Project 86-060-27
August 1991

CanonieEnvironmental

Volume III - Appendices

Tailings Reclamation Plan
As Approved by NRC March 1, 1991
License No. SUA - 1475

Church Rock Site
Gallup, New Mexico

Prepared For:

United Nuclear Corporation
Gallup, New Mexico

Volume III - Appendices

Tailings Reclamation Plan
As Approved by NRC March 1, 1991
License No. SUA - 1475

Canonie Environmental

LIST OF APPENDICES

APPENDIX	TITLE
A	Geotechnical Investigation Data
B	Construction/Technical Specifications
C	Radon Model Calculations, Long-Term Moisture Lab Test Results and Bulk Density Calculations
D	In-Situ Moisture Contents Coarse Tailings, Soil Cover, and Fine Tailings
E	Surface Water Hydrology and Hydraulic Calculations
F	Reclamation Plan Cost Estimate License No. SUA-1475 United Nuclear Corporation Church Rock Facility Gallup, New Mexico

APPENDIX A

APPENDIX A

GEOTECHNICAL INVESTIGATION DATA

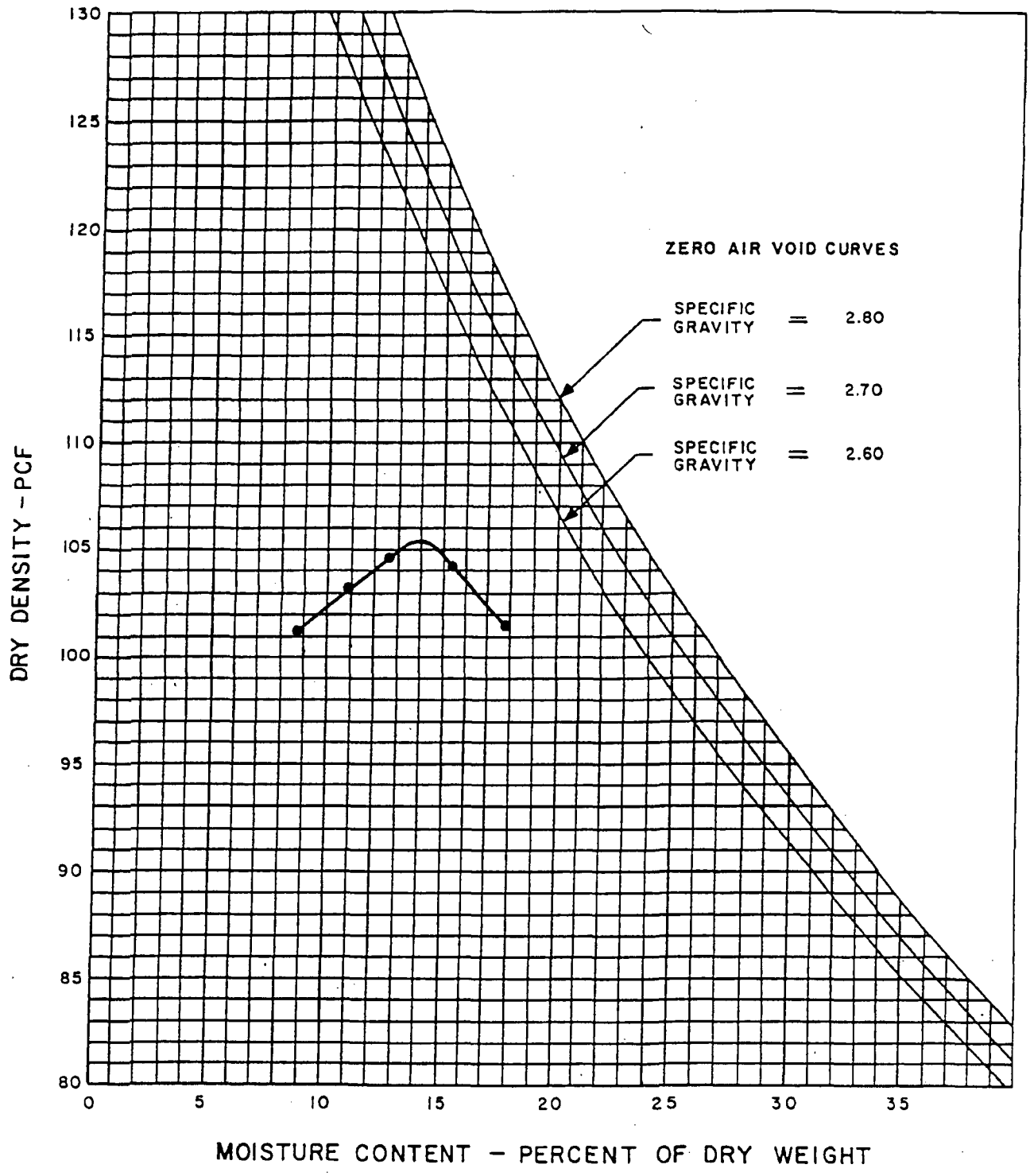
TABLE OF CONTENTS

APPENDIX A

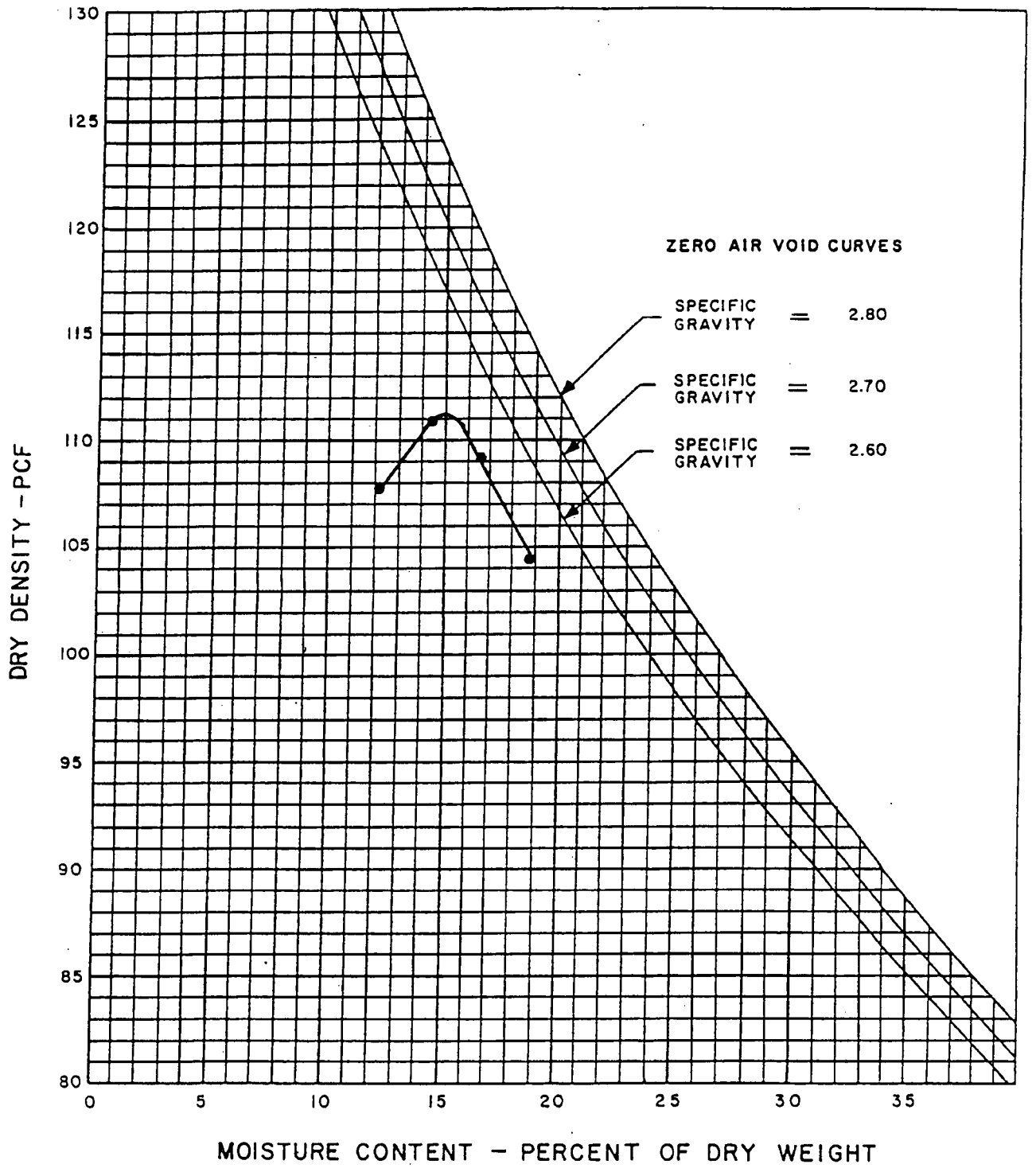
	Page No.
APPENDIX A-1	
Moisture Density Relationships	A-2
APPENDIX A-2	
Particle Size Gradation Curves	A-10
APPENDIX A-3	
Rock Core Logs	A-27
APPENDIX A-4	
Boring Logs	A-30
APPENDIX A-5	
Test Pit Logs	A-62
APPENDIX A-6	
Existing Soil Stockpile - Geotechnical Data	A-78
APPENDIX A-7	
North and Central Cell - Geotechnical Data	A-84
APPENDIX A-8	
Laboratory Permeabilities and Dispersion Testing	A-98

APPENDIX A-1

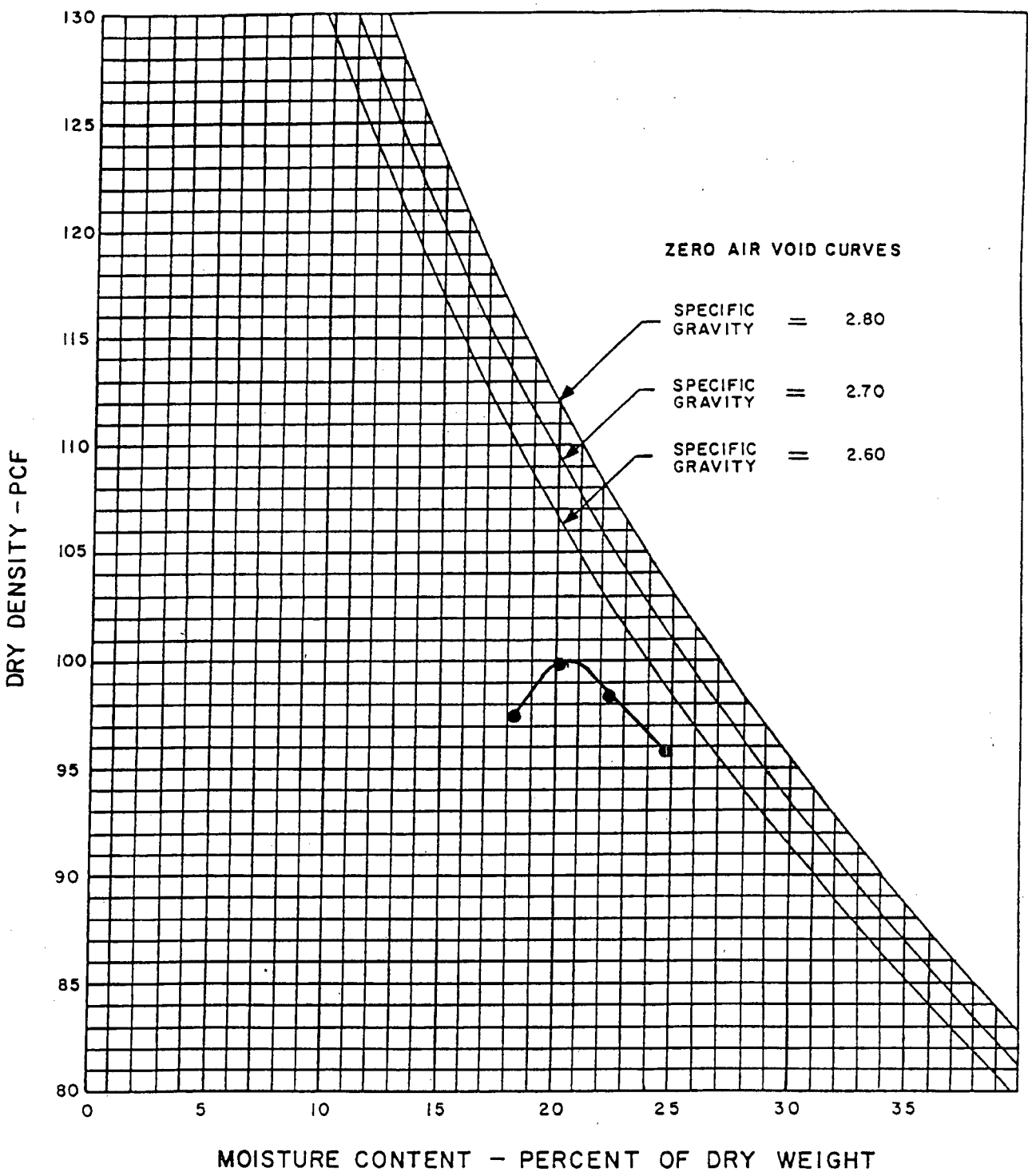
Moisture Density Relationships



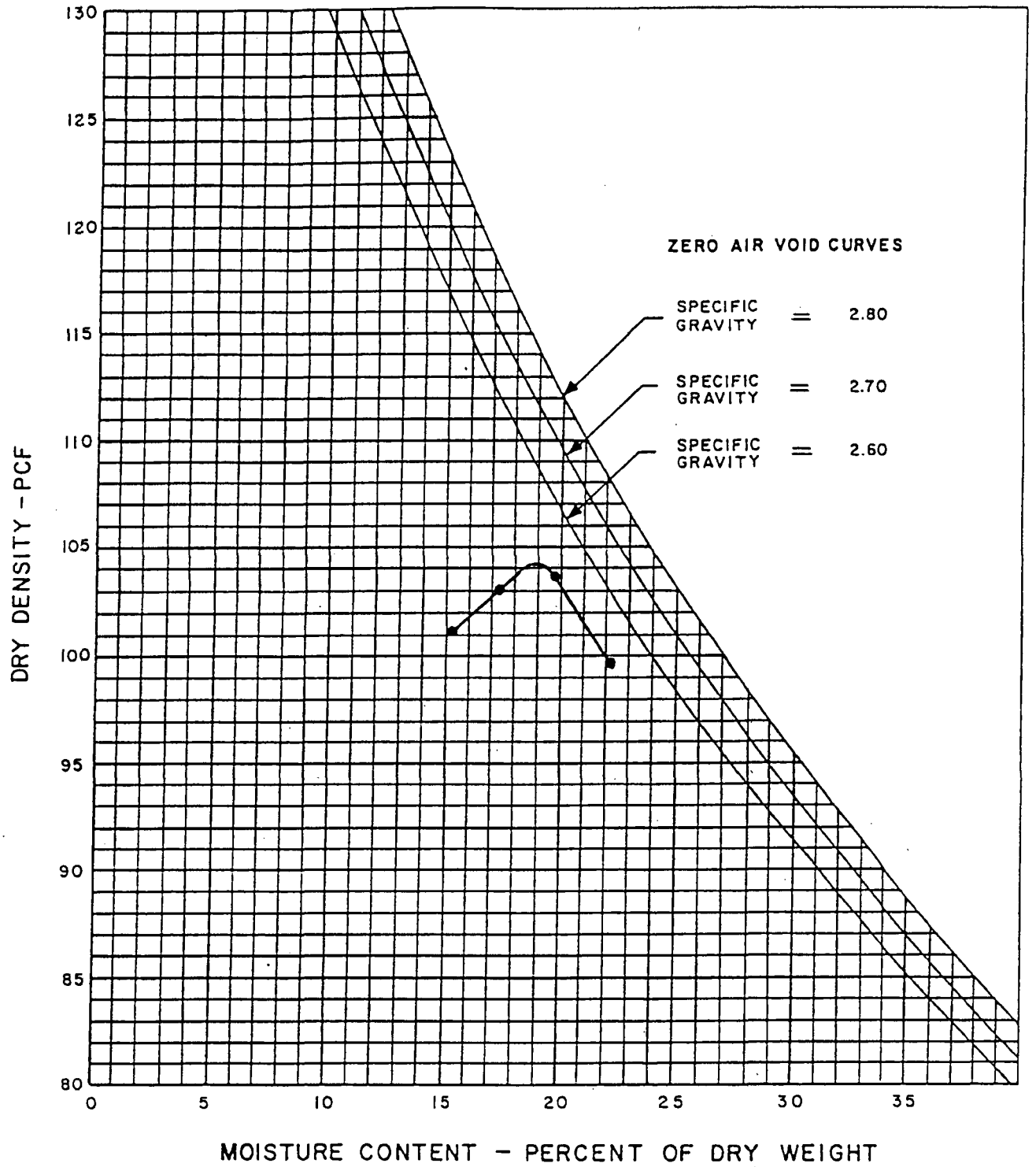
LOCATION: Canonie Environmental	MOISTURE-DENSITY RELATIONSHIPS	
HOLE NO.: TP-1 DEPTH: 5-6' SAMPLE NO.:		
SOIL DESCRIPTION: Brown sand, little silt	GOODSON & ASSOC. INC.	
MAX. DRY DENSITY: 105.4 PCF OPT. MOIST. CONTENT: 14.0 %	PROCEDURE: ASTM D-698 A	
LIQUID LIMIT: ____ PLASTICITY INDEX: ____	JOB NO.: 6583.01	FIG. NO.
GRAVEL: 2 % SAND: 80 % SILT AND CLAY (-200): 18 %	DATE: 12-23-86	



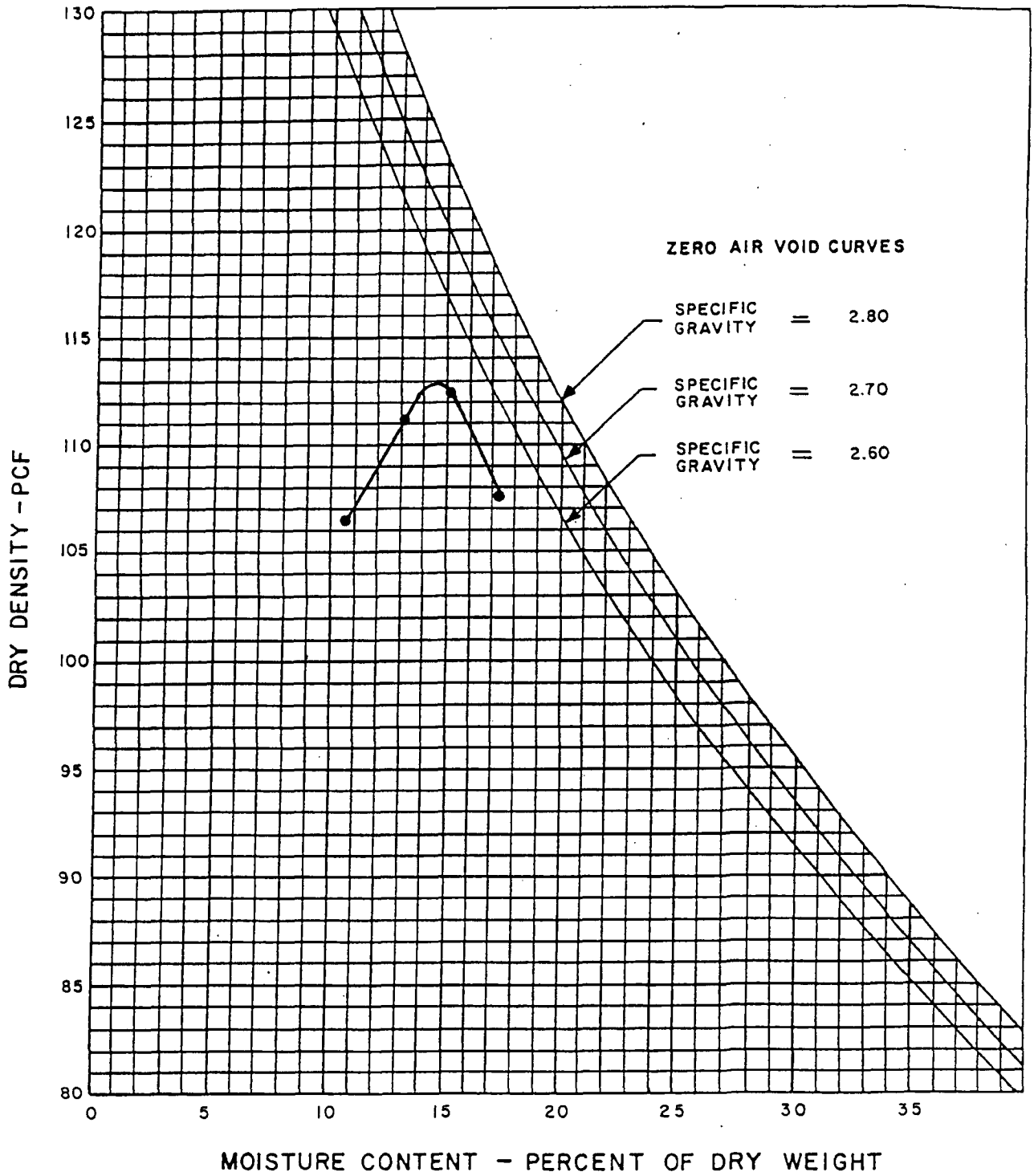
LOCATION: Canonie Environmental	MOISTURE-DENSITY RELATIONSHIPS	
HOLE NO.: TP-2 DEPTH: 6-7' SAMPLE NO.:		
SOIL DESCRIPTION: Brown silty sand	GOODSON & ASSOC. INC.	
MAX. DRY DENSITY: 111.2 PCF OPT. MOIST. CONTENT: 15.0 %	PROCEDURE: ASTM D-698 A	
LIQUID LIMIT: PLASTICITY INDEX:	JOB NO.: 6583.01	FIG. NO.
GRAVEL: 2 % SAND: 58 % SILT AND CLAY (-200): 40 %	DATE: 12-23-86	



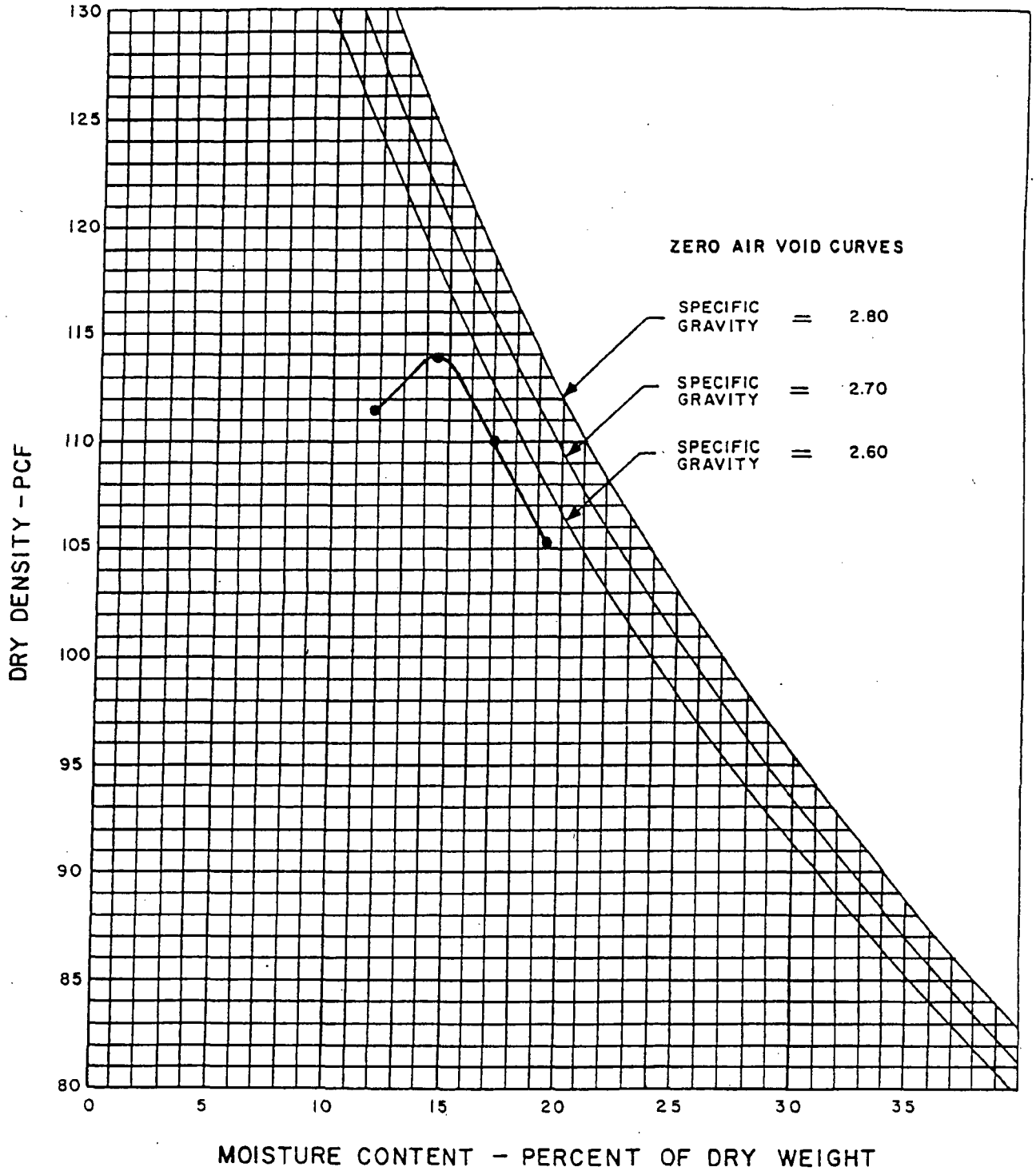
LOCATION: Canonie Environmental	MOISTURE-DENSITY RELATIONSHIPS	
HOLE NO.: TP4 DEPTH: 2-3' SAMPLE NO.:		
SOIL DESCRIPTION: Brown silt, some clay, trace sand	GOODSON & ASSOC. INC.	
MAX. DRY DENSITY: 100.0 PCF OPT. MOIST. CONTENT: 20.5 %	PROCEDURE: ASTM D-698 A	
LIQUID LIMIT: ____ PLASTICITY INDEX: ____	JOB NO.: 6583.01	FIG. NO.
GRAVEL: 0 % SAND: 15 % SILT AND CLAY(-200): 50 %	DATE: 12-23-86	



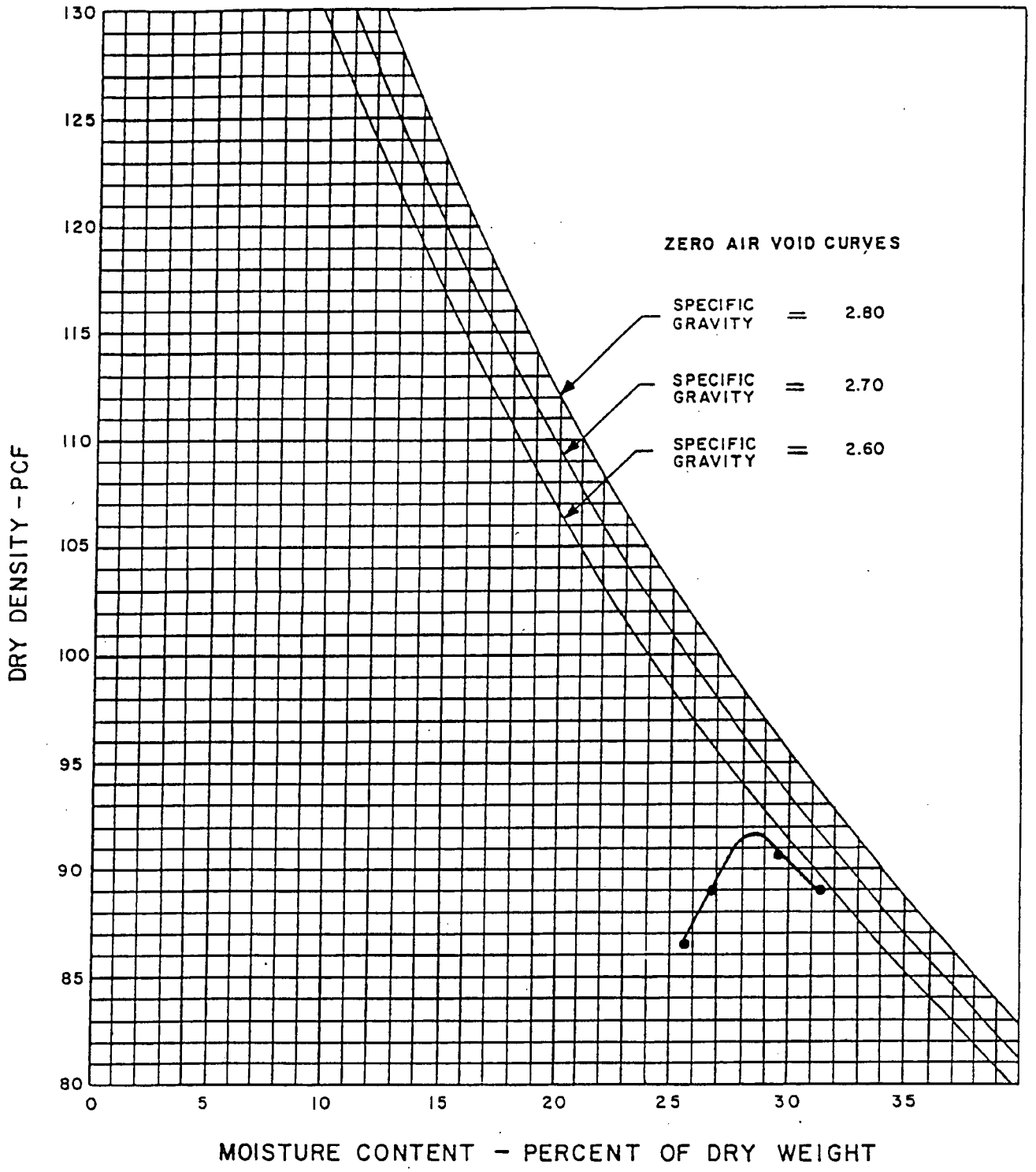
LOCATION: Canonie Environmental	MOISTURE-DENSITY RELATIONSHIPS	
HOLE NO.: TP-7 DEPTH: 4-5' SAMPLE NO.:		
SOIL DESCRIPTION: Brown sandy silt, some clay	GOODSON & ASSOC. INC.	
MAX. DRY DENSITY: 104.2 PCF OPT. MOIST. CONTENT: 18.9 %	PROCEDURE: ASTM D-698 A	
LIQUID LIMIT: ____ PLASTICITY INDEX: ____	JOB NO.: 6583.01	FIG. NO.
GRAVEL: 1 % SAND: 21 % SILT AND CLAY(-200): 78 %	DATE: 12-23-86	



LOCATION: Canonie Environmental	MOISTURE-DENSITY RELATIONSHIPS	
HOLE NO.: TP-8 DEPTH: 3-5' SAMPLE NO.:		
SOIL DESCRIPTION: Brown silty sand	GOODSON & ASSOC. INC.	
MAX. DRY DENSITY: 112.9 PCF OPT. MOIST. CONTENT: 14.6 %	PROCEDURE: ASTM D-698 A	
LIQUID LIMIT: ____ PLASTICITY INDEX: ____	JOB NO.: 6583.01	FIG. NO.
GRAVEL: 0 % SAND: 65 % SILT AND CLAY(-200): 35 %	DATE: 12-23-86	



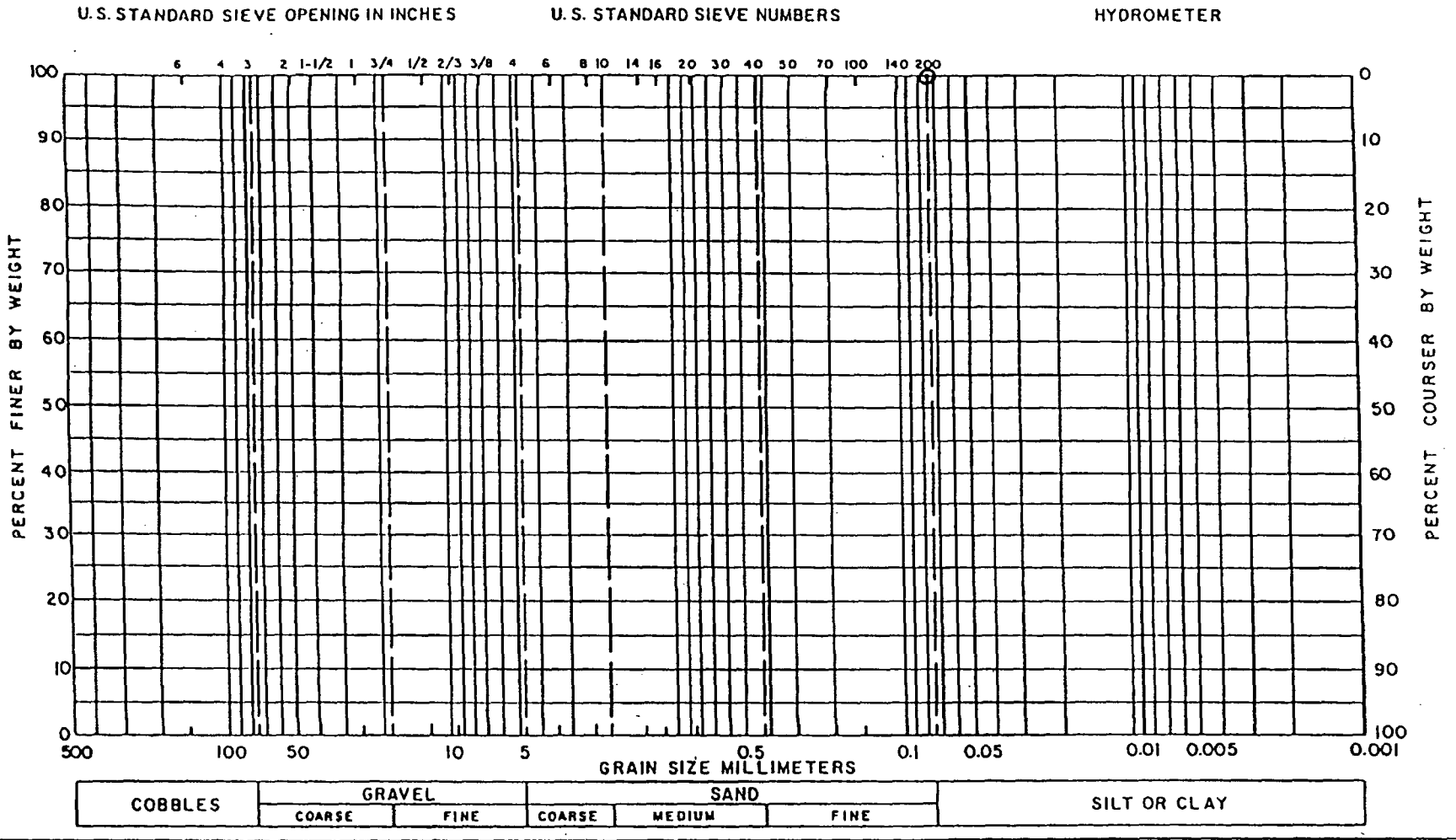
LOCATION: Canonie Environmental	MOISTURE-DENSITY RELATIONSHIPS	
HOLE NO.: TP-10 DEPTH: 2-3' SAMPLE NO.:		
SOIL DESCRIPTION: Brown silty sand, little clay	GOODSON & ASSOC. INC.	
MAX. DRY DENSITY: 113.9 PCF OPT. MOIST. CONTENT: 14.4 %	PROCEDURE: ASTM D-698 A	
LIQUID LIMIT: _____ PLASTICITY INDEX: _____	JOB NO.: 6583.01	FIG. NO.
GRAVEL: 3 % SAND: 50 % SILT AND CLAY (-200): 47 %	DATE: 12-23-86	



LOCATION: Canonie Environmental		MOISTURE-DENSITY RELATIONSHIPS
HOLE NO.: B-4 DEPTH: 6-10' SAMPLE NO.:		
SOIL DESCRIPTION: Brown siltstone, some clay, trace sand		GOODSON & ASSOC. INC.
MAX. DRY DENSITY: 91.7 PCF OPT. MOIST. CONTENT: 28.6 %		PROCEDURE: ASTM D-698 A
LIQUID LIMIT: PLASTICITY INDEX:		JOB NO.: 6583.01 FIG. NO.
GRAVEL: 0 % SAND: 10 % SILT AND CLAY(-200): 90 %		DATE: 12-23-86

APPENDIX A-2

Particle Size Gradation Curves



BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	W_n	W_L	W_p	PI
P-2		10.5-11'	Grey - Brown Clay	20.3%			

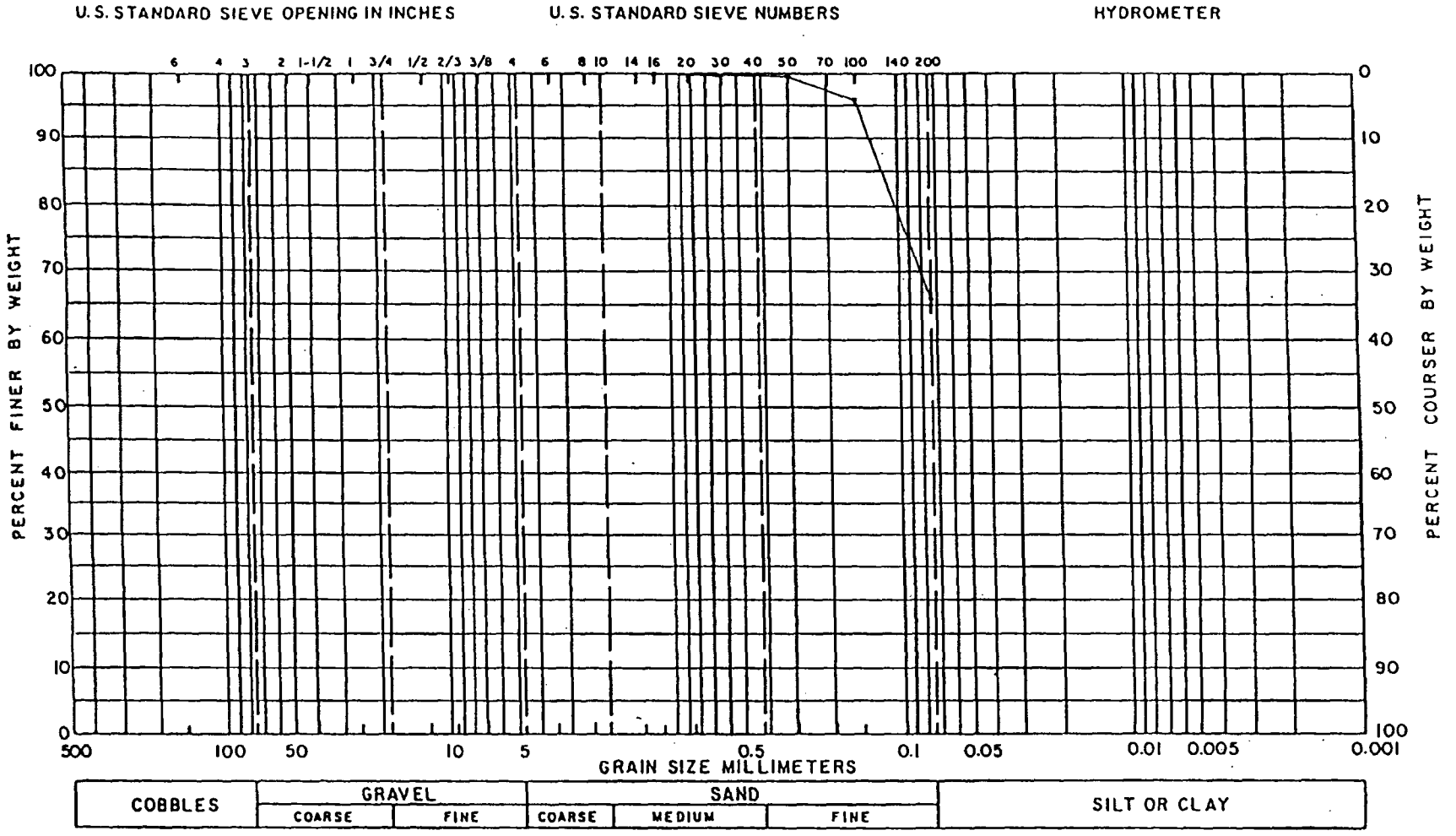
Canonie Environmental

Drawn by:	DAC		Note: 100% passing the No. 200 sieve.
Engr.	DWE		PROJECT NO. 6583.01 — DWG. NO. RM 86-060-01
Revised:			GRADATION CURVES

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

FIGURE

A-11

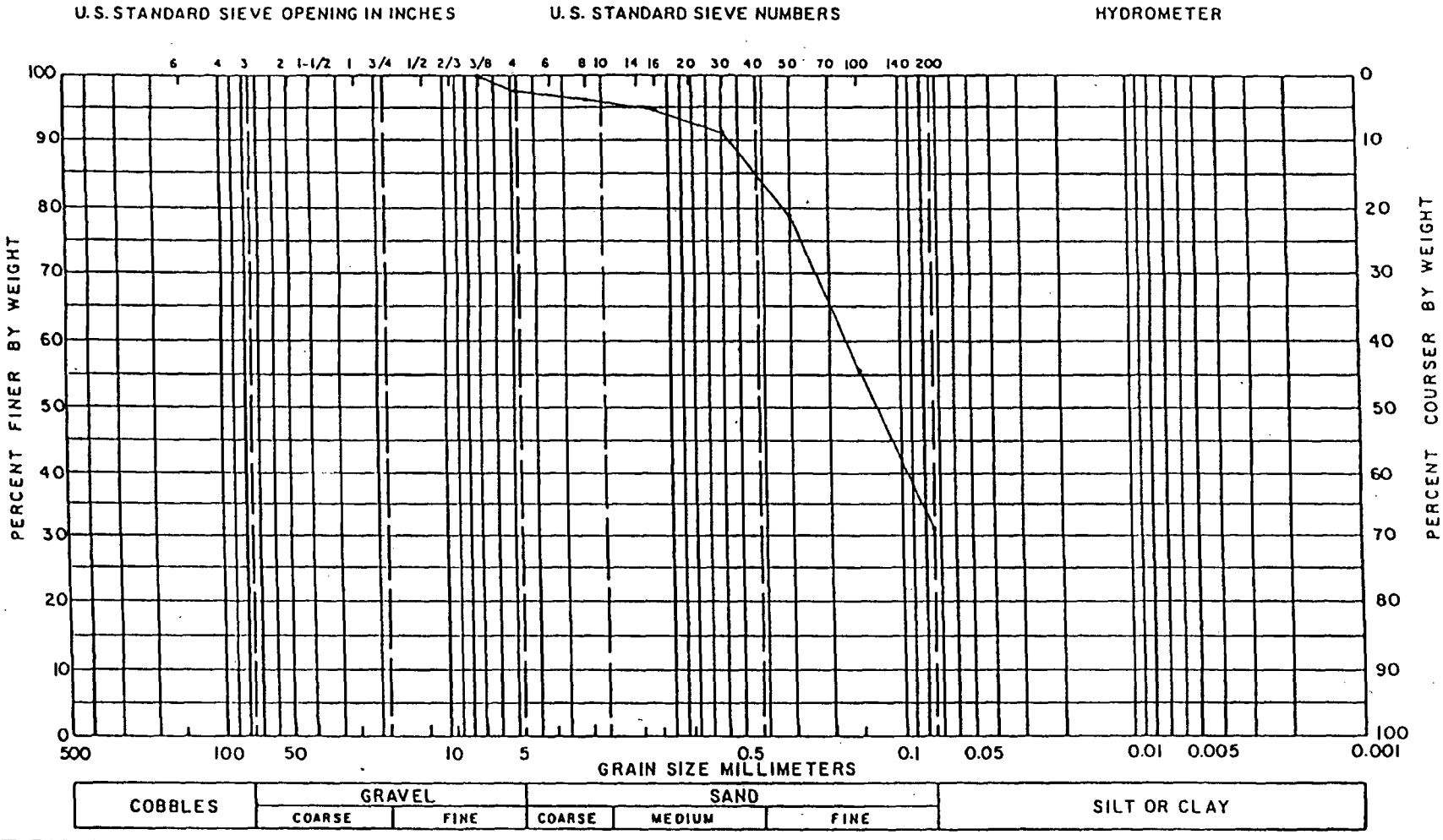


BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
P-3		10.5-11'	Brown sandy silt	16.2%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

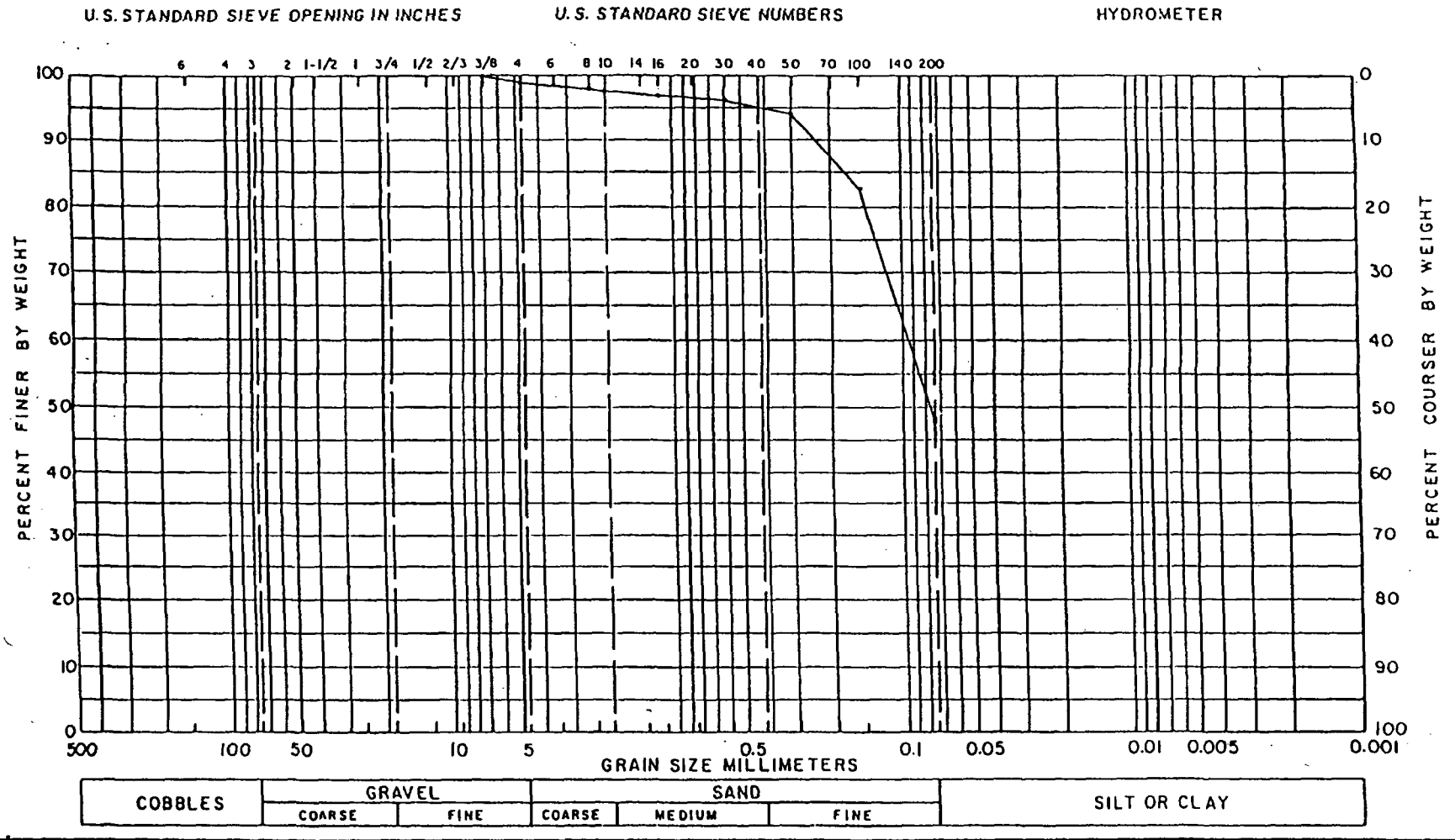


BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
P-4		5.5-6'	Brown sand, some silt	10.6%			
Drawn by:	DAC						
Engr.	DWE		PROJECT NO. 6583.01	DWG. NO. RM 86-060-01			
Revised:			GRADATION CURVES				

Canonie Environmental

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

A-13



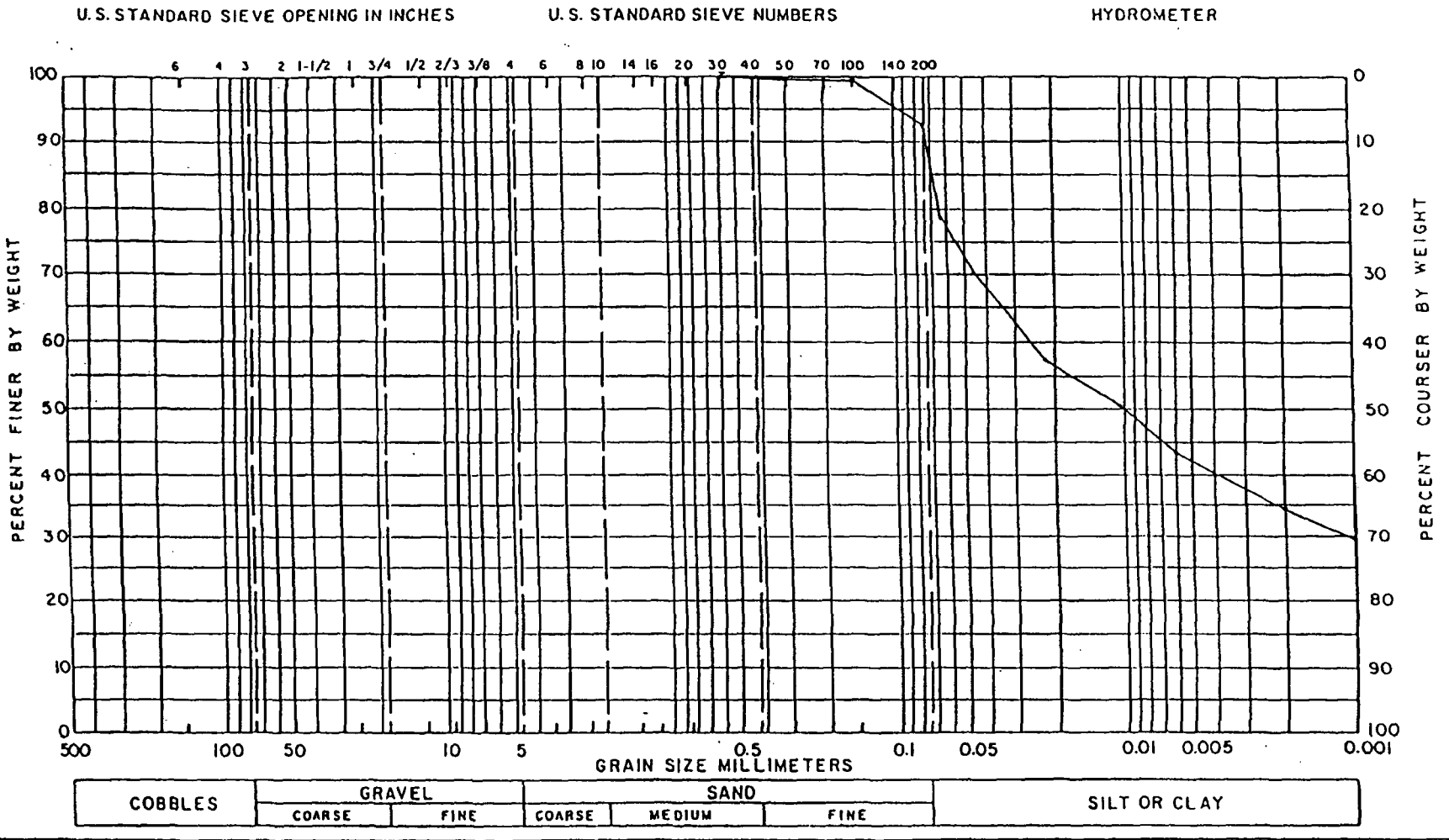
BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
P-5		6-6.5'	Brown silty sand	6.6 %			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

A-14

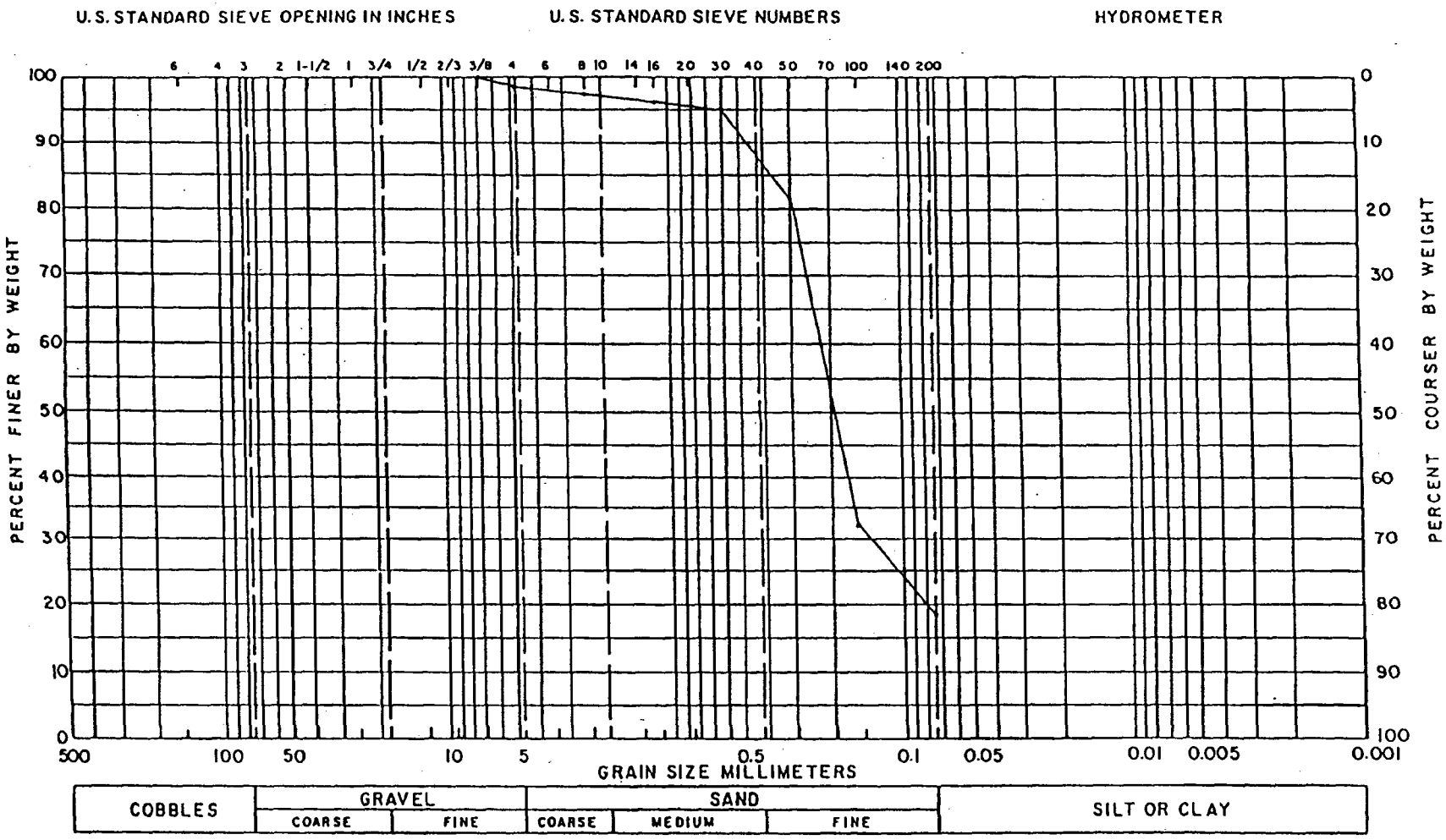


BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
P-8		11-11.5'	Brown silt; some clay trace sand	17.5%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

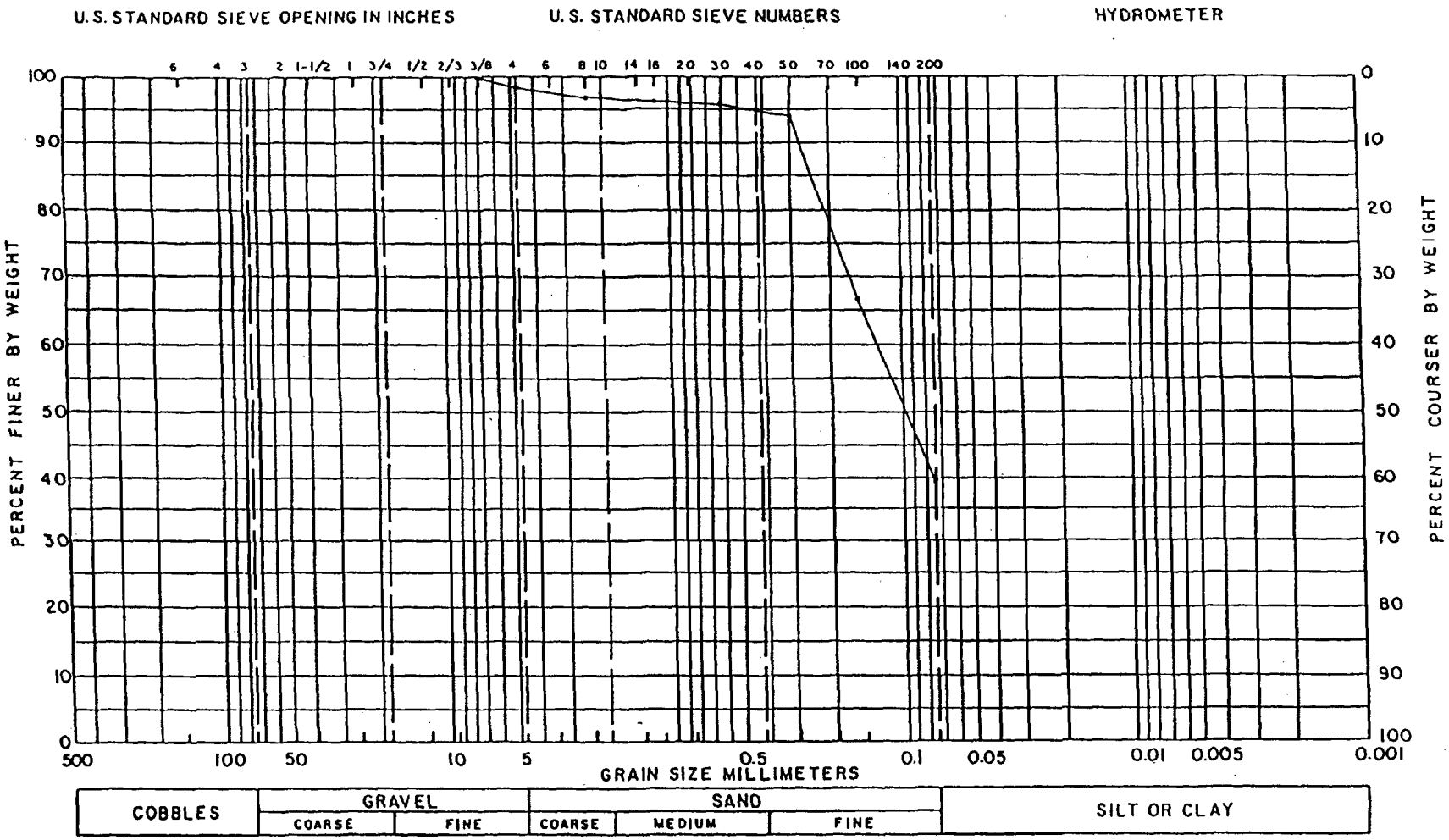


BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-1		5-6'	Brown sand, little silt	7.8 %			
Drawn by:	DAC						
Engr.	DWF		PROJECT NO. 6583.01	DWG. NO. RM 86-060-01			
Revised:			GRADATION CURVES				

Canonie Environmental

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

A-10

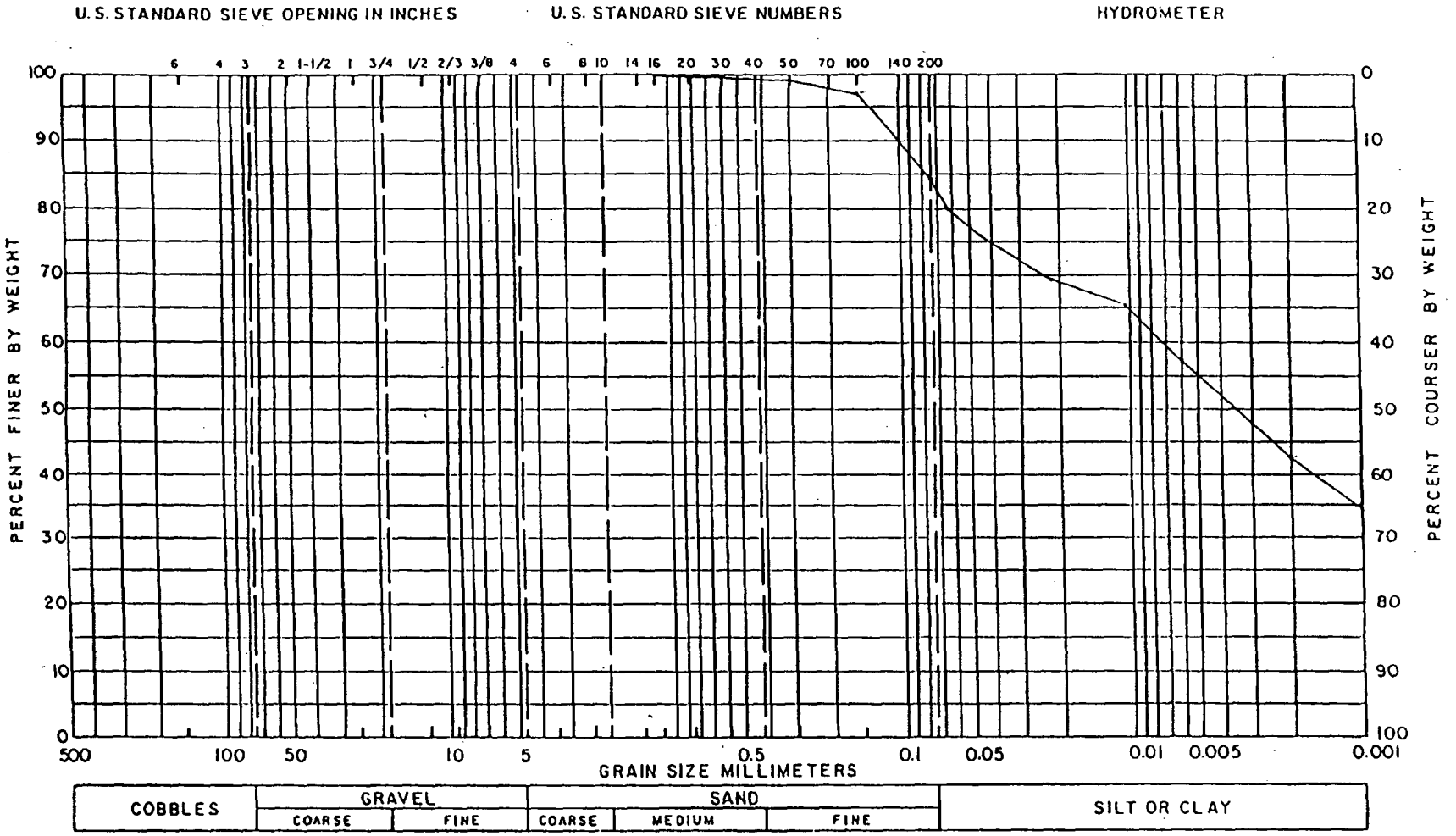


BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-2		6-7'	Brown silty sand	11.9%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

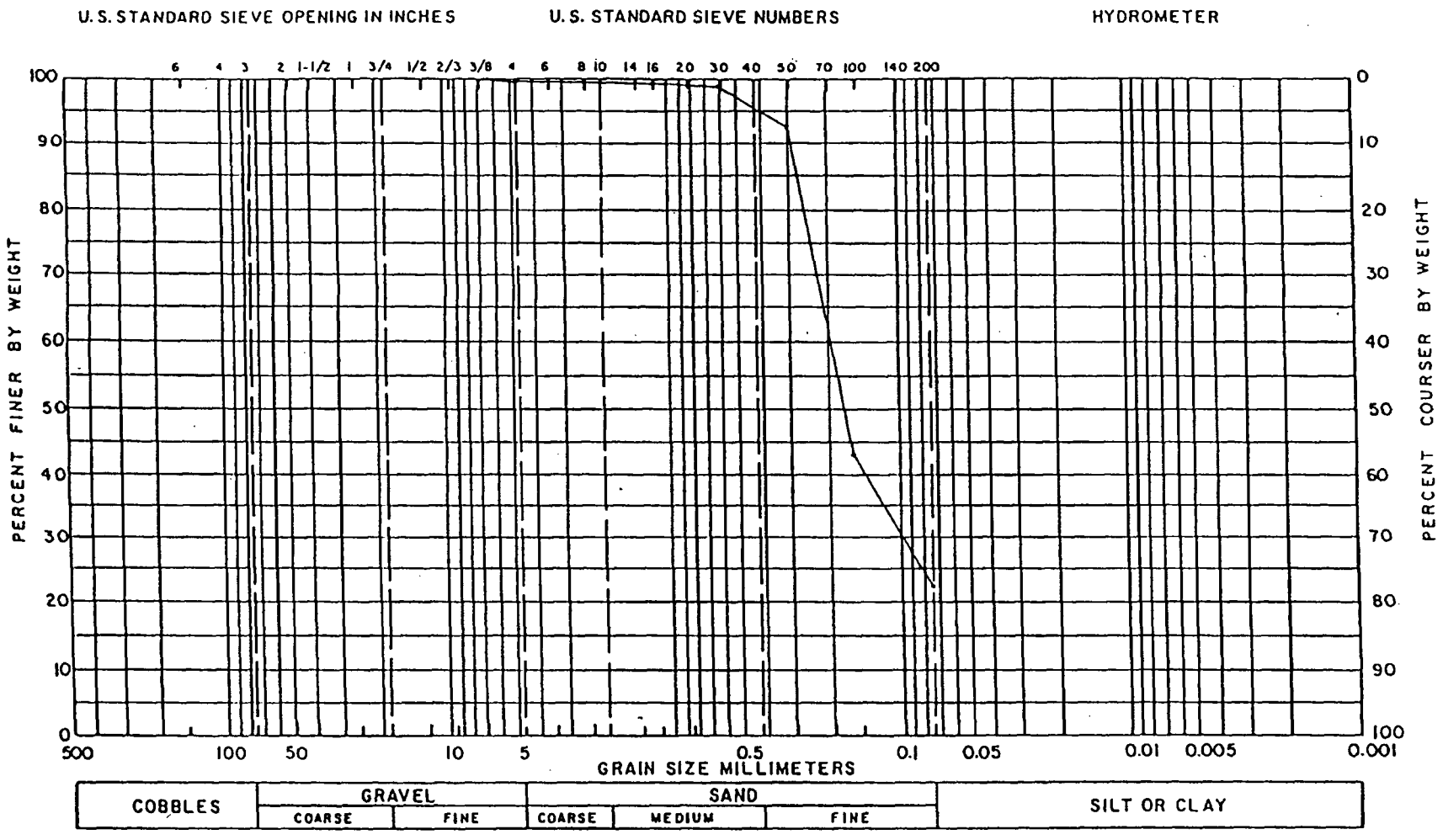


BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-4		2-3'	Brown silt, some clay trace sand	13.6%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWF	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS



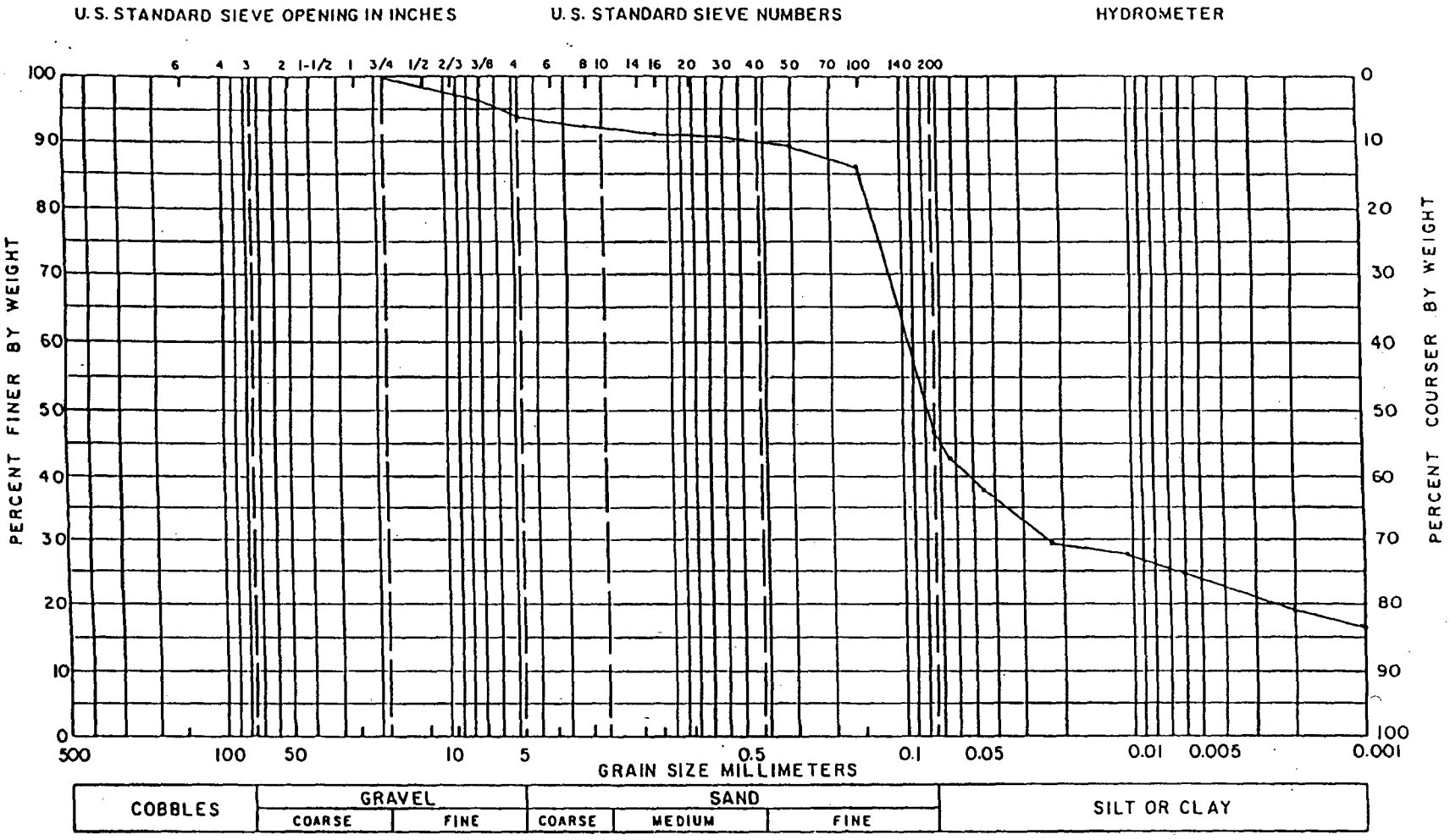
BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-4		8-9'	Brown sand, some silt	6.5%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

A-19

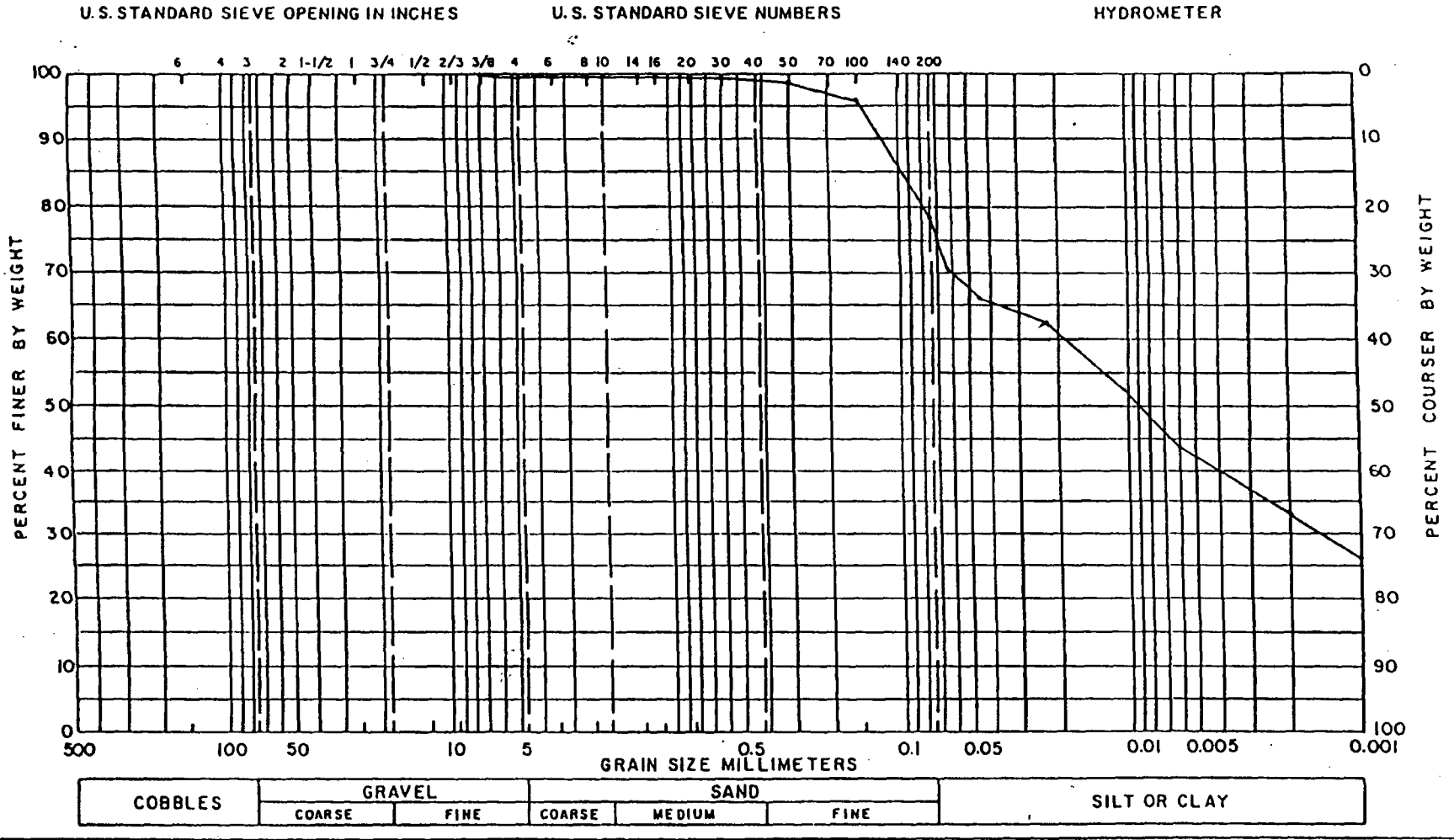


BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-6		9-10'	Brown silty sand	8.5%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

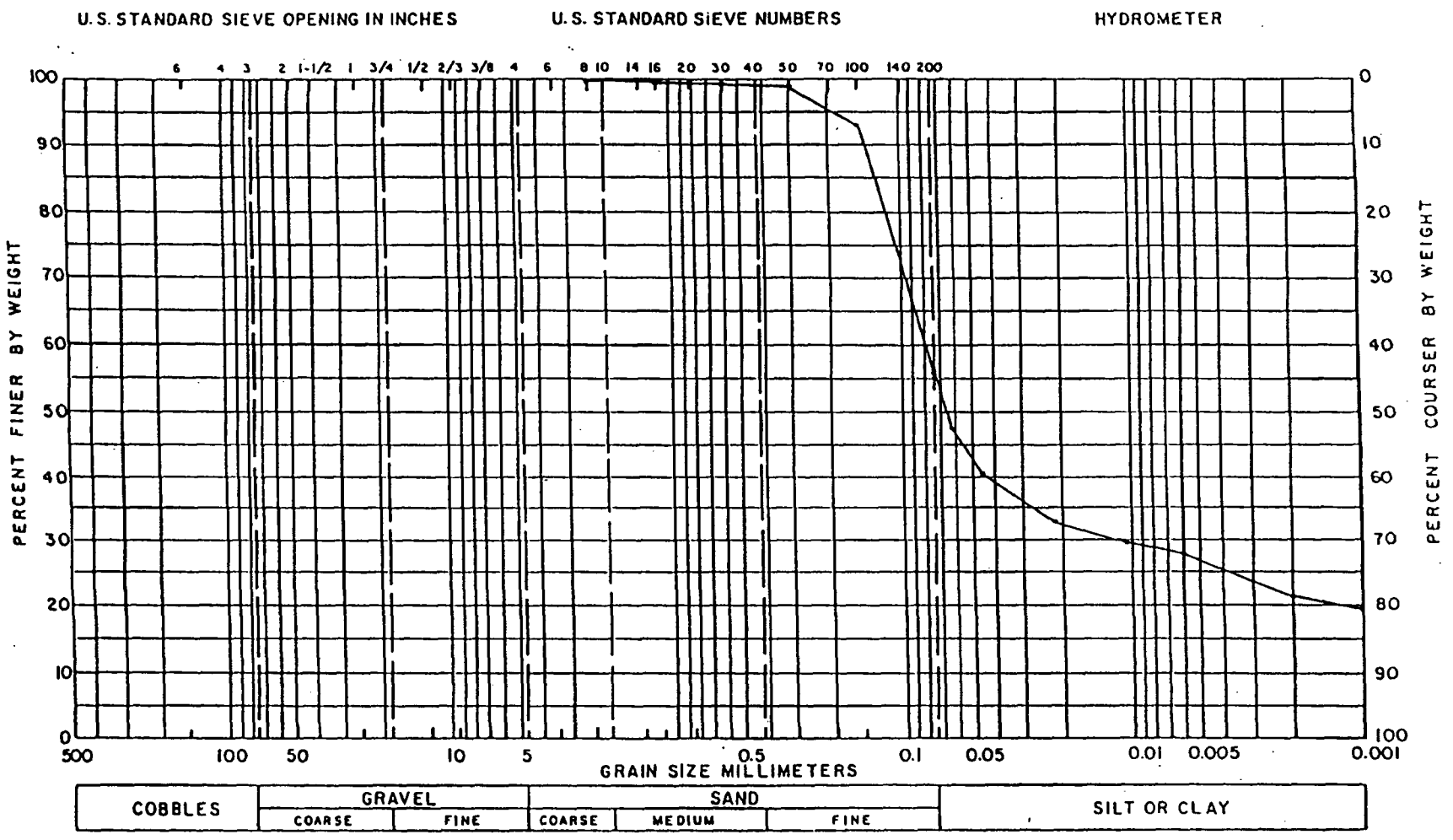


BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-7		4-5'	Brown sandy silt,	9.7 %			
			some clay				

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS



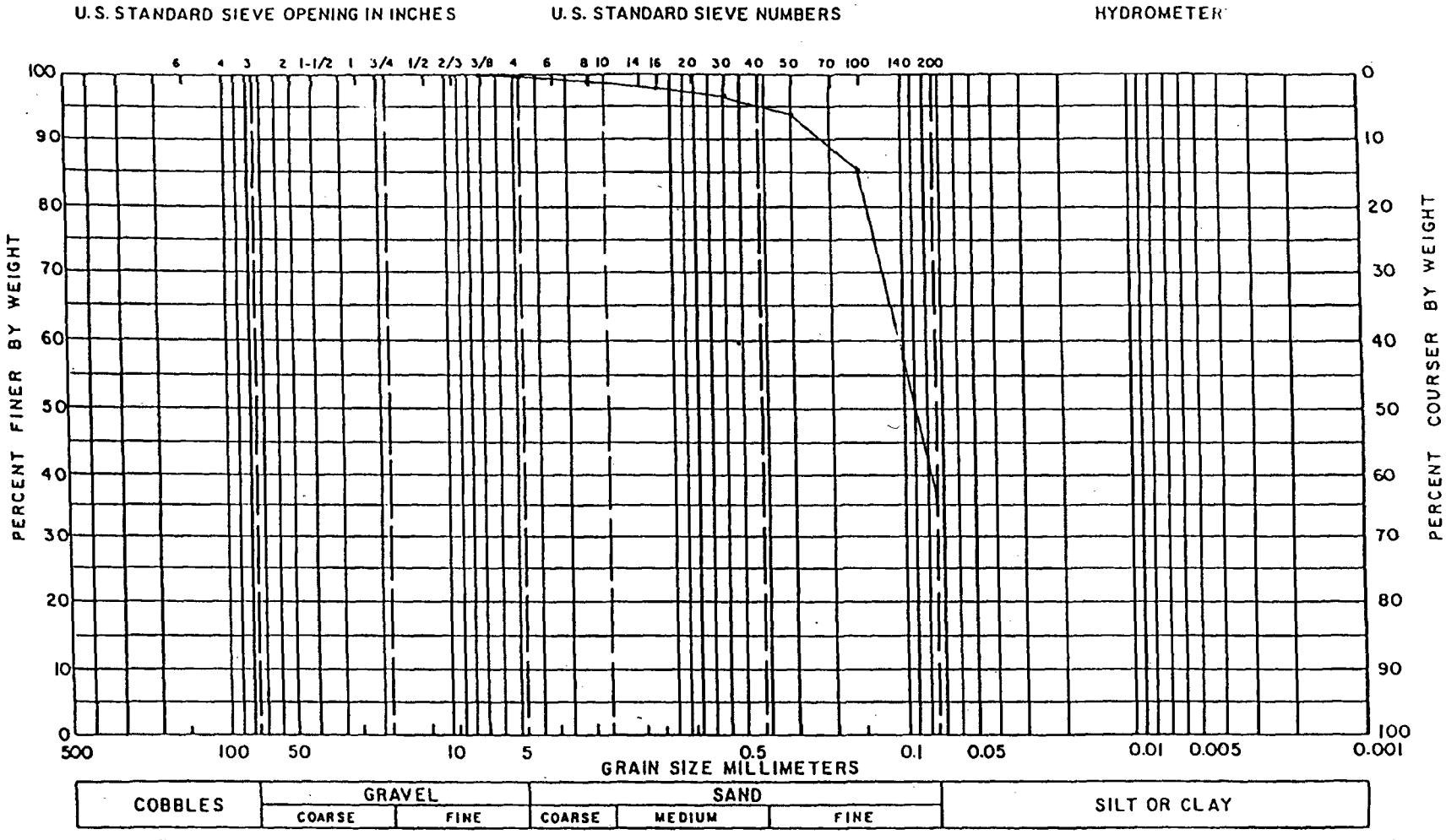
BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-7		9-10'	Brown silty sand	7.4%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

A-22



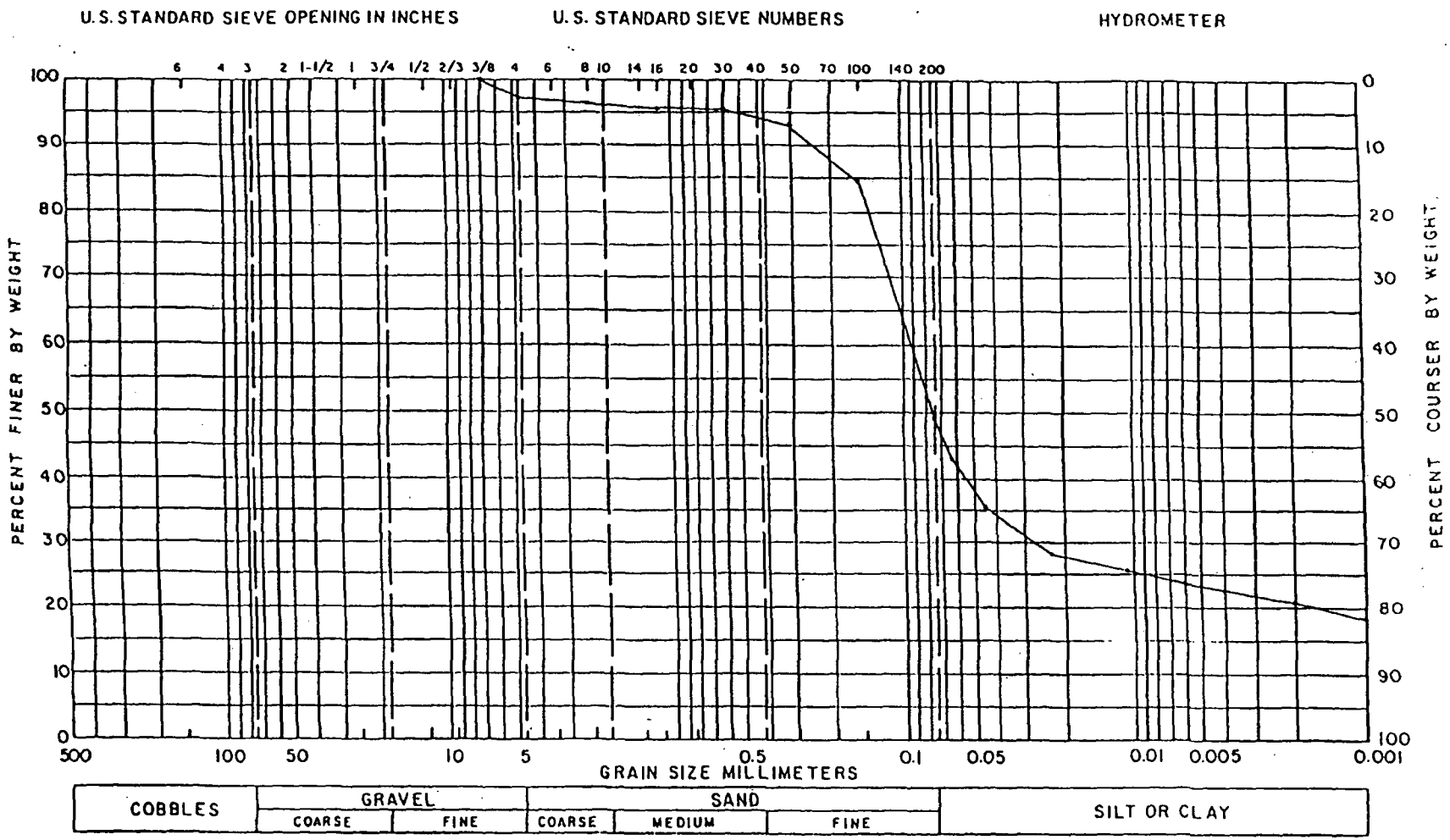
BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-8		3-5'	Brown silty sand	5.5%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWF	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

A-23

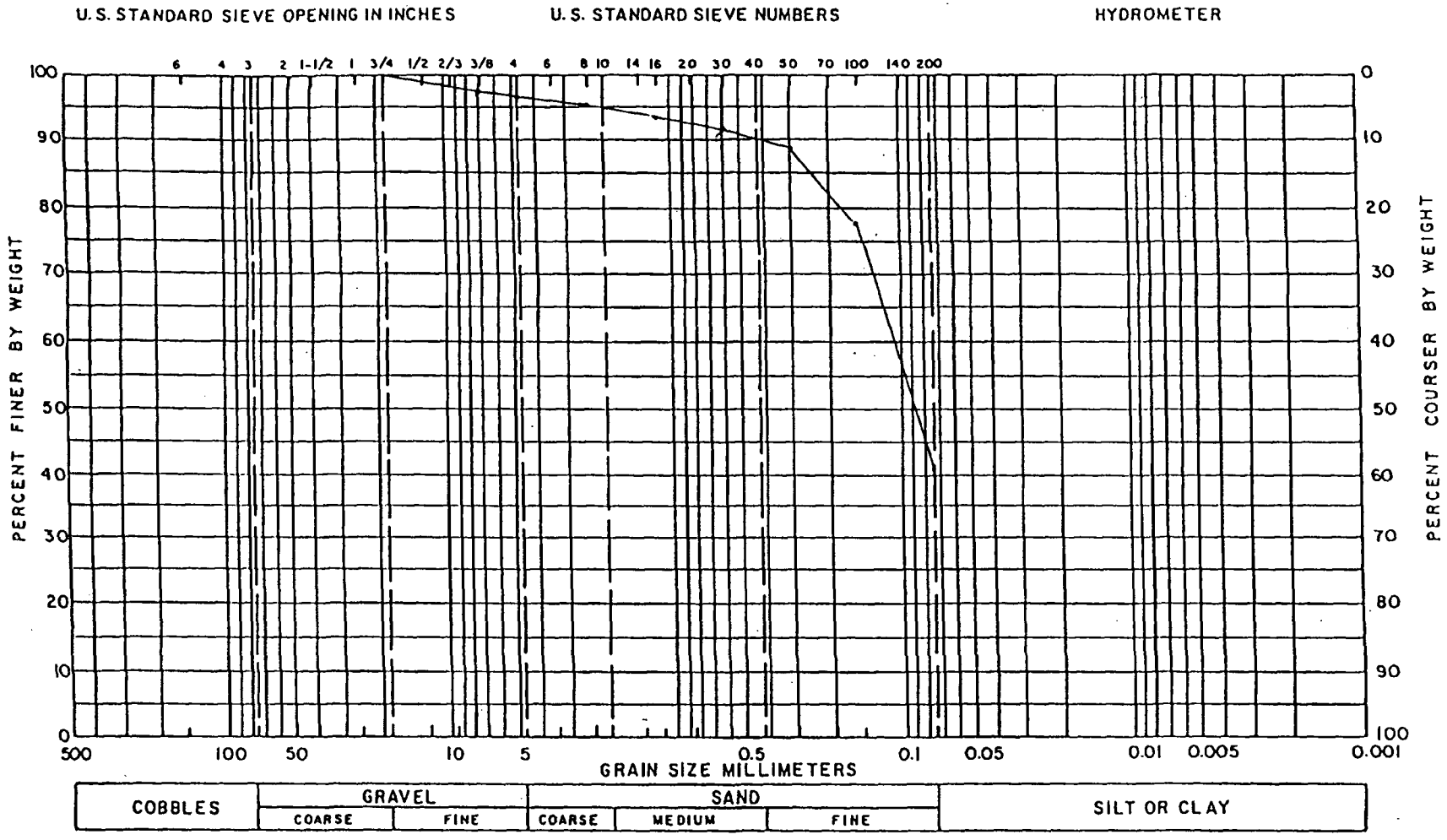


BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-10		2-3'	Brown silty sand, little clay	7.2%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. Rm 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS



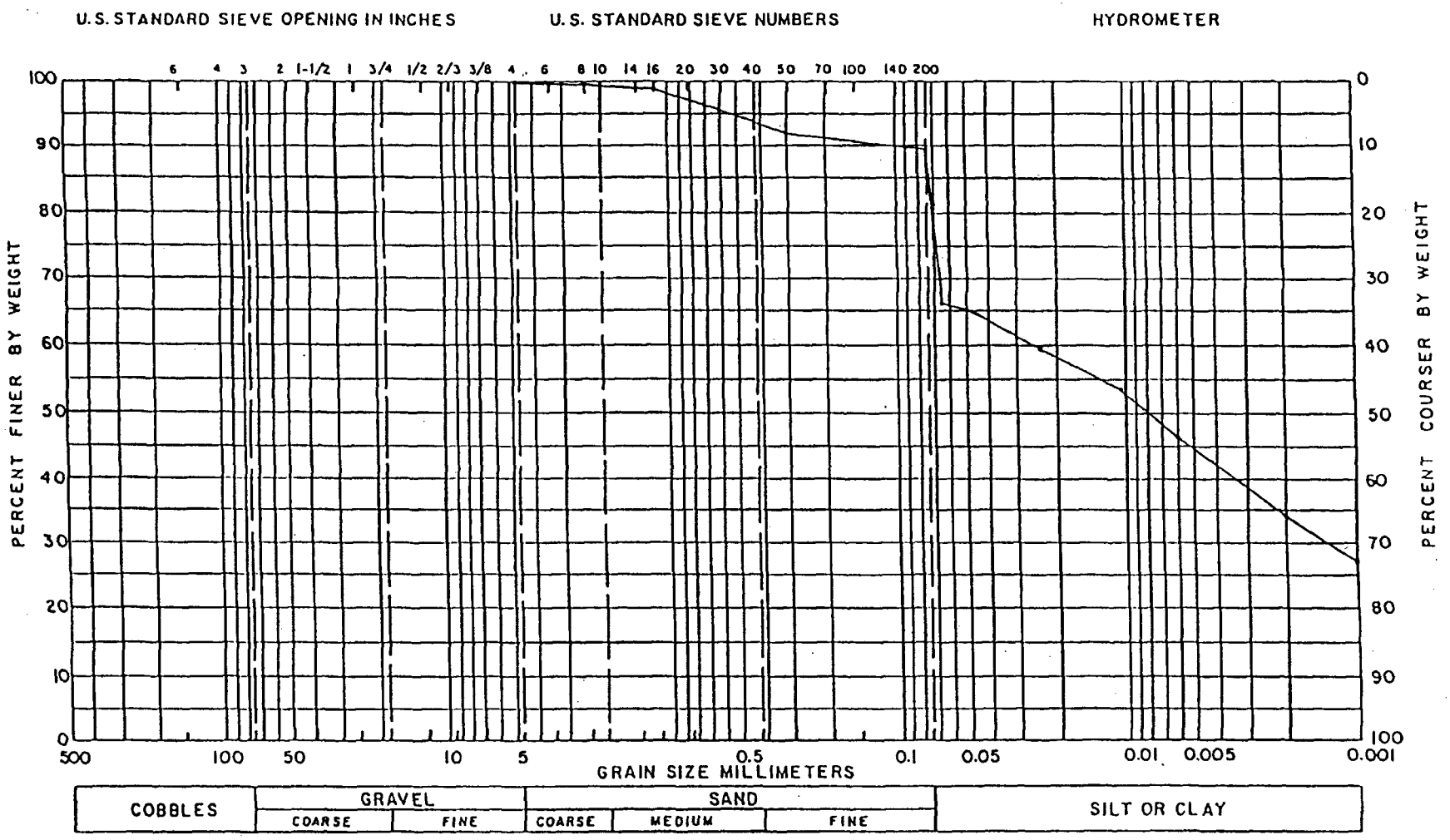
BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
TP-15		6'	Brown silty sand, trace gravel	5.6%			

Canonie Environmental

Drawn by:	DAC		
Engr.	DWE	PROJECT NO. 6583.01	DWG. NO. RM 86-060-01
Revised:		GRADATION CURVES	

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

A-25



BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
B-4		10'	Brown siltstone, some clay, trace sand	22.9 %			

Canonie Environmental

Drawn by: DAC

Engr. DWE

Revised:

PROJECT NO. 6583.01

DWG. NO. RM 86-060-01

GRADATION CURVES

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS

FIGURE

APPENDIX A-3

Rock Core Logs

Canonie

Rock Core Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-RR-1
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 71640.0 E 56744.3 SURFACE ELEV. 6969.7
DRILLER HEBER MINING & EXPLORATION DATE: START 11/20/86 FINISH 11/20/86

DEPTH	CORE NO.	CORE LEN.	BOX NO.	CORE DATA SIZE	PSI	FPM	% C.R.	LOSS	DISCONTINUITIES RQD	FPF	JOINT	BEDDING	HARDNESS	DESCRIPTION AND REMARKS	STRENGTH TESTS Qu TSF	Is PSI
														TAN WEATHERED FINE SANDSTONE		
														3.3		
	1	5	1	NX		1	98		84	2	H.C	TN	MH	MODERATELY HARD, TAN-LIGHT GRAY, FINE SANDSTONE, OCCASIONAL ORANGE LENSE, SOME DARK BROWN, BLACK SANDSTONE INTERNAL AT 8 FEET - 9 FEET AND AGAIN AT 12 FEET. GRAY CLAY IN FRACTURE AT 13 FEET. RETURN WATER TAN.		
5																
	2	5	1	NX		1	94		88	1.6	H,CCL	TN	MH			
10																
	3	5	2	NX		1	84		40	3	H.C	TT	MH	ALTERNATING ORANGE AND LIGHT GRAY LENSES AT 1/8-INCH CENTERS, OCCASIONAL THICKER BED. RETURN WATER ORANGE/TAN 15 FEET TO 18 FEET.		
15																
	4	5	2	NX		2	66		18	4	H,VC	TT	MH	HEAVILY FRACTURED 21 TO 21.5 FEET. DARK GRAY 1/8-INCH LENSE AT 22 FEET.		
20																
25																
30														NOTES: 1) TOTAL DEPTH 23.3 FEET. 2) DRILL RETURN WATER CONSISTENT THROUGHOUT. 3) CME 55 DRILL RIG. 4) ZONE 1 OF UPPER GALLUP FORMATION.		

Rev. 7-85

Canonie

Rock Core Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-RR-2
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 77181.3 E 59170.4 SURFACE ELEV. 7066.7
DRILLER HEBER MINING & EXPLORATION DATE: START 11/20/86 FINISH 11/20/86

DEPTH	CORE NO.	CORE LEN.	BOX NO.	CORE DATA SIZE	PSI	FPM	% C.R.	LOSS	DISCONTINUITIES RQD	FPF	JOINT	BEDDING	HARDNESS	DESCRIPTION AND REMARKS	STRENGTH TESTS Qu TSF	Is PSI
5														6.0		
	1	5	1	NX		2	100		94	1.6	H,C		MH	MODERATELY HARD, TAN, FINE SANDSTONE, SOME RANDOM BLACK SAND AT 9 FEET TO 11 FEET. LENSE OF LOOSE SAND AT 9.5 FEET. RETURN WATER TAN.		
10																
	2	5	1	NX		2	92		18	5.4	H,VC		MH			
15														RETURN WATER LOST AT 15 FEET.		
	3	4	2	NX		2	100		0	9	HV,VC		MH			
20												TT		BEGINNING AT 19 FEET, ALTERNATING 1/8-INCH LENSES OF TAN, ORANGE, AND DARK BROWN SANDSTONE. CLAY COATING IN FRACTURES.		
25														NOTES: 1) TOTAL DEPTH 20 FEET. 2) DRILL RETURN WATER CONSISTENT THROUGHOUT. 3) CME 55 DRILL RIG. 4) LOWER DALTON FORMATION.		

Rev. 7-85

APPENDIX A-4

Boring Logs

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-1
LOGGED BY DAVID KURZ
PAGE 1 OF 2

PROJECT NAME UNC
BORING LOCATION N 73692.9 E 57568.5 SURFACE ELEV. 6947.7
DRILLER HEBER MINING & EXPLORATION DATE: START 11-8-86 FINISH 11-8-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													HARD LENSE AT 1.5 AND 2.5 FEET.	
	1	SS	3	4.5	5	8	8	18	SP				MEDIUM DENSE, DARK GRAY FINE	
5												5	SAND, DRY, TRACE COAL, TRACE	
													YELLOW AND WHITE FINE SAND.	
	2	SS	6	7.5	2	2	5	18	CL				GRAY CUTTINGS AT 5 FEET.	
													MEDIUM STIFF, GRAY-BROWN CLAY,	
													DAMP, TRACE SILT (ALLUVIUM).	
10												10		
	3	SS	10	10.2	50/2			0					MODERATELY HARD, LIGHT GRAY -	
													WHITE FINE SANDSTONE (ZONE 3,	
													GALLUP SANDSTONE).	
15														
	4	SS	15	16.5	6	8	8	18					SAME. SOME ORANGE (RUSTY)	
													STAINED ZONES. MOIST GRAVEL-	
													SIZE WHITE ROCK IN CUTTINGS AT	
20													17 FEET; CUTTINGS FINE SAND AT	
													18 FEET.	
	5	SS	20	20.2	50/2			2						
												22	MODERATELY HARD, LIGHT GRAY	
												23	SILTSTONE, MOIST, UNTIL APPROXI-	
													MATELY 22 FEET.	
25	6	SS	24	25	50	42	-	12					COAL IN CUTTINGS 22 - 23 FEET.	
													HARD, LIGHT GRAY SILTSTONE,	
													MOIST.	
30													BEGIN CORING AT 29 FEET.	
													NOTES:	
													1) TOTAL DEPTH 34 FEET.	
35													2) GROUND WATER AT -13 FEET ON	
													11/9/86.	
													3) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Rock Core Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-1
PAGE 2 OF 2

PROJECT NAME UNC
BORING LOCATION N 73692.9 E 57568.5 SURFACE ELEV. 6947.7
DRILLER HEBER MINING & EXPLORATION DATE: START 11/8/86 FINISH 11/8/86

DEPTH	CORE NO.	CORE LEN.	BOX NO.	CORE DATA SIZE	PSI	FPM	% C.R.	LOSS	DISCONTINUITIES RQD	FPF	JOINT	BEDDING	HARDNESS	DESCRIPTION AND REMARKS	STRENGTH TESTS Qu TSF	Is PSI
														BEGIN CORING AT 29 FEET.		
30	1	5	1	NX		1	82		25	4	H,C	TT	MH	MODERATELY HARD, GRAY, MEDIUM TO COARSE SANDSTONE, ORANGE AND BROWN LENSES, ANGULAR GRAINS.		
35														NOTES: 1) TOTAL DEPTH 34 FEET. 2) GROUND WATER -13 FEET ON 11/9/86. 3) CME 55 DRILL RIG.		

Rev 7-85

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-2
LOGGED BY DAVID KURZ
PAGE 1 OF 2

PROJECT NAME UNC
BORING LOCATION N 73393.2 E 57548.5 SURFACE ELEV. 6941.3
DRILLER HEBER MINING & EXPLORATION DATE: START 11-8-86 FINISH 11-12-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													MEDIUM DENSE, DARK GRAY/BROWN CLAYEY FINE TO MEDIUM SAND, DRY, TRACE ORGANICS (ALLUVIUM).	
5												5.5		
	1	SS	5	6.5	14	9	14	18	SC-SP				MEDIUM DENSE, LIGHT GRAY FINE TO MEDIUM SAND BEGINNING AT 5.5 FEET. TRACE WEATHERED SANDSTONE, ROUNDED WITH ORANGE STAINING.	
10														
	2	SS	10	11.5	9	6	11	18	CL			10.3		
													BEGINNING AT 10.3 FEET, VERY STIFF, DARK GRAY-BROWN CLAY, DAMP, TRACE COAL, ORGANIC, SILT, AND WEATHERED SANDSTONE.	
15														
	3	SS	15	16.5	4	14	11	18	CL				SAME.	
20														
	4	SS	20	21.5	5	5	9	18	CL				SAME, MOIST, SOME SILT. BECOMING CLAYEY SILT, TRACE VERY FINE SAND AT 21 FEET.	
25														
30													NOTES: 1) TOTAL DEPTH 30 FEET ON 11/8/86. EXTENDED TO 80 FEET ON 11/12/86. 2) GROUND WATER AT 26 FEET ON 11/9/86.	
35														
40														
	5	SS	40	41.5	3	5	5	18	ML				SAME, STIFF, BROWN CLAYEY SILT, MOIST, TRACE FINE SAND.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-2
LOGGED BY DAVID KURZ
PAGE 2 OF 2

PROJECT NAME UNC
BORING LOCATION N 73393.2 E 57548.5 SURFACE ELEV. 6941.3
DRILLER HEBER MINING & EXPLORATION DATE: START 11-8-86 FINISH 11-12-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
	5	SS	40	41.5	3	5	5	18	ML					
45												45		
50	6	SS	50	51.5	4	4	4	18	SM				LOOSE, LIGHT BROWN/TAN, FINE TO MEDIUM SAND, SOME SILT AND CLAY (CONTACT APPROXIMATE).	
55														
60	7	SS	60	61.5	11	22	40	18	SM				SAME, TRACE CLAY.	
65														
70	8	SS	70	70.2	50/2			2	SM				SAME, VERY DENSE.	
75														
80	9	SS	80	-	100/0			0					NOTES: 3) TOTAL DEPTH 80 FEET. 4) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-3
LOGGED BY David Kurz
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 73557.5 E 57738.1 SURFACE ELEV. 6944.8
DRILLER Heber Mining & Exploration DATE: START 11-8-86 FINISH 11-8-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
5	1	SS	5	6.5	5	5	10	18	SC				Medium Dense, Dark Gray-Brown, Fine to Medium Sand, Damp, Some Clay and Silt, Trace Coal, Organics, Roots, and Weathered Orange Stained Sandstone (Alluvium).	
10	2	SS	10	11.5	5	7	7	18	SC-CL			11	Gray Moist Clay Layer 5.9 to 6.4 Feet. Medium Dense, Greenish Gray-Brown Fine Sand, Moist, Trace Coal, Organics, and Clay.	
												14		
15	3	SS	15	16.5	3	2	2	18	SC				Beginning at 11 Feet, Dark Gray Clay, Moist, Some Silt, Trace Roots, Organics.	
20	4	SS	20	21.5	3	3	5	18	SC				Loose, Greenish-Gray Brown Fine Sand, Trace Clay, Coal, Organics (Contact Approximate). Stiff, Clumpy Cuttings at 17 Feet Same, Increasing Clay and Silt.	
25														
30														
35													Notes: 1) Total Depth 35 Feet. 2) Ground Water at -26.1 Feet on 11/9/86. 3) CME 55 Drill Rig.	
40														

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-4
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 73728.5 E 57891.4 SURFACE ELEV. 6945.8
DRILLER HEBER MINING & EXPLORATION DATE: START 11-9-86 FINISH 11-9-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	6-12	12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													CUTTINGS, DARK BROWN, MEDIUM SAND, SOME SILT, TRACE COARSE SAND TO 4.5 FEET. CUTTINGS LIGHT GRAY AFTER 4.5 FEET.	
5														
	1	SS	5	6.5	21	28	21	18	SM-ML			5.7	DENSE, LIGHT GRAY, MEDIUM SAND, MOIST, TRACE COAL AND WEATHERED SANDSTONE (ALLUVIUM).	
10													AT 5.7 FEET BECOMING GRAY-BROWN, CLAYEY SILT, TRACE COAL, ORGANICS, ROOTS.	
	2	SS	10	11.5	3	6	5	18	ML			11	SAME, BECOMING CLAYEY SAND AT BOTTOM.	
15														
	3	SS	15	16.5	3	4	3	18	SC				LOOSE, GREENISH GRAY-BROWN FINE SAND, MOIST, TRACE CLAY, SOME COAL POWDER.	
20													WET CLUMPY CUTTINGS AT 18 FEET.	
	4	SS	20	21.5	3	4	3	18	SC				LOOSE, GRAY-BROWN FINE SAND, MOIST, SOME CLAY, TRACE ORGANICS.	
25														
													CUTTINGS, LIGHTER TAN SAND FROM 28 TO 30 FEET.	
30												29		
	5	SS	30	31.5	7	9	9	18	CL				VERY STIFF, DARK BROWN-GRAY, SILTY CLAY, MOIST, TRACE COAL, ORGANICS, ROOTS (CONTACT APPROXIMATE).	
35														
40													NOTES: 1) TOTAL DEPTH 40 FEET. 2) GROUND WATER DATA UNAVAILABLE DUE TO CAVING. 3) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-5
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 73184.7 E 57038.7 SURFACE ELEV. 6937.4
DRILLER HEBER MINING & EXPLORATION DATE: START 11-9-86 FINISH 11-9-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	6-12	12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
5	1	SS	5	6.5	11	15	17	18	ML				DENSE, DARK GRAY, SANDY SILT, DAMP, TRACE CLAY, COAL, ORGANICS (ALLUVIUM).	
10	2	SS	10	11.5	4	7	9	18	ML				SAME, DRY, TRACE SAND.	
15	3	SS	15	16	28	30	-	12	ML				SAME, GREENISH GRAY-BROWN, SOME CLAY, TRACE WHITE SLIVERS, AND ORGANICS.	
20	4	SS	20	21.5	7	10	12	18	ML				SAME.	
25													CLUMPY CUTTINGS AT 26 FEET.	
												27		
30	5	SS	30	31.5	6	6	5	18	CL				DARK BROWNISH-GRAY SILTY CLAY, DAMP, TRACE FINE SAND AND ORGANICS (CONTACT APPROXIMATED).	
35														
40													NOTES: 1) TOTAL DEPTH 40 FEET. 2) GROUND WATER DATA UNAVAILABLE DUE TO CAVING. 3) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-6
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 72289.3 E 56311.5 SURFACE ELEV. 6921.7
DRILLER HEBER MINING & EXPLORATION DATE: START 11-9-86 FINISH 11-9-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	6-12	12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
												3	CUTTINGS, DARK BROWN SILTY CLAY TO 3 FEET.	
5	1	SS	5	6.5	7	11	11	18	SM				MEDIUM DENSE, TAN, SILTY FINE SAND, DRY, TRACE CLAY, ORGANICS, AND COAL (ALLUVIUM).	
10	2	SS	10	11.5	6	4	4	18	SM				SAME, NO CLAY, TRACE WEATHERED ROCK AND COAL CHIPS.	
15	3	SS	15	16.5	6	8	9	18	SM				SAME, TRACE CLAY.	
20	4	SS	20	21.5	7	9	9	18	SM				SAME. WEATHERED SANDSTONE LENSES NOTED AT 20 AND 25 FEET BY BRIEF HARD DRILLING.	
25														
30	5	SS	30	31.5	7	7	9	18	SM				SAME.	
35													NOTES: 1) TOTAL DEPTH 35 FEET. 2) GROUND WATER DATA UNAVAILABLE DUE TO CAVING. 3) CME 55 DRILLING.	
40														

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-7
LOGGED BY DAVID KURZ
PAGE 1 OF 2

PROJECT NAME UNC
BORING LOCATION N 73635.5 E 57517.2 SURFACE ELEV. 6942.7
DRILLER HEBER MINING & EXPLORATION DATE: START 11-9-86 FINISH 11-9-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													BROWN, SILTY SAND CUTTINGS, DRY, TO 4 FEET.	
												4		
5													LIGHT GRAY WEATHERED SANDSTONE.	
													o TRICONE ROTARY WATER DRILLING 8 TO 12 FEET.	
10													o BEGIN CORING AT 12 FEET.	
15														
20													NOTES: 1) TOTAL DEPTH 22 FEET. 2) GROUND WATER DATA UNVAILABLE DUE TO CAVING. 3) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Rock Core Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-7
PAGE 2 OF 2

PROJECT NAME UNC
BORING LOCATION N 73635.5 E 57517.2 SURFACE ELEV. 6942.7
DRILLER HEBER MINING & EXPLORATION DATE: START 11/9/86 FINISH 11/9/86

DEPTH	CORE NO.	CORE LEN.	BOX NO.	CORE DATA SIZE	PSI	FPM	% C.R.	LOSS	DISCONTINUITIES RQD	FPF	JOINT	BEDDING	HARDNESS	DESCRIPTION AND REMARKS	STRENGTH TESTS Qu TSF	Is PSI
														BEGIN CORING AT 12 FEET.		
	1	3	1	NX		1	97		53	5	H,C	TT	MH	MODERATELY HARD, LIGHT GRAY SILTSTONE INTERBEDDED WITH DARK GRAY AND OCCASIONAL ORANGE LENSES. CORE BLOCKING 15 FEET TO 16.5 FEET, COAL BED.		
15	2	1.5	–	NX		1	0		0							
20														TRICONE ROTARY WATER DRILLING 16.5 FEET TO 22 FEET.		
25														SANDSTONE NOT COMPETENT ENOUGH TO CORE.		
														NOTES: 1) TOTAL DEPTH 22 FEET. 2) GROUND WATER DATA UNAVAILABLE DUE TO CAVING ABOVE BENTONITE PLUG. 3) CME 55 DRILL RIG.		

Rev. 7-85

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-8
LOGGED BY DAVID KURZ
PAGE 1 OF 2

PROJECT NAME UNC
BORING LOCATION N 73475.2 E 57467.5 SURFACE ELEV. 6938.1
DRILLER HEBER MINING & EXPLORATION DATE: START 11-12-86 FINISH 11-12-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
												1.5	FILL.	
5														
	1	SS	5	6.5	5	5	7	18	ML				MEDIUM DENSE, BROWN SILT, DRY, TRACE FINE SAND, ROOTS (ALLUVIUM).	
10														
	2	SS	10	11.5	5	5	5	18	ML-CL			10.8	STIFF, BROWN CLAYEY SILT, DRY, TRACE FINE SAND, ORANGE STAINING. BECOMING MOIST BROWN CLAY, TRACE SILT AT 10.8 FEET.	
15														
	3	SS	1.5	16.5	5	10	14	18	CL				SAME, TRACE WHITE SILT POCKETS.	
20														
	4	SS	20	21.5	10	12	14	18	CL				SAME, TRACE GRAY CLAY AND TRACE ORANGE POCKETS.	
25														
30														
	5	SS	30	31.5	1	1	1	6	CL-SM			31.3	SAME, WET.	
													BECOMING VERY LOOSE, BROWN FINE SAND AND SILT, WET, TRACE CLAY, AT 31.3 FEET. CUTTINGS WET AT 31 FEET.	
35														
40												40.5		
	6	SS	40	41	50	-	-	12						

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-P-8
LOGGED BY DAVID KURZ
PAGE 2 OF 2

PROJECT NAME UNC
BORING LOCATION N 73475.2 E 57467.5 SURFACE ELEV. 6938.1
DRILLER HEBER MINING & EXPLORATION DATE: START 11-12-86 FINISH 11-12-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
	6	SS	40	41	50	-	-	12					SAME. BECOMING GRAY-BROWN CLAY, MOIST, AT 40 FEET. BECOMING DARK BROWN-BLACK WEATHERED SHALE WITH ORANGE STAINING AT 40.5 FEET (ZONE 2, GALLUP SANDSTONE).	
45														
50	7	SS	50	50.3	100/4			4					HARD, BROWN AND BLACK CLAY, SOME ORGANICS. BECOMING ORANGE AND LIGHT GRAY TO WHITE FINE SANDSTONE.	
55														
60	8	SS	60	60.5	50	30/0		6					HARD, BROWN AND BLACK CLAY, DAMP, AND WEATHERED SHALE. BECOMING ORANGE, YELLOW, AND WHITE FINE SANDSTONE.	
65														
70	9	SS	70	-	50/0			0					NOTES: 1) TOTAL DEPTH 70 FEET. 2) GROUND WATER AT -25.5 FEET ON 11/12/86. 3) CME 55 DRILL RIG.	

Rev 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-1
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 75189.1 E 56935.9 SURFACE ELEV. 6999.2
DRILLER HEBER MINING & EXPLORATION DATE: START 11-6-86 FINISH 11-6-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													4 INCHES ASPHALT.	
	1	SS	1	2.5	5	9	9	18	SM				VERY LOOSE TO MEDIUM DENSE, BROWN, DRY, FINE SAND, SOME SILT,	
	2	SS	3	4.5	2	2	2	18	SM				TRACE BLACK, RUST, AND WHITE STAINING.	
5														
	3	SS	6	7.5	2	1	2	18	SM					
10	4	SS	9	10.5	12	42	-	12	SM				SAME. BECOMING VERY DENSE, LIGHT BROWN/TAN FINE SAND. CUTTINGS, DARK GRAY/BLACK WITH KEROSENE ODOR 11 TO 12.5 FEET.	
												13		
15	5	SS	14	14.3	100/4			3					SOFT TO MODERATELY HARD, TAN, FINE SANDSTONE, UNDERLYING DARK GRAY, ODOROUS FINE SAND (CONSIDERED SLOUGH) (CONTACT APPROXIMATE).	
20	6	SS	19	19.2	100/2			2					SAME.	
25	7	SS	24	-	50/0			0						
30													NOTES: 1) TOTAL DEPTH 24 FEET. 2) NO GROUND WATER ENCOUNTERED. 3) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-2
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 75085.8 E 56950.7 SURFACE ELEV. 6999.0
DRILLER HEBER MINING & EXPLORATION DATE: START 11-6-86 FINISH 11-6-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													4 INCHES ASPHALT.	
	1	SS	1	2.5	9	9	12	18	SP				MEDIUM DENSE BROWN AND GRAY FINE SAND, DRY, TRACE RUST, ORANGE AND WHITE STAINING, ORGANICS, ROOTS.	
	2	SS	3	4.5	10	13	10	18	SP					
5														
	3	SS	6	7.5	2	1	2	18	SM				LOOSE, BROWN, FINE SAND, DRY, SOME SILT.	
10	4	SS	9	10.5	2	2	3	18	SM				SAME.	
15														
	5	SS	15	16.5	2	4	4	18	SC				SAME, SOME CLAY.	
20														
	6	SS	20	21.5	6	5	32	18	SP				AT 20.2 FEET, DENSE, TAN/LIGHT GRAY, FINE SAND, DRY, SLIGHTLY ODOROUS (KEROSENE).	
25														
	7	SS	25	26.5	21	41	50/4	14	SP				DENSE, BROWN, FINE SAND, DRY, (ODOROUS), BLACK AND RUST LENSES.	
30												30		
	8	SS	30	30.4	80/5			5				32	VERY DENSE, BLACK, LOW GRADE COAL	
	9	SS	33	33.3	100/3			3					SOFT TO MODERATELY HARD, TAN, FINE SANDSTONE (CONTACT APPROXIMATE).	
35														
40													NOTES: 1) AUGER REFUSAL AND TOTAL DEPTH 33.3 FEET. 2) NO GROUND WATER ENCOUNTERED. 3) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-4
LOGGED BY DAVID KURZ
PAGE 1 OF 2

PROJECT NAME UNC
BORING LOCATION N 74936.9 E 57155.5 SURFACE ELEV. 6996.0
DRILLER HEBER MINING & EXPLORATION DATE: START 11-6-86 FINISH 11-6-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
	1	SS	0.5	2.0	4	9	9	18	SM				4 INCHES ASPHALT. MEDIUM DENSE, BROWN FINE SAND AND SILT, DRY, TRACE GRAVEL.	
5	2	SS	3	4.5	4	4	7	18	SM				TRACE DARK BROWN, ORANGE, WHITE, AND YELLOW STAINING.	
	3	SS	6	7.5	2	4	4	18	SC			7.5	MEDIUM DENSE, DARK GRAY, FINE SAND, SOME SILT AND CLAY, TRACE ORGANICS, ROOTS.	
10	4	SS	9	10.5	7	13	9	18	SC					
												14		
15	5	SS	14	15.5	5	4	5	18	SP				LOOSE, LIGHT BROWN, FINE SAND. DRY.	
20	6	SS	19	20.5	4	6	6	18	SP				SAME.	
25														
30	7	SS	29	30.5	6	6	7	18	SP				CUTTINGS, DARK BROWN CLUMPY AT 28 FEET. MEDIUM DENSE, DARK GRAY FINE SAND, MOIST, VERY ODOROUS (KEROSENE).	
	8	BR	32	33	-	11		12	SP				SAME.	
35														
40	9	BR	39	40	-	21		0	SP				ESTIMATED SAME, WET.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-4
LOGGED BY DAVID KURZ
PAGE 2 OF 2

PROJECT NAME UNC
BORING LOCATION N 74936.9 E 57155.5 SURFACE ELEV. 6996.0
DRILLER HEBER MINING & EXPLORATION DATE: START 11-6-86 FINISH 11-6-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
												41	HARDER DRILLING 41 TO 42 FEET.	
45	10	SS	45	45.3	100/3			3					MODERATELY HARD, TAN FINE SANDSTONE.	

NOTES:
1) TOTAL DEPTH 45.3 FEET.
2) NO GROUND WATER ENCOUNTERED.
3) CME 55 DRILL RIG.

Rev. 2-86

Canonie

Boring Log.

