WIDOWS CREEK

Ponded Fly Ash (Ash Pond)
Scrubber Gypsum
Bottom Ash - From Pond

WIDOWS CREEK

Ponded Fly Ash (Ash Pond)

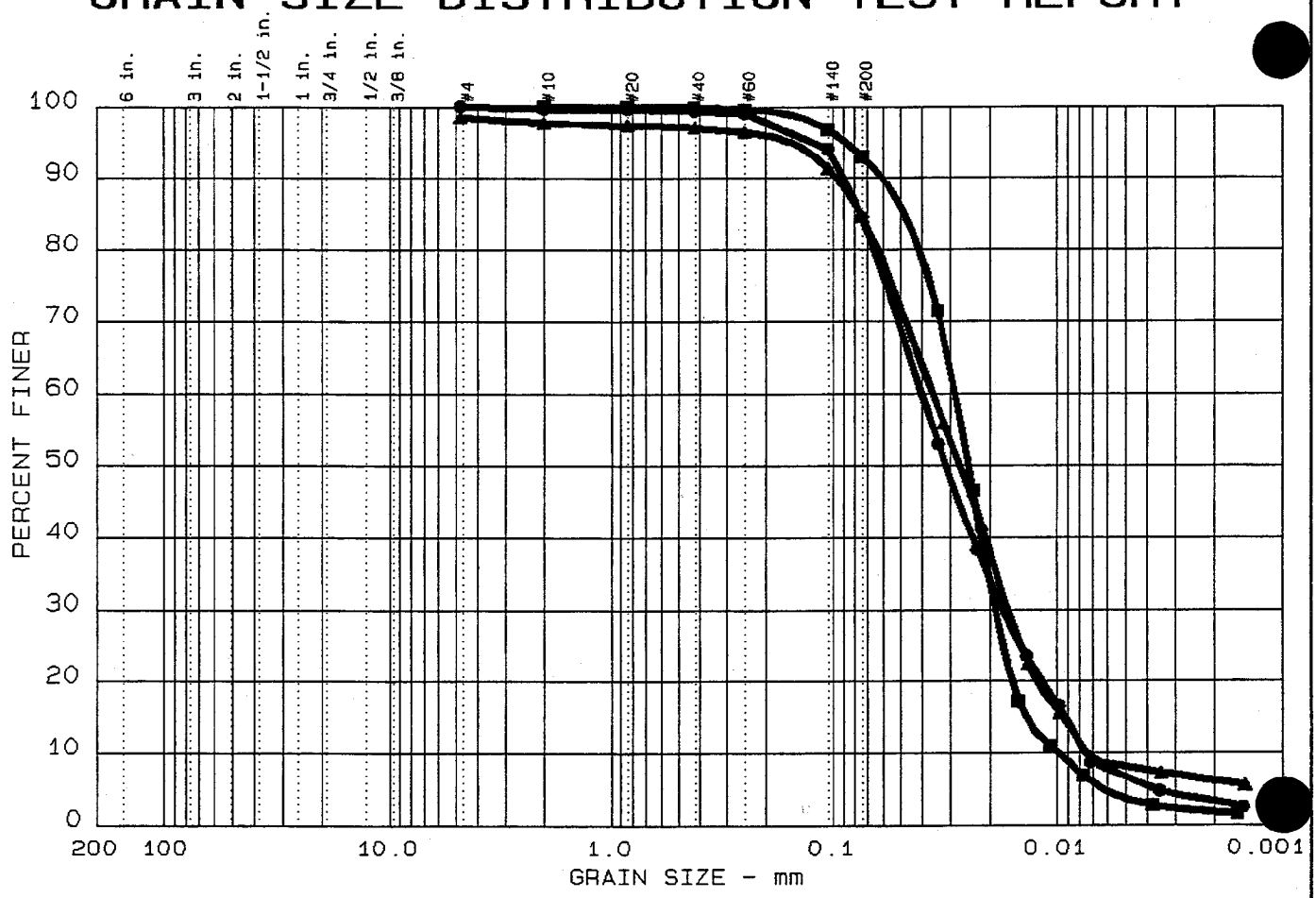
Grain Size Distribution Test Report
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Consolidation Test Report
Hydraulic Conductivity - Falling Head (2 Pages)
Triaxial Compression Test (2 Pages)
Direct Shear Test
California Bearing Ratio
Resilient Modulus (Standard Proctor) (9 Pages)
Resilient Modulus (Modified Proctor) (9 Pages)

TVA - WIDOWS CREEK
PONDED FLY ASH (ASH POND)

Description	Test Method	Property	Sample 1	Sample 2	Sample 3
Grain Size	ASTM D 422	Percent Retained on the #4 Sieve Percent Passing the #200 Sieve Percent Passing the 0.005 mm Sieve	0.0 84.5 6.7	1.5 84.6 8.2	0.0 92.9 3.6
Atterberg Limits	ASTM D 4318	Liquid Limit Plastic Limit Plasticity Index	NL NP N/A	NL NP N/A	NL NP N/A
Specific Gravity	ASTM D 854	Specific Gravity at 20°C	2.38	2.40	2.22
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	ML A-4(0.0)	ML A-4(0.0)	ML A-4(0.0)
			Composite Sample		
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %	67.0 39.8		
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %	73.5 27.8		
			Result	Dry Density, pcf	Moisture Content, %
Consolidation	ASTM D2435	Compression Index C_c	0.12	64.6	38.5
Hydraulic Conductivity	ASTM D 5084	Hydraulic Conductivity, cm/sec	1.8E-4	64.5	38.1
Triaxial Shear Strength Consolidated-Undrained (CU)	ASTM D4767	Effective Stress, Cohesion, c', ksf Effective Stress, Internal Friction Angle, ϕ', degrees	1.85 25.5	64.4	38.3
		Total Stress, Cohesion, c, ksf Total Stress, Internal Friction Angle, ϕ, degrees	1.94 21.5	64.4	38.3
Direct Shear Strength	ASTM D 3080	Cohesion, c, ksf Internal Friction Angle, ϕ, degrees	1.70 31.2	63.6	40.0
California Bearing Ratio	ASTM D 1883	CBR, %	3	66.1	35.7
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	2,384	63.2	38.2
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	5,500	66.8	27.8
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm	1,400		
pH of Soil	AASHTO T 289	pH	9.2		
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg	1060		
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg	<10		

wcf-fa.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	0.0	15.5	77.8	6.7
▲	16	0.0	1.5	13.9	76.4	8.2
■	17	0.0	0.0	7.1	89.3	3.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP	0.07		0.03	0.017	0.0092	0.0075	1.00	5.3
▲	NL	NP	0.07		0.03	0.017	0.0094	0.0074	1.03	4.9
■	NL	NP			0.02	0.019	0.0138	0.0097	1.28	2.9

MATERIAL DESCRIPTION	USCS	AASHTO
● Ash Pond	ML	A-4 (0.0)
▲ Ash Pond	ML	A-4 (0.0)
■ Ash Pond	ML	A-4 (0.0)

Project No.: 5810860101
Project: TVA - Widows Creek
● Location: Ponded Fly Ash A & B
▲ Location: Ponded Fly Ash C & D
■ Location: Ponded Fly Ash E & F
Date: July 18, 1995

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

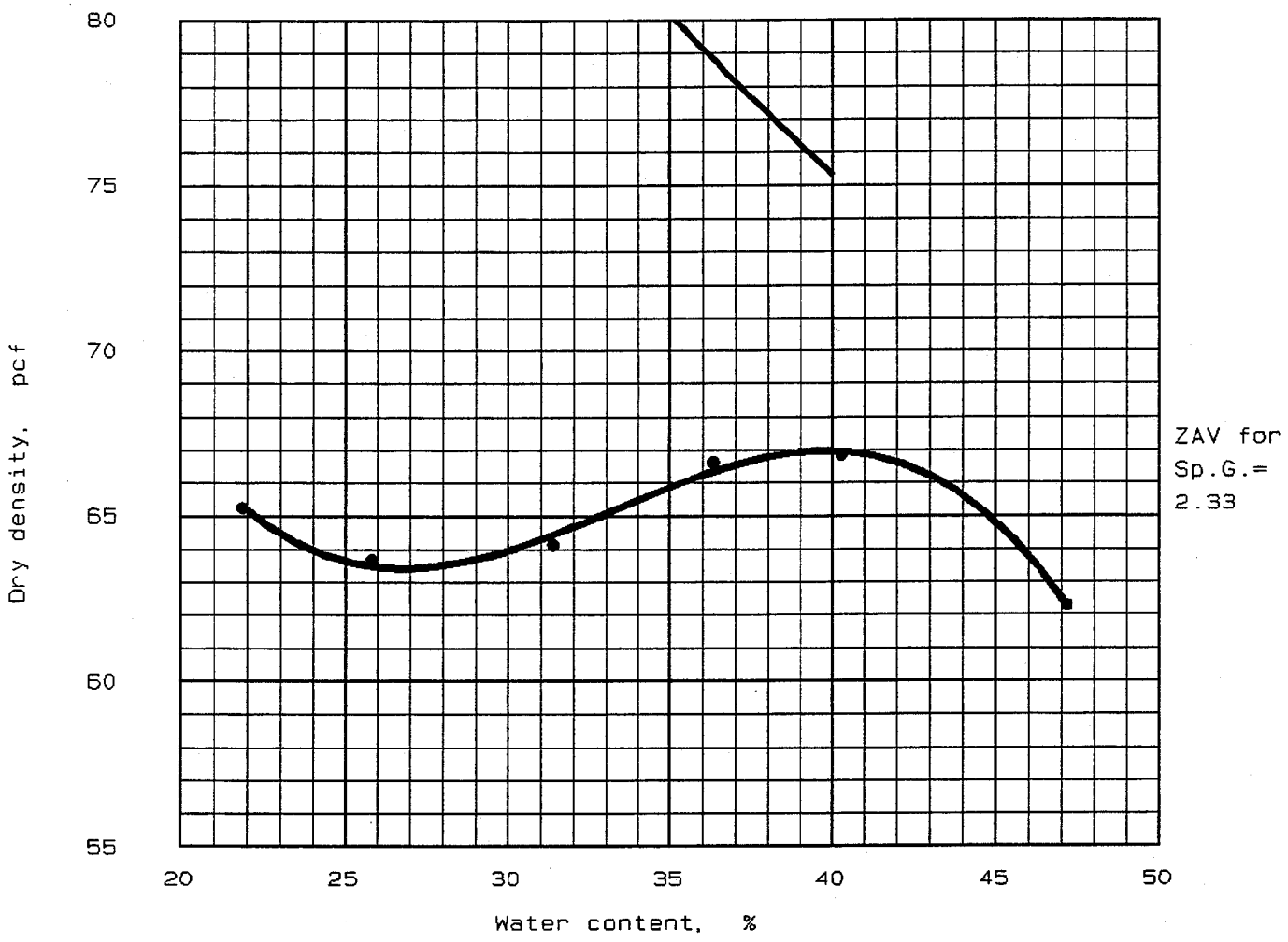
Remarks:

Tested by: JCR

Reviewed by: HS

Figure No.

MOISTURE-DENSITY RELATIONSHIP



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	ML	A-4 (0.0)	60.3 %	2.33	NL	NP	0.5 %	87.3 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 39.8 % Maximum dry density = 67.0 pcf	

Project No.: 5810860101
Project: TVA - Widows Creek
Location: Ponded Fly Ash
Ash Pond
Date: July 25, 1995

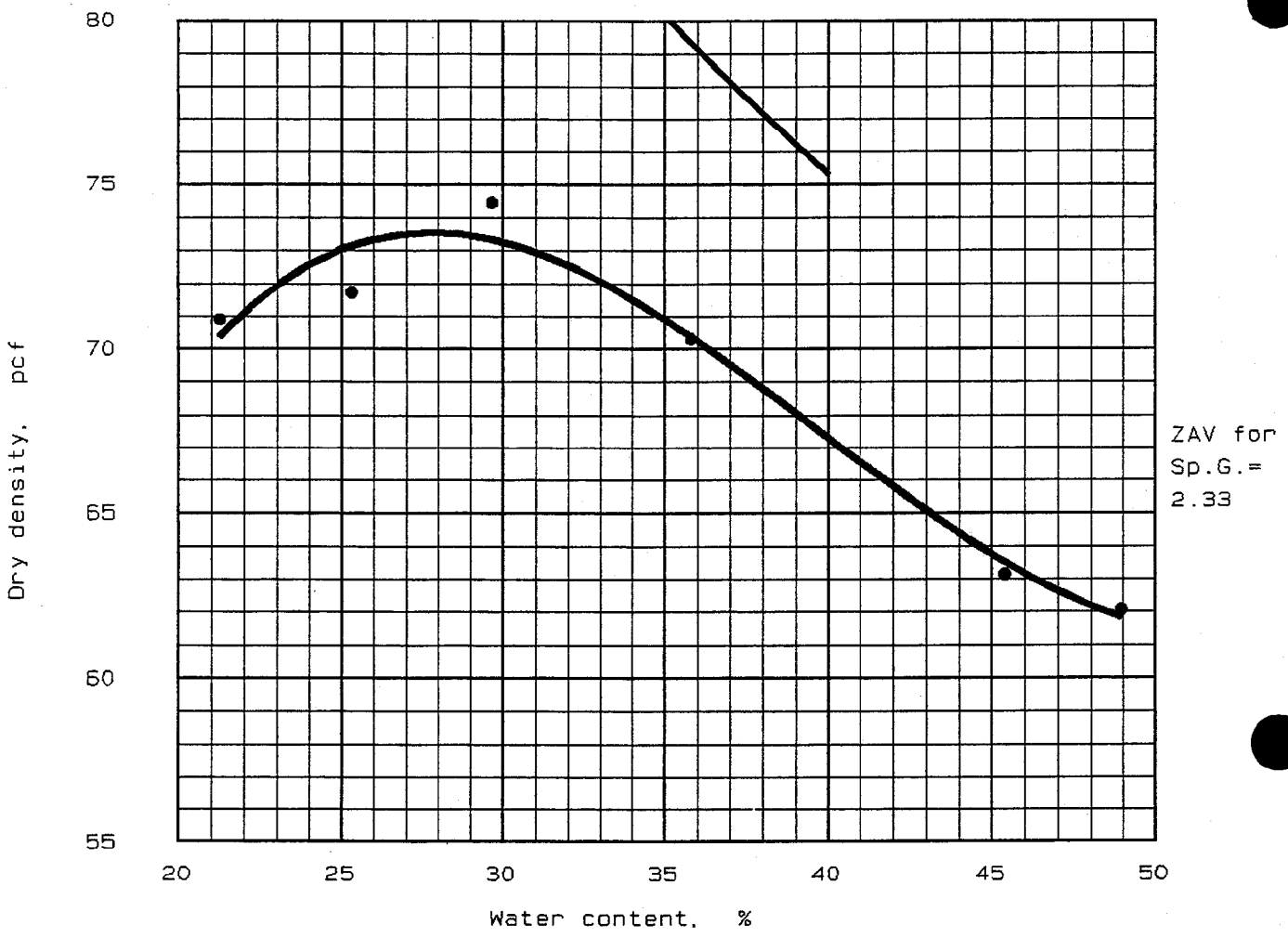
Remarks:
Tested by: JCR
Reviewed by: RCB

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

MOISTURE-DENSITY RELATIONSHIP



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	ML	A-4(0.0)	60.3 %	2.33	NL	NP	0.5 %	87.3 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 27.8 % Maximum dry density = 73.5 pcf	

Project No.: 5810860101
Project: TVA - Widows Creek
Location: Ponded Fly Ash
Ash Pond
Date: July 25, 1995

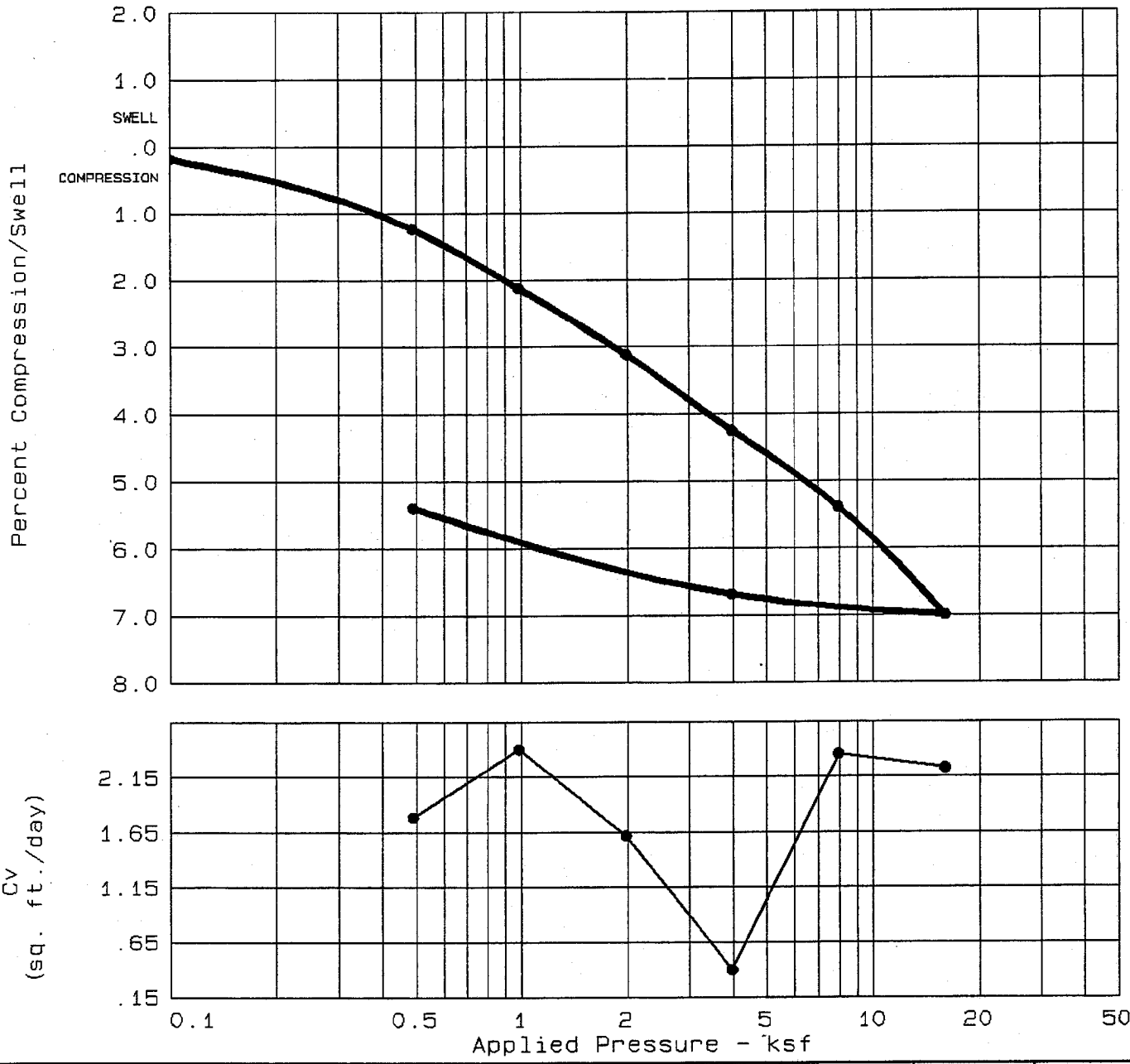
Remarks:
Tested by: JCR
Reviewed by: RLB

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

CONSOLIDATION TEST REPORT



Natural Saturation	Natural Moisture	Dry Density	LL	PI	Sp.Gr.	Precons. press.	C_c	e_0
71.6 %	38.5	64.6	NL	NP	2.332	8.00	0.12	1.2530

TEST RESULTS

Compression Index = 0.12

MATERIAL DESCRIPTION

Class: ML, A-4(0.0)

Project No.: 5810860101
Project: TVA - Widows Creek
Location: Ponded Fly Ash
Ash Pond
Date: August 22, 1995

Remarks:

Tested by: ASK
Reviewed by: MJ

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

Fig. No. _____

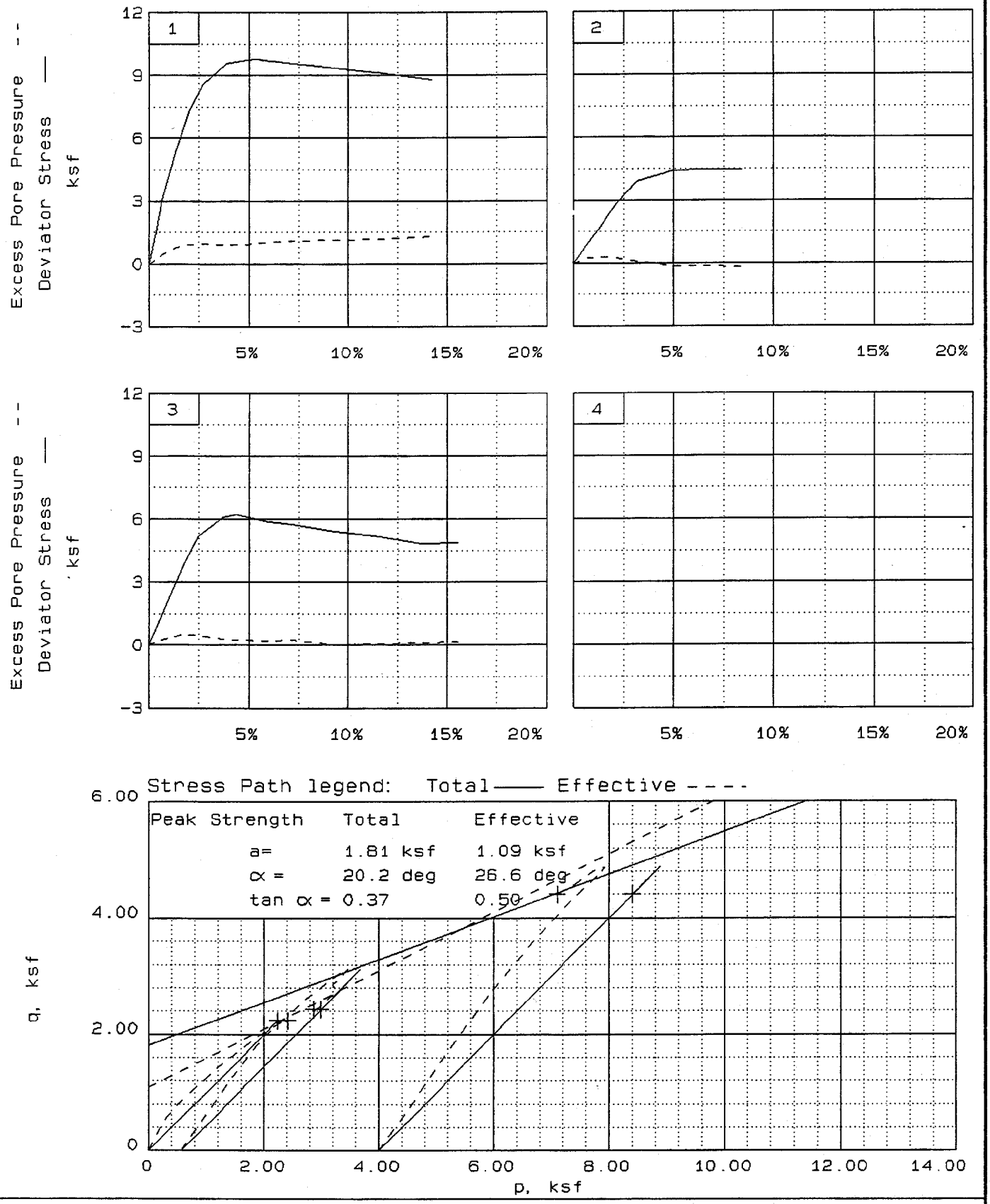
HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*HEJ*
Project Name	*TVA - Widows Creek*	Test Date	*07/22/95*
Material (Source)	*Ponded Fly Ash (Ash Pond)*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D5084 - Falling Head

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*38.1*
Wet Unit Weight, pcf:	*89.0*
Dry Unit Weight, pcf:	*64.5*
Compaction, %:	*96.2*
Hydraulic Conductivity, cm/sec. @20 °C:	***1.8E-04***

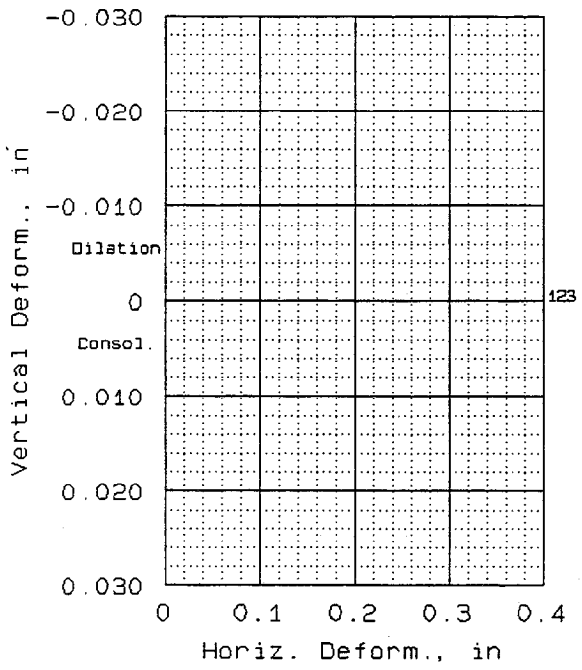


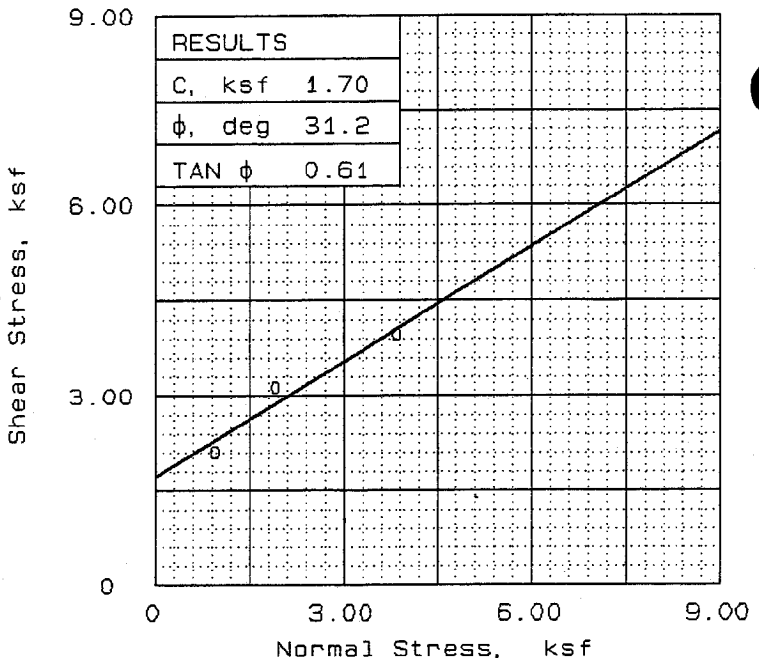
Client:

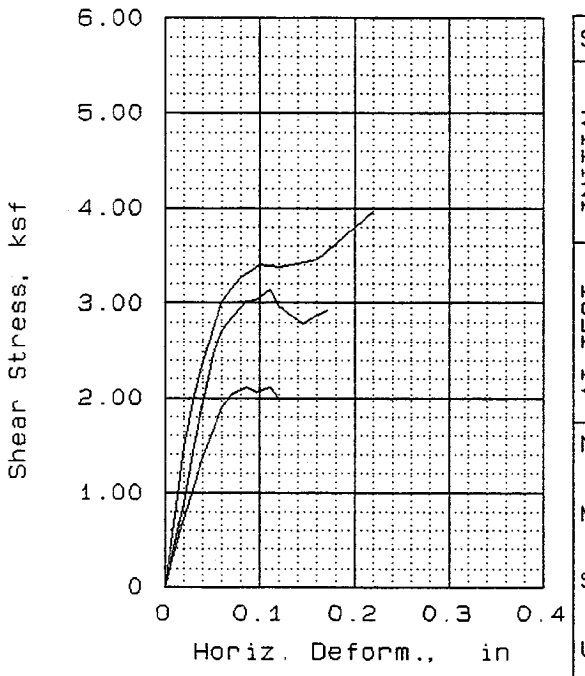
Project: TVA - Widows Creek

Location: Ponded Fly Ash Ash Pond

File: 86010 Project No.: 5810860101 Page 2/2 Fig. No. ____







SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	40.0	39.7	40.3
	DRY DENSITY, pcf	64.3	64.3	62.1
	SATURATION, %	73.7	73.3	69.9
	VOID RATIO	1.264	1.262	1.342
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	40.0	39.7	40.3
	DRY DENSITY, pcf	64.3	64.3	62.1
	SATURATION, %	73.7	73.3	69.9
	VOID RATIO	1.264	1.262	1.342
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
NORMAL STRESS, ksf		0.97	1.94	3.88
MAX. SHEAR, ksf		2.12	3.14	3.96
STRAIN RATE, %/min.		0.500	0.500	0.500
ULT. SHEAR, ksf				

SAMPLE DATA

SAMPLE TYPE: Remolded

DESCRIPTION:

LL= NL PL= NP PI=

SPECIFIC GRAVITY= 2.33

REMARKS: Tested by: HJ

Reviewed by: RWB

FIG. NO.

