

June 14, 2021

Mayberry Communities  
5155 North Academy Boulevard  
Colorado Springs, Colorado 80918

Attention: Mr. Jason Kvols

Subject: Preliminary Geotechnical Investigation  
Mayberry Development  
AKA Ellicott Town Center  
Filings 1 through 4  
Highway 94 and Log Road  
Ellicott, Colorado  
Project No. CS18969.000-115

CTL|Thompson, Inc. prepared a Preliminary Geotechnical Investigation for the Ellicott Town Center Community, Filing No. 1 through 4 located west of Ellicott, Colorado (Project No. CS18969.001-115; report dated February 6, 2019). This letter was supplemental to a report prepared by CTL|T under Project No. CS16091-115, dated July 13, 2006. A validation and update letter was prepared referencing the original July 13, 2006 report under CTL|T Project No. CS18969-115, dated August 9, 2018.

We reviewed the previously prepared reports and letters and observed the site conditions. In our opinion, the analysis and preliminary recommendations, as outlined in our report and letters, are still valid. It is critical that all recommendations be followed, unless otherwise revised by CTL|Thompson.

If we can be of further service in discussing the contents of this letter or in the analysis of the influence of subsurface conditions on design of the proposed development, please call.

CTL | THOMPSON, INC.



Patrick Foley, EIT  
Staff Engineer

(via email)

Via e-mail: [jasonkvols@mayberrycoloradosprings.com](mailto:jasonkvols@mayberrycoloradosprings.com)

Reviewed By:



Timothy A. Mitchell, P.E.  
Division Manager



February 6, 2019

Colorado Springs Mayberry, LLC  
32823 Temecula Parkway  
Temecula, California 92592

Attention: Mr. John Boggs

Subject: Preliminary Geotechnical Investigation  
Ellicott Town Center, Filing No. 1  
Highway 94 and Log Road  
Ellicott, Colorado  
CTL|T Project No. CS18969.001-115

Colorado Springs Mayberry, LLC has requested we perform an additional geotechnical investigation to provide preliminary geotechnical recommendations for a previously developed 15 acres parcel located near the northeastern portion of the Ellicott Town Center development that was not included in our previously published reports (CTL|T Project No. CS16091-115), dated July 13, 2006, and (CTL|T Project No. CS18969.000-115), dated August 9, 2018. Previous figures presenting locations of exploratory borings, summary of boring logs, and results of laboratory testing are attached in Appendix A of this report.

The proposed Ellicott Town Center Filing No. 1 development consists of a total of approximately 90 acres of mostly vacant land and includes a previously developed 15-acre parcel. The site is located one-half mile west of the intersection of Colorado State Highway 94 and Log Road. We understand the 15-acre parcel is to be developed and used for the construction of prefabricated residences. The residential development portion of the site is to include single-family residences and be constructed in multiple phases. Preliminary plans show 91 single family lots are planned within Filing No. 1. Currently, water lines are present at the site. Sewer lines are reportedly installed. No other utilities were observed to be present at the site.

Our recent preliminary geotechnical investigation was performed to evaluate the subsurface conditions at the site on a preliminary basis by drilling two additional borings within the previously developed 15-acre parcel. Based on aerial photographs, the existing and previously existing structures present at the site appeared to be present in an aerial photograph dated 1999, indicating previous development took place around that time.

Our recent investigation identified suspect quality fill present at various areas within the previously developed 15-acre parcel. Samples of the fill materials obtained from the site during our drilling operation were submitted to our laboratory for analysis. Samples of the fill were judged to be loose to medium dense based on field penetration testing. The fill materials contained 5 to 9 percent clay and silt-sized particles (percent passing the -200 sieve) and did not exhibit plastic properties. Samples of the natural soils were judged to be medium dense to very dense and contained 6 to 11 percent clay and silt-sized particles. Based on experience with similar soils, we do not believe



the granular soils encountered at the site will exhibit expansive properties. Boring logs and our laboratory test results for this investigation can be found in Figs. 3 through 5 and Table I. Data from our previous investigation can be found in Appendix A

Results of our additional investigation indicated undocumented fill is present in various areas, existing at the ground surface and extending to a depth of about seven feet within the 15-acre parcel. Fill may be encountered at more shallow or deeper depths than indicated by our borings across the site. Records regarding the existing fill placement such as observation and density testing were not available for our review, therefore, the fill must be considered to be of suspect quality. The existing suspect quality fill is not suitable to underlie new foundations of proposed structures. The materials must be reconstructed as moisture conditioned and densely compacted fill. Reconstruction of the existing fill materials should be completed according to the previous recommendations provided in our previous report. Additionally, all recommendations found in our previously published report and letter should be followed.

We recommend future investigations be performed by CTL Thompson, Inc for the following: site-specific design level Geotechnical Investigation to provide criteria for foundations and floor systems of proposed commercial or manufacturing buildings or warehouses; site-specific design level Soils and Foundation Investigation to provide criteria for foundations and floor systems for the proposed residential buildings; Subgrade investigations should be completed following the completion of grading at the site; and, we should perform construction testing and observation during site development and the construction of new residential buildings.

If we can be of further service in discussing the contents of this letter or the project from a geotechnical or construction materials point-of-view, please call.

Very truly yours,

CTL | THOMPSON, INC.

Patrick Foley, EIT  
Staff Engineer

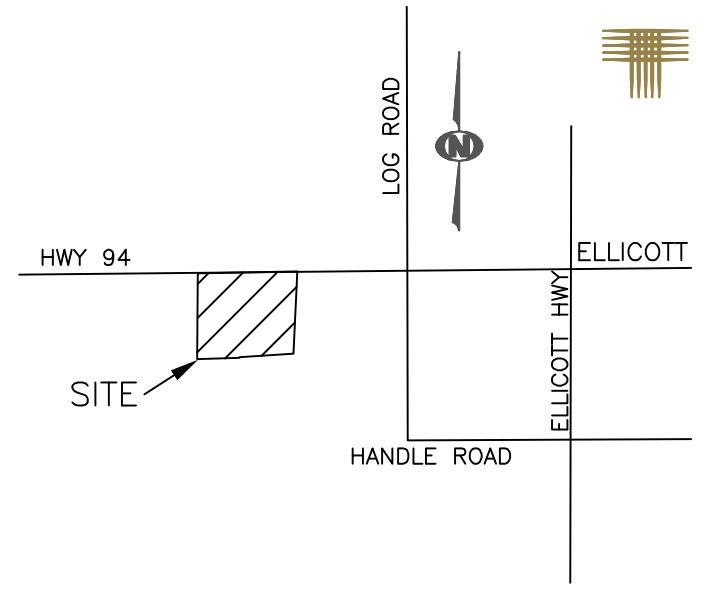
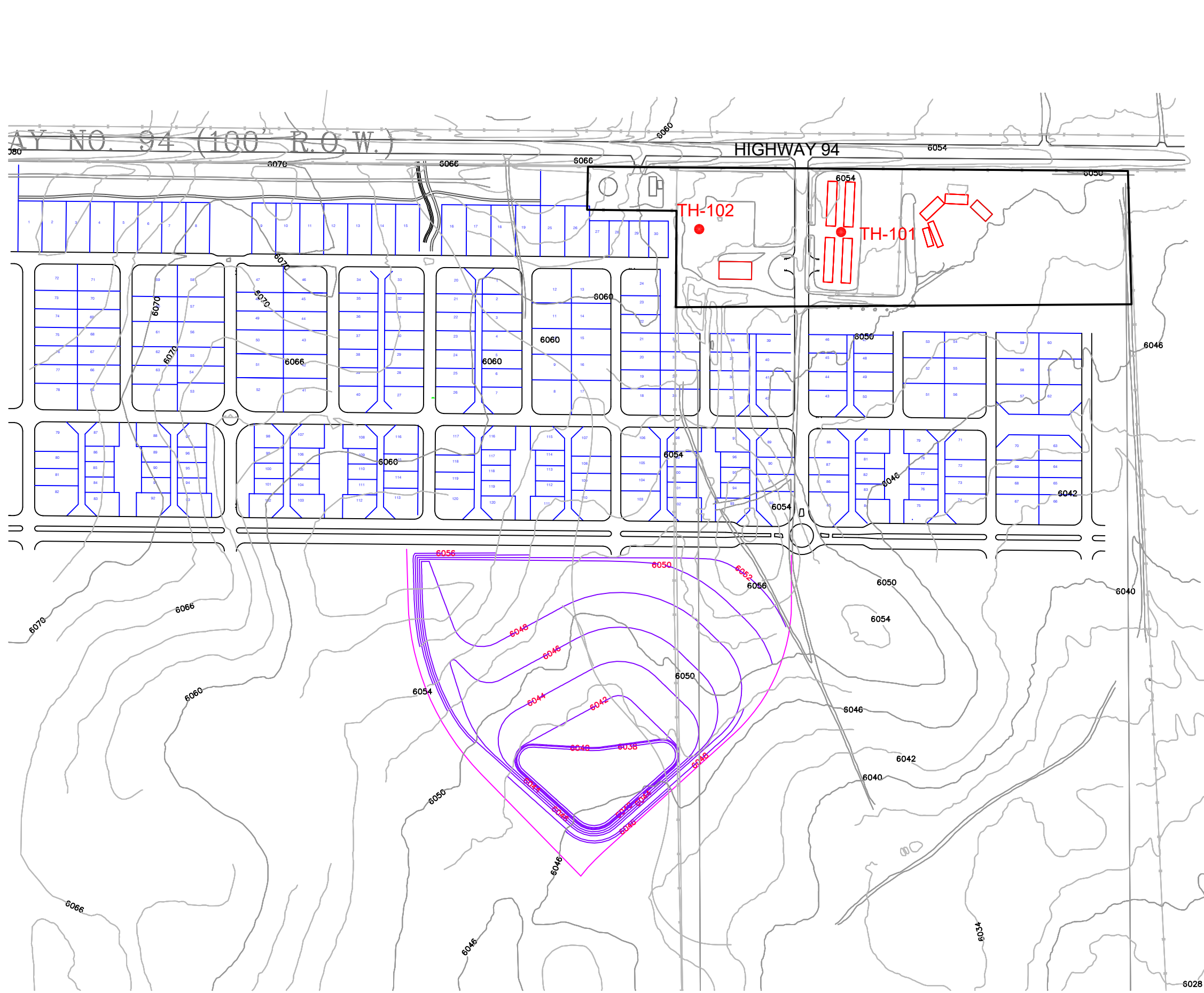
Reviewed by:

Timothy A. Mitchell, P.E.  
Division Manager



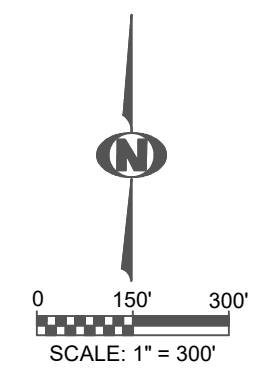
PF:TAM

Via Email: [jboggs@cormanleigh.com](mailto:jboggs@cormanleigh.com)



VICINITY MAP  
(NOT TO SCALE)

- LEGEND:
- TH-101 APPROXIMATE LOCATION OF EXPLORATORY BORING.
  - UPDATED PROJECT BOUNDARY INCLUDED IN THIS INVESTIGATION.
  - LOCATION OF EXISTING STRUCTURES AND FOUNDATIONS.
  - LOCATION OF PROPOSED LOTS.
  - EXISTING TOPOGRAPHY



NOTE:  
BASE DRAWING WAS PROVIDED BY ROCKY MOUNTAIN DRAFTING.

## Location of Exploratory Borings

**LEGEND:**

FILL, SAND, SLIGHTLY SILTY, SLIGHTLY GRAVELLY, LOOSE TO MEDIUM DENSE, SLIGHTLY MOIST, BROWN.



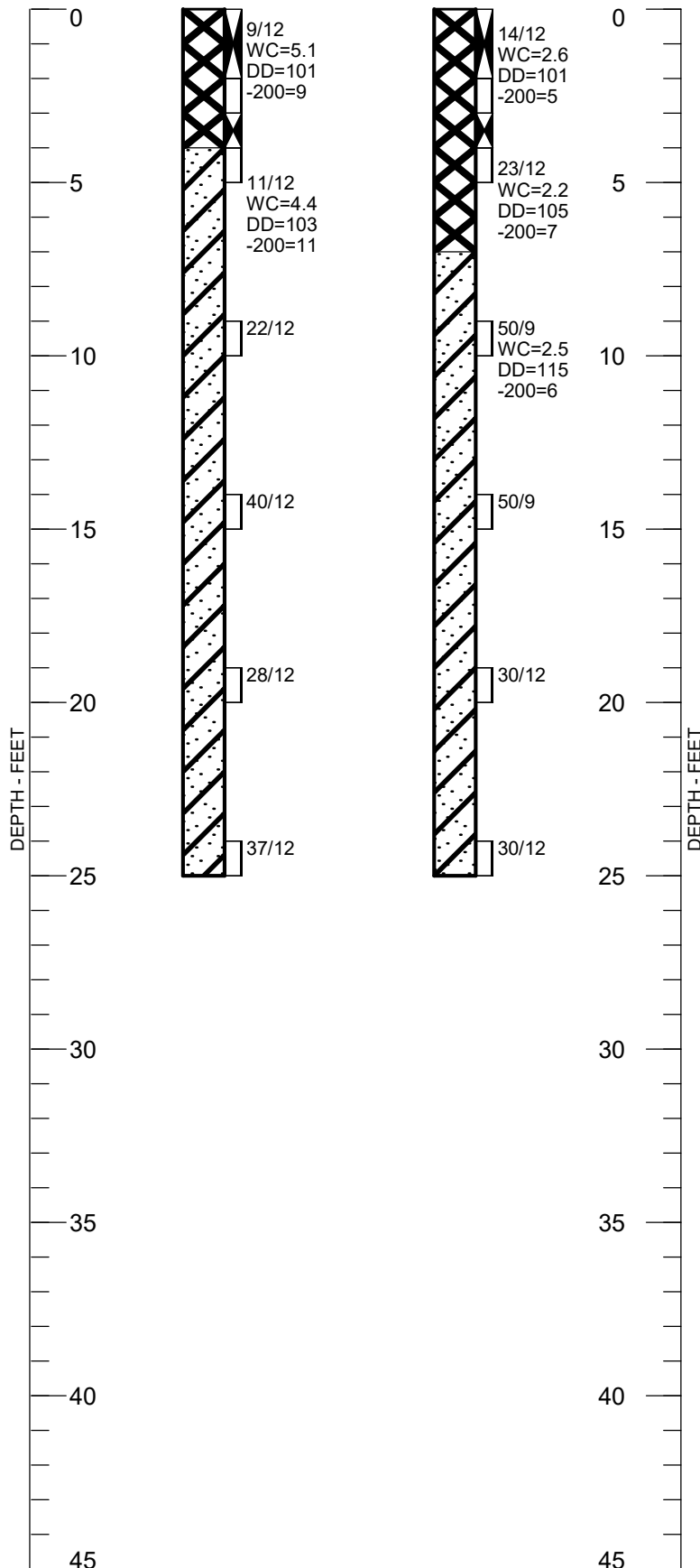
SAND, SLIGHTLY SILTY, MEDIUM DENSE TO VERY DENSE, SLIGHTLY MOIST, LIGHT BROWN TO BROWN. (SP-SM)



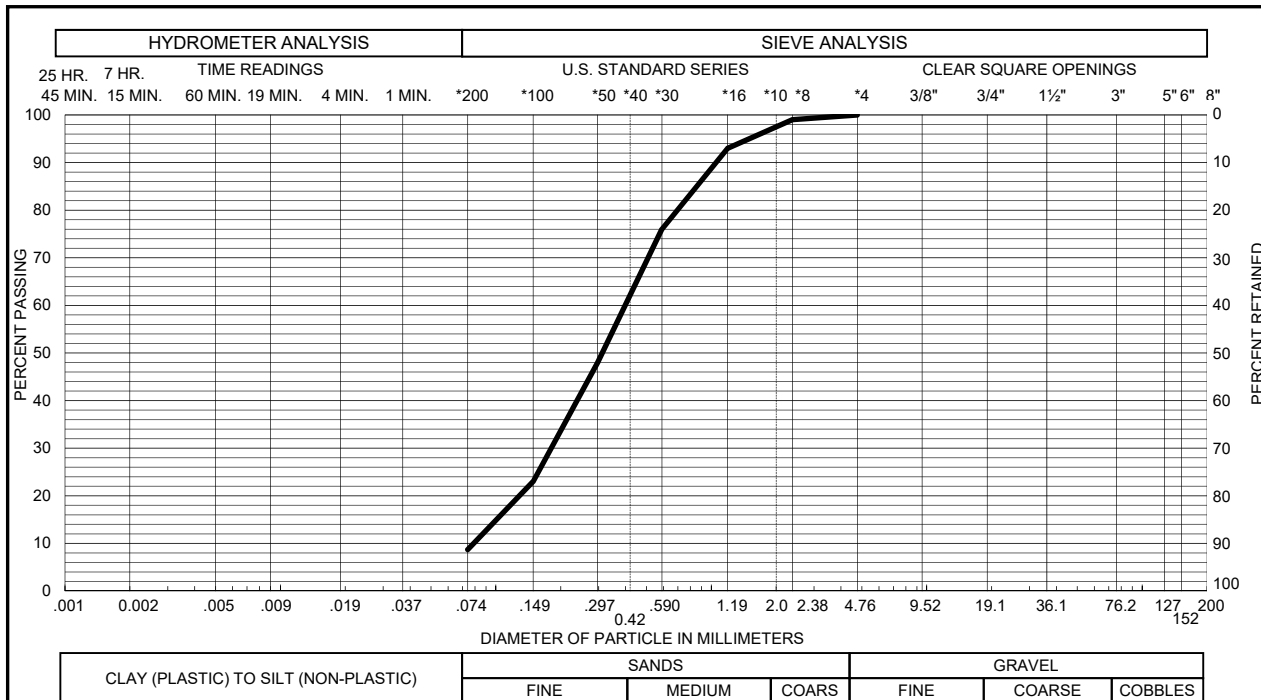
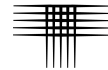
DRIVE SAMPLE. THE SYMBOL 9/12 INDICATES 9 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.



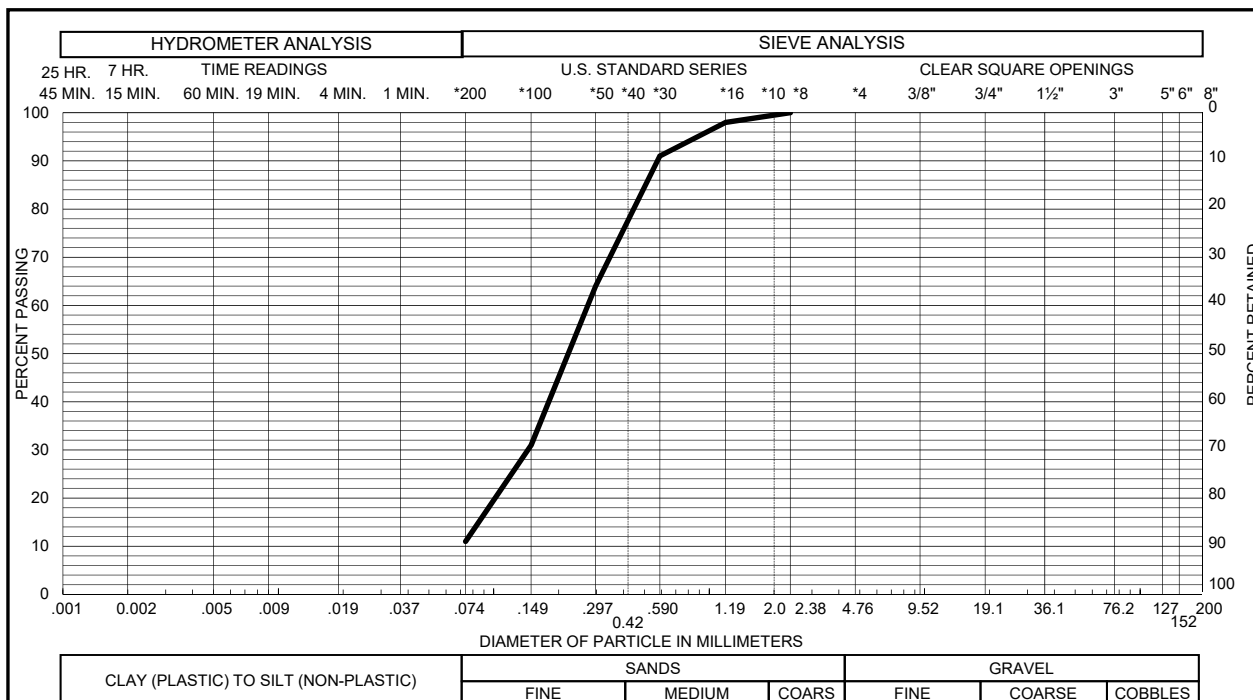
INDICATES BULK SAMPLE OBTAINED FROM AUGER CUTTINGS.