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-5
LOGGED BY DAVID KURZ
PAGE 1 OF 2

PROJECT NAME UNC
BORING LOCATION N 74747.3 E 57312.2 SURFACE ELEV. 6991.9
DRILLER HEBER MINING & EXPLORATION DATE: START 11-5-86 FINISH 11-5-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													6 INCHES CONCRETE.	
	1	SS	1	2.5	4	5	5	16	SM				LOOSE, BROWN FINE SAND, MOIST, SOME SILT.	
	2	SS	3	4.5	5	5	9	18	SM				BLACK, DARK GRAY SAND WITH DECOMPOSED ORGANIC ODOR FROM 1.5 TO 2.5 FEET AND AGAIN AT	
5														
	3	SS	6	7.5	3	4	4	18	SM				6 TO 7.2 FEET.	
10	4	SS	9	10.5	10	3	5	18	SM				SAME, TRACE ORANGE STAINING 9.5 - 10 FEET.	
	5	BR	11	12	-			12	SM				SAME, DARK BROWN, TRACE ROOTS.	
15														
	6	BR	15	16	-	18		12	SM				SAME, TRACE ROOTS.	
20														
	7	BR	20	21	-	12		12	SP				BROWN SAND, MOIST. FROM 20 TO 24 FEET, NO FINES.	
25														
	8	BR	25	26	-	11		12	SC				STIFF, BROWN CLAYEY SAND.	
30														
35														
	9	BR	35	36	-	18		12	SM				MEDIUM DENSE, BROWN, FINE SAND, SOME SILT AND CLAY. CLEAN (NO FINES) SAND LENSE AT 35.5 FEET.	
40												40	HARDER DRILLING AT 40 FEET.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-5
LOGGED BY DAVID KURZ
PAGE 2 OF 2

PROJECT NAME UNC
BORING LOCATION N 74747.3 E 57312.2 SURFACE ELEV. 6991.9
DRILLER HEBER MINING & EXPLORATION DATE: START 11-5-86 FINISH 11-5-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
45	10	BR	45	-	50/0			0						
50	11	SS	50	50.2	100/2			2					SOFT TO MODERATELY HARD. TAN. FINE SANDSTONE.	
55													NOTES: 1) TOTAL DEPTH 55.2 FEET. 2) NO GROUND WATER ENCOUNTERED. 3) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-6
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 74773.4 E 57456.0 SURFACE ELEV. 6991.9
DRILLER HEBER MINING & EXPLORATION DATE: START 11-5-86 FINISH 11-5-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													6 INCHES CONCRETE.	
	1	SS	1	2.5	6	11	6	14	SM				MEDIUM DENSE, BROWN SAND, MOIST, SOME SILT, TRACE COARSE SAND AND GRAVEL.	
	2	SS	3	4.5	8	6	8	18	SM					
5														
	3	SS	6	7.5	2	3	4	18	SM				SAME, LOOSE, SOME TAN AND ORANGE STRINGERS.	
10	4	BR	9	10.5	4	4	4	10	SM				SAME, SOME LENSES (1/2-TO 1-INCH THICK) MODERATELY HARD SANDSTONE.	
15	5	BR	14.5	15.5	-	8		12	SM				SAME.	
20	6	BR	19	20	-	19		12	SM				STARTING AT 19.8 FEET, MEDIUM DENSE, BROWN SAND, MOIST, SOME SILT.	
25	7	BR	24	25	-	12		10	SM				SAME.	
30	8	BR	29	30	-	38		12	SM				SAME.	
													NOTES: 1) TOTAL DEPTH 40 FEET. 2) 4-FOOT DIAMETER HOLE THROUGH CONCRETE NEARBY. 3) NO GROUND WATER ENCOUNTERED. 4) CME 55 DRILL RIG.	
35														
40	9	BR	39	40	-	45		12	SM				SAME, DRY.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-7
LOGGED BY DALE EVANS
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 75106.4 E 57445.3 SURFACE ELEV. 6998.9
DRILLER HEBER MINING & EXPLORATION DATE: START 11-4-86 FINISH 11-4-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	6-12	12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
	1	SS	0.5	2	27	14	14	18	SM				4 INCHES ASPHALT. GRAY-BROWN, SILTY, SANDY, GRAVELLY FILL. THIN LAYER OF LIMESTONE CAP-ROCK.	
	2	SS	3	4.5	7	8	13	18	SM					
5												6.5		
	3	SS	6	7.5	8	12	14	18	SM				OLIVE-GRAY SILTY SAND WITH ORGANICS, BECOMING DARK GRAY AT 7.5 FEET.	
												9		
10	4	SS	9	10.5	4	4	5	18						
												11	WEATHERED YELLOW-BROWN SANDSTONE, LITTLE SILT, TRACE COAL FRAGMENTS, OXIDES. BECOMING FIRM AT 11 FEET.	
	5	SS	12	12.5	100			6						
15														

NOTES:
1) TOTAL DEPTH 12.5 FEET.
2) NO GROUND WATER ENCOUNTERED.
3) CME 55 DRILL RIG.

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-8
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 75376.4 E 57488.9 SURFACE ELEV. 6996.3
DRILLER HEBER MINING & EXPLORATION DATE: START 11-4-86 FINISH 11-4-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
	1	SS	0	1.5	3	6	35		SP-SM				LOOSE, LIGHT GRAY FINE SAND, MOIST, TO 0.3 FEET,	
	2	SS	3	3.5	100/6			6					DENSE, BROWN, SILTY FINE SAND, MOIST, TO 1 FOOT.	
5													HARD, LIGHT BROWN, FINE SANDSTONE, DRY.	
	3	SS	6	7	16	50/6		12					SAME.	
10														

NOTES:
1) TOTAL DEPTH 7 FEET.
2) NO GROUND WATER ENCOUNTERED.
3) CME 55 DRILL RIG.

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-9
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 75279.5 E 57656.3 SURFACE ELEV. 6991.6
DRILLER HEBER MINING & EXPLORATION DATE: START 11-4-86 FINISH 11-4-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	6-12	12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
	1	SS	0	1	26	50	-	12	SM				VERY DENSE, LIGHT GRAY SAND, MOIST, SOME GRAVEL, TRACE CLAY AND SILT.	
5	2	SS	3.5	5	5	6	6	18	SM				MEDIUM DENSE, LIGHT BROWN FINE SAND, TRACE SILT AND CLAY, WHITE SILT STRINGERS. BECOMING REDDISH BROWN AT 6 FEET.	
	3	SS	7.5	9	8	9	9	18	SM				SAME.	
10														
	4	SS	13.5	15	4	4	5	18	SM				SAME, TRACE COAL CHIPS.	
15														
												17	CUTTINGS BECOMING BROWN WEATHERED SANDSTONE.	
	5	SS	18.5	19	50/5			5					SOFT TO MODERATELY HARD, BROWN-GRAY SANDSTONE, MOIST, TRACE COAL CHIPS AND IRON OXIDE STAINING (CONTACT APPROXIMATE).	
20														

NOTES:
1) TOTAL DEPTH 19 FEET.
2) NO GROUND WATER ENCOUNTERED.
3) CME 55 DRILL RIG

Rev. 2 86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-10
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 75266.2 E 57861.6 SURFACE ELEV. 6990.2
DRILLER HEBER MINING & EXPLORATION DATE: START 11-4-86 FINISH 11-4-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	6-12	12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
	1	SS	0	1.2	8	19	50/2	14	SP			1	MEDIUM DENSE, LIGHT GRAY FINE SAND, MOIST, BROWN SAND STRINGERS.	
	2	SS	3	3.4	100/5			5					SOFT TO MODERATELY HARD, LIGHT BROWN SANDSTONE, DRY, TRACE SILT.	
5														
	3	SS	6	6.9	11	50/5		11					SAME.	
10														

NOTES:
1) TOTAL DEPTH OF 6.9 FEET.
2) NO GROUND WATER ENCOUNTERED.
3) CME 55 DRILL RIG.

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-11
LOGGED BY DALE EVANS
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 75373.2 E 57633.9 SURFACE ELEV. 6994.5
DRILLER HEBER MINING & EXPLORATION DATE: START 11-4-86 FINISH 11-4-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
												0.5	BROWN SILTY SAND.	
													BROWN SANDY SILTSTONE.	
5														
													NOTES: 1) TOTAL DEPTH 4 FEET. 2) NO GROUND WATER ENCOUNTERED. 3) 4-INCH SOLID STEM AUGER. 4) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-12
LOGGED BY DALE EVANS
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 75392.0 E 57778.8 SURFACE ELEV. 6994.6
DRILLER HEBER MINING & EXPLORATION DATE: START 11-4-86 FINISH 11-4-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO
												0.5	BROWN SILTY SAND.	
													BROWN SANDY SILTSTONE.	
5														
													NOTES: 1) TOTAL DEPTH 4 FEET. 2) NO GROUND WATER ENCOUNTERED. 3) 4-INCH SOLID STEM AUGER. 4) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-13
LOGGED BY Dale Evans
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 75048.2 E 57844.3 SURFACE ELEV. 6985.1
DRILLER Heber Mining & Exploration DATE: START 11-4-86 FINISH 11-4-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													Brown Sandy Siltstone.	
5													Notes: 1) Total Depth 4 Feet. 2) No Ground Water Encountered. 3) 4-Inch Solid Stem Auger. 4) CME 55 Drill Rig.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-14
LOGGED BY DALE EVANS
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 74958.9 E 57729.7 SURFACE ELEV. 6988.5
DRILLER HEBER MINING & EXPLORATION DATE: START 11-4-86 FINISH 11-4-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
												0.5	GRAY SILTY SAND.	
													BROWN SANDY SILTSTONE.	
5														
													NOTES: 1) TOTAL DEPTH 4 FEET. 2) NO GROUND WATER ENCOUNTERED. 3) 4-INCH SOLID STEM AUGER. 4) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-M-15
LOGGED BY DALE EVANS
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 74971.8 E 57593.8 SURFACE ELEV. 6992.8
DRILLER HEBER MINING & EXPLORATION DATE: START 11-4-86 FINISH 11-4-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													BROWN SANDY SILTSTONE.	
5													NOTES: 1) TOTAL DEPTH 4 FEET. 2) NO GROUND WATER ENCOUNTERED. 3) 4-INCH SOLID STEM AUGER. 4) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-B-1
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 78021.8 E 61445.6 SURFACE ELEV. 6975.1
DRILLER HEBER MINING & EXPLORATION DATE: START 11-6-86 FINISH 11-6-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	6-12	12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
5	1	SS	5	6.5	5	8	14	18	SM				MEDIUM DENSE, BROWN SILTY SAND, DRY (ALLUVIUM).	
10	2	SS	10	11.5	7	15	16	18	SM				SAME. CUTTINGS DAMP AT 12 FEET.	
15	3	SS	15	16.5	4	3	3	18	SM				SAME, MOIST.	
20														
25	4	SS	25	26.5	12	8	9	18	SC				SAME, SOME CLAY, DAMP.	

NOTES:
1) TOTAL DEPTH 26.5 FEET.
2) NO GROUND WATER ENCOUNTERED.
3) CME 55 DRILL RIG.

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-B-2
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 76833.1 E 61535.4 SURFACE ELEV. 6994.3
DRILLER HEBER MINING & EXPLORATION DATE: START 11-6-86 FINISH 11-6-86

DEPTH	SAMPLE No.	SAMPLE TYPE	SAMPLE INTERVAL FROM	SAMPLE INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
5													BROWN SILTY SAND, DRY. ALTERNATING ZONES OF HIGHLY WEATHERED SANDSTONE AND HARD LENSES. HARD, BUT RIPPABLE LENSES AT 7, 12, AND 17 FEET.	
10														
15														
20													NOTES: 1) TOTAL DEPTH 20 FEET. 2) NO GROUND WATER ENCOUNTERED. 3) 4-INCH SOLID STEM AUGER. 4) CME 55 DRILL RIG.	

Rev. 2-86

Canonie

Boring Log

PROJECT No. RM 86-060-01
BORING No. 86-RP-B-3
LOGGED BY DAVID KURZ
PAGE 1 OF 1

PROJECT NAME UNC
BORING LOCATION N 76631.5 E 61199.1 SURFACE ELEV. 6965.9
DRILLER HEBER MINING & EXPLORATION DATE: START 11-6-86 FINISH 11-6-86

DEPTH	SAMPLE No.	TYPE	INTERVAL FROM	INTERVAL TO	BLOW COUNT 0-6	BLOW COUNT 6-12	BLOW COUNT 12-18	RECOVERY IN INCHES	U.S.C.S. SOIL TYPE	PERCENT MOISTURE	qu TSF	CONTACT DEPTH	SOIL DESCRIPTION AND REMARKS	PIEZO.
													CUTTINGS, TAN SILTY SAND, DRY.	
5														
	1	SS	5	6.5	7	11	11	18	SM				MEDIUM DENSE, BROWN SILTY SAND, SOME ROOTS, TRACE ORANGE AND WHITE STAINING (ALLUVIUM).	
10														
	2	SS	10	11.5	8	12	20	18	SM				DENSE, BROWN, VERY FINE SAND AND SILT, SOME ORANGE, YELLOW, AND WHITE MOTTLING.	
												14		
15														
	3	SS	15	15.9	17	50/5		11					MODERATELY HARD, DARK BROWN SHALE (CONTACT APPROXIMATED).	
20													CUTTINGS, VERY DARK BROWN AT 22 FEET.	
25														
	4	SS	25	25.2	50/2			2					SAME, ORANGE IRON OXIDES PREVALENT.	

NOTES:
1) TOTAL DEPTH 25.2 FEET.
2) NO GROUND WATER ENCOUNTERED.
3) CME 55 DRILL RIG.

Rev. 2-86

APPENDIX A-5

Test Pit Logs

DATE BEGAN: 11/5/86
DATE FINISHED: 11/5/86
GROUND SURFACE EL.: 6957.2

TEST PIT NO. 86RP-TP-1
N 75782.9 E 59844.1

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			LIGHT BROWN SAND, LITTLE SILT, TRACE GRAVEL	PIT APPROXIMATELY 133 FEET EAST OF RADIAL AT C+400
	5			1-GALLON BAG SAMPLE AT 5-6 FEET
			GRAVELLY LENSE AT 6-7 FEET	3.5-GALLON SAMPLE AT 5-6 FEET
	10			
	11		STIFF DARK BROWN SILT, LITTLE SAND	
	12		BOTTOM OF PIT AT 12 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/5/86
DATE FINISHED: 11/5/86
GROUND SURFACE EL.: 6962.0

TEST PIT NO. 86RP-TP-2
N 76339.2 E 60379.2

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
	0.5		BROWN SILT, CLAYEY, LITTLE SAND, MOIST	PIT APPROXIMATELY 115 FEET WEST OF RADIAL AT C+175
	5			1-GALLON BAG SAMPLE AT 4-5 FEET
	5.5			3.5-GALLON SAMPLE AT 6-7 FEET
	6		DARK BROWN SILT, CLAYEY, MOIST	
			BROWN SAND, LITTLE SILT, MOIST	
			OCCASIONAL CLAYEY SILT STRINGERS	
	10			
	12		BOTTOM OF PIT AT 12 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/5/86
DATE FINISHED: 11/5/86
GROUND SURFACE EL.: 6966.9

TEST PIT NO. 86RP-TP-3
N 75907.1 E 60607.5

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			LIGHT BROWN SILTY SAND, MOIST	PIT APPROXIMATELY 125 FEET EAST OF RADIAL AT C+600
				1-GALLON BAG SAMPLE AT 7-8 FEET
	5		BECOMING CLEAN, MOIST	1-GALLON BAG SAMPLE AT 11-12 FEET
	10			
	11		DARK BROWN SANDY SILT, MOIST	
	12		BOTTOM OF PIT AT 12 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/5/86
DATE FINISHED: 11/5/86
GROUND SURFACE EL.: 6958.3

TEST PIT NO. 86RP-TP-4
N 75751.3 E 60715.0

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

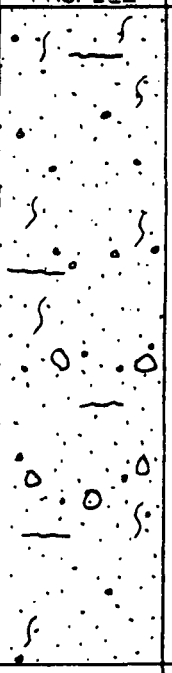
EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			HARD, BROWN SILT, SOME CLAY, ORGANICS, MOIST	PIT APPROXIMATELY 115 FEET EAST OF RADIAL D
			BECOMING DRY	1-GALLON BAG SAMPLE AT 2-3 FEET 1-GALLON SAMPLE AT 2-3 FEET 3.5-GALLON SAMPLE AT 2-3 FEET 1-GALLON BAG SAMPLE AT 8-9 FEET
	5			
			YELLOWISH LIGHT BROWN FINE SAND, TRACE SILT	
	9			
	10		BOTTOM OF PIT AT 9 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 6975.4

TEST PIT NO. 86RP-TP-5
N 77965.7 E 60521.2

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			SILTY SAND, TRACE GRAVEL, ORGANICS, MOIST BECOMING CLEAN, DRY, SOME GRAVEL OCCASIONALLY THIN GRAVEL ZONES WITH COBBLES UP TO 4 INCHES IN DIAMETER	1-GALLON BAG SAMPLE AT 1-2 FEET 1-GALLON BAG SAMPLE AT 6 FEET
	5			
	10			
	11		BOTTOM OF PIT AT 11 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 6980.2

TEST PIT NO. 86RP-TP-6
N 78086.6 E 61903.8

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			DARK BROWN CLAYEY SILT, ORGANICS, MOIST BECOMING DRY	
	5			1-GALLON BAG SAMPLE AT 1 FOOT 1-GALLON BAG SAMPLE AT 9-10 FEET
			LIGHT BROWN SAND, LITTLE SILT	
	10			
	11		BOTTOM OF PIT AT 11 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 6984.2

TEST PIT NO. 86RP-TP-7
N 77410.3 E 61945.6

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			DARK BROWN CLAYEY SILT, ORGANICS, MOIST, HIGH DRY STRENGTH	
			BECOMING DRY	HARD DIGGING
				3.5-GALLON SAMPLE AT 4.5 FEET 1 GALLON SAMPLE AT 4-5 FEET 1 GALLON BAG SAMPLE AT 4-5 FEET 1 GALLON BAG SAMPLE AT 9-10 FEET
	5		BECOMING SANDY	
			LIGHT BROWN FINE SAND, LITTLE SILT	
	10			
	11		BOTTOM OF PIT AT 11 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 6984.3

TEST PIT NO. 86RP-TP-8
N 77252.8 E 61551.8

FIELD ENGINEER: D. Evans
CHECKED BY: D. Kurz

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
	1		Dark Brown Silt, Little Sand, Moist	
			Light Brown Fine Sand, Little Silt, Trace Gravel	3.5-Gallon Sample at 3-5 Feet
	5		Occasional Thin Gravelly Stringers	
	10			
	11		Bottom of Pit at 11 Feet	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 6963.1

TEST PIT NO. 86RP-TP-9
N 76290.5 E 60906.4

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			LIGHT BROWN SILTY SAND, MOIST	PIT ADJACENT TO RADIAL AT C+400
	2		BECOMING DRY	
			DARK BROWN SILT, LITTLE CLAY AND SAND	1 GALLON BAG SAMPLE AT 5 FEET
	5			
			FINE SAND, LITTLE SILT, TRACE TO LITTLE GRAVEL	
	10		THIN GRAVELLY LAYERS	
	11		BOTTOM OF PIT AT 11 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 7023.7

TEST PIT NO. 86RP-TP-10
N 75887.6 E 61421.8

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
	2 4		REDDISH BROWN SILT, LITTLE CLAY, TRACE SAND, MOIST, BECOMING DRY DARK BROWN SILT, LITTLE CLAY AND SAND	PIT 68 FEET WEST OF RADIAL E+500 (494.547)
	5		MEDIUM SOFT GRAY SHALELY SILTSTONE, SOME THIN SANDY LAYERS, BROKEN TO VERY BROKEN	SILTSTONE WAS RELATIVELY EASY TO EXCAVATE 3.5-GALLON SAMPLE AT 2-3 FEET 1-GALLON BAG SAMPLE AT 7 FEET 1-GALLON BAG SAMPLE AT 9 FEET
	9.5 10		MEDIUM HARD LIGHT GRAY SANDSTONE	
			BOTTOM OF PIT AT 9.5 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 7017.4

TEST PIT NO. 86RP-TP-11
N 76192.3 E 61643.9

FIELD ENGINEER: D. Evans
CHECKED BY: D. Kurz

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			Reddish Brown Silt, Little Clay, Trace Sand, Moist Becoming Dry	
	4		Medium Hard to Hard Gray-White Mottled Sandstone, Broken to Blocky	
	5			
	6		Bottom of Pit at 6 Feet	
	10			
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 7976.8

TEST PIT NO. 86RP-TP-12
N 76806.9 E 59972.9

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			BROWN SILT, SOME SAND, LITTLE GRAVEL BECOMING DRY	
	5			1-GALLON BAG SAMPLE AT 6 FEET
	10			
	12		BOTTOM OF PIT AT 12 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 6973.0

TEST PIT NO. 86RP-TP-13
N 77601.0 E 60129.6

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
	1		BROWN SILT, WET	
	2.5		MEDIUM HARD GRAY-BROWN SHALELY SILTSTONE	
			BOTTOM OF PIT AT 2.5 FEET	1-GALLON BAG SAMPLE AT 1.5 FEET
	5			
	10			
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 6967.4

TEST PIT NO. 86RP-TP-14
N 77040.9 E 60049.3

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
	4		MEDIUM SOFT, DARK GRAY TO BLACK SILTSTONE, BROKEN TO VERY BROKEN	TEST PIT WAS EXCAVATED INTO SIDE OF EXPOSED ROCK OUTCROP
	5		MEDIUM HARD TO HARD, GRAY-WHITE SANDSTONE, BROKEN TO BLOCKY	
			BOTTOM OF PIT AT 5 FEET	
	10			
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

DATE BEGAN: 11/7/86
DATE FINISHED: 11/7/86
GROUND SURFACE EL.: 6961.9

TEST PIT NO. 86RP-TP-15
N 76390.4 E 59464.4

FIELD ENGINEER: D. EVANS
CHECKED BY: D. KURZ

EL. (FT.)	DEPTH (FT.)	PROFILE	DESCRIPTION	REMARKS
			LIGHT BROWN SILTY SAND, MOIST	
	5			1-GALLON BAG SAMPLE AT 6 FEET
	10			
	11		BROWN SANDSTONE	
			BOTTOM OF PIT AT 11 FEET	
	15			
	20			
	25			

PROJECT NO.: RM 86-060-01
PROJECT NAME: UNC

APPENDIX A-6

Existing Soil Stockpile - Geotechnical Data

TABULATIO.. OF TEST RESULTS

Job No. E78-1096

Project Embankment Volumes - Borrow Quantities

Church Rock, New Mexico

Material

Source

HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING											% Moist	LAB NO
						200	100	40	16	10	4	¼	⅜	¾	1	1½		
1	See Site Plan	4½'	ML	26	NP	54	85	94		98	100						6	96-1
2	See Site Plan	9½'	CL	25	10	53	72	84		90	95		98	100			7	96-2
3	See Site Plan	14½'	SM	NV	NP	48	91	99		100							5	96-3
4	See Site Plan	4½'	CL	34	16	79	95	99		100							8	96-4
5	See Site Plan	4½'	CL	32	15	76	91	98		100							7	96-5
5	See Site Plan	14½'	CL	30	13	62	80	93		100							8	96-6
6	See Site Plan	4½'	CL-ML	24	5	61	84	96		98	99		100				5	96-7
7	See Site Plan	9½'	SM	23	NP	44	85	97		99	100						5	96-8
8	See Site Plan	24½'	CL	33	14	94	99	100									13	96-9
9	See Site Plan	9½'	CL	42	18	93	94	96		98	99		100				11	96-10
10	See Site Plan	9½'	SM	NV	NP	22	43	57		69	79		87	96		100	4	96-11
11	See Site Plan	4½'	CL	31	11	64	86	95		97	99		100				5	96-12
12	See Site Plan	½'	CL	30	8	56	84	91		94	96		99	100			6	96-13
16	See Site Plan	4½'	CH	54	29	93	95	97		99	100						13	96-14
* 18	See Site Plan	4½'	CL	26	11	52	79	90		95	99		100				4	96-15

SERGENT, HAUSKINS & BECKWITH

TABULATIC OF TEST RESULTS

Job No. E78-1096

Project Embankment Volumes - Borrow Quantities

Church Rock, New Mexico

Material

Source

	HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING											%	LAB NO
							200	100	40	16	10	4	¼	⅜	¾	1	1½	Moist	
*	18	See Site Plan	14½'	CL	32	11	92	98	99		100							38	96-16
*	19	See Site Plan	4½'	SM	22	NP	41	64	82		88	94		98	100			5	96-17
	21	See Site Plan	4½'	SM	NV	NP	21	58	85		90	95		99	100			3	96-18
	22	See Site Plan	4½'	CL	28	9	51	74	84		90	95		99	100			5	96-19
	23	See Site Plan	4½'	CL	30	9	56	80	92		94	96		96	98		100	7	96-20
	24	See Site Plan	9½'	CL	43	18	96	97	98		100							10	96-21
	25	See Site Plan	9½'	CL-ML	25	5	52	80	93		98	99		100				20	96-22
	26	See Site Plan	14½'	SM	NV	NP	22	42	52		63	77		91	100			2	96-23
	29	See Site Plan	4½'	CL	49	22	97	98	98		100							10	96-24
	30	See Site Plan	4½'	CL	27	11	55	73	80		86	92		96	100			8	96-25
*	31	See Site Plan	9½'	CL	26	11	52	83	98		99	100						5	96-26
*	32	See Site Plan	4½'	SM	NV	NP	29	70	96		100							5	96-27
	32	See Site Plan	24½'	CL-ML	25	6	61	92	99		100							6	96-28
*	33	See Site Plan	4½'	CL	27	9	51	77	98		100							7	96-29
*	33	See Site Plan	14½'	SM	21	NP	47	86	99		100							5	96-30

SERGENT, HAUSKINS & BECKWITH

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS

APPLIED SOIL MECHANICS • ENGINEERING GEOLOGY • MATERIALS ENGINEERING • HYDROLOGY

E. DWAINE SERGENT, P.E.
LAWRENCE A. HANSEN, Ph.D., P.E.
RALPH E. WEBB, P.G.
DARRELL L. SUFFINGTON, P.E.
DONALD VAN DUSEN, P.G.
GALE V. BEDENKOP, P.E.

JOHN D. HAUSKINS, P.E.
MICHAEL L. BUCKER, P.E.
ROBERT W. CROSSLEY, P.E.
JONATHAN A. CRYSTAL, P.E.
PAUL V. SMITH, P.G.
NORMAN H. WETT, P.E.

GEORGE H. BECKWITH, P.E.
ROBERT L. FREW
JAMES H. CLARY, C.P.G.
NICHOLAS T. KOBECKI, P.E.
GERALD P. LINDSEY, P.G.
RONALD E. BAGER, P.G.

ROBERT D. BOOTH, P.E.
SUANG CHENG, P.E.
JAMES P. PARY, P.E.
MICHAEL HULAKE, P.G.
DAVID C. PETERSON, P.G.
ALBERT E. BUCKMAN, P.E.
PAUL MARCAN, P.E.

April 26, 1989

United Nuclear Corporation
P.O. Drawer QQ
Gallup, New Mexico 87301

SHB Job No. C89-5034

Attention: Mr. Charles G. Johnson

Project: 1989 Reclamation Plant
Church Rock Uranium Mill

89-551

Lab No. 1219: Sandy silt, predominantly fine, nonplastic, medium brown, sampled from borrow area, N 72+40, E 60+80 by SHB on April 12, 1989.

SIEVE ANALYSIS

Sieve Size	Percent Passing
No. 4	100
No. 10	99
No. 40	97
No. 100	80
No. 200	55

LIQUID LIMIT NV

PLASTICITY INDEX NP

U.S. CLASSIFICATION ML

MOISTURE-DENSITY RELATIONSHIP (ASTM D698)

Maximum Dry Density 116.9 pcf

Optimum Moisture 12.8%

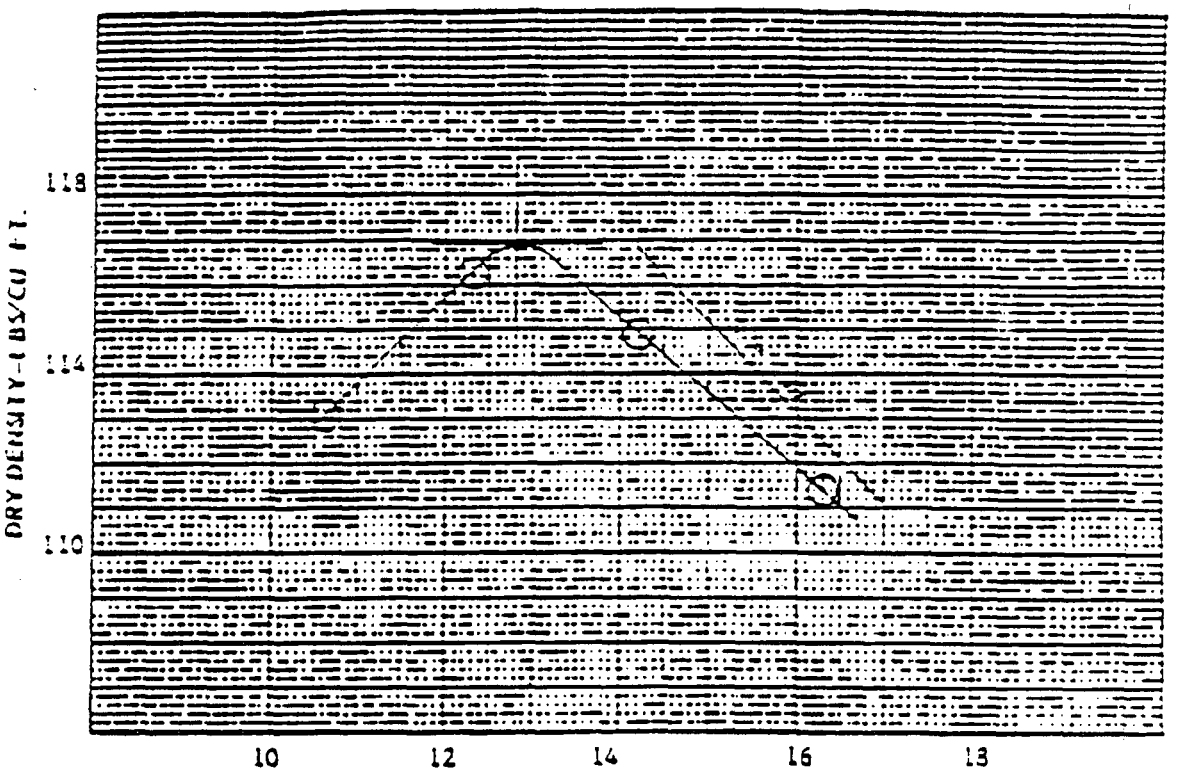
Copies: Addressee (2)

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109

PHOENIX (602) 272-6646 | TUCSON (602) 792-2779 | ALBUQUERQUE (505) 884-0930 | SANTA FE (505) 471-7836 | SALT LAKE CITY (801) 266-0720 | EL PASO (915) 564-1017

SUMMARY OF MOISTURE DENSITY RELATIONSHIP TESTS

PROJECT 1989 Reclamation Work - Church Rock JOB NO. C89-5034



CURVE	SOURCE	OPTIMUM MOISTURE CONTENT % DRY WT.	MAXIMUM DRY DENSITY LBS/CU. FT.	TEST DESIGNATION	TEST METHOD	LAB NO.
	Borrow area N 72+40,	12.8	116.9	ASTM D698	A	1219
	E 60+80					

MOISTURE-DENSITY RELATIONSHIP TEST METHOD DATA

AASHTO T99 and ASTM D698 (Standard Proctor)

METHOD	MATERIAL	MOLD DIAMETER	MOLD HEIGHT	NO. OF LAYERS	BLOWS PER LAYER	HAMMER WEIGHT	HEIGHT OF FALL	COMPACTIVE EFFORT FT. LBS/CU. FT.
A	-#4	4"	4.58"	3	25	5.5 LBS.	12"	12,375
B	-#4	6"	4.58"	3	56	5.5 LBS.	12"	12,317
C	-3/4	6"	4.58"	3	56	5.5 LBS.	12"	12,317
D	-3/4	6"	4.58"	3	56	5.5 LBS.	12"	12,317

AASHTO T180 and ASTM D1557 (Modified Proctor)

METHOD	MATERIAL	MOLD DIAMETER	MOLD HEIGHT	NO. OF LAYERS	BLOWS PER LAYER	HAMMER WEIGHT	HEIGHT OF FALL	COMPACTIVE EFFORT FT. LBS/CU. FT.
A	-#4	4"	4.58"	5	25	10.0 LBS.	18"	56,250
B	-#4	6"	4.58"	5	56	10.0 LBS.	18"	56,000
C	-3/4	6"	4.58"	5	56	10.0 LBS.	18"	56,000
D	-3/4	6"	4.58"	5	56	10.0 LBS.	18"	56,000

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS
PHOENIX • ALBUQUERQUE • SANTA FE • SALT LAKE CITY

Material: Soil Cover Material — Job No. 314C 235

Source of Material: Borrow Areas

Test Procedure: — Tested/Calc. By: H. Kuebler — Date:

Reviewed By: — Date:

Sample No.	Location	Depth	Classification AASHTO	Classification Unified	LL	PI	Sieve Analysis - Accum % Passing 200	100	50	40	30	16	10	8	4	3/8	1/2	3/4	1	Lab No./Ft
P-16	73100N 59600E	Surface		CL	26	8	58.4	85	94	95	96	96	97	97	98	99	100	-	-	
9055-1 —	Sta. 1+00 stockpile	Surface		SM-SC	23	3	49.9	79	91	92	92	93	94	95	96	98	100	-	-	
9055-2 —	Borrow Pit #2 Sta. 19'-12.5'			ML-CL	26	7	54.1	84	93	94	95	96	97	97	98	100	-	-	-	
A-13	74260'N 58[illegible]E	Surface		CL	27	9	60.1	83	93	94	94	95	96	96	97	99	99	100	-	
L-5	74180N 59778E	6977.4		CL	31	11	65.6	87	95	96	96	97	98	98	99	100	-	-	-	
J-12	73730N 59330E	6980.8		CL	30	15	67.6	86	95	96	97	97	98	98	99	100	-	-	-	
O-16	73800N 60850E	6981.0		SC	25	9	45.4	77	91	93	93	94	95	96	98	99	100	-	-	
D-15	73330N 58330E	6974.9		CL	32	16	61.3	84	94	96	97	98	99	99	100	-	-	-	-	
M-15	73350N 59430E	6992.[illegible]		SC	26	12	48.1	56	84	90	91	92	93	93	94	96	97	98	99	
G-17	73410N 58680E	6967.4		[illegible]	35	15	65.4	86	94	96	96	97	98	98	99	100	100	100	-	

TABULATION OF TEST RESULTS

APPENDIX A-7

North and Central Cell - Geotechnical Data

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS

APPLIED SOIL MECHANICS • ENGINEERING GEOLOGY • MATERIALS ENGINEERING • HYDROLOGY

B. DWAINE SERGENT, P.E.
LAWRENCE A. HANSEN, Ph.D., P.E.
RALPH E. WEEKS, P.G.
GARRELL L. BUFFINGTON, P.E.
DONALD VAN GUSSIKIN, P.G.
DALE V. BEDENKOP, P.E.
JOHN G. HAUSKINS, P.E.
MICHAEL L. RUCKER, P.E.
ROBERT W. CROSSLEY, P.E.
JONATHAN A. CRYSTAL, P.E.
PAUL F. SMITH, P.G.
NORMAN H. METZ, P.E.
GEORGE H. BECKWITH, P.E.
ROBERT L. FREW
JAMES H. CLARY, C.P.G.
NICHOLAS T. KORECKI, P.E.
GERALD P. LINDSEY, P.G.
RONALD E. RAGER, P.G.
ROBERT S. BOOTH, P.E.
SUANG CHENG, P.E.
JAMES R. FANY, P.E.
MICHAEL HULPHE, P.G.
DAVID E. PETERSON, P.G.
ALBERT C. SUGAMAN, P.E.
PAUL KAPLAN, P.E.

April 26, 1989

United Nuclear Corporation
P.O. Drawer QQ
Gallup, New Mexico 87301

SHB Job No. C89-5034

Attention: Mr. Charles G. Johnson

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89 NC-1

Lab No. 1217: Sandy clay, trace of gravel, low plasticity, dark brown sampled from borrow area, N 76+00, E 61+00 by SHB on April 12, 1989.

SIEVE ANALYSIS

Sieve Size	Percent Passing
3/4 inch	100
1/2 inch	99
3/8 inch	97
No. 4	96
No. 10	96
No. 40	94
No. 100	80
No. 200	61

LIQUID LIMIT 26

PLASTICITY INDEX 10

U.S. CLASSIFICATION CL

MOISTURE-DENSITY RELATIONSHIP (ASTM D698)

Maximum Dry Density 109.2 pcf

Optimum Moisture 16.0%

Copies: Addressee (2)

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109

PHOENIX (602) 272-6848 | TUCSON (602) 792-2779 | ALBUQUERQUE (505) 884-0850 | SANTA FE (505) 471-7836 | SALT LAKE CITY (801) 266-0720 | EL PASO (915) 564-1017

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS

APPLIED SOIL MECHANICS • ENGINEERING GEOLOGY • MATERIALS ENGINEERING • HYDROLOGY

B. DWAINE SERGENT, P.E.
LAWRENCE A. HANSEN, PH.D., P.E.
RALPH E. WEEKS, P.E.
DARREL L. SUPPINGTON, P.E.
DONALD VAN DUSEN, P.G.
DALE V. GEDENKOP, P.E.
JOHN D. HAUSKINS, P.E.
MICHAEL L. RUCKER, P.E.
ROBERT W. CROSSLEY, P.E.
JONATHAN A. CRYSTAL, P.E.
PAULY SMITH, P.G.
NORMAN H. WETZ, P.E.
GEORGE H. BECKWITH, P.E.
ROBERT L. FREW
JAMES H. CLARY, C.P.G.
NICHOLAS T. SORECHI, P.E.
GERALD P. LINDSEY, P.G.
RONALD E. RAGER, P.G.
ROBERT D. BOOTH, P.E.
SUANG CHENG, P.E.
JAMES R. FANY, P.E.
MICHAEL HULAKE, P.G.
DAVID E. PETERSON, P.G.
ALBERT E. BUCKMAN, P.E.
PAUL KAPLAN, P.E.

April 26, 1989

United Nuclear Corporation
P.O. Drawer QQ
Gallup, New Mexico 87301

SHB Job No. CS9-5034

Attention: Mr. Charles G. Johnson

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89NC-2

Lab No. 1218: Silty sand, trace of gravel, nonplastic, medium brown, sampled from borrow area, N 75+30, E 59+80, by SHB on April 12, 1989.

SIEVE ANALYSIS

Sieve Size	Percent Passing
3/8 inch	100
No. 4	99
No. 10	98
No. 40	92
No. 100	70
No. 200	47

LIQUID LIMIT NV

PLASTICITY INDEX NP

U.S. CLASSIFICATION SM

MOISTURE-DENSITY RELATIONSHIP (ASTM D698)

Maximum Dry Density 119.1 pcf

Opitmum Moisture 11.8%

Copies: Addressee (2)

REPLY TO: 4700 LINCOLN ROAD, N.E., ALBUQUERQUE, NEW MEXICO 87109

PHOENIX (602) 272-6848 | TUCSON (602) 792-2778 | ALBUQUERQUE (505) 884-0850 | SANTA FE (505) 471-7836 | SALT LAKE CITY (801) 268-0720 | EL PASO (915) 564-1017

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

June 15, 1989

United Nuclear Corporation
P.O. Drawer QQ
Gallup, New Mexico 87301

SHB Job No. C89-5034

Attention: Mr. Charles G. Johnson

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89 NC-3

Lab No. 1366: Sandy clay, predominantly fine, low plasticity, dark brown, sampled from N 75140, E 59350, FSG -5.0' by SHB on May 26, 1989.

SIEVE ANALYSIS

Sieve Size	Percent Passing
No. 4	100
No. 10	98
No. 40	95
No. 100	84
No. 200	61

LIQUID LIMIT 27

PLASTICITY INDEX 10

U.S. CLASSIFICATION CL

MOISTURE-DENSITY RELATIONSHIP (ASTM D698)

Maximum Dry Density 113.7 pcf

Optimum Moisture 14.0%

Copies: Addressee (2)

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109

PHOENIX (602) [illegible] TUCSON (602) 792-2779 ALBUQUERQUE (505) 884-0990 SANTA FE (505) 471-7836 SALT LAKE CITY (801) 268-0720 EL PASO (915) 564-1017 RENO/SPARKS (702) 331-2373

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

June 15, 1989

United Nuclear Corporation
P.O. Drawer GQ
Gallup, New Mexico 87301

SHB Job No. C89-5034

Attention: Mr. Charles G. Johnson

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89 NC-4

Lab No. 1367: Sandy clay, predominantly fine, medium plasticity, dark brown sampled from N 74890, E 59130, FSG -4.0' by SHB on May 26, 1989.

SIEVE ANALYSIS

Sieve Size	Percent Passing
No. 4	100
No. 10	99
No. 40	97
No. 100	89
No. 200	70

LIQUID LIMIT 33

PLASTICITY INDEX 16

U.S. CLASSIFICATION CL

MOISTURE-DENSITY RELATIONSHIP (ASTM D698)

Maximum Dry Density 110.1 pcf

Optimum Moisture 15.5%

Copies: Addressee (2)

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

December 18, 1989

United Nuclear Corporation
P. O. Drawer QQ
Gallup, New Mexico 87301
Atten: Mr. Charles G. Johnson

SHB Job No. C89-5034

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89 NC-5

Lab No. 1548: Silty sand, very fine, nonplastic, tan sampled from 59, 260 E and 74, 570 N by SHB on 7/18/89

SIEVE ANALYSIS

Sieve Size	Percent Passing
No. 10	100
No. 40	99
No. 100	69
No. 200	45

LIQUID LIMIT	NV
PLASTICITY INDEX	NP
U. S. CLASSIFICATION	SM

SHB 30 YEARS OF SERVICE

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109

PHOENIX (602) 272-6848 FAX 272-7238
TUCSON (602) 792-2779 FAX 620-6622
ALBUQUERQUE (505) 884-0860 FAX 884-1694
SANTA FE (505) 471-7836 FAX 438-7156
SALT LAKE CITY (801) 268-0720 FAX 268-0727
EL PASO (915) 564-1017 FAX 562-7739
RENO/SPARKS (702) 331-2375 FAX 331-4153

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

December 18, 1989

United Nuclear Corporation
P. O. Drawer QQ
Gallup, New Mexico 87301
Atten: Mr. Charles G. Johnson

SHB Job No. C89-5034

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89NC-6

Lab No. 1547: Sandy clay, trace of gravel, low plasticity, dark brown sampled from North embankment, 59, 500 E & 74, 970 N by SHB on 7/28/89

SIEVE ANALYSIS

Sieve Size	Percent Passing
1/2 inch	100
3/8 inch	100
No. 4	97
No. 10	92
No. 40	87
No. 100	76
No. 200	56

LIQUID LIMIT	25
PLASTICITY INDEX	8
U. S. CLASSIFICATION	CL

1959-1989 SHB 30 YEARS OF SERVICE

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109

PHOENIX	TUCSON	ALBUQUERQUE	SANTA FE	SALT LAKE CITY	EL PASO	RENO/SPARKS
(602) 272-6848	(602) 792-2779	(505) 884-0850	(505) 471-7836	(801) 266-0730	(915) 564-1017	(702) 331-2378
FAX 272-7239	FAX 620-6622	FAX 884-1694	FAX 438-7156	FAX 266-0727	FAX 562-7729	FAX 331-4153

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

June 15, 1989

United Nuclear Corporation
P.O. Drawer QQ
Gallup, New Mexico 87301

SHB Job No. CS9-5034

Attention: Mr. Charles G. Johnson

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89 NC-7

Lab No. 1348: Clayey sand, considerable amount of gravel, low plasticity, dark brown sampled from Toe Dam, N 75250, E 59200 by SHB on May 22, 1989.

SIEVE ANALYSIS

Sieve Size	Percent Passing
2 inches	100
1 1/2 inches	95
1 inch	95
3/4 inch	93
1/2 inch	89
3/8 inch	86
No. 4	79
No. 10	74
No. 40	70
No. 100	63
No. 200	48

LIQUID LIMIT 27

PLASTICITY INDEX 8

U.S. CLASSIFICATION SC - SM

MOISTURE-DENSITY RELATIONSHIP (ASTM D698)

Maximum Dry Density 115.5 pcf

Optimum Moisture 13.4%

Copies: Addressee (2)

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

June 15, 1989

United Nuclear Corporation
P.O. Drawer CQ
Gallup, New Mexico 87301

SHB Job No. C89-5034

Attention: Mr. Charles G. Johnson

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89NC-8

Lab No. 1350: Sandy clay, trace of gravel, medium plasticity, dark brown, sampled from area between NW embankment & Toe Dam by SHB on May 22, 1989.

SIEVE ANALYSIS

Sieve Size	Percent Passing
3/4 inch	100
1/2 inch	99
3/8 inch	99
No. 4	98
No. 10	97
No. 40	96
No. 100	80
No. 200	63

LIQUID LIMIT 31

PLASTICITY INDEX 13

U.S. CLASSIFICATION CL

MOISTURE-DENSITY RELATIONSHIP (ASTM D698)

Maximum Dry Density 113.2 pcf

Optimum Moisture 13.3%

Copies: Addressee (2)

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109

PHOENIX (602) 272-6848 TUCSON (602) 792-2770 ALBUQUERQUE (505) 884-0990 SANTA FE (505) 471-7836 SALT LAKE CITY (801) 268-0723 EL PASO (915) 584-1017 RENO/SPARKS (702) 331-2373

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

August 29, 1989

United Nuclear Corporation
P. O. Drawer QQ
Gallup, New Mexico 87301
Atten: Mr. Charles G. Johnson

SHB Job No. C89-5034

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89 NC-9.

Lab No. 1509: Sandy clay, fine, medium plasticity, medium brown, sampled from North embankment, by SHB on 7/18/89.

SIEVE ANALYSIS

Sieve Size	Percent Passing
No. 4	100
No. 10	99
No. 40	98
No. 100	85
No. 200	60

LIQUID LIMIT 34

PLASTICITY INDEX 17

U. S. CLASSIFICATION CL

MOISTURE-DENSITY RELATIONSHIP (ASTM D698)

Maximum Dry Density 109.0 pcf

Optimum Moisture 16.1%

mjd
Copies: Addressee (2)

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

July 20, 1989

United Nuclear Corporation
P.O. Drawer QQ
Gallup, New Mexico 87301

SEB Job No. C89-5034

Attention: Mr. Charles G. Johnson

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89 NC-10

Lab No. 1492: Silty sand, gravelly, nonplastic, tan, sampled from existing fill area at F6, N cell by SEB on July 12, 1989.

SIEVE ANALYSIS

Sieve Size	Percent Passing
3 inches	100
2 inches	91
1 1/2 inches	83
1 inch	79
3/4 inch	73
1/2 inch	67
3/8 inch	63
No. 4	56
No. 10	48
No. 40	43
No. 100	25
No. 200	20

LIQUID LIMIT NV

PLASTICITY INDEX NP

U.S.CLASSIFICATION SM

MOISTURE-DENSITY RELATIONSHIP (ASTM D698)

Maximum Dry Density 118.3 pcf

Optimum Moisture 11.2%

Robert E. Thendel

Copies: Addressee (2)

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109

PHOENIX (602) 272-6540 TUCSON (602) 792-2779 ALBUQUERQUE (505) 884-0800 SANTA FE (505) 471-7636 SALT LAKE CITY (801) 268-0720 EL PASO (915) 584-1017 RENO/SPARKS (702) 331-2378

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

June 15, 1989

United Nuclear Corporation
P.O. Drawer QQ
Gallup, New Mexico 87301

SHB Job No. C89-5034

Attention: Mr. Charles G. Johnson

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89 NC-11

Lab No. 1349: Clayey sand, trace of gravel, low plasticity, greyish brown sampled from NW embankment (surface) by SHB on May 22, 1989.

SIEVE ANALYSIS

Sieve Size	Percent Passing
3/4 inch	100
1/2 inch	99
3/8 inch	99
No. 4	99
No. 10	98
No. 40	90
No. 100	63
No. 200	43

LIQUID LIMIT 22

PLASTICITY INDEX 7

U.S. CLASSIFICATION SC - SM

MOISTURE-DENISTY RELATIONSHIP (ASTM D698)

Maximum Dry Density 121.0 pcf

Opitimum Moisture 12.0%

Copies: Addressee (2)

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109
PHOENIX (602) 272-6848 TUCSON (602) 792-2779 ALBUQUERQUE (505) 884-0990 SANTA FE (505) 471-7636 SALT LAKE CITY (801) 266-0729 EL PASO (915) 564-1617 RENO/SPARKS (702) 331-2373

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

December 18, 1989

United Nuclear Corporation
P. O. Drawer QQ
Gallup, New Mexico 87301
Atten: Mr. Charles G. Johnson

SHB Job No. C89-5034

Project: 1989 Reclamation Work
Church Rock Uranium Mill

89NC-12

Lab No. 1614: Sandy clay, very fine, medium high plasticity, dark brown sampled from clay barrier @ South end of North cell by SHB on August 28, 1989

SIEVE ANALYSIS

Sieve Size	Percent Passing
No. 10	100
No. 40	100
No. 100	82
No. 200	63

LIQUID LIMIT	43
PLASTICITY INDEX	21
U. S. CLASSIFICATION	CL

1959-1989 SHB 30 YEARS OF SERVICE

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109

PHOENIX (602) 272-6848 FAX 272-7239
TUCSON (602) 792-2779 FAX 620-6022
ALBUQUERQUE (505) 884-0990 FAX 884-1684
SANTA FE (505) 471-7836 FAX 438-7156
SALT LAKE CITY (801) 268-0730 FAX 268-0727
EL PASO (915) 564-1017 FAX 562-7739
RENO/SPARKS (702) 331-2375 FAX 331-4153

Material: Soil Cover Material — Job No. 314 035

Source of Material: Borrow Areas

Test Procedure: _____ Tested/Calc. By: H. Kuebler Date: _____

Reviewed By: _____ Date: _____

CENTRAL CELL

CENTRAL CELL SUMMARY

	Grid Pt.	Location	Depth	Classification AASHTO	Classification Unified	LL	PI	Sieve Analysis - Accum % Passing 200	100	50	40	30	16	10	8	4	3/8	1/2	3/4	1	Lab No /Ti
90CC-7	P-16	73100N 57600E	Surface		CL	26	8	59.4	85	94	95	96	96	97	97	98	99	100	-	-	
	—	Sta 6+00 Stock Pile	Surface		SM-SC	23	3	49.9	79	91	92	92	93	94	95	96	98	100	-	-	
	—	Borrow Pit #2 Stock Pile	10'-12½'		ML-CL	26	7	54.1	84	93	94	95	96	97	97	98	100	-	-	-	
90CC-1	A-13	74260'N 58[illegible]E	Surface		CL	27	9	60.1	83	93	94	94	95	96	96	97	99	99	100	-	
90CC-5	L-5	74180N 52998E	6977.4		CL	31	11	65.6	87	95	96	96	97	98	98	99	100	-	-	-	
90CC-4	J-12	73770N 59370E	6980.8		CL	30	15	67.6	86	95	96	97	97	98	98	99	100	-	-	-	
	D-16	73200N 60850E	6981.0		SC	25	9	45.4	77	91	93	93	94	95	96	98	99	100	-	-	
90CC-2	D-15	73330N 58120E	6974.9		CL	32	16	61.3	84	94	96	97	98	99	99	100	-	-	-	-	
90CC-9	M-15	73350N 59430E	6982.6		SC	26	12	49.4	56	84	90	91	92	93	93	94	96	97	98	99	
90CC-3	G-17	74100N 58680E	6967.4		CL	35	15	65.4	86	94	96	96	97	98	98	99	100	100	100	-	

TABULATION OF TEST RESULTS

APPENDIX A-8

Laboratory Permeabilities and Dispersion Testing

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

December 18, 1989

United Nuclear Corporation
P. O. Drawer QQ
Gallup, New Mexico 87301
Atten: Mr. Charles G. Johnson

SHB Job No. C89-5034

Project: 1989 Reclamation Work
Church Rock Uranium Mill

Lab No. 1548: Silty sand, very fine, nonplastic, tan sampled from 59, 260 E and 74, 570 N by SHB on 7/13/89

SIEVE ANALYSIS

Sieve Size	Percent Passing
No. 10	100
No. 40	99
No. 100	69
No. 200	45

LIQUID LIMIT NV

PLASTICITY INDEX NP

U. S. CLASSIFICATION SM

1959-1989 SHB 30 YEARS OF SERVICE

REPLY TO: 4700 LINCOLN ROAD, N.E., ALBUQUERQUE, NEW MEXICO 87109

PHOENIX	TUCSON	ALBUQUERQUE	SANTA FE	SALT LAKE CITY	EL PASO	RENO/SPARKS
(602) 272-6848	(602) 793-2779	(505) 884-0860	(505) 471-7836	(801) 266-0720	(915) 544-1017	(702) 331-2375
FAX 272-7239	FAX 620-6622	FAX 884-1684	FAX 438-7186	FAX 266-0727	FAX 562-7739	FAX 331-4153

1989 Reclamation Work
Church Rock Uranium Mill

SHB Job No. C89-5034

REMOLDED PERMIABILITY

95% of ASTM D-698 Method "A", Field Lab #F-1004, Maximum Density 114.7 pcf
@ Optimum Moisture 14.4%

Beginning Moisture	14.5%
Final Moisture	19.1%

Flow 1.38×10^{-6} CM/SEC

mjd
Copies: Addressee (2)

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

December 18, 1989

United Nuclear Corporation
P. O. Drawer QQ
Gallup, New Mexico 87301
Attn: Mr. Charles G. Johnson

SHB Job No. C89-5034

Project: 1989 Reclamation Work
Church Rock Uranium Mill

Lab No. 1547: Sandy clay, trace of gravel, low plasticity, dark brown sampled from North embankment, 59, 500 E & 74, 970 N by SHB on 7/28/89

SIEVE ANALYSIS

Sieve Size	Percent Passing
1/2 inch	100
3/8 inch	100
No. 4	97
No. 10	92
No. 40	87
No. 100	76
No. 200	56

LIQUID LIMIT	25
PLASTICITY INDEX	8
U. S. CLASSIFICATION	CL

1959-1989 SHB 30 YEARS OF SERVICE

REPLY TO: 4700 LINCOLN ROAD, N.E., ALBUQUERQUE, NEW MEXICO 87109

PHOENIX	TUCSON	ALBUQUERQUE	SANTA FE	SALT LAKE CITY	EL PASO	RENO/SPARKS
(602) 272-6848	(602) 792-2779	(505) 884-0930	(505) 471-7836	(801) 280-0720	(915) 564-1017	(702) 331-2375
FAX 272-7238	FAX 620-6622	FAX 884-1684	FAX 438-7156	FAX 280-0727	FAX 562-7739	FAX 331-4153

1989 Reclamation Work
Church Rock Uranium Mill

SHB Job No. C89-5034

REMOLDED PERMEABILITY

95% of ASTM D698 Method "A", Field Lab #F-1001, Maximum Density 114.2 pcf
@ Optimum Moisture 13.4%

Beginning Moisture	13.4%
Final Moisture	14.6%

Flow 3.48×10^{-8} CM/SEC

mjd
Copies: Addressee (2)

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS
SOIL & FOUNDATION ENGINEERING • ENGINEERING GEOLOGY • HYDROGEOLOGY
MATERIALS ENGINEERING • MATERIALS TESTING • ENVIRONMENTAL SERVICES

December 18, 1989

United Nuclear Corporation
P. O. Drawer QQ
Gallup, New Mexico 87301
Atten: Mr. Charles G. Johnson

SHB Job No. C89-5034

Project: 1989 Reclamation Work
Church Rock Uranium Mill

Lab No. 1614: Sandy clay, very fine, medium high plasticity, dark brown sampled from clay barrier @ South end of North cell by SHB on August 28, 1989

SIEVE ANALYSIS

Sieve Size	Percent Passing
No. 10	100
No. 40	100
No. 100	82
No. 200	63

LIQUID LIMIT	43
PLASTICITY INDEX	21
U. S. CLASSIFICATION	CL

1959-1989 SHB 30 YEARS OF SERVICE

REPLY TO: 4700 LINCOLN ROAD, N.E. ALBUQUERQUE, NEW MEXICO 87109

PHOENIX	TUCSON	ALBUQUERQUE	SANTA FE	SALT LAKE CITY	EL PASO	RENO/SPARKS
(602) 272-6048	(602) 792-2779	(505) 884-0950	(505) 471-7836	(801) 266-0720	(915) 584-1017	(702) 331-2375
FAX 272-7259	FAX 620-6622	FAX 884-1884	FAX 438-7156	FAX 266-0727	FAX 562-7738	FAX 331-4153

1989 Reclamation Work
Church Rock Uranium Mill

SHB Job No. C89-5034

REMOLDED PERMIABILITY

95% of ASTM D-698 Method "A", Lab #1509, Maximum Density 109.0 pcf @ Optimum Moisture 16.1%

Beginning Moisture	16.1%
Final Moisture	16.7%

Flow 3.87×10^{-8} CM/SEC

mjd
Copies: Addressee (2)

A-105

CENTRAL CELL

Client: UNC

Project:

Soil Type:

Lab Inv.

Location: M-6

Tested By: J. Boyd.

Proctor Values: 112.3 @ 14.5

Proctor Type:

Specimen % Compaction & Moisture Content: 95% @ Optimum

Head Setting, psi	Time	Date

Weight of mold & material

Weight of mold

Weight of material

Moisture content

Wet weight

Dry weight

% Moisture

Material dry weight

Volume

In-place density

Difference

Reading, Q	Time	Date	Head, psi	Q, CM.	t, Sec.	Kt, cm/sec
0.6	10:19	9-6	10			
1.6	10:36	9.6	10	1	1020	3.33×10^{-7}
4.2	11:23	9-6	9	2.6	2820	3.49×10^{-7}
8.4	12:50	9-6	9	4.2	5220	3.039×10^{-7}
11.8	1:42	9-6	9	3.4	3120	4.117×10^{-7}
13.0	2:15	9-6	9.0	1.2	1980	2.250×10^{-7}
14.3	3:15	9-6	9	1.3	3600	1.836×10^{-7}
16.6	3:45	9-6	9	2.3	1800	4.827×10^{-7}

Average 2.937×10^{-7}

112.3 x .95 = 106.7

$K_t = 3.4 \times 10^{-3} \times Q/t \times psi$

based on Mold HT = 2.999"

ID = 2.507

(K_t = QL/ALT)

106.7 x .00857 = .91

.914 x 453.6 = 414

414.9 x 1.145 = 474.

COEFFICIENT OF PERMEABILITY
CONSTANT HEAD

Rt Perm
Central Cell

'ient: UNC
'oject:
:il Type:

Lab Inv. K035
Location: I-17
Tested By:

:octor Values: 112.0 @ 14.9
Proctor Type:
:ecimen % Compaction & Moisture Content: 95% @ optimum

Head Setting, psi	Time	Date
2	4:14 P.M	8/28
7		
9	8:17 AM	8/29
15	10:07 AM	8/29
20	1:30	8/30
26	5:04	8/30
35	8:24 AM	8/31
40	8:15	8/31

Weight of mold & material: 9150
Weight of mold
Weight of material

Moisture content
Wet weight
Dry weight
% Moisture

Material dry weight
Volume
In-place density

Difference

ading, Q	Time	Date	Head, psi	Q, CM.	t, Sec.	Kt, cm/sec
6.2	10:59	8/31	41			
6.6	11:25	8/2	41			
Start Over 5.8	11:42	"	"			
6.5	2:12	"	"			6.4×10^{-9}
6.6	2:18	"	"			2.03×10^{-8}
6.9	2:36	"	"			2.03×10^{-8}
7.5	3:15	"	"			2.13×10^{-8}
8.3	4:07	"	"			2.13×10^{-8}

112.0 x .95 = 106.4
106.4 x .00857 = .911
.9118 x 453.6 = 413.
413.6 x 1.149 = 475.3

$= 3.4 \times 10^{-3} \times Q/t \times psi$
sed on Mold HT = 2.999"

$(K_t = QL/ALT)$

③ 1.9×10^{-8} cm/sec

COEFFICIENT OF PERMEABILITY
CONSTANT HEAD

Left Perm
Central Cell

Client: UNC
Project:
Soil Type:

Lab Inv. K035
Location: G-12
Tested By:

Proctor Values: 112.3 @ 14.5
Proctor Type:
Specimen % Compaction & Moisture Content: 95% @ Optimum

Head Setting, psi	Time	Date
2	4:14 P.M.	8/28
9	8:17 A.M	8/29
15	10:07 A.M	
20	1:30	8/30
26	5:04	8/30
35	8:24 AM	8/31
40	8:31 A.M	9/31

Weight of mold & material
Weight of mold
Weight of material

Moisture content
Wet weight
Dry weight
% Moisture

Material dry weight
Volume
In-place density

Difference

Reading, Q	Time	Date	Head, psi	Q, CM.	t, Sec.	Kt, cm/sec
1.4	11:01	8-31	41			
3.6	11:25	8-31	41			1.15x10^-7
4.5	11:41	8-31	41			9.5x10^-8
16.2	2:12	"	"			1.02x10^-7
16.7	2:19	"	"			9.87x10^-8
16.8	2:35	"	"			8.64x10^-8
19.3	3:15	"	"			8.64x10^-8
22.9	4:07	"	"			9.57x10^-8

112.3 x .95 = 106.7
106.7 x .00857 = .91
.91 x 453.6 = 414
414.9 x 1.145 = 474.

$K_t = 3.4 \times 10^{-3} \times Q/t \times psi$
based on Mold HT = 2.999"

$(K_t = QL/ALT)$

(4). 8.67×10^{-8} cm/sec

COEFFICIENT OF PERMEABILITY
CONSTANT HEAD

Central Cell

Client: UNC
Project:
Soil Type:

Lab Inv.
Location: SM-5
Tested By:

Proctor Values: 111.3 @ 14.6
Proctor Type:
Specimen % Compaction & Moisture Content: 95% @ Optimum

Head Setting, psi	Time	Date

Weight of mold & material
Weight of mold
Weight of material

Moisture content
Wet weight
Dry weight
% Moisture

Material
dry weight
Volume
In-place density

Reading, Q	Time	Date	Head, psi	Difference Q, CM.	Difference t, Sec.	Kt, cm/sec
1.0	1:02	9-7	31			
3.9	1:51	9-7	31	2.9	2940	1.082×10^{-7}
4.8	2:07	9-7	31	.9	960	1.028×10^{-7}
7.0	2:42	9-7	31	2.2	2160	1.197×10^{-7}
9.6	3:13	9-7	31	2.6	1800	1.558×10^{-7}
11.1	3:34	9-7	31	1.5	1260	1.306×10^{-7}
13.1	4:04	9-7	31	2.0	1800	1.29×10^{-7}

Average = 1.218×10^{-7} cm/sec

111.3 X .95 = 105.7
105.7 X .00857 = .906
.9061 X 453.6 = 411.0
411.0 X 1.146 = 471.0

$K_t = 3.4 \times 10^{-3} \times Q/t \times psi$ (K_t = QL/ALT)
Based on Mold HT = 2.999"
TD = 2.507

Canonie Environmental

A-109

By [illegible] Date 9/10/90 Subject [illegible] Sheet No. 1 of ___

Chkd. By [illegible] Date 9/12/90 [illegible] Proj. No. [illegible]

1/4" X 1/4"

CRUMB TEST

METHOD: PLACE SMALL CRUMBS OF CL SOIL FROM THE UNITED NUCLEAR SITE IN A CLEAR BEAKER FILLED WITH DISTILLED, DEMINERALIZED WATER. OBSERVE THE BEHAVIOR OF THE SOIL CRUMB WITH READINGS TAKEN AT 10 AND 30 MINUTES AFTER IMERSION.

DISPERSION IS DETECTED BY FORMATION OF A COLLOIDAL CLOUD, WHICH APPEARS AS A FINE MISTY HALO AROUND THE SOIL CRUMB. FOR EACH READING, THE SOIL CRUMB IS RATED FOR REACTION OR COLLOIDAL CLOUD FORMATION AS FOLLOWS:

1 = NO SIGN OF CLOUDY WATER CAUSED BY COLLOIDAL SUSPENSION

2 = BARE HINT OF COLLOIDAL CLOUD FORMATION AT SURFACE OF SOIL CRUMB.

3 = EASILY RECOGNIZED COLLOIDAL CLOUD COVERING 1/4 TO 1/2 OF THE BOTTOM OF THE BEAKER

4 = STRONG REACTION WITH COLLOIDAL CLOUD COVERING MOST OF THE BOTTOM OF THE BEAKER.

Canonie Environmental

A-110

By mjg Date 9/10/90 Subject UNC Sheet No. 1 of

Chkd. By CBu Date 9/12/90 CRUMB TEST Proj. No. B6-060-21

1/4" X 1/4"

TEST: SAMPLE DESCRIPTION: DK BROWN SILTY CLAY LOW PLASTICITY

SAMPLE I.D.: 86-060-P2 10.5'-11.0'

CRUMB NO.	10 MIN RATING	NOTES	30 MIN RATING	NOTES
1 (20:18)	1 (20:28)	NO VISIBLE CLOUDINESS	1 (20:48)	NO VISIBLE CLOUDINESS
2 "	1 "	"	1 "	"
3 "	1 "	"	1 "	"

SAMPLE I.D.: 86-060-P3 5'-8'

SAMPLE DESCRIPTION: DK. BROWN SILTY CLAY, SOME SILT, LOW PLASTICITY

CRUMB NO.	10 MIN. RATING	NOTES	30 MIN RATING	NOTES
1 (17:50)	1 (18:00)	NO VISIBLE CLOUDINESS	1 (18:22)	No visible cloudiness.
2 "	1 "	"	1 "	"
3 "	1 "	"	1 "	"

APPENDIX
B

APPENDIX B

CONSTRUCTION/TECHNICAL SPECIFICATIONS
INTERIM STABILIZATION/FINAL RECLAMATION PLANS
UNITED NUCLEAR CORPORATION
GALLUP, NEW MEXICO

CanonieEnvironmental

APPENDIX B

CONSTRUCTION/TECHNICAL SPECIFICATIONS
INTERIM STABILIZATION/FINAL RECLAMATION PLANS
UNITED NUCLEAR CORPORATION
GALLUP, NEW MEXICO

1.0 INTRODUCTION

1.1 General Description of Work

The work covered by these Specifications consists of construction and related activities for Interim Stabilization and Final Reclamation of the tailings disposal area and mill at the United Nuclear Corporation (United Nuclear) Mining and Milling Church Rock site, located northeast of Gallup, New Mexico. All work performed shall be in accordance with these Specifications and the Construction Drawings.

Materials, products, equipment, supplies, utilities, skill, labor and all other items necessary for the work described for the stabilization and reclamation of the tailings disposal and mill areas shall be provided. Work shall be performed in compliance with a health and safety plan. The materials and products used shall be as specified here for the services intended.

The methods used shall produce satisfactory work for the services intended and shall be in accordance with standard construction industry practices.

The following is a partial list of the primary work items which may be required to complete the job:

1. Mill demolition

2. Backfill and grading of Borrow Pit No. 2

3. Tailings grading

4. Soil cover

5. Haul road construction

6. Surface water control structures

7. Revegetation.

1.1.1 Interim Stabilization

Interim stabilization shall be done to stabilize the tailings area and prevent further migration of tailings by either the wind or from surface water runoff. The primary activities to be performed during interim stabilization are as follows:

1. Drainage of Borrow Pit No. 2

2. Reconfiguration of tailings

3. Reconfiguration of embankment

4. Removal of wind-blown tailings

5. Construction of interim soil cover

6. Interim surface water control

7. Revegetation

8. Mill facilities decommissioning.

The work performed as part of these activities is described below:

1. Borrow Pit No. 2 shall be drained of any remaining water. Water from Borrow Pit No. 2 shall be used, as needed, to provide water for construction operations, including dust abatement and compaction activities.

2. The tailings surface shall be regraded to conform to the lines and grades shown on the Drawings. The regrading shall provide a relatively horizontal final surface (2 percent average slope). Regrading shall also provide a minimum of seven feet of coarse tailings or other acceptable fill material overlaying the cover slimes.

3. The soil embankment west and south of the tailings cells shall be graded to the lines and grades shown on the Drawings to partially provide soil materials for the interim soil cover. The maximum embankment slope allowable shall be five horizontal to one vertical (5H:1V).

4. An interim soil cover of approximately 12 inches of compacted soil, obtained from regrading soil embankment areas or borrow areas, shall be placed over the graded tailings shown on the Drawings.

5. Control of localized surface water runoff during construction shall be maintained by installing temporary drainage ditches, runoff control ditches, downdrains, gutters, and culverts as needed to minimize soil erosion.

Erosion shall be reduced by revegetating the interim stabilization soil cover, if necessary, and any other areas disturbed by interim stabilization.

6. The mill facilities shall be decommissioned by demolishing and disposing of the remaining mill structures, equipment, asphalt and appurtenances. Demolition rubble, asphalt, ore-pad materials, and contaminated soils shall be disposed of in Borrow Pit No. 2. Subsequent to decommissioning activities, the ore pad shall be covered with one foot of soil, and the area re-graded as shown on the Drawings.

1.1.2 Final Reclamation

Final reclamation will provide final stabilization of the mill facilities and tailings areas. The primary activities are:

1. Completion of backfilling and grading Borrow Pit No. 2,

2. Modification of the Pipeline Arroyo,

3. Construction of surface water control channels, ditches, swales, and the buried jetty,

4. Placement of final soil cover and soil/rock matrix, and

5. Placement of riprap.

These activities are described below:

1. Borrow Pit No. 2 shall be backfilled with mill debris during interim stabilization. During final reclamation, excess soils containing tailings materials excavated from the drainage areas shown on the Drawings shall also be placed in Borrow Pit No. 2. After placement of these materials, Borrow Pit No. 2 shall be backfilled to the surface using soil from the adjacent stockpile, in accordance with these Specifications, if necessary to achieve the grades shown in the Drawings.

2. The Pipeline Arroyo channel shall be modified to have a consistent low-flow channel as shown on the Drawings. Soil materials generated during modification shall be subsequently placed over the tailings area for the final soil cover. In addition, the nickpoint area shall be stabilized by installing a buried jetty, shown in the Drawings.

3. Surface water control shall be maintained by constructing permanent drainage swales and channels, modifying the existing drainage ditches, and constructing a runoff control ditch and protective bench to minimize soil erosion.

4. A final soil cover shall be placed such that the total soil cover, including a 1.5 feet thick radon attenuation layer and a 6-inch soil/rock matrix erosion protection layer, will be placed over the entire tailings area in accordance with the Drawings and these specifications.

5. Soil-cover placement and reclamation shall be completed by revegetating all disturbed areas not receiving the soil/rock matrix. In addition, a fence shall be installed around the tailings area at specified locations.

1.2 Sanitary Facilities

Suitable sanitary facilities and potable water shall be provided and maintained on the construction site at all times. These facilities shall be subject to approval of the county and state health departments.

1.3 Construction Drawings

The Construction Drawings accompany and form a part of the Specifications and Contract Documents. The location, extent, and general character of the work is shown on the Construction Drawings and is described within these Specifications. The work shall be executed in accordance with these Drawings and such additional or supplemental Drawings as may be furnished as necessary.

1.4 As-Built Drawings

"As-built" drawings shall be prepared to properly record all dimensions that are necessary for construction but are not indicated on the plans, and all changes to any contours or dimensions on the plans.

1.5 State and Local Laws and Permits

State and local laws governing the work to be completed shall be followed. Permit acquisition for performance of any aspect of the work shall be completed.

1.6 Project Schedule

The project shall commence within 14 days after the "Notice to Proceed." Within this period, an estimate of the required time period for completion of the project shall be

submitted, with a detailed bar chart schedule of construction activities. This schedule shall be updated at regular intervals to reflect any significant schedule changes.

1.7 Codes and Standards

Work described herein shall be conducted in accordance with industry standards including, but not limited to, the most current designation of the Codes and Standards designated herein. The following definitions shall identify the abbreviations used in these specifications or on the plans:

1.	ASTM:	American Society for Testing and Materials
2.	ASTM A 121:	"Specifications for Zinc-Coated (Galvanized) Steel Barbed Wire"
3.	ASTM A 760:	"Specifications for Pipe, Corrugated Steel, Zinc Coated (Galvanized)"
4.	ASTM D 698:	"Test Method for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 5.5-lb (2.49-kg) Hammer and 12-in (305-mm) Drop"
5.	ASTM D 422:	"Method for Particle-Size Analysis of Soils"
6.	ASTM D-4318:	"Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils"
7.	ASTM C-33:	"Specifications for Concrete Aggregate"

8. ASTM C-88: "Test Methods for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate"

9. ASTM C-97: "Test Methods for Adsorption and Bulk Specific Gravity of Dimension Stone"

10. ASTM C-127: "Test Methods for Specific Gravity and Adsorption of Coarse Aggregate"

11. ASTM C-150: "Specifications for Portland Cement".

1.8 Submittals

1.8.1 Permits

If mandated by federal, state, or local ordinances, copies of all permits shall be available for inspection at the site prior to commencement of the permitted activity including, but not limited to, the following:

1. Fugitive dust

2. Water control

3. Burning

4. Road use

5. General construction.

1.8.2 Equipment

A typed equipment list shall be prepared indicating the appropriate equipment types including the numbers, types, manufacturer, and model number of all excavators, loaders, scrapers, dozers, graders, compactors, and trucks prior to procurement and use of the equipment. The approximate duration of time the equipment shall be used on-site shall be designated on the equipment list.

1.8.3 Products

Prior to use, manufacturer's certification shall be provided for all products utilized in construction stating and supplying supporting data that products meet or exceed the requirements given for each product. The products requiring submittals prior to use are presented below:

1. Riprap
2. Corrugated steel pipe
3. Geotextile fabric
4. Seed mixture
5. Fertilizer
6. Mulch
7. Fence.

2.0 INTERIM STABILIZATION CLEARING AND GRUBBING

2.1 General

2.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations related to interim stabilization clearing and grubbing shall be conducted in accordance with the Drawings and these Specifications. This work shall also include the preservation from injury or defacement of all vegetation and objects intended to remain.

2.1.2 Related to Work

1. Section 3.0 - Interim Stabilization Haul Roads/Access Roads

2. Section 4.0 - Interim Stabilization Excavation and Grading.

2.2 Products

Not applicable.

2.3 Execution

Clearing and grubbing shall be performed within the construction work areas to be disturbed as shown on the Drawings. Clearing and grubbing on the United Nuclear property shall also be performed to a maximum distance of 20 feet outside of the limits to be disturbed by construction activities. The work performed shall provide a complete removal of all vegetative materials on the surface and major root systems adjacent to the

surface. All vegetative debris shall be placed in a designated stockpile or shall be burned, subject to approval. Under no circumstances shall cleared material be placed in fill areas or cover layers.

3.0 INTERIM STABILIZATION HAUL ROADS/ACCESS ROADS

3.1 General

3.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations related to construction and maintenance of interim stabilization haul and access roads shall be conducted in accordance with the Drawings and these Specifications.

3.1.2 Related Work

1. Section 4.0 - Interim Stabilization Excavation and Grading

2. Section 5.0 - Interim Stabilization Surface Water Control Structures.

3.1.3 Definitions

For the purposes of the work required, the following definitions shall identify the features shown on the Drawings and earth materials used during construction.

Haul Road - The haul road shall be constructed to a 75- or 50-foot width, as identified on the Drawings, during interim stabilization to provide access to construction areas by labor and equipment. The haul road includes a 50-foot wide access ramp as shown on the Drawings.

Access Roads - Access roads are roads which currently exist to provide access to the site, or which are constructed as required during the work.

Soil - Soil consists of all earth materials capable of being excavated with conventional earthwork excavation equipment without the use of rippers, hammers, or blasting, as may be required for rock. Soils shall be uncontaminated and free from ore, tailings materials, and rocks larger than 6 inches in diameter, debris, roots, branches, stumps, or other organic matter. In the case of materials for interim stabilization and final reclamation covers, soils shall be primarily fine-grained or shall be mixed with other soils to achieve a homogeneous, predominantly fine-grained mixture.

Soil to be used in the radon attenuation soil cover shall have a particle size distribution that is within the limits shown on Figure B-1 and classify as a silty clay (CL), clayey sand (SC), silt (ML), or silty sand (SM). The above soil types will be blended during excavation and construction to provide a homogeneous mixture. This soil mixture shall fit within the specified gradation envelope to be consistent with the soil-cover design.

Tailings - Tailings consist of milled ore materials, a by-product of the extraction of uranium. The tailings have been hydraulically placed in an acidic solution in the tailings disposal area identified in the Drawings. The tailings, for the purposes of this work, are subdivided into the three categories described below:

Coarse Tailings - Coarse tailings consist of all tailings materials of which the predominant (greater than 50 percent) fraction is sand size, retained on the No. 200 sieve using the procedures outlined by ASTM D 422.

Wind-blown Tailings - Wind-blown tailings consist of soils and materials which have been covered with tailings and transported by the wind. These tailings have been identified for removal as shown on the Drawings.

Slimes - Slimes are fine-grained, typically wet-to-saturated tailings, which consist of all tailings materials of which the predominant (greater than 50 percent) fraction passes the No. 200 sieve using the procedures outlined by ASTM D 422.

3.2 Products

Submittals for the following products shall be provided.

3.2.1 Geotextile Fabric

Geotextile fabric shall be a non-woven synthetic material of 90 mil thickness or greater, such as Fibretex 300, manufactured by Crown Zellerbach Geotextile Fabrics (Washougal, Washington), or equivalent.

3.3 Execution

3.3.1 Haul Road Construction

Haul road construction shall provide for a final alignment and configuration to the lines and grades shown on the Drawings. Construction of the haul road may involve excavation of both tailings materials and soil embankment materials. Excavation shall be coordinated so that tailings and tailings-contaminated soils are maintained separately from uncontaminated soils. Excavated tailings and tailings-contaminated soils shall be placed within the tailings cells and graded with tailings.

The haul road surface shall consist of at least 2 feet of uncontaminated soil placed prior to extensive traffic to preclude spreading of tailings. Existing base soils and tailings along haul road alignments shall be scarified to a minimum depth of 4 inches and recompacted to 95 percent of the maximum dry density as determined by ASTM D 698. Geotextile

fabric shall be placed over the compacted tailings surface prior to placement of fill. Side edges and end sections of adjacent geotextile panels shall be lapped a minimum of 12 inches. Fill materials shall be placed in 8-inch maximum lift thicknesses measured loose, and mechanically compacted to a minimum of 95 percent of the maximum dry density obtainable by the Standard Proctor compaction method (ASTM D 698).

Throughout construction operations, haul roads shall be maintained in a satisfactory condition. Haul roads shall be graded and filled as necessary to allow year-round access.

3.3.2 Access Road Construction

Access roads shall be constructed to provide vehicular access via 20-foot minimum width roads in the locations necessary for conduct of the work, in addition to access provided by the haul roads. The surface of the access roads shall be cleared of obstructions, evenly graded, and maintained. Access roads shall be graded and filled as necessary to allow year-round access. Compaction shall be required only as necessary to meet the performance standard above.

4.0 INTERIM STABILIZATION

4.1 General

4.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations related to interim stabilization excavation and grading shall be conducted in accordance with the Drawings and these Specifications.

Work shall include, but not be limited to, the following:

1. Excavation and grading for haul/access roads,
2. Excavation and grading of tailings materials,
3. Excavation and grading of soil embankments,
4. Excavation and grading of wind-blown tailings,
5. Placement and grading of interim stabilization soil cover materials.

Areas subject to earthwork operations identified herein shall be designated by staking. Surveying necessary to conduct earthwork to the lines and grades specified shall be provided.

4.1.2 Related Work

1. Section 2.0 - Interim Stabilization Clearing and Grubbing

2. Section 3.0 - Interim Stabilization Haul Roads/Access Roads

3. Section 5.0 - Interim Stabilization Surface Water Control Structures.

4.1.3 Definitions

For the purposes of the work required, the following definitions shall identify the earth materials used during construction.

Soil - Soil consists of all earth materials capable of being excavated with conventional earthwork excavation equipment without the use of rippers, hammers, or blasting, as may be required for rock. Soils shall be uncontaminated and free from ore and tailings materials, rocks larger than 6 inches in diameter, debris, roots, branches, stumps, or other organic matter. In the case of materials for interim stabilization cover, soils shall be primarily fine-grained or shall be mixed with other soils to achieve a homogeneous, predominantly fine-grained mixture.

Soil to be used in the radon attenuation soil cover shall have a particle size distribution that is within the limits shown on Figure B-1 and classify as a silty clay (CL), clayey sand (SC), silt (ML), or silty sand (SM). The above soil types will be blended during excavation and construction to provide a homogeneous mixture. This soil mixture shall fit within the specified gradation envelope to be consistent with the soil-cover design.

Rock - Rock shall consist of all earth materials harder than soil which must be excavated by ripping with a D-9 Caterpillar bulldozer or equivalent equipped with a single shank ripper, hammering, or blasting.

Tailings - Tailings consist of milled ore materials, a by-product of the extraction of uranium. The tailings have been hydraulically placed in an acidic solution in the tailings

disposal area identified in the Drawings. The tailings, for the purposes of this work, are subdivided into the three categories described below:

Coarse Tailings - Coarse tailings consist of all tailings materials of which the predominant (greater than 50 percent) fraction is sand size, retained on the No. 200 sieve using the procedures outlined by ASTM D 422.

Slimes - Slimes are fine-grained typically wet-to-saturated tailings which consist of all tailings materials of which the predominant (greater than 50 percent) fraction passes the No. 200 sieve using the procedures outlined by ASTM D 422.

Wind-blown Tailings - Wind-blown tailings are soils and rock materials which have been mixed or covered with tailings transported by the wind and which have been identified for removal as shown on the Drawings.

Ore - Ore is material which has been mined for uranium extraction. The ore shall be distinguished from tailings through evaluations.

Tailings Cells - The tailings disposal area is divided into three cells designated as the North, Central, and South Cells.

Soil Embankment - The soil embankment which is located along the west side of the tailings cells between the cells and Pipeline Arroyo.

Pipeline Arroyo - Pipeline Arroyo refers to the epheremal stream channel located along the east side of State Highway 566 between the highway and the tailings disposal area as shown on the Drawings.

4.2 Products

Not applicable.

4.3 Execution

4.3.1 General

Excavation and grading operation shall begin in undisturbed areas by clearing and grubbing of the work area in accordance with Section 2.0 - Interim Stabilization Clearing and Grubbing, of these Specifications. Throughout excavation and grading operations, debris in graded material and fill material shall be removed and disposed of prior to placement of the material. Debris shall be disposed of only in designated locations.

All work shall be performed in a manner that minimizes surface water runoff into tailings disposal areas and construction or fill areas. Surface runoff from exposed tailings grading areas shall be routed to areas in the tailings and shall not be allowed to flow outside the tailings disposal area.

All slopes and excavations shall be configured by either cutting existing materials to form the design lines and grades, or by placing compacted fill to beyond the lines and grades and trimming to the design configuration. The acceptable tolerance limit for earthwork and rock excavation is to within ±0.33 foot of the lines and grades shown in the Drawings.

Adequate water shall be utilized for dust suppression on haul/access roads and in all grading and compaction work areas. A water supply shall be at the mill site or other suitable location.

4.3.2 Tailings Regrading

Tailings materials within the designated tailings cells shall be graded during interim stabilization to conform to the lines and grades shown on the Drawings. Grading of tailings shall provide an entire regraded surface of coarse tailings. A minimum 7-foot thickness of coarse tailings or other suitable uncontaminated material shall be placed over all slime areas by progressive pushing of the material in approximate 18- to 24-inch thick lifts across the slimes from peripheral areas. In areas where greater than seven feet of material is placed over slime materials, at least the upper seven feet of material shall contain either coarse tailings or other uncontaminated fill material. Compaction of the final coarse tailings surface shall be performed prior to placement of the overlying interim soil cover to a minimum of 90 percent of the maximum dry density as determined by the Standard Proctor method of compaction (ASTM D 698).

Tailings materials outside the limits of the tailings cells as identified on the Drawings shall be excavated from their present location and placed within the confines of the cells. The locations outside of the cell areas from which materials are to be excavated during interim stabilization include, but are not limited to, the wind-blown areas and other areas as noted on the Drawings. Tailings materials uncovered as part of other excavation activities, including, but not limited to, embankment grading, south cell drainage channel excavation, and haul road construction, shall also be excavated and placed within the tailings cells. Tailings being graded or placed in fill sections shall be placed in 18-inch maximum thickness lifts by track-mounted earthmoving equipment. The final tailings surface shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D 698.

4.3.3 Soil Excavation and Grading

Soil excavation and grading shall include, but not be limited to, soil embankment excavation and grading, south cell drainage channel excavation, stripping of soils containing wind-blown tailings, excavation and grading of surface water control structures, and soil cover placement.

4.3.3.1 Soil Embankment Grading

Soil embankment grading shall consist of operations necessary for cut and fill operations on the west and south soil tailings retention embankment of the disposal area. Excavation and grading shall be performed to the lines and grades shown on the Drawings. Excess soil from these grading operations shall be used as interim stabilization soil cover.

In general, the slopes of the soil embankment shall be regraded to a maximum slope of 5H:1V. Fill shall be placed as required to attain the lines and grades in a 12-inch maximum horizontal lift thickness measured loose. Each lift shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D 698. Depressions on slopes shall be filled beyond the lines and grades shown in the Drawings and subsequently trimmed to the desired configuration. Acceptable tolerance for the lines and grades shown on the Drawings is to within ±0.33 foot.

Following to grading operations, the soil embankment shall be revegetated in accordance with the requirements of Section 6.0 - Interim Stabilization Revegetation.

4.3.3.2 Wind-Blown Tailings Removal

Soils containing wind-blown tailings shall be removed to a depth of 6 inches from the surface in the areas shown on the Drawings or in designated areas. Excavated soils shall be placed to a uniform thickness over the entire regraded coarse tailings surface in up to a 12-inch thick maximum lift thickness, measured loose, and compacted by tracking with construction equipment. The stripped areas shall be regraded to meet the approximate contours of adjacent areas and shall be revegetated in accordance with Section 6.0 - Interim Stabilization Revegetation.

4.3.3.3 Soil Cover Materials Placement

Soil cover shall be placed over tailings during the interim stabilization phase to attain a 12-inch uniform thickness over the regraded tailings. Interim stabilization soil cover shall be placed over all exposed tailings materials. The soil for the interim cover shall be placed in lifts of up to 12-inch maximum thickness measured loose. The total compacted thickness of the interim soil cover shall be a minimum of 12 inches.

Soils used for interim soil cover shall be fine-grained clays, silts, and sands, well-mixed, having the Unified Soil Classification System (USCS) symbols CL, ML, or SC. The soil shall be placed at a moisture content of optimum to +2 percent of optimum as determined by the Standard Proctor method of compaction (ASTM D 698). The lifts shall be compacted by tracking with construction equipment. Each lift shall be compacted to at least 95 percent of the maximum dry density attainable as measured using the Standard Proctor method of compaction (ASTM D 698). Subsequent to placement, the entire soil cover shall be scarified and revegetated in accordance with Section 6.0 - Interim Stabilization Revegetation.

4.3.4 Rock Excavation

Rock excavation shall be performed by ripping and finishing to the lines and grades shown for removal of any rock materials encountered while grading between the North and Central Cells. Excavated rock material shall be used as fill in the large depression along the channel alignment prior to the confluence with the arroyo as shown on the Drawings. Rock materials placed in fill sections shall be placed in 18-inch thick maximum lifts, measured loose, and shall be compacted by tracking with construction equipment.

4.4 Interim Stabilization Soil Cover Quality Control Program

The quality control program originally outlined in the specifications for the proposed plan in 1987 represented the design engineer's minimum acceptable program to confirm that the construction meets the design intent. United Nuclear has been conducting interim reclamation of the tailings impoundment and performing quality control monitoring at the direction of the National Regulatory Commission (NRC) since 1989.

A minimum of one foot of soil cover has been placed over regraded tailings in the North and Central Cells. In placing that cover, United Nuclear has conducted a quality control program that exceeds the minimum acceptable program stipulated by the original design specifications and more closely complies with the guidance provided by NRC's Staff Technical Position (STP) on Testing and Inspection Plans. The NRC has inspected this work on two occasions and has found the field quality control program to be in compliance with the NRC requirements.

However, NRC indicated that greater quality control monitoring in the field would be necessary for the thinner soil cover. Therefore, United Nuclear has agreed to expand the quality assurance/quality control (QA/QC) program for future reclamation activities. Table B.1 summarizes the required testing frequencies in the Field Testing and Inspection Plan

(FTIP) for the soil cover. At a minimum, QA/QC testing shall be conducted at the frequencies provided in Table B.1 during interim stabilization activities beginning in 1991. The testing shall include the following:

1. Standard Proctor Compaction Testing (ASTM D 698)

2. One-Point Proctor testing

3. Field moisture/density verification test using Sand Cone methods, and

4. Gradation and Soil Classification testing.

The testing frequencies are described in more detail in Section 10.0 - Final Reclamation Excavation and Grading of these Specifications. The acceptable soil types for use in the soil cover construction shall classify as silty clay (CL), clayey sand (SC), silt (ML), or silty sand (SM) in accordance with the Unified Soil Classification System (USCS). The gradation limits of the mixed soil to be placed in the soil cover are presented on Figure B-1 as approved by the NRC.

Nuclear Density Gauge Correlation

As stipulated in NRC's Testing STP, moisture/density compaction verification testing performed by nuclear density gauge methods was correlated to one in-situ field density Sand Cone test (ASTM D 1556) and one oven-dry moisture test for every ten nuclear density gauge tests performed. During initial interim stabilization activities, 20 Sand Cone tests were performed on the interim soil cover in the North and Central Cells. Sand Cone tests were used exclusively to verify moisture/density compaction of the North Cell interim cover when a good correlation between the nuclear gauge and Sand Canonie Environmental Services Corp. (Canonie) one tests could not be obtained. Future

moisture/density verification testing shall meet the frequency requirement of NRC's Testing STP.

Based on performance-to-date for interim construction activities, it has been determined that test results obtained by the nuclear densimeter are erratic. The as-built report for the North Cell Interim Reclamation Activities documented the erratic nature of the nuclear densimeter testing. Therefore, only the Sand Cone method of in-place density determinations was used in the 1990 construction activities and shall be used in all future construction.

Soil Cover Materials

It is not expected that other sources of borrow material will be required other than those identified in this plan. However, if other borrow sources are required, then gradation and classification tests shall be performed to ensure that these materials meet project specifications. Representative samples shall be obtained by means of borehole drilling and sampling or test pit excavation and sampling and analyses for gradation and classification. The on-site quality assurance engineer shall review and accept or reject the test results prior to placement of imported fill as soil cover material. Additionally, the gradation results for the soil sample shall be compared to the graphical representation of the range of allowable soil types for use in the soil cover to assure consistency with the soil types modeled in the design of the soil cover (Figure B-1).

5.0 INTERIM STABILIZATION SURFACE WATER CONTROL STRUCTURES

5.1 General

5.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations related to construction of interim stabilization surface water control structures shall be conducted in accordance with the Drawings and these Specifications.

5.1.2 Related Work

1. Section 3.0 - Interim Stabilization Haul Roads/Access Roads

2. Section 4.0 - Interim Stabilization Excavation and Grading.

5.2 Products

Submittals for all of the following products shall be provided for approval prior to use.

5.2.1 Corrugated Steel Pipe

All corrugated steel pipe shall be 24-inch diameter corrugated (2 2/3-inch x 1/2-inch) galvanized steel pipe with a minimum wall thickness of 0.109 inches. A 10 1/2-inch wide dimpled band connector shall be used to join the pipe. Culverts shall have material specifications in accordance with ASTM A 760.

5.2.2 Riprap

Riprap shall be angular, dense, sound limestone, abrasion and weather-resistant, and free from cracks, seams or other defects that would tend to increase their destruction by water and frost action. Only approved riprap shall be used. Riprap shall be well-graded limestone size-specific to each particular application shown on the Drawings unless otherwise approved. Riprap material shall have a rock quality designation of at least 50.

5.3 Execution

5.3.1 Culverts

Culverts shall be placed during interim stabilization in locations required to conduct the work. Large diameter culverts, as approved, shall be required for installation of any crossing of Pipeline Arroyo. Culverts placed during interim stabilization may remain until final reclamation. However, before the completion of final reclamation operations, all culverts shall be removed, and the areas shall be recontoured to provide natural surface drainage.

Culverts which are used to carry construction traffic shall be placed in an excavation on a base compacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor method of compaction (ASTM D 698). Compaction of fill to the final grade around and over the pipe shall also be to a density at least 95 percent of the soil's maximum dry density (ASTM D 698). Backfill over the culvert shall provide a minimum thickness of 24 inches from the top of the culvert to grade.

6.0 INTERIM STABILIZATION REVEGETATION

6.1 General

6.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations related to interim stabilization revegetation shall be conducted in accordance with the Drawings and these Specifications. Revegetation efforts shall be directed at areas disturbed by construction where required.

6.1.2 Related Work

1. Section 4.0 - Interim Stabilization Excavation and Grading,

2. Section 5.0 - Interim Stabilization Surface Water Control Structures.

6.2 Products

Submittals for each of the following products shall be provided.

6.2.1 Seed Mixture

All seed shall be fresh, clean, new crop seed. Areas that will not be covered with the soil/rock matrix layer in the final reclamation cover (e.g., areas where wind-blown tailings have been removed) shall be vegetated with a native seed mixture of the following composition by weight of pure live seed (PLS) per acre (AC):

Scientific Name	Common Name	Growth Habit	Pounds PLS/AC
Agropyron smithii	Western Wheat-grass	NS	5.0
Bouteloua gracilis	Blue Grama	NB	2.0
Oryzopsis hymenoides	Indian Ricegrass	NB	4.0
Sporobolus airoides	Alkali Sacaton	NB	0.5
Bouteloua curtipendula	Sideoats Grama	NB	2.0
Hilaria jamisii	Galleta	NS	3.0

Notes:

1. NB - Native bunchgrass.
2. NS - Native sodgrass.

In interim stabilization, areas that will be covered with the soil/rock matrix layer in the final reclamation cover (e.g., regraded tailings disposal area and embankment slopes) shall be vegetated as required with either the native seed mixture identified above or a temporary grass seed mixture of the following composition by weight of PLS/AC:

Scientific Name	Common Name	Growth Habit	Pounds PLS/AC
Agropyron tricophorum	Pubescent Wheat-grass	IS	8.0
Agropyron intermadium	Intermediate Wheatgrass	IS	4.0
Agropyron elongatum	Tall Wheatgrass	IB	8.0
Agropyron desertorum	Crested Wheatgrass	IB	2.0
Elymus juncas	Russian Wildrye	IB	2.0

Notes:

1. IS - Introduced sod former.
2. IB - Introduced bunchgrass.

The specified application rates are for drill seeding. All seed shall be furnished in original containers showing analysis of seed mixture, percentage of pure live seed, year of production, net weight, date, and location of packaging. Seed which has become moldy, or otherwise damaged in transit or storage shall not be accepted.

6.2.2 Fertilizer

Fertilizer shall be applied at the rate of 30 pounds of nitrogen and 40 pounds of phosphate per acre. All fertilizer shall be delivered in waterproof bags or other standard containers with the name of material, name of manufacturer, net weight, and analysis on each bag or container.

6.2.3 Mulch

Mulch shall be small-grain hay or straw in a dry condition. Mulch shall be free of weeds and foreign matter detrimental to plant life.

6.3 Execution

6.3.1 General

Revegetation shall be conducted as specified on the embankments, channels, covers, and any other areas disturbed by the interim stabilization activities, as required.

6.3.2 Soil Preparation

The soil to be revegetated shall be prepared by first cultivating to a minimum depth of 6 inches. Fertilizer shall be added to the soil at an application rate to be determined after soil analyses are conducted and shall be worked into the upper 6 inches of soil by disking

along the contours to the extent practical. This application shall not precede seeding by more than one day.

6.3.3 Seeding

Seeding shall be conducted by drill seeding the specified seed mixture at the specified application rate along the contours or opposite the direction of the prevailing wind. Hydro seeding may be allowed on steep slopes or broadcast seeding on gentle slopes, upon approval, using twice the application rate specified for drill seeding. Seeding shall not be performed immediately following a heavy rain, during windy periods, or when the ground is too dry. Drill seeding shall use a roller attachment, or its equivalent, attached behind the drill to inhibit movement of seeds previously sown. Prior to mulching, water free from oils, acids, alkalis, and salt, which may inhibit grass growth, shall be applied with a fine spray after an area has been seeded. No seeding shall be performed in areas in excess of that which can be mulched the same day. If broadcast seeding is conducted, seed application rates shall be twice the rate specified previously.

6.3.4 Mulching

Mulch shall be applied to seeded areas at the application rate of 2 tons per acre and crimped into the surface utilizing dozer tracks or other approved means.

6.3.5 Restoration

Planted areas damaged during execution of this work shall be restored. The areas which fail to show a "catch" or uniform stand, for any reasons whatsoever, shall be reseeded during the next growing season with the specified seed moisture and methodology.

7.0 MILL DECOMMISSIONING

7.1 General

7.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations in connection with decommissioning the mill facilities shall be performed in accordance with the Drawings and these Specifications.

The work consists of dismantling and removal or demolition and cleanup of designated mill structures and mill areas including, but not limited to, those indicated on the Drawings. The work shall include, but not be limited to, the removal of asphalt paving, fencing, concrete slabs and foundations, tanks and associated piping, discontinued utilities, miscellaneous wood, metal, and masonry structures, and the transport and disposal of said demolished materials within Borrow Pit No. 2. Cleanup of miscellaneous debris exposed at the surface and randomly distributed across the site has not been specifically identified due to the impracticality of such extensive identification. However, it is the intent of these Specifications to require removal and disposal of all surface debris which shall be included in the scope of work. Demolition and hauling procedures shall be conducted in accordance with the Mill Decommissioning Plan submitted to the NRC in December 1988, with supplementary information submitted in April 1990, and approved by the NRC in January 1991.

Work shall also include final site grading to the contours shown on the Drawings.

7.1.2 Related Work

Section 10.0 - Final Reclamation Excavation and Grading.

7.2 Products

Not applicable.

7.3 Execution

7.3.1 Site Preparation/Precautions

Demolition procedures shall be conducted to minimize dust generation and shall provide, erect, and maintain temporary barriers and security devices as necessary to ensure safety. Operations shall be conducted with minimum interference to public or private thoroughfares and shall maintain egress and access at all times.

Care shall be exercised to protect existing utilities and landscaping materials which are not to be demolished or relocated. Utility lines in use shall be relocated from within demolition areas as required, the location marked, and as-built drawings of the relocated utilities provided.

Required permits for the demolition work shall be secured.

7.3.2 Demolition

The following sequence of events shall be conducted for demolition and regrading:

1. Dismantling of all remaining wood stave tanks,

2. Removal of equipment attached to the precipitation and countercurrent decantation (CCD) building frames,

3. Removal of standing equipment within the floor space of the CCD and precipitation buildings which would impede disassembly of the structures,

4. Dismantling of the CCD and precipitation building structures,

5. Removal of any remaining equipment within the concrete foundations of these buildings,

6. Removal of the covers, walkways and platforms associated with the solvent extraction tanks,

7. Dismantling of the semiautogenous grinding (SAG) mill conveyor housing and the grizzly,

8. Removal and cutting of any remaining steel storage tanks, if any,

9. Decontamination or demolition of the solvent extraction tank concrete,

10. Decontamination or demolition of other above-grade or on-grade concrete,

11. Decontamination of below-grade concrete, if feasible, followed by backfilling of the void space with clean soil,

12. Removal of the tailings discharge lines and the support structures over Pipeline Arroyo,

13. Ripping and removal of the asphalt paving and the solvent extraction dump pond,

14. Radiological surveying of the exposed soil and buried piping,

15. Removal of contaminated soil and sealing of buried pipe openings,

16. Removal of radium contaminated soils in and near the Catch Basins,

17. Removal of the mill yard fencing,

18. Stripping the surface of the ore storage area,

19. Final grading for drainage,

20. Revegetation of the disturbed area.

The cutting, crushing, or other size reduction of scrap equipment will proceed simultaneously with the above activities as required to minimize void space during burial.

Once debris is reduced in size or its shape modified, organized placement shall be followed when disposing into Borrow Pit No. 2. The material shall be placed in lifts not exceeding 5 feet and compacted using soil to work into any existing void spaces. Each lift shall be covered with a uniform lift of one-foot minimum thickness of soil, measured loose that has been compacted to a minimum of 90 percent of the maximum dry density as determined by the standard Proctor method of compaction (ASTM D698).

Relics, antiques, and similar objects shall be identified for removal and/or resale.

Structures that can be easily and economically decontaminated by processes such as acid rinsing, sand blasting, or scrapping shall be treated in that manner. Foundations, foundation walls and footings not decontaminated shall be removed and disposed of in Borrow Pit No. 2. Asphalt paving and any soil contaminated by tailings materials, as designed, shall be removed.

Buried process lines, tanks and sumps shall be excavated and disposed of in Borrow Pit No. 2. Specific exemptions may be requested, if supported by information including contamination levels, the reason for the exemption request and the location of the item. Generic exemptions shall not be allowed.

An adequate water supply system for dust suppression on haul roads and demolition work areas shall be provided.

Depressions resulting from demolition operations shall be filled with approved soil materials from on-site unless located in an area where further excavation is required to yield a uniformly graded site similar to the reclamation contours shown on the Drawings. The fill materials shall be clean natural soils free of debris and rubble and shall be compacted to at least the density of the surrounding undisturbed soil.

Decommissioning activities with regard to soils in the mill area shall be limited to removal of the asphalt surface in all areas, except around the administration building, warehouse, lube storage area, tire storage shed, and guard/change house buildings, and scraping of approximately six inches of soils to remove possible surface contamination. Ore materials remaining in the ore storage area shall be removed and disposed of in the tailings disposal area. Approximately six inches of surface material shall then be scraped

from the ore storage area to remove possible surface contamination. Refer to Drawings for areas which shall be stripped except within the unrestricted use areas.

Finally, a verification gamma survey shall be conducted to identify possible "hot spots" remaining. Identified hot spots shall be dealt with on a case-by-case basis.

Before removing all materials from the mill area for disposal, all remaining excavations shall be backfilled and the entire mill site shall be graded to the lines and grades shown on the Drawings. This grading shall provide for a minimum 1-foot thick soil cover over the ore pad area. Soil used for cover shall be obtained either on, or directly adjacent to, the demolished mill area. Excess soil shall be placed over deep backfilled foundation areas as directed to accommodate consolidation which may occur in soils unable to be thoroughly compacted. The mill area disturbed by decommissioning activities shall be revegetated in accordance with Section 12.0 - Final Reclamation Revegetation.

7.3.3 Salvaging Materials

Materials shall not be salvaged after initiating Mill Decommissioning. Salvaged materials from the structures may be stored on-site temporarily, provided that they do not hinder completion of the work and provided that they are not stored beyond the date specified for completion.

8.0 FINAL RECLAMATION CLEARING AND GRUBBING

8.1 General

8.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations related to final reclamation clearing and grubbing shall be conducted in accordance with the Drawings and these Specifications. This work shall also include the preservation of all vegetation and objects intended to remain from injury or defacement.

8.1.2 Related Work

1. Section 9.0 - Final Reclamation Haul Roads/Access Roads

2. Section 10.0 - Final Reclamation Excavation and Grading.

8.2 Products

Not applicable.

8.3 Execution

Clearing and grubbing shall be performed within the construction work areas to be disturbed as shown on the Drawings. Clearing and grubbing on the United Nuclear property shall also be conducted no more than 20 feet outside of the limits to be disturbed by construction activities. The work performed shall provide for complete removal of all vegetative materials on the surface and major root systems adjacent to the surface in areas to be disturbed, including the interim soil cover. Clearing operations shall

be conducted in a manner so that the interim soil cover placed previously is not penetrated by more than 4 inches. All vegetative debris shall be placed in a designated stockpile or shall be burned, with written approval. Under no circumstances shall cleared material be placed in fill areas or cover layers.

9.0 FINAL RECLAMATION HAUL ROADS/ACCESS ROADS

9.1 General

9.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations related to grading and maintenance of final reclamation haul and access roads shall be conducted in accordance with the Drawings and these Specifications.

9.1.2 Related Work

1. Section 10.0 - Final Reclamation Excavation and Grading

2. Section 11.0 - Final Reclamation Surface Water Control Structures.

9.1.3 Definitions

For the purposes of the work required, the following definitions shall identify the features shown on the Drawings and earth materials used during construction.

Haul Roads - Haul roads are roads constructed previously during interim stabilization along the top of the tailings embankment and traversing the embankment.

Access Roads - Access roads are roads which currently exist to provide access to the site, or which are constructed as required during the work.

Soil - Soil consists of all earth materials capable of being excavated with conventional earthwork excavation equipment without the use of rippers, hammers, or blasting as may

be required for rock. Soils shall be uncontaminated and free from ore, tailings materials, and rock larger than 6 inches in diameter, debris, roots, branches, stumps, or other organic matter. In the case of materials for the final reclamation cover, soils shall be primarily fine-grained or shall be mixed with other soils to achieve a homogeneous, predominately fine-grained mixture.

Soil to be used in the radon attenuation soil cover shall have a particle size distribution that is within the limits shown on Figure B-1 and classify as a silty clay (CL), clayey sand (SC), silt (ML), or silty sand (SM). The above soil types will be blended during excavation and construction to provide a homogeneous mixture. This soil mixture shall fit within specified gradation envelope to be consistent with the soil-cover design.

9.2 Products

Not applicable.

9.3 Execution

9.3.1 Existing Haul Road Grading

During final reclamation, in areas where the existing haul road alignment passes directly over tailings materials, sufficient soils shall be placed to provide the minimum cover thickness as specified in Section 10.0 - Final Reclamation Excavation and Grading. Additionally, existing haul roads which traverse the embankment shall be removed prior to completion of final reclamation. The final configuration shall meet the lines and grades shown on the Drawings.

Throughout construction operations, haul roads shall be maintained in a satisfactory condition and shall be graded and filled as necessary to allow year-round access.

Prior to completion of final reclamation, the haul roads shall be graded and covered with soil/rock matrix in accordance with Section 12.0 - Final Reclamation Revegetation.

9.3.2 Access Road Grading

Access roads shall be maintained to provide vehicular access via 20-foot minimum width roads in the locations shown on the Drawings, in addition to access provided by the haul roads. The surface of the access roads shall be cleared of obstructions, evenly graded, and maintained in a condition meeting approval. Access roads shall be graded and filled as necessary to allow year-round access.

The access roads shall be graded over and revegetated in accordance with Section 12.0 - Final Reclamation Revegetation, prior to completion of final reclamation.

10.0 FINAL RECLAMATION EXCAVATION AND GRADING

10.1 General

10.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be provided, and operations related to final reclamation excavation and grading shall be conducted in accordance with the Drawings and these Specifications.

Work shall include, but not be limited to, the following:

1. Grading for haul/access roads;

2. Excavation and grading for modification of the Pipeline Arroyo;

3. Excavation and grading of other surface water control channels and ditches; and

4. Placement and grading of final reclamation soil cover materials.

Areas subjected to earthwork operations identified herein shall be staked. All surveying necessary to conduct earthwork to the lines and grades specified shall be provided.

10.1.2 Related Work

1. Section 7.0 - Mill Decommissioning

2. Section 8.0 - Final Reclamation Clearing and Grubbing

3. Section 9.0 - Final Reclamation Haul Roads/Access Roads

4. Section 11.0 - Final Reclamation Surface Water Control Structures.

10.1.3 Definitions

For the purposes of the work required, the following definitions shall identify the earth materials used during construction.

Soil - Soil consists of all earth materials capable of being excavated with conventional earthwork excavation equipment without the use of rippers, hammers, or blasting as may be required by rock. Soils shall be uncontaminated and free from ore and tailings materials, rocks larger than 6 inches in diameter, debris, roots, branches, stumps, or other organic matter. In the case of materials for final reclamation cover, soils shall be primarily fine-grained or shall be mixed with other soils to achieve a homogeneous, predominantly fine grained mixture.

Soil to be used in the radon attenuation soil cover shall have a particle size distribution that is within the limits shown on Figure B-1 and classify as a silty clay (CL), clayey sand (SC), silt (ML), or silty sand (SM). The above soil types will be blended during excavation and construction to provide a homogeneous mixture. This soil mixture shall fit within the specified gradation envelope to be consistent with the soil-cover design.

Rock - Rock shall consist of all earth materials harder than soils which must be excavated by ripping with a D-9 Caterpillar bulldozer or equivalent equipped with a single shank ripper, by hammering, or by blasting.

Tailings - Tailings consist of milled ore materials, a by-product of the extraction of uranium. The tailings have been hydraulically placed in an acidic solution in the tailings disposal area identified in the Drawings. The tailings, for the purposes of this work, are subdivided into the two categories described below.

Coarse Tailings - Coarse tailings consist of all tailings materials of which the predominant (greater than 50 percent) fraction is sand size, retained on the No. 200 sieve using the procedures outlined by ASTM D 422.

Slimes - Slimes are fine-grained typically wet-to-saturated tailings which consist of all tailings materials of which the predominant (greater than 50 percent) fraction passes the No. 200 sieve using the procedures outlined by ASTM D 422.

Ore - Ore is material which has been mined for uranium extraction. The ore shall be distinguished from tailings through evaluation.

Tailings Cells - The tailings disposal area is divided into three cells designated as the North, Central, and South Cells.

Soil Embankment - The soil embankment located along the west side of the tailings cells between the cells and Pipeline Arroyo.

Pipeline Arroyo - Pipeline Arroyo refers to the ephemeral stream channel located along the east side of State Highway 566 between the highway and the tailings disposal area as shown on the Drawings.

Buried Jetty - Buried jetty refers to a stone-filled trench constructed adjacent to the Pipeline Arroyo to maintain the long-term geomorphic stability of the Pipeline Arroyo.

10.2 Products

Soil for Soil/Rock Matrix - The soil material to be used for the soil/rock matrix shall be a clayey sand to sandy clay from the Pipeline Arroyo alluvium or other borrow areas for the tailings cover material. No more than 25 percent of the soil shall be greater than 1/2 inch in diameter. The soil will be capable of being compacted into the rock mulch portion of the matrix.

Rock for Soil/Rock Matrix - The rock mulch used in the soil/rock matrix shall be free from cracks, seams, and other defects that would tend to increase its destruction by water and frost action. Only approved rock mulch shall be used. Rock mulch shall be well-graded limestone with sizes specified in Table B.2 in these Specifications and on the Drawings unless otherwise approved. Rock mulch shall meet the durability requirements for riprap identified in Section 11.0 - Final Surface Water Control Structures.

10.3 Execution

10.3.1 General

Excavation and grading operations shall begin in undisturbed areas by clearing and grubbing of the work area in accordance with Section 8.0 - Final Reclamation Clearing and Grubbing of these Specifications.

Throughout excavation and grading operations, debris within graded and fill material shall be removed and disposed of prior to placement. Debris shall be disposed of only in designated locations.

Work shall be performed in a manner that minimizes surface water runoff into construction or fill areas.

Slopes and excavations shall be configured by either cutting existing materials to form the design lines and grades or by placing compacted fill to beyond the lines and grades and trimming to the design configuration. The acceptable tolerance limit for earthwork and rock excavation is to within ± 0.3 foot of the lines and grades shown in the Drawings.

Fill shall be placed in maximum 12-inch thick lifts, measured loose, and compacted to at least 95 percent of the maximum dry density obtainable by the Standard Proctor method of compaction (ASTM D 698) at a moisture content of within ± 2 percent of optimum unless otherwise noted.

Adequate water shall be utilized for dust suppression on haul/access roads and all grading and compaction work areas. A water supply shall be available at the mill site as shown in the Drawings.

10.3.2 Tailings/Ore Excavation and Grading

Tailings and ore materials outside the limits of the tailings cells as identified on the Drawings shall be excavated from their present location and placed within the confines of Borrow Pit No. 2. The locations outside of the cell areas from which materials are to be excavated during final reclamation include, but are not limited to, miscellaneous areas as determined in the field. Tailings materials uncovered as part of other excavation activities shall also be excavated and placed within Borrow Pit No. 2.

Tailings and ore materials being graded or placed in fill sections in Borrow Pit No. 2 shall be placed in 18-inch maximum thickness lifts, measured loose, and shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D 698 or tracked into place. Materials which are excessively wet shall be air dried or mixed with dry fill prior to placement in Borrow Pit No. 2 so that no free liquids flow from the backfill materials.

10.3.3 Soil Excavation and Grading

Soil excavation and grading shall include, but not be limited to, soil embankment excavation and grading, completion of the south cell drainage channel excavation, Pipeline Arroyo channel reconfiguration, excavation and grading of surface water control structures, and final soil cover placement.

Slopes and excavations shall be configured by either cutting existing materials to form the design lines and grades or by placing compacted fill to beyond the lines and grades and trimming to the design configuration. The acceptable tolerance limit is to within ± 0.25 foot of the lines and grades shown in the Drawings.

10.3.3.1 Soil Embankment

Soil embankment grading shall consist of operations necessary for removing access roads which traverse the west tailings retention embankment prior to completion of final reclamation. Excavation and grading shall be performed to the lines and grades shown on the Drawings. Excess soils from these grading operations shall be used as final reclamation soil cover or in fill areas as necessary.

In general, the slopes of the soil embankment shall be regraded to a maximum slope of 5H:1V. Fill shall be placed in horizontal lifts as required with a maximum loose lift thickness of 12 inches to attain the lines and grades shown. Each lift shall be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D 698. Depressions on slopes shall be filled beyond the lines and grades shown in the drawings and then trimmed to the desired configuration. Acceptable tolerance for the lines and grades shown is to within ± 0.25 foot.

Subsequent to grading operations, areas disturbed on the soil embankment shall be repaired in accordance with the requirements of this section for placement of the soil/rock matrix (Section 9.3.4).

10.3.3.2 South Cell Drainage Channel

The South Cell drainage channel shall be excavated during final reclamation from the South Cell towards the Pipeline Arroyo as shown on the Drawings. Work shall be performed in a manner which prevents surface runoff from exposed tailings grading areas from flowing outside the tailings area. Rock shall be excavated in accordance with Section 10.3.5. The excess excavation materials shall be used in fill sections south of the tailings retention embankment which are required to fill the natural depression to match the lines and grades shown on the Drawings. Portions of the drainage channel which are not excavated into natural rock formations shall be protected by riprap placed in areas as shown on the Drawings in accordance with Section 11.0 - Final Surface Water Control Structures. The channel shall be constructed from the South Cell drainage channel to the Pipeline Arroyo as shown on the Drawings. The exposed soil excavation areas shall be revegetated in accordance with Section 12.0 - Final Reclamation Revegetation.

10.3.3.3 Pipeline Arroyo Channel Modification

The Pipeline Arroyo channel shall be modified during final reclamation to the lines and grades shown on the Drawings to provide a consistent low flow channel. All operations within the channel shall be performed to allow adequate stream flow and safety in the event of a major storm event. Soils excavated shall be used in fill areas between the arroyo and the tailings embankment.

Some areas within and adjacent to the arroyo disturbed by these activities shall be revegetated in accordance with Section 12.0 - Final Reclamation Revegetation.

10.3.3.4 Buried Jetty Construction

Soil shall be excavated as necessary to install the buried jetty adjacent to the arroyo as shown on the Drawings. Riprap shall be installed in accordance with Section 11.0 - Final Surface Water Control Structures. After riprap placement is complete, soil shall be placed in horizontal lifts with a maximum loose lift thickness of 12 inches as required to attain the lines and grades shown on the Drawings. Each lift shall be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D 698. Excess soils shall be used in fill sections including the final cover and backfilling of Borrow Pit No. 2. Subsequent to grading operations, areas disturbed by the jetty installation shall be revegetated in accordance with the requirements of Section 12.0 - Final Reclamation Revegetation.

10.3.3.5 Runoff Control Ditch Construction

The Runoff Control Ditch construction shall be performed during final reclamation to the lines and grades as shown on the Drawings. Soils excavated shall be used as soil cover materials for final reclamation.

10.3.3.6 Protective Bench Construction

The Protective Bench construction shall be constructed with the Runoff Control Ditch during final reclamation to the lines and grades shown on the Drawings.

10.3.3.7 North Diversion Ditch Extension

The North Diversion Ditch shall be extended to match the lines and grades shown on the Drawings. Soils excavated shall be used to construct the dikes adjacent to the channel as shown on the Drawings. Excess soil material shall be used as needed for either final

soil cover material or Borrow Pit No. 2 backfill. Rock excavation within the ditch excavation shall be performed in accordance with Section 10.3.5.

10.3.3.8 Soil Cover Material Placement

Soil cover shall be placed over the tailings area during the final reclamation phase using soils from various sources including the modification of the Pipeline Arroyo, excavation of other surface water channels, and from the existing soil stockpile to attain a radon attenuation layer over regraded tailings with a total thickness of 1.5 feet. Final reclamation soil cover shall be placed over the entire extent of the interim stabilization soil cover. The compacted thickness of the complete radon attenuation soil cover shall be 1.5 feet. After clearing and grubbing the existing interim stabilization soil cover (temporarily stockpiling surficial soils for spreading over the final reclamation cover), the remaining interim stabilization soil cover shall be compacted to a minimum of 95 percent of the maximum dry density at a moisture content of within 2 percent above the optimum moisture content as determined by the Standard Proctor compaction method (ASTM D 698). Subsequent soil layers shall be placed and compacted as specified above.

Soils used for final reclamation cover shall be fine-grained clays, silts, and sands, and result in a well-mixed soil having the USCS symbols CL, ML, SC, or SM. A grain-size envelope of acceptable material types for the soil cover was developed. This envelope is presented on Figure B-1. Only those soils with gradations falling within the soil cover gradation limits shown on Figure B-1 shall be used for soil cover construction. No individual soil type, particularly sand (SP) is suitable alone for use as soil cover. Following placement, the entire soil cover shall be covered with a soil/rock matrix in accordance with Section 10.3.4 below.

10.3.4 Soil/Rock Matrix Placement

A soil/rock matrix shall be constructed over the entire extent of the soil cover for erosion protection. The rock mulch portion of the soil/rock matrix shall be placed by end or belly dump trucks in a manner that shall minimize degradation and separation of the material. The rock mulch shall be spread with a road grader to achieve the desired thickness of 3 inches.

The soil shall be placed over the rock mulch only after the rock mulch thickness has been tested and documented as being acceptable. The soil shall be placed by end dump or belly dump trucks or self-propelled scrapers. A 4- to 6-inch thick random soil layer shall be spread by a grader. The soil shall be compacted with a vibrator roller/compactor to push the soil into the rock mulch.

The soil shall be forced into the rock mulch voids by passing construction equipment over the soil. The 4- to 6-inch-thick soil lift shall be placed over the rock to maintain an approximate thickness of three inches above the rock layer after compaction. Compaction of the soil shall densify the rock layer by tightly wedging the stones.

10.4 Final Reclamation Quality Control

10.4.1 Final Reclamation Soil Cover Quality Control Program

The quality control program originally outlined in the specifications for the proposed plan in 1987 represented the design engineer's minimum acceptable program to confirm that the construction meets the design intent. United Nuclear has been conducting interim reclamation of the tailings impoundment and performing quality control monitoring at the direction of the NRC since 1989.

A minimum of one foot of soil cover has been placed over regraded tailings in the North and Central Cells. In placing that cover, United Nuclear has conducted a quality control program that exceeds the minimum acceptable program stipulated by the original design specifications and more closely complies with the guidance provided by NRC's Staff Technical Position (STP) on Testing and Inspection Plans. The NRC has inspected this work on two occasions and has found the field quality control program to be in compliance with the NRC requirements.

However, NRC indicated that greater quality control monitoring in the field would be necessary for the thinner soil cover. Therefore, United Nuclear has agreed to expand the quality assurance/quality control (QA/QC) program for future reclamation activities. Table B.1 summarizes the required testing frequencies in the Field Testing and Inspection Plan (FTIP) for the soil cover. Additionally, as described below, increased testing frequencies are required during final reclamation to attain the testing frequencies in Table B.1 based on an average of all tests taken for the project. United Nuclear may petition the NRC for a license amendment for reduction of required QA/QC activities to those originally proposed if testing and inspection activities consistently meet QA/QC criteria during reclamation.

Accordingly, the quality control program, described in more detail herein, reflects the quality control procedures that shall be implemented in the field beginning in 1991. The tests presented herein shall be implemented for all future reclamation activities and shall be used to verify the criteria used in the design of the radon barrier. The quality control data are expected to be adequate to meet this verification requirement.

Soil Cover Materials

It is not expected that other sources of borrow material will be required other than those identified in this plan. However, if other borrow sources are required, then gradation and

classification tests shall be performed to ensure that these materials meet project specifications. Representative samples shall be obtained by means of borehole drilling and sampling or test pit excavation and sampling and analyses for gradation and classification. The on-site quality assurance engineer shall review and accept or reject the test results prior to placement of imported fill as soil cover material. Additionally, the gradation results for the soil sample shall be compared to the graphical representation of the range of allowable soil types for use in the soil cover to assure consistency with the soil types modeled in the design of the soil cover (Figure B-1).

Standard Proctor Compaction Testing (ASTM D 698)

The frequency of conducting Standard Proctor laboratory tests to confirm the moisture versus density relationship of the soil shall be a minimum of one compaction test for every 15 field moisture/density (i.e., compaction verification) tests performed as recommended by NRC's Testing STP. NRC's Testing STP frequency is one Standard Proctor test for every 10 to 15 field moisture/density tests performed.

One-Point Proctor Testing

NRC's Testing STP specifies that a one-point Proctor test be performed for every five field moisture/density tests. The Standard Proctor testing frequency employed by United Nuclear during North and Central Cell interim stabilization of one full Standard Proctor test for every four field moisture/density tests exceeds the total recommended frequency of testing for both one-point and Standard Proctor compaction tests. One-point tests shall be performed at the minimum frequency of one test for every five field moisture/density tests performed during future reclamation activities.

