 (inches)**
Asphalt Concrete	6.0
Aggregate Base	14.0
Borrow Excavation (Imported) *	24.0

* See Appendix C for subgrade requirements

Alternative 6 – AC over AB over Lime Stabilized Subgrade	
Material	**New Construction/Widening MC 85- 107thAvenue to 91st Avenue, SN = 4.08 (inches)**
Asphalt Concrete	4.0
Aggregate Base	11.0
Lime Slurry Stabilization Subbase (5%)	12.0

Alternative 7 – AC over Imported Fill Subgrade*	
Material	**New Construction/Widening MC 85- 107thAvenue to 91st Avenue, SN = 4.08 (inches)**
Asphalt Concrete	10.0
Borrow Excavation (Imported) *	24.0

* See Appendix C for subgrade requirements

Alternative 8 – AC over Lime Stabilized Subgrade	
Material	**New Construction/Widening MC 85- 107thAvenue to 91st Avenue, SN = 4.08 (inches)**
Asphalt Concrete	7.0
Lime Slurry Stabilization Subbase (5%)	12.0

6.4.2 Reconstruction of MC 85 Pavement

As indicated in Table 1, the top of the existing PCCP varies from about 10 to 30 inches in depth below the existing AC pavement surface. Given the depths involved and the fact that much of the new alignment will be elevated from existing site grades, MCDOT has determined that the PCCP should remain in-place. In accordance with the AASHTO method for layered thickness design, and based on the given design parameters, the following alternatives were developed. Alternatives 9 and 10 address the reconstruction of MC 85 with the assumption that the existing

AB and PCCP will be left in-place. Both the existing AB and AC are highly variable in thickness along MC 85. The existing profile will need to be raised, from 10 inches to 27 inches, to meet the proposed new profile grade. Though re-using the existing AB for the new AB section is not recommended given the variability and unknowns concerning quality, it would be good to leave the existing AB as subgrade for the new pavement section. The existing AC will first need to be removed to expose the AB. The removed AC may be milled and taken to a disposal site, and/or milled and reused as a percentage of the AB or as part of the general import fill given that it meets a minimum correlated R-value of 30.

Alternative 9 –AR over AB/Import over Existing AB	
Material	**Reconstruction MC 85- 107th Avenue to 91st Avenue, SN = 3.86 (inches)**
Asphalt Rubber	1.5
Asphalt Concrete	5.0
Aggregate Base	8.0

Alternative 10 – AC over AB/Import over Existing AB	
Material	**Reconstruction MC 85- 107th Avenue to 91st Avenue, SN = 3.86 (inches)**
Asphalt Concrete	6.0
Aggregate Base	12.0

6.5 ALTERNATIVE COST ESTIMATES

Anticipated costs for the 10 alternative pavement sections described in Section 6.4 are presented herein. The cost estimates are prepared on the basis of cost per lane mile of pavement. In accordance with MCDOT (2004), a lane mile of pavement is considered as 15-feet wide by 5280-feet in length. The roadway excavation cost includes both scarification, and recompaction of the exposed soil. The lime stabilization assumes that the subgrade will be stabilized in place.

Alternative 1 – AR over AC over AB over Imported Fill Subgrade				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
325.10125 Asphalt-Rubber, (12.5 mm Mix) @ 137 pcf	1.5	678	$50/ton	$33,900
321.01300 Asphalt Concrete (19 mm Mix) @ 145 pcf	5.0	2,393	$32/ton	$76,576
329.01000 Bituminous Tack Coat (0.07 gal/sq yd)	-	9	$350/ton	$3,150
310.03300 Aggregate Base (135 pcf)	10.0	4,455	$8/ton	$35,640
205.01150 Roadway Excavation	24	5,867	$2.00 cu yd	$11,734
210.02000 Borrow Excavation (Imported)	24	5,867	$5.00 cu yd	$29,335
			Total Cost per lane mile	$190,335

Alternative 2 – AR over AC over AB over Lime Stabilized Subgrade				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
325.10125 Asphalt-Rubber, (12.5 mm Mix) @ 137 pcf	1.5	678	$50/ton	$33,900
321.01300 Asphalt Concrete (19 mm Mix) @ 145 pcf	3.5	2,393	$32/ton	$53,600
329.01000 Bituminous Tack Coat (0.07 gal/sq yd)	-	9	$350/ton	$3,150
310.03300 Aggregate Base (135 pcf)	6.0	2,673	$8/ton	$21,384
309.05008 Lime Slurry Stabilization (5%)	12.0	79,200	$0.36 sq ft	$28,600
			Total Cost per lane mile	$140,634

Alternative 3 – AR over AC over Imported Fill Subgrade				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
325.10125 Asphalt-Rubber, (12.5 mm Mix) @ 137 pcf	1.5	678	$50/ton	$33,900
321.01300 Asphalt Concrete (19 mm Mix) @ 145 pcf	8.0	3,828	$32/ton	$122,496
329.01000 Bituminous Tack Coat (0.07 gal/sq yd)	-	9	$350/ton	$3,150
205.01150 Roadway Excavation	24	5,867	$2.00 cu yd	$11,734
210.02000 Borrow Excavation (Imported)	24	5,867	$5.00 cu yd	$29,335
			Total Cost per lane mile	$200,615

Alternative 4 – AR over AC over Lime Stabilized Subgrade				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
325.10125 Asphalt-Rubber, (12.5 mm Mix) @ 137 pcf	1.5	678	$50/ton	$33,900
321.01300 Asphalt Concrete (19 mm Mix) @ 145 pcf	5.0	2,393	$32/ton	$76,576
329.01000 Bituminous Tack Coat (0.07 gal/sq yd)	-	9	$350/ton	$3,150
309.05008 Lime Slurry Stabilization (5%)	12	79,200	$0.36 sq ft	$28,600
			Total Cost per lane mile	$142,226

Alternative 5 – AC over AB over Imported Fill Subgrade				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
321.01200 Asphalt Concrete (12.5mm Mix) @ 145 pcf	1.5	718	$32/ton	$22,976
321.01300 Asphalt Concrete (19mm Mix) @ 145 pcf	4.5	2,153	$32/ton	$68,896
329.01000 Bituminous Tack Coat (0.07 gal/sq yd)	-	9	$350/ton	$3,150
310.03300 Aggregate Base Course (135 pcf)	14.0	6,237	$8/ton	$49,896
205.01150 Roadway Excavation	24	5,867	$2.00 cu yd	$11,734
210.02000 Borrow Excavation (Imported)	24	5,867	$5.00 cu yd	$29,335
			Total Cost per lane mile	$185,987

Alternative 6 – AC over AB over Lime Stabilized Subgrade				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
321.01200 Asphalt Concrete (12.5mm Mix) @ 145 pcf	1.5	678	$32/ton	$21,696
321.01300 Asphalt Concrete (19mm Mix) @ 145 pcf	2.5	1197	$32/ton	$38,304
329.01000 Bituminous Tack Coat (0.07 gal/sq yd)	-	3	$350/ton	$1,050
310.03300 Aggregate Base Course (135 pcf)	11	4,901	$8/ton	$39,208
309.05008 Lime Slurry Stabilization (5%)	12	79,200	$0.36 sq ft	$28,600
			Total Cost per lane mile	$128,858

Alternative 7 – AC over Imported Fill Subgrade				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
321.01200 Asphalt Concrete (12.5mm Mix) @ 145 pcf	1.5	718	$32/ton	$22,976
321.01300 Asphalt Concrete (19mm Mix) @ 145 pcf	8.5	4,067	$32/ton	$130,144
329.01000 Bituminous Tack Coat (0.07 gal/sq yd)	-	9	$350/ton	$3,150
205.01150 Roadway Excavation	24	5,867	$2.00 cu yd	$11,734
210.02000 Borrow Excavation (Imported)	24	5,867	$5.00 cu yd	$29,335
			Total Cost per lane mile	$197,339

Alternative 8 – AC over Lime Stabilized Subgrade				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
321.01200 Asphalt Concrete (12.5mm Mix) @ 145 pcf	1.5	718	$32/ton	$22,976
321.01300 Asphalt Concrete (19mm Mix) @ 145 pcf	5.5	2,632	$32/ton	$84,224
329.01000 Bituminous Tack Coat (0.07 gal/sq yd)	-	9	$350/ton	$3,150
309.05008 Lime Slurry Stabilization (5%)	12	8,800	$0.36 sq ft	$28,600
			Total Cost per lane mile	$138,950

Alternative 9 – AR over AB/Import over Existing AB				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
325.10125 Asphalt-Rubber, (12.5mm Mix) @ 137 pcf)	1.5	678	$50/ton	$33,900
321.01300 Asphalt Concrete (19mm Mix) @ 145 pcf	5.0	2,393	$32/ton	$76,576
329.01000 Bituminous Tack Coat, (0.07 gal/sq yd)	-	9	$350/ton	$3,150
310.03300 Aggregate Base Course, (135 pcf)	8.0	3,564	$8/ton	$28,512
			Total Cost per lane mile	$142,138

Alternative 10 – AC over AB/Import over Existing AB				
Pavement Construction Item	**Section Thickness (in)**	**Quantity**	**Unit Price**	**Cost per lane mile**
321.01200 Asphalt Concrete (12.5mm Mix) @ 145 pcf	1.5	718	$32/ton	$22,976
321.01300 Asphalt Concrete (19mm Mix) @ 145 pcf	4.5	2,153	$32/ton	$68,896
329.01000 Bituminous Tack Coat (0.07 gal/sq yd)	-	9	$350/ton	$3,150
310.03300 Aggregate Base Course (135 pcf)	12.0	5,346	$8/ton	$42,768
			Total Cost per lane mile	$137,790

6.6 RECOMMENDATIONS

The Alternative 10 – AC over AB/Import over Existing AB appears to be the most economical choice for reconstruction of the existing MC85 pavement. However, given the relative minor cost differential between Alternatives 9 and 10, and the fact that MCDOT prefers that asphalt rubber be used as the surface coarse, it is recommended that Alternative 9 be utilized. The use of import soils versus placement of additional AB to accommodate the planned profiles changes along MC 85 should be based on the quantities involved and the difficulty associated with placement of soil between existing and new AB in combination with varying existing and proposed roadway profiles.

The cost analysis indicates that Alternative 6 - AC and AB over lime stabilized subbase is the most economical alternative for new construction (widening) of the two-mile design segment. However, as the use of an asphalt rubber surface is preferred, Alternative 2 – asphalt rubber over AC over AB over lime stabilized subgrade, would be the preferred choice. It may also be preferable to match the AR, AC and AB sections for Alternative 2 with that of Alternative 9 in order to accommodate construction. Though more costly, this will result in added benefit for the widened section of pavement.

For reconstruction and widening of the cross-road pavements (where AR is not currently utilized), the Alternative 10 section is recommended. As the scope of work for this project did not include an investigation of the pavement subgrade of the cross-roads, this recommendation may be conservative relative to what materials actually exist. However, given the lack of data and the belief that the subgrade conditions are similar to what was encountered along MC 85, the recommendation is likely warranted. As with MC 85, it is recommended that the subgrade soils located within the limits of pavement widening be modified with a 12-inch layer of lime stabilized base.

It is recommended that any driveways associated with this project be constructed with a minimum section of 4 inches AC over 6 inches AB.

7.0 MATERIAL SOURCES

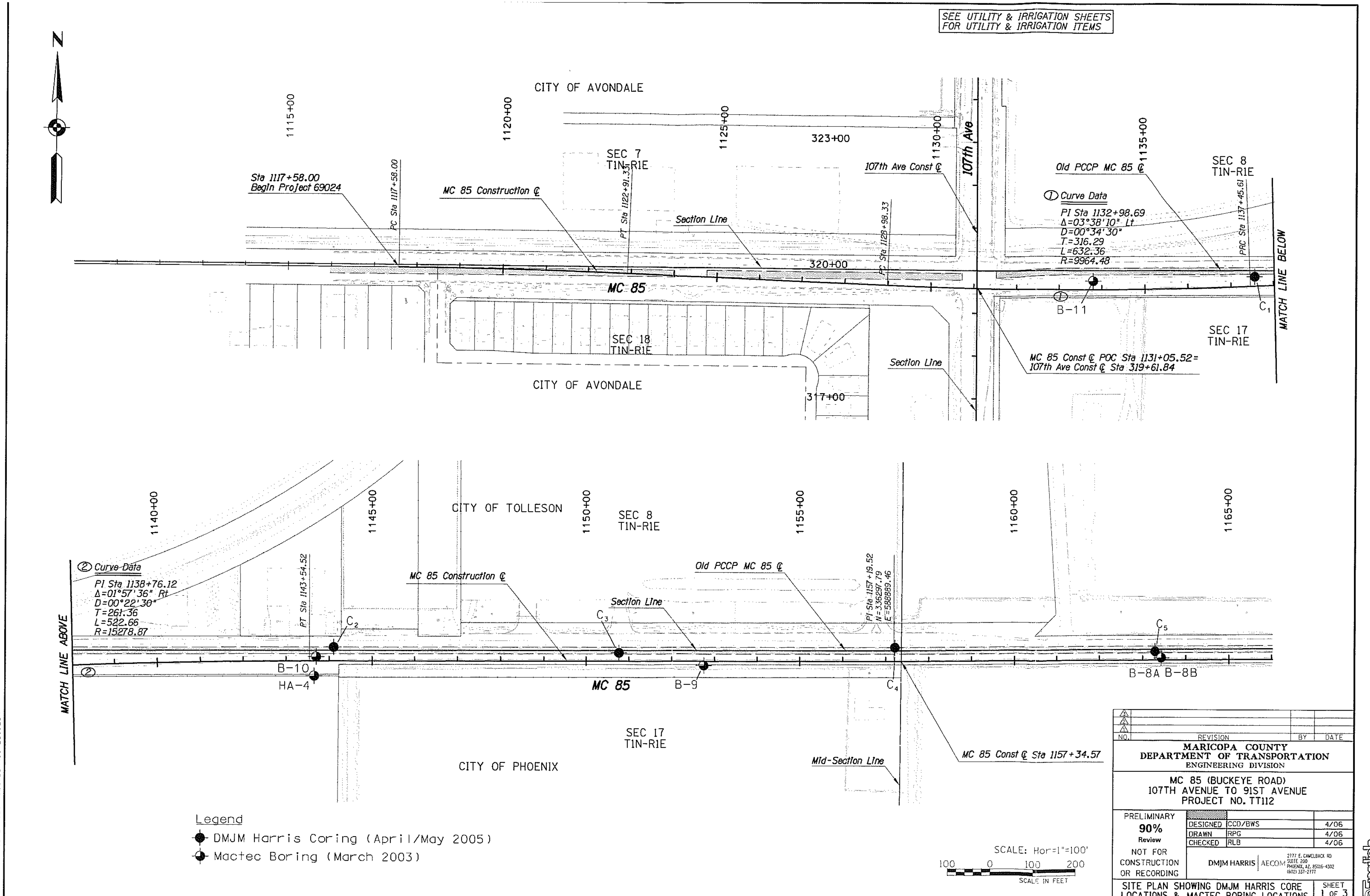
Although there are material sources known to exist near this project, there is currently no designated source for borrow or aggregates within the project limits. Fills imported from other sites should contain no debris or other deleterious or hazardous materials, and meet a minimum correlated R-value criteria of 30.

Asphalt concrete should be as specified in Section 321, 329, 710 and 711 of the MAG Specifications (1998 includes updates through 2005). The Superpave mix design method is recommended, though the surface coarse may be better suited to the Marshall mix. Asphalt rubber should be as specified in Section 325 of the current MAG Specifications. The Aggregate Base shall be as specified in Section 702 of the current MAG Specifications.

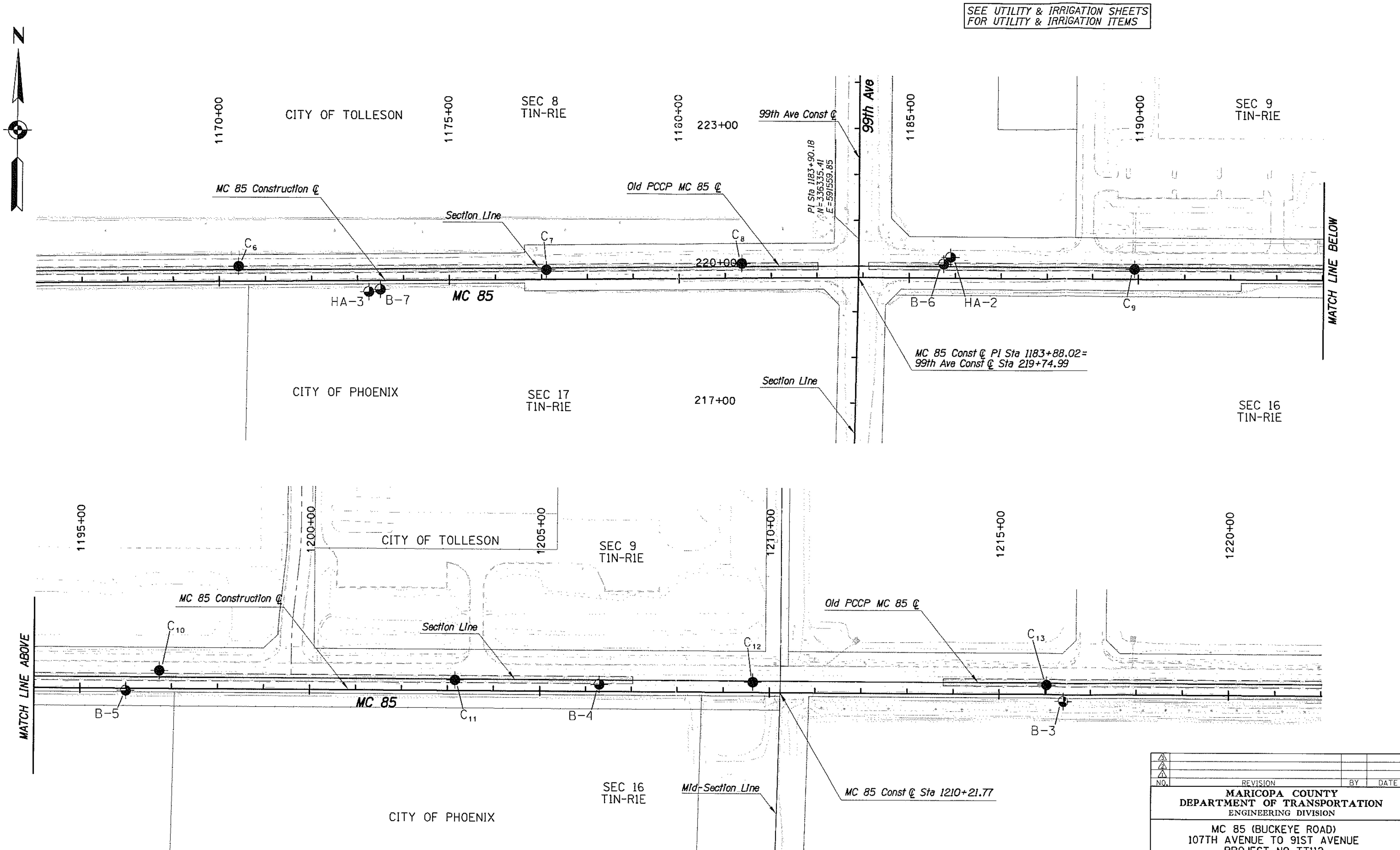
8.0 CLOSURE

The recommendations presented in this report are based on a limited number of small diameter test corings, review of a geotechnical investigation performed by others, our understanding of this project and our general experience in the project area. The subsurface conditions identified are based on the conditions encountered only at the specific test bore and pavement core locations and it is anticipated that the subsurface conditions will vary between test locations.

APPENDIX A – SITE PLAN



SEE UTILITY & IRRIGATION SHEETS FOR UTILITY & IRRIGATION ITEMS
N
CITY OF AVONDALE
1115+00
1120+00
1125+00
1130+00
1135+00
323+00
320+00
317+00
SEC 7 T1N-R1E
SEC 8 T1N-R1E
SEC 18 T1N-R1E
SEC 17 T1N-R1E
107th Ave
Sta 1117+58.00 Begin Project 69024
PC Sta 1117+58.00
MC 85 Construction ℄
PT Sta 1122+91.33
Section Line
PC Sta 1128+98.33
107th Ave Const ℄
Old PCCP MC 85 ℄
PRC Sta 1137+45.61
① Curve Data
PI Sta 1132+98.69
Δ=03°38'10" Lt
D=00°34'30"
T=316.29
L=632.36
R=9964.48
MC 85
B-11
C1
MATCH LINE BELOW
MC 85 Const ℄ POC Sta 1131+05.52= 107th Ave Const ℄ Sta 319+61.84
CITY OF AVONDALE
CITY OF TOLLESON
1140+00
1145+00
1150+00
1155+00
1160+00
1165+00
SEC 8 T1N-R1E
② Curve Data
PI Sta 1138+76.12
Δ=01°57'36" Rt
D=00°22'30"
T=261.36
L=522.66
R=15278.87
MATCH LINE ABOVE
PT Sta 1143+54.52
C2
MC 85 Construction ℄
C3
Section Line
Old PCCP MC 85 ℄
PI Sta 1157+19.52
N=336297.79
E=588889.46
C5
B-10
HA-4
MC 85
B-9
C4
B-8A B-8B
SEC 17 T1N-R1E
CITY OF PHOENIX
Mid-Section Line
MC 85 Const ℄ Sta 1157+34.57
Legend
DMJM Harris Coring (April/May 2005)
Mactec Boring (March 2003)
SCALE: Hor=1"=100'
100 0 100 200
SCALE IN FEET
NO. REVISION BY DATE
MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION
MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. TT112
PRELIMINARY
90%
Review
NOT FOR CONSTRUCTION OR RECORDING
DESIGNED CCD/BWS 4/06
DRAWN RPG 4/06
CHECKED RLB 4/06
DMJM HARRIS | AECOM
SITE PLAN SHOWING DMJM HARRIS CORE LOCATIONS & MACTEC BORING LOCATIONS
SHEET 1 OF 3
TRACS NO.
4/25/2006 1:34:49 PM
English



Legend

- DMJM Harris Coring (April/May 2005)
- Mactec Boring (March 2003)

SCALE: Hor=1"=100'

100 0 100 200

SCALE IN FEET

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. TT112

PRELIMINARY
90%
Review
NOT FOR CONSTRUCTION OR RECORDING

DESIGNED	CCD/BWS	4/06
DRAWN	RPG	4/06
CHECKED	RLB	4/06

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

SITE PLAN SHOWING DMJM HARRIS CORE LOCATIONS & MACTEC BORING LOCATIONS

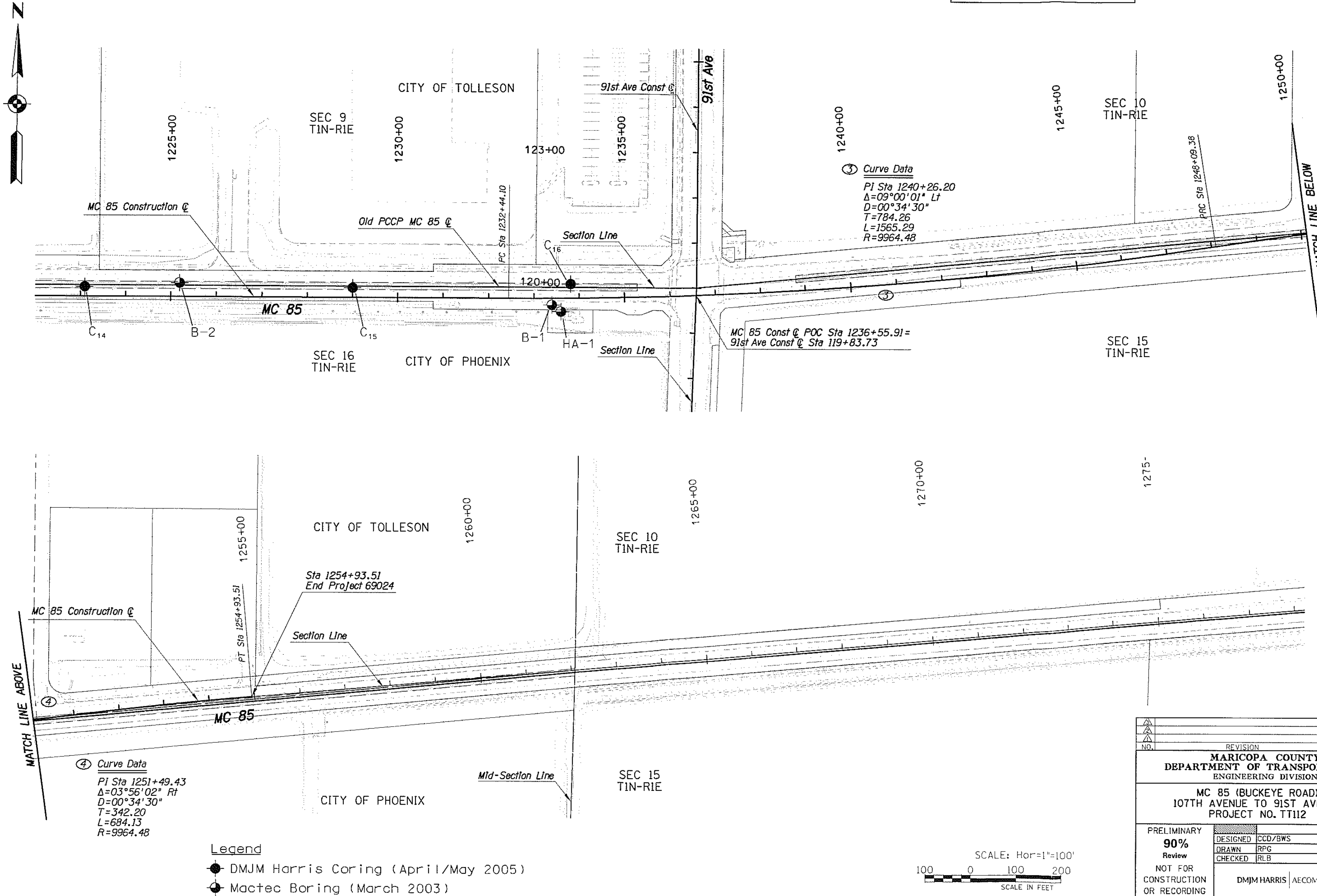
SHEET 2 OF 3

TRACS NO.

