

**REPORT FOR
GEOTECHNICAL ENGINEERING SERVICES
NEW RIVER CHANNELIZATION
GRAND AVENUE TO GREENWAY ROAD
PEORIA , ARIZONA**

For

**Wood, Patel & Associates, Inc.
Attention: Ash Patel
1550 East Missouri, Suite 203
Phoenix, Arizona 85014**

Project No. 93-0472

13 July 1993

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13 July 1993

Wood, Patel & Associates, Inc.
1550 East Missouri, Suite 203
Phoenix, Arizona 85014

Attention: Ash Patel

Subject: Report for Geotechnical Engineering Services
New River Channelization
Grand Avenue to Greenway Road
Peoria County, Arizona

Project No. 93-0472

This report presents the results of the geotechnical engineering services authorized on the site for the New River Channelization in Maricopa County, Arizona.

The purpose of these services is to determine the soil conditions at the locations indicated which thereby provide a basis for the design discussions and recommendations presented herein. This firm should be notified for evaluation if conditions other than described herein are encountered during construction.

The recommendations presented in this report are based upon the project information received and described in "Scope" Part I. This firm should be contacted for review if the design conditions are changed substantially.

If requested, we will be available to review project plans and specifications relative to compliance to the intent of this report.

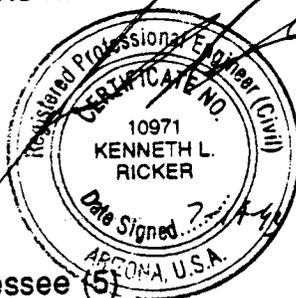
Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By:

/cm

Addressee (5)



Reviewed By:

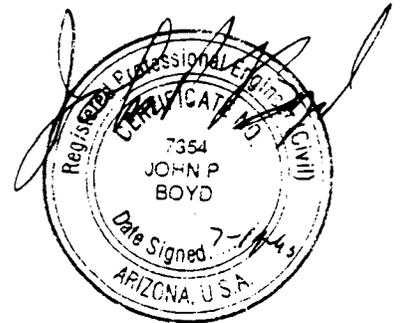


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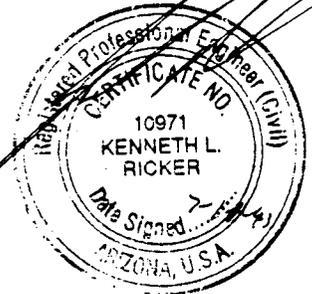
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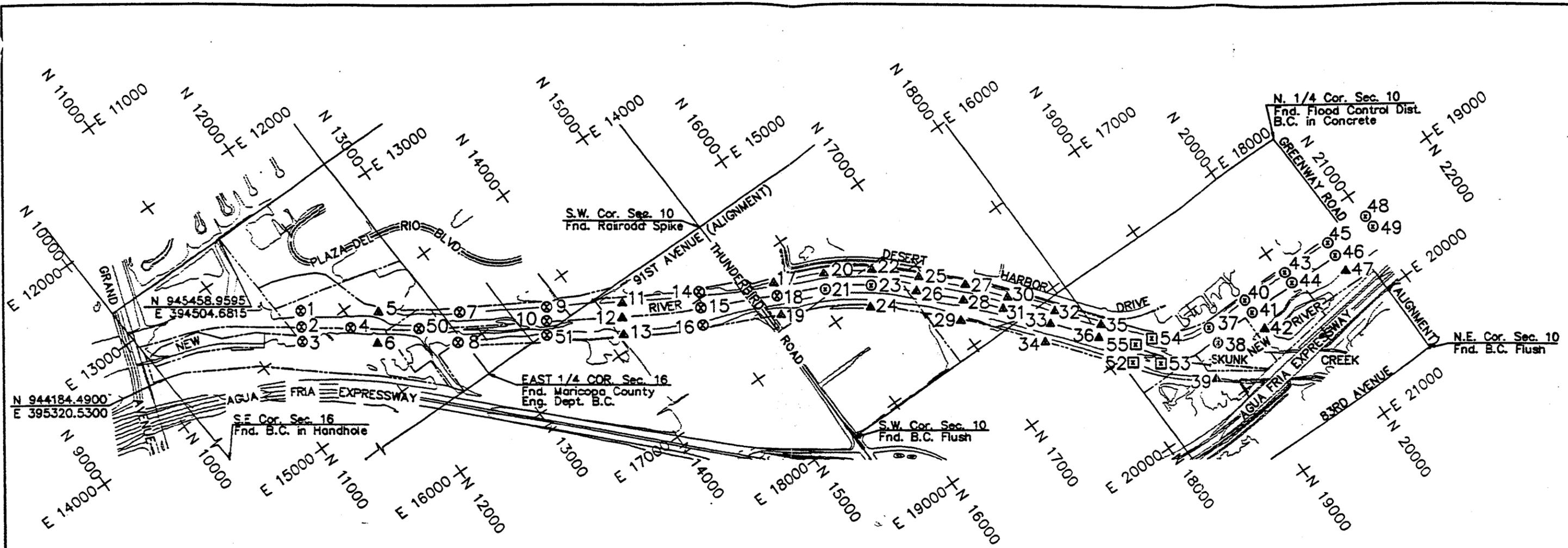
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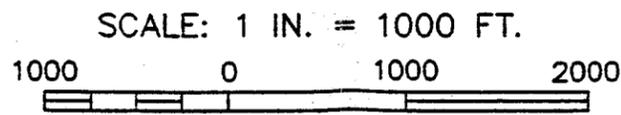
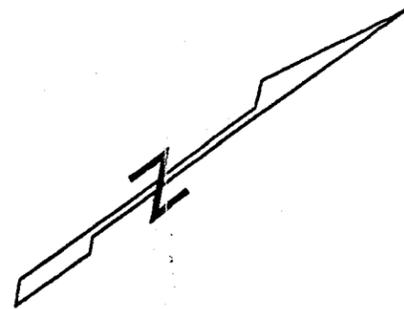
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GENERAL NOTES

1. Location And Elevations of The Explorations Are Approximate.
2. All Test Pits Were Excavated in May 1993. See Test Pit Log For Day.
3. Test Pits 1 Thru 51 Were Excavated By A Backhoe With 24" Wide Bucket.
4. Test Pits 52 Thru 55 Were Excavated By A Link-Belt Trackhoe.
5. Percentages of Plus 3" Material Shown on Test Pit Logs Were Visually Estimated.
6. No Free Ground Water Was Excavated in Any of The Test Pits During Execution Except Test Pits 4,5, And 50 as Shown on Test Logs.



MAP LEGEND

- ⊗ 2 Location And Number of Test Pit - 5' Deep
- △ 5 Location And Number of Test Pit - 10' Deep
- ⊗ 53 Location And Number of Test Pit - 25' Deep

WOOD, PATEL & ASSOC., INC.
 1550 EAST MISSOURI SUITE 203
 PHOENIX, ARIZONA (602)234-1344

**FOUNDATION INVESTIGATION
 TEST PIT LOCATION MAP**

DATE NOV., 1993	SCALE 1"=1000'	SHEET 1 OF 1
JOB NO. 91755.02	DESIGN JGT DRAWN VF	CHECK ACP FILE -



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Wood, Patel & Associates
1550 East Missouri, Suite 203
Phoenix, Arizona 85014

15 November 1993

Attention: Ash Patel

Subject: Report for Geotechnical Engineering Services
New River Channelization
Grand Avenue to Greenway Road
Peoria County, Arizona

Project No. 93-0472
Addendum No. 1

At your request this firm has reviewed the subject geotechnical report with respect to review comments from the Flood Control District of Maricopa County as presented in your letter dated October 29, 1993 and your FAX dated November 11, 1993.

1. Drop Structure: A sample specification for the roller compaction concrete is attached. The material must be placed in horizontal lifts. The width or thickness of the sloping side walls of the structure were not given on the plan. This should be added and should be wide enough to accommodate horizontal placement and compaction of the concrete. The following equivalent fluid active and passive pressure may be used in design.

Lateral active pressure:

Granular.....	32 psf/ft.
Granular soils (submerged).....	78 psf/ft.
Clays and silts	40 psf/ft.
Clays and silts (submerged).....	82 psf/ft.

Lateral passive pressure:

Granular	300 psf/ft.
Granular (submerged).....	212 psf/ft.
Clay and silt	180 psf/ft.
Clay and silt (submerged).....	152 psf/ft.