Field Moisture/Density Verification Test

NRC's Testing STP recommends that one moisture/density (compaction verification) test be performed for every 500 cubic yards (cy) of fill placed and that a minimum of two moisture/density tests be performed each day. During interim stabilization of the North and Central Cells, United Nuclear performed field moisture/density testing at the frequency of one test for every 2,000 cy of fill placed and performing at least two tests daily. This frequency exceeds the design engineer's minimum specification requirements that were included in the proposed plan in 1987 and is in accordance with Bureau of Reclamation (BUREC) dam construction standards.

However, due to NRC's concerns regarding the thinner soil cover being placed at the Church Rock site, the field moisture/density testing frequency will be increased to an average of one test per 500 cy of soil cover placed for the project. During initial interim stabilization activities, a total of 62 moisture/density tests were taken in the interim cover for 125,000 cy of soil cover material placed in the North and Central Cells. This is equivalent to a testing frequency of one test per 2,000 cy, which meets the BUREC frequency. It will be possible to attain the higher testing frequency of one test per 500 cy based on an average of all tests taken for the project. This shall be accomplished when the interim soil cover is conditioned (i.e., moisture adjusted and compacted) immediately prior to placement of the final soil cover. Additional in-place density tests shall be performed at this time with sufficient frequency to meet required project frequencies. This will provide assurance that the material placed meets the requirements modeled in the design.

Nuclear Density Gauge Correlation

As stipulated in NRC's Testing STP, moisture/density compaction verification testing performed by nuclear density gauge methods was correlated to one in-situ field density sand cone test (ASTM D 1556) and one oven-dry moisture test for every 10 nuclear density gauge tests performed. During initial interim stabilization activities, 20 Sand Cone

tests were performed on the interim soil cover in the North and Central Cells. Sand cone tests were used exclusively to verify moisture/density compaction of the North Cell interim cover when a good correlation between the nuclear gauge and Sand Cone tests could not be obtained. Future moisture/density verification testing shall meet the frequency requirement of NRC's Testing STP.

Based on performance-to-date for interim construction activities, it has been determined that test results obtained by the nuclear densimeter are erratic. The as-built report for the North Cell Interim Reclamation Activities documented the erratic nature of the nuclear densimeter testing. Therefore, only the sand cone method of in-place density determinations was used in the 1990 construction activities and shall be used in all future construction.

Gradation and Soil Classification

A detailed evaluation of expected soil types and gradations was performed as part of the reclamation design. This evaluation was based on over 50 gradation analyses of samples obtained from test pits and borings installed within the proposed borrow areas. The test data summarized in Figure B-1 demonstrates the relative uniformity of grain-size distribution of these soil samples. In addition, further uniformity of the soil cover will be achieved through the mixing of soils as the material is removed from the proposed borrow areas and spread and compacted as the soil cover. Therefore, the characteristics of the soil cover are also expected to be relatively uniform.

In initial interim stabilization activities, the testing frequency was one set of gradation and classification tests per 6,500 cy of soil placed. As illustrated on Figure B-1, the gradations of the material placed in the North and Central Cells for interim soil cover construction are uniform and very similar to those samples in the proposed borrow areas.

However, in review, the NRC expressed concern that a thinner soil cover design would be more sensitive to material gradation fluctuations and resultant radon attenuating characteristics. To address this concern, the gradation and Atterberg testing frequency shall be increased to an average of one test per 1,000 cy of soil cover material placed for the project. Testing on the soil cover before 1991 was at the lower frequency of one test per 6,500 cy as specified in the proposed plan in 1987. It will be possible to attain the higher testing frequency of one test per 1,000 cy based on an average of all tests taken for the project. This shall be accomplished when the interim soil cover is conditioned (i.e., moisture-adjusted and compacted) immediately prior to placement of the final soil cover. Additional gradation and Atterberg tests, as well as in-place density tests as identified above, shall be performed at this time with sufficient frequency to meet required project frequencies. This will provide assurance that the material placed meets the requirements of that modeled in the design.

The acceptable soil types for use in the soil cover construction shall classify as silty clay (CL), clayey sand (SC), silt (ML), or silty sand (SM) in accordance with the Unified Soil Classification System (USCS). The gradation limits of the mixed soil to be placed in the soil cover are presented on Figure B-1 as approved by the NRC.

10.4.2 Soil/Rock Matrix Quality Control Program

The thickness of the emplaced rock mulch shall be verified by construction control, staking, and probing. Thickness verification shall be performed by the following procedures:

1. Establish a 100-foot by 100-foot grid over the tailings impoundment,

2. Place a stake at each grid line intersection and mark the stake to indicate the required depth of rock mulch (i.e., 3 inches),

3. Place rock mulch and grade to the grade line marked on each stake,

4. Use a tape measure or surveying equipment to locate and mark the center point of each grid square,

5. Use a spade to make a vertical, straight-edged cut which penetrates the rock mulch at the grid square center point,

6. Place a straight-edge (ruler) on top of the rock mulch at the edge of the cut and measure the distance from the bottom of the straight-edge to the bottom of the rock mulch to the nearest 0.1 inch,

7. Record the thickness measurement from each test location,

8. If the average rock mulch thickness within the grid is 3 inches or greater, the grid is acceptable,

9. If the average thickness within the grid is less than 3 inches, mark the location and add additional rock mulch. Then repeat the test starting with Step 4 above.

The maximum and minimum thickness and adequacy of soil intrusion into the rock mulch shall be verified by using the testing scheme as described above for the rock mulch except that the extent to which the soil is present throughout the rock mulch layer will also be measured. As long as the soil is present throughout the upper two-thirds (i.e., 2 inches) of the rock mulch and is a minimum of 3 inches thick and a maximum of 4.5 inches thick above the rock mulch at three of the five test locations (four grid corners and grid center) in a grid square, the soil layer shall be considered adequate. If the thickness measures less than the minimum, additional soil material will be spread until measurement

verifies the appropriate thickness has been placed. If the thickness measures more than the maximum, additional grading and/or compaction of the excess material shall be performed until measurement verifies that the appropriate thickness has been placed.

Two inches of soil intrusion is considered adequate because this amount, along with the three inches of soil above the rock, will stabilize the rock layer for the short term. Gravity and infiltration of precipitation will cause the soil to fill in the lowest one-third of the rock layer.

11.0 FINAL SURFACE WATER CONTROL STRUCTURES

11.1 General

11.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations related to final reclamation surface water control structures shall be conducted in accordance with the Drawings and these Specifications.

11.1.2 Related Work

1. Section 9.0 - Final Reclamation Haul Roads/Access Roads

2. Section 10.0 - Final Reclamation Excavation and Grading.

11.1.3 Definitions

Pipeline Arroyo - Pipeline Arroyo refers to the ephemeral stream channel located along the east side of State Highway 566 between the highway and the tailings area as shown on the Drawings.

Buried Jetty - Buried jetty refers to a stone filled trench constructed adjacent to the Pipeline Arroyo near the Nickpoint to maintain the long-term geomorphic stability of Pipeline Arroyo.

Nickpoint - Nickpoint refers to the rock outcrop area within the Pipeline Arroyo as shown on the Drawings.

Runoff Control Ditch - Runoff Control Ditch refers to the ditch along the west toe of the tailings embankment which intercepts runoff from the soil embankment and prevents gullying between the embankment and the low flow arroyo channel as shown on the Drawings.

Drainage Swale - Drainage swale refers to shallow ditches which convey surface water runoff from the tailings cover as shown on the Drawings.

Drainage Ditch - Drainage ditch refers to ditches which convey water to Pipeline Arroyo as shown on the Drawings. Four drainage ditches are used, including the North and South Diversion Ditches and the North and South Cell Drainage Channels.

Riprap - Riprap refers to hard, durable limestone of the size range shown on the Drawings and identified herein.

11.2 Products

11.2.1 General

Submittals for all of the following products shall be provided for approval.

11.2.2 Corrugated Steel Pipe

All corrugated steel pipe shall be 24-inch diameter corrugated (2-2/3-inch x 1/2-inch) galvanized steel pipe with a minimum wall thickness of 0.109 inch. A 10-1/2-inch wide dimpled band connector shall be used on the pipe. Culverts shall have material specifications in accordance with ASTM A 760.

11.2.3 Riprap

Riprap shall be angular, dense, sound limestone, abrasion and weather-resistant and shall be free from cracks, seams, and other defects that would tend to increase its destruction by water and frost action. Only approved riprap shall be used. Riprap shall be well-graded limestone or other suitable rock with the sizes specified for each particular application shown on Tables B.2, B.3, and B.4 in these Specifications and on the Drawings unless otherwise approved.

The exact sources of rock to be used for erosion protection have not been identified at this time. However, based on the economic considerations included in the Reclamation Plan, the following specifications for quality of material shall be used.

The source for rock material used for riprap and rock mulch shall be dense limestone or other suitable rock and shall meet the following minimum criteria:

Specific Gravity	2.6 or greater
Absorption	1.8 percent or less
Sodium Sulfate Loss	10 percent or less

Alternatively, the rock source shall have a minimum score of 50 using the scoring criteria shown on Table D1 of the August 1990 Staff Technical Position (STP), "Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites," or equivalent, and shall be oversized, if needed, in accordance with the procedures provided in Appendix D of the August 1990 STP.

Additionally, rock used for riprap to be placed in all critical areas (i.e. Buried Jetty, Runoff Control Ditch, North and South Cell Drainage Channels, and existing North Diversion

Ditch) shall have a minimum score of 65 using the scoring criteria shown on Table D1 of the August 1990 STP.

Test methods used to determine these values shall be the standard test methods described in NUREG/CR-2642. These include ASTM C-97, 1958 for specific gravity; ASTM C-97, 1958 and ASTM C-127, modified, 1949 for absorption; and ASTM C-88, 1973 for sodium sulfate loss.

The bedding material shall consist of well-graded angular limestone. The grading of the bedding material shall be such that it will prevent undercutting and piping during periods of surface water runoff as specified in Table B.3.

11.3 Execution

11.3.1 Pipeline Arroyo Reconfiguration

The existing Pipeline Arroyo shall be regraded during final reclamation to provide a low flow channel as shown on the Drawings. Excavated soil meeting the requirements of Section 9.0 shall be placed on the tailings area as final soil cover. Excavated rock materials shall be placed as backfill within Borrow Pit No. 2. Excavation and placement of materials shall be in accordance with the Drawings and Section 10.0 - Final Excavation and Grading, in these Specifications.

The buried jetty adjacent to the Pipeline Arroyo shall be constructed as shown on the Drawings. Riprap in the buried jetty shall be well-graded and shall meet the requirements previously specified in these Specifications and identified in Tables B.2 and B.3.

11.3.2 South Cell Drainage Channel Construction

The South Cell Drainage Channel shall be constructed during final reclamation to the discharge point in the Pipeline Arroyo as shown on the Drawings. Soil and rock shall be excavated in accordance with Section 10.0 - Final Reclamation Excavation and Grading. The excess excavation materials shall be used in fill sections south of the tailings embankment which are required to match the lines and grades shown on the Drawings. Upstream portions of the drainage channel which are not excavated into natural rock formations shall be protected by riprap placed in the areas as shown on the Drawings. Riprap shall not be required in portions of the channel downstream of the rock cut. Riprap installed in the South Cell Drainage Channel shall be well-graded and shall meet the material and placement requirements outlined in these Specifications and Tables B.2 and B.3.

11.3.3 North Cell Drainage Channel Construction

The North Cell Drainage Channel shall be constructed during final reclamation to the exit section with the North Diversion Ditch as shown on the Drawings. Soil shall be excavated in accordance with Section 10.0 - Final Reclamation Excavation and Grading. The excess excavation materials shall be used in filling Borrow Pit No. 2. The drainage channel shall be protected by riprap placed as shown on the Drawings. Riprap installed in the North Cell Drainage Channel shall be well-graded and shall meet the material and placement requirements outlined in these Specifications and Tables B.2 and B.3

pg break

11.3.4 Diversion Ditch Construction

Construction of the North and South Diversion Ditches was substantially completed during mill construction operations. The South Diversion Ditch discharges into a natural drainage leading to the Pipeline Arroyo and shall not require further work.

The North Diversion Ditch currently discharges into the north borrow area as shown on the Drawings. The ditch shall be extended during final reclamation to discharge surface water to the Pipeline Arroyo. The diversion ditch shall be constructed to the lines and grades shown on the Drawings. Excavation of soils and rock materials as required shall be performed in accordance with the requirements of Section 10.0 - Final Reclamation Excavation and Grading. Portions of the ditch shall be protected with riprap at the locations shown on the Drawings. The riprap installed in the ditch shall be well-graded and shall meet the requirements outlined in these Specifications and in Tables B.2 and B.3.

11.3.5 Runoff Control Ditch Construction

The Runoff Control Ditch shall be constructed between the tailings embankment and the protective berm in the location and to the lines and grades shown on the Drawings. Excavation and placement of materials shall be in accordance with Section 10.0 - Final Reclamation Excavation and Grading. Excavated soil meeting the requirements of Section 10.0 shall be placed on the tailings areas as final soil cover. The Runoff Control Ditch shall be protected by riprap as shown on the Drawings. Riprap shall meet the material and placement requirements outlined in these Specifications and Tables B.2 and B.3.

11.3.6 Construction of Drainage Swales

Drainage swales shall be constructed in the locations and to the lines and grades shown on the Drawings and identified in Table B.4. Where swales are placed directly over tailings soil cover materials, the soil cover shall meet or exceed the minimum design

thickness. Additionally, the swales shall be protected by riprap as shown on the Drawings. Riprap shall meet the material and placement requirements outlined in these Specifications and Tables B.2, B.3, and B.4.

11.3.7 Culvert Installation

Culverts shall be placed during final reclamation in locations required for access as approved. Large diameter culverts, as approved, shall be required for installation at any crossing of Pipeline Arroyo. At the completion of final reclamation operations, all culverts shall be removed, and the areas shall be recontoured to provide natural surface drainage.

Culverts may be placed within the Pipeline Arroyo to provide site access subsequent to reconfiguration operations. However, prior to placement, a design for the crossing shall be submitted and certified by a licensed professional engineer. Access to the site from the north borrow area shall also be allowed.

Culverts which are used to carry construction traffic shall be placed in excavations on a base compacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor method of compaction (ASTM D 698). Compaction of fill to the final grade around and over the pipe shall also be to at least 95 percent of the soil's maximum dry density (ASTM D 698). Backfill over the culvert shall provide a minimum thickness of 24 inches from the top of the culvert to grade.

11.3.8 Bedding Material

The bedding material shall consist of crushed limestone. The material shall be reasonably free from clay, loam, or deleterious material. The bedding material shall be uniformly graded so as to prevent undercutting and piping during periods of surface water runoff.

Bedding material shall meet the thickness and gradation requirements identified in Table B.3 for each location.

11.3.9 Riprap Placement

All riprap shall be placed to the depth and grades shown on the Drawings. The riprap shall be placed in a manner to ensure that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger rock fragments so that a densely-placed, uniform layer of riprap of the specified thickness will result. Hand placing will be required only to the extent necessary to secure the results specified above. Riprap material shall meet the thickness and gradation requirements identified in Tables B.2 and B.4 for each location.

All riprap shall be placed in a manner that prevents degradation and separation of the material. Riprap material shall be dumped from end dump or belly dump trucks and dozed to the specified depth. Dozed material shall not be pushed more than 50 feet from dumped location.

12.0 FINAL RECLAMATION REVEGETATION

12.1 General

12.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations in connection with final reclamation revegetation shall be performed in accordance with the Drawings and these Specifications. Revegetation efforts shall be directed at all areas disturbed by construction that are not covered with riprap or soil/rock matrix and shall include, but not be limited to, embankment areas, side slopes within excavated channels, final reclamation soil cover, and the regraded mill area.

12.1.2 Related Work

1. Section 7.0 - Mill Decommissioning

2. Section 10.0 - Final Reclamation Excavation and Grading

3. Section 11.0 - Final Reclamation Surface Water Control Structures.

12.2 Products

Submittals for each of the following products shall be provided.

12.2.1 Seed Mixture

All seed shall be fresh, clean, new crop seed. Disturbed areas, as identified above, that will not be covered with riprap or the soil/rock matrix layer in the final reclamation cover

shall be vegetated with a native seed mixture of the following composition by weight of PLS/AC:

Scientific Name	Common Name	Growth Habit	Pounds PLS/AC
Agropyron smithii	Western Wheat-grass	NS	5.0
Bouteloua gracilis	Blue Grama	NB	2.0
Oryzopsis hymenoides	Indian Ricegrass	NB	4.0
Sporobolus airoides	Alkali Sacaton	NB	0.5
Bouteloua curtipendula	Sideoats Grama	NB	2.0
Hilaria jamisii	Galleta	NS	3.0

Notes:

1. NB - Native bunchgrass.
2. NS - Native sodgrass.

The specified application rates are for drill seeding. All seed shall be furnished in original containers showing analysis of seed mixture, percentage of PLS, year of production, net weight, date, and location of packaging. Seed which has become moldy, or otherwise damaged in transit or storage shall not be accepted.

12.2.2 Fertilizer

Fertilizer shall be applied at the rate of 30 pounds of nitrogen and 40 pounds of phosphate per acre. All fertilizer shall be delivered in waterproof bags or other standard containers with the name of material, name of manufacturer, net weight, and analysis on each bag or container.

12.2.3 Mulch

Mulch shall be small-grain hay or straw in a dry condition. Mulch shall be free of weeds and foreign matter detrimental to plant life.

12.3 Execution

12.3.1 General

Revegetation shall be conducted as specified on the embankments, channels, mill area, the arroyo, and any other areas disturbed by the final reclamation activities that are not covered with riprap or soil/rock matrix.

12.3.2 Soil Preparation

The soil to be revegetated shall be prepared by first cultivating to a minimum depth of 6 inches. Fertilizer shall be added to the soil at an application rate to be determined after soil analyses are conducted and shall be worked into the upper 6 inches of soil by disking along the contours to the extent practical. This application shall not precede seeding by more than one day.

12.3.3 Seeding

Seeding shall be conducted by drill seeding the specified seed mixture at the specified application rate along the contours or opposite the direction of the prevailing wind. Hydroseeding may be allowed on steep slopes or broadcast seeding on gentle slopes upon approval using twice the application rate specified for drill seeding. Seeding shall not be performed immediately following a heavy rain, during windy periods, or when the ground is too dry. Drill seeding shall use a roller attachment, or its equivalent, attached

behind the drill to inhibit movement of seeds previously sown. Prior to mulching, water, free from oils, acids, alkalis, and salt which may inhibit grass growth, shall be applied with a fine spray after an area has been seeded. No seeding shall be performed in areas in excess of that which can be mulched the same day. If broadcast seeding is conducted, seed application rates shall be twice the rate specified previously.

12.3.4 Mulching

Mulch shall be applied to seeded areas at the application rate of two tons per acre and crimped into the surface utilizing dozer tracks or other approved means.

12.3.5 Restoration

Planted areas damaged during execution of this work shall be restored. The areas which fail to show a "catch" or uniform stand, for any reason whatsoever, shall be reseeded during the next growing season with the specified seed mixture and methodology.

13.0 FENCING

13.1 General

13.1.1 Scope of Work

Unless otherwise specified, labor, materials and required equipment shall be furnished, and operations related to construction of fence shall be conducted in accordance with the Drawings and these Specifications.

Work shall consist of installation of a barbed wire fence to preclude unauthorized access to the reclaimed tailings area. Work associated with the barbed wire fence shall include installation of steel T-posts and three strands of barbed wire where necessary to form a complete perimeter fence around the tailings area.

13.1.2 Related Work

Not applicable.

13.2 Products

Submittals for the following products shall be provided for approval prior to use. Submittals shall include shop drawings showing, at a minimum, brace sections, gate details, and any details pertinent to the long-term effectiveness of the fences.

13.2.1 Barbed Wire Fence

The three-strand barbed wire fence shall consist of 12-1/2 gauge galvanized steel wire with zinc coating which shall meet the requirements of ASTM A 121 and standard steel T-posts.

13.2.2 Concrete Foundations

Concrete used in the installation shall conform to

1. Portland Cement: ASTM C 150, Type I

2. Aggregates: Fine and coarse, ASTM C 33 and

3. Water: Clean, potable, and free of oil, strong acids, salt, or organic matter.

13.3 Execution

13.3.1 Fence Installation

Fence and gates shall be installed as directed and specified herein.

13.3.2 Barbed Wire Fence Installation

Barbed wire strands shall be fastened to T-posts with wire that shall not be less than nine-gauge, galvanized, preformed steel wire. Maximum spacing for posts shall be 15 feet from center to center. All T-posts shall extend at least 18 inches into the ground.

The finished fence shall be plumb, taut, true-to-line, and complete in every detail.

TABLES

TABLES

TABLE B.1

SUMMARY OF THE FIELD TESTING AND INSPECTION PLAN

Quality Control Activity	NRC Staff Technical Position Frequency (a)
Full Proctor tests (ASTM D 698)	One test per every 15 field density tests
One-point Proctor tests	One test per every 5 field density tests
Field test for moisture/density	One test for each 500 cubic yards (cy) of cover soil or a minimum of two tests for each day of cover soil in excess of 150 cy
Nuclear density guage correlation (if appropriate)	One sand cone test and one oven-dry test per every 10 nuclear density tests
Gradation and classification testing of cover soil (includes Atterberg limits)	Minimum of one test each day of cover soil in excess of 150 cy and one test per 1,000 cy
Rock durability tests (specific gravity, absorption, soundness, L.A. Abrasion)	One test series at 10,000 cy and 20,000 cy riprap placed, then one test series per 10,000 cy of riprap placed in excess of 30,000 cy

(a) The August 1990 NRC Staff Position Paper is officially titled "Testing and Inspection Plans during Construction of DOE's Remedial Action at Inactive Uranium Mill Tailings Sites."

TABLE B.2

RIPRAP MATERIAL GRADATION REQUIREMENTS (a)

Location	D 50 (b) (inches)	Layer Thickness (inches)	Sieve Size:	Percent Passing by Weight									
				20 Inch	15 Inch	12 Inch	10 Inch	6 Inch	5 Inch	4 Inch	3 Inch	1 Inch	No. 4
Upper Section South Cell Drainage Channel	15	23		100		28-40		8-21		2-14	0-10		
North Cell Drainage Channel	9	15			100		45-58		10-33		0-23		
North Diversion Ditch	6.0	10					100	28-51		13-36		0-9	
Buried Jetty	6.0	96					100	28-51		13-36		0-9	
Branch Swales H and I, Lower Reach of Runoff Control Ditch	3.0	6						100		45-67		0-22	
Soil/Rock Matrix, Branch Swales, Upper Reach of Runoff Control Ditch	1.5	3									100	8-37	0-8

(a) The rock quality will be determined in accordance with Appendix D of the NRC's Staff Technical Position (STP) on "Design of Erosion Protection Covers" dated August 1990.

(b) Rock sizes shown will be oversized, if required, based on their rock quality rating by the methods provided in Appendix D of the NRC's STP.

(c) See Table B.3 for bedding material requirements.

TABLE B.3

Revised: July 8, 1992

BEDDING MATERIAL REQUIREMENTS

Location	Bedding Layers	Bedding D 50 (inches)	Thickness (inches)
Upper Section South Cell Drainage Channel	Layer 1	0.02	3
	Layer 2	0.35	3
North Cell Drainage Channel	Layer 1	0.02	3
	Layer 2	0.35	3
North Diversion Ditch	Layer 1	0.02	3
	Layer 2	0.35	3
Buried Jetty	None	NA	NA
Branch Swales H and I and Lower Reach of Runoff Control Ditch	Layer 1	0.02	3
	Layer 2	0.35	3
Soil/Rock Matrix	None	NA	NA
Branch Swales and Upper Reach of Runoff Control Ditch	Layer 1	0.02	3

Sieve Size:	Bedding D 50 (inches)	Bedding Material Gradation					
		3-inch	3/4 inch	No. 4	No. 10	No. 40	No. 200
Bedding Layer 1	0.02	100	85-100	65-100	47-94	23-70	15-30
Bedding Layer 2	0.35	65-100	43-80	22-60	15-38	5-12	0-10

CanonieEnvironmental

TABLE B.4

BRANCH SWALE CHARACTERISTICS

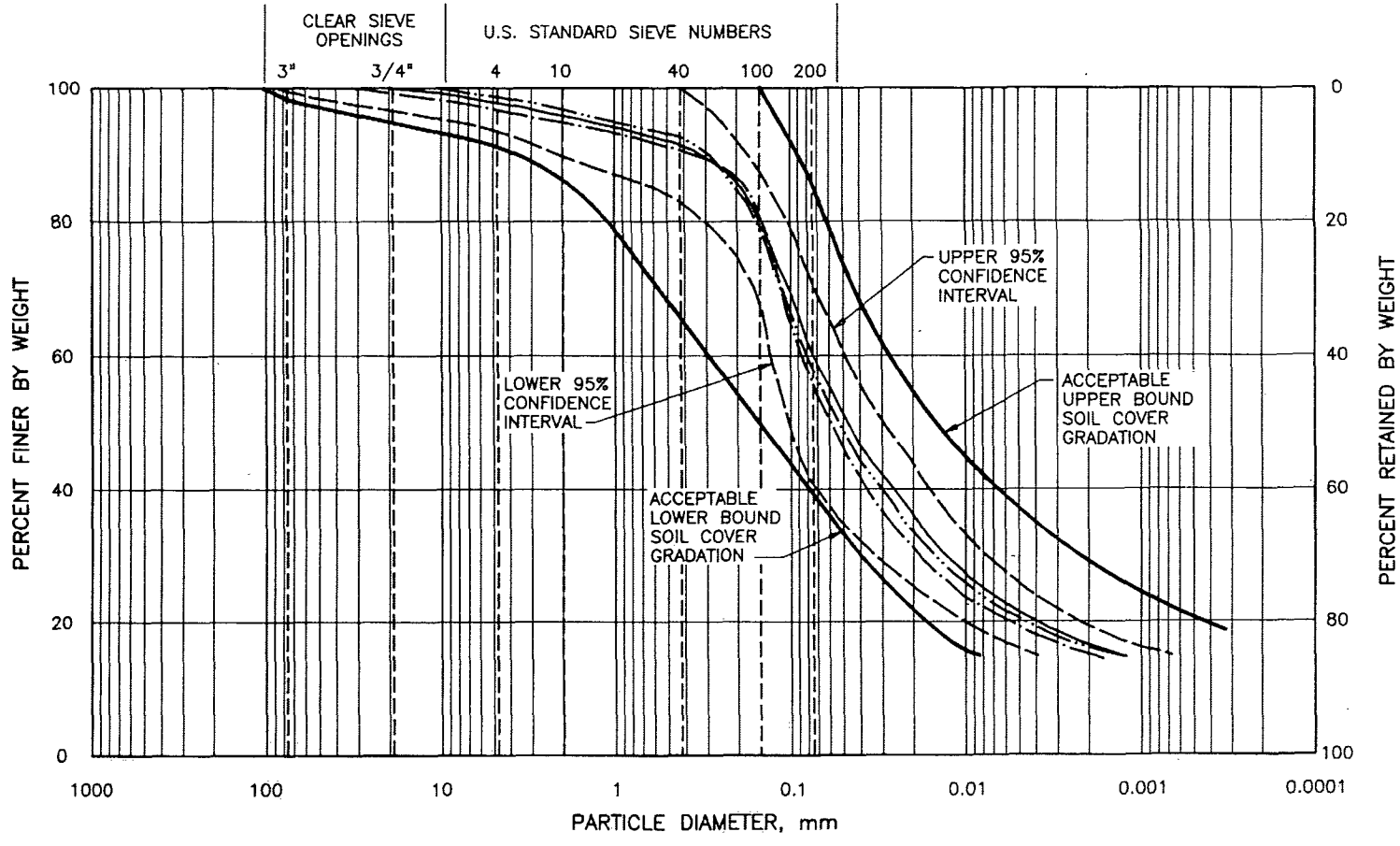
Swale Designation	Length (ft)	Slope (ft/ft)	Bottom Width (ft)	Peak Discharge (cfs)	Depth of Flow (ft)	Minimum Swale Depth (ft)	Riprap D 50 (in)	Riprap Thickness (in)
A	2,600	0.0038	10	40	0.98	2.0	1.5	3.0
B	3,600	0.0083	20	97	0.97	2.0	1.5	3.0
C	3,400	0.0050	10	75	1.38	2.0	1.5	3.0
D	3,200	0.0028	10	68	1.43	2.0	1.5	3.0
E	1,350	0.0037	10	85	1.53	2.5	1.5	3.0
F	1,600	0.0031	10	126	2.00	2.5	1.5	3.0
G	1,400	0.0021	10	99	1.88	2.5	1.5	3.0
H	2,550	0.0085	20	284	1.90	2.5	3.0	6.0
I	550	0.0040	20	385	2.65	3.5	3.0	6.0
J	1,900	0.0047	10	101	1.66	2.5	1.5	3.0

Note: See Figures 5-1 and 5-2 for swale locations.

FIGURES

FIGURES

DRAWING NUMBER 86-060-B591



NOTES:

1. AVERAGES DERIVED FROM AVAILABLE FIELD AND LABORATORY TEST DATA TO DATE IN DESIGNATED BORROW AREAS.
2. AFTER DRAWING NO. 86-060-B497 (FIGURE 1) IN THE MARCH 4, 1991 RESPONSE TO NRC COMMENTS.

LEGEND:

- AVERAGE PIPELINE ARROYO BORROW SOILS
- AVERAGE NORTH AND CENTRAL CELLS INTERIM COVER SOILS
- AVERAGE EXISTING SOIL STOCKPILE SOILS

ACCEPTABLE SOIL COVER GRAIN SIZE ENVELOPE

PREPARED FOR

UNC MINING AND MILLING
GALLUP, NEW MEXICO

Canonie Environmental

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1	8-24-91	ISSUED FOR 1991 RECLAMATION PLAN	R.H.	DWK	DHG

DATE: 6-21-91	FIGURE B-1	DRAWING NUMBER 86-060-B591
SCALE: AS SHOWN		

1

APPENDIX
C

APPENDIX C

RADON MODEL CALCULATION, LONG-TERM MOISTURE LAB TEST RESULTS AND BULK DENSITY CALCULATIONS

Canonie Environmental

C-1

By mjg Date 2/20/91 Subject UNC Sheet No. 1 of

Chkd. By SJM Date 3-1-91 RADON BARRIER Proj. No. 86-060-24

1/4" X 1/4"

PURPOSE: TO DETERMINE THE REQ'D SOIL COVER THICKNESS TO LIMIT RADON EMISSIONS FROM THE RECLAIMED UNC TAILINGS IMPOUNDMENT TO 20 pCi/m²/sec USING NRC APPROVED METHODS AND INPUTS

METHOD: DETERMINE GEOTECHNICAL AND RADIOLOGICAL PROPERTIES OF THE TAILINGS AND SOIL COVER MATERIALS BASED ON NRC-ACCEPTABLE METHODS. USE THE EXISTING DATABASE OF VALUES INCLUDING INTERIM RECLAMATION OF THE NORTH AND CENTRAL CELLS AND OTHER PARAMETERS AS DISCUSSED AND AGREED ON WITH NRC. INPUT APPROPRIATE PARAMETERS INTO THE RADON COMPUTER CODE.

RESULTS: FOR THE FOLLOWING INPUTS, THE REQUIRED THICKNESS IS 1.5 FEET.

LAYER	POROSITY	MASS DENSITY	RADIUM ACTIVITY	MOISTURE CONTENT	DIFF COEFF	EMAN FRACTION	THICK
FINE TAILS	0.48	1.45 g/cc	547 pCi/gm	6.0%	0.040 cm²/sec	0.26	16.4 ft
COARSE TAILS	0.47	1.56 g/cc	154 pCi/gm	6%	0.036 cm²/sec	0.26	7.0
COVER	0.33	1.73	0	12.9%	0.0036 cm²/sec	NA	1.5 ft

Canonie Environmental

C-2

By mpj Date 2/20/91 Subject UNC Sheet No. 2 of

Chkd. By [illegible] Date 3-1-91 RADON BARRIER Proj. No. 86-060-34

1/4" X 1/4"

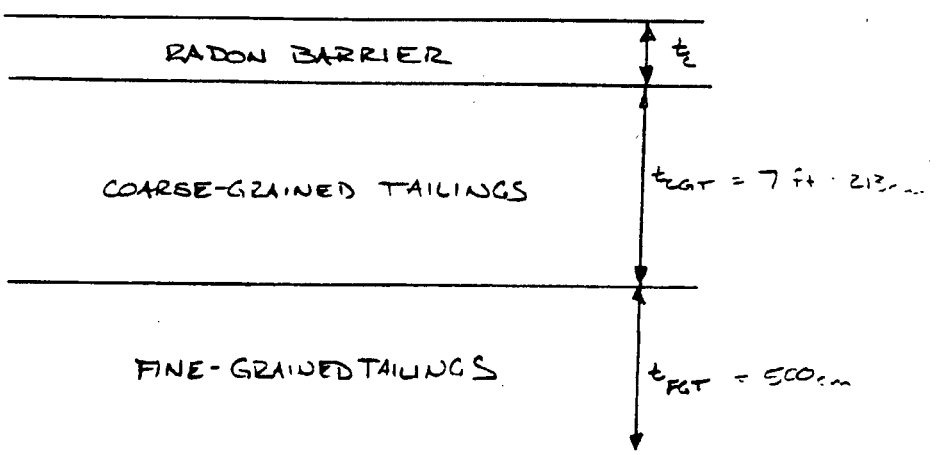
CALCULATIONS

THE RADON CODE REQUIRES INPUT OF THE FOLLOWING PARAMETERS FOR ALL TAILINGS AND SOIL COVER LAYERS:

- LAYER THICKNESS (cm);
- POROSITY;
- MASS DENSITY (g/cm^3);
- RADIUM ACTIVITY (pCi/g), SOURCE TERM ($pCi/cm^2 s$) OR ORE GRADE PERCENTAGE;
- EMANATION COEFFICIENT
- WEIGHT PERCENT MOISTURE (LONG-TERM); AND

INPUTS HAVE BEEN DEVELOPED IN ACCORDANCE WITH NRC-ACCEPTED CRITERIA AND HAVE BEEN AGREED ON WITH NRC

THE FOLLOWING SOIL PROFILE WILL BE MODELED.



LAYER THICKNESSES

THE THICKNESS OF THE FINE-GRAINED TAILINGS (t_{FGT}) WILL BE ASSUMED TO BE EFFECTIVELY AN INFINITELY THICK RADON SOURCE. IN ACCORDANCE WITH NRC CRITERIA (REG GUIDE 3.64, p 3.64-5) A VALUE OF 500 cm WILL BE USED.

$t_{FGT} = 500 cm$

A MINIMUM OF 7 FEET OF COARSE TAILINGS ARE TO BE PLACED OVER FINE-GRAINED TAILINGS DURING REGRADING OF THE TAILINGS IMPOUNDMENT. THIS OPTIMIZES THE COARSE-GRAINED TAILINGS EFFECTIVENESS IN REDUCING RADON FLUX FROM THE FINE-GRAINED TAILINGS. ACCORDINGLY THE THICKNESS OF COARSE-GRAINED TAILINGS, t_{CGT} = 7 ft or 213 cm

$t_{CGT} = 213 cm$

THE SOIL COVER THICKNESS WILL BE OPTIMIZED BY THE RADON COMPUTER CODE.

$t_c = ?$

MASS DENSITY

THE MASS DENSITY OF THE FINE-GRAINED TAILINGS IS OBTAINED BY AVERAGING IN-SITU BULK DRY DENSITIES OF SAMPLES OBTAINED FROM THE SITE AND INCREASING BY 5% TO ACCOUNT FOR CONSOLIDATION. TABLE 1, ATTACHED, PRESENTS THE IN-SITU DENSITY DATA. THE AVERAGE IN-SITU DRY DENSITY OF THE FINE GRAINED TAILINGS IS 86 pcf. INCREASE 5% FOR CONSOLIDATION EQUALS 90 pcf

$$\rho_{FGT} = 90 pcf / 62.4 pcf/g/cm^3 = 1.45 g/cm^3$$

MASS DENSITY (CONT.)

THE MASS DENSITY OF COARSE-GRAINED TAILINGS IS OBTAINED BY AVERAGING INSITU DRY BULK DENSITIES OF SAMPLES OBTAINED DURING INVESTIGATION ACTIVITIES PRIOR TO DEVELOPMENT OF THE RECLAMATION PLAN. TABLE 2, ATTACHED, SHOWS THAT THE AVERAGE DRY BULK DENSITY FROM 11 SAMPLES IS 97.5 pcf. THIS IS CONSERVATIVE AS COARSE TAILINGS PLACED OVER FINE-GRAINED TAILINGS WILL BE COMPACTED BY EQUIPMENT TRAFFIC AND THE TOP 1 FT MUST BE COMPACTED TO 95% RELATIVE COMPACTION DENSITY. THE CONSERVATIVE VALUE OF 97.5 pcf WILL BE USED

$$\rho_{CGT} = 97.5 \text{ pcf} / 62.4 \text{ pcf}/\text{g/cm}^3 = 1.56 \text{ g/cm}^3$$

THE MASS DENSITY OF THE COMPACTED SOIL COVER IS OBTAINED BY DEVELOPING AVERAGE STD PROCTOR MAXIMUM DRY DENSITIES FROM INTERIM RECLAMATION SOIL COVER PLACEMENT TO DATE FOR ACCEPTABLE SOIL COVER MATERIALS IN 3 CLASSIFICATIONS. FIGURE 1 SHOWS THE ACCEPTABLE GRADATION RANGE FOR SOIL COVER MATERIAL. CLASSIFICATIONS FOR DENSITIES WILL BE FOR USCS CLASSIFICATIONS CL, ML, AND SM-SC. THEN, THE EXISTING DATABASE OF SOIL SAMPLE GRADATION ANALYSES WILL BE USED TO DETERMINE THE RELATIVE PROPORTION OF EACH ACCEPTABLE SOIL TYPE (CL, ML, SM-SC) IN THE BORROW AREAS ON-SITE. THE AVERAGE MAXIMUM DRY DENSITY FOR EACH SOIL TYPE WILL BE SUBJECT TO A WEIGHTED AVERAGE CALCULATION USING THE PROPORTIONS OF THOSE SOIL TYPES ON-SITE

Canonie Environmental

C-5

By [illegible] Date 2/20/91 Subject LINC Sheet No. 5 of ___

Chkd. By [illegible] Date 3-1-91 RAVEN BAILER Proj. No. E6-060C-2d

1/4" X 1/4"

MAX. PROCTOR DRY DENSITIES FOR LOW PLASTICITY CLAYS (CL)

LOCATION	$\gamma_{dry\,max}$ (PCF)
NORTH CELL	109.2
	113.2
	113.7
	110.1
	109.0
CENTRAL CELL	114.6
	113.0
	112.3
AVG =	111.9

MAX PROCTOR DRY DENSITIES FOR SILTS (ML)

LOCATION	$\gamma_{dry\,max}$ (PCF)
NORTH CELL	116.9
CENTRAL CELL	111.3
	114.1

MAX. PROCTOR DRY DENSITY FOR SILTY AND CLAYEY SANDS (SC-SM)

LOCATION	$\gamma_{dry\,max}$ (PCF)
NORTH CELL	119.1
	115.5
	121.0
	114.7
	112.2
	~~118.3~~ DOES NOT MEET GRADATION SPEC.
CENTRAL CELL	114.7
	118.0
AVG =	116.5

USE GRADATION ANALYSES FROM BORROW AREA AND INTERIM SOIL COVER SAMPLES TO DETERMINE THE PROPORTION OF EACH SOIL TYPE ON-SITE.

TABLE 3 PRESENTS CLASSIFICATION DATA FOR INTERIM SOIL COVER SAMPLES. TABLE 4 PRESENTS CLASSIFICATION DATA FOR POTENTIAL BORROW SOILS IN PIPELINE ARROYO. TABLE 5 PRESENTS CLASSIFICATION DATA FOR THE BORROW PIT 2 STOCKPILE.

NOTE: SOIL SAMPLES NOT MEETING THE GRADATION REQ'MTS SHOWN ON FIGURE 1 WILL NOT BE USED IN THE EVALUATION. HOWEVER, ONCE OUT OF SPEC SOILS FROM THE BORROW AREA ARE LOADED IN A SCRAPER, DUMPED, SPREAD, COMPACTED AND MIXED W/ OTHER BORROW SOILS ON THE SOIL COVER, IT WILL LIKELY MEET SPECIFICATIONS.

ASSUME THAT SAMPLES LISTED IN TABLES 3 THRU 5 ARE REPRESENTATIVE OF BORROW SOILS ON SITE. THEREFORE

20/39 SAMPLES (51%) ARE CL,
12/39 SAMPLES (31%) ARE SM-SC; and
7/39 SAMPLES (18%) ARE ML

CALCULATE A WEIGHTED AVERAGE MAX DRY DENSITY FOR THE COMPACTED SOIL COVER.

$$\gamma_{d_{max}} = \frac{20\,(111.9\text{ pcf}) + 12\,(116.5\text{ pcf}) + 7\,(114.1)}{39}$$

$$\gamma_{d_{max}} = 113.7 \text{ pcf}$$

ALL COVER SOILS MUST BE COMPACTED TO A MINIMUM OF 95% OF MAX. STD. PROCTOR DRY DENSITY, THEREFORE

$$\gamma_{min_{DRY}} = 0.95\,(113.7) = 108.0 \text{ pcf} \quad [\rho_d = 1.73]$$

Canonie Environmental

C-7

By mm Date 2/20/91 Subject LINC Sheet No. 7 of

Chkd. By SWM Date 3-1-91 RADON BARRIER Proj. No. 86-060-24

1/4" X 1/4"

NOTE: USE OF γ_{dry} = 108.0 pcf FOR THE SOIL COVER IS CONSERVATIVE. ACTUAL IN PLACE DENSITY TESTS PERFORMED ON THE INTERIM SOIL COVE OF THE NORTH AND CENTRAL CELLS OF THE TAILINGS IMPOUNDMENT HAVE SHOWN THAT THE AVERAGE DRY DENSITY OF THE SOIL COVER IS 113.6 pcf FOR THE NORTH CELL AND 111.1 pcf FOR THE CENTRAL CELL. THESE TESTS WERE PERFORMED AS PART OF CONSTRUCTION QC DURING THE CONSTRUCTION SEASONS OF 1989 AND 1990, RESPECTIVELY.

Canonie Environmental

C-8

By [illegible] Date 2/12/91 Subject UNC Sheet No. 3 of ___

Chkd. By [illegible] Date 3-1-91 TAILINGS BARRIER Proj. No. 96-060-24

1/4" X 1/4"

POROSITY

THE POROSITY OF THE FINE-GRAINED TAILINGS WILL BE CALCULATED USING THE CALCULATED BULK DENSITY AND THE AVERAGE SPECIFIC GRAVITY PRESENTED ON TABLE 1

$$e = G_s \rho_w / \rho_d - 1$$
$$= 2.78 (1/1.45) - 1 = 0.92$$
$$n = e/1+e = .92/1.92$$

$$n = 0.48$$

IN-SITU POROSITIES OF SAMPLES OF COARSE-GRAINED TAILINGS IS PRESENTED IN TABLE 2. USE THE OUTER-BOUND 95% CONFIDENCE UPPER VALUE OF 0.47

THE SOIL COVER POROSITY IS CALCULATED FROM BULK DENSITY AND SPECIFIC GRAVITY

$$e = 2.6 (1/1.73) - 1$$
$$= 0.50$$

$$n = 0.50/1.50 = 0.33$$

$$n_c = 0.33$$

CanonieEnvironmental

C-9

By mm Date 2/20/91 Subject UMC Sheet No. 9 of

Chkd. By [illegible] Date [illegible] RADON BARRIER Proj. No. 86-06[illegible]-24

1/4" X 1/4"

RADIUM ACTIVITY, SOURCE TERM, OR ORE GRADE %

RADIUM ACTIVITY WILL BE INPUT FOR TAILINGS

THE RADIUM ACTIVITY INPUT FOR THE FINE-GRAINED TAILINGS WILL BE TAKEN FROM MEASURED VALUES WHICH ARE PRESENTED IN TABLE 1. THE AVERAGE VALUE WILL BE CHOSEN. THIS VALUE IS 547 pCi/gm

$$R_{FGT} = 547 \text{ pCi/gm}$$

THE RADIUM ACTIVITY INPUT VALUE FOR THE COARSE-GRAINED TAILINGS WILL BE TAKEN FROM MEASURED VALUES WHICH ARE PRESENTED IN TABLE 2. THE AVERAGE VALUE WILL BE CHOSEN. THIS VALUE IS 154 pCi/gm

$$R_{CGT} = 154 \text{ pCi/gm}$$

THE RADIUM ACTIVITY OF THE COVER MATERIALS ARE ASSUMED TO BE Ø pCi/g PER NRC GUIDANCE (REF: PAGE 10, REG. GUIDE 3.64) SINCE SOIL COVER MAT'LS ARE NOT ASSOCIATED WITH THE ORE BODY OR RADIUM-ENRICHED SOILS. SINCE R = 0, → SOURCE TERM = 0
INPUT SOURCE TERM CONC = 0 FOR COVER IN RADON

Canonie Environmental

C-10

By [illegible] Date 2/20/91 Subject UNC Sheet No. 11 of ___

Chkd. By [illegible] Date [illegible] RADON INPUT Proj. No. [illegible]

1/4" X 1/4"

EMANATION COEFFICIENT

EMANATION COEFFICIENT INPUT FOR THE FINE-GRAINED TAILINGS WILL BE DETERMINED FROM MEASURED VALUES WHICH ARE PRESENTED IN TABLE 1. THE AVERAGE VALUE WILL BE CHOSEN. THIS VALUE IS 0.26

$$E_{FAT} = 0.26$$

THE EMANATION COEFFICIENT INPUT FOR COARSE-GRAINED TAILINGS WILL BE DETERMINED FROM MEASURED VALUES WHICH ARE PRESENTED IN TABLE 2. THE AVERAGE VALUE WILL BE CHOSEN. THIS VALUE IS 0.26

$$E_{CGT} = 0.26$$

AN EMANATION COEFFICIENT FOR THE SOIL COVER IS NOT REQUIRED FOR INPUT INTO RADON.

NOTE: USE OF NRC'S DEFAULT VALUE OF E=0.35 FOR TAILINGS IS NOT CONSIDERED APPROPRIATE SINCE LABORATORY ANALYSES OF EMANATION COEFFICIENTS ARE AVAILABLE

Canonie Environmental

By [illegible] Date 2/20/91 Subject UMC Sheet No. 11 of ___
Chkd. By [illegible] Date ___ RAISON RAPPRITE Proj. No. 84-060-24
1/4" X 1/4"

LONG-TERM MOISTURE CONTENT

NRC CONSIDERS SEVERAL METHODS OF DETERMINING LONG-TERM MOISTURE CONTENTS TO BE ACCEPTABLE (REF: SECTION 1.1.3, REG GUIDE 3.64) THESE ACCEPTABLE METHODS INCLUDE:

- IN-SITU MEASUREMENTS;
- UNSATURATED FLOW COMPUTER MODELS;
- LAB TESTING FOR WILTING POINT MOISTURE; AND
- THE RAWLS/BRAKENSKI EMPIRICAL EQUATION FOR WILTING POINT MOISTURE.

SEVERAL METHODS FOR EACH SOIL TYPE WILL BE USED TO DETERMINE LONG-TERM MOISTURE FOR THAT SOIL.

FINE-GRAINED TAILINGS

TABLE 1 PRESENTS IN-SITU MOISTURE CONTENTS FOR FINE-GRAINED TAILINGS. THE AVERAGE IN-SITU MOISTURE CONTENT WAS DETERMINED TO BE 38.7% WITH A 95% CONFIDENCE INTERVAL OF 29.7% TO 47.7%. THE WORST-CASE (CONSERVATIVE) 95% CONFIDENCE INTERVAL VALUE OF 29.7% WILL BE USED FOR COMPARISON.

THE RAWLS EMPIRICAL EQUATION IS:

$\theta = 0.026 + 0.005Z + 0.0158Y$ WHERE

θ = VOLUMETRIC LONG-TERM MOISTURE CONTENT

Y = ORGANIC MATTER CONTENT (%) OF THE SOIL

Z = CLAY FRACTION OF THE SOIL (%)

(REF: PG 9, REG. GUIDE 3.64)

ASSUME Y = 0 AND FROM TEST RESULTS IN ATTACHMENT:

$Z = 13 + 6/2 = 9.5\%$

$\theta = 0.026 + 0.005(9.5) + 0.0158(0)$

$\theta = 0.0735 = 7.35\%$

CONVERT TO WT. PERCENT MOISTURE

$$mc_w = \frac{mc_v \rho_w}{\epsilon_{FLT}} = \frac{7.4(1)}{1.45} = 5\%$$

THIS IS LOWER THAN NRC'S DEFAULT VALUE THEREFORE, USE THE DEFAULT VALUE OF 6%

$$mc_{FLT} = 6\%$$

COARSE-GRAINED TAILINGS

TABLE 2 PRESENTS IN-SITU MOISTURE CONTENTS FOR COARSE-GRAINED TAILINGS. THE AVERAGE IN-SITU MOISTURE CONTENT WAS DETERMINED TO BE 21.5% WITH A RANGE OF 6.1% TO 34.1%. THE AVERAGE MOISTURE CONTENT IS NOT CONSIDERED REPRESENTATIVE OF LONG-TERM CONDITIONS

THE LONG-TERM MOISTURE OF COARSE-GRAINED TAILINGS IS EXPECTED TO APPROACH THAT OF NATURAL SOILS HAVING A SIMILAR PARTICLE SIZE GRADATION. A REVIEW OF PREVIOUS GEOTECHNICAL REPORTS (SHB, 1978) IDENTIFIED THE MOISTURE CONTENTS OF SIMILAR NON-TAILINGS SANDS FOUND ON-SITE 79 SAMPLES WERE SELECTED BASED ON A GRADATION SIMILAR TO THAT OF THE COARSE TAILINGS. MOISTURE CONTENTS FOR THESE SAMPLES WERE ANALYZED TO ESTIMATE THE LONG-TERM MOISTURE OF COARSE-TAILINGS. THE AVERAGE MC WAS 10.1%

THE RAWLS/BRAKENSKI EMPIRICAL EQUATION CAN ALSO BE USED. IT IS ANTICIPATED THAT THE FINES CONTENT OF THE COARSE-GRAINED TAILINGS IS APPROXIMATELY 15% TO 25%. ASSUME A 10% FRACTION OF [illegible] MATERIAL

$$\theta = 0.026 + 0.005(10) - 0.015\rho_d$$

$$\theta = 7.6\%$$

CONVERT TO WT PERCENT MOISTURE

$$wc_w = \frac{7.6\,(1)}{1.56} = 5\%$$

THIS IS BELOW THE DEFAULT VALUE. THEREFORE USE NRC'S DEFAULT VALUE FOR TAILINGS LONG-TERM MOISTURE IS 6%

THEREFORE, CHOOSE THE COARSE TAILINGS LONG-TERM MOISTURE CONTENT TO BE 6% FOR CONSERVATISM.

$$MC_{LT_{C\&T}} = 6\%$$

SOIL COVER

THE LONG-TERM MOISTURE CONTENT OF THE SOIL COVER MATERIAL WILL BE CALCULATED 3 WAYS. A LITERATURE-BASED VALUE IS ALSO AVAILABLE FOR COMPARISON.

Canonie Environmental

C-14

By [illegible] Date 2/20/91 Subject [illegible] Sheet No. 14 of ___

Chkd. By [illegible] Date [illegible] RADON BARRIER Proj. No. 86-060-2-1

1/4" X 1/4"

A COVER SOIL SAMPLE WAS LABORATORY TESTED FOR DETERMINATION OF LONG-TERM MOISTURE. THE SAMPLE WAS SUBJECT TO A TENSION OF 15 ATMOSPHERES WHICH IS THE NRC-ACCEPTED CRITERIA FOR THE PERMANENT WILTING POINT OR LONG-TERM MOISTURE. TEST METHOD ASTM-D-3152 WAS PERFORMED ON THE SAMPLE WHICH HAD A -200 FRACTION OF 65%. THAT IS 8% MORE FINES THAN THE AVERAGE SOIL SHOWN ON FIG 1. THE LONG-TERM MOISTURE WAS DETERMINED TO BE 13.6%.

THE RAWLS EQUATION CAN BE CALCULATED TO DETERMINE THE LONG-TERM MOISTURE CONTENT. THE CLAY FRACTION CAN BE TAKEN FROM FIGURE 1, THE ALLOWABLE SOIL COVER GRADATION.

THE AVG CLAY FRACTION (0.002 mm) IS 18%

$$\theta = 0.026 + 0.005(18) = 11.6\%$$

$$mc_w = 11.6\left(1/1.73\right) = 7\%.$$ THIS IS CONSIDERED TOO CONSERVATIVE.

UNSLEY AND FRANZINI REPORT THAT THE LONG-TERM (WILTING POINT) MOISTURE OF A SILTY LOAM SOIL IS APPROXIMATELY 13%. THE AVG SOIL FROM FIGURE 1 IS GENERALLY A CL OR AT WORST AN ML. THEREFORE THIS VALUE IS APPROPRIATE AND CONSERVATIVE.

IN-SITU MOISTURE CONTENTS FOR SAMPLES MEETING THE GRADATION REQUIREMENT OF FIGURE 1.[illegible] THE 120 cm TO 500 cm DEPTH CRITERIA OF REG GUIDE 3.64 WERE ANALYZED, THIS DATA IS DIRECTLY CORRELATED TO LOW INITIAL MOISTURE CONTENT.

47 SAMPLES MEETING THE CRITERIA AND LOCATED IN POTENTIAL BORROW SOURCES WERE IDENTIFIED. THE AVG. MOISTURE CONTENT WAS 12.9%. THIS CALC IS REPEATED IN ATTACH. CALC BRIEF.

THE VALUE OF 12.9% WILL BE USED AS INPUT TO THE DALTON MODEL

DIFFUSION COEFFICIENTS

DIFFUSION COEFFICIENTS WILL BE DETERMINED BY THE COMPUTER MODEL.

---------- RADON ----------

Version 1.2 - MAY 22, 1989 - G.F. Birchard tel.# (301)492-7000
U.S. Nuclear Regulatory Commission Office of Research

RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

UNC RADON BARRIER 2/91

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	3	
DESIRED RADON FLUX LIMIT	20	pCi m^-2 s^-1
NO. OF THE LAYER TO BE OPTIMIZED	3	
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
SURFACE FLUX PRECISION	.001	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1 FINE-GRAINED TAILINGS

THICKNESS	500	cm
POROSITY	.48	
MEASURED MASS DENSITY	1.45	g cm^-3
MEASURED RADIUM ACTIVITY	547	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.26	
CALCULATED SOURCE TERM CONCENTRATION	9.022D-04	pCi cm^-3 s^-1
WEIGHT % MOISTURE	6	%
MOISTURE SATURATION FRACTION	.181	
CALCULATED DIFFUSION COEFFICIENT	4.003D-02	cm^2 s^-1

LAYER 2 COARSE-GRAINED TAILINGS

THICKNESS	213	cm
POROSITY	.47	
MEASURED MASS DENSITY	1.56	g cm^-3
MEASURED RADIUM ACTIVITY	154	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.26	
CALCULATED SOURCE TERM CONCENTRATION	2.791D-04	pCi cm^-3 s^-1
WEIGHT % MOISTURE	6	%
MOISTURE SATURATION FRACTION	.199	
CALCULATED DIFFUSION COEFFICIENT	3.759D-02	cm^2 s^-1

LAYER 3 SOIL DOWN

THICKNESS	50	cm
POROSITY	.33	
MEASURED MASS DENSITY	1.73	g cm^-3
MEASURED SOURCE TERM CONCENTRATION	0	pCi cm^-3 s^-1
WEIGHT % MOISTURE	12.9	%
MOISTURE SATURATION FRACTION	.676	
CALCULATED DIFFUSION COEFFICIENT	3.569D-03	cm^2 s^-1

✓ Sim
3-1-91

BARE SOURCE FLUX FROM LAYER 1: 5.815D+02 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	1.895D+02	2.821D+05
2	2.130D+02	3.418D+01	1.657D+05
3	4.562D+01	1.998D+01	0.000D+00

18in = 1.5 ft

TABLES

TABLE 1

Fine-Grained Tailings Laboratory Test Data

General Description	Boring Number	Depth	Specific Gravity	Dry Bulk Density (pcf)	Porosity	Moisture Content (%)	Radium Content (pCi/g)	Diffusion Coefficient (cm^2/sec)	Emanation Coefficier
Fine-Grained Tailings Slimes	659	37.5'	2.72	78	.54	29.6	602	0.0056	0.16
	660	8.0'	2.81	74	.58	44.27	341	0.0000011	0.37
	660	15.0'	2.84	94	.47	60.0	1099	0.0000016	0.31
	660	27.5'	2.75	89	.48	32.2	285	0.0000016	0.26
	660	37.5'	2.84	79	.56	41.4	526	0.0000027	0.28
	662	40.0'	2.72	84	.51	36.4	574	0.0000062	0.21
	662	42.5'		89	.55	43.8			
	658	10.0'	2.81	88	.50	17.4	402	0.0067	0.22
	658	32.5'		97	.55	43.6			
Averages			2.78	86	.53	38.7	547	1.76×10^{-3}	.26
95 Percent Confidence Interval			2.73 to 2.83	N.A.	0.50 to 0.56	29.7 to 47.7	296 to 798	0.00022 to 0.0053	0.20 to 0.32

TABLE 2

Coarse Tailings Laboratory Test Data

General Description	Boring Number	Depth	Specific Gravity	Dry Bulk Density (pcf)	Porosity	Moisture Content (%)	Radium Content (pCi/g)	Diffusion Coefficient (cm^2/sec)	Emanation Coefficien
Tailings Sands	658	15'		105	.40				
	658	20'	2.83	104	.41	23.5	160	0.0000053	0.32
	658	30'	2.81	98	.44	23.4	141	0.000019	0.27
	658	40'	2.89	92	.49	31.2	212	0.000002	0.25
	659	10'	2.84	95	.46	6.1	125	0.037 *	0.18
	659	20'	2.83	94	.47	10.5	227	0.023 *	0.21
	659	30'	2.74	97	.43	13.1	132	0.016 *	0.20
	659	32.5'		106	.47	8.1	115	0.042 *	0.27
	662	20'		97	.49	34.1			
	662	25'	2.78	96	.36	25.1	108	0.0000025	0.33
	662	30'	2.79	94	.46	29.6	177	0.0000013	0.28
Supplemental							143.1		
Averages			2.81	97.5	0.45	21.5	154	0.029	0.26
95 percent Confidence Interval			2.77 to 2.84	N.A.	0.43 to 0.47	N.A.	125.0 to 183.0	0.018 to 0.047	0.25 to 0.27

TABLE 5

SUMMARY OF GEOTECHNICAL PROPERTIES
NORTH AND CENTRAL CELL INTERIM COVER SOILS

Estimated Borrow Volume: 45,000 cubic yards

Sample Identification	Depth of Sample	Liquid Limit	Plasticity Index	Unified Soil Classification	(U.S. Standard Sieve Size Numbers) Percent Passing 200	100	40	10	4	3/8	3/4
North Cell:											
89 NC-1	0-5	26	10	CL	61	80	94	96	96		100
89 NC-2	0-5	--	NP	SM	47	70	92	98	99	100	
89 NC-3	0-5	27	10	CL	61	84	95	98	100		
89 NC-4	0-4	33	16	CL	70	89	97	99	100		
89 NC-5	0-1	--	NP	SM	45	69	99	100			
89 NC-6	0-1	25	8	CL	56	76	87	92	97	100	
~~89 NC-7~~	~~0-2~~	~~27~~	~~8~~	~~SC - SM~~	~~68~~	~~63~~	~~70~~	~~74~~	~~79~~	~~86~~	~~93~~
89 NC-8	0-1	31	13	CL	63	80	96	97	98	99	100
89 NC 9	0-1	34	17	CL	60	85	98	99	100		
~~89 NC 10~~	~~0-1~~		~~NP~~	~~SM~~	~~20~~	~~25~~	~~43~~	~~48~~	~~56~~	~~63~~	~~73~~
89 NC-11	0-1	22	7	SC - SM	43	63	90	98	99	99	100
89 NC-12	0-1	43	21	CL	63	82	100				
Central Cell:											
90 CC-1	SURFACE	27	9	CL	60	83	94	96	97	99	100
90 CC-2	SURFACE	32	16	CL	61	84	96	99	100		
90 CC-3	SURFACE	35	15	CL	65	86	96	98	99	100	
90 CC-4	SURFACE	30	15	CL	68	86	96	98	99	100	
90 CC-5	SURFACE	31	11	CL	66	87	96	98	99	100	
90 CC-6	SURFACE	26	12	SC	48	56	90	93	94	96	98
90 CC-7	SURFACE	26	8	CL	59	85	95	97	98	99	100
				~~Average:~~	~~50.0~~	~~75.4~~	~~90.7~~	~~93.6~~	~~95.3~~	~~96.9~~	~~98.1~~
				~~Standard Deviation:~~	~~11.9~~	~~15.5~~	~~13.5~~	~~12.4~~	10.6	8.82	6.10
				95 Percent Confidence Level (+/-):	2.33	6.96	5.97	5.59	4.78	3.97	2.03

Notes:

1. NP = Non plastic.
2. All results listed above are laboratory test results obtained from the "North Cell Interim Stabilization As-Built Report" dated January 1990 and preliminary field data from the Central Cell Interim Stabilization.

TABLE 4

SUMMARY OF GEOTECHNICAL PROPERTIES
PIPELINE ARROYO BORROW MATERIAL

Estimated Borrow Volume: 300,000 cubic yards

Sample Identification	Depth of Sample	Liquid Limit	Plasticity Index	Unified Soil Classification	Grain Size Analysis (U.S. Standard Sieve Size Numbers) Percent Passing 200	100	40	10	4	3/8	3/4
~~74 SHB-2~~	~~10~~	~~38~~	~~20~~	~~CL~~	~~93~~	~~98~~	~~99~~	~~99~~	~~100~~		
78 SHB-7	2.5-4.5	26	5	ML CL	57	84	99				
~~78 SHB-7~~	~~4.0-5.5~~	~~--~~	~~NP~~	~~SM~~	~~81~~	~~67~~	~~99~~				
78 SHB-8	9.5-10.5	31	14	CL	63	84	96	98	100		
78 SHB-13	0-1.5	22	1	SM	49	81	99				
78 SHB-14	0-1.5	28	12	CL	57	80	91	94	95	99	100
~~78 SHB-30~~	~~9.5-11~~	~~--~~	~~NP~~	~~SM~~	~~23~~	~~74~~	~~100~~				
78 SHB-31	4.5-6	29	14	CL	55	79	90	95	98	100	
78 SHB-42	4.5 6	28	14	CL	65	74	82	87	92	96	100
~~86 RP-P2~~	~~10.5-11~~	~~NI~~	~~NI~~	~~CL~~	~~100~~						
86 RP-P3	10.5-11	NI	NI	SM	66	96	100				
~~86 RP-P4~~	~~5.5-6~~	~~NI~~	~~NI~~	~~SM ML~~	~~82~~	~~56~~	~~84~~	~~97~~	~~98~~	~~100~~	
86 RP-P5	0 3	NI	NI	ML	65	86	98	99	100		
86 RP-P5	3 6	NI	NI	ML	68	87	98	99	99	100	
86 RP P5	6-6.5	NI	NI	SM	48	83	95	97	98	100	
86-RP-P6	0 3	NI	NI	CL	70	89	98	99	100		
86 RP P6	3 6	NI	NI	SM	51	80	97	98	99	99	100
~~86-RP-P8~~	~~11-11.5~~	~~NI~~	~~NI~~	~~ML~~	~~93~~	~~99~~	~~100~~				
~~86-RP-TP1~~	~~5-6~~	~~NI~~	~~NI~~	~~SM~~	~~18~~	~~52~~	~~87~~	~~97~~	~~99~~	~~100~~	
86 RP-TP2	6-7	NI	NI	SM ML	40	67	95	97	98	100	
86 RP-TP3	0-10	NI	NI	CL ML	85	97	99	100			
				~~Average:~~	~~50.5~~	80 6	95 5	97.9	98.8	99.7	100 0
				~~Standard Deviation:~~	~~22.5~~	16.0	5.48	3.05	2.02	0.90	0 0
				~~95 Percent Confidence Level (+/-):~~	~~9.01~~	~~6.84~~	~~2 34~~	~~1.38~~	~~0.86~~	~~0 39~~	0 0

Notes:

1. NI - Not tested.
2. NP - Non plastic.
3. Data also include the South Diversion Ditch and the Runoff Control Ditch material

Canonie Environmental

TABLE 5

SUMMARY OF GEOTECHNICAL PROPERTIES
EXISTING SOIL STOCKPILE

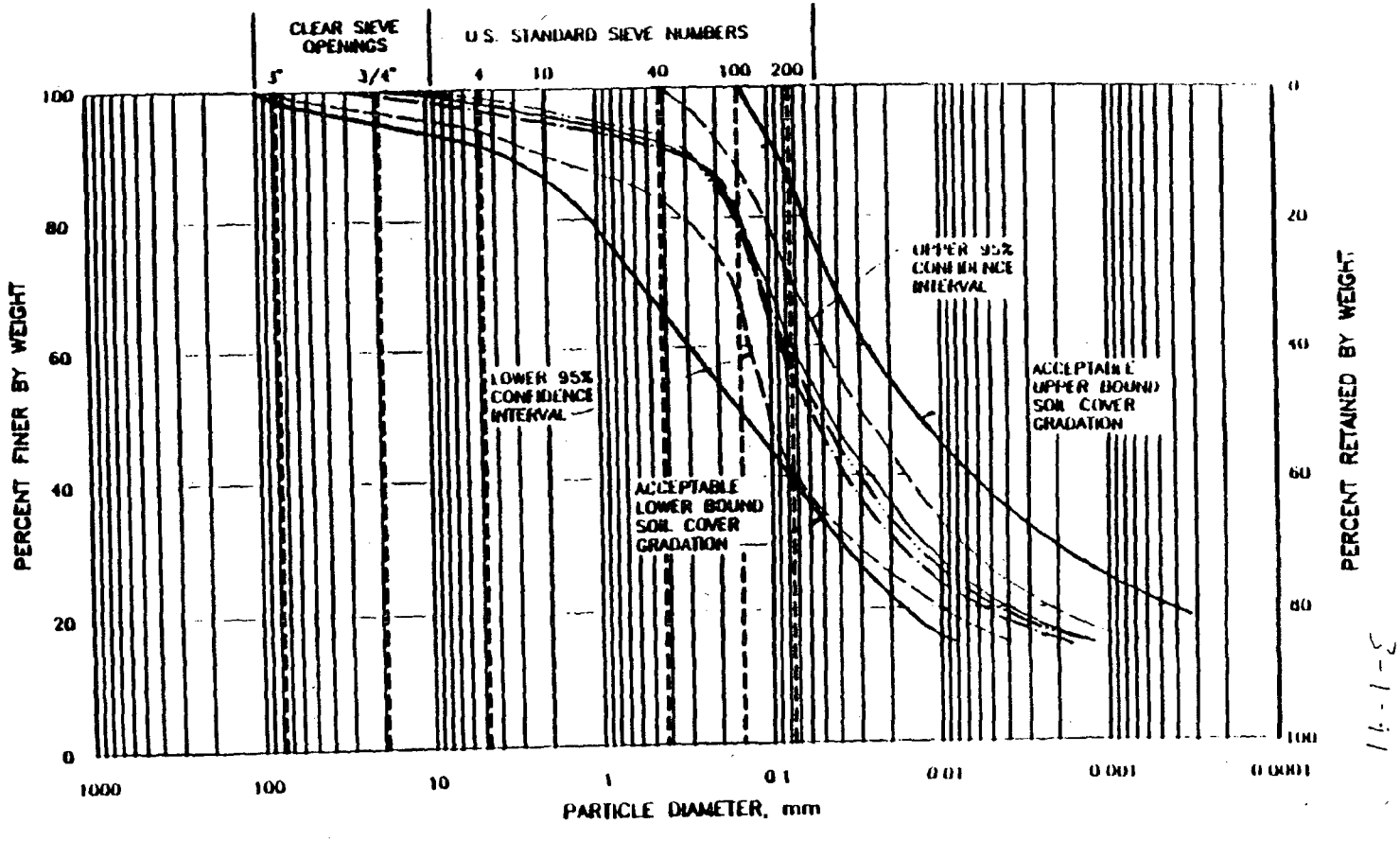
Estimated Borrow Volume: 100,000 cubic yards

Boring Identification	Depth of Sample	Liquid Limit	Plasticity Index	Unified Soil Classification	Grain Size Analysis (U.S. Standard Sieve Size Numbers) Percent Passing 200	100	40	10	4	3/8	3/4
78 SNB-18	4.5	26	11	CL	52	79	90	95	99		100
	~~14.5~~	~~32~~	~~11~~	~~CL~~	~~92)~~	~~98~~	~~99~~	~~100~~			
78 SNB-19	4.5	22	NP	SM	41	64	82	88	94	98	100
78 SNB-31	9.5	26	11	CL	52	83	98	99	100		
78 SNB-33	4.5	27	9	CL	51	77	98	100			
	14.5	21	NP	SM	47	86	99	100			
~~78 SNB-32~~	~~4.5~~	~~--~~	~~NP~~	~~SM~~	~~29)~~	~~78~~	~~96~~	~~100~~			
89 SS-1	SURFACE	--	NP	ML	55	80	97	99	100		
90 SS-1	SURFACE	23	3	SC-SM	50	79	92	94	96	98	100
90 SS-2	10.5-12.5	26	7	ML-CL	54	84	94	97	98	100	
				Average:	52.3	80.0	94.5	97.2	98.7	99.6	100.0
				Standard Deviation:	16.0	9.1	5.34	3.91	2.11	0.84	0.0
				95 Percent Confidence Level (+/-):	9.92	5.64	3.31	2.42	1.31	0.52	0.0

Note: NP - Non plastic.

Canonie Environmental

FIGURES



NOTE:

1. AVERAGES DERIVED FROM AVAILABLE [illegible] AND LABORATORY TEST DATA TO DATE IN DESIGNATED BORROW AREAS

LEGEND:

- AVERAGE PIPELINE ARROYO BORROW SOILS
- AVERAGE NORTH AND CENTRAL CELLS INTERIM COVER SOILS
- AVERAGE EXISTING SOIL STOCKPILE SOILS

ACCEPTABLE SOIL COVER GRAIN SIZE ENVELOPE

UNC MINING AND MILLING
GALLUP, NEW MEXICO

Canonie

C-25

ATTACHMENTS

Chen & Associates
Soil and Engineering Laboratories

Denver
Englewood
Fort Collins
Rock Springs
Salt Lake City
San Antonio

August 31, 1988

Subject: Laboratory Testing, Canonie Project
No. 86-060-04

Job No. 1 719 88

Mr. Matthew J. Yovich
Canonie Environmental Services Corporation
94 Inverness Terrace East, Suite 100
Englewood, Colorado 80112

Dear Mr. Yovich:

As requested, we have performed gradation analyses on four soil samples received July 27, 1988, at our Denver laboratory. These results are presented on Figs. 1 and 2. In addition, we have performed a Harvard miniature compaction test (Fig. 3) and a capillary-moisture relationship test (Table 1 and Fig. 4) on Sample No. 88-RP-P-5 at 0 to 3 feet. All testing assigned to date has been completed.

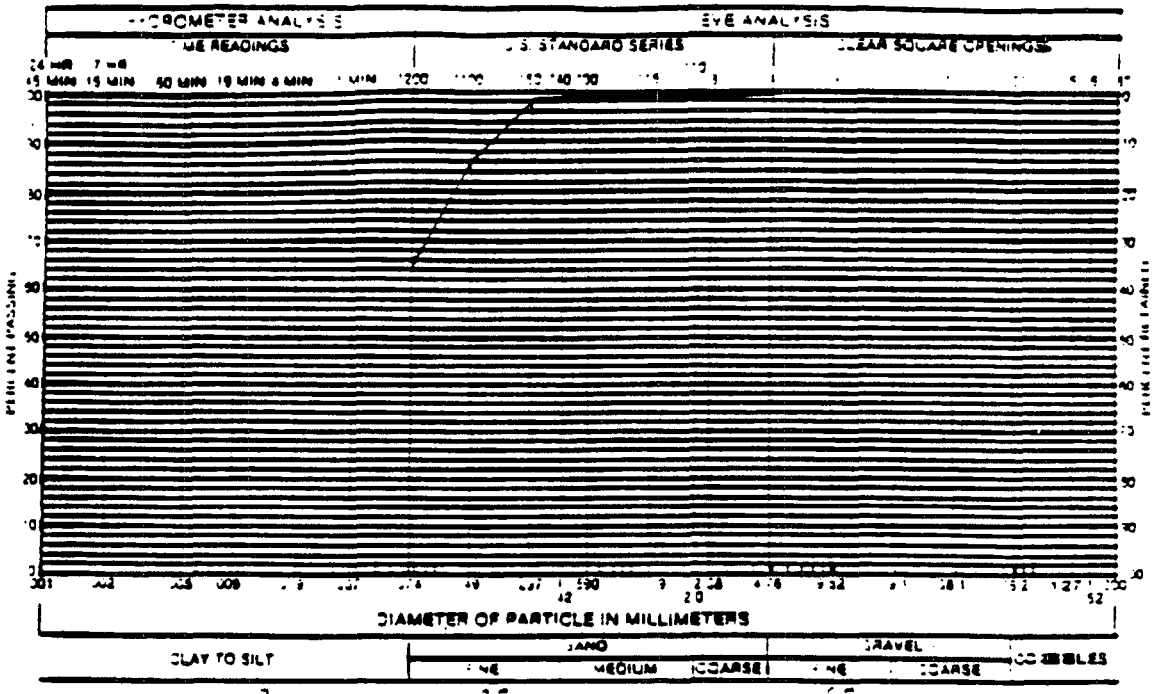
If you have any questions or need further assistance, please feel free to call.

Sincerely,

CHEN & ASSOCIATES, INC.

By Sally K. Miller
Sally K. Miller, A.E.T.
Soils Laboratory Supervisor

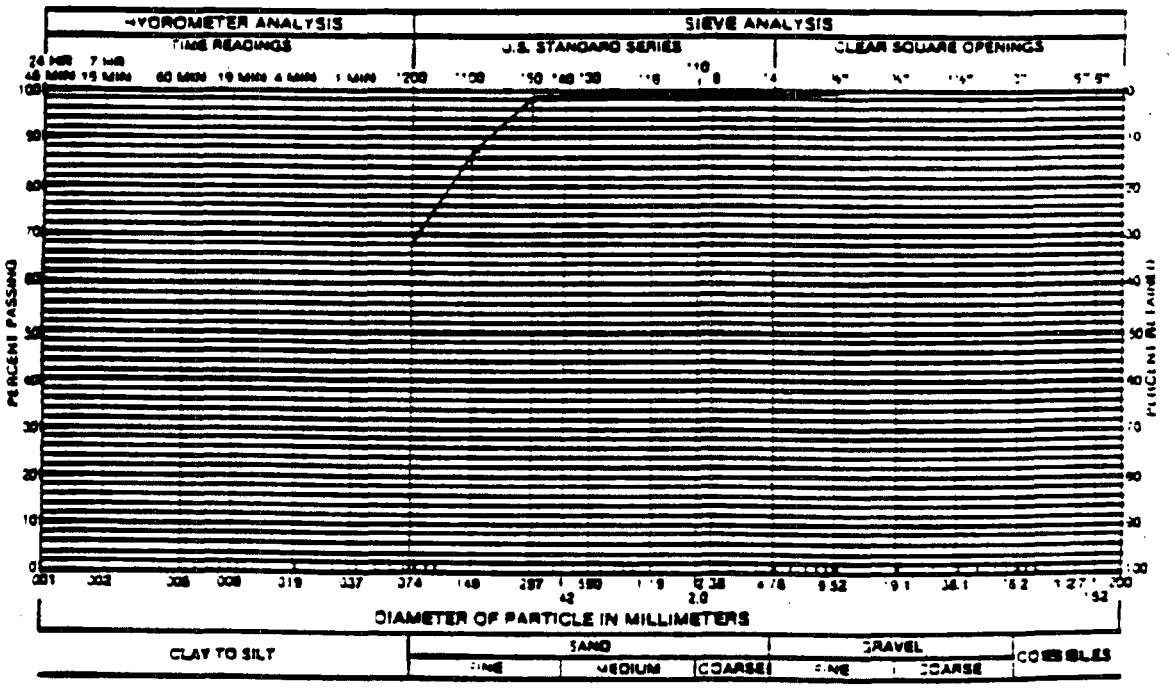
SKM/djb
Rev. By: KRC



GRAVEL 0 % SAND 35 % SILT AND CLAY 65 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF FROM Hole 88-RP-P-5 at depth 0' to 3'



GRAVEL 1 % SAND 31 % SILT AND CLAY 68 %

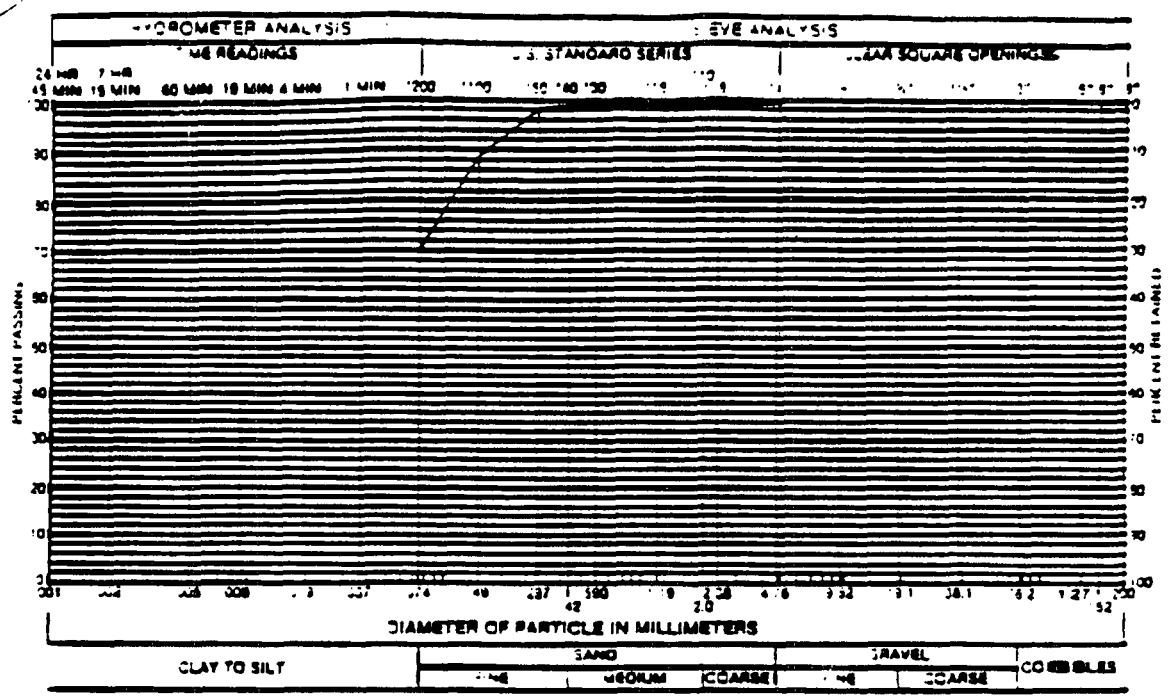
LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF FROM Hole 88-RP-P-5 at depth 3' to 6'

1 719 88

GRADATION TEST RESULTS

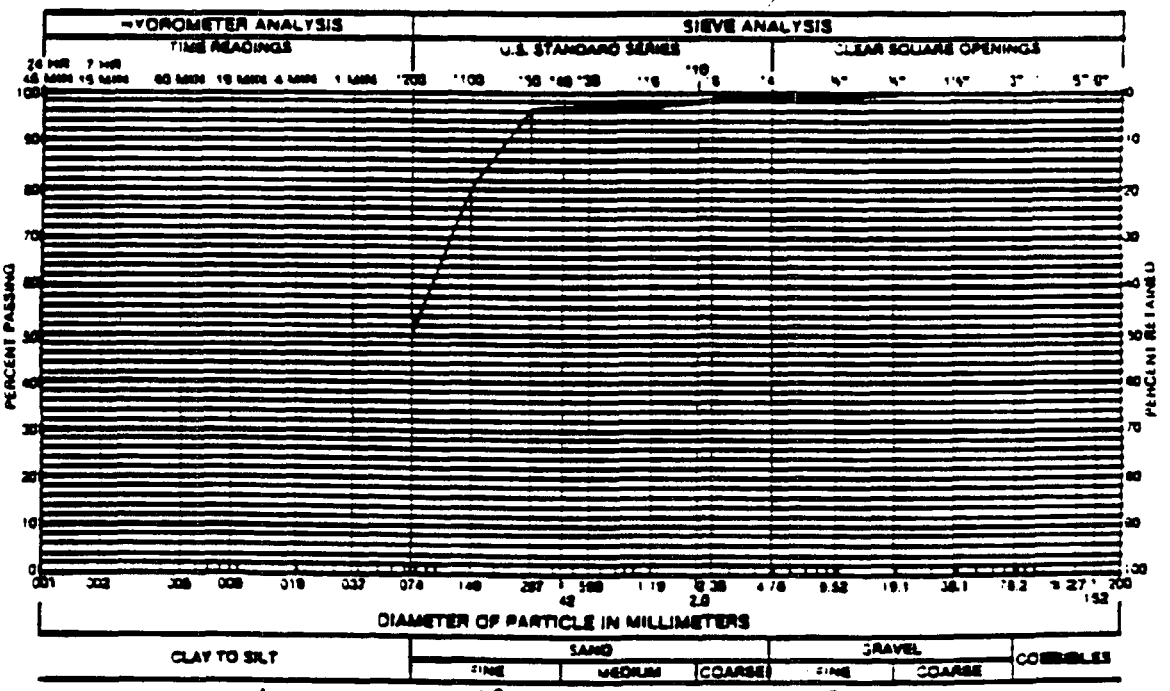
Fig.



GRAVEL 0 % SAND 30 % SILT AND CLAY 70 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF FROM Hole 88-RP-P-6 at depth 0' to 3'



GRAVEL 1 % SAND 48 % SILT AND CLAY 51 %

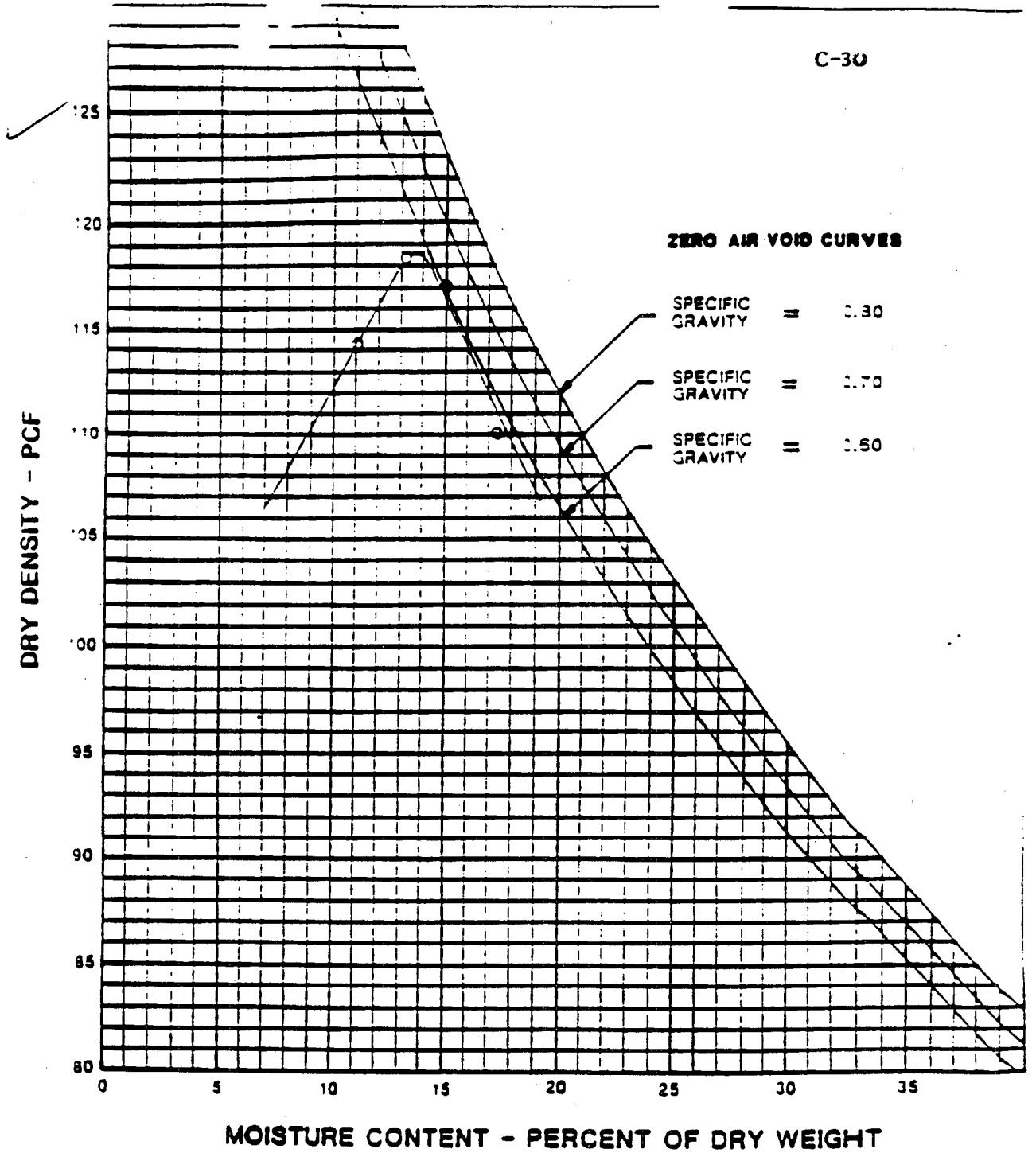
LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF FROM Hole 88-RP-P-6 at depth 3' to 6'

1 719 88

GRADATION TEST RESULTS

Fig. 2



LOCATION :	MOISTURE-DENSITY RELATIONSHIPS
HOLE NO. : 88-RP-P-5 DEPTH : 0'-3' SAMPLE NO. :	
SOIL DESCRIPTION :	Chen & Associates
MAX. DRY DENSITY 118.5 PCF OPT. MOIST. CONTENT : 13.6 %	PROCEDURE : HARVARD MINIATURE
LIQUID LIMIT : PLASTICITY INDEX :	JOB NO. : 1 719 88 — FIG. NO.
GRAVEL : 0 % SAND : 35 % SILT AND CLAY (-200) : 65 %	DATE : August 3, 1988 — 3

August 31, 1988
#86-060-04
Job No. 1 719 88

CHEN AND ASSOCIATES, INC.

TABLE I

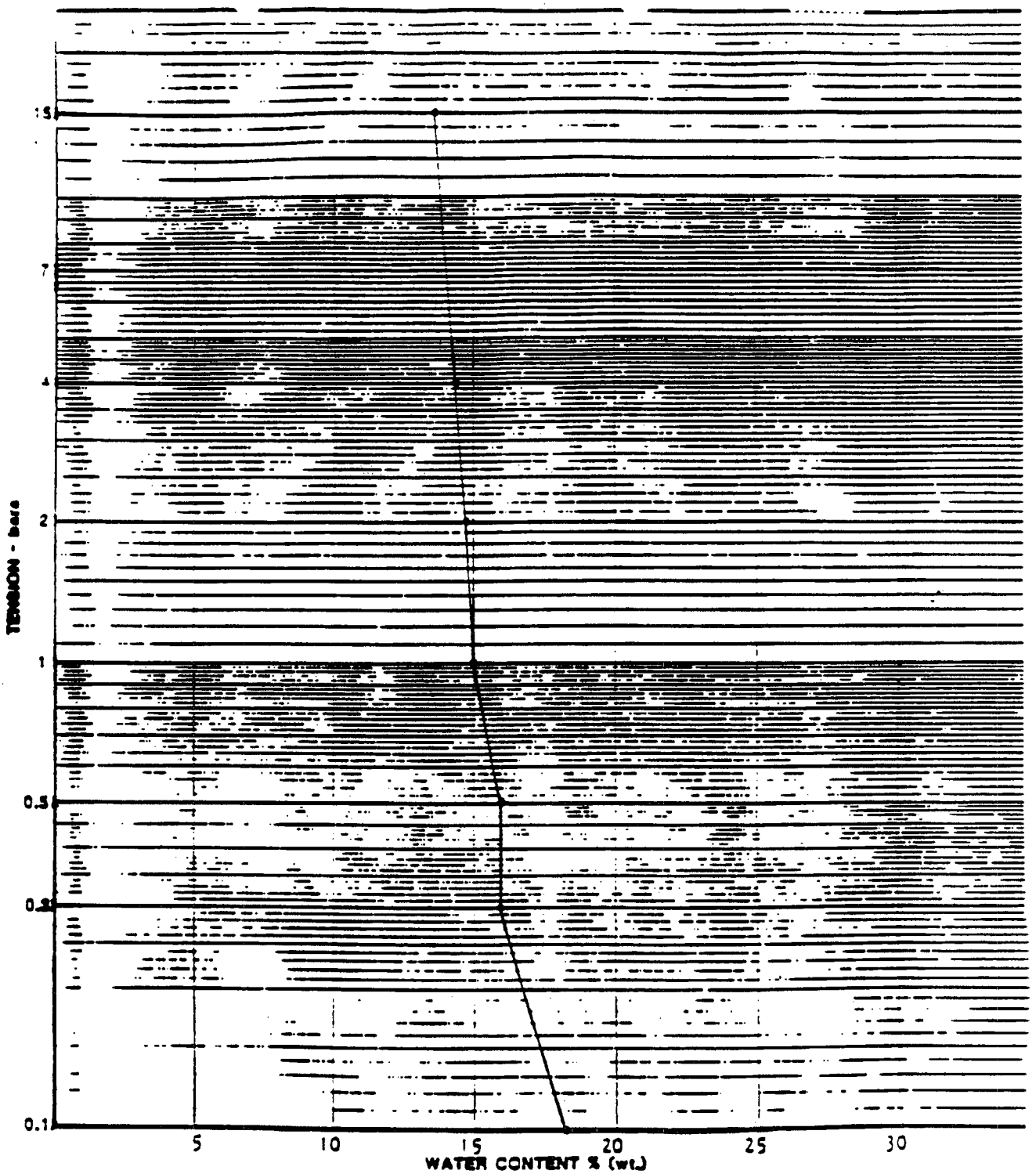
Summary of Capillary-Moisture Relationship Test Results

Sample No. 88-RP-P-5 @ 0-3'

Average Initial Moisture
Content, % = 14.6

Average Initial Dry Density, pcf = 112.6

Tension, bars	Moisture Content, %
0.1	18.29
0.3	15.89
0.5	16.00
1.0	14.96
2.0	14.88
4.0	14.43
15.0	13.63



LOCATION: _____

HOLE: B-5 DEPTH: 0-3' SAMPLE NO: _____

DESCRIPTION: Sandy Clay Average DRY DENSITY pcf: 112.6 Average WATER CONTENT %: 14.6

LIQUID LIMIT: - PLASTIC LIMIT: - PLASTIC INDEX: - -200: 65

1 719 88	Chen & Associates	CAPILLARY-MOISTURE RELATIONSHIPS Fig. -

Chen-Northern, Inc.

Denver Colorado 80231
303 [illegible]
303 [illegible] Fax

February 25, 1991

Mr. Matthew Yovich
Canonie Environmental Services Corporation
94 Inverness Terrace East
Englewood, Colorado 80112

Subject: Laboratory Testing

Job No. 1 305 91, Part 3

Dear Mr. Yovich:

As requested, we have performed a grain-size analysis including hydrometer analysis on each of two tailings samples which we received at our Denver laboratory on February 15, 1991. Testing was performed in accordance with ASTM D422-63. The results of the tests are presented on Figure 1, attached.

If you have any questions or if we can be of further assistance, please call.

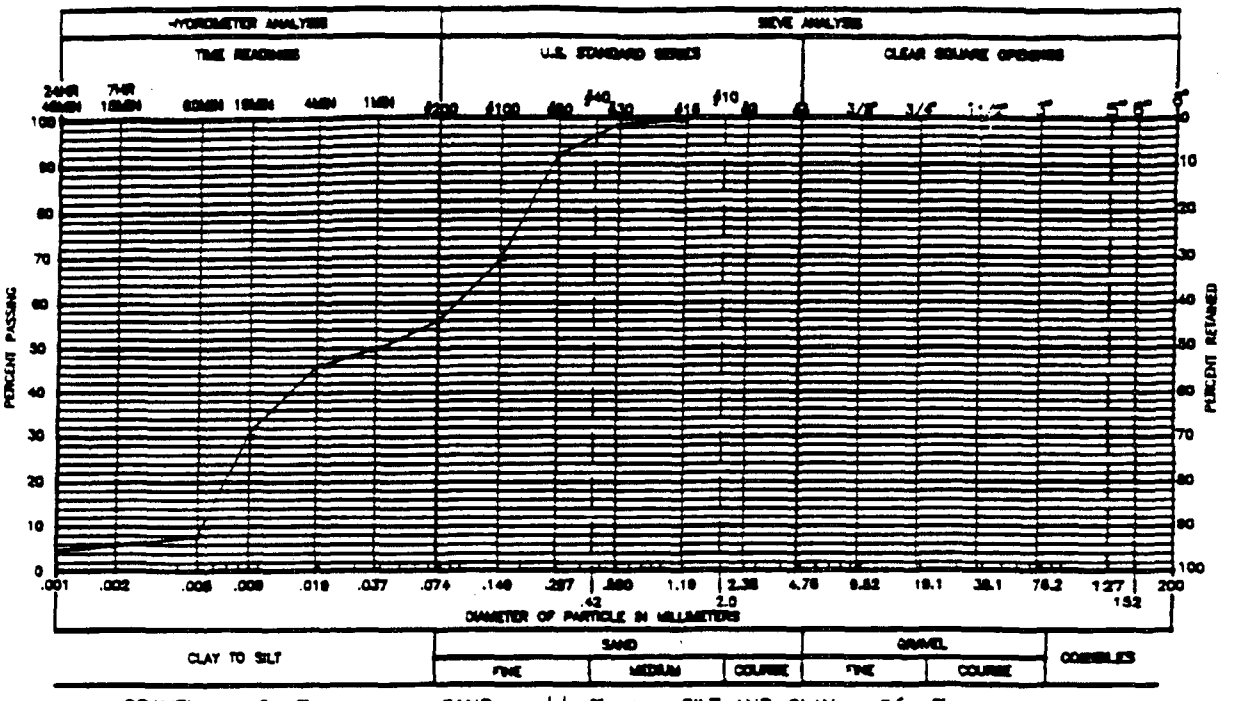
Sincerely,

Chen-Northern, Inc.

Sally K. Miller

Sally K. Miller, A.E.T.
Laboratory Supervisor

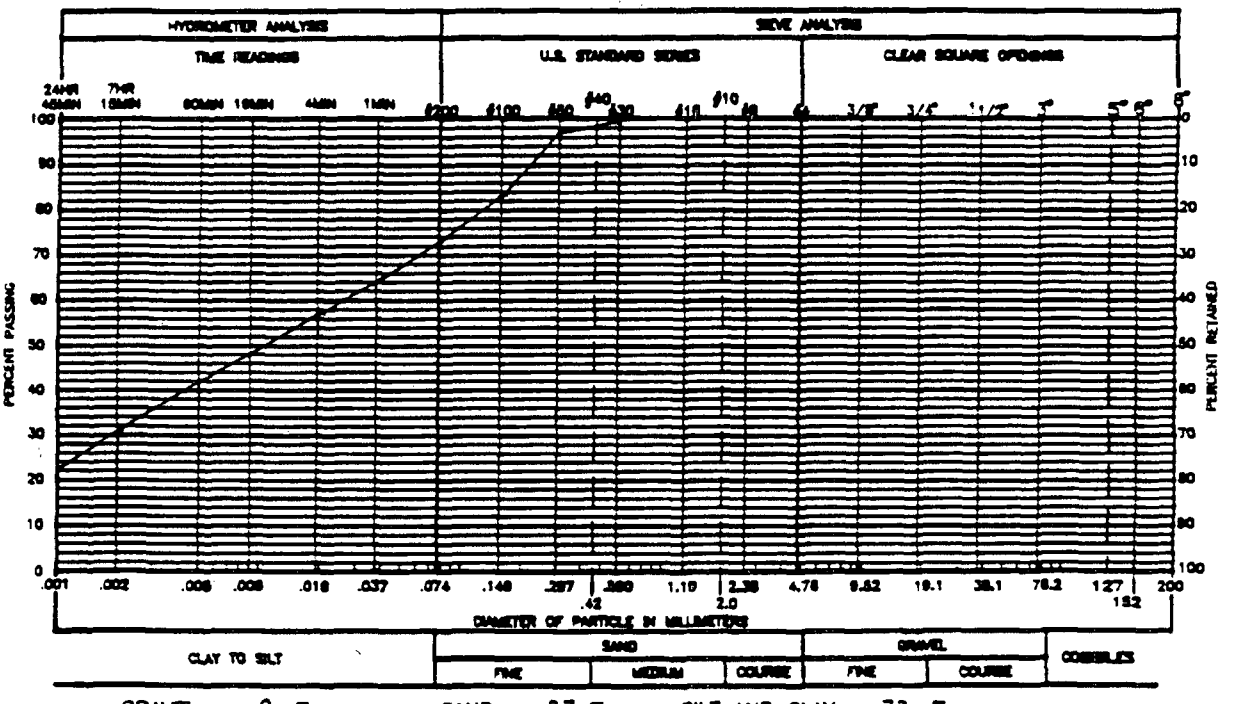
Rev. by: NFL
SKM/kd
Enclosure



GRAVEL 0 % SAND 44 % SILT AND CLAY 56 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF Tailings FROM "East"



GRAVEL 0 % SAND 27 % SILT AND CLAY 73 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF Tailings FROM "West"

1 305 91	Chen Northern, Inc.	GRADATION TEST RESULTS	Fig. 1

APPENDIX
D

APPENDIX D

IN-SITU MOISTURE CONTENTS
COARSE TAILINGS, SOIL COVER, AND FINE TAILINGS

COARSE TAILINGS AND SOIL COVER IN-SITU MOISTURE CONTENTS

Canonie Environmental

D-2

By [illegible] Date 2/16/91 Subject UNC SOIL COVER Sheet No. 1 of

Chkd. By [illegible] Date 3-1-91 LONG TERM MOISTURE Proj. No. 86-060-2-1

1/4" X 1/4"

PURPOSE: TO DETERMINE THE LONG-TERM MOISTURE CONTENT OF THE RADON BARRIER AT THE UNITED NUCLEAR SITE USING IN-SITU SOIL MOISTURES AS DISCUSSED WITH NRC PERSONNEL ON 2/13/91

METHOD: USE EXISTING IN-SITU MOISTURE DATA FOR SAMPLES WHERE GRADATION ANALYSES WERE PERFORMED AND FALL WITHIN THE ACCEPTABLE SOIL COVER ENVELOPE FOR THE SITE AND WHERE THE SAMPLES WERE OBTAINED FROM A REPRESENTATIVE BORROW SOURCE AND FROM A DEPTH OF 120 cm TO 500 cm (4 ft - 16.5 ft). THIS METHOD WAS DEEMED AN ACCEPTABLE METHOD FOR DETERMINATION OF THE LONG-TERM MOISTURE CONTENT FOR THE RADON BARRIER AT A 2/13/91 MEETING BETWEEN DAWN JACOBY OF NRC AND CANONIE.

RESULTS: THE AVERAGE IN-SITU MOISTURE OF 47 TESTS MEETING BOTH DEPTH AND GRADATION CRITERIA IS 12.9 %

CALCULATION: ACCEPTABLE GRADATION

SEIVE SIZE	% PASSING
200 mm	> 40 & < 85
100 mm	> 50
40 mm	> 65
10 mm	> 85
4 mm	> 90
3/4 in.	> 95
3 in.	> 100

Canonie Environmental

D-3

By mjj Date 2/15/91 Subject UNC SOIL COVER Sheet No. ____ of ____

Chkd. By SMM Date 3-1-91 LONG-TERM MOISTURE Proj. No. 86-060-24

1/4" X 1/4"

LOCATION	DEPTH (ft)	-200 FRACTION (%)	% MOISTURE
78-1041-3	13	59	10
-10	11	71	12
-11	5	60	12
-15	10	75	14
-22	9	55	21
-24	16	83	24
-19	10	50	10
			Σ = 103

N = 7

$\bar{x}$ = 14.7

Canonie Environmental

D-4

By mjj Date 2/15/91 Subject UNC SOIL COVER Sheet No. ___ of ___

Chkd. By [illegible] Date [illegible] LONG-TERM MOISTURE Proj. No. 56060-31

1/4" X 1/4"

LOCATION	DEPTH (ft)	-200 FRACTION (%)	% MOISTURE
78-1096-2	9.0	53	7
-3	14.5	48	5
-4	4.5	79	8
-5	4.5	76	7
-5	14.5	62	8
-7	9.5	44	5
-18	4.5	52	4
~~-18~~	~~14.5~~	~~92~~	~~38~~
-31	9.5	52	5
			Σ = 49

N = 8

$\bar{x}$ = 6.1 %

Canonie Environmental

D-5

By mjj Date 2/15/91 Subject LLRC Soil Cover Sheet No. ____ of ____

Chkd. By [illegible] Date [illegible] LONG-TERM MOISTURE Proj. No. 86-1660-21

1/4" X 1/4"

LOCATION	DEPTH (FT)	-200 FRACTION (%)	% MOISTURE
79-1096-A1-2	10.5	57	16
A2-6	9.0	54	15
A2-8	9.0	58	17
A3-1	12.0	77	14
A3-2	7.0	54	16
A6-1	11.5	79	21
C1-8	6.0	49	21
C1-11	9.0	45	18
C1-16	14.0	56	17
C1-20	10.0	61	18
C1-21	11.0	62	12
C2-4	7.0	54	8
C2-8	5.0	52	16
C3-5	4.5	58	12
C4-5	9.0	56	20
C4-16	8.2	54	15
C4-26	8.5	80	9
D1-2	7.0	63	12
D1-3	8.0	55	10
D1-4	10.0	45	8
D1-7	16.0	58	10
D2-3	4.0	50	10
D2-5	6.0	59	10
D2-8	11.0	63	11
D2-10	15.0	56	11
E1-5	6.5	44	17
E1-7	8.5	50	20
E1-12	13.5	46	13
E1-15	15.0	46	20
			Σ = 417

N = 29 $\bar{X}$ = 14.4

Canonie Environmental

D-6

By mm Date 2/5/91 Subject LINC SOIL COVER Sheet No. ____ of ____

Chkd. By SAM Date 2-1-91 LONG TERM MOISTURE Proj. No. [illegible]

1/4 X 1/4

LOCATION	DEPTH	-200 FRACTION (%)	% MOISTURE
~~86-RP-P2~~	~~10~~	~~100~~	~~[illegible]~~
P3	10	66	16.2
P5	6	48	7.6
~~P8~~	~~5~~	~~93~~	~~17.5~~
TP2	6-7	40	11.9
			35.7

N = 3

$\bar{x}$ = 11.9

Canonie Environmental

D-7

By mpp Date 2/15/91 Subject UMC SOIL COVER Sheet No. ____ of ____

Chkd. By [illegible] Date [illegible] LONG-TERM MOISTURE Proj. No. [illegible]

1/4" X 1/4"

DETERMINE OVERALL AVERAGE

$$\frac{417 + 49 + 35.7 + 103}{29 + 8 + 3 + 7} = \frac{604.7}{47} = 12.9$$

GEOTECHNICAL AND DESIGN DEVELOPMENT INVESTIGATION REPORT

Tailings Disposal Systems Analysis

United Nuclear Church Rock Mill

Church Rock, New Mexico

July 1978

SHB Job No. E78-1041
Volume No. 2

SERGENT, HAUSKINS & BECKWITH

CONSULTING SOIL AND FOUNDATION ENGINEERS
PHOENIX • ALBUQUERQUE • EL PASO • TUCSON

7

TABULATION OF TEST RESULTS

Job No. E78-1041

Project Tailings Disposal System Analysis

Material

Source

HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING 200	100	40	16	10	4	¼	⅜	¾	1	1½	2	LAB NO.
1	See Site Plan	4½'-6'	SM	23	1	44	78	97	98	99	99	99	100					104 3
1	See Site Plan	34½'-36'	ML-CL	23	4	51	77	92	95	97	99	100						-9
1	See Site Plan	59½'-61'	CL	30	15	82	92	97	98	98	99	100						-1
3	See Site Plan	0'-1'	CL	29	13	60	86	97		99	100							-1
3	See Site Plan	5½'-7'	CL	30	13	60	82	94	95	96	97	98	98	100				-2
3	See Site Plan	13'-14'	CL	29	12	59	85	95		97	100						10%	-1
3	See Site Plan	15'1"-16'1"	CL	31	14	65	88	97		98	100							-1
3	See Site Plan	56½'-57½'	CL	35	18	66	90	98		100								-1
3	See Site Plan	69½'-70½'	SC	27	8	34	60	73		80	84	100						1
4	See Site Plan	½'-2'	CL-ML	26	6	56	81	95	97	97	99	100						-8
4	See Site Plan	14½'-16'	CL	32	16	61	86	97	98	98	99	99	100					-7
4	See Site Plan	24½'-25½'	ML	21	3	69	80	95	95	95	98	98	100					-8
4	See Site Plan	44½'-46'	SM	22	2	37	52	64	71	76	87	91	97	100				-4
4	See Site Plan	59½'-61'	CL	34	15	89	99	100										-1
5	See Site Plan	15½'-18'	ML-CL	28	7	51	79	95	96	97	98	99	100					-3

SERGENT, HAUSKINS & BECKWITH

TABULATIC OF TEST RESULTS

Job No. E78-1041

Project Tailings Disposal System Analysis

Material

Source

HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS -- ACCUM % PASSING												LAB NO.
						200	100	40	16	10	4	¼	⅜	¾	1	1½	2	
6	See Site Plan	4½'-6'	CL	26	8	64	87	98	99	99	100							104-9
6	See Site Plan	14½'-15½'	CL	30	13	59	84	95	97	98	99	100						-10
6	See Site Plan	39½'-40½'	CL	30	12	74	92	99	100									-10
6	See Site Plan	59½'-60½'	CL	36	20	72	92	99		100								-1[illegible]
7	See Site Plan	2½'-4½'	ML-CL	26	5	57	84	99	100									-11
7	See Site Plan	6'-7'	SM		NP	31	67	99	100									-11
7	See Site Plan	40½'-41½'	SM		NP	34	82	100										-14
7	See Site Plan	54'-55½'	CL	34	15	51	74	95		97	100							-1[illegible]
8	See Site Plan	9½'-10½'	CL	31	14	63	84	96	97	98	100							-15
8	See Site Plan	34½'-35½'	CL	44	28	76	93	99	100									-33
9	See Site Plan	6½'-9'	SM-SP		NP	10	20	82	99	100								-34
9	See Site Plan	20½'-23'	SM-SP		NP	8	17	71	98	100								-35
9	See Site Plan	28'-30½'	SM-SC	25	5	44	74	93	95	96	97	97	98	100				-35
10	See Site Plan	2½'-4'	CL	29	13	67	85	95		99	100							-1[illegible]
10	See Site Plan	10'-11½'	CL	25	19	71	86	96		99	100						12%	-1[illegible]

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E78-1041

Project Tailings Disposal Systems Analysis

Material

Source

HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM. % PASSING												LAB NO.
						200	100	40	16	10	4	¼	⅜	¾	1	1½	2	
10	See Site Plan	17½'-19'	CL	31	13	69	90	98		99	100							1041-R10
10	See Site Plan	29'-29½'	CL	32	16	66	82	96		99	100							-R11
10	See Site Plan	33'-34½'	CL	29	15	57	84	96		98	100							-R12
10	See Site Plan	72'-73½'	CL	39	22	69	88	96		98	100							-R13
10	See Site Plan	77'-77'5"	CL	30	13	59	86	97		99	100							-R14
11	See Site Plan	4½'-5½'	CL	27	12	60	86	95		98	100						12%	-R15
11	See Site Plan	19½'-20½'	CL	33	18	62	89	98		99	100							-R16
11	See Site Plan	34½'-35½'	CL	29	14	57	84	97		98	100							-R17
11	See Site Plan	79½'-80½'	CL	39	21	55	84	94		100								-R18
12	See Site Plan	4½'-6'	CL	34	17	66	86	96	97	97	99	99	100					-218
12	See Site Plan	34½'-35½'	CL	28	9	59	82	96	98	99	100							-224
12	See Site Plan	54½'-55½'	CL	32	16	70	91	99	99	100								-228
12	See Site Plan	59½'-61'	CL	27	9	58	87	100										-229
13	See Site Plan	0'-1½'	SM	22	1	49	81	99	100									-233
13	See Site Plan	14½'-16'	CL	28	12	60	83	94	95	96	97	97	99	100				-237

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E78-1041

Project Tailings Disposal System Analysis

Material

Source

HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING												LAB
						200	100	40	16	10	4	¼	⅜	¾	1	1½	2	
13	See Site Plan	39½'-40½'	ML	40	12	88	99	100										1041-R1
14	See Site Plan	0'-1½'	CL	28	12	57	80	91	93	94	95	97	99	100				-24
14	See Site Plan	19½'-20½'	CL	31	10	96	98	99	100									-24
14	See Site Plan	34½'-35½'	CL	49	29	89	98	100										-25
15	See Site Plan	9½'-10½'	CL	32	10	75	93	99		100							14%	-R2
15	See Site Plan	24½'-25'	CL	42	22	75	90	99		99	100							-R2
17	See Site Plan	19½'-20½'	CL	30	12	63	88	98		99	100							-R2
19	See Site Plan	2'-3½'	CL	29	13	61	86	99	99	100								-27
19	See Site Plan	9½'-11'	CL	23	8	50	72	94	96	97	98	99	100				10%	-28
19	See Site Plan	32'-33½'	SM		NP	46	88	99		100								-R2
19	See Site Plan	36'-37½'	CL	41	22	74	94	99		100								-R2
19	See Site Plan	40'-41½'	CH	61	38	73	80	99		100								-R2
19	See Site Plan	44'-45'	CH	67	41	78	87	97		100								-R2
20	See Site Plan	9½'-10½'	CL	28	13	63	86	97	98	99	100							-29
20	See Site Plan	19½'-20½'	SM		NP	16	35	98	100									-30

TABULATION OF TEST RESULTS

Job No. E78-1041

Project Tailings Disposal System Analysis

Material

Source

HOLE NO	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING												LAB NO
						200	100	40	16	10	4	1/4	3/8	3/4	1	1 1/2	2	
20	See Site Plan	39½'-40½'	CH	57	31	93	96	100										1041-
21	See Site Plan	4½'-6'	CL	34	16	77	90	96	97	97	98	98	99	100				-30
21	See Site Plan	19½'-21'	CL	39	21	72	88	100										-30
21	See Site Plan	39½'-40½'	CH	50	32	84	94	100										-R2
22	See Site Plan	8'-9½'	CL	26	10	55	78	100									21%	-R2
22	See Site Plan	12'-13½'	CL	27	10	56	69	99		100								-R3
24	See Site Plan	6½'-9'	SM		NP	13	25	84	100									-32
24	See Site Plan	15½'-17'	CL	42	23	83	93	99		100							24%	-R3
24	See Site Plan	22'-23½'	CL	42	21	87	97	100										-
25	See Site Plan	5'-6½'	SM		NP	14	25	69	98	98	100							-35
25	See Site Plan	15½'-18'	SM		NP	14	25	75	98	99	100							-35
25	See Site Plan	23'-24½'	CL	35	17	59	81	100										-36
25	See Site Plan	27'-29½'	SC	28	12	42	79	100										-36
26	See Site Plan	6½'-9'	SM		NP	22	43	93	100									-36
26	See Site Plan	15½'-18'	SM		NP	14	23	74	99	100								-36

SERGENT, HAUSKINS & BECKWITH

TABULATIC OF TEST RESULTS

Job No. E78-1041

Project Tailings Disposal System Analysis

Material

Source

HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING												LAB #
						200	100	40	16	10	4	¼	⅜	¾	1	1½	2	
26	See Site Plan	19½'-22'	SM		NP	20	33	86	100									1041-37
26	See Site Plan	31'-32½'	CL	39	22	78	91	98	99	100								-37
27	See Site Plan	9½'-11'	CL	37	15	86	95	100										-38
27	See Site Plan	14½'-15½'	CL	42	21	66	78	88		92	94		96	100				-38
27	See Site Plan	19½'-21'	CL	31	11	89	98	100										-38
27	See Site Plan	44½'-45½'	CL	40	20	80	93	100										-38
28	See Site Plan	4½'-6'	CL	41	21	92	98	100										-39
28	See Site Plan	34½'-36'	CL	36	16	90	98	100										-39
	Bulk Sample Tailings		SM-SP	NV	NP	5	11	60	100									-40
30	See Site Plan	9½'-11'	SM	NV	NP	23	74	100										-41
31	See Site Plan	4½'-6'	CL	29	14	55	79	90		95	98		100					-41
33	See Site Plan	4½'-6'	SC	27	13	39	70	94		100								-43
33	See Site Plan	9½'-11'	CL	42	27	70	88	98		100								-43
34	See Site Plan	14½'-16'	CL	29	14	75	93	99		100								-44
34	See Site Plan	24½'-26'	CL	44	21	84	93	99		100								-44

SERGENT HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E78-1041

Project Tailings Disposal System Analysis

Material

Source

HOLE NO	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING												LAB NO
						200	100	40	16	10	4	¼	⅜	¾	1	1½	2	
37	See Site Plan	4½'-6'	SM	27	NP	48	78	95		99	100							1041-498
37	See Site Plan	9½'-11'	SC-SM	24	7	49	83	97		99	100							-499
37	See Site Plan	19½'-21'	CL	33	17	55	83	95		98	99		100					-501
37	See Site Plan	29½'-31'	SM	22	NP	32	73	97		100								-503
41	See Site Plan	4½'-6'	CL	35	18	81	93	98		99	100							-508
41	See Site Plan	14½'-16'	CL	40	21	85	94	99		100								-510
41	See Site Plan	34½'-36'	CL	39	22	77	89	98		99	100							-514
42	See Site Plan	4½'-6'	CL	28	14	65	74	82		87	92		96	100				-465
42	See Site Plan	19½'-21'	SM	19	NP	24	45	80		87	93		99	100				-468
42	See Site Plan	29½'-31'	SC	29	9	37	51	62		74	81		89	96		100		-470
42	See Site Plan	39½'-41'	CL	40	18	90	90	92		95	99		100					-472
47	See Site Plan	0'-5'	SC	26	8	42	71	92		95	97		98	100				-523
48	See Site Plan	4½'-6'	SM	19	NP	18	38	66		76	83		90	94		100		-526
50	See Site Plan	4½'-6'	CL	28	8	64	87	99		100								-553
50	See Site Plan	14½'-16'	SM	21	NP	29	62	92		99	100							-556

SERGENT HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E78-1041

Project Tailings Disposal System Analysis

Material

Source

HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING												LAB NO
						200	100	40	16	10	4	¼	⅜	¾	1	1½	2	
52	See Site Plan	5'-10'	SC	27	11	4[illegible]	73	91		95	98		100					1041-5[illegible]
55	See Site Plan	24½'-26'	SC	29	14	49	72	90		95	98		99	100				-544
57	See Site Plan	½'-2'	CL	26	9	51	78	94		97	99		100					-560
57	See Site Plan	9½'-11'	CL	29	10	72	86	95		96	97		99	100				-562
59	See Site Plan	4½'-6'	SC	39	19	38	62	88		92	96		100					-56[illegible]
61	See Site Plan	4½'-6'	SM	22	NP	50	77	95		98	99		100					-567
61	See Site Plan	9½'-11'	SM		NP	22	37	63		65	69		76	82		100		-56[illegible]
63	See Site Plan	0'-5'	SM		NP	22	44	63		76	83		90	94		100		-571
64	See Site Plan	½'-2'	SC-SM	23	7	46	64	79		87	94		100					-[illegible]
64	See Site Plan	2'-4½'	SM		NP	27	54	60		64	68		77	86		100		-57[illegible]
64	See Site Plan	4½'-6'	GM	20	NP	25	28	42		46	54		76	100				-57[illegible]
68	See Site Plan	4½'-6'	SM	20	NP	31	48	59		67	74		80	92		100		-57[illegible]
68	See Site Plan	9½'-11'	SM	21	NP	40	60	64		70	80		93	100				-58[illegible]
68	See Site Plan	14½'-16'	CL	32	12	93	95	98		100								-581
74	See Site Plan	0'-10'	CL	31	13	72	86	98		100								-601

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E78-1041

Project Tailings Disposal System Analysis

Material

Source

HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM. % PASSING												LAB NO.
						200	100	40	16	10	4	¼	⅜	¾	1	1½	2	
76	See Site Plan	0'-5'	CL	33	16	71	77	98		100								1041-608
76	See Site Plan	5'-10'	CL	42	21	79	92	100										-609
76	See Site Plan	16'-19½'	ML	23	NP	52	84	98		100								-610
78	See Site Plan	6'-10'	SM	23	NP	48	81	95		98	100							-611
78	See Site Plan	17'-20'	SC	26	9	49	67	78		83	87		93	100				-612
78	See Site Plan	22'-25'	CL	33	15	75	90	96		99	100							-613
83	See Site Plan	4½'-6'	SM	NV	NP	26	51	81		87	94		100					-633
83	See Site Plan	9½'-11'	SM	NV	NP	24	49	89		94	97		100					-634
85	See Site Plan	4½'-6'	CL	33	15	60	77	95		100								-635
85	See Site Plan	9½'-11'	SM		NP	34	62	88		94	97		100					-639
85	See Site Plan	14½'-16'	CL	35	16	80	93	99		100								-640
85	See Site Plan	19½'-21'	CL	34	15	74	87	96		98	99		100					-641

SERGENT HAUSKINS & BECKWITH

SERGENT, HAUSKINS & BECKWITH CONSULTING SOIL AND FOUNDATION ENGINEERS

APPLIED SOIL MECHANICS • ENGINEERING GEOLOGY • MATERIALS ENGINEERING

S. DWAINE SERGENT, P.E.
DALE V. BEDENKOP, P.E.
JOHN S. HAUSKINS, P.E.
ROBERT D. BOOTH, P.E.
GEORGE H. BECKWITH, P.E.
BENNY E. McMILLAN, P.E.
BUD WOODWARD

October 26, 1978

United Nuclear Corporation
4801 Indian School Road, N.E.
Albuquerque, New Mexico 87110

SHB Job No. E78-1096

Attention: Mr. John Abbiss

Re: Embankment Volumes-Borrow Quantities
Tailings Disposal Systems Analysis
UNC Church Rock Mill Site
Church Rock, New Mexico

Gentlemen:

Our Engineering Analysis Report relative to available borrow quantities and required embankment volumes for various schemes of future construction on the referenced project is herewith submitted. The report includes the results of test drilling, laboratory analyses and estimated quantities of borrow and embankment materials. Also included are estimated data relative to tailings storage volumes and reservoir life based upon projected future milling rates.

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

Respectfully submitted,
Sergent, Hauskins & Beckwith Engineers

By Robert D. Booth
Robert D. Booth, P.E.

REPLY TO: 2821 GIRARD BLVD., N.E., ALBUQUERQUE, NEW MEXICO 87107

PHOENIX (602) 272-6848 | ALBUQUERQUE (505) 345-8306 | EL PASO (915) 591-8188 | TUCSON (602) 884-9333

TABULATION OF TEST RESULTS

Job No. E78-1096

Project Embankment Volumes - Borrow Quantities

Church Rock, New Mexico

Material

Source

HOLE NO	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING											% Moist	
						200	100	40	16	10	4	¼	⅜	¾	1	1½		
1	See Site Plan	4½'	ML	26	NP	54	85	94		98	100						6	96-1
2	See Site Plan	9½'	CL	25	10	53	72	84		90	95		98	100			7	96-2
3	See Site Plan	14½'	SM	NV	NP	48	91	99		100							5	96-3
4	See Site Plan	4½'	CL	34	16	79	95	99		100							8	96-4
5	See Site Plan	4½'	CL	32	15	76	91	98		100							7	96-5
5	See Site Plan	14½'	CL	30	13	62	80	93		100							8	96-6
6	See Site Plan	4½'	CL-ML	24	5	61	84	96		98	99		100				5	96-7
7	See Site Plan	9½'	SM	23	NP	44	85	97		99	100						5	96-8
8	See Site Plan	24½'	CL	33	14	94	99	100									13	96-9
9	See Site Plan	9½'	CL	42	18	93	94	96		98	99		100				11	96-1
10	See Site Plan	9½'	SM	NV	NP	22	43	57		69	79		87	96		100	4	96-1
11	See Site Plan	4½'	CL	31	11	64	86	95		97	99		100				5	96-1
12	See Site Plan	½'	CL	30	8	56	84	91		94	96		99	100			6	96-1
16	See Site Plan	4½'	CH	54	29	93	95	97		99	100						13	96-1
18	See Site Plan	4½'	CL	26	11	52	79	90		95	99		100				4	96-1

SERGENT, HAUSKINS & BECKW.

