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ATL, Inc.

CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

RITTENHOUSE CHANNEL PHASE II
MCFCD CONTRACT NO. 92-13
ATL JOB NO. 192023-1

ATL Job No. 192023-1 *March 15, 1994*

REPORT OF

GEOTECHNICAL INVESTIGATION

FOR

GANNETT FLEMING, INC.

RITTENHOUSE CHANNEL PHASE II
MCFCD CONTRACT NO. 92-13
ATL JOB NO. 192023-1

Corporate
Review By:

Frank C. Rivera
President

Registered Professional Engineer (Civil)
CERTIFICATE NO.
23577
JAMES D.
ROSE
Date Signed 3-17-94

ATL, Inc.
Construction Quality Control
Geotechnical Consultation

March 15, 1994

Gannett Fleming, Inc.
3001 East Camelback Road Suite 130
Phoenix, AZ 85016-4498

Attn: Mr. Ronald Schreier, P.E.

Re: Rittenhouse Channel Phase II
MCFCD Contract No. 92-13
ATL Job No. 192023-1

Gentlemen:

This report presents the results of the field exploration, laboratory tests, and engineering analysis for the Rittenhouse Channel Phase II. This report also incorporates the work performed in Phase I of this project in 1993. ATL's work was done in accordance with ATL's Proposal P92255 dated August 11, 1992.

ATL has appreciated the opportunity to be of service to you on this project and looks forward to a continued association on future projects. Should any questions arise, please do not hesitate to contact us at your earliest convenience.

Reviewed by:

David P. Hayes, P.E.
Executive Vice President

Very truly yours,

Registered Professional Engineer (Civil)
CERTIFICATE NO. 23577
JAMES D. ROSE
Date Signed 3-17-94

James D. Rose, P.E.
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Reviewed by:

David P. Hayes, P.E.
Executive Vice President

Registered Professional Engineer (Civil)
CERTIFICATE NO. 22577
JAMES D. ROSE
Date Signed 3-17-94
ARIZONA, U.S.A.

ATL Job No. 192023-1 *March 15, 1994*

REPORT OF

GEOTECHNICAL INVESTIGATION

FOR

GANNETT FLEMING, INC.

RITTENHOUSE CHANNEL PHASE II
MCFCD CONTRACT NO. 92-13
ATL JOB NO. 192023-1

1.0 PROJECT DESCRIPTION

The project consists of a shallow, wide flood control channel to intercept storm water from the area east and north of Rittenhouse Road and convey the storm water west to the East Maricopa Floodway. The project includes design of the channel, side inlets, outlet to the Floodway, slope stability, bank protection, sedimentation, design of the box culvert structures for the existing road crossings and drop structures. The proposed channel will be approximately 4.5 miles in length beginning east of Queen Creek School and terminating at the East Maricopa Floodway.

2.0 SCOPE OF WORK

Based upon ATL's proposal dated August 11, 1992 and the contract with Gannett Fleming of Arizona, Inc. dated January 27, 1993, the following items are required:

a. Provide Foundation analysis for box culverts and drop structures.

b. Provide pavement recommendations for the four road crossings.

c. Include the Phase I analysis in the Phase II report.

Eight (8) copies of the Phase II geotechnical report are submitted. Boring logs and laboratory data from Phase I are included in Appendices A and B. The Phase I letter report is in Appendix C. Please note that Plate 1 summarizes the guidelines to use in interpreting this report and is meant to clarify, for legal purposes, the way in which this Report should be used.

3.0 SITE LOCATION AND GEOLOGIC DESCRIPTION

The proposed Rittenhouse Channel is located in the southeast part of Maricopa County approximately 27 miles southeast of downtown Phoenix. The site is northeast of the Southern Pacific Railroad tracks which parallel Rittenhouse Road. The proposed channel is bounded on the west by the East Maricopa Floodway and runs southeast parallel to the railroad tracks past Hawes Road where it turns east. The proposed channel extends eastward to approximately 1/4 mile east of Ellsworth Road past Queen Creek School along Queen Creek Road. The site is located on Quaternary Age younger alluvial deposits.

4.0 DRILLING AND SAMPLING PROCEDURES

For Phase II a total of sixteen (16) borings were drilled to depths of 10 to 20 feet. thirteen (13) borings were drilled to depths of 20 feet at the proposed box culvert locations. Three (3) borings were drilled to depths of 10 feet along the

proposed channel alignment.

In Phase I of this project, ten (10) borings were drilled to depths of 20 feet along the proposed channel alignment. The borings drilled in Phase I are numbered 1 through 10 and Phase II borings are numbered 11 through 26. All boring locations were the result of preliminary agreement by Gannett Fleming and ATL, approval by the MCFCD and field access.

A Mobile B-50 drill rig with a 6-inch outside diameter hollow stem continuous flight auger as used to drill and sample the borings. Sampling of the subsurface material was achieved by collecting soil at the collar of the bore holes. Driven SPT and ring samples were also taken at selected intervals. Boring locations and general plan view of the site are presented on Plate Nos. 4 and 5.

Borings were sampled and logged by ATL's field representative and edited boring logs are presented in Appendix A.

5.0 LABORATORY TESTING

Representatives bulk samples of the subgrade were collected at each boring location for analysis. Selected driven samples were also collected for analysis.

The following table lists the types and quantities of tests performed in each Phase to provide the project design information:

PHASE I

TEST	NUMBER OF TESTS PERFORMED
Sieve Analysis	10
Atterberg Limit	10
Moisture Content	10
pH and Resistivity	4
Standard Proctor	4

PHASE II

TEST	NUMBER OF TEST PERFORMED
Sieve Analysis	16
Atterberg Limit	16
Moisture Content	16
Expansion/Swell	1
Consolidation	8
Direct Shear	3

All laboratory tests were conducted in accordance with ASTM Standards, and are summarized in Appendix B, "Laboratory Test Results". Soils were classified using the Unified Soils Classification System.

6.0 SUMMARY OF EXISTING SUBSURFACE CONDITIONS

As presented in the Phase I letter report and supplemented by data from Boring Nos. 16, 17 and 18, the soils encountered from the East Maricopa Floodway to Sossaman Road, within the upper, 10 feet consists of clayey silty sand (SC-SM), sandy clay (CL), clayey sand (SC), and silty sand (SM). From Sossaman Road to Queen Creek School, the upper 10 feet of soil consist of sandy silt (ML), silty sand (SM) and clayey sand (SC). The soil classifications appearing in parentheses are from the Unified Soils Classification System (USCS).

In addition to the soil types listed above, the borings for the box culverts also encountered well graded silty sand (SW-SM), poorly graded silty sand (SP-SM) and poorly graded sand (SP). The clays encountered exhibit low swell potential. The subgrade soils exhibit very low to moderate consolidation potential.

The site soils have box resistivity results ranging from 734 ohm-cm at Boring No. 4 to 3869 ohm-cm at Boring No. 8.

Further discussion of the above summarized results are presented in Section 7.0 of this report.

7.0 DISCUSSION AND RECOMMENDATIONS

7.1 General

The 30 percent design plans call for a shallow, wide channel with earthen bottom and side slopes. The main channel will be sized to carry a maximum depth of 5 feet of water with 1.4 feet of freeboard. All embankment slopes on both sides will be a maximum of 4:1 (H:V). Within the main channel, a low-flow section, 1-foot depth will be constructed on the north side for the entire channel length.

The 30 percent design has low-flow velocities, a maximum channel slope of 0.05 percent, and box culverts at road crossings with grouted riprap lining at the transitions where flow velocities are increased. Proposed box culvert depths would be 5-6 feet in the main channel and 6-7 feet in the low-flow portion of the channel.

7.2 Box Culverts

The proposed box culverts may be founded on compacted native soils or excavated and replaced soils as presented below in Table 1.

Table 1

Location	Bearing Soils	Allowable Bearing Capacity
Sossaman Road Ellsworth Road Queen Creek School	Native Recompacted 12" Depth	2500 psf
Power Road	Remove 18" Existing Soil. Replace with 18" of SM, SC, SP SW-SP or SP-SM Soil	2000 psf
Germann Road	Remove 18" Existing Soil. Replace with 18" of SM, SC, SP SW-SP or SP-SM Soil	2500 psf

A thick silt layer at Power Road resulted in a lower bearing capacity at that location. All gross settlements are less than 0.5 inch.

Structure excavation and backfill shall conform to Section 206 of the Maricopa Association of Governments (MAG) "Uniform standard Specifications for Public Works Construction". Compaction requirements shall be specified in in Section 8.1 of this report.

7.3 Drop Structures

The proposed drop structures may be supported on spread footings bearing on 12 inches of compacted native soils except at Stations 20+00 and 36+40. Excavation and replacement shall be accomplished with 12 inches of compacted SM, SC, SP, SW-SM soils. An allowable bearing capacity of 2500 psf may be used on 12 inches of compacted soils.

For design purposes, the following equivalent fluid pressures (EFP) should be used:

Active	29 pcf
At-Rest	46 pcf
Passive	504 pcf

The above EFP's are based on a unit weight of 110 pcf and a 38° angle of internal friction. The coefficient of sliding friction for the footing-soil interface is 0.55.

In order to control migration of backfill soil through weep holes, a non-woven geotextile should be used in conjunction with a gravel pack at the entrance to the weep holes. AMOCO No. 4551 or equal may be used.

Structure excavation and backfill shall conform to Section 206 of the Maricopa Association of Governments (MAG) "Uniform standard Specifications for Public Works Construction". Compaction requirements shall be specified in Section 8.1 of this report.

7.4 Corrosivity

Soils along the proposed channel have pH levels of 7.9 to 8.5 and Resistivities of 234 to 3869 ohm-cm. Corrosion protection will be required for metal pipes where resistivities are below 1500 ohm-cm.

7.5 Pavement Sections

Pavement sections at road crossings should be replaced with an equal section of asphaltic concrete (AC) and aggregate base (AB). Materials for replacement pavement shall conform to requirements of Section 8.2 of this report.

8.0 GENERAL CONSTRUCTION RECOMMENDATIONS

8.1 Backfill and Compaction

Compaction of structural Backfill type III shall be in accordance with MAG specifications Section 601. Table 601-2, of material for replacement pavement shall conform to Backfill Type I requirement in Table 601-2

8.2 Pavement

The Aggregate base materials shall conform to the requirements of Section 702 under subsection 702.2 "Crushed Aggregate" of MAG specifications.

The asphaltic concrete pavement shall conform with Section 321 of the "Uniform Standard Specifications for Public Works Construction", sponsored by MAG and all supplements. The gradation of the asphaltic concrete aggregate shall be in conformance with Type C-3/4 of Table 710.

9.0 ADDITIONAL SERVICES

It is recommended that ATL be retained to provide material testing services during construction. Our staff of experienced technicians and field engineers can provide competent and reliable testing services. In addition, geotechnical expertise is readily available if needed.

It has been ATL's pleasure to serve Gannett Fleming Inc. on this project. ATL has in-house expertise in a variety of geotechnical related areas and the firm looks forward to working with Gannett Fleming Inc. in the near future.

PLATES

GUIDELINES IN THE USE AND INTERPRETATION

OF THIS GEOTECHNICAL REPORT

ATL Job No. 192023-1

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.

SOIL CLASSIFICATION & TERMINOLOGY

GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
	GW	Well graded gravels, gravel - sand mixtures, or sand - gravel - cobble mixtures.
	GP	Poorly graded gravels, gravel - sand mixtures, or sand - gravel - cobble mixtures.
	GM	Silty gravels, gravel - sand - silt mixtures.
	GC	Clayey gravels, gravel - sand - clay mixtures.
	SW	Well graded sands, gravelly sands.
	SP	Poorly graded sands, gravelly sands.
	SM	Silty sands, sand - silt mixtures
	SC	Silty sands, sand - silt mixtures
	ML	Inorganic silts, clayey silts with slight plasticity
	MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand - gravel mixtures,