**NOTES:**

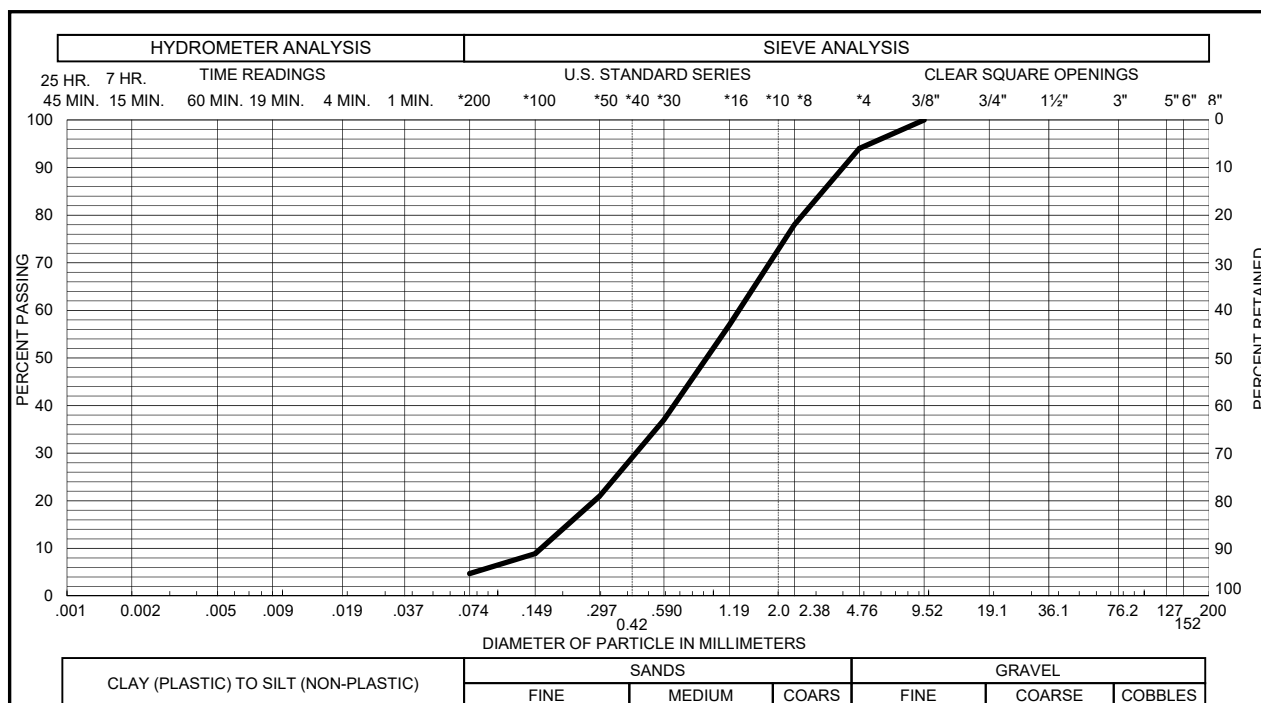
1. THE BORINGS WERE DRILLED JANUARY 9, 2019 USING A 4-INCH DIAMETER, CONTINUOUS-FLIGHT AUGER AND A CME-55, TRUCK-MOUNTED DRILL RIG.
2. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS, AND CONCLUSIONS AS CONTAINED IN THIS REPORT.
3. GROUNDWATER WAS NOT ENCOUNTERED IN THE EXPLORATORY BORINGS DURING THIS INVESTIGATION.
4. WC - INDICATES MOISTURE CONTENT. (%)  
DD - INDICATES DRY DENSITY. (PCF)  
LL - INDICATES LIQUID LIMIT. (%)  
(NV : NO VALUE)  
PI - INDICATES PLASTICITY INDEX. (%)  
(NP : NON-PLASTIC)  
-200 - INDICATES PASSING NO. 200 SIEVE. (%)



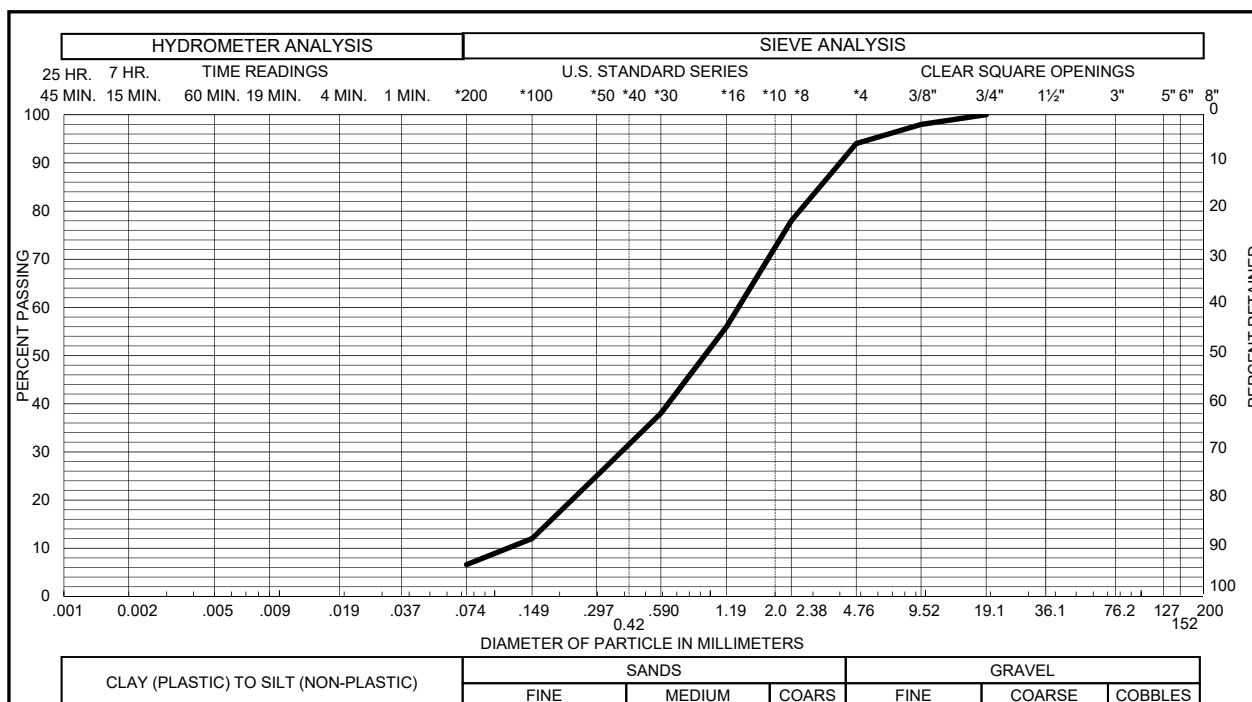
Sample of FILL, SAND, SLIGHTLY SILTY GRAVEL 0 % SAND 91 %  
From TH - 101 AT 2 FEET SILT & CLAY 9 % LIQUID LIMIT      %  
PLASTICITY INDEX      %



Sample of SAND, SLIGHTLY SILTY (SP-SM) GRAVEL 0 % SAND 89 %  
From TH - 101 AT 4 FEET SILT & CLAY 11 % LIQUID LIMIT      %  
PLASTICITY INDEX      %



Sample of FILL, SAND, SLT. SILTY, SLT. GRAVELLY GRAVEL 6 % SAND 89 %  
From TH - 102 AT 2 FEET SILT & CLAY 5 % LIQUID LIMIT        %  
PLASTICITY INDEX        %



Sample of FILL, SAND, SLT. SILTY, SLT. GRAVELLY GRAVEL 6 % SAND 87 %  
From TH - 102 AT 4 FEET SILT & CLAY 7 % LIQUID LIMIT        %  
PLASTICITY INDEX        %

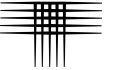




**SUMMARY OF LABORATORY TESTING**  
**CTL/T PROJECT NO. CS18969.001-115**

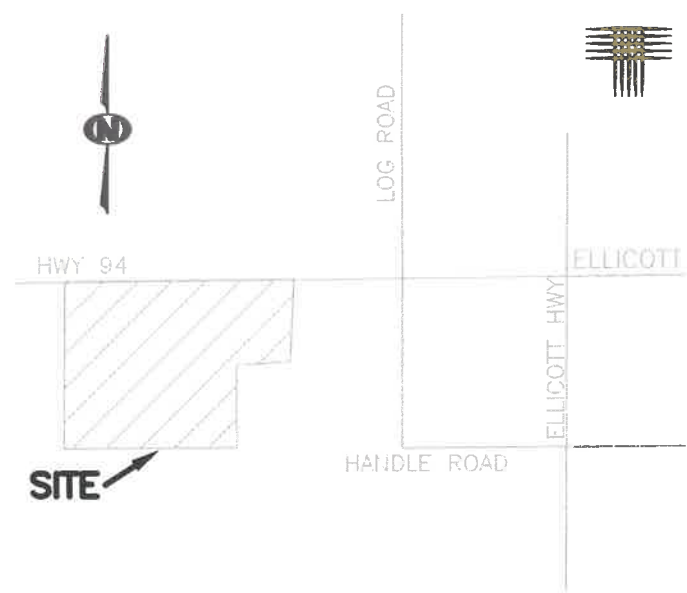
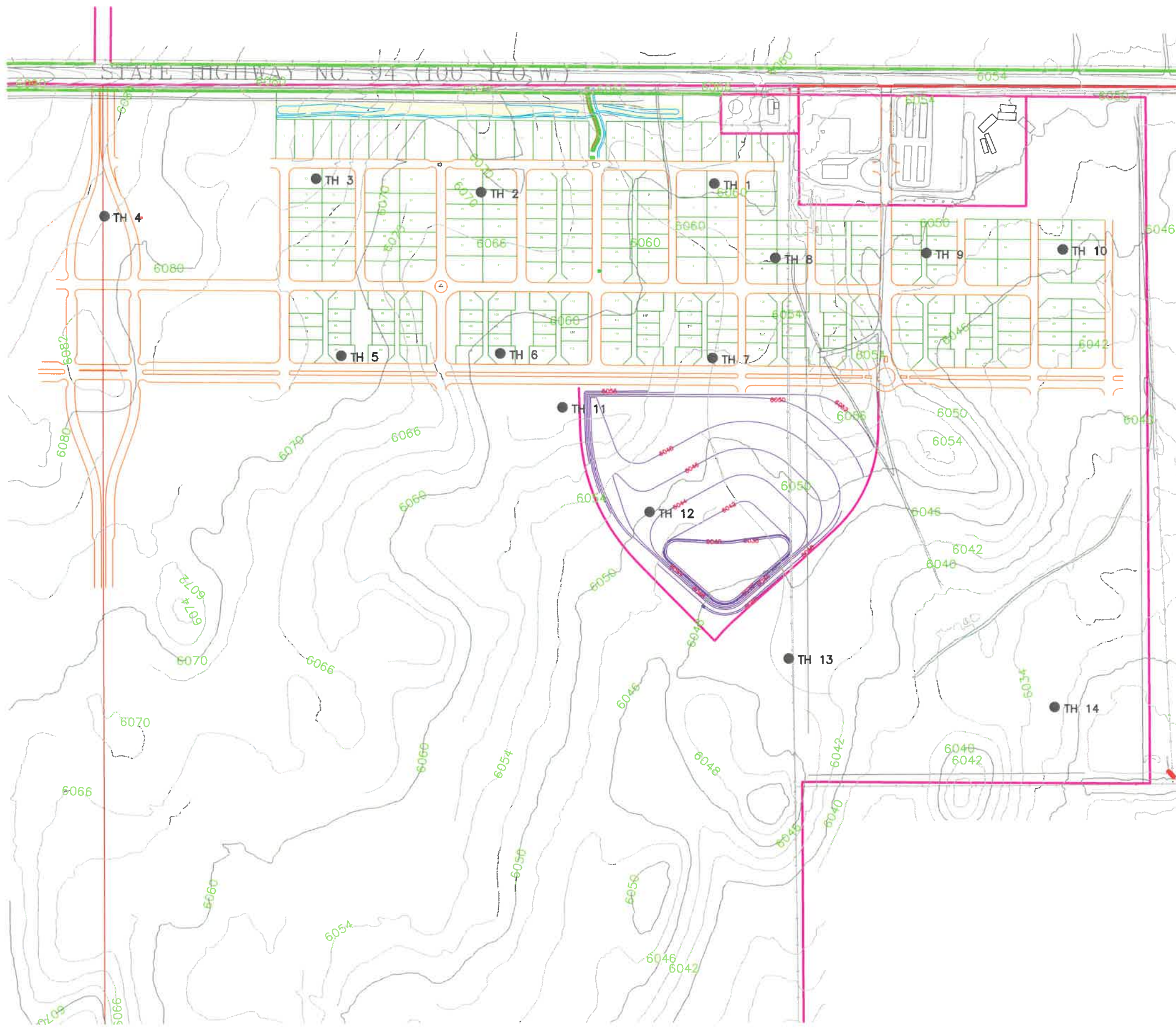
[illegible]

\* SWELL MEASURED WITH ESTIMATED IN-SITU OVERBURDEN PRESSURE.  
NEGATIVE VALUE INDICATES COMPRESSION.



Appendix A  
Figures From CTL|Thompson Project No. CS16091-115  
(Figures 1-3, Appendix A, Appendix B)  
Location of Exploratory Borings  
Passive and Active Drains Beside Sewers  
Summary Logs of Exploratory Borings  
Results of Laboratory Testing  
Table B-1

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VICINITY MAP  
(NO SCALE)

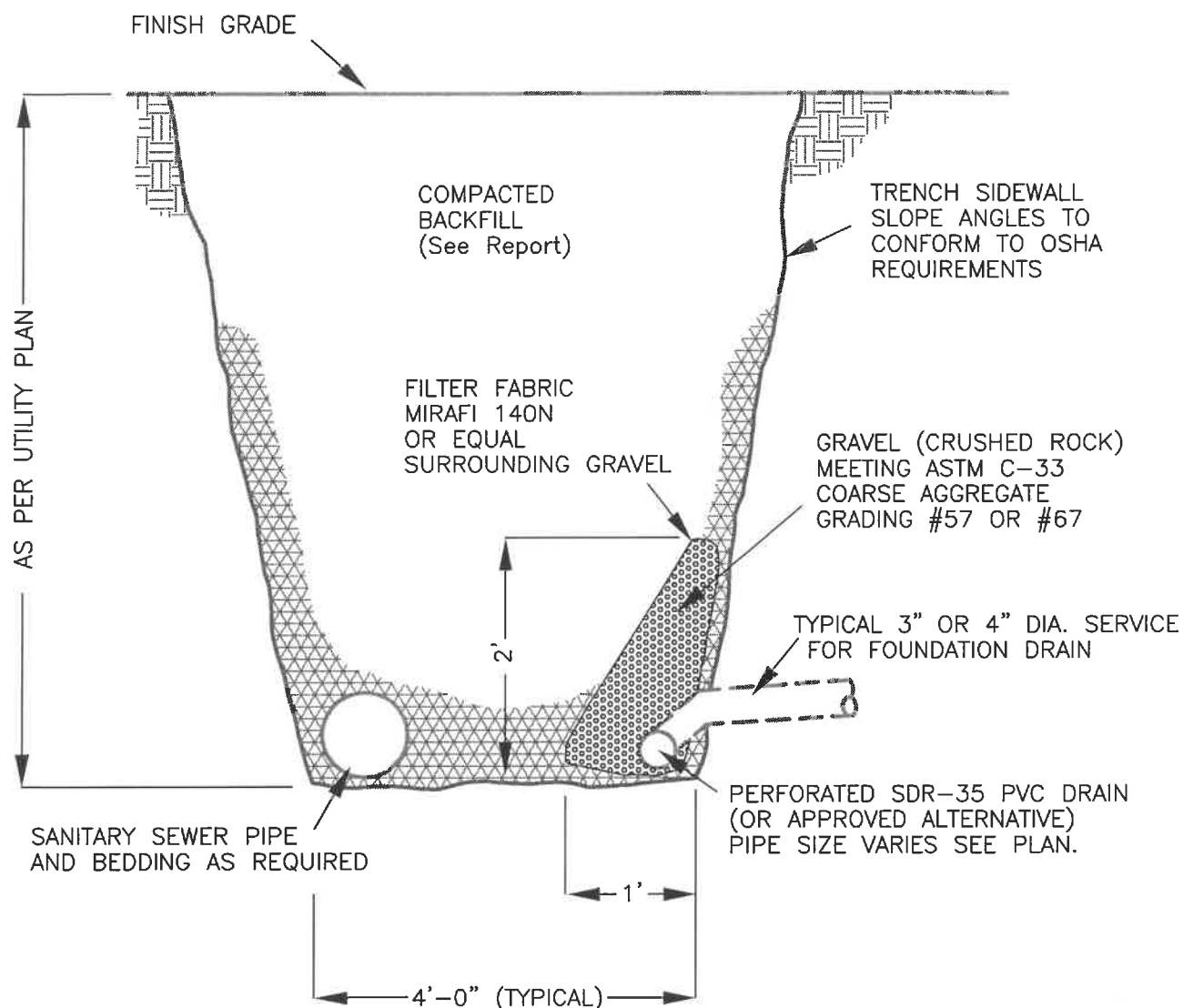
- LEGEND:
- TH 1 INDICATES APPROXIMATE LOCATION OF TEST HOLES INCLUDED IN THIS INVESTIGATION.
  - INDICATES EXISTING ELEVATION CONTOURS.
  - INDICATES PROPOSED GRADING CONTOURS.

NOTE:  
BASE DRAWING PROVIDED BY ROCKY MOUNTAIN DRAFTING.



SCALE: 1" = 400'

Location of  
Exploratory Borings

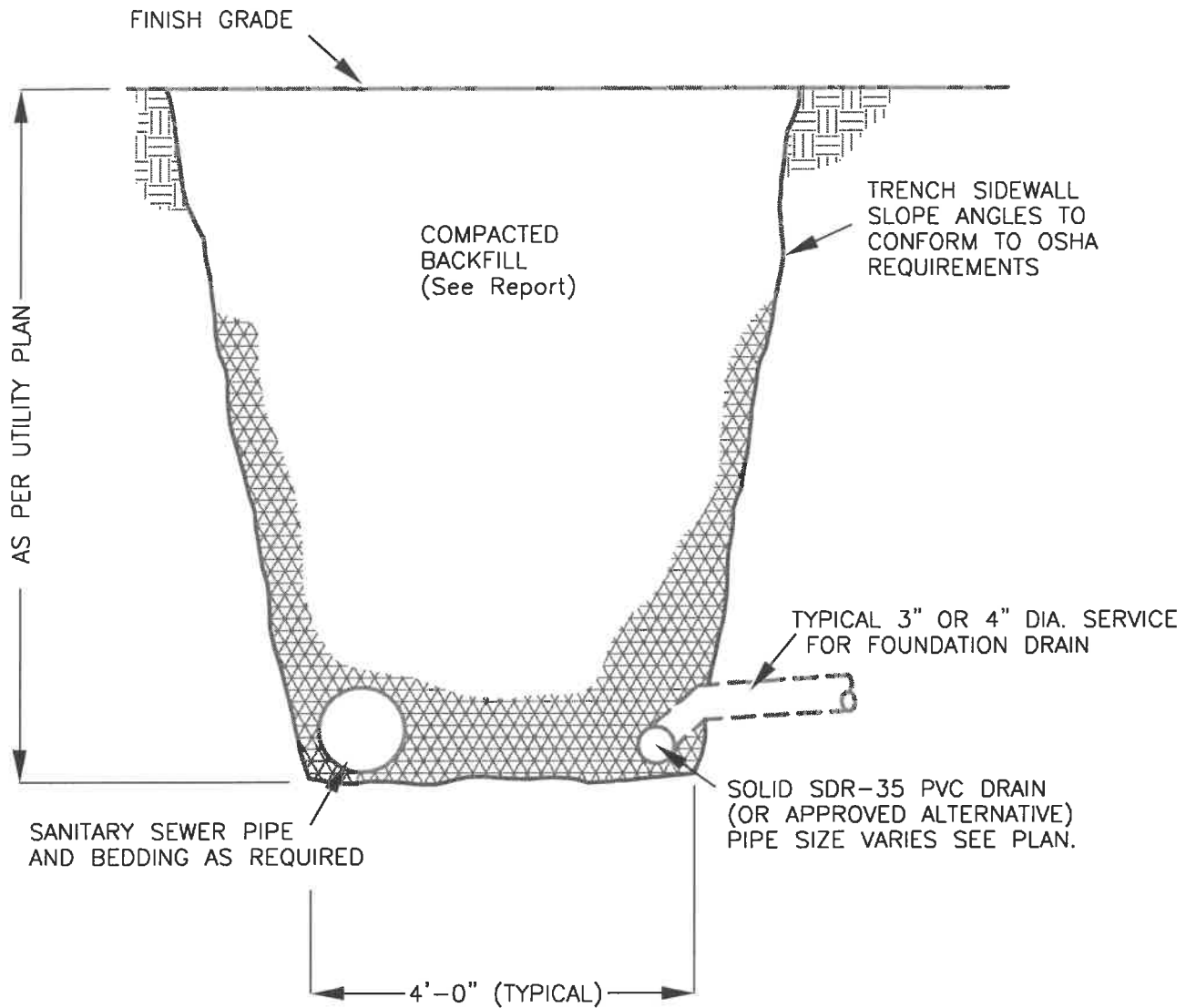


Grading Requirements for Coarse Aggregates per ASTM C-33

Size Number	Nominal Size (Sieves with Square Openings)	Amounts Finer than Each Laboratory Sieve (Square Openings), Weight Percent						
		1 1/2 in. (37.5 mm)	1 in. (25.0 mm)	3/4 in. (19.0 mm)	1/2 in. (12.5 mm)	3/8 in. (9.5 mm)	No. 4 (4.5 mm)	No. 8 (2.36 mm)
67	3/4 in. to No. 4 (19.0 to 4.75 mm)	--	100	90 to 100	--	20 to 55	0 to 10	0 to 5
57	1 in. to No. 4 (25.0 to 9.5 mm)	100	95 to 100	--	25 to 60	--	0 to 10	0 to 5

NOTE:  
TO BE USED IN CASES WHERE GROUND WATER IS  
FOUND DURING TRENCHING OR WHERE SHALLOW  
GROUND WATER IS KNOWN TO EXIST.

## Active Drain Beside Sewer



NOTE:  
TO BE USED IN CASES WHERE NO  
SHALLOW GROUND WATER IS KNOWN TO EXIST.