CLIENT:

PROJECT: TVA - Widows Creek

SAMPLE LOCATION: Ponded Fly Ash
East Cell

PROJ. NO.: 5810860101 DATE: 9/6/95

DIRECT SHEAR TEST

LAW ENGINEERING, INC.

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

LAW ENGINEERING

Job Number	5810860101	Tested By	HEJ
Project Name	TVA - Widows Creek	Test Date	07/22/95
Material (Source)	Ponded Fly Ash (Ash Pond)	Reviewed By	RLB
		Review Date	09/06/95

Sample Data

Length, in		Diameter, in		Pan No.	
Location 1	6.000	Location 1	2.830	Dry Soil+Pan, grams	638.78
Location 2	6.000	Location 2	2.830	Pan Weight, grams	0.00
Location3	6.000	Location 3	2.830		
Average	6.000	Average	2.830	Moisture Content, %	38.1
		Wet Soil + Tare, grams	882.06	Wet Unit Wt, pcf	89.0
		Tare Weight, grams	0.00	Dry Unit Wt, pcf	64.5

Chamber Pressure, psi	37
Back Pressure, psi	23
Confining Pressure, psi	14

Date Start	Date Finish	Time Start	Time Finish	Time (sec)	Division Start	Division Finish	H0 (cm)	Hf (cm)	k cm/sec	Temp (°C)	k cm/sec at 20 °C
				245	50.0	0.0	169.13	119.13	1.8E-04	21	1.8E-04
				246	50.0	0.0	169.13	119.13	1.8E-04	21	1.8E-04
				247	50.0	0.0	169.13	119.13	1.8E-04	21	1.8E-04

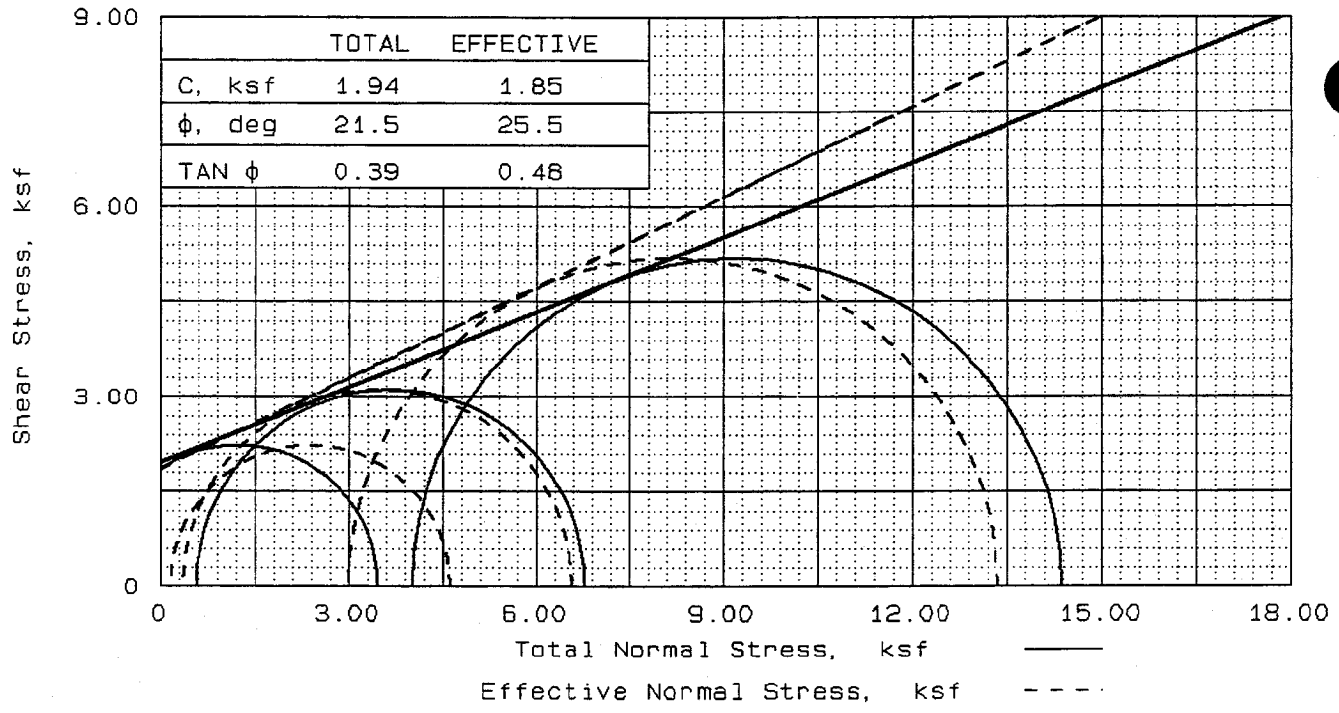
No. of Trial	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
3	Remolded	67.0	96.2	Vertical

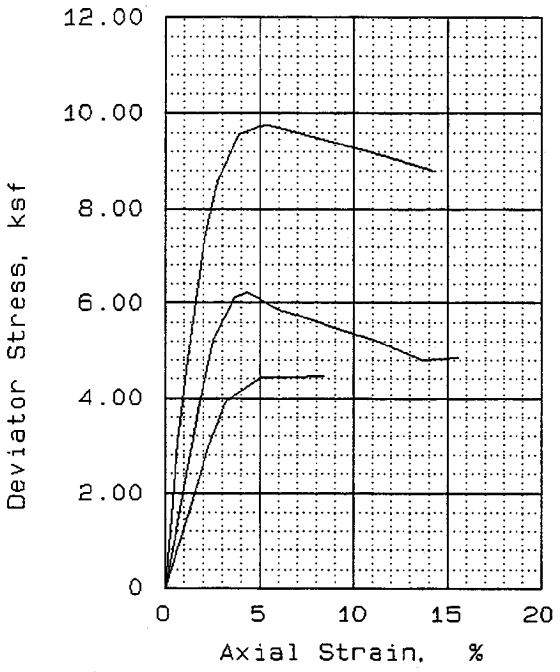
Avg. k at 20 °C 1.8E-04 cm/sec

a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

H0 = initial head in cm
Hf = final head in cm
t = time in seconds

a = 0.34 cm²
A = 40.582 cm²
L = 15.24 cm





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	38.4	38.5	38.1
	DRY DENSITY, pcf	64.4	64.3	64.5
	SATURATION, %	71.0	70.9	70.7
	VOID RATIO	1.260	1.264	1.256
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	27.3	22.7	24.2
	DRY DENSITY, pcf	88.9	95.2	93.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.636	0.529	0.564
	DIAMETER, in	2.42	2.33	2.36
	HEIGHT, in	5.93	5.98	6.00
BACK PRESSURE, ksf		3.38	4.26	3.56
CELL PRESSURE, ksf		7.39	3.27	4.12
FAILURE STRESS, ksf		10.36	4.46	6.22
PORE PRESSURE, ksf		4.39	3.11	3.77
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		13.36	4.62	6.57
$\bar{\sigma}_3$ FAILURE, ksf		3	0.16	0.35

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

LL= NL PL= NP PI=
SPECIFIC GRAVITY= 2.33
REMARKS: Tested by: HJ

Reviewed by: RLP

FIG. NO.

CLIENT:

PROJECT: TVA - Widows Creek

SAMPLE LOCATION: Ponded Fly Ash
Ash Pond

PROJ. NO.: 5810860101 DATE: August 30, 1995

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.

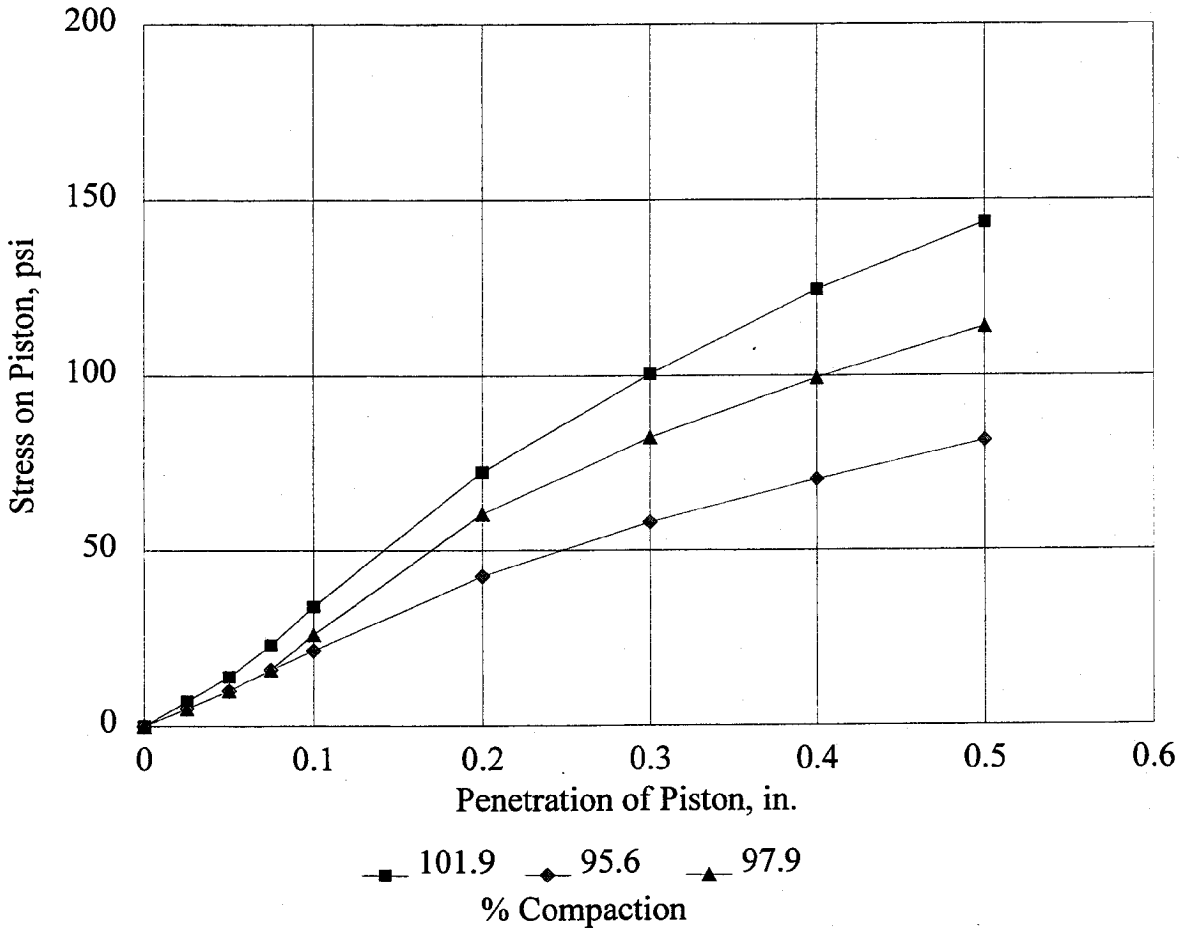
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Widows Creek	**Test Date**	08/18/95
Material (Source)	Ponded Fly Ash (Ash Pond)	**Reviewed By**	RLB
		Review Date	08/23/95

Compaction, %	101.9	95.6	97.9
Before Soak Dry Density, pcf	68.4	64.2	65.7
Before Soak Moisture Content,	36.8	35.0	35.4
After Soak Dry Density, pcf	66.9	62.8	64.1
After Soak Moisture Content, %	51.3	53.3	52.0
CBR @ 0.1 in.	3.4	2.2	2.6
CBR @ 0.2 in.	4.8	2.8	4.0



LABORATORY MATERIAL HANDLING AND TESTING SHEET NO 1 OF 2

LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Ponded fly Ash (Ash Pond)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO .:*	
	SPECIMEN DIAM., inch	
	TOP	2.86
	MIDDLE	2.85
	BOTTOM	2.85
	AVERAGE	2.85
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.14
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.14
	INITIAL AREA, A_0 , in^2	6.29
	INITIAL VOLUME $A_0 L_0$, in^3	38.60
7.	*SOIL SPECIMEN WEIGHT* :	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1077.00
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	190.90
	WEIGHT OF WET SOIL USED , grams	886.10
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	39.8
	MAX. DRY DENSITY, pcf	67.0
	95 % MAX. DRY DENSITY, pcf	63.7
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	38.2
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	38.2
	COMPACTION DRY DENSITY, γ_d pcf	63.2
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	23.5
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	08-24-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

R J Bendana 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Widows Creek
2. *MATERIAL DESCRIPTION:* Ponded fly Ash (Ash Pond)
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-24-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ ._	_ _ _ ._	_	_ _ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ ._	_ ._ _ _ _ _	_ ._ _ _ _ _	_ ._ _ _ _ _	._ _ _ _	_ _ _ _ .
SEQUENCE 1	6.0	2.0	1	12.3	11.0	1.3	2.0	1.8	0.2	0.00303	0.00284	0.00293	0.00048	3,660
			2	12.3	10.9	1.3	1.9	1.7	0.2	0.00303	0.00284	0.00294	0.00048	3,636
			3	12.3	11.0	1.3	2.0	1.7	0.2	0.00303	0.00283	0.00293	0.00048	3,647
			4	12.3	11.0	1.3	2.0	1.7	0.2	0.00303	0.00284	0.00293	0.00048	3,651
			5	12.3	11.0	1.3	2.0	1.7	0.2	0.00304	0.00284	0.00294	0.00048	3,649
	COLUMN AVERAGE			12.3	11.0	1.3	2.0	1.7	0.2	0.00303	0.00284	0.00294	0.00048	3,649
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	9

Source: Widows Creek Description: Ponded fly Ash (Ash Pond) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.0	22.6	2.4	4.0	3.6	0.4	0.00627	0.00599	0.00613	0.00100	3,594
			2	25.0	22.6	2.4	4.0	3.6	0.4	0.00628	0.00600	0.00614	0.00100	3,589
			3	25.0	22.6	2.4	4.0	3.6	0.4	0.00627	0.00598	0.00613	0.00100	3,598
			4	25.0	22.9	2.1	4.0	3.6	0.3	0.00632	0.00602	0.00617	0.00101	3,620
			5	25.1	22.7	2.4	4.0	3.6	0.4	0.00628	0.00600	0.00614	0.00100	3,608
	COLUMN AVERAGE			25.0	22.7	2.3	4.0	3.6	0.4	0.00629	0.00600	0.00614	0.00100	3,602
	STANDARD DEV.			0.0	0.1	0.1	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	12
SEQUENCE 3	6.0	6.0	1	36.7	33.1	3.6	5.8	5.3	0.6	0.00972	0.00935	0.00954	0.00155	3,387
			2	36.7	33.1	3.6	5.8	5.3	0.6	0.00972	0.00935	0.00953	0.00155	3,389
			3	36.8	33.2	3.6	5.8	5.3	0.6	0.00974	0.00934	0.00954	0.00155	3,391
			4	36.8	33.2	3.6	5.9	5.3	0.6	0.00971	0.00935	0.00953	0.00155	3,402
			5	36.8	33.2	3.6	5.9	5.3	0.6	0.00974	0.00935	0.00954	0.00156	3,398
	COLUMN AVERAGE			36.8	33.2	3.6	5.8	5.3	0.6	0.00972	0.00935	0.00954	0.00155	3,394
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	6
SEQUENCE 4	6.0	8.0	1	49.5	44.6	4.8	7.9	7.1	0.8	0.01331	0.01288	0.01309	0.00213	3,324
			2	49.5	44.6	4.8	7.9	7.1	0.8	0.01328	0.01288	0.01308	0.00213	3,328
			3	49.5	44.6	4.8	7.9	7.1	0.8	0.01332	0.01285	0.01309	0.00213	3,328
			4	49.5	44.6	4.8	7.9	7.1	0.8	0.01327	0.01287	0.01307	0.00213	3,331
			5	49.4	44.6	4.8	7.9	7.1	0.8	0.01329	0.01286	0.01307	0.00213	3,327
	COLUMN AVERAGE			49.5	44.6	4.8	7.9	7.1	0.8	0.01329	0.01287	0.01308	0.00213	3,328
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	2

Source: Widows Creek Description: Ponded fly Ash (Ash Pond) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	62.1	56.0	6.1	9.9	8.9	1.0	0.01662	0.01617	0.01640	0.00267	3,332
			2	62.2	56.1	6.1	9.9	8.9	1.0	0.01659	0.01619	0.01639	0.00267	3,337
			3	62.1	56.0	6.1	9.9	8.9	1.0	0.01662	0.01618	0.01640	0.00267	3,332
			4	62.1	56.1	6.1	9.9	8.9	1.0	0.01661	0.01617	0.01639	0.00267	3,338
			5	62.2	56.1	6.1	9.9	8.9	1.0	0.01662	0.01619	0.01641	0.00267	3,335
	COLUMN AVERAGE			62.1	56.1	6.1	9.9	8.9	1.0	0.01661	0.01618	0.01640	0.00267	3,335
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	3
SEQUENCE 6	4.0	2.0	1	12.5	10.8	1.7	2.0	1.7	0.3	0.00368	0.00346	0.00357	0.00058	2,947
			2	12.6	10.9	1.7	2.0	1.7	0.3	0.00372	0.00350	0.00361	0.00059	2,939
			3	12.5	10.8	1.7	2.0	1.7	0.3	0.00370	0.00349	0.00360	0.00059	2,929
			4	12.6	10.8	1.7	2.0	1.7	0.3	0.00371	0.00348	0.00359	0.00059	2,943
			5	12.5	10.8	1.7	2.0	1.7	0.3	0.00370	0.00347	0.00359	0.00058	2,947
	COLUMN AVERAGE			12.5	10.8	1.7	2.0	1.7	0.3	0.00370	0.00348	0.00359	0.00059	2,941
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	7
SEQUENCE 7	4.0	4.0	1	24.6	22.2	2.4	3.9	3.5	0.4	0.00870	0.00838	0.00854	0.00139	2,537
			2	24.5	22.1	2.4	3.9	3.5	0.4	0.00869	0.00839	0.00854	0.00139	2,526
			3	24.7	22.3	2.4	3.9	3.5	0.4	0.00872	0.00842	0.00857	0.00140	2,535
			4	24.5	22.1	2.4	3.9	3.5	0.4	0.00870	0.00840	0.00855	0.00139	2,520
			5	24.5	22.1	2.4	3.9	3.5	0.4	0.00872	0.00842	0.00857	0.00140	2,516
	COLUMN AVERAGE			24.6	22.2	2.4	3.9	3.5	0.4	0.00870	0.00840	0.00855	0.00139	2,527
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	9

Source: Widows Creek Description: Ponded fly Ash (Ash Pond) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	36.9	33.3	3.6	5.9	5.3	0.6	0.01337	0.01300	0.01319	0.00215	2,464
			2	37.0	33.3	3.6	5.9	5.3	0.6	0.01339	0.01295	0.01317	0.00215	2,469
			3	36.9	33.3	3.6	5.9	5.3	0.6	0.01339	0.01294	0.01316	0.00215	2,468
			4	36.9	33.3	3.6	5.9	5.3	0.6	0.01340	0.01298	0.01319	0.00215	2,462
			5	37.0	33.4	3.6	5.9	5.3	0.6	0.01341	0.01297	0.01319	0.00215	2,467
	COLUMN AVERAGE			36.9	33.3	3.6	5.9	5.3	0.6	0.01339	0.01297	0.01318	0.00215	2,466
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	3
SEQUENCE 9	4.0	8.0	1	49.7	44.8	4.9	7.9	7.1	0.8	0.01713	0.01664	0.01689	0.00275	2,589
			2	49.8	44.9	4.8	7.9	7.1	0.8	0.01713	0.01664	0.01689	0.00275	2,596
			3	49.7	44.9	4.9	7.9	7.1	0.8	0.01710	0.01665	0.01688	0.00275	2,594
			4	49.7	44.8	4.9	7.9	7.1	0.8	0.01713	0.01662	0.01688	0.00275	2,591
			5	49.7	44.8	4.9	7.9	7.1	0.8	0.01709	0.01665	0.01687	0.00275	2,590
	COLUMN AVERAGE			49.7	44.9	4.9	7.9	7.1	0.8	0.01711	0.01664	0.01688	0.00275	2,592
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	3
SEQUENCE 10	4.0	10.0	1	62.5	56.4	6.1	9.9	9.0	1.0	0.02048	0.01999	0.02024	0.00330	2,718
			2	62.5	56.4	6.1	9.9	9.0	1.0	0.02049	0.01998	0.02023	0.00330	2,719
			3	62.7	56.5	6.1	10.0	9.0	1.0	0.02046	0.01995	0.02021	0.00329	2,729
			4	62.8	56.7	6.1	10.0	9.0	1.0	0.02047	0.01998	0.02023	0.00330	2,732
			5	62.8	56.8	6.1	10.0	9.0	1.0	0.02047	0.01998	0.02023	0.00330	2,737
	COLUMN AVERAGE			62.6	56.5	6.1	10.0	9.0	1.0	0.02047	0.01998	0.02023	0.00330	2,727
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8

Source: Widows Creek Description: Ponded fly Ash (Ash Pond) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.1	11.0	2.1	2.1	1.8	0.3	0.00527	0.00504	0.00515	0.00084	2,088
			2	13.1	11.0	2.1	2.1	1.7	0.3	0.00528	0.00507	0.00518	0.00084	2,066
			3	13.2	11.1	2.1	2.1	1.8	0.3	0.00525	0.00507	0.00516	0.00084	2,093
			4	13.1	11.0	2.1	2.1	1.8	0.3	0.00527	0.00505	0.00516	0.00084	2,080
			5	13.2	11.1	2.1	2.1	1.8	0.3	0.00529	0.00505	0.00517	0.00084	2,093
	COLUMN AVERAGE			13.1	11.0	2.1	2.1	1.8	0.3	0.00527	0.00506	0.00516	0.00084	2,084
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	11
SEQUENCE 12	2.0	4.0	1	24.5	22.1	2.4	3.9	3.5	0.4	0.01212	0.01178	0.01195	0.00195	1,805
			2	24.6	22.1	2.4	3.9	3.5	0.4	0.01210	0.01181	0.01196	0.00195	1,807
			3	24.6	22.2	2.4	3.9	3.5	0.4	0.01213	0.01180	0.01196	0.00195	1,808
			4	24.6	22.1	2.4	3.9	3.5	0.4	0.01212	0.01182	0.01197	0.00195	1,805
			5	24.6	22.2	2.4	3.9	3.5	0.4	0.01212	0.01179	0.01196	0.00195	1,814
	COLUMN AVERAGE			24.6	22.2	2.4	3.9	3.5	0.4	0.01212	0.01180	0.01196	0.00195	1,808
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	4
SEQUENCE 13	2.0	6.0	1	37.7	34.1	3.7	6.0	5.4	0.6	0.01783	0.01740	0.01762	0.00287	1,887
			2	37.5	33.9	3.6	6.0	5.4	0.6	0.01784	0.01741	0.01762	0.00287	1,875
			3	37.5	33.8	3.6	6.0	5.4	0.6	0.01782	0.01739	0.01761	0.00287	1,875
			4	37.6	33.9	3.6	6.0	5.4	0.6	0.01781	0.01742	0.01762	0.00287	1,879
			5	37.5	33.9	3.6	6.0	5.4	0.6	0.01781	0.01742	0.01762	0.00287	1,877
	COLUMN AVERAGE			37.6	33.9	3.6	6.0	5.4	0.6	0.01782	0.01741	0.01762	0.00287	1,879
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	5

Source: Widows Creek Description: Ponded fly Ash (Ash Pond) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.6	45.7	4.9	8.0	7.3	0.8	0.02171	0.02126	0.02149	0.00350	2,072
			2	50.5	45.6	4.9	8.0	7.2	0.8	0.02169	0.02127	0.02148	0.00350	2,071
			3	50.5	45.6	4.9	8.0	7.3	0.8	0.02172	0.02125	0.02149	0.00350	2,072
			4	50.5	45.6	4.9	8.0	7.3	0.8	0.02168	0.02125	0.02147	0.00350	2,073
			5	50.4	45.5	4.9	8.0	7.2	0.8	0.02170	0.02124	0.02147	0.00350	2,068
	COLUMN AVERAGE			50.5	45.6	4.9	8.0	7.3	0.8	0.02170	0.02126	0.02148	0.00350	2,071
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	2
SEQUENCE 15	2.0	10.0	1	63.3	57.1	6.1	10.1	9.1	1.0	0.02545	0.02491	0.02518	0.00410	2,213
			2	63.2	57.1	6.2	10.1	9.1	1.0	0.02543	0.02490	0.02517	0.00410	2,212
			3	63.3	57.2	6.2	10.1	9.1	1.0	0.02544	0.02489	0.02516	0.00410	2,217
			4	63.4	57.2	6.1	10.1	9.1	1.0	0.02542	0.02490	0.02516	0.00410	2,219
			5	63.4	57.2	6.2	10.1	9.1	1.0	0.02543	0.02488	0.02515	0.00410	2,219
	COLUMN AVERAGE			63.3	57.2	6.2	10.1	9.1	1.0	0.02543	0.02489	0.02516	0.00410	2,216
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	3

