Appendix B.3

Drain Cover Fill Permeability Testing

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October 11, 1999

Our Ref.: 993-2075.002

Cripple Creek & Victor Gold Mining Company
P.O. Box 191
2755 State Highway 67
Victor, CO 80860

Attention: Mr. Ron Roberts

RE: LOAD-PERMEABILITY TESTING RESULTS

Dear Ron:

Golder Associates Inc. (Golder) is pleased to present the results of Load-Permeability tests conducted in support of the Cripple Creek and Victor Gold Mining Company (CC&V) Valley Leach Facility (VLF). This report details the results for gradation and permeability versus load (consolidation) testing performed on Drain Cover Fill material.

1.0 MATERIAL DESCRIPTION

A sample of Drain Cover Fill was provided by CC&V and used in the Load-Permeability testing program. The general sample gradation and description is provided below and summarized in Table 1:

U.S. Standard Sieve Size	Percent Passing
1-1/2 inch	100
3/4 inch	78
3/8 inch	53
No. 4	36
No. 40	13
No. 200	6

The sample classifies as a fine to coarse GRAVEL, with some fine to coarse sand with little clay (Figures 1 and 2).

2.0 CONSOLIDATION AND PERMEABILITY TESTING

Hydraulic conductivity (permeability) and consolidation testing was conducted on the Drain Cover Fill sample. The sample was loaded to normal pressures of 153, 305, and 450 pounds per square inch (psi) and tested for permeability. The maximum test pressure of 450 psi is the maximum capacity of the testing apparatus.

2.1 Test Apparatus

The testing apparatus for this program consisted of a 10-inch inside diameter (ID) aluminum load cell, approximately 18 inches in height. Figure 3 shows the assembled testing cell. The cell was clamped to the base plate and the tie-down rods anchored to the cell base plate. A porous loading plate was placed in contact with the material and a hydraulic jack was used to apply the force to the sample against the top plate. A digital pressure transducer was used to monitor the applied load and dial gauges measured deformation. The load from the hydraulic jack is adjusted to maintain the desired loading stress throughout the test.

2.2 Test Configuration

Figure 4 shows the Drain Cover Fill used for this program. The Drain Cover fill was placed in the testing cell (Figure 5), the initial sample height was recorded and the loading plate was secured. The sample was loaded in approximately 150 psi increments up to 450 psi. Vertical displacement values were recorded at each load beginning at 153 psi. The sample was saturated at 153 psi and additional consolidation was allowed to occur before permeability testing. After the consolidation of the sample stopped, the permeability of the material was tested. The sample was loaded further to consolidation pressures of 305, and 450 psi; and the permeability measured at these increments.

3.0 TESTING RESULTS

A summary of the load-permeability test results is presented on Table 2 and presented in Figures 6 through 8. The average coefficient of permeability of the material at the 153, 305 and 450 psi loads was found to be .15, .15, and .11 centimeters per second (cm/sec), respectively. In general, the minimum acceptable permeability of ore and drain cover fills is in the range of 10^{-4} cm/sec (Van Zyl, 1988). Therefore, the load-permeability test results indicate that the Drain Cover Fill material permeability exceeds the minimum acceptable value by three orders of magnitude even under a heap load of 450 psi (an equivalent heap height of 590 feet based on an average ore density of 110 pcf). It is important to note that previous tests conducted on the Drain Cover Fill material yielded similar results.

The test results also show that the Drain Cover Fill material undergoes approximately 16 % vertical strain (change in sample height/original sample height) during loading. The vertical strain results in a densification of the material from 109.1 pcf (dry density) at 153 psi to 115 pcf (dry density) at 450 psi. Additionally, the Drain Cover Fill void ratio decreases from 0.44 at 153 psi to 0.36 at 450 psi.

After completion of the test program, a post-test gradation was conducted on the material to evaluate the potential for mechanical degradation of the Drain Cover Fill material under

load. The post-consolidation grain size distribution is presented in Table 1 and Figures 9 and 10. The post-test gradation results indicate an overall decrease in percentage of the fine gravel fraction, with a corresponding increase in percentage of the fine sand fraction. These results indicate that some mechanical degradation of the Drain Cover Fill does occur under loading. The amount degradation is considered insignificant, as evident with the measured high permeability under load.

4.0 CLOSURE

If there are any questions or concerns about this report or the information contained in it, please call us at (303) 980-0540.

Sincerely,

GOLDER ASSOCIATES INC.

David M. Dix
Laboratory Manager

John F. Lupo, Ph.D., P.E.
Sr. Project Manager

DMD/JFL/llr

Attachments: Tables
Figures

REFERENCES

Van Zyl, 1988. *Introduction to Evaluation, Design and Operations of Precious Metal Heap Leaching Projects*. Society of Mining Engineers.