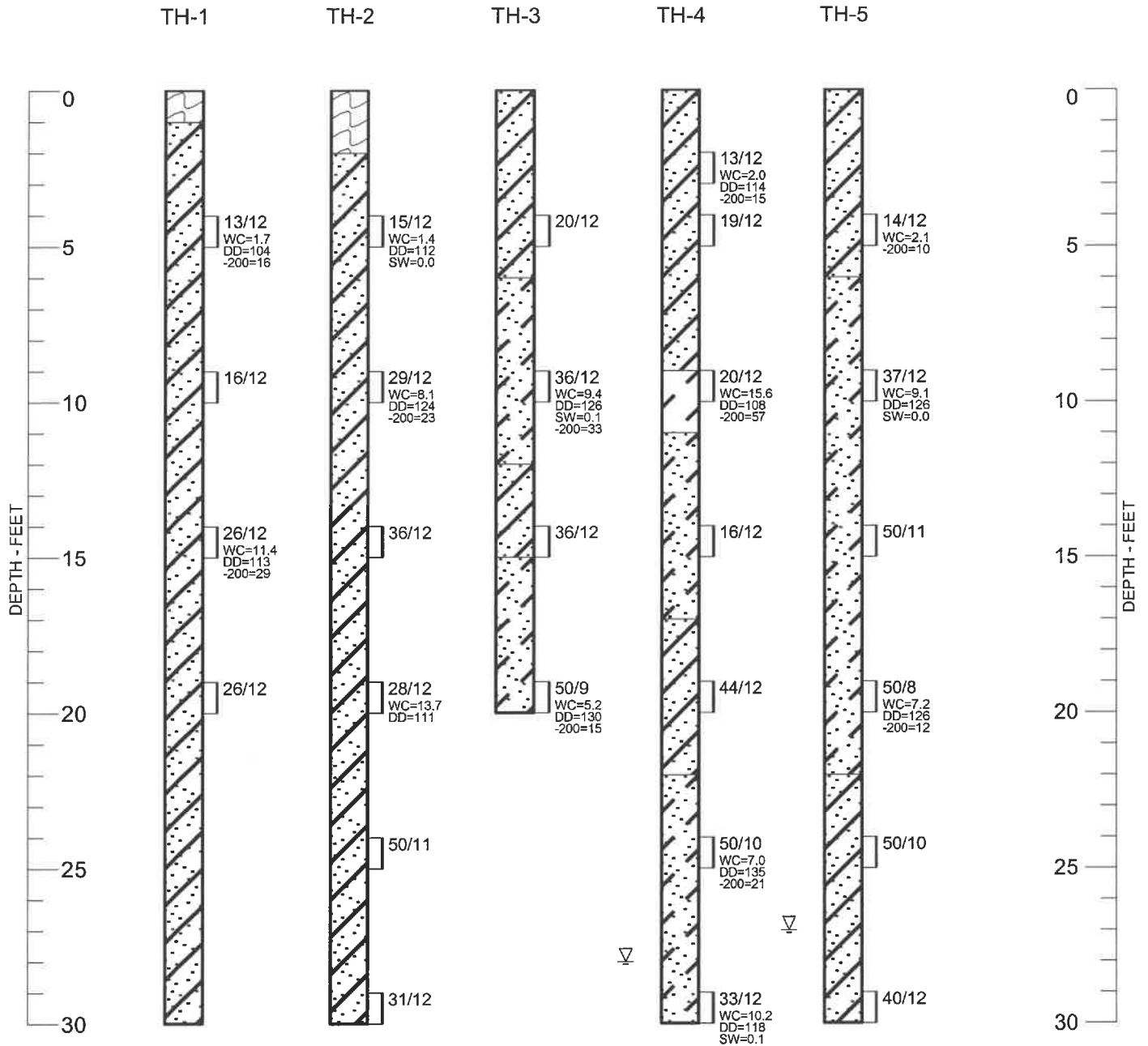
## Passive Drain Beside Sewer

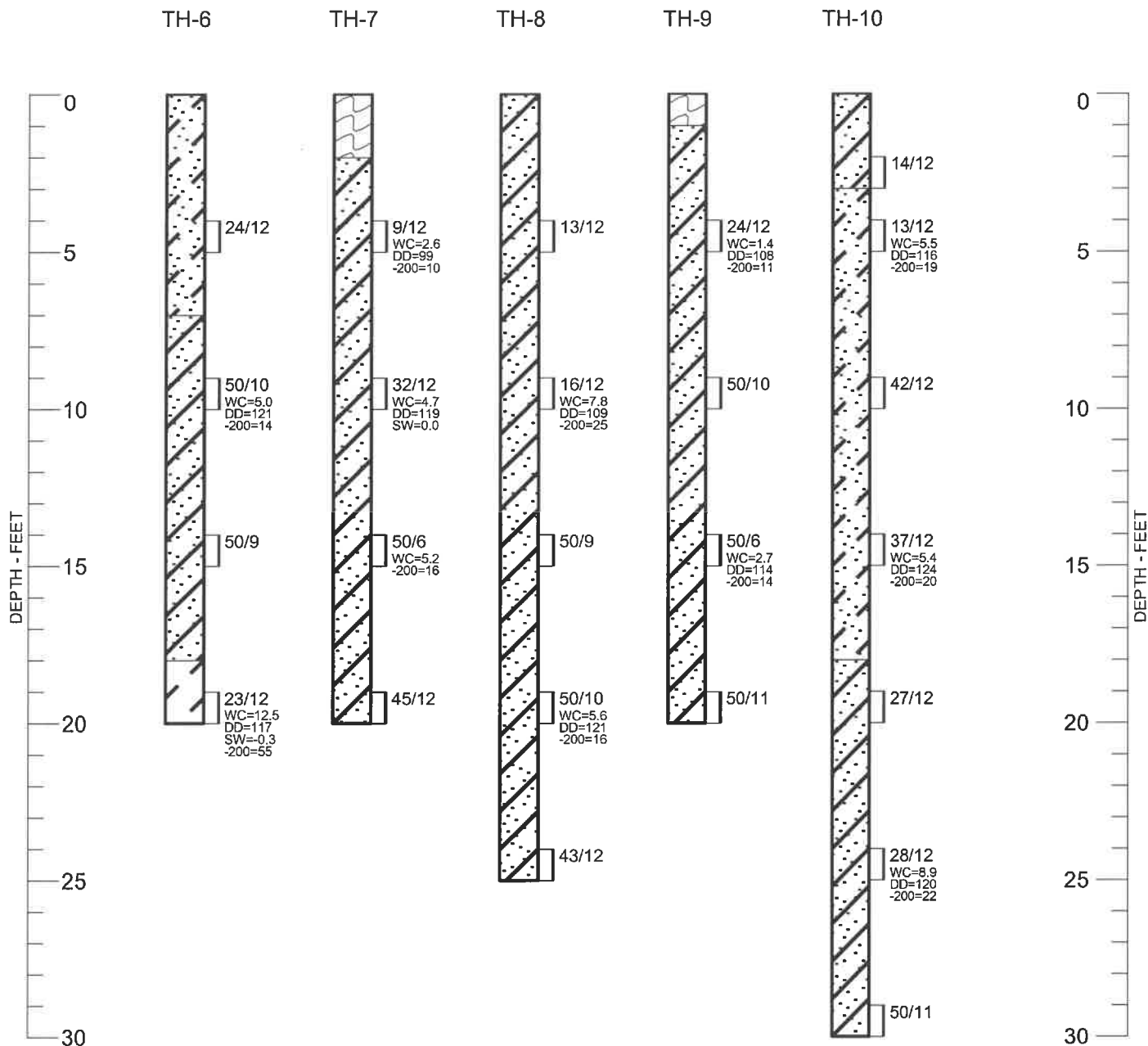
FIG. 3



**APPENDIX A**

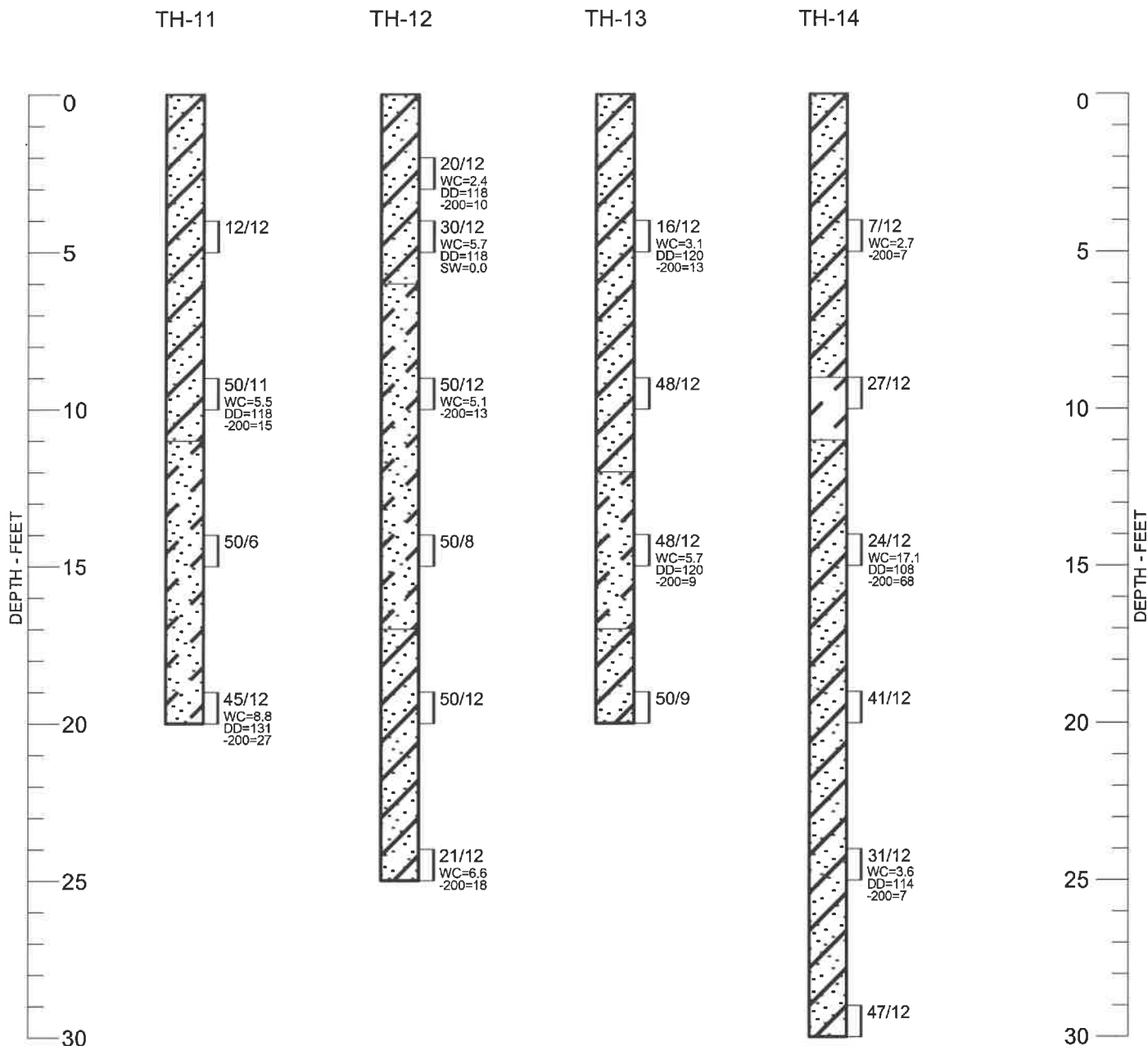
**SUMMARY LOGS OF EXPLORATORY BORINGS**





## FIG. A-2





## LEGEND:



TOPSOIL.



SAND, SLIGHTLY SILTY TO SILTY, MEDIUM DENSE TO VERY DENSE, DRY TO MOIST, LIGHT BROWN TO MEDIUM BROWN(SP-SM, SM).



SAND, SLIGHTLY CLAYEY TO CLAYEY, MEDIUM DENSE TO DENSE, MOIST, MEDIUM BROWN(SP-SC, SC).



CLAY, SANDY, STIFF, MOIST, MEDIUM BROWN(CL).



DRIVE SAMPLE. THE SYMBOL 13/12 INDICATES 13 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.



WATER LEVEL MEASURED AT TIME OF DRILLING.

## NOTES:

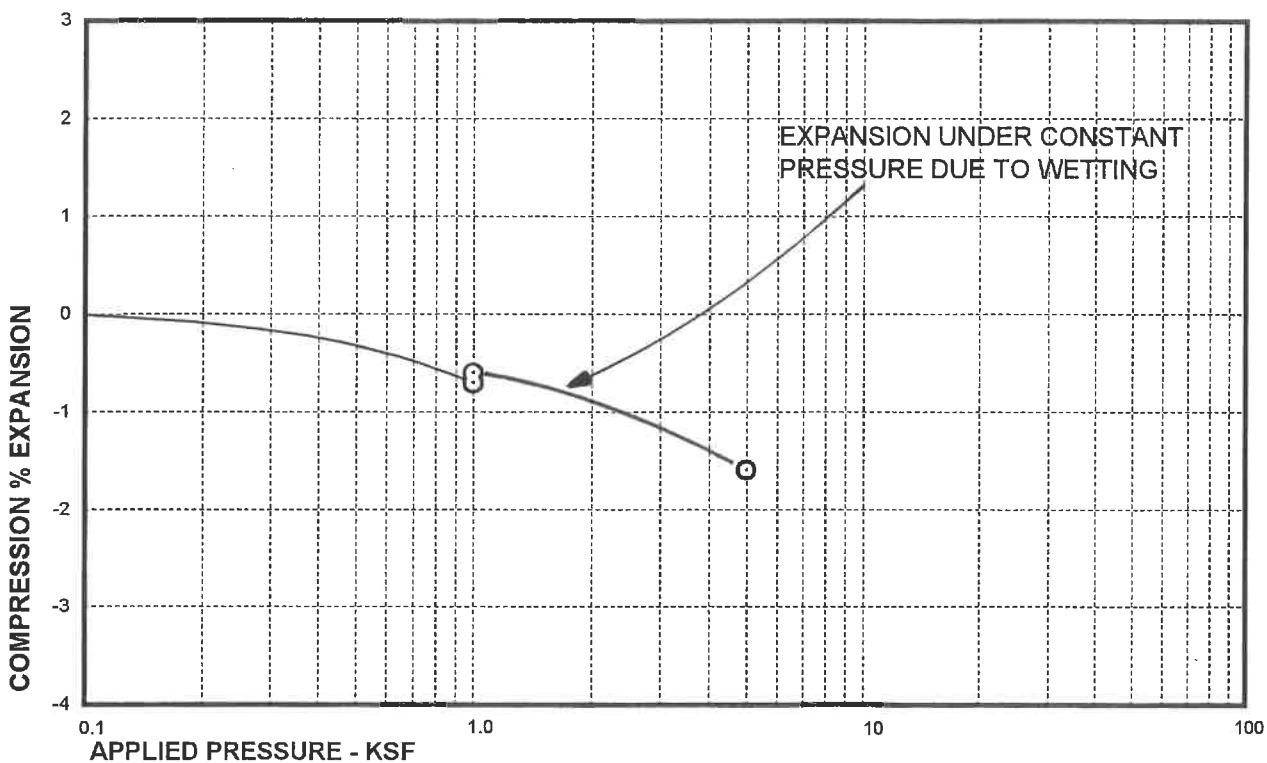
1. THE BORINGS WERE DRILLED MAY 25 AND 26, 2006 USING A 4-INCH DIAMETER CONTINUOUS FLIGHT AUGER AND A TRUCK MOUNTED DRILL RIG.
2. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS AND CONCLUSIONS CONTAINED IN THIS REPORT.
3. WC - INDICATES MOISTURE CONTENT (%).  
DD - INDICATES DRY DENSITY (PCF).  
SW - INDICATES SWELL WHEN WETTED UNDER 1 KSF LOAD (%).  
-200 - INDICATES PASSING NO. 200 SIEVE (%).  
SS - INDICATES SOLUBLE SULFATE CONTENT (%).

**Summary Logs of  
Exploratory  
Borings**



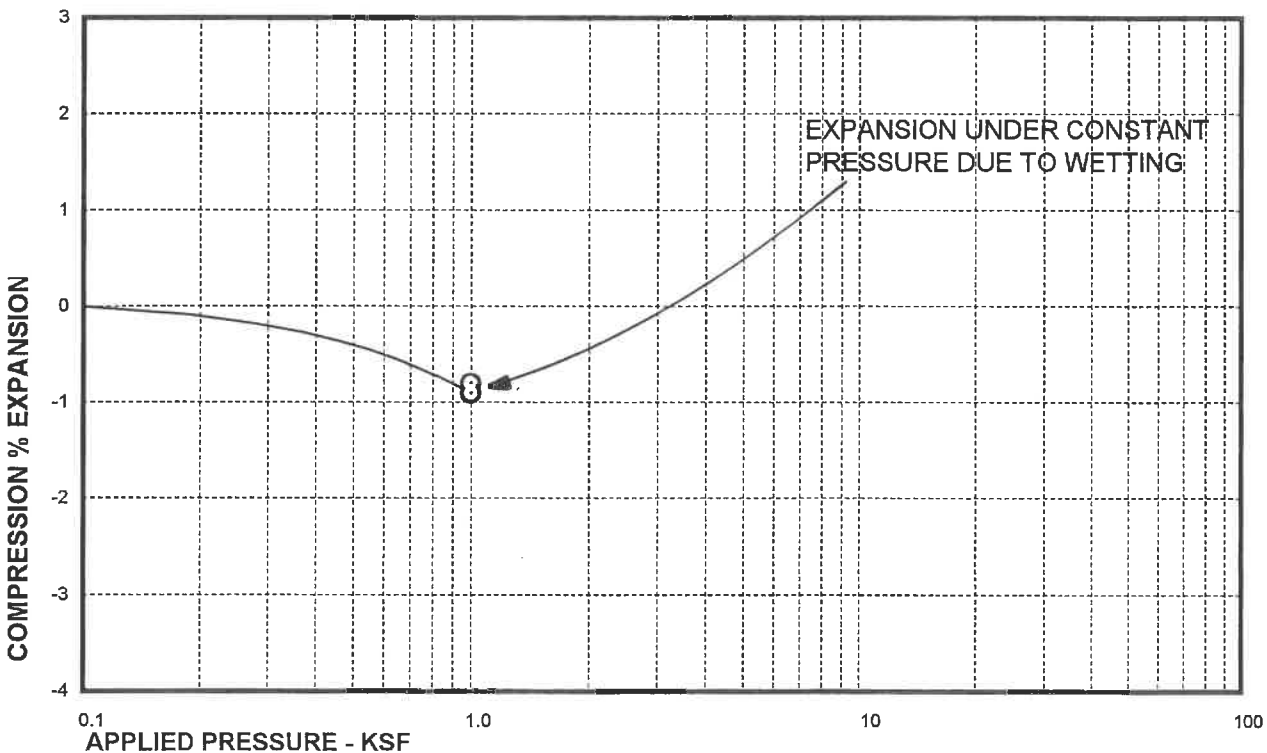
## **APPENDIX B**

### **LABORATORY TEST RESULTS**



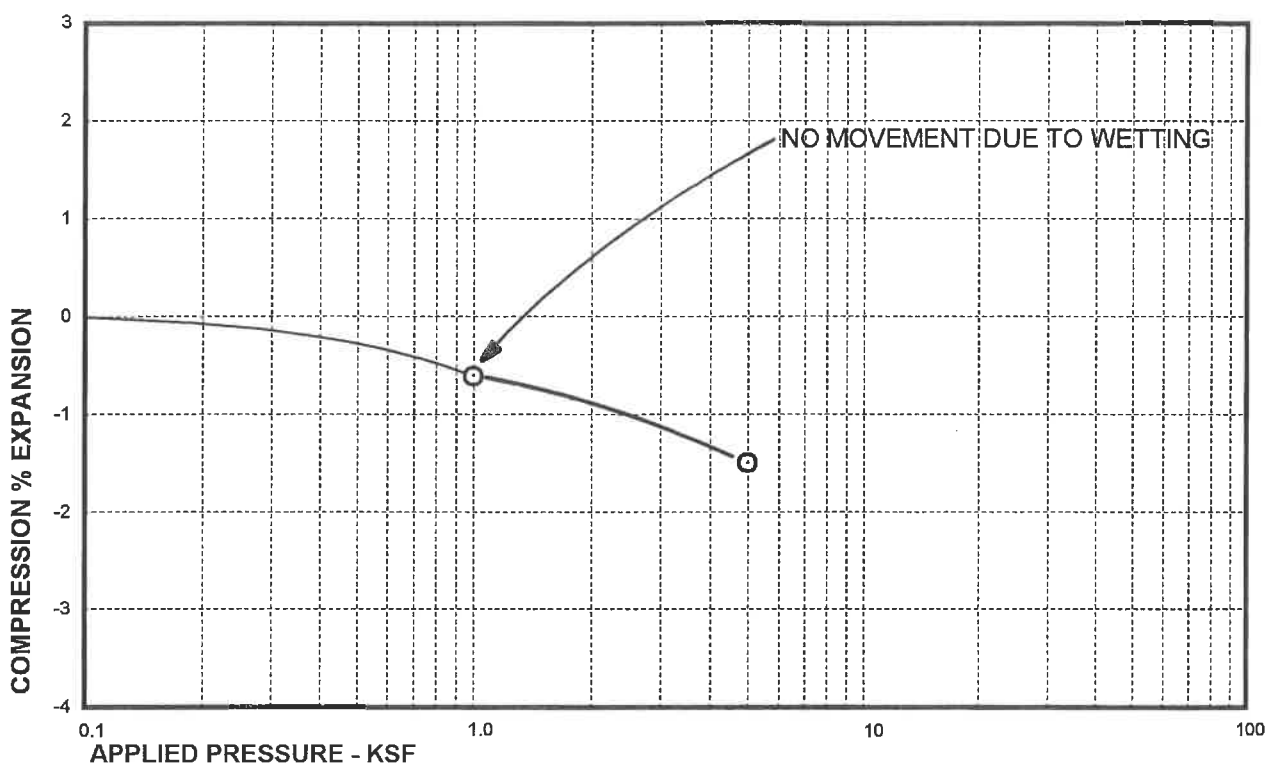
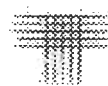
Sample of SAND, CLAYEY (SC)  
From TH-3 AT 9 FEET