4/25/2006 1:35:37 PM
N:\64901PROD\EXHIBIT\GEOTECH\SITE02.DGN

English

SEE UTILITY & IRRIGATION SHEETS
FOR UTILITY & IRRIGATION ITEMS



Legend
- DMJM Harris Coring (April/May 2005)
- Mactec Boring (March 2003)

SCALE: Hor=1"=100'
100 0 100 200
SCALE IN FEET

NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

MC 85 (BUCKEYE ROAD)
107TH AVENUE TO 91ST AVENUE
PROJECT NO. TT112

PRELIMINARY
90%
Review

NOT FOR CONSTRUCTION OR RECORDING

DESIGNED	CCD/BWS	4/06
DRAWN	RPG	4/06
CHECKED	RLB	4/06

DMJM HARRIS | AECOM
2777 E. CAMELBACK RD
SUITE 200
PHOENIX, AZ. 85016-4302
(602) 331-2777

SITE PLAN SHOWING DMJM HARRIS CORE LOCATIONS & MACTEC BORING LOCATIONS

SHEET 3 OF 3

TRACS NO.

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English

APPENDIX B – PAVEMENT ANALYSIS

WORKSHEET FOR CALCULATING RESILIENT MODULUS OF SUBGRADE, MEAN, DESIGN, AND CONSTRUCTION CONTROL R-VALUES

(Based on Section 202.02, Subsections F, G, H, I of

Arizona Department of Transportation, Materials Preliminary Engineering and Design Manual, 1989)

PROJECT: MC 85, 91st Ave to 107th Ave

No.: 6490.0000

ENTER LABORATORY TEST DATA IN APPROPRIATE CELLS-CLEAR CELLS IF NO DATA

R-VALUE TEST RESULTS:		GRADATION/P.I. TEST RESULTS:		Note: if sample is non plastic, enter 0 for P.I.		
SAMPLE I.D. Boring-(Depth)	R-VALUE @ 300 psi (R_t)	SAMPLE I.D. Boring-(Depth)	% Passing No. 200 Sieve	Plasticity Index	Correlated R-Value	Resilient Modulus
1		4.0-5.0	53.8	16	25	**15143**
2		4 0-5.0	88	20	14	**8842**
3		4 0-5.0	57.4	27	16	**9911**
4		4.0-5.0	93	22	12	**7958**
5		4 0-5.0	75.9	16	19	**11453**
6		4.0-5.0	76.9	29	11	**7684**
7		4 0-5.0	77.6	24	13	**8758**
9		4.0-5.0	79.2	30	10	**7333**
10		4.0-5 0	68.9	23	16	**9893**
HA1	7	0-3.0	72	19	18	**10853**
HA2	9	0.3.0	55.2	19	22	**13306**
HA3	7	0-3.0	72.4	19	17	**10803**
HA4	19	0-3.0	61.1	15	24	**14272**
					NO VALUE	NO VALUE
					NO VALUE	NO VALUE
					NO VALUE	NO VALUE
					NO VALUE	NO VALUE
					NO VALUE	NO VALUE
					NO VALUE	NO VALUE
					NO VALUE	NO VALUE
					NO VALUE	NO VALUE
number of actual R-Values, N_t=	4			number of correlated R-Values, N_c=	13	13
mean of the actual R-Values, R_t=	10.50			mean of the correlated R-Values, R_c=	16.68	10478
standard deviation of actual R-Values, σ_t=	5.74			standard deviation of correlated R-Values, σ_c=	4.86	2511.72
min	7			min	10	MCDOT<8000
max	19			max	25	Standard Deviation ok

No adjustment, std deviation <10

MEAN R-VALUE FROM TEST DATA:	
R_{mean}=	**15.56**

RESILIENT MODULUS DETERMINATION:	
Enter seasonal variation factor (SVF) from ADOT reference	
SVF=	**1.0**

Resilient Modulus, M_R=	**9830**	psi

IF DESIRED, ALTERNATIVELY ENTER A CHOSEN DESIGN R-VALUE:		
Enter Design R-value:	25	15
Design Resilient Modulus, M_R=	14900	9550

CONSTRUCTION CONTROL R-VALUE (R_{CC}) DETERMINATION:	
** Critical t-Value (90%) for N_C-1 Correlated R-Values tested:	1.356
CONSTRUCTION CONTROL R-VALUE (R_{CC}):	**10.1**

WORKSHEET FOR CALCULATION OF ESAL LOADING ESTIMATES

PROJECT: MC 85, 107th Ave to 91st Ave
No.: 046106490.0000

CUMULATIVE TRAFFIC VOLUME ESTIMATE THRU YEAR:	2026
DESIGN PERIOD, END YEAR:	2026
DESIGN/ASSUMED INITIAL YEAR OF SERVICE:	2006

LOCATION/DESIGN SEGMENT	DESIGN PAVEMENT TYPE (enter FLEX or RIGID)	DESIGN PERIOD CUMULATIVE TWO-WAY TRAFFIC VOLUME, (ΣTV) [millions]	DESIGN LANE ALLOWABLE VALUE** Dl	DIRECTIOAL DISTRIBUTION FACTOR Dd	% PASSENGER CARS	% HEAVY TRUCKS	% GROWTH RATE	GROWTH FACTOR	**DESIGN PERIOD** TOTAL ONE-WAY 18-kip ESALs, W_{18} (millions)
Mactec -MC 85 - 91st Ave to 107th Ave	Flex	26.063	0.7	0.5	86.0	14.0	5.4	34	9.122
MC 85 -107th Ave to 91th Ave	Flex	33.497	0.7	0.5	83.0	17.0	2.25	25	11.724
MC 85 - 107th Ave to 91st Ave Option- 2	Flex	27.609	0.7	0.5	86.0	14.0	2.25	25	9.663
91st Ave	Flex	26.047	0.9	0.5	83.0	17.0	5.5	35	11.721
99th Ave	Flex	24.500	0.9	0.5	83.0	17.0	7.0	41	11.025
107th Ave	Flex	20.838	0.9	0.5	83.0	17.0	5.5	35	9.377

** See following table for values

# of Traffic Lanes	Value
1	1.0
2	0.9
3	0.7
4 or more	0.6

ROW	Item	2003-2005 ADT 2-way	2026 ADT 2-way	MACTEC 2-Way
11	MC85	18,000	28,778	12,270
12	MC85	18,000	28,778	11,505
13	MC85	18,000	28,778	11,808
14	91st Ave	10,000	25,921	4,985
15	99th Ave	8,000	35,746	6,519
16	107th Ave	8,000	25,999	4,985

ENTER THE DESIGN/ASSUMED PARAMETER VALUES IN WHITE CELLS FOR EACH DESIGN SECTION BELOW:			
DESIGN SECTION:	**Mactec Design 1/Full Depth**	DESIGN SECTION:	**Alt 1- Rubberized AC & AB over Import**
Initial Design Serviceability Index, p_0	4.5	Initial Design Serviceability Index, p_0	4.5
Design Terminal Serviceability Index, p_t	2.5	Design Terminal Serviceability Index, p_t	2.5
Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0	Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0
Reliability, R (%)	95	Reliability, R (%)	95
Standard Normal Deviate, Z_R	-1.645	Standard Normal Deviate, Z_R	-1.645
Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45	Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45
Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	9.500	Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724

ENTER TRIAL PAVEMENT SECTION THICKNESSES (inches) AND APPROPRIATE COEFFICIENTS TO DETERMINE SN:

MANIPULATE LAYER THICKNESSES TO DESIGN ADEQUATE PAVEMENT SECTION - CHECK RESULTS BELOW TO VERIFY ADEQUACY OF PAVEMENT SECTION FOR GIVEN DATA AND SUBGRADE MODULUS

DESIGN SECTION:		**Mactec Design 1/Full Depth**		DESIGN SECTION:		**Alt 1- Rubberized AC & AB over Import**	
MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)	MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)
Asphaltic Rubber (AR)	0.61		1.5	Asphaltic Rubber (AR)	0.61		1.5
Asphaltic Concrete (AC)	0.42		8.5	Asphaltic Concrete (AC)	0.42		5.0
Treated Subgrade				Aggregate Base (AB)	0.12	0.93	10.0
Aggregate Base (AB)	0.12	0.93	0.0	Import		0.93	24.0
LSSubBase/Other	0.16	0.93	0.0	Aggregate SubBase/Other			
PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.49	PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.13
ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:				ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:			
R=17	M_R (psi) =	10,393		R=25	M_R (psi) =	14,900	
	$\log_{10}W_{18}$=	6.977723605			$\log_{10}W_{18}$=	7.069075099	
	right side eq'n	6.994324649			right side eq'n	7.110652228	
ADEQUATE SECTION?		**YES**		ADEQUATE SECTION?		**YES**	

ENTER THE DESIGN/ASSUMED PARAMETER VALUES IN WHITE CELLS FOR EACH DESIGN SECTION BELOW:			
DESIGN SECTION:	**Mactec Design 2/Full Depth**	DESIGN SECTION:	**Alt 2 -Rubberized AC & AB over LSS**
Initial Design Serviceability Index, p_0	4.5	Initial Design Serviceability Index, p_0	4.5
Design Terminal Serviceability Index, p_t	2.5	Design Terminal Serviceability Index, p_t	2.5
Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0	Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0
Reliability, R (%)	95	Reliability, R (%)	95
Standard Normal Deviate, Z_R	-1.645	Standard Normal Deviate, Z_R	-1.645
Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45	Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45
Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	5.000	Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724

ENTER TRIAL PAVEMENT SECTION THICKNESSES (inches) AND APPROPRIATE COEFFICIENTS TO DETERMINE SN:

MANIPULATE LAYER THICKNESSES TO DESIGN ADEQUATE PAVEMENT SECTION - CHECK RESULTS BELOW TO VERIFY ADEQUACY OF PAVEMENT SECTION FOR GIVEN DATA AND SUBGRADE MODULUS

DESIGN SECTION:		**Mactec Design 2/Full Depth**		DESIGN SECTION:		**Alt 2 -Rubberized AC & AB over LSS**	
MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)	MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)
Asphaltic Rubber (AR)	0.61		1.5	Asphaltic Rubber (AR)	0.61		1.5
Asphaltic Concrete (AC)	0.42		7.5	Asphaltic Concrete (AC)	0.42		3.5
Aggregate Base (AB)	0.12	0.93	0.0	Treated Subgrade			
LSS SubBase	0.16	0.93	0.0	Aggregate Base (AB)	0.12	0.93	6.0
Aggregate SubBase/Other				LimeSSubBase/Other	0.16	0.93	12.0
PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.07	PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.84
ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:				ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:			
R=17	M_R (psi) =	10,393		R=16	M_R (psi) =	9,830	
	$\log_{10}W_{18}$=	6.698970004			$\log_{10}W_{18}$=	7.069075099	
	right side eq'n	6.700164794			right side eq'n	7.173235187	
ADEQUATE SECTION?		**YES**		ADEQUATE SECTION?		**YES**	

ENTER THE DESIGN/ASSUMED PARAMETER VALUES IN WHITE CELLS FOR EACH DESIGN SECTION BELOW:			
DESIGN SECTION:	Alt 3 -Rubberized AC Full Depth over import	DESIGN SECTION:	Alt-5 AC/AB over Import
Initial Design Serviceability Index, p_0	4.5	Initial Design Serviceability Index, p_0	4.5
Design Terminal Serviceability Index, p_t	2.5	Design Terminal Serviceability Index, p_t	2.5
Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0	Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0
Reliability, R (%)	95	Reliability, R (%)	95
Standard Normal Deviate, Z_R	-1.645	Standard Normal Deviate, Z_R	-1.645
Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45	Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45
Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724	Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724

ENTER TRIAL PAVEMENT SECTION THICKNESSES (inches) AND APPROPRIATE COEFFICIENTS TO DETERMINE SN:

MANIPULATE LAYER THICKNESSES TO DESIGN ADEQUATE PAVEMENT SECTION - CHECK RESULTS BELOW TO VERIFY ADEQUACY OF PAVEMENT SECTION FOR GIVEN DATA AND SUBGRADE MODULUS

DESIGN SECTION:		Alt 3 -Rubberized AC Full Depth over import		DESIGN SECTION:		Alt-5 AC/AB over Import	
MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)	MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)
Asphaltic Rubber (AR)	0.61		1.5	Asphaltic Rubber (AR)	0.61		0.0
Asphaltic Concrete	0.42		8.0	Asphaltic Concrete (AC)	0.42		6.0
Import			24.0	Treated Subgrade			
Aggregate Base (AB)	0.12	0.93	0.0	Aggregate Base (AB)	0.12	0.93	14.0
Aggregate SubBase/Other	0.16	0.93	0.0	import		0.93	24.0
PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.28	PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.08

ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:			ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:		
R=25	M_R (psi) =	14,900	R=25	M_R (psi) =	14,900
	$\log_{10}W_{18}$=	7.069075099		$\log_{10}W_{18}$=	7.069075099
	right side eq'n	7.212603217		right side eq'n	7.075700887
ADEQUATE SECTION?		**YES**	ADEQUATE SECTION?		**YES**

ENTER THE DESIGN/ASSUMED PARAMETER VALUES IN WHITE CELLS FOR EACH DESIGN SECTION BELOW:			
DESIGN SECTION:	Alt 4 - Rubberized AC Full Depth over LSS	DESIGN SECTION:	Alt 6 - Option 1 AC/AB over LSS
Initial Design Serviceability Index, p_0	4.5	Initial Design Serviceability Index, p_0	4.5
Design Terminal Serviceability Index, p_t	2.5	Design Terminal Serviceability Index, p_t	2.5
Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0	Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0
Reliability, R (%)	95	Reliability, R (%)	95
Standard Normal Deviate, Z_R	-1.645	Standard Normal Deviate, Z_R	-1.645
Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45	Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45
Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724	Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724

ENTER TRIAL PAVEMENT SECTION THICKNESSES (inches) AND APPROPRIATE COEFFICIENTS TO DETERMINE SN:

MANIPULATE LAYER THICKNESSES TO DESIGN ADEQUATE PAVEMENT SECTION - CHECK RESULTS BELOW TO VERIFY ADEQUACY OF PAVEMENT SECTION FOR GIVEN DATA AND SUBGRADE MODULUS

DESIGN SECTION:		Alt 4 - Rubberized AC Full Depth over LSS		DESIGN SECTION:		Alt 6 - Option 1 AC/AB over LSS	
MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)	MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)
Asphaltic Rubber (AR)	0.61		1.5	Asphaltic Rubber (AR)	0.61		0.0
Asphaltic Concrete	0.42		5.0	Asphaltic Concrete (AC)	0.42		4.0
Import				Aggregate Base (AB)	0.12	0.93	11.0
Aggregate Base (AB)	0.12	0.93	0.0	LSS SubBase	0.16	0.93	12.0
LSS SubBase	0.16	0.93	12.0	Aggregate SubBase/Other			
PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.80	PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.69

ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:			ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:		
R=16	M_R (psi) =	9,830	R=16	M_R (psi) =	9,830
	$\log_{10}W_{18}$=	7.069075099		$\log_{10}W_{18}$=	7.069075099
	right side eq'n	7.147594641		right side eq'n	7.077362587
ADEQUATE SECTION?		**YES**	ADEQUATE SECTION?		**YES**

ENTER THE DESIGN/ASSUMED PARAMETER VALUES IN WHITE CELLS FOR EACH DESIGN SECTION BELOW:

DESIGN SECTION:	Alt 7 - AC Full Depth over import	DESIGN SECTION:	Alt 9- Rubberized AC/AB over Existing AB
Initial Design Serviceability Index, p_0	4.5	Initial Design Serviceability Index, p_0	4.5
Design Terminal Serviceability Index, p_t	2.5	Design Terminal Serviceability Index, p_t	2.5
Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0	Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0
Reliability, R (%)	95	Reliability, R (%)	95
Standard Normal Deviate, Z_R	-1.645	Standard Normal Deviate, Z_R	-1.645
Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45	Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45
Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724	Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724

ENTER TRIAL PAVEMENT SECTION THICKNESSES (inches) AND APPROPRIATE COEFFICIENTS TO DETERMINE SN:

MANIPULATE LAYER THICKNESSES TO DESIGN ADEQUATE PAVEMENT SECTION. CHECK RESULTS BELOW TO VERIFY ADEQUACY OF PAVEMENT SECTION FOR GIVEN DATA AND SUBGRADE MODULUS

DESIGN SECTION:		Alt 7 - AC Full Depth over import		DESIGN SECTION:		Alt 9- Rubberized AC/AB over Existing AB	
MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)	MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)
Asphaltic Rubber (AR)	0.61			Asphaltic Rubber (AR)	0.61		1.5
Asphaltic Concrete (AC)	0.42		10.0	Asphaltic Concrete (AC)	0.42		5.0
Aggregate Base (AB)	0.12	0.93		Treated Subgrade			
Import	0.16	0.93		Aggregate Base (AB)	0.12	0.93	8.0
Aggregate SubBase/Other				LimeSubBase	0.10	0.93	0.0
PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.20	PAVEMENT SECTION STRUCTURAL NUMBER, SN:			3.91

ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:			ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:		
R=25	M_R (psi) =	14,900	R=30	M_R (psi) =	17,875
	$\log_{10}W_{18}$=	7.069075099		$\log_{10}W_{18}$=	7.069075099
	right side eq'n	7.159797004		right side eq'n	7.131114674
ADEQUATE SECTION?		YES	ADEQUATE SECTION?		YES

ENTER THE DESIGN/ASSUMED PARAMETER VALUES IN WHITE CELLS FOR EACH DESIGN SECTION BELOW:

DESIGN SECTION:	Alt 8 - AC Full Depth over LSS	DESIGN SECTION:	Alt 10- AC/AB over Existing AB
Initial Design Serviceability Index, p_0	4.5	Initial Design Serviceability Index, p_0	4.5
Design Terminal Serviceability Index, p_t	2.5	Design Terminal Serviceability Index, p_t	2.5
Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0	Design Serviceability Loss, ΔPSI (=p_0-p_t)	2.0
Reliability, R (%)	95	Reliability, R (%)	95
Standard Normal Deviate, Z_R	-1.645	Standard Normal Deviate, Z_R	-1.645
Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45	Overall Standard Deviation, S_0 (S_0=0.35 for flex pvmt, per ADOT)	0.45
Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724	Estimated Design PeriodTotal 18-kip ESAL Applications, W_{18} (10^6)	11.724

ENTER TRIAL PAVEMENT SECTION THICKNESSES (inches) AND APPROPRIATE COEFFICIENTS TO DETERMINE SN:

MANIPULATE LAYER THICKNESSES TO DESIGN ADEQUATE PAVEMENT SECTION. CHECK RESULTS BELOW TO VERIFY ADEQUACY OF PAVEMENT SECTION FOR GIVEN DATA AND SUBGRADE MODULUS