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

2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

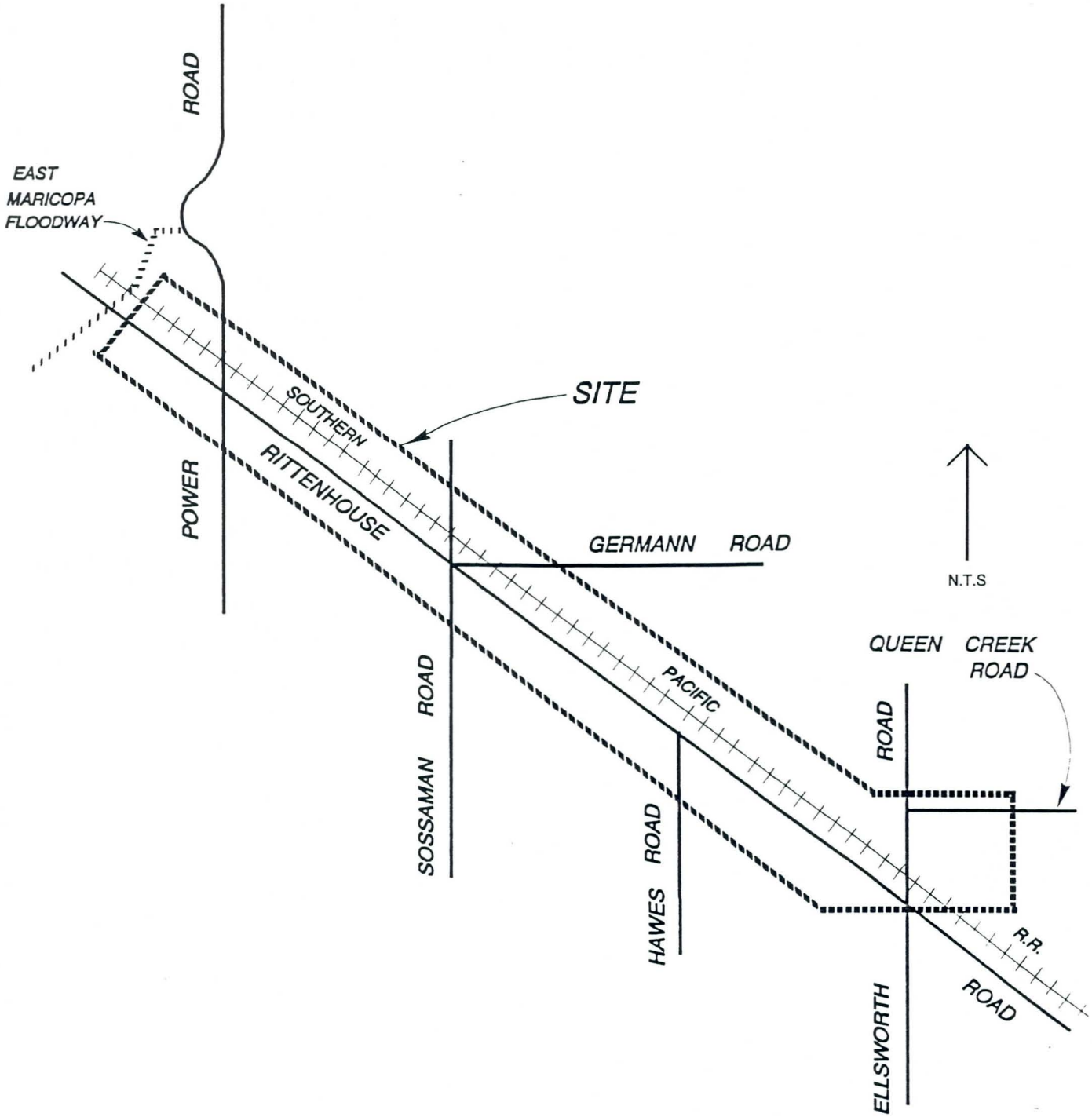
N	Relative Consistency	Remarks
0 - 4	Very soft	Easily penetrated several inches with fist.
3 - 4	Soft	Easily penetrated several inches with thumb.
5 - 8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9 - 15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16 - 30	Very stiff	Readily indented with thumb-nail.
30 +	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and / or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

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

DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 inches
Gravel	3 inches to No. 4 sieve
Coarse gravel	3 inches to 3/4 inch
Fine gravel	3/4 inch to No. 4 sieve
Sand	No. 4 sieve to No. 200
Coarse	No. 4 sieve to No. 10
Medium	No. 10 sieve to No. 40
Fine	No. 40 sieve to No. 200
Fines (silt or clay)	Below No. 200 sieve

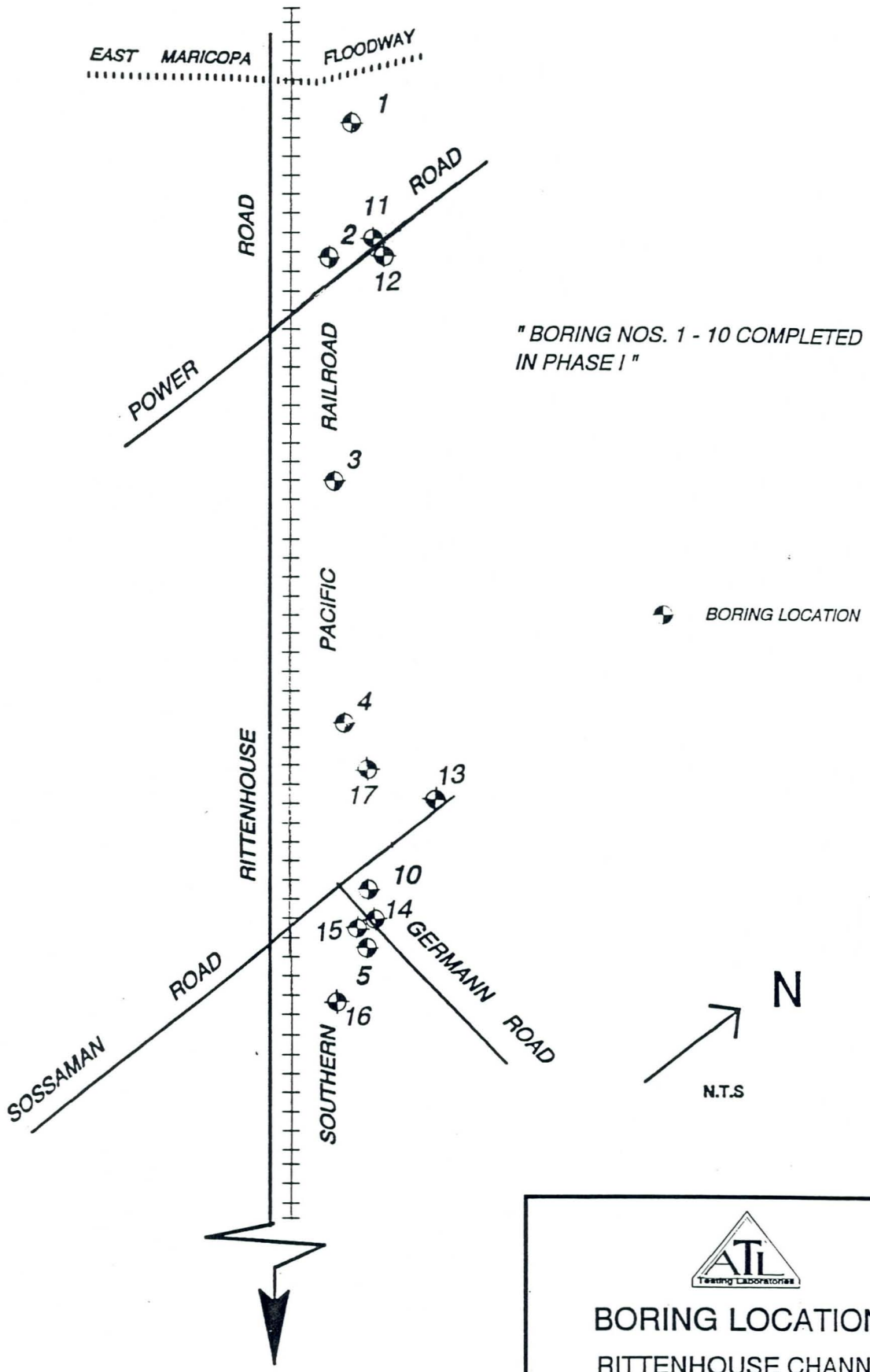


ATL Testing Laboratories

VICINITY MAP

RITTENHOUSE CHANNEL
PHASE II
MCFCD 92 - 13

ATL JOB NO. 192023 - 1



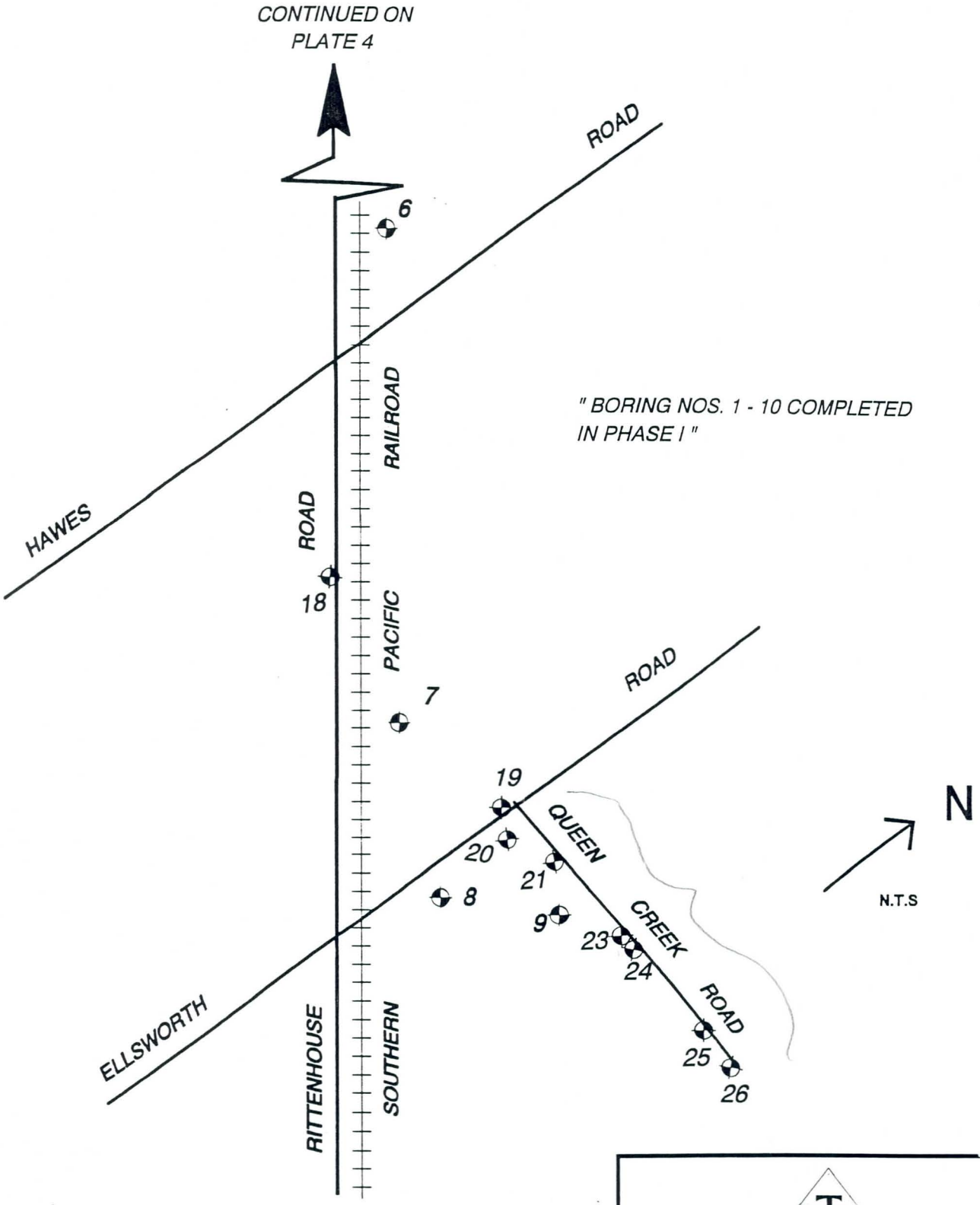
CONTINUED ON PLATE 5

ATL Testing Laboratories

BORING LOCATIONS

RITTENHOUSE CHANNEL
PHASE II
MCFCD 92 - 13

ATL JOB NO. 192023 -1



BORING LOCATION

ATL Testing Laboratories

BORING LOCATIONS

RITTENHOUSE CHANNEL
PHASE II
MCFCD 92 - 13

ATL JOB NO. 192023 -1

APPENDIX A

BORING LOGS

RITTENHOUSE CHANNEL PHASE I
MCFCD CONTRACT NO. 92-13

ATL Testing Laboratories

ATL Job No. 192023

Boring Number: *01*
Boring Location: *2485' N.W. of Power Road C/L, 111' N.E. of Railroad C/L*
Date of Boring: *3/15/93*
Elevation of Boring: *Existing Grade*

Boring Equipment: *Mobile B-50 With 6 Inch Diameter Hollow Stem Auger*
Driller: *L. Usrey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		BROWN SILTY CLAYEY FINE SAND, (SC-SM), MOIST			*10.3*	
	5	*LIGHT BROWN SANDY CLAY, (CL), SLIGHTLY MOIST, HARD TO VERY STIFF, WEAK CEMENTATION*	*73*			
	10		*28*			
	15	*BROWN SILTY FINE SAND,(SM), SLIGHTLY MOIST, MEDIUM DENSE*	*20*			
	20	*LIGHT BROWN SAND AND GRAVEL, (SP), WITH SOME SILT, DENSE*	*53*			
		BOTTOM AT 21.5 FEET				
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A1

RITTENHOUSE CHANNEL PHASE I

MCFCD CONTRACT NO. 92-13

ATL Job No. 192023

ATL Testing Laboratories

Boring Number: 02

Boring Location: 75' W. of Power Road C/L, 250' N. of Rittenhouse Road C/L

Date of Boring: 3/15/93

Elevation of Boring: Existing Grade

Boring Equipment: Mobile B-50 With 6 Inch Diameter Hollow Stem Auger

Driller: L. Usrey

Logger: J. Cowell

Reviewed By: J. Rose

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		BROWN SILTY FINE SAND, (SM), MOIST				
	5	BROWN SANDY CLAY, (CL), MOIST, HARD, WEAK CEMENTATION	24			
	10					
		LIGHT BROWN SILTY FINE SAND, (SM), MOIST, MEDIUM DENSE, WEAK CEMENTATION	16			
	15	LIGHT BROWN SANDY CLAY, WITH NODULES OF OF STRONG CEMENTATION TO 1.25 INCH SIZE, (CL), VERY MOIST				
		BROWN SILTY SAND, WITH TRACE OF GRAVEL, (SM), LOOSE	10			
		LIGHT BROWN SANDY CLAY, (CL)				
	20		14			
		BROWN SILTY SAND WITH TRACE OF GRAVEL, (SM)				
		BOTTOM AT 21.5 FEET				
	25					

Boring Stopped at 21.5 Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A2

RITTENHOUSE CHANNEL PHASE I

MCFCD CONTRACT NO. 92-13

ATL Job No. 192023

Boring Number: 03
Boring Location: 1531' S.E. of Power Road, 109' N.E. of Railroad C/L
Date of Boring: 3/15/93
Elevation of Boring: Existing Grade