SUBMITTED BY, DATE

R S Boudreau 9/10/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Ponded fly Ash (Ash Pond)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-24-1995

$$M_R = K1\,(S_C)^{K2}\,(1+S_3)^{K5}$$

K1 =	1,026
K2 =	-0.02608
K5 =	0.63430
R^2 =	0.92

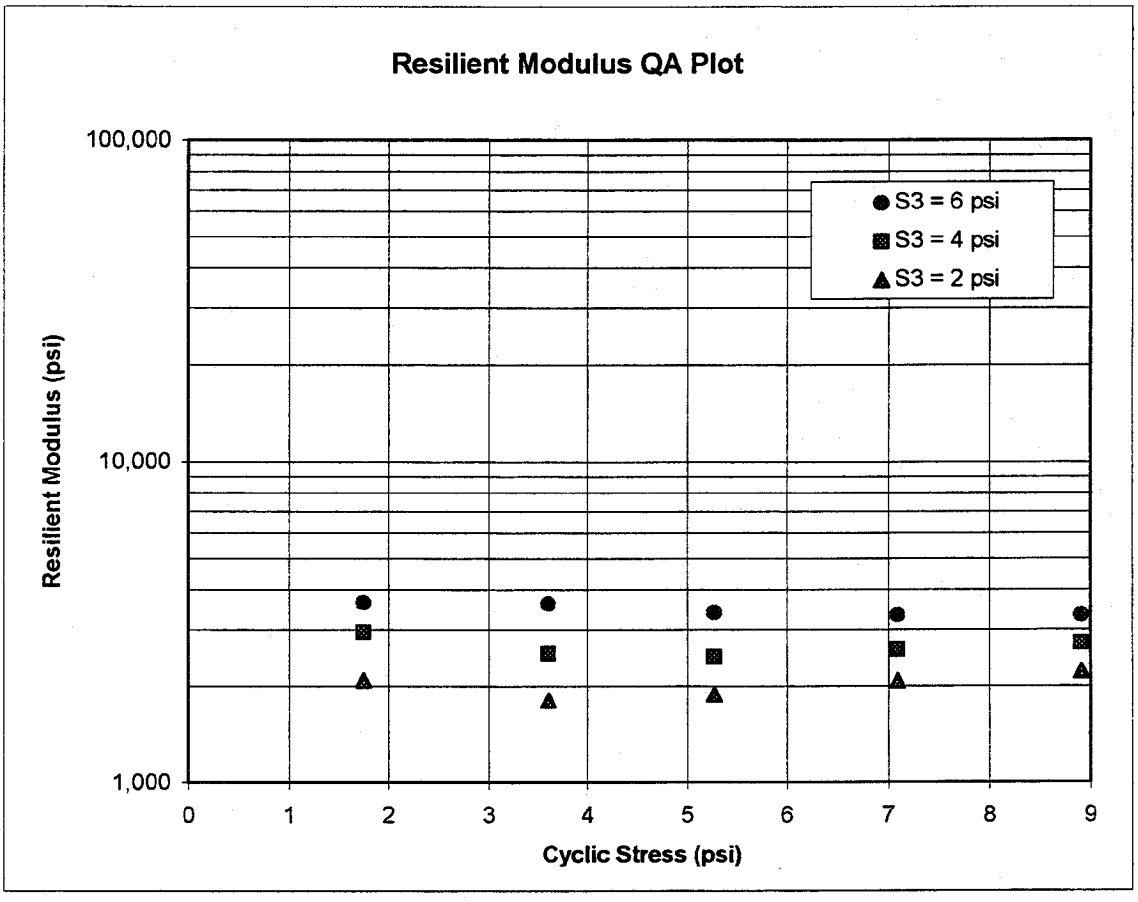
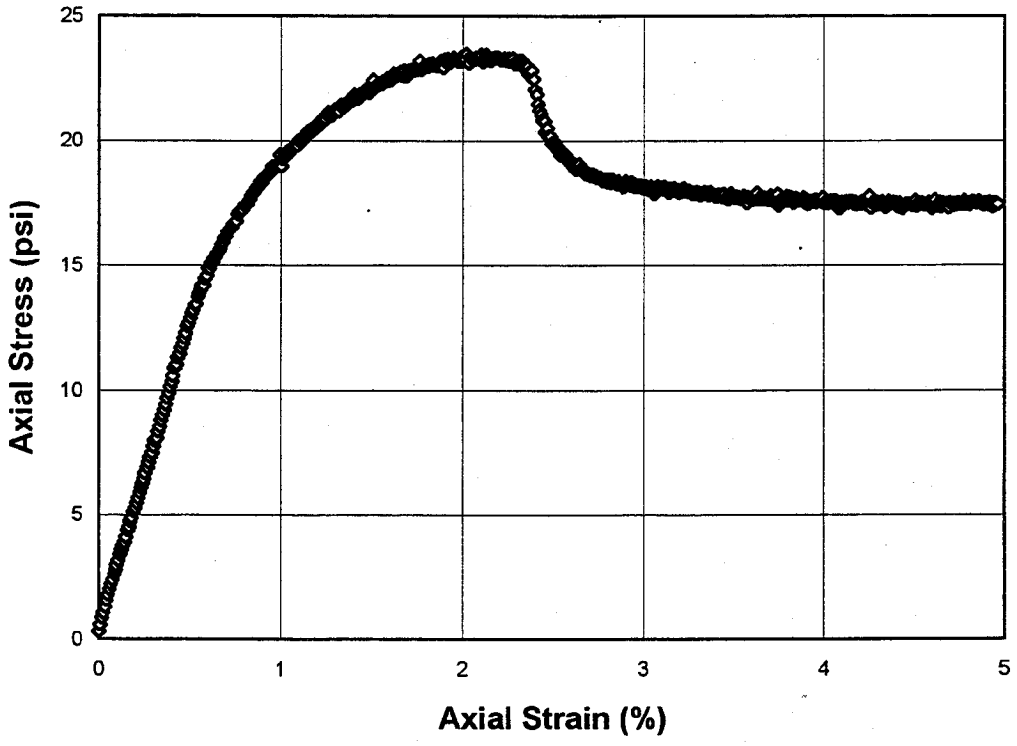


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Ponded fly Ash (Ash Pond)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-24-1995



LABORATORY MATERIAL HANDLING AND TESTING
LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Ash Pond)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO.*:	
	SPECIMEN DIAM., inch	
	TOP	2.86
	MIDDLE	2.87
	BOTTOM	2.87
	AVERAGE	2.87
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.84
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.20
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.20
	INITIAL AREA, A_0 , in^2	6.35
	INITIAL VOLUME $A_0 L_0$, in^3	39.32
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	882.29
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	882.29
8.	*SOIL PROPERTIES*.:	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	27.8
	MAX. DRY DENSITY, pcf	73.5
	95 % MAX. DRY DENSITY, pcf	69.8
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	27.8
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	27.8
	COMPACTION DRY DENSITY, γ_d pcf	66.8
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	39.5
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	09-15-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RJ Bowthorn 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Widows Creek
2. *MATERIAL DESCRIPTION:* Ponded Fly Ash (Ash Pond)
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 09-15-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε	
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _._	_ _ _._	_	_ _ _._	_ _ _._	_ _ _._	_ _ _._	_ _ _._	_ _._	_._ _ _ _	_._ _ _ _	_._ _ _ _	_._ _ _ _	_ _ _.
SEQUENCE 1	6.0	2.0	95	12.6	11.3	1.3	2.0	1.8	0.2	0.00222	0.00230	0.00226	0.00036	4,884
			96	12.6	11.3	1.3	2.0	1.8	0.2	0.00221	0.00230	0.00226	0.00036	4,871
			97	12.6	11.3	1.3	2.0	1.8	0.2	0.00221	0.00230	0.00226	0.00036	4,902
			98	12.6	11.3	1.3	2.0	1.8	0.2	0.00222	0.00231	0.00226	0.00036	4,890
			100	12.6	11.3	1.3	2.0	1.8	0.2	0.00221	0.00230	0.00225	0.00036	4,897
	COLUMN AVERAGE			12.6	11.3	1.3	2.0	1.8	0.2	0.00221	0.00230	0.00226	0.00036	4,889
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	12

Source: Widows Creek Description: Ponded Fly Ash (Ash Pond) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	95	25.5	23.1	2.4	4.0	3.6	0.4	0.00453	0.00465	0.00459	0.00074	4,920
			96	25.5	23.1	2.4	4.0	3.6	0.4	0.00453	0.00466	0.00459	0.00074	4,921
			97	25.4	23.0	2.4	4.0	3.6	0.4	0.00453	0.00466	0.00460	0.00074	4,893
			98	25.4	23.0	2.4	4.0	3.6	0.4	0.00452	0.00466	0.00459	0.00074	4,893
			100	25.5	23.1	2.4	4.0	3.6	0.4	0.00453	0.00466	0.00460	0.00074	4,907
	COLUMN AVERAGE			25.5	23.1	2.4	4.0	3.6	0.4	0.00453	0.00466	0.00459	0.00074	4,907
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	14
SEQUENCE 3	6.0	6.0	95	37.5	33.9	3.6	5.9	5.3	0.6	0.00723	0.00745	0.00734	0.00118	4,503
			96	37.5	33.9	3.6	5.9	5.3	0.6	0.00724	0.00743	0.00734	0.00118	4,510
			97	37.5	33.9	3.6	5.9	5.3	0.6	0.00724	0.00743	0.00733	0.00118	4,512
			98	37.6	33.9	3.6	5.9	5.3	0.6	0.00726	0.00743	0.00734	0.00119	4,511
			100	37.5	33.8	3.6	5.9	5.3	0.6	0.00721	0.00742	0.00731	0.00118	4,515
	COLUMN AVERAGE			37.5	33.9	3.6	5.9	5.3	0.6	0.00724	0.00743	0.00733	0.00118	4,510
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	5
SEQUENCE 4	6.0	8.0	95	50.0	45.1	4.9	7.9	7.1	0.8	0.00998	0.01025	0.01011	0.00163	4,351
			96	50.1	45.2	4.9	7.9	7.1	0.8	0.00999	0.01025	0.01012	0.00163	4,363
			97	50.0	45.1	4.9	7.9	7.1	0.8	0.00996	0.01024	0.01010	0.00163	4,361
			98	49.9	45.0	4.9	7.9	7.1	0.8	0.00999	0.01024	0.01012	0.00163	4,344
			100	50.1	45.2	4.9	7.9	7.1	0.8	0.01000	0.01025	0.01012	0.00163	4,363
	COLUMN AVERAGE			50.0	45.1	4.9	7.9	7.1	0.8	0.00998	0.01024	0.01011	0.00163	4,357
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8

Source: Widows Creek Description: Ponded Fly Ash (Ash Pond) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	95	63.2	57.0	6.2	10.0	9.0	1.0	0.01256	0.01290	0.01273	0.00205	4,376
			96	63.2	57.1	6.1	10.0	9.0	1.0	0.01257	0.01289	0.01273	0.00205	4,378
			97	63.1	57.0	6.2	10.0	9.0	1.0	0.01258	0.01290	0.01274	0.00206	4,365
			98	63.1	56.9	6.2	9.9	9.0	1.0	0.01257	0.01290	0.01274	0.00206	4,363
			100	63.1	56.9	6.2	9.9	9.0	1.0	0.01257	0.01290	0.01273	0.00206	4,363
	COLUMN AVERAGE			63.2	57.0	6.2	10.0	9.0	1.0	0.01257	0.01289	0.01273	0.00206	4,369
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	7
SEQUENCE 6	4.0	2.0	95	12.9	11.2	1.7	2.0	1.8	0.3	0.00261	0.00267	0.00264	0.00043	4,142
			96	12.9	11.2	1.7	2.0	1.8	0.3	0.00262	0.00267	0.00265	0.00043	4,125
			97	12.9	11.2	1.7	2.0	1.8	0.3	0.00264	0.00268	0.00266	0.00043	4,114
			98	12.9	11.2	1.7	2.0	1.8	0.3	0.00263	0.00268	0.00266	0.00043	4,112
			100	13.0	11.3	1.7	2.0	1.8	0.3	0.00263	0.00267	0.00265	0.00043	4,158
	COLUMN AVERAGE			12.9	11.2	1.7	2.0	1.8	0.3	0.00262	0.00268	0.00265	0.00043	4,130
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	20
SEQUENCE 7	4.0	4.0	95	24.6	22.2	2.4	3.9	3.5	0.4	0.00597	0.00609	0.00603	0.00097	3,593
			96	24.7	22.3	2.4	3.9	3.5	0.4	0.00596	0.00610	0.00603	0.00097	3,604
			97	24.7	22.3	2.4	3.9	3.5	0.4	0.00596	0.00611	0.00603	0.00097	3,607
			98	24.6	22.2	2.4	3.9	3.5	0.4	0.00594	0.00609	0.00602	0.00097	3,599
			100	24.7	22.3	2.4	3.9	3.5	0.4	0.00596	0.00609	0.00603	0.00097	3,606
	COLUMN AVERAGE			24.6	22.2	2.4	3.9	3.5	0.4	0.00596	0.00609	0.00603	0.00097	3,602
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	6

Source: Widows Creek Description: Ponded Fly Ash (Ash Pond) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	95	37.0	33.4	3.6	5.8	5.3	0.6	0.00934	0.00951	0.00943	0.00152	3,454
			96	36.9	33.3	3.7	5.8	5.2	0.6	0.00931	0.00952	0.00942	0.00152	3,450
			97	37.0	33.4	3.6	5.8	5.3	0.6	0.00931	0.00954	0.00942	0.00152	3,455
			98	37.0	33.4	3.6	5.8	5.3	0.6	0.00934	0.00953	0.00943	0.00152	3,454
			100	36.9	33.3	3.6	5.8	5.2	0.6	0.00932	0.00952	0.00942	0.00152	3,451
	COLUMN AVERAGE			37.0	33.3	3.6	5.8	5.3	0.6	0.00932	0.00952	0.00942	0.00152	3,453
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	2
SEQUENCE 9	4.0	8.0	95	49.2	44.4	4.8	7.7	7.0	0.8	0.01223	0.01251	0.01237	0.00200	3,499
			96	49.1	44.3	4.8	7.7	7.0	0.8	0.01224	0.01253	0.01239	0.00200	3,488
			97	49.0	44.2	4.8	7.7	7.0	0.8	0.01225	0.01253	0.01239	0.00200	3,485
			98	49.1	44.3	4.8	7.7	7.0	0.8	0.01221	0.01250	0.01236	0.00199	3,497
			100	49.0	44.2	4.8	7.7	7.0	0.8	0.01223	0.01252	0.01237	0.00200	3,488
	COLUMN AVERAGE			49.1	44.3	4.8	7.7	7.0	0.8	0.01223	0.01252	0.01238	0.00200	3,491
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	6
SEQUENCE 10	4.0	10.0	95	62.4	56.4	6.0	9.8	8.9	0.9	0.01473	0.01505	0.01489	0.00240	3,697
			96	62.4	56.3	6.0	9.8	8.9	1.0	0.01474	0.01504	0.01489	0.00240	3,693
			97	62.4	56.4	6.1	9.8	8.9	1.0	0.01474	0.01504	0.01489	0.00240	3,696
			98	62.5	56.4	6.1	9.8	8.9	1.0	0.01476	0.01507	0.01492	0.00241	3,690
			100	62.3	56.2	6.0	9.8	8.9	0.9	0.01471	0.01506	0.01488	0.00240	3,689
	COLUMN AVERAGE			62.4	56.3	6.0	9.8	8.9	1.0	0.01474	0.01505	0.01489	0.00240	3,693
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	4

Source: Widows Creek Description: Ponded Fly Ash (Ash Pond) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	95	13.6	11.5	2.1	2.1	1.8	0.3	0.00262	0.00270	0.00266	0.00043	4,215
			96	13.5	11.4	2.1	2.1	1.8	0.3	0.00262	0.00271	0.00267	0.00043	4,186
			97	13.5	11.5	2.1	2.1	1.8	0.3	0.00262	0.00271	0.00267	0.00043	4,196
			98	13.5	11.4	2.1	2.1	1.8	0.3	0.00263	0.00271	0.00267	0.00043	4,158
			100	13.5	11.4	2.1	2.1	1.8	0.3	0.00263	0.00269	0.00266	0.00043	4,189
	COLUMN AVERAGE			13.5	11.4	2.1	2.1	1.8	0.3	0.00263	0.00270	0.00266	0.00043	4,189
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	21
SEQUENCE 12	2.0	4.0	95	24.3	21.9	2.4	3.8	3.4	0.4	0.00600	0.00612	0.00606	0.00098	3,522
			96	24.2	21.8	2.4	3.8	3.4	0.4	0.00600	0.00614	0.00607	0.00098	3,509
			97	24.2	21.8	2.4	3.8	3.4	0.4	0.00598	0.00614	0.00606	0.00098	3,513
			98	24.1	21.7	2.4	3.8	3.4	0.4	0.00599	0.00613	0.00606	0.00098	3,495
			100	24.2	21.7	2.4	3.8	3.4	0.4	0.00600	0.00614	0.00607	0.00098	3,496
	COLUMN AVERAGE			24.2	21.8	2.4	3.8	3.4	0.4	0.00600	0.00613	0.00606	0.00098	3,507
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	12
SEQUENCE 13	2.0	6.0	95	37.8	34.2	3.6	6.0	5.4	0.6	0.00707	0.00722	0.00714	0.00115	4,680
			96	37.9	34.3	3.6	6.0	5.4	0.6	0.00702	0.00720	0.00711	0.00115	4,709
			97	37.9	34.3	3.6	6.0	5.4	0.6	0.00706	0.00722	0.00714	0.00115	4,693
			98	37.9	34.3	3.6	6.0	5.4	0.6	0.00702	0.00719	0.00710	0.00115	4,712
			100	37.9	34.3	3.6	6.0	5.4	0.6	0.00705	0.00721	0.00713	0.00115	4,692
	COLUMN AVERAGE			37.9	34.3	3.6	6.0	5.4	0.6	0.00704	0.00721	0.00713	0.00115	4,697
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00002	0.00000	13

Source: Widows Creek Description: Ponded Fly Ash (Ash Pond) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	95	50.8	45.9	4.9	8.0	7.2	0.8	0.00897	0.00920	0.00908	0.00147	4,933
			96	50.8	46.0	4.8	8.0	7.2	0.8	0.00899	0.00919	0.00909	0.00147	4,937
			97	50.8	45.9	4.9	8.0	7.2	0.8	0.00899	0.00919	0.00909	0.00147	4,930
			98	50.8	45.9	4.9	8.0	7.2	0.8	0.00899	0.00921	0.00910	0.00147	4,924
			100	50.9	46.0	4.9	8.0	7.2	0.8	0.00899	0.00921	0.00910	0.00147	4,934
	COLUMN AVERAGE			50.8	45.9	4.9	8.0	7.2	0.8	0.00899	0.00920	0.00909	0.00147	4,931
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	5
SEQUENCE 15	2.0	10.0	95	63.5	57.4	6.1	10.0	9.0	1.0	0.01066	0.01089	0.01077	0.00174	5,197
			96	63.6	57.5	6.1	10.0	9.1	1.0	0.01063	0.01085	0.01074	0.00173	5,226
			97	63.6	57.5	6.1	10.0	9.1	1.0	0.01065	0.01088	0.01076	0.00174	5,215
			98	63.6	57.5	6.1	10.0	9.1	1.0	0.01065	0.01088	0.01076	0.00174	5,216
			100	63.6	57.5	6.1	10.0	9.1	1.0	0.01060	0.01086	0.01073	0.00173	5,228
	COLUMN AVERAGE			63.6	57.5	6.1	10.0	9.1	1.0	0.01064	0.01087	0.01075	0.00174	5,217
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	12

SUBMITTED BY, DATE

R J Boudreau 9/10/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Ash Pond)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	09-15-1995

$$M_R = K1\ (S_C)^{K2}\ (1+S_3)^{K5}$$

K1 =	3,283
K2 =	-0.01625
K5 =	0.38843
R^2 =	0.89

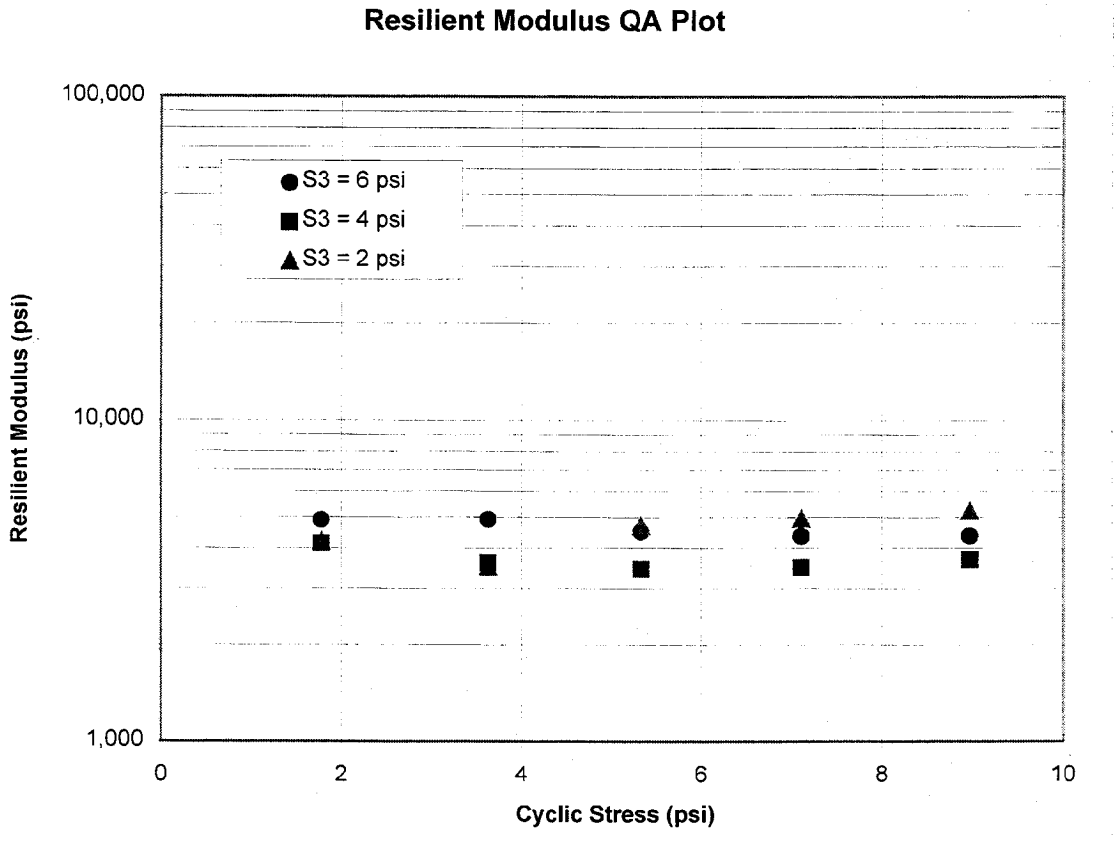
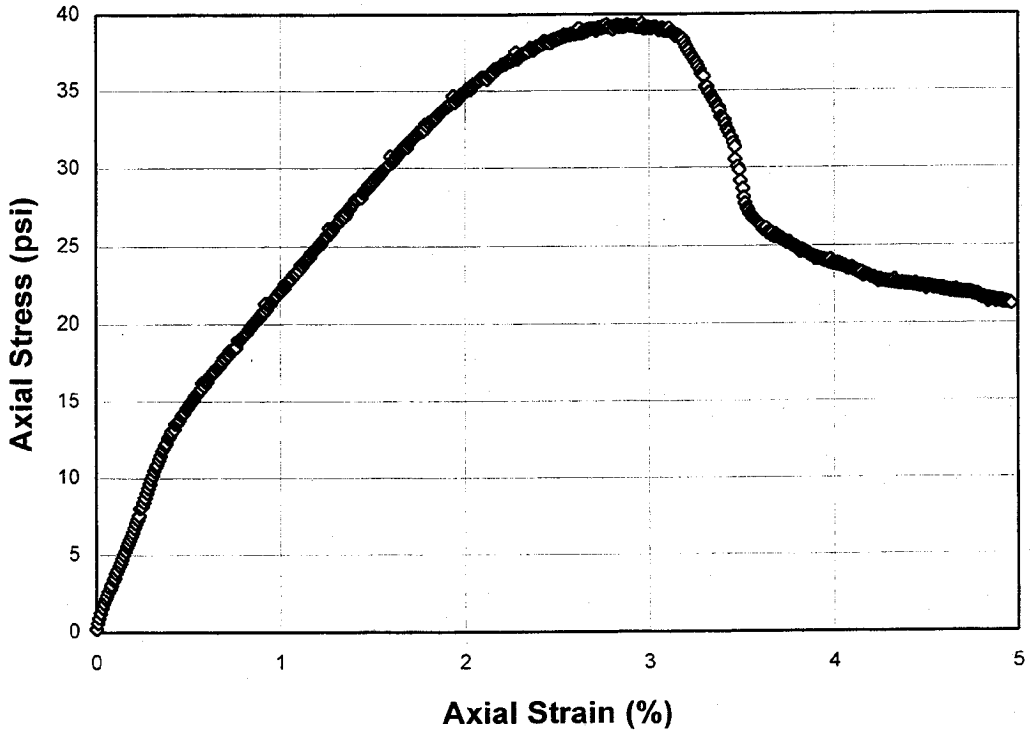


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Ash Pond)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	09-15-1995



WIDOWS CREEK

Scrubber Gypsum

Grain Size Distribution Test Report (**Not Performed**)
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Consolidation Test Report
Hydraulic Conductivity - Falling Head (2 Pages)
Triaxial Compression Test (2 Pages)
Direct Shear Test
California Bearing Ratio
Resilient Modulus (Standard Proctor) (9 Pages)
Resilient Modulus (Modified Proctor) (9 Pages)