Submerged pressure includes hydrostatic pressure.

2. Fill Material: Materials obtained from channel excavations which are free of organic matter, debris, rubble and material 8 inches or larger in size may be used as fill in the bank areas.

3. Soil Cement: All granular soils encountered in the excavations and channel areas which are free of organic matter, rubble, debris and material greater than 3 inches in size may be used in soil cement. The sandy clay and sandy silt soils should not be used in soil cement.
4. Riprap Material: A majority of the material encountered in our field explorations is less than 8 inches in size. Therefore little or no riprap material will be generated by screening site soils. A limited amount of 4-to 8-inch material is available for use in filling gabions.
5. Landfill Areas: Other than the areas described in our original report, we have no further information on the location, extent or limits of landfills along the channel improvements. Groundwater table along the stream channel will be dependent upon the length of time since the last flow in the river channel has occurred and the duration of that flow and could influence construction. In addition, localized perched water conditions may exist along the top of the sandy clay and sandy silt deposits which occur on the channel and which take longer to disappate.

This addendum shall be attached to the original report and shall become a part thereof. Please call if you have any questions or if we may be of further service.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By:



Reviewed by:



/cm

Copies to: Addressee (5)

PART I - REPORT



SCOPE

The proposed New River Channelization will extend from 1000 feet north of Grand Avenue to the alignment of Greenway Road along the New River in Peoria, Arizona. The improvements will include:

1. The construction of approximately 12,500 linear feet of bank protection on each side of the river and along a short section of Skunk Creek.
2. Establishing a new flow line for the river.
3. A drop structure approximately 800 feet south of the confluence of the New River and Skunk Creek.

PURPOSE

The purpose of these geotechnical services is to provide subsurface information, laboratory test data and geotechnical engineering information with respect to:

1. How site conditions, such as the location of landfills, in the channelization area which are identified during the field exploration will effect the proposed improvements.
2. Foundation recommendations for the drop structures.
3. Site preparation and fill placement criteria for bank protection and the drop structure.
4. Recommendation for cement treated materials.
5. Analysis and recommendations for temporary and permanent cut and fill slopes.

SITE DESCRIPTION AND SITE HISTORY

The proposed improvements are within the existing channel of the New River and extend from 1000 feet north of Grand Avenue to the alignment of Greenway Road in Peoria, Arizona. For purposes of this report, the centerline of Grand Avenue is assumed to be Sta. 0+00 of the centerline of the New River Channel. Stationing increases upstream along the channel. At the time of our field explorations the limits of the channel were fairly well defined but these limits are constantly being changed by filling along the banks.

The following landfill areas were observed during our field work:

1. Sta. 40+00 to 47+00 the upper 1/3 of the left bank contains loose fill.
2. Sta. 79+00 to 88+00 the area at the top and behind the right bank contains buried and dumped debris, rubble and trash.
3. Sta. 105+00 and extending for a distance of 800 to 900 feet behind the crest of the right bank contains a garbage and debris landfill.

Other areas of the banks and channel have been cut and filled over the years as the area was being developed. As the result of recent rain, numerous areas of ponded water existed in the channel bottom. For the most part, the remainder of the channel is very sparsely to moderately vegetated with weeds and brush and also contain sand bars, gravel bars and near Sta. 96+00 a hard clay layer. The channel bottom was very irregular with numerous depressions and local rises.

INVESTIGATION

Test pits were excavated with a Case 580 rubber tire backhoe using a 24-inch wide bucket at 51 locations along the alignment. An additional 4 test pits (Test Pits 52 to 55) were excavated by a Link-belt 4300 track hoe in the drop structure area. The stations and off-sets of the field explorations are listed in Appendix A. During the field explorations the soils encountered were visually classified, the amount of plus 3-inch material estimated and representative samples of the minus 3 inch material obtained at selected depths. At two locations (Test Pits 20 and 22) the amount of plus 3-inch material was measured in the field. The

results of the field explorations are presented on Appendix A "Field Results". An estimate of the amount of plus 3 inch material observed at each field exploration location is presented on the boring logs.

Representative samples obtained during the field exploration were subjected to the following laboratory analyses:

<u>Test</u>	<u>Sample(s)</u>	<u>Purpose</u>
Sieve Analyses & Plasticity Index	Representative (60)	Classification and aggregate evaluation

The results of the laboratory testing are presented in Appendix B.

SOIL CONDITIONS

The soil profile encountered at the field exploration locations was somewhat variable. Detailed descriptions of the materials encountered are presented on the test pit logs in Appendix A. The soils for the most part were granular deposits containing various amounts and combinations of sand, gravel, cobbles and lesser amounts of silt and clay. However, in the channel bottom starting in Test Pit 21 and going upstream to Test Pit 39, a hard sandy clay deposit which graded in some areas to a very dense clayey sand and a stiff sand silt was encountered at various locations and depths below existing channel grades. This deposit was also observed in some of the four deep test pits excavated at the drop structures.

Groundwater in and adjacent to the river channel will vary considerably with location, releases from the upstream dam and discharges from local runoff from the ACDC and drainage facilities at and upstream from the improvements. Groundwater or perched water conditions resulting from ponded water was encountered in Test Pits 4, 5 and 50 at depths ranging from 1.5 to 8.5 feet below existing grade at the time of our field exploration. No groundwater was encountered in the remainder of the field explorations accomplished for this project.

DISCUSSION AND RECOMMENDATIONS

General: Geotechnical engineering recommendations for development of the channel, bank protection, and drop structure for the proposed New River improvements are presented in the following sections. These recommendations are based upon the results of the field and laboratory testing which are presented in Appendicies A and B of this report.

Channel Development: In order to provide permanent channelization and bank protection of the New River area, approximately 12,500 linear feet of bank protection will be developed on each side of the channel. The channel section heights will vary along different reaches of the channel improvements.

The channel bottom and slopes will be constructed with materials obtained from the channel improvement area. We recommend that the channel bottom and slope fills be constructed with the sand and gravel soils which contain no to some silty and clayey fines.

Slope stability analysis of the proposed 1.5H:1V slope configurations were performed. The following parameters were used in the evaluation.

1. Embankment fill and native alluvium
 - $\phi = 41$ degrees
 - C = 0 psf
 - In-place density = 135 pcf
 - Submerged = 72 pcf
2. Materials at submerged conditions
3. Rapid draw-down

This embankment configuration has resulted in calculated factors of safety for the various conditions and configuration in the range of 1.4 to 4.3. The analyses was conservative in that the strength of bank protection was ignored. Therefore, it is our opinion that embankments may be satisfactorily constructed.

Bank Construction: The proposed channel development will include the construction of various heights and widths of fills. Foundation preparation in the fill area should include, as a minimum, the complete removal of all sandy silty, sand and silt sand, soils and debris and rubble laden materials. Any landfill

which encroaches on the channel improvements should be removed from below the improvement area. After removal of the various materials, the foundation area should be scarified to a minimum depth of 8 inches, compacted and the fill material placed and compacted in horizontal lifts. Scarified soil and fill materials should be compacted to at least 98 percent of the maximum dry density as determined by ASTM D698 at a moisture content in the range of 3 percent below to 3 percent above optimum.

Cement Stabilized Alluvium: Erosion bank protection along the proposed channel may include either rip-rap placed on 3 to 1 (H to V) slopes and cement stabilized alluvium placed on a 1.5 to 1 (H to V) slope. The cement stabilized alluvium should be at least 8 feet wide (horizontally) and extend below existing grade down to the channel thalweg. Depending on groundwater conditions at the time of construction, dewatering of this bank protection excavation area may be required. The design of the dewatering system should be accomplished by the contractor and approved by the project designer. During the design of the dewatering system, the effect of seepage on slope stability should be considered.

In general, the cement stabilized alluvium will consist of the clean sand, gravel and cobble deposits which are non-plastic and have been processed to the following requirements.

<u>Sieve Size</u>	<u>Percent Passing</u>
3"	100
#4	40 - 60
#200	0 - 8

The aggregate should be blended with 10 to 12 percent (estimated) cement/fly ash and water in a mixing plant and transported to the construction area. The mixture shall have minimum 7 day compressive strength of 500 psi. The material should be uniformly spread so that compacted horizontal lift thickness does not exceed 9 inches. The materials should be compacted to at least 98 percent of the maximum dry density as determined by ASTM D698. All exposed portions of the compacted material should be kept moist for at least 7 days. Compaction of the cement stabilized alluvium should be completed within one

hour after the water is added to the mix. The surface of the compacted materials which has not been worked for more than two hours should be scarified to a depth of 1 inch, and the loose material removed prior to placing additional materials.