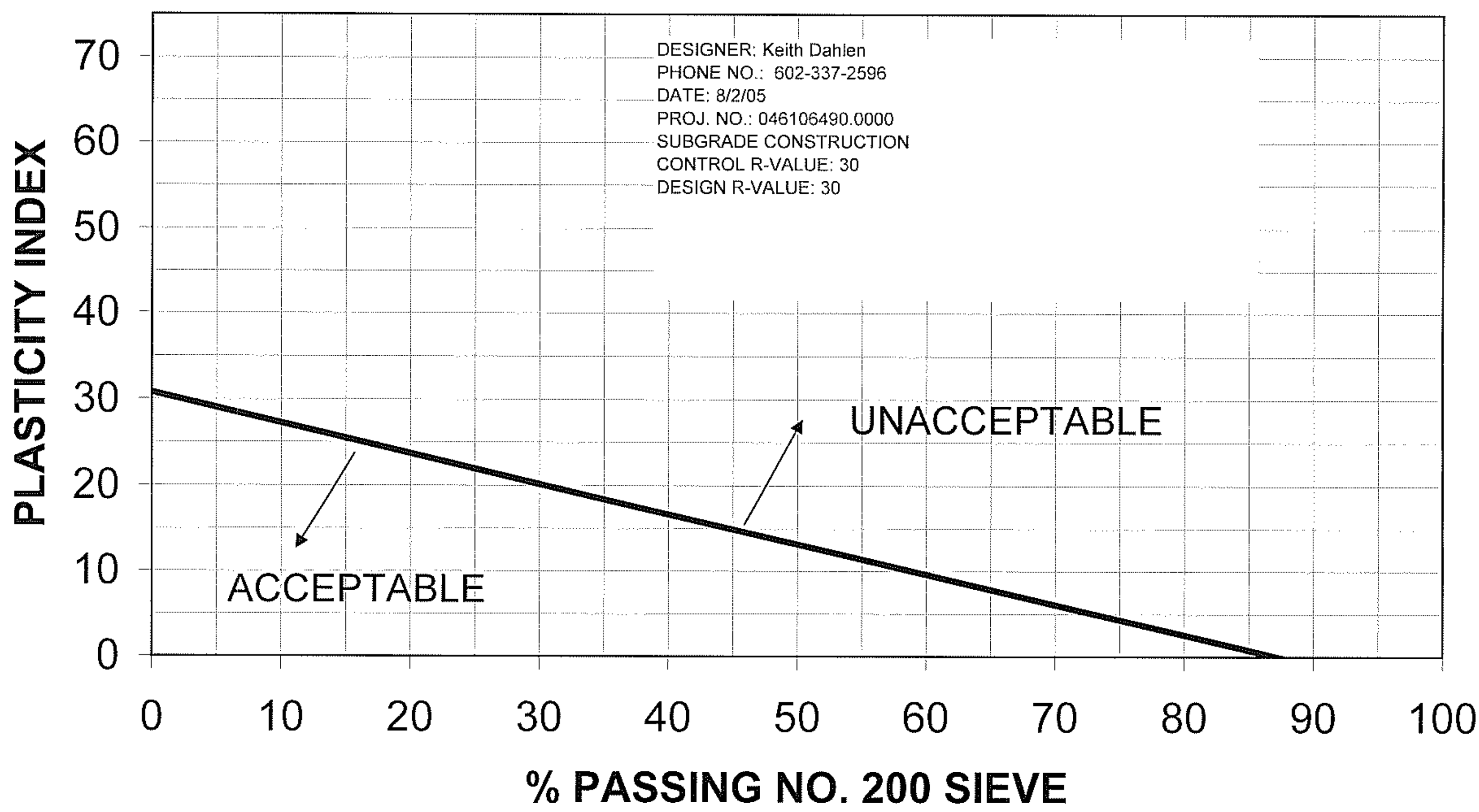
DESIGN SECTION:		Alt 8 - AC Full Depth over LSS		DESIGN SECTION:		Alt 10- AC/AB over Existing AB	
MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)	MATERIAL	STRUCTURAL LAYER COEFFICIENT	DRAINAGE COEFFICIENT, M_i	LAYER THICKNESS (inches)
Asphaltic Rubber (AR)	0.61			Asphaltic Rubber (AR)	0.61		0.0
Asphaltic Concrete (AC)	0.42		7.0	Asphaltic Concrete (AC)	0.42		6.0
Aggregate Base (AB)	0.12	0.93		Import			
Existing SubBase	0.16	0.93	12.0	Aggregate Base (AB)	0.12	0.93	12.0
Aggregate SubBase/Other				Aggregate SubBase/Other	0.16	0.93	0.0
PAVEMENT SECTION STRUCTURAL NUMBER, SN:			4.73	PAVEMENT SECTION STRUCTURAL NUMBER, SN:			3.86

ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:			ENTER THE DESIGN RESILIENT MODULUS OF SUBGRADE:		
R=16	M_R (psi) =	9,830	R=30	M_R (psi) =	17,875
	$\log_{10}W_{18}$=	7.069075099		$\log_{10}W_{18}$=	7.069075099
	right side eq'n	7.098657763		right side eq'n	7.094763427
ADEQUATE SECTION?		YES	ADEQUATE SECTION?		YES

APPENDIX C – SUBGRADE ACCEPTANCE CHART

SUBGRADE ACCEPTANCE CHART

MC85, 107TH AVENUE TO 91ST AVENUE



APPENDIX PAV-D

Ninyo and Moore Report

Ninyo & Moore

Geotechnical and Environmental Sciences Consultants

GEOTECHNICAL EVALUATION
MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE
MARICOPA, ARIZONA

PREPARED FOR:

Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

PREPARED BY:

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
3001 South 35th Street, Suite 6
Phoenix, Arizona 85034

September 28, 2010
Project No. 601301002

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

September 28, 2010
Project No. 601301002

Mr. John Shi
Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

Subject: Geotechnical Evaluation
MC-85 Roadway Improvements
75th Avenue to 91st Avenue
Maricopa County, Arizona

Dear Mr. Shi:

In accordance with your authorization, we have performed a geotechnical evaluation for the above-referenced project in Maricopa County, Arizona. This report presents our geotechnical findings, conclusions, and recommendations for the design and construction of the subject project.

We appreciate the opportunity to be of service to you during this phase of the project. If you have any questions or comments regarding this report, please call.

Sincerely,
NINYO & MOORE

Marek J. Kasztalski, P.E., P.M.P., LEED A.P.
Senior Geotechnical Engineer

Steven D. Nowaczyk, P.E.
Principal Engineer

Registered Professional Engineer (Civil)
CERTIFICATE NO. 34866
STEVEN D. NOWACZYK
Date Signed 9.28.10
ARIZONA U.S.A.
EXPIRES 6/30/12

SV/MJK/SDN/tns

Distribution: (3) Addressee (3 hard copy & via e-mail)

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Appendices

1. INTRODUCTION

In accordance with your authorization, we have performed a geotechnical evaluation for the proposed roadway improvements along Maricopa County (MC)-85 Road from 75th Avenue to 91st Avenue in Maricopa County, Arizona. The purpose of our evaluation was to assess the general subsurface conditions along the alignment of the proposed roadway improvements in order to formulate geotechnical recommendations for the design and construction. Maricopa County Department of Transportation Roadway Design Manual (MCDOT-RDM) guidelines were followed in the design of new flexible pavement for this project. This report presents the results of our evaluation and our geotechnical conclusions and recommendations regarding the proposed construction.

2. SCOPE OF SERVICES

Ninyo and Moore's geotechnical scope of services for this project included:

- Reviewing available background data, including topographic maps, geologic data, and aerial photographs of the site.
- Reviewing and utilizing information from the Pavement Engineering Report by Terracon, dated May 22, 2003, which was part of the Final Design Concept Report (DCR) prepared by Parsons Brinckerhoff and dated October 14, 2003.
- Establishing boring locations in the field and arranging for the mark out of underground utilities through Arizona Blue Stake.
- Drilling, logging and sampling 11 exploratory soil borings along the roadway alignment. The target depth of these borings was approximately 20 feet below ground surface (bgs). The borings are presented in Appendix A.
- Conducting eight field resistivity measurements of the subsurface materials. Results of the field resistivity testing are presented in Appendix C.
- Conducting laboratory testing of selected soil samples obtained from the borings to evaluate in-situ moisture content and dry density, grain size analysis, Atterberg limits, response-to-wetting behavior (collapse/swell) and corrosivity characteristics (including pH, minimum electrical resistivity, sulfate content, and chloride content) and R-value tests. The results of the laboratory testing performed are presented on the boring logs in Appendix B of this report.

- Preparing this report presenting our findings, conclusions, and recommendations regarding the design and construction of the proposed roadway improvements.

3. SITE DESCRIPTION

The project site is located along a 2-mile roadway segment of MC-85 between 75th Avenue and 91st Avenue, in Maricopa County, Arizona. The site lies within Sections 10, 11, 14, and 15 within Township 1 North, Range 1 East. The approximate location of the site is depicted on Figure 1. At the time of our evaluation, the study consisted of a two-lane asphalt concrete (AC) paved roadway surrounded by residential and commercial developments on the north and south sides.

According to the *Fowler*, Arizona-Maricopa Co., 7.5-Minute United States Geological Survey (USGS) Topographic Quadrangle Map (1982), the site elevation ranges from approximately 1,000 feet above mean sea level (MSL) at its western limits to approximately 1,020 feet MSL at its eastern limits. The project area typically slopes from the northeast down to the southwest with approximately 20 feet of topographic relief along the project corridor.

Four aerial photographs were reviewed for this project. A 1997 United States Department of Agriculture (USDA) aerial photograph depicted the project site as being an AC paved roadway surrounded by agricultural land to the north and south sides of the roadway, and scattered residential buildings on the agricultural land. A 1999 *Landiscor's Phoenix Real Estate Photo Book* aerial photograph depicted some commercial development along the project corridor. A 2005 Maricopa County Flood Control District aerial photograph depicted the site with additional commercial development, as well as residential development along the sides of the roadway. A 2007 FCDMC aerial photograph depicted several industrial buildings and a gas station constructed adjacent to the north side of MC-85. This photograph depicted the site as being similar to its current condition.

4. PROPOSED CONSTRUCTION

The project consists of the design and construction of the improvements for the segment of MC-85 between 75th Avenue and 91st Avenue in Maricopa County, Arizona. The improvements include widening of the existing roadways in order to increase the capacity, improve the vertical and horizontal geometry of the roadway in order to meet the design speed, improve the onsite drainage, and increased intersection efficiency. The project also includes new utility lines that will be located on the north side of the roadway and will have an invert depth of approximately 15 feet. This report addresses the pavement considerations. A separate data report that addresses the utility lines is presented under a separate cover letter.

5. FIELD EXPLORATION AND LABORATORY TESTING

On June 26 and July 13, 2006, Ninyo & Moore conducted a subsurface evaluation along the proposed alignment in order to evaluate the existing subsurface conditions and to collect soil samples for laboratory testing. This exploration consisted of drilling, logging, and sampling eleven exploratory borings. The borings were advanced using a CME-75 truck-mounted drill rig equipped with hollow-stem-augers. The 11 borings extended to depths ranging from 17 to 20 feet bgs.

Ninyo & Moore personnel logged the borings in general accordance with the Unified Soil Classification System (USCS) and American Society for Testing and Materials (ASTM) D 2488 by observing cuttings and drive samples. Collected ring samples from selected intervals were trimmed in the field, wrapped in plastic bags, and placed in cylindrical plastic containers to retain in-place moisture conditions. Similarly, the Standard Penetration Test (SPT) and bulk samples were collected at selected intervals and sealed in plastic bags to retain their approximate in-place moisture. Detailed descriptions of the soils encountered in our boreholes are presented on the boring logs in Appendix A. The approximate locations of the borings are shown on the Boring and Field Resistivity Lines Location Map (Figure 2). Figure 2 also contains the approximate locations of the borings advanced by Terracon (2003) as part of the DCR.

On June 30, 2006, representatives from our office conducted soil resistivity measurements of the subsurface materials. Soil resistivity information of the subsurface materials was obtained at the site near the intersection of 75th Avenue and MC-85, near the intersection of 80th Avenue and MC-85, near the intersection of 79th Avenue and MC-85, and near the intersection of 83rd Avenue and MC-85 (Figure 2). The data was collected in general accordance with ASTM G57 using an L&R MINIRES Resistivity Meter and four electrodes in a Wenner array configuration. Soil resistivity measurements were collected at electrode spacings of 2, 5, 10, 20, 30 50, and 75 feet along surveyed traverses. The results of the resistivity surveys and details regarding the data collection are presented in Appendix C. In general, the resistivity data collected are of good quality with good to fair agreement between orthogonal traverses indicating fairly homogenous to slightly heterogeneous soil electrical properties at the locations we surveyed. Note that several of our resistivity measurements indicate that the materials we surveyed are potentially corrosive ferrous metals.

The soil samples obtained during the drilling operations were transported to our laboratory in Phoenix for testing and evaluation. The laboratory testing included in-situ moisture content and dry density, grain-size distribution, Atterberg limits, response-to-wetting behavior (collapse/swell), corrosivity characteristics (including pH, minimum electrical resistivity, sulfate content, and chloride content) and R-value tests. The results of the in-situ moisture and dry density tests are shown on the boring logs presented in Appendix A. Detailed descriptions of our laboratory test methods and the results of the tests are presented in Appendix B.

6. GEOLOGY AND SUBSURFACE CONDITIONS

Our findings regarding the geology and groundwater conditions along the proposed alignments are provided in the following sections.

6.1. Geologic Setting

The project site is located in the Sonoran Desert Section of the Basin and Range Physiographic Province, which is typified by broad alluvial valleys separated by steep, discontinuous, subparallel mountain ranges. The mountain ranges generally trend north-south and northwest-southeast. The basin floors consist of alluvium with thickness extending to several thousands of feet.

The basins and surrounding mountains were formed approximately 10 to 13 million years ago during the mid- to late-Tertiary age. Extensional tectonics resulted in the formation of horsts (mountains) and grabens (basins) with vertical displacement along high-angle normal faults. Intermittent volcanic activity also occurred during this time. The surrounding basins filled with alluvium from the erosion of the surrounding mountains, as well as from deposition from rivers. Coarser-grained alluvial material was deposited at the margins of the basins near the mountains.

The surficial geology of the site generally consists of Holocene (<10,000 years) to Middle Pleistocene (<790,000 years) alluvial deposits consisting of well-sorted silt, sand, gravel, and cobbles with Stage I to Stage II caliche cementation (Demsey, 1989).

According to the USDA National Resources Conservation Service (NRCS) Soil Survey, well-drained soils of clay, silt, and sand are at the surface of the project site. These soils exhibit characteristics such as low strength, shrink-swell potential, and moderate permeability. Furthermore, excavation sidewalls may cave in due to on-site cohesionless soils.

6.2. Subsurface Conditions

Our knowledge of the subsurface conditions at the project site is based on our field exploration and laboratory testing and our understanding of the general geology of the area. The following sections provide generalized descriptions of the materials encountered in our borings. More detailed descriptions are presented on the boring logs in Appendix A.

6.2.1. Asphalt Concrete and Aggregate Base

Asphalt concrete (AC) was encountered at the surface of each of our borings drilled. The thickness of the AC ranged from approximately 3 to 8 inches. Aggregate base (AB) was encountered beneath the pavement in each of these borings. The AB was typically classified as gravel with sand, and ranged from approximately 7 to 10 inches thick.

6.2.2. Engineered Fill

Engineered fill was encountered below the pavement section in borings B-1, B-2, B-3, and B-5. The fill material generally consisted of clay, silty sand, and clayey sand. The density of the fill material ranged from medium dense to very stiff and extended to depths ranging from approximately 3.5 to 6 feet bgs.

6.2.3. Alluvium

Alluvium was encountered beneath the fill material in borings B-1, B-2, B-3, and B-5 and beneath the AB in borings B-4, and B-6 through B-8 and extended to the explored depth. This material generally consisted of silty sand, silt, clayey sand, clay, and silty gravel. Caliche filaments were encountered at various depths within the borings. Cobbles and possible boulders were noted in our borings.

6.3. Groundwater

Groundwater was not encountered in our borings. Based on well data from the Arizona Department of Water Resources, the approximate depth to groundwater is located about 90 feet bgs or deeper at the site. Groundwater levels can fluctuate due to seasonal variations, irrigation, groundwater withdrawal or injection, and other factors. In general, groundwater is not expected to be a constraint to project design and construction.

7. GEOLOGIC HAZARDS

The following sections describe potential geologic hazards at the site, including land subsidence and earth fissures, faulting and seismicity, and liquefaction.

7.1. Land Subsidence and Earth Fissures

Groundwater depletion due to groundwater pumping has caused land subsidence and earth fissures in numerous alluvial basins in southern Arizona. It has been estimated that subsidence has affected more than 3,000 square miles and has caused damage to a variety of engineered structures and agricultural land (Schumann and Genualdi, 1986). From 1948 to 1983, excessive groundwater withdrawal has been documented in several alluvial valleys where groundwater levels have been reportedly lowered by up to 500 feet. With such large depletions of groundwater, the alluvium has undergone consolidation resulting in large areas of land subsidence.

In Arizona, earth fissures are generally associated with land subsidence and pose an on-going geologic hazard. Earth fissures generally form near the margins of geomorphic basins where significant amounts of groundwater depletion have occurred. Reportedly, earth fissures have also formed due to tensional stress caused by differential subsidence of the unconsolidated alluvial materials over buried bedrock ridges and irregular bedrock surfaces (Schumann and Genualdi, 1986).

Based on our field reconnaissance and review of the referenced material, there are no known earth fissures underlying the subject site. Based on our research, the closest documented earth fissure to the project site is located approximately 8 miles to the northwest of the site, near the base of the White Tank, where the water levels have dropped 300 to 500 feet. Groundwater levels at the project site have dropped up to approximately 100 feet. Continued groundwater withdrawal in the area may result in subsidence and the formation of new fissures or the extension of existing fissures. While the future occurrence of land subsidence and earth fissures cannot accurately be predicted, these phenomena are not expected to be a constraint of this project.

7.2. Faulting and Seismicity

The site lies within the Sonoran Zone, which is a relatively stable tectonic region located in southwestern Arizona, southeastern California, southern Nevada, and northern Mexico (Euge et al., 1992). This zone is characterized by sparse seismicity and few Quaternary faults. Based on our field observations, review of pertinent geologic data and analysis of aerial photographs, faults are not located on or adjacent to the project. The closest fault to the site is the Carefree Fault Zone, located approximately 40 miles to the northeast of the site (Pearthree, 1998). Approximately 2 meters of displacement has occurred along this fault within middle Pleistocene deposits (<750,000 years), but the upper Pleistocene and Holocene deposits (1<250,000 years) are not displaced.

7.3. Liquefaction Potential

Based on the SPT values at the site, the lack of near surface water, and the low ground motion hazard (relatively low ground accelerations), the likelihood or potential for liquefaction is considered to be negligible and is therefore not a design consideration.

8. CONCLUSIONS

Based on the results of our subsurface evaluation, laboratory testing, and data analysis, it is our opinion that the proposed roadway improvements along MC-85 within the project limits are feasible from a geotechnical standpoint, provided that the recommendations of this report are incorporated into the design and construction of the proposed project, as appropriate. Geotechnical considerations include the following:

- The on-site soils should generally be excavatable to expected roadway depths, with earth moving construction equipment in good working condition. However, scattered caliche filaments were encountered in the borings, which could be more difficult to excavate depending on the actual size and degree of cementation encountered during construction. In addition, cobbles and possible boulders were encountered in some of our borings which may result in slower excavation rates.

- Subgrade soils at the project site are primarily clayey soils that exhibit moderate expansive potentials. Therefore, based on the recommendations presented in the MCDOT-RDM, these clayey roadbed subgrade soils under the newly placed pavement aggregate base should be stabilized in place using lime slurry stabilization to a depth of 6 inches.

- Four alternatives for new flexible pavement as presented in this report are suitable for new pavement for this project.
- A mill and overlay is feasible for the existing pavement.
- Imported soils and soils generated from on-site excavation activities can generally be used as engineered fill.
- Groundwater was not observed in our borings. The regional groundwater table in the area is anticipated to be as shallow as 90 feet bgs.
- Corrosivity test results indicate that subgrade soils at the site may be corrosive to ferrous metals, and the sulfate content of the soils present a negligible sulfate exposure to concrete.
- No known or reported geologic hazards are reported underlying or adjacent to the site.

9. RECOMMENDATIONS

Based on our understanding of the project, the following recommendations are provided for the design and construction of this project. If the proposed construction is changed from that discussed in this report, Ninyo & Moore should be contacted for additional recommendations. In general, MCDOT-RDM (2004) Guidelines and Specifications contained in Maricopa Association of Governments (MAG), *Uniform Standard Specifications and Details for Public Works Construction (2006)* were followed in the design of the new flexible pavement for this project.

9.1. Earthwork

The following sections present our earthwork recommendations including our discussions on the material characteristics, grading, fill placement and compaction, and imported fill material.

9.1.1. Site Preparation

Construction areas should be cleared of deleterious materials, including grass, weeds, construction debris, and any other material that might interfere with the performance or progress of the work. These materials, if found along the alignment of the proposed improvements, should be disposed at a legal dumpsite. An earthwork, shrinkage factor of 10 to 20 percent is estimated for the on-site soils.

It may be desirable to recognize utilities, underground and aboveground structures or other features that are near the planned construction, and to survey or document (e.g., photographs, video, official documentation, etc.) their pre-construction condition. The findings of the survey could be used to document any damage to the existing utilities that might result from this construction.

9.1.2. Excavation Characteristics

Our evaluation of the excavation characteristics of the onsite materials is based on the results of our field exploration, laboratory testing and our experience with similar materials. In our opinion, roadway excavation of the near surface soils can be accomplished with earthmoving construction equipment in good operating condition. However, scattered caliche filaments were encountered in our borings, which could be more difficult to excavate depending on the actual size and degree of cementation encountered during construction. In addition, cobbles and possible boulders were encountered in our borings which and could prove to be a hindrance to excavation activities. The contractor should be prepared for such conditions.

The contractor should provide a safely sloped or adequately constructed and braced shoring system, in compliance with Occupational Safety and Health Administration requirements, for employees working in an excavation that may expose them to the danger of moving ground. If material is stored or equipment is operated near an excavation, stronger shoring should be used to resist the extra pressure due to superimposed loads. Care should be taken by the contractor when excavating near existing utilities to protect them from damage.

9.1.3. Subgrade Preparation

We recommend that the new pavement sections be founded on a zone of adequately moisture-conditioned and compacted engineered fill that extends 12 inches below the bottom of the AB layer or until the cobble and boulder layer is encountered, whichever is shallower. This new fill should be placed in new lifts approximately 6 inches in loose thickness and compacted by appropriate mechanical methods, to 95 percent or more relative compaction, in accordance with ASTM D698 at a moisture content generally above optimum. The overexcavation should extend 1 or more feet horizontally beyond the edge of the pavement.

Following the overexcavation as described above, and prior to the placement of new fill, the resulting exposed surface should be carefully evaluated by the geotechnical consultant. Based on this evaluation additional remediation may be needed. This may include scarification of the exposed surface, moisture conditioning and recompaction. The additional remediation, if needed, should be addressed by the geotechnical consultant during the earthwork operations.

After the subgrade has been constructed and brought to grade, the upper 6 inches of the exposed subgrade should then be lime slurry stabilized to a depth of 6 inches, in accordance with the requirements of MAG Section 309. Based on our exploration, there may be isolated areas where sandy soils (PI<10) predominate at subgrade level, for which lime stabilization offers little improvement. At the discretion of the engineer, if those areas are large enough, the requirement for lime stabilization may be waived in those areas.

9.2. Fill Materials

Imported soils and soils form onsite excavation activities (excluding cobbles and large diameter particles) are generally suitable for use as roadway engineered fill. Suitable fill should not include deleterious or organic material (more than 4 percent), clay lumps, construction debris, rock particles, and other non-soil fill materials larger than 3 inches in dimension. This material should be disposed of offsite or in non-structural areas.

Imported roadway fill, if utilized, should be inorganic soils free of debris or fragments larger than 3 inches, which will exhibit an R-value of 20 or more. The geotechnical consultant should evaluate such materials and details of their placement prior to importation. In general, imported clayey soils which are suitable for lime stabilization are preferred under the new aggregate base.

Fill material should be placed in horizontal lifts approximately 6 inches in loose thickness. The fill should be compacted by appropriate mechanical methods, to 95 percent relative compaction, in accordance with ASTM D698 at a moisture content generally near optimum.

9.3. Seismic Design Considerations

Based on a Probabilistic Seismic Hazard Assessment for the Western United States, issued by the USGS (2008), the site is located in a zone where the peak ground accelerations that have a 10, 5, and 2 percent probability of being exceeded in 50 years are 0.04g, 0.05g, and 0.07g respectively. These ground motion values are calculated for "firm rock" sites, which correspond to a shear-wave velocity of approximately 2,500 feet per second in approximately the top 100 feet bgs. Different soil or rock conditions may amplify or de-amplify these values. Seismic design parameters according to the 2006 International Building Code (IBC) are presented in Table 1.

Table 1 – 2006 International Building Code Seismic Design Criteria

Seismic Design Factors	Value
Site Class	D
Site Coefficient, F_a	1.6
Site Coefficient, F_v	2.4
Mapped Spectral Acceleration at 0.2-second Period, S_s	0.170 g
Mapped Spectral Acceleration at 1.0-second Period, S_1	0.059 g
Spectral Acceleration at 0.2-second Period Adjusted for Site Class, S_{MS}	0.272 g
Spectral Acceleration at 1.0-second Period Adjusted for Site Class, S_{M1}	0.142 g
Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	0.181 g
Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	0.095 g

9.4. Corrosion

The corrosion potential of the onsite materials was analyzed in the field and laboratory to evaluate its potential effect on any buried pipelines. Corrosion potential was evaluated using the results of laboratory testing of a near-surface soil sample obtained during our subsurface evaluation that was considered representative of soils at the project site Corrosion potential was also analyzed in the field, results of which are presented in Appendix C.