DRY UNIT WEIGHT= 126 PCF  
MOISTURE CONTENT= 9.4 %

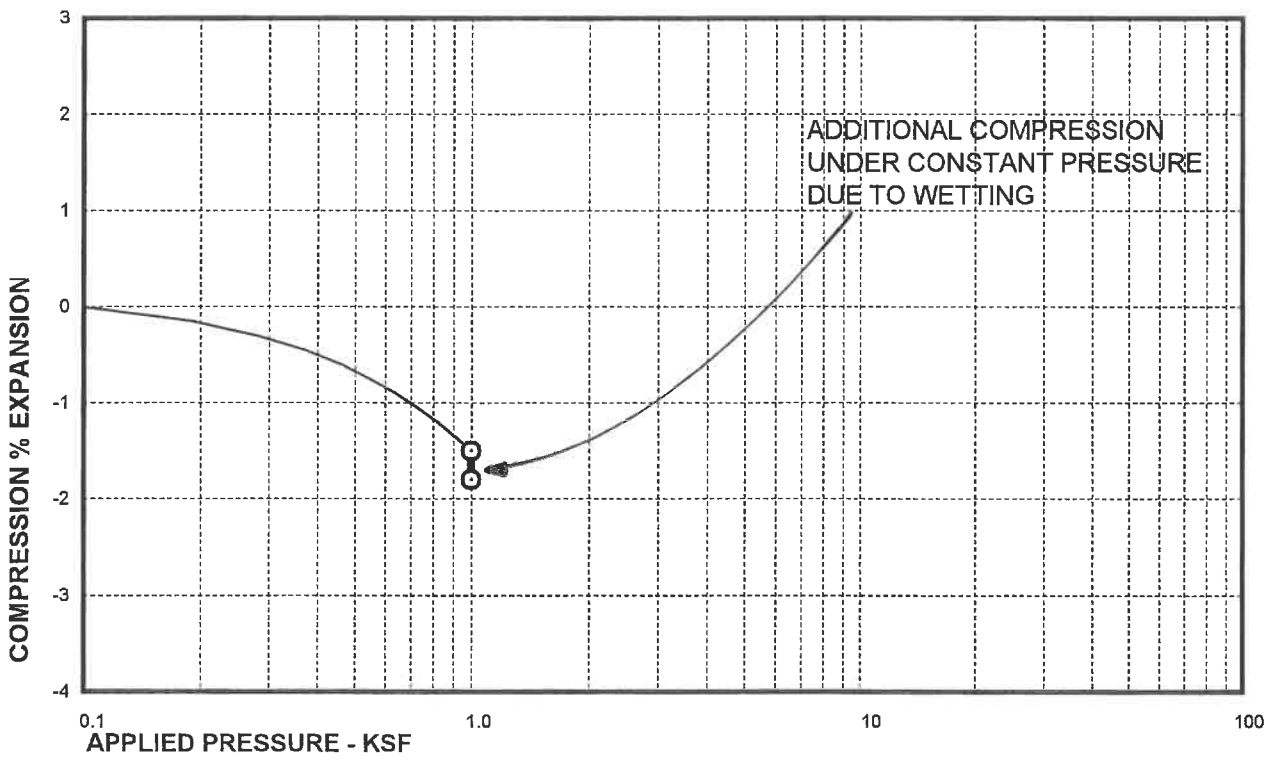


Sample of SAND, CLAYEY (SC)  
From TH-4 AT 29 FEET

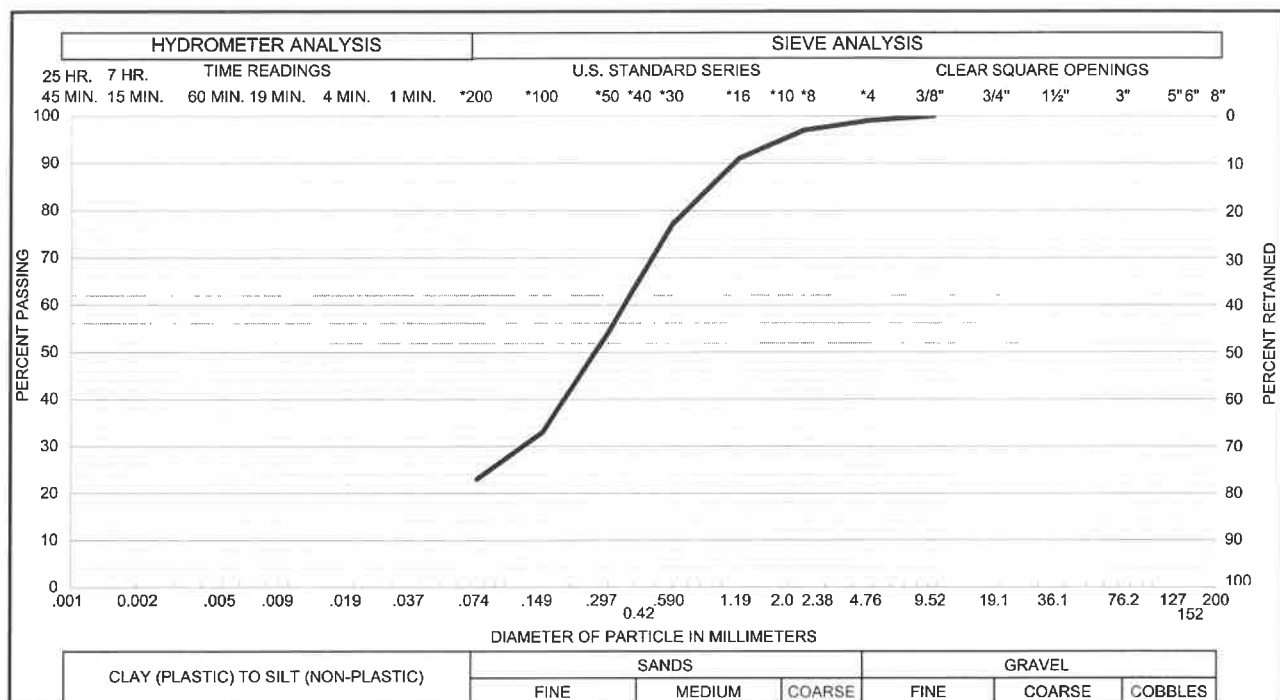
DRY UNIT WEIGHT= 118 PCF  
MOISTURE CONTENT= 10.2 %



Sample of SAND, CLAYEY (SC) DRY UNIT WEIGHT=126 PCF  
From TH-5 AT 9 FEET MOISTURE CONTENT=9.1 %

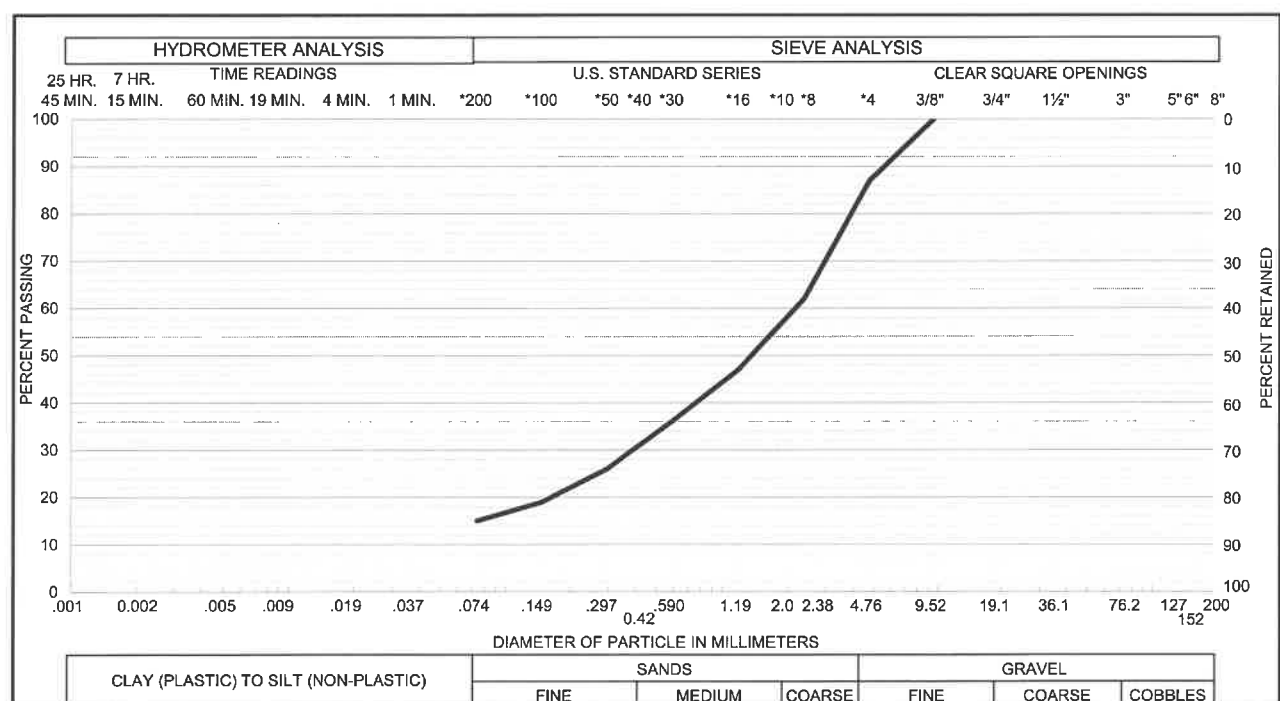


Sample of CLAY, SANDY (CL) DRY UNIT WEIGHT=117 PCF  
From TH-6 AT 19 FEET MOISTURE CONTENT=12.5 %



Sample of SAND, SILTY (SM)  
From TH - 2 AT 9 FEET

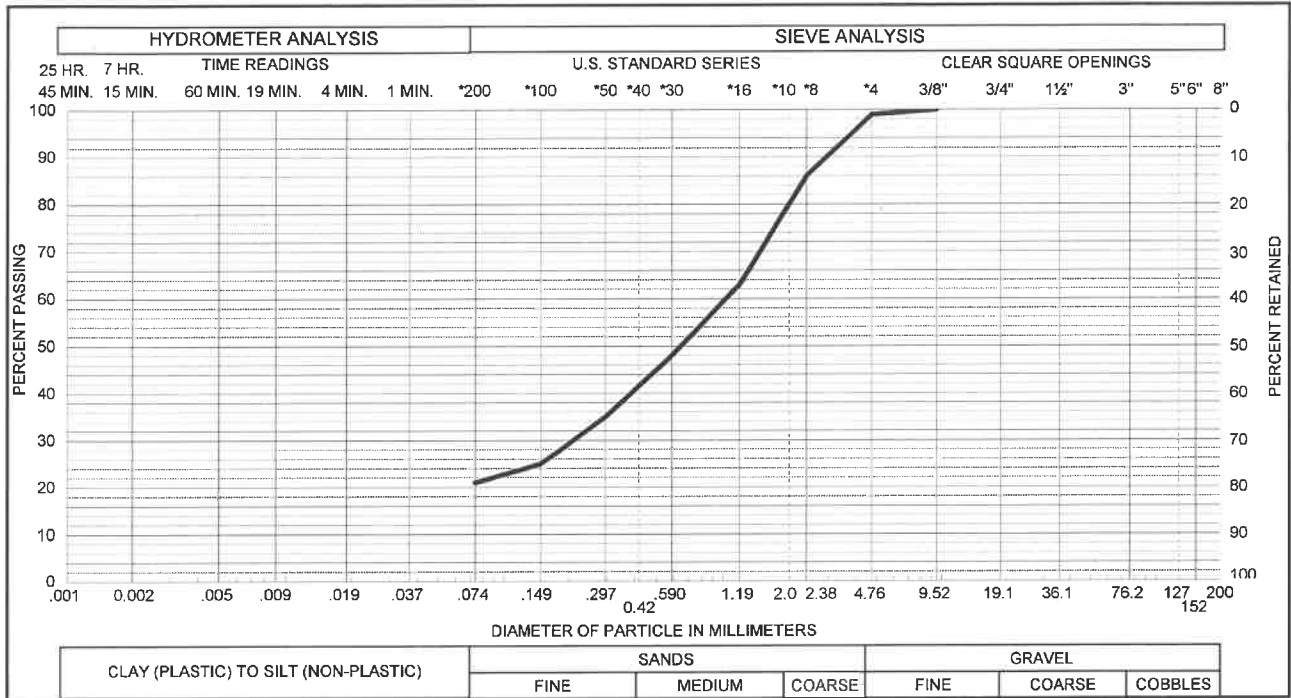
GRAVEL	1 %	SAND	76 %
SILT & CLAY	23 %	LIQUID LIMIT	- %
PLASTICITY INDEX			- %



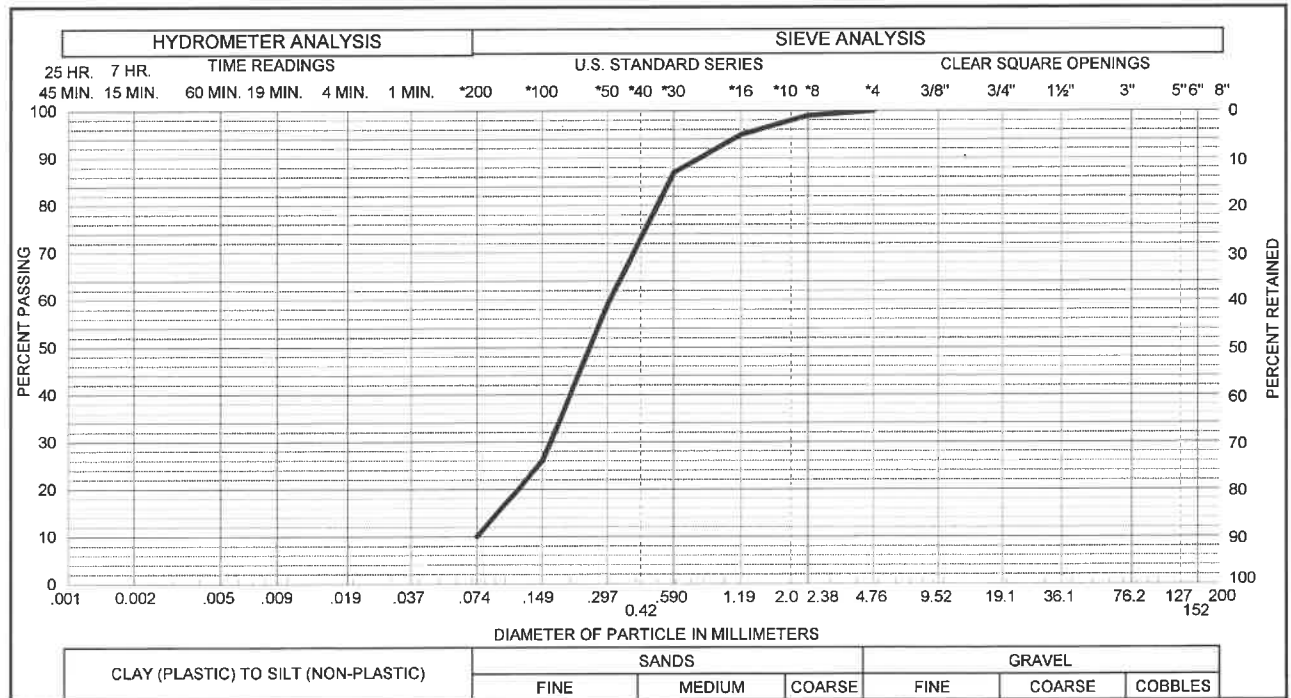
Sample of SAND, CLAYEY (SC)  
From TH - 3 AT 19 FEET

GRAVEL	13 %	SAND	72 %
SILT & CLAY	15 %	LIQUID LIMIT	- %
PLASTICITY INDEX			- %

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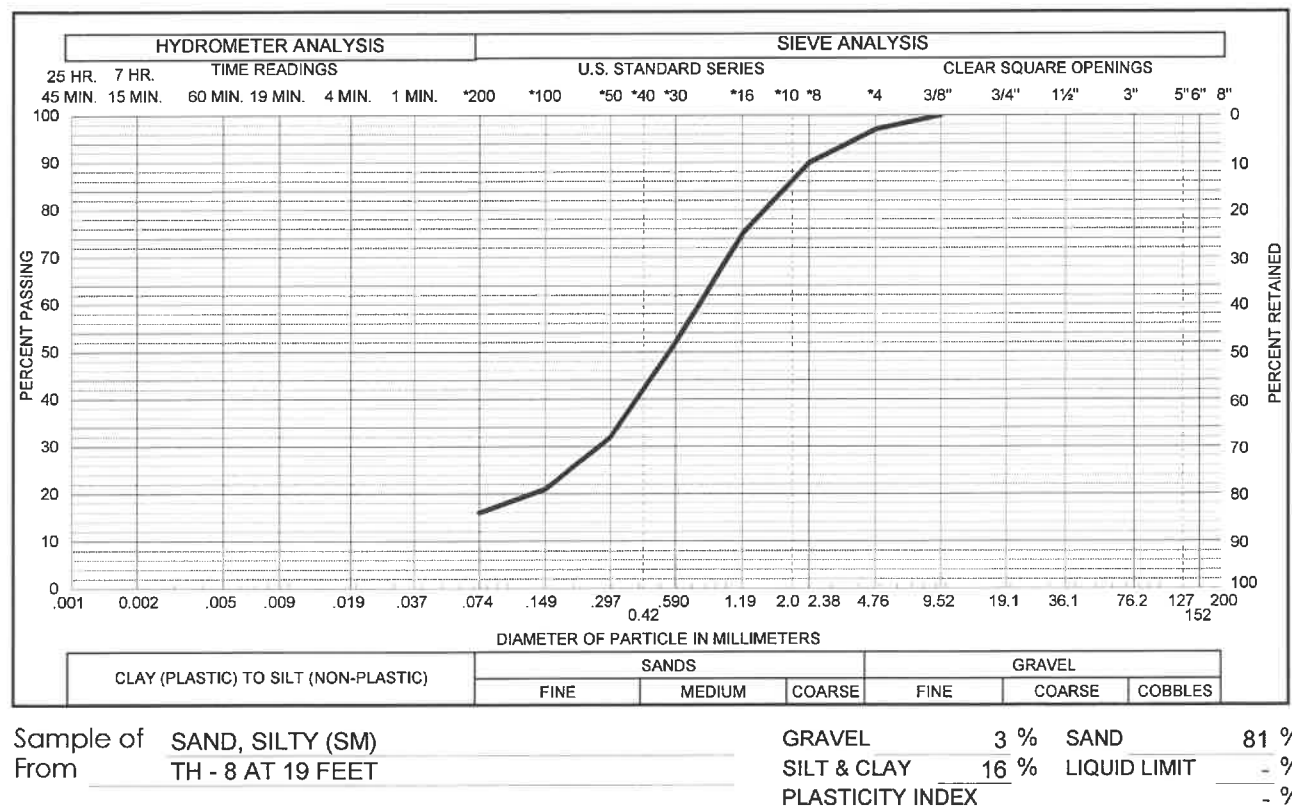
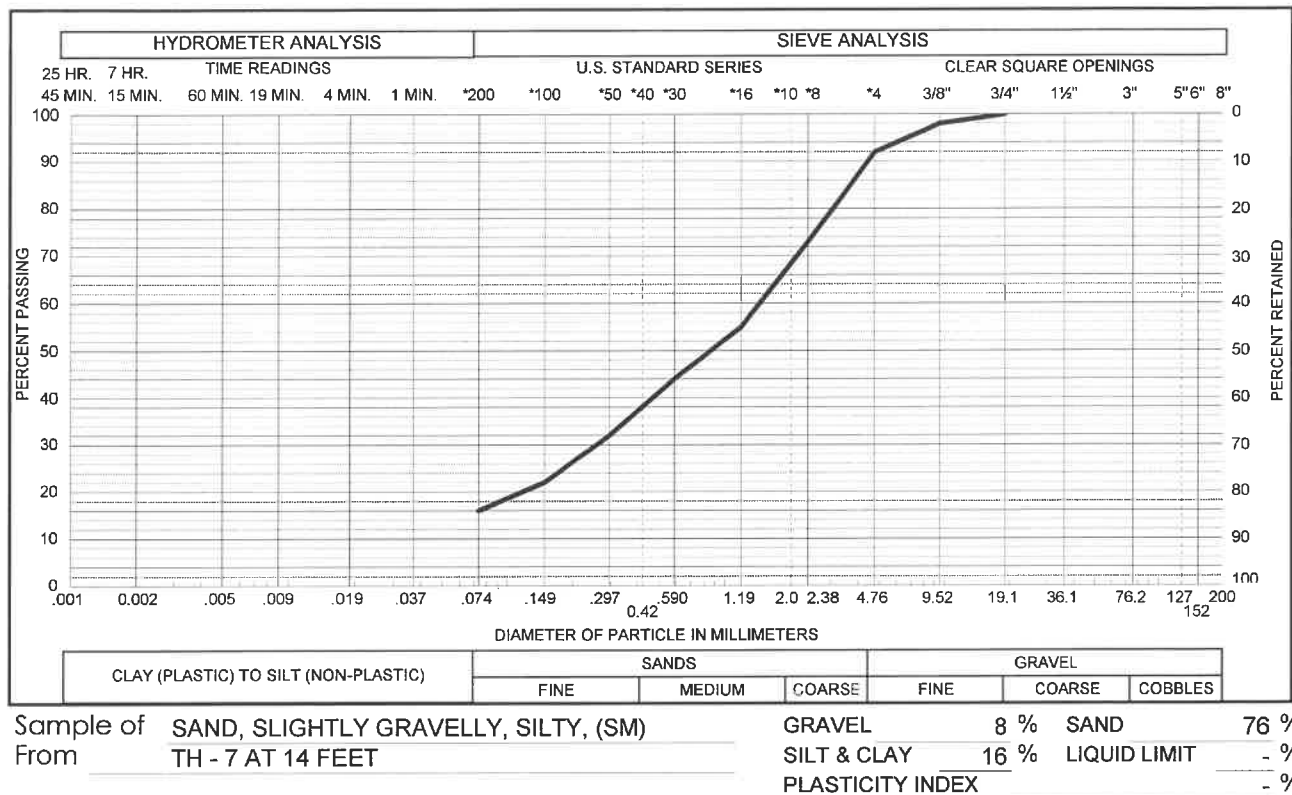