Drop Structure: The drop structures will lower the channel grade approximately 14 feet and will consist of a soil cement or cement stabilized alluvium.

In order to provide uniform support of the drop structure, we recommend that foundation preparation below the entire structure include:

1. The complete removal of the loose recent alluvium, estimated to be 5 to 12 feet thick, and any fills, debris or landfill materials.
2. All areas which have been over-excavated and which require the placement of fill should be scarified to a minimum depth of 8 inches and compacted.
3. All fill materials required below the structure should be placed in horizontal lifts, moisture conditioned to a uniform moisture content in the range of 3 percent below to 3 percent above optimum and compacted to at least 98 percent of the maximum dry density as determined in accordance with ASTM D698.
4. Granular soils obtained during excavation of the drop structure or from other parts of the channelization project may be used as fill materials provided these materials are free of organic matter, debris, rubble and garbage.

Excavation Conditions: The field exploration and sampling at the site was performed for design purposes. It is not possible to accurately correlate results of the various methods of field explorations with the ease or difficulty of digging for various types and sizes of excavation equipment. We present the following general comments regarding excavatability for the designer's information with the understanding that they are approximations based only on field exploration data. More accurate information regarding excavatability should be evaluated

by contractors or other interested parties from test excavations using the intended equipment.

Excavations into the site soils should be possible with conventional excavating equipment. Due to the granular nature of these soils, the presence of relatively clean sand layers, possible shallow groundwater and the presence of cobble sized material, excavations may be slow and difficult to accomplish. Excavations into the underlying, hard sandy clay layer may be difficult and may require the assistance of specialized heavy duty equipment.

Temporary Construction Slopes: Temporary slopes required for the construction of various aspects of the project will be dependent on the materials encountered, groundwater conditions, seepage conditions and the location, type, extent and weight of surcharge loads. In general, the following temporary slopes may be used in design but flatter or steeper slopes may be accomplished or required in the field as dictated by specific conditions.

<u>Material</u>	<u>*Temporary Slope Configuration (Horizontal to Vertical)</u>
Sand, gravel & cobbles	1 to 1
Sand, silty sand, sandy silt	1.5 to 1
Sandy Clay	0.5 to 1

*These slopes are for soils at relatively low water contents not subjected to seepage forces or submerged. Flatter slopes will be required for these conditions.

APPENDIX A
FIELD RESULTS



Test Pit Locations

Sta. 0+00 = \odot of Grand Avenue on \odot of New River Channel (All Test Pit elevations interpolated from topo shown on plan).

Test Pits 1 to 51 excavated with a Case 580 rubber tire backhoe. Test Pits 52 to 55 excavated with a Link Belt 4300 track hoe.

<u>Test Pit No.</u>	<u>Location</u>
1	Sta. 17+50 L 160'
2	Sta. 17+50 \odot
3	Sta. 17+50 R 150'
4	Sta. 21+20 \odot
5	Sta. 25+50 L 160'
6	Sta. 25+50 R 160'
7	Sta. 33+70 L 140'
8	Sta. 33+40 R 170'
9	Sta. 42+50 L 140'
10	Sta. 42+50 \odot
11	Sta. 50+00 L 150'
12	Sta. 50+00 \odot
13	Sta. 50+00 R 180'
14	Sta. 58+00 L 160'
15	Sta. 58+00 \odot
16	Sta. 58+00 R 170'
C T-Bird	Sta. 63+50
17	Sta. 65+70 L 130'
18	Sta. 65+70 \odot
19	Sta. 65+70 R 150'
20	Sta. 70+80 L 160'
21	Sta. 70+80 \odot

Test Pit No.

Location

22	Sta. 75+50 L 160'
23	Sta. 75+50 ϕ
24	Sta. 75+50 R 150'
25	Sta. 80+20 L 150'
26	Sta. 80+20 ϕ
27	Sta. 85+00 L 160'
28	Sta. 85+00 ϕ
29	Sta. 85+00 R 130'
30	Sta. 89+00 L 120'
31	Sta. 89+00 ϕ
32	Sta. 94+10 L 140'
33	Sta. 94+10 ϕ
34	Sta. 94+10 R 150'
35	Sta. 99+20 L 140'
36	Sta. 97+70 ϕ
37	Sta. 111+90 L 140'
38	Sta. 111+90 R 40'
39	Sta. 108+60 R 240'
40	Sta. 116+80 L 150'
41	Sta. 116+80 ϕ
42	Sta. 116+80 R 200'
43	Sta. 121+70 L 150'
44	Sta. 121+70 L 30'
45	Sta. 126+80 L 150'
46	Sta. 126+80 ϕ
47	Sta. 126+80 R 180'
48	Sta. 131+50 L 150'
49	Sta. 131+50 L 20'
50	Sta. 31+40 ϕ
51	Sta. 42+50 L 114'
52	Sta. 102+90 R 140'
53	Sta. 105+40 R 50'
54	Sta. 104+10 L 140'
55	Sta. 102+70 L 40'

LEGEND

SOIL CLASSIFICATION

COARSE-GRAINED SOIL

More than 50% larger than 200 sieve size

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

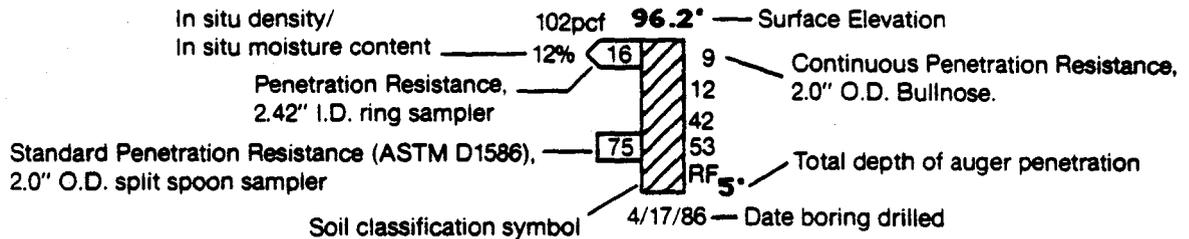
FINE-GRAINED SOIL

More than 50% smaller than 200 sieve size

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

LEGEND FOR GRAPHICAL BORING LOGS:

Log denotes visual approximation unless accompanied by mechanical analysis and Atterberg limits.



PENETRATION RESISTANCE: Blows per foot using 140 lb. hammer with 30" free-fall unless otherwise noted.

GRAIN SIZES								
SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	U.S. STANDARD SERIES SIEVE			CLEAR SQUARE SIEVE OPENINGS			COBBLES	BOULDERS
	200	40	10	4	3/4"	3"		
	SAND			GRAVEL				
	FINE	MEDIUM	COARSE	FINE	COARSE			
MOISTURE CONDITION (INCREASING MOISTURE →)								
DRY	SLIGHTLY DAMP		DAMP (Plastic Limit)	MOIST	VERY MOIST	WET (SATURATED) (Liquid Limit)		

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

*Number of blows of 140 lb. hammer falling 30" to drive a 2" O.D. (1-3/8" I.D.) split-spoon sampler (ASTM D1586).

LEGEND OF SOIL TYPES



FILL MATERIAL - SILTY SAND AND GRAVEL WITH COBBLES (SM/GM); brown; some debris; loose; slightly damp.



GRAVELLY SAND (SP/SW); light brown; some cobbles; medium dense; slightly damp.



GRAVELLY COBBLES (GP); brown; some sand; medium dense; slightly damp.



CLAYEY SANDY GRAVEL AND COBBLES (GC); reddish brown; medium dense; damp.



SILTY SAND AND GRAVEL WITH COBBLES (SM/GM); brown; loose; slightly damp.



SAND - SOME SILT AND GRAVEL (SP/SM); brown; occasional to some cobbles; medium dense; slightly damp to saturated.



SILTY GRAVELLY SAND (SM); light brown; some cobbles; loose; slightly damp.



SANDY GRAVEL AND COBBLES (GP); brown; loose; slightly damp.



GRAVELLY SAND (SP); brown; some to occasional cobbles; medium dense; damp.



SANDY GRAVEL WITH COBBLES (GP/GC); brown; some clay; medium dense; damp.