Boring Equipment: Mobile B-50 With 6 Inch Diameter Hollow Stem Auger
Driller: L. Usrey
Logger: J. Cowell
Reviewed By: J. Rose

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	LIGHT BROWN POORLY GRADED CLAYEY SAND, (SC), SLIGHTLY MOIST	73		7.2	
	10	LIGHT BROWN SILTY SAND, (SM), SLIGHTLY MOIST, VERY DENSE, WEAK CEMENTATION	50			
	15	LIGHT BROWN SILTY CLAYEY FINE SAND, WITH TRACE OF GRAVEL, (SC-SM), SLIGHTLY MOIST, MEDIUM DENSE	24			
	20	LIGHT BROWN SANDY CLAY, (CL), SLIGHTLY MOIST, HARD, WEAK CEMENTATION	31			
	25	BOTTOM AT 21.5 FEET				

Boring Stopped at 21.5 Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A3

RITTENHOUSE CHANNEL
PHASE I
MCFCD CONTRACT NO. 92-13

ATL Testing Laboratories

ATL Job No. *192023*

Boring Number: *04*
Boring Location: *1409' N.W. of Sossaman Road, 108' N.E. of Railroad C/L*
Date of Boring: *3/16/93*
Elevation of Boring: *Existing Grade*

Boring Equipment: *Mobile B-50 With 6 Inch Diameter Hollow Stem Auger*
Driller: *J. Cowell*
Logger: *R. Smith*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*BROWN SILTY FINE SAND, (SM), MOIST, LOOSE*	12			
	10	*LIGHT BROWN SILTY FINE SAND WITH GRAVEL, (SM), SLIGHTLY MOIST TO MOIST, DENSE TO VERY DENSE, WEAK CEMENTATION*				
		LIGHT BROWN CLAYEY SAND WITH FINE GRAVEL, (SC), SLIGHTLY MOIST TO MOIST, DENSE TO VERY DENSE, WEAK CEMENTATION	66			
	15	*TAN CLAYEY FINE SAND, (SC), SLIGHTLY MOIST, DENSE, WEAK CEMENTATION*	42			
	20	*TAN CLAYEY SAND, (SC), SLIGHTLY MOIST, DENSE, NONE TO WEAK CEMENTATION*	25			
	25	*BOTTOM AT 21.5 FEET*				

Boring Stopped at *21.5* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A4

RITTENHOUSE CHANNEL PHASE I
MCFCD CONTRACT NO. 92-13

ATL Job No. *192023*

Boring Number: *05*
Boring Location: *Germann Road, 650' E. of Sossaman Road, 22' S. of C/L*
Date of Boring: *3/16/93*
Elevation of Boring: *Existing Grade*

Boring Equipment: *Mobile B-50 With 6 Inch Diameter Hollow Stem Auger*
Driller: *L. Usrey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*BROWN SILTY FINE SAND, (SM), MOIST, VERY LOOSE, OCCASIONAL THIN CLAY LENSES*	*3*			
	10	*LIGHT BROWN SILTY FINE SAND,(SM), MOIST, LOOSE*	*9*			
	15	*LIGHT BROWN SILTY FINE SAND WITH CEMENTED NODULES, (SM), MOIST, LOOSE TO MEDIUM DENSE, WEAK CEMENTATION*	*18*			
	20	*LIGHT BROWN CLAYEY FINE SAND,(SC), MOIST, WEAK CEMENTATION*	*25*			
	25	*BOTTOM AT 21.5 FEET*				

Boring Stopped at *21.5* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A5

RITTENHOUSE CHANNEL PHASE I
MCFCD CONTRACT NO. 92-13

ATL Testing Laboratories

ATL Job No. *192023*

Boring Number: *06*
Boring Location: *5636' W. of Ellsworth Road, 106' N. E. of Railroad C/L*
Date of Boring: *3/16/93*
Elevation of Boring: *Existing Grade*

Boring Equipment: *Mobile B-50 With 6 Inch Diameter Hollow Stem Auger*
Driller: *J. Cowell*
Logger: *R. Smith*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		BROWN SANDY SILT, (ML), MOIST, SOFT			*16.5*	
	5		*4*			
	10	*BROWN SILTY FINE SAND,(SM),MOIST, MEDIUM DENSE TO DENSE, WEAK CEMENTATION*	*42*			
		BROWN CLAYEY SAND, (SC), VERY MOIST, MEDIUM DENSE, WEAK CEMENTATION			*20.0*	
	15		*18*			
	20		*12*			
		BOTTOM AT 21.5 FEET				
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A6

RITTENHOUSE CHANNEL PHASE I
MCFCD CONTRACT NO. 92-13

ATL Job No. *192023*

Testing Laboratories

Boring Number: *07*
Boring Location: *1433' N. W. of Ellsworth Road, 107' N. E. of Railroad C/L*
Date of Boring: *3/16/93*
Elevation of Boring: *Existing Grade*

Boring Equipment: *Mobile B-50 With 6 Inch Diameter Hollow Stem Auger*
Driller: *J. Cowell*
Logger: *R. Smith*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*BROWN SILTY FINE SAND, (SM), MOIST, VERY LOOSE*	*3*			
	10	*LIGHT BROWN CLAYEY SAND, (SC), MOIST, MEDIUM DENSE TO DENSE, WEAK CEMENTATION, LAYERS OF STRONG CEMENTATION FROM 12.5 TO 14.5 FEET*	*29*			
	15		*21*			
	20	*LIGHT BROWN FINE SAND, (SP), VERY MOIST, MEDIUM DENSE*	*32*			
	25	*BOTTOM AT 21.5 FEET*				

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A7

RITTENHOUSE CHANNEL PHASE I
MCFCD CONTRACT NO. 92-13

ATL Job No. *192023*

Boring Number: *08*
Boring Location: *50' E. of Ellsworth Road C/L, 40' S.of S. Fence at Queen Creek School*
Date of Boring: *3/16/93*
Elevation of Boring: *Existing Grade*

Boring Equipment: *Mobile B-50 With 6 Inch Diameter Hollow Stem Auger*
Driller: *J. Cowell*
Logger: *R. Smith*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		BROWN SILTY SAND, (SM), MOIST, LOOSE			*8.9*	
	5		*10*			
	10	*LIGHT BROWN SILTY SAND , (SM), MOIST, MEDIUM DENSE TO DENSE, WEAK CEMENTATION*	*42*		*14.4*	
	15	*LIGHT BROWN CLAYEY SAND WITH CEMENTED NODULES, (SC), MOIST, DENSE TO VERY DENSE, WEAK TO MODERATE CEMENTATION*	*56*			
	20	*LIGHT BROWN FINE SAND WITH THIN CLAYEY SAND LAYERS, (SP), MOIST, DENSE*	*36*			
		BOTTOM AT 21.5 FEET				
	25					

Boring Stopped at *21.5* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A8

RITTENHOUSE CHANNEL PHASE I
MCFCD CONTRACT NO. 92-13

ATL Job No. *192023*

Testing Laboratories

Boring Number: *09*
Boring Location: *422' S. of Queen Creek Road C/L, 600' E. of Ellsworth Road C/L*
Date of Boring: *3/16/93*
Elevation of Boring: *Existing Grade*

Boring Equipment: *Mobile B-50 With 6 Inch Diameter Hollow Stem Auger*
Driller: *J. Cowell*
Logger: *R. Smith*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*BROWN SILTY FINE SAND, (SM), MOIST, LOOSE,*	*16*			
	10	*LIGHT BROWN CLAYEY SAND , (SC), MOIST, VERY LOOSE*	*9*			
	15	*LIGHT BROWN CLAYEY SAND, (SC), MOIST, VERY DENSE,*	*50/3"*			
	20		*43*			
	25	*BOTTOM AT 21.5 FEET*				

Boring Stopped at *21.5* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL PHASE I
MCFCD CONTRACT NO. 92-13

ATL Job No. *192023*

Boring Number: *10*
Boring Location: *176' N. of Railroad C/L, 28' E. of Sossaman Road C/L*
Date of Boring: *3/16/93*
Elevation of Boring: *Existing Grade*

Boring Equipment: *Mobile B-50 With 6 Inch Diameter Hollow Stem Auger*
Driller: *L. Usrey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		LIGHT BROWN SILTY FINE SAND, (SM), MOIST				
	5	*TAN SANDY SILT, (ML), MOIST, STIFF*	12		9.2	
	10	*LIGHT BROWN SANDY CLAY, (SC), SLIGHTLY MOIST, WEAK CEMENTATION*	48			
		LIGHT BROWN SILTY FINE SAND, (SM)				
	15	*LIGHT BROWN SILTY SAND, (SM), VERY MOIST, LOOSE TO MEDIUM DENSE, WEAK CEMENTATION*	9		15.9	
	20		19			
		BOTTOM AT 21.5 FEET				
	25					

Boring Stopped at *21.5* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A10

RITTENHOUSE CHANNEL PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *11*
Boring Location: *315 Feet North of Railroad, 32 Feet West of C/L Power Road*
Date of Boring: *1 - 27 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown silty SAND, (SM), Moist, (Fill)				
		Brown silty CLAY, (CL), Moist				
	5	*Brown silty SAND, (SM), Moist*				
		Brown sandy SILT, (ML), Moist to slightly moist, Soft to hard	6	16	13.5	
	10		50/5"	200		
	15		12			
		Brown silty CLAY, (CL), Moist, Nodules of strong calcareous cementation to 1 - inch size				
	20	*Light brown silty SAND, (SM), Moist*				
		Bottom at 21.5 feet	18			
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Testing Laboratories

Boring Number: *12*
Boring Location: *315 Feet North of Railroad, 35 Feet East of C/L Power Road*
Date of Boring: *1 - 28 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown silty SAND with fine gravel, (SM), Moist				
	5					
		Light brown CLAY with fine sand, (CL), Hard, Moist, Weak calcareous cementation	62	32		
		Light brown CLAY, (CL), Firm, Moist, Weak to moderate calcareous cementation			14.9	
	10		19	115		
		Brown silty CLAY, (CL), Moist, Moderately firm, Nodules of strong calcareous cementation				
	15		9			
		Brown silty fine SAND, Moist				
		Gray - brown SAND, with some silt and gravel to 1 - inch size, (SM), Moist, Medium dense				
	20	*Bottom at 21.5 feet*	25			
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A12

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Testing Laboratories

Boring Number: *13*
Boring Location: *160 Feet North of C/L Germann Road, 40 Feet W est of C/L Sossaman Road*
Date of Boring: *1 - 28 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*Brown silty fine SAND, (SM), Moist to wet*				
		Brown silty SAND, (SM), Loose, Moist	10	9		
	10	*Light brown silty fine SAND, (SM), Dense, Moist, Moderate calcareous cementation*	34	127	20.1	
	15	*Light brown sandy CLAY with fine gravel, (CL), Moderately firm, Weak calcareous cementation*	9			
	20	*Light brown silty fine SAND, (SM), Moist, Weak calcareous cementation*	12			
		Bottom at 21 feet				
	25					

Boring Stopped at *21* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *14*
Boring Location: *600 Feet East of Sossaman Road, 6 Feet North of C/L Germann Road*
Date of Boring: *2 - 1 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		1 - inch Asphaltic Concrete, 7 inches Aggregate Base				
		Light brown silty fine SAND, (SM), Moist				
		Brown sandy SILT, (ML), Moist				
	5	*Light brown silty fine SAND, (SM), Moist*		6		
		Brown clayey SAND, (SC), Moist, Soft	3			
		Light brown sandy SILT, (ML), Soft to hard, Moist			11.5	
	10			32		
			67			
		Light brown clayey SAND, (SC), Hard, Moist, Weak calcareous cementation				
	15	*Light brown clayey SAND, (SC), Moist, Very firm, With trace of granite to 1 - inch size, Weak calcareous cementation*				
		Light brown clayey SAND, (SC), Moist, Firm, Weak calcareous cementation	33			
	20	*Bottom at 21.5 feet*	24			
	25					

Boring Stopped at *21.5* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A14

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *15*
Boring Location: *600 Feet East of Sossaman Road, 20 Feet South of C/L Germann Road*
Date of Boring: *2 - 1 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*Brown silty fine SAND, (SM), Moist*				
		Brown sandy SILT, (ML), Soft, Moist, (Near wet)	3			
	10	*Light brown sandy SILT, (ML), Soft, Moist*	46			
	15	*Light brown clayey SAND, (SC), Very firm, Moist, Trace of gravel to 1 - inch size, Weak calcareous cementation*				
	20	*Light brown clayey SAND, (SC), Hard to firm, Moist, Weak calcareous cementation with nodules of strong cementation below 17 - foot depth*	54			
		Bottom at 21.5 feet	22			
	25					

Boring Stopped at *21.5* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Testing Laboratories

ATL Job No. *192023-1*

Boring Number: *16*
Boring Location: *7/10 Mile East of Sossaman Road, 110 Feet North of Railroad*
Date of Boring: *1 - 28 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown sandy SILT, (ML), Moist, Non - plastic			*18.3*	
	5	*Moisture increases to wet*				
		Gray - brown silty SAND, (SM), Moist, Loose, Trace of gravel to 1 - inch size	*6*			
	10	*Brown sandy CLAY, (CL), Very firm, Weak calcareous cementation*	*42*			
		Bottom at 21.5 feet				
	15					
	20					
	25					