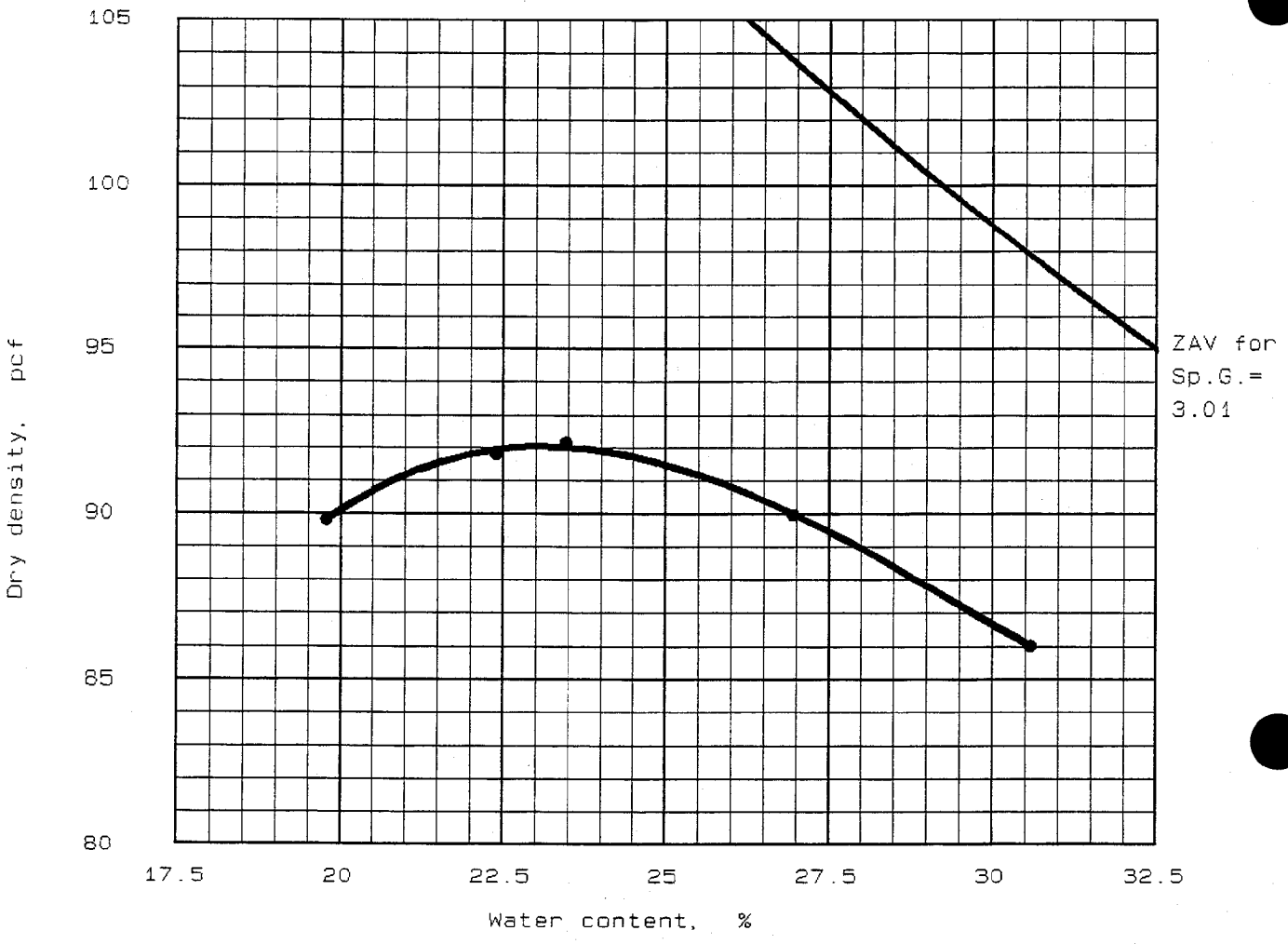
TVA - WIDOWS CREEK
SCRUBBER GYPSUM

Description	Test Method	Property	Sample 1	Sample 2	Sample 3
Grain Size	ASTM D 422	Percent Retained on the #4 Sieve Percent Passing the #200 Sieve Percent Passing the 0.005 mm Sieve	see note 1 see note 1 see note 1	see note 1 see note 1 see note 1	see note 1 see note 1 see note 1
Atterberg Limits	ASTM D 4318	Liquid Limit Plastic Limit Plasticity Index	NL NP N/A	NL NP N/A	NL NP N/A
Specific Gravity	ASTM D 854	Specific Gravity at 20°C		3.01 (see note 2)	
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	see note 3 see note 3	see note 3 see note 3	see note 3 see note 3
			Composite Sample		
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %	92.0 23.1		
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %	99.9 19.4		
			Result	**Dry Density, pcf**	**Moisture Content, %**
Consolidation	ASTM D2435	Compression Index C_c	0.07	84.5	25.8
Hydraulic Conductivity	ASTM D 5084	Hydraulic Conductivity, cm/sec	3.9E-4	87.2	22.2
Triaxial Shear Strength Consolidated-Undrained (CU)	ASTM D4767	Effective Stress, Cohesion, c', ksf Effective Stress, Internal Friction Angle, ϕ',degrees	0.00 37.8	87.2	22.9
		Total Stress, Cohesion, c, ksf Total Stress, Internal Friction Angle, ϕ, degrees	3.01 33.1	87.2	22.9
Direct Shear Strength	ASTM D 3080	Cohesion, c, ksf Internal Friction Angle, ϕ, degrees	0.55 28.9	83.0	25.4
California Bearing Ratio	ASTM D 1883	CBR, %	15	87.5	23.0
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	12,513	85.7	24.7
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	13,079	90.2	24.3
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm	1,200		
pH of Soil	AASHTO T 289	pH	6.7		
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg	3050		
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg	130		

Note 1: Material observed to chrystalize/set-up upon wetting. Test could not be performed.
Note 2: A test was performed on a composite sample from the 3 independant samples.
Note 3: A classification could not be performed without the ASTM D 422 results.

wcf-gy.xls

MOISTURE-DENSITY RELATIONSHIP



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
				3.01	NL			

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 23.1 % Maximum dry density = 92.0 pcf	Gypsum

Project No.: 5810860101
Project: TVA - Widows Creek
Location: Scrubber Gypsum

Date: September 26, 1995

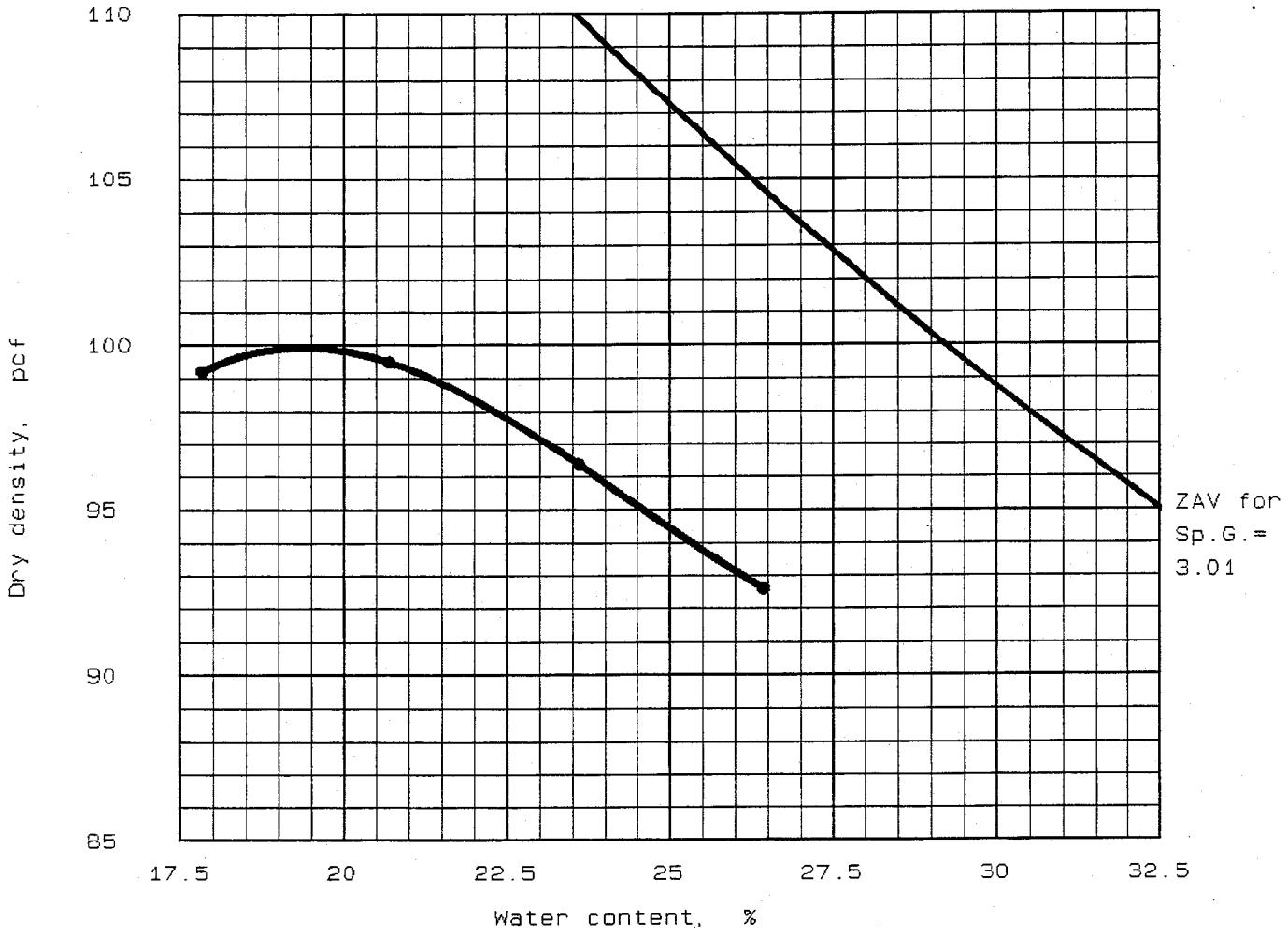
Remarks:
Tested by: CS
Reviewed by: HG

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

MOISTURE-DENSITY RELATIONSHIP



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
				3.01	NL	NP		

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 19.4 % Maximum dry density = 99.9 pcf	Gypsum

Project No.: 5810860101
Project: TVA -Widows Creek
Location: Scrubber Gypsum

Date: September 26, 1995

Remarks:

Tested by: CS

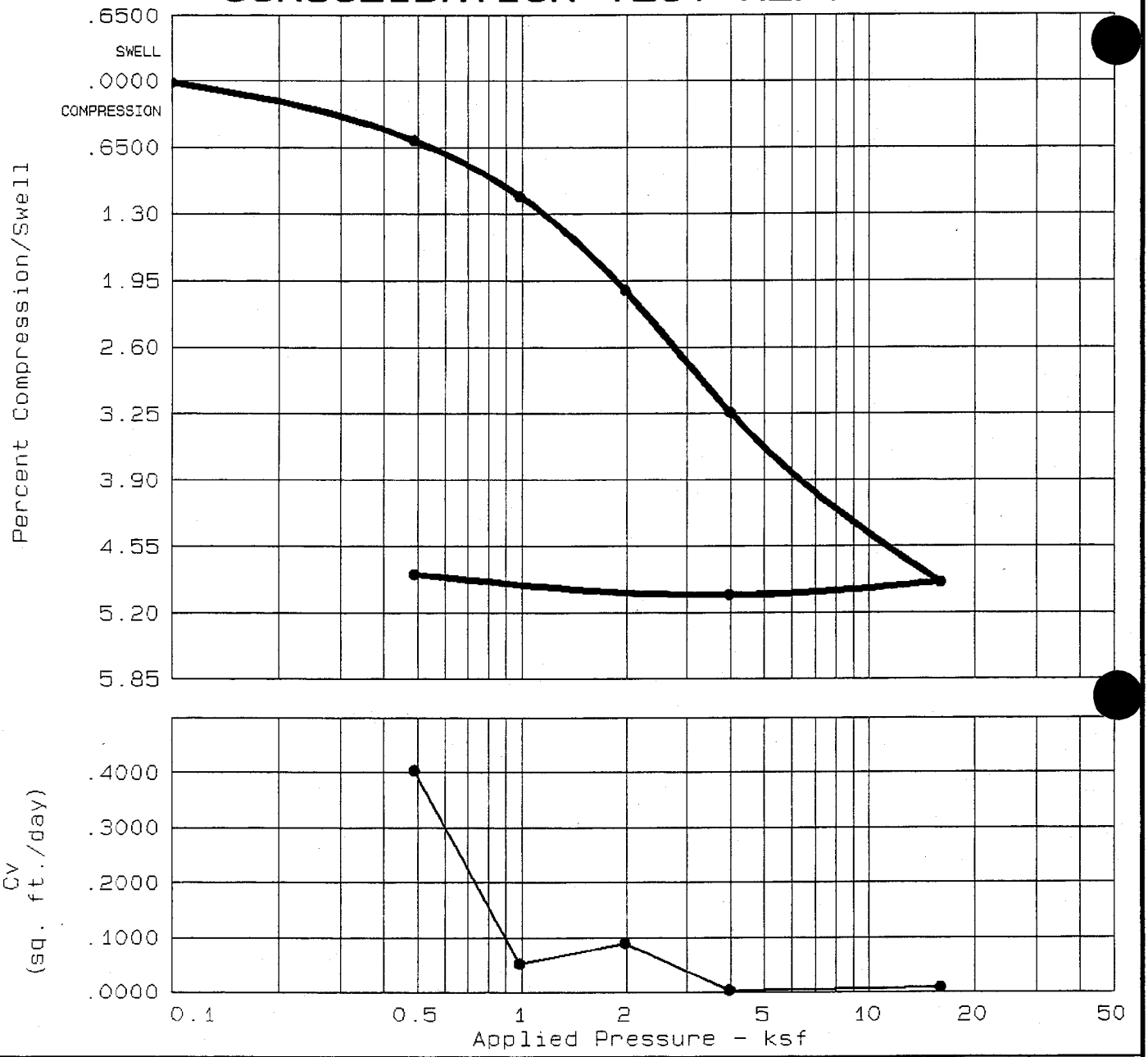
Reviewed by: HB

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

CONSOLIDATION TEST REPORT



Natural Saturation	Natural Moisture	Dry Density	LL	PI	Sp.Gr.	Precons. press.	C_c	e_0
63.5 %	25.8	84.5	NL	NP	3.010	1.93	0.07	1.2220

TEST RESULTS	MATERIAL DESCRIPTION
Compression Index = 0.07	

Project No.: 5910860101
Project: TVA - Widows Creek
Location: Scrubber Gypsum

Date: 9/28/95

Remarks:

Tested by: AdK
Reviewed by:

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

Fig. No._____

HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*HEJ*
Project Name	*TVA -Widows Creek*	Test Date	*10/09/95*
Boring No.	*Scrubber Gypsum*	Reviewed By	*RLB*
Sample No.	*Bag*	Review Date	10/19/95
Sample Depth			
Sample Description	*Gypsum*		

ASTM D5084 - Falling Head

Sample Type:	*Bag*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*22.2*
Wet Unit Weight, pcf:	*106.5*
Dry Unit Weight, pcf:	*87.2*
Compaction, %:	*94.7*
Hydraulic Conductivity, cm/sec. @20 °C:	***3.9E-04***

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

LAW ENGINEERING

Job Number	5810860101	Tested By	HEJ
Project Name	TVA -Widows Creek	Test Date	10/09/95
Boring No.	Scrubber Gypsum	Reviewed By	RLB
Sample No.	Bag	Review Date	10/19/95
Sample Depth			
Sample Description	Gypsum		

Sample Data

Length, in		Diameter, in		Pan No.	AB-30
Location 1	6.000	Location 1	2.830	Dry Soil+Pan, grams	947.13
Location 2	6.000	Location 2	2.830	Pan Weight, grams	83.66
Location3	6.000	Location 3	2.830		
Average	6.000	Average	2.830	Moisture Content, %	22.2
		Wet Soil + Tare, grams	1054.96	Wet Unit Wt, pcf	106.5
		Tare Weight, grams	0.00	Dry Unit Wt, pcf	87.2

Chamber Pressure, psi	49
Back Pressure, psi	35
Confining Pressure, psi	14

Date Start	Date Finish	Time Start	Time Finish	Time (sec)	Division Start	Division Finish	H0 (cm)	Hf (cm)	k cm/sec	Temp (°C)	k cm/sec at 20 °C
				242	50.0	0.0	93.94	43.94	4.0E-04	21	3.9E-04
				242	50.0	0.0	93.94	43.94	4.0E-04	21	3.9E-04
				243	50.0	0.0	93.94	43.94	4.0E-04	21	3.9E-04

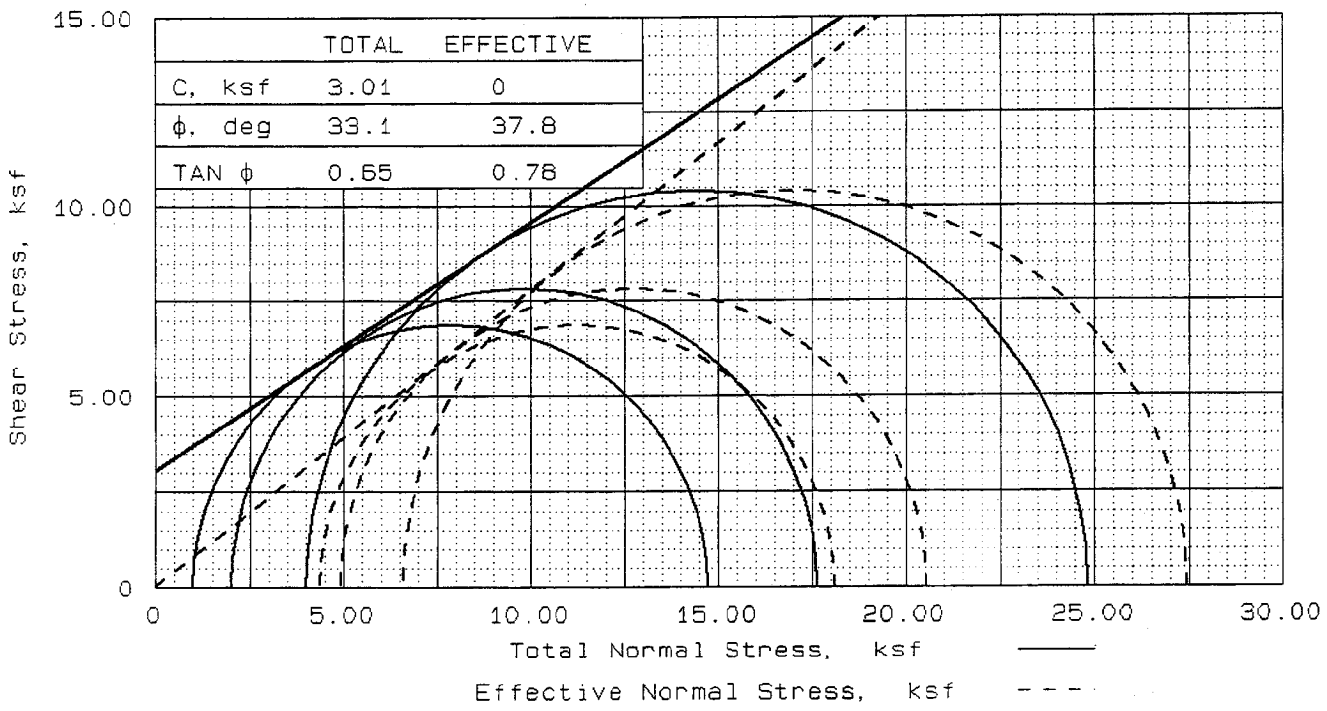
No. of Tria	Sample Type	Max. Densit (pcf)	Compaction %	Sample Orientation
3	Bag	92	94.7	Vertical

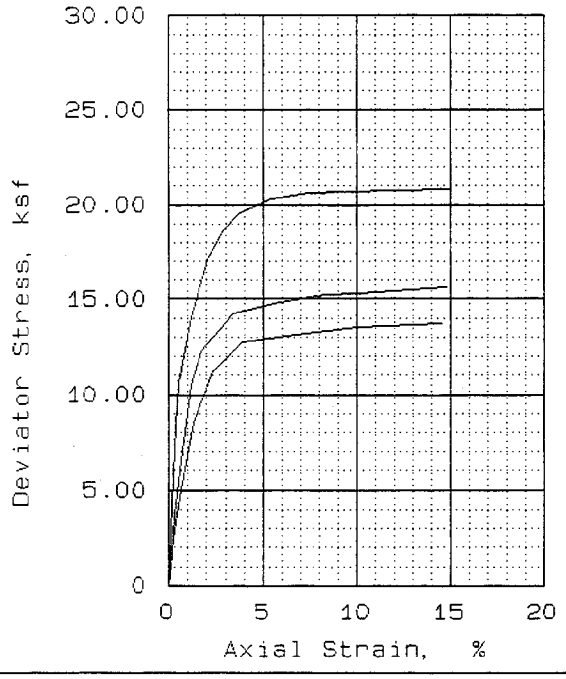
Avg. k at 20 °C 3.9E-04 cm/sec

a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

H0 = initial head in cm
Hf = final head in cm
t = time in seconds

a = 0.34 cm²
A = 40.582 cm²
L = 15.24 cm





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	23.5	22.2	23.1
	DRY DENSITY, pcf	87.2	87.2	87.2
	SATURATION, %	61.2	57.7	60.1
	VOID RATIO	1.155	1.156	1.155
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	38.0	37.5	37.0
	DRY DENSITY, pcf	87.7	88.3	88.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.143	1.128	1.113
	DIAMETER, in	2.83	2.82	2.81
	HEIGHT, in	5.98	5.95	5.96
BACK PRESSURE, ksf		5.00	5.08	5.01
CELL PRESSURE, ksf		6.00	7.08	9.01
FAILURE STRESS, ksf		13.73	15.64	20.83
PORE PRESSURE, ksf		1.63	2.17	2.42
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		18.09	20.55	27.42
$\bar{\sigma}_3$ FAILURE, ksf		4.37	4.91	6.59

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Remolded
DESCRIPTION: Gypsum

LL= NL PL= NP PI=
SPECIFIC GRAVITY= 3.01
REMARKS: Tested by: HB

Reviewed by: RLB

FIG. NO.