Sample of **SAND, CLAYEY (SC)** GRAVEL 1 % SAND 78 %  
From **TH - 4 AT 24 FEET** SILT & CLAY 21 % LIQUID LIMIT - %  
PLASTICITY INDEX - %



Sample of **SAND, SLIGHTLY SILTY(SP-SM)** GRAVEL 0 % SAND 90 %  
From **TH - 5 AT 4 FEET** SILT & CLAY 10 % LIQUID LIMIT - %  
PLASTICITY INDEX - %

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ACCRETIVE INVESTMENTS  
ELLCOT TOWN CENTER, FILING NO. 1  
PROJECT NO. CS16091-115

## Gratation Test Results

FIG. B-5



TABLE B-I

**SUMMARY OF LABORATORY TESTING  
PROJECT NO. CS16091-115**

BORING	DEPTH (FEET)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS		SWELL TEST RESULTS*		PASSING NO. 200 SIEVE (%)	SOLUBLE SULFATES (%)	DESCRIPTION
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SWELL (%)	SWELL PRESSURE (PSF)			
TH-1	4	1.7	104					16		SAND, SILTY (SM)
	14	11.4	113					29		SAND, SILTY (SM)
TH-2	4	1.4	112						0.006	SAND, SILTY (SM)
	9	8.1	124					23		SAND, SILTY (SM)
	19	13.7	111							SAND, SILTY (SM)
TH-3	9	9.4	126			0.1		33		SAND, CLAYEY (SC)
	19	5.2	130					15		SAND, CLAYEY (SC)
TH-4	2	2.0	114					15		SAND, SILTY (SM)
	9	15.6	108					57		CLAY, SANDY (CL)
	24	7.0	135					21		SAND, CLAYEY (SC)
	29	10.2	118			0.1				SAND, CLAYEY (SC)
TH-5	4	2.1						10		SAND, SLIGHTLY SILTY (SP-SM)
	9	9.1	126			0.0				SAND, CLAYEY (SC)
	19	7.2	126					12		SAND, SLIGHTLY CLAYEY (SP-SC)
TH-6	9	5.0	121					14		SAND, SILTY (SM)
	19	12.5	117			-0.3		55		CLAY, SANDY (CL)
TH-7	4	2.6	99					10		SAND, SLIGHTLY SILTY (SP-SM)
	9	4.7	119						0.002	SAND, SILTY (SM)
	14	5.2						16		SAND, SILTY (SM)
TH-8	9	7.8	109					25		SAND, SILTY (SM)
	19	5.6	121					16		SAND, SILTY (SM)
TH-9	4	1.4	108					11		SAND, SLIGHTLY SILTY (SP-SM)
	14	2.7	114					14		SAND, SILTY (SM)
TH-10	4	5.5	116					19		SAND, SILTY (SM)
	14	5.4	124					20		SAND, CLAYEY (SC)
	24	8.9	120					22		SAND, SILTY (SM)
TH-11	9	5.5	118					15		SAND, SILTY (SM)
	19	8.8	131					27		SAND, CLAYEY (SC)
TH-12	2	2.4	118					10		SAND, SLIGHTLY SILTY (SP-SM)
	4	5.7	118						0.002	SAND, SILTY (SM)
	9	5.1						13		SAND, CLAYEY (SC)
	24	6.6						18		SAND, SILTY (SM)
TH-13	4	3.1	120					13		SAND, SILTY (SM)

\* SWELL MEASURED WITH 1000 PSF APPLIED PRESSURE. NEGATIVE VALUE INDICATES COMPRESSION.

TABLE B-1

**SUMMARY OF LABORATORY TESTING**  
**PROJECT NO. CS16091-115**

[illegible]

\* SWELL MEASURED WITH 1000 PSF APPLIED PRESSURE. NEGATIVE VALUE INDICATES COMPRESSION.



**PRELIMINARY GEOTECHNICAL INVESTIGATION  
ELLICOTT TOWN CENTER  
ELLICOTT HIGHWAY AND LOG ROAD  
EL PASO COUNTY, COLORADO**

**Prepared for:**

**ACCRETIVE INVESTMENTS  
c/o Development Services, Inc.  
520 East Colorado Avenue  
Colorado Springs, Colorado 80903**

**Attention: Mr. Al Watson**

**Project No. CS16091-115**

**July 13, 2006**



## TABLE OF CONTENTS

<b>SCOPE</b>	<b>1</b>
<b>SUMMARY</b>	<b>1</b>
<b>SITE CONDITIONS</b>	<b>2</b>
<b>PROPOSED DEVELOPMENT</b>	<b>2</b>
<b>SITE GEOLOGY</b>	<b>3</b>
Eolian Sand	3
<b>SUBSURFACE CONDITIONS</b>	<b>3</b>
Sand	4
Clay	4
Ground Water	4
<b>SITE DEVELOPMENT CONSIDERATIONS</b>	<b>5</b>
Existing Utility Trench Backfill	5
Site Grading	5
Utility Construction	6
Underdrain	7
Channel and Detention Pond	8
Pavements	8
Seismicity	9
Radon Mitigation	9
<b>RESIDENTIAL CONSTRUCTION CONSIDERATIONS</b>	<b>9</b>
Foundations	10
Slab-on-Grade and Basement Floor Construction	10
Basements	10
Surface Drainage	10
Concrete	11
<b>RECOMMENDED FUTURE INVESTIGATIONS</b>	<b>11</b>
<b>LIMITATIONS</b>	<b>12</b>
<b>FIG. 1 - LOCATION OF EXPLORATORY BORINGS</b>	
<b>FIGS. 2 AND 3 - DRAIN BESIDE SEWER DETAILS</b>	
<b>APPENDIX A - SUMMARY LOGS OF EXPLORATORY BORINGS</b>	
<b>APPENDIX B - LABORATORY TEST RESULTS</b>	
<b>TABLE B-1 - SUMMARY OF LABORATORY TESTING</b>	
<b>APPENDIX C - GUIDELINE SITE GRADING SPECIFICATIONS</b>	



## **SCOPE**

**This report presents the results of our Preliminary Geotechnical Investigation for Ellicott Town Center in El Paso County, Colorado. The purpose of our investigation was to evaluate subsurface conditions to assist in planning and development of the site.**


**This report summarizes our opinions regarding the influence of subsurface conditions on site development and their potential impact on construction of residential dwellings. The conclusions and recommendations in this report are based on conditions found in exploratory borings, results of laboratory testing, and our experience. We believe this investigation was performed in general accordance with our proposal dated April 3, 2006 (Proposal No. CS-06-0275).**

**The conclusions and recommendations contained in this report were prepared for the subject development as described in this report. Changes in the proposed use of the property may influence our recommendations and conclusions. We should be contacted if changes are made to evaluate the applicability of our recommendations and conclusions.**

**The following section summarizes the report. More detailed descriptions of our interpretations, conclusions, and recommendations are presented in the report.**

## **SUMMARY**

- 1. We found no geotechnical or geologic conditions that we believe preclude development of this site for construction of a residential subdivision.**
- 2. Subsurface conditions encountered in our exploratory borings generally consisted of slightly silty to clayey sand. Bedrock was not encountered. Samples tested exhibited low measured swell or compression.**
- 3. We believe site grading and utility installation can be accomplished with conventional, heavy-duty earthmoving equipment.**
- 4. Based on the results of our investigation, we expect natural slightly silty to clayey sand will be present near foundation elevations. Spread footing foundations will likely be appropriate. We expect the detached single-family structures will be constructed with full or partial basements. We expect low swell materials will be present at basement level.**

- 
5. The sands and granular fill should provide comparatively good support characteristics for pavements. Where at least 2 feet of sand subgrade is present, full-depth asphalt sections on the order of 4 to 5 inches will likely be appropriate for residential streets. Thicker sections will be appropriate for higher traffic roadway classifications. A subgrade investigation and pavement design should be conducted after overlot grading is complete.
  6. Surface drainage will impact performance of foundations, slabs-on-grade, and pavements. Surface drainage should be designed to provide rapid removal of surface runoff away from structures and off of pavements.

## **SITE CONDITIONS**

The site is located south of Ellicott Highway and about ½ mile west of Log Road in eastern El Paso County, Colorado. Phase 1 includes about 90 acres of residential construction and a channel and detention pond. The majority of the site is currently undeveloped and used for livestock grazing. A storage facility is located near the east portion of the property with frontage on Ellicott Highway. A steel water storage tank is also located along Ellicott Highway. Several underground water and sewer lines have previously been installed on the property. We are not aware of compaction test results available to document the compaction of the trench backfill.

Topography on the site is gently rolling hills, with grades on the order of about 3 to 5 percent. A moderate growth of native grasses cover the site. Figure 1 shows the size, shape, topography, and vicinity of the site.

## **PROPOSED DEVELOPMENT**

We understand the site will be developed for residential construction. Plans prepared by JPS Engineering indicate a total of 245 residential lots. A channel and detention basin will be constructed to the south of the residences. We anticipate the proposed residences will be wood-frame, one or two-story structures with attached garages and basements. Foundation loads are expected to vary between 1,000 and 3,000 pounds per lineal foot of foundation wall. Interior column loads are expected to be 20,000 pounds or less.

The plan provided to us at commencement of our investigation depicted the detention pond farther south than currently planned. Two borings drilled for the detention pond are now outside the area of the currently planned development.

Grading plans provided indicate cuts and fills of less than 10 feet will be required to achieve final grades. The plans indicate a total of about 95,000 cubic yards of earth will be placed during grading.

## **SITE GEOLOGY**

The site lies within the High Plains topographic region adjacent to the Front Range topographic region. Published geologic mapping indicates the site is underlain by eolian sands. The geologic materials are described in greater detail below. Logs of the exploratory borings from our investigation are presented in Appendix A.

### **Eolian Sand**

Areas mapped as eolian sand generally consist of fine to coarse sand and silty to clayey sand. The eolian sands were deposited by wind, and may exhibit land forms of well-defined dunes.

## **SUBSURFACE CONDITIONS**

Subsurface conditions at the site were investigated by drilling fourteen exploratory borings at the approximate locations shown on Fig. 1. Graphical logs of the subsurface conditions found in the borings, results of laboratory tests, and field penetration resistance test results are presented in Appendix A.

The exploratory borings were drilled to depths of 20 to 30 feet using a 4-inch diameter, continuous flight auger and truck-mounted drill rig. Our field representative supervised drilling, logged the conditions encountered, and obtained samples. Samples were returned to our laboratory where they were visually classified and laboratory tests were assigned. Laboratory testing included moisture content, dry density, swell-consolidation testing, gradation analyses, and water-soluble sulfate content. The results



of swell-consolidation tests and gradation analyses are presented graphically in Appendix B. Laboratory test results are shown on the Summary Logs of Exploratory Borings in Appendix A and are also summarized on Table B-I in Appendix B.

Subsurface conditions encountered in the exploratory borings generally consisted of natural slightly silty to clayey sand and minor amounts of sandy clay. Bedrock was not encountered within the depths explored. The following paragraphs discuss the subsurface conditions in more detail.

### Sand

Natural slightly silty to silty or clayey sand was encountered in all fourteen borings extending from the existing ground surface to depths of up to 30 feet. The sands were medium dense to very dense according to field penetration resistance testing. Samples of the sand tested generally exhibited compression or low measured swell when wetted under an applied pressure of 1,000 psf. Samples of the sand tested contained 7 to 35 percent silt and clay-size particles (passing the No. 200 sieve).

### Clay

Sandy clay was encountered in two borings at the site. The clay was very sandy, containing 43 percent sand. The clay was stiff according to field penetration resistance testing.

### Ground Water

Ground water was encountered in borings TH-4 and TH-5, located at the west end of the site at depths of 27 to 28 feet below the existing ground surface at the time of drilling. The borings were backfilled the day of drilling due to cattle on the property. Subsequent measurement of groundwater levels was not possible. Based on the depths, we do not anticipate groundwater will be encountered within excavations for construction. Changes in surface drainage and irrigation of landscaping associated with this development and adjacent developments can result in changes to ground water





levels. Seasonal fluctuations from runoff and precipitation may also result in changes in ground water levels.

## **SITE DEVELOPMENT CONSIDERATIONS**

We did not identify geotechnical conditions we believe will preclude development of the site as planned. The presence of backfill in existing utility trenches on the site with no compaction documentation will need to be considered. Regional geologic conditions that may affect the site include seismicity and the potential for developing radon gas. We believe these conditions can be mitigated with engineering design and construction methods commonly employed in this area. These conditions are discussed in greater detail in the following sections.

### **Existing Utility Trench Backfill**

Underground water and sewer lines are located in several areas of the site. A water line runs in an east-west direction across the central portion of the Phase 1 area. Existing water and sewer lines installed by a previous developer are present in the eastern portion of Phase 1. To our knowledge, compaction test records are not available for placement of the backfill. Where structures and/or roadways are planned over the in-place backfill, the backfill should be removed and recompacted in accordance with the recommendations presented in the later sections of this report. If compaction test records are located, they should be provided for our review.

### **Site Grading**

Based on review of site grading plans, we expect cuts and fills less than 10 feet will be required to achieve final grades. We believe grading can be accomplished using conventional construction techniques and heavy-duty equipment.

We recommend grading plans consider cut and fill slopes no steeper than 3:1 (horizontal to vertical). These slope ratios should be applicable to soil materials where cuts and fills are less than 10 feet in height. These ratios consider that no seepage of ground water occurs.



Prior to grading, all debris and any undocumented existing fill should be removed to expose natural soils. Where roads or structures are planned in areas where existing utility trench backfill is present, the backfill should be removed and replaced as compacted fill. Deleterious debris such as wood or other organic materials should be disposed of off site. Vegetation and organic topsoil should be removed from the ground surface of areas to be filled. We anticipate most stripping will require about 4 to 6-inch cuts or less. Soft or loose soils, if encountered, should be stabilized or removed to firm material prior to placement of fill. Organic soils should be wasted in landscape areas. If insufficient landscape areas are planned, topsoil can be mixed with clean fill soils at a ratio of 15:1 (fill:topsoil) and placed below pavements.

The ground surface in areas to be filled should be scarified, moisture conditioned, and compacted. Granular fill should be moisture conditioned to within 2 percent of optimum and compacted to at least 92 percent of maximum modified Proctor dry density (ASTM D 1557). Clay fill, if it is present, should be moisture conditioned from optimum to 4 percent above optimum and compacted to at least 95 percent of maximum standard Proctor dry density (ASTM D 698). The properties of the fill will affect the performance of foundations, slabs-on-grade, and pavements. Even properly compacted fills are likely to settle about 1 percent of the fill thickness. Placement and compaction of fill should be observed and tested during construction. Guideline Site Grading Specifications are presented in Appendix C.

#### Utility Construction

The overburden soils found in our borings should not present unusually difficult conditions for utility excavations. We believe the materials can be excavated with either heavy-duty trenchers or large trackhoes. Stabilization of the base of excavations may be required where loose soft soils or sands are encountered.

Excavations for utilities should be braced or sloped to maintain stability and meet applicable local, state, and federal safety regulations. Based on the Occupational Safety and Health Administration (OSHA) Standards, we believe most of the soil on this site classify as Type C soils. Type C soils require maximum slope inclination of 1.5:1 (horizontal to vertical). Where ground water seepage occurs, flatter slopes will likely be



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(horizontal to vertical). Where ground water seepage occurs, flatter slopes will likely be required.

The contractor should identify soils and bedrock encountered in trench excavations and refer to OSHA standards to determine appropriate slopes. Excavations deeper than 20 feet should be designed by a Professional Engineer.

Water and sewer lines are usually constructed beneath paved roads. Compaction of trench backfill will have a significant effect on the life and serviceability of pavements. We recommend trench backfill consisting of granular soils be placed in thin, loose lifts, moisture conditioned to within 2 percent of optimum and compacted to at least 92 percent of maximum modified Proctor dry density (ASTM D 1557). Clay fill, if it is present, should be moisture conditioned to within 2 percent of optimum and compacted to at least 95 percent of maximum standard Proctor dry density (ASTM D 698). Personnel of our firm should periodically observe placement and test the density of trench backfill.

#### Underdrain

Ground water levels will likely rise with development and associated landscape irrigation. The use of underdrain systems incorporated with design of sanitary sewer systems and sewer collection systems can provide a positive gravity outfall for residence foundation drains. This can eliminate the need for sump pits in the residences. Details for underdrain designs are shown on Figs. 2 and 3.

For a passive underdrain, the drainpipe should consist of smooth, solid rigid PVC pipe placed at a minimum slope of 0.5 percent. An active underdrain with smooth, perforated or slotted, rigid PVC pipe should be placed for a minimum distance of 10 feet upstream and downstream of the manholes. Concrete check dams should be constructed at the manhole locations to force water flowing through pipe bedding into the underdrain.

If wet conditions or free water are encountered in the sanitary sewer trench, we recommend an active underdrain system with perforated or slotted pipe for these areas. A positive cutoff column (concrete) should be constructed around the sewer pipe and



underdrain pipe immediately downstream of the point the underdrain pipe exits the sewer trench or changes from active to passive. Solid pipe should be used down gradient of this cutoff column to the point of discharge from the pipe. The underdrain should be maintained at least 2 and preferably 3 feet below foundation elevations for buildings connected to the underdrain. The underdrain should be designed to discharge to a gravity outfall. A permanent concrete head wall, vent, and trash rack should be provided at the underdrain discharge point to reduce risk of the drain becoming plugged and to facilitate future location of the discharge point. The discharge point should be above the high water line of any detention/retention ponds and drainage channels, and a back flow preventer valve should be provided at the end of the discharge pipe.

The underdrain pipe should be designed for anticipated flow. A 4-inch diameter pipe sloping at 1 percent will generally provide adequate service for 50 to 75 residences, a 6-inch pipe at 1 percent is usually adequate for 150 residences, an 8-inch pipe up to 300 residences, and a 10-inch pipe, up to about 600 residences. If this underdrain system is planned to connect to up-gradient systems or is an active system in an area of shallow ground water, larger pipe diameters will likely be required. Design of the underdrain system should consider adjacent developments that will connect to this system.

#### **Channel and Detention Pond**

A channel and detention pond are planned to the south of the residential construction. Two borings were drilled roughly within the area of the detention pond. The soils consist of slightly silty and clayey sand. These soils are expected to be relatively permeable. A clay or impervious liner may be installed if a reduction in the rate of infiltration of impounded water into the ground is desired.

#### **Pavements**

Based on our understanding of the proposed construction and the findings of our study, subgrade soils will likely consist of slightly silty and clayey sand. These materials should provide relatively good subgrade support characteristics. Where at least 2 feet of sand is present below pavements, we anticipate full-depth asphaltic concrete pavement sections on the order of 4 to 5 inches will be appropriate for residential streets. Thicker

sections will be appropriate for higher traffic roadway classifications. A subgrade investigation and pavement design should be performed after overlot grading is complete.

### **Seismicity**

This area like most of southern Colorado is subject to a degree of seismic activity. It is our understanding The Pikes Peak regional Building Department has adopted the 2003 International Residential Code (IRC) for single and two-family dwellings. The site classifies as Seismic Design Category C according to the IRC.

### **Radon Mitigation**

Passive and active radon mitigation procedures are commonly employed in this region to effectively reduce the buildup of radon gas. Passive mitigation includes placement of a gravel layer below basement or crawl space floors that are connected to the standard foundation drain. A ventilation riser pipe is also connected to the foundation drainpipe. Active measures that can be taken after building construction include installing a blower on the ventilation riser pipe, and sealing the joints and cracks in concrete floors and foundation walls. Many variables influence whether or not high levels of radon develop. Radon levels are generally higher in below grade areas like basements. If the occurrence of radon is a concern, we believe buildings should be tested after they are constructed and "closed in" to get a more accurate determination of the levels.

## **RESIDENTIAL CONSTRUCTION CONSIDERATIONS**

The property is planned for residential construction. Below are preliminary opinions regarding foundations, floor systems, basements, and surface drainage for the anticipated construction. The following discussions are preliminary and are not intended for design or construction. After grading is complete, design-level investigations should be performed on a lot-by-lot basis.



## **Foundations**

Based on data from our exploratory borings, we expect soils with low measured swell will be present near foundation elevations for this site. Spread footing foundations will likely be appropriate.

## **Slab-on-Grade and Basement Floor Construction**

Based on our exploratory borings and laboratory test results, we believe the lots will be rated as low swell potential. Structural floor systems (crawl space) should be anticipated in all non-basement finished living areas. Slab-on-grade floors for unfinished basement areas will be appropriate for lots rated as low swell potential. Swell potential should be more thoroughly defined during design-level soils and foundation investigations after site grading is complete.