TABULATION OF TEST RESULTS

Job No. E78-1096

Project Embankment Volumes - Borrow Quantities

Church Rock, New Mexico

Material

Source

HOLE NO	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING 200	100	40	16	10	4	¼	⅜	¾	1	1½	% Moist	LAB NO
18	See Site Plan	14½'	CL	32	11	92	98	99		100							38	96-16
19	See Site Plan	4½'	SM	22	NP	41	64	82		88	94		98	100			5	96-17
21	See Site Plan	4½'	SM	NV	NP	21	58	85		90	95		99	100			3	96-18
22	See Site Plan	4½'	CL	28	9	51	74	84		90	95		99	100			5	96-19
23	See Site Plan	4½'	CL	30	9	56	80	92		94	96		96	98		100	7	96-20
24	See Site Plan	9½'	CL	43	18	96	97	98		100							10	96-21
25	See Site Plan	9½'	CL-ML	25	5	52	80	93		98	99		100				20	96-22
26	See Site Plan	14½'	SM	NV	NP	22	42	52		63	77		91	100			2	96-23
29	See Site Plan	4½'	CL	49	22	97	98	98		100							10	96-24
30	See Site Plan	4½'	CL	27	11	55	73	80		86	92		96	100			8	96-25
31	See Site Plan	9½'	CL	26	11	52	83	98		99	100						5	96-26
32	See Site Plan	4½'	SM	NV	NP	29	70	96		100							5	96-27
32	See Site Plan	24½'	CL-ML	25	6	61	92	99		100							6	96-28
33	See Site Plan	4½'	CL	27	9	51	77	98		100							7	96-29
33	See Site Plan	14½'	SM	21	NP	47	86	99		100							5	96-30

SERGENT, HAUSKINS & BECKWITH

TABULA I OF TEST RESULTS

Job No. E78-1096

Project Embankment Volumes - Borrow Quantities

Church Rock, New Mexico

Material

Source

HOLE NO	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM % PASSING											% Moist	LAB
						200	100	40	16	10	4	¼	⅜	¾	1	1½		
34	See Site Plan	14½'	SM	18	NP	40	69	96		98	98		99	100			5	96-
35	See Site Plan	9½'	SC	24	6	47	75	94		97	98		98	100			5	96-
36	See Site Plan	4½'	SM	NV	NP	25	55	91		96	99		100				2	96-
37	See Site Plan	4½'	SM	22	NP	45	78	88		89	90		100				6	96-

SERGENT, HAUSKINS & BECKW

FIELD MOISTURE TESTS

Test Pit No.	Sample No.	Depth (ft.)	% Moisture
A-3	A3-6	1.5	13
	A3-7	3.0	7
	A3-8	6.0	20
	A3-9	2.0	13
A-4	A4-1	9.0	12
	A4-2	5.5	12
	A4-3	4.0	7
	A4-4	1.5	7
	A4-5	5.5	5
	A4-6	9.5	18
	A4-7	2.5	7
	A4-8	1.5	9
A-5	A5-1	10.5	8
	A5-2	9.0	4
	A5-3	7.5	13
	A5-4	6.5	8
	A5-5	5.0	5
	A5-6	2.5	12
	A5-7	.5	16
	A5-8	8.0	14
	A5-9	5.0	9
	A5-10	2.0	10
A-6	A6-1	11.5	21
	A6-2	5.5	9
	A6-3	4.5	8
	A6-4	2.0	8

FIELD MOISTURE TESTS

Test Pit No.	Sample No.	Depth (ft.)	% Moisture
A-6	A6-5	1.0	12
	A6-6	6.5	18
	A6-7	4.5	6
	A6-8	3.5	8
	A6-9	1.0	14
A-7	A7-1	7.0	6
	A7-2	5.0	6
	A7-3	3.0	12
	A7-4	6.5	7
	A7-5	5.0	5
	A7-6	3.0	14
	A7-7	2.0	11
C-1	C1-1	0	18
	C1-2	.5	22
	C1-3	1.8	15
	C1-4	2.2	22
	C1-4	3.0	13
	C1-6	4.0	24
	C1-7	5.0	18
	C1-8	6.0	21
	C1-9	8.0	22
	C1-10	8.0	19
	C1-11	9.0	18
	C1-12	10.0	20
	C1-13	11.0	21
	C1-14	12.0	21

FIELD MOISTURE TESTS

Test Pit No.	Sample No.	Depth (ft.)	% Moisture
C-1	C1-15	13.0	17
	C1-16	14.0	17
	C1-17	7.2	13
	C1-18	8.2	13
	C1-19	9.0	22
	C1-20	10.0	18
	C1-21	11.0	12
	C1-22	12.5	14
	C1-23	14.0	12
	C1-24	14.0	14
	C1-25	9.0	16
	C1-26	7.0	21
C-2	C2-4	7.0	8
	C2-5	5.0	19
	C2-6	3.0	12
	C2-7	2.0	11
	C2-8	5.0	16
	C2-9	2.0	12
C-3	C3-2	6.5	11
	C3-4	5.5	17
	C3-5	4.5	12
	C3-6	3.5	14
	C3-7	5.0	14
	C3-8	2.5	14
	C3-9	.5	12

FIELD MOISTURE TESTS

Test Pit No.	Sample No.	Depth (ft.)	% Moisture
C-3	C3-10	2.5	11
	C3-11	3.5	14
	C3-12	4.5	17
	C3-13	5.5	14
	C3-14	6.5	19
	C3-15	7.5	17
C-4	C4-1	1.0	13
	C4-2	2.5	10
	C4-3	4.0	13
	C4-4	6.0	10
	C4-5	9.0	20
	C4-6	1.5	13
	C4-7	3.0	7
	C4-8	4.0	9
	C4-10	6.0	12
	C4-12	8.0	18
	C4-13	8.0	19
	C4-14	5.0	7
	C4-15	7.5	19
	C4-16	8.2	15
	C4-17	9.0	18
	C4-18	9.8	17
	C4-19	2.2	8
	C4-20	3.5	7
	C4-21	4.5	6
	C4-25	7.5	6
	C4-26	8.5	9
	C4-28	6.0	9

FIELD MOISTURE TESTS

Section No.	Sample No.	Depth (ft.)	% Moisture
D-1	D1-1	6.0	12
	D1-2	7.0	12
	D1-3	8.0	10
	D1-4	10.0	8
	D1-5	12.0	10
	D1-6	15.0	10
	D1-7	16.0	10
	D1-8	17.0	13
	D1-9	18.0	11
	D1-10	19.0	12
	D1-11	20.0	16
	D1-12	21.0	12
	D1-13	22.0	12
	D1-14	23.0	9
	D1-15	24.0	10
	D1-16	25.0	12
	D1-17	26.0	14
	D1-18	27.0	14
	D1-19	28.0	14
	D1-20	29.0	11
D-2	D2-1	2.0	16
	D2-2	3.0	2
	D2-3	4.0	10
	D2-4	5.0	14
	D2-5	6.0	10

GOODSON & ASSOCIATES, INC.

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO: 6583.01

Boring No.	Depth (feet)	Sample Identification	Type of Sample	Visual Description	Natural Moisture (%)	Specific Gravity	Other Testing	Remarks
P-1	3	P-1-1B, 3.5-4, Qal	SS	brown sandy silt	12.8			
P-1	6	P-1-2B, 6.5-7, Qal	SS	tan clay	34.8			
P-1	15	P-1-4B, 15.5-16, Zone 3	SS	gray-white silty sand	7.0			
P-2	5	P-2-1A, 6-6.5, Qal	SS	tan sand, some clay lumps	9.8			
P-2	10	P-2-2B, 10.5-11, Qal	SS	brown clay, some organics	20.3		gradation	10 %
P-2	15	P-2-3B, 15.5-16, Qal	SS	gray clay, some sand	20.2			
P-3	5	P-3-1A, 6-6.5, Qal	SS	gray sandy clay	29.2			
P-3	10	P-3-2B, 10.5-11, Qal	SS	brown silty sand, some organics	16.2		gradation	
P-3	15	P-3-3B, 15.5-16, Qal	SS	brown sandy clay	21.4			
P-4	5	P-4-1B, 5.5-6, Qal	SS	tan sand, some clay	10.6		gradation	
P-4	10	P-4-2B, 10.5-11, Qal	SS	brown clay, slightly sandy	16.8			
P-4	15	28-30, P-4-3B, 15.5-16, Qal	SS	brown clay	13.0			
P-5	5	P-5-1A, 6-6.5, Qal	SS	brown silty clay, slightly sandy	7.6		gradation	
P-5	10	P-5-2A, 11-11.5, Qal	SS	tan silty sand	4.6			
P-5	15	3-4-3, P-4, 3B, 15.5-16, Qal	SS	brown silty sand	19.4			
P-6	5	P-6-1A, 6-6.5, Qal	SS	brown slightly sandy clay	6.6			
P-6	10	P-6-2A, 11-11.5, Qal	SS	brown silty sand	3.6			

Note: All split spoon (ss) jar samples had loose lids when received. Several bag samples had holes in the bags. lids were tightened and bags double-bagged when received.

GOODSON & ASSOCIATES, INC.

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO: 6583.01

Boring No.	Depth (feet)	Sample Identification	Type of Sample	Visual Description	Natural Moisture (%)	Specific Gravity	Other Testing	Remarks
P-8	5	P-8-1A, 6-6.5, Qal	SS	brown slightly sandy clay	17.0			
P-8	10	P-8-2A, 11-11.5, Qal	SS	brown slightly sandy clay	17.5		hydrometer, gradation	
P-8	15	P-8-3B, 15.5-16, Qal	SS	brown slightly sandy clay	23.0			
B-4	5	B-4-1B, 5.5-6, Mancos	SS	gray claystone	28.5			
B-4	10	B-4-2B, 10.5-11, Mancos	SS	gray claystone	22.9	2.57	hydrometer, gradation	
B-4	15	B-4-3B, 15.5-16, Mancos	SS	gray claystone	23.3			
TP-1	5-6	sand	bag	brown silty sand	7.8		gradation, standard proctor	
TP-2	4-5	sand	bag	brown silty sand	11.8			
TP-2	6-7	sand	bucket	brown silty sand	11.9		gradation, standard proctor	
TP-3	7-8	silt	bag	brown silty sand	6.7			
TP-3	11-12	sand	bag	brown silty sand	27.0			hole in bag when received
~~TP-4~~	~~2-3~~	~~silt~~	~~bucket~~	~~brown sandy clay~~	~~13.6~~	~~2.56~~	~~hydrometer, gradation, stan. proctor~~	
TP-4	8-9	sand	bag	brown silty sand	6.5	2.62	gradation	
TP-5	1-2	sand	bag	brown silty sand	13.6			
TP-5	6	sand	bag	brown silty sand	5.0			
TP-6	1	silt	bag	brown silty sand	14.1			
TP-6	9-10	silt/sand	bag	brown silty sand	8.5	2.63	hydrometer, gradation	

GOODSON & ASSOCIATES, INC.

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO: 6583.01

Boring No.	Depth (feet)	Sample Identification	Type of Sample	Visual Description	Natural Moisture (%)	Specific Gravity	Other Testing	Remarks
TP-7	4-5	silt	bag	brown silty sand	9.7		hydrometer, gradation, stan. proctor	
TP-7	9-10	sand	bag	brown sandy silt	7.4		hydrometer, gradation	
TP-8	3-5	sand	bucket	brown sand	5.5	2.63	gradation, standard proctor	
TP-9	5	silt	bag	brown silty clay	9.0			hole in bag when received
TP-10	2-3	silt	bucket		8.2	2.63	hydrometer, gradation, stan. proctor	
TP-15	6	sand	bag	brown slightly gravelly sandy silt	5.6		gradation	
B-4	-	cuttings - Mancos	bucket		--		standard proctor	
--	-	Bentonite	bag	industrial bentonite	--		standard proctor	
TP-2	6-7	80% soil, 20% bentonite	--	---	--		standard proctor	
TP-2	6-7	95% soil, 5% bentonite	--	---	--		standard proctor	
P-1	20	P-1-5A, 20-20.2	jar	gray siltstone	8.5			
P-1	25	P-1-6A, 24.5-25	jar	gray siltstone	9.2			
P-2	20	P-2-4B, 20.5-21	jar	brown silty clay	25.0			
P-3	20	P-3-4B, 20.5-21	jar	brown silt/clay	24.9			
P-4	20	P-4-4B, 20.5-21	jar	brown silty clay	25.0			
P-4	30	P-4-5B, 30.5-31	jar	gray silty clay	24.4			24.6% after 1 wk w/ loose lid
P-5	20	P-5-4B, 20.5-21	jar	brown silty clay	9.8			12.0% after 1 wk w/ loose lid

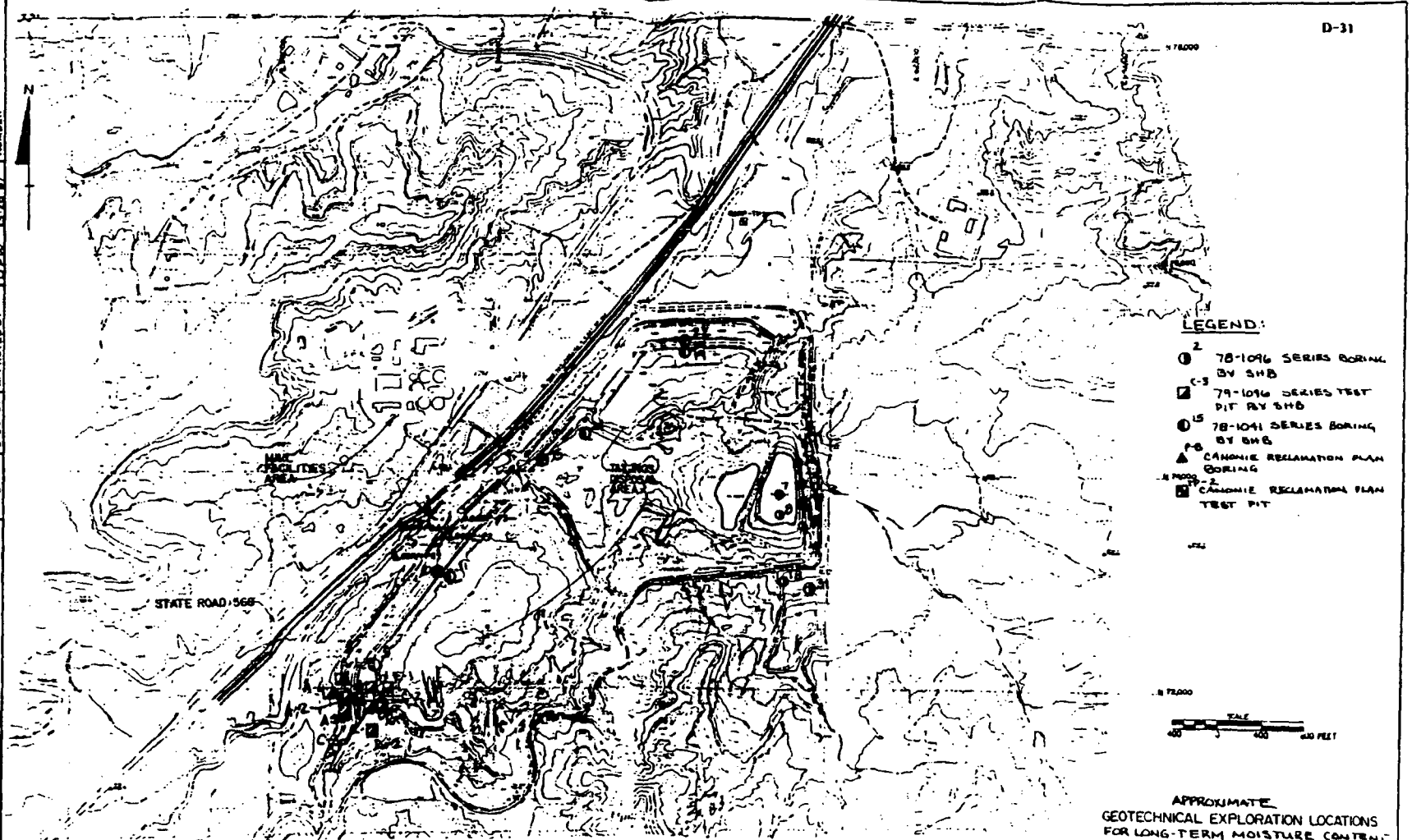
Note: P-5 @ 30' was not in the group of samples delivered on 12-24-86 for testing.

GOODSON & ASSOCIATES, INC.

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO: 6583.01

Boring No.	Depth (feet)	Sample Identification	Type of Sample	Visual Description	Natural Moisture (%)	Specific Gravity	Other Testing	Remarks
P-6	15	P-6-3B, 15.5-16	jar	brown silty clay	8.2			
P-6	20	P-6-4B, 20.5-21	jar	brown clayey silt	8.1			
P-6	30	P-6-5B, 30.5-31	jar	brown silty clay	5.2			8.2% after 1 wk with loose lid
P-8	15	P-8-3A, 16-16.5	jar	brown silty clay	21.9			23.2% after 1 wk w/ loose lid
P-8	20	P-8-4B, 20.5-21	jar	brown silty clay	22.8			
P-8	30	P-8-5A, 31-31.5	jar	brown silty clay	30.4			



APPROXIMATE
GEOTECHNICAL EXPLORATION LOCATIONS
FOR LONG-TERM MOISTURE CONTENT
PREPARED FOR

UNC MINING AND MILLING
GALLUP, NEW MEXICO

Canonie Environmental

DATE	FIGURE 4-1	DRAWING NUMBER
SCALE		

REVISIONS	NO.	DATE

DRAWN BY	CHECKED BY	DWF	DRAWING NUMBER
J.M. Mijich 5-26-87	APPROVED BY	DPW	RM86-060-E56

Purpose

The purpose of this calculation brief is to determine the long-term moisture content of the soil cover at the UNC site.

Summary

The moisture content was calculated to be 13.4%.

References

1) "Stability and Integrity Assessment Church Rock Tailings Dam, Church Rock New Mexico. Volume 3 - Breach Investigation." Sergent, Hauskins, and Beckwith. (SHB Job. No. E 79-1096) August, 1979.

Method

The long-term moisture content was calculated as follows:

I. The most probable percentage of each of the major soil types (ie. sand, silt, and clay) that will be in the soil cover was calculated based on grain size analysis results, boring log descriptions, laboratory description, and visual analysis of representative samples obtained at depths from 0 to 20 feet within the pipeline arroyo. The depth of excavation for the cover material will not exceed twenty feet. The cover

material will be excavated primarily from the pipeline arroyo.

Attached to this calculation brief are the laboratory results and borings logs from the pipeline arroyo.

II. The average moisture content of each of the major soil types was calculated from laboratory results from soil samples obtained in test pits and soil borings by SHB and Canonie at the UNC site.

III. The composite moisture content was calculated as follows:

$$\omega_{comp} = (\%_{sand})(\bar{\omega}_{sand}) + (\%_{silt})(\bar{\omega}_{silt}) + (\%_{clay})(\bar{\omega}_{clay})$$

CALCULATIONS

I. Percentage of Soil Type

Table 1 presents the calculation for the percent sand and percent fines (ie silt and clay) in the soil cover. Soil samples were obtained at regular depth intervals of approximately five feet. The percent of sands were obtained from either gradation analysis, boring logs, laboratory classification, or visual classification.

The thickness of the strata designated by each soil sample was assumed to extend from the depth of the sample to the depth of the sample above it, or the ground surface for the top sample.

The thickness of the sands and fines was calculated by multiplying the thickness of

the strata by the percentage of the soil type. This is demonstrated in the following example for boring P-3:

Sample #1
Sample Depth = 6'
Percent Sand = 30%
Percent Fines = 70%
Thickness of Strata = 6' − 0' = 6'
Thickness of Sand = 6' × 0.30 = 1.8'
Thickness of Fines = 6' × 0.70 = 4.2'

Sample #2
Sample Depth = 10'
Percent Sand = 34%
Percent Fines = 66%
Thickness of Strata = 10' − 6' = 4'
Thickness of Sand = 4' × 0.34 = 1.36'
Thickness of Fines = 4' × 0.66 = 2.64'

As shown on Table 1,
Total Sand Thickness = 48.86'
Total Fines Thickness = 77.14'

$$\text{Percentage Sands} = \frac{48.86}{48.86 + 77.14} = 39\%$$

$$\text{Percentage Fines} = \frac{77.14}{48.86 + 77.14} = 61\%$$

Based on visual description, it is estimated that the percent of silt is 40%. Therefore -

Sand = 39%
Silt = 40%
Clay = 21%

II. CALCULATION OF MOISTURE FOR SOIL TYPE

The moisture content for each soil type was calculated by averaging the moisture contents from soil data obtained by Canonie and Sargent, Hauskins & Beckwith (SHB)

Tables 2 through 8 present the calculations of the average moisture contents. Figures 1 through 4 present a plot of moisture content versus depth for the components.

The final moisture contents were determined from the predominant soil fraction in each soil type. For example, the moisture content from a sample of sandy clay was used to determine the average for clay.

Table 9 presents a summary of the moisture contents. The average moisture contents were calculated to be:

$\bar{\omega}_{sand} = 10.12\%$

$\bar{\omega}_{silt} = 15.93\%$

$\bar{\omega}_{clay} = 14.80\%$

Canonie Environmental

D-36

By [illegible] Date 2/11/91 Subject LONG-TERM MOISTURE CONTENT Sheet No. 4A of 19

Chkd. By DAG Date 2/11/91 Proj. No. 96-060-01

1/4" X 1/4"

BECAUSE THE IN-SITU MOISTURE CONTENT OF COARSE TAILINGS MEASURED DURING FIELD INVESTIGATIONS PERFORMED PRIOR TO RECLAMATION DESIGN IN 1986 ARE NOT CONSIDERED REPRESENTATIVE OF LONG-TERM CONDITIONS FOR THE COARSE TAILINGS, THE VALUE FROM IN-SITU MOISTURES OF NATIVE SOILS WITH APPROXIMATELY THE SAME CHARACTERISTICS AND GRADATION ARE USED. AS SHOWN ON PAGE 4 AND DESCRIBED MORE FULLY IN THE FOLLOWING PAGES, THE AVERAGE VALUE OF MOISTURE CONTENT OF NATIVE SOILS IS 10.1% THIS IS FROM A SAMPLE SIZE OF 79 SAMPLES AND DEFINITELY REPRESENTATIVE OF LONG-TERM MOISTURE OF THE COARSE TAILINGS

By SRP Date 6/24/88 Subject LONG-TERM MOISTURE CONTENT Sheet No. 5 of 19

Chkd. By MJB Date 6/27/88 UNC SOIL COVER Proj. No. 86-060-01

1/4 X 1/4

III COMPOSITE MOISTURE CONTENT

The composite moisture content was calculated as follows:

$$\text{Average Moisture Content} = (\%\ \text{sand})(\bar{\omega}_{sand}) + (\%\ \text{silt})(\bar{\omega}_{silt}) + (\%\ \text{clay})(\bar{\omega}_{clay})$$

Where $\bar{\omega}$ = Average Moisture Content

$$(0.39)(10.12) + (0.40)(15.93) + (0.21)(14.80) = \underline{\underline{13.4\%}}$$

Canonie Environmental

D-38

By TMK Date 2/27/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 6 of 19

Chkd. By SRP Date 3/4/87 UNC SOIL COVER Proj. No. 86-060-01

TABLE 1 — PERCENTAGE OF SANDS AND 1/4" X 1/4" FINES.

Data from Goodson & Associates Laboratory Test Results

Boring No.		Depth	% Sand	% Fines	thickness sand	thickness fines
P-1		3	100	0	3	0
		6	0	100	0	3
P-2		6	90	10	5.4	.6
	*	10	0	100	0	4
		15	10	90	.5	4.5
		20	0	100	0	5
P-3		6	30	70	1.8	4.2
	*	10	34	66	1.36	2.64
		15	40	60	2	3
		20	0	100	0	5
P-4	*	5	68	32	3.4	1.6
		10	70	30	3.5	1.5
		15	100	0	5	0
		20	0	100	0	5
P-5	*	6	53	47	3.18	2.82
		10	60	40	2.4	1.6
		15	80	20	4	1
		20	0	100	0	5
P-6		6	60	40	3.6	2.4
		10	60	40	2.4	1.6
		15	60	40	3	2
		20	60	40	3	2
P-8		5	10	90	.5	4.5
	*	11	7	93	.42	5.58
		15	10	90	.4	3.6
		20	0	100	0	5
					43.86	77.4
					Total	26
					39%	61%
					Sand	silt/clay

* denotes grain size analysis
other samples were
estimated for % sand and
% fines (silt/clay)

Canonie Environmental

D-39

By Tmk Date 1/29/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 7 of 19

Chkd. By SRP Date 3/12/87 UNC SOIL COVER Proj. No. RMR-960-01

1/4" X 1/4"

TABLE 2

Canonie Test Pits

Boring No.	Depth (ft)	Sand Nat. Moisture	Description
P-1	15	7.0	Silty Sand
P-2	5	9.8	Sand
P-3	10	16.2	Silty Sand
P-4	5	10.6	Silty Sand
P-5	10	4.6	Silty Sand
P-5	15	19.4	Silty Sand
P-6	5	6.6	Silty Sand
P-6	10	3.6	Silty Sand
TP-1	5-6	7.8	Silty Sand
TP-2	4-5	11.8	Silty Sand
TP-2	6-7	11.9	Silty Sand
TP-3	11-12	27.0	Silty Sand
TP-4	8-9	6.5	Silty Sand
TP-5	1-2	13.6	Silty Sand
TP-5	6	5.0	Silty Sand
TP-6	9-10	8.5	Silty Sand
TP-7	9-10	7.4	Silty Sand
TP-8	3-5	5.5	Sand
TP-15	6	5.6	[illegible] gravel in Sand
	N = 19	Σ 188.4	

$\bar{X} = 9.92$

$S = 5.86$

95% confidence interval 7.3 to 12.6

By TMS Date 1/22/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 8 of 17

Chkd. By SRP Date 3/12/87 UNC SOIL COVER Proj. No. KM 26-960-01

1/4" X 1/4"

TABLE 3

SHB Test Pits (Report E79-1096)

Sand

Test Pit No.	Depth (ft)	Nat. moisture
A1-7	2.0	11
A2-1	20.0	11
A2-9	2.5	11
A2-10	4.5	8
A2-11	7.5	18
A3-7	3.0	7
A4-3	4.0	7
A4-7	2.5	7
A5-5	5.0	5
A5-9	5.0	9
A6-3	4.5	8
A6-7	4.5	6
A7-2	5.0	6
A7-5	5.0	5
C3-7	5.0	14
		Σ 133

N = 15 $\bar{x}$ = 8.87

s = 3.60

95% confidence interval 7.0 to 10.7

Canonie Environmental

D-41

By TMK Date 1/29/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 9 of 19

Chkd. By [illegible] Date 3/2/87 UNC SOIL COVER Proj. No. [illegible]

1/4" X 1/4"

TABLE 4

SHG Test Pits (Report E79-1096)

Silty Sand

Test Pit No.	Depth (ft)	Nat. moisture
A1-3	9.0	14
A1-4	3.5	7
A1-5	1.5	9
A1-6	3.5	10
A1-8	4.5	9
A1-9	5.0	14
A2-2	4.0	11
A2-3	5.6	14
A2-12	1.7	16
A2-13	3.0	15
A3-3	4.5	11
A3-4	2.0	9
A3-5	1.0	9
A3-6	1.5	13
A3-9	2.0	13
A4-1	9.0	12
A4-2	5.5	12
A4-4	1.5	7
A4-5	5.5	5
A4-6	9.5	18
A4-8	1.5	9
A5-2	9.0	4

sand + silty sand combined:

N=60 $\bar{x}$ = 10.18

s = 3.66

95% confidence 9.3 to 11.1

Test Pit No.	Depth (ft)	Nat. moisture
A5-3	7.5	13
A5-4	6.5	8
A5-6	2.5	12
A5-8	2.0	14
A6-2	5.5	9
A6-4	2.0	8
A6-8	3.5	8
A7-1	7.0	6
A7-4	6.5	7
A7-6	3.0	14
C3-2	6.5	11
C4-2	2.5	10
C4-3	4.0	13
C4-4	6.0	10
C4-7	3.0	7
C4-8	4.0	9
C4-10	6.0	12
C4-13	8.0	19
C4-14	5.0	7
C4-15	7.5	19
C4-19	2.2	8
C4-20	3.5	7
C4-21	4.5	6

N = 45 Σ 478

$\bar{x}$ = 10.62

s = 3.61

95% confidence interval 9.6 to 1[illegible]

Canonie Environmental

D-42

By TMC Date 1/29/97 Subject LONG-TERM MOISTURE CONTENT Sheet No. 10 of 19

Chkd. By SEO Date 3/12/97 UNC SOIL COVER Proj. No. 80-060-01

1/4" X 1/4"

TABLE 5

Canonie Test Pits
Silt

Boring No.	Depth (ft)	Nat Moisture	Description	$(x-\bar{x})^2$
P-1	3	12.8	Sandy Silt	1.85
P-8	10	17.5	Silt	36.72
TP-3	7-8	6.7	Sandy Silt	22.47
TP-4	2-3	13.6	Sandy Silt	4.67
TP-6	1	14.1	Sandy Silt	7.08
TP-7	4-5	9.7	Sandy Silt	3.03
TP-9	5	9.0	Clayey Silt	5.95
P-6	20	8.1	Clayey Silt	11.16
	N = 8	Σ 91.5		Σ 92.9
		$\bar{x}$ = 11.44		
		S = 3.64	95% Limits 8.9 to 14.0	

Canonie Environmental

By [illegible] Date 1/29/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 11 of 19

Chkd. By [illegible] Date 3/12/87 UNC SOIL COVER Proj. No. BG-060-01

1/4" X 1/4"

TABLE 6

SHB Test Pits (Report E79-1096)

Sandy Silt

Test Pit No	Depth (ft)	Nat. Moisture
C1-6	4.0	24
C1-7	5.0	18
C1-8	6.0	21
C1-9	8.0	22
C1-10	8.0	19
C1-11	9.0	18
C1-12	10.0	20
C1-17	7.2	13
C1-18	8.2	13
C1-19	9.0	22
C1-25	9.0	16
C1-26	7.0	21
		Σ 227

N = 12

$\bar{x}$ = 18.92 ✓ DWK 5/14/87

s = 3.50 ✓ DWK 5/14/87

95% confidence interval: 16.9 to 20.9

CanonieEnvironmental

D-44

By [illegible] Date 1/29/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 12 of 19

Chkd. By SRP Date 5/12/87 LNC SOIL COVER Proj. No. RMS-060-01

1/4" X 1/4"

TABLE 7

Canonie Test Pits

Clay

Boring No.	Depth (ft)	Nat. Moisture	Description	$x-\bar{x}$	$(x-\bar{x})^2$
P-1	6	34.8	Clay	14.8	21
P-2	10	20.3	Clay	0.3	.0
P-2	15	20.2	Sandy Clay	0.2	.0
P-3	5	29.2	Sandy Clay	9.2	84.6
P-3	15	21.4	Sandy Clay	1.4	1.9
P-4	10	16.8	Sandy Clay	-3.2	10.
X P-4	15	13.0	Clay	-7.0	49
P-5	5	7.6	Silty Clay	-12.4	15[illegible]
P-8	5	17.0	Sandy Clay	-3.0	9.
P-8	15	23.0	Sandy Clay	3.0	9.
P-2	20	25.0	Silty Clay	5.0	25
P-3	20	24.9	Silty Clay	4.9	24
P-4	20	25.0	Silty Clay	5.0	25
P-4	30	24.4	Silty Clay	4.4	19.
P-5	20	9.8	Silty Clay	-10.2	104
X P-6	15	8.2	Silty Clay	-11.8	139.
X P-6	30	5.2	Silty Clay	-14.8	219
P-8	15	21.9	Silty Clay	1.9	3.6
P-8	20	22.8	Silty Clay	2.8	7.8
P-8	30	30.4	Silty Clay	10.4	108
		400.9			[illegible] 121.

$\bar{X} = 20.05$ SAY 20.0

$N = 20$

$S = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N-1}} = 7.99$

$\bar{X} \pm 1.96 S/\sqrt{N} =$

$= 6.64$ to 22

LIMITS OF 95% CONFIDENCE INTERVAL = 16.54 to 23.55

Canonie Environmental

D-45

By TMK Date 1/20/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 13 of 19

Chkd. By SRP Date 2/12/87 UNC SOIL COVER Proj. No. M86-260-01

1/4" X 1/4"

TABLE 8

SHB Test Pits (Report E79-1096)

Sandy Clay

Test Pit No.	Depth (ft)	Nat. Moisture
A1-1	10.5	18
A1-2	10.5	16
A2-4	7.1	16
A2-5	9.0	16
A2-6	9.0	15
A2-7	9.0	13
A2-8	9.0	17
A3-1	12.0	14
A3-2	7.0	16
A3-8	6.0	20
A5-7	0.5	16
A5-10	2.0	10
A6-1	11.5	21
A6-5	1.0	12
A6-6	6.5	18
A6-9	1.0	14
A7-3	3.0	12
A7-7	2.0	11
C1-1	0	18
C1-2	0.5	22
C1-3	1.8	15
C1-4	2.2	22
C1-5	3.0	13
C1-13	11.0	21
C1-14	12.0	21
C1-15	13.0	17
C1-16	14.0	17
C1-20	10.0	18

Test Pit No.	Depth (ft)	Nat. Moisture
C1-21	11.0	12
C1-22	12.5	14
C1-23	14.0	12
C1-24	14.0	14
C2-4	7.0	8
C2-5	5.0	19
C2-6	3.0	12
C2-7	2.0	11
C2-8	5.0	16
C2-9	2.0	12
C3-4	5.5	17
C3-5	4.5	12
C3-6	3.5	14
C3-8	2.5	14
C3-9	0.5	12
C3-10	2.5	11
C3-11	3.5	14
C3-12	4.5	17
C3-13	5.5	14
C3-14	6.5	19
C3-15	7.5	17
C4-1	1.0	13
C4-5	9.0	20
C4-6	1.5	13
C4-12	8.0	18
C4-16	8.2	15
C4-17	9.0	18
C4-18	9.8	17

Canonie Environmental

D-46

By TMK Date 1/29/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 14 of 19

Chkd. By SRP Date 3/12/87 UNC SOIL COVER Proj. No. RMB-060-01

1/4" X 1/4"

Sandy Clay (cont.)

Test Pit No.	Depth (ft)	Nat. Moisture
C4-25	7.5	6
C4-26	8.5	9
D1-1	6.0	12
D1-2	7.0	12
D1-3	8.0	10
D1-4	10.0	8
D1-5	12.0	10
D1-6	15.0	10
D1-7	16.0	10
D1-8	17.0	13
D1-9	18.0	11
D1-10	19.0	12
D1-11	20.0	16
D1-12	21.0	12
D1-13	22.0	12
D1-14	23.0	9
D1-15	24.0	10
D1-16	25.0	12
D1-17	26.0	14
D1-18	27.0	14
D1-19	28.0	14
D1-20	29.0	11
D2-1	2.0	16
D2-2	3.0	2
D2-3	4.0	10
D2-4	5.0	14
D2-5	6.0	10
D2-6	7.0	6
D2-7	9.0	11

Test Pit No.	Depth (ft)	Nat. Moisture
D2-8	11.0	11
D2-9	13.0	10
D2-10	15.0	11
E1-1	1.5	4
E1-2	3.5	5
E1-3	4.5	6
E1-4	5.5	13
E1-5	6.5	17
E1-6	7.5	12
E1-7	8.5	20
E1-8	10.5	20
E1-9	11.5	7
E1-10	12.5	9
E1-11	13.0	10
E1-12	13.5	13
E1-13	14.0	15
E1-14	14.5	17
E1-15	15.0	20
E1-16	15.5	17
E1-17	15.0	12
E1-18	16.0	20
E1-19	16.8	13
E1-20	17.2	19

Σ 1493

N = 108 $\bar{x}$ = 13.82 ✓ DWK 5/1

s = 4.13 ✓ DWK 5

95% confidence interval 13.0 to 14.6

By SRP Date 6/24/88 Subject LONG-TERM MOISTURE CONTENT Sheet No. 15 of 19

Chkd. By [illegible] Date 6/27/88 UNC SOIL COVER Proj. No. 86-060-01

1/4" X 1/4"

TABLE 9

SUMMARY OF MOISTURE CONTENTS

	Average, $\bar{x}$	Number, n	Standard Deviation, σ	95% Confidence Interval
SAND				
Canonie	7.92	19	5.86	7.3 - 12.6
SHB	10.18	60	3.66	9.3 - 11.1
SILT				
Canonie	11.44	8	3.64	8.9 - 14.0
SHB	18.92	12	3.50	16.9 - 20.9
CLAY				
Canonie	20.05	20	7.99	16.5 - 23.6
SHB	13.82	108	4.13	13.0 - 14.6
COMBINED				
Sand	10.12	79	4.25	9.2 - 11.1
Silt	15.93	20	5.11	13.7 - 18.2
Clay	14.80	128	5.39	13.9 - 15.7

Canonie Environmental

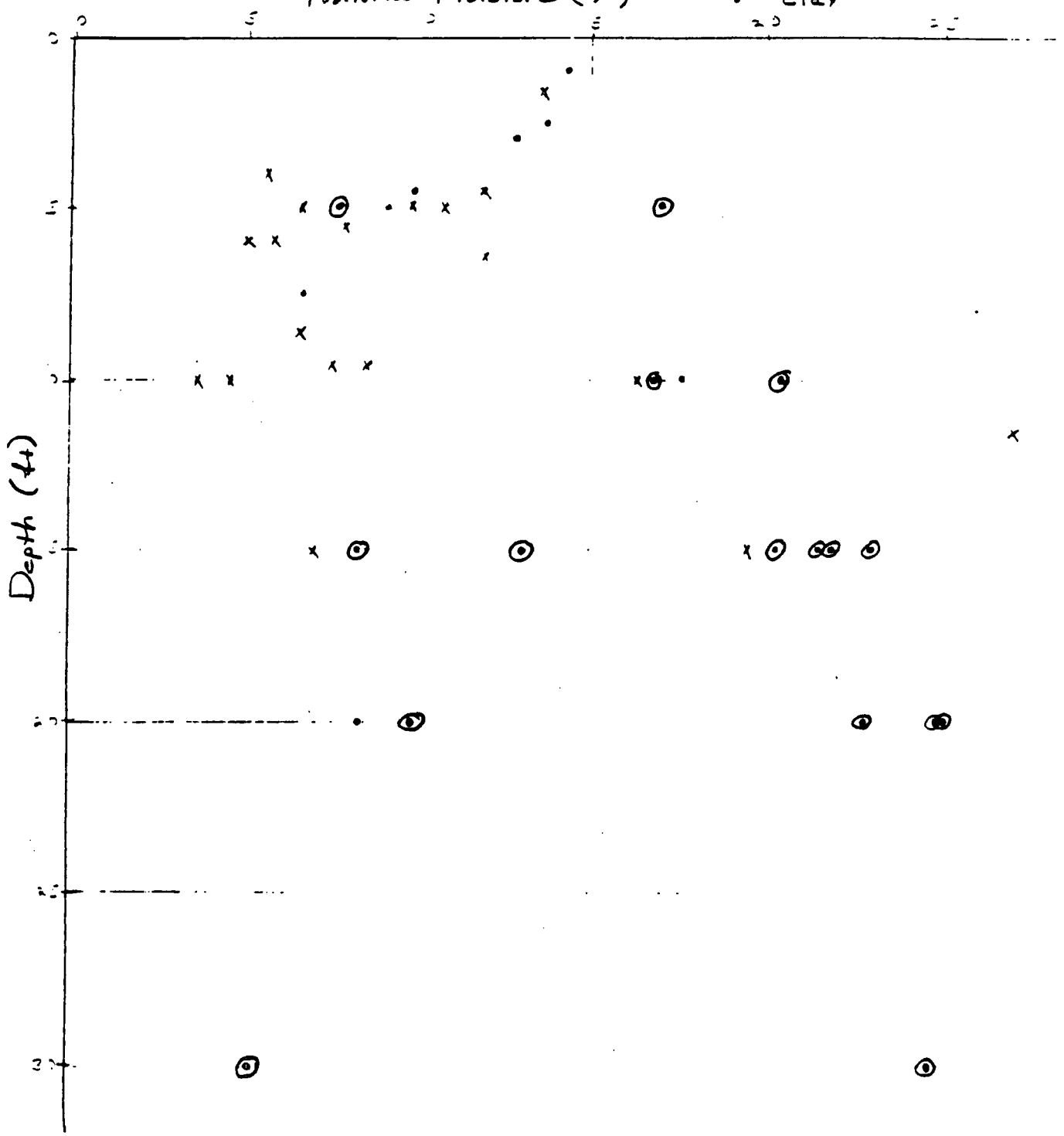
D-43

By TME Date 1/29/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 16 of 19

Chkd. By SKP Date 3/2/87 UNC SOIL COVER Proj. No. PMX-363-01

1/4" X 1/4"

Figure 1
(Canonie Samples)
Natural Moisture (%)



Canonie Environmental

D-49

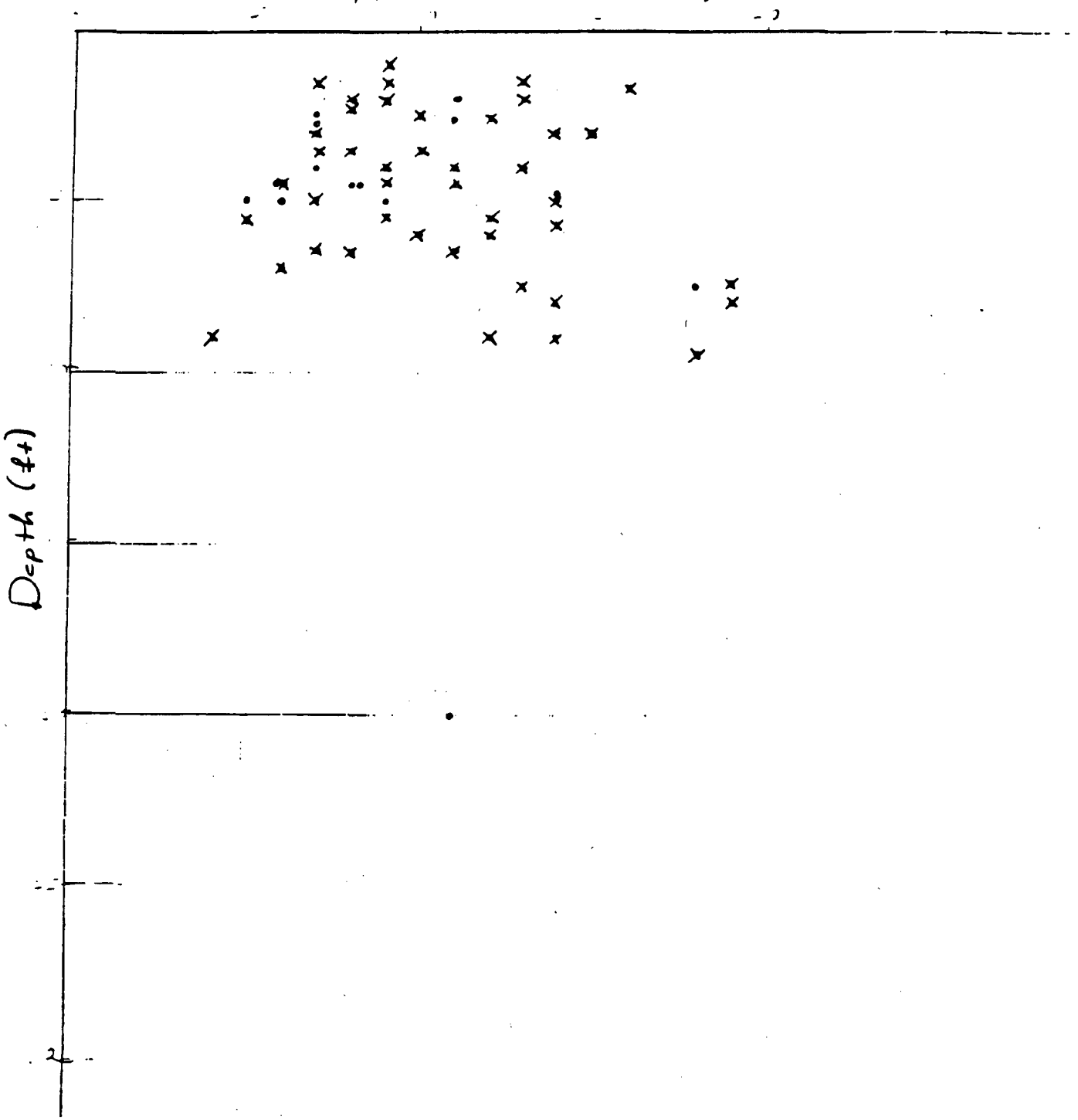
By TMK Date 1/29/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 17 of 19

Chkd. By GBP Date 3/12/87 UNC SOIL COVER Proj. No. RM86-060-01

1/4" X 1/4"

Figure 2
(SHB Samples)
Natural Moisture (%)

• sand
x silty sand



Canonie Environmental

D-50

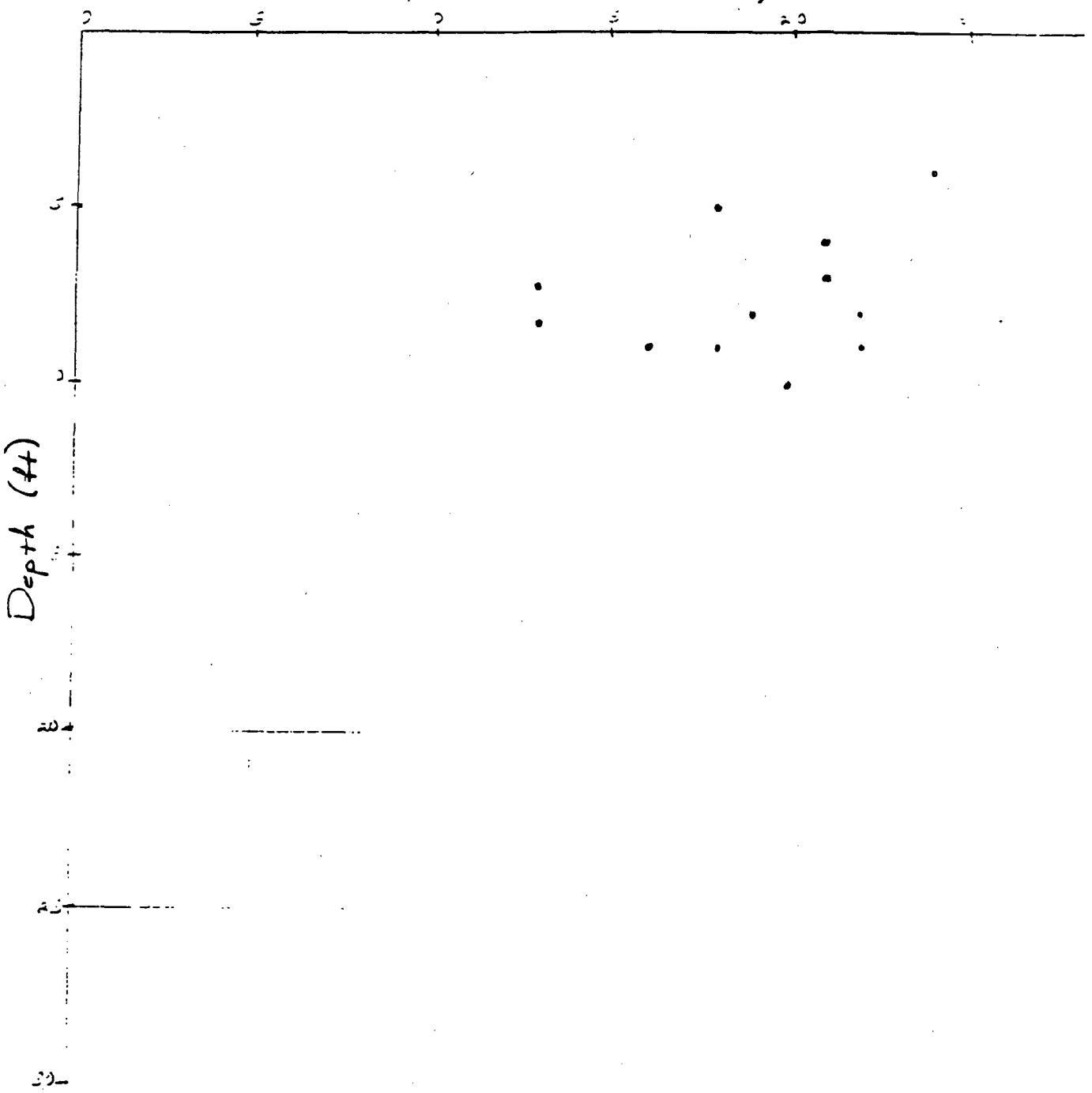
By TMK Date 1/29/87 Subject LONG-TERM MOISTURE CONTENT Sheet No. 18 of 19

Chkd. By SRP Date 3/12/87 UNIC SOIL COVER Proj. No. RMP6-060-01

1/4" X 1/4"

Figure 3
(SHB Samples)
Natural Moisture (%)

Sandy Silt



Canonie Environmental

D-51

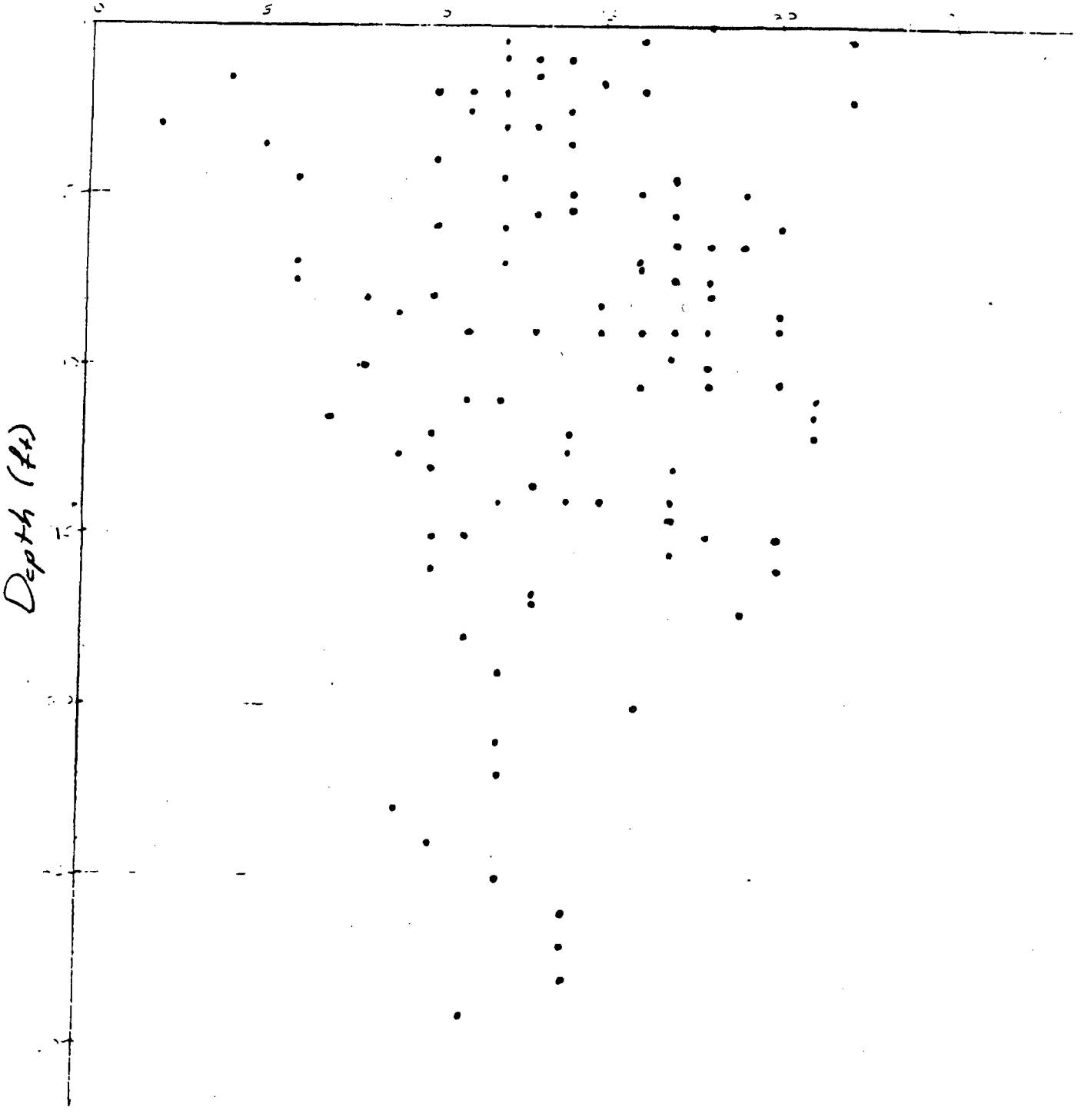
By TMK Date 11/19/97 Subject LONG-TERM MOISTURE CONTENT Sheet No. 19 of 19

Chkd. By SRP Date 3/18/97 UNC SOIL COVER Proj. No. RMK-060-01

1/4" X 1/4"

Figure 4
(SHB Samples)
Natural Moisture (%)

Sandy Clay



FINE TAILINGS IN-SITU MOISTURE CONTENTS

HOLE 06L
South Pond

DEPTH INTERVAL FEET (CORE RECOVERY)	DESCRIPTION	SOIL CLASS	% LESS THAN 200 MESH	SPECIFIC GRAVITY SOLIDS	DRY BULK DENSITY lbs/ft³	POROSITY %	MOISTURE CONTENT OPTIMUM %	STD. PROCTOR OPTIMUM MOISTURE @ 90% STD. PROCTOR DRY DEN. lbs/ft³	K, SATURATED COMPRESSION CONTENT % OF PROCTOR	2a-2b 21 PSI	DIFFUSION COEFFICIENT (cm²/s)	EXCHANGEABLE FRACTION (cm²/s)
0-2.5	Coarse sand, damp											
2.5-5.0 (2.0')												
5.0-7.5	Coarse sand damp											
7.5-10.0 (2.0')												
10.0-12.5												
12.5-15.0 (2.0')	Coarse-medium sand damp			2.80	92	47	31			115±2	4.2×10^{-2}	0.27±.02
15.0-17.5												
17.5-20.0 (5.0')	Coarse sand wet wet at 15'				97	49 est.	24.1		.043			
20.0-22.5												
22.5-25.0 (2.5')	Coarse sand wet			2.78	96	36	25.1			108±2	1.1×10^{-5}	0.33±.02
25.0-27.5	Coarse-medium sand wet brown (Yz-1)											
27.5-30.0	Coarse-medium sand wet gray			2.79	94	46	28.6			117±2	1.3×10^{-6}	0.28±.02
30.0-32.5												
32.5-35.0 (3.0')	Coarse-medium sand wet											
35.0-37.5	Medium sand wet brown											
37.5-40.0 (4.5')	Slimes wet gray			2.70	84	51	36.4			57±2	6.4×10^{-6}	0.21±.01
40.0-42.5	Mixed sands & slimes				89	55 calc.	43.9		.082			
42.5-45.0 (5.0')	Wet slime to 44.0											
45.0-47.5	Contact at 44' Silt/clay alluvium wet											
	TD = 50'											

HOLE 60
CENTRAL CELL - EAST

DEPTH INTERVAL FEET	DESCRIPTION (SAMPLE RECOVERY)	SOIL CLASS	% LESS THAN 200 MESH	SPECIFIC GRAVITY SOLIDS	DRY BULK DENSITY lbs/ft³	POROSITY %	MOISTURE CONTENT % DRY WT	STD. PROCTOR OPTIMUM MOISTURE lbs./ft³	OPTIMUM MOISTURE CONTENT %	K, saline @ 90% STD. PROCTOR	COMPRESSION INDEX @ 21 psi	Ra-226 pCi/g	DIFFUSION COEFFICIENT cm²/s	EFFECTIVE FRACTION
0-2.5	Road fill													
2.5-5.0 (2.5')	Tailings sands													
5.0-7.5	Sand dams													
	Slime 7.5-8.0, wet			2.81	74	58	44.2					34 ± 3	1.1×10^{-6}	0.57 ± .01
7.5-10.0 (2.5')	Fine sand 8.0-10.0													
10.0-12.5	Sand, wet													
				2.44	94	47	60.0					109 ± 5	1.6×10^{-6}	0.31 ± .01
12.5-15.0 (2.5')	Clay slime wet													
15.0-17.5	Sands wet													
17.5-20.0 (2.5')														
20.0-22.5	Coarse-fine sands wet													
22.5-25.0 (2.5')														
				2.75	89	49	22.1					285 ± 3	1.1×10^{-6}	0.26 ± .01
25.0-27.5	Fine sand wet													
27.5-30.0 (2.5')	Very fine sand/slime wet													
30.0-32.5	Fine sand wet													
32.5-35.0 (2.5')														
				2.64	79	56	41.4					526 ± 4	2.7×10^{-6}	0.28 ± .01
35.0-37.5	Clay slime wet													
		values of 38-slimes			173	5 samples	44.51			100				
37.5-40.0 (2.5')	Alluvium at 39.5													
				2.78	96	49	27.9					49 ± 1	3.2×10^{-6}	0.39 ± .10
40.0-42.5	Alluvium wet													
42.5-45.0 (5.0')	TD = 45'													
	screened 40-45'													

HOLE 1039
1" CENTRAL CELL TAILINGS - CYCLONE STOCKPILE

DEPTH: MATERIAL DESCRIPTION (FEET - SAMPLE RECOVERY)	SOIL CLASS	% LESS THAN 200 MESH	SPECIFIC GRAVITY SOLIDS	DRY BULK DENSITY lbs/ft³	POROSITY %	MOISTURE CONTENT % of DRY WT.	STD. PROCTOR OPTIMUM MOISTURE CONTENT lbs./ft³	OPTIMUM MOISTURE CONTENT %	K, critical COMPACTION @ 80% STD PROCTOR	20-226 ZIRCON 21 PSI	DIFFUSION pCi/g	FORMATION COEFFICIENT cm²/s	FRACTION
0-2.5 Coarse sands damp													
2.5-5.0 (2.0')													
5.0-7.5 Medium-coarse sands damp			2.74	95	46	6.1					12552	3.7×10^{-2}	0.19 ± .02
7.5-10.0 (2.5')													
10.0-12.5 Medium-fine sands damp													
12.5-15.0 (2.5')													
15.0-17.5 Medium-coarse sands damp			2.74	94	47	10.5					727 ± 2	2.3×10^{-2}	0.21 ± .01
17.5-20.0 (2.5')													
20.0-22.5 Medium sand damp													
22.5-25.0 (2.5') Fine slimy sand wet													
25.0-27.5 Medium-coarse sands damp			2.74	97	45	15.0					1322 ± 3	1.6×10^{-3}	0.20 ± .02
27.5-30.0 (2.5')													
				106	47	12.0							
30.0-32.5 Fine-medium sand damp													
32.5-35.0 (5.0')													
			2.72	78	54	29.6					602 ± 2	5.6×10^{-3}	0.16 ± .01
35.0-37.5 Sand/slim mix wet													
37.5-40.0 (4.5') Alluvium at 39.0													
40.0-42.5 Clay/silt alluvium damp													
			2.80	85	51	24.3					4 ± 4	1.4×10^{-3}	0.14 ± .04
42.5-45.0 (2.5') TD = 45'													

E 6C8

CENTRAL CASS TAILINGS - WEST

DEPTH (SAMPLE RECOVERY)	DESCRIPTION	SOIL CLASS	% LESS THAN 200 MESH	SPECIFIC GRAVITY SOLIDS	DRY BULK DENSITY lbs/ft³	POROSITY %	MOISTURE CONTENT % DRY WT	STD PROCTOR OPTIMUM MOISTURE CONTENT, %	OPTIMUM DRY DENSITY lbs/ft³	K critical @ 80% STD PROCTOR	COMPRESSION INDEX	20-2.6 kg/cm²	DIFFUSION COEFFICIENT cm²/s	EXPANSION FRACTION
5'	Fine sands dry													
30(2')														
5'	Medium sands dry			2.81	98	50	17.9					0.022	6.3×10⁻⁸	0.22±.01
20(2.5')														
25'	Fine - Medium sands dry				105	40 (est)	21.4			0.18				
35.0(4.5')														
35'	Medium sands - damp wet at 17.5'			2.67	104	41	23.5					0.022	5.3×10⁻⁸	0.37±.02
40(4.5')	Fine sands & silts wet													
40-42.5	Fine sand wet													
45-50(2.5')														
50-52.5	Wet sand			2.81	98	44	23.9					0.014	1.9×10⁻⁵	0.37±.02
50(4.5')														
					97	55 (est)	27.0			0.55				
55'	Wet sand													
55(4.5')														
57.5	Wet sand			2.81	90	49	27.2					0.022	2.01×10⁻⁶	0.25±.01
60(5.0')														
62.5	Wet clay silt - alluvium													
65(5.5')	Contact at 40'													
	TD - 45'													
65	Screened 40-45'													

APPENDIX
E

APPENDIX E

SURFACE WATER HYDROLOGY AND HYDRAULIC CALCULATIONS

CanonieEnvironmental

APPENDIX E

TABLE OF CONTENTS

			Page No.
E.1	Pipeline Arroyo Hydraulic Calculations		
	a.	PMF Calculation for the Pipeline Arroyo	E-3
	b.	Printout of HEC-2 Computer Model Reaches #1, #2, and #3 to Determine the Limits of the PMF	E-6
	c.	HEC-2 Analysis for Low Flow Channel at the Buried Jetty	E-49
	d.	Nickpoint Stability - Riprap Design for Jetty	E-65
E.2	North and South Diversion Ditch Hydraulic Calculations:		
	a.	PMF Calculation for Watersheds A_1, A_2, and B	E-71
	b.	100 Year Flood Calculations for Watersheds A_1, A_2, and B	E-79
	c.	Flow Depth Calculations - North Diversion Ditch, Sections K, L, M, N, and O	E-86
	d.	North Diversion Ditch - Confluence Stability	E-92
	e.	PMF Calculations for the South Diversion Ditch and Flow Depth Calculations for Limiting Sections 1 and 2	E-104
	f.	Flow Depth Calculations for the North Diversion Ditch Inward Curves	E-109
	g.	Riprap Calculations for the North Diversion Ditch Inward Curves	E-112

APPENDIX E

TABLE OF CONTENTS
(Continued)

		Page No.
E.3	Tailings Embankment Hydraulic Calculations	
	a. Runoff Control Ditch Design	E-119
	b. Scour Along Protective Bench	E-131
	c. Rock Mulch Design for Embankment	E-140
E.4	Tailings Embankment Slope Stability Calculation	E-143
E.5	Tailings Top Hydraulic Calculations	
	a. Hydraulic Analyses for Swales	E-205
	b. Soil/Rock Matrix Stability Calculations	E-230
E.6	South Cell Drainage Channel Hydraulic Calculations	E-248
E.7	North Cell Drainage Channel Hydraulic Calculations	E-258
E.8	Riprap and Bedding Calculations	E-268

E.1(a)

PMF Arroyo Hydraulic Calculation

HYDROGRAPH CALCULATION FOR ONE-HOUR PMP EVENTS USING THE SCS CURVE NUMBER METHOD
HMR 49 RAINFALL DISTRIBUTION USED

Design of Small Dams - Revised Watershed
PIPELINE ARROYO UNC PROJECT RM86-060-01
13-May-88 14:59

ONE-HOUR RAINFALL AMOUNT	9.4 INCHES		
SCS CURVE NUMBER	79	S =	2.66
MEAN BASIN ELEV.	7275 FEET		
DURATION (D)	0.25 HOURS		
WATER COURSE LENGTH (L)	6.98 MILES	0.880681818	
WATERSHED AREA (A)	18.22 SQ. MILES		
MAXIMUM RELIEF (H)	819.00 FEET		
ELEV ADJUSTMENT	0.88625 ADJ. RAINFAL		8.33 INCHES
AREAL ADJUSTMENT (OSD)	0.75 ADJ. RAINFAL		6.25 INCHES
WATERSHED ADJUSTMENT (OSD. TABLE 5. PG 67)	1.04		

ITEM	TIME PERIOD. HRS 0-0.25	0.25-0.50	0.50-0.75	0.75-1.00
PERCENT OF 1-HOUR RAINFALL (OSD.TABLE 2. PG 52)	74	89	95	100
ULATIVE RAINFALL	4.62	5.56	5.94	6.25
INCREMENTAL RAINFALL	4.62	0.94	0.37	0.31
SEQUENCE	0.37	0.94	4.62	0.31
P - CUMULATIVE DESIGN RAINFALL	0.37	1.31	5.94	6.25
Q - CUMULATIVE RUNOFF	0.01	0.18	3.62	3.90
INCREMENTAL RUNOFF OR EXCESS RAINFALL	0.01	0.17	3.45	0.28

TIME OF CONCENTRATION (Tc)	1.86 HOURS
ADJUSTED Tc	1.92 HOURS
TIME TO PEAK (Tp)	1.28 HOURS
BASE PERIOD (Tb)	3.42 HOURS
TT PEAK DISCHARGE	6893 CFS

CanonieEnvironmental

INTERMEDIATE HYDROGRAPHS

	TIME	FIRST	SECOND	THIRD	FOURTH	COMBINED HYDROGRAPH
PEAK DISCHARGE (cfs)		67.72	1153.31	23748.32	1928.13	
	0.00	0.00				0.00
	0.16	8.46				8.46
	0.32	16.93	0.00			16.93
	0.48	25.39	144.16	0.00		169.56
	0.64	33.86	288.33	2968.54		3290.73
	0.80	42.32	432.49	5937.08	0.00	6411.90
	0.96	50.79	576.66	8906.62	241.02	9774.08
	1.12	59.25	720.82	11874.16	482.03	13136.27
	1.28	67.72	864.98	14842.70	723.05	16498.45
	1.44	62.65	1009.15	17811.24	964.06	19847.10
	1.60	57.58	1153.31	20779.78	1205.08	23195.75
	1.76	52.51	1066.98	23748.32	1446.10	26313.92
	1.92	47.44	980.66	21970.75	1687.11	24685.97
	2.08	42.38	894.33	20193.18	1928.13	23058.02
	2.24	37.31	808.01	18415.61	1783.81	21044.74
	2.40	32.24	721.68	16638.05	1639.49	19031.45
	2.56	27.17	635.36	14860.48	1495.16	17018.17
	2.72	22.10	549.03	13082.91	1350.84	15004.88
	2.88	17.03	462.71	11305.34	1206.52	12991.60
	3.04	11.96	376.38	9527.77	1062.20	10978.31
	3.20	6.89	290.05	7750.20	917.88	8965.03
	3.36	1.82	203.73	5972.63	773.56	6951.75
	3.52	0.00	117.40	4195.06	629.24	4941.70
	3.68		31.08	2417.49	484.92	2933.49
	3.84		0.00	639.92	340.60	980.52
	4.00			0.00	196.28	196.28
	4.16				51.96	51.96
	4.32				0.00	0.00
	4.48					

E.1(b)

HEC-2 Calculations to Determine Limits of the PMF For:

- Subcritical Reaches #1 and #2
  (Flatter slopes)

- Supercritical Reach #3
  (Steeper slopes)

By: SWM Date: 11-29-90 Subject: UNC Gallup, New Mexico
Pipeline Arroyo Redesign

Checked By: GS/12-03-90 Project #: 86-060-24 Page 1 of 40

Purpose:

This calculation brief presents a description and HEC-2 analysis of Alternative #7 (recommended redesign alternative for Pipeline Arroyo). More specifically, the design assumptions, summary, and HEC-2 input/output for Alterative #7 are included.

The HEC-2 analysis for Alternative #7 involved two separate runs of the HEC-2 program. The first HEC-2 run represents subcritical flow in Reaches #1 &#2 (flatter slopes) of the reconfigured channel. The second HEC-2 run represents supercritical flow in Reach #3 (steeper slopes) of the reconfigured channel.

The cross sections used in the HEC-2 analysis are shown on the enclosed maps (Figures J-1 & J-2).

Method:

The U.S. Army Corps of Engineers' HEC-2 computer model for open channel flow was utilized to analyze the reconfigured channel.

Results:

- See the HEC-2 output that is included at the end of this calculation brief.
- See Figure #2 on page #4 for relationship (profile view) between the following elevations:

  1) Bench Top

  2) Embankment Top

  3) Bench Toe

  4) Channel Bottom

  5) PMF Maximum Water Surface Elevation

Assumptions: The following assumptions were made in the design process:

- o the reference line used in all alternatives is the centerline for the present channel design under the existing reclamation plan. All station numbers refer to stations along this line. which is plotted on the enclosed maps.
- o The sandstone outcrop located at @Sta 62+70 is known as the Nickpoint.
- o Reach #1 is defined as that part of the channel that is located between Sta 0+00 to Sta 40+00.
- o Reach #2 is defined as that part of the channel that is located between Sta 40+00 to Nickpoint.
- o Reach #3 is defined as that part of the channel that is located between the Nickpoint and Sta 85+70 (end of channel).

Summary of Alternative #7:

In Alternative #7, the channel is modified only slightly from the existing configuration as follows:

- o ensure a 30' wide, 2' deep channel bottom from Sta 5+00 to Sta 61+70 (i.e. low-flow channel)
- o Fill existing depressions and headcuts
- o a stone filled trench (jetty) will be installed at Sta 59+50 to reinforce the Nickpoint and maintain shallow upstream slopes.
- o a 40' wide protective bench will be constructed at the tailings embankment toe which would protect the embankment and tailings during the PMF.

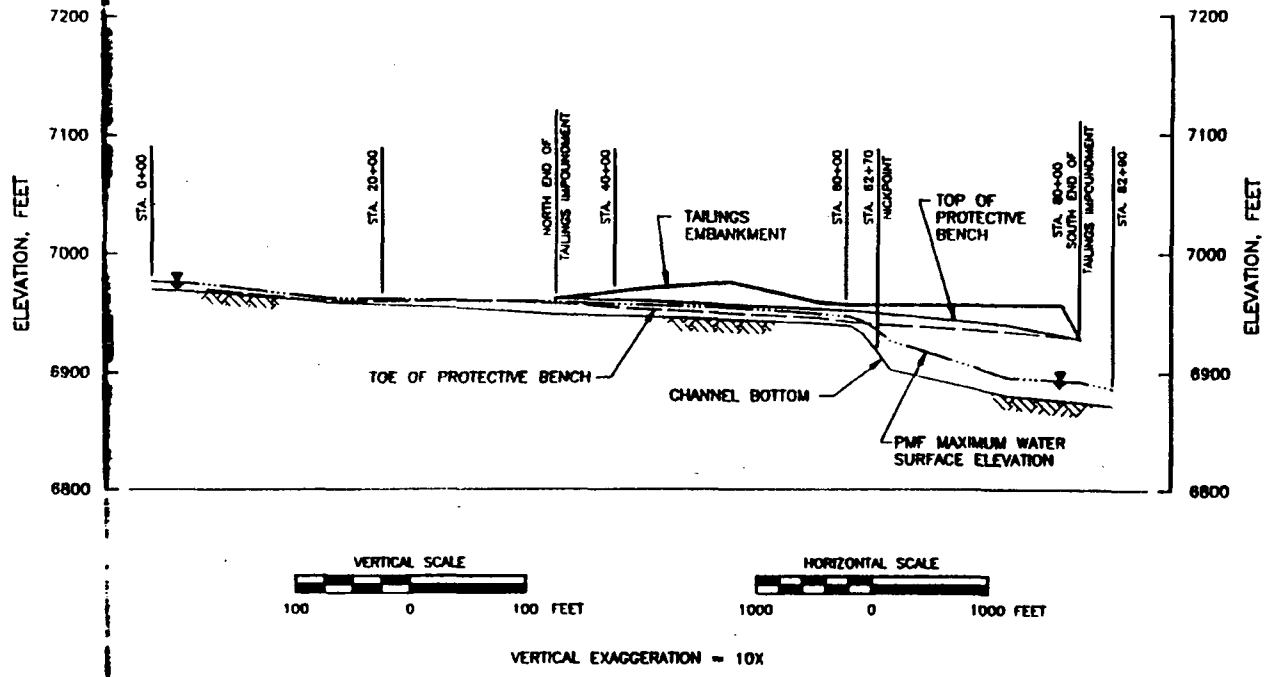
DRAWING NUMBER 36-060-8420

E-10

PAGE #4 OF 10

ALTERNATIVE #7

FIGURE #2



[redacted]

PIPELINE ARROYO PROFILE

PREPARED FOR

UNC MINING AND MILLING
GALLUP, NEW MEXICO

No	DATE	ISSUE / REVISION	DWN	CHK'D	APP'D
1			R.HP		

DATE: 11-9-90	FIGURE 4-3	DRAWING NUMBER 86-060-8420
SCALE: AS SHOWN		

1

[redacted]

```
*************************************************
*  WATER SURFACE PROFILES                       *
*  VERSION OF SEPTEMBER 1988                    *
   ERROR: 01,02,03,04                           *
   UPDATED:  JUNE 1990                          *
*  RUN DATE    11/23/90      TIME   23:03:22    *
*************************************************
```

```
*  U.S. ARMY CORPS OF ENGINEERS        *
*  THE HYDROLOGIC ENGINEERING CENTER   *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*                                      *
****************************************
```

BY: SNM
12/3/90
Chkd. By: GS
12/3/90

p. 5 of 40

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X    X            X    X
X     X  X        X                      X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                 X
X     X  X        X    X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

```
:::::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::::
:::                                       :::
:::   FULL MICRO-COMPUTER INPLEMENTATION   :::
:::                                       :::
:::::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::::
```

REACHES #1 + #2

```
****************************
H A E S T A D   M E T H O D S
****************************
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

END OF BANNER

Run Date: 11/26/90 Run Time: 18:20:33 HMVersion: 5.30 Data File: alt7.hc2

THIS RUN EXECUTED 11/26/90 18:20:33

****

HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

ERROR CORR - 01.02.03.04
MODIFICATION -

****

p. 6 of 40

T1 ALTERNATIVE #7--REACH 1&2--Q=26300 CFS
T2 UNC PROJECT NO. 86-060-24 RESP. TO NRC COMMENTS 11/7/90
T3 PIPELINE ARROYO SUBCRITICAL FLOW

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	0	0	0	0.04	0	0	26300	6950	0

NC	0.035	0.035	0.03							
X1	61.40	17	250	676	0	0	0			
GR	6960	0	6955	55	6950	127	6945	250	6940	260
GR	6935	270	6933	275	6933	300	6937	310	6937	480
GR	6942	600	6942	650	6942	660	6942	676	6951.5	727.5
GR	6951.5	767.5	6957	792						
X1	60.40	10	110	515	160	130	100			
GR	6960	0	6950	110	6939	115	6939	140	6941.5	145
GR	6943	515	6943	530	6952	572.5	6962	612.5	6957	632
X1	57.75	16	145	543	270	295	262			
GR	6960	0	6955	35	6950	90	6945.5	145	6941	155
GR	6941	185	6945	195	6945	230	6945	270	6945	295
GR	6945	330	6945	375	6945	543	6953.5	587.5	6953.5	627.5
GR	6960	660								
X1	50.00	14	455	712	750	850	775			
GR	6975	0	6970	10	6965	30	6960	100	6950	140
GR	6950	320	6950	455	6944	532	6944	562	6950	650
GR	6960	712	6957	745	6957	785	6976	880		
X1	41.95	12	535	772	820	880	885			
GR	6970	0	6965	70	6960	165	6955	235	6950	535
GR	6947	557	6947	587	6953.5	700	6953.5	772	6960.5	810
GR	6960.5	850	6970	985						
X1	35.00	9	215	780	700	700	705			
GR	6970	0	6960	145	6955	215	6948.7	583	6948.7	613
GR	6958	710	6958.5	780	6962.5	800	6962.5	840		
X1	30.10	21	135	980	495	1140	490			
GR	6970	0	6960	135	6955	565	6952	575	6952	605
GR	6955	615	6955	650	6955	765	6955	800	6955	850
GR	6955	880	6956	980	6958	990	6960	1000	6960	1070
GR	6962	1422	6962.4	1510	6964.5	1680	6966.5	1795	6968	1900
GR	6970	1910								

Run Date: 11/23/90 Run Time: 23: 3:22 HNVersion: 5.30 Data File: ALT7.HC2

X1	24.95	26	795	1800	560	540	520			
GR	7000	0	6990	45	6980	140	6970	275	6960	545
GR	6960	615	6960	795	6955	865	6953	865	6953	895
GR	6955	895	6955	1175	6955	1295	6955	1385	6955	1715
GR	6958	1770	6960	1800	6960	1970	6962	2060	6964	2070
GR	6966	2080	6968	2090	6970	2100	6980	2150	6990	2165
GR	7000	2230								

p. 7/40

X1	15.05	15	690	795	910	1180	990			
GR	7000	0	6990	35	6980	105	6970	210	6960	690
GR	6959	710	6959	740	6960	795	6960	1520	6975	1575
GR	6980	1600	6985	1620	6990	1645	6995	1660	7000	1690

X1	4.85	14	820	1155	1035	1070	1022			
GR	6980	0	6970	820	6970	890	6968	890	6968	920
GR	6970	920	6970	930	6970	950	6970	1000	6970	1030
GR	6970	1060	6970	1105	6970	1155	6980	1540		

Run Date: 11/23/90 Run Time: 23: 3:22 HNVersion: 5.30 Data File: ALT7.HC2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

p. 8/40

*SECNO 61.400
3720 CRITICAL DEPTH ASSUMED

61.400	10.32	6943.32	6943.32	6950.00	6945.77	2.45	.00	.00	6945.00
26300.0	.0	26286.8	13.2	.0	2090.3	4.7	.0	.0	6942.00
.00	.00	12.58	2.80	.000	.030	.035	.000	6933.00	253.36
.007727	0.	0.	0.	0	18	0	.00	429.80	683.16

*SECNO 60.400
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

60.400	7.99	6946.99	6946.99	.00	6949.47	2.48	.79	.00	6950.00
26300.0	.0	25507.0	793.0	.0	2000.7	97.3	4.8	1.0	6943.00
.00	.00	12.75	8.15	.000	.030	.035	.000	6939.00	111.37
.007987	160.	100.	130.	20	15	0	.00	437.46	548.83

*SECNO 57.750
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

57.750	8.64	6949.64	6949.64	.00	6952.05	2.41	2.05	.00	6945.50
26300.0	626.4	25313.3	360.3	104.5	2002.5	56.3	17.7	3.8	6945.00
.01	5.99	12.64	6.40	.035	.030	.035	.000	6941.00	94.45
.007597	270.	262.	295.	20	8	0	.00	472.82	567.27

*SECNO 50.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, XRATIO = 1.60

50.000	10.33	6954.33	.00	.00	6955.52	1.20	3.48	.00	6950.00
26300.0	8537.4	17593.8	168.8	1401.0	1787.5	44.2	65.4	13.3	6950.00
.03	6.09	9.84	3.82	.035	.030	.035	.000	6944.00	122.69
.002981	750.	775.	850.	3	0	0	.00	609.72	732.41

Run Date: 11/23/90 Run Time: 23: 3:22 HNVersion: 5.30 Data File: ALT7.HC2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

P. 9/40

*SECNO 41.950

41.950	9.92	6956.92	.00	.00	6958.39	1.47	2.86	.00	6950.00
26300.0	9943.8	16232.2	123.9	1350.5	1481.8	31.7	122.2	24.5	6953.50
.06	7.36	10.95	3.91	.035	.030	.035	.000	6947.00	208.18
.004254	820.	805.	800.	3	0	0	.00	582.37	790.54

*SECNO 35.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.62

35.000	10.68	6959.38	.00	.00	6960.13	.75	1.74	.00	6955.00
26300.0	386.5	25911.6	1.9	134.4	3709.7	1.9	176.4	34.3	6958.50
.08	2.88	6.98	.98	.035	.030	.035	.000	6948.70	153.66
.001619	700.	705.	700.	2	0	0	.00	630.75	784.41

*SECNO 30.100

30.100	8.40	6960.40	.00	.00	6961.22	.82	1.09	.00	6960.00
26300.0	.9	26026.9	272.2	1.1	3557.5	90.0	219.2	44.7	6956.00
.10	.82	7.32	3.02	.035	.030	.035	.000	6952.00	129.61
.003213	495.	490.	1140.	3	0	0	.00	1010.69	1140.30

*SECNO 24.950

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.36

24.950	8.57	6961.57	.00	.00	6961.81	.24	.59	.00	6960.00
26300.0	570.0	25313.9	416.1	426.0	6286.2	322.6	283.3	60.2	6960.00
.14	1.34	4.03	1.29	.035	.030	.035	.000	6953.00	502.59
.000577	560.	520.	540.	2	0	0	.00	1538.10	2040.69

*SECNO 15.050

Run Date: 11/23/90 Run Time: 23: 3:22 HNVersion: 5.30 Data File: ALT7.HC2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

p. 10 /40

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

15.050	4.03	6963.03	6963.03	.00	6964.48	1.45	1.61	.00	6960.00
26300.0	1277.3	4707.3	20315.4	220.3	385.6	2213.4	400.2	90.6	6960.00
.17	5.80	12.21	9.18	.035	.030	.035	.000	6959.00	544.57
.010721	910.	990.	1180.	20	14	0	.00	986.54	1531.11

*SECNO 4.850
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

4.850	6.56	6974.56	6974.56	.00	6976.23	1.67	9.03	.00	6970.00
26300.0	5277.9	18544.5	2477.6	851.3	1586.5	399.7	468.2	113.1	6970.00
.20	6.20	11.69	6.20	.035	.030	.035	.000	6968.00	446.36
.007113	1035.	1022.	1070.	3	14	0	.00	884.08	1330.43

PROFILE FOR STREAM IKE ARROYO SUBCRITICAL F

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,N-LOWER END STA

p. 11/40

```
ELEVATION 6933.    6938.    6943.    6948.    6953.    6958.    6963.    6968.    6973.    6978.
   SECNO  CUNDIS

   61.40     0. I        .      R .W  L E  .        .      N .        .        .        .        .        .
   60.40   100. .        . I      R      W .  EL    .      N .        .        .        .        .        .
           200. .        .  I    . R      WL  E    .        N        .        .        .        .        .
           300. .        .   I   .  R  L . W   E  .        .  N       .        .        .        .        .
   57.75   400. .        .    I  .   RL   . W   E .        .   N      .        .        .        .        .
           500. C        .     I .   RL   .  W   E.        .      N .        .        .        .        .
           600. C        .      I .     L .    W  E        .        . N      .        .        .        .
           700. C        .      I .      L .     W .E       .         .   N  .        .        .        .
           800. C        .       I.       RL      W . E     .         .      N.        .        .        .
           900. C        .        I        RL      W.  E    .         .        . N     .        .        .
          1000. C        .        .I       . L      .W E    .         .        .     N  .        .        .
          1100. C        .        .I       .  L     . W E   .         .        .        .N       .        .
   50.00  1200. C        .        . I      .  L     .  W E  .         .        .        .  N     .        .
          1300. C        .        .  I     .  LR    .  W  E .         .        .        .  N     .        .
          1400. C        .        .  I     .  L R   .  W E  .         .        .        . N      .        .
          1500. C        .        .   I    .  L  R  .  W E .         .        .        N        .        .
          1600. C        .        .    I   .  L  R  .  W  E.         .        .       N.        .        .
          1700. C        .        .     I  .  L  R. .   W  E.        .        .      N .        .        .
          1800. C        .        .     I  .  L  R.     W E.        .        .     N  .        .        .
          1900. C        .        .      I .  L   R     W  E        .        .   N    .        .        .
   41.95  2000. C        .        .       I .  L    .R     W .E      .        .  N     .        .        .
          2100. C        .        .       I .   L   . R     W.E      .        . N      .        .        .
          2200. C        .        .        I.     L .  R   W. E      .        N        .        .        .
          2300. C        .        .        I.      L .   R   W E     .       N .       .        .        .
          2400. C        .        .         I        L     R  .W E   .    N   .        .        .        .
          2500. C        .        .         I        .L     R .W E   .  N     .        .        .        .
          2600. C        .        .         .I       .  L     R W E   .N       .        .        .        .
   35.00  2700. C        .        .         .I       .   L    .R WE  N.        .        .        .        .
          2800. C        .        .         .  I     .    L  R  W E  . N       .        .        .        .
          2900. C        .        .         .   I    .      LR.  WE   .    N   .        .        .        .
          3000. C        .        .         .    I   .      R L  W E  .       N .       .        .        .
          3100. C        .        .         .     I  .     R  . L W E  .        .N       .        .        .
   30.10  3200. C        .        .         .      I .    R   .  LWE  .        .  N     .        .        .
          3300. C        .        .         .      I .      R .  LW E .        .        .    N   .        .
          3400. C        .        .         .       I.       R.  L WE .        .        .        .      N  .
          3500. C        .        .         .       I.        .R  L WE .        .        .        .        N
          3600. C        .        .         .        I        . R L  E .        .        .        .        N
   24.95  3700. C        .        .         .        I        .   L  WE .        .        .        .        N
          3800. C        .        .         .        .I       .   L  WE .        .        .        .        N
          3900. C        .        .         .        . I      .   L  WE.        .        .        .        N
          4000. C        .        .         .        .  I     .   L  WE.        .        .        .        N
          4100. C        .        .         .        .   I    .   L  W E        .        .        .        N
          4200. C        .        .         .        .    I   .   L   WE        .        .        .        N
          4300. C        .        .         .        .     I  .   L   W.E       .        .        .        N
          4400. C        .        .         .        .      I .   L   W.E       .        .        .        N
          4500. C        .        .         .        .       I   L   W. E       .        .        .        N
          4600. C        .        .         .        .       .I  L    W E       .        .        .        N
   15.05  4700. .        .        .         .        .       . I L    W  E      .        .        .        N
          4800. .        .        .         .        .        .  I L  . W  E    .        .        .        N
```

```
      5100.  .         .         .         .         .         .         . . .       E         .         .         M
      5200.  .         .         .         .         .         .         .I  L       .W  E      .         .         M
      5300.  .         .         .         .         .         .         .  I  L    .    W  E  .         .         M
      5400.  .         .         .         .         .         .         .   I   L .      W  E.           .         M
      5500.  .         .         .         .         .         .         .     I   L        W .E          .         M
      5600.  .         .         .         .         .         .         .       I . L        W    E      .        M.
4.85  5700.  .         .         .         .         .         .         .         I   L     . W  E  .   M         .
```

E-18

p.12/40

Run Date: 11/23/90 Run Time: 23: 3:22 HNVersion: 5.30 Data File: ALT7.HC2

THIS RUN EXECUTED 11/23/90 23: 3:31

****
HEC2 RELEASE DATED SEP 80 UPDATED JUN 1990

p. 13/40

ERROR CORR - 01,02,03,04
MODIFICATION -
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

INE ARROYO SUBCRITICAL F

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	61.400	.00	.00	.00	6933.00	26300.00	6943.32	6943.32	6945.77	77.27	12.58	2095.00	2992.01
*	60.400	100.00	.00	.00	6939.00	26300.00	6946.99	6946.99	6949.47	79.87	12.75	2098.02	2942.85
*	57.750	262.00	.00	.00	6941.00	26300.00	6949.64	6949.64	6952.05	75.97	12.64	2163.31	3017.47
*	50.000	775.00	.00	.00	6944.00	26300.00	6954.33	.00	6955.52	29.81	9.84	3232.61	4817.25
	41.950	805.00	.00	.00	6947.00	26300.00	6956.92	.00	6958.39	42.54	10.95	2864.02	4032.10
*	35.000	705.00	.00	.00	6948.70	26300.00	6959.38	.00	6960.13	16.19	6.98	3845.98	6536.47
	30.100	490.00	.00	.00	6952.00	26300.00	6960.40	.00	6961.22	32.13	7.32	3648.57	4639.55
*	24.950	520.00	.00	.00	6953.00	26300.00	6961.57	.00	6961.81	5.77	4.03	7034.72	10951.51
*	15.050	990.00	.00	.00	6959.00	26300.00	6963.03	6963.03	6964.48	107.21	12.21	2819.36	2539.98
*	4.850	1022.00	.00	.00	6968.00	26300.00	6974.56	6974.56	6976.23	71.13	11.69	2837.44	3118.29

Run Date: 11/23/90 Run Time: 23: 3:22 HNVersion: 5.30 Data File: ALT7.HC2

:NE ARROYO SUBCRITICAL F

SUMMARY PRINTOUT TABLE 150

p. 14/40

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	61.400	26300.00	6943.32	.00	.00	-6.68	429.80	.00
*	60.400	26300.00	6946.99	.00	3.67	.00	437.46	100.00
*	57.750	26300.00	6949.64	.00	2.65	.00	472.82	262.00
*	50.000	26300.00	6954.33	.00	4.69	.00	609.72	775.00
	41.950	26300.00	6956.92	.00	2.59	.00	582.37	805.00
*	35.000	26300.00	6959.38	.00	2.46	.00	630.75	705.00
	30.100	26300.00	6960.40	.00	1.02	.00	1010.69	490.00
*	24.950	26300.00	6961.57	.00	1.17	.00	1538.10	520.00
*	15.050	26300.00	6963.03	.00	1.46	.00	986.54	990.00
	4.850	26300.00	6974.56	.00	11.53	.00	884.08	1022.00

```
*************************************************
*  WATER SURFACE PROFILES                       *
*  VERSION OF SEPTEMBER 1988                    *
*  ERROR: 01,02,03,04                           *
*  UPDATED:  JUNE 1990                          *
*  RUN DATE    11/26/90      TIME   15:58:57    *
*************************************************
```

```
*************************************
*  U.S. ARMY CORPS OF ENGINEERS     *
*  THE HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET, SUITE D       *
*  DAVIS, CALIFORNIA 95616-4687     *
*                                   *
*************************************
```

/ Sw 021
12-3-90
Chkd. By: GS.
12-03-90

p. 15/40

```
X     X  XXXXXXX   XXXXX            XXXXX
X     X  X       X     X          X     X
X     X  X       X                      X
XXXXXXX  XXXX     X         XXXXX   XXXXX
X     X  X       X                X
X     X  X       X     X          X
X     X  XXXXXXX   XXXXX           XXXXXXX
```

```
:::::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::::
:::                                       :::
:::   FULL MICRO-COMPUTER IMPLEMENTATION   :::
:::                                       :::
:::::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::::
```

REACH #3

```
****************************
H A E S T A D   M E T H O D S
****************************
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

END OF BANNER

Run Date: 11/26/90 Run Time: 18:30:52 HMVersion: 5.30 Data File: reach3.hc2

THIS RUN EXECUTED 11/26/90 18:30:52

****

HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

Chkd. By: GS
12-03-90

ERROR CORR - 01.02.03.04
MODIFICATION -

****

p. 16/40

T1 ALTERNATIVE #7-RECONFIGURED REACH #3 Q(PMF)=26300 CFS
T2 UNC PROJECT NO. 86-060-24 RESP. TO NRC COMMENTS 10/17/90
T3 REACH 3 - SUPERCRITICAL FLOW

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ	
	0	0	0	1	0.015	0	0	26300	6956		
NC	0.035	0.035	0.03								
X1	57.75	16	145	543	275	285	262				
GR	6960	0	6955	35	6950	90	6945.5	145	6941	155	
GR	6941	185	6945	195	6945	230	6945	270	6945	295	
GR	6945	330	6945	375	6945	543	6953.5	587.5	6953.5	627.5	
GR	6960	660									
X1	60.40	10	110	515	160	130	100				
GR	6960	0	6950	110	6939	115	6939	140	6941.5	145	
GR	6943	515	6943	530	6952	572.5	6952	612.5	6957	632	
X1	61.40	17	250	660	60	165	95				
GR	6960	0	6955	55	6950	127	6945	250	6940	260	
GR	6935	270	6933	275	6933	300	6937	310	6937	480	
GR	6942	600	6942	650	6942	650	6942	676	6951.9	727.5	
GR	6951.5	767.5	6957	792							
X1	62.30	22	250	330	265	75	150				
GR	6960	0	6955	35	6950	85	6945	155	6945	175	
GR	6940	250	6935	260	6930	265	6922	280	6922	300	
GR	6930	320	6935	330	6935	395	6935	435	6939	476	
GR	6939	595	6940	620	6940	655	6940.7	717	6950.5	769.9	
GR	6950.5	809.9	6957	845							
X1	63.80	20	300	335	1080	945	1085				
GR	6960	0	6955	80	6950	90	6945	185	6940	180	
GR	6935	245	6925	250	6920	270	6925	300	6902	305	
GR	6902	325	6925	330	6930	335	6935	375	6939	575	
GR	6940	655	6940.7	728.5	6950.5	777.5	6950.5	817.5	6957	850	
X1	73.80	20	650	735	850	520	630				
GR	6960	0	6955	40	6950	105	6945	240	6945	340	
GR	6945	350	6940	450	6930	605	6925	625	6900	650	
GR	6880	670	6880	690	6900	735	6925	757	6925	995	
GR	6934	1075	6934	1180	6940	1210	6940	1250	6957	1335	

Run Date: 11/26/90 Run Time: 15:58:57 HMVersion: 5.30 Data File: reach3.hc2

X1	80.10	15	325	440	290	330	280			
GR	6925	0	6920	140	6920	270	6915	280	6910	290
GR	6905	310	6900	325	6874.3	380	6874.3	400	6900	440
GR	5912	480	6925	790	6928	900	6928	1072	6957	1275
X1	82.90	19	480	645	0	0	0			
GR	6925	0	6920	115	6915	200	6910	460	6905	470
GR	6900	480	6871	510	6871	530	6900	645	6905	655
GR	6905	705	6905	860	6899	900	6899	935	6926	1100
GR	6930	1180	6940	1195	6950	1205	6960	1215		

p. 17/40

Run Date: 11/26/90 Run Time: 15:58:57 HNVersion: 5.30 Data File: reach3.hc2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

*SECNO 57.750

57.750	7.76	6948.76	6949.66	6956.00	6952.43	3.67	.00	.00	6945.50
26300.0	465.8	25545.1	289.1	64.9	1642.2	37.0	.0	.0	6945.00
.00	7.18	15.55	7.82	.035	.030	.035	.000	6941.00	105.17
.014971	0.	0.	0.	0	14	6	.00	457.51	562.68

10.13/40

*SECNO 60.400

3301 HV CHANGED MORE THAN HVINS

60.400	7.05	6946.05	6946.99	.00	6949.47	2.63	2.96	.00	6950.00
26300.0	.0	25523.5	776.5	.0	1944.7	92.7	11.4	2.7	6943.00
.01	.00	13.12	8.38	.000	.030	.035	.000	6939.00	111.43
.008786	275.	262.	285.	2	8	0	.00	436.74	548.17

SECNO 61.400

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.84

61.400	8.15	6941.15	6943.30	.00	6947.99	6.84	1.48	.00	6945.00
26300.0	.0	26300.0	.0	.0	1253.2	.0	15.2	3.6	6942.00
.01	.00	20.99	.00	.000	.030	.000	.000	6933.00	257.69
.029659	160.	100.	130.	7	11	0	.00	322.08	579.76

*SECNO 62.300

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .58

62.300	16.91	6938.91	6941.60	.00	6946.37	7.46	1.62	.00	6940.00
26300.0	.0	21460.3	4839.7	.0	901.3	488.6	18.5	4.3	6935.00
.01	.00	23.81	9.91	.000	.030	.035	.000	6922.00	252.10
.010000	60.	95.	165.	8	17	0	.00	222.87	475.05

Run Date: 11/26/90 Run Time: 15:58:57 HNVersion: 5.30 Data File: reach3.hc2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 63.800

3301 HV CHANGED MORE THAN HVINS

219/40

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.64

63.800	24.85	6926.85	6932.13	.00	6944.03	17.18	2.34	.00	6925.00
26300.0	3988.3	22311.7	.0	218.7	632.4	.0	22.2	4.8	6930.00
.01	18.24	35.28	.00	.035	.030	.000	.000	6902.00	249.07
.026800	265.	150.	75.	7	14	0	.00	82.79	331.86

*SECNO 73.800

3301 HV CHANGED MORE THAN HVINS

73.800	15.92	6895.92	6901.95	.00	6916.08	20.16	27.95	.00	6900.00
26300.0	.0	26300.0	.0	.0	729.8	.0	40.7	6.6	6900.00
.02	.00	36.04	.00	.000	.030	.000	.000	6880.00	654.09
.028546	1080.	1005.	945.	6	15	0	.00	71.72	725.81

*SECNO 80.100

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .70

80.100	18.08	6892.38	6895.78	.00	6903.90	11.52	12.18	.00	6900.00
26300.0	.0	26300.0	.0	.0	965.5	.0	52.9	7.7	6900.00
.02	.00	27.24	.00	.000	.030	.000	.000	6874.30	341.31
.013957	850.	630.	520.	6	11	0	.00	86.82	428.13

*SECNO 82.900

3301 HV CHANGED MORE THAN HVINS

82.900	15.55	6886.55	6890.63	.00	6899.37	12.82	4.53	.00	6900.00
26300.0	.0	26300.0	.0	.0	915.2	.0	59.0	8.3	6900.00
.03	.00	28.74	.00	.000	.030	.000	.000	6871.00	493.92
.018988	290.	280.	330.	7	8	0	.00	97.73	591.65

PROFILE FOR STREAM 3 - SUPERCRITICAL FLOW

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,N-LOWER END STA

10.20/40

```
ELEVATION  6871.    6881.    6891.    6901.    6911.    6921.    6931.    6941.    6951.    6961.
   SECNO   CUMDIS

   57.75      0. .        .        .        .        .        .        .        .  I  RL WC.E      N.        .
             50. .        .        .        .        .        .        .        .  I  RL WC .E     N .       .
            100. .        .        .        .        .        .        .        . I. R LWC E      N .       .
            150. .        .        .        .        .        .        .        . I. R  W  E      N .       .
            200. .        .        .        .        .        .        .        I . R  WCLE.      N .       .
            250. .        .        .        .        .        .        .        I . R  W  E.     N  .       .
   60.40    300. .        .        .        .        .        .        .        I . R  W EL.     N  .       .
            350. .        .        .        .        .        .        .     I    . RWC  LE .     N  .       .
   61.40    400. .        .        .        .        .        .        . I      WRC L  E  .     N  .       .
            450. .        .        .        .        .        .    I   .      R W.C   E  .     N  .       .
   62.30    500. .        .        .        .        .       .I        .   R  WL.C  E  .     N  .       .
            550. .        .        .        .        .   I    .        . R W  C  .   E  .     N  .       .
            600. .        .        .        .      I .        .       LWR  C    .  E   .     N  .       .
   63.80    650. .        .        .       .I        .        .  L W  R.C       . E    .     N  .       .
            700. .        .        .      I          .        . LW   R C        . E    .     N  .       .
            750. .        .        .     I.          .        . LW  R C .       E      .     N  .       .
            800. .        .        .    I .          .       LW   R C  .      E.      .     N  .       .
            850. .        .        .   I  .          .      LW  R C    .    E  .      .     N  .       .
            900. .        .        .  I   .          .     W . R C     .   E  .      .     N  .       .
            950. .        .        . I    .          .    W  R C       .  E   .      .     N  .       .
           1000. .        .        .I     .          .   W   R.C       . E    .      .     N  .       .
           1050. .        .        .I     .          .  W  R C.        . E    .      .     N  .       .
           1100. .        .        .I     .          . WL  R C .       .E     .      .     N  .       .
           1150. .        .        I      .          W L R C  .      E.      .      .     N  .       .
           1200. .        .       I.      .          WL  R C  .     E .      .      .     N  .       .
           1250. .        .      I .      .         W L.R C   .    E  .      .      .     N  .       .
           1300. .        .     I  .      .        W L R C    .   E   .      .      .     N  .       .
           1350. .        .    I   .      .       W  LR C     .  E    .      .      .     N  .       .
           1400. .        .   I    .      .      W L R C.     . E     .      .      .     N  .       .
           1450. .        . I      .      .     .W  LR C  .   .E      .      .      .     N  .       .
           1500. .        . I      .      .     W  LR C  .   E.       .      .      .     N  .       .
           1550. .        .I       .      .    W . L C   .  E .       .      .      .     N  .       .
           1600. .        I        .      .   W  LR C    .  E .       .      .      .     N  .       .
   73.80   1650. .       I.        .      .  W   L.C     .  E  .       .      .      .     N  .       .
           1700. .       I.        .      .  W   LC      .  E  .       .      .      .  N   .       .
           1750. .      I .        .      . W    LC      . E   .       .      .     .N    .       .
           1800. .      I .        .      . W    C.      . E   .       .      .    N .    .       .
           1850. .     I  .        .      . W    C.      .E    .       .      .   N  .    .       .
           1900. .     I  .        .      . W    C.      E     .       .      . N    .    .       .
           1950. .    I   .        .      . W   CL.      E.    .       .      .N     .    .       .
           2000. .    I   .        .      . W   CL.     E .    .       .     N .     .    .       .
           2050. .   I    .        .      . W  C L.    E  .    .       .    N  .     .    .       .
           2100. .   I    .        .      .W   C L.   E   .    .       .   N   .     .    .       .
           2150. .  I     .        .      .W  C  L.  E    .    .       .N      .     .    .       .
           2200. .  I     .        .      .W  C  L. E     .    .      N .      .     .    .       .
   80.10   2250. . I      .        .      .W  C  L. E     .    .      N .      .     .    .       .
           2300. . I      .        .      W  C   L. E     .    .      N .      .     .    .       .
           2350. .I       .        .     W. C    L.E      .    .      N .      .     .    .       .
           2400. .I       .        .    W . C    LE       .    .      N .      .     .    .       .
```

82.90 2550. I . W EL. . . A . . .

Run Date: 11/26/90 Run Time: 15:58:57 HNVersion: 5.30 Data File: reach3.hc2

THIS RUN EXECUTED 11/26/90 15:59: 5

p. 21/46

****
HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

ERROR CORR - 01,02,03,04
MODIFICATION -
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

3 - SUPERCRITICAL FLOW

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	57.750	.00	.00	.00	6941.00	26300.00	6948.76	6949.66	6952.43	149.71	15.55	1744.13	2149.50
	60.400	262.00	.00	.00	6939.00	26300.00	6946.85	6946.99	6949.47	87.86	13.12	2037.41	2805.80
*	61.400	100.00	.00	.00	6933.00	26300.00	6941.15	6943.30	6947.99	296.59	20.99	1253.16	1527.14
*	62.300	95.00	.00	.00	6922.00	26300.00	6938.91	6941.60	6946.37	100.00	23.81	1389.88	2630.05
*	63.800	150.00	.00	.00	6902.00	26300.00	6926.85	6932.13	6944.03	268.00	35.28	851.14	1606.52
	73.800	1005.00	.00	.00	6880.00	26300.00	6895.92	6901.95	6916.00	285.46	36.04	729.82	1556.62
*	80.100	630.00	.00	.00	6874.30	26300.00	6892.38	6895.78	6903.90	139.57	27.24	965.47	2226.16
	82.900	280.00	.00	.00	6871.00	26300.00	6886.55	6890.63	6899.37	189.88	28.74	915.20	1908.63

Run Date: 11/26/90 Run Time: 15:58:57 HNVersion: 5.30 Data File: reach3.hc2

3 - SUPERCRITICAL FLOW

SUMMARY PRINTOUT TABLE 150

p.22/40

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	57.750	26300.00	6948.76	.00	.00	-7.24	457.51	.00
	60.400	26300.00	6946.85	.00	-1.91	.00	436.74	262.00
*	61.400	26300.00	6941.15	.00	-5.69	.00	322.08	100.00
*	62.300	26300.00	6938.91	.00	-2.25	.00	222.87	95.00
*	63.800	26300.00	6926.85	.00	-12.06	.00	82.79	150.00
	73.800	26300.00	6895.92	.00	-30.93	.00	71.72	1005.00
*	80.100	26300.00	6892.38	.00	-3.54	.00	86.82	630.00
	82.900	26300.00	6886.55	.00	-5.83	.00	97.73	280.00

```
*****************************************
* WATER SURFACE PROFILES                *
* VERSION OF SEPTEMBER 1988             *
  ERROR: 01.02.03.04                    *
* UPDATED:  JUNE 1990                   *
* RUN DATE   11/12/90      TIME  17:45:06 *
*****************************************
```

```
*****************************************
* U.S. ARMY CORPS OF ENGINEERS          *
* THE HYDROLOGIC ENGINEERING CENTER     *
* 609 SECOND STREET, SUITE D            *
* DAVIS, CALIFORNIA 95616-4687          *
*                                       *
*****************************************
```

p.23/40

```
X    X  XXXXXXX  XXXXX          XXXXX
X    X  X       X    X         X    X
X    X  X       X              X
XXXXXXX  XXXX   X        XXXXX  XXXXX
X    X  X       X              X
X    X  X       X    X         X
X    X  XXXXXXX  XXXXX          XXXXXX
```

```
:::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::
:::                                     :::
:::   FULL MICRO-COMPUTER IMPLEMENTATION  :::
:::                                     :::
:::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::
```

==========
HAESTAD METHODS
==========

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

END OF BANNER

Run Date: 11/12/90 Run Time: 17:45: 6 HMVersion: 5.30 Data File: AL7.HC2

THIS RUN EXECUTED 11/12/90 17:45: 6

****

HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

ERROR CORR - 01.02.03.04
MODIFICATION -

****

p.24/40

T1 ALTERNATIVE #7--REACH 1&2--Q=26300 CFS
T2 UNC PROJECT NO. 86-060-24 RESP. TO NRC COMMENTS 11/7/90
T3 PIPELINE ARROYO SUBCRITICAL FLOW

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	0	0	0	0.04	0	0	26300	6950	0

NC	0.035	0.035	0.03							
X1	61.40	17	250	676	0	0	0			
GR	6960	0	6955	55	6950	127	6945	250	6940	260
GR	6935	270	6933	270	6933	300	6937	310	6937	480
GR	6942	500	6942	650	6942	660	6942	676	6951.5	727.5
GR	6951.5	767.5	6957	792						
X1	60.40	10	110	515	160	130	100			
GR	6960	0	6950	110	6939	115	6939	145	6941.5	145
GR	6943	515	6943	530	6952	572.5	6952	612.5	6957	632
X1	57.75	16	145	543	270	295	262			
GR	6960	0	6955	35	6950	90	6945.5	145	6941	155
GR	6941	185	6945	195	6945	230	6945	270	6945	295
GR	6945	330	6945	375	6945	543	6953.5	587.5	6953.5	627.5
GR	6960	660								
X1	50.00	14	455	712	750	850	775			
GR	6975	0	6970	10	6965	30	6960	100	6950	140
GR	6950	320	6950	455	6944	532	6944	562	6950	650
GR	6950	712	6957	745	6957	785	6976	880		
X1	41.95	12	535	772	820	800	805			
GR	6970	0	6965	70	6960	165	6955	235	6950	535
GR	6947	557	6947	587	6953.5	700	6953.5	772	6960.5	810
GR	6960.5	850	6970	905						
X1	35.00	9	215	780	700	700	705			
GR	6970	0	6960	145	6955	215	6948.7	583	6948.7	603
GR	6958	710	6958.5	780	6962.5	900	6962.5	840		
X1	30.10	21	135	980	495	1140	490			
GR	6970	0	6960	135	6955	565	6952	575	6952	605
GR	6955	615	6955	660	6955	765	6955	800	6955	850
GR	6955	880	6956	980	6958	990	6960	1000	6960	1070
GR	6960	1422	6962	1510	6964	1680	6966	1795	6968	1900
GR	6970	1910								

Run Date: 11/12/90 Run Time: 17:45: 6 HMVersion: 5.30 Data File: AL17.HC2

X1	24.95	26	795	1800	560	540	520			
GP	7000	0	6990	45	6980	140	6970	275	6950	545
GR	6960	515	6960	795	6955	865	6953	965	6953	995
GR	6955	995	6955	1175	6955	1295	6955	1385	6959	1715
GR	6958	1770	6960	1800	6960	1970	6962	2060	6964	2070
GR	6966	2080	6968	2090	6970	2100	6980	2130	6990	2155
GR	7000	2230								
X1	15.05	15	690	795	910	1190	990			
GP	7000	0	6990	35	6980	105	6970	210	6960	690
GP	6959	735	6959	765	6960	795	6960	1520	6975	1575
GR	6980	1600	6985	1620	6990	1645	6995	1660	7000	1690
X1	4.85	14	820	1155	1035	1070	1022			
GP	6980	0	6970	820	6970	890	6968	890	6968	920
GR	6970	920	6970	930	6970	950	6970	1000	6970	1030
GR	6970	1060	6970	1105	6970	1155	6980	1540		

p. 25/40

Run Date: 11/12/90 Run Time: 17:45: 6 HMVersion: 5.30 Data File: ALT7.HC2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EI	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	ICC	ICONT	CORAR	TOPWID	ENDST

P. 26/40

*PROF 1

*SECNO 61.400
3720 CRITICAL DEPTH ASSUMED

61.400	10.31	6943.31	6943.31	6950.00	6945.76	2.45	.00	.00	6945.00
26300.0	.0	26287.0	13.0	.0	2091.8	4.7	.0	.0	6942.00
.00	.00	12.57	2.79	.000	.030	.035	.000	6933.00	253.38
.007747	0.	0.	0.	0	18	0	.00	429.74	623.11

*SECNO 60.400
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

60.400	7.98	6946.98	6946.98	.00	6949.45	2.48	.79	.00	6950.00
26300.0	.0	25509.9	790.1	.0	2002.4	97.0	4.9	1.0	6943.00
.00	.00	12.74	8.15	.000	.030	.035	.000	6939.00	111.37
.008015	160.	100.	130.	20	19	0	.00	437.40	548.78

*SECNO 57.750
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

57.750	8.64	6949.64	6949.64	.00	6952.05	2.41	2.05	.00	6945.50
26300.0	526.7	25312.9	360.4	124.6	2003.1	56.3	17.7	3.8	6945.00
.01	5.99	12.64	6.40	.035	.030	.035	.000	6941.00	34.43
.007589	270.	262.	295.	20	8	0	.00	472.84	567.28

*SECNO 50.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE. XRATIO = 1.60

50.000	10.33	6954.33	.00	.00	6955.52	1.20	3.48	.00	6950.00
26300.0	8537.0	17594.2	168.8	1400.8	1787.3	44.2	65.4	13.3	6950.00
.03	6.09	9.84	3.82	.035	.030	.035	.000	6944.00	122.69
.002982	750.	775.	850.	3	0	0	.00	609.72	732.40

Run Date: 11/12/90 Run Time: 17:45: 6 HMVersion: 5.30 Data File: ALT7.HC2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	QLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	BETA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IOC	ICONT	IDRAR	TOPWID	ENDST

P.27/40

*SECNO 41.950

41.950	9.92	6956.92	.00	.00	6958.39	1.47	2.86	.00	6950.00
26300.0	9943.8	15232.2	123.9	1350.5	1481.8	31.7	122.2	24.5	6953.50
.06	7.36	10.95	3.91	.035	.030	.035	.000	6947.00	306.18
.004254	820.	805.	800.	3	0	0	.00	582.37	790.54

*SECNO 35.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.62

35.000	10.68	6959.38	.00	.00	6960.13	.75	1.74	.00	6955.00
26300.0	386.5	25911.6	1.9	134.3	3709.4	1.9	176.4	34.3	6958.50
.08	2.88	6.99	.98	.035	.030	.035	.000	6948.70	153.67
.001619	700.	705.	700.	2	0	0	.00	630.74	784.40

*SECNO 30.100

30.100	8.42	6960.42	.00	.00	6961.21	.80	1.09	.00	6960.00
26300.0	1.0	25839.4	459.7	1.2	3572.4	228.1	221.1	48.6	6956.00
.10	.83	7.23	2.01	.035	.030	.035	.000	6952.00	129.37
.003124	495.	490.	1140.	3	.0	0	.00	1310.98	1440.35

*SECNO 24.950

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.32

24.950	8.56	6961.56	.00	.00	6961.81	.24	.59	.00	6960.00
26300.0	565.3	25322.2	412.5	423.0	6275.8	320.1	286.1	65.9	6960.00
.14	1.34	4.03	1.29	.035	.030	.035	.000	6953.00	502.87
.000580	560.	520.	540.	2	0	0	.00	1537.36	2040.22

*SECNO 15.050

Run Date: 11/12/90 Run Time: 17:45: 6 HMVersion: 5.30 Data File: A177.HC2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	QLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	XNDST

p. 23/40

3301 HV CHANGED MORE THAN HVINS

3665 10 TRIALS ATTEMPTED WSEL.CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

15.050	4.03	6963.03	6963.03	.00	6964.48	1.45	1.03	.00	6960.00
26300.0	1278.6	4706.1	20315.3	220.7	385.9	2215.6	403.1	96.5	6960.00
.17	5.79	13.19	9.17	.035	.030	.035	.000	6959.00	544.43
.010687	910.	990.	1190.	20	14	0	.00	986.69	1531.12

*SECNO 4.850
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

4.850	6.56	6974.56	6974.56	.00	6976.23	1.67	9.01	.00	6970.00
26300.0	5277.9	18544.5	2477.6	851.3	1586.5	399.7	471.1	119.0	6970.00
.20	6.20	11.69	6.20	.035	.030	.035	.000	6968.00	446.36
.007113	1035.	1022.	1070.	3	14	0	.00	984.08	1330.43

PROFILE FOR STREAM INE ARROYO SUBCRITICAL F

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

p.29/40

```
ELEVATION 6933.    6938.    6943.    6948.    6953.    6958.    6963.    6968.    6973.    6978.
   SECND  CUMDIS

  61.40     0. I        .     R .W  L E  .        .     M .        .        .        .        .        .
  60.40   100. .        . I     R     W .  EL     .     M .        .        .        .        .        .
          200. .        .  I    . R     WL   E    .       M        .        .        .        .        .
          300. .        .   I   .  R  L . W   E .        .  M     .        .        .        .        .
  57.75   400. .        .    I  .  RL   . W   E .        .  M     .        .        .        .        .
          500. C        .     I .   RL   .  W   E.        .     M .        .        .        .        .
          600. C        .      I .    L .    W  E        .       . M      .        .        .        .
          700. C        .      I .     L .     W .E       .        .   M   .        .        .        .
          800. C        .       I.      RL      W . E     .            M.        .        .        .
          900. C        .        I       RL      W.  E    .        .     . M      .        .        .
         1000. C        .        .I       . L      .W E   .        .        .   M .        .        .
         1100. C        .        .I       .  L     . W E  .        .        .       .M       .        .
  50.00  1200. C        .        . I      .  L     .  W E .        .        .        .  M     .        .
         1300. C        .        .  I     .  LR    .  W E .        .        .        . M      .        .
         1400. C        .        .  I     .  L R   .  W E .        .        .        . M      .        .
         1500. C        .        .  I     .  L R   .  W E .        .        .        M        .        .
         1600. C        .        .   I    .  L R   .  W E.        .        .       M.        .
         1700. C        .        .    I   .  L  R  .   W E.        .        .      M .        .        .
         1800. C        .        .    I   .  L  R.     W E.        .        .     M  .        .        .
         1900. C        .        .     I  .  L   R     W E        .        .   M   .        .        .
  41.95  2000. C        .        .     I  .  L   .R     W .E       .        .  M    .        .        .
         2100. C        .        .     I  .   L  . R     W.E       .        . M     .        .        .
         2200. C        .        .      I.     L .  R   W. E       .        M       .        .
         2300. C        .        .      I.      L .  R   W E       .      M .       .        .        .
         2400. C        .        .       I       L     R .W E      .   M   .        .        .        .
         2500. C        .        .       I       .L    R .W E      . M     .        .        .        .
         2600. C        .        .       .I       . L    R W E    .M       .        .        .        .
  35.00  2700. C        .        .       .I       .  L    .R WE   M.        .        .        .        .
         2800. C        .        .       . I     .    L  R W E  . M       .        .        .        .
         2900. C        .        .       .  I    .     LR.  WE   .   M     .        .        .        .
         3000. C        .        .       .   I   .     R L  W E  .      M .        .        .        .
         3100. C        .        .       .    I  .    R  . L W E  .        .M       .        .        .
  30.10  3200. C        .        .       .     I .   R   .  LWE  .        .  M     .        .        .
         3300. C        .        .       .     I .     R .  LW E .        .        .    M   .        .
         3400. C        .        .       .      I.      R.  L WE .        .        .        .     M  .
         3500. C        .        .       .      I.       .R  L WE .        .        .        .       M
         3600. C        .        .       .       I       . R L  E .        .        .        .       M
  24.95  3700. C        .        .       .       I       .  L  WE .        .        .        .       M
         3800. C        .        .       .       .I      .  L  WE .        .        .        .       M
         3900. C        .        .       .       . I     .  L  WE.        .        .        .       M
         4000. C        .        .       .       .  I    .  L  WE.        .        .        .       M
         4100. C        .        .       .       .   I   .  L  W E        .        .        .       M
         4200. C        .        .       .       .    I  .  L   WE        .        .        .       M
         4300. C        .        .       .       .     I .  L   W.E       .        .        .       M
         4400. C        .        .       .       .      I.  L   W.E       .        .        .       M
         4500. C        .        .       .       .       I  L   W. E      .        .        .       M
         4600. C        .        .       .       .       .I L    W E      .        .        .       M
  15.05  4700. .        .        .       .       .       . I L    W  E    .        .        .       M
         4800. .        .        .       .       .       .  I L  . W  E   .        .        .       M
```

```
      5200.
      5300.
      5400.
      5500.
      5600.
4.35  5700.
```

Run Date: 11/12/90 Run Time: 17:45: 6 HMVersion: 5.30 Data File: ALT7.HC2

THIS RUN EXECUTED 11/12/90 17:45:16

****

HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

p. 31/40

ERROR CORR - 01,02,03.04
MODIFICATION -

****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

INE ARROYO SUBCRITICAL F

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	61.400	.00	.00	.00	6933.00	26300.00	6943.31	6943.31	6945.76	77.47	12.57	2096.43	2988.09
	60.400	100.00	.00	.00	6939.00	26300.00	6946.98	6946.98	6949.45	80.15	12.74	2099.36	2937.65
*	57.750	262.00	.00	.00	6941.00	26300.00	6949.64	6949.64	6952.05	75.89	12.64	2164.00	3013.39
*	50.000	775.00	.00	.00	6944.00	26300.00	6954.33	.00	6955.52	29.82	9.84	3232.31	4616.55
	41.950	805.00	.00	.00	6947.00	26300.00	6956.92	.00	6958.39	42.54	10.95	2364.02	4032.10
*	35.000	705.00	.00	.00	6948.70	26300.00	6959.38	.00	6960.13	16.19	6.59	3845.67	5125.54
	30.100	490.00	.00	.00	6952.00	26300.00	6960.42	.00	6961.21	31.24	7.23	3801.67	4705.30
*	24.950	520.00	.00	.00	6953.00	26300.00	6961.56	.00	6961.81	5.80	4.03	7018.56	10918.06
*	15.050	990.00	.00	.00	6959.00	26300.00	6963.03	6963.03	6964.48	106.87	12.19	2922.25	2544.09
*	4.850	1022.00	.00	.00	6968.00	26300.00	6974.56	6974.56	6976.23	71.13	11.69	2897.44	3113.29

Run Date: 11/12/90 Run Time: 17:45: 6 HMVersion: 5.30 Data File: ALT7.HC2

ARROYO SUBCRITICAL F

SUMMARY PRINTOUT TABLE 150

p. 32/40

	SECNO	Q	WSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	61.400	26300.00	6943.31	.00	.00	-6.69	429.74	.00
*	60.400	26300.00	6946.98	.00	3.66	.00	437.40	100.00
*	57.750	26300.00	6949.64	.00	2.66	.00	472.84	262.00
*	50.000	26300.00	6954.33	.00	4.69	.00	609.72	775.00
	41.950	26300.00	6956.92	.00	2.59	.00	642.37	805.00
*	35.000	26300.00	6959.38	.00	2.46	.00	650.74	705.00
	30.100	26300.00	6960.42	.00	1.03	.00	1310.98	490.00
*	24.950	26300.00	6961.56	.00	1.15	.00	1537.36	520.00
*	15.050	26300.00	6963.03	.00	1.47	.00	986.69	990.00
	4.850	26300.00	6974.56	.00	11.52	.00	684.08	1022.00

```
*****************************************************
*  WATER SURFACE PROFILES                           *
*  VERSION OF SEPTEMBER 1988                        *
*  ERROR: 01,02,03,04                               *
*  UPDATED:  JUNE 1990                              *
*  RUN DATE    11/26/90      TIME   15:16:43        *
*****************************************************
```

```
*************************************
*  U.S. ARMY CORPS OF ENGINEERS     *
*  THE HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET, SUITE D       *
*  DAVIS, CALIFORNIA 95616-4687     *
*                                   *
*************************************
```