TABLES

TABLE
SUMMARY OF SOIL DATA

BORING NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (ft)	USCS SOIL CLASSIFICATION	ATTERBERG LIMITS			GRAIN SIZE DISTRIBUTION			DRAIN DOWN MOISTURE	SPECIFIC GRAVITY	ADDITIONAL TESTS COMMENTS (See Notes)
				LL	PL	PI	% FINER 3/4"	% FINER #4	% FINER #200			
BEFORE PERM	DRAIN COVER FILL	--	GP-GC	--	--	--	78	36	6	--	--	
AFTER PERM	DRAIN COVER FILL	--	GP-GC	--	--	--	86	47	9	--	--	

NOTES:

TABLE 2
TEST RESULTS

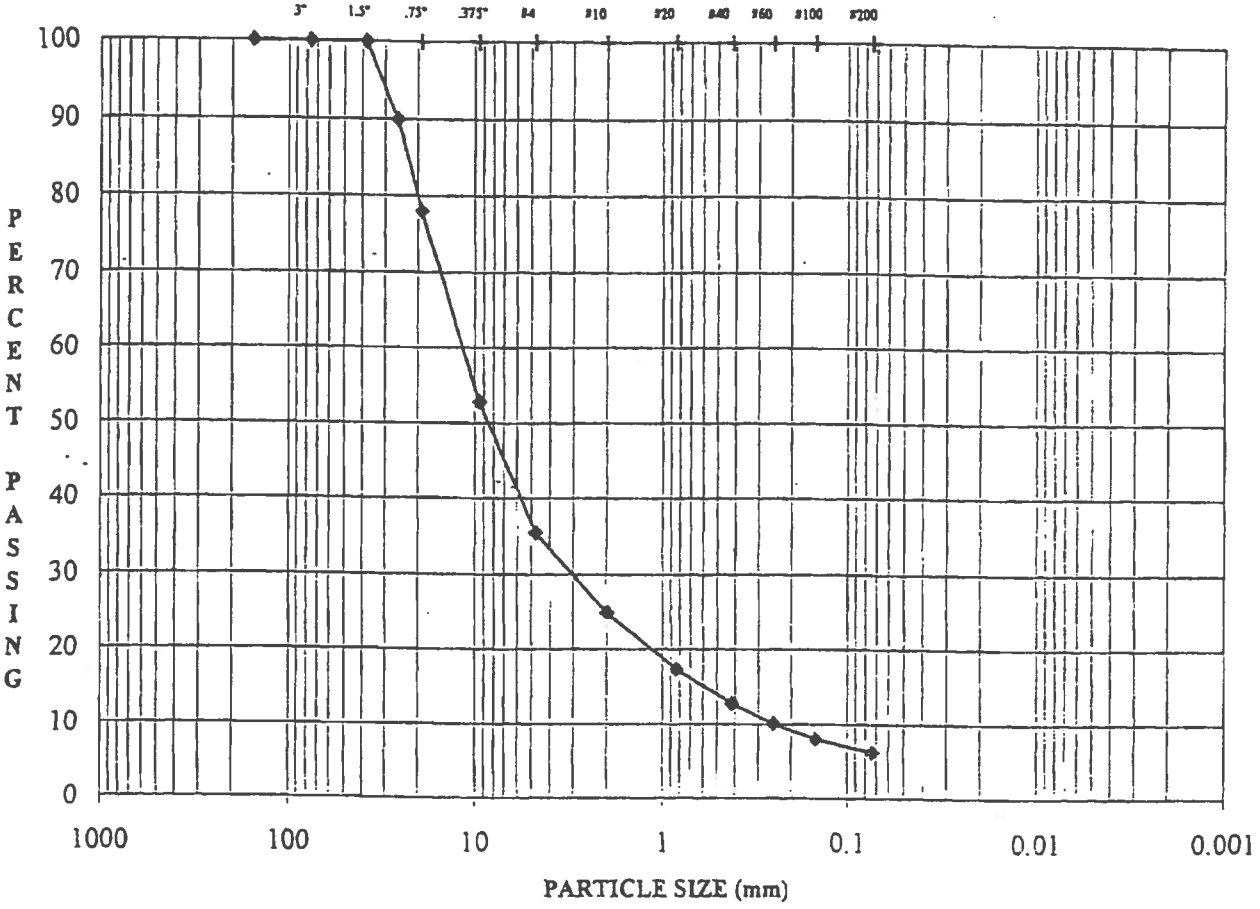
Sample Information

Specific Gravity	2.51
Height (in)	9.579
Sample Area (in^2)	78.54

Load (psi)	Height (in)	Dry Density (pcf)	Void Ratio	Vertical Strain (in/in)	Permeability (cm/sec)	Flow Rate (ml/sec)
0.1	9.579	96.6	0.62	0.00	0.0	0
153	8.481	109.1	0.44	0.11	0.15	2.88
305	8.200	112.8	0.39	0.14	0.15	3.63
450	8.043	115.0	0.36	0.16	0.11	2.57

FIGURES

PARTICLE-SIZE DISTRIBUTION ASTM D 421 AND D 422
US STANDARD SIEVE OPENING SIZES



COBBLES	Coarse	Fine	Cor	Med	Fine	Silt or Clay Size
	GRAVEL		SAND			FINES

SAMPLE #:	DRAIN COVER FILL 3
DEPTH (ft):	BEFORE PERM
DESCRIPTION:	Fine to coarse GRAVEL with some fine to coarse sand, little clay (GP-GC)