Laboratory testing consisted of pH, minimum electrical resistivity, and chloride and soluble sulfate contents. The pH and minimum electrical resistivity tests were performed in general accordance with Arizona Test 236b, while soluble sulfate and chloride content tests were performed in accordance with Arizona Test 733 and 736, respectively. The results of the corrosivity tests are presented in Appendix B.

The soil pH values of the sample tested from boring B-1 indicated a pH value of 7.9, which is considered to represent an alkaline environment and the minimum electrical resistivity value measured in the laboratory from this boring was found to be 1,026 ohm-cm, which is considered to be corrosive towards ferrous materials. The chloride content of the samples tested was found to be 47 ppm , and the water soluble sulfate content was found to be 0.0057 percent. The chloride content of the samples indicates that the soils are corrosive to ferrous metals. The water soluble sulfate content of the soils is considered to represent negligible potential for degradation of buried concrete due to sulfate attack.

The results of the laboratory testing indicate that the onsite materials may be corrosive to ferrous metals. Therefore, special consideration should be given to the use of heavy gauge, corrosion protected, underground steel pipe or culverts, if any are planned. As an alternative, plastic pipe or reinforced concrete pipe could be considered. A corrosion specialist should be consulted for further recommendations.

9.5. Concrete

Laboratory chemical tests performed on selected samples from borings B-1 and B-9 were found to be 0.0057 and 0.0055 percent by weight, respectively. Based on the following American Concrete Institute (ACI) table, the on-site soils are considered to have a negligible sulfate exposure to concrete.

Table 2 – Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate exposure	Water soluble sulfate (SO_4) in soil, percent by weight	Sulfate (SO_4) in water (ppm)	Cement type	Maximum water-cementitious material ratio, by weight, normal weight concrete*	Minimum f'_c, normal weight and lightweight concrete, psi
Negligible	$0.00 \leq SO_4 < 0.10$	$0 \leq SO_4 < 150$	—	—	—
Moderate[1]	$0.10 \leq SO_4 < 0.20$	$150 \leq SO_4 < 1500$	II, IP(MS), IS (MS), P(MS), I(PM) (MS), I(SM) (MS)	0.50	4,000
Severe	$0.20 \leq SO_4 < 2.00$	$1500 \leq SO_4 < 10,000$	V	0.45	4,500

Table 2 – Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate exposure	Water soluble sulfate (SO_4) in soil, percent by weight	Sulfate (SO_4) in water (ppm)	Cement type	Maximum water-cementitious material ratio, by weight, normal weight concrete*	Minimum f'_c, normal weight and lightweight concrete, psi
Very severe	SO_4 > 2.00	SO_4 > 10,000	V plus pozzolan[2]	0.45	4,500

*When both Table 4.3.1 ands Table 4.2.2 are considered, the lowest applicable maximum water-cementitious material ratio and highest applicable minimum f'_c shall be used.
[1] Seawater.
[2] Pozzolan that has been determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement.

Based on our experience with similar soil conditions and the Valley practice, we recommend the use of Type II cement for construction of concrete structures at this site. Due to potential uncertainties as to the use of reclaimed irrigation water, or topsoil that may contain higher sulfate contents, pozzolon or admixtures designed to increase sulfate resistance may be considered. The geotechnical consultant should evaluate such materials prior to their placement.

The concrete should have a water-cementitious materials ratio no more than 0.45 by weight for normal weight aggregate concrete. The structural engineer should select the concrete design strength based on the project specific loading conditions. Higher strength concrete may be selected for increased durability, resistance to slab curling, and shrinkage cracking.

9.6. Pavements

The following sections present our design assumptions and recommendations for new flexible pavement along MC-85 from 75th Avenue to 91st Avenue in Maricopa County, Arizona. MCDOT-RDM (2004) Guidelines and Specifications contained within MAG *Uniform Standard Specifications and Details for Public Works Construction (2006)* were followed in the design of new flexible pavement for this project.

9.6.1. Existing Pavement

Based on our field exploration, pavement distress of low to medium severity fatigue, edge cracking, polished aggregate, and longitudinal and transverse cracking were noted at various locations of MC-85 within the project limits. It is our opinion that the various distress features noted on the existing pavement may be the result of repeated traffic loadings, age of pavement, and/or environmental factors. It is our opinion that the distresses noted indicate both structural and functional failure of the pavement at those locations.

The existing pavement indicated structural sections as shown in Table 3 below. The asphalt thickness varied from 3 inches to 8 inches, and the aggregate base ranged in thickness from 5 inches to 10 inches.

Table 3 – Observed Pavement Sections at the Boring Locations

Boring Number	Estimated Total Pavement Thickness (inches)	Estimated AB Thickness (inches)
B-1	7.0	10.0
B-2	6.0	9.0
B-3	6.0	9.0
B-4	5.0	8.0
B-5	8.0	8.0
B-6	3.0	7.0
B-7	8.0	10.0
B-8	8.0	10.0
B-9	7.0	5.0
B-10	7.0	5.0
B-11	7.0	10.0

9.7. New Pavement

The following sections provide design assumptions and recommendations for those areas of MC-85 within the project limits that will be widened. In providing these recommendations, we assumed that AC would be used for the new flexible pavement and subgrade preparation recommendations outlined in this report would be employed.

9.7.1.1. Traffic

Based on information provided by the MCDOT Traffic Count Program and the Design Concept Report prepared by Parsons Brinkerhoff, we understand that the 2005 Average Daily Traffic (ADT) was 19,068 the percentage truck traffic was 15 percent, and the annual growth rate was 5 percent. Based on these parameters the resulting design lane equivalent single axle load (ESAL) was estimated to be approximately 15,000,000 for the year 2026.

9.7.1.2. R-value

The subsurface soils encountered in our borings predominantly consisted of clay, silty sand and silt. The recommended R-value provided below assumes the soil conditions encountered within the borings are representative of the soil conditions within the proposed pavement areas. If during construction, the subgrade is found to vary from the expected soil conditions, we should be contacted so we may re-evaluate our recommended R-value.

Based on MCDOT-RDM Section 10.2.2.1.1.2, the average correlated R-value obtained form seven laboratory tests performed by Ninyo & Moore and Terracon were found to be 21 (<50) and the standard deviation was found to be 2.8 (<10). For purposes of design and new construction, it is assumed that soils located within 3 feet of the finished roadway subgrade will exhibit an average R-value of 20. If the project needs fill from an offsite source, we recommend the soils used for subgrade support should have an R-value of 20 or more.

9.7.1.3. *Resilient Modulus and Drainage Coefficient*

Based on Section 10.2.2.1.1.3 of the MCDOT-RDM, the approximate subgrade soil resilient modulus was calculated to be 13,000 pounds per square inch (psi). A seasonal variation factor (SVF) of 1.0 was used in the design of flexible pavement for the project.

9.7.1.4. *Roadbed Swelling*

Remolded swell laboratory tests conducted by Terracon on select soil samples indicated that the average expansion was approximately 4 percent. Based on the MCDOT-RDM, a 6 inch lime stabilized layer below the AB layer is recommended.

9.7.1.5. *Recommended Asphalt Pavement Sections*

Based on the estimated traffic and the resilient modulus of the subgrade soils, the calculated asphalt pavement sections are presented in Table 5 below. The minimum structural number is 4.42. The AASHTO method was used to evaluate bituminous layer thicknesses and was based on the input parameters presented in Table 4.

Table 4 – Pavement Design Parameters

Design Period	20 years
Average Daily Traffic (Year 2005)	19,068 vehicles
Percent Heavy Trucks:	15%
Growth Rate:	5% per year
Approximate Design ESALs (Year 2026)	15,000,000
Reliability:	95 percent
Overall Deviation:	0.45
Resilient Modulus:	13,000 psi
Initial Serviceability	4.5
Terminal Serviceability:	2.5

The following table presents the layer materials and thicknesses recommended for this project.

Table 5 – Pavement Structural Section Recommendations

Road Name	Layer	Thickness Alternative 1	Thickness Alternative 2	Thickness Alternative 3
MC 85 75th Avenue to 91st Avenue	Rubberized AC	-	-	1.5"
	Bituminous Surface Course 12.5 mm	2.0"	2.0"	2.0"
	Bituminous Base Course 19.0 mm	5.0"	6.0"	3.0"
	Aggregate Base Course MAG 710	5.0"	4.0"	4.0"
	Lime Stabilized Subgrade	6.0"	6.0"	6.0"
	Structural Number	4.50	4.80	4.46
	Cost per square yard	$34.43	$37.48	$32.22

The AB mentioned above should meet Section 710 of the MAG specifications requirements, as shown in Table 6.

Table 6 – Recommended Aggregate Base Gradation

Sieve Size (Per ASTM D422-63 (02))	Percent Passing by Weight
1 – ¼ inch	100
No. 4	38-65
No. 8	25-60
No. 30	10-40
No. 200	3-12
P.I. Max.	5

Aggregate base material should be compacted to a relative compaction of 100 percent or more of the maximum dry density, as evaluated by ASTM D-698, at a moisture content generally not exceeding the optimum moisture content.

9.7.2. Remove and Replace

Our field exploration indicated a pavement structural section of 3 inches of AC over 6 inches of AB at Boring B-6. Based on station numbers as indicated in the Final Design Concept Report (DCR) prepared by Parsons Brinckerhoff on October 14, 2003, we recommend that the existing pavement between Sta. 1293 (approximate) and Sta. 1297 (approximate) be removed and replaced with new pavement as recommended in Section 9.6.1.5 of this report. The subgrade preparation for this new pavement should also be followed as per Section 9.1.3 of this report.

9.7.3. Mill and Overlay

Our visual evaluation of the existing pavement condition indicates that the existing pavement areas should be suitable for a milling and overlaying operation. Within existing pavement areas not planned to be reconstructed, we recommend the pavement areas be milled to a depth of 1.5 inches and overlain with 1.5 inches of hot mix AC.

If cracks larger than ¼ inch wide are observed at the surface of the AC after the milling operation is finished, we recommend that a paving fabric or geotextile be incorporated into the pavement section. The paving fabric or geotextile should generally be centered on the crack, and should extend 6 or more inches laterally beyond the crack. For this application, we recommend that a ½ inch layer of gap graded AC be placed on the milled surface, and the paving fabric or geotextile be placed over this thin lift of AC. This thin lift of AC is recommended because the paving fabric or geotextile may have difficulty adhering to the milled surface due to the dust and surface roughness. After the pavement fabric or geotextile is applied, the remainder of the pavement overlay can be constructed.

For areas where high severity pavement distresses are apparent at the existing roadway surface after the milling, and also in areas where the underlying soils might get exposed during milling operations, we recommend that the asphalt be removed and replaced with new AC. After the cracked asphalt is removed and prior to the placement of the new asphalt, the exposed subgrade and/or base should be evaluated for excessively loose or wet material. If encountered, the unacceptable material should either be removed and replaced or recompacted in place. Subgrade preparation guidelines as outlined in Section 9.1.3 should be followed.

9.8. Site Drainage

Surface drainage should be provided to divert water away from the paved surfaces. Surface water should also not be permitted to pond on or below pavement areas. Positive drainage for this project is defined as a slope of 2 percent or more for a distance of 5 feet or more away from the pavements. To deter accumulation of water below the new pavement sections, the subgrade soils below the new pavement sections should be sloped away from the center of the roadway.

10. PRE-CONSTRUCTION CONFERENCE

We recommend that a pre-construction conference be held. Representatives of the owner, the civil engineer, the geotechnical consultant, and the contractor should be in attendance to discuss the project plans and schedule. Our office should be notified if the project description included herein is incorrect or if the project characteristics are significantly changed.

11. CONSTRUCTION OBSERVATION AND TESTING

During construction operations, we recommend that a qualified geotechnical consultant perform observation and testing services for the project. These services should be performed to evaluate exposed subgrade conditions, including the extent and depth of overexcavation, to evaluate the suitability of proposed borrow materials for use as fill and to observe placement and test compaction of fill soils. If another geotechnical consultant is selected to perform observation and testing services for the project, we request that the selected consultant provide a letter to the owner, with a copy to Ninyo & Moore, indicating that they fully understand our recommendations and that they are in full agreement with the recommendations contained in this report. Qualified subcontractors utilizing appropriate techniques and construction materials should perform construction of the proposed improvements.

12. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but are not limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

13. REFERENCES

American Concrete Institute, 1991a, Guidelines for Concrete Floor and Slab Construction (ACI 302.1R).

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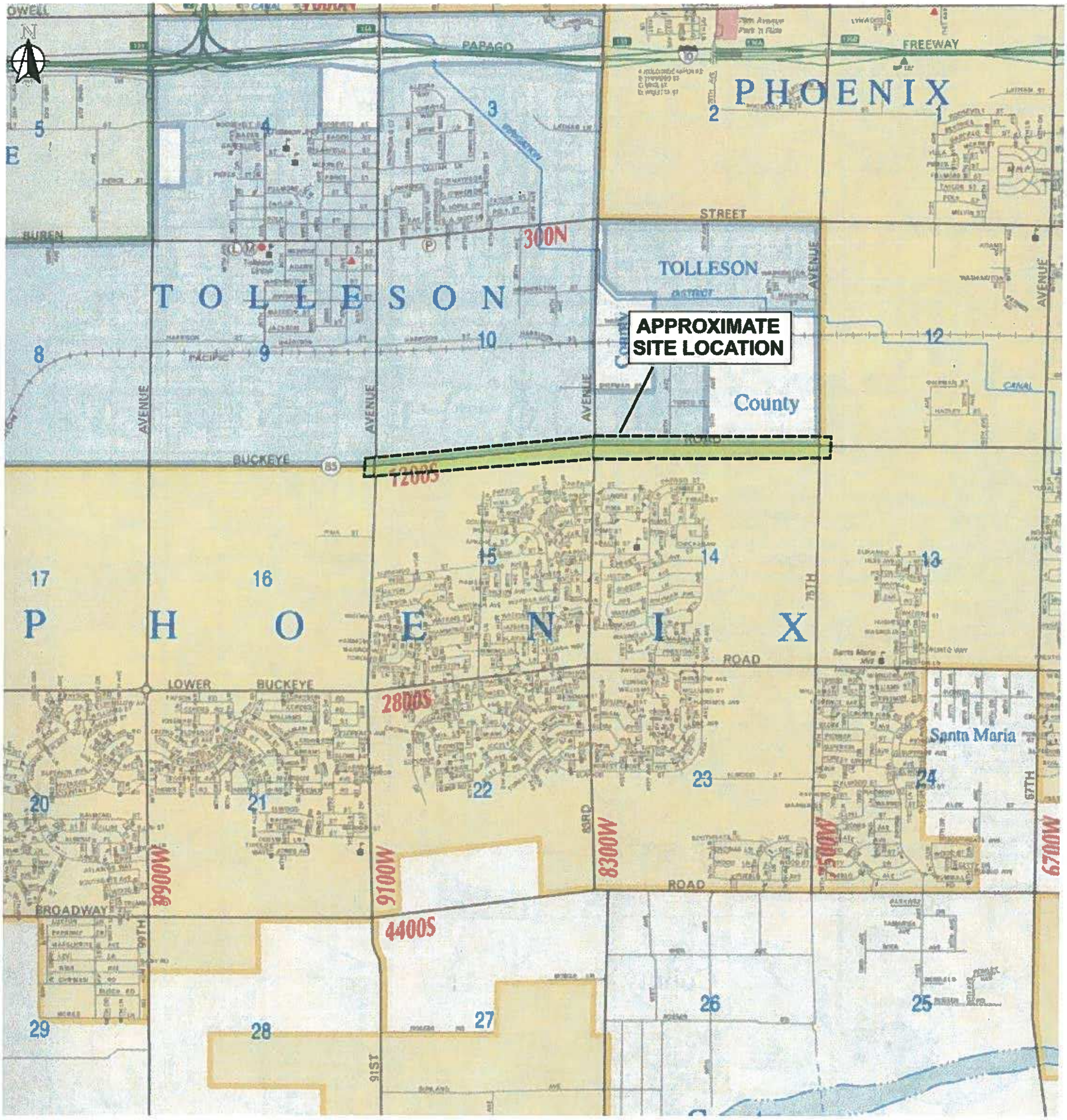
Aerial Photographs Reviewed

Source	Date
Flood Control District of Maricopa County	2005, 2007
Landiscor's Real Estate Photo Book	1999
United States Department of Agriculture	1997



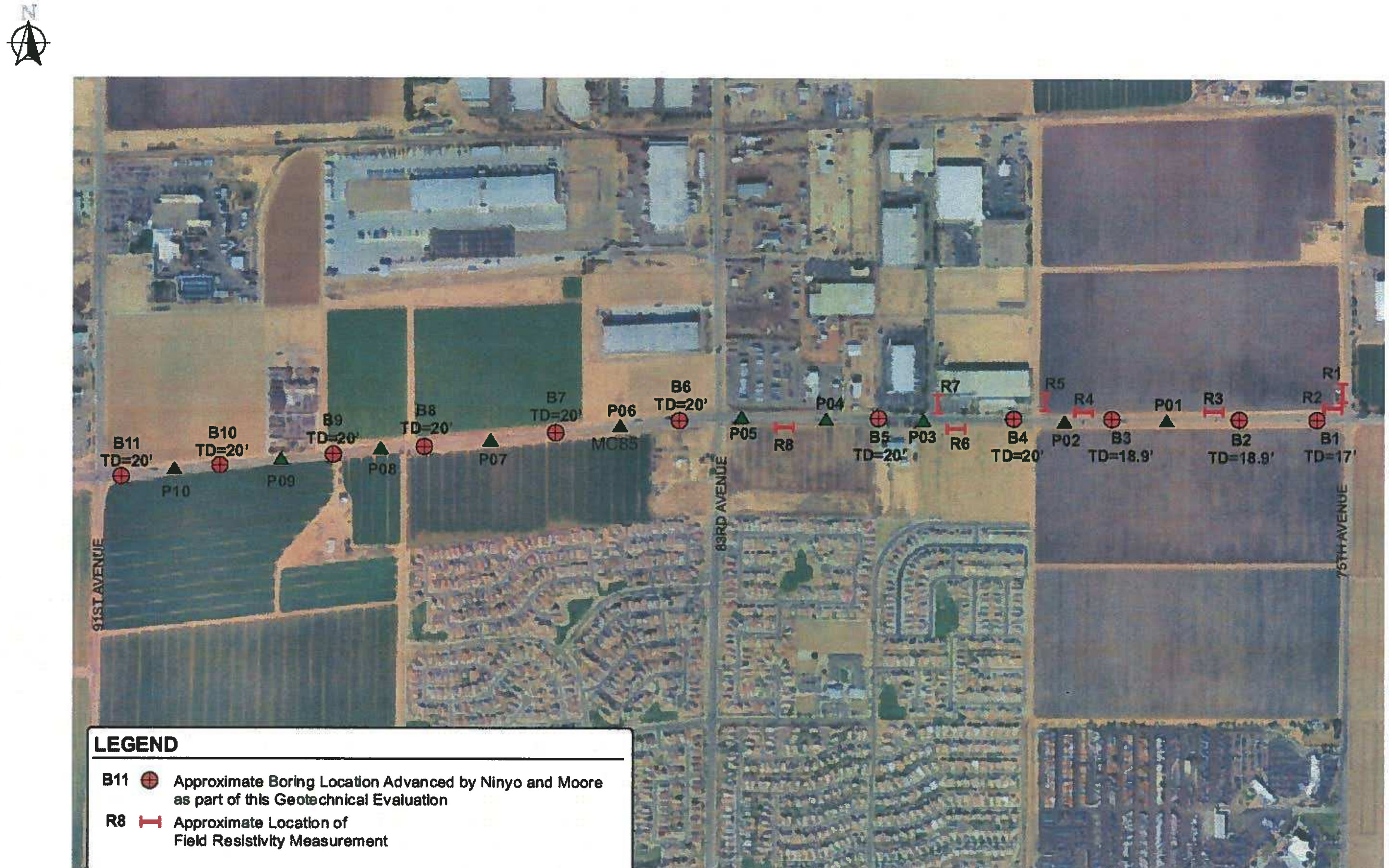
0 3300

Approximate Scale:
1 inch = 3300 feet

Source: Phoenix Mapping Service, Phoenix Metro Edition 2005

Ninyo & Moore		SITE LOCATION MAP	FIGURE
PROJECT NO: 601301002	DATE: 9/10	MC-85 ROADWAY IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE MARICOPA COUNTY, ARIZONA	1

1301vmap0910



LEGEND

B11 — Approximate Boring Location Advanced by Ninyo and Moore as part of this Geotechnical Evaluation

R8 — Approximate Location of Field Resistivity Measurement

P11 — Approximate Boring Location Advanced by Terracon in 2003 as part of the DCR

0 1200

Approximate Scale: 1 inch = 1200 feet

NOTE: All boundaries and locations are approximate.

Ninyo & Moore		BORING AND FIELD RESISTIVITY LINES LOCATION MAP	FIGURE 2
PROJECT NO: 601301002	DATE: 9/10	MC-85 ROADWAY IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE MARICOPA COUNTY, ARIZONA	

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples
Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples
Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler
Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples
Relatively undisturbed soil samples were obtained in the field using the following methods.

The Modified Split-Barrel Drive Sampler
The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a hammer or the Kelly bar of the drill rig in general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer or bar, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

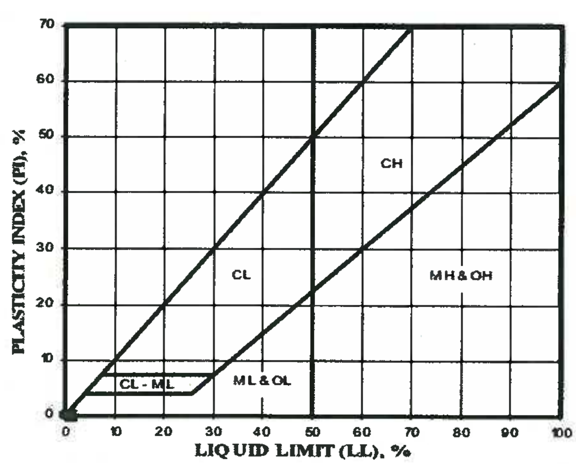
U.S.C.S. METHOD OF SOIL CLASSIFICATION

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil >No. 200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction <No. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than 1/2 of soil <No. 200 sieve size)	SILTS & CLAYS Liquid Limit <50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit >50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

GRAIN SIZE CHART

CLASSIFICATION	RANGE OF GRAIN SIZE	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL Coarse Fine	3" to No. 4 3" to 3/4" 3/4" to No. 4	76.2 to 4.76 76.2 to 19.1 19.1 to 4.76
SAND Coarse Medium Fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.76 to 0.075 4.76 to 2.00 2.00 to 0.420 0.420 to 0.075
SILT & CLAY	Below No. 200	Below 0.075

PLASTICITY CHART



Ninyo & Moore | U.S.C.S. METHOD OF SOIL CLASSIFICATION

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	BORING LOG EXPLANATION SHEET
0								Bulk sample.
								Modified split-barrel drive sampler.
								No recovery with modified split-barrel drive sampler.
								Sample retained by others.
								Standard Penetration Test (SPT).
5								No recovery with a SPT.
			XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
								No recovery with Shelby tube sampler.
								Continuous Push Sample.
								Seepage.
10								Groundwater encountered during drilling.
								Groundwater measured after drilling.
							SM	ALLUVIUM: Solid line denotes unit change.
								Dashed line denotes material change.
								Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Sheared Bedding Surface
15								
20								The total depth line is a solid line that is drawn at the bottom of the boring.