P. 33/40

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X       X     X           X     X
X     X  X       X                       X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X       X                 X
X     X  X       X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

```
:::::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::::
:::                                       :::
:::   FULL MICRO-COMPUTER IMPLEMENTATION   :::
:::                                       :::
:::::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::::
```

```
============================
H A E S T A D   M E T H O D S
============================
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

END OF BANNER

Run Date: 11/26/90 Run Time: 15:16:43 HNVersion: 5.30 Data File: re3old.hc2

THIS RUN EXECUTED 11/26/90 15:16:43

****
HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

p.34/40

ERROR CORR - 01,02,03,04
MODIFICATION -
****

T1 ALTERNATIVE 88B-PRESENT REACH 3--Q=26300 CFS
T2 UNC PROJECT NO. 86-060-24 RESP. TO NRC COMMENTS 10/17/90
T3 REACH 3 - SUPERCRITICAL FLOW

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ	
	0	0	0	1	0.015	0	0	26300	6956		
NC	0.035	0.035	0.03								
X1	57.75	17	145	540	270	285	262				
GR	6960	0	6955	35	6950	90	6945.5	145	6941	160	
GR	6941	180	6945	195	6946	230	6945	270	6945	295	
GR	6945	330	6945	375	6946	540	6953.5	580	6953.5	620	
GR	6960	655	6960	755							
X1	60.40	9	110	520	160	130	100				
GR	6960	0	6950	110	6939	120	6939	140	6941.5	145	
GR	6943	520	6952	560	6952	600	6962	640			
X1	61.40	16	250	660	60	200	95				
GR	6960	0	6955	55	6950	127	6945	250	6940	260	
GR	6935	270	6933	275	6933	295	6937	297	6937	480	
GR	6942	600	6942	650	6942	660	6951.9	710	6951.9	750	
GR	6960	795									
X1	62.30	23	250	330	265	110	150				
GR	6960	0	6955	35	6950	85	6945	155	6945	175	
GR	6940	250	6935	260	6930	265	6922	280	6922	300	
GR	6930	320	6935	330	6935	395	6933.8	420	6935	435	
GR	6939	476	6939	595	6940	620	6940	655	6940.7	717	
GR	6950.5	769.9	6950.5	809.9	6957	845					
X1	63.80	20	300	335	1080	1015	1005				
GR	6960	0	6955	60	6950	90	6945	105	6940	180	
GR	6935	245	6925	250	6920	270	6925	300	6902	305	
GR	6902	325	6925	330	6930	335	6935	375	6939	575	
GR	6940	655	6940.7	728.5	6950.5	777.5	6950.5	817.5	6957	850	
X1	73.80	20	650	735	850	595	630				
GR	6960	0	6955	40	6950	105	6945	240	6945	340	
GR	6945	350	6940	450	6930	605	6925	625	6900	650	
GR	6880	670	6880	690	6900	735	6920	757	6925	960	
GR	6935	1075	6934	1180	6940	1210	6940	1250	6957	1335	

Run Date: 11/26/90 Run Time: 15:16:43 HNVersion: 5.30 Data File: re3old.hc2

X1	80.10	15	325	440	290	330	275			
GR	6925	0	6920	140	6920	270	6915	280	6910	290
GR	6905	310	6900	325	6874.3	380	6874.3	400	6900	440
GR	6912	480	6925	790	6928	900	6928	1072	6957	1275
X1	82.90	19	480	645	0	0	0			
GR	6925	0	6920	115	6915	200	6910	460	6905	470
GR	6900	480	6871	510	6871	530	6900	645	6905	655
GR	6905	705	6905	860	6899	900	6899	935	6926	1100
GR	6930	1180	6940	1195	6950	1205	6960	1215		

p. 35/40

Run Date: 11/26/90 Run Time: 15:16:43 HNVersion: 5.30 Data File: re3old.hc2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

p. 36/40

*SECNO 57.750

57.750	8.01	6949.01	6949.95	6956.00	6952.71	3.70	.00	.00	6945.50
26300.0	567.8	25569.2	162.9	75.3	1637.6	24.2	.0	.0	6946.00
.00	7.54	15.61	6.75	.035	.030	.035	.000	6941.00	102.10
.014977	0.	0.	0.	0	14	6	.00	453.95	556.05

*SECNO 60.400

3301 HV CHANGED MORE THAN HVINS

60.400	7.83	6946.83	6947.12	.00	6949.64	2.81	3.07	.00	6950.00
26300.0	.0	26096.7	203.3	.0	1933.5	32.5	11.2	2.7	6943.00
.01	.00	13.50	6.25	.000	.030	.035	.000	6939.00	112.88
.009423	270.	262.	285.	3	5	0	.00	424.12	537.01

*SECNO 61.400

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.79

61.400	8.27	6941.27	6943.38	.00	6948.09	6.82	1.55	.00	6945.00
26300.0	.0	26300.0	.0	.0	1255.1	.0	14.9	3.5	6942.00
.01	.00	20.95	.00	.000	.030	.000	.000	6933.00	257.45
.030088	160.	100.	130.	7	11	0	.00	325.12	582.57

*SECNO 62.300

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .59

62.300	16.70	6938.70	6941.51	.00	6946.35	7.65	1.73	.00	6940.00
26300.0	.0	21368.2	4931.8	.0	885.4	483.1	18.3	4.3	6935.00
.01	.00	24.13	10.21	.000	.030	.035	.000	6922.00	252.59
.010444	60.	95.	200.	8	17	0	.00	220.36	472.96

Run Date: 11/26/90 Run Time: 15:16:43 HNVersion: 5.30 Data File: re3old.hc2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 63.800

3301 HV CHANGED MORE THAN HVINS

p.37/40

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.59

63.800	24.89	6926.89	6931.98	.00	6943.91	17.01	2.45	.00	6925.00
26300.0	4035.3	22264.7	.0	221.0	633.8	.0	22.2	4.8	6930.00
.01	18.26	35.13	.00	.035	.030	.000	.000	6902.00	249.05
.026521	265.	150.	110.	7	14	0	.00	82.85	331.90

*SECNO 73.800

3301 HV CHANGED MORE THAN HVINS

73.800	15.91	6895.91	6901.95	.00	6916.09	20.18	27.82	.00	6900.00
26300.0	.0	26300.0	.0	.0	729.5	.0	40.7	6.6	6900.00
.02	.00	36.05	.00	.000	.030	.000	.000	6880.00	654.09
.020576	1080.	1005.	1015.	6	15	0	.00	71.71	725.80

*SECNO 80.100

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .70

80.100	18.00	6892.38	6895.78	.00	6903.90	11.53	12.19	.00	6900.00
26300.0	.0	26300.0	.0	.0	965.3	.0	52.9	7.8	6900.00
.02	.00	27.25	.00	.000	.030	.000	.000	6874.30	341.32
.013964	850.	630.	595.	6	11	0	.00	86.81	428.13

*SECNO 82.900

3301 HV CHANGED MORE THAN HVINS

82.900	15.51	6886.51	6890.63	.00	6899.43	12.92	4.47	.00	6900.00
26300.0	.0	26300.0	.0	.0	911.8	.0	58.9	8.4	6900.00
.03	.00	28.84	.00	.000	.030	.000	.000	6871.00	493.95
.019177	290.	275.	330.	7	8	0	.00	97.56	591.51

PROFILE FOR STREAM 3 - SUPERCRITICAL FLOW

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,N-LOWER END STA

p. 38/40

```
ELEVATION  6871.    6881.    6891.    6901.    6911.    6921.    6931.    6941.    6951.    6961.
   SECNO   CUMDIS

   57.75      0.  .        .        .        .        .        .        .        .        I   L WC. E     N.        .
             50.  .        .        .        .        .        .        .        .        I  RL  W .E     N.        .
            100.  .        .        .        .        .        .        .        .       I.   R LWC .E     N.        .
            150.  .        .        .        .        .        .        .        .       I.  R   W  E      N.        .
            200.  .        .        .        .        .        .        .        .      I .  R  WCLE.      N.        .
            250.  .        .        .        .        .        .        .        .      I . R   W  E.      N.        .
   60.40    300.  .        .        .        .        .        .        .        .      I . R   W  E.      N.        .
            350.  .        .        .        .        .        .        .        .   I    . RWC  LE .      N.        .
   61.40    400.  .        .        .        .        .        .        .        . I      WRC L  E  .      N.        .
            450.  .        .        .        .        .        .        .    I   .     R W.C    E  .     N  .        .
   62.30    500.  .        .        .        .        .        .I       .        .  R  WL.C   E   .    N  .        .
            550.  .        .        .        .        .  I     .        .        . R W  C  .   E   .    N  .        .
            600.  .        .        .        .      I .        .        .      LWR  C     .  E    .    N  .        .
   63.80    650.  .        .        .        .I       .        .        .  L W  R.C        . E    .    N  .        .
            700.  .        .        .        I        .        .        . LW   RC.         . E    .    N  .        .
            750.  .        .        .       I.        .        .        . LW  R C .        E      .    N  .        .
            800.  .        .        .      I .        .        .       LW   RC  .       E.      .    N  .        .
            850.  .        .        .     I  .        .        .      LW  R C   .     E  .      .    N  .        .
            900.  .        .        .    I   .        .        .     W . R C    .    E   .      .    N  .        .
            950.  .        .        .   I    .        .        .    W  R C      .   E    .      .    N  .        .
           1000.  .        .        .  I     .        .        .   W   R.C       . E     .      .    N  .        .
           1050.  .        .        . I      .        .        .  W  R C.        . E     .      .    N  .        .
           1100.  .        .        .I       .        .        . WL  R C .       E       .      .    N  .        .
           1150.  .        .        I        .        .        W L R C  .      E.        .      .    N  .        .
           1200.  .        .       I.        .        .        WL  R C  .     E .        .      .    N  .        .
           1250.  .        .      I .        .        .      W L.R C    .    E  .        .      .    N  .        .
           1300.  .        .     I  .        .        .     W L R C     .   E   .        .      .    N  .        .
           1350.  .        .    I   .        .        .    W  LR C      .  E    .        .      .    N  .        .
           1400.  .        .   I    .        .        .   W L R C.      . E     .        .      .    N  .        .
           1450.  .        . I      .        .        .W  LR C  .      .E       .        .      .    N  .        .
           1500.  .        . I      .        .        W  LR C  .      E.        .        .      .    N  .        .
           1550.  .        .I       .        .      W . L C    .     E .        .        .      .    N  .        .
           1600.  .        I        .        .     W  LR C     .    E  .        .        .      .    N  .        .
   73.80   1650.  .       I.        .        .   W   L.C       .   E   .        .        .      .    N  .        .
           1700.  .       I.        .        .   W   LC        .  E    .        .        .        .  N     .        .
           1750.  .      I .        .        .  W   LC        . E     .        .        .        .N       .        .
           1800.  .      I .        .        .  W   C.        . E     .        .        .      N .        .        .
           1850.  .     I  .        .        .  W   C.        .E      .        .        .    N   .        .        .
           1900.  .     I  .        .        .  W   C.        E       .        .        .  N     .        .        .
           1950.  .    I   .        .        . W   CL.       E.       .        .        .N       .        .        .
           2000.  .    I   .        .        . W   CL.      E .       .        .      N .        .        .        .
           2050.  .   I    .        .        . W   C L.     E  .      .        .    N   .        .        .        .
           2100.  .   I    .        .        .W   C L.    E   .       .        . N     .        .        .        .
           2150.  .  I     .        .        .W   C  L.   E    .       .       .N       .        .        .        .
           2200.  .  I     .        .        .W   C  L.  E     .       .     N .        .        .        .        .
   80.10   2250.  . I      .        .        .W   C  L. E      .       .    N   .        .        .        .        .
           2300.  .. I     .        .        W   C   L. E      .       .    N   .        .        .        .        .
           2350.  . I      .        .       W.  C    L.E       .       .    N   .        .        .        .        .
           2400.  .I       .        .      W . C     LE        .       .    N   .        .        .        .        .
```

```
        2500.  .        .    W   .    C.        .        .    A    .        .        .        .
  82.90 2550.  I        .    W        EL.       .        .    N    .        .        .        .
```


Run Date: 11/26/90 Run Time: 15:16:43 HNVersion: 5.30 Data File: re3old.hc2

THIS RUN EXECUTED 11/26/90 15:16:50

****
HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

p. 39/40

ERROR CORR - 01,02,03,04
MODIFICATION -
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

3 - SUPERCRITICAL FLOW

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	57.750	.00	.00	.00	6941.00	26300.00	6949.01	6949.95	6952.71	149.77	15.61	1737.04	2149.01
	60.400	262.00	.00	.00	6939.00	26300.00	6946.83	6947.12	6949.64	94.23	13.50	1966.05	2709.27
*	61.400	100.00	.00	.00	6933.00	26300.00	6941.27	6943.38	6948.09	300.88	20.95	1255.08	1516.20
*	62.300	95.00	.00	.00	6922.00	26300.00	6938.70	6941.51	6946.35	104.44	24.13	1368.54	2573.47
*	63.800	150.00	.00	.00	6902.00	26300.00	6926.89	6931.98	6943.91	265.21	35.13	854.82	1614.95
	73.800	1005.00	.00	.00	6880.00	26300.00	6895.91	6901.95	6916.09	285.76	36.05	729.54	1555.81
*	80.100	630.00	.00	.00	6874.30	26300.00	6892.38	6895.78	6903.90	139.64	27.25	965.30	2225.64
	82.900	275.00	.00	.00	6871.00	26300.00	6886.51	6890.63	6899.43	191.77	28.84	911.82	1899.17

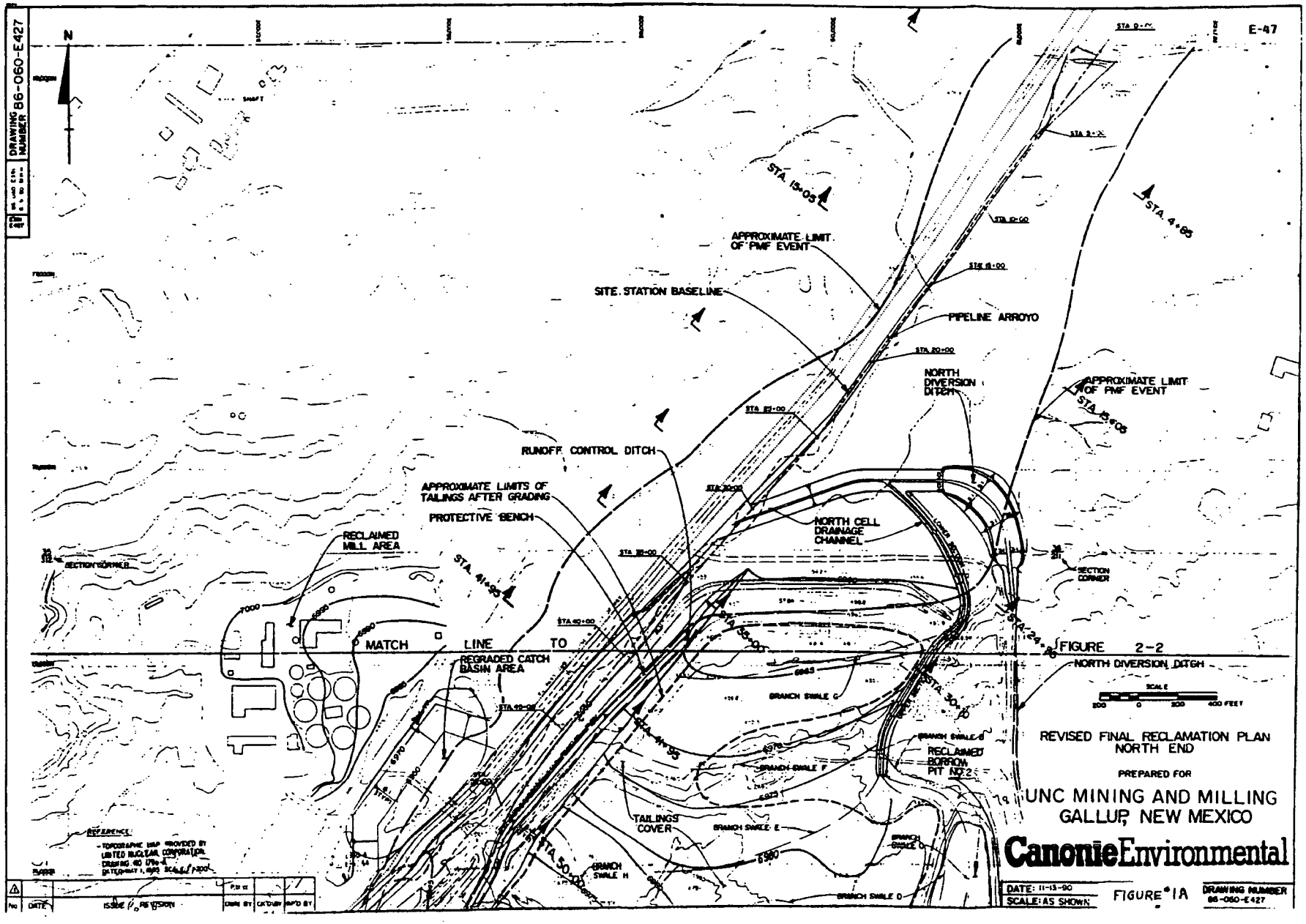
Run Date: 11/26/90 Run Time: 15:16:43 HNVersion: 5.30 Data File: re3old.hc2

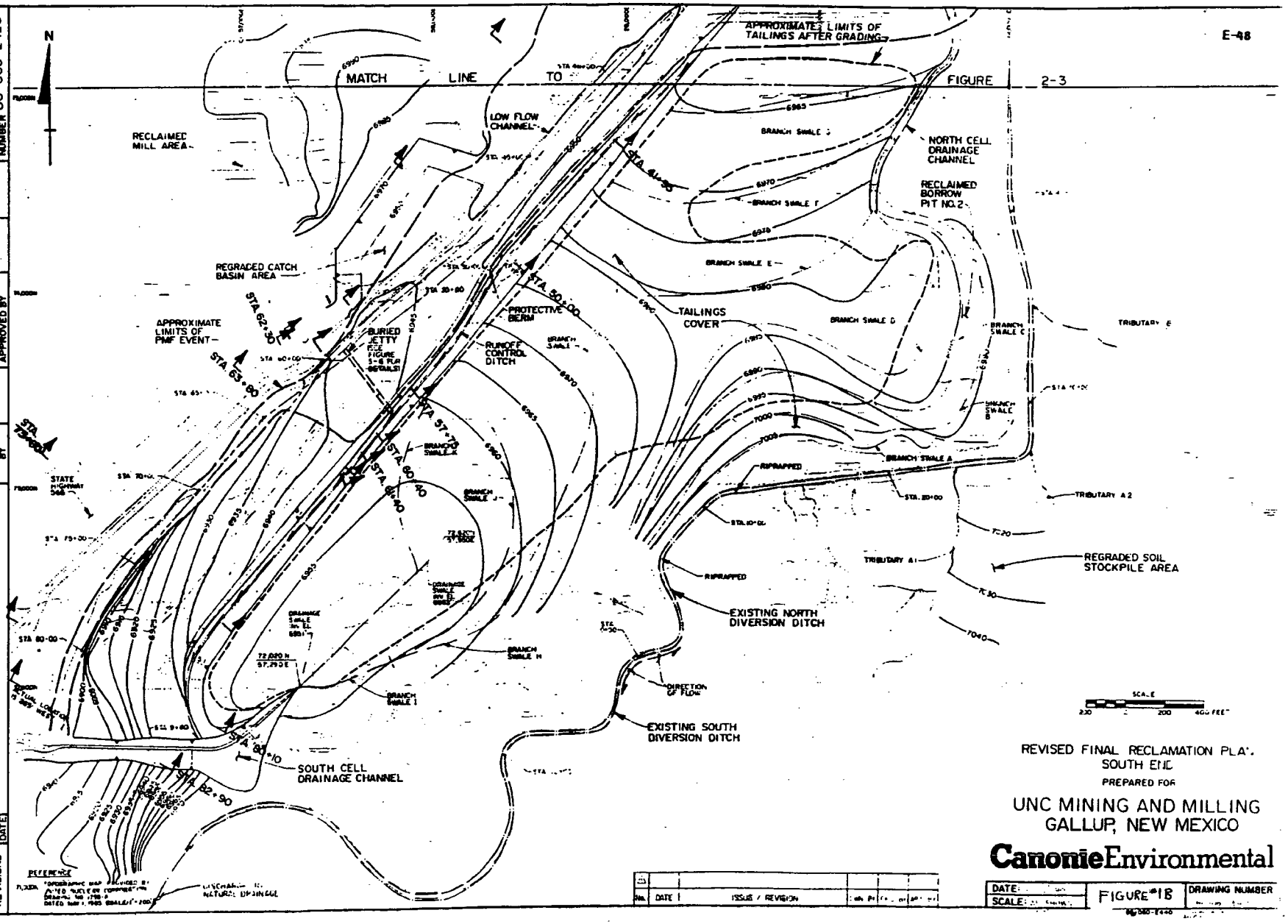
3 - SUPERCRITICAL FLOW

SUMMARY PRINTOUT TABLE 150

p. 40/40

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	57.750	26300.00	6949.01	.00	.00	-6.99	453.95	.00
	60.400	26300.00	6946.83	.00	-2.18	.00	424.12	262.00
*	61.400	26300.00	6941.27	.00	-5.56	.00	325.12	100.00
*	62.300	26300.00	6938.70	.00	-2.57	.00	220.36	95.00
*	63.800	26300.00	6926.89	.00	-11.81	.00	82.85	150.00
	73.800	26300.00	6895.91	.00	-30.98	.00	71.71	1005.00
*	80.100	26300.00	6892.38	.00	-3.54	.00	86.81	630.00
	82.900	26300.00	6886.51	.00	-5.86	.00	97.56	275.00


E-47
DRAWING NUMBER 86-060-E427
N
STA. 13+05
STA. 4+65
APPROXIMATE LIMIT OF PMF EVENT
SITE STATION BASELINE
PIPELINE ARROYO
NORTH DIVERSION DITCH
APPROXIMATE LIMIT OF PMF EVENT
STA. 13+05
RUNOFF CONTROL DITCH
APPROXIMATE LIMITS OF TAILINGS AFTER GRADING
PROTECTIVE BENCH
NORTH CELL DRAINAGE CHANNEL
RECLAIMED MILL AREA
STA. 41+95
SECTION CORNER
SECTION CORNER
MATCH LINE TO
REGRADED CATCH BASIN AREA
STA. 35+00
STA. 24+85
FIGURE 2-2
NORTH DIVERSION DITCH
SCALE
200 0 200 400 FEET
BRANCH SWALE G
BRANCH SWALE F
BRANCH SWALE E
BRANCH SWALE D
BRANCH SWALE H
RECLAIMED BORROW PIT NO. 2
TAILINGS COVER
STA. 41+95
STA. 50+00
STA. 30+75
REFERENCE:
- TOPOGRAPHIC MAP PROVIDED BY UNITED NUCLEAR CORPORATION, DRAWING NO. DTN-4, DATED MAY 1, 1982 SCALE 1"=200'
REVISED FINAL RECLAMATION PLAN
NORTH END
PREPARED FOR
UNC MINING AND MILLING
GALLUP, NEW MEXICO
CanonieEnvironmental
DATE: 11-13-90
SCALE: AS SHOWN
FIGURE 1A
DRAWING NUMBER 86-060-E427
No. DATE ISSUE / REVISION DRN BY CK'D BY APP'D BY


E-48
MATCH LINE TO FIGURE 2-3
N
APPROXIMATE LIMITS OF TAILINGS AFTER GRADING
RECLAIMED MILL AREA
LOW FLOW CHANNEL
NORTH CELL DRAINAGE CHANNEL
RECLAIMED BORROW PIT NO. 2
BRANCH SWALE J
BRANCH SWALE F
BRANCH SWALE E
BRANCH SWALE D
BRANCH SWALE C
BRANCH SWALE B
BRANCH SWALE A
BRANCH SWALE K
BRANCH SWALE J
BRANCH SWALE H
BRANCH SWALE I
REGRADED CATCH BASIN AREA
APPROXIMATE LIMITS OF PMF EVENT
BURIED JETTY
PROTECTIVE BERM
RUNOFF CONTROL DITCH
TAILINGS COVER
TRIBUTARY E
TRIBUTARY A2
TRIBUTARY A1
RIPRAPPED
REGRADED SOIL STOCKPILE AREA
EXISTING NORTH DIVERSION DITCH
EXISTING SOUTH DIVERSION DITCH
DIRECTION OF FLOW
SOUTH CELL DRAINAGE CHANNEL
STATE HIGHWAY 566
STA 62+30
STA 63+80
STA 50+00
STA 57+70
STA 60+40
STA 80+10
STA 82+90
STA 80+00
SCALE
200
400 FEET
REVISED FINAL RECLAMATION PLAN
SOUTH END
PREPARED FOR
UNC MINING AND MILLING
GALLUP, NEW MEXICO
CanonieEnvironmental
DATE
SCALE
FIGURE 18
DRAWING NUMBER
86-060-E425
DRAWING NUMBER
CHECKED BY
APPROVED BY
DRAWN BY
REVISIONS
NO.
DATE
ISSUE / REVISION

E.1(c)

HEC-2 Analysis for Low Flow Channel at the Buried Jetty

Canonie Environmental

E-50

By SWM Date 11-8-90 Subject UNC Sheet No. 1 of

Chkd. By mm Date 12/3/90 PIPELINE ARROYO Proj. No. 86-060-24

HEC-2 ANALYSIS OF LOW FLOW CHANNEL AT BURIED JETTY

1/4" X 1/4"

PURPOSE: TO COMPUTE THE DISCHARGE (Q) AT WHICH THE STORMWATER WILL OVERTOP THE LOW-FLOW CHANNEL AND CONTACT THE BURIED JETTY (SEE FIGURE #1). THIS ANALYSIS WILL BE PERFORMED FOR THE RECOMMENDED REDESIGN ALTERNATIVE (i.e. HEC-2 ALTERNATIVE #7).

METHOD: PERFORM A TRIAL AND ERROR ANALYSIS USING THE HEC-2 DATA FILE THAT DESCRIBES THE ALTERNATIVE #7 CHANNEL CONFIGURATION (SEE PAGE 5 FOR SUMMARY OF ALTERNATIVE #7). THE INPUT DISCHARGE WILL BE VARIED TO PRODUCE A DISCHARGE VS. WATER SURFACE ELEVATION CURVE (SEE FIGURE 2)

NOTE: THE PROPOSED JETTY WILL BE LOCATED AT STATION 59+50. THIS IS IN CLOSE PROXIMITY TO THE HEC-2 CROSS-SECTION AT STATION 60+40. THEREFORE IT IS ASSUMED THAT THE WATER SURFACE ELEVATIONS AT THESE STATIONS ARE EQUIVALENT (i.e. THE HEC-2 DATA FOR STATION 60+40 IS REPRESENTATIVE OF STATION 59+50)

Canonie Environmental

E-51

By SWM Date 11-8-90 Subject UNC Sheet No. ___ of 2

Chkd. By [illegible] Date 12/5/90 Proj. No. 86-060-29

1/4" X 1/4"

RESULTS:

THE CHANNEL IS OVERTOPPED AT ELEVATION 6943', WHICH OCCURS AT A DISCHARGE Q = 2250 CFS.

THE HEC-2 OUTPUT FOR Q_{INPUT} = 2250 CFS IS INCLUDED IN THIS CALC BRIEF.

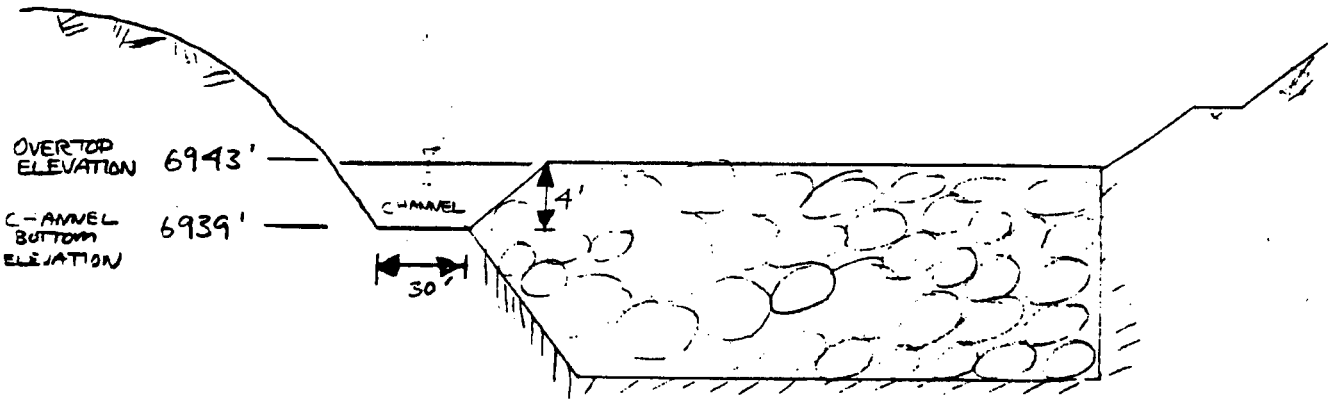
Canonie Environmental

E-52

By SWM Date 11-8-90 Subject UNC Sheet No. 3 of

Chkd. By mm Date 12/3/90 FIGURE # 1 Proj. No. 86-060-24

1/4" X 1/4"



STATION 5950'

FIGURE 1

Canonie Environmental

E-53

By SVM Date 11-8-90 Subject UNC Sheet No. 4 of

Chkd. By Date 12/3/90 FIGURE 2 Proj. No. 86-060-29

1/4" X 1/4"

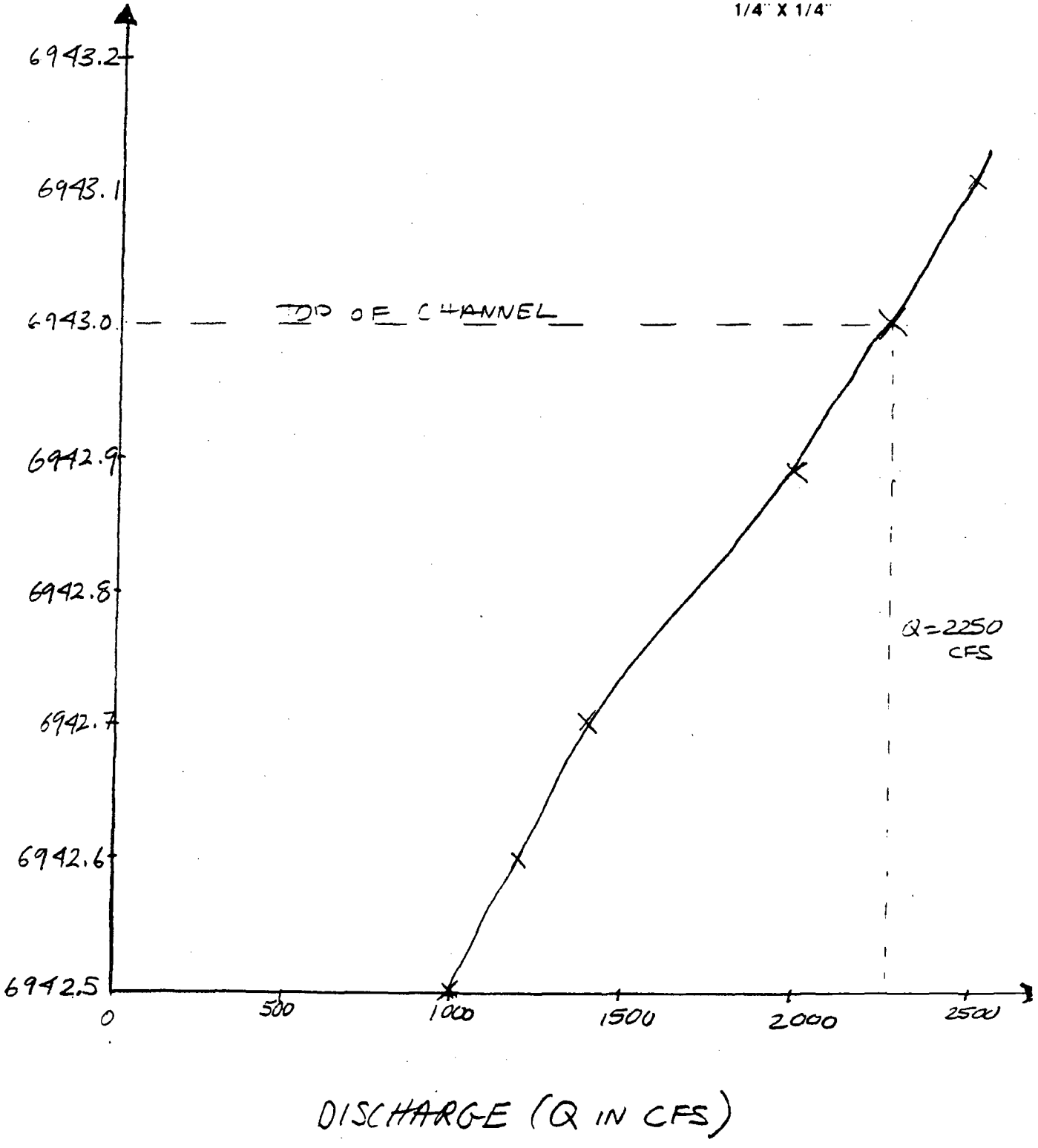


FIGURE 2

Canonie Environmental

E-50

By SWM Date 11-8-90 Subject UNC Sheet No. 1 of ___

Chkd. By [illegible] Date 12/3/90 PIPELINE ARROYO Proj. No. 86-060-24

HEC-2 ANALYSIS OF LOW FLOW CHANNEL AT BURIED JETTY

1/4" X 1/4"

PURPOSE: TO COMPUTE THE DISCHARGE (Q) AT WHICH THE STORMWATER WILL OVERTOP THE LOW-FLOW CHANNEL AND CONTACT THE BURIED JETTY (SEE FIGURE #1). THIS ANALYSIS WILL BE PERFORMED FOR THE RECOMMENDED REDESIGN ALTERNATIVE (i.e. HEC-2 ALTERNATIVE #7).

METHOD: PERFORM A TRIAL AND ERROR ANALYSIS USING THE HEC-2 DATA FILE THAT DESCRIBES THE ALTERNATIVE #7 CHANNEL CONFIGURATION (SEE PAGE 5 FOR SUMMARY OF ALTERNATIVE #7). THE INPUT DISCHARGE WILL BE VARIED TO PRODUCE A DISCHARGE VS. WATER SURFACE ELEVATION CURVE (SEE FIGURE 2)

NOTE: THE PROPOSED JETTY WILL BE LOCATED AT STATION 59+50. THIS IS IN CLOSE PROXIMITY TO THE HEC-2 CROSS-SECTION AT STATION 60+40. THEREFORE IT IS ASSUMED THAT THE WATER SURFACE ELEVATIONS AT THESE STATIONS ARE EQUIVALENT (i.e. THE HEC-2 DATA FOR STATION 60+40 IS REPRESENTATIVE OF STATION 59+50)

Canonie Environmental

E-51

By SWM Date 11-8-90 Subject UNC Sheet No. ___ of 2

Chkd. By [illegible] Date 12/3/90 Proj. No. 86-060-29

1/4" X 1/4"

RESULTS:

THE CHANNEL IS OVERTOPPED AT ELEVATION 6943', WHICH OCCURS AT A DISCHARGE Q = 2250 CFS.

THE HEC-2 OUTPUT FOR Q_{INPUT} = 2250 CFS IS INCLUDED IN THIS CALC BRIEF.

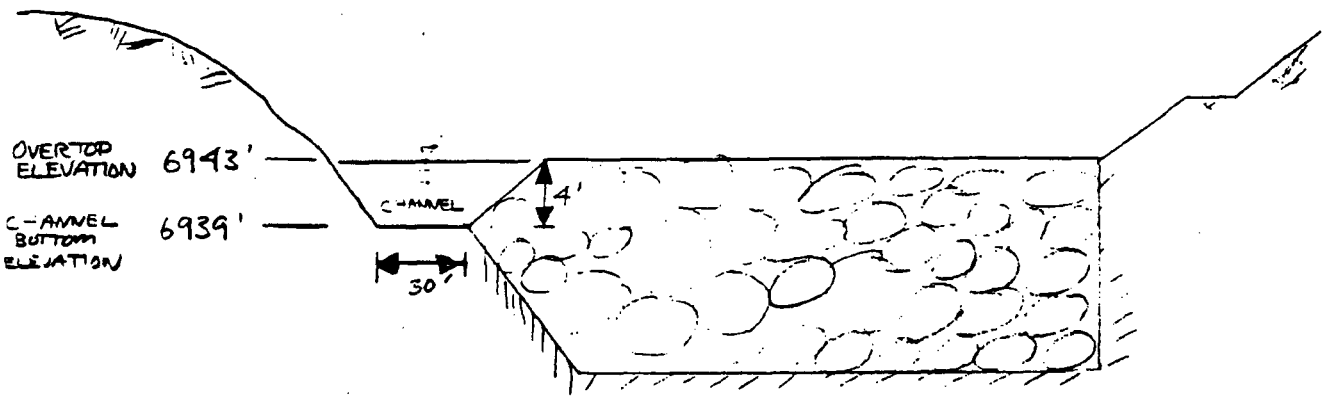
Canonie Environmental

E-52

By SWM Date 11-8-90 Subject UNC Sheet No. 3 of

Chkd. By mm Date 12/3/90 FIGURE # 1 Proj. No. 86-060-24

1/4" X 1/4"



STATION 5950'

FIGURE 1

Canonie Environmental

E-53

By SMM Date 11-8-90 Subject UNC Sheet No. 4 of ___

Chkd. By [illegible] Date 12/3/90 FIGURE 2 Proj. No. 86-060-28

1/4" X 1/4"

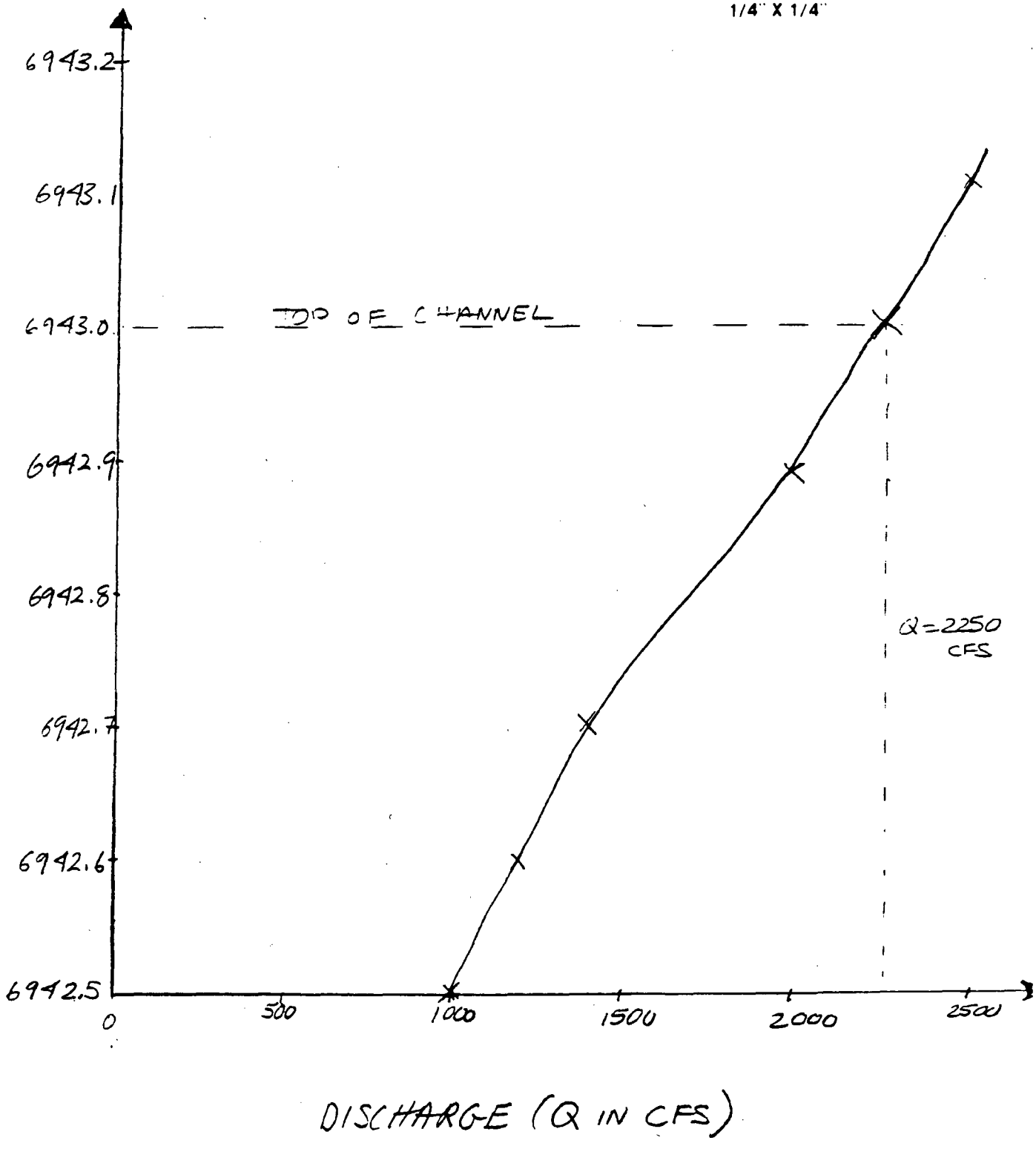


FIGURE 2

Summary of Alternative #7:

In Alternative #7, the channel is modified only slightly from the existing configuration as follows:

- o ensure a 30' wide, 2' deep channel bottom from Sta 5+00 to Sta 61+70 (i.e. low-flow channel)
- o Fill existing depressions and headcuts
- o a stone filled trench (jetty) will be installed at Sta 59+50 to reinforce the Nickpoint and maintain shallow upstream slopes.
- o a 40' wide protective bench will be constructed at the tailings embankment toe which would protect the embankment and tailings during the PMF.

L 22-7/1 2/3/92


```
*****************************************
*  WATER SURFACE PROFILES               *
*  VERSION OF SEPTEMBER 1988            *
   ERROR: 01.02.03.04                   *
   UPDATED:  JUNE 1990                  *
*  RUN DATE    11/26/90      TIME   17:12:29   *
*****************************************
```

```
*****************************************
*  U.S. ARMY CORPS OF ENGINEERS         *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*  609 SECOND STREET, SUITE D           *
*  DAVIS, CALIFORNIA 95616-4687         *
*                                       *
*****************************************
```

```
X    X  XXXXXXX  XXXXX          XXXXX
X    X  X       X    X         X    X
X    X  X       X                   X
XXXXXXX  XXXX    X        XXXXX  XXXXX
X    X  X       X              X
X    X  X       X    X         X
X    X  XXXXXXX  XXXXX          XXXXXXX
```

BY: SWM
11-8-90

P. 6

```
:::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::
:::                                     :::
:::   FULL MICRO-COMPUTER IMPLEMENTATION  :::
:::                                     :::
:::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::
```

HAESTAD METHODS

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

END OF BANNER

ALTERNATIVE # 7
RUN FOR
Q = 2250 cfs

Run Date: 11/26/90 Run Time: 17:12:29 HMVersion: 5.30 Data File: alt7.hc2

✓ 12/3/90

THIS RUN EXECUTED 11/26/90 17:12:29

****

HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

ERROR CORR - 01.02.03.04
MODIFICATION -

****

C. 7

T1 ALTERNATIVE #7—REACH 1&2-[redacted]
T2 UNC PROJECT NO. 86-060-24 RESP. TO NRC COMMENTS 11/7/90
T3 PIPELINE ARROYO SUBCRITICAL FLOW

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	O	WSEL	FQ
	0	0	0	0	0.04	0	0	2250	6950	0

NC	0.035	0.035	0.03							
X1	61.40	17	250	676	0	0	0			
GR	6960	0	6955	55	6950	127	6945	250	6940	260
GR	6935	270	6933	275	6933	300	6937	310	6937	480
GR	6942	600	6942	650	6942	660	6942	676	6951.5	727.5
GR	6951.5	767.5	6957	792						
X1	60.40	10	110	515	160	130	100			
GR	6960	0	6950	110	6939	115	6939	140	6941.5	145
GR	6943	515	6943	530	6952	572.5	6952	612.5	6957	632
X1	57.75	16	145	543	270	295	262			
GR	6960	0	6955	35	6950	90	6945.5	145	6941	155
GR	6941	185	6945	195	6945	230	6945	270	6945	295
GR	6945	330	6945	375	6945	543	6953.5	587.5	6953.5	627.5
GR	6960	660								
X1	50.00	14	455	712	750	850	775			
GR	6975	0	6970	10	6965	30	6960	100	6950	140
GR	6950	320	6950	455	6944	532	6944	562	6950	650
GR	6950	712	6957	745	6957	785	6976	880		
X1	41.95	12	535	772	820	800	805			
GR	6970	0	6965	70	6960	165	6955	235	6950	535
GR	6947	557	6947	587	6953.5	700	6953.5	772	6960.5	810
GR	6960.5	850	6970	905						
X1	35.00	9	215	780	700	700	705			
GR	6970	0	6960	145	6955	215	6948.7	583	6948.7	603
GR	6958	710	6958.5	780	6962.5	800	6962.5	840		
1	30.10	21	135	980	495	1140	490			
GR	6970	0	6960	135	6955	565	6952	575	6952	605
GR	6955	615	6955	660	6955	765	6955	800	6955	850
GR	6955	880	6956	980	6958	990	6960	1000	6960	1070
GR	6962	1422	6962.4	1510	6964.5	1680	6966.5	1795	6968	1900
GR	6970	1910								

Run Date: 11/26/90 Run Time: 17:12:29 HMVersion: 5.30 Data File: alt7.hc2

✓ mgj 12/3/90

X1	24.95	26	795	1800	560	540	520			
GR	7000	0	6990	45	6980	140	6970	275	6960	545
GR	6960	615	6960	795	6955	865	6953	865	6953	895
GR	6955	895	6955	1175	6955	1295	6955	1385	6955	1715
GR	6958	1770	6960	1800	6960	1970	6962	2060	6964	2070
GR	6966	2080	6968	2090	6970	2100	6980	2150	6990	2165
GR	7000	2230								

P.8

X1	15.05	15	690	795	910	1180	990			
GR	7000	0	6990	35	6980	105	6970	210	6960	690
GR	6959	710	6959	740	6960	795	6960	1520	6975	1575
GR	6980	1600	6985	1620	6990	1645	6995	1660	7000	1690

X1	4.85	14	820	1155	1035	1070	1022			
GR	6980	0	6970	820	6970	890	6968	890	6968	920
GR	6970	920	6970	930	6970	950	6970	1000	6970	1030
GR	6970	1060	6970	1105	6970	1155	6980	1540		

Run Date: 11/26/90 Run Time: 17:12:29 HMVersion: 5.30 Data File: alt7.hc2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	THA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

*SECNO 61.400
3720 CRITICAL DEPTH ASSUMED

61.400	4.79	6937.79	6937.79	6950.00	6938.58	.78	.00	.00	6945.00
2250.0	.0	2250.0	.0	.0	317.2	.0	.0	.0	6942.00
.00	.00	7.09	.00	.000	.030	.000	.000	6933.00	264.41
.013861	0.	0.	0.	0	17	0	.00	234.66	499.07

p. 9

*SECNO 60.400
3685 20 TRIALS ATTEMPTED WSEL.CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

60.400	4.02	6943.02	6943.02	.00	6943.50	.49	1.34	.00	6950.00
2250.0	.0	2249.9	.1	.0	401.8	.3	.8	.8	6943.00
.00	.00	5.60	.32	.000	.030	.035	.000	6939.00	113.17
.012921	160.	100.	130.	20	10	0	.00	416.91	530.08

SECNO 57.750

57.750	4.76	6945.76	.00	.00	6946.13	.37	2.63	.00	6946.50
2250.0	.4	2246.6	3.0	.4	461.1	1.5	3.4	3.2	6946.00
.02	.98	4.87	1.97	.035	.030	.035	.000	6941.00	141.79
.008000	270.	262.	295.	5	0	0	.00	406.20	546.99

*SECNO 50.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE. KRATIO = 1.85

50.000	4.83	6948.83	.00	.00	6949.19	.36	3.06	.00	6950.00
2250.0	.0	2250.0	.0	.0	465.8	.0	11.7	8.3	6950.00
.06	.00	4.83	.00	.000	.030	.000	.000	6944.00	470.01
.002349	750.	775.	850.	5	0	0	.00	162.84	632.85

*SECNO 41.950

41.950	4.15	6951.15	.00	.00	6951.79	.64	2.60	.00	6950.00
2250.0	79.4	2170.6	.0	39.5	332.2	.0	19.4	11.6	6953.50
.10	2.01	6.53	.00	.035	.030	.000	.000	6947.00	466.15
.004698	820.	805.	800.	3	0	0	.00	192.95	659.10

Run Date: 11/26/90 Run Time: 17:12:29 HMVersion: 5.30 Data File: alt7.hc2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 35.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE. KRATIO = 2.02

35.000	4.40	6953.10	.00	.00	6953.24	.14	1.45	.00	6955.00
2250.0	.0	2250.0	.0	.0	763.0	.0	28.6	15.8	6958.50
.17	.00	2.95	.00	.000	.030	.000	.000	6948.70	326.30
.001147	700.	705.	700.	2	0	0	.00	327.27	653.56

*SECNO 30.100
3686 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

30.100	3.74	6956.74	6956.74	.00	6956.22	.48	1.38	.00	6960.00
2250.0	.0	2250.0	.0	.0	483.5	.0	35.2	20.2	6956.00
.19	.00	5.58	.00	.000	.030	.000	.000	6952.00	501.47
.014804	495.	490.	1140.	20	9	0	.00	452.41	953.88

*SECNO 24.950

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE. KRATIO = 6.30

24.950	3.77	6956.77	.00	.00	6956.80	.03	.58	.00	6960.00
2250.0	.0	2250.0	.0	.0	1609.9	.0	47.2	28.3	6960.00
.29	.00	1.40	.00	.000	.030	.000	.000	6963.00	840.30
.000373	560.	520.	540.	5	0	0	.00	907.04	1747.34

*SECNO 15.050
3686 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

15.050	1.61	6960.61	6960.61	.00	6960.92	.31	1.12	.00	6960.00
2250.0	18.2	799.9	1431.8	9.0	131.7	444.3	73.1	50.0	6960.00
.36	2.03	6.07	3.22	.035	.030	.035	.000	6959.00	660.63
.011109	910.	990.	1180.	20	12	0	.00	861.61	1522.24

Run Date: 11/26/90 Run Time: 17:12:29 HMVersion: 5.30 Data File: alt7.hc2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 4.850

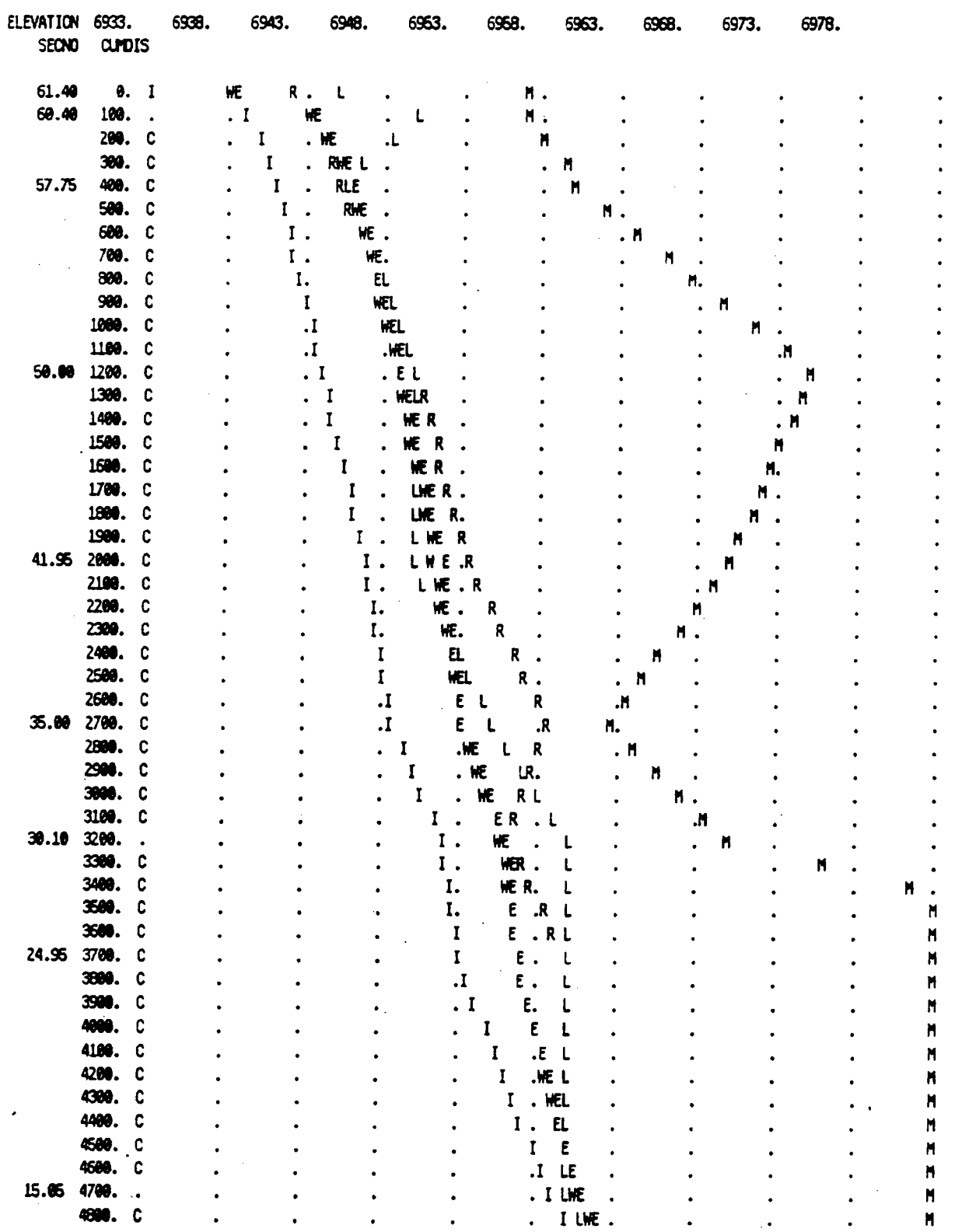
4.850	3.00	6971.00	.00	.00	6971.41	.41	10.49	.00	6970.00
2250.0	106.5	2093.5	50.0	41.3	396.3	19.4	85.6	65.8	6970.00
.42	2.58	5.28	2.58	.035	.030	.035	.000	6968.00	737.68
.009235	1035.	1022.	1070.	5	0	0	.00	455.97	1193.65

p. 11

/ mjr 3:90

PROFILE FOR STREAM INE ARROYO SUBCRITICAL F

PLOTTED POINTS (BY PRIORITY) E-ENERGY.W-WATER SURFACE.I-INVERT.C-CRITICAL W.S..L-LEFT BANK.R-RIGHT BANK.M-LOWER END STA



P. 12

```
      5100.  C        .        .        .        .        .        I. LWE    .        .        .        M
      5200.  C        .        .        .        .        .        .I  LWE   .        .        .        M
      5300.  C        .        .        .        .        .        .  I  LWE .        .        .        M
      5400.  C        .        .        .        .        .        .  I   LWE        .        .        M
      5500.  C        .        .        .        .        .        .    I  LWE       .        .        M
      5600.  C        .        .        .        .        .        .     I . L E     .        .       M.
 .85  5700.  C        .        .        .        .        .        .       I  L WE   .        .  M     .
```

E-62

✓ mps 12/3/90

p.13

Run Date: 11/26/90 Run Time: 17:12:29 HMVersion: 5.30 Data File: alt7.hc2

✓ mjs 12/3/90

THIS RUN EXECUTED 11/26/90 17:12:37

****

HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

ERROR CORR - 01,02,03,04
MODIFICATION -

****

p. 14

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

INE ARROYO SUBCRITICAL F

SUMMARY PRINTOUT TABLE 150

	SECND	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	61.400	.00	.00	.00	6933.00	2250.00	6937.79	6937.79	6938.58	138.61	7.09	317.21	191.11
*	[redacted]	100.00	.00	.00	6939.00	[redacted]	6943.02	6943.50	129.21	5.60	402.01	197.94
	57.750	262.00	.00	.00	6941.00	2250.00	6945.76	.00	6946.13	80.00	4.87	463.00	251.55
*	50.000	775.00	.00	.00	6944.00	2250.00	6948.83	.00	6949.19	23.49	4.83	465.76	464.22
	41.950	805.00	.00	.00	6947.00	2250.00	6951.15	.00	6951.79	46.98	6.53	371.69	328.25
*	35.000	705.00	.00	.00	6948.70	2250.00	6953.10	.00	6953.24	11.47	2.95	763.04	664.28
*	30.100	490.00	.00	.00	6952.00	2250.00	6955.74	6955.74	6956.22	148.04	5.58	403.47	184.92
*	24.950	520.00	.00	.00	6953.00	2250.00	6956.77	.00	6956.80	3.73	1.40	1609.86	1165.44
*	15.050	990.00	.00	.00	6959.00	2250.00	6960.61	6960.61	6960.92	111.09	6.07	584.98	213.48
	4.850	1022.00	.00	.00	6968.00	2250.00	6971.00	.00	6971.41	92.36	5.28	457.03	234.13

Run Date: 11/26/90 Run Time: 17:12:29 HMVersion: 5.30 Data File: alt7.hc2

✓ mjm 12/3/90

ROYO SUBCRITICAL F

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	61.400	2250.00	6937.79	.00	.00	-12.21	234.66	.00
*	60.400	2250.00	6943.02	.00	5.22	.00	416.91	100.00
	57.750	2250.00	6945.76	.00	2.74	.00	405.20	262.00
*	50.000	2250.00	6948.83	.00	3.07	.00	162.84	775.00
	41.950	2250.00	6951.15	.00	2.32	.00	192.95	805.00
*	35.000	2250.00	6953.10	.00	1.96	.00	327.27	705.00
*	30.100	2250.00	6955.74	.00	2.63	.00	452.41	490.00
*	24.950	2250.00	6956.77	.00	1.03	.00	907.04	520.00
*	15.050	2250.00	6960.61	.00	3.84	.00	861.61	990.00
	4.850	2250.00	6971.00	.00	10.39	.00	456.97	1022.00

p. 15

E.1(d)

Nickpoint Stability - Riprap Design for Jetty

Canonie Environmental

E-66

By SWM Date 12-3-90 Subject UNC Sheet No. 1 of 3

Chkd. By mjj Date 12/3/90 Proj. No. 86-060-24

1/4" X 1/4"

PURPOSE: TO DETERMINE THE RIPRAP d_{50} FOR THE BURIED JETTY AT STA 59+50 OF THE RECOMMENDED PIPELINE ARROYO REDESIGN ALTERNATIVE (HEC-2 ALTERNATIVE #7).

METHOD: USE RIPSFHEC.WR1 (LOTUS SYMPHONY SPREADSHEET) TO DETERMINE RIPRAP d_{50} BY MEANS OF THE SAFETY FACTOR METHOD. HEC-2 RESULTS FROM ALTERNATIVE #7 ARE USED AS INPUT FOR RIPSFHEC.WR1.

REFERENCES: "APPLIED HYDROLOGY AND SEDIMENTOLOGY FOR DISTURBED AREAS", PAGES 185-194.

86-060-24 CALC. BRIEF - HEC-2 ANALYSIS OF THE RECOMMENDED REDESIGN ALTERNATIVE FOR PIPELINE ARROYO.

RESULTS: A RIPRAP d_{50} OF 6.4 INCHES WAS CALCULATED FOR THE BURIED JETTY. (SEE ATTACHED RIPSFHEC.WR1 PRINTOUT)

Canonie Environmental

E-67

By SWM Date 12-3-90 Subject UNC Sheet No. 2 of 3

Chkd. By [illegible] Date 12/3/90 Proj. No. 86-060-29

1/4" X 1/4"

CALCULATIONS :

- SLOPE BETWEEN STA 59+50 AND STA 57+75 (ELEVATIONS WERE DERIVED FROM JIM FLETCHER'S SURVEY DATA OF PIPELINE ARROYO) :

$$m = \frac{\Delta \text{ elev.}}{\Delta \text{ dist}} = \frac{6941.4 - 6940.5}{|5775 - 5950|} = \underline{\underline{0.005}}$$

- ASSUME A SPECIFIC GRAVITY OF 2.6 FOR RIPRAP.

✓ mjj 12/3/90

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD USING HEC2 RESULTS RIPSFHEC.WR1
REF: "Applied Hydrology and Sedimentology
for Disturbed Areas", pages 185-194

LOCATION: CROSS-SECTION @ STA 60.40

Z (SIDE SLOPE)	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.005	Theta =	0.29 Degrees
RIPRAP S.G. =	2.6	Phi =	41.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM

D50 (ASSUM) =	0.53 FT	6.4 INCHES
n =	0.036	
DEPTH=	8 FT	
t =	2.50 PSF	
nb =	0.991	
SFb =	1.00	

CHANNEL SIDE SLOPES

D50 (ASSUM) =	0.53 FT	6.4 INCHES
n =	0.036	
DEPTH=	8 FT	
t =	1.87 PSF	
nb =	0.74	
Beta =	45.45	
n' =	0.64	
SFs =	1.06	

EMBANKMENT SIDESLOPES

D50 (ASSUM) =	NA FT	NA INCHES
n =	NA	
DEPTH=	NA FT	
t =	NA PSF	
nb =	NA	
Beta =	NA	
n' =	NA	
SFs =	NA	

UNC MINING AND MILLING

Division of United Nuclear Corporation
A UNC RESOURCES Company
Church Rock Operations
P.O. Drawer CQ
Gallup, New Mexico 87301
Telephone 505/722-8851

Memorandum

To: C. Johnson

Date: April 9, 1990

From: J. Fletcher

Subject: Pipeline Arroyo Profile

Station	Latitude	Departure	Elevation
0	73847.56	57678.51	6941.37
1+3	73788.83	57593.20	6939.73
1+14	73782.34	57585.59	6940.43
1+32	73770.67	57571.88	6940.69
1+69	73746.03	57542.96	6940.58
2+13	73717.63	57509.62	6938.44
2+37	73700.25	57493.06	6940.34
2+64	73679.98	57473.74	6939.48
3+13	73645.23	57440.63	6939.88
3+54	73615.19	57412.00	6939.61
3+62	73608.83	57405.74	6939.23
3+68	73604.24	57401.22	6938.53
3+78	73601.07	57398.09	6936.70
3+88	73594.01	57391.13	6936.23
3+99	73585.54	57382.79	6933.55
4+13	73575.65	57373.05	6932.73
4+33	73561.89	57359.49	6931.37
4+53.5	73547.41	57345.24	6930.16
4+54	73547.06	57344.89	6925.53
4+60	73542.36	57340.25	6925.30
4+84	73558.56	57323.21	6924.63
5+01	73548.52	57309.52	6922.26
5+47	73538.35	57263.91	6909.56
5+70	73525.86	57245.39	6908.77
5+85	73512.16	57239.49	6905.77
6+40	73477.88	57196.88	6901.02

C. Jc ·on
Pipel...a Arroyo Profile
April 9, 1990
Page 2

Station	Latitude	Departure	Elevation
7+09	73431.33	57146.01	6902.68
7+92	73358.79	57105.69	6901.95
8+10	73342.24	57098.60	6900.57
9+11	73272.66	57025.03	6901.04
9+35	73254.66	57009.14	6901.54
10+33	73182.37	56942.97	6899.94
10+72	73160.12	56911.23	6899.92
10+81	73155.60	56903.00	6897.37
10+99	73143.01	56890.13	6897.03
11+07	73137.35	56884.48	6894.58
11+32	73113.96	56877.09	6897.84
11+75	73082.95	56846.17	6896.85
11+83	73075.49	56843.27	6889.91
12+36	73041.90	56802.52	6889.84
12+93	73019.42	56749.93	6886.93
13+25	72989.53	56738.58	6887.17
14+05	72957.42	56665.82	6884.52
14+82	72893.62	56620.82	6881.92
15+67	72837.58	56558.59	6880.91
16+54	72766.46	56508.04	6879.85
17+39	72707.64	56446.60	6879.84
18+30	72628.77	56399.89	6879.80
19+22	72553.61	56348.16	6878.01
19+97	72498.07	56297.93	6877.51
20+76	72429.84	56257.85	6876.75
21+32	72383.18	56226.09	6875.84
22+19	72307.06	56184.12	6875.07
23+04	72233.58	56141.40	6874.31
23+98	72146.88	56106.32	6874.29
24+94	72057.86	56069.97	6873.95
25+86	71968.17	56049.39	6872.66
27+41	71813.21	56041.22	6868.74
27+80	71776.55	56052.79	6871.27
28+86	71691.52	55988.75	6869.76
29+85	71721.69	55894.24	6869.07
29+99	71729.18	55882.32	6868.76

E.2(a)

PMF Calculation for Watersheds A_1, A_2, and B

HYDROGRAPH CALCULATION FOR ONE-HOUR PMP EVENTS USING THE SCS CURVE NUMBER ME

WATERSHED A1 UNC PROJECT RM86-060-01
20-Mar-87 13:54

ONE-HOUR RAINFALL AMOUNT	9.4	INCHES	
SCS CURVE NUMBER	80	S =	2.50
MEAN BASIN ELEV.	7080	FEET	
DURATION (D)	0.25	HOURS	
WATER COURSE LENGTH (L)	0.62	MILES	1.216856060
WATERSHED AREA (A)	0.15	SQ. MILES	
MAXIMUM RELIEF (H)	200.00	FEET	
ELEV ADJUSTMENT	0.896	ADJ. RAINFAL	8.42 INCHES
AREAL ADJUSTMENT (DSD)	1	ADJ. RAINFAL	8.42 INCHES

ITEM	TIME PERIOD, HRS 0-0.25	0.25-0.50	0.50-0.75	0.75-1.00
PERCENT OF 1-HOUR RAINFALL (DSD,TABLE I, PG 52)	48	71	88	100
CUMULATIVE RAINFALL	4.04	5.98	7.41	8.42
INCREMENTAL RAINFALL	4.04	1.94	1.43	1.01
SEQUENCE	1.43	1.94	4.04	1.01
P - CUMULATIVE DESIGN RAINFALL	1.43	3.37	7.41	8.42
Q - CUMULATIVE RUNOFF	0.25	1.53	5.09	6.02
INCREMENTAL RUNOFF OR EXCESS RAINFALL	0.25	1.28	3.54	0.95

TIME OF CONCENTRATION (Tc)	0.19	HOURS
WATERSHED ADJUSTMENT (DSD, TABLE 5, PG 67)	1.00	
ADJUSTED Tc	0.19	HOURS
TIME TO PEAK (Tp)	0.24	HOURS
BASE PERIOD (Tb)	0.64	HOURS
UNIT PEAK DISCHARGE	301	CFS

INTERMEDIATE HYDROGRAPHS

	TIME	FIRST	SECOND	THIRD	FOURTH	COMBINED HYDROGRAPH
PEAK DISCHARGE (cfs)		76.04	384.71	1064.75	284.40	
	0.00	0.00				0.00
	0.06	19.01				19.01
	0.12	38.02				38.02
	0.18	57.03				57.03
	0.24	76.04	0.00			76.04
	0.30	64.66	96.18			160.87
	0.36	53.27	192.36			245.63
	0.42	41.89	288.54			330.43
	0.48	30.51	384.71	0.00		415.22
	0.54	19.12	337.12	266.19		612.43
	0.60	7.74	289.53	532.37		809.64
	0.66	0.00	241.94	798.56		1010.50
	0.72		154.35	1064.75	0.00	1219.09
	0.79		96.75	905.35	71.10	1073.21
	0.85		39.16	745.96	142.20	927.32
	0.91		0.00	586.57	213.30	799.87
	0.97			427.17	284.40	711.58
	1.03			267.78	241.83	509.61
	1.09			108.39	199.25	307.64
	1.15			0.00	156.68	156.68
	1.21				114.10	114.10
					71.53	71.53
					28.95	28.95
					0.00	0.00

HYDROGRAPH CALCULATION FOR ONE-HOUR PMP EVENTS USING THE SCS CURVE NUMBER METHOD

WATERSHED A2 UNC PROJECT RM86-060-01
14-May-87 06:23

ONE-HOUR RAINFALL AMOUNT	9.4 INCHES		
SCS CURVE NUMBER	80	S =	2.50
MEAN BASIN ELEV.	7080 FEET		
DURATION (D)	0.25 HOURS		
WATER COURSE LENGTH (L)	0.62 MILES	1.216856060	
WATERSHED AREA (A)	0.12 SQ. MILES		
MAXIMUM RELIEF (H)	360.00 FEET		
ELEV ADJUSTMENT	0.896 ADJ. RAINFAL	8.42 INCHES	
AREAL ADJUSTMENT (DBD)	1 ADJ. RAINFAL	8.42 INCHES	

ITEM	TIME PERIOD, HRS 0-0.25	0.25-0.50	0.50-0.75	0.75-1.00
PERCENT OF 1-HOUR RAINFALL (SED.TABLE 2, PG 53)	48	71	88	100
CUMULATIVE RAINFALL	4.04	5.98	7.41	8.42
INCREMENTAL RAINFALL	4.04	1.94	1.43	1.01
SEQUENCE	1.43	1.94	4.04	1.01
P - CUMULATIVE DESIGN RAINFALL	1.43	3.37	7.41	8.42
Q - CUMULATIVE RUNOFF	0.25	1.53	5.08	6.02
INCREMENTAL RUNOFF OR EXCESS RAINFALL	0.25	1.28	3.54	0.95

TIME OF CONCENTRATION (Tc)	0.15 HOURS	
SLOPED ADJUSTMENT (SED. TABLE 5, PG 67)	1.00	
ADJUSTED Tc	0.15 HOURS	
TIME TO PEAK (Tp)	0.32 HOURS	

UNIT PEAK DISCHARGE 186 CFS

INTERMEDIATE HYDROGRAPHS

	TIME	FIRST	SECOND	THIRD	FOURTH	COMBINED HYDROGRAPH
PEAK DISCHARGE (cfs)		67.42	341.10	944.05	252.16	
	0.00	0.00				0.00
	0.05	16.86				16.86
	0.11	33.71				33.71
	0.16	50.57				50.57
	0.22	67.42				67.42
	0.27	57.33	0.00			57.33
	0.33	47.23	85.28			132.51
	0.38	37.14	170.55			207.69
	0.44	27.05	255.83			282.88
	0.49	16.96	341.10	0.00		358.06
	0.54	6.86	290.04	236.01		532.92
	0.60	0.00	238.98	472.03		711.00
	0.65		187.91	708.04		895.95
	0.71		136.85	944.05		1080.90
	0.76		85.79	802.73	0.00	888.51
	0.82		34.72	661.40	63.04	759.17
	0.87		0.00	520.08	126.08	646.16
	0.93			378.75	189.12	567.88
	0.98			237.43	252.16	489.59
	1.04			96.10	214.42	310.52
	1.09			0.00	176.67	176.67
					138.92	138.92
					101.17	101.17
					63.42	63.42
					25.67	25.67
					0.00	0.00

HYDROGRAPH CALCULATION FOR ONE-HOUR PMP EVENTS USING THE SCS CURVE NUMBER METHOD

WATERSHED B UNC PROJECT RM86-060-01
20-Mar-87 13:58

ONE-HOUR RAINFALL AMOUNT	9.4	INCHES	
SCS CURVE NUMBER	80	S =	2.50
MEAN BASIN ELEV.	7100	FEET	
DURATION (D	0.25	HOURS	
WATER COURSE LENGTH (L)	1.23	MILES	
WATERSHED AREA (A)	0.57	SQ. MILES	
MAXIMUM RELIEF (H)	440.00	FEET	
ELEV ADJUSTMENT	0.895	ADJ. RAINFAL	8.41 INCHES
AREAL ADJUSTMENT (DSD)	1	ADJ. RAINFAL	8.41 INCHES

ITEM	TIME PERIOD, HRS 0-0.25	0.25-0.50	0.50-0.75	0.75-1.00
PCENT OF 1-HOUR RAINFALL (SD,TABLE 2, PG 52)	48	71	88	100
CUMULATIVE RAINFALL	4.04	5.97	7.40	8.41
INCREMENTAL RAINFALL	4.04	1.93	1.43	1.01
SEQUENCE	1.43	1.93	4.04	1.01
P - CUMULATIVE DESIGN RAINFALL	1.43	3.37	7.40	8.41
Q - CUMULATIVE RUNOFF	0.25	1.53	5.07	6.01
INCREMENTAL RUNOFF OR EXCESS RAINFALL	0.25	1.28	3.54	0.95

TIME OF CONCENTRATION (Tc)	0.32	HOURS
WATERSHED ADJUSTMENT (DSD, TABLE 5, PG 67)	1.00	
ADJUSTED Tc	0.32	HOURS
TIME TO PEAK (Tp)	0.31	HOURS
BASE PERIOD (Tb)	0.84	HOURS
UNIT PEAK DISCHARGE	876	CFS

INTERMEDIATE HYDROGRAPHS

	TIME	FIRST	SECOND	THIRD	FOURTH	COMBINED HYDROGRAPH
PEAK DISCHARGE (cfs)		221.05	1119.79	3100.34	828.21	
	0.00	0.00				0.00
	0.08	55.26				55.26
	0.16	110.53				110.53
	0.24	165.79	0.00			165.79
	0.31	221.05	279.95			501.00
	0.39	187.96	559.90			747.86
	0.47	154.87	839.84	0.00		994.71
	0.55	121.78	1119.79	775.08		2016.65
	0.63	88.69	952.16	1550.17		2591.01
	0.71	55.59	784.52	2325.25	0.00	3165.37
	0.79	22.50	616.89	3100.34	207.05	3946.78
	0.87	0.00	449.26	2636.22	414.11	3499.58
	0.94		281.62	2172.09	621.16	3074.86
	1.02		113.99	1707.97	828.21	2650.17
	1.10		0.00	1243.85	704.23	1948.08
	1.18			779.73	580.24	1359.97
	1.26			315.60	456.26	771.86
	1.34			0.00	332.28	332.28
	1.42				208.29	208.29
	1.50				84.31	84.31
	1.57				0.00	0.00

Canonie Environmental

E-78

By TMS Date 5-21-87 Subject UNC - North Sheet No. 1 of 1

Chkd. By ____ Date ____ Diversion Ditch Proj. No. RM8[illegible]-01

1/4" X 1/4"

Objective: Determine the PMF flow rate for sections along the North Diversion Ditch

Summary of PMF Flow Rates

Section	Watershed which contributes to flow	Q_{max} (1) cfs	time Q_{max} occurs (1) hrs
K	A_2	1081	.71
L	$A_1 + A_2$	2205	.71
M	$A_1 + A_2$	2205	.71
N	$A_2 + A_1 + B$	5844	.79
O	$A_2 + A_1 + B$	5814	.79

Summation of Q's into Diversion Ditch

watershed	A1	A2	$\Sigma A_1 A_2$	B	$\Sigma A_1 A_2 B$
time		Flowrate			
.71	1184	1081	2265 ← Qmax	3165	5430
.72	1219	1042	2261	3266	5527
.79	1073	842	1879	3947	5844 - Qm

E.2(b)

100 Year Flood Calculations for

Watersheds A_1, A_2, and B

TOGRAPH CALCULATION FOR ONE-HOUR RAINFALL EVENTS USING THE SCS CURVE NUMBER METHOD

-TERSHED A1 - NORTH DIVERSION DITCH UNC PROJECTRM86-060-01
08-May-87 08:25

ETURN PERIOD	100 YRS	
E-HOUR RAINFALL AMOUNT	1.81 INCHES	
S CURVE NUMBER	80	S = 2.50
EAN BASIN ELEV.	5000 FEET	
RATION (D)	0.25 HOURS	
TER COURSE LENGTH (L)	0.62 MILES	
TERSHED AREA (A)	0.15 SQ. MILES	
XIMUM RELIEF (H)	200 FEET	

EAL ADJUSTMENT	0.999 ADJ. RAINFAL	1.81 INCHES
ED. FIG 21, PG 54)		

ITEM	TIME PERIOD, HRS 0-0.25	0.25-0.50	0.50-0.75	0.75-1.00
OF 1-HOUR RAINFALL (SCS, TABLE 2, PG 52)	48	71	88	100
UMULATIVE RAINFALL	0.87	1.28	1.59	1.81
NCREMENTAL RAINFALL	0.87	0.42	0.31	0.22
EQUENCE	0.31	0.42	0.87	0.22
- CUMULATIVE DESIGN RAINFALL	0.3074	0.7233	1.5912	1.8082
- CUMULATIVE RUNOFF	0.0000	0.0183	0.3316	0.4494
NCREMENTAL RUNOFF OR EXCESS RAINFALL	0.0000	0.0183	0.3133	0.1178

TIME OF CONCENTRATION (Tc)	0.19 HOURS
WATERSHED ADJUSTMENT (DSD, TABLE 5, PG 67)	1.04
ADJUSTED Tc	0.20 HOURS
G PEAK (Tp)	0.25 HOURS
BASE PERIOD (Tb)	0.66 HOURS
UNIT PEAK DISCHARGE	295 CFS

WATERSHED A1 - NORTH DIVERSION DITCH UNC PROJECTRM86-060-01
08-May-87 08:25

RETURN PERIOD 100 YRS
ONE-HOUR RAINFALL AMOUNT 1.81 INCHES

INTERMEDIATE HYDROGRAPHS

	TIME	FIRST	SECOND	THIRD	FOURTH	COMBINED HYDROGRAPH
PEAK DISCHARGE (cfs)		0.0	5.4	92.4	34.7	
	0.00	0.0				0.0
	0.06	0.0				0.0
	0.12	0.0				0.0
	0.18	0.0				0.0
	0.25	0.0	0.0			0.0
	0.31	0.0	1.3			1.3
	0.37	0.0	2.7			2.7
	0.43	0.0	4.0			4.0
	0.49	0.0	5.4	0.0		5.4
	0.55	0.0	4.6	23.1		27.7
	0.62	0.0	3.8	46.2		50.0
	0.68	0.0	3.0	69.3		72.2
	0.74		2.2	92.4	0.0	94.5
	0.80		1.4	78.5	8.7	88.6
	0.86		0.5	64.7	17.4	82.6
	0.92		0.0	50.9	26.1	76.9
	0.98			37.1	34.7	71.8
	1.05			23.2	29.5	52.8
	1.11			9.4	24.3	33.7
	1.17			0.0	19.1	19.1
	1.23				13.9	13.9
					8.7	8.7
					3.5	3.5
					0.0	0.0
						0.0

--DROGRAPH CALCULATION FOR ONE-HOUR RAINFALL EVENTS USING THE SCS CURVE NUMBER METHOD

.WR1

-ATERSHED A2 - NORTH DIVERSION DITCH UNC PROJECTRM86-060-01
09-May-87 09:30

RETURN PERIOD	100 YRS	
ONE-HOUR RAINFALL AMOUNT	1.81 INCHES	
SCS CURVE NUMBER	80	S = 2.50
MEAN BASIN ELEV.	5000 FEET	
DURATION (D)	0.25 HOURS	
WATER COURSE LENGTH (L)	0.62 MILES	
WATERSHED AREA (A)	0.12 SQ. MILES	
MAXIMUM RELIEF (H)	360 FEET	

-REAL ADJUSTMENT 0.999 ADJ. RAINFAL 1.81 INCHES
(DSD. FIG 21, PG 54)

ITEM	TIME PERIOD, HRS 0-0.25	0.25-0.50	0.50-0.75	0.75-1.00
% OF 1-HOUR RAINFALL (DSD.TABLE 2, PG 52)	48	71	88	100
CUMULATIVE RAINFALL	0.87	1.28	1.59	1.81
INCREMENTAL RAINFALL	0.87	0.42	0.31	0.22
SEQUENCE	0.31	0.42	0.87	0.22
P - CUMULATIVE DESIGN RAINFALL	0.3074	0.7233	1.5912	1.8082
Q - CUMULATIVE RUNOFF	0.0000	0.0183	0.3316	0.4494
INCREMENTAL RUNOFF OR EXCESS RAINFALL	0.0000	0.0183	0.3133	0.1178

TIME OF CONCENTRATION (Tc)	0.15 HOURS
WATERSHED ADJUSTMENT (DSD, TABLE 5, PG 67)	1.04
ADJUSTED Tc	0.16 HOURS
TIME TO PEAK (Tp)	0.22 HOURS
BASE PERIOD (Tb)	0.59 HOURS
UNIT PEAK DISCHARGE	262 CFS

..-ED A2 - NORTH DIVERSION DITCH UNC PROJECTRM86-060-01
02-May-87 08:30

RETURN PERIOD 100 YRS
ONE--HOUR RAINFALL AMOUNT 1.81 INCHES

INTERMEDIATE HYDROGRAPHS

	TIME	FIRST	SECOND	THIRD	FOURTH	COMBINED HYDROGRAPH
PEAK DISCHARGE cfs:		0.0	4.8	82.1	30.9	
	0.00	0.0				0.0
	0.06	0.0				0.0
	0.11	0.0				0.0
	0.17	0.0				0.0
	0.22	0.0				0.0
	0.28	0.0	0.0			0.0
	0.33	0.0	1.2			1.2
	0.39	0.0	2.4			2.4
	0.44	0.0	3.6			3.6
	0.50	0.0	4.8	0.0		4.8
	0.55	0.0	4.1	20.5		24.6
	0.61	0.0	3.4	41.0		44.4
	0.67		2.6	61.6		64.2
	0.72		1.9	82.1	0.0	84.0
	0.78		1.2	69.8	7.7	78.7
	0.83		0.5	57.5	15.4	73.4
	0.89		0.0	45.2	23.2	68.4
	0.94			32.9	30.9	63.8
	1.00			20.6	26.2	46.9
	1.05			8.4	21.6	30.0
	1.11			0.0	17.0	17.0
					12.4	12.4
					7.8	7.8
					3.1	3.1
					0.0	0.0

← Omit

WATERSHED B - NORTH DIVERSION DITCH UNC PROJECT RM86-060-01
09-May-87 08:19

RETURN PERIOD 100 YRS
ONE-HOUR RAINFALL AMOUNT 1.81 INCHES

INTERMEDIATE HYDROGRAPHS

	TIME	FIRST	SECOND	THIRD	FOURTH	COMBINED HYDROGRAPH
PEAK DISCHARGE (cfs)		0.0	14.8	262.6	99.2	
	0.00	0.0				0.0
	0.08	0.0				0.0
	0.16	0.0				0.0
	0.24	0.0	0.0			0.0
	0.32	0.0	3.7			3.7
	0.40	0.0	7.4			7.4
	0.48	0.0	11.1	0.0		11.1
	0.56	0.0	14.8	65.7		80.5
	0.64	0.0	12.6	131.3		143.9
	0.73	0.0	10.4	197.0	0.0	207.3
	0.81	0.0	8.2	262.6	24.8	295.6
	0.89	0.0	5.9	223.3	49.6	278.8
	0.97		3.7	184.0	74.4	262.1
	1.05		1.5	144.7	99.2	245.4
	1.13		0.0	105.4	84.4	189.7
	1.21			66.0	69.5	135.6
	1.29			26.7	54.7	81.4
	1.37			0.0	39.8	39.8
	1.45				25.0	25.0
	1.53				10.1	10.1
	1.61				0.0	0.0
						0.0
						0.0
						0.0
						0.0

0.102

CanonieEnvironmental

E-85

By _____ Date _____ Subject UNC - North Diversion Ditch Sheet No. 1 of 1

Chkd. By _____ Date _____ Proj. No. 86-060

1/4" X 1/4"

Calculation to total the 100 year flow rate for the North Diversion Ditch from watersheds A1, A2, and B.

Procedure: Combine the hydrographs for all watersheds to determine the maximum total flow rate - Q max

From trial & error time at which Q max occures = .81 hrs

Breakdown of flow rates

Watershed	Flow rate @ .81 hrs (CFS)
A_1	87.6
A_2	75.5
A_3	295.6

Qmax for 100 year flood 458.7 cfs

E.2(c)

Flow Depth Calculations North-Diversion Ditch

Sections K, L, M, N, and O

MANNING S EQUATION FOR DETERMINING NORMAL FLOW DEPTHS MANEQT.WP
IN TRAPEZOIDAL CHANNELS

STATION:NORTH DIVERSION CHANNEL - SECTION K

	DISCHARGE =	1081	CFS
	BOTTOM WIDTH =	19	FT
	Z (SIDE SLOPE) =	2.3	
	CHANNEL SLOPE =	0.0054	
	MANNING'S n =	0.0230	
*	d =	4.22	FT
*	A =	120.5	FT^2
CALCS *	R =	2.96	FT
*	v =	9.0	FPS
*	Q (CALC) =	1085	CFS
*	DIFFERENCE =	0.33	%

- SELECT A TRIAL DEPTH

- CHECK THIS Q VALUE AND THE DIFFERENCE TO SEE IF IT MATCHES LISTED DISCHARGE

MANNING S EQUATION FOR DETERMINING NORMAL FLOW DEPTHS MANEQT.WP
IN TRAPEZOIDAL CHANNELS

LOCATION: NORTH DIVERSION CHANNEL - SECTION L

DISCHARGE =	2265	CFS
BOTTOM WIDTH =	20	FT
Z (SIDE SLOPE) =	2.1	
CHANNEL SLOPE =	0.00714	
MANNING'S n =	0.0250	

*	d =	5.69	FT	- SELECT A TRIAL DEPTH
*	A =	181.8	FT^2	
CALCS *	R =	3.91	FT	
*	v =	12.5	FPS	
*	Q (CALC) =	2267	CFS	- CHECK THIS Q VALUE AND THE DIFFERENCE TO SEE IF IT MATCHES LISTED DISCHARGE
*	DIFFERENCE =	0.09	%	

MANNING'S EQUATION FOR DETERMINING NORMAL FLOW DEPTHS IN TRAPEZOIDAL CHANNELS

MANEQT.WF

ATION: NORTH DIVERSION CHANNEL - SECTION M

DISCHARGE =	2265	CFS
BOTTOM WIDTH =	20	FT
Z (SIDE SLOPE) =	7.6	
CHANNEL SLOPE =	0.00746	
MANNING'S n =	0.0250	

*	d =	4.34	FT	- SELECT A TRIAL DEPTH
*	A =	230.0	FT^2	
CALCS *	R =	2.66	FT	
*	v =	9.8	FPS	
*	Q (CALC) =	2265	CFS	- CHECK THIS Q VALUE AND THE DIFFERENCE TO SEE IF IT MATCHES LISTED DISCHARGE
*	DIFFERENCE =	-0.00	%	

MANNING'S EQUATION FOR DETERMINING NORMAL FLOW DEPTHS IN TRAPEZOIDAL CHANNELS

MANEQT.WR

CATION:NORTH DIVERSION CHANNEL - SECTION N

	DISCHARGE =	5850	CFS
	BOTTOM WIDTH =	22	FT
	Z (SIDE SLOPE) =	3.3	
	CHANNEL SLOPE =	0.00746	
	MANNING'S n =	0.0250	
*	d =	8.02	FT
*	A =	388.7	FT^2
CALCS *	R =	5.03	FT
*	v =	15.1	FPS
*	Q (CALC) =	5857	CFS
*	DIFFERENCE =	0.12	%

- SELECT A TRIAL DEPTH

- CHECK THIS Q VALUE AND THE DIFFERENCE TO SEE IF IT MATCHES LISTED DISCHARGE

ATION:NORTH DIVERSION CHANNEL - SECTION 0

	DISCHARGE =	5850 CFS	
	BOTTOM WIDTH =	12 FT	
	Z (SIDE SLOPE) =	1.11	
	CHANNEL SLOPE =	0.00746	
	MANNING'S n =	0.0250	
*	d =	12.54 FT	- SELECT A TRIAL DEPTH
*	A =	325.0 FT^2	
CALCS *	R =	6.57 FT	
*	V =	18.0 FPS	
*	Q (CALC) =	5854 CFS	- CHECK THIS Q VALUE AND THE DIFFERENCE TO SEE IF IT MATCHES LISTED DISCHARGE
*	DIFFERENCE =	0.07 %	

E.2(d)

North Diversion Ditch

Confluence Stability

CanonieEnvironmental

E-93

By MT Date 12 Nov 90 Subject UMC Sheet No. 1 of 9

Chkd. By MYP Date 12/3/90 Confluence Stability Proj. No. PE-060-24

1/4" X 1/4"

Purpose: To compare the total head of the PMF peak discharge in three tributaries to the North Diversion Ditch with the total head of the PMF peak discharge in the North Diversion Ditch at their confluences.

Figure 1 provides the tributary locations and designations

Methods: 1. The PMF peak discharges in the North Diversion Ditch at the locations shown on Figure 2 were estimated by the SCS triangular unit hydrograph method as discussed in Appendix C of the original reclamation plan.

2. The PMF peak discharges of the tributaries at the confluence was determined by the SCS TR-55 graphical method.

3. The depth and velocity of the PMF peak discharges was determined with Manning's equation

4. The total head (velocity head + elevation head) was determined using Bernoulli's equation.

Results: Table 1 on Page 2 provides the results of the calculations

Canonie Environmental

E-94

By MT Date 12 Nov 90 Subject UMC Sheet No. 2 of 9

Chkd. By [illegible] Date 12/3/90 Confluence Stability Proj. No. 85-050-21

1/4" X 1/4"

Table 1
Results of Calculations

Location (1)	Peak Discharge (cfs)	Channel Slope (ft/ft)	Depth of Flow (ft)	Velocity (fps)	Velocity head (ft)	Total Head (2) (ft)
K	1081	0.0054	4.22	9.0	1.26	[illegible]
A_1	383	0.044	0.98	11.2	1.95	2.93
L	2265	0.00714	5.69	12.5	2.43	8.12
A_2	765	0.02	1.81	10.8	1.82	3.63
M	2265	0.00746	4.34	9.8	1.49	5.83
B	2046	0.019	2.48	13.2	2.74	5.19
N	5850	0.00746	8.02	15.1	3.54	11.56

(1) See Figure 2 for schematic of locations

(2) Total head = Depth of flow + Velocity head.
This assumes that the channel bottom for the North Division Ditch and the tributary are at the same datum at each confluence

Methods

1. The peak discharges and velocities at cross-sections 1, 2, 3, and 4 are provided in Appendix C to the original reclamation plan. They are summarized in Table 1 of this calc brief.

2. The peak discharges at cross sections A_1, A_2, and B were determined with the SCS-TR-55 method. The input data for the watersheds contributing runoff to these locations are summarized below. Figure 1 delineates the watersheds.

		A_1	A_2	B
Mean Basin EL	(ft)	7080	7080	7100
Longest Flow Path	(mi)	0.62	0.62	1.23
Maximum Relief	(ft)	360	200	440
Watershed Area	(mi^2)	0.08	0.16	0.58
Curve Number		80	80	80
PMP Amount	(inches)	9.4	9.4	9.4
Corrected PMP	(inches)	8.42	8.42	8.41
t_c	(hours)	0.2	0.2	0.4

The curve number is that used in previous calculations as shown in Appendix C of the reclamation plan. The PMP amount of 9.4 inches was determined from HMR-49. It is corrected by the formula

$$PMP \times [1 - [(\text{Mean Basin Elevation} - 5000\,ft)/1000 \times 0.05]]$$

The t_c values (times of concentration) were determined by the methods provided in TR-55.

The output from the SCS TR-55 calculations are provided on page 6.

3. Mannings equation, as utilized by the Hoeisel Methods Inc Program Flow Master, was used to calculate flow depth and velocity for the peak discharges calculated above. The channel characteristics for the tributaries are summarized below:

		A_1	A_2	B
Bottom Width	(ft)	30	30	50
Side slope, Z		5	5	5
Mannings n		0.025	0.025	0.025
Channel Slope	(ft/ft)	0.044	0.020	0.019
Peak Discharge	(cfs)	383	765	2046

The resulting depths and velocities are summarized below: (See page 7, 8, 9)

Depth	(ft)	0.98	1.81	2.48
Velocity	(fps)	11.2	10.8	13.2

4. The velocity head was calculated with the formula $H_v = V^2/2g$ where H_v = velocity head, V = flow velocity and g = gravitational acceleration (32.2 fps^2). Total head was calculated as the velocity head plus the depth as follows

		A_1	A_2	B
Velocity head	(ft)	1.95	1.82	2.71
Depth	(ft)	0.98	1.81	2.48
Total head	(ft)	2.93	3.63	5.19

Table 1 provides the velocity and total heads at the cross sections on the North Diversion Ditch

Canonie Environmental

E-97

By MC Date 12 Nov 90 Subject UNC Sheet No. 5 of 9

Chkd. By WMJ Date 12/3/90 Confluence Stability Proj. No. PS-060-20

1/4" X 1/4"

Discussion

Table 1 shows that the total head for flows in tributaries A1 and A2 are considerably less than those of the North Diversion cross sections (1 + 2) located immediately upstream of the confluences. Thus, while the tributary flow will cause turbulence at the confluences, the tributary flow will not be able to impinge directly on the far bank of the ditch. The total head of tributary B flows is greater than that of cross section 3 of the North Diversion Ditch. Thus this tributary has the potential for more direct impingement on the far bank of the ditch. However, the tributary B confluence angle is about 45° thus lessening the effect of impingement. Also about 150' of bank material exists in the far bank that would have to be scoured away before flow could pass over the tailings.

Tc = 0.2 RUNOFF HYDROGRAPHS BY THE SCS TR-55 METHOD

TYPE-II STORM DISTRIBUTION

01-Dec-90
05:21 PM

TIME OF CONCENTRATION = 0.2 HOURS
TRAVEL TIME = 0 HOURS

HYDROGRAPH TIME IN HOURS

WATERSHED DESIGNATION	DRAINAGE AREA (AC)	DRAINAGE AREA (SQ MI)	CURVE NUMBER	PPT AMT (IN)	RUNOFF (IN)	(TIME)	11.0	11.3	11.6	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.8	14.0	14.3	14.6
						(CSM/IN)	23	31	47	209	403	739	880	481	258	166	128	102	86	70	61	54	49	44	40	35	33
TRIBUTARY A1	51.00	7.97E-02	80.0	8.4	6.00	(CFS)	10.999	14.824	22.475	99.944	192.715	353.391	382.561	230.015	119.550	79.381	61.210	40.777	41.125	33.474	29.170	25.823	23.432	21.041	19.128	16.737	15.781
TRIBUTARY A2	102.00	1.59E-01	80.0	8.4	6.00	(CFS)	21.997	29.649	44.951	199.888	385.431	706.782	765.123	460.030	239.101	158.763	122.420	97.553	82.251	66.948	58.341	51.646	46.864	42.082	38.256	33.474	31.561

Tc = 0.4 RUNOFF HYDROGRAPHS BY THE SCS TR-55 METHOD

TYPE-II STORM DISTRIBUTION

01-Dec-90
05:23 PM

TIME OF CONCENTRATION = 0.4 HOURS
TRAVEL TIME = 0 HOURS

HYDROGRAPH TIME IN HOURS

WATERSHED DESIGNATION	DRAINAGE AREA (AC)	DRAINAGE AREA (SQ MI)	CURVE NUMBER	PPT AMT (IN)	RUNOFF (IN)	(TIME)	11.0	11.3	11.6	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.8	14.0	14.3	14.6
						(CSM/IN)	18	25	36	77	141	271	468	592	574	431	298	216	163	104	77	63	56	49	44	38	34
TRIBUTARY B	368	5.75E-01	80.0	8.41	6.01	(CFS)	62	86	124	266	487	937	1617	2046	1984	1490	1030	746	563	359	266	218	190	169	152	131	118

Page 6 of 6
92-080-26
Sheet 2
Hydro 11/14/90

Page 7 of 9
FO-060-24
mi
✓ mp 12/3/90

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: UNC

Comment: CONFLUENCE A1

Solve For Depth

Given Input Data:

Bottom Width.....	30.00 ft
Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n.....	0.025
Channel Slope....	0.0440 ft/ft
Discharge.....	383.00 cfs

Computed Results:

Depth.....	0.98 ft
Velocity.....	11.22 fps
Flow Area.....	34.13 sf
Flow Top Width...	39.78 ft
Wetted Perimeter.	39.98 ft
Critical Depth...	1.57 ft
Critical Slope...	0.0084 ft/ft
Froude Number....	2.13 (flow is Supercritical)

Channel Flow Module, Version 3.12 (c) 1990
estad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Page 8 of 9
P6-060-24
MC
[illegible] 12/3/90

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: UNC

Comment: CONFLUENCE A2

Solve For Depth

Given Input Data:

Bottom Width.....	30.00 ft
Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n.....	0.025
Channel Slope....	0.0200 ft/ft
Discharge.....	765.00 cfs

Computed Results:

Depth.....	1.81 ft
Velocity.....	10.82 fps
Flow Area.....	70.73 sf
Flow Top Width...	48.11 ft
Wetted Perimeter.	48.47 ft
Critical Depth...	2.37 ft
Critical Slope...	0.0075 ft/ft
Froude Number....	1.57 (flow is Supercritical)

en Channel Flow Module, Version 3.12 (c) 1990
aestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Page 9 of 9
86-060-24
MT
[illegible] 12/3/90

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: UNC

Comment: CONFLUENCE B

Solve For Depth

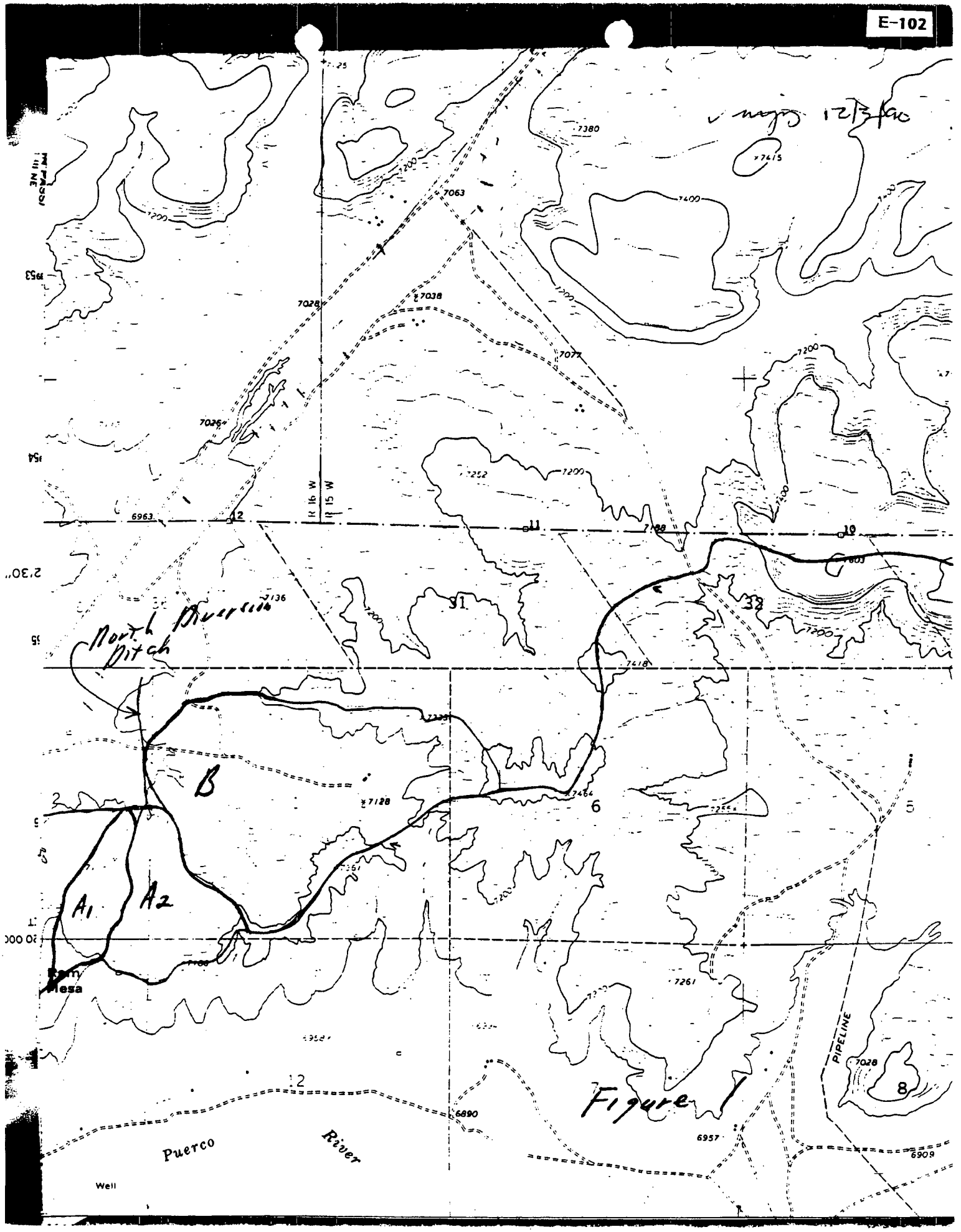
Given Input Data:

Bottom Width.....	50.00 ft
Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n.....	0.025
Channel Slope....	0.0190 ft/ft
Discharge.....	2046.00 cfs

Computed Results:

Depth.....	2.48 ft
Velocity.....	13.24 fps
Flow Area.....	154.56 sf
Flow Top Width...	74.77 ft
Wetted Perimeter.	75.27 ft
Critical Depth...	3.32 ft
Critical Slope...	0.0066 ft/ft
Froude Number....	1.62 (flow is Supercritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708


North Riverside Ditch
B
A1
A2
Puerco River
PIPELINE
Well
Figure 1

Canonie Environmental

E-103

By _____ Date _____ Subject _____ Sheet No. ____ of ____

Chkd. By ____ Date _____ _____ Proj. No. _____

1/4" X 1/4"

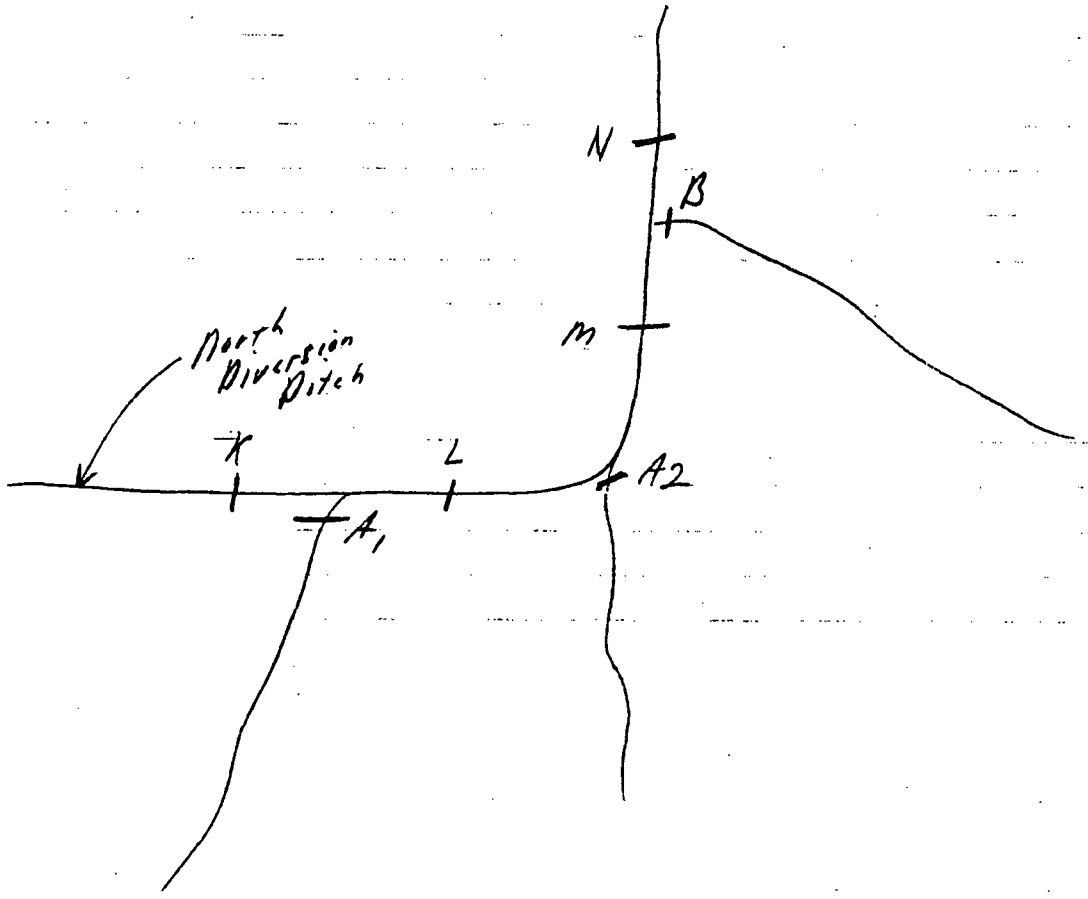


Figure 2

Schematic of Cross-Section Locations

E.2(e)

PMF Calculations for the South Diversion Ditch and

Flow Depth Calculations for Limiting Sections 1 and 2

HYDROGRAPH CALCULATION FOR ONE-HOUR PMP EVENTS USING THE SCS CURVE NUMBER METHOD

South Cheyenne Ditch

WATERSHED C UNC PROJECT RM86-060-01
20-Mar-97 13:45

ONE-HOUR RAINFALL AMOUNT	9.4	INCHES	
SCS CURVE NUMBER	80	S =	2.50
MEAN BASIN ELEV.	7080	FEET	
DURATION (D)	0.25	HOURS	
WATER COURSE LENGTH (L)	0.73	MILES	
WATERSHED AREA (A)	0.17	SQ. MILES	
MAXIMUM RELIEF (H)	400.00	FEET	
ELEV ADJUSTMENT	0.896	ADJ. RAINFAL	8.42 INCHES
AREAL ADJUSTMENT (DSD)	1	ADJ. RAINFAL	8.42 INCHES

ITEM	TIME PERIOD, HRS 0-0.25	0.25-0.50	0.50-0.75	0.75-1.00
PERCENT OF 1-HOUR RAINFALL (DSD.TABLE 2, PG 52)	48	71	88	100
CUMULATIVE RAINFALL	4.04	5.98	7.41	8.42
INCREMENTAL RAINFALL	4.04	1.94	1.43	1.01
SEQUENCE	1.43	1.94	4.04	1.01
P - CUMULATIVE DESIGN RAINFALL	1.43	3.37	7.41	8.42
Q - CUMULATIVE RUNOFF	0.25	1.53	5.08	6.02
INCREMENTAL RUNOFF OR EXCESS RAINFALL	0.25	1.28	3.54	0.95

TIME OF CONCENTRATION (Tc)	0.18	HOURS
WATERSHED ADJUSTMENT (DSD. TABLE 5, PG 67)	1.00	
ADJUSTED Tc	0.18	HOURS
TIME TO PEAK (Tp)	0.23	HOURS
BASE PERIOD (Tb)	0.62	HOURS
UNIT PEAK DISCHARGE	353	CFS

INTERMEDIATE HYDROGRAPHS

	TIME	FIRST	SECOND	THIRD	FOURTH	COMBINED HYDROGRAPH
PEAK DISCHARGE (cfs)		89.42	452.44	1252.18	334.47	
	0.00	0.00				0.00
	0.06	22.36				22.36
	0.12	44.71				44.71
	0.17	67.07				67.07
	0.23	89.42	0.00			89.42
	0.29	76.04	113.11			189.15
	0.35	62.65	226.22			288.87
	0.41	49.26	339.33			388.59
	0.47	35.88	452.44			488.31
	0.52	22.49	384.71	0.00		407.20
	0.58	9.10	316.98	313.04		639.12
	0.64	0.00	249.25	626.09		875.33
	0.70		181.52	939.13		1120.65
	0.76		113.79	1252.18	0.00	1365.96
	0.81		46.06	1064.72	83.62	1194.40
	0.87		0.00	877.27	167.23	1044.51
	0.93			689.82	250.85	940.67
	0.99			502.37	334.47	836.84
	1.05			314.92	284.40	599.32
	1.11			127.47	234.33	361.79
	1.16			0.00	184.26	184.26
					134.19	134.19
					84.12	84.12
					34.05	34.05
					0.00	0.00

Canonie Environmental

E-107

By MT Date 3-21-87 Subject UNC - South Sheet No. ___ of 2

Chkd. By ___ Date ___ Diversion Ditch Proj. No. FM86-010-01

1/4" X 1/4"

Objective: Determine the depth of flow for the PMF at limiting sections 1 & 2 on the South Diversion Ditch

Method: Used HP41 Calculator Program: "Hydraulic Properties for Irregular River Cross-Sections"

Section 1 - Cross Section Coordinates

X ft	Y ft
0	97.5
12	[illegible]
24.1	90.4
37.2	91.9
50.4	95.1
55.3	97.5

Trial & error calculations: Find Depth that correlates with Q = 1366 cfs (2)

Depth ft	K (1)	Q cfs
	S = 0.002	
1	480	21.5
2	2293	101
4	10982	491
5	17845	798
6	26944	1205
6.4	31100	1390 ← Close to Q.

Depth of flow = 6.4

Canonie Environmental

E-108

By MT Date 5-21-87 Subject UNC - South Diversion Ditch Sheet No. 2 of 2

Chkd. By ____ Date ____ Proj. No. RM86-000-0

1/4" X 1/4"

Section 2 - Cross Section Coordinates:

x ft	y ft
1	95.7
11.1	90.2
39.7	90.1
58.0	90.3
69.2	92.0
93.2	93.9
104.2	94.8
115.2	95.7

[illegible]

[illegible] S = 0.002 Q (2)

6	65387	
4	27012	1216
5	43257	1946
4.2	29022	1346
4.24	30523	1373 ←

Depth of Flow = 4.24 ft

Note (1) $K = \frac{1.486}{N} r^{2/3} A$

(2) $Q = K S^{1/2}$

E.2(f)

Flow Depth Calculations North-Diversion Ditch Inward Curves

MANNING'S EQUATION FOR DETERMINING NORMAL FLOW DEPTHS IN TRAPEZOIDAL CHANNELS MANEQT.WR

LOCATION:UNC - NORTH DIVERSION DITCH, SECTION DD

DISCHARGE =	1081	CFS
BOTTOM WIDTH =	18	FT
Z (SIDE SLOPE)=	1.6	
CHANNEL SLOPE =	0.0033	
MANNING'S n =	0.0250	

*	d =	5.14	FT	- SELECT A TRIAL DEPTH
*	A =	134.8	FT^2	
CALCS *	R =	3.60	FT	
*	t =	34.448	FT	
*	v =	8.0	FPS	
*	Q (CALC) =	1082	CFS	- CHECK THIS Q VALUE TO SEE IF IT MATCHES LISTED DISCHARGE
*	DIFFERENCE =	0.10	%	

Froude Number =	0.715	
Velocity Head =	1.001	FT
Tractive force =	0.742	PSF

MANNING'S EQUATION FOR DETERMINING NORMAL FLOW DEPTHS IN TRAPEZOIDAL CHANNELS MANEQT.WR

LOCATION:UNC - NORTH DIVERSION DITCH, SECTION EE

```
            DISCHARGE =     1081 CFS
         BOTTOM WIDTH =       20 FT
        Z (SIDE SLOPE)=     5.43
        CHANNEL SLOPE =   0.0033
          MANNING'S n =   0.0250

      *             d =     4.01 FT     - SELECT A TRIAL DEPTH
      *             A =    167.5 FT^2
CALCS *             R =     2.61 FT
      *             t =  63.5486 FT
      *             v =      6.5 FPS
      *     Q (CALC) =     1083 CFS    - CHECK THIS Q VALUE TO
      *    DIFFERENCE =     0.21 %        SEE IF IT MATCHES LISTED
                                         DISCHARGE

        Froude Number  =   0.702
        Velocity Head =    0.649 FT
        Tractive force =   0.537 PSF
```

E.2(g)

Riprap Calculations for the North Diversion Ditch Inward Curves

Canonie Environmental

E-113

By ZD Date 7/28/88 Subject UNC - North Diversion Ditch calcs for curved sections Sheet No. 1 of 3

Chkd. By MAD Date 8/1/88 Proj. No. 86-066-04

1/4" X 1/4"

Purpose: TO determine riprap size needed for the curved sections of the North diversion ditch at cross sections DD + EE.

Method: Get mind necessary parameters from various figures & calc briefs, previously indicated, & ran riprap2 spreadsheet calcs.

Results: For cross section DD:

$D_{50} = 0.458$

$D_{max} = 0.578$ ft.

For cross section EE

$D_{50} = 0.362$

$D_{max} = 0.454$ ft

* NOTE: The rip rap calcs were run using the side slopes on the sides nearest the tailings.

Canonie Environmental

E-114

By LBO Date 7/28/88 Subject UNC-NORTH DIVERSION Sheet No. 2 of 8
Chkd. By MAD Date 8/1/88 Ditch calcs for curve Proj. No. 86-060-04
SECTIONS INCATE
1/4" X 1/4"

Channel slope = 0.003 — See figures 1, 2, & 3

side slope = 3 (towards tailings)
8 - (east side) } see figure 2
Bottom width = 20'
C = 0.3*
Discharge 1081 cfs — See pg 4 (from Previous calc Rice)

D_{50} = 0.362
D_{max} = 0.454 ft } — See Spread sheets

CROSS SECTION DD

Channel slope = 0.0033 — Figures 1, 2, & 3

Side slope = 1.0 (towards tailings)
2.0 (east side) } figure 2
Bottom width = 18 ft
C = 0.3*
Discharge 1081 CFS — See pg 5 (from Previous calc [illegible])

D50 = 0.458
Dmax = 0.578 ft } See spread sheets

* See pg. 3 for reference

UAD 8/1/88

over the toe of the side slope, the velocity and shear stress on the side slope are significantly higher on the outer bank of the curved channel. Side slope stability tests in straight channels cannot be used in channel bends. The representative velocity used herein for side slope riprap stability is the average velocity in the vertical over the toe of the side slope. Maximum velocities in the curved channel tests occurred over the toe of the side slope.

Using depth and velocity over the toe of the side slope, the threshold of incipient failure of 1V:2H side slope riprap in <u>straight</u> channels is described by

$$\frac{d_{30}}{D} = 0.24\left[\left(\frac{\gamma_w}{\gamma_s - \gamma_w}\right)^{1/2} \frac{V}{\sqrt{gD}}\right]^{2.5}$$

based on model and prototype data for thickness = $1d_{100}$.

For 1V:2H side slope riprap in <u>curved</u> channels:

$$\frac{d_{30}}{D} = \left[\left(\frac{\gamma_w}{\gamma_s - \gamma_w}\right)^{1/2} \frac{V}{\sqrt{gD}}\right]^{2.5}$$

based on model and prototype data for thickness of $1d_{100}$. This relation was also found applicable to bottom riprap in straight channels.

Since these relations define the threshold of incipient failure, safety factors must be determined before they can be used. A common problem in the design of riprap is the addition of safety factors at each step in the design procedure. A safety factor of 1.2 times the d_{30} riprap size given by the threshold of incipient failure curve is used in the sizing nomograph (Figure 5.1) developed in this investigation. The designer can easily use other safety factors and apply them to the incipient failure relations.

MAD 8/1/88

```
MAYNORD'S (1987) METHOD FOR DETERMINING RIPRAP              RIPRAP2.WR1
        SIZE FOR OPEN CHANNEL FLOWS


LOCATION:UNC NORTH DIVERSION DITCH SECTION EE

        BOTTOM WIDTH =       20 FT
        Z (SIDE SLOPE)        3
        CHANNEL SLOPE =   0.003
        DISCHARGE =        1081 CFS
        C =                 0.3 - SEE PG 78 OF MAYNORD'S MAR 1988 REPORT
        RIPRAP S.W. =       165
        SAFETY FACTOR =    1.00
                Vmax =     1.33 Vavg - SEE PG 73 OG MAYNORD'S MAR 1988 REPORT

        D30 (ASSUMED) =   0.217 FT     - SELECT A D30 SIZE
            D50(CALC) =   0.362
                    n =   0.033
                    d =    5.30 FT     - SELECT A DEPTH OF FLOW
                    A =   190.3 FT^2
                    R =    3.56 FT
            Q (CALC) =   1082.0 CFS    - CHECK THIS Q VALUE TO
                    v =     5.7 FPS      SEE IF IT MATCHES LISTED
                                         DISCHARGE
                Vmax =   7.563
                   Fr =  0.523

          D30 (CALC) =   0.218 FT     - CHECK THIS D30 VALUE TO
                Dmax =   0.454 FT       SEE IF IT MATCHES THE
           THICKNESS =    0.50 FT       ASSUMED D30 VALUE


