MACTEC ENGINEERING AND CONSULTING, INC.

RALEIGH, NORTH CAROLINA

IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST IN ACCORDANCE WITH CORPS OF ENGINEERS, (WATERWAYS EXPERIMENT STATION, RTH 381-80

PROJECT NAME: NORTH ANNA COL
PROJECT NUMBER: 6468-06-1472
REPORT DATE: 12/7/2006 Revised 1-13-07
BORING NO: B-949

Given Parameters

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Test Section Length, ℓ, ft:	5			
Radius of Borehole r_0, in:	2.00			
GW Depth, ft:	23.00	(from top of casing)	21.40	(from ground surface)

Test Number	Q (GPM)	P_{Test} (psi)	P_T (psi)	P_M (psi)	P_B (psi)	Q (cfs)	H_M (ft)	K_e (fpy)
Interval 1, ft:	**84 - 89**	(from ground surface)						
1	TNP					-		-
2	0.6072	39.66	3.06	28.43	31.18	25.91538	91.52	178.24
3	1.7712	60.1	3.06	28.43	31.18	73.08462	138.69	184.36
4	0	30	3.06	28.43	31.18	3.62308	69.23	0.00
5	1.6763	60.1	3.06	28.43	31.18	73.08462	138.69	174.49
							K_e, ft/year:	**173.05**
Interval 2, ft:	**89 - 94**	(from ground surface)						
1	TNP							-
2	25.10769231	41.5	3.22	30.62	33.42	25.1076923	95.77	0.00
3	74.4923	62.9	3.22	30.62	33.42	74.4923077	145.15	38.11
4	1.8	31.4	3.22	30.62	33.42	1.8	72.46	0.00
5	74.4923	62.9	3.22	30.62	33.42	74.4923077	145.15	58.97
	Report Ke as average of intervals 3 and 5 = 48.5						**K_e, ft/year:**	**NA**
Interval 3, ft:	**95 - 99.5**	(from ground surface)						
1	TNP	21.79	3.15	33.01	35.72			-
2	8.05	43.57	3.1	32.75	35.54	0.01793	100.55	2451.8
3	17.52	66.03	3.1	32.75	35.54	0.03903	152.38	3390.4
4	0.00	33.01	3.15	33.01	35.72	0.00000	76.18	NA
5	18.15	66.03	3.15	33.01	35.72	0.04044	152.38	1939.5
							K_e, ft/year:	**2293.2**

Notations:

Q = flow rate
P_{Test} = total test pressure
P_T = pressure above top packer, near water surface
P_M = initial pressure in the test section
P_B = pressure below bottom packer

H_M = P_{Test} converted to feet of head (P_{Test}*144in^2/ft^2/γ_W)
K_e = ((Q/(H_M-P_m))*(1/ℓ))*1/2π*ln(R/r_0)*(525,600 min/year)*(0.1337ft^3/gal)
R = total length between packers, ℓ
TNP = Test not performed
NM = not measured

Note:

Pressures Pt, Pm and Pb taken from initial data for transducers.
Outside diameter of boring is 4 in.

IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST IN ACCORDANCE WITH CORPS OF ENGINEERS, WATERWAYS EXPERIMENT STATION, RTH 381-80

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/16/2006
Boring No: B-949
Test Interval: 85.6 ft to 90.6 ft (below top of casing)
Stick up length: 1.6 ft
Test Interval: 84.0 ft to 89 ft (from surface)
Test Type: Double Packer Technique

Prepared by: ZO Date: 12-7-06
Checked by: Jar Date: 1-17-07

Depth of Water
Table= 23.00 ft (from top of casing)
h1= 23.00 (from top of casing)
h2 = 65.1 ft (from top of casing)
ρ_w = 62.4 lb/ft^3

Abreviations:
N.O. Not Observed
N.A. Not Aplicable

P_0 Max= 60.11 psi Value on field data sheet= 60.1

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1

Actual Excess Pressure= -8.63 psi
Initial Middle Transducer Reading= 28.43 psi
Test Pressure= 19.80 psi