Boring Stopped at *11.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *17*
Boring Location: *7/10 Mile West of Ellsworth Road, 125 Feet North of Railroad*
Date of Boring: *1 - 27 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown silty SAND, (SM), Moist			*11.2*	
	5	*Brown silty SAND, (SM), Loose, Moist, Increasing silt content*	*4*			
	10	*Brown sandy SILT, (ML), Soft, Moist to wet*	*12*			
		Brown sandy CLAY, (CL), Moderately firm, Moist, Weak to moderate calcareous cementation				
	15	*Brown silty SAND, (SM), Moist* *Bottom at 15 feet*				
	20					
	25					

Boring Stopped at *15* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A17

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *18*
Boring Location: *4/10 Mile West of Ellsworth Road, South Edge Queen Creek Road*
Date of Boring: *1 - 28 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown silty fine SAND, (SM), Moist				
	5	*Gray - brown SAND with trace of gravel to 1 - inch size, (SP-SM), Moist*				
	10	*Brown silty fine SAND, (SM), Loose, Moist*	*5*			
		Light brown sandy CLAY, (CL), Firm, Moist, Weak calcarerous Cementation	*21*			
		Bottom at 11.5 feet				
	15					
	20					
	25					

Boring Stopped at *11.5* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *19*
Boring Location: *25 Feet South of C/L Queen Creek Road, 30 Feet West of West Edge Pavement Ellsworth Road*
Date of Boring: *1 - 31 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*Brown silty fine SAND, (SM), Moist*		13		
	10	*Gray - brown SAND with trace of gravel to 1 - inch size, (SP-SM), Medium dense, Slightly moist*	12	14	3.7	
	15	*Brown clayey SAND, (SC), Firm, Moist, Weak calcareous cementation*	19			
	20	*Brown sandy CLAY, (CL), Firm to moderately firm, Moist, moderate calcareous cementation* *Contains nodules of strong cementation to 1 - inch size below 16 - foot depth* *Bottom at 21.5 feet*	25 10			
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *20*
Boring Location: *50 Feet East of C/L Ellsworth Road, 42 Feet South of C/L Queen Creek Road*
Date of Boring: *1 - 31 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
		Brown silty SAND, (SM), Loose to medium dense, Moist				
	5			11		
			12			
		Gray - brown silty well graded SAND, (SW-SM), Moist			3.9	
	10	*Silty sand lense*		13		
		Gray - brown SAND with trace of granite to 1 - inch size, (SP)	15			
		Light brown sandy CLAY, (CL), Firm, Moist, Weak calcareous cementation				
	15		24			
		Contains nodules of strong cementation below 17 - foot depth				
	20		18			
		Bottom at 21.5 feet				
	25					

Boring Stopped at *21.5* Feet
Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A20

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *21*
Boring Location: *225 Feet East of C/L Ellsworth Road, 35 Feet South of C/L Queen Creek Road*
Date of Boring: *1 - 31 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*Brown silty fine SAND, (SM), Loose, Moist*	6	11		
	10	*Brown poorly graded SAND, (SP), Loose, Slightly moist*			3.3	
		Gravelly SAND with silty coating, (SM), Medium dense, Slightly moist, Gravel to 1 - inch size	16	29		
	15	*Light brown silty fine SAND, (SM), Moist*	61			
	20	*Light brown sandy CLAY, (SC), Hard to firm, Moist, Weak to moderate calcareous cementation*	16			
		Bottom at 21.5 feet				
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A21

RITTENHOUSE CHANNEL PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. 192023-1

Boring Number: 22
Boring Location: 255 Feet East of C/L Ellsworth Road, 35 Feet South of C/L Queen Creek Road
Date of Boring: 1 - 31 - 94
Elevation of Boring: Existing Grade

Drilling Equipment: Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger
Driller: L. Dorsey
Logger: J. Cowell
Reviewed By: J. Rose

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	Brown silty fine SAND, (SM), Moist	10	15		
	10	Brown well graded SAND with trace of gravel to 1 - inch size, (SW-SM), Loose, Slightly moist	9	17	3.7	
	15	Light brown sandy CLAY, (CL), Hard to firm, Moist, Weak to moderate calcareous cementation	50/5"			
		Contains nodules of strong cementation to 1 - inch size below 17 - foot depth				
	20	Bottom at 21.5 feet	14			
	25					

Boring Stopped at 21.5 Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *23*
Boring Location: *805 Feet East of Ellsworth Road, 37 Feet South of C/L Queen Creek Road*
Date of Boring: *2 - 1 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*Brown silty fine SAND, (SM), Moist*		9		
	10	*Gray - brown well graded silty SAND, (SW-SM), Loose, Moist, Trace of gravel to 1- inch size*	9		5.4	
	15	*Brown clayey fine SAND, (SC), Moderately firm to hard, Calcareous cementation with stratum of strong cementation*	14	15		
			82/11"			
	20	*Bottom at 21.5 feet*	10			
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A23

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Testing Laboratories

Boring Number: *24*
Boring Location: *840 Feet East of Ellsworth Road, 39 Feet South of C/L Queen Creek Road*
Date of Boring: *2 - 1 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*Brown silty fine SAND, (SM), Loose, Moist*	10	9		
	10	*Gray - brown SAND, (SM), Loose, Loose, Moist, Trace of gravel to 1 - inch size*			4.2	
		Light brown silty fine SAND, (SM), Medium dense, Moist	14	19		
	15	*Light brown clayey fine SAND, (SC), Hard to firm, Moist, Weak calcareous cementation*	66			
	20	*Contains nodules of strong cementation below 17 - foot depth*				
		Bottom at 21.5 feet	14			
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *25*
Boring Location: *1245 Feet East of C/L Ellsworth Road, 39 Feet South of C/L Queen Creek Road*
Date of Boring: *2 - 1 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*Brown silty fine SAND, (SM), Moist*		13		
	10	*Gray - brown well graded SAND with thin silty stratum, (SW-SM), Medium dense, Moist*	12		4.3	
		Silty sand lense		16		
		Light brown SAND with gravel to 1 - inch size, (SP)	15			
	15	*Light brown clayey SAND, (SC), Very firm to moderately firm, Moist, Weak calcareous cementation*	50			
	20	*Bottom at 21.5 feet*	15			
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

RITTENHOUSE CHANNEL
PHASE II
MCFCD CONTRACT NO. 92 - 13

ATL Job No. *192023-1*

Boring Number: *26*
Boring Location: *1285 Feet East of C/L Ellsworth Road, 40 Feet South of C/L Queen Creek Road*
Date of Boring: *2 - 1 - 94*
Elevation of Boring: *Existing Grade*

Drilling Equipment: *Mobile B - 50 With 8 - inch Diameter Hollow Stem Auger*
Driller: *L. Dorsey*
Logger: *J. Cowell*
Reviewed By: *J. Rose*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/Ft	Ring Blows/Ft	Water Content %	Dry Density (PCF)
	5	*Brown silty fine SAND, (SM), Moist*		17		
	10	*Gray - brown poorly graded silty SAND, (SP-SM), Medium dense, Moist, Trace of gravel to 1 - inch size*	11			
		Light brown silty SAND, (SM), Loose, Moist		12		
		Gray - brown SAND, (SP), Loose, Moist, Trace of gravel to 1 - inch size	9			
	15	*Light brown clayey SAND, (SC), Hard to firm, Moist, Weak to moderate calcareous cementation*				
		Contains nodules of strong cementation below 17 - foot depth	50 / 5 1/2"			
	20	*Bottom at 21.5 feet*	17			
	25					

Boring Stopped at *21.5* Feet Below Existing Grade

Groundwater		
Initial Depth	Hour	24 Hour Depth
Not Encountered		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

APPENDIX B

LABORATORY TEST RESULTS

SUMMARY OF LABORATORY ANALYSIS

PROJECT: RITTENHOUSE CHANNEL PHASE I DATE: 03-31-93

LOCATION: RITTENHOUSE ROAD, MARICOPA COUNTY, ARIZONA

MATERIAL: BOREHOLE SAMPLES SAMPLING DATE: 03-16-93

REQUESTED BY: J. ROSE ATL JOB NO: 192023

LOG NO.	DEPTH (FT)	MOIST (%)	USCS	LL	PI	SIEVE ANALYSIS – PERCENT PASSING											
						200	100	50	40	30	16	10	4	3/8	3/4	1 1/2	3
1	0-2.5	10.3	SC-SM	23	6	14.7	33	55	61	67	78	85	99	99	100		
3	0-6	6.1	SC	27	8	6.1	15	42	60	70	79	84	95	99	100		
3	6-14	7.2	SM		NP	43.6	54	65	69	73	80	85	94	99	100		
3	14-19	8.7	SC	27	8	11.4	30	50	56	62	72	79	88	92	100		
6	0-8	16.5	ML	19	1	72.4	74	90	97	99	99	99	100				
6	12-20	20.0	SC	27	8	47.2	53	57	58	59	61	62	64	82	100		
8	0-5	8.9	SM		NP	31.4	42	71	80	85	89	90	92	96	100		
8	10-15	14.4	SM		NP	12.9	19	33	41	49	62	72	88	93	100		
10	5-9.5	9.2	ML		NP	62.6	73	84	86	88	91	93	96	99	100		
10	15-20	15.9	SM		NP	18.2	34	47	51	55	65	76	92	97	100		

SUMMARY OF LABORATORY ANALYSIS

PROJECT: RITTENHOUSE CHANNEL PHASE II DATE: 02-14-94

LOCATION: RITTENHOUSE ROAD, MARICOPA COUNTY, ARIZONA

MATERIAL: BOREHOLE SAMPLES SAMPLING DATE: 1-27 TO 2-1-94

REQUESTED BY: J. ROSE ATL JOB NO: 192023(1)

LOG NO.	DEPTH (FT)	MOIST (%)	USCS	LL	PI	SIEVE ANALYSIS – PERCENT PASSING											
						200	100	50	40	30	16	10	4	3/8	3/4	1 1/2	3
11	6-16.5	13.5	ML		NP	61.8	71	78	81	84	90	94	98	100			
12	5.5-13	14.9	CL	29	9	54.9	60	74	79	82	89	94	98	100			
13	9-13.5	20.1	SM	27	NP	42.1	48	61	66	70	79	87	95	98	100		
14	6.5-12	11.5	ML	19	1	60.4	73	84	87	90	95	97	99	100			
15	8.5-12	14.7	ML	20	1	67.4	79	87	89	91	94	97	99	100			
16	0-6	18.3	ML		NP	56.5	78	92	96	97	99	100					
17	0-6	11.2	SM		NP	42.3	63	86	92	95	98	99	100				
18	2.5-6	4.6	SP-SM		NP	5.3	10	26	35	43	58	68	80	89	96	100	
19	7-11	3.7	SP-SM		NP	5.9	14	51	70	81	91	94	97	98	100		
20	7.5-13	3.9	SW-SM		NP	9.5	17	35	49	63	83	89	94	97	98	100	
21	7.5-10.5	3.3	SP		NP	3.7	8	31	55	74	90	95	99	100			
22	8-14	3.7	SW-SM		NP	9.5	14	27	40	54	71	79	88	92	95	98	100
23	6.5-11	5.4	SW-SM		NP	12.0	18	38	51	61	72	78	85	91	96	100	
24	7.5-10	4.2	SM		NP	12.1	16	23	29	39	63	73	82	89	96	100	
25	6.5-13	4.3	SW-SM		NP	11.0	18	39	53	64	78	85	92	98	100		
26	6-10.5	4.2	SP-SM		NP	7.8	15	42	55	67	82	87	93	95	98	100	

RITTENHOUSE CHANNEL
MCFCD Contract No. 92-13
Maricopa County, Arizona
Ellis-Murphy Gannett Fleming
ATL Job No. 192023

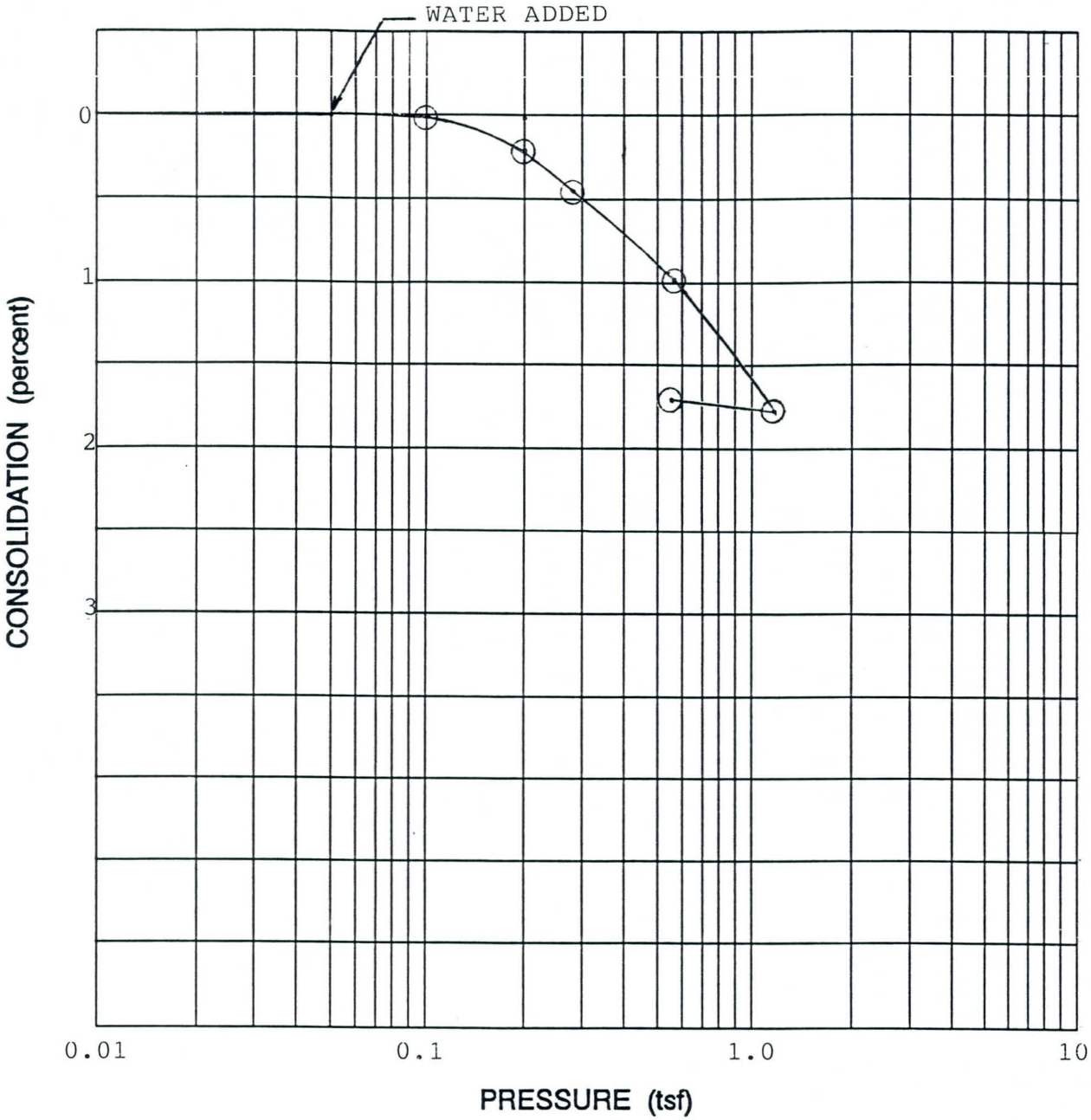
pH and Box Resistivity Test Results

Boring No.	Sample Depth, ft.	USCS	pH	Box Resistivity (ohm-cm)
1	2.5 - 9	CL	8.5	1668
4	0 - 8	SM	7.9	734
6	0 - 8	ML	8.0	1801
8	0 - 8	SM	8.2	3869