GRAVELLY SAND (SP/SC); reddish brown; some clay; medium dense; damp.



CLAYEY GRAVELLY SAND (SC); reddish brown; medium dense to dense; damp.

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

LEGEND OF SOIL TYPES



GRAVELLY SAND WITH COBBLES (SP/SC); reddish brown; some clay; medium dense; damp.



CLAYEY GRAVELLY SAND WITH COBBLES (SC); reddish brown; medium dense; damp.



GRAVELLY SAND (SP); brown; loose; damp.



SANDY CLAY (CL); reddish brown; stiff to very hard; damp; medium plasticity; moderate to very heavy cementation.



SANDY SILT (MH); brown; stiff; damp; highly elastic.



SANDY GRAVEL (GP/GM); reddish brown; trace to some silt and cobbles; medium dense; damp.



SAND AND GRAVEL WITH COBBLES (GP/SC); reddish brown; some clay; medium dense; damp.



FILL MATERIAL - CLAYEY SANDY GRAVEL WITH COBBLES.
CONCRETE DEBRIS, PLASTIC (GC); dark brown; loose; damp.



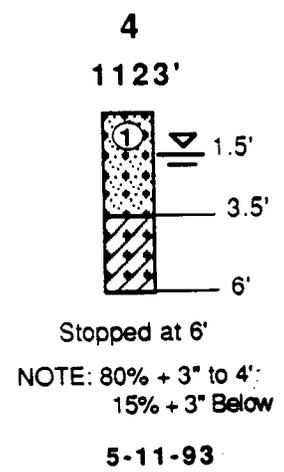
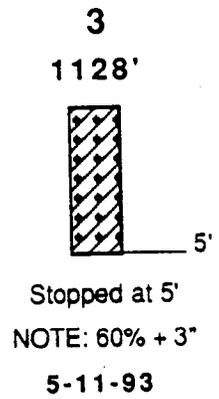
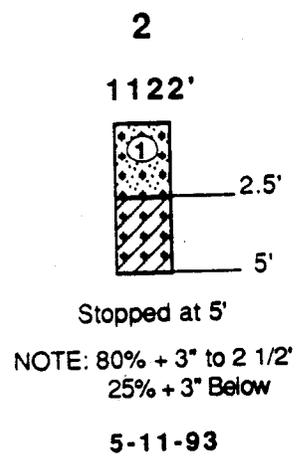
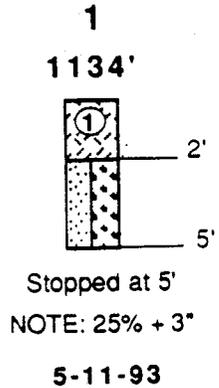
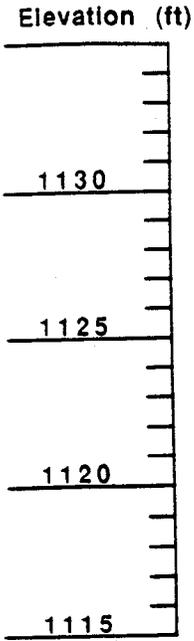
SANDY SILT (ML); brown; firm; slightly damp.



SILTY TO CLAYEY GRAVELLY SAND (SM/SC); brown; medium dense; damp.

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

TEST PIT LOGS



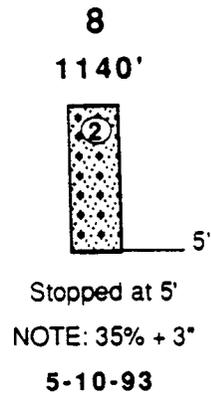
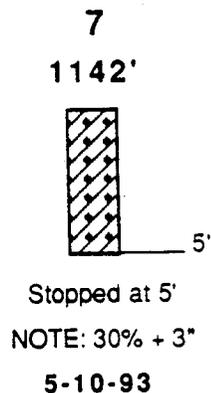
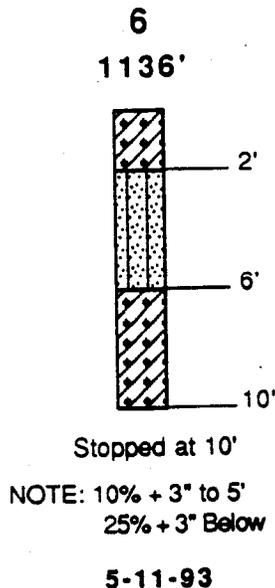
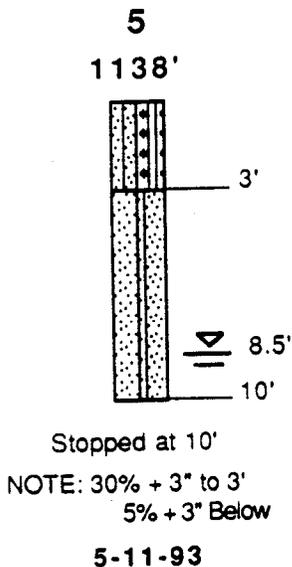
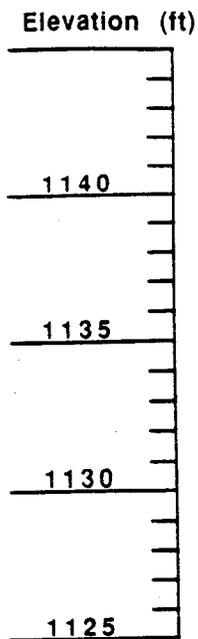
No free groundwater was encountered in any of the test pits during excavation except Test Pit 4 as shown.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

Project No. 93-0472
Thomas-Hartig & Associates

TEST PIT LOGS



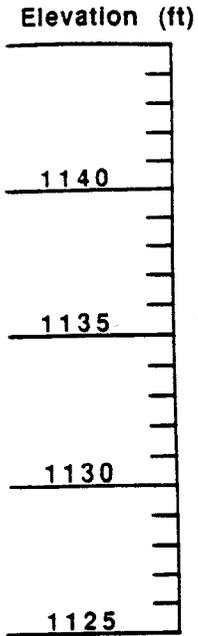
No free groundwater was encountered in any of the test pits during excavation except Test Pit 5 as shown.

All test pits excavated with 24-inch wide bucket.

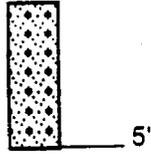
NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

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Thomas-Hartig & Associates

TEST PIT LOGS

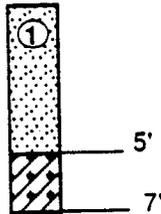


9
1140'



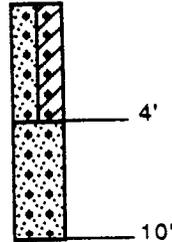
Stopped at 5'
NOTE: 50 to 60% + 3"
5-10-93

10
1132'



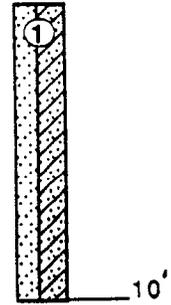
Stopped at 7'
NOTE: 5% + 3" to 5"
20% + 3" Below
5-10-93

11
1138'



Stopped at 10'
NOTE: 25% + 3"
5-10-93

12
1136'



Stopped at 10'
NOTE: 5% + 3"
5-10-93

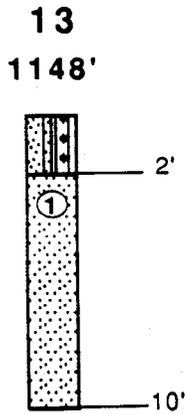
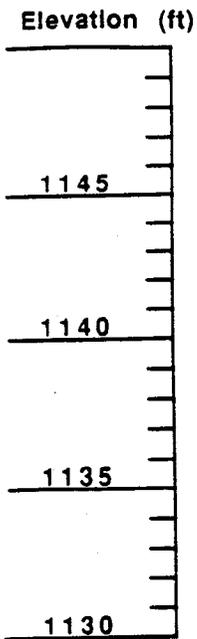
No free groundwater was encountered in any of the test pits during excavation.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

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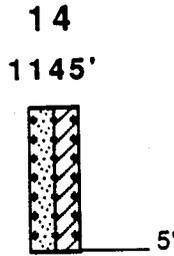
TEST PIT LOGS



Stopped at 10'