Test not performed

TEST #2

Actual Excess Pressure= 11.23 psi
Initial Middle Transducer Reading= 28.43 psi
Test Pressure= 39.66 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2752.2		0.2
0.5	2752.6	0.8	7.3
1	2753.2	1.2	10.1
1.5	2753.5	0.6	5.8
2	2753.7	0.4	8.5
2.5	2754.1	0.8	8.8
3	2754.5	0.8	10.4
3.5	2754.8	0.6	9.1
4	2754.9	0.2	8.2
4.5	2755.2	0.6	8.3
5	2755.4	0.4	8.2
6	2755.9	0.5	8.3

TEST #3

Actual Excess Pressure= 31.67 psi
Initial Middle Transducer Reading= 28.43 psi
Test Pressure= 60.10 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2756		0.4
0.5	2757.5	3.0	26
1	2758.7	2.4	27.4
1.5	2759.6	1.8	27.7
2	2760.6	2.0	25.5
2.5	2761.5	1.8	25.3
3	2762.1	1.2	24.8
3.5	2762.9	1.6	24.2
4	2763.7	1.6	24
4.5	2764.5	1.6	23.7
5	2765.3	1.6	23.6
6	2767.2	1.9	23.6

Average Q: gpm
Excess Pore pressure: -8.63 psi

Average Q: 0.54 gpm
Excess Pore pressure: 11.23 psi

Average Q: 1.7 gpm
Excess Pore pressure: 31.67 psi

Jad 1-17-07

Boring No: B-949
Test Interval: 84 ft to 89 ft
(belwo surface)

Density of water, ρ_w=62.4 lb/ft^3
= 0.0361 lb/in^3
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

TEST #4

Actual Excess Pressure= 1.57 psi
Initial Middle Transducer 28.43 psi
Test Pressure= 30.00 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2767.2		
0.5	2767.2	0.0	-2
1	2767.2	0.0	-1
1.5	2767.2	0.0	-0.8
2	2767.2	0.0	-0.8
2.5	2767.2	0.0	-0.5
3	2767.2	0.0	-0.4
3.5	2767.2	0.0	-0.6
4	2767.2	0.0	-0.6
4.5	2767.2	0.0	-0.6
5	2767.2	0.0	-0.6
6	2767.2	0.0	-0.6

TEST #5

Actual Excess Pressure= 31.67 psi
Initial Middle Transducer 28.43 psi
Test Pressure= 60.1 psi

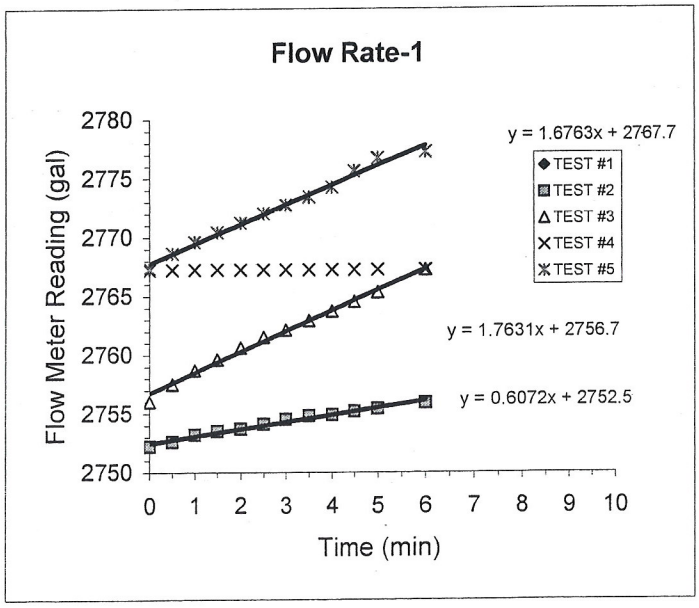
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2767.3		-2
0.5	2768.6	2.6	25.6
1	2769.6	2.0	23.4
1.5	2770.4	1.6	23.9
2	2771.2	1.6	24
2.5	2772	1.6	23.7
3	2772.7	1.4	23.4
3.5	2773.4	1.4	23.4
4	2774.2	1.6	23.3
4.5	2775.6	2.8	23.2
5	2776.7	2.2	23.2
6	2777.2	0.5	22.9