## **Basements**

Surface water can penetrate relatively permeable loose backfill soils located adjacent to residences and collect at the bottom of relatively impermeable excavations causing wet or moist basement and crawl space conditions. Foundation drains should be anticipated around all basement areas. We suggest foundation drains be connected to the sewer underdrain system if constructed. They may also discharge to sumps where water can be removed by pumping. Basement walls should be designed to withstand lateral earth pressures. The design pressure should be established during design-level soils investigations.

## **Surface Drainage**

The performance of this development will be influenced by surface drainage. When developing an overall drainage scheme, consideration should be given to drainage around each structure. Drainage should be planned such that surface runoff is directed away from foundations and is not allowed to pond adjacent to or between structures or over pavements. Minimum slopes of 5 percent should be maintained away from residences. Roof downspouts and other water collection systems should discharge well



beyond the structures. Proper control of surface runoff is also important to prevent the erosion of surface soils. Sheet flow should not be directed over unprotected slopes. Water should not be allowed to pond at the crest of slopes. Permanent overlot slopes should be seeded or mulched to reduce the potential for erosion. Backfill soils behind the curb and gutter adjacent to streets and in utility trenches within individual lots should be compacted. If surface drainage between preliminary development and construction phases is neglected, performance of pavements, flatwork, and foundations may be poor.

### **Concrete**

We measured water-soluble sulfate concentrations in three samples from this site. Measured concentrations were between 0.002 and 0.006 percent. Sulfate concentrations less than 0.1 percent indicate Class 0 exposure to sulfate attack for concrete that comes into contact with the subsoils, according to ACI 201.2R-01 as published in the 2005 ACI Manual of Concrete Practice. For this level of sulfate concentration, the American Concrete Institute (ACI) indicates Type I cement can be used for concrete that comes into contact with the subsoils. In our experience, superficial damage may occur to the exposed surfaces of highly permeable concrete, even though sulfate levels are relatively low. To control this risk and to resist freeze-thaw deterioration, the water-to-cementitious material ratio should not exceed 0.50 for concrete in contact with soils that are likely to stay moist due to surface drainage or high water tables. Concrete should be air entrained.

### **RECOMMENDED FUTURE INVESTIGATIONS**

We recommend the following future investigations for the site:

1. **Site-specific, design-level Soils and Foundation Investigation to provide design criteria for foundations and floor systems for proposed residential buildings.**
2. **Subgrade investigation and pavement design after grading.**
3. **Construction testing and observation during site development and residential building construction.**





## **LIMITATIONS**

Our borings were spaced to obtain preliminary subsurface information to aid in planning and development of this site. Variations between the borings should be anticipated. Personnel of our firm should be present during site grading to observe grading operations and perform compaction tests on fills. Further site-specific investigations for design of foundations, slabs-on-grade, and pavements should be performed after overlot grading has been completed.

We believe this investigation was conducted in a manner consistent with the level of care and skill ordinarily used by geotechnical engineers practicing in this area at this time. No warranty, express or implied, is made.

If we can be of further service in discussing the contents of this report or analyses of the influence of subsurface conditions on the design and construction of the proposed development, please call.

**CTL | THOMPSON, INC.**

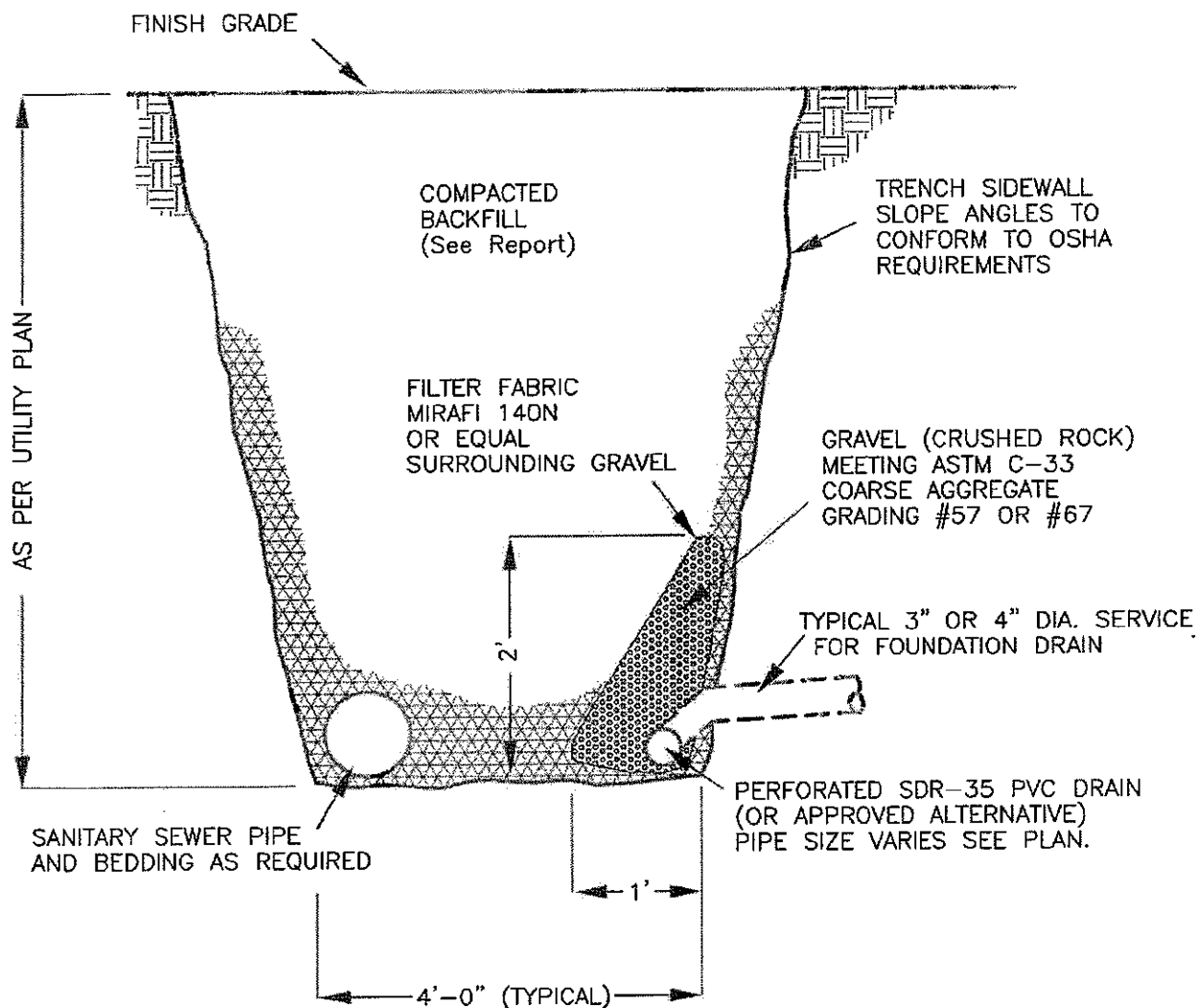
**Debbie A. Carroll, P.G.  
Engineering Geologist**

**Reviewed by:**

**Michael N. Lemons, P.E.  
Associate Engineer**

**DAC:MNL:slb  
(4 copies sent)**



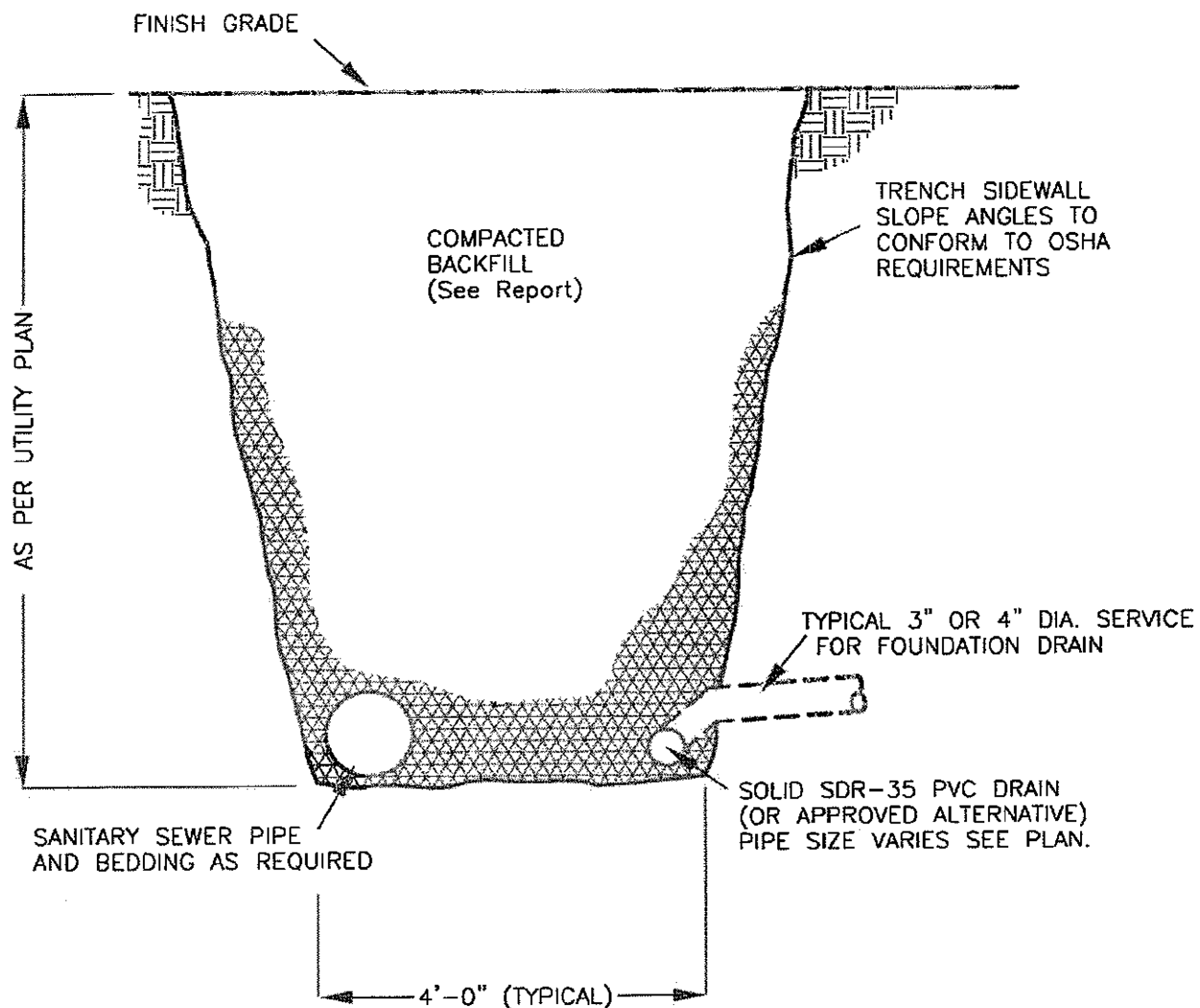


Grading Requirements for Coarse Aggregates per ASTM C-33								
Size Number	Nominal Size (Sieves with Square Openings)	Amounts Finer than Each Laboratory Sieve (Square Openings), Weight Percent						
		1 1/2 in. (37.5 mm)	1 in. (25.0 mm)	3/4 in. (19.0 mm)	1/2 in. (12.5 mm)	3/8 in. (9.5 mm)	No. 4 (4.5 mm)	No. 8 (2.36 mm)
67	3/4 in. to No. 4 (19.0 to 4.75 mm)	--	100	90 to 100	--	20 to 55	0 to 10	0 to 5
57	1 in. to No. 4 (25.0 to 9.5 mm)	100	95 to 100	--	25 to 60	--	0 to 10	0 to 5

NOTE:  
TO BE USED IN CASES WHERE GROUND WATER IS  
FOUND DURING TRENCHING OR WHERE SHALLOW  
GROUND WATER IS KNOWN TO EXIST.

## Active Drain Beside Sewer

FIG. 2

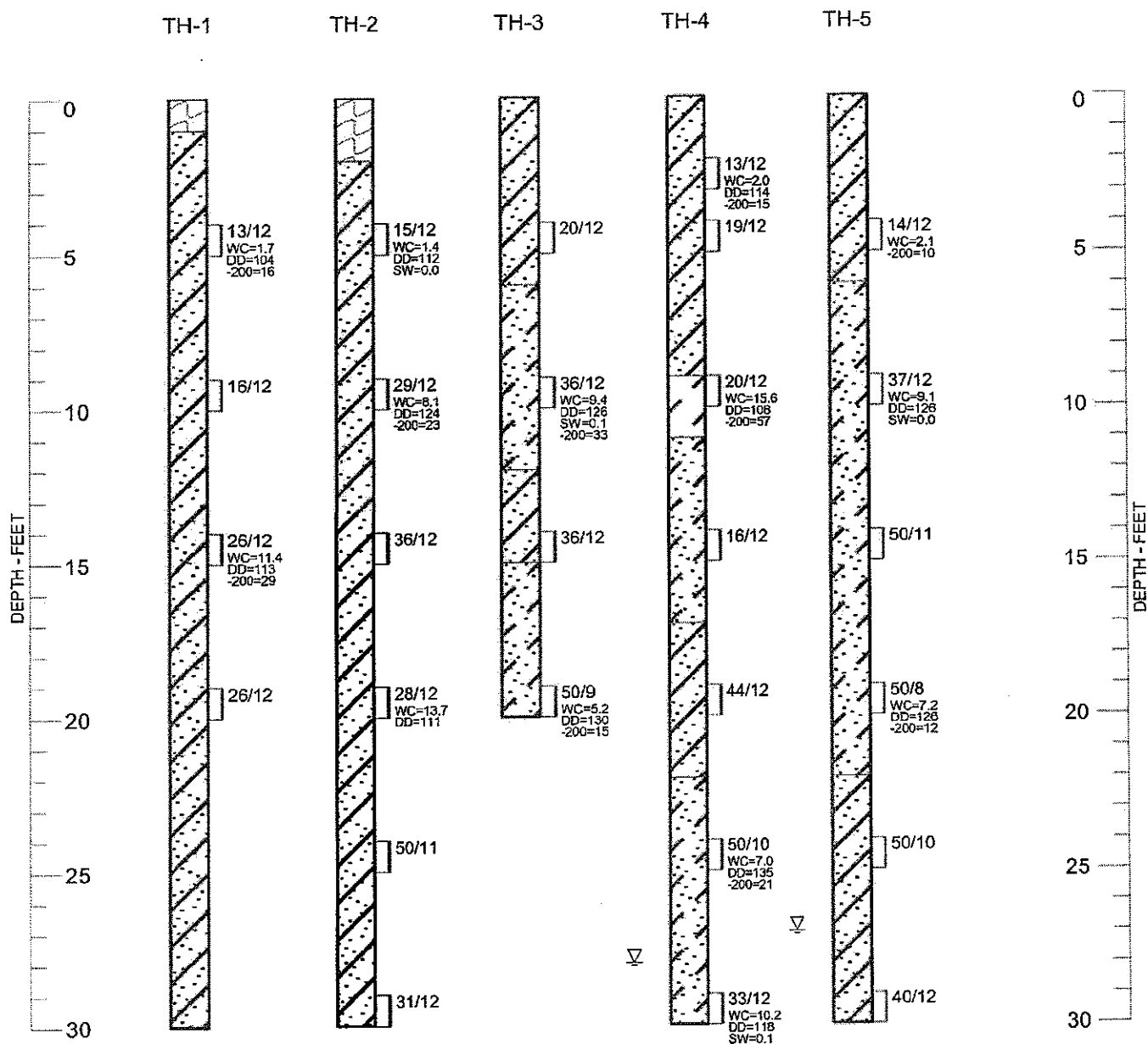


NOTE:  
TO BE USED IN CASES WHERE NO  
SHALLOW GROUND WATER IS KNOWN TO EXIST.

## Passive Drain Beside Sewer

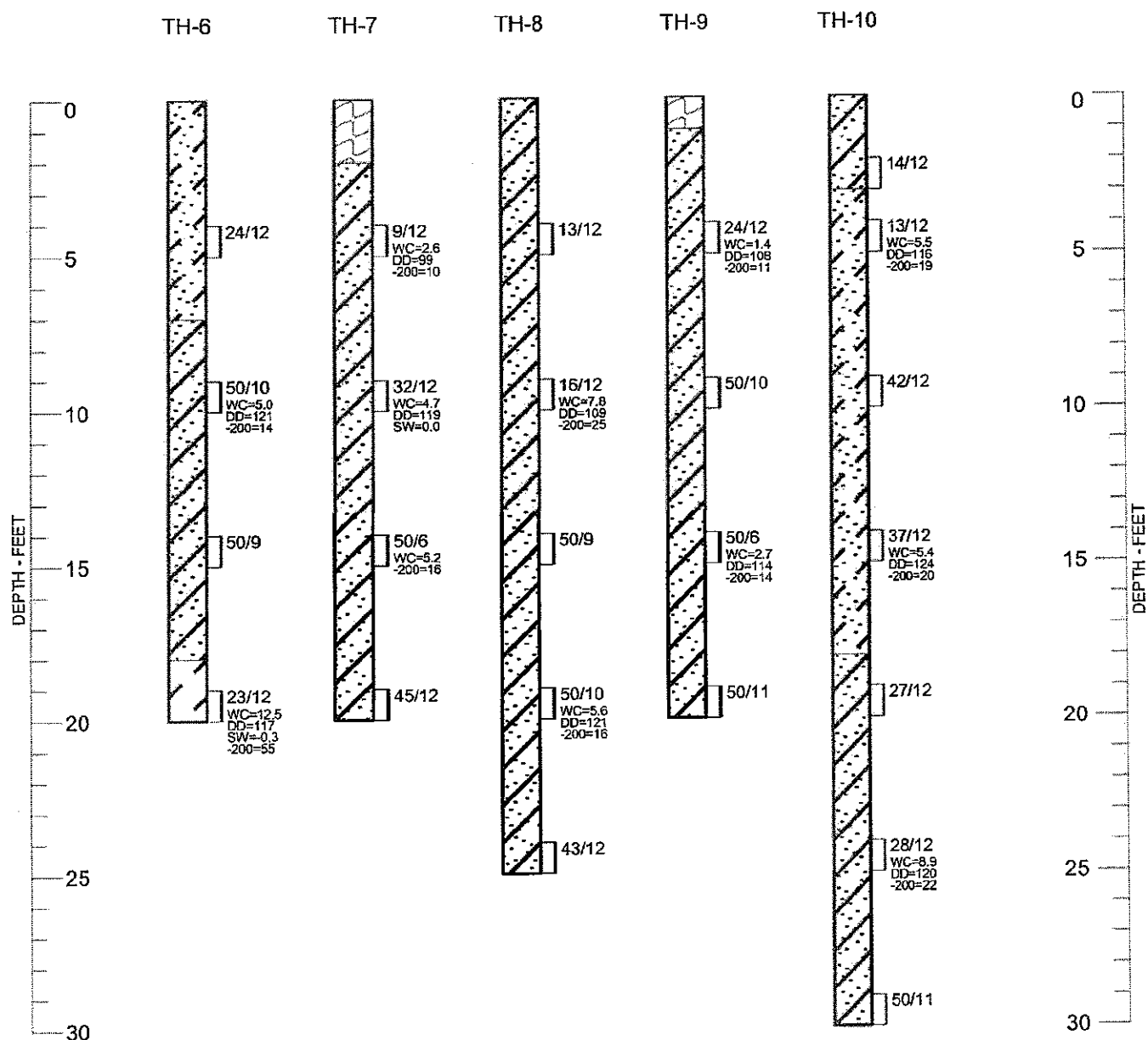


**APPENDIX A**  
**SUMMARY LOGS OF EXPLORATORY BORINGS**



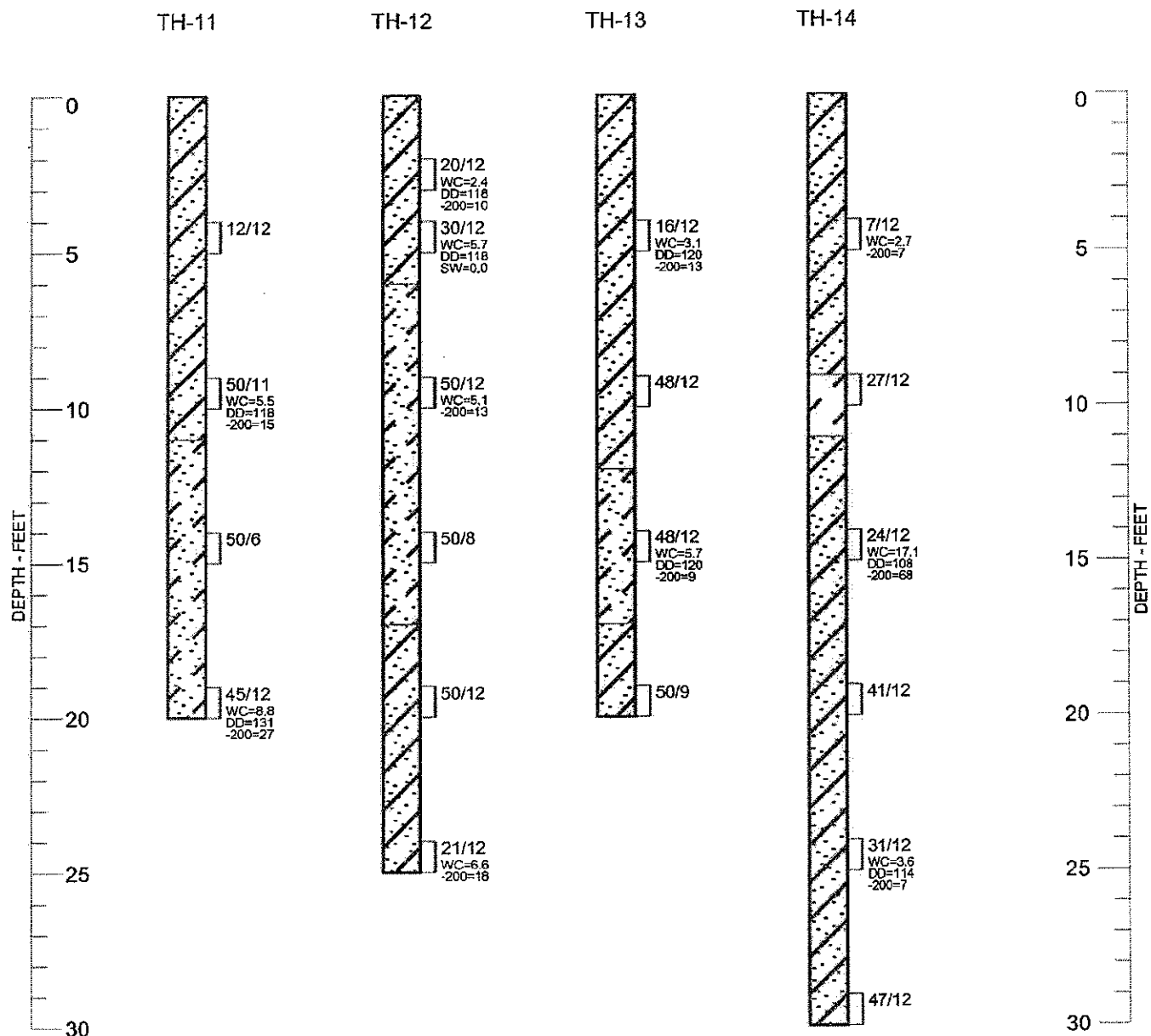
Summary Logs of  
Exploratory  
Borings

FIG. A-1



## FIG. A-2

UEP IH 30 F 1 16091-115.GPJ CILMAIN.GDI / 17206



**Summary Logs of  
Exploratory  
Borings**

FIG. A-3

ACCRETIVE INVESTMENTS  
ELLCOT TOWN CENTER, FILING NO. 1  
PROJECT NO. CS16091-115



**LEGEND:**



TOPSOIL.



SAND, SLIGHTLY SILTY TO SILTY, MEDIUM DENSE TO VERY DENSE, DRY TO MOIST, LIGHT BROWN TO MEDIUM BROWN(SP-SM, SM).



SAND, SLIGHTLY CLAYEY TO CLAYEY, MEDIUM DENSE TO DENSE, MOIST, MEDIUM BROWN(SP-SC, SC).



CLAY, SANDY, STIFF, MOIST, MEDIUM BROWN(CL).



DRIVE SAMPLE. THE SYMBOL 13/12 INDICATES 13 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.



WATER LEVEL MEASURED AT TIME OF DRILLING.

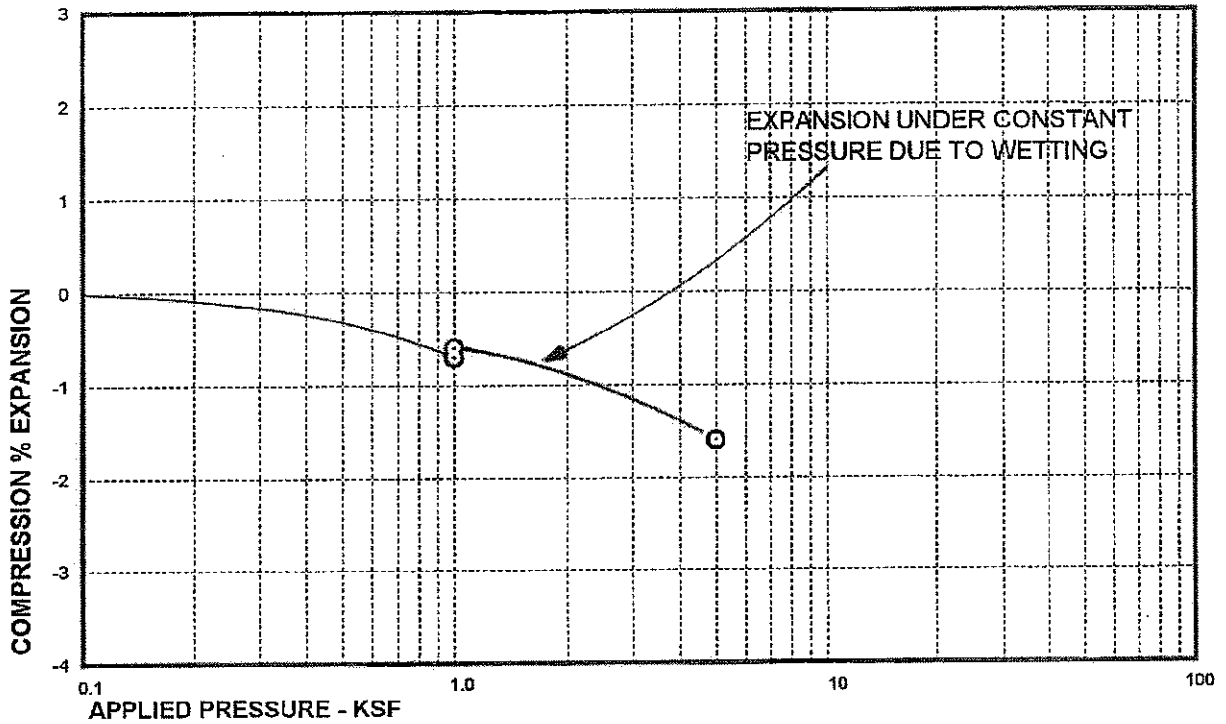
**NOTES:**

1. THE BORINGS WERE DRILLED MAY 25 AND 26, 2006 USING A 4-INCH DIAMETER CONTINUOUS FLIGHT AUGER AND A TRUCK MOUNTED DRILL RIG.
2. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS AND CONCLUSIONS CONTAINED IN THIS REPORT.
3. WC - INDICATES MOISTURE CONTENT (%).  
DD - INDICATES DRY DENSITY (PCF).  
SW - INDICATES SWELL WHEN WETTED UNDER 1 KSF LOAD (%).  
-200 - INDICATES PASSING NO. 200 SIEVE (%).  
SS - INDICATES SOLUBLE SULFATE CONTENT (%).

**Summary Logs of  
Exploratory  
Borings**

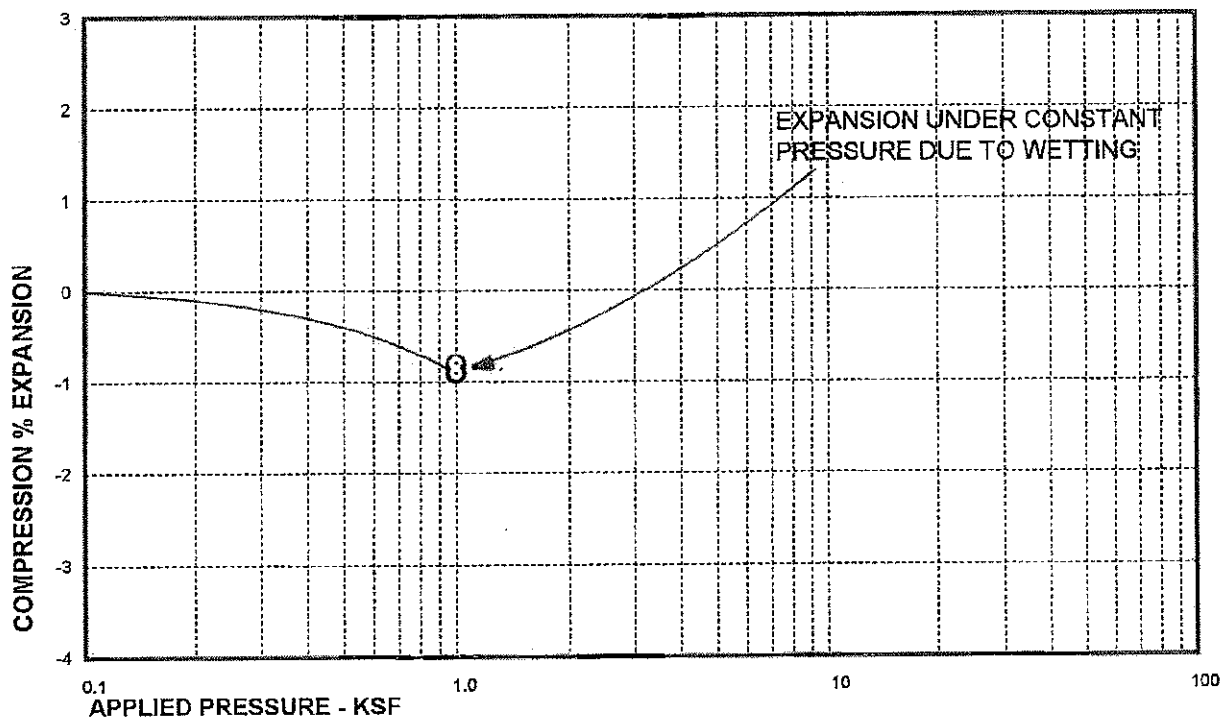


**APPENDIX B**  
**LABORATORY TEST RESULTS**



Sample of SAND, CLAYEY (SC)  
From TH-3 AT 9 FEET

DRY UNIT WEIGHT= 126 PCF  
MOISTURE CONTENT= 9.4 %



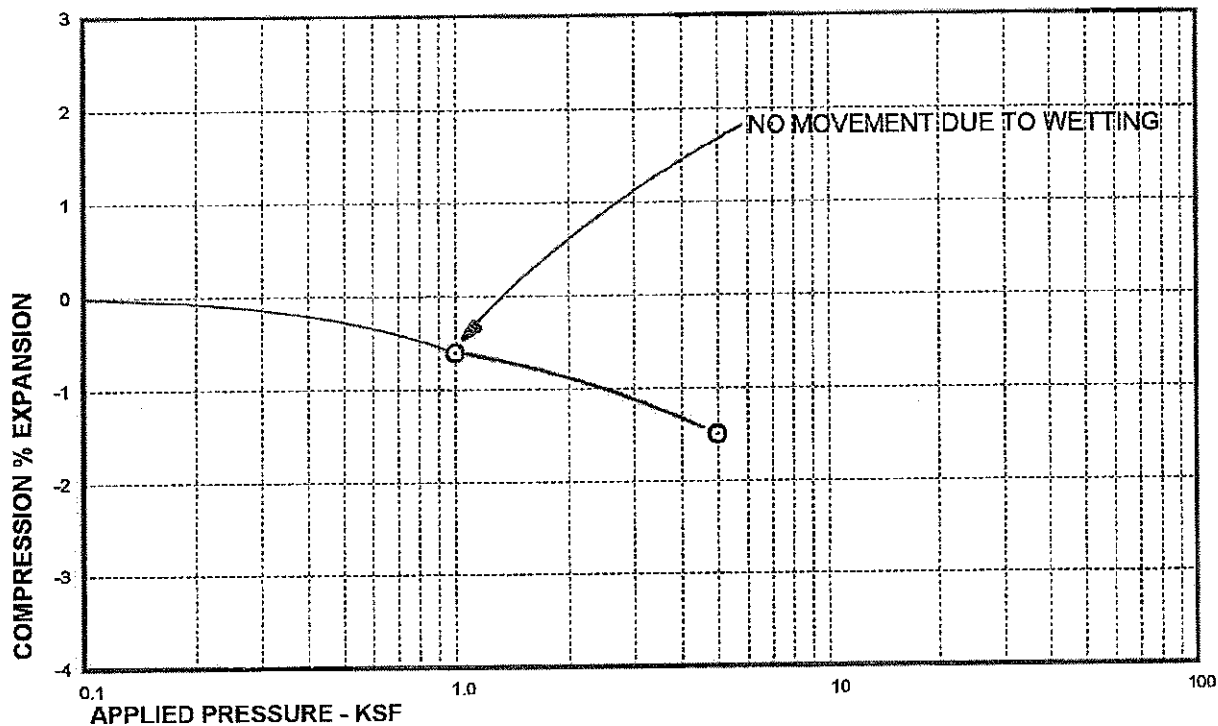
Sample of SAND, CLAYEY (SC)  
From TH-4 AT 29 FEET

DRY UNIT WEIGHT= 118 PCF  
MOISTURE CONTENT= 10.2 %

ACCRETIVE INVESTMENTS  
ELLCOT TOWN CENTER, FILING NO. 1  
PROJECT NO. CS16091-115

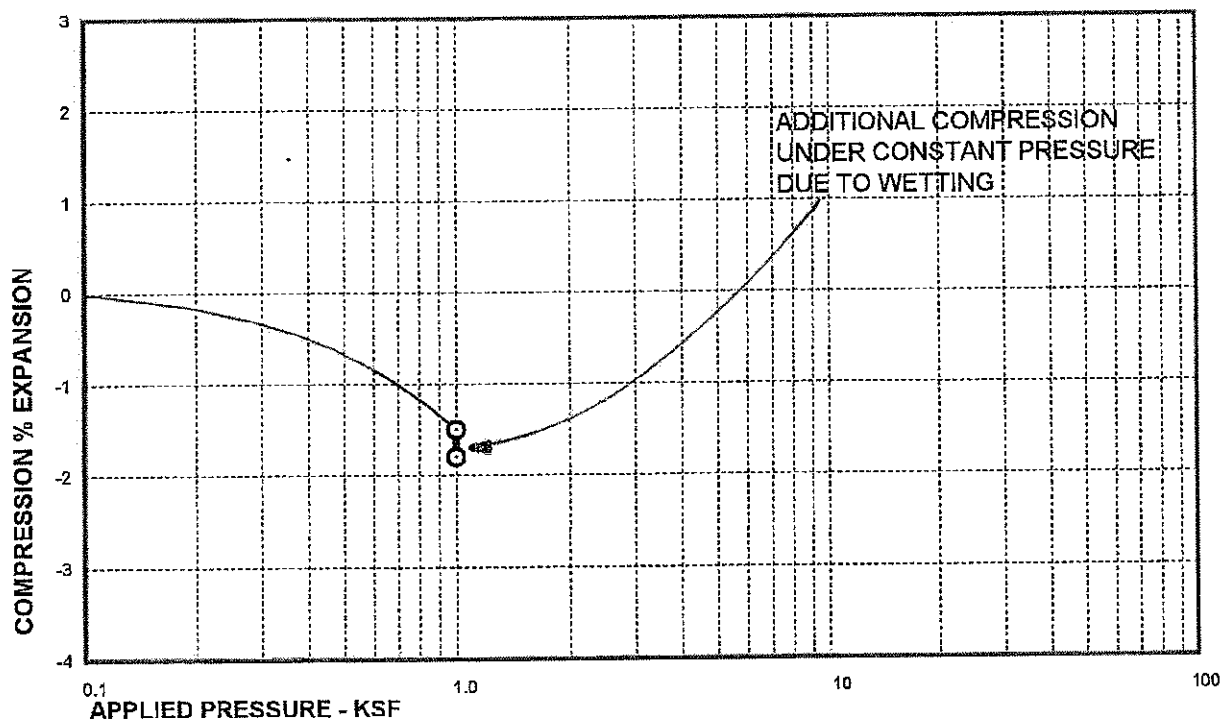
## Swell Consolidation Test Results

FIG. B-1



Sample of SAND, CLAYEY (SC)  
From TH-5 AT 9 FEET

DRY UNIT WEIGHT= 126 PCF  
MOISTURE CONTENT= 9.1 %



Sample of CLAY, SANDY (CL)  
From TH-6 AT 19 FEET

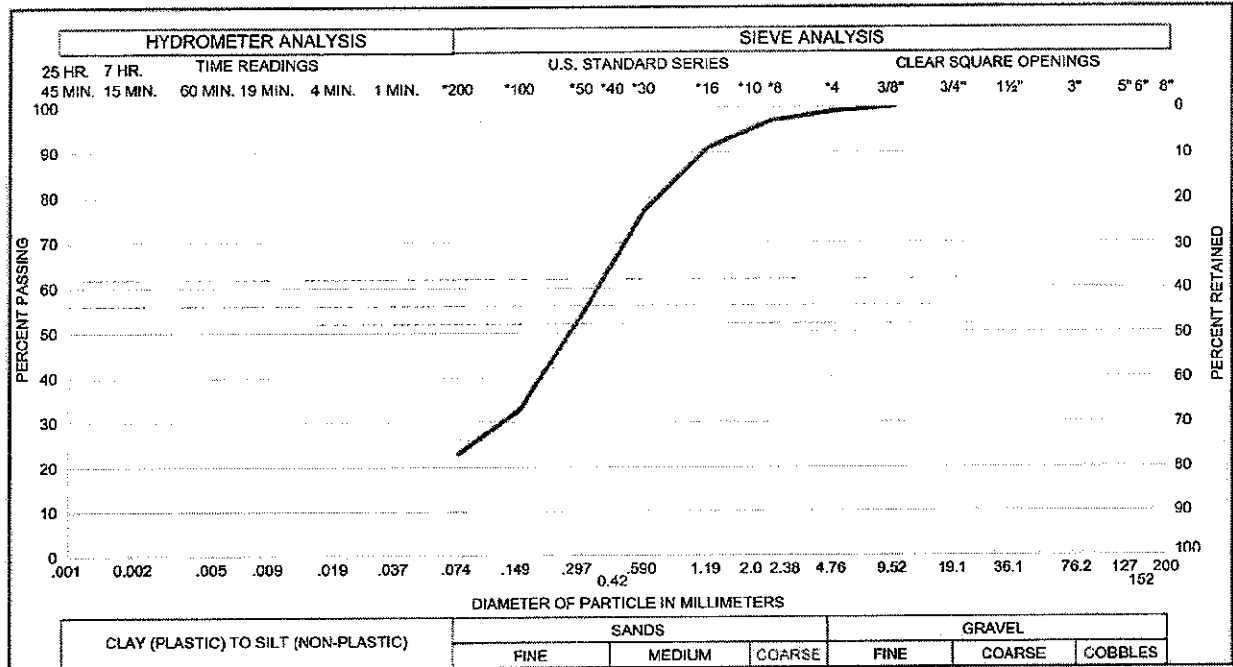
DRY UNIT WEIGHT= 117 PCF  
MOISTURE CONTENT= 12.5 %

ACCRETIVE INVESTMENTS  
ELLCOT TOWN CENTER, FILING NO. 1  
PROJECT NO. CS16091-115

## Swell Consolidation Test Results

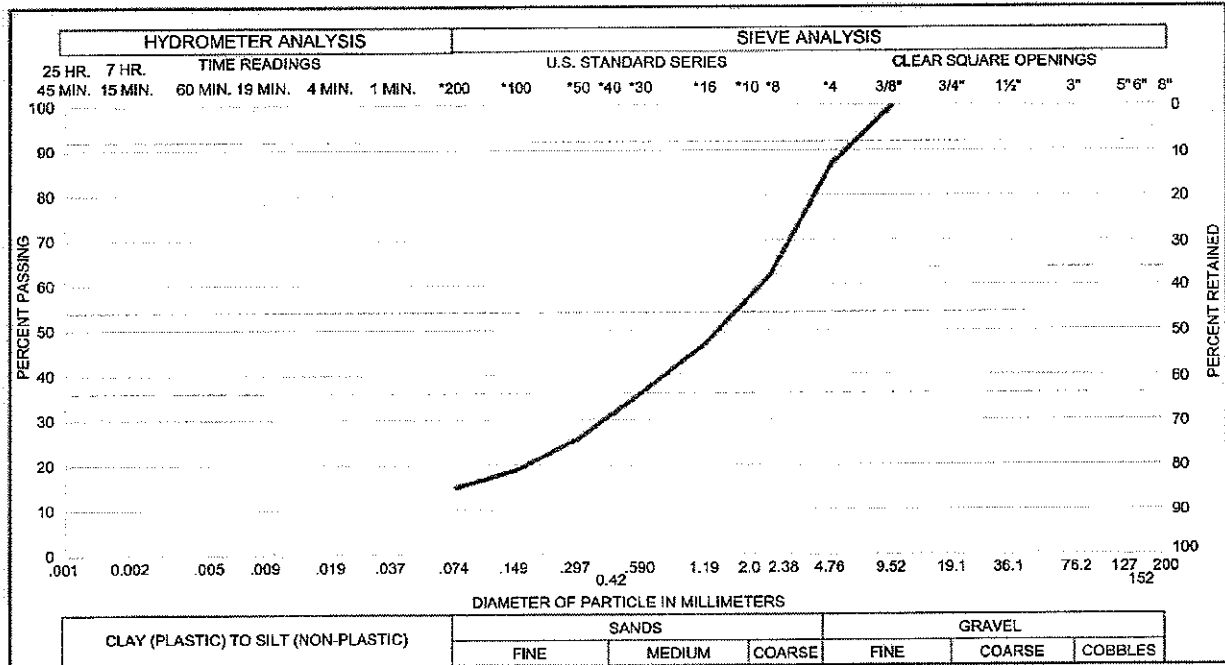
FIG. B-2

[S:\CS\16000-16499\CS16091.000\115\2.REPORTS\16091-115 GRAD]



Sample of SAND, SILTY (SM)  
From TH - 2 AT 9 FEET

GRAVEL 1 % SAND 76 %  
SILT & CLAY 23 % LIQUID LIMIT - %  
PLASTICITY INDEX - %



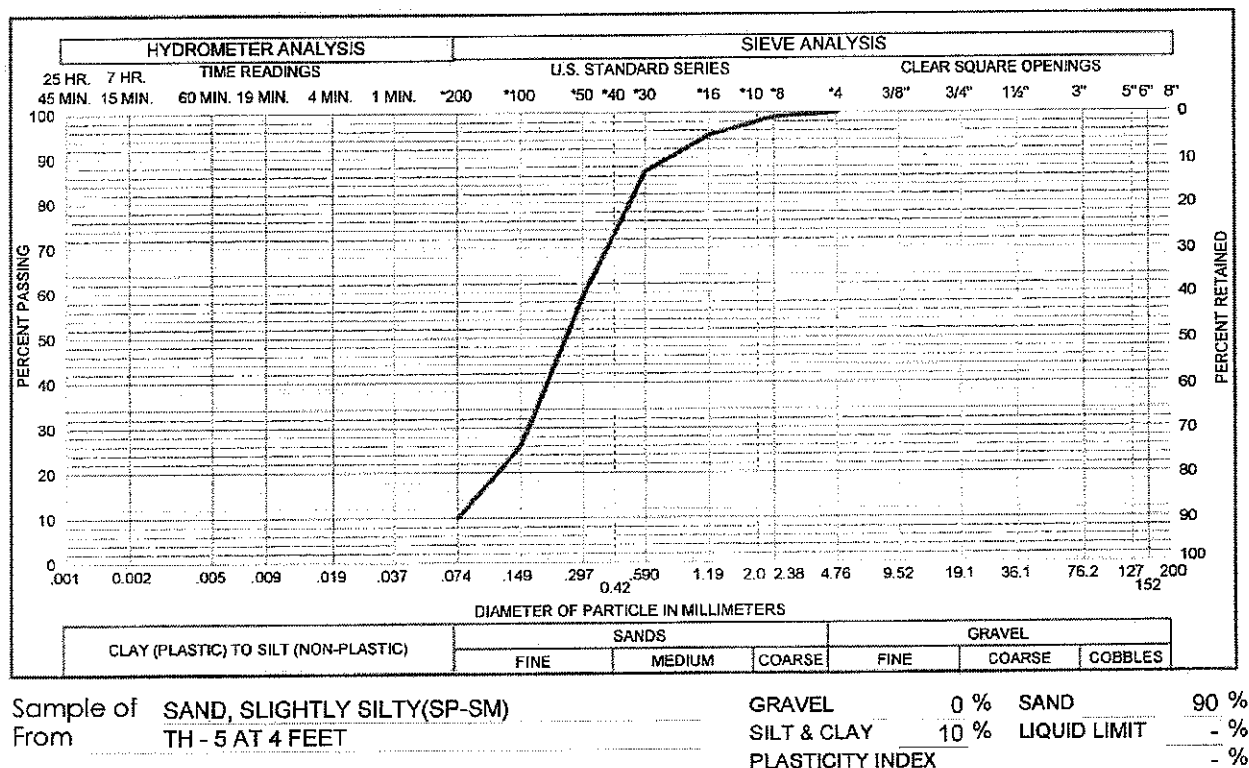
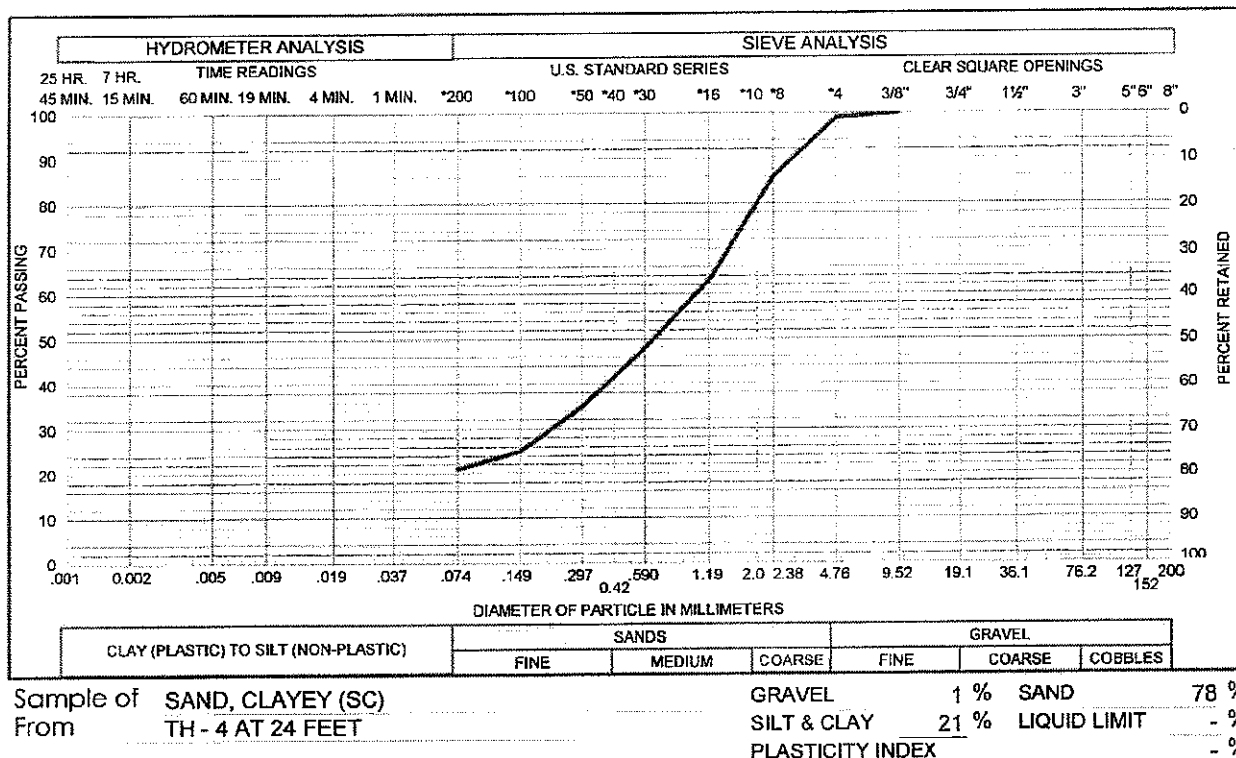
Sample of SAND, CLAYEY (SC)  
From TH - 3 AT 19 FEET

GRAVEL 13 % SAND 72 %  
SILT & CLAY 15 % LIQUID LIMIT - %  
PLASTICITY INDEX - %

ACCREDITIVE INVESTMENTS  
ELLCOT TOWN CENTER, FILING NO. 1  
PROJECT NO. CS16091-115

## Gradation Test Results

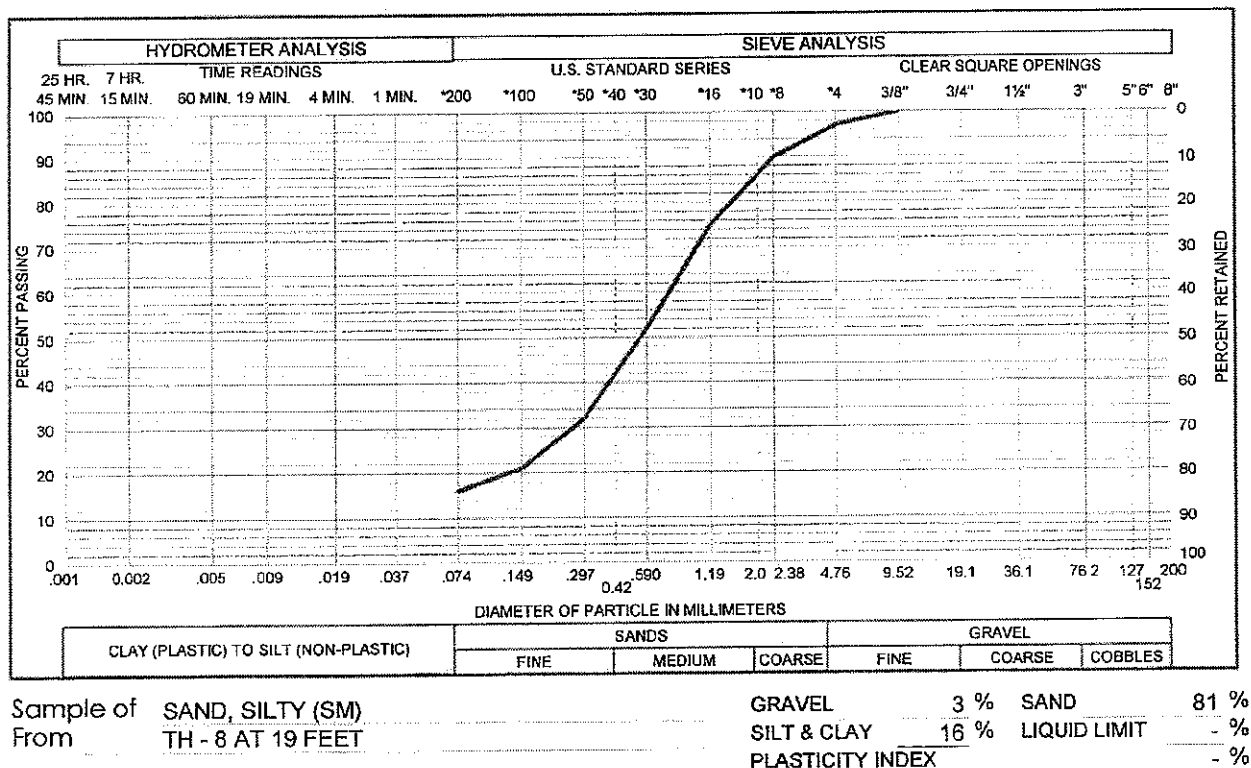
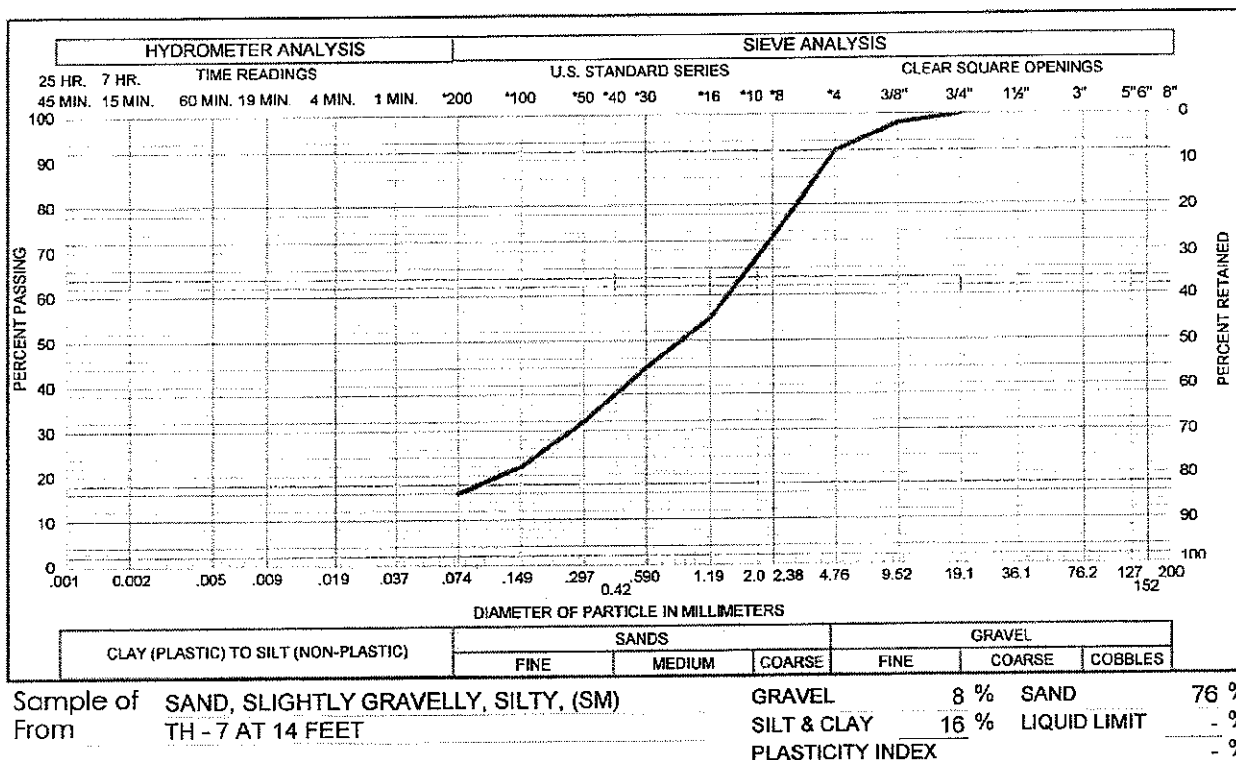
FIG. B-3



ACCRETIVE INVESTMENTS  
ELLICOT TOWN CENTER, FILING NO. 1  
PROJECT NO. CS16091-115

## Gradation Test Results

FIG. B-4



ACCRETIVE INVESTMENTS  
ELLCOT TOWN CENTER, FILING NO. 1  
PROJECT NO. CS16091-115

## Gradation Test Results

FIG. B-5

[S:\CS16000-16499\CS16091.000\1152.REPORTS\16091-115\_GRAD]

TABLE B-I

SUMMARY OF LABORATORY TESTING  
PROJECT NO. CS16091-115

BORING	DEPTH (FEET)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS			SWELL TEST RESULTS*		PASSING NO. 200 SIEVE (%)	SOLUBLE SULFATES (%)	DESCRIPTION
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SWELL (%)	SWELL PRESSURE (PSF)				
TH-1	4	1.7	104						16		SAND, SILTY (SM)
	14	11.4	113						29		SAND, SILTY (SM)
TH-2	4	1.4	112							0.006	SAND, SILTY (SM)
	9	8.1	124						23		SAND, SILTY (SM)
TH-3	19	13.7	111								SAND, SILTY (SM)
	9	9.4	126			0.1			33		SAND, CLAYEY (SC)
TH-4	19	5.2	130						15		SAND, CLAYEY (SC)
	2	2.0	114						15		SAND, SILTY (SM)
	9	15.6	108						57		CLAY, SANDY (CL)
	24	7.0	135						21		SAND, CLAYEY (SC)
	29	10.2	118			0.1					SAND, CLAYEY (SC)
	4	2.1							10		SAND, SLIGHTLY SILTY (SP-SM)
TH-5	9	9.1	126			0.0					SAND, CLAYEY (SC)
	19	7.2	126						12		SAND, SLIGHTLY CLAYEY (SP-SC)
TH-6	9	5.0	121						14		SAND, SILTY (SM)
	19	12.5	117			-0.3			55		CLAY, SANDY (CL)
TH-7	4	2.6	99						10		SAND, SLIGHTLY SILTY (SP-SM)
	9	4.7	119							0.002	SAND, SILTY (SM)
	14	5.2							16		SAND, SILTY (SM)
	9	7.8	109						25		SAND, SILTY (SM)
TH-8	19	5.6	121						16		SAND, SILTY (SM)
	4	1.4	108						11		SAND, SLIGHTLY SILTY (SP-SM)
TH-9	14	2.7	114						14		SAND, SILTY (SM)
	4	5.5	116						19		SAND, SILTY (SM)
TH-10	14	5.4	124						20		SAND, CLAYEY (SC)
	24	8.9	120						22		SAND, SILTY (SM)
TH-11	9	5.5	118						15		SAND, SILTY (SM)
	19	8.8	131						27		SAND, CLAYEY (SC)
TH-12	2	2.4	118						10		SAND, SLIGHTLY SILTY (SP-SM)
	4	5.7	118							0.002	SAND, SILTY (SM)
	9	5.1							13		SAND, CLAYEY (SC)
	24	6.6							18		SAND, SILTY (SM)
TH-13	4	3.1	120						13		SAND, SILTY (SM)

\* SWELL MEASURED WITH 1000 PSF APPLIED PRESSURE. NEGATIVE VALUE INDICATES COMPRESSION.



**SUMMARY OF LABORATORY TESTING**  
**PROJECT NO. CS16091-115**

\* SWELL MEASURED WITH 1000 PSF APPLIED PRESSURE. NEGATIVE VALUE INDICATES COMPRESSION.



## **APPENDIX C**

### **GUIDELINE SITE GRADING SPECIFICATIONS ELLICOTT TOWN CENTER EL PASO COUNTY, COLORADO PROJECT NO. CS16091-115**



**GUIDELINE SITE GRADING SPECIFICATIONS  
EL LICOTT TOWN CENTER  
EL PASO COUNTY, COLORADO**

**1. DESCRIPTION**

This item shall consist of the excavation, transportation, placement and compaction of materials from locations indicated on the plans, or staked by the engineer, as necessary to achieve preliminary pavement and building pad elevations. These specifications shall also apply to compaction of materials that may be placed outside of the project.

**2. GENERAL**

The soils engineer shall be the owner's representative. The soils engineer shall approve fill materials, method of placement, moisture contents and percent compaction, and shall give written approval of the completed fill.

**3. CLEARING JOB SITE**

The contractor shall remove all trees, brush and rubbish before excavation or fill placement is begun. The contractor shall dispose of the cleared material to provide the owner with a clean, neat appearing job site. Cleared material shall not be placed in areas to receive fill or where the material will support structures of any kind.

**4. SCARIFYING AREA TO BE FILLED**

All topsoil and vegetable matter shall be removed from the ground surface upon which fill is to be placed. The surface shall then be plowed or scarified until the surface is free from ruts, hummocks or other uneven features that would prevent uniform compaction by the equipment to be used.

**5. PLACEMENT OF FILL ON NATURAL SLOPES**

Where natural slopes are steeper than 20 percent in grade and the placement of fill is required, cut benches shall be provided at the rate of one bench for each 5 feet in height (minimum of two benches). Benches shall be at least 10 feet in width. The engineer may require larger bench widths. Fill shall be placed on completed benches as outlined within this specification.

**6. COMPACTING AREA TO BE FILLED**

After the foundation for the fill has been cleared and scarified, it shall be disced or bladed until it is free from large clods, brought to a workable moisture content and compacted to not less than 95 percent of maximum dry density as determined in accordance with ASTM D 698 for clay soils and 92 percent of maximum dry density as determined in accordance with ASTM D 1557 for granular soils. Cohesive materials shall be moisture conditioned to within 1 to 4 percent above optimum moisture content. Non-cohesive materials shall be moisture conditioned to within 2 percent of optimum moisture content.



## **7. FILL MATERIALS**

Fill soils shall be free from vegetable matter or other deleterious substances and shall not contain rocks or lumps having a diameter greater than six (6) inches. Fill materials shall be obtained from cut areas shown on the plans or staked in the field by the engineer or imported to the site.

## **8. MOISTURE CONTENT**

For fill material classifying as CH, CL, or SC, the fill shall be moisture treated to between 1 and 4 percent above optimum moisture content if it is to be placed within 10 feet of the final grade. For deep claystone/clay fill (greater than 15 feet below final grade) it shall be moisture conditioned to within 2 percent of optimum. Non-expansive soils classifying as SM, SW, SP, GP, GC, and GM shall be moisture treated to within 2 percent of optimum moisture content as determined from Proctor compaction tests. Sufficient laboratory compaction tests shall be made to determine the optimum moisture content for the various soils encountered in borrow areas.

The contractor may be required to add moisture to the excavation materials in the borrow area if, in the opinion of the soils engineer, it is not possible to obtain uniform moisture content by adding water on the fill surface. The contractor may be required to rake or disc the fill soils to provide uniform moisture content throughout the soils.

The application of water to embankment materials shall be made with any type of watering equipment approved by the soils engineer, which will give the desired results. Waterjets from the spreader shall not be directed at the embankment with such force that fill materials are washed out.

Should too much water be added to any part of the fill, such that the material is too wet to permit the desired compaction to be obtained, all work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. The contractor will be permitted to rework wet material in an approved manner to hasten its drying.

## **9. COMPACTION OF FILL AREAS**

Selected fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted to not less than the specified percentage of maximum density. Clay fill placed less than 15 feet below final grade shall be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D 698. Granular fill placed less than 15 feet below final grade shall be compacted to at least 92 percent of maximum dry density as determined in accordance with ASTM D 1557. For deep fill (to be placed 15 feet or deeper below final grade), cohesive materials shall be compacted to at least 98 percent of standard Proctor maximum dry density (ASTM D 698) and granular materials shall be compacted to at least 95 percent of modified Proctor maximum dry density (ASTM D 1557). Deep fills shall be placed within 2 percent of optimum moisture content. Fill materials shall be placed such that the thickness of loose materials does not exceed 10 inches and the compacted lift thickness does not exceed 6 inches.



Compaction, as specified above, shall be obtained by the use of sheepfoot rollers, multiple-wheel pneumatic-tired rollers, or other equipment approved by the soils engineer for claystone and soils classifying as CL, CH, or SC. Granular fill shall be compacted using vibratory equipment or other equipment approved by the soils engineer. Compaction shall be accomplished while the fill material is at the specified moisture content. Compaction of each layer shall be continuous over the entire area. Compaction equipment shall make sufficient trips to insure that the required density is obtained.

#### **10. COMPACTION OF SLOPES**

Fill slopes shall be compacted by means of sheepfoot rollers or other suitable equipment. Compaction operations shall be continued until slopes are stable, but not too dense for planting, and there is no appreciable amount of loose soil on the slopes. Compaction of slopes may be done progressively in increments of three to five feet (3' to 5') in height or after the fill is brought to its total height. Permanent fill slopes shall not exceed 3:1 (horizontal to vertical).

#### **11. DENSITY TEST**

Field density tests shall be made by the soils engineer at locations and depths of his choosing. Where sheepfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests shall be taken in compacted material below the disturbed surface. When density tests indicate the density or moisture content of any layer of fill or portion thereof is below that required, the particular layer or portion shall be reworked until the required density or moisture content has been achieved.

#### **12. SEASONAL LIMITS**

No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the soils engineer indicates the moisture content and density of previously placed materials are as specified.

#### **13. NOTICE REGARDING START OF GRADING**

The contractor shall submit notification to the soils engineer and owner advising them of the start of grading operations at least three days in advance of the starting date. Notification shall also be submitted at least three days in advance of any resumption dates when grading operations have been stopped for any reason other than adverse weather conditions.

#### **14. REPORTING OF FIELD DENSITY TESTS**

Density tests made by the soils engineer, as specified under Density Tests above, shall be submitted progressively to the owner. Dry density, moisture content and percent compaction shall be reported for each test taken.