RITTENHOUSE CHANNEL
MCFCD Contract No. 92-13
Maricopa County, Arizona
Ellis-Murphy Gannett Fleming
ATL Job No. 192023

STANDARD PROCTOR TESTS (ASTM D698)

Boring No.	Sample Depth (ft)	USCS	Maximum Dry Density (pcf)	Optimum Moisture (%)
1	2.5 - 9	CL	105.7	17.0
3	0 - 6	SC	105.0	8.4
6	0 - 8	ML	112.0	14.0
8	0 - 8	SM	115.6	13.8



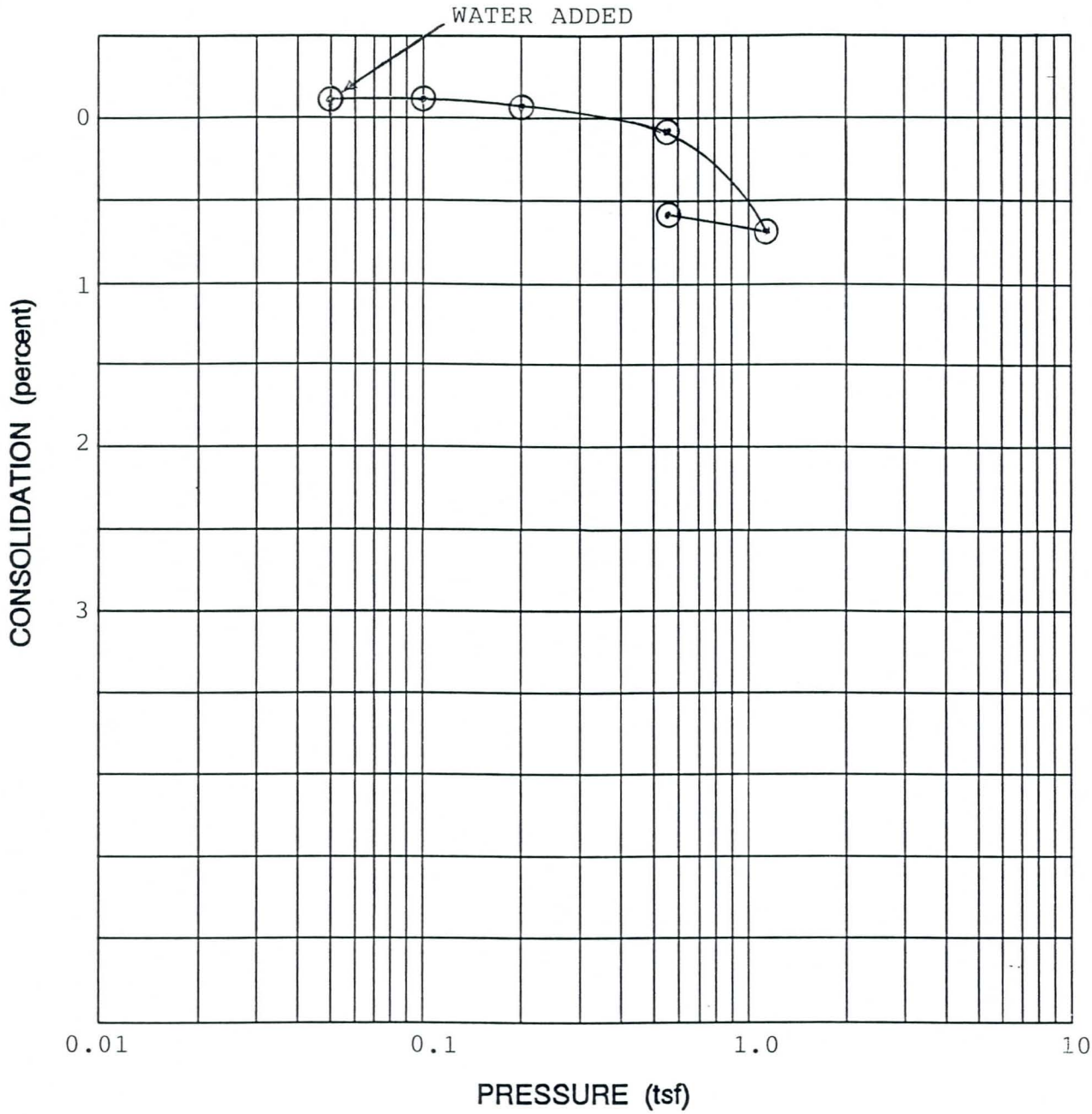
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)		Dry Density (pcf)
						Before	After	
	11	10-11	SANDY SILT (ML)		NP	11.3	23.3	100.7

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 192023 - 1

Date 1/31/94



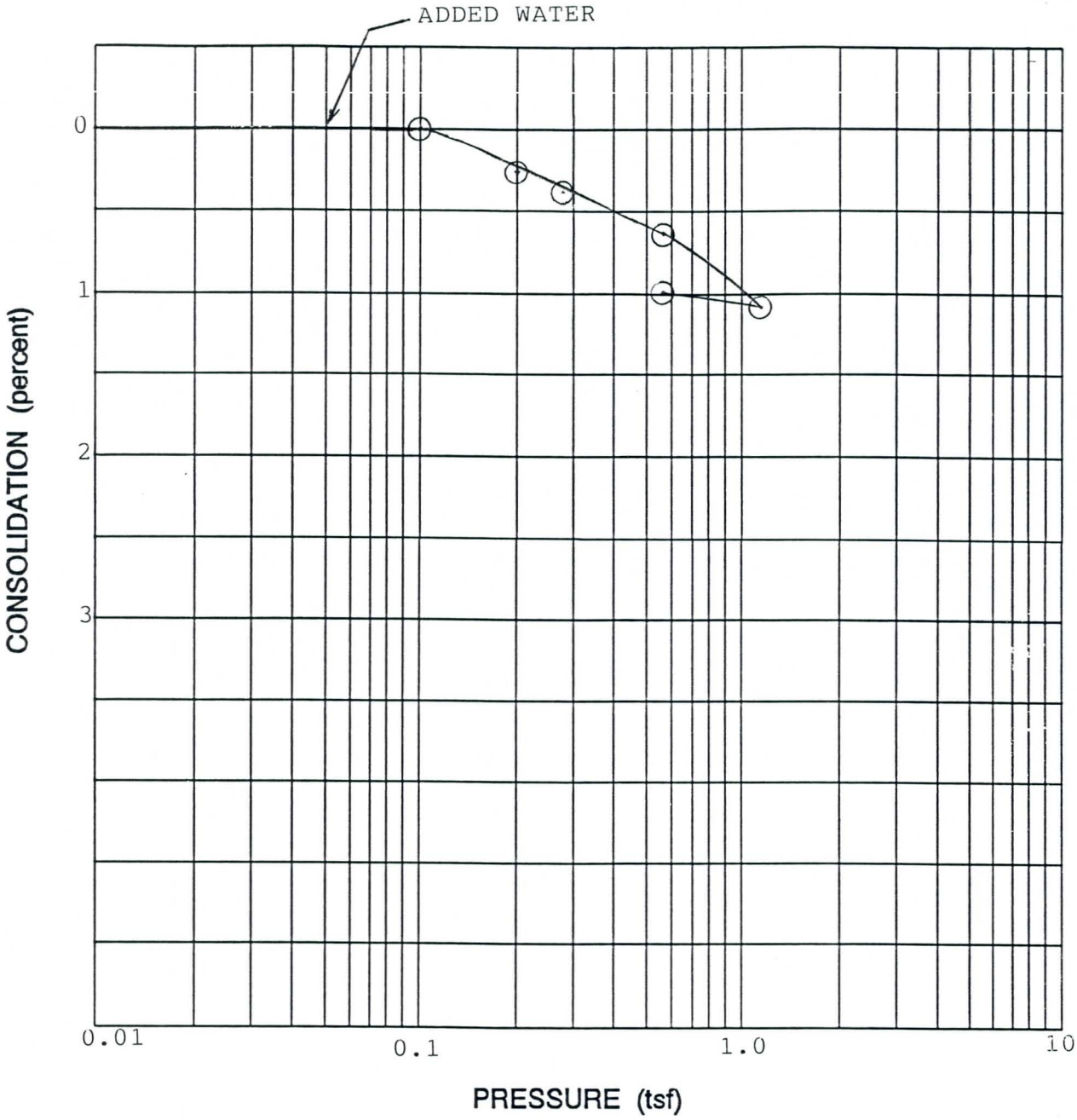
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)		Dry Density (pcf)
						Before	After	
	12	10-11.5	SANDY CLAY (CL)	29	9	14.7	23.5	102.1

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 192023-1

Date 3-2-94



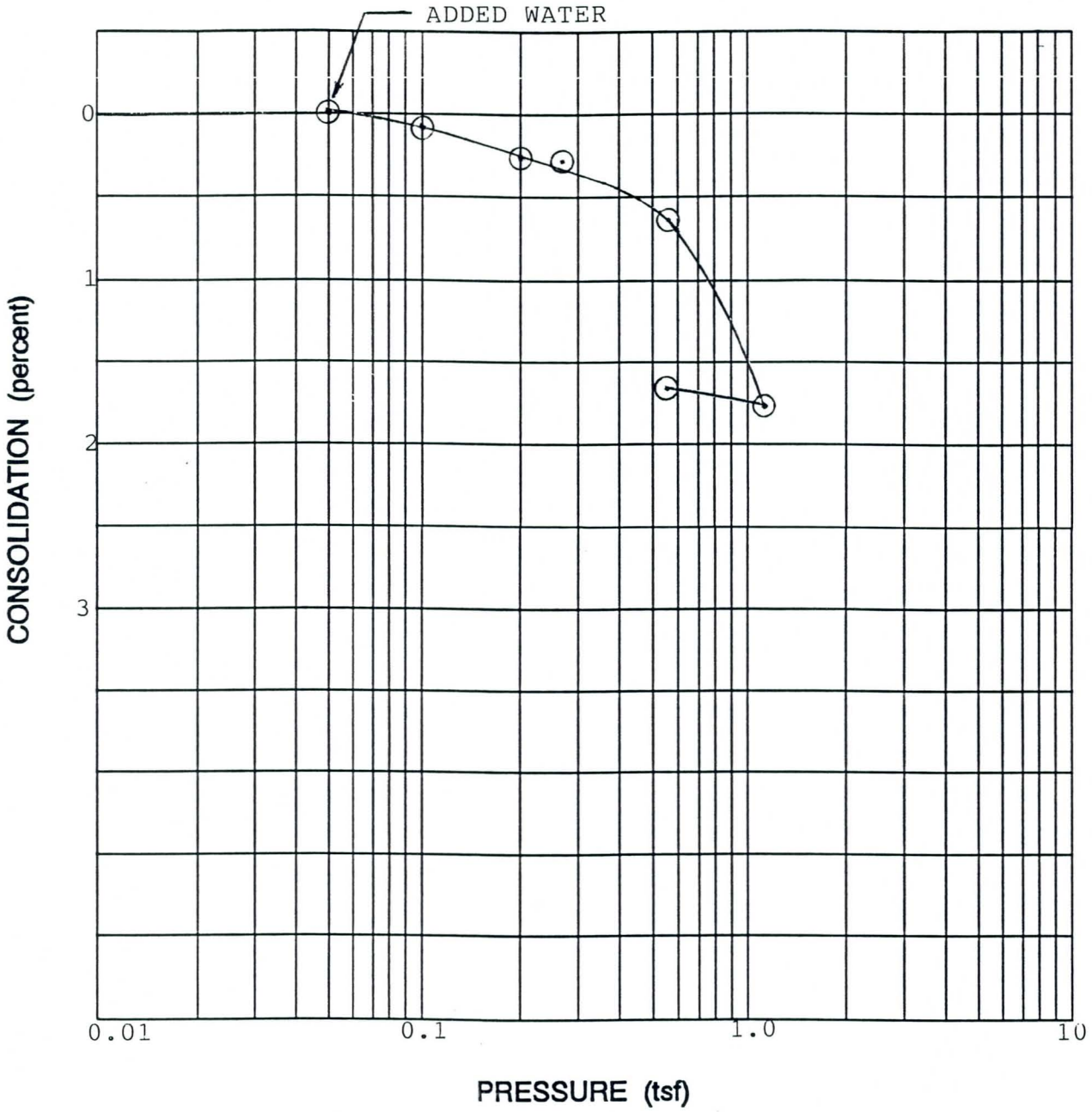
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)		Dry Density (pcf)
						Before	After	
	13	10-11	SILTY SAND (SM)	27	NP	12.3	17.9	113.5