MC (As tested):	7.7%
LL:	LL
PL:	PL
PI:	PI
Gs:	Gs

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FIGURE 1

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM C 117, C 136, D 421, D 422, D 1140, D 2216, D 2217

CC&V/TECHNICAL SUPPORT/CO 993-2075	SAMPLE #: DRAIN COVER FILL 3 DEPTH (ft): BEFORE PERM

MOISTURE CONTENT (As tested)

Tare	DC3
Weight Wet Soil & Tare, g	321.91
Weight Dry Soil & Tare, g	301.30
Weight Tare, g	33.79
Weight Water, g	20.61
Weight Dry Soil, g	267.51
Moisture, %	7.70%

#200 WASH (Percent Fines)

Tare	-
Weight Soil & Tare Before Wash, g	-
Weight Soil & Tare After Wash, g	-
Weight Tare, g	-
Weight Fines Lost, g	-
Weight Dry Soil, g	12,331.14
Fines Lost, %	-

	SIEVE	Wt. Ret.	% Ret.	% Pass.	SIEVE	
	6.000"	0.00	0.00%	100.00%	6.000"	
Coarse Gravel	3.000"	0.00	0.00%	100.00%	3.000"	Coarse Gravel
	1.500"	0.00	0.00%	100.00%	1.500"	
	1.000"	1,240.50	10.06%	89.94%	1.000"	
Fine Gravel	0.750"	2,716.60	22.03%	77.97%	0.750"	Fine Gravel
	0.375"	5,823.20	47.22%	52.78%	0.375"	
Coarse Sand	#4	7,953.60	64.50%	35.50%	#4	Coarse Sand
Medium Sand	#10	9,260.76	75.10%	24.90%	#10	Medium Sand
	#20	10,196.60	82.69%	17.31%	#20	
Fine Sand	#40	10,762.36	87.28%	12.72%	#40	Fine Sand
	#60	11,096.17	89.98%	10.02%	#60	
	#100	11,340.81	91.97%	8.03%	#100	
	#200	11,565.57	93.79%	6.21%	#200	
Fines	PAN	12,331.14	0.00%	100.00%	PAN	Fines

% C GRVL:	22.0%		Wet Color:	Fine to coarse GRAVEL	
% F GRVL:	42.5%	64.5%	Description:	with some fine to coarse sand,	
% C SAND:	10.6%			little clay (GP-GC)	
% M SAND:	12.2%		LL:	LL	
% F SAND:	6.5%	29.3%	PL:	PL	DATE: 02-Oct-99
% FINES:	6.2%		PI:	PI	TECH: RD
% TOTAL:	100.0%		Gs:	Gs	REVIEW: DMD