           FREEBOARD =     0.5 FT      -FROM TOP OF WATER TO TOP OF RIPRAP
        RIPRAP DEPTH =     5.8 FT      -DEPTH OF WATER + DEPTH OF FREEBOARD
        CHANNEL LENGTH     600 FT
          RIPRAP VOL =  629.80 CY      -RIPRAP PERIMETER * THICKNESS * CHANNEL LENGTH
          TOP WIDTH OF
        WATER CHANNEL =   51.8 FT
```

Reference: Maynord, Stephen T, 1987, Stable Riprap Size For Open Channel Flows, Dissertation, Colorado State University, Fort Collins, Colorado.

MAD 2/1/88

MAYNORD'S (1987) METHOD FOR DETERMINING RIPRAP SIZE FOR OPEN CHANNEL FLOWS — RIPRAP2.WR1

LOCATION:UNC NORTH DIVERSION DITCH SECTION DD

BOTTOM WIDTH =	18	FT	
Z (SIDE SLOPE)	1		
CHANNEL SLOPE =	0.003		
DISCHARGE =	1081	CFS	
C =	0.3		- SEE PG 78 OF MAYNORD'S MAR 1988 REPORT
RIPRAP S.W. =	165		
SAFETY FACTOR =	1.00		
Vmax =	1.33	Vavg	- SEE PG 73 OG MAYNORD'S MAR 1988 REPORT
D30 (ASSUMED) =	0.275	FT	- SELECT A D30 SIZE
D50(CALC) =	0.458		
n =	0.035		
d =	6.80	FT	- SELECT A DEPTH OF FLOW
A =	168.6	FT^2	
R =	4.53	FT	
Q (CALC) =	1083.4	CFS	- CHECK THIS Q VALUE TO SEE IF IT MATCHES LISTED DISCHARGE
v =	6.4	FPS	
Vmax =	8.544		
Fr =	0.490		
D30 (CALC) =	0.278	FT	- CHECK THIS D30 VALUE TO SEE IF IT MATCHES THE ASSUMED D30 VALUE
Dmax =	0.578	FT	
THICKNESS =	0.50	FT	
FREEBOARD =	0.5	FT	-FROM TOP OF WATER TO TOP OF RIPRAP
RIPRAP DEPTH =	7.3	FT	-DEPTH OF WATER + DEPTH OF FREEBOARD
CHANNEL LENGTH	600	FT	
RIPRAP VOL =	429.42	CY	-RIPRAP PERIMETER * THICKNESS * CHANNEL LENGTH
TOP WIDTH OF WATER CHANNEL =	31.6	FT	

Reference: Maynord, Stephen T, 1987, Stable Riprap Size For Open Channel Flows, Dissertation, Colorado State University, Fort Collins, Colorado.

MAYNORD'S (1987) METHOD FOR DETERMINING RIPRAP SIZE FOR OPEN CHANNEL FLOWS

LOCATION--NW NORTH DIVERSION DITCH SECTION 0+

BOTTOM WIDTH =	18	FT
Z (SIDE SLOPE)	1	
CHANNEL SLOPE =	0.003	
DISCHARGE =	1081	CFS
C	0.3	SEE P.78 OF MAYNORD'S MAR 1988 REPORT
RIPRAP S.W. =	165	
SAFETY FACTOR =	1.00	
Vmax =	1.33	Vavg
D30 (ASSUMED) =	0.275	FT - SELECT A D30 SIZE
D50(CALC) =	0.458	
n =	0.035	
d =	6.79	FT - SELECT A DEPTH OF FLOW
A =	168.4	FT^2
R =	4.52	FT
Q (CALC) =	1081.0	CFS - CHECK THIS Q VALUE TO SEE IF IT MATCHES LISTED DISCHARGE
v =	6.4	FPS
Vmax =	8.539	
Fr =	0.490	
D30 (CALC) =	0.277	FT - CHECK THIS D30 VALUE TO SEE IF IT MATCHES THE ASSUMED D30 VALUE
Dmax =	0.578	FT
THICKNESS =	0.58	FT

Reference: Maynord, Stephen T, 1987, Stable Riprap Size for Open Channel Flows, Dissertation, Colorado State University, Fort Collins, Colorado.

FREEBOARD =	0.5	FT	-FROM TOP OF WATER TO TOP OF RIPRAP
RIPRAP DEPTH =	7.2915	FT	-DEPTH OF WATER + DEPTH OF FREEBOARD
CHANNEL LENGTH	150	FT	
RIPRAP VOL =	123.94	CY	-RIPRAP PERIMETER * THICKNESS * CHANNEL LENGTH
TOP WIDTH OF WATER CHANNEL =	31.583	FT	

E.3(a)

Runoff Control Ditch Design Calculation

Canonie Environmental

E-120

By GS Date 11/12/90 Subject LNC - Runoff Control Ditch Design Sheet No. 1 of 10

Chkd. By [illegible] Date 11/30/90 Proj. No. [illegible]

1/4" X 1/4"

PURPOSE: To determine the right design for the run-off control ditch for the reclaimed uranium tailings impoundment embankment at the LNC site.

METHODS: 1) Determine:

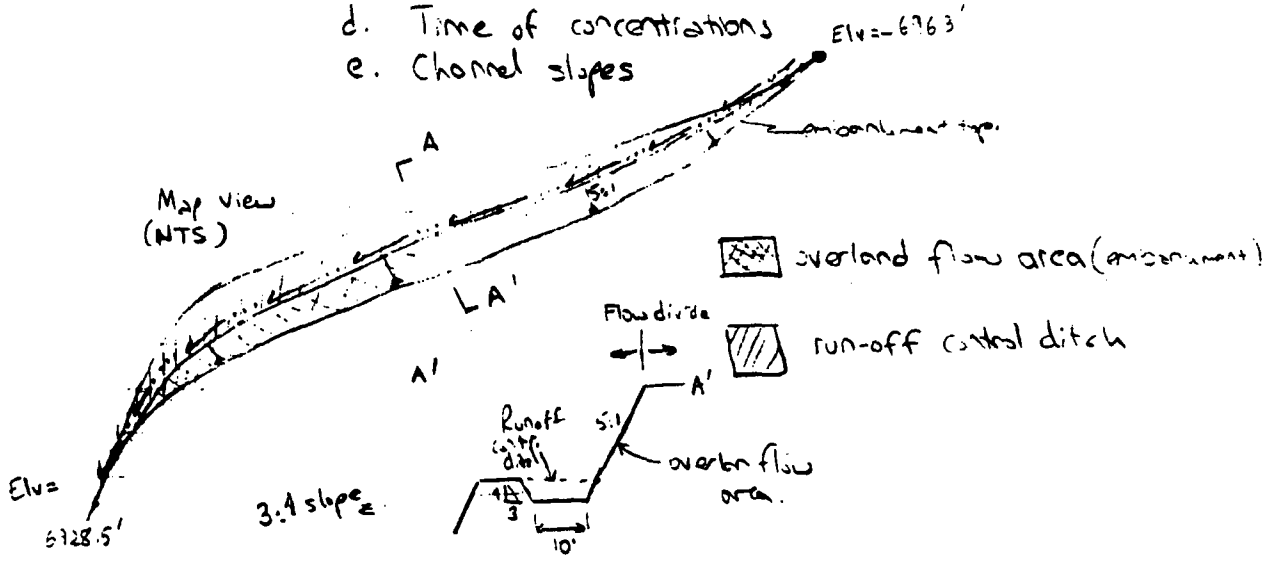
a. Drainage Area

b. Maximum flow length

c. Maximum elevation difference

d. Time of concentrations

e. Channel slopes



2) Inputting the probable maximum precipitation event and curve numbers previously determined for the site, determine the PMF storm hydrograph using the SCS TR-55 Method for a type II storm distribution

CanonieEnvironmental

E-121

By GS Date 1-3-90 Subject UNC - Run-off control Sheet No. 2 of 10

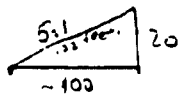
Chkd. By MJP Date 1/30/90 Cover design Proj. No. [illegible]

1/4" X 1/4"

CALCULATIONS Measure the following from plan topo map

Drainage area (embankment area + run-off control ditch area) =
402,587.46 ft² = 9.24 acres

Max overland flow length = 102 feet



Max. channel flow length = 4,400 feet

Max. elev. diff (6903 - 6928.5) = 34.5 feet

Determine 1st cut time of concentration by adding overland flow time and channel flow time. Assume $V_{overland}$ = 1 ft/sec & $V_{chan.}$ = 3 ft/sec

t_c = 102 ft / (1 ft/sec) + 4,400 ft / (3 ft/sec) = 1569 sec.

t_c = 26.15 min. / 60 = 0.43 hrs

DETERMINE CURVE NO. (CN)

A CN of 79 was determined by Faith & provided in its 1981 Report to UNC entitled "Design Flood Analysis: North Cell Tailings Embankment". Faith used an area-weighted determination using the names, cover types, hydrologic soil groups, CN.

Science Application, Inc. determined a CN of 80 for the area draining to the N & S diversion ditches in its June 1981 report entitled "PMF Determination for the Southeast Diversion Channel & Section 1 Watershed using SCS Hydrologic Techniques" (REF: Response to NRC Comments, May 23, 1988)

USE CN = 80

CanonieEnvironmental

E-122

By GS Date 11-12-90 Subject UNC-Runoff Control Sheet No. 3 of 10

Chkd. By [illegible] Date 11/30/90 Ditch Design Proj. No. 86-060-221

1/4" X 1/4"

DETERMINE PMP EVENT

PMP has been determined to be 9.4 inch. However a correction must be made for the high elevation of the site. (Mean basin elevation correction)

The correction factor is -5%. For every 1000 ft of elevation in excess of 5000 ft concentatively choose mean basin elevation of 7000 ft.

PMP = 8.43 inches.

DETERMINE HYDROGRAPH BY TR-55 METHOD.

(see p. 4)

Tc = 0.4

RUNOFF HYDROGRAPHS BY THE SCS TR-55 METHOD

TYPE-II STORM DISTRIBUTION

TIME OF CONCENTRATION = 0.4 HOURS
TRAVEL TIME = 0 HOURS

27-Nov-90
02:48 PM

HYDROGRAPH TIME IN HOURS

WATERSHED DESIGNATION	DRAINAGE AREA (AC)	DRAINAGE AREA (SQ MI)	CURVE NUMBER	PPT ART (IN)	RUNOFF (IN)	(TIME)	11.0	11.3	11.6	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.8	14.0
						(CSM/IN)	18	25	36	77	141	271	468	592	574	431	298	216	163	104	73	63	55	49	44
RUNOFF CONTROL DITCH	9.24	1.44E-02	80.0	8.43	6.03	(CFS)	1.57	2.18	3.13	6.70	12.27	23.59	40.74	51.53	49.97	37.52	25.94	18.80	14.19	9.05	6.70	5.48	4.79	4.27	3.83

peak flow

14.3	14.6	15.0	15.5	16.0	16.5	17.0	17.5	18.0	19.0	20.0	22.0	26.0
38	34	31	28	25	22	21	20	18	16	14	12	0
3.31	2.96	2.70	2.44	2.18	1.92	1.83	1.74	1.57	1.39	1.22	1.04	0.00

drainage 11/30/90

Canonie Environmental

E-124

By GS Date 11-12-90 Subject LMC - Run-off Control Sheet No. 5 of 10

Chkd. By [illegible] Date 11/30/90 Ditch Design Proj. No. 86-060-24

1/4" X 1/4"

Determine channel & riprap design

Use peak flows resulting from PMF as determined by SCS TR-55 Hydrograph

Peak flow = 51.5 cfs at time 12.3 hrs

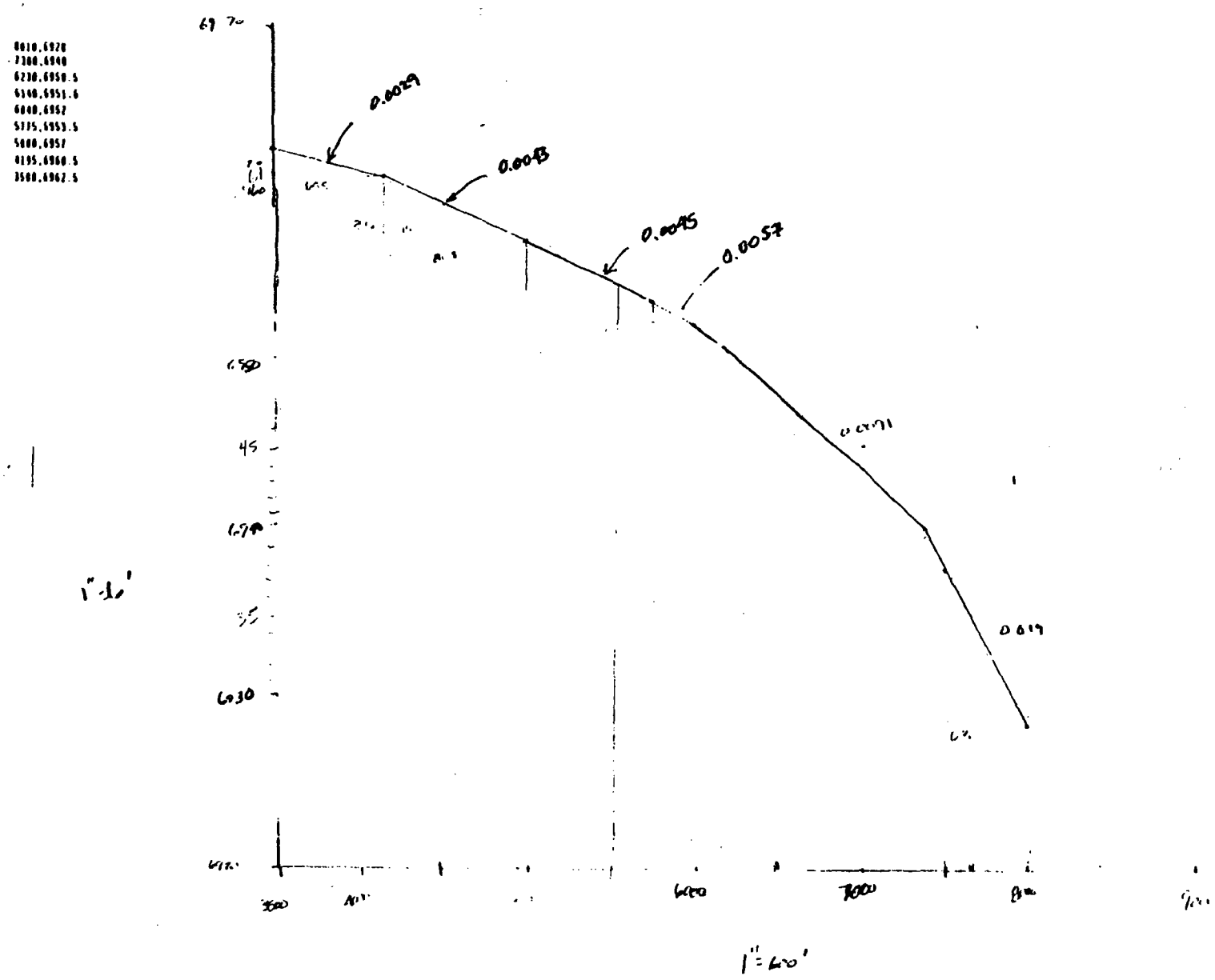
Input peak flow rates assumed channel slopes & bottom widths and side slopes to calculate channel dimensions & riprap sizes by Safety Factor Method. Use spreadsheet "RIPSF. WR1".

(results in pages 7, 8 & 9).

DITCH SLOPE

ΔElv.	Length	Slope	
6963 - 6928.5 = 34.5	4,400 feet	0.0078	Avg.
	for 3" rock ←	0.019	Max
	for 1.5" rock	0.0029	Min
		0.0091	Max

→ see profile in next page for slope variation.



Chris 11/30/90

0000 ✓ mjg 11/30/90

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

Using avg. slope (0.0078)

LOCATION: RUNOFF CONTROL DITCH

DISCHARGE =	51.5 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	4	Alpha =	14.04 Degrees
CHANNEL SLOPE =	0.0078	Theta =	0.45 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.13 FT	1.5 inches	D50 (ASSUM) =	0.13 FT	1.5 inches
n =	0.028		n =	0.028	
* TRIAL d =	1.00 ft	******			
DIFFERENCE =	7.06 %				
* calc d =	0.96 ft	******			
DIFFERENCE =	0.22 %				
* calc d =	0.96 ft	******			
DIFFERENCE =	0.02 %				
* calc d =	0.96 ft	******			
DIFFERENCE =	0.00 %				
FINAL d =	0.96 ft				
A =	13.35 sq ft				
R =	0.74 ft		t =	0.35 PSF	
t =	17.71 ft		nb =	0.63	
V =	3.86 fps				
Q(calc) =	52 cfs		Beta =	44.23	
t =	0.47 PSF				
nb =	0.042		n' =	0.54	
SFb =	1.17	OK	SFs =	1.26	OK

d = 0.96'

✓ [illegible] 11/30/90

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

Using max. slope (0.019)

LOCATION: RUNOFF CONTROL DITCH

DISCHARGE =	51.5 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	4	Alpha =	14.04 Degrees
CHANNEL SLOPE =	0.019	Theta =	1.09 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.80 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.22 FT	2.6 inches	D50 (ASSUM) =	0.22 FT	2.6 inches
n =	0.031		n =	0.031	
* TRIAL d =	0.80 ft	******			
DIFFERENCE =	1.24 %				
* calc d =	0.80 ft	******			
DIFFERENCE =	0.11 %				
* calc d =	0.79 ft	******			
DIFFERENCE =	0.01 %				
* calc d =	0.79 ft	******			
DIFFERENCE =	0.00 %				
FINAL d =	0.79 ft				
A =	10.47 sq ft				
R =	0.63 ft		t =	0.75 PSF	
t =	16.36 ft		nb =	0.77	
V =	4.92 fps				
Q(calc) =	52 cfs		Beta =	49.41	
t =	0.94 PSF				
nb =	0.961		n' =	0.68	
SFb =	(1.01) ok		SFs =	(1.09) ok	

d = 0.79

mjg 11/30/90

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: RUNOFF CONTROL DITCH

Using min. slope. (0.0029)

DISCHARGE =	51.5 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	4	Alpha =	14.04 Degrees
CHANNEL SLOPE =	0.0029	Theta =	0.17 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.80 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.13 FT	1.5 inches	D50 (ASSUM) =	0.13 FT	1.5 inches
n =	0.028		n =	0.028	
* TRIAL d =	1.25 ft	******			
DIFFERENCE =	-1.09 %				
* calc d =	1.26 ft	******			
DIFFERENCE =	-0.07 %				
* calc d =	1.26 ft	******			

DIFFERENCE =	-0.00 %		
* calc d =	1.26 ft ******		
DIFFERENCE =	-0.00 %		
FINAL d =	1.26 ft		
A =	18.90 sq ft		
R =	0.93 ft	t =	0.18 PSF
t =	20.06 ft	nb =	0.33
V =	2.73 fps		
Q(calc) =	51 cfs	Beta =	26.87
t =	0.23 PSF		
nb =	0.400	n' =	0.24
SFb =	(2.43) ok	SFs =	(1.85) ok

d = 1.26 ft

12/3/90

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: RUNOFF CONTROL DITCH

DISCHARGE =	51.5 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	4	Alpha =	14.04 Degrees
CHANNEL SLOPE =	0.0091	Theta =	0.52 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM

D50 (ASSUM) =	0.13 FT	1.5 inches
n =	0.028	
* TRIAL d =	0.92 ft	******
DIFFERENCE =	-0.77 %	
* calc d =	0.92 ft	******
DIFFERENCE =	-0.07 %	
* calc d =	0.92 ft	******
DIFFERENCE =	-0.01 %	
* calc d =	0.92 ft	******
DIFFERENCE =	-0.00 %	
FINAL d =	0.92 ft	
A =	12.65 sq ft	
R =	0.72 ft	
t =	17.39 ft	
V =	4.07 fps	
Q(calc) =	51 cfs	
t =	0.52 PSF	
nb =	0.942	
SFb =	1.05	

CHANNEL SIDE SLOPES

D50 (ASSUM) =	0.13 FT	1.5 inches
n =	0.028	
t =	0.39 PSF	
nb =	0.71	
Beta =	47.37	
n' =	0.62	
SFs =	1.16	

VERIFICATION OF THE TIME OF CONCENTRATION ASSUMPTION FOR THE RUNOFF CONTROL DITCH:

Water velocity of 3 ft/sec was assumed in calculating the time of concentration in page 2. This velocity revealed 0.4 hrs for the time of concentration. This number was checked by using the average slope (0.0078) of the runoff control ditch (see the spread sheet in page 7).

As shown in the spread sheet, water velocity in the ditch was calculated to be 3.8 ft/sec.

Using the velocity of 3.8 ft/sec

$$t_c = \underbrace{102\ (1\ ft/s)}_{\text{For the overland flow}} + \underbrace{4{,}400\ (3.8\ ft/s)}_{\text{For the runoff control ditch}} = 0.35\ hrs = \sim \underline{\underline{0.4\ hrs}}$$

RESULTS

The runoff control ditch for the reclaimed uranium tailings impoundment embankment at the UNC site will be armored with 6" thick 1.5" diameter rock except the last 630' in the profile. This part requires 6" thick, 3" diameter rock.

E.3(b)

Scour Along Protective Bench Calculation

Canonie Environmental

E-132

By MT Date 26 Nov 90 Subject UNC Sheet No. 1 of 4

Chkd. By MJM Date 12/3/90 Bench Scour Proj. No. 86-060-24

1/4" X 1/4"

Purpose: The purpose of this calc sheet is to estimate the potential scour of the protective bench during passage of the PMF

Methods. The empirical methods found in the US Bureau of Reclamations Technical Guideline "Computing Degradation and Local Scour" by Pemberton and Lara (1984) were used. Specifically equations 25 through 30 were used. These equations were derived primarily for wide alluvial channels. The width of the PMF (> 430') indicates that these equations are valid for determining the depth of scour.

The extent of lateral bank scour on the protective bench was considered as one half of the depth of scour, because the tractive forces are less on the bench sideslopes than on the channel bottom and the bench is located approximately 350 feet from the channel. Most of the scour will occur in or near the channel

Results The extent of scour as determined by three methods are summarized below

Method	Extent of bench scour
Neill	2.45 ft
Lacey	1.91 ft
Blench	4.85 ft

Thus for the worst case the bench will be scoured 4.85 ft.

Canonie Environmental

E-133

By MT Date 26 Nov 90 Subject UNC Sheet No. 2 of 4

Chkd. By [illegible] Date 12/3/90 Bench Scour Proj. No. 86-060-24

1/4" X 1/4"

Calculations

Neill Method (Equations 25 and 28)

$$d_f = d_i \left(\frac{q_f}{q_i}\right)^m \qquad (25)$$

where d_f = Scoured depth below design flood water level

d_i = Average depth of bankfull discharge in incised reach - assumed to be 8 feet

q_f = Design flood discharge per unit width

= 26300 cfs / 430 ft = 61.2 cfs/ft

q_i = Bankfull discharge in incised reach per unit width

= 2250 cfs / 50' = 45 cfs/ft

m = 0.67 for sand

$$d_f = 8\left(\frac{61.2}{45}\right)^{0.67} = 9.83'$$

$d_s = 0.5\, d_f$ for straight reach (28)

where d_s = depth of scour

$d_s = 0.5 \cdot 9.83 = 4.92'$

Extent of scour = $0.5 \cdot 4.92 = 2.45'$

Canonie Environmental

E-134

By MT Date 26 Nov 90 Subject UNC Sheet No. 3 of 4

Chkd. By mmp Date 12/3/90 Bench Scour Proj. No. 86-060-24

1/4" X 1/4"

Lacey Method

$$d_m = 0.47 \left(\frac{Q}{f}\right)^{1/3} \qquad (26)$$

where d_m = Mean depth at design discharge

Q = Design discharge = 26300 cfs

$f = 1.76 (D_m)^{1/2}$ where D_m = average grain size of bed material

assume that bed material is a fine sand

so $D_m = 0.2$ mm

$= 1.76 (0.2)^{1/2} = 0.79$

$$d_m = 0.47 \left(\frac{26300}{0.79}\right)^{1/3} = 15.1'$$

$$d_s = 0.25\, d_m = 3.78' \qquad (29)$$

Extent of scour = 0.5 · 3.78 = 1.9'

Canonie Environmental

E-135

By MT Date 26 Nov 90 Subject UAC Sheet No. 4 of 4

Chkd. By [illegible] Date 12/3/90 Bench Scour Proj. No. 88-060-24

1/4" X 1/4"

Blench Equation

$$d_{fo} = \frac{q_f^{2/3}}{F_{bo}^{1/3}} \qquad (27)$$

where d_{fo} = Depth for zero bed transport

q_f = Design flood discharge for unit width

= 26200 cfs / 430 ft = 61.2 cfs/ft

F_{bo} = Blench's zero bed factor from Figure 9 (attached)

= 0.9 for D_m = 0.2 mm

$$d_{fo} = \frac{61.2^{2/3}}{0.9^{1/3}} = 16.1'$$

$$d_s = 0.6 \cdot 16.1' = 9.7' \qquad (30)$$

Extent of scour = 0.5 · 9.7' = 4.85'

The use of equation 24 except as a check on other methods would be limited to channels similar to those observed on relatively steep slopes ranging from 0.004 to 0.008 ft/ft (m/m). Because of shallow depths of flow and medium to coarse sand size bed material the bedload transport should also be very high.

Regime equations supported by field measurements method. - This approach as suggested by Neill (1973) on recommendations by Blench (1969) involves obtaining field measurements in an incised reach of river from which the bankfull discharge and hydraluics can be determined. From the bankfull hydraulics in the incised reach of river, the flood depths can be computed by:

$$d_f = d_i \left(\frac{q_f}{q_i}\right)^m \qquad (25)$$

where:

d_f = Scoured depth below design floodwater level
d_i = Average depth at bankfull discharge in incised reach
q_f = Design flood discharge per unit width
q_i = Bankfull discharge in incised reach per unit width
m = Exponent varying from 0.67 for sand to 0.85 for coarse gravel

This method has been expanded for Reclamation use to include the empirical regime equation by Lacey (1930) and the method of zero bed-sediment transport by Blench (1969) in the form of the Lacey equation:

$$d_m = 0.47 \left(\frac{Q}{f}\right)^{1/3} \qquad (26)$$

where:

d_m = Mean depth at design discharge, ft (m)
Q = Design discharge, ft^3/s (m^3/s)
f = Lacey's silt factor equals 1.76 $(D_m)^{1/2}$ where D_m equal mean grain size of bed material in millimeters

and the Blench equation for "zero bed factor":

$$d_{fo} = \frac{q_f^{\ 2/3}}{F_{bo}^{1/3}} \qquad (27)$$

where:

d_{fo} = Depth for zero bed sediment transport, ft (m)
q_f = Design flood discharge per unit width, ft^3/s per ft (m^3/s per m)
F_{bo} = Blench's "zero bed factor" in ft/s^2 (m/s^2) from figure 9

The maximum natural channel scour depth for design of any structure placed below the streambed (i.e., siphon) or along the bank of a channel must

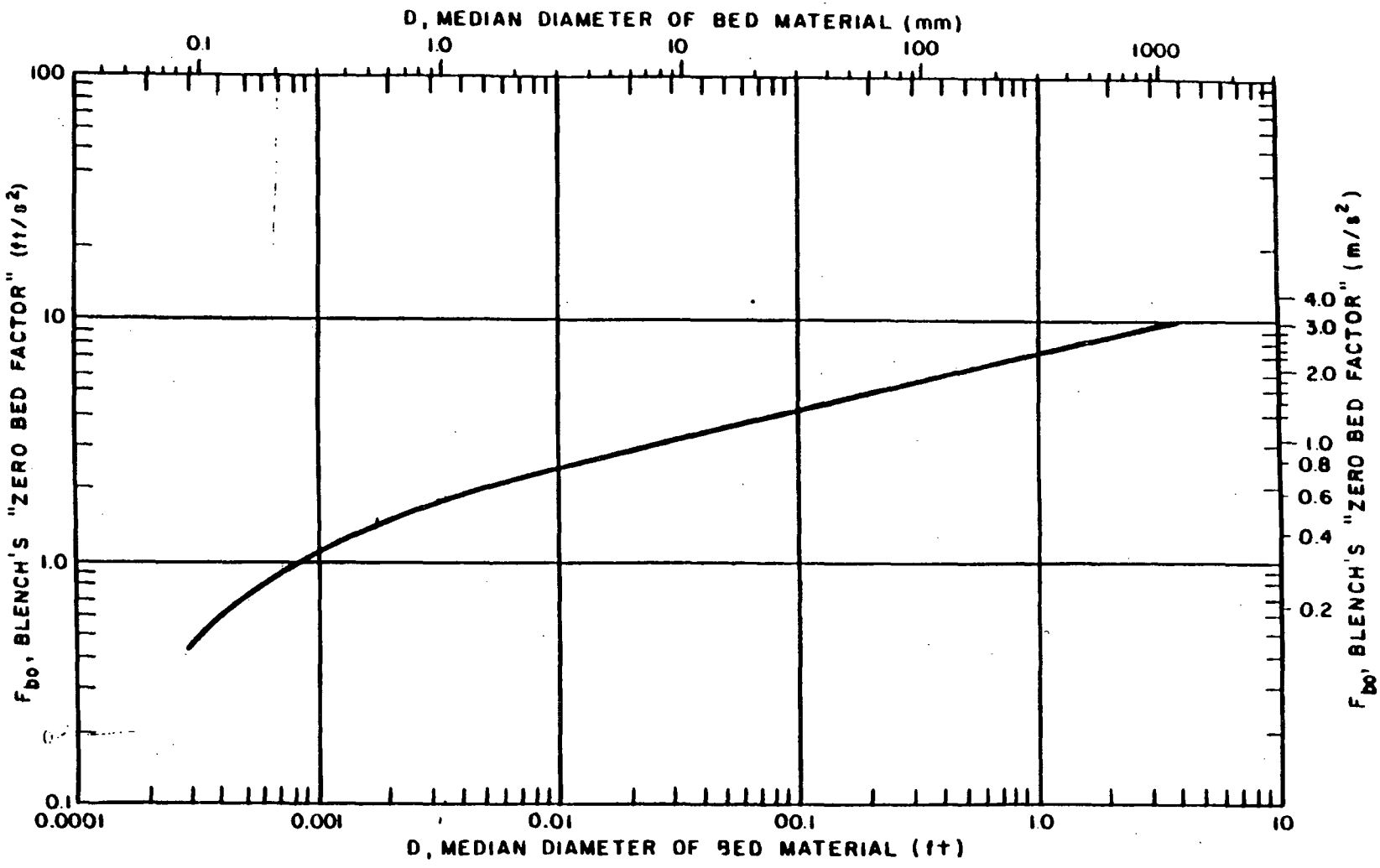


CHART FOR ESTIMATING F_{bo} (AFTER BLENCH)

Figure 9. - Chart for estimating F_{bo} (after Blench, 1969).

consider the probable concentration of floodflows in some portion of the natural channel. Equations 25, 26, or 27 for predicting this maximum depth are to be adjusted by the empirical multiplying factors, Z, shown for formula Types A and B (table 6), in table 7. An illustration of maximum scour depth associated with a flood discharge is shown in a sketch of a natural channel, figure 10. As shown in table 7 and on figure 10, the d_s equals depth of scour below streambed.

$$d_s = Z\, d_f \tag{28}$$

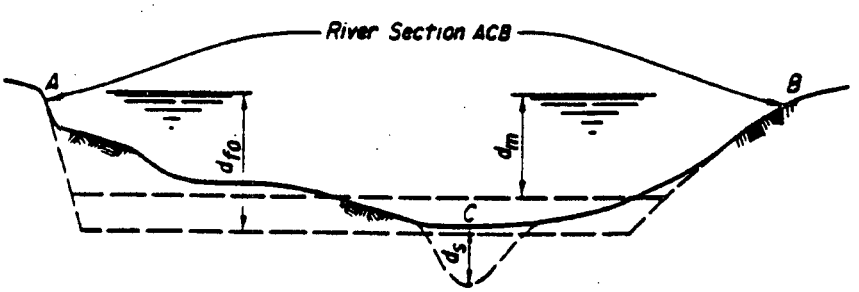
$$d_s = Z\, d_m \tag{29}$$

$$d_s = Z\, d_{fo} \tag{30}$$

Table 7. - Multiplying factors, Z, for use in scour depths by regime equations

Condition	Value of Z		
	Neill $d_s = Z\, d_f$	Lacey $d_s = Z\, d_m$	Blench $d_s = Z\, d_{fo}$
Equation Types A and B			
Straight reach	~~0.5~~	[redacted]	} [redacted]
Moderate bend	0.6	0.5	
Severe bend	0.7	0.75	
Right angle bends		1.0	1.25
Vertical rock bank or wall		1.25	
Equation Types C and D			
Nose of piers	1.0		0.5 to 1.0
Nose of guide banks	0.4 to 0.7	1.50 to 1.75	1.0 to 1.75
Small dam or control across river		1.5	0.75 to 1.25

1/ Z value selected by USBR for use on bends in river.



NOTE: $d_{fo} > d_f > d_m$. Point C is low point of natural section.

Figure 10. - Sketch of natural channel scour by regime method.

EX mjo 10/24/90

-/2
86-060-24

E-139

✓ SWM 12/2/90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UMC: 86-060-24
LOCATION: EMBANKMENT SIDESLOPES

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

RUNOFF COEF:	1	RETURN PERIOD:	PMP
SLOPE LENGTH:	100 FT	1-HR PPT AMOUNT:	8.47 INCHES
AVE SLOPE:	0.2 FT/FT	Tc (calc):	0.502 MIN EQTN 4.44, NUREG4620
MANNING'S n:	0.038	Tc (actual):	2.5 MIN
FLOW CONC:	3	%OF 1-HR PPT:	27.5 % TABLE 2.1, NUREG 4620
DRAINAGE AREA:	0.002 ACRES	PPT AMOUNT:	2.329 INCHES
Mannings n(calc)	0.038	PPT INTENSITY:	55.98 IPH

PEAK DISCHARGE: 0.120 CFS Q = CIA
CONC. DISCHARGE: 0.385 CFS

DEPTH: 0.101 FT EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 1.264 PSF
FLOW VELOCITY: 3.80 FPS V = Q/FLOW AREA

CALC. d50: 1.533 INCHES d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
Development of Riprap Design Criteria, Phase II, CSU Method

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	80.833333333
60	100	

E.3(c)

Rock Mulch Design for Embankment

Canonie Environmental

E-141

By mjj Date 10/29/90 Subject UNC-ROCK MULCH SIZING Sheet No. 1 of ___
Chkd. By SWM Date 11/2/90 FOR 5:1 EMBANKMENT SIDES Proj. No. 86-060-24
1/4" X 1/4"

PURPOSE: TO DETERMINE THE SIZE (D_{50}) OF ROCK MULCH REQUIRED TO PROTECT THE 5H:1V EMBANKMENT SIDESLOPES AT UNC

METHOD: USE THE CSU METHOD (NUREG 4651) FOR OVERLAND FLOW CALCULATIONS TO DETERMINE ROCK MULCH SIZE REQUIRED.

THE SPREADSHEET PROGRAM OVERCSU.WR1 WAS DEVELOPED TO AID IN CALCULATION OF ROCK MULCH SIZE.

RESULTS: FOR THE PMF, A ROCK MULCH WITH A $D_{50} = 1.5"$ IS REQUIRED

CALCULATIONS:

THE EMBANKMENT SLOPE IS 100 FT WIDE AND HAS A 5H:1V SLOPE (WORST CASE, MAX.)

AT 5H:1V
THE SLOPE IS 20% OR 0.20

~~FOR THE~~
THE PMP CORRECTED FOR ALTITUDE = 8.47 INCHES

THE SPREADSHEET OUTPUT, INCLUDING INPUT VALUES FOLLOWS.

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UMC: 86-060-24
LOCATION: EMBANKMENT SIDESLOPES

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

RUNOFF COEF: 1
SLOPE LENGTH: 100 FT
AVE SLOPE: 0.2 FT/FT
MANNING'S n: 0.038
FLOW CONC: 3
DRAINAGE AREA: 0.002 ACRES
Mannings n(calc)0.038

RETURN PERIOD: PMP
1-HR PPT AMOUNT: 8.47 INCHES
Tc (calc): 0.502 MIN EQTN 4.44, NUREG4620
Tc (actual): 2.5 MIN
%OF 1-HR PPT: 27.5 % TABLE 2.1, NUREG 4620
PPT AMOUNT: 2.329 INCHES
PPT INTENSITY: 55.90 IPH

PEAK DISCHARGE: 0.128 CFS Q = CiA
CONC. DISCHARGE:0.385 CFS

DEPTH: 0.101 FT EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 1.264 PSF
FLOW VELOCITY: 3.80 FPS V = Q/FLOW AREA

CALC. d50: 1.533 INCHES d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
Development of Riprap Design Criteria,
Phase II, CSU Method

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	88.833333333
60	100	

E.4

Tailings Embankment Slope Stability Calculation

Canonie Environmental

E-144

By CEM Date 8/13/91 Subject UNC - SLOPE STABILITY Sheet No. 1 of 61

Chkd. By mjj Date 8-16-91 Proj. No 86-060-7

1/4" X 1/4"

PURPOSE: TO DETERMINE THE SLOPE STABILITY OF THE MODIFIED PIPELINE ARROYO AT STATION 30+00 AT THE UNC SITE IN GALLUP, NEW MEXICO. THE MOST CRITICAL FAILURE CIRCLE AND THE MINIMUM FACTOR OF SAFETY WAS DETERMINED FOR THE MODIFIED ARROYO. TWO SCENARIO'S WERE CONSIDERED; THE FIRST SCENARIO IS, THE ARROYO PROFILE WITH A WATER TABLE AND NO EARTHQUAKE EFFECTS, AND THE SECOND SCENARIO IS, THE ARROYO WITH A WATER TABLE AND EARTHQUAKE (PSUEDO-STATIC) EFFECTS.

METHODS:

1.) DETERMINE MODIFIED ARROYO PROFILE AT CRITICAL STATION LOCATION ALONG THE MODIFIED ARROYO. REFER TO FIGURE 1 Pg. 41 FOR BOUNDARY POINTS OF THE CRITICAL PROFILE CONFIGURATION. REFER TO DRAWING FIGURE 51 → 86-060-E544 FOR CRITICAL STATION LOCATION.

NOTE: ADDITIONAL SLOPE STABILITY CHECKS WERE CONSIDERED (REFER TO UNC-SLOPE STABILITY SUPPORT FILE 8/16/91), ONLY THE CRITICAL STATION WAS CONSIDERED IN THIS CALCULATION BRIEF).

2.) SELECT WORST CASE SCENARIO FOR WATER TABLE ELEVATION; REFER TO FIGURE 1, P. 41

3.) DETERMINE SOIL TYPES (PARAMETERS) FOR THE EMBANKMENT SOIL "1b" AND FOR THE NATIVE SOIL "1a".

METHOD CONT.:

4.) RUN COMPUTER ITERATION USING "STABL" FOR FIRST SCENARIO, ARROYO PROFILE WITH WATER TABLE AND NO EARTH QUAKE EFFECTS. IN OTHER WORDS, STATIC SCENARIO.

5.) SELECT EARTHQUAKE PARAMETERS AND RUN COMPUTER ITERATION USING "STABL" FOR SECOND SCENARIO, ARROYO PROFILE WITH WATER TABLE AND EARTHQUAKE EFFECTS. IN OTHER WORDS, PSUEDO-STATIC SCENARIO.

6) DRAW CONCLUSIONS, DETERMINE IF COMPUTER GENERATED FACTOR-OF-SAFETY(FS) IS O.K, IF FS > 1 THEN NO FAILURE AND SLOPE IS STABLE. FS > 1 IS A TYPICAL CHECK USED WHEN DETERMINING SLOPE STABILITY USING "STABL".

"STABL" - SLOPE STABILITY PROGRAM IS USED TO DETERMINE THE FACTOR OF SAFETY OF SPECIFIC FAILURE SURFACES GENERATED WHILE RUNNING THE PROGRAM.

Canonie Environmental

E-146

By CEM Date 8/13/91 Subject UNC - SLOPE STAB. Sheet No. 3 of 61

Chkd. By MJJ Date 8-16-91 Proj. No 86-066-3

1/4" X 1/4"

REFERENCES:

- "STABL" PURDUE UNIVERSITY, DEPARTMENT OF HIGHWAY, MAY 1986, (JAMES R. CARPENTER).
- SERGENT, HAUSKINS AND BECKWITH, GEOTECHNICAL AND DESIGN DEVELOPMENT INVESTIGATION REPORT, JULY 1978.

CONCLUSIONS: AT STATION 80+00:

SCENARIO	CRITICAL FACTOR-OF-SAFETY
1) STATIC	2.651
2) PSUEDO-STATIC	1.617

NOTE: FAILURE SURFACES CAN BE SEEN AT THE END OF EACH COMPUTER ITERATION. CRITICAL FAILURE SURFACE IS REPRESENTED BY THE NUMBER "1".

Canonie Environmental

E-147

By [illegible] Date 8/13/91 Subject UNC - SLOPE STAB Sheet No. 4 of 61

Chkd. By [illegible] Date [illegible] Proj. No 86-560-[illegible]

1/4" X 1/4"

SLOPE CONFIGURATION AT STATION 80+00 FOR EACH BOUNDARY

STATION	BOUNDARY #	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BOUNDARY
80+00	1	0	110	10	105	2
	2	10	105	40	100	2
	3	40	100	85	74	2
	4	85	74	105	74	2
	5	105	74	160	100	2
	6	160	100	180	110	1
	7	180	110	370	115	1
	8	370	115	420	118	1
	9	420	118	550	125	2
	10	550	125	580	126.5	2
	11	580	126.5	635	137	1
	12	635	137	650	137	1
	13	650	137	655	135	1
	14	655	135	665	135	1
	15	665	135	790	160	1
	16	790	160	990	160	1
	17	160	100	280	110	2
	18	280	110	340	110	2
	19	340	110	420	118	2
	~~-~~	~~420~~	~~118~~	~~450~~	~~120~~	~~2~~
	~~21~~	~~450~~	~~120~~	~~550~~	~~125~~	~~2~~
	21	550	125	580	126.5	2
	22	580	126.5	990	126.5	2

Canonie Environmental

E-148

By CEM Date 3/13/91 Subject UNC-SLOPE STAB. Sheet No. 5 of 61

Chkd. By [illegible] Date 3-16-91 Proj. No 86-060-27

1/4 X 1/4

WATER SURFACE ELEVATION FOR STATION 30+00 %

-LOOK AT A WORSE CASE SITUATION

BOUNDARY #	X-AXIS (FT)	Y-AXIS (FT)
1	0	110
2	10	105
3	40	100
4	55	92
5	145	92
6	160	100
7	180	110
8	370	115
9	450	120
10	550	125
11	580	126.5
12	635	137
13	990	137

Canonie Environmental

E-149

By CEM Date 8/12/91 Subject UNC - SLOPE STAB. Sheet No. 6 of 61

Chkd. By mjj Date 8-16-91 Proj. No 8606027

1/4" X 1/4"

SOIL TYPES OF CONCERN:

SOIL NAME	SOIL TYPE	TOT. UNIT WEIGHT (PCF)	SATURATED UNIT WEIGHT (PCF)	COHESION COEFF. (PSF)	FRICTION ANGLE(°)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZ SURFACE NO.
NATIVE	1a	94.6	120.3	960	11	0	0	1
EMBANK	1b	94.6	120.3	1600	15	0	0	1

Canonie Environmental

E-150

By CEM Date 8/13/91 Subject UNC - SLOPE STAB. Sheet No. 7 of 61

Chkd. By mjy Date 8-16-91 Proj. No 86-066-27

1/4" X 1/4"

SOIL TYPE OF CONCERN (CONT.):

+ REF: SERGENT, HAUSKINS & BECKWITH, FIGURE E-11 ATTACHED IN APPENDIX B.

++ REF: SERGENT, HAUSKINS & BECKWITH, p. 49 AND p. 53 ATTACHED IN APPENDIX B.

BOREHOLE #	DEPTH (FT)	IN-SITU DRY DENSITY	IN-SITU DRY DENSITY (AVE)	AVERAGE IN-SITU DRY DENSITY
9	5½ - 6½	90.8 (PCF)		
		91.85		
		92.34	91.66	
13	9½ - 10½	98.92		
		99.86		
		93.53	97.44	94.6

+++ REF: S, H AND B., FIGURE B-24, ATTACHED IN APPENDIX B.

++++ REF: S, H AND B, p. B-85, ATTACHED IN APPENDIX B. AND IN CALCULATION FOR γ SATURATED.

NOTES: CONSIDERING REFERENCES, TOTAL DENSITY IS CALCULATED USING DIRECT SHEAR TEST INFORMATION FROM BOREHOLES LOCATED IN THE AREA. THE TWO BOREHOLES SELECTED, 9 AND 13, WERE DRILLED IN NATIVE MATERIAL AT SHALLOW DEPTHS. THE AVERAGE TOTAL "IN-SITU" DENSITY WERE CONSERVATIVE FOR BOTH BOREHOLE SAMPLES IN COMPARISON TO THE EXISTING AVAILABLE SAMPLE DATA IN S, H AND B. THESE BOREHOLE SAMPLES ARE REPRESENTATIVE OF OF THE NATIVE SOILS.

SOIL TYPES OF CONCERN (CONT.):

NOTES: THE COHESION COEFFICIENTS AND FRICTION ANGLES WERE DETERMINED IN S, H AND B FOR EMBANKMENT SOIL "1b" AND NATIVE SOIL "1a". TRI-AXIAL TESTS WERE RUN ON SAMPLES COLLECTED ALONG THE ARROYO AT UNC. WITH THE RESULTS FROM THE TRI-AXIAL TESTS, MOHR'S CIRCLE WAS PLOTTED FOR EACH SAMPLE. TWO STRENGTH ENVELOPES WITH COHESION COEFF.S AND FRICTION ANGLES, FOR BOTH, WERE DETERMINED FROM THE PLOTS FOR EMBANKMENT SOIL "1b" AND NATIVE SOIL "1a". GRADATION, BORING DEPTHS, AND OTHER PERTINANT DATA IS AVAILABLE IN S, H AND B REPORT.

THE COHESION COEFFICIENTS AND FRICTION ANGLES DETERMINED IN S, H AND B REPORT ARE CONSERVATIVE VALUES FOR THE REPRESENTATIVE SOIL MATERIALS (NATIVE AND ENBANKMENT BEING USED FOR SLOPE STABILITY. IN FIGURES B-24 AND B-11, APPENDIX B, THE STRENGTH ENVELOPE IS DRAWN BELOW MOST OF THE SAMPLES (MOHR'S CIRCLE PLOTS) FAILURE PLANES AND THEREFORE, PRODUCE COHESION COEFFICIENTS AND FRICTION ANGLES WHICH ARE CONSERVATIVE.

THE TOTAL "IN SITU" DENSITY AND SATURATED DENSITY, 94.6 AND 120.3 pcF, RESPECTFULLY, ARE USED FOR BOTH EMBANKMENT "1B" AND NATIVE SOIL "1A". SINCE THE EMBANKMENT SOIL IS NATIVE SOIL COMPACTED TO 95% MAXIMUM DRY DENSITY, THESE VALUES ARE CONSERVATIVE VALUES FOR EMBANKMENT SOIL.

$\gamma_{H_2O} = 62.4$ PCF

1 lb. = 453.6 g

- THE FOLLOWING SOIL VARIABLES WHERE REFERENCED FROM SERGENT, HAUSKINS & BECKWITH, GEOTECHNICAL AND DESIGN DEVELOPMENT INVESTIGATION REPORT, JULY 1978.

$W_S = 242.2\,g = 0.54$ lbs

$e = 0.8290$

$V_T = 167.171$ cc $= 0.0059$ FT^3

CALCULATIONS TO FIND $\gamma_{SAT.}$:

$$e = \frac{V_V}{V_S} = \frac{V_V}{V_T - V_V}$$

$$0.8290 = \frac{V_V}{167.171 - V_V}$$

$$138.6 - 0.8290 V_V = V_V$$

$$V_V\, 1.829 = 138.6$$

$$V_V = 75.8 \text{ cc}$$

CONVERSION:

$$V_V = \frac{75.8\ cm^3}{} \left| \frac{(1)^3\ IN^3}{(2.54)^3\ CM^3} \right| \frac{(1)^3\ FT^3}{(12)^3\ IN^3}$$

$$V_V = 0.0027\ FT^3$$

CALCULATIONS TO FIND γ_{SAT} (CONT.):

$$W_{SAT} = W_S + W_W$$

$$W_{SAT} = W_S + V_V \gamma_W$$

$$W_{SAT} = .54 + 0.0027(62.5)$$

$$W_{SAT} = .54 + 0.169$$

$$W_{SAT} = 0.71 \text{ lbs}$$

$$\gamma_{SAT} = \frac{W_{SAT}}{V_T}$$

$$\gamma_{SAT} = \frac{0.71}{0.0059}$$

$$\gamma_{SAT} = 120.3 \text{ PCF}$$

Canonie Environmental

E-154

By CEM Date 8/13/91 Subject UNC - SLOPE STAB. Sheet No. 11 of 61

Chkd. By mjy Date 8-16-91 Proj. No [illegible]

1/4" X 1/4"

COMPUTER ITERATION OF PSUEDO-STATIC SCENARIO

THE FILE NAME IS UNCSTAB12.TN. THIS ITERATION CONSIDERS WATER TABLE AND EARTHQUAKE EFFECTS WHEN USING "STABL".

STATION 80+00

** PCSTABL5 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 8/16/91
Time of Run: 1330
Run By: CEM
Input Data Filename: A:UNCSTA12.IN
Output Filename: A:UNCSTA12.OUT
Plotted Output Filename: A:UNCSTA12.PLT

PROBLEM DESCRIPTION UNC ARROYO - LOCATION, STATION 80+00

BOUNDARY COORDINATES

16 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	110.00	10.00	105.00	2
2	10.00	105.00	40.00	100.00	2
3	40.00	100.00	85.00	74.00	2
4	85.00	74.00	105.00	74.00	2
5	105.00	74.00	160.00	100.00	2
6	160.00	100.00	180.00	110.00	1
7	180.00	110.00	370.00	115.00	1
8	370.00	115.00	420.00	118.00	1
9	420.00	118.00	550.00	125.00	2
10	550.00	125.00	580.00	126.50	2
11	580.00	126.50	635.00	137.00	1
12	635.00	137.00	650.00	137.00	1
13	650.00	137.00	655.00	135.00	1
14	655.00	135.00	665.00	135.00	1
15	665.00	135.00	790.00	160.00	1
16	790.00	160.00	990.00	160.00	1
17	160.00	100.00	280.00	110.00	2
18	280.00	110.00	340.00	110.00	2
19	340.00	110.00	420.00	118.00	2
20	550.00	125.00	580.00	126.50	2
21	580.00	126.50	990.00	126.50	2

by CEM
12 of 61
✓ mjy 8-16-91

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	94.6	120.3	1600.0	15.0	.00	.0	1
2	94.6	120.3	960.0	11.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 13 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	110.00
2	10.00	105.00
3	40.00	100.00
4	55.00	92.00
5	145.00	92.00
6	160.00	100.00
7	180.00	110.00
8	370.00	115.00
9	450.00	120.00
10	550.00	125.00
11	580.00	126.50
12	635.00	137.00
13	990.00	137.00

A Horizontal Earthquake Loading Coefficient
Of .050 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = 200.0 psf

1

by CEM
13 of 61
✓ mjy 8-16-91

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 85.00 ft.
and X = 665.00 ft.

Unless Further Limitations Were Imposed The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

20.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	103.53	66.48
3	122.22	59.36
4	141.06	52.63
5	160.03	46.30
6	179.13	40.36
7	198.35	34.84
8	217.68	29.72
9	237.12	25.00
10	256.65	20.70
11	276.27	16.81
12	295.96	13.33
13	315.73	10.27
14	335.55	7.62
15	355.43	5.40
16	375.34	3.59
17	395.30	2.20
18	415.27	1.23
19	435.27	.69
20	455.27	.56
21	475.26	.85
22	495.25	1.57
23	515.22	2.71
24	535.16	4.26
25	555.06	6.24
26	574.92	8.64
27	594.72	11.45
28	614.45	14.68
29	634.12	18.32
30	653.70	22.38
31	673.20	26.85
32	692.59	31.73
33	711.88	37.01
34	731.06	42.70
35	750.11	48.79
36	769.02	55.29
37	787.80	62.18
38	806.43	69.46
39	824.89	77.13
40	843.20	85.19

by CEM
14 of 61
✓ mjy
8-16-91

42	[illegible]	[illegible]
43	[illegible]	[illegible]
44	[illegible]	121.23
45	931.95	131.17
46	949.09	141.48
47	966.01	152.14
48	977.93	160.00

*** 1.617 ***

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	103.74	67.02
3	122.62	60.42
4	141.63	54.19
5	160.75	48.34
6	179.99	42.86
7	199.33	37.78
8	218.77	33.07
9	238.30	28.76
10	257.91	24.83
11	277.59	21.29
12	297.34	18.14
13	317.15	15.39
14	337.01	13.03
15	356.92	11.06
16	376.85	9.49
17	396.82	8.31
18	416.81	7.54
19	436.80	7.15
20	456.80	7.17
21	476.80	7.58
22	496.78	8.39
23	516.74	9.59
24	536.68	11.19
25	556.58	13.18
26	576.44	15.57
27	596.24	18.36
28	615.99	21.53
29	635.67	25.10
30	655.27	29.06
31	674.80	33.40
32	694.23	38.13
33	713.56	43.25
34	732.79	48.74
35	751.91	54.62
36	770.91	60.88
37	789.77	67.51
38	808.51	74.52
39	827.10	81.89
40	845.54	89.64
41	863.82	97.74
42	881.94	106.21
43	899.89	115.04
44	917.65	124.22
45	935.24	133.75
46	952.63	143.63

by CEM
15 of 61
mjy 8-16-91

48	879.71	160.00

*** 1.655 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	103.63	66.72
3	122.43	59.91
4	141.40	53.56
5	160.52	47.68
6	179.77	42.28
7	199.15	37.35
8	218.65	32.89
9	238.25	28.92
10	257.95	25.44
11	277.72	22.44
12	297.56	19.93
13	317.46	17.91
14	337.40	16.38
15	357.38	15.34
16	377.37	14.79
17	397.37	14.74
18	417.36	15.18
19	437.34	16.11
20	457.29	17.53
21	477.20	19.45
22	497.05	21.85
23	516.84	24.74
24	536.56	28.12
25	556.18	31.99
26	575.70	36.34
27	595.11	41.16
28	614.39	46.47
29	633.54	52.24
30	652.54	58.49
31	671.38	65.20
32	690.05	72.38
33	708.53	80.01
34	726.83	88.10
35	744.91	96.63
36	762.79	105.61
37	780.43	115.03
38	797.84	124.87
39	815.00	135.15
40	831.90	145.84
41	848.53	156.95
42	852.87	160.00

*** 1.710 ***

by CEM
16 of 61
✓ mjy 8-16-91

Failure Surface Specified By 40 Coordinate Points

No.	(ft)	(ft)
1	278.33	112.59
2	294.40	100.68
3	310.90	89.37
4	327.80	78.68
5	345.09	68.63
6	362.74	59.23
7	380.73	50.49
8	399.03	42.42
9	417.62	35.04
10	436.47	28.35
11	455.55	22.37
12	474.85	17.10
13	494.32	12.55
14	513.95	8.72
15	533.71	5.63
16	553.57	3.27
17	573.51	1.65
18	593.49	.77
19	613.49	.64
20	633.48	1.24
21	653.43	2.59
22	673.32	4.68
23	693.12	7.51
24	712.80	11.07
25	732.34	15.35
26	751.70	20.36
27	770.87	26.08
28	789.80	32.52
29	808.49	39.65
30	826.90	47.47
31	845.00	55.96
32	862.78	65.12
33	880.21	74.94
34	897.25	85.40
35	913.90	96.48
36	930.13	108.17
37	945.91	120.46
38	961.22	133.32
39	976.05	146.75
40	989.64	160.00

*** 1.766 ***

by CEM
17 of 61
✓ mjy 8-16-91

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	104.02	67.83
3	123.17	62.05
4	142.43	56.67
5	161.80	51.69
6	181.27	47.11
7	200.83	42.93
8	220.47	39.16
9	240.19	35.80
10	259.97	32.85

12	299.69	25.17
13	319.62	26.44
14	339.52	25.13
15	359.55	24.24
16	379.55	23.75
17	399.55	23.68
18	419.55	24.02
19	439.53	24.78
20	459.50	25.95
21	479.43	27.53
22	499.34	29.52
23	519.19	31.93
24	538.99	34.74
25	558.73	37.97
26	578.40	41.60
27	597.99	45.64
28	617.49	50.08
29	636.89	54.92
30	656.19	60.17
31	675.38	65.81
32	694.45	71.85
33	713.38	78.28
34	732.18	85.10
35	750.84	92.30
36	769.34	99.90
37	787.69	107.87
38	805.86	116.22
39	823.86	124.95
40	841.67	134.04
41	859.29	143.50
42	876.71	153.33
43	887.99	160.00

*** 1.770 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	342.78	114.28
2	358.05	101.37
3	373.91	89.19
4	390.33	77.77
5	407.27	67.13
6	424.69	57.31
7	442.56	48.32
8	460.82	40.18
9	479.46	32.91
10	498.41	26.53
11	517.64	21.04
12	537.12	16.47
13	556.78	12.82
14	576.59	10.11
15	596.51	8.33
16	616.50	7.49
17	636.50	7.59
18	656.47	8.63
19	676.37	10.62
20	696.16	13.54
21	715.78	17.39

by CEN
18 of 61
✓ mjy 8-16-91

23	754.35	27.84
24	773.27	34.42
25	791.33	41.38
26	810.01	50.20
27	827.78	59.38
28	845.10	69.38
29	861.93	80.19
30	878.23	91.78
31	893.97	104.12
32	909.11	117.19
33	923.61	130.96
34	937.45	145.40
35	950.18	160.00

*** 1.772 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	342.78	114.28
2	358.24	101.60
3	374.25	89.61
4	390.77	78.34
5	407.78	67.81
6	425.23	58.04
7	443.09	49.05
8	461.34	40 86
9	479 93	33.48
10	498.82	26.93
11	517.99	21.22
12	537.39	16.36
13	556.99	12.37
14	576.74	9.24
15	596.62	6.98
16	616.57	5.61
17	636.56	5.12
18	656.56	5.51
19	676.52	6.79
20	696.40	8.94
21	716.17	11.97
22	735.79	15.87
23	755.21	20.63
24	774.41	26.25
25	793.34	32.71
26	811.96	39.99
27	830.25	48.09
28	848.16	56.99
29	865.66	66.68
30	882.71	77.12
31	899.29	88.31
32	915.36	100.22
33	930.88	112.83
34	945.84	126.11
35	960 19	140.04
36	973.92	154.58
37	978.59	160.00

by CEM
19 of 61
Vmjy 5-16-91

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	104.12	68.12
3	123.34	62.62
4	142.68	57.49
5	162.11	52.75
6	181.63	48.39
7	201.23	44.42
8	220.90	40.84
9	240.65	37.64
10	260.45	34.84
11	280.30	32.42
12	300.20	30.40
13	320.13	28.77
14	340.10	27.54
15	360.08	26.69
16	380.07	26.24
17	400.07	26.19
18	420.07	26.53
19	440.06	27.26
20	460.03	28.39
21	479.97	29.91
22	499.88	31.83
23	519.74	34.14
24	539.56	36.83
25	559.32	39.92
26	579.01	43.40
27	598.64	47.26
28	618.18	51.51
29	637.64	56.15
30	657.00	61.17
31	676.25	66.57
32	695.40	72.34
33	714.43	78.50
34	733.34	85.03
35	752.11	91.93
36	770.74	99.19
37	789.23	106.83
38	807.56	114.82
39	825.73	123.18
40	843.73	131.90
41	861.56	140.96
42	879.20	150.38
43	896.40	160.00

*** 1.792 ***

by CEM
20 of 61
✓ mjy 8-16-91

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

2	293.09	39.08
3	308.52	36.16
4	324.60	34.46
5	341.27	63.42
6	358.49	53.25
7	376.22	44.00
8	394.41	35.67
9	413.00	28.31
10	431.95	21.92
11	451.21	16.53
12	470.73	12.15
13	490.44	8.78
14	510.31	6.45
15	530.26	5.15
16	550.26	4.89
17	570.25	5.67
18	590.16	7.50
19	609.96	10.35
20	629.58	14.23
21	648.97	19.12
22	668.08	25.02
23	686.86	31.90
24	705.26	39.75
25	723.22	48.55
26	740.70	58.26
27	757.65	68.88
28	774.03	80.36
29	789.78	92.68
30	804.88	105.80
31	819.27	119.68
32	832.92	134.30
33	845.80	149.61
34	853.65	160.00

*** 1.795 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	104.26	68.62
3	123.61	63.55
4	143.04	58.81
5	162.54	54.38
6	182.12	50.28
7	201.76	46.50
8	221.46	43.05
9	241.21	39.92
10	261.01	37.11
11	280.86	34.64
12	300.74	32.49
13	320.66	30.67
14	340.61	29.17
15	360.57	28.01
16	380.55	27.18
17	400.55	26.67
18	420.55	26.50
19	440.55	26.65
20	460.54	27.14

by CEM
21 of 61

✓ mjy 8-16-91

22	500.49	28.49
23	520.44	30.56
24	540.36	32.37
25	560.24	34.49
26	580.09	36.95
27	599.90	39.73
28	619.65	42.84
29	639.36	46.28
30	659.00	50.04
31	678.58	54.12
32	698.09	58.52
33	717.52	63.25
34	736.87	68.29
35	756.14	73.66
36	775.32	79.34
37	794.40	85.33
38	813.38	91.64
39	832.25	98.26
40	851.01	105.19
41	869.65	112.43
42	888.18	119.98
43	906.57	127.83
44	924.83	135.98
45	942.96	144.44
46	960.94	153.19
47	974.38	160.00

*** 1.803 ***

```
          Y            A     X     I     S           F     T

           .00    123.75    247.50    371.25    495.00    618.75

X       .00 +-------**+---------+---------+---------+---------+
            -
            -        *
            -       W
            -      *
            -     1*
     123.75 +     1
            -    15 W.
            -    1.  .*
            -   15....*
            -   18.....
            - 12......
A    247.50 + 15.....
            -125.....4
            -138....4*
            -150...4.
            -15...4..*
            125.994.66
X    371.25 125.44.6.*
            1254..6...
            1254.6....*
            124.66....
            1246......*
            1236.......
I    495.00 1238.......
            1235.......
```

by CEM
22 of 61

✓ mjy 8-16-91

```
            41.3.....*
            41.38.....*
            41.35.......
S    618.75 41203.......
            412.38.....*
            461.03.....*
            4612033.....
            -4.1.03... .
            -4 19053....
     742.50 +44.19053  ..
            - 46129.53...
            - 74.199.3...*
            -  46.10.53...
            -   46120 533
            -   .461 0.593
F    866.25 +    46.10.85.
            -     46110.55
            -      4421...
            -       .4.16.
            -        .4126
            -         .411
T    990.00 +          *W.*
```

by CEM
23 of 61

✓ mjj 8-16-91

Canonie Environmental

E-167

By CEM Date 8/13/91 Subject UNC- SLOPE STAB Sheet No. 24 of 61

Chkd. By MJJ Date 8-16-91 Proj. No 86-CCC-27

1/4 X 1/4

COMPUTER ITERATION

OF

STATIC SCENARIO

THE FILE NAME IS UNCSTAB13.IN. THIS ITERATION CONSIDERED ONLY WATER TABLE EFFECTS WHEN USING "STABL".

STATION 80+00

** PCSTABL5 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 8/16/91
Time of Run: 1420
Run By: CEM
Input Data Filename: A:UNCSTA13.IN
Output Filename: A:UNCSTA13.OUT
Plotted Output Filename: A:UNCSTA13.PLT

PROBLEM DESCRIPTION UNC ARROYO - LOCATION, STATION 80+00

BOUNDARY COORDINATES

16 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	110.00	10.00	105.00	2
2	10.00	105.00	40.00	100.00	2
3	40.00	100.00	85.00	74.00	2
4	85.00	74.00	105.00	74.00	2
5	105.00	74.00	160.00	100.00	2
6	160.00	100.00	180.00	110.00	1
7	180.00	110.00	370.00	115.00	1
8	370.00	115.00	420.00	118.00	1
9	420.00	118.00	550.00	125.00	2
10	550.00	125.00	580.00	126.50	2
11	580.00	126.50	635.00	137.00	1
12	635.00	137.00	650.00	137.00	1
13	650.00	137.00	655.00	135.00	1
14	655.00	135.00	665.00	135.00	1
15	665.00	135.00	790.00	160.00	1
16	790.00	160.00	990.00	160.00	1
17	160.00	100.00	280.00	110.00	2
18	280.00	110.00	340.00	110.00	2
19	340.00	110.00	420.00	118.00	2
20	550.00	125.00	580.00	126.50	2
21	580.00	126.50	990.00	126.50	2

by CEM
25 of 61
✓ mjy 8-16-91

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	94.6	120.3	1600.0	15.0	.00	.0	1
2	94.6	120.3	960.0	11.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 13 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	110.00
2	10.00	105.00
3	40.00	100.00
4	55.00	92.00
5	145.00	92.00
6	160.00	100.00
7	180.00	110.00
8	370.00	115.00
9	450.00	120.00
10	550.00	125.00
11	580.00	126.50
12	635.00	137.00
13	990.00	137.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

by CEM
26 of 61

100 Trial Surfaces Have Been Generated.

✓ mjy 8-16-91

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 85.00 ft.
and X = 665.00 ft.

Each Surface Terminates Between X = 790.00 ft.
and X = 990.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

20.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Ten Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	103.53	66.48
3	122.22	59.36
4	141.06	52.63
5	160.03	46.30
6	179.13	40.36
7	198.35	34.84
8	217.68	29.72
9	237.12	25.00
10	256.65	20.70
11	276.27	16.81
12	295.96	13.33
13	315.73	10.27
14	335.55	7.62
15	355.43	5.40
16	375.34	3.59
17	395.30	2.20
18	415.27	1.23
19	435.27	.69
20	455.27	.56
21	475.26	.85
22	495.25	1.57
23	515.22	2.71
24	535.16	4.26
25	555.06	6.24
26	574.92	8.64
27	594.72	11.45
28	614.45	14.68
29	634.12	18.32
30	653.70	22.38
31	673.20	26.85
32	692.59	31.73
33	711.88	37.01
34	731.06	42.70
35	750.11	48.79
36	769.02	55.29
37	787.80	62.18
38	806.43	69.46
39	824.89	77.13
40	843.20	85.19
41	861.33	93.64
42	879.28	102.46
43	897.03	111.66
44	914.60	121.23
45	931.95	131.17
46	949.09	141.48
47	966.01	152.14
48	977.93	160.00

*** 2.651 ***

by CEM
27 of 61
✓ mjy
8-16-91

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	103.74	67.02
3	122.62	60.42
4	141.63	54.19
5	160.75	48.34
6	179.99	42.86
7	199.33	37.78
8	218.77	33.07
9	238.30	28.76
10	257.91	24.83
11	277.59	21.29
12	297.34	18.14
13	317.15	15.39
14	337.01	13.03
15	356.92	11.06
16	376.85	9.49
17	396.82	8.31
18	416.81	7.54
19	436.80	7.15
20	456.80	7.17
21	476.80	7.58
22	496.78	8.39
23	516.74	9.59
24	536.68	11.19
25	556.58	13.18
26	576.44	15.57
27	596.24	18.36
28	615.99	21.53
29	635.67	25.10
30	655.27	29.06
31	674.80	33.40
32	694.23	38.13
33	713.56	43.25
34	732.79	48.74
35	751.91	54.62
36	770.91	60.88
37	789.77	67.51
38	808.51	74.52
39	827.10	81.89
40	845.54	89.64
41	863.82	97.74
42	881.94	106.21
43	899.89	115.04
44	917.65	124.22
45	935.24	133.75
46	952.63	143.63
47	969.82	153.85
48	979.71	160.00

*** 2.712 ***

by CEM
28 of 61

✓ mjy
8-16-91

1

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	103.63	66.72
3	122.43	59.91
4	141.40	53.56
5	160.52	47.68
6	179.77	42.28
7	199.15	37.35
8	218.65	32.89
9	238.25	28.92
10	257.95	25.44
11	277.72	22.44
12	297.56	19.93
13	317.46	17.91
14	337.40	16.38
15	357.38	15.34
16	377.37	14.79
17	397.37	14.74
18	417.36	15.18
19	437.34	16.11
20	457.29	17.53
21	477.20	19.45
22	497.05	21.85
23	516.84	24.74
24	536.56	28.12
25	556.18	31.99
26	575.70	36.34
27	595.11	41.16
28	614.39	46.47
29	633.54	52.24
30	652.54	58.49
31	671.38	65.20
32	690.05	72.38
33	708.53	80.01
34	726.83	88.10
35	744.91	96.63
36	762.79	105.61
37	780.43	115.03
38	797.84	124.87
39	815.00	135.15
40	831.90	145.84
41	848.53	156.95
42	852.87	160.00

*** 2.742 ***

by CEM
29 of 61
✓ mjj 8-16-91

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	407.22	117.33
2	421.44	103.26
3	436.62	90.23
4	452.68	78.32
5	469.56	67.59
6	487.15	58.08
7	505.38	49.85
8	524.15	42.94

10	602.41	[illegible]
11	622.73	30.44
12	602.68	29.08
13	622.68	29.15
14	642.63	30.64
15	662.41	33.55
16	681.94	37.86
17	701.12	43.55
18	719.84	50.59
19	738.01	58.95
20	755.54	68.58
21	772.34	79.43
22	788.32	91.45
23	803.41	104.58
24	817.53	118.74
25	830.60	133.83
26	842.56	149.91
27	849.02	160.00

*** 2.825 ***

1

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	407.22	117.33
2	421.93	103.77
3	437.52	91.24
4	453.92	79.80
5	471.07	69.51
6	488.87	60.40
7	507.26	52.52
8	526.13	45.91
9	545.42	40.60
10	565.01	36.61
11	584.84	33.96
12	604.80	32.67
13	624.80	32.73
14	644.75	34.15
15	664.55	36.93
16	684.12	41.04
17	703.37	46.48
18	722.20	53.21
19	740.54	61.20
20	758.28	70.42
21	775.36	80.83
22	791.70	92.37
23	807.21	105.00
24	821.82	118.65
25	835.48	133.26
26	848.11	148.77
27	856.05	160.00

*** 2.839 ***

by CFM
30 of 61
✓ mjj 8-16-91

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.00	74.00
2	104.02	67.83
3	123.17	62.05
4	142.43	56.67
5	161.80	51.69
6	181.27	47.11
7	200.83	42.93
8	220.47	39.16
9	240.19	35.80
10	259.97	32.85
11	279.81	30.30
12	299.69	28.17
13	319.62	26.44
14	339.58	25.13
15	359.55	24.24
16	379.55	23.75
17	399.55	23.68
18	419.55	24.02
19	439.53	24.78
20	459.50	25.95
21	479.43	27.53
22	499.34	29.52
23	519.19	31.93
24	538.99	34.74
25	558.73	37.97
26	578.40	41.60
27	597.99	45.64
28	617.49	50.08
29	636.89	54.92
30	656.19	60.17
31	675.38	65.81
32	694.45	71.85
33	713.38	78.28
34	732.18	85.10
35	750.84	92.30
36	769.34	99.90
37	787.69	107.87
38	805.86	116.22
39	823.86	124.95
40	841.67	134.04
41	859.29	143.50
42	876.71	153.33
43	887.99	160.00

*** 2.840 ***

by LEM
31 of 61
✓ mjy 8-16-

1

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	342.78	114.28
2	358.21	101.56
3	374.32	89.70
4	391.05	78.75
5	408.36	68.73

7	444.50	51.62
8	463.22	44.33
9	482.30	38.53
10	501.68	33.64
11	521.30	29.77
12	541.10	26.98
13	561.03	25.29
14	581.02	24.69
15	601.02	25.19
16	620.95	26.79
17	640.77	29.49
18	660.41	33.26
19	679.81	38.12
20	698.92	44.03
21	717.67	50.98
22	736.01	58.95
23	753.89	67.92
24	771.25	77.86
25	788.03	88.73
26	804.19	100.51
27	819.68	113.16
28	834.46	126.65
29	848.46	140.92
30	861.67	155.94
31	864.85	160.00

*** 2.849 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	342.78	114.28
2	358.05	101.37
3	373.91	89.19
4	390.33	77.77
5	407.27	67.13
6	424.69	57.31
7	442.56	48.32
8	460.82	40.18
9	479.46	32.91
10	498.41	26.53
11	517.64	21.04
12	537.12	16.47
13	556.78	12.82
14	576.59	10.11
15	596.51	8.33
16	616.50	7.49
17	636.50	7.59
18	656.47	8.63
19	676.37	10.62
20	696.16	13.54
21	715.78	17.39
22	735.21	22.16
23	754.38	27.84
24	773.27	34.42
25	791.83	41.88
26	810.01	50.20
27	827.78	59.38
28	845.10	69.38

by CEM
32 of 61

✓ mjy
5-16-91

30	878.23	91.78
31	893.97	104.12
32	909.11	117.19
33	923.61	130.96
34	937.45	145.40
35	950.18	160.00

E-176

*** 2.852 ***

1

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.33	112.59
2	293.09	99.08
3	308.52	86.36
4	324.60	74.46
5	341.27	63.42
6	358.49	53.25
7	376.22	44.00
8	394.41	35.67
9	413.00	28.31
10	431.95	21.92
11	451 21	16.53
12	470.73	12.15
13	490.44	8.78
14	510.31	6.45
15	530.26	5.15
16	550.26	4.89
17	570.25	5.67
18	590.16	7.50
19	609.96	10.35
20	629.58	14.23
21	648.97	19.12
22	668.08	25.02
23	686.86	31.90
24	705.26	39.75
25	723.22	48.55
26	740.70	58.26
27	757.65	68.88
28	774.03	80.36
29	789.78	92.68
30	804.88	105.80
31	819.27	119.68
32	832.92	134.30
33	845.80	149.61
34	853.65	160.00

*** 2.856 ***

by

33 of 61

Vmjj
8-16-91

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

2	357.50	100.75
3	373.04	88.15
4	389.31	76.53
5	406.28	65.94
6	423.86	56.41
7	442.00	47.99
8	460.63	40.70
9	479.67	34.57
10	499.05	29.63
11	518.69	25.89
12	538.54	23.38
13	558.49	22.09
14	578.49	22.03
15	598.46	23.21
16	618.31	25.61
17	637.98	29.24
18	657.39	34.07
19	676.46	40.09
20	695.13	47.27
21	713.32	55.59
22	730.95	65.02
23	747.98	75.51
24	764.32	87.04
25	779.93	99.55
26	794.73	113.00
27	808.67	127.34
28	821.71	142.51
29	833.78	158.45
30	834.81	160.00

*** 2.874 ***

1

```
            Y            A     X     I     S           F     T

            .00     123.75    247.50    371.25    495.00    618.75

X        .00 +-------**+---------+---------+---------+---------+
            -
            -        *
            -       W
            -      *
            -     1*
     123.75 +     1
            -    16 W.
            -    1. .*
            -   16....*
            -   1.. ...
            -  12......
A    247.50 + 16......
            -126.....9
            -13.....9*
            -16....9.
            -16...9..*
            126.99..77
X    371.25 126.9..7.*
            1269..7...
            126..87.44*
            126.87.4..
            12687.4.. *
```

by CFr
34 of 61

mjy 5-16-91

```
I     495.00 1237.4....
             12344......
             12345  .. .
             9173 .....*
             9143... ..*
             .1436.......
S     618.75 .1253.......
             .1253......*
             .814.3.....*
             .812.33.....
             -8.14.3... .
             -8 14063....
      742.50 + 8.14063....
             - 88124063...
             -  8.19403...*
             -  .8.1.463...
             -   .812.74330
             -   ..81...543
F     866.25 +    .8.1...65
             -     .811..66
             -      ..21...
             -       ...18.
             -        ..128
             -         ..11
T     990.00 +          *W.*
1
*****************************************
******          - Illegal Command  ******
*****************************************


Legal Commands - PROFIL
                 LOADS
                 TIES
                 WATER
                 SURFAC
                 EXECUT
                 EQUAKE
                 SOIL
                 RANDOM
                 CIRCLE
                 CIRCL2
                 BLOCK
                 BLOCK2
                 LIMITS
                 ANISO
                 SURBIS
                 SPENCR
```

by CEM
35 of 61

✓ mjy 8-16-91

Canonie Environmental

E-179

By CEM Date 8/13/91 Subject UNC - SLOPE STAB Sheet No. 36 of 61

Chkd. By MJY Date 8-16-91 Proj. No. 88-666-27

1/4" X 1/4"

FIGURES

PROFILE AND BOUNDARY POINTS FOR STATION 80+00

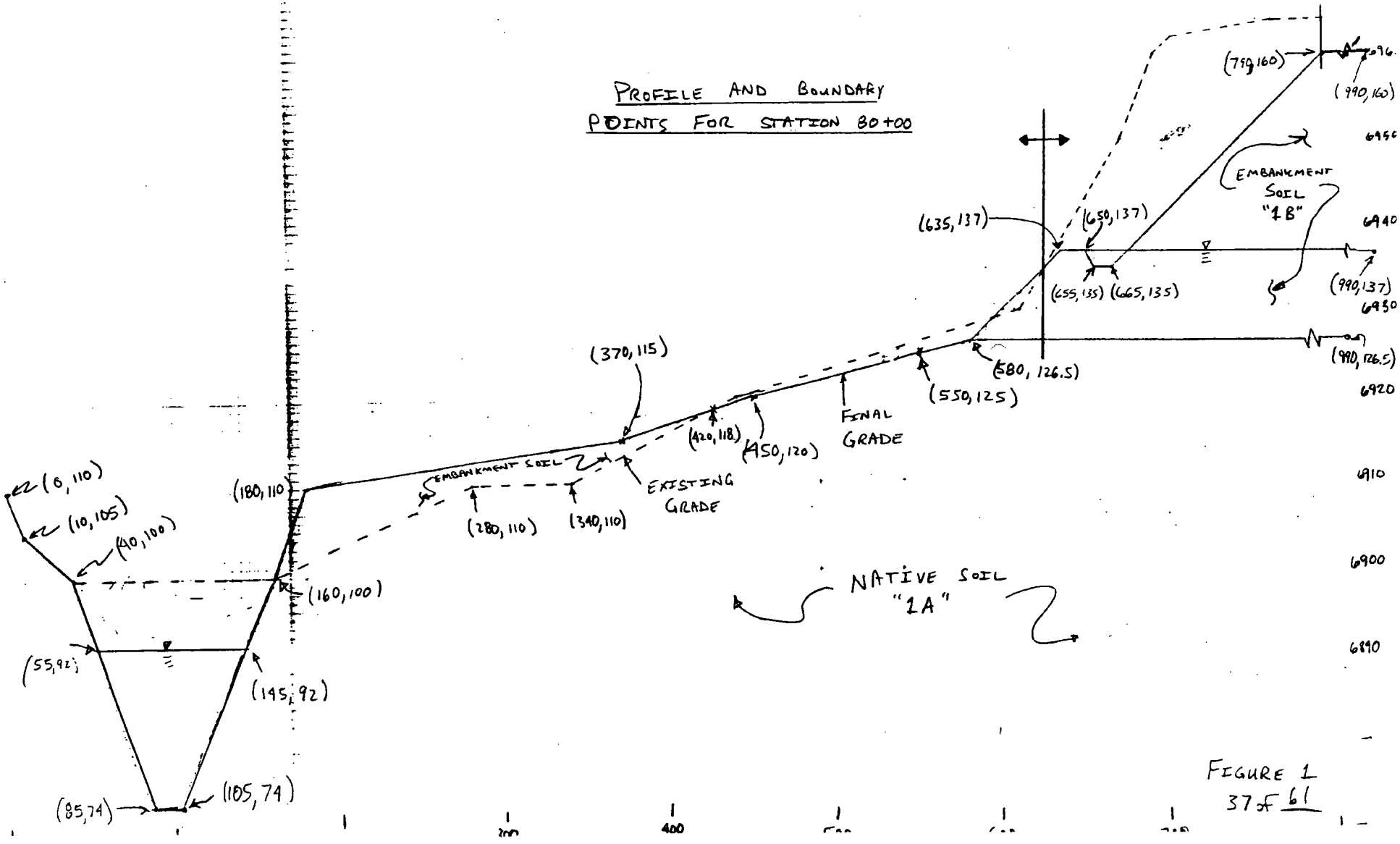
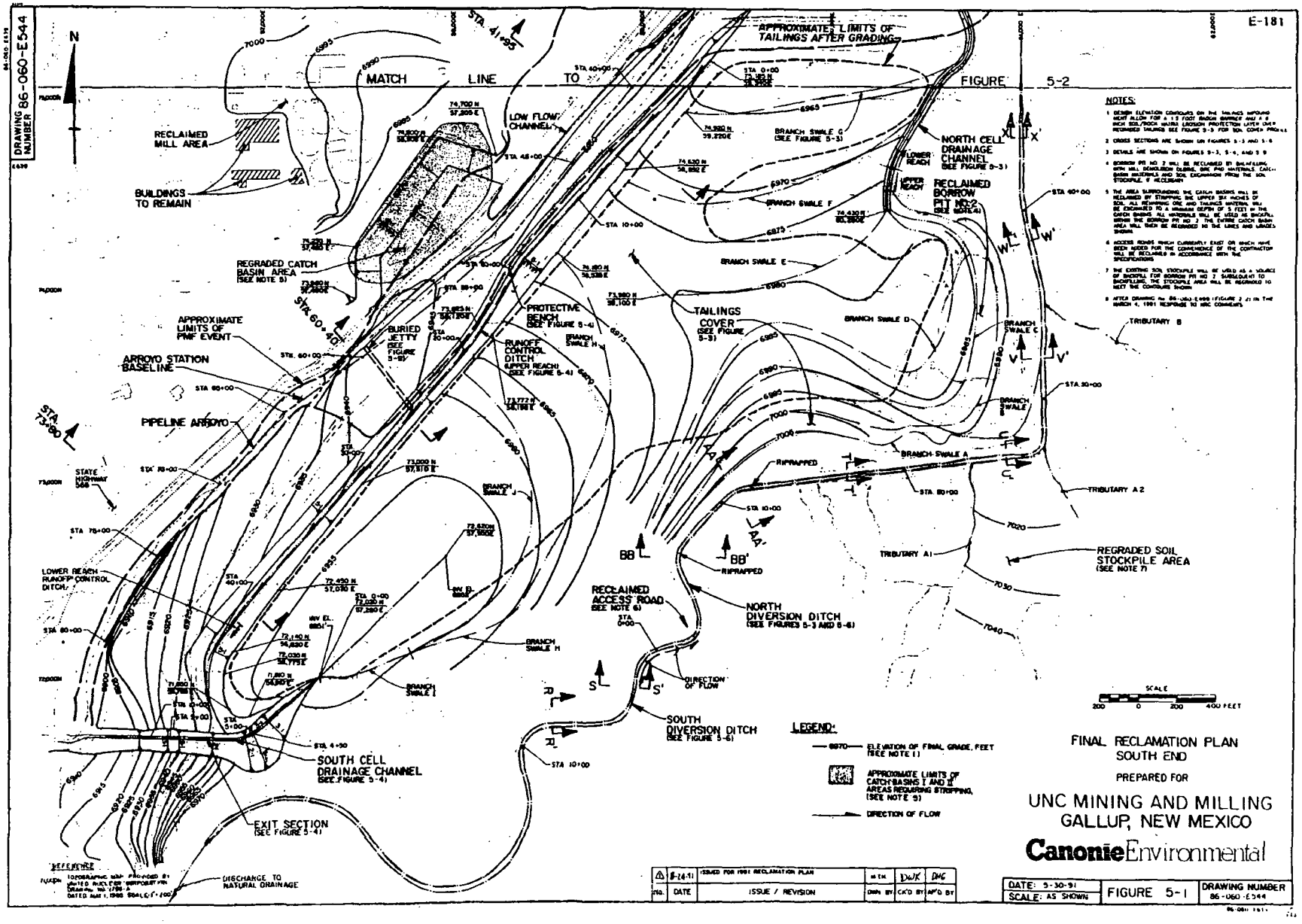
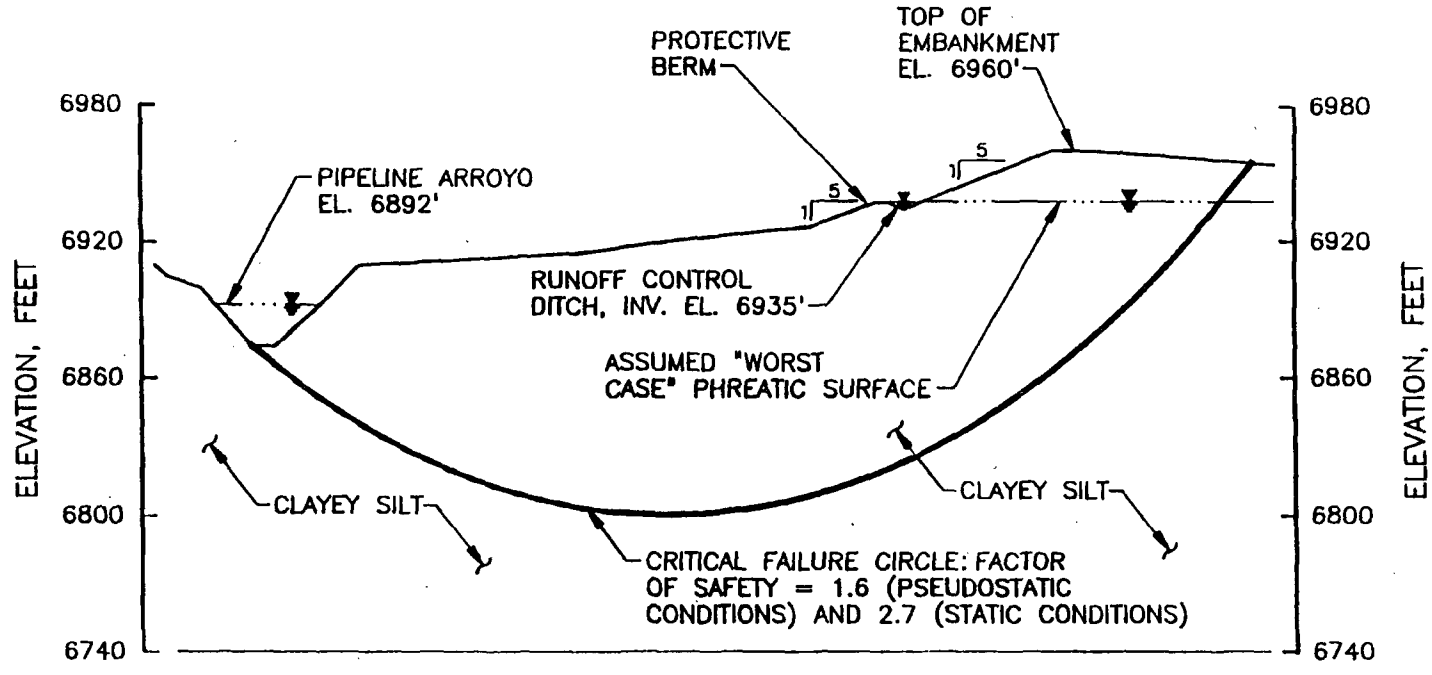


FIGURE 1


E-181
DRAWING NUMBER 86-060-E544
MATCH LINE TO FIGURE 5-2
N
APPROXIMATE LIMITS OF TAILINGS AFTER GRADING
RECLAIMED MILL AREA
BUILDINGS TO REMAIN
LOW FLOW CHANNEL
BRANCH SWALE G (SEE FIGURE 5-3)
NORTH CELL DRAINAGE CHANNEL (SEE FIGURE 5-3)
LOWER REACH
UPPER REACH
RECLAIMED BORROW PIT NO. 2 (SEE NOTE 4)
BRANCH SWALE F
BRANCH SWALE E
REGRADED CATCH BASIN AREA (SEE NOTE 3)
APPROXIMATE LIMITS OF PMF EVENT
ARROYO STATION BASELINE
PIPELINE ARROYO
BURIED JETTY (SEE FIGURE 5-3)
PROTECTIVE BENCH (SEE FIGURE 5-4)
RUNOFF CONTROL DITCH UPPER REACH (SEE FIGURE 5-4)
TAILINGS COVER (SEE FIGURE 5-3)
BRANCH SWALE D
BRANCH SWALE C
BRANCH SWALE
TRIBUTARY B
TRIBUTARY A2
TRIBUTARY A1
BRANCH SWALE A
RIPRAPPED
REGRADED SOIL STOCKPILE AREA (SEE NOTE 7)
STATE HIGHWAY 566
LOWER REACH RUNOFF CONTROL DITCH
BRANCH SWALE J
BRANCH SWALE H
BRANCH SWALE I
RECLAIMED ACCESS ROAD (SEE NOTE 6)
NORTH DIVERSION DITCH (SEE FIGURES 5-3 AND 5-6)
DIRECTION OF FLOW
SOUTH DIVERSION DITCH (SEE FIGURE 5-6)
SOUTH CELL DRAINAGE CHANNEL (SEE FIGURE 5-4)
EXIT SECTION (SEE FIGURE 5-4)
DISCHARGE TO NATURAL DRAINAGE
STA 41+95
STA 60+40
STA 73+90
NOTES:
LEGEND:
6970 ELEVATION OF FINAL GRADE, FEET (SEE NOTE 1)
APPROXIMATE LIMITS OF CATCH BASINS I AND II AREAS REQUIRING STRIPPING (SEE NOTE 5)
DIRECTION OF FLOW
SCALE
200 0 200 400 FEET
FINAL RECLAMATION PLAN
SOUTH END
PREPARED FOR
UNC MINING AND MILLING
GALLUP, NEW MEXICO
Canonie Environmental
8-24-91 ISSUED FOR 1991 RECLAMATION PLAN
DATE: 9-30-91
SCALE: AS SHOWN
FIGURE 5-1
DRAWING NUMBER 86-060-E544

DRAWING NUMBER 86-060-A606



SOIL PARAMETERS	NATIVE SOIL	EMBANKMENT SOIL
COHESION (psf)	960	1,600
INTERNAL ANGLE OF FRICTION	11°	15°
DRY DENSITY (pcf)	95	95
SATURATED DENSITY (pcf)	120	120

NOTES:

1. MAXIMUM SECTION SHOWN IS TAKEN FROM STATION 80+00.
2. HORIZONTAL ACCELERATION = 0.05 g.

SLOPE STABILITY ANALYSIS

PREPARED FOR

UNC MINING AND MILLING
GALLUP, NEW MEXICO

E-182

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR 1991 RECLAMATION PLAN	P.M.W.		

DATE: 8-19-91 SCALE: N.T.S.	FIGURE 5-11	DRAWING NUMBER 86-060-A606

37% 1

APPENDIX A

FILE NAME: UNCSTAB6.IN

COMPUTER ITERATION OF PSUEDO-STATIC SCENARIO. THIS ITERATION VARIES THE CAVITATION PRESSURE TO PROVE ONCE A MAXIMUM LOAD IS APPLIED, CAVITATION PRESSURE HAS NO EFFECT ON THE FACTOR-OF-SAFETY. THEREFORE, EARTHQUAKE EFFECTS UTILIZED THE CAVITATION PRESSURE WHICH RESULTS IN THE MINIMUM FACTOR-OF-SAFETY.

** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:	8/13/91
Time of Run:	1400
Run By:	CEM
Input Data Filename:	A:UNCSTAB6.IN
Output Filename:	A:UNCSTAB6.OUT
Plotted Output Filename:	A:UNCSTAB6.PLT

Ou LEM
41 - 61
✓ mjp
8-16-91

PROBLEM DESCRIPTION UNC ARROYO - LOCATION, STATION 50+00

BOUNDARY COORDINATES

8 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	50.00	171.00	51.50	2
2	171.00	51.50	201.75	57.50	2
3	201.75	57.50	212.00	59.50	1
4	212.00	59.50	227.00	59.50	1
5	227.00	59.50	233.00	57.50	1
6	233.00	57.50	243.00	57.50	1
7	243.00	57.50	340.00	76.00	1
8	340.00	76.00	390.00	76.00	1
9	201.75	57.50	390.00	57.50	2

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	94.6	120.3	1600.0	15.0	.00	.0	1
2	94.6	120.3	960.0	11.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

by CEM
42 of 67
✓ mjy
8-16-91

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	50.00
2	171.00	51.50
3	212.00	59.50
4	390.00	59.50

A Horizontal Earthquake Loading Coefficient
Of .050 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = 5000.0 psf

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = .00 ft.
and X = 212.00 ft.

Each Surface Terminates Between X = 243.00 ft.
and X = 390.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

43 of 61

8-16-91

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.33	51.24
2	149.35	45.26
3	157.68	39.73
4	166.31	34.67
5	175.20	30.10
6	184.34	26.04
7	193.69	22.49
8	203.22	19.47
9	212.91	16.98
10	222.71	15.03
11	232.62	13.64
12	242.58	12.80
13	252.58	12.52
14	262.57	12.79
15	272.54	13.62
16	282.44	15.00
17	292.25	16.93
18	301.94	19.41
19	311.48	22.42
20	320.83	25.96
21	329.97	30.02
22	338.87	34.57
23	347.51	39.62
24	355.85	45.14
25	363.86	51.11
26	371.54	57.53
27	378.84	64.36
28	385.75	71.58
29	389.53	76.00

*** 2.836 ***

by CEM
44 of 61
✓ mjy 8-16-91

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	70.67	50.62
2	79.18	45.37
3	87.89	40.45
4	96.77	35.87
5	105.83	31.62
6	115.04	27.72
7	124.39	24.18
8	133.86	20.99
9	143.46	18.16
10	153.15	15.70
11	162.93	13.61
12	172.78	11.89
13	182.69	10.55
14	192.64	9.58
15	202.62	9.00
16	212.62	8.79
17	222.62	8.96
18	232.60	9.51
19	242.56	10.44
20	252.48	11.75
21	262.33	13.43
22	272.12	15.49
23	281.82	17.91
24	291.42	20.70
25	300.91	23.86
26	310.28	27.37
27	319.50	31.24
28	328.57	35.45
29	337.47	40.00
30	346.19	44.89
31	354.73	50.11
32	363.05	55.64
33	371.17	61.49
34	379.05	67.64
35	386.69	74.09
36	388.79	76.00

*** 2.943 ***

by CEM
45 of 61
✓ mjj
8-16-91

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	70.67	50.62
2	79.21	45.42
3	87.94	40.54
4	96.85	36.00
5	105.92	31.79
6	115.14	27.93
7	124.51	24.42
8	134.00	21.26
9	143.60	18.47
10	153.30	16.03
11	163.08	13.96
12	172.93	12.26
13	182.85	10.94
14	192.80	9.99
15	202.78	9.41
16	212.78	9.21
17	222.78	9.38
18	232.76	9.93
19	242.72	10.86
20	252.64	12.16
21	262.50	13.83
22	272.29	15.88
23	281.99	18.28
24	291.60	21.06
25	301.10	24.19
26	310.47	27.68
27	319.70	31.51
28	328.79	35.70
29	337.71	40.22
30	346.45	45.07
31	355.00	50.25
32	363.36	55.75
33	371.50	61.55
34	379.41	67.66
35	387.10	74.07
36	389.25	76.00

*** 2.956 ***

by CEN
46 of 61
✓ mjy
8-16-91

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	70.67	50.62
2	78.15	43.99
3	85.99	37.77
4	94.14	31.99
5	102.60	26.65
6	111.33	21.77
7	120.31	17.37
8	129.51	13.46
9	138.91	10.05
10	148.48	7.15
11	158.20	4.78
12	168.02	2.92
13	177.94	1.60
14	187.90	.82
15	197.90	.57
16	207.90	.87
17	217.86	1.69
18	227.77	3.06
19	237.59	4.96
20	247.29	7.38
21	256.85	10.32
22	266.23	13.77
23	275.42	17.72
24	284.38	22.16
25	293.09	27.08
26	301.52	32.46
27	309.65	38.28
28	317.45	44.53
29	324.91	51.20
30	331.99	58.25
31	338.69	65.68
32	344.98	73.46
33	346.81	76.00

*** 2.964 ***

by C-F
47 of 61
/mjy
E-16-91

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.89	51.45
2	172.61	45.09
3	180.75	39.28
4	189.28	34.06
5	198.16	29.46
6	207.33	25.48
7	216.76	22.16
8	226.41	19.51
9	236.21	17.55
10	246.13	16.27
11	256.11	15.69
12	266.11	15.82
13	276.08	16.64
14	285.96	18.17
15	295.71	20.38
16	305.29	23.27
17	314.63	26.82
18	323.71	31.03
19	332.47	35.85
20	340.86	41.28
21	348.86	47.29
22	356.42	53.84
23	363.49	60.91
24	370.06	68.45
25	375.75	76.00

*** 2.965 ***

Imjy
8-16-91

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.33	51.24
2	148.96	44.77
3	157.02	38.86
4	165.49	33.54
5	174.32	28.84
6	183.46	24.78
7	192.87	21.39
8	202.49	18.68
9	212.29	16.67
10	222.20	15.36
11	232.18	14.77
12	242.18	14.89
13	252.15	15.73
14	262.03	17.28
15	271.77	19.53
16	281.33	22.47
17	290.65	26.09
18	299.69	30.37
19	308.40	35.28
20	316.74	40.80
21	324.66	46.91
22	332.12	53.56
23	339.09	60.74
24	345.52	68.39
25	351.04	76.00

*** 3.040 ***

49 of 61

✓ mjj

8-16-91

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	117.78	51.03
2	126.24	45.70
3	134.95	40.79
4	143.89	36.31
5	153.04	32.28
6	162.38	28.70
7	171.88	25.58
8	181.52	22.93
9	191.28	20.76
10	201.14	19.07
11	211.07	17.87
12	221.04	17.16
13	231.04	16.93
14	241.04	17.20
15	251.01	17.96
16	260.93	19.21
17	270.78	20.94
18	280.53	23.16
19	290.16	25.85
20	299.65	29.01
21	308.97	32.63
22	318.10	36.70
23	327.02	41.22
24	335.71	46.17
25	344.15	51.54
26	352.31	57.32
27	360.17	63.50
28	367.73	70.05
29	373.95	76.00

*** 3.058 ***

EO-61

mjy
8-16-91

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.89	51.45
2	173.11	45.76
3	181.69	40.61
4	190.58	36.03
5	199.74	32.03
6	209.15	28.63
7	218.75	25.85
8	228.51	23.69
9	238.40	22.16
10	248.36	21.28
11	258.36	21.04
12	268.35	21.45
13	278.29	22.50
14	288.15	24.20
15	297.87	26.52
16	307.43	29.47
17	316.77	33.03
18	325.87	37.19
19	334.68	41.92
20	343.16	47.21
21	351.29	53.04
22	359.02	59.39
23	366.32	66.21
24	373.17	73.50
25	375.24	76.00

*** 3.130 ***

Page E1 of 6

✓ mjy
8-16-91

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	117.78	51.03
2	126.21	45.66
3	134.91	40.73
4	143.86	36.26
5	153.03	32.27
6	162.39	28.76
7	171.92	25.74
8	181.60	23.22
9	191.40	21.22
10	201.29	19.72
11	211.24	18.75
12	221.23	18.29
13	231.23	18.36
14	241.21	18.95
15	251.15	20.06
16	261.02	21.69
17	270.78	23.83
18	280.43	26.47
19	289.92	29.62
20	299.23	33.26
21	308.35	37.38
22	317.23	41.96
23	325.87	47.01
24	334.22	52.50
25	342.28	58.42
26	350.03	64.75
27	357.43	71.48
28	361.91	76.00

*** 3.168 ***

52 of 61

8-16-91

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	50.00
2	8.74	45.15
3	17.63	40.55
4	26.64	36.22
5	35.77	32.15
6	45.02	28.35
7	54.38	24.82
8	63.84	21.57
9	73.38	18.59
10	83.01	15.90
11	92.72	13.48
12	102.49	11.36
13	112.32	9.52
14	122.20	7.96
15	132.12	6.70
16	142.07	5.73
17	152.04	5.04
18	162.04	4.65
19	172.04	4.56
20	182.03	4.75
21	192.02	5.24
22	201.99	6.02
23	211.94	7.08
24	221.84	8.44
25	231.71	10.09
26	241.52	12.03
27	251.27	14.25
28	260.95	16.76
29	270.55	19.54
30	280.07	22.61
31	289.49	25.96
32	298.82	29.57
33	308.03	33.46
34	317.12	37.62
35	326.09	42.04
36	334.93	46.72
37	343.63	51.66
38	352.17	56.85
39	360.57	62.29
40	368.80	67.97
41	376.86	73.88
42	379.57	76.00

*** 3.190 ***

53 of 61

✓ mjj
8-16-91