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 192023 - 1

Date 2/9/94



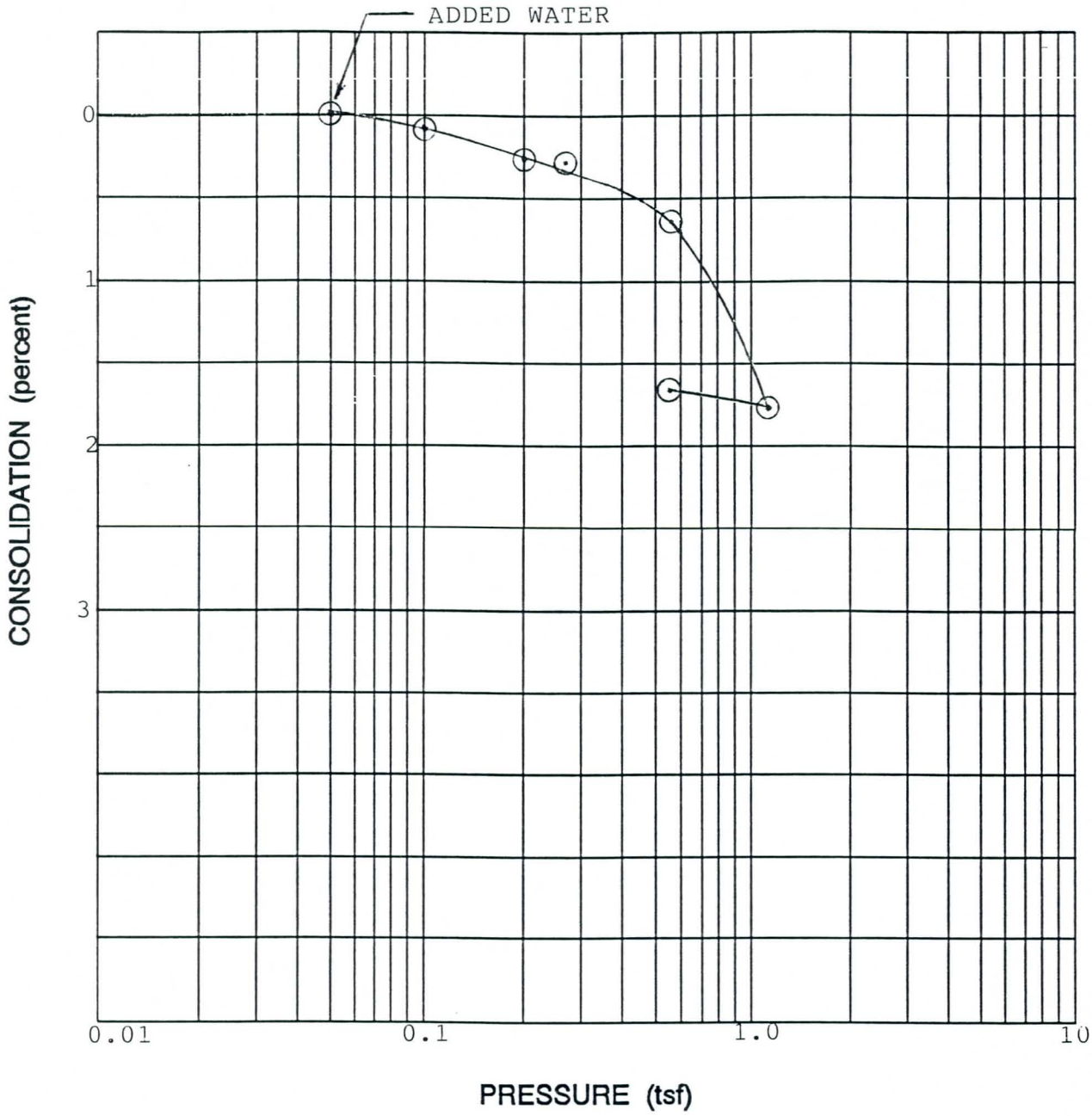
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)		Dry Density (pcf)
						Before	After	
	14	10 - 11.5	SANDY SILT (ML)	19	1	13.4	28.9	97.0

ATL

CONSOLIDATION TEST DATA

Project No. 192023 - 1

Date 2/9/94



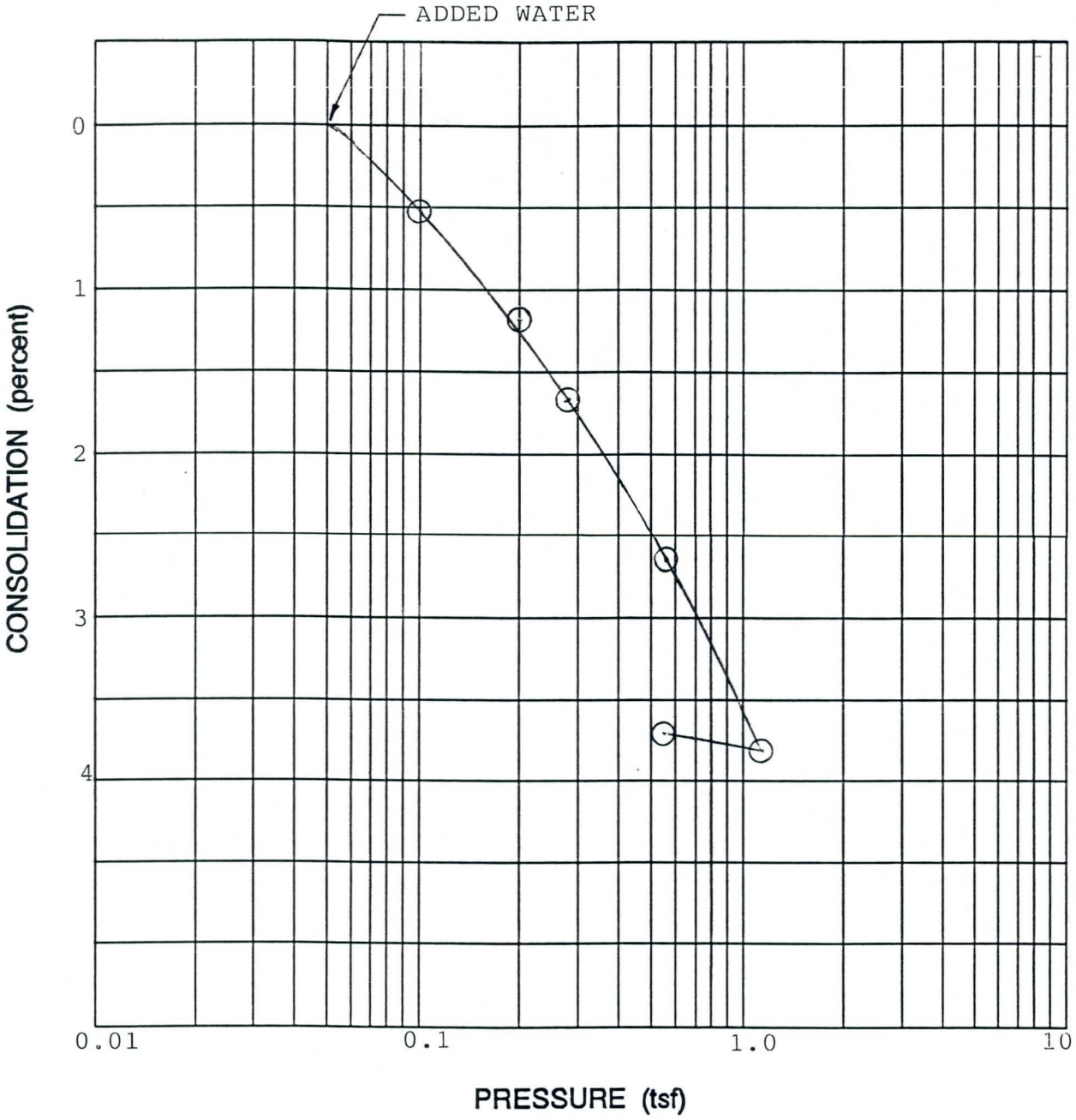
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)		Dry Density (pcf)
						Before	After	
	14	10 - 11.5	SANDY SILT (ML)	19	1	13.4	28.9	97.0

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 192023 - 1

Date 2/9/94



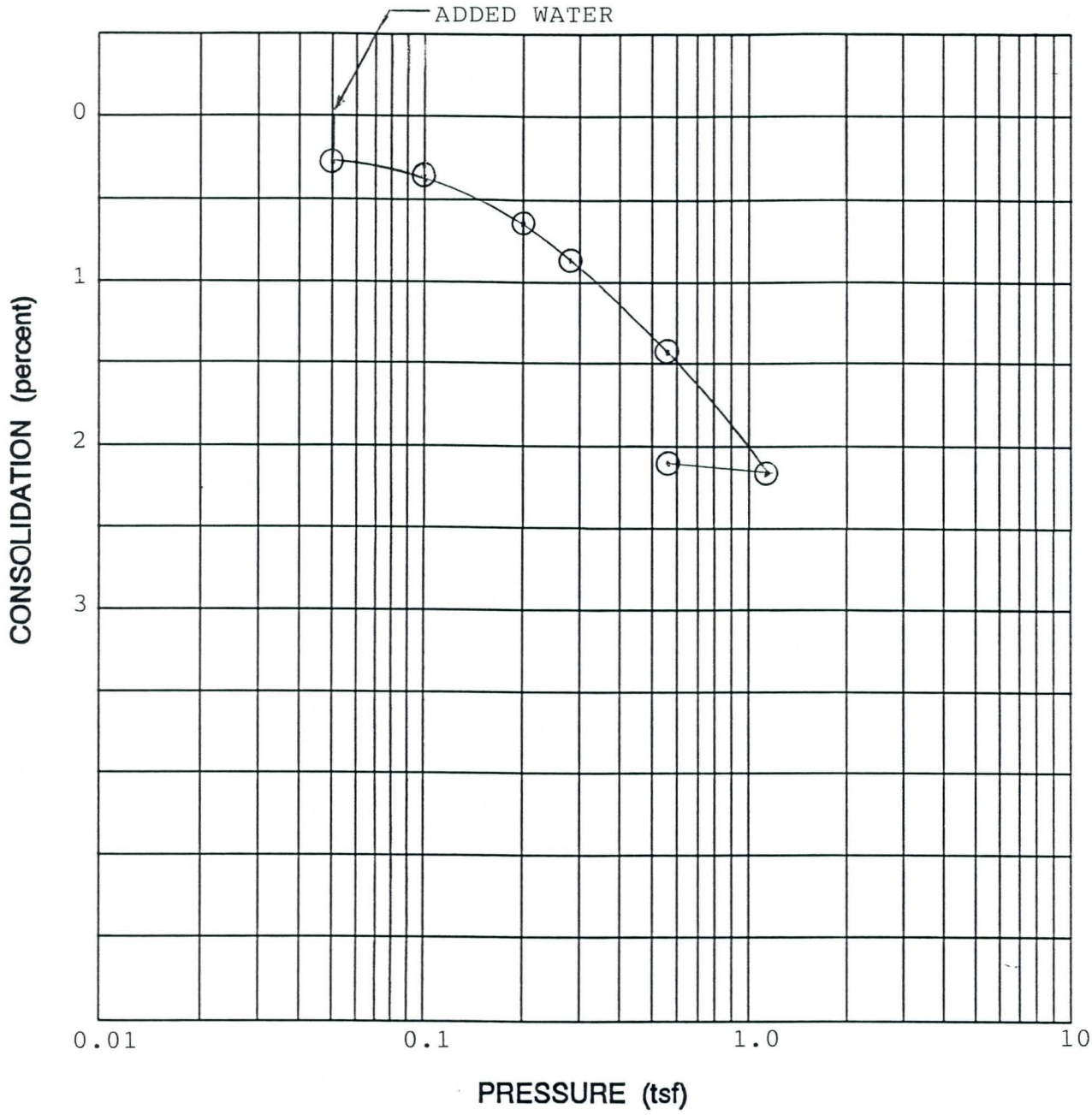
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)		Dry Density (pcf)
						Before	After	
	20	10 - 11.5	WELL GRADED SAND WITH SILT (SW-SM)	--	NP	9.4	22.1	105.6

