

GEOTECHNICAL INVESTIGATION REPORT  
SALT RIVER BANK PROTECTION  
PIMA FREEWAY TO ALMA SCHOOL ROAD  
SALT RIVER PIMA-MARICOPA INDIAN COMMUNITY  
MARICOPA COUNTY, ARIZONA

Pi

scott V.



**AGRA** Earth & Environmental

ENGINEERING GLOBAL SOLUTIONS

GEOTECHNICAL INVESTIGATION REPORT  
SALT RIVER BANK PROTECTION  
PIMA FREEWAY TO ALMA SCHOOL ROAD  
SALT RIVER PIMA-MARICOPA INDIAN COMMUNITY  
MARICOPA COUNTY, ARIZONA

scott v.

Submitted To:

Dibble & Associates  
2633 East Indian School Road  
Suite 401  
Phoenix, Arizona 85016-6763

Submitted By:

AGRA Earth & Environmental, Inc.  
3232 West Virginia Avenue  
Phoenix, Arizona 85009-1502



April 3, 1998

AEE Job No. 8-117-001008

Property of  
Flood Control District of MC L...  
Please Return to  
2801 W. Durango  
Phoenix, AZ 85009

April 3, 1998  
AEE Job No. 8-117-001008

Dibble & Associates  
2633 East Indian School Road  
Suite 401  
Phoenix, Arizona 85016-6763

**Attention: Brian J. Frye, P.E.**

Gentlemen:

**RE: GEOTECHNICAL INVESTIGATION REPORT  
PIMA FREEWAY TO ALMA SCHOOL ROAD  
SALT RIVER PIMA-MARICOPA INDIAN COMMUNITY  
MARICOPA COUNTY, ARIZONA**

Our Geotechnical Investigation Report for the referenced project is herewith submitted. The report includes the results of test pit excavation and laboratory analysis, and presents recommended criteria for bank protection and embankment stability.

Should any questions arise concerning this report, we would be pleased to discuss them with you.

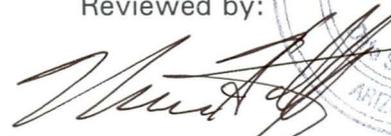
Respectfully submitted,

**AGRA Earth & Environmental, Inc.**

  
James D. Wilson, E.I.T.

c: Addressee (3)  
njf/J2-98/4-3-98

Reviewed by:

  
Norman H. Wetz, P.E.  
Senior Geotechnical Engineer



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Sheets 1 & 2



## **1.0 INTRODUCTION**

This report presents the results of a geotechnical investigation addressing the proposed hardbank protection for the north side of the Salt River in Maricopa County, Arizona. Recommendations and design criteria for materials to be used in the construction of the hardbank are presented herein.

## **2.0 PROJECT DESCRIPTION**

Details of the project were provided by Brian J. Frye, P.E. of Dibble & Associates. It is understood that about 8,700 lineal feet of bank protection is required along the north bank of the Salt River. The bank protection will begin at the Pima Freeway and extend east to a point about 3,500 feet west of Alma School Road. The purpose of the bank protection is to reclaim land north of the bank protection which is currently in the Salt River floodplain.

## **3.0 INVESTIGATION**

### **3.1 GEOLOGIC RECONNAISSANCE & MAPPING**

A geologic reconnaissance of the bank protection alignment was performed by Richard Bansberg, P.G. of this firm. During the reconnaissance, surface deposits along and adjacent to the alignment were mapped and test pit locations were staked on approximately 500-foot centers. A Site Plan showing the preliminary test pit locations was submitted to the Flood Control District of Maricopa County (FCDMC) for approval prior to excavating the test pits. Upon completing the test pit excavations, the test pit locations were surveyed and a Site Plan was prepared showing the distribution of surface materials along the bank protection alignment and the locations of the test pits (Sheet 1, map pocket).

### **3.2 TEST PIT EXCAVATIONS**

Twenty-four test pits were excavated to depths of 4 to 20 feet below existing grades along and adjacent to the bank protection alignment. The test pits were excavated with an LS-4300 Trackhoe. An attempt was made to excavate each pit to a depth of 20 feet. However, a number of pits were terminated due to caving conditions and two pits were terminated due to backhoe refusal on concrete washout from concrete-mixer trucks. While the test pits were excavated, the soils were continuously examined, classified and logged by Elizabeth A. Judd, E.I.T of this firm. Samples of the soils were collected at selected intervals in the pits for laboratory testing. Logs of the test pits are presented in Appendix A and the locations of the pits are shown on Sheet 1.

### 3.3 LABORATORY TESTING

Grain-size analysis and Atterberg limits tests were performed on selected samples to assist with classification and to determine their suitability for use in construction of the bank protection. The results of the laboratory testing are presented in Appendix B.

## 4.0 SITE CONDITIONS & GEOTECHNICAL PROFILE

### 4.1 SITE CONDITIONS

The bank protection will extend about 8,700 feet along the north bank of the Salt River from the Pima Freeway on the west to a point about 3,500 feet west of Alma School Road on the east. The new bank will generally be located about 100 feet north of the temporary levee which has been constructed to define the northern limit of the Salt River. The area to the north of the Salt River presently is utilized by two sand and gravel operations, Salt River Sand & Rock and CalMat.

Surface deposits present along and adjacent to the bank protection alignment include alluvial fill deposits and mine fill deposits. The distribution of these deposits is shown on Sheet 1. The alluvial fill consists of deposits of recent alluvium and fill that appears to have been deposited during recent flood events. The deposits include sand, sand and gravel, and sand, gravel and cobbles (SGC). A minor amount of trash and debris occurs locally in the upper several feet of the deposits. The mine fill consists of mine-related material including stockpiles of cobbles and boulders, deposits of silt from a settling pond, and concrete washout from concrete-mixer trucks.

The surface topography varies significantly along the alignment. The westernmost section of the alignment is relatively level with a few minor water-filled depressions. The central section of the alignment is characterized by large stockpiles of cobbles and boulders and a large gravel pit. The eastern section of the alignment contains large stockpiles of gravel and cobbles, a large settling pond and concrete washout from concrete-mixer trucks.

### 4.2 GEOTECHNICAL PROFILE

Based on the soils encountered in the test pits excavated along the alignment, the subsurface profile is characterized by three soil layers (from top to bottom): a sand layer, a sand, gravel and cobble layer, and a clayey sand, gravel and cobble layer. The sand layer is not present along the entire alignment and appears to have been deposited during recent flood events. The sand layer varies from about 1 to 5 feet in thickness and averages about 1.5 to 2.5 feet in thickness. The sand is predominantly fine to medium grained and subangular to subrounded.

The deposit is neoplastic and brown and locally grades to a silty sand to gravelly sand. The sand layer locally contains a trace to considerable amount of trash and debris.

The sand, gravel and cobble layer either underlies the sand layer or is exposed at the ground surface, depending upon the absence or presence of the sand layer. The sand, gravel and cobble layer ranges from several feet to about 15 feet in thickness and averages about 5 to 10 feet in thickness. The deposit locally contains occasional boulders to a considerable amount of boulders ranging up to 36 inches in diameter, and may contain a trace to some clay. The deposit typically is poorly graded, nonplastic to low in plasticity and brown. The deposit becomes reddish brown with an increase in clay content.

The sand, gravel and cobble layer grades with depth to a clayey sand, gravel and cobble layer or to sand, gravel and cobbles with a considerable amount of clay. The clay content generally comprises less than 5 percent of the deposit by weight, but the clay commonly has a medium to high plasticity. The deposit contains a trace amount to some boulders which range up to 24 inches in diameter. The sand, gravel and cobbles are poorly graded and the deposit is reddish brown. A cross section showing the test pit data and proposed bank protection is presented on Sheet 2 in the map pocket.

#### 4.3 GROUNDWATER & SOIL MOISTURE CONDITIONS

Groundwater was encountered in 13 of the test pits excavated for this project at depths ranging from 2 to 18 feet below existing grade. The soil moisture conditions above the water table were described as slightly moist to very moist. It is expected that the groundwater level will fluctuate seasonally and, therefore, dewatering may be necessary during construction, depending upon the time of year construction takes place and if flows are occurring in the Salt River. Also, treated water from the City of Mesa Wastewater Treatment Plant was being ponded in the Salt River and is suspected to be contributing to shallow groundwater conditions.

Permit

#### 5.0 DISCUSSION & RECOMMENDATIONS

##### 5.1 ANALYSIS OF RESULTS

A levee will be required to provide protection from flood waters in the Salt River. Erosion protection on the upstream side of the levee should consist of a mixture of on-site sand, gravel and cobbles prevalent at the site and cement. The width of the cementitious material should be 8 feet and extend from the top of the levee (elevation 1185 to 1197 feet) to the anticipated scour depth (elevation 1140 to 1150 feet). The remainder of the embankment should consist of the granular deposits encountered in the investigation.

Based on the information provided by the test pits and estimated grain-size distributions, there is sufficient granular material along the alignment for the construction of the levee. However, the granular material will need to be processed to provide a reasonably uniform and properly graded material. The cement content required for the cement-stabilized hardbank will be higher for the SGC materials which contain clay than those that are relatively clean. It is recommended that where clay layers are encountered within excavations, these materials be wasted due to the difficulty in blending these materials with the SGC. Also, clay-coated granular deposits should be avoided in the materials to be used for the erosion protection. However, these materials could be used for the embankments.

## 5.2 CEMENT-STABILIZED ALLUVIUM

Soil-cement and roller-compacted concrete (RCC) can be used for hardbank construction. However, availability of the required type of aggregate for these two alternatives governs construction costs. The fines content (defined as percent finer than the no. 40 sieve) of the SGC does not meet conventional requirements for either soil-cement or RCC construction. If either of these alternatives are to be used, fines will have to be imported from a borrow source to achieve a conventional mix.