```
          Y            A     X     I     S            F     T

                .00     48.75     97.50    146.25    195.00    243.75

X          .00 +---------*---------+---------+---------+---------+
               -        0.
               -       0.
               -     .0. .
               -    ..0 ..
               -   . . ..
           48.75 +  .  0....
               -  . 0.....
               - . 0.....
               -  .0.....2
               -..0 ....2.
               -..0....2..
A          97.50 +......2...
               . 0..423...
               ..0.4.2...7
               ..0.42.....
               .0.42....7.
               .04.....7..1
X         146.25 .4..2..7.1.
               .4.2...71..
               .0.2..71.. 5
               -423.76..5.*
               402..71.5..
               4.3..1.5....
I         195.00 402.615.....
               -02.1..8... *
               4021758.....*
               4 2175.......
               -4 758......*
               -42158......*
S         243.75 + 217.......*
               - 217........
               - 416.........
               -  269........
               -  148........
               -  124.........
          292.50 +  1264........
               -   1264.......
               -    1264......
               -    12864......
               -     527064....
               -     15.7064...
F         341.25 +      12.8764 4*
               -       1258796.4
               -        12587.9.
               -         125.7.9
               -           12585
               -            1210
T         390.00 +           *  2*
```

LUCEM
54 of 61
✓ mjj
8-16-91

APPENDIX B.

REFERENCES.

Tailings Disposal Systems Analysis
United Nuclear Church Rock Mill
Church Rock, New Mexico
SHB Job No. E78-1041

E-199

NATIVE SOIL

PERMEABILITY TEST
(Pressurized Permeameter)

Lab No. 8-1041-118: Boring #7 @ 6' to 7' -- test insitu on tube sample

Diameter 4.887 cm Length 8.913 cm Area 18.755 cm^2 Vol. 167.171 cc

W_s 242.2 grms. w_o 3.8% w_f 30.0% G_s 2.65 V_s 91.396 cc

Void Ratio 0.8290 Dry Density 90.4 PCF Trials 9 days

Pressure (PSI)	Head (inches)	Q (cc)	Time (min.)	K (cm/sec)	K (ft/yr)	Remarks
0	43.9	315	242	9.25×10^{-5}	96.0	Flow
0	45.7	335	385	5.95×10^{-5}	61.0	Flow
0	45.6	295	537	3.76×10^{-5}	39.0	Flow
Constant Head	70.8	875	1570	2.45×10^{-5}	25.0	Flow
Constant Head	70.8	135	410	1.45×10^{-5}	15.0	Flow
Constant Head	70.8	140	447	1.38×10^{-5}	14.0	Flow
5	181.9	320	351	1.56×10^{-5}	16.0	Flow
5	181.5	215	265	1.39×10^{-5}	14.0	Flow
5	181.7	170	203	1.44×10^{-5}	15.0	Flow

Note: Saturation (initial) = 12%, saturation achieved 96% based on assumed 2.65 specific gravity.

REPORT ON LABORATORY TESTS

PROJECT Tailings Disposal Systems Analysis JOB NO. E78-1041
LOCATION UNC Church Rock Mill LAB NO. 8-1041-348
SAMPLE #9 @ 5½' - 6½'

DIRECT SHEAR TESTS

In Situ - Point No. 1 (=±1.00 KSF)		
Initial Moisture Content	29.7	%
Dry Density (PCF)	90.80	
Submerged		
Final Moisture Content	29.7	%
Maximum Vertical Strain @ T Max.	(-).023	inches
Shearing Stress T Max	0.19	KSF
In Situ - Point No. 2 (=± 3.00 KSF)		
Initial Moisture Content	30.2	%
Dry Density (PCF)	91.85	
Submerged (Specimen extruded from ring upon saturation)		
Final Moisture Content	30.2	%
Maximum Vertical Strain @ T max.	(-).036	inches
Shearing Stress T max.	0.41	KSF
In Situ - Point No. 3 (=± 5.08KSF)		
Initial Moisture Content	29.6	%
Dry Density (PCF)	92.34	
Submerged		
Final Moisture Content	29.6	%
Maximum Vertical Strain @ T max.	(-).019	inches
Shearing Stress T max.	1.74	KSF

57 of 61

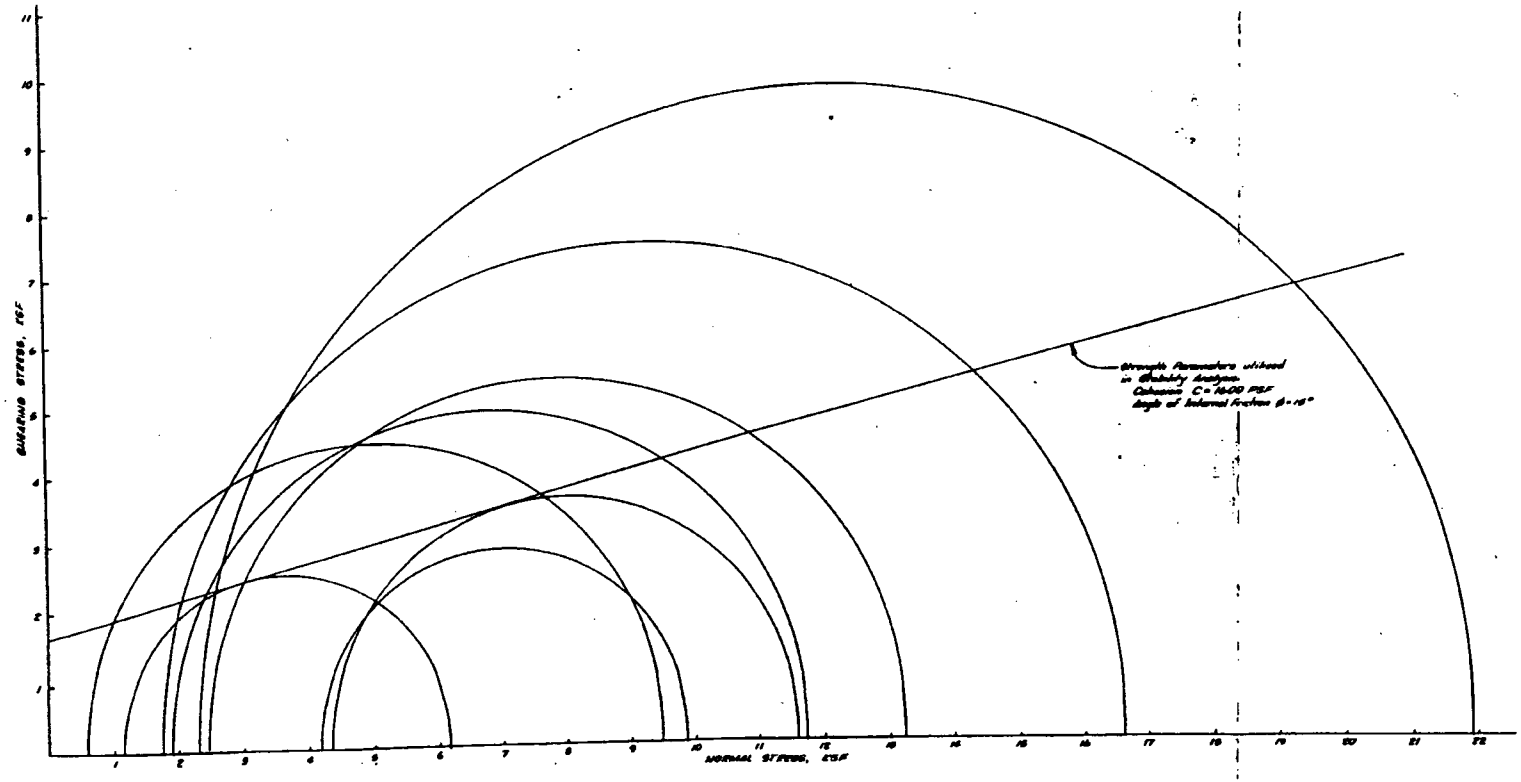
REPORT ON LABORATORY TESTS

PROJECT Tailings Disposal Systems Analysis JOB NO. E78-1041
LOCATION UNC Church Rock Mill LAB NO. 8-1041-236
SAMPLE #13 @ 9½' - 10½'

DIRECT SHEAR TESTS

In Situ - Point No. 1 (=± 1.00KSF)		
Initial Moisture Content	8.8	%
Dry Density (PCF)	98.92	
Submerged		
Final Moisture Content	24.1	%
Maximum Vertical Strain @ T Max.	(-).012	inches
Shearing Stress T Max	0.57	KSF
In Situ - Point No. 2 (=± 3.00 KSF)		
Initial Moisture Content	8.0	%
Dry Density (PCF)	99.86	
Submerged		
Final Moisture Content	24.0	%
Maximum Vertical Strain @ T max.	(-).017	inches
Shearing Stress T max.	1.71	KSF
In Situ - Point No. 3 (=± 5.08KSF)		
Initial Moisture Content	8.6	%
Dry Density (PCF)	93.53	
Submerged		
Final Moisture Content	26.4	%
Maximum Vertical Strain @ T max.	(-).022	inches
Shearing Stress T max.	2.99	KSF

58 of 61



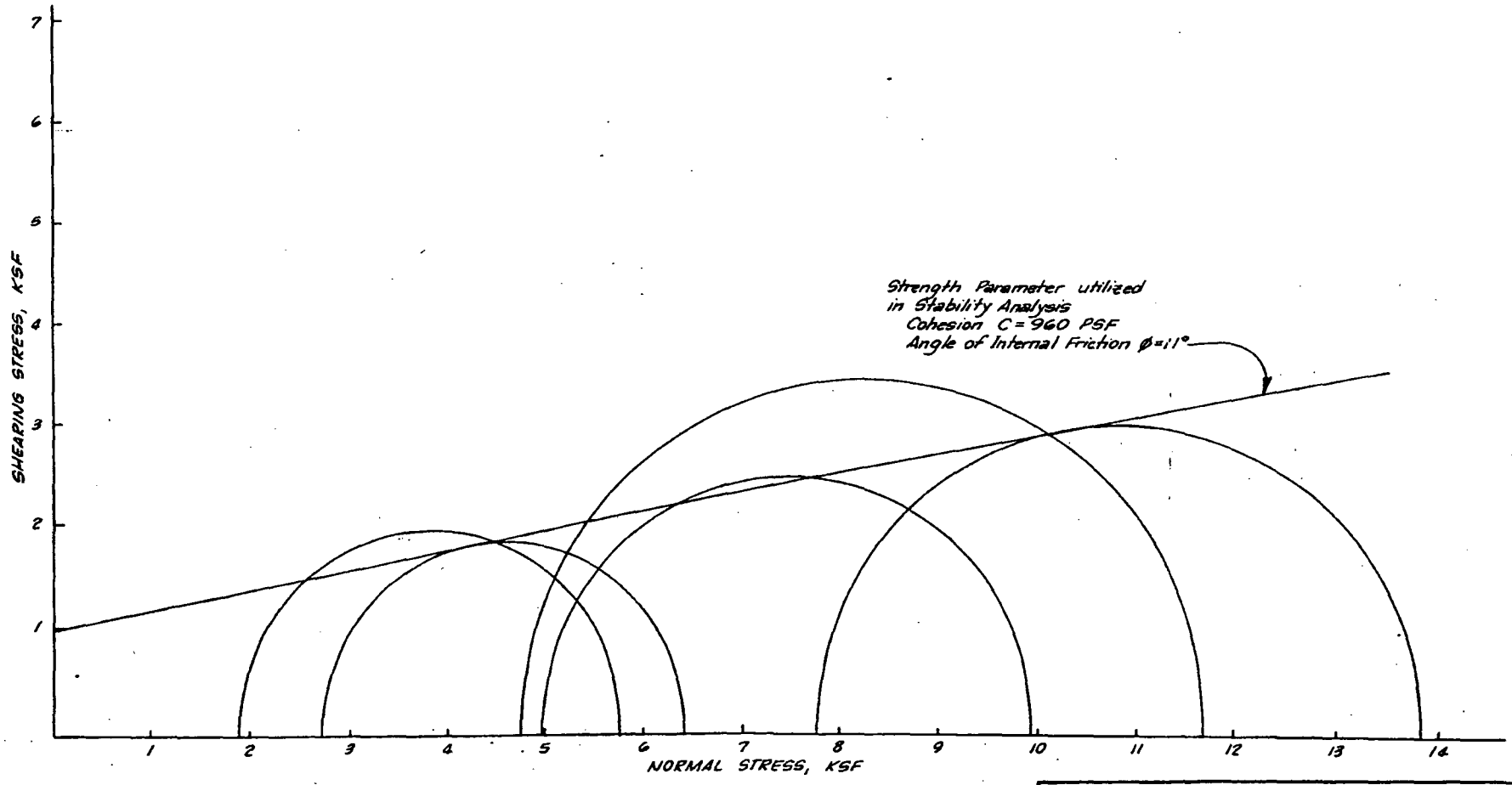
SUMMARY OF TRIAXIAL SHEAR TESTS PERFORMED BY ROLLA GEOTECHNICAL CONSULTANTS, ROLLA, MISSOURI

EXISTING EMBANKMENT SOILS
TOTAL STRESS ANALYSIS

SERGENT, HAUSKINS & BECKWITH
CONSULTING SOIL AND FOUNDATION ENGINEERS

8-24

E-203

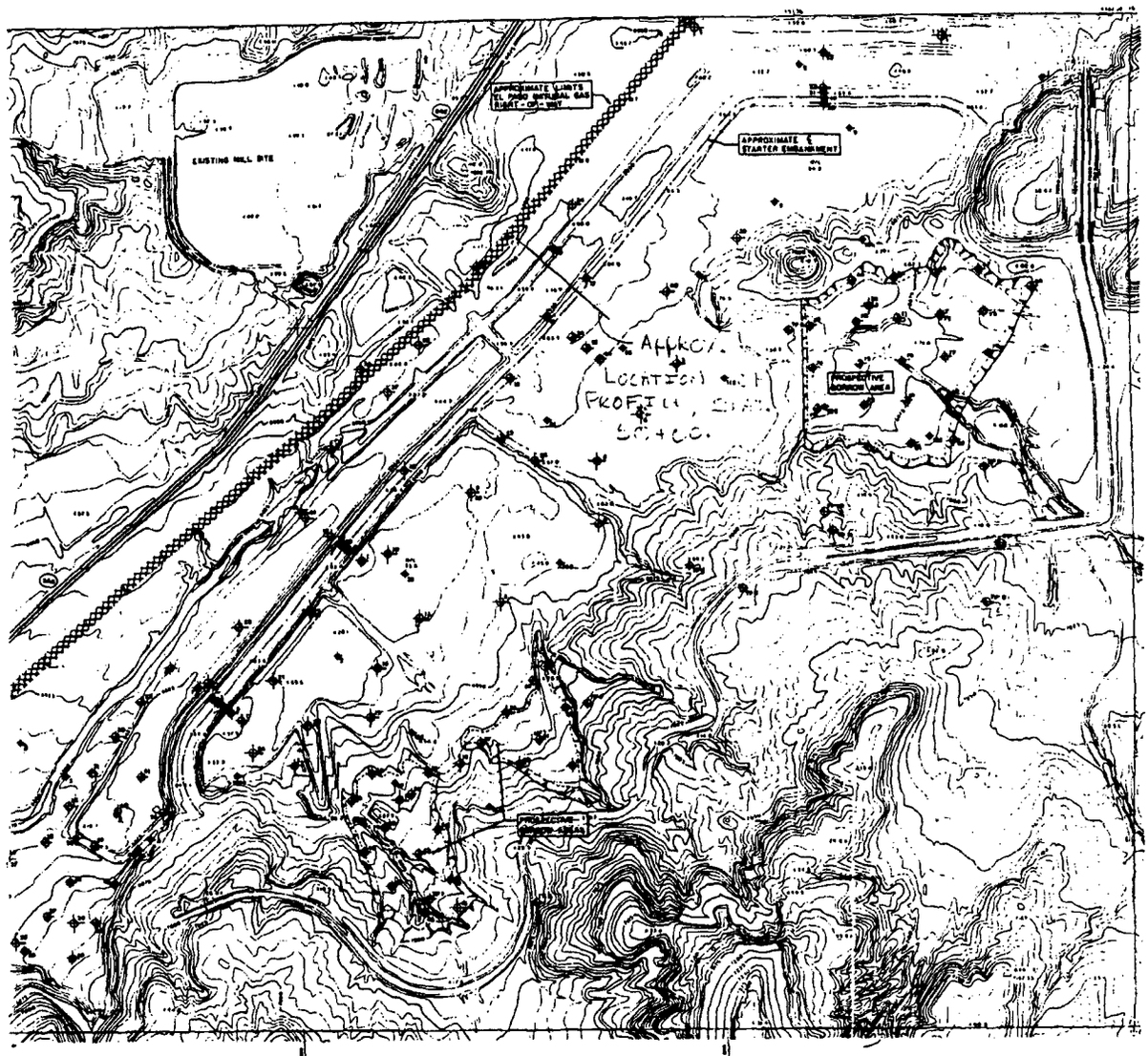


SUMMARY OF TRIAXIAL SHEAR TESTS
PERFORMED BY ROLLA GEOTECHNICAL
CONSULTANTS, ROLLA, MISSOURI

FOUNDATION (NATIVE) SOILS
TOTAL STRESS ANALYSIS

SERGENT, HAUSKINS & BECKWITH
CONSULTING SOIL AND FOUNDATION ENGINEERS

B-11



LEGEND

- TEST BORING PREVIOUS INVESTIGATION JOB NO. E76-1072
- TEST PIT PREVIOUS INVESTIGATION JOB NO. E75-1118
- TEST BORING PREVIOUS INVESTIGATION WITH ADJACENT E-W TEST JOB NO. E76-1043
- SEEPAGE DETECTION WELL, PREVIOUS INVESTIGATION WITH ADJACENT GROUND WATER MONITORING WELL JOB NO. E76-1043
- TEST BORING HOLLOW STEM AUGER, THIS INVESTIGATION JOB NO. E76-1041
- TEST BORING CONVENTIONAL FLIGHT AUGER, THIS INVESTIGATION JOB NO. E76-1041

SITE PLAN

SHOWING BORING LOCATIONS

SERGENT, HAUSKINS & BECKWITH
CONSULTING SOIL AND FOUNDATION ENGINEERS

UNITED NUCLEAR CORPORATION

SEC. 2, T.16 N., R.16 W., N.M.P.M.

E.5(a)

Hydraulic Analyses for Swales

Canonie Environmental

E-206

By _____ Date _____ Subject _____ Sheet No. ____ of 23

Chkd. By GC Date 2-03-90 _____ Proj. No. _____

1/4" X 1/4"

PURPOSE: TO DETERMINE THE SWALE DESIGN(S) FOR THE RECLAIMED URANIUM TAILINGS IMPOUNDMENT AT THE UNC SITE

METHODS:

1) DIVIDE IMPOUNDMENT TOP INTO DRAINAGE AREAS BASED ON SWALE LOCATIONS AND DETERMINE FOR EACH AREA:
   - A) AREA
   - B) MAX. FLOW LENGTH
   - C) MAX ELEVATION DIFFERENCE
   - D) TIME OF CONCENTRATION

2) INPUTTING THE PROBABLE MAXIMUM PRECIPITATION EVENT AND CURVE NUMBER PREVIOUSLY DETERMINED FOR THE SITE, DETERMINE THE PMF STORM HYDROGRAPH USING THE SCS TR-55 METHOD FOR A TYPE II STORM DISTRIBUTION

RESULTS: SEE TABLE NEXT PAGE FOR DETAILS

Canonie Environmental

By [illegible] Date 11/14/90 Subject LINC - IMPOUNDMENT TOP Sheet No. 2 of 23

Chkd. By GS Date 12-03-90 SWALE DESIGN Proj. No. 88-060-24

1/4" X 1/4"

E-207

IMPOUNDMENT TOP DRAINAGE SWALE CHARACTERISTICS
SIDE SLOPES 3H:1V

CHANNEL REACH	LENGTH (ft)	SLOPE (ft/ft)	BOTTOM WIDTH (ft)	Q (cfs)	DEPTH OF FLOW (ft)	RIPRAP D_{50} (in)	
A	2600	0.0038	10	40	0.98	0.7	USE 1.5
B	3600	0.0083	20	97	0.97	1.5	
C	3400	0.0050	10	75	1.38	1.5	
D	3200	0.0028	10	68	1.43	0.7	= USE 1.5"
E	1350	0.0037	10	85	1.53	0.9	USE 1.5"
F	1600	0.0031	10	126	2.00	1.0	USE 1.5"
G	1400	0.0021	10	99	1.88	0.7	USE 1.5"
H	2,550	0.0085	20	284	1.90	3.0	
I	550	0.0040	20	385	2.65	1.8	
J	1900	0.0042	10	101	1.66	1.2	USE 1.5"

Canonie Environmental

E-208

By [illegible] Date 11/10/90 Subject UNC - Impoundment Top Sheet No. 3 of 23

Chkd. By GS Date 12-03-90 SWALE DESIGN Proj. No. 86-060-21

1/4" X 1/4"

CHANNEL SLOPE DETERMINATIONS

CHANNEL	ΔEL	LENGTH	SLOPE
SWALE A	7005 - 6995 (10)	2600	0.0038
B	7003 - 6973 (30)	3600	0.0083
C	6995 - 6978 (17)	3400	0.0054
D	6989 - 6980 (9)	3200	0.0028
E	6982 - 6977 (5)	1350	0.0037
F	6973 - 6968 (5)	1600	0.0031
G	6966 - 6963 (3)	1400	0.0021
H	6977 - 6955 (22)	2600	0.0085
J	6963 - 6955 (8)	1900	0.0042
I	6955 - 6953 2ft	500'	0.004

Canonie Environmental

E-209

By [illegible] Date [illegible]/10/90 Subject INC - IMPOUNDMENT TOP SWALE DESIGN Sheet No. 4 of 23

Chkd. By GJ Date 12-03-90 Proj. No. [illegible]

1/4" X 1/4"

CALCULATIONS: MEASURE THE FOLLOWING FROM PLAN TOPO MAP

FOR AREA AND DRAINAGE SWALE A

DRAINAGE AREA: 231880 ft² = 5.3 AC

MAX OVERLAND FLOW LENGTH: 200 ft

MAX CHANNEL FLOW LENGTH: 2600 ft

MAX ELEV DIFF (7005 - 6995) 10 ft

DETERMINE 1ST CUT TIME OF CONCENTRATION BY ADDING OVERLAND FLOW TIME AND CHANNEL FLOW TIME. ASSUME $V_{overland}$ = 1 ft/sec & $V_{channel}$ = 5 ft/sec. (Check this assumption later)

t_c = 200 ft/(1 ft/sec) + 2600 ft/(5 ft/sec) = 720 sec

= 0.2 hrs

FOR AREA AND DRAINAGE SWALE B

DRAINAGE AREA: 562961 = 12.9 AC

MAX OVERLAND FLOW LENGTH: 540 ft

MAX CHANNEL FLOW LENGTH: 3600 ft

MAX ELEV DIFF 7003 - 6936 36 ft

First cut t_c = 540/1 + 3600/5 = 1,260 sec

= 0.35 hrs → 0.3 hrs

THE 540' overland flow length is at the downstream end of the swale (near end of swale). Max upstream overland flow length is 120 ft. If 120 ft is used a more conservative t_c = 0.23 ⇒ 0.2 is obtained

Use 0.2 = t_c

Canonie Environmental

E-210

By [illegible] Date 11/10/90 Subject [illegible] Sheet No. 5 of 23
Chkd. By GS Date 12-03-90 [illegible] Proj. No. 86-060-24

1/4" X 1/4"

FOR AREA AND DRAINAGE SWALE C

DRAINAGE AREA: 430281 = 9.9 AC.
MAX. OVERLAND FLOW LENGTH: 200 ft
MAX CHANNEL FLOW LENGTH: 3400 ft
MAX ELEV. DIFF: 6995 - 6978 17 ft

First cut $t_c = 200/1 + 3400/5 = 880$ sec
$= 0.24$ hrs $\rightarrow 0.2$ hrs

FOR AREA AND DRAINAGE SWALE D

DRAINAGE AREA: 462521 ft² = 10.6 AC
MAX OVERLAND FLOW LENGTH: 260 ft
MAX CHANNEL FLOW LENGTH: 3200 ft
MAX ELEV. DIFF: 6989 - 6980 9 ft

FIRST CUT $t_c = 260/1 + 3200/5 = 900$ sec
$= 0.25$ hrs $\rightarrow 0.3$ hrs.

FOR AREA AND DRAINAGE SWALE E

DRAINAGE AREA: 580321 ft² = 13.3 AC.
MAX. OVERLAND FLOW LENGTH: 950 ft
MAX CHANNEL FLOW LENGTH: 1350 ft
MAX ELEV DIFF: (6982-6977) 5 ft

FIRST CUT $t_c = 750/1 + 1350/5 = 1020$ sec
$= 0.28$ hrs $\rightarrow 0.3$ hrs

Canonie Environmental

E-211

By mm Date 11/10/90 Subject UNC - IMPOUNDMENT TOP SWALE DESIGN Sheet No. 6 of 23

Chkd. By GS Date 12-03-90 Proj. No. 86-060-24

1/4" X 1/4"

FOR AREA AND DRAINAGE SWALE F

DRAINAGE AREA:	729121 ft²	= 16.7 AC
MAX OVERLAND FLOW LENGTH:		500 ft
MAX CHANNEL FLOW LENGTH:		1600 ft
MAX ELEV. DIFF:	6973 - 6968	5 ft

FIRST CUT $t_c = 500/1 + 1600/5 = 820$ sec
$= 0.23$ hrs $\rightarrow 0.2$ hrs

FOR AREA AND DRAINAGE SWALE G

DRAINAGE AREA:	570401 ft²	13.1 AC.
MAX OVERLAND FLOW LENGTH:		500 ft
MAX CHANNEL FLOW LENGTH:		1400 ft
MAX ELEV. DIFF:	6966 - 6963	3 ft

FIRST CUT $t_c = 500/1 + 1400/5 = 780$ sec
$= 0.22$ hrs $\rightarrow 0.2$ hrs

FOR AREA AND DRAINAGE SWALE H & I

DRAINAGE AREA:	2,481,864 ft²	57.0 AC.
MAX OVERLAND FLOW LENGTH:		1300 ft
MAX CHANNEL FLOW LENGTH:		3100 ft
MAX ELEV. DIFF:	(6953 - 6977)	24 ft

First cut $t_c = 1300\ ft/1 + 3100\ ft/5 = 1920$ sec
$= 0.53$ hrs $\rightarrow 0.5$ hrs

Canonie Environmental

E-212

By [illegible] Date 11/10/90 Subject UNC - IMPOUNDMENT TOP SWALE DESIGN Sheet No. 7 of 23

Chkd. By GS Date 12-03-90 Proj. No. 86-060-24

1/4" X 1/4"

FOR AREA AND DRAINAGE SWALE J

DRAINAGE AREA: 689,441 ft² = 15.8 Ac.

MAX. OVERLAND FLOW LENGTH: 800 ft

MAX CHANNEL FLOW LENGTH: 1900 ft

MAX ELEV DIFF. 463-55 8 ft

FIRST CUT t_c = 800/1 + 1900/5 = 1180 sec

= 0.33 hrs → 0.3 hrs

Canonie Environmental

E-213

By [illegible] Date 11/10/90 Subject UNC - IMPOUNDMENT TOP Sheet No. 8 of 23
Chkd. By GS Date 12-03-90 SWMCE DESIGN Proj. No. 86-020-24
1/4" X 1/4"

DETERMINE CURVE NO.

A CN OF 79 WAS DETERMINED BY FAITH AND PROVIDED IN ITS 1981 REPORT TO UNC ENTITLED "DESIGN FLOOD ANALYSIS: NORTH CELL TAILINGS EMBANKMENT." FAITH USED AN AREA-WEIGHTED DETERMINATION USING THE NAMES, COVER TYPES, HYDROLOGIC SOIL GROUPS, CN, AND AREA OF EACH OF FIVE SOIL ASSOCIATIONS FOUND IN PIPELINE ARROYO.

SCIENCE APPLICATION, INC. DETERMINED A CN OF 80 FOR THE AREA DRAINING TO THE N. & S. DIVERSION DITCHES IN ITS JUNE 1981 REPORT ENTITLED "PMF DETERMINATION FOR THE SOUTHEAST DIVERSION CHANNEL AND SECTION 1 WATERSHED USING SCS HYDROLOGICAL TECHNIQUES." (REF: RESPONSE TO NRC COMMENTS, MAY 23, FOR)

USE CN = 80

DETERMINE PMP EVENT

PMP HAS BEEN DETERMINED TO BE 9.4 IN. HOWEVER A CORRECTION MUST BE MADE FOR THE HIGH ELEVATION OF THE SITE. (MEAN BASIN ELEVATION CORRECTION).

THE CORRECTION FACTOR IS -5% FOR EVERY 1000 FT OF ELEVATION IN EXCESS OF 5000 FT. CONSERVATIVELY CHOOSE MEAN BASIN ELEVATION OF 7000 FT.

PMP = 8.43 inches

DETERMINE HYDROGRAPH BY TR-55 METHOD

Canonie Environmental

E-214

By mjg Date 11/10/90 Subject UNC-IMPOUNDMENT TOP SWALE DESIGN Sheet No. 9 of 23

Chkd. By GS Date 12-03-90 Proj. No. 86-060-24

1/4" X 1/4"

DETERMINE CHANNEL AND RIPRAP DESIGN

USE PEAK FLOWS RESULTING FROM PMF AS DETERMINED BY SCS TR-55 HYDROGRAPH.

INPUT PEAK FLOW RATES, ASSUMED CHANNEL SLOPES & BOTTOM WIDTHS, AND SIDE SLOPES TO CALCULATE CHANNEL DIMENSIONS AND RIPRAP SIZES BY SAFETY FACTOR METHOD. USE SPREADSHEET "RIPSF.WR1."

TRY TO KEEP ROCK SIZES AS UNIFORM AS POSSIBLE.

0

101

12-0340

Tc = 0.2 RUNOFF HYDROGRAPHS BY THE SCS TR-55 METHOD

TYPE-II STORM DISTRIBUTION

10-Nov-90
02:24 PM

TIME OF CONCENTRATION = 0.2 HOURS
TRAVEL TIME = 0 HOURS

HYDROGRAPH TIME IN HOURS

WATERSHED DESIGNATION	DRAINAGE AREA (AC)	DRAINAGE AREA (SQ MI)	CURVE NUMBER	PPT AMT (IN)	RUNOFF (IN)	(TIME)	11.0	11.3	11.6	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.8	14.0	14.3	14.6
						(CSM/IN)	23	31	47	209	403	739	880	481	250	166	128	102	86	70	61	54	49	44	40	35	33
AREA A UNC	5.3	8.28E-03	80.0	8.43	6.03	(CFS)	1	2	2	10	20	37	40	24	12	8	6	5	4	3	3	3	2	2	2	2	2
AREA B UNC	12.9	2.02E-02	80.0	8.43	6.03	(CFS)	3	4	6	25	49	90	97	58	30	20	16	12	10	9	7	7	6	5	5	4	4
AREA C UNC	9.9	1.55E-02	80.0	8.43	6.03	(CFS)	2	3	4	19	38	69	75	45	23	15	12	10	8	7	6	5	5	4	4	3	3
AREA F UNC	16.7	2.61E-02	80.0	8.43	6.03	(CFS)	4	5	7	33	63	116	126	76	39	26	20	16	14	11	10	8	8	7	6	6	5
AREA G UNC	13.1	2.05E-02	80.0	8.43	6.03	(CFS)	3	4	6	26	50	91	99	59	31	20	16	13	11	9	8	7	6	5	5	4	4

5.133

Tc = 0.5 RUNOFF HYDROGRAPHS BY THE SCS TR-55 METHOD

TYPE-II STORM DISTRIBUTION

10-Nov-90
02:24 PM

TIME OF CONCENTRATION = 0.5 HOURS
TRAVEL TIME = 0 HOURS

HYDROGRAPH TIME IN HOURS

WATERSHED DESIGNATION	DRAINAGE AREA (AC)	DRAINAGE AREA (SQ MI)	CURVE NUMBER	PPT AMT (IN)	RUNOFF (IN)	(TIME)	11.0	11.3	11.6	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.8	14.0	14.3	14.6
						(CSM/IN)	17	23	32	57	94	170	308	467	529	507	402	297	226	140	96	74	61	53	47	41	36
W/I AREA ~~G~~ UNC	57.0	8.91E-02	80.0	8.43	6.03	(CFS)	9	12	17	31	50	91	165	251	284	272	216	159	121	75	52	40	33	28	25	22	19

Tc = 0.3 RUNOFF HYDROGRAPHS BY THE SCS TR-55 METHOD

TYPE II STORM DISTRIBUTION

10-Nov 90
02:24 PM

TIME OF CONCENTRATION = 0.3 HOURS
TRAVEL TIME = 0 HOURS

E-215

HYDROGRAPH TIME IN HOURS

WATERSHED DESIGNATION	DRAINAGE AREA (AC)	DRAINAGE AREA (SQ MI)	CURVE NUMBER	PPT AMT (IN)	RUNOFF (IN)	(TIME) (CSM/IN)	11.0 20	11.3 28	11.6 41	11.9 118	12.0 236	12.1 447	12.2 676	12.3 676	12.4 459	12.5 283	12.6 196	12.7 146	12.8 114	13.0 80	13.2 66	13.4 57	13.6 51	13.8 46	14.0 42	14.3 37	14.6 33
AREA D UNC	10.6	1.66E-02	80.0	8.43	6.83	(CFS)	2	3	4	12	23	45	68	68	46	28	20	15	11	8	7	6	5	5	4	4	3
AREA E UNC	13.3	2.08E-02	80.0	8.43	6.83	(CFS)	3	4	5	15	29	56	85	85	58	35	25	18	14	10	8	7	6	6	5	5	4
AREA G-2 UNC	15.8	2.47E-02	80.0	8.43	6.83	(CFS)	3	4	6	18	35	67	101	101	68	42	29	22	17	12	10	8	8	7	6	6	5
AREA G-3 UNC	13.6	2.12E-02	80.0	8.43	6.83	(CFS)	3	4	5	15	30	57	87	87	59	36	25	19	15	10	8	7	7	6	5	5	4

E-216

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE A

DISCHARGE =	40 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0038	Theta =	0.22 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.06 FT	0.7 inches	D50 (ASSUM) =	0.06 FT	0.7 inches
n =	0.025		n =	0.025	
* TRIAL d =	1.00 ft	******			
DIFFERENCE =	3.49 %				
* calc d =	0.98 ft	******			
DIFFERENCE =	0.28 %				
* calc d =	0.98 ft	******			
DIFFERENCE =	0.03 %				
* calc d =	0.98 ft	******			
DIFFERENCE =	0.00 %				
FINAL d =	0.98 ft				
A =	12.70 sq ft				
R =	0.78 ft		t =	0.17 PSF	
t =	15.89 ft		nb =	0.65	
V =	3.15 fps				
Q(calc) =	40 cfs		Beta =	37.78	
t =	0.23 PSF				
nb =	0.070		n' =	0.53	
SFb =	1.14		SFs =	1.10	

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE B

DISCHARGE =	97 CFS		
BOTTOM WIDTH =	20 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0083	Theta =	0.48 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.13 FT	1.5 inches	D50 (ASSUM) =	0.13 FT	1.5 inches
n =	0.028		n =	0.028	
* TRIAL d =	0.97 ft	******			
DIFFERENCE =	-0.33 %				
* calc d =	0.97 ft	******			
DIFFERENCE =	-0.05 %				
* calc d =	0.97 ft	******			
DIFFERENCE =	-0.01 %				
* calc d =	0.97 ft	******			
DIFFERENCE =	-0.00 %				
FINAL d =	0.97 ft				
A =	22.27 sq ft				
R =	0.85 ft		t =	0.38 PSF	
t =	25.83 ft		nb =	0.68	
V =	4.36 fps				
Q(calc) =	97 cfs		Beta =	38.73	
t =	0.50 PSF				
nb =	0.903		n' =	0.55	
SFb =	1.09		SFs =	1.00	

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE C

DISCHARGE =	75 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	[redacted]	Theta =	0.29 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.13 FT	1.5 inches	D50 (ASSUM) =	0.13 FT	1.5 inches
n =	0.028		n =	0.028	
* TRIAL d =	1.40 ft	******			
DIFFERENCE =	3.30 %				
* calc d =	1.38 ft	******			
DIFFERENCE =	0.18 %				
* calc d =	1.38 ft	******			
DIFFERENCE =	0.01 %				
* calc d =	1.38 ft	******			
DIFFERENCE =	0.00 %				
FINAL d =	1.38 ft				
A =	19.43 sq ft				
R =	1.04 ft		t =	0.32 PSF	
t =	18.25 ft		nb =	0.58	
V =	3.86 fps				
Q(calc) =	75 cfs		Beta =	34.45	
t =	0.43 PSF				
nb =	0.770		n' =	0.45	
SFb =	1.29		SFs =	1.19	

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas". pages 185-194

LOCATION: UNC — DRAINAGE SWALE D

DISCHARGE =	68 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0028	Theta =	0.16 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16. ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.06 FT	0.7 inches	D50 (ASSUM) =	0.06 FT	0.7 inches
n =	0.025		n =	0.025	
* TRIAL d =	1.50 ft	******			
DIFFERENCE =	9.50 %				
* calc d =	1.43 ft	******			
DIFFERENCE =	0.05 %				
* calc d =	1.43 ft	******			
DIFFERENCE =	0.00 %				
* calc d =	1.43 ft	******			
DIFFERENCE =	0.00 %				
FINAL d =	1.43 ft				
A =	20.40 sq ft				
R =	1.07 ft		t =	0.19 PSF	
t =	18.57 ft		nb =	0.70	
V =	3.33 fps				
Q(calc) =	68 cfs		Beta =	39.76	
t =	0.25 PSF				
nb =	0.933		n' =	0.57	
SFb =	1.07		SFs =	1.06	

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE E

DISCHARGE =	85 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0037	Theta =	0.21 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.08 FT	0.9 inches	D50 (ASSUM) =	0.08 FT	0.9 inches
n =	0.026		n =	0.026	
* TRIAL d =	1.50 ft	******			
DIFFERENCE =	-4.02 %				
* calc d =	1.53 ft	******			
DIFFERENCE =	-0.40 %				
* calc d =	1.53 ft	******			
DIFFERENCE =	-0.03 %				
* calc d =	1.53 ft	******			
DIFFERENCE =	-0.00 %				
FINAL d =	1.53 ft				
A =	22.39 sq ft				
R =	1.14 ft		t =	0.27 PSF	
t =	19.20 ft		nb =	0.74	
V =	3.80 fps				
Q(calc) =	85 cfs		Beta =	41.49	
t =	0.35 PSF				
nb =	0.993		n' =	0.62	
SFb =	1.00		SFs =	1.02	

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: UMC -- DRAINAGE SWALE F

DISCHARGE =	126 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0031	Theta =	0.18 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.09 FT	1.0 inches	D50 (ASSUM) =	0.09 FT	1.0 inches
n =	0.026		n =	0.026	
* TRIAL d =	2.00 ft	******			
DIFFERENCE =	0.06 %				
* calc d =	2.00 ft	******			
DIFFERENCE =	0.00 %				
* calc d =	2.00 ft	******			
DIFFERENCE =	0.00 %				
* calc d =	2.00 ft	******			
DIFFERENCE =	0.00 %				
FINAL d =	2.00 ft				
A =	31.99 sq ft				
R =	1.41 ft		t =	0.29 PSF	
t =	22.00 ft		nb =	0.72	
V =	3.94 fps				
Q(calc) =	126 cfs		Beta =	40.67	
t =	0.39 PSF				
nb =	0.964		n' =	0.60	
SFb =	1.03		SFs =	1.04	

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: UNC — DRAINAGE SWALE G

DISCHARGE =	99 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0021	Theta =	0.12 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.06 FT	0.7 inches	D50 (ASSUM) =	0.06 FT	0.7 inches
n =	0.025		n =	0.025	
* TRIAL d =	1.97 ft	******			
DIFFERENCE =	8.94 %				
* calc d =	1.88 ft	******			
DIFFERENCE =	-0.18 %				
* calc d =	1.88 ft	******			
DIFFERENCE =	-0.01 %				
* calc d =	1.88 ft	******			
DIFFERENCE =	-0.00 %				
FINAL d =	1.88 ft				
A =	29.48 sq ft				
R =	1.35 ft		t =	0.19 PSF	
t =	21.30 ft		nb =	0.69	
V =	3.36 fps				
Q(calc) =	99 cfs		Beta =	39.47	
t =	0.25 PSF				
nb =	0.923		n' =	0.57	
SFb =	1.08		SFs =	1.07	

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE H

DISCHARGE =	284 CFS		
BOTTOM WIDTH =	20 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0085	Theta =	0.49 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.25 FT	3 inches	D50 (ASSUM) =	0.25 FT	3 inches
n =	0.031		n =	0.031	
* TRIAL d =	2.00 ft	******			
DIFFERENCE =	5.12 %				
* calc d =	1.91 ft	******			
DIFFERENCE =	0.37 %				
* calc d =	1.91 ft	******			
DIFFERENCE =	0.04 %				
* calc d =	1.90 ft	******			
DIFFERENCE =	0.00 %				
FINAL d =	1.90 ft				
A =	48.98 sq ft				
R =	1.53 ft		t =	0.76 PSF	
t =	31.43 ft		nb =	0.68	
V =	5.80 fps				
Q(calc) =	284 cfs		Beta =	38.82	
t =	1.01 PSF				
nb =	0.907		n' =	0.56	
SFb =	1.09		SFs =	1.08	

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE I

DISCHARGE =	385 CFS		
BOTTOM WIDTH =	20 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.004	Theta =	0.23 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.15 FT	1.8 inches	D50 (ASSUM) =	0.15 FT	1.8 inches
n =	0.029		n =	0.029	
* TRIAL d =	2.60 ft	******			
DIFFERENCE =	-3.26 %				
* calc d =	2.64 ft	******			
DIFFERENCE =	-0.35 %				
* calc d =	2.65 ft	******			
DIFFERENCE =	-0.03 %				
* calc d =	2.65 ft	******			
DIFFERENCE =	-0.00 %				
FINAL d =	2.65 ft				
A =	73.97 sq ft				
R =	2.01 ft		t =	0.50 PSF	
t =	35.00 ft		nb =	0.74	
V =	5.20 fps				
Q(calc) =	385 cfs		Beta =	41.35	
t =	0.66 PSF				
nb =	0.900		n' =	0.62	
SFb =	1.01		SFs =	1.02	

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SL

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE J

DISCHARGE =	101 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0042	Theta =	0.24 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.10 FT	1.2 inches	D50 (ASSUM) =	0.10 FT	1.2 inches
n =	0.027		n =	0.027	
* TRIAL d =	1.65 ft	******			
DIFFERENCE =	-0.91 %				
* calc d =	1.66 ft	******			
DIFFERENCE =	-0.06 %				
* calc d =	1.66 ft	******			
DIFFERENCE =	-0.00 %				
* calc d =	1.66 ft	******			
DIFFERENCE =	-0.00 %				
FINAL d =	1.66 ft				
A =	24.83 sq ft				
R =	1.21 ft		t =	0.33 PSF	
t =	19.96 ft		nb =	0.73	
V =	4.07 fps				
Q(calc) =	101 cfs		Beta =	40.96	
t =	0.43 PSF				
nb =	0.975		n' =	0.61	
SFb =	1.02		SFs =	1.03	

Canonie Environmental

E-227

By [illegible] Date 11/12/90 Subject UNC - Impoundment Top Sheet No. 22 of 23
Chkd. By GS Date 12-03-90 Swale Design Proj. No. 86-060-24

1/4" X 1/4"

CHECK TIME OF CONCENTRATIONS

AREA A: Design channel velocity = 3.19 fps
Assume overland flow still = 1 ft/sec

$t_c = 200/1 + 2600/3.19 = 1025$ sec = 0.28 hrs
∴ use of t_c = 0.2 hrs is conservative.
(ie will give higher peak flow)

AREA B: Design channel velocity = 4.36 fps

$t_c = 540/1 + 3600/4.36 = 946$ sec = 0.38 hrs
∴ use of t_c = 0.2 hrs is conservative

AREA C: Design channel velocity = 3.86 fps

$t_c = 200/1 + 3400/3.86 = 1081$ sec = 0.30 hrs
∴ use of t_c = 0.2 hrs is conservative

AREA D: Design channel velocity = 3.33 fps

$t_c = 260/1 + 3200/3.33 = 1220$ sec = .34 hrs
∴ use of t_c = 0.3 is conservative

AREA E: Design channel velocity = 3.80 fps

$t_c = 960/1 + 1350/3.80 = 1125$ sec = 0.30 hrs
∴ use of t_c = 0.3 hrs is appropriate

AREA F: Design channel velocity = 3.94 fps

$t_c = 500/1 + 1600/3.94 = 900$ sec = 0.25 hrs
∴ use of t_c = 0.2 hrs is conservative

Canonie Environmental

E-228

By [illegible] Date 11/12/90 Subject UNC - Impoundment Top Sheet No. 23 of 23
Chkd. By GJ Date 12-03-90 Swale Design Proj. No. 86-060-24
1/4" X 1/4"

AREA G: Design channel velocity = 3.36 fps

$t_c = 500/1 + 1400/3.36 = 917$ sec $= 0.25$ hrs
∴ use of $t_c = 0.2$ hrs is conservative

AREA H-I: Design channel velocity = 5.80 fps in Swale G-H

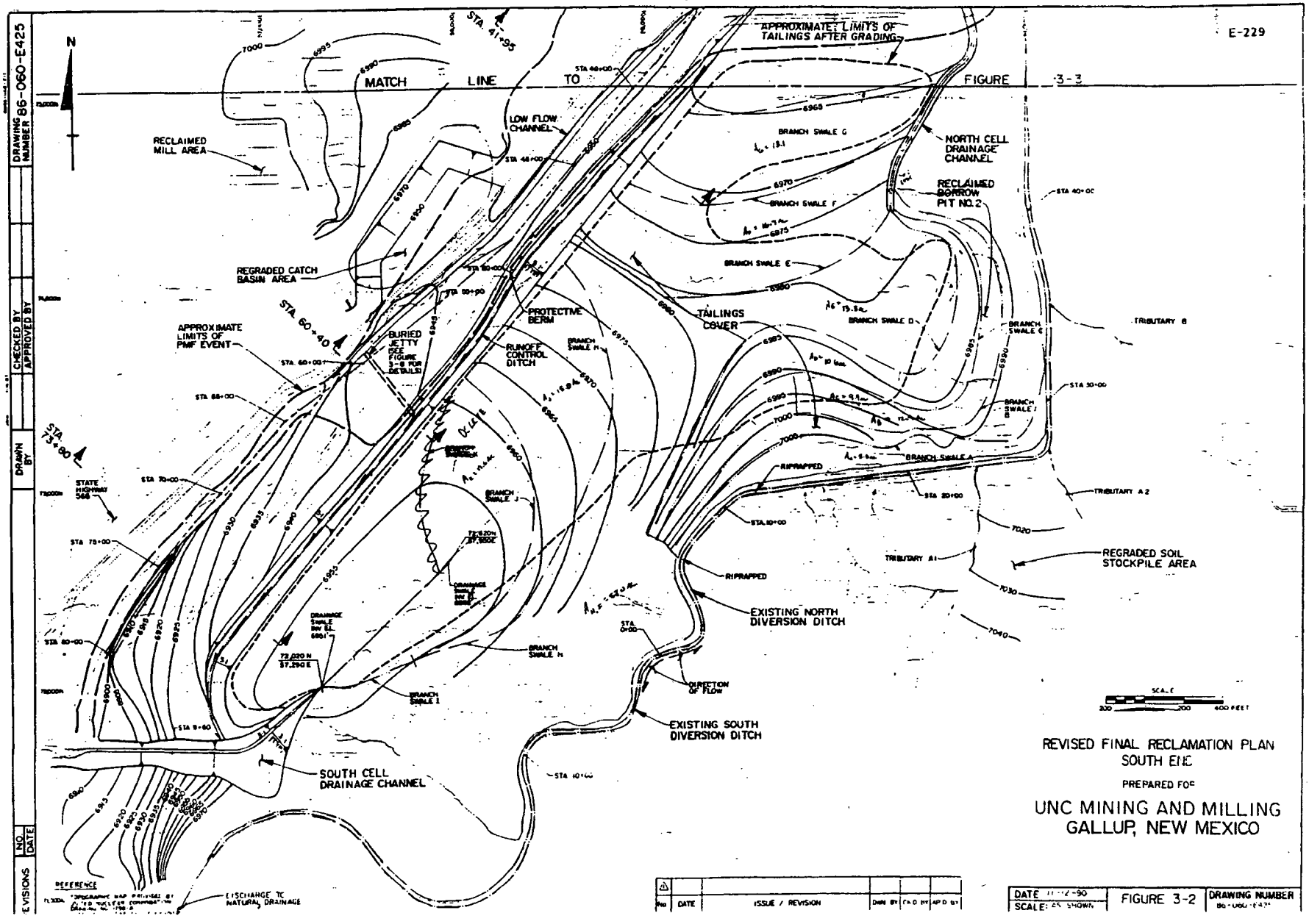
$t_{c_{G-1A}} = 1300/1 + 3100/5.80 = 1834$ sec $= 0.51$ hrs
∴ use of $t_c = 0.5$ hrs is appropriate

Design channel velocity = 4.17 ft/sec in SWALE G-1B

$t_{c_{G-1B}} = 1300/1 + 3100/4.17 = 2043$ sec $= 0.57$ hrs
∴ use of $t_c = 0.5$ hrs is conservative

AREA J: Design channel velocity = 4.02 fps

$t_c = 800/1 + 1900/4.02 = 1261$ sec $= 0.35$ hrs
∴ use of $t_c = 0.3$ hrs is conservative


E-229
MATCH LINE TO FIGURE 3-3
N
APPROXIMATE LIMITS OF TAILINGS AFTER GRADING
RECLAIMED MILL AREA
LOW FLOW CHANNEL
NORTH CELL DRAINAGE CHANNEL
RECLAIMED BORROW PIT NO. 2
BRANCH SWALE G
BRANCH SWALE F
BRANCH SWALE E
BRANCH SWALE D
BRANCH SWALE C
BRANCH SWALE B
BRANCH SWALE A
BRANCH SWALE H
BRANCH SWALE I
BRANCH SWALE J
REGRADED CATCH BASIN AREA
APPROXIMATE LIMITS OF PMF EVENT
BURIED JETTY (SEE FIGURE 3-8 FOR DETAILS)
PROTECTIVE BERM
RUNOFF CONTROL DITCH
TAILINGS COVER
STA 41+95
STA 60+40
STA 75+90
STATE HIGHWAY 568
TRIBUTARY B
TRIBUTARY A2
TRIBUTARY A1
RIPRAPPED
REGRADED SOIL STOCKPILE AREA
EXISTING NORTH DIVERSION DITCH
EXISTING SOUTH DIVERSION DITCH
DIRECTION OF FLOW
SOUTH CELL DRAINAGE CHANNEL
EXCHANGE TO NATURAL DRAINAGE
SCALE
200 200 400 FEET
REVISED FINAL RECLAMATION PLAN
SOUTH END
PREPARED FOR
UNC MINING AND MILLING
GALLUP, NEW MEXICO
DATE
SCALE: AS SHOWN
FIGURE 3-2
DRAWING NUMBER
ISSUE / REVISION
DRAWN BY
CHECKED BY
APPROVED BY
NO.
DATE
REVISIONS

E.5(b)

Soil/Rock Matrix Stability Calculations

Canonie Environmental

E-231

By SWM Date 10-29-90 Subject UNC-ROCK MULCH SIZING Sheet No. 1 of 16

Chkd. By GS Date 12-03-90 ON IMPOUNDMENT TOP Proj. No. 86-060-29

1/4" X 1/4"

PURPOSE : DETERMINE THE ROCK MULCH SIZE (d_{50}) AND THICKNESS FOR THE IMPOUNDMENT TOPS AT UNC USING THE PROPOSED REVISED GRADING PLAN (2' RADON BARRIER).

METHOD : FIGURE 1 SHOWS THE SLOPE SEGMENTS FOR WHICH THE OVERLAND FLOW CALCULATIONS WERE PERFORMED. THE CSU METHOD OF RIPRAP SIZING (NUREG/CR-4651 PHASE II) WAS USED TO SIZE THE RIPRAP.

THE SPREADSHEET PROGRAM "OVERCSU" (LOTUS SYMPHONY) WAS DEVELOPED TO ASSIST IN THE CALCULATIONS. THIS PROGRAM DETERMINES THE OVERLAND FLOW RATE PER UNIT WIDTH (q) FOR THE IMPOUNDMENT TOP USING THE RATIONAL FORMULA AS PER NUREG 4620 AND THE NRC'S STP. FROM THIS POINT THE PROGRAM UTILIZES THE q VALUE AND THE SLOPE TO DETERMINE THE RIPRAP d_{50} BY MEANS OF THE FOLLOWING FORMULA (AS PER NUREG/CR-4651 PHASE II):

$$d_{50} = 5.23 \times (\text{slope})^{0.43} \times (q)^{0.56}$$

THIS IS THE CSU METHOD.

Canonie Environmental

E-232

By SWM Date 11-29-90 Subject UNC - ROCK MULCH SIZING Sheet No. 2 of 16

Chkd. By GS Date 12-03-90 OIL IMPOUNDMENT TOP Proj. No. 86-060-29

1/4" X 1/4"

RESULTS : PAGE 3 PROVIDES A SUMMARY TABLE OF THE SLOPE SEGMENTS AND THE RIPRAP SIZES AND THICKNESSES CALCULATED BY THE CSU METHOD.

Canonie Environmental

E-233

By SWM Date 11-29-90 Subject UNC - SIZING OF ROCK MULCH Sheet No. 3 of 16

Chkd. By GS Date 12-03-90 Proj. No. 86-060-24

1/4" X 1/4"

TABLE 1 SUMMARY OF RESULTS

SLOPE SEGMENT	SLOPE LENGTH (ft)	RELIEF (ft)	SLOPE (ft/ft)	q (cfs/ft)	CSU d_{50} (inches)	THICKNESS (inches)
A	240	13.0	0.054	0.92	1.49	3.0
B	120	5.0	0.042	0.46	0.37	↓
C	205	9.0	0.044	0.79	1.20	↓
D	260	7.5	0.029	1.00	1.14	↓
E	205	3.5	0.017	0.79	0.79	↓
F	470	9.0	0.019	1.55	1.22	↓
G	440	6.5	0.015	1.44	1.05	↓
H	500	15.0	0.030	1.71	1.56	↓
J	800	14.5	0.018	2.20	1.44	↓
K	1100	11.0	0.010	2.37	1.71	↓
L	95	5.5	0.058	0.37	0.88	↓
M	155	9.5	0.061	0.60	1.18	↓
N	100	7.0	0.070	0.39	0.98	↓

BY: SWM

p. 4 of 16

BY: SWM
11-30-90

Chkd. By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UNC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION A

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

RUNOFF COEF: 1
SLOPE LENGTH: 240 FT
AVE SLOPE: 0.054 FT/FT
MANNING'S n: 0.030
FLOW CONC: 3
DRAINAGE AREA: 0.005 ACRES
Mannings n(calc) 0.030

RETURN PERIOD: PMP
1-HR PPT AMOUNT: 8.47 INCHES
Tc (calc): 1.632 MIN EQTN 4.44, NUREG4620
Tc (actual): 2.5 MIN
%OF 1-HR PPT: 27.5 % TABLE 2.1, NUREG 4620
PPT AMOUNT: 2.329 INCHES
PPT INTENSITY: 55.90 IPH

PEAK DISCHARGE: 0.308 CFS Q = CiA
CONC. DISCHARGE: 0.924 CFS

DEPTH: 0.220 FT EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.741 PSF
FLOW VELOCITY: 4.20 FPS V = Q/FLOW AREA

CALC. d50: 1.426 INCHES d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
Development of Riprap Design Criteria, Phase II, CSU Method

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	88.833333333
60	100	

BY SWM

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UNC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION B

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

RUNOFF COEF:	1	RETURN PERIOD: PMP YEARS	
SLOPE LENGTH:	120 FT	1-HR PPT AMOUNT: 8.47 INCHES	
AVE SLOPE:	0.042 FT/FT	Tc (calc): 1.054 MIN	EQTN 4.44, NUREG4620
MANNING'S n:	0.027	Tc (actual): 2.5 MIN	
FLOW CONC:	3	%OF 1-HR PPT: 27.5 %	TABLE 2.1, NUREG 4620
DRAINAGE AREA:	0.002 ACRES	PPT AMOUNT: 2.329 INCHES	
Mannings n(calc)	0.027	PPT INTENSITY: 55.90 IPH	
PEAK DISCHARGE:	0.154 CFS	Q = CiA	
CONC. DISCHARGE:	0.462 CFS		
DEPTH:	0.147 FT	EQTN 4.46, NUREG 4620	
TRACTIVE FORCE:	0.385 PSF		
FLOW VELOCITY:	3.14 FPS	V = Q/FLOW AREA	
CALC. d50:	0.868 INCHES	d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56 Development of Riprap Design Criteria, Phase II, CSU Method	

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT O 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	80.833333333
60	100	

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UNC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION C

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

RUNOFF COEF: 1
SLOPE LENGTH: 205 FT
AVE SLOPE: 0.044 FT/FT
MANNING'S n: 0.029
FLOW CONC: 3
DRAINAGE AREA: 0.004 ACRES
Mannings n(calc)0.029

RETURN PERIOD: PMP YEARS
1-HR PPT AMOUNT: 8.47 INCHES
Tc (calc): 1.564 MIN EQTN 4.44, NUREG4620
Tc (actual): 2.5 MIN
%OF 1-HR PPT: 27.5 % TABLE 2.1, NUREG 4620
PPT AMOUNT: 2.329 INCHES
PPT INTENSITY: 55.90 IPH

PEAK DISCHARGE: 0.263 CFS Q = CiA
CONC. DISCHARGE:0.789 CFS

DEPTH: 0.208 FT EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.573 PSF
FLOW VELOCITY: 3.78 FPS V = Q/FLOW AREA

CALC. d50: 1.195 INCHES d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
Development of Riprap Design Criteria,
Phase II, CSU Method

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	80.833333333
60	100	

P. 7 of 16

BY: SWM
11-29-90

Chkd By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UNC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION D

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

```
   RUNOFF COEF:     1          RETURN PERIOD: PMP YEARS
  SLOPE LENGTH:   260 FT      1-HR PPT AMOUNT: 8.47 INCHES
     AVE SLOPE: 0.029 FT/FT        Tc (calc): 2.205 MIN   EQTN 4.44, NUREG4620
   MANNING'S n: 0.027            Tc (actual):   2.5 MIN
     FLOW CONC:     3           %OF 1-HR PPT:  27.5 %     TABLE 2.1, NUREG 4620
 DRAINAGE AREA: 0.005 ACRES        PPT AMOUNT: 2.329 INCHES
Mannings n(calc)0.027          PPT INTENSITY: 55.90 IPH

PEAK DISCHARGE: 0.333 CFS      Q = CIA
CONC. DISCHARGE:1.001 CFS

        DEPTH: 0.261 FT        EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.472 PSF
 FLOW VELOCITY:  3.83 FPS      V = Q/FLOW AREA

    CALC. d50: 1.141 INCHES    d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
                               Development of Riprap Design Criteria,
                               Phase II, CSU Method
```

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	80.833333333
60	100	

BY: SWM

p. 8 of 16

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UMC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION E

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

```
   RUNOFF COEF:     1          RETURN PERIOD: PMP YEARS
  SLOPE LENGTH:   205 FT      1-HR PPT AMOUNT: 8.47 INCHES
     AVE SLOPE: 0.017 FT/FT        Tc (calc): 2.256 MIN   EQTN 4.44, NUREG4620
   MANNING'S n: 0.025            Tc (actual):   2.5 MIN
     FLOW CONC:     3           %OF 1-HR PPT:  27.5 %     TABLE 2.1, NUREG 4620
 DRAINAGE AREA: 0.004 ACRES        PPT AMOUNT: 2.329 INCHES
Mannings n(calc)0.025          PPT INTENSITY: 55.90 IPH

PEAK DISCHARGE: 0.263 CFS      Q = CiA
CONC. DISCHARGE:0.789 CFS

        DEPTH: 0.253 FT        EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.269 PSF
 FLOW VELOCITY:  3.11 FPS      V = Q/FLOW AREA

    CALC. d50: 0.794 INCHES    d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
                               Development of Riprap Design Criteria,
                               Phase II, CSU Method
```

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	80.833333333
60	100	

BY: SWM

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UNC: 86-060-24
LOCATION: INPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION F

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

RUNOFF COEF:	1	RETURN PERIOD:	PMP YEARS
SLOPE LENGTH:	470 FT	1-HR PPT AMOUNT:	8.47 INCHES
AVE SLOPE:	0.019 FT/FT	Tc (calc):	4.095 MIN EQTN 4.44, NUREG4620
MANNING'S n:	0.027	Tc (actual):	4.1 MIN
FLOW CONC:	3	%OF 1-HR PPT:	38.7 % TABLE 2.1, NUREG 4620
DRAINAGE AREA:	0.010 ACRES	PPT AMOUNT:	3.277 INCHES
Mannings n(calc)	0.027	PPT INTENSITY:	47.96 IPH

PEAK DISCHARGE: 0.517 CFS Q = CIA
CONC. DISCHARGE: 1.552 CFS

DEPTH: 0.386 FT EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.457 PSF
FLOW VELOCITY: 4.02 FPS V = Q/FLOW AREA

CALC. d50: 1.217 INCHES d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
Development of Riprap Design Criteria,
Phase II, CSU Method

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	38.7
5	45	41.94
10	62	47.84
15	74	56.56
20	82	70.87
30	89	78.64
45	95	81.366666667
60	100	

BY: SWM

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

PROJECT: UMC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION 6

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

```
   RUNOFF COEF:     1          RETURN PERIOD: PMP YEARS
  SLOPE LENGTH:   440 FT      1-HR PPT AMOUNT: 8.47 INCHES
     AVE SLOPE: 0.015 FT/FT        Tc (calc): 4.263 MIN   EQTN 4.44, NUREG4620
   MANNING'S n: 0.026            Tc (actual):   4.3 MIN
     FLOW CONC:     3           %OF 1-HR PPT:  40.1 %     TABLE 2.1, NUREG 4620
 DRAINAGE AREA: 0.010 ACRES        PPT AMOUNT: 3.396 INCHES
Mannings n(calc)0.026          PPT INTENSITY: 47.39 IPH

PEAK DISCHARGE: 0.478 CFS      Q = CiA
CONC. DISCHARGE:1.436 CFS

      DEPTH: 0.386 FT       EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.361 PSF
 FLOW VELOCITY:  3.71 FPS      V = Q/FLOW AREA

    CALC. d50: 1.052 INCHES   d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
                              Development of Riprap Design Criteria,
                              Phase II, CSU Method
```

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT O 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	40.1
5	45	42.62
10	62	48.32
15	74	56.88
20	82	71.01
30	89	78.72
45	95	81.433333333
60	100	

BY: SWM

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

p. 11 of 16

BY: SWM
11-29-90

Ckd By: GS
12-03-90

PROJECT: UMC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION H

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

RUNOFF COEF: 1
SLOPE LENGTH: 500 FT
AVE SLOPE: 0.03 FT/FT
MANNING'S n: 0.028
FLOW CONC: 3
DRAINAGE AREA: 0.011 ACRES
Mannings n(calc) 0.028

RETURN PERIOD: PMP
1-HR PPT AMOUNT: 8.47 INCHES
Tc (calc): 3.602 MIN EQTN 4.44, NUREG4620
Tc (actual): 3.6 MIN
%OF 1-HR PPT: 35.2 % TABLE 2.1, NUREG 4620
PPT AMOUNT: 2.981 INCHES
PPT INTENSITY: 49.69 IPH

PEAK DISCHARGE: 0.570 CFS Q = CiA
CONC. DISCHARGE: 1.711 CFS

DEPTH: 0.364 FT EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.682 PSF
FLOW VELOCITY: 4.69 FPS V = Q/FLOW AREA

CALC. d50: 1.564 INCHES d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
Development of Riprap Design Criteria,
Phase II, CSU Method

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT O 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	35.2
5	45	40.24
10	62	46.64
15	74	55.76
20	82	70.52
30	89	78.44
45	95	81.2
60	100	

BY: SWM

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UNC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION J

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

```
   RUNOFF COEF:     1          RETURN PERIOD: PMP YEARS
  SLOPE LENGTH:   800 FT      1-HR PPT AMOUNT: 8.47 INCHES
     AVE SLOPE: 0.018 FT/FT        Tc (calc): 6.297 MIN   EQTN 4.44, NUREG4620
   MANNING'S n: 0.020            Tc (actual):   6.3 MIN
     FLOW CONC:     3           %OF 1-HR PPT: 49.42 %     TABLE 2.1, NUREG 4620
 DRAINAGE AREA: 0.018 ACRES        PPT AMOUNT: 4.185 INCHES
Mannings n(calc)0.020           PPT INTENSITY: 39.86 IPH

PEAK DISCHARGE: 0.732 CFS      Q = CiA
CONC. DISCHARGE:2.196 CFS

        DEPTH: 0.493 FT        EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.554 PSF
 FLOW VELOCITY:  4.45 FPS      V = Q/FLOW AREA

    CALC. d50: 1.444 INCHES   d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
                              Development of Riprap Design Criteria,
                              Phase II, CSU Method
```

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	54.1
5	45	49.42
10	62	53.12
15	74	60.08
20	82	72.41
30	89	79.52
45	95	82.1
60	100	

BY: SWM

p. 13 of 16

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UMC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION X

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

```
   RUNOFF COEF:     1          RETURN PERIOD: PMP YEARS
  SLOPE LENGTH:  1100 FT      1-HR PPT AMOUNT: 8.47 INCHES
     AVE SLOPE:  0.01 FT/FT        Tc (calc): 10.09 MIN   EQTN 4.44, NUREG4620
   MANNING'S n: 0.027           Tc (actual): 10.1 MIN
     FLOW CONC:     3           %OF 1-HR PPT: 62.24 %     TABLE 2.1, NUREG 4620
 DRAINAGE AREA: 0.025 ACRES       PPT AMOUNT: 5.271 INCHES
Mannings n(calc)0.027          PPT INTENSITY: 31.31 IPH

PEAK DISCHARGE: 0.790 CFS      Q = CiA
CONC. DISCHARGE:2.372 CFS

        DEPTH: 0.603 FT        EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.376 PSF
 FLOW VELOCITY:  3.93 FPS      V = Q/FLOW AREA

    CALC. d50: 1.171 INCHES    d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
                               Development of Riprap Design Criteria,
                               Phase II, CSU Method
```

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	80.7
5	45	62.34
10	62	62.24
15	74	66.16
20	82	75.07
30	89	81.04
45	95	83.366666667
60	100	

BY: SWM

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

PROJECT: UNC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION L

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

RUNOFF COEF:	1	RETURN PERIOD: PMP YEARS	
SLOPE LENGTH:	95 FT	1-HR PPT AMOUNT: 8.47 INCHES	
AVE SLOPE:	0.050 FT/FT	Tc (calc): 0.778 MIN	EQTN 4.44, NUREG4620
MANNING'S n:	0.028	Tc (actual): 2.5 MIN	
FLOW CONC:	3	%OF 1-HR PPT: 27.5 %	TABLE 2.1, NUREG 4620
DRAINAGE AREA:	0.002 ACRES	PPT AMOUNT: 2.329 INCHES	
Mannings n(calc)	0.028	PPT INTENSITY: 55.90 IPH	

PEAK DISCHARGE: 0.121 CFS Q = CIA
CONC. DISCHARGE: 0.365 CFS

DEPTH: 0.118 FT EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.429 PSF
FLOW VELOCITY: 3.08 FPS V = Q/FLOW AREA

CALC. d50: 0.875 INCHES d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
Development of Riprap Design Criteria,
Phase II, CSU Method

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	80.833333333
60	100	

BY: SWM

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

PROJECT: UNC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION N

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

RUNOFF COEF: 1
SLOPE LENGTH: 155 FT
AVE SLOPE: 0.061 FT/FT
MANNING'S n: 0.030
FLOW CONC: 3
DRAINAGE AREA: 0.003 ACRES
Mannings n(calc)0.030

RETURN PERIOD: PMP YEARS
1-HR PPT AMOUNT: 8.47 INCHES
Tc (calc): 1.112 MIN EQTN 4.44, NUREG4620
Tc (actual): 2.5 MIN
%OF 1-HR PPT: 27.5 % TABLE 2.1, NUREG 4620
PPT AMOUNT: 2.329 INCHES
PPT INTENSITY: 55.90 IPH

PEAK DISCHARGE: 0.198 CFS Q = CIA
CONC. DISCHARGE:0.596 CFS

DEPTH: 0.163 FT EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.621 PSF
FLOW VELOCITY: 3.65 FPS V = Q/FLOW AREA

CALC. d50: 1.176 INCHES d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
"Development of Riprap Design Criteria, Phase II, CSU Method

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT O 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	80.833333333
60	100	

BY: SWM

BY: SWM
11-29-90

Chkd. By: GS
12-03-90

OVERLAND FLOW AND RIPRAP CALCULATIONS USING THE CSU METHOD OVERCSU.WR1

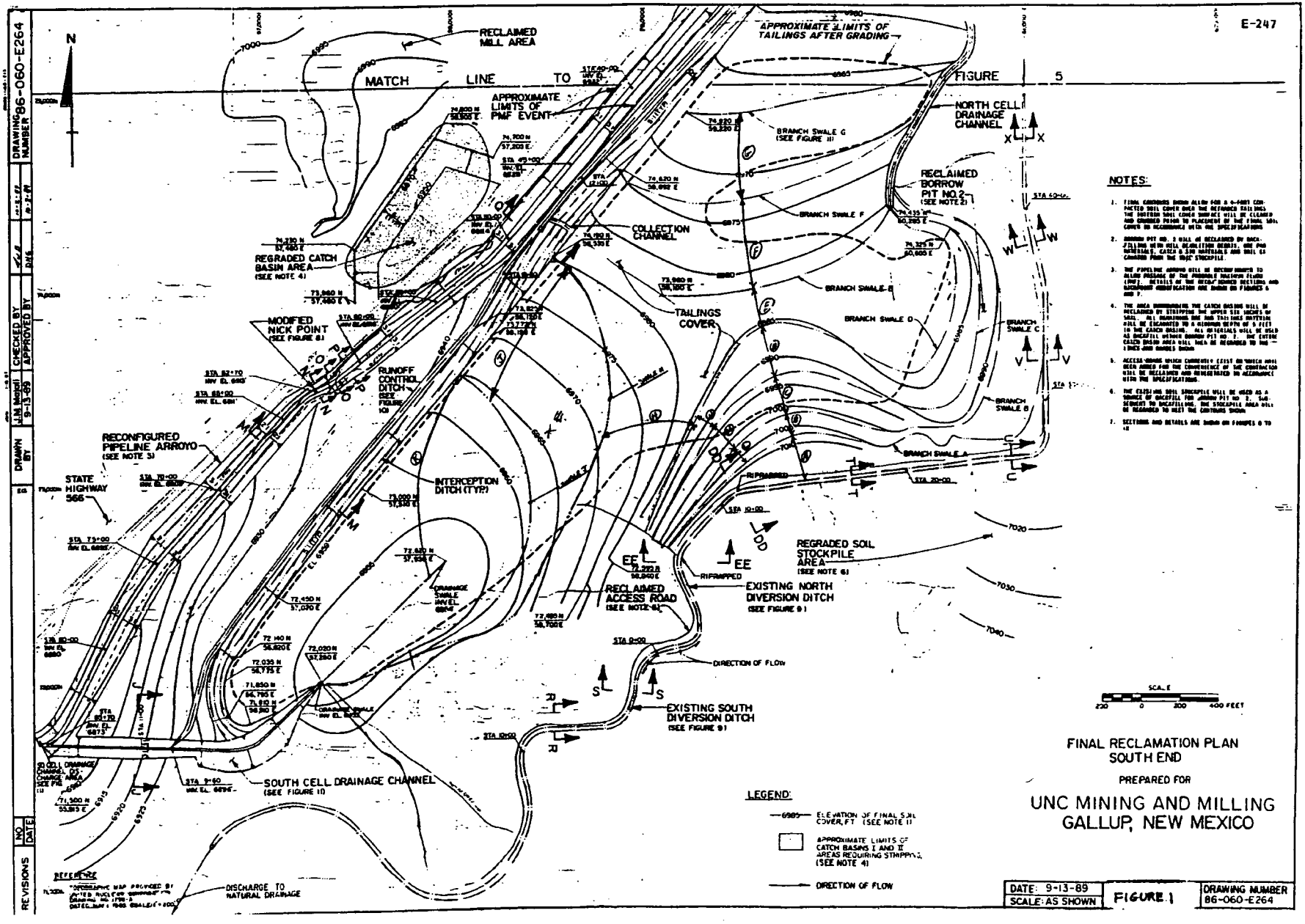
PROJECT: UMC: 86-060-24
LOCATION: IMPOUNDMENT TOP, ORIGINAL DESIGN, LOCATION N

OVERLAND FLOW CALCULATIONS (NUREG-4620, Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments)

```
   RUNOFF COEF:     1          RETURN PERIOD:   PMP
  SLOPE LENGTH:   100 FT      1-HR PPT AMOUNT: 8.47 INCHES
     AVE SLOPE:  0.07 FT/FT        Tc (calc): 0.752 MIN   EQTN 4.44, NUREG4620
   MANNING'S n: 0.030            Tc (actual):   2.5 MIN
     FLOW CONC:     3           %OF 1-HR PPT:  27.5 %     TABLE 2.1, NUREG 4620
 DRAINAGE AREA: 0.002 ACRES        PPT AMOUNT: 2.329 INCHES
Mannings n(calc)0.030           PPT INTENSITY: 55.90 IPH