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 192023 - 1

Date 2/8/94



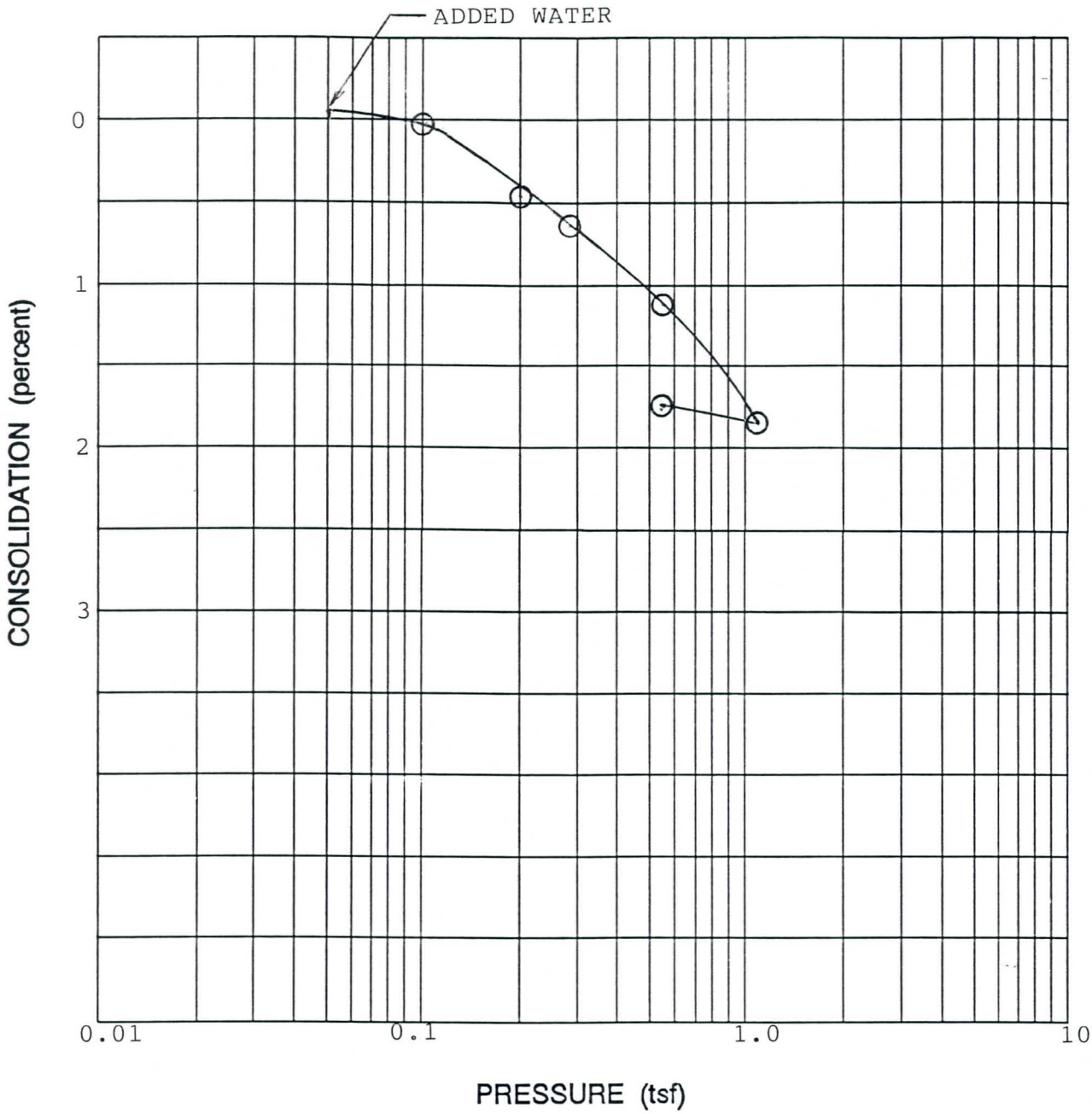
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)		Dry Density (pcf)
						Before	After	
	22	10 - 11.5	WELL GRADED SAND WITH SILT (SW-SM)	--	NP	3.8	20.4	110.2

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 192023 - 1

Date 2/9/94



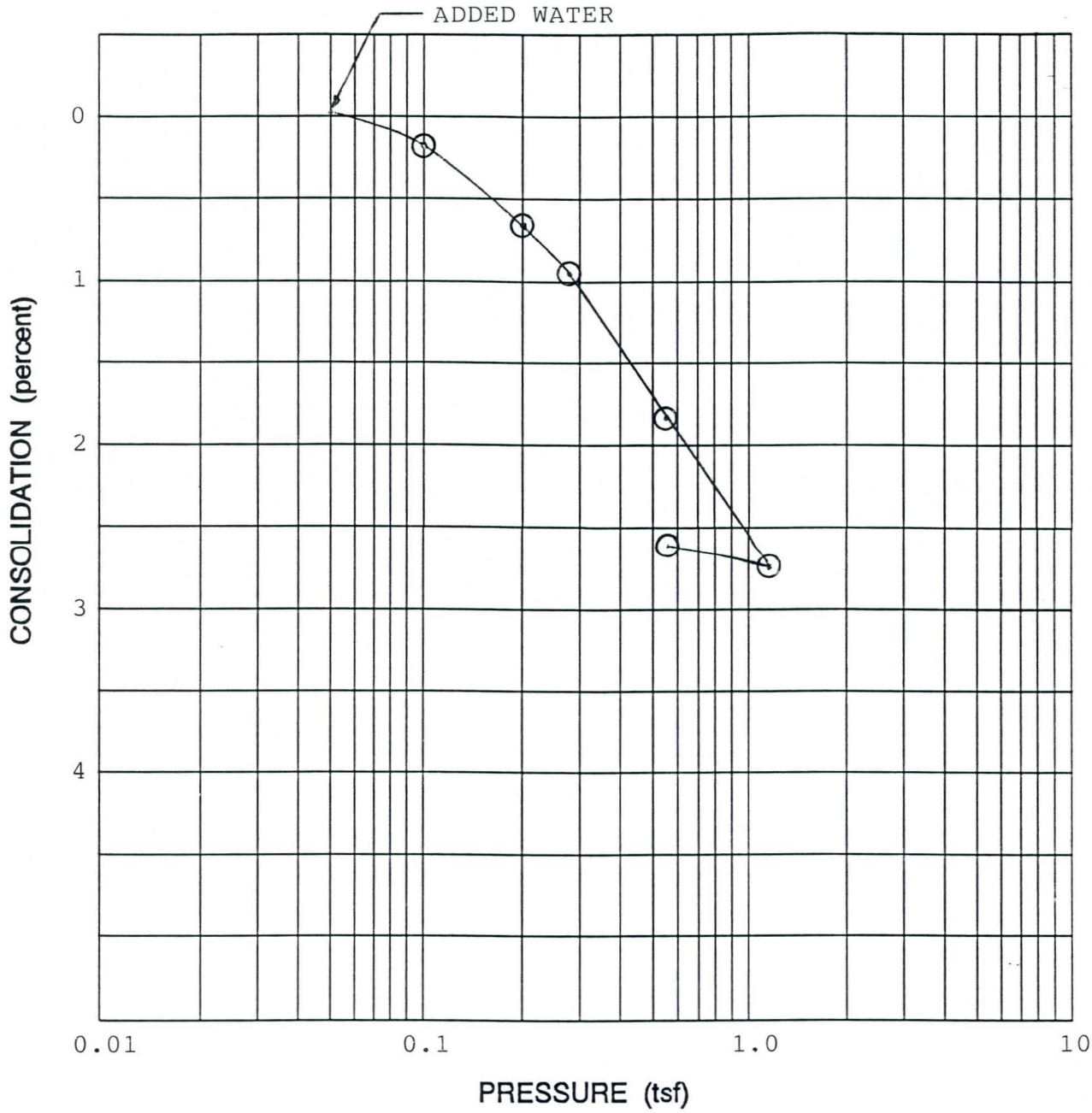
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)		Dry Density (pcf)
						Before	After	
	24	10 - 11.5	SILTY SAND (SM)		NP	11.2	17.6	112.2

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 192023 - 1

Date 2/9/94



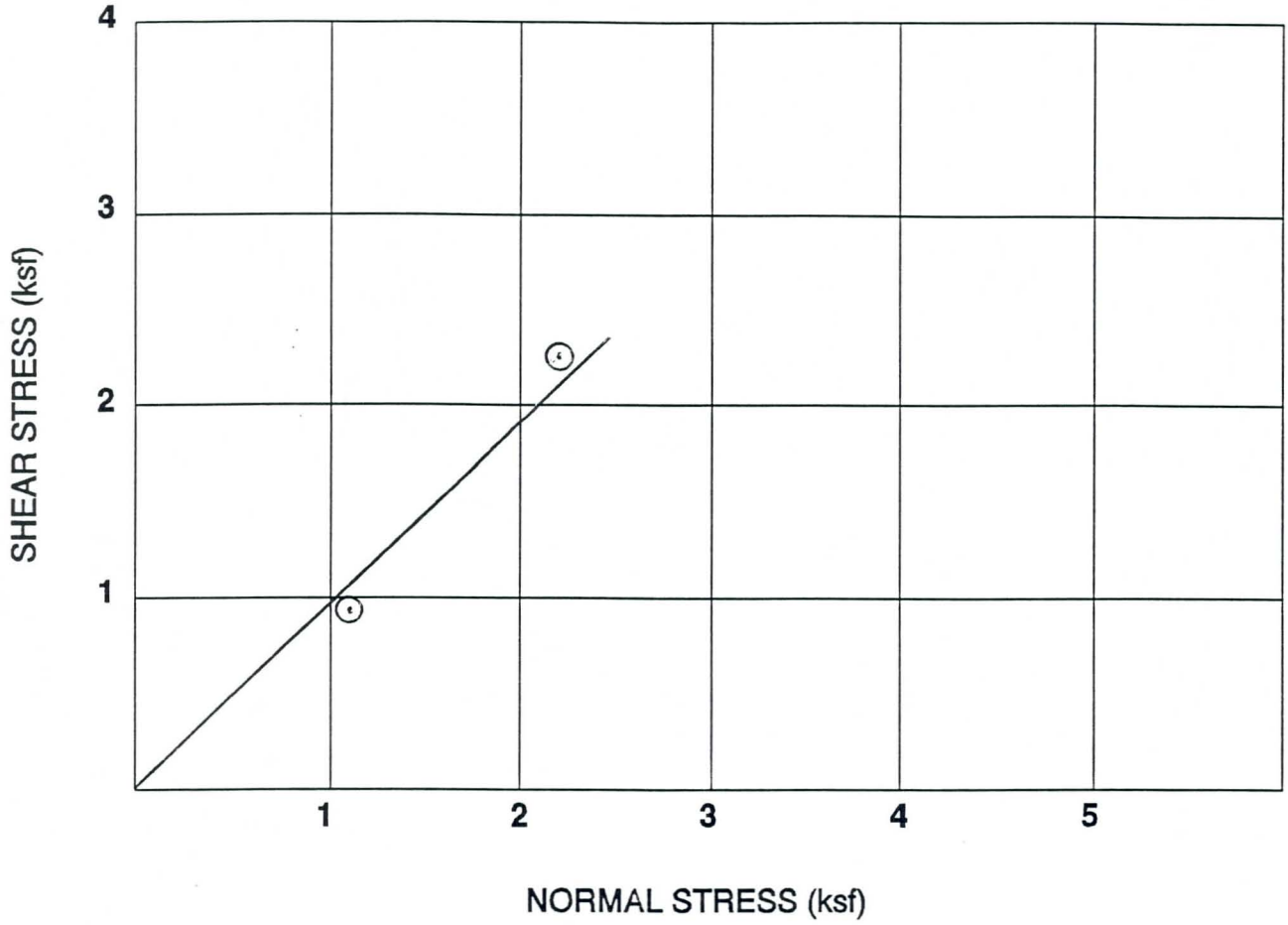
Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)		Dry Density (pcf)
						Before	After	
	25	10 - 11.5	WELL GRADED SAND WITH SILT (SW-SM)	--	NP	11.6	22.0	109.8

ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 192023 - 1

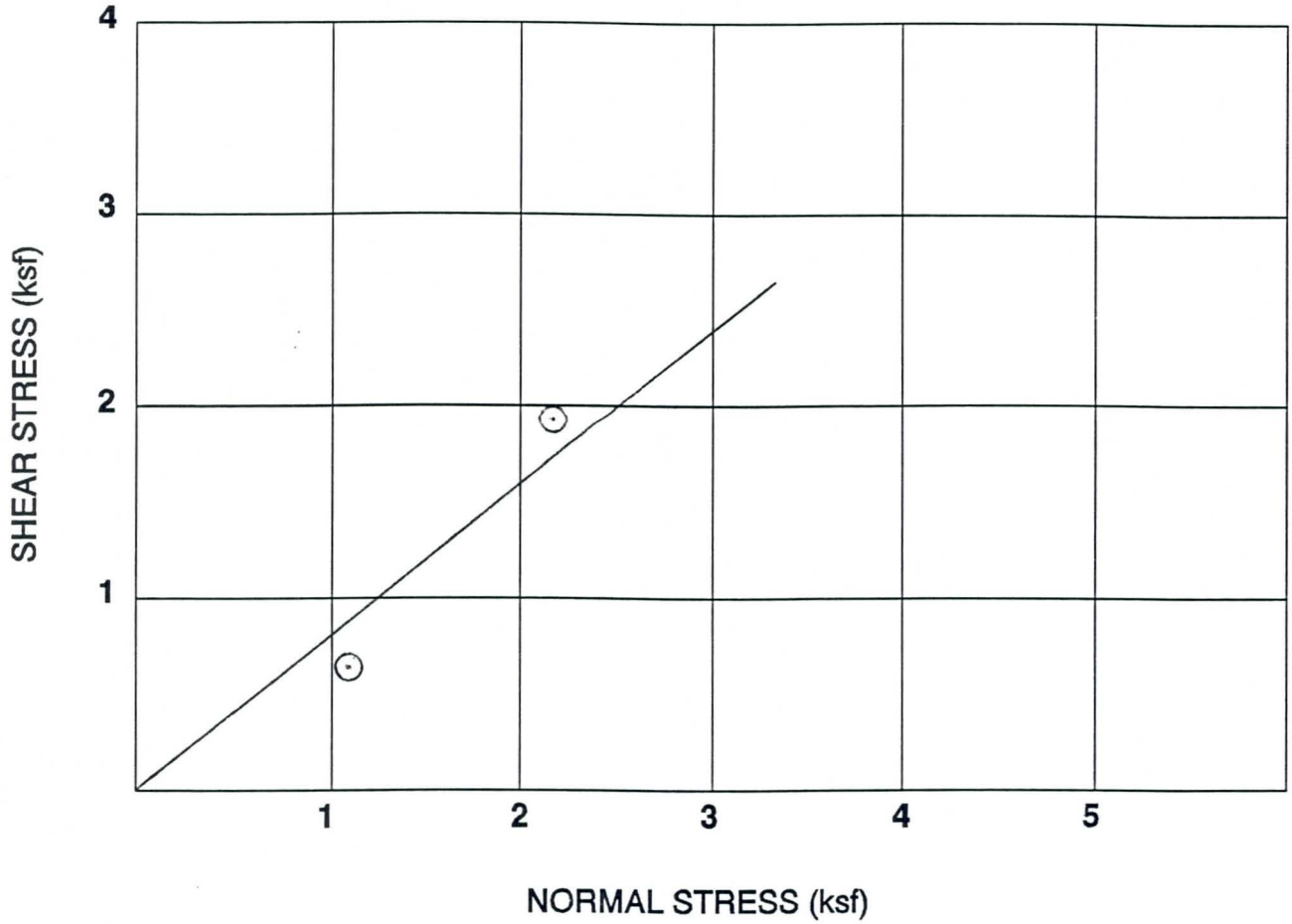
Date 2/9/94



Boring or Test Pit no.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
15	10-11.5	ML	SANDY SILT	0	43.5	19.3	101.1