Ninyo & Moore

BORING LOG

EXPLANATION OF BORING LOG SYMBOLS

PROJECT NO.	DATE	FIGURE
	Rev. 01/03	

DATE DRILLED 06/26/06 BORING NO. B-1

GROUND ELEVATION - SHEET 1 OF 1

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 7 inches thick.
						GP	AGGREGATE BASE: Approximately 10 inches thick. Brown, damp, medium dense, fine to coarse GRAVEL with sand; subrounded; few silt.
		19	9.0	120.3		CL	FILL: Brown, damp, very stiff, CLAY; few fine to coarse sand; scattered reworked caliche filaments.
		2					Soft.
5							
		22					Very stiff.
						ML	ALLUVIUM: Brown, damp, medium dense, fine sandy SILT.
		13					
10							
						CL	Brown, damp, firm, silty CLAY; few fine sand.
		32				ML	Light brown, damp, dense, fine sandy SILT; trace clay.
15							
							Total Depth = 17 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 06/26/06 promptly after completion of drilling. Information on this soil boring data sheet was obtained for design purposes. It is the contractor's responsibility to establish soil information for their bid and construction purposes.
20							

Ninyo & Moore

BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-1

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 6 inches thick.
							GP	AGGREGATE BASE: Approximately 9 inches thick. Brown, damp, medium dense, coarse GRAVEL with sand; few silt.
			28				SM	FILL: Brown, moist, medium dense, silty fine to coarse SAND; few fine gravel.
							SC	Brown, moist, medium dense, clayey fine to coarse SAND; few silt.
			8					Coarse gravel; cobbles and possible boulders; difficult drilling.
5							CL	ALLUVIUM: Brown, moist, stiff, CLAY; few fine sand; scattered caliche filaments.
			23					Very stiff.
10			17					Decrease in sand content; scattered organics.
							ML	Brown, damp, dense, sandy SILT; few coarse gravel; trace clay.
15			66					
							SM	Brown, damp, very dense, silty fine SAND; trace coarse gravel.
			50/5"					
20								Total Depth = 18.9 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 06/26/06 promptly after completion of drilling.

DATE DRILLED 06/26/06 BORING NO. B-2

GROUND ELEVATION ______ SHEET 1 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH

Ninyo & Moore

BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-2

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20								Information on this soil boring data sheet was obtained for design purposes. It is the contractor's responsibility to establish soil information for their bid and construction purposes.
25								
30								
35								
40								

DATE DRILLED 06/26/06 BORING NO. B-2

GROUND ELEVATION ______ SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH

Ninyo & Moore

BORING LOG

MC-85 ROADWAY IMPROVEMENTS

75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-3

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 06/26/06 BORING NO. B-3 GROUND ELEVATION ____ SHEET 1 OF 2 METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.) DRIVE WEIGHT 140 lbs. (Automatic) DROP 30" SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 6 inches thick.
							GP	AGGREGATE BASE: Approximately 9 inches thick. Brown, damp, medium dense, fine to coarse GRAVEL with sand; few silt.
			8				CL	FILL: Brown, moist, stiff, CLAY; few fine sand; scattered reworked caliche filaments.
5			14				SC-SM	Brown, damp, loose to medium dense, silty clayey fine SAND.
			6				SM	ALLUVIUM: Brown, moist, loose, silty fine SAND.
10			17					Medium dense.
15			11					
			50/5"					Cobbles and possible boulders.
20								Total Depth = 18.9 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 06/26/06 promptly after completion of drilling.

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-4

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.
20							
25							
30							
35							
40							

DATE DRILLED 06/26/06 BORING NO. B-3

GROUND ELEVATION ______ SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH

DESCRIPTION/INTERPRETATION

Information on this soil boring data sheet was obtained for design purposes. It is the contractor's responsibility to establish soil information for their bid and construction purposes.

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-5

DATE DRILLED	07/13/06	BORING NO.	B-4
GROUND ELEVATION		SHEET	1 OF 2
METHOD OF DRILLING	CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)		
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"
SAMPLED BY	DM	LOGGED BY DM	REVIEWED BY HAH

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 5" thick.
						GP	AGGREGATE BASE: Approximately 8" thick. Brown, damp, medium dense, fine to coarse GRAVEL with sand; few silt.
		19	15.5	114.8		CL	ALLUVIUM: Brown, moist, stiff to very stiff, fine sandy CLAY; trace to few silt.
		8					
5							Scattered caliche nodules.
		27					
		11					
10							
		16	13.1	114.4		SP	Brown, damp, medium dense, fine to medium SAND; trace silt.
15							
						SM	Brown, damp, medium dense, silty fine to medium SAND.
		18					
20							

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-6

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.

DATE DRILLED 07/13/06 BORING NO. B-4

GROUND ELEVATION ______ SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DESCRIPTION/INTERPRETATION

20

Total Depth = 20 feet.
Groundwater not encountered during drilling.
Backfilled and asphalt patched on 07/13/06 promptly after completion of drilling.

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-7

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8 inches thick.
							GP	AGGREGATE BASE: Approximately 8 inches thick. Brown, damp, medium dense, fine to coarse GRAVEL; few silt.
			22				CL	FILL: Brown, moist, very stiff, CLAY; few fine sand; scattered reworked caliche filaments.
5			24					
			27				SM	ALLUVIUM: Brown, damp, medium dense, silty fine SAND; trace clay; scattered caliche filaments.
10			23				CL	Brown, damp, hard, silty CLAY; trace fine sand.
							SM	Brown, moist, medium dense, silty fine to coarse SAND; trace fine gravel.
15			40					
							SC	Brown, damp, dense, clayey fine to medium SAND; few silt; scattered caliche filaments.
20			23					

DATE DRILLED 06/26/06 BORING NO. B-5
GROUND ELEVATION ____ SHEET 1 OF 2
METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH

Ninyo & Moore

BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-6

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.
20							
25							
30							
35							
40							

DATE DRILLED 06/26/06 BORING NO. B-5

GROUND ELEVATION ______ SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH

DESCRIPTION/INTERPRETATION

Total Depth = 20 feet.
Groundwater not encountered during drilling.
Backfilled and asphalt patched on 06/26/06 promptly after completion of drilling.
Information on this soil boring data sheet was obtained for design purposes. It is the contractor's responsibility to establish soil information for their bid and construction purposes.

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-7

DATE DRILLED	06/26/06	BORING NO.	B-6
GROUND ELEVATION	-	SHEET	1 OF 2
METHOD OF DRILLING	CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)		
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"
SAMPLED BY	JSR	LOGGED BY	JSR
REVIEWED BY	HAH		

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 3 inches thick.
						GP	AGGREGATE BASE: Approximately 7 inches thick. Brown, damp, medium dense, fine to coarse GRAVEL with sand; few silt.
	Driven	5				CL	ALLUVIUM: Brown, moist, stiff, CLAY; trace fine sand; scattered caliche filaments.
	Driven	36				SC	Brown, damp, medium dense, clayey fine to medium SAND; few silt; scattered to numerous caliche filaments and nodules; moderately cemented.
5							
	Driven	20				CL	Brown, damp, very stiff to hard, CLAY; trace fine sand; scattered caliche filaments.
	Driven	21					Scattered organics.
10							
						SC	Brown, damp, very dense, clayey fine to medium SAND; few silt; scattered caliche filaments; weakly cemented.
	Driven	67					
15							
						GM	Brown, moist, medium dense, silty fine to coarse GRAVEL with sand.
	Driven	38					
20							

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-8

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 06/26/06 BORING NO. B-6
								GROUND ELEVATION - SHEET 2 OF 2
								METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
								DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
								SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH
								DESCRIPTION/INTERPRETATION
20								Total Depth = 20 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 06/26/06 promptly after completion of drilling. Information on this soil boring data sheet was obtained for design purposes. It is the contractor's responsibility to establish soil information for their bid and construction purposes.
25								
30								
35								
40								

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-9

DATE DRILLED	06/26/06	BORING NO.	B-7
GROUND ELEVATION	-	SHEET	1 OF 2
METHOD OF DRILLING	CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)		
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"
SAMPLED BY	JSR	LOGGED BY	JSR
REVIEWED BY	HAH		

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8 inches thick.
							GP	AGGREGATE BASE: Approximately 10 inches thick. Brown, damp, medium dense, fine to coarse GRAVEL with sand; few silt.
							GP	ALLUVIUM: Brown, damp, dense, fine to coarse GRAVEL with sand; few silt; cobbles and possible boulders.
5							CL	Brown, damp, hard, CLAY; trace fine gravel.
			28					
							ML	Light brown, damp, medium dense, fine sandy SILT.
			11					
10								
							ML	Brown, damp, very dense, sandy SILT; scattered caliche filaments and nodules.
			50/2"					Sample disturbed.
15								
							SM	Brown, moist, medium dense, silty fine SAND.
			8					
20								

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BORING LOG		
MC-85 ROADWAY IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA		
PROJECT NO.	DATE	FIGURE
601301002	9/10	A-10

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.
20							
25							
30							
35							
40							

DATE DRILLED 06/26/06 BORING NO. B-7

GROUND ELEVATION - SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH

DESCRIPTION/INTERPRETATION

Total Depth = 20 feet.
Groundwater not encountered during drilling.
Backfilled and asphalt patched on 06/26/06 promptly after completion of drilling.
Information on this soil boring data sheet was obtained for design purposes. It is the contractor's responsibility to establish soil information for their bid and construction purposes.

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-11

DATE DRILLED 06/26/06 BORING NO. B-8

GROUND ELEVATION ______ SHEET 1 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill,Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 8" thick.
							SP	AGGREGATE BASE: Approximately 10" thick. Brown, damp, medium dense, fine to coarse SAND with gravel; few silt.
							GP	ALLUVIUM: Brown, damp, dense, fine to coarse GRAVEL with sand; few silt; cobbles and possible boulders.
							CL	Brown, damp, very stiff, fine sandy CLAY; trace to few silt; scattered caliche nodules.
			14					
5								
			49					Hard; scattered pinhole-sized pore spaces.
			21					
10								
			50/5"					
15								
							SP	Brown, damp, medium dense, fine to coarse SAND; trace to few silt and fine gravel.
			18					
20								

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS

75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-14

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 06/26/06 BORING NO. B-8 GROUND ELEVATION ______ SHEET 2 OF 2 METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill,Inc.) DRIVE WEIGHT 140 lbs. (Automatic) DROP 30" SAMPLED BY JSR LOGGED BY JSR REVIEWED BY HAH DESCRIPTION/INTERPRETATION
20								Total Depth = 20 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 06/26/06 promptly after completion of drilling.
25								
30								
35								
40								

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-15

DATE DRILLED	07/13/06	BORING NO.	B-9
GROUND ELEVATION		SHEET	1 OF 2
METHOD OF DRILLING	CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)		
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"
SAMPLED BY	DM	LOGGED BY	DM
REVIEWED BY	HAH		

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 7" thick.
							GP	AGGREGATE BASE: Approximately 5" thick. Brown, damp, medium dense, GRAVEL with sand.
			6				SM	ALLUVIUM: Brown, damp, loose, silty fine to medium SAND; scattered caliche nodules.
							CL	Brown, moist, very stiff, fine sandy CLAY; trace to few silt; scattered caliche nodules.
5			23	22.1	95.5			
			16				SM	Brown, damp, medium dense, silty fine to medium SAND; scattered caliche nodules.
			34	19.6	104.3		CL	Brown, moist, hard, fine sandy CLAY; trace silt.
10								
			50/4"				SP	Brown, damp, very dense, fine to coarse SAND; trace to few silt; scattered caliche nodules; weakly cemented.
15								
			31					Medium dense.
20								

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BORING LOG		
MC-85 ROADWAY IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA		
PROJECT NO.	DATE	FIGURE
601301002	9/10	A-16

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20								Total Depth = 20 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 07/13/06 promptly after completion of drilling.
25								
30								
35								
40								

DATE DRILLED 07/13/06 BORING NO. B-9

GROUND ELEVATION ______ SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

Ninyo & Moore

BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-17

DATE DRILLED 07/13/06 BORING NO. B-10

GROUND ELEVATION ____ SHEET 1 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 7" thick.
						GP	AGGREGATE BASE: Approximately 5" thick.
						SP	Brown, damp, medium dense, fine to coarse GRAVEL with fine sand.
							ALLUVIUM:
		17				CL	Brown, damp, medium dense, fine to coarse SAND; trace to few silt; trace fine to coarse gravel.
							Dark brown, damp, very stiff, fine sandy CLAY; trace silt.
		8					Stiff.
5							
		46	12.7	134.0			Hard; numerous caliche nodules.
		18					Very stiff.
10							
						SC	Brown, damp, very dense, clayey fine to coarse SAND; trace to few silt; weakly to moderately cemented.
		76/10"	8.5	117.4			
15							
						SP	Brown, damp, medium dense, fine to coarse SAND; trace silt.
		13					
20							

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-18

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 07/13/06 BORING NO. B-10 GROUND ELEVATION ___ SHEET 2 OF 2 METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.) DRIVE WEIGHT 140 lbs. (Automatic) DROP 30" SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH DESCRIPTION/INTERPRETATION
20								Total Depth = 20 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 07/13/06 promptly after completion of drilling.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-19

DATE DRILLED 07/13/06 BORING NO. B-11

GROUND ELEVATION ____ SHEET 1 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 7" thick.
						GP	AGGREGATE BASE: Approximately 10" thick. Brown, damp, medium dense, fine to coarse GRAVEL with sand.
		8				CL	ALLUVIUM: Brown, moist, stiff, fine sandy CLAY; trace silt; scattered caliche filaments and nodules.
		24	20.8	96.9			Very stiff.
5							
		21				SC	Brown, damp, dense, clayey fine to coarse SAND; trace to few silt; scattered caliche nodules.
		36				CL	Brown, damp, hard, fine sandy CLAY; trace to few silt; scattered caliche nodules.
10							
		63/11"					
						SP	Brown, damp, very dense, fine to coarse SAND; trace to few silt; trace fine gravel.
15							
		51	9.8	107.8			Dense.
20							

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BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-20

DATE DRILLED	07/13/06	BORING NO.	B-11
GROUND ELEVATION		SHEET	2 OF 2
METHOD OF DRILLING	CME-75, 6.5" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)		
DRIVE WEIGHT	140 lbs. (Automatic)	DROP	30"
SAMPLED BY	DM	LOGGED BY	DM
REVIEWED BY	HAH		

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20								Total Depth = 20 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 07/13/06 promptly after completion of drilling.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

MC-85 ROADWAY IMPROVEMENTS
75TH AVENUE TO 91ST AVENUE - MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601301002	9/10	A-21

APPENDIX B

LABORATORY TESTING

Classification
Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the exploratory borings in Appendix A.

In-Place Moisture and Density Tests
The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D 2937. The test results are presented on the logs of the exploratory borings in Appendix A.

Gradation Analysis
Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422. The grain-size distribution curves are shown on Figures B-1through B-4. These test results were utilized in evaluating the soil classifications in accordance with the Unified Soil Classification System (USCS).

Atterberg Limits
Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D 4318. These test results were utilized to evaluate the soil classification in accordance with the Unified Soil Classification System (USCS). The test results and classifications are shown on Figure B-5.

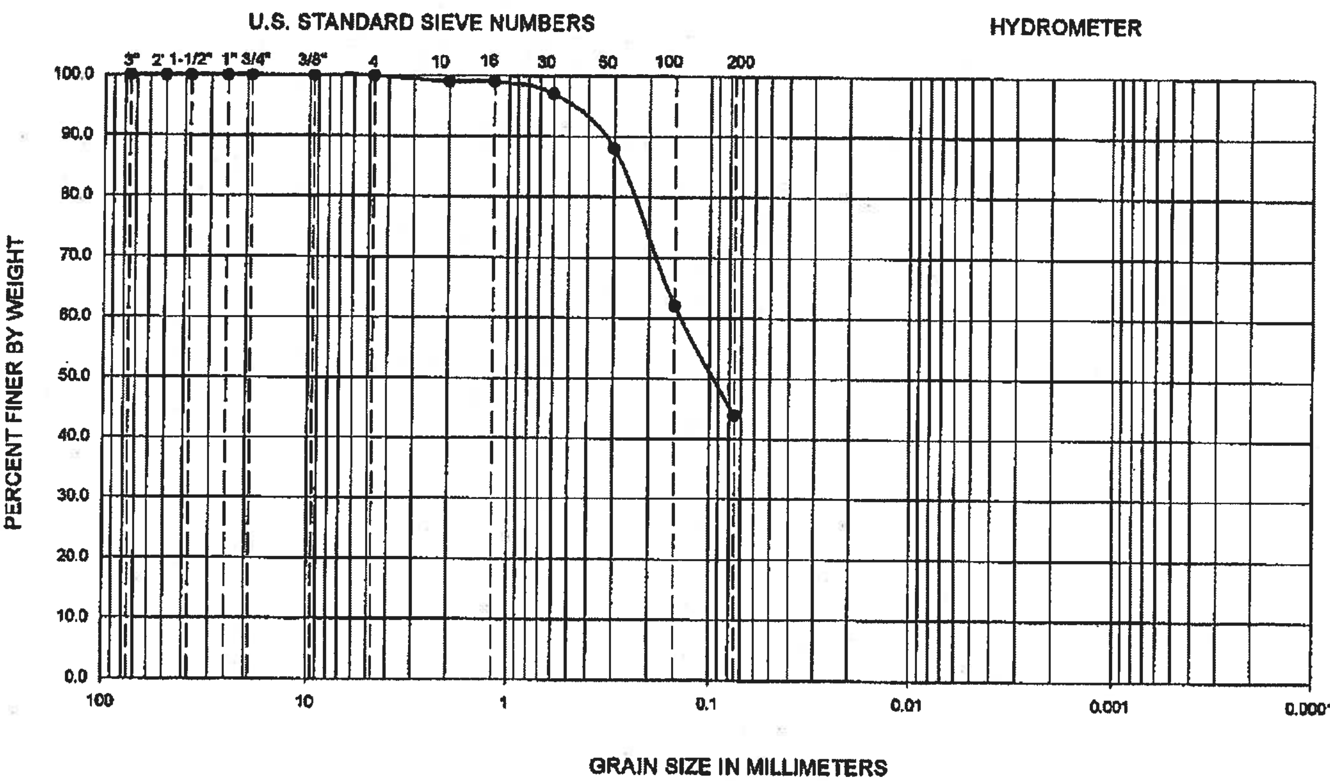
Consolidation Tests
Consolidation tests were performed on selected relatively undisturbed soil samples in general accordance with ASTM D 2435. The samples were inundated during testing to represent adverse field conditions. The percent of consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. The results of the tests are summarized on Figure B-6

Soil Corrosivity Tests
Soil pH, and resistivity tests were performed on representative samples in general accordance with Arizona Test Method 236b. The soluble sulfate and chloride content of selected samples were evaluated in general accordance with Arizona Test Method 733 and 736), respectively. The test results are presented on Figure B-7

R-Value

The resistance value, or R-value, for site soils was evaluated in general accordance with California Test (CT) 301. Samples were prepared and evaluated for exudation pressure and expansion pressure. The equilibrium R-value is reported as the lesser or more conservative of the two calculated results. The test results are shown on Figure B-8

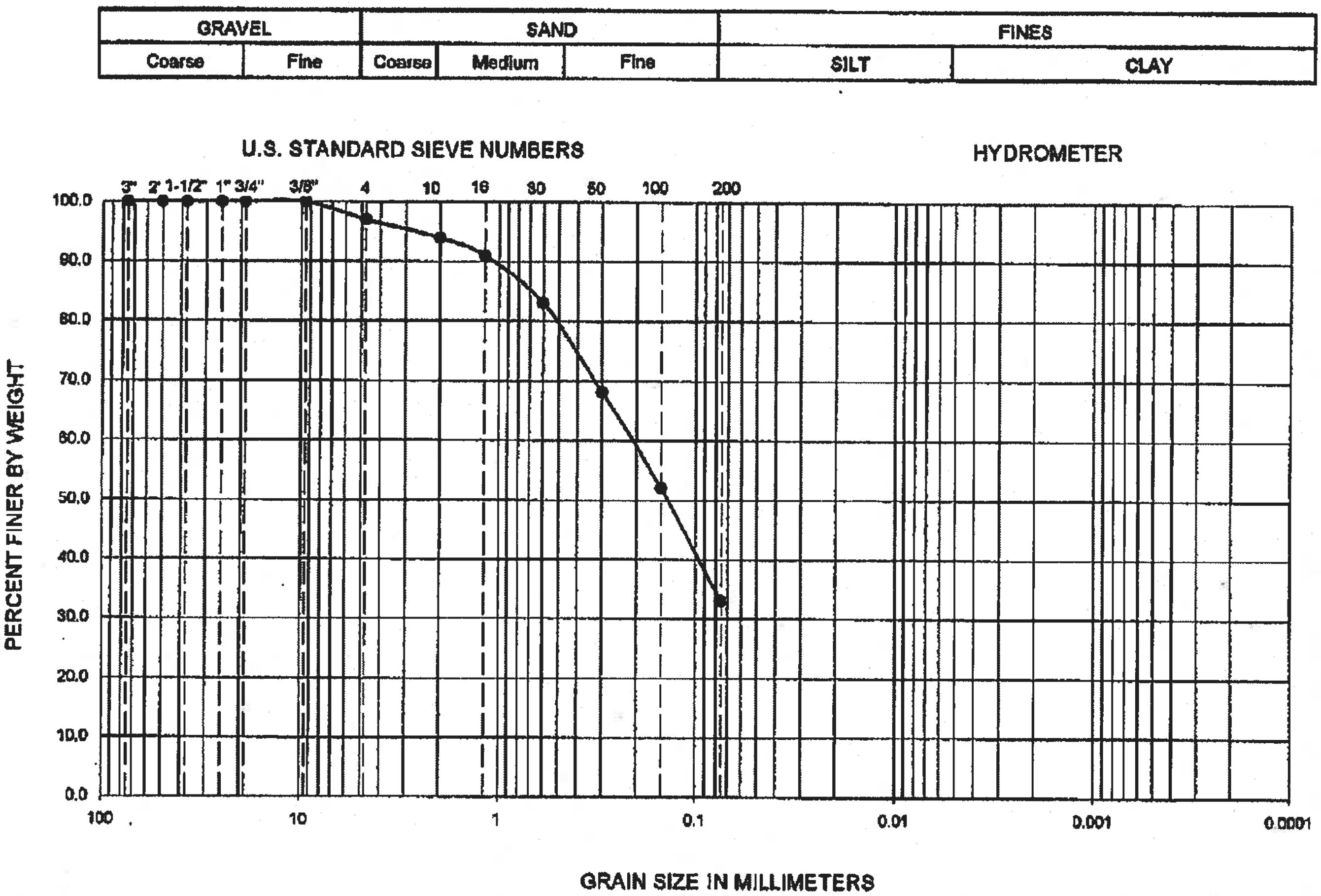
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-3	3.5-5	22	17	5	--	--	--	--	--	44	SC-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	MC-85 ROADWAY IMPROVEMENTS	B-1
601301002 / 9/10	75TH AVENUE TO 91ST AVENUE MARICOPA COUNTY, ARIZONA	