NOTE: 45% + 3" to 2'
10% + 3" 2 to 5 1/2'
3 to 5% + 3" Below

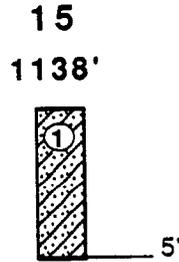
5-11-93



Stopped at 5'

NOTE: 35% + 3"

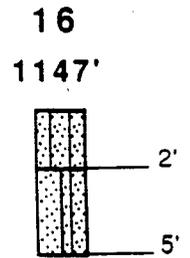
5-10-93



Stopped at 5'

NOTE: 5% + 3"

5-10-93



Stopped at 5'

NOTE: 3% to 5% + 3" to 2'
20% + 3" Below

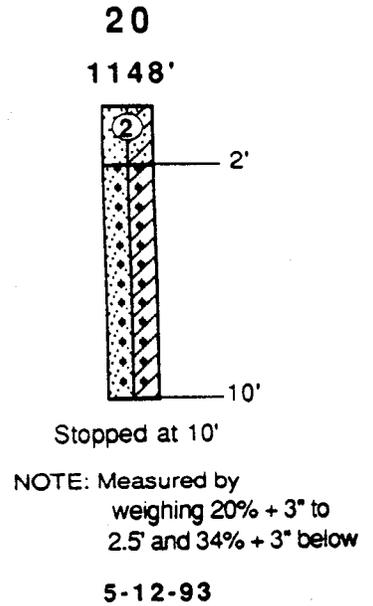
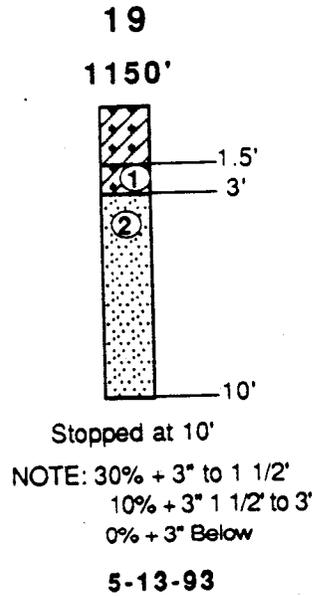
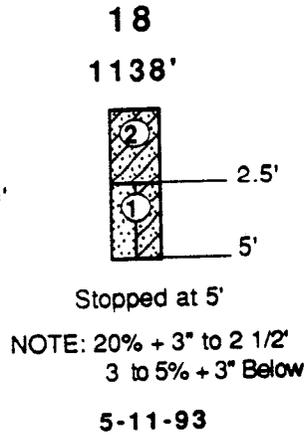
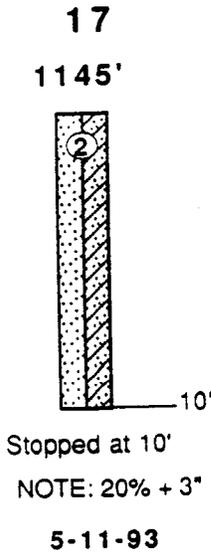
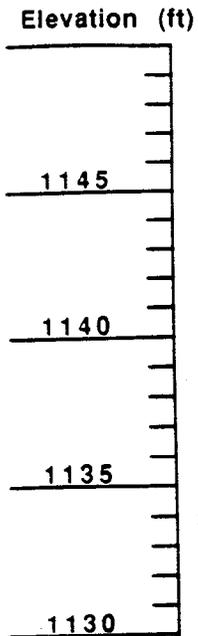
5-11-93

No free groundwater was encountered in any of the test pits during excavation.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

TEST PIT LOGS



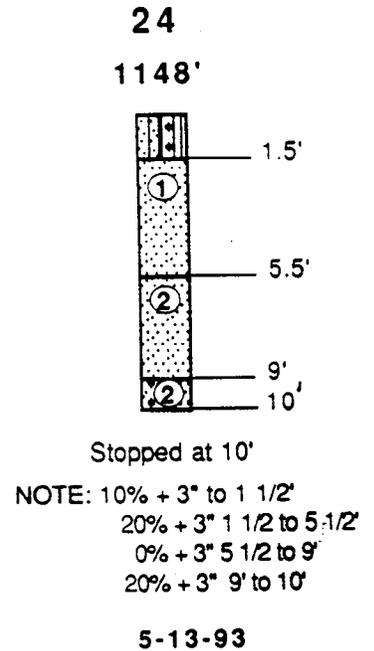
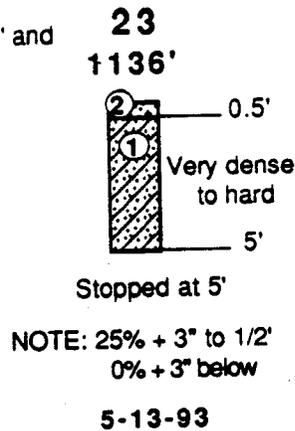
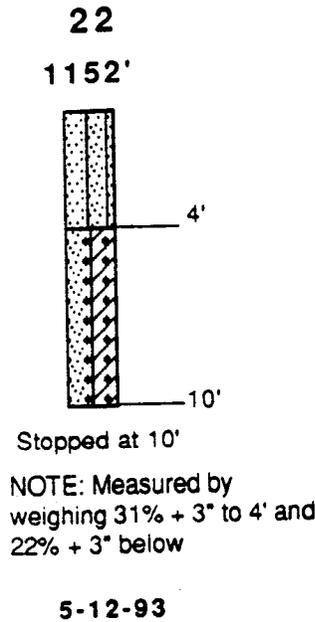
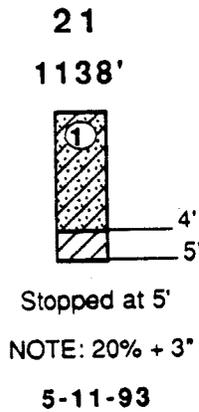
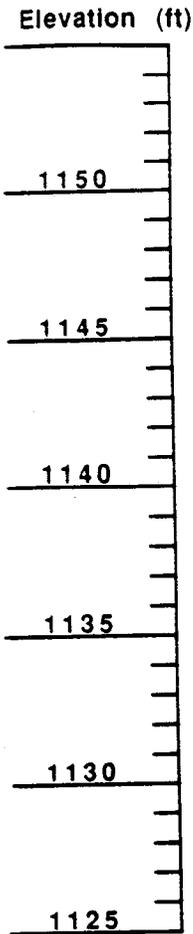
No free groundwater was encountered in any of the test pits during excavation.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

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Thomas-Hartig & Associates

TEST PIT LOGS



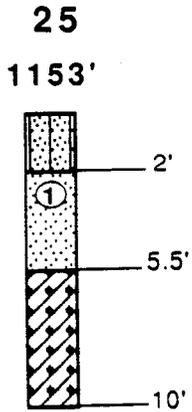
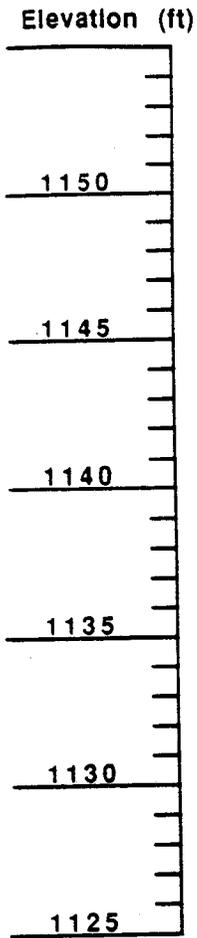
No free groundwater was encountered in any of the test pits during excavation.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

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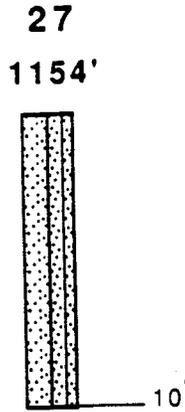
TEST PIT LOGS



Stopped at 10'

NOTE: 5% + 3" to 2'
30% + 3" 2 to 5 1/2'
40% + 3" 5 1/2' to 10'

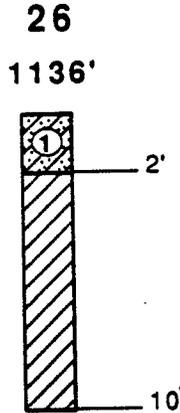
5-12-93



Stopped at 10'

NOTE: 3 to 5% + 3" to 7'
15% + 3" below

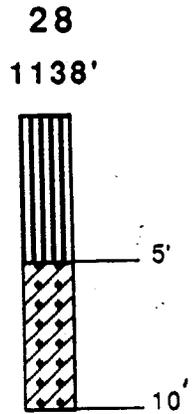
5-12-93



Stopped at 10'

NOTE: 5% + 3" to 2'
0% + 3" Below

5-12-93



Stopped at 10'

NOTE: 0 to 5% + 3" to 5'
10% + 3" below

5-12-93

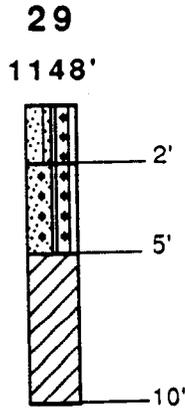
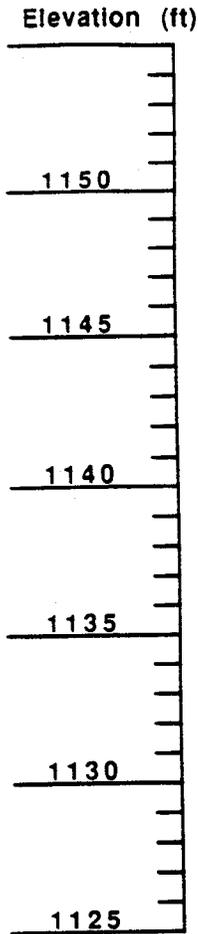
No free groundwater was encountered in any of the test pits during excavation.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

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Thomas-Hartig & Associates

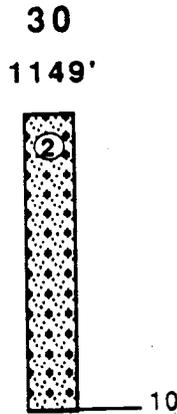
TEST PIT LOGS



Stopped at 10'

NOTE: 15 to 20% + 3" to 2'
5% + 3" 2 to 5'
0% + 3" Below

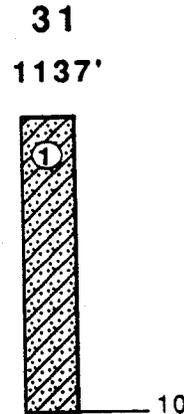
5-13-93



Stopped at 10'

NOTE: 35% + 3"

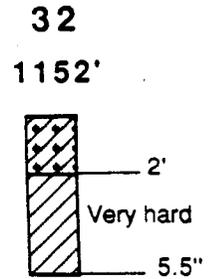
5-12-93



Stopped at 10'

NOTE: 5% + 3" to 4'
0% + 3" below

5-12-93



Refusal at 5.5'

NOTE: 20% + 3" to 2'
0% + 3" Below

5-12-93

No free groundwater was encountered in any of the test pits during excavation.

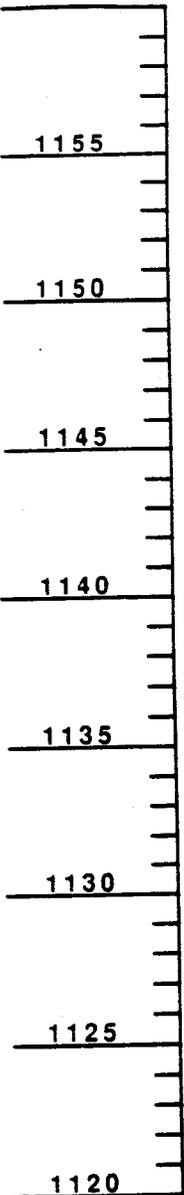
All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

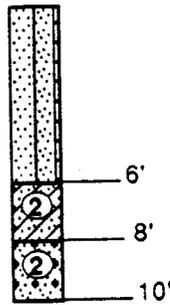
Project No. 93-0472
Thomas-Hartig & Associates

TEST PIT LOGS

Elevation (ft)



34
1160'

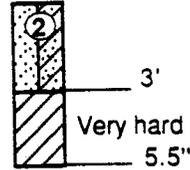


Stopped at 10'

NOTE: 20% + 3" to 6"
10% + 3" 6 to 8"
20% + 3" Below

5-13-93

35
1153'

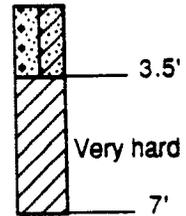


Refusal at 5.5'

NOTE: 20% + 3" to 3"
0% + 3" Below

5-12-93

36
1142'

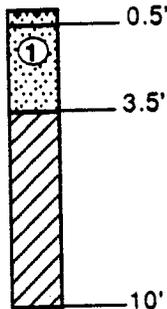


Refusal 7'

NOTE: 30% + 3" to 3 1/2"
0% + 3" Below

5-12-93

33
1136'



Stopped at 10'

NOTE: 70% + 3" to 1/2"
20% + 3" 1/2 to 3 1/2"
0% Below

5-12-93

No free groundwater was encountered in any of the test pits during excavation.

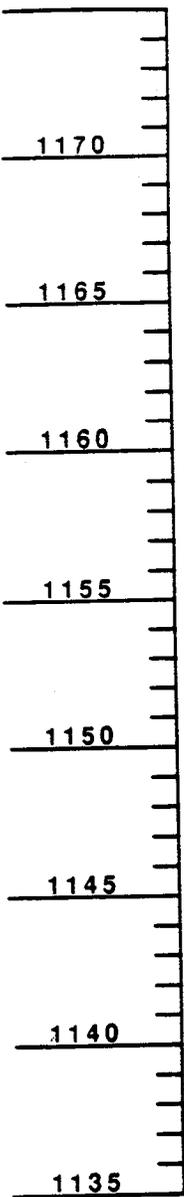
All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

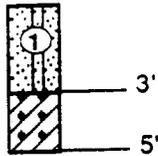
Project No. 93-0472
Thomas-Hartig & Associates

TEST PIT LOGS

Elevation (ft)

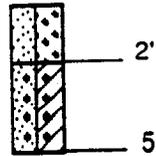


37
1170'



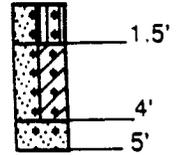
Stopped at 5'
NOTE: 25% + 3" to 2'
10% + 3" 2 to 4'
30% + 3" Below
5-13-93

38
1164'



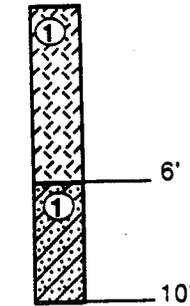
Stopped at 5'
NOTE: 20% + 3" to 1'
30% + 3" Below
5-13-93

40
1172'



Stopped at 5'
NOTE: 40% + 3" to 1-1/2'
30% + 3" 1-1/2 to 4'
60% + 3" Below
5-13-93

39
1155'



Stopped at 10'
NOTE: 15% + 3" to 2'
60% + 3" 2' to 5'
10% + 3" 5' to 6'
0% + 3" Below
5-13-93

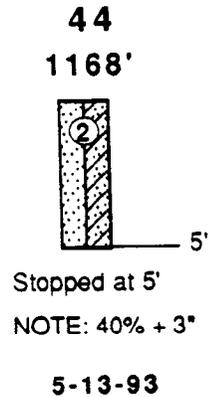
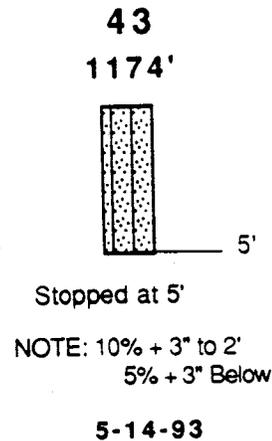
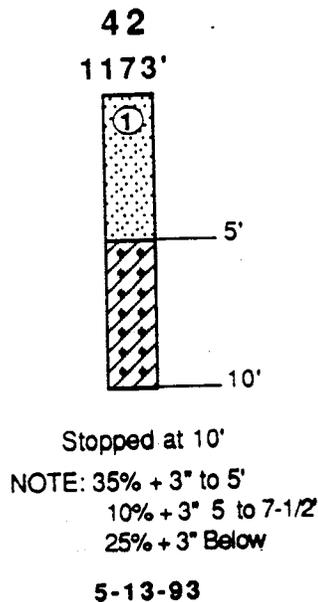
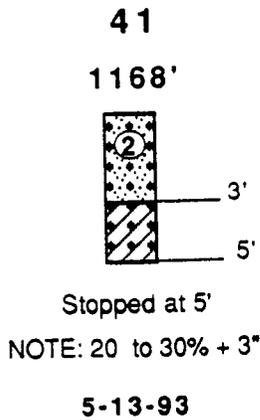
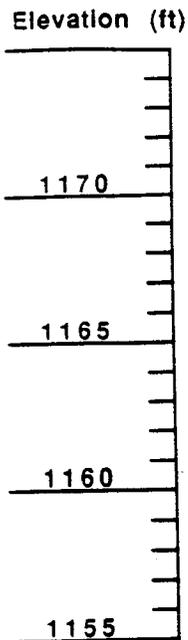
No free groundwater was encountered in any of the test pits during excavation.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

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TEST PIT LOGS



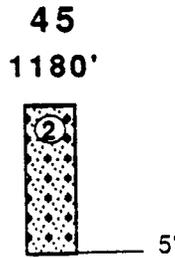
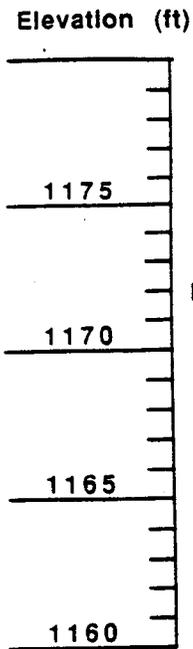
No free groundwater was encountered in any of the test pits during excavation.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

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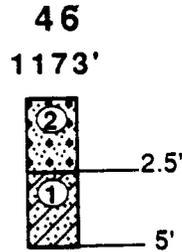
TEST PIT LOGS



Stopped at 5'

NOTE: 45% + 3" to 1-1/2'
60% + 3" Below

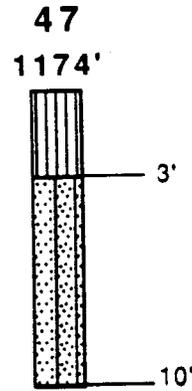
5-14-93



Stopped at 5'

NOTE: 40% + 3" to 2-1/2'
50% + 3" Below

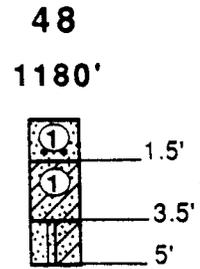
5-14-93



Stopped at 10'

NOTE: 0% + 3" to 3'
5% + 3" 3 to 7'
8% + 3" 7 to 10'

5-14-93



Stopped at 5'

NOTE: 70% + 3" to 1-1/2'
0% + 3" 1-1/2 to 3'
20% + 3" 3 to 5'

5-14-93

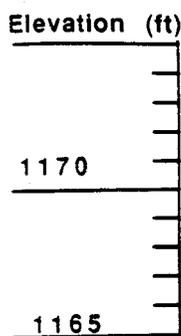
No free groundwater was encountered in any of the test pits during excavation.

All test pits excavated with 24-inch wide bucket.

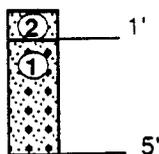
NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

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TEST PIT LOGS



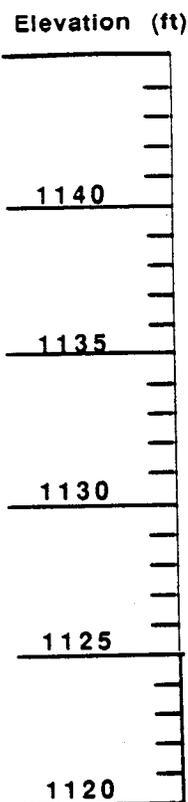
49
1173'



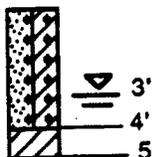
Stopped at 5'

NOTE: 0% + 3" to 1'
50% + 3" Below

5-14-93



50
1128'

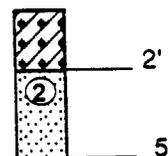


Stopped at 5'

NOTE: 25% + 3" to 1'
3 to 5% + 3" Below

5-10-93

51
1142'



Stopped at 5'

NOTE: 25% + 3" to 2'
3-5% + 3" Below

5-11-93

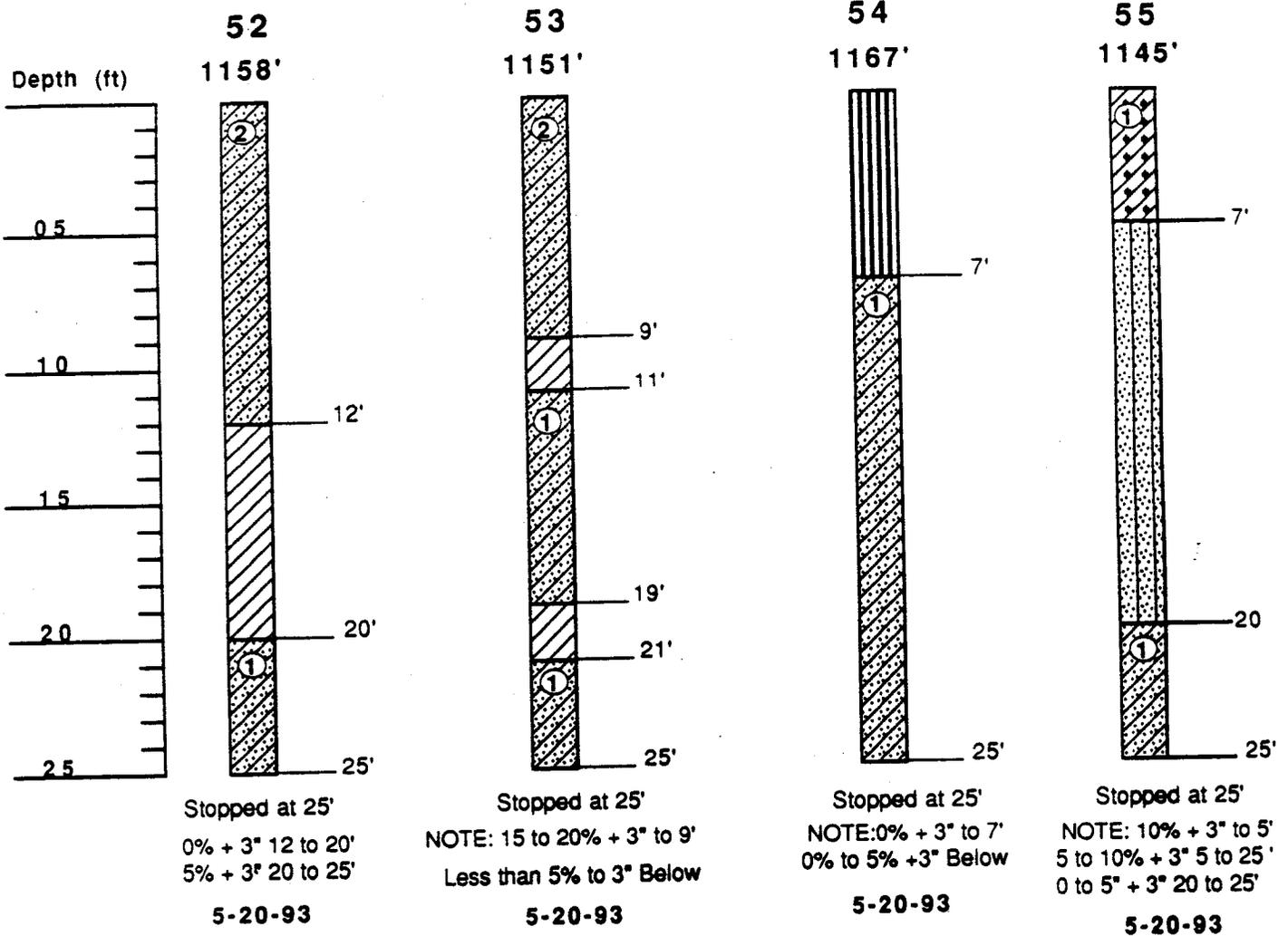
No free groundwater was encountered in any of the test pits during excavation, except Test Pit 50 as shown.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

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TEST BORING LOGS



No free groundwater was encountered in any of the test pits during excavation.

All test pits excavated with 24-inch wide bucket.

NOTE: The data presented on the test pits represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This test pit data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit.