It is our opinion that the Salt River alluvium can provide adequate bank protection without the addition of fines if the embankment material is plant-mixed on the site to produce cement stabilized alluvium (CSA). Based on the results of laboratory analyses, the following guidelines for gradation are recommended:

Sieve Size (square openings)	Percent Passing by Weight
3 inch	100
no. 4	35 - 70
no. 200	0 - 15

DISCUSS IN  
VE mtg.

crushing to provide  
more fines →  
less cement?

The materials should be free of organic or other deleterious material and should contain no clay lumps larger than 1-inch in diameter. The plasticity index of the material should be no greater than 25 when determined in accordance with the requirements of AASHTO T-90.

Where materials are nonplastic, a cement content of 6 to 7 percent is estimated to be required to achieve a 7-day minimum compressive strength of 1,500 pounds per square inch (psi). Where the SGC materials are clayey and have a plasticity index of 15 to 25, a cement content of 8 to 10 percent is estimated to be required. The clay will have an adverse effect on the strength of the proposed hardbank materials. It is recommended that a mix design be

performed using the specific materials proposed for construction. Where possible, the clayey SGC should be avoided in the production of cement-stabilized embankment materials.

### 5.3 TEMPORARY CUT SLOPES

Temporary cut slopes of 1 1/2H:1V (horizontal to vertical) are recommended for the upper, cleaner portions of the SGC. Temporary cut slopes of 1 1/4H:1V are recommended for the more clayey SGC strata. Where loose man-made fill, construction debris or loose cohesionless sands are present, the slopes should be laid back at a slope of 2H:1V or flatter. Some minor raveling as a result of precipitation or drying should be anticipated. All surface runoff should be diverted from the top of cut slopes to help prevent surface erosion of the slope. The temporary cut slopes in the silty fill (settlement pond) will require relatively flat slopes, possibly as flat as 4H:1V to 5H:1V. Special techniques such as use of draglines may be required to make the necessary excavation for construction.

### 5.4 PERMANENT SLOPES

Permanent slopes consisting of CSA should be placed in horizontal lifts 8 feet in horizontal width. Exact geometries were not available at the time of this report; however, the maximum embankment height is estimated to be 45 feet, with toe-down elevations ranging from 1140 to 1150 feet and embankment crest elevations ranging from 1185 to 1195 feet. A finished CSA slope of 1 1/2H:1V and a unprotected slope of 2 1/2H:1V are recommended. Stability analysis was performed for both slope configurations utilizing the computer program STABL5 (Achilleos, 1988)\*, developed by Purdue University. The cases analyzed included post-construction, pseudo-static, steady-state seepage and rapid drawdown. Maximum scour depth was assumed for all cases. Safety factors determined are tabulated as follows:

Slope	Post-Construction	Pseudo-Static	Steady-State Seepage	Rapid Drawdown
1 1/2H:1V CSA	1.86	1.52	2.11	1.29
2 1/2H:1V Unprotected	1.98	1.50	1.91	N/A

\*Achilleos, E., 1988, User Guide for PC STABL 5M, Purdue University and Indiana Department of Highways, Joint Highway Research Project, Report JHRP-88/19, December.

Geometries and calculated slip surfaces are illustrated in figures presented in Appendix C. Based on the results of the stability analyses, the embankment slopes will provide an adequate degree of stability. Steeper slopes were considered for the upstream slope, however, it likely is not feasible to place CSA on steeper slopes.

## 5.5 SITE GRADING

### 5.5.1 Surface Preparation

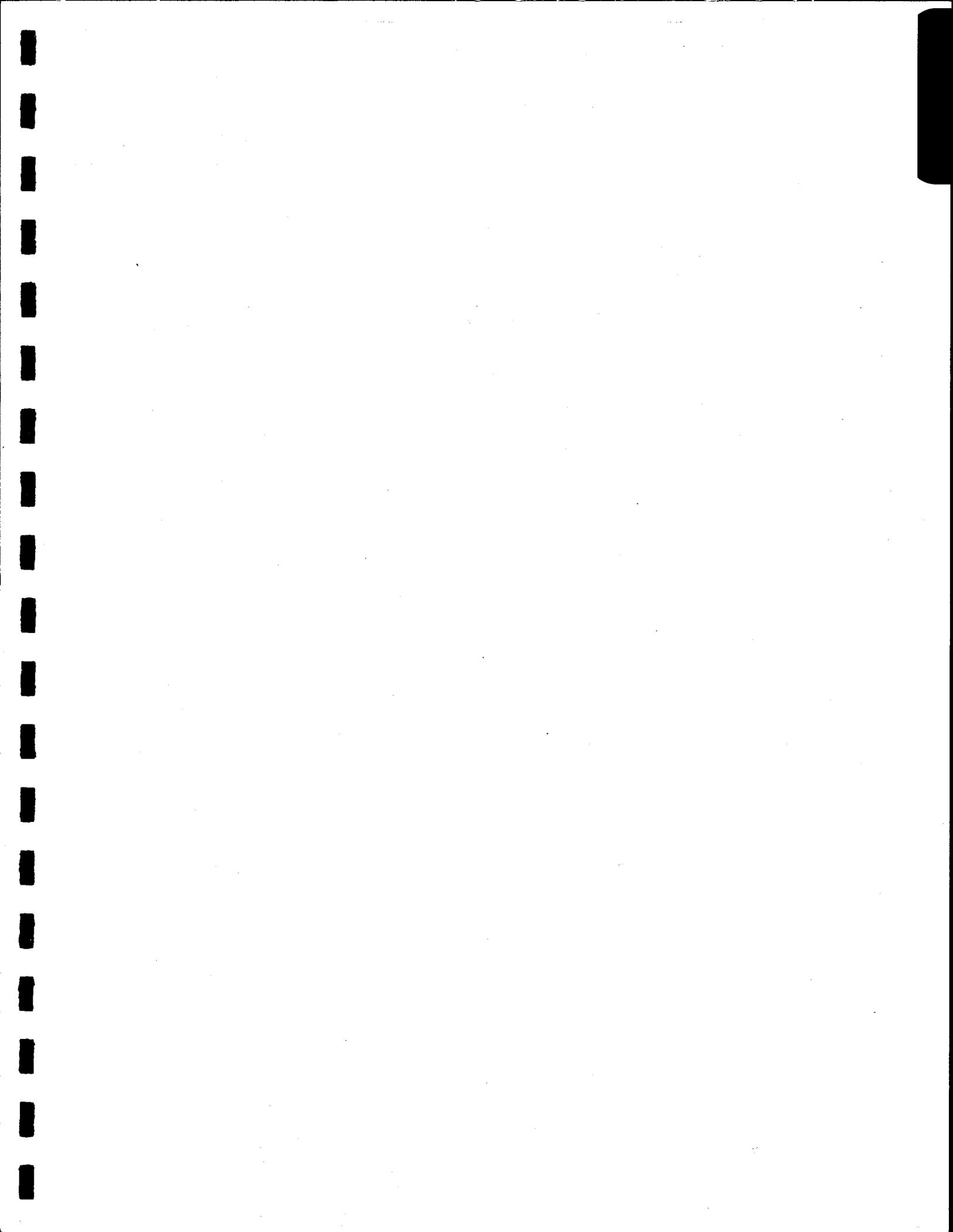
All loose, fine-grained man-made fill materials should be removed from beneath the embankments. It is anticipated that the hardbank will be of sufficient depth to penetrate all fills. Also, all materials that contain debris should be overexcavated. The cut surface beneath the embankments should be scarified, conditioned to between minus 1 and plus 3 percent of optimum moisture content and compacted to at least 95 percent of maximum density in accordance with ASTM D698.

### 5.5.2 Embankment Fill

Embankment fill should consist of granular soils and generally contain no particles larger than 12 inches. The materials should be reasonably well-graded sand, gravel and cobbles with occasional boulders and fines. Deleterious material such as wood, metal or other biodegradable materials should not be used in the embankment fills. Any clays or silts should be wasted or mixed with the granular soils. No more than 25 percent of the embankment materials should pass the no. 200 sieve. Occasional particles larger than 12 inches can be used in the embankment provided it is distributed in the fills and is encapsulated with finer grained materials.

All embankment fills should be compacted to at least 95 percent of maximum dry density in accordance with ASTM D698. The fills should be compacted at moisture contents between 1 percent below to 3 percent above optimum moisture content.

Where the soils are too coarse to test by conventional methods, a roller specification may be used. The materials passing the no. 40 sieve size should be conditioned to between minus 1 to plus 3 percent of optimum moisture content. Lifts should be no thicker than 12 inches (loose). The lifts should then be subjected to five passes with a heavy vibratory roller having a static weight of at least 25,000 pounds. The weight of the vibrating portion (including the drum, shaft and internal machinery) should be at least 12,000 pounds. The frequency of vibration during operation should be between 1,100 and 1,500 cycles per minute and the dynamic force at the operating frequency should not be less than 40,000 pounds. The maximum roller speed during operation should be no greater than 1.5 miles per hour. The compaction equipment used should be subject to approval by the geotechnical engineer.



**APPENDIX A**

**FIELD INVESTIGATION**

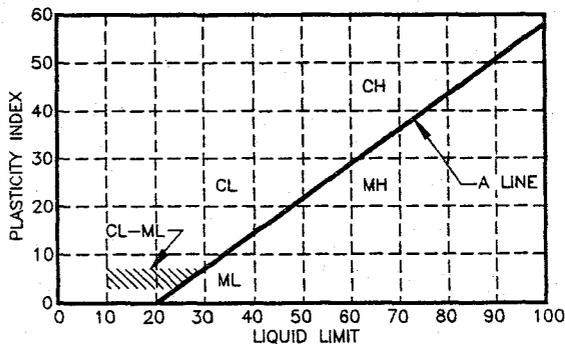
## UNIFIED CLASSIFICATION SYSTEM FOR SOILS

Soils are visually classified by the Unified Soil Classification System on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" ASTM Designation: D2487.