DIRECT SHEAR TEST DATA

JOB NO. 192023-1

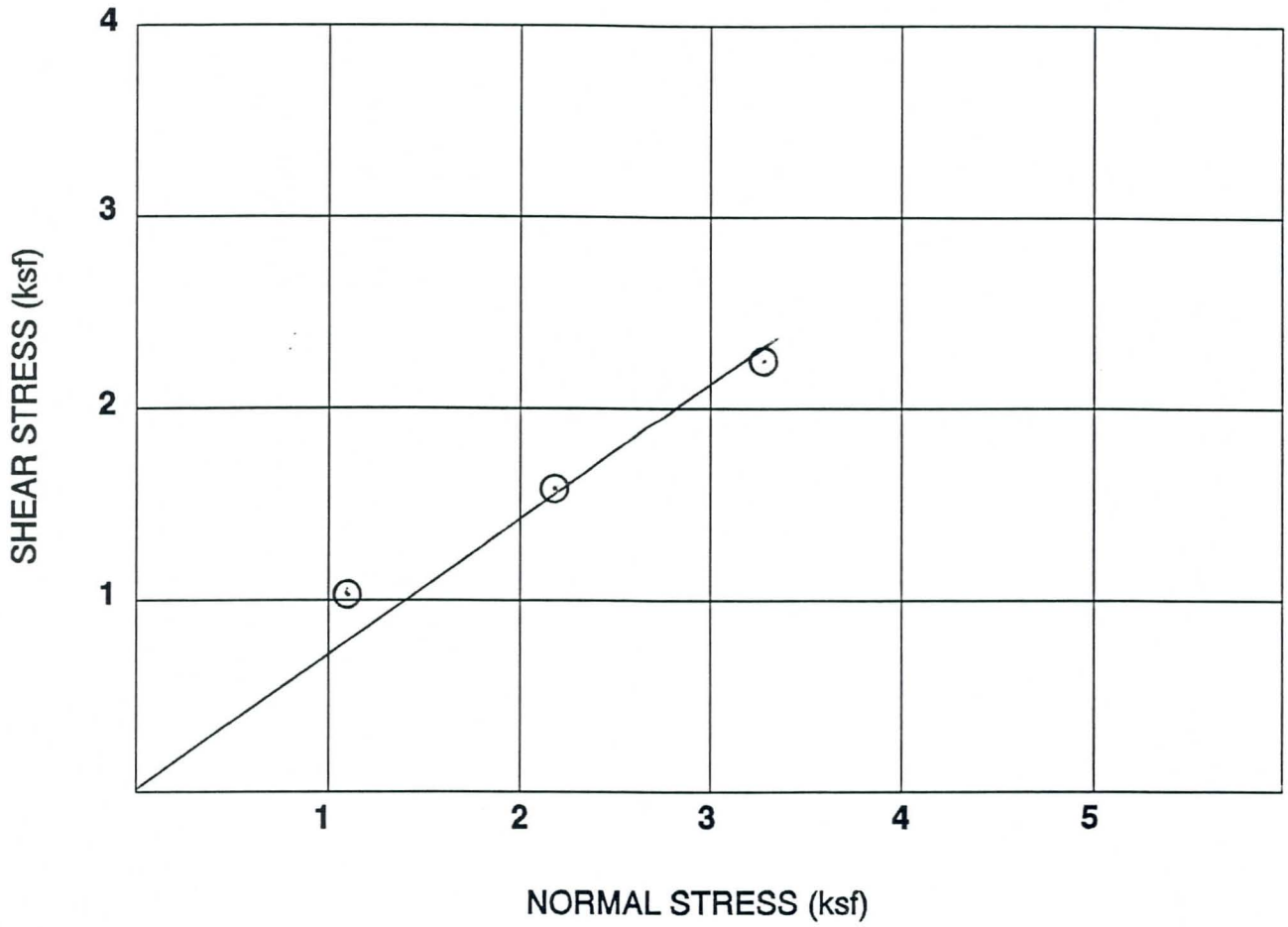


Boring or Test Pit no.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
19	10-11.5	SP-SM	POORLY GRADED SAND WITH SILT	0	38.0	7.0	92.4

DIRECT SHEAR TEST DATA

(REMOLDED)

JOB NO. 192023-1



Boring or Test Pit no.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
27	5-6.5	SM	SILTY SAND	0	35.0	12.4	95.8

DIRECT SHEAR TEST DATA

JOB NO. 192023-1

RITTENHOUSE CHANNEL PHASE II
MCFCD CONTRACT NO. 92-13
MARICOPA COUNTY, ARIZONA
ATL JOB NO. 192023-1

SWELL TEST

Boring No.	Depth (ft)	USCS	Load to Control Swell (psf)	Dry Density (psf)	Moisture (%)
12	5-6.5	CL	175	92.3	13.8

APPENDIX C

PHASE I REPORTS

ATL Inc.
Testing Laboratories
GEOTECHNICAL AND MATERIALS CONSULTANTS

April 5, 1993

Ellis-Murphy Division of Gannett Fleming
3001 E. Camelback, Suite 130
Phoenix, Arizona 85016-4498

Attn: Mr. Ronald Schreier, P.E.

Re: Rittenhouse Channel
MCFCD Contract No. 92-13
ATL Job No. 192023

Gentlemen:

This letter report presents the results of ATL, Inc. (ATL) Phase I geotechnical investigation of the Rittenhouse Channel. ATL conducted the investigation in accordance with the contract with Ellis-Murphy Gannett Fleming (EM) dated January 27, 1993 and ATL's Proposal No. P92255.

The proposed Rittenhouse Channel will be a shallow, wide flood control channel to intercept storm water from the area east and north of Rittenhouse Road and convey it to the east Maricopa Floodway. The proposed channel will be approximately 4.5 miles in length beginning east of Queen Creek School and terminating at the East Maricopa Floodway.

FIELD INVESTIGATION

The field investigation consisted of drilling ten (10) borings to 20 feet of depth at locations selected by Ellis-Murphy. The boring locations are shown on Plates 3 and 4. The borings were completed with a Mobile B50 drill rig.

LABORATORY INVESTIGATION

Selected bulk samples were transported to ATL's laboratory for basic index tests consisting of moisture content, plasticity index and gradation. In addition, pH, resistivity and Standard Proctor determinations were made on selected samples. The laboratory test results are tabulated in the attached sheets.

2922 WEST CLARENDON
16921 S. WESTERN AVE., SUITE 109
PHOENIX, ARIZONA 85017
GARDENA, CALIFORNIA 90247
TELEPHONE (602) 241-1097 / FAX (602) 234-0699
TELEPHONE (310) 538-3757 / FAX (310) 538-0725

SUMMARY OF SUBSURFACE CONDITIONS

The soils encountered from the East Maricopa Floodway to Sossaman Road within the upper 10 feet consist of clayey silty sand (SC-SM), sandy clay (CL), clayey sand (SC), and silty sand (SM). From Sossaman Road to Queen Creek School, the upper 10 feet of soil consists of sandy silt (ML), silty sand (SM) and clayey sand (SC). The soil classifications appearing in parentheses are from the Unified Soils Classification System (USCS).

DISCUSSION AND RECOMMENDATIONS

The design guidelines of the Maricopa County Flood Control District (MCFCD) call for a shallow, wide channel with earthen bottom and side slopes. The main channel will be sized to carry a maximum depth of 2 feet of water with 1 foot of freeboard. All embankment slopes will be a maximum of 4:1 (H:V). Within the main channel, a low-flow section, 1-foot depth will be constructed on the north side for the entire channel length.

The "Alternate A" design of E-M has flow velocities ranging from 2.8 to 5.3 feet per second (fps), a maximum channel slope of 0.28 percent, and box culverts at road crossings with grouted riprap lining at the transitions where flow velocities are increased. Proposed box culvert depths would be 3 feet in the main channel and 4 feet in the low flow portion of the channel.

The MCFCD uses the Federal Highway Administration (FHWA) - Hydraulic Design Series 3 and 4 with Table 5.1 entitled "Maximum Permissible Velocities for Roadside Drainage Channels With Erodible Linings" for the design of earthen channels. Several soil types listed in Table 5.1 have permissible velocities of less than 5 fps. As excerpted from Table 5.1, the soils type with permissible velocities less than 5 fps are given below:

Soils Type of Lining (Earth, No Vegetation)	Maximum Permissible Velocity, fps
Fine Sand (noncolloidal)	2.5
Sandy Loam (noncolloidal)	2.5
Silt Loam (noncolloidal)	3.0
Ordinary Firm Loam	3.5
Alluvial Silts (noncolloidal)	3.5

Based upon the FHWA criteria, field and laboratory data, a major portion of the project has soil types requiring lower maximum permissible velocities or channel lining to prevent erosion. This area with increased soil erosion potential is represented by Boring Nos. 4, 5, 6, 7, 8, 9 and 10. Alternatives for this area should include:

- Soil cement lining of channel bottom and sides.
- Plating the channel bottom and sides with clayey soil from other areas of the project.
- Concrete lining.
- Riprap lining.

Project economics will likely preclude the latter two alternatives.

Four (4) soil samples had pH and box resistivity tests performed. pH values ranged from 7.9 to 8.5. Box resistivities ranged from 734 to 3869 ohm-cm. The sample from Boring No. 4 had a resistivity of 734 ohm-cm. All other samples were above 1500 ohm-cm. Corrosion protection should be provided for metal pipes when resistivities are less than 1500 ohm-cm.

For the Phase II investigation, it is recommended that the frequency and number of borings to 10 feet of depth be increased in order to gain more soil classification information along the route of the proposed shallow channel. With box culverts at road crossings, borings deeper than 10 feet would not be necessary.

It has been ATL's pleasure to serve Ellis-Murphy Gannett Fleming on Phase I of this project. ATL looks forward to performing the work in Phase II of this project.

Reviewed by:

David P. Hayes, P.E.
Executive Vice President

Very truly yours,

James D. Rose, P.E.
Vice President, Geotechnical

JDR/mms

Enclosure

Table 5.1
Maximum Permissible Velocities for Roadside Drainage Channels with Erodible Linings

Soils Type of Lining (Earth, No Vegetation)	Permissible Velocity, fps
Fine Sand (noncolloidal)	2.5
Sandy Loam (noncolloidal)	2.5
Silt Loam (noncolloidal)	3.0
Ordinary Firm Loam	3.5
Fine Gravel	5.0
Stiff Clay (very colloidal)	5.0
Graded, Loam to Cobbles (noncolloidal)	5.0
Graded, Silt to Cobbles (noncolloidal)	5.5
Alluvial Silts (noncolloidal)	3.5
Alluvial Silts (colloidal)	5.0
Coarse Gravel (noncolloidal)	6.0
Cobbles and Shingles	5.5
Shales and Hard Pans	6.0

From: FHWA - HDS 3 & 4, Uniform Soils Classification.

For sinuous channels multiply allowable velocity by:

0.95 for slightly sinuous;
0.9 for moderately sinuous; and
0.8 for highly sinuous

Rounding the channel bottom to approximate a parabolic shape will cause the centerline of the channel to act as a low flow channel. Alternatively, the channel bottom could be graded into a shallow V-shape to lower the centerline.

Because of the potential for long-term channel aggradation, base flows and crop irrigation return flows may require specific consideration. Waterways which are normally dry often have somewhat continuous low flows after urbanization because of lawn irrigation and other outside uses of water, including crop irrigation return flows for developments on the edge of urbanizing areas. Maricopa County is generally typified by low groundwater tables, porous surface materials and limited irrigation, which tend to reduce low flows and short-term problems of aggradation and wet channel bottoms.

Base flows for larger drainage basins can be a significant stability and maintenance problem for earth- or grass-bottomed channels. In this discussion, base flows can be considered as flow rates that are less than the 5- or 10-year storm events. If grass and earth channels are too wide, the low flows will tend to incise a channel within the bottom, giving rise to both higher maintenance requirements and more channel instability when larger storms occur. Because flows of sufficient size to cause a low flow channel to form may not occur for several years, the magnitude of this problem may not be observed for several years.