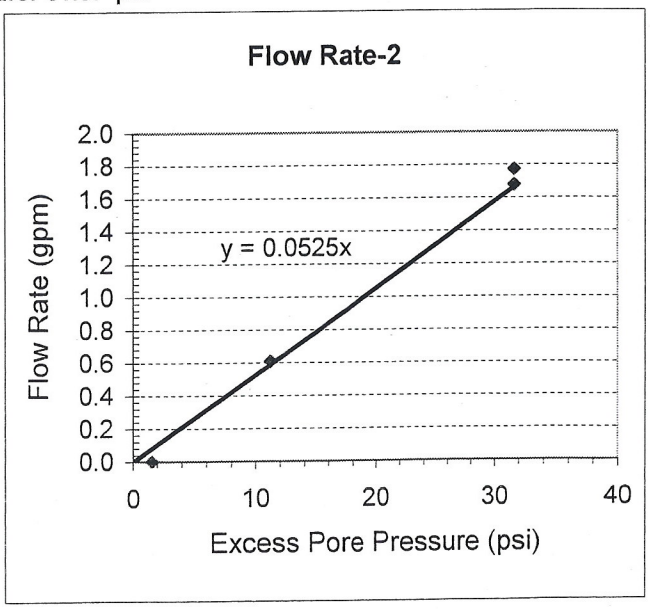
	Excess Pressure (psi)	Q* (gpm)	Test Pres. (ft).	k_e (fpy)
1	-8.63	TNP	-19.92	
2	11.23	0.607	25.92	178.24
3	31.67	1.771	73.08	184.36
4	1.57	0.000	3.62	0.00
5	31.67	1.676	73.1	174.49

* Q obtained from graph Flow Rate-1

Average Q: 0 gpm
Excess Pore pressure: 1.57 psi

Average Q: 1.8 gpm
Excess Pore pressure: 31.67 psi





obtain Q from graph 2 in gpm/psi --> 0.0525 gal/psi

$k_e = Q^* \ln(R/r_0)/(2\pi L H_0)$

k_e= 1.67E-04 cm/sec
= 173.05 ft/year

Pressure Decay Test

Prepared by: ZI Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/16/2006
Boring No: B-949
Test Interval: 84 ft to 89 ft (below surface)

N.O. Not Observed
N.A. Not Aplicable

Test #1

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
Test not conducted		

Test #2

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	8.3	39.53
0.5	3.5	33.58
1.0	2.5	31.56
1.5	1.7	33.39
2.0	1.2	29.58
2.5	0.9	29.09
3.0	0.8	28.84
3.5	0.6	28.57
4.0	0.6	28.57
4.5	0.5	28.48
5.0	0.5	28.45
5.5	0.5	28.44
6.0	0.5	28.43
6.5	0.5	28.42

Test #3

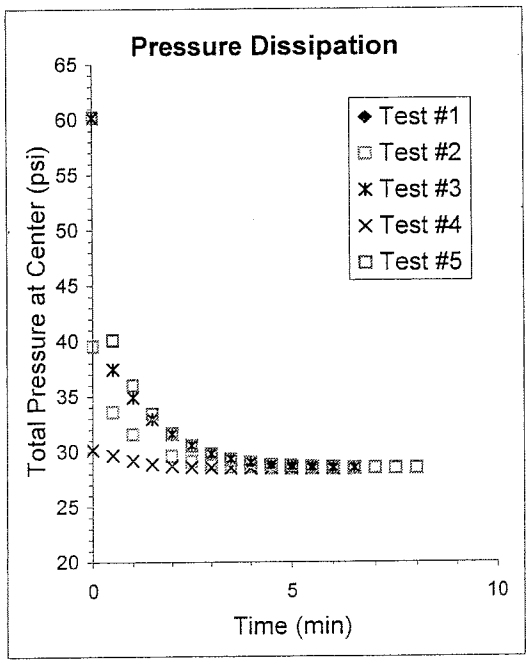
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	23.6	60.15
0.5	3	37.42
1.0	1.6	34.87
1.5	0.5	32.94
2.0	0.0	31.56
2.5	-0.6	30.56
3.0	-1.1	29.77
3.5	-1.4	29.30
4.0	-1.7	28.99
4.5	-1.6	28.76
5.0	-1.8	28.66
5.5	-1.9	28.57
6.0	-1.9	28.52
6.5	-1.9	28.48