MAJOR DIVISION		GRAPH SYMBOL	GROUP SYMBOL	TYPICAL DESCRIPTION		
<b>COARSE-GRAINED SOILS</b> (Less than 50% passes No. 200 sieve)	<b>GRAVELS</b> (50% or less of coarse fraction passes No. 4 sieve)	<b>CLEAN GRAVELS</b> (Less than 5% passes No. 200 sieve)		 GW	Well graded gravels, gravel-sand mixtures or sand-gravel-cobble mixtures.	
		<b>GRAVELS WITH FINES</b> (More than 12% passes No. 200 sieve)		Limits plot below "A" line & hatched zone on plasticity chart  GP	poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.	
				Limits plot above "A" line & hatched zone on plasticity chart  GM	Silty gravels, gravel-sand-silt mixtures.	
		<b>GRAVELS WITH FINES</b> (More than 12% passes No. 200 sieve)		Limits plot above "A" line & hatched zone on plasticity chart  GC	Clayey gravels, gravel-sand-clay mixtures.	
	<b>CLEAN SANDS</b> (Less than 5% passes No. 200 sieve)			 SW	Well graded sands, gravelly sands.	
	<b>SANDS</b> (More than 50% of coarse fraction passes No. 4 sieve)		<b>CLEAN SANDS</b> (Less than 5% passes No. 200 sieve)		 SP	Poorly graded sands, gravelly sands.
					<b>SANDS WITH FINES</b> (More than 12% passes No. 200 sieve)	
			<b>SANDS WITH FINES</b> (More than 12% passes No. 200 sieve)			
<b>FINE-GRAINED SOILS</b> (50% or more passes No. 200 sieve)					<b>SILTS OF LOW PLASTICITY</b> (Liquid Limit Less Than 50)	
		<b>SILTS OF HIGH PLASTICITY</b> (Liquid Limit More Than 50)		 MH	Inorganic silts of high plasticity, silty soils, elastic silts.	
		<b>CLAYS OF LOW PLASTICITY</b> (Liquid Limit Less Than 50)		 CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	
		<b>CLAYS OF HIGH PLASTICITY</b> (Liquid Limit More Than 50)		 CH	Inorganic clays of high plasticity, fat clays, silty and sandy clays of high plasticity.	

**NOTE:** Coarse-grained soils with between 5% & 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart to have dual symbol.

**PLASTICITY CHART**



**DEFINITIONS OF SOIL FRACTIONS**

SOIL COMPONENT	PARTICLE SIZE RANGE
Boulders	Above 300mm (12in.)
Cobbles	300mm to 75mm (12in. to 3in.)
Gravel	75mm (3in.) to No. 4 sieve
Coarse gravel	75mm to 19mm (3in. to 3/4in.)
Fine gravel	19mm (3/4in.) to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-1

JOB NO. 8-117-001008

DATE 2-24-98

GROUNDWATER

BACKHOE TYPE LS-4300 Trackhoe

DEPTH	HOUR	DATE
6.0	07:44	2-24-98

LOCATION \_\_\_\_\_

ELEVATION 1153.3'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D		GP-GM	slightly moist to moist	<b>SILTY SAND, GRAVEL &amp; COBBLES</b> , some small boulders, poorly graded, subangular to subrounded, nonplastic, brown  note: estimated maximum particle size of 18"  note: some construction debris (concrete & wood) on surface
5			D		GP-GC	wet	<b>CLAYEY SAND, GRAVEL &amp; COBBLES</b> , occasional small boulder, poorly graded, subangular to subrounded, medium plasticity, brown  note: estimated maximum particle size of 18"
10							Stopped Trackhoe at 10' due to caving
15							
20							
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-2

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-2

JOB NO. 8-117-001008

DATE 2-24-98

GROUNDWATER

BACKHOE TYPE LS-4300 Trackhoe

DEPTH	HOUR	DATE
2.0	08:20	2-24-98

LOCATION \_\_\_\_\_

ELEVATION 1151.1'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D		SP	slightly moist to wet loose	SAND, predominantly fine to medium grained, subangular to subrounded, brown
4					GP	wet	SAND, GRAVEL & COBBLES, trace to some silt, poorly graded, subangular to subrounded, nonplastic, brown note: estimated maximum particle size of 12"
5							Stopped Trackhoe at 4' due to caving
10							
15							
20							
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-3

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-3

JOB NO. 8-117-001008

DATE 2-24-98

BACKHOE TYPE LS-4300 Trackhoe

GROUNDWATER		
DEPTH	HOUR	DATE
4.0	09:10	2-24-98

LOCATION \_\_\_\_\_  
 ELEVATION 1152.1'  
 DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					GP	slightly moist to moist  loose	<b>SAND, GRAVEL &amp; COBBLES</b> , some silt, some small boulders, poorly graded, subangular to subrounded, nonplastic, brown to reddish brown  note: estimated maximum particle size of 15"
5		D				wet	<b>CLAYEY SAND, GRAVEL &amp; COBBLES</b> , occasional small boulders, poorly graded, subangular to subrounded, low to medium plasticity, reddish brown  note: estimated maximum particle size of 15"
10					GP-GC		
15							Stopped Trackhoe at 15' due to caving
20							
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-4

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-4

JOB NO. 8-117-001008

DATE 2-24-98

GROUNDWATER

DEPTH	HOUR	DATE
3.0	09:30	2-24-98

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1153.4'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION				
0					GP	slightly moist to moist	<b>SAND, GRAVEL &amp; COBBLES</b> , some to considerable small boulders, well graded sand, poorly graded gravel, subangular to subrounded, nonplastic, brown				
						loose	note: estimated maximum particle size of 24"				
5			D			wet	<b>SAND, GRAVEL &amp; COBBLES</b> , some to considerable clay, poorly graded, subangular to subrounded, medium plasticity, brown to reddish brown				
							note: estimated maximum particle size of 12"				
10							GP				
15											
20											
25											
											Stopped Trackhoe at 20'

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-5

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-5

JOB NO. 8-117-001008

DATE 2-24-98

GROUNDWATER

DEPTH	HOUR	DATE
5.0	10:00	2-24-98

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1152.6'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS		VISUAL CLASSIFICATION	
0						moist very loose	FILL SAND, predominantly fine to medium grained, subangular to subrounded, nonplastic, brown  note: some household trash & plant roots encountered in upper 2' of excavation		
5			D		SP				
5					GP	moist to wet	SAND, GRAVEL & COBBLES, some clay, poorly graded, subangular to subrounded, low plasticity, brown to reddish brown  note: estimated maximum particle size of 12"		
							Stopped Trackhoe at 6' due to caving		
10									
15									
20									
25									

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-6

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-6

JOB NO. 8-117-001008

DATE 2-24-98

GROUNDWATER

DEPTH	HOUR	DATE
7.0	10:20	2-24-98

BACKHOE TYPE LS-4300 Trackhoe  
 LOCATION \_\_\_\_\_  
 ELEVATION 1155.8'  
 DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					SP	slightly moist very loose	FILL SAND, predominantly fine to medium grained, subangular to subrounded, nonplastic, brown  note: some household trash on surface & plant roots encountered to 1'
5					GP	slightly moist to wet	SANDY COBBLES & BOULDERS, predominantly fine to medium grained sand, subangular to subrounded, nonplastic, brown  note: estimated maximum particle size of 30"
10							Stopped Trackhoe at 8' due to caving
15							
20							
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-7

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-7

JOB NO. 8-117-001008

DATE 2-24-98

GROUNDWATER

DEPTH	HOUR	DATE
9.0	10:30	2-24-98

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1158.0'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
						0	
5					GP		
10					GP-GC	very moist to wet	<b>CLAYEY SAND, GRAVEL &amp; COBBLES</b> , poorly graded, low to medium plasticity, reddish brown  note: estimated maximum particle size of 12"
15							Stopped Trackhoe at 10' due to caving
20							
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-8

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-8

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

DEPTH	HOUR	DATE
18.0	08:30	2-25-98

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1160.0'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					SP	slightly moist	<b>GRAVELLY SAND</b> , poorly graded, subangular to subrounded, nonplastic, brown
5					SP	slightly moist	<b>SAND</b> , predominantly fine to medium grained, subangular to subrounded, nonplastic, brown
10			D		GP	slightly moist to moist	<b>SAND, GRAVEL &amp; COBBLES</b> , trace to considerable clay, poorly graded, subangular to subrounded, nonplastic to medium plasticity, reddish brown  note: estimated maximum particle size of 6"
20					GP	wet	<b>SAND, GRAVEL &amp; COBBLES</b> , some clay, poorly graded, subangular to subrounded, low to medium plasticity, reddish brown to brown  note: estimated maximum particle size of 12" Stopped Trackhoe at 20'
25							

8-117-001008.GWH.04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-9

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-9

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1163.2'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	moist to very moist	SANDY SILT, nonplastic, brown
5					GP	slightly moist to moist	SAND, GRAVEL & COBBLES, some to considerable boulders, poorly graded sand, well graded gravel, subangular to subrounded, nonplastic, brown  note: estimated maximum particle size of 30"
10							
15							
20		D			GP	moist	SAND, GRAVEL & COBBLES, some to considerable clay poorly graded, subangular to subrounded, medium to high plasticity, reddish brown  note: estimated maximum particle size of 12"
20							Stopped Trackhoe at 20'
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-10