CLIENT: TVA

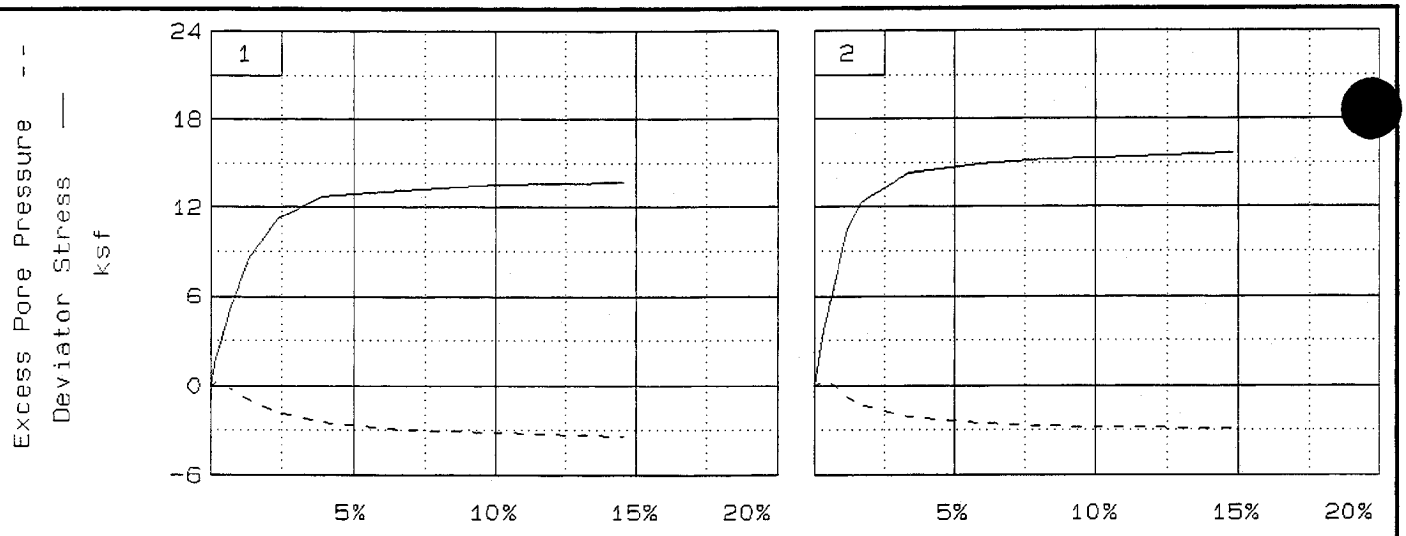
PROJECT: TVA-Widows Creek

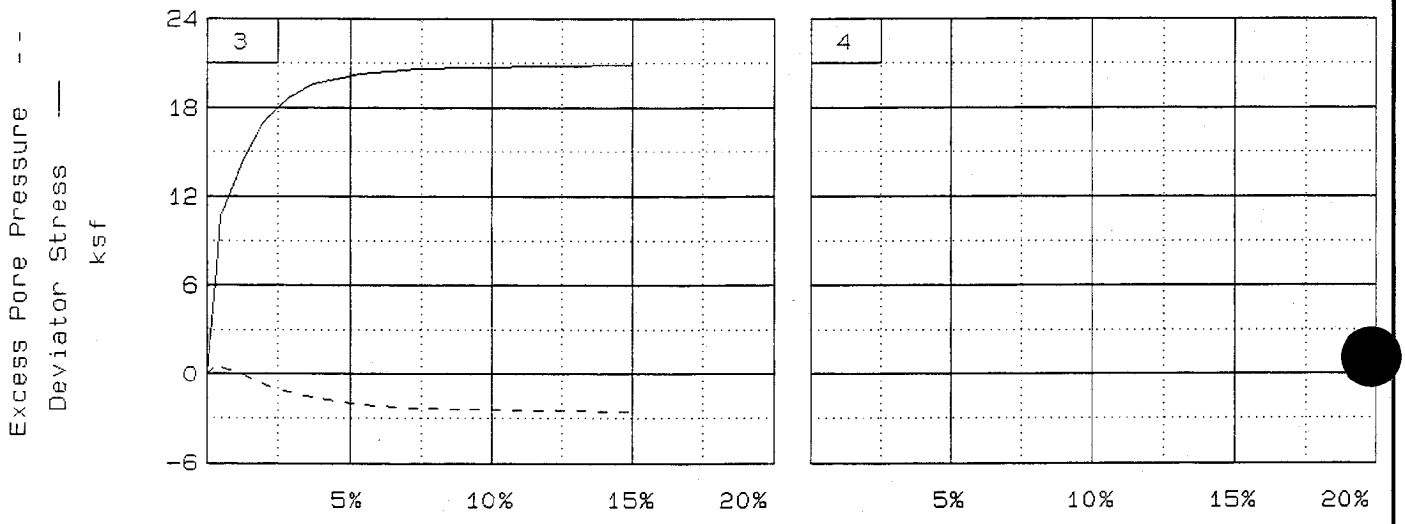
SAMPLE LOCATION: Scrubber Gypsum

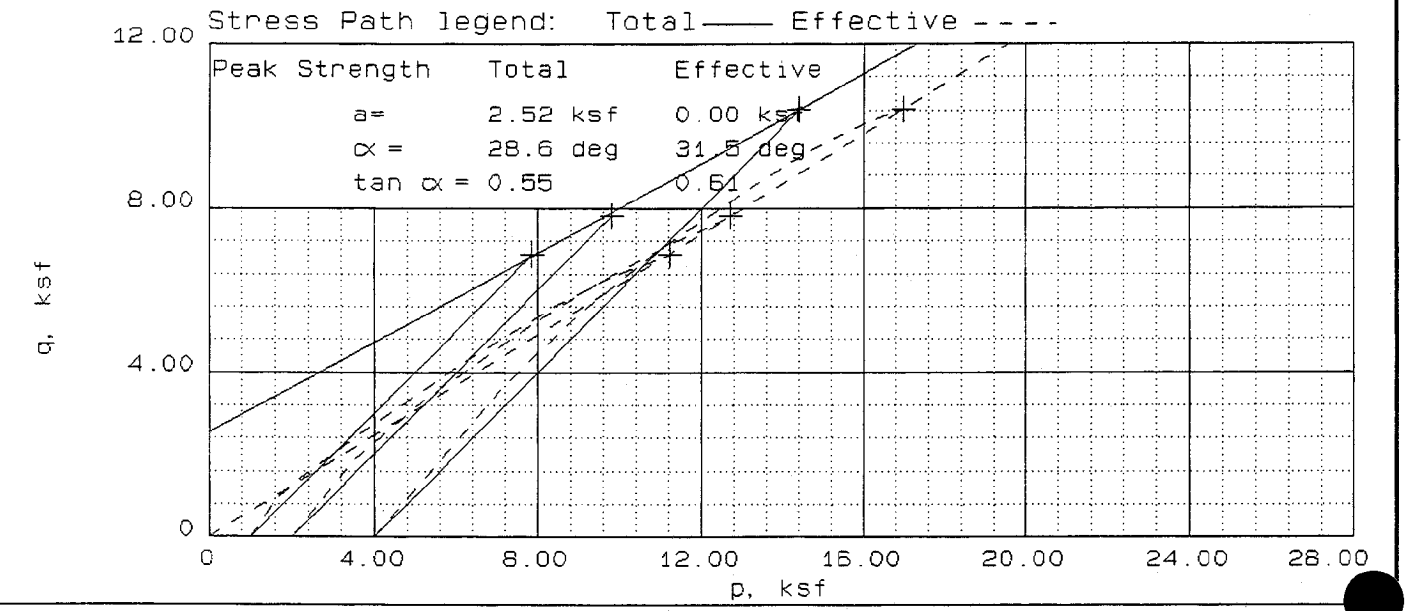
PROJ. NO.: 5810860101 DATE: 10/23/95

TRIAXIAL COMPRESSION TEST

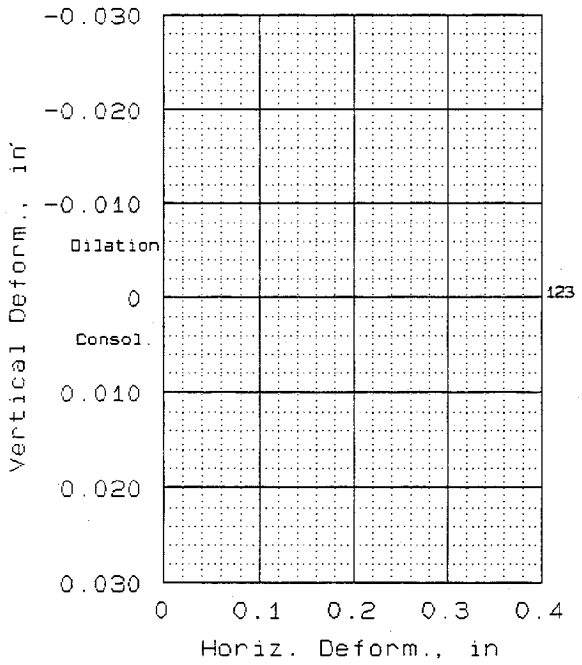
LAW ENGINEERING, INC.

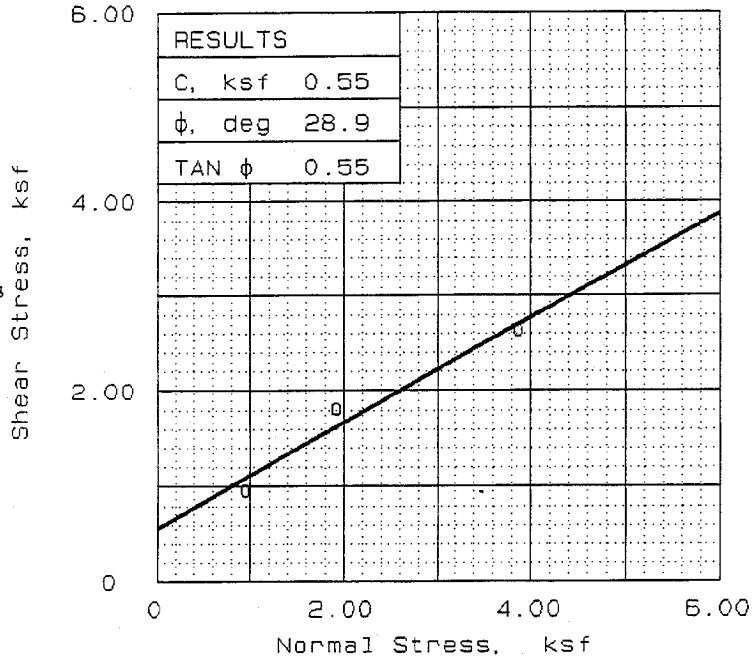


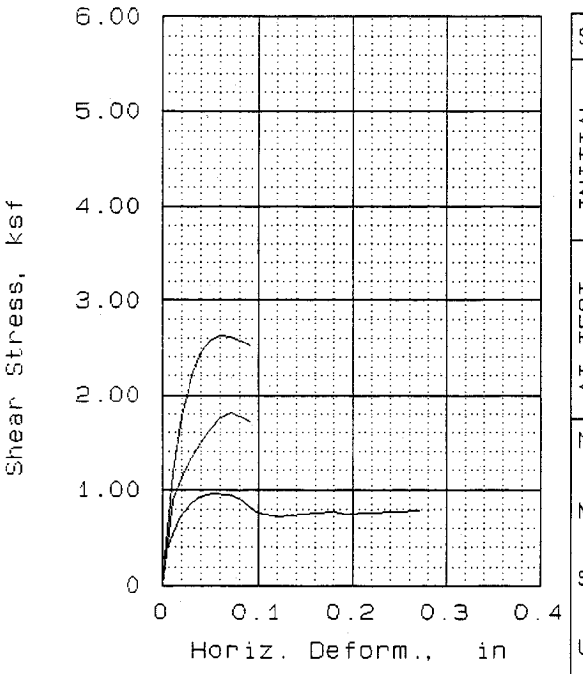




Client: TVA
Project: TVA-Widows Creek
Location: Scrubber Gypsum
File: 8601R Project No.: 5810860101 Page 2/2 Fig. No. ____







SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	25.4	25.8	25.0
	DRY DENSITY, pcf	82.4	82.1	84.6
	SATURATION, %	66.8	67.3	69.3
	VOID RATIO	1.007	1.016	0.955
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	25.4	25.8	25.0
	DRY DENSITY, pcf	82.4	82.1	84.6
	SATURATION, %	66.8	67.3	69.3
	VOID RATIO	1.007	1.016	0.955
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
NORMAL STRESS, ksf		0.97	1.94	3.88
MAX. SHEAR, ksf		0.96	1.81	2.63
STRAIN RATE, %/min.		0.500	0.500	0.500
ULT. SHEAR, ksf				

SAMPLE DATA

SAMPLE TYPE: Remolded

DESCRIPTION:

LL= NL PL= NP PI=

SPECIFIC GRAVITY= 3.01

REMARKS: Tested by: HJ

Reviewed by: RLB

FIG. NO.

CLIENT:

PROJECT: TVA - Widows Creek

SAMPLE LOCATION: Scrubber Gypsum

PROJ. NO.: 5810860101 DATE: 10/11/95

DIRECT SHEAR TEST

LAW ENGINEERING, INC.

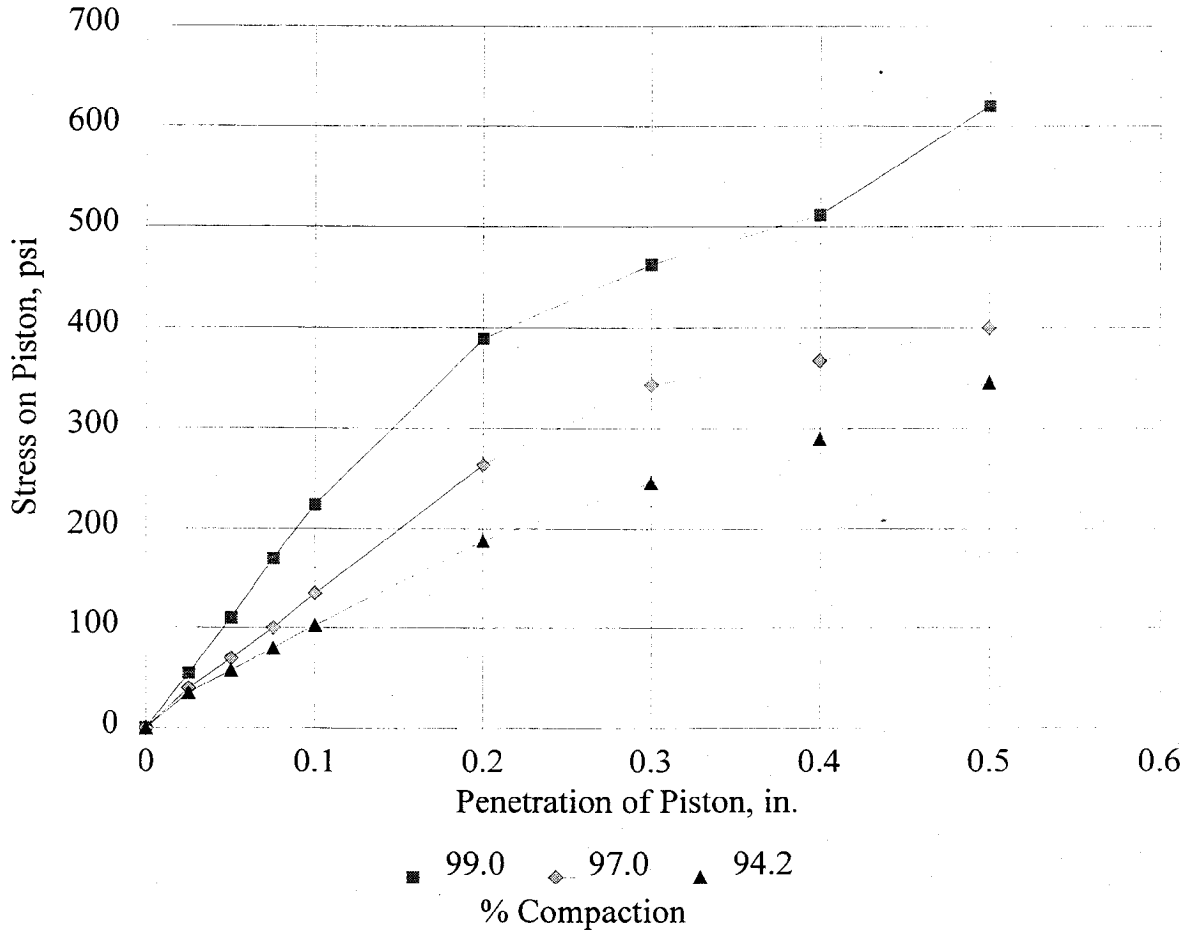
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Widows Creek	**Test Date**	10/09/95
Material (Source)	Gypsum	**Reviewed By**	RLB
		Review Date	10/10/95

Compaction, %	99.0	97.0	94.2
Before Soak Dry Density, pcf	91.3	89.4	86.9
Before Soak Moisture Content,	24.7	23.3	22.6
After Soak Dry Density, pcf	91.2	89.3	86.7
After Soak Moisture Content, %	31.2	31.6	32.0
CBR @ 0.1 in.	22.4	13.5	10.3
CBR @ 0.2 in.	26.0	17.6	12.5



LABORATORY MATERIAL HANDLING AND TESTING
LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*		Widows Creek
2.	*MATERIAL DESCRIPTION:*		Gypsum
3.	*REMOLDING TARGETS:*		95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)		2
5.	*TEST INFORMATION*		
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)		N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)		N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)		15
6.	*SPECIMEN INFO.:*		
	SPECIMEN DIAM., inch		
		TOP	2.85
		MIDDLE	2.85
		BOTTOM	2.85
		AVERAGE	2.85
		MEMBRANE THICKNESS (1), inch	0.01
		MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch		2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch		6.03
	HEIGHT OF CAP AND BASE, inch		0.00
	INITIAL LENGTH, L_0, inch		6.03
	INITIAL AREA, A_0, in^2		6.29
	INITIAL VOLUME $A_0 L_0$, in^3		37.92
7.	*SOIL SPECIMEN WEIGHT*:		
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams		1065.33
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams		0.00
	WEIGHT OF WET SOIL USED, grams		1065.33
8.	*SOIL PROPERTIES.:*		
	IN SITU MOISTURE CONTENT (NUCLEAR), %		N/A
	IN SITU WET DENSITY (NUCLEAR), pcf		N/A
	or		
	OPTIMUM MOISTURE CONTENT, %		23.1
	MAX. DRY DENSITY, pcf		92.2
	95 % MAX. DRY DENSITY, pcf		87.6
9.	*SPECIMEN PROPERTIES:*		
	COMPACTION MOISTURE CONTENT, %		24.7
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %		24.7
	COMPACTION DRY DENSITY, γ_d pcf		85.7
10.	*QUICK SHEAR TEST*		
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)		Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi		37.4
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)		Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)		
	(a) *CODE*	0 0 0 0 0 0	
	(b) *NOTE*		
12.	*TEST DATE*		10-05-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

Richard S. Boudreau 10/18/95
LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Widows Creek
2. *MATERIAL DESCRIPTION:* Gypsum
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 10-05-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ . _	_ _ _ . _	_	_ _ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	. _ _ _ _ _	. _ _ _ _ _	. _ _ _ _ _	. _ _ _ _ _	_ _ _ _ .
SEQUENCE 1	6.0	2.0	95	12.6	11.4	1.3	2.0	1.8	0.2	0.00083	0.00088	0.00085	0.00014	12,771
			96	12.6	11.4	1.3	2.0	1.8	0.2	0.00086	0.00087	0.00086	0.00014	12,667
			97	12.6	11.4	1.3	2.0	1.8	0.2	0.00084	0.00088	0.00086	0.00014	12,677
			98	12.7	11.5	1.2	2.0	1.8	0.2	0.00084	0.00089	0.00086	0.00014	12,777
			100	12.7	11.5	1.3	2.0	1.8	0.2	0.00083	0.00089	0.00086	0.00014	12,804
	COLUMN AVERAGE			12.7	11.4	1.3	2.0	1.8	0.2	0.00084	0.00088	0.00086	0.00014	12,739
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	63

Source: Widows Creek Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	95	25.1	22.7	2.4	4.0	3.6	0.4	0.00147	0.00162	0.00154	0.00026	14,130
			96	25.2	22.8	2.4	4.0	3.6	0.4	0.00147	0.00162	0.00155	0.00026	14,133
			97	25.2	22.8	2.4	4.0	3.6	0.4	0.00146	0.00162	0.00154	0.00026	14,197
			98	25.2	22.8	2.4	4.0	3.6	0.4	0.00147	0.00163	0.00155	0.00026	14,111
			100	25.1	22.7	2.4	4.0	3.6	0.4	0.00144	0.00162	0.00153	0.00025	14,217
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00146	0.00162	0.00154	0.00026	14,158
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	46
SEQUENCE 3	6.0	6.0	95	37.7	34.1	3.6	6.0	5.4	0.6	0.00208	0.00235	0.00221	0.00037	14,756
			96	37.7	34.1	3.6	6.0	5.4	0.6	0.00210	0.00234	0.00222	0.00037	14,711
			97	37.7	34.1	3.6	6.0	5.4	0.6	0.00208	0.00235	0.00221	0.00037	14,773
			98	37.7	34.1	3.6	6.0	5.4	0.6	0.00207	0.00235	0.00221	0.00037	14,823
			100	37.7	34.1	3.6	6.0	5.4	0.6	0.00208	0.00233	0.00221	0.00037	14,803
	COLUMN AVERAGE			37.7	34.1	3.6	6.0	5.4	0.6	0.00208	0.00234	0.00221	0.00037	14,773
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	43
SEQUENCE 4	6.0	8.0	95	50.2	45.3	4.9	8.0	7.2	0.8	0.00268	0.00310	0.00289	0.00048	15,026
			96	50.2	45.3	4.9	8.0	7.2	0.8	0.00270	0.00308	0.00289	0.00048	15,059
			97	50.2	45.3	4.9	8.0	7.2	0.8	0.00269	0.00309	0.00289	0.00048	15,051
			98	50.2	45.3	4.9	8.0	7.2	0.8	0.00270	0.00308	0.00289	0.00048	15,036
			100	50.2	45.3	4.9	8.0	7.2	0.8	0.00268	0.00308	0.00288	0.00048	15,082
	COLUMN AVERAGE			50.2	45.3	4.9	8.0	7.2	0.8	0.00269	0.00309	0.00289	0.00048	15,051
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	22

Source: Widows Creek Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	95	62.9	56.8	6.1	10.0	9.0	1.0	0.00329	0.00379	0.00354	0.00059	15,403
			96	63.0	56.8	6.1	10.0	9.0	1.0	0.00330	0.00378	0.00354	0.00059	15,403
			97	63.0	56.9	6.1	10.0	9.0	1.0	0.00330	0.00379	0.00355	0.00059	15,375
			98	63.0	56.9	6.1	10.0	9.0	1.0	0.00329	0.00378	0.00354	0.00059	15,427
			100	62.9	56.8	6.1	10.0	9.0	1.0	0.00329	0.00379	0.00354	0.00059	15,385
	COLUMN AVERAGE			63.0	56.8	6.1	10.0	9.0	1.0	0.00330	0.00379	0.00354	0.00059	15,399
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	20
SEQUENCE 6	4.0	2.0	95	13.0	11.3	1.7	2.1	1.8	0.3	0.00083	0.00091	0.00087	0.00014	12,553
			96	13.0	11.4	1.7	2.1	1.8	0.3	0.00082	0.00089	0.00086	0.00014	12,747
			97	13.0	11.3	1.7	2.1	1.8	0.3	0.00083	0.00090	0.00086	0.00014	12,576
			98	13.0	11.3	1.7	2.1	1.8	0.3	0.00082	0.00090	0.00086	0.00014	12,610
			100	13.0	11.4	1.7	2.1	1.8	0.3	0.00082	0.00089	0.00085	0.00014	12,805
	COLUMN AVERAGE			13.0	11.4	1.7	2.1	1.8	0.3	0.00082	0.00090	0.00086	0.00014	12,658
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	111
SEQUENCE 7	4.0	4.0	95	25.2	22.8	2.4	4.0	3.6	0.4	0.00155	0.00174	0.00164	0.00027	13,285
			96	25.1	22.7	2.4	4.0	3.6	0.4	0.00156	0.00175	0.00165	0.00027	13,184
			97	25.2	22.8	2.4	4.0	3.6	0.4	0.00156	0.00176	0.00166	0.00027	13,193
			98	25.2	22.8	2.4	4.0	3.6	0.4	0.00156	0.00175	0.00165	0.00027	13,258
			100	25.1	22.8	2.4	4.0	3.6	0.4	0.00156	0.00174	0.00165	0.00027	13,223
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00156	0.00175	0.00165	0.00027	13,229
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	43

Source: Widows Creek Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	95	37.6	34.0	3.7	6.0	5.4	0.6	0.00222	0.00251	0.00237	0.00039	13,773
			96	37.6	34.0	3.6	6.0	5.4	0.6	0.00222	0.00252	0.00237	0.00039	13,766
			97	37.7	34.0	3.6	6.0	5.4	0.6	0.00223	0.00251	0.00237	0.00039	13,773
			98	37.6	34.0	3.6	6.0	5.4	0.6	0.00223	0.00252	0.00238	0.00039	13,707
			100	37.6	34.0	3.6	6.0	5.4	0.6	0.00223	0.00253	0.00238	0.00039	13,698
	COLUMN AVERAGE			37.6	34.0	3.6	6.0	5.4	0.6	0.00223	0.00252	0.00237	0.00039	13,743
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	37
SEQUENCE 9	4.0	8.0	95	50.3	45.5	4.9	8.0	7.2	0.8	0.00290	0.00330	0.00310	0.00051	14,090
			96	50.4	45.5	4.8	8.0	7.2	0.8	0.00290	0.00329	0.00310	0.00051	14,115
			97	50.4	45.5	4.9	8.0	7.2	0.8	0.00288	0.00329	0.00309	0.00051	14,145
			98	50.3	45.4	4.9	8.0	7.2	0.8	0.00289	0.00328	0.00308	0.00051	14,133
			100	50.3	45.5	4.9	8.0	7.2	0.8	0.00291	0.00330	0.00310	0.00051	14,055
	COLUMN AVERAGE			50.3	45.5	4.9	8.0	7.2	0.8	0.00290	0.00329	0.00309	0.00051	14,108
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	36
SEQUENCE 10	4.0	10.0	95	63.1	57.0	6.1	10.0	9.1	1.0	0.00359	0.00407	0.00383	0.00063	14,281
			96	63.1	56.9	6.1	10.0	9.1	1.0	0.00359	0.00408	0.00383	0.00064	14,243
			97	62.9	56.8	6.1	10.0	9.0	1.0	0.00359	0.00408	0.00384	0.00064	14,207
			98	63.0	56.9	6.1	10.0	9.0	1.0	0.00359	0.00408	0.00384	0.00064	14,223
			100	62.9	56.8	6.1	10.0	9.0	1.0	0.00359	0.00407	0.00383	0.00063	14,239
	COLUMN AVERAGE			63.0	56.9	6.1	10.0	9.0	1.0	0.00359	0.00408	0.00383	0.00064	14,239
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	28

Source: Widows Creek Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	95	13.3	11.2	2.1	2.1	1.8	0.3	0.00094	0.00102	0.00098	0.00016	10,985
			96	13.3	11.2	2.1	2.1	1.8	0.3	0.00092	0.00101	0.00097	0.00016	11,113
			97	13.3	11.2	2.1	2.1	1.8	0.3	0.00093	0.00100	0.00096	0.00016	11,127
			98	13.2	11.1	2.1	2.1	1.8	0.3	0.00094	0.00101	0.00098	0.00016	10,957
			100	13.3	11.2	2.1	2.1	1.8	0.3	0.00093	0.00099	0.00096	0.00016	11,259
	COLUMN AVERAGE			13.3	11.2	2.1	2.1	1.8	0.3	0.00093	0.00101	0.00097	0.00016	11,088
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	122
SEQUENCE 12	2.0	4.0	95	25.1	22.7	2.4	4.0	3.6	0.4	0.00183	0.00203	0.00193	0.00032	11,268
			96	25.2	22.8	2.4	4.0	3.6	0.4	0.00183	0.00203	0.00193	0.00032	11,368
			97	25.2	22.8	2.4	4.0	3.6	0.4	0.00181	0.00203	0.00192	0.00032	11,387
			98	25.1	22.7	2.4	4.0	3.6	0.4	0.00185	0.00203	0.00194	0.00032	11,268
			100	25.2	22.8	2.4	4.0	3.6	0.4	0.00184	0.00203	0.00193	0.00032	11,305
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00183	0.00203	0.00193	0.00032	11,319
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	56
SEQUENCE 13	2.0	6.0	95	37.6	33.9	3.6	6.0	5.4	0.6	0.00260	0.00291	0.00275	0.00046	11,821
			96	37.6	34.0	3.6	6.0	5.4	0.6	0.00259	0.00292	0.00276	0.00046	11,829
			97	37.6	34.0	3.6	6.0	5.4	0.6	0.00259	0.00293	0.00276	0.00046	11,837
			98	37.6	34.0	3.6	6.0	5.4	0.6	0.00259	0.00293	0.00276	0.00046	11,808
			100	37.5	33.9	3.6	6.0	5.4	0.6	0.00257	0.00294	0.00275	0.00046	11,806
	COLUMN AVERAGE			37.6	34.0	3.6	6.0	5.4	0.6	0.00259	0.00292	0.00276	0.00046	11,820
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	13

Source: Widows Creek Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	95	50.4	45.5	4.9	8.0	7.2	0.8	0.00334	0.00377	0.00356	0.00059	12,267
			96	50.4	45.5	4.9	8.0	7.2	0.8	0.00336	0.00376	0.00356	0.00059	12,284
			97	50.4	45.6	4.8	8.0	7.3	0.8	0.00334	0.00376	0.00355	0.00059	12,319
			98	50.4	45.5	4.9	8.0	7.2	0.8	0.00334	0.00376	0.00355	0.00059	12,293
			100	50.4	45.5	4.8	8.0	7.2	0.8	0.00334	0.00375	0.00355	0.00059	12,322
	COLUMN AVERAGE			50.4	45.5	4.9	8.0	7.2	0.8	0.00334	0.00376	0.00355	0.00059	12,297
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	23
SEQUENCE 15	2.0	10.0	95	63.0	56.9	6.1	10.0	9.1	1.0	0.00411	0.00464	0.00437	0.00073	12,491
			96	63.1	57.0	6.1	10.0	9.1	1.0	0.00414	0.00463	0.00439	0.00073	12,473
			97	63.1	57.0	6.1	10.0	9.1	1.0	0.00414	0.00465	0.00439	0.00073	12,455
			98	63.1	56.9	6.1	10.0	9.1	1.0	0.00414	0.00463	0.00438	0.00073	12,461
			100	63.1	57.0	6.1	10.0	9.1	1.0	0.00414	0.00465	0.00440	0.00073	12,435
	COLUMN AVERAGE			63.1	57.0	6.1	10.0	9.1	1.0	0.00413	0.00464	0.00439	0.00073	12,463
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	21