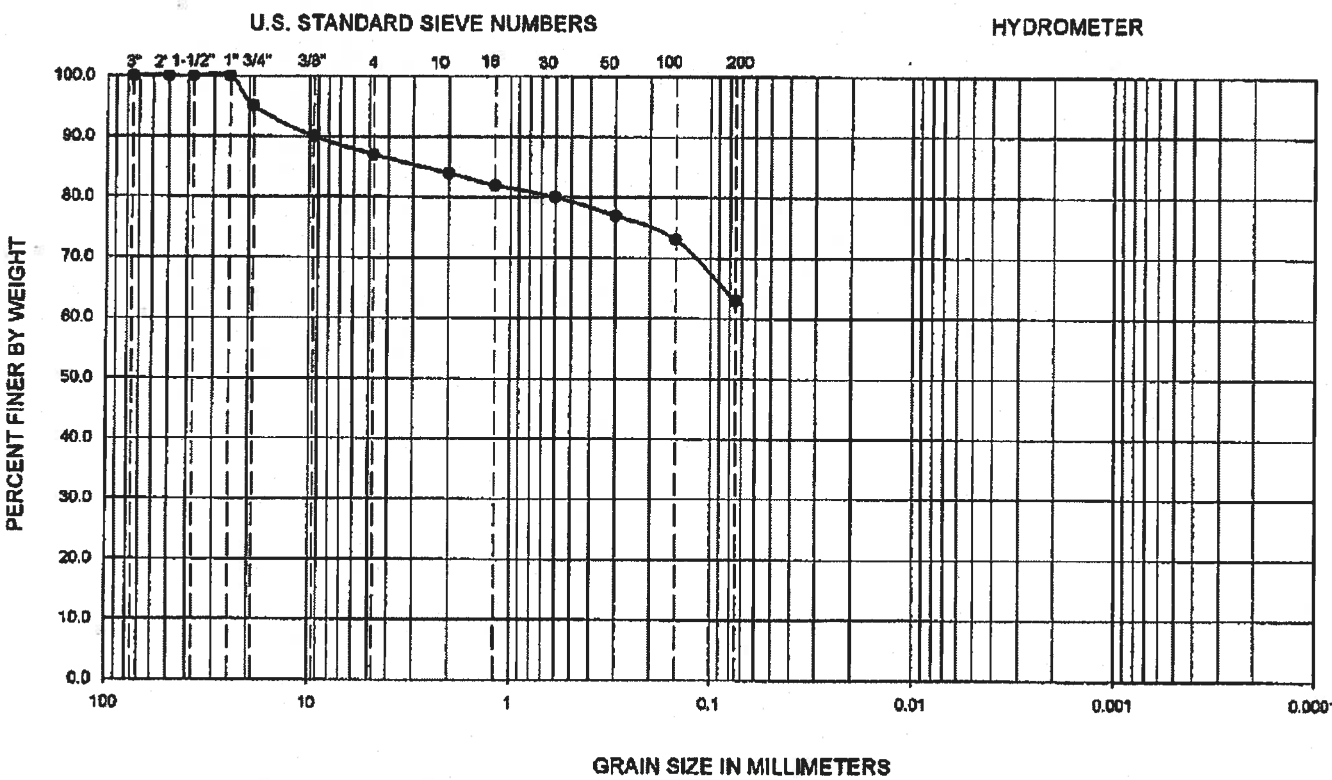
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-5	13.5-15	NP	NP	NP	--	--	--	--	--	33	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

NP Indicates Non Plastic

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	MC 85 IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE MARICOPA COUNTY, ARIZONA	B-2
601301002 / 9/10		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

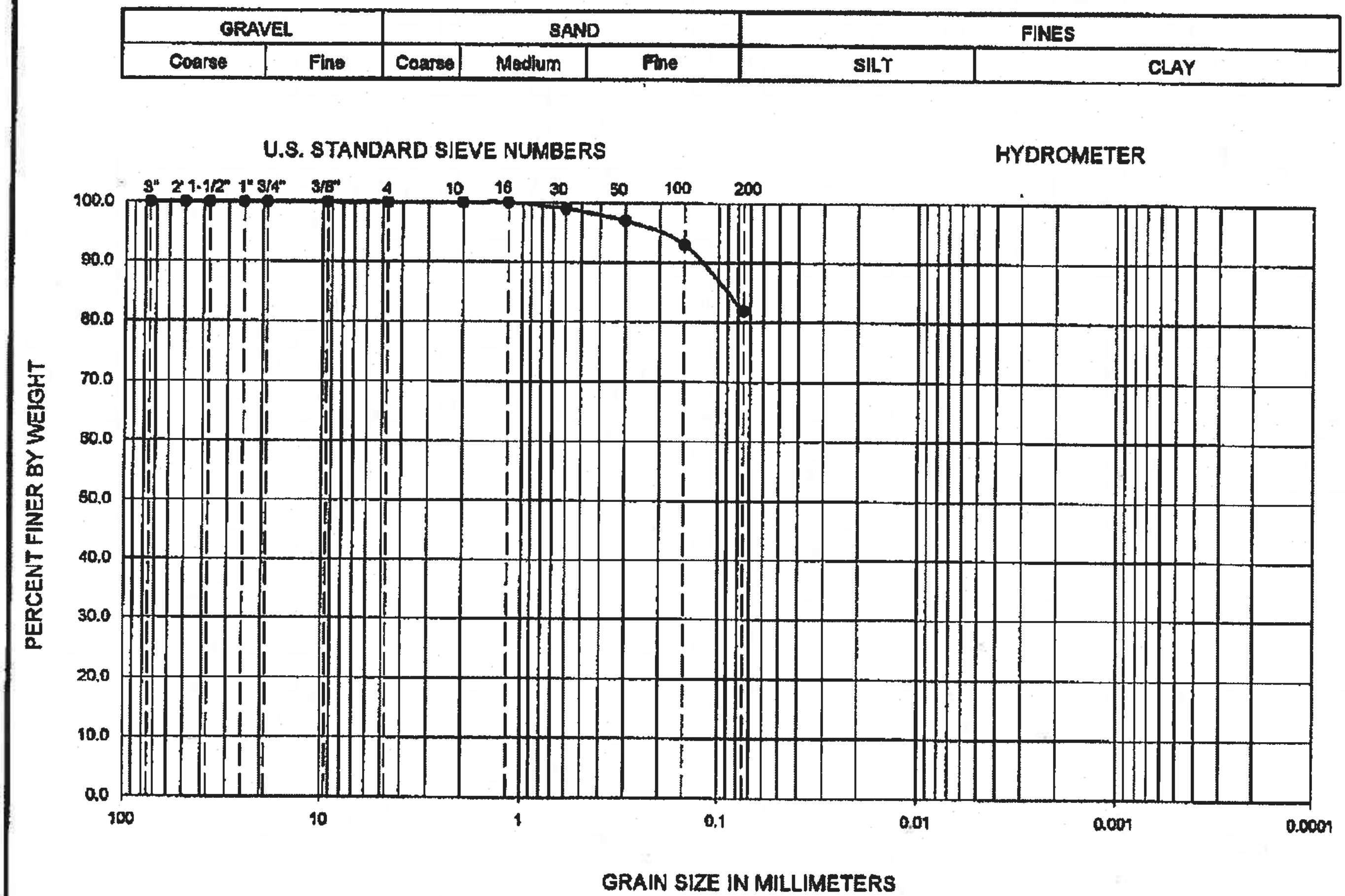


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-7	13.5-14.1	NP	NP	NP	--	--	--	--	--	63	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

NP Indicates Non Plastic

Ninyo & Moore		GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	MC 85 IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE MARICOPA COUNTY, ARIZONA	B-3
601301002	9/10		



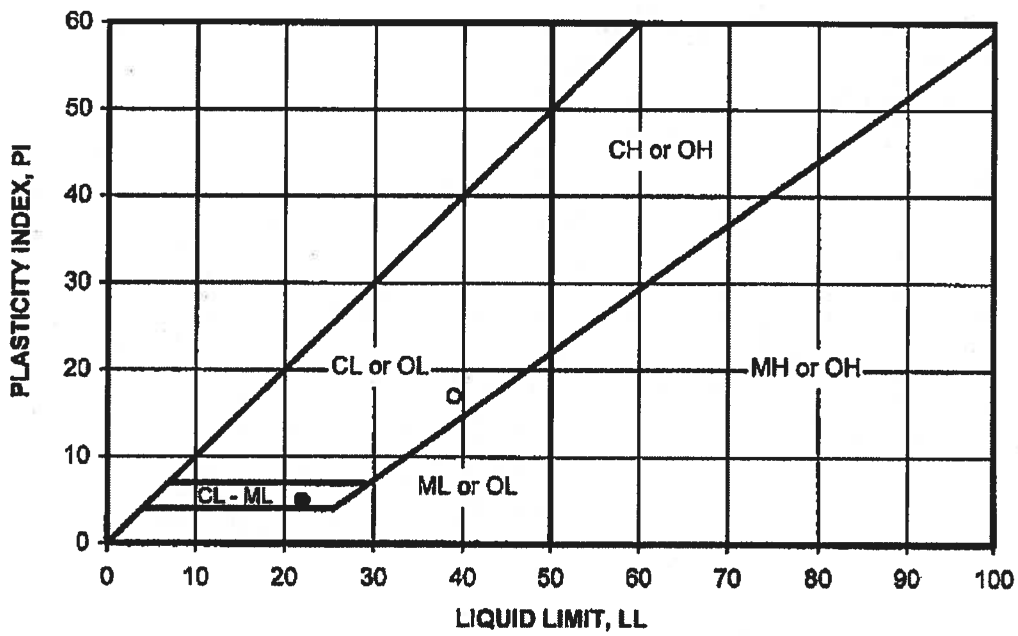
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-11	8.5-10	39	22	17	--	--	--	--	--	82	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore		GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	MC 85 IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE MARICOPA COUNTY, ARIZONA	B-4
601301002	9/10		

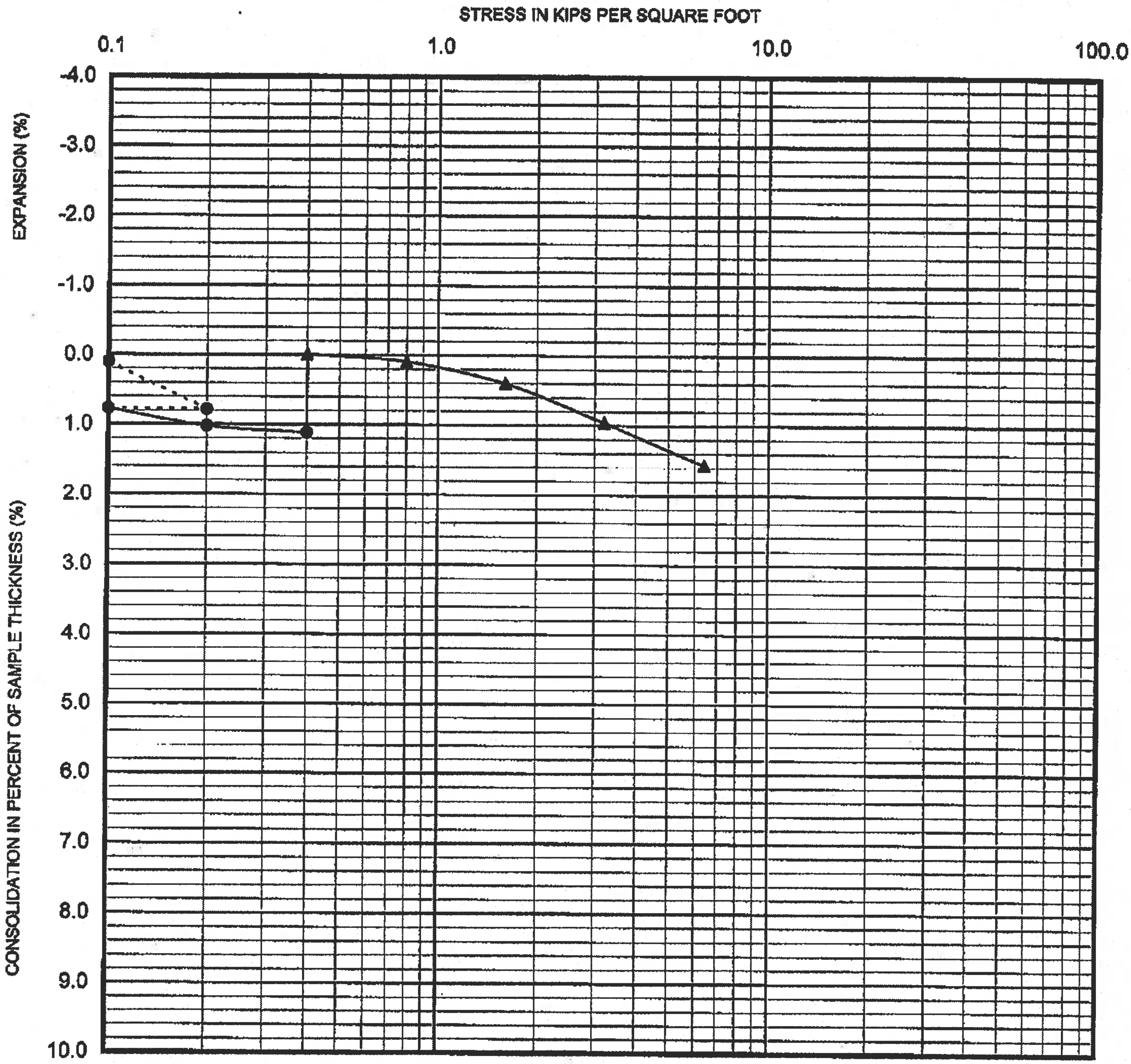
SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-3	3.5-5	22	17	5	CL-ML	SC-SM
■	B-5	13.5-15	NP	NP	NP	NP	SM
◆	B-7	13.5-14.1	NP	NP	NP	NP	ML
○	B-11	8.5-10	39	22	17	CL	CL

NP - Indicates Non-Plastic



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-05

Ninyo & Moore		ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO.	DATE	MC 85 IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE MARICOPA COUNTY, ARIZONA	B-5
601301002	9/10		



Seating Cycle		Sample Location	B-1
Loading Prior to Inundation		Depth (ft.)	1.4-2.9
Loading After Inundation		Soil Type	CL
Rebound Cycle			

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-04

Ninyo & Moore		CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	MC-85 ROADWAY IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE MARICOPA COUNTY, ARIZONA	B-6
601301002	9/10		

SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH 1	RESISTIVITY 1 (Ohm-cm)	SULFATE CONTENT 2		CHLORIDE CONTENT 3 (ppm)
				(ppm)	(%)	
B-1	1.6-5.0	7.9	1,026	57	0.0057	47
B-9	10-15	8.5	1,847	55	0.0055	48

1 PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD ARIZ 236b
2 PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD ARIZ 733
3 PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD ARIZ 736

Ninyo & Moore		CORROSIVITY TEST RESULTS	FIGURE
PROJECT	DATE	MC-85 ROADWAY IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE MARICOPA COUNTY, ARIZONA	B-7
601301002	9/10		

SAMPLE LOCATION	SAMPLE DEPTH (FT)	R-VALUE
B-2	1.2-2.7	15
B-5	1-5	18
B-11	1.5	15

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844-01

Ninyo & Moore

R-VALUE TEST RESULTS

PROJECT NO.	DATE		FIGURE
601301002	9/10	MC 85 IMPROVEMENTS 75TH AVENUE TO 91ST AVENUE PHOENIX, ARIZONA	B-8

APPENDIX C

GEOPHYSICAL SURVEYS

On June 30, 2006 representatives from our office conducted geophysical studies that consisted of performing soil resistivity measurements at the project site at eight surveyed locations. The following paragraphs summarize our field techniques, data analysis, and results.

Soil resistivity information of the subsurface materials was obtained at the site locations indicated on Figure 2. The data were collected in general accordance with ASTM G57 using an L&R MINIRES Resistivity Meter and four electrodes in a Wenner array configuration. The MINIRES can generate up to 500volts and 5 mA, at a switching frequency of 30 Hertz. The instrument allows for the measurement of earth resistance in ohms.

It should be noted that existing buried utility lines including possible metallic lines such as electrical, water supply, and natural gas parallel many of our survey traverses within the right of way for MC-85 on both the north and south sides of the roadway. These lines can be a source of interference to our resistivity measurements and can cause measurement inaccuracies, specifically artificially decreased soil resistivity values. It should also be noted that due to site conditions, it was also not possible to conduct the orthogonal traverses over a common mid-point. This may adversely affect our accurate estimation of the soil's electrical heterogeneity in lateral dimensions.

Soil resistivity measurements were collected at electrode spacings of 2, 5, 10, 20, 30, 50, and 75 feet along surveyed traverses, generally oriented north-south or east-west respectively. The results of the resistivity surveys are presented in Table C-1. In general, the resistivity data collected are of good quality, with good to fair agreement between orthogonal traverses indicating fairly homogenous to slightly heterogeneous soil electrical properties at the locations we surveyed. Note that several of our resistivity measurements indicate that the materials we surveyed are potentially corrosive to ferrous metals.

Table C-1 – Electrical Resistivity Results

Line No.	Spacing (ft.)	Resistance (ohms)	Apparent Resistivity (ohm ft)	Apparent Resistivity (ohm cm)
R-1	2	5.57	70	2,133
	5	1.14	36	1,092
	10	0.76	48	1,455
	20	0.40	50	1,532
	30	0.31	58	1,781
	50	0.16	50	1,532
	75	0.15	71	2,155
R-2	2	5.62	71	2,153
	5	1.13	35	1,082
	10	0.74	46	1,417
	20	0.39	49	1,494
	30	0.33	62	1,896
	50	0.15	47	1,436
	75	0.14	66	2,011
R-3	2	4.76	59	1812
	5	1.57	49	1,503
	10	0.64	40	1,226
	20	0.29	36	1,111
	30	0.21	40	1,207
	50	0.14	44	1,341
	75	0.14	66	2,011

Table C-1 – Electrical Resistivity Results

Line No.	Spacing (ft.)	Resistance (ohms)	Apparent Resistivity (ohm ft)	Apparent Resistivity (ohm cm)
R-4	2	2.67	34	1,023
	5	1.61	51	1,542
	10	0.91	57	1,743
	20	0.43	54	1,647
	30	0.27	51	1,551
	20	0.43	54	1,647
	30	0.27	51	1,551
	50	0.16	50	1,532
	75	0.15	71	2,155
R-5	2	4.70	59	1,800
	5	1.59	50	1,523
	10	0.68	43	1,302
	20	0.31	39	1,187
	30	0.22	41	1,264
	50	0.16	50	1,532
	75	0.14	66	2,011
R-6	2	4.40	55	1,685
	5	1.35	42	1,293
	10	0.57	36	1,092
	20	0.39	49	1,494
	30	0.33	62	1,896
	50	0.14	44	1,341

Table C-1 – Electrical Resistivity Results

Line No.	Spacing (ft.)	Resistance (ohms)	Apparent Resistivity (ohm ft)	Apparent Resistivity (ohm cm)
R-6	75	0.14	66	2,011
R-7	2	2.65	33	1,015
	5	1.63	51	1,561
	10	0.87	55	1,666
	20	0.41	52	1,570
	30	0.30	57	1,724
	50	0.14	44	1,341
	75	0.16	75	2,298
R-8	2	4.34	55	1,662
	5	1.60	50	1,532
	10	0.82	52	1,570
	20	0.44	55	1,685
	30	0.33	62	1,896
	50	0.25	79	2,394
	75	0.20	94	2,873

APPENDIX D

BORING LOGS & LABORATORY TEST RESULTS FROM THE FINAL DESIGN CONCEPT REPORT

LOG OF BORING NO. P01

Page 1 of 1

CLIENT
MCDOT

SITE MC 85 between 75th Ave. and 91st Ave.
Maricopa County, Arizona

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1338 + 88, 17 feet Left.

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: INTERVAL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: #200
0.58	**ASPHALT CONCRETE**; 7 inches.											
1.75	**AGGREGATE BASE COURSE**; 14 inches.		CL/SC		RS	12	15					
	SANDY LEAN CLAY/CLAYEY SAND; trace gravel, brown, medium dense, stiff, dry.	2	CL/SC		BS					30	15	54
		4										
		6										
		8	CL/SC		BS							
10	**Bottom of Boring**.	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			5-1-03
BORING COMPLETED			5-1-03
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

LOG OF BORING NO. P02

CLIENT: MCDOT

SITE: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

PROJECT: MC 85 between 75th Ave. and 91st Ave

BORING Location: 1326 + 68, 17 feet Right.

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: INTERVAL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: #200
0.42	**ASPHALT CONCRETE**; 5 inches.											
1.8	**AGGREGATE BASE COURSE**; 17 inches.											
	SANDY LEAN CLAY; brown, stiff to very stiff, moist, weakly cemented.	2	CL CL		RS BS	12	18	20	102	36	21	68
		6	CL		BS							
10	**Bottom of Boring**.	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	∇ None WD	▼
WL	∇	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			5-1-03
BORING COMPLETED			5-1-03
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

LOG OF BORING NO. P03

CLIENT: MCDOT

SITE: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

PROJECT: MC 85 between 75th Ave. and 91st Ave

BORING Location: 1314 + 43, 17 feet Left.

Depth (strata)	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: #200
0.67	ASPHALT CONCRETE.										
1.67	AGGREGATE BASE COURSE.										
	SANDY LEAN CLAY; trace gravel, brown, stiff to very stiff, moist, weakly cemented.	2	CL CL	RS BS	12	18	15	109	33	18	60
		6	CL	BS							
10	dry.										
	Bottom of Boring.	10									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft

WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	5-1-03		
BORING COMPLETED	5-1-03		
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. P04

CLIENT
MCDOT

SITE **MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona**

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1301 + 18, 17 feet Right.

Graphic Log Depth	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	INTERVAL	TYPE	RECOVERY (in)	BLOWS/FT.	WATER CONTENT, %	DRY DENSITY pcf	LIQUID LIMIT	PLASTICITY INDEX	#200
0.42	**ASPHALT CONCRETE**; 5 inches.											
1.6	**AGGREGATE BASE COURSE**; 14 inches.											
	SANDY LEAN CLAY; trace gravel, brown, very stiff, moist.	2	CL		RS	NR	21			37	19	64
			CL		BS							
		4										
		6	CL		BS							
		8										
10	**Bottom of Boring**	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			5-1-03
BORING COMPLETED			5-1-03
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. P05

CLIENT
MCDOT

SITE **MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona**

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1289 + 93, 17 feet Left.

GRAPHIC LOG (depth)	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: INTERVAL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: #200
0.67	**ASPHALT CONCRETE**; 8 inches.											
2	**AGGREGATE BASE COURSE**; 14 inches.											
	SANDY LEAN CLAY; trace gravel, brown, very stiff, moist, weakly cemented.	2	CL CL		RS BS	12	21	15	107	34	17	56
		6	CL		BS							
10	**Bottom of Boring**.	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	∇ None WD	▼
WL	∇	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			5-1-03
BORING COMPLETED			5-1-03
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

LOG OF BORING NO. P06

CLIENT: MCDOT

SITE: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

PROJECT: MC 85 between 75th Ave. and 91st Ave

BORING Location: 1287 + 71, 17 feet Right.

GRAPHIC LOG (depth, ft)	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: INTERVAL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: -#200
0.75	**ASPHALT CONCRETE**; 9 inches.											
1.75	**AGGREGATE BASE COURSE**; 12 inches.											
10	**SANDY LEAN CLAY**; brown, stiff to very stiff, moist.	2	CL		RS	12	18	16	107	33	16	60
			CL		BS							
		6	CL		BS							
	Bottom of Boring.	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	5-1-03		
BORING COMPLETED	5-1-03		
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. P07

CLIENT: MCDOT

SITE: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

PROJECT: MC 85 between 75th Ave. and 91st Ave

BORING Location: 1277 + 76, 17 feet Left.