Test #4

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	-0.6	30.14
0.5	-1.1	29.64
1.0	-1.4	29.15
1.5	-1.6	28.84
2.0	-1.7	28.67
2.5	-1.8	28.56
3.0	-1.9	28.50
3.5	-1.9	28.47
4.0	-1.9	28.45
4.5	-1.9	28.44
5.0	-1.9	28.43
5.5	-1.9	28.43
6.0	-1.9	28.43

Test #5

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	22.9	60.19
0.5	4.3	40.08
1.0	1	35.98
1.5	-1	33.40
2.0	-1.8	31.61
2.5	-2.6	30.48
3.0	-3.0	29.75
3.5	-3.3	29.28
4.0	-3.5	29.01
4.5	-3.6	28.78
5.0	-3.7	28.68
5.5	-3.7	28.61
6.0	-3.7	28.57
6.5	-3.7	28.52
7.0	-3.8	28.50
7.5	-3.8	28.48
8	-3.7	28.48



IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST
IN ACCORDANCE WITH CORPS OF ENGINEERS,
WATERWAYS EXPERIMENT STATION, RTH 381-80

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/30/2006
Boring No: B-949
Test Interval: 90.6 ft to 95.6 ft (below top of casing)
Stick up length: 1.6 ft
Test Interval: 89.0 ft to 94 ft (from surface)
Test Type: Double Packer Technique

Depth of Water
Table= 23.00 ft (from top of casing)
h1= 23.00 (from top of casing)
h2 = 70.1 ft (from top of casing)
ρ_w = 62.4 lb/ft^3

Abreviations:
N.O. Not Observed
N.A. Not Aplicable

P_0 Max= 62.96 psi Value on field data sheet= 62.9

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1

Actual Excess Pressure= -9.92 psi
Initial Middle Transducer Reading= 30.62 psi
Test Pressure= 20.70 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Test not performed			

Average Q: gpm
Excess Pore pressure: -9.92 psi

TEST #2

Actual Excess Pressure= 10.88 psi
Initial Middle Transducer Reading= 30.62 psi
Test Pressure= 41.50 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2741		-0.2
0.5	2741.4	0.8	8.2
1	2741.6	0.4	7.6
1.5	2741.6	0.0	7.6
2	2741.6	0.0	7.9
2.5	2741.6	0.0	7.9
3	2741.6	0.0	7.9
3.5	2741.6	0.0	8.1
4	2741.6	0.0	7.9
4.5	2741.6	0.0	8
5	2741.6	0.0	7.9

Average Q: 0.0 gpm
Excess Pore pressure: 10.88 psi

TEST #3

Actual Excess Pressure= 32.28 psi
Initial Middle Transducer Reading= 30.6 psi
Test Pressure= 62.9 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2741.6		0
0.5	2743	2.8	26
1	2743.5	1.0	27.1
1.5	2743.9	0.8	26.8
2	2744.1	0.4	25
2.5	2744.4	0.6	25.7
3	2744.7	0.6	26
3.5	2745	0.6	26
4	2745.3	0.6	25.7
4.5	2745.5	0.4	25.5
5	2745.8	0.6	25.5
6	2746.3	0.5	24.7
7	2746.8	0.5	26.1
8	2747.3	0.5	26.4
9	2747.7	0.4	26.4
10	2748.3	0.6	26.1

Average Q: 0.5 gpm
Excess Pore pressure: 32.28 psi

JAZ 1-17-07

Boring No: 84
Test Interval: 89 ft to 94 ft
(below surface)

Density of water, ρ_w=62.4 lb/ft^3
= 0.0361 lb/in^3
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

TEST #4

Actual Excess Pressure= 0.78 psi
Initial Middle Transducer 30.62 psi
Test Pressure= 31.40 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2748.5		-1.6
0.5	2748.5	0.0	-1.6
1	2748.5	0.0	-1.5
1.5	2748.6	0.2	-0.5
2	2748.6	0.0	-0.7
2.5	2748.6	0.0	-0.9
3	2748.6	0.0	-1
3.5	2748.6	0.0	-1.2
4	2748.6	0.0	-1.1
4.5	2748.6	0.0	-0.7
5	2748.6	0.0	-0.7