SUBMITTED BY, DATE

Richard S. Bruehan 10/18/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	10-05-1995

$$M_R = K1\ (S_c)^{K2}(1+S_3)^{K5}$$

K1 =	7,937
K2 =	0.08949
K5 =	0.23891
R^2 =	0.97

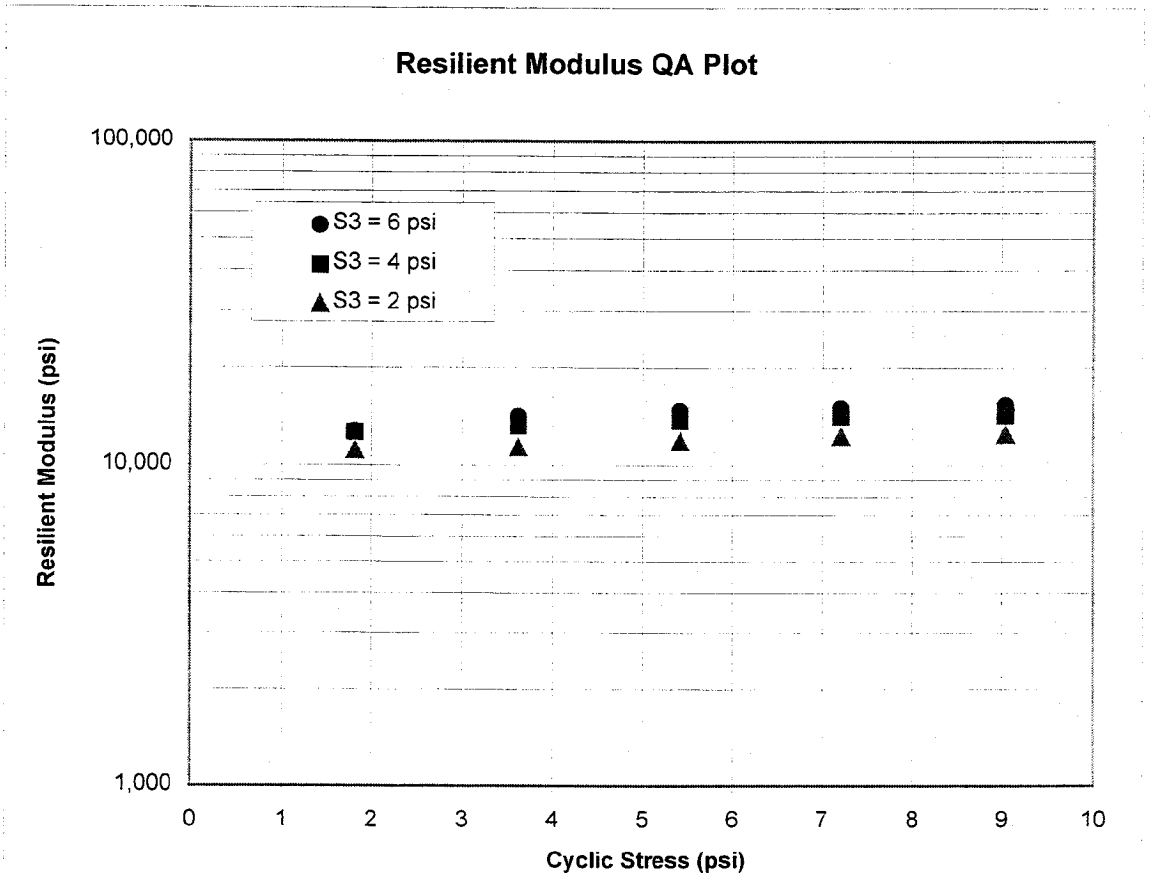
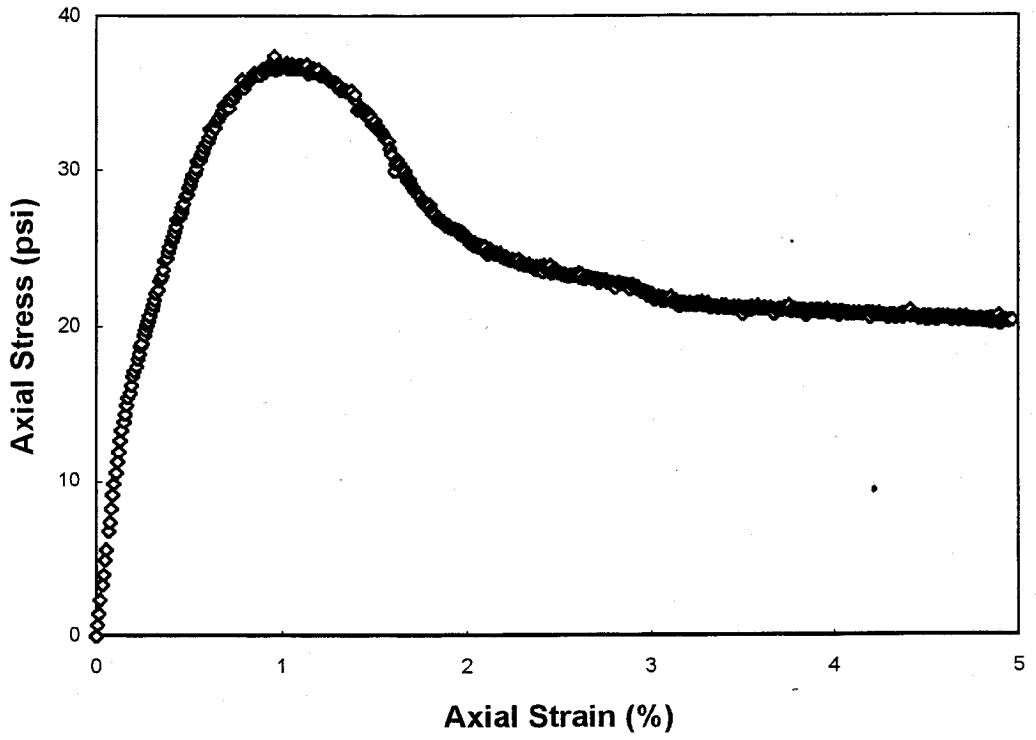


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	10-05-1995



LABORATORY MATERIAL HANDLING AND TESTING SHEET NO 1 OF 2

LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO.*:	
	SPECIMEN DIAM., inch	
	TOP	2.86
	MIDDLE	2.86
	BOTTOM	2.86
	AVERAGE	2.86
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.05
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.05
	INITIAL AREA, A_0 , in^2	6.29
	INITIAL VOLUME $A_0 L_0$, in^3	38.05
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1121.10
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	1121.10
8.	*SOIL PROPERTIES*.:	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	19.4
	MAX. DRY DENSITY, pcf	99.9
	95 % MAX. DRY DENSITY, pcf	94.9
9.	*SPECIMEN PROPERTIES*:	
	COMPACTION MOISTURE CONTENT, %	24.3
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	24.3
	COMPACTION DRY DENSITY, γ_d pcf	90.2
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	53.9
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	10-05-1995

GENERAL REMARKS:

SUBMITTED BY. DATE

Richard S. Bluethman 10/18/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Widows Creek
2. *MATERIAL DESCRIPTION:* Gypsum
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 10-05-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_._	_._	_	_._	_._	_._	_._	_._	_._	_._	_._	_._	_._	_._
SEQUENCE 1	6.0	2.0	95	12.6	11.4	1.3	2.0	1.8	0.2	0.00078	0.00074	0.00076	0.00013	14,381
			96	12.7	11.4	1.3	2.0	1.8	0.2	0.00077	0.00076	0.00076	0.00013	14,326
			97	12.7	11.5	1.3	2.0	1.8	0.2	0.00078	0.00076	0.00077	0.00013	14,283
			98	12.7	11.4	1.3	2.0	1.8	0.2	0.00077	0.00076	0.00076	0.00013	14,334
			100	12.7	11.4	1.3	2.0	1.8	0.2	0.00078	0.00075	0.00077	0.00013	14,314
	COLUMN AVERAGE			12.7	11.4	1.3	2.0	1.8	0.2	0.00078	0.00075	0.00076	0.00013	14,328
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	35

Source: Widows Creek Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	95	25.1	22.7	2.4	4.0	3.6	0.4	0.00153	0.00141	0.00147	0.00024	14,842
			96	25.2	22.9	2.3	4.0	3.6	0.4	0.00153	0.00140	0.00146	0.00024	14,985
			97	25.2	22.8	2.4	4.0	3.6	0.4	0.00153	0.00141	0.00147	0.00024	14,921
			98	25.2	22.8	2.4	4.0	3.6	0.4	0.00153	0.00141	0.00147	0.00024	14,887
			100	25.1	22.7	2.4	4.0	3.6	0.4	0.00151	0.00139	0.00145	0.00024	15,018
	COLUMN AVERAGE			25.1	22.8	2.4	4.0	3.6	0.4	0.00152	0.00141	0.00146	0.00024	14,931
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	71
SEQUENCE 3	6.0	6.0	95	37.8	34.1	3.6	6.0	5.4	0.6	0.00223	0.00206	0.00214	0.00035	15,305
			96	37.8	34.2	3.7	6.0	5.4	0.6	0.00223	0.00205	0.00214	0.00035	15,341
			97	37.8	34.1	3.6	6.0	5.4	0.6	0.00223	0.00205	0.00214	0.00035	15,330
			98	37.8	34.2	3.6	6.0	5.4	0.6	0.00224	0.00205	0.00214	0.00035	15,305
			100	37.8	34.1	3.6	6.0	5.4	0.6	0.00224	0.00205	0.00214	0.00035	15,288
	COLUMN AVERAGE			37.8	34.2	3.6	6.0	5.4	0.6	0.00223	0.00205	0.00214	0.00035	15,314
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	22
SEQUENCE 4	6.0	8.0	95	50.4	45.5	4.9	8.0	7.2	0.8	0.00291	0.00270	0.00280	0.00046	15,601
			96	50.3	45.4	4.9	8.0	7.2	0.8	0.00292	0.00271	0.00281	0.00047	15,499
			97	50.3	45.4	4.9	8.0	7.2	0.8	0.00290	0.00271	0.00280	0.00046	15,571
			98	50.3	45.4	4.9	8.0	7.2	0.8	0.00291	0.00269	0.00280	0.00046	15,566
			100	50.3	45.5	4.8	8.0	7.2	0.8	0.00293	0.00269	0.00281	0.00046	15,543
	COLUMN AVERAGE			50.3	45.4	4.9	8.0	7.2	0.8	0.00291	0.00270	0.00281	0.00046	15,556
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	38

Source: Widows Creek Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	95	63.1	57.1	6.1	10.0	9.1	1.0	0.00362	0.00332	0.00347	0.00057	15,783
			96	63.1	57.0	6.1	10.0	9.1	1.0	0.00361	0.00330	0.00345	0.00057	15,858
			97	63.0	56.9	6.1	10.0	9.0	1.0	0.00362	0.00330	0.00346	0.00057	15,805
			98	63.2	57.0	6.1	10.0	9.1	1.0	0.00360	0.00332	0.00346	0.00057	15,830
			100	63.1	57.0	6.1	10.0	9.1	1.0	0.00361	0.00333	0.00347	0.00057	15,778
	COLUMN AVERAGE			63.1	57.0	6.1	10.0	9.1	1.0	0.00361	0.00331	0.00346	0.00057	15,811
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	33
SEQUENCE 6	4.0	2.0	95	13.0	11.4	1.6	2.1	1.8	0.3	0.00079	0.00081	0.00080	0.00013	13,578
			96	12.9	11.3	1.6	2.1	1.8	0.3	0.00080	0.00081	0.00080	0.00013	13,495
			97	13.0	11.3	1.7	2.1	1.8	0.3	0.00081	0.00081	0.00081	0.00013	13,457
			98	12.9	11.3	1.7	2.1	1.8	0.3	0.00079	0.00080	0.00080	0.00013	13,532
			100	13.2	11.6	1.6	2.1	1.8	0.3	0.00081	0.00082	0.00082	0.00014	13,587
	COLUMN AVERAGE			13.0	11.4	1.7	2.1	1.8	0.3	0.00080	0.00081	0.00081	0.00013	13,530
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	55
SEQUENCE 7	4.0	4.0	95	25.3	22.9	2.4	4.0	3.6	0.4	0.00162	0.00154	0.00158	0.00026	13,901
			96	25.3	22.9	2.4	4.0	3.6	0.4	0.00164	0.00154	0.00159	0.00026	13,822
			97	25.3	22.9	2.4	4.0	3.6	0.4	0.00162	0.00153	0.00158	0.00026	13,966
			98	25.3	22.9	2.4	4.0	3.6	0.4	0.00162	0.00153	0.00158	0.00026	13,942
			100	25.3	22.9	2.4	4.0	3.6	0.4	0.00162	0.00155	0.00159	0.00026	13,859
	COLUMN AVERAGE			25.3	22.9	2.4	4.0	3.6	0.4	0.00163	0.00154	0.00158	0.00026	13,898
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	59

Source: Widows Creek Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	95	37.7	34.1	3.6	6.0	5.4	0.6	0.00240	0.00223	0.00232	0.00038	14,146
			96	37.7	34.1	3.6	6.0	5.4	0.6	0.00241	0.00223	0.00232	0.00038	14,116
			97	37.8	34.2	3.6	6.0	5.4	0.6	0.00239	0.00222	0.00231	0.00038	14,220
			98	37.7	34.1	3.6	6.0	5.4	0.6	0.00240	0.00223	0.00232	0.00038	14,147
			100	37.7	34.1	3.6	6.0	5.4	0.6	0.00240	0.00222	0.00231	0.00038	14,187
	COLUMN AVERAGE			37.7	34.1	3.6	6.0	5.4	0.6	0.00240	0.00223	0.00231	0.00038	14,163
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	41
SEQUENCE 9	4.0	8.0	95	50.4	45.6	4.9	8.0	7.2	0.8	0.00312	0.00292	0.00302	0.00050	14,505
			96	50.5	45.6	4.9	8.0	7.2	0.8	0.00314	0.00292	0.00303	0.00050	14,463
			97	50.4	45.5	4.9	8.0	7.2	0.8	0.00312	0.00292	0.00302	0.00050	14,485
			98	50.4	45.6	4.9	8.0	7.2	0.8	0.00314	0.00293	0.00303	0.00050	14,421
			100	50.3	45.4	4.9	8.0	7.2	0.8	0.00313	0.00290	0.00302	0.00050	14,465
	COLUMN AVERAGE			50.4	45.5	4.9	8.0	7.2	0.8	0.00313	0.00292	0.00302	0.00050	14,468
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	31
SEQUENCE 10	4.0	10.0	95	63.2	57.1	6.1	10.0	9.1	1.0	0.00388	0.00363	0.00375	0.00062	14,598
			96	63.2	57.1	6.1	10.0	9.1	1.0	0.00387	0.00363	0.00375	0.00062	14,634
			97	63.2	57.1	6.1	10.0	9.1	1.0	0.00387	0.00363	0.00375	0.00062	14,626
			98	63.2	57.1	6.1	10.0	9.1	1.0	0.00387	0.00363	0.00375	0.00062	14,620
			100	63.1	57.0	6.1	10.0	9.0	1.0	0.00388	0.00363	0.00375	0.00062	14,577
	COLUMN AVERAGE			63.2	57.1	6.1	10.0	9.1	1.0	0.00387	0.00363	0.00375	0.00062	14,611
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	23

Source: Widows Creek Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	95	13.3	11.3	2.1	2.1	1.8	0.3	0.00089	0.00095	0.00092	0.00015	11,756
			96	13.3	11.3	2.0	2.1	1.8	0.3	0.00089	0.00096	0.00092	0.00015	11,735
			97	13.4	11.4	2.0	2.1	1.8	0.3	0.00091	0.00094	0.00093	0.00015	11,822
			98	13.4	11.3	2.1	2.1	1.8	0.3	0.00090	0.00094	0.00092	0.00015	11,815
			100	13.4	11.3	2.1	2.1	1.8	0.3	0.00090	0.00094	0.00092	0.00015	11,796
	COLUMN AVERAGE			13.4	11.3	2.1	2.1	1.8	0.3	0.00090	0.00095	0.00092	0.00015	11,785
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	38
SEQUENCE 12	2.0	4.0	95	25.1	22.8	2.4	4.0	3.6	0.4	0.00189	0.00184	0.00186	0.00031	11,740
			96	25.2	22.8	2.4	4.0	3.6	0.4	0.00189	0.00184	0.00187	0.00031	11,756
			97	25.2	22.8	2.4	4.0	3.6	0.4	0.00188	0.00185	0.00186	0.00031	11,755
			98	25.1	22.8	2.4	4.0	3.6	0.4	0.00187	0.00185	0.00186	0.00031	11,780
			100	25.2	22.8	2.4	4.0	3.6	0.4	0.00190	0.00184	0.00187	0.00031	11,743
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00188	0.00184	0.00186	0.00031	11,755
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	16
SEQUENCE 13	2.0	6.0	95	37.6	34.0	3.6	6.0	5.4	0.6	0.00275	0.00263	0.00269	0.00044	12,134
			96	37.6	34.0	3.6	6.0	5.4	0.6	0.00277	0.00263	0.00270	0.00045	12,104
			97	37.6	34.0	3.6	6.0	5.4	0.6	0.00276	0.00262	0.00269	0.00044	12,153
			98	37.8	34.2	3.6	6.0	5.4	0.6	0.00277	0.00262	0.00270	0.00045	12,159
			100	37.5	33.9	3.6	6.0	5.4	0.6	0.00277	0.00262	0.00269	0.00045	12,087
	COLUMN AVERAGE			37.6	34.0	3.6	6.0	5.4	0.6	0.00276	0.00262	0.00269	0.00045	12,128
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	31

Source: Widows Creek Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	95	50.5	45.6	4.9	8.0	7.3	0.8	0.00358	0.00338	0.00348	0.00058	12,593
			96	50.6	45.7	4.9	8.0	7.3	0.8	0.00360	0.00338	0.00349	0.00058	12,580
			97	50.5	45.6	4.9	8.0	7.2	0.8	0.00358	0.00340	0.00349	0.00058	12,561
			98	50.5	45.6	4.9	8.0	7.2	0.8	0.00359	0.00340	0.00349	0.00058	12,541
			100	50.4	45.5	4.9	8.0	7.2	0.8	0.00356	0.00338	0.00347	0.00057	12,592
	COLUMN AVERAGE			50.5	45.6	4.9	8.0	7.2	0.8	0.00358	0.00339	0.00348	0.00058	12,574
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	22
SEQUENCE 15	2.0	10.0	95	63.2	57.1	6.1	10.0	9.1	1.0	0.00441	0.00419	0.00430	0.00071	12,746
			96	63.2	57.1	6.1	10.0	9.1	1.0	0.00442	0.00421	0.00432	0.00071	12,693
			97	63.2	57.1	6.1	10.0	9.1	1.0	0.00442	0.00420	0.00431	0.00071	12,737
			98	63.2	57.1	6.1	10.0	9.1	1.0	0.00442	0.00419	0.00430	0.00071	12,753
			100	63.2	57.0	6.1	10.0	9.1	1.0	0.00441	0.00420	0.00430	0.00071	12,726
	COLUMN AVERAGE			63.2	57.1	6.1	10.0	9.1	1.0	0.00442	0.00420	0.00431	0.00071	12,731
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	24

SUBMITTED BY, DATE

Richard S. Boudreau 10/18/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	10-05-1995

$$M_R = K1\ (S_C)^{K2}(1+S_3)^{K5}$$

K1 =	8,454
K2 =	0.05337
K5 =	0.26140
R^2 =	0.99

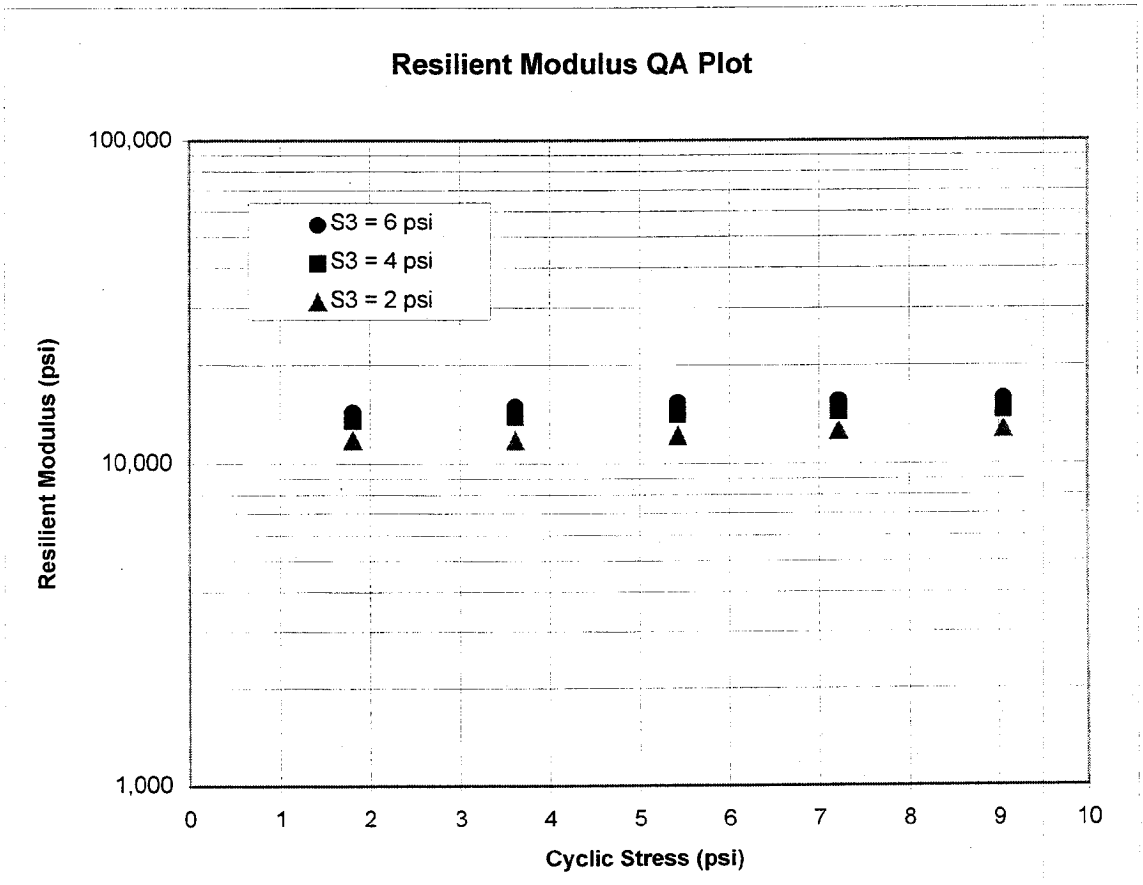
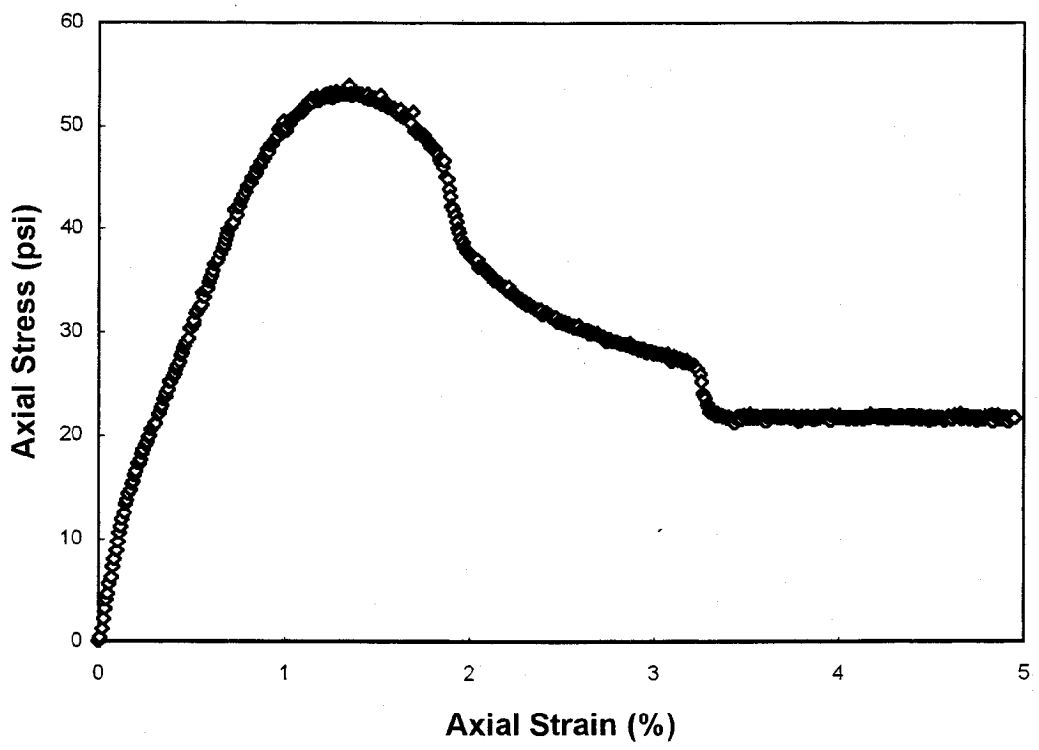


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	10-05-1995



WIDOWS CREEK

Bottom Ash - From Pond

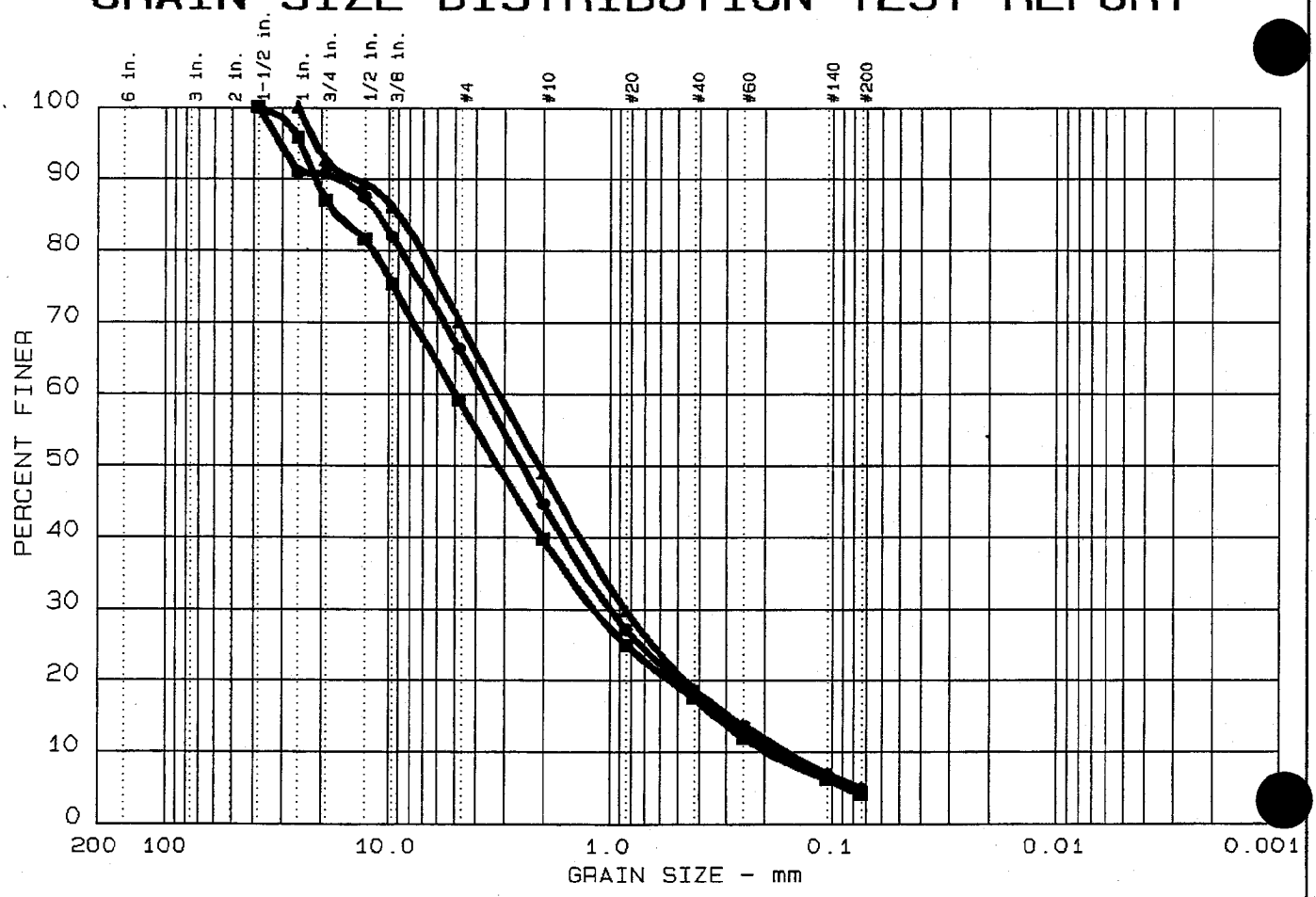
Grain Size Distribution Test Report
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Relative Density Test
Hydraulic Conductivity - Constant Head (2 Pages)
California Bearing Ratio
Resilient Modulus (Standard Proctor) (9 Pages)
Resilient Modulus (Modified Proctor) (9 Pages)

TVA - WIDOWS CREEK
BOTTOM ASH - FROM POND

Description	Test Method	Property	Sample 1	Sample 2	Sample 3
Grain Size	ASTM D 422	Percent Retained on the #4 Sieve Percent Passing the #200 Sieve	33.7 4.8	29.9 4.1	40.9 4.5
Atterberg Limits	ASTM D 4318	Liquid Limit Plastic Limit Plasticity Index	NL NP N/A	NL NP N/A	NL NP N/A
Specific Gravity	ASTM D 854	Specific Gravity at 20°C	2.74	2.60	2.67
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	SW A-1-a	SW A-1-a	SW A-1-a
			Composite Sample		
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %	106.2 17.6		
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %	120.8 15.8		
Relative Density	ASTM D 4254 ASTM D 4253	Minimum Dry Density, pcf Maximum Dry Density (Dry Method), pcf	83.0 103.3		
			Result	Dry Density, pcf	Moisture Content, %
Hydraulic Conductivity	ASTM D 2434	Hydraulic Conductivity, cm/sec	3.4E-2	90.8	0.0
Angle of Repose	LAW TP6	Angle of Repose, degrees	29.0	83.0	0.0
California Bearing Ratio	ASTM D 1883	CBR, %	30	95.2	16.4
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	7,379	104.5	12.0
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	4,788	117.1	11.2
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm	3,100		
pH of Soil	AASHTO T 289	pH	8.0		
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg	4070		
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg	130		

wcf-ba.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	20	0.0	33.7	61.5	4.8	
▲	19	0.0	29.9	66.0	4.1	
■	18	0.0	40.9	54.6	4.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP	10.96	3.67	2.48	0.989	0.2884	0.1567	1.70	23.4
▲	NL	NP	8.91	3.16	2.09	0.851	0.3090	0.1841	1.24	17.2
■	NL	NP	16.98	4.95	3.20	1.175	0.3311	0.1972	1.41	25.1

	MATERIAL DESCRIPTION	USCS	AASHTO
●		SW	A-1-a
▲		SW	A-1-a
■		SW	A-1-a

Project No.: 5810860101
Project: TVA - Widows Creek
● Location: Bottom Ash A & B
▲ Location: Bottom Ash C & D
■ Location: Bottom Ash E & F
Date: July 18, 1995

Remarks:

Tested by: JCR

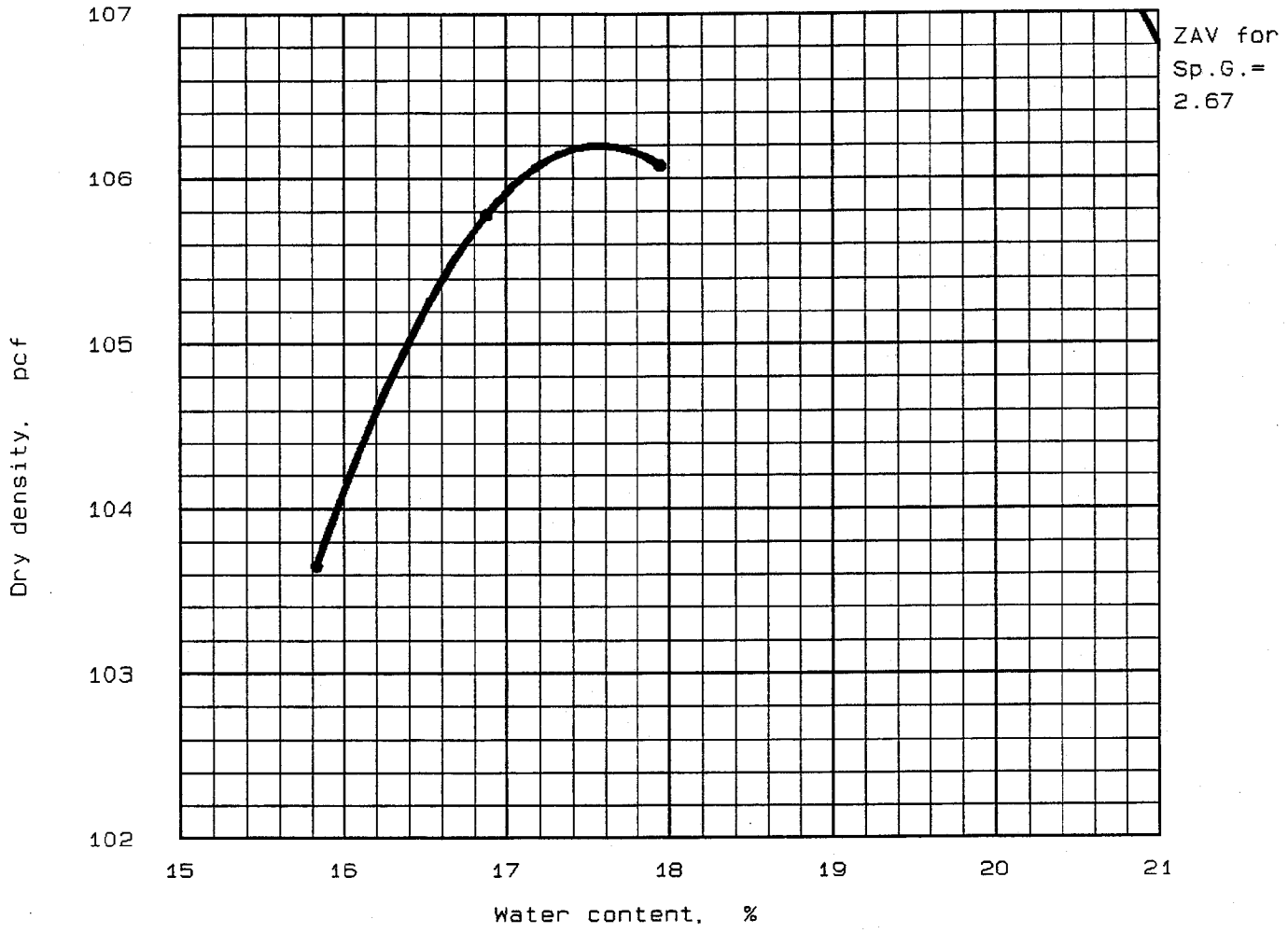
Reviewed by: HS

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

Figure No.

MOISTURE-DENSITY RELATIONSHIP



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SW	A-1-a	3.55 %	2.67	NL	NP	34.8 %	4.47 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 17.6 % Maximum dry density = 106.2 pcf	

Project No.: 5810860101
Project: TVA - Widows Creek
Location: Bottom Ash

Date: July 25, 1995

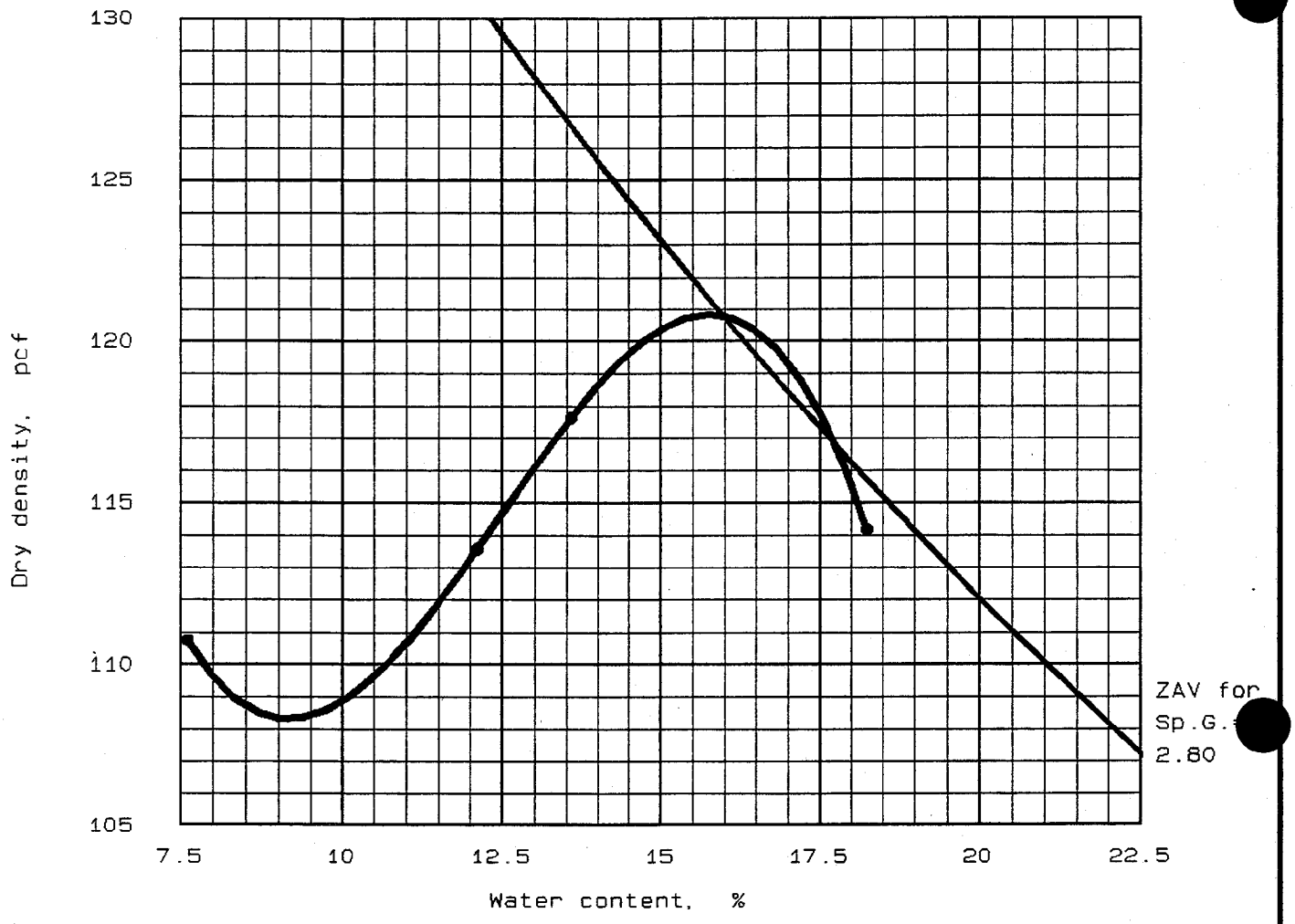
Remarks:
Tested by: JCN
Reviewed by: RWB

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

MOISTURE-DENSITY RELATIONSHIP



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SW	A-1-a	3.55 %	2.67	NL	NP	34.8 %	4.47 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 15.8 % Maximum dry density = 120.8 pcf	

Project No.: 5810860101
Project: TVA - Widows Creek
Location: Bottom Ash

Date: July 25, 1995

Remarks:
Tested by: JCR
Reviewed by: RWB

MOISTURE-DENSITY RELATIONSHIP

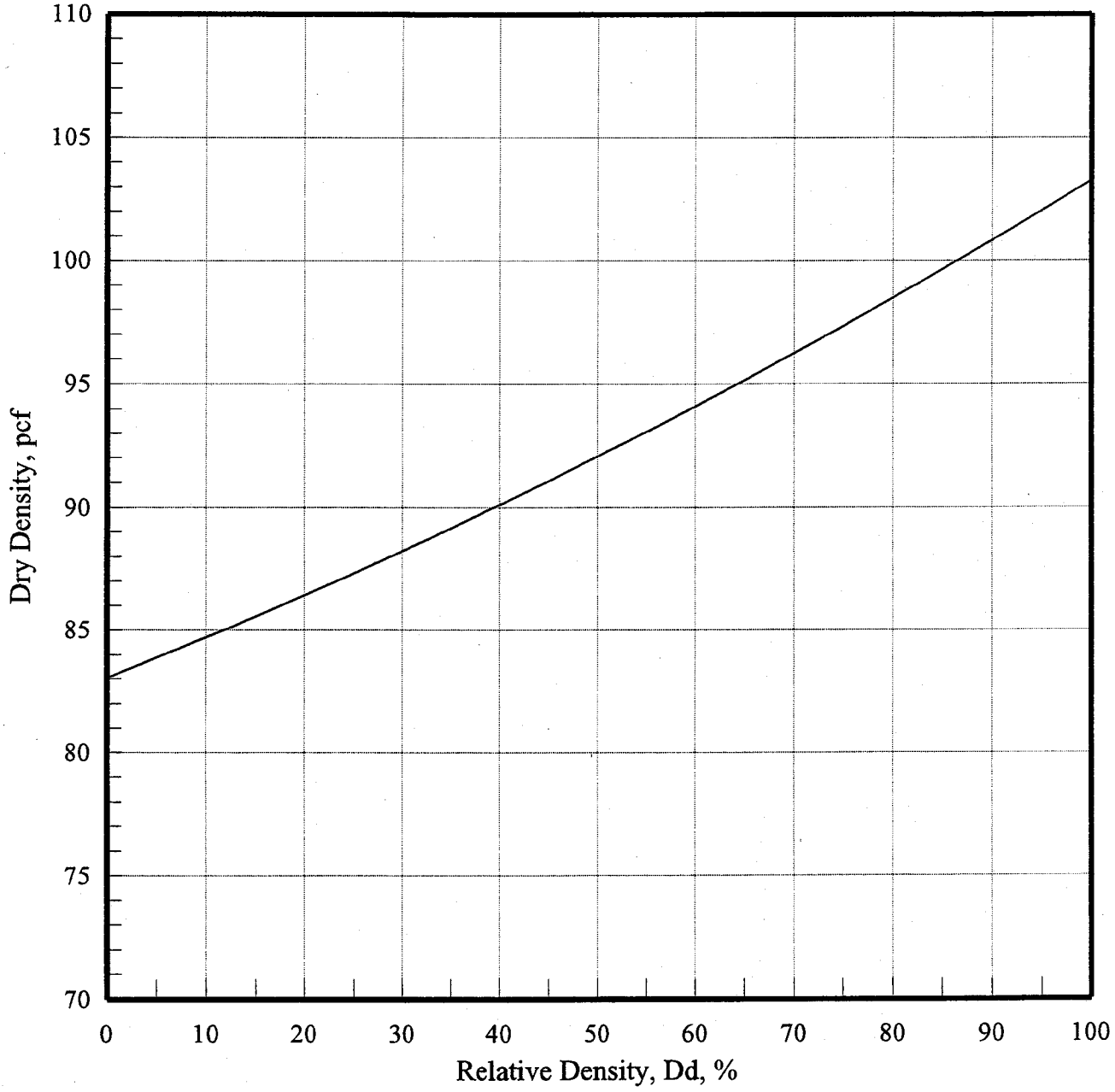
LAW ENGINEERING, INC.

Figure No. _____

Relative Density Test

TVA - Widows Creek, Bottom Ash

Law Project No. 5810860101



HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*JCR*
Project Name	*TVA - Widows Creek*	Test Date	*08/17/95*
Material	*Bottom Ash*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D2434-68 Constant Head Permeability

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*0.0*
Wet Unit Weight, pcf:	*90.8*
Dry Unit Weight, pcf:	*90.8*
Compaction, %:	*85.5*
Hydraulic Conductivity, cm/sec. @20° C:	***3.4E-02***

PERMEABILITY TEST - Constant Head
(ASTM D2434 - 68)

LAW ENGINEERING

Project No. 5810860101
Project Name TVA - Widows Creek
Material Bottom Ash

Tested By JCR
Test Date 08/17/95
Reviewed By RLB
Review Date 09/06/95

Sample Data

Length, in		Diameter, in		Pan No.	
Location 1	5.636	Location 1	2.858	Wet Soil + Pan, grams	857.45
Location 2	5.513	Location 2	2.875	Dry Soil+Pan, grams	857.45
Location3	5.577	Location 3	2.868	Pan Weight, grams	0.00
Average	5.575	Average	2.867	Moisture Content, %	0.0
		Sample wet weight, grams	857.45	Wet Unit Wt, pcf	90.8
		Membrane, Cap weight, grams	0.00	Dry Unit Wt, pcf	90.8

Time (sec)	Q (cm^3)	H (cm)	k (cm/sec)	Temp ° C	k (cm/sec at 20° C)	i (cm/cm)
600	325.00	5.08	3.6E-02	20.0	3.6E-02	0.36
1200	610.00	5.08	3.4E-02	20.0	3.4E-02	0.36

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
2	Remolded	106.2	85.5	Vertical

L = length of sample in cm
A = area of sample in cm^2
H = constant head in cm
t = time in seconds

A = 41.65 cm^2
L = 14.161 cm

Avg. k at 20° C 3.4E-02 cm/sec

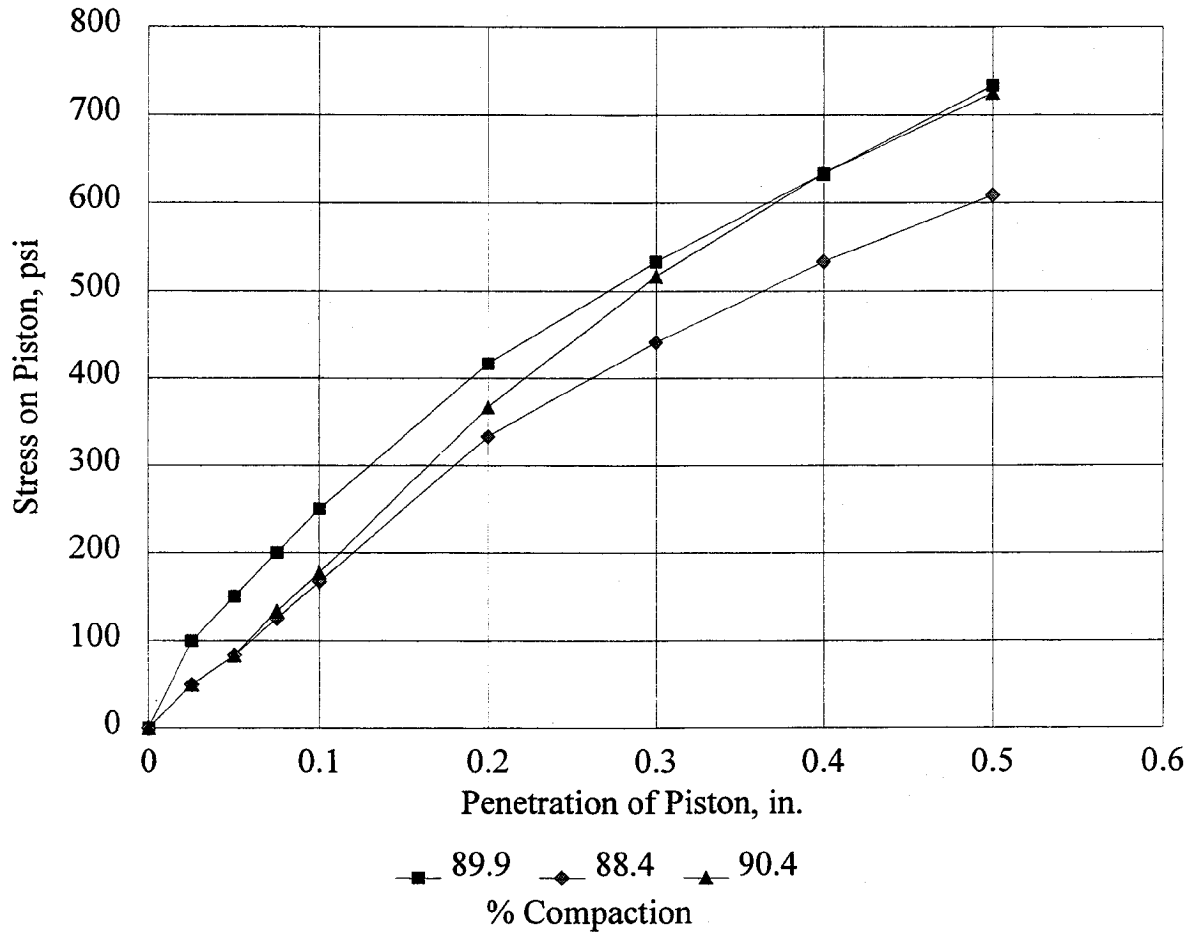
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Widows Creek	**Test Date**	08/18/95
Material (Source)	Bottom Ash	**Reviewed By**	RLB
		Review Date	08/23/95

Compaction, %	89.9	88.4	90.4
Before Soak Dry Density, pcf	95.5	94.0	96.1
Before Soak Moisture Content,	15.7	16.6	16.9
After Soak Dry Density, pcf	96.5	94.3	96.5
After Soak Moisture Content, %	17.9	18.9	18.2
CBR @ 0.1 in.	25.0	16.7	17.7
CBR @ 0.2 in.	27.8	22.2	24.4



LABORATORY MATERIAL HANDLING AND TESTING
LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE
MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO.:*	
	SPECIMEN DIAM., inch	
	TOP	2.86
	MIDDLE	2.86
	BOTTOM	2.87
	AVERAGE	2.86
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.84
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.06
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0, inch	6.06
	INITIAL AREA, A_0, in^2	6.32
	INITIAL VOLUME $A_0 L_0$, in^3	38.28
7.	*SOIL SPECIMEN WEIGHT:*	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1580.50
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	403.90
	WEIGHT OF WET SOIL USED, grams	1176.60
8.	*SOIL PROPERTIES.:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	17.6
	MAX. DRY DENSITY, pcf	106.2
	95 % MAX. DRY DENSITY, pcf	100.9
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	12.0
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	12.0
	COMPACTION DRY DENSITY, γ_d pcf	104.5
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	36.0
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	08-23-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RL Baughman 9/10/95
LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Widows Creek
2. *MATERIAL DESCRIPTION:* Bottom Ash
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-23-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_._	_._	_	_._	_._	_._	_._	_._	_._	_._	_._	_._	_._	_._
SEQUENCE 1	6.0	2.0	1	12.8	11.5	1.3	2.0	1.8	0.2	0.00108	0.00125	0.00116	0.00019	9,514
			2	12.9	11.6	1.3	2.0	1.8	0.2	0.00107	0.00125	0.00116	0.00019	9,614
			3	12.8	11.5	1.3	2.0	1.8	0.2	0.00107	0.00125	0.00116	0.00019	9,488
			4	12.8	11.5	1.3	2.0	1.8	0.2	0.00107	0.00125	0.00116	0.00019	9,510
			5	12.9	11.6	1.3	2.0	1.8	0.2	0.00109	0.00126	0.00117	0.00019	9,477
	COLUMN AVERAGE			12.8	11.6	1.3	2.0	1.8	0.2	0.00108	0.00125	0.00116	0.00019	9,521
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	55

Source: Widows Creek Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.5	23.1	2.4	4.0	3.7	0.4	0.00185	0.00210	0.00198	0.00033	11,215
			2	25.4	23.0	2.4	4.0	3.6	0.4	0.00185	0.00210	0.00198	0.00033	11,170
			3	25.5	23.1	2.4	4.0	3.7	0.4	0.00185	0.00208	0.00197	0.00032	11,280
			4	25.5	23.1	2.4	4.0	3.7	0.4	0.00185	0.00210	0.00198	0.00033	11,223
			5	25.4	23.0	2.4	4.0	3.6	0.4	0.00185	0.00208	0.00197	0.00032	11,246
	COLUMN AVERAGE			25.5	23.1	2.4	4.0	3.7	0.4	0.00185	0.00209	0.00197	0.00033	11,227
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	40
SEQUENCE 3	6.0	6.0	1	38.0	34.3	3.6	6.0	5.4	0.6	0.00269	0.00298	0.00284	0.00047	11,618
			2	37.9	34.3	3.6	6.0	5.4	0.6	0.00270	0.00297	0.00284	0.00047	11,615
			3	37.9	34.3	3.6	6.0	5.4	0.6	0.00269	0.00297	0.00283	0.00047	11,619
			4	37.9	34.3	3.6	6.0	5.4	0.6	0.00270	0.00296	0.00283	0.00047	11,626
			5	37.9	34.3	3.6	6.0	5.4	0.6	0.00270	0.00298	0.00284	0.00047	11,586
	COLUMN AVERAGE			37.9	34.3	3.6	6.0	5.4	0.6	0.00270	0.00297	0.00283	0.00047	11,613
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	16
SEQUENCE 4	6.0	8.0	1	50.8	45.9	4.9	8.0	7.3	0.8	0.00357	0.00387	0.00372	0.00061	11,843
			2	50.8	45.9	4.9	8.0	7.3	0.8	0.00358	0.00387	0.00372	0.00061	11,846
			3	50.8	45.9	4.9	8.0	7.3	0.8	0.00357	0.00388	0.00373	0.00061	11,820
			4	50.9	46.0	4.9	8.1	7.3	0.8	0.00356	0.00388	0.00372	0.00061	11,849
			5	50.8	45.9	4.9	8.0	7.3	0.8	0.00357	0.00389	0.00373	0.00062	11,821
	COLUMN AVERAGE			50.8	45.9	4.9	8.0	7.3	0.8	0.00357	0.00388	0.00372	0.00061	11,836
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	14