PEAK DISCHARGE: 0.128 CFS      Q = CIA
CONC. DISCHARGE:0.385 CFS

        DEPTH: 0.120 FT        EQTN 4.46, NUREG 4620
TRACTIVE FORCE: 0.526 PSF
 FLOW VELOCITY:  3.20 FPS      V = Q/FLOW AREA

    CALC. d50: 0.976 INCHES    d50 = 5.23 x Slope^0.43 x Conc. Discharge^0.56
                               Development of Riprap Design Criteria,
                               Phase II, CSU Method
```

TABLE 2.1 OF NUREG 4620

RAINFALL DURATION (MIN)	PERCENT 0 1-HR PPT	INTERPOLATED PERCENT
2.5	27.5	27.5
5	45	36.5
10	62	44
15	74	54
20	82	69.75
30	89	78
45	95	80.833333333
60	100	


E-247
MATCH LINE TO FIGURE 5
N
RECLAIMED MILL AREA
APPROXIMATE LIMITS OF TAILINGS AFTER GRADING
APPROXIMATE LIMITS OF PMF EVENT
NORTH CELL DRAINAGE CHANNEL
BRANCH SWALE G (SEE FIGURE 11)
RECLAIMED BORROW PIT NO. 2 (SEE NOTE 2)
BRANCH SWALE F
COLLECTION CHANNEL
REGRADED CATCH BASIN AREA (SEE NOTE 4)
BRANCH SWALE E
TAILINGS COVER
BRANCH SWALE D
BRANCH SWALE C
MODIFIED NICK POINT (SEE FIGURE 8)
RUNOFF CONTROL DITCH (SEE FIGURE 10)
RECONFIGURED PIPELINE ARROYO (SEE NOTE 3)
STATE HIGHWAY 566
INTERCEPTION DITCH (TYP.)
BRANCH SWALE B
BRANCH SWALE A
RIPRAPPED
REGRADED SOIL STOCKPILE AREA (SEE NOTE 6)
EXISTING NORTH DIVERSION DITCH (SEE FIGURE 9)
RECLAIMED ACCESS ROAD (SEE NOTE 6)
DIRECTION OF FLOW
EXISTING SOUTH DIVERSION DITCH (SEE FIGURE 9)
SOUTH CELL DRAINAGE CHANNEL (SEE FIGURE 11)
DISCHARGE TO NATURAL DRAINAGE
NOTES:
LEGEND:
ELEVATION OF FINAL SOIL COVER, FT (SEE NOTE 1)
APPROXIMATE LIMITS OF CATCH BASINS I AND II AREAS REQUIRING STRIPPING (SEE NOTE 4)
DIRECTION OF FLOW
SCALE
FINAL RECLAMATION PLAN
SOUTH END
PREPARED FOR
UNC MINING AND MILLING
GALLUP, NEW MEXICO
DATE: 9-13-89
SCALE: AS SHOWN
FIGURE 1
DRAWING NUMBER 86-060-E264
DRAWING NUMBER 86-060-E264
DRAWN BY EG
CHECKED BY DHS
APPROVED BY
REVISIONS
NO. DATE

E.6

South Cell Drainage Channel Hydraulic Calculations

Canonie Environmental

By [illegible] Date 1/31/91 Subject UNC Sheet No. 1 of ___

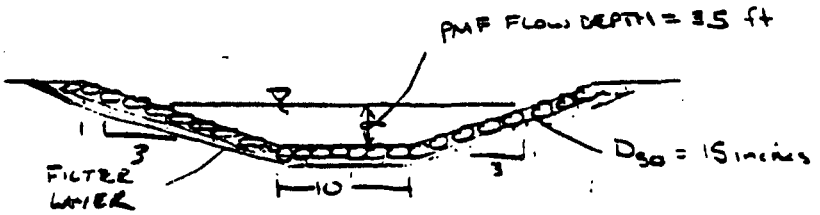
Chkd. By [illegible] Date [illegible] South Cell Drainage Channel Proj. No. [illegible]

1/4" X 1/4"

PURPOSE: TO DETERMINE THE DESIGN FOR THE SOUTH CELL DRAINAGE CHANNEL AT UNC

METHODS:
1) DETERMINE DRAINAGE AREA CHARACTERISTICS,
2) DETERMINE PMF HYDROGRAPH USING THE TABULAR SCS TR-55 METHOD,
3) DETERMINE CHANNEL SIZE AND RIPRAP DESIGN USING THE SAFETY FACTORS METHOD

RESULT: DESIGN FOR CHANNEL STA 0+00 TO 4+50



Canonie Environmental

E-250

By [illegible] Date 1/31/91 Subject LINC Sheet No. 2 of ___

Chkd. By [illegible] Date 2-1-91 SOUTH CELL DRAINAGE CHANNEL Proj. No. 86-060-2d

1/4" X 1/4

CALCULATIONS.

DETERMINE DRAINAGE BASIN CHARACTERISTICS

AREA: MEASURED BY DIGITAL PLANIMETER TAKEN FOR THE AREA SHOWN ON FIGURE 1, ATTACHED

AREA = 109 ACRES = 0.170 SQ. MILES

TIME OF CONCENTRATION. SINCE THE SOUTH CELL DRAINAGE CHANNEL IS FED NOT ONLY BY OVERLAND FLOW BUT BY DRAINAGE SWALES MUST CONSIDER BOTH OVERLAND FLOW AND IN-CHANNEL FLOW.

THE MAXIMUM OVERLAND FLOW LENGTH IS 1300'; THE SOUTH CELL DRAINAGE CHANNEL IS ~ 450' LONG (in riprapped portion), BRANCH SWALES H & I COMBINED ARE ~ 3100' LONG

WATER FALLING AT THE HYDRAULICALLY MOST DISTANT PORTION OF THE BASIN (THE NE END) WOULD TRAVEL 800 ft overland, 2200 feet in swales H & I and 450 feet in the south cell drainage channel.
Velocity of overland flow at a slope of 0.019 ≈ 1 fps (See Figure 2).
Velocity of water in Swales H & I = 5.8 fps (See Appendix A of the 90 Submittal)
Velocity of water in South Cell Drainage Channel = 9.4 fps

$$t_c = \frac{800 ft}{1 fps} + \frac{2200 ft}{5.8 fps} + \frac{450 ft}{9.4 fps} = 1227 sec = 0.34 hrs$$

Canonie Environmental

E-251

By [illegible] Date 1/31/91 Subject UNC Sheet No. 3 of ____

Chkd. By SWM Date 2-1-91 SOUTH CELL DRAINAGE CHANNEL Proj. No. 86-260-24

1/4" X 1/4"

CURVE NO: SCIENCE APPLICATION, INC. DETERMINED A CN OF 80 FOR THE AREA DRAINING THE N. & S. DIVERSION DITCHES IN ITS JUNE 1981 REPORT ENTITLED "PMF DETERMINATION FOR THE SOUTHEAST DIVERSION CHANNEL AND SECTION 1 WATERSHED USING SCS HYDROLOGICAL TECHNIQUES." (REF: RESPONSE TO NRC COMMENTS, MAY 23, 1982). THIS AREA INCLUDES ROCKY AREAS AND SOIL AREAS WITH LIMITED VEGETATION. THE SOIL/ROCK MATRIX COVER WILL BE VERY SIMILAR. THEREFORE, USE CN OF 80

DETERMINE PMP EVENT:

THE PMP HAS BEEN DETERMINED TO BE 9.4 INCHES. THIS MUST BE CORRECTED FOR ELEVATION. THE CORRECTION IS -5% FOR EVERY 1000 FT OF ELEVATION IN EXCESS OF 5000 FT.

PMP = 8.43 inches

DETERMINE THE PMF HYDROGRAPH:

USE SCS TR-55 METHOD

SEE SPREADSHEET, NEXT PAGE

Q_{max} = 695 cfs @ 12.3 hrs

✓ SWM 2-1-91

Tc = 0.3 RUNOFF HYDROGRAPHS BY THE SCS TR 55 METHOD

TYPE II STORM DISTRIBUTION

TIME OF CONCENTRATION = 0.3 HOURS
TRAVEL TIME = 0 HOURS

31-Jan-91
01:27 PM

HYDROGRAPH TIME IN HOURS

WATERSHED DESIGNATION	DRAINAGE AREA (AC)	DRAINAGE AREA (SQ MI)	CURVE NUMBER	PPI (IN)	RUNOFF (IN)	(TIME)	11.0	11.3	11.6	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.8	14.0
						(CSM/IN)	20	20	41	110	235	447	676	676	459	283	196	146	114	80	66	57	51	46	42
SOUTH CITY DRAINAGE	105.00	1.701	01	90.0	8.43	6.83	(CFS)	20.54	20.75	42.10	121.17	241.31	459.00	694.15	694.15	471.33	290.60	201.26	149.92	117.86	82.15	67.77	58.51	52.37	47.29	43.11

E-252

Canonie Environmental

E-253

By [illegible] Date 1/31/91 Subject UNC Sheet No. 5 of

Chkd. By SWM Date 2-1-91 S. CELL DRAINAGE CHANNEL Proj. No. 86-060-24

1/4" X 1/4"

DETERMINE CHANNEL CHARACTERISTICS

DETERMINE CHANNEL SLOPES

STA	ELEV	SLOPE
0+00	6960	
		0.0244
4+50	6940	
		0.0533
12+00	6900	
		0.0750
16+00	6870	

ONLY THE CHANNEL FROM 0+00 TO 4+50 NEEDS RIPRAPPED. FROM 4+50 TO 9+60 IS IN BEDROCK AND THE REMAINDER DOES NOT NEED RIPRAP BECAUSE THE ROCK UPSTREAM OF 9+60 WILL NOT ALLOW HEADCUTS.

USE THE SAFETY FACTOR METHOD TO DETERMINE CHANNEL SIZE AND TO SIZE RIPRAP.

SEE SPREADSHEET, NEXT PAGE.
FOR 10' BOTTOM, 3:1 SIDESLOPES AT 0.0244 slope

D_{50} = 15 inches ∴ D_{MAX} = 29 inches
THICKNESS = 23 inches

FROM STA 4+50 to 9+60 USE 2:1 SIDESLOPES, 10' BOTTOM BECAUSE IT IS IN ROCK.
FROM 9+60 TO PIPELINE ARROYO USE 3:1 SIDESLOPES, 10' BOTTOM

✓ SWM 2-1-91

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: SOUTH CELL DRAINAGE CHANNEL

DISCHARGE =	694 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0244	Theta =	1.40 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see Fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	1.25 FT	15.0 inches	D50 (ASSUM) =	1.25 FT	15.0 inches
n =	0.041		n =	0.041	
* TRIAL d =	3.00 ft	57.0 **			
DIFFERENCE =	-26.99 %				
* calc d =	3.40 ft	68.8 **			
DIFFERENCE =	-5.52 %				
* calc d =	3.50 ft	71.7 **			
DIFFERENCE =	-0.00 %				
* calc d =	3.50 ft	71.8 **			
DIFFERENCE =	0.00 %				
FINAL d =	3.50 ft				
A =	71.75 sq ft				
R =	2.23 ft		t =	4.00 PSF	
t =	31.00 ft		nb =	0.72	
V =	9.67 fps				
Q(calc) =	694 cfs		Beta =	39.93	
t =	5.33 PSF				
nb =	0.956		n' =	0.60	
SFb =	1.01		SFs =	1.03	

E-255

✓ SWM 2-1-91

J - 165

product of the rainfall excess intensity, i_e, in iph and the flow length, L, in feet is greater than 500. The equation is

$$t_c = 0.928\,(n\,L)^{0.6}/(i_e^{\,0.4}\,S^{0.3}) \qquad (2.57)$$

where t_c is in minutes, n is Mannings n, L is in feet, i_e is in iph and S is the slope in ft/ft. Table 2.25 presents some values for n for overland flow surfaces.

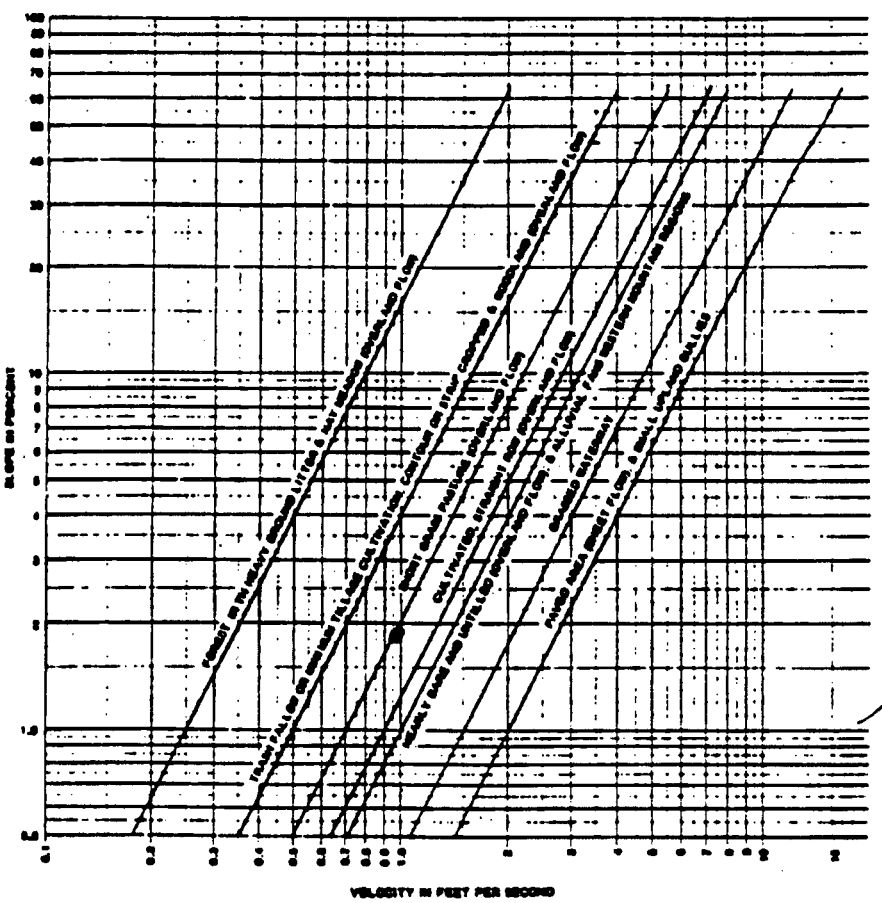


Figure 2.34. Velocities for upland method of estimating t_c.

Figure 2

HYDR

S

S:
A
P
L
D
D

1.

EXAMP.

To
flow len
infiltrati
Solution

i_e
S
L
n
t_c =
=
or

Canonie Environmental

E-256

By _____ Date _____ Subject _____ Sheet No. ____ of ____

Chkd. By S.M. Date 2-1-91 _____ Proj. No. _____

1/4" X 1/4"

For Reference only

$$SF_b = \frac{\cos\theta \tan\phi}{\sin\theta + \eta_b \tan\phi}$$

θ = channel slope

ϕ = angle of repose = 37°

$$\eta_b = \frac{21\,\tau}{\gamma(SG-1)D} \qquad \tau = \gamma d S$$

$S = 0.0244$

$d = 3.31$ ft

$\gamma = 62.4$

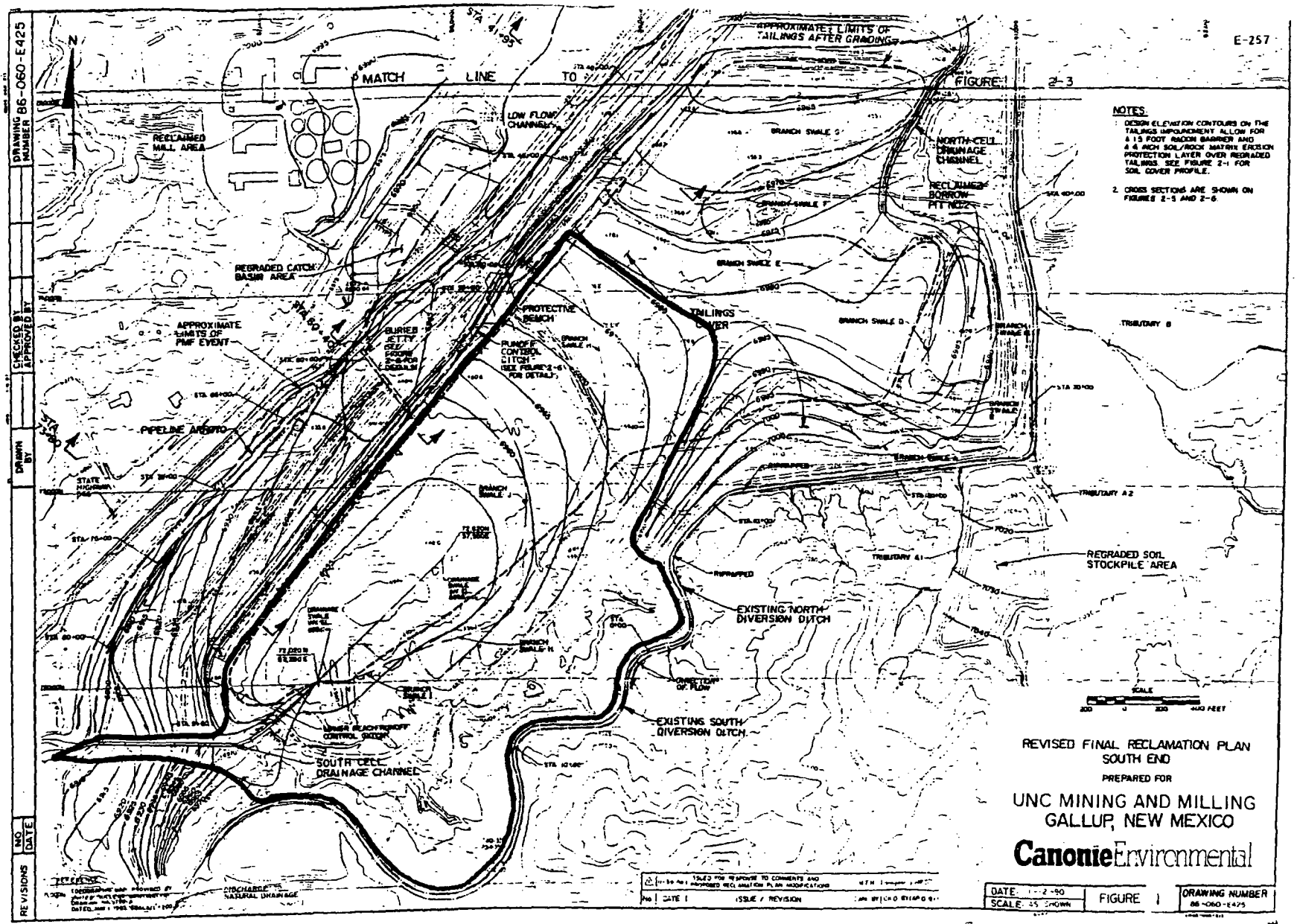
$\tau = 62.4\ \text{lbm/ft}^3 (3.31\ \text{ft})(0.0244) = 5.04\ \text{lb/ft}^2$

$$\eta_b = \frac{21\,(5.04\ \text{lb/ft}^2)}{(62.4\ \text{lb/ft}^3)(2.5-1)(1.25\ \text{ft})} = 0.905$$

$\theta = \tan^{-1} 0.0244 = 1.40°$

$\phi = 37°$

$$SF_b = \frac{\cos(1.4)\tan(37)}{\sin(1.4) + 0.905(\tan 37)} = 1.066 = 1.07 \quad \text{ok}$$



SOUTH CELL DRAINAGE AREA

E.7

North Cell Drainage Channel Hydraulic Calculations

Canonie Environmental

E-259

By MJ Date 1/31/91 Subject UNC Sheet No. 1 of

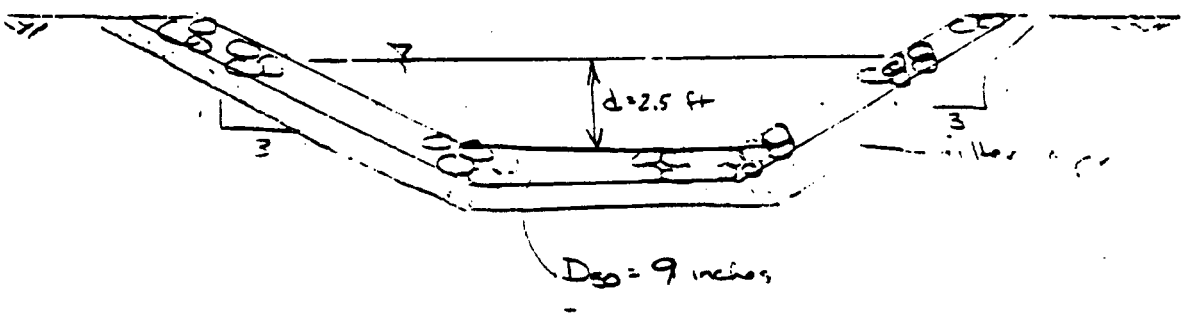
Chkd. By [illegible] Date 2-1-91 NORTH CELL DRAINAGE CHANNEL Proj. No. [illegible]

1/4" X 1/4

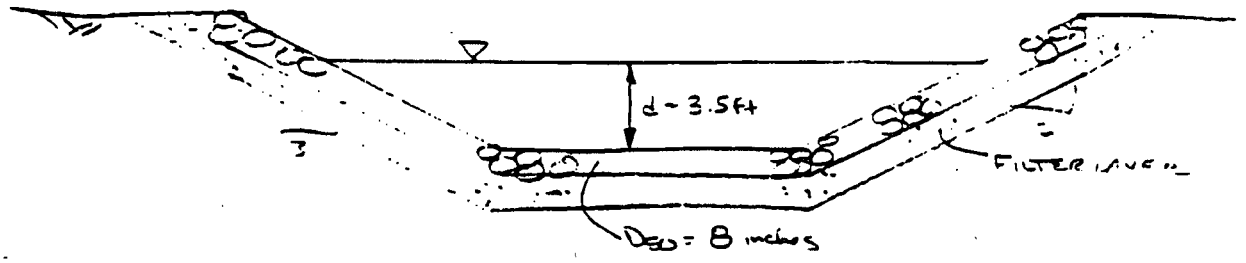
PURPOSE: TO DETERMINE THE DESIGN FOR BOTH THE UPPER AND LOWER SECTIONS OF THE NORTH CELL DRAINAGE CHANNEL AT UNC

METHODS:
1) DETERMINE DRAINAGE BASIN CHARACTERISTICS,
2) DETERMINE THE PMF HYDROGRAPH USING THE TABULAR SCS TR-55 METHOD,
3) DETERMINE CHANNEL SIZE AND RIPRAP DESIGN USING THE SAFETY FACTORS METHOD

RESULTS:



UPPER SECTION (NTS)



LOWER SECTION NTS

Canonie Environmental

E-260

By [illegible] Date 1/21/91 Subject UNC Sheet No. [illegible] of ___

Chkd. By [illegible] Date [illegible] North Cell Drainage Channel Proj. No. 86-000-24

1/4" X 1/4"

CALCULATIONS:

DETERMINE DRAINAGE BASIN CHARACTERISTICS

AREA: AREA FROM FIGS 1 & 2 ATTACHED MEASURED BY DIGITAL PLANIMETER

UPPER DRAINAGE AREA = 47.6 ACRES

LOWER DRAINAGE AREA = 34.8 Ac + 5.9 = 40.7 acres

Total = 88.3 acres

TIME OF CONCENTRATION

SINCE THE DRAINAGE BASIN IS DIVIDED BY BRANCH SWALES, OVERLAND FLOW IS LIMITED. THEREFORE, ASSUME (CONSERVATIVELY) THAT t_c = time for flow from farthest BRANCH SWALE w/ flow AT 5 FPS.

BRANCH SWALE B IS 3600 FT LONG AND THE NORTH CELL DRAINAGE CHANNEL IS 1750 FT LONG (400 FT = UPPER SECTION, 1350 FT LOWER SECTION)

$t_{c_{upper}} = (3600 + 400)/5\ ft/sec = 800\ sec = 0.2\ hrs$

$t_{c_{lower}} = (3600 + 1750\ ft)/5\ ft/sec = 1070\ sec = 0.3\ hrs$

CURVE NUMBER

SCIENCE APPLICATION, INC. DETERMINED A CN OF 80 FOR THE AREA DRAINING THE N 4S. DIVERSION DITCHES IN ITS JUNE 1981 REPORT ENTITLED "PMF DETERMINATION FOR THE SOUTHEAST DIVERSION CHANNEL AND SECTION 1 WATERSHED USING SCS HYDROLOGICAL TECHNIQUES." (REF: RESPONSE TO NRC COMMENTS, MAY 23, 1980) THIS AREA INCLUDES ROCKY AREAS AND SOILS AREA WITH LIMITED VEGETATION. THE SOIL/ROCK MATRIX POWER WILL BE V. SIMILAR. THEREFORE, USE CN = 80.

Canonie Environmental

E-261

By [illegible] Date 1/31/91 Subject CMC Sheet No. 3 of ___

Chkd. By [illegible] Date [illegible] N. CELL DRAINAGE CHANNEL Proj. No. 86-060-24

1/4" X 1/4"

DETERMINE PMP EVENT

THE PMP FOR THIS AREA HAS BEEN DETERMINED TO BE 9.4 INCHES. THIS VALUE MUST BE CORRECTED FOR ELEVATION (MEAN BASIN ELEVATION). THE CORRECTION IS -5% FOR EVERY 1000 FT OF ELEVATION IN EXCESS OF 5000 FT

PMP = 9.43 INCHES

DETERMINE PMF HYDROGRAPH

USE SCS TR-55 METHOD ON COMPUTER SPREADSHEET SCSHYD II.WR1 FOR t_c = 0.3

SEE RESULTS NEXT PAGE

PEAK FLOW = CFS

DETERMINE CHANNEL CHARACTERISTICS

DETERMINE CHANNEL SLOPES

UPPER SECTION $S_{max} = \frac{6973-6968}{250} = 0.0200$ ft/ft

LOWER SECTION $S = \frac{6168-5956}{1350} = 0.0126$ ft/ft

ASSUME 3:1 SIDESLOPES

USE SAFETY FACTORS METHOD TO DETERMINE CHANNEL AND RIPRAP DESIGN

✓ SWM 2-1-91

Tc = 0.3

RUNOFF HYDROGRAPHS BY THE SCS TR 55 METHOD

TYPE-II STORM DISTRIBUTION

TIME OF CONCENTRATION 0.3 HOURS
TRAVEL TIME = 0 HOURS

31-Jan-91
02:50 PM

HYDROGRAPH TIME IN HOURS

WATERSHED DESIGNATION	DRAINAGE AREA (AC)	DRAINAGE AREA (SQ MI)	CURVE NUMBER	PRI ADJ (IN)	RUNOFF (IN)	TIME	11.0	11.3	11.6	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.8	14.0
						(CSM/IN)	28	28	91	110	235	447	676	676	459	283	196	146	114	88	66	57	51	46	42
LOWER SECTION																									
NORTH CELL DRAINAGE	88.30	1.30E-01	80.0	0.45	6.03	(CFS)	16.64	23.29	34.11	90.16	195.40	371.84	562.33	562.33	381.82	235.41	163.04	121.45	94.83	66.55	54.90	47.42	42.42	38.26	34.94

E-262

V SWM 2-1-91

Tc = 0.2

RUNOFF HYDROGRAPHS BY THE SCS TR-55 METHOD

TYPE-II STORM DISTRIBUTION

11-13-91
10:41 PM

TIME OF CONCENTRATION = 0.2 HOURS
TRAVEL TIME = 0 HOURS

HYDROGRAPH TIME IN HOURS

WATERSHED DESIGNATION	DRAINAGE AREA (AC)	DRAINAGE AREA (SQ MI)	CURVE NUMBER	PPT (IN)	RUNOFF (IN)	(TIME)	11.0	11.3	11.6	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.8	14.0
						(CSM/IN)	23	58	47	269	650	739	988	490	250	165	128	102	85	70	61	54	49	44	40
UPPER SECTION																									
NORTH CELL DRAINAGE	47.6000	7.44E-02	68.0	8.4	6.83	(CFS)	16.1	[illegible]	1.1	14.7	168.7	531.4	948.7	715.7	412.1	74.4	57.4	45.7	38.6	34.4	27.4	24.2	22.0	19.7	17.9

√ SWM 2-1-91

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPSF.WR1 REF: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-194

LOCATION: LOWER SECTION - NORTH CELL DRAINAGE CHANNEL

DISCHARGE =	562 CFS		
BOTTOM WIDTH =	10 FT		
Z (SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0126	Theta =	0.72 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see fig 3.16, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.67 FT	8.0 inches	D50 (ASSUM) =	0.67 FT	8.0 inches
n =	0.037		n =	0.037	
* TRIAL d =	3.00 ft	57.0 **			
DIFFERENCE =	-28.11 %				
* calc d =	3.42 ft	69.3 **			
DIFFERENCE =	-6.02 %				
* calc d =	3.52 ft	72.5 **			
DIFFERENCE =	-0.10 %				
* calc d =	3.53 ft	72.6 **			
DIFFERENCE =	0.00 %				
FINAL d =	3.53 ft.				
A =	72.57 sq ft				
R =	2.25 ft		t =	2.08 PSF	
T =	31.16 ft		nb =	0.70	
V =	7.74 fps				
Q(calc) =	562 cfs		Beta =	39.39	
t =	2.77 PSF				
nb =	0.928		n' =	0.57	
SFb =	1.06		SFs =	1.06	

V Sum 2-1-91

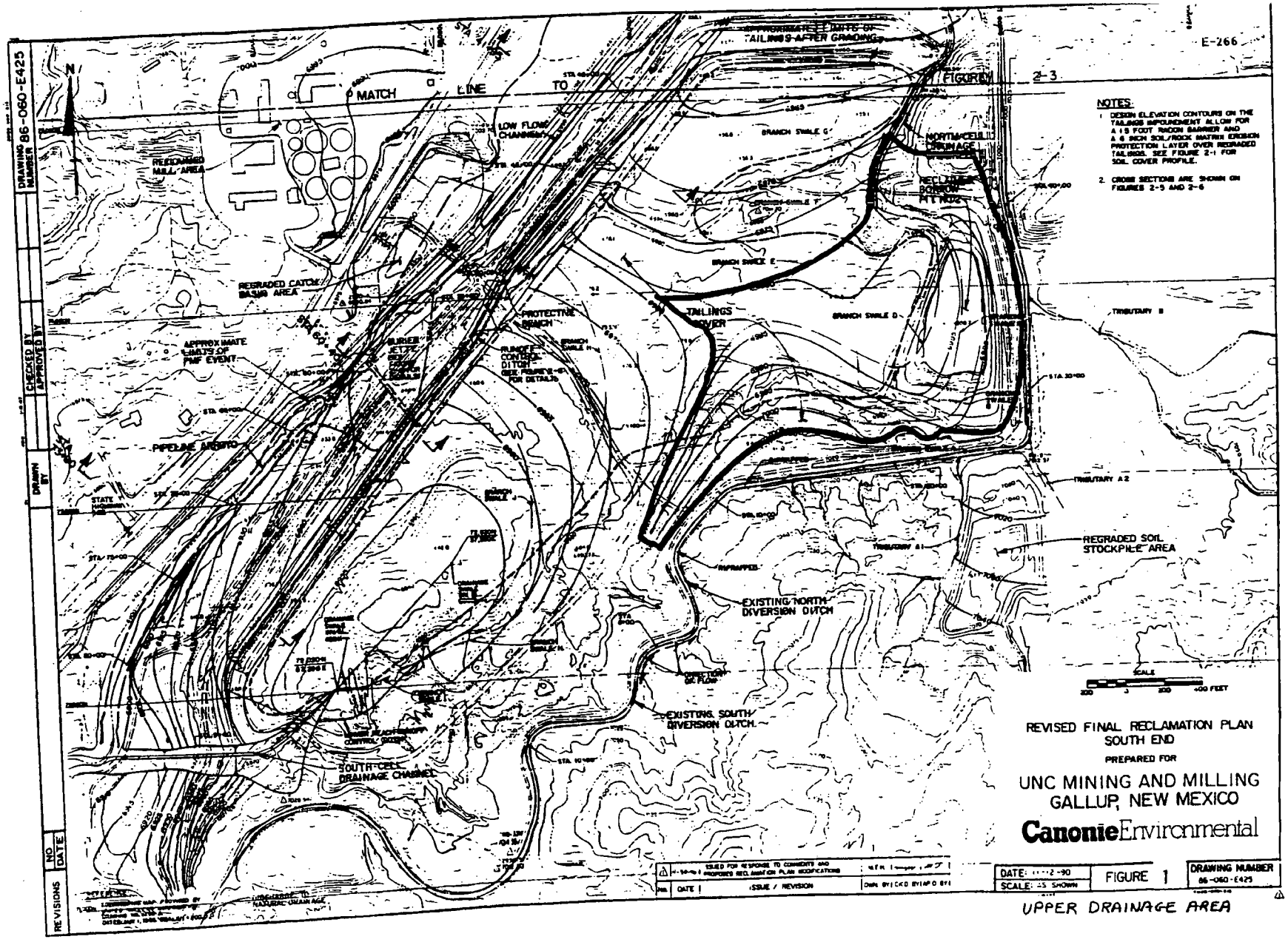
RIPRAP DETERMINATION BY SAFETY FACTOR METHOD FOR CHANNEL BOTTOM AND SIDE SLOPES

RIPRF.WR1 REF: "Stable Hydrology and Sedimentology for Disturbed Areas", pages 135-1[illegible]

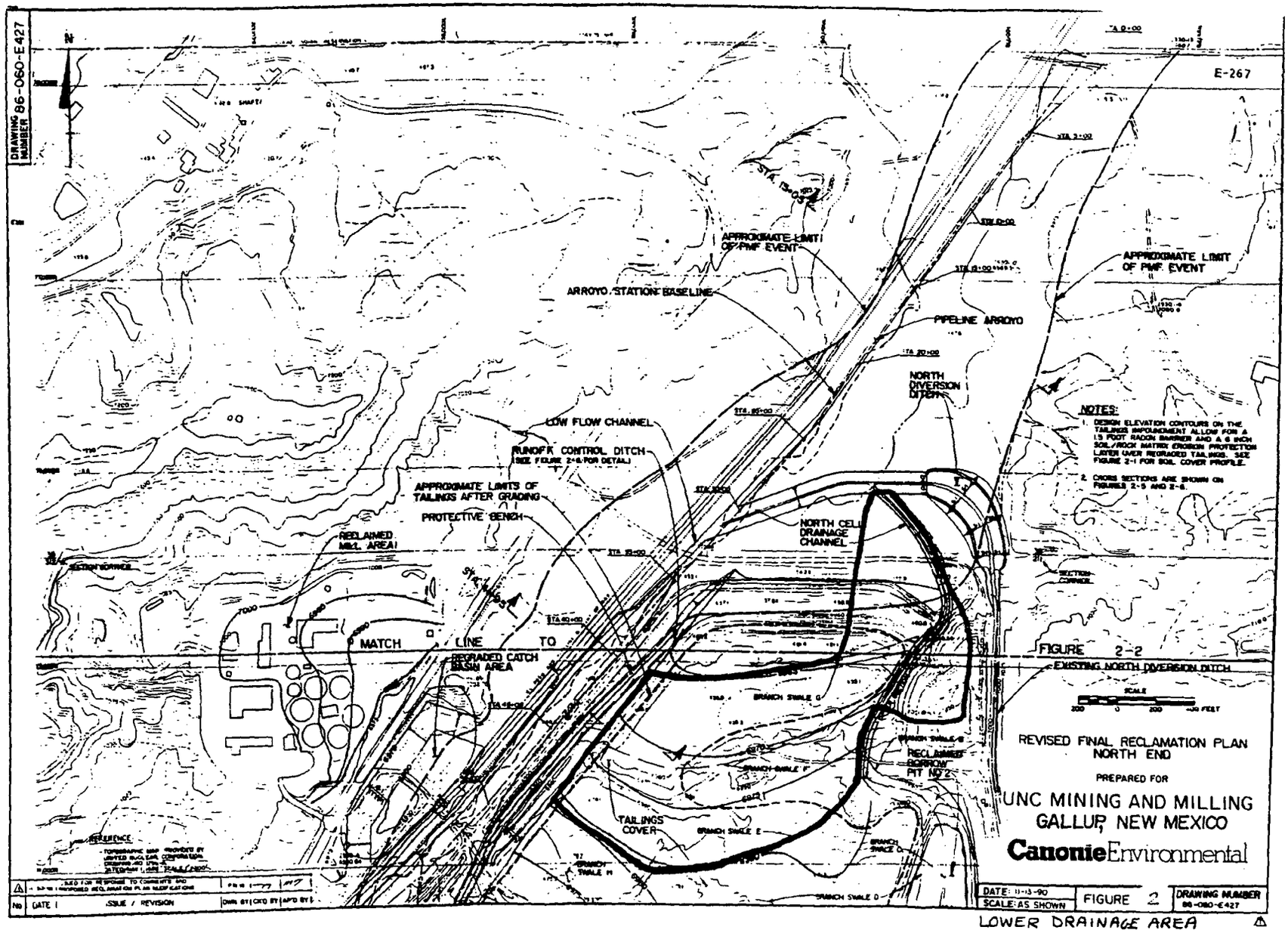
LOCATION: UPPER SECTION - NORTH CELL DRAINAGE CHANNEL

DISCHARGE =	359 CFS		
BOTTOM WIDTH =	10 FT		
(SIDE SLOPE)=	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.02	Theta =	1.15 Degrees
RIPRAP S.G. =	2.5	Phi =	37.00 Degrees
COEF FOR t =	0.75 see fig 3.15, ref.		

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUM) =	0.75 FT	9.0 inches	D50 (ASSUM) =	0.75 FT	9.0 inches
n =	0.021		n =	0.032	
* TRIAL d =	1.50 ft	43.9 **			
DIFFERENCE =	-1.20 %				
* calc d =	2.54 ft	44.8 **			
DIFFERENCE =	-0.12 %				
* calc d =	2.54 ft	44.8 **			
DIFFERENCE =	-0.00 %				
* calc d =	2.54 ft	44.8 **			
DIFFERENCE =	-0.00 %				
FINAL d =	2.54 ft				
A =	44.32 sq ft				
R =	1.72 ft		t =	1.15 PSF	
t =	23.25 ft		KD =	0.71	
V =	8.01 fps				
Q(calc) =	359 cfs		Beta =	33.33	
t =	3.17 PSF				
nb =	0.943		n' =	0.69	
SFb =	1.02		SFs =	1.04	



UPPER DRAINAGE AREA



LOWER DRAINAGE AREA

E.8

Riprap and Bedding Calculations

By S.YM Date -12-91 Subject UNC - Riprap Distribution Sheet No. ___ of ___

Chkd. By [illegible] Date [illegible] Proj. No. 15-360-04

1/4 X 1/4

PURPOSE: THE PURPOSE OF THIS CALC. BRIEF IS TO DETERMINE THE GRADATION REQUIREMENTS FOR THE RIPRAP AND FILTER MATERIAL THAT IS TO BE USED IN THE TAILINGS RECLAMATION PROJECT.

METHOD: DEVELOP GRADATION CURVES THAT CONFORM TO THE FOLLOWING TWO SETS OF CRITERIA:

1) NUREG/CL-4620 ROCK GRADATION REQUIREMENTS RELATIVE TO WEIGHT DISTRIBUTION. (SEE PAGES 5-7)

2) PARTICLE SIZE GRADATION REQUIREMENTS AS PER UNIFIED SOIL CLASSIFICATION SYSTEM (WELL-GRADED GRAVELS, COARSE, LITTLE OR NO F.

- $C_u = \frac{D_{60}}{D_{10}}$ $\left[\begin{array}{l} C_u > 4 \text{ - GRAVELS} \\ C_u > 6 \text{ - SANDS} \end{array}\right]$

- $C_z = \frac{D_{30}^2}{D_{10} D_{60}}$ $\left[1 \leq C_z \leq 3 \right]$

REFERENCES: "METHODOLOGIES FOR EVALUATING LONG TERM STABILIZATION DESIGNS OF URANIUM MILL TAILINGS IMPOUNDMENTS" — NUREG/CL-4620 (PREPARED FOR NUCLEAR REGULATORY COMMISSION WASHINGTON, DC)

FUNDAMENTALS OF GEOTECHNICAL ANALYSIS, DUNN, ANDERSON, AND KIEFER; JOHN WILEY AND SONS INC, NEW YORK, 1980

GRADATION CURVE DEVELOPMENT PROCEDURE:

THE GRADATION CURVES WERE DEVELOPED THROUGH A SERIES OF STEPS. GIVEN A D_{50}, D_{max} WAS CALCULATED BY MEANS OF THE FOLLOWING CRITERIA WHICH CANONIE HAS FOUND TO BE ADEQUATE FOR THIS TYPE OF APPLICATION:

$D_{max} = 1.25(D_{50})$ @ $D_{50} \geq 10''$

$D_{max} = 1.5(D_{50})$ @ $6'' < D_{50} < 10''$

$D_{max} = 2(D_{50})$ @ $D_{50} \leq 6''$

ONCE D_{50} AND D_{max} WERE KNOWN, THEY WERE PLOTTED ON A GRAIN SIZE DISTRIBUTION GRAPH. SINCE THE SHAPE OF A WELL-DISTRIBUTED CURVE WAS KNOWN, A CURVE WAS EXTRAPOLATED FROM THE AFOREMENTIONED POINTS. THIS INITIAL GRAIN SIZE DISTRIBUTION CURVE WAS CHECKED AGAINST THE UNIFIED SOIL CLASSIFICATION SYSTEM PARTICLE SIZE GRADATION REQUIREMENTS TO ENSURE THAT THE DISTRIBUTION WAS WELL-GRADED.

USING AN ITERATIVE PROCESS, UPPER AND LOWER LIMIT CURVES WERE DRAWN ON THE RIGHT AND LEFT SIDES (RESPECTIVELY) OF THE EXISTING CURVE.

CONTINUED →

Canonie Environmental

E-271

By SNM Date 1-23-91 Subject UNC Sheet No. 3 of

Chkd. By [illegible] Date 2/5/91 Proj. No. 86-060-29

1/4" X 1/4"

GRADATION CURVE DEVELOPMENT PROCEDURE CONT.:

THESE UPPER AND LOWER LIMIT CURVES WERE REFINED (THROUGH ITERATION) TO DEPICT THE LARGEST POSSIBLE BAND WIDTH WHILE BEING FAIRLY SYMMETRICAL ABOUT THE INITIAL GRAIN SIZE DISTRIBUTION CURVE ([illegible] CURVE THAT CONTAINS d_{50} POINT). FOR THE SAKE OF BREVITY, THE ITERATIONS USED TO DEFINE THE CURVE PLACEMENT ARE NOT DOCUMENTED HERE. ONLY THE CHECKS OF THE FINAL CURVE PLACEMENTS AGAINST THE CRITERIA ARE SHOWN IN THIS CALC. BRIEF.

RESULTS:

SEE PAGE 4 FOR GRADATION REQUIREMENTS THAT WERE BASED ON THE ENCLOSED GRAPHS.

E-272

PAGE 5

NUREG/CR-4620

Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments

Oak Ridge National Lab., TN

Prepared for

Nuclear Regulatory Commission
Washington, DC

Jun 86

U.S. Department of Commerce
National Technical Information Service
NTIS

Canonie Environmental Services Corp.
94 Inverness Terrace East · Suite 100
Englewood, Colorado 80112

Phone: 303-790-1747
Fax: 303-799-0186

Peter M. Weber
Assistant Project Scientist

The riprap layer thickness should be underlain with a gravel filter for channel, toe and side slope applications. The filter will serve to stabilize the rock layer, allow drainage and prevent the movement of fine embankment materials. Filter criteria are presented in Section 4.4 of this report.

Rock Gradation

The gradation of rocks in riprap revetment affects the riprap's resistance to erosion. The stone should be reasonably well graded throughout the layer thickness. The following criteria provide guidelines for establishing gradation limit..

1. The lower limit of W_{50} rock should not be less than the weight of rock required to withstand the design shear forces.

2. The upper limit of W_{50} rock should not exceed that weight which can be obtained economically from the quarry or that size which will satisfy layer thickness requirements.

3. The lower limit of W_{100} rock should not be less than two times the lower limit of W_{50} rock.

4. The upper limit of W_{100} rock should not exceed: (a) five times the lower limit of W_{50} rock, (b) that size which can be obtained economically from the quarry, or (c) that size which will satisfy layer thickness requirements.

5. The lower limit of W_{15} rock should not be less than one-sixteenth the upper limit of W_{100} rock.

6. The upper limit of W_{15} rock should be less than the upper limit of W_{50} rock as required to satisfy criteria for graded stone filters.

7. The bulk volume of rock lighter than the W_{15} rock should not exceed the volume of voids in the revetment without this lighter rock.

8. W_0 to W_{25} rock may be used instead of W_{15} rock in criteria 5, 6, and 7 if desirable to better utilize available rock sizes. Design memoranda and specifications should indicate the permissible stone gradation limits.

4.2.2.4 U.S. Bureau of Reclamation Method

The U.S. Bureau of Reclamation (USBR) Method (DOI, 1978) for riprap design was developed for the prevention of damage in and near stilling basins. The USBR procedure is empirically based upon extensive laboratory testing and field observations. Riprap failure was determined to occur because alternative design procedures underestimate the required stone size in highly turbulent zones, and there is a tendency for inplace riprap to be

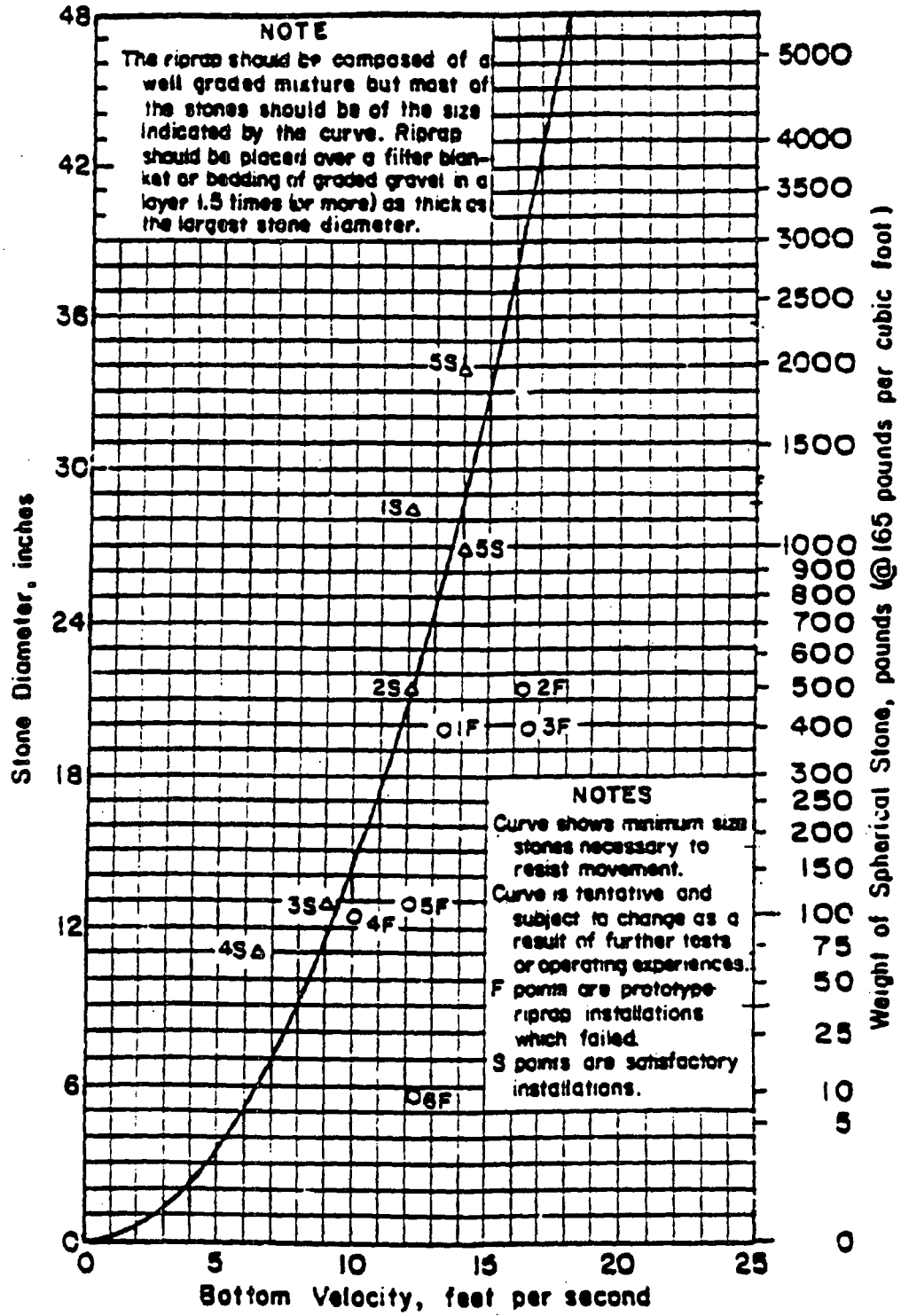


Fig. 4.11. Parametric curve used to determine maximum stone size in riprap mixture as a function of channel flow velocity.

E-275

Canonie Environmental

By ____ Date ____ Subject ____ Sheet No. ____ of ____

Chkd. By ____ Date ____ Proj. No. 86-060-24

1/4" X 1/4"

LOCATION	D50 1)	D100 1)	PERCENT PASSING BY WEIGHT 30"	25"	20"	15"	12"	10"	6"	5"	4"	3"	1"	NO4
UPPER SECTION SOUTH CELL ① DRAINAGE CHANNEL	15"	18.75" (say 19")			100		28-40		8-21		2-14	0-10		
NORTH CELL ② DRAINAGE CHANNEL	9"	13.5" (SAY 15")				100		45-58		10-33		0-23		
NORTH DIVERSION ③ DITCH BURIED JETTY	6"	10"						100	28-51		13-36		0-9	
SWALES H&I LOWER REACH ④ OF RUNOFF CONTROL DITCH	3"	6"							100		45-67		0-22	
SOIL/ROCK MATRIX SWALES ⑤ UPPER REACH RUNOFF CONTROL DITCH	1.5"	3"										100	8-37	0-8

1) D_{50} & D_{100} ARE BASED ON SAFETY FACTORS METHOD; D_{100} VALUE IS REFLECTED AS 100% PASSING BY WEIGHT

Canonie Environmental

E-276

By EB Date 02/27/91 Subject _____ Sheet No. ____ of ____

Chkd. By [illegible] Date [illegible] _____ Proj. No. 86-060-24

1/4" X 1/4"

LOCATION (2): (UPPER SECTION SOUTH CELL DRAINAGE CHANNEL)

CHECK INITIAL GRAIN SIZE DISTRIBUTION CURVE TO SEE - ITS WELL GRADED:

D_{10} = 76 mm

D_{30} = 230 mm

D_{60} = 400 mm

C_u = 5.3

C_z = 1.7

LOCATION (1) - CONT.:

NU-PEG CL-4620 CRITERIA CHECK:

$W_{100LL} \rightarrow 22.5'' \rightarrow 570$ lbs

$W_{100UL} \rightarrow 19'' \rightarrow 343$ lbs

$W_{50LL} \rightarrow 17.7'' \rightarrow 277$ lbs

$W_{15LL} \rightarrow 7.9'' \rightarrow 25$ lbs

(#3) $W_{100LL} \geq 2(W_{50LL})$

$570 \geq 2(277)$

$570 > 554$ O.K.

(#4) $W_{100UL} \leq 5(W_{50LL})$

$343 \leq 5(277)$

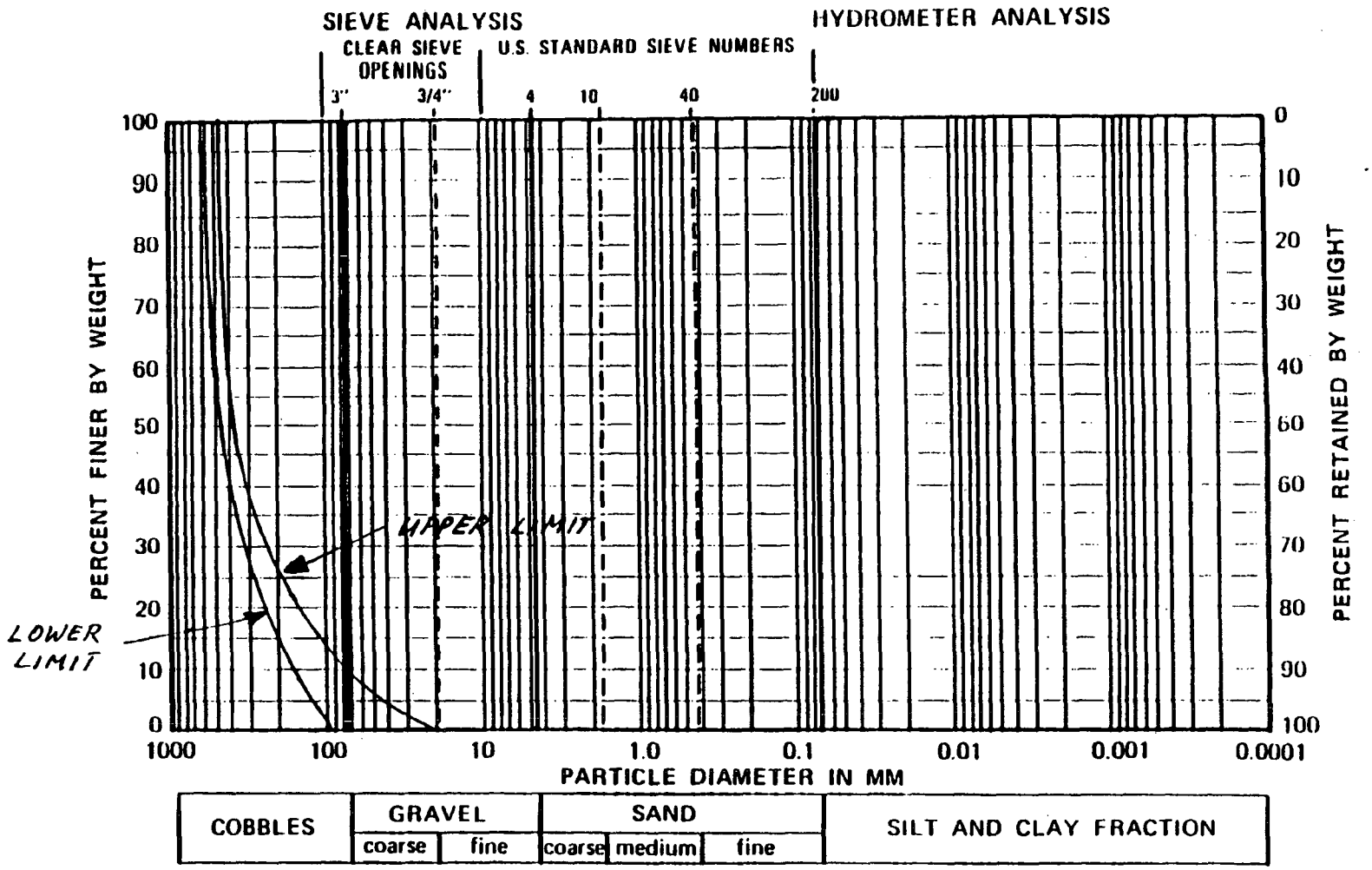
$343 < 1385$ O.K.

(#5) $W_{15LL} \geq \frac{W_{100UL}}{16}$

$25 \geq \frac{343}{16}$

$25 > 21$ O.K.

E-278



TYPICAL FORMAT

GRAIN SIZE DISTRIBUTION DATA

FIGURE 1

Cano e

Canonie Environmental

E-279

By EB Date 02/27/91 Subject _____ Sheet No. ____ of ____

Chkd. By ____ Date ____ _____ Proj. No. 85-060-24

1/4" X 1/4"

LOCATION (2): (NORTH CELL DRAINAGE CHANNEL)

CHECK INITIAL GRAIN SIZE DISTRIBUTION CURVE TO SEE - ITS WELL GRADED:

$D_{10} = 34$ mm

$D_{30} = 105$ mm

$D_{60} = 270$ mm

$C_u = 7.9$

O.K.

$C_z = 1.2$

Canonie Environmental

E-280

By EB Date 02/27/91 Subject _____ Sheet No. ____ of ____

Chkd. By [illegible] Date [illegible] _____ Proj. No. 25-060-241

1/4" X 1/4"

LOCATION (2) - CONT.

VU - REG CL - 4620 CRITERIA CHECK:

$W_{100\,LL} \rightarrow 15.0'' \rightarrow 169$ lbs

$W_{100\,UL} \rightarrow 15'' \rightarrow 169$ lbs

$W_{50\,LL} \rightarrow 10.6'' \rightarrow 60$ lbs

$W_{15\,LL} \rightarrow 6.1'' \rightarrow 11$ lbs

(#3) $W_{100\,LL} \geq 2\,(W_{50\,LL})$

$123 \geq 2\,(60)$

$169 > 120$ O.K

(#4) $W_{100\,UL} \leq 5\,(W_{50\,LL})$

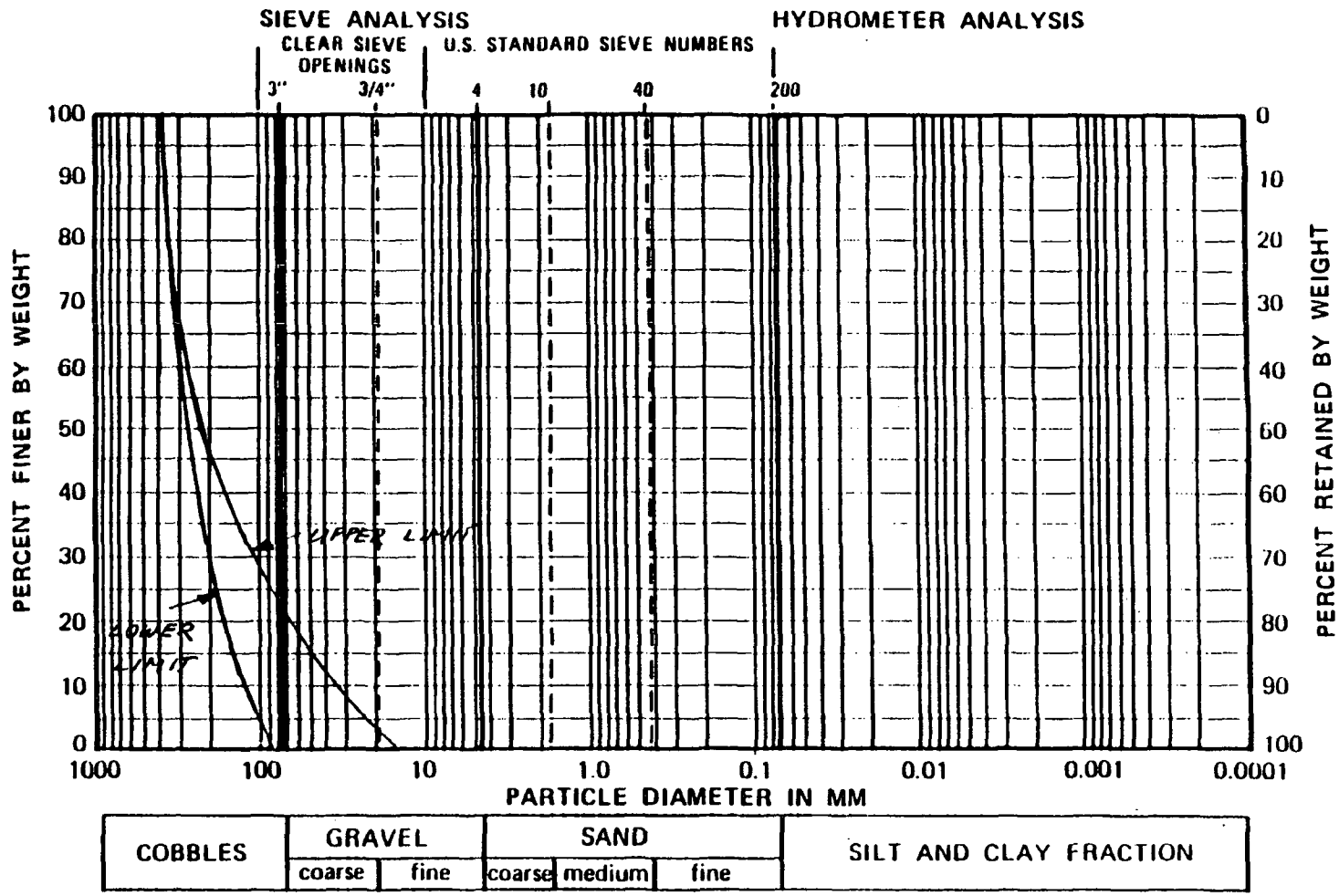
$169 \leq 5\,(60)$

$169 < 300$ O.K.

(#5) $W_{15\,LL} \geq \frac{W_{100\,UL}}{16}$

$11 \geq \frac{169}{16}$

$11 > 10.6$ O.K



TYPICAL FORMAT

GRAIN SIZE DISTRIBUTION DATA

FIGURE 1

Canonie

E-281

Canonie Environmental

E-282

By EB Date 02/27/91 Subject _____ Sheet No. ____ of ____

Chkd. By [illegible] Date [illegible] _____ Proj. No. 86-060-24

1/4" X 1/4"

LOCATION ③: NORTH DIVERSION DITCH, BURIED JETTY

CHECK INITIAL GRAIN SIZE DISTRIBUTION CURVE TO SEE IF ITS WELL GRADED:

D_{10} = 27mm

D_{30} = 84mm

D_{60} = 170

C_u = 6.3

C_z = 1.5

O.K.

By EB Date 02/27/91 Subject _____ Sheet No. ____ of ____

Chkd. By [illegible] Date [illegible] _____ Proj. No. 26-060-241

1/4" X 1/4

LOCATION (3) - CONT.:

NU-REG CL-4620 CRITERIA CHECK:

$W_{100LL} \rightarrow 10'' \rightarrow 50$ lbs

$W_{100UL} \rightarrow 10'' \rightarrow 50$ lbs

$W_{50LL} \rightarrow 7.9'' \rightarrow 24.6$ lbs

$W_{15LL} \rightarrow 4.3 \rightarrow 4$ lbs

(#3) $W_{100LL} \geq 2\,(W_{50LL})$

$50 \geq 2(24.6)$

$50 > 49.2$ O.K

(#4) $W_{100UL} \leq 5\,(W_{50LL})$

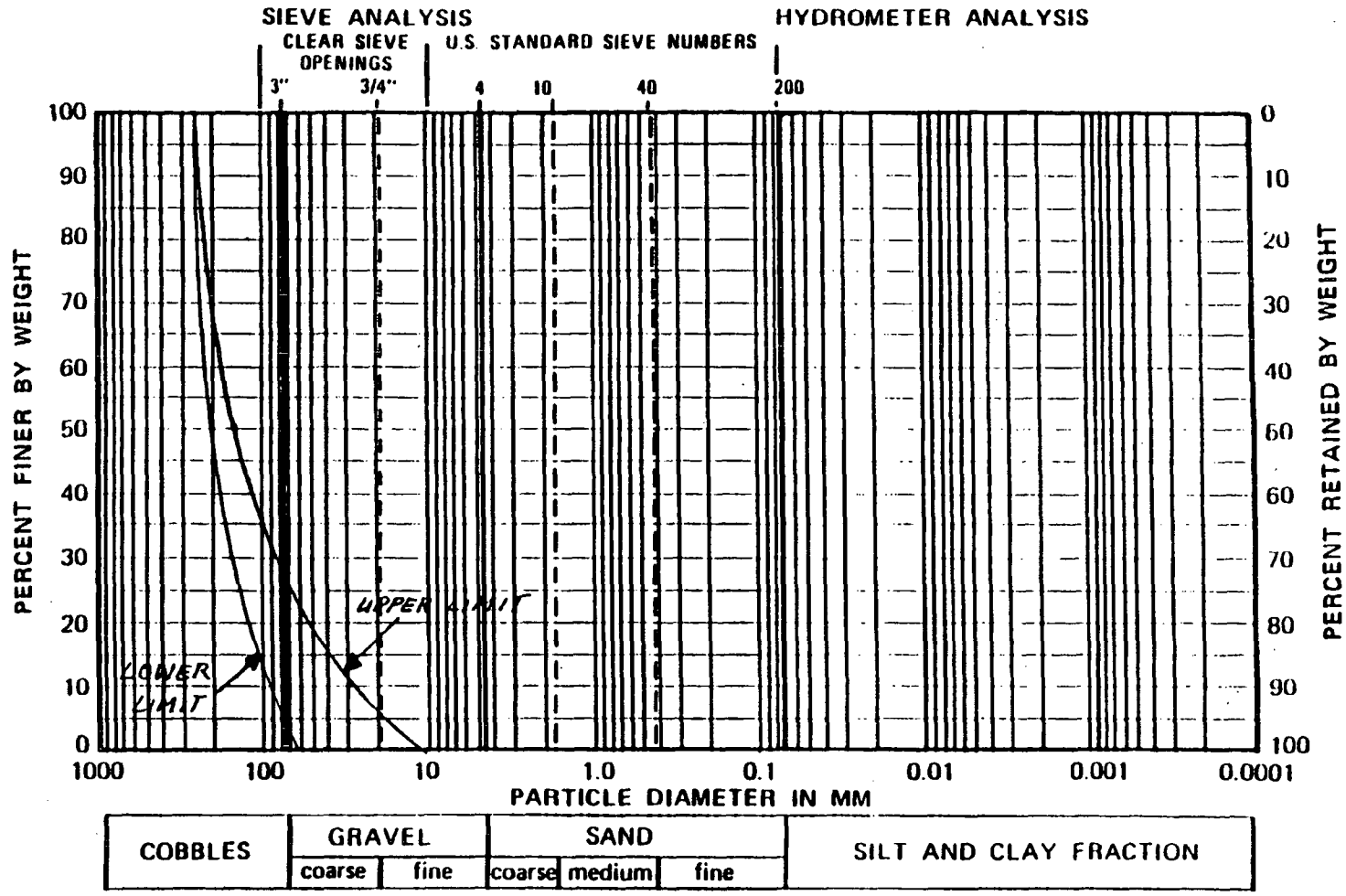
$50 \leq 5(24.6)$

$50 < 123$ O.K.

(#5) $W_{15LL} \geq \frac{W_{100UL}}{16}$

$4 \geq \frac{50}{16}$

$4 > 3.1$ O.K



TYPICAL FORMAT

GRAIN SIZE DISTRIBUTION DATA

FIGURE 1

Canonie

E-284

LOCATION (3)

3-1-91

Canonie Environmental

E-285

By EB Date 02/28/91 Subject _____ Sheet No. ____ of ____

Chkd. By [illegible] Date [illegible] _____ Proj. No. 86-060-24

1/4" X 1/4"

LOCATION (4) - CONT.:

NU-REG CL-4620 CRITERIA CHECK:

$W_{100LL} \rightarrow 6'' \rightarrow 10.8$ lbs

$W_{100UL} \rightarrow 6'' \rightarrow 10.8$ lbs

$W_{50LL} \rightarrow 4.3'' \rightarrow 4.0$ lbs

$W_{15LL} \rightarrow 2.6'' \rightarrow 0.9$ lbs

(#3) $W_{100LL} \geq 2(W_{50LL})$

$10.8 \geq 2(4.0)$

$10.8 > 8.0$ O.K.

(#4) $W_{100UL} \leq 5(W_{50LL})$

$10.8 \leq 5(4.0)$

$10.8 < 20$ O.K.

(#5) $W_{15LL} \geq \frac{W_{100UL}}{16}$

$0.9 \geq \frac{10.8}{16}$

$0.9 > 0.7$ O.K

Canonie Environmental

E-286

By EB Date 02/28/91 Subject _____ Sheet No. ____ of ____

Chkd. By [illegible] Date [illegible] _____ Proj. No. 86-960-24

1/4" X 1/4

LOCATION (4): SWALES H & I LOWER REACH OF RUNOFF CONTROL DITCH.

CHECK INITIAL GRAIN SIZE DISTRIBUTION CURVE TO SEE IF ITS WELL GRADED:

$D_{10} = 13$ mm

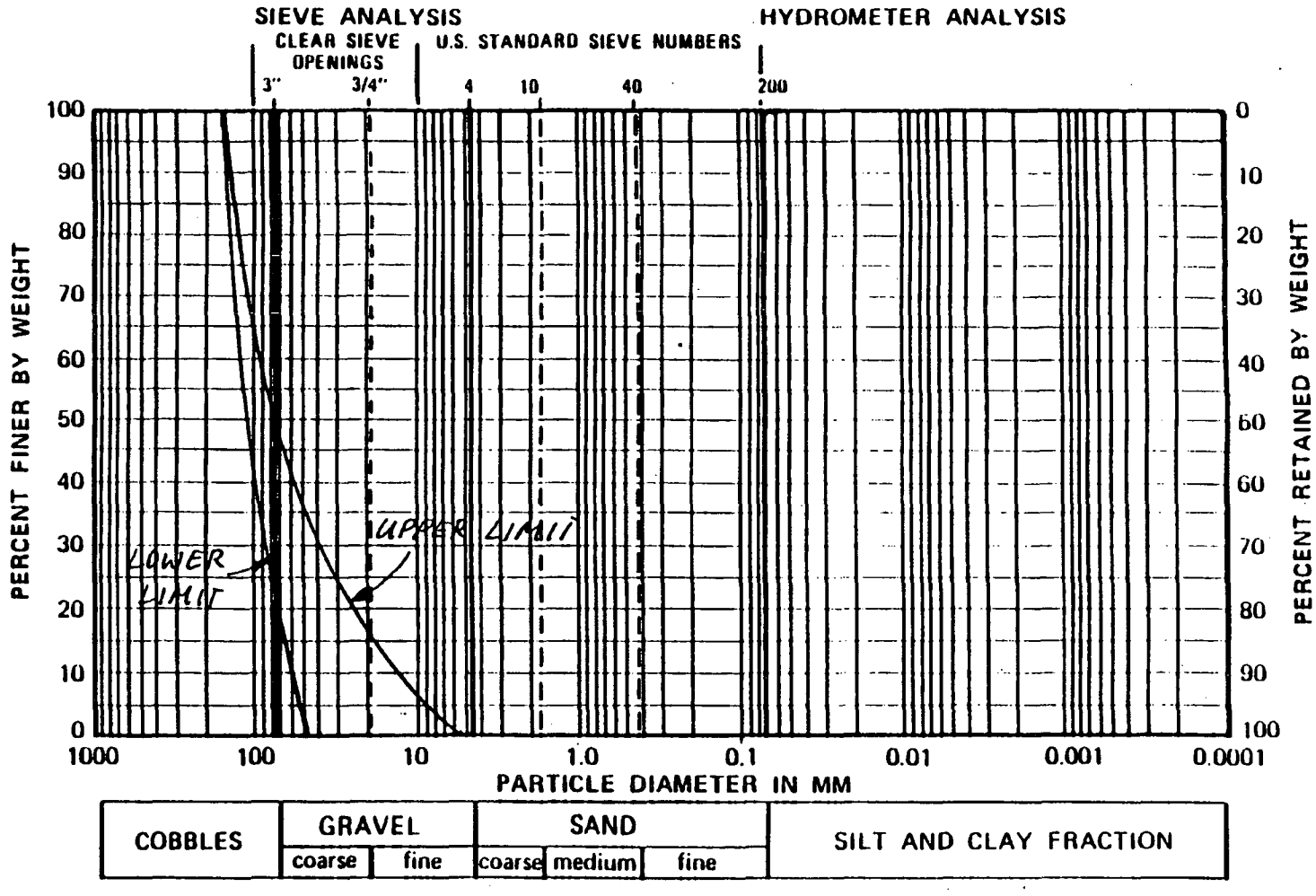
$D_{30} = 38$ mm

$D_{60} = 90$ mm

$C_u = 6.9$

$C_z = 1.2$

O.K.



TYPICAL FORMAT

GRAIN SIZE DISTRIBUTION DATA

FIGURE 1

Canonie

E-287

Canonie Environmental

E-288

By EB Date 02/28/91 Subject _____ Sheet No. ____ of ____

Chkd. By SWM Date 3-1-91 _____ Proj. No. 86-060-24

1/4" X 1/4"

LOCATION (5): SOIL/ROCK MATRIX SWALES, UPPER REACH RUNOFF CONTROL DITCH.

CHECK INITIAL GRAIN SIZE DISTRIBUTION CURVE TO SEE IF ITS WELL GRADED:

D_{10} = 5.5 mm

D_{30} = 20 mm

D_{60} = 48 mm

C_u = 8.7

C_z = 1.5

O.K.

Canonie Environmental

E-289

By EB Date 02/28/91 Subject _____ Sheet No. ____ of ____

Chkd. By SWM Date 3-1-91 _____ Proj. No. 86-060-24

1/4" X 1/4"

LOCATION (5) - CONT.:

NU-REG CL-4620 CRITERIA CHECK:

$W_{100LL} \rightarrow 3'' \rightarrow 1.3$ lbs

$W_{100UL} \rightarrow 3'' \rightarrow 1.3$ lbs

$W_{50LL} \rightarrow 2.3 \rightarrow 0.6$ lbs

$W_{15LL} \rightarrow 1.2'' \rightarrow 0.09$ lbs

(#3) $W_{100LL} \geq 2(W_{50LL})$

$1.3 \geq 2(0.6)$

$1.3 > 1.2$ O.K.

(#4) $W_{100UL} \leq 5(W_{50LL})$

$1.3 \leq 5(0.6)$

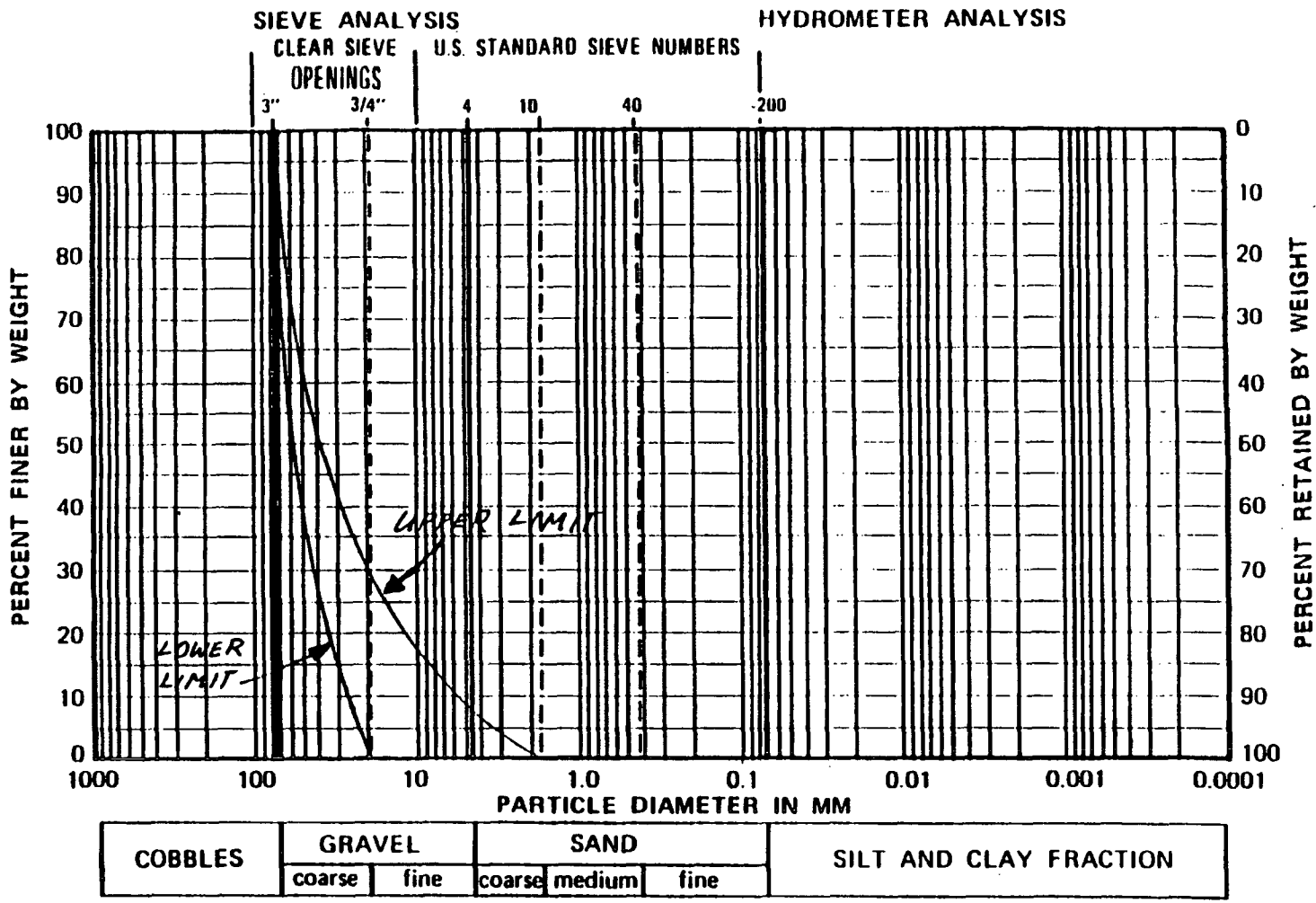
$1.3 < 3.0$ O.K

(#5) $W_{15LL} \geq \frac{W_{100UL}}{16}$

$0.09 \geq \frac{1.3}{16}$

$0.09 > 0.08$ O.K

E—290



LOCATION (5)

TYPICAL FORMAT

GRAIN SIZE DISTRIBUTION DATA

3-1-91

FIGURE 1

Cano e

APPENDIX F

APPENDIX F

RECLAMATION PLAN COST ESTIMATE
LICENSE NO. SUA-1475
UNITED NUCLEAR CORPORATION CHURCH ROCK FACILITY
GALLUP, NEW MEXICO

CanonieEnvironmental

APPENDIX F

RECLAMATION PLAN COST ESTIMATE
LICENSE NO. SUA-1475
UNITED NUCLEAR CORPORATION CHURCH ROCK FACILITY
GALLUP, NEW MEXICO

This document presents a cost estimate for performance of the remaining reclamation activities at United Nuclear Corporation's (United Nuclear) Church Rock uranium mill and tailings disposal facility near Gallup, New Mexico. The cost estimate has been prepared to satisfy the requirements of Criteria 9 and 10 of 10 Code of Federal Regulations 40, Appendix A. This estimate supersedes the reclamation plan cost estimate submitted to the Nuclear Regulatory Commission (NRC) in August 1988. The reclamation plan estimated in August 1988 has been amended on several occasions. It was approved in March 1991 with several significant technical changes from the original submittal, thus requiring a new estimate.

The August 1988 cost estimate reflected the cost of the proposed reclamation plan, which consisted of three distinct phases of activity identified as interim stabilization, seepage collection, and final reclamation.

Interim stabilization consisted mainly of activities responsive to the continuing NRC concern regarding placement of interim cover over tailings, cleanup of wind-blown tailings, and decommissioning of the mill. It required that the tailings disposal area be regraded to its final configuration and that 1 foot of the originally project 4 feet of radon attenuation soil cover be placed over the tailings. It also called for the cleanup of wind-blown tailings and decommissioning of the mill.

Seepage collection called for construction of two 5-acre lined evaporation ponds, drilling of a series of seepage collection and monitoring wells, and installation of an enhanced evaporation system. The seepage collection system was designed to operate until 1995.

Final reclamation was to consist of significant excavation of the Pipeline Arroyo to route large flood events away from the tailings facility as quickly as possible and placement of the remaining 3 feet of radon attenuating soil cover over the tailings. It also called for decommissioning of the seepage collection system and construction of permanent drainageways.

Since the time United Nuclear submitted the original cost estimate, the company has proceeded to implement the plan as required by various NRC license amendments and an Environmental Protection Agency (EPA) Administrative Order. This order also resulted in the requirement that United Nuclear provide the EPA with a $3 million Letter of Credit to cover the cost of the seepage collection program.

The reclamation accomplished to date consists of regrading and placing 1 foot of the radon attenuation soil cover over two-thirds of the tailings disposal facility and cleanup of all windblown tailings. The evaporation ponds have been constructed, seepage collection and monitoring wells drilled, and the enhanced evaporation system installed. The seepage collection system has been in operation since October 1989. To date, United Nuclear has expended approximately $3.8 million on reclamation. The EPA Letter of Credit has since been reduced to $2.5 million.

Also, since the time United Nuclear submitted the original cost estimate, several components of the reclamation plan have changed significantly, particularly in the area of final reclamation. As a result of NRC concerns, the design was changed such that an erosion protection layer consisting of a 6-inch soil/rock matrix will be placed on top of the radon attenuation soil cover. Additional water diversion swales will be constructed on the cover, and 3 inches of rock mulch will be added to all swales and onto the face of the dam. The Pipeline Arroyo will no longer be extensively excavated. Instead, a buried rock jetty will be constructed across the valley from the nickpoint to the dam to stabilize the nickpoint outcrop. Also, the 4-foot radon attenuation soil cover

has been reduced to 1.5 feet based on actual geotechnical characteristics of the soil compared to those assumed for design purposes.

Details of the modified plan as approved by the NRC are contained in various submittals to the NRC. These submittals will be consolidated into a single comprehensive package and provided to the NRC per license condition No. 34.

This cost estimate presents the cost estimated to complete the work described in the approved reclamation plan. It includes the following activities:

1. Phase I - Remaining Interim Stabilization

    - Regrading the tailings and placing 1 foot of radon attenuating soil cover on the remaining exposed tailings.

    - Decommissioning of the mill including the ore pad and catch basins.

2. Phase II - Seepage Cleanup

    - Installation of additional seepage collection wells.

    - Operation of the system.

3. Phase III - Final Reclamation

    - Placement of the final 6 inches of radon attenuating soil cover and the 6-inch soil/rock matrix erosion protection layer over the tailings area.

- Construction of all swales and diversion ditches, and placement of 3 inches of rock mulch.

- Construction of the buried jetty.

The estimate assumes that all reclamation construction activities will be performed in an expedited fashion progressing to final reclamation, except that the seepage collection program constrains the schedule by the rate at which seepage can be removed from the geologic formations.

Table 1 provides a summary of estimated costs for the reclamation activities. As identified by this table, the total direct cost to the contractor (labor, equipment, materials) for performance of this work by a third party is estimated to be $7,369,438. The direct cost was subsequently increased by 15 percent for contractor overhead and profit, by 15 percent for contingencies as recommended by the NRC, and by 5.625 percent to account for the New Mexico gross receipts tax. The long-term surveillance costs (i.e., $250,000 in 1978 dollars equal to $494,000 in 1991 dollars) has also been added. The total estimated cost for conducting the remaining reclamation is $10,716,793.

Details of construction direct cost estimates, including the hourly wage rates used for categories of reclamation personnel, equipment rates for construction equipment, materials prices, on-site overhead items, and labor/equipment spread for each primary component of reclamation are provided in Appendices A, B, and C for the remaining interim stabilization, seepage collection, and final reclamation phase of the plan, respectively.

Interim Stabilization

This phase consists of completion of the interim stabilization activity described in the original estimate as modified by the approved plan. It basically consists of regrading the tailings to their final configuration and placing a minimum of 12 inches of clean borrow soils over the regraded tailings surface to construct the radon attenuation soil cover. In this phase, the mill will also be decommissioned and disposed of in Borrow Pit No. 2 of the tailings facility. The total estimated direct cost for this phase is $1,733,201. The cost estimate for interim stabilization in Appendix A presents detailed costing for the following activities:

1. Mobilization;

2. Haul/access road construction;

3. Regrading of the tailings in preparation for soil cover;

4. Excavation and regrading of the tailings retention embankment to provide soil cover material;

5. Placement of 12 inches of soil cover over the regraded tailings;

6. Construction of drainages to prevent adverse effects due to runoff;

7. Decommissioning and demolishing of the mill;

8. Decontamination of ore pads and catch basins;

9. Site supervision;

10. Radiological monitoring;

11. Site security;

12. Quality assurance/quality control;

13. Associated precautionary and health and safety measures and jobsite overheads; and

14. Demobilization.

Seepage Collection

This phase is designed to expand and continue to operate the seepage collection program approved by the NRC and the EPA. Seepage collection is ongoing at the present time and will continue into the final reclamation cover period. The total estimated direct cost for seepage collection is $2,447,992. The cost estimate for seepage collection in Appendix B presents detailed costing for the following activities:

1. Installation of eight new wells;

2. Installation of the electrical system for these new wells;

3. Operation of the seepage collection system until 1995;

4. Plugging 290 wells; and

5. Annual water quality reporting.

Final Reclamation Cover

Activities in this phase consist primarily of completing the placement of the radon attenuating soil cover over the tailings by placing the additional 6 inches of soil over the already placed 1 foot, placement of the 6-inch soil/rock matrix for erosion protection, construction of the swale and diversion channels, placement of 3 inches of rock mulch in the swales and on the dam face, closure of the evaporation ponds, decommissioning of the seepage collection system, and construction of the buried jetty. The total estimated direct cost for final reclamation is $3,188,245. The cost estimate for final reclamation in Appendix C presents detailed costing of the following activities:

1. Mobilization;

2. Clearing and grubbing of vegetation;

3. Final soil cover placement (1.5 feet total thickness);

4. Final backfill and covering of Borrow Pit No. 2;

5. Radiological monitoring;

6. Site security;

7. Quality assurance/quality control;

8. Associated precautionary and health and safety measures and jobsite overheads;

9. Demobilization; and

10. Site supervision.

TABLES

TABLE 1

SUMMARY OF TOTAL ESTIMATED REMAINING RECLAMATION COSTS

Item Description	Estimated Cost (1991 dollars)
Interim Stabilization Direct Cost	1,733,201
Seepage Collection Direct Cost	2,447,992
Final Reclamation Direct Cost	3,188,245
Subtotal	7,369,438
Contractor Profit and Overhead (15 percent)	1,105,416
Subtotal	8,474,854
Contingency (15 percent)	1,271,228
New Mexico Gross Receipts Tax (5.625 percent)	476,711
Subtotal	10,222,793
Long-term Surveillance	494,000
Total Estimated Reclamation Cost	10,716,793

ATTACHMENT A

INTERIM STABILIZATION

PROJECT: INTERIM REMEDIATION FOR UNC ESTIMATOR: WJY

JOB NO.: 86-60-26

DATE: 06-Jun-91 TIME: 02:03 PM

ESTIMATE SUMMARY

ITEM DESCRIPTION	DETAIL SHEET	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIAL	SUBS	TRAVEL	UNIT COSTS	TOTAL COSTS
TOTAL FIXED OVERHEADS	SHT 6	1	LS	0	0	0	0	0	5,150		550	0	5,700.00	5,700
VARIABLE JOBSITE OVERHEADS	SHT 7	25	WEEKS	167,900	3,750	24,275	3,375	2,250	12,125		21,000	22,750	10,297.00	257,425
MOBILIZATION	SHT 8	1	LS	5,127	0	541	236	136	0	3,000	28,644	0	37,683.00	37,683
CLEARING AND GRUBBING	SHT 9	10	AC	1,371	0	3,228	417	288	0	0	0	0	530.40	5,304
HAUL/ACCESS ROADS	SHT 10	14,500	SY	1,861	0	4,694	741	509	0	19,383	0	0	1.88	27,188
TAILINGS REGRADING	SHT 11	122,300	CY	19,223	0	71,512	11,146	7,452	0	13,041	0	985	1.01	123,279
EMBANKMENT EXCAVATION	SHT 12	78,000	CY	22,280	0	80,811	11,451	7,998	0	3,000	0	1,470	1.63	127,010
MILL DECOMMISIONING	SHT 13	1	LS	169,385	0	389,085	27,417	23,283	0	0	0	0	609,010.00	609,010
ORE PADS AND CATCH BASINS	SHT 14	103,100	CY	57,731	0	229,075	26,569	16,275	0	3,000	0	4,340	3.27	336,980
SOIL COVER MATERIAL	SHT 15	42,270	CY	1,476	0	2,528	440	415	0	500	0	0	0.13	5,359
MISC. SITE DRAINAGE	SHT 16	1	LS	3,287	0	3,489	414	340	0	9,975	0	0	17,425.00	17,425
DEWATERING PREP.	SHT 17	1	LS	2,912	0	1,193	402	200	0	5,500	0	0	10,207.00	10,207
DEMOBILIZATION	SHT 18	1	LS	9,040	0	954	414	240	0	3,000	21,000	0	34,656.00	34,656
SECURITY SERVICE	SHT 19	25	WK	0	0	0	0	0	0	0	37,050	0	1,482.00	37,050
RADIOLOGICAL MONITORING	SHT 20	25	WK	0	0	0	0	0	42,500	0	0	0	1,700.00	42,500
QUALITY CONTROL	SHT 21	25	WK	35,025	0	14,900	0	0	0	0	0	6,500	2,257.00	56,425
SUBTOTAL				496,546	3,750	826,125	83,011	59,386	69,775	60,399	108,244	36,965		1,733,201

PROJECT: INTERIM REMEDIATION FOR UNC — DATE: 06-Jun-91

JOB NO.: 86-60-26 — TIME: 02:03 PM

WEEKLY WORK HOUR BASIS: — ESTIMATOR: WJY

1) PROJECT BASED ON WORKING 50 HOURS PER WEEK.

2) RATES ARE BASED ON PREVAILING RATES IN GALLUP NEW MEXICO.

SUBSISTENCE AND TRAVEL COST CALCULATIONS: AMOUNTS APPLIED TO THE FIRST 40 HOURS OF WORK

S&T CLASS	GENERAL DESCRIPITON	TRAVEL BASIS (WKS/TRP)	TRAVEL COST (PER TRIP)	LODGING COST (PER NIGHT)	SUBSISTENCE COST (PER DAY)	HOURLY COSTS TRAVEL	LODGING	SUBSISTENCE	TOTALS
SALARIED PERSONNEL:									
S1	SALARY, REGIONAL TRAVEL	2	$100	$35	$0	$1.25	$5.25	$0.00	$6.50
S2	SALARY, LOCAL TRAVEL	1	$50	$35	$0	$1.25	$4.38	$0.00	$5.63
S3		1				$0.00	$0.00	$0.00	$0.00
S4		1				$0.00	$0.00	$0.00	$0.00
S5		1				$0.00	$0.00	$0.00	$0.00
HOURLY PERSONNEL:									
H1	HOURLY, REGIONAL TRAVEL	3	$100	$35	$15	$0.83	$5.54	$2.38	$8.75
H2	HOURLY, LOCAL TRAVEL	1	$0	$0	$0	$0.00	$0.00	$0.00	$0.00
H3		1				$0.00	$0.00	$0.00	$0.00
H4		1				$0.00	$0.00	$0.00	$0.00
H5		1				$0.00	$0.00	$0.00	$0.00

TAX AND INSURANCE CALCULATIONS:

	DESCRIPTION	NON-REP	SALARY	REMARKS
*	FUI %	0.80%	0.80%	STANDARD FEDERAL RATE APPLIED TO ALL WAGES PAID
*	SUI %	2.60%	2.60%	RATE VARIES WITH STATE, APPLIES TO ALL WAGES PAID
*	FICA %	7.65%	7.65%	STANDARD FEDERAL RATE APPLIED TO ALL WAGES PAID
	WC %	7.55%	7.55%	VARIES BY CRAFT SEE WAGE RATE TABLE, BASE WAGE ONLY
	HEALTH (MNTHLY)	$350	$350	MONTHLY COST, CANONIE COVERAGE, FIRST 40 HOURS (AVG $350)
	LTL %	N/A	1.18%	SALARY EMPLOYEES ONLY, BASE WAGE ONLY.
	STRAIGHT %	18.60%	19.78%	
*	OVERTIME %	11.05%	11.05%	

PROJECT: INTERIM REMEDIATION FOR UNC DATE: 06-Jun-91

JOB NO.: 86-60-26 TIME: 02:03 PM

ESTIMATOR: WJY

WAGE RATE TABLE

	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
				<= TAXABLE FRINGES =>		<= NON-TAXBLE FRNGS =>		<==== CANONIE ADDITIONS ====>			STRAIGHT HOURLY		PREMIUM HOURLY		AVG HOURLY	@ 50 HRS
DESCRIPTION	ESCAL FACTOR MULTIPLIER	SUB & TRVL CLASS	BASE WAGE	VACATION	ALL OTHER	H&W	ALL OTHER	WKRS COMP %'AGE	HEALTH INS	SUB & TRAVEL	BARE HOURLY	TOTAL HOURLY	BARE HOURLY	TOTAL HOURLY	BARE HOURLY	TOTAL HOURLY
72 MECHANIC	1.00	H2	$13.00					7.55%	$1.99	$0.00	$13.00	$17.41	$19.50	$22.64	$14.30	$18.45
73 KEY OPERATOR	1.00	H1	$12.00					7.55%	$1.99	$8.75	$12.00	$24.97	$18.00	$20.90	$13.20	$24.16
74 LOCAL OPERATOR	1.00		$12.00					7.55%	$1.99	$0.00	$12.00	$16.22	$18.00	$20.90	$13.20	$17.16
75 OILER	1.00		$10.00					7.55%	$1.99	$0.00	$10.00	$13.85	$15.00	$17.41	$11.00	$14.56
76 KEY LABORER	1.00	H1	$8.00					7.55%	$1.99	$8.75	$8.00	$20.23	$12.00	$13.93	$8.80	$18.97
77 LOCAL LABORER	1.00		$8.00					7.55%	$1.99	$0.00	$8.00	$11.48	$12.00	$13.93	$8.80	$11.97
78 PIPEFITTER	1.00	H2						7.55%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
79 ELECTRICIAN	1.00	H2						7.55%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
80																
81 CARPENTER FRM.	1.00	H1						7.55%	$0.00	$8.75	$0.00	$8.75	$0.00	$0.00	$0.00	$7.00
82 CARPENTER	1.00	H2						7.55%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
83 CEMENT MASONS	1.00	H2						7.55%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
84 TEAMSTERS	1.00	H1						7.55%	$0.00	$8.75	$0.00	$8.75	$0.00	$0.00	$0.00	$7.00
85																
86 MECHANIC HELPER	1.00		$10.00					7.55%	$1.99	$0.00	$10.00	$13.85	$15.00	$17.41	$11.00	$14.56
87																
88																
89																
90																
91																
92 PROJECT MANAGER	1.00	S1	$28.85					7.55%	$1.99	$6.50	$28.85	$43.04	$0.00	$0.00	$23.08	$34.43
93 SUPERINTENDENT	1.00	S1	$27.76					7.55%	$1.99	$6.50	$27.76	$41.74	$0.00	$0.00	$22.21	$33.40
94 FIELD FORMAN	1.00	H2	$24.48					7.55%	$1.99	$0.00	$24.48	$31.31	$0.00	$0.00	$19.59	$25.05
95 PROJ. ENGINEER	1.00	S1	$23.08					7.55%	$1.99	$6.50	$23.08	$36.13	$0.00	$0.00	$18.46	$28.90
96 HES OFFICER	1.00	S1	$21.63					7.55%	$1.99	$6.50	$21.63	$34.40	$32.45	$37.93	$23.80	$35.11
97 AST. PROJ. ENG.	1.00	S1	$20.19					7.55%	$1.99	$6.50	$20.19	$32.67	$30.29	$36.40	$22.21	$33.22
98 ENGINEER TECH.	1.00	S1	$18.27					7.55%	$1.99	$6.50	$18.27	$30.37	$27.40	$32.83	$20.10	$30.70
99 OFFICE MANAGER	1.00		$9.50					7.55%	$1.99	$0.00	$9.50	$13.37	$14.25	$16.65	$10.45	$14.02
100 CLERK	1.00		$8.50					7.55%	$1.99	$0.00	$8.50	$12.17	$12.75	$14.90	$9.35	$12.72
101 PROJ. SUPERVISOR	1.00	S1	$24.04					7.55%	$1.99	$6.50	$24.04	$37.28	$36.06	$42.14	$26.44	$38.25
102																
103																
104																

PROJECT: INTERIM REMEDIATION FOR UNC | DATE: 06-Jun-91 | USE TAX RATE =======> 0.00% | SHT 4 OF SHT 21

JOB NO.: 86-60-26 | TIME: 02:03 PM | HOURLY FUEL RATE IS BASED UPON PAYING $1.15 PER GALLON.

ESTIMATOR: WJY

EQUIPMENT RENTAL RATES

BASED ON OPERATING 176 HOURS PER MONTH

DESCRIPTION	TYPE		F MONTHLY RENTAL	G USE TAX	H HOURLY RENTAL 176 HR/MO	I HOURLY FUEL RATE	J HOURLY REPAIRS RATE	K PERIOD USAGE D,W,M	L ADJUSTMENT FACTOR APPLIED
****** INTERNAL EQUIPMENT ******									
121				1.00	$0.00	$2.30	$1.00	M	1.00
122				1.00	$0.00	$1.15	$0.50	M	1.00
123				1.00	$0.00	$0.00	$0.00	M	1.00
124				1.00	$0.00	$1.72	$1.00	M	1.00
125				1.00	$0.00	$0.00	$0.00	M	1.00
126				1.00	$0.00	$0.00	$0.00	M	1.00
127				1.00	$0.00	$0.00	$0.00	M	1.00
128				1.00	$0.00	$0.00	$0.00	M	1.00
129				1.00	$0.00	$0.00	$0.00	M	1.00
130				1.00	$0.00	$0.00	$0.00	M	1.00
131				1.00	$0.00	$0.00	$0.00	M	1.00
****** EXTERNAL EQUIPMENT ******								M	
133 CASE 580 BKH	BACKHOE	(CY)	$1,400	1.00	$7.95	$3.45	$2.00	M	1.00
134 CAT 215 BKH	BACKHOE	(1.25 CY)		1.00	$0.00	$4.60	$3.50	M	1.00
135 CAT 225 BKH	BACKHOE	(1.62 CY)	$7,500	1.00	$42.61	$5.18	$4.25	M	1.00
136 CAT 235 BKH	BACKHOE	(2.75 CY)	$9,000	1.00	$51.14	$7.48	$6.00	M	1.00
137 CAT 245 BKH	BACKHOE W/L STICK	(3.75 CY)	$12,500	1.00	$71.02	$12.65	$7.50	M	1.00
138 CRANE W/BALL	CRANE & BALL		$15,000	1.00	$85.23	$4.02	$3.50	M	1.00
139 CAT 235 BKH|A	BKH WITH ATTACH		$15,000	1.00	$85.23	$4.60	$4.00	M	1.00
140 CAT 950 FEL	FEL	(3.25 CY)		1.00	$0.00	$5.75	$5.00	M	1.00
141 CAT 966 FEL	FEL	(4.50 CY)	$5,900	1.00	$33.52	$8.05	$6.00	M	1.00
142 CAT 953 FEL|T	FEL/TRACK	(2.0 CY)		1.00	$0.00	$5.18	$5.50	M	1.00
143 CAT 973 FEL|T	FEL/TRACK	(2.5 CY)	$8,375	1.00	$47.59	$5.90	$7.00	M	1.00
144 CAT D5 DZR	DOZER		$5,750	1.00	$32.67	$4.60	$4.50	M	1.00
145 CAT D6 DZR	DOZER		$6,625	1.00	$37.64	$6.32	$4.50	M	1.00
146 CAT D6 DZR|D	DOZER/DISC			1.00	$0.00	$6.32	$4.50	M	1.00
147 CAT D6 DZR|LGP	DOZER/LGP		$8,525	1.00	$48.44	$6.32	$4.50	M	1.00
148 CAT D7 DZR	DOZER			1.00	$0.00	$8.05	$5.25	M	1.00
149 CAT D8 DZR	DOZER		$12,350	1.00	$70.17	$12.65	$7.50	M	1.00
150 CAT D9 DZR	DOZER		$14,750	1.00	$83.81	$18.40	$10.00	M	1.00
151 CAT D9 DZR|R	DOZER/RIPR		$15,960	1.00	$90.68	$21.85	$13.00	M	1.00
152 CAT 14 GDR	GRADER		$6,975	1.00	$39.63	$6.90	$6.50	M	1.00
153 CAT 16 GDR	GRADER		$13,730	1.00	$78.01	$9.20	$8.00	M	1.00
154 CAT 815 COMP	COMPACTOR		$8,000	1.00	$45.45	$12.65	$5.00	M	1.00
155 CAT CP 563 COMP	COMPACTOR		$3,700	1.00	$21.02	$5.90	$4.00	M	1.00
156 4"/6" PUMP				1.00	$0.00	$4.60	$2.00	M	1.00
157 MISC. EQUIPMENT			$2,800	1.00	$15.91	$4.60	$2.00	M	1.00
158 CAT 613 SCPR|E	SCRAPER/ELEV	(11 CY)	$6,850	1.00	$38.92	$5.75	$4.00	M	1.00
159 CAT 631 SCPR|E	SCRAPER/ELEV	(31 CY)	$16,500	1.00	$93.75	$10.06	$8.75	M	1.00
160 CAT 627 SCPR|T	SCRAPER/TWIN	(20 CY)		1.00	$0.00	$18.11	$12.50	M	1.00
161 CAT 637 SCPR|T	SCRAPER/TWIN	(31 CY)		1.00	$0.00	$27.31	$17.50	M	1.00
162 WATER TRUCK	WATER TRUCK	(5,000 GAL)	$5,700	1.00	$32.39	$4.60	$3.00	M	1.00
163 TANDEM DUMP TRUCK		(10 CY)	$8,000	1.00	$50.00	$0.00	$0.00	M	1.00

EQUIPMENT ADJUSTMENT FACTORS:

MONTHLY	M	1.00
WEEKLY	W	1.44
DAILY	D	1.81

PROJECT: INTERIM REMEDIATION FOR UNC DATE: 06-Jun-91 SHT 5 OF SHT 21

JOB NO.: 86-60-26 TIME: 02:03 PM SALES TAX RATE =======> 0.00%

ESTIMATOR: WJY

SUMMARY OF MATERIAL AND SUBCONTRACT PRICES
USED IN CURRENT ESTIMATE

	B	E	F	G	H	I	J	L	N	O
	DESCRIPTION	QUANTITY	UNIT	QUOTED UNIT PRICE	SALES TAX	UNIT PRICE WITH TAX	TOTAL PRICE	PLUGGED - P QUOTED - Q	NO. OF QUOTES RECEIVED	PRICE DIFF. BETWEEN LOW & SECOND
			PERMANENT MATERIAL PRICES							
187	STRAW BALES	2,000	EA	$2.50	1.00	$2.50	$5,000.00			
188	GEOTEXTILE	420,337	SF	$0.07	1.00	$0.07	$29,423.59			
189					1.00	$0.00	$0.00			
190	MISC. SUPPLIES	5	LS	$3,000.00	1.00	$3,000.00	$15,000.00			
191	MISC. SHANK WORK	1	LS	$5,000.00	1.00	$5,000.00	$5,000.00	P		
192	CULVERT PIPE	175	LF	$25.00	1.00	$25.00	$4,375.00			
193	ARCH PIPE (83"-57")	50	LF	$100.00	1.00	$100.00	$5,000.00			
194	MISC. PIPE	1	LS	$500.00	1.00	$500.00	$500.00			
195					1.00	$0.00	$0.00			
196					1.00	$0.00	$0.00			
197					1.00	$0.00	$0.00			
198					1.00	$0.00	$0.00			
199					1.00	$0.00	$0.00			
200					1.00	$0.00	$0.00			
201					1.00	$0.00	$0.00			
202					1.00	$0.00	$0.00			
203					1.00	$0.00	$0.00			
204					1.00	$0.00	$0.00			
			MAJOR SUPPLY PRICES							
207					1.00	$0.00	$0.00			
208					1.00	$0.00	$0.00			
209					1.00	$0.00	$0.00			
210	RADIOLOGICAL MONITORING	25	WK	$1,700.00	1.00	$1,700.00	$42,500.00			
211					1.00	$0.00	$0.00			
212					1.00	$0.00	$0.00			
213					1.00	$0.00	$0.00			
214					1.00	$0.00	$0.00			
			SUBCONTRACT PRICES:							
217					1.00	$0.00	$0.00			
218					1.00	$0.00	$0.00			
219	HAUL: SPECIAL LOADS	40	EA	$500.00	1.00	$500.00	$19,920.00			
220	HAUL: REGULAR LOADS	18	EA	$300.00	1.00	$300.00	$5,478.00			
221	HAUL: SMALL LOADS	13	EA	$150.00	1.00	$150.00	$1,992.00			
222					1.00	$0.00	$0.00			
223					1.00	$0.00	$0.00	P		
224	HEALTH & SAFETY TRAINING	528	MNHR	$25.00	1.00	$25.00	$13,200.00			
225	CRANE	83	HR	$90.00	1.00	$90.00	$7,470.00			
226	INDUSTRIAL HYGIENIST	53	MNHRS	$30.00	1.00	$30.00	$1,584.00			
227	SECURITY SERVICE	31	WK	$1,482.00	1.00	$1,482.00	$45,942.00			

PROJECT: INTERIM REMEDIATION FOR UNC DATE: 06-Jun-91 SHT 6 OF SHT 21

JOB NO.: 86-60-26 TIME: 02:03 PM

ESTIMATOR: WJY

FIXED COST JOBSITE OVERHEADS

	DESCRIPTION	REQUIRED Y OR N	REQUIRED QUANTITY	UNIT RATE	I LABOR	J INT EQUIP	K EXT EQUIP	L FUEL	M REPAIRS	N SUPPLIES	O SUBS	P TRAVEL	Q TOTALS
245	COPY MACHINE (LONG TERM PROJECT)			56						0			0
246	PHONE SYSTEM (LONG TERM PROJECT)	Y	1	500						500			500
247	PHYSICALS			500						0			0
248	UTILITY HOOKUPS:												
249	ELECTRIC	Y	1	350							350		350
250	WATER			250							0		0
251	SEWER										0		0
252	GAS										0		0
253	TELEPHONE	Y	1	200							200		200
254	SPECIAL TAXES									0			0
255	PERMITS			100						0			0
256	ROYALITIES ON PROCESSES									0			0
257										0			0
258										0			0
259	TEMPORARY FENCING			3.5						0			0
260	OFFICE FURNITURE	Y	10	75						750			750
261	FAX MACHINE	Y	1	300						300			300
262	COMPUTER	Y	1	500						500			500
263	COMPUTER SOFTWARE	Y	3	200						600			600
264	MOVING EXPENSES (LONG TERM PROJECT)									0			0
265	PROJECT SIGN									0			0
266	H & S TRAINING-OPERATORS			1,149	0								0
267	H & S TRAINING-LABORERS			959	0					0			0
268	INITIAL H & S PURCHASES	Y	1	2500						2500			2500
269	TRAINING CLASS COSTS-EXTERNAL			700							0		0
270	TRAINING CLASS COSTS-INTERNAL			450							0		0
271										0			0
272										0			0
273										0			0
274										0			0
275										0			0
276										0			0
277										0			0
278										0			0
279										0			0
280										0			0
281										0			0
282										0			0
283										0			0
	TOTAL FIXED OVERHEADS				0	0	0	0	0	5150	550	0	5700

PROJECT: INTERIM REMEDIATION FOR UNC DATE: 06-Jun-91

JOB NO.: 86-60-26 TIME: 02:03 PM

ESTIMATOR: WJY PROJECT DURATION = 25.0 WEEKS

VARIABLE COST JOBSITE OVERHEADS

	PROJECT MANAGER DESCRIPTION	REQUIRED Y OR N	REQUIRED QUANTITY	DURATION	UNIT RATE	I TOTAL LABOR	J WEEKLY LABOR	K WEEKLY INT EQUIP	L WEEKLY EXT EQUIP	M WEEKLY FUEL	N WEEKLY REPAIRS	O WEEKLY SUPPLIES	P WEEKLY SUBS	Q WEEKLY TRAVEL	Q WEEKLY TOTALS
305	PROJECT MANAGER			25	$1,462	0	0	0		0	0			0	0
306	SUPERINTENDENT	Y	1	25	$1,410	35,250	1,410	150		30	20			260	1,870
307	FIELD FORMAN			25	$1,253	0	0	0		0	0			0	0
308	PROJ. ENGINEER	Y	1	25	$1,185	29,625	1,185		150	30	20			260	1,645
309	H&S OFFICER	Y	1	25	$1,495	37,375	1,495		150	30	20			260	1,955
310	ENGINEER TECH.	Y	0.5	25	$1,275	15,938	638		75	15	10			130	868
311	OFFICE MANAGER	Y	1	25	$701	17,525	701							0	701
312	CLERK			25	$636	0	0							0	0
313	MECHANIC	Y	1	25	$923	23,075	923		150	30	20			0	1,123
314	MECHANIC HELPER	Y	0.5	25	$728	9,100	364							0	364
315	SURVEY CREW	Y	1	6	$3,500								840		840
316	OFFICE TRAILER			25	$150				0						0
317	TOOL TRAILER			25	$75			0							0
318	CHANGE TRAILER			25	$100				0						0
319	DECONTAMINATION TRAILER			25	$225				0						0
320	OFFICE SUPPLIES	Y	1	25	$50							50			50
321	SURVEY SUPPLIES	Y	1	25	$100							100			100
322	SAFETY SUPPLIES	Y	1	25	$30							30			30
323	COPY MACHINE			25	$50							0			0
324	PHONE			25	$150							0			0
325	FUEL TRUCK			25	$100				0						0
326	GREASE TRUCK	Y	1	25	$221				221						221
327	PRESSURE WASHER	Y	1	25	$225				225						225
328	SAFETY EQUIPMENT (OVA)			25	$95			0							0
329	MISC. EQUIP			25	$75			0							0
330				25											0
331	UTILITY SERVICES	Y	1	25	$35							35			35
332	POTABLE WATER			25	$40							0			0
333	SANITARY FACILITIES	Y	2	25	$40							80			80
334	SMALL TOOLS	Y	1	25	$150							150			150
335	JOBSITE PHOTOS	Y	1	25	$40							40			40
336	STORAGE TANK			25	$105				0						0
337				25											0
338	TRAVEL, EXECUTIVE			25	$500							0			0
339	KEY OPERATOR ADJUSTMENT			25	$438							0			0
340	KEY LABORER ADJUSTMENT			25	$438							0			0
341	ON-SITE QC TESTING			25	$200								0		0
342	SECURITY			25	$2,520								0		0
343															
	VARIABLE JOBSITE OVERHEADS (WEEKLY)						6,716	150	971	135	90	485	840	910	10,297
	VARIABLE JOBSITE OVERHEADS (TOTAL)		25 WEEKS				167,900	3,750	24,275	3,375	2,250	12,125	21,000	22,750	257,425

PROJECT: INTERIM REMEDIATION FOR UNC ESTIMATOR: WJY SHT 8 OF SHT 21

JOB NO: 86-60-26 DATE: 06-Jun-91 TIME: 02:03 PM

ITEM DESCRIPTION: MOBILIZATION JOB QUANTITY: 1 LS

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 68 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CASE 580 BKH	1.00	EA	17.16		7.95	3.45	2.00				0.00		
LOCAL OPERATOR	2.00	EA	34.31								0.00		
LOCAL LABORER	2.00	EA	23.93								0.00		
CREW			75.40	0.00	7.95	3.45	2.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	88.80
SUBTOTAL	68	HOURS	5,127	0	541	235	136	0	0	0	0	6,039	6,039.00
MATERIALS:													
												0	
HAUL: SPECIAL LOADS	16	EA								7,920		7,920	
HAUL: REGULAR LOADS	7	EA								2,178		2,178	
HAUL: SMALL LOADS	5	EA								792		792	
MISC. SUPPLIES	1	LS							3,000			3,000	
CRANE	33	HR								2,970		2,970	
HEALTH & SAFETY TRAINING	528	MNHR								13,200		13,200	
INDUSTRIAL HYGIENIST	53	MNHRS								1,584		1,584	
												0	
												0	
												0	
												0	
TOTALS			5,127	0	541	235	136	0	3,000	28,644	0	37,683	37,683.00

PROJECT: INTERIM REMEDIATION FOR UNC ESTIMATOR: WJY SHT 9 OF SHT 21

JOB NO: 86-60-26 DATE: 06-Jun-91 TIME: 02:03 PM

ITEM DESCRIPTION: CLEARING AND GRUBBING JOB QUANTITY: 10 AC

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 25 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D6 DZR	1.00	EA	17.16		37.64	6.32	4.50				0.00		
LOCAL LABORER	1.00	EA	11.97								0.00		
CAT 966 FEL	1.00	EA	17.16		33.52	8.05	6.00				0.00		
TANDEM DUMP TRUCK *	1.00	EA			50.00	0.00	0.00				0.00		
MISC. EQUIPMENT	0.50	EA	8.58		7.96	2.30	1.00				0.00		
CREW			54.86	0.00	129.12	16.67	11.50	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	212.15
SUBTOTAL	25	HOURS	1,371	0	3,228	417	288	0	0	0	0	5,304	530.40

MATERIALS:

	0
	0
	0
	0
	0
	0
	0
	0
	0
	0
	0
	0

TOTALS	1,371	0	3,228	417	288	0	0	0	0	5,304	530.40

PROJECT: INTERIM REMEDIATION FOR UNC

ESTIMATOR: WJY

SHT 10 OF SHT 21

JOB NO: 86-60-26

DATE: 06-Jun-91

TIME: 02:03 PM

ITEM DESCRIPTION: HAUL/ACCESS ROADS

JOB QUANTITY: 14,500 SY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 34 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D6 DZR	1.00	EA	17.16		37.64	6.32	4.50				0.00		
CAT 815 COMP	0.50	EA	8.58		22.73	6.32	2.50				0.00		
CAT 16 GDR	1.00	EA	17.16		78.01	9.20	8.00				0.00		
LOCAL LABORER	1.00	EA	11.97								0.00		
											0.00		
CREW			54.86	0.00	138.38	21.85	15.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	230.08
SUBTOTAL	34	HOURS	1,861	0	4,694	741	509	0	0	0	0	7,805	0.54
MATERIALS:													
GEOTEXTILE	276,900	SF							19,383			19,383	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			1,861	0	4,694	741	509	0	19,383	0	0	27,188	1.88

PROJECT: INTERIM REMEDIATION FOR UNC

ESTIMATOR: WJY

SHT 11 OF SHT 21

JOB NO: 86-60-26

DATE: 06-Jun-91

TIME: 02:03 PM

ITEM DESCRIPTION: TAILINGS REGRADING

JOB QUANTITY: 122,300 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 86 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D9 DZR	4.00	EA	68.62		336.24	73.60	40.00				0.00		
CAT 631 SCPR|E	4.00	EA	68.62		375.00	40.25	35.00				0.00		
CAT D6 DZR|LGP	1.00	EA	17.16		48.44	6.32	4.50				0.00		
FIELD FORMAN	1.00	EA	25.05								0.00		
KEY LABORER	1.50	EA	17.95								10.50		
WATER TRUCK	1.00	EA	17.16		32.39	4.60	3.00				0.00		
CAT 16 GDR	0.50	EA	8.58		39.01	4.60	4.00				0.00		
											0.00		
CREW			223.14	0.00	830.08	129.38	86.50	0.00	0.00	0.00	10.50	HOURLY CREW COSTS	1,269.09
SUBTOTAL	86	HOURS	19,223	0	71,512	11,146	7,452	0	0	0	905	110,238	0.90
MATERIALS:													
MISC. SUPPLIES	1	LS							3,000			3,000	
GEOTEXTILE	143,437	SF							10,041			10,041	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			19,223	0	71,512	11,146	7,452	0	13,041	0	905	123,279	1.01

PROJECT: INTERIM REMEDIATION FOR UNC ESTIMATOR: WJY SHT 12 OF SHT 21

JOB NO: 86-60-26 DATE: 06-Jun-91 TIME: 02:03 PM

ITEM DESCRIPTION: EMBANKMENT EXCAVATION JOB QUANTITY: 78,000 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 70 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT 631 SCPR|E	6.00	EA	102.93		562.50	60.38	52.50				0.00		
CAT D9 DZR	2.00	EA	34.31		167.62	36.00	20.00				0.00		
WATER TRUCK	2.00	EA	34.31		64.78	9.20	6.00				0.00		
FIELD FORMAN	1.00	EA	25.05								0.00		
KEY LABORER	1.00	EA	11.97								7.00		
CAT 16 GDR	1.00	EA	17.16		78.01	9.20	8.00				0.00		
CAT D6 DZR|LGP	2.00	EA	34.31		96.88	12.65	9.00				0.00		
CAT 815 COMP	2.00	EA	34.31		90.90	25.30	10.00				0.00		
KEY LABORER	2.00	EA	23.93								14.00		
CAT 631 SCPR|E *	1.09	EA			93.75	10.86	8.75				0.00		
CREW			318.29	0.00	1154.44	163.59	114.25	0.00	0.00	0.00	21.00	HOURLY CREW COSTS	1,750.56
SUBTOTAL	70	HOURS	22,280	0	80,811	11,451	7,998	0	0	0	1,470	124,010	1.59
MATERIALS:													
MISC. SUPPLIES	1	LS							3,000			3,000	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			22,280	0	80,811	11,451	7,998	0	3,000	0	1,470	127,010	1.63

PROJECT: INTERIM REMEDIATION FOR UNC

ESTIMATOR: WJY

SHT 13 OF SHT 21

JOB NO: 86-60-26

DATE: 06-Jun-91

TIME: 02:03 PM

ITEM DESCRIPTION: MILL DECOMMISIONING

JOB QUANTITY: 1 LS

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 780 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CRANE W/BALL	1.00	EA	17.16		85.23	4.02	3.50				0.00		
CAT 235 EXH|A	2.00	EA	34.31		170.46	9.20	8.00				0.00		
CAT 973 FEL|T	2.00	EA	34.31		95.18	13.80	14.00				0.00		
LOCAL LABORER	4.00	EA	47.87								0.00		
TANDEM DUMP TRUCK	2.00	EA	34.31		100.00	0.00	0.00				0.00		
MISC. EQUIPMENT	1.00	EA	17.16		15.91	4.60	2.00				0.00		
CREW			185.11	0.00	466.78	31.62	27.50	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	711.02
SUBTOTAL	780	HOURS	144,388	0	364,088	24,667	21,450	0	0	0	0	564,593	564,593.00
MATERIALS:													
- MILL GRADING	1	LS	18,667		18,667	2,000	1,333					40,667	
- DRAINAGE WORK	1	LS	6,250		6,250	750	500					13,750	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			169,305	0	389,005	27,417	23,283	0	0	0	0	609,010	609,010.00

PROJECT: INTERIM REMEDIATION FOR UNC

ESTIMATOR: WJY

SHT 14 OF SHT 21

JOB NO: 86-60-26

DATE: 06-Jun-91

TIME: 02:03 PM

ITEM DESCRIPTION: ORE PADS AND CATCH BASINS

JOB QUANTITY: 103,100 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 310 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D9 DZR	2.00	EA	34.31		167.62	36.80	20.00				0.00		
CAT 966 FEL	2.00	EA	34.31		67.04	16.10	12.00				0.00		
WATER TRUCK	1.00	EA	17.16		32.39	4.60	3.00				0.00		
CAT 16 GDR	1.00	EA	17.16		78.01	9.20	8.00				0.00		
FIELD FORMAN	1.00	EA	25.85								0.00		
KEY LABORER	2.00	EA	23.93								14.00		
TANDEM DUMP TRUCK *	6.00	EA			300.00	0.00	0.00						
CAT D6 DZR|LGP	1.00	EA	17.16		48.44	6.32	4.50				0.00		
CAT 815 COMP	1.00	EA	17.16		45.45	12.65	5.00				0.00		
CREW			186.23	0.00	738.95	86.68	52.50	0.00	0.00	0.00	14.00	HOURLY CREW COSTS	1,063.36
SUBTOTAL	310	HOURS	57,731	0	229,075	26,559	16,275	0	0	0	4,340	333,980	3.24
MATERIALS:													
MISC. SUPPLIES	1	LS							3,000			3,000	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			57,731	0	229,075	26,559	16,275	0	3,000	0	4,340	336,980	3.27

PROJECT: INTERIM REMEDIATION FOR UNC ESTIMATOR: WJY SHT 15 OF SHT 21

JOB NO: 86-60-26 DATE: 06-Jun-91 TIME: 02:03 PM

ITEM DESCRIPTION: SOIL COVER MATERIAL JOB QUANTITY: 42,270 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 64 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT 14 GDR	1.00	EA	17.16		39.63	6.90	6.50				0.00		
LOCAL LABORER	0.50	EA	5.98								0.00		
											0.00		
CREW			23.14	0.00	39.63	6.90	6.50	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	76.17
SUBTOTAL	64	HOURS	1,476	0	2,528	440	415	0	0	0	0	4,859	0.11
MATERIALS:													
- MISC. SUPPLIES	1	LS							500			500	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			1,476	0	2,528	440	415	0	500	0	0	5,359	0.13

PROJECT: INTERIM REMEDIATION FOR UNC ESTIMATOR: WJY SHT 16 OF SHT 21

JOB NO: 86-60-26 DATE: 06-Jun-91 TIME: 02:03 PM

ITEM DESCRIPTION: MISC. SITE DRAINAGE JOB QUANTITY: 1 LS

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 80 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT 225 BKH	1.00	EA	17.16		42.61	5.18	4.25				0.00		
LOCAL LABORER	2.00	EA	23.93								0.00		
											0.00		
CREW			41.09	0.00	42.61	5.18	4.25	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	93.13
SUBTOTAL	80	HOURS	3,287	0	3,409	414	340	0	0	0	0	7,450	7,450.00
MATERIALS:													
CULVERT PIPE	175	LF							4,375			4,375	
ARCH PIPE (83"-57")	50	LF							5,000			5,000	
MISC. SUPPLIES	0.2	LS							600			600	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			3,287	0	3,409	414	340	0	9,975	0	0	17,425	17,425.00

PROJECT: INTERIM REMEDIATION FOR UNC ESTIMATOR: WJY SHT 17 OF SHT 21

JOB NO: 86-60-26 DATE: 06-Jun-91 TIME: 02:03 PM

ITEM DESCRIPTION: DEWATERING PREP. JOB QUANTITY: 1 LS

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 50 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CASE 580 BKH	1.00	EA	17.16		7.95	3.45	2.00				0.00		
MISC. EQUIPMENT	1.00	EA	17.16		15.91	4.60	2.00				0.00		
LOCAL LABORER	2.00	EA	23.93								0.00		
CREW			58.25	0.00	23.86	8.05	4.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	94.16
SUBTOTAL	50	HOURS	2,912	0	1,193	402	200	0	0	0	0	4,707	4,707.00
MATERIALS:													
MISC. PIPE	1	LS							500			500	
STRAW BALES	2,000	EA							5,000			5,000	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			2,912	0	1,193	402	200	0	5,500	0	0	10,207	10,207.00

PROJECT: INTERIM REMEDIATION FOR UNC ESTIMATOR: WJY SHT 18 OF SHT 21

JOB NO: 86-60-26 DATE: 06-Jun-91 TIME: 02:03 PM

ITEM DESCRIPTION: DEMOBILIZATION JOB QUANTITY: 1 LS

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 120 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CASE 580 BKH	1.00	EA	17.16		7.95	3.45	2.00				0.00		
LOCAL OPERATOR	2.00	EA	34.31								0.00		
LOCAL LABORER	2.00	EA	23.93								0.00		
CREW			75.40	0.00	7.95	3.45	2.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	88.80
SUBTOTAL	120	HOURS	9,048	0	954	414	240	0	0	0	0	10,656	10,656.00
MATERIALS:													
HAUL: SPECIAL LOADS	24	EA								12,000		12,000	
HAUL: REGULAR LOADS	11	EA								3,300		3,300	
HAUL: SMALL LOADS	8	EA								1,200		1,200	
MISC. SUPPLIES	1	LS							3,000			3,000	
CRANE	50	HR								4,500		4,500	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			9,048	0	954	414	240	0	3,000	21,000	0	34,656	34,656.00

PROJECT: INTERIM REMEDIATION FOR UNC

ESTIMATOR: WJY

SHT 19 OF SHT 21

JOB NO: 86-60-26

DATE: 06-Jun-91

TIME: 02:03 PM

ITEM DESCRIPTION: SECURITY SERVICE

JOB QUANTITY: 25 WK

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CREW			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	0.00
SUBTOTAL	0	HOURS	0	0	0	0	0	0	0	0	0	0	0.00
MATERIALS:													
SECURITY SERVICE	25	WK								37,050		37,050	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			0	0	0	0	0	0	0	37,050	0	37,050	1,482.00

PROJECT: INTERIM REMEDIATION FOR UNC

ESTIMATOR: WJY

SHT 20 OF SHT 21

JOB NO: 86-60-26

DATE: 06-Jun-91

TIME: 02:03 PM

ITEM DESCRIPTION: RADIOLOGICAL MONITORING

JOB QUANTITY: 25 WK

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CREW			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	0.00
SUBTOTAL	0 HOURS		0	0	0	0	0	0	0	0	0	0	0.00
MATERIALS:													
RADIOLOGICAL MONITORING	25 WK							42,500				42,500	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			0	0	0	0	0	42,500	0	0	0	42,500	1,700.00

PROJECT: INTERIM REMEDIATION FOR UNC

ESTIMATOR: WJY

SHT 21 OF SHT 21

JOB NO: 86-60-26

DATE: 06-Jun-91

TIME: 02:03 PM

ITEM DESCRIPTION: QUALITY CONTROL

JOB QUANTITY: 25 WK

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 1,250 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
AST. PROJ. ENG.	1.00	EA	28.02								5.20		
CREW			28.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.20	HOURLY CREW COSTS	28.02
SUBTOTAL	1,250	HOURS	35,025	0	0	0	0	0	0	0	6,500	41,525	1,661.00
MATERIALS:													
- MISC. EQUIPMENT	1	LS			14,900							14,900	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			35,025	0	14,900	0	0	0	0	0	6,500	56,425	2,257.00

ATTACHMENT B

SEEPAGE COLLECTION

PROJECT: SEEPAGE COLLECTION FOR UNC ESTIMATOR: WJY

JOB NO.: 86-60-26

DATE: 06-Jun-91 TIME: 02:17 PM

ESTIMATE SUMMARY

ITEM DESCRIPTION	DETAIL SHEET	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIAL	SUBS	TRAVEL	UNIT COSTS	TOTAL COSTS
TOTAL FIXED OVERHEADS	SHT 6	1	LS	0	0	0	0	0	0		0	0	0.00	0
VARIABLE JOBSITE OVERHEADS	SHT 7	1	WEEKS	0	0	0	0	0	0		0	0	0.00	0
SYSTEM OPERATION	SHT 8	260	WK	294,540	0	0	0	0	0	0	0	0	1,132.86	294,540
PLUG WELLS	SHT 9	290	EA	0	0	0	0	0	0	0	636,840	0	2,196.00	636,840
INSTALLATION OF WELLS	SHT 10	8	EA	0	0	0	0	0	0	0	64,000	0	8,000.00	64,000
GROUND WATER MONITORING	SHT 11	364	WK	0	0	0	0	0	0	0	612,612	0	1,683.00	612,612
REPORTING	SHT 12	7	YR	0	0	0	0	0	0	0	840,000	0	120,000.00	840,000
SUBTOTAL				294,540	0	0	0	0	0	0	2,153,452	0		2,447,992

PROJECT: SEEPAGE COLLECTION FOR UNC DATE: 06-Jun-91

JOB NO.: 86-60-26 TIME: 02:17 PM

WEEKLY WORK HOUR BASIS: ESTIMATOR: WJY

1) PROJECT BASED ON WORKING 50 HOURS PER WEEK.

2) RATES ARE BASED ON PREVAILING RATES IN THE SUTTER COUNTY CALIFORNIA.

SUBSISTENCE AND TRAVEL COST CALCULATIONS: AMOUNTS APPLIED TO THE FIRST 40 HOURS OF WORK

S&T CLASS	GENERAL DESCRIPITON	TRAVEL BASIS (WKS/TRP)	TRAVEL COST (PER TRIP)	LODGING COST (PER NIGHT)	SUBSISTENCE COST (PER DAY)	HOURLY COSTS TRAVEL	LODGING	SUBSISTENCE	TOTALS
SALARIED PERSONNEL:									
S1	SALARY, REGIONAL TRAVEL	2	$100	$35	$0	$1.25	$5.25	$0.00	$6.50
S2	SALARY, LOCAL TRAVEL	1	$60	$35	$0	$1.25	$4.38	$0.00	$5.63
S3		1				$0.00	$0.00	$0.00	$0.00
S4		1				$0.00	$0.00	$0.00	$0.00
S5		1				$0.00	$0.00	$0.00	$0.00
HOURLY PERSONNEL:									
H1	HOURLY, REGIONAL TRAVEL	3	$100	$35	$15	$0.83	$5.54	$2.38	$8.75
H2	HOURLY, LOCAL TRAVEL	1	$0	$0	$0	$0.00	$0.00	$0.00	$0.00
H3		1				$0.00	$0.00	$0.00	$0.00
H4		1				$0.00	$0.00	$0.00	$0.00
H5		1				$0.00	$0.00	$0.00	$0.00

TAX AND INSURANCE CALCULATIONS:

	DESCRIPTION	NON-REP	SALARY	REMARKS
*	FUI %	0.80%	0.80%	STANDARD FEDERAL RATE APPLIED TO ALL WAGES PAID
*	SUI %	2.60%	2.60%	RATE VARIES WITH STATE, APPLIES TO ALL WAGES PAID
*	FICA %	7.65%	7.65%	STANDARD FEDERAL RATE APPLIED TO ALL WAGES PAID
	WC %	7.55%	7.55%	VARIES BY CRAFT SEE WAGE RATE TABLE, BASE WAGE ONLY
	HEALTH (MNTHLY)	$350	$350	MONTHLY COST, CANONIE COVERAGE, FIRST 40 HOURS (AVG $350)
	LTL %	N/A	1.18%	SALARY EMPLOYEES ONLY, BASE WAGE ONLY.
	STRAIGHT %	18.60%	19.78%	
*	OVERTIME %	11.05%	11.05%	

PROJECT: SEEPAGE COLLECTION FOR UNC DATE: 06-Jun-91

JOB NO.: 86-60-26 TIME: 02:17 PM

ESTIMATOR: WJY

WAGE RATE TABLE

	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
				<= TAXABLE FRINGES =>		<= NON-TXBLE FRNGS =>		<===== CANONIE ADDITIONS =====>			STRAIGHT HOURLY		PREMIUM HOURLY		AVG HOURLY	@ 50 HRS
DESCRIPTION	ESCAL FACTOR MULTIPLIER	SUB & TRVL CLASS	BASE WAGE	VACATION	ALL OTHER	H&W	ALL OTHER	WKRS COMP %'AGE	HEALTH INS	SUB & TRAVEL	BARE HOURLY	TOTAL HOURLY	BARE HOURLY	TOTAL HOURLY	BARE HOURLY	TOTAL HOURLY
72 MECHANIC	1.00	H2	$13.00					7.56%	$1.99	$0.00	$13.00	$17.41	$19.50	$22.64	$14.30	$18.45
73 KEY OPERATOR	1.00	H1	$12.00					7.56%	$1.99	$8.75	$12.00	$24.97	$18.00	$20.90	$13.20	$24.16
74 LOCAL OPERATOR	1.00	H2	$12.00					7.56%	$1.99	$0.00	$12.00	$16.22	$18.00	$20.90	$13.20	$17.16
75 OILER	1.00	H2	$10.00					7.56%	$1.99	$0.00	$10.00	$13.85	$15.00	$17.41	$11.00	$14.56
76 KEY LABORER	1.00	H1	$8.00					7.56%	$1.99	$8.75	$8.00	$20.23	$12.00	$13.93	$8.80	$18.97
77 LOCAL LABORER	1.00	H2	$8.00					7.56%	$1.99	$0.00	$8.00	$11.48	$12.00	$13.93	$8.80	$11.97
78 PIPEFITTER	1.00	H2						7.56%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
79 ELECTRICIAN	1.00	H2						7.56%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
80																
81 CARPENTER FRM.	1.00	H1						7.56%	$0.00	$8.75	$0.00	$8.75	$0.00	$0.00	$0.00	$7.00
82 CARPENTER	1.00	H2						7.56%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
83 CEMENT MASONS	1.00	H2						7.56%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
84 TEAMSTERS	1.00	H1						7.56%	$0.00	$8.75	$0.00	$8.75	$0.00	$0.00	$0.00	$7.00
85																
86 MECHANIC HELPER	1.00		$10.00					7.56%	$1.99	$0.00	$10.00	$13.85	$15.00	$17.41	$11.00	$14.56
87																
88																
89																
90																
91																
92 PROJECT MANAGER	1.00	S1	$28.85					7.56%	$1.99	$6.50	$28.85	$43.04	$0.00	$0.00	$23.08	$34.43
93 SUPERINTENDENT	1.00	S1	$27.76					7.56%	$1.99	$6.50	$27.76	$41.74	$0.00	$0.00	$22.21	$33.40
94 FIELD FORMAN	1.00	H2	$24.48					7.56%	$1.99	$0.00	$24.48	$31.31	$0.00	$0.00	$19.59	$25.05
95 PROJ. ENGINEER	1.00	S2	$23.08					7.56%	$1.99	$6.63	$23.08	$35.26	$0.00	$0.00	$18.46	$28.21
96 H&S OFFICER	1.00	S2	$21.63					7.56%	$1.99	$6.63	$21.63	$33.53	$32.45	$37.93	$23.80	$34.41
97 AST. PROJ. ENG.	1.00	S2	$20.19					7.56%	$1.99	$6.63	$20.19	$31.80	$30.29	$35.40	$22.21	$32.52
98 ENGINEER TECH.	1.00	S2	$18.27					7.56%	$1.99	$6.63	$18.27	$29.50	$27.40	$32.03	$20.10	$30.01
99 OFFICE MANAGER	1.00	S2	$9.50					7.56%	$1.99	$6.63	$9.50	$19.00	$14.25	$16.65	$10.45	$18.53
100 CLERK	1.00	S2	$8.50					7.56%	$1.99	$6.63	$8.50	$17.00	$12.75	$14.90	$9.35	$17.22
101 PROJ. SUPERVISOR	1.00	S2	$24.04					7.56%	$1.99	$6.63	$24.04	$36.41	$36.06	$42.14	$26.44	$37.56
102																
103																
104																

PROJECT: SEEPAGE COLLECTION FOR UNC | DATE: 06-Jun-91 | USE TAX RATE =======> 0.00% | SHT 4 OF SHT 12

JOB NO.: 86-60-26 | TIME: 02:17 PM | HOURLY FUEL RATE IS BASED UPON PAYING $1.15 PER GALLON.

ESTIMATOR: WJY

EQUIPMENT RENTAL RATES

BASED ON OPERATING 176 HOURS PER MONTH

DESCRIPTION	TYPE		F MONTHLY RENTAL	G USE TAX	H HOURLY RENTAL 176 HR/MO	I HOURLY FUEL RATE	J HOURLY REPAIRS RATE	K PERIOD USAGE D,W,M	L ADJUSTMENT FACTOR APPLIED
****** INTERNAL EQUIPMENT ******									
121				1.00	$0.00	$2.30	$1.00	M	1.00
122				1.00	$0.00	$1.15	$0.50	M	1.00
123				1.00	$0.00	$0.00	$0.00	M	1.00
124				1.00	$0.00	$1.72	$1.00	M	1.00
125				1.00	$0.00	$0.00	$0.00	M	1.00
126				1.00	$0.00	$0.00	$0.00	M	1.00
127				1.00	$0.00	$0.00	$0.00	M	1.00
128				1.00	$0.00	$0.00	$0.00	M	1.00
129				1.00	$0.00	$0.00	$0.00	M	1.00
130				1.00	$0.00	$0.00	$0.00	M	1.00
131				1.00	$0.00	$0.00	$0.00	M	1.00
****** EXTERNAL EQUIPMENT ******								M	
133 CASE 580 BKH	BACKHOE	(CY)	$1,400	1.00	$7.95	$3.45	$2.00	M	1.00
134 CAT 215 BKH	BACKHOE	(1.25 CY)		1.00	$0.00	$4.60	$3.50	M	1.00
135 CAT 225 BKH	BACKHOE	(1.62 CY)	$7,500	1.00	$42.61	$6.18	$4.25	M	1.00
136 CAT 235 BKH	BACKHOE	(2.75 CY)	$9,000	1.00	$51.14	$7.48	$6.00	M	1.00
137 CAT 245 BKH	BACKHOE W/L STICK	(3.75 CY)	$12,500	1.00	$71.02	$12.65	$7.50	M	1.00
138 CRANE W/BALL	CRANE & BALL		$15,000	1.00	$85.23	$4.02	$3.50	M	1.00
139 CAT 235 BKH|A	BKH WITH ATTACH		$11,000	1.00	$62.50	$4.60	$4.00	M	1.00
140 CAT 950 FEL	FEL	(3.25 CY)		1.00	$0.00	$5.75	$5.00	M	1.00
141 CAT 966 FEL	FEL	(4.50 CY)	$5,900	1.00	$33.52	$8.05	$6.00	M	1.00
142 CAT 953 FEL|T	FEL/TRACK	(2.0 CY)		1.00	$0.00	$5.18	$5.50	M	1.00
143 CAT 973 FEL|T	FEL/TRACK	(2.5 CY)	$8,375	1.00	$47.59	$5.90	$7.00	M	1.00
144 CAT D5 DZR	DOZER		$5,750	1.00	$32.67	$4.60	$4.50	M	1.00
145 CAT D6 DZR	DOZER		$6,625	1.00	$37.64	$6.32	$4.50	M	1.00
146 CAT D6 DZR|D	DOZER/DISC			1.00	$0.00	$6.32	$4.50	M	1.00
147 CAT D6 DZR|LGP	DOZER/LGP		$8,525	1.00	$48.44	$6.32	$4.50	M	1.00
148 CAT D7 DZR	DOZER			1.00	$0.00	$8.05	$5.25	M	1.00
149 CAT D8 DZR	DOZER		$12,350	1.00	$70.17	$12.65	$7.50	M	1.00
150 CAT D9 DZR	DOZER		$14,750	1.00	$83.81	$18.40	$10.00	M	1.00
151 CAT D9 DZR|R	DOZER/RIPR		$15,950	1.00	$90.68	$21.85	$13.00	M	1.00
152 CAT 14 GDR	GRADER		$6,975	1.00	$39.63	$6.90	$6.50	M	1.00
153 CAT 16 GDR	GRADER		$13,730	1.00	$78.01	$9.20	$8.00	M	1.00
154 CAT 815 COMP	COMPACTOR		$8,000	1.00	$45.45	$12.65	$5.00	M	1.00
155 CAT CP 563 COMP	COMPACTOR		$3,700	1.00	$21.02	$6.90	$4.00	M	1.00
156 4"/6" PUMP				1.00	$0.00	$4.60	$2.00	M	1.00
157 MISC. EQUIPMENT			$2,800	1.00	$15.91	$4.60	$2.00	M	1.00
158 CAT 613 SCPR|E	SCRAPER/ELEV	(11 CY)	$6,850	1.00	$38.92	$5.75	$4.00	M	1.00
159 CAT 631 SCPR|E	SCRAPER/ELEV	(31 CY)	$16,500	1.00	$93.75	$10.06	$8.75	M	1.00
160 CAT 627 SCPR|T	SCRAPER/TWIN	(20 CY)		1.00	$0.00	$18.11	$12.50	M	1.00
161 CAT 637 SCPR|T	SCRAPER/TWIN	(31 CY)		1.00	$0.00	$27.31	$17.50	M	1.00
162 WATER TRUCK	WATER TRUCK	(5,000 GAL)	$5,700	1.00	$32.39	$4.60	$3.00	M	1.00
163 TANDEM DUMP TRUCK		(10 CY)	$7,000	1.00	$39.77	$0.00	$0.00	M	1.00

EQUIPMENT ADJUSTMENT FACTORS:

MONTHLY	M	1.00
WEEKLY	W	1.44
DAILY	D	1.81

PROJECT: SEEPAGE COLLECTION FOR UNC DATE: 06-Jun-91 SHT 5 OF SHT 12

JOB NO.: 86-60-26 TIME: 02:17 PM SALES TAX RATE =======) 0.00%

ESTIMATOR: WJY

SUMMARY OF MATERIAL AND SUBCONTRACT PRICES
USED IN CURRENT ESTIMATE

B	E	F	G	H	I	J	L	N	O
DESCRIPTION	QUANTITY	UNIT	QUOTED UNIT PRICE	SALES TAX	UNIT PRICE WITH TAX	TOTAL PRICE	PLUGGED - P QUOTED - Q	NO. OF QUOTES RECEIVED	PRICE DIFF. BETWEEN LOW & SECOND
		PERMANENT MATERIAL PRICES							
187 STRAW BALES		EA	$2.50	1.00	$2.50	$0.00			
188 GEOTEXTILE		SF	$0.05	1.00	$0.05	$0.00			
189				1.00	$0.00	$0.00			
190 MISC. SUPPLIES		LS	$3,000.00	1.00	$3,000.00	$0.00			
191 MISC. SHANK WORK		LS	$5,000.00	1.00	$5,000.00	$0.00	P		
192 CULVERT PIPE	175	LF	$25.00	1.00	$25.00	$4,375.00			
193 ARCH PIPE (83"-57")	50	LF	$100.00	1.00	$100.00	$5,000.00			
194 MISC. PIPE	1	LS	$500.00	1.00	$500.00	$500.00			
195				1.00	$0.00	$0.00			
196				1.00	$0.00	$0.00			
197				1.00	$0.00	$0.00			
198				1.00	$0.00	$0.00			
199				1.00	$0.00	$0.00			
200				1.00	$0.00	$0.00			
201				1.00	$0.00	$0.00			
202				1.00	$0.00	$0.00			
203				1.00	$0.00	$0.00			
204				1.00	$0.00	$0.00			
		MAJOR SUPPLY PRICES							
207 1.5" STONE		TN	$8.50	1.00	$8.50	$0.00			
208				1.00	$0.00	$0.00			
209				1.00	$0.00	$0.00			
210 RADIOLOGICAL MONITORING	1	WK	$3,500.00	1.00	$3,500.00	$3,500.00			
211				1.00	$0.00	$0.00			
212				1.00	$0.00	$0.00			
213				1.00	$0.00	$0.00			
214				1.00	$0.00	$0.00			
		SUBCONTRACT PRICES:							
217 PLUG WELLS	280	EA	$2,305.80	1.00	$2,305.80	$645,624.00			
218				1.00	$0.00	$0.00			
219				1.00	$0.00	$0.00			
220				1.00	$0.00	$0.00			
221				1.00	$0.00	$0.00			
222				1.00	$0.00	$0.00			
223				1.00	$0.00	$0.00	P		
224				1.00	$0.00	$0.00			
225				1.00	$0.00	$0.00			
226				1.00	$0.00	$0.00			
227 SECURITY SERVICE		WK	$1,482.00	1.00	$1,482.00	$0.00			

PROJECT: SEEPAGE COLLECTION FOR UNC DATE: 06-Jun-91

JOB NO.: 86-60-26 TIME: 02:17 PM

ESTIMATOR: WJY

FIXED COST JOBSITE OVERHEADS

	DESCRIPTION	REQUIRED Y OR N	REQUIRED QUANTITY	UNIT RATE	I LABOR	J INT EQUIP	K EXT EQUIP	L FUEL	M REPAIRS	N SUPPLIES	O SUBS	P TRAVEL	Q TOTALS
245	COPY MACHINE (LONG TERM PROJECT)			55						0			0
246	PHONE SYSTEM (LONG TERM PROJECT)									0			0
247	PHYSICALS			1300						0			0
248	UTILITY HOOKUPS:												
249	ELECTRIC			350							0		0
250	WATER			250							0		0
251	SEWER										0		0
252	GAS										0		0
253	TELEPHONE			200							0		0
254	SPECIAL TAXES									0			0
255	PERMITS			100						0			0
256	ROYALITIES ON PROCESSES									0			0
257										0			0
258										0			0
259	TEMPORARY FENCING			3.5						0			0
260	OFFICE FURNITURE			75						0			0
261	FAX MACHINE			300						0			0
262	COMPUTER			500						0			0
263	COMPUTER SOFTWARE			200						0			0
264	MOVING EXPENSES (LONG TERM PROJECT)									0			0
265	PROJECT SIGN									0			0
266	H & S TRAINING-OPERATORS			1,149	0								0
267	H & S TRAINING-LABORERS			959	0					0			0
268	INITIAL H & S PURCHASES			250						0			0
269	TRAINING CLASS COSTS-EXTERNAL			700							0		0
270	TRAINING CLASS COSTS-INTERNAL			450							0		0
271										0			0
272										0			0
273										0			0
274										0			0
275										0			0
276										0			0
277										0			0
278										0			0
279										0			0
280										0			0
281										0			0
282										0			0
283										0			0
	TOTAL FIXED OVERHEADS				0	0	0	0	0	0	0	0	0

PROJECT: SEEPAGE COLLECTION FOR UNC DATE: 06-Jun-91

JOB NO.: 86-60-26 TIME: 02:17 PM

ESTIMATOR: WJY PROJECT DURATION = 1.0 WEEKS

VARIABLE COST JOBSITE OVERHEADS

	PROJECT MANAGER DESCRIPTION	REQUIRED Y OR N	REQUIRED QUANTITY	DURATION	UNIT RATE	I TOTAL LABOR	J WEEKLY LABOR	K WEEKLY INT EQUIP	L WEEKLY EXT EQUIP	M WEEKLY FUEL	N WEEKLY REPAIRS	O WEEKLY SUPPLIES	P WEEKLY SUBS	Q WEEKLY TRAVEL	Q WEEKLY TOTALS
305	PROJECT MANAGER			1	$1,462	0	0	0		0	0			0	0
306	SUPERINTENDENT			1	$1,410	0	0	0		0	0			0	0
307	FIELD FORMAN			1	$1,253	0	0	0		0	0			0	0
308	PROJ. ENGINEER			1	$1,185	0	0		0	0	0			0	0
309	H&S OFFICER			1	$1,495	0	0		0	0	0			0	0
310	ENGINEER TECH.			1	$1,275	0	0		0	0	0			0	0
311	OFFICE MANAGER			1	$701	0	0							0	0
312	CLERK			1	$636	0	0							0	0
313	MECHANIC			1	$923	0	0		0	0	0			0	0
314	MECHANIC HELPER			1	$728	0	0							0	0
315	SURVEY CREW			1	$3,500								0		0
316	OFFICE TRAILER			1	$150				0						0
317	TOOL TRAILER			1	$75			0							0
318	CHANGE TRAILER			1	$100				0						0
319	DECONTAMINATION TRAILER			1	$225				0						0
320	OFFICE SUPPLIES			1	$50							0			0
321	SURVEY SUPPLIES			1	$50							0			0
322	SAFETY SUPPLIES			1	$30							0			0
323	COPY MACHINE			1	$50							0			0
324	PHONE			1	$150							0			0
325	FUEL TRUCK			1	$100				0						0
326	GREASE TRUCK			1	$221				0						0
327	PRESSURE WASHER			1	$225				0						0
328	SAFETY EQUIPMENT (OVA)			1	$95			0							0
329	MISC. EQUIP			1	$75			0							0
330				1											0
331	UTILITY SERVICES			1	$35							0			0
332	POTABLE WATER			1	$40							0			0
333	SANITARY FACILITIES			1	$40							0			0
334	SMALL TOOLS			1	$150							0			0
336	JOBSITE PHOTOS			1	$40							0			0
336	STORAGE TANK			1	$105				0						0
337				1											0
338	TRAVEL, EXECUTIVE			1	$250							0			0
339	KEY OPERATOR ADJUSTMENT			1	$438							0			0
340	KEY LABORER ADJUSTMENT			1	$438							0			0
341	ON-SITE QC TESTING			1	$200								0		0
342	SECURITY			1	$2,520								0		0
343															
	VARIABLE JOBSITE OVERHEADS (WEEKLY)						0	0	0	0	0	0	0	0	0
	VARIABLE JOBSITE OVERHEADS (TOTAL)		1 WEEKS				0	0	0	0	0	0	0	0	0

PROJECT: SEEPAGE COLLECTION FOR UNC | ESTIMATOR: WJY | SHT 8 OF SHT 12

JOB NO: 86-60-26 | DATE: 06-Jun-91 | TIME: 02:17 PM

ITEM DESCRIPTION: SYSTEM OPERATION | JOB QUANTITY: 260 WK

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CREW			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	0.00
SUBTOTAL	0	HOURS	0	0	0	0	0	0	0	0	0	0	0.00
MATERIALS:													
- SYSTEM OPERATIONS			294,540									294,540	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			294,540	0	0	0	0	0	0	0	0	294,540	1,132.85

PROJECT: SEEPAGE COLLECTION FOR UNC

ESTIMATOR: WJY

SHT 9 OF SHT 12

JOB NO: 86-60-26

DATE: 06-Jun-91

TIME: 02:17 PM

ITEM DESCRIPTION: PLUG WELLS

JOB QUANTITY: 290 EA

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CREW			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	0.00
SUBTOTAL	0	HOURS	0	0	0	0	0	0	0	0	0	0	0.00
MATERIALS:													
- PLUGGING WELLS	290	EA								636,840		636,840	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			0	0	0	0	0	0	0	636,840	0	636,840	2,196.00

PROJECT: SEEPAGE COLLECTION FOR UNC | ESTIMATOR: WJY | SHT 10 OF SHT 12

JOB NO: 86-60-26 | DATE: 06-Jun-91 | TIME: 02:17 PM

ITEM DESCRIPTION: INSTALLATION OF WELLS | JOB QUANTITY: 8 EA

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CREW			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	0.00
SUBTOTAL	0	HOURS	0	0	0	0	0	0	0	0	0	0	0.00
MATERIALS:													
- INSTALLATION OF WELLS	8	EA								64,000		64,000	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			0	0	0	0	0	0	0	64,000	0	64,000	8,000.00

PROJECT: SEEPAGE COLLECTION FOR UNC

ESTIMATOR: WJY

SHT 11 OF SHT 12

JOB NO: 86-60-26

DATE: 06-Jun-91

TIME: 02:17 PM

ITEM DESCRIPTION: GROUND WATER MONITORING

JOB QUANTITY: 364 WK

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CREW			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	0.00
SUBTOTAL	0	HOURS	0	0	0	0	0	0	0	0	0	0	0.00
MATERIALS:													
												0	
- GROUND WATER MONITORING	364	WK								612,612		612,612	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			0	0	0	0	0	0	0	612,612	0	612,612	1,683.00

PROJECT: SEEPAGE COLLECTION FOR UNC ESTIMATOR: WJY SHT 12 OF SHT 12

JOB NO: 86-60-26 DATE: 06-Jun-91 TIME: 02:17 PM

ITEM DESCRIPTION: REPORTING JOB QUANTITY: 7 YR

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CREW			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	0.00
SUBTOTAL	0	HOURS	0	0	0	0	0	0	0	0	0	0	0.00
MATERIALS:													
												0	
- REPORTING	7	YR								840,000		840,000	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			0	0	0	0	0	0	0	840,000	0	840,000	120,000.00

ATTACHMENT C

FINAL RECLAMATION

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WJY

JOB NO.: 86 60-76

DATE: 23-May 91 TIME: 04:31 PM

ESTIMATE SUMMARY

ITEM DESCRIPTION	DETAIL SHEET	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIAL	SUBS	TRAVEL	UNIT COSTS	TOTAL COSTS
TOTAL FIXED OVERHEADS	SHT 6	1	LS	0	0	0	0	0	0		0	0	0.00	0
VARIABLE JOB-LIFE OVERHEADS	SHT 7	55	WEEKS	369,380	8,250	53,405	7,425	4,950	27,500		21,010	50,050	9,854.00	541,970
MOBILIZATION	SHT 8	1	LS	11,310	0	1,193	518	300	0	3,000	23,600	0	39,921.00	39,921
CLEARING AND GRUBBING	SHT 9	89	AC	12,786	0	22,728	3,127	2,256	0	0	0	0	459.52	40,897
ARROYO LOW FLOW CHANNEL	SHT 10	30,300	CY	7,158	0	19,352	4,186	2,678	0	8,000	0	0	1.37	41,374
INSTALL ROCK JETTY	SHT 11	8,500	CY	6,777	0	22,559	3,245	2,404	0	132,000	0	0	19.66	166,985
BACKFILL PIT NO. 2	SHT 12	115,000	CY	27,011	0	92,148	12,659	9,065	0	1,500	0	987	1.25	143,290
EVAPORATION POND FILLING	SHT 13	49,000	CY	8,381	0	25,528	5,621	2,912	0	1,500	0	0	0.90	43,942
RUNOFF CONTROL DITCH	SHT 14	13,520	CY	7,253	0	32,855	3,001	1,800	0	250	0	0	3.34	45,159
NORTH DRAINAGE CELL	SHT 15	11,000	CY	7,223	0	32,100	4,331	2,633	0	250	0	0	4.23	46,537
SOUTH DRAINAGE CHANNEL	SHT 16	83,700	CY	18,003	0	124,254	13,225	8,250	0	3,000	0	0	1.99	166,732
PLACE RIPRAP IN CHANNELS	SHT 17	4,400	CY	5,162	0	5,978	867	879	0	197,722	0	0	47.87	210,608
MISC. SITE DRAINAGE	SHT 18	1	LS	3,698	0	3,835	466	383	0	10,875	0	0	19,257.00	19,257
SOIL COVER MATERIAL	SHT 19	91,000	CY	32,332	0	95,076	13,548	10,317	0	1,500	0	0	1.68	152,773
PLACE ROCK MULCH	SHT 20	66,351	CY	63,472	0	80,453	18,138	11,658	0	914,907	0	0	16.41	1,088,628
SOIL COVER OF ROCK MULCH	SHT 21	44,700	CY	10,036	0	30,496	3,720	2,999	0	0	0	0	1.06	47,251
SITE FENCING	SHT 22	15,000	LF	0	0	0	0	0	0	0	110,396	0	7.36	110,396
DEMOBILIZATION	SHT 23	1	LS	5,563	0	954	414	240	0	3,000	6,000	0	16,161.00	16,161
SECURITY SERVICE	SHT 24	55	WK	0	0	0	0	0	0	0	81,510	0	1,482.00	81,510
RADIATION MONITORING & QC	SHT 25	55	WK	77,054	0	0	0	0	93,500	0	0	14,300	3,360.98	184,854
SUBTOTAL				672,589	8,250	642,914	94,491	63,724	121,000	1,277,504	242,516	65,257		3,188,245

[illegible] DATE: [illegible] May 91 [illegible]

[illegible] TIME: 01:31 PM

ESTIMATOR: [illegible]

WAGE RATE TABLE

	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
	FICA			TAXABLE FRINGES		NON TAXABLE FRINGES		CANONIC ADDITIONS			STRAIGHT HOURLY		PREMIUM HOURLY		AVG HOURLY	8.50 HRS
	FACTOR	SUB & TRVL	BASE		ALL		ALL	WCMS COMP	HEALTH	SUB &	BASE	TOTAL	BASE	TOTAL	BASE	TOTAL
OCCUPATION	MULTIPLIER	CLASS	WAGE	VACATION	OTHER	HSW	OTHER	%'AGE	INS	TRAVEL	HOURLY	HOURLY	HOURLY	HOURLY	HOURLY	HOURLY
72 MECHANIC	1.00	H2	$13.00					7.55%	$1.99	$0.00	$13.00	$17.41	$19.50	$2[illegible]	$14.30	$18.[illegible]
73 KEY OPERATOR	1.00	H1	$12.00					7.55%	$1.99	$3.75	$12.00	$24.97	$18.00	$20.[illegible]	$13.20	$24.16
74 LOCAL OPERATOR	1.00		$12.00					7.55%	$1.99	$0.00	$12.00	$16.22	$18.00	$20.99	$13.20	$17.16
75 OILER	1.00	H2	$10.00					7.55%	$1.99	$0.00	$10.00	$13.65	$15.00	$17.41	$11.00	$14.55
76 KEY LAFORER	1.00	H1	$8.00					7.55%	$1.99	$0.75	$8.00	$20.23	$12.00	$13.93	$8.80	$18.97
77 LOCAL LABORER	1.00		$8.00					7.55%	$1.99	$0.00	$8.00	$11.43	$12.00	$13.93	$8.80	$11.97
78 PIPEFITTER	1.00	H2						7.55%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
79 ELECTRICIAN	1.00	H2						7.55%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
80																
81 CARPENTER FRM.	1.00	H1						7.55%	$0.00	$3.75	$0.00	$3.75	$0.00	$0.00	$0.00	$7.00
82 CARPENTER	1.00	H2						7.55%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
83 CEMENT MASON	1.00	H2						7.55%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
84 FLOATERS	1.00	H1						7.55%	$0.00	$3.75	$0.00	$3.75	$0.00	$0.00	$0.00	$7.00
85																
86 MECHANIC HELPER	1.00		$10.00					7.55%	$1.99	$0.00	$10.00	$13.[illegible]	$15.00	$17.41	$11.00	$14.[illegible]
87																
88																
89																
90																
91																
92 PROJECT MANAGER	1.00	S1	$28.85					7.55%	$1.99	$6.50	$28.85	$43.04	$0.00	$0.00	$[illegible].85	$34.43
93 SUPERINTENDENT	1.00	S1	$27.76					7.55%	$1.99	$6.50	$27.76	$41.74	$0.00	$0.00	$[illegible].21	$33.40
94 FIELD FOREMAN	1.00	H2	$24.48					7.55%	$1.99	$0.00	$24.48	$41.31	$0.00	$0.00	$19.59	$[illegible]
95 PROJ. ENGINEER	1.00	S1	$23.08					7.55%	$1.99	$6.50	$23.08	$36.13	$0.00	$0.00	$18.46	$28.90
96 RES OFFICER	1.00	S1	$21.63					7.55%	$1.99	$6.50	$21.63	$34.40	$32.45	$37.93	$[illegible].00	$35.11
97 ASS. PROJ. ENG.	1.00	S1	$20.19					7.55%	$1.99	$6.50	$20.19	$32.67	$30.29	$35.40	$22.21	$33.22
98 ENGINEER TECH.	1.00	S1	$18.27					7.55%	$1.99	$6.50	$18.27	$30.37	$27.40	$32.03	$20.10	$30.70
99 OFFICE MANAGER	1.00		$9.50					7.55%	$1.99	$0.00	$9.50	$13.37	$14.25	$16.65	$10.45	$14.02
100 CLERK	1.00		$8.50					7.55%	$1.99	$0.00	$8.50	$12.17	$12.75	$14.50	$9.35	$12.72
101 PROJ. SUPERVISOR	1.00	S1	$24.04					7.55%	$1.99	$6.50	$24.04	$37.28	$36.06	$42.14	$26.44	$39.[illegible]
102																
103																
104																

PROJECT: FINAL REMEDIATION FOR INC | DATE: 23 May 91 | USE TAX RATE ******* | 0.00% | SHT 4 OF SHT 25

WORK DAYS: 05 PER 26 | TIME: 04:41 PM | HOURLY FUEL RATE IS BASED UPON PAYING $1.15 PER GALLON.

ESTIMATOR: WTF

EQUIPMENT RENTAL RATES:

BASED ON OPERATING: 176 HOURS PER MONTH

DESCRIPTION	TYPE		F MONTHLY RENTAL	G USE TAX	H HOURLY RENTAL 176 HR/MO	I HOURLY FUEL RATE	J HOURLY REPAIRS RATE	K PERIOD USAGE D,W,M	L ADJUSTMENT FACTOR APPLIED
****** INTERNAL EQUIPMENT ******									
121				1.00	$0.00	$2.30	$1.00	M	1.00
122				1.00	$0.00	$1.15	$0.50	M	1.00
123				1.00	$0.00	$0.00	$0.00	M	1.00
124				1.00	$0.00	$1.72	$1.00	M	1.00
125				1.00	$0.00	$0.00	$0.00	M	1.00
126				1.00	$0.00	$0.00	$0.00	M	1.00
127				1.00	$0.00	$0.00	$0.00	M	1.00
128				1.00	$0.00	$0.00	$0.00	M	1.00
129				1.00	$0.00	$0.00	$0.00	M	1.00
130				1.00	$0.00	$0.00	$0.00	M	1.00
131				1.00	$0.00	$0.00	$0.00	M	1.00
****** EXTERNAL EQUIPMENT ******								M	
133 CAT 350 EXH	BACKHOE	(CY)	$1,400	1.00	$7.95	$3.45	$2.00	M	1.00
134 CAT 215 EXH	BACKHOE	(1.25 CY)		1.00	$0.00	$4.60	$3.50	M	1.00
135 CAT 225 EXH	BACKHOE	(1.62 CY)	$7,500	1.00	$42.61	$5.18	$4.25	M	1.00
136 CAT 235 EXH	BACKHOE	(2.75 CY)	$9,000	1.00	$51.14	$7.48	$6.00	M	1.00
137 CAT 245 EXH	BACKHOE W/L STICK	(3.75 CY)	$12,500	1.00	$71.02	$12.65	$7.50	M	1.00
138 CAT 235 EXH\A	BACKHOE W/ATTACH.		$15,000	1.00	$85.23	$4.02	$3.50	M	1.00
139 RANT & CRANE	CRANE W/WRECKING BALL	(2.75 CY)		1.00	$0.00	$4.60	$1.00	M	1.00
140 CAT 950 FEL	FEL	(3.25 CY)		1.00	$0.00	$5.75	$5.00	M	1.00
141 CAT 966 FEL	FEL	(4.50 CY)	$5,900	1.00	$33.52	$8.05	$6.00	M	1.00
142 CAT 980 FEL	FEL	(5.75 CY)	$9,945	1.00	$56.51	$5.18	$5.50	M	1.00
143 CAT 973 FEL\T	FEL/TRACK	(7.5 CY)	$8,375	1.00	$47.59	$6.90	$7.00	M	1.00
144 CAT D5 DZR	DOZER		$5,750	1.00	$32.67	$4.60	$4.50	M	1.00
145 CAT D6 DZR	DOZER		$6,625	1.00	$37.64	$6.32	$4.50	M	1.00
146 CAT D6 DZR\D	DOZER/DISC			1.00	$0.00	$6.32	$4.50	M	1.00
147 CAT D6 DZR\LGP	DOZER/LGP		$8,525	1.00	$48.44	$6.32	$4.50	M	1.00
148 CAT D7 DZR	DOZER			1.00	$0.00	$8.05	$5.25	M	1.00
149 CAT D8 DZR	DOZER		$12,350	1.00	$70.17	$12.65	$7.50	M	1.00
150 CAT D9 DZR	DOZER		$14,750	1.00	$83.81	$18.40	$10.00	M	1.00
151 CAT D9 DZR\R	DOZER/RIPPER		$15,960	1.00	$90.68	$21.85	$13.00	M	1.00
152 CAT 14 GDR	GRADER		$6,975	1.00	$39.63	$6.90	$6.50	M	1.00
153 CAT 16 GDR	GRADER		$13,730	1.00	$78.01	$9.20	$6.00	M	1.00
154 CAT 825 COMP	COMPACTOR		$8,000	1.00	$45.45	$12.65	$5.00	M	1.00
155 CAT CP 563 COMP	COMPACTOR		$3,700	1.00	$21.02	$6.90	$1.00	M	1.00
156 CRANE & OPER	CRANE & OPERATOR	(100 TN)	$18,900	1.00	$103.89	$4.60	$2.00	D	1.31
157 MISC. EQUIPMENT			$2,000	1.00	$15.91	$4.60	$2.00	M	1.00
158 CAT 613 SCRP\E	SCRAPER/ELEV	(11 CY)	$6,700	1.00	$38.07	$5.75	$4.00	M	1.00
159 CAT 631 SCRP\E	SCRAPER/ELEV	(31 CY)	$16,700	1.00	$95.25	$10.35	$3.75	M	1.00
160 CAT 637 SCRP\T	SCRAPER/TWIN	(20 CY)		1.00	$0.00	$13.11	$12.50	M	1.00
161 CAT 637 SCRP\T	SCRAPER/TWIN	(31 CY)		1.00	$0.00	$27.51	$17.50	M	1.00
162 WATER TRUCK	WATER TRUCK	(5,000 GAL)	$5,700	1.00	$32.39	$4.60	$3.00	M	1.00
163 TRAVEL COMP TRUCK		(10 CY)	$5,500	1.00	$26.00	$0.00	$0.00	M	1.00

EQUIPMENT ADJUSTMENT FACTORS:

MONTHLY	M	1.00
WEEKLY	W	1.44
DAILY	D	1.81

PROJECT: FINAL REMEDIATION FOR [illegible] DATE: [illegible] May 91 SHT 5 OF SHT 25

[illegible] TIME: [illegible] PM SALES TAX RATE [illegible] 0.00%

ESTIMATOR: [illegible]

SUMMARY OF MATERIAL AND SUBCONTRACT PRICES
[illegible] ESTIMATE

B	E	F	G	H	I	J	L	P	Q
DESCRIPTION	QUANTITY	UNIT	QUOTED UNIT PRICE	SALES TAX	UNIT PRICE WITH TAX	TOTAL PRICE	PLUGGED QUOTED - Q	NO. OF QUOTES RECEIVED	PRICE DIFF. BETWEEN LOW & SECOND
			PERMANENT MATERIAL PRICES						
187 STRAW BALES	2,000	EA	$2.50	1.00	$2.50	$5,000.00			
188 GEOTEXTILE	490,337	SY	$0.07	1.00	$0.07	$39,423.61			
189				1.00	$0.00	$0.00			
190 MISC. SUPPLIES	5	LS	$3,000.00	1.00	$3,000.00	$15,500.00			
191 MISC. TRAFF WORK	1	LS	$5,000.00	1.00	$5,000.00	$5,000.00			
192				1.00	$0.00	$0.00			
193				1.00	$0.00	$0.00			
194 CULVERT PIPE	175	LF	$25.00	1.00	$25.00	$4,375.00			
195 AQUA PIPE (3" 1/2")	50	LF	$100.00	1.00	$100.00	$5,000.00			
196 MISC. PIPE	1	LS	$400.00	1.00	$400.00	$400.00			
197 1.5" BASE STONE	101,280	TN	$8.37	1.00	$8.37	$847,713.60			
198 15" D50 RIPRAP	7,700	TN	$25.00	1.00	$25.00	$192,500.00			
199				1.00	$0.00	$0.00			
200				1.00	$0.00	$0.00			
201				1.00	$0.00	$0.00			
202				1.00	$0.00	$0.00			
203				1.00	$0.00	$0.00			
204				1.00	$0.00	$0.00			
			MAJOR SUPPLY PRICES						
228 PARBIOLOGICAL MONITORING	55	WK	$1,700.00	1.00	$1,700.00	$93,500.00			
229				1.00	$0.00	$0.00			
230				1.00	$0.00	$0.00			
231				1.00	$0.00	$0.00			
232				1.00	$0.00	$0.00			
233				1.00	$0.00	$0.00			
234				1.00	$0.00	$0.00			
235				1.00	$0.00	$0.00			
			SUBCONTRACT PRICES						
237				1.00	$0.00	$0.00			
238				1.00	$0.00	$0.00			
239 TRAVEL: SPECIAL LOADS	60	EA	$300.00	1.00	$300.00	$19,920.00			
240 TRAVEL: RETURNS LOADS	18	EA	$299.00	1.00	$300.00	$5,400.00			
241 TRAVEL: SMALL LOADS	13	EA	$150.00	1.00	$150.00	$1,932.00			
242 SECURITY SERVICE	1	WK	$1,492.00	1.00	$1,492.00	$1,492.00			
243 CORRECTED WIRE FENCING	11,000	LF	$4.47	1.00	$4.47	$48,670.00			
244 HEAD HILL SAFETY TRAINING	100	MEN	$15.00	1.00	$15.00	$1,500.00			
245 [illegible]	83	HR	$90.00	1.00	$90.00	$7,470.00			
246 HOSPITAL [illegible]	20	MEN	$50.00	1.00	$50.00	$000.00			
247 [illegible]	4,300	LF	$14.04	1.00	$14.04	$61,776.00			

PROJECT: FINAL REMEDIATION FACILITY DATE: 23-May-91 SHEET 6 OF SHEET 25

WORKSHEET: 25.10.26 TIME: 04:31 PM

ESTIMATOR: WIY

LEVELIZED JOBSITE OVERHEADS

	DESCRIPTION	REQUIRED Y OR N	REQUIRED QUANTITY	UNIT RATE	I LABOR	J INT EQUIP	K EXT EQUIP	L FUEL	M REPAIRS	N SUPPLIES	O SUBS	P TRAVEL	Q TOTALS
245	COPY MACHINE (LONG TERM PROJECT)			55						0			0
246	PHONE SYSTEM (LONG TERM PROJECT)			500						0			0
247	MAP/LOGS			500						0			0
248	UTILITY HOOKUPS:												
249	ELECTRIC			50							0		0
250	WATER			250							0		0
251	SEWER										0		0
252	GAS										0		0
253	TELEPHONE			200							0		0
254	SPECIAL TAXES									0			0
255	PERMITS			100						0			0
256	ROYALTIES ON PROPERTIES									0			0
257										0			0
258										0			0
259	TEMPORARY FENCING			25						0			0
260	OFFICE FURNITURE			75						0			0
261	FAX MACHINE			300						0			0
262	COMPUTER			500						0			0
263	COMPUTER SOFTWARE			200						0			0
264	MOVING EXPENSES (LONG TERM PROJECT)									0			0
265	PROJECT SIGN									0			0
266	H & S TRAINING OPERATORS			1,149		0							0
267	H & S TRAINING LABORERS			919		0				0			0
268	INITIAL H & S PURCHASES			2500						0			0
269	TRAINING CLASS COSTS-EXTERNAL			200							0		0
270	TRAINING CLASS COSTS-INTERNAL			450							0		0
271										0			0
272										0			0
273										0			0
274										0			0
275										0			0
276										0			0
277										0			0
278										0			0
279										0			0
280										0			0
281										0			0
282										0			0
283										0			0
	TOTAL LEVELIZED OVERHEADS				0	0	0	0	0	0	0	0	0

PROJECT: FINAL REMEDIATION FOR INC DATE: 23 May 91 SHT 7 OF SHT 25

SCHED.: 05.CO.16 TIME: 01:31 PM

ESTIMATOR: WIY PROJECT DURATION = 55.0 WEEKS

VARIABLE COST WEEKLY OVERHEAD:

PROJECT MANAGER DESCRIPTION	REQUIRED Y OR N	REQUIRED QUANTITY	DURATION	UNIT RATE	I TOTAL LABOR	J WEEKLY LABOR	K WEEKLY INT EQUIP	L WEEKLY EXT EQUIP	M WEEKLY FUEL	N WEEKLY REPAIRS	O WEEKLY SUPPLIES	P WEEKLY SUBS	Q WEEKLY TRAVEL	Q WEEKLY TOTALS
305 PROJECT MANAGER			55	$1,467	0	0	0		0	0			0	0
306 SUPERINTENDENT	Y	1	55	$1,410	77,550	1,410	150		30	20			260	1,870
307 FIELD FORMAN			55	$1,253	0	0	0		0	0			0	0
308 PROJ. ENGINEER	Y	1	55	$1,185	65,175	1,185		150	30	20			260	1,645
309 HSE. OFFICER	Y	1	55	$1,495	82,225	1,495		150	30	20			260	1,955
310 ENGINEER TECH.	Y	0.5	55	$1,275	35,063	638		75	15	10			100	838
311 OFFICE MANAGER	Y	1	55	$701	38,556	701							0	701
312 CLERK			55	$636	0	0							0	0
313 MECHANIC	Y	1	55	$923	50,765	923		150	30	20			0	1,123
314 MECHANIC HELPER	Y	0.5	55	$728	20,020	364							0	364
315 SURVEY CREW	Y	1	6	$3,500							[illegible]			[illegible]
316 OFFICE TRAILER			55	$150				0						0
317 TOOL TRAILER			55	$75			0							0
318 CHANGE TRAILER			55	$100				0						0
319 DECONTAMINATION TRAILER			55	$275				0						0
320 OFFICE SUPPLIES	Y	1	55	$50							50			50
321 SURVEY SUPPLIES	Y	1	55	$100							100			100
322 SAFETY SUPPLIES	Y	1	55	$30							30			30
323 COPY MACHINE			55	$30							0			0
324 PHONE			55	$150							0			0
325 FUEL TRUCK			55	$100				0						0
326 GREASE TRUCK	Y	1	55	$221				221						221
327 PRESSURE WASHER	Y	1	55	$225				225						[illegible]
328 SAFETY EQUIPMENT (OVA)			55	$95			0							0
329 MISC. EQUIP			55	$75			0							0
330			55											0
331 UTILITY SERVICES	Y	1	55	$50							50			50
332 POTABLE WATER			55	$40							0			0
333 SANITARY FACILITIES	Y	2	55	$40							80			80
334 SMALL TOOLS	Y	1	55	$150							150			150
335 SITE PHOTOS	Y	1	55	$40							40			40
336 STORAGE TANK			55	$105				0						0
337			55											0
338 TRAVEL, EXECUTIVE			55	$500							0			0
339 KEY OPERATOR ADJUSTMENT			55	$438							0			0
340 KEY LABORER ADJUSTMENT			55	$438							0			0
341 ON-SITE QC TESTING			55	$200								0		0
342 [illegible]			55	$2,520								0		0
343														
VARIABLE WEEKLY OVERHEAD (WEEKLY)						6,716	150	971	135	90	500	252	910	[illegible]
VARIABLE WEEKLY OVERHEAD (TOTAL)		55 WEEKS				369,438	8,250	53,405	7,425	4,950	27,500	13,860	50,050	541,950

PROJECT: FINAL REMEDIATION FOR UNC

ESTIMATOR: WJY

SHT 8 OF SHT 25

JOB NO: 85-60-26

DATE: 23-May-91

TIME: 04:31 PM

TASK DESCRIPTION: MOBILIZATION

JOB QUANTITY: 1 LS

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 150 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CASE 580 BKH	1.00	EA	17.16		7.95	3.45	2.00				0.00		
LOCAL OPERATOR	2.00	EA	34.31								0.00		
LOCAL LABORER	2.00	EA	23.93								0.00		
CREW			75.40	0.00	7.95	3.45	2.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	88.80
DURATION	150	HOURS	11,310	0	1,193	518	300	0	0	0	0	13,321	13,321.00
MATERIALS:													
												0	
HAUL: SPECIAL LOADS	24	EA								12,000		12,000	
HAUL: REGULAR LOADS	11	EA								3,300		3,300	
HAUL: SMALL LOADS	3	EA								1,200		1,200	
MISC. SUPPLIES	1	LS							3,000			3,000	
CRANE	50	HR								4,500		4,500	
HEALTH & SAFETY TRAINING	80	MNHR								2,000		2,000	
REPUBLIC INSTRUMENT	20	MNHRS								600		600	
												0	
												0	
												0	
												0	
TOTAL			11,310	0	1,193	518	300	0	3,000	23,600	0	39,921	39,921.00

PROJECT: FINAL REMEDIATION FOR UNC | ESTIMATOR: WJY | SHT 9 OF SHT 25

WO NO: [illegible] | DATE: 23-May-91 | TIME: 04:31 PM

ITEM DESCRIPTION: CLEARING AND GRUBBING | JOB QUANTITY: 89 AC

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION - 116 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D6 DZR	3.00	EA	51.47		[illegible]	[illegible]	13.50				0.00		
LOCAL LABORER	3.00	EA	35.90								0.00		
CAT 966 LDR	1.00	EA	17.16		33.52	8.05	6.00				0.00		
TANDEM DUMP TRUCK	1.00	EA			50.00	0.00	0.00				0.00		
LOCAL LABORER	0.50	EA	5.98								0.00		
CREW			110.51	0.00	196.44	27.03	19.50	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	353.47
[illegible]	116 HOURS		12,786	0	[illegible]	3,137	2,266	0	0	0	0	40,997	[illegible]

EQUIPMENT:

0
0
0
0
0
0
0
0
0
0
0
0

TOTALS			12,786	0	[illegible]	3,137	2,266	0	0	0	0	40,997	[illegible]

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WJY SHT 10 OF SHT 25

WO NO: 85-60-26 DATE: 23-May-91 TIME: 04:31 PM

ITEM DESCRIPTION: ARROYO FOR FINAL CHANNEL JOB QUANTITY: 30,300 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION: 70 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D9 D/R/P	2.00	EA	34.31		181.36	43.70	26.00				0.00		
CAT D6 D/R	2.00	EA	34.31		75.28	12.65	9.00				0.00		
CAT 14 GDR	0.50	EA	8.58		19.82	3.45	3.25				0.00		
FIELD FOREMAN	1.00	EA	25.05								0.00		
CREW			102.25	0.00	276.46	59.80	38.25	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	476.76
ORIGINAL	70	HOURS	7,158	0	19,352	4,186	2,678	0	0	0	0	33,374	1.10
MATERIALS:													
MISC. SHOP WORK	1	LS							5,000			5,000	
MISC. SUPPLIES	1	LS							3,000			3,000	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTAL			7,158	0	19,352	4,186	2,678	0	8,000	0	0	41,374	1.37

PROJECT: FINAL REVEGETATION FOR UNC ESTIMATOR: HJY SHEET 11 OF SHEET 25

WO NO: [illegible] DATE: 23-May 91 TIME: 04:31 PM

ITEM DESCRIPTION: INSTALL ROCK JETTY JOB QUANTITY: 8,500 CY

EQUIPMENT RATES AND ASSUMPTIONS:

DURATION - 38 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT 631 SCRPR	3.00	EA	51.47		281.25	30.19	26.25				0.00		
CAT D9 DZR/R	1.00	EA	17.16		90.63	21.05	13.00				0.00		
CAT 966 FEL	2.00	EA	34.31		67.04	16.10	12.00				0.00		
CAT 235 EXR/A	1.00	EA	17.16		85.23	4.02	3.50				0.00		
CAT CP 563 COMP	1.00	EA	17.16		21.02	6.90	4.00				0.00		
CAT D6 DZR/LGP	1.00	EA	17.16		48.44	6.32	4.50				0.00		
[illegible] LANDER	2.00	EA	23.93								0.00		
CREW			178.33	0.00	593.06	85.39	63.25	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	920.63
SUBTOTAL	38	HOURS	6,777	0	22,560	3,245	2,404	0	0	0	0	34,985	4.12
MATERIALS:													
MISC. SUPPLIES	1	LS							3,000			3,000	
15" DFO RIPRAP	5,160	TN							129,000			129,000	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			6,777	0	22,560	3,245	2,404	0	132,000	0	0	166,985	19.63

PROJECT: FINAL REMEDIATION FOR UNC

ESTIMATOR: WJY

SHT 12 OF SHT 26

WO NO: 16 CO 26

DATE: 23 May 91

TIME: 04:31 PM

ITEM DESCRIPTION: BACKFILL PIT NO. 2

JOB QUANTITY: 115,000 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION 130 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT 631 SCRPR	4.00	EA	68.62		375.00	40.25	35.00				0.00		
CAT D9 DZR	1.00	EA	17.16		83.81	18.40	10.00				0.00		
WATER TRUCK	1.00	EA	17.16		32.39	4.00	3.00				0.00		
FIELD FOREMAN	1.00	EA	75.05								0.00		
CAT D6 COMP	1.00	EA	17.16		78.01	9.20	8.00				0.00		
CAT D6 DZR/TGP	2.00	EA	34.31		96.88	12.65	9.00				0.00		
CAT 815 COMP	1.00	EA	17.16		45.45	12.65	5.00				0.00		
FLT TANKER	1.00	EA	11.97								7.00		
CREW			283.57	0.00	711.54	97.75	70.00	0.00	0.00	0.00	7.00	HOURLY CREW COSTS	1,037.86
SUBTOTAL	130	HOURS	27,011	0	92,148	12,669	9,065	0	0	0	907	141,790	1.23
MATERIALS:													
MISC. SUPPLIES	1.0								1,500			1,500	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			27,011	0	92,148	12,669	9,065	0	1,500	0	907	143,290	1.25

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WJY SHT 13 OF SHT 25

WO NO: 05-L0 70 DATE: 23-May 91 TIME: 01:0 PM

TASK DESCRIPTION: EVAPORATION POND FILLING JOB QUANTITY: 40,000 CY

ESTIMATE NOTES AND ASSUMPTIONS:

DURATION 101 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D9 DOZ	2.00	EA	34.31		[illegible]	[illegible]	20.00				0.00		
[illegible] LOADER	1.00	EA	11.97								0.00		
CAT R15 COMP	1.00	EA	17.16		46.46	12.65	5.00				0.00		
WATER TRUCK	1.00	EA	17.16		[illegible]	4.60	3.00				0.00		
CREW			80.59	0.00	245.46	54.05	28.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	408.10
[illegible]	101 HOURS		8,380	0	[illegible]	5,621	2,912	0	0	0	0	[illegible]	0.37
MATERIALS:													
MISC. SUPPLIES	1 LS								1,500			1,500	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTAL			8,[illegible]	0	[illegible]	5,[illegible]	2,912	0	1,500	0	0	43,942	0.90

PROJECT: FINAL REMEDIATION FOR UIC ESTIMATOR: WJY SHT 14 OF SHT 25

JOB NO: FS-60 26 DATE: 23-May-91 TIME: 04:31 PM

ITEM DESCRIPTION: BUNDED CONTROL DITCH JOB QUANTITY: 13,520 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION 90 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D6 DOZER/CRP	1.00	EA	17.16		48.44	6.32	4.50				0.00		
CAT 966 FEL	1.00	EA	17.16		33.52	8.05	6.00				0.00		
LOAD TANDEM	1.00	EA	11.97								0.00		
TANDEM DUMP TRUCK	4.00	EA			200.00	0.00	0.00						
CAT D6 DOZ	1.00	EA	17.16		37.64	6.32	4.50				0.00		
CAT 815 COMP	1.00	EA	17.16		45.45	12.65	5.00				0.00		
CREW			80.59	0.00	365.05	33.35	20.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	478.39
SUBTOTAL	90	HOURS	7,253	0	32,855	3,001	1,800	0	0	0	0	44,909	3.32
MATERIALS:													
MISC. SUPPLIES									250			250	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			7,253	0	32,855	3,001	1,800	0	250	0	0	45,159	3.34

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WJY SHEET 15 OF SHEET 25

JOB NO: 95-08-16 DATE: 23-May-91 TIME: 01:01 PM

TASK DESCRIPTION: NORTH DRAINAGE CELL JOB QUANTITY: 11,000 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION 61 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D9 DOZER	1.00	EA	17.16		90.03	21.85	13.00				0.00		
CAT 950 FEL	1.00	EA	17.16		33.52	8.05	6.00				0.00		
TARPIN DUMP TRUCK	3.00	EA			150.00	0.00	0.00				0.00		
CAT 14 GDR	0.50	EA	8.58		91.01	4.60	4.00				0.00		
LOCAL LABORER	1.00	EA	11.97								0.00		
CAT D6 D/R	1.00	EA	17.16		37.64	6.32	4.50				0.00		
CAT 815 COMP	1.00	EA	17.16		45.04	12.65	5.00				0.00		
CREW			89.17	0.00	396.30	53.47	32.50	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	571.44
TOTAL	61	HOURS	7,223	0	32,100	4,331	2,633	0	0	0	0	46,287	4.21
MATERIALS:													
MISC. SUPPLIES									250			250	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS:			7,223	0	32,100	4,331	2,633	0	250	0	0	46,537	4.23

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WJY SHT 16 OF SHT 26

WO NO: 96 68 26 DATE: 23-May 91 TIME: 04:41 PM

ITEM DESCRIPTION: SOUTH DRAINAGE CHANNEL JOB QUANTITY: 83,700 CY

CONTRACTOR NOTES AND ASSUMPTIONS:

DURATION = 250 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D9 DOZER	1.00	EA	17.16		90.03	21.56	13.00				0.00		
CAT D9 DOZER	1.00	EA	17.16		93.31	18.40	10.00				0.00		
CAT 966 LDR	1.00	EA	17.16		33.52	8.05	6.00				0.00		
INTERNATIONAL DUMP TRUCK	5.00	EA			250.00	0.00	0.00				0.00		
CAT 16 GDR	0.50	EA	8.58		30.01	4.00	4.00				0.00		
TOTAL LABORER	1.00	EA	11.97								0.00		
CREW			77.01	0.00	497.07	52.90	33.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	654.93
SUBTOTAL	250	HOURS	18,003	0	124,294	13,225	8,250	0	0	0	0	163,732	1.96
MATERIALS:													
MISC. SUPPLIES	1	LS							3,000			3,000	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			18,003	0	124,294	13,225	8,250	0	3,000	0	0	166,732	1.99

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WDY SOL 17 Q SOL 25

WO NO: 33 [illegible] DATE: 23 May 91 TIME: 01:[illegible]

ITEM DESCRIPTION: PLACE RIPRAP IN CHANNELS JOB QUANTITY: 4,400 CY

ASSUMPTIONS AND ASSUMPTIONS:

DURATION: 176 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	OPAVEL	TOTAL	UNIT COST
CAT 973 FELIT	1.00	EA	17.16		47.59	6.90	7.00				0.00		
LOCAL LABORER	2.00	EA	23.93								0.00		
CREW			41.09	0.00	47.59	6.90	7.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	10.58
TOTALS	176	HOURS	5,167	0	5,[illegible]	127	879	0	0	0	0	12,[illegible]	[illegible]
MATERIALS:													
15" D50 RIPRAP	7,700	IN							192,500			192,500	
GEOTEXTILE	74,000	SF							5,222			5,222	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTAL			5,167	0	[illegible]	127	879	0	197,722	0	0	10,[illegible]	[illegible]

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WJY SHT 18 OF SHT 25

WO NO: 86-60 26 DATE: 23-May-91 TIME: 01:31 PM

ITEM DESCRIPTION: MISC. SITE DRAINAGE JOB QUANTITY: 1 LS

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION: 90 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT 245 EXCA	1.00	EA	17.16		42.61	5.18	4.25				0.00		
LOCAL LABORER	2.00	EA	23.93								0.00		
CREW			41.09	0.00	42.61	5.18	4.25	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	93.13
TOTAL	90	HOURS	3,698	0	3,835	466	383	0	0	0	0	8,382	8,382.00
MATERIALS:													
CULVERT PIPE	175	LF							4,375			4,375	
ADPE PIPE (83"x67")	50	LF							5,000			5,000	
MISC. SUPPLIES	1	LS							1,500			1,500	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTAL:			3,698	0	3,835	466	383	0	10,875	0	0	19,257	19,257.00

PROJECT: FINAL REMEDIATION FOR UNC | ESTIMATOR: WJY | SHEET 19 OF 30 25

WO NO: 95-140-20 | DATE: 23-May-91 | TIME: 04:34 PM

ITEM DESCRIPTION: SOIL COVER MATERIAL | ITEM QUANTITY: 91,000 CY

ESTIMATING NOTES AND ASSUMPTIONS:

DURATION 133 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT 631 SCRAPER	4.00	EA	68.62		375.00	40.25	35.00				0.00		
DUMP TRUCK	1.00	EA	17.16		32.50	4.00	3.00				0.00		
FIELD FOREMAN	1.00	EA	25.05								0.00		
CAT D6 DZR	1.00	EA	17.16		37.61	6.32	4.50				0.00		
CAT D7 DZR	1.00	EA	17.16		83.81	18.40	10.00				0.00		
CAT D5 DZR	2.00	EA	34.31		65.34	9.20	9.00				0.00		
CAT CP 563 COMP	2.00	EA	34.31		42.04	13.40	8.00				0.00		
CONC LAND COMP	1.00	EA	11.97								0.00		
CAT 16 GRD	1.00	EA	17.16		78.01	9.20	8.00				0.00		
CREW			242.89	0.00	714.23	101.77	77.50	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	1,136.39
SUBTOTAL	133	HOURS	32,332	0	95,006	13,548	10,317	0	0	0	0	151,273	1.66

MATERIALS:

MISC. SUPPLIES	1,500
	0
	0
	0
	0
	0
	0
	0
	0
	0
	0
	0

TOTALS			32,332	0	95,006	13,548	10,317	0	1,500	0	0	152,773	1.68

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WJY SHT 20 OF SHT 25

WO NO: 86 F0-26 DATE: 23-May-91 TIME: 04:31 PM

TASK DESCRIPTION: PLACE BASE MATERIAL JOB QUANTITY: 66,351 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 656 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT D6 D/R	2.00	EA	34.31		75.28	12.65	9.00				0.00		
CAT CP 563 COMP	2.00	EA	34.31		42.04	13.00	8.00				0.00		
TRAVEL LABORERS	2.00	EA	23.93								0.00		
CREW			92.56	0.00	117.32	26.45	17.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	253.33
SUBTOTAL	656	HOURS	63,472	0	80,453	18,138	11,658	0	0	0	0	173,721	2.62
MATERIALS:													
MISC. SUPPLIES	1	LS							3,000			3,000	
1.5" BASE STONE	107,820	TN							902,457			902,457	
GEOTEXTILE	136,000	SF							9,450			9,450	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTAL			[illegible]	0	[illegible]	[illegible]	[illegible]	0	914,907	0	0	[illegible]	[illegible]

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WDY SHT 21 OF SHT 25

WO NO: [illegible] DATE: 23 May 91 TIME: 01:[illegible] PM

TASK DESCRIPTION: SOIL COVER OF ROCK MULCH WBS QUANTITY: 44,700 CY

ESTIMATOR NOTES AND ASSUMPTIONS:

OPERATION 28 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CAT 631 SCRAPER	3.00	EA	51.47		281.[illegible]	8.19	26.25				0.00		
WATER TRUCK	1.00	EA	17.16		[illegible]	4.60	3.00				0.00		
FIELD COMPANY	1.00	EA	25.85								0.00		
CAT D6 DOZ	2.00	EA	34.21		75.[illegible]	12.85	9.00				0.00		
CREW			127.93	0.00	[illegible]	47.44	38.25	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	642.50
DURATION	28 HOURS		10,030	0	30,49[illegible]	3,720	2,999	0	0	0	0	47,251	1.0[illegible]

MATERIALS:

0
0
0
0
0
0
0
0
0
0
0
0

TOTALS	10,03[illegible]	0	[illegible]	3,720	2,999	0	0	0	0	47,251		1.0[illegible]

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WJY SHT 22 OF SHT 25

JOB NO: 86-60-76 DATE: 23-May-91 TIME: 04:31 PM

ITEM DESCRIPTION: SITE FENCING JOB QUANTITY: 15,000 LF

ESTIMATOR NOTES AND ASSUMPTIONS:

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	DURATION TRAVEL	TOTAL	HOURS UNIT COST
CREW			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	0.00
SUBTOTAL	0 HOURS		0	0	0	0	0	0	0	0	0	0	0.00
MATERIALS:													
BARBED WIRE FENCING	11,000	LF								48,620		48,620	
CHAIN LINK FENCING	4,400	LF								61,776		61,776	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			0	0	0	0	0	0	0	110,396	0	110,396	7.36

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: HJY SHT 23 OF SHT 25

WO ID: 88-48-26 DATE: 23-May-91 TIME: 04:31 PM

ITEM DESCRIPTION: DEMOBILIZATION JOB QUANTITY: 1 LS

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION = 120 HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
LAKE SEO FOR	1.00	EA	17.16		7.95	3.45	2.00				0.00		
LOCAL OPERATOR	1.00	EA	17.16								0.00		
LOCAL LABORER	1.00	EA	11.97								0.00		
CREW			46.28	0.00	7.95	3.45	2.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	59.68
DURATION	120	HOURS	5,553	0	954	414	240	0	0	0	0	7,161	7,161.00
MATERIALS:													
HAUL: SPECIAL LOADS	6	EA								3,000		3,000	
HAUL: REGULAR LOADS	3	EA								900		900	
HAUL: SMALL LOADS	2	EA								300		300	
MISC. SUPPLIES	1	LS							3,000			3,000	
CRANE	20	HR								1,800		1,800	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTAL			5,553	0	954	414	240	0	3,000	6,000	0	16,161	16,161.00

PROJECT: FINAL REMEDIATION FOR UNC ESTIMATOR: WJY SHT 24 OF SHT 25

JOB NO: 86-60-26 DATE: 23-May-91 TIME: 04:31 PM

TASK DESCRIPTION: SECURITY SERVICE JOB QUANTITY: 55 WK

ESTIMATOR NOTES AND ASSUMPTIONS:

DURATION - HOURS

DESCRIPTION	QUANTITY	UNIT	LABOR	INT EQUIP	EXT EQUIP	FUEL	REPAIRS	SUPPLIES	MATERIALS	SUBS	TRAVEL	TOTAL	UNIT COST
CREW			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HOURLY CREW COSTS	0.00
SUBTOTAL	0	HOURS	0	0	0	0	0	0	0	0	0	0	0.00
MATERIALS:													
SECURITY SERVICE	55	WK								81,510		81,510	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
												0	
TOTALS			0	0	0	0	0	0	0	81,510	0	81,510	1,483.00