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FIGURE 2

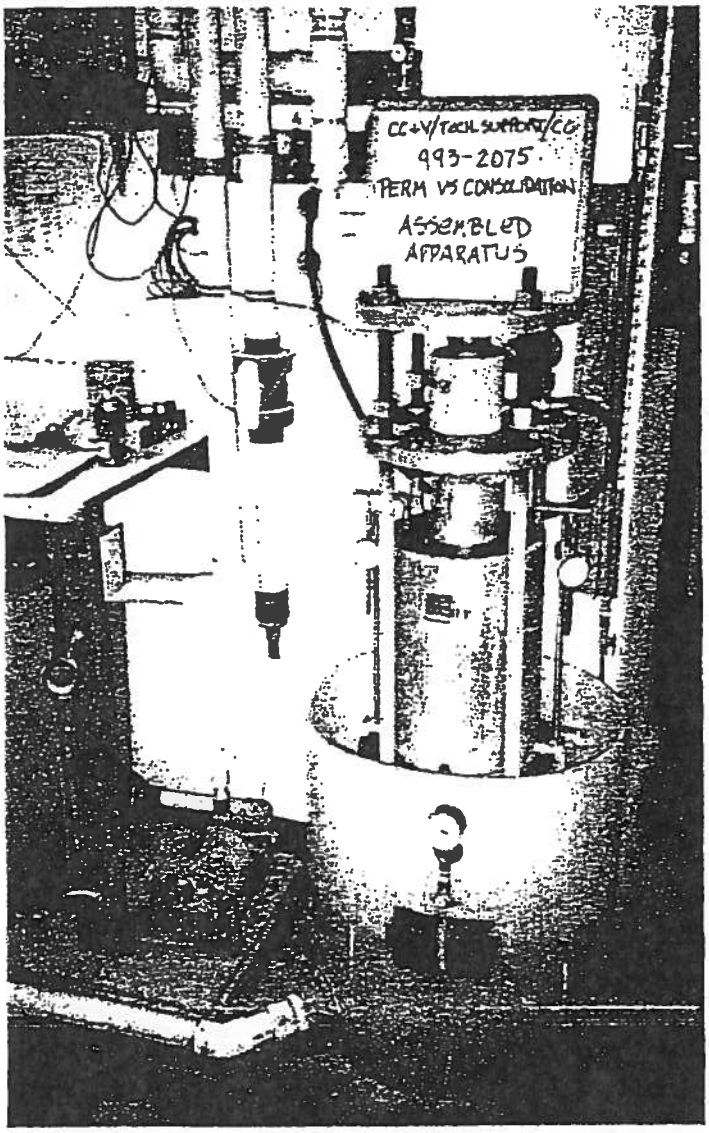


FIGURE 3 – Test Cell Assembly

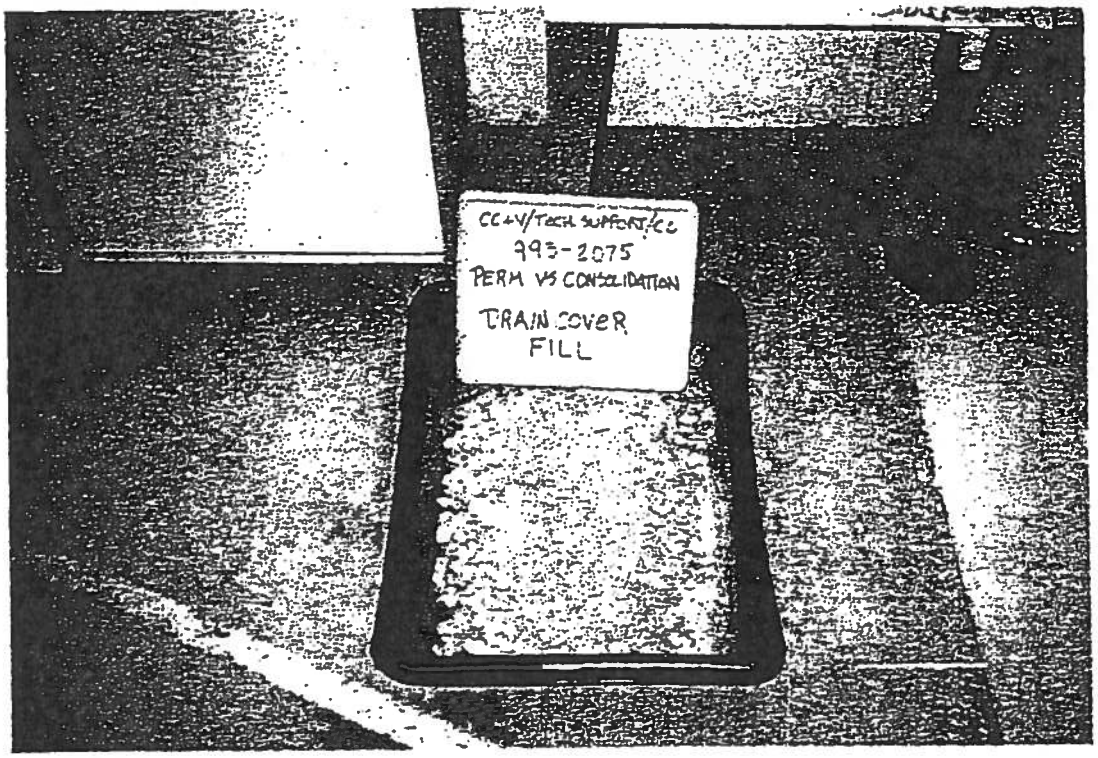


FIGURE 4 – Drain Cover Fill Test Material

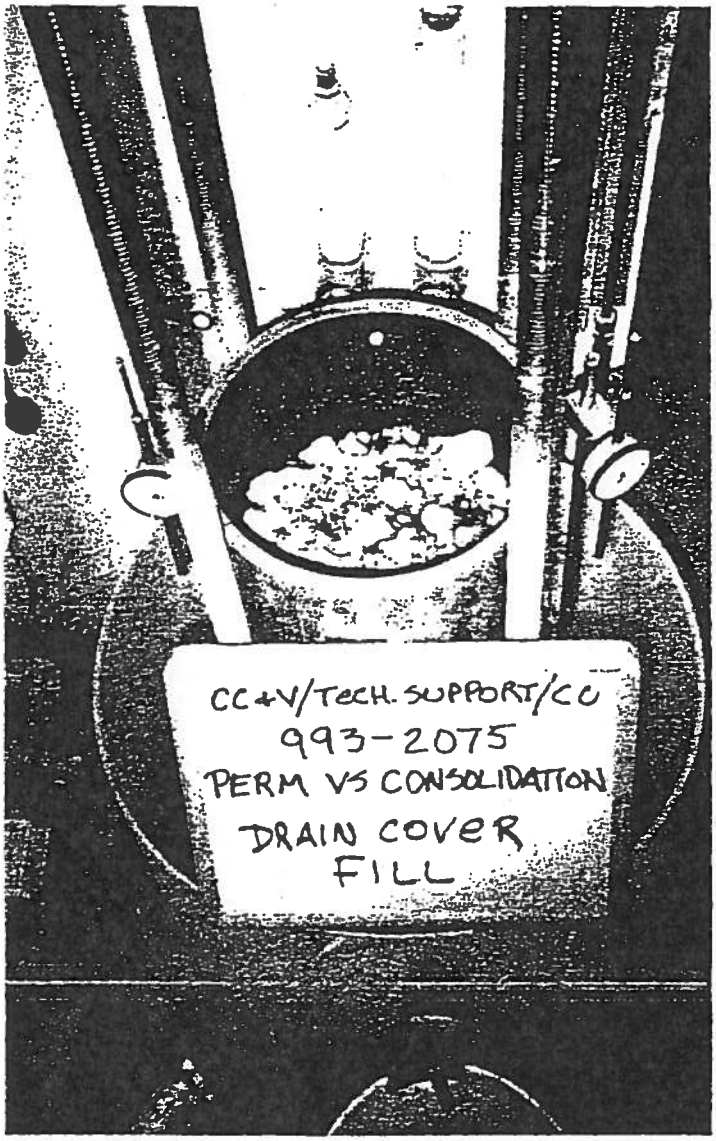


FIGURE 5 - Drain Cover Fill in Test Cell