Source: Widows Creek Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.6	57.5	6.1	10.1	9.1	1.0	0.00439	0.00475	0.00457	0.00075	12,071
			2	63.5	57.4	6.1	10.1	9.1	1.0	0.00440	0.00475	0.00458	0.00076	12,038
			3	63.6	57.5	6.1	10.1	9.1	1.0	0.00441	0.00476	0.00458	0.00076	12,034
			4	63.6	57.4	6.1	10.1	9.1	1.0	0.00440	0.00475	0.00458	0.00076	12,038
			5	63.6	57.5	6.1	10.1	9.1	1.0	0.00441	0.00475	0.00458	0.00076	12,031
	COLUMN AVERAGE			63.6	57.5	6.1	10.1	9.1	1.0	0.00440	0.00475	0.00458	0.00076	12,042
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	16
SEQUENCE 6	4.0	2.0	1	13.0	11.4	1.6	2.1	1.8	0.3	0.00140	0.00157	0.00148	0.00024	7,377
			2	13.0	11.4	1.7	2.1	1.8	0.3	0.00139	0.00156	0.00147	0.00024	7,408
			3	13.0	11.4	1.6	2.1	1.8	0.3	0.00141	0.00157	0.00149	0.00025	7,356
			4	13.0	11.3	1.6	2.1	1.8	0.3	0.00139	0.00156	0.00147	0.00024	7,387
			5	13.0	11.3	1.6	2.1	1.8	0.3	0.00139	0.00156	0.00147	0.00024	7,381
	COLUMN AVERAGE			13.0	11.4	1.6	2.1	1.8	0.3	0.00139	0.00156	0.00148	0.00024	7,382
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	19
SEQUENCE 7	4.0	4.0	1	25.6	23.3	2.3	4.1	3.7	0.4	0.00269	0.00294	0.00281	0.00046	7,948
			2	25.6	23.3	2.4	4.1	3.7	0.4	0.00267	0.00294	0.00281	0.00046	7,956
			3	25.6	23.3	2.4	4.1	3.7	0.4	0.00266	0.00294	0.00280	0.00046	7,988
			4	25.7	23.3	2.4	4.1	3.7	0.4	0.00267	0.00294	0.00281	0.00046	7,971
			5	25.6	23.2	2.4	4.1	3.7	0.4	0.00267	0.00294	0.00281	0.00046	7,945
	COLUMN AVERAGE			25.6	23.3	2.4	4.1	3.7	0.4	0.00267	0.00294	0.00281	0.00046	7,962
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	18

Source: Widows Creek Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	38.1	34.5	3.6	6.0	5.5	0.6	0.00364	0.00394	0.00379	0.00063	8,740
			2	38.0	34.4	3.6	6.0	5.5	0.6	0.00363	0.00393	0.00378	0.00062	8,742
			3	38.2	34.6	3.6	6.0	5.5	0.6	0.00364	0.00394	0.00379	0.00062	8,763
			4	38.2	34.6	3.6	6.1	5.5	0.6	0.00364	0.00394	0.00379	0.00062	8,771
			5	38.2	34.6	3.6	6.0	5.5	0.6	0.00363	0.00394	0.00379	0.00062	8,769
	COLUMN AVERAGE			38.1	34.6	3.6	6.0	5.5	0.6	0.00364	0.00394	0.00379	0.00062	8,757
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	15
SEQUENCE 9	4.0	8.0	1	50.9	46.1	4.9	8.1	7.3	0.8	0.00450	0.00484	0.00467	0.00077	9,466
			2	50.9	46.1	4.9	8.1	7.3	0.8	0.00450	0.00482	0.00466	0.00077	9,479
			3	50.9	46.1	4.8	8.1	7.3	0.8	0.00450	0.00482	0.00466	0.00077	9,483
			4	50.8	46.0	4.8	8.0	7.3	0.8	0.00450	0.00482	0.00466	0.00077	9,470
			5	50.9	46.1	4.9	8.1	7.3	0.8	0.00451	0.00482	0.00467	0.00077	9,473
	COLUMN AVERAGE			50.9	46.0	4.9	8.1	7.3	0.8	0.00450	0.00483	0.00466	0.00077	9,474
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	7
SEQUENCE 10	4.0	10.0	1	63.8	57.7	6.1	10.1	9.1	1.0	0.00545	0.00578	0.00562	0.00093	9,857
			2	63.8	57.7	6.1	10.1	9.1	1.0	0.00545	0.00578	0.00561	0.00093	9,864
			3	63.9	57.7	6.1	10.1	9.1	1.0	0.00546	0.00579	0.00563	0.00093	9,853
			4	64.0	57.9	6.1	10.1	9.2	1.0	0.00544	0.00578	0.00561	0.00093	9,895
			5	63.9	57.8	6.1	10.1	9.2	1.0	0.00544	0.00578	0.00561	0.00093	9,889
	COLUMN AVERAGE			63.9	57.8	6.1	10.1	9.1	1.0	0.00545	0.00578	0.00562	0.00093	9,872
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	19

Source: Widows Creek Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.2	11.1	2.0	2.1	1.8	0.3	0.00201	0.00217	0.00209	0.00034	5,118
			2	13.2	11.2	2.0	2.1	1.8	0.3	0.00200	0.00218	0.00209	0.00035	5,139
			3	13.3	11.3	2.0	2.1	1.8	0.3	0.00202	0.00219	0.00210	0.00035	5,151
			4	13.3	11.2	2.0	2.1	1.8	0.3	0.00201	0.00218	0.00209	0.00035	5,153
			5	13.3	11.3	2.0	2.1	1.8	0.3	0.00202	0.00219	0.00210	0.00035	5,160
	COLUMN AVERAGE			13.3	11.2	2.0	2.1	1.8	0.3	0.00201	0.00218	0.00210	0.00035	5,144
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	17
SEQUENCE 12	2.0	4.0	1	25.6	23.3	2.3	4.1	3.7	0.4	0.00379	0.00407	0.00393	0.00065	5,685
			2	25.6	23.2	2.4	4.1	3.7	0.4	0.00378	0.00406	0.00392	0.00065	5,692
			3	25.5	23.2	2.3	4.0	3.7	0.4	0.00378	0.00406	0.00392	0.00065	5,688
			4	25.5	23.2	2.3	4.0	3.7	0.4	0.00378	0.00406	0.00392	0.00065	5,677
			5	25.5	23.2	2.4	4.0	3.7	0.4	0.00379	0.00407	0.00393	0.00065	5,664
	COLUMN AVERAGE			25.6	23.2	2.3	4.0	3.7	0.4	0.00378	0.00406	0.00392	0.00065	5,681
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	11
SEQUENCE 13	2.0	6.0	1	38.4	34.8	3.6	6.1	5.5	0.6	0.00492	0.00519	0.00505	0.00083	6,616
			2	38.3	34.7	3.6	6.1	5.5	0.6	0.00492	0.00520	0.00506	0.00083	6,589
			3	38.4	34.8	3.6	6.1	5.5	0.6	0.00492	0.00519	0.00506	0.00083	6,611
			4	38.3	34.7	3.6	6.1	5.5	0.6	0.00492	0.00518	0.00505	0.00083	6,593
			5	38.2	34.6	3.6	6.0	5.5	0.6	0.00492	0.00518	0.00505	0.00083	6,578
	COLUMN AVERAGE			38.3	34.7	3.6	6.1	5.5	0.6	0.00492	0.00519	0.00505	0.00083	6,597
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	16

Source: Widows Creek Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.8	46.0	4.8	8.0	7.3	0.8	0.00606	0.00633	0.00620	0.00102	7,128
			2	50.8	46.0	4.8	8.0	7.3	0.8	0.00605	0.00632	0.00618	0.00102	7,142
			3	50.8	46.0	4.8	8.0	7.3	0.8	0.00606	0.00632	0.00619	0.00102	7,135
			4	50.8	46.1	4.8	8.1	7.3	0.8	0.00605	0.00633	0.00619	0.00102	7,142
			5	50.9	46.1	4.8	8.1	7.3	0.8	0.00606	0.00633	0.00620	0.00102	7,136
	COLUMN AVERAGE			50.8	46.0	4.8	8.0	7.3	0.8	0.00606	0.00633	0.00619	0.00102	7,136
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	6
SEQUENCE 15	2.0	10.0	1	63.8	57.7	6.1	10.1	9.1	1.0	0.00719	0.00748	0.00734	0.00121	7,547
			2	63.8	57.8	6.1	10.1	9.1	1.0	0.00720	0.00747	0.00733	0.00121	7,558
			3	63.8	57.7	6.1	10.1	9.1	1.0	0.00719	0.00748	0.00734	0.00121	7,549
			4	63.9	57.8	6.1	10.1	9.2	1.0	0.00719	0.00747	0.00733	0.00121	7,569
			5	63.9	57.8	6.1	10.1	9.2	1.0	0.00719	0.00748	0.00734	0.00121	7,565
	COLUMN AVERAGE			63.8	57.8	6.1	10.1	9.1	1.0	0.00719	0.00748	0.00733	0.00121	7,558
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	10

SUBMITTED BY, DATE

R Y Bowden 9/10/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-23-1995

$$M_R = K1\ (S_C)^{K2}\ (1+S_3)^{K5}$$

K1 =	2,258
K2 =	0.19103
K5 =	0.66319
R^2 =	0.98

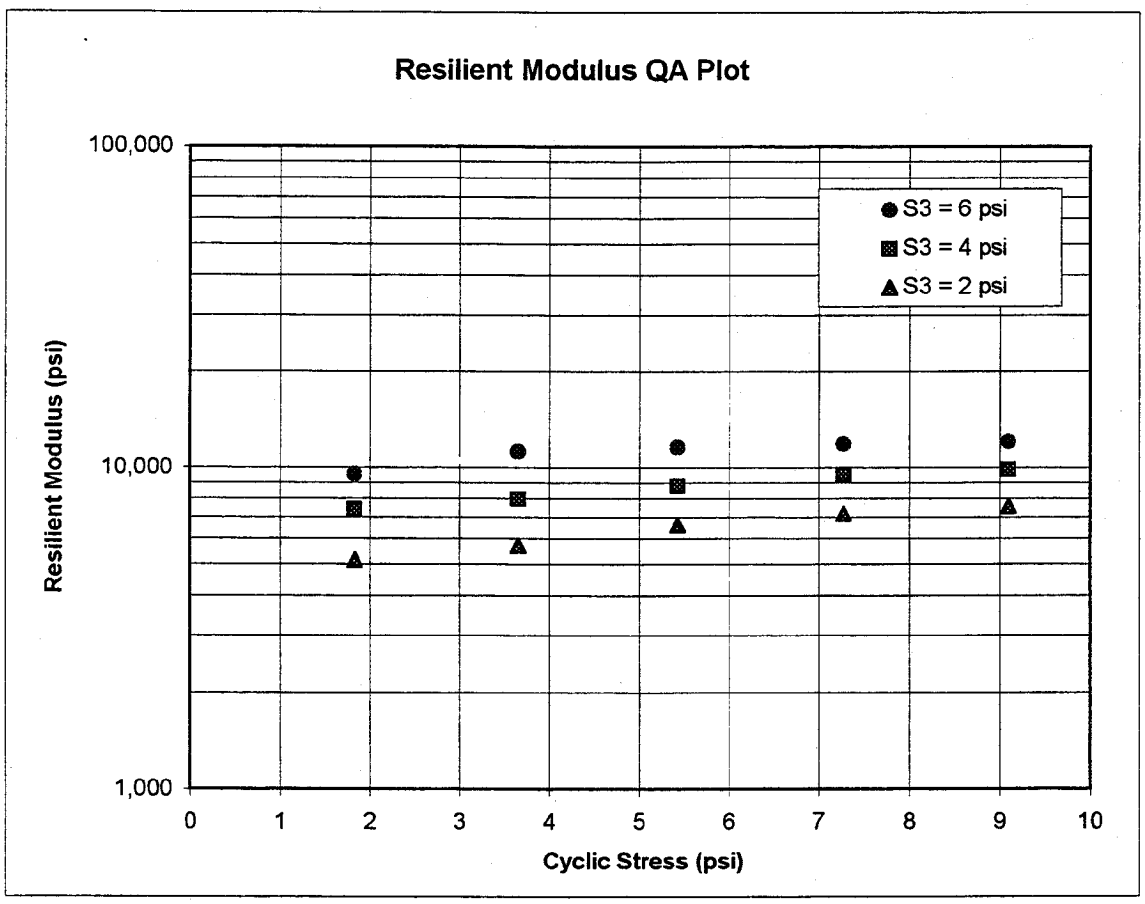
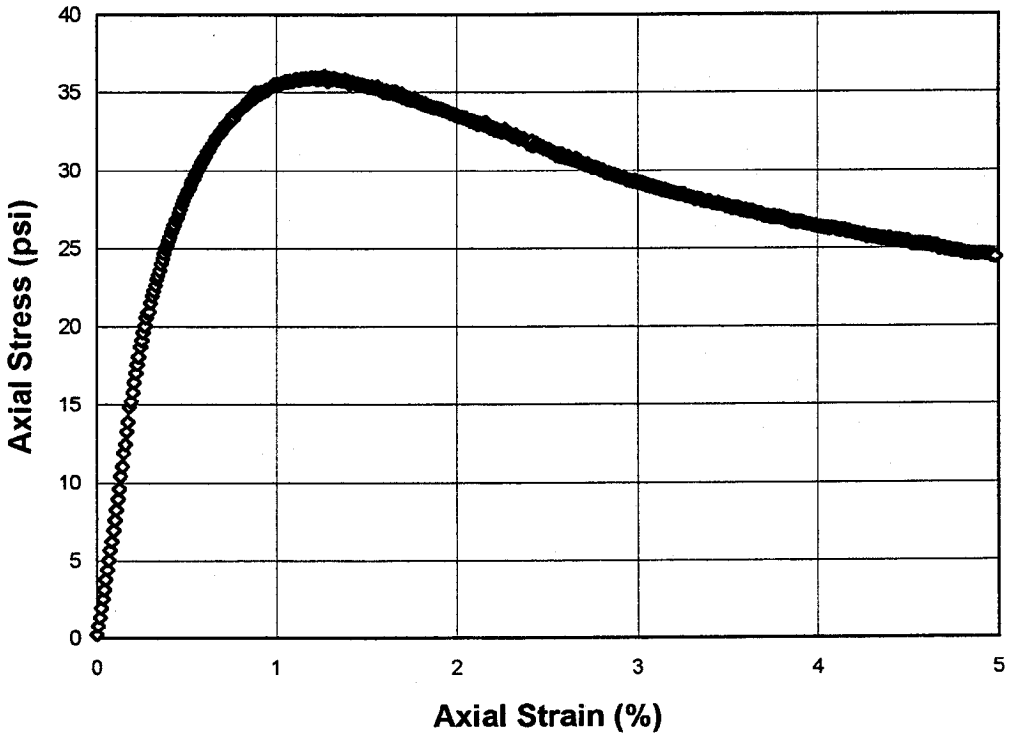


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-23-1995



LABORATORY MATERIAL HANDLING AND TESTING
LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO .:*	
	SPECIMEN DIAM., inch	
	TOP	2.86
	MIDDLE	2.86
	BOTTOM	2.86
	AVERAGE	2.86
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.84
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.09
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.09
	INITIAL AREA, A_0 , in^2	6.32
	INITIAL VOLUME $A_0 L_0$, in^3	38.48
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1649.70
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	333.10
	WEIGHT OF WET SOIL USED , grams	1316.60
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	15.8
	MAX. DRY DENSITY, pcf	120.8
	95 % MAX. DRY DENSITY, pcf	114.8
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	11.2
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	11.2
	COMPACTION DRY DENSITY, γ_d pcf	117.1
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	29.2
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	08-24-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RJ Boudreau 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Widows Creek
2. *MATERIAL DESCRIPTION:* Bottom Ash
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-24-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ ._	_ _ _ ._	_	_ _ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ ._	_ ._ _ _ _ _	_ ._ _ _ _ _	_ ._ _ _ _ _	._ _ _ _	_ _ _ .
SEQUENCE 1	6.0	2.0	1	12.4	11.1	1.3	2.0	1.8	0.2	0.00210	0.00199	0.00205	0.00034	5,245
			2	12.4	11.1	1.3	2.0	1.8	0.2	0.00211	0.00199	0.00205	0.00034	5,234
			3	12.4	11.1	1.3	2.0	1.8	0.2	0.00210	0.00199	0.00205	0.00034	5,218
			4	12.4	11.1	1.3	2.0	1.8	0.2	0.00210	0.00199	0.00204	0.00034	5,238
			5	12.4	11.1	1.3	2.0	1.8	0.2	0.00212	0.00200	0.00206	0.00034	5,213
	COLUMN AVERAGE			12.4	11.1	1.3	2.0	1.8	0.2	0.00211	0.00199	0.00205	0.00034	5,230
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	14

Source: Widows Creek Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.1	22.7	2.4	4.0	3.6	0.4	0.00381	0.00355	0.00368	0.00060	5,949
			2	25.1	22.7	2.4	4.0	3.6	0.4	0.00382	0.00355	0.00369	0.00060	5,936
			3	25.1	22.7	2.4	4.0	3.6	0.4	0.00381	0.00355	0.00368	0.00060	5,949
			4	25.1	22.7	2.4	4.0	3.6	0.4	0.00381	0.00354	0.00368	0.00060	5,949
			5	25.1	22.7	2.4	4.0	3.6	0.4	0.00382	0.00355	0.00369	0.00060	5,937
	COLUMN AVERAGE			25.1	22.7	2.4	4.0	3.6	0.4	0.00381	0.00355	0.00368	0.00060	5,944
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	7
SEQUENCE 3	6.0	6.0	1	37.6	34.0	3.7	6.0	5.4	0.6	0.00569	0.00523	0.00546	0.00090	6,000
			2	37.7	34.0	3.7	6.0	5.4	0.6	0.00568	0.00522	0.00545	0.00089	6,019
			3	37.7	34.0	3.7	6.0	5.4	0.6	0.00568	0.00523	0.00546	0.00090	6,013
			4	37.7	34.0	3.7	6.0	5.4	0.6	0.00569	0.00523	0.00546	0.00090	6,015
			5	37.7	34.0	3.7	6.0	5.4	0.6	0.00569	0.00524	0.00547	0.00090	6,006
	COLUMN AVERAGE			37.7	34.0	3.7	6.0	5.4	0.6	0.00569	0.00523	0.00546	0.00090	6,010
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	8
SEQUENCE 4	6.0	8.0	1	50.9	46.0	4.9	8.1	7.3	0.8	0.00721	0.00668	0.00695	0.00114	6,387
			2	50.8	45.9	4.9	8.0	7.3	0.8	0.00720	0.00666	0.00693	0.00114	6,392
			3	50.9	46.0	4.9	8.1	7.3	0.8	0.00721	0.00667	0.00694	0.00114	6,389
			4	50.9	46.0	4.9	8.1	7.3	0.8	0.00720	0.00668	0.00694	0.00114	6,400
			5	50.9	46.0	4.9	8.1	7.3	0.8	0.00721	0.00668	0.00695	0.00114	6,391
	COLUMN AVERAGE			50.9	46.0	4.9	8.1	7.3	0.8	0.00721	0.00668	0.00694	0.00114	6,392
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	5

Source: Widows Creek Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.7	57.6	6.1	10.1	9.1	1.0	0.00835	0.00774	0.00805	0.00132	6,907
			2	63.8	57.6	6.1	10.1	9.1	1.0	0.00835	0.00774	0.00805	0.00132	6,908
			3	63.8	57.7	6.1	10.1	9.1	1.0	0.00836	0.00774	0.00805	0.00132	6,911
			4	63.8	57.7	6.1	10.1	9.1	1.0	0.00836	0.00773	0.00804	0.00132	6,914
			5	63.8	57.7	6.1	10.1	9.1	1.0	0.00834	0.00776	0.00805	0.00132	6,910
	COLUMN AVERAGE			63.8	57.6	6.1	10.1	9.1	1.0	0.00835	0.00774	0.00805	0.00132	6,910
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	3
SEQUENCE 6	4.0	2.0	1	12.9	11.2	1.7	2.0	1.8	0.3	0.00296	0.00272	0.00284	0.00047	3,811
			2	12.8	11.2	1.7	2.0	1.8	0.3	0.00295	0.00270	0.00283	0.00046	3,812
			3	12.9	11.3	1.6	2.0	1.8	0.3	0.00296	0.00272	0.00284	0.00047	3,831
			4	12.9	11.2	1.6	2.0	1.8	0.3	0.00297	0.00273	0.00285	0.00047	3,798
			5	12.9	11.2	1.7	2.0	1.8	0.3	0.00298	0.00274	0.00286	0.00047	3,793
	COLUMN AVERAGE			12.9	11.2	1.7	2.0	1.8	0.3	0.00296	0.00272	0.00284	0.00047	3,809
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	15
SEQUENCE 7	4.0	4.0	1	25.2	22.9	2.4	4.0	3.6	0.4	0.00559	0.00526	0.00542	0.00089	4,073
			2	25.2	22.7	2.4	4.0	3.6	0.4	0.00559	0.00527	0.00543	0.00089	4,039
			3	25.2	22.8	2.5	4.0	3.6	0.4	0.00557	0.00524	0.00541	0.00089	4,064
			4	25.1	22.7	2.4	4.0	3.6	0.4	0.00558	0.00525	0.00541	0.00089	4,048
			5	25.1	22.7	2.4	4.0	3.6	0.4	0.00557	0.00524	0.00540	0.00089	4,053
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00558	0.00525	0.00542	0.00089	4,055
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	13

Source: Widows Creek Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	38.5	34.9	3.7	6.1	5.5	0.6	0.00697	0.00663	0.00680	0.00112	4,948
			2	38.5	34.9	3.7	6.1	5.5	0.6	0.00698	0.00662	0.00680	0.00112	4,950
			3	38.4	34.7	3.7	6.1	5.5	0.6	0.00697	0.00662	0.00680	0.00112	4,926
			4	38.4	34.7	3.7	6.1	5.5	0.6	0.00698	0.00662	0.00680	0.00112	4,923
			5	38.1	34.5	3.7	6.0	5.5	0.6	0.00698	0.00662	0.00680	0.00112	4,889
	COLUMN AVERAGE			38.4	34.7	3.7	6.1	5.5	0.6	0.00698	0.00662	0.00680	0.00112	4,927
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	25
SEQUENCE 9	4.0	8.0	1	51.3	46.4	4.9	8.1	7.4	0.8	0.00792	0.00755	0.00774	0.00127	5,792
			2	51.3	46.4	4.9	8.1	7.3	0.8	0.00793	0.00754	0.00773	0.00127	5,786
			3	51.3	46.4	4.9	8.1	7.4	0.8	0.00792	0.00756	0.00774	0.00127	5,785
			4	51.3	46.4	4.9	8.1	7.3	0.8	0.00791	0.00753	0.00772	0.00127	5,791
			5	51.3	46.4	4.9	8.1	7.3	0.8	0.00792	0.00755	0.00774	0.00127	5,781
	COLUMN AVERAGE			51.3	46.4	4.9	8.1	7.3	0.8	0.00792	0.00755	0.00773	0.00127	5,787
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	4
SEQUENCE 10	4.0	10.0	1	63.7	57.6	6.2	10.1	9.1	1.0	0.00863	0.00825	0.00844	0.00139	6,579
			2	63.7	57.6	6.2	10.1	9.1	1.0	0.00865	0.00827	0.00846	0.00139	6,565
			3	63.8	57.7	6.2	10.1	9.1	1.0	0.00867	0.00829	0.00848	0.00139	6,560
			4	63.8	57.7	6.2	10.1	9.1	1.0	0.00867	0.00829	0.00848	0.00139	6,562
			5	63.8	57.6	6.2	10.1	9.1	1.0	0.00865	0.00828	0.00846	0.00139	6,565
	COLUMN AVERAGE			63.8	57.6	6.2	10.1	9.1	1.0	0.00865	0.00828	0.00847	0.00139	6,566
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00002	0.00000	7

Source: Widows Creek Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.3	11.3	2.0	2.1	1.8	0.3	0.00310	0.00281	0.00296	0.00049	3,676
			2	13.3	11.5	1.8	2.1	1.8	0.3	0.00314	0.00285	0.00299	0.00049	3,719
			3	13.1	11.3	1.8	2.1	1.8	0.3	0.00314	0.00280	0.00297	0.00049	3,677
			4	13.3	11.6	1.7	2.1	1.8	0.3	0.00319	0.00285	0.00302	0.00050	3,693
			5	13.3	11.2	2.1	2.1	1.8	0.3	0.00308	0.00283	0.00295	0.00048	3,674
	COLUMN AVERAGE			13.3	11.4	1.9	2.1	1.8	0.3	0.00313	0.00283	0.00298	0.00049	3,688
	STANDARD DEV.			0.1	0.2	0.2	0.0	0.0	0.0	0.00004	0.00002	0.00003	0.00000	19
SEQUENCE 12	2.0	4.0	1	25.7	23.4	2.4	4.1	3.7	0.4	0.00589	0.00551	0.00570	0.00094	3,952
			2	25.5	23.2	2.4	4.0	3.7	0.4	0.00590	0.00548	0.00569	0.00093	3,926
			3	25.5	23.2	2.4	4.0	3.7	0.4	0.00591	0.00550	0.00570	0.00094	3,923
			4	25.7	23.3	2.3	4.1	3.7	0.4	0.00591	0.00549	0.00570	0.00094	3,945
			5	25.6	23.3	2.3	4.1	3.7	0.4	0.00590	0.00550	0.00570	0.00094	3,943
	COLUMN AVERAGE			25.6	23.3	2.4	4.1	3.7	0.4	0.00590	0.00550	0.00570	0.00094	3,938
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	13
SEQUENCE 13	2.0	6.0	1	38.8	35.1	3.7	6.1	5.6	0.6	0.00732	0.00693	0.00712	0.00117	4,758
			2	38.6	35.0	3.7	6.1	5.5	0.6	0.00730	0.00689	0.00709	0.00116	4,757
			3	38.8	35.2	3.7	6.1	5.6	0.6	0.00732	0.00692	0.00712	0.00117	4,768
			4	38.7	35.1	3.7	6.1	5.6	0.6	0.00728	0.00689	0.00709	0.00116	4,772
			5	38.7	35.1	3.7	6.1	5.6	0.6	0.00733	0.00692	0.00712	0.00117	4,750
	COLUMN AVERAGE			38.7	35.1	3.7	6.1	5.6	0.6	0.00731	0.00691	0.00711	0.00117	4,761
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	9

FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Widows Creek
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-24-1995