Project No. 93-0472
Thomas-Hartig & Associates

APPENDIX B
LABORATORY RESULTS



REPORT ON SIEVE ANALYSIS AND PLASTICITY INDEX

SAMPLE:

Date: 6-10-93

Source: Noted Below
 Type: Grab Samples
 Material: Subsoils
 Sampled By: TH/Sercu

TESTED: Sieve Analysis and Plasticity Index

RESULTS

Sample	Plasticity		Sieve Size -										Class.	
	LL	PI	200	100	50	30	16	8	4	3/4"	1"	2"		3"
1; 2 - 5'		NP	3	6	11	24	43	53	58	71	76	92	100	SP/SW
2; 0 - 2 1/2'		NP	2	2	3	8	18	26	31	46	51	75	100	GP
3; 0 - 3'	30	10	15	19	24	29	36	44	49	60	64	82	100	GC
4; 0 - 3'	No Samples Obtained For Testing													
5; 3 - 10'		NP	10	16	30	55	74	82	86	90	93	100		SP/SM
6; 3 - 6'		NP	17	25	33	46	58	66	69	80	84	95	100	SM
7; 0 - 5'	30	13	5	6	7	13	22	30	35	50	57	77	100	GC
8; 0 - 5'		NP	2	4	5	10	20	30	38	57	63	85	100	GP
9; 0 - 5'		NP	3	4	6	14	24	33	38	55	62	83	**99	GP
10; 0 - 5'		NP	2	3	5	17	37	50	58	74	79	91	100	SP
11; 0 - 4'	36	17	9	11	15	25	38	47	52	68	74	89	100	GP/GC
12; 1 - 10'	54	26	6	9	15	28	43	51	56	70	75	85	**98	SP/SC
13; 5 1/2 - 10'		NP	3	4	8	25	50	64	71	83	87	98	100	SP
14; 0 - 5'	28	9	6	8	11	17	26	35	43	59	65	84	100	GP/GC
15; 1 - 5'	54	29	12	15	19	37	59	69	73	84	88	91	**97	SC
16; 2 - 5'		NP	6	9	17	34	53	59	62	71	74	86	**98	SP/SM
17; 0 - 10'	40	22	7	8	12	26	47	53	58	68	74	88	100	SP/SC

NP = Non-Plastic

*Unified Soil Classification

**100% Passing 6" Sieve

Project No. 93-0472

Thomas-Hartig & Associates, Inc.

REPORT ON SIEVE ANALYSIS AND PLASTICITY INDEX

SAMPLE:

Date: 6-10-93

Source: Noted Below
 Type: Grab Samples
 Material: Subsoils
 Sampled By: TH/Sercu

TESTED: Sieve Analysis and Plasticity Index

RESULTS

Sample	Plasticity		Sieve Size -										Class.	
	LL	PI	200	100	50	30	16	8	4	3/4"	1"	2"		3"
18; 0 - 2 1/2'	34	14	12	15	21	33	49	58	64	78	83	94	100	SC
19; 3 - 10'		NP	2	4	10	36	64	76	80	89	92	100		SP
20; 0 - 2 1/2'	30	8	9	12	17	31	50	61	66	78	82	98	100	SP/SC
20; 2 1/2 - 10'	81	37	9	11	15	22	32	40	45	64	71	89	100	GP/GC
21; 0 - 4'	46	20	24	29	36	49	64	74	81	87	91	100		SC
22; 0 - 4'		NP	7	10	13	22	37	52	62	74	80	94	100	SP/SM
22; 4 - 10'	41	20	7	9	13	24	37	47	53	70	75	90	100	GP/GC
23; 1/2 - 5'	32	10	37	44	55	68	77	83	87	92	92	100		SC
24; 2 - 6'		NP	2	4	8	21	42	49	52	64	69	85	100	SP
25; 2 - 5 1/2'		NP	2	3	5	15	34	47	53	66	72	87	**95	SP
26; 0 - 2'	47	15	23	29	36	48	62	75	85	97	97	100		SC
27; 0 - 7'		NP	5	12	30	51	71	82	86	92	95	100		SP/SM
28; 0 - 4 1/2'	53	18	75	82	89	94	98	95	99	100				MH
29; 2 1/2 - 5 1/2'	62	29	5	8	10	18	29	35	39	51	57	83	100	GP/GM
30; 0 - 10'		NP	4	6	12	24	34	40	44	57	62	80	100	GP
31; 0 - 4'	41	23	15	18	23	33	45	57	67	86	91	100		SC
32; 2.5 - 5.5'	42	23	55	62	69	77	84	88	89	95	98	100		CL

NP = Non-Plastic

*Unified Soil Classification

**100% Passing 6" Sieve

Project No. 93-0-472

Thomas-Hartig & Associates, Inc.

REPORT ON SIEVE ANALYSIS AND PLASTICITY INDEX

SAMPLE:

Date: 6-10-93

Source: Noted Below
 Type: Grab Samples
 Material: Subsoils
 Sampled By: TH/Sercu

TESTED: Sieve Analysis and Plasticity Index

RESULTS

Sample	LL	PI	Sieve Size -							Accumulative % Passing				Class.
			200	100	50	30	16	8	4	3/4"	1"	2"	3"	
33: 0 - 3 1/2'	35	12	3	5	7	19	38	51	59	81	86	97	100	SP
34: 0 - 6 1/2'		NP	6	9	12	21	33	47	59	76	80	91	100	SP/SM
35: 0 - 3 1/2'	34	16	7	8	12	27	47	57	63	77	81	90	100	SP/SC
36: 0 - 4'	35	8	6	8	11	22	36	46	53	69	79	89	100	GP/SC
37: 1 1/2 - 4'		NP	7	10	19	36	56	67	71	82	87	94	100	SP/SM
38: 1 - 5'	69	37	11	13	16	20	31	44	52	73	82	95	100	GP/GC
39: 6 - 10'	48	24	13	19	27	38	59	73	81	93	96	100	SC	
40: 2 - 4 1/2'	60	31	7	8	11	17	27	36	41	57	64	79	100	GP/GC
41: 0 - 3'		NP	3	4	6	13	26	38	46	70	76	98	100	GP
42: 2 - 5 1/2'		NP	3	5	10	28	53	64	68	78	80	95	100	SP
43: 0 - 5'		NP	28	38	50	63	75	81	83	87	88	100	SM	
44: 0 - 5'	30	11	5	5	8	18	31	41	46	57	62	88	100	SP/SC
45: 1 1/2 - 5'		NP	2	3	5	12	24	32	37	55	64	85	**96	GP
46: 0 - 3'	30	11	4	5	7	13	21	28	33	50	57	82	100	GP
47: 0 - 3'		NP	62	79	88	94	97	99	99	100				ML
48: 3 1/2 - 5'	27	6	37	46	52	59	66	69	72	77	82	96	100	SM/SC
49: 1 - 5'		NP	2	3	4	9	17	24	30	47	55	75	**90	GP

NP = Non-Plastic

*Unified Soil Classification

**100% Passing 6" Sieve

REPORT ON SIEVE ANALYSIS AND PLASTICITY INDEX

SAMPLE:

Date: 6-10-93

Source: Noted Below
 Type: Grab Samples
 Material: Subsoils
 Sampled By: TH/Sercu

TESTED: Sieve Analysis and Plasticity Index

RESULTS

Sample	LL	PI	Sieve Size -					Accumulative % Passing					Class.	
			200	100	50	30	16	8	4	3/4"	1"	2"		3"
50: 1 - 5'	59	30	9	11	13	18	29	38	45	60	68	87	100	GP/GC
51: 2 - 5'		NP	3	4	9	27	50	62	67	80	85	98	100	SP
52: 0 - 12'	39	26	13	16	21	28	41	54	62	75	78	95	100	SC
52: 12 - 20'	40	17	32	39	54	72	80	84	86	91	91	100		SC
53: 0 - 9'	62	28	15	19	24	34	47	58	66	84	85	93	100	SM
53: 9 - 12'	50	21	13	17	23	34	45	55	62	81	85	94	100	SM
54: 0 - 7'	66	25	55	66	76	86	94	98	99	100				MH
54: 8 - 16'	41	14	11	13	20	33	47	54	58	70	74	81	**90	SP./SC
55: 0 - 5'	63	36	13	16	20	26	41	51	56	74	81	98	100	GC
55: 5 - 20'		NP	24	32	42	59	73	83	89	97	100			SM

NP = Non-Plastic

*Unified Soil Classification

**100% Passing 6" Sieve