FIGURE 6
CC&V/TECIINICAL SUPPORT/CO
Rigid-Wall Compression - Constant-Head Permeability Testing
Permeability Versus Load

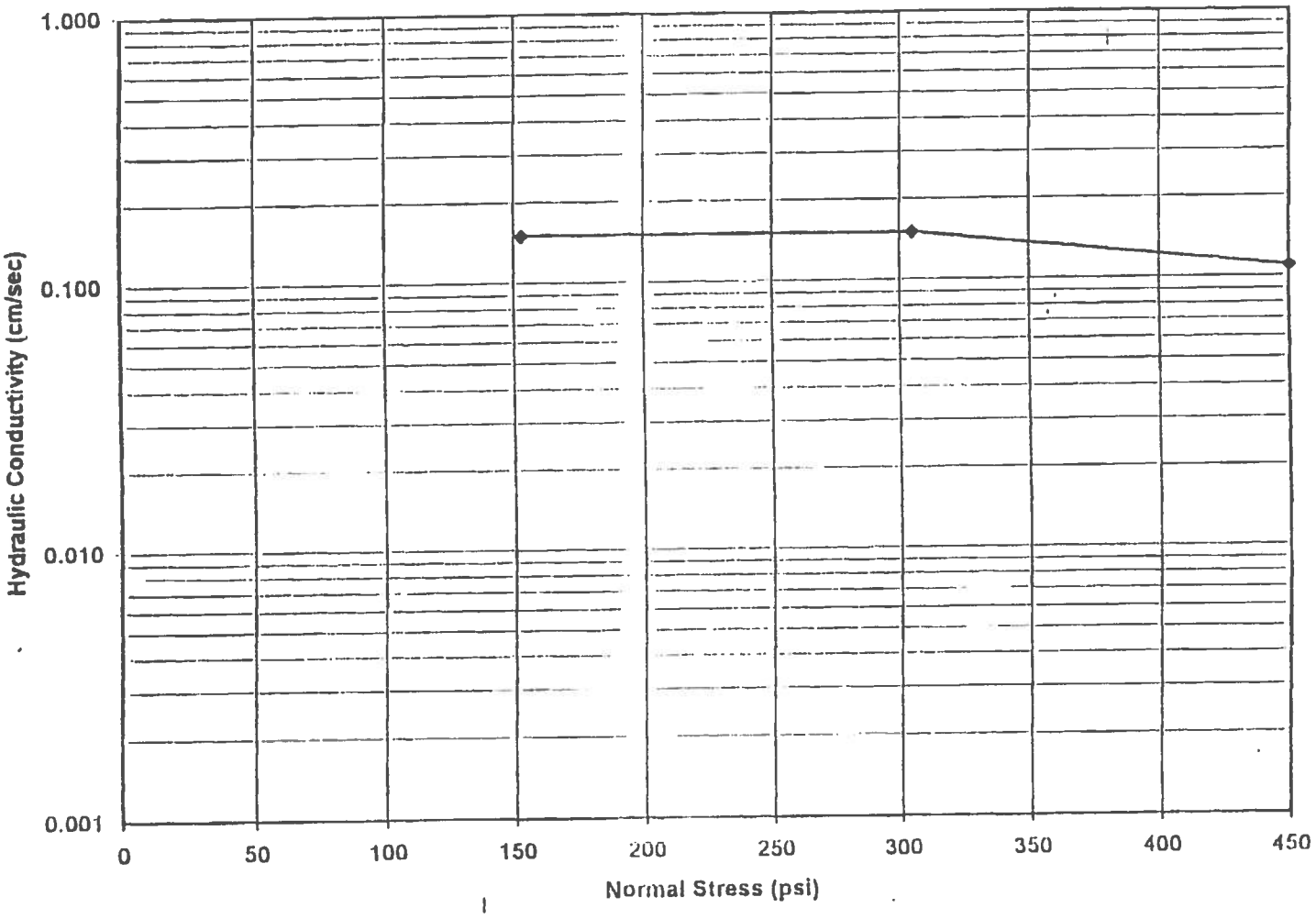


FIGURE 7
CC&V/TECHNICAL SUPPORT/CO
Rigid-Wall Compression - Constant-Head Permeability Testing
Void Ratio versus Load