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-10

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

BACKHOE TYPE LS-4300 Trackhoe

DEPTH	HOUR	DATE
2.5	09:25	2-25-98

LOCATION

ELEVATION 1157.5'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D		GP	moist to wet	<b>SAND, GRAVEL &amp; COBBLES</b> , trace to considerable clay, some to considerable boulders, poorly graded, subangular to subrounded, nonplastic to medium plasticity, brown  note: estimated maximum particle size of 24"  note: a few tires present on surface
5			D			wet	<b>SAND, GRAVEL &amp; COBBLES</b> , some to considerable clay, occasional small boulders, poorly graded, subangular to subrounded, medium to high plasticity, reddish brown  note: estimated maximum particle size of 24"
10					GP		
15							
20							Stopped Trackhoe at 20'
25							

8-117-001008.GWH.04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-11

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-11

JOB NO. 8-117-001008

DATE 2-25-98

BACKHOE TYPE LS-4300 Trackhoe

GROUNDWATER		
DEPTH	HOUR	DATE
4.0	11:45	2-25-98

LOCATION \_\_\_\_\_

ELEVATION 1152.9'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					SP	moist very loose	<b>FILL GRAVELLY SAND</b> , poorly graded, subangular to subrounded, nonplastic, brown  note: some household trash encountered in upper 2' of excavation
5					GP	moist to wet	<b>SAND, GRAVEL &amp; COBBLES</b> , some clay, poorly graded, subangular to subrounded, low to medium plasticity, reddish brown  note: estimated maximum particle size of 12"
10					GP	wet	<b>SAND, GRAVEL &amp; COBBLES</b> , poorly graded, subangular to subrounded, nonplastic, brown  note: estimated maximum particle size of 12"
15							
20							Stopped Trackhoe at 20'
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE  
 B - Undisturbed Block Sample.  
 D - Disturbed Bulk Sample.

A-12

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-12

JOB NO. 8-117-001008

DATE 2-25-98

BACKHOE TYPE LS-4300 Trackhoe

GROUNDWATER		
DEPTH	HOUR	DATE
7.0	12:10	2-25-98

LOCATION \_\_\_\_\_

ELEVATION 1152.9'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					SP	slightly moist	FILL SAND, predominantly fine to medium grained, subangular to subrounded, nonplastic, brown  note: household debris encountered in upper 2'6" of excavation
5					GP	slightly moist to wet	SAND, GRAVEL & COBBLES, some to considerable boulders, poorly graded, subangular to subrounded, nonplastic, brown  note: estimated maximum particle size of 24"
10		D			GP-GC	wet to moist	CLAYEY SAND, GRAVEL & COBBLES, poorly graded, subangular to subrounded, medium plasticity, reddish brown  note: estimated maximum particle size of 12"
15							
20							Stopped Trackhoe at 20'
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-13

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-13

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1157.7'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					SM	moist	FILL <b>SILTY SAND</b> , predominantly fine to medium grained, subangular to subrounded, nonplastic, brown  note: some to considerable household trash
5					GP	moist  dense to very dense	<b>SAND, GRAVEL &amp; COBBLES</b> , occasional small boulders, poorly graded, subangular to subrounded, medium plasticity, brown  note: estimated maximum particle size of 24"
10							
15							
20							Stopped Trackhoe at 20'
25							

8-117-001008.GWH.04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-14

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-14

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1144.6'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					GC	moist	FILL CLAYEY SAND & GRAVEL, poorly graded sand, subangular to subrounded, low to medium plasticity, brown
5					GP	moist	SAND, GRAVEL & COBBLES, some to considerable clay, poorly graded, subangular to subrounded, medium plasticity, reddish brown  note: estimated maximum particle size of 12"
10		D					
15							
20							Stopped Trackhoe at 20'
25							

8-117-001008\_GWH\_02/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-15

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-15

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1157.6'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0		D			GP	moist	<b>SAND, GRAVEL &amp; COBBLES</b> , poorly graded, subangular to subrounded, nonplastic, brown  note: maximum estimated particle size of 12"
5						moist	<b>CLAYEY SAND, GRAVEL &amp; COBBLES</b> , poorly graded, subangular to subrounded, medium plasticity, reddish brown  note: estimated maximum particle size of 12"
10					GP-GC		
15							
20							Stopped Trackhoe at 20'
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-16

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-16

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1155.3'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D		ML	very moist	FILL SANDY SILT, nonplastic, brown  note: some household trash
					SP	slightly moist	FILL SAND, fine grained, subangular to subrounded, nonplastic, brown  note: household trash encountered in upper 2' of excavation
5					GP	slightly moist to moist	SAND, GRAVEL & COBBLES, occasional small boulders, poorly graded, subangular to subrounded, nonplastic, brown  note: maximum estimated particle size of 18"
10							
15					GP-GC	moist	CLAYEY SAND, GRAVEL & COBBLES, poorly graded, subangular to subrounded, medium plasticity, reddish brown  note: maximum estimated particle size of 12"
20							Stopped Trackhoe at 20'
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-17

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-17

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1181.4'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					GC	moist	FILL <b>CLAYEY GRAVEL</b> , predominantly fine grained, angular to subangular, low to medium plasticity, brown  note: cobble lens from 1' to 1'6"
					CL		
					GP	moist	FILL <b>SILTY CLAY</b> , low to medium plasticity, brown
5						moist	FILL <b>SANDY COBBLES &amp; BOULDERS</b> , poorly graded sand, subangular to subrounded, nonplastic, brown  note: maximum estimated particle size of 24"
							Stopped Trackhoe at 6' due to caving
10							
15							
20							
25							

8-117-001008\_GWH\_02/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-18

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-18

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1194.7'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS		VISUAL CLASSIFICATION	
0					GP	slightly moist to moist	FILL <b>SANDY COBBLES &amp; BOULDERS</b> , poorly graded sand, subangular to subrounded, nonplastic, brown  note: estimated maximum particle size of 24"		
					SP	slightly moist	FILL <b>SAND</b> , predominantly fine to medium grained, subangular to subrounded, nonplastic, brown		
5							FILL <b>CONCRETE WASHOUT</b> Trackhoe refused at 4'6" on concrete washout		
10									
15									
20									
25									

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE  
B - Undisturbed Block Sample.  
D - Disturbed Bulk Sample.

A-19

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-19

JOB NO. 8-117-001008

DATE 2-25-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1195.2'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D		GC	slightly moist	FILL CLAYEY TO SILTY SAND & GRAVEL, occasional cobbles, poorly graded, low plasticity, reddish brown  note: maximum estimated particle size of 12"
5					GC	slightly moist	FILL CONCRETE WASHOUT mixed with CLAYEY SAND, GRAVEL & COBBLES
10							Trackhoe refused at 8' on concrete washout
15							
20							
25							

8-117-001008\_GWH\_04/02/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

A-20

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-20

JOB NO. 8-117-001008

DATE 2-25-98

BACKHOE TYPE LS-4300 Trackhoe  
 LOCATION \_\_\_\_\_  
 ELEVATION 1166.6'  
 DATUM JMA Engineering Survey

GROUNDWATER		
DEPTH	HOUR	DATE
4.0	15:10	2-25-98

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0							<b>SAND, GRAVEL, COBBLES &amp; BOULDERS,</b> note: maximum estimated particle size of 30"
4.0		D				slightly moist to wet	<b>SAND, GRAVEL &amp; COBBLES,</b> some to considerable clay, poorly graded, subangular to subrounded, medium plasticity, reddish brown to brown note: maximum estimated particle size of 12"
5					GP		
10							
15							
20							Stopped Trackhoe at 20'
25							

8-117-001008.GWH.04.02.98

SAMPLE TYPE  
 B - Undisturbed Block Sample.  
 D - Disturbed Bulk Sample.

A-21

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-21

JOB NO. 8-117-001008

DATE 3-27-98

GROUNDWATER

BACKHOE TYPE LS-4300 Trackhoe



DEPTH	HOUR	DATE
	none	

LOCATION \_\_\_\_\_  
 ELEVATION 1184.1'  
 DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					GP	moist	<b>SAND, GRAVEL &amp; COBBLES</b> , some boulders up to 16" in diameter, predominantly medium grained subrounded sand, predominantly coarse grained rounded gravel, nonplastic, grayish brown
5					GP-GC	very moist	<b>SAND, GRAVEL &amp; COBBLES</b> , some clay & boulders up to 24" in diameter, predominantly medium grained subrounded sand, predominantly coarse grained rounded gravel, low medium plasticity, brown  note: considerable caving of pit during excavation
10							
15							Stopped Trackhoe at 13'
20							
25							

8-117-001008.GWH.04/02/98

SAMPLE TYPE  
 B - Undisturbed Block Sample.  
 D - Disturbed Bulk Sample.

A-22

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-22

JOB NO. 8-117-001008

DATE 3-27-98

BACKHOE TYPE LS-4300 Trackhoe

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

LOCATION \_\_\_\_\_

ELEVATION 1197.2'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D			slightly moist to moist	Man-made FILL <b>SILTY SAND, GRAVEL &amp; COBBLES</b> , well graded subangular sand, predominantly coarse grained rounded gravel, nonplastic, light brown  note: some construction debris consisting of tree branches & metal fencing
5					GP		
10							
12'6"							Stopped Trackhoe at 12'6"
15							
20							
25							

8-117-001008\_GWH\_04/03/98

SAMPLE TYPE  
 B - Undisturbed Block Sample.  
 D - Disturbed Bulk Sample.

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-23

JOB NO. 8-117-001008

DATE 3-27-98

GROUNDWATER

DEPTH	HOUR	DATE
6.0	10:00	3-27-98

BACKHOE TYPE LS-4300 Trackhoe

LOCATION \_\_\_\_\_

ELEVATION 1195.1'

DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D			very moist	SANDY SILT, nonplastic, yellowish brown
					ML		
5							
			D			wet	CLAYEY SILT, nonplastic, brown
					ML		
10							
					GP	wet	SAND, GRAVEL & COBBLES, well graded, subrounded sand, predominantly coarse grained rounded gravel, nonplastic, grayish brown
15							Stopped Trackhoe at 13'6"
20							
25							

8-117-001008\_GWH\_04/03/98

SAMPLE TYPE

- B - Undisturbed Block Sample.
- D - Disturbed Bulk Sample.

PROJECT Salt River Bank Protection

LOG OF TEST PIT NO. TP-24

JOB NO. 8-117-001008

DATE 3-27-98

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

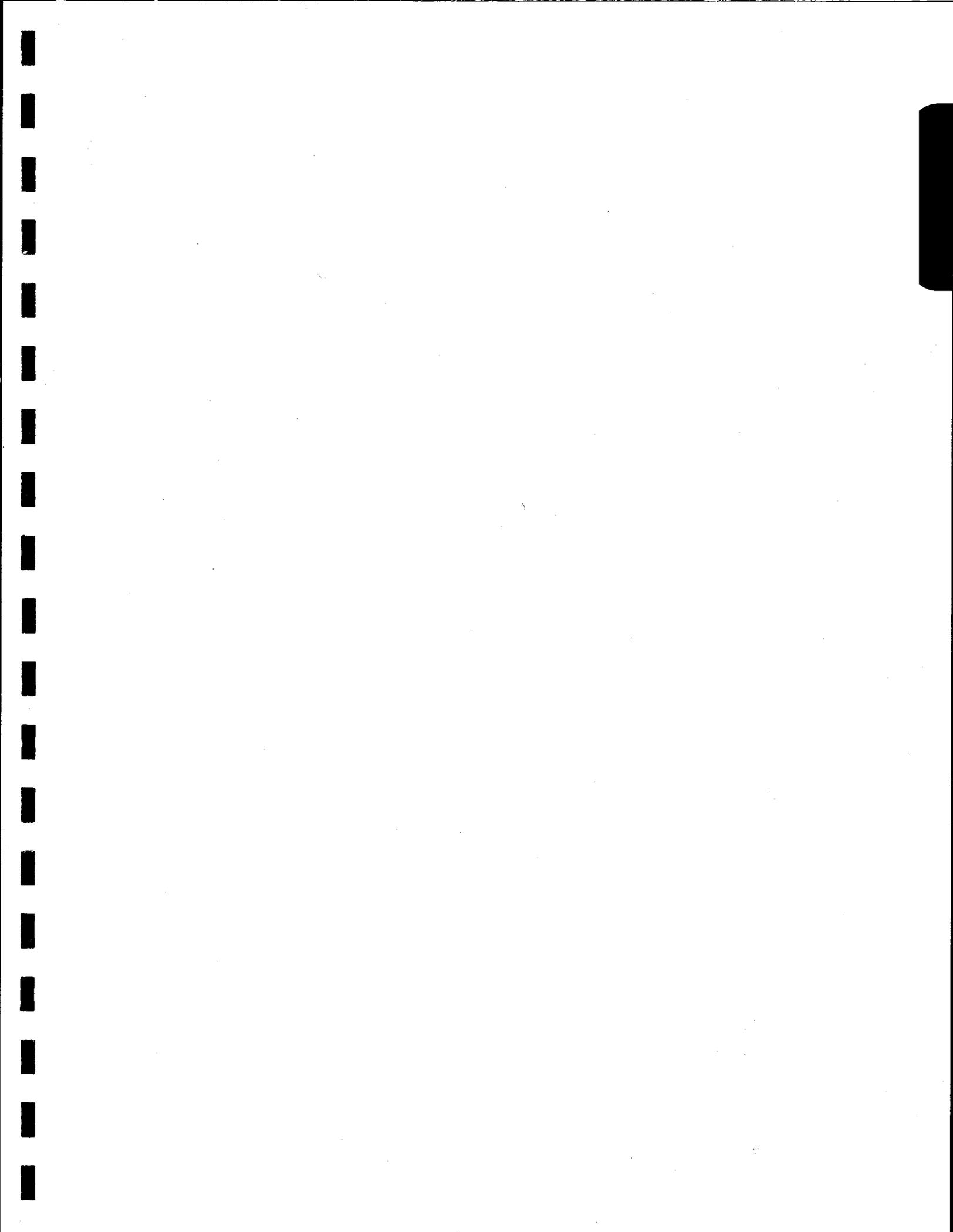
BACKHOE TYPE LS-4300 Trackhoe  
 LOCATION \_\_\_\_\_  
 ELEVATION 1201.2'  
 DATUM JMA Engineering Survey

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0					GP	moist	Man-made FILL <b>SAND, GRAVEL &amp; COBBLES</b> , well graded, subangular sand, predominantly coarse grained rounded gravel, nonplastic, brown  note: some construction debris composed of concrete fragments, metal pipes, asphaltic concrete
5					GP	moist	<b>SANDY GRAVEL</b> , some cobbles, predominantly coarse grained, rounded, nonplastic, brown  note: interbedded with gravelly sand lenses from 6' to 10'
10							
15							Stopped Trackhoe at 12'
20							
25							

8-117-001008.GWH\_04/02/98

SAMPLE TYPE  
 B - Undisturbed Block Sample.  
 D - Disturbed Bulk Sample.

A-25



**APPENDIX B**  
**LABORATORY TESTS**

**AGRA Earth & Environmental, Inc.**

PROJECT: SALT RIVER BANK PROTECTION  
 LOCATION: PIMA FREEWAY TO ALMA SCHOOL RD.

JOB NO: 8-117-001008  
 WORK ORDER NO: 1  
 DATE SAMPLED: 2-26-98

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

**SIEVE SIZES**

Location & Depth	USCS	LL	PI	Silt or Clay	SAND								GRAVEL						COBBLES		Lab #
					Fine			Medium			Coarse	Fine			Coarse			4"	6"		
					#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"			1"	

**PERCENT PASSING BY WEIGHT**

Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	Lab #
TP1 @ 1-3'	GP-GM	NV	NP	7.2	12	15	19	24	32	36	37	41	44	48	52	58	64	73	82	93	100	100	1
TP1 @ 7-9'	GP-GC	30	12	5.9	9	13	16	19	24	27	28	31	32	36	38	44	49	58	66	83	100	100	2
TP3 @ 2-4'	GP	NV	NP	3.6	6	15	20	23	27	29	29	31	32	34	36	40	45	65	81	100	100	100	4
TP4 @ 5-7'	GP	33	17	3.0	5	9	13	18	29	32	33	36	38	42	46	54	61	72	78	90	100	100	5
TP8 @ 9-11'	SP	NV	NP	4.3	7	18	27	33	44	49	49	53	54	57	62	74	78	100	100	100	100	100	7
TP9 @ 19-20'	GP	51	32	3.5	5	7	9	10	14	17	18	22	25	29	33	42	50	67	81	100	100	100	8
TP10 @ 5-7'	GP	53	31	3.8	8	13	17	23	42	36	37	43	46	52	56	66	75	81	90	100	100	100	9
TP12 @ 10-12'	GP-GC	35	17	5.4	7	12	17	21	31	36	37	41	42	43	45	48	54	67	95	100	100	100	10
TP13 @ 6-8'	GP	40	22	2.0	3	5	8	14	26	31	32	36	38	44	50	62	72	89	93	100	100	100	11
TP14 @ 10-12'	GP	37	14	3.3	4	8	12	19	30	34	35	39	41	44	48	54	61	74	87	100	100	100	12

**AGRA Earth & Environmental, Inc.**

**PROJECT:** SALT RIVER BANK PROTECTION  
**LOCATION:** PIMA FREEWAY TO ALMA SCHOOL RD.

**JOB NO:** 8-117-001008  
**WORK ORDER NO:** 1  
**DATE SAMPLED:** 2-26-98

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

**SIEVE SIZES**

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 1/2"	2"	

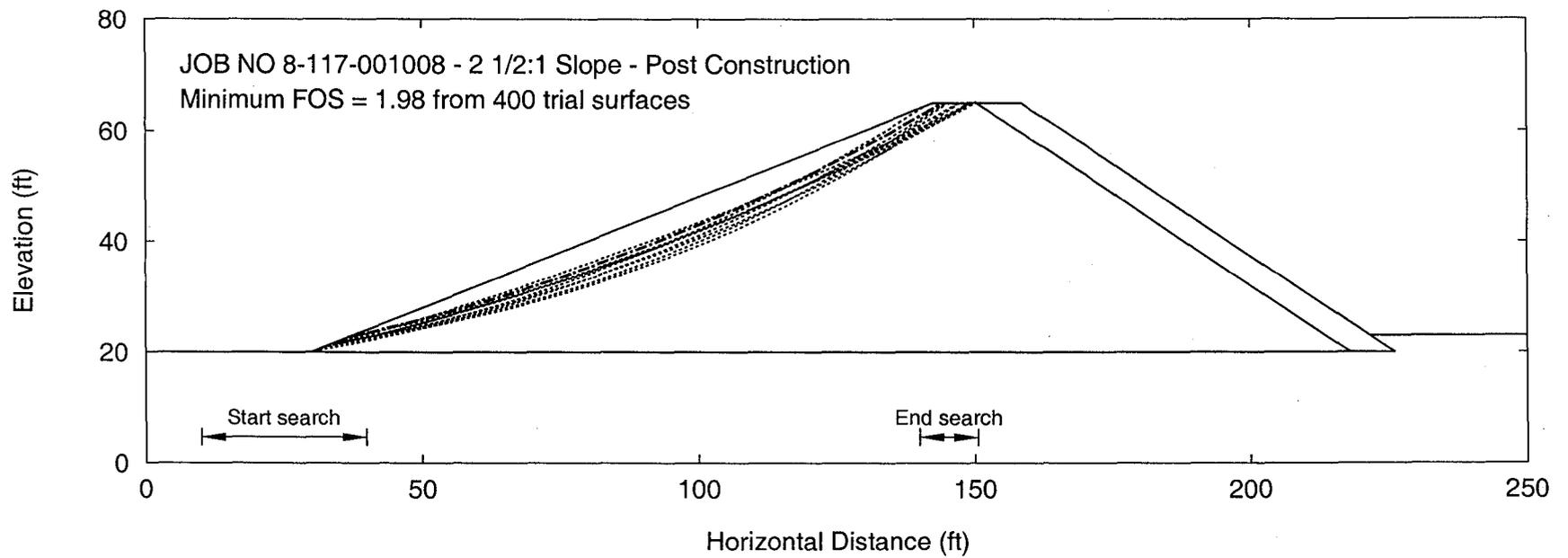
**PERCENT PASSING BY WEIGHT**

TP15 @ 0-1'	GP	NV	NP	3.6	6	11	14	19	28	33	35	40	42	46	49	58	63	80	92	100	100	100	13
TP19 @ 0-2'	GC-GM	24	5	40	47	53	54	57	61	64	65	68	70	75	80	89	95	97	98	100	100	100	15
TP20 @ 1-3'	GP	45	25	4.5	7	11	14	17	23	25	26	28	29	33	38	50	62	80	94	100	100	100	16
TP10 @ 0-1'	SM	NV	NP	21	23	27	34	41	51	56	57	61	64	68	72	79	83	91	93	100	100	100	17

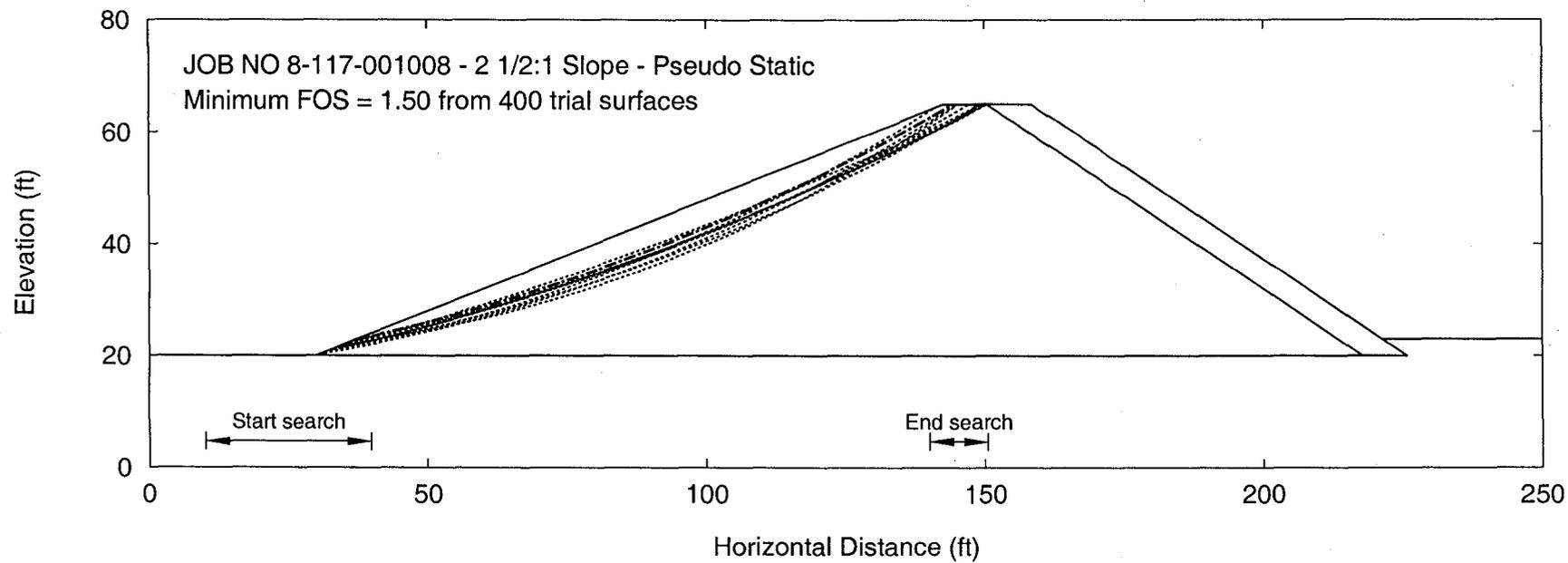
B-2

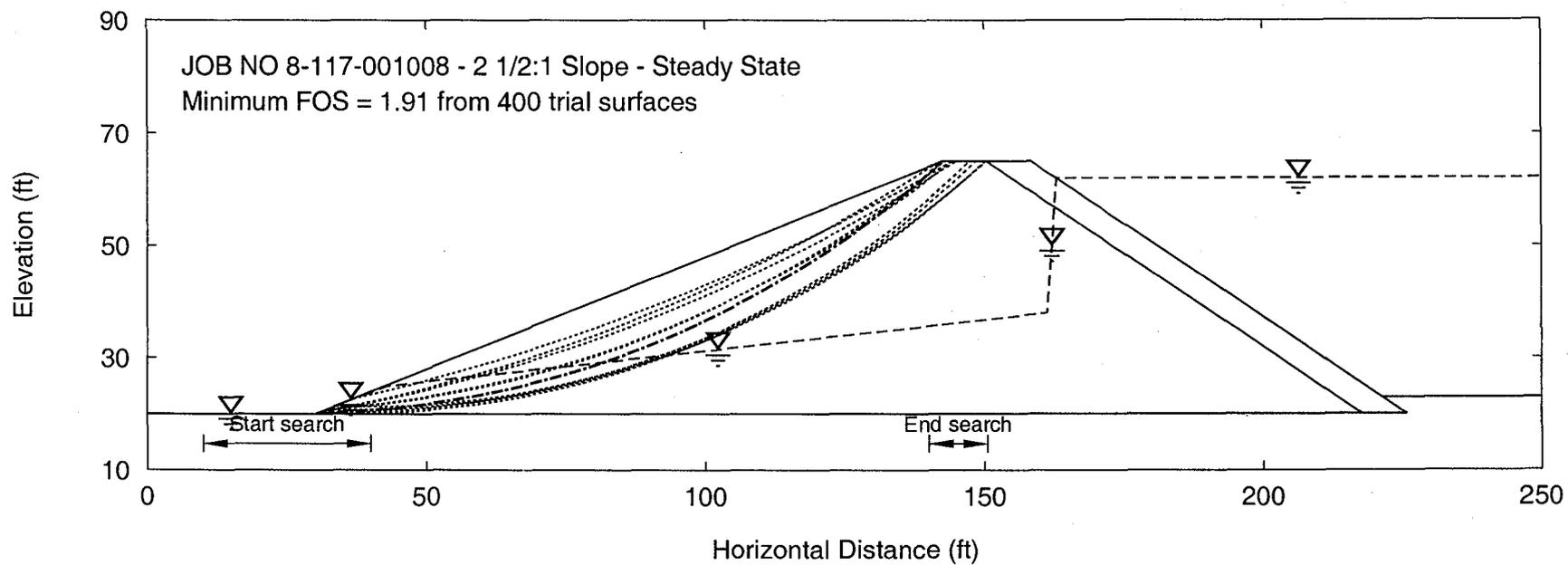


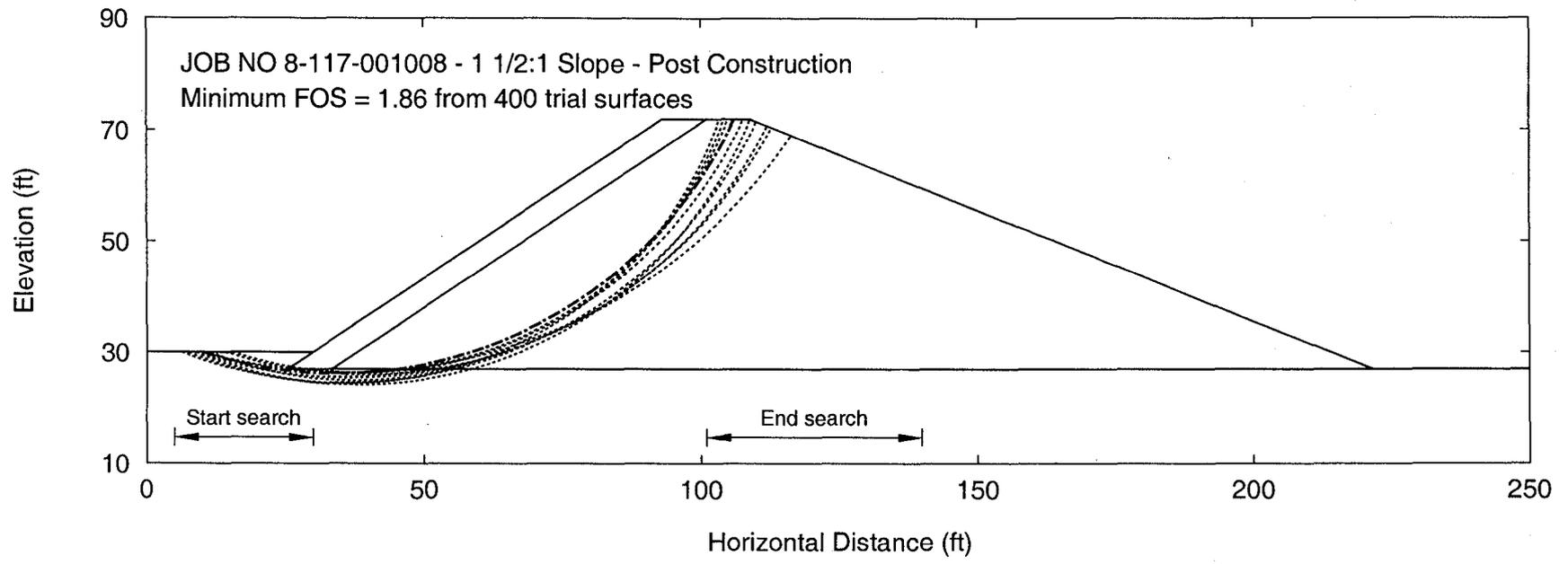
**APPENDIX C**  
**STABILITY ANALYSIS**



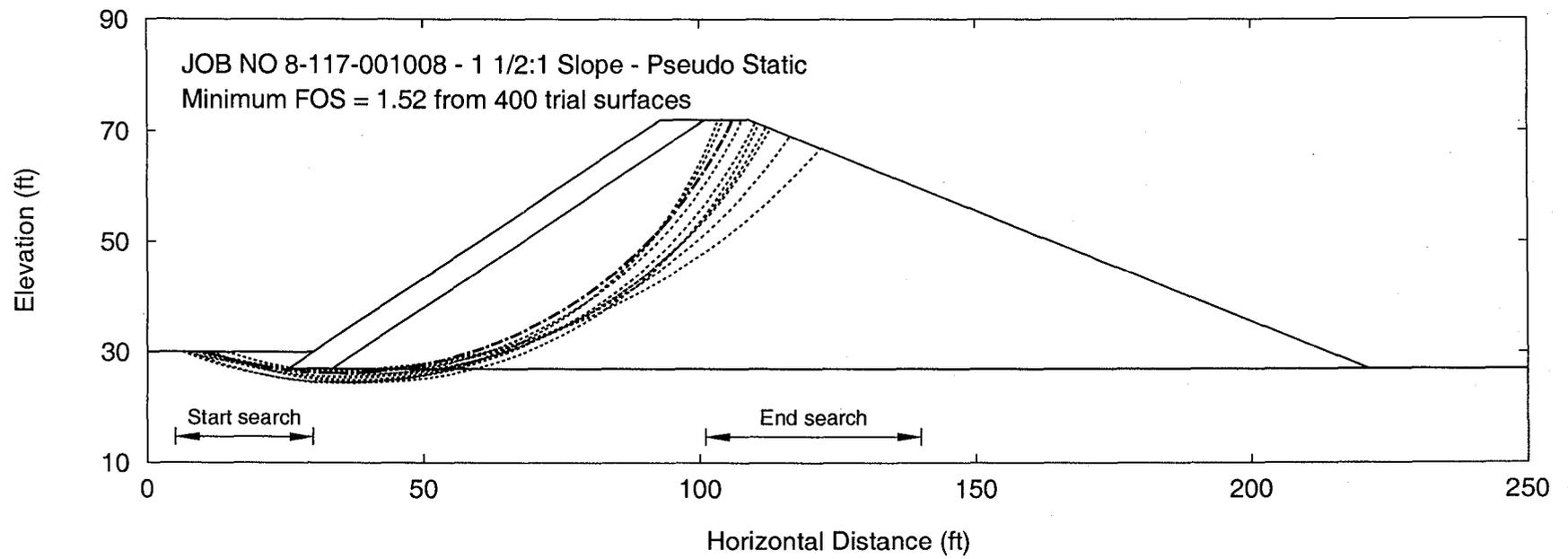
C-1

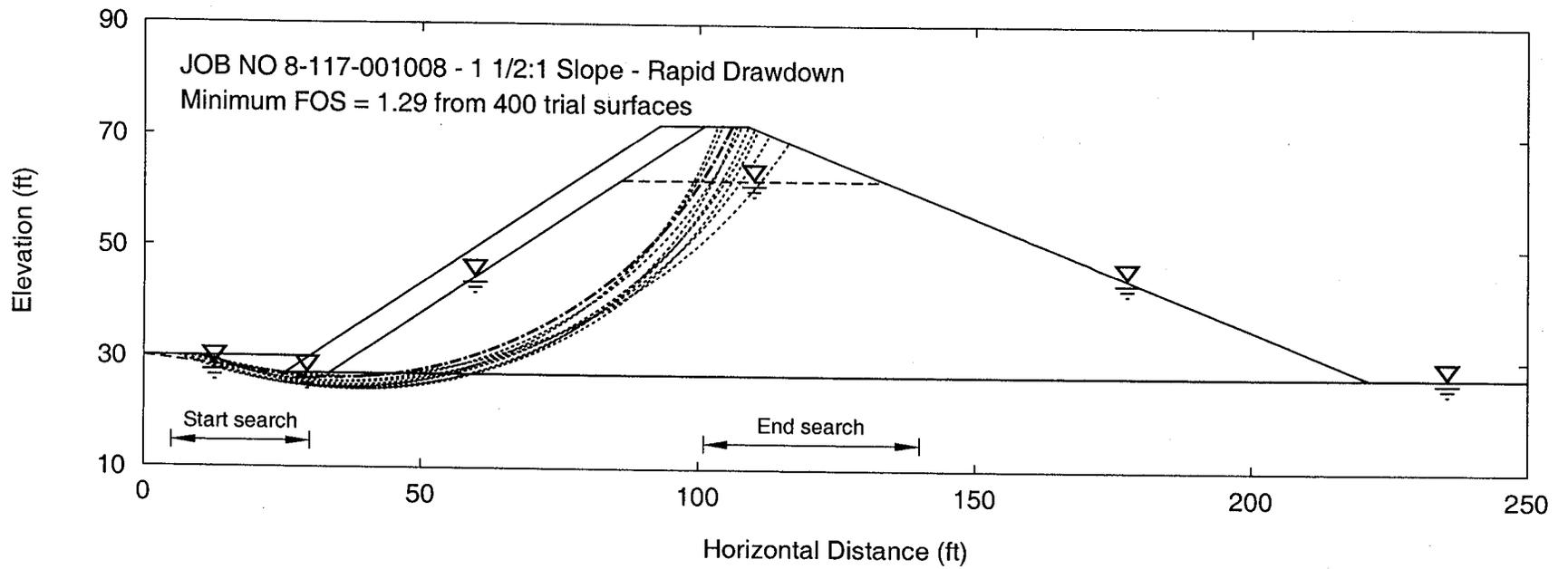


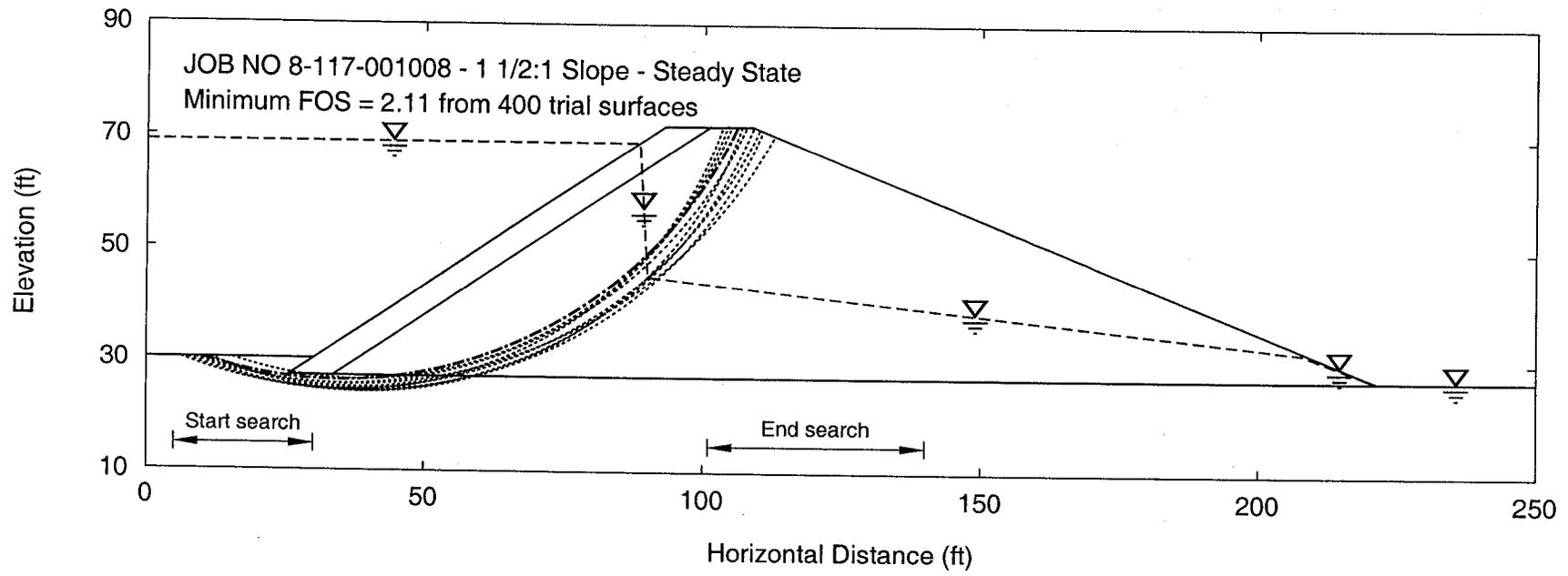




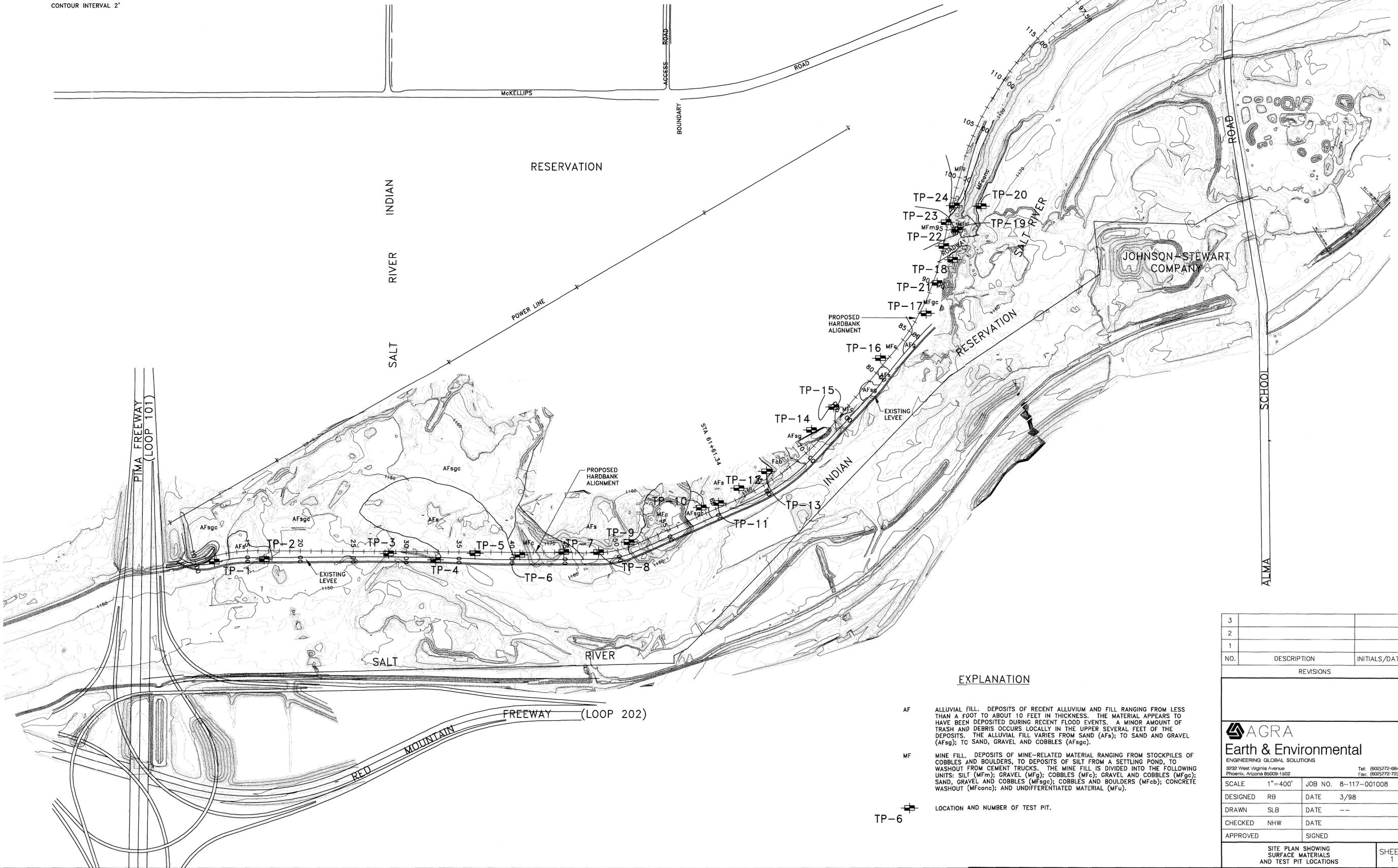
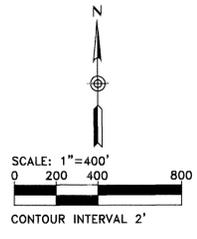
C-4







C-7



**EXPLANATION**

- AF ALLUVIAL FILL. DEPOSITS OF RECENT ALLUVIUM AND FILL RANGING FROM LESS THAN A FOOT TO ABOUT 10 FEET IN THICKNESS. THE MATERIAL APPEARS TO HAVE BEEN DEPOSITED DURING RECENT FLOOD EVENTS. A MINOR AMOUNT OF TRASH AND DEBRIS OCCURS LOCALLY IN THE UPPER SEVERAL FEET OF THE DEPOSITS. THE ALLUVIAL FILL VARIES FROM SAND (AFs); TO SAND AND GRAVEL (AFsg); TO SAND, GRAVEL AND COBBLES (AFsgc).
- MF MINE FILL. DEPOSITS OF MINE-RELATED MATERIAL RANGING FROM STOCKPILES OF COBBLES AND BOULDERS, TO DEPOSITS OF SILT FROM A SETTLING POND, TO WASHOUT FROM CEMENT TRUCKS. THE MINE FILL IS DIVIDED INTO THE FOLLOWING UNITS: SILT (Mfm); GRAVEL (Mfg); COBBLES (Mfc); GRAVEL AND COBBLES (Mfgc); SAND, GRAVEL AND COBBLES (Mfsgc); COBBLES AND BOULDERS (Mfcb); CONCRETE WASHOUT (Mfconc); AND UNDIFFERENTIATED MATERIAL (Mfu).
- TP-6 LOCATION AND NUMBER OF TEST PIT.

3		
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1		
NO.	DESCRIPTION	INITIALS/DATE
REVISIONS		

**AGRA**  
Earth & Environmental

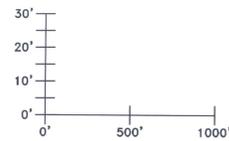
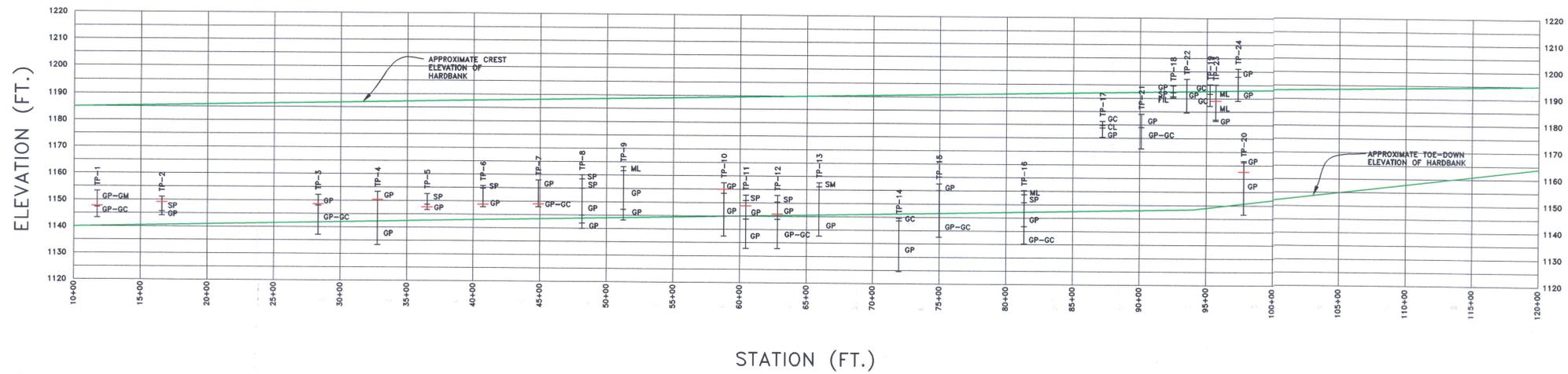
ENGINEERING GLOBAL SOLUTIONS  
3325 West Virginia Avenue Phoenix, Arizona 85029-1822 Tel: (602)272-8848 Fax: (602)272-7239

SCALE: 1"=400'	JOB NO. 8-117-001008
DESIGNED RB	DATE 3/98
DRAWN SLB	DATE --
CHECKED NHW	DATE
APPROVED	SIGNED

SITE PLAN SHOWING SURFACE MATERIALS AND TEST PIT LOCATIONS

SHEET 1

G:\Geotech\Salt River Bank Protection 8-1008\sample.dwg P1 Apr 03 14:06:55 1998  
HP Design: 7550M Hewlett-Packard HP-GL/2 devices, ADI 4.3 - For Autocad by HP



SCALE  
HORIZ 1"=500'  
VERT .4"=10'

**EXPLANATION**

- GW WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES OR SAND-GRAVEL-COBBLE MIXTURES.
- GP POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, OR SAND-GRAVEL-COBBLE MIXTURES.
- GM SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES.
- GC CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES.
- SW WELL GRADED SANDS, GRAVELLY SANDS.
- SP POORLY GRADED SANDS, GRAVELLY SANDS.
- SM SILTY SANDS, SAND-SILT MIXTURES.
- SC CLAYEY SANDS, SAND-CLAY MIXTURES.
- ML INORGANIC SILTS, CLAYEY SILTS WITH SLIGHT PLASTICITY.
- MH INORGANIC SILTS OF HIGH PLASTICITY, SILTY SOILS, ELASTIC SILTS.
- CL INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
- CH INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS, SILTY AND SANDY CLAYS OF HIGH PLASTICITY.

- TP-6 TEST PIT NUMBER
- SP TOP OF TEST PIT
- GP SOIL CLASSIFICATION
- GC CHANGE IN SOIL TYPE
- ML WATER ELEVATION (3/98)
- CL BOTTOM OF TEST PIT

3		
2		
1		
NO.	DESCRIPTION	INITIALS/DATE

REVISIONS	
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<b>AGRA</b> Earth & Environmental ENGINEERING GLOBAL SOLUTIONS 3232 West Virginia Avenue Phoenix, Arizona 85009-1502 Tel: (602)272-6848 Fax: (602)272-7239	
SCALE AS NOTED	JOB NO. 8-117-001008
DESIGNED RB	DATE 4/98
DRAWN SLB	DATE --
CHECKED NHW	DATE
APPROVED	SIGNED

PROFILE OF HARDBANK SHOWING TEST PIT DATA	SHEET 2
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