Graphic Log depth	Description	Depth, ft.	USCS Symbol	Sample Interval	Sample Type	Recovery (in)	Blows/ft.	Water Content, %	Dry Density pcf	Liquid Limit	Plasticity Index	-#200
1	**ASPHALT CONCRETE**; 12 inches.											
1.83	**AGGREGATE BASE COURSE**; 10 inches.											
	SANDY LEAN CLAY; trace gravel, brown, stiff, moist, weakly cemented.	2	CL CL		RS BS	12	17	13	112	36	18	66
		6	CL		BS							
10	moist to dry.											
	Bottom of Boring.	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	5-1-03
BORING COMPLETED	5-1-03
RIG	CME 75
FOREMAN	JRH
APPROVED	SDN
JOB #	65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. P08

CLIENT
MCDOT

SITE MC 85 between 75th Ave. and 91st Ave.
Maricopa County, Arizona

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1267 + 76, 17 feet Right.

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE RECOVERY (in)	SAMPLE BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS LIQUID LIMIT	TESTS PLASTICITY INDEX	TESTS #200
0.58	**ASPHALT CONCRETE**; 7 inches.											
1.08	**AGGREGATE BASE COURSE**; 6 inches.											
	SANDY LEAN CLAY; brown, moist.											
		2	CL CL		RS BS	12	19	16	110	35	19	62
		6	CL		BS							
10	**Bottom of Boring**.	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	5-1-03
BORING COMPLETED	5-1-03
RIG CME 75	FOREMAN JRH
APPROVED SDN	JOB # 65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. P09

CLIENT	
MCDOT	
SITE	MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona
PROJECT	MC 85 between 75th Ave. and 91st Ave

BORING Location: 1257 + 76, 17 feet Left.

GRAPHIC LOG (depth)	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE RECOVERY (in)	SAMPLE BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS LIQUID LIMIT	TESTS PLASTICITY INDEX	TESTS #200
0.67	**ASPHALT CONCRETE**; 8 inches.											
1.4	**AGGREGATE BASE COURSE**; 9 inches.											
5	**SANDY LEAN CLAY**; trace gravel, brown, loose to medium dense, moist, weakly cemented.	2	CL CL		RS BS	12	16	13	107	33	17	65
10	**LEAN CLAY WITH SAND**; brown, moist.	6	CL		BS							
	Bottom of Boring.	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	5-1-03		
BORING COMPLETED	5-1-03		
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

LOG OF BORING NO. P10

CLIENT: MCDOT

SITE: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

PROJECT: MC 85 between 75th Ave. and 91st Ave

BORING Location: 1247 + 76, 17 feet Right.

Graphic log depth	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	INTERVAL	TYPE	RECOVERY (in)	BLOWS/FT.	WATER CONTENT, %	DRY DENSITY pcf	LIQUID LIMIT	PLASTICITY INDEX	#200
0.67	**ASPHALT CONCRETE**; 8 Inches.											
1.4	**AGGREGATE BASE COURSE**; 9 inches.											
	LEAN CLAY WITH SAND; brown, loose to medium dense, moist, weakly cemented.	2	CL CL		RS BS	12	18	17	106	38	21	71
		6	CL		BS							
10	**Bottom of Boring**.	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			5-1-03
BORING COMPLETED			5-1-03
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. PERC1

CLIENT
MCDOT

SITE MC 85 between 75th Ave. and 91st Ave.
Maricopa County, Arizona

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1338 + 88, 26 feet Left.

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE RECOVERY (in)	SAMPLE BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS LIQUID LIMIT	TESTS PLASTICITY INDEX	TESTS #200
	SANDY LEAN CLAY; some gravel, brown, moist, trace cobbles.		CL		BS							
3	**Bottom of Boring**.	2, 4										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	5-1-03		
BORING COMPLETED	5-1-03		
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

LOG OF BORING NO. P11

CLIENT
MCDOT

SITE **MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona**

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1237 + 76, 17 feet Left.

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: INTERVAL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: -#200
	ASPHALT CONCRETE; 12 inches.	1										
	AGGREGATE BASE COURSE; 5 inches.	1.42										
	LEAN CLAY WITH SAND; brown, stiff, moist, weakly cemented.	2	CL CL		RS BS	12	25	21	104	45	23	81
		5										
	Bottom of Boring. Boring completed at 5 feet based on reported proximity to sewer main.	6										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			5-1-03
BORING COMPLETED			5-1-03
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

LOG OF BORING NO. PERC2

CLIENT
MCDOT

SITE MC 85 between 75th Ave. and 91st Ave.
Maricopa County, Arizona

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1326 + 68, 26 feet Right.

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: INTERVAL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: #200
3	**SILTY SAND**; some gravel, brown, moist.	2	SM	↕	BS							
	Bottom of Boring.	4										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	∇ None WD	▼
WL	∇	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			5-1-03
BORING COMPLETED			5-1-03
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. PERC3

CLIENT
MCDOT

SITE MC 85 between 75th Ave. and 91st Ave.
Maricopa County, Arizona

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1301 + 18, 26 feet Right

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE RECOVERY (in)	SAMPLE BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS LIQUID LIMIT	TESTS PLASTICITY INDEX	TESTS #200
	SANDY LEAN CLAY; some gravel, brown, moist, trace cobbles.		CL	0–3	BS							
3	**Bottom of Boring**.											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	5-1-03
BORING COMPLETED	5-1-03
RIG CME 75	FOREMAN JRH
APPROVED SDN	JOB # 65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. PERC4

CLIENT
MCDOT

SITE MC 85 between 75th Ave. and 91st Ave.
Maricopa County, Arizona

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1287 + 71, 26 feet Right.

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: INTERVAL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: #200
	SANDY LEAN CLAY/CLAYEY SAND; some gravel, brown, moist, trace cobbles.	2	CL/SC	↕	BS							
3	**Bottom of Boring**.	4										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	∇ None WD	▼
WL	▼	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			5-1-03
BORING COMPLETED			5-1-03
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. PERC5

CLIENT: MCDOT

SITE: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

PROJECT: MC 85 between 75th Ave. and 91st Ave

BORING Location: 1267 + 76, 26 feet Right.

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: INTERVAL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: -#200
0.5	**ASPHALT CONCRETE**; 6 inches.											
1	**AGGREGATE BASE COURSE**; 7 inches.											
3	**SANDY LEAN CLAY**; trace gravel, brown, moist.	2	CL		BS							
	Bottom of Boring.	4										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	5-1-03		
BORING COMPLETED	5-1-03		
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

BOREHOLE 2000 65035025.GPJ TERR2000.GDT 5/19/03

LOG OF BORING NO. PERC6

CLIENT
MCDOT

SITE MC 85 between 75th Ave. and 91st Ave.
Maricopa County, Arizona

PROJECT
MC 85 between 75th Ave. and 91st Ave

BORING Location: 1247 + 76, 26 feet Right.

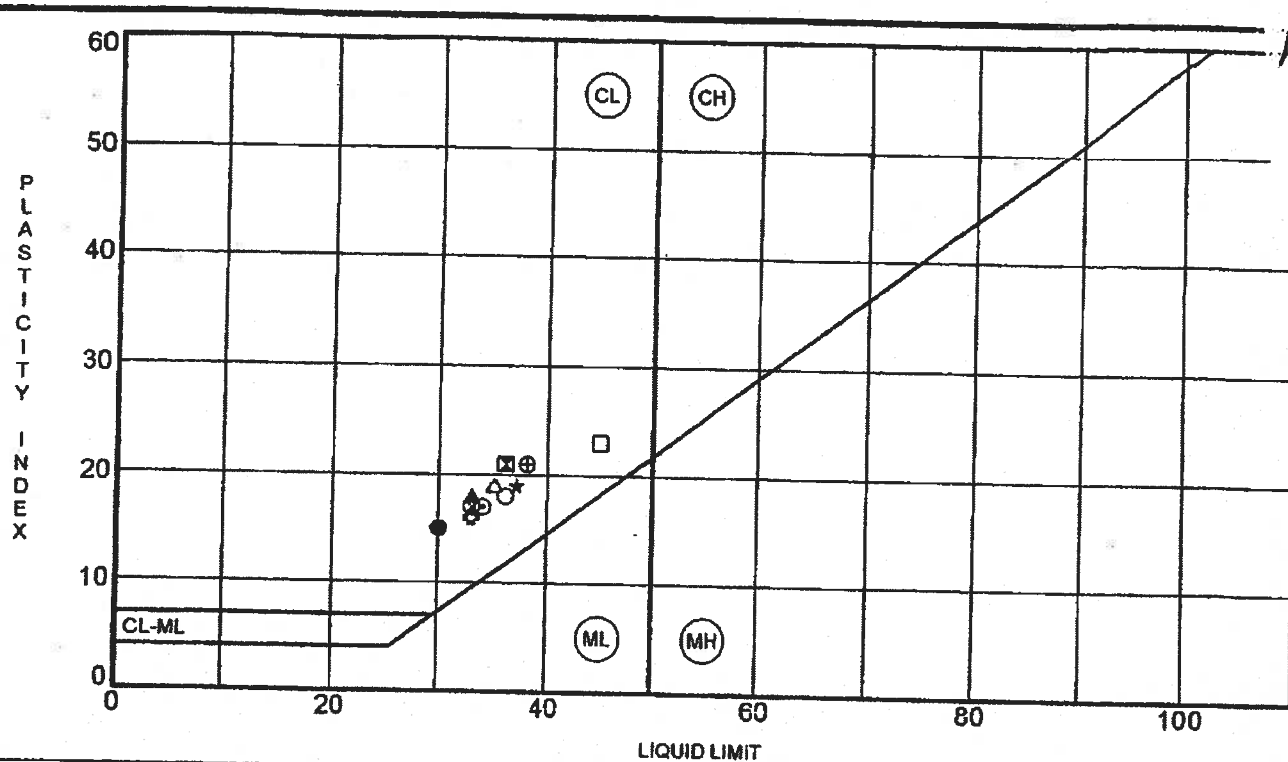
GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLE: INTERVAL	SAMPLE: TYPE	SAMPLE: RECOVERY (in)	SAMPLE: BLOWS/FT.	TESTS: WATER CONTENT, %	TESTS: DRY DENSITY pcf	TESTS: LIQUID LIMIT	TESTS: PLASTICITY INDEX	TESTS: -#200
	SANDY LEAN CLAY; some gravel, brown, moist, trace cobbles.		CL	↕	BS							
		2										
3	**Bottom of Boring**.											
		4										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	None WD	
WL		
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			5-1-03
BORING COMPLETED			5-1-03
RIG	CME 75	FOREMAN	JRH
APPROVED	SDN	JOB #	65035025

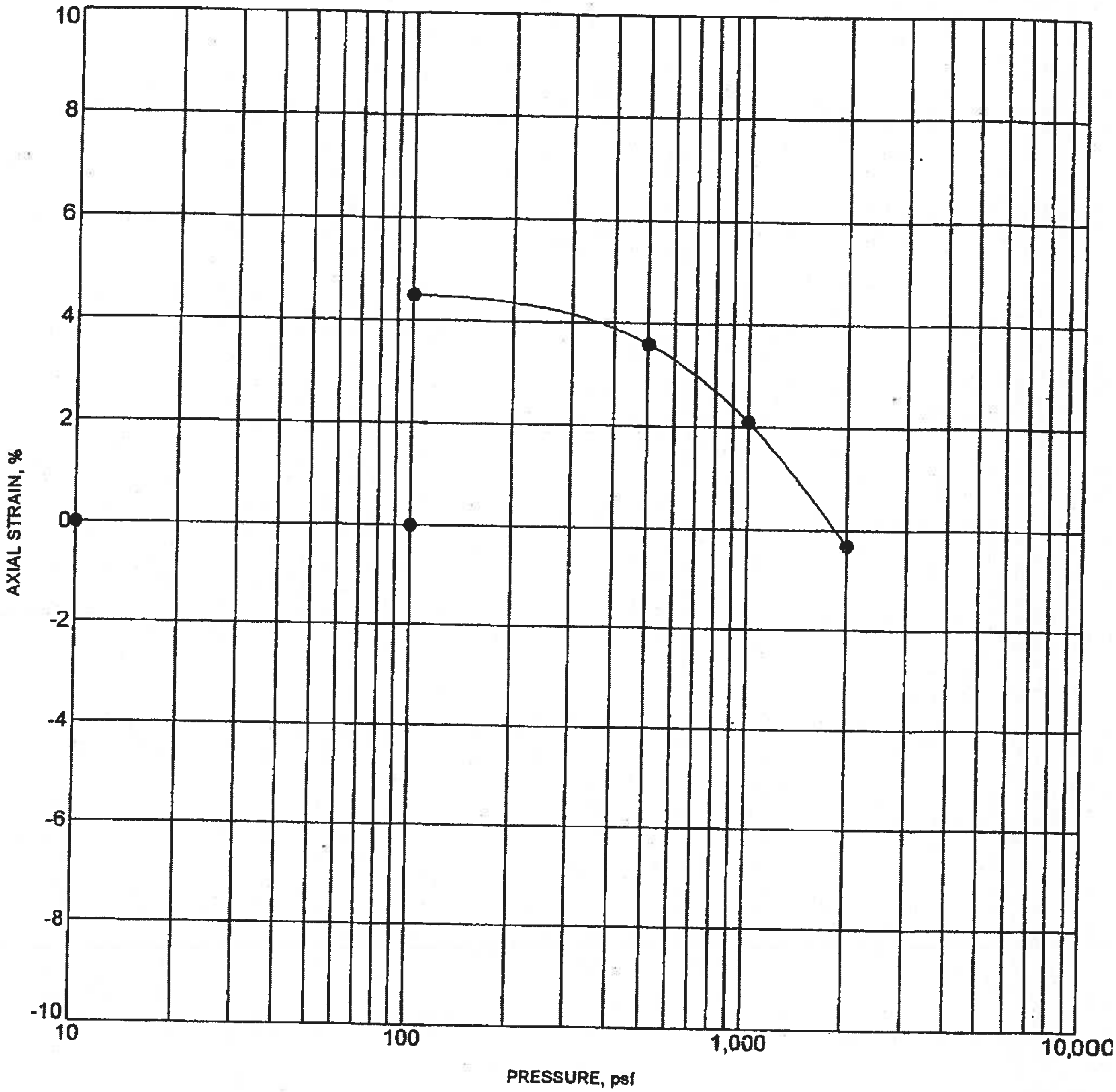


	Specimen Identification		LL	PL	PI	%Fines	Classification
●	P01	2.0ft	30	15	15	54	SANDY LEAN CLAY(CL)
⊠	P02	2.0ft	36	15	21	68	SANDY LEAN CLAY(CL)
▲	P03	2.0ft	33	15	18	60	SANDY LEAN CLAY(CL)
★	P04	2.0ft	37	18	19	64	SANDY LEAN CLAY(CL)
⊙	P05	2.0ft	34	17	17	56	SANDY LEAN CLAY(CL)
✿	P06	2.0ft	33	17	16	60	SANDY LEAN CLAY(CL)
○	P07	2.0ft	36	18	18	66	SANDY LEAN CLAY(CL)
△	P08	2.0ft	35	16	19	62	SANDY LEAN CLAY(CL)
⊗	P09	2.0ft	33	16	17	65	SANDY LEAN CLAY(CL)
⊕	P10	2.0ft	38	17	21	71	LEAN CLAY with SAND(CL)
□	P11	2.0ft	45	22	23	81	LEAN CLAY with SAND(CL)

Terracon

ATTERBERG LIMITS RESULTS

Project: MC 85 between 75th Ave. and 91st Ave
Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona
Job #: 65035025
Date: 5-14-03



	Specimen Identification		Classification	γ_d, pcf	WC,%
●	P02	2.0 ft	SANDY LEAN CLAY(CL)	106	13

Notes: Sample remolded to the dry density and water content indicated. Water added at 100 psf.

Terracon

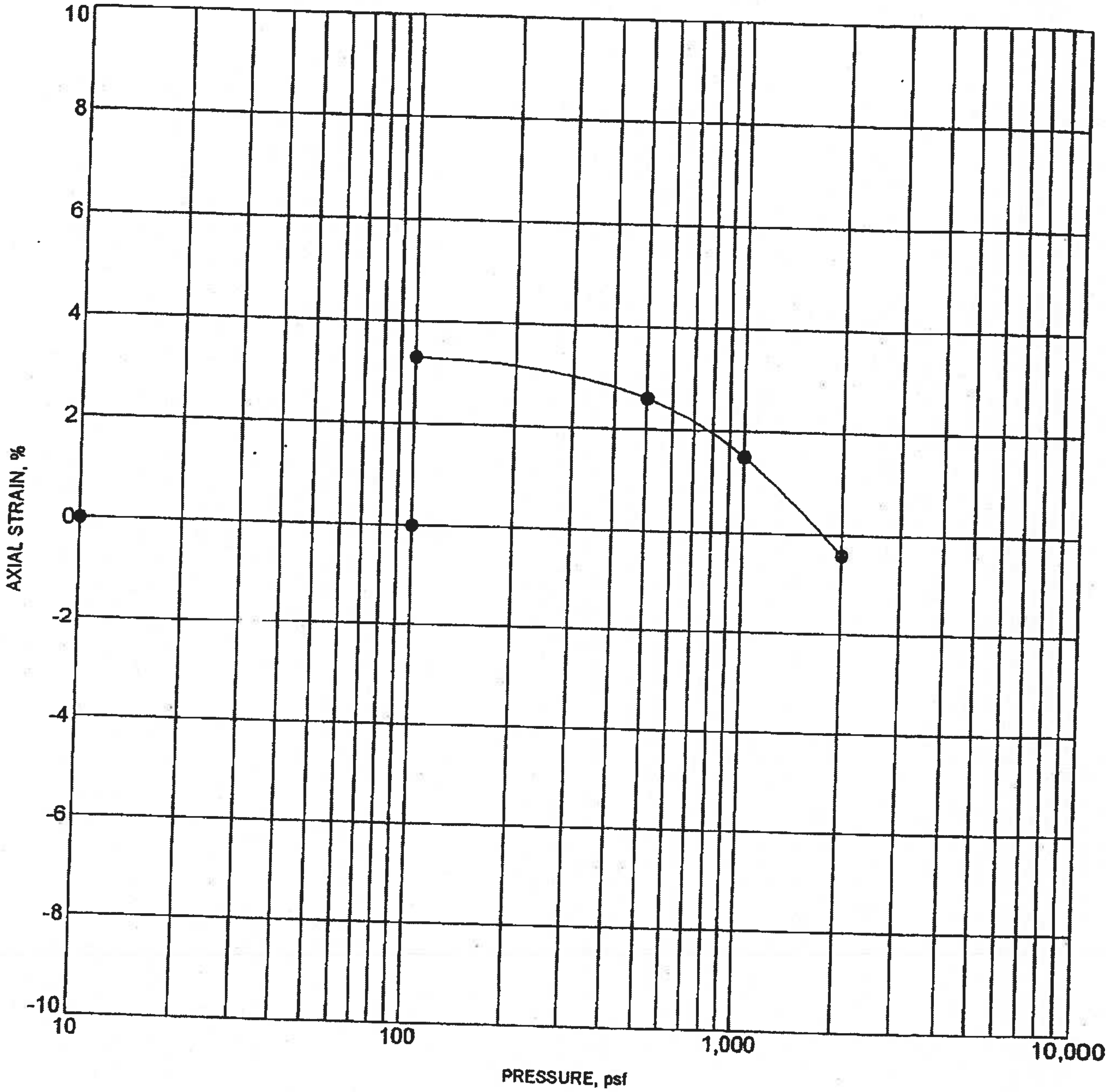
SWELL TEST

Project: MC 85 between 75th Ave. and 91st Ave

Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

Job #: 65035025

Date: 5-14-03



Specimen Identification			Classification	γ_d, pcf	WC,%
●	P03	2.0 ft	SANDY LEAN CLAY(CL)	105	14

Notes: Sample remolded to the dry density and water content indicated. Water added at 100 psf.

Terracon

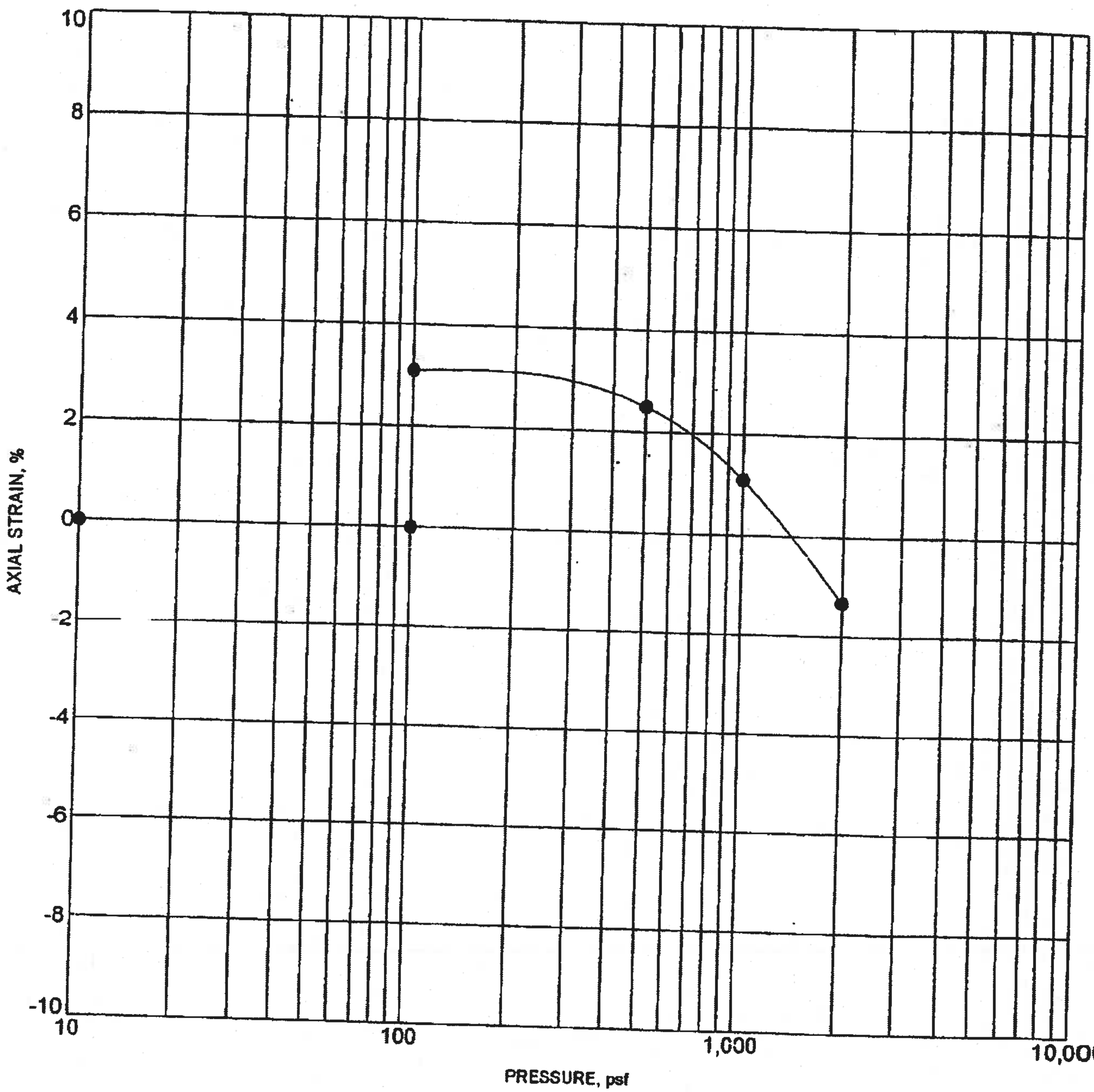
SWELL TEST

Project: MC 85 between 75th Ave. and 91st Ave

Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

Job #: 65035025

Date: 5-14-03



Specimen Identification			Classification	γ_d, pcf	WC,%
●	P05	2.0 ft	SANDY LEAN CLAY(CL)	106	13

Notes: Sample remolded to the dry density and water content indicated. Water added at 100 psf.

TC_SWELL1_STRAIN 65035025.GPJ TERRACON.GDT 5/14/03

Terracon

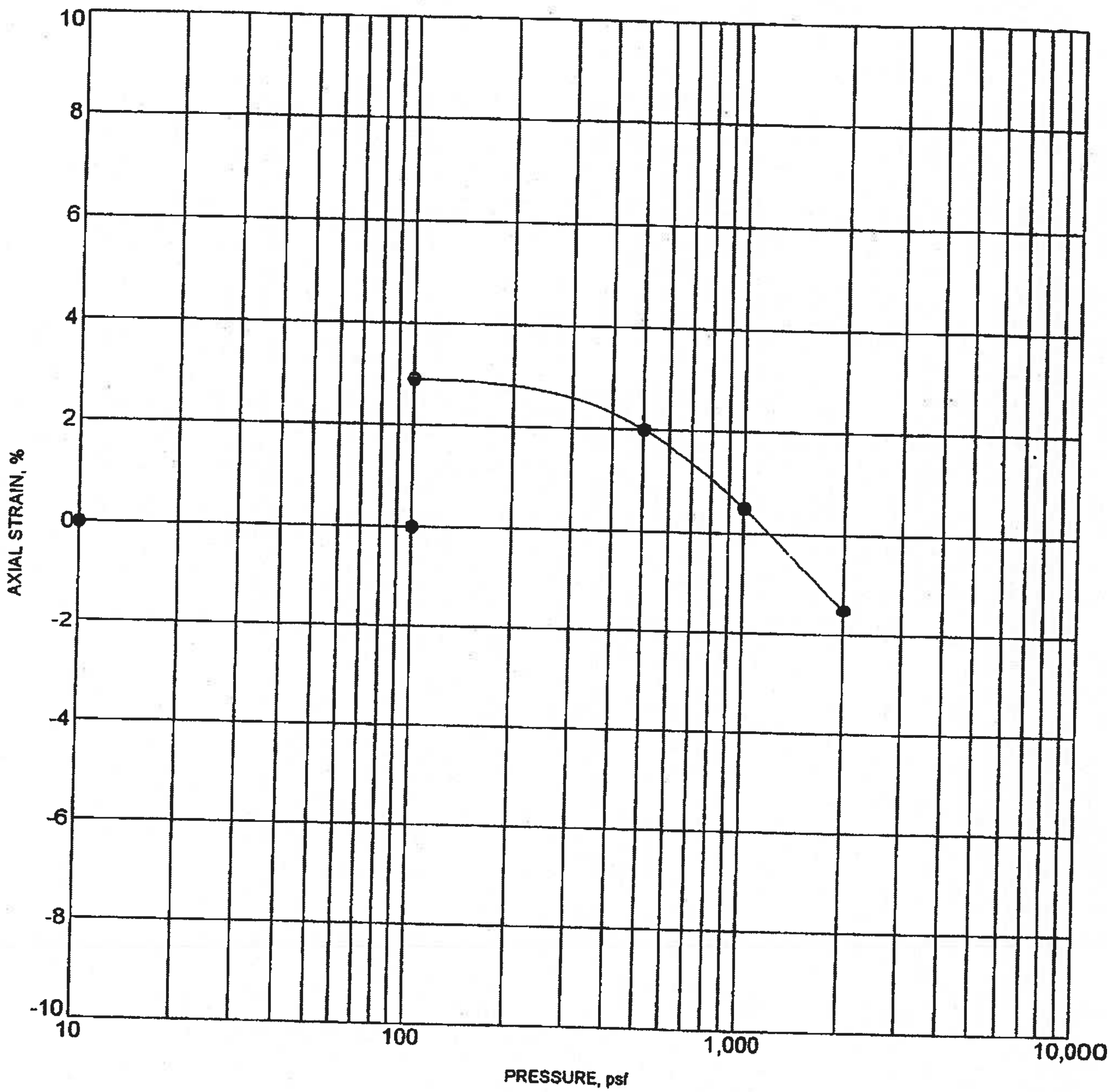
SWELL TEST

Project: MC 85 between 75th Ave. and 91st Ave

Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

Job #: 65035025

Date: 5-14-03



Specimen Identification			Classification	γ_d, pcf	WC,%
●	P07	2.0 ft	SANDY LEAN CLAY(CL)	104	14

Notes: Sample remolded to the dry density and water content indicated. Water added at 100 psf.

TC_SWELL1_STRAIN 65035025.GPJ TERRACON.GDT 5/14/03

Terracon

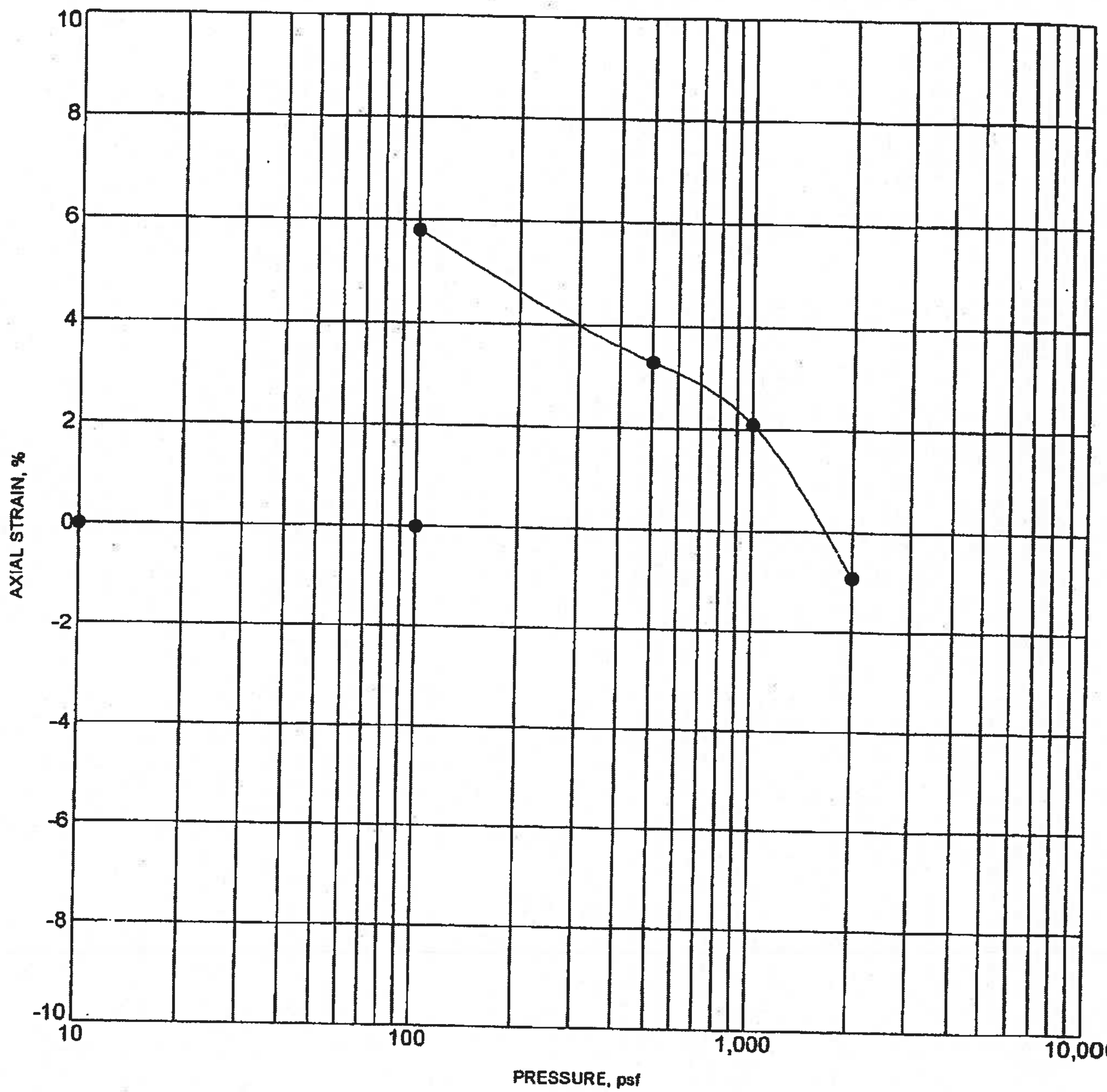
SWELL TEST

Project: MC 85 between 75th Ave. and 91st Ave

Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

Job #: 65035025

Date: 5-14-03



	Specimen Identification		Classification	γ_d, pcf	WC,%
●	P08	2.0 ft	SANDY LEAN CLAY(CL)	104	14

Notes: Sample remolded to the dry density and water content indicated. Water added at 100 psf.

Terracon

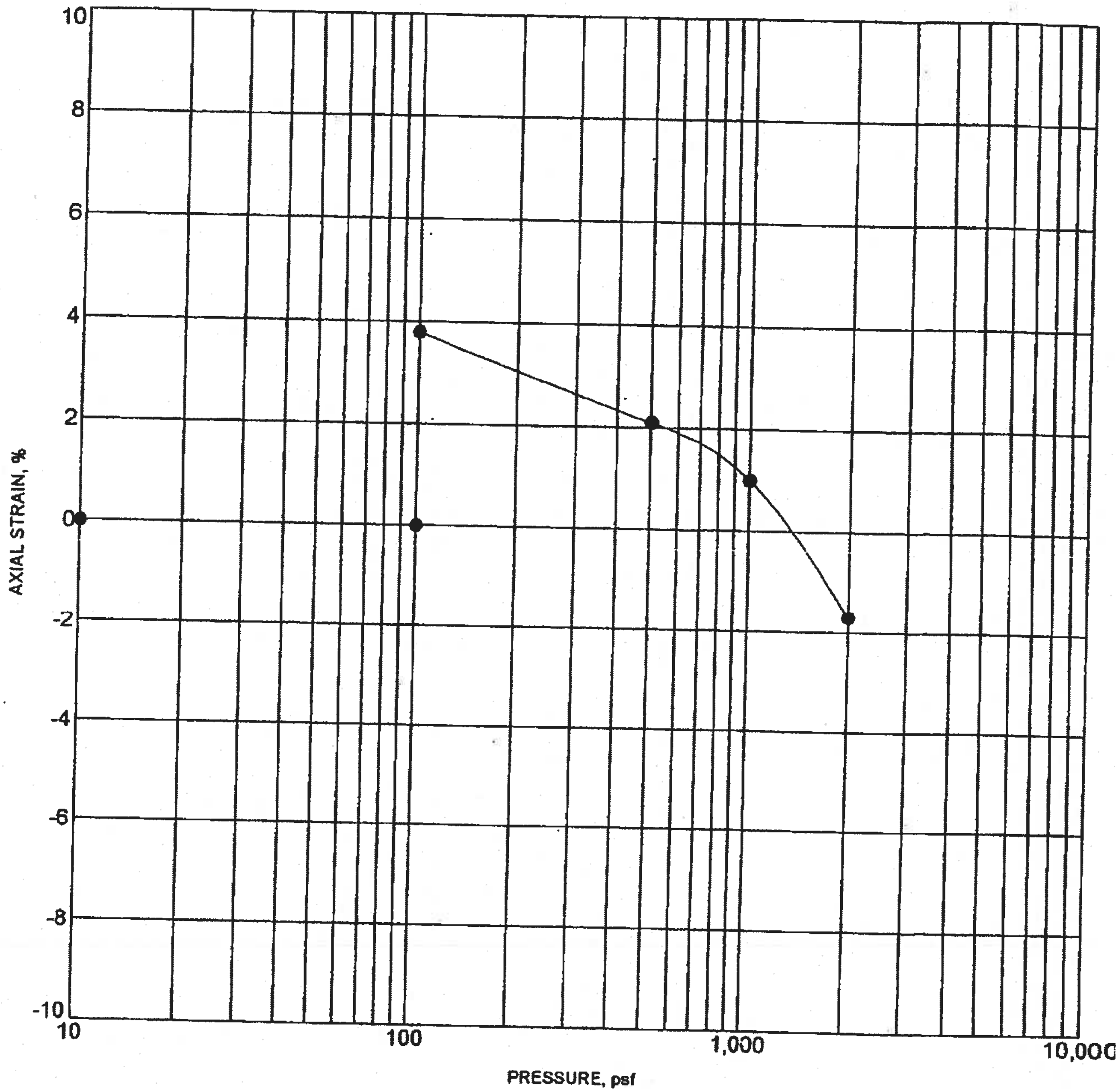
SWELL TEST

Project: MC 85 between 75th Ave. and 91st Ave

Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

Job #: 65035025

Date: 5-14-03



Specimen Identification		Classification	γ_d, pcf	WC,%
● P09	2.0 ft	SANDY LEAN CLAY(CL)	103	13

Notes: Sample remolded to the dry density and water content indicated. Water added at 100 psf.

Terracon

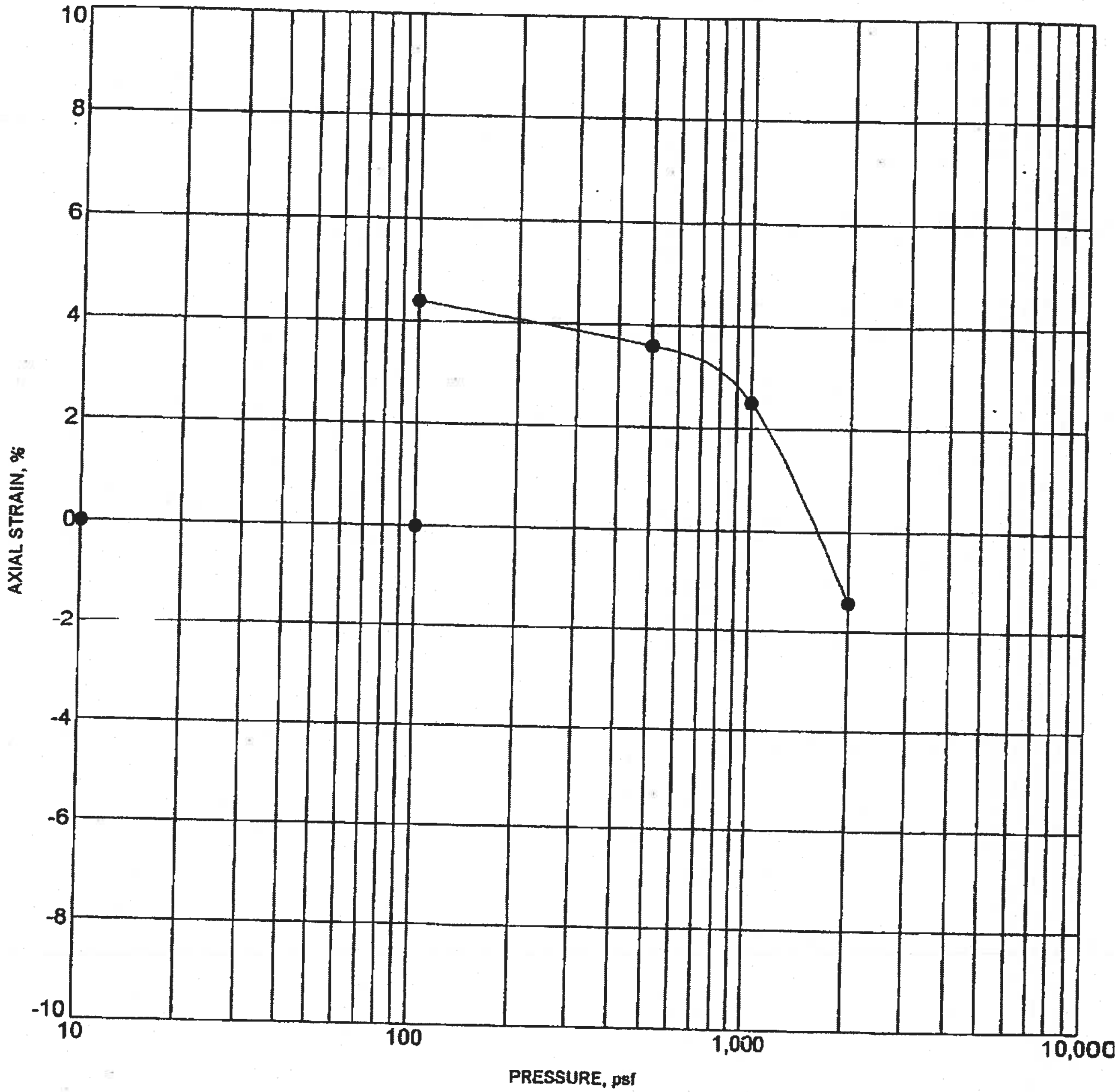
SWELL TEST

Project: MC 85 between 75th Ave. and 91st Ave

Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

Job #: 65035025

Date: 5-14-03



Specimen Identification			Classification	γ_d , pcf	WC,%
●	P10	2.0 ft	LEAN CLAY with SAND(CL)	103	15

Notes: Sample remolded to the dry density and water content indicated. Water added at 100 psf.

Terracon

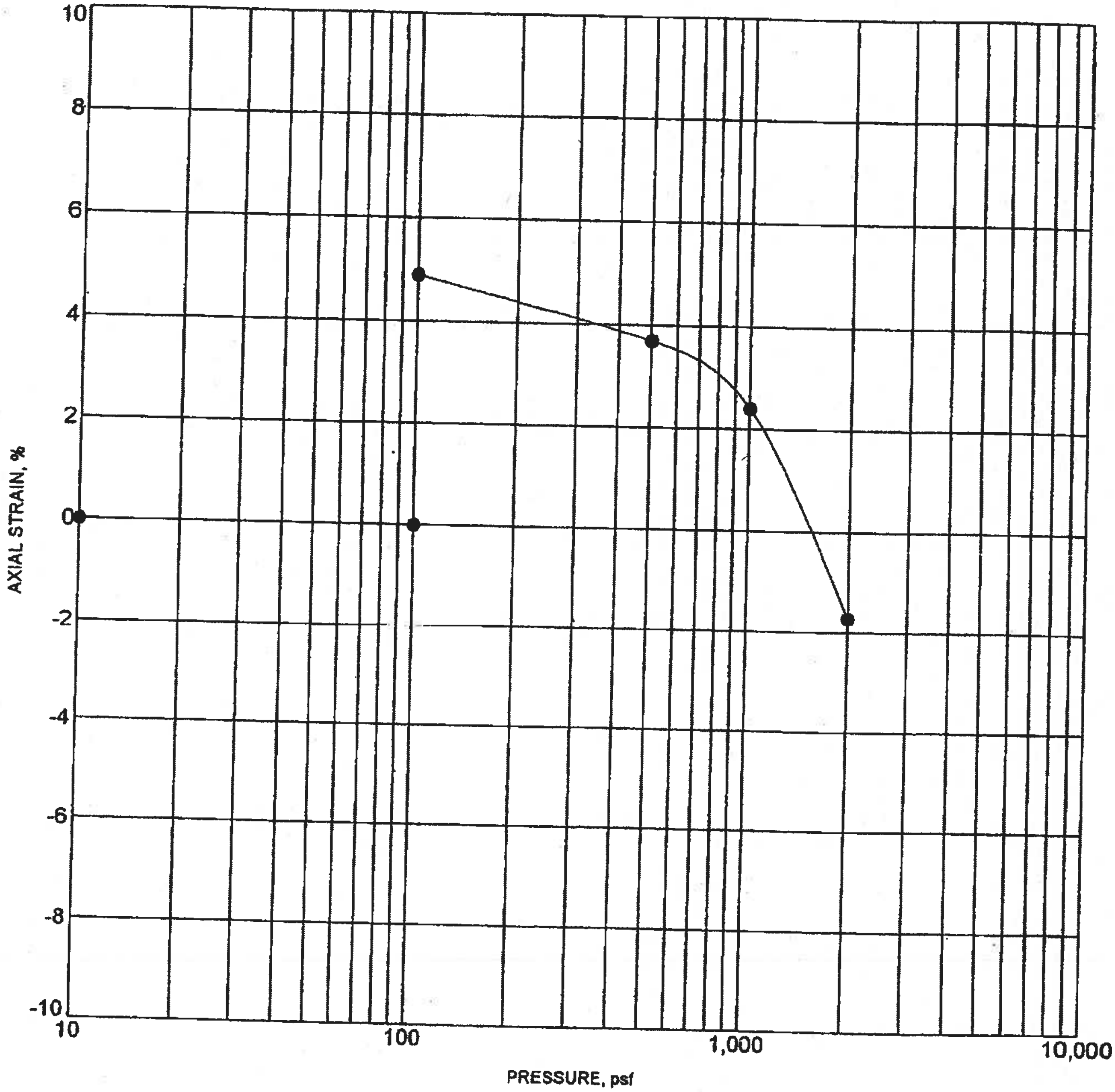
SWELL TEST

Project: MC 85 between 75th Ave. and 91st Ave

Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

Job #: 65035025

Date: 5-14-03



	Specimen Identification		Classification	γ_d, pcf	WC,%
●	P11	2.0 ft	LEAN CLAY with SAND(CL)	99	17

Notes: Sample remolded to the dry density and water content indicated. Water added at 100 psf.

Terracon

SWELL TEST

Project: MC 85 between 75th Ave. and 91st Ave

Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona

Job #: 65035025

Date: 5-14-03

TC SWELL1 STRAIN 65035025.GPJ TERRACON.GDT 5/14/03

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Remolded Expansion				Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits LL	PL	PI	Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	pH	Resistivity (ohm-cm)	Water Soluble Chloride (ppm)	Sulfates (%)	
P01	2	CL			54	30	15	15									
P02	2	CL	102	20	68	36	15	21	106	13.4	100	4.5					1
P03	2	CL	109	15	60	33	15	18	105	13.5	100	3.3					1
P04	2	CL			64	37	18	19					8.4	1100			
P05	2	CL	107	15	56	34	17	17	106	13.3	100	3.1					1
P06	2	CL	107	16	60	33	17	16					8.4	1500			1
P07	2	CL	112	13	66	36	18	18	104	14.2	100	2.9					1
P08	2	CL	110	16	62	35	16	19	104	14.4	100	5.8					1
P09	2	CL	107	13	65	33	16	17	103	13.2	100	3.8					1
P10	2	CL	106	17	71	38	17	21	103	14.6	100	4.4					1
P11	2	CL	104	21	81	45	22	23	99	16.6	100	4.9					1

REMARKS
1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.

Terracon

SUMMARY OF LABORATORY RESULTS

Project: MC 85 between 75th Ave. and 91st Ave
Site: MC 85 between 75th Ave. and 91st Ave. Maricopa County, Arizona
Job #: 65035025
Date: 5-14-03

SECTION 8

LIMITATIONS

TABLE OF CONTENTS

8 LIMITATIONS

8.1 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

The work performed was based on project information provided by the Client. If the Client does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, the Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations. Failure to do so will vitiate Kleinfelder's recommendations.

This report may be used only by the Client and their representatives, and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on site and off site), or other factors may change over time, and additional work may be required with the passage of time. Any party other than the Client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. It should be recognized that definition and evaluation of geologic and environmental conditions are a difficult and inexact science. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service that provide adequate information for their purposes at acceptable levels of risk. More extensive studies, including subsurface studies or field tests, should be performed to reduce uncertainties. Acceptance of this report will indicate that the Client has reviewed the document and determined that it does not need or want a greater level of service than provided.

8.2 ADDITIONAL SERVICES

The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be performed during the construction process to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Kleinfelder would be pleased to provide additional services to further evaluate any particular item or items described in this report.
- Observations and testing during the site grading, preparation and earthwork.
- Consultation as may be required during construction.

We also recommend that project plans and specifications be reviewed by us to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

APPENDIX L-A

ASFE Document

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

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