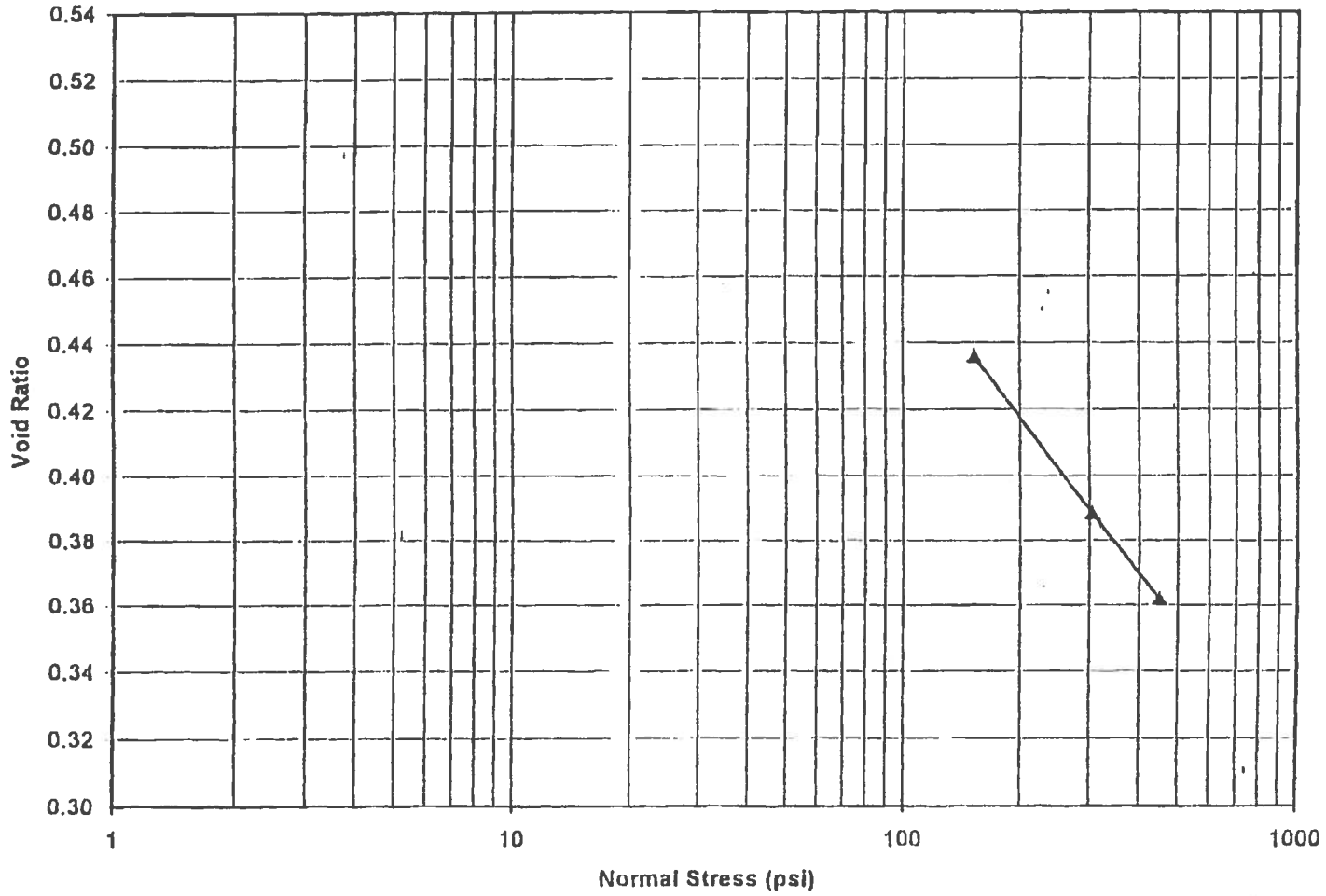
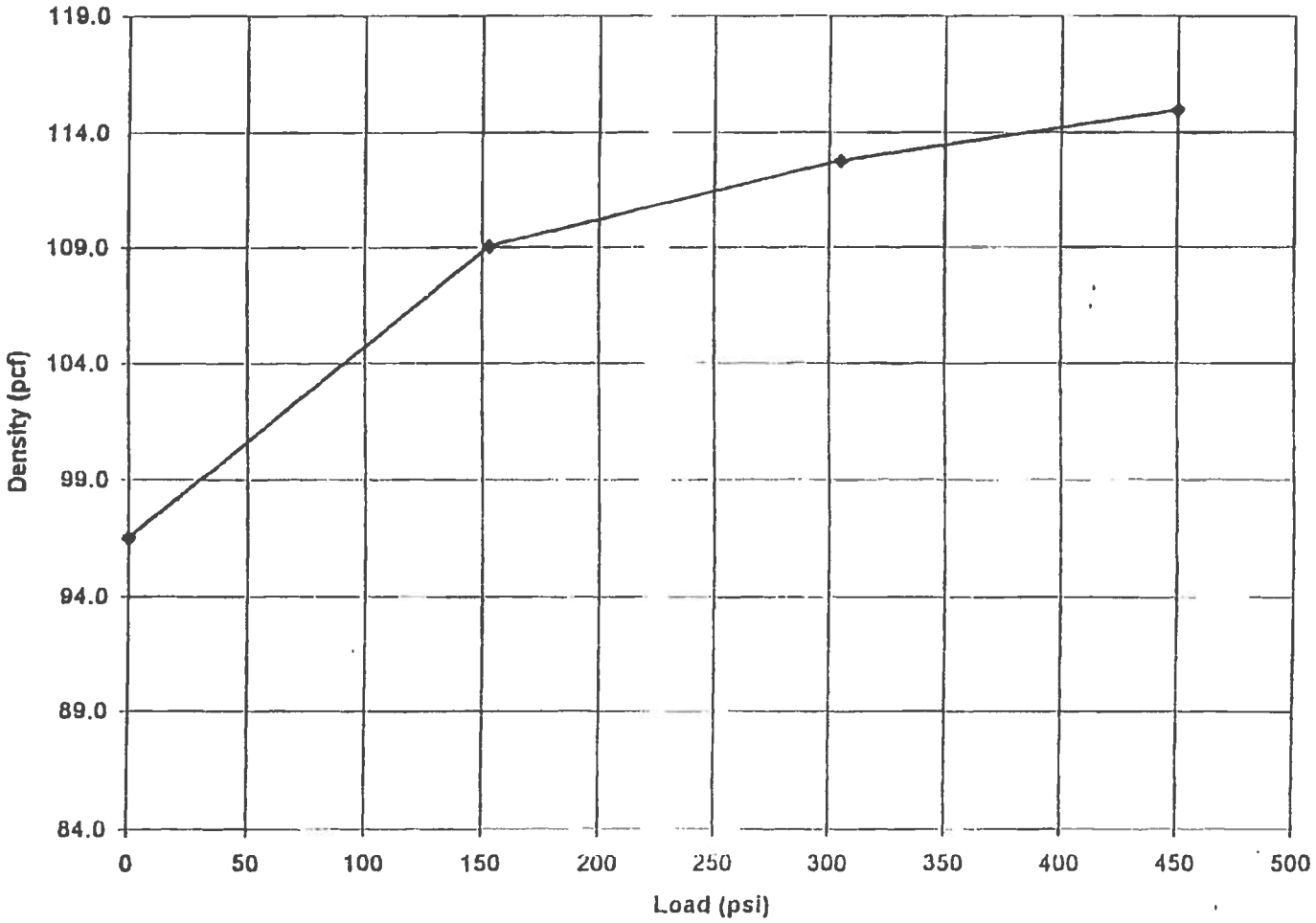
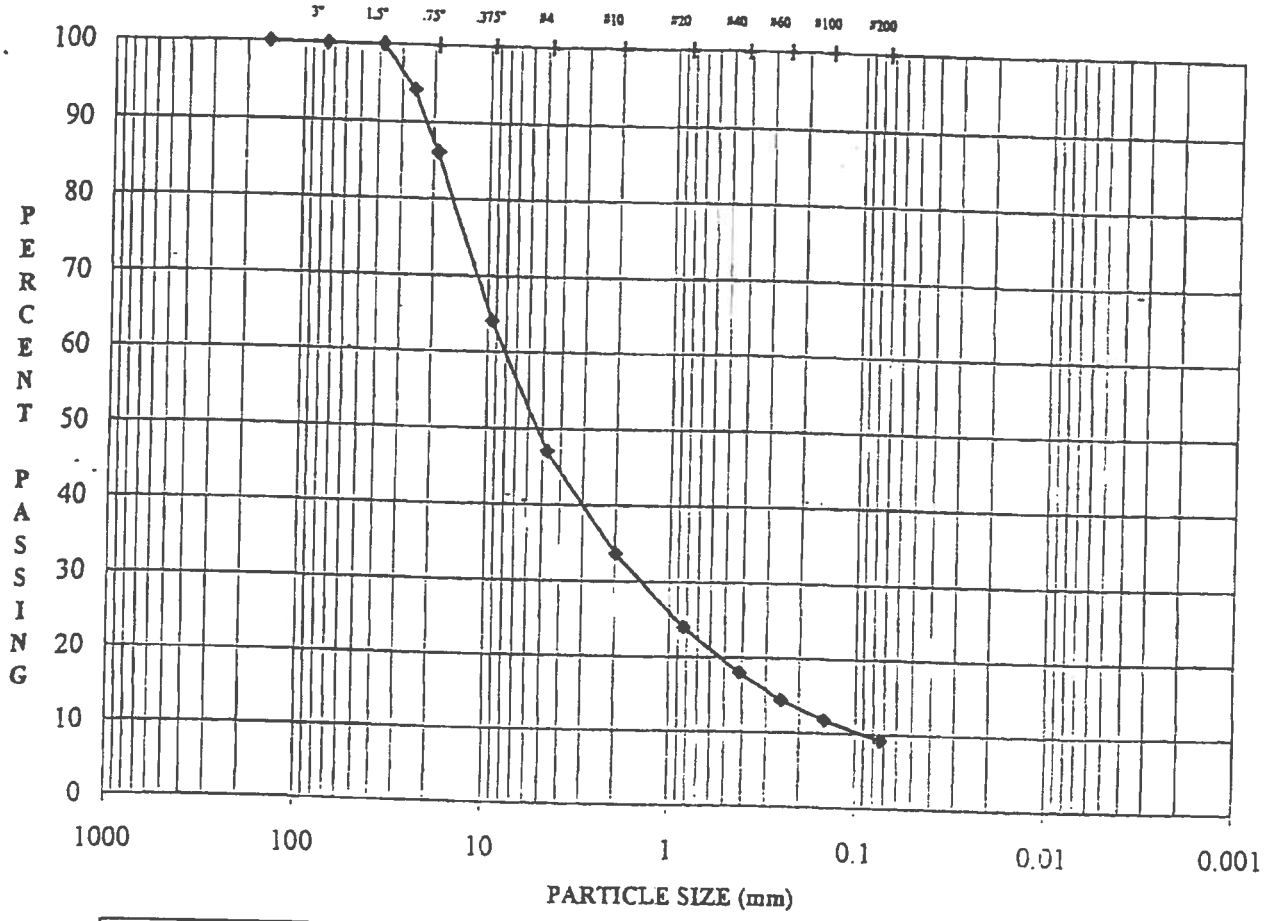