Average Q: 0.0 gpm
Excess Pore pressure: 0.78 psi

TEST #5

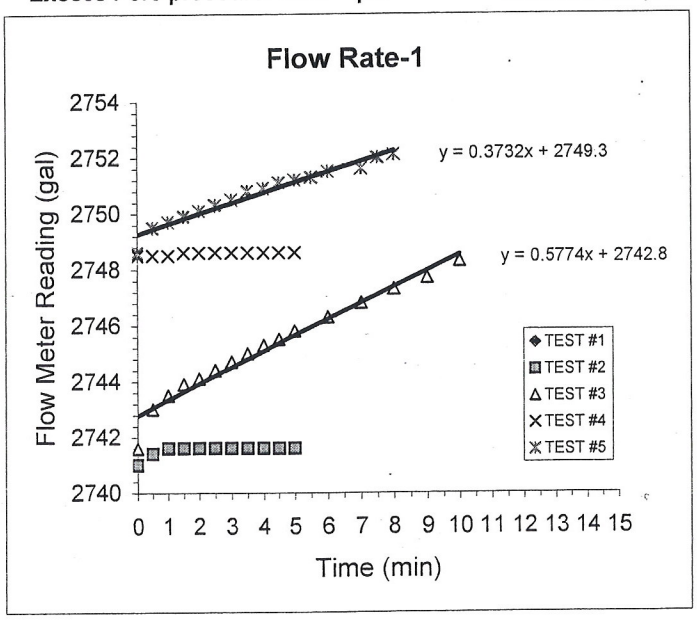
Actual Excess Pressure= 32.28 psi
Initial Middle Transducer 30.62 psi
Test Pressure= 62.9 psi

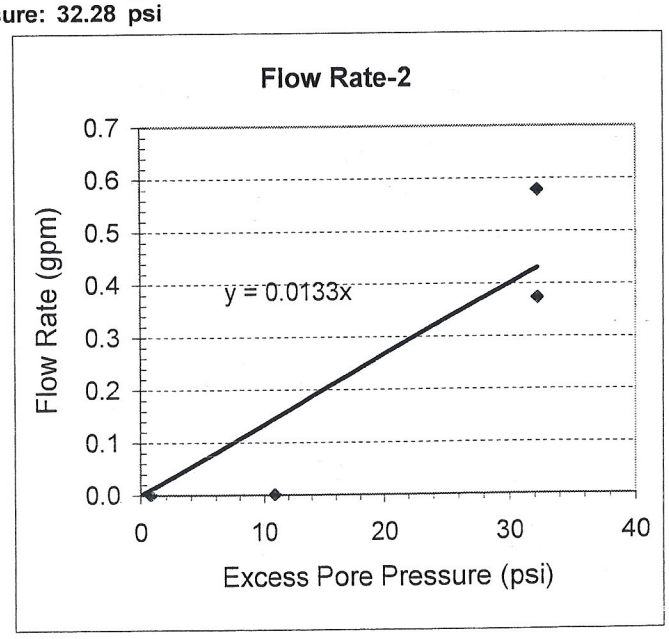
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2748.6		-1.6
0.5	2749.5	1.8	26.6
1	2749.7	0.4	25.6
1.5	2749.9	0.4	24.4
2	2750.1	0.4	24.1
2.5	2750.3	0.4	25.5
3	2750.5	0.4	26.1
3.5	2750.8	0.6	24.3
4	2750.9	0.2	22.2
4.5	2751.1	0.4	23.7
5	2751.2	0.2	23.6
5.5	2751.3	0.2	23.2
6	2751.5	0.4	24.6
7	2751.6	0.1	24.5
7.5	2752	0.8	24.7
8	2752.1	0.2	24.7

Average Q: 0.4 gpm
Excess Pore pressure: 32.28 psi

	Excess Pressure (psi)	Q* (gpm)	Test Pres. (ft)	k_e (fpy)
1	-9.92	0.000	-22.89	0
2	10.88	0.000	25.11	0
3	32.28	0.373	74.49	38.11
4	0.78	0.000	1.80	0
5	32.28	0.577	74.5	58.97

* Q obtained from graph Flow Rate-1





obