EMCSF 25.2 VII
EMRRR 25.2 VI

APPENDIX M

GEOTECHNICAL AND DRAINAGE CALCULATIONS

USEPA SF
1361671

Bechtel National, Inc.

CALCULATION COVER SHEET

PROJECT	JOB NO.	CALC NO.	SHEET
EMF	24230	P4-FC-101	1

SUBJECT	GROUP
Phase IV Ponds - Surface drainage dtiches	Remediation Engineering

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	☐	☒	☐	☐

COMPUTER PROGRAM / TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION / RELEASE NO.
	☐ YES ☒ NO	☐	☐		

NO.	REASON FOR REVISION	TOTAL NO OF SHEETS	LAST SHEET NO.	BY	CHECKED	APPROVED / ACCEPTED	DATE
0	Final Calculation	5	5	RLN	MK	MK	9-20-01

RECORD OF REVISIONS

Calculation Sheet

Originator	R. Ng	Date	6/26/2001	Calc. No.	P4-FC-101	Rev. No.	0
Project	EMF	Job No.	24230-027	Checked		Date	
Subject	Phase IV Ponds - Surface drainage dtiches					Sheet No.	2

Drainage Area	Discharge Rate Q (cfs) 25-year Storm	100-year Storm
D	5.6	9.1
E	13.4	22.3
F	4.5	7.3
G	14.2	23.4
H	3.9	6.3
I	15.0	25.1
J	4.5	7.3
K	17.2	28.1

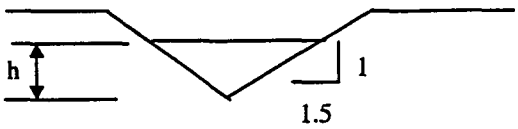
Drainage Area D:

Use concrete lined "V" ditch with 1-1/2 : 1 side slopes,

n= 0.013 ; minimum slope (due to adjacent roadway)= 1 % or s = 0.01

Manning's Formula:
v= 1.486*(HR)^(2/3)*s^(1/2)/n ; HR= A/WP ; WP= wetted perimeter ; A = area ;

Q= v*A



WP = (1^(2)+1.5^(2))^(1/2)*h*2 = 3.606 *h

A = h*(1.5*h) = 1.5*h^(2)

HR = 1.5*h^(2)/(3.61*h) = 0.416 *h

v= 1.486*(.42h)^(2/3)*(.01)^(1/2)/.013 = 6.37 *h^(2/3)

Q = (6.37*h(2/3)*1.5*h^(2) = 9.555 *h^(8/3)

Q_{25} = 5.6 = 9.56*h^(8/3) ; h = (0.7/9.56)^(3/8) = 0.818 ft. ; v = 5.6 fps

Q_{100} = 9.1 = 9.56*h^(8/3) ; h = (1.1/9.56)^(3/8) = 0.982 ft. ; v = 6.3 fps

USE CONCRETE LINED "V" DITCH W/ MIN. 1% SLOPE AND DEPTH OF 12 INCHES

Drainage Areas E, G, I and K:

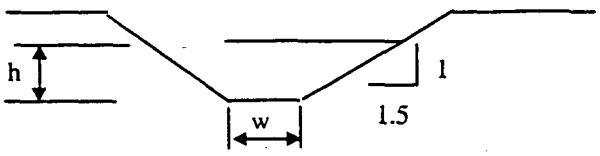
Try unlined trapezoidal ditch with 1-1/2 : 1 side slopes,

n= 0.025 ; s = 0.2 % or s = 0.002 ; w = 2 ft.

Manning's Formula:

v= 1.486*(HR)^(2/3)*s^(1/2)/n ; HR= A/WP ; WP= wetted perimeter ; A = area ;

Q= v*A



WP = (1^(2)+1.5^(2))^(1/2)*h*2 + w = 3.606 *h + 2

A = h*(1.5*h) + w*h = (1.5*h + 2)*h

HR = A / WP

Drainage Area E:

Q_{25} = 13.4 cfs ;

Try h = 1.41 ft. WP = 7.066 ft ; A = 5.771 sq. ft.; HR = 0.817 ft.
v = 2.32 fps ; Q = 13.4 cfs

Q_{100} = 22.3 cfs ;

Try h = 1.79 ft. WP = 8.468 ft ; A = 8.416 sq. ft.; HR = 0.994 ft.
v = 2.65 fps ; Q = 22.3 cfs

USE UNLINED TRAPEZODIAL DITCH W/ 0.2% SLOPE, WIDTH OF 2' AND DEPTH OF 24 INCHES MINIMUM

Drainage Area G:

Q_{25} = 14.2 cfs ;

Try h = 1.45 ft. WP = 7.21 ft ; A = 6.022 sq. ft.; HR = 0.835 ft.
v = 2.36 fps ; Q = 14.2 cfs

Q_{100} = 23.4 cfs ;

Try h = 1.84 ft. WP = 8.616 ft ; A = 8.721 sq. ft.; HR = 1.012 ft.
v = 2.68 fps ; Q = 23.4 cfs

USE HDPE OR CONCRETE LINED TRAPEZODIAL DITCH W/ 0.2% SLOPE, WIDTH OF 2' AND DEPTH OF 24 INCHES MINIMUM

Drainage Area I:

Q_{25} = 15.0 cfs ;

Try h = 1.49 ft. WP = 7.354 ft ; A = 6.278 sq. ft.; HR = 0.854 ft.
v = 2.39 fps ; Q = 15.0 cfs

Q_{100} = 25.1 cfs ;

Calculation Sheet

Originator	R. Ng	Date	6/26/2001	Calc. No.	P4-FC-101	Rev. No.	0
Project	EMF	Job No.	24230-027	Checked		Date	
Subject	Phase IV Ponds - Surface drainage dtiches					Sheet No.	5

USE LINED "V" DITCH W/ 7% SIDE SLOPES AND MIN. 0.19% DITCH SLOPE AND 15-FOOT WIDE LINING

Use concrete lined "V" ditch with 1-1/2 : 1 side slopes, for steep portion

Try h = 1.90 ft. WP = 8.847 ft ; A = 9.207 sq. ft.; HR = 1.041 ft.
v = 2.73 fps ; Q = 25.1 cfs

USE UNLINED TRAPEZODIAL DITCH W/ 0.2% SLOPE, WIDTH OF 2' AND DEPTH OF 24 INCHES MINIMUM

Drainage Area K:

Q_{25} = 17.2 cfs ;

Try h = 1.59 ft. WP = 7.724 ft ; A = 6.956 sq. ft.; HR = 0.901 ft.
v = 2.48 fps ; Q = 17.2 cfs

Q_{100} = 28.1 cfs ;

Try h = 2.00 ft. WP = 9.211 ft ; A = 9.999 sq. ft.; HR = 1.086 ft.
v = 2.81 fps ; Q = 28.1 cfs

USE UNLINED TRAPEZODIAL DITCH W/ 0.2% SLOPE, WIDTH OF 2' AND DEPTH OF 24 INCHES MINIMUM

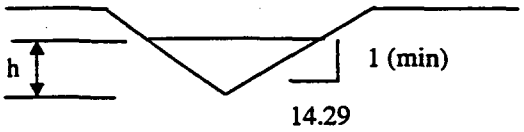
Ditches for Drainage Area F, I and J:

Use concrete lined "V" ditch with 7 % side slopes, for flat portion

n= 0.013 ; minimum slope = 0.19 % or s = 0.0019

Manning's Formula:
v= 1.486*(HR)^(2/3)*s^(1/2)/n ; HR= A/WP ; WP= wetted perimeter ; A = area ;

Q= v*A side slope = 14.29 : 1



WP =(14.29 ^(2)+1^(2))^(1/2)*h*2 = 28.64 *h

A = h*(14.29 *h) = 14.29 *h^(2)

HR = 14.29 h^(2)/ 28.64 *h = 0.499 *h

v= 1.486*(HR)^(2/3)*(s)^(1/2)/n = 3.12 *h^(2/3)

Q = (v* A) = 44.61 *h^(8/3)

Q_{25} = 4.5 = 44.61 *h^(8/3) h = (4.5 / 44.61) ^(3/8) = 0.42 ft. ; v = 1.8 fps

Q_{100} = 7.3 = 53.61*h^(8/3) ; h = (7.3/53.61)^(3/8) = 0.51 ft. ; v = 2.0 fps

Maximum width of lined ditch = 0.51/.07 14.49 ft.

Bechtel National, Inc.

CALCULATION COVER SHEET

PROJECT	JOB NO.	CALC NO.	SHEET
EMF	24230	P4-FC-102	1

SUBJECT	GROUP
Phase IV Ponds - Final Cover Subdrain Capacity	Remediation Engineering

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	☐	☒	☐	☐

COMPUTER PROGRAM / TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION / RELEASE NO.
	☐ YES ☒ NO	☐	☐		

NO.	REASON FOR REVISION	TOTAL NO OF SHEETS	LAST SHEET NO.	BY	CHECKED	APPROVED / ACCEPTED	DATE
0	Final Calculation	3	3	RLN	MIC	MK	9-20-01

RECORD OF REVISIONS

Calculation Sheet

Originator	R. Ng	Date	6/26/2001	Calc. No.	P4-FC-102	Rev. No.	0
Project	EMF	Job No.	24230-027	Checked		Date	
Subject	Phase IV Ponds - Final Cover Subdrain Capacity					Sheet No.	2

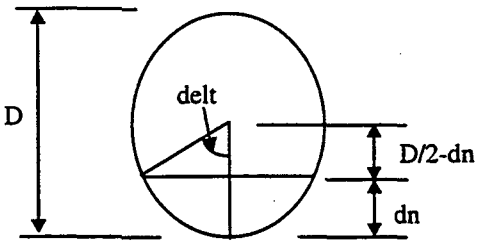
Drainage Area	area (acs)	Discharge Rate Q (cfs)	Length of run (ft.)	Head (ft.)
1	0.41	0.004	660	9
2	2.04	0.018	780	9
3	1.38	0.012	790	3
4	1.42	0.013	790	3
5	1.35	0.012	820	3
6	1.29	0.011	640	3
7	1.01	0.009	500	3
8	2.78	0.025	1000	3

Maximum discharge Q_{max} = 0.02 cfs ; run = 1000 ft. ; head = 3 ft. ; s= 0.003

or assume conservatively area 2 is flat Q 0.018 cfs ; maximumu run = 780 ft. ; head = 0 ft. or pipe is flat

Try 6" diameter N-12 pipe (as manufactured by ADS D= 6 in.

n = 0.01



delta = $\cos^{-1}$ (D/2-dn)/(D/2)

WP = 2*delta*(D/2)

A = delta*(D/2)^2 - (D/2)^2*sin(delta)*cos(delta)

HR = A / WP

For Q = 0.02 cfs ; run = 1000 ft. ; head = 3 ft. ; s= 0.003
dn= 0.93 in.

delta = 0.809 radian ; WP = 0.405 ft. ; A = 0.019 ft^2

HR = 0.048 ft.

v = 1.486 * HR^(2/3)*s^(1/2)/n = 1.073 fps

Q = v * A = 0.02 cfs dn = 0.93 " < 6" **O.K.**

Therefore 6" diameter N-12 Pipe is O.K.

For Q = 0.018 cfs ; run = 780 ft. ; head = 0 ft. ; Assuming s= 0.00005
dn= 2.43 in.

delta = 1.38 radian ; WP = 0.69 ft. ; A = 0.075 ft^2

HR = 0.108 ft.

v = 1.486 * HR^(2/3)*s^(1/2)/n = 0.238 fps

Q = v * A = 0.018 cfs

Assuming an average flow depth of dn or 2.43 inches and an average friction slope of .00005, maximum hydraulic grade line at beginning of pipe, if the pipe is laid flat =

2.43 +780/2*.00005*12 = 2.664 " < 6 " ; therefore flow in pipe is partial and pipe has no surcharge say O.K.

USE 6" PERFORATED N-12 PIPE AS SUBDRAIN COLLECTION PIPING FOR ALL AREAS

Bechtel National, Inc.

CALCULATION COVER SHEET

PROJECT	JOB NO.	CALC NO.	SHEET
EMF	24230	P4-FC-104	1

SUBJECT	GROUP
Structural Capacity of Corrugated HDPE Subdrain Piping	Remediation Engineering

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	☐	☒	☐	☐

COMPUTER PROGRAM / TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION / RELEASE NO.
	☐ YES ☒ NO	☐	☐		

NO.	REASON FOR REVISION	TOTAL NO OF SHEETS	LAST SHEET NO.	BY	CHECKED	APPROVED / ACCEPTED	DATE
0	Final Calculation	8	8	RLN	MK	[illegible]	9/20/01

RECORD OF REVISIONS

Reference : Technical Report 4.103 by Advanced Drainage System, Inc.

Given:

H-20 loading
Min. Cover = 2 ft. @ 120 pcf
Soil Cover = 7 ft.
bedding angle = 30 °
backfill compaction 85% ASTM D 1557 or equivalent to 90% of standard Proctor
backfill material granular fill

N-12 Corrugated HDPE manufactured by Advanced Drainage Systems, Inc.

Pipe:	D	= Pipe diameter	=	6	in	
	R	= Pipe radius	=	3	in	
	Ap	= Pipe Wall area	=	0.107	in^2/in	*
	I	= Moment of inertia of the pipe wall	=	0.0036	in4/in	*
	E	= Modulus of Elasticity (Pipe Material)	=	21,000	psi	**

*Refer to ADS N-12 Product Information Sheet
**for 100 yr. - long term value

Piping Stiffness:

$FF = D^2/EI$; where: FF = Flexibility Factor
Min. AASHTO specified FF = 0.095

or

FF = 53.77/(PS x D) ; where: PS = Pipe stiffness in lb-in/in

PS = 53.77/(FF x D) = **94.33 lb-in/in**

Wall Crushing:

T = P x D'/2 Where: T = Thrust in lbs/ft
P = Design Load in psf
D' = Diameter in Feet = 0.5 ft.

For 2' of soil cover w/ traffic load, find Design Load P_1

soil load = 2 ft x 120 pcf = 240 psf
traffic load = 5.56 psi = 800.6 psf Refer to Table 5, "Live Load on Flexible Pipes"

P_1 = 240 + 801 = **1041 psf**

For 7' of soil cover w/o traffic load, find Design Load P_2

P_2 = 7 ft x 120 pcf = **840 psf**

Since $P_1 > P_2$ 7' cover is less critical

Determine the Thrust

T = 1041 psf * 0.5 ft /2 = 260.2 lbs/ft

f_s = T / Ap
= 260 x (1ft/12in) / 0.107 = 202.6 psi ; where f_s is ring compression stresses

f_a = fu / SF ; where: fa = allowable ring compression stress
f_u = Minimum Tensile Strength = 3000 psi
SF = Safety Factor = 2

f_a = 1,500 psi >> fs of 202.6 psi **O.K.**

Wall Buckling - Using AASHTO method:

Pcr = 9.24 (R/Ap) x (Cw Ms EI/(0.149xR^3))^(1/2)

Where:
Pcr = Critical Buckling Pressure (psi)
Ms = Soil Modulus (psi)
Refer to Table 3, Design Values of E' (psi)
For 90% standard Proctor, 2 ft. cover, and granular soil Ms = 1,000
Cw = Water Buoyancy Factor
Cw = (1- 0.33 Hw/H) = 1.0
Where Hw = Height of water above top of pipe = 0 ft.
H = Height of ground surface above top of pipe = 3.5 ft.
I = Moment of inertia of the pipe wall (in^4/in)
E = Modulus of Elasticity (Pipe Material) (psi)
R = Pipe radius (in)
Ap = Pipe Wall area in^2/in

Pcr = 35,513.65 psi

T = 260 lb/ft From Thrust calculations above.
P = T / Ap = 260 lb/ft *(1 ft/ 12 in) /0.107 in2/in = 202.492 psi

P = 202 psi << Pcr = 35,513.65 psi **O.K.**

Pipe Deflection using Modified Iowa Formula (Marston-Spangler):

$\Delta x = D_L \{kWr^3/[(D^3PS/53.77) + (0.061E'r^3)]\}$

where : Δx = Horizontal deflection in inches
D_L = Loading factor
k = Bedding constant
W = Total load in pounds/liner inch
r = Pipe radius in inches
D = Pipe diameter in inches
E' = Modulus of soil reactions in lbs/in^2 (psi)

From wall buckling calculation, Ms = E' = 1000 psi ; D_L = 1.0
For bedding angle of 30° k = 0.108 Refer to Table 1, "Values of Bedding Constant, k"

Calculation Sheet

Originator	R. Ng	Date	6/26/2001	Calc. No.	P4-FC-104	Rev. No.	0
Project	EMF	Job No.	24230-027	Checked		Date	
Subject	Sturctural Capacity of Corrugated HDPE Subdrain Piping					Sheet No.	4

For 2' of soil cover w/ traffic load, find Total Load W_1

soil load = 2 ft x 120 pcf x 0.5 ft x 1 ft/12 in = 10 lb/in.

traffic load = 5.56 psf x 0.5 ft x 12 in/1 ft = 33.36 lb/in.

W_1 = 10 + 33 = **43.36 lb/in.**

For 7' of soil cover w/o traffic load, find Total Load W_2

W_2 = 2 ft x 120 pcf x 0.5 ft x 1 ft/ 12 in = **35 lb/in.**

$W_1 > W_2$ therefore the traffic load governs

Δx = **0.062 in** or 1.04% < 7.5% allowable **O.K.**

PIPE HAVE NO PROBLEM IN SUPPORTING TRAFFIC LOADING AFTER PLACEMENT OF 2 FOOT OF EARTH COVER

Table 3

Design Values of E' (psi)

Type of soil (1)	Depth of Cover (ft) (2)	Standard AASHTO Relative Compaction 85% (3)	90% (4)	95% (5)	100% (6)
Fine-grained soils with less than 25% sand content (CL, ML, DL-ML)	0-5	500	700	1,000	1,500
	5-10	600	1,000	1,400	2,000
	10-15	700	1,200	1,600	2,300
	15-20	800	1,300	1,800	2,600
Coarse-grained soils with fines (SM,SC)	0-5	600	1,000	1,200	1,900
	5-10	900	1,400	1,800	2,700
	10-15	1,000	1,500	2,100	3,200
	15-20	1,100	1,600	2,400	3,700
Coarse-grained soils with little or no fines (SP, SW, GP, GW)	0-5	700	1,000	1,600	2,500
	5-10	1,000	1,500	2,200	3,300
	10-15	1,050	1,600	2,400	3,600
	15-20	1,100	1,700	2,500	3,800

"TECHNICAL REPORT 4.103" BY ADVANCED DRAINAGE SYSTEM, INC

The design load is generally assumed to be the weight of the soil load above the pipe calculated by multiplying the soil density times the height of cover. Any anticipate live load must be added to this dead load. Live loads are given in Table 5 and shown on Figure 4, 5, and 6.

Table 5

Live Loads on Flexible Pipe
(Live Load Transferred to Pipe, lb/in2)

Height of Cover	Highway	Railway	Airports
(FT)	H20	E80	
1	12.50	N.R.	N.R.
2	5.56	26.39	13.14
3	4.17	23.61	12.28
4	2.78	18.40	11.27
5	1.74	16.67	10.09
6	1.39	15.63	8.79
7	1.22	12.15	7.85
8	0.69	11.11	6.93
10	N.S.	7.64	6.08
12	-	5.56	4.76
14	-	4.17	3.06
16	-	3.47	2.29
18	-	2.78	1.91
20	-	2.08	1.53
22	-	1.91	1.14
24	-	1.74	1.05
26	-	1.39	N.S.
28	-	1.04	-
30	-	0.69	-
35	-	N.S.	-
40	-	-	-

Notes: H20 load simulates 20 ton truck traffic and impact.
E80 load simulates 80,000 lb./ft. railway load and impact.
Airport load simulates 180,000 lb. dual tandem gear, 26 inch spacing between tires and 66 inch center-to-center spacing between fore and aft tires under rigid pavement 12" thick plus impact.

N.S. = Not Significant
N.R. = Not Recommended

"TECHNICAL REPORT 4.103" BY ADVANCED DRAINAGE SYSTEM, INC.

Advanced Drainage Systems, Inc.
Muncy, PA; Wooster, OH; Ludlow, MA; London, OH; Buena Vista, VA
3300 Riverside Drive
Columbus, OH 43221
614-457-3051 FAX: 614-459-0169

Types of Pipe		HDPE								
Nominal Sizes		4"	6"	8"	10"	12"	15"	18"	24"	18"
Wall Type - Corrugated of Profile		Type C	Type C	Type C	Type C	Type C	Type C	Type C	Type C	AdvanEDGE
Nominal Pipe Diameter		4"	6"	8"	10"	12"	15"	18"	24"	18"
Inside Diameter (Min)		3.94	5.91	7.88	9.85	11.82	14.78	17.73	23.64	0.75
Outside Diameter		4.71	6.93	9.47	11.89	14.78	17.45	21.05	28.25	1.6
Weight (lb/ft)		0.3	0.7	1.2	1.8	2.8	4.0	6.0	11.2	1.2
Minimum Wall Thickness (In)		.029	.033	.045	.050	.067	.097	.100	.180	.033
Pipe Wall Area (In 2/ft)	(Required)					1.50	1.91	2.34	3.14	
	(Actual)	0.672	1.032	1.224	1.536	1.99	2.31	2.77	4.03	1.04
Pipe Stiffness	(Required)	35	35	35	35	50	42	40	34	
	(Typical)	45.5	49.5	42.9	42.7	62.5	46.4	45.0	40.9	
Tensile Strength	(Minimum)	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
	(Typical)	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
Tensile Modulus	(Minimum)	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
	(Typical)	125,000	125,000	125,000	125,000	138,000	138,000	138,000	138,000	125,000
50 yr. Tensile Strength	(Minimum)	900	900	900	900	900	900	900	900	900
	(Typical)	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
100 yr. Tensile Strength	(Minimum)									
	(Typical)	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
50 yr. Tensile Modulus	(Minimum)	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000
	(Typical)	25,000	25,000	25,000	25,000	27,500	27,500	27,500	27,500	25,000
100 yr. Tensile Modulus	(Minimum)									
	(Typical)	21,000	21,000	21,000	21,000	23,000	23,000	23,000	23,000	21,000
Moment of Inertia	(Required)					0.024	0.053	0.062	0.116	
	(Actual)	0.0011	0.0034	0.010	0.019	0.034	0.070	0.090	0.200	0.035
Years of Use in Transportation		21	21	20	20	16	14	12	12	5

PA-FC-124(7)

A number of factors in the equation are contentious and deserve explanation:

A. The deflection lag factor (D_L) was included in the equation because Dr. Spangler believed that deflections could increase as much as 30% over a period of 40 years. He recommended a D_L of 1.5 to be conservative. We now know virtually all of the deflection occurs during the first year, therefore a D_L of 1.0 may be used.

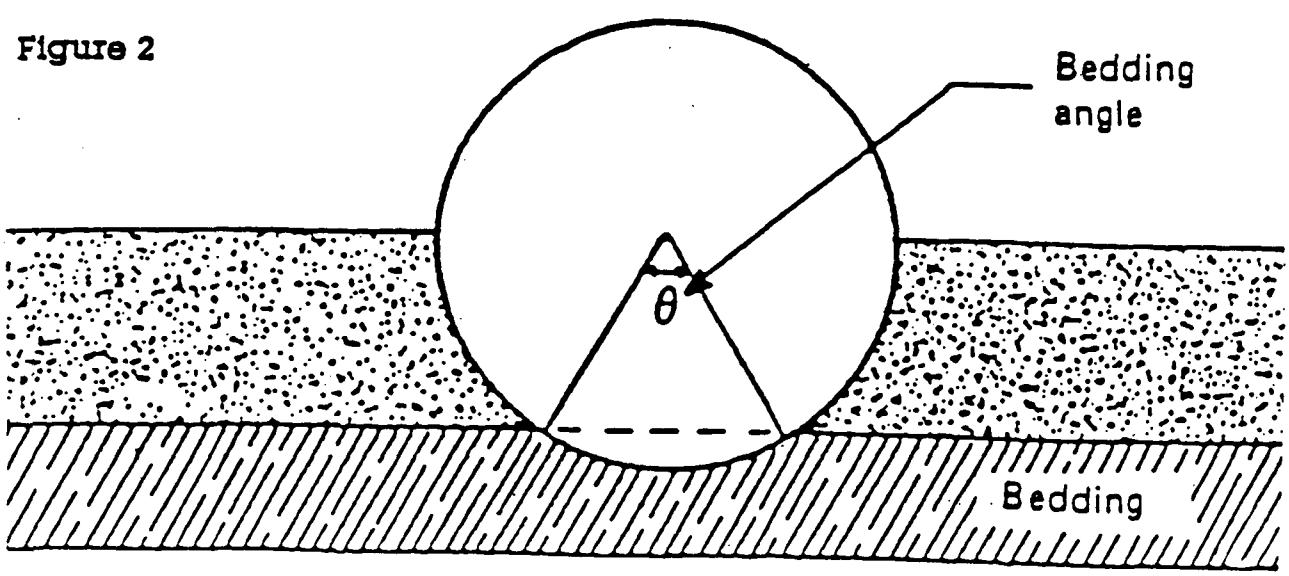
B. The bedding constant (k) is usually assumed to equal 0.1, although, as shown in Table 1, other values may be appropriate for specific installation conditions. A bedding angle (see Figure 2) of 0° would indicate a very firm foundation which would not be recommended for any pipe type.

Table 1

Values of Bedding Constant, K

Bedding angle, degrees	K
0	0.110
30	0.108
45	0.105
60	0.102
90	0.096
120	0.090
180	0.083

Figure 2



"TECHNICAL REPORT 4.103" BY ADVANCED DRAINAGE SYSTEM, INC.

CALCULATION COVER SHEET

PROJECT FMC Corporation Pocatello	JOB NO. 24230-027	CALC NO. P4calc1	SHEET 1
SUBJECT Estimation of Design Surface Runoff Flow Rates for the Phase IV Ponds		DISCIPLINE Hydrology/Modeling	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[X]	[✓]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] YES [x] NO	[ ]	[ ]		

Abstract

The purpose of this calculation is to estimate design surface runoff rates for Phase IV Ponds at Pocatello, Idaho. The perimeter drains will collect and convey surface runoff to existing local drainage courses. The design flow rates are computed for 25-year and 100-year storm return periods. Intensity duration-frequency curves for both return periods are determined from the Precipitation-Frequency Atlas for the State of Idaho. Based on the proposed grade of pond closure caps, the pond area is divided into smaller sub-areas, each discharging to a different section of the perimeter drains (Figure 1). The design storm durationS for each sub-area of the pond are estimated using the Kirpich formula. Peak surface runoff is estimated using the Rational Method.

The time of concentration for the different sections of the perimeter drains range between 5 and 10 minutes. The design flow rates based on a 25-year return periods range between 2.7 and 17.2 cfs. The design flow rates based on a 100-year return periods range between 4.4 and 28.1 cfs.

Prepared by Jim Q Zhang
Checked by Nadim Copty
Approved by Angelos Findikakis

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
				QZ	N.C.	AF	
1	Final Calculation	15	15	J. Zhang	N. Copty	A. Findikakis	June 5, 2001

Record of Revisions

Table of Contents

LIST OF FIGURES 3

LIST OF TABLES 3

1. INTRODUCTION 4

2. INTENSITY DURATION-FREQUENCY CURVES 6

3. SURFACE RUNOFF 8

3.1. Runoff Coefficient *C* 8

3.2. Time of Concentration 9

3.3. Peak Flow Rate 10

4. LIST OF REFERENCES 13

List of Figures

Figure 1: Phase IV ponds 13

Figure 2: Intensity Duration-Frequency Curves for Pocatello, Idaho 14

List of Tables

Table 1: Drainage Sub-areas of the Phase IV Ponds and Pond 8E 4

Table 2: Rainfall-Duration-Intensity for Pocatello, Idaho 5

Table 3: Time of Concentration for Phase IV Ponds 10

Table 4: Peak Surface Runoff for Each Section of the Perimeter Drain 11

1. Introduction

A plan view of Phase IV Ponds is shown in Figure 1. Based on the proposed grade of 5% for the cap, the cap surface area can be divided into small sub-areas; each discharges to a section of the perimeter drain. Drainage water is also collected from Pond 8E and Pond 8S, located just east of the Phase IV Ponds. (For Pond 8E and Pond 8S surface runoff calculations, refer to calculation package 8ECALC1 and 8SCALC1, respectively.) Figure 1 also shows the direction of flow along the different sections of the perimeter drains. The surface areas of each sub-area of the Phase IV Ponds as well as 8E Pond are listed in Table 1. The drainage system of the entire site is under CERCLA remediation of the FMC facility and will be addressed in this calculation.

The purpose of this calculation is to estimate the design flow rates for the different sections of the perimeter drain. Design flow rates will be calculated at points A through K (Figure 1), each located at the downstream end of each section of the perimeter drains. The calculations are made based on 25-year and the 100-year return periods. Intensity duration-frequency curves for Pocatello are determined from the Precipitation-Frequency Atlas of the Western United States, Volume V-Idaho (Miller et al., 1973). The time of concentration and the corresponding surface runoff are estimated using the Kirpich Formula and the Rational Method (described in Chow et al., 1988), respectively. These methods were selected because they are applicable to small undeveloped areas such as the Phase IV Ponds.

The rest of the calculation is addressed as follows:

- Section 2 develops intensity duration-frequency curves for the Pocatello region.
- Section 3 estimates the peak surface runoff.

Table 1: Drainage Sub-areas of the Phase IV Ponds and Pond 8E

Sub-Area	Area (sq. ft)
A1	145,000
A2	84,000
A3	82,000
A4	23,000
A5	7,000
A6	67,000
A7	30,000
A8	25,000
A9	48,000
A10	48,000
A11	65,000
A12	23,000
A13	46,000
A14	43,000
A15	55,000
A16	72,000
A17	110,000
A18	75,000
Total	1,048,000

2. Intensity Duration-Frequency Curves

Table 2 lists rainfall intensities for 2-year, 25-year and 100-year return periods and various storm durations determined from the Precipitation-Frequency Atlas of the Western United States, Volume V-Idaho (Miller et al., 1973). The rainfall intensity for the 6-hour and 24-hour duration storms are obtained from precipitation-frequency maps (Figures 19-30) for the town of Pocatello.

Table 1: Rainfall-Duration Intensity for Pocatello, Idaho

Storm Duration	Return Period (Years)	Rainfall (inches)
24 hours	100	2.6[1]
	25	2.1[1]
	2	1.1[1]
6 hours	100	1.7[1]
	25	1.4[1]
	2	0.8[1]
3 hours	100	1.4[2]
	25	1.1[2]
	2	0.6[2]
2 hours	100	1.3[2]
	25	1.0[2]
	2	0.5[2]
1 hour	100	1.1[3]
	25	0.8[4]
	2	0.4[3]
30 minutes	100	0.87[5]
	25	0.63[5]
	2	0.32[5]
15 minutes	100	0.63[5]
	25	0.46[5]
	2	0.23[5]
10 minutes	100	0.50[5]
	25	0.36[5]
	2	0.18[5]
5 minutes	100	0.32[5]
	25	0.23[5]
	2	0.12[5]

[1] Determined from precipitation-duration maps
[2] Interpolated from the 1-hour and 6-hour rainfall values
[3] Estimated using regional regression equations
[4] Interpolated from the 2-year and 100-year rainfall values
[5] Estimated from the one-hour rainfall values and adjustment factors

The 2-year, 1-hour rainfall and the 100-year, 1-hour rainfall are estimated using regression equations defined in Table 12 for Region 2 (Miller et al., 1973):

$$Y_2 = 0.019 + 0.711\frac{X_1^2}{X_2} + 0.001Z \qquad (1)$$

$$Y_{100} = 0.338 + 0.670\frac{X_3^2}{X_4} + 0.001Z \qquad (2)$$

where

Y_2	2-year, 1-hour estimated rainfall value [in.]
Y_{100}	100-year, 1-hour estimated rainfall value [in.]
X_1	2-year, 6-hour rainfall from precipitation-frequency maps [in.]
X_2	2-year, 24-hour rainfall from precipitation-frequency maps [in.]
X_3	100-year, 6-hour rainfall from precipitation-frequency maps [in.]
X_4	100-year, 24-hour rainfall from precipitation-frequency maps [in.]
Z	Point elevation in hundreds of feet. For the FMC Pocatello site, Z=45.

The 25-year 1-hour rainfall is estimated by interpolating between the 2-year and 100-year values, as described in Figure 6 (Miller et al., 1973). The 2-hour and 3-hour rainfall values are estimated by interpolating between the 1-hour and 6-hour values. Finally, the rainfall for storm duration shorter than 1 hour is estimated from the Adjustment Factors listed in Table 13 (Miller et al., 1973).

Based on the data shown in Table 1, intensity duration-frequency curves for Pocatello are shown in Figure 2.

3. Surface Runoff

The rational method is a widely used method for the design of storm drains, particularly for small drainage areas. The rational method relates peak surface runoff flow rate to rainfall intensity, surface drainage area and the runoff coefficient C, defined as the fraction of rainfall that appears as surface runoff:

$$Q_R = C\,i\,A \tag{3}$$

where

Q_R	peak runoff flow rate [L^3/T]
C	runoff coefficient which includes the combined effects of ponding, infiltration and evaporation
A	drainage area [L^2]
i	rainfall intensity which depends on the design return period and the storm duration [L/T].

3.1. Runoff Coefficient C

The Runoff Coefficient C is a factor representing the fraction of rainfall that will reach the storm drains. It is influenced by the combination of many factors which include the following:

- storm intensity and duration
- soil properties such as: character and condition of the soil
- soil cover
- ground slope
- ponding character of the surface
- antecedent soil moisture content
- proximity of the water table
- depression storage

The runoff coefficient that is selected must take into account the integrated effects of all of the above factors. Typical values for the runoff coefficient as a function of surface characteristics and storm return period are listed by Chow et al. (Table 15.1.1, page 498, 1988). For a

pasture/range soil cover and an average slope of 2-7 %, Chow et al. (1988) report C values of 0.42 and 0.49 for storm return values of 25 and 100 years, respectively. To provide some measure of conservatism, C values of 0.5 and 0.6 are used in this calculation for the 25-year and 100-year return periods, respectively.

3.2. Time of Concentration

The time of concentration for each subarea of Pond 8E is the sum of the overland travel time from the most remote point and the channel travel time:

$$t_c = t_o + t_{ch} \tag{4}$$

where

t_c time of concentration

t_o maximum overland travel time to channel.

t_{ch} maximum channel travel time

Several empirical equations are found in the literature for the estimation of the time of concentrations for various watershed areas and conditions. The equation selected in this calculation is the Kirpich formula (Kirpich, 1940) which was developed based on Soil Conservation Service data collected from small rural drainage areas:

$$t_o = 0.0078 L_o^{0.77} s^{-0.385} \tag{5}$$

where

t_o overland travel time in minutes

L_o maximum overland flow distance in feet

s surface slope

The travel time through the channel can be estimated using the Manning Equation. Alternatively, because the channel is not designed yet, an average channel velocity is assumed and the travel time is given by:

$$t_o = \frac{L_{ch}}{V_{ch}} \tag{6}$$

where

L_{ch} is the channel length

V_{ch} average channel velocity

Reasonable flow velocities for a self-cleaning channel are 2-5 ft/s. In this calculation, we assume that the velocity is equal to the upper limit of this range, i.e., V_{ch}=5 ft/s.

Table 3 presents the sub-areas contributing surface runoff, overland travel-time, channel-travel time, and time of concentration for points A through N at different locations along the perimeter drains (Figure 1). These values are based on a cap surface slope of 5%. For downstream sections, the time of concentrations was calculated as the design time of concentration of the upstream section plus the additional length of channel traveled. A minimum design time of concentration equal to 5 minutes was used for all sections of the perimeter drains.

The calculated design time of concentration ranges between 5 and 10 minutes. Values of 5 minutes were calculated for the perimeter drains surrounding Pond 8E (refer to Calculation Package 8ECALC1) and the north-south drainage ditches separating the different ponds of the Phase IV Ponds. The larger values were calculated at the south/eastern downstream end of the drainage collection system.

3.3. Peak Flow Rate

Based on the rational equation (Eq. 1) and the runoff coefficient and time of concentration values estimated in Sections 3.1 and 3.2, the peak surface runoff flow rates at points A through K at the downstream end of each perimeter drain sections for the 25-year and 100-year return periods are presented in Table 4. The 25-year and 100-year rainfall corresponding to a 6-, 7-, and 8-minute storms were estimated from the 5-minute and 10-minute storm intensities (Table 2) using linear interpolation.

Table 3: Time of Concentration for Phase IV Ponds

Point	Sub-areas contributing flow	Drainage Area (sq ft)	Overland Distance (ft)	Channel Distance (ft)	Overland Travel Time (min)	Channel Travel Time (min)	Time of Concentration (min)*	Design Time (min)**
A	A1***	415,000	-	650	-	-	6.1	6
B	A2	84,000	200	700	1.5	2.3	3.8	5
C	A3, A5	89,000	180	650	1.3	2.0	3.3	5
D (B+C)	A2, A3, A5	173,000	-	-	-	-	-	5
E	A1, A7	445,000	-	180	-	0.6	6.7	6
F	A4, A6, A9	138,000	150	600	1.2	2.0	3.2	5
G	A1, A7, A11	510,000	-	220	-	0.7	7.4	7
H	A8, A10, A13	119,000	110	600	0.9	2.0	2.9	5
I	A1, A7, A11, A15	565,000	-	210	-	0.7	8.1	8
J	A12, A14, A16	138,000	180	700	1.3	2.3	3.6	5
K	A1, A7, A11, A15, A17	675,000	-	600	-	2.0	10.1	10

* Includes time of concentration of upstream sections of perimeter drain.

** Minimum design time of concentration is 5 minutes.

*** Includes the southern portion of Pond 8S which discharges into drainage system of pond 8E and Phase IV ponds. (The time of concentration of 6.1 minutes is from calc 8Ecalc1.doc)

Table 4: Peak Surface Runoff For Each Section of the Perimeter Drain

Point	Drainage Area	Design Time	25-year Return Period			100-year Return Period		
			Rainfall Intensity		Peak Surface Runoff	Rainfall Intensity		Peak Surface Runoff
	(sq. ft)	(min)	(in)	(in/hr)	(cfs)	(in)	(in/hr)	(cfs)
A	415,000	6	0.26	2.6	12.5	0.36	3.6	20.8
B	84,000	5	0.23	2.8	2.7	0.32	3.8	4.4
C	89,000	5	0.23	2.8	2.9	0.32	3.8	4.7
D	173,000	5	0.23	2.8	5.6	0.32	3.8	9.1
E	445,000	6	0.26	2.6	13.4	0.36	3.6	22.3
F	138,000	5	0.23	2.8	4.5	0.32	3.8	7.3
G	510,000	7	0.28	2.4	14.2	0.39	3.3	23.4
H	119,000	5	0.23	2.8	3.9	0.32	3.8	6.3
I	565,000	8	0.31	2.3	15.0	0.43	3.2	25.1
J	138,000	5	0.23	2.8	4.5	0.32	3.8	7.3
K	675,000	10	0.36	2.2	17.2	0.50	3.0	28.1

4. List of References

Kirpich, Z. P., Time of concentration of small agricultural watersheds, *Civ Eng.*, Vol. 10, No. 6, p 362, 1940.

Miller, J. F., R. H., Frederick, and R. J. Tracey, 1973, *Precipitation-Frequency Atlas of the Western United States, Volume V-Idaho*, U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Chow, V. T. D. R., Maidment, and L W. Mays, 1988, *Applied Hydrology*, McGraw-Hill.

USDA, Soil Conservation Service, 1985, *National Engineering Handbook, Section 4, Hydrology*, U.S. Government Printing Office, Washington DC.

CALCULATION SHEET

		PROJECT	*FMC, Pocatello*
		JOB NUMBER	*24230-027*
		CALC NO.	*P4calc1*
SUBJECT	*Estimation of Design Surface Runoff Flow Rates for the Phase IV Ponds*	SHEET NO.	*14 of 15*
BY	*Jim Zhang* DATE *February 8, 2001*	SHEET REV	*1*

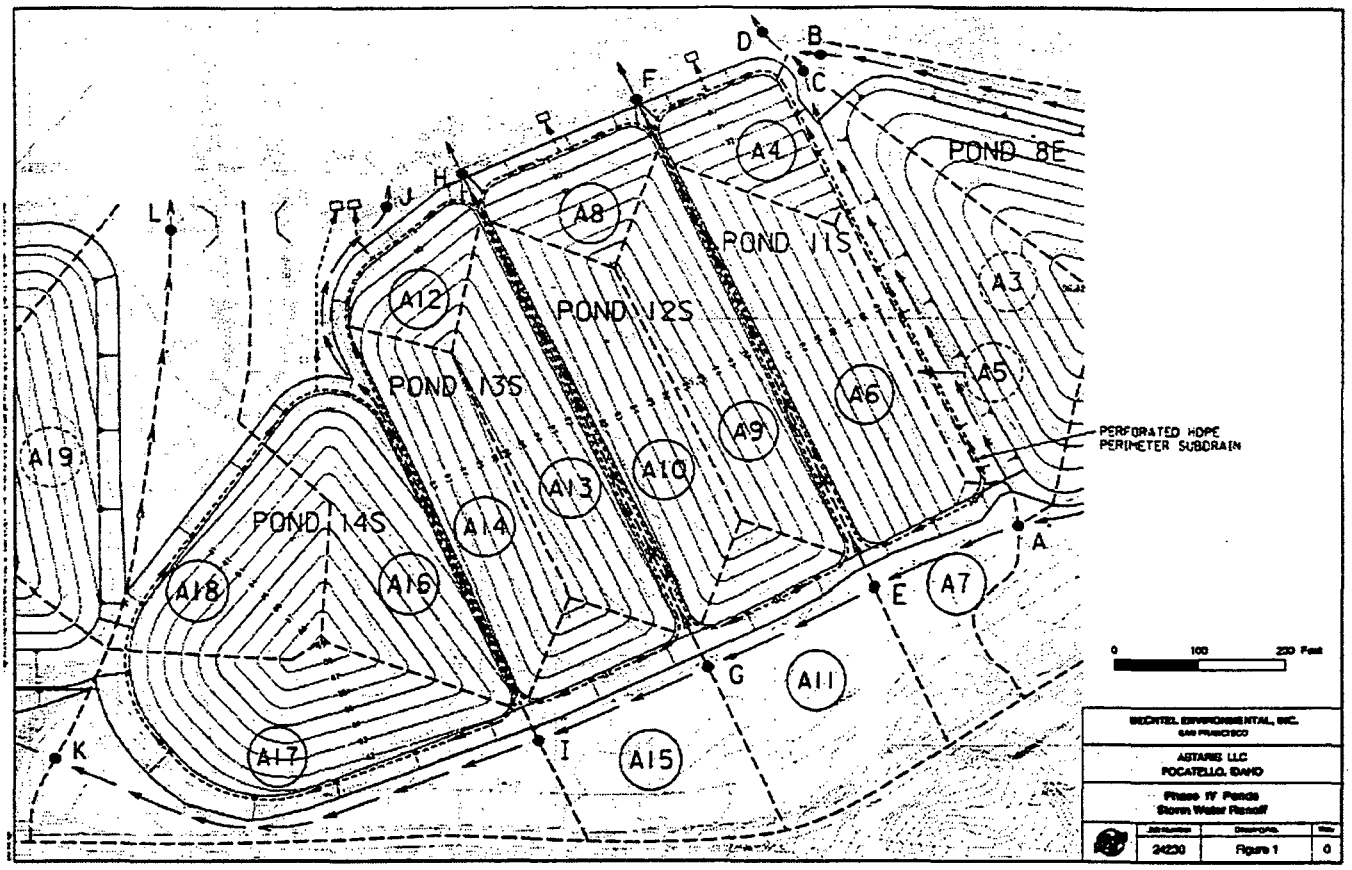


Figure 1. Phase IV ponds.

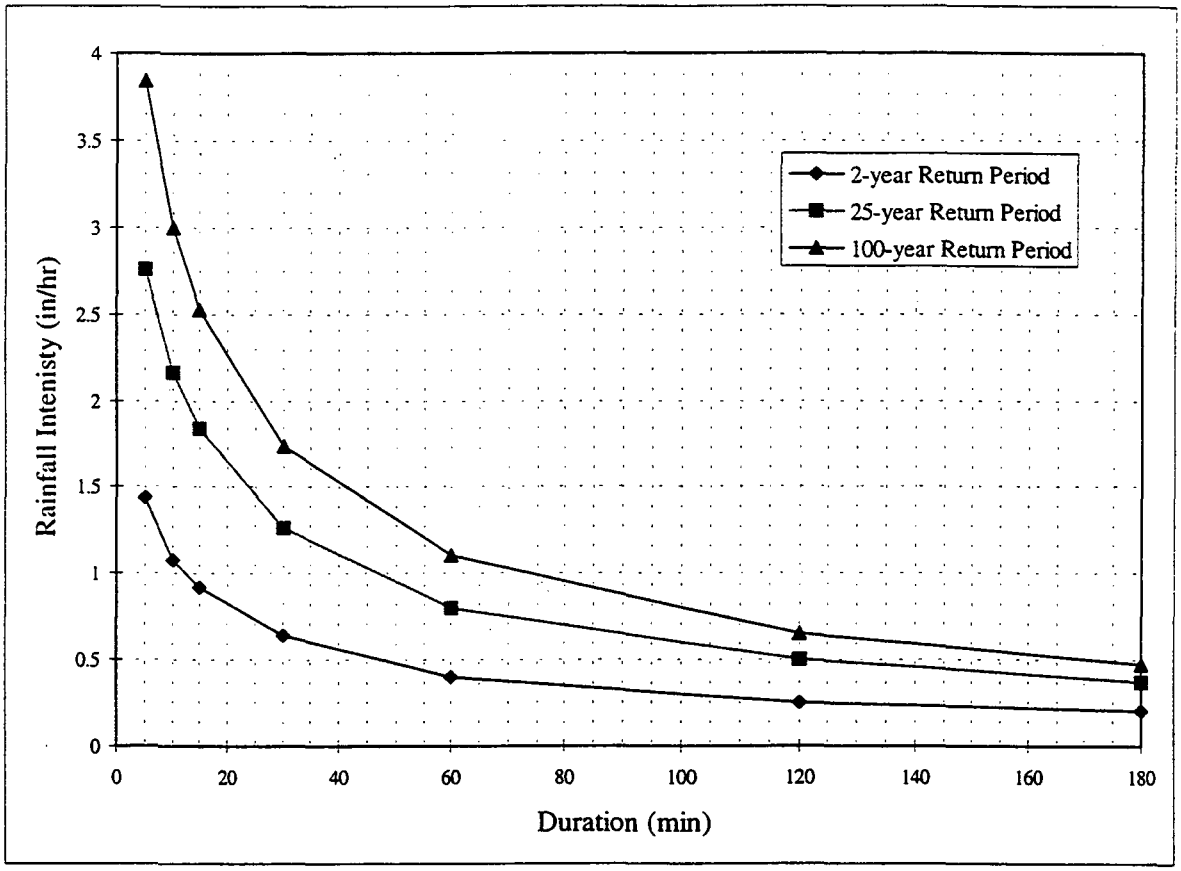


Figure 2: Intensity Duration-Frequency Curves for Pocatello, Idaho

CALCULATION COVER SHEET

PROJECT FMC Corporation Pocatello	JOB NO. 20906-027	CALC NO. P4CALC2	SHEET 1
SUBJECT Estimation of the Design Flow Rate for the Phase IV Ponds Subdrainage System		DISCIPLINE Hydrology/Modeling	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[x]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] YES [x] NO	[ ]	[ ]		

Abstract

The proposed subdrainage system for The Phase IV Ponds at the FMC facility at Pocatello, Idaho consists of a perimeter subsurface drain for the collection of water from the cap drainage layer. Surface runoff from the pond cover are collected through a separate perimeter ditch. The purpose of this calculation is to estimate the design flow rates of the subdrain. Surface runoff calculations are presented in a separated calculation package (refer to calculation P4calc1).

The peak drainage rate from the cap drainage layer was estimated using the Hydrologic Evaluation of Landfill Performance (HELP) computer program (EPA, 1994a, b). The peak drainage rate is defined as the 100-year 24-hour peak flow rate through the cap drainage layer. A shorter storm duration was not used because of the relatively large travel-times through the various cap layers that tend to dissipate flow rates resulting from shorter-duration, higher-intensity events.

The 100-year 24-hour peak flow rate was estimated by simulating the HELP model for 100 years (based on 100 years of synthetic weather data) and taking the peak flow rate equal to the peak daily drainage from the 100 years of simulation.

Based on the proposed grade of the cap drainage layers, the drainage area of each pond is divided into smaller sub-areas, each discharging to a section of the subdrain. For a 100-year return period and using the HELP program, the drainage from each of the pond subareas varies between 0.0036 and 0.0245 cfs.

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/Accepted	Date
				N.C.	Klein, I.	AF	
0	Final Calculation	10	10	N.Copty	I.Klein	A.Findikakis	July 3, 2001

Record of Revisions

Table of Contents

Phase IV Ponds Subdrainage System 3
- Climatological Data 3
- Soil Characteristics 4

List of References 9

List of Tables

Table 1: General Climatological Data 4
Table 2: Soil Characteristics 7
Table 3: Peak Daily Drainage Rates for the Phase IV Ponds 8

Phase IV Ponds Subdrainage System

The drainage system for the proposed Phase IV Ponds closure cap at the FMC facility in Pocatello, Idaho consists of two components:

1. perimeter drain for the collection of surface runoff

2. perimeter subdrain for the collection of water collected by the subdrainage layer of the cap

The purpose of this calculation is to estimate the design flow rates of the cap subdrain. Surface runoff calculations are presented in a separated calculation package (refer to calculation P4calc1). A plan view of the proposed cap is shown in Figure 1. Based on its grade, the proposed cap drainage layer can be divided into smaller sub-areas, each discharging to a section of the subdrain. A separate flow rate is calculated for each section of the subdrain.

The peak drainage rate from the cap drainage layer was estimated using the Hydrologic Evaluation of Landfill Performance (HELP) computer program (EPA, 1994a, b). The HELP program, was developed by the US Army Engineer Waterways Experiment Station (WES), Vicksburg, MS for the US Environmental Protection Agency (EPA). HELP is a quasi two-dimensional hydrologic model, which performs water balance analyses to predict water movement through landfills and other solid waste containment facilities.

The peak drainage rate is defined as the 100-year 24-hour peak flow rate through the cap drainage layer. A shorter storm duration was not considered because of the relatively large travel-times through the various cap layers that tend to dissipate flow rates resulting from shorter-duration, higher-intensity events. Consequently, peak lateral drainage flow rates will be significantly lower than surface runoff flow rates.

Climatological Data

Climatological data for the HELP program consist of daily rainfall, temperature, and solar radiation data in addition to general climate data such as average annual wind speed and average quarterly relative humidity. Daily rainfall and minimum and maximum temperature recorded at the Pocatello Municipal Airport (National Weather Service Station No. 24156) for the years 1948 to 1991 were obtained from the National Climatic Center in Asheville, North Carolina. To calculate the 100-year 24-hour peak flow rate through the drainage cap, 100 years of daily rainfall, temperature and solar radiation data were synthetically generate from the 44 years of

record. The 100-year 24-hour peak flow rate was set to the maximum daily drainage reported by the HELP program within the simulated 100-year period.

The routine used to generate the climatological data was developed by the USDA Agricultural Research Service (Richardson and Wright, 1984) and is described in the HELP manual (EPA, 1994a). The generating procedure is designed to preserve the dependence in time, the correlation between variables and the seasonal characteristics of the actual weather data at the specified locations. The daily temperature values used in the model were the average of the daily minimum and maximum temperature readings. The daily solar radiation data were synthetically generated using parameters for the Pocatello area in the HELP database. The general climatological data were set equal to the HELP default values for the Pocatello area. A list of these data is presented in Table 1.

Table 1: General Climatological Data

Maximum Leaf Area (dimensionless)	1.00
Start of Growth Season (Julian Date)	132
End of Growth Season (Julian Date)	275
Average Annual Wind Speed (mph)	10.20
Average First Quarter Relative Humidity	70.00 %
Average Second Quarter Relative Humidity	52.00 %
Average Third Quarter Relative Humidity	43.00 %
Average Fourth Quarter Relative Humidity	65.00 %

Soil Characteristics

The proposed closure cap for the Phase IV Ponds will consist of the following layers from top to bottom:

- Topsoil consisting of 12 inches of native topsoil with 15% by weight pea gravel admixture, underlain by 30 inches of native topsoil without pea gravel.

The upper 12 inches include 15% by weight pea gravel which will serve to stabilize the cap surface and hence reduce erosion losses.

- Graded filter material consisting of 6 inches of coarse sand and 6 inches of 1-1/2" minus graded crushed and screened slag.
- 18 inches of crushed and screened coarse slag. The general crushed slag product produced at the site will be comprised of angular slag, well-graded material, ranging in particle size from 1-1/2 inches with a maximum size of 12 inches.
- Foundation material consisting of 12 inches of coarse sand to be placed underneath the coarse slag biointrusion layer to protect the underlying synthetic materials.
- Drainage layer consisting of geofabric and geosynthetic drainage net (Geonet).
- Flexible membrane liner (FML), HDPE having a minimum thickness of 60-mil.
- Low Hydraulic Conductivity Layer consisting of a Geosynthetic Clay Liner (GCL) having an equivalent hydraulic conductivity to that of a 2-ft thick clay layer. The material will consist of Gundseal HDPE/Bentonite composite liner or equivalent. The GCL is to be installed over a prepared subgrade which includes a 6 inch sand foundation layer over the slag fill.

In effect the proposed cap consists of two main components:

1. a capillary barrier comprising of the topsoil, the graded filter material and the biointrusion layer. The purpose of the capillary barrier in semi-arid climates such as that present in Pocatello is to limit the rate of infiltration through the cap and ensure the longevity of the cap.
2. a secondary barrier underlying the capillary barrier and comprising of the drainage layer and the synthetic liners. The purpose of the secondary barrier is to act as a contingency barrier diverting that will further decrease the net infiltration into the waste area by allowing for the lateral drainage of the excess infiltration through the capillary barrier.

The base-case characteristics for the proposed RCRA cap are presented in Table 2 (from the Phase IV Ponds Closure Cap Plan, 2000). The porosity, field capacity and wilting point values for each of the layers were set to HELP default values of comparable soil materials (page 30, Table 4, EPA, 1994b). The hydraulic conductivity was assigned conservative values (i.e., leading to higher infiltration rates through the cap) that are consistent with the HELP default values, and the design and manufacturer's specifications. A discussion of these values is presented below.

- *Top Soil*: The hydraulic conductivity of the top soil was set to 9.35 x 10^{-4} cm/s which is approximately two times the HELP default value for sand-silt mixtures (page 30, Table 4, EPA, 1994b).
- *Sand Filter (Transition):* The saturated hydraulic conductivity, porosity, field capacity and wilting point values used in the numerical model were set to the default HELP values for coarse sand (0.01 cm/s).
- *Gravel Filter (Transition)*: The saturated hydraulic conductivity was set to 0.1 cm/s. Default HELP values were used for the porosity, field capacity, and wilting point
- *Coarse Slag*: The hydraulic conductivity of this layer was assumed to be 1 cm/s, one order of magnitude greater than that of the gravel filter layer
- *Sand*: The hydraulic conductivity was assumed to be identical to that of the sand filter material (0.01 cm/s).
- *Geonet:* The thickness and transmissivity of the geonet at 10,000 psf compressive are reported in the manufacturer's specifications as 0.2 inches and 0.002 m^2/s, respectively. These values correspond to a saturated hydraulic conductivity of 40 cm/s. To provide some measure of conservatism, the geonet hydraulic conductivity in the HELP model was set to 10 cm/s.
- *Flexible Membrane Liner (FML):* The thickness of the FML used in the model is 40 mil which is less than the minimum of 60 mil proposed for the cap. The hydraulic conductivity of the FML was set equal to 2 x 10^{-12} cm/s, as specified in the manufacturers specifications. This value is also an order of magnitude larger than the HELP default value for HDPE. The placement quality an of the FML was assumed to be good. Because the design life of the cap is quite long, the pinhole density was assumed to be "poor" on a scale ranging from "excellent" to "poor", which corresponds to 10 holes/acre.
- *Geosynthetic Clay Liner (GCL):* The hydraulic conductivity of the GCL was set equal to the HELP default value of a bentonite mat (3 x 10^{-9} cm/s). The thickness of the GCL is 0.17 in.
-

Table 2: Soil Characteristics

Layer	Thickness (in)	Saturated Conductivity (cm/s)	Porosity	Field Capacity Dimension	Wilting Point
Top soil	36	9.35×10^{-4}	0.473	0.222	.105
Sand Transition Layer	6	0.01	.417	0.045	0.018
Crushed Slag Transition Layer	6	0.1	.397	0.032	0.013
Coarse Slag	18	1.0	.375	0.022	0.01
Foundation Layer	12	0.01	.417	0.045	0.018
Geonet	0.2	10	.85	.01	.005
FML	0.04	2×10^{-12}	-	-	-
GCL	.17	3×10^{-9}	.75	.747	.4

Other assumptions include the following:

- To maximize drainage rates, no surface runoff was allowed.
- The evaporative depth was set to 24 inches
- Initial conditions were set to steady state conditions, as estimated by the HELP program.
- The drainage length of the cap was set to 200 ft. The calculation was also repeated with a drainage slope length of 100 ft, resulting in practically the same subsurface drainage rates.
- The slope of the drainage layer is 5 %.

Based on the above input parameters and assumptions, the peak daily drainage rate is about 0.21 in/day (2.025×10^{-7} ft/s). The flow rate to each subdrain section (Figure 1) are shown in Table 3.

Table 3: Peak Daily Drainage Flow Rates for the Phase IV Ponds

Subdrain Section	Area (ft^2)	Drainage (cfs)
1	18,000	0.0036
2	89,000	0.0180
3	60,000	0.0122
4	62,000	0.0126
5	59,000	0.0120
6	56,000	0.0113
7	44,000	0.0089
8	121,000	0.0245
Total	509,000	0.1031

List of References

EPA, 1994a, The Hydrologic Evaluation of Landfill Performance (HELP) Model, Engineering Documentation for Version 3, EPA/600/R-94/168b, September 1994.

EPA, 1994a, The Hydrologic Evaluation of Landfill Performance (HELP) Model, User's Guide for Version 3, EPA/600/R-94/168a, September 1994.

Richardson, C.W., and Wright D.A, 1984, WGEN: A Model for Generating Daily Weather Variables," ARS-8, Agricultural Research Service, USDA, 83 pp.

CALCULATION COVER SHEET

PROJECT FMC Corporation Pocatello	JOB NO. 24230-027	CALC NO. Ph4CALC3	SHEET 1
SUBJECT Estimation of Rainfall and Wind Erosion from the Phase IV Closure Cap		DISCIPLINE Hydrology/Modeling	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[x]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP		MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] YES	[x] NO	[ ]	[ ]		

Abstract:

The purpose of this calculation is to estimate long-term rainfall and wind erosion losses from the closure caps of the Phase 4 Ponds at FMC Corporation, Pocatello, Idaho. The average annual and peak daily (100-year return period) rainfall erosion rates are estimated using the Universal Soil Loss Equation (USLE) and Modified Universal Soil Loss Equation (MUSLE), respectively. The average annual wind erosion is estimated using the Wind Erosion Equation.

The annual rainfall erosion rate is estimated to be around 0.0046 in or 0.9 tons/acre. Peak daily rainfall erosion (100-year return period) is estimated to be 0.0017 in. This value will have negligible effect on the performance of the cap. Wind induced erosion is estimated to be about 0.0068 in/yr which corresponds to about 1.3 ton/acre/yr. The combined rainfall and wind induced erosion is 2.2 ton/acre/yr, or about 5.7 in over the 500-year service life of the cap. This can be conservatively rounded to 6 in of erosion over the 500-year live of the cap.

prepared by Nadim Copty
checked by Iosif Kleyn
approved by Angelos Findikakis

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/Accepted	Date
				NC	IK	AF	
0	Final Calculation	17	17	N.Copty	I.Kleyn	A.Findikakis	July 2, 2001

Record of Revisions

Table of Contents

1. Introduction 4
2. Rainfall Erosion 4
   - 2.1. Universal Soil Loss Equation 4
   - 2.2. Modified Universal Soil Loss Equation 5
   - 2.3. Rainfall Erosion Index 7
   - 2.4. Soil Erodibility Factor 7
   - 2.5. Topographic Factor 8
   - 2.6. Cover and Management Factor 9
   - 2.7. Soil Conservation Factor 9
   - 2.8. Rainfall Erosion Losses 9
     - 2.8.1. Average Annual Soil Losses 9
     - 2.8.2. Peak Daily Soil Losses 10
3. Wind Erosion 11
   - 3.1. Soil Wind Erodibility Factor 12
   - 3.2. Climatic Factor 13
   - 3.3. Soil Surface Roughness Coefficient 13
   - 3.4. Vegetative Factor 13
   - 3.5. Unsheltered Length of Field 14
   - 3.6. Wind Erosion Losses 14
4. Summary of Results 15
5. List of References 17

List of Figures

Figure 1: Nomograph for the Wind Soil Loss Equation 16

List of Tables

Table 1: Soil Erodibility Factor 8
Table 2: Topographic Factor 8
Table 3: Average Annual Rainfall Erosion Losses 10
Table 4: Peak Daily Rainfall Erosion Losses 11
Table 5: Soil Wind Erodibility Factor 13
Table 6: Average Annual Wind Erosion Losses 15
Table 7: Summary of Rainfall and Wind Erosion Losses 15

1. Introduction

The purpose of this calculation is to estimate the rainfall and wind erosion losses from the closure caps of the Phase IV Ponds at FMC Corporation, Pocatello, Idaho. The average annual and peak daily (100-year return period) rainfall erosion rates are estimated using the Universal Soil Loss Equation (USLE) and the Modified Universal Soil Loss Equation (MUSLE), respectively. The average annual wind erosion losses are estimated using the wind erosion equation. Where specific data or information are not available, conservative values were used in these equations.

Section 2 of this report describe the rainfall erosion calculation. Section 3 describes the wind erosion calculation. Section 4 presents a brief summary of the rainfall and wind-induced soil erosion estimates.

2. Rainfall Erosion

2.1. Universal Soil Loss Equation

The Universal Soil Loss Equation (USLE) is an empirical equation developed by the National Runoff and Soil Loss Data Center which was established by the Science and Education Administration, in cooperation with Purdue University to estimate long-term soil losses due to rainfall. The equation is based on extensive data collected from numerous locations within the United States. The equation expresses the soil erosion rate as a function of rainfall, soil parameters and management practices (page 4 of Wischmeier and Smith, 1978):

$$A = RKLSCP \tag{1}$$

where

A computed soil loss rate [short tons/acre where 1 short ton = 907.2 kg]

R rainfall erosion index [tons/acre]

K soil erodibility factor [dimensionless]

LS topographic factor [dimensionless] which is the product of the slope-length factor, *L*, and slope-steepness factor, *S*.

C cover and management factor [dimensionless]

P soil conservation practice factor [dimensionless]

A description of these factor as well as the numerical values used in this calculation are presented in Sections 2.3 through 2.7.

2.2. Modified Universal Soil Loss Equation

To estimate the rainfall erosion due to a particular event (such as the 100-year, 24-hour storm), the MUSLE is used instead (as described in EPA, 1988):

$$Y = a_1 (V_r q_p)^{0.56} KLSCP \qquad (2)$$

where

Y sediment yield [tons per event, metric tons per event]

V_r storm runoff volume [acre-feet, m^3]

q_p peak flow rate [ft^3/s, m^3/s]

a_1 conversion constant [95 English, 11.8 metric]

The only difference between the USLE and MUSLE is that the rainfall erosion index in the former is replaced by the expression $(V_r q_p)^{0.56}$, function of a particular storm event. This expression is calculated as described below. The storm runoff volume is given by:

$$V_r = a_2 A_r Q_r \qquad (3)$$

where

A_r area [acres, ha]

Q_r depth of runoff [in, cm]

a_2 conversion constant [0.083 English, 100 metric]

The depth of runoff is determined by:

$$Q_r = \frac{(R_t - 0.2S_w)^2}{(R_t + 0.8S_w)} \tag{4}$$

where

R_t total storm rainfall [in, cm]

S_w water retention factor [in, cm]

The water retention factor can be obtained as follows:

$$S_w = \frac{1000}{CN} - 10a_3 \tag{5}$$

where

CN Soil Conservation Service Runoff Curve Number [dimensionless]

a_3 conversion constant [1.0, English, 2.54 metric]

Finally, the peak runoff rate can be calculated as follows:

$$q_p = \frac{a_3 A_r R_t Q_r}{T_r (R_t - 0.2S_w)} \tag{6}$$

where

q_p peak runoff rate [ft^3/s, m^3/s]

T_r storm duration [hour]

a_3 conversion constant [1.01 English, 0.028 metric]

Sections 2.3 through 2.8, discuss the input parameters used in the MUSLE and the resultant rainfall erosion losses due to the 100-year, 24-hour storm event.

2.3. Rainfall Erosion Index

Field data suggest that, with all parameters except rainfall kept constant, the soil loss due to a single storm is directly proportional to the product of the storm energy and the maximum 30-minute intensity EI_{30}:

$$A \propto R = EI_{30} \tag{7}$$

where

E the kinetic energy of a storm [10^2 foot-tons/acre inch]

I_{30} maximum 30-minute intensity [in/hour]

R rainfall index factor [dimensionless]

The storm kinetic energy is given by:

$$E = 9.16 + 3.31 \log_{10} I \tag{8}$$

where

I intensity of the storm [in/hour].

Average annual values of the rainfall erosion index can be determined from isoerodent maps (Figure 1, Wischmeier and Smith., 1978). These values were estimated based on Eqs. (7) and (8) by summing up the contribution of individual events, neglecting rainfalls of less than half an inch. For the area of Pocatello, the annual rainfall erosion index 20.

2.4. Soil Erodibility Factor

The soil erodibility factor K describes the inherent properties of the soil independent of other parameters such as land slope, rainfall and vegetative cover. Values of K can be obtained from the nomograph shown in Figure 3 (Wischmeier and Smith, 1978) as a function of (1) soil particle

size distribution, (2) percent organic matter, (3) soil structure and (4) permeability. Based on laboratory testing of top soil samples, the percent of silt and very fine sand is 95% and the percent of sand (0.1-2.0 mm) is 5%. The percent of organic matter is assumed to be 1 %. The resulting soil erodibility factor *K* is about 0.73 (Table 1).

Table 1: Soil Erodibility Factor

Assumed Soil Characteristics		Soil Erodibility Factor
Percent silt and very fine sand (< 0.1 mm)	95 %	
Percent sand (0.1-2.0 mm)	5 %	
Percent organic matter	1 %	0.73
Soil structure	Fine granular	
Permeability	Slow	

2.5. Topographic Factor

The topographic factor *LS* for a given site is defined as the expected ratio of soil loss from that field to the soil loss from a "reference" plot 72.6 ft long with a uniform slope of 9 %. Values of *LS* can be obtained from Table 3 (page 12) of Wischmeier and Smith (1978) as a function of the slope length and steepness. This table indicates that the soil losses can increase substantially- up to 2-3 orders of magnitude- with increase in slope length and steepness. The Phase IV ponds consist of ponds 11S, 12S, 13S and 14S. The maximum slope length of these 4 ponds is 180 m, 140 m, 140 m, 200 m. Consequently, the rainfall erosion calculation will be conservatively based on a slope length of 200 m. The surface slope of all four ponds is 5 %. Therefore, based on a slope length of 200 ft and slope of 5 %, the corresponding value of *LS* is 0.758 (Table 2).

Table 2: Topographic Factor

Slope-Length (ft)	Slope Steepness	*LS* Factor
200	5 %	0.758

2.6. Cover and Management Factor

The cover and management factor *C* primarily depends on the type of vegetation present and, if crops are present, the management practices taken in between growing seasons. By definition, *C* is assigned a value of 1 for bare soils. Values of *C* as a function of the type and density of the vegetation can be obtained from various figures and tables (Wischmeier and Smith, 1978; Hydrodynamics, 1991). Assuming that the vegetative cover of the closure cap consists of established native grass with a 50 % areal cover, the corresponding *C* factor is 0.08 (Hydrodynamics, 1991).

2.7. Soil Conservation Factor

The Soil Conservation Factor *P* depends on various agricultural practices other than vegetation effects such as contouring, terracing and maintaining slope-length limits, that can be taken to slow runoff water and, hence, reduce the amount of soil it can carry. For the closure cap of the Phase IV ponds, no such measures are incorporated in the design. Therefore, the P factor is assigned a conservative value of 1.

2.8. Rainfall Erosion Losses

2.8.1. Average Annual Soil Losses

Using the USLE equation and the factors defined in Section 2.3 through 2.7, the average annual rainfall erosion losses were computed. A summary of the USLE factors and the corresponding

rainfall erosion losses are presented in Table 3. The annual erosion losses were estimated to be 0.0046 in or 0.9 tons/acre. Over a period of 500 years, the service life of the proposed cap, the projected soil erosion losses due to rainfall are about 2.3 in.

Table 3: Average Annual Rainfall Erosion Losses

Duration	USLE Factors					Soil Loss *A*	
	R	*LS*[1]	*C*[2]	*P*[3]	*K*[4]	(tons/acre/yr)	(in/yr)[5]
Annual	20	0.758	0.08	1	0.73	0.9	0.0046

[1] Corresponds to slope length and steepness of 200 ft and 5 %, respectively.
[2] Corresponds to established native grass, 50 % areal cover.
[3] Assumes no soil conservation measures beyond vegetation.
[4] Based on the soil characteristics defined in Table 1
[5] Assuming a bulk density of 1.7 g/cc.
In units of tons/(acre-inch):
1.7 g/cc=1.7x(1/907,200 ton/g)x(40,470,000 cm^2/acre)x (2.54 cm/in) =193 tons/acre-inch

2.8.2. Peak Daily Soil Losses

The rainfall erosion losses due to the 100-year, 24-hour storm are calculated based on equations (2)-(6). Assuming that the top soil curve number is 85 (corresponds approximately to fine silty sand with a fair vegetative cover), the water retention factor is

$$S_w = \frac{1000}{85} - 10 = 1.8$$

The 100-year, 24-hour total rainfall for Pocatello is R_t= 2.6 in, estimated by extrapolation from data presented in the Precipitation-Frequency Atlas of the Western United States, Volume V-Idaho (Miller et al., 1973). Therefore, depth of runoff and runoff volumes are (Eqs (3) and (4)):

$$Q_r = \frac{(2.6 - 0.2 \times 1.8)^2}{(2.6 + 0.8 \times 1.8)} = 1.24 \text{ in}$$

$$V_r = 0.083 \times 11.7 \times 1.24 = 1.2 \text{ acre-ft}$$

where 11.7 [acres] is the total area of the four Phase IV ponds (ponds 11S, 12S, 13S, and 14S). The peak runoff rate (Eq. (6)) is:

$$q_p = \frac{1.01 \times 11.7 \times 1.24 \times 2.6}{24(2.6 - 0.2 \times 1.8)} = 0.71 \text{ cfs}$$

Based on the above values and the erosion parameters listed in Table 3, the erosion loss due to the 100-year 24-hour storm is 0.0017 in (Table 4).

Table 4: Peak Daily Rainfall Erosion Losses

Storm	MUSLE Factors						Sediment Yield Y	
	q_p (cfs)	V_r (acre-ft)	SL[1]	C[2]	P[3]	K[4]	(tons)	(in)[5]
100-year 24-hour storm	0.71	1.2	0.758	0.08	1	0.73	3.8	0.0017

[1] Corresponds to slope length and steepness of 200 ft and 5 %, respectively. The slope length of 200 ft is a conservative estimate because it is based on the largest of the 4 Phase IV ponds: 11S, 12S, 13S, and 14S.
[2] Corresponds to established native grass, 50 % areal cover.
[3] Assumes no soil conservation measures beyond vegetation.
[4] Based on the soil characteristics defined in Table 1.
[5] Assuming a bulk density of 1.7 g/cc (193 tons/acre-inch) and total cap area of 11.7 acres (11.7 acres is the total area of ponds 11S, 12S, 13S and 14S).

3. Wind Erosion

The Wind Erosion Equation is an empirical equation similar to the USLE, designed to estimate wind induced soil losses. The wind erosion equation was initially developed by Chepil (1945), but since then has been continuously modified as new research data became available (e.g.,

Woodruff and Siddoway, 1965; Cowherd, 1974; Israelsen et al., 1980). The equation expresses the wind soil erosion rate as a function of climatic conditions, soil parameters and management practices:

$$E' = f(I', C', K', V', L')$$

where

E' computed wind soil loss rate [tons/acre/yr]

I' soil wind erodibility factor [tons/acre/yr]

C' local wind erosion climatic factor [dimensionless]

K' soil surface roughness factor [dimensionless]

V' vegetative factor [thousand pounds/acre]

L' length of unshielded distance parallel to wind direction [ft]

Once values for the above factors are defined, the wind soil loss rate is estimated with the nomograph shown in Figure 1 (from Figure 3-3, Israelsen et al., 1980). A description of each factor as well the numerical values used in this calculation are presented in the following sections.

3.1. Soil Wind Erodibility Factor

The soil erodibility factor I' is the potential soil loss in tons/acre/yr for a wide, unsheltered, isolated field with bare, smooth, crusted or non-crusted soil surface. Field data suggest that values of I' increase as the percentage of soil fractions greater than 0.84 mm (20-mesh which is equivalent to medium-sized sand) in size decreases. For slopes facing the dominant wind direction that are less than 500 feet long, erosion is accelerated. Therefore, the erodibility factor I' needs to be adjusted by the knoll erodibility factor I_s. Values of I' and I_s can be obtained from tables presented in Woodruff and Siddoway, (1965) or Israelsen et al. (1980).

Laboratory testing of top soil samples indicated that the percent of topsoil greater than 0.84 mm (percent of soil retained on the sieve #20) is about 1%. Furthermore, it is expected that the top soil will form a crusted surface relatively soon after construction, in response to rain and snow.

Based on these conditions, the wind erodibility factor I' is estimated to be 51.7 ton/acre/yr (Table 3-1, Israelsen et al., 1980). For a surface slope of 5 %, the windward knoll erodibility factor I_s is approximately 3. Therefore, the adjusted erodibility factor I' will be approximately 155 tons/acre/year (Table 5).

Table 5: Soil Wind Erodibility Factor

Percent Topsoil Larger than 0.84 mm	Erodibility Factor I'	Windward Knoll Erodibility Factor I_s	Adjusted Erodibility Factor I'
1 %	51.7	3.0	155

3.2. Climatic Factor

The climatic factor C' represents the relationship between wind erosion and climatic conditions at the field, irrespective of other parameters. Research has indicated that the rate of soil movement by wind is directly proportional to the cube of the velocity and inversely proportional to the square of soil surface moisture. Instead of actually calculating C' from soil moisture and wind velocity, average annual values of C' for various parts of the United States can be obtained from Figure 11 in Cowherd et al. (1974). Based on figure, the climatic factor for Pocatello, Idaho is $C' = 0.3$.

3.3. Soil Surface Roughness Coefficient

The soil surface roughness coefficient K' is a measure of the natural or artificial roughness of the soil surface in the form of ridges or small undulation. It can be determined from the average soil roughness height (Figure 4, Woodruff and Siddoway, 1965). The soil roughness factor varies from 1 for fairly smooth surfaces to 0.5 for average roughness heights of 3-4 in. In this calculation, K' is set to 0.63 which corresponds to soil roughness height of about 1 in.

3.4. Vegetative Factor

The vegetative factor V' represents the reduction in erosion due to the presence of vegetation and/or vegetative residue in the topsoil. The value of V' can be estimated from the amount of organic material in air-dried soil samples from the top 3 in of soil in air-dried soil samples (Figure 3-2, Israelsen et al, 1980). Assuming that its air-dried organic material content is 0.1 % and the soil bulk density is 1.7 g/cc (1.7/454 x 4.047 x10^7 x 2.54 = 3.85 x 10^5 lb/acre-in), the mass of organic material per unit acre is:

$$V' = f_{oc} \times \rho_b \times t = 1.2 \times 10^3 \text{ lb/acre}$$

where

f_{oc} organic material content (0.1 %)

ρ_b bulk density 1.7 g/cc (3.85 x 10^5 lb/acre-in)

t thickness of soil (3 in).

This value is comparable to the air-dried residue of various crops listed in Table A-2 of Cowherd et al. (1974). The resulting vegetative factor, assuming anchored flat straw or grass (Figure 3-2, Israelsen et al., 1980) is 3,800 lb/acre.

3.5. Unsheltered Length of Field

The unsheltered length of field L' is defined as the length (ft) of field in the direction of wind in excess of 10 times the height of any barriers. For the Phase IV ponds closure cap, we assume that L' = 200 ft which is approximately equal to the maximum distance between the highest point of the cap along its centerline and the edge of the cap.

3.6. Wind Erosion Losses

Table 6 presents the input parameters defined in the Sections 3.1 through 3.5 for the wind erosion equation. Using these input parameters and the nomograph of the wind erosion equation shown in Figure 1, the average annual wind erosion is estimated to be 1.3 tons/acre or 0.0068 in. This value corresponds to 3.4 in over a period of 500 years, the service life of the cap. This value is particularly sensitive to the vegetative factor V'.

Table 6: Average Annual Wind Erosion Losses

Wind Erosion Factors					Intermediate Variables[1]		Wind Erosion Losses	
I'	*C'*	*K'*	*V'* (lb/acre)	*L'* (ft)	*I'K'*	*I'K'C'*	(tons/acre/yr)	(in/yr)[2]
155	0.3	0.63	3,800	200	98	29	1.3	0.0068

[1] Used in wind erosion nomograph (Figure 1)
[2] Assuming bulk density of 1.7 g/cc (193 tons/acre-in)
In units of tons/(acre-inch):
1.7 g/cc=1.7x(1/907,200 ton/g)x(40,470,000 cm^2/acre)x (2.54 cm/in) =193 tons/acre-inch

4. Summary of Results

A summary of the estimated erosion losses due to rainfall and wind are presented in Table 7. The annual rainfall erosion is estimated to be about 0.9 ton/acre or about 0.0046 in. Over a period of 500 years, the service life of the cap, the rainfall erosion is expected to be about 2.3 in. . Rainfall erosion due to extreme short-term events (100-year, 24-hour storm) is about 0.0017 in.. Since the occurrence of such extreme events is rare, their contribution to the long term annual average is minimal.

The annual wind erosion is estimated to be about 1.3 ton/acre or about 0.0068 in. Over a period of 500 years, this value corresponds to 3.4 in. Therefore, the total erosion due to rainfall and wind is expected to be about 5.7 in.

Table 7: Summary of Rainfall and Erosion Losses

	Peak Daily[1] (in)	Average Annual[1] (ton/acre)	Average Annual[1] (in)	Service Life of Cap[2] (in)
Rainfall Erosion	0.0017	0.9	0.0046	2.3
Wind Erosion	NC[3]	1.3	0.0068	3.4
Total Erosion	-	2.2	0.0114	5.7

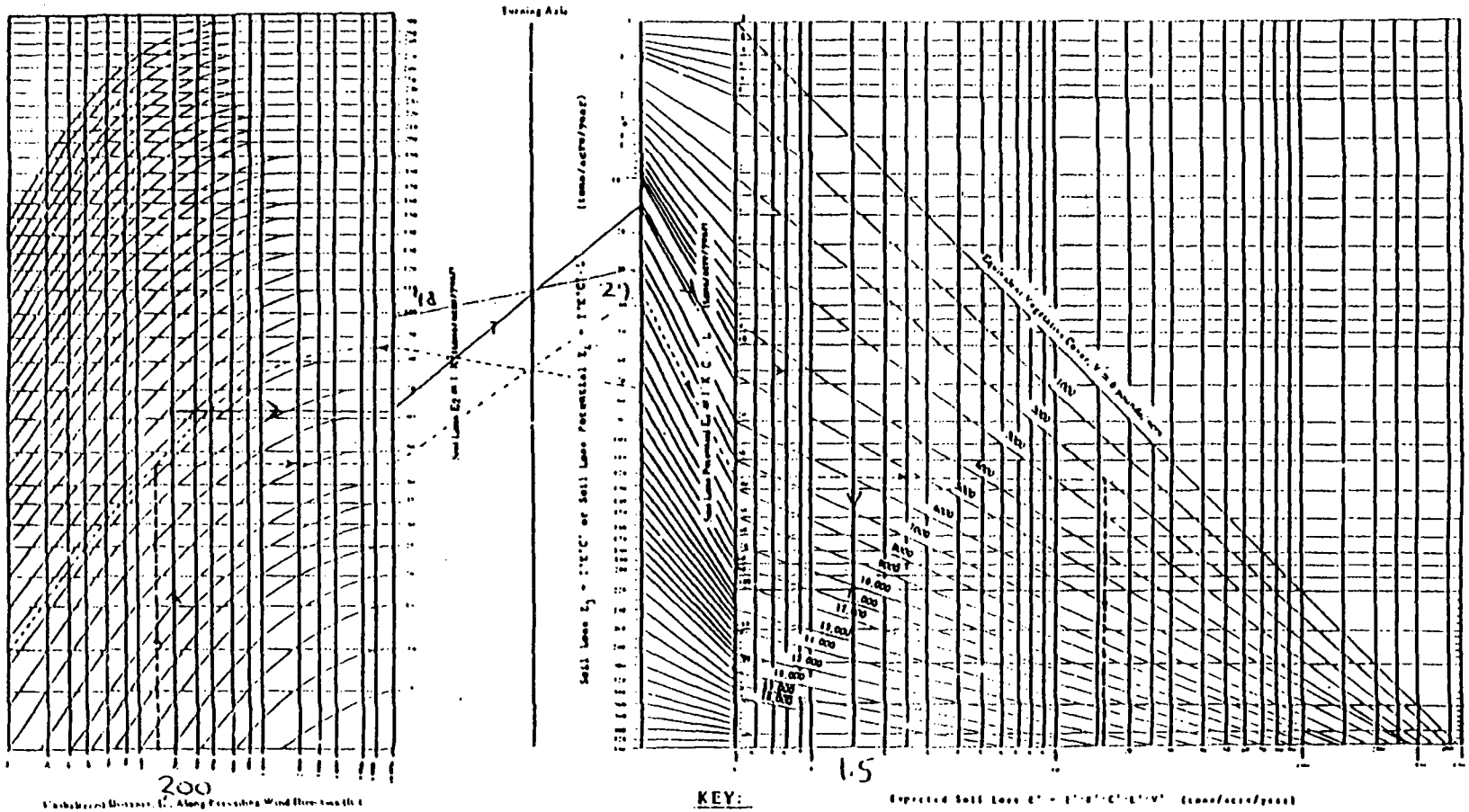
[1] (100-year return period)
[2] Service life of cap is 500 years
[3] NC- Not calculated

CALCULATION SHEET

PROJECT	*FMC; Pocatello*
JOB NUMBER	*24230-016*
CALC NO.	*15SCALC3*
SHEET NO.	*16 of 17*
SHEET REV	*1*

SUBJECT *Estimation of Rainfall and Wind Erosion from Pond 15S Closure Cap*

BY *Nadim Copty* DATE *2 July, 2001*



Step 1. Locate I'K' value on vertical scale to the left of turning axis and construct curved dotted line as indicated.

Step 2. Move vertically upward from I.' value to intercept curved line (Step 1) then horizontally to E_1 scale.

Step 3. Mark I'K'C' value on vertical scale to the right of turning axis.

Step 4. Draw line from I'K' value (Step 1) to I'K'C' value (Step 3) and mark intercept on turning axis.

Step 5. Draw line from value on E_2 scale (Step 2) through point on turning axis (Step 4) to E_1 scale, then diagonally to second E_1 scale, horizontally to intercept with appropriate V' value, and then vertically downward to read expected soil loss on E' scale.

Figure 1: Nomograph for the Wind Soil Loss Equation

5. List of References

Chepil, W.S., The transport Capacity of the Wind, Soil Science 60, 1945.

Cowherd, C Jr., et al., Development of Emission Factors for Fugitive Dust Sources, Midwest Research Institute, PB-238 262, Environmental Protection Agency, June 1974.

EPA, Superfund Exposure Assessment Manual, EPA/540/1-88/001, April 1988.

Hydrodynamics Incorporated, Draft of the Douglas County Storm Drainage Design and Technical Criteria - Addendum A, Erosion Control Criteria. Prepared for Douglas County, Colorado, December 1991.

Israelsen, C. E., C.G. Clyde, J.E. Fletcher, E.K. Israelsen, F.W. Haws, P.E. Packer, E.E. Farmer, Erosion Control During Highway Construction, Manual on Principles and Practices, National Cooperative Highway Research Program, Report 221, Transportation Research Board, National Research Council, April 1980.

Miller, J. F., R. H., Frederick, and R. J. Tracey, 1973, *Precipitation-Frequency Atlas of the Western United States, Volume V-Idaho*, US Department of Commerce, National Oceanic and Atmospheric Administration.

Wischmeier, W.H., and D.D. Smith, Predicting Rainfall Erosion Losses- A guide to Conservation Planning, U.S. Department of Agriculture, Agriculture Handbook No. 537, 1978.

Woodruff, N.P. and F.H. Siddoway, A Wind Erosion Equation, Soil Science Society of America Proceedings, Vol. 29, No. 5, September-October 1965.

CALCULATION COVER SHEET

PROJECT	FMC - Phase IV Ponds	JOB NO. 20906-027	CALC. NO. 20906-027-1	SHEET 1
SUBJECT	Settlement Evaluation		DISCIPLINE Geotechnical	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[X]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] Yes [ ] No	[ ]	[X]	ACCUMV	--

REV

Purpose: Evaluate pond settlement of Phase IV Ponds (11S, 12S, 13S, and 14S) during construction and after final cover is installed. The conclusions in this calculation are based on the laboratory testing results of the sludge samples taken from the ponds. The results of this calculation compare well with ongoing settlement after the initial large-strain settlement has occurred.

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
1	Incorporated settlement monitoring data	149	Att. C-49	JTC	[illegible]	[illegible]	12/26/01
0	Issued for use	136	Att. C-49	JTC	[illegible]	[illegible]	12/26/01

Record of Revision

h:\geotech\jtc analysis\phase iv\500year\sett500.doc

CALCULATION SHEET

PROJECT FMC - Phase IV Ponds JOB NO. 20906-027 CALC. NO. 20906-027-1

SUBJECT Pond Settlement Evaluation of Planned Configuration SHEET NO. 2

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

Purpose of Calculation

This calculation performs an evaluation of the cap settlement for the planned cover design configuration for the Phase IV ponds (see Figures 1 and 2a through 2d) using the soil parameters developed from laboratory test results of the samples from Pond 11S, 12S and 13S. Since the Phase IV ponds will all be closed within the same construction season the following analyses only consider Ponds 11S and 12S, which have the largest amount of sludge (15.75 ft). Ponds 13S and 14S, which only contain 4.2 ft and 1.1 ft of sludge, respectively, will settle a lesser amount and more quickly than the other two ponds. Therefore, specific analyses for these two ponds are not necessary.

Introduction

Constructed in 1980, the four single-lined clarification ponds are operated in series, with wastewater generally being received initially by Pond 11S. The wastewater would then cascade into 12S, then 13S, and, finally, into 14S. Occasionally, wastewater was also received initially by Pond 12S or 13S. However, Pond 14S has functioned solely as a surge pond. The clarified water from Pond 14S is recycled back to the plant for reuse.

The four ponds have a combined design capacity of 94.5 acre-feet, as follows:

Pond 11S	19.3 acre-feet
Pond 12S	21.8 acre-feet
Pond 13S	20.4 acre-feet
Pond 14S	33.0 acre-feet

Ponds 11S, 12S, and 13S were last dredged to the maximum extent practical, so as not to damage the liner, in August 1993. In 1996, Pond 11S became full and islands formed thereby necessitating that some of the solids be moved from Pond 11S to Pond 12S.

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

It is currently planned to place a permanent cap over the pond solids. Excess water would be pumped from the pond as fill is placed, an initial fill placed over the pond solids, and after an interval of time provided to allow settlement to occur, a final cap would be placed over the initial fill. The initial fill would be allowed to settle until the rate of settlement had decreased to an acceptable level.

Special measures and equipment are required to place the fill safely. The principal features of current planning include using a conveyor system to place the initial sand fill over the sludge in thin controlled layers to attain a thickness of approximately 5 feet. Slag fill of varying thicknesses will be placed over the sand. The weight of the fill will cause substantial consolidation of the sediments and time dependent settlement of the fill will result. The magnitude and rate of settlement of the fill are important factors in the planning, design and scheduling of the closure process.

Estimating the magnitude and rate of settlement of very soft, fine-grained sediments is an approximate but well-established process. This process normally includes obtaining undisturbed samples of the sediments and measuring strength and consolidation characteristics in the laboratory. This process normally yields reasonable results for the magnitude of settlement, but prediction of time-rates of settlement without the support of field measurements is always a very approximate process.

In the case of the phossy wastes, the accuracy of estimates of both the magnitude and time-rate of settlement are severely degraded because of the impossibility of obtaining undisturbed samples and the difficulty in accurately measuring basic, essential soil properties in the laboratory. Extreme effort, special equipment and special non-standard procedures are required to safely test the materials in the laboratory because of the hazardous nature of the sediments.

Information on the properties of the phossy sediments were first obtained in 1993. Disturbed sampling and insitu vane shear tests were performed at Ponds 8S and 15S. The vane shear strengths

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

indicated the very soft nature of the Pond 8S sediments and the even weaker condition of sediments in Pond 15S. Very limited laboratory tests were performed at that time. The findings of these investigations are presented in Reference 1.

The information on the sediments and published data were used to estimate settlement of Pond 8S. These studies predicted large settlements and a long period of consolidation if no special measures are taken to accelerate consolidation. Experience with placing the initial fill on Pond 8S and the use of wick drains to accelerate drainage indicated that consolidation would be faster than anticipated. The amount of settlement occurring after placement of fill was also less than anticipated.

Additional sampling and special laboratory testing were accomplished in 1994 to provide more reliable data on the properties of the sediments and to provide an improved basis for predicting the performance of Pond 15S. The testing (on disturbed samples) primarily included moisture content, gradient ratio/permeability and consolidation tests. The results of the testing are summarized in Reference 2. These early field explorations, construction experience, and monitoring data provided valuable insight of the behavior of the phossy waste sludge material.

A field investigation and laboratory test program for Phase IV ponds, Ponds 11S, 12S and 13S, was conducted between July 27 and August 25, 1997. The in-situ vane shear tests indicated that the phossy wastes inside these ponds are similar to those found in Pond 8S, i.e., very soft and very sensitive to disturbance. The vane shear tests are summarized in Reference 3. The laboratory tests provided the soil characteristics for the Phase IV Ponds sludge. Test results are summarized in Reference 4. The recommended design parameters are summarized in Reference 5.

The settlement analyses documented in this calculation are based on the new laboratory test results, the settlement monitoring data obtained from Pond 8S, and the use of analysis methods that account for the major changes in the basic soil properties of void ratio, permeability, and compressibility that take place during consolidation of these very soft sediments.

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

Previous Settlement Analyses

Settlement analyses were performed by Bechtel in References 1 and 2 using field and laboratory test, and settlement monitoring results for Ponds 8S and 15S. In these earlier analyses two computer codes (TCON, Reference 6 and ACCUMV, Reference 7) and hand calculations were used.

TCON1 is a finite difference code based on infinitesimal linear strain theory. Large strains are taken into account by adjusting the thickness of consolidating layer at the end of each time step. The accuracy of the solution is enhanced by increasing the number of layers in the soil model and reducing the time step increment. The program also accommodates non-linear stress dependent relationships of void ratio and permeability by interpolation along a specified curve.

ACCUMV is a finite difference code which implements a non-linear finite strain theory of consolidation which accounts for changes in the thickness of the consolidating stratum (i.e. drainage path length) without having to make the adjustments necessary with TCON1. Non-linear stress dependency of void ratio and permeability can be accommodated using several different types of constitutive relationships.

The required soil design parameters include a relationship between void ratio, *e*, and effective pressure, σ', and a relationship between void ratio and permeability, k. Laboratory test results presented in Reference 8 indicated that the coefficient of consolidation varied between about 4 and 45 ft^2/month. Due to limited laboratory test data, it is assumed that C_h is equal to C_v. Comparison of results using both computer codes found them to provide solutions within 5 percent of one another. In Reference 2, Section 7, it was concluded that wick drain spacings on the order of 5 to 7 feet could achieve primary consolidation within 1 to 2 months after initial filling of Pond 15S and potentially advance the installation of the permanent cap by about one year.

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

Laboratory test results on samples taken from Pond 8E and the Phase IV Ponds (Reference 4) indicated that the compressibility characteristics of the sludge were a function of the individual pond material type and the depth below the top of the sludge.

Method of Analysis

Primary Consolidation

The computer program ACCUMV (Reference 7) was used to evaluate the final settlement and the time sequence for Phase IV Ponds due to primary consolidation. A check of the proper usage and understanding of the program was made by comparing measured settlements at Pond 8S with those estimated using ACCUMV. This comparison is provided in Figure 3. The ACCUMV analysis appears to underestimate early settlement and overestimate settlement for later times. However, the results of the model are considered acceptable for estimating purposes.

ACCUMV requires two constitutive relationships be established for the soft soil layer, i.e., the void ratio versus effective stress, and permeability versus void ratio. These two relationships are provided in Reference 5. The relationship between void ratio and effective stress in terms of the natural logarithm is in the general form:

$$e = \frac{A + B * \ln \sigma'}{1 + C * \ln \sigma' + D * (\ln \sigma')^2} \qquad (1)$$

where e = void ratio

A, B, C, D = Curve-fitting parameters,

$\sigma' = \sigma_0' + \Delta\sigma'$ = effective vertical stress,

σ_0' = initial effective vertical stress, and

$\Delta\sigma'$ = change in effective vertical stress

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

If we let C = D = 0, as in Reference 1, then Eq.(1) degenerates to the conventional formula for settlement analysis:

$$e = A + B * \ln \sigma' \quad e = A + B * \ln \sigma' \quad e = A + B * \ln \sigma' \qquad (2)$$

where $A = e_0 + C_c \text{ Log } \sigma_0'$, $B = -0.4343\ C_c$, e_0 is the initial void ratio at a particular depth of interest, and C_c is the compression index at the same depth.

As suggested in Reference 5, if we let $\sigma'_0 = 1$ psf and denominate $e_i = e_0$ ($\sigma'_0 = 1$ psf), Eq.(2) can be written as

$$e = e_i - 0.4343\ C_c \ln \sigma' \qquad (3)$$

As recommended in Reference 5, for sludge in Phase IV ponds, the following relationships exist

$$e_i = 7.13 - 0.33*(\text{depth}) \qquad (4)$$

$$C_c = 1.06 - 0.07*(\text{depth}) \qquad (5)$$

Since e_i and C_c vary with depth while ACCUMV analyzes the entire sediment as one layer, an average depth value should be used to obtain an overall reasonable settlement value. It was found by a hand-calculation that using a depth of 0.55H for both Pond 11S and Pond 12S in the above relationships the overall settlement values from ACCUMV compare well with the hand calculation. For Ponds 11S and 12S, H = 15.75 feet. Therefore, $e_i = 7.13 - 0.33*(0.55*15.75) = 4.27$, and $C_c = 1.06 - 0.07*(0.55*15.75) = 0.454$. These parameters are used in the following calculation. The hand calculations are attached as Attachment A-1 and A-2. It should be noted that ACCUMV uses e_i, which is the projected void ratio at a stress of 1 psf, and the hand calculation uses the e_0 reported in the laboratory test results. The average design curve for Ponds 11S and 12S is shown in Figure 4 in comparison with the laboratory test results (Reference 5).

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

ACCUMV also requires a second constitutive relationship between permeability and void ratio in an equation form. The equation has the general form:

$$k = \frac{G \cdot e^F}{1 + E \cdot e} \qquad (6)$$

where k is permeability, e is the void ratio, and E, F, G are curve-fitting constants. Based on the laboratory test data, it is recommended in Reference 5 that the following equation be used for Phase IV Ponds:

$$k = 0.005\, e^{2.6} \quad \text{(k in ft./month)} \qquad (7)$$

i.e., G = 0.005 (ft./month), F = 2.6, and E = 0.

Secondary Consolidation

The secondary compression, C_α, has been inferred from field settlement monitoring results at Pond 8S (References 1 and 2) to be 0.02 per log cycle. For Ponds 11S and 12S, the thickness of the sludge is 15.75 feet, which corresponds to a creep rate, α, of 0.315 ft/log cycle of time, for both ponds. The additional settlement is added to the primary settlement as calculated by ACCUMV in respective calculations.

Wick Drain Design and Analysis

The methodology presented in Reference 9 for wick drain design is used and is summarized below. The wick drain is first converted to an equivalent sand drain diameter, then radial drainage theory is used to estimate the beneficial effects of the wick drains.

Total area of wick drain, A_w = width * thickness

Void area of wick drain, $A_v = A_w$ * %voids/100

where %voids is typically about 90% to 95%, assume 92%

Equivalent void circle diameter: $d_v = \sqrt{\frac{4 * A_v}{\pi}}$

Equivalent sand drain (or well) diameter: $d_w = \frac{d_v}{n}$, where n = sand porosity (typically about 0.3)

The time to achieve a particular degree of consolidation is determined from the following relationship (Reference 9)

$$t = \frac{d_e^{\,2}}{8C_h}\left[\ln\frac{d_e}{d_w} - 0.75\right]\ln\frac{1}{1-U_h} \qquad (8)$$

where

- t = time for consolidation
- C_h = coefficient of consolidation of soil for horizontal flow, assumed to be the same as the vertical coefficient of consolidation, C_v
- d_w = diameter of equivalent sand drain
- d_e = sphere of influence for wick drain (for a triangular pattern use 1.05 spacing; for a square pattern use 1.13 spacing)
- U_h = average degree of consolidation in the horizontal direction

The vertical and horizontal components of degree of consolidation are combined per Reference 10 using the following relationship:

$$U = 1 - (1 - U_h)(1 - U_v) \qquad (9)$$

where U_v = the average amount of vertical consolidation.

Note that wick drains only affect the primary settlement. Therefore, the amount of settlement that occurs over a given time period after primary settlement is complete should be the same whether wick drains are present or not.

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

The spacing of the wick drain was assumed to be 7 feet. It was also assumed that wick drains will be installed one month after the initial fills are placed over the sludge.

Time for Final Cap Placement

Following the practice for Ponds 8S and 15S, the time for final cap placement is defined as when the rate of settlement under the initial fill loading reduces to less than 1 inch per year. (References 1, 2)

The settlement that will occur over the 500-year design life of the final cap is also estimated.

Input Data and Assumptions

Consistent with the previous analyses, the following assumptions were adopted in the current calculation: (All specific formulas and soil parameters are taken from Reference 5)

- Pond design life = 500 years after final cap is installed,
- Consider drainage occurs only in the vertically upward direction for the primary consolidation stage,
- Surface water is drawn down to top of sludge prior to loading.
- Pond sludge is normally consolidated, i.e. zero excess pore pressures at start of loading.
- Sludge thickness = 15.75 feet for Ponds 11S and 12S.
- Total unit weight of sand backfill = 115 pcf
- Total unit weight of slag backfill = 130 pcf
- Average total unit weight of final cap material = 120 pcf
- Specific gravity of solids = 2.79
- Unit weight of solids = 174.1 pcf.
- Void ratio vs. effective stress relationship as defined in Eq.(3) is used. i.e., $e_i = 4.27$, $C_c = 0.454$ for both ponds.
- Permeability vs. e relationship as defined in Eq.(7) is used.

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

- Dimensions of the wick drain are assumed to be 110mm by 4mm with 92% void area. For preliminary analyses assume wick drains are placed at 7 feet spacing and wick drains will be placed after the initial 5 feet of sand is placed.
- By inspection of the Ponds 11S and 12S laboratory data (Reference 5), the coefficient of vertical consolidation, C_v, is taken as 7 ft^2/month for Pond 11S, and 15 ft^2/month for Pond 12S, respectively. The values of C_v correspond to an effective overburden pressure of about 500 - 600 psf, roughly the pressure from the initial sand fill. The coefficient of horizontal consolidation, C_h, is assumed to be the same as C_v in both ponds.
- Assume soil porosity for equivalent sand drain is 0.3.
- Secondary compression, C_α, = 0.02 per log cycle. This value corresponds to a creep rate, α, of 0.315 ft./log cycle for both ponds.

Loading Conditions

Table 1 summarizes the loading sequence anticipated for filling of Phase IV ponds:

CALCULATION SHEET

PROJECT FMC - Phase IV Ponds JOB NO. 20906-027 CALC. NO. 20906-027-1

SUBJECT Pond Settlement Evaluation of Planned Configuration SHEET NO. 12

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

Table 1 - Summary of Loads

Description	Units	11S	12S	13S	14S	Comments
Elev. Top of Cap	ft	4481.7	4482.6	4482.6	4485.5	
Elev. Top of Slag	ft	4474.7	4475.6	4475.6	4478.5	
Elev. Top of Sludge	ft	4467.3	4467.1	4455.3	4451.5	
Elev. Pond Bottom [min]	ft	4451.5	4451.3	4451.1	4450.4	
Sludge Thickness	ft	15.8	15.8	4.2	1.1	
Ht. Sand	ft	5.0	5.0	5.0	5.0	
Init. Ht Slag	ft	2.4	3.6	15.3	22.0	
Settlement (Calculated)	ft	1.6	1.7	0.8	0.2	Assume 20% of init. Ht. for 13S and 14S settlement
Final Ht. Slag	ft	4.0	5.2	16.1	22.2	= init. ht. Slag + settlement
Final Cap Ht.	ft	7	7	7	7	
Addtl. Stress - Sand	psf	575	575	575	575	
Addtl. Stress - Slag	psf	520	680	2098	2889	
Addtl. Stress - Cap	psf	840	840	840	840	
Time to place sand	months	0.4	0.4	0.4	0.3	
Time to place slag	months	0.3	0.5	0.6	0.5	
Begin Cap Construction	month	24.0	24.0	24.0	24.0	after initial filling begins
Time to place cap	months	2.0	2.0	2.0	2.0	

Notes:

Total Unit Weight Sand *115 pcf*
Total Unit Weight Slag *130 pcf*
Total Unit Weight Cap *120 pcf*
The last digit of the elevation/thickness values may not add up due to rounding.

For analysis purposes it is assumed that the total unit weights provided in Table 1 above are approximately equal to the saturated unit weights. This loading sequence was used with the soil properties discussed above to perform an ACCUMV run.

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								1

Calculations

Primary Consolidation and Secondary Compression

Primary consolidation values are obtained directly from the ACCUMV program results. The printed output for Ponds 11S and 12S are provided as Attachments B and C, respectively.

Secondary compression, δ_{sec}, is derived using the following expression (Reference 13):

$$\delta_{sec} = \alpha * \log(t/t_p) \qquad (10)$$

where α is the creep rate and t_p = time to reach primary consolidation. By inspection of the settlement vs. log (time) output from the ACCUMV program results this value is about 9 months for Pond 11S and 4 months for Pond 12S.

Wick Drains

Utilizing the assumed wick drain properties, the degree of horizontal consolidation, U_h, can be derived as a function of the time, t, following Eq. (8):

Wick drain spacing, S = 7 ft

$d_e = 7 * 1.05 = 7.35$ ft

$A_w = 110 * 4 = 440$ mm^2

$A_v = 440 * 0.92 = 405$ mm^2

$d_v = (4*405/\pi) = 22.7$ mm

$d_w = 22.7/0.3 = 75.7$ mm $= 0.25$ ft

From Eq.(8), we have

$C_h * t = [7.35^2/(8)]\ [\ln (7.35/0.25) - 0.75]\ \ln [1/(1-U_h)] = 17.767 \ln [1/(1-U_h)]$

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

Therefore, for the particular wick drain configuration, $U_h = 1 - e^{-C_h t / 17.767}$

For Pond 11S, $C_h = 7$ ft.^{2}/month, $U_h = 1 - e^{-(7/17.767)t} = 1 - e^{-0.394t}$

For Pond 12S, $C_h = 15$ ft.^{2}/month, $U_h = 1 - e^{-(15/17.767)t} = 1 - e^{-0.844t}$

The horizontal degree of consolidation, U_h, is combined with the vertical degree of consolidation, U_v, obtained from the ACCUMV output following Eq. (9)

$$U = 1 - (1 - U_h)(1 - U_v)$$

to determine the average degree of consolidation, U. The total amount of settlement including the effects of wick drains, δ_{wick}, is then determined using the following relationship:

$$\delta_{wick} = (\delta_{prim}/U_v) * U + \delta_{sec} \qquad (11)$$

where δ_{prim} = the amount of primary settlement calculated by ACCUMV.

ACCUMV reports the degree of consolidation, U_v, based on the total final load. Therefore, the ratio of the current settlement over the degree of settlement reported by ACCUMV, (δ_{prim}/U_v), provides a rough approximation of the amount of total settlement that the sludge would experience under the current load. The quantity $(\delta_{prim}/U_v) * U$, therefore represents an approximation of the primary settlement under the current load with wick drains installed.

Determination of time to reach a settlement rate of 1 in/yr.

Based on previous studies performed in References 1 and 2, it was estimated that the final cap could be placed after the settlement rate reduced to less than one inch per year. The rate of settlement can be checked between successive pairs of calculated time-settlement values to determine when this occurs. However, the time, t, can also be explicitly determined based on the value of creep rate, α, as follows.

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

$\delta_{sec} = y = \alpha * \log(t)$

$\delta y/\delta t = 1 \text{ in/yr} = \alpha / (t * \ln 10)$

Therefore:

$$t = \alpha / (1 \text{ in/yr} * \ln 10) \qquad (13)$$

For Ponds 11S and 12S:

$\alpha = 0.315$ ft/log cycle of time, $t = 20$ months.

Estimate the amount of settlement that will occur over the 500-year design life of the ponds

Under the additional cap loading, additional primary consolidation are estimated to be about 4.3 inches for Pond 11S and about 3.8 inch for Pond 12S. The above relationship (Equation 10) can again be used to estimate the amount of additional secondary settlement that will occur over the 500-year design life of Pond 11S. Assuming that the final cap is completely installed within 26 months, primary consolidation is complete under the cap increment of load at 30 months, and secondary compression of 0.315 ft/cycle, the amount of additional settlement at Pond 11S that will occur with time after completion of cap is determined as follows:

$$\delta_{yr} = \alpha * \log([t + t_p]/t_p), \qquad (14)$$

where $\alpha = 0.315$ ft/cycle, $t_p = 30$ months, $t = 6000$ months

$$\delta_{500\,yr} = 0.315 * \log([6000+30]/30) = 0.726 \text{ ft} = 8.7 \text{ in.}$$

Pond 12S will have the same amount of secondary settlement.

Therefore, for the above conservative assumptions of α and t_p, the estimated amount of additional settlement (primary plus secondary) that will occur after installation of cap is about 13 inches for Pond 11S, and 12.5 inches for Pond 12S, respectively. These estimates include primary settlement under the cap loading and secondary settlement. Differential settlement will be less.

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

Results of Calculation

The ACCUMV computer printout are provided in Attachment B. For Pond 11S, a tabular output of the results is presented in Figure 5a and the plotted results are included in Figures 6a, 7a, and 8a. Figure 6a shows the estimates of primary and secondary compression. Figure 7a presents the same information with the effects of adding wick drains at 7-foot spacing using a coefficient of horizontal consolidation of 7 ft^2/month. The effect of the wick drains essentially reduces the time for primary settlement to the end by about 2.5 months. Table 2 summarizes the calculated results of ultimate primary settlement resulting from each element of the filling operation. These values are plotted in Figure 8a. A schematic cross section of Pond 11S showing relative elevations of the fill layers before and after the settlement of the initial fill, is provided in Figure 9a.

Results for Pond 12S are shown in Figures 5b, 6b, 7b, and 8b. These results are in parallel with the results for Pond 11S except that the coefficient of horizontal consolidation used in the wick drain design is 15 ft^2/month, and the wick drain reduces the time for primary consolidation by about 5 months. Table 3 summarizes the calculated results of ultimate primary settlement resulting from each element of the filling operation. A schematic cross section of Pond 12S showing relative elevations of the fill layers before and after the settlement of the initial fill, is provided in Figure 9b. 1

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								

Table 2 - Summary of Load/Settlement Analysis Results for Pond 11S

Phase of Construction	Net Pressure, psf	Primary Settlement
	(psf)	(ft)
Begin	0	0
Sand fill, 5-ft thickness	575	1.20
Sand and 1 ft of slag (near perimeter dike)	705	1.32
Sand and 4 ft of slag	1095	1.60
Permanent, 7-ft cap	1935	1.96

Table 3 - Summary of Load/Settlement Analysis Results for Pond 12S

Phase of Construction	Net Pressure, psf	Primary Settlement
	(psf)	(ft)
Begin	0	0
Sand fill, 5-ft thickness	575	1.20
Sand and 1 ft of slag (near perimeter dike)	705	1.32
Sand and 5.2 ft of slag	1255	1.68
Permanent, 7-ft cap	2095	2.00

Once primary consolidation ends the creep rate controls the time rate of settlement and thereby the time at which the cap may be added. This correlates to 20 months after initial filling commences for Ponds 11S and 12S. The time for placement of the final cap will be controlled by monitoring settlements after the initial fill is placed.

It is estimated that after the final cap is installed the amount of additional settlement that will occur over the 500-year design life of Ponds 11S and 12S will be about 13 inches and 12.5 inches, respectively.

Figures 10 through 22 show the measured settlements for the 20 settlement monuments installed in the Phase IV Ponds (Ref. 11). After the initial large-strain settlement have occurred, the rates of settlement show a good correlation with those predicted. The discrepancy between the plotted and

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								1

estimated settlements shown in these figures is due primarily to the absence of a well-defined sludge/water interface in the field. The computer program requires input of a definite interface. However, in the field it is likely that the interface is instead a diffuse zone that varies from fluid to solid over a thickness of 2 or more feet. After all the loading has been placed (30-60 days after start of initial filling) the shape, or rate, of the measured settlements are similar to those predicted.

Conclusions

The results of the analyses for Ponds 11S and 12S are summarized in Table 4.

Table 4 - Summary of Settlement Analyses for Ponds 11S and 12S

Item	Pond 11S	Pond 12S
Primary Consolidation of Initial Fill		
Settlement [ft]	1.60	1.68
Elapsed Time [months after start of filling]	9	9
Time to Reach Settlement Rate of 1 in/yr [months]	20	20
500-yr Secondary Settlement [ft]	0.73	0.73
Primary Settlement due to Permanent Cap [ft]	0.36	0.32
Total Post-Construction 500-yr Settlement [ft]	1.09	1.05

For the horizontal consolidation coefficient $C_h = 7$ ft^2/yr and 7-foot triangular spacing, the effect of adding wick drains in Pond 11S speeds up the time for primary consolidation to occur by about 2.5 months.

For the horizontal consolidation coefficient $C_h = 15$ ft^2/yr and 7-foot triangular spacing, the effect of adding wick drains in Pond 12S speeds up the time for primary consolidation to occur by about 5 months.

Field measurements should be made after the initial cap is installed to determine when the final cap may be placed (when settlement rates reduce to 1 in/yr.).

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								1

Ponds 13S and 14S, which only contain 4.2 ft and 1.1 ft of sludge, respectively, will settle a lesser amount and more quickly than the other two ponds. Pond 13S can be assumed to settle about 30 percent as much as Pond 11S, while Pond 14S will only experience minor settlement after the initial fill is placed and both ponds will achieve full consolidation prior to Ponds 11S and 12S.

The results of this calculation compare acceptably with ongoing settlement after the initial large-strain settlement has occurred. 1

CALCULATION SHEET

PROJECT FMC - Phase IV Ponds JOB NO. 20906-027 CALC. NO. 20906-027-1

SUBJECT Pond Settlement Evaluation of Planned Configuration SHEET NO. 20

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J. T. Cameron	5/29/98								
1	J. T. Cameron	9/29/01								1

References

1. 8S Closure Plan for Pond 8S and 8S Recovery Process, FMC Corporation, Pocatello, Idaho, April 1, 1993.

2. Phossy Waste Surface Impoundment, Pond 15S Closure Plan, FMC Corporation, Pocatello, Idaho, September, 1996.

3. Final Report for Field Geotechnical Investigation, FMC Corp. Eastern Michaud Flats Project, Pocatello, Idaho. Engineers and Scientists, Inc., Lakeland, Florida, August 1997. (For Ponds 8E, 11S, 12S, and 13S)

4. Final Report, Geotechnical Laboratory Test Results, Pond 8E, 11S, 12S and 13S, FMC's Elemental Phosphorus Plant, Eastern Michaud Flats Project, Pocatello, Idaho, Applied Geotechnical Engineer Consultants, Inc., September 9, 1997.

5. FMC Pocatello - Pond 8E and Phase IV Ponds - Evaluation of Laboratory Test Results, Job No. 20905-025&026, Calculation No. 20906-025&026, by J. T. Cameron, September 30, 1997.

6. TCON1, Version 4197a from TAGA Engineering Systems and Software, 1996.

7. ACCUMV, The One-Dimensional Consolidation of Saturated Clays, A Computer Program for Nonlinear Finite Strain Theory, by Schiffman, R.L., Szavits-Nossan, V., and McArthur, J.M, December 1992.

8. "Final Report, Geotechnical Laboratory Test Results, Pond 15S Samples, FMC's Elemental Phosphorus Plant," by Mountain States Analytical, Inc. and Applied Geotechnical Engineering Consultants, Inc., November 18, 1994, Appendix L of Pond 15S Closure Plan, September 1996.

9. Koerner, R. M., Designing with Geosynthetics, Second Edition, Prentice Hall, Englewood Cliffs, N.J., 1990.

10. Soil Mechanics, Design Manual, DM7.1, Naval Facilities Engineering Command, May 1982.

11. Closure Settlement Report, Pond 8E, Pond 15S, and Phase IV Ponds - Progress Report No. 7, Pond 16S - Progress Report No. 3," Bechtel, July 31, 2001. 1

Pond 11S: Check the ultimate settlement using the updated lab data

$\Delta e_i = Cc_i * \log *((P_0+\Delta P)/P_0)$

$\Delta H_i = H_{0i} * \Delta e_i /(1+e_{0i})$

$e_0 = 5.99 - 0.27 * (\text{mid-depth})$

$Cc = 1.06 - 0.07 * (\text{mid-depth})$

$\gamma_{total} = 76.64 + 1.26 *(\text{mid-depth})$

Total Sludge Thickness: 15.75 ft

Layer	Depth (ft)	Mid-Depth (ft)	H_0 (ft)	e_0	Cc	P_0 (psf)	ΔP (psf)	Δe	ΔH (ft.)
	0								
1		1.575	3.15	5.56	0.950	24	1095	1.29	0.62
	3.15								
2		4.725	3.15	4.71	0.729	81	1095	0.85	0.47
	6.30								
3		7.875	3.15	3.86	0.509	151	1095	0.47	0.30
	9.45								
4		11.025	3.15	3.01	0.288	234	1095	0.22	0.17
	12.60								
5		14.175	3.15	2.16	0.068	328	1095	0.04	0.04
	15.75								
								Total:	1.60 ft.

Notes:

Change of Void Ratio in the P<50 psf range was ignored.

e_0, Cc, γ_{total} relationships per Reference 5.

Pond 12S: Check the ultimate settlement using the updated lab data

$\Delta e_i = Cc_i * \log *((P_0+\Delta P)/P_0)$

$\Delta H_i = H_{0i} * \Delta e_i /(1+e_{0i})$

$e_0 = 5.99 - 0.27 * (\text{mid-depth})$

$Cc = 1.06 - 0.07 * (\text{mid-depth})$

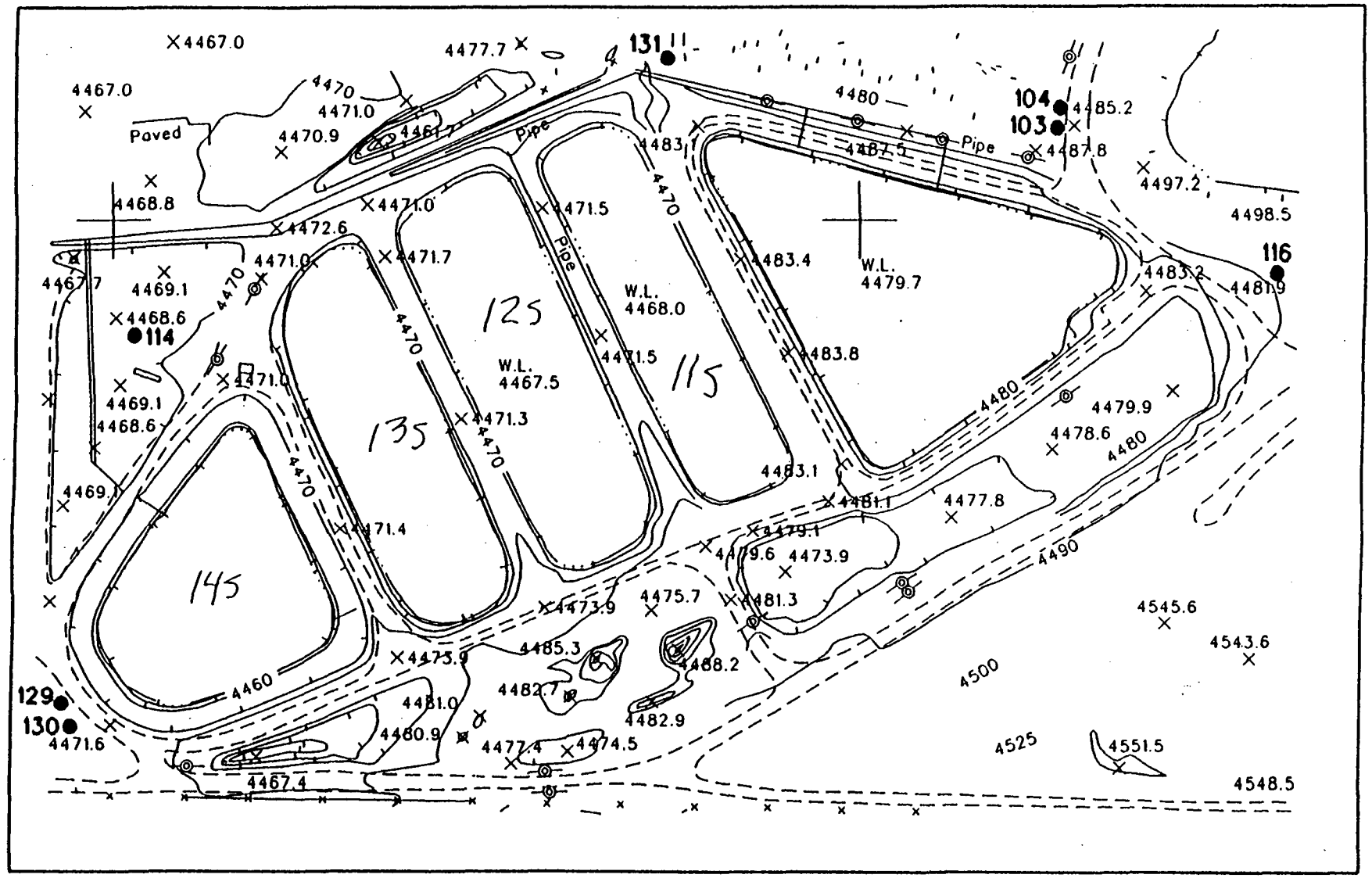
$\gamma_{total} = 76.64 + 1.26 *(\text{mid-depth})$

Total Sludge Thickness: 15.75 ft

Layer	Depth (ft)	Mid-Depth (ft)	H_0 (ft)	e_0	Cc	P_0 (psf)	ΔP (psf)	Δe	ΔH (ft.)
	0								
1		1.575	3.15	5.56	0.950	24	1277	1.35	0.65
	3.15								
2		4.725	3.15	4.71	0.729	81	1277	0.89	0.49
	6.30								
3		7.875	3.15	3.86	0.509	151	1277	0.50	0.32
	9.45								
4		11.025	3.15	3.01	0.288	234	1277	0.23	0.18
	12.60								
5		14.175	3.15	2.16	0.068	328	1277	0.05	0.05
	15.75								
								Total:	1.69 ft.

Notes:

Change of Void Ratio in the P<50 psf range was ignored.
e_0, Cc, γ_{total} relationships per Reference 5.



Bechtel Environmental, Inc.
San Francisco

FMC CORPORATION
POCATELLO, IDAHO

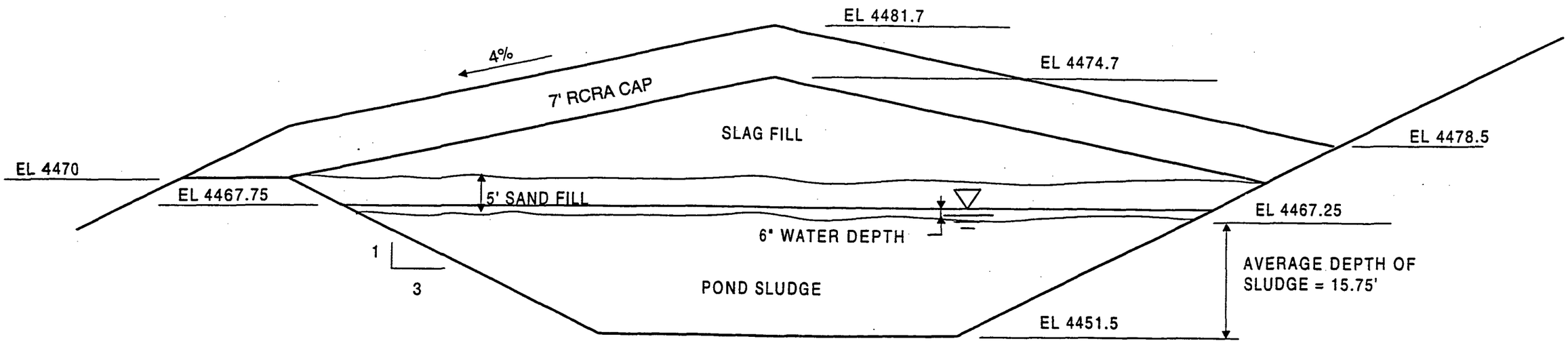
Location of Borings

Job No.	Drawing No.	Rev.
20906	~~PHASE IV~~	0

PHASE4.DGN

Phase IV Ponds Closure Plan

PHASE 4.DGN Figure 1

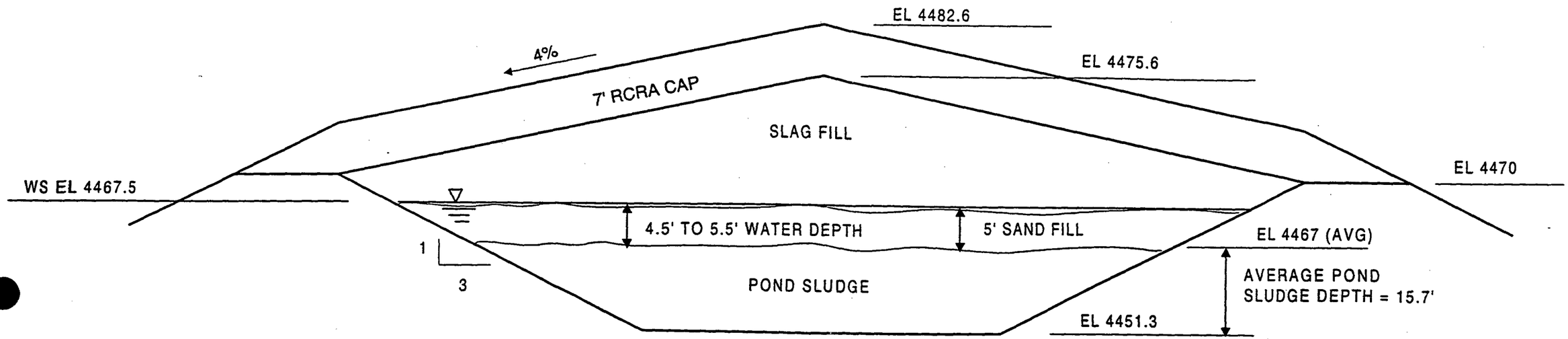


POND 11S

Ref: Provided by Project 5-98

Schematic Cross Section of Pond 11S

Figure 2a

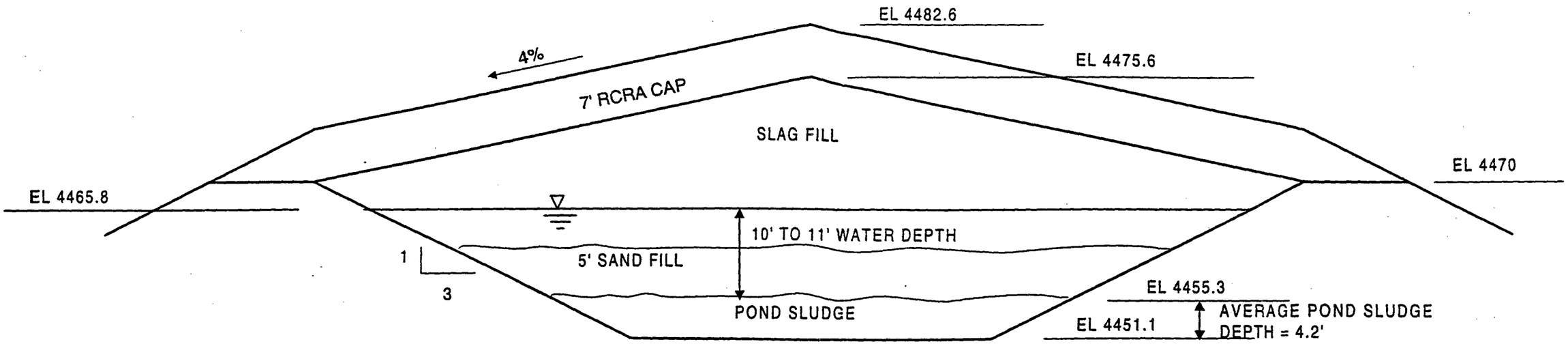


POND 12S

Ref. Provided by Project 5/98

Schematic Section of Pond 12S

Figure 2b

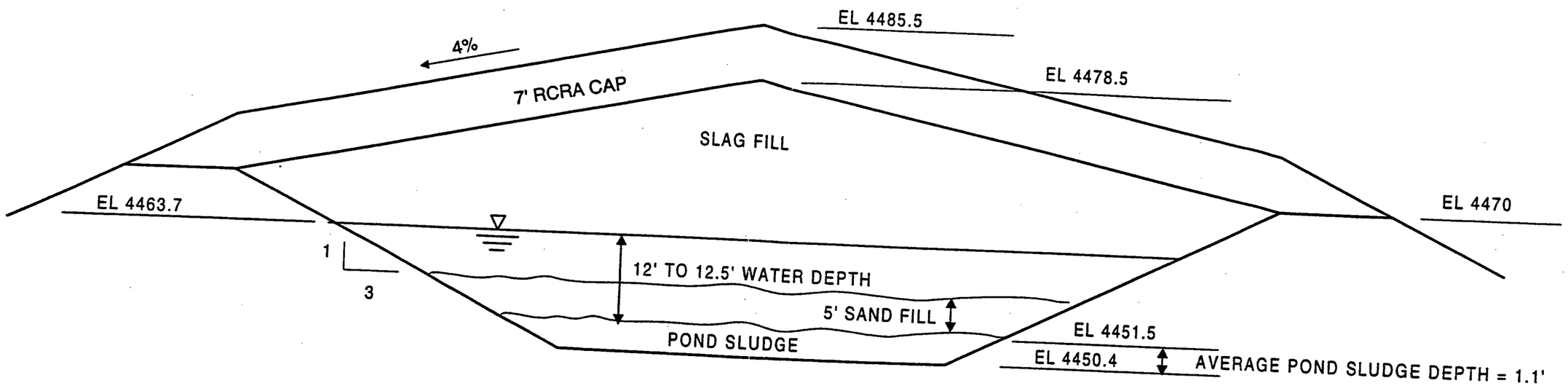


POND 13S

Ref. Provided by Project 5-98

Schematic Cross Section of Pond 13S

Figure 2c

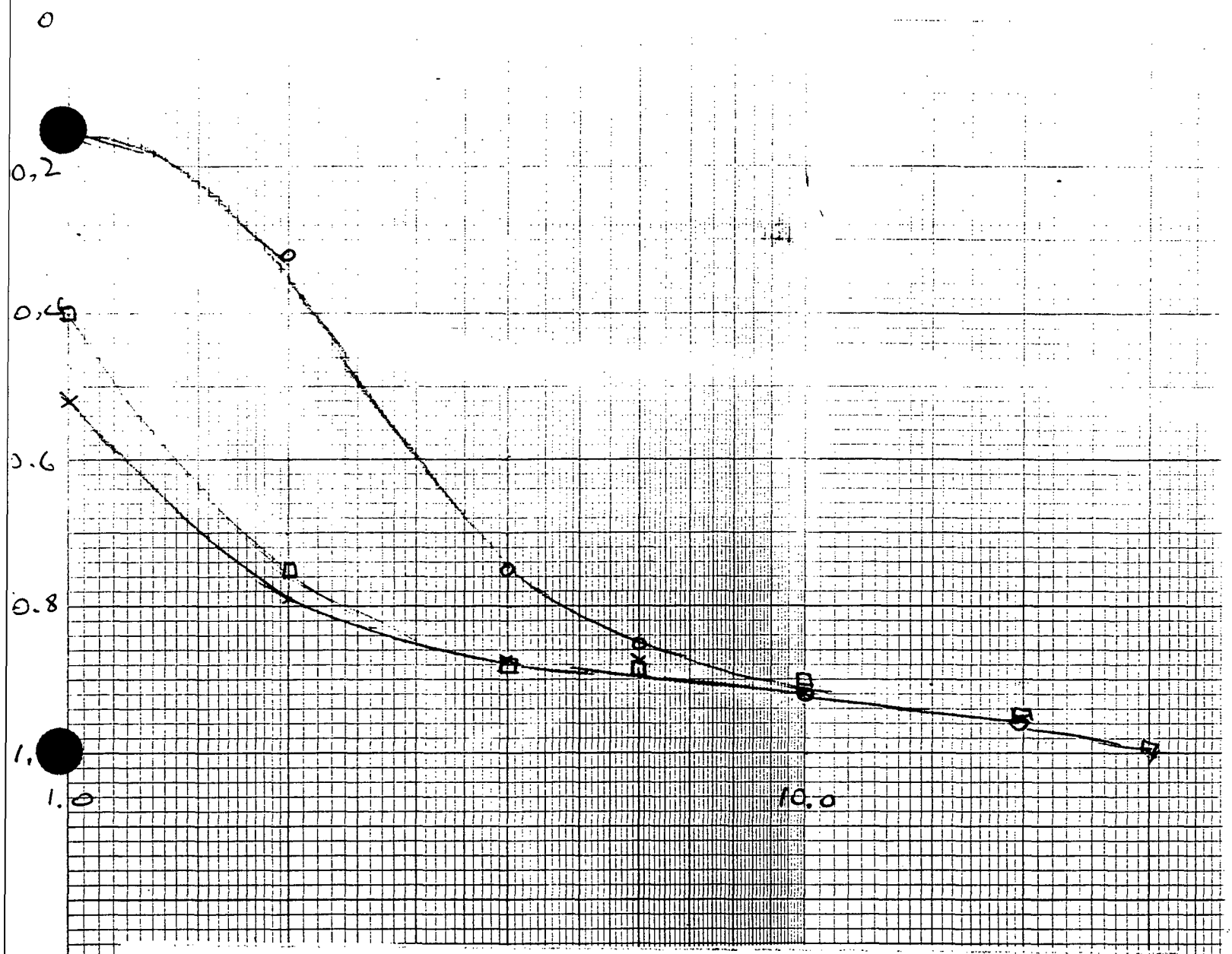


POND 14S

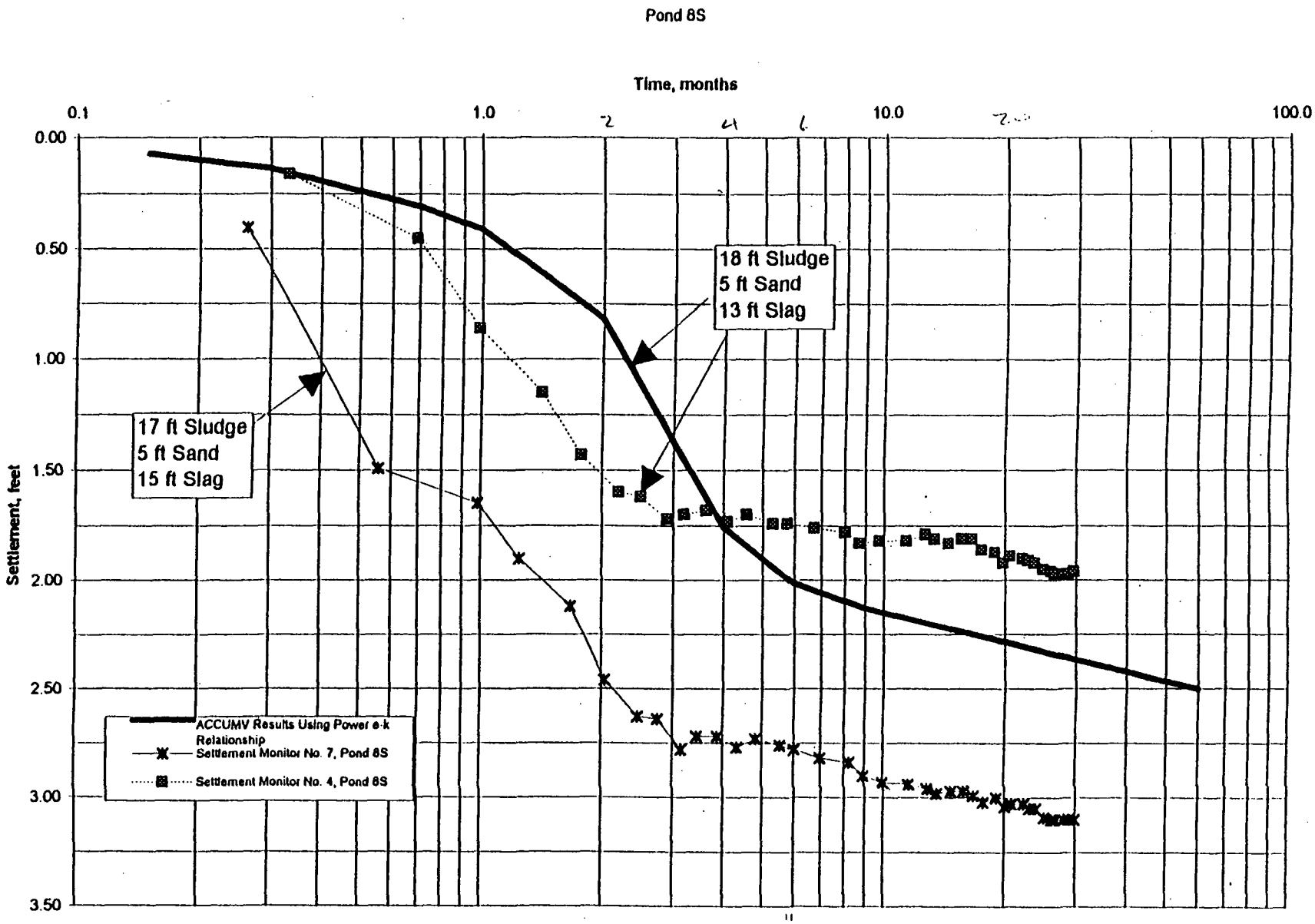
Ref: Provided by Project 5-98

Schematic Cross Section of Pond 14S

Figure 2d

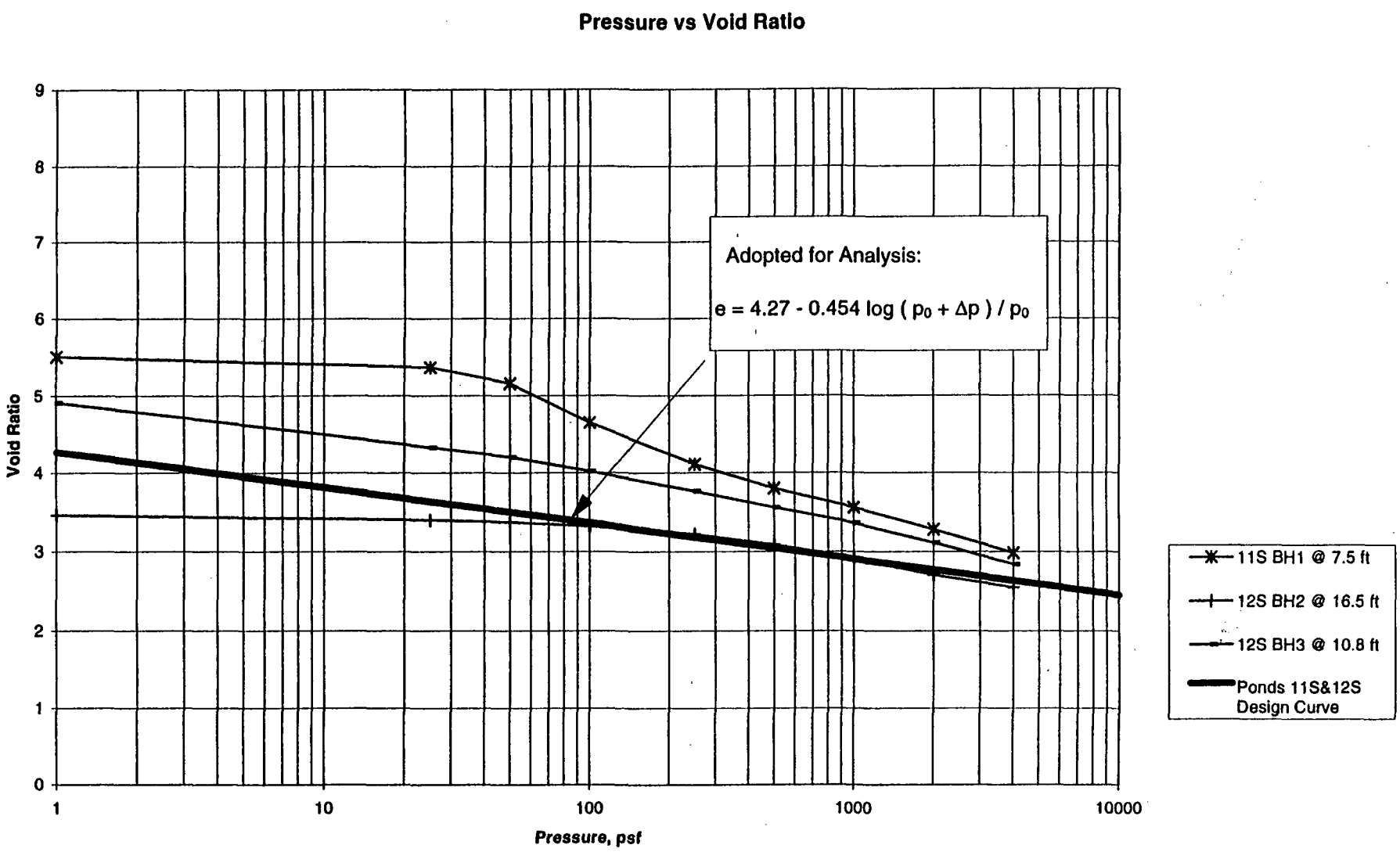


Time	×	×	□	□	⊖	⊖
0.3	0.6	0.19	0.20	0.1	0.15	0.06
1.0	1.65	0.52	0.80	0.4	0.40	0.17
2	2.50	0.79	1.50	0.75	0.76	0.32
4	2.75	0.87	1.75	0.88	1.75	0.75
6	2.75	0.87	1.75	0.88	2.00	0.85
10	2.90	0.92	1.80	0.90	2.15	0.92
20	3.0	0.95	1.90	0.95	2.25	0.96
30	3.15	1.00	2.00	1.00	2.35	1.00



Comparison of ACCUMV Results and Measured Data for Pond 8S

Figure 3



Ponds 11S and 12S - Consolidation Tests
Void Ratio vs Pressure

Figure 4

Project:	FMC - Pond 11S - 500-Year Design				Material			Sand	Slag	Cap	Load Sequence					
Computed by:	J. Cameron				Thickness, ft			5	4	7	Time, mths	Load				
Date	5/29/98				Unit Weight, psf			115	130	120	0.2	300				
					Additional Load, psf			575	520	840	0.4	575				
					Begin Loading, months			0	0.4	24	0.6	857				
All required inputs are blocked with a bold box.		INPUT			Time for Loading, months			0.4	0.3	2	0.7	1139				
											24.0	1139				
Sludge Thickness, H		15.75	ft		Begin Wick Drain Installation			1	Months		26.0	1979				
Coef. of Horizontal Consolidation, C_h		7	ft^2/mth								60.0	1979				
Wick Drain Spacing (Triangular), S		7	ft								75.0	1979				
Wick Drain Width, W		110	mm		Start of Secondary Settlement, t_p						9	months w/o wick drains		6	months with wick drains	
Wick Drain Thickness, b		4	mm		Rate of 2ndary Compr. [ft/log cycle], $\alpha = 0.02 * H$						0.315					
Percent Void Area of Wick Drain, A_w		92			Design Life						500	years				
Assumed Equivalent Sand Porosity, por		0.3			ACCUMV OUTPUT (w/o wick drains)									With Wick Drains		
Equivalent Void Diameter, d_v (see Note 6)		22.7	mm				Total	Effective	Prim.	Deg.	Secndry	Total	Deg.	Deg.	Primary	Secondary	Prim+Sec
Equivalent Sand Drain Diameter, d_w (see Note 7)		75.7	mm	Time	Average	Stress	Stress	Sett.	Vert. Cons.	Sett. [ft]	Sett. [ft]	Hor. Cons.	Sett.	Sett.[ft]	Settlement	
Equivalent Sand Drain Diameter, d_w		0.25	ft	t [months]	void ratio	(psf)	(psf)	δ_{prim}	U_v	δ_{sec} [2]	$\delta_{prim} + \delta_{sec}$	U_h [3]	U [4]	δ_{wick} [5]	(ft)	(ft)
Equivalent Drain Diameter = d_e (see Note 1)	1.05 * S =	7.4	ft	0.00E+00	3.29E+00	709.682	206.1408	0	0	0.00	0.00	0.000	0.00	0.0000	0.00	0.0000
n	d_e / d_w =	30		1.50E-01	3.25E+00	934.804	214.7944	0.1484	0.0759	0.00	0.15	0.000	0.08	0.1484	0.00	0.1484
				2.00E-01	3.24E+00	1009.871	218.023	0.165	0.0844	0.00	0.17	0.000	0.08	0.1650	0.00	0.1650
NOTES:				2.25E-01	3.24E+00	1044.287	219.6437	0.1735	0.0887	0.00	0.17	0.000	0.09	0.1735	0.00	0.1735
[1] Multiply S by 1.05 for triangular pattern and 1.13 for square pattern				2.50E-01	3.24E+00	1078.706	221.336	0.1822	0.0931	0.00	0.18	0.000	0.09	0.1822	0.00	0.1822
[2] $\delta_{sec} = \alpha * \log(t/t_p)$				2.75E-01	3.24E+00	1113.13	223.1099	0.1912	0.0977	0.00	0.19	0.000	0.10	0.1912	0.00	0.1912
[3] $U_h = 1 - 1/(e^{AT})$				3.00E-01	3.23E+00	1147.557	224.9782	0.2005	0.1025	0.00	0.20	0.000	0.10	0.2005	0.00	0.2005
where $A = d_e^2/(8*C_{v,h})*(\ln d_e/d_w - 0.75)$				3.50E-01	3.23E+00	1216.42	229.0072	0.22	0.1125	0.00	0.22	0.000	0.11	0.2200	0.00	0.2200
[4] $U = 1 - (1 - U_v) * (1 - U_h)$				4.00E-01	3.22E+00	1285.301	233.6123	0.2413	0.1234	0.00	0.24	0.000	0.12	0.2413	0.00	0.2413
[5] $\delta_{wick} = (\delta_{prim}/U_v) * U$				5.00E-01	3.21E+00	1426.623	245.6288	0.2906	0.1486	0.00	0.29	0.000	0.15	0.2906	0.00	0.2906
[6] $d_v = \mathrm{sqrt}(4*A_v/\pi)$				6.00E-01	3.19E+00	1568.033	263.7262	0.349	0.1785	0.00	0.35	0.000	0.18	0.3490	0.00	0.3490
[7] $d_w = d_v/por$				7.00E-01	3.17E+00	1850.538	297.076	0.4192	0.2143	0.00	0.42	0.000	0.21	0.4192	0.00	0.4192
		Primary		8.00E-01	3.16E+00	1851.089	328.4744	0.4804	0.2456	0.00	0.48	0.000	0.25	0.4804	0.00	0.4804
Phase of Construction	Net Pressure, psf	Settlement		9.00E-01	3.15E+00	1851.597	345.583	0.5212	0.2665	0.00	0.52	0.000	0.27	0.5212	0.00	0.5212
	(psf)	(ft)		1.00E+00	3.14E+00	1852.192	362.4463	0.561	0.2868	0.00	0.56	0.000	0.29	0.5610	0.00	0.5610
Begin	0	0		1.25E+00	3.11E+00	1853.848	405.6033	0.6531	0.3339	0.00	0.65	0.094	0.40	0.6531	0.00	0.6531
Sand fill, 5-ft thickness	575	1.2		1.50E+00	3.09E+00	1855.488	445.3537	0.7291	0.3728	0.00	0.73	0.178	0.48	0.7769	0.00	0.7769
Sand and 1 ft. of slag (near perimeter dike)	705	1.32		1.75E+00	3.07E+00	1857.134	482.549	0.7947	0.4063	0.00	0.79	0.255	0.56	0.8942	0.00	0.8942
Sand and 4 ft. of slag	1095	1.60		2.00E+00	3.06E+00	1858.786	517.8525	0.8531	0.4362	0.00	0.85	0.325	0.62	0.9928	0.00	0.9928
Permanent, 7.-ft cap	1935	1.96		2.25E+00	3.04E+00	1860.429	551.6071	0.9057	0.4631	0.00	0.91	0.388	0.67	1.0763	0.00	1.0763
				2.50E+00	3.03E+00	1862.052	584.0729	0.9539	0.4877	0.00	0.95	0.445	0.72	1.1475	0.00	1.1475
				2.75E+00	3.02E+00	1863.646	615.5049	0.9984	0.5105	0.00	1.00	0.497	0.75	1.2084	0.00	1.2084
				3.00E+00	3.01E+00	1865.2	646.1648	1.0398	0.5316	0.00	1.04	0.544	0.79	1.2608	0.00	1.2608
				3.50E+00	2.98E+00	1868.158	706.1387	1.1151	0.5701	0.00	1.12	0.626	0.84	1.3449	0.00	1.3449
				4.00E+00	2.97E+00	1870.877	765.4143	1.1821	0.6044	0.00	1.18	0.692	0.88	1.4078	0.00	1.4078
				5.00E+00	2.94E+00	1875.515	882.4055	1.2954	0.6623	0.00	1.30	0.792	0.93	1.4905	0.00	1.4905
				6.00E+00	2.91E+00	1879.1	991.6902	1.384	0.7076	0.00	1.38	0.860	0.96	1.5372	0.00	1.5372
				7.00E+00	2.89E+00	1881.755	1085.705	1.4506	0.7417	0.00	1.45	0.905	0.98	1.5637	0.02	1.5848
				8.00E+00	2.88E+00	1883.657	1160.771	1.4989	0.7664	0.00	1.50	0.936	0.99	1.5790	0.04	
				9.00E+00	2.87E+00	1884.984	1217.302	1.5328	0.7837	0.00	1.53	0.957	0.99	1.5879	0.06	
				1.00E+01	2.86E+00	1885.891	1258.071	1.5561	0.7956	0.01	1.57	0.971	0.99	1.5934	0.07	
				1.20E+01	2.86E+00	1886.913	1306.101	1.5825	0.8091	0.04	1.62	0.987	1.00	1.5988	0.09	
				1.25E+01	2.86E+00	1887.063	1313.339	1.5863	0.8111	0.04	1.63	0.989	1.00	1.5996	0.10	
				1.50E+01	2.85E+00	1887.483	1333.891	1.5972	0.8166	0.07	1.67	0.996	1.00	1.6017	0.13	
				1.75E+01	2.85E+00	1887.631	1341.201	1.601	0.8186	0.09	1.69	0.998	1.00	1.6025	0.15	
				1.80E+01	2.85E+00	1887.646	1341.948	1.6014	0.8188	0.09	1.70	0.999	1.00	1.6025	0.15	
				2.00E+01	2.85E+00	1887.682	1343.766	1.6024	0.8193	0.11	1.71	0.999	1.00	1.6027	0.16	1.7116
				2.25E+01	2.85E+00	1887.7	1344.655	1.6028	0.8195	0.13	1.73	1.000	1.00	1.6028	0.18	
				2.40E+01	2.85E+00	1887.704	1344.877	1.6029	0.8196	0.13	1.74	1.000	1.00	1.6029	0.19	
				2.50E+01	2.83E+00	2308.807	1473.017	1.6713	0.8545	0.14	1.81	1.000	1.00	1.9405	0.20	
				2.60E+01	2.80E+00	2731.681	1722.66	1.784	0.9121	0.15	1.93	1.000	1.00	1.9405	0.20	
				2.75E+01	2.78E+00	2735.484	1978.078	1.8849	0.9637	0.15	2.04	1.000	1.00	1.9405	0.21	
				2.80E+01	2.77E+00	2736.208	2029.225	1.9032	0.9731	0.16	2.06	1.000	1.00	1.9405	0.21	
				3.00E+01	2.76E+00	2737.669	2138.015	1.9405	0.9921	0.16	2.11	0.000	0.99	1.9405	0.22	
				3.20E+01	2.76E+00	2738.1	2171.51	1.9515	0.9978	0.17	2.13	0.544	1.00	1.9515	0.23	
				3.40E+01	2.76E+00	2738.224	2181.24	1.9546	0.9994	0.18	2.14	0.792	1.00	1.9546	0.24	
				3.50E+01	2.76E+00	2738.246	2183.051	1.9552	0.9997	0.19	2.14	0.860	1.00	1.9552	0.24	
				3.80E+01	2.76E+00	2738.269	2184.789	1.9558	1	0.20	2.15	0.957	1.00	1.9558	0.25	
				4.00E+01	2.76E+00	2738.271	2185.005	1.9559	1	0.20	2.16	0.980	1.00	1.9559	0.26	
				4.50E+01	2.76E+00	2738.271	2185.005	1.9559	1	0.22	2.18	0.997	1.00	1.9559	0.28	
				5.00E+01	2.76E+00	2738.271	2185.005	1.9559	1	0.23	2.19	1.000	1.00	1.9559	0.29	
				5.50E+01	2.76E+00	2738.271	2185.005	1.9559	1	0.25	2.20	1.000	1.00	1.9559	0.30	
				6.00E+01	2.76E+00	2738.271	2185.005	1.9559	1	0.26	2.22	1.000	1.00	1.9559	0.32	

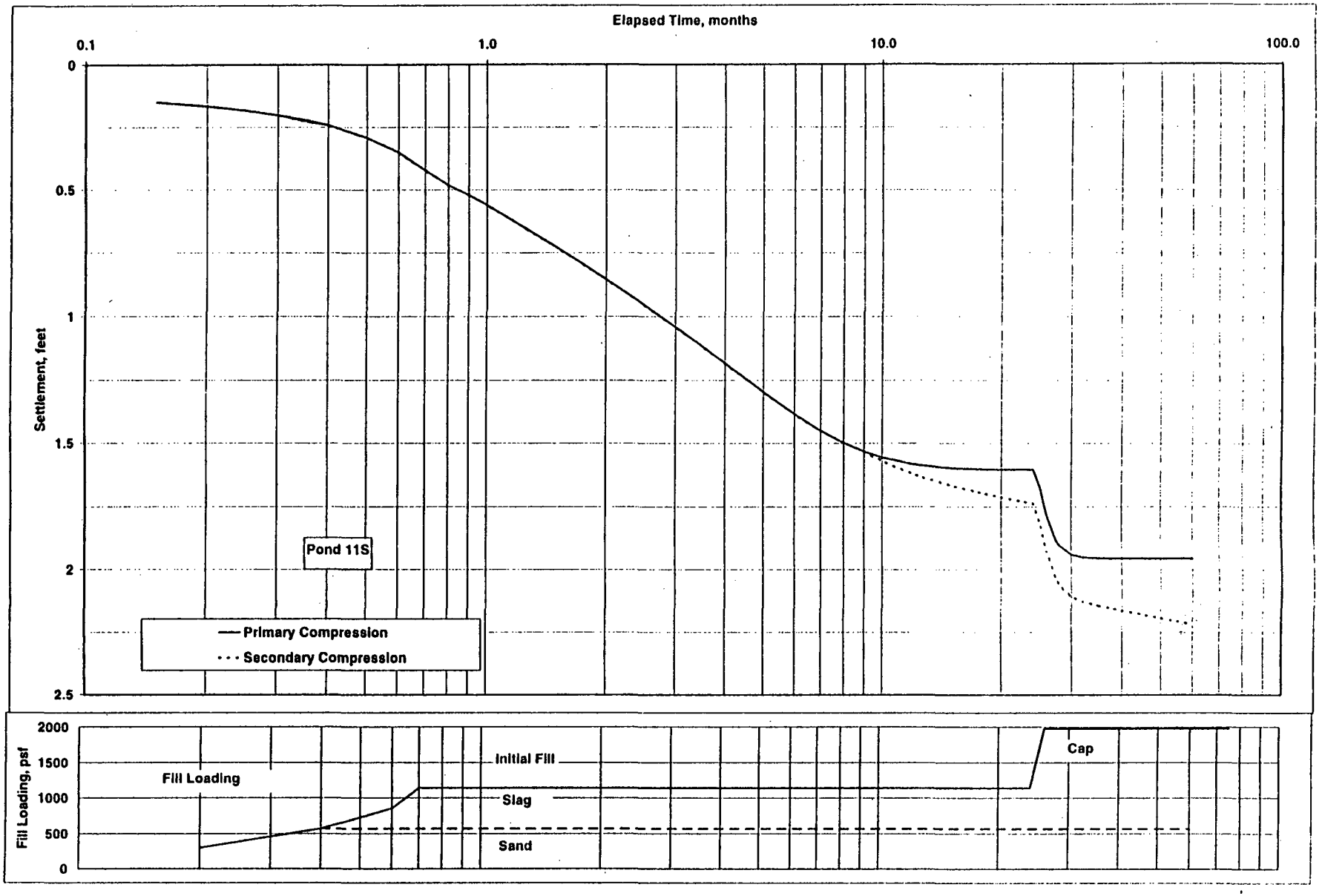
Pond 11S - Settlement Analysis

Figure 5a

Project:	FMC - Pond 12S - 500-Year Design				Material			Sand	Slag	Cap	Load Sequence					
Computed by:	J. Cameron				Thickness, ft			5	5.2	7	Time, mths	Load				
Date	6/29/98				Unit Weight, psf			115	130	120	0.2	300				
					Additional Load, psf			575	680	840	0.4	575				
					Begin Loading, months			0	0.4	24	0.7	929				
All required inputs are blocked with a bold box.		INPUT			Time for Loading, months			0.4	0.3	2	0.9	1282				
											24.0	1282				
Sludge Thickness, H		15.75	ft		Begin Wick Drain Installation			1	Months		26.0	2122				
Coef. of Horizontal Consolidation, C_h		15	ft²/mth								60.0	2122				
Wick Drain Spacing (Triangular), S		7	ft								75.0	2122				
Wick Drain Width, W		110	mm		Start of Secondary Settlement, t_p						9	months w/o wick drains		4	months with wick drains	
Wick Drain Thickness, b		4	mm		Rate of 2ndary Compr. [ft/log cycle], $\alpha = 0.02 * H$						0.315					
Percent Void Area of Wick Drain, A_w		82			Design Life						500	years				
Assumed Equivalent Sand Porosity, por		0.3			ACCUMV OUTPUT (w/o wick drains)									With Wick Drains		
Equivalent Void Diameter, d_v (see Note 6)		22.7	mm				Total	Effective	Prim.	Deg.	Secndry	Total	Deg.	Deg.	Primary	Secondary	Prim+Sec
Equivalent Sand Drain Diameter, d_w (see Note 7)		75.7	mm	Time	Average	Stress	Stress	Sett.	Vert. Cons.	Sett. (ft)	Sett. (ft)	Hor. Cons.	Sett.	Sett.(ft)	Settlement	
Equivalent Sand Drain Diameter, d_w		0.25	ft	t (months)	void ratio	(psf)	(psf)	δ_{prim}	U_v	δ_{sec}[3]	$\delta_{prim} + \delta_{sec}$	U_h[3]	U[4]	δ_{wick}[5]	(ft)	(ft)
Equivalent Drain Diameter = d_e (see Note 1)	1.05 * S =	7.4	ft	0.00E+00	3.29E+00	709.682	206.1408	0	0	0.00	0.00	0.000	0.00	0.0000	0.00	0.0000
n	d_e / d_w =	30		1.50E-01	3.25E+00	934.804	214.7944	0.1484	0.0741	0.00	0.15	0.000	0.07	0.1484	0.00	0.1484
				2.00E-01	3.24E+00	1009.871	218.023	0.165	0.0824	0.00	0.17	0.000	0.08	0.1650	0.00	0.1650
NOTES:				2.25E-01	3.24E+00	1044.287	219.6437	0.1735	0.0866	0.00	0.17	0.000	0.09	0.1735	0.00	0.1735
[1] Multiply S by 1.05 for triangular pattern and 1.13 for square pattern				2.50E-01	3.24E+00	1078.706	221.336	0.1822	0.091	0.00	0.18	0.000	0.09	0.1822	0.00	0.1822
[2] $\delta_{sec} = \alpha * \log(t/t_p)$				2.75E-01	3.24E+00	1113.13	223.1099	0.1912	0.0955	0.00	0.19	0.000	0.10	0.1912	0.00	0.1912
[3] $U_h = 1 - 1/(e^{U_v})$				3.00E-01	3.23E+00	1147.557	224.9782	0.2005	0.1002	0.00	0.20	0.000	0.10	0.2005	0.00	0.2005
where $A = d_e^2/(8*C_{v,h}) * (\ln d_e/d_w - 0.75)$				3.50E-01	3.23E+00	1216.42	229.0072	0.22	0.1099	0.00	0.22	0.000	0.11	0.2200	0.00	0.2200
[4] $U = 1 - (1 - U_v) * (1 - U_h)$				4.00E-01	3.22E+00	1285.301	233.6123	0.2413	0.1205	0.00	0.24	0.000	0.12	0.2413	0.00	0.2413
[5] $\delta_{wick} = (\delta_{prim}/U_v) * U$				5.00E-01	3.21E+00	1403.62	244.7918	0.2894	0.1446	0.00	0.29	0.000	0.14	0.2894	0.00	0.2894
[6] $d_v = \text{sqrt}(4*A_v/\pi)$				6.00E-01	3.19E+00	1522.018	261.4809	0.3455	0.1726	0.00	0.35	0.000	0.17	0.3455	0.00	0.3455
[7] $d_w = d_v/por$				7.00E-01	3.18E+00	1640.475	285.4283	0.4052	0.2024	0.00	0.41	0.000	0.20	0.4052	0.00	0.4052
		Primary		8.00E-01	3.16E+00	1817.468	316.1187	0.4633	0.2314	0.00	0.46	0.000	0.23	0.4633	0.00	0.4633
Phase of Construction	Net Pressure, psf	Settlement		9.00E-01	3.15E+00	1994.531	349.2206	0.5192	0.2594	0.00	0.52	0.000	0.26	0.5192	0.00	0.5192
	(psf)	(ft)		1.00E+00	3.13E+00	1995.173	374.0843	0.5678	0.2837	0.00	0.57	0.000	0.28	0.5678	0.00	0.5678
Begin	0	0		1.25E+00	3.11E+00	1996.995	426.165	0.6722	0.3358	0.00	0.67	0.190	0.46	0.7744	0.00	0.7744
Sand fill, 5-ft thickness	575	1.2		1.50E+00	3.08E+00	1998.814	473.2302	0.7571	0.3782	0.00	0.76	0.344	0.59	0.9923	0.00	0.9923
Sand and 1 ft. of slag (near perimeter dike)	705	1.32		1.75E+00	3.06E+00	2000.643	516.6545	0.8298	0.4145	0.00	0.83	0.468	0.69	1.1546	0.00	1.1546
Sand and 5.2 ft. of slag	1255	1.68		2.00E+00	3.05E+00	2002.481	558.0849	0.894	0.4466	0.00	0.89	0.569	0.76	1.2769	0.00	1.2769
Permanent, 7.-ft cap	2095	2.00		2.25E+00	3.03E+00	2004.309	597.3928	0.9519	0.4755	0.00	0.95	0.651	0.82	1.3697	0.00	1.3697
				2.50E+00	3.01E+00	2006.116	635.1274	1.0046	0.5018	0.00	1.00	0.717	0.86	1.4404	0.00	1.4404
				2.75E+00	3.00E+00	2007.888	671.639	1.0532	0.5261	0.00	1.05	0.771	0.89	1.4946	0.00	1.4946
				3.00E+00	2.99E+00	2009.614	707.2875	1.0984	0.5487	0.00	1.10	0.814	0.92	1.5362	0.00	1.5362
				3.50E+00	2.97E+00	2012.888	777.3246	1.1804	0.5897	0.00	1.18	0.878	0.95	1.5928	0.00	1.5928
				4.00E+00	2.95E+00	2015.877	847.1249	1.2532	0.626	0.00	1.25	0.920	0.97	1.6265	0.00	1.6265
				5.00E+00	2.91E+00	2020.906	985.9327	1.3752	0.6869	0.00	1.38	0.966	0.99	1.6585	0.03	
				6.00E+00	2.89E+00	2024.697	1114.741	1.4686	0.7336	0.00	1.47	0.985	1.00	1.6700	0.06	
				7.00E+00	2.87E+00	2027.42	1222.987	1.5368	0.7677	0.00	1.54	0.994	1.00	1.6741	0.08	
				8.00E+00	2.86E+00	2029.303	1306.541	1.5845	0.7915	0.00	1.58	0.997	1.00	1.6756	0.09	
				9.00E+00	2.85E+00	2030.568	1367.013	1.6168	0.8077	0.00	1.62	0.999	1.00	1.6762	0.11	
				1.00E+01	2.84E+00	2031.4	1408.83	1.6382	0.8183	0.01	1.65	0.999	1.00	1.6764	0.13	
				1.20E+01	2.84E+00	2032.288	1455.253	1.661	0.8297	0.04	1.70	1.000	1.00	1.6766	0.15	
				1.25E+01	2.84E+00	2032.411	1461.863	1.6642	0.8313	0.04	1.71	1.000	1.00	1.6766	0.16	
				1.50E+01	2.83E+00	2032.74	1479.684	1.6727	0.8356	0.07	1.74	1.000	1.00	1.6766	0.18	
				1.75E+01	2.83E+00	2032.846	1485.435	1.6754	0.8369	0.09	1.77	1.000	1.00	1.6766	0.20	
				1.80E+01	2.83E+00	2032.856	1485.986	1.6757	0.8371	0.09	1.77	1.000	1.00	1.6766	0.21	
				2.00E+01	2.83E+00	2032.879	1487.27	1.6763	0.8374	0.11	1.79	1.000	1.00	1.6766	0.22	1.7855
				2.25E+01	2.83E+00	2032.89	1487.853	1.6766	0.8375	0.13	1.80	1.000	1.00	1.6766	0.24	
				2.40E+01	2.83E+00	2032.892	1487.998	1.6766	0.8375	0.13	1.81	1.000	1.00	1.6766	0.25	
				2.50E+01	2.81E+00	2453.974	1621.99	1.7411	0.8697	0.14	1.88	1.000	1.00	1.9900	0.25	
				2.60E+01	2.79E+00	2876.754	1881.446	1.848	0.9231	0.15	1.99	1.000	1.00	1.9900	0.26	
				2.75E+01	2.76E+00	2880.302	2139.875	1.9417	0.97	0.15	2.09	1.000	1.00	1.9900	0.26	
				2.80E+01	2.76E+00	2880.947	2189.229	1.9581	0.9781	0.16	2.11	1.000	1.00	1.9900	0.27	
				3.00E+01	2.75E+00	2882.198	2289.267	1.99	0.9941	0.16	2.15	0.000	0.99	1.9900	0.28	
				3.20E+01	2.74E+00	2882.54	2317.672	1.9987	0.9984	0.17	2.17	0.814	1.00	1.9987	0.28	
				3.40E+01	2.74E+00	2882.631	2325.338	2.001	0.9996	0.18	2.18	0.966	1.00	2.0010	0.29	
				3.50E+01	2.74E+00	2882.647	2326.686	2.0015	0.9998	0.19	2.19	0.985	1.00	2.0015	0.30	
				3.80E+01	2.74E+00	2882.662	2327.928	2.0018	1	0.20	2.20	0.999	1.00	2.0018	0.31	
				4.00E+01	2.74E+00	2882.662	2327.989	2.0019	1	0.20	2.21	1.000	1.00	2.0019	0.32	
				4.50E+01	2.74E+00	2882.662	2327.989	2.0019	1	0.22	2.22	1.000	1.00	2.0019	0.33	
				5.00E+01	2.74E+00	2882.662	2327.989	2.0019	1	0.23	2.24	1.000	1.00	2.0019	0.35	
				5.50E+01	2.74E+00	2882.662	2327.989	2.0019	1	0.25	2.25	1.000	1.00	2.0019	0.36	
				6.00E+01	2.74E+00	2882.662	2327.989	2.0019	1	0.26	2.26	1.000	1.00	2.0019	0.37	

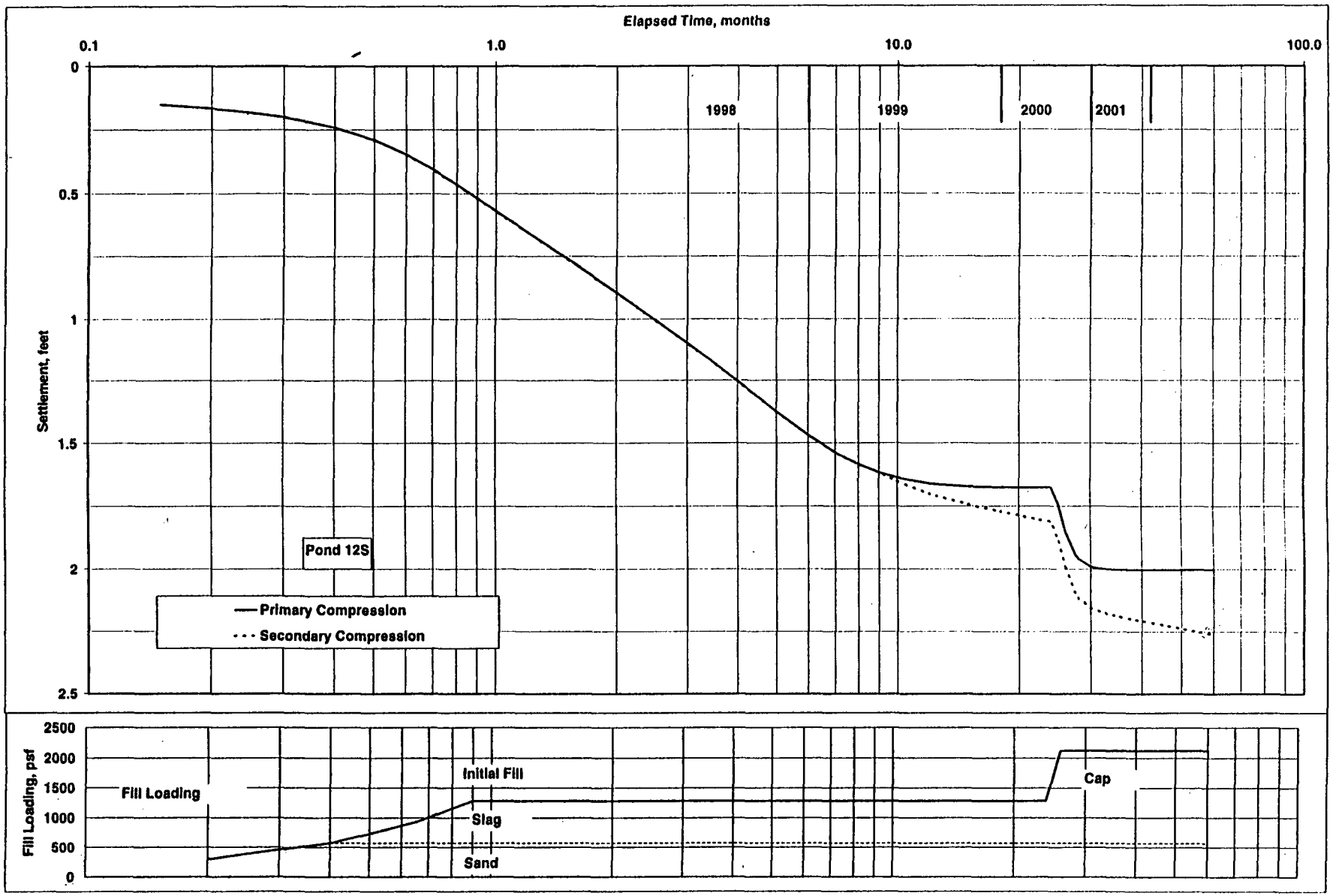
Pond 12S - Settlement Analysis

Figure 5b



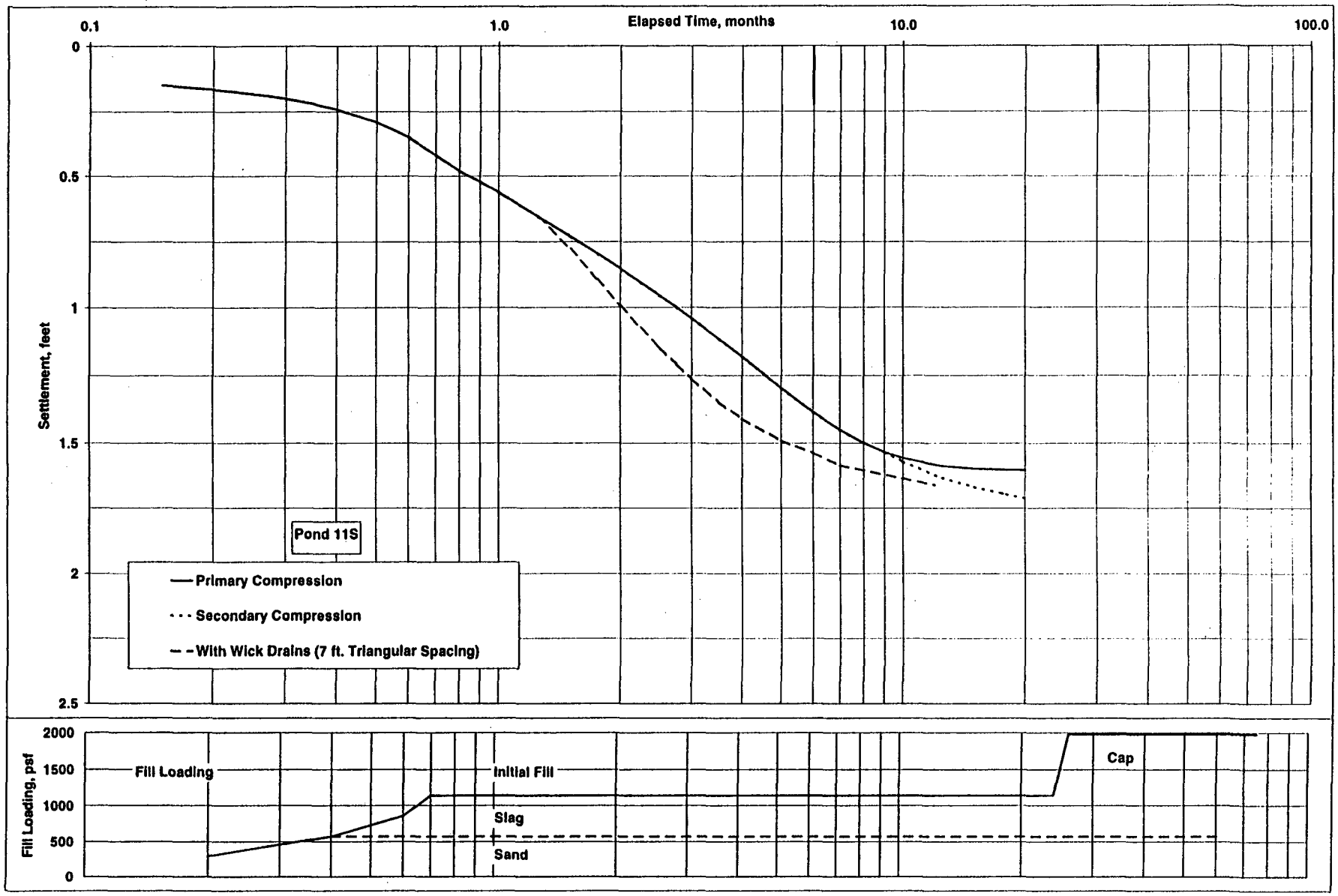
Pond 11S - Loading/Settlement vs Time

Figure 6a



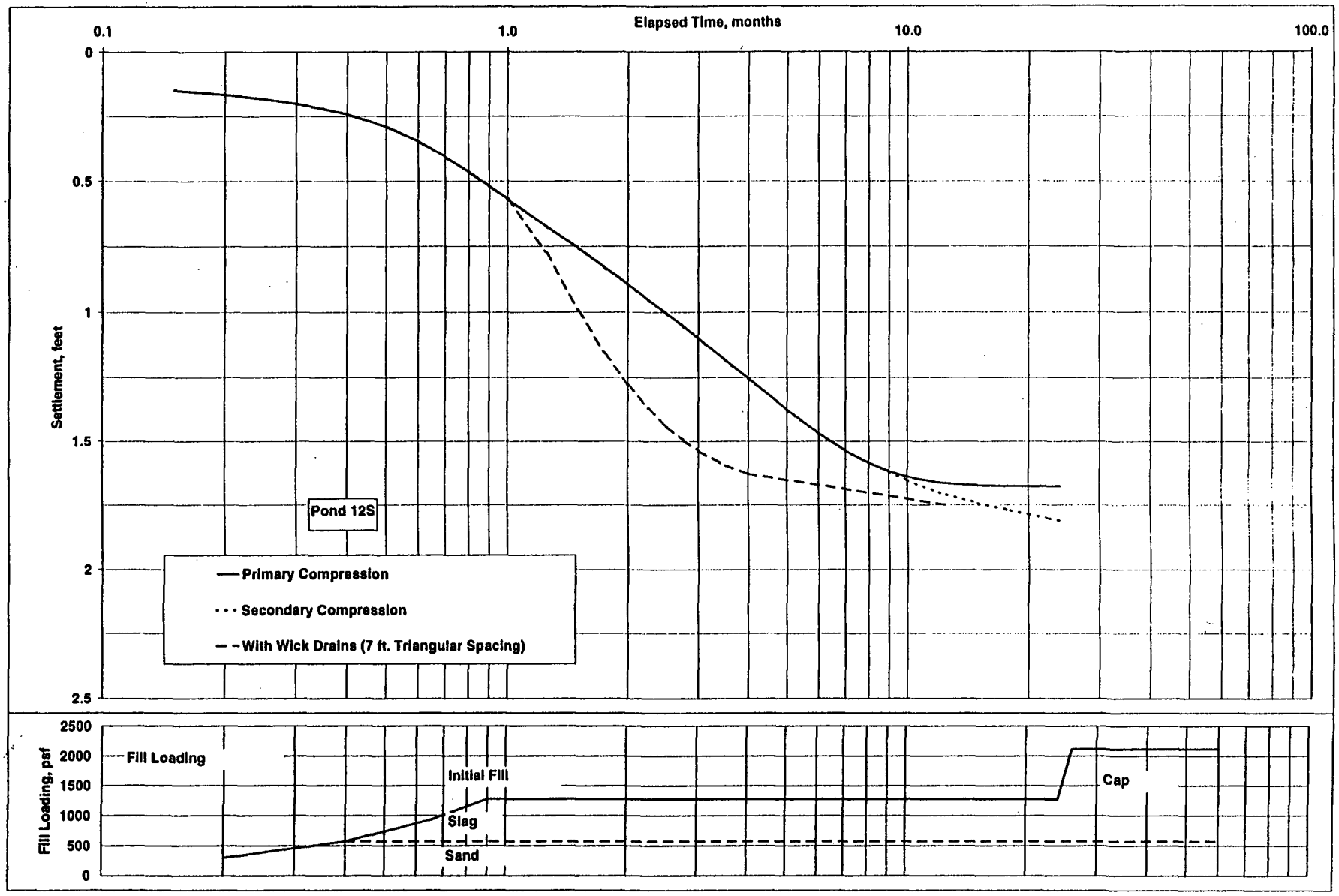
Pond 12S - Loading/Settlement vs Time

Figure 6b



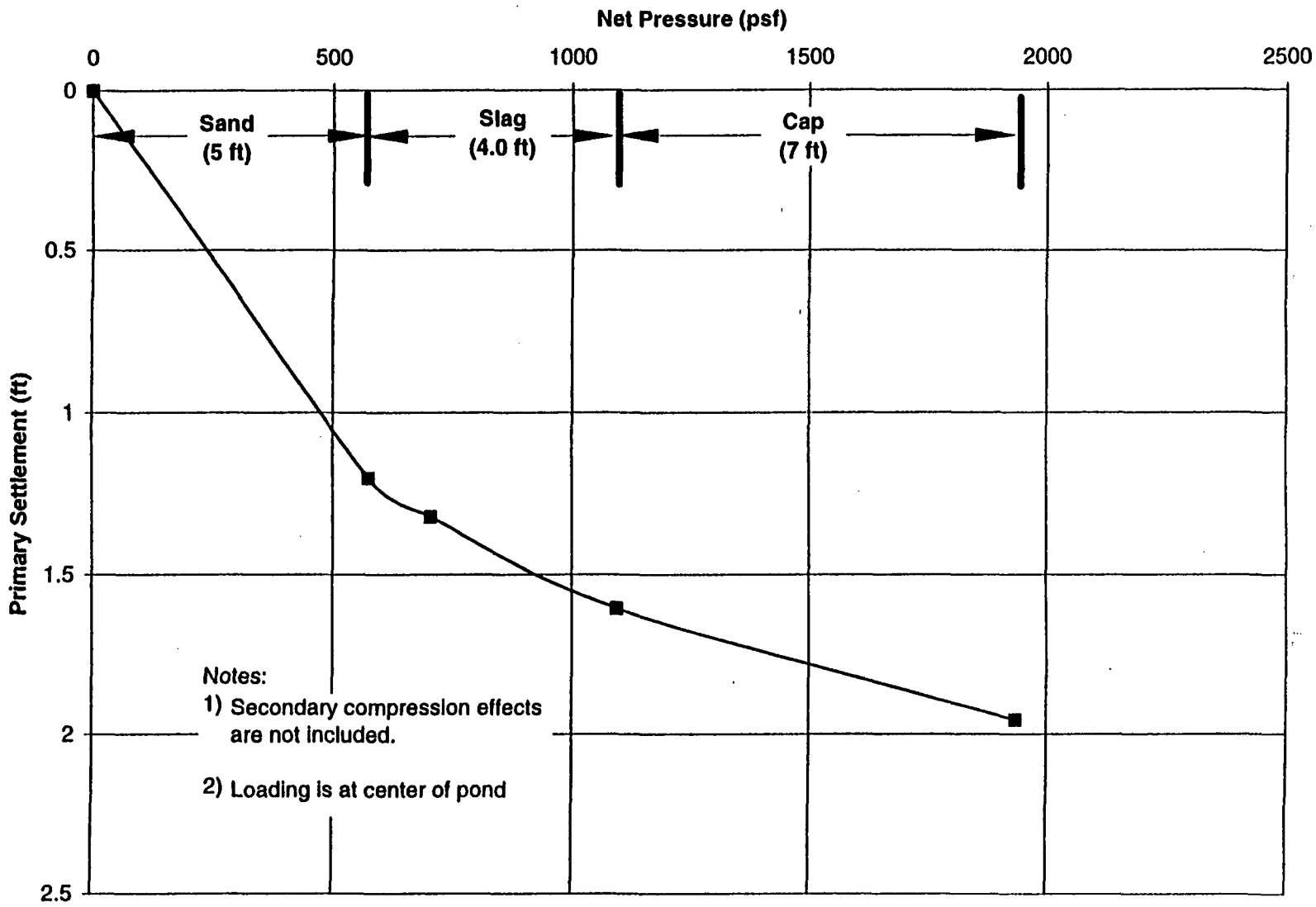
Pond 11S - Loading/Settlement vs Time, Wick Drain Alternative

Figure 7a



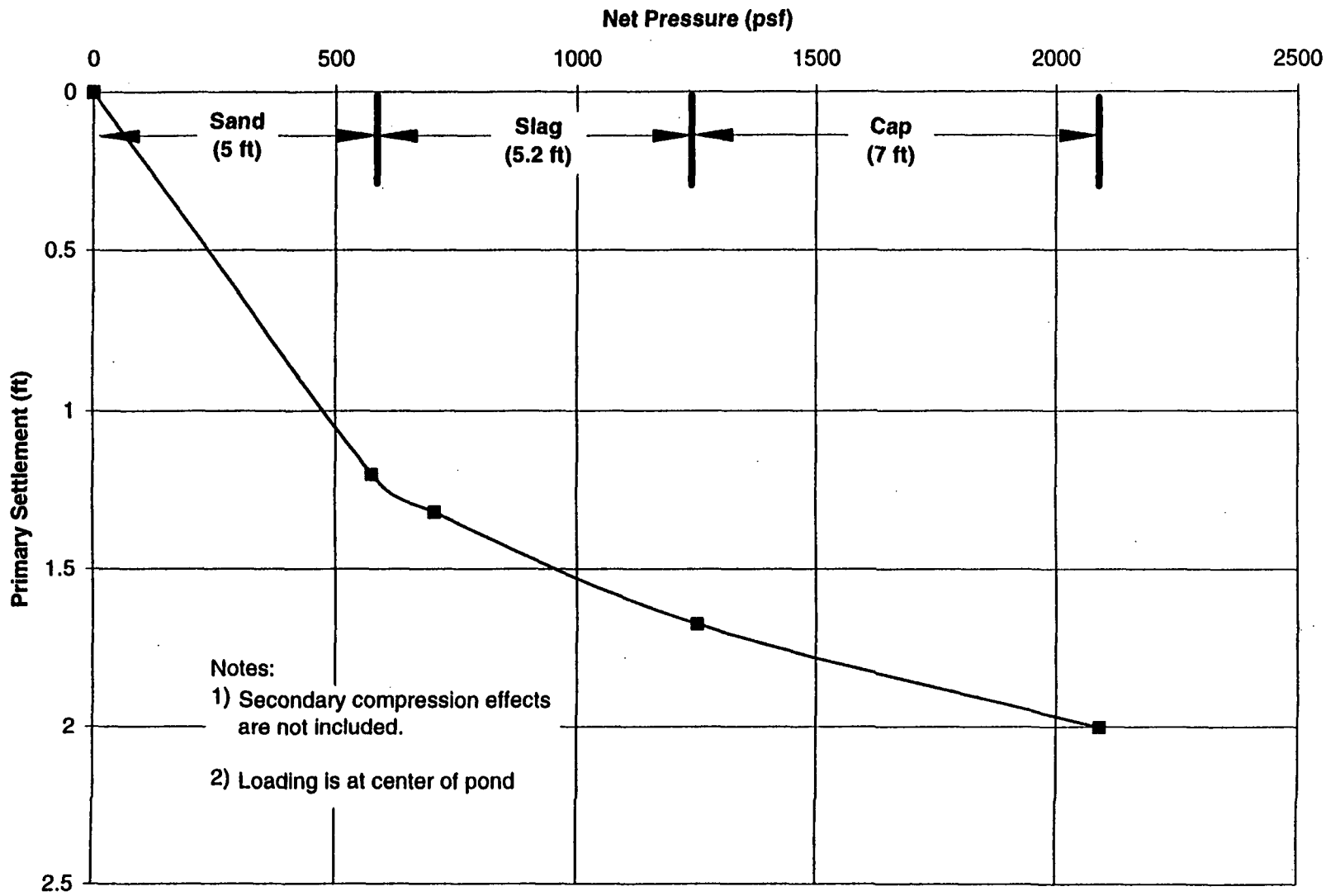
Pond 12S - Loading/Settlement vs Time, Wick Drain Alternative

Figure 7b



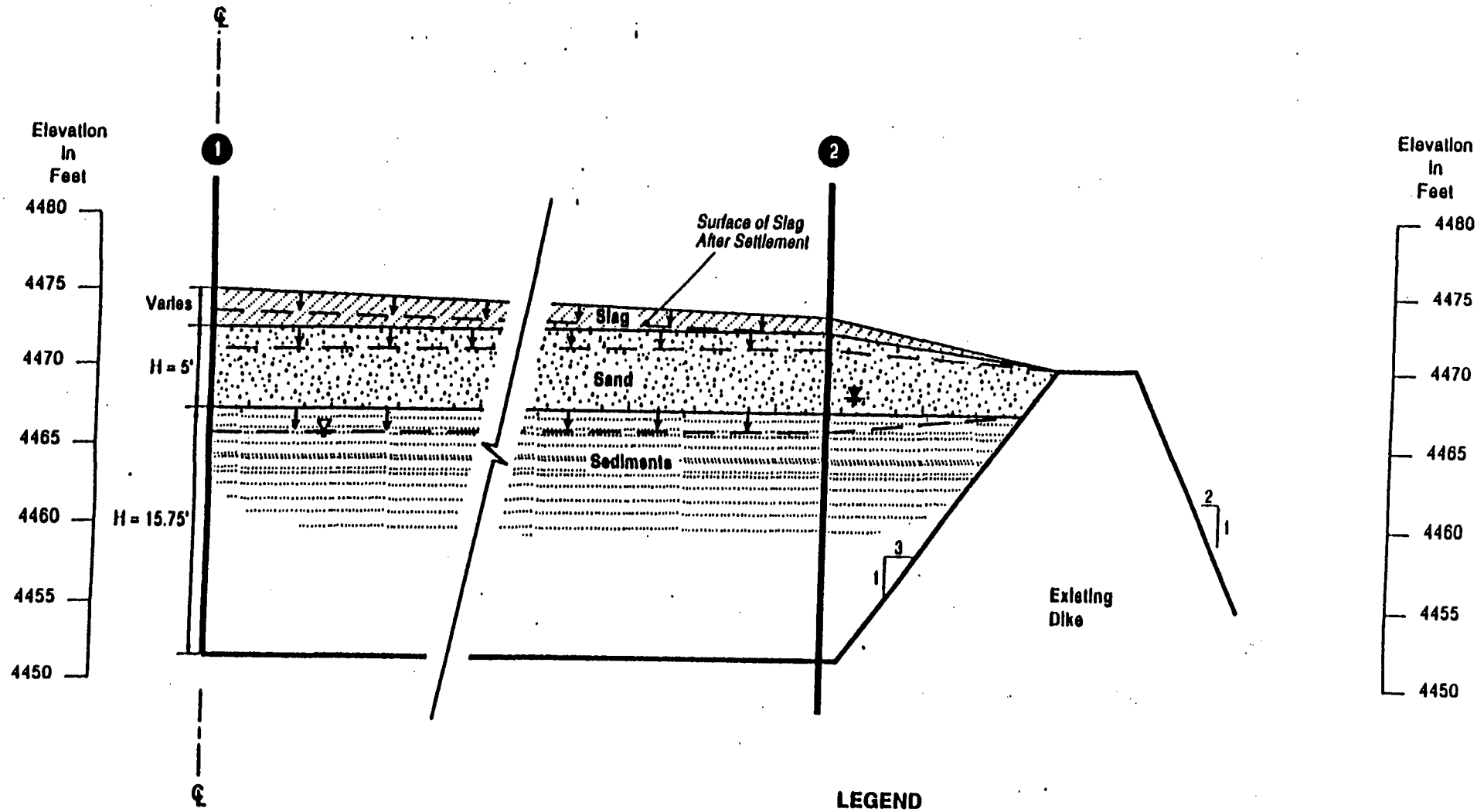
POND 11S - Primary Settlement vs Pressure

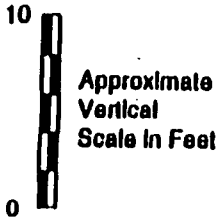
Figure 8a



POND 12S - Primary Settlement vs Pressure

Figure 8 b



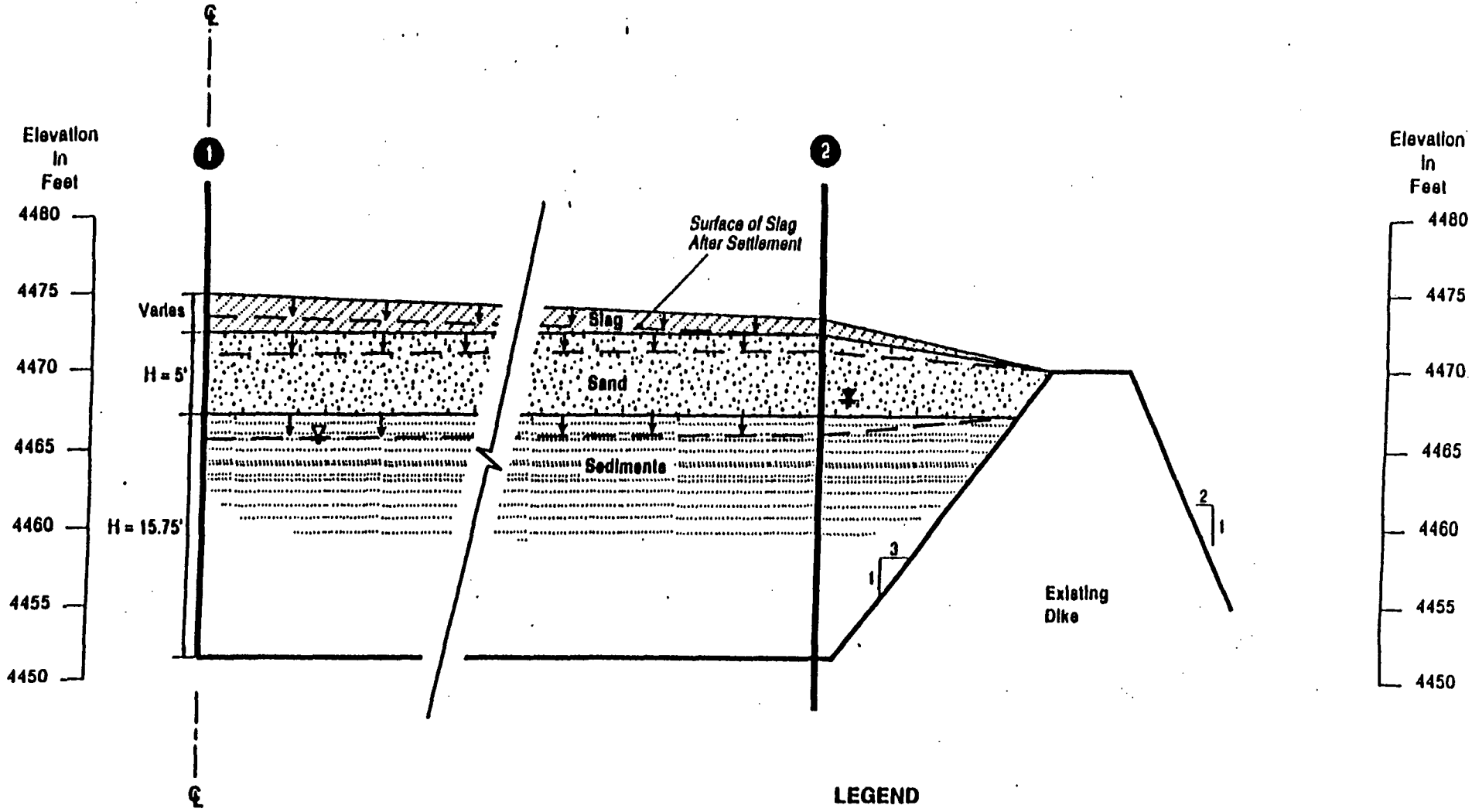


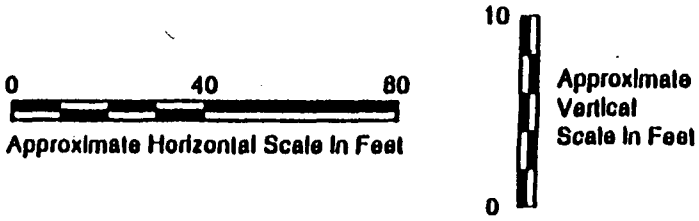
LEGEND

- Before Settlement
- After Settlement
- Water Level Before Settlement
- Water Level After Settlement
- Analysis Section

Figure 9a
Pond 11S - Fill and Settlement Profiles

SF019/BEI_DESIGN/DRAFT_2/FMC/11S
3/26/97





LEGEND

- Before Settlement
- After Settlement
- Water Level Before Settlement
- Water Level After Settlement
- Analysis Section

Figure 9b
Pond 12S - Fill and Settlement Profiles

SFD19BEI_DESIGN\DRAFT_2\FMCN1Sta.ai
3/26/97

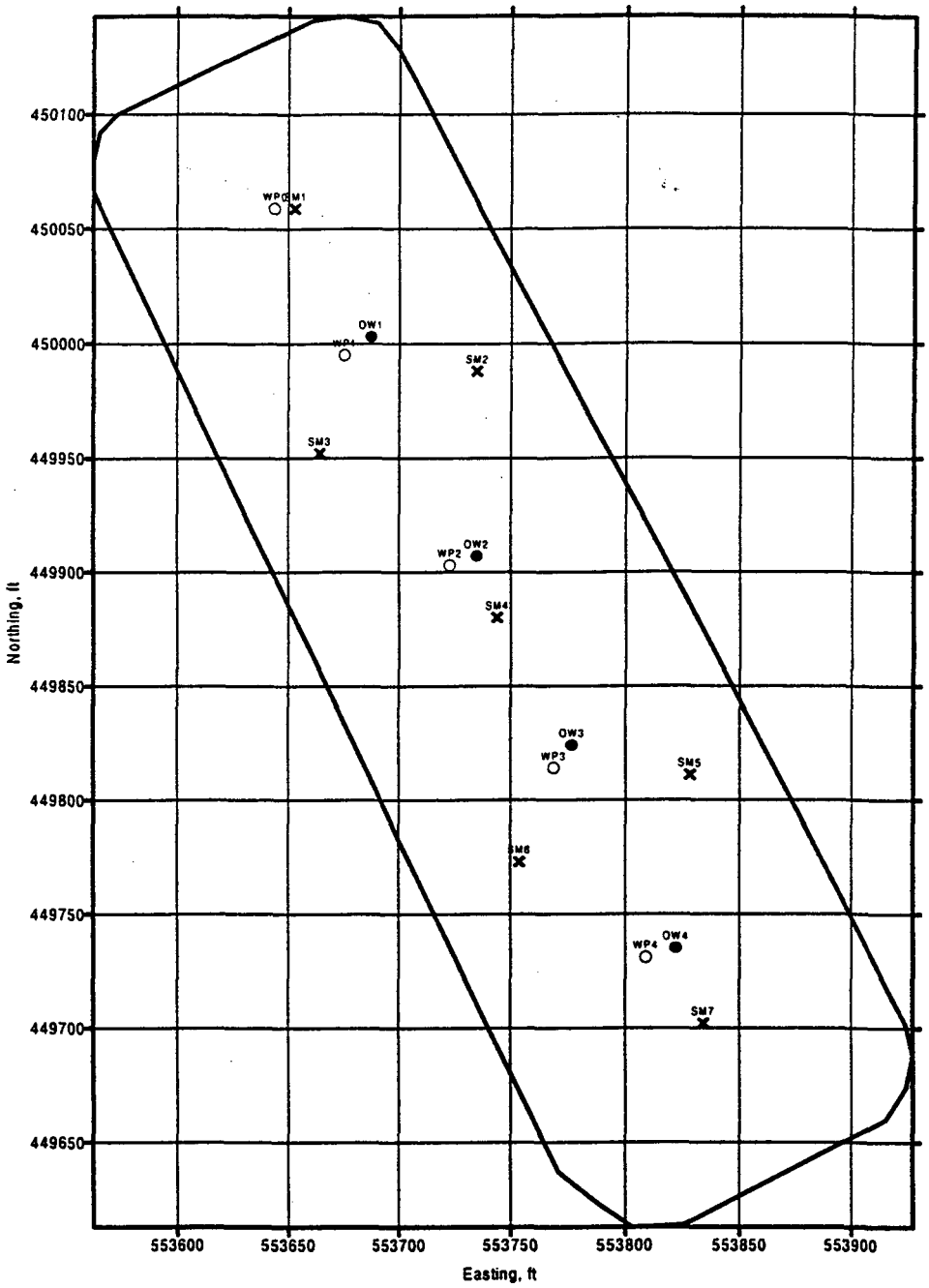
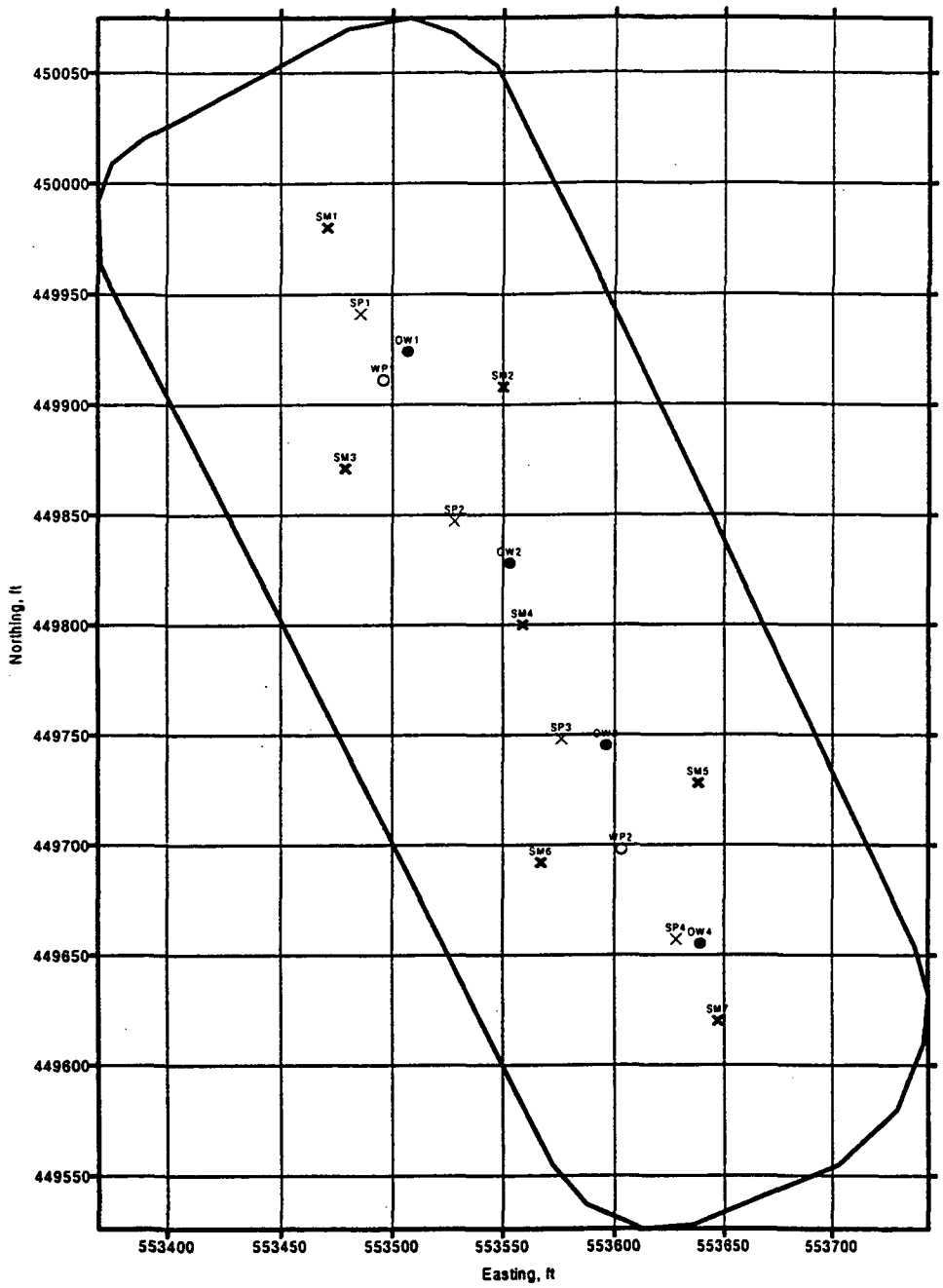


Figure 10 - Pond 11S – Pond Configuration and Location of Monitoring Points

Rev 1

Pond 12S

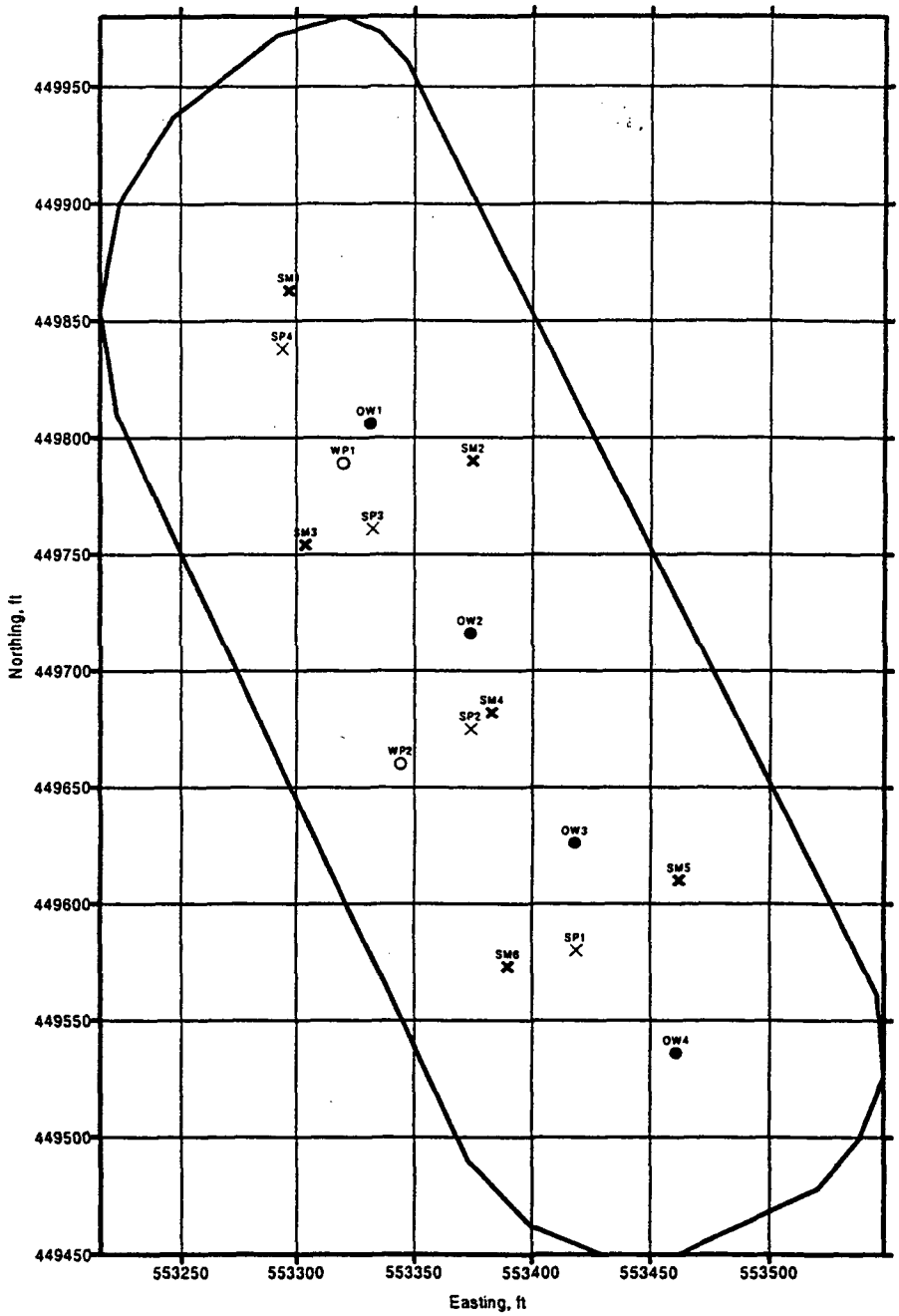


O WP - 2-in PVC
X SP - Temp. Settlement Plate
● OW - 6-in dia. Observation Well
X SM - Settlement Monument

Figure 11 - Pond 12S – Pond Configuration and Location of Monitoring Points

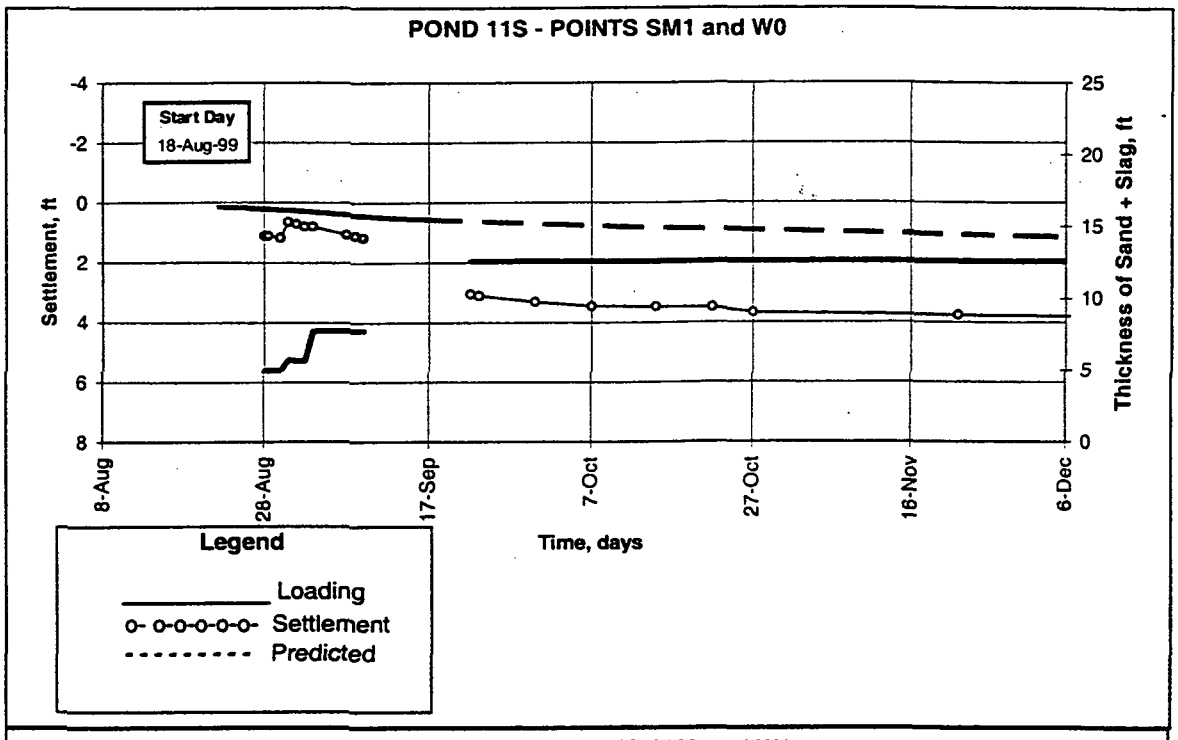
Rev 1

Pond 13S



O WP - 2-in PVC
X SP - Temp. Settlement Plate
● OW - 6-in dia. Observation Well
X SM - Settlement Monument

Figure 12 - Pond 13S – Pond Configuration and Location of Monitoring Points



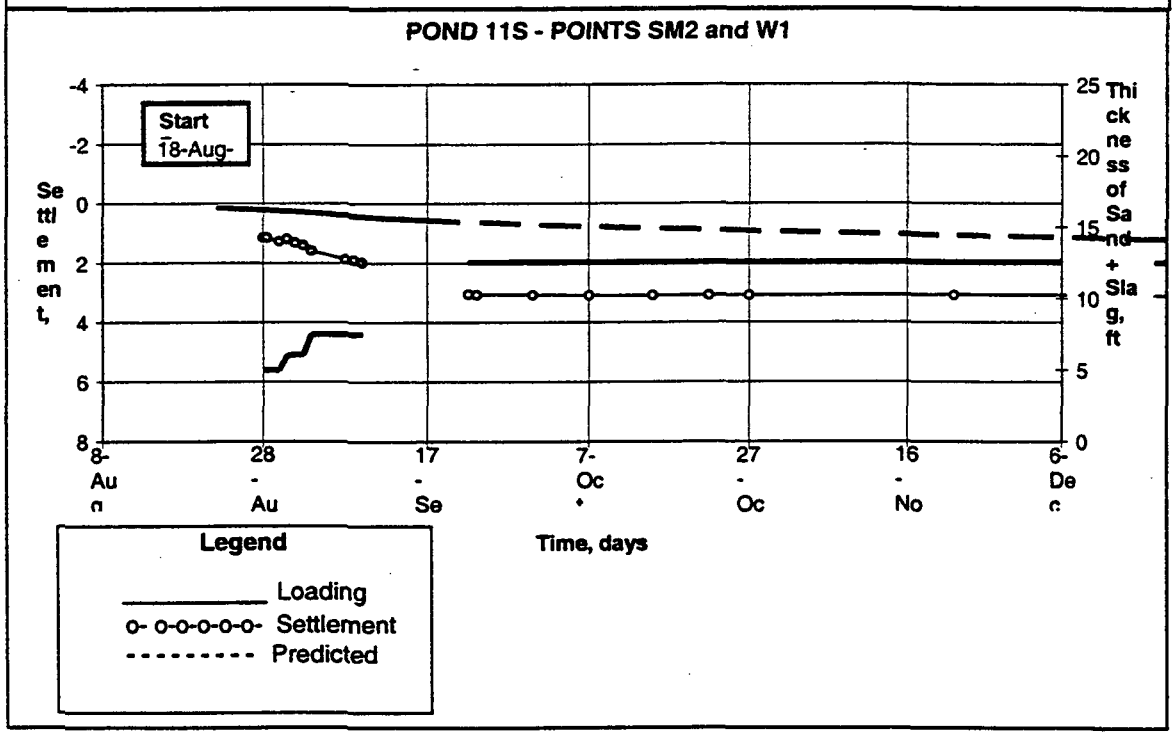


Figure 13 – Settlement Monitoring Results as of July 2001

Rev 1

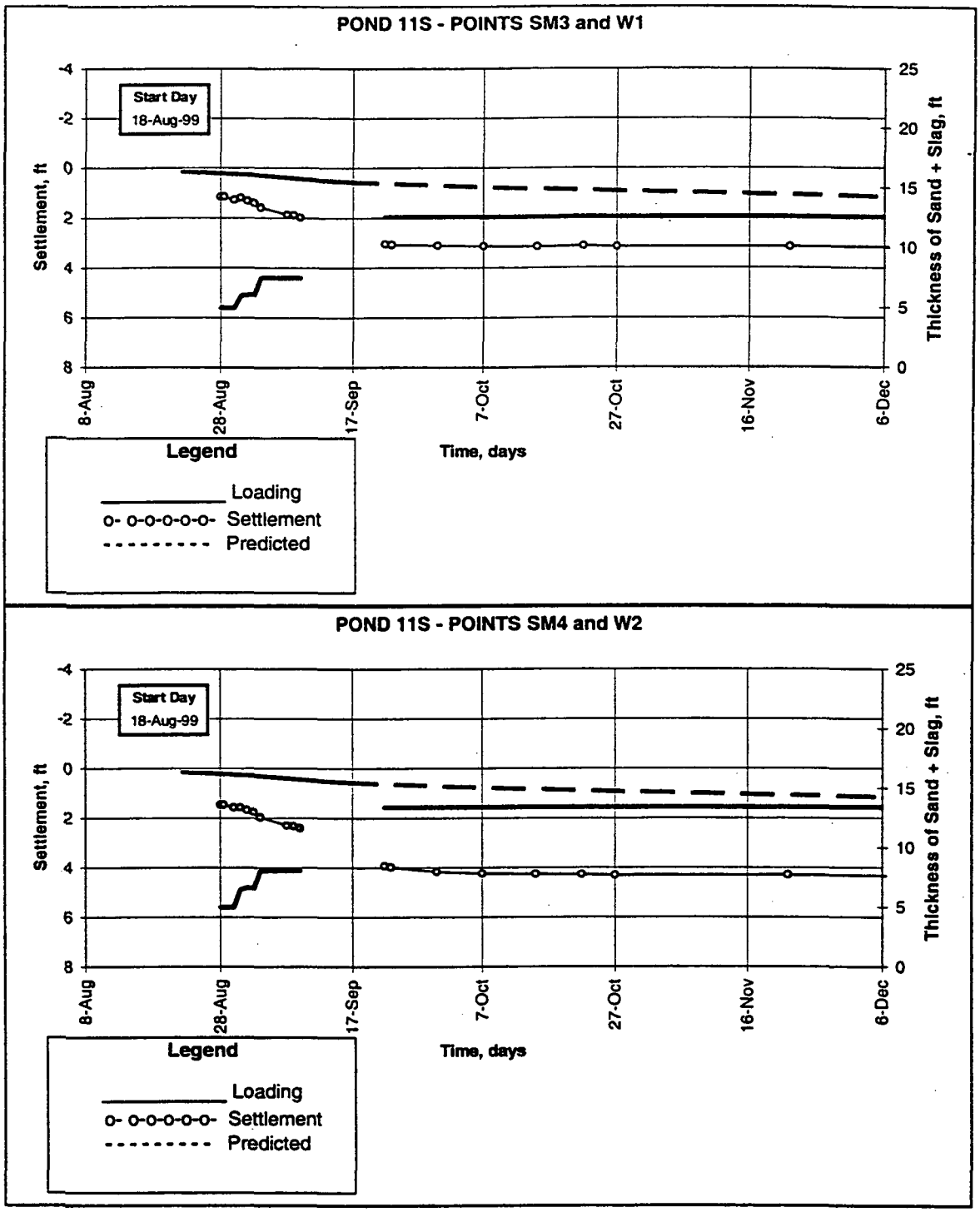


Figure 14 – Settlement Monitoring Results as of July 2001

Rev 1

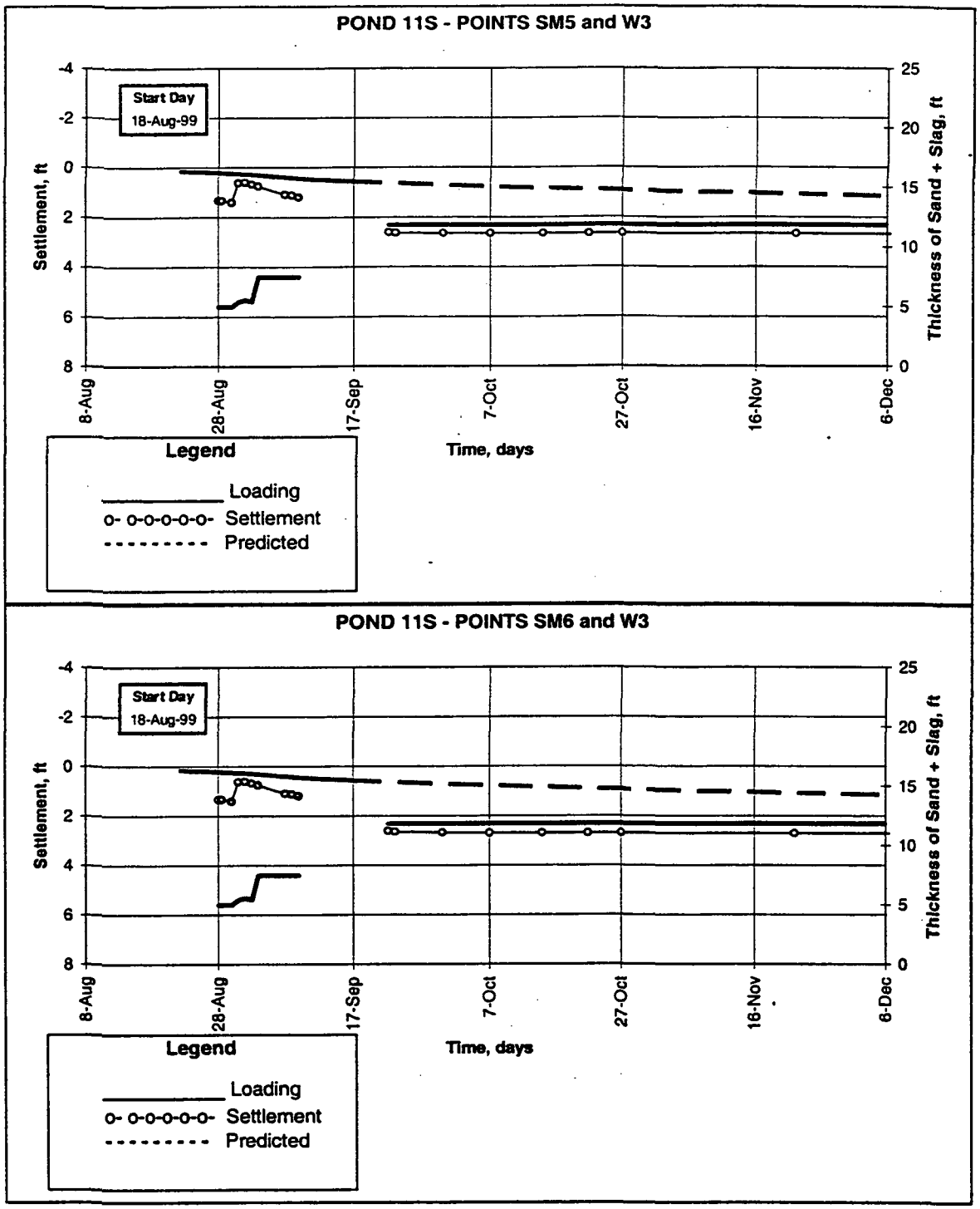


Figure 15 – Settlement Monitoring Results as of July 2001

Rev 1

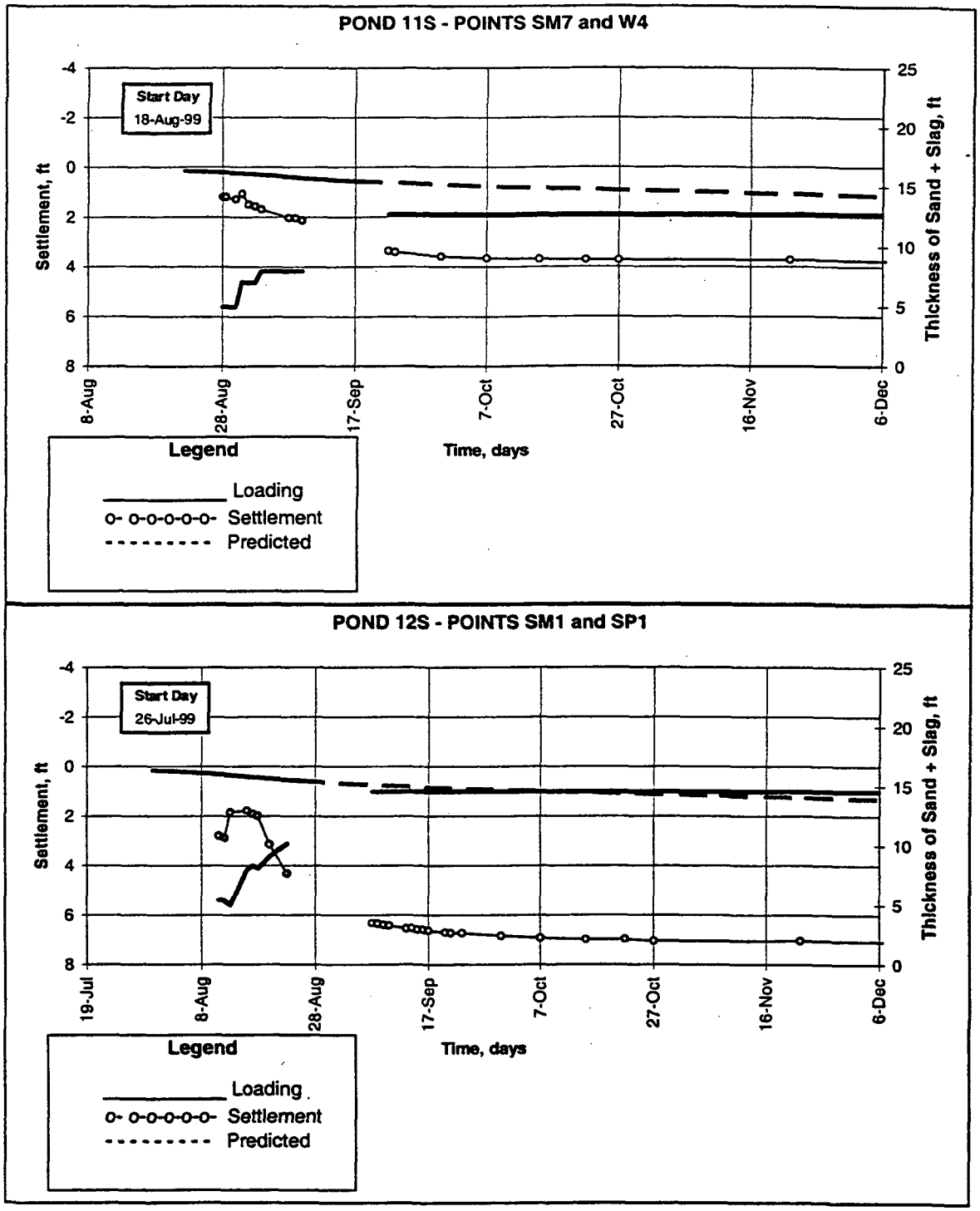


Figure 16 – Settlement Monitoring Results as of July 2001

Rev 1

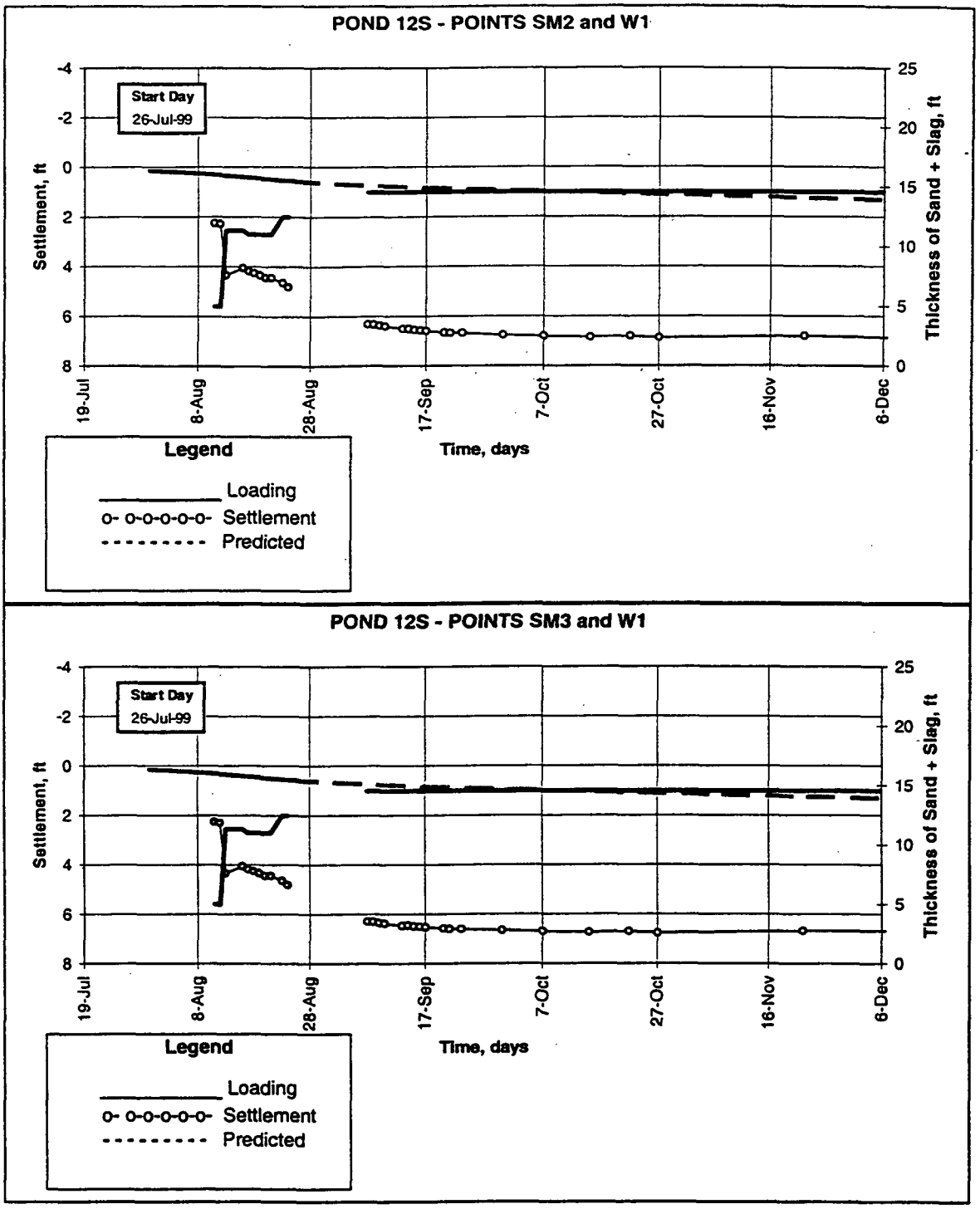


Figure 17 – Settlement Monitoring Results as of July 2001

Rev 1

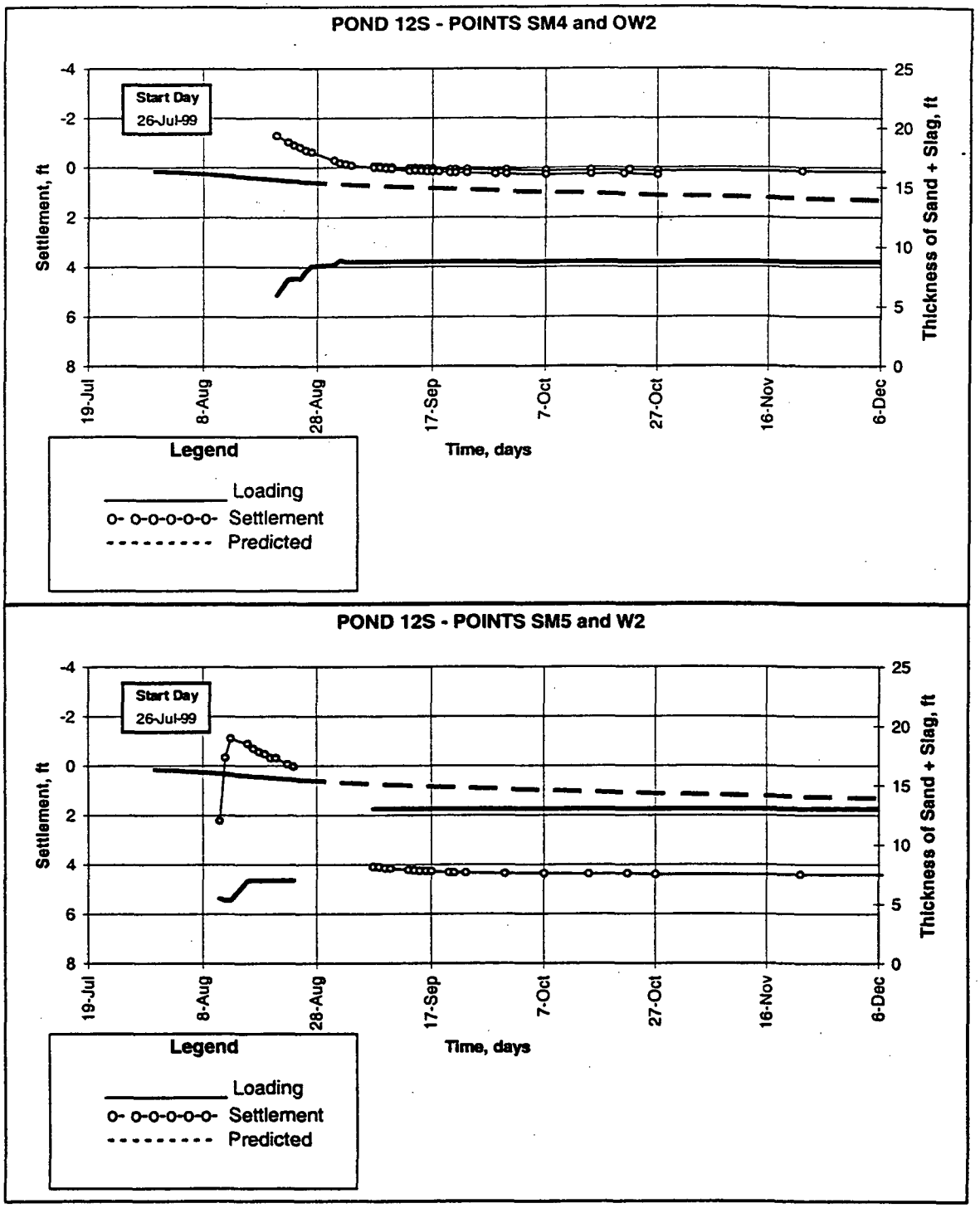


Figure 18 – Settlement Monitoring Results as of July 2001

Rev 1

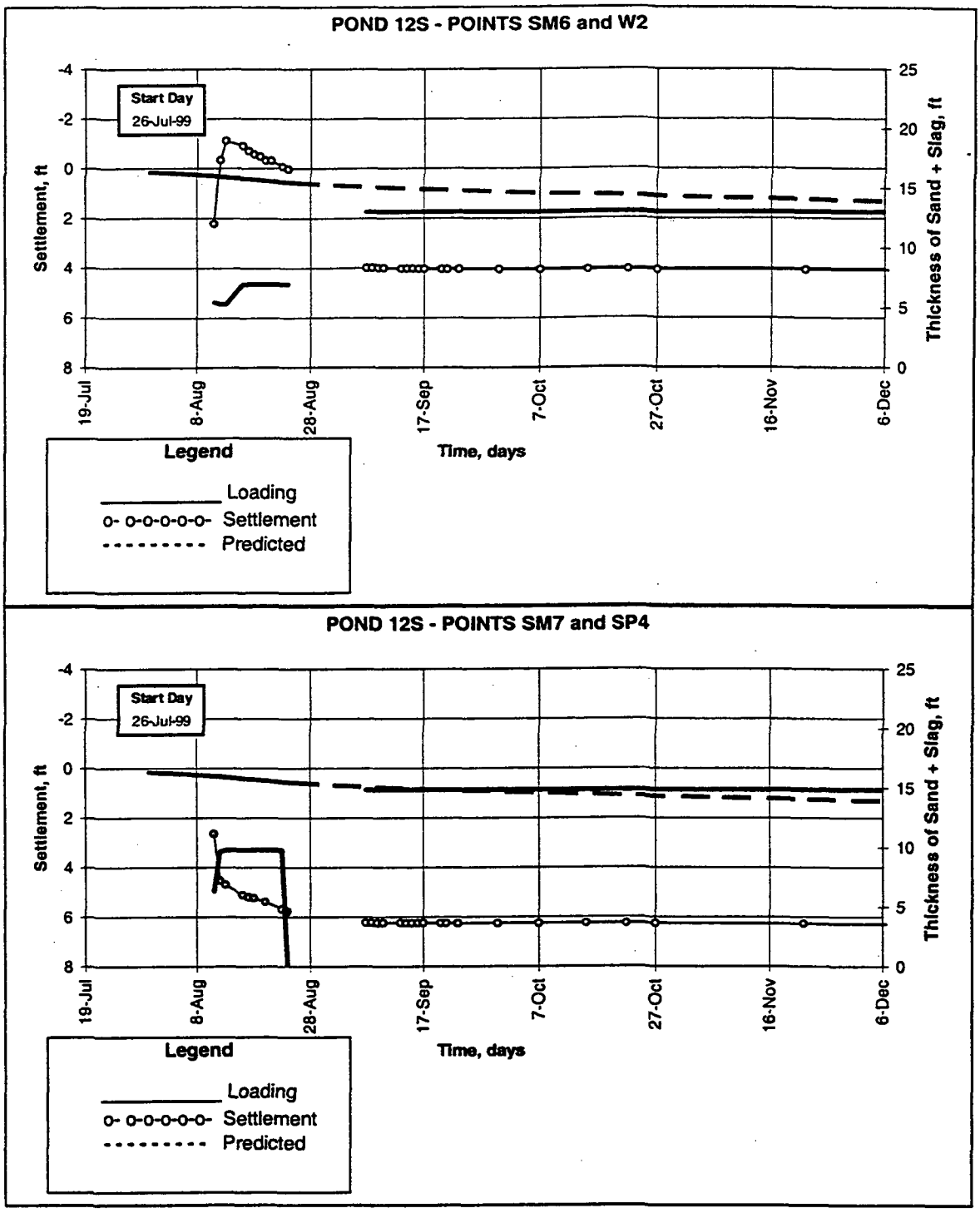


Figure 19 – Settlement Monitoring Results as of July 2001

Rev 1

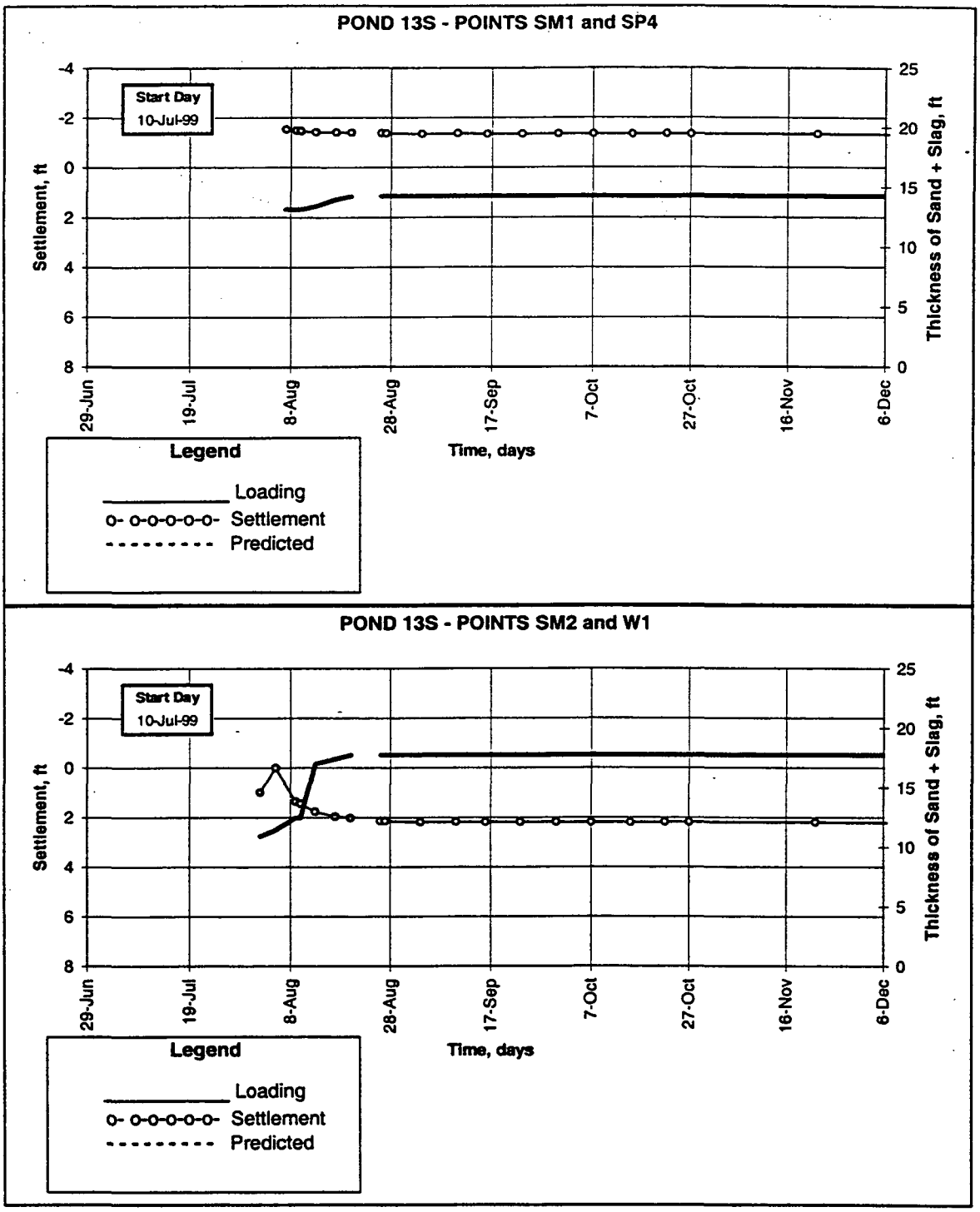
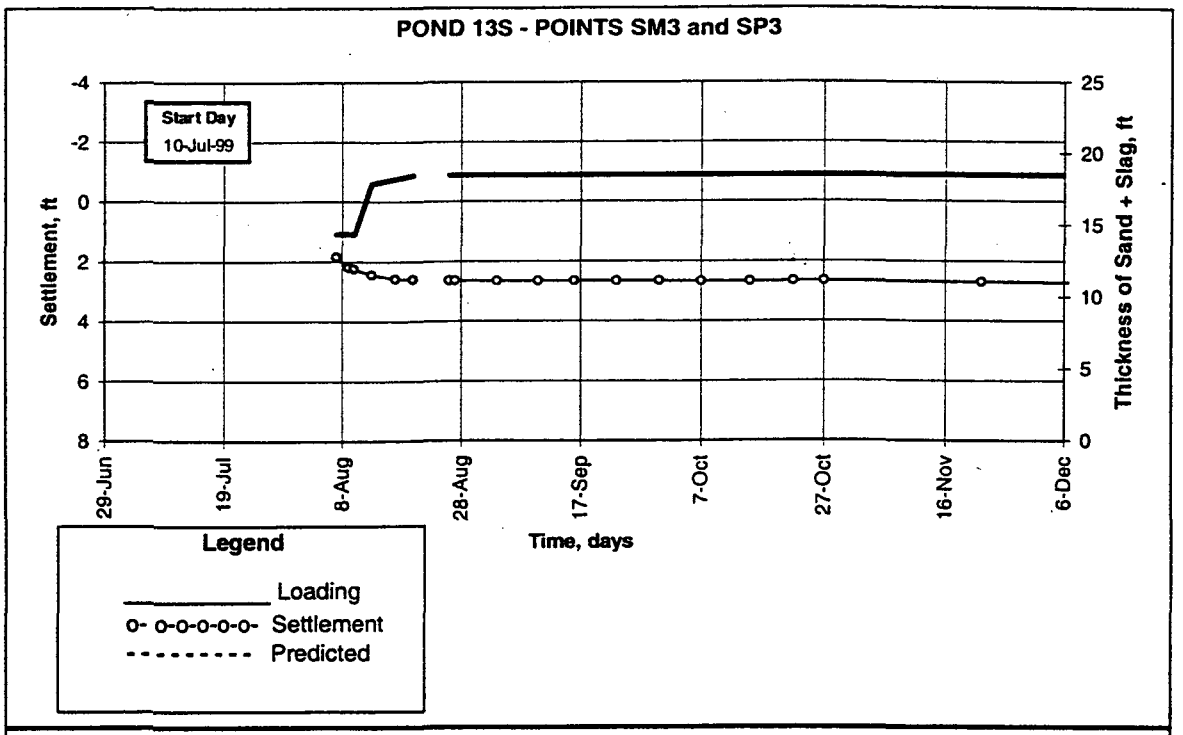


Figure 20 – Settlement Monitoring Results as of July 2001

Rev 1



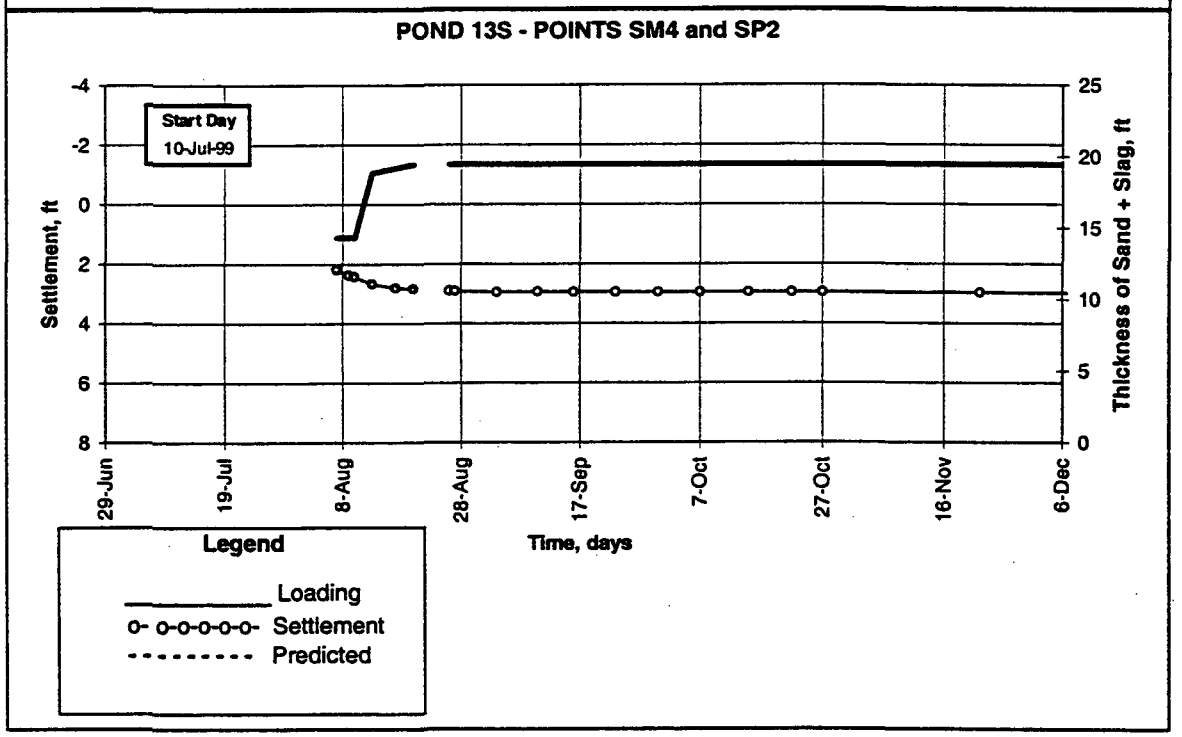


Figure 21 – Settlement Monitoring Results as of July 2001

Rev 1

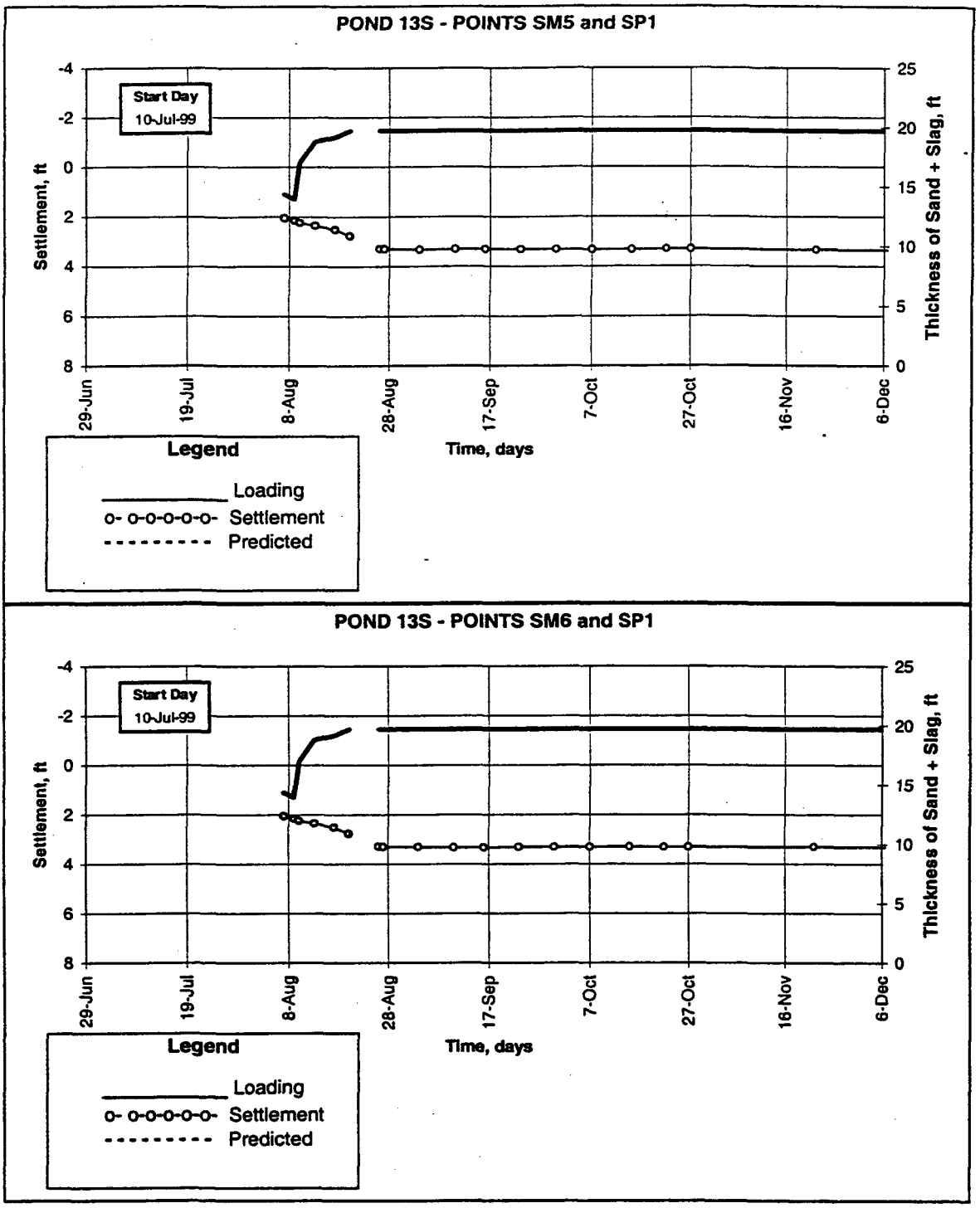


Figure 22 – Settlement Monitoring Results as of July 2001

Rev 1

```
*******************************************************************
*                                                                 *
*       ACCUMV - NONLINEAR LARGE STRAIN CONSOLIDATION             *
*                    by                                           *
*                ROBERT L. SCHIFFMAN                              *
*               VLASTA SZAVITS-NOSSAN                             *
*                JOHN M. McARTHUR                                 *
*                                                                 *
*            DEPARTMENT OF CIVIL ENGINEERING                      *
*           UNIVERSITY OF COLORADO AT BOULDER                     *
*             BOULDER, CO 80309-0428  USA                         *
*                                                                 *
*                                                                 *
*  COPYRIGHT @1992 by Robert L. Schiffman, Vlasta Szavits-Nossan, *
*                and John M. McArthur                             *
*                                                                 *
*******************************************************************
```

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

```
****************
*              *
* INPUT DATA   *
*              *
****************
```

****** UNITS ******

LENGTH	FORCE	TIME
feet	pounds	months

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* UNIT WEIGHTS *******

GAMMAS	GAMMAW
174.1000	62.4000

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* INITIAL GEOMETRY *******

H(0) TOTAL HEADS

	TOT HD(L)	HW
15.750	.000	15.750

******* VOID RATIO RANGE *******

EMAX	EMIN
8.000	1.000

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* EFFECTIVE STRESS AT TOP OF LAYER *******

Q0
1.0000

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* CONSTITUTIVE RELATIONSHIPS *******

$$E = \frac{(.4270E+01) + (-.1970E+00) * LN(EFFSTR)}{1 + (.0000E+00) * LN(EFFSTR) + (.0000E+00) * LN(EFFSTR)*LN(EFFSTR)}$$

```
                ( .5000E-02) * (E) ** ( .2600E+01)
          K = ----------------------------------
                  1 + ( .0000E+00) * (E)
```

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

********** CALCULATION DATA **********

N	TMAX	ALPHA
10	.6000E+02	.5000E+00

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* HEIGHT-TIME FUNCTION *******

TIME	H
.000E+00	15.750
.100E+03	15.750

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* TIME - LOAD FUNCTIONS *******

TIME	LOAD
.0000E+00	.0000
.2000E+00	300.0000
.4000E+00	575.0000
.6000E+00	857.0000
.7000E+00	1139.0000
.2400E+02	1139.0000
.2600E+02	1979.0000
.6000E+02	1979.0000

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

**** PRINT TIMES ****
.15000E+00
.20000E+00
.22500E+00
.25000E+00
.27500E+00
.30000E+00
.35000E+00
.40000E+00
.50000E+00
.60000E+00
.70000E+00
.80000E+00
.90000E+00
.10000E+01
.12500E+01
.15000E+01
.17500E+01
.20000E+01
.22500E+01
.25000E+01
.27500E+01
.30000E+01
.35000E+01
.40000E+01
.50000E+01
.60000E+01
.70000E+01
.80000E+01
.90000E+01
.10000E+02
.12000E+02
.12500E+02
.15000E+02
.17500E+02
.18000E+02
.20000E+02
.22500E+02
.24000E+02
.25000E+02
.26000E+02
.27500E+02
.28000E+02
.30000E+02
.32000E+02
.34000E+02
.35000E+02
.38000E+02
.40000E+02
.45000E+02
.50000E+02

.55000E+02
.60000E+02

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

```
***************
*             *
* FUNCTIONS   *
*             *
***************
```

E	EFFSTR	K	G	D(G)	D(K/1+E)	AV
1.000	.162E+08	.500E-02	-.329E+04	.979E+04	.525E-02	.122E-07
1.700	.463E+06	.199E-01	-.277E+03	.109E+04	.853E-02	.425E-06
2.400	.133E+05	.487E-01	-.154E+02	.662E+02	.113E-01	.149E-04
3.100	.380E+03	.947E-01	-.713E+00	.320E+01	.137E-01	.519E-03
3.800	.109E+02	.161E+00	-.296E-01	.136E+00	.159E-01	.181E-01
4.500	.311E+00	.250E+00	-.115E-02	.538E-02	.180E-01	.633E+00
5.200	.891E-02	.364E+00	-.425E-04	.201E-03	.199E-01	.221E+02
5.900	.255E-03	.505E+00	-.152E-05	.726E-05	.216E-01	.772E+03
6.600	.730E-05	.676E+00	-.528E-07	.254E-06	.233E-01	.270E+05
7.300	.209E-06	.878E+00	-.180E-08	.871E-08	.249E-01	.942E+06
8.000	.599E-08	.111E+01	-.603E-10	.293E-09	.265E-01	.329E+08

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .00000E+00 LOAD = .000
SET = .0000

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.7500	.0000	4.2700	1.000	1.0000
.1000	13.9763	.3673	3.5335	152.704	42.0281
.2000	12.3459	.7346	3.3994	295.475	83.0564
.3000	10.7378	1.1019	3.3203	436.847	124.0845
.4000	9.1693	1.4692	3.2640	575.746	165.1127
.5000	7.6114	1.8365	3.2203	713.990	206.1409
.6000	6.0681	2.2038	3.1845	851.320	247.1691
.7000	4.5368	2.5711	3.1543	987.902	288.1970
.8000	3.0158	2.9385	3.1280	1123.838	329.2253

.9000	1.5039	3.3058	3.1049	1259.211	370.2537
1.0000	.0000	3.6731	3.0842	1394.082	411.2814

********** PORE PRESSURES **********

CHI	UW	U0	U
15.7500	.000	.000	.0000
13.9763	110.676	110.676	.0000
12.3459	212.419	212.419	.0000
10.7378	312.763	312.763	-.0001
9.1693	410.634	410.634	-.0001
7.6114	507.849	507.849	-.0001
6.0681	604.151	604.151	-.0001
4.5368	699.705	699.705	.0001
3.0158	794.613	794.613	-.0001
1.5039	888.957	888.957	-.0002
.0000	982.800	982.800	.0002

TIMESTEP SIZE = .00, ITERATIONS BETWEEN PRINT TIMES = 0

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+00 LOAD = 225.000
SET = .1484

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.6016	.0000	3.2022	235.259	226.0000
.1000	13.9851	.3673	3.4985	377.155	50.2129
.2000	12.3456	.7346	3.3979	520.493	83.6755
.3000	10.7516	1.1019	3.3201	660.984	124.1748
.4000	9.1693	1.4692	3.2640	800.748	165.1487
.5000	7.6114	1.8365	3.2203	938.990	206.1623
.6000	6.0681	2.2038	3.1845	1076.321	247.1831
.7000	4.5368	2.5711	3.1543	1212.903	288.2071
.8000	3.0158	2.9385	3.1280	1348.839	329.2329
.9000	1.5039	3.3058	3.1049	1484.211	370.2591
1.0000	.0000	3.6731	3.0842	1619.082	411.2864

********** PORE PRESSURES **********

CHI	UW	U0	U
15.6016	9.259	9.259	.0000
13.9851	326.942	110.127	216.8152
12.3456	436.817	212.436	224.3808
10.7516	536.810	311.900	224.9097
9.1693	635.599	410.635	224.9639

7.6114	732.827	507.849	224.9785
6.0681	829.138	604.152	224.9858
4.5368	924.696	699.706	224.9900
3.0158	1019.606	794.613	224.9924
1.5039	1113.952	888.957	224.9944
.0000	1207.795	982.800	224.9952

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 4

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+00 LOAD = 300.000
SET = .1650

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5850	.0000	3.1457	311.296	301.0000
.1000	13.9818	.3673	3.4794	452.367	55.3119
.2000	12.3454	.7346	3.3966	595.506	84.2133
.3000	10.7512	1.1019	3.3200	736.011	124.2453
.4000	9.1693	1.4692	3.2639	875.748	165.1651
.5000	7.6114	1.8365	3.2202	1013.989	206.1703
.6000	6.0681	2.2038	3.1845	1151.321	247.1882
.7000	4.5368	2.5711	3.1543	1287.903	288.2106
.8000	3.0158	2.9385	3.1280	1423.839	329.2353
.9000	1.5039	3.3058	3.1049	1559.211	370.2613
1.0000	.0000	3.6731	3.0842	1694.082	411.2884

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5850	10.295	10.296	.0000
13.9818	397.055	110.339	286.7163
12.3454	511.293	212.450	298.8430
10.7512	611.766	311.927	299.8391
9.1693	710.583	410.636	299.9475
7.6114	807.819	507.848	299.9705
6.0681	904.133	604.152	299.9807
4.5368	999.692	699.706	299.9865
3.0158	1094.603	794.613	299.9900
1.5039	1188.950	888.958	299.9921
.0000	1282.793	982.800	299.9932

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 6

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+00 LOAD = 334.375
SET = .1735

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5765	.0000	3.1244	346.199	335.3751
.1000	13.9795	.3673	3.4680	486.885	58.6055
.2000	12.3452	.7346	3.3957	629.892	84.6110
.3000	10.7507	1.1019	3.3199	770.413	124.3000
.4000	9.1693	1.4692	3.2639	910.124	165.1761
.5000	7.6114	1.8365	3.2202	1048.364	206.1745
.6000	6.0681	2.2038	3.1845	1185.696	247.1909
.7000	4.5368	2.5711	3.1543	1322.278	288.2124
.8000	3.0158	2.9385	3.1280	1458.214	329.2365
.9000	1.5039	3.3058	3.1049	1593.586	370.2622
1.0000	.0000	3.6731	3.0842	1728.457	411.2894

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5765	10.824	10.824	-.0001
13.9795	428.279	110.481	317.7977
12.3452	545.281	212.460	332.8203
10.7507	646.113	311.954	334.1594
9.1693	744.948	410.636	334.3116
7.6114	842.189	507.848	334.3412
6.0681	938.505	604.152	334.3531
4.5368	1034.066	699.706	334.3597
3.0158	1128.977	794.613	334.3638
1.5039	1223.324	888.958	334.3662
.0000	1317.167	982.800	334.3672

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 7
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+00 LOAD = 368.750
SET = .1822

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5678	.0000	3.1052	381.117	369.7499
.1000	13.9769	.3673	3.4558	521.420	62.3762

.2000	12.3450	.7346	3.3946	664.279	85.0930
.3000	10.7502	1.1019	3.3198	804.820	124.3696
.4000	9.1693	1.4692	3.2639	944.499	165.1895
.5000	7.6114	1.8365	3.2202	1082.738	206.1793
.6000	6.0681	2.2038	3.1845	1220.071	247.1936
.7000	4.5368	2.5711	3.1543	1356.653	288.2141
.8000	3.0158	2.9385	3.1280	1492.589	329.2377
.9000	1.5039	3.3058	3.1049	1627.961	370.2635
1.0000	.0000	3.6731	3.0842	1762.832	411.2904

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5678	11.367	11.367	.0001
13.9769	459.044	110.642	348.4020
12.3450	579.186	212.473	366.7133
10.7502	680.450	311.985	368.4649
9.1693	779.310	410.637	368.6732
7.6114	876.559	507.847	368.7115
6.0681	972.878	604.152	368.7254
4.5368	1068.439	699.706	368.7330
3.0158	1163.351	794.613	368.7376
1.5039	1257.697	888.958	368.7399
.0000	1351.541	982.800	368.7412

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 8

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+00 LOAD = 403.125
SET = .1912

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5588	.0000	3.0877	416.054	404.1250
.1000	13.9740	.3673	3.4426	555.973	66.6926
.2000	12.3448	.7346	3.3933	698.669	85.6700
.3000	10.7497	1.1019	3.3197	839.230	124.4567
.4000	9.1693	1.4692	3.2639	978.875	165.2059
.5000	7.6114	1.8365	3.2202	1117.113	206.1845
.6000	6.0681	2.2038	3.1845	1254.446	247.1963
.7000	4.5368	2.5711	3.1542	1391.028	288.2162
.8000	3.0158	2.9385	3.1280	1526.964	329.2393
.9000	1.5039	3.3058	3.1049	1662.336	370.2644
1.0000	.0000	3.6731	3.0842	1797.207	411.2914

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5588	11.929	11.929	.0000
13.9740	489.281	110.820	378.4605
12.3448	612.999	212.488	400.5113
10.7497	714.774	312.021	402.7527
9.1693	813.669	410.637	403.0318
7.6114	910.928	507.847	403.0813
6.0681	1007.250	604.152	403.0977
4.5368	1102.812	699.706	403.1059
3.0158	1197.724	794.613	403.1110
1.5039	1292.072	888.958	403.1140
.0000	1385.915	982.800	403.1152

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 9

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+00 LOAD = 437.500
SET = .2005

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5495	.0000	3.0716	451.012	438.5002
.1000	13.9709	.3673	3.4285	590.545	71.6385
.2000	12.3445	.7346	3.3917	733.062	86.3543
.3000	10.7490	1.1019	3.3195	873.645	124.5646
.4000	9.1693	1.4692	3.2639	1013.250	165.2260
.5000	7.6114	1.8365	3.2202	1151.487	206.1905
.6000	6.0681	2.2038	3.1845	1288.821	247.1993
.7000	4.5368	2.5711	3.1542	1425.403	288.2183
.8000	3.0158	2.9385	3.1280	1561.339	329.2409
.9000	1.5039	3.3058	3.1049	1696.711	370.2658
1.0000	.0000	3.6731	3.0842	1831.582	411.2924

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5495	12.512	12.512	-.0002
13.9709	518.906	111.017	407.8896
12.3445	646.707	212.505	434.2020
10.7490	749.081	312.061	437.0198
9.1693	848.024	410.637	437.3866
7.6114	945.296	507.846	437.4503
6.0681	1041.622	604.152	437.4697
4.5368	1137.185	699.706	437.4788
3.0158	1232.098	794.613	437.4844
1.5039	1326.445	888.958	437.4876

.0000 1420.289 982.800 437.4892

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 10

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S. 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+00 LOAD = 506.250
SET = .2200

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5300	.0000	3.0429	520.977	507.2499
.1000	13.9639	.3673	3.3982	659.732	83.5240
.2000	12.3438	.7346	3.3880	801.855	88.0014
.3000	10.7476	1.1019	3.3191	942.484	124.8348
.4000	9.1693	1.4692	3.2638	1082.001	165.2773
.5000	7.6115	1.8365	3.2202	1220.235	206.2045
.6000	6.0681	2.2038	3.1845	1357.572	247.2056
.7000	4.5368	2.5711	3.1542	1494.153	288.2225
.8000	3.0158	2.9385	3.1280	1630.089	329.2437
.9000	1.5039	3.3058	3.1049	1765.461	370.2680
1.0000	.0000	3.6731	3.0842	1900.332	411.2949

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5300	13.727	13.727	.0001
13.9639	576.208	111.454	464.7542
12.3438	713.854	212.549	501.3049
10.7476	817.649	312.150	505.4996
9.1693	916.724	410.639	506.0853
7.6115	1014.031	507.845	506.1863
6.0681	1110.366	604.153	506.2133
4.5368	1205.931	699.706	506.2246
3.0158	1300.845	794.613	506.2316
1.5039	1395.193	888.958	506.2354
.0000	1489.037	982.800	506.2367

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 12

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+00 LOAD = 575.000
SET = .2413

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5087	.0000	3.0178	591.056	575.9999
.1000	13.9556	.3673	3.3642	729.001	99.2968
.2000	12.3428	.7346	3.3830	870.664	90.2463
.3000	10.7460	1.1019	3.3185	1011.336	125.2218
.4000	9.1692	1.4692	3.2637	1150.753	165.3523
.5000	7.6115	1.8365	3.2202	1288.983	206.2232
.6000	6.0681	2.2038	3.1845	1426.322	247.2130
.7000	4.5368	2.5711	3.1542	1562.903	288.2267
.8000	3.0158	2.9385	3.1280	1698.839	329.2469
.9000	1.5039	3.3058	3.1049	1834.211	370.2703
1.0000	.0000	3.6731	3.0842	1969.082	411.2968

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5087	15.056	15.056	.0001
13.9556	629.704	111.973	517.7314
12.3428	780.417	212.607	567.8101
10.7460	886.115	312.252	573.8626
9.1692	985.400	410.640	574.7603
7.6115	1082.760	507.842	574.9176
6.0681	1179.109	604.153	574.9559
4.5368	1274.677	699.706	574.9705
3.0158	1369.592	794.614	574.9784
1.5039	1463.941	888.958	574.9832
.0000	1557.785	982.800	574.9847

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 14

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+00 LOAD = 716.000
SET = .2906

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.4594	.0000	2.9747	735.130	717.0002
.1000	13.9344	.3673	3.2841	871.321	149.0891
.2000	12.3399	.7346	3.3680	1011.847	97.3720
.3000	10.7422	1.1019	3.3164	1152.572	126.5159
.4000	9.1692	1.4692	3.2634	1291.757	165.6156
.5000	7.6116	1.8365	3.2201	1429.977	206.2856
.6000	6.0681	2.2038	3.1845	1567.322	247.2337

.7000	4.5368	2.5711	3.1542	1703.903	288.2364
.8000	3.0158	2.9385	3.1280	1839.839	329.2536
.9000	1.5039	3.3058	3.1049	1975.211	370.2761
1.0000	.0000	3.6731	3.0842	2110.082	411.3018

********** PORE PRESSURES **********

CHI	UW	U0	U
15.4594	18.130	18.131	-.0002
13.9344	722.232	113.293	608.9391
12.3399	914.475	212.791	701.6843
10.7422	1026.056	312.487	713.5685
9.1692	1126.142	410.645	715.4970
7.6116	1223.692	507.836	715.8552
6.0681	1320.089	604.153	715.9352
4.5368	1415.667	699.706	715.9607
3.0158	1510.585	794.614	715.9716
1.5039	1604.935	888.958	715.9774
.0000	1698.780	982.800	715.9797

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 17

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+00 LOAD = 857.000
SET = .3490

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.4010	.0000	2.9393	879.780	858.0001
.1000	13.9063	.3673	3.1902	1014.078	240.1398
.2000	12.3348	.7346	3.3431	1153.166	110.5033
.3000	10.7382	1.1019	3.3127	1293.821	128.9537
.4000	9.1690	1.4692	3.2628	1432.767	166.1358
.5000	7.6117	1.8365	3.2200	1570.968	206.4092
.6000	6.0680	2.2038	3.1844	1708.323	247.2687
.7000	4.5368	2.5711	3.1542	1844.903	288.2504
.8000	3.0158	2.9385	3.1280	1980.839	329.2612
.9000	1.5039	3.3058	3.1049	2116.211	370.2819
1.0000	.0000	3.6731	3.0842	2251.082	411.3078

********** PORE PRESSURES **********

CHI	UW	U0	U
15.4010	21.780	21.780	-.0001
13.9063	773.938	115.050	658.8883
12.3348	1042.663	213.110	829.5530

10.7382	1164.868	312.737	852.1307
9.1690	1266.631	410.654	855.9768
7.6117	1364.559	507.828	856.7316
6.0680	1461.054	604.154	856.9003
4.5368	1556.653	699.706	856.9467
3.0158	1651.578	794.614	856.9641
1.5039	1745.929	888.958	856.9716
.0000	1839.774	982.800	856.9738

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 20

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98. Pond 11S. 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+00 LOAD = 1139.000
SET = .4192

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.3308	.0000	2.8834	1166.158	1140.0000
.1000	13.8703	.3673	3.0887	1298.318	401.9043
.2000	12.3261	.7346	3.3030	1435.709	135.4641
.3000	10.7352	1.1019	3.3058	1576.008	133.5262
.4000	9.1687	1.4692	3.2616	1714.784	167.1294
.5000	7.6119	1.8365	3.2198	1852.957	206.6502
.6000	6.0680	2.2038	3.1844	1990.324	247.3342
.7000	4.5368	2.5711	3.1542	2126.903	288.2724
.8000	3.0158	2.9385	3.1280	2262.839	329.2715
.9000	1.5039	3.3058	3.1049	2398.211	370.2886
1.0000	.0000	3.6731	3.0842	2533.082	411.3138

********** PORE PRESSURES **********

CHI	UW	U0	U
15.3308	26.158	26.158	.0001
13.8703	896.414	117.290	779.1238
12.3261	1300.245	213.653	1086.5920
10.7352	1442.482	312.924	1129.5580
9.1687	1547.655	410.672	1136.9830
7.6119	1646.307	507.816	1138.4910
6.0680	1742.990	604.155	1138.8350
4.5368	1838.631	699.706	1138.9250
3.0158	1933.568	794.614	1138.9540
1.5039	2027.923	888.958	1138.9650
.0000	2121.768	982.800	1138.9680

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 23

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge, 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .80000E+00 LOAD = 1139.000
SET = .4804

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.2696	.0000	2.8834	1169.979	1140.0000
.1000	13.8276	.3673	3.0093	1300.985	601.6889
.2000	12.3114	.7346	3.2403	1436.622	186.1967
.3000	10.7344	1.1019	3.2932	1576.056	142.3396
.4000	9.1682	1.4692	3.2594	1714.817	169.0176
.5000	7.6121	1.8365	3.2193	1852.946	207.1116
.6000	6.0680	2.2038	3.1843	1990.326	247.4591
.7000	4.5368	2.5711	3.1542	2126.903	288.3107
.8000	3.0158	2.9385	3.1280	2262.840	329.2867
.9000	1.5039	3.3058	3.1049	2398.211	370.2971
1.0000	.0000	3.6731	3.0842	2533.082	411.3203

********** PORE PRESSURES **********

CHI	UW	U0	U
15.2696	29.979	29.979	.0001
13.8276	699.296	119.957	579.3392
12.3114	1250.426	214.566	1035.8600
10.7344	1433.716	312.971	1120.7450
9.1682	1545.800	410.705	1135.0950
7.6121	1645.835	507.806	1138.0290
6.0680	1742.867	604.157	1138.7100
4.5368	1838.593	699.706	1138.8860
3.0158	1933.553	794.614	1138.9390
1.5039	2027.914	888.958	1138.9560
.0000	2121.761	982.800	1138.9610

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 26

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge, 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .90000E+00 LOAD = 1139.000
SET = .5212

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE

.0000	15.2288	.0000	2.8834	1172.521	1140.0000
.1000	13.7876	.3673	2.9887	1303.480	667.7136
.2000	12.2896	.7346	3.1677	1437.983	269.2074
.3000	10.7354	1.1019	3.2701	1575.998	160.0843
.4000	9.1672	1.4692	3.2550	1714.882	172.8163
.5000	7.6118	1.8365	3.2185	1852.966	208.0275
.6000	6.0679	2.2038	3.1841	1990.329	247.7054
.7000	4.5368	2.5711	3.1541	2126.903	288.3844
.8000	3.0158	2.9385	3.1280	2262.840	329.3126
.9000	1.5039	3.3058	3.1049	2398.211	370.3092
1.0000	.0000	3.6731	3.0842	2533.082	411.3297

********** PORE PRESSURES **********

CHI	UW	U0	U
15.2288	32.522	32.521	.0001
13.7876	635.766	122.452	513.3146
12.2896	1168.776	215.927	952.8489
10.7354	1415.913	312.913	1103.0000
9.1672	1542.066	410.770	1131.2960
7.6118	1644.938	507.825	1137.1130
6.0679	1742.624	604.161	1138.4640
4.5368	1838.518	699.706	1138.8130
3.0158	1933.527	794.615	1138.9130
1.5039	2027.902	888.958	1138.9440
.0000	2121.752	982.800	1138.9520

TIMESTEP SIZE = .03, ITERATIONS BETWEEN PRINT TIMES = 29

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .10000E+01 LOAD = 1139.000
SET = .5610

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.1890	.0000	2.8834	1175.004	1140.0000
.1000	13.7479	.3673	2.9756	1305.960	713.8063
.2000	12.2632	.7346	3.1115	1439.634	358.1290
.3000	10.7289	1.1019	3.2363	1576.400	190.0794
.4000	9.1652	1.4692	3.2468	1715.007	180.1523
.5000	7.6107	1.8365	3.2168	1853.035	209.8530
.6000	6.0678	2.2038	3.1837	1990.336	248.1936
.7000	4.5368	2.5711	3.1540	2126.902	288.5272
.8000	3.0158	2.9385	3.1280	2262.840	329.3592
.9000	1.5039	3.3058	3.1049	2398.211	370.3285
1.0000	.0000	3.6731	3.0842	2533.082	411.3431

********** PORE PRESSURES **********

CHI	UW	U0	U
15.1890	35.004	35.004	.0001
13.7479	592.153	124.931	467.2219
12.2632	1081.505	217.578	863.9273
10.7289	1386.321	313.316	1073.0050
9.1652	1534.855	410.894	1123.9600
7.6107	1643.182	507.894	1135.2880
6.0678	1742.143	604.167	1137.9750
4.5368	1838.375	699.705	1138.6700
3.0158	1933.481	794.615	1138.8660
1.5039	2027.883	888.958	1138.9250
.0000	2121.739	982.800	1138.9380

TIMESTEP SIZE = .03, ITERATIONS BETWEEN PRINT TIMES = 33

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12500E+01 LOAD = 1139.000
SET = .6531

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.0969	.0000	2.8834	1180.753	1140.0000
.1000	13.6587	.3673	2.9515	1311.523	806.7644
.2000	12.1916	.7346	3.0400	1444.100	514.7545
.3000	10.6891	1.1019	3.1434	1578.886	304.5621
.4000	9.1529	1.4692	3.2053	1715.771	222.4317
.5000	7.6061	1.8365	3.2048	1853.318	223.0420
.6000	6.0669	2.2038	3.1806	1990.392	252.1886
.7000	4.5366	2.5711	3.1532	2126.911	289.7551
.8000	3.0157	2.9385	3.1277	2262.845	329.7561
.9000	1.5039	3.3058	3.1048	2398.212	370.4769
1.0000	.0000	3.6731	3.0841	2533.082	411.4373

********** PORE PRESSURES **********

CHI	UW	U0	U
15.0969	40.753	40.753	.0001
13.6587	504.759	130.495	374.2638
12.1916	929.345	222.044	707.3018
10.6891	1274.324	315.802	958.5223
9.1529	1493.340	411.659	1081.6810
7.6061	1630.276	508.177	1122.0990
6.0669	1738.204	604.223	1133.9800
4.5366	1837.156	699.714	1137.4420

3.0157	1933.089	794.620	1138.4690
1.5039	2027.735	888.959	1138.7760
.0000	2121.645	982.800	1138.8440

TIMESTEP SIZE = .03, ITERATIONS BETWEEN PRINT TIMES = 42

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+01 LOAD = 1139.000
SET = .7291

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.0209	.0000	2.8834	1185.496	1140.0000
.1000	13.5849	.3673	2.9382	1316.133	863.1503
.2000	12.1263	.7346	3.0053	1448.172	613.7847
.3000	10.6413	1.1019	3.0822	1581.867	415.5352
.4000	9.1286	1.4692	3.1499	1717.285	294.6304
.5000	7.5975	1.8365	3.1780	1853.856	255.5090
.6000	6.0637	2.2038	3.1709	1990.591	264.8643
.7000	4.5355	2.5711	3.1500	2126.983	294.4479
.8000	3.0154	2.9385	3.1267	2262.865	331.4766
.9000	1.5038	3.3058	3.1044	2398.217	371.1631
1.0000	.0000	3.6731	3.0839	2533.082	411.8772

********** PORE PRESSURES **********

CHI	UW	U0	U
15.0209	45.497	45.497	.0001
13.5849	452.983	135.105	317.8778
12.1263	834.388	226.116	608.2716
10.6413	1166.332	318.783	847.5493
9.1286	1422.655	413.173	1009.4820
7.5975	1598.347	508.715	1089.6320
6.0637	1725.727	604.422	1121.3050
4.5355	1832.535	699.786	1132.7490
3.0154	1931.389	794.640	1136.7490
1.5038	2027.054	888.963	1138.0900
.0000	2121.205	982.800	1138.4040

TIMESTEP SIZE = .03, ITERATIONS BETWEEN PRINT TIMES = 52

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .17500E+01 LOAD = 1139.000
SET = .7947

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.9553	.0000	2.8834	1189.591	1140.0000
.1000	13.5207	.3673	2.9294	1320.135	902.5477
.2000	12.0677	.7346	2.9838	1451.833	684.8331
.3000	10.5934	1.1019	3.0448	1584.857	502.3782
.4000	9.0966	1.4692	3.1039	1719.287	372.2004
.5000	7.5811	1.8365	3.1433	1854.882	304.6705
.6000	6.0565	2.2038	3.1531	1991.046	289.8736
.7000	4.5324	2.5711	3.1425	2127.172	305.8931
.8000	3.0143	2.9385	3.1237	2262.933	336.5114
.9000	1.5035	3.3058	3.1032	2398.238	373.5330
1.0000	.0000	3.6731	3.0831	2533.082	413.5444

********** PORE PRESSURES **********

CHI	UW	U0	U
14.9553	49.591	49.591	.0001
13.5207	417.588	139.107	278.4804
12.0677	767.000	229.777	537.2232
10.5934	1082.479	321.773	760.7062
9.0966	1347.087	415.175	931.9122
7.5811	1550.212	509.742	1040.4700
6.0565	1701.173	604.877	1096.2950
4.5324	1821.279	699.975	1121.3040
3.0143	1926.421	794.707	1131.7140
1.5035	2024.705	888.985	1135.7200
.0000	2119.537	982.800	1136.7370

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 63
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+01 LOAD = 1139.000
SET = .8531

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.8969	.0000	2.8834	1193.232	1140.0000
.1000	13.4635	.3673	2.9231	1323.709	931.7397
.2000	12.0142	.7346	2.9689	1455.169	738.4453
.3000	10.5473	1.1019	3.0195	1587.736	571.1968
.4000	9.0615	1.4692	3.0700	1721.478	442.0088

.5000	7.5586	1.8365	3.1103	1856.281	360.1732
.6000	6.0444	2.2038	3.1304	1991.796	325.3228
.7000	4.5267	2.5711	3.1302	2127.529	325.6245
.8000	3.0118	2.9385	3.1178	2263.087	346.8775
.9000	1.5025	3.3058	3.1001	2398.295	379.3259
1.0000	.0000	3.6731	3.0810	2533.082	418.0249

********** PORE PRESSURES **********

CHI	UW	U0	U
14.8969	53.232	53.232	.0001
13.4635	391.969	142.680	249.2885
12.0142	716.723	233.112	483.6111
10.5473	1016.539	324.651	691.8877
9.0615	1279.469	417.365	862.1038
7.5586	1496.108	511.141	984.9676
6.0444	1666.474	605.628	1060.8460
4.5267	1801.905	700.332	1101.5730
3.0118	1916.210	794.862	1121.3480
1.5025	2018.969	889.042	1129.9270
.0000	2115.057	982.800	1132.2570

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 74

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+01 LOAD = 1139.000
SET = .9057

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.8443	.0000	2.8834	1196.518	1140.0000
.1000	13.4116	.3673	2.9184	1326.944	954.3989
.2000	11.9652	.7346	2.9580	1458.227	780.6004
.3000	10.5036	1.1019	3.0011	1590.461	626.9495
.4000	9.0259	1.4692	3.0448	1723.699	502.4244
.5000	7.5330	1.8365	3.0826	1857.884	414.6896
.6000	6.0284	2.2038	3.1070	1992.797	366.4253
.7000	4.5179	2.5711	3.1145	2128.079	352.6244
.8000	3.0075	2.9385	3.1085	2263.359	363.5119
.9000	1.5008	3.3058	3.0946	2398.405	390.1458
1.0000	.0000	3.6731	3.0768	2533.082	427.0565

********** PORE PRESSURES **********

CHI	UW	U0	U
14.8443	56.519	56.518	.0001

13.4116	372.545	145.916	226.6293
11.9652	677.627	236.171	441.4559
10.5036	963.511	327.376	636.1350
9.0259	1221.275	419.586	801.6882
7.5330	1443.194	512.743	930.4512
6.0284	1626.372	606.629	1019.7440
4.5179	1775.454	700.882	1074.5730
3.0075	1899.847	795.134	1104.7130
1.5008	2008.259	889.151	1119.1080
.0000	2106.025	982.800	1123.2250

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 85

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S. 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+01 LOAD = 1139.000
SET = .9539

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.7961	.0000	2.8834	1199.524	1140.0000
.1000	13.3641	.3673	2.9146	1329.909	972.5913
.2000	11.9199	.7346	2.9495	1461.055	814.7682
.3000	10.4624	1.1019	2.9872	1593.033	673.0789
.4000	8.9908	1.4692	3.0253	1725.886	554.5203
.5000	7.5058	1.8365	3.0598	1859.581	465.4005
.6000	6.0095	2.2038	3.0852	1993.975	409.2403
.7000	4.5063	2.5711	3.0973	2128.804	384.7307
.8000	3.0011	2.9385	3.0966	2263.755	386.2067
.9000	1.4981	3.3058	3.0863	2398.574	406.9067
1.0000	.0000	3.6731	3.0701	2533.082	441.8847

********** PORE PRESSURES **********

CHI	UW	U0	U
14.7961	59.524	59.524	.0001
13.3641	357.318	148.881	208.4368
11.9199	646.287	238.998	407.2881
10.4624	919.954	329.948	590.0056
8.9908	1171.366	421.774	749.5923
7.5058	1394.181	514.440	879.7403
6.0095	1584.735	607.806	976.9286
4.5063	1744.073	701.607	1042.4660
3.0011	1877.548	795.530	1082.0190
1.4981	1991.667	889.320	1102.3470
.0000	2091.197	982.800	1108.3970

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 97

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98. Pond 11S. 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+01 LOAD = 1139.000
SET = .9984

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.7516	.0000	2.8834	1202.300	1140.0000
.1000	13.3201	.3673	2.9116	1332.653	987.5983
.2000	11.8777	.7346	2.9428	1463.687	843.1717
.3000	10.4234	1.1019	2.9761	1595.462	712.0255
.4000	8.9568	1.4692	3.0099	1728.010	599.8102
.5000	7.4781	1.8365	3.0411	1861.310	511.8057
.6000	5.9889	2.2038	3.0658	1995.261	451.6597
.7000	4.4925	2.5711	3.0801	2129.663	419.9935
.8000	2.9931	2.9385	3.0828	2264.259	414.1364
.9000	1.4945	3.3058	3.0756	2398.800	429.7333
1.0000	.0000	3.6731	3.0609	2533.082	462.9647

********** PORE PRESSURES **********

CHI	UW	U0	U
14.7516	62.301	62.300	.0001
13.3201	345.054	151.625	193.4299
11.8777	620.516	241.631	378.8846
10.4234	883.436	332.377	551.0590
8.9568	1128.200	423.898	704.3024
7.4781	1349.505	516.170	833.3351
5.9889	1543.601	609.092	934.5092
4.4925	1709.669	702.466	1007.2040
2.9931	1850.122	796.034	1054.0890
1.4945	1969.066	889.546	1079.5200
.0000	2070.117	982.800	1087.3170

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 109
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+01 LOAD = 1139.000
SET = 1.0398

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.7102	.0000	2.8834	1204.885	1140.0000
.1000	13.2791	.3673	2.9091	1335.209	1000.2800
.2000	11.8382	.7346	2.9372	1466.152	867.3337
.3000	10.3866	1.1019	2.9670	1597.760	745.5836
.4000	8.9239	1.4692	2.9972	1730.059	639.7427
.5000	7.4505	1.8365	3.0254	1863.031	554.3398
.6000	5.9675	2.2038	3.0485	1996.600	492.9287
.7000	4.4774	2.5711	3.0634	2130.609	457.1597
.8000	2.9837	2.9385	3.0681	2264.843	446.3528
.9000	1.4901	3.3058	3.0629	2399.071	458.1788
1.0000	.0000	3.6731	3.0497	2533.082	490.0586

********** PORE PRESSURES **********

CHI	UW	U0	U
14.7102	64.885	64.885	.0001
13.2791	334.929	154.181	180.7478
11.8382	598.819	244.096	354.7226
10.3866	852.176	334.676	517.5009
8.9239	1090.316	425.946	664.3699
7.4505	1308.691	517.890	790.8010
5.9675	1503.671	610.431	893.2402
4.4774	1673.449	703.412	970.0374
2.9837	1818.490	796.618	1021.8720
1.4901	1940.892	889.818	1051.0750
.0000	2043.023	982.800	1060.2230

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 121
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+01 LOAD = 1139.000
SET = 1.1151

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.6349	.0000	2.8834	1209.583	1140.0000
.1000	13.2046	.3673	2.9051	1339.862	1020.9750
.2000	11.7660	.7346	2.9284	1470.659	907.1064
.3000	10.3186	1.1019	2.9527	1602.003	801.7381
.4000	8.8623	1.4692	2.9771	1733.907	708.4445
.5000	7.3972	1.8365	2.9999	1866.356	630.8235
.6000	5.9243	2.2038	3.0192	1999.293	572.1398
.7000	4.4454	2.5711	3.0324	2132.605	534.8809
.8000	2.9630	2.9385	3.0379	2266.135	520.3794
.9000	1.4802	3.3058	3.0347	2399.692	528.7651

1.0000	.0000	3.6731	3.0236	2533.082	559.2921

********** PORE PRESSURES **********

CHI	UW	U0	U
14.6349	69.583	69.583	.0001
13.2046	318.888	158.834	160.0535
11.7660	563.553	248.603	314.9499
10.3186	800.265	338.919	461.3463
8.8623	1025.463	429.795	595.6681
7.3972	1235.533	521.215	714.3173
5.9243	1427.153	613.124	814.0291
4.4454	1597.725	705.409	892.3162
2.9630	1745.756	797.910	947.8459
1.4802	1870.927	890.438	980.4883
.0000	1973.790	982.800	990.9894

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 145

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+01 LOAD = 1139.000
SET = 1.1821

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.5679	.0000	2.8834	1213.763	1140.0000
.1000	13.1382	.3673	2.9018	1344.007	1037.9920
.2000	11.7014	.7346	2.9213	1474.687	940.1649
.3000	10.2574	1.1019	2.9413	1605.820	849.3043
.4000	8.8061	1.4692	2.9611	1737.412	768.4012
.5000	7.3478	1.8365	2.9793	1869.440	700.5375
.6000	5.8832	2.2038	2.9944	2001.854	648.6916
.7000	4.4140	2.5711	3.0048	2134.564	615.4695
.8000	2.9420	2.9385	3.0089	2267.442	602.8004
.9000	1.4699	3.3058	3.0060	2400.335	611.7068
1.0000	.0000	3.6731	2.9964	2533.082	642.2695

********** PORE PRESSURES **********

CHI	UW	U0	U
14.5679	73.763	73.763	.0001
13.1382	306.015	162.979	143.0357
11.7014	534.522	252.630	281.8914
10.2574	756.516	342.736	413.7801
8.8061	969.010	433.299	535.7114
7.3478	1168.903	524.299	644.6033

5.8832	1353.163	615.686	737.4774
4.4140	1519.095	707.367	811.7275
2.9420	1664.642	799.217	865.4249
1.4699	1788.628	891.081	897.5466
.0000	1890.812	982.800	908.0121

TIMESTEP SIZE = .02. ITERATIONS BETWEEN PRINT TIMES = 170

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S. 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+01 LOAD = 1139.000
SET = 1.2954

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.4546	.0000	2.8834	1220.835	1140.0000
.1000	13.0258	.3673	2.8963	1351.017	1067.5030
.2000	11.5923	.7346	2.9096	1481.500	998.0723
.3000	10.1538	1.1019	2.9226	1612.285	933.9875
.4000	8.7107	1.4692	2.9349	1743.362	877.6426
.5000	7.2634	1.8365	2.9455	1874.704	831.4685
.6000	5.8126	2.2038	2.9537	2006.262	797.8170
.7000	4.3594	2.5711	2.9584	2137.970	778.7962
.8000	2.9052	2.9385	2.9591	2269.741	776.0760
.9000	1.4515	3.3058	2.9554	2401.478	790.7153
1.0000	.0000	3.6731	2.9475	2533.082	823.0626

********** PORE PRESSURES **********

CHI	UW	U0	U
14.4546	80.835	80.835	.0001
13.0258	283.513	169.989	113.5247
11.5923	483.427	259.443	223.9840
10.1538	678.297	349.201	329.0970
8.7107	865.720	439.250	426.4700
7.2634	1043.235	529.563	513.6723
5.8126	1208.445	620.093	588.3519
4.3594	1359.174	710.773	648.4009
2.9052	1493.665	801.516	692.1492
1.4515	1610.763	892.225	718.5381
.0000	1710.019	982.800	727.2190

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 220

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY

IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+01 LOAD = 1139.000
SET = 1.3840

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.3660	.0000	2.8834	1226.364	1140.0000
.1000	12.9381	.3673	2.8915	1356.491	1094.0320
.2000	11.5073	.7346	2.8995	1486.804	1050.3700
.3000	10.0735	1.1019	2.9070	1617.296	1010.9210
.4000	8.6372	1.4692	2.9136	1747.951	977.6068
.5000	7.1987	1.8365	2.9188	1878.741	952.2990
.6000	5.7586	2.2038	2.9220	2009.630	936.7258
.7000	4.3178	2.5711	2.9230	2140.566	932.3770
.8000	2.8771	2.9385	2.9213	2271.494	940.3970
.9000	1.4375	3.3058	2.9169	2402.353	961.5069
1.0000	.0000	3.6731	2.9100	2533.082	995.9631

********** PORE PRESSURES **********

CHI	UW	U0	U
14.3660	86.364	86.364	.0001
12.9381	262.459	175.463	86.9960
11.5073	436.433	264.747	171.6859
10.0735	606.375	354.211	252.1637
8.6372	770.344	443.838	326.5059
7.1987	926.443	533.601	392.8418
5.7586	1072.904	623.461	449.4431
4.3178	1208.189	713.369	494.8201
2.8771	1331.097	803.269	527.8282
1.4375	1440.846	893.100	547.7465
.0000	1537.119	982.800	554.3185

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 272
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+01 LOAD = 1139.000
SET = 1.4506

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.2994	.0000	2.8834	1230.520	1140.0000
.1000	12.8722	.3673	2.8874	1360.601	1116.9750
.2000	11.4437	.7346	2.8912	1490.772	1095.6290

.3000	10.0138	1.1019	2.8945	1621.024	1077.4690
.4000	8.5828	1.4692	2.8970	1751.344	1063.9630
.5000	7.1512	1.8365	2.8983	1881.708	1056.4810
.6000	5.7192	2.2038	2.8984	2012.090	1056.2510
.7000	4.2875	2.5711	2.8969	2142.455	1064.2870
.8000	2.8567	2.9385	2.8938	2272.767	1081.3560
.9000	1.4273	3.3058	2.8890	2402.988	1107.9290
1.0000	.0000	3.6731	2.8826	2533.082	1144.1800

********** PORE PRESSURES **********

CHI	UW	U0	U
14.2994	90.520	90.520	.0001
12.8722	243.625	179.573	64.0527
11.4437	395.143	268.715	126.4275
10.0138	543.555	357.940	185.6153
8.5828	687.381	447.231	240.1497
7.1512	825.227	536.568	288.6598
5.7192	955.839	625.921	329.9181
4.2875	1078.167	715.258	362.9096
2.8567	1191.411	804.542	386.8697
1.4273	1295.059	893.735	401.3240
.0000	1388.902	982.800	406.1019

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 326

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .80000E+01 LOAD = 1139.000
SET = 1.4989

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.2511	.0000	2.8834	1233.530	1140.0000
.1000	12.8246	.3673	2.8842	1363.573	1135.4170
.2000	11.3978	.7346	2.8847	1493.634	1132.0190
.3000	9.9709	1.1019	2.8849	1623.703	1130.9300
.4000	8.5440	1.4692	2.8845	1753.770	1133.2200
.5000	7.1173	1.8365	2.8834	1883.820	1139.8630
.6000	5.6913	2.2038	2.8813	2013.833	1151.7030
.7000	4.2661	2.5711	2.8783	2143.790	1169.4310
.8000	2.8423	2.9385	2.8743	2273.665	1193.5540
.9000	1.4201	3.3058	2.8693	2403.436	1224.3850
1.0000	.0000	3.6731	2.8633	2533.082	1262.0390

********** PORE PRESSURES **********

CHI	UW	U0	U

14.2511	93.530	93.530	.0001
12.8246	228.156	182.545	45.6107
11.3978	361.615	271.577	90.0374
9.9709	492.773	360.618	132.1543
8.5440	620.551	449.658	170.8930
7.1173	743.957	538.679	205.2775
5.6913	862.131	627.665	234.4663
4.2661	974.359	716.592	257.7663
2.8423	1080.111	805.439	274.6715
1.4201	1179.051	894.183	284.8684
.0000	1271.042	982.800	288.2424

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 382

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .90000E+01 LOAD = 1139.000
SET = 1.5328

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.2172	.0000	2.8834	1235.645	1140.0000
.1000	12.7911	.3673	2.8817	1365.661	1149.3650
.2000	11.3657	.7346	2.8800	1495.639	1159.5430
.3000	9.9409	1.1019	2.8780	1625.575	1171.3430
.4000	8.5169	1.4692	2.8756	1755.461	1185.5190
.5000	7.0938	1.8365	2.8728	1885.287	1202.7430
.6000	5.6719	2.2038	2.8694	2015.042	1223.5910
.7000	4.2514	2.5711	2.8654	2144.712	1248.5260
.8000	2.8324	2.9385	2.8609	2274.285	1277.8850
.9000	1.4152	3.3058	2.8557	2403.746	1311.8720
1.0000	.0000	3.6731	2.8500	2533.082	1350.5720

********** PORE PRESSURES **********

CHI	UW	U0	U
14.2172	95.645	95.645	.0001
12.7911	216.297	184.633	31.6634
11.3657	336.096	273.583	62.5132
9.9409	454.232	362.490	91.7414
8.5169	569.941	451.348	118.5935
7.0938	682.544	540.146	142.3981
5.6719	791.451	628.873	162.5779
4.2514	896.186	717.515	178.6711
2.8324	996.400	806.060	190.3401
1.4152	1091.873	894.492	197.3810
.0000	1182.510	982.800	199.7098

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 443

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge, 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .10000E+02 LOAD = 1139.000
SET = 1.5561

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1939	.0000	2.8834	1237.100	1140.0000
.1000	12.7681	.3673	2.8800	1367.096	1159.4460
.2000	11.3436	.7346	2.8767	1497.016	1179.4440
.3000	9.9203	1.1019	2.8732	1626.857	1200.5550
.4000	8.4983	1.4692	2.8695	1756.616	1223.2980
.5000	7.0778	1.8365	2.8655	1886.287	1248.1300
.6000	5.6587	2.2038	2.8612	2015.865	1275.4390
.7000	4.2413	2.5711	2.8566	2145.340	1305.5320
.8000	2.8256	2.9385	2.8517	2274.707	1338.6320
.9000	1.4118	3.3058	2.8465	2403.956	1374.8810
1.0000	.0000	3.6731	2.8409	2533.082	1414.3260

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1939	97.100	97.100	.0001
12.7681	207.650	186.068	21.5819
11.3436	317.572	274.960	42.6121
9.9203	426.302	363.773	62.5290
8.4983	533.318	452.504	80.8148
7.0778	638.157	541.147	97.0107
5.6587	740.425	629.696	110.7297
4.2413	839.808	718.143	121.6647
2.8256	936.074	806.481	129.5929
1.4118	1029.075	894.703	134.3726
.0000	1118.756	982.800	135.9558

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 507

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge, 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12000E+02 LOAD = 1139.000
SET = 1.5825

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1675	.0000	2.8834	1238.745	1140.0000
.1000	12.7421	.3673	2.8780	1368.718	1171.3440
.2000	11.3187	.7346	2.8728	1498.570	1202.9330
.3000	9.8972	1.1019	2.8676	1628.302	1235.0270
.4000	8.4775	1.4692	2.8624	1757.916	1267.8580
.5000	7.0598	1.8365	2.8572	1887.411	1301.6310
.6000	5.6439	2.2038	2.8520	2016.788	1336.5200
.7000	4.2300	2.5711	2.8468	2146.044	1372.6580
.8000	2.8180	2.9385	2.8415	2275.179	1410.1430
.9000	1.4080	3.3058	2.8361	2404.192	1449.0330
1.0000	.0000	3.6731	2.8307	2533.082	1489.3540

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1675	98.745	98.745	.0001
12.7421	197.374	187.690	9.6837
11.3187	295.637	276.514	19.1230
9.8972	393.275	365.218	28.0570
8.4775	490.058	453.803	36.2546
7.0598	585.781	542.271	43.5100
5.6439	680.268	630.619	49.6492
4.2300	773.386	718.847	54.5391
2.8180	865.036	806.954	58.0818
1.4080	955.159	894.939	60.2202
.0000	1043.728	982.800	60.9275

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 640

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12500E+02 LOAD = 1139.000
SET = 1.5863

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1637	.0000	2.8834	1238.987	1140.0000
.1000	12.7383	.3673	2.8777	1368.956	1173.1380
.2000	11.3150	.7346	2.8722	1498.798	1206.4760
.3000	9.8938	1.1019	2.8668	1628.514	1240.2250
.4000	8.4745	1.4692	2.8614	1758.107	1274.5770
.5000	7.0571	1.8365	2.8560	1887.576	1309.6980
.6000	5.6418	2.2038	2.8507	2016.923	1345.7260
.7000	4.2284	2.5711	2.8453	2146.147	1382.7720

.8000	2.8169	2.9385	2.8400	2275.248	1420.9160
.9000	1.4075	3.3058	2.8346	2404.227	1460.2010
1.0000	.0000	3.6731	2.8292	2533.082	1500.6510

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1637	98.987	98.987	.0001
12.7383	195.819	187.928	7.8905
11.3150	292.322	276.742	15.5800
9.8938	388.289	365.430	22.8595
8.4745	483.530	453.994	29.5360
7.0571	577.878	542.435	35.4433
5.6418	671.197	630.754	40.4430
4.2284	763.374	718.950	44.4249
2.8169	854.332	807.023	47.3096
1.4075	944.025	894.973	49.0520
.0000	1032.430	982.800	49.6301

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 675

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+02 LOAD = 1139.000
SET = 1.5972

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1528	.0000	2.8834	1239.665	1140.0000
.1000	12.7276	.3673	2.8769	1369.625	1178.2360
.2000	11.3048	.7346	2.8706	1499.438	1216.5420
.3000	9.8842	1.1019	2.8644	1629.108	1254.9950
.4000	8.4659	1.4692	2.8584	1758.640	1293.6620
.5000	7.0497	1.8365	2.8526	1888.037	1332.6030
.6000	5.6357	2.2038	2.8469	2017.301	1371.8640
.7000	4.2238	2.5711	2.8413	2146.435	1411.4850
.8000	2.8138	2.9385	2.8358	2275.441	1451.4920
.9000	1.4059	3.3058	2.8304	2404.323	1491.9050
1.0000	.0000	3.6731	2.8250	2533.082	1532.7290

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1528	99.665	99.665	.0001
12.7276	191.389	188.597	2.7923
11.3048	282.896	277.382	5.5144
9.8842	374.114	366.024	8.0897

8.4659	464.978	454.528	10.4504
7.0497	555.434	542.896	12.5378
5.6357	645.437	631.132	14.3049
4.2238	734.949	719.238	15.7116
2.8138	823.949	807.216	16.7331
1.4059	912.418	895.070	17.3484
.0000	1000.353	982.800	17.5528

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 850

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S. 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .17500E+02 LOAD = 1139.000
SET = 1.6010

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1490	.0000	2.8834	1239.904	1140.0000
.1000	12.7239	.3673	2.8766	1369.860	1180.0500
.2000	11.3012	.7346	2.8700	1499.663	1220.1250
.3000	9.8809	1.1019	2.8636	1629.317	1260.2520
.4000	8.4629	1.4692	2.8574	1758.828	1300.4530
.5000	7.0472	1.8365	2.8514	1888.198	1340.7500
.6000	5.6336	2.2038	2.8456	2017.433	1381.1600
.7000	4.2221	2.5711	2.8399	2146.535	1421.6950
.8000	2.8128	2.9385	2.8343	2275.509	1462.3660
.9000	1.4054	3.3058	2.8289	2404.357	1503.1780
1.0000	.0000	3.6731	2.8236	2533.082	1544.1350

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1490	99.904	99.904	.0001
12.7239	189.810	188.832	.9786
11.3012	279.538	277.606	1.9314
9.8809	369.065	366.233	2.8326
8.4629	458.374	454.715	3.6596
7.0472	547.448	543.057	4.3910
5.6336	636.273	631.264	5.0090
4.2221	724.841	719.338	5.5023
2.8128	813.143	807.284	5.8592
1.4054	901.179	895.103	6.0753
.0000	988.947	982.800	6.1471

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1028

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .18000E+02 LOAD = 1139.000
SET = 1.6014

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1486	.0000	2.8834	1239.928	1140.0000
.1000	12.7235	.3673	2.8765	1369.884	1180.2350
.2000	11.3008	.7346	2.8699	1499.686	1220.4900
.3000	9.8805	1.1019	2.8635	1629.338	1260.7890
.4000	8.4626	1.4692	2.8573	1758.847	1301.1460
.5000	7.0469	1.8365	2.8513	1888.215	1341.5830
.6000	5.6334	2.2038	2.8454	2017.447	1382.1080
.7000	4.2220	2.5711	2.8397	2146.546	1422.7380
.8000	2.8127	2.9385	2.8342	2275.516	1463.4760
.9000	1.4053	3.3058	2.8287	2404.360	1504.3320
1.0000	.0000	3.6731	2.8234	2533.082	1545.3010

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1486	99.928	99.928	.0001
12.7235	189.648	188.856	.7929
11.3008	279.196	277.629	1.5667
9.8805	368.549	366.254	2.2956
8.4626	457.701	454.734	2.9670
7.0469	546.632	543.074	3.5583
5.6334	635.339	631.278	4.0610
4.2220	723.808	719.349	4.4592
2.8127	812.040	807.291	4.7491
1.4053	900.028	895.107	4.9215
.0000	987.780	982.800	4.9804

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1064
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+02 LOAD = 1139.000
SET = 1.6024

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1476	.0000	2.8834	1239.987	1140.0000

.1000	12.7225	.3673	2.8765	1369.942	1180.6870
.2000	11.2999	.7346	2.8698	1499.741	1221.3820
.3000	9.8797	1.1019	2.8633	1629.390	1262.0940
.4000	8.4619	1.4692	2.8571	1758.893	1302.8330
.5000	7.0463	1.8365	2.8510	1888.255	1343.6070
.6000	5.6328	2.2038	2.8451	2017.479	1384.4200
.7000	4.2216	2.5711	2.8394	2146.571	1425.2760
.8000	2.8124	2.9385	2.8338	2275.533	1466.1820
.9000	1.4052	3.3058	2.8284	2404.368	1507.1350
1.0000	.0000	3.6731	2.8231	2533.082	1548.1370

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1476	99.987	99.987	.0001
12.7225	189.255	188.914	.3414
11.2999	278.359	277.685	.6741
9.8797	367.296	366.305	.9903
8.4619	456.060	454.780	1.2794
7.0463	544.648	543.114	1.5337
5.6328	633.059	631.310	1.7490
4.2216	721.294	719.374	1.9206
2.8124	809.351	807.307	2.0437
1.4052	897.234	895.115	2.1188
.0000	984.945	982.800	2.1445

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1207

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+02 LOAD = 1139.000
SET = 1.6028

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1472	.0000	2.8834	1240.016	1140.0000
.1000	12.7221	.3673	2.8764	1369.970	1180.9070
.2000	11.2995	.7346	2.8697	1499.768	1221.8180
.3000	9.8793	1.1019	2.8632	1629.415	1262.7360
.4000	8.4615	1.4692	2.8569	1758.916	1303.6610
.5000	7.0459	1.8365	2.8508	1888.274	1344.5990
.6000	5.6326	2.2038	2.8449	2017.495	1385.5510
.7000	4.2214	2.5711	2.8392	2146.583	1426.5190
.8000	2.8123	2.9385	2.8336	2275.541	1467.5020
.9000	1.4051	3.3058	2.8282	2404.373	1508.5050
1.0000	.0000	3.6731	2.8229	2533.082	1549.5240

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1472	100.016	100.016	.0001
12.7221	189.064	188.942	.1214
11.2995	277.950	277.712	.2379
9.8793	366.679	366.331	.3486
8.4615	455.254	454.803	.4512
7.0459	543.675	543.133	.5414
5.6326	631.944	631.326	.6177
4.2214	720.064	719.386	.6781
2.8123	808.039	807.316	.7229
1.4051	895.868	895.119	.7484
.0000	983.557	982.800	.7574

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1386

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .24000E+02 LOAD = 1139.000
SET = 1.6029

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1471	.0000	2.8834	1240.023	1140.0000
.1000	12.7220	.3673	2.8764	1369.977	1180.9630
.2000	11.2994	.7346	2.8697	1499.775	1221.9290
.3000	9.8792	1.1019	2.8632	1629.421	1262.8960
.4000	8.4614	1.4692	2.8569	1758.921	1303.8700
.5000	7.0459	1.8365	2.8508	1888.279	1344.8470
.6000	5.6325	2.2038	2.8449	2017.499	1385.8310
.7000	4.2213	2.5711	2.8391	2146.586	1426.8260
.8000	2.8122	2.9385	2.8336	2275.543	1467.8310
.9000	1.4051	3.3058	2.8281	2404.374	1508.8450
1.0000	.0000	3.6731	2.8229	2533.082	1549.8690

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1471	100.023	100.023	.0001
12.7220	189.015	188.949	.0656
11.2994	277.846	277.719	.1271
9.8792	366.525	366.337	.1882
8.4614	455.051	454.808	.2430
7.0459	543.432	543.138	.2941
5.6325	631.668	631.330	.3376
4.2213	719.760	719.389	.3708
2.8122	807.712	807.318	.3943

1.4051	895.529	895.120	.4087
.0000	983.212	982.800	.4123

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1494

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge, 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+02 LOAD = 1559.000
SET = 1.6713

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0787	.0000	2.8216	1664.289	1560.0010
.1000	12.6734	.3673	2.8297	1793.006	1496.5830
.2000	11.2656	.7346	2.8354	1921.881	1454.5820
.3000	9.8562	1.1019	2.8385	2050.856	1431.2120
.4000	8.4461	1.4692	2.8396	2179.879	1423.5250
.5000	7.0358	1.8365	2.8389	2308.906	1428.6460
.6000	5.6261	2.2038	2.8368	2437.899	1443.9770
.7000	4.2174	2.5711	2.8336	2566.832	1467.3250
.8000	2.8100	2.9385	2.8297	2695.683	1496.9640
.9000	1.4041	3.3058	2.8252	2824.437	1531.6660
1.0000	.0000	3.6731	2.8202	2953.082	1570.6840

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0787	104.288	104.289	-.0011
12.6734	296.423	191.978	104.4448
11.2656	467.299	279.824	187.4744
9.8562	619.643	367.771	251.8722
8.4461	756.354	455.766	300.5876
7.0358	880.260	543.765	336.4949
5.6261	993.922	631.730	362.1915
4.2174	1099.507	719.635	379.8724
2.8100	1198.719	807.458	391.2615
1.4041	1292.771	895.183	397.5873
.0000	1382.398	982.800	399.5977

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1566

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .26000E+02 LOAD = 1979.000

SET = 1.7840

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.9660	.0000	2.7746	2091.323	1980.0000
.1000	12.5776	.3673	2.7849	2218.985	1879.4240
.2000	11.1858	.7346	2.7936	2346.865	1798.1000
.3000	9.7910	1.1019	2.8006	2474.926	1735.1900
.4000	8.3940	1.4692	2.8058	2603.127	1689.6360
.5000	6.9954	1.8365	2.8093	2731.428	1660.2640
.6000	5.5959	2.2038	2.8110	2859.788	1645.8560
.7000	4.1960	2.5711	2.8111	2988.168	1645.2480
.8000	2.7964	2.9385	2.8096	3116.532	1657.4210
.9000	1.3975	3.3058	2.8068	3244.847	1681.5500
1.0000	.0000	3.6731	2.8027	3373.082	1717.0530

********** PORE PRESSURES **********

CHI	UW	U0	U
13.9660	111.323	111.323	.0004
12.5776	339.561	197.957	141.6043
11.1858	548.765	284.809	263.9560
9.7910	739.736	371.841	367.8946
8.3940	913.491	459.014	454.4765
6.9954	1071.164	546.287	524.8766
5.5959	1213.932	633.619	580.3131
4.1960	1342.920	720.971	621.9487
2.7964	1459.111	808.307	650.8039
1.3975	1563.297	895.594	667.7037
.0000	1656.029	982.800	673.2285

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1639

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+02 LOAD = 1979.000
SET = 1.8849

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.8651	.0000	2.7746	2097.615	1980.0000
.1000	12.4785	.3673	2.7756	2225.168	1969.9510
.2000	11.0916	.7346	2.7765	2352.743	1961.2040
.3000	9.7043	1.1019	2.7771	2480.336	1955.0030
.4000	8.3169	1.4692	2.7774	2607.939	1952.5200
.5000	6.9295	1.8365	2.7771	2735.542	1954.8440

.6000	5.5422	2.2038	2.7763	2863.134	1962.9280
.7000	4.1554	2.5711	2.7748	2990.699	1977.5640
.8000	2.7693	2.9385	2.7727	3118.223	1999.3670
.9000	1.3840	3.3058	2.7698	3245.689	2028.7430
1.0000	.0000	3.6731	2.7662	3373.082	2065.8910

********** PORE PRESSURES **********

CHI	UW	U0	U
13.8651	117.615	117.615	.0004
12.4785	255.217	204.140	51.0770
11.0916	391.539	290.687	100.8521
9.7043	525.334	377.252	148.0819
8.3169	655.419	463.826	191.5928
6.9295	780.698	550.401	230.2968
5.5422	900.205	636.965	263.2407
4.1554	1013.135	723.502	289.6330
2.7693	1118.856	809.998	308.8582
1.3840	1216.946	896.436	320.5101
.0000	1307.190	982.800	324.3902

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1767

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .28000E+02 LOAD = 1979.000
SET = 1.9032

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.8468	.0000	2.7746	2098.760	1980.0000
.1000	12.4604	.3673	2.7743	2226.299	1982.5530
.2000	11.0741	.7346	2.7740	2353.831	1986.0760
.3000	9.6880	1.1019	2.7735	2481.354	1991.5260
.4000	8.3021	1.4692	2.7726	2608.860	1999.7930
.5000	6.9166	1.8365	2.7715	2736.345	2011.6950
.6000	5.5316	2.2038	2.7699	2863.797	2027.9460
.7000	4.1473	2.5711	2.7678	2991.209	2049.1350
.8000	2.7637	2.9385	2.7653	3118.567	2075.7180
.9000	1.3813	3.3058	2.7623	3245.862	2107.9890
1.0000	.0000	3.6731	2.7587	3373.082	2146.1020

********** PORE PRESSURES **********

CHI	UW	U0	U
13.8468	118.761	118.760	.0004
12.4604	243.746	205.271	38.4748

11.0741	367.755	291.775	75.9800
9.6880	489.828	378.269	111.5588
8.3021	609.068	464.748	144.3197
6.9166	724.650	551.204	173.4461
5.5316	835.852	637.629	198.2234
4.1473	942.073	724.012	218.0616
2.7637	1042.849	810.342	232.5072
1.3813	1137.874	896.609	241.2649
.0000	1226.980	982.800	244.1798

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1814

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+02 LOAD = 1979.000
SET = 1.9405

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.8095	.0000	2.7746	2101.085	1980.0000
.1000	12.4236	.3673	2.7717	2228.593	2009.3850
.2000	11.0388	.7346	2.7688	2356.035	2039.0600
.3000	9.6550	1.1019	2.7659	2483.411	2069.3240
.4000	8.2723	1.4692	2.7630	2610.720	2100.4530
.5000	6.8907	1.8365	2.7600	2737.961	2132.6920
.6000	5.5102	2.2038	2.7569	2865.132	2166.2520
.7000	4.1308	2.5711	2.7537	2992.232	2201.3100
.8000	2.7527	2.9385	2.7505	3119.258	2237.9910
.9000	1.3757	3.3058	2.7471	3246.209	2276.3870
1.0000	.0000	3.6731	2.7437	3373.082	2316.5390

********** PORE PRESSURES **********

CHI	UW	U0	U
13.8095	121.085	121.085	.0004
12.4236	219.208	207.565	11.6427
11.0388	316.976	293.979	22.9967
9.6550	414.087	380.327	33.7600
8.2723	510.267	466.607	43.6595
6.8907	605.269	552.820	52.4484
5.5102	698.880	638.963	59.9167
4.1308	790.922	725.035	65.8873
2.7527	881.268	811.033	70.2345
1.3757	969.822	896.956	72.8662
.0000	1056.543	982.800	73.7430

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2006

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .32000E+02 LOAD = 1979.000
SET = 1.9515

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7985	.0000	2.7746	2101.772	1980.0000
.1000	12.4128	.3673	2.7709	2229.271	2017.6590
.2000	11.0284	.7346	2.7672	2356.686	2055.4000
.3000	9.6453	1.1019	2.7636	2484.018	2093.3140
.4000	8.2635	1.4692	2.7601	2611.267	2131.4800
.5000	6.8831	1.8365	2.7566	2738.436	2169.9650
.6000	5.5039	2.2038	2.7531	2865.524	2208.8380
.7000	4.1260	2.5711	2.7496	2992.532	2248.1410
.8000	2.7494	2.9385	2.7461	3119.461	2287.9160
.9000	1.3741	3.3058	2.7427	3246.311	2328.1890
1.0000	.0000	3.6731	2.7393	3373.082	2368.9640

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7985	121.773	121.772	.0004
12.4128	211.613	208.243	3.3695
11.0284	301.286	294.630	6.6567
9.6453	390.703	380.933	9.7700
8.2635	479.788	467.155	12.6329
6.8831	568.471	553.295	15.1757
5.5039	656.686	639.355	17.3308
4.1260	744.391	725.335	19.0562
2.7494	831.545	811.235	20.3095
1.3741	918.122	897.057	21.0647
.0000	1004.117	982.800	21.3175

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2211
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .34000E+02 LOAD = 1979.000
SET = 1.9546

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE

.0000	13.7954	.0000	2.7746	2101.969	1980.0000
.1000	12.4097	.3673	2.7707	2229.466	2020.0630
.2000	11.0254	.7346	2.7668	2356.873	2060.1510
.3000	9.6425	1.1019	2.7630	2484.192	2100.2900
.4000	8.2610	1.4692	2.7592	2611.424	2140.4990
.5000	6.8809	1.8365	2.7556	2738.572	2180.7990
.6000	5.5021	2.2038	2.7520	2865.636	2221.2100
.7000	4.1247	2.5711	2.7484	2992.618	2261.7450
.8000	2.7485	2.9385	2.7449	3119.519	2302.4130
.9000	1.3736	3.3058	2.7414	3246.340	2343.2240
1.0000	.0000	3.6731	2.7380	3373.082	2384.1790

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7954	121.970	121.970	.0004
12.4097	209.403	208.438	.9653
11.0254	296.721	294.817	1.9049
9.6425	383.901	381.107	2.7942
8.2610	470.925	467.312	3.6136
6.8809	557.773	553.431	4.3420
5.5021	644.426	639.467	4.9592
4.1247	730.873	725.421	5.4520
2.7485	817.106	811.293	5.8127
1.3736	903.115	897.086	6.0291
.0000	988.902	982.800	6.1021

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2419

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+02 LOAD = 1979.000
SET = 1.9552

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7948	.0000	2.7746	2102.006	1980.0000
.1000	12.4091	.3673	2.7706	2229.502	2020.5100
.2000	11.0248	.7346	2.7667	2356.907	2061.0340
.3000	9.6420	1.1019	2.7629	2484.224	2101.5870
.4000	8.2606	1.4692	2.7591	2611.453	2142.1730
.5000	6.8805	1.8365	2.7554	2738.597	2182.8140
.6000	5.5018	2.2038	2.7518	2865.657	2223.5120
.7000	4.1244	2.5711	2.7482	2992.634	2264.2760
.8000	2.7483	2.9385	2.7447	3119.529	2305.1120
.9000	1.3735	3.3058	2.7412	3246.345	2346.0220
1.0000	.0000	3.6731	2.7378	3373.082	2387.0120

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7948	122.006	122.006	.0004
12.4091	208.992	208.474	.5178
11.0248	295.873	294.851	1.0221
9.6420	382.637	381.139	1.4973
8.2606	469.280	467.341	1.9395
6.8805	555.783	553.456	2.3271
5.5018	642.145	639.488	2.6570
4.1244	728.358	725.437	2.9215
2.7483	814.418	811.304	3.1137
1.3735	900.323	897.091	3.2312
.0000	986.070	982.800	3.2699

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2524

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .38000E+02 LOAD = 1979.000
SET = 1.9558

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7942	.0000	2.7746	2102.041	1980.0000
.1000	12.4085	.3673	2.7706	2229.537	2020.9410
.2000	11.0243	.7346	2.7666	2356.941	2061.8870
.3000	9.6415	1.1019	2.7627	2484.255	2102.8360
.4000	8.2601	1.4692	2.7589	2611.481	2143.7940
.5000	6.8801	1.8365	2.7552	2738.621	2184.7560
.6000	5.5015	2.2038	2.7516	2865.677	2225.7250
.7000	4.1242	2.5711	2.7480	2992.649	2266.7020
.8000	2.7482	2.9385	2.7444	3119.540	2307.6930
.9000	1.3735	3.3058	2.7410	3246.350	2348.7010
1.0000	.0000	3.6731	2.7376	3373.082	2389.7230

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7942	122.042	122.041	.0004
12.4085	208.596	208.509	.0874
11.0243	295.053	294.884	.1689
9.6415	381.419	381.170	.2483
8.2601	467.687	467.369	.3187
6.8801	553.865	553.481	.3847
5.5015	639.952	639.508	.4438

4.1242	725.947	725.452	.4950
2.7482	811.846	811.314	.5319
1.3735	897.649	897.097	.5523
.0000	983.359	982.800	.5587

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2838

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+02 LOAD = 1979.000
SET = 1.9559

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7941	.0000	2.7746	2102.046	1980.0000
.1000	12.4084	.3673	2.7706	2229.541	2020.9900
.2000	11.0242	.7346	2.7666	2356.945	2061.9820
.3000	9.6414	1.1019	2.7627	2484.259	2102.9790
.4000	8.2601	1.4692	2.7589	2611.485	2143.9810
.5000	6.8801	1.8365	2.7552	2738.625	2184.9860
.6000	5.5014	2.2038	2.7515	2865.679	2225.9970
.7000	4.1241	2.5711	2.7479	2992.651	2267.0120
.8000	2.7481	2.9385	2.7444	3119.541	2308.0310
.9000	1.3734	3.3058	2.7409	3246.351	2349.0530
1.0000	.0000	3.6731	2.7375	3373.082	2390.0790

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7941	122.046	122.046	.0004
12.4084	208.551	208.513	.0385
11.0242	294.963	294.888	.0741
9.6414	381.280	381.174	.1057
8.2601	467.504	467.372	.1317
6.8801	553.638	553.484	.1547
5.5014	639.682	639.510	.1719
4.1241	725.639	725.454	.1849
2.7481	811.510	811.316	.1938
1.3734	897.297	897.097	.2000
.0000	983.003	982.800	.2030

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3048

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .45000E+02 LOAD = 1979.000
SET = 1.9559

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7941	.0000	2.7746	2102.046	1980.0000
.1000	12.4084	.3673	2.7706	2229.541	2020.9900
.2000	11.0242	.7346	2.7666	2356.945	2061.9820
.3000	9.6414	1.1019	2.7627	2484.259	2102.9790
.4000	8.2601	1.4692	2.7589	2611.485	2143.9810
.5000	6.8801	1.8365	2.7552	2738.625	2184.9860
.6000	5.5014	2.2038	2.7515	2865.679	2225.9970
.7000	4.1241	2.5711	2.7479	2992.651	2267.0120
.8000	2.7481	2.9385	2.7444	3119.541	2308.0310
.9000	1.3734	3.3058	2.7409	3246.351	2349.0530
1.0000	.0000	3.6731	2.7375	3373.082	2390.0790

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7941	122.046	122.046	.0004
12.4084	208.551	208.513	.0385
11.0242	294.963	294.888	.0741
9.6414	381.280	381.174	.1057
8.2601	467.504	467.372	.1317
6.8801	553.638	553.484	.1547
5.5014	639.682	639.510	.1719
4.1241	725.639	725.454	.1849
2.7481	811.510	811.316	.1938
1.3734	897.297	897.097	.2000
.0000	983.003	982.800	.2030

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3572
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+02 LOAD = 1979.000
SET = 1.9559

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7941	.0000	2.7746	2102.046	1980.0000
.1000	12.4084	.3673	2.7706	2229.541	2020.9900
.2000	11.0242	.7346	2.7666	2356.945	2061.9820
.3000	9.6414	1.1019	2.7627	2484.259	2102.9790

.4000	8.2601	1.4692	2.7589	2611.485	2143.9810
.5000	6.8801	1.8365	2.7552	2738.625	2184.9860
.6000	5.5014	2.2038	2.7515	2865.679	2225.9970
.7000	4.1241	2.5711	2.7479	2992.651	2267.0120
.8000	2.7481	2.9385	2.7444	3119.541	2308.0310
.9000	1.3734	3.3058	2.7409	3246.351	2349.0530
1.0000	.0000	3.6731	2.7375	3373.082	2390.0790

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7941	122.046	122.046	.0004
12.4084	208.551	208.513	.0385
11.0242	294.963	294.888	.0741
9.6414	381.280	381.174	.1057
8.2601	467.504	467.372	.1317
6.8801	553.638	553.484	.1547
5.5014	639.682	639.510	.1719
4.1241	725.639	725.454	.1849
2.7481	811.510	811.316	.1938
1.3734	897.297	897.097	.2000
.0000	983.003	982.800	.2030

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 4096

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .55000E+02 LOAD = 1979.000
SET = 1.9559

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7941	.0000	2.7746	2102.046	1980.0000
.1000	12.4084	.3673	2.7706	2229.541	2020.9900
.2000	11.0242	.7346	2.7666	2356.945	2061.9820
.3000	9.6414	1.1019	2.7627	2484.259	2102.9790
.4000	8.2601	1.4692	2.7589	2611.485	2143.9810
.5000	6.8801	1.8365	2.7552	2738.625	2184.9860
.6000	5.5014	2.2038	2.7515	2865.679	2225.9970
.7000	4.1241	2.5711	2.7479	2992.651	2267.0120
.8000	2.7481	2.9385	2.7444	3119.541	2308.0310
.9000	1.3734	3.3058	2.7409	3246.351	2349.0530
1.0000	.0000	3.6731	2.7375	3373.082	2390.0790

********** PORE PRESSURES **********

CHI UW U0 U

13.7941	122.046	122.046	.0004
12.4084	208.551	208.513	.0385
11.0242	294.963	294.888	.0741
9.6414	381.280	381.174	.1057
8.2601	467.504	467.372	.1317
6.8801	553.638	553.484	.1547
5.5014	639.682	639.510	.1719
4.1241	725.639	725.454	.1849
2.7481	811.510	811.316	.1938
1.3734	897.297	897.097	.2000
.0000	983.003	982.800	.2030

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 4620

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge, 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+02 LOAD = 1979.000
SET = 1.9559

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7941	.0000	2.7746	2102.046	1980.0000
.1000	12.4084	.3673	2.7706	2229.541	2020.9900
.2000	11.0242	.7346	2.7666	2356.945	2061.9820
.3000	9.6414	1.1019	2.7627	2484.259	2102.9790
.4000	8.2601	1.4692	2.7589	2611.485	2143.9810
.5000	6.8801	1.8365	2.7552	2738.625	2184.9860
.6000	5.5014	2.2038	2.7515	2865.679	2225.9970
.7000	4.1241	2.5711	2.7479	2992.651	2267.0120
.8000	2.7481	2.9385	2.7444	3119.541	2308.0310
.9000	1.3734	3.3058	2.7409	3246.351	2349.0530
1.0000	.0000	3.6731	2.7375	3373.082	2390.0790

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7941	122.046	122.046	.0004
12.4084	208.551	208.513	.0385
11.0242	294.963	294.888	.0741
9.6414	381.280	381.174	.1057
8.2601	467.504	467.372	.1317
6.8801	553.638	553.484	.1547
5.5014	639.682	639.510	.1719
4.1241	725.639	725.454	.1849
2.7481	811.510	811.316	.1938
1.3734	897.297	897.097	.2000
.0000	983.003	982.800	.2030

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 5144

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 11S, 15.75 feet of sludge, 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

```
**********************
*                    *
* FUNCTIONS OF TIME  *
*                    *
**********************
```

TIME	EAV	TOTAV	EFFAV	SET	DEG
.0000E+00	.3288E+01	709.682	206.1408	.0000	.0000
.1500E+00	.3248E+01	934.804	214.7944	.1484	.0759
.2000E+00	.3243E+01	1009.871	218.0230	.1650	.0844
.2250E+00	.3241E+01	1044.287	219.6437	.1735	.0887
.2500E+00	.3238E+01	1078.706	221.3360	.1822	.0931
.2750E+00	.3236E+01	1113.130	223.1099	.1912	.0977
.3000E+00	.3233E+01	1147.557	224.9782	.2005	.1025
.3500E+00	.3228E+01	1216.420	229.0072	.2200	.1125
.4000E+00	.3222E+01	1285.301	233.6123	.2413	.1234
.5000E+00	.3209E+01	1426.623	245.6288	.2906	.1486
.6000E+00	.3193E+01	1568.033	263.7262	.3490	.1785
.7000E+00	.3174E+01	1850.538	297.0760	.4192	.2143
.8000E+00	.3157E+01	1851.089	328.4744	.4804	.2456
.9000E+00	.3146E+01	1851.597	345.5830	.5212	.2665
.1000E+01	.3135E+01	1852.192	362.4463	.5610	.2868
.1250E+01	.3110E+01	1853.848	405.6033	.6531	.3339
.1500E+01	.3089E+01	1855.488	445.3537	.7291	.3728
.1750E+01	.3072E+01	1857.134	482.5490	.7947	.4063
.2000E+01	.3056E+01	1858.786	517.8525	.8531	.4362
.2250E+01	.3041E+01	1860.429	551.6071	.9057	.4631
.2500E+01	.3028E+01	1862.052	584.0729	.9539	.4877
.2750E+01	.3016E+01	1863.646	615.5049	.9984	.5105
.3000E+01	.3005E+01	1865.200	646.1648	1.0398	.5316
.3500E+01	.2984E+01	1868.158	706.1387	1.1151	.5701
.4000E+01	.2966E+01	1870.877	765.4143	1.1821	.6044
.5000E+01	.2935E+01	1875.515	882.4055	1.2954	.6623
.6000E+01	.2911E+01	1879.100	991.6902	1.3840	.7076
.7000E+01	.2893E+01	1881.755	1085.7050	1.4506	.7417
.8000E+01	.2880E+01	1883.657	1160.7710	1.4989	.7664
.9000E+01	.2871E+01	1884.984	1217.3020	1.5328	.7837
.1000E+02	.2864E+01	1885.891	1258.0710	1.5561	.7956
.1200E+02	.2857E+01	1886.913	1306.1010	1.5825	.8091
.1250E+02	.2856E+01	1887.063	1313.3390	1.5863	.8111
.1500E+02	.2853E+01	1887.483	1333.8910	1.5972	.8166
.1750E+02	.2852E+01	1887.631	1341.2010	1.6010	.8186
.1800E+02	.2852E+01	1887.646	1341.9480	1.6014	.8188
.2000E+02	.2852E+01	1887.682	1343.7660	1.6024	.8193
.2250E+02	.2852E+01	1887.700	1344.6550	1.6028	.8195
.2400E+02	.2852E+01	1887.704	1344.8770	1.6029	.8196

.2500E+02	.2833E+01	2308.807	1473.0170	1.6713	.8545
.2600E+02	.2802E+01	2731.681	1722.8600	1.7840	.9121
.2750E+02	.2775E+01	2735.484	1978.0780	1.8849	.9637
.2800E+02	.2770E+01	2736.208	2029.2250	1.9032	.9731
.3000E+02	.2760E+01	2737.669	2138.0150	1.9405	.9921
.3200E+02	.2757E+01	2738.100	2171.5100	1.9515	.9978
.3400E+02	.2756E+01	2738.224	2181.2400	1.9546	.9994
.3500E+02	.2756E+01	2738.246	2183.0510	1.9552	.9997
.3800E+02	.2756E+01	2738.269	2184.7890	1.9558	1.0000
.4000E+02	.2755E+01	2738.271	2185.0050	1.9559	1.0000
.4500E+02	.2755E+01	2738.271	2185.0050	1.9559	1.0000
.5000E+02	.2755E+01	2738.271	2185.0050	1.9559	1.0000
.5500E+02	.2755E+01	2738.271	2185.0050	1.9559	1.0000
.6000E+02	.2755E+01	2738.271	2185.0050	1.9559	1.0000

TIME	UWAV	U0AV	UAV
.0000E+00	503.5412	503.5412	-.0001
.1500E+00	720.0093	503.6629	216.3464
.2000E+00	791.8481	503.7303	288.1178
.2250E+00	824.6432	503.7711	320.8721
.2500E+00	857.3704	503.8156	353.5548
.2750E+00	890.0197	503.8638	386.1559
.3000E+00	922.5786	503.9160	418.6626
.3500E+00	987.4130	504.0294	483.3836
.4000E+00	1051.6890	504.1602	547.5285
.5000E+00	1180.9940	504.4819	676.5120
.6000E+00	1304.3070	504.8920	799.4146
.7000E+00	1553.4620	505.3974	1048.0650
.8000E+00	1522.6150	505.9485	1016.6660
.9000E+00	1506.0140	506.4559	999.5579
.1000E+01	1489.7450	507.0510	982.6946
.1250E+01	1448.2450	508.7076	939.5374
.1500E+01	1410.1340	510.3468	899.7871
.1750E+01	1374.5850	511.9931	862.5917
.2000E+01	1340.9330	513.6450	827.2883
.2250E+01	1308.8220	515.2877	793.5337
.2500E+01	1277.9790	516.9110	761.0679
.2750E+01	1248.1410	518.5048	729.6360
.3000E+01	1219.0350	520.0591	698.9760
.3500E+01	1162.0190	523.0170	639.0021
.4000E+01	1105.4630	525.7360	579.7265
.5000E+01	993.1100	530.3746	462.7354
.6000E+01	887.4095	533.9590	353.4506
.7000E+01	796.0502	536.6142	259.4359
.8000E+01	722.8856	538.5160	184.3696
.9000E+01	667.6820	539.8427	127.8393
.1000E+02	627.8203	540.7505	87.0697
.1200E+02	580.8121	541.7726	39.0395
.1250E+02	573.7241	541.9225	31.8016
.1500E+02	553.5917	542.3425	11.2493
.1750E+02	546.4294	542.4899	3.9395
.1800E+02	545.6974	542.5048	3.1926
.2000E+02	543.9165	542.5413	1.3752
.2250E+02	543.0447	542.5591	.4856
.2400E+02	542.8278	542.5635	.2642

.2500E+02	835.7896	543.6658	292.1238
.2600E+02	1008.8220	546.5407	462.2814
.2750E+02	757.4055	550.3430	207.0625
.2800E+02	706.9824	551.0668	155.9155
.3000E+02	599.6546	552.5287	47.1259
.3200E+02	566.5900	552.9592	13.6307
.3400E+02	556.9831	553.0826	3.9004
.3500E+02	555.1960	553.1055	2.0905
.3800E+02	553.4793	553.1275	.3519
.4000E+02	553.2663	553.1302	.1360
.4500E+02	553.2663	553.1302	.1360
.5000E+02	553.2663	553.1302	.1360
.5500E+02	553.2663	553.1302	.1360
.6000E+02	553.2663	553.1302	.1360

```
*****************************************************************
*                                                               *
*      ACCUMV - NONLINEAR LARGE STRAIN CONSOLIDATION            *
*                    by                                         *
*              ROBERT L. SCHIFFMAN                              *
*              VLASTA SZAVITS-NOSSAN                            *
*               JOHN M. McARTHUR                                *
*                                                               *
*          DEPARTMENT OF CIVIL ENGINEERING                      *
*          UNIVERSITY OF COLORADO AT BOULDER                    *
*           BOULDER, CO 80309-0428  USA                         *
*                                                               *
*                                                               *
*  COPYRIGHT @1992 by Robert L. Schiffman, Vlasta Szavits-Nossan, *
*              and John M. McArthur                             *
*                                                               *
*****************************************************************
```

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

```
****************
*              *
* INPUT DATA   *
*              *
****************
```

****** UNITS ******

LENGTH	FORCE	TIME
feet	pounds	months

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* UNIT WEIGHTS *******

GAMMAS	GAMMAW
174.1000	62.4000

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* INITIAL GEOMETRY *******

H(0)	TOTAL HEADS	
	TOT HD(L)	HW
15.750	.000	15.750

******* VOID RATIO RANGE *******

EMAX	EMIN
8.000	1.000

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* EFFECTIVE STRESS AT TOP OF LAYER *******

Q0
1.0000

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* CONSTITUTIVE RELATIONSHIPS *******

$$E = \frac{(.4270E+01) + (-.1970E+00) * LN(EFFSTR)}{1 + (.0000E+00) * LN(EFFSTR) + (.0000E+00) * LN(EFFSTR)*LN(EFFSTR)}$$

$$K = \frac{(.5000E\text{-}02) * (E) ** (.2600E+01)}{1 + (.0000E+00) * (E)}$$

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

********** CALCULATION DATA **********

N	TMAX	ALPHA
10	.6000E+02	.5000E+00

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* HEIGHT-TIME FUNCTION *******

TIME	H
.000E+00	15.750
.100E+03	15.750

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* TIME - LOAD FUNCTIONS *******

TIME	LOAD
.0000E+00	.0000
.2000E+00	300.0000
.4000E+00	575.0000
.7000E+00	929.0000
.9000E+00	1282.0000
.2400E+02	1282.0000
.2600E+02	2122.0000
.6000E+02	2122.0000

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

**** PRINT TIMES ****
.15000E+00
.20000E+00
.22500E+00
.25000E+00
.27500E+00
.30000E+00
.35000E+00
.40000E+00
.50000E+00
.60000E+00
.70000E+00
.80000E+00
.90000E+00
.10000E+01
.12500E+01
.15000E+01
.17500E+01
.20000E+01
.22500E+01
.25000E+01
.27500E+01
.30000E+01
.35000E+01
.40000E+01
.50000E+01
.60000E+01
.70000E+01
.80000E+01
.90000E+01
.10000E+02
.12000E+02
.12500E+02
.15000E+02
.17500E+02
.18000E+02
.20000E+02
.22500E+02
.24000E+02
.25000E+02
.26000E+02
.27500E+02
.28000E+02
.30000E+02
.32000E+02
.34000E+02
.35000E+02
.38000E+02
.40000E+02
.45000E+02
.50000E+02

.55000E+02
.60000E+02

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

```
***************
*             *
* FUNCTIONS   *
*             *
***************
```

E	EFFSTR	K	G	D(G)	D(K/1+E)	AV
1.000	.162E+08	.500E-02	-.329E+04	.979E+04	.525E-02	.122E-07
1.700	.463E+06	.199E-01	-.277E+03	.109E+04	.853E-02	.425E-06
2.400	.133E+05	.487E-01	-.154E+02	.662E+02	.113E-01	.149E-04
3.100	.380E+03	.947E-01	-.713E+00	.320E+01	.137E-01	.519E-03
3.800	.109E+02	.161E+00	-.296E-01	.136E+00	.159E-01	.181E-01
4.500	.311E+00	.250E+00	-.115E-02	.538E-02	.180E-01	.633E+00
5.200	.891E-02	.364E+00	-.425E-04	.201E-03	.199E-01	.221E+02
5.900	.255E-03	.505E+00	-.152E-05	.726E-05	.216E-01	.772E+03
6.600	.730E-05	.676E+00	-.528E-07	.254E-06	.233E-01	.270E+05
7.300	.209E-06	.878E+00	-.180E-08	.871E-08	.249E-01	.942E+06
8.000	.599E-08	.111E+01	-.603E-10	.293E-09	.265E-01	.329E+08

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .00000E+00 LOAD = .000
SET = .0000

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.7500	.0000	4.2700	1.000	1.0000
.1000	13.9763	.3673	3.5335	152.704	42.0281
.2000	12.3459	.7346	3.3994	295.475	83.0564
.3000	10.7378	1.1019	3.3203	436.847	124.0845
.4000	9.1693	1.4692	3.2640	575.746	165.1127
.5000	7.6114	1.8365	3.2203	713.990	206.1409
.6000	6.0681	2.2038	3.1845	851.320	247.1691
.7000	4.5368	2.5711	3.1543	987.902	288.1970
.8000	3.0158	2.9385	3.1280	1123.838	329.2253

.9000	1.5039	3.3058	3.1049	1259.211	370.2537
1.0000	.0000	3.6731	3.0842	1394.082	411.2814

********** PORE PRESSURES **********

CHI	UW	U0	U
15.7500	.000	.000	.0000
13.9763	110.676	110.676	.0000
12.3459	212.419	212.419	.0000
10.7378	312.763	312.763	-.0001
9.1693	410.634	410.634	-.0001
7.6114	507.849	507.849	-.0001
6.0681	604.151	604.151	-.0001
4.5368	699.705	699.705	.0001
3.0158	794.613	794.613	-.0001
1.5039	888.957	888.957	-.0002
.0000	982.800	982.800	.0002

TIMESTEP SIZE = .00, ITERATIONS BETWEEN PRINT TIMES = 0

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+00 LOAD = 225.000
SET = .1484

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.6016	.0000	3.2022	235.259	226.0000
.1000	13.9851	.3673	3.4985	377.155	50.2129
.2000	12.3456	.7346	3.3979	520.493	83.6755
.3000	10.7516	1.1019	3.3201	660.984	124.1748
.4000	9.1693	1.4692	3.2640	800.748	165.1487
.5000	7.6114	1.8365	3.2203	938.990	206.1623
.6000	6.0681	2.2038	3.1845	1076.321	247.1831
.7000	4.5368	2.5711	3.1543	1212.903	288.2071
.8000	3.0158	2.9385	3.1280	1348.839	329.2329
.9000	1.5039	3.3058	3.1049	1484.211	370.2591
1.0000	.0000	3.6731	3.0842	1619.082	411.2864

********** PORE PRESSURES **********

CHI	UW	U0	U
15.6016	9.259	9.259	.0000
13.9851	326.942	110.127	216.8152
12.3456	436.817	212.436	224.3808
10.7516	536.810	311.900	224.9097
9.1693	635.599	410.635	224.9639

7.6114	732.827	507.849	224.9785
6.0681	829.138	604.152	224.9858
4.5368	924.696	699.706	224.9900
3.0158	1019.606	794.613	224.9924
1.5039	1113.952	888.957	224.9944
.0000	1207.795	982.800	224.9952

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 4

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+00 LOAD = 300.000
SET = .1650

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5850	.0000	3.1457	311.296	301.0000
.1000	13.9818	.3673	3.4794	452.367	55.3119
.2000	12.3454	.7346	3.3966	595.506	84.2133
.3000	10.7512	1.1019	3.3200	736.011	124.2453
.4000	9.1693	1.4692	3.2639	875.748	165.1651
.5000	7.6114	1.8365	3.2202	1013.989	206.1703
.6000	6.0681	2.2038	3.1845	1151.321	247.1882
.7000	4.5368	2.5711	3.1543	1287.903	288.2106
.8000	3.0158	2.9385	3.1280	1423.839	329.2353
.9000	1.5039	3.3058	3.1049	1559.211	370.2613
1.0000	.0000	3.6731	3.0842	1694.082	411.2884

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5850	10.295	10.296	.0000
13.9818	397.055	110.339	286.7163
12.3454	511.293	212.450	298.8430
10.7512	611.766	311.927	299.8391
9.1693	710.583	410.636	299.9475
7.6114	807.819	507.848	299.9705
6.0681	904.133	604.152	299.9807
4.5368	999.692	699.706	299.9865
3.0158	1094.603	794.613	299.9900
1.5039	1188.950	888.958	299.9921
.0000	1282.793	982.800	299.9932

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 6

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+00 LOAD = 334.375
SET = .1735

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5765	.0000	3.1244	346.199	335.3751
.1000	13.9795	.3673	3.4680	486.885	58.6055
.2000	12.3452	.7346	3.3957	629.892	84.6110
.3000	10.7507	1.1019	3.3199	770.413	124.3000
.4000	9.1693	1.4692	3.2639	910.124	165.1761
.5000	7.6114	1.8365	3.2202	1048.364	206.1745
.6000	6.0681	2.2038	3.1845	1185.696	247.1909
.7000	4.5368	2.5711	3.1543	1322.278	288.2124
.8000	3.0158	2.9385	3.1280	1458.214	329.2365
.9000	1.5039	3.3058	3.1049	1593.586	370.2622
1.0000	.0000	3.6731	3.0842	1728.457	411.2894

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5765	10.824	10.824	-.0001
13.9795	428.279	110.481	317.7977
12.3452	545.281	212.460	332.8203
10.7507	646.113	311.954	334.1594
9.1693	744.948	410.636	334.3116
7.6114	842.189	507.848	334.3412
6.0681	938.505	604.152	334.3531
4.5368	1034.066	699.706	334.3597
3.0158	1128.977	794.613	334.3638
1.5039	1223.324	888.958	334.3662
.0000	1317.167	982.800	334.3672

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 7
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+00 LOAD = 368.750
SET = .1822

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5678	.0000	3.1052	381.117	369.7499
.1000	13.9769	.3673	3.4558	521.420	62.3762

.2000	12.3450	.7346	3.3946	664.279	85.0930
.3000	10.7502	1.1019	3.3198	804.820	124.3696
.4000	9.1693	1.4692	3.2639	944.499	165.1895
.5000	7.6114	1.8365	3.2202	1082.738	206.1793
.6000	6.0681	2.2038	3.1845	1220.071	247.1936
.7000	4.5368	2.5711	3.1543	1356.653	288.2141
.8000	3.0158	2.9385	3.1280	1492.589	329.2377
.9000	1.5039	3.3058	3.1049	1627.961	370.2635
1.0000	.0000	3.6731	3.0842	1762.832	411.2904

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5678	11.367	11.367	.0001
13.9769	459.044	110.642	348.4020
12.3450	579.186	212.473	366.7133
10.7502	680.450	311.985	368.4649
9.1693	779.310	410.637	368.6732
7.6114	876.559	507.847	368.7115
6.0681	972.878	604.152	368.7254
4.5368	1068.439	699.706	368.7330
3.0158	1163.351	794.613	368.7376
1.5039	1257.697	888.958	368.7399
.0000	1351.541	982.800	368.7412

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 8

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+00 LOAD = 403.125
SET = .1912

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5588	.0000	3.0877	416.054	404.1250
.1000	13.9740	.3673	3.4426	555.973	66.6926
.2000	12.3448	.7346	3.3933	698.669	85.6700
.3000	10.7497	1.1019	3.3197	839.230	124.4567
.4000	9.1693	1.4692	3.2639	978.875	165.2059
.5000	7.6114	1.8365	3.2202	1117.113	206.1845
.6000	6.0681	2.2038	3.1845	1254.446	247.1963
.7000	4.5368	2.5711	3.1542	1391.028	288.2162
.8000	3.0158	2.9385	3.1280	1526.964	329.2393
.9000	1.5039	3.3058	3.1049	1662.336	370.2644
1.0000	.0000	3.6731	3.0842	1797.207	411.2914

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5588	11.929	11.929	.0000
13.9740	489.281	110.820	378.4605
12.3448	612.999	212.488	400.5113
10.7497	714.774	312.021	402.7527
9.1693	813.669	410.637	403.0318
7.6114	910.928	507.847	403.0813
6.0681	1007.250	604.152	403.0977
4.5368	1102.812	699.706	403.1059
3.0158	1197.724	794.613	403.1110
1.5039	1292.072	888.958	403.1140
.0000	1385.915	982.800	403.1152

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 9

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+00 LOAD = 437.500
SET = .2005

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5495	.0000	3.0716	451.012	438.5002
.1000	13.9709	.3673	3.4285	590.545	71.6385
.2000	12.3445	.7346	3.3917	733.062	86.3543
.3000	10.7490	1.1019	3.3195	873.645	124.5646
.4000	9.1693	1.4692	3.2639	1013.250	165.2260
.5000	7.6114	1.8365	3.2202	1151.487	206.1905
.6000	6.0681	2.2038	3.1845	1288.821	247.1993
.7000	4.5368	2.5711	3.1542	1425.403	288.2183
.8000	3.0158	2.9385	3.1280	1561.339	329.2409
.9000	1.5039	3.3058	3.1049	1696.711	370.2658
1.0000	.0000	3.6731	3.0842	1831.582	411.2924

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5495	12.512	12.512	-.0002
13.9709	518.906	111.017	407.8896
12.3445	646.707	212.505	434.2020
10.7490	749.081	312.061	437.0198
9.1693	848.024	410.637	437.3866
7.6114	945.296	507.846	437.4503
6.0681	1041.622	604.152	437.4697
4.5368	1137.185	699.706	437.4788
3.0158	1232.098	794.613	437.4844
1.5039	1326.445	888.958	437.4876

.0000 1420.289 982.800 437.4892

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 10

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+00 LOAD = 506.250
SET = .2200

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5300	.0000	3.0429	520.977	507.2499
.1000	13.9639	.3673	3.3982	659.732	83.5240
.2000	12.3438	.7346	3.3880	801.855	88.0014
.3000	10.7476	1.1019	3.3191	942.484	124.8348
.4000	9.1693	1.4692	3.2638	1082.001	165.2773
.5000	7.6115	1.8365	3.2202	1220.235	206.2045
.6000	6.0681	2.2038	3.1845	1357.572	247.2056
.7000	4.5368	2.5711	3.1542	1494.153	288.2225
.8000	3.0158	2.9385	3.1280	1630.089	329.2437
.9000	1.5039	3.3058	3.1049	1765.461	370.2680
1.0000	.0000	3.6731	3.0842	1900.332	411.2949

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5300	13.727	13.727	.0001
13.9639	576.208	111.454	464.7542
12.3438	713.854	212.549	501.3049
10.7476	817.649	312.150	505.4996
9.1693	916.724	410.639	506.0853
7.6115	1014.031	507.845	506.1863
6.0681	1110.366	604.153	506.2133
4.5368	1205.931	699.706	506.2246
3.0158	1300.845	794.613	506.2316
1.5039	1395.193	888.958	506.2354
.0000	1489.037	982.800	506.2367

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 12

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+00 LOAD = 575.000
SET = .2413

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5087	.0000	3.0178	591.056	575.9999
.1000	13.9556	.3673	3.3642	729.001	99.2968
.2000	12.3428	.7346	3.3830	870.664	90.2463
.3000	10.7460	1.1019	3.3185	1011.336	125.2218
.4000	9.1692	1.4692	3.2637	1150.753	165.3523
.5000	7.6115	1.8365	3.2202	1288.983	206.2232
.6000	6.0681	2.2038	3.1845	1426.322	247.2130
.7000	4.5368	2.5711	3.1542	1562.903	288.2267
.8000	3.0158	2.9385	3.1280	1698.839	329.2469
.9000	1.5039	3.3058	3.1049	1834.211	370.2703
1.0000	.0000	3.6731	3.0842	1969.082	411.2968

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5087	15.056	15.056	.0001
13.9556	629.704	111.973	517.7314
12.3428	780.417	212.607	567.8101
10.7460	886.115	312.252	573.8626
9.1692	985.400	410.640	574.7603
7.6115	1082.760	507.842	574.9176
6.0681	1179.109	604.153	574.9559
4.5368	1274.677	699.706	574.9705
3.0158	1369.592	794.614	574.9784
1.5039	1463.941	888.958	574.9832
.0000	1557.785	982.800	574.9847

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 14

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+00 LOAD = 693.000
SET = .2894

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.4606	.0000	2.9811	712.060	694.0001
.1000	13.9345	.3673	3.2848	848.318	148.5630
.2000	12.3399	.7346	3.3680	988.847	97.3694
.3000	10.7421	1.1019	3.3164	1129.575	126.5159
.4000	9.1692	1.4692	3.2634	1268.757	165.6156
.5000	7.6116	1.8365	3.2201	1406.977	206.2856
.6000	6.0681	2.2038	3.1845	1544.322	247.2337

.7000	4.5368	2.5711	3.1542	1680.903	288.2364
.8000	3.0158	2.9385	3.1280	1816.839	329.2536
.9000	1.5039	3.3058	3.1049	1952.211	370.2761
1.0000	.0000	3.6731	3.0842	2087.082	411.3018

********** PORE PRESSURES **********

CHI	UW	U0	U
15.4606	18.060	18.060	-.0001
13.9345	699.755	113.290	586.4652
12.3399	891.478	212.791	678.6870
10.7421	1003.059	312.490	690.5685
9.1692	1103.142	410.645	692.4970
7.6116	1200.692	507.836	692.8552
6.0681	1297.089	604.153	692.9352
4.5368	1392.667	699.706	692.9607
3.0158	1487.585	794.614	692.9716
1.5039	1581.935	888.958	692.9774
.0000	1675.780	982.800	692.9797

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 17

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+00 LOAD = 811.000
SET = .3455

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.4045	.0000	2.9502	833.560	812.0001
.1000	13.9070	.3673	3.1946	968.029	234.8838
.2000	12.3348	.7346	3.3434	1107.164	110.3457
.3000	10.7383	1.1019	3.3127	1247.814	128.9490
.4000	9.1690	1.4692	3.2628	1386.767	166.1356
.5000	7.6117	1.8365	3.2200	1524.969	206.4090
.6000	6.0680	2.2038	3.1844	1662.323	247.2687
.7000	4.5368	2.5711	3.1542	1798.903	288.2504
.8000	3.0158	2.9385	3.1280	1934.839	329.2612
.9000	1.5039	3.3058	3.1049	2070.211	370.2819
1.0000	.0000	3.6731	3.0842	2205.082	411.3078

********** PORE PRESSURES **********

CHI	UW	U0	U
15.4045	21.559	21.559	-.0001
13.9070	733.145	115.000	618.1444
12.3348	996.818	213.108	783.7106

10.7383	1118.865	312.729	806.1355
9.1690	1220.631	410.654	809.9771
7.6117	1318.560	507.828	810.7319
6.0680	1415.054	604.154	810.9003
4.5368	1510.653	699.706	810.9468
3.0158	1605.578	794.614	810.9641
1.5039	1699.929	888.958	810.9716
.0000	1793.774	982.800	810.9738

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 20

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+00 LOAD = 929.000
SET = .4052

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.3448	.0000	2.9235	955.286	930.0002
.1000	13.8738	.3673	3.1063	1088.100	367.7341
.2000	12.3263	.7346	3.3048	1225.692	134.2252
.3000	10.7357	1.1019	3.3059	1365.979	133.4606
.4000	9.1687	1.4692	3.2616	1504.784	167.1259
.5000	7.6119	1.8365	3.2198	1642.958	206.6497
.6000	6.0680	2.2038	3.1844	1780.324	247.3342
.7000	4.5368	2.5711	3.1542	1916.903	288.2724
.8000	3.0158	2.9385	3.1280	2052.839	329.2715
.9000	1.5039	3.3058	3.1049	2188.211	370.2886
1.0000	.0000	3.6731	3.0842	2323.082	411.3138

********** PORE PRESSURES **********

CHI	UW	U0	U
15.3448	25.285	25.285	-.0002
13.8738	720.366	117.072	603.2941
12.3263	1091.467	213.636	877.8311
10.7357	1232.519	312.895	919.6238
9.1687	1337.658	410.672	926.9867
7.6119	1436.309	507.818	928.4911
6.0680	1532.990	604.155	928.8347
4.5368	1628.631	699.706	928.9247
3.0158	1723.568	794.614	928.9537
1.5039	1817.923	888.958	928.9648
.0000	1911.768	982.800	928.9678

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 23

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .80000E+00 LOAD = 1105.500
SET = .4633

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.2867	.0000	2.8892	1135.411	1106.5000
.1000	13.8366	.3673	3.0371	1266.926	522.4637
.2000	12.3130	.7346	3.2501	1403.025	177.1507
.3000	10.7351	1.1019	3.2940	1542.515	141.8157
.4000	9.1682	1.4692	3.2594	1681.317	168.9822
.5000	7.6120	1.8365	3.2194	1819.453	207.1086
.6000	6.0680	2.2038	3.1843	1956.826	247.4588
.7000	4.5368	2.5711	3.1542	2093.403	288.3107
.8000	3.0158	2.9385	3.1280	2229.340	329.2867
.9000	1.5039	3.3058	3.1049	2364.711	370.2971
1.0000	.0000	3.6731	3.0842	2499.582	411.3203

********** PORE PRESSURES **********

CHI	UW	U0	U
15.2867	28.912	28.911	.0002
13.8366	744.462	119.398	625.0644
12.3130	1225.874	214.468	1011.4060
10.7351	1400.699	312.930	1087.7690
9.1682	1512.335	410.704	1101.6300
7.6120	1612.344	507.812	1104.5320
6.0680	1709.367	604.157	1105.2100
4.5368	1805.093	699.706	1105.3860
3.0158	1900.053	794.614	1105.4390
1.5039	1994.414	888.958	1105.4560
.0000	2088.261	982.800	1105.4610

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 26
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .90000E+00 LOAD = 1282.000
SET = .5192

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE

.0000	15.2308	.0000	2.8601	1315.400	1283.0000
.1000	13.7942	.3673	2.9875	1446.067	671.9923
.2000	12.2932	.7346	3.1827	1580.760	249.5206
.3000	10.7344	1.1019	3.2735	1719.058	157.3578
.4000	9.1672	1.4692	3.2553	1857.879	172.5296
.5000	7.6118	1.8365	3.2185	1995.966	207.9981
.6000	6.0679	2.2038	3.1841	2133.330	247.7018
.7000	4.5368	2.5711	3.1541	2269.903	288.3837
.8000	3.0158	2.9385	3.1280	2405.840	329.3122
.9000	1.5039	3.3058	3.1049	2541.211	370.3092
1.0000	.0000	3.6731	3.0842	2676.082	411.3297

********** PORE PRESSURES **********

CHI	UW	U0	U
15.2308	32.399	32.400	-.0005
13.7942	774.075	122.039	652.0358
12.2932	1331.239	215.703	1115.5360
10.7344	1561.700	312.974	1248.7270
9.1672	1685.349	410.766	1274.5830
7.6118	1787.968	507.826	1280.1430
6.0679	1885.628	604.160	1281.4670
4.5368	1981.519	699.706	1281.8130
3.0158	2076.528	794.615	1281.9130
1.5039	2170.902	888.958	1281.9440
.0000	2264.752	982.800	1281.9520

TIMESTEP SIZE = .04, ITERATIONS BETWEEN PRINT TIMES = 29

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .10000E+01 LOAD = 1282.000
SET = .5678

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.1822	.0000	2.8601	1318.433	1283.0000
.1000	13.7490	.3673	2.9596	1448.889	774.0546
.2000	12.2666	.7346	3.1146	1582.422	352.3974
.3000	10.7298	1.1019	3.2417	1719.347	184.8954
.4000	9.1654	1.4692	3.2479	1857.994	179.1528
.5000	7.6109	1.8365	3.2169	1996.020	209.7022
.6000	6.0678	2.2038	3.1837	2133.336	248.1729
.7000	4.5368	2.5711	3.1540	2269.902	288.5244
.8000	3.0158	2.9385	3.1280	2405.840	329.3592
.9000	1.5039	3.3058	3.1049	2541.211	370.3285
1.0000	.0000	3.6731	3.0842	2676.082	411.3437

********** PORE PRESSURES **********

CHI	UW	U0	U
15.1822	35.433	35.433	-.0005
13.7490	674.835	124.861	549.9735
12.2666	1230.025	217.366	1012.6590
10.7298	1534.451	313.262	1221.1890
9.1654	1678.841	410.881	1267.9600
7.6109	1786.318	507.879	1278.4390
6.0678	1885.163	604.167	1280.9960
4.5368	1981.378	699.705	1281.6730
3.0158	2076.481	794.615	1281.8660
1.5039	2170.883	888.958	1281.9250
.0000	2264.738	982.800	1281.9380

TIMESTEP SIZE = .03, ITERATIONS BETWEEN PRINT TIMES = 33

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12500E+01 LOAD = 1282.000
SET = .6722

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.0778	.0000	2.8601	1324.943	1283.0000
.1000	13.6478	.3673	2.9307	1455.207	896.4016
.2000	12.1875	.7346	3.0243	1587.358	557.4223
.3000	10.6890	1.1019	3.1379	1721.889	313.1987
.4000	9.1533	1.4692	3.2058	1858.745	221.8762
.5000	7.6062	1.8365	3.2053	1996.317	222.3692
.6000	6.0670	2.2038	3.1807	2133.389	251.9482
.7000	4.5367	2.5711	3.1532	2269.910	289.6906
.8000	3.0157	2.9385	3.1277	2405.845	329.7413
.9000	1.5039	3.3058	3.1048	2541.212	370.4738
1.0000	.0000	3.6731	3.0841	2676.082	411.4368

********** PORE PRESSURES **********

CHI	UW	U0	U
15.0778	41.942	41.943	-.0005
13.6478	558.805	131.178	427.6266
12.1875	1029.936	222.302	807.6340
10.6890	1408.690	315.805	1092.8860
9.1533	1636.869	411.632	1225.2360
7.6062	1773.947	508.176	1265.7710
6.0670	1881.441	604.220	1277.2210
4.5367	1980.219	699.713	1280.5070

3.0157	2076.104	794.620	1281.4840
1.5039	2170.738	888.959	1281.7800
.0000	2264.645	982.800	1281.8450

TIMESTEP SIZE = .03, ITERATIONS BETWEEN PRINT TIMES = 43

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+01 LOAD = 1282.000
SET = .7571

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.9929	.0000	2.8601	1330.245	1283.0000
.1000	13.5652	.3673	2.9162	1460.362	965.1105
.2000	12.1143	.7346	2.9858	1591.922	677.9063
.3000	10.6357	1.1019	3.0675	1725.218	447.6425
.4000	9.1270	1.4692	3.1431	1860.385	305.0446
.5000	7.5973	1.8365	3.1764	1996.869	257.5487
.6000	6.0638	2.2038	3.1708	2133.589	265.0262
.7000	4.5355	2.5711	3.1501	2269.980	294.3691
.8000	3.0154	2.9385	3.1267	2405.865	331.4221
.9000	1.5038	3.3058	3.1044	2541.216	371.1397
1.0000	.0000	3.6731	3.0839	2676.082	411.8627

********** PORE PRESSURES **********

CHI	UW	U0	U
14.9929	47.245	47.245	-.0005
13.5652	495.252	136.334	358.9177
12.1143	914.015	226.865	687.1500
10.6357	1277.575	319.133	958.4420
9.1270	1555.340	413.272	1142.0680
7.5973	1739.320	508.728	1230.5920
6.0638	1868.563	604.421	1264.1430
4.5355	1975.611	699.783	1275.8280
3.0154	2074.443	794.640	1279.8030
1.5038	2170.077	888.963	1281.1140
.0000	2264.219	982.800	1281.4190

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 54

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .17500E+01 LOAD = 1282.000
SET = .8298

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.9202	.0000	2.8601	1334.778	1283.0000
.1000	13.4941	.3673	2.9069	1464.797	1011.7110
.2000	12.0491	.7346	2.9627	1595.994	762.0906
.3000	10.5821	1.1019	3.0266	1728.564	550.9374
.4000	9.0910	1.4692	3.0910	1862.633	397.3802
.5000	7.5791	1.8365	3.1369	1998.006	314.7087
.6000	6.0559	2.2038	3.1510	2134.082	293.0670
.7000	4.5323	2.5711	3.1420	2270.182	306.7469
.8000	3.0143	2.9385	3.1236	2405.934	336.6952
.9000	1.5035	3.3058	3.1032	2541.238	373.5533
1.0000	.0000	3.6731	3.0831	2676.082	413.5369

********** PORE PRESSURES **********

CHI	UW	U0	U
14.9202	51.777	51.778	-.0005
13.4941	453.085	140.769	312.3167
12.0491	833.903	230.937	602.9658
10.5821	1177.627	322.480	855.1470
9.0910	1465.253	415.520	1049.7320
7.5791	1683.297	509.865	1173.4320
6.0559	1841.014	604.912	1236.1020
4.5323	1963.435	699.985	1263.4500
3.0143	2069.239	794.708	1274.5300
1.5035	2167.685	888.984	1278.7000
.0000	2262.545	982.800	1279.7450

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 66
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+01 LOAD = 1282.000
SET = .8940

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.8560	.0000	2.8601	1338.788	1283.0000
.1000	13.4309	.3673	2.9004	1468.738	1045.6560
.2000	11.9899	.7346	2.9472	1599.687	824.5840
.3000	10.5306	1.1019	2.9997	1731.776	631.5851
.4000	9.0515	1.4692	3.0538	1865.101	479.8421

.5000	7.5537	1.8365	3.0996	1999.593	380.4297
.6000	6.0424	2.2038	3.1249	2134.925	334.4865
.7000	4.5260	2.5711	3.1280	2270.576	329.2684
.8000	3.0116	2.9385	3.1170	2406.102	348.2092
.9000	1.5025	3.3058	3.0999	2541.299	379.8101
1.0000	.0000	3.6731	3.0809	2676.082	418.3037

********** PORE PRESSURES **********

CHI	UW	U0	U
14.8560	55.788	55.788	-.0005
13.4309	423.082	144.710	278.3723
11.9899	775.103	234.631	540.4723
10.5306	1100.191	325.691	774.4994
9.0515	1385.259	417.989	967.2705
7.5537	1619.163	511.452	1107.7110
6.0424	1800.439	605.756	1194.6820
4.5260	1941.308	700.379	1240.9290
3.0116	2057.893	794.876	1263.0160
1.5025	2161.489	889.046	1272.4430
.0000	2257.778	982.800	1274.9780

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 78

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+01 LOAD = 1282.000
SET = .9519

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.7981	.0000	2.8601	1342.397	1283.0000
.1000	13.3739	.3673	2.8955	1472.294	1071.7190
.2000	11.9358	.7346	2.9359	1603.061	873.1907
.3000	10.4821	1.1019	2.9805	1734.803	696.2067
.4000	9.0115	1.4692	3.0268	1867.596	550.4609
.5000	7.5245	1.8365	3.0688	2001.413	444.7459
.6000	6.0240	2.2038	3.0982	2136.069	383.0743
.7000	4.5160	2.5711	3.1100	2271.201	360.8879
.8000	3.0067	2.9385	3.1065	2406.408	367.3489
.9000	1.5005	3.3058	3.0937	2541.421	392.0045
1.0000	.0000	3.6731	3.0762	2676.082	428.3750

********** PORE PRESSURES **********

CHI	UW	U0	U
14.7981	59.396	59.397	-.0005

13.3739	400.574	148.266	252.3087
11.9358	729.870	238.005	491.8656
10.4821	1038.596	328.719	709.8777
9.0115	1317.135	420.483	896.6517
7.5245	1556.667	513.272	1043.3950
6.0240	1752.994	606.900	1146.0950
4.5160	1910.313	701.003	1209.3090
3.0067	2039.059	795.183	1243.8760
1.5005	2149.417	889.168	1260.2490
.0000	2247.707	982.800	1264.9070

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 90

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+01 LOAD = 1282.000
SET = 1.0046

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.7454	.0000	2.8601	1345.688	1283.0000
.1000	13.3219	.3673	2.8917	1475.544	1092.4810
.2000	11.8860	.7346	2.9273	1606.171	912.2776
.3000	10.4365	1.1019	2.9660	1737.650	749.2297
.4000	8.9723	1.4692	3.0063	1870.041	610.8132
.5000	7.4937	1.8365	3.0441	2003.335	504.0914
.6000	6.0024	2.2038	3.0738	2137.417	433.5945
.7000	4.5026	2.5711	3.0903	2272.035	398.8029
.8000	2.9994	2.9385	3.0927	2406.863	393.9468
.9000	1.4974	3.3058	3.0841	2541.616	411.4208
1.0000	.0000	3.6731	3.0685	2676.082	445.4505

********** PORE PRESSURES **********

CHI	UW	U0	U
14.7454	62.687	62.688	-.0005
13.3219	383.062	151.515	231.5467
11.8860	693.893	241.114	452.7787
10.4365	988.420	331.566	656.8547
8.9723	1259.228	422.928	836.2994
7.4937	1499.243	515.194	984.0494
6.0024	1703.823	608.248	1095.5740
4.5026	1873.232	701.838	1171.3940
2.9994	2012.917	795.638	1217.2780
1.4974	2130.195	889.362	1240.8330
.0000	2230.631	982.800	1247.8310

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 103

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+01 LOAD = 1282.000
SET = 1.0532

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.6968	.0000	2.8601	1348.722	1283.0000
.1000	13.2738	.3673	2.8887	1478.544	1109.5160
.2000	11.8397	.7346	2.9204	1609.059	944.5878
.3000	10.3935	1.1019	2.9547	1740.331	793.7316
.4000	8.9344	1.4692	2.9902	1872.406	662.9346
.5000	7.4625	1.8365	3.0241	2005.283	558.0176
.6000	5.9789	2.2038	3.0524	2138.884	483.3912
.7000	4.4867	2.5711	3.0707	2273.025	440.4698
.8000	2.9900	2.9385	3.0768	2407.447	426.9651
.9000	1.4932	3.3058	3.0717	2541.877	438.3119
1.0000	.0000	3.6731	3.0578	2676.082	470.2282

********** PORE PRESSURES **********

CHI	UW	U0	U
14.6968	65.721	65.722	-.0005
13.2738	369.029	154.516	214.5126
11.8397	664.471	244.003	420.4685
10.3935	946.599	334.247	612.3528
8.9344	1209.472	425.294	784.1780
7.4625	1447.266	517.143	930.1232
5.9789	1655.492	609.715	1045.7780
4.4867	1832.555	702.828	1129.7270
2.9900	1980.482	796.222	1184.2600
1.4932	2103.566	889.624	1213.9420
.0000	2205.854	982.800	1223.0530

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 116
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+01 LOAD = 1282.000
SET = 1.0984

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.6516	.0000	2.8601	1351.542	1283.0000
.1000	13.2290	.3673	2.8862	1481.336	1123.8610
.2000	11.7964	.7346	2.9148	1611.759	971.9759
.3000	10.3529	1.1019	2.9454	1742.861	831.9316
.4000	8.8980	1.4692	2.9770	1874.680	708.6967
.5000	7.4315	1.8365	3.0075	2007.214	607.2119
.6000	5.9546	2.2038	3.0336	2140.405	531.6379
.7000	4.4693	2.5711	3.0520	2274.112	484.3416
.8000	2.9792	2.9385	3.0599	2408.124	465.2254
.9000	1.4881	3.3058	3.0570	2542.193	472.1700
1.0000	.0000	3.6731	3.0447	2676.082	502.4865

********** PORE PRESSURES **********

CHI	UW	U0	U
14.6516	68.541	68.542	-.0005
13.2290	357.475	157.308	200.1669
11.7964	639.783	246.702	393.0804
10.3529	910.929	336.777	574.1529
8.8980	1165.983	427.567	738.4160
7.4315	1400.002	519.073	880.9289
5.9546	1608.767	611.236	997.5311
4.4693	1789.771	703.915	1085.8550
2.9792	1942.899	796.899	1146.0000
1.4881	2070.023	889.940	1180.0830
.0000	2173.595	982.800	1190.7950

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 129

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+01 LOAD = 1282.000
SET = 1.1804

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.5696	.0000	2.8601	1356.658	1283.0000
.1000	13.1478	.3673	2.8821	1486.408	1147.2590
.2000	11.7175	.7346	2.9058	1616.683	1017.0440
.3000	10.2783	1.1019	2.9308	1747.517	895.8268
.4000	8.8298	1.4692	2.9563	1878.932	787.3740
.5000	7.3721	1.8365	2.9807	2010.920	695.5835
.6000	5.9059	2.2038	3.0020	2143.438	624.1581
.7000	4.4329	2.5711	3.0178	2276.386	576.1540
.8000	2.9554	2.9385	3.0257	2409.610	553.5192
.9000	1.4766	3.3058	3.0245	2542.911	556.8788

1.0000	.0000	3.6731	3.0145	2676.082	585.7369

********** PORE PRESSURES **********

CHI	UW	U0	U
14.5696	73.657	73.658	-.0005
13.1478	339.148	162.379	176.7689
11.7175	599.638	251.626	348.0120
10.2783	851.690	341.432	510.2577
8.8298	1091.558	431.819	659.7386
7.3721	1315.337	522.779	792.5573
5.9059	1519.280	614.269	905.0108
4.4329	1700.232	706.189	994.0431
2.9554	1856.091	798.385	1057.7060
1.4766	1986.033	890.658	1095.3750
.0000	2090.345	982.800	1107.5450

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 156

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+01 LOAD = 1282.000
SET = 1.2532

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.4968	.0000	2.8601	1361.197	1283.0000
.1000	13.0756	.3673	2.8788	1490.910	1166.6740
.2000	11.6473	.7346	2.8987	1621.066	1054.8420
.3000	10.2115	1.1019	2.9192	1751.685	950.4268
.4000	8.7682	1.4692	2.9397	1882.777	856.6046
.5000	7.3175	1.8365	2.9590	2014.326	776.7150
.6000	5.8602	2.2038	2.9755	2146.290	714.0906
.7000	4.3976	2.5711	2.9875	2278.585	671.7752
.8000	2.9317	2.9385	2.9934	2411.087	652.1819
.9000	1.4649	3.3058	2.9920	2543.643	656.7665
1.0000	.0000	3.6731	2.9835	2676.082	685.8741

********** PORE PRESSURES **********

CHI	UW	U0	U
14.4968	78.196	78.197	-.0005
13.0756	324.236	166.882	157.3540
11.6473	566.224	256.009	310.2145
10.2115	801.258	345.601	455.6576
8.7682	1026.172	435.664	590.5081
7.3175	1237.611	526.185	711.4258

5.8602	1432.199	617.121	815.0784
4.3976	1606.810	708.388	898.4219
2.9317	1758.906	799.862	959.0433
1.4649	1886.876	891.389	995.4869
.0000	1990.208	982.800	1007.4070

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 183

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+01 LOAD = 1282.000
SET = 1.3752

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.3748	.0000	2.8601	1368.810	1283.0000
.1000	12.9546	.3673	2.8731	1498.459	1201.0630
.2000	11.5296	.7346	2.8864	1628.410	1122.4120
.3000	10.0996	1.1019	2.8997	1758.667	1049.4810
.4000	8.6649	1.4692	2.9122	1889.221	984.8256
.5000	7.2259	1.8365	2.9232	2020.046	931.0645
.6000	5.7831	2.2038	2.9320	2151.100	890.7575
.7000	4.3378	2.5711	2.9375	2282.319	866.2365
.8000	2.8911	2.9385	2.9390	2413.619	859.3916
.9000	1.4447	3.3058	2.9363	2544.907	871.4698
1.0000	.0000	3.6731	2.9293	2676.082	902.9498

********** PORE PRESSURES **********

CHI	UW	U0	U
14.3748	85.809	85.810	-.0005
12.9546	297.396	174.431	122.9655
11.5296	505.998	263.354	242.6441
10.0996	709.186	352.583	356.6035
8.6649	904.395	442.108	462.2870
7.2259	1088.982	531.906	557.0764
5.7831	1260.343	621.931	638.4114
4.3378	1416.083	712.122	703.9606
2.8911	1554.228	802.394	751.8337
1.4447	1673.437	892.653	780.7836
.0000	1773.132	982.800	790.3318

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 238

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY

IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+01 LOAD = 1282.000
SET = 1.4686

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.2814	.0000	2.8601	1374.641	1283.0000
.1000	12.8621	.3673	2.8680	1504.233	1232.2030
.2000	11.4399	.7346	2.8759	1634.007	1183.8260
.3000	10.0148	1.1019	2.8834	1763.958	1139.8740
.4000	8.5872	1.4692	2.8900	1894.071	1102.3670
.5000	7.1574	1.8365	2.8952	2024.320	1073.2720
.6000	5.7259	2.2038	2.8987	2154.671	1054.4140
.7000	4.2936	2.5711	2.9001	2285.078	1047.3770
.8000	2.8612	2.9385	2.8989	2415.487	1053.3930
.9000	1.4297	3.3058	2.8952	2545.841	1073.2590
1.0000	.0000	3.6731	2.8891	2676.082	1107.2890

********** PORE PRESSURES **********

CHI	UW	U0	U
14.2814	91.641	91.641	-.0005
12.8621	272.030	180.205	91.8254
11.4399	450.182	268.951	181.2304
10.0148	624.084	357.874	266.2102
8.5872	791.704	446.958	344.7458
7.1574	951.048	536.180	414.8688
5.7259	1100.257	625.502	474.7548
4.2936	1237.700	714.880	522.8199
2.8612	1362.094	804.261	557.8327
1.4297	1472.582	893.587	578.9945
.0000	1568.793	982.800	585.9929

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 295
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+01 LOAD = 1282.000
SET = 1.5368

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.2132	.0000	2.8601	1378.898	1283.0000
.1000	12.7946	.3673	2.8639	1508.443	1258.6090
.2000	11.3748	.7346	2.8674	1638.072	1235.9220

.3000	9.9536	1.1019	2.8706	1767.778	1216.4770
.4000	8.5315	1.4692	2.8730	1897.549	1201.7690
.5000	7.1086	1.8365	2.8744	2027.363	1193.1970
.6000	5.6855	2.2038	2.8746	2157.197	1192.0090
.7000	4.2625	2.5711	2.8734	2287.019	1199.2530
.8000	2.8402	2.9385	2.8707	2416.797	1215.7160
.9000	1.4192	3.3058	2.8665	2546.496	1241.9060
1.0000	.0000	3.6731	2.8608	2676.082	1278.0200

********** PORE PRESSURES **********

CHI	UW	U0	U
14.2132	95.898	95.898	-.0005
12.7946	249.834	184.414	65.4194
11.3748	402.150	273.015	129.1347
9.9536	551.301	361.694	189.6073
8.5315	695.780	450.436	245.3433
7.1086	834.166	539.223	294.9438
5.6855	965.188	628.028	337.1598
4.2625	1087.766	716.822	370.9443
2.8402	1201.081	805.572	395.5091
1.4192	1304.590	894.242	410.3478
.0000	1398.062	982.800	415.2619

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 354

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .80000E+01 LOAD = 1282.000
SET = 1.5845

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1655	.0000	2.8601	1381.875	1283.0000
.1000	12.7475	.3673	2.8607	1511.383	1279.1350
.2000	11.3294	.7346	2.8611	1640.903	1276.4270
.3000	9.9112	1.1019	2.8612	1770.428	1275.9840
.4000	8.4930	1.4692	2.8607	1899.950	1278.8550
.5000	7.0751	1.8365	2.8596	2029.454	1285.9980
.6000	5.6578	2.2038	2.8578	2158.925	1298.2440
.7000	4.2413	2.5711	2.8550	2288.343	1316.2760
.8000	2.8259	2.9385	2.8514	2417.689	1340.6020
.9000	1.4120	3.3058	2.8469	2546.942	1371.5440
1.0000	.0000	3.6731	2.8416	2676.082	1409.2290

********** PORE PRESSURES **********

CHI	UW	U0	U

14.1655	98.874	98.875	-.0005
12.7475	232.247	187.355	44.8929
11.3294	364.475	275.846	88.6288
9.9112	494.444	364.344	130.1002
8.4930	621.095	452.837	168.2575
7.0751	743.457	541.314	202.1431
5.6578	860.681	629.756	230.9254
4.2413	972.067	718.146	253.9210
2.8259	1077.087	806.464	270.6231
1.4120	1175.398	894.688	280.7097
.0000	1266.853	982.800	284.0526

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 416

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .90000E+01 LOAD = 1282.000
SET = 1.6168

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1332	.0000	2.8601	1383.889	1283.0000
.1000	12.7157	.3673	2.8584	1513.371	1294.0510
.2000	11.2988	.7346	2.8566	1642.813	1305.8640
.3000	9.8826	1.1019	2.8546	1772.212	1319.2090
.4000	8.4672	1.4692	2.8523	1901.561	1334.7930
.5000	7.0527	1.8365	2.8496	2030.853	1353.2530
.6000	5.6393	2.2038	2.8464	2160.078	1375.1370
.7000	4.2271	2.5711	2.8428	2289.225	1400.8830
.8000	2.8164	2.9385	2.8386	2418.282	1430.8210
.9000	1.4073	3.3058	2.8339	2547.238	1465.1510
1.0000	.0000	3.6731	2.8288	2676.082	1503.9590

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1332	100.889	100.889	-.0005
12.7157	219.320	189.343	29.9776
11.2988	336.949	277.757	59.1922
9.8826	453.003	366.127	86.8755
8.4672	566.768	454.448	112.3193
7.0527	677.600	542.712	134.8874
5.6393	784.941	630.909	154.0319
4.2271	888.342	719.028	169.3139
2.8164	987.461	807.057	180.4045
1.4073	1082.087	894.985	187.1025
.0000	1172.123	982.800	189.3228

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 483
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .10000E+02 LOAD = 1282.000
SET = 1.6382

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1118	.0000	2.8601	1385.221	1283.0000
.1000	12.6946	.3673	2.8568	1514.685	1304.3860
.2000	11.2786	.7346	2.8535	1644.074	1326.2700
.3000	9.8637	1.1019	2.8502	1773.387	1349.1630
.4000	8.4502	1.4692	2.8466	1902.620	1373.5340
.5000	7.0380	1.8365	2.8429	2031.771	1399.7990
.6000	5.6272	2.2038	2.8389	2160.834	1428.3120
.7000	4.2179	2.5711	2.8347	2289.802	1459.3590
.8000	2.8102	2.9385	2.8302	2418.670	1493.1420
.9000	1.4042	3.3058	2.8254	2547.432	1529.7970
1.0000	.0000	3.6731	2.8204	2676.082	1569.3750

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1118	102.221	102.221	-.0005
12.6946	210.299	190.657	19.6424
11.2786	317.804	279.018	38.7860
9.8637	424.223	367.302	56.9210
8.4502	529.087	455.508	73.5789
7.0380	631.973	543.630	88.3422
5.6272	732.522	631.665	100.8568
4.2179	830.443	719.605	110.8383
2.8102	925.528	807.445	118.0829
1.4042	1017.635	895.179	122.4566
.0000	1106.707	982.800	123.9068

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 554
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12000E+02 LOAD = 1282.000
SET = 1.6610

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0890	.0000	2.8601	1386.647	1283.0000
.1000	12.6721	.3673	2.8551	1516.091	1315.8780
.2000	11.2570	.7346	2.8502	1645.421	1348.9610
.3000	9.8437	1.1019	2.8454	1774.640	1382.4660
.4000	8.4321	1.4692	2.8406	1903.749	1416.5890
.5000	7.0223	1.8365	2.8358	2032.748	1451.4990
.6000	5.6143	2.2038	2.8310	2161.636	1487.3480
.7000	4.2080	2.5711	2.8261	2290.415	1524.2440
.8000	2.8036	2.9385	2.8213	2419.082	1562.2760
.9000	1.4009	3.3058	2.8164	2547.638	1601.4960
1.0000	.0000	3.6731	2.8115	2676.082	1641.9230

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0890	103.647	103.647	-.0005
12.6721	200.213	192.063	8.1502
11.2570	296.460	280.365	16.0952
9.8437	392.174	368.556	23.6185
8.4321	487.160	456.636	30.5239
7.0223	581.248	544.607	36.6415
5.6143	674.289	632.468	41.8214
4.2080	766.171	720.218	45.9536
2.8036	856.806	807.857	48.9494
1.4009	946.142	895.385	50.7577
.0000	1034.159	982.800	51.3590

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 700

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12500E+02 LOAD = 1282.000
SET = 1.6642

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0858	.0000	2.8601	1386.846	1283.0000
.1000	12.6689	.3673	2.8548	1516.287	1317.5160
.2000	11.2540	.7346	2.8497	1645.609	1352.1940
.3000	9.8409	1.1019	2.8447	1774.815	1387.2110
.4000	8.4296	1.4692	2.8397	1903.906	1422.7210
.5000	7.0201	1.8365	2.8348	2032.884	1458.8630
.6000	5.6125	2.2038	2.8299	2161.748	1495.7520
.7000	4.2067	2.5711	2.8249	2290.500	1533.4800

.8000	2.8027	2.9385	2.8200	2419.139	1572.1140
.9000	1.4004	3.3058	2.8151	2547.667	1611.6980
1.0000	.0000	3.6731	2.8103	2676.082	1652.2460

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0858	103.845	103.846	-.0005
12.6689	198.771	192.258	6.5120
11.2540	293.415	280.553	12.8621
9.8409	387.604	368.730	18.8738
8.4296	481.185	456.793	24.3919
7.0201	574.021	544.743	29.2782
5.6125	665.996	632.579	33.4167
4.2067	757.020	720.303	36.7170
2.8027	847.025	807.914	39.1112
1.4004	935.969	895.413	40.5557
.0000	1023.835	982.800	41.0354

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 738

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+02 LOAD = 1282.000
SET = 1.6727

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0773	.0000	2.8601	1387.376	1283.0000
.1000	12.6606	.3673	2.8542	1516.810	1321.9320
.2000	11.2459	.7346	2.8485	1646.110	1360.9150
.3000	9.8334	1.1019	2.8429	1775.280	1400.0090
.4000	8.4229	1.4692	2.8374	1904.324	1439.2610
.5000	7.0144	1.8365	2.8321	2033.245	1478.7180
.6000	5.6078	2.2038	2.8269	2162.045	1518.4140
.7000	4.2031	2.5711	2.8218	2290.726	1558.3800
.8000	2.8002	2.9385	2.8167	2419.292	1598.6390
.9000	1.3992	3.3058	2.8118	2547.743	1639.2030
1.0000	.0000	3.6731	2.8070	2676.082	1680.0770

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0773	104.376	104.376	-.0005
12.6606	194.877	192.781	2.0958
11.2459	285.194	281.053	4.1411
9.8334	375.271	369.196	6.0758

8.4229	465.063	457.212	7.8511
7.0144	554.527	545.104	9.4228
5.6078	643.631	632.876	10.7546
4.2031	732.346	720.529	11.8170
2.8002	820.652	808.066	12.5859
1.3992	908.540	895.489	13.0509
.0000	996.005	982.800	13.2047

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 928

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .17500E+02 LOAD = 1282.000
SET = 1.6754

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0746	.0000	2.8601	1387.546	1283.0000
.1000	12.6579	.3673	2.8540	1516.977	1323.3570
.2000	11.2434	.7346	2.8481	1646.270	1363.7330
.3000	9.8310	1.1019	2.8423	1775.429	1404.1410
.4000	8.4207	1.4692	2.8367	1904.458	1444.6000
.5000	7.0125	1.8365	2.8313	2033.361	1485.1240
.6000	5.6062	2.2038	2.8259	2162.140	1525.7270
.7000	4.2019	2.5711	2.8208	2290.799	1566.4180
.8000	2.7994	2.9385	2.8157	2419.340	1607.2000
.9000	1.3988	3.3058	2.8107	2547.767	1648.0800
1.0000	.0000	3.6731	2.8059	2676.082	1689.0600

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0746	104.546	104.546	-.0005
12.6579	193.620	192.949	.6712
11.2434	282.537	281.213	1.3234
9.8310	371.288	369.344	1.9440
8.4207	459.858	457.345	2.5129
7.0125	548.236	545.220	3.0165
5.6062	636.413	632.971	3.4416
4.2019	724.380	720.602	3.7788
2.7994	812.140	808.115	4.0249
1.3988	899.687	895.514	4.1731
.0000	987.022	982.800	4.2220

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1121

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .18000E+02 LOAD = 1282.000
SET = 1.6757

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0743	.0000	2.8601	1387.562	1283.0000
.1000	12.6576	.3673	2.8540	1516.993	1323.4930
.2000	11.2431	.7346	2.8480	1646.285	1364.0020
.3000	9.8308	1.1019	2.8422	1775.443	1404.5360
.4000	8.4205	1.4692	2.8366	1904.471	1445.1120
.5000	7.0123	1.8365	2.8312	2033.372	1485.7390
.6000	5.6061	2.2038	2.8259	2162.149	1526.4270
.7000	4.2018	2.5711	2.8207	2290.806	1567.1860
.8000	2.7994	2.9385	2.8156	2419.345	1608.0190
.9000	1.3988	3.3058	2.8106	2547.769	1648.9280
1.0000	.0000	3.6731	2.8058	2676.082	1689.9180

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0743	104.562	104.562	-.0005
12.6576	193.500	192.965	.5350
11.2431	282.283	281.229	1.0544
9.8308	370.906	369.359	1.5480
8.4205	459.359	457.358	2.0006
7.0123	547.632	545.231	2.4016
5.6061	635.721	632.980	2.7416
4.2018	723.619	720.608	3.0108
2.7994	811.325	808.120	3.2059
1.3988	898.841	895.516	3.3252
.0000	986.163	982.800	3.3632

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1160
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+02 LOAD = 1282.000
SET = 1.6763

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0737	.0000	2.8601	1387.600	1283.0000

.1000	12.6570	.3673	2.8539	1517.030	1323.8130
.2000	11.2426	.7346	2.8479	1646.321	1364.6330
.3000	9.8303	1.1019	2.8421	1775.476	1405.4600
.4000	8.4201	1.4692	2.8365	1904.500	1446.3050
.5000	7.0119	1.8365	2.8310	2033.397	1487.1710
.6000	5.6058	2.2038	2.8256	2162.170	1528.0630
.7000	4.2015	2.5711	2.8204	2290.822	1568.9820
.8000	2.7992	2.9385	2.8154	2419.356	1609.9280
.9000	1.3987	3.3058	2.8104	2547.775	1650.9070
1.0000	.0000	3.6731	2.8056	2676.082	1691.9200

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0737	104.600	104.600	-.0005
12.6570	193.217	193.002	.2147
11.2426	281.688	281.264	.4236
9.8303	370.016	369.392	.6247
8.4201	458.195	457.388	.8073
7.0119	546.226	545.256	.9696
5.6058	634.107	633.001	1.1058
4.2015	721.840	720.625	1.2155
2.7992	809.428	808.130	1.2975
1.3987	896.868	895.521	1.3463
.0000	984.162	982.800	1.3618

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1315

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+02 LOAD = 1282.000
SET = 1.6766

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0734	.0000	2.8601	1387.617	1283.0000
.1000	12.6568	.3673	2.8539	1517.047	1323.9580
.2000	11.2423	.7346	2.8479	1646.337	1364.9180
.3000	9.8300	1.1019	2.8421	1775.491	1405.8800
.4000	8.4199	1.4692	2.8364	1904.514	1446.8480
.5000	7.0117	1.8365	2.8309	2033.409	1487.8210
.6000	5.6056	2.2038	2.8255	2162.179	1528.8010
.7000	4.2014	2.5711	2.8203	2290.829	1569.7930
.8000	2.7991	2.9385	2.8153	2419.361	1610.7950
.9000	1.3987	3.3058	2.8103	2547.777	1651.8080
1.0000	.0000	3.6731	2.8055	2676.082	1692.8330

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0734	104.617	104.617	-.0005
12.6568	193.089	193.019	.0705
11.2423	281.418	281.280	.1379
9.8300	369.611	369.407	.2045
8.4199	457.666	457.401	.2646
7.0117	545.588	545.268	.3197
5.6056	633.378	633.010	.3678
4.2014	721.036	720.632	.4045
2.7991	808.566	808.135	.4303
1.3987	895.969	895.524	.4451
.0000	983.248	982.800	.4483

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1509

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .24000E+02 LOAD = 1282.000
SET = 1.6766

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0734	.0000	2.8601	1387.621	1283.0000
.1000	12.6567	.3673	2.8539	1517.051	1323.9910
.2000	11.2422	.7346	2.8479	1646.341	1364.9840
.3000	9.8300	1.1019	2.8420	1775.495	1405.9800
.4000	8.4198	1.4692	2.8364	1904.517	1446.9780
.5000	7.0117	1.8365	2.8309	2033.412	1487.9810
.6000	5.6056	2.2038	2.8255	2162.182	1528.9880
.7000	4.2014	2.5711	2.8203	2290.831	1570.0000
.8000	2.7991	2.9385	2.8152	2419.362	1611.0150
.9000	1.3986	3.3058	2.8103	2547.778	1652.0340
1.0000	.0000	3.6731	2.8054	2676.082	1693.0610

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0734	104.621	104.621	-.0005
12.6567	193.060	193.023	.0368
11.2422	281.356	281.284	.0718
9.8300	369.515	369.410	.1041
8.4198	457.540	457.405	.1350
7.0117	545.430	545.271	.1595
5.6056	633.194	633.013	.1809
4.2014	720.831	720.634	.1973
2.7991	808.346	808.136	.2100

1.3986	895.743	895.524	.2191
.0000	983.021	982.800	.2209

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1626

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+02 LOAD = 1702.000
SET = 1.7411

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0089	.0000	2.8043	1811.643	1702.9990
.1000	12.6102	.3673	2.8113	1939.950	1643.6820
.2000	11.2094	.7346	2.8161	2068.391	1604.1550
.3000	9.8071	1.1019	2.8188	2196.919	1581.9470
.4000	8.4042	1.4692	2.8198	2325.488	1574.4580
.5000	7.0013	1.8365	2.8192	2454.061	1579.1680
.6000	5.5988	2.2038	2.8173	2582.605	1593.7790
.7000	4.1971	2.5711	2.8146	2711.096	1616.3450
.8000	2.7966	2.9385	2.8111	2839.515	1645.3140
.9000	1.3975	3.3058	2.8070	2967.848	1679.5750
1.0000	.0000	3.6731	2.8025	3096.082	1718.4380

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0089	108.645	108.643	.0012
12.6102	296.268	195.922	100.3460
11.2094	464.236	283.335	180.9012
9.8071	614.972	370.834	244.1374
8.4042	751.030	458.375	292.6547
7.0013	874.893	545.920	328.9731
5.5988	988.826	633.436	355.3900
4.1971	1094.751	720.899	373.8523
2.7966	1194.201	808.290	385.9112
1.3975	1288.273	895.594	392.6787
.0000	1377.644	982.800	394.8440

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1704

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .26000E+02 LOAD = 2122.000

SET = 1.8480

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.9020	.0000	2.7609	2238.314	2122.9990
.1000	12.5189	.3673	2.7699	2365.646	2028.3190
.2000	11.1328	.7346	2.7774	2493.169	1951.6600
.3000	9.7442	1.1019	2.7835	2620.849	1892.2690
.4000	8.3536	1.4692	2.7881	2748.650	1849.2350
.5000	6.9616	1.8365	2.7910	2876.538	1821.5480
.6000	5.5688	2.2038	2.7925	3004.475	1808.1850
.7000	4.1758	2.5711	2.7925	3132.430	1808.1600
.8000	2.7830	2.9385	2.7911	3260.368	1820.6180
.9000	1.3909	3.3058	2.7885	3388.262	1844.8560
1.0000	.0000	3.6731	2.7848	3516.082	1880.3820

********** PORE PRESSURES **********

CHI	UW	U0	U
13.9020	115.315	115.314	.0007
12.5189	337.328	201.618	135.7095
11.1328	541.509	288.113	253.3965
9.7442	728.580	374.764	353.8156
8.3536	899.415	461.537	437.8774
6.9616	1054.990	548.397	506.5932
5.5688	1196.291	635.306	560.9844
4.1758	1324.269	722.233	602.0367
2.7830	1439.751	809.143	630.6077
1.3909	1543.405	896.008	647.3972
.0000	1635.700	982.800	652.8998

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1783

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+02 LOAD = 2122.000
SET = 1.9417

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.8083	.0000	2.7609	2244.164	2122.9990
.1000	12.4268	.3673	2.7614	2371.396	2117.5930
.2000	11.0451	.7346	2.7618	2498.640	2113.3630
.3000	9.6634	1.1019	2.7619	2625.890	2111.4480
.4000	8.2816	1.4692	2.7618	2753.141	2112.9160
.5000	6.9000	1.8365	2.7613	2880.384	2118.7560

.6000	5.5186	2.2038	2.7602	3007.609	2129.8290
.7000	4.1377	2.5711	2.7587	3134.804	2146.8580
.8000	2.7575	2.9385	2.7565	3261.957	2170.3980
.9000	1.3782	3.3058	2.7538	3389.054	2200.8250
1.0000	.0000	3.6731	2.7504	3516.082	2238.3210

********** PORE PRESSURES **********

CHI	UW	U0	U
13.8083	121.164	121.164	.0007
12.4268	253.804	207.368	46.4356
11.0451	385.277	293.583	91.6933
9.6634	514.442	379.805	134.6362
8.2816	640.225	466.028	174.1971
6.9000	761.627	552.243	209.3844
5.5186	877.779	638.440	239.3396
4.1377	987.947	724.607	263.3394
2.7575	1091.559	810.732	280.8268
1.3782	1188.229	896.801	291.4285
.0000	1277.761	982.800	294.9605

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1920

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .28000E+02 LOAD = 2122.000
SET = 1.9581

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7919	.0000	2.7609	2245.185	2122.9990
.1000	12.4106	.3673	2.7602	2372.405	2129.7520
.2000	11.0296	.7346	2.7595	2499.610	2137.3670
.3000	9.6488	1.1019	2.7587	2626.797	2146.6970
.4000	8.2684	1.4692	2.7576	2753.962	2158.5400
.5000	6.8885	1.8365	2.7562	2881.099	2173.6160
.6000	5.5091	2.2038	2.7545	3008.200	2192.5680
.7000	4.1304	2.5711	2.7524	3135.259	2215.9170
.8000	2.7526	2.9385	2.7499	3262.264	2244.0690
.9000	1.3757	3.3058	2.7470	3389.208	2277.2880
1.0000	.0000	3.6731	2.7437	3516.082	2315.7150

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7919	122.186	122.185	.0007
12.4106	242.653	208.377	34.2762

11.0296	362.243	294.554	67.6896
9.6488	480.100	380.712	99.3877
8.2684	595.422	466.849	128.5728
6.8885	707.483	552.958	154.5248
5.5091	815.633	639.031	176.6013
4.1304	919.341	725.061	194.2796
2.7526	1018.196	811.039	207.1567
1.3757	1111.920	896.955	214.9651
.0000	1200.367	982.800	217.5670

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1970

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+02 LOAD = 2122.000
SET = 1.9900

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7600	.0000	2.7609	2247.174	2122.9990
.1000	12.3792	.3673	2.7580	2374.367	2154.4240
.2000	10.9994	.7346	2.7551	2501.495	2186.0920
.3000	9.6206	1.1019	2.7522	2628.557	2218.2410
.4000	8.2430	1.4692	2.7493	2755.552	2251.1030
.5000	6.8663	1.8365	2.7464	2882.481	2284.8800
.6000	5.4908	2.2038	2.7434	3009.342	2319.7450
.7000	4.1164	2.5711	2.7404	3136.134	2355.8440
.8000	2.7431	2.9385	2.7373	3262.856	2393.2830
.9000	1.3710	3.3058	2.7341	3389.505	2432.1380
1.0000	.0000	3.6731	2.7308	3516.082	2472.4410

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7600	124.174	124.174	.0007
12.3792	219.943	210.339	9.6041
10.9994	315.403	296.439	18.9645
9.6206	410.315	382.472	27.8432
8.2430	504.449	468.440	36.0096
6.8663	597.601	554.340	43.2607
5.4908	689.597	640.173	49.4236
4.1164	780.290	725.937	54.3534
2.7431	869.573	811.631	57.9423
1.3710	957.367	897.252	60.1152
.0000	1043.641	982.800	60.8404

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2175

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .32000E+02 LOAD = 2122.000
SET = 1.9987

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7513	.0000	2.7609	2247.719	2122.9990
.1000	12.3706	.3673	2.7573	2374.906	2161.4390
.2000	10.9911	.7346	2.7539	2502.011	2199.9460
.3000	9.6129	1.1019	2.7504	2629.038	2238.5810
.4000	8.2360	1.4692	2.7470	2755.987	2277.4120
.5000	6.8603	1.8365	2.7437	2882.858	2316.4910
.6000	5.4858	2.2038	2.7404	3009.653	2355.8610
.7000	4.1126	2.5711	2.7371	3136.373	2395.5610
.8000	2.7405	2.9385	2.7338	3263.017	2435.6260
.9000	1.3697	3.3058	2.7306	3389.586	2476.0700
1.0000	.0000	3.6731	2.7273	3516.082	2516.9030

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7513	124.720	124.719	.0007
12.3706	213.467	210.877	2.5892
10.9911	302.066	296.955	5.1103
9.6129	390.457	382.954	7.5032
8.2360	478.575	468.874	9.7003
6.8603	566.368	554.718	11.6498
5.4858	653.793	640.484	13.3081
4.1126	740.812	726.176	14.6366
2.7405	827.391	811.792	15.5995
1.3697	913.516	897.333	16.1831
.0000	999.179	982.800	16.3785

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2392
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .34000E+02 LOAD = 2122.000
SET = 2.0010

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE

.0000	13.7490	.0000	2.7609	2247.865	2122.9990
.1000	12.3682	.3673	2.7572	2375.050	2163.3340
.2000	10.9889	.7346	2.7535	2502.150	2203.6880
.3000	9.6109	1.1019	2.7499	2629.167	2244.0740
.4000	8.2341	1.4692	2.7464	2756.103	2284.5150
.5000	6.8587	1.8365	2.7430	2882.959	2325.0210
.6000	5.4845	2.2038	2.7395	3009.737	2365.6040
.7000	4.1116	2.5711	2.7362	3136.436	2406.2770
.8000	2.7398	2.9385	2.7329	3263.060	2447.0480
.9000	1.3693	3.3058	2.7296	3389.608	2487.9230
1.0000	.0000	3.6731	2.7264	3516.082	2528.9000

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7490	124.866	124.865	.0007
12.3682	211.716	211.021	.6944
10.9889	298.462	297.093	1.3688
9.6109	385.093	383.083	2.0102
8.2341	471.588	468.991	2.5975
6.8587	557.938	554.818	3.1198
5.4845	644.133	640.568	3.5654
4.1116	730.159	726.239	3.9202
2.7398	816.011	811.835	4.1769
1.3693	901.684	897.354	4.3301
.0000	987.182	982.800	4.3819

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2612

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+02 LOAD = 2122.000
SET = 2.0015

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7485	.0000	2.7609	2247.891	2122.9990
.1000	12.3678	.3673	2.7571	2375.075	2163.6690
.2000	10.9885	.7346	2.7535	2502.174	2204.3460
.3000	9.6105	1.1019	2.7499	2629.190	2245.0410
.4000	8.2338	1.4692	2.7463	2756.124	2285.7620
.5000	6.8584	1.8365	2.7428	2882.977	2326.5210
.6000	5.4843	2.2038	2.7394	3009.751	2367.3190
.7000	4.1114	2.5711	2.7360	3136.448	2408.1620
.8000	2.7397	2.9385	2.7327	3263.067	2449.0570
.9000	1.3693	3.3058	2.7295	3389.612	2490.0050
1.0000	.0000	3.6731	2.7262	3516.082	2531.0090

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7485	124.892	124.891	.0007
12.3678	211.406	211.047	.3595
10.9885	297.828	297.118	.7101
9.6105	384.148	383.105	1.0432
8.2338	470.361	469.011	1.3502
6.8584	556.456	554.836	1.6195
5.4843	642.432	640.582	1.8498
4.1114	728.286	726.250	2.0352
2.7397	814.010	811.842	2.1681
1.3693	899.607	897.358	2.2485
.0000	985.072	982.800	2.2723

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2723

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .38000E+02 LOAD = 2122.000
SET = 2.0018

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7482	.0000	2.7609	2247.915	2122.9990
.1000	12.3675	.3673	2.7571	2375.098	2163.9730
.2000	10.9881	.7346	2.7534	2502.196	2204.9490
.3000	9.6102	1.1019	2.7498	2629.210	2245.9300
.4000	8.2335	1.4692	2.7462	2756.142	2286.9140
.5000	6.8581	1.8365	2.7427	2882.993	2327.9040
.6000	5.4840	2.2038	2.7393	3009.765	2368.8980
.7000	4.1112	2.5711	2.7359	3136.458	2409.9020
.8000	2.7396	2.9385	2.7326	3263.074	2450.9100
.9000	1.3692	3.3058	2.7293	3389.615	2491.9280
1.0000	.0000	3.6731	2.7261	3516.082	2532.9520

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7482	124.915	124.914	.0007
12.3675	211.125	211.070	.0555
10.9881	297.247	297.140	.1071
9.6102	383.281	383.126	.1545
8.2335	469.229	469.030	.1990
6.8581	555.089	554.852	.2367
5.4840	640.866	640.596	.2707

4.1112	726.555	726.261	.2948
2.7396	812.164	811.849	.3151
1.3692	897.687	897.362	.3252
.0000	983.129	982.800	.3294

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3054

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+02 LOAD = 2122.000
SET = 2.0019

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7481	.0000	2.7609	2247.916	2122.9990
.1000	12.3675	.3673	2.7571	2375.099	2163.9860
.2000	10.9881	.7346	2.7534	2502.197	2204.9760
.3000	9.6101	1.1019	2.7498	2629.211	2245.9710
.4000	8.2335	1.4692	2.7462	2756.143	2286.9690
.5000	6.8581	1.8365	2.7427	2882.994	2327.9720
.6000	5.4840	2.2038	2.7393	3009.765	2368.9790
.7000	4.1112	2.5711	2.7359	3136.458	2409.9900
.8000	2.7396	2.9385	2.7326	3263.075	2451.0050
.9000	1.3692	3.3058	2.7293	3389.615	2492.0250
1.0000	.0000	3.6731	2.7261	3516.082	2533.0500

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7481	124.916	124.916	.0007
12.3675	211.114	211.071	.0426
10.9881	297.221	297.141	.0802
9.6101	383.241	383.127	.1138
8.2335	469.174	469.031	.1436
6.8581	555.022	554.853	.1691
5.4840	640.787	640.596	.1904
4.1112	726.468	726.261	.2071
2.7396	812.069	811.849	.2201
1.3692	897.590	897.362	.2285
.0000	983.031	982.800	.2313

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3275

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .45000E+02 LOAD = 2122.000
SET = 2.0019

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7481	.0000	2.7609	2247.916	2122.9990
.1000	12.3675	.3673	2.7571	2375.099	2163.9860
.2000	10.9881	.7346	2.7534	2502.197	2204.9760
.3000	9.6101	1.1019	2.7498	2629.211	2245.9710
.4000	8.2335	1.4692	2.7462	2756.143	2286.9690
.5000	6.8581	1.8365	2.7427	2882.994	2327.9720
.6000	5.4840	2.2038	2.7393	3009.765	2368.9790
.7000	4.1112	2.5711	2.7359	3136.458	2409.9900
.8000	2.7396	2.9385	2.7326	3263.075	2451.0050
.9000	1.3692	3.3058	2.7293	3389.615	2492.0250
1.0000	.0000	3.6731	2.7261	3516.082	2533.0500

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7481	124.916	124.916	.0007
12.3675	211.114	211.071	.0426
10.9881	297.221	297.141	.0802
9.6101	383.241	383.127	.1138
8.2335	469.174	469.031	.1436
6.8581	555.022	554.853	.1691
5.4840	640.787	640.596	.1904
4.1112	726.468	726.261	.2071
2.7396	812.069	811.849	.2201
1.3692	897.590	897.362	.2285
.0000	983.031	982.800	.2313

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3826
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+02 LOAD = 2122.000
SET = 2.0019

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7481	.0000	2.7609	2247.916	2122.9990
.1000	12.3675	.3673	2.7571	2375.099	2163.9860
.2000	10.9881	.7346	2.7534	2502.197	2204.9760
.3000	9.6101	1.1019	2.7498	2629.211	2245.9710

.4000	8.2335	1.4692	2.7462	2756.143	2286.9690
.5000	6.8581	1.8365	2.7427	2882.994	2327.9720
.6000	5.4840	2.2038	2.7393	3009.765	2368.9790
.7000	4.1112	2.5711	2.7359	3136.458	2409.9900
.8000	2.7396	2.9385	2.7326	3263.075	2451.0050
.9000	1.3692	3.3058	2.7293	3389.615	2492.0250
1.0000	.0000	3.6731	2.7261	3516.082	2533.0500

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7481	124.916	124.916	.0007
12.3675	211.114	211.071	.0426
10.9881	297.221	297.141	.0802
9.6101	383.241	383.127	.1138
8.2335	469.174	469.031	.1436
6.8581	555.022	554.853	.1691
5.4840	640.787	640.596	.1904
4.1112	726.468	726.261	.2071
2.7396	812.069	811.849	.2201
1.3692	897.590	897.362	.2285
.0000	983.031	982.800	.2313

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 4377

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .55000E+02 LOAD = 2122.000
SET = 2.0019

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7481	.0000	2.7609	2247.916	2122.9990
.1000	12.3675	.3673	2.7571	2375.099	2163.9860
.2000	10.9881	.7346	2.7534	2502.197	2204.9760
.3000	9.6101	1.1019	2.7498	2629.211	2245.9710
.4000	8.2335	1.4692	2.7462	2756.143	2286.9690
.5000	6.8581	1.8365	2.7427	2882.994	2327.9720
.6000	5.4840	2.2038	2.7393	3009.765	2368.9790
.7000	4.1112	2.5711	2.7359	3136.458	2409.9900
.8000	2.7396	2.9385	2.7326	3263.075	2451.0050
.9000	1.3692	3.3058	2.7293	3389.615	2492.0250
1.0000	.0000	3.6731	2.7261	3516.082	2533.0500

********** PORE PRESSURES **********

CHI	UW	U0	U

13.7481	124.916	124.916	.0007
12.3675	211.114	211.071	.0426
10.9881	297.221	297.141	.0802
9.6101	383.241	383.127	.1138
8.2335	469.174	469.031	.1436
6.8581	555.022	554.853	.1691
5.4840	640.787	640.596	.1904
4.1112	726.468	726.261	.2071
2.7396	812.069	811.849	.2201
1.3692	897.590	897.362	.2285
.0000	983.031	982.800	.2313

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 4928

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+02 LOAD = 2122.000
SET = 2.0019

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.7481	.0000	2.7609	2247.916	2122.9990
.1000	12.3675	.3673	2.7571	2375.099	2163.9860
.2000	10.9881	.7346	2.7534	2502.197	2204.9760
.3000	9.6101	1.1019	2.7498	2629.211	2245.9710
.4000	8.2335	1.4692	2.7462	2756.143	2286.9690
.5000	6.8581	1.8365	2.7427	2882.994	2327.9720
.6000	5.4840	2.2038	2.7393	3009.765	2368.9790
.7000	4.1112	2.5711	2.7359	3136.458	2409.9900
.8000	2.7396	2.9385	2.7326	3263.075	2451.0050
.9000	1.3692	3.3058	2.7293	3389.615	2492.0250
1.0000	.0000	3.6731	2.7261	3516.082	2533.0500

********** PORE PRESSURES **********

CHI	UW	U0	U
13.7481	124.916	124.916	.0007
12.3675	211.114	211.071	.0426
10.9881	297.221	297.141	.0802
9.6101	383.241	383.127	.1138
8.2335	469.174	469.031	.1436
6.8581	555.022	554.853	.1691
5.4840	640.787	640.596	.1904
4.1112	726.468	726.261	.2071
2.7396	812.069	811.849	.2201
1.3692	897.590	897.362	.2285
.0000	983.031	982.800	.2313

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 5479

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/28/98, Pond 12S, 15.75 feet of sludge. 500 yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

```
************************
*                      *
* FUNCTIONS OF TIME    *
*                      *
************************
```

TIME	EAV	TOTAV	EFFAV	SET	DEG
.0000E+00	.3288E+01	709.682	206.1408	.0000	.0000
.1500E+00	.3248E+01	934.804	214.7944	.1484	.0741
.2000E+00	.3243E+01	1009.871	218.0230	.1650	.0824
.2250E+00	.3241E+01	1044.287	219.6437	.1735	.0866
.2500E+00	.3238E+01	1078.706	221.3360	.1822	.0910
.2750E+00	.3236E+01	1113.130	223.1099	.1912	.0955
.3000E+00	.3233E+01	1147.557	224.9782	.2005	.1002
.3500E+00	.3228E+01	1216.420	229.0072	.2200	.1099
.4000E+00	.3222E+01	1285.301	233.6123	.2413	.1205
.5000E+00	.3209E+01	1403.620	244.7918	.2894	.1446
.6000E+00	.3194E+01	1522.018	261.4809	.3455	.1726
.7000E+00	.3178E+01	1640.475	285.4283	.4052	.2024
.8000E+00	.3162E+01	1817.468	316.1187	.4633	.2314
.9000E+00	.3147E+01	1994.531	349.2208	.5192	.2594
.1000E+01	.3133E+01	1995.173	374.0843	.5678	.2837
.1250E+01	.3105E+01	1996.995	426.1650	.6722	.3358
.1500E+01	.3082E+01	1998.814	473.2302	.7571	.3782
.1750E+01	.3062E+01	2000.643	516.8545	.8298	.4145
.2000E+01	.3045E+01	2002.481	558.0849	.8940	.4466
.2250E+01	.3029E+01	2004.309	597.3928	.9519	.4755
.2500E+01	.3014E+01	2006.116	635.1274	1.0046	.5018
.2750E+01	.3001E+01	2007.888	671.6390	1.0532	.5261
.3000E+01	.2989E+01	2009.614	707.2875	1.0984	.5487
.3500E+01	.2967E+01	2012.888	777.3246	1.1804	.5897
.4000E+01	.2947E+01	2015.877	847.1249	1.2532	.6260
.5000E+01	.2914E+01	2020.906	985.9327	1.3752	.6869
.6000E+01	.2888E+01	2024.697	1114.7410	1.4686	.7336
.7000E+01	.2870E+01	2027.420	1222.9870	1.5368	.7677
.8000E+01	.2857E+01	2029.303	1306.5410	1.5845	.7915
.9000E+01	.2848E+01	2030.568	1367.0130	1.6168	.8077
.1000E+02	.2842E+01	2031.400	1408.8300	1.6382	.8183
.1200E+02	.2836E+01	2032.288	1455.2530	1.6610	.8297
.1250E+02	.2835E+01	2032.411	1461.8630	1.6642	.8313
.1500E+02	.2833E+01	2032.740	1479.6840	1.6727	.8356
.1750E+02	.2832E+01	2032.846	1485.4350	1.6754	.8369
.1800E+02	.2832E+01	2032.856	1485.9860	1.6757	.8371
.2000E+02	.2832E+01	2032.879	1487.2700	1.6763	.8374
.2250E+02	.2832E+01	2032.890	1487.8530	1.6766	.8375
.2400E+02	.2832E+01	2032.892	1487.9980	1.6766	.8375

.2500E+02	.2814E+01	2453.974	1621.9900	1.7411	.8697
.2600E+02	.2785E+01	2876.754	1881.4460	1.8480	.9231
.2750E+02	.2759E+01	2880.302	2139.8750	1.9417	.9700
.2800E+02	.2755E+01	2880.947	2189.2290	1.9581	.9781
.3000E+02	.2746E+01	2882.198	2289.2670	1.9900	.9941
.3200E+02	.2744E+01	2882.540	2317.6720	1.9987	.9984
.3400E+02	.2743E+01	2882.631	2325.3380	2.0010	.9996
.3500E+02	.2743E+01	2882.647	2326.6860	2.0015	.9998
.3800E+02	.2743E+01	2882.662	2327.9280	2.0018	1.0000
.4000E+02	.2743E+01	2882.662	2327.9890	2.0019	1.0000
.4500E+02	.2743E+01	2882.662	2327.9890	2.0019	1.0000
.5000E+02	.2743E+01	2882.662	2327.9890	2.0019	1.0000
.5500E+02	.2743E+01	2882.662	2327.9890	2.0019	1.0000
.6000E+02	.2743E+01	2882.662	2327.9890	2.0019	1.0000

TIME	UWAV	U0AV	UAV
.0000E+00	503.5412	503.5412	-.0001
.1500E+00	720.0093	503.6629	216.3464
.2000E+00	791.8481	503.7303	288.1178
.2250E+00	824.6432	503.7711	320.8721
.2500E+00	857.3704	503.8156	353.5548
.2750E+00	890.0197	503.8638	386.1559
.3000E+00	922.5786	503.9160	418.6626
.3500E+00	987.4130	504.0294	483.3836
.4000E+00	1051.6890	504.1602	547.5285
.5000E+00	1158.8290	504.4796	654.3490
.6000E+00	1260.5370	504.8768	755.6600
.7000E+00	1355.0470	505.3345	849.7125
.8000E+00	1501.3490	505.8272	995.5222
.9000E+00	1645.3100	506.3899	1138.9200
.1000E+01	1621.0880	507.0318	1114.0570
.1250E+01	1570.8300	508.8537	1061.9760
.1500E+01	1525.5840	510.6736	1014.9110
.1750E+01	1483.7890	512.5021	971.2864
.2000E+01	1444.3960	514.3401	930.0560
.2250E+01	1406.9160	516.1683	890.7480
.2500E+01	1370.9880	517.9749	853.0134
.2750E+01	1336.2490	519.7473	816.5018
.3000E+01	1302.3270	521.4733	780.8533
.3500E+01	1235.5630	524.7471	710.8162
.4000E+01	1168.7520	527.7362	641.0160
.5000E+01	1034.9740	532.7654	502.2081
.6000E+01	909.9563	536.5564	373.3998
.7000E+01	804.4329	539.2794	265.1535
.8000E+01	722.7619	541.1622	181.5997
.9000E+01	663.5552	542.4271	121.1282
.1000E+02	622.5701	543.2595	79.3106
.1200E+02	577.0345	544.1470	32.8875
.1250E+02	570.5486	544.2705	26.2782
.1500E+02	553.0570	544.5997	8.4573
.1750E+02	547.4103	544.7049	2.7054
.1800E+02	546.8699	544.7149	2.1550
.2000E+02	545.6088	544.7384	.8705
.2250E+02	545.0365	544.7490	.2875
.2400E+02	544.8944	544.7516	.1428

.2500E+02	831.9835	545.8331	286.1503
.2600E+02	995.3079	548.6132	446.6947
.2750E+02	740.4266	552.1609	188.2657
.2800E+02	691.7177	552.8062	138.9114
.3000E+02	592.9310	554.0567	38.8742
.3200E+02	564.8674	554.3987	10.4688
.3400E+02	557.2934	554.4901	2.8033
.3500E+02	555.9612	554.5062	1.4551
.3800E+02	554.7336	554.5209	.2127
.4000E+02	554.6731	554.5216	.1515
.4500E+02	554.6731	554.5216	.1515
.5000E+02	554.6731	554.5216	.1515
.5500E+02	554.6731	554.5216	.1515
.6000E+02	554.6731	554.5216	.1515

CALCULATION COVER SHEET

PROJECT	JOB NO.	CALC. NO.	SHEET
FMC – Phase IV Ponds	20906-027	20906-027-2B	1
SUBJECT: Slope Stability Analysis for 500-year Cover Design		DISCIPLINE: Geotechnical Engineering	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[X]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP			MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ]	Yes	[X] No	[ ]	[X]	SLOPE/W	4.20

Purpose -

The stability of the permanent exterior slopes of the dike and cover system were evaluated by inspection and further demonstrated by calculation. The analyses were performed on assumed geometries that are more severe than actual conditions. The internal slopes of the ponds under construction conditions were also analyzed on the basis of assumed conditions more severe than expected.

The interior stability of the sand fill placed during construction is not addressed in this calculation.

References -

1. FMC Pond 11S-14S Final 500-year Cover Design Drawings (Draft).
2. FMC Drawings No. 38722, 38730, dated Feb. 20 1997.
3. UBC code, 1988, Section 2312, Figure 2 and Table 23-I.
4. SLOPE/W for Slope Stability Analyses, Version 4.20, Geo-Slope International, Ltd., Calgary, Alberta, Canada, 1998

Rev. No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
0	ORIGINAL ISSUE	13	Fig. 8	[signature]	[signature] 7/30/98	RJD 7/30/98	7/30/98

Record of Revision

Calculation Sheet

Originator	N. Deng	Date	07/07/98	Calc. No.	20906-027-2B	Rev. No.	0
Project	FMC Pond 11S - 14S	Job No.	20906	Checked	-	Date	-
Subject	Slope Stability Analysis for 500-year Cover Design					Sheet No.	2

Assumed Dike Sections for Analysis

The ground surface around the Phase IV Ponds is near the top of the dikes and essentially there are no external slopes in the present dike system except those created by minor exterior depressions on the order of 5 feet in depth. The permanent cover system will raise the surface at the existing dikes by a minor amount. Ponds 11S, 12S, and 13S contain substantial depths of sludge which buttress the internal slopes of these ponds. By inspection, there are no stability issues associated with interior or exterior slops at Ponds 11S, 12S, and 13S.

Pond 14S contains about one foot of sludge and a substantial depth of water. The water will be pumped out and the pond filled during closure. There are no stability issues with the interior of exterior slopes at this pond during or after closure.

However, to further demonstrate dike stability, calculations have been performed for assumed geometry and boundary conditions that are more severe than those present at the site. The calculations address both interior and exterior slopes. A typical section considered in the analysis is shown in Figure 1 (based on information provided in References 1 and 2). The adopted section for analysis has a top width of about 28 feet, an exterior height of about 10 feet at a 2:1 slopes, and an interior height of about 19 feet at a 3:1 slope.

The dikes between Ponds 11S and 12S, 12S and 13S, 13S and 14S are all internal slopes with both sides of the slope being 3:1. It was judged that the dikes between the ponds were less critical than were the external dikes. Therefore, these dikes were not analyzed separately.

When the pond is filled with sludge and the designed cover layers (sand, slag, and RCRA cap), the fill materials stabilize the internal slope. During construction of the initial sand fill, a crane will be resting on top of the dike, adding a surcharge to the dike top. The case for the internal slope was therefore selected as an empty pond (Pond 14S will only have about 1 foot of sludge when construction occurs) with a crane surcharge.

Soil Properties and Design Criteria

Soil conditions of the foundation materials are represented in boring logs adjacent to the ponds. The boring logs are summarized in Figure 2. Locations of the borings are shown in Figure 3. The foundation material is a silt with SPT N-value that increases with depth (Minimum of 18 blows/ft. at shallow depth and can be as high as 50 blows/ft at 50-foot depth). Based on the data, it can be inferred that the silt is dense to very dense. The body of the dike is assumed to consist of a medium dense silt fill, which corresponds to the minimum N-value of 13 blows per foot obtained from a near-surface test at Pond 8S.

Calculation Sheet

Originator	N. Deng	Date	07/07/98	Calc. No.	20906-027-2B	Rev. No.	0
Project	FMC Pond 11S - 14S	Job No.	20906	Checked	-	Date	-
Subject	Slope Stability Analysis for 500-year Cover Design					Sheet No.	3

For this after-cap completion (long-term) stability analyses, the conservative geotechnical soil parameters presented in Table 1 were used. These long-term soil strength parameters used in the current analysis were similar to the values used in the previous slope stability analyses of other adjacent ponds, e.g., Pond 8S and Pond 9E.

The water table beneath Pond 11S - 14S, as measured in nearby ground water monitoring wells, was about elevation 4398 feet, or over 50 feet below the pond bottom (See summary in Figure 2). The existence of the liner along the internal boundary of the dike eliminates exterior seepage. The effects of groundwater were therefore excluded from the analyses since no critical failure planes would intersect the phreatic surface.

Table 1 - Summary of Soil Properties

Soil Type	Total Density (pcf)	Cohesion (psf)	Internal Friction Angle (deg)
Cap (Slag+ Sand)	120	--	35
Slag	130	--	35
Sand	115	--	30
Sludge	100	50	--
Dike	115	--	28
Foundation	120	--	30

Based on the UBC code (Ref. 3) the site is in seismic zone 2B with a seismic zone factor of Z=0.2. This value of acceleration was used as a pseudo-static coefficient to evaluate slope stability under seismic loading. In addition, the critical pseudo-static seismic coefficient required to yield a factor of safety of 1.0 was also determined.

Calculation Sheet

Originator	N. Deng	Date	07/07/98	Calc. No.	20906-027-2B	Rev. No.	0
Project	FMC Pond 11S - 14S	Job No.	20906	Checked	-	Date	-
Subject	Slope Stability Analysis for 500-year Cover Design					Sheet No.	4

The effect of a crane operating along the top of the dike was also evaluated assuming a uniform 500 psf load acting over a 20-foot width the top of the dike. The crane would not be expected to be present after the dike was completed, but was included in the slope stability analysis for the construction phase. The value of crane load was determined from the weight of actual cranes which were used in the constructions of the final cover for Pond 8S.

Methodology and Calculations

The slope stability analyses were performed using the computer program, SLOPE/W (Ref.4), and circular failure surfaces. The Spencer method, which satisfies both force and moment equilibrium, was utilized in calculating the factors of safety for all the cases. Each program run was made using an automatic search for the minimum failure surface on specified depth tangents. The sections analyzed and the five different cases considered herein are shown in Figures 4 through 8.

Results of Analysis

Table 2 summarizes the stability analyses results.

Table 2 - Summary of Results for Slope Stability Analyses

Case	Minimum Factor of Safety	Corresponding Figure No.
Static, External Slope	1.8	Figure 4
Seismic, External Slope, Z = 0.2	1.1	Figure 5
Seismic, External Slope, Yield Acce. = 0.27g		Figure 6
Static, External Slope with 500 psf Crane Load	1.4	Figure 7
Static, Internal Slope with 500 psf Crane Load	1.6	Figure 8

Plots of the analysis outputs are shown in Figures 4 through 8.

Calculation Sheet

Originator	N. Deng	Date	07/07/98	Calc. No.	20906-027-2B	Rev. No.	0
Project	FMC Pond 11S - 14S	Job No.	20906	Checked	-	Date	-
Subject	Slope Stability Analysis for 500-year Cover Design					Sheet No.	5

Stability of Cover

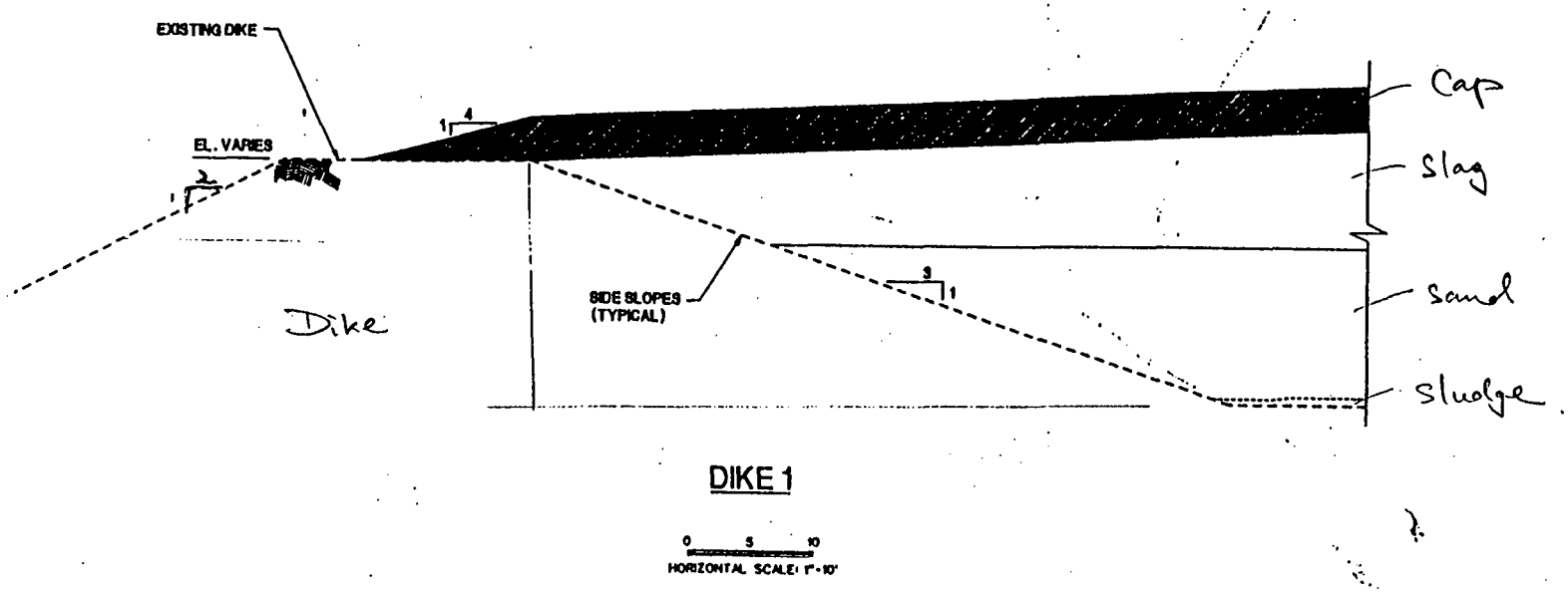
The final cap consists of top soil, slag, geotextile, geonet, HDPE membrane, geocomposite clay liner and a bedding layer of sand. The internal stability of the cap will be controlled by the interface friction between the HDPE and the geonet. The cap will be initially constructed to a maximum surface gradient of 5 percent (3 degrees). The grade is expected to decrease to about 4% after the initial fill settles for approximately 2 years. The effective coefficient of friction of the HDPE-geonet interface is approximately 12 degrees. Thus, the cap will have a factor of safety against internal sliding of approximately four (sin 12°/sin 3°).

Conclusion

The stability analysis results indicate that the dike slopes are stable for both static and seismic conditions.

Figures:

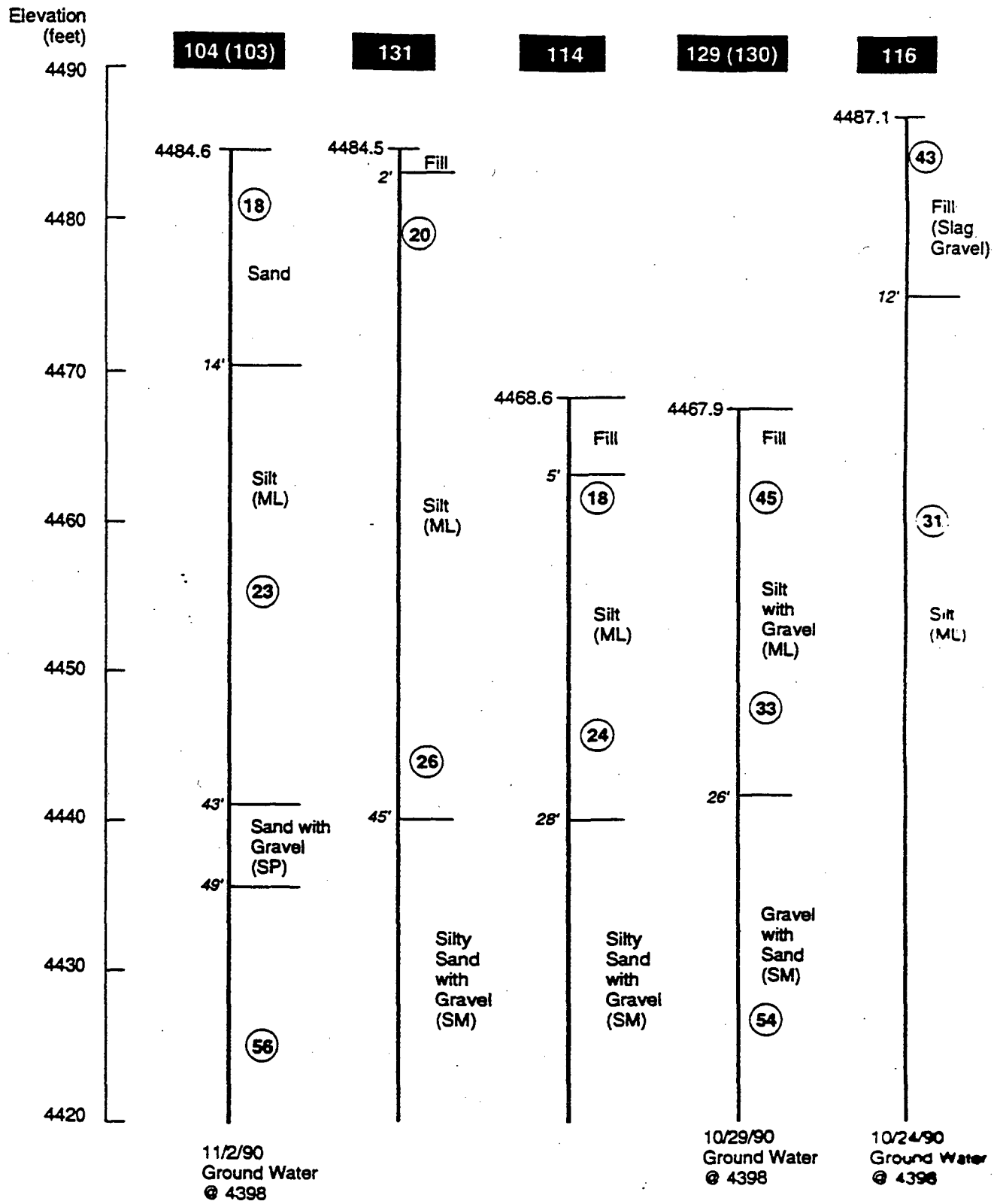
Figure 1	Typical Design Section
Figure 2	Summary of Soil Boring Logs
Figure 3	Location Map for Borings
Figure 4	Analysis Result for Static, External Slope
Figure 5	Analysis Result for Seismic, External Slope, Z = 0.2
Figure 6	Analysis Result for Seismic, External Slope, Yield Acce. = 0.27g
Figure 7	Analysis Result for Static, External Slope, 500 psf Crane Load
Figure 8	Analysis Result for Static, Internal Slope, 500 psf Crane Load



PHASE IV PONDS CLOSURE PLAN

PH4SECT1.DGN /Mon Mar 17 1997 15:31:28 /ALNeray

Figure 1 Pond 11S - 14S Final cover Design - Dike 1
(Thickness of internal fill material may vary but have no effect on the final results)



Blowcount (SPT-N)

Bechtel Environmental, Inc. San Francisco		
FMC Corporation Pocatello, Idaho		
Summary of Boring Logs		
Job No.	Figure No.	Rev
20906	2	0

97-05930.010

April 1997

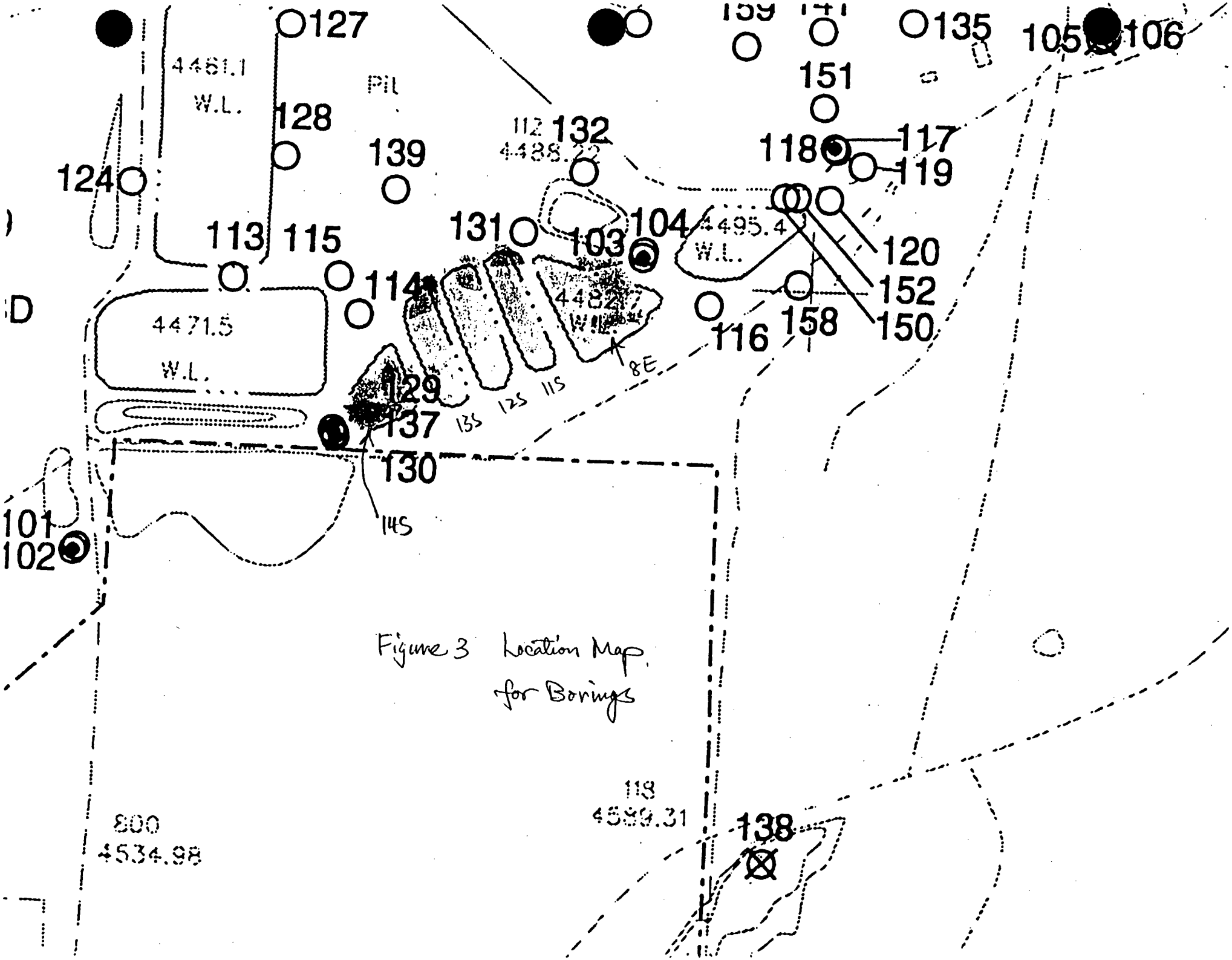


Figure 3 Location Map for Borings

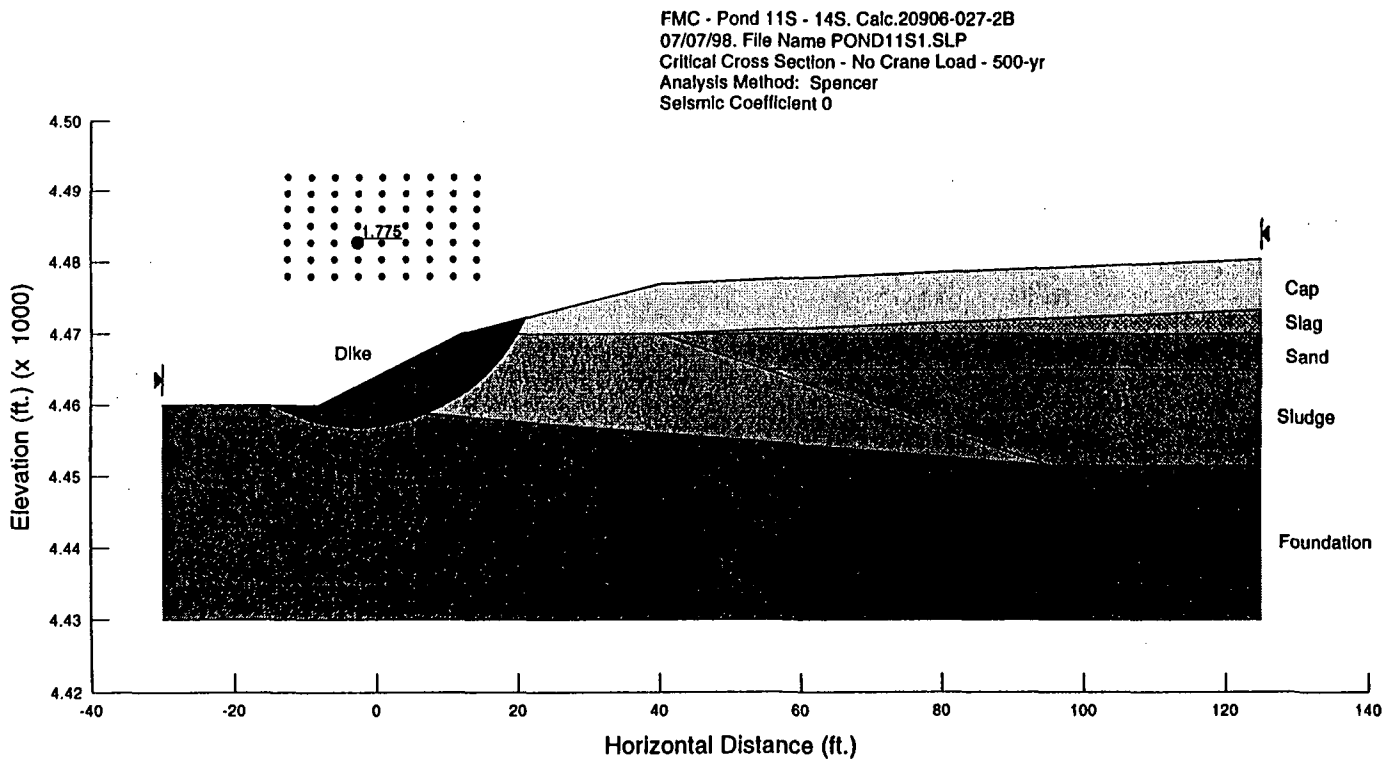

FMC - Pond 11S - 14S. Calc.20906-027-2B
07/07/98. File Name POND11S1.SLP
Critical Cross Section - No Crane Load - 500-yr
Analysis Method: Spencer
Seismic Coefficient 0
1.775
Dike
Cap
Slag
Sand
Sludge
Foundation
Elevation (ft.) (x 1000)
4.50
4.49
4.48
4.47
4.46
4.45
4.44
4.43
4.42
-40
-20
0
20
40
60
80
100
120
140
Horizontal Distance (ft.)

Figure 4

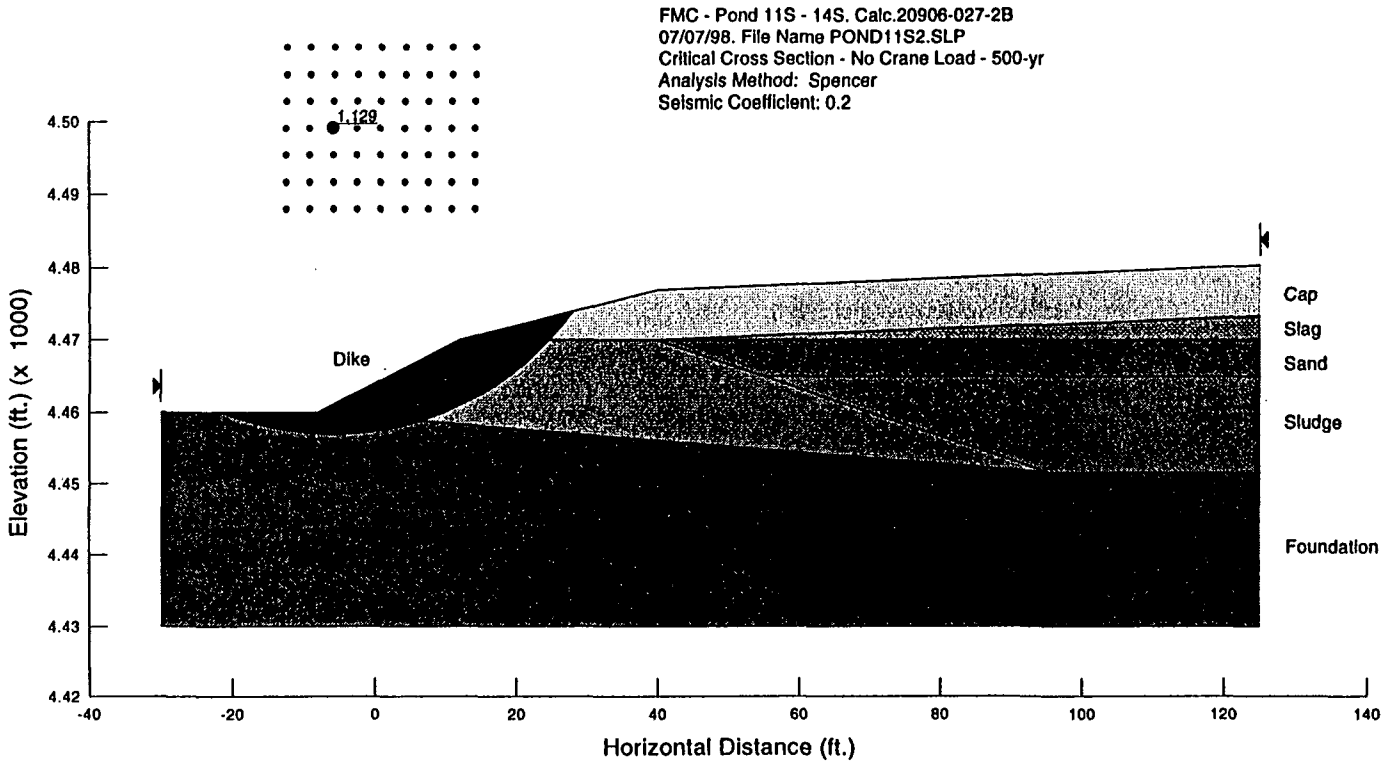

FMC - Pond 11S - 14S. Calc.20906-027-2B
07/07/98. File Name POND11S2.SLP
Critical Cross Section - No Crane Load - 500-yr
Analysis Method: Spencer
Seismic Coefficient: 0.2
1.129
Dike
Cap
Slag
Sand
Sludge
Foundation
Elevation (ft.) (x 1000)
4.50
4.49
4.48
4.47
4.46
4.45
4.44
4.43
4.42
-40
-20
0
20
40
60
80
100
120
140
Horizontal Distance (ft.)

Figure 5

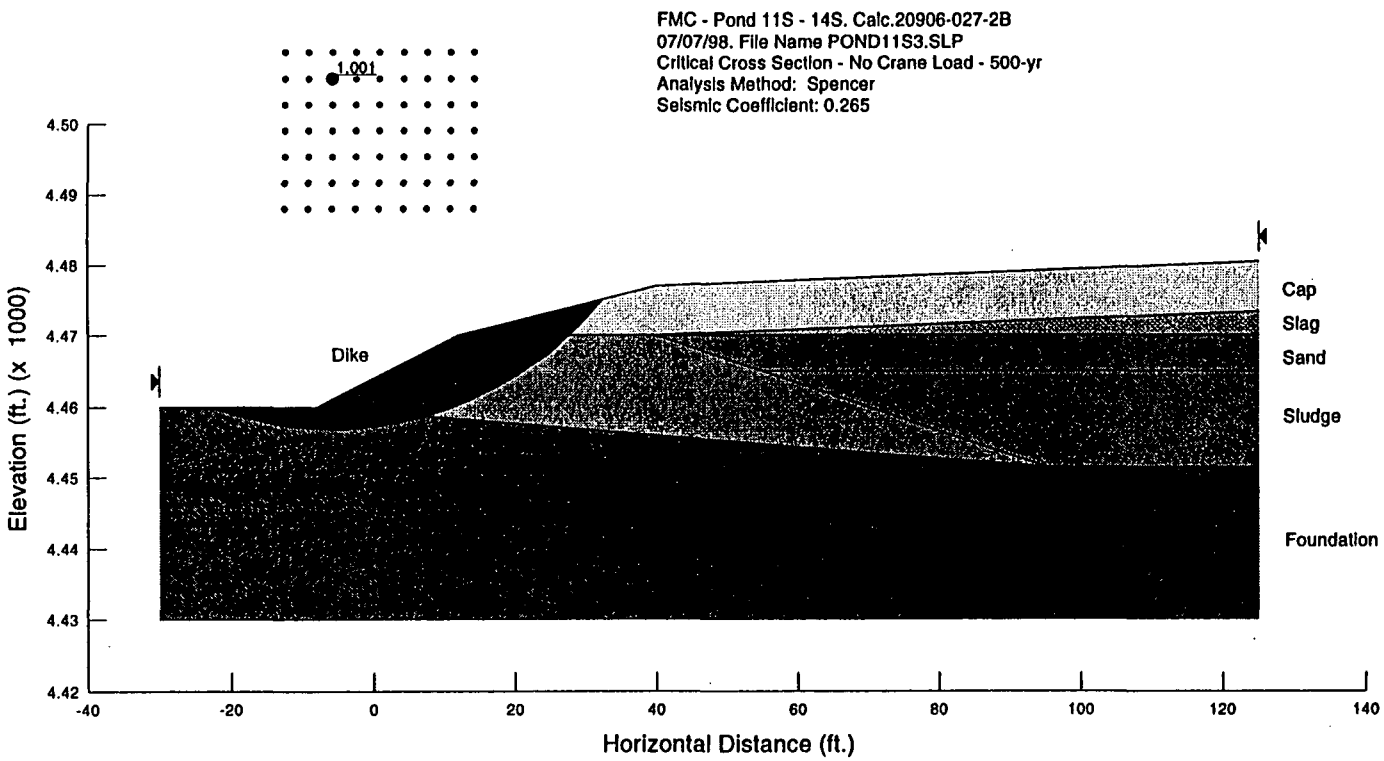

FMC - Pond 11S - 14S. Calc.20906-027-2B
07/07/98. File Name POND11S3.SLP
Critical Cross Section - No Crane Load - 500-yr
Analysis Method: Spencer
Seismic Coefficient: 0.265
1.001
Dike
Cap
Slag
Sand
Sludge
Foundation
Elevation (ft.) (x 1000)
4.50
4.49
4.48
4.47
4.46
4.45
4.44
4.43
4.42
-40
-20
0
20
40
60
80
100
120
140
Horizontal Distance (ft.)

Figure 6

FMC - Pond 11S - 14S. Calc.20906-027-2B
07/07/98. File Name POND11S4.SLP
Critical Cross Section During Construction - 500 psf Crane Load
External Slope
Analysis Method: Spencer
Seismic Coefficient: 0

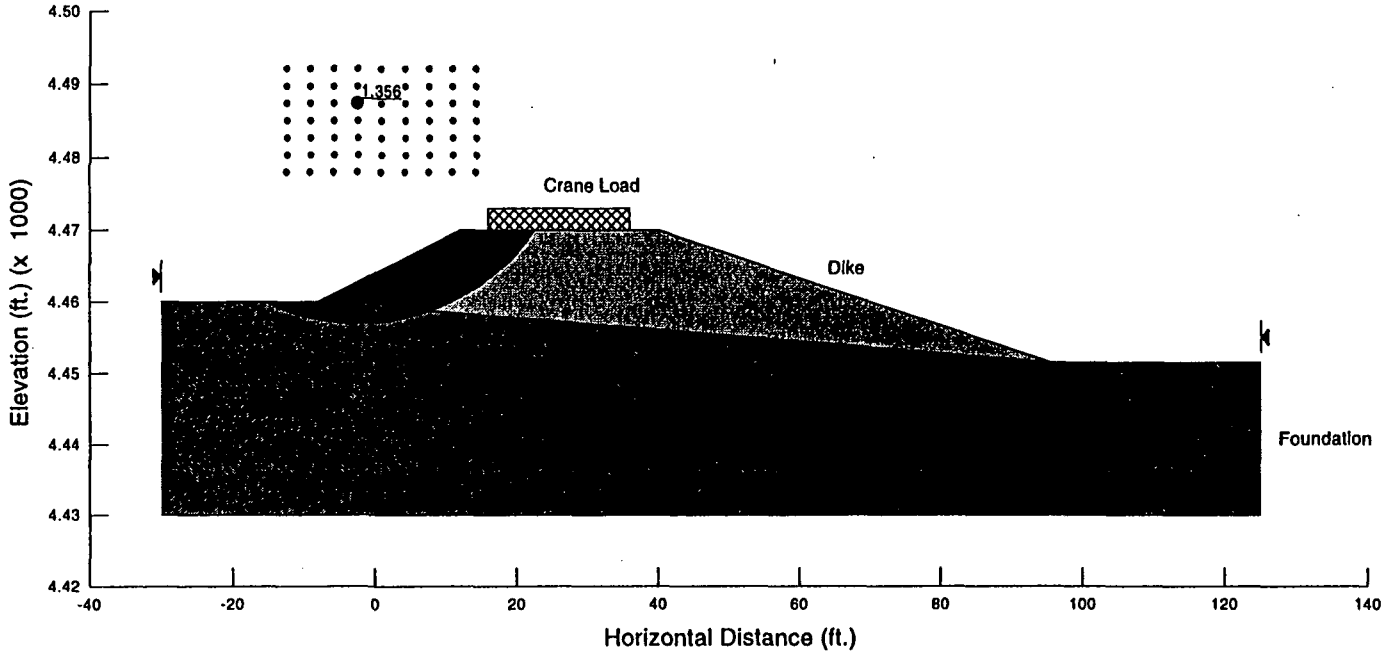


Figure 7

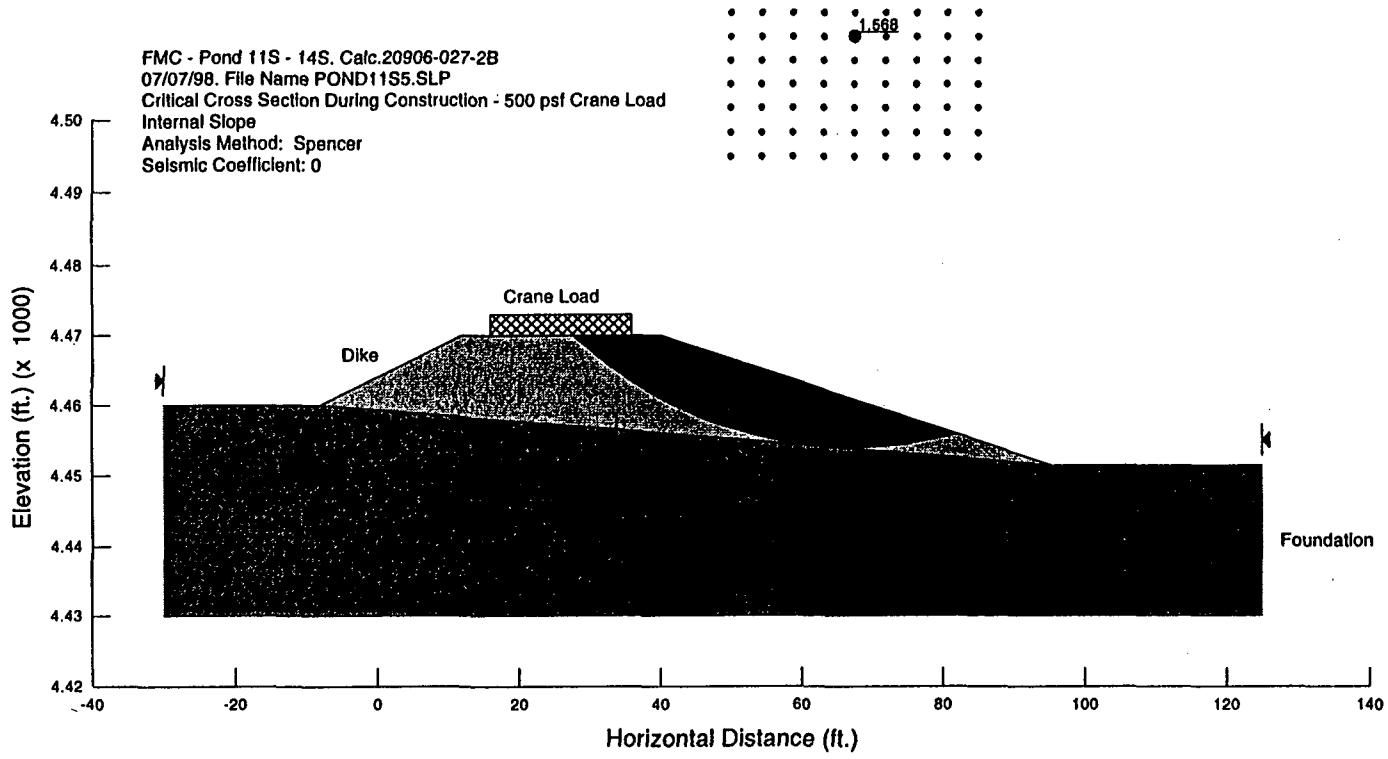

FMC - Pond 11S - 14S. Calc.20906-027-2B
07/07/98. File Name POND11S5.SLP
Critical Cross Section During Construction - 500 psf Crane Load
Internal Slope
Analysis Method: Spencer
Seismic Coefficient: 0
1.568
Crane Load
Dike
Foundation
Elevation (ft.) (x 1000)
4.50
4.49
4.48
4.47
4.46
4.45
4.44
4.43
4.42
-40
-20
0
20
40
60
80
100
120
140
Horizontal Distance (ft.)

Figure 8

CALCULATION COVER SHEET

PROJECT	FMC - Phase IV Ponds (11S, 12S, 13S, and 14S)	JOB NO. 20906-027	CALC. NO. 20906-027-3	SHEET 1
SUBJECT	Evaluation of Strains in Final Pond Configuration		DISCIPLINE Geotech	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[X]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] Yes [ ] No	[ ]	[ ]		

Purpose: Evaluate the effect of settlement for the Phase IV ponds (11S, 12S, 13S, and 14S) after the final cover is installed. In particular, address the potential strains of the membrane elements caused by the settlement.

References: 1. Calculation, 24230-027-4, Phase IV Ponds - Settlement Evaluation, Rev. 1, May 6, 2002.

Conclusions: Estimated cap settlement will only result in minor depressions that will not produce ponding on the 5 percent slope of the final cap. The possibility that the synthetic elements of the final cover, particularly the HDPE membrane and the GCL, could be breached due to post-cap total and differential settlement, was also considered. The elongation properties of each are as follows:

Property	HDPE/Bentonite Composite liner (15mil HDPE)	Geotextile/ Bentonite Composite Liner	60 mil HDPE
Elongation at yield (%)	10	NA	12
Elongation at break (%)	500	100	500

Assuming the maximum calculated settlement occurs near the edge of the pond, a maximum elongation of 8% was calculated. As the properties demonstrate, both liner types can tolerate the strains imposed by the estimated differential settlement of the permanent cap with a factor of safety of about 2. Other elements of the cap have similar or better elongation properties and will be even more tolerant of settlement-induced strains. Therefore, settlement of the final cap is not expected to have any significant detrimental effect on the cap system.

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
2	Incorporated initial fill settlement & final grading	7	7	JTC	[illegible]	[illegible]	5/8/02
1	Incorporated settlement monitoring data	7	7	JTC	ND	IA	12/26/01
0	Issued for use	7	7	JTC	ND	IA	12/26/01

Record of Revision

f:\geotech\jtc analysis\phase iv\500year\finalstrains.doc

Purpose: Evaluate the effect of settlement on the permanent cap elements. Include effects of initial fill settlement and final grading presented in Reference 1.

1) The cap is expected to settle at a slow rate over time.

Little differential settlement is expected over the central pond.

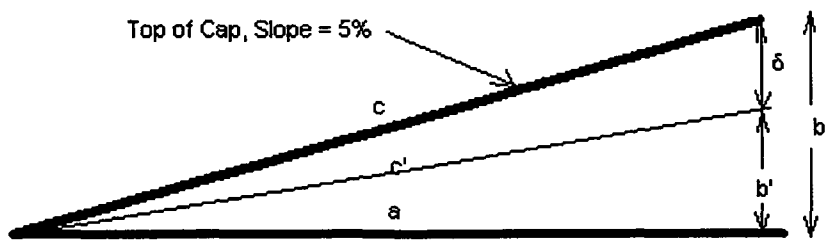
A maximum long-term settlement about 15 inches is estimated for the cap at Pond 11S (see Reference 1).

Measured settlement will be less because measured points will be set a few months after grading commences.

Maximum differential settlement will occur around the pond perimeter.

2) The effect of settlement around the perimeter will be to place the cap elements into a small amount of compression.

For example, assume 15 inches differential in 47 feet. (Note that 47 feet is the approximate horizontal distance of the sludge-covered 3:1 interior slope of Pond 8S.)



$slope := 5 \cdot \%$ $\quad \delta := 15 \cdot in$

$a := 47 \cdot ft$

$b := a \cdot slope$ $\quad b = 2.35\,ft$

$c := \left(a^2 + b^2\right)^{.5}$ $\quad c = 47.0587\,ft$

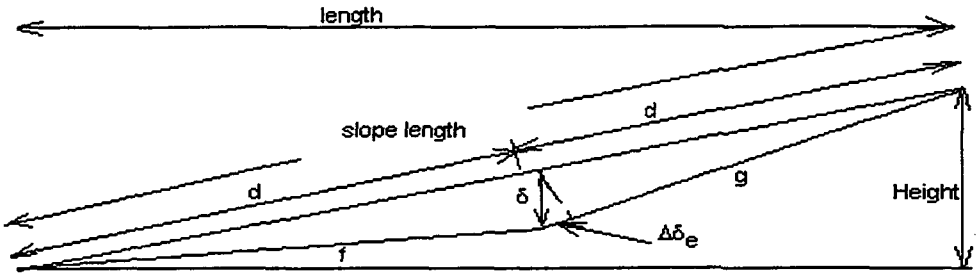
$b_1 := b - \delta$ $\quad b_1 = 1.1\,ft$

$c_1 := \left(a^2 + b_1^2\right)^{.5}$ $\quad c_1 = 47.0129\,ft$

$c - c_1 = 0.0458\,ft$

$\varepsilon := \dfrac{c - c_1}{c}$ $\quad \varepsilon = 0.0974\,\%$ strain compression

3) Consider a localized settlement depression superimposed on a plane surface of the cap.



Assume $\delta := 6 \cdot in$ within a 100 ft diameter circle

$length := 100 \cdot ft$

$height := slope \cdot length$ $\quad height = 5\,ft$

$slope\_length := \left(length^2 + height^2\right)^{.5}$

$slope\_length = 100.1249\,ft$

$d := \dfrac{slope\_length}{2}$ $\quad d = 50.0625\,ft$

$f := \left[\left(\dfrac{length}{2}\right)^2 + \left(\dfrac{height}{2} - \delta\right)^2\right]^{.5}$ $\quad f = 50.04\,ft$

$\Delta\delta_c := d - f$ $\quad \Delta\delta_c = 0.0225\,ft$ compression

$\varepsilon_c := \dfrac{\Delta\delta_c}{\left(\dfrac{length}{2}\right)}$ $\quad \varepsilon_c = 0.045\,\%$

$g := \left[\left(\dfrac{length}{2}\right)^2 + \left(\dfrac{height}{2} + \delta\right)^2\right]^{.5}$ $\quad g = 50.0899\,ft$

$\Delta\delta_e := d - g$ $\quad \Delta\delta_e = -0.0275\,ft$ elongation

$\varepsilon_e := \dfrac{\Delta\delta_e}{\left(\dfrac{length}{2}\right)}$ $\quad \varepsilon_e = -0.0549\,\%$

Assume $\delta := 15 \cdot in$ within a 100 ft diameter circle

$length = 100\ ft$

$height = 5\ ft$

$slope\_length := \left(length^2 + height^2\right)^{.5}$

$slope\_length = 100.1249\ ft$

$d := \frac{slope\_length}{2}$ $\quad d = 50.0625\ ft$

$f := \left[\left(\frac{length}{2}\right)^2 + \left(\frac{height}{2} - \delta\right)^2\right]^{.5}$ $\quad f = 50.0156\ ft$

$\Delta\delta_c := d - f$ $\quad \Delta\delta_c = 0.0468\ ft$ compression

$\varepsilon_c := \frac{\Delta\delta_c}{\left(\frac{length}{2}\right)}$ $\quad \varepsilon_c = 0.0937\ \%$

$g := \left[\left(\frac{length}{2}\right)^2 + \left(\frac{height}{2} + \delta\right)^2\right]^{.5}$ $\quad g = 50.1404\ ft$

$\Delta\delta_e := d - g$ $\quad \Delta\delta_e = -0.078\ ft$ elongation

$\varepsilon_e := \frac{\Delta\delta_e}{\left(\frac{length}{2}\right)}$ $\quad \varepsilon_e = -0.1559\ \%$

Assume $\delta := 3 \cdot in$ within a 100 ft diameter circle

$length = 100\ ft$

$height = 5\ ft$

$slope\_length := \left(length^2 + height^2\right)^{.5}$

$slope\_length = 100.1249\ ft$

$d := \frac{slope\_length}{2}$ $\quad d = 50.0625\ ft$

$f := \left[\left(\frac{length}{2}\right)^2 + \left(\frac{height}{2} - \delta\right)^2\right]^{.5}$ $\quad f = 50.0506\ ft$

$\Delta\delta_c := d - f$ $\quad \Delta\delta_c = 0.0119\ ft$ compression

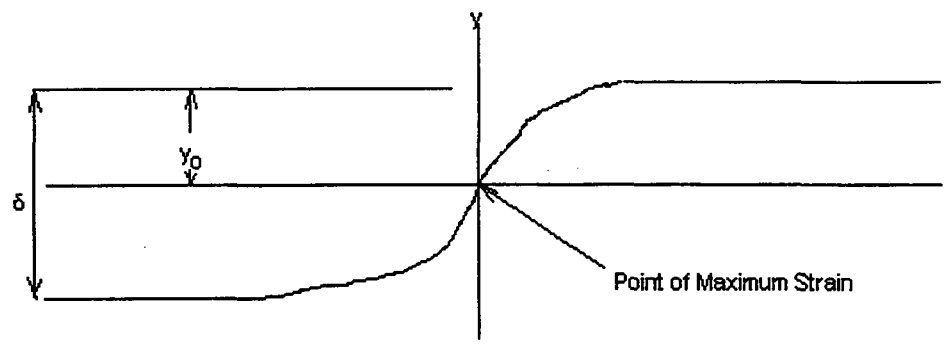
$$\varepsilon_c := \frac{\Delta\delta_c}{\left(\frac{\text{length}}{2}\right)} \qquad \varepsilon_c = 0.0237\,\%$$

$$g := \left[\left(\frac{\text{length}}{2}\right)^2 + \left(\frac{\text{height}}{2} + \delta\right)^2\right]^{.5} \qquad g = 50.0756\ \text{ft}$$

$$\Delta\delta_e := d - g \qquad \Delta\delta_e = -0.0131\ \text{ft}$$ elongation

$$\varepsilon_e := \frac{\Delta\delta_e}{\left(\frac{\text{length}}{2}\right)} \qquad \varepsilon_e = -0.0262\,\%$$

The above analyses assume that strain is equally distributed along the membrane. In fact, it is more appropriate to assume a tangent shape to the deformed membrane where the maximum strain occurs at the maximum slope as depicted below:



The general formula describing the tangent deformation shape is

y = A atan(x)

'A' can be determined for a maximum vertical deformation, δ, of say 18 inches (y_0 = 9 inches for the half amplitude deformation), which occurs when atan(x)=π/2.

$$\delta := 15\cdot\text{in}$$

$$y_0 := \frac{\delta}{2} \qquad y_0 = 0.625\ \text{ft} \qquad y_0 = 7.5\ \text{in}$$

$$A := \frac{y_0}{\left(\frac{\pi}{2}\right)} \qquad A = 0.3979\ \text{ft}$$

Hence, maximum strain occurs at $x := 0\ ft$

$y := A \cdot atan(x)$

$dy_x := \frac{A}{1 + x^2}$ $\quad dy_x = 0.3979\ ft\ /ft$

$\theta := atan\left(\frac{dy_x}{1 \cdot ft}\right)$ $\quad \theta = 21.697\ deg$

$\varepsilon := \frac{1}{\cos(\theta)} - 1$ $\quad \varepsilon = 7.625\ \%$

Similarly, for $\delta := 6 \cdot in$

$y_0 := \frac{\delta}{2}$ $\quad y_0 = 0.25\ ft$

$A := \frac{y_0}{\left(\frac{\pi}{2}\right)}$ $\quad A = 0.1592\ ft$

Hence, maximum strain occurs at $x := 0\ ft$

$y := A \cdot atan(x)$

$dy_x := \frac{A}{1 + x^2}$ $\quad dy_x = 0.1592\ ft\ /ft$

$\theta := atan\left(\frac{dy_x}{1 \cdot ft}\right)$ $\quad \theta = 9.0431\ deg$

$\varepsilon := \frac{1}{\cos(\theta)} - 1$ $\quad \varepsilon = 1.2586\ \%$

and for $\delta := 3 \cdot in$

$y_0 := \frac{\delta}{2}$ $\quad y_0 = 0.125\ ft$

$A := \frac{y_0}{\left(\frac{\pi}{2}\right)}$ $\quad A = 0.0796\ ft$

Hence, maximum strain occurs at $x := 0$ ft

$y := A \cdot atan(x)$

$dy_x := \frac{A}{1 + x^2}$ $dy_x = 0.0796\,ft\ /ft$

$\theta := atan\left(\frac{dy_x}{1 \cdot ft}\right)$ $\theta = 4.5499\,deg$

$\varepsilon := \frac{1}{\cos(\theta)} - 1$ $\varepsilon = 0.3161\,\%$

Conclusions:

The maximum elongation is estimated to be on the order of 0.3% assuming a 3-inch depression in the pond surface near the perimeter, increasing to 8% for an assumed 15-inch depression. These calculated strains are less than the tolerance of the cap section and material components.

CALCULATION COVER SHEET

PROJECT	FMC - Phase IV Ponds	JOB NO. 24230-027	CALC. NO. 24230-027-4	SHEET 1
SUBJECT	Settlement Evaluation Final Cap		DISCIPLINE Geotechnical	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[X]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] Yes [ ] No	[ ]	[X]	ACCUMV	--

Purpose:
Evaluate pond settlement of the Phase IV Ponds after final caps are installed. This analysis augments the earlier analyses performed for estimating initial and final cap settlement by accounting for average settlements that were measured during initial fill settlement, as-built grades, and the planned final grading required to complete the cap.

References:
1. FMC-Phase IV Ponds, Settlement Evaluation, Calculation No. 20906-027-1, Bechtel Geotechnical, dated 12/26/01.
2. Phase IV Ponds, Final Grading Plans, Drawing Nos. 270-C-213, Rev. 0, and 270-C-214, Rev. 0.
3. Closure Settlement Report, Pond 8E, Pond 15S, and Phase IV Ponds - Progress Report No. 10, Pond 16S - Progress Report No. 6," Bechtel, April 30, 2002.
4. ACCUMV, The One-Dimensional Consolidation of Saturated Clays, A Computer Program for Nonlinear Finite Strain Theory, by Schiffman, R.L., Szavits-Nossan, V., and McArthur, J.M, December 1992.

Summary of Conclusions:
Estimated permanent cap settlement is about 15 inches over its 500-year design life. This is approximately 1 inch greater than the value estimated in Reference 1.

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
0	Issued for use	42	A-39	JTC	[signature]	F.O. by [signature]	5/6/02

Record of Revision

f:\geotech\jtc analysis\phase iv\500year\ph4final.doc

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

Purpose of Calculation

This calculation performs an evaluation of the final cap settlement for the planned cap design configuration of the Phase IV ponds using the same soil parameters as reported in Reference 1. The general description of the Phase IV ponds construction and the description of methodology used in this analysis are also included in Reference 1.

Input Data and Assumptions

All input parameters used for the initial fill calculation (Ref. 1) are the same except that the thickness of slag has been modified to reflect measurements made during the construction, the current grade, and the final grading plan (see Refs. 2 and 3). Based on this information, the following estimates were made for the total slag thickness added to each of the ponds during initial filling:

Table 1 - Summary of Loading

	Pond 11S	Pond 12S	Pond 13S	Pond 14S
Current top of slag Elevation [ft]	4478.6	4479.1	4479.3	4483.6
- Elevation of top of sludge (initial [ft])	4467.3	4467.1	4458.3	4462.5
- Sand thickness (initial) [ft]	5	5	5	5
+ Measured settlement [ft] (Ref. 3)	3.5	5.5	2.75	7
Current slag thickness [ft]	9.8	12.5	18.75	23.1
Current slag load @ 130 pcf [psf]	1274	1625	2438	3003

Prior to constructing the final cap some regrading will be required. Based on the grading plans it is estimated that in addition to the 7-foot thick final cap, it will be necessary to add an average of up to1.4 feet of additional fill over portions of Pond 11S, which represents the worst case loading condition for the Phase IV Ponds. The final load required for the cap installation is therefore:

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

Table 2 - Summary of Final Cap Loading

	Pond 11S	Pond 12S	Pond 13S	Pond 14S
Final cap thickness [ft]	7	7	7	7
Regrading fill [ft]	1.4	0.8	0.5	-1.0
Total thickness [ft]	8.4	7.8	7.5	6
Final cap load @ 120 pcf [psf]	1008	936	900	720

Since Pond 11S represents the worst loading condition for the final cap, and contains the greatest sludge thickness (see Ref. 1), only Pond 11S was analyzed for final cap settlement.

Results As for the calculations in Reference 1, the analyses were performed using ACCUMV (Reference 4). The summary of the analysis results and computer output for the analysis is attached as Appendix A. The results of the analyses for Pond 11S are summarized in the following table:

Table 3 - Summary of Settlement Analyses for Phase IV Ponds

Item	Pond 11S
Primary Settlement of Permanent Cap [ft]	0.3
500-yr Secondary Settlement [ft]	1.0
Total Post-Construction 500-yr Settlement [ft]	1.3

Conclusions

It is estimated that the permanent cap will settle about 14.8 inches over its 500-year design life. This is about 1 inch greater than the value estimated in Reference 1.

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-1

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

Analysis Results

Project:	FMC - Pond 11S - 500-Year Design
Computed by:	J. Cameron
Date	5/6/2002

All required inputs are blocked with a bold box.		INPUT	
Sludge Thickness, H		15.75	ft
Coef. of Horizontal Consolidation, C_h		7	ft^2/mth
Wick Drain Spacing (Triangular), S		7	ft
Wick Drain Width, W		110	mm
Wick Drain Thickness, b		4	mm
Percent Void Area of Wick Drain, A_v		92	
Assumed Equivalent Sand Porosity, por		0.3	
Equivalent Void Diameter, d_v (see Note 6)		22.7	mm
Equivalent Sand Drain Diameter, d_w (see Note 7)		75.7	mm
Equivalent Sand Drain Diameter, d_w		0.25	ft
Equivalent Drain Diameter = d_e (see Note 1)	1.05 * S =	7.4	
n	d_e / d_w =	30	

Material	Sand	Slag	Cap
Thickness, ft	5	9.8	8.4
Unit Weight, pcf	115	130	120
Additional Load, psf	575	1274	1008
Begin Loading, months	0	0.4	24
Time for Loading, months	0.4	0.3	2

Begin Wick Drain Installation: 1 Months

Load Sequence	
Time, mths	Load
0.2	300
0.4	575
0.7	1000
1.0	1424
2.0	1849
26.0	2857
60.0	2857

Start of Secondary Settlement, t_p: 9 months w/o wick drains; 6 months with wick drains

Rate of 2ndary Compr. (ft/log cycle), c_α = 0.02 * H: 0.315

Design Life: 500 years

NOTES:

[1] Multiply S by 1.05 for triangular pattern and 1.13 for square pattern

[2] $\delta_{sec} = c_\alpha * \log(t/t_p)$

[3] $U_h = 1 - 1/(e^{A})$

where $A = d_e^2/(8*C_{v,h}) * (\ln d_e/d_w - 0.75)$

[4] $U = 1 - (1 - U_v) * (1 - U_h)$

[5] $\delta_{wick} = (\delta_{prim}/U_v) * U$

[6] $d_v = \mathrm{sqrt}(4*A_v/\pi)$

[7] $d_w = d_v/por$

Phase of Construction	Net Pressure, psf (psf)	Primary Settlement (ft)
Begin	0	0
Sand fill, 5-ft thickness	575	1.2
Sand and 1 ft. of slag (near perimeter dike)	705	1.32
Sand and 9.8 ft. of slag	1849	1.91
Permanent, 7-ft cap + 1.4 ft regrading	2857	2.20

Secondary Settlement of Final Cap, ft: 0.95

Total Additional Settlement After Final Cap Installed (500 -year): 14.8 inches

ACCUMV OUTPUT (w/o wick drains)								With Wick Drains				
Time t (months)	Average void ratio	Total Stress (psf)	Effective Stress (psf)	Prim. Sett. δ_{prim}	Deg. Vert. Cons. U_v	Secndry Sett. (ft) δ_{sec}[2]	Total Sett. (ft) $\delta_{prim} + \delta_{sec}$	Deg. Hor. Cons. U_h[3]	Deg. Sett. U[4]	Primary Sett.(ft) δ_{wick}[5]	Secondary Settlement (ft)	Prim+Sec (ft)
0.00E+00	3.29E+00	709.682	206.1408	0	0	0.00	0.00	0.000	0.00	0.0000	0.00	0.0000
1.50E-01	3.25E+00	934.804	214.7944	0.1484	0.0674	0.00	0.15	0.000	0.07	0.1484	0.00	0.1484
2.00E-01	3.24E+00	1009.871	218.023	0.165	0.075	0.00	0.17	0.000	0.08	0.1650	0.00	0.1650
2.25E-01	3.24E+00	1044.287	219.6437	0.1735	0.0788	0.00	0.17	0.000	0.08	0.1735	0.00	0.1735
2.50E-01	3.24E+00	1078.706	221.336	0.1822	0.0828	0.00	0.18	0.000	0.08	0.1822	0.00	0.1822
2.75E-01	3.24E+00	1113.13	223.1099	0.1912	0.0869	0.00	0.19	0.000	0.09	0.1912	0.00	0.1912
3.00E-01	3.23E+00	1147.557	224.9782	0.2005	0.0911	0.00	0.20	0.000	0.09	0.2005	0.00	0.2005
3.50E-01	3.23E+00	1216.42	229.0072	0.22	0.1	0.00	0.22	0.000	0.10	0.2200	0.00	0.2200
4.00E-01	3.22E+00	1285.301	233.6123	0.2413	0.1096	0.00	0.24	0.000	0.11	0.2413	0.00	0.2413
5.00E-01	3.21E+00	1427.29	245.6631	0.2906	0.132	0.00	0.29	0.000	0.13	0.2906	0.00	0.2906
6.00E-01	3.19E+00	1569.367	263.7913	0.3491	0.1586	0.00	0.35	0.000	0.16	0.3491	0.00	0.3491
7.00E-01	3.18E+00	1711.517	290.726	0.4129	0.1876	0.00	0.41	0.000	0.19	0.4129	0.00	0.4129
8.00E-01	3.16E+00	1853.363	322.483	0.4721	0.2145	0.00	0.47	0.000	0.21	0.4721	0.00	0.4721
9.00E-01	3.15E+00	1995.257	352.8418	0.5252	0.2386	0.00	0.53	0.000	0.24	0.5252	0.00	0.5252
1.00E+00	3.13E+00	2137.271	386.2454	0.5798	0.2635	0.00	0.58	0.000	0.26	0.5798	0.00	0.5798
1.25E+00	3.10E+00	2245.584	462.2201	0.7053	0.3205	0.00	0.71	0.094	0.38	0.7341	0.00	0.7341
1.50E+00	3.07E+00	2354.025	537.4698	0.814	0.3699	0.00	0.81	0.178	0.48	0.9218	0.00	0.9218
1.75E+00	3.04E+00	2462.615	615.2452	0.9134	0.415	0.00	0.91	0.255	0.56	1.0786	0.00	1.0786
2.00E+00	3.01E+00	2571.353	696.3914	1.007	0.4576	0.00	1.01	0.325	0.63	1.2115	0.00	1.2115
2.25E+00	2.99E+00	2573.896	766.2944	1.0888	0.4947	0.00	1.09	0.388	0.69	1.3204	0.00	1.3204
2.50E+00	2.97E+00	2576.411	829.1517	1.1608	0.5274	0.00	1.16	0.445	0.74	1.4103	0.00	1.4103
2.75E+00	2.95E+00	2578.676	888.9167	1.2262	0.5571	0.00	1.23	0.497	0.78	1.4857	0.00	1.4857
3.00E+00	2.94E+00	2581.269	947.0863	1.2863	0.5845	0.00	1.29	0.544	0.81	1.5494	0.00	1.5494
3.50E+00	2.91E+00	2585.752	1062.977	1.3942	0.6335	0.00	1.39	0.626	0.86	1.6490	0.00	1.6490
4.00E+00	2.88E+00	2589.746	1182.128	1.4886	0.6764	0.00	1.49	0.692	0.90	1.7210	0.00	1.7210
5.00E+00	2.84E+00	2596.1	1423.617	1.6406	0.7456	0.00	1.64	0.792	0.95	1.8103	0.00	1.8103
6.00E+00	2.81E+00	2600.421	1636.839	1.7469	0.7937	0.00	1.75	0.860	0.97	1.8660	0.00	1.8660
7.00E+00	2.79E+00	2603.149	1796.561	1.8152	0.8248	0.00	1.82	0.905	0.98	1.8796	0.02	1.9007
8.00E+00	2.78E+00	2604.783	1902.68	1.8566	0.8436	0.00	1.86	0.936	0.99	1.8922	0.04	1.9316
9.00E+00	2.78E+00	2605.727	1967.875	1.8806	0.8545	0.00	1.88	0.957	0.99	1.8993	0.06	1.9548
1.00E+01	2.77E+00	2606.261	2006.063	1.8943	0.8607	0.01	1.91	0.971	1.00	1.9035	0.07	1.9734
1.20E+01	2.77E+00	2606.725	2040.013	1.9062	0.8661	0.04	1.95	0.987	1.00	1.9079	0.09	2.0027
1.25E+01	2.77E+00	2606.778	2043.899	1.9075	0.8667	0.04	1.95	0.989	1.00	1.9085	0.10	2.0089
1.50E+01	2.77E+00	2606.895	2052.598	1.9105	0.8681	0.07	1.98	0.996	1.00	1.9105	0.13	2.0359
1.75E+01	2.77E+00	2606.921	2054.563	1.9112	0.8684	0.09	2.00	0.998	1.00	1.9112	0.15	2.0576
1.80E+01	2.77E+00	2606.923	2054.701	1.9112	0.8684	0.09	2.01	0.999	1.00	1.9112	0.15	2.0615
2.00E+01	2.77E+00	2606.927	2055.001	1.9113	0.8685	0.11	2.02	0.999	1.00	1.9113	0.16	2.0760
2.25E+01	2.77E+00	2606.927	2055.022	1.9113	0.8685	0.13	2.04	1.000	1.00	1.9113	0.18	2.0921
2.40E+01	2.77E+00	2606.927	2055.022	1.9113	0.8685	0.13	2.05	1.000	1.00	1.9113	0.19	2.1009
2.50E+01	2.75E+00	3112.138	2240.762	1.975	0.8974	0.14	2.11	1.000	1.00	2.1962	0.20	2.3914
2.60E+01	2.72E+00	3619.063	2593.628	2.0806	0.9454	0.15	2.23	1.000	1.00	2.1962	0.20	2.3968
2.75E+01	2.70E+00	3622.283	2911.563	2.1646	0.9835	0.15	2.32	1.000	1.00	2.1962	0.21	2.4045
2.80E+01	2.70E+00	3622.761	2981.156	2.1767	0.989	0.16	2.33	1.000	1.00	2.1962	0.21	2.4069
3.00E+01	2.69E+00	3623.529	3043.243	2.1952	0.9979	0.16	2.36	0.000	1.00	2.1962	0.22	2.4164
3.20E+01	2.69E+00	3623.677	3059.344	2.1999	0.9996	0.17	2.37	0.544	1.00	2.1999	0.23	2.4289
3.40E+01	2.69E+00	3623.704	3062.404	2.2007	0.9999	0.18	2.38	0.792	1.00	2.2007	0.24	2.4380
3.50E+01	2.69E+00	3623.708	3062.805	2.2008	1	0.19	2.39	0.860	1.00	2.2008	0.24	2.4421
3.80E+01	2.69E+00	3623.71	3062.943	2.2008	1	0.20	2.40	0.957	1.00	2.2008	0.25	2.4533
4.00E+01	2.69E+00	3623.71	3062.943	2.2008	1	0.20	2.40	0.980	1.00	2.2008	0.26	2.4603
4.50E+01	2.69E+00	3623.71	3062.943	2.2008	1	0.22	2.42	0.997	1.00	2.2008	0.28	2.4764
5.00E+01	2.69E+00	3623.71	3062.943	2.2008	1	0.23	2.44	1.000	1.00	2.2008	0.29	2.4909
5.50E+01	2.69E+00	3623.71	3062.943	2.2008	1	0.25	2.45	1.000	1.00	2.2008	0.30	2.5039
6.00E+01	2.69E+00	3623.71	3062.943	2.2008	1	0.26	2.46	1.000	1.00	2.2008	0.32	2.5158

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-2

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
*********************************************************************
*                                                                   *
*          ACCUMV - NONLINEAR LARGE STRAIN CONSOLIDATION            *
*                              by                                   *
*                        ROBERT L. SCHIFFMAN                        *
*                       VLASTA SZAVITS-NOSSAN                       *
*                         JOHN M. McARTHUR                          *
*                                                                   *
*                  DEPARTMENT OF CIVIL ENGINEERING                  *
*                 UNIVERSITY OF COLORADO AT BOULDER                 *
*                    BOULDER, CO 80309-0428  USA                    *
*                                                                   *
*                                                                   *
*    COPYRIGHT @1992 by Robert L. Schiffman, Vlasta Szavits-Nossan, *
*                        and John M. McArthur                       *
*                                                                   *
*********************************************************************
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

                              ****************
                              *              *
                              *  INPUT DATA  *
                              *              *
                              ****************

                           ******    UNITS    ******

                     LENGTH              FORCE              TIME
                     feet                pounds              months
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY


                       *******  UNIT  WEIGHTS  *******

                           GAMMAS          GAMMAW
                          174.1000         62.4000
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY


                         *******  INITIAL GEOMETRY  *******
```

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-3

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
                    H(0)                    TOTAL HEADS

                                        TOT HD(L)      HW
                  15.750                     .000    15.750


              *******  VOID RATIO RANGE  *******

                  EMAX                    EMIN
                  8.000                   1.000
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


          *******  EFFECTIVE STRESS AT TOP OF LAYER  *******

                                  Q0
                                1.0000
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


         *******    CONSTITUTIVE RELATIONSHIPS    *******


                    ( .4270E+01) + (-.1970E+00) * LN(EFFSTR)
     E = ------------------------------------------------------------------
         1 + ( .0000E+00) * LN(EFFSTR) + ( .0000E+00) * LN(EFFSTR)*LN(EFFSTR)


                        ( .5000E-02) * (E) ** ( .2600E+01)
                  K = ----------------------------------
                              1 + ( .0000E+00) * (E)
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


              **********    CALCULATION DATA    **********

                  N           TMAX              ALPHA
                  10        .6000E+02         .5000E+00
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


              *******  HEIGHT-TIME  FUNCTION  *******

                  TIME                H
                 .000E+00           15.750
```

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-4

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
                    .100E+03          15.750
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


                 *******  TIME - LOAD FUNCTIONS  *******

                      TIME           LOAD
                   .0000E+00          .0000
                   .2000E+00       300.0000
                   .4000E+00       575.0000
                   .7000E+00      1000.0000
                   .1000E+01      1424.0000
                   .2000E+01      1849.0000
                   .2400E+02      1849.0000
                   .2600E+02      2857.0000
                   .6000E+02      2857.0000
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


                      **** PRINT TIMES ****
                           .15000E+00
                           .20000E+00
                           .22500E+00
                           .25000E+00
                           .27500E+00
                           .30000E+00
                           .35000E+00
                           .40000E+00
                           .50000E+00
                           .60000E+00
                           .70000E+00
                           .80000E+00
                           .90000E+00
                           .10000E+01
                           .12500E+01
                           .15000E+01
                           .17500E+01
                           .20000E+01
                           .22500E+01
                           .25000E+01
                           .27500E+01
                           .30000E+01
                           .35000E+01
                           .40000E+01
                           .50000E+01
                           .60000E+01
                           .70000E+01
                           .80000E+01
                           .90000E+01
                           .10000E+02
                           .12000E+02
                           .12500E+02
                           .15000E+02
                           .17500E+02
                           .18000E+02
                           .20000E+02
                           .22500E+02
                           .24000E+02
```

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-5

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
                    .25000E+02
                    .26000E+02
                    .27500E+02
                    .28000E+02
                    .30000E+02
                    .32000E+02
                    .34000E+02
                    .35000E+02
                    .38000E+02
                    .40000E+02
                    .45000E+02
                    .50000E+02
                    .55000E+02
                    .60000E+02
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY


                    ***************
                    *             *
                    *  FUNCTIONS  *
                    *             *
                    ***************
```

E	EFFSTR	K	G	D(G)	D(K/1+E)	AV
1.000	.162E+08	.500E-02	-.329E+04	.979E+04	.525E-02	.122E-07
1.700	.463E+06	.199E-01	-.277E+03	.109E+04	.853E-02	.425E-06
2.400	.133E+05	.487E-01	-.154E+02	.662E+02	.113E-01	.149E-04
3.100	.380E+03	.947E-01	-.713E+00	.320E+01	.137E-01	.519E-03
3.800	.109E+02	.161E+00	-.296E-01	.136E+00	.159E-01	.181E-01
4.500	.311E+00	.250E+00	-.115E-02	.538E-02	.180E-01	.633E+00
5.200	.891E-02	.364E+00	-.425E-04	.201E-03	.199E-01	.221E+02
5.900	.255E-03	.505E+00	-.152E-05	.726E-05	.216E-01	.772E+03
6.600	.730E-05	.676E+00	-.528E-07	.254E-06	.233E-01	.270E+05
7.300	.209E-06	.878E+00	-.180E-08	.871E-08	.249E-01	.942E+06
8.000	.599E-08	.111E+01	-.603E-10	.293E-09	.265E-01	.329E+08

```
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

              TIME =  .00000E+00          LOAD =       .000
              SET =      .0000
```

******** COORDINATES		*********	VOID RATIO	****** STRESSES	*******
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.7500	.0000	4.2700	1.000	1.0000
.1000	13.9763	.3673	3.5335	152.704	42.0281
.2000	12.3459	.7346	3.3994	295.475	83.0564
.3000	10.7378	1.1019	3.3203	436.847	124.0845
.4000	9.1693	1.4692	3.2640	575.746	165.1127
.5000	7.6114	1.8365	3.2203	713.990	206.1409
.6000	6.0681	2.2038	3.1845	851.320	247.1691
.7000	4.5368	2.5711	3.1543	987.902	288.1970
.8000	3.0158	2.9385	3.1280	1123.838	329.2253
.9000	1.5039	3.3058	3.1049	1259.211	370.2537
1.0000	.0000	3.6731	3.0842	1394.082	411.2814

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-6

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

********** PORE PRESSURES **********

CHI	UW	U0	U
15.7500	.000	.000	.0000
13.9763	110.676	110.676	.0000
12.3459	212.419	212.419	.0000
10.7378	312.763	312.763	-.0001
9.1693	410.634	410.634	-.0001
7.6114	507.849	507.849	-.0001
6.0681	604.151	604.151	-.0001
4.5368	699.705	699.705	.0001
3.0158	794.613	794.613	-.0001
1.5039	888.957	888.957	-.0002
.0000	982.800	982.800	.0002

TIMESTEP SIZE = .00, ITERATIONS BETWEEN PRINT TIMES = 0

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+00 LOAD = 225.000
SET = .1484

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.6016	.0000	3.2022	235.259	226.0000
.1000	13.9851	.3673	3.4985	377.155	50.2129
.2000	12.3456	.7346	3.3979	520.493	83.6755
.3000	10.7516	1.1019	3.3201	660.984	124.1748
.4000	9.1693	1.4692	3.2640	800.748	165.1487
.5000	7.6114	1.8365	3.2203	938.990	206.1623
.6000	6.0681	2.2038	3.1845	1076.321	247.1831
.7000	4.5368	2.5711	3.1543	1212.903	288.2071
.8000	3.0158	2.9385	3.1280	1348.839	329.2329
.9000	1.5039	3.3058	3.1049	1484.211	370.2591
1.0000	.0000	3.6731	3.0842	1619.082	411.2864

********** PORE PRESSURES **********

CHI	UW	U0	U
15.6016	9.259	9.259	.0000
13.9851	326.942	110.127	216.8152
12.3456	436.817	212.436	224.3808
10.7516	536.810	311.900	224.9097
9.1693	635.599	410.635	224.9639
7.6114	732.827	507.849	224.9785
6.0681	829.138	604.152	224.9858
4.5368	924.696	699.706	224.9900
3.0158	1019.606	794.613	224.9924
1.5039	1113.952	888.957	224.9944
.0000	1207.795	982.800	224.9952

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 4

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+00 LOAD = 300.000
SET = .1650

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-7

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

   .0000       15.5850       .0000       3.1457        311.296        301.0000
   .1000       13.9818       .3673       3.4794        452.367         55.3119
   .2000       12.3454       .7346       3.3966        595.506         84.2133
   .3000       10.7512      1.1019       3.3200        736.011        124.2453
   .4000        9.1693      1.4692       3.2639        875.748        165.1651
   .5000        7.6114      1.8365       3.2202       1013.989        206.1703
   .6000        6.0681      2.2038       3.1845       1151.321        247.1882
   .7000        4.5368      2.5711       3.1543       1287.903        288.2106
   .8000        3.0158      2.9385       3.1280       1423.839        329.2353
   .9000        1.5039      3.3058       3.1049       1559.211        370.2613
  1.0000         .0000      3.6731       3.0842       1694.082        411.2884

                ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

   15.5850      10.295        10.296         .0000
   13.9818     397.055       110.339      286.7163
   12.3454     511.293       212.450      298.8430
   10.7512     611.766       311.927      299.8391
    9.1693     710.583       410.636      299.9475
    7.6114     807.819       507.848      299.9705
    6.0681     904.133       604.152      299.9807
    4.5368     999.692       699.706      299.9865
    3.0158    1094.603       794.613      299.9900
    1.5039    1188.950       888.958      299.9921
     .0000    1282.793       982.800      299.9932
 TIMESTEP SIZE =     .05, ITERATIONS BETWEEN PRINT TIMES =      6
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

              TIME =  .22500E+00          LOAD =    334.375
              SET =      .1735

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

   .0000       15.5765       .0000       3.1244        346.199        335.3751
   .1000       13.9795       .3673       3.4680        486.885         58.6055
   .2000       12.3452       .7346       3.3957        629.892         84.6110
   .3000       10.7507      1.1019       3.3199        770.413        124.3000
   .4000        9.1693      1.4692       3.2639        910.124        165.1761
   .5000        7.6114      1.8365       3.2202       1048.364        206.1745
   .6000        6.0681      2.2038       3.1845       1185.696        247.1909
   .7000        4.5368      2.5711       3.1543       1322.278        288.2124
   .8000        3.0158      2.9385       3.1280       1458.214        329.2365
   .9000        1.5039      3.3058       3.1049       1593.586        370.2622
  1.0000         .0000      3.6731       3.0842       1728.457        411.2894

                ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

   15.5765      10.824        10.824        -.0001
   13.9795     428.279       110.481      317.7977
   12.3452     545.281       212.460      332.8203
   10.7507     646.113       311.954      334.1594
    9.1693     744.948       410.636      334.3116
    7.6114     842.189       507.848      334.3412
    6.0681     938.505       604.152      334.3531
```

```
        4.5368    1034.066        699.706       334.3597
        3.0158    1128.977        794.613       334.3638
        1.5039    1223.324        888.958       334.3662
         .0000    1317.167        982.800       334.3672
 TIMESTEP SIZE =     .05, ITERATIONS BETWEEN PRINT TIMES =      7
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

              TIME =  .25000E+00          LOAD =    368.750
              SET =     .1822

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y          CHI          Z           E            TOTAL        EFFECTIVE

     .0000      15.5678      .0000      3.1052        381.117       369.7499
     .1000      13.9769      .3673      3.4558        521.420        62.3762
     .2000      12.3450      .7346      3.3946        664.279        85.0930
     .3000      10.7502     1.1019      3.3198        804.820       124.3696
     .4000       9.1693     1.4692      3.2639        944.499       165.1895
     .5000       7.6114     1.8365      3.2202       1082.738       206.1793
     .6000       6.0681     2.2038      3.1845       1220.071       247.1936
     .7000       4.5368     2.5711      3.1543       1356.653       288.2141
     .8000       3.0158     2.9385      3.1280       1492.589       329.2377
     .9000       1.5039     3.3058      3.1049       1627.961       370.2635
    1.0000        .0000     3.6731      3.0842       1762.832       411.2904

                ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     15.5678      11.367        11.367         .0001
     13.9769     459.044       110.642       348.4020
     12.3450     579.186       212.473       366.7133
     10.7502     680.450       311.985       368.4649
      9.1693     779.310       410.637       368.6732
      7.6114     876.559       507.847       368.7115
      6.0681     972.878       604.152       368.7254
      4.5368    1068.439       699.706       368.7330
      3.0158    1163.351       794.613       368.7376
      1.5039    1257.697       888.958       368.7399
       .0000    1351.541       982.800       368.7412
 TIMESTEP SIZE =     .05, ITERATIONS BETWEEN PRINT TIMES =      8
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

              TIME =  .27500E+00          LOAD =    403.125
              SET =     .1912

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y          CHI          Z           E            TOTAL        EFFECTIVE

     .0000      15.5588      .0000      3.0877        416.054       404.1250
     .1000      13.9740      .3673      3.4426        555.973        66.6926
     .2000      12.3448      .7346      3.3933        698.669        85.6700
     .3000      10.7497     1.1019      3.3197        839.230       124.4567
     .4000       9.1693     1.4692      3.2639        978.875       165.2059
     .5000       7.6114     1.8365      3.2202       1117.113       206.1845
     .6000       6.0681     2.2038      3.1845       1254.446       247.1963
```

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-9

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

.7000	4.5368	2.5711	3.1542	1391.028	288.2162
.8000	3.0158	2.9385	3.1280	1526.964	329.2393
.9000	1.5039	3.3058	3.1049	1662.336	370.2644
1.0000	.0000	3.6731	3.0842	1797.207	411.2914

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5588	11.929	11.929	.0000
13.9740	489.281	110.820	378.4605
12.3448	612.999	212.488	400.5113
10.7497	714.774	312.021	402.7527
9.1693	813.669	410.637	403.0318
7.6114	910.928	507.847	403.0813
6.0681	1007.250	604.152	403.0977
4.5368	1102.812	699.706	403.1059
3.0158	1197.724	794.613	403.1110
1.5039	1292.072	888.958	403.1140
.0000	1385.915	982.800	403.1152

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 9

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+00 LOAD = 437.500
SET = .2005

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.5495	.0000	3.0716	451.012	438.5002
.1000	13.9709	.3673	3.4285	590.545	71.6385
.2000	12.3445	.7346	3.3917	733.062	86.3543
.3000	10.7490	1.1019	3.3195	873.645	124.5646
.4000	9.1693	1.4692	3.2639	1013.250	165.2260
.5000	7.6114	1.8365	3.2202	1151.487	206.1905
.6000	6.0681	2.2038	3.1845	1288.821	247.1993
.7000	4.5368	2.5711	3.1542	1425.403	288.2183
.8000	3.0158	2.9385	3.1280	1561.339	329.2409
.9000	1.5039	3.3058	3.1049	1696.711	370.2658
1.0000	.0000	3.6731	3.0842	1831.582	411.2924

********** PORE PRESSURES **********

CHI	UW	U0	U
15.5495	12.512	12.512	-.0002
13.9709	518.906	111.017	407.8896
12.3445	646.707	212.505	434.2020
10.7490	749.081	312.061	437.0198
9.1693	848.024	410.637	437.3866
7.6114	945.296	507.846	437.4503
6.0681	1041.622	604.152	437.4697
4.5368	1137.185	699.706	437.4788
3.0158	1232.098	794.613	437.4844
1.5039	1326.445	888.958	437.4876
.0000	1420.289	982.800	437.4892

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 10

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-10

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
IMPERVIOUS LOWER BOUNDARY

              TIME =  .35000E+00          LOAD =    506.250
              SET =      .2200

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

   .0000       15.5300      .0000      3.0429         520.977        507.2499
   .1000       13.9639      .3673      3.3982         659.732         83.5240
   .2000       12.3438      .7346      3.3880         801.855         88.0014
   .3000       10.7476     1.1019      3.3191         942.484        124.8348
   .4000        9.1693     1.4692      3.2638        1082.001        165.2773
   .5000        7.6115     1.8365      3.2202        1220.235        206.2045
   .6000        6.0681     2.2038      3.1845        1357.572        247.2056
   .7000        4.5368     2.5711      3.1542        1494.153        288.2225
   .8000        3.0158     2.9385      3.1280        1630.089        329.2437
   .9000        1.5039     3.3058      3.1049        1765.461        370.2680
  1.0000         .0000     3.6731      3.0842        1900.332        411.2949

                ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

   15.5300      13.727        13.727         .0001
   13.9639     576.208       111.454      464.7542
   12.3438     713.854       212.549      501.3049
   10.7476     817.649       312.150      505.4996
    9.1693     916.724       410.639      506.0853
    7.6115    1014.031       507.845      506.1863
    6.0681    1110.366       604.153      506.2133
    4.5368    1205.931       699.706      506.2246
    3.0158    1300.845       794.613      506.2316
    1.5039    1395.193       888.958      506.2354
     .0000    1489.037       982.800      506.2367
 TIMESTEP SIZE =     .05, ITERATIONS BETWEEN PRINT TIMES =     12
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

              TIME =  .40000E+00          LOAD =    575.000
              SET =      .2413

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

   .0000       15.5087      .0000      3.0178         591.056        575.9999
   .1000       13.9556      .3673      3.3642         729.001         99.2968
   .2000       12.3428      .7346      3.3830         870.664         90.2463
   .3000       10.7460     1.1019      3.3185        1011.336        125.2218
   .4000        9.1692     1.4692      3.2637        1150.753        165.3523
   .5000        7.6115     1.8365      3.2202        1288.983        206.2232
   .6000        6.0681     2.2038      3.1845        1426.322        247.2130
   .7000        4.5368     2.5711      3.1542        1562.903        288.2267
   .8000        3.0158     2.9385      3.1280        1698.839        329.2469
   .9000        1.5039     3.3058      3.1049        1834.211        370.2703
  1.0000         .0000     3.6731      3.0842        1969.082        411.2968

                ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

   15.5087      15.056        15.056         .0001
   13.9556     629.704       111.973      517.7314
```

```
      12.3428     780.417        212.607        567.8101
      10.7460     886.115        312.252        573.8626
       9.1692     985.400        410.640        574.7603
       7.6115    1082.760        507.842        574.9176
       6.0681    1179.109        604.153        574.9559
       4.5368    1274.677        699.706        574.9705
       3.0158    1369.592        794.614        574.9784
       1.5039    1463.941        888.958        574.9832
        .0000    1557.785        982.800        574.9847
 TIMESTEP SIZE =      .05, ITERATIONS BETWEEN PRINT TIMES =     14
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .50000E+00          LOAD =    716.667
               SET =      .2906

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      15.4594       .0000       2.9745        735.799       717.6670
     .1000      13.9344       .3673       3.2841        871.988       149.1042
     .2000      12.3399       .7346       3.3680       1012.514        97.3720
     .3000      10.7422      1.1019       3.3164       1153.239       126.5159
     .4000       9.1692      1.4692       3.2634       1292.424       165.6156
     .5000       7.6116      1.8365       3.2201       1430.644       206.2856
     .6000       6.0681      2.2038       3.1845       1567.989       247.2337
     .7000       4.5368      2.5711       3.1542       1704.570       288.2364
     .8000       3.0158      2.9385       3.1280       1840.506       329.2536
     .9000       1.5039      3.3058       3.1049       1975.878       370.2761
    1.0000        .0000      3.6731       3.0842       2110.748       411.3018

                ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     15.4594      18.132        18.133        -.0003
     13.9344     722.883       113.293       609.5906
     12.3399     915.142       212.791       702.3510
     10.7422    1026.723       312.487       714.2352
      9.1692    1126.809       410.645       716.1637
      7.6116    1224.358       507.836       716.5219
      6.0681    1320.755       604.153       716.6019
      4.5368    1416.334       699.706       716.6274
      3.0158    1511.252       794.614       716.6383
      1.5039    1605.602       888.958       716.6440
       .0000    1699.447       982.800       716.6464
 TIMESTEP SIZE =      .05, ITERATIONS BETWEEN PRINT TIMES =     17
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .60000E+00          LOAD =    858.333
               SET =      .3491

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      15.4009       .0000       2.9390        881.120       859.3334
     .1000      13.9062       .3673       3.1901       1015.413       240.2925
```

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

.2000	12.3348	.7346	3.3431	1154.500	110.5077
.3000	10.7382	1.1019	3.3127	1295.155	128.9537
.4000	9.1690	1.4692	3.2628	1434.100	166.1358
.5000	7.6117	1.8365	3.2200	1572.302	206.4092
.6000	6.0680	2.2038	3.1844	1709.656	247.2687
.7000	4.5368	2.5711	3.1542	1846.237	288.2504
.8000	3.0158	2.9385	3.1280	1982.172	329.2612
.9000	1.5039	3.3058	3.1049	2117.545	370.2819
1.0000	.0000	3.6731	3.0842	2252.415	411.3078

********** PORE PRESSURES **********

CHI	UW	U0	U
15.4009	21.786	21.786	.0000
13.9062	775.121	115.051	660.0691
12.3348	1043.992	213.110	830.8820
10.7382	1166.201	312.737	853.4641
9.1690	1267.964	410.654	857.3102
7.6117	1365.893	507.828	858.0649
6.0680	1462.388	604.154	858.2336
4.5368	1557.986	699.706	858.2801
3.0158	1652.911	794.614	858.2974
1.5039	1747.263	888.958	858.3049
.0000	1841.107	982.800	858.3071

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 20

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+00 LOAD = 1000.000
SET = .4129

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.3371	.0000	2.9090	1026.765	1001.0000
.1000	13.8712	.3673	3.0951	1159.262	389.0491
.2000	12.3261	.7346	3.3030	1296.709	135.4207
.3000	10.7353	1.1019	3.3058	1437.003	133.5282
.4000	9.1687	1.4692	3.2616	1575.784	167.1294
.5000	7.6119	1.8365	3.2198	1713.957	206.6502
.6000	6.0680	2.2038	3.1844	1851.324	247.3342
.7000	4.5368	2.5711	3.1542	1987.903	288.2724
.8000	3.0158	2.9385	3.1280	2123.839	329.2715
.9000	1.5039	3.3058	3.1049	2259.211	370.2886
1.0000	.0000	3.6731	3.0842	2394.082	411.3138

********** PORE PRESSURES **********

CHI	UW	U0	U
15.3371	25.766	25.765	.0002
13.8712	770.213	117.234	652.9790
12.3261	1161.288	213.652	947.6356
10.7353	1303.474	312.918	990.5563
9.1687	1408.655	410.672	997.9832
7.6119	1507.307	507.816	999.4906
6.0680	1603.990	604.155	999.8347
4.5368	1699.631	699.706	999.9247
3.0158	1794.568	794.614	999.9537
1.5039	1888.923	888.958	999.9648
.0000	1982.768	982.800	999.9678

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 23

1

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-13

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

          TIME =  .80000E+00          LOAD =   1141.333
          SET =      .4721

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

   Y          CHI         Z          E           TOTAL        EFFECTIVE

 .0000      15.2779      .0000      2.8830      1171.795      1142.3340
 .1000      13.8320      .3673      3.0240      1303.045       558.2662
 .2000      12.3120      .7346      3.2446      1438.919       182.2350
 .3000      10.7349     1.1019      3.2934      1578.359       142.2247
 .4000       9.1682     1.4692      3.2594      1717.151       169.0158
 .5000       7.6120     1.8365      3.2193      1855.283       207.1114
 .6000       6.0680     2.2038      3.1843      1992.659       247.4591
 .7000       4.5368     2.5711      3.1542      2129.237       288.3111
 .8000       3.0158     2.9385      3.1280      2265.173       329.2867
 .9000       1.5039     3.3058      3.1049      2400.545       370.2971
1.0000        .0000     3.6731      3.0842      2535.415       411.3203

           ***********  PORE PRESSURES  ***********

   CHI          UW            U0            U

 15.2779      29.461        29.462        -.0005
 13.8320     744.779       119.683       625.0953
 12.3120    1256.684       214.529      1042.1550
 10.7349    1436.135       312.941      1123.1930
  9.1682    1548.135       410.705      1137.4300
  7.6120    1648.172       507.809      1140.3630
  6.0680    1745.200       604.157      1141.0430
  4.5368    1840.926       699.706      1141.2190
  3.0158    1935.886       794.614      1141.2720
  1.5039    2030.248       888.958      1141.2900
   .0000    2124.095       982.800      1141.2950
TIMESTEP SIZE =     .05, ITERATIONS BETWEEN PRINT TIMES =     26
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

          TIME =  .90000E+00          LOAD =   1282.667
          SET =      .5252

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

   Y          CHI         Z          E           TOTAL        EFFECTIVE

 .0000      15.2248      .0000      2.8600      1316.438      1283.6670
 .1000      13.7893      .3673      2.9818      1447.042       691.6189
 .2000      12.2911      .7346      3.1739      1581.557       260.8604
 .3000      10.7347     1.1019      3.2715      1719.707       158.9314
 .4000       9.1672     1.4692      3.2551      1858.548       172.7212
 .5000       7.6118     1.8365      3.2185      1996.632       208.0212
 .6000       6.0679     2.2038      3.1841      2133.996       247.7048
 .7000       4.5368     2.5711      3.1541      2270.569       288.3844
 .8000       3.0158     2.9385      3.1280      2406.507       329.3122
 .9000       1.5039     3.3058      3.1049      2541.878       370.3092
1.0000        .0000     3.6731      3.0842      2676.748       411.3297

           ***********  PORE PRESSURES  ***********
```

```
        CHI          UW            U0            U

      15.2248      32.772        32.772        -.0001
      13.7893     755.423       122.347       633.0759
      12.2911    1320.697       215.834      1104.8630
      10.7347    1560.776       312.956      1247.8200
       9.1672    1685.827       410.769      1275.0580
       7.6118    1788.611       507.825      1280.7860
       6.0679    1886.291       604.161      1282.1310
       4.5368    1982.185       699.706      1282.4790
       3.0158    2077.194       794.615      1282.5800
       1.5039    2171.569       888.958      1282.6110
        .0000    2265.418       982.800      1282.6190
 TIMESTEP SIZE =     .04, ITERATIONS BETWEEN PRINT TIMES =     29
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .10000E+01          LOAD =   1424.000
               SET =      .5798

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z            E            TOTAL        EFFECTIVE

      .0000      15.1702       .0000       2.8394       1461.181      1425.0000
      .1000      13.7425       .3673       2.9487       1591.298       818.1396
      .2000      12.2635       .7346       3.1063       1724.615       367.6158
      .3000      10.7291      1.1019       3.2379       1861.388       188.4772
      .4000       9.1652      1.4692       3.2472       2000.003       179.7861
      .5000       7.6108      1.8365       3.2168       2138.025       209.8060
      .6000       6.0678      2.2038       3.1837       2275.336       248.1897
      .7000       4.5368      2.5711       3.1540       2411.902       288.5275
      .8000       3.0158      2.9385       3.1280       2547.840       329.3592
      .9000       1.5039      3.3058       3.1049       2683.211       370.3285
     1.0000        .0000      3.6731       3.0842       2818.082       411.3431

                 ***********  PORE PRESSURES  ***********

        CHI          UW            U0            U

      15.1702      36.181        36.181        -.0005
      13.7425     773.158       125.270       647.8885
      12.2635    1356.999       217.559      1139.4410
      10.7291    1672.911       313.304      1359.6070
       9.1652    1820.217       410.890      1409.3270
       7.6108    1928.219       507.884      1420.3350
       6.0678    2027.146       604.167      1422.9790
       4.5368    2123.375       699.705      1423.6700
       3.0158    2218.481       794.615      1423.8660
       1.5039    2312.883       888.958      1423.9250
        .0000    2406.739       982.800      1423.9380
 TIMESTEP SIZE =     .03, ITERATIONS BETWEEN PRINT TIMES =     33
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .12500E+01          LOAD =   1530.250
               SET =      .7053

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******
```

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-15

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	15.0447	.0000	2.8252	1575.263	1531.2510
.1000	13.6264	.3673	2.9011	1704.788	1042.0100
.2000	12.1760	.7346	3.0007	1836.325	628.4255
.3000	10.6846	1.1019	3.1237	1970.415	336.5114
.4000	9.1522	1.4692	3.2013	2107.065	227.0332
.5000	7.6058	1.8365	3.2043	2244.591	223.5054
.6000	6.0669	2.2038	3.1805	2381.642	252.2164
.7000	4.5367	2.5711	3.1532	2518.159	289.7565
.8000	3.0157	2.9385	3.1277	2654.095	329.7577
.9000	1.5039	3.3058	3.1048	2789.462	370.4787
1.0000	.0000	3.6731	3.0841	2924.332	411.4383

********** PORE PRESSURES **********

CHI	UW	U0	U
15.0447	44.012	44.013	-.0010
13.6264	662.778	132.510	530.2681
12.1760	1207.900	223.019	984.8809
10.6846	1633.903	316.080	1317.8230
9.1522	1880.032	411.702	1468.3290
7.6058	2021.085	508.200	1512.8850
6.0669	2129.426	604.223	1525.2030
4.5367	2228.403	699.712	1528.6910
3.0157	2324.337	794.620	1529.7180
1.5039	2418.983	888.959	1530.0250
.0000	2512.893	982.800	1530.0930

TIMESTEP SIZE = .03, ITERATIONS BETWEEN PRINT TIMES = 43

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+01 LOAD = 1636.500
SET = .8140

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.9360	.0000	2.8120	1688.292	1637.5010
.1000	13.5250	.3673	2.8736	1817.371	1197.8860
.2000	12.0887	.7346	2.9492	1948.021	815.9849
.3000	10.6220	1.1019	3.0392	2080.569	516.8032
.4000	9.1217	1.4692	3.1271	2215.218	330.8702
.5000	7.5958	1.8365	3.1707	2351.463	265.0743
.6000	6.0634	2.2038	3.1692	2488.115	267.0918
.7000	4.5354	2.5711	3.1497	2624.487	294.9465
.8000	3.0154	2.9385	3.1266	2760.367	331.5914
.9000	1.5038	3.3058	3.1044	2895.717	371.1950
1.0000	.0000	3.6731	3.0839	3030.582	411.8946

********** PORE PRESSURES **********

CHI	UW	U0	U
14.9360	50.791	50.792	-.0012
13.5250	619.484	138.843	480.6417
12.0887	1132.036	228.465	903.5714
10.6220	1563.766	319.985	1243.7810
9.1217	1884.348	413.606	1470.7420
7.5958	2086.389	508.823	1577.5670
6.0634	2221.024	604.447	1616.5770
4.5354	2329.541	699.790	1629.7510

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
        3.0154    2428.775        794.641      1634.1340
        1.5038    2524.521        888.963      1635.5580
         .0000    2618.687        982.800      1635.8870
 TIMESTEP SIZE =     .02, ITERATIONS BETWEEN PRINT TIMES =     55
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .17500E+01          LOAD =   1742.750
               SET =     .9134

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      14.8366      .0000       2.7996       1800.745      1743.7500
     .1000      13.4316      .3673       2.8522       1929.445      1335.2310
     .2000      12.0056      .7346       2.9143       2059.459       974.3738
     .3000      10.5549     1.1019       2.9860       2191.006       676.9160
     .4000       9.0769     1.4692       3.0616       2324.264       461.3376
     .5000       7.5733     1.8365       3.1211       2459.114       341.0568
     .6000       6.0539     2.2038       3.1448       2594.956       302.4043
     .7000       4.5316     2.5711       3.1400       2730.975       309.8801
     .8000       3.0141     2.9385       3.1230       2866.696       337.7489
     .9000       1.5034     3.3058       3.1030       3001.990       373.9418
    1.0000        .0000     3.6731       3.0830       3136.832       413.7742

               ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     14.8366      56.995        56.995         .0005
     13.4316     594.214       144.667      449.5470
     12.0056    1085.085       233.652      851.4325
     10.5549    1514.090       324.171     1189.9180
      9.0769    1862.926       416.401     1446.5250
      7.5733    2118.058       510.224     1607.8340
      6.0539    2292.552       605.037     1687.5150
      4.5316    2421.095       700.028     1721.0670
      3.0141    2528.947       794.720     1734.2260
      1.5034    2628.049       888.987     1739.0620
       .0000    2723.057       982.800     1740.2570
 TIMESTEP SIZE =     .02, ITERATIONS BETWEEN PRINT TIMES =     69
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .20000E+01          LOAD =   1849.000
               SET =    1.0070

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      14.7430      .0000       2.7880       1912.837      1850.0010
     .1000      13.3434      .3673       2.8343       2041.203      1462.4300
     .2000      11.9254      .7346       2.8875       2170.709      1116.1380
     .3000      10.4867     1.1019       2.9478       2301.516       822.0432
     .4000       9.0248     1.4692       3.0122       2433.763       592.6227
     .5000       7.5399     1.8365       3.0715       2567.450       438.7317
     .6000       6.0364     2.2038       3.1101       2702.298       360.5710
     .7000       4.5237     2.5711       3.1218       2837.721       339.8865
```

.8000	3.0108	2.9385	3.1146	2973.152	352.4025
.9000	1.5022	3.3058	3.0990	3108.314	381.6019
1.0000	.0000	3.6731	3.0803	3243.082	419.5007

********** PORE PRESSURES **********

CHI	UW	U0	U
14.7430	62.836	62.837	-.0009
13.3434	578.773	150.174	428.5984
11.9254	1054.572	238.653	815.9186
10.4867	1479.473	328.432	1151.0410
9.0248	1841.141	419.651	1421.4900
7.5399	2128.718	512.309	1616.4090
6.0364	2341.727	606.129	1735.5980
4.5237	2497.835	700.524	1797.3110
3.0108	2620.750	794.927	1825.8230
1.5022	2726.713	889.061	1837.6510
.0000	2823.581	982.800	1840.7810

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 84

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+01 LOAD = 1849.000
SET = 1.0888

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.6612	.0000	2.7880	1917.939	1850.0010
.1000	13.2631	.3673	2.8259	2046.211	1525.8160
.2000	11.8499	.7346	2.8699	2175.422	1220.4070
.3000	10.4194	1.1019	2.9201	2305.712	946.0876
.4000	8.9696	1.4692	2.9749	2437.210	716.4746
.5000	7.4996	1.8365	3.0290	2569.968	544.2539
.6000	6.0111	2.2038	3.0727	2703.875	436.1128
.7000	4.5101	2.5711	3.0965	2838.568	386.4751
.8000	3.0043	2.9385	3.1002	2973.560	379.1423
.9000	1.4997	3.3058	3.0907	3108.475	397.8503
1.0000	.0000	3.6731	3.0742	3243.082	432.6264

********** PORE PRESSURES **********

CHI	UW	U0	U
14.6612	67.938	67.939	-.0009
13.2631	520.395	155.183	365.2121
11.8499	955.015	243.366	711.6494
10.4194	1359.624	332.627	1026.9970
8.9696	1720.735	423.097	1297.6380
7.4996	2025.714	514.827	1510.8870
6.0111	2267.762	607.706	1660.0560
4.5101	2452.093	701.371	1750.7220
3.0043	2594.417	795.334	1799.0830
1.4997	2710.625	889.222	1821.4030
.0000	2810.455	982.800	1827.6550

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 100

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-18

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

TIME = .25000E+01 LOAD = 1849.000
SET = 1.1608

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.5892	.0000	2.7880	1922.433	1850.0010
.1000	13.1919	.3673	2.8213	2050.654	1562.2760
.2000	11.7815	.7346	2.8592	2179.692	1288.6870
.3000	10.3563	1.1019	2.9018	2309.652	1037.9410
.4000	8.9147	1.4692	2.9483	2440.637	819.8752
.5000	7.4557	1.8365	2.9957	2572.704	644.5206
.6000	5.9800	2.2038	3.0381	2705.817	519.7078
.7000	4.4908	2.5711	3.0678	2839.770	447.0762
.8000	2.9939	2.9385	3.0802	2974.208	419.7039
.9000	1.4953	3.3058	3.0772	3108.748	426.1014
1.0000	.0000	3.6731	3.0635	3243.082	456.9423

********** PORE PRESSURES **********

CHI	UW	U0	U
14.5892	72.432	72.433	-.0009
13.1919	488.378	159.626	328.7523
11.7815	891.005	247.635	643.3696
10.3563	1271.711	336.568	935.1436
8.9147	1620.762	426.524	1194.2370
7.4557	1928.183	517.563	1410.6200
5.9800	2186.110	609.648	1576.4610
4.4908	2392.694	702.573	1690.1210
2.9939	2554.504	795.983	1758.5210
1.4953	2682.646	889.495	1793.1520
.0000	2786.139	982.800	1803.3390

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 117
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+01 LOAD = 1849.000
SET = 1.2262

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.5238	.0000	2.7880	1926.512	1850.0010
.1000	13.1271	.3673	2.8178	2054.696	1589.9820
.2000	11.7188	.7346	2.8513	2183.605	1341.3030
.3000	10.2974	1.1019	2.8885	2313.324	1110.6450
.4000	8.8619	1.4692	2.9287	2443.933	905.5368
.5000	7.4112	1.8365	2.9701	2575.481	733.8703
.6000	5.9457	2.2038	3.0089	2707.959	602.7100
.7000	4.4672	2.5711	3.0395	2841.243	516.1638
.8000	2.9799	2.9385	3.0566	2975.081	473.2598
.9000	1.4890	3.3058	3.0586	3109.138	468.4543
1.0000	.0000	3.6731	3.0475	3243.082	495.4172

********** PORE PRESSURES **********

CHI	UW	U0	U
14.5238	76.511	76.512	-.0009
13.1271	464.714	163.667	301.0465
11.7188	842.302	251.549	590.7531

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
      10.2974    1202.679        340.240       862.4391
       8.8619    1538.396        429.820      1108.5760
       7.4112    1841.611        520.340      1321.2710
       5.9457    2105.249        611.790      1493.4590
       4.4672    2325.079        704.046      1621.0330
       2.9799    2501.821        796.856      1704.9650
       1.4890    2640.684        889.885      1750.7990
        .0000    2747.665        982.800      1764.8640
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =    134
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                TIME =  .30000E+01          LOAD =   1849.000
                SET =    1.2863

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y           CHI          Z           E            TOTAL        EFFECTIVE

     .0000      14.4637      .0000       2.7880       1930.266      1850.0010
     .1000      13.0675      .3673       2.8151       2058.419      1612.4490
     .2000      11.6607      .7346       2.8451       2187.226      1384.3360
     .3000      10.2424     1.1019       2.8781       2316.756      1171.0640
     .4000       8.8116     1.4692       2.9134       2447.071       978.7006
     .5000       7.3675     1.8365       2.9498       2578.210       813.7325
     .6000       5.9102     2.2038       2.9844       2710.171       682.4148
     .7000       4.4412     2.5711       3.0132       2842.868       589.6366
     .8000       2.9633     2.9385       3.0315       2976.114       537.5344
     .9000       1.4812     3.3058       3.0361       3109.625       524.9998
    1.0000        .0000     3.6731       3.0273       3243.082       549.0597

                ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     14.4637      80.265        80.266        -.0009
     13.0675     445.970       167.390       278.5792
     11.6607     802.890       255.170       547.7203
     10.2424    1145.692       343.672       802.0206
      8.8116    1468.370       432.958      1035.4120
      7.3675    1764.478       523.069      1241.4080
      5.9102    2027.757       614.003      1413.7540
      4.4412    2253.231       705.671      1547.5610
      2.9633    2438.579       797.888      1640.6910
      1.4812    2584.625       890.371      1694.2540
       .0000    2694.022       982.800      1711.2220
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =    152
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                TIME =  .35000E+01          LOAD =   1849.000
                SET =    1.3942

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y           CHI          Z           E            TOTAL        EFFECTIVE

     .0000      14.3558      .0000       2.7880       1937.001      1850.0010
     .1000      12.9603      .3673       2.8107       2065.106      1648.4610
     .2000      11.5561      .7346       2.8354       2193.755      1454.0100
```

.3000	10.1425	1.1019	2.8620	2322.992	1270.7000
.4000	8.7189	1.4692	2.8898	2452.854	1103.0890
.5000	7.2850	1.8365	2.9180	2583.360	956.1712
.6000	5.8409	2.2038	2.9447	2714.499	835.1880
.7000	4.3877	2.5711	2.9671	2846.207	745.2173
.8000	2.9275	2.9385	2.9821	2978.350	690.5299
.9000	1.4636	3.3058	2.9869	3110.726	673.8679
1.0000	.0000	3.6731	2.9806	3243.082	696.0121

********** PORE PRESSURES **********

CHI	UW	U0	U
14.3558	87.000	87.001	-.0009
12.9603	416.644	174.078	242.5668
11.5561	739.745	261.698	478.0464
10.1425	1052.292	349.907	702.3845
8.7189	1349.765	438.741	911.0237
7.2850	1627.189	528.219	1098.9700
5.8409	1879.311	618.330	1260.9810
4.3877	2100.989	709.009	1391.9800
2.9275	2287.820	800.125	1487.6950
1.4636	2436.858	891.472	1545.3850
.0000	2547.069	982.800	1564.2690

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 188

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+01 LOAD = 1849.000
SET = 1.4886

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.2614	.0000	2.7880	1942.886	1850.0010
.1000	12.8666	.3673	2.8071	2070.951	1679.1200
.2000	11.4646	.7346	2.8275	2199.468	1513.9960
.3000	10.0548	1.1019	2.8489	2328.465	1358.1610
.4000	8.6371	1.4692	2.8707	2457.959	1215.5430
.5000	7.2114	1.8365	2.8921	2587.951	1090.4500
.6000	5.7781	2.2038	2.9117	2718.416	987.4561
.7000	4.3383	2.5711	2.9275	2849.290	911.1356
.8000	2.8936	2.9385	2.9376	2980.465	865.6035
.9000	1.4465	3.3058	2.9403	3111.789	853.9165
1.0000	.0000	3.6731	2.9349	3243.082	877.5088

********** PORE PRESSURES **********

CHI	UW	U0	U
14.2614	92.886	92.886	-.0009
12.8666	391.831	179.923	211.9086
11.4646	685.473	267.412	418.0606
10.0548	970.305	355.381	614.9236
8.6371	1242.417	443.847	798.5700
7.2114	1497.502	532.811	964.6910
5.7781	1730.960	622.247	1108.7130
4.3383	1938.154	712.092	1226.0620
2.8936	2114.861	802.239	1312.6220
1.4465	2257.873	892.536	1365.3370
.0000	2365.573	982.800	1382.7730

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 225

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-21

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+01 LOAD = 1849.000
SET = 1.6406

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.1094	.0000	2.7880	1952.375	1850.0010
.1000	12.7158	.3673	2.8004	2080.365	1736.8430
.2000	11.3175	.7346	2.8132	2208.644	1627.7420
.3000	9.9145	1.1019	2.8259	2337.217	1525.6940
.4000	8.5070	1.4692	2.8382	2466.078	1433.8510
.5000	7.0951	1.8365	2.8493	2595.206	1355.4560
.6000	5.6795	2.2038	2.8584	2724.569	1293.7110
.7000	4.2610	2.5711	2.8650	2854.113	1251.5910
.8000	2.8406	2.9385	2.8681	2983.769	1231.6030
.9000	1.4198	3.3058	2.8675	3113.455	1235.5300
1.0000	.0000	3.6731	2.8630	3243.082	1264.2330

********** PORE PRESSURES **********

CHI	UW	U0	U
14.1094	102.374	102.375	-.0009
12.7158	343.521	189.337	154.1848
11.3175	580.902	276.588	304.3139
9.9145	811.523	364.133	447.3904
8.5070	1032.227	451.965	580.2617
7.0951	1239.750	540.066	699.6845
5.6795	1430.858	628.400	802.4583
4.2610	1602.522	716.916	885.6060
2.8406	1752.166	805.544	946.6219
1.4198	1877.925	894.202	983.7236
.0000	1978.849	982.800	996.0488

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 300
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+01 LOAD = 1849.000
SET = 1.7469

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	14.0031	.0000	2.7880	1959.004	1850.0010
.1000	12.6106	.3673	2.7947	2086.929	1788.2630
.2000	11.2155	.7346	2.8013	2215.007	1729.1980
.3000	9.8181	1.1019	2.8075	2343.233	1675.0740
.4000	8.4185	1.4692	2.8131	2471.596	1628.1460
.5000	7.0171	1.8365	2.8177	2600.076	1590.5990
.6000	5.6141	2.2038	2.8210	2728.646	1564.4560
.7000	4.2103	2.5711	2.8226	2857.274	1551.4720
.8000	2.8062	2.9385	2.8224	2985.918	1553.0540
.9000	1.4025	3.3058	2.8203	3114.536	1570.1520
1.0000	.0000	3.6731	2.8162	3243.082	1603.2240

********** PORE PRESSURES **********

CHI	UW	U0	U
14.0031	109.003	109.004	-.0009
12.6106	298.666	195.901	102.7652
11.2155	485.808	282.951	202.8579
9.8181	668.159	370.148	298.0102
8.4185	843.449	457.483	385.9662
7.0171	1009.476	544.935	464.5413
5.6141	1164.191	632.478	531.7134
4.2103	1305.802	720.077	585.7252
2.8062	1432.865	807.693	625.1716
1.4025	1544.384	895.283	649.1017
.0000	1639.858	982.800	657.0580

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 379

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+01 LOAD = 1849.000
SET = 1.8152

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.9348	.0000	2.7880	1963.269	1850.0010
.1000	12.5430	.3673	2.7904	2091.146	1827.2990
.2000	11.1503	.7346	2.7927	2219.076	1806.2290
.3000	9.7569	1.1019	2.7947	2347.056	1788.3110
.4000	8.3628	1.4692	2.7961	2475.076	1774.9940
.5000	6.9683	1.8365	2.7970	2603.122	1767.6320
.6000	5.5736	2.2038	2.7970	2731.178	1767.4350
.7000	4.1791	2.5711	2.7961	2859.224	1775.4170
.8000	2.7850	2.9385	2.7942	2987.239	1792.3600
.9000	1.3919	3.3058	2.7913	3115.199	1818.7940
1.0000	.0000	3.6731	2.7875	3243.082	1854.9670

********** PORE PRESSURES **********

CHI	UW	U0	U
13.9348	113.268	113.269	-.0009
12.5430	263.846	200.117	63.7287
11.1503	412.847	287.020	125.8271
9.7569	558.746	373.972	184.7739
8.3628	700.082	460.963	239.1190
6.9683	835.490	547.981	287.5087
5.5736	963.742	635.009	328.7336
4.1791	1083.807	722.027	361.7802
2.7850	1194.879	809.013	385.8650
1.3919	1296.405	895.946	400.4595
.0000	1388.115	982.800	405.3148

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 461

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .80000E+01 LOAD = 1849.000
SET = 1.8566

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-23

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.8934	.0000	2.7880	1965.850	1850.0010
.1000	12.5021	.3673	2.7876	2093.695	1853.3940
.2000	11.1110	.7346	2.7872	2221.530	1857.7390
.3000	9.7201	1.1019	2.7865	2349.352	1863.9710
.4000	8.3294	1.4692	2.7856	2477.156	1872.9660
.5000	6.9392	1.8365	2.7842	2604.935	1885.5210
.6000	5.5495	2.2038	2.7825	2732.678	1902.3330
.7000	4.1606	2.5711	2.7803	2860.376	1923.9790
.8000	2.7726	2.9385	2.7775	2988.017	1950.8970
.9000	1.3856	3.3058	2.7743	3115.590	1983.3790
1.0000	.0000	3.6731	2.7705	3243.082	2021.5650

********** PORE PRESSURES **********

CHI	UW	U0	U
13.8934	115.849	115.850	-.0009
12.5021	240.301	202.666	37.6345
11.1110	363.791	289.473	74.3172
9.7201	485.382	376.268	109.1138
8.3294	604.190	463.044	141.1466
6.9392	719.414	549.794	169.6203
5.5495	830.345	636.509	193.8359
4.1606	936.397	723.179	213.2177
2.7726	1037.120	809.792	227.3283
1.3856	1132.211	896.336	235.8745
.0000	1221.517	982.800	238.7170

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 546

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .90000E+01 LOAD = 1849.000
SET = 1.8806

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.8694	.0000	2.7880	1967.351	1850.0010
.1000	12.4784	.3673	2.7859	2095.176	1869.4690
.2000	11.0882	.7346	2.7838	2222.953	1889.4790
.3000	9.6988	1.1019	2.7816	2350.681	1910.5790
.4000	8.3102	1.4692	2.7793	2478.358	1933.2740
.5000	6.9225	1.8365	2.7768	2605.979	1958.0210
.6000	5.5357	2.2038	2.7741	2733.541	1985.2160
.7000	4.1500	2.5711	2.7711	2861.037	2015.1820
.8000	2.7654	2.9385	2.7679	2988.463	2048.1610
.9000	1.3821	3.3058	2.7645	3115.813	2084.3150
1.0000	.0000	3.6731	2.7608	3243.082	2123.7190

********** PORE PRESSURES **********

CHI	UW	U0	U
13.8694	117.350	117.351	-.0009
12.4784	225.706	204.148	21.5587
11.0882	333.474	290.897	42.5771
9.6988	440.102	377.597	62.5052
8.3102	545.084	464.245	80.8388
6.9225	647.958	550.839	97.1193
5.5357	748.325	637.372	110.9530
4.1500	845.856	723.840	122.0153
2.7654	940.302	810.238	130.0641

```
      1.3821    1031.499        896.560        134.9387
       .0000    1119.363        982.800        136.5628
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =    637
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .10000E+02          LOAD =   1849.000
               SET =    1.8943

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y           CHI          Z           E            TOTAL        EFFECTIVE

     .0000      13.8557      .0000       2.7880       1968.203      1850.0010
     .1000      12.4649      .3673       2.7849       2096.016      1878.8990
     .2000      11.0753      .7346       2.7819       2223.760      1908.1000
     .3000       9.6867     1.1019       2.7788       2351.434      1937.9170
     .4000       8.2993     1.4692       2.7757       2479.037      1968.6360
     .5000       6.9130     1.8365       2.7726       2606.569      2000.5140
     .6000       5.5279     2.2038       2.7693       2734.027      2033.7710
     .7000       4.1440     2.5711       2.7660       2861.410      2068.5830
     .8000       2.7614     2.9385       2.7625       2988.715      2105.0920
     .9000       1.3800     3.3058       2.7590       3115.939      2143.3840
    1.0000        .0000     3.6731       2.7553       3243.082      2183.5030

               ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     13.8557     118.202       118.203        -.0009
     12.4649     217.118       204.988       12.1296
     11.0753     315.660       291.704       23.9565
      9.6867     413.517       378.349       35.1677
      8.2993     510.402       464.925       45.4770
      6.9130     606.055       551.428       54.6265
      5.5279     700.257       637.858       62.3983
      4.1440     792.827       724.213       68.6138
      2.7614     883.623       810.490       73.1330
      1.3800     972.555       896.686       75.8694
       .0000    1059.578       982.800       76.7784
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =    732
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .12000E+02          LOAD =   1849.000
               SET =    1.9062

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y           CHI          Z           E            TOTAL        EFFECTIVE

     .0000      13.8438      .0000       2.7880       1968.944      1850.0010
     .1000      12.4532      .3673       2.7840       2096.748      1887.2850
     .2000      11.0640      .7346       2.7802       2224.462      1924.6660
     .3000       9.6762     1.1019       2.7764       2352.088      1962.2370
     .4000       8.2898     1.4692       2.7726       2479.627      2000.0880
     .5000       6.9048     1.8365       2.7689       2607.081      2038.3000
     .6000       5.5212     2.2038       2.7652       2734.449      2076.9340
     .7000       4.1389     2.5711       2.7615       2861.732      2116.0530
     .8000       2.7579     2.9385       2.7579       2988.932      2155.6920
```

```
      .9000      1.3783     3.3058      2.7542      3116.049      2195.8760
     1.0000       .0000     3.6731      2.7506      3243.082      2236.6230

                 ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     13.8438     118.944       118.944       -.0009
     12.4532     209.462       205.720       3.7429
     11.0640     299.795       292.405       7.3899
      9.6762     389.851       379.003      10.8474
      8.2898     479.539       465.514      14.0244
      6.9048     568.781       551.940      16.8411
      5.5212     657.514       638.280      19.2346
      4.1389     745.680       724.535      21.1441
      2.7579     833.241       810.707      22.5336
      1.3783     920.172       896.795      23.3772
       .0000    1006.458       982.800      23.6583
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =    926
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .12500E+02          LOAD =   1849.000
               SET =    1.9075

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      13.8425       .0000      2.7880       1969.028      1850.0010
     .1000      12.4519       .3673      2.7839       2096.831      1888.2490
     .2000      11.0627       .7346      2.7800       2224.541      1926.5660
     .3000       9.6750      1.1019      2.7761       2352.162      1965.0250
     .4000       8.2888      1.4692      2.7723       2479.694      2003.6910
     .5000       6.9039      1.8365      2.7685       2607.138      2042.6240
     .6000       5.5204      2.2038      2.7647       2734.496      2081.8740
     .7000       4.1383      2.5711      2.7610       2861.769      2121.4810
     .8000       2.7575      2.9385      2.7573       2988.957      2161.4780
     .9000       1.3781      3.3058      2.7537       3116.061      2201.8800
    1.0000        .0000      3.6731      2.7501       3243.082      2242.7000

                 ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     13.8425     119.028       119.028       -.0009
     12.4519     208.581       205.802       2.7788
     11.0627     297.975       292.485       5.4905
      9.6750     387.137       379.077       8.0598
      8.2888     476.003       465.581      10.4217
      6.9039     564.515       551.997      12.5171
      5.5204     652.622       638.327      14.2947
      4.1383     740.287       724.572      15.7157
      2.7575     827.479       810.732      16.7470
      1.3781     914.181       896.807      17.3735
       .0000    1000.381       982.800      17.5811
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =    976
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY
```

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-26

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
                TIME =  .15000E+02          LOAD =   1849.000
                SET =    1.9105

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

    .0000       13.8395      .0000       2.7880       1969.216       1850.0010
    .1000       12.4489      .3673       2.7837       2097.015       1890.3990
    .2000       11.0599      .7346       2.7796       2224.718       1930.8140
    .3000        9.6724     1.1019       2.7755       2352.327       1971.2600
    .4000        8.2864     1.4692       2.7715       2479.842       2011.7530
    .5000        6.9018     1.8365       2.7675       2607.267       2052.3070
    .6000        5.5187     2.2038       2.7637       2734.603       2092.9370
    .7000        4.1370     2.5711       2.7599       2861.850       2133.6450
    .8000        2.7566     2.9385       2.7561       2989.012       2174.4390
    .9000        1.3776     3.3058       2.7525       3116.088       2215.3280
   1.0000         .0000     3.6731       2.7489       3243.082       2256.3070

              ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

   13.8395      119.215       119.216       -.0009
   12.4489      206.617       205.987        .6295
   11.0599      293.904       292.662       1.2423
    9.6724      381.066       379.242       1.8240
    8.2864      468.089       465.730       2.3594
    6.9018      554.960       552.126       2.8334
    5.5187      641.666       638.434       3.2319
    4.1370      728.205       724.653       3.5521
    2.7566      814.572       810.786       3.7858
    1.3776      900.761       896.835       3.9258
     .0000      986.774       982.800       3.9745
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   1224
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

                TIME =  .17500E+02          LOAD =   1849.000
                SET =    1.9112

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

    .0000       13.8388      .0000       2.7880       1969.258       1850.0010
    .1000       12.4483      .3673       2.7837       2097.056       1890.8840
    .2000       11.0593      .7346       2.7795       2224.758       1931.7720
    .3000        9.6718     1.1019       2.7753       2352.364       1972.6640
    .4000        8.2859     1.4692       2.7713       2479.875       2013.5680
    .5000        6.9014     1.8365       2.7673       2607.296       2054.4890
    .6000        5.5183     2.2038       2.7634       2734.626       2095.4230
    .7000        4.1367     2.5711       2.7596       2861.868       2136.3760
    .8000        2.7564     2.9385       2.7559       2989.024       2177.3470
    .9000        1.3775     3.3058       2.7522       3116.094       2218.3410
   1.0000         .0000     3.6731       2.7486       3243.082       2259.3590

              ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

   13.8388      119.257       119.258       -.0009
   12.4483      206.173       206.028        .1444
   11.0593      292.985       292.701        .2840
    9.6718      379.700       379.279        .4206
```

```
        8.2859     466.308        465.763          .5447
        6.9014     552.807        552.155          .6515
        5.5183     639.203        638.457          .7456
        4.1367     725.492        724.671          .8209
        2.7564     811.677        810.799          .8786
        1.3775     897.754        896.841          .9128
         .0000     983.722        982.800          .9222
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   1473
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                TIME =  .18000E+02          LOAD =   1849.000
                SET =    1.9112

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z           E            TOTAL        EFFECTIVE

      .0000      13.8388       .0000       2.7880       1969.261      1850.0010
      .1000      12.4482       .3673       2.7837       2097.060      1890.9180
      .2000      11.0592       .7346       2.7795       2224.761      1931.8400
      .3000       9.6718      1.1019       2.7753       2352.366      1972.7690
      .4000       8.2858      1.4692       2.7713       2479.878      2013.7040
      .5000       6.9013      1.8365       2.7673       2607.298      2054.6480
      .6000       5.5183      2.2038       2.7634       2734.628      2095.6080
      .7000       4.1367      2.5711       2.7596       2861.870      2136.5830
      .8000       2.7564      2.9385       2.7559       2989.025      2177.5730
      .9000       1.3775      3.3058       2.7522       3116.095      2218.5770
     1.0000        .0000      3.6731       2.7486       3243.082      2259.5970

                ***********  PORE PRESSURES  ***********

       CHI          UW            U0            U

      13.8388     119.260       119.261       -.0009
      12.4482     206.142       206.032        .1101
      11.0592     292.921       292.704        .2162
       9.6718     379.597       379.282        .3155
       8.2858     466.174       465.765        .4083
       6.9013     552.650       552.157        .4923
       5.5183     639.020       638.459        .5605
       4.1367     725.287       724.673        .6141
       2.7564     811.451       810.800        .6518
       1.3775     897.518       896.842        .6768
        .0000     983.484       982.800        .6844
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   1523
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                TIME =  .20000E+02          LOAD =   1849.000
                SET =    1.9113

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z           E            TOTAL        EFFECTIVE

      .0000      13.8387       .0000       2.7880       1969.267      1850.0010
      .1000      12.4481       .3673       2.7837       2097.066      1890.9890
      .2000      11.0591       .7346       2.7794       2224.767      1931.9800
      .3000       9.6717      1.1019       2.7753       2352.372      1972.9770
```

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-28

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

.4000	8.2857	1.4692	2.7713	2479.883	2013.9770
.5000	6.9013	1.8365	2.7673	2607.303	2054.9820
.6000	5.5182	2.2038	2.7634	2734.632	2095.9910
.7000	4.1366	2.5711	2.7596	2861.873	2137.0070
.8000	2.7564	2.9385	2.7558	2989.027	2178.0240
.9000	1.3775	3.3058	2.7521	3116.096	2219.0470
1.0000	.0000	3.6731	2.7485	3243.082	2260.0700

********** PORE PRESSURES **********

CHI	UW	U0	U
13.8387	119.266	119.267	-.0009
12.4481	206.077	206.038	.0390
11.0591	292.787	292.711	.0760
9.6717	379.395	379.288	.1079
8.2857	465.906	465.771	.1353
6.9013	552.321	552.162	.1591
5.5182	638.640	638.463	.1775
4.1366	724.865	724.675	.1900
2.7564	811.003	810.802	.2011
1.3775	897.049	896.843	.2068
.0000	983.011	982.800	.2113

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1723

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+02 LOAD = 1849.000
SET = 1.9113

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.8387	.0000	2.7880	1969.268	1850.0010
.1000	12.4481	.3673	2.7837	2097.066	1890.9940
.2000	11.0591	.7346	2.7794	2224.767	1931.9900
.3000	9.6717	1.1019	2.7753	2352.372	1972.9910
.4000	8.2857	1.4692	2.7712	2479.884	2013.9970
.5000	6.9012	1.8365	2.7673	2607.303	2055.0070
.6000	5.5182	2.2038	2.7634	2734.632	2096.0190
.7000	4.1366	2.5711	2.7596	2861.873	2137.0360
.8000	2.7564	2.9385	2.7558	2989.027	2178.0560
.9000	1.3775	3.3058	2.7521	3116.096	2219.0790
1.0000	.0000	3.6731	2.7485	3243.082	2260.1060

********** PORE PRESSURES **********

CHI	UW	U0	U
13.8387	119.267	119.268	-.0009
12.4481	206.073	206.038	.0345
11.0591	292.778	292.711	.0666
9.6717	379.381	379.288	.0935
8.2857	465.887	465.771	.1159
6.9012	552.296	552.162	.1342
5.5182	638.613	638.463	.1497
4.1366	724.837	724.676	.1615
2.7564	810.971	810.802	.1696
1.3775	897.017	896.843	.1746
.0000	982.976	982.800	.1756

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1973

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-29

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

          TIME =  .24000E+02          LOAD =   1849.000
          SET =    1.9113

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

    Y            CHI          Z           E            TOTAL        EFFECTIVE

   .0000       13.8387      .0000       2.7880       1969.268      1850.0010
   .1000       12.4481      .3673       2.7837       2097.066      1890.9940
   .2000       11.0591      .7346       2.7794       2224.767      1931.9900
   .3000        9.6717     1.1019       2.7753       2352.372      1972.9910
   .4000        8.2857     1.4692       2.7712       2479.884      2013.9970
   .5000        6.9012     1.8365       2.7673       2607.303      2055.0070
   .6000        5.5182     2.2038       2.7634       2734.632      2096.0190
   .7000        4.1366     2.5711       2.7596       2861.873      2137.0360
   .8000        2.7564     2.9385       2.7558       2989.027      2178.0560
   .9000        1.3775     3.3058       2.7521       3116.096      2219.0790
  1.0000         .0000     3.6731       2.7485       3243.082      2260.1060

            ***********  PORE PRESSURES  ***********

    CHI          UW            U0            U

  13.8387      119.267       119.268      -.0009
  12.4481      206.073       206.038       .0345
  11.0591      292.778       292.711       .0666
   9.6717      379.381       379.288       .0935
   8.2857      465.887       465.771       .1159
   6.9012      552.296       552.162       .1342
   5.5182      638.613       638.463       .1497
   4.1366      724.837       724.676       .1615
   2.7564      810.971       810.802       .1696
   1.3775      897.017       896.843       .1746
    .0000      982.976       982.800       .1756
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   2123
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

          TIME =  .25000E+02          LOAD =   2353.000
          SET =    1.9750

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

    Y            CHI          Z           E            TOTAL        EFFECTIVE

   .0000       13.7750      .0000       2.7405       2477.242      2354.0000
   .1000       12.4000      .3673       2.7460       2604.068      2289.7720
   .2000       11.0233      .7346       2.7500       2731.002      2243.6800
   .3000        9.6454     1.1019       2.7526       2858.012      2213.8560
   .4000        8.2667     1.4692       2.7540       2985.068      2198.3540
   .5000        6.8878     1.8365       2.7543       3112.143      2195.2730
   .6000        5.5089     2.2038       2.7536       3239.212      2202.8550
   .7000        4.1305     2.5711       2.7521       3366.257      2219.5760
   .8000        2.7527     2.9385       2.7499       3493.259      2244.1880
   .9000        1.3758     3.3058       2.7472       3620.205      2275.7680
  1.0000         .0000     3.6731       2.7439       3747.082      2313.7280

            ***********  PORE PRESSURES  ***********

    CHI          UW            U0            U
```

```
      13.7750     123.242        123.242          .0002
      12.4000     314.296        209.040       105.2564
      11.0233     487.322        294.946       192.3759
       9.6454     644.156        380.928       263.2282
       8.2667     786.713        466.955       319.7581
       6.8878     916.869        553.002       363.8676
       5.5089    1036.357        639.043       397.3135
       4.1305    1146.681        725.060       421.6214
       2.7527    1249.071        811.034       438.0370
       1.3758    1344.437        896.951       447.4858
         .0000   1433.353        982.800       450.5533
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =    2223
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .26000E+02          LOAD =   2857.000
               SET =    2.0805

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z           E            TOTAL        EFFECTIVE

      .0000      13.6695      .0000       2.7023       2987.826      2858.0000
      .1000      12.3083      .3673       2.7091       3113.791      2760.3110
      .2000      10.9448      .7346       2.7150       3239.902      2679.4030
      .3000       9.5793     1.1019       2.7198       3366.135      2614.8560
      .4000       8.2123     1.4692       2.7235       3492.466      2566.1400
      .5000       6.8441     1.8365       2.7261       3618.868      2532.6760
      .6000       5.4752     2.2038       2.7276       3745.317      2513.8680
      .7000       4.1059     2.5711       2.7279       3871.788      2509.1330
      .8000       2.7367     2.9385       2.7273       3998.254      2517.9510
      .9000       1.3680     3.3058       2.7255       4124.693      2539.8930
     1.0000         .0000     3.6731       2.7229       4251.082      2574.6260

                ***********  PORE PRESSURES  ***********

       CHI           UW            U0            U

      13.6695     129.826       129.826          .0000
      12.3083     353.481       214.763       138.7176
      10.9448     560.499       299.846       260.6530
       9.5793     751.279       385.050       366.2287
       8.2123     926.325       470.353       455.9725
       6.8441    1086.192       555.728       530.4645
       5.4752    1231.449       641.149       590.3008
       4.1059    1362.655       726.591       636.0645
       2.7367    1480.303       812.029       668.2741
       1.3680    1584.801       897.440       687.3608
         .0000   1676.455       982.800       693.6551
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =    2326
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .27500E+02          LOAD =   2857.000
               SET =    2.1645

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z           E            TOTAL        EFFECTIVE
```

.0000	13.5855	.0000	2.7023	2993.068	2858.0000
.1000	12.2256	.3673	2.7020	3118.949	2861.6690
.2000	10.8659	.7346	2.7017	3244.825	2866.2790
.3000	9.5063	1.1019	2.7013	3370.691	2872.7380
.4000	8.1469	1.4692	2.7007	3496.546	2881.9140
.5000	6.7878	1.8365	2.6998	3622.384	2894.5990
.6000	5.4290	2.2038	2.6986	3748.198	2911.4840
.7000	4.0707	2.5711	2.6972	3873.983	2933.1540
.8000	2.7131	2.9385	2.6954	3999.730	2960.0640
.9000	1.3561	3.3058	2.6932	4125.433	2992.5180
1.0000	.0000	3.6731	2.6907	4251.082	3030.6820

********** PORE PRESSURES **********

CHI	UW	U0	U
13.5855	135.068	135.068	.0000
12.2256	257.281	219.921	37.3595
10.8659	378.546	304.768	73.7775
9.5063	497.953	389.607	108.3464
8.1469	614.632	474.433	140.1988
6.7878	727.785	559.243	168.5417
5.4290	836.714	644.029	192.6846
4.0707	940.829	728.786	212.0433
2.7131	1039.667	813.505	226.1615
1.3561	1132.915	898.179	234.7356
.0000	1220.400	982.800	237.5999

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2505

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .28000E+02 LOAD = 2857.000
SET = 2.1767

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.5733	.0000	2.7023	2993.824	2858.0000
.1000	12.2137	.3673	2.7012	3119.696	2873.8860
.2000	10.8544	.7346	2.7001	3245.542	2890.3950
.3000	9.4955	1.1019	2.6989	3371.363	2908.1560
.4000	8.1372	1.4692	2.6975	3497.154	2927.7560
.5000	6.7793	1.8365	2.6961	3622.913	2949.7210
.6000	5.4220	2.2038	2.6944	3748.636	2974.5250
.7000	4.0653	2.5711	2.6926	3874.320	3002.5490
.8000	2.7094	2.9385	2.6905	3999.958	3034.0910
.9000	1.3543	3.3058	2.6882	4125.547	3069.3620
1.0000	.0000	3.6731	2.6857	4251.082	3108.4690

********** PORE PRESSURES **********

CHI	UW	U0	U
13.5733	135.824	135.824	.0000
12.2137	245.810	220.668	25.1424
10.8544	355.148	305.486	49.6615
9.4955	463.206	390.278	72.9280
8.1372	569.398	475.041	94.3568
6.7793	673.192	559.772	113.4193
5.4220	774.111	644.467	129.6438
4.0653	871.771	729.123	142.6485
2.7094	965.867	813.733	152.1342
1.3543	1056.185	898.294	157.8914

```
        .0000    1142.613        982.800        159.8131
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   2570
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .30000E+02          LOAD =   2857.000
               SET =    2.1962

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z           E            TOTAL        EFFECTIVE

      .0000      13.5538      .0000       2.7023       2995.042      2858.0000
      .1000      12.1944      .3673       2.6998       3120.898      2894.1190
      .2000      10.8359      .7346       2.6974       3246.698      2930.3540
      .3000       9.4782     1.1019       2.6949       3372.442      2966.8420
      .4000       8.1215     1.4692       2.6925       3498.130      3003.6930
      .5000       6.7657     1.8365       2.6901       3623.762      3041.0060
      .6000       5.4107     2.2038       2.6876       3749.339      3078.8720
      .7000       4.0567     2.5711       2.6852       3874.859      3117.3710
      .8000       2.7036     2.9385       2.6827       4000.323      3156.5540
      .9000       1.3513     3.3058       2.6802       4125.731      3196.4660
     1.0000        .0000     3.6731       2.6778       4251.082      3237.1210

                ***********  PORE PRESSURES  ***********

       CHI          UW            U0             U

      13.5538     137.042       137.042         .0000
      12.1944     226.779       221.870        4.9090
      10.8359     316.344       306.642        9.7018
       9.4782     405.600       391.357       14.2424
       8.1215     494.437       476.017       18.4193
       6.7657     582.756       560.621       22.1349
       5.4107     670.467       645.170       25.2974
       4.0567     757.488       729.662       27.8263
       2.7036     843.769       814.098       29.6713
       1.3513     929.265       898.477       30.7878
        .0000    1013.961       982.800       31.1607
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   2835
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .32000E+02          LOAD =   2857.000
               SET =    2.1999

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z           E            TOTAL        EFFECTIVE

      .0000      13.5501      .0000       2.7023       2995.277      2858.0000
      .1000      12.1907      .3673       2.6996       3121.130      2898.0900
      .2000      10.8323      .7346       2.6968       3246.920      2938.2030
      .3000       9.4749     1.1019       2.6942       3372.649      2978.3620
      .4000       8.1185     1.4692       2.6915       3498.317      3018.5910
      .5000       6.7631     1.8365       2.6889       3623.925      3058.9080
      .6000       5.4086     2.2038       2.6863       3749.473      3099.3440
      .7000       4.0550     2.5711       2.6838       3874.962      3139.8920
      .8000       2.7024     2.9385       2.6812       4000.393      3180.5710
      .9000       1.3508     3.3058       2.6787       4125.766      3221.3860
```

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-33

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
     1.0000        .0000      3.6731       2.6762       4251.082      3262.3470

                 ***********  PORE PRESSURES  ***********

       CHI          UW            U0             U

     13.5501     137.277       137.277          .0000
     12.1907     223.039       222.102          .9378
     10.8323     308.718       306.864         1.8537
      9.4749     394.288       391.565         2.7229
      8.1185     479.726       476.205         3.5218
      6.7631     565.017       560.784         4.2326
      5.4086     650.129       645.304         4.8249
      4.0550     735.070       729.765         5.3048
      2.7024     819.822       814.168         5.6545
      1.3508     904.380       898.513         5.8669
       .0000     988.735       982.800         5.9347
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   3109
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .34000E+02          LOAD =   2857.000
               SET =    2.2007

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y           CHI          Z           E            TOTAL        EFFECTIVE

      .0000      13.5493      .0000       2.7023       2995.321      2858.0000
      .1000      12.1900      .3673       2.6995       3121.174      2898.8440
      .2000      10.8316      .7346       2.6967       3246.962      2939.6960
      .3000       9.4743     1.1019       2.6940       3372.688      2980.5580
      .4000       8.1179     1.4692       2.6913       3498.353      3021.4310
      .5000       6.7626     1.8365       2.6887       3623.956      3062.3200
      .6000       5.4082     2.2038       2.6861       3749.499      3103.2320
      .7000       4.0547     2.5711       2.6835       3874.982      3144.1670
      .8000       2.7022     2.9385       2.6809       4000.406      3185.1280
      .9000       1.3507     3.3058       2.6784       4125.772      3226.1150
     1.0000        .0000     3.6731       2.6759       4251.082      3267.1280

                 ***********  PORE PRESSURES  ***********

       CHI          UW            U0             U

     13.5493     137.321       137.321          .0000
     12.1900     222.329       222.145          .1837
     10.8316     307.266       306.906          .3600
      9.4743     392.131       391.604          .5268
      8.1179     476.922       476.240          .6817
      6.7626     561.636       560.815          .8210
      5.4082     646.266       645.330          .9365
      4.0547     730.815       729.785         1.0306
      2.7022     815.279       814.181         1.0976
      1.3507     899.657       898.519         1.1382
       .0000     983.954       982.800         1.1539
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   3384
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .35000E+02          LOAD =   2857.000
```

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
                SET =     2.2008

 ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

    .0000       13.5492      .0000       2.7023       2995.327       2858.0000
    .1000       12.1899      .3673       2.6995       3121.179       2898.9390
    .2000       10.8315      .7346       2.6967       3246.968       2939.8880
    .3000        9.4742     1.1019       2.6940       3372.694       2980.8390
    .4000        8.1179     1.4692       2.6913       3498.357       3021.8000
    .5000        6.7625     1.8365       2.6887       3623.960       3062.7680
    .6000        5.4081     2.2038       2.6860       3749.502       3103.7470
    .7000        4.0547     2.5711       2.6835       3874.984       3144.7330
    .8000        2.7022     2.9385       2.6809       4000.408       3185.7290
    .9000        1.3506     3.3058       2.6784       4125.773       3226.7360
   1.0000          .0000     3.6731       2.6759       4251.082       3267.7600

                ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

    13.5492      137.327       137.327        .0000
    12.1899      222.240       222.151        .0889
    10.8315      307.079       306.912        .1679
     9.4742      391.855       391.609        .2456
     8.1179      476.557       476.245        .3126
     6.7625      561.192       560.819        .3725
     5.4081      645.755       645.333        .4219
     4.0547      730.251       729.787        .4637
     2.7022      814.679       814.183        .4960
     1.3506      899.037       898.520        .5173
       .0000     983.321       982.800        .5211
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   3522
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                TIME =  .38000E+02          LOAD =   2857.000
                SET =     2.2008

 ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

    .0000       13.5492      .0000       2.7023       2995.329       2858.0000
    .1000       12.1899      .3673       2.6995       3121.181       2898.9710
    .2000       10.8315      .7346       2.6967       3246.970       2939.9490
    .3000        9.4742     1.1019       2.6940       3372.695       2980.9330
    .4000        8.1178     1.4692       2.6913       3498.359       3021.9210
    .5000        6.7625     1.8365       2.6887       3623.961       3062.9170
    .6000        5.4081     2.2038       2.6860       3749.503       3103.9200
    .7000        4.0547     2.5711       2.6835       3874.985       3144.9270
    .8000        2.7022     2.9385       2.6809       4000.409       3185.9410
    .9000        1.3506     3.3058       2.6784       4125.774       3226.9620
   1.0000          .0000     3.6731       2.6759       4251.082       3267.9900

                ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

    13.5492      137.329       137.329        .0000
    12.1899      222.210       222.153        .0572
    10.8315      307.021       306.913        .1073
     9.4742      391.763       391.611        .1518
     8.1178      476.438       476.246        .1917
```

```
        6.7625      561.045        560.820          .2243
        5.4081      645.583        645.334          .2493
        4.0547      730.058        729.788          .2696
        2.7022      814.467        814.183          .2841
        1.3506      898.811        898.520          .2910
         .0000      983.092        982.800          .2918
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   3935
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .40000E+02          LOAD =   2857.000
               SET =    2.2008

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      13.5492      .0000       2.7023       2995.329      2858.0000
     .1000      12.1899      .3673       2.6995       3121.181      2898.9710
     .2000      10.8315      .7346       2.6967       3246.970      2939.9490
     .3000       9.4742     1.1019       2.6940       3372.695      2980.9330
     .4000       8.1178     1.4692       2.6913       3498.359      3021.9210
     .5000       6.7625     1.8365       2.6887       3623.961      3062.9170
     .6000       5.4081     2.2038       2.6860       3749.503      3103.9200
     .7000       4.0547     2.5711       2.6835       3874.985      3144.9270
     .8000       2.7022     2.9385       2.6809       4000.409      3185.9410
     .9000       1.3506     3.3058       2.6784       4125.774      3226.9620
    1.0000        .0000     3.6731       2.6759       4251.082      3267.9900

               ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     13.5492     137.329       137.329        .0000
     12.1899     222.210       222.153        .0572
     10.8315     307.021       306.913        .1073
      9.4742     391.763       391.611        .1518
      8.1178     476.438       476.246        .1917
      6.7625     561.045       560.820        .2243
      5.4081     645.583       645.334        .2493
      4.0547     730.058       729.788        .2696
      2.7022     814.467       814.183        .2841
      1.3506     898.811       898.520        .2910
       .0000     983.092       982.800        .2918
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   4211
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .45000E+02          LOAD =   2857.000
               SET =    2.2008

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      13.5492      .0000       2.7023       2995.329      2858.0000
     .1000      12.1899      .3673       2.6995       3121.181      2898.9710
     .2000      10.8315      .7346       2.6967       3246.970      2939.9490
     .3000       9.4742     1.1019       2.6940       3372.695      2980.9330
     .4000       8.1178     1.4692       2.6913       3498.359      3021.9210
```

.5000	6.7625	1.8365	2.6887	3623.961	3062.9170
.6000	5.4081	2.2038	2.6860	3749.503	3103.9200
.7000	4.0547	2.5711	2.6835	3874.985	3144.9270
.8000	2.7022	2.9385	2.6809	4000.409	3185.9410
.9000	1.3506	3.3058	2.6784	4125.774	3226.9620
1.0000	.0000	3.6731	2.6759	4251.082	3267.9900

********** PORE PRESSURES **********

CHI	UW	U0	U
13.5492	137.329	137.329	.0000
12.1899	222.210	222.153	.0572
10.8315	307.021	306.913	.1073
9.4742	391.763	391.611	.1518
8.1178	476.438	476.246	.1917
6.7625	561.045	560.820	.2243
5.4081	645.583	645.334	.2493
4.0547	730.058	729.788	.2696
2.7022	814.467	814.183	.2841
1.3506	898.811	898.520	.2910
.0000	983.092	982.800	.2918

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 4900

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+02 LOAD = 2857.000
SET = 2.2008

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.5492	.0000	2.7023	2995.329	2858.0000
.1000	12.1899	.3673	2.6995	3121.181	2898.9710
.2000	10.8315	.7346	2.6967	3246.970	2939.9490
.3000	9.4742	1.1019	2.6940	3372.695	2980.9330
.4000	8.1178	1.4692	2.6913	3498.359	3021.9210
.5000	6.7625	1.8365	2.6887	3623.961	3062.9170
.6000	5.4081	2.2038	2.6860	3749.503	3103.9200
.7000	4.0547	2.5711	2.6835	3874.985	3144.9270
.8000	2.7022	2.9385	2.6809	4000.409	3185.9410
.9000	1.3506	3.3058	2.6784	4125.774	3226.9620
1.0000	.0000	3.6731	2.6759	4251.082	3267.9900

********** PORE PRESSURES **********

CHI	UW	U0	U
13.5492	137.329	137.329	.0000
12.1899	222.210	222.153	.0572
10.8315	307.021	306.913	.1073
9.4742	391.763	391.611	.1518
8.1178	476.438	476.246	.1917
6.7625	561.045	560.820	.2243
5.4081	645.583	645.334	.2493
4.0547	730.058	729.788	.2696
2.7022	814.467	814.183	.2841
1.3506	898.811	898.520	.2910
.0000	983.092	982.800	.2918

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 5589

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

CALCULATION SHEET

PROJECT FMC – Phase IV JOB NO. 24230-027 CALC. NO. 24230-027-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-37

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

          TIME =  .55000E+02          LOAD =   2857.000
          SET =    2.2008

******** COORDINATES *********     VOID RATIO     ****** STRESSES *******

   Y          CHI         Z          E            TOTAL        EFFECTIVE

  .0000     13.5492      .0000     2.7023       2995.329      2858.0000
  .1000     12.1899      .3673     2.6995       3121.181      2898.9710
  .2000     10.8315      .7346     2.6967       3246.970      2939.9490
  .3000      9.4742     1.1019     2.6940       3372.695      2980.9330
  .4000      8.1178     1.4692     2.6913       3498.359      3021.9210
  .5000      6.7625     1.8365     2.6887       3623.961      3062.9170
  .6000      5.4081     2.2038     2.6860       3749.503      3103.9200
  .7000      4.0547     2.5711     2.6835       3874.985      3144.9270
  .8000      2.7022     2.9385     2.6809       4000.409      3185.9410
  .9000      1.3506     3.3058     2.6784       4125.774      3226.9620
 1.0000       .0000     3.6731     2.6759       4251.082      3267.9900

            *********** PORE PRESSURES ***********

   CHI          UW            U0            U

  13.5492     137.329       137.329       .0000
  12.1899     222.210       222.153       .0572
  10.8315     307.021       306.913       .1073
   9.4742     391.763       391.611       .1518
   8.1178     476.438       476.246       .1917
   6.7625     561.045       560.820       .2243
   5.4081     645.583       645.334       .2493
   4.0547     730.058       729.788       .2696
   2.7022     814.467       814.183       .2841
   1.3506     898.811       898.520       .2910
    .0000     983.092       982.800       .2918
TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   6278
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

          TIME =  .60000E+02          LOAD =   2857.000
          SET =    2.2008

******** COORDINATES *********     VOID RATIO     ****** STRESSES *******

   Y          CHI         Z          E            TOTAL        EFFECTIVE

  .0000     13.5492      .0000     2.7023       2995.329      2858.0000
  .1000     12.1899      .3673     2.6995       3121.181      2898.9710
  .2000     10.8315      .7346     2.6967       3246.970      2939.9490
  .3000      9.4742     1.1019     2.6940       3372.695      2980.9330
  .4000      8.1178     1.4692     2.6913       3498.359      3021.9210
  .5000      6.7625     1.8365     2.6887       3623.961      3062.9170
  .6000      5.4081     2.2038     2.6860       3749.503      3103.9200
  .7000      4.0547     2.5711     2.6835       3874.985      3144.9270
  .8000      2.7022     2.9385     2.6809       4000.409      3185.9410
  .9000      1.3506     3.3058     2.6784       4125.774      3226.9620
 1.0000       .0000     3.6731     2.6759       4251.082      3267.9900

            *********** PORE PRESSURES ***********

   CHI          UW            U0            U
```

```
      13.5492     137.329        137.329          .0000
      12.1899     222.210        222.153          .0572
      10.8315     307.021        306.913          .1073
       9.4742     391.763        391.611          .1518
       8.1178     476.438        476.246          .1917
       6.7625     561.045        560.820          .2243
       5.4081     645.583        645.334          .2493
       4.0547     730.058        729.788          .2696
       2.7022     814.467        814.183          .2841
       1.3506     898.811        898.520          .2910
        .0000     983.092        982.800          .2918
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   6967
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****JTC 5/6/02, Pond 11S, 15.75 feet of sludge. 500-yr

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                          ************************
                          *                      *
                          *  FUNCTIONS OF TIME   *
                          *                      *
                          ************************
```

TIME	EAV	TOTAV	EFFAV	SET	DEG
.0000E+00	.3288E+01	709.682	206.1408	.0000	.0000
.1500E+00	.3248E+01	934.804	214.7944	.1484	.0674
.2000E+00	.3243E+01	1009.871	218.0230	.1650	.0750
.2250E+00	.3241E+01	1044.287	219.6437	.1735	.0788
.2500E+00	.3238E+01	1078.706	221.3360	.1822	.0828
.2750E+00	.3236E+01	1113.130	223.1099	.1912	.0869
.3000E+00	.3233E+01	1147.557	224.9782	.2005	.0911
.3500E+00	.3228E+01	1216.420	229.0072	.2200	.1000
.4000E+00	.3222E+01	1285.301	233.6123	.2413	.1096
.5000E+00	.3209E+01	1427.290	245.6531	.2906	.1320
.6000E+00	.3193E+01	1569.367	263.7913	.3491	.1586
.7000E+00	.3176E+01	1711.517	290.7260	.4129	.1876
.8000E+00	.3159E+01	1853.363	322.4830	.4721	.2145
.9000E+00	.3145E+01	1995.257	352.8418	.5252	.2386
.1000E+01	.3130E+01	2137.271	386.2454	.5798	.2635
.1250E+01	.3096E+01	2245.584	462.2201	.7053	.3205
.1500E+01	.3066E+01	2354.025	537.4698	.8140	.3699
.1750E+01	.3039E+01	2462.615	615.2452	.9134	.4150
.2000E+01	.3014E+01	2571.353	696.3914	1.0070	.4576
.2250E+01	.2992E+01	2573.896	766.2944	1.0888	.4947
.2500E+01	.2972E+01	2576.411	829.1517	1.1608	.5274
.2750E+01	.2954E+01	2578.876	888.9167	1.2262	.5571
.3000E+01	.2938E+01	2581.268	947.0853	1.2863	.5845
.3500E+01	.2908E+01	2585.752	1062.9770	1.3942	.6335
.4000E+01	.2883E+01	2589.746	1182.1280	1.4886	.6764
.5000E+01	.2841E+01	2596.100	1423.6170	1.6406	.7455
.6000E+01	.2812E+01	2600.421	1636.8390	1.7469	.7937
.7000E+01	.2794E+01	2603.149	1796.5610	1.8152	.8248
.8000E+01	.2783E+01	2604.783	1902.6800	1.8566	.8436
.9000E+01	.2776E+01	2605.727	1967.8750	1.8806	.8545
.1000E+02	.2772E+01	2606.261	2006.0630	1.8943	.8607
.1200E+02	.2769E+01	2606.725	2040.0130	1.9062	.8661
.1250E+02	.2769E+01	2606.778	2043.8990	1.9075	.8667
.1500E+02	.2768E+01	2606.895	2052.5980	1.9105	.8681
.1750E+02	.2768E+01	2606.921	2054.5530	1.9112	.8684
.1800E+02	.2768E+01	2606.923	2054.7010	1.9112	.8684
.2000E+02	.2768E+01	2606.927	2055.0010	1.9113	.8685
.2250E+02	.2768E+01	2606.927	2055.0220	1.9113	.8685
.2400E+02	.2768E+01	2606.927	2055.0220	1.9113	.8685
.2500E+02	.2750E+01	3112.138	2240.7620	1.9750	.8974
.2600E+02	.2722E+01	3619.063	2593.8280	2.0805	.9454
.2750E+02	.2699E+01	3622.283	2911.5630	2.1645	.9835

.2800E+02	.2695E+01	3622.761	2961.1560	2.1767	.9890
.3000E+02	.2690E+01	3623.529	3043.2430	2.1962	.9979
.3200E+02	.2689E+01	3623.677	3059.3440	2.1999	.9996
.3400E+02	.2689E+01	3623.704	3062.4040	2.2007	.9999
.3500E+02	.2689E+01	3623.708	3062.8050	2.2008	1.0000
.3800E+02	.2689E+01	3623.710	3062.9430	2.2008	1.0000
.4000E+02	.2689E+01	3623.710	3062.9430	2.2008	1.0000
.4500E+02	.2689E+01	3623.710	3062.9430	2.2008	1.0000
.5000E+02	.2689E+01	3623.710	3062.9430	2.2008	1.0000
.5500E+02	.2689E+01	3623.710	3062.9430	2.2008	1.0000
.6000E+02	.2689E+01	3623.710	3062.9430	2.2008	1.0000

TIME	UWAV	U0AV	UAV
.0000E+00	503.5412	503.5412	-.0001
.1500E+00	720.0093	503.6629	216.3464
.2000E+00	791.8481	503.7303	288.1178
.2250E+00	824.6432	503.7711	320.8721
.2500E+00	857.3704	503.8156	353.5548
.2750E+00	890.0197	503.8638	386.1559
.3000E+00	922.5786	503.9160	418.6626
.3500E+00	987.4130	504.0294	483.3836
.4000E+00	1051.6890	504.1602	547.5285
.5000E+00	1181.6360	504.4820	677.1544
.6000E+00	1305.5750	504.8924	800.6829
.7000E+00	1420.7910	505.3761	915.4149
.8000E+00	1530.8800	505.8888	1024.9910
.9000E+00	1642.4150	506.4498	1135.9660
.1000E+01	1751.0260	507.1309	1243.8960
.1250E+01	1783.3640	509.1929	1274.1710
.1500E+01	1816.5550	511.3840	1305.1710
.1750E+01	1847.3700	513.7241	1333.6460
.2000E+01	1874.9610	516.2119	1358.7490
.2250E+01	1807.6020	518.7556	1288.8460
.2500E+01	1747.2600	521.2704	1225.9890
.2750E+01	1689.9590	523.7351	1166.2240
.3000E+01	1634.1820	526.1266	1108.0560
.3500E+01	1522.7750	530.6111	992.1636
.4000E+01	1407.6180	534.6049	873.0130
.5000E+01	1172.4830	540.9592	631.5239
.6000E+01	963.5813	545.2796	418.3017
.7000E+01	806.5886	548.0084	258.5803
.8000E+01	702.1026	549.6421	152.4605
.9000E+01	637.8523	550.5863	87.2659
.1000E+02	600.1984	551.1205	49.0778
.1200E+02	566.7122	551.5844	15.1278
.1250E+02	562.8790	551.6367	11.2423
.1500E+02	554.2961	551.7538	2.5424
.1750E+02	552.3675	551.7799	.5876
.1800E+02	552.2217	551.7820	.4397
.2000E+02	551.9260	551.7860	.1400
.2250E+02	551.9053	551.7863	.1190
.2400E+02	551.9053	551.7863	.1190
.2500E+02	871.3760	552.9973	318.3787
.2600E+02	1025.2350	555.9222	469.3134
.2750E+02	710.7212	559.1428	151.5784
.2800E+02	661.6047	559.6206	101.9841
.3000E+02	580.2864	560.3883	19.8981
.3200E+02	564.3325	560.5358	3.7968
.3400E+02	561.3005	560.5636	.7369
.3500E+02	560.9030	560.5673	.3357
.3800E+02	560.7662	560.5685	.1977
.4000E+02	560.7662	560.5685	.1977
.4500E+02	560.7662	560.5685	.1977
.5000E+02	560.7662	560.5685	.1977
.5500E+02	560.7662	560.5685	.1977
.6000E+02	560.7662	560.5685	.1977

Appendix N

APPENDIX N

VENDOR INFORMATION AND LABORATORY DATA ON LINER COMPATIBILITY

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

October 23, 1997

Ms. Susan E. Lackey
FMC Corporation
PO Box 4111
Pocatello, Idaho 83205

Dear Ms. Lackey:

This letter is written to forward a revised TRI 9090A report, generated under a 1995 work agreement for FMC Corporation. We understand from your office that the original leachate designation as "Calcium Chloride" was in error and that you are assured that new barrels had been used for leachate transportation to our laboratory for material exposure.

Per your request, we have changed the title on the applicable report pages to reflect the correct leachate designation of "NOSAP Precipitator Slurry".

TRI/Environmental, Inc. (TRI) is pleased to be of service to FMC. If you have any questions or if I may provide any additional assistance, please call me (1-800-880-8378).

Sincerely,

Sam R. Allen

Sam R. Allen
Vice President and Program Manager
Geosynthetics Testing Program

9063 Bee Caves Road • Austin, TX 78733-6201 • (512) 263-2101 • FAX 263-2558 • 1-800-880-T·E·S·T

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

June 13, 1995

Mr. Larry Plooster
FMC Corporation
P.O. Box 4111
Pocatello, Idaho 83205

Dear Mr Plooster:

TRI/Environmental, Inc. (TRI) is pleased to present this 120 Day Final Report for geosynthetic chemical compatibility studies via EPA Method 9090.

TRI thanks FMC Corporation for the opportunity to participate in this project and looks forward to working with you in the future. Please call me if you have any questions or require any additional information.

Respectfully submitted,

Martin D. Nelson

Martin D. Nelson
Laboratory Administrator: Geosynthetic Technologies

cc: Sam R. Allen
Program Manager

9063 Bee Caves Road • Austin, TX 78733-6201 • (512) 263-2101 • FAX (512) 263-2558

FOREWORD

The testing reported herein is based upon accepted industry practice as well as the test method listed. TRI/Environmental Inc. (TRI) neither accepts responsibility for nor makes claim as to the final use and purpose of the materials tested.

Tests were performed under laboratory conditions and not under actual usage conditions. TRI can give no conclusions as to the serviceability, life expectancy or general durability of the products tested when used in a lining and/or leachate collection system.

1.0 INTRODUCTION

This report describes the work performed by TRI/Environmental, Inc. (TRI) to determine the chemical compatibility of various geosynthetic products with one waste leachate. The study included one textured high density polyethylene (HDPE) geomembrane, one polyvinyl chloride (PVC) geomembrane, one nonwoven polypropylene geotextile, one HDPE geonet, and one HDPE geopipe. The objective was to determine the resistance of each geosynthetic to changes caused by exposure to leachate. Changes in physical, mechanical and hydraulic properties were measured after exposure to leachate provided by FMC Corporation at 23°C and 50°C for 30, 60, 90 and 120 days following the exposure regimen specified in United States Environmental Protection Agency (EPA) Method 9090.

Methods, results and discussion are provided in the sections which follow. Test results are provided in the Tables and Graphs of Results which accompany this report.

2.0 METHODS

2.1 *Materials*

Table 1 lists products selected for evaluation in this chemical compatibility study.

Table 1. List of geomembranes evaluated in chemical compatibility study

Geosynthetic	Source
60 mil textured HDPE geomembrane	Serrot Corporation
30 mil PVC geomembrane	Staff Industries
Trevira 1120 nonwoven polypropylene geotextile	Hoechst Celanese Corporation
Polynet 3000 HDPE geonet	National Seal Company
Plexco 6" IPS 17.0 PE3408 HDPE geopipe	Chevron

2.2 Leachate

The waste leachate used during the testing was provided by FMC Corporation. The leachate provided was NOSAP precipitator slurry.

2.3 Exposure Conditions

Geosynthetic test specimens were exposed to the waste leachate following the specifications of EPA Method 9090A as they relate to exposure to waste fluids. The tanks used for these exposures were maintained at 23 $\pm$ 2°C and 50 $\pm$ 2°C throughout the 120-day exposure period. Tanks were constructed from chemically resistant stainless steel, fitted with stirrers and heated with a circulating hot water heat exchanger system. The 50°C tanks were sealed with a lid, and a reflux condenser was installed to minimize loss of volatile leachate components.

2.4 Testing Procedures

The following sections list tests performed on the various geosynthetic products.

2.4.1 HDPE Geomembrane

Table 2 lists tests performed on HDPE geomembrane. The number of test replicates was doubled for baseline determinations on unexposed material. Where required, testing was performed in both the machine and transverse directions

Table 2. Tests performed on HDPE geomembrane

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Hardness	ASTM D 2240 D scale
Volatiles and Extractables	EPA SW 870 Appendix III
Environmental Stress Crack Resistance	ASTM D 1693, Condition B
Specific Gravity	ASTM D 792
Tensile Properties	ASTM D 638
Modulus of Elasticity	ASTM D 882, 2% secant method
Hydrostatic Resistance	ASTM D 751 Method A
Tear Strength	ASTM D 1004
Puncture Resistance	FTMS 101C Method 2065
Seam Peel & Shear Strength	ASTM D 4437

2.4.2 *PVC Geomembrane*

Table 3 lists tests performed on PVC geomembrane. The number of test replicates was doubled for baseline determinations on unexposed material. Where required, testing was performed in both the machine and transverse directions

Table 3. Tests performed on PVC geomembrane

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Hardness	ASTM D 2240 D scale
Volatiles and Extractables	EPA SW 870 Appendix III
Specific Gravity	ASTM D 792
Tensile Properties	ASTM D 882
Hydrostatic Resistance	ASTM D 751 Method A
Tear Strength	ASTM D 1004
Puncture Resistance	FTMS 101C Method 2065
Seam Peel & Shear Strength	ASTM D 4437

2.4.3 *Geotextile*

Table 4 lists tests performed on the geotextile. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 4. Tests performed on geotextile

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Grab Tensile Properties	ASTM D 4632
Trapezoidal Tear Resistance	ASTM D 4533
Puncture Resistance	ASTM D 4833
Mullen Burst Strength	ASTM D 3786
Permittivity (flow rate: gal/min/ft^2)	ASTM D 4491

At each testing period, exposed geotextile specimens dedicated to dimension analysis were rinsed, blotted dry with absorbent towels and dried in an air oven at 45°C for eight hours. Test specimens dedicated to mechanical testing were rinsed, blotted dry with absorbent towels and stored in polyethylene bags until tested. Test specimens were tested in a moist condition.

2.4.4 *HDPE Geonet*

Table 5 lists tests performed on the drainage geonet. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 5. Tests performed on geonet

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Tensile Properties	ASTM D 1682
Transmissivity - machine direction Grad. 1.0 Normal Load:10000 psf	ASTM D 4716

At each testing period, exposed geonet specimens dedicated to mechanical property testing were rinsed, blotted dry with absorbent towels and stored in polyethylene bags until tested.

2.4.5 *HDPE Geopipe*

Table 6 lists tests performed on the HDPE geopipe. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 6. Tests performed on geonet

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Compressive Strength @ 5% & 10% deflection	ASTM D 2412

At each testing period, exposed geopipe specimens dedicated to mechanical property testing were rinsed, blotted dry with absorbent towels and stored in polyethylene bags until tested.

3.0 DISCUSSION/RESULTS

Test results are presented in the Tables of Test Results (raw data) and graphical presentations are presented in Appendix A.

In considering these results, it must be determined through engineering judgment whether observed differences in the value of test results measured before and after immersion are due to product variability, unidentified factors relating to the test procedure, or leachate interaction with the products. Any significant chemical interaction with leachate would be expected to result in degradation trends which are consistent across the various properties being evaluated, and not isolated to one set of test results only. However, with each type of material there may be specific properties which are highly sensitive to leachate-induced effects. These factors must be considered in evaluating the various test results for a given product. These issues are addressed in the following sections for each class of geosynthetic

Also of critical importance is the issue of product variability. With geotextiles, a range of physical and mechanical index test values covering 25% or more of the average is not uncommon. This can be traced to variability inherent in the product, and the randomness associated with the onset of failure under the specified testing conditions. However, in chemical compatibility testing the statistical sampling of a broad range of manufactured product is not possible. Therefore, the small size of the sample population tested at each time point must be taken into consideration. The criteria to be applied in evaluating data measured before and after leachate immersion should be that property changes, if observed, are consistent and so great that product variability and experimental factors can be ruled out.

In this report, standard deviations (STD) are reported for most measurements involving three or more replicate specimens. In statistics, the standard deviation is defined as root of the mean squared deviations of individual test results about the mean value. The standard deviation is a quantitative measure of variability within a group of measurements.

One related measure of variability observed within a sample set, relative to the magnitude of the mean value itself, is the *coefficient of variation or variance* (COV). The coefficient of variance is defined as the standard deviation divided by the mean associated with a group of specimens, and may be expressed as a percentage. The COV provides an indication of what proportion of the mean value may be attributable to random experimental factors or product variability. It is useful to consider apparent changes in property values against the criterion of COV since observed changes which fall below the COV may not be significant. This approach was used in preparing the tables in the next sections.

The term *range* refers to the difference between the extreme highest and lowest points within a group of measured values. Considering range as a percentage of the mean values provides another measure of variability within a dataset.

In the tables, the high and low extremes for percentage change in mean values are listed for comparison against COV and range as a percentage of mean from the baseline sample group. The high and low percentage changes are the extremes from data measured at 30, 60, 90 and 120 days.

3.1 Serrot HDPE Geomembrane

Table 7 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Serrot HDPE geomembrane.

Table 7. Baseline coefficients of variation and range of percentage change results for Serrot HDPE Geomembrane

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at yield (MD)	1	5	9	-7
Stress at break (MD)	6	16	-1	-24
Elongation at yield (MD)	9	24	21	-9
Elongation at break (MD)	9	25	-7	-23
Modulus (MD)	16	41	1	-16
Tear strength (MD)	2	6	9	0
Puncture Resistance	3	8	22	5
Hydrostatic Resistance	2	6	11	1
Seam Shear Strength	3	9	14	5
Seam Peel Strength	3	9	15	2

3.2 Staff PVC Geomembrane

Table 8 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Staff PVC geomembrane.

Table 8. Baseline coefficients of variation and range of percentage change results for Staff PVC Geomembrane

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at break (MD)	4	11	14	-20
Elongation at break (MD)	8	23	13	-24
Tear strength (MD)	3	9	11	-2
Puncture Resistance	5	10	22	0
Hydrostatic Resistance	3	9	10	-9
Seam Shear Strength	6	17	17	4
Seam Peel Strength	10	26	42	8

3.3 Polypropylene Hoechst Celanese Trevira Geotextile

Table 9 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Trevira 1120 geotextile.

Table 9. Baseline coefficients of variation and range of percentage change results for Polypropylene Hoechst Celanese Geotextile

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Grab Strength (MD)	13	32	-5	-23
Grab Elongation (MD)	5	19	14	-18
Tear Strength (MD)	15	49	-13	-26
Puncture Resistance	13	44	-5	-23
Burst Strength	10	34	1	-11
Permittivity	6	24	3	-24

3.4 National Seal Polynet 3000 HDPE Geonet

Table 10 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Polynet 3000 HDPE geonet.

Table 10. Baseline coefficients of variation and range of percentage change results for Polynet 3000 HDPE Geonet

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Tensile Strength (MD)	7	24	6	-6
Transmissivity (MD)	3	8	-12	-17

3.5 Chevron Plexco HDPE Geopipe

Table 11 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Chevron Plexco HDPE geopipe.

Table 11. Baseline coefficients of variation and range of percentage change results for Plexco HDPE Geopipe

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Compressive Strength @ 5% deflection	22	57	21	-14
Compressive Strength @ 10% deflection	16	49	8	-17

4.0 CONCLUSION

While changes in certain measured physical and mechanical properties were noted for some products, the effects of product variability and experimental factors could not be ruled out as causes. In the opinion of the authors, the data, considered together, do not support the conclusion that observed changes were consistently and uniformly caused by the test exposures.

TRI/Environmental, Inc. is pleased to have been selected to participate in this project. We trust that the information provided in this report meets your requirements for technical documentation of this chemical compatibility study. Please do not hesitate to call me if I may provide any further information.

Respectfully submitted,

Sam R. Allen
Program Manager: Geosynthetics Testing Technologies

APPENDIX A - TEST RESULTS

This section includes generated test data provided in both tabular and graphical form. Each graph is represented by a series of "I" beam plots. Each "I" beam represents a single test population and illustrates the high and low value as the end points, and the mean as a central box on the beam.

At each testing period, two "I" beams are shown. The left beam represents the 23°C exposed specimens while the right beam represents the 50°C specimens. The initial "I" beam represents the baseline or unexposed test specimens. Graphical representations are

EPA METHOD 9090 TEST RESULTS

SERROT 60 mil TEXTURED HDPE GEOMEMBRANE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

SR4
Quality Review

Report Date: June 13, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
GEOMEMBRANE: SERROT 60 mil TEXTURED HDPE GEOMEMBRANE									
Tensile Properties:									
Tensile Stress @ Yield (psi)	2569	2811	3007	2829	2878	2683	2587	2412	2488
ASTM D638	2694	2827	2595	2788	2899	2755	2847	2638	2350
Machine Direction	2640	2904	2811	2740	2622	2729	2571	2420	2447
	2623								
	2592								
	2619								
Average	2623	2847	2804	2786	2800	2722	2668	2490	2428
STD	39	41	168	36	126	30	127	105	58
Coefficient of Variation	1	1	6	1	4	1	5	4	2
% Change		9	7	6	7	4	2	-5	-7
Tensile Strength @ Break (psi)	3465	3342	2429	3254	3608	1688	1337	2830	1349
ASTM D638	3216	3226	2490	3285	3391	3117	3261	3115	2885
Machine Direction	2965	1864	3191	3111	1490	3191	3070	2842	3151
	3271								
	3148								
	3490								
Average	3259	2811	2703	3217	2830	2665	2556	2929	2462
STD	181	671	346	76	951	692	865	132	794
Coefficient of Variation	6	24	13	2	34	26	34	4	32
% Change		-14	-17	-1	-13	-18	-22	-10	-24
Tensile Properties:									
Elongation @ Yield (%)	16	15	18	15	16	16	17	18	22
ASTM D638	16	15	19	17	17	17	15	17	19
Machine Direction	17	17	16	16	19	15	14	16	20
	20								
	16								
	16								
Average	17	16	18	16	17	16	15	17	20
STD	1	1	1	1	1	1	1	1	1
Coefficient of Variation	9	6	7	5	7	5	8	5	6
% Change		-7	5	-5	3	-5	-9	1	21

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Elongation @ Break (%)	454	398	242	383	420	308	256	370	301
ASTM D638	390	394	330	391	389	372	380	379	397
Machine Direction	356	354	374	356	241	392	411	370	394
	419								
	377								
	457								
Average	409	382	315	377	350	357	349	373	364
STD	38	20	55	15	78	36	67	4	45
Coefficient of Variation	9	5	17	4	22	10	19	1	12
% Change		-7	-23	-8	-14	-13	-15	-9	-11
Set after Break (%)	361	332	214	322	362	278	242	342	338
ASTM D638	314	294	250	300	331	276	274	387	367
Machine Direction	279	274	271	294	247	303	350	381	421
	345								
	307								
	354								
Average	327	300	245	305	313	286	289	370	375
STD	29	24	24	12	49	12	45	20	34
Coefficient of Variation	9	8	10	4	16	4	16	5	9
% Change		-8	-25	-7	-4	-13	-12	13	15
Stress @ 100% Elongation (psi)	2091	2333	2550	2399	2394	2252	2180	2055	2093
ASTM D638	2110	2338	2160	2400	2481	2249	2337	2292	2017
Machine Direction	2034	2305	2272	2355	2233	2247	2091	2079	2020
	2063								
	2103								
	2041								
Average	2074	2325	2327	2385	2369	2249	2203	2142	2043
STD	30	15	164	21	103	2	102	107	35
Coefficient of Variation	1	1	7	1	4	0	5	5	2
% Change		12	12	15	14	8	6	3	-1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

SPA
Quality Review

Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Stress @ 200% Elongation (psi)	2174	2454	2456	2371	2523	2204	2111	2017	2101
ASTM D638	2249	2303	2217	2482	2387	2231	2385	2271	2133
Machine Direction	2137	2368	2361	2396	2177	2220	2161	2058	2065
	2186								
	2223								
	2205								
Average	2196	2375	2345	2410	2362	2218	2219	2115	2100
STD	36	62	98	38	142	11	119	111	28
Coefficient of Variation	2	3	4	2	6	0	5	5	1
% Change		8	7	10	8	1	1	-4	-4
Tensile Properties:									
Tensile Stress @ Yield (psi)	2651	3051	2552	2784	2758	2829	2727	2406	2472
ASTM D638	2624	3011	3064	2600	2749	2835	2839	2511	2726
Transverse Direction	2551	2992	2886	2763	2709	2865	2719	2638	2444
	2755								
	2826								
	2691								
Average	2683	3018	2834	2716	2739	2843	2762	2518	2547
STD	89	25	212	82	21	16	55	95	127
Coefficient of Variation	3	1	7	3	1	1	2	4	5
% Change		12	6	1	2	6	3	-6	-5
Tensile Strength @ Break (psi)	2807	1837	3199	2603	2937	2694	1997	1233	2586
ASTM D638	2850	2137	3561	2643	3090	1010	1223	2633	2910
Transverse Direction	2984	3249	2466	2512	3314	1579	1402	1482	2872
	3302								
	3114								
	2203								
Average	2877	2408	3075	2586	3114	1761	1541	1783	2789
STD	344	607	456	55	155	699	331	610	145
Coefficient of Variation	12	25	15	2	5	40	21	34	5
% Change		-16	7	-10	8	-39	-46	-38	-3

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

SRA
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Tensile Properties:									
Elongation @ Yield (%)	16	15	18	15	15	15	15	17	16
ASTM D638	16	15	16	16	16	16	16	16	16
Transverse Direction	19	15	18	15	14	16	17	18	18
	16								
	16								
	14								
Average	16	15	17	15	15	16	16	17	17
STD	1	0	1	0	1	0	1	1	1
Coefficient of Variation	9	0	5	3	5	3	5	5	6
% Change		-7	7	-5	-7	-3	-1	5	3
Elongation @ Break (%)	354	334	450	324	382	347	220	233	347
ASTM D638	368	360	423	358	409	177	241	358	342
Transverse Direction	393	415	217	325	440	280	342	324	386
	441								
	415								
	295								
Average	378	370	363	336	410	268	268	305	358
STD	47	34	104	16	24	70	53	53	20
Coefficient of Variation	12	9	29	5	6	26	20	17	5
% Change		-2	-4	-11	9	-29	-29	-19	-5
Set after Break (%)	286	275	372	274	388	282	213	352	362
ASTM D638	310	256	342	286	337	126	246	390	338
Transverse Direction	317	310	174	254	358	254	306	384	381
	359								
	355								
	265								
Average	315	280	296	271	361	221	255	375	360
STD	34	22	87	13	21	68	38	17	18
Coefficient of Variation	11	8	29	5	6	31	15	4	5
% Change		-11	-6	-14	14	-30	-19	19	14

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

SRA
Quality Review

Report Date: June 13, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Stress @ 100% Elongation (psi)	1863	2133	1937	2022	2011	2118	1975	1808	1846
ASTM D638	1768	2145	2466	1992	2042	2076	2060	1966	2113
Transverse Direction	1831	2162	2213	2112	2099	2160	2003	1947	1834
	1970								
	1900								
	1954								
Average	1881	2147	2205	2042	2051	2118	2013	1907	1931
STD	70	12	216	51	36	34	35	70	129
Coefficient of Variation	4	1	10	2	2	2	2	4	7
% Change		14	17	9	9	13	7	1	3
Stress @ 200% Elongation (psi)	2060	2139	2075	2153	2094	2084	2034	1912	1962
ASTM D638	1938	2185	2325	1977	2085	2134	2111	2030	2117
Transverse Direction	1982	2178	2266	2089	2165	2102	2079	2076	1965
	2019								
	2004								
	1991								
Average	1999	2167	2222	2073	2115	2107	2075	2006	2015
STD	37	20	107	73	36	21	32	69	72
Coefficient of Variation	2	1	5	4	2	1	2	3	4
% Change		8	11	4	6	5	4	0	1
Modulus of Elasticity:									
ASTM D882 (psi)	77075	76389	68798	66892	65426	68554	64572	56211	67738
Machine Direction	80440	75964	65662	61443	68106	72186	76701	65329	69742
2% Secant	70599	71787	76096	70891	57168	73012	69998	65265	67716
	60724								
	62466								
	91264								
Average	73761	74713	70185	66409	63567	71251	70424	62268	68399
STD	11571	2543	5354	4743	5701	2372	6076	5246	1163
Coefficient of Variation	16	3	8	7	9	3	9	8	2
% Change		1	-5	-10	-14	-3	-5	-16	-7

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

SRA
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Modulus of Elasticity:									
ASTM D882 (psi)	66153	80634	59948	73617	66166	75450	75843	60607	73688
Transverse Direction	62397	76929	73594	68372	70382	71559	68234	60674	75371
2% Secant	50823	76892	69820	71828	68419	75683	61710	48320	63182
	57759								
	62697								
	75615								
Average	62574	78152	67787	71272	68322	74231	68596	56534	70747
STD	8297	2150	7046	2666	2110	2317	7073	7113	6605
Coefficient of Variation	13	3	10	4	3	3	10	13	9
% Change		25	8	14	9	19	10	-10	13
Indentation Hardness:									
Reading	53	46	54	48	51	49	49	43	46
ASTM D2240	56	53	55	49	51	50	48	38	43
(with TYPE D DUROMETER)	53	53	53	51	48	45	48	45	44
	53	52	51	50	53	49	48	48	50
	53	46	48	49	54	48	48	43	44
	52								
	52								
	48								
	48								
	53								
Average	52	50	52	49	51	48	48	43	45
STD	2	4	3	1	2	2	0	4	3
Coefficient of Variation	5	7	5	2	4	4	1	8	6
% Change		-4	0	-5	-1	-7	-7	-17	-13
Specific Gravity:									
ASTM D792, Method A	0.942	0.941	0.941	0.936	0.949	0.939	0.933	0.931	0.934
	0.947	0.940	0.938	0.936	0.947	0.933	0.933	0.934	0.942
	0.944	0.936	0.940	0.941	0.948	0.937	0.939	0.945	0.940
	0.940								
	0.944								
	0.939								
Average	0.943	0.939	0.940	0.938	0.948	0.936	0.935	0.937	0.939
STD	0.003	0.003	0.002	0.003	0.001	0.003	0.003	0.007	0.004
Coefficient of Variation	0	0	0	0	0	0	0	1	0
% Change		-0.39	-0.32	-0.53	0.57	-0.67	-0.81	-0.64	-0.42
Environmental Stress Crack Resistance:									
ASTM D1693, Condition B									
Machine Direction (% Failed)	N/A	0	0	0	0	0	0	0	0
Transverse Direction (% Failed)	N/A	0	0	0	0	0	0	0	0

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

SRA
Quality Review

Report Date: June 13, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Puncture Resistance:									
Load @ Rupture (lbs)	85	98	92	95	98	102	106	95	94
FTMS 101C Method 2065	86	95	98	96	99	103	105	95	91
	84	95	97	93	99	104	109	92	91
	89								
	91								
	91								
Average	88	96	96	95	99	103	107	94	92
STD	3	1	3	1	0	1	2	1	1
Coefficient of Variation	3	1	3	1	0	1	2	2	2
% Change		10	9	8	13	17	22	7	5
Volatiles and Extractables:									
Machine Diameter Change (%)	-0.18	-0.27	-0.10	0.00	-0.12	0.70	-0.35	-0.08	0.08
SW 870 - Appendix III-D	-0.16	-0.17	-0.03	-0.13	-0.75	-0.60	-0.23	-0.23	0.05
	-0.15								
	-0.16								
Average	-0.16	-0.22	-0.07	-0.07	-0.44	-0.29	-0.29	-0.16	0.07
STD	0.01	0.05	0.04	0.07	0.32	0.06	0.06	0.08	0.02
Transverse Diameter Change (%)	0.25	-0.58	-0.20	-0.22	-0.35	-0.95	-0.38	-0.30	-0.56
SW 870 - Appendix III-D	0.07	-0.40	-0.38	-0.25	-0.47	0.73	-0.12	-0.25	-0.58
	-0.29								
	-0.33								
Average	-0.08	-0.49	-0.29	-0.24	-0.41	-0.11	-0.25	-0.28	-0.57
STD	0.24	0.09	0.09	0.02	0.06	0.84	0.13	0.02	0.01
% Volatiles	0.03	0.04	0.10	0.05	0.05	0.08	0.08	0.10	0.18
SW 870 - Appendix III-D	0.04	0.04	0.06	0.04	0.05	0.07	0.08	0.09	0.19
	0.04								
	0.04								
Average	0.04	0.04	0.08	0.05	0.05	0.08	0.08	0.10	0.19
STD	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.01	0.01
% Extractables	0.08	0.06	0.10	0.49	0.43	0.35	0.26	0.50	0.48
SW 870 - Appendix III-D	0.09	0.24	0.17	0.46	0.38	0.35	0.25	0.31	0.29
	0.10								
	0.10								
Average	0.09	0.15	0.14	0.48	0.41	0.35	0.26	0.41	0.39
STD	0.01	0.09	0.04	0.01	0.02	0.00	0.01	0.10	0.10

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

SRA
Quality Review

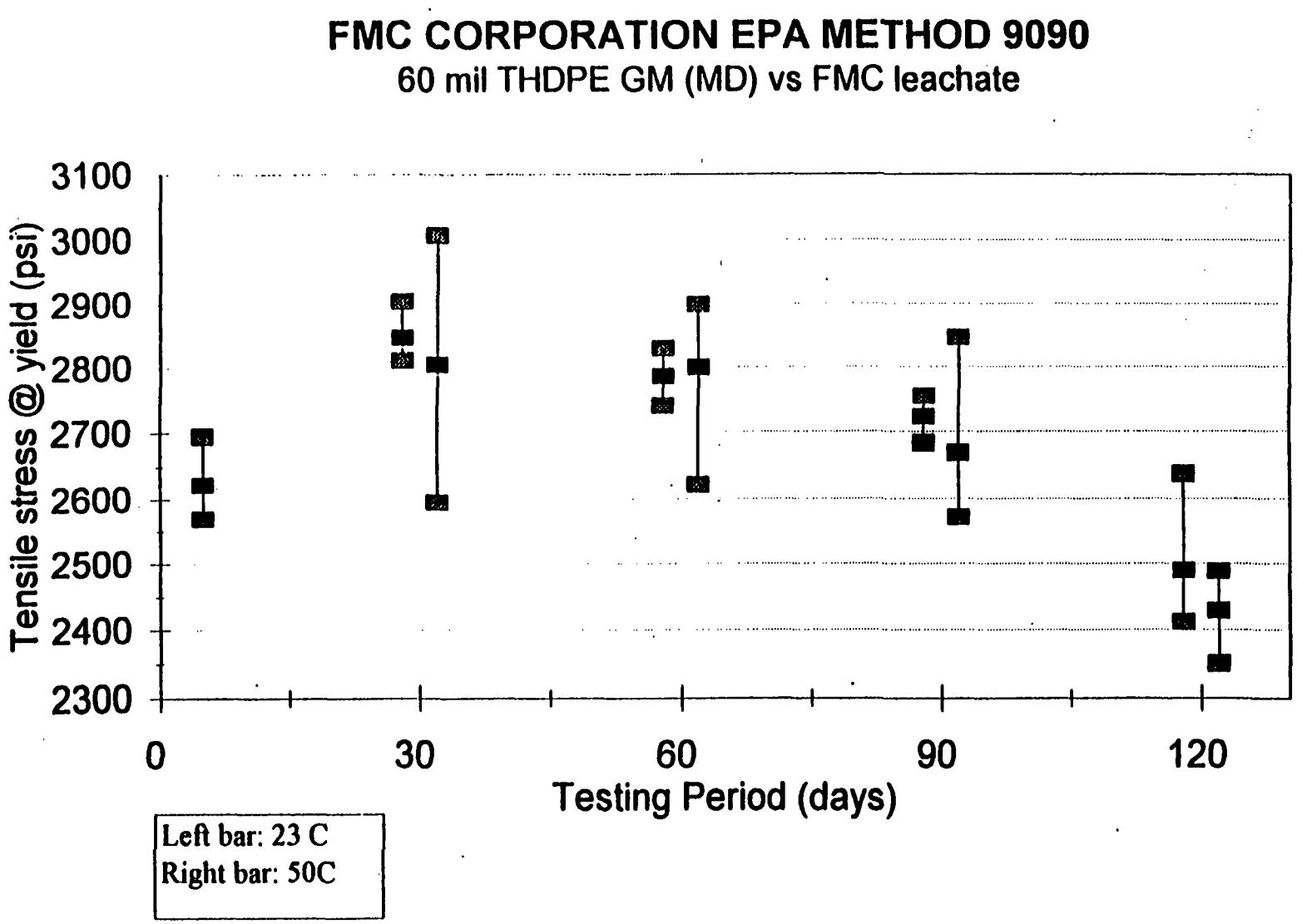
Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tear Resistance:									
ASTM D1004	53	54	56	57	56	53	54	51	50
(lbs)	51	55	57	52	53	53	52	51	50
Machine Direction	52	54	56	53	55	51	56	51	51
	53								
	52								
	50								
Average	52	54	56	54	55	52	54	51	50
STD	1	1	1	3	2	1	2	0	1
Coefficient of Variation	2	1	1	5	3	2	4	0	1
% Change		5	9	4	5	1	4	-2	-3
Tear Resistance:									
ASTM D1004	51	54	55	51	54	54	55	52	51
(lbs)	51	52	56	52	53	53	54	54	48
Transverse Direction	50	52	53	54	51	52	56	51	52
	51								
	50								
	50								
Average	51	53	55	52	53	53	55	52	50
STD	1	1	2	2	2	1	1	2	2
Coefficient of Variation	1	2	3	3	3	2	2	3	4
% Change		4	8	4	4	5	9	4	-0
Hydrostatic Resistance:									
ASTM D751	420	450	430	460	470	450	450	450	460
(psi)	420	440	410	470	480	450	475	425	480
	415	440	440	470	470	455	480	440	460
	425								
	420								
	440								
Average	423	443	427	467	473	452	468	438	467
STD	9	6	15	6	6	3	16	13	12
Coefficient of Variation	2	1	4	1	1	1	3	3	2
% Change		5	1	10	12	7	11	4	10

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

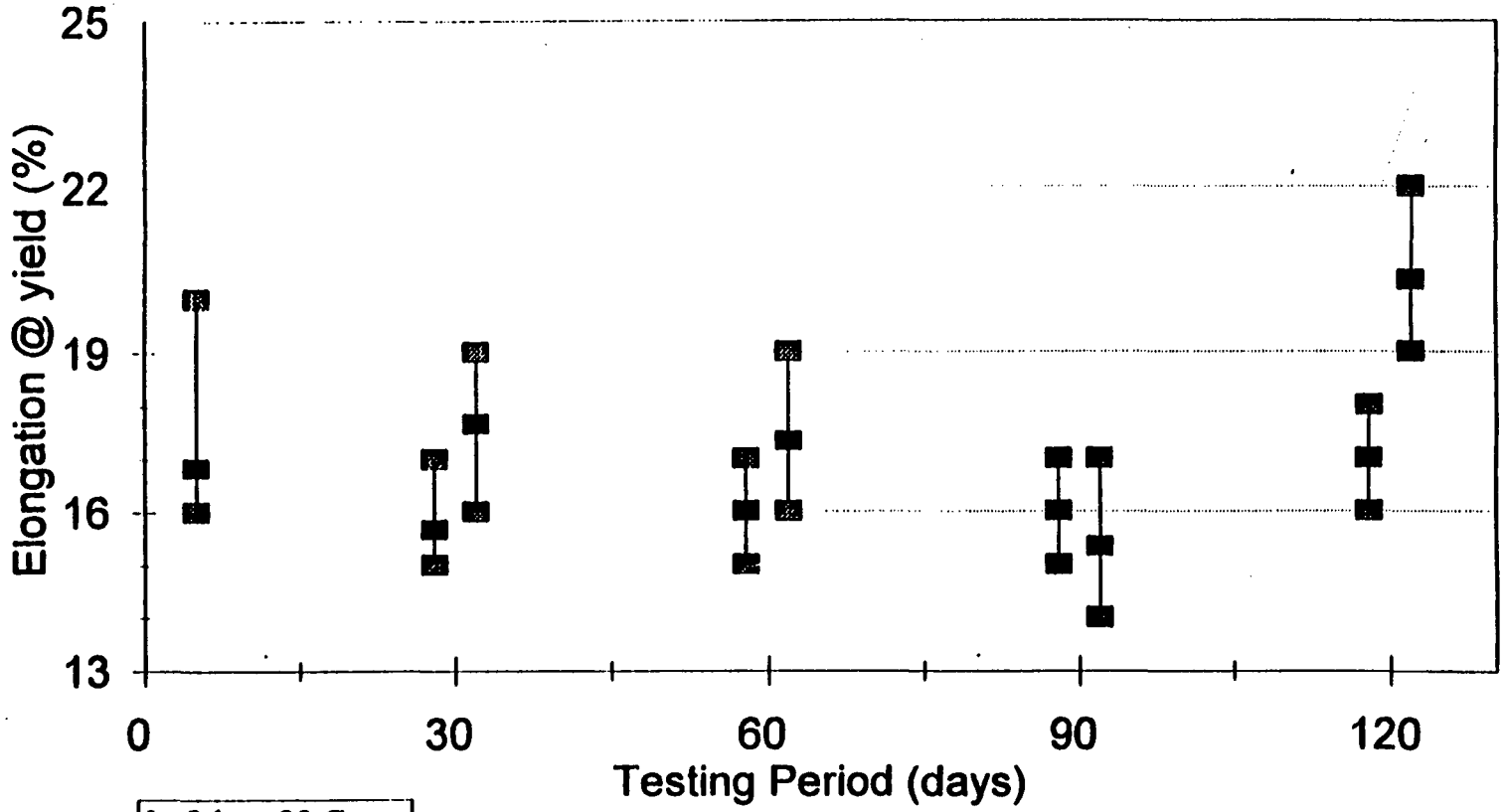
SRA
Quality Review

Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Seam Peel Adhesion:									
ASTM D4437 (lbs)	118	137	142	121	134	135	128	142	143
	128	142	148	132	121	122	124	138	130
	126	139	142	128	128	131	130	145	138
	119	128	136	131	137	122	130	133	140
	126	133	147	124	128	138	126	134	138
	124	145	136	133	117	126	119	139	136
	122								
	121								
	129								
	123								
	122								
	125								
Average	124	137	142	128	128	129	126	139	138
STD	3	6	5	4	7	6	4	4	4
Coefficient of Variation	3	4	3	3	5	5	3	3	3
% Change		11	15	4	3	4	2	12	11
Failure Mode (FTB = All Film Tear Bond)	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB
Shear Seam Strength:									
Shear Seam Strength (lbs)	144	168	169	160	165	156	160	167	168
ASTM D4437	156	164	161	160	165	154	160	170	168
	145	169	163	162	163	154	160	166	166
	149								
	142								
	149								
Average	148	167	164	161	164	155	160	168	167
STD	5	2	3	1	1	1	0	2	1
Coefficient of Variation	3	1	2	1	1	1	0	1	1
% Change		13	11	9	11	5	8	14	13

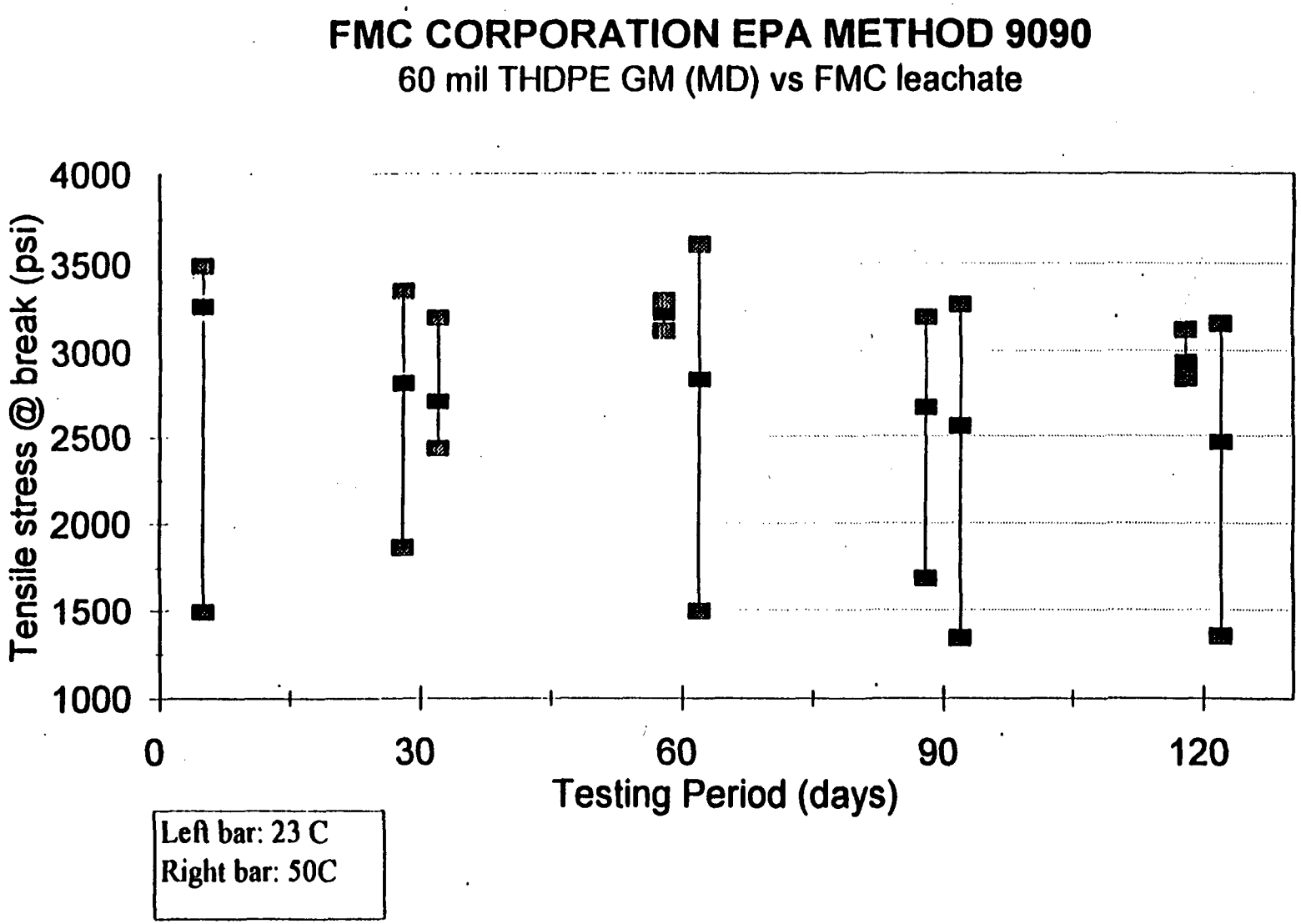

FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
Tensile stress @ yield (psi)
3100
3000
2900
2800
2700
2600
2500
2400
2300
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

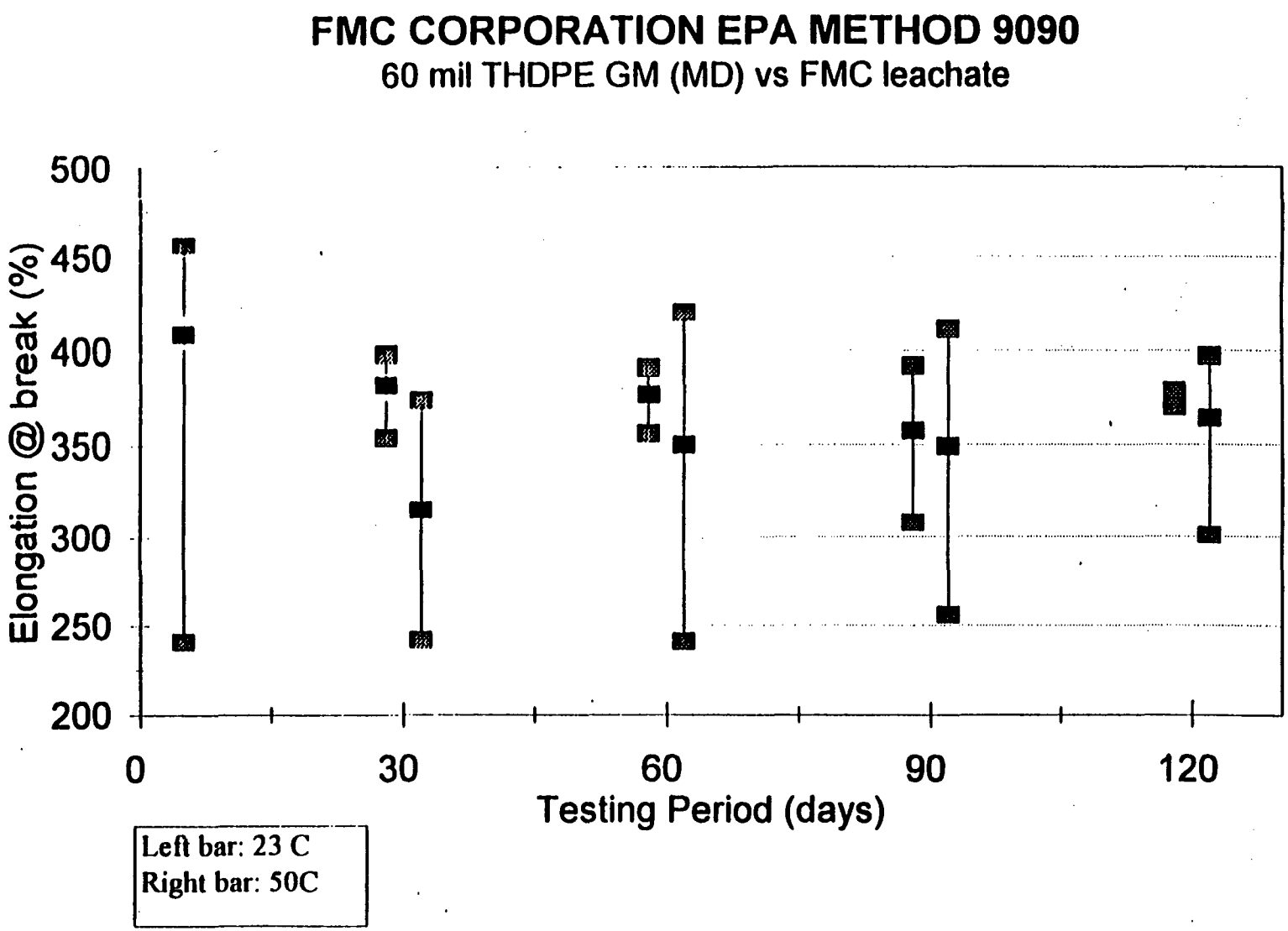
FMC CORPORATION EPA METHOD 9090

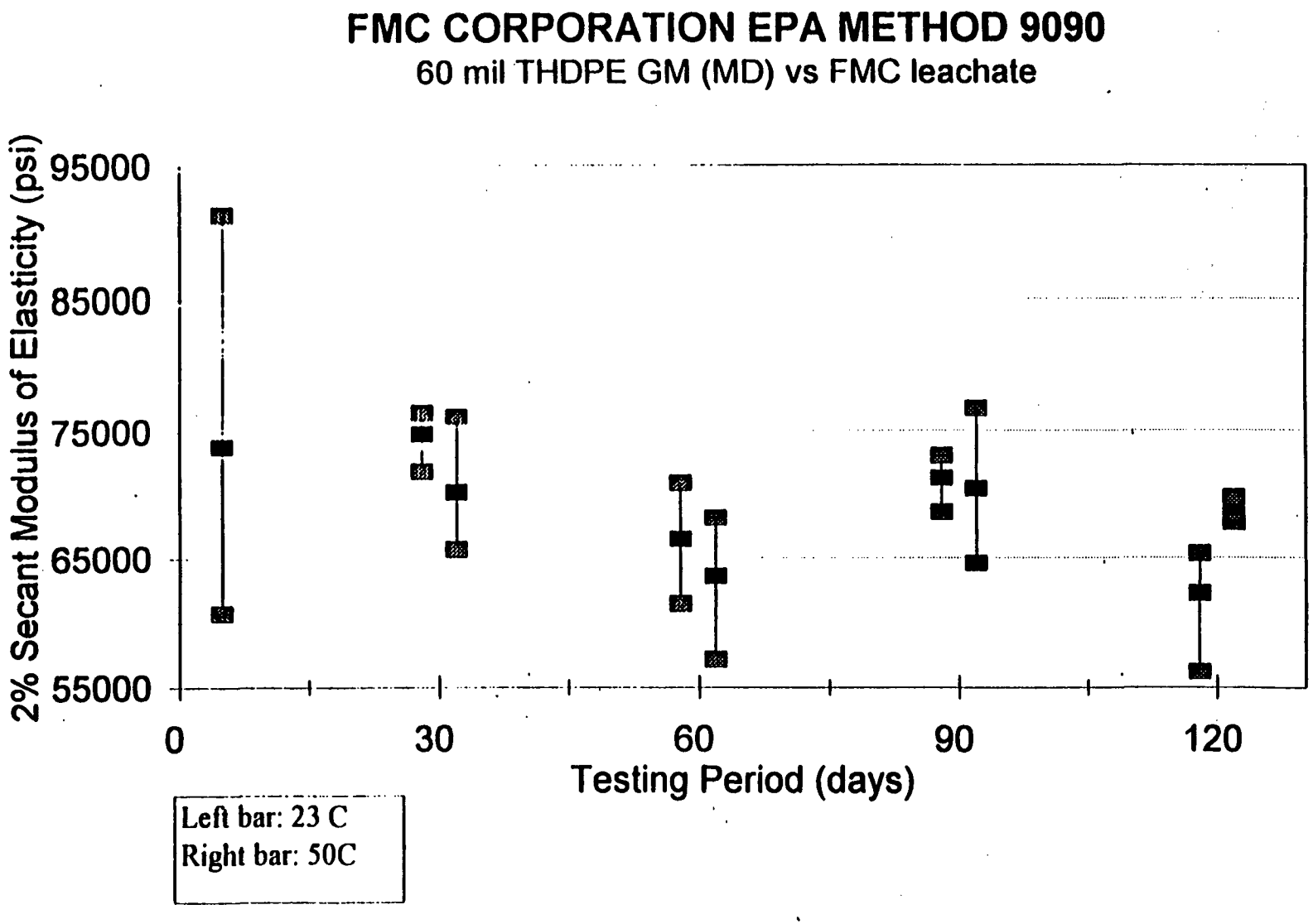
60 mil THDPE GM (MD) vs FMC leachate

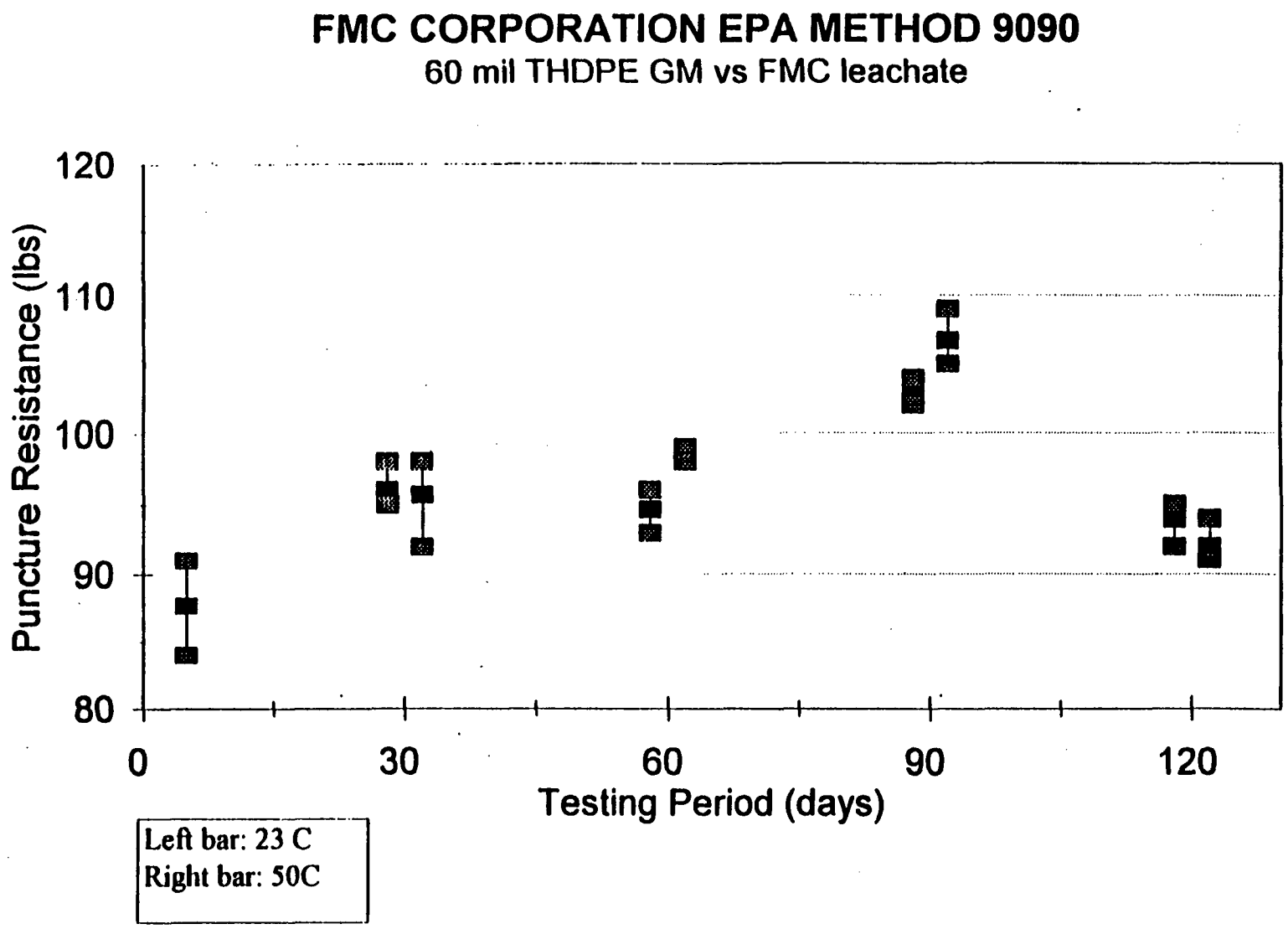


Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
Tensile stress @ break (psi)
4000
3500
3000
2500
2000
1500
1000
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

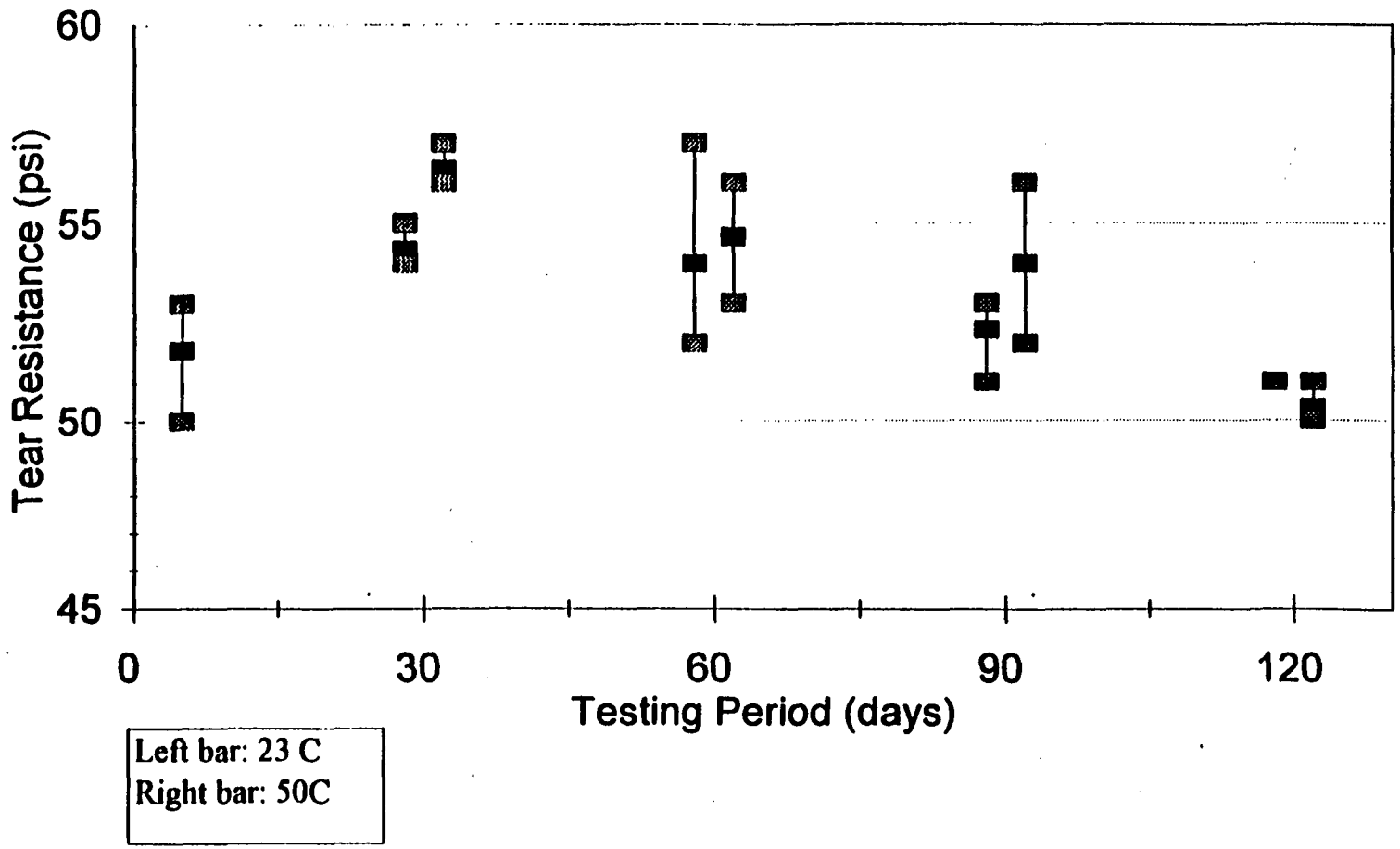

FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
Elongation @ break (%)
500
450
400
350
300
250
200
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
2% Secant Modulus of Elasticity (psi)
95000
85000
75000
65000
55000
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM vs FMC leachate
Puncture Resistance (lbs)
120
110
100
90
80
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

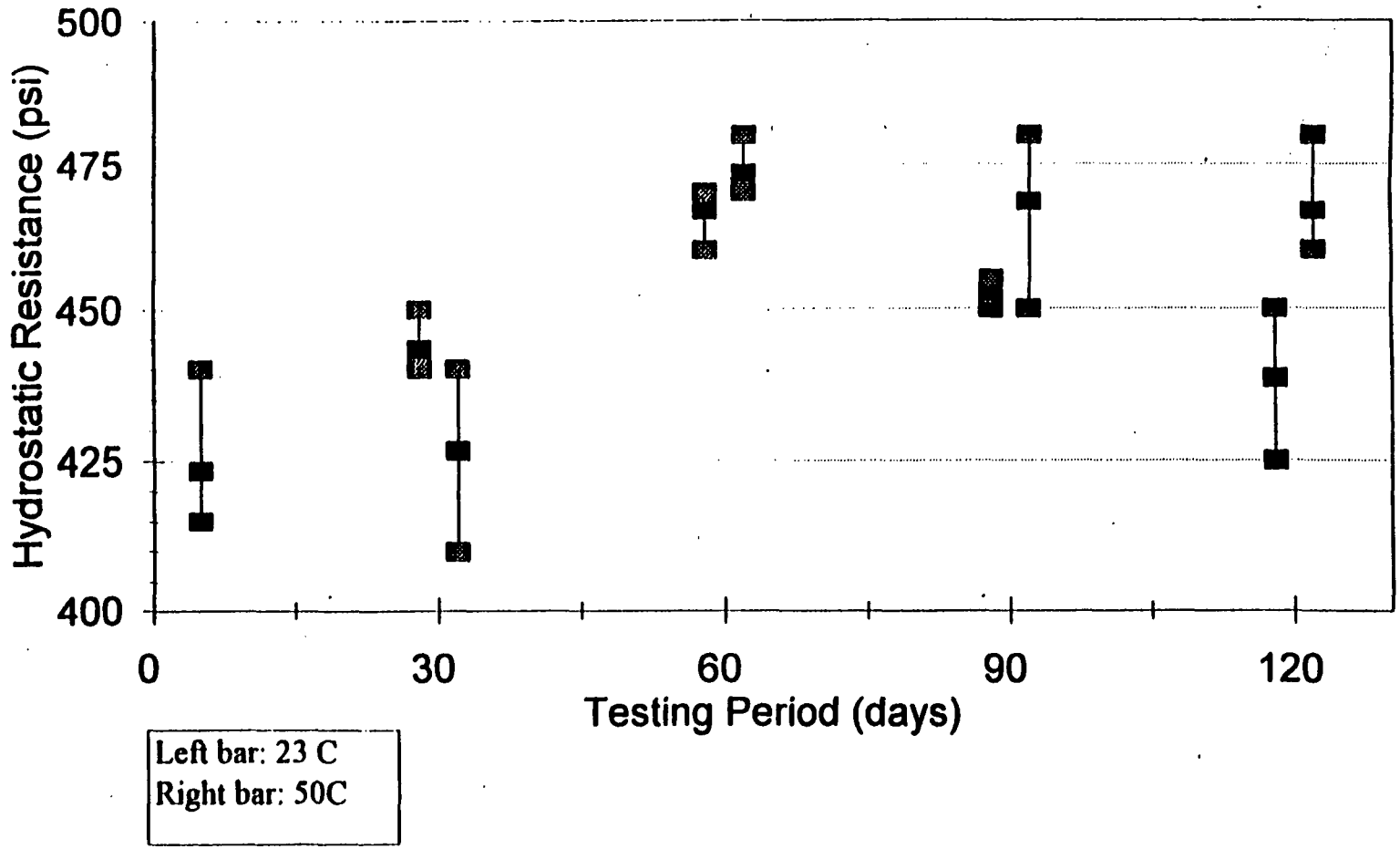
FMC CORPORATION EPA METHOD 9090

60 mil THDPE GM (MD) vs FMC leachate



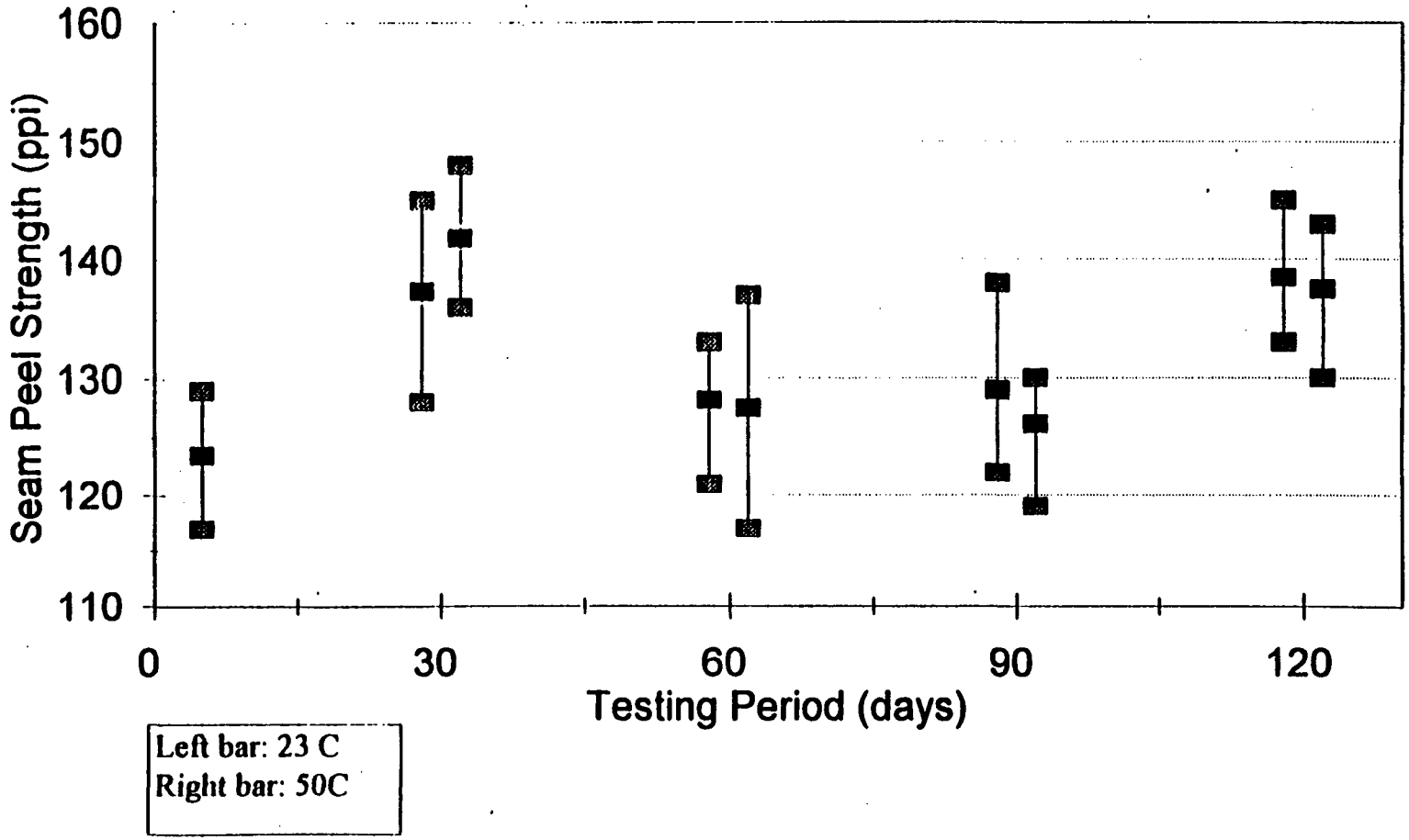
FMC CORPORATION EPA METHOD 9090

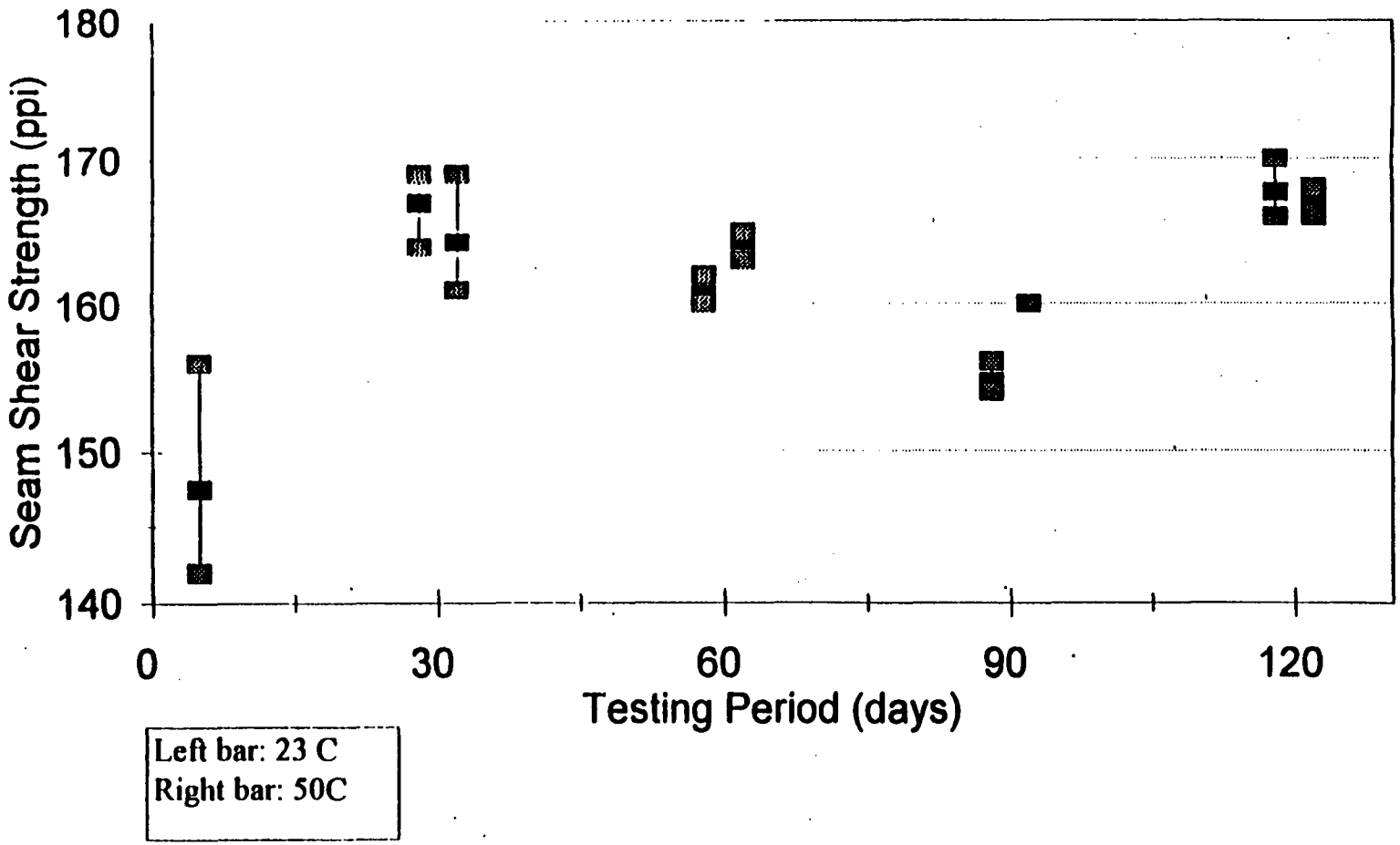
60 mil THDPE GM vs FMC leachate



FMC CORPORATION EPA METHOD 9090

60 mil THDPE GM vs FMC leachate




FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM vs FMC leachate
Seam Shear Strength (ppi)
180
170
160
150
140
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

EPA METHOD 9090 TEST RESULTS

STAFF 30 mil PVC GEOMEMBRANE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

SEA
Quality Review

Report Date: June 12, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
GEOMEMBRANE: STAFF INDUSTRIES 30 MIL PVC GEOMEMBRANE									
Tensile Properties:									
Tensile Stress @ Break (psi)	2583	2715	2602	2068	2158	2676	2947	2479	2514
ASTM D882	2675	2769	2791	2225	2099	2327	3094	2603	2712
Machine Direction	2561	2721	2583	2105	2250	2501	3030	2530	2715
	2851								
	2680								
	2612								
Average	2682	2735	2662	2133	2169	2501	3024	2537	2647
STD	95	24	91	67	62	142	60	51	94
Coefficient of Variation	4	1	3	3	3	6	2	2	4
% Change		3	0	-20	-19	-6	14	-5	-1
Tensile Properties:									
Elongation @ Break (%)	397	475	312	418	478	372	475	382	435
ASTM D882	403	389	344	468	427	305	480	417	472
Machine Direction	380	405	309	447	488	347	467	407	488
	477								
	460								
	410								
Average	421	423	322	444	464	341	474	402	465
STD	35	37	16	20	27	28	5	15	22
Coefficient of Variation	8	9	5	5	6	8	1	4	5
% Change		0	-24	5	10	-19	13	-5	10
Set after Break (%)	69	98	79	75	95	57	95	56	72
ASTM D882	69	98	73	100	82	42	100	68	78
Machine Direction	62	98	99	85	100	51	82	68	85
	95								
	76								
	68								
Average	73	98	84	87	92	50	92	64	78
STD	11	0	11	10	8	6	8	6	5
Coefficient of Variation	14	0	13	12	8	12	8	9	7
% Change		34	14	18	26	-32	26	-13	7
Stress @ 100% Elongation (psi)	1209	788	1137	1102	1128	1558	1604	1363	1378
ASTM D882	1257	1006	1170	1087	1140	1537	1653	1392	1390
Machine Direction	1304	933	1117	1062	1130	1537	1642	1345	1367
	1159								
	1180								
	1235								
Average	1224	909	1141	1084	1133	1544	1633	1367	1378
STD	48	91	22	16	5	10	21	19	9
Coefficient of Variation	4	10	2	2	0	1	1	1	1
% Change		-26	-7	-11	-7	26	33	12	13
Stress @ 200% Elongation (psi)	2049	1231	1467	1589	1572	2204	2168	1972	1917
ASTM D882	2092	1311	1516	1595	1590	2163	2241	1983	1938
Machine Direction	2092	1284	1440	1558	1576	2167	2253	1944	1897
	1981								
	1961								
	2014								
Average	2032	1275	1474	1581	1579	2178	2221	1966	1917
STD	51	33	31	16	8	18	38	16	17
Coefficient of Variation	2	3	2	1	0	1	2	1	1
% Change		-37	-27	-22	-22	7	9	-3	-6

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

SRA
Quality Review

Report Date: June 12, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Tensile Properties:									
Tensile Stress @ Break (psi)	2462	2711	2771	1853	1932	2794	2864	2546	2513
ASTM D882	2391	2644	2775	1996	2156	2780	2979	2496	2654
Transverse Direction	2434	2749	2859	2062	1958	2801	2888	2568	2524
	2495								
	2536								
	2514								
Average	2472	2701	2802	1970	2015	2792	2844	2537	2564
STD	49	43	41	87	100	9	120	30	64
Coefficient of Variation	2	2	1	4	5	0	4	1	2
% Change		9	13	-20	-18	13	15	3	4
Tensile Properties:									
Elongation @ Break (%)	440	328	360	400	422	482	482	487	482
ASTM D882	413	389	357	447	490	485	507	475	502
Transverse Direction	407	389	349	472	430	475	445	498	465
	453								
	457								
	447								
Average	436	369	355	440	447	481	471	487	476
STD	19	29	5	30	30	4	26	9	18
Coefficient of Variation	4	8	1	7	7	1	6	2	4
% Change		-15	-19	1	3	10	8	12	9
Set after Break (%)	83	79	99	75	89	109	104	96	78
ASTM D882	71	97	89	110	110	111	119	138	93
Transverse Direction	66	64	89	100	91	105	86	103	85
	85								
	78								
	80								
Average	77	80	92	95	97	108	103	112	85
STD	7	13	5	15	9	2	13	18	6
Coefficient of Variation	9	17	5	15	10	2	13	16	7
% Change		4	20	23	25	40	33	46	11
Stress @ 100% Elongation (psi)	1126	1107	1074	998	1080	1409	1554	1228	1341
ASTM D882	1132	932	1205	1010	1088	1404	1552	1237	1330
Transverse Direction	1147	1024	1219	1030	1058	1411	1527	1211	1327
	1130								
	1092								
	1147								
Average	1129	1021	1166	1013	1075	1408	1544	1225	1333
STD	18	71	65	13	13	3	12	11	6
Coefficient of Variation	2	7	6	1	1	0	1	1	0
% Change		-10	3	-10	-5	25	37	9	18
Stress @ 200% Elongation (psi)	1856	1434	1381	1437	1482	1996	2086	1747	1825
ASTM D882	1848	1251	1512	1470	1511	1984	2081	1753	1813
Transverse Direction	1898	1306	1504	1477	1477	1996	2030	1713	1809
	1832								
	1833								
	1878								
Average	1858	1330	1466	1461	1490	1992	2088	1738	1816
STD	24	77	60	17	15	6	25	18	7
Coefficient of Variation	1	6	4	1	1	0	1	1	0
% Change		-28	-21	-21	-20	7	11	-6	-2

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Exposed to NOSAP Precipitator Slurry

SRA
Quality Review

Report Date: June 12, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Puncture Resistance:									
Load @ Rupture (lbs)	47	49	51	56	49	55	62	55	57
FTMS 101C Method 2065	48	51	51	45	50	58	62	56	54
	46	50	46	50	53	64	56	54	56
	50								
	52								
	52								
Average	49	50	49	50	51	59	60	55	56
STD	2	1	2	4	2	4	3	1	1
Coefficient of Variation	5	2	5	9	3	6	5	1	2
% Change		2	0	2	3	20	22	12	13
Tear Resistance:									
Maximum Load (ppi)	11	11	12	11	12	11	12	14	11
ASTM D1004	11	11	11	11	12	11	12	11	11
Machine Direction	11	12	12	10	12	11	11	11	12
	11								
	10								
	11								
Average	11	11	12	11	12	11	12	12	11
STD	0	0	0	0	0	0	0	1	0
Coefficient of Variation	3	4	4	4	0	0	4	12	4
% Change		5	8	-2	11	2	8	11	5
Maximum Load (ppi)	10	11	11	11	11	10	12	9	10
ASTM D1004	11	10	11	11	12	11	11	10	10
Transverse Direction	11	10	10	10	11	11	12	11	11
	12								
	11								
	11								
Average	11	10	11	11	11	11	12	10	10
STD	1	0	0	0	0	0	0	1	0
Coefficient of Variation	5	5	4	4	4	4	4	8	5
% Change		-6	-3	-3	3	-3	6	-9	-6

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Exposed to NOSAP Precipitator Slurry

Report Date: June 12, 1995
Reissued (October 21, 1997)

Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Indentation Hardness:									
Reading	86	84	83	89	89	92	90	90	88
ASTM D2240	87	90	85	89	89	92	90	87	88
(with TYPE D DUROMETER)	88	89	85	90	88	88	89	89	91
	88								
	86								
	87								
Average	87	88	84	89	89	91	90	89	89
STD	1	3	1	1	1	2	1	2	2
Coefficient of Variation	1	4	1	1	1	3	1	2	2
% Change		1	-3	3	2	4	3	2	2
Hydrostatic Resistance									
ASTM D751, Method A	107	98	110	105	110	108	104	97	94
	98	100	115	107	110	110	108	90	92
	106	110	118	107	110	107	107	99	98
	105								
	103								
	103								
Average	104	103	114	106	110	108	106	95	95
STD	3	6	4	1	0	2	2	5	3
Coefficient of Variation	3	6	4	1	0	1	2	5	3
% Change	-	-1	10	3	6	5	3	-8	-9
Specific Gravity:									
ASTM D792, Method A	1.205	1.244	1.252	1.284	1.281	1.221	1.231	1.237	1.233
	1.240	1.250	1.266	1.284	1.283	1.224	1.235	1.236	1.232
	1.232	1.243	1.255	1.284	1.284	1.232	1.238	1.232	1.236
	1.245								
	1.221								
	1.214								
Average	1.226	1.246	1.258	1.284	1.283	1.226	1.235	1.235	1.234
STD	0.016	0.004	0.007	0.000	0.002	0.006	0.004	0.003	0.002
Coefficient of Variation	1	0	1	0	0	0	0	0	0
% Change		1.59	2.57	4.72	4.61	-0.04	0.69	0.72	0.61

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Exposed to NOSAP Precipitator Slurry

SRA

Report Date: June 12, 1995
Reissued (October 21, 1997)

Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Volatiles and Extractables:									
Machine Diameter Change (%)	1.41	1.04	-2.33	-3.42	-5.66	-4.14	-0.96	-4.02	-2.52
SW 870 - Appendix III-D	-2.90	0.57	-3.28	-3.05	0.48	-3.45	0.50	-3.75	-2.98
	1.20								
	1.35								
Average	0.27	0.81	-2.81	-3.24	-2.59	-3.80	-0.23	-3.89	-2.75
STD	1.83	0.24	0.47	0.19	3.07	0.34	0.73	0.13	0.23
Transverse Diameter Change (%)	-4.46	-4.39	-0.10	0.58	1.15	1.31	0.18	0.58	-0.03
SW 870 - Appendix III-D	0.25	-4.34	0.15	0.93	-4.28	1.24	-1.42	0.28	1.47
	-3.65								
	-2.64								
Average	-2.63	-4.37	0.02	0.76	-1.57	1.28	-0.62	0.43	0.72
STD	1.78	0.02	0.13	0.18	2.72	0.04	0.80	0.15	0.75
% Volatiles	0.25	0.48	0.65	0.31	0.27	0.52	0.78	0.25	0.19
SW 870 - Appendix III-D	0.24	0.41	0.69	0.30	0.28	0.54	0.71	0.21	0.15
	0.18								
	0.13								
Average	0.20	0.45	0.67	0.31	0.28	0.53	0.75	0.23	0.17
STD	0.05	0.04	0.02	0.01	0.01	0.01	0.04	0.02	0.02
% Extractables	24.32	21.58	22.91	24.50	22.92	27.82	25.87	22.16	24.34
SW 870 - Appendix III-D	24.98	27.05	23.05	23.92	22.61	28.46	25.85	23.91	24.24
	24.43								
	23.41								
Average	24.29	24.32	22.98	24.21	22.77	28.14	25.86	23.04	24.29
STD	0.56	2.74	0.07	0.29	0.16	0.32	0.01	0.88	0.05

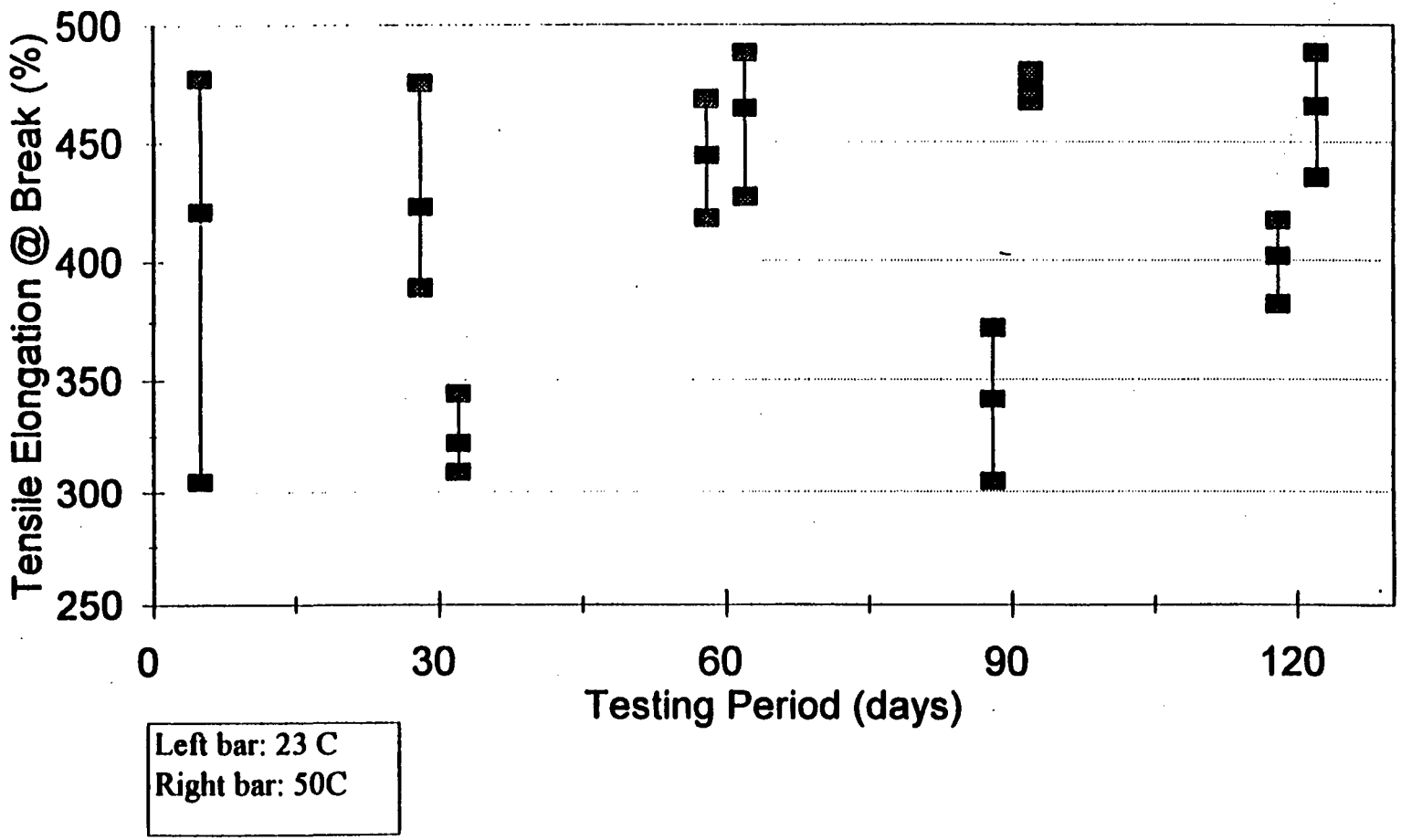
TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

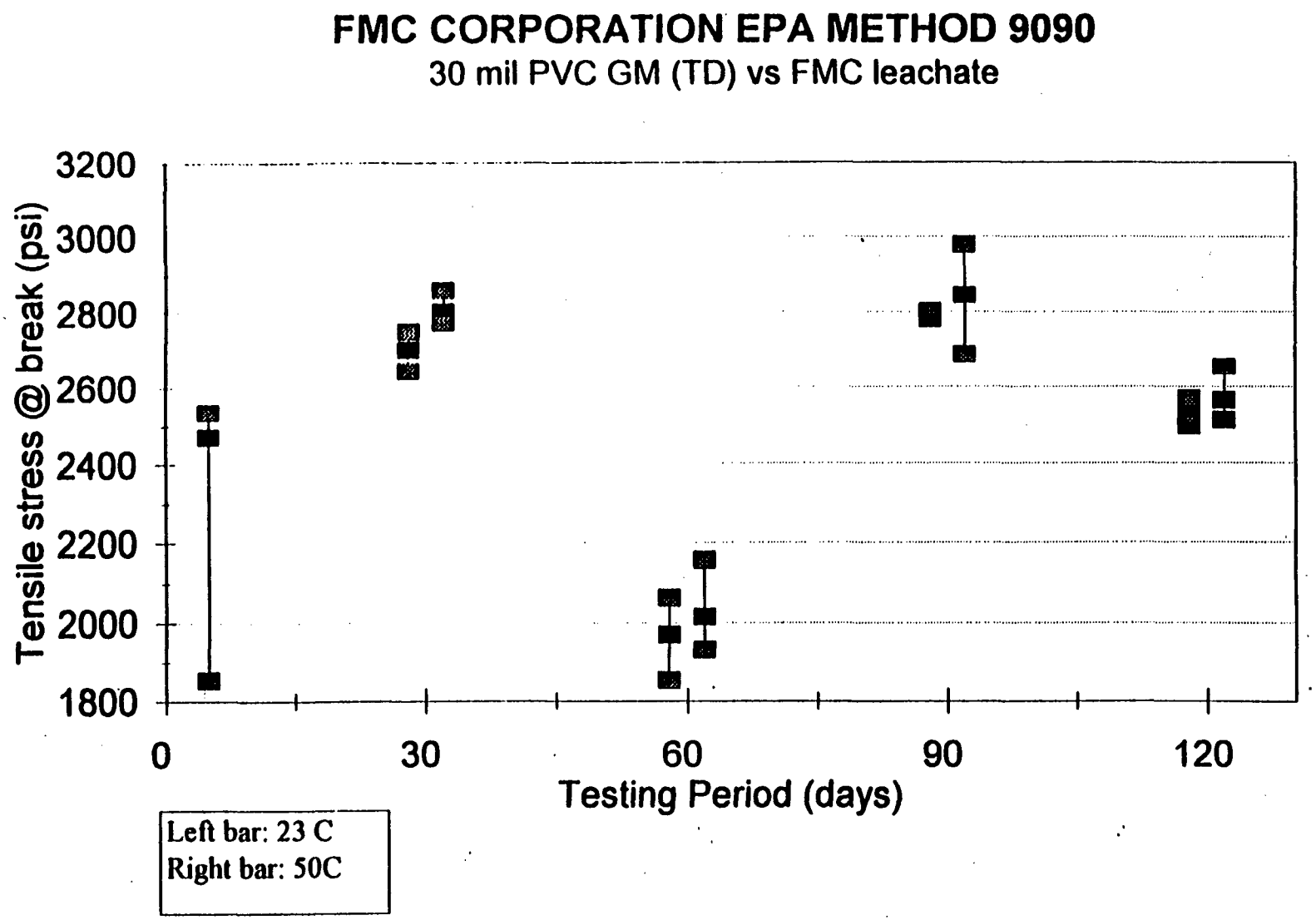
MDN
Quality Review

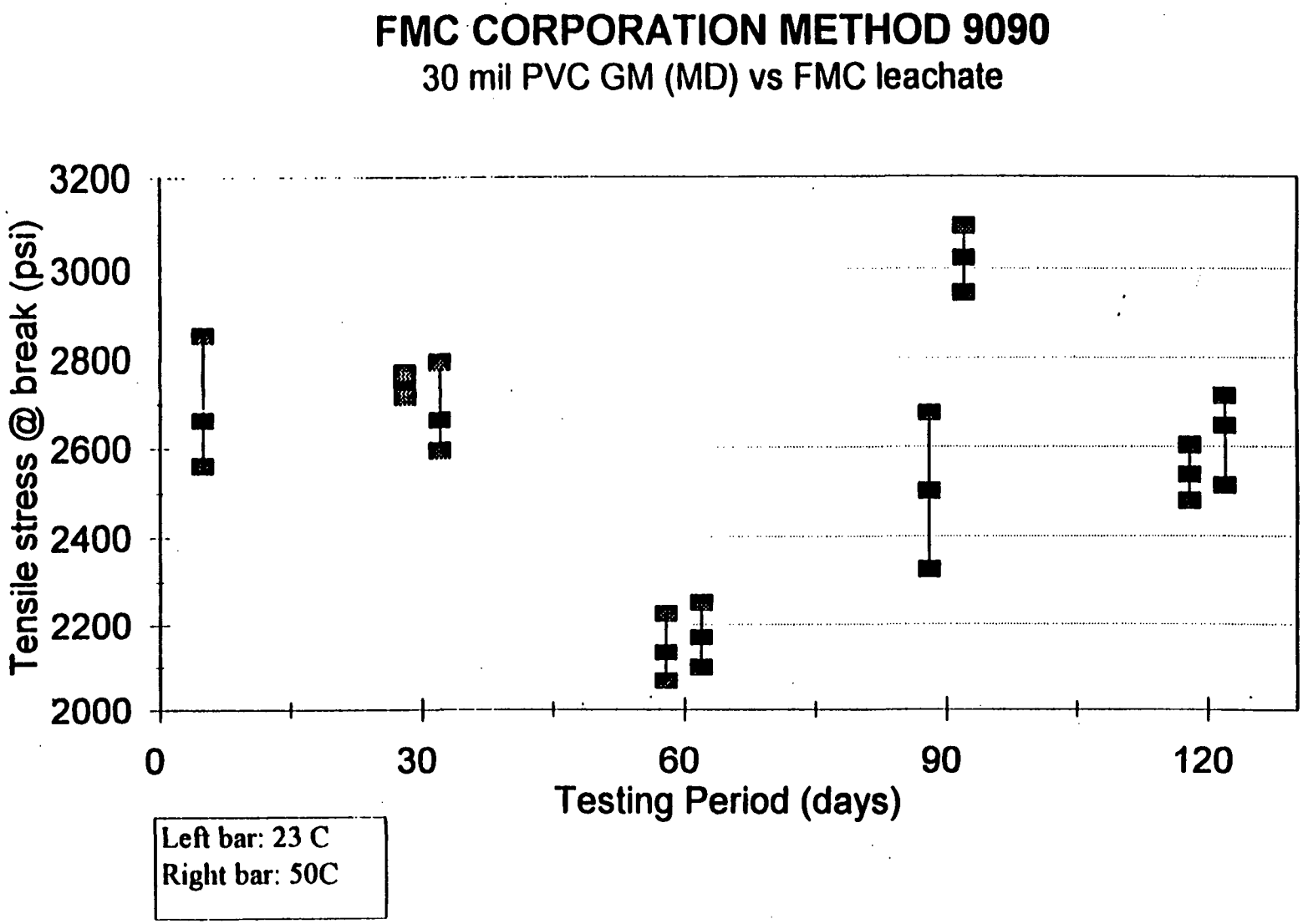
Report Date: June 12, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Seam Peel Adhesion:									
ASTM D4437 (lbs)	23	35	34	26	17	34	32	27	27
	24	19	28	30	30	31	31	27	34
	20	26	22	24	26	31	29	21	34
	25								
	19								
	24								
Average	23	27	28	27	24	32	31	25	32
STD	2	7	5	2	5	1	1	3	3
Coefficient of Variation	10	25	17	9	22	4	4	11	10
% Change		19	24	19	8	42	36	11	41
Failure Mode (SF: 100% Peel)	SF	SF	SF	SF	SF	SF	SF	SF	SF
Shear Seam Strength:									
Shear Seam Strength (lbs)	53	60	60	62	65	57	58	55	66
ASTM D4437	46	49	59	60	63	60	56	58	62
	54	57	62	49	58	58	55	70	56
	54								
	55								
	57								
Average	53	55	60	57	62	58	56	61	61
STD	3	5	1	6	3	1	1	6	5
Coefficient of Variation	6	8	2	10	5	2	2	11	7
% Change		4	13	7	17	10	6	15	15

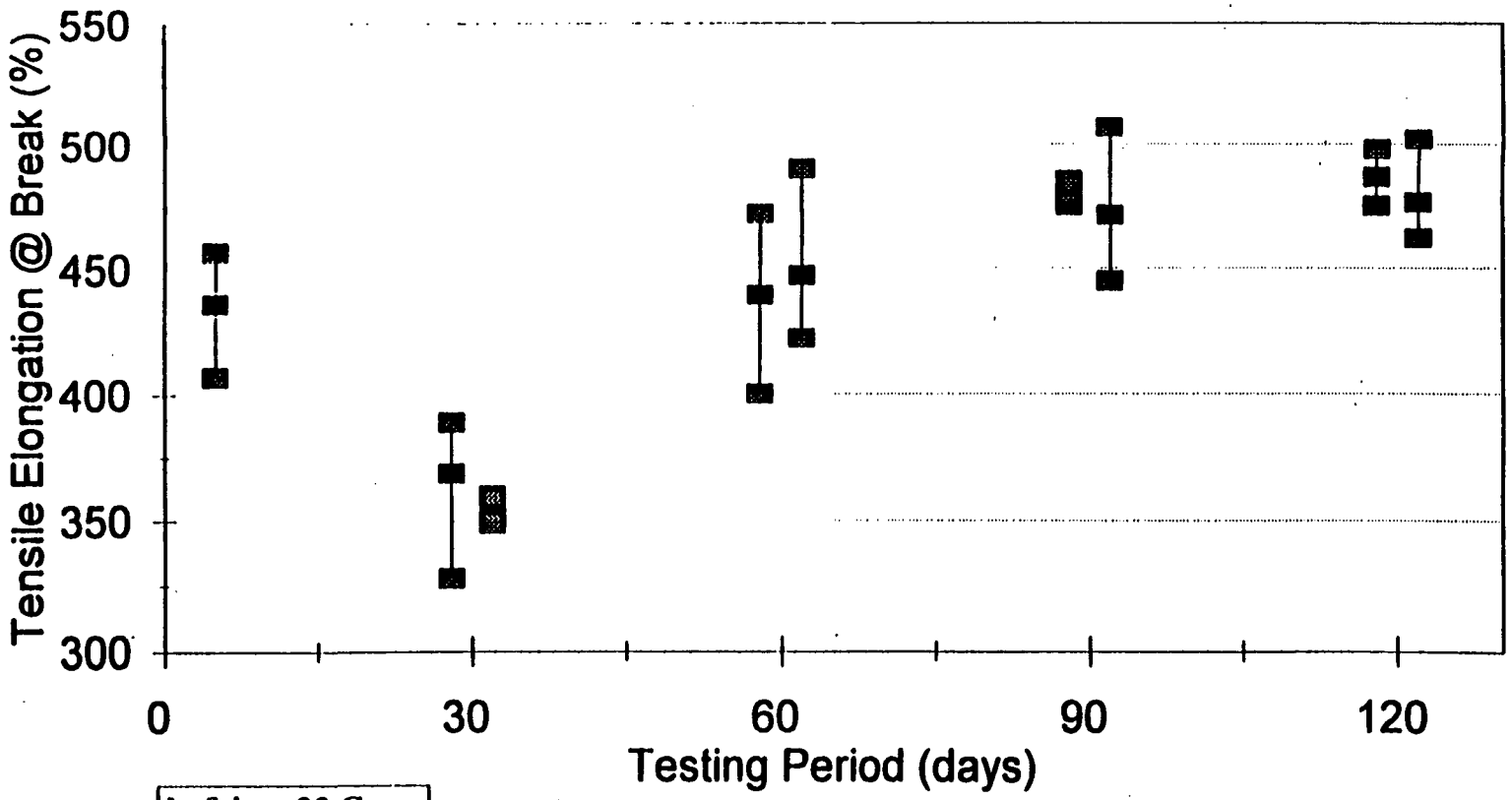

FMC CORPORATION EPA METHOD 9090
30 mil PVC GM (MD) vs FMC leachate
Tensile Elongation @ Break (%)
500
450
400
350
300
250
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
30 mil PVC GM (TD) vs FMC leachate
Tensile stress @ break (psi)
3200
3000
2800
2600
2400
2200
2000
1800
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION METHOD 9090
30 mil PVC GM (MD) vs FMC leachate
Tensile stress @ break (psi)
3200
3000
2800
2600
2400
2200
2000
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

FMC CORPORATION EPA METHOD 9090

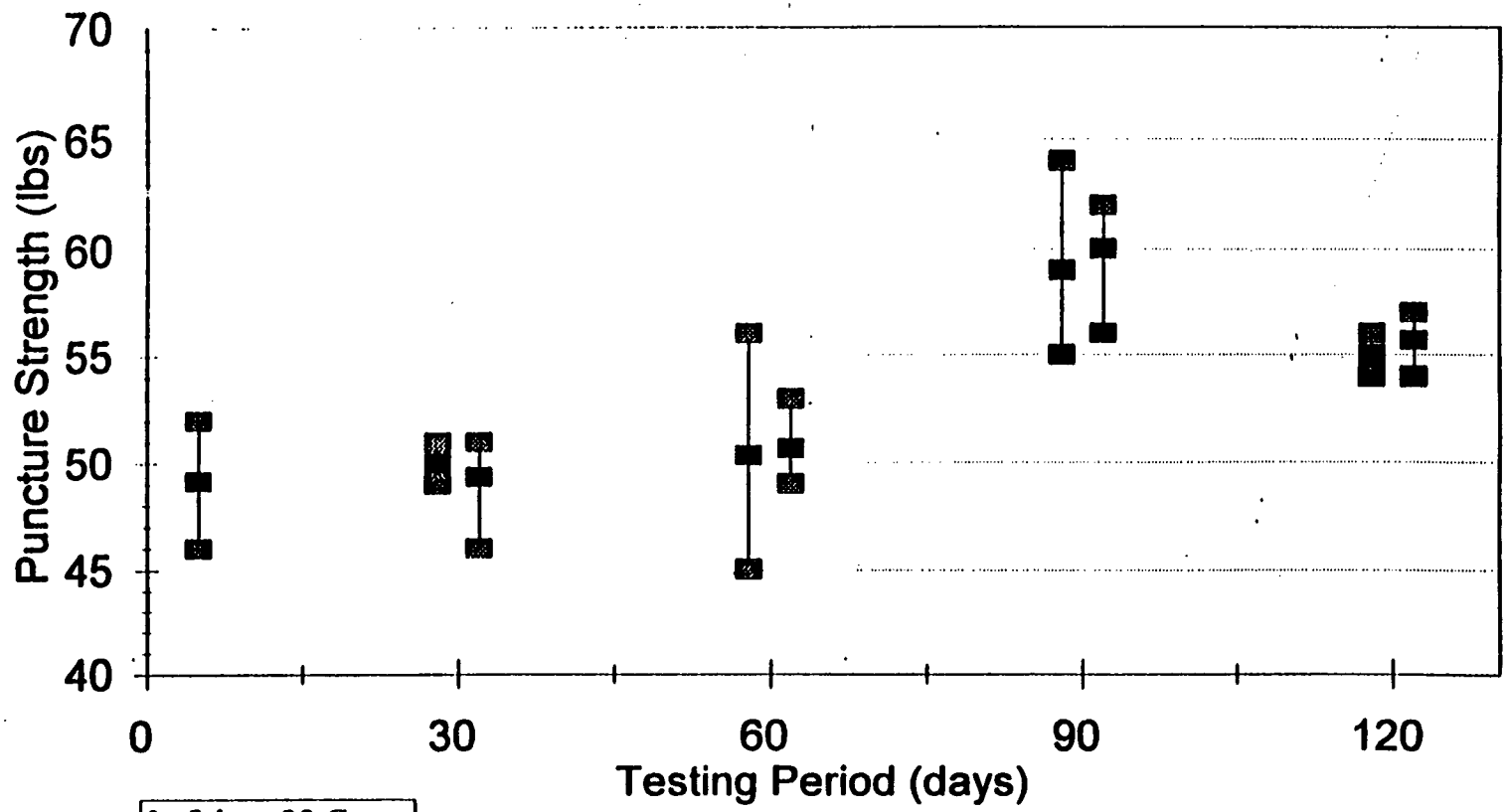
30 mil PVC GM (TD) vs FMC leachate



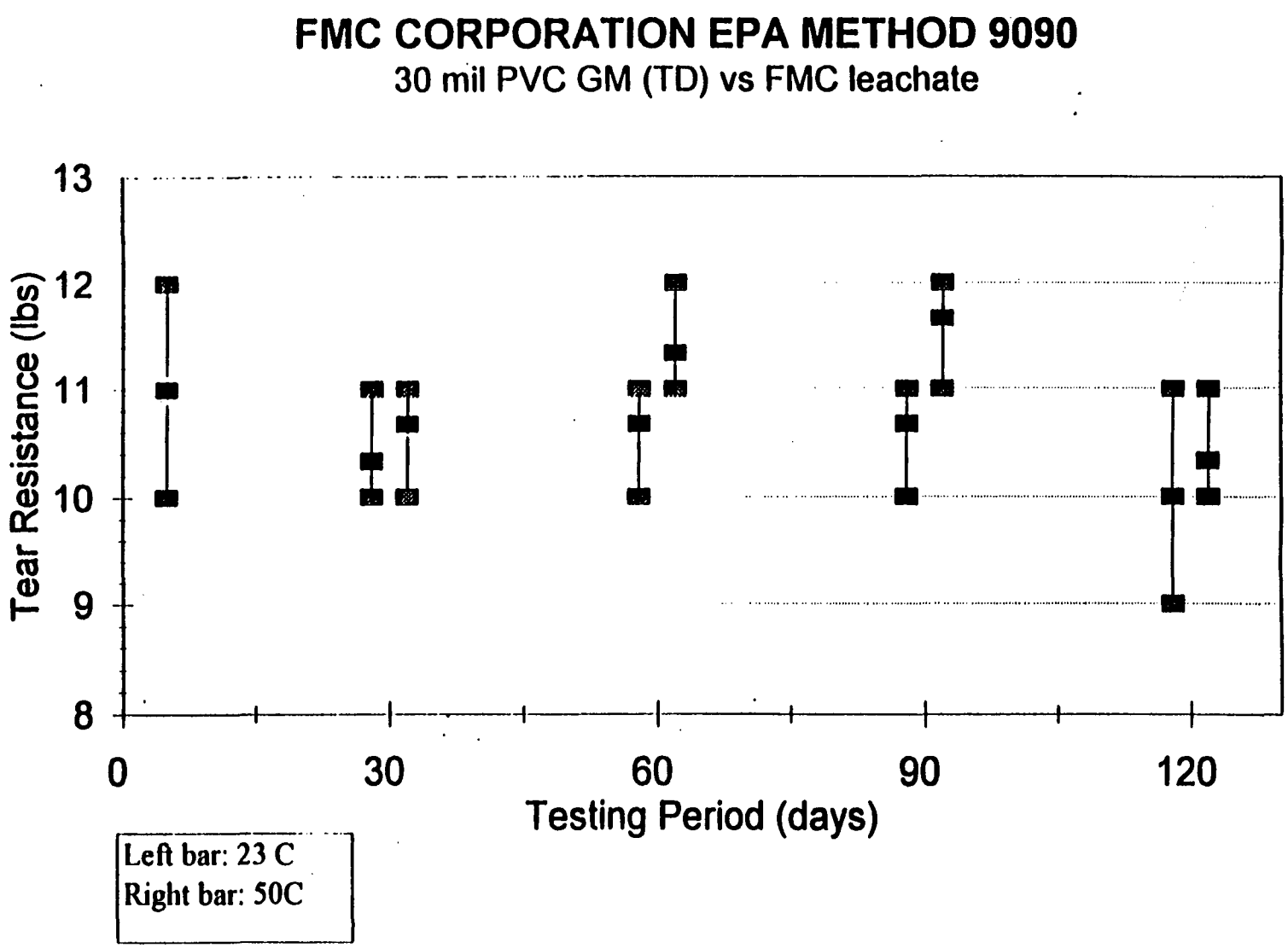
Left bar: 23 C
Right bar: 50C

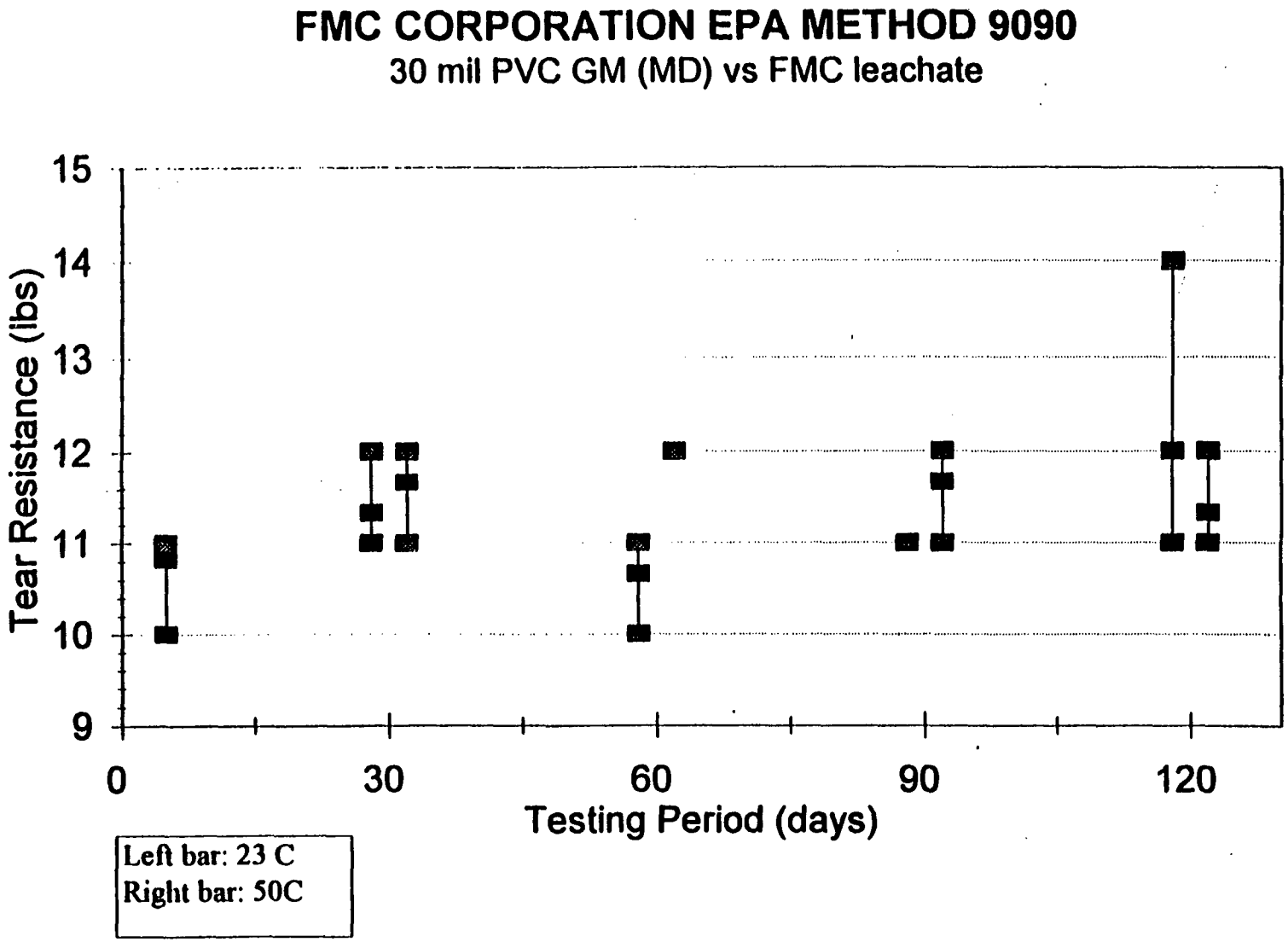
FMC CORPORATION EPA METHOD 9090

30 mil PVC GM vs FMC leachate



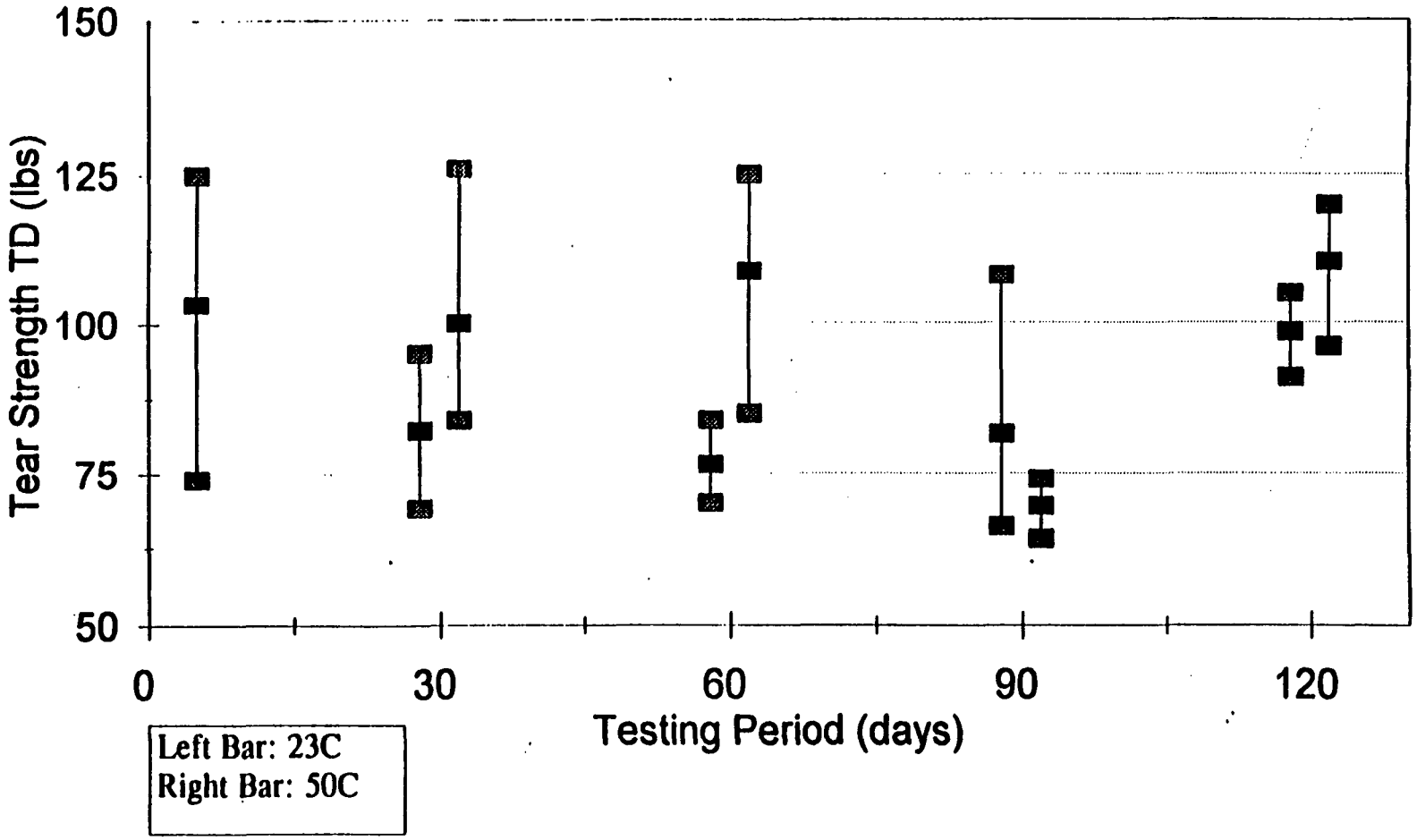
Left bar: 23 C
Right bar: 50C

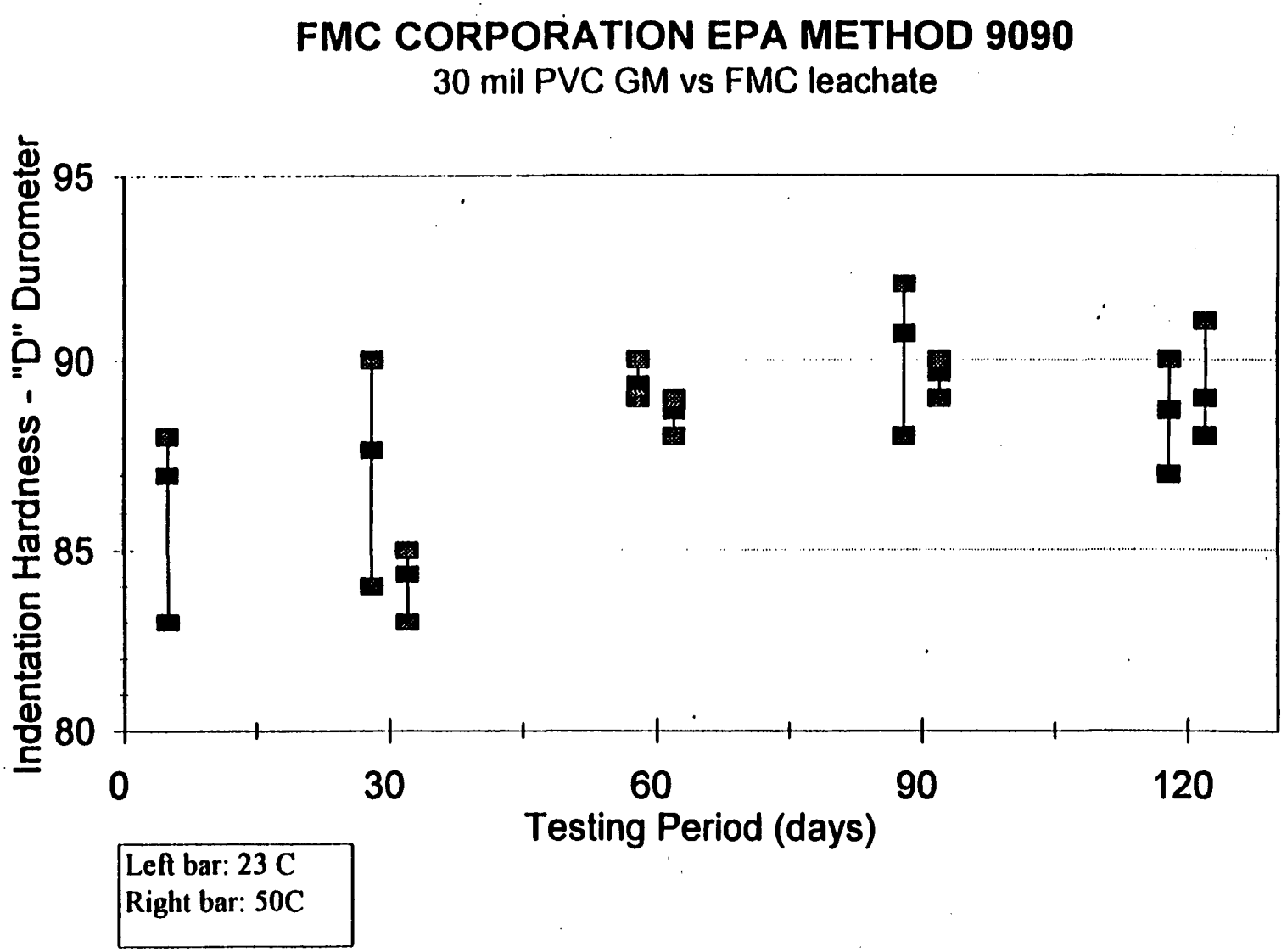

FMC CORPORATION EPA METHOD 9090
30 mil PVC GM (TD) vs FMC leachate
Tear Resistance (lbs)
13
12
11
10
9
8
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

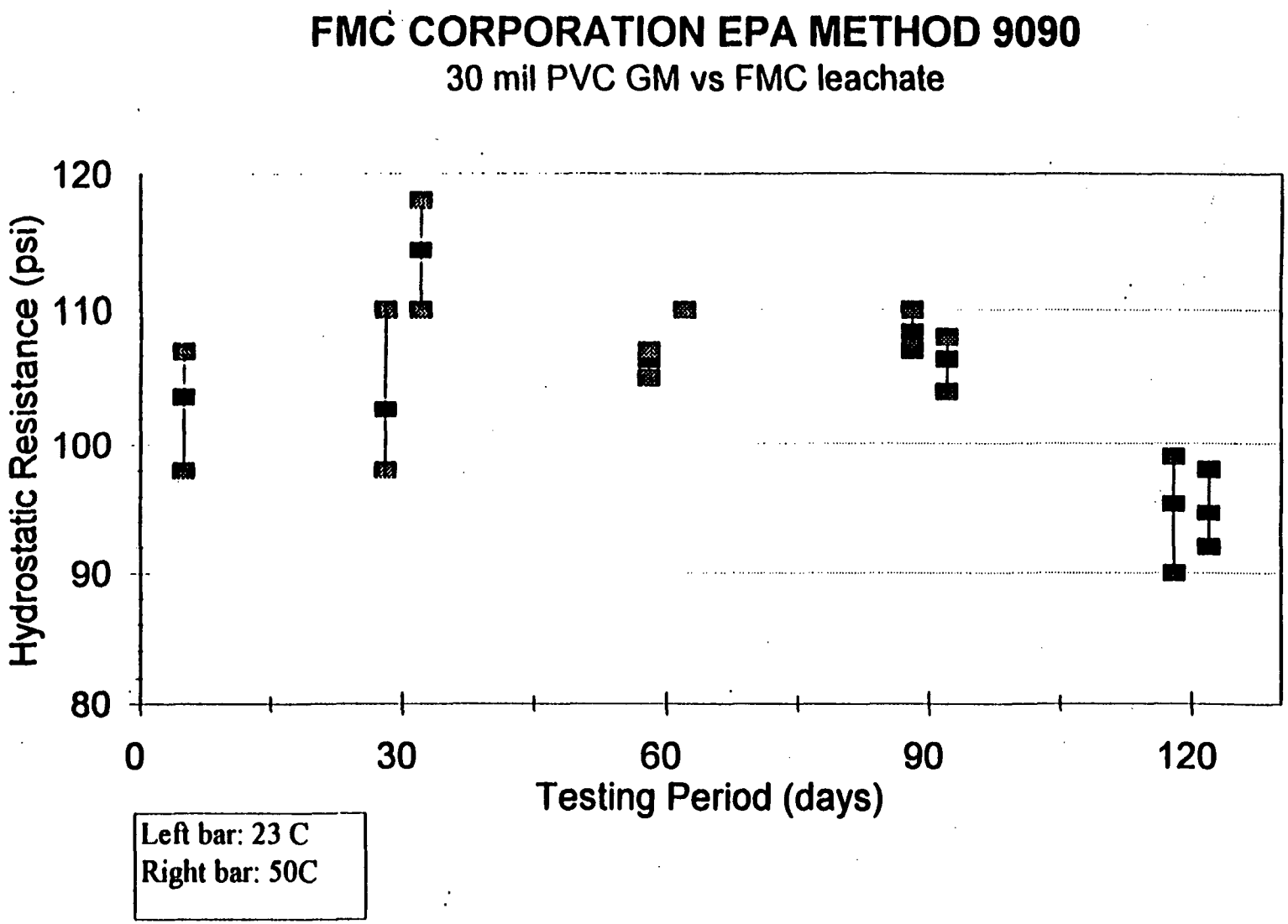

FMC CORPORATION EPA METHOD 9090
30 mil PVC GM (MD) vs FMC leachate
Tear Resistance (lbs)
15
14
13
12
11
10
9
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate

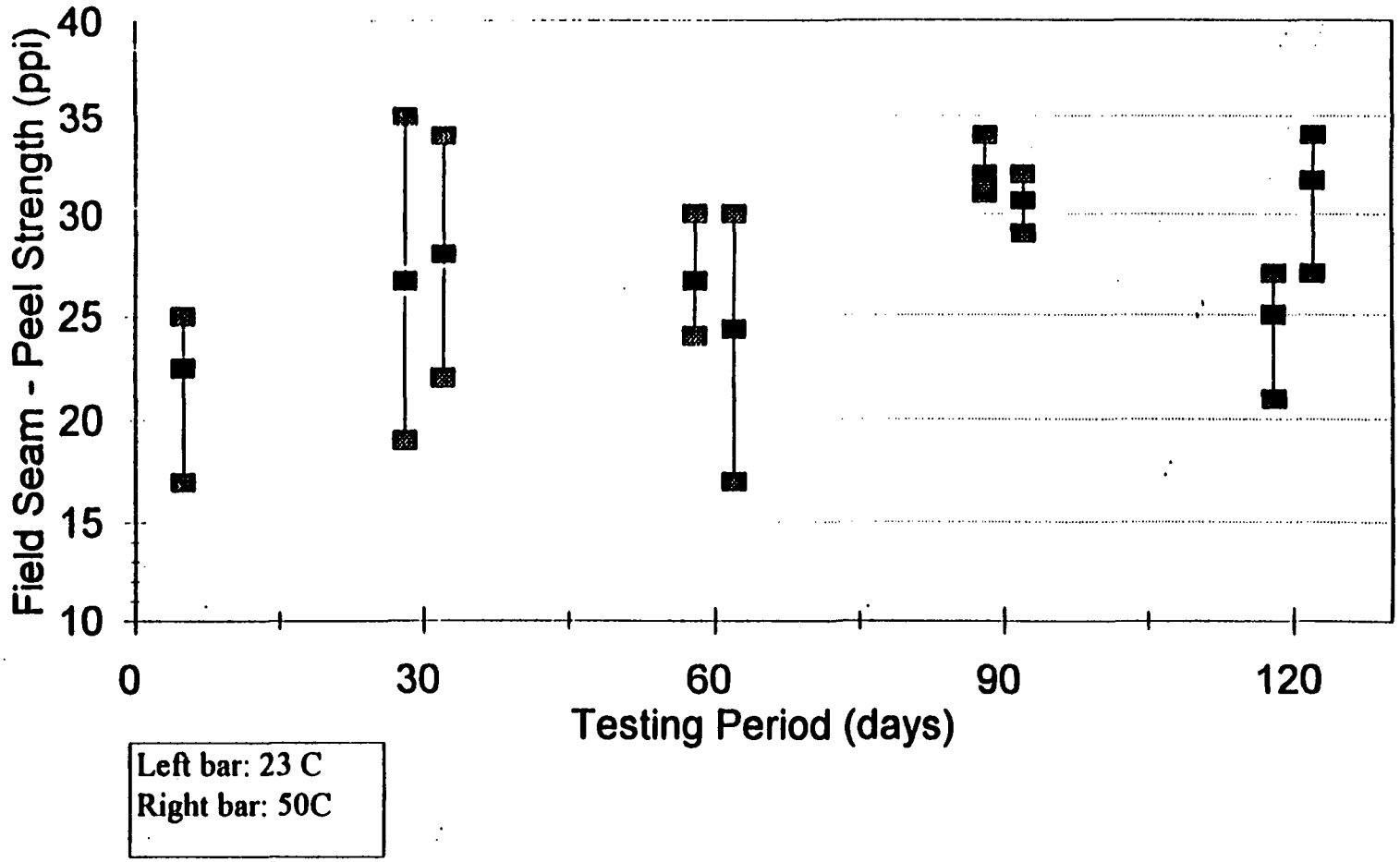



FMC CORPORATION EPA METHOD 9090
30 mil PVC GM vs FMC leachate
Indentation Hardness - "D" Durometer
95
90
85
80
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
30 mil PVC GM vs FMC leachate
Hydrostatic Resistance (psi)
120
110
100
90
80
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

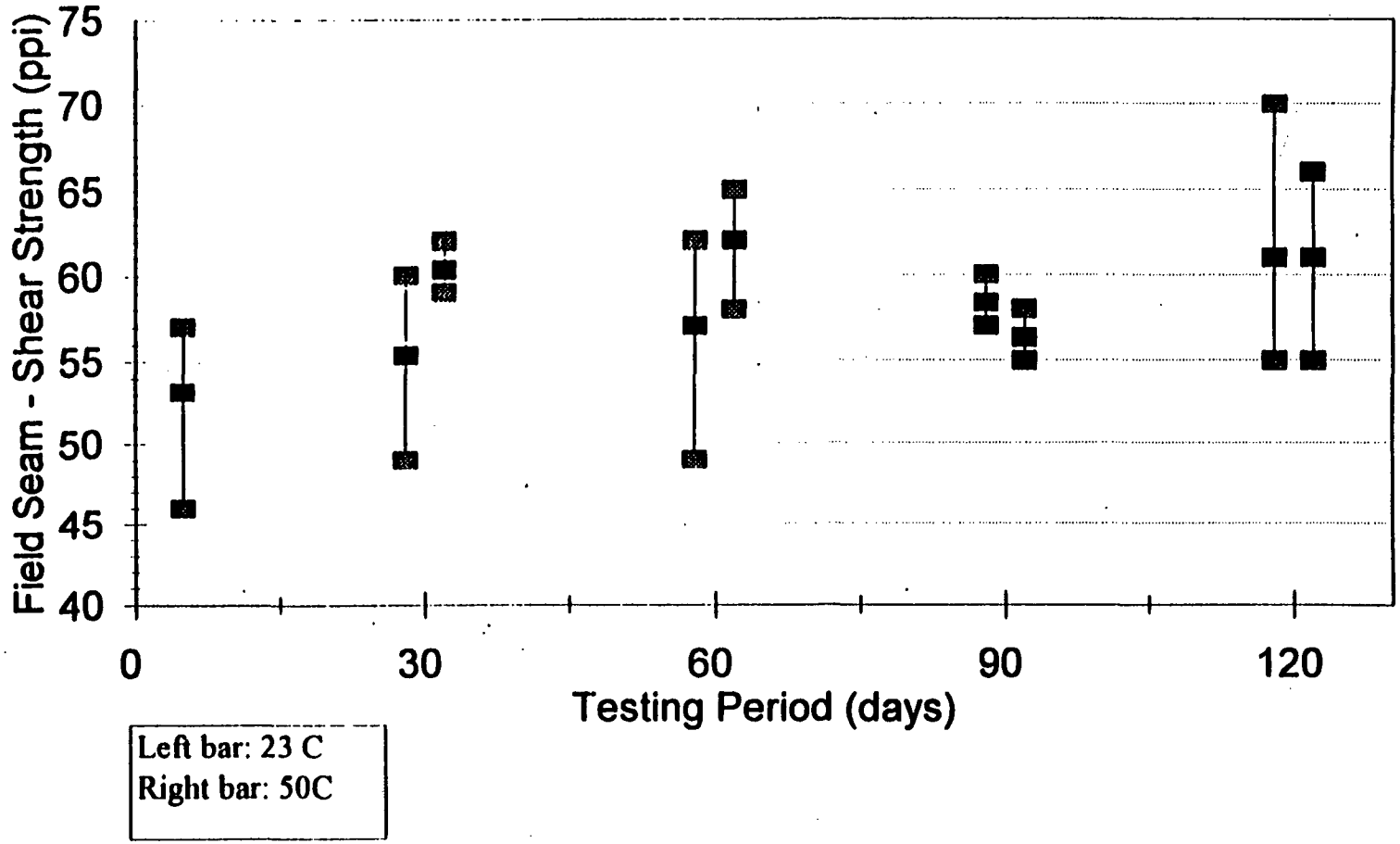
FMC CORPORATION EPA METHOD 9090

30 mil PVC Seam vs FMC leachate



FMC CORPORATION EPA METHOD 9090

30 mil PVC Seam vs FMC leachate



EPA METHOD 9090 TEST RESULTS

HOECHST CELANESE TREVIRA 1120 6 oz. GEOTEXTILE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 12, 1995
Reissued (October 22, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Grab:									
Grab Strength (lb)	191	176	162	205	186	224	193	199	166
ASTM D4632	213	204	182	202	180	206	143	214	174
Machine Direction	187	242	173	237	214	158	166	186	160
	204	204	174	201	216	174	172	193	173
	187	227	169	203	185	146	188	181	185
	230								
	257								
	256								
	258								
	237								
Average	222	211	172	210	196	182	172	195	172
STD	28	23	7	14	15	29	18	11	8
Coefficient of Variation	13	11	4	7	8	16	10	6	5
% Change		-5	-23	-6	-12	-18	-22	-12	-23
Grab Elongation (%)	75	65	68	63	63	93	84	78	80
ASTM D4632	88	65	81	60	67	69	63	96	83
Machine Direction	75	79	65	67	67	136	68	87	80
	79	75	77	64	75	73	68	92	93
	73	73	72	63	68	69	73	85	89
	75								
	80								
	76								
	79								
	75								
Average	78	71	73	63	68	88	71	88	85
STD	4	6	6	2	4	26	7	6	5
Coefficient of Variation	5	8	8	4	6	29	10	7	6
% Change		-8	-6	-18	-12	14	-8	13	10

SRA
Quality Review

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 12, 1995
Reissued (October 22, 1997)

Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Grab:									
Grab Strength (lb)	167	165	135	138	155	150	139	215	187
ASTM D4632	160	152	157	148	152	145	151	158	200
Transverse Direction	175	147	138	143	179	138	134	225	187
	189	165	139	141	151	148	130	177	215
	177	140	154	145	158	146	129	188	192
	157								
	158								
	160								
	147								
	175								
Average	167	154	145	143	159	145	137	193	196
STD	12	10	9	3	10	4	8	25	11
Coefficient of Variation	7	6	6	2	6	3	6	13	5
% Change		-8	-13	-14	-5	-13	-18	16	18
Grab Elongation (%)	99	92	76	79	92	96	85	79	79
ASTM D4632	97	84	89	81	81	92	83	107	76
Transverse Direction	97	89	93	77	109	97	84	100	73
	99	99	91	67	80	97	75	75	75
	92	83	99	81	99	92	92	63	72
	85								
	95								
	87								
	83								
	91								
Average	93	89	90	77	92	95	84	85	75
STD	6	6	8	5	11	2	5	16	2
Coefficient of Variation	6	7	8	7	12	2	6	19	3
% Change		-3	-3	-17	-0	2	-9	-8	-19

SRA
Quality Review

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 12, 1995
Reissued (October 22, 1997)

Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tear Resistance:									
Trapezoidal Tear Strength (lb)	93	67	74	74	77	68	82	74	82
ASTM D4533	89	71	67	77	75	57	74	65	90
Machine Direction	76	80	74	75	75	70	82	63	69
	80	63	78	72	80	71	62	65	74
	115	64	66	77	81	67	82	63	74
	94								
	71								
	110								
	79								
	86								
Average	89	69	72	75	78	67	76	66	78
STD	14	6	5	2	2	5	8	4	7
Coefficient of Variation	15	9	6	3	3	8	10	6	9
% Change		-23	-20	-16	-13	-25	-14	-26	-13
Tear Resistance:									
Trapezoidal Tear Strength (lb)	87	89	112	82	85	108	66	91	116
ASTM D4533	123	81	91	70	111	77	70	105	120
Transverse Direction	99	77	84	84	125	66	73	104	96
	99	95	126	74	112	88	64	94	106
	114	69	87	73	111	69	74	98	114
	120								
	74								
	96								
	97								
	125								
Average	103	82	100	77	109	82	69	98	110
STD	16	9	16	5	13	15	4	5	9
Coefficient of Variation	15	11	16	7	12	19	6	6	8
% Change		-21	-3	-26	5	-21	-33	-5	7
Puncture:									
Load @ Rupture (lb)	105	79	84	73	97	78	86	94	83
ASTM D4833	90	79	74	83	110	89	96	82	104
	111	91	98	88	92	83	107	84	91
	96	56	96	92	86	84	81	77	83
	103	85	80	80	92	88	99	93	68
	79								
	117								
	123								
	102								
	83								
Average	101	78	86	83	95	84	94	86	86
STD	13	12	9	7	8	4	9	7	12
Coefficient of Variation	13	15	11	8	8	5	10	8	14
% Change		-23	-14	-18	-5	-16	-7	-15	-15

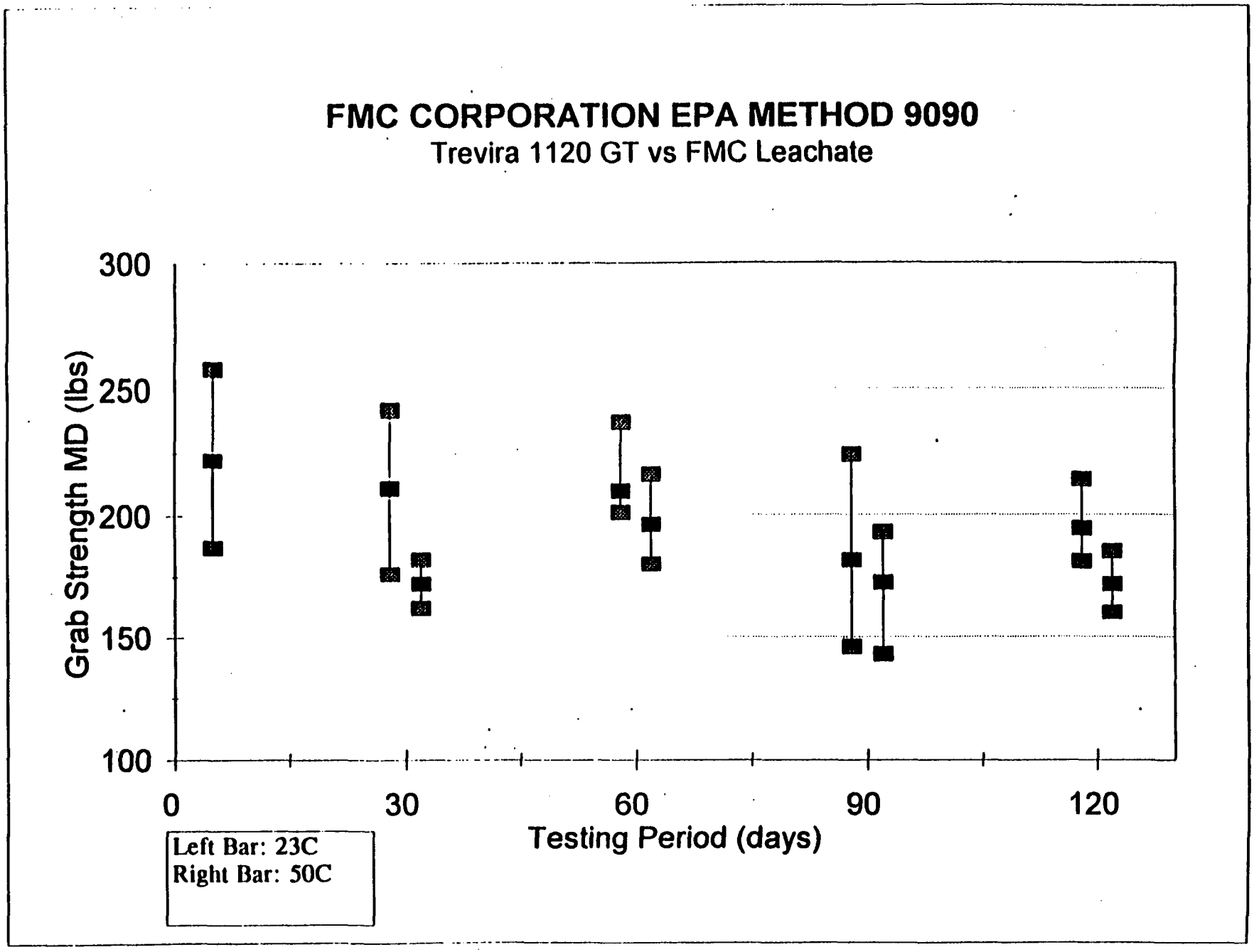
SR4

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 12, 1995
Reissued (October 22, 1997)

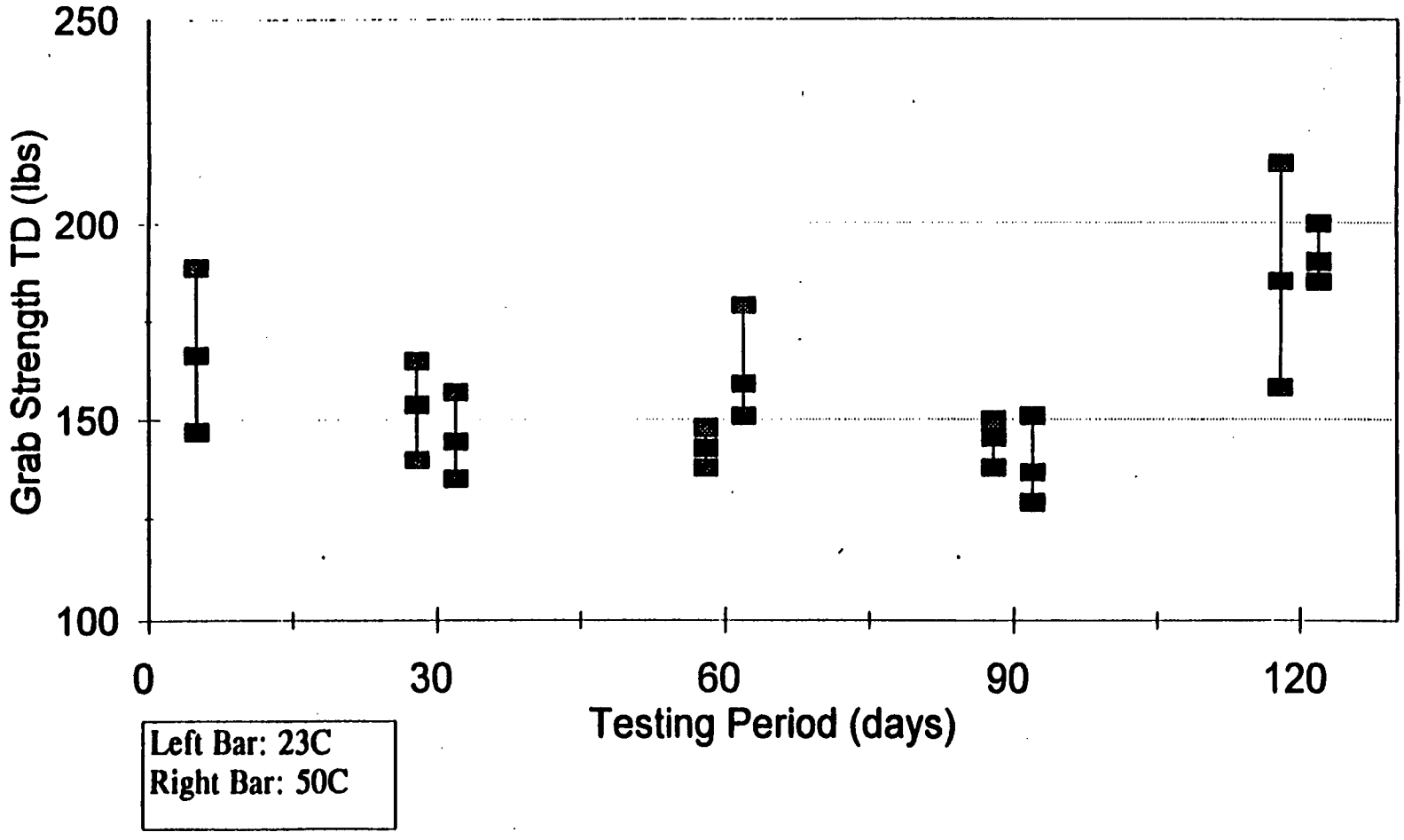
Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Permittivity:									
(gal/min/ft2)	129	143	160	127	141	133	127	150	140
ASTM D4491	158	143	151	135	153	123	128	147	149
	150	162	153	132	142	95	134	157	161
	144	163	149	132	132	125	122	150	156
	147	160	155	125	145	136	132	151	163
	165								
	156								
	145								
	149								
	159								
Average	150	154	154	130	143	122	129	151	154
STD	10	9	4	4	7	15	4	3	8
Coefficient of Variation	6	6	2	3	5	12	3	2	5
% Change		3	2	-13	-5	-19	-14	1	2
Mullen Burst:									
Burst Strength (psi)	310	280	280	280	280	250	290	290	260
ASTM D3786	270	280	285	240	250	280	275	250	255
	290	280	295	260	220	270	330	300	265
	280	285	295	240	280	270	280	300	300
	320	265	305	275	280	250	280	230	330
	250								
	260								
	265								
	310								
	350								
Average	291	278	292	259	262	264	291	274	282
STD	30	7	9	17	24	12	20	29	29
Coefficient of Variation	10	2	3	7	9	5	7	10	10
% Change		-4	1	-11	-10	-9	0	-6	-3

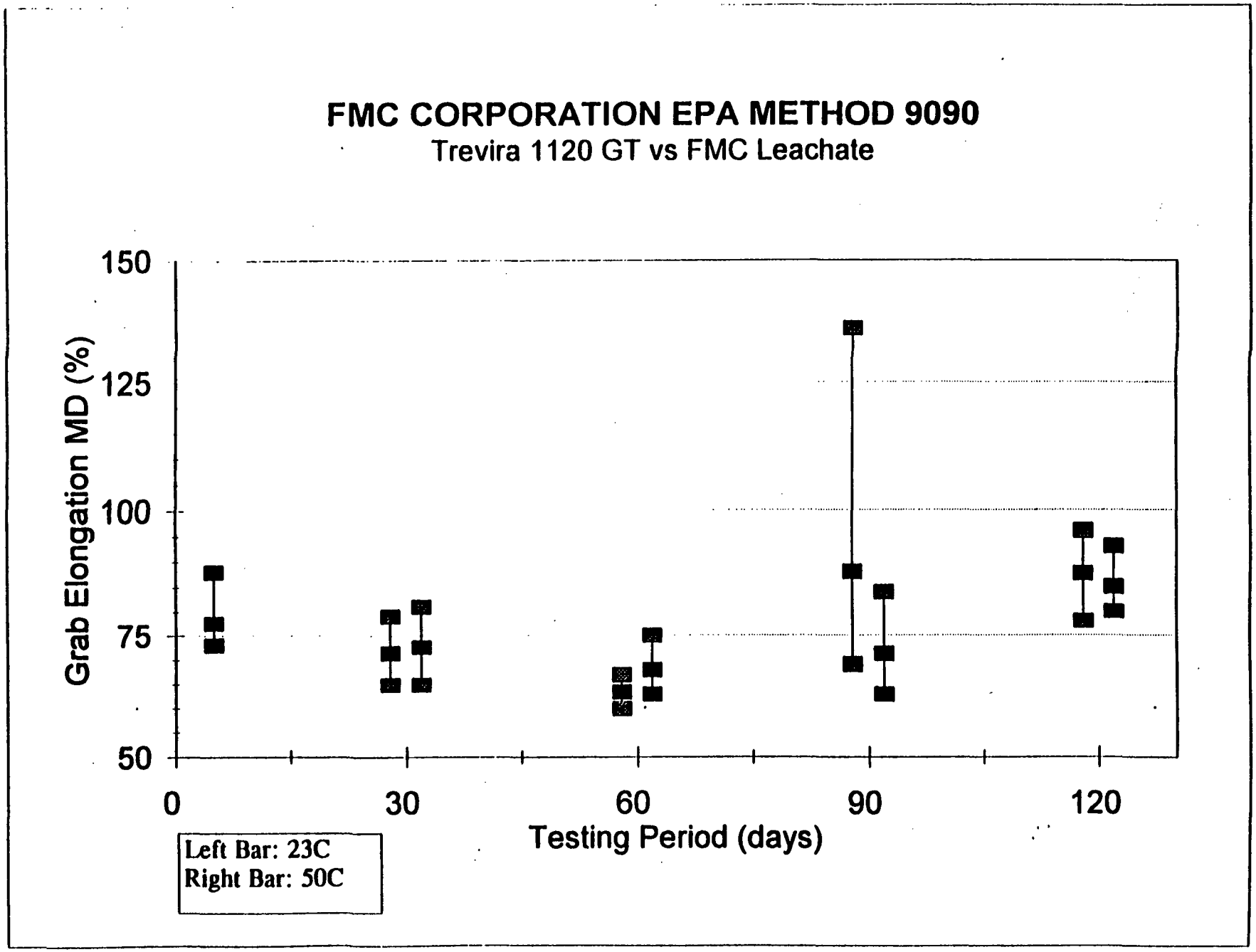
SRA
Quality Review


FMC CORPORATION EPA METHOD 9090
Trevira 1120 GT vs FMC Leachate
Grab Strength MD (lbs)
300
250
200
150
100
0
30
60
90
120
Testing Period (days)
Left Bar: 23C
Right Bar: 50C

FMC CORPORATION EPA METHOD 9090

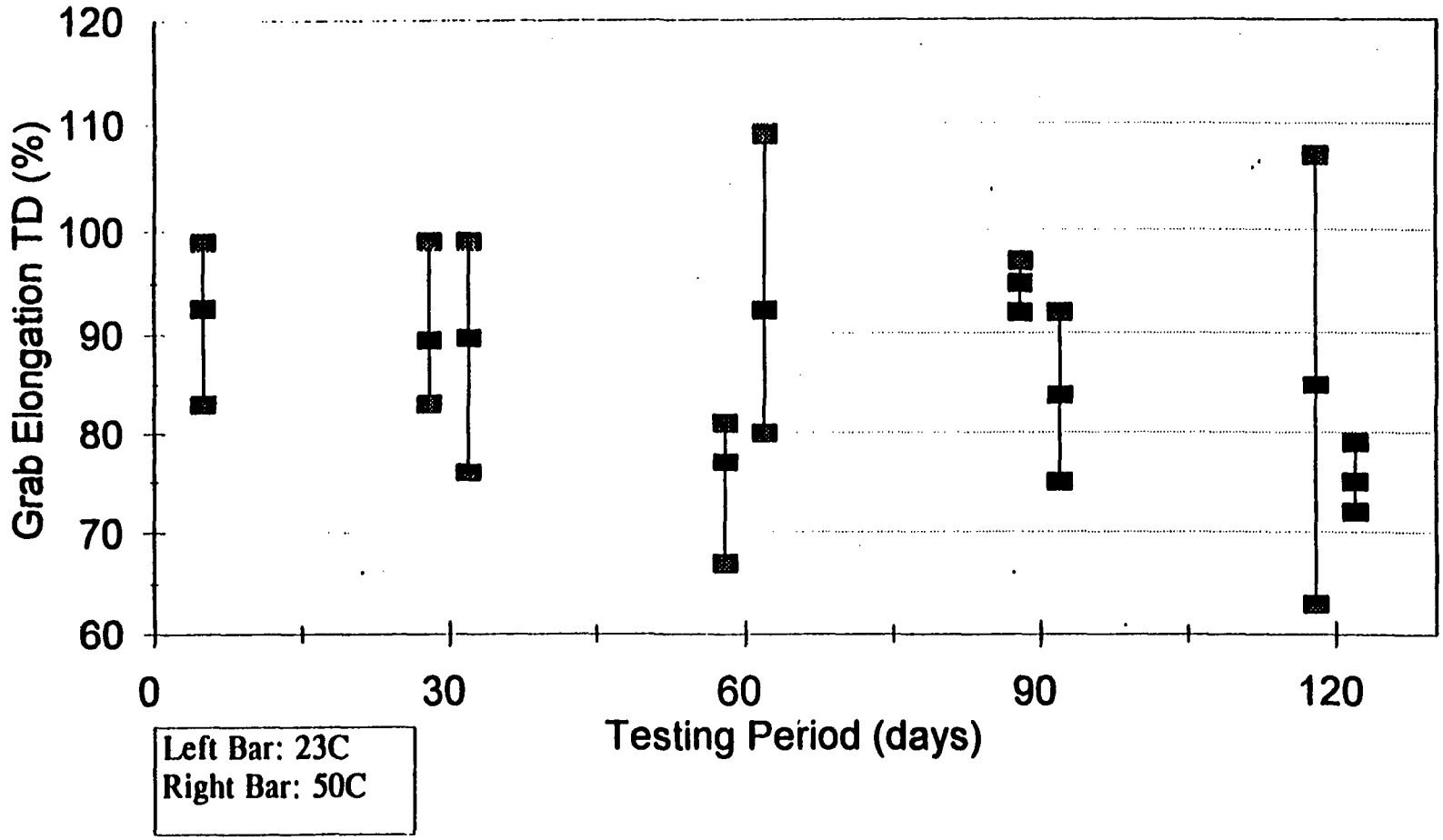
Trevira 1120 GT vs FMC Leachate




FMC CORPORATION EPA METHOD 9090
Trevira 1120 GT vs FMC Leachate
Grab Elongation MD (%)
150
125
100
75
50
0
30
60
90
120
Testing Period (days)
Left Bar: 23C
Right Bar: 50C

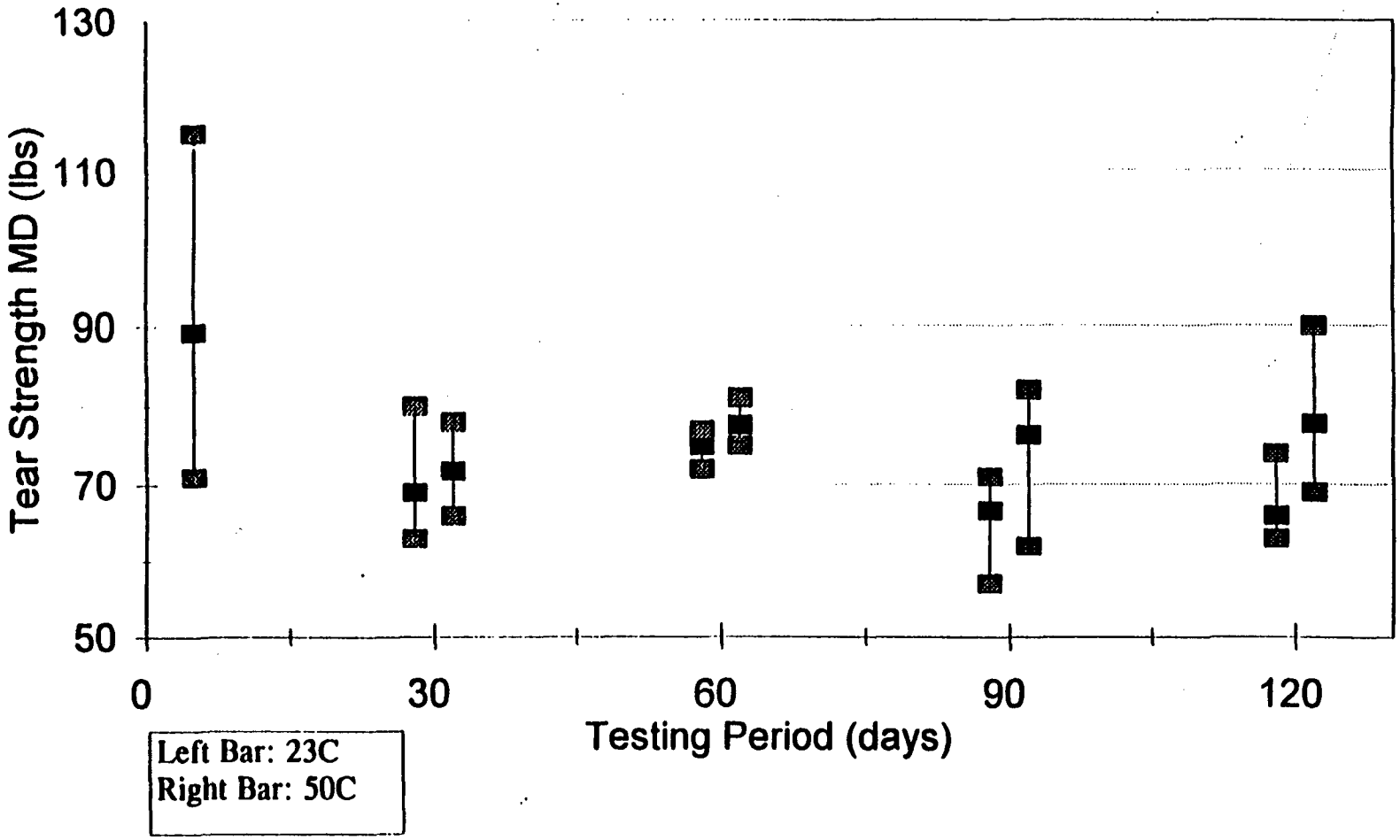
FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate



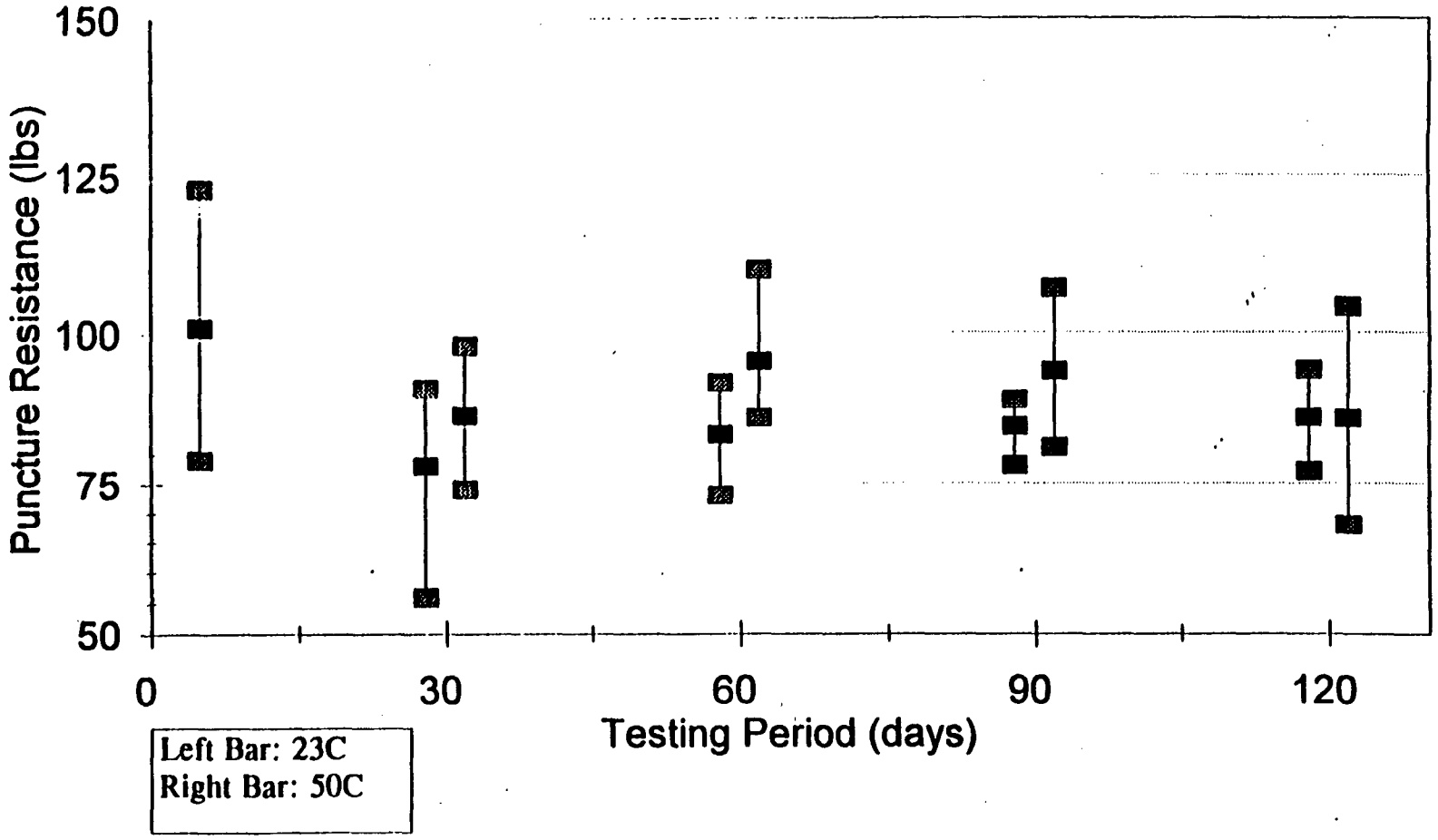
FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate



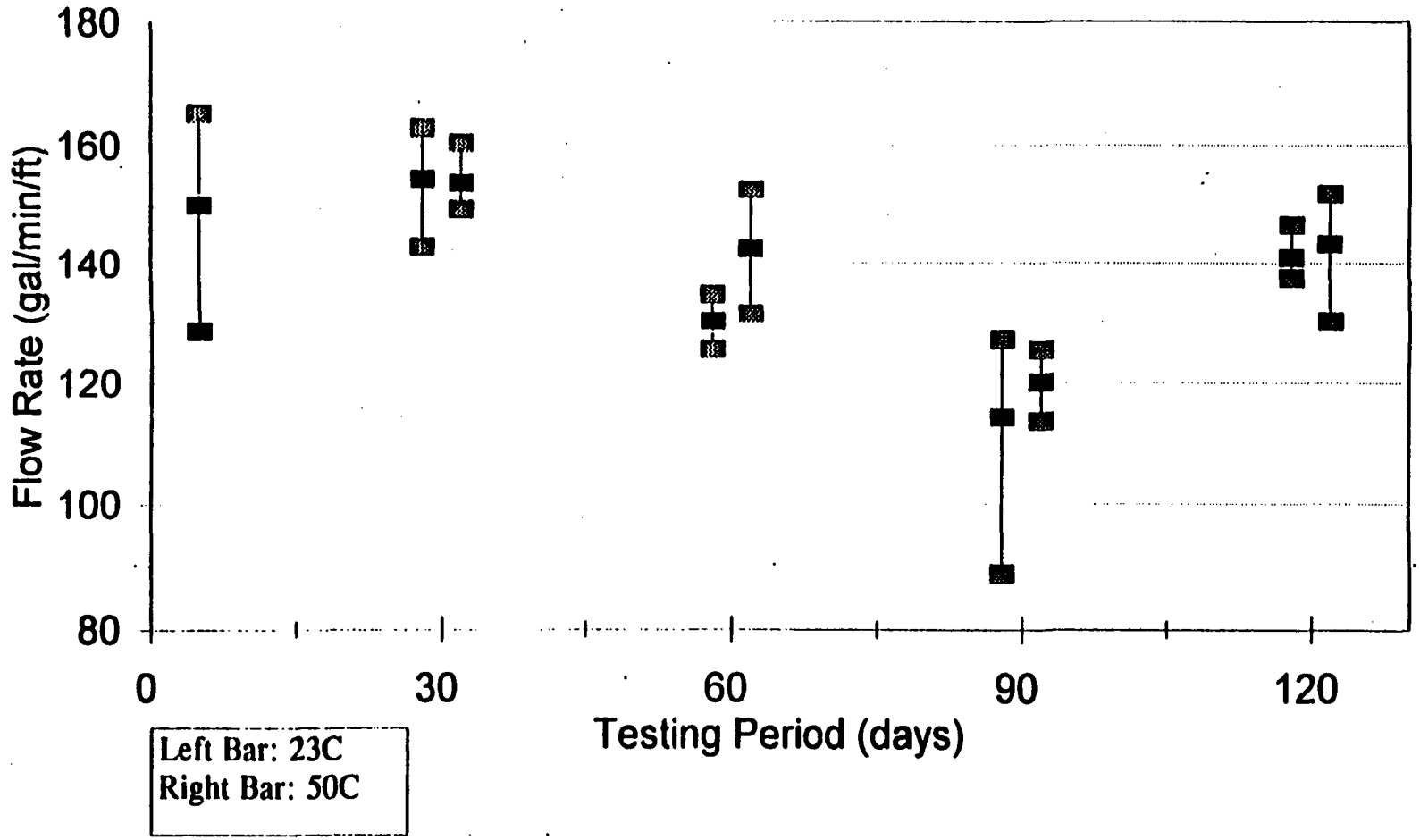
FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate



FMC CORPORAT EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate



EPA METHOD 9090 TEST RESULTS

NATIONAL SEAL POLYNET 3000 HDPE GEONET

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

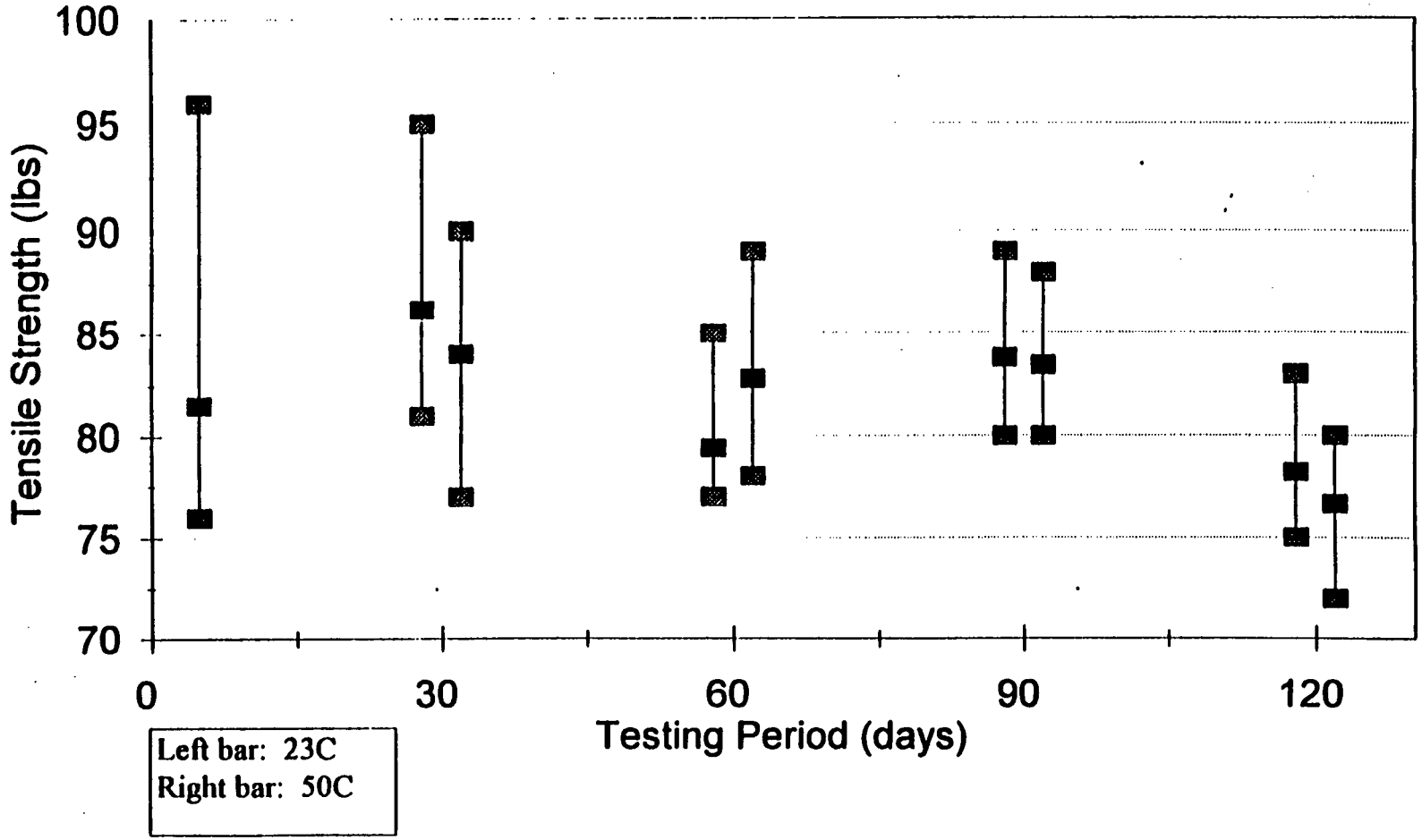
Report Date: June 12, 1995
Reissued (October 21, 1997)

SRA
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
GEONET: NATIONAL SEAL POLYNET 3000 HDPE GEONET									
Tensile Properties:									
Load at Break (lbs/in)	96	84	84	85	81	80	83	77	74
Machine Direction	82	89	77	77	89	81	88	80	78
ASTM D1682	79	95	86	78	78	88	81	76	80
	84	82	90	77	79	81	85	83	72
	77	81	83	80	87	89	80	75	79
	84								
	81								
	78								
	78								
	76								
Average	82	86	84	79	83	84	83	78	77
STD	6	5	4	3	4	4	3	3	3
Coefficient of Variation	7	6	5	4	5	5	3	4	4
% Change		6	3	-3	2	3	2	-4	-6
Load at Break (lbs/in)	53	50	55	54	54	55	53	51	55
Transverse Direction	54	54	54	54	52	54	55	49	54
ASTM D1682	55	51	56	54	53	52	53	52	54
	57	55	59	55	53	56	55	54	54
	55	55	56	54	53	55	52	53	53
	52								
	55								
	53								
	51								
	53								
Average	54	53	56	54	53	54	54	52	54
STD	2	2	2	0	1	1	1	2	1
Coefficient of Variation	3	4	3	1	1	2	2	3	1
% Change		-1	4	1	-1	1	-0	-4	0
Transmissivity:	1.71E-03	N/A	N/A	1.38E-03	1.39E-03	N/A	N/A	1.51E-03	1.41E-03
ASTM D4716 (m2/sec)	1.64E-03	N/A	N/A	1.50E-03	1.36E-03	N/A	N/A	1.42E-03	1.48E-03
Machine Direction	1.57E-03	N/A	N/A	1.52E-03	1.39E-03	N/A	N/A	1.34E-03	1.41E-03
Hydraulic Grad 1.0	1.67E-03								
Compressive Load 10000 psf	1.71E-03								
	1.69E-03								
Average	1.67E-03			1.47E-03	1.38E-03			1.42E-03	1.43E-03
STD	4.89E-05			6.18E-05	1.41E-05			6.94E-05	3.30E-05
Coefficient of Variation	2.94E+00			4.22E+00	1.02E+00			4.88E+00	2.30E+00
% Change				-12	-17			-15	-14

FMC CORPORATION EPA METHOD 9090

NSC Polynet 3000 GN vs. FMC Leachate



EPA METHOD 9090 TEST RESULTS

PLEXCO 6" IPS 17.0 PE3408 OIL & GAS GATHER HDPE GEOPIPE

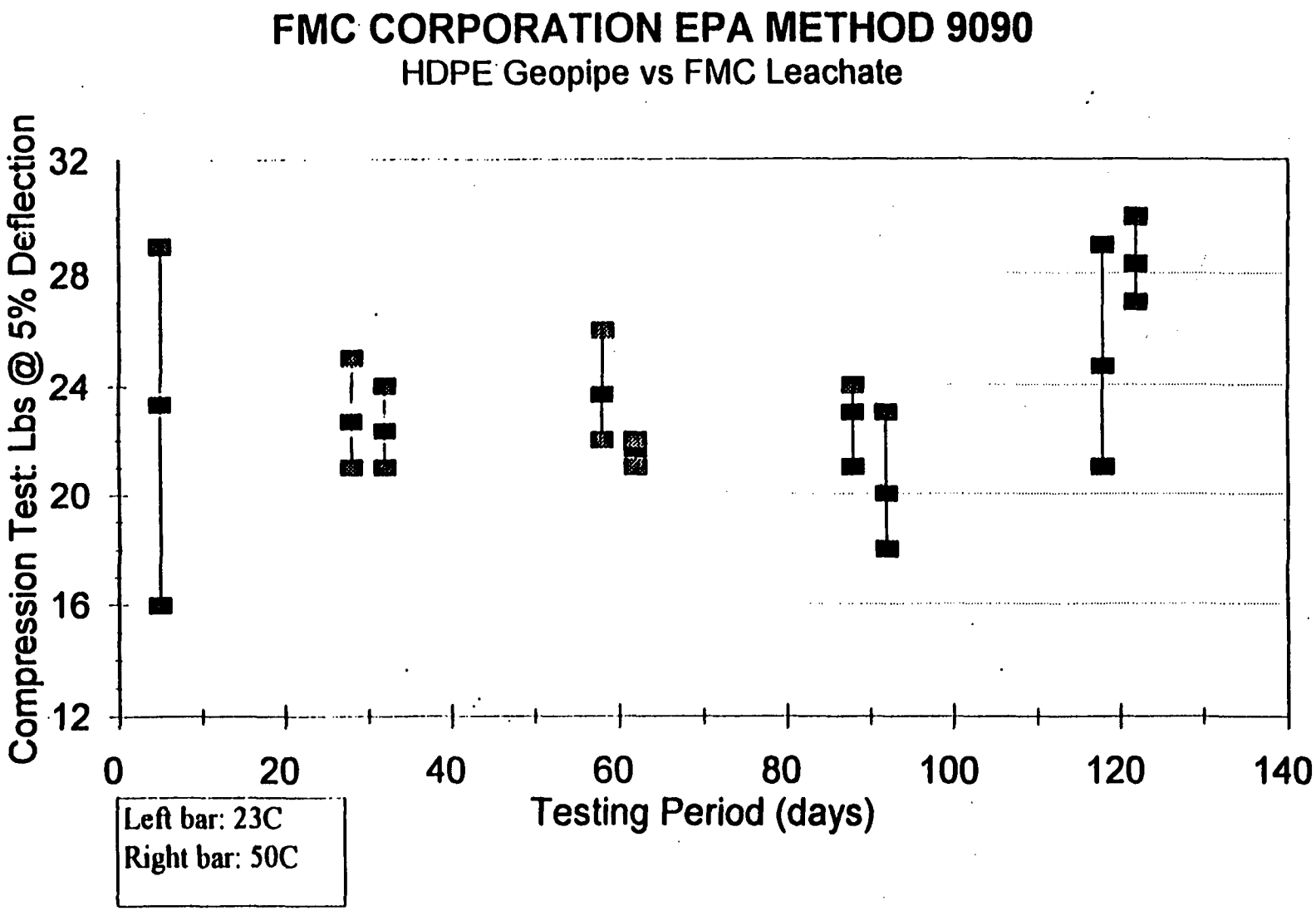
TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

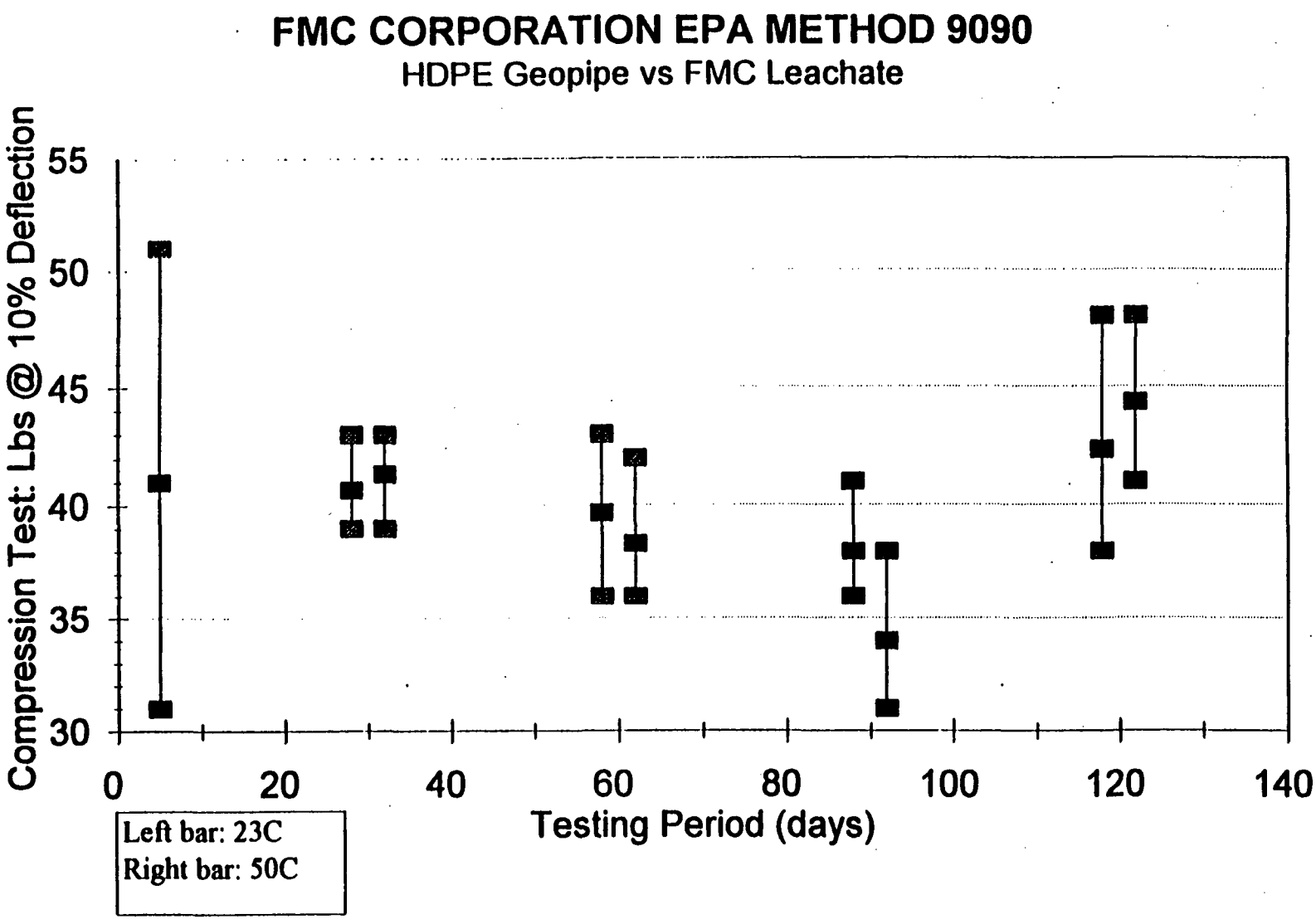
Report Date: June 12, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature						Quality Review	

GEOPIPE: PLEXCO 6" IPS 17.0 PE3408 OIL & GAS GATHER HDPE GEOPIPE

Compression Test:	29	21	22	23	22	24	23	29	30
Load @ 5% deflection (lb)	20	25	24	26	22	21	18	21	27
ASTM D2412	28	22	21	22	21	24	19	24	28
	19								
	28								
	16								
Average	23	23	22	24	22	23	20	25	28
STD	5	2	1	2	0	1	2	3	1
Coefficient of Variation	22	7	6	7	2	6	11	13	4
% Change		-3	-4	1	-7	-1	-14	6	21
Compression Test:	51	40	39	36	42	36	38	48	48
Load @ 10% deflection (lb)	38	43	43	40	36	37	33	38	41
ASTM D 2412	46	39	42	43	37	41	31	41	44
	36								
	44								
	31								
Average	41	41	41	40	38	38	34	42	44
STD	7	2	2	3	3	2	3	4	3
Coefficient of Variation	16	4	4	7	7	6	9	10	6
% Change		-1	1	-3	-7	-7	-17	3	8


FMC CORPORATION EPA METHOD 9090
HDPE Geopipe vs FMC Leachate
Compression Test: Lbs @ 5% Deflection
32
28
24
20
16
12
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
HDPE Geopipe vs FMC Leachate
Compression Test: Lbs @ 10% Deflection
55
50
45
40
35
30
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23C
Right bar: 50C

EPA METHOD 9090 TEST RESULTS

GEOSYNTHETIC DIMENSIONS

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Dimensional Stability Data — Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

SRA
Quality Review

Exposure Time and Temperature

Test Parameters	Temp.	30 Day Baseline	30 Day Exposed	30 Day % Change	60 Day Baseline	60 Day Exposed	60 Day % Change	90 Day Baseline	90 Day Exposed	90 Day % Change	120 Day Baseline	120 Day Exposed	120 Day % Change
GEOMEMBRANE: SERROT 60 mil TEXTURED HDPE GEOMEMBRANE													
Thickness (mils)	23C	60	58	-3.3	57	57	0.0	59	57	-3.4	59	62	5.1
	50C	61	61	0.0	58	59	1.7	62	60	-3.2	60	59	-1.7
Length (inches)	23C	10.04	10.03	-0.1	10.00	10.00	0.0	10.00	9.99	-0.1	9.98	10.00	0.2
	50C	10.00	9.99	-0.1	10.01	9.99	-0.2	10.03	10.04	0.1	10.00	10.01	0.1
Width (inches)	23C	8.13	8.11	-0.2	8.22	8.22	0.0	8.15	8.16	0.1	8.20	8.18	-0.2
	50C	8.22	8.22	0.0	8.26	8.26	0.0	8.09	8.10	0.1	8.14	8.13	-0.1
Mass (g)	23C	85.04	85.09	0.1	82.02	82.01	-0.0	85.22	85.18	-0.0	81.76	82.38	0.8
	50C	85.75	86.20	0.5	86.37	86.35	-0.0	85.37	85.45	0.1	85.69	86.64	1.1
GEOMEMBRANE: STAFF INDUSTRIES 30 Mil PVC GEOMEMBRANE													
Thickness (mils)	23C	28	29	3.6	29	29	0.0	28	30	7.1	28	29	3.6
	50C	29	29	0.0	28	29	3.6	28	29	3.6	28	29	3.6
Length (inches)	23C	9.98	9.99	0.1	10.02	9.96	-0.6	10.02	9.98	-0.4	9.99	9.94	-0.5
	50C	10.01	9.90	-1.1	10.03	10.00	-0.3	10.01	9.87	-1.4	10.01	9.86	-1.5
Width (inches)	23C	7.98	8.00	0.3	8.02	8.02	0.0	7.98	8.00	0.3	8.01	8.03	0.2
	50C	7.99	8.03	0.5	8.00	7.99	-0.1	7.99	8.04	0.6	8.01	8.02	0.1
Mass (g)	23C	46.70	46.71	0.0	47.52	47.35	-0.4	47.80	47.52	-0.6	46.53	46.62	0.2
	50C	46.95	47.39	0.9	47.36	47.22	-0.3	47.52	46.59	-2.0	47.13	47.02	-0.2

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Dimensional Stability Data — Exposed to NOSAP Precipitator Slurry

SR4
Quality Review

Report Date: June 13, 1995
Reissued (October 21, 1997)

Exposure Time and Temperature

Test Parameters	Temp.	30 Day Baseline	30 Day Exposed	30 Day % Change	60 Day Baseline	60 Day Exposed	60 Day % Change	90 Day Baseline	90 Day Exposed	90 Day % Change	120 Day Baseline	120 Day Exposed	120 Day % Change
GEOTEXTILE: HOECHST CELANESE TREVIRA 1120 6oz. GEOTEXTILE													
Thickness (mils)	23C	73	81	11.0	83	89	7.2	83	93	12.0	81	99	22.2
	50C	85	89	4.7	74	85	14.9	83	94	13.3	77	82	6.5
Length (inches)	23C	8.04	8.06	0.2	8.00	7.98	-0.2	8.03	8.12	1.1	8.00	8.17	2.1
	50C	8.03	8.04	0.1	8.02	7.90	-1.5	7.99	8.04	0.6	8.02	7.95	-0.9
Width (inches)	23C	4.02	4.02	0.0	4.03	4.02	-0.2	4.01	3.98	-0.7	4.04	4.03	-0.2
	50C	4.02	3.98	-1.0	4.01	3.90	-2.7	4.05	3.98	-1.7	4.03	3.94	-2.2
Mass (g)	23C	4.24	4.34	2.4	4.27	4.50	5.4	4.30	4.49	4.4	4.39	4.78	8.9
	50C	4.27	4.31	0.9	4.16	4.40	5.8	4.48	4.44	-0.9	4.22	4.24	0.5
GEONET: NATIONAL SEAL POLYNET 3000 HDPE GEONET													
Thickness (mils)	23C	226	225	-0.4	225	228	1.3	228	229	0.4	224	225	0.4
	50C	226	228	0.9	223	224	0.4	223	225	0.9	228	223	-2.2
Length (inches)	23C	5.45	5.45	0.0	5.62	5.62	0.0	5.68	5.67	-0.2	5.82	5.82	0.0
	50C	5.44	5.43	-0.2	5.40	5.41	0.2	5.72	5.74	0.3	5.60	5.55	-0.9
Width (inches)	23C	1.93	1.92	-0.5	1.95	1.94	-0.5	2.00	2.01	0.5	1.99	2.00	0.5
	50C	2.00	1.98	-1.0	1.99	1.99	0.0	1.98	1.98	0.0	1.93	1.96	1.6
Mass (g)	23C	8.56	8.55	-0.1	8.85	8.85	0.0	9.49	9.48	-0.1	9.66	9.67	0.1
	50C	8.87	8.89	0.2	8.67	8.77	1.2	9.35	9.34	-0.1	8.77	8.82	0.6

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Dimensional Stability Data — Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

Exposure Time and Temperature

SRA
Quality Review

Test Parameters	Temp.	Baseline	30 Day Exposed	% Change	Baseline	60 Day Exposed	% Change	Baseline	90 Day Exposed	% Change	Baseline	120 Day Exposed	% Change
GEOPIPE: PLEXCO 6" IPS 17.0 PE3408 OIL & GAS GATHER HDPE GEOPIPE													
Thickness (inches)	23C	0.417	0.415	-0.5	0.417	0.420	0.7	0.415	0.413	-0.5	0.423	0.429	1.3
	50C	0.418	0.417	-0.2	0.420	0.422	0.5	0.416	0.417	0.2	0.419	0.421	0.5
Width (inches)	23C	1.017	1.028	1.1	1.018	1.018	0.0	1.015	1.016	0.1	1.015	1.015	0.0
	50C	1.019	1.029	1.0	1.023	1.030	0.7	1.019	1.019	0.0	1.013	1.013	-0.1
Mass (g)	23C	129.19	129.23	0.0	129.38	130.79	1.1	129.34	129.28	-0.0	129.49	129.57	0.1
	50C	129.63	129.66	0.0	130.77	129.45	-1.0	130.24	130.21	-0.0	129.93	130.02	0.1

GSE™

GSE Lining Technology, Inc.

19103 Gundle Road
Houston, Texas 77073
800-435-2008
713-443-8564
Fax: 713-875-6010

10 September, 1997

Bechtel Corporation
50 Beale Street
San Franscico, CA 94105

Attn: Michael Kostanian

Re: Chemical Resistance of Polyethylene Geomembranes

GSE geomembranes are made of high quality, virgin polyethylene resin which demonstrates excellent chemical resistance. GSE polyethylene geomembranes are resistant to a great number and combinations of chemicals. It is this property of HDPE geomembranes that makes it the lining material of choice.

The chemical resistance of polyethylene has been investigated by many people over the past several decades. We are able to draw from that work when making statements about the chemical resistance of today's polyethylene geomembranes. In addition to that, many tests have been performed that specifically use geomembranes and certain chemical mixtures. Naturally, however, every mixture of chemicals cannot be tested for. Please refer to the attached chemical resistance data sheet for polyethylene.

Polyethylene is, for practical purposes, considered impermeable. Be aware, however, that all materials are permeable to some extent that varies with concentration, temperature, pressure and type of permeant. The rates of permeation are so low, however, that they are usually insignificant. In general, oxidizing chemicals are the only substances that can degrade polyethylene. For example, long term containment of concentrated sulphuric acid is not recommended.

In the case of containment of phosphene and elemental phosphorous in the project you described, GSE recommends HDPE liner. HDPE can withstand exposure to phosphene and elemental phosphorous for many years without any permanent damage (provided the temperature is less than 30 °C); we cannot make any guarantee of *maximum* exposure time.

If you have any questions, please feel free to call or fax.

Regards,

Matt Adams

Matthew W. Adams
Technical Support
Chemist

Chemical Resistance

For environmental lining solutions...the world comes to GSE.

GSE is the world's leading supplier of high quality, polyethylene geomembranes. GSE polyethylene geomembranes are resistant to a great number and combinations of chemicals. Note that the effect of chemicals on any material is influenced by a number of variable factors such as temperature, concentration, exposed area and duration. Many tests have been performed that use geomembranes and certain specific chemical mixtures. Naturally, however, every mixture of chemicals cannot be tested for, and various criteria may be used to judge performance. Reported performance ratings may not apply to all applications of a given material in the same chemical. Therefore, these ratings are offered as a guide only.

Abbreviations

S = Satisfactory
L = Limited application possible
U = Unsatisfactory
— = Not tested

Concentration

sat. sol. = Saturated aqueous solution, prepared at 20°C (68°F)
sol. = aqueous solution with concentration above 10% but below saturation level
dil. sol. = diluted aqueous solution with concentration below 10%
cust. conc. = customary service concentration

Medium	Concentration	Resistance at: 20 °C (68 °F)	60 °C (140 °F)
A			
Acetic acid	100%	S	L
Acetic acid	10%	S	S
Acetic acid anhydride	100%	S	L
Acetone	100%	L	L
Adipic acid	sat. sol.	S	S
Allyl alcohol	96%	S	S
Aluminum chloride	sat. sol.	S	S
Aluminum fluoride	sat. sol.	S	S
Aluminum sulfate	sat. sol.	S	S
Alum	sol.	S	S
Ammonia, aqueous	dil. sol.	S	S
Ammonia, gaseous dry	100%	S	S
Ammonia, liquid	100%	S	S
Ammonium chloride	sat. sol.	S	S
Ammonium fluoride	sol.	S	S
Ammonium nitrate	sat. sol.	S	S
Ammonium sulfate	sat. sol.	S	S
Ammonium sulfide	sol.	S	S
Amyl acetate	100%	S	L
Amyl alcohol	100%	S	L
Aniline	100%	S	L
Antimony trichloride	90%	S	S
Arsenic acid	sat. sol.	S	S
Aqua regia	HCl-HNO33/1	U	U
B			
Barium carbonate	sat. sol.	S	S
Barium chloride	sat. sol.	S	S
Barium hydroxide	sat. sol	S	S
Barium sulfate	sat. sol	S	S
Barium sulfide	sol.	S	S
Benzaldehyde	100%	S	L
Benzene	—	L	L
Benzoic acid	sat. sol.	S	S
Beer	—	S	S
Borax (sodium tetraborate)	sat. sol.	S	S
Boric acid	sat. sol	S	S
Bromine, gaseous dry	100%	U	U
Bromine, liquid	100%	U	U
Butane, gaseous	100%	S	S
1-Butanol	100%	S	S
Butyric acid	100%	S	L
C			
Calcium carbonate	sat. sol.	S	S
Calcium chlorate	sat. sol.	S	S
Calcium chloride	sat. sol.	S	S
Calcium nitrate	sat. sol.	S	S
Calcium sulfate	sat. sol	S	S
Calcium sulfide	dil. sol.	L	L
Carbon dioxide, gaseous dry	100%	S	S
Carbon disulfide	100%	L	U
Carbon monoxide	100%	S	S
Chloracetic acid	sol.	S	S
Carbon tetrachloride	100%	L	U
Chlorine, aqueous solution	sat. sol.	L	U
Chlorine, gaseous dry	100%	L	U
Chloroform	100%	U	U
Chromic acid	20%	S	L
Chromic acid	50%	S	L
Citric acid	sat. sol.	S	S
Copper chloride	sat. sol.	S	S
Copper nitrate	sat. sol.	S	S
Copper sulfate	sat. sol.	S	S
Cresylic acid	sat. sol.	L	—
Cyclohexanol	100%	S	S
Cyclohexanone	100%	S	L
D			
Decahydronaphthalene	100%	S	L
Dextrine	sol.	S	S
Diethyl ether	100%	L	—
Dioctylphthalate	100%	S	L
Dioxane	100%	S	S
E			
Ethanediol	100%	S	S
Ethanol	40%	S	L
Ethyl acetate	100%	S	U
Ethylene trichloride	100%	U	U
F			
Ferric chloride	sat. sol.	S	S
Ferric nitrate	sol.	S	S
Ferric sulfate	sat. sol.	S	S
Ferrous chloride	sat. sol.	S	S
Ferrous sulfate	sat. sol.	S	S
Fluorine, gaseous	100%	U	U
Fluorosilicic acid	40%	S	S
Formaldehyde	40%	S	S
Formic acid	50%	S	S
Formic acid	98-100%	S	S
Furfuryl alcohol	100%	S	L
G			
Gasoline	—	S	L
Glacial acetic acid	96%	S	L
Glucose	sat. sol.	S	S
Glycerine	100%	S	S
Glycol	sol.	S	S
H			
Heptane	100%	S	U
Hydrobromic acid	50%	S	S

(CONTINUED ON OTHER SIDE)

(S) Satisfactory: *Liner material is resistant to the given reagent at the given concentration and temperature. No mechanical or chemical degradation is observed.*
(L) Limited Application Possible: *Liner material may reflect some attack. Factors such as concentration, pressure and temperature directly affect liner performance against the given media. Application, however, is possible under less severe conditions, e.g. lower concentration, secondary containment, additional liner protections, etc.*
(U) Unsatisfactory: *Liner material is not resistant to the given reagent at the given concentration and temperature. Mechanical and/or chemical degradation is observed.*
(–) Not tested

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information.

Medium	Concentration	Resistance at: 20 °C (68 °F)	60 °C (140 °F)
Hydrobromic acid	100%	S	S
Hydrochloric acid	10%	S	S
Hydrochloric acid	35%	S	S
Hydrocyanic acid	10%	S	S
Hydrofluoric acid	4%	S	S
Hydrofluoric acid	60%	S	L
Hydrogen	100%	S	S
Hydrogen peroxide	30%	S	L
Hydrogen peroxide	90%	S	U
Hydrogen sulfide, gaseous	100%	S	S
L			
Lactic acid	100%	S	S
Lead acetate	sat. sol.	S	—
M			
Magnesium carbonate	sat. sol.	S	S
Magnesium chloride	sat. sol.	S	S
Magnesium hydroxide	sat. sol.	S	S
Magnesium nitrate	sat. sol.	S	S
Maleic acid	sat. sol.	S	S
Mercuric chloride	sat. sol.	S	S
Mercuric cyanide	sat. sol.	S	S
Mercuric nitrate	sol.	S	S
Mercury	100%	S	S
Methanol	100%	S	S
Methylene chloride	100%	L	—
Milk	—	S	S
Molasses	—	S	S
N			
Nickel chloride	sat. sol.	S	S
Nickel nitrate	sat. sol.	S	S
Nickel sulfate	sat. sol.	S	S
Nicotinic acid	dil. sol.	S	—
Nitric acid	25%	S	S
Nitric acid	50%	S	U
Nitric acid	75%	U	U
Nitric acid	100%	U	U
O			
Oils and Grease	—	S	L
Oleic acid	100%	S	L
Orthophosphoric acid	50%	S	S
Orthophosphoric acid	95%	S	L
Oxalic acid	sat. sol.	S	S
Oxygen	100%	S	L
Ozone	100%	L	U
P			
Petroleum (kerosene)	—	S	L
Phenol	sol.	S	S
Phosphorus trichloride	100%	S	L
Photographic developer	cust. conc.	S	S
Picric acid	sat. sol.	S	—
Potassium bicarbonate	sat. sol	S	S
Potassium bisulfide	sol.	S	S
Potassium bromate	sat. sol.	S	S
Potassium bromide	sat. sol.	S	S
Potassium carbonate	sat. sol.	S	S
Potassium chlorate	sat. sol.	S	S
Potassium chloride	sat. sol.	S	S
Potassium chromate	sat. sol.	S	S
Potassium cyanide	sol.	S	S
Potassium dichromate	sat. sol.	S	S
Potassium ferricyanide	sat. sol.	S	S
Potassium ferrocyanide	sat. sol.	S	S
Potassium fluoride	sat. sol.	S	S
Potassium hydroxide	10%	S	S
Potassium hydroxide	sol.	S	S
Potassium hypochlorite	sol.	S	L
Potassium nitrate	sat. sol.	S	S
Potassium orthophosphate	sat. sol.	S	S
Potassium perchlorate	sat. sol.	S	S
Potassium permanganate	20%	S	S
Potassium persulfate	sat. sol.	S	S
Potassium sulfate	sat. sol.	S	S
Potassium sulfite	sol.	S	S
Propionic acid	50%	S	S
Propionic acid	100%	S	L
Pyridine	100%	S	L
Q			
Quinol (Hydroquinone)	sat. sol.	S	S
S			
Salicylic acid	sat. sol.	S	S
Silver acetate	sat. sol.	S	S
Silver cyanide	sat. sol.	S	S
Silver nitrate	sat. sol.	S	S
Sodium benzoate	sat. sol.	S	S
Sodium bicarbonate	sat. sol.	S	S
Sodium biphosphate	sat. sol.	S	S
Sodium bisulfite	sol.	S	S
Sodium bromide	sat. sol.	S	S
Sodium carbonate	sat. sol.	S	S
Sodium chlorate	sat. sol.	S	S
Sodium chloride	sat. sol.	S	S
Sodium cyanide	sat. sol.	S	S
Sodium ferricyanide	sat. sol.	S	S
Sodium ferrocyanide	sat. sol.	S	S
Sodium fluoride	sat. sol.	S	S
Sodium hydroxide	40%	S	S
Sodium hydroxide	sat. sol.	S	S
Sodium hypochlorite	15% active chlorine	S	S
Sodium nitrate	sat. sol.	S	S
Sodium nitrite	sat. sol.	S	S
Sodium orthophosphate	sat. sol.	S	S
Sodium sulfate	sat. sol.	S	S
Sodium sulfide	sat. sol.	S	S
Sulfur dioxide, dry	100%	S	S
Sulfur trioxide	100%	U	U
Sulfuric acid	10%	S	S
Sulfuric acid	50%	S	S
Sulfuric acid	98%	S	U
Sulfuric acid	fuming	U	U
Sulfurous acid	30%	S	S
T			
Tannic acid	sol.	S	S
Tartaric acid	sol.	S	S
Thionyl chloride	100%	L	U
Toluene	100%	L	U
Triethylamine	sol.	S	L
U			
Urea	sol.	S	S
Urine	—	S	S
W			
Water	—	S	S
Wine vinegar	—	S	S
Wines and liquors	—	S	S
X			
Xylenes	100%	L	U
Y			
Yeast	sol.	S	S
Z			
Zinc carbonate	sat. sol.	S	S
Zinc chloride	sat. sol.	S	S
Zinc (II) chloride	sat. sol.	S	S
Zinc (IV) chloride	sat. sol.	S	S
Zinc oxide	sat. sol.	S	S
Zinc sulfate	sat. sol.	S	S

Specific immersion testing should be undertaken to ascertain the suitability of chemicals not listed above with reference to special requirements.

GSE is a registered trademark of GSE Lining Technology, Inc.

GSE Lining Technology, Inc.
Corporate Headquarters
19103 Gundle Road
Houston, Texas 77073
USA
800-435-2008, 281-443-8564
FAX: 281-875-6010

GSE Lining Technology GmbH
European Headquarters
Buxtehuder Straße 112
D-21073 Hamburg
Germany
49-40-767-420
FAX: 49-40-767-42-33

Sales/Installation Offices
Australia
Egypt
Singapore
United Kingdom

Distributed by:

A Gundle/SLT Environmental, Inc. Company

STAFF

TECH FACTS

METHANE GAS TRANSMISSION RATES

UC 4000 has the best methane gas transmission rates or commercially available Geomembranes in today's market.

TEST RESULTS

Sample		Det.	CC/M² 24 Hours ATM	Thickness, mil	
Avg.	Min.	Max.			
36 MIL	1	48.5	36.8	36.4	37.3
UC 4000	2	47.9	36.9	36.5	37.7
	3	49.2	36.4	36.1	36.8
Avg. 48.5					
36 MIL	1	52.8	37.9	37.6	38.1
HYPALON	2	53.6	37.5	37.2	38.0
	3	53.2	37.7	37.5	38.0
Avg. 53.2					
40 MIL	1	63.5	39.4	39.9	38.9
HDPE	2	65.3	39.3	39.9	38.8
	3	63.0	39.7	40.0	39.3
Avg. 63.9					
40 MIL	1	89.8	39.9	36.9	40.2
O.R. PVC	2	93.0	37.0	36.9	37.2
	3	90.9	39.0	38.0	39.4
Avg. 91.2					
40 MIL	1	359	40.3	40.1	40.5
PVC	2	342	40.5	40.0	40.8
	3	339	40.9	40.0	41.0
Avg. 347					

TEST PERFORMED: The submitted samples were tested for Methane Gas Permeability in accordance with the procedures outlined in ASTM D1434, Procedure V.

Staff Industries, Inc. 240 Chene, Detroit, MI 48207 (313) 259-1818 Fax (313) 259-0631

Sample locations for samples collected for 9090 waste compatibility testing.

NOSAP sample: Collected in August 1994, shipped December 1994.
Location: Pilot circulation loop, 2nd pass #4 furnace.
Amount collected: Two 55 gallon drums.

Dock Sample: Collected February 1997. Comprised of approximately 40% NE sump effluent and 60% North Solids Tank.
Location: Sample Port Pump discharges next to NE Sump and North Solids Tank.
Amount collected: 5 Ten gallon carboys (50 gallons)

V3600: Collected February 1997
Location: Sample taken at P3601 discharge pump bleed valve.
Amount collected: 5 Ten gallon carboys (50 gallons)

FMC Corporation

Phosphorus Chemicals Division
P. O. Box 4111 - Highway 30 West of City
Pocatello, Idaho 83202

TRANSFER REPORT 1257

REQUESTER'S NAME	PURCHASE ORDER NO.	RELEASE NO.	DATE
C.D.W.	97347PIC		5/6/97
VENDOR'S NAME	**VENDOR'S ORDER NO.**		**O.S.&D. NO.**
TRI ENVIRONMENTAL			

Please forward to the Shipping Department, the following material:

Material Located:

QUANTITY	UNIT OF MEASURE	DESCRIPTION	FMC STORES NO.	VALUE
4	DR	30 Gallon Drums, Waste		
		Phosphorus, Yellow, Under		
		Water		

REASON FOR SHIPMENT: Analysis / Lines Testing

RETURN SHIPMENT EXPECTED: YES

SPECIAL INSTRUCTIONS TO ACCOUNTING:

SPECIAL INSTRUCTIONS TO SHIPPING:

Ship To: TRI ENVIRONMENTAL
7703 ECC CLUB RD.
AUSTIN TX 78733

Ship Via: ☒ Prepaid ☐ Collect
UPS: Air: Vendor:
Mail: Truck: Other:

CHARGE SHIPMENT COSTS TO: C7706001

AUTHORIZED SIGNATURE:

SHIPPED BY: EXPRESS

HOW SHIPPED:

PREPAID CHARGES:

DATE SHIPPED:

NO. OF CONTAINERS:

APPROX. WEIGHT:

CARRIER'S AGENT SIGNATURE:

BILL OF LADING NO.:

1257

1st WHITE - Accounting Copy 2nd WHITE - Packing Slip 3rd YELLOW - Receiver 4th GOLD - Purchasing 5th PINK - Requestor 6th BLUE - Log Book

FMC Corporation

Phosphorus Chemicals Division
P. O. Box 4111 Highway 30 West of City
Pocatello, Idaho 83202

TRANSFER REPORT 12727

REQUESTER'S NAME	PURCHASE ORDER NO.	RELEASE NO.	DATE
[illegible]	77-4781C		2/12/97
VENDOR'S NAME	**VENDOR'S ORDER NO.**		**O.S. & D. NO.**
[illegible]			

Please forward to the Shipping Department, the following material:

Material Located:

QUANTITY	UNIT OF MEASURE	DESCRIPTION	FMC STORES NO.	VALUE
5	EA	30 Gallon Drums - Solid -		
		Thiophenols in Water.		

REASON FOR SHIPMENT: [illegible] Testing

RETURN SHIPMENT EXPECTED: YES

SPECIAL INSTRUCTIONS TO ACCOUNTING:

SPECIAL INSTRUCTIONS TO SHIPPING: [illegible] Department

Ship To: [illegible]

Ship Via: ☐ Prepaid ☐ Collect
UPS: ____ Air: ____ Vendor: ____
Mail: ____ Truck: X Other: [illegible]

CHARGE SHIPMENT COSTS TO: [illegible]

AUTHORIZED SIGNATURE: [illegible]

SHIPPED BY: INEL

HOW SHIPPED: X CF Bob Hrlicsny

PREPAID CHARGES: [illegible]

DATE SHIPPED: [illegible]

NO. OF CONTAINERS: [illegible]

APPROX. WEIGHT: [illegible]

CARRIER'S AGENT SIGNATURE: [illegible]

BILL OF LADING NO.: [illegible]

12727

1st WHITE - Accounting Copy 2nd WHITE - Packing Slip 3rd YELLOW - Receiver 4th GOLD - Purchasing 5th PINK - Requestor 6th BLUE - Log Book

File C97-06 6.2.1.4

TRI/ENVIRONMENTAL, INC.

A Texas Research International Company

A 120 Day Final Report:

Laboratory Testing of Geosynthetics for Waste Containment EPA Method 9090A

Leachate: phosphorus bearing mixture of phos dock effluent from the north solids tank and northest sump

June 1997

TRI

A 120 Day Final Report:

Laboratory Testing of Geosynthetics for Waste Containment EPA Method 9090A

Leachate: phosphorus bearing mixture of phos dock effluent from the north solids tank and northest sump

June 1997
(Reissued October 1997)

Submitted to:
FMC Corporation
P.O. Box 4111
Pocatello, Idaho 83205

Attn: **Mr. Larry Plooster**

Submitted by:

TRI/Environmental, Inc.
9063 Bee Caves Rd.
Austin, Texas 78733

FOREWORD

The testing reported herein is based upon accepted industry practice as well as the test method listed. TRI/Environmental Inc. (TRI) neither accepts responsibility for nor makes claim as to the final use and purpose of the materials tested.

Tests were performed under laboratory conditions and not under actual usage conditions. TRI can give no conclusions as to the serviceability, life expectancy or general durability of the products tested when used in a lining and/or leachate collection system.

1.0 INTRODUCTION

This report describes the work performed by TRI/Environmental, Inc. (TRI) to determine the chemical compatibility of two geomembranes, one geonet, one geopipe and two component geotextiles (one woven and one nonwoven) of a geosynthetic clay liner product with one waste leachate. The products selected represented possible liner system materials for the proposed waste facility construction project. The objective was to determine the resistance of each product to changes caused by exposure to leachate. Changes in physical, mechanical properties and dimensional stability were measured after exposure to the leachate at 23°C and 50°C for 30, 60, 90 and 120 days following the exposure regime specified in United States Environmental Protection Agency (EPA) Method 9090A

Methods, results and discussion are provided in the sections which follow. Test results are provided in the Tables of Results which accompany this report.

2.0 METHODS

2.1 Materials

Table 1 lists products selected for evaluation in this chemical compatibility study.

Table 1. List of geosynthetics evaluated in chemical compatibility study
60 mil high density polyethylene (HDPE) geomembrane
30 mil poly-vinyl chloride (PVC) geomembrane
HDPE geonet
HDPE geopipe
geosynthetic clay liner (GCL) component woven geotextile
GCL component non-woven geotextile

2.2 Leachate

The waste leachate was received from FMC Corporation and used directly from the shipping tanks. The leachate represented a phosphorus bearing mixture of phos dock effluent from the north solids tank and the northeast sump.

2.3 Exposure Conditions

Geosynthetic test coupons and specimens were exposed to the exposure leachate following the specifications of EPA Method 9090A as they relate to exposure to waste fluids. The tanks used for these exposures were maintained at 23 ±2°C and 50 ±2°C throughout the 120-day exposure period. Tanks were constructed from chemically resistant stainless steel, fitted with stirrers and heated with a circulating hot water heat exchanger system. The 50°C tanks were sealed with a lid, and a reflux condenser was installed to minimize loss of volatile leachate components.

2.4 Testing Procedures

Testing coupons and specimens were cut from provided sample material for subsequent exposure in the leachate baths. Upon removal from the exposure baths, sample materials were rinsed with deionized water and wiped or patted with absorbent towels to remove excess water and stored in polyethylene baggies until tested.

At each testing session, samples of unexposed and exposed specimens were tested. This "baseline" testing at each testing interval served to minimize variation in observed changes caused by testing machine variability.

The following sections list tests performed on the various geosynthetic products.

2.4.1 HDPE Geomembrane

Table 2 lists tests performed on HDPE geomembrane. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 2. Tests performed on HDPE geomembrane

Test or Physical Property	Method	Number of specimens
Dimensions and weight	EPA 9090A	3
Hardness	ASTM D 2240, D scale	3
Volatiles and Extractables	EPA SW 870, App..III	2
Specific Gravity	ASTM D 792	3
Tensile Properties	ASTM D 638	3
Modulus of Elasticity	ASTM D 882	3
Hydrostatic Resistance	ASTM D 751 Method A	3

Table 2. Tests performed on HDPE geomembrane		
Test or Physical Property	**Method**	**Number of specimens**
Tear Strength	ASTM D 1004	3
Puncture Resistance	FTMS 101C Method 2065	3
Seam Peel and Shear	ASTM D 4437	3

2.4.2 *PVC Geomembrane*

Table 3 lists tests performed on PVC geomembrane. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 3. Tests performed on PVC geomembrane		
Test or Physical Property	**Method**	**Number of specimens**
Dimensions and weight	EPA 9090A	3
Hardness	ASTM D 2240, A scale	3
Volatiles and Extractables	EPA SW 870 Appendix III	2
Specific Gravity	ASTM D 792	3
Tensile Properties	ASTM D 882	3
Hydrostatic Resistance	ASTM D 751 Method A	3
Tear Strength	ASTM D 1004	3
Puncture Resistance	FTMS 101C Method 2065	3
Seam Shear Resistance	ASTM D 4437	3

2.4.3 *HDPE Geonet*

Table 4 lists tests performed on HDPE geonet. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 4. Tests performed on HDPE geonet

Test or Physical Property	Method	Number of specimens
Dimensions and weight	EPA 9090A	3
Transmissivity	ASTM D 4716, grad. 0.5, load: 1000 psf	3
Tensile Properties	ASTM D 5035	3

Tensile properties were measures using strip test specimens cut in the machine direction only. Transmissivity testing was performed using a hydraulic gradient of 0.5 and a normal compressive stress of 1000 psf. Transmissivity testing was performed at 60 and 120 days only.

2.4.4 *Geopipe*

Table 5 lists tests performed on HDPE geopipe. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 5. Tests performed on HDPE geopipe

Test or Physical Property	Method	Number of specimens
Dimensions and weight	EPA 9090A	3
Arc bend strength	ASTM D 2412, modified using arc shaped test specimens	3

2.4.5 *Woven Geotextile*

Table 6 lists tests performed on the GCL woven geotextile component material. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 6. Tests performed on woven geotextile		
Test or Physical Property	**Method**	**Number of specimens**
Dimensions and weight	EPA 9090A	3
Grab Tensile Properties (MD)	ASTM D 4632	5
Tear Resistance (MD)	ASTM D 4533	5
Puncture Resistance	ASTM D 4833	5
Mullen Burst Strength	ASTM D 3786	5
Permittivity (falling head)	ASTM D 4491	5

Grab tensile properties and tear resistance strength were measured in the machine direction only. Permittivity was measured using a falling head test procedure.

2.4.6 Non Woven Geotextile

Table 7 lists tests performed on the GCL non woven geotextile component material. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 7. Tests performed on non woven geotextile		
Test or Physical Property	**Method**	**Number of specimens**
Dimensions and weight	EPA 9090A	3
Grab Tensile Properties (MD)	ASTM D 4632	5
Tear Resistance (MD)	ASTM D 4533	5
Puncture Resistance	ASTM D 4833	5
Mullen Burst Strength	ASTM D 3786	5
Permittivity (constant head)	ASTM D 4491	5

Grab tensile properties and tear resistance strength were measured in the machine direction only. Permittivity was measured using a constant head testing apparatus and a 2 inch head.

3.0 Results and Discussion

Test results are presented in the Tables of Results which are included in the Appendix of this report.

In considering these results, it must be determined through engineering judgment whether observed differences in the value of test results measured before and after immersion are due to product variability, unidentified factors relating to the test procedure, or leachate interaction with the products. Any significant chemical interaction with leachate would be expected to result in degradation trends which are consistent across the various properties being evaluated, and not isolated to one set of test results only. However, with each type of material there may be specific properties which are highly sensitive to leachate-induced effects. These factors must be considered in evaluating the various test results for a given product. .

Also of critical importance is the issue of product variability. With most geosynthetics, a range of physical and mechanical index test values covering 15% or more of the average is not uncommon. This can be traced to variability inherent in the product, and the randomness associated with the onset of failure under the specified testing conditions. Due to this variability, TRI employed in this testing program baseline testing at each testing period rather than just at the beginning of the study. However, in chemical compatibility testing the statistical sampling of a broad range of manufactured product is not possible. Therefore, the small size of the sample population tested at each time point must be taken into consideration. The criteria to be applied in evaluating data measured before and after leachate immersion should be that property changes, if observed, are consistent and so great that product variability and experimental factors can be ruled out.

In this report, standard deviations (STD) are reported for most measurements involving three or more replicate specimens. In statistics, the standard deviation is defined as root of the mean squared deviations of individual test results about the mean value. The standard deviation is a quantitative measure of variability within a group of measurements.

One related measure of variability observed within a sample set, relative to the magnitude of the mean value itself, is the *coefficient of variation or variance* (COV). The coefficient of variance is defined as the standard deviation divided by the mean associated with a group of specimens, and may be expressed as a percentage. The COV provides an indication of what proportion of the mean value may be attributable to random experimental factors or product variability. It is useful to consider apparent changes in property values against the criterion of COV since observed changes which fall below the COV may not be significant. This approach was used in preparing the tables in the next sections.

The term *range* refers to the difference between the extreme highest and lowest points within a group of measured values. Considering range as a percentage of the mean values provides another measure of variability within a dataset.

In the tables, the high and low extremes for percentage change in selected mean values are listed for comparison against the largest COV and range-as-a-percentage-of-mean from all of the baseline sample groups. The high and low percentage changes are the extremes from data measured at 30, 60, 90 and 120 days.

3.1 HDPE Geomembrane

Table 8 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for HDPE geomembrane.

Table 8. Baseline coefficients of variation and range of percentage change results for HDPE Geomembrane

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at break (MD)	7	21	3	-7
Elongation at break (MD)	7	18	7	-5
Modulus (MD)	14	43	3	-7
Tear strength (MD)	2	6	3	-6
Puncture Resistance	4	13	5	-5
Hydrostatic resistance	4	14	5	-3
Seam Peel Adhesion	8	30	6	-4
Shear Seam Strength	2	7	11	-2

3.2 PVC Geomembrane

Table 9 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for PVC geomembrane.

Table 9. Baseline coefficients of variation and range of percentage change results for PVC geomembrane

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at break (MD)	4	11	1	-13
Elongation at break (MD)	7	18	6	-11
Tear strength (MD)	6	18	15	-4
Puncture resistance	6	20	12	-12
Hydrostatic resistance	7	20	10	-2
Shear Seam Strength	4	12	9	-2

3.2 HDPE Geonet

Table 10 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for HDPE geonet.

Table 10. Baseline coefficients of variation and range of percentage change results for HDPE geonet

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Tensile strength (MD)	6	17	7	-13
Transmissivity (MD)	7	21	11	0

3.2 HDPE Geopipe

Table 11 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for HDPE geonet.

Table 11. Baseline coefficients of variation and range of percentage change results for HDPE geopipe

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Arc Bend strength (@5% strain)	5	13	9	-5

Table 11. Baseline coefficients of variation and range of percentage change results for HDPE geopipe

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Arc Bend strength (@10% strain)	5	14	10	-6

3.4 Woven Component Geotextile of GCL

Table 12 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for the woven component geotextile of GCL.

Table 12. Baseline coefficients of variation and range of percentage change results for woven geotextile

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Grab tensile strength (MD)	19	62	29	-13
Elongation @ break (MD)	14	43	8	-10
Tear strength (MD)	18	54	22	-17
Puncture resistance	19	73	48	-1
Mullen burst	17	54	7	-4
Permittivity	14	42	3	-8

3.5 Non Woven Component Geotextile of GCL

Table 13 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for the non woven component geotextile of GCL.

Table 13. Baseline coefficients of variation and range of percentage change results for non woven geotextile

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Grab tensile strength (MD)	6	21	10	-1
Elongation @ break (MD)	20	65	11	-6
Tear strength (MD)	10	36	14	-9
Puncture resistance	9	30	39	-4
Mullen burst	11	29	9	0
Permittivity	19	67	42	-11

4.0 CONCLUSION

Because of random variability inherent in the geotextiles studied, results for most index mechanical property tests were observed to vary greatly. This was related to their construction as "component" geotextiles. In addition, certain measurements were subject to greater random variability. These included geomembrane modulus of elasticity (because of the visco-elastic properties of HDPE which cause uncertainty in the determination of the best linear fit), and tensile elongation at break and tensile set after break (attributed to the element of randomness associated with the initiation of tear upon failure). As a general rule, individual sample means showing changes within this range after exposure should not be considered significant, unless there is a pattern or trend which would suggest a time-dependent degradation process. Any loss of performance attributed to chemical interaction should be consistent across measurements of several physical and mechanical index properties, and would be expected to show changes outside the range of expected variability.

While changes in certain measured physical and mechanical properties were noted for some products, the effects of product variability and experimental factors could not be ruled out as causes. In the opinion of the authors, the data, considered together, do not support the conclusion that observed changes were caused by the test exposures.

TRI/Environmental, Inc. is pleased to have been selected to participate in this project. We trust that the information provided in this report meets your requirements for technical documentation of this chemical compatibility study. Please do not hesitate to call if we can provide any further information.

Respectfully submitted,

Sam R. Allen

Sam R. Allen
Vice President and Program Manager
Geosynthetics Technology

TEST RESULTS

This section includes generated test data provided in both tabular and graphical form. Each graph is represented by a series of "I" beam plots. Each "I" beam represents a single test population and illustrates the high and low value as the end points, and the mean as a central box on the beam.

At each testing period, three "I" beams are shown. The left beam represents the 23°C exposed specimens, the center beam represents unexposed baseline specimens, and the right beam represents the 50°C specimens.

EPA METHOD 9090 TEST RESULTS

GEOSYNTHETIC DIMENSIONS

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure T Exposure Time and Temperature

Test Parameters	Temp.	30 Day Baseline	30 Day Exposed	30 Day % Change	60 Day Baseline	60 Day Exposed	60 Day % Change	90 Day Baseline	90 Day Exposed	90 Day % Change	120 Day Baseline	120 Day Exposed	120 Day % Change
GEOMEMBRANE: 60 mil SMOOTH HDPE													
Thickness (mils)	23C	60	61	1.7	63	62	-1.6	60	61	1.7	62	61	-1.6
	50C	63	63	0.0	61	61	0.0	60	61	1.7	61	61	0.0
Length (inches)	23C	10.00	10.00	0.0	10.00	9.99	-0.1	10.00	10.00	0.0	10.00	10.00	0.0
	50C	10.01	10.00	-0.1	10.01	10.00	-0.1	10.00	9.99	-0.1	10.00	9.99	-0.1
Width (inches)	23C	8.01	8.01	0.0	8.01	7.99	-0.2	7.99	8.00	0.1	8.01	8.01	0.0
	50C	8.00	8.00	0.0	8.01	8.00	-0.1	7.97	7.99	0.3	8.01	7.99	-0.2
Mass (g)	23C	74.85	74.86	0.0	78.19	78.01	-0.2	75.17	75.31	0.2	76.32	76.11	-0.3
	50C	76.26	76.10	-0.2	74.80	74.76	-0.1	75.90	75.95	0.1	75.79	74.87	-1.2
GEOMEMBRANE: 30 mil PVC													
Thickness (mils)	23C	31	32	3.2	31	31	0.0	31	30	-3.2	31	31	0.0
	50C	31	32	3.2	31	31	0.0	30	30	0.0	31	31	0.0
Length (inches)	23C	9.98	9.99	0.0	9.96	9.98	0.0	9.90	9.94	0.4	10.00	9.94	-0.6
	50C	9.99	9.88	-1.1	9.98	9.85	-1.3	9.81	9.84	0.3	9.99	9.83	-1.6
Width (inches)	23C	8.00	8.01	0.1	7.98	8.02	0.4	7.98	8.01	0.4	8.01	7.99	-0.2
	50C	7.99	8.06	0.9	7.99	8.03	0.5	7.99	8.04	0.6	8.02	8.02	0.0
Mass (g)	23C	50.24	50.55	0.6	50.49	50.75	0.5	49.96	50.14	0.4	50.31	50.10	-0.4
	50C	48.51	50.85	4.8	50.25	50.50	0.5	51.95	52.04	0.2	50.48	50.07	-0.8
GEONET: HDPE GEONET													
Thickness (mils)	23C	231	230	-0.4	230	229	-0.9	224	227	1.3	225	227	0.9
	50C	225	224	-0.4	222	228	2.7	222	225	1.4	225	227	0.9
Mass (g)	23C	50.50	50.60	0.2	54.90	55.08	0.3	53.47	53.61	0.3	51.41	51.39	-0.0
	50C	52.64	52.73	0.2	51.39	51.96	1.1	52.26	52.41	0.2	51.90	51.95	0.1
GEOPIPE: HDPE GEOPIPE													
Thickness (mils)	23C	63	63	0.0	63	63	0.0	62	62	0.0	63	62	-1.6
	50C	63	64	1.6	62	63	1.6	64	64	0.0	61	61	0.0
Width (mils)	23C	1.00	1.00	0.0	1.00	1.01	1.0	1.00	1.00	0.0	1.00	1.00	0.0
	50C	1.00	1.01	1.0	1.00	1.01	1.0	1.00	1.00	0.0	1.00	1.00	-0.1
Mass (g)	23C	185.90	185.74	-0.1	183.52	183.89	0.2	184.23	184.56	0.2	183.78	185.11	0.7
	50C	188.32	188.51	0.1	185.28	185.29	0.0	184.86	185.07	0.1	186.31	186.69	0.2

SRA 12-22-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: June 18, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	Temp.	30 Day Baseline	30 Day Exposed	30 Day % Change	60 Day Baseline	60 Day Exposed	60 Day % Change	90 Day Baseline	90 Day Exposed	90 Day % Change	120 Day Baseline	120 Day Exposed	120 Day % Change
GEOTEXTILE: BENTOFIX GCL - woven textile component													
Thickness (mils)	23C	80	85	6.3	85	92	8.2	81	86	6.2	72	77	6.9
	50C	73	80	9.6	74	85	14.9	79	86	8.9	74	83	12.2
Length (inches)	23C	7.97	7.87	-1.3	7.96	7.95	-0.1	8.00	7.95	-0.6	7.97	7.96	-0.1
	50C	7.95	7.87	-1.1	7.98	7.91	-0.9	8.00	7.93	-0.9	8.01	7.97	-0.5
Width (inches)	23C	4.01	4.02	0.2	4.03	4.03	0.0	4.01	4.02	0.2	4.02	4.02	0.0
	50C	4.04	4.04	0.0	4.06	4.06	0.0	3.99	4.04	1.3	4.07	4.06	-0.2
Mass (g)	23C	5.98	5.94	-0.7	5.96	6.39	7.2	6.67	6.90	3.4	5.06	5.19	2.6
	50C	5.55	5.53	-0.4	5.83	5.93	1.7	6.09	6.18	1.5	5.83	5.93	1.7
GEOTEXTILE: BENTOFIX GCL - nonwoven textile component													
Thickness (mils)	23C	137	140	2.2	128	136	7.9	135	144	6.7	149	147	-1.3
	50C	133	135	1.5	128	134	4.7	138	140	1.4	143	143	0.0
Length (inches)	23C	7.95	7.86	-1.1	7.84	7.83	-0.1	7.86	7.83	-0.4	8.10	8.08	-0.2
	50C	7.98	7.95	-0.4	7.98	7.83	-1.9	7.99	7.94	-0.6	7.83	7.83	0.0
Width (inches)	23C	4.05	3.98	-1.7	4.01	4.00	-0.2	4.05	4.08	0.7	4.07	4.06	-0.2
	50C	4.06	3.97	-2.2	4.06	4.00	-1.5	4.01	4.07	1.5	4.05	4.05	0.0
Mass (g)	23C	5.15	5.09	-1.2	4.85	4.88	0.7	5.16	5.33	3.3	5.39	5.54	2.8
	50C	5.11	5.06	-1.0	4.77	4.83	1.3	5.27	5.28	0.2	5.32	5.48	3.0

SRA 12.22.97
Quality Review/Date

EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

60 mil SMOOTH HDPE GEOMEMBRANE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tensile Properties:	2605	2538	2537	2485	2385	2234	2502	2466	2601	2527	2583	2648
Tensile Stress @ Yield (psi)	2630	2484	2593	2485	2306	2466	2523	2420	2599	2543	2478	2633
ASTM D638	2404	2612	2489	2495	2388	2667	2487	2506	2602	2567	2531	2684
Machine Direction	2523			2456			2463			2528		
	2516			2548			2494			2547		
	2490			2494			2462			2528		
Average	2528	2545	2540	2494	2360	2456	2489	2464	2601	2540	2531	2655
STD	75	52	42	27	38	177	21	35	1	14	43	21
Coefficient of Variation	3	2	2	1	2	7	1	1	0	1	2	1
Range as % of Baseline	9			4			2			2		
% Change		1	0		-5	-2		-1	5		-0	5
Tensile Properties:	4285	3848	4377	3919	3929	3622	4383	4144	4030	4017	4415	4256
Tensile Strength @ Break (psi)	4771	4740	3795	4254	3896	4212	4178	4664	4210	3985	4516	4510
ASTM D638	3957	4882	4666	3917	3811	4826	5007	4410	4831	4158	3136	3538
Machine Direction	4699			4147			4774			4231		
	4382			4664			4083			4366		
	4098			4117			4537			4631		
Average	4365	4490	4279	4170	3879	4220	4494	4406	4357	4231	4022	4101
STD	295	458	362	252	50	492	323	212	343	220	628	412
Coefficient of Variation	7	10	8	6	1	12	7	5	8	5	16	10
Range as % of Baseline	19			18			21			15		
% Change		3	-2		-7	1		-2	-3		-5	-3
Tensile Properties:	17	18	18	17	18	18	17	17	17	16	16	15
Elongation @ Yield (%)	18	17	18	17	17	18	17	19	18	16	16	16
ASTM D638	18	17	17	17	17	19	18	16	18	15	15	15
Machine Direction	17			17			17			16		
	18			17			17			16		
	18			17			17			16		
Average	18	17	18	17	17	18	17	17	18	16	16	15
STD	0	0	0	0	0	0	0	1	0	0	0	0
Coefficient of Variation	3	3	3	0	3	3	2	7	3	2	3	3
% Change		-2	0		2	8		1	3		-1	-3

SR4 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	Baseline	60 Day 23C	60 Day 50C	Baseline	90 Day 23C	90 Day 50C	Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tensile Properties:	729	663	740	680	786	737	823	841	694	719	839	732
Elongation @ Break (%)	792	800	650	735	768	763	715	799	715	694	575	779
ASTM D638	694	813	804	708	786	814	840	778	807	722	757	677
Machine Direction	779			737			811			734		
	766			750			703			760		
	719			751			777			799		
Average	747	759	731	727	780	771	778	806	739	738	724	729
STD	35	68	63	25	8	32	53	26	49	34	110	42
Coefficient of Variation	5	9	9	3	1	4	7	3	7	5	15	6
Range as % of Baseline	13			10			18			14		
% Change		2	-2		7	6		4	-5		-2	-1
Tensile Properties:	647	618	660	625	686	667	715	707	602	660	695	638
Set after Break (%)	740	726	615	653	690	680	653	686	655	640	572	700
ASTM D638	615	710	734	685	685	731	665	672	689	688	640	590
Machine Direction	681			613			729			652		
	688			660			667			666		
	660			732			646			670		
Average	672	685	670	663	687	693	679	688	649	664	636	643
STD	39	48	49	39	2	28	31	14	36	14	50	45
Coefficient of Variation	6	7	7	6	0	4	5	2	6	2	8	7
Range as % of Baseline	19			18			12			7		
% Change		2	-0		4	4		1	-4		-4	-3
Tensile Properties:	1976	1984	2064	1953	1852	1680	1992	1948	2076	1984	2032	2024
Tensile Stress @ 100% Elongation (psi)	2018	1992	2078	1998	1823	1885	1988	2011	2076	2015	1969	2082
ASTM D638	1965	2025	2011	1966	1853	2071	1982	1946	2075	2034	2036	2099
Machine Direction	2028			1948			1942			2034		
	1949			1993			1988			2026		
	1933			1980			1956			2025		
Average	1978	2000	2051	1973	1846	1879	1975	1968	2076	2020	2012	2068
STD	34	18	29	19	17	160	19	30	0	17	31	32
Coefficient of Variation	2	1	1	1	1	9	1	2	0	1	2	2
Range as % of Baseline	5			3			3			2		
% Change		1	4		-6	-5		-0	5		-0	2
Tensile Properties:	2015	2025	2175	1992	1701	1672	2038	1933	2081	2007	2068	2029
Tensile Stress @ 200% Elongation (psi)	2061	2024	2093	1993	1726	1859	2002	2014	2093	2097	2014	2163
ASTM D638	2004	2054	2087	2004	1775	2053	2041	2009	2139	2021	2086	2119
Machine Direction	2058			1986			1995			2090		
	1982			1989			2024			2045		
	1988			1986			1988			2076		
Average	2018	2034	2118	1992	1734	1865	2015	1985	2104	2056	2056	2104
STD	31	14	40	6	31	160	21	37	25	34	31	56
Coefficient of Variation	2	1	2	0	2	9	1	2	1	2	1	3
Range as % of Baseline	4			1			3			4		
% Change		1	5		-13	-6		-1	4		0	2

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tensile Properties:	2568	2599	2567	2662	2270	2721	2642	2555	2752	2608	2568	2607
Tensile Stress @ Yield (psi)	2593	2625	2696	2546	2322	2705	2656	2587	2604	2576	2552	2739
ASTM D638	2581	2675	2601	2619	2264	2765	2623	2526	2626	2576	2559	2710
Transverse Direction	2606			2561			2420			2621		
	2676			2597			2553			2610		
	2615			2173			2608			2648		
Average	2607	2633	2621	2526	2285	2730	2584	2556	2661	2607	2560	2685
STD	35	32	55	162	26	25	80	25	65	25	7	57
Coefficient of Variation	1	1	2	6	1	1	3	1	2	1	0	2
Range as % of Baseline	4			19			9			3		
% Change		1	1		-10	8		-1	3		-2	3
Tensile Properties:	4360	4629	3660	3630	3439	3016	4195	4523	4582	3086	4415	4556
Tensile Strength @ Break (psi)	3537	4990	4369	3763	3619	3744	4059	3950	4280	4333	4516	4510
ASTM D638	4074	4518	4841	4428	2981	3756	3554	4282	4037	4159	3136	3538
Transverse Direction	4524			4148			3641			3077		
	4745			3791			3897			2680		
	4635			3565			3904			3484		
Average	4313	4712	4290	3888	3346	3505	3875	4252	4300	3470	4022	4201
STD	407	202	485	304	269	346	222	235	223	598	628	469
Coefficient of Variation	9	4	11	8	8	10	6	6	5	17	16	11
Range as % of Baseline	28			22			17			48		
% Change		9	-1		-14	-10		10	11		16	21
Tensile Properties:	15	16	19	15	16	16	15	16	16	16	15	15
Elongation @ Yield (%)	16	15	17	15	16	16	16	16	16	15	14	15
ASTM D638	16	16	16	15	14	16	15	16	16	15	15	16
Transverse Direction	16			16			19			15		
	16			15			16			15		
	16			15			16			15		
Average	16	16	17	15	15	16	16	16	16	15	15	15
STD	0	0	1	0	1	0	1	0	0	0	0	0
Coefficient of Variation	2	3	7	2	6	0	8	0	0	2	3	3
Range as % of Baseline	6			7			25			7		
% Change		-1	9		1	5		-1	-1		-3	1
Tensile Properties:	766	798	669	639	740	737	697	812	768	564	794	778
Elongation @ Break (%)	635	851	765	673	745	793	744	718	756	782	822	780
ASTM D638	718	770	846	770	725	781	615	765	715	752	579	766
Transverse Direction	765			743			649			561		
	793			725			606			667		
	787			730			619			627		
Average	744	806	760	713	737	770	655	765	746	659	732	775
STD	54	34	72	44	8	24	50	38	23	85	109	6
Coefficient of Variation	7	4	10	6	1	3	8	5	3	13	15	1
Range as % of Baseline	21			18			21			34		
% Change		8	2		3	8		17	14		11	18

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tensile Properties:	664	741	614	600	648	674	641	692	684	550	720	658
Set after Break (%)	615	725	682	654	663	683	650	653	673	672	715	780
ASTM D638	654	750	682	684	650	685	600	668	651	710	545	666
Transverse Direction	711			661			598			665		
	655			654			576			540		
	650			662			575			561		
Average	658	739	659	653	654	681	607	671	669	616	660	701
STD	28	10	32	26	7	5	29	16	14	68	81	56
Coefficient of Variation	4	1	5	4	1	1	5	2	2	11	12	8
Range as % of Baseline	15			13			12			28		
% Change		12	0		0	4		11	10		7	14
Tensile Properties:	1857	1896	1896	1897	1784	1978	1937	1856	1908	1895	1861	1836
Tensile Stress @ 100% Elongation (psi)	1862	1919	1876	1851	1854	1959	1887	1920	1862	1857	1876	1960
ASTM D638	1864	1965	1927	1868	1552	1994	1966	1859	1919	1862	1921	1910
Transverse Direction	1908			1842			1969			1910		
	1932			1835			1906			1861		
	1896			1592			1919			1934		
Average	1887	1927	1900	1814	1730	1977	1931	1878	1896	1887	1886	1902
STD	28	29	21	101	129	14	30	29	25	29	25	51
Coefficient of Variation	1	1	1	6	7	1	2	2	1	2	1	3
Range as % of Baseline	4			17			4			4		
% Change		2	1		-5	9		-3	-2		-0	1
Tensile Properties:	1950	1924	2016	1930	1926	2036	1981	1882	2027	1997	1932	1908
Tensile Stress @ 200% Elongation (psi)	1907	2018	1988	1907	1947	2051	1925	1884	1928	2006	2014	1960
ASTM D638	1923	1971	2007	1901	1912	2060	1959	1873	1949	1950	2062	1910
Transverse Direction	1962			1869			2004			1990		
	1987			1859			1926			2034		
	1980			1929			1923			2010		
Average	1952	1971	2004	1899	1928	2049	1953	1880	1968	1998	2003	1926
STD	29	38	12	27	14	10	31	5	43	25	54	24
Coefficient of Variation	1	2	1	1	1	0	2	0	2	1	3	1
Range as % of Baseline	4			4			4			4		
% Change		1	3		2	8		-4	1		0	-4
Modulus of Elasticity:	116722	85335	101415	67805	69213	79320	77511	78639	82095	66929	75555	66855
Tangential (psi)	75578	76904	90054	78409	82340	76408	80303	74854	83621	75202	73929	74911
ASTM D882	97419	104116	101954	84530	81997	61548	82092	82601	83099	78866	69958	80190
Machine Direction	92820			75034			76709			68145		
	96378			84972			84367			69951		
	95350			74804			83850			81159		
Average	95711	88785	97808	77592	77850	72425	80805	78698	82938	73375	73147	73985
STD	13105	13930	6720	5963	6109	7783	2930	3163	633	5396	2351	5483
Coefficient of Variation	14	16	7	8	8	11	4	4	1	7	3	7
Range as % of Baseline	43			22			9			19		
% Change		-7	2		0	-7		-3	3		-0	1

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Modulus of Elasticity:	82872	75123	99583	83154	78609	73002	78929	77514	79862	75543	70109	67697
Tangential (psi)	91734	79360	95825	82909	76596	76612	81224	84358	81114	64657	79578	68921
ASTM D882	92860	115752	84933	65632	81622	79304	83570	76983	75832	72258	81452	84381
Transverse Direction	93412			76115			79391			56864		
	93013			82675			83440			74903		
	105500			72003			77667			81930		
Average	93232	90078	93447	77081	78942	76306	80704	79618	78936	71026	77046	73666
STD	7215	22335	7609	6582	2065	2582	2239	3358	2254	8134	4965	7593
Coefficient of Variation	8	25	8	9	3	3	3	4	3	11	6	10
Range as % of Baseline	24			23			7			35		
% Change		-3	0		2	-1		-1	-2		8	4
Indentation Hardness:	63	62	62	62	62	63	62	62	62	62	62	62
Reading	62	62	62	62	62	62	63	62	62	61	61	62
ASTM D2240	63	62	63	62	63	62	62	60	61	62	62	61
(with TYPE D DUROMETER)	61			62			62			62		
	63			62			62			62		
	62			62			63			61		
Average	62	62	62	62	62	62	62	61	62	62	62	62
STD	1	0	1	0	0	0	0	1	0	0	0	0
Coefficient of Variation	1	0	1	0	1	1	1	2	1	1	1	1
Range as % of Baseline	3			0			2			2		
% Change		-1	0		1	1		-2	-1		0	0
Specific Gravity:	0.951	0.950	0.950	0.952	0.949	0.952	0.949	0.957	0.949	0.946	0.948	0.949
Specific Gravity (grams/cu.cm)	0.951	0.950	0.950	0.953	0.958	0.951	0.953	0.947	0.949	0.948	0.949	0.946
ASTM D792, Method A	0.951	0.951	0.950	0.951	0.952	0.956	0.951	0.948	0.952	0.948	0.948	0.948
	0.951			0.949			0.951			0.944		
	0.951			0.953			0.949			0.946		
	0.951			0.950			0.952			0.947		
Average	0.951	0.950	0.950	0.951	0.953	0.953	0.951	0.951	0.950	0.947	0.948	0.948
STD	0.000	0.001	0.000	0.001	0.004	0.002	0.001	0.004	0.001	0.001	0.000	0.001
Coefficient of Variation	0.000	0.061	0.000	0.157	0.393	0.227	0.154	0.473	0.149	0.146	0.050	0.132
Range as % of Baseline	0.00			0.42			0.42			0.42		
% Change		-0.07	-0.11		0.18	0.18		-0.02	-0.09		0.19	0.12
Environmental Stress Crack Resistance:												
ASTM D1693, Condition B												
Machine Direction (% Failed)	N/A	0	0	N/A	0	0	N/A	0	0	N/A	0	0
Transverse Direction (% Failed)	N/A	0	0	N/A	0	0	N/A	0	0	N/A	0	0

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Puncture Resistance:	88	85	91	86	93	93	90	88	93	89	90	97
Load @ Rupture (lbs)	91	85	91	94	94	89	87	88	93	92	93	97
FTMS 101C Method 2065	90	87	90	98	91	91	90	89	95	92	91	95
	90			98			87			92		
	90			94			88			93		
	91			96			92			93		
Average	90	86	91	94	93	91	89	88	94	92	91	96
STD	1	1	0	4	1	2	2	0	1	1	1	1
Coefficient of Variation	1	1	1	4	1	2	2	1	1	1	1	1
Range as % of Baseline	3			13			6			4		
% Change		-5	1		-2	-4		-1	5		-1	5
Volatiles and Extractables:	-0.48	-0.55	-0.32	0.05	-0.08	0.00	-0.28	-0.13	-0.20	-0.21	-0.18	-0.21
Diameter Change (%)	-0.43	-0.57	-0.20	-0.57	-0.28	-0.08	-0.23	-0.07	-0.15	-0.17	-0.23	-0.24
SW 870 - Appendix III-D	-0.48			-0.05			-0.17			-0.17		
Machine Direction	-0.28			-0.15			-0.22			-0.20		
Average	-0.42	-0.56	-0.26	-0.18	-0.18	-0.04	-0.23	-0.10	-0.18		-0.21	-0.23
STD	0.08	0.01	0.06	0.24	0.10	0.04	0.04	0.03	0.03		0.03	-100
Volatiles and Extractables:	-0.03	-0.10	0.18	-0.03	-0.15	-0.13	-0.05	-0.23	-0.02	-0.11	-0.15	-0.07
Diameter Change (%)	0.20	0.15	-0.08	-0.18	-0.18	-0.08	-0.16	-0.12	-0.04	-0.15	-0.19	-0.13
SW 870 - Appendix III-D	-0.10			0.30			-0.11			-0.06		
Transverse Direction	0.20			-0.23			-0.08			-0.14		
Average	0.07	0.02	0.05	-0.04	-0.17	-0.11	-0.11	-0.18	-0.03		-0.17	-0.10
STD	0.13	0.13	0.13	0.21	0.02	0.03	0.05	0.06	0.01		0.02	0.03
Volatiles and Extractables:	0.03	0.09	0.08	0.08	0.08	0.05	0.05	0.06	0.08	0.08	0.05	0.09
% Volatiles	0.02	0.08	0.05	0.07	0.09	0.07	0.05	0.07	0.06	0.07	0.08	0.09
SW 870 - Appendix III-D	0.04			0.04			0.06			0.09		
	0.02			0.03			0.07			0.07		
Average	0.03	0.09	0.07	0.06	0.09	0.06	0.06	0.07	0.07		0.07	0.09
STD	0.01	0.00	0.02	0.02	0.00	0.01	0.01	0.01	0.01		0.02	0.00
Volatiles and Extractables:	0.24	0.24	0.26	0.19	0.23	0.23	0.20	0.22	0.25	0.21	0.27	0.24
% Extractables	0.27	0.26	0.20	0.22	0.22	0.22	0.22	0.22	0.21	0.24	0.24	0.22
SW 870 - Appendix III-D	0.28			0.23			0.18			0.23		
	0.24			0.17			0.24			0.17		
Average	0.26	0.25	0.23	0.20	0.23	0.23	0.21	0.22	0.23		0.26	0.23
STD	0.02	0.01	0.03	0.02	0.01	0.01	0.02	0.00	0.02		0.02	0.01

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tear Resistance:	53	48	48	51	51	51	49	51	48	49	50	51
Tear Resistance (lbs)	50	47	49	51	51	51	52	51	52	51	49	53
ASTM D1004	51	48	50	50	51	52	50	47	50	50	51	50
Machine Direction	50			51			51			51		
	50			49			49			49		
	50			50			52			49		
Average	51	48	49	50	51	51	51	50	50	50	50	51
STD	1	1	1	1	0	0	1	2	2	1	1	1
Coefficient of Variation	2	1	2	1	0	1	2	4	3	2	2	2
Range as % of Baseline	6			4			6			4		
% Change		-6	-3		1	2		-2	-1		0	3
Tear Resistance:	50	49	52	46	49	47	48	49	49	49	46	50
Tear Resistance (lbs)	49	49	49	47	50	47	48	48	52	49	44	53
ASTM D1004	51	47	49	49	49	48	48	48	49	49	48	51
Transverse Direction	53			46			48			51		
	50			46			49			49		
	49			46			50					
Average	50	48	50	47	49	47	49	48	50	49	46	51
STD	2	1	2	1	0	0	1	0	1	1	2	1
Coefficient of Variation	3	2	3	2	1	1	2	1	3	2	4	2
Range as % of Baseline	8			6			4			4		
% Change		-4	-1		6	1		-0	3		-7	4
Hydrostatic Resistance:	450	430	440	470	460	485	510	510	525	458	453	454
Load @ Rupture (psi)	470	450	450	475	470	460	490	510	510	456	455	454
ASTM D751	440	440	455	470	450	455	480	520	520	458	454	453
	450			495			480			505		
	460			475			500			465		
	450			485			510			442		
Average	453	440	448	478	460	467	495	513	518	464	454	454
STD	10	10	8	9	8	13	13	5	6	20	1	0
Coefficient of Variation	2	2	2	2	2	3	3	1	1	4	0	0
Range as % of Baseline	7			5			6			14		
% Change		-3	-1		-4	-2		4	5		-2	-2

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

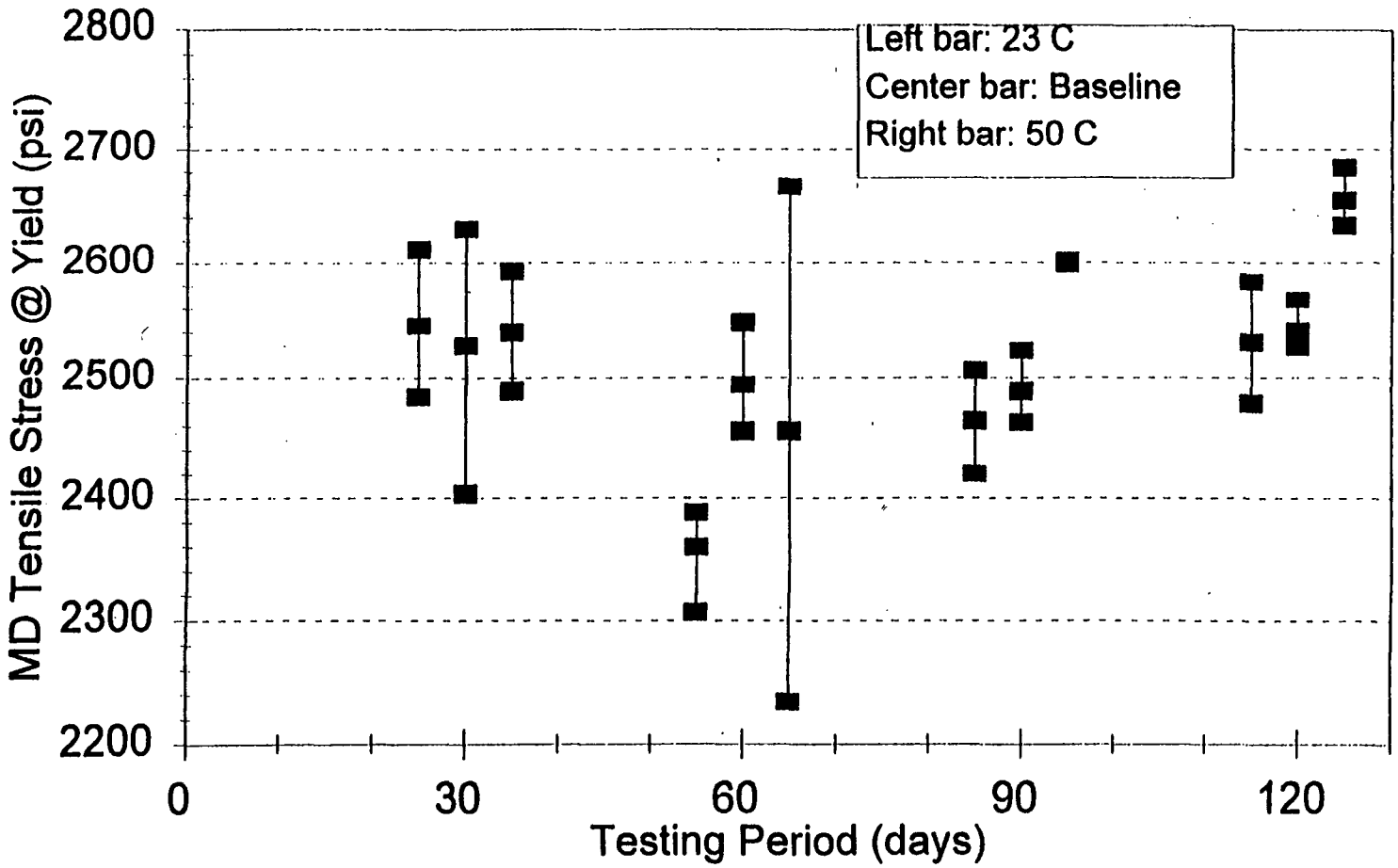
Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Seam Shear Strength:	150	152	149	149	151	159	150	147	144	148	148	161
Seam Shear Strength (ppi)	151	156	150	149	150	158	150	148	142	146	152	163
ASTM D4437	150	155	144	153	152	160	151	149	147	148	153	167
	150			143			145			148		
	151			149			143			140		
	155			152			147			151		
Average	151	154	148	149	151	159	148	148	144	147	151	164
STD	2	2	3	3	1	1	3	1	2	3	2	2
Coefficient of Variation	1	1	2	2	1	1	2	1	1	2	1	2
Range as % of Baseline	3			7			5			7		
% Change		2	-2		1	7		0	-2		3	11
Seam Peel Adhesion:	127	131	121	120	130	128	125	131	120	120	112	120
Seam Peel Strength (ppi)	129	121	119	121	97	123	122	130	120	115	120	120
ASTM D4437	130	131	124	119	128	125	115	123	115	127	121	118
	126	118	121	131	114	121	118	121	121	117	127	133
	123	127	116	122	112	123	115	118	119	128	129	133
	116	119	119	120	112	124	120	120	117	120	130	127
	121			118			118			121		
	119			118			119			106		
	130			116			119			136		
	118			118			112			123		
	118			117			105			121		
	94			123			112			102		
Average	121	125	120	120	116	124	117	124	119	120	123	125
STD	9	5	2	4	11	2	5	5	2	9	6	6
Coefficient of Variation	8	4	2	3	10	2	4	4	2	7	5	5
Range as % of Baseline	30			6			12			28		
% Change		3	-1		-4	3		6	2		3	5
Failure Mode (FTB = All Film Tear Bond)	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB

SRA 10-21-97
Quality Review/Date

FMC CORPORATION EPA METHOD 9090

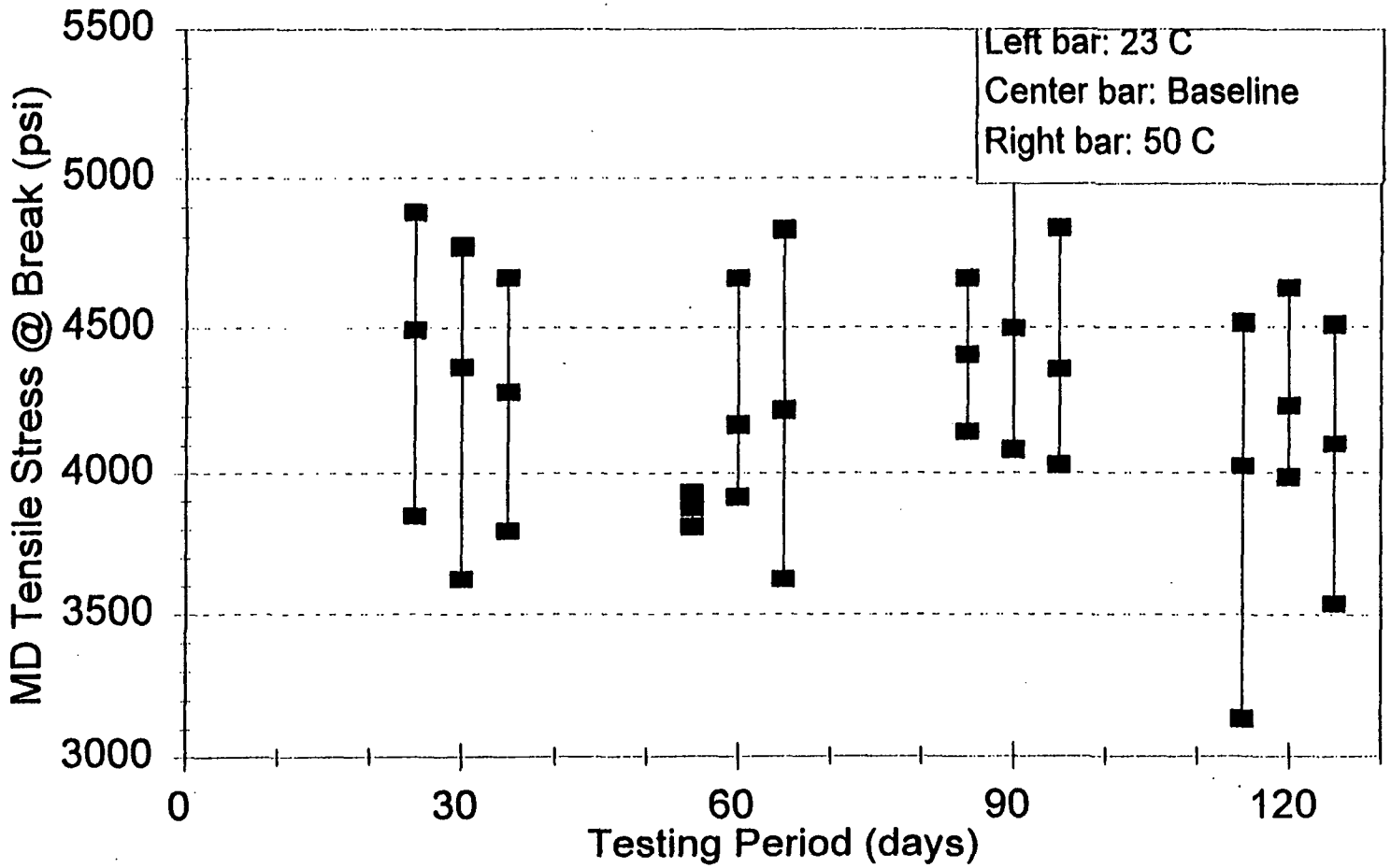
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

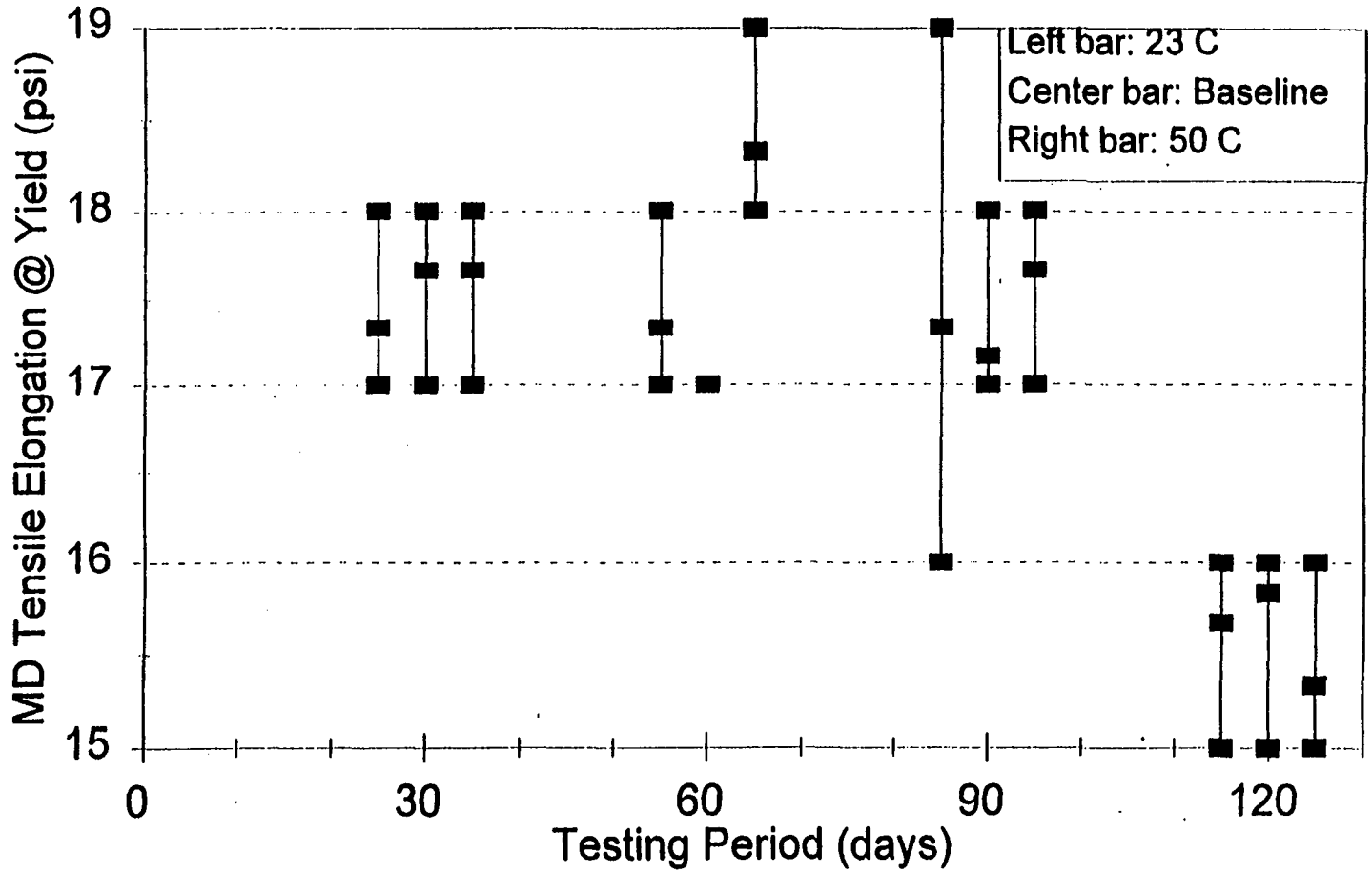
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

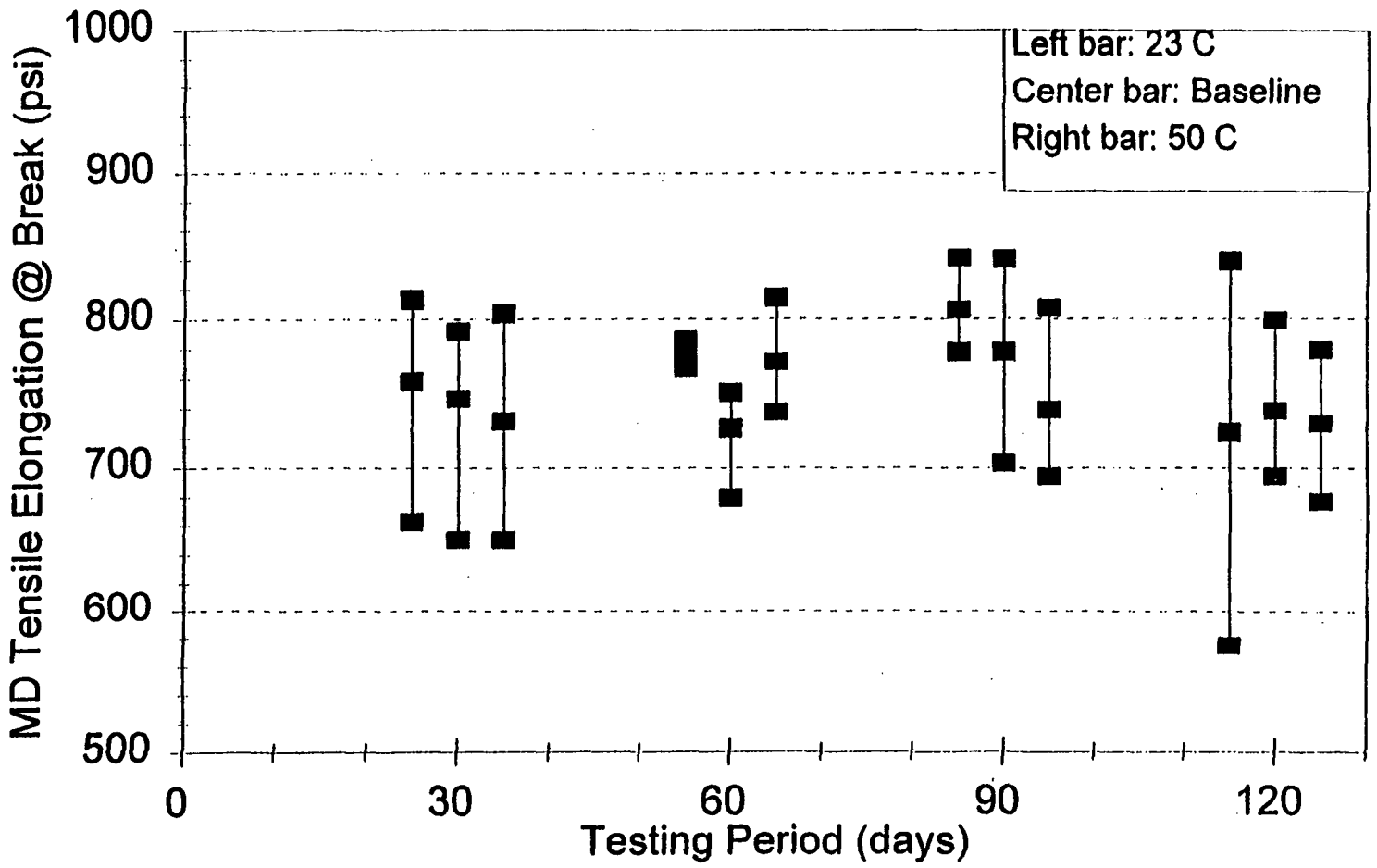
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

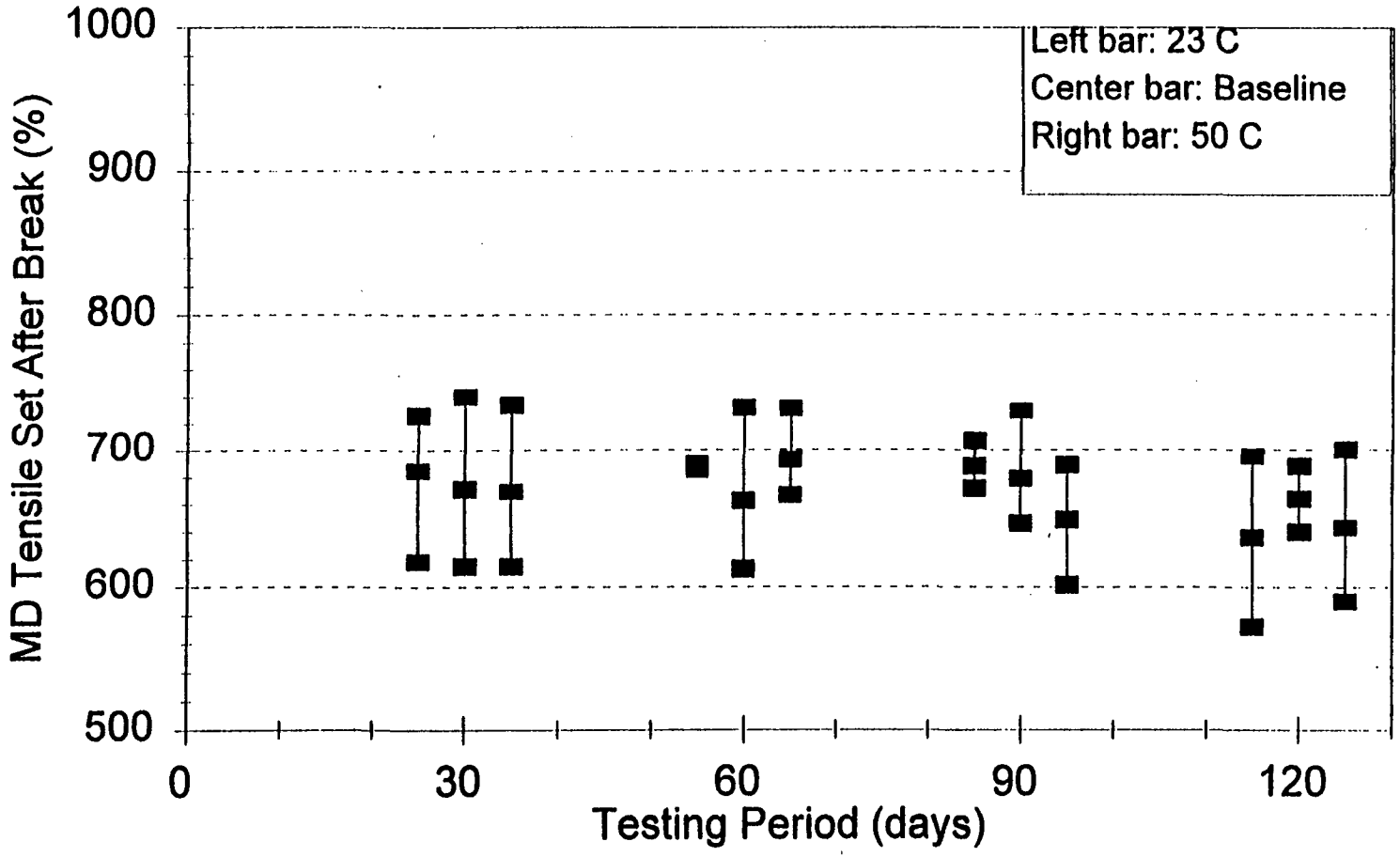
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

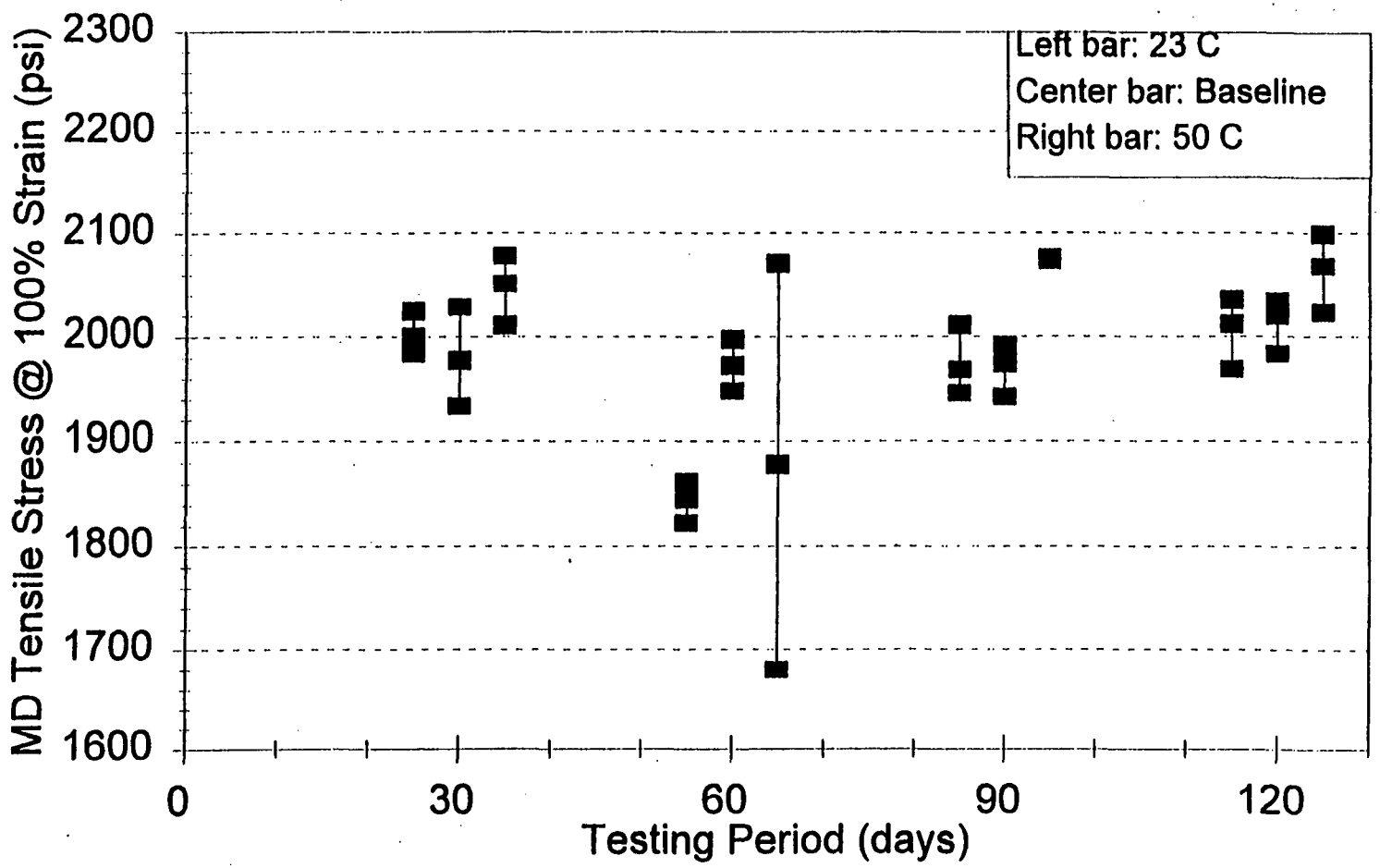
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

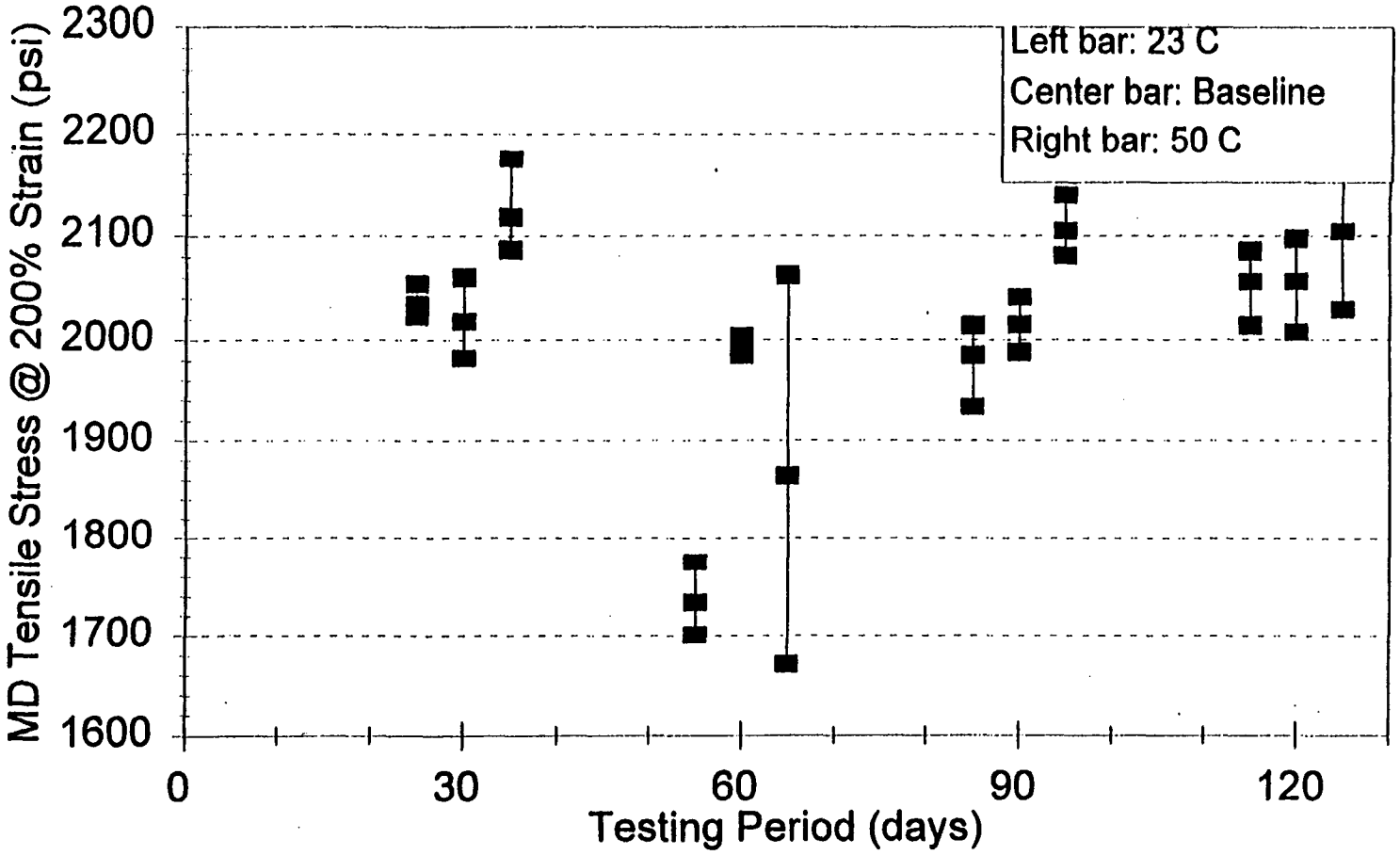
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

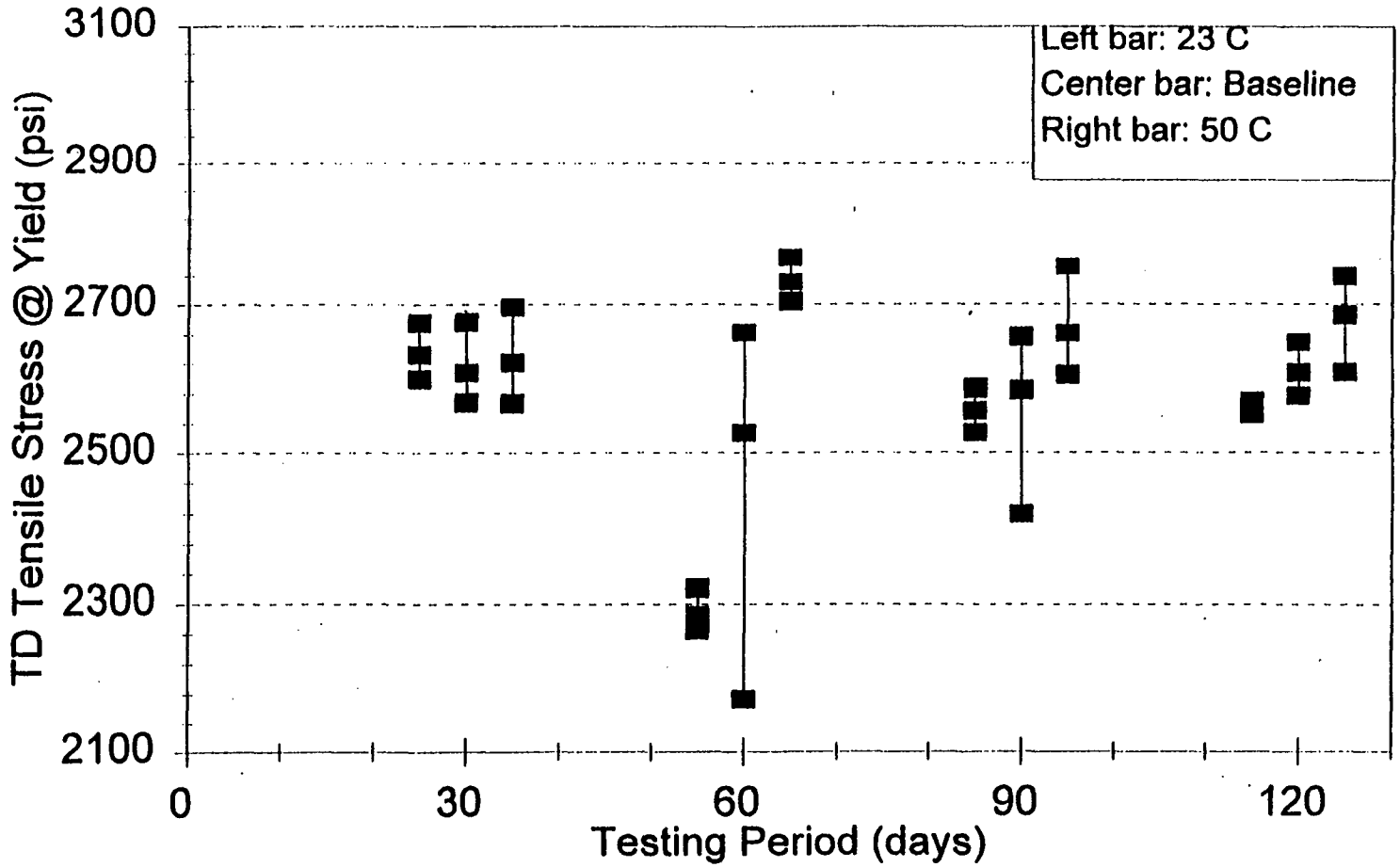
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

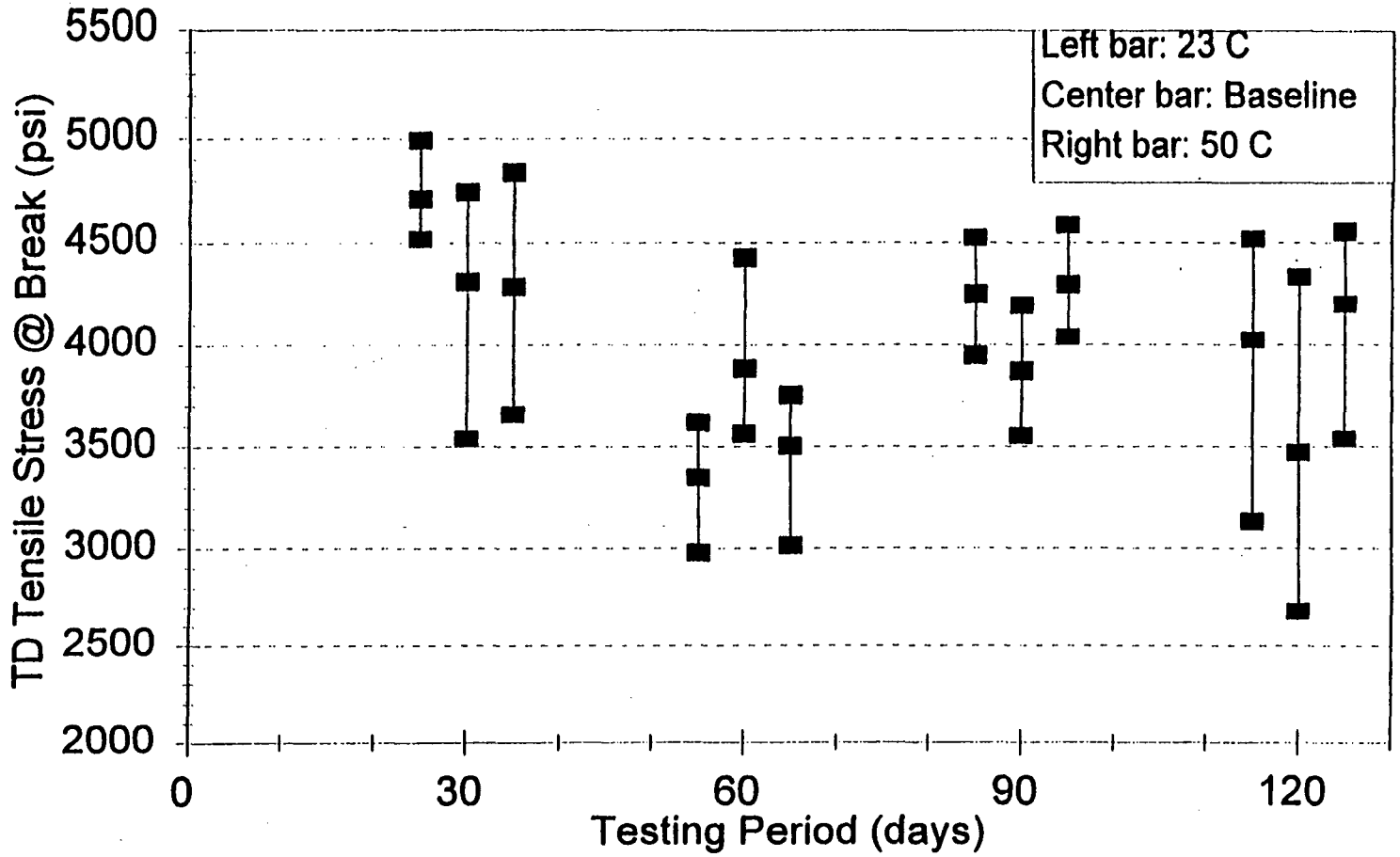
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

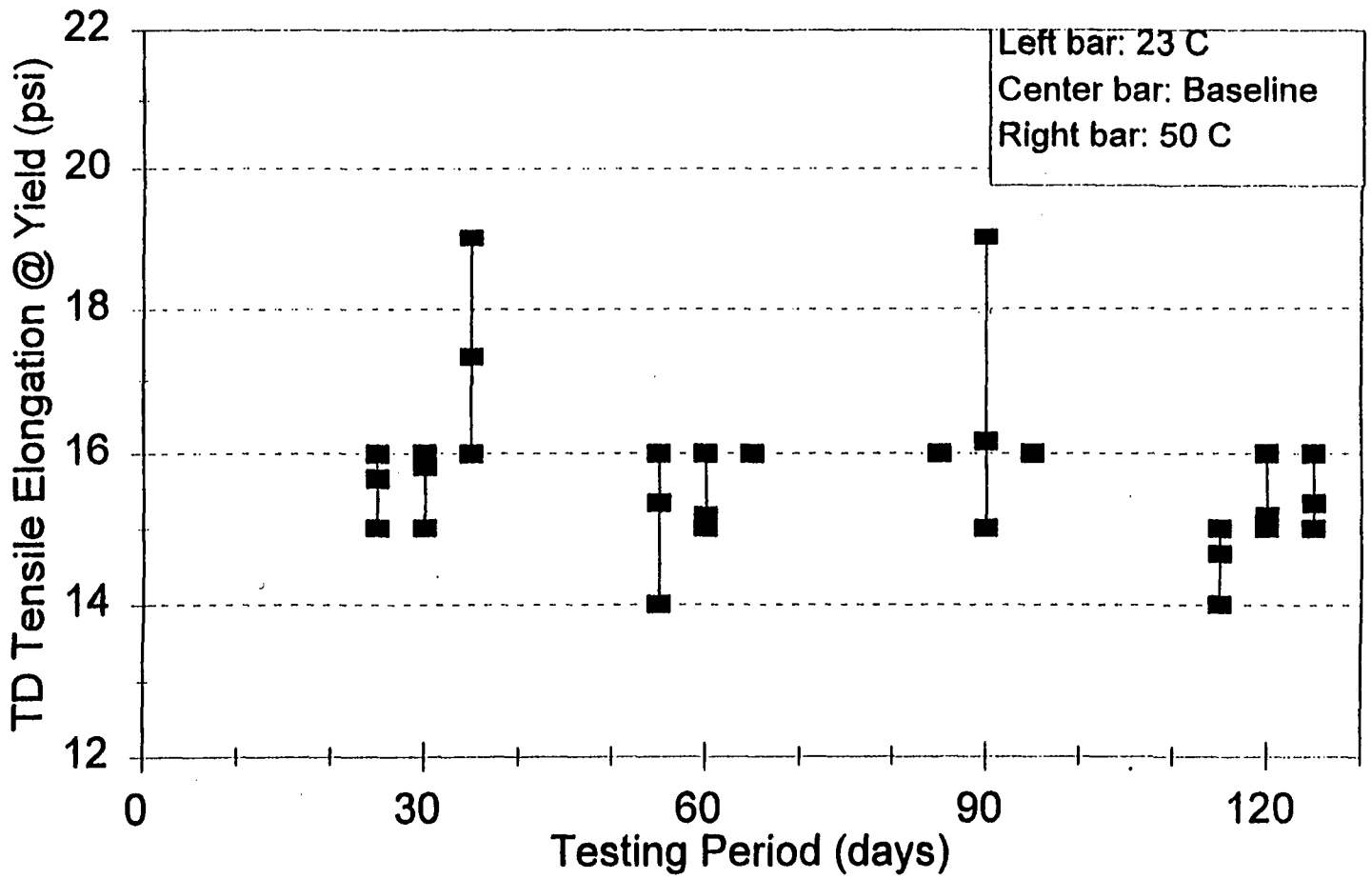
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

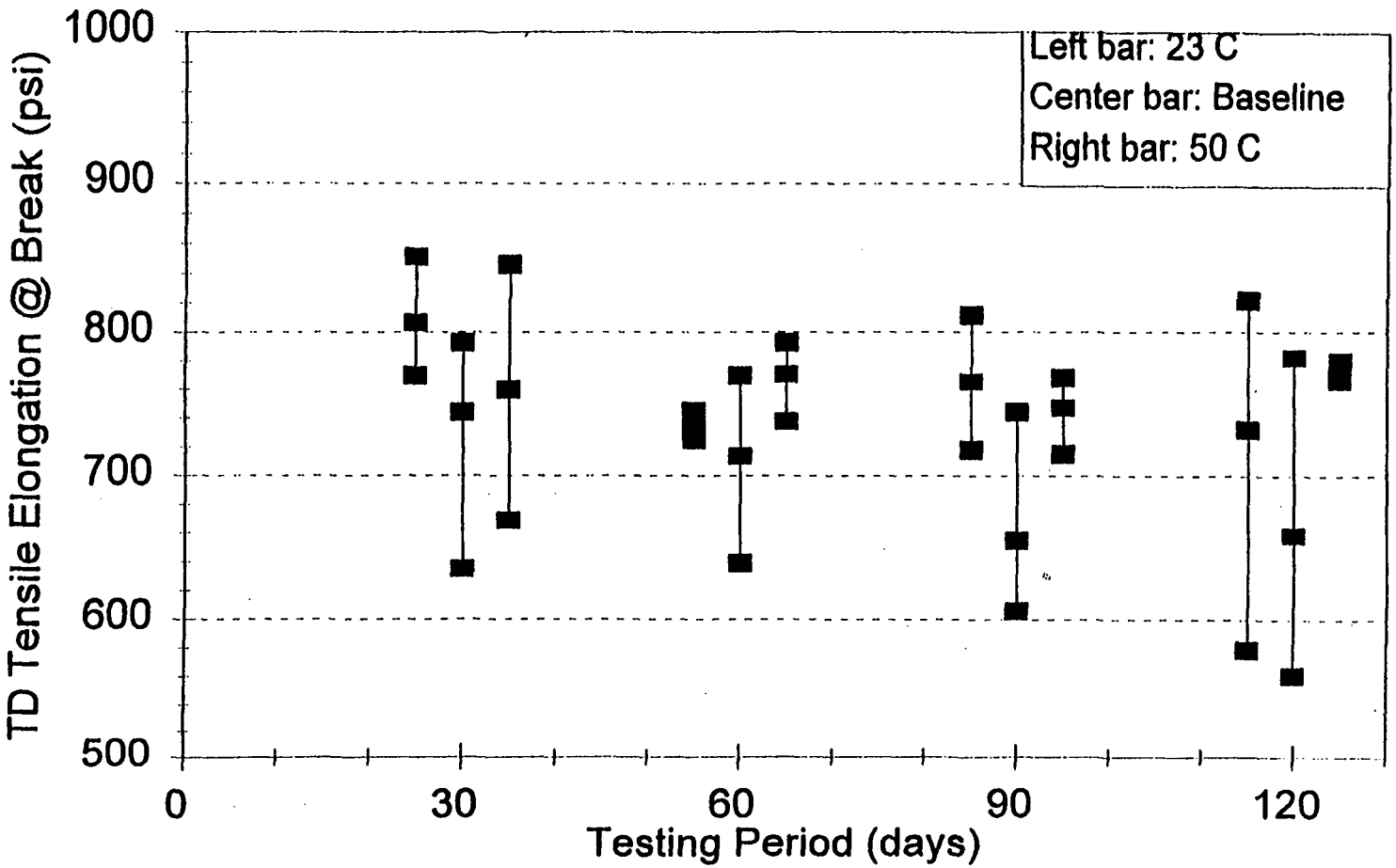
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

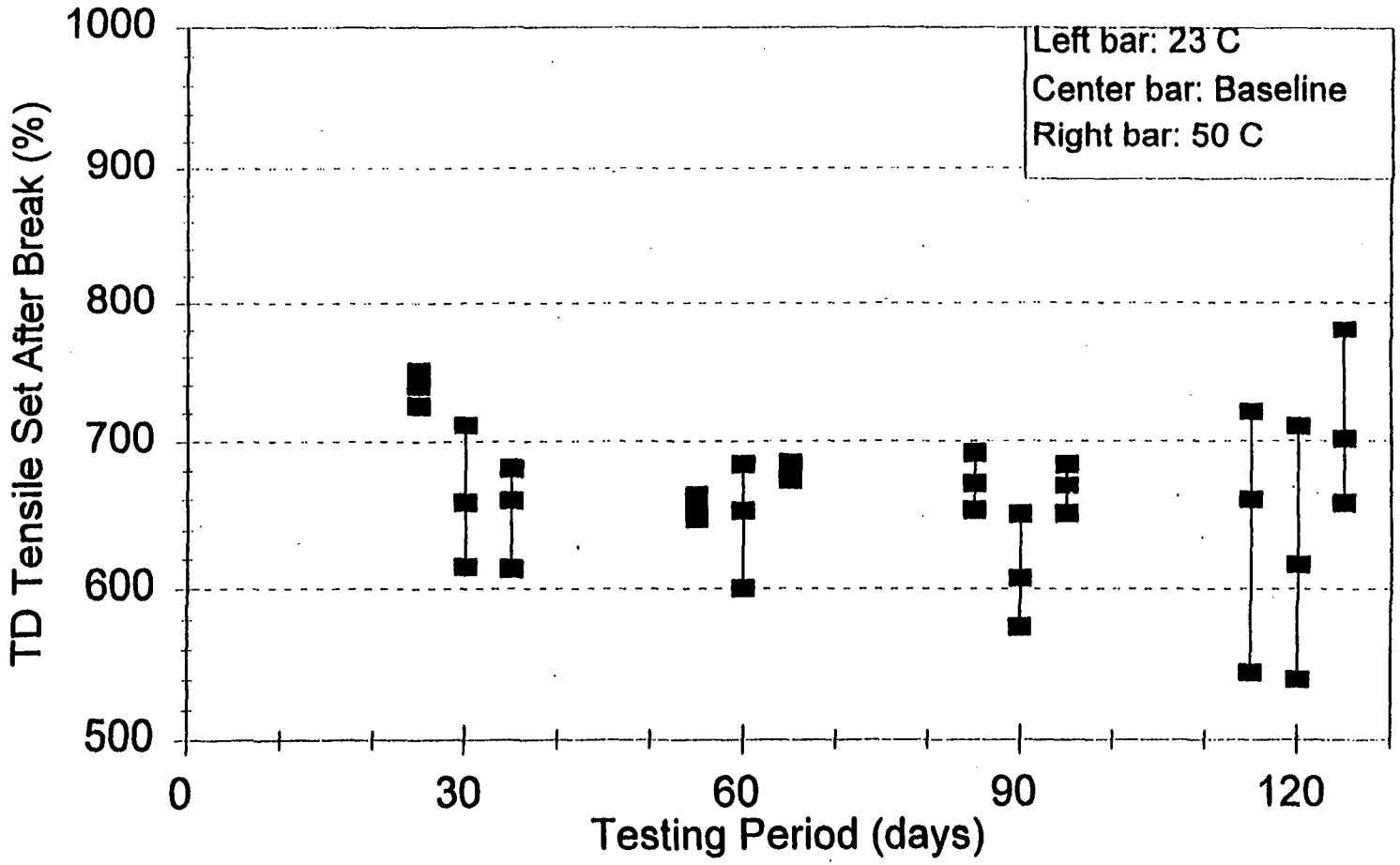
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

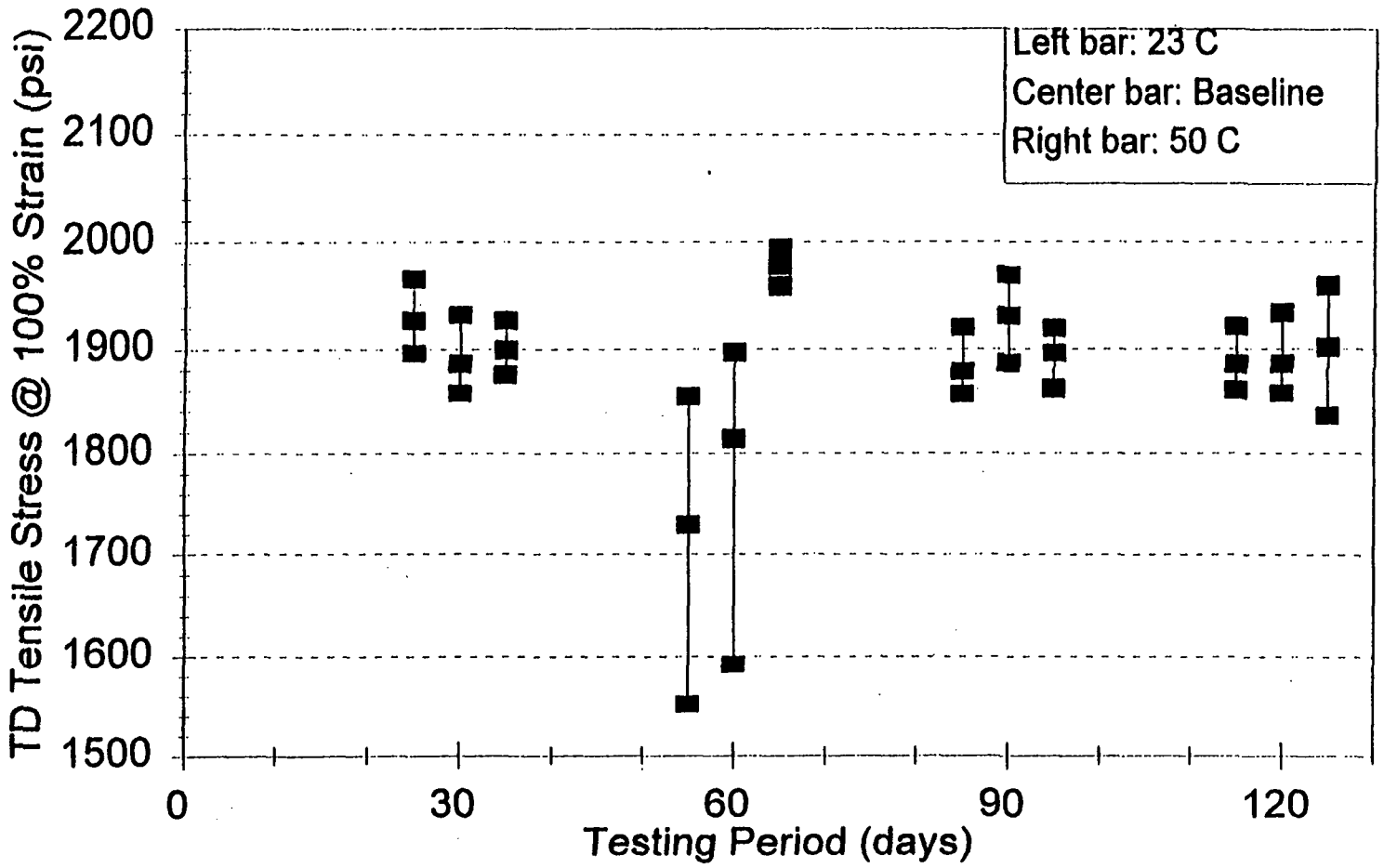
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

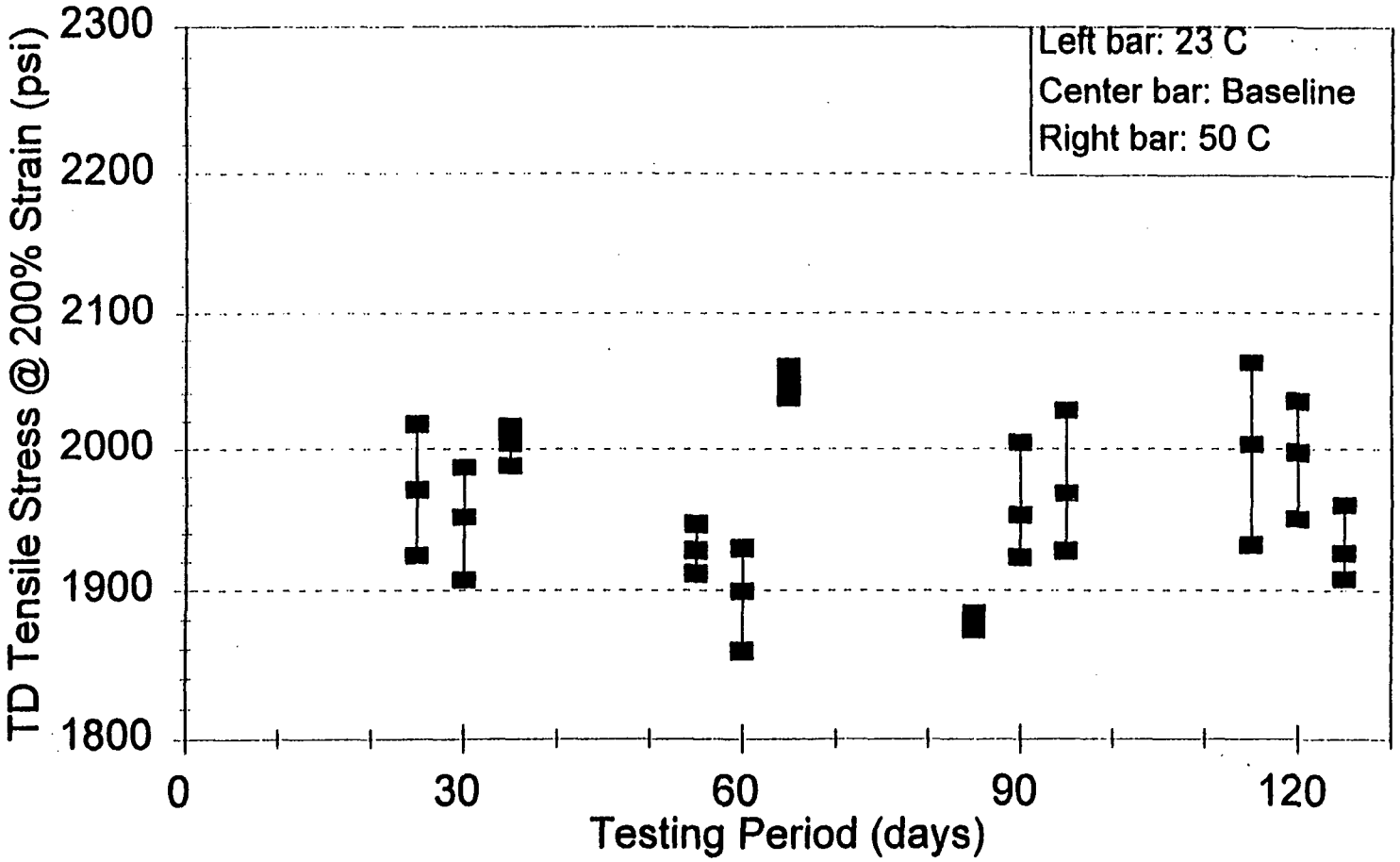
60 mil HDPE GM vs Phos Dock Effluent



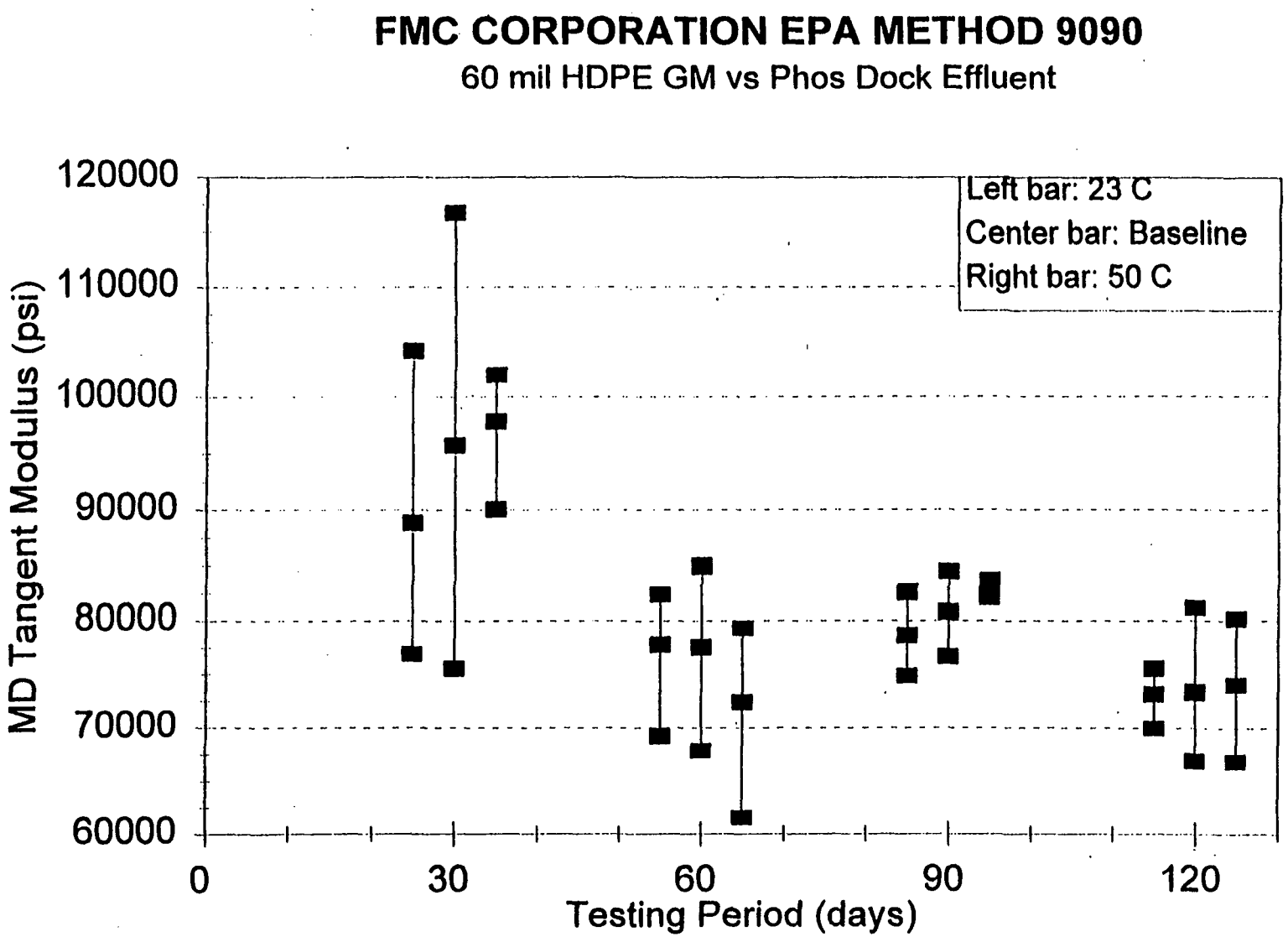
Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

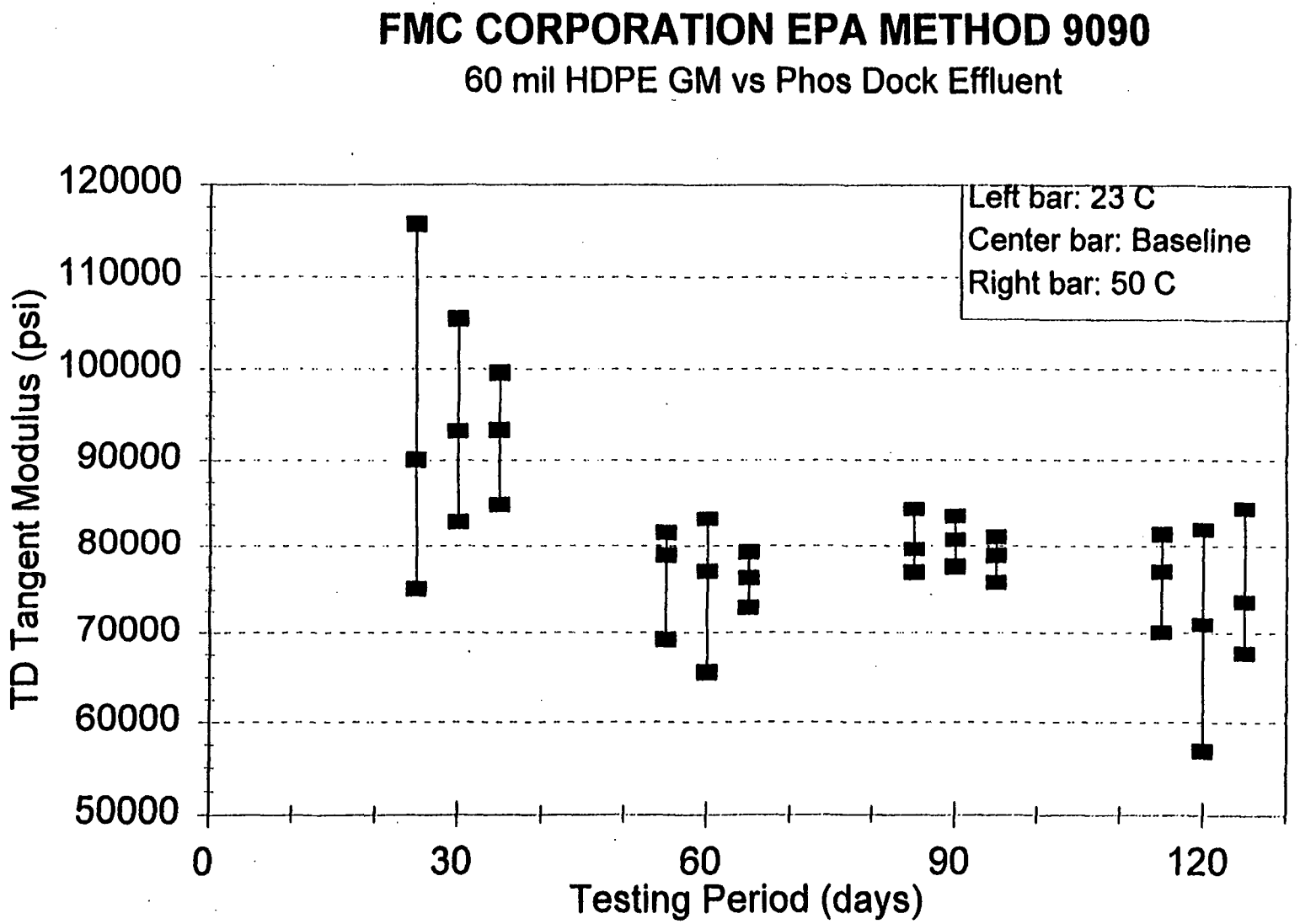
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1



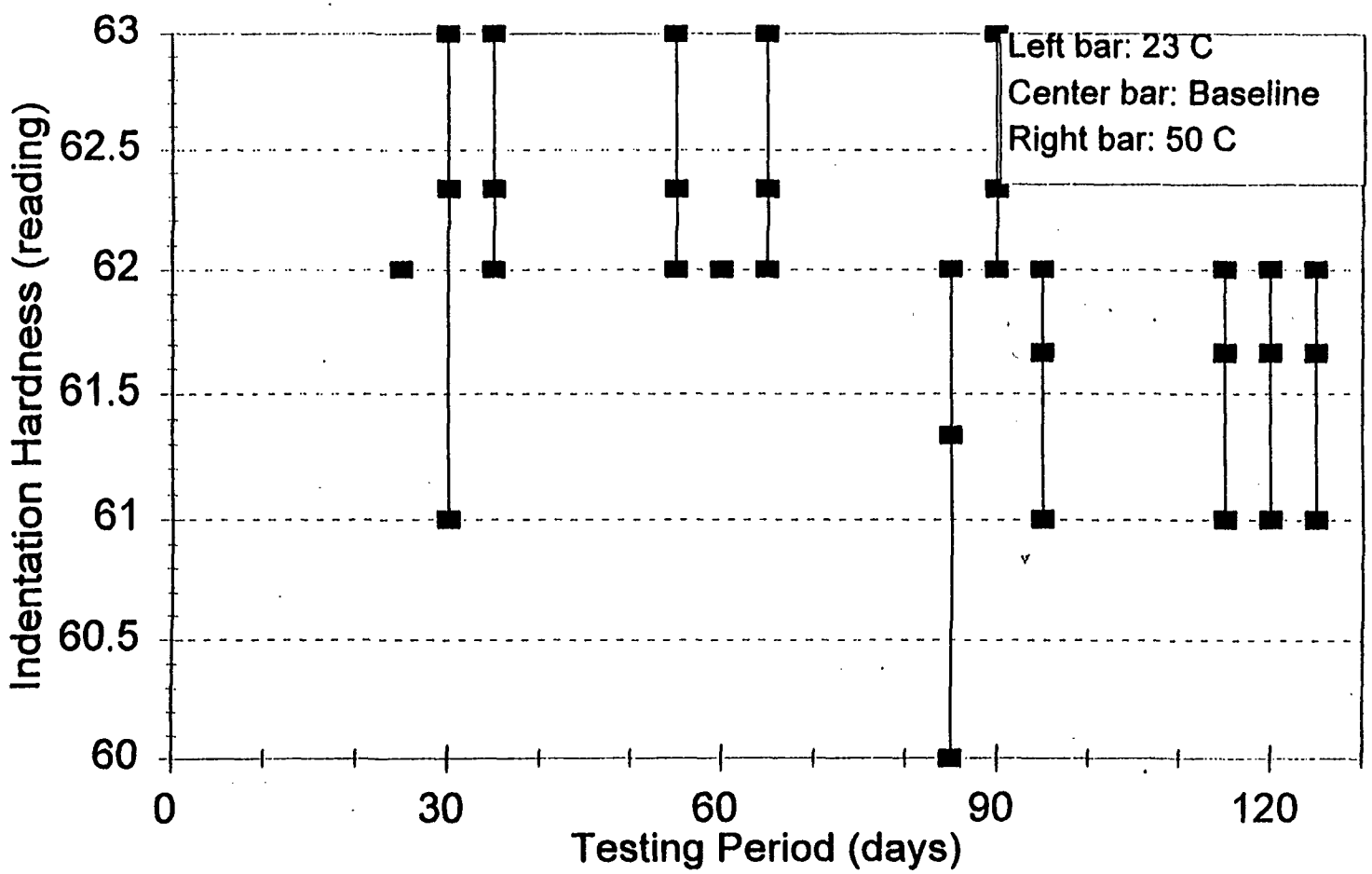
Client: FMC Corporation, File: 942-fmc HDPE GM.wb1



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

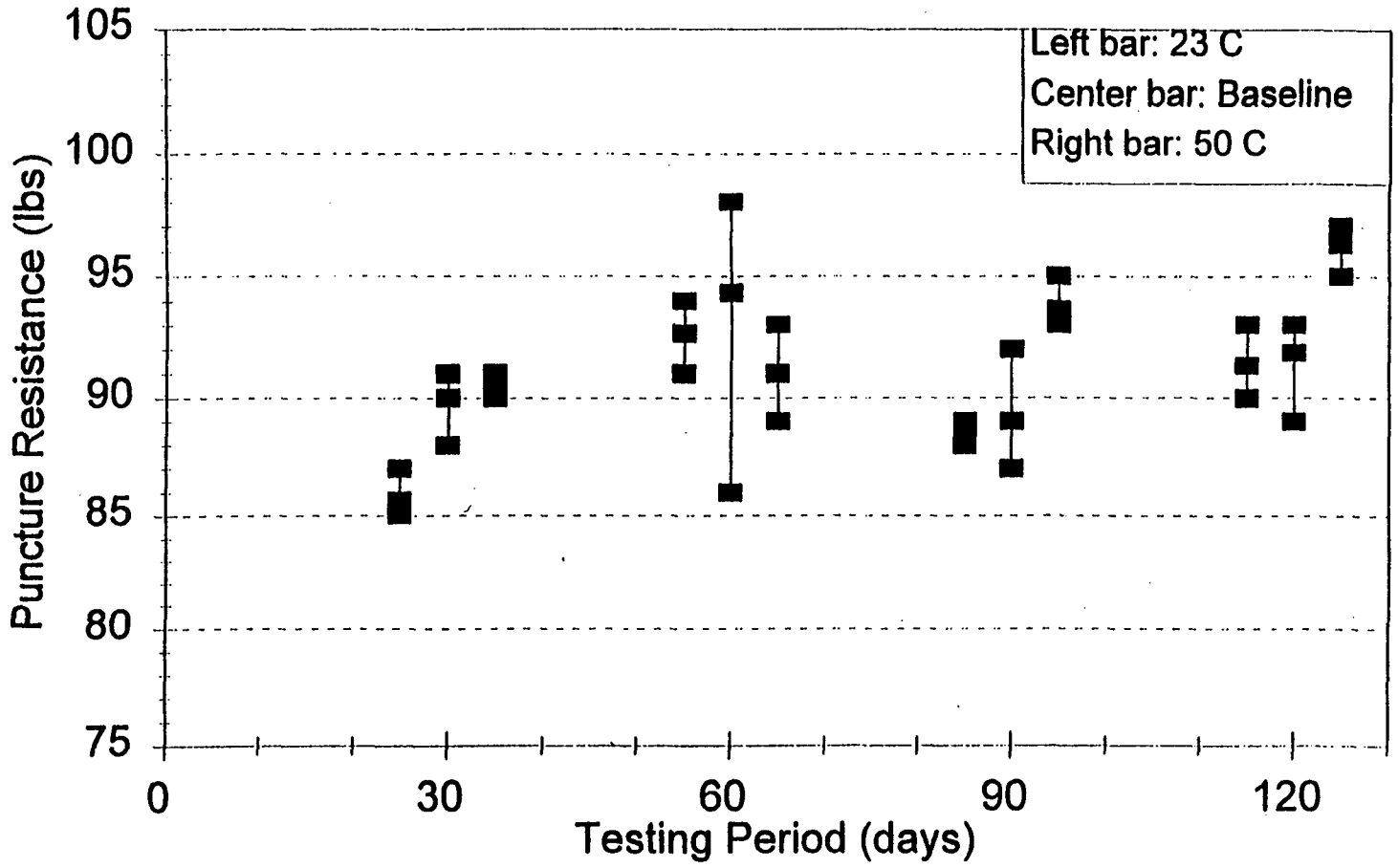
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

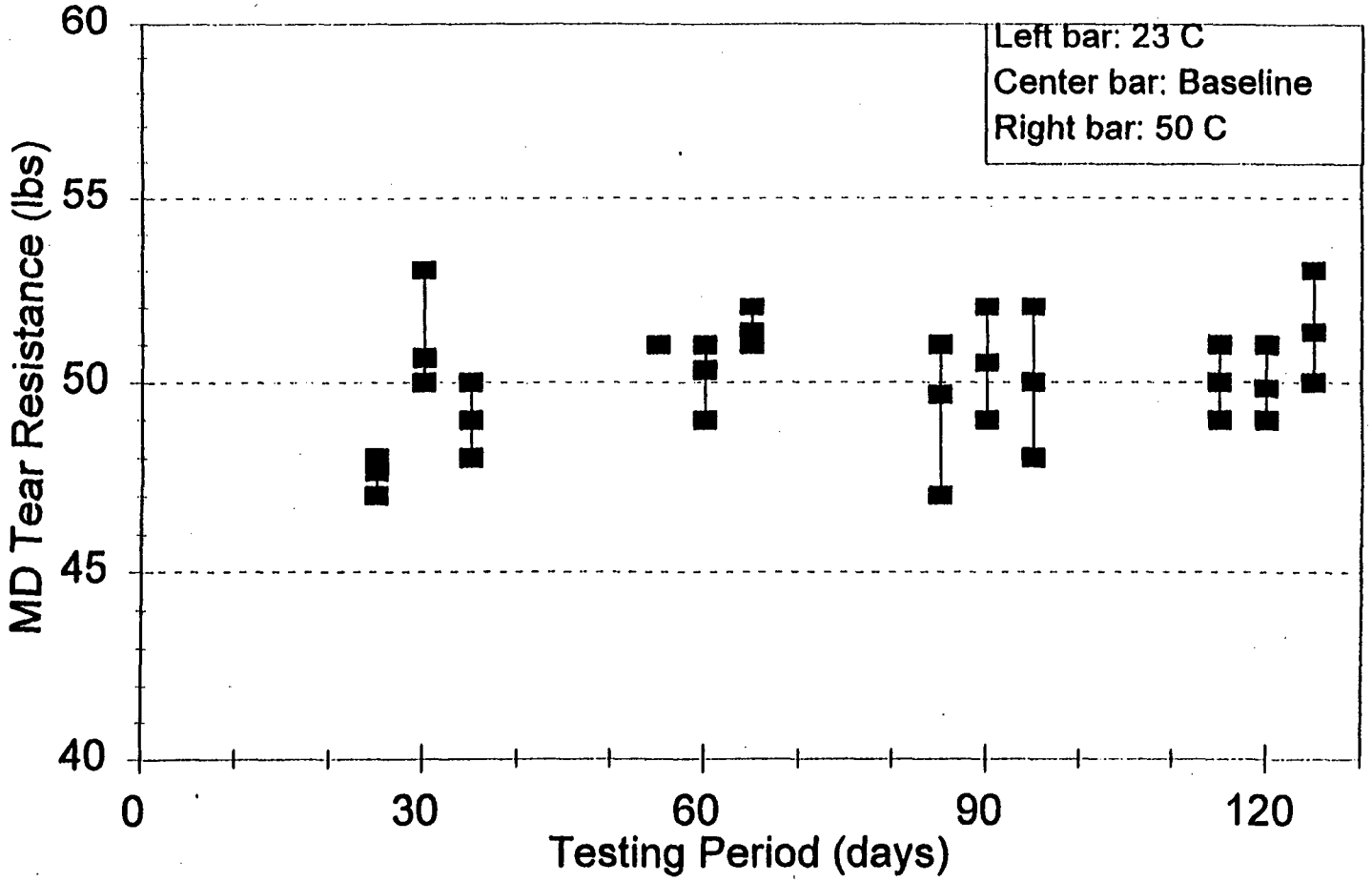
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

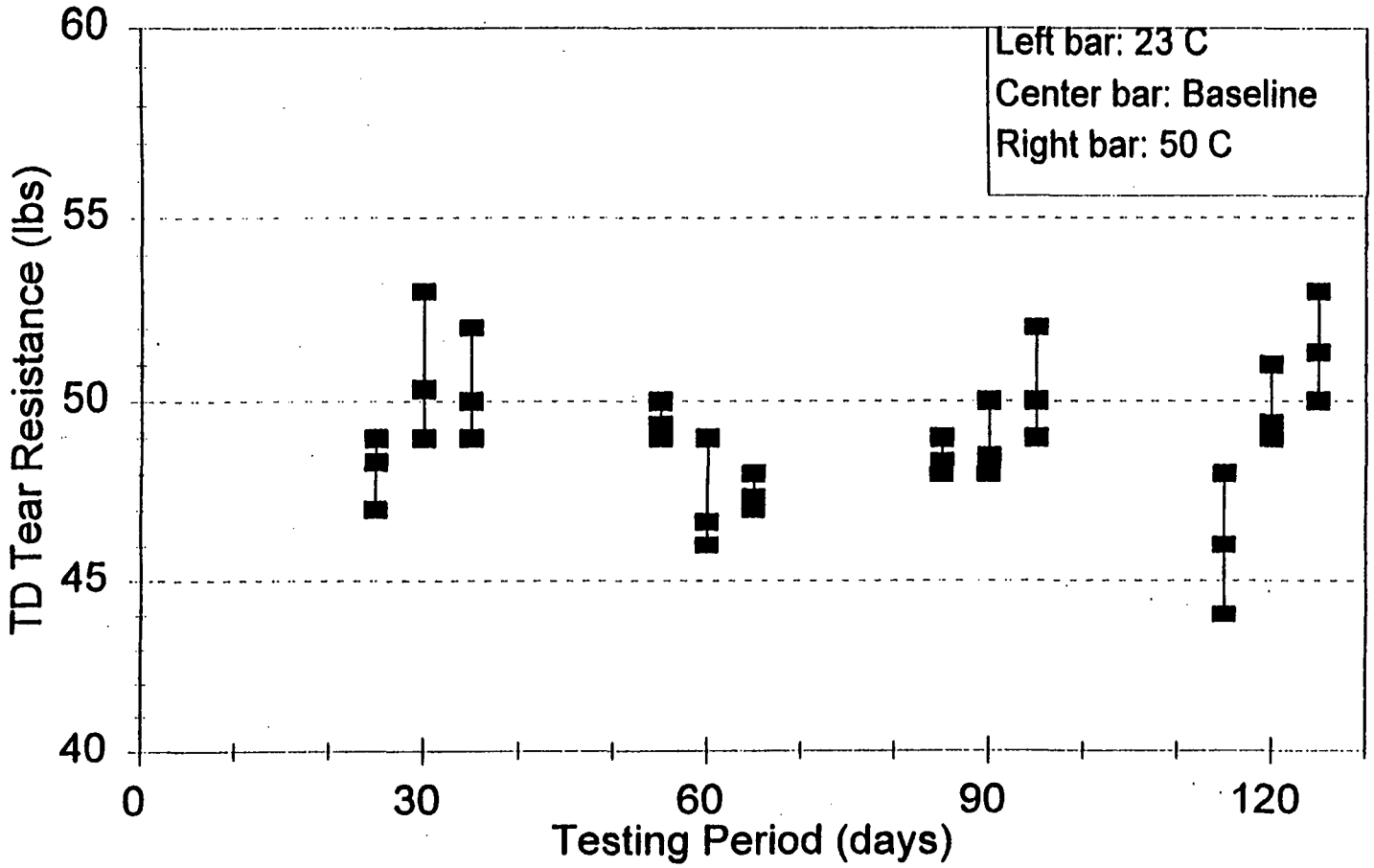
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

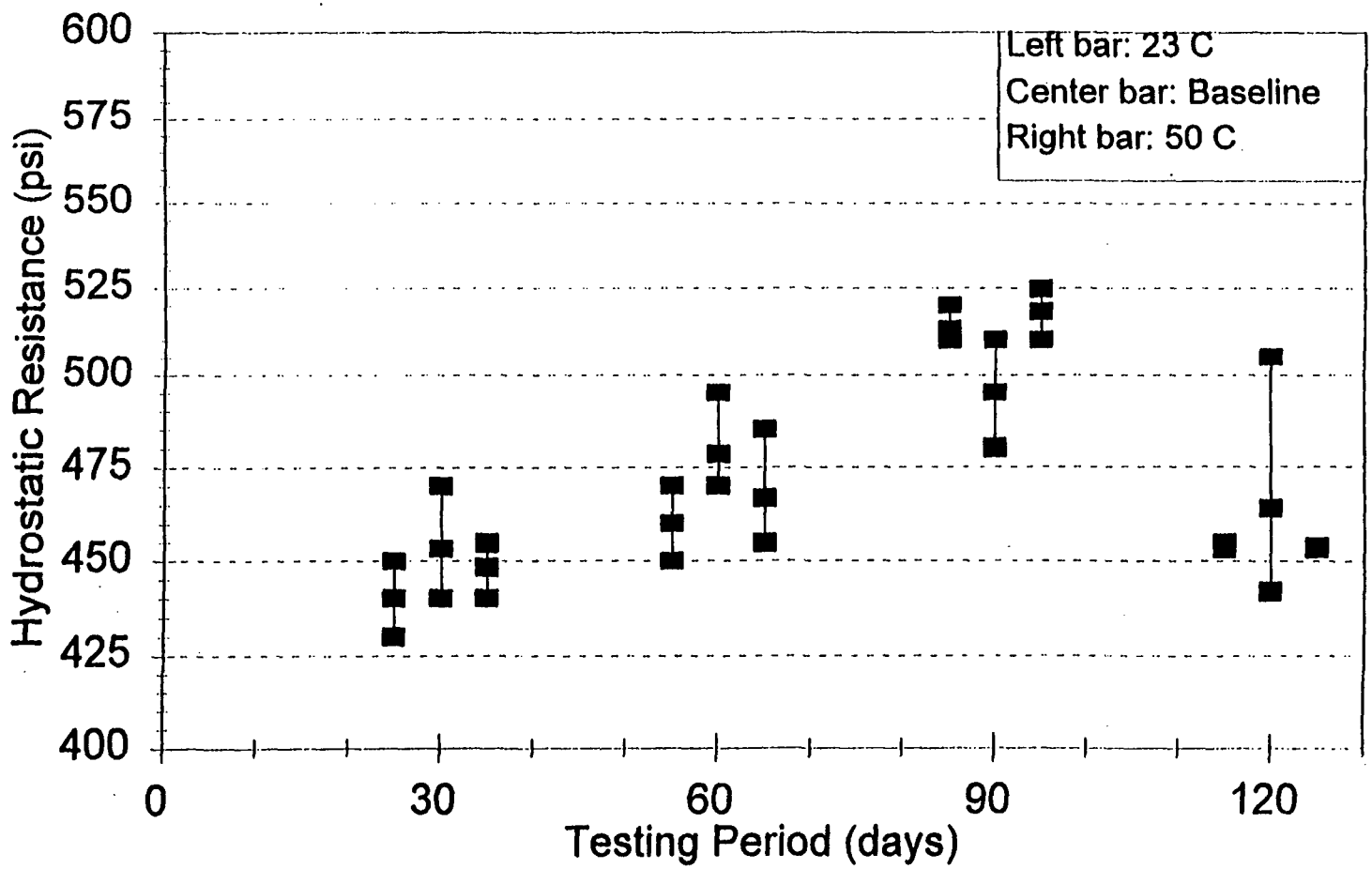
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

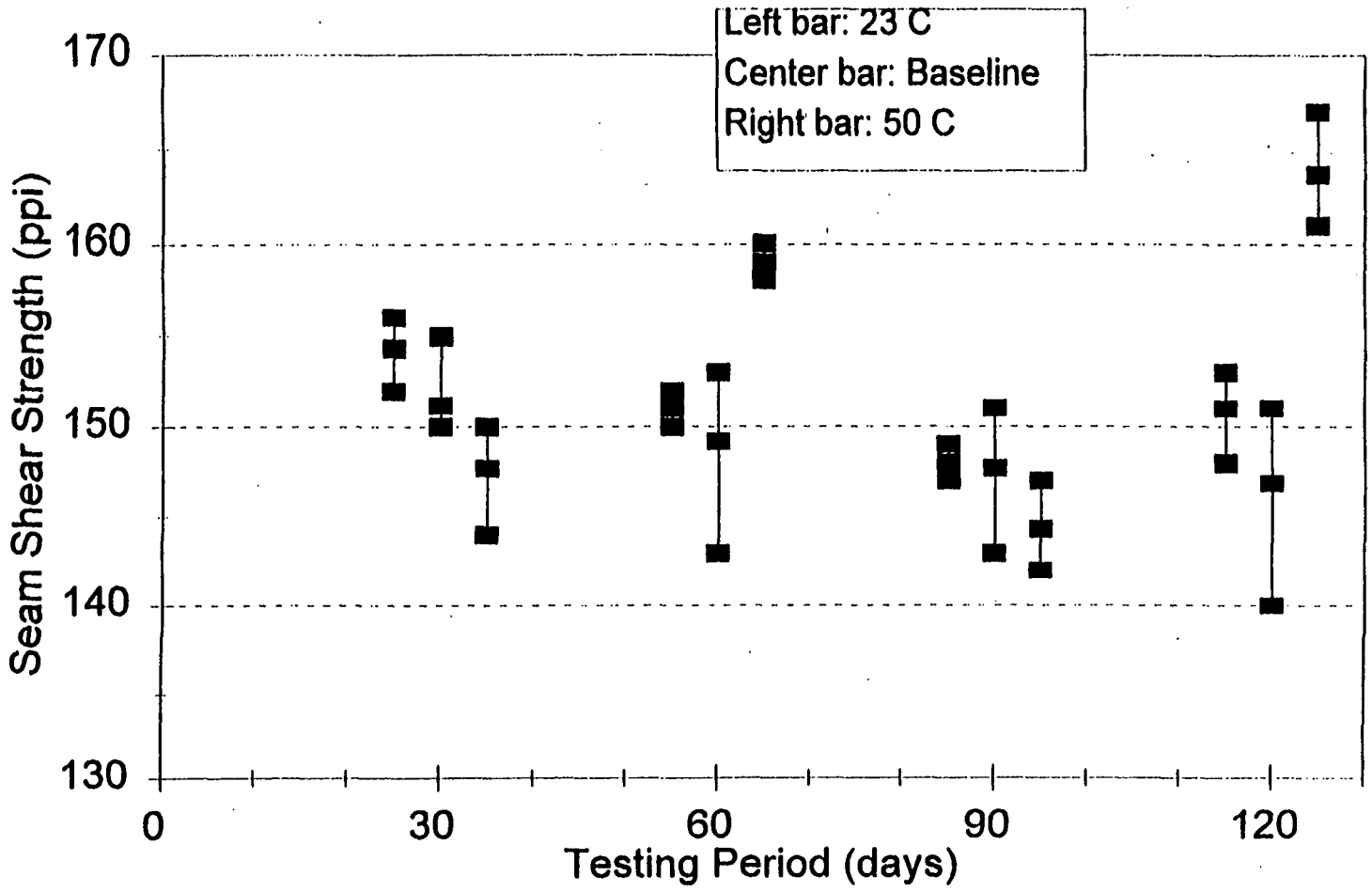
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

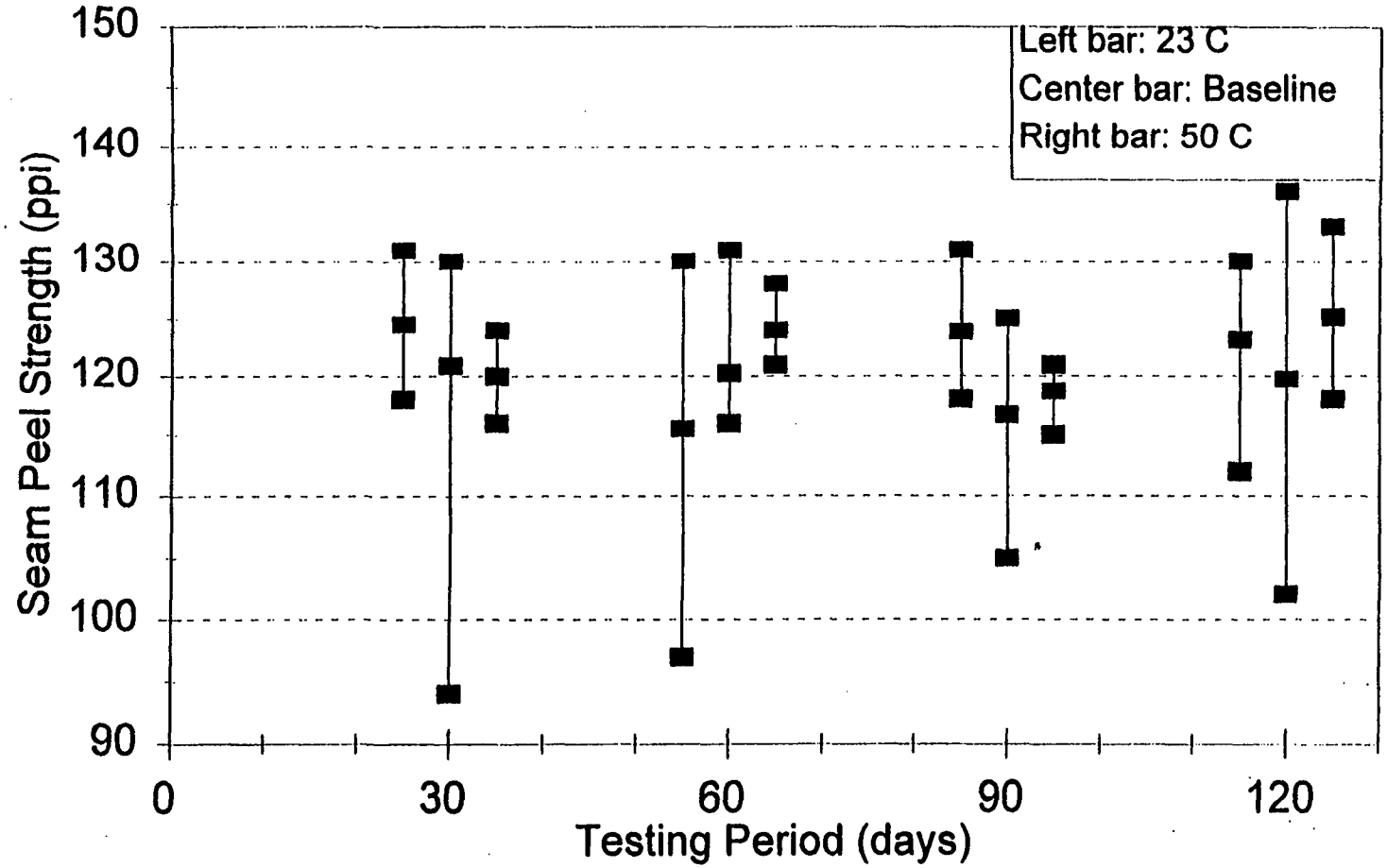
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

30 mil PVC GEOMEMBRANE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 30 mil PVC												
Tensile Properties:	3296	3234	3235	3116	3117	3062	3083	2965	2977	3086	2911	2756
Tensile Stress @ Break (psi)	3373	3054	3119	3165	2987	3200	3149	2893	2784	3050	2819	2718
ASTM D882	3388	3218	3219	3207	3392	2991	2991	3279	2963	2998	1963	2800
Machine Direction	3433			3252			2905			3079		
	3266			3266			3072			2749		
	3251			3314			2881			2816		
Average	3335	3169	3191	3220	3165	3084	3014	3046	2908	2963	2564	2758
STD	67	81	51	66	169	87	97	168	88	132	427	34
Coefficient of Variation	2	3	2	2	5	3	3	6	3	4	17	1
Range as % of Baseline	5			6			9			11		
% Change		-5	-4		-2	-4		1	-4		-13	-7
Tensile Properties:	449	458	474	521	492	484	490	467	436	497	470	463
Tensile Elongation @ Break (%)	460	393	484	469	477	512	499	476	415	540	436	506
ASTM D882	470	447	482	532	546	467	512	504	462	498	483	431
Machine Direction	465			564			485			540		
	444			514			500			475		
	433			532			454			449		
Average	454	433	480	522	505	488	490	482	438	500	463	467
STD	13	28	4	28	30	19	18	16	19	33	20	31
Coefficient of Variation	3	7	1	5	6	4	4	3	4	7	4	7
Range as % of Baseline	8			18			12			18		
% Change		-5	6		-3	-7		-2	-11		-7	-7
Tensile Properties:	1636	1627	1749	1488	1509	1645	1483	1424	1612	1377	1459	1575
Tensile Stress @ 100% Elongation (psi)	1658	1652	1592	1551	1474	1612	1495	1364	1547	1397	1440	1545
ASTM D882	1647	1639	1673	1470	1530	1596	1403	1482	1538	1413	1404	1546
Machine Direction	1664			1434			1389			1385		
	1625			1528			1440			1353		
	1688			1492			1440			1435		
Average	1653	1639	1671	1494	1504	1618	1442	1423	1566	1393	1434	1555
STD	20	10	64	38	23	20	38	48	33	26	23	14
Coefficient of Variation	1	1	4	3	2	1	3	3	2	2	2	1
Range as % of Baseline	4			8			7			6		
% Change		-1	1		1	8		-1	9		3	12
Tensile Properties:	2162	2150	2195	1965	1992	2072	1979	1923	2052	1855	1921	1961
Tensile Stress @ 200% Elongation (psi)	2196	2179	2032	2063	1949	2056	1991	1839	1983	1857	1908	1940
ASTM D882	2193	2169	2125	1948	2024	2021	1876	2003	1965	1880	1876	1945
Machine Direction	2214			1906			1857			1846		
	2166			2034			1932			1791		
	2228			1991			1921			1896		
Average	2193	2166	2117	1985	1988	2050	1926	1922	2000	1854	1902	1949
STD	24	12	67	52	31	21	49	67	37	33	19	9
Coefficient of Variation	1	1	3	3	2	1	3	3	2	2	1	0
Range as % of Baseline	3			8			7			6		
% Change		-1	-3		0	3		-0	4		3	5

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 30 mil PVC												
Tensile Properties:	2964	2820	3013	2659	3006	2773	2859	2713	2887	2740	2756	2856
Tensile Stress @ Break (psi)	3048	2888	2858	2690	2913	2710	2798	2802	2806	2735	2728	2839
ASTM D882	3023	2920	3167	2655	2675	2671	2833	2853	2901	2814	2800	2769
Transverse Direction	2921			2664			2850			2796		
	2777			2791			2805			2826		
	3013			2755			2819			2726		
Average	2958	2876	3013	2702	2865	2718	2827	2789	2865	2773	2761	2821
STD	91	42	126	52	139	42	22	58	42	40	30	38
Coefficient of Variation	3	1	4	2	5	2	1	2	1	1	1	1
Range as % of Baseline	9			5			2			4		
% Change		-3	2		6	1		-1	1		-0	2
Tensile Properties:	439	472	482	475	514	497	512	480	492	515	501	503
Tensile Elongation @ Break (%)	469	438	445	469	501	482	484	465	464	478	488	491
ASTM D882	492	484	519	455	462	445	531	477	484	521	512	462
Transverse Direction	500			475			490			505		
	469			492			497			515		
	494			455			517			505		
Average	477	465	482	470	492	475	505	474	480	507	500	485
STD	21	19	30	13	22	22	16	6	12	14	10	17
Coefficient of Variation	4	4	6	3	4	5	3	1	2	3	2	4
Range as % of Baseline	13			8			9			8		
% Change		-3	1		5	1		-6	-5		-1	-4
Tensile Properties:	1540	1422	1569	1338	1467	1389	1349	1289	1467	1318	1345	1476
Tensile Stress @ 100% Elongation (psi)	1536	1490	1527	1301	1426	1439	1383	1342	1474	1359	1337	1513
ASTM D882	1495	1410	1601	1335	1345	1411	1280	1352	1466	1333	1331	1531
Transverse Direction	1419			1332			1327			1325		
	1403			1368			1289			1327		
	1469			1372			1279			1281		
Average	1477	1441	1566	1341	1413	1413	1318	1328	1469	1324	1338	1507
STD	53	35	30	24	51	20	39	28	4	23	6	23
Coefficient of Variation	4	2	2	2	4	1	3	2	0	2	0	2
Range as % of Baseline	9			5			8			6		
% Change		-2	6		5	5		1	11		1	14
Tensile Properties:	2022	1867	1981	1769	1911	1779	1799	1729	1849	1735	1754	1851
Tensile Stress @ 200% Elongation (psi)	2013	1976	1942	1739	1871	1811	1826	1803	1864	1780	1747	1873
ASTM D882	1968	1879	2023	1770	1776	1810	1719	1815	1859	1748	1754	1904
Transverse Direction	1870			1753			1792			1751		
	1844			1793			1739			1761		
	1932			1821			1722			1711		
Average	1942	1907	1982	1774	1853	1800	1766	1782	1857	1748	1752	1876
STD	67	49	33	27	57	15	41	38	6	21	3	22
Coefficient of Variation	3	3	2	2	3	1	2	2	0	1	0	1
Range as % of Baseline	9			5			6			4		
% Change		-2	2		4	1		1	5		0	7

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 30 mil PVC												
Tear Resistance:	11	13	12	11	11	13	11	11	11	11	11	11
Tear Resistance (lbs)	11	13	13	12	11	13	11	11	11	11	13	13
ASTM D1004	11	12	11	11	13	13	12	11	10	12	12	12
Machine Direction	11			12			11			12		
	12			11			10			11		
	11			11			12			13		
Average	11	13	12	11	12	13	11	11	11	12	12	12
STD	0	0	1	0	1	0	1	0	0	1	1	1
Coefficient of Variation	3	4	7	4	8	0	6	0	4	6	7	7
Range as % of Baseline	9			9			18			17		
% Change		13	7		3	15		-1	-4		3	3
Tear Resistance:	10	11	11	11	11	12	10	10	10	10	9	11
Tear Resistance (lbs)	11	10	11	11	10	12	10	10	10	10	11	11
ASTM D1004	11	11	11	11	11	12	11	10	11	11	12	12
Transverse Direction	10			10			11			11		
	11			10			10			10		
	11			10			10			11		
Average	11	11	11	11	11	12	10	10	10	11	11	11
STD	0	0	0	1	0	0	0	0	0	1	1	0
Coefficient of Variation	4	4	0	5	4	0	5	0	5	5	12	4
Range as % of Baseline	9			10			10			10		
% Change		0	3		2	14		-3	0		2	8
Puncture Resistance:	65	64	56	67	63	60	68	67	68	54	59	62
Load @ Rupture (lbs)	62	57	57	65	63	59	68	71	67	57	62	61
FTMS 101C Method 2065	61	54	56	63	62	59	61	64	71	60	60	65
	65			64			70			58		
	68			66			65			49		
	65			61			70			57		
Average	64	58	56	64	63	59	67	67	69	56	60	63
STD	2	4	0	2	0	0	3	3	2	4	1	2
Coefficient of Variation	4	7	1	3	1	1	5	4	2	6	2	3
Range as % of Baseline	11			9			13			20		
% Change		-9	-12		-3	-8		0	2		8	12
Hydrostatic Resistance:	110	110	110	95	100	105	110	110	115	110	100	110
Load @ Rupture (psi)	110	110	110	95	100	100	110	110	120	100	90	105
ASTM D751	110	105	115	90	105	100	105	115	115	90	110	120
	110			95			110			110		
	110			100			115			100		
	110			100			110			100		
Average	110	108	112	96	102	102	110	112	117	102	100	112
STD	0	2	2	3	2	2	3	2	2	7	8	6
Coefficient of Variation	0	2	2	4	2	2	3	2	2	7	8	6
Range as % of Baseline	0			10			9			20		
% Change		-2	2		6	6		2	6		-2	10

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 30 mil PVC												
Indentation Hardness:	94	95	97	92	96	97	98	97	99	98	97	96
Reading	94	96	96	96	95	97	94	97	99	98	97	96
ASTM D2240	96	97	95	98	97	97	97	95	97	98	97	97
(with SHORE A DUROMETER)	96			95			97			99		
	96			96			96			98		
	95			97			95			99		
Average	95	96	96	96	96	97	96	96	98	98	97	96
STD	1	1	1	2	1	0	1	1	1	0	0	0
Coefficient of Variation	1	1	1	2	1	0	1	1	1	0	0	0
Range as % of Baseline	2			6			4			1		
% Change		1	1		0	1		0	2		-1	-2
Specific Gravity:	1.25	1.24	1.25	1.24	1.23	1.24	1.23	1.24	1.27	1.23	1.25	1.25
Specific Gravity (grams/cu.cm)	1.25	1.25	1.25	1.28	1.25	1.25	1.24	1.25	1.25	1.25	1.25	1.25
ASTM D792, Method A	1.25	1.24	1.25	1.25	1.27	1.25	1.24	1.24	1.24	1.25	1.24	1.24
Machine Direction	1.25			1.26			1.24			1.25		
	1.25			1.25			1.23			1.24		
	1.25			1.26			1.24			1.25		
Average	1.25	1.24	1.25	1.26	1.25	1.25	1.24	1.24	1.25	1.25	1.25	1.25
STD	0.00	0.01	0.00	0.01	0.02	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Coefficient of Variation	0.00	0.46	0.00	0.99	1.31	0.38	0.38	0.38	1.00	0.61	0.38	0.38
Range as % of Baseline	0			3			1			2		
% Change		-0.53	0.00		-0.53	-0.80		0.54	1.35		0	0
Volatiles and Extractables:	-0.58	-0.25	-0.37	-0.26	-0.32	-0.15	-0.45	-0.24	-0.39	-0.34	-0.22	-0.31
Diameter Change (%)	-0.15	-0.25	-0.61	-0.22	-0.38	-0.27	-0.28	-0.26	-0.28	-0.27	-0.25	-0.27
SW 870 - Appendix III-D	-0.67			-0.37			-0.19			-0.31		
Machine Direction	-0.38			-0.08			-0.31			-0.25		
Average	-0.45	-0.25	-0.49	-0.23	-0.35	-0.21	-0.31	-0.25	-0.34	-0.29	-0.24	-0.29
STD	0.20	0.00	0.12	0.10	0.03	0.06	0.09	0.01	0.06	0.03	0.02	0.02
Volatiles and Extractables:	-0.45	0.50	0.05	0.11	0.33	0.17	0.05	0.15	0.21	0.07	0.12	0.21
Diameter Change (%)	0.28	0.48	0.30	-0.03	0.41	0.22	0.09	0.16	0.29	0.05	0.11	0.26
SW 870 - Appendix III-D	0.18			0.28			0.16			0.11		
Transverse Direction	0.23			0.14			0.01			0.08		
Average	0.06	0.49	0.18	0.13	0.37	0.20	0.08	0.16	0.25	0.08	0.12	0.24
STD	0.30	0.01	0.12	0.11	0.04	0.02	0.06	0.01	0.04	0.02	0.00	0.03

SZA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

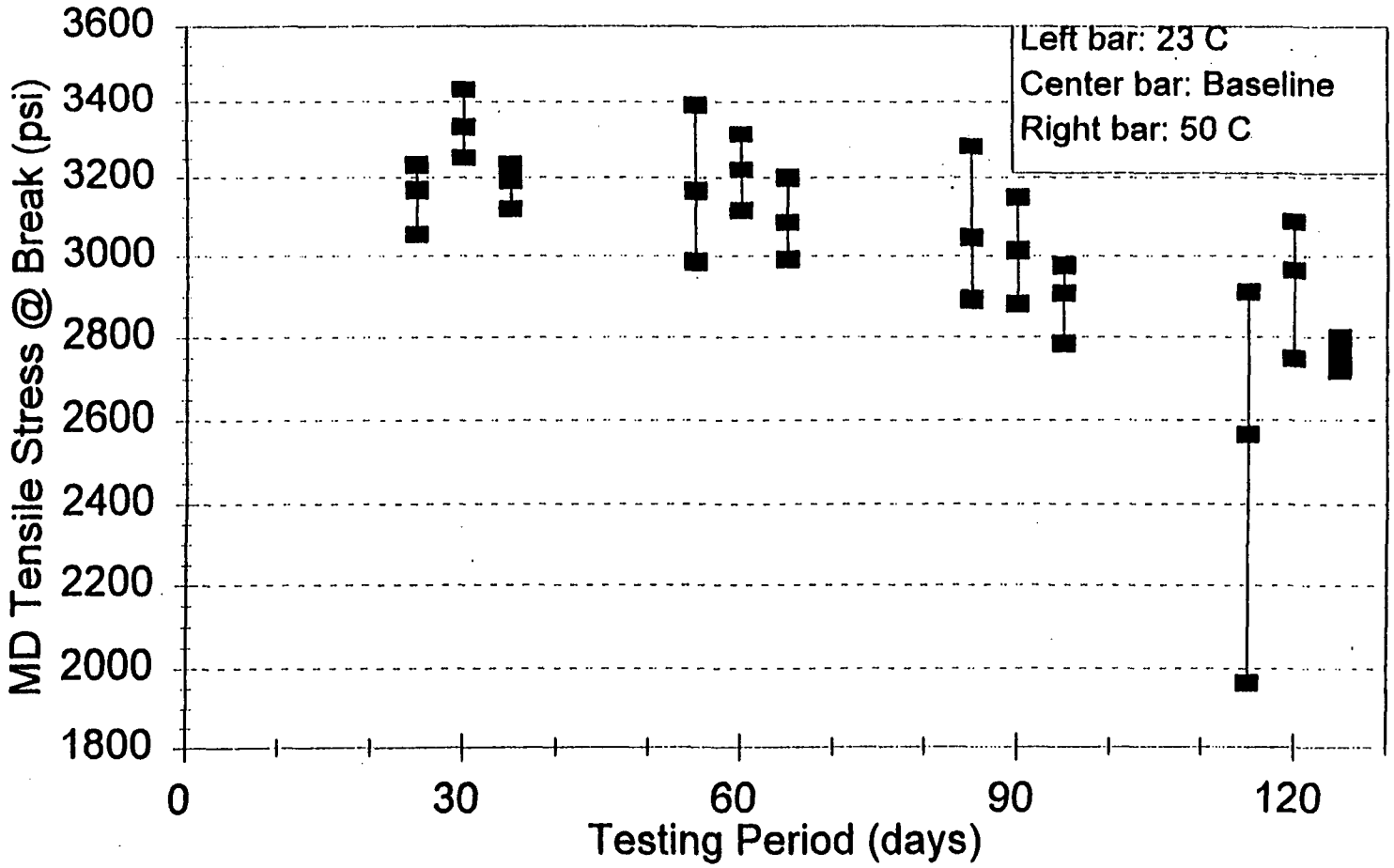
	Exposure Time and Temperature											
		30 Day			60 Day			90 Day			120 Day	
Test Parameters	Baseline	23C	50C	Baseline	23C	50C	Baseline	23C	50C	Baseline	23C	50C
GEOMEMBRANE: 30 mil PVC												
Volatiles and Extractables:	0.47	0.20	0.15	0.42	0.18	0.24	0.37	0.20	0.26	0.37	0.21	0.25
% Volatiles	0.26	0.15	0.18	0.44	0.23	0.30	0.29	0.12	0.23	0.28	0.18	0.24
SW 870 - Appendix III-D	0.32			0.36			0.33			0.34		
	0.31			0.48			0.28			0.29		
Average	0.34	0.18	0.17	0.43	0.21	0.27	0.32	0.16	0.25	0.32	0.20	0.25
STD	0.08	0.03	0.02	0.04	0.03	0.03	0.04	0.04	0.02	0.04	0.02	0.01
Volatiles and Extractables:	42.81	42.90	43.71	37.69	36.26	36.89	41.22	40.07	42.03	42.33	41.24	42.31
% Extractables	42.87	42.79	43.03	36.71	36.92	37.04	37.55	39.65	40.46	39.41	31.56	41.25
SW 870 - Appendix III-D	42.72			33.41			34.98			43.29		
	42.51			35.84			39.62			44.21		
Average	42.73	42.85	43.37	35.91	36.59	36.97	38.34	39.86	41.25	42.31	36.40	41.78
STD	0.14	0.05	0.34	1.59	0.33	0.07	2.34	0.21	0.79	1.80	4.84	0.53
Seam Shear Strength:	68	72	70	67	72	73	63	70	71	64	64	71
Seam Shear Strength (ppi)	63	68	65	71	70	73	65	69	69	65	63	69
ASTM D4437	65	71	75	76	71	75	65	70	70	64	63	70
	66			73			64			65		
	62			73			64			64		
	65			75			64			65		
Average	65	70	70	73	71	74	64	70	70	65	63	70
STD	2	2	5	3	1	1	1	0	1	1	0	1
Coefficient of Variation	3	3	7	4	1	1	1	1	1	1	1	1
Range as % of Baseline	9			12			3			3		
% Change		8	8		-2	2		9	9		-2	8

Note: Peel adhesion testing could not be performed due to lack of seam overlap

SRA 10-21-97
Quality Review/Date

FMC CORPORATION EPA METHOD 9090

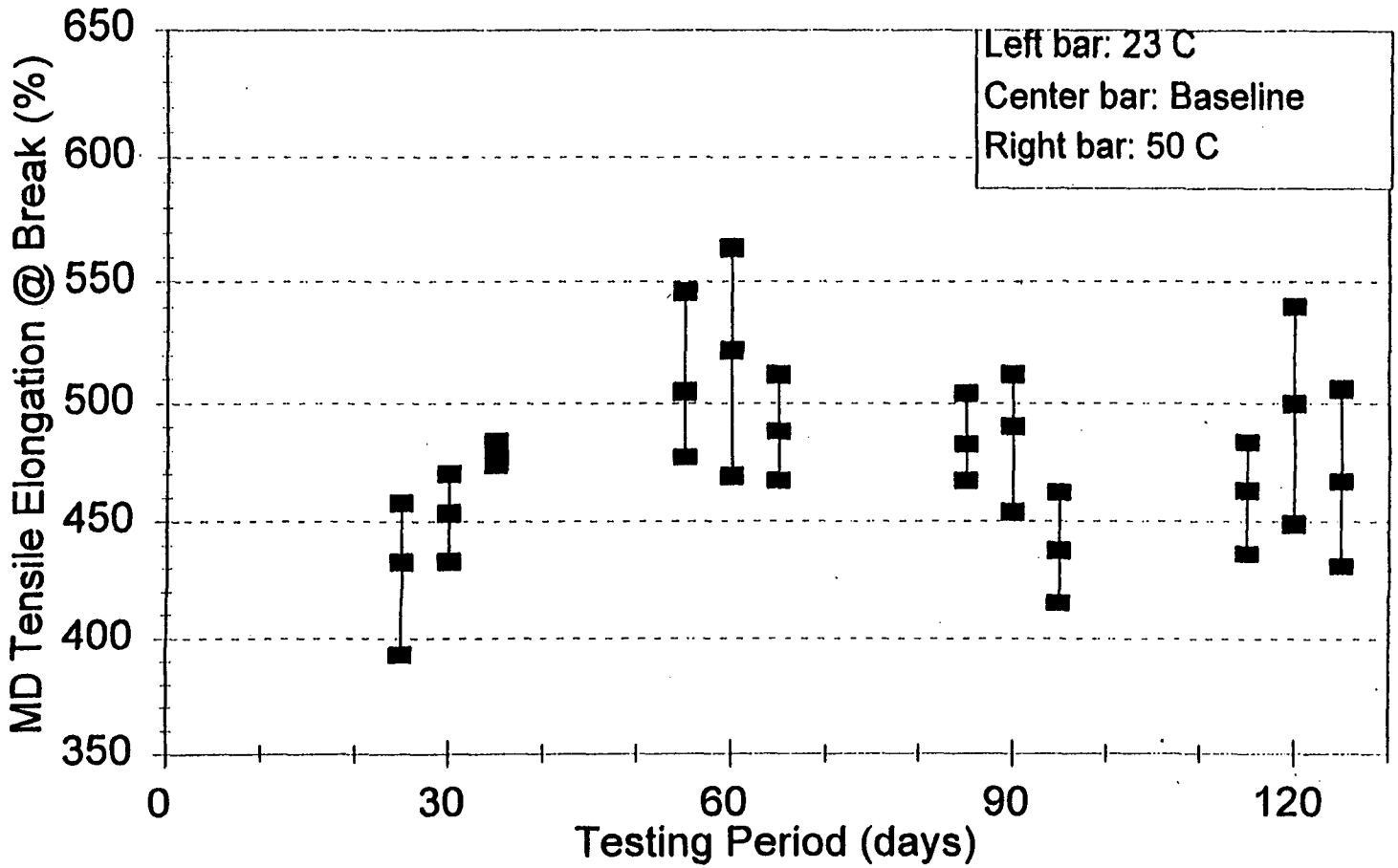
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

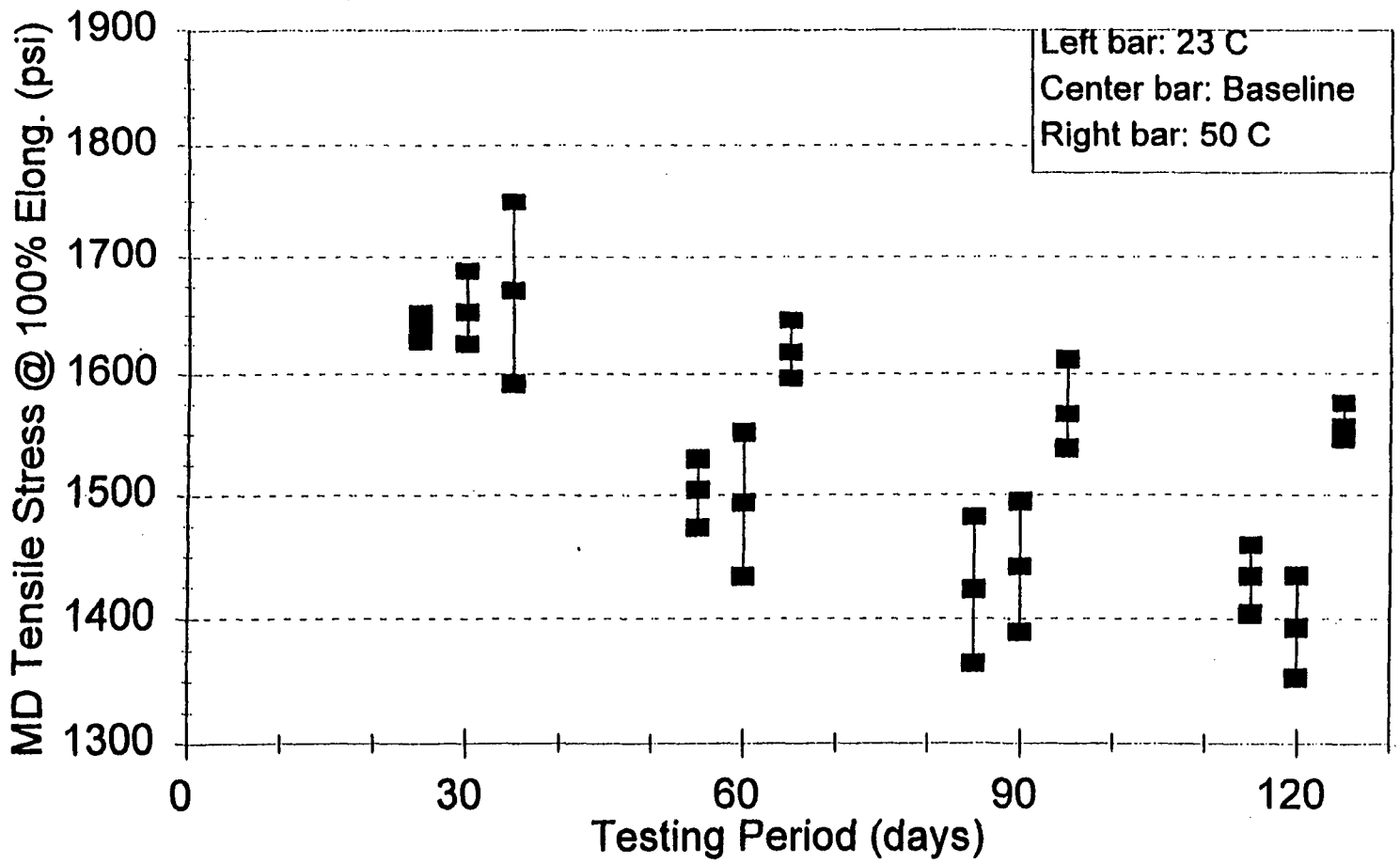
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

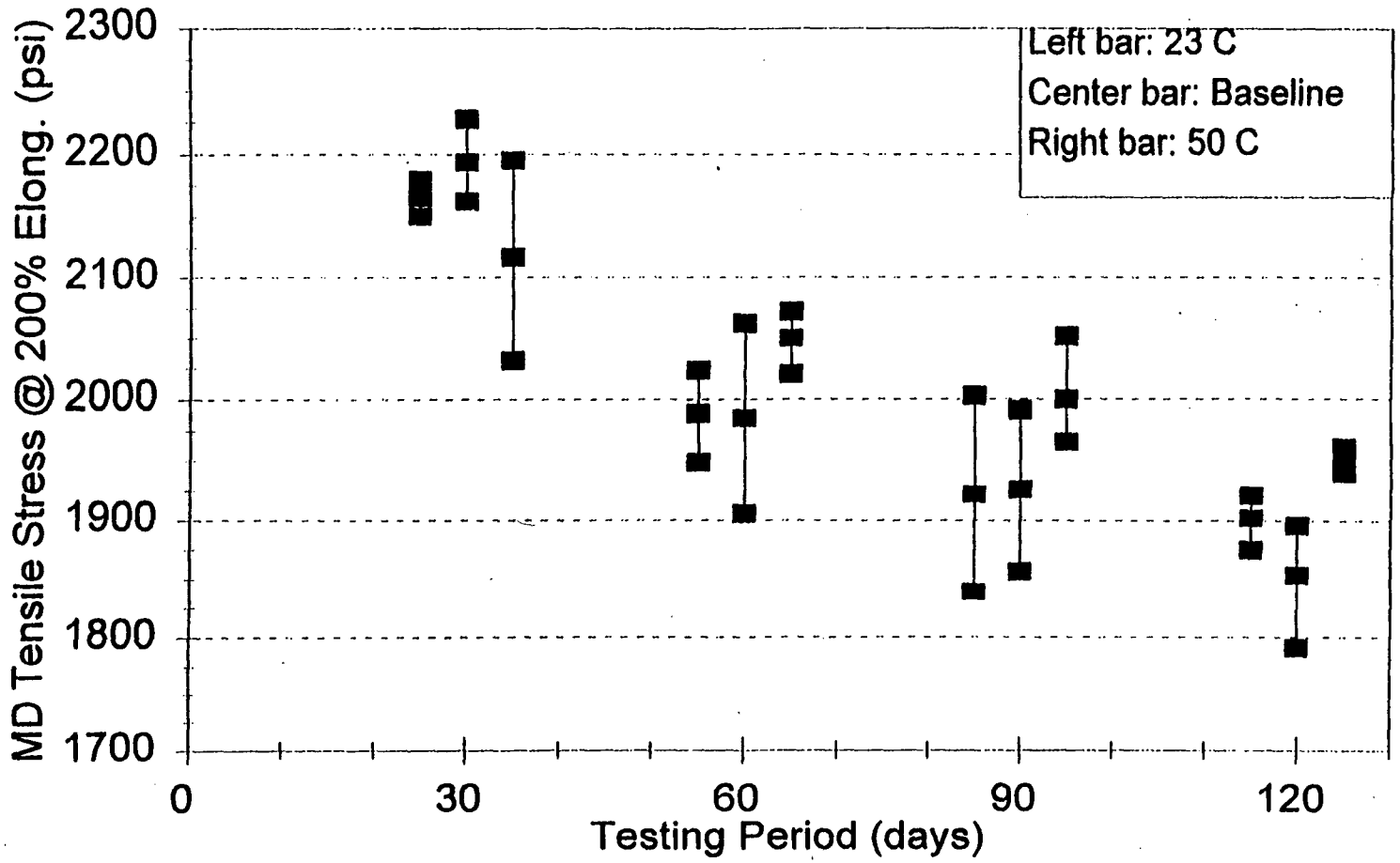
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

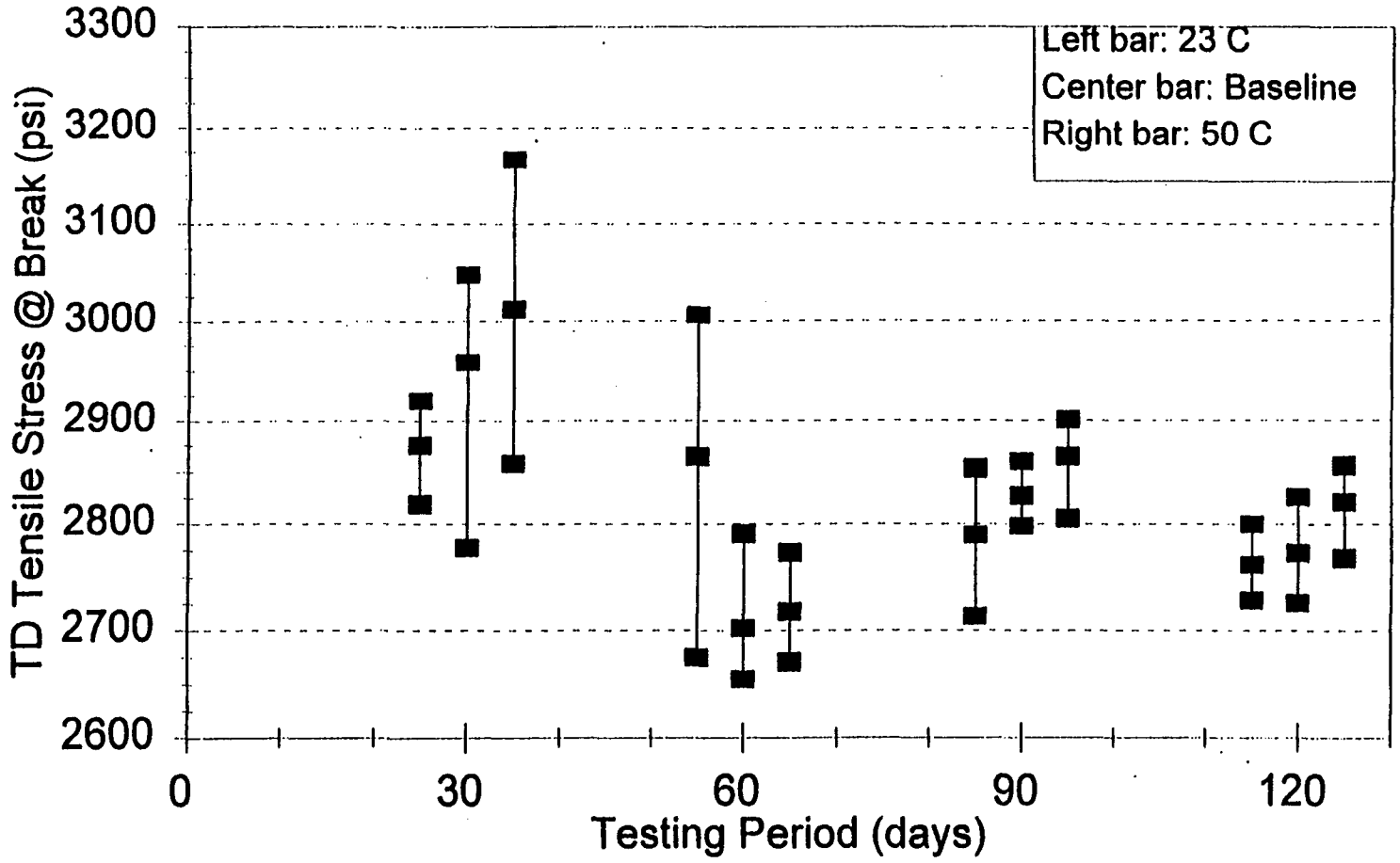
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

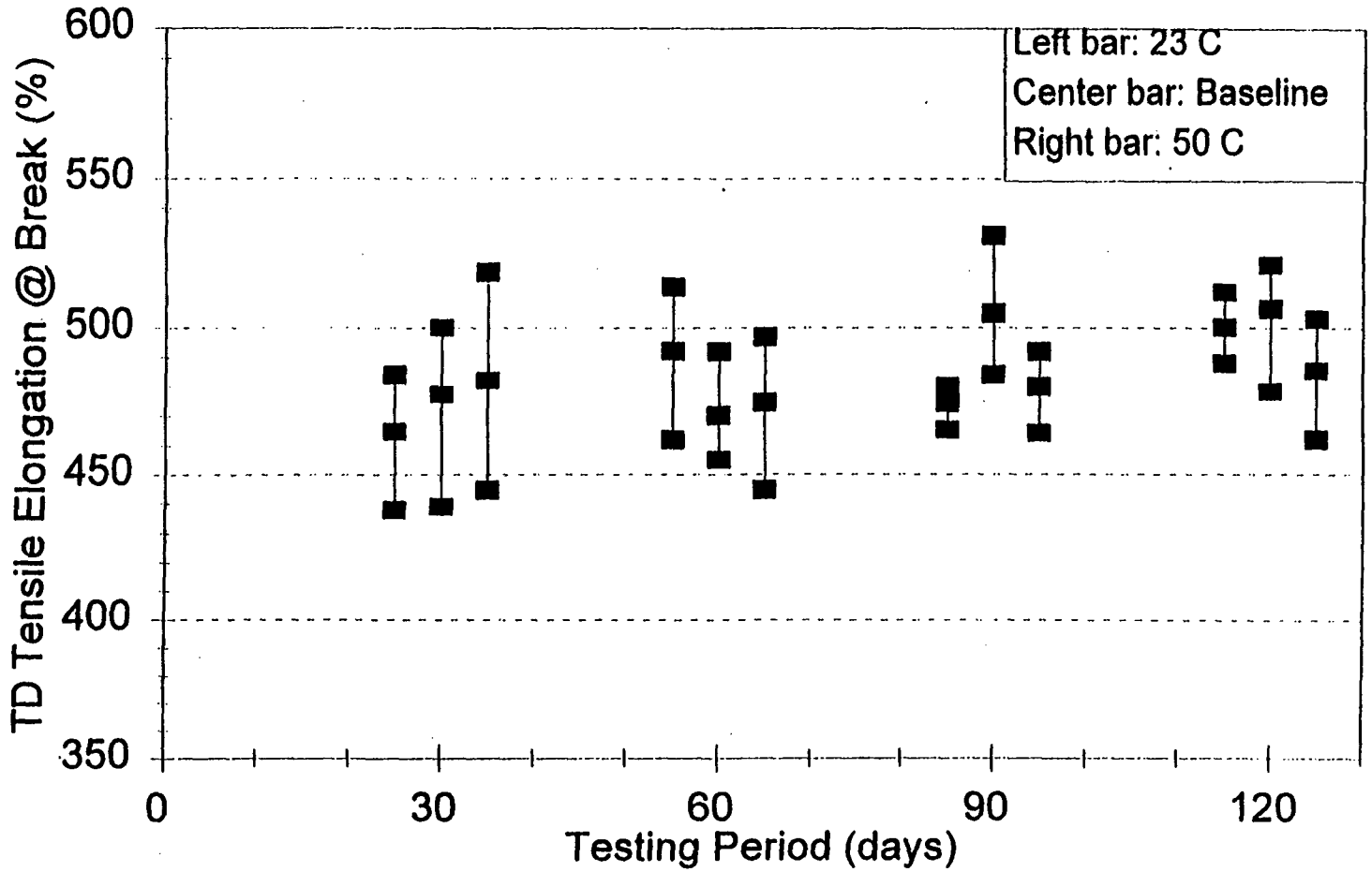
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

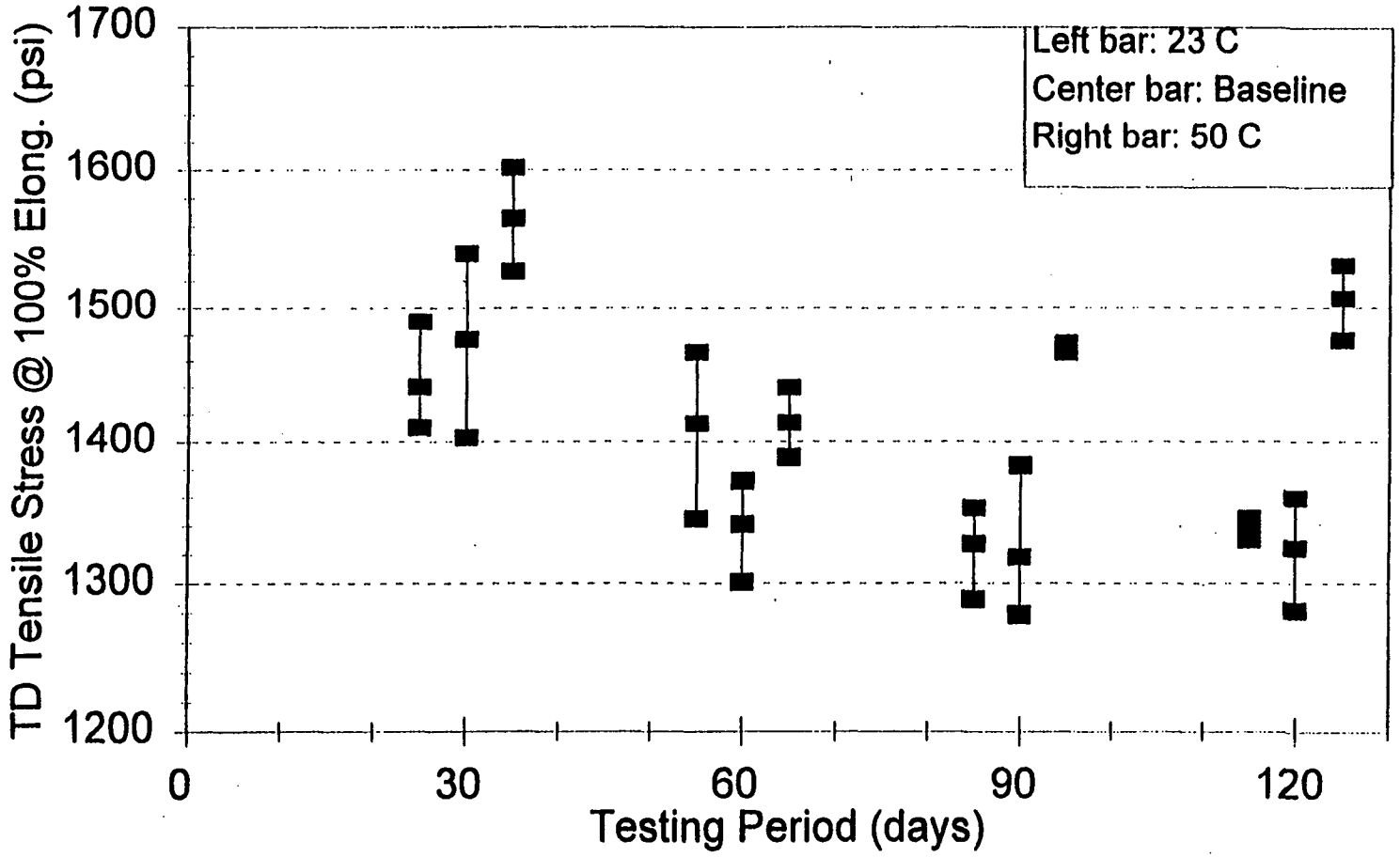
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

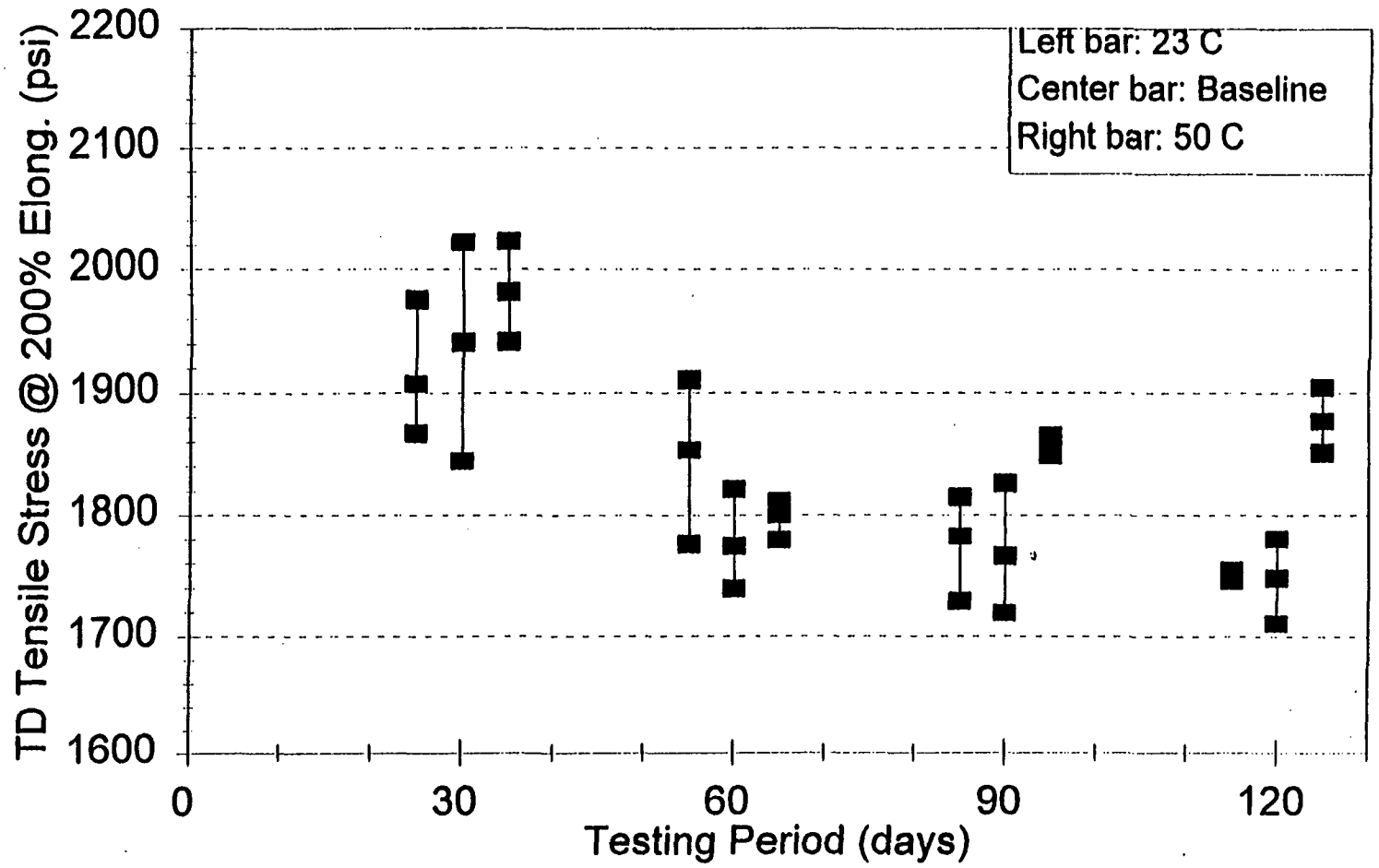
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

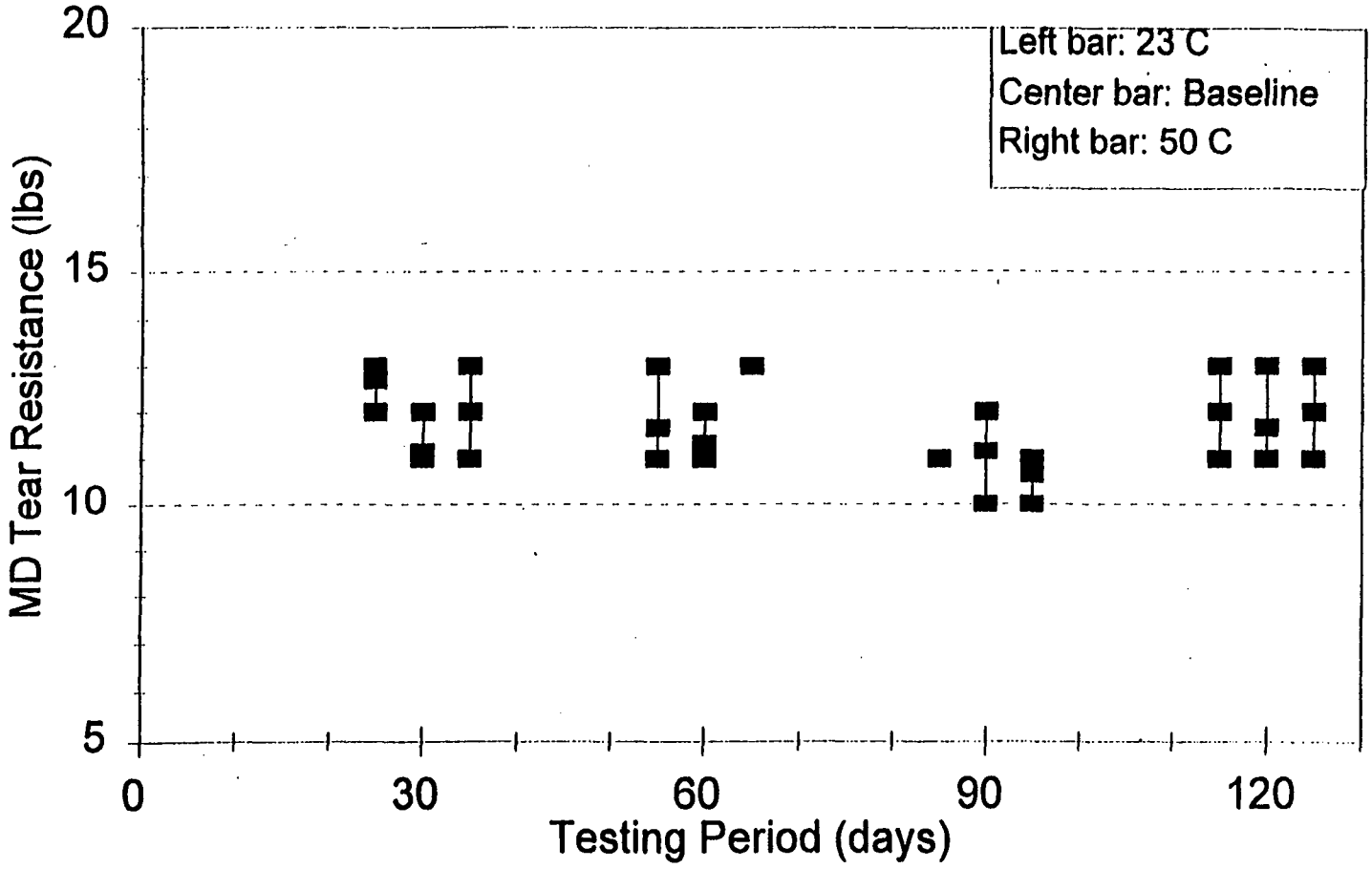
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

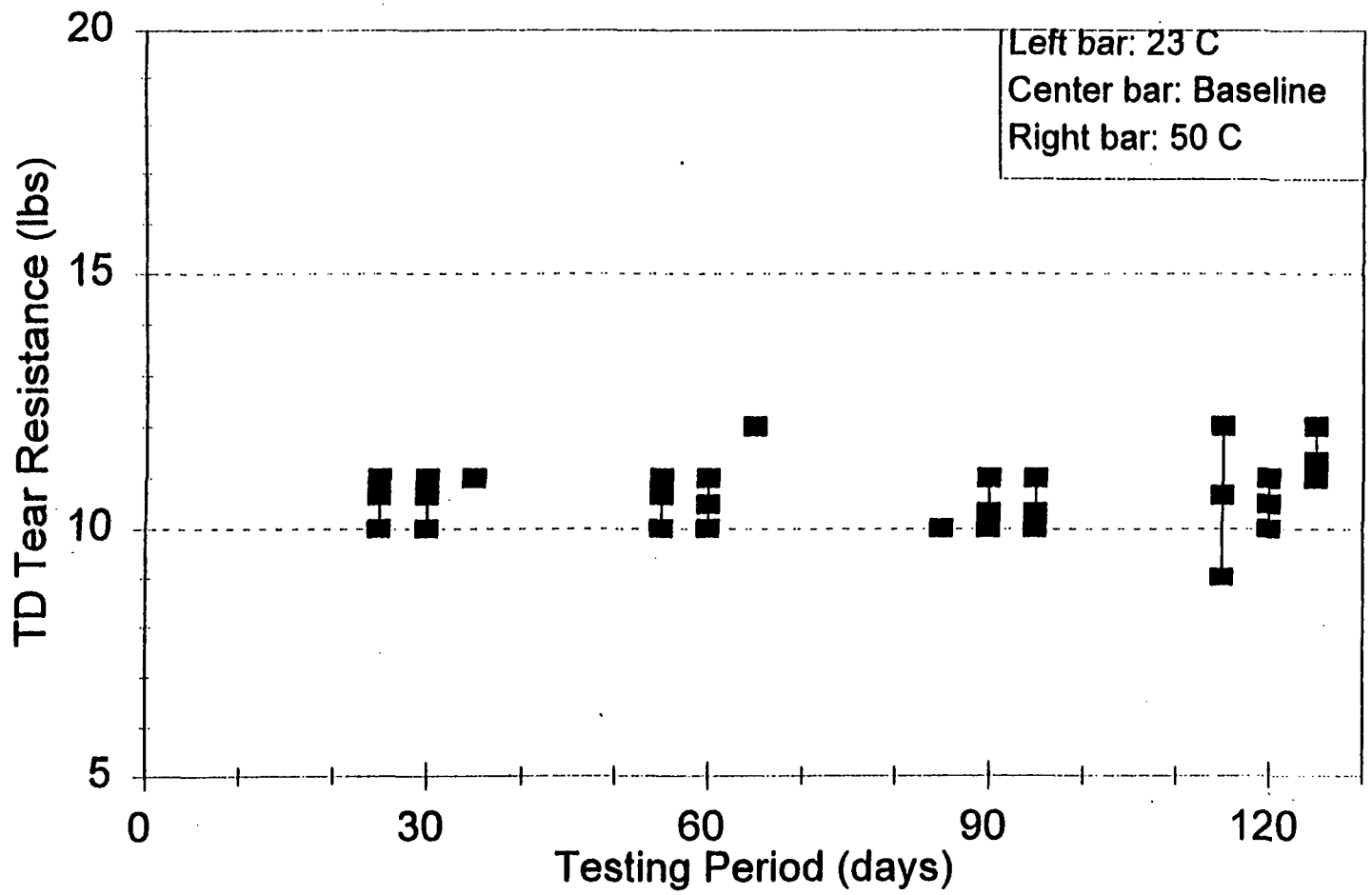
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

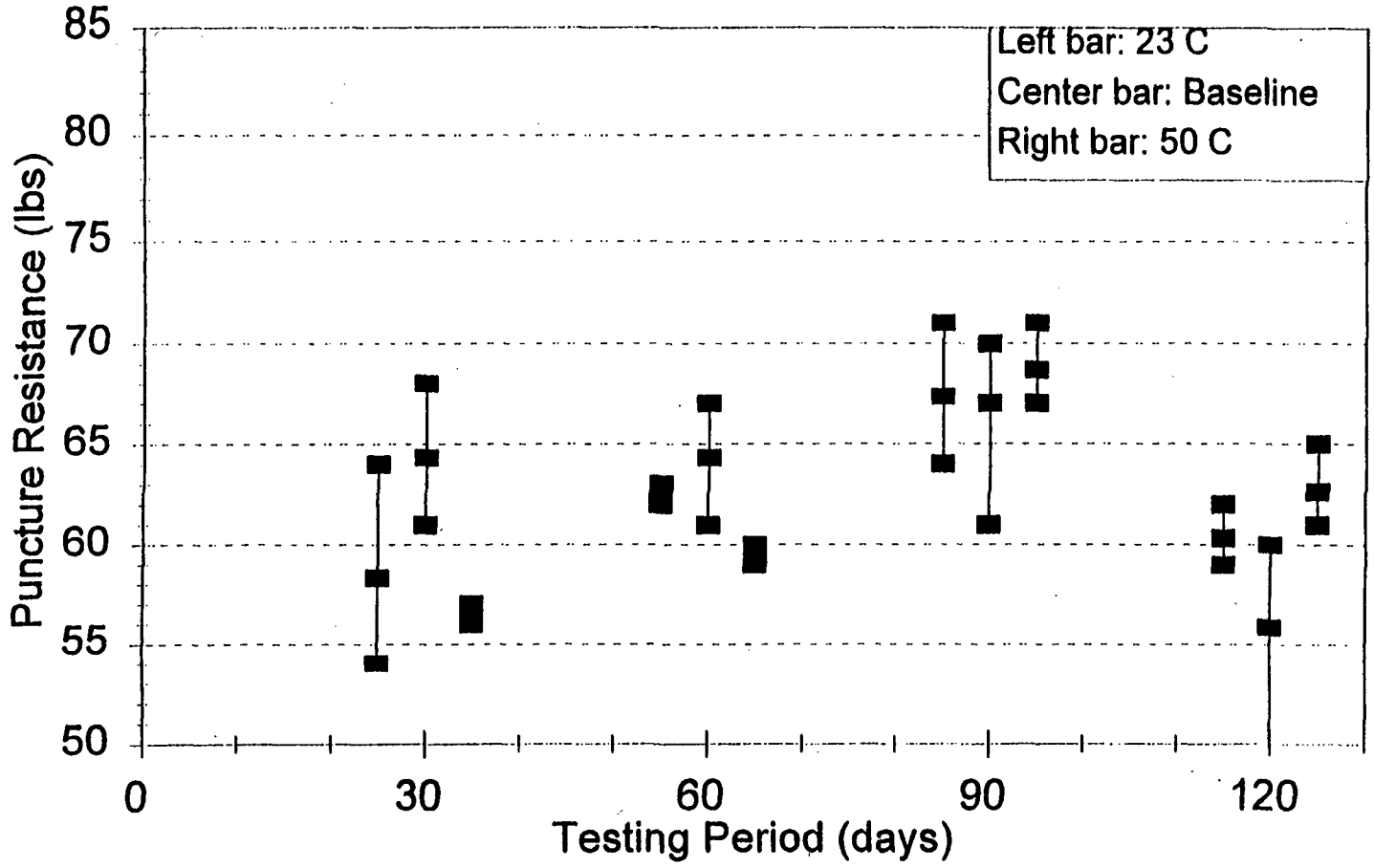
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

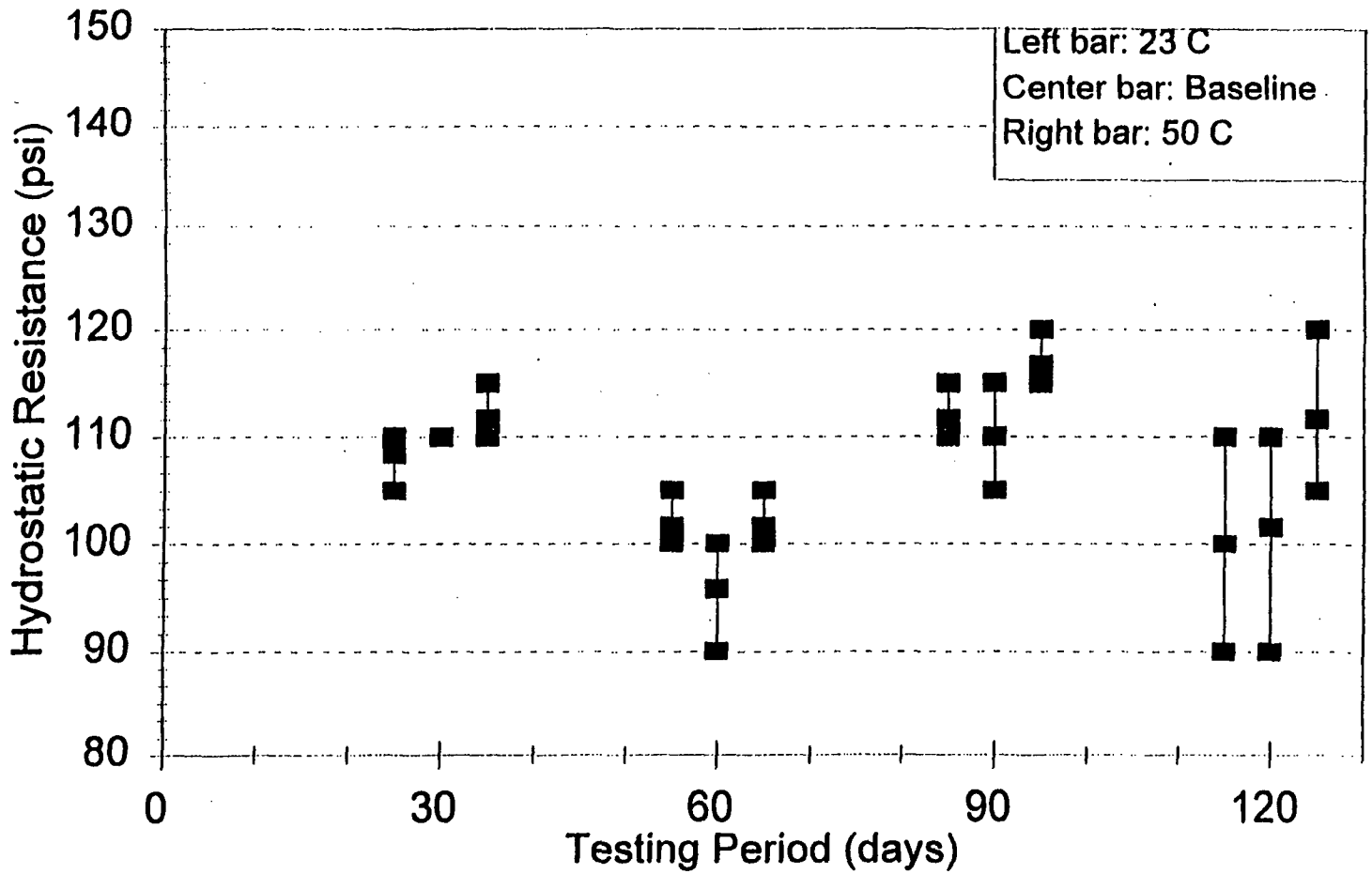
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

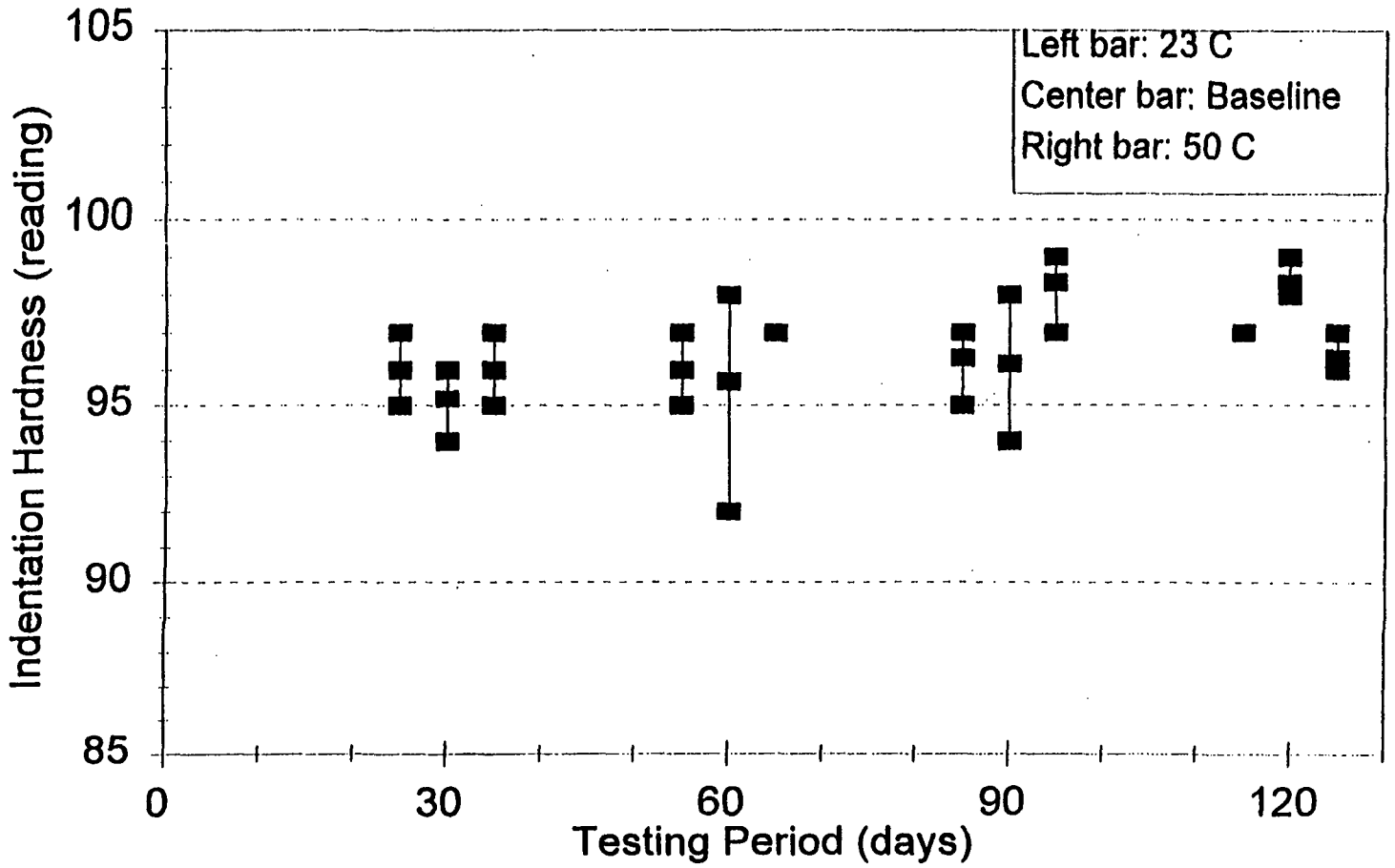
PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

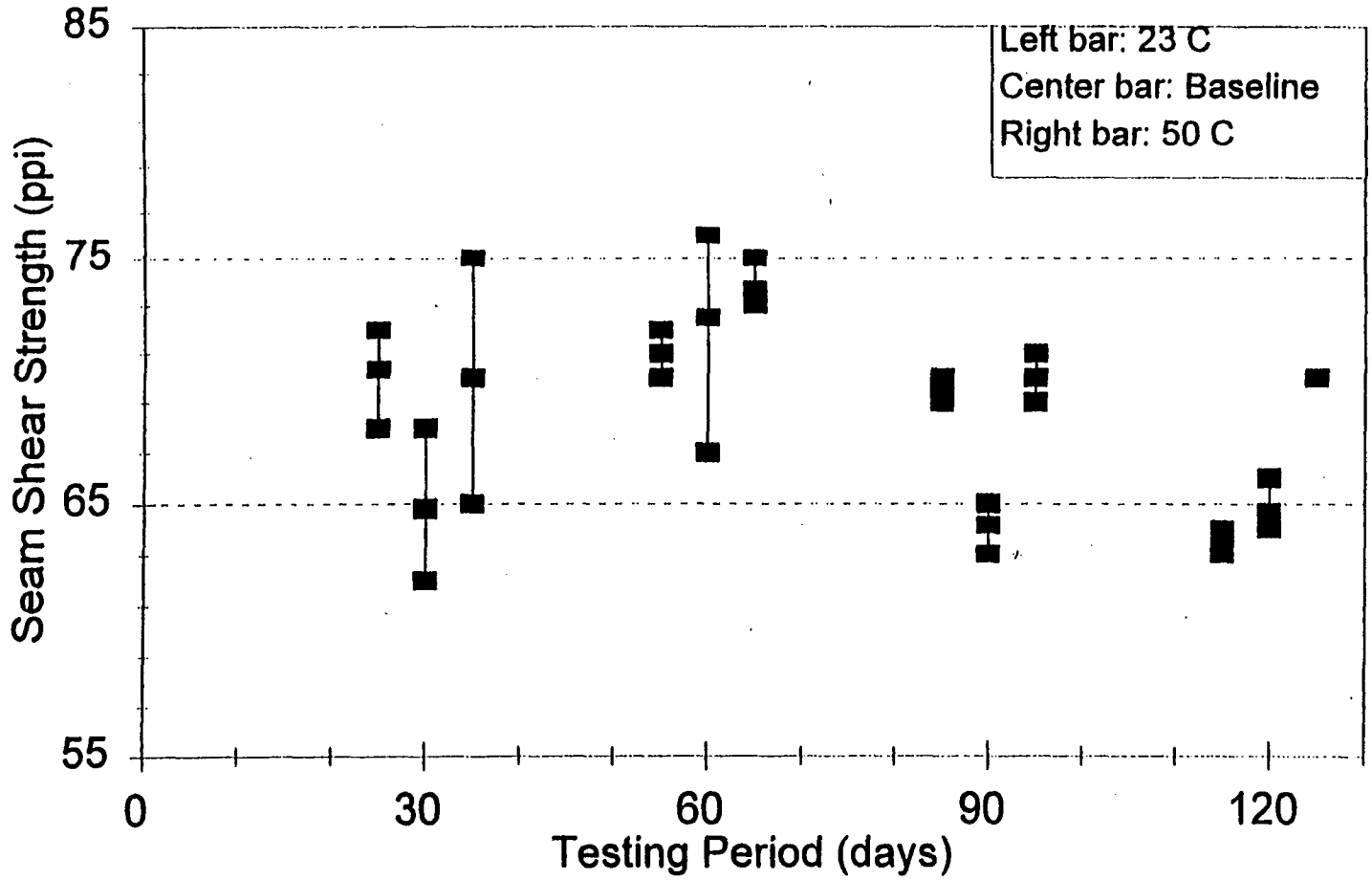
PVC Geomembrane vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc PVC GM.wb1

EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

HDPE GEONET

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

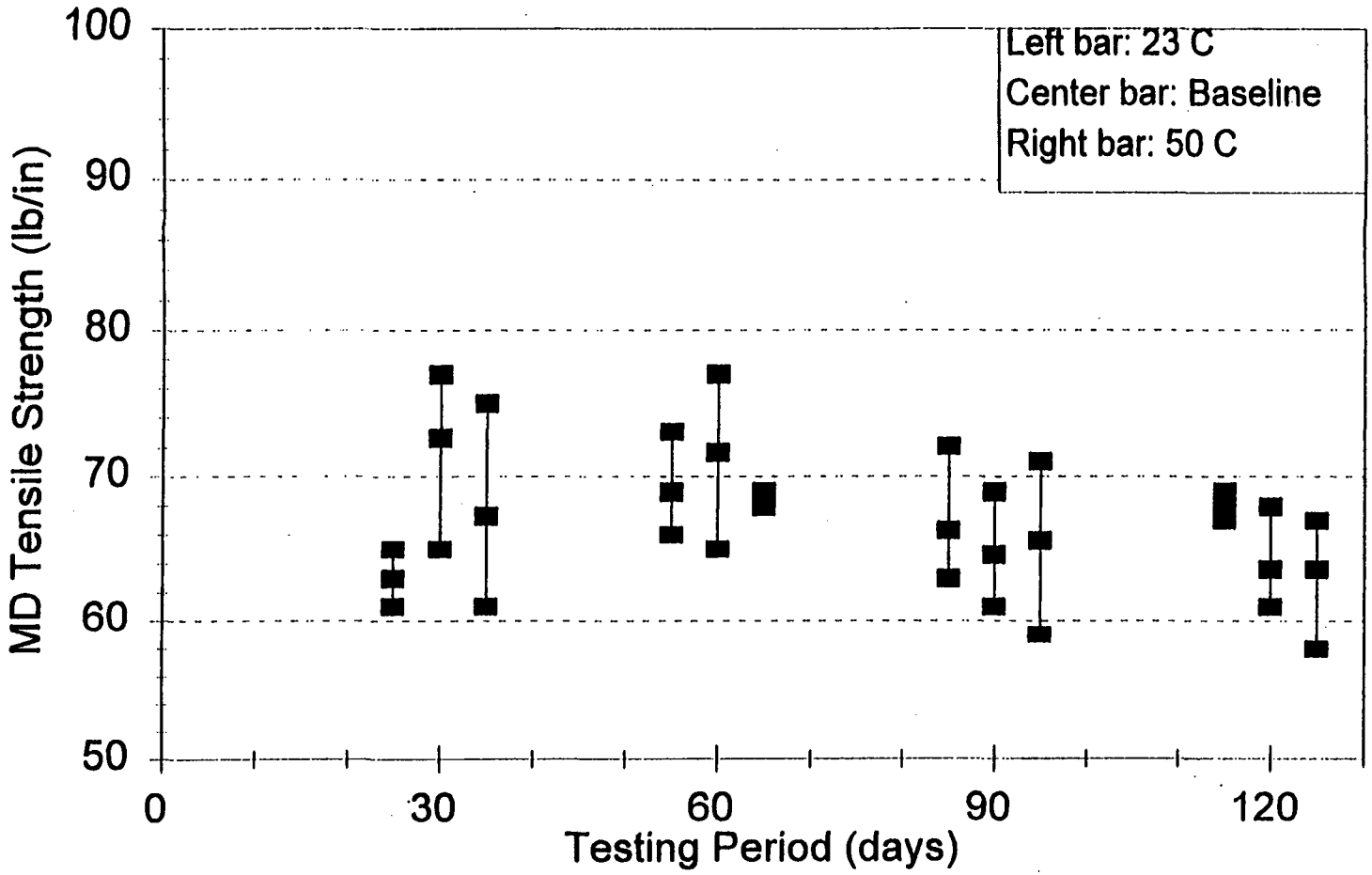
Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEONET: HDPE GEONET												
Tensile Properties:	77	65	61	77	68	68	61	64	59	68	68	58
Load at Break (lbs/in)	76	63	66	68	66	68	69	72	71	61	67	66
Machine Direction	74	61	75	69	73	69	64	63	67	64	69	67
ASTM D5035	65			75			62			65		
	71			76			63			63		
	73			65			69			61		
Average	73	63	67	72	69	68	65	66	66	64	68	64
STD	4	2	6	5	3	0	3	4	5	2	1	4
Coefficient of Variation	5	3	9	6	4	1	5	6	8	4	1	6
Range as % of Baseline	17			17			12			11		
% Change		-13	-7		-4	-5		3	2		7	0
Transmissivity:	N/A	N/A	N/A	1.70E-03	1.82E-03	1.83E-03	N/A	N/A	N/A	1.37E-03	1.49E-03	1.44E-03
ASTM D4716 (m2/sec)	N/A	N/A	N/A	1.63E-03	1.83E-03	1.81E-03	N/A	N/A	N/A	1.25E-03	1.37E-03	1.30E-03
Machine Direction	N/A	N/A	N/A	1.64E-03	1.83E-03	1.84E-03	N/A	N/A	N/A	1.19E-03	1.33E-03	1.28E-03
Hydraulic Gradient: 0.5	N/A			1.57E-03			N/A			1.47E-03		
Compressive Load: 1000 psf	N/A			1.63E-03			N/A			1.42E-03		
	N/A			1.64E-03			N/A			1.37E-03		
Average	0	0	0	1.65E-03	1.83E-03	1.83E-03	0	0	0	1.35E-03	1.40E-03	1.34E-03
STD	0	0	0	2.54E-05	4.71E-06	1.25E-05	0	0	0	9.62E-05	6.80E-05	7.12E-05
Coefficient of Variation	N/A	N/A	N/A	1.54E+00	2.58E-01	6.83E-01	N/A	N/A	N/A	7.15E+00	4.87E+00	5.31E+00
Range as % of Baseline	N/A	N/A	N/A	4			N/A	N/A	N/A	21		
% Change		N/A	N/A		11	11		N/A	N/A		4	-0

SRA 10-21-97
Quality Review/Date

FMC CORPORATION EPA METHOD 9090

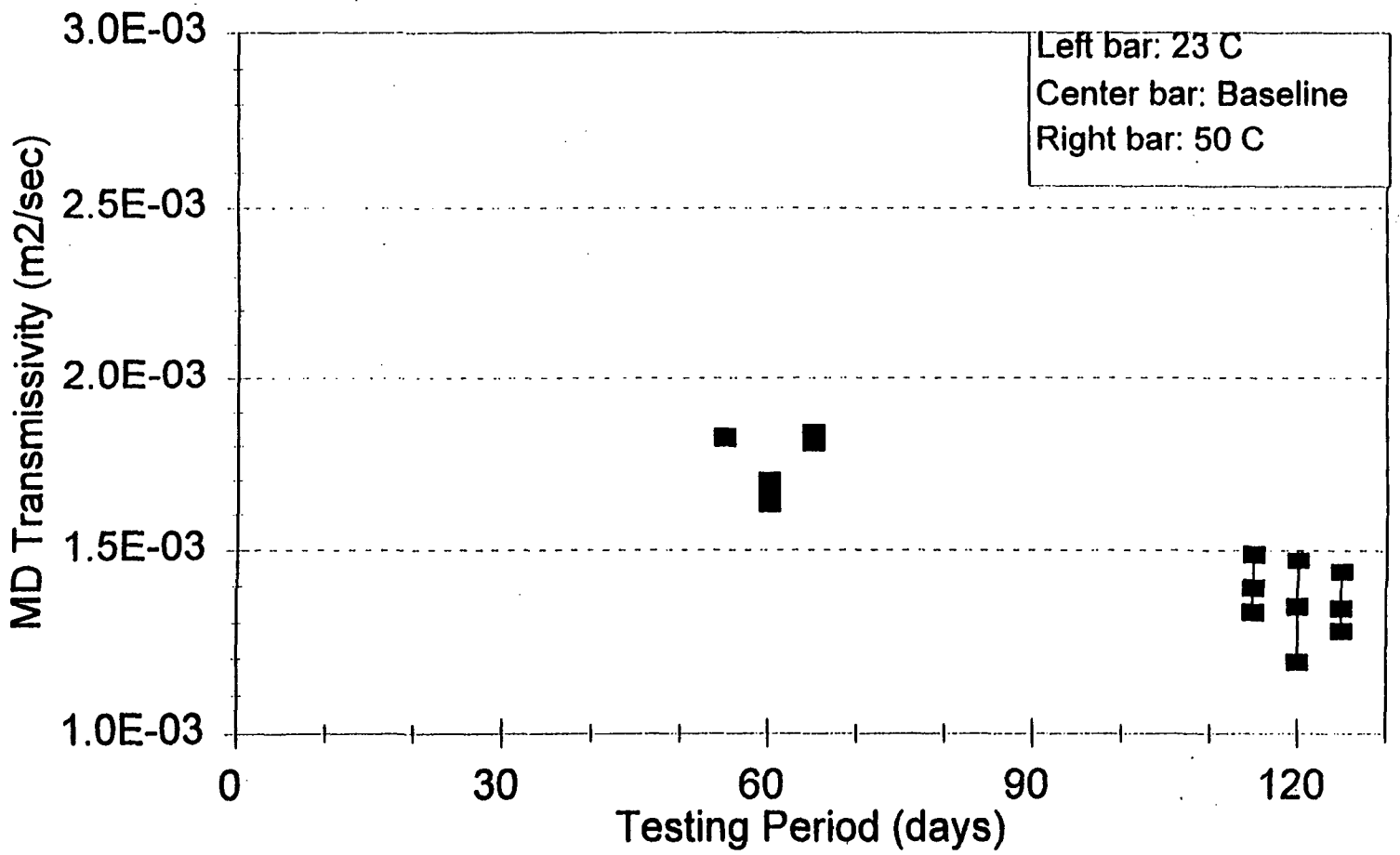
HDPE Geonet vs Phos Dock Effluent



Client: FMC Corporation, File: 942-net.wb1

FMC CORPORATION EPA METHOD 9090

HDPE Geonet vs Phos Dock Effluent



Client: FMC Corporation, File: 942-net.wb1

EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

HDPE GEOPIPE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

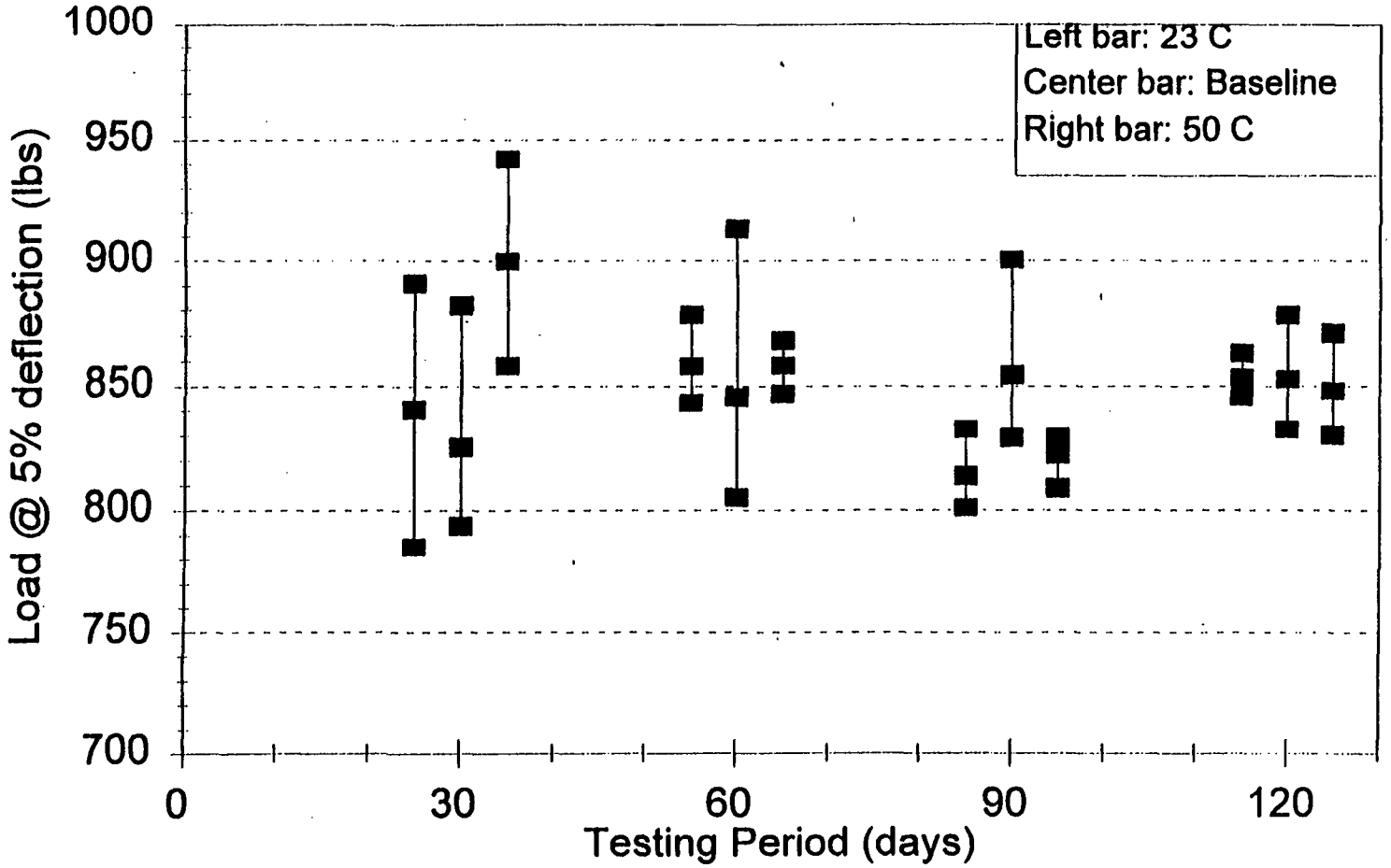
Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEONET: HDPE GEOPIPE												
Arc Bend Strength:	882	785	899	818	843	868	833	801	827	856	863	830
Load @ 5% deflection (lbs)	794	846	858	816	852	847	865	808	809	847	846	843
ASTM D 2412	822	891	942	879	878	859	839	832	829	832	851	871
	822			913			900			861		
	811			805			829			842		
	821			842			862			878		
Average	825	841	900	846	858	858	855	814	822	853	853	848
STD	27	43	34	39	15	9	24	13	9	15	7	17
Coefficient of Variation	3	5	4	5	2	1	3	2	1	2	1	2
Range as % of Baseline	11			13			8			5		
% Change		2	9		1	1		-5	-4		0	-1
Arc Bend Strength:	792	685	802	750	749	768	740	708	740	752	765	738
Load @ 10% deflection (lbs)	692	745	760	723	754	743	766	710	718	748	748	749
ASTM D 2412	723	798	832	781	780	762	739	733	734	759	758	769
Hydraulic Gradient: 0.5	726			810			796			789		
Compressive Load: 1000 psf	711			707			737			781		
	721			748			775			764		
Average	728	743	798	753	761	758	759	717	731	766	757	752
STD	31	46	30	34	14	11	22	11	9	15	7	13
Coefficient of Variation	4	6	4	5	2	1	3	2	1	2	1	2
Range as % of Baseline	14			14			8			5		
% Change		2	10		1	1		-6	-4		-1	-2

SZA 10-21-97
Quality Review/Date

FMC CORPORATION EPA METHOD 9090

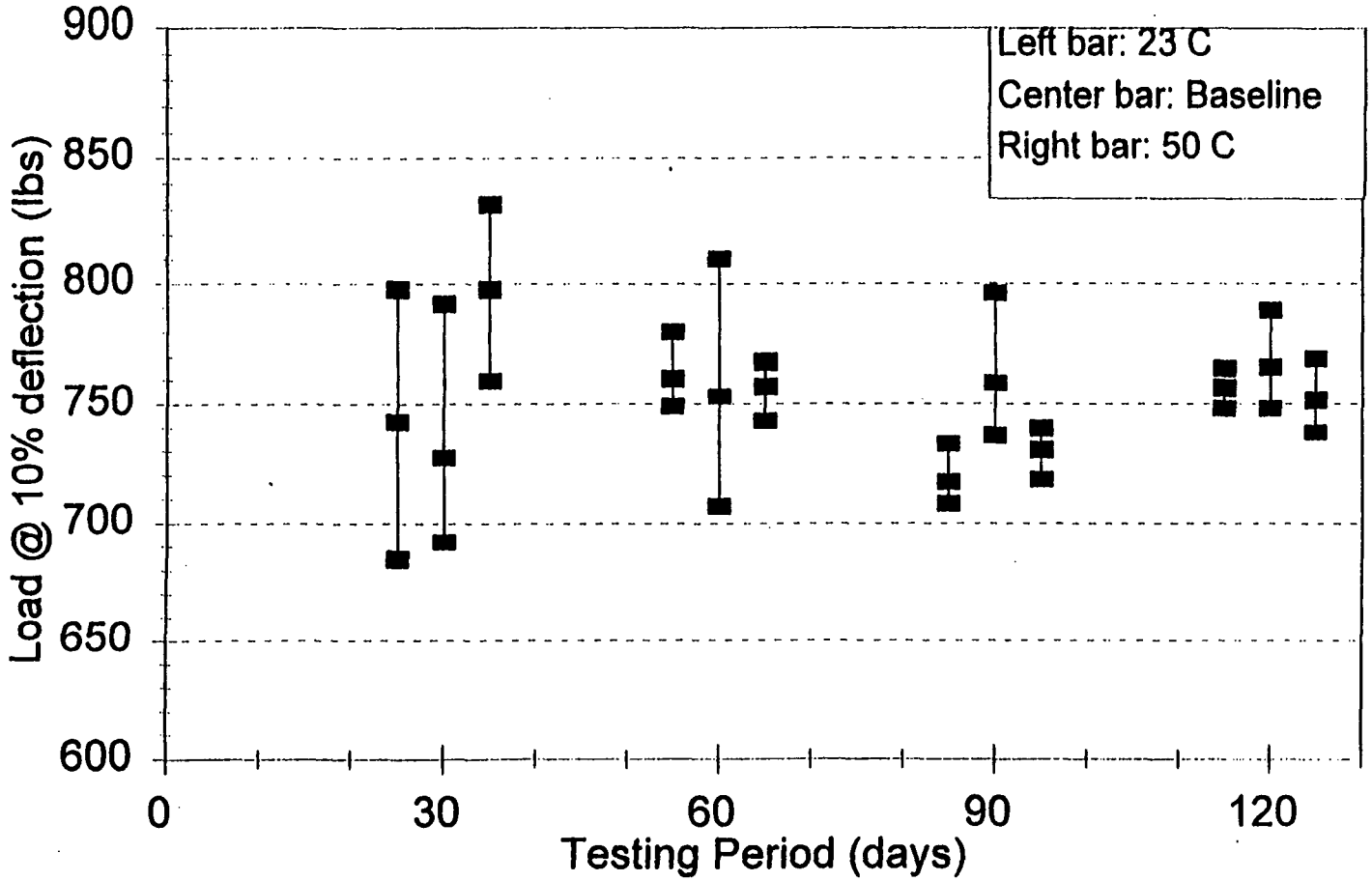
HDPE Geopipe vs Phos Dock Effluent



Client: FMC Corporation, File: 942-pipe.wb1

FMC CORPORATION EPA METHOD 9090

HDPE Geopipe vs Phos Dock Effluent



Client: FMC Corporation, File: 942-pipe.wb1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOTEXTILE: Bentofix GCL - woven textile component												
Grab Tensile Properties:	149	141	145	144	146	149	137	146	148	140	145	147
Maximum Strength (lbs)	132	150	137	138	143	141	129	147	145	149	136	150
ASTM D4632	150	145	140	144	152	151	142	150	150	152	138	153
Machine Direction	146	136	147	158	153	151	136	158	143	135	153	157
	131	147	143	139	153	165	133	150	126	161	146	145
	147			136			128			142		
	137			130			150			143		
	142			147			131			154		
	140			149			131			146		
	145			154			149			130		
Average	142	144	142	144	149	151	137	150	142	145	144	150
STD	6	5	4	8	4	8	8	4	9	9	6	4
Coefficient of Variation	5	3	2	6	3	5	6	3	6	6	4	3
Range as % of Baseline	13			19			16			21		
% Change		1	0		4	5		10	4		-1	4
Grab Tensile Properties:	21	19	24	21	19	21	19	19	21	17	18	18
Elongation @ Max. Strength (%)	17	19	18	21	19	19	16	23	23	20	18	18
ASTM D4632	18	19	17	20	19	23	17	21	19	22	18	20
Machine Direction	20	18	19	21	20	21	20	21	26	20	20	19
	21	15	18	21	23	25	25	24	22	21	19	18
	12			21			29			19		
	16			18			19			20		
	19			19			18			21		
	18			19			16			19		
	19			21			21			18		
Average	18	18	19	20	20	22	20	22	22	20	19	19
STD	3	2	2	1	2	2	4	2	2	1	1	1
Coefficient of Variation	14	9	13	5	8	9	20	8	10	7	4	4
Range as % of Baseline	50			15			65			25		
% Change		-1	6		-1	8		8	11		-6	-6
Tear Resistance:	71	72	88	80	90	75	72	85	64	73	76	96
Trapezoidal Tear Strength (lbs)	86	67	78	85	79	79	80	81	71	75	74	64
ASTM D4533	79	74	90	92	77	85	81	61	86	73	84	84
Machine Direction	73	73	85	74	68	79	86	70	79	83	90	75
	78	75	81	79	88	94	91	85	96	79	83	88
	68			67			79			83		
	80			67			102			75		
	74			87			84			81		
	68			84			86			79		
	65			81			76			73		
Average	74	72	84	80	80	82	84	76	79	77	81	81
STD	6	3	4	8	8	7	8	9	11	4	6	11
Coefficient of Variation	8	4	5	10	10	8	10	12	14	5	7	14
Range as % of Baseline	28			31			36			13		
% Change		-3	14		1	4		-9	-5		5	5

SRA 10-21-97
Quality Review/Date

EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

WOVEN GEOTEXTILE COMPONENT - BENTOFIX GCL

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

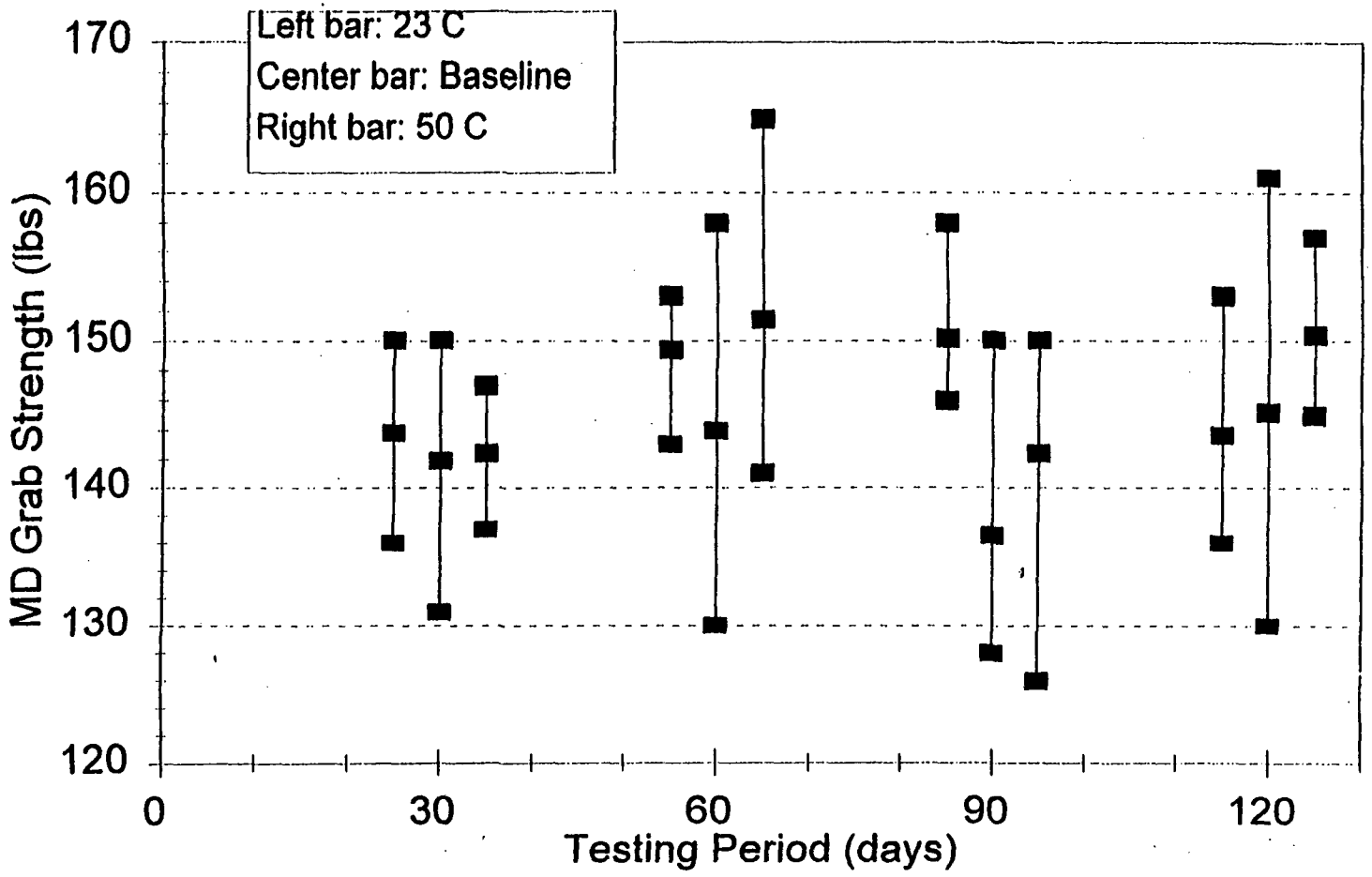
Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOTEXTILE: Bentofix GCL - woven textile component												
Puncture Resistance:	143	155	179	128	149	152	129	164	165	134	135	145
Load @ Rupture (lb)	140	117	198	148	155	148	132	146	121	134	148	148
ASTM D4833	123	116	181	165	137	154	132	148	158	124	133	153
	132	106	229	125	134	162	137	141	145	131	163	140
	145	147	145	149	157	152	134	134	153	125		
	121			131			144			142		
	126			146			143			130		
	117			143			110			143		
	138			132			118			149		
	157			146			114			134		
Average	134	128	186	141	146	154	129	147	148	135	145	147
STD	12	19	27	12	9	5	11	10	15	8	12	5
Coefficient of Variation	9	15	15	8	6	3	9	7	10	6	8	3
Range as % of Baseline	30			28			26			19		
% Change		-4	39		4	9		13	15		8	9
Mullen Burst Strength:	540	560	525	450	475	460	435	550	455	425	465	425
Burst Strength (psi)	430	510	475	465	485	545	470	410	470	445	435	430
ASTM D3786	460	450	525	540	460	435	455	455	370	425	430	450
	405	505	475	415	480	480	460	490	460	430	455	425
	485	500	470	450	445	460	450	410	495	430	435	454
	530			460			430			425		
	430			460			455			420		
	405			450			420			415		
	525			520			445			435		
	430			490			470			465		
Average	464	505	494	470	469	476	449	463	450	432	444	437
STD	50	35	25	35	15	37	16	53	42	14	14	13
Coefficient of Variation	11	7	5	7	3	8	4	11	9	3	3	3
Range as % of Baseline	29			27			11			12		
% Change		9	6		-0	1		3	0		3	1
Permittivity:	0.040	0.070	0.050	0.050	0.060	0.070	0.055	0.055	0.060	0.060	0.070	0.075
(sec -1)	0.040	0.060	0.060	0.050	0.060	0.050	0.055	0.055	0.060	0.055	0.065	0.080
ASTM D4491	0.030	0.060	0.060	0.030	0.050	0.050	0.055	0.050	0.065	0.045	0.065	0.075
	0.050	0.060	0.070	0.040	0.050	0.040	0.060	0.045	0.050	0.050	0.085	0.070
	0.040	0.070	0.070	0.040	0.050	0.060	0.060	0.050	0.055	0.055	0.080	0.055
	0.040			0.040			0.045			0.055		
	0.050			0.030			0.055			0.065		
	0.050			0.050			0.060			0.060		
	0.060			0.040			0.060			0.060		
	0.050			0.030			0.065			0.065		
Average	0.045	0.064	0.062	0.040	0.054	0.054	0.057	0.051	0.058	0	0	0
STD	0.008	0.005	0.007	0.008	0.005	0.010	0.005	0.004	0.005	0	0	0
Coefficient of Variation	18	8	12	19	9	19	9	7	9	11	11	12
Range as % of Baseline	67			50			35			35		
% Change		42	38		35	35		-11	2		28	25

SRA 10-21-97
Quality Review/Date

FMC CORPORATION EPA METHOD 9090

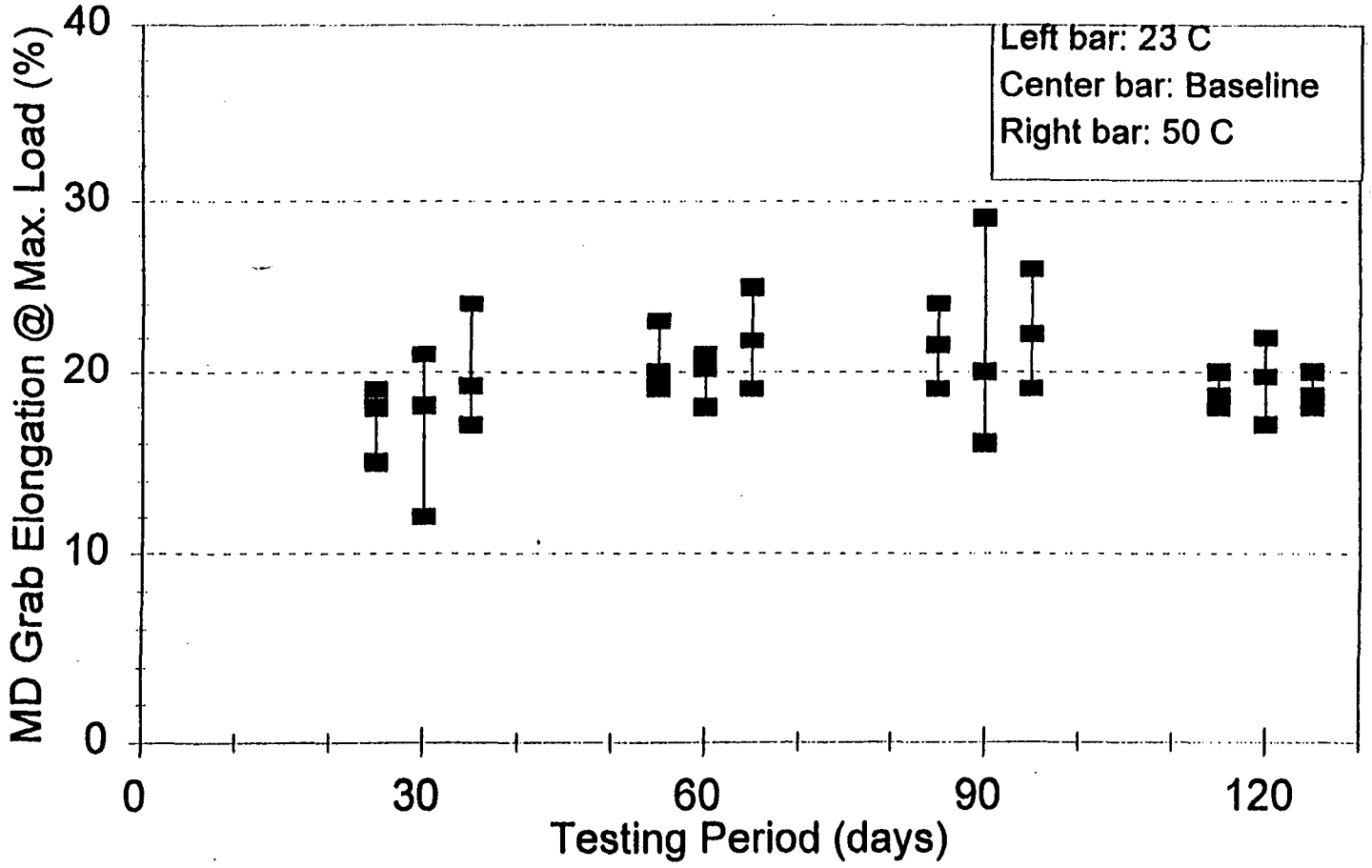
GCL (WV GT) vs Phos Dock Effluent



Client: FMC Corporation, File: 942textw.wb1

FMC CORPORATION EPA METHOD 9090

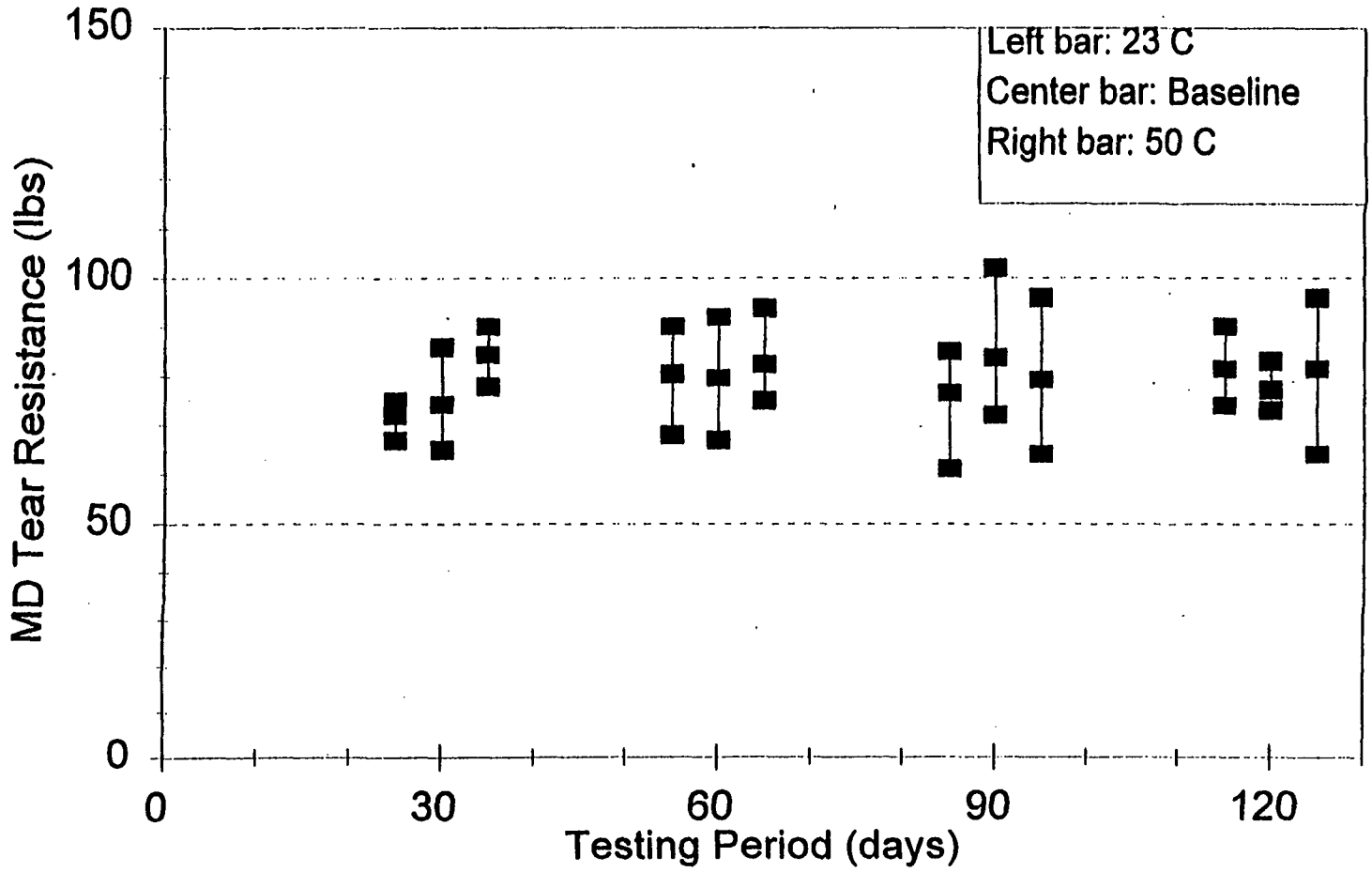
GCL (WV GT) vs Phos Dock Effluent



Client: FMC Corporation, File: 942textw.wb1

FMC CORPORATION EPA METHOD 9090

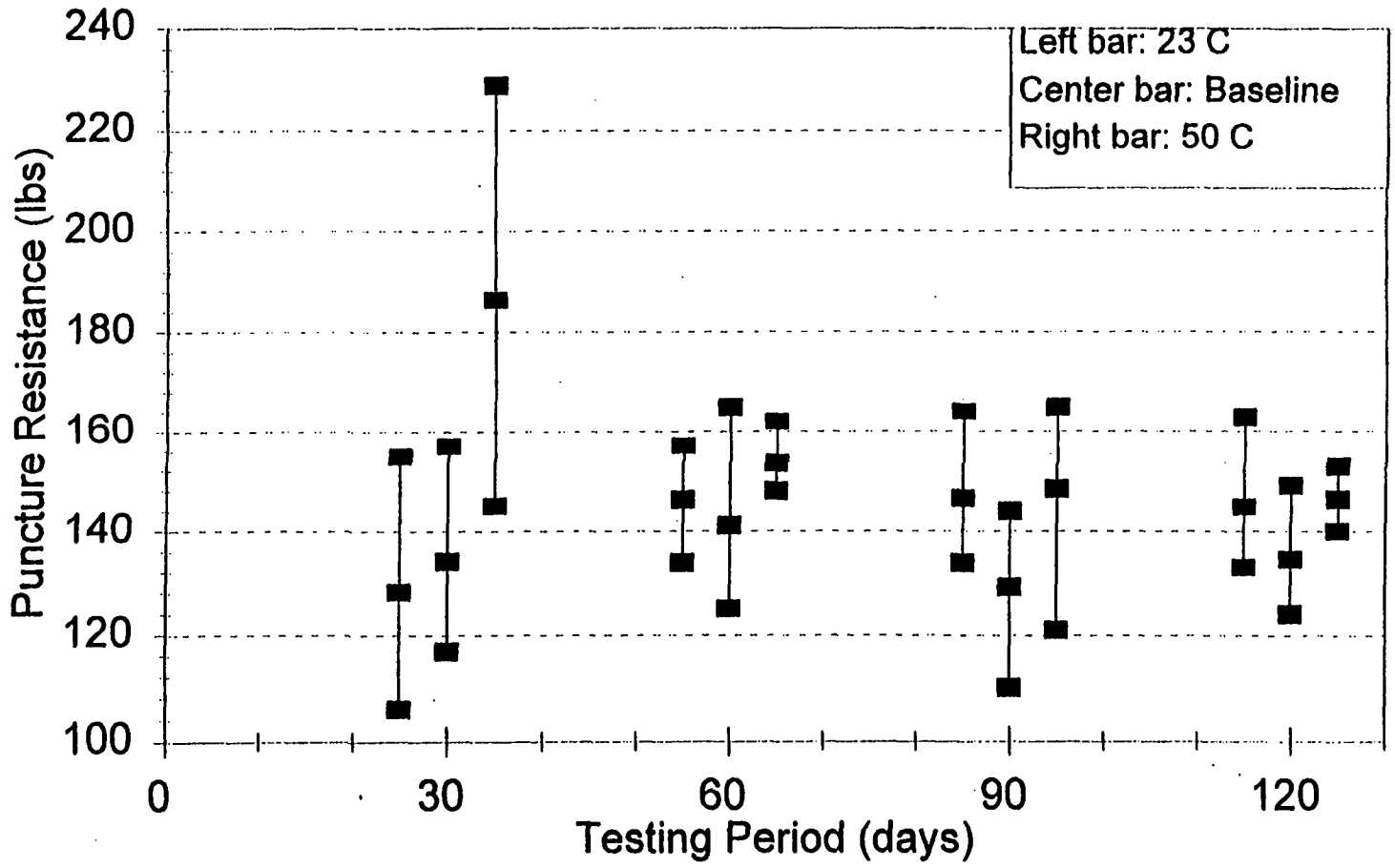
GCL (WV GT) vs Phos Dock Effluent



Client: FMC Corporation, File: 942textw.wb1

FMC CORPORATION EPA METHOD 9090

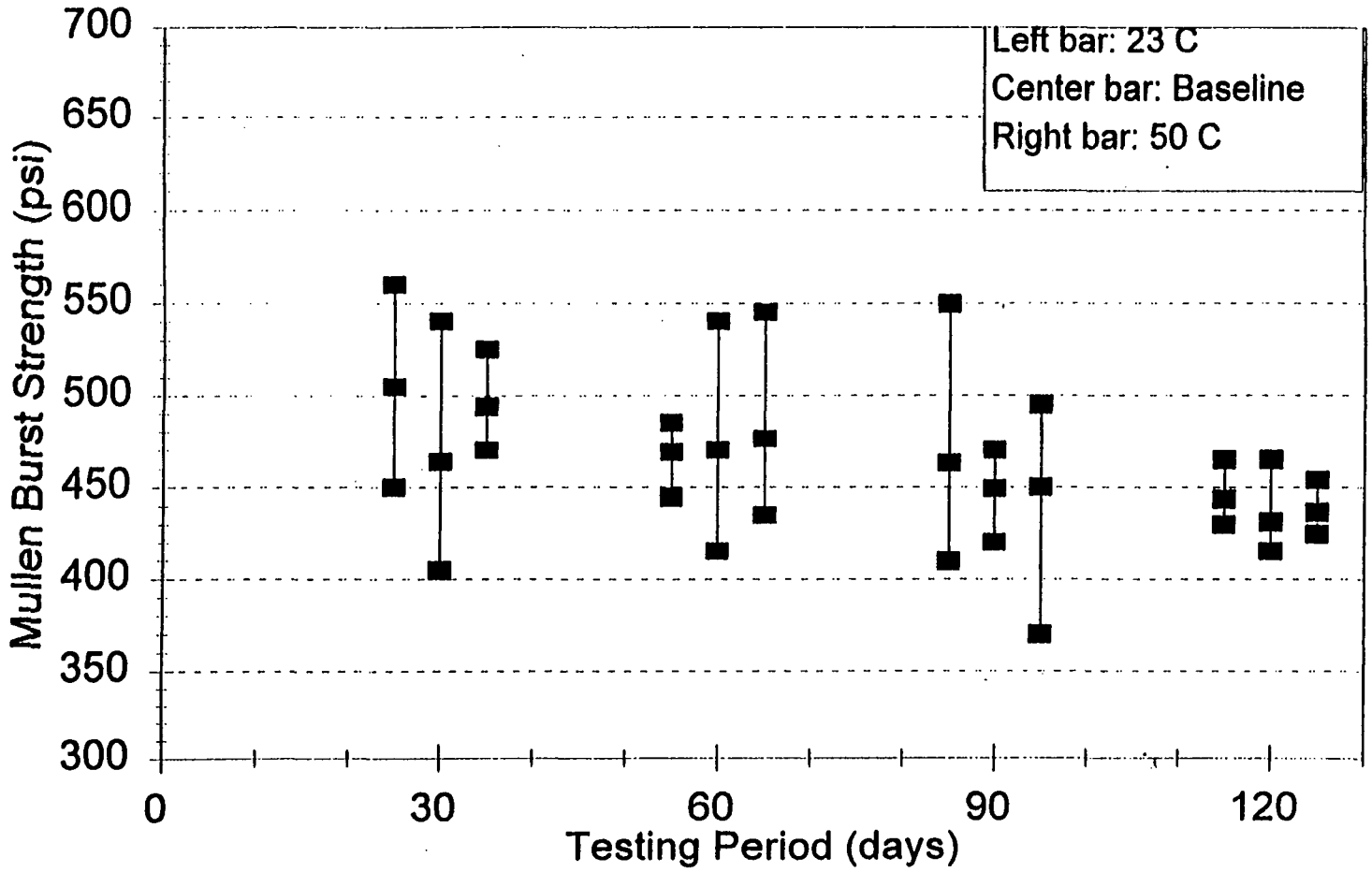
GCL (WV GT) vs Phos Dock Effluent



Client: FMC Corporation, File: 942textw.wb1

FMC CORPORATION EPA METHOD 9090

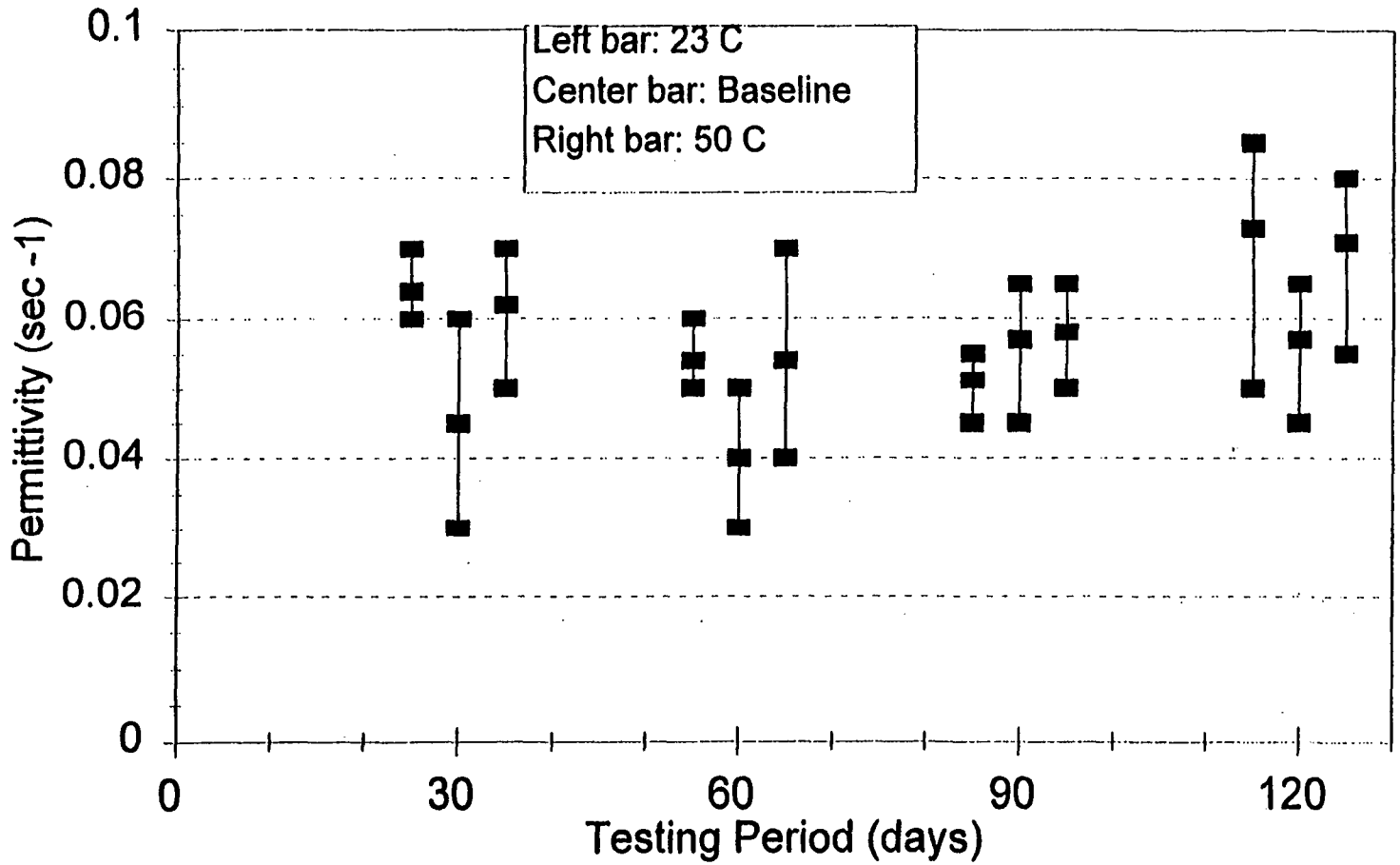
GCL (WV GT) vs Phos Dock Effluent



Client: FMC Corporation, File: 942textw.wb1

FMC CORPORATION EPA METHOD 9090

GCL (WV GT) vs Phos Dock Effluent



Client: FMC Corporation, File: 942textw.wb1

EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

NONWOVEN GEOTEXTILE COMPONENT - BENTOFIX GCL

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOTEXTILE: Bentofix GCL -nonwoven textile component												
Grab Tensile Properties:	74	63	86	65	69	76	56	64	81	94	83	91
Maximum Strength (lbs)	68	69	85	87	68	79	72	88	71	74	117	88
ASTM D4632	71	74	88	85	72	76	64	101	65	61	79	92
Machine Direction	72	61	70	66	74	75	85	88	64	74	88	106
	90	65	72	69	87	70	83	87	72	67	109	85
	74			74			98			61		
	72			75			81			77		
	71			66			77			85		
	92			65			53			73		
	80			67			61			71		
Average	76	66	80	72	74	75	73	86	71	74	95	92
STD	8	5	8	8	7	3	14	12	6	10	15	7
Coefficient of Variation	10	7	9	11	9	4	19	14	9	13	16	8
Range as % of Baseline	31			31			62			45		
% Change		-13	5		3	5		17	-3		29	25
Grab Tensile Properties:	194	196	188	201	205	209	179	175	291	220	207	177
Elongation @ Max. Strength (%)	192	181	208	198	203	209	177	210	212	215	208	221
ASTM D4632	206	189	211	195	207	208	224	191	249	209	199	187
Machine Direction	195	198	211	173	202	218	215	210	204	229	201	202
	192	184	209	205	205	213	208	196	225	196	217	184
	196			205			270			224		
	202			203			219			193		
	198			191			269			209		
	202			187			213			215		
	199			201			204			198		
Average	198	190	205	196	204	211	218	196	236	211	206	194
STD	4	7	9	9	2	4	30	13	31	12	6	16
Coefficient of Variation	2	3	4	5	1	2	14	7	13	5	3	8
Range as % of Baseline	7			16			43			17		
% Change		-4	4		4	8		-10	8		-2	-8
Tear Resistance:	33	25	35	32	49	36	29	21	28	34	46	41
Trapezoidal Tear Strength (lbs)	28	24	37	26	32	33	30	30	42	43	40	44
ASTM D4533	38	33	37	31	32	30	29	24	34	37	46	47
Machine Direction	30	38	37	27	27	34	20	19	26	24	45	44
	35	47	31	33	34	30	31	20	24	26	32	37
	33			34			31			32		
	34			34			27			31		
	29			28			25			38		
	34			34			25			41		
	35			34			27			43		
Average	33	33	35	31	35	33	27	23	31	35	42	43
STD	3	9	2	3	7	2	3	4	7	6	5	3
Coefficient of Variation	9	26	7	10	21	7	12	17	21	18	13	8
Range as % of Baseline	30			26			40			54		
% Change		2	8		11	4		-17	12		20	22

SRA 10-21-97
Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

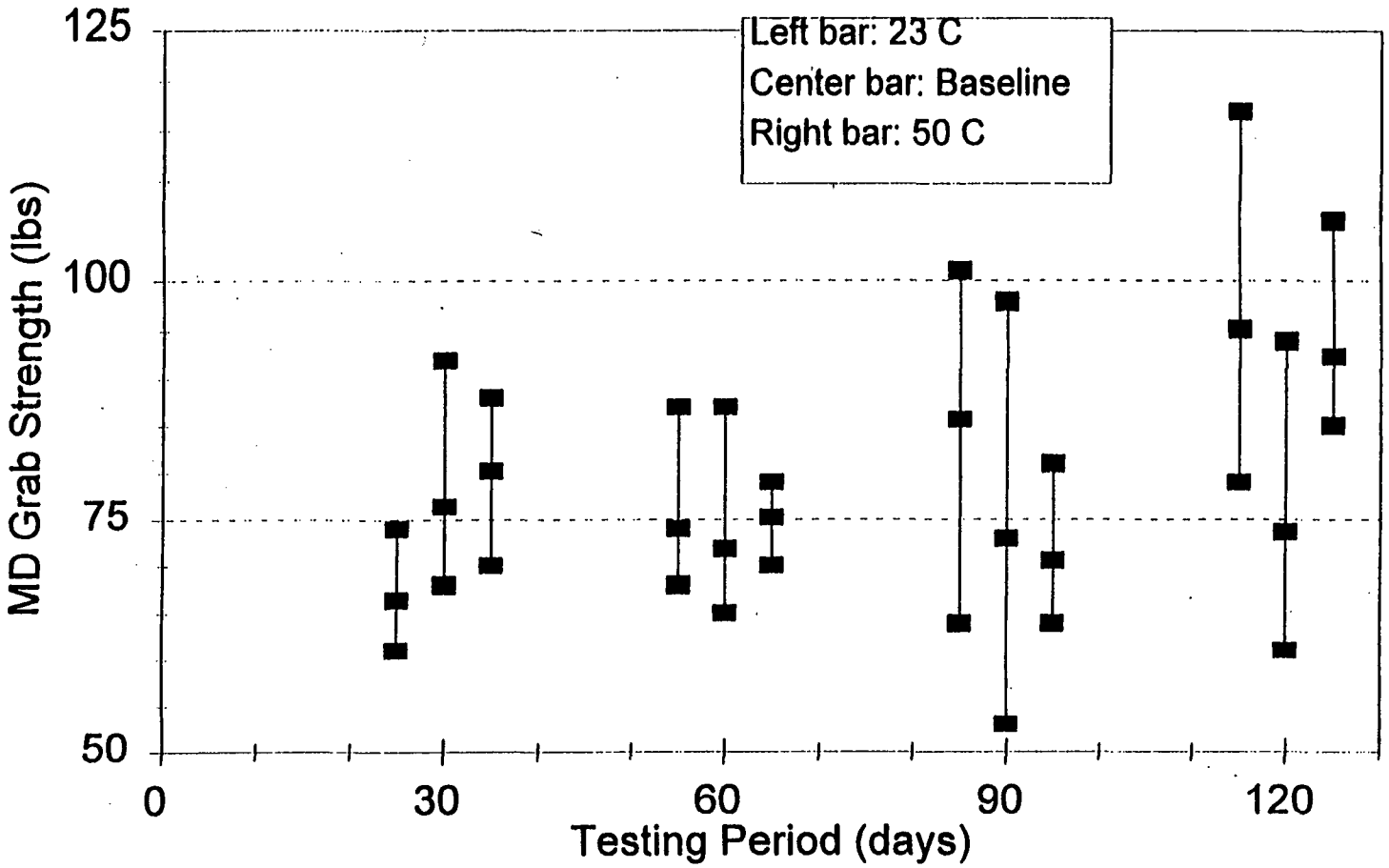
Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOTEXTILE: Bentofix GCL -nonwoven textile component												
Puncture Resistance:	107	99	125	90	106	102	82	111	110	55	94	111
Load @ Rupture (lb)	108	93	80	99	84	94	70	99	92	64	87	88
ASTM D4833	108	94	89	91	95	94	56	132	109	73	116	92
	91	97	77	83	97	96	76	105	131	85	104	101
	91	99	138	92	79	89	88	94	142	80	92	95
	97			63			90			64		
	101			95			66			48		
	85			92			115			65		
	86			100			81			64		
	95			85			89					
Average	97	96	102	89	92	95	81	108	117	66	99	97
STD	8	2	25	10	10	4	15	13	18	11	10	8
Coefficient of Variation	9	3	24	11	10	4	19	12	15	16	10	8
Range as % of Baseline	24			42			73			56		
% Change		-1	5		4	7		33	44		48	47
Mullen Burst Strength:	325	300	295	210	290	250	220	235	220	370	340	350
Burst Strength (psi)	330	335	360	350	260	250	210	280	230	340	280	390
ASTM D3786	320	295	305	250	270	250	290	265	220	300	310	340
	210	285	340	240	250	240	225	260	240	300	340	300
	215	330	295	230	250	300	285	225	260	360	340	330
	275			260			205			310		
	345			300			200			330		
	310			280			250			330		
	370			250			275			260		
	330			240			290			310		
Average	303	309	319	261	264	258	245	253	234	321	322	342
STD	51	20	26	38	15	21	35	20	15	30	24	29
Coefficient of Variation	17	6	8	15	6	8	14	8	6	9	7	9
Range as % of Baseline	53			54			37			34		
% Change		2	5		1	-1		3	-4		0	7
Permittivity:	3.13	3.98	3.90	3.26	3.47	3.69	3.24	3.28	3.65	3.48	3.12	3.28
(sec -1)	4.01	4.67	4.09	3.77	3.71	3.55	3.41	3.63	3.52	3.44	2.92	3.28
ASTM D4491	4.67	4.57	3.76	3.59	3.98	3.96	3.55	3.45	3.91	3.28	2.92	2.92
	4.62	4.05	4.26	3.11	3.85	4.02	3.70	3.23	3.72	3.36	2.88	2.88
	4.86	3.85	4.47	4.44	3.66	4.10	4.30	3.77	3.50	3.28	2.84	2.8
	3.86			4.05			4.12			3.00		
	3.91			3.86			3.99			2.96		
	4.46			3.22			3.33			2.89		
	3.15			4.17			3.92			3.16		
	4.15			4.21			4.16			2.95		
Average	4.08	4.22	4.10	3.77	3.73	3.86	3.77	3.47	3.66	3	3	3
STD	0.57	0.33	0.25	0.44	0.17	0.21	0	0	0	0	0	0
Coefficient of Variation	14	8	6	12	5	5	9	6	4	7	3	7
Range as % of Baseline	42			35			28			19		
% Change		3	0		-1	3		-8	-3		-8	-5

SRA 10-21-97
Quality Review/Date

FMC CORPORATION EPA METHOD 9090

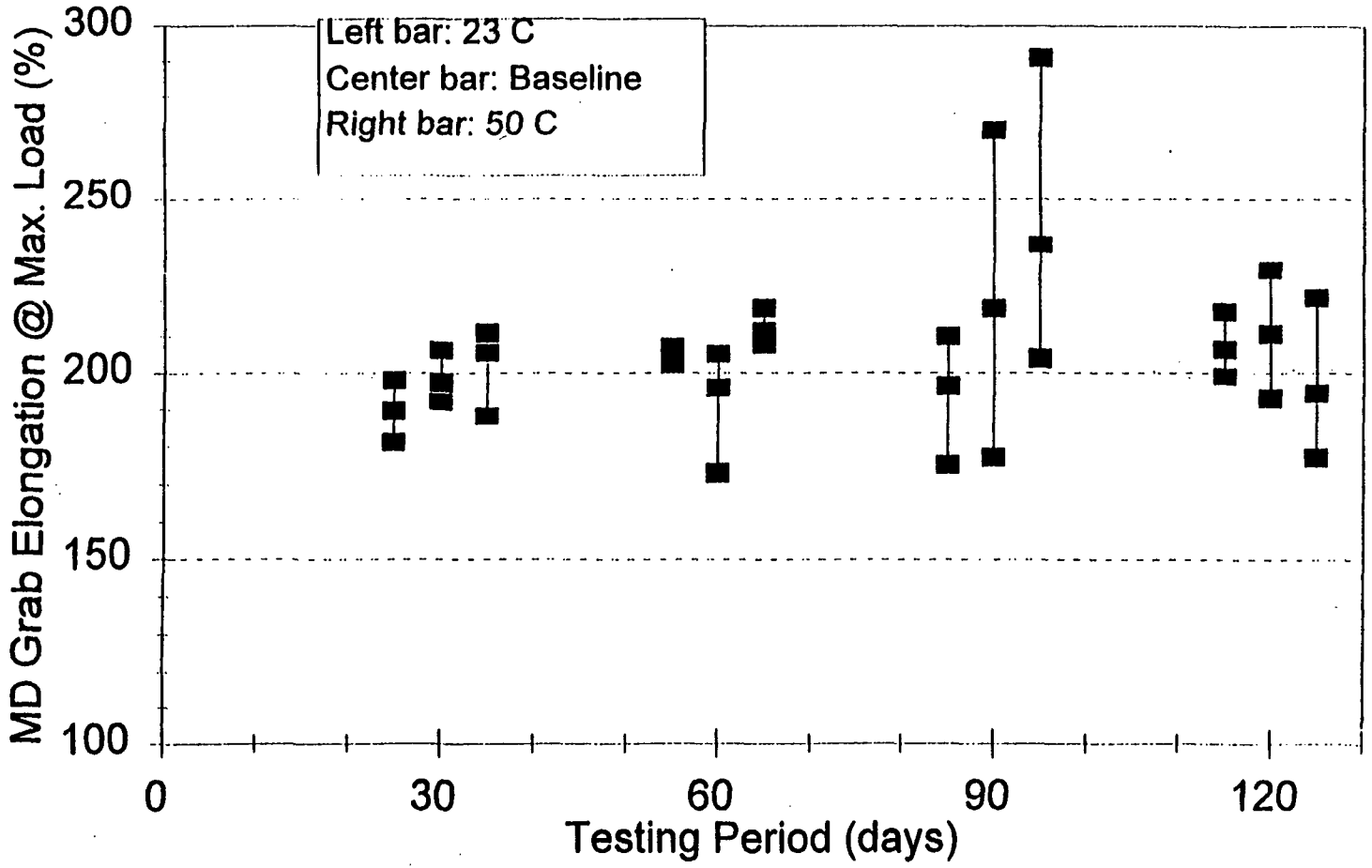
GCL (NW GT) vs Phos Dock Effluent



Client: FMC Corporation, File: 942textn.wb1

FMC CORPORATION EPA METHOD 9090

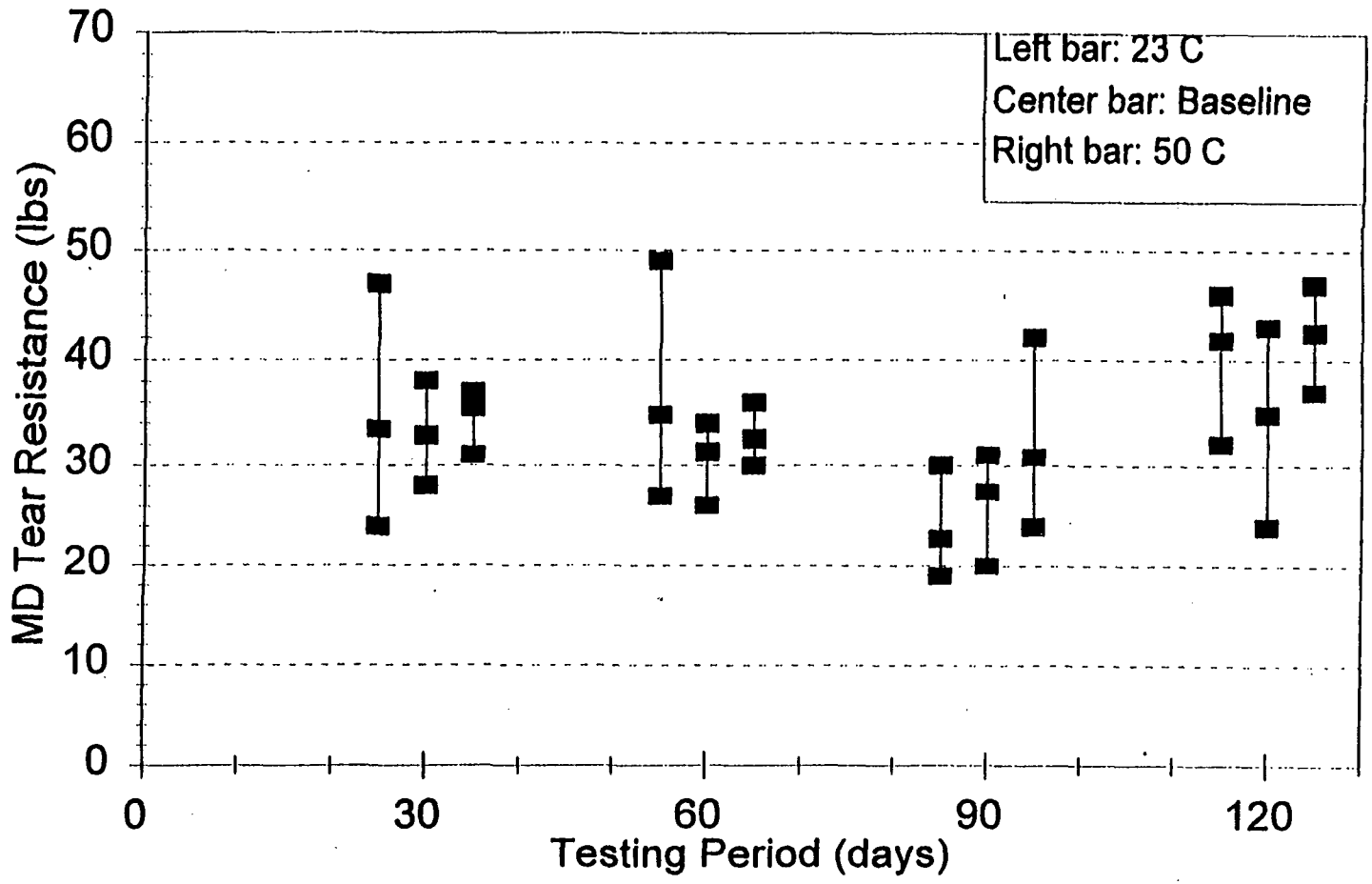
GCL (NW GT) vs Phos Dock Effluent



Client: FMC Corporation, File: 942textn.wb1

FMC CORPORATION EPA METHOD 9090

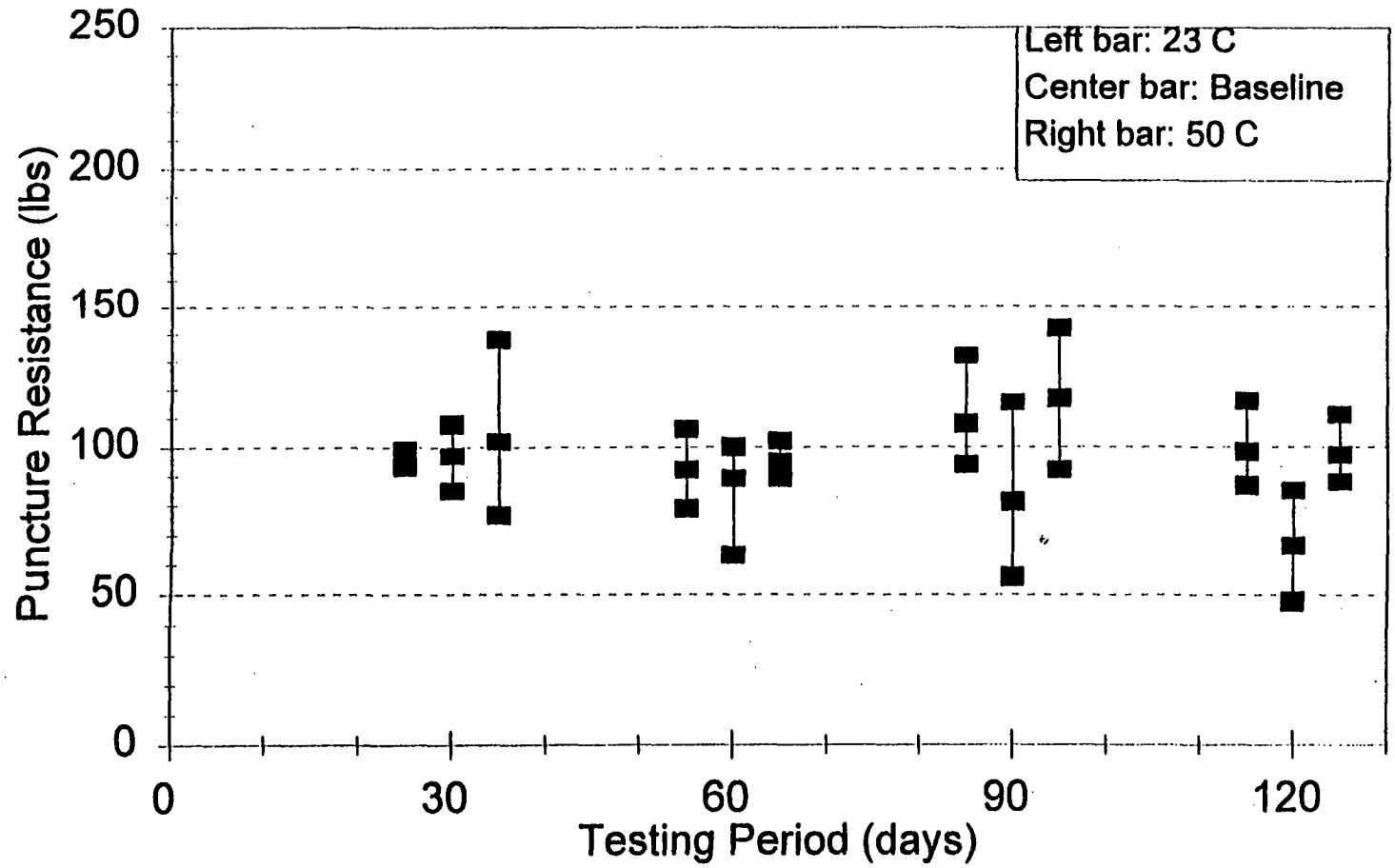
GCL (NW GT) vs Phos Dock Effluent



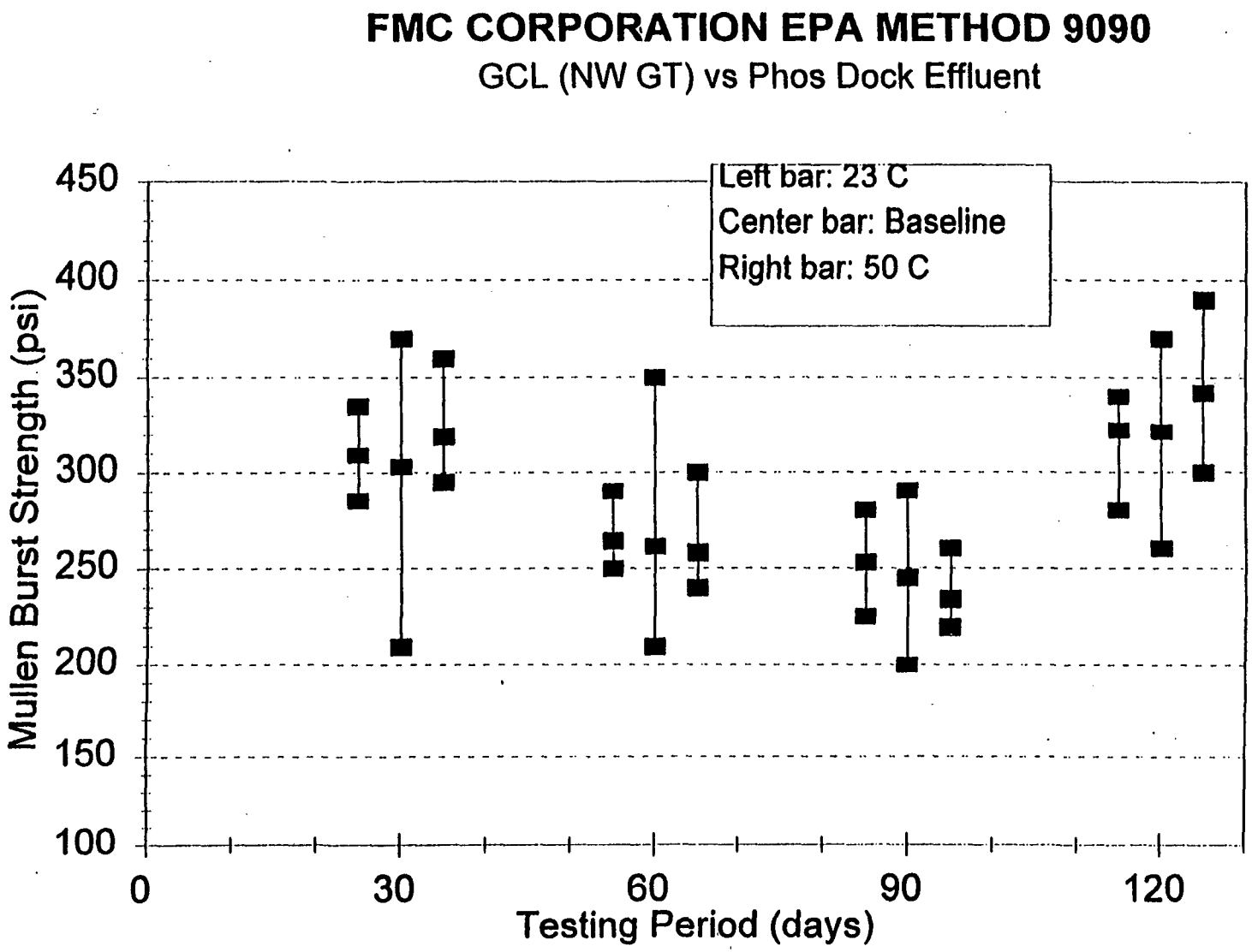
Client: FMC Corporation, File: 942textn.wb1

FMC CORPORATION EPA METHOD 9090

GCL (NW GT) vs Phos Dock Effluent



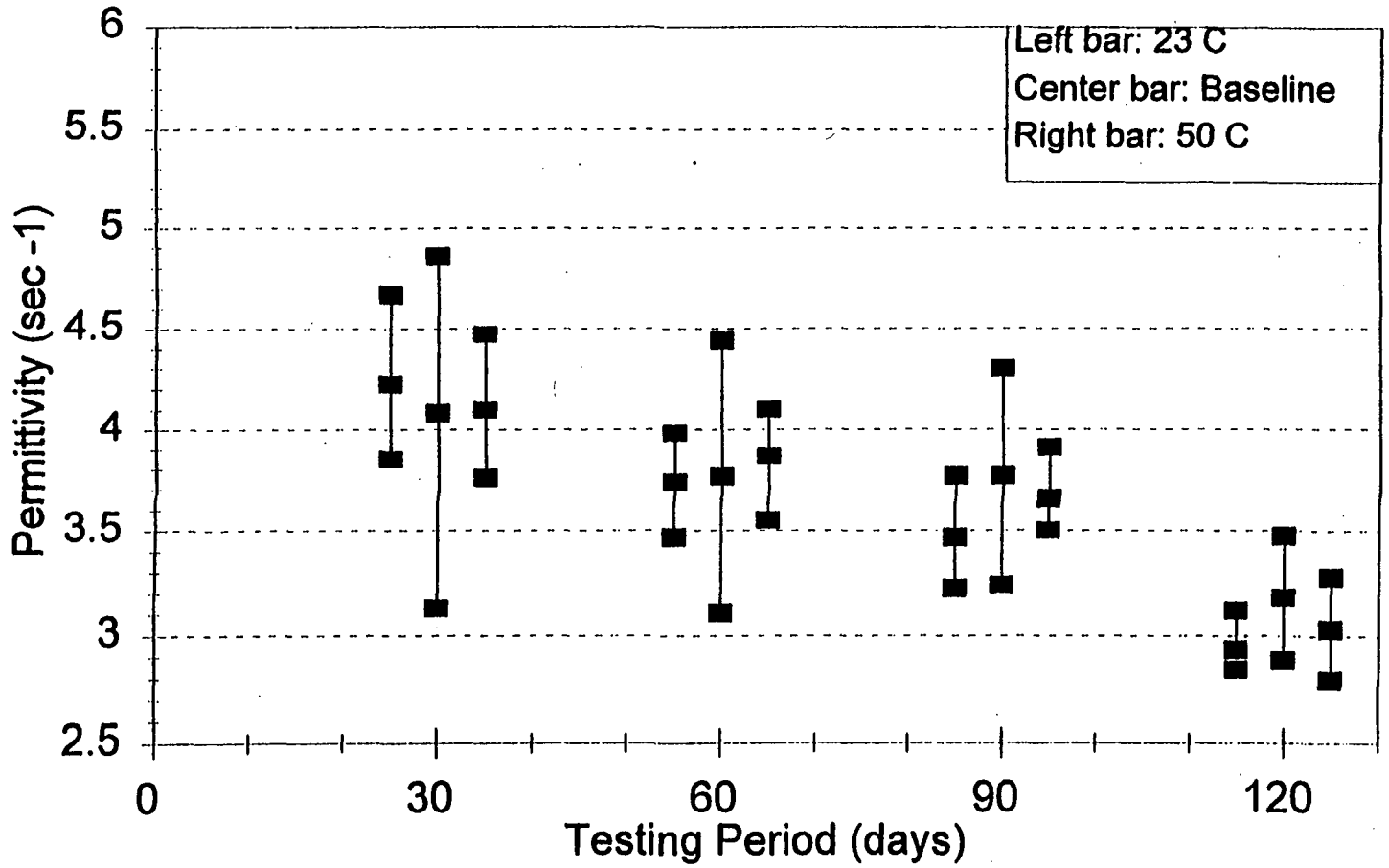
Client: FMC Corporation, File: 942textn.wb1



Client: FMC Corporation, File: 942texin.wb1

FMC CORPORATION EPA METHOD 9090

GCL (NW GT) vs Phos Dock Effluent



Client: FMC Corporation, File: 942textn.wb1