FIGURE 8
CC&V/TECHNICAL SUPPORT/CO
Rigid-Wall Compression - Constant-Head Permeability Testing
Density versus Load



PARTICLE-SIZE DISTRIBUTION ASTM D 421 AND D 422
US STANDARD SIEVE OPENING SIZES



COBBLES	Coarse	Fine	Cor	Med	Fine	Silt or Clay Size
	GRAVEL		SAND			FINES

SAMPLE #:	DRAIN COVER FILL 3 AFTER PERM
DEPTH (ft):	
DESCRIPTION:	Fine to coarse GRAVEL and fine to coarse sand, little clay (GP-GC)

MC (As tested):	2.9%
LL:	LL
PL:	PL
PI:	PI
Gs:	Gs

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FIGURE 9

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM C 117, C 136, D 421, D 422, D 1140, D 2216, D 2217

CC&V/TECHNICAL SUPPORT/CO 993-2075	SAMPLE #: DRAIN COVER FILL 3 DEPTH (ft): AFTER PERM

MOISTURE CONTENT (As tested)

Tare	S7
Weight Wet Soil & Tare, g	185.08
Weight Dry Soil & Tare, g	180.59
Weight Tare, g	28.09
Weight Water, g	4.49
Weight Dry Soil, g	152.50
Moisture, %	2.94%

#200 WASH (Percent Fines)

Tare	-
Weight Soil & Tare Before Wash, g	-
Weight Soil & Tare After Wash, g	-
Weight Tare, g	-
Weight Fines Lost, g	-
Weight Dry Soil, g	18,370.64
Fines Lost, %	-

	SIEVE	Wt. Ret.	% Ret.	% Pass.	SIEVE
	6.000"	0.00	0.00%	100.00%	6.000"
Coarse Gravel	3.000"	0.00	0.00%	100.00%	3.000" Coarse Gravel
	1.500"	0.00	0.00%	100.00%	1.500"
	1.000"	1,068.50	5.82%	94.18%	1.000"
Fine Gravel	0.750"	2,559.10	13.93%	86.07%	0.750" Fine Gravel
	0.375"	6,606.70	35.96%	64.04%	0.375"
Coarse Sand	#4	9,734.90	52.99%	47.01%	#4 Coarse Sand
Medium Sand	#10	12,179.47	66.30%	33.70%	#10 Medium Sand
	#20	13,971.25	76.05%	23.95%	#20
Fine Sand	#40	15,073.05	82.05%	17.95%	#40 Fine Sand
	#60	15,731.93	85.64%	14.36%	#60
	#100	16,207.79	88.23%	11.77%	#100
	#200	16,686.69	90.83%	9.17%	#200
Fines	PAN	18,370.64	0.00%	100.00%	PAN Fines

% C GRVL:	13.9%		Wet Color:	Fine to coarse GRAVEL
% F GRVL:	39.1%	53.0%	Description:	and fine to coarse sand, little clay (GP-GC)
% C SAND:	13.3%			
% M SAND:	15.8%		LL:	LL
% F SAND:	8.8%	37.8%	PL:	PL
% FINES:	9.2%		PI:	PI
% TOTAL:	100.0%		Gs:	Gs

DATE: 07-Aug-99
TECH: PLB
REVIEW: DMD

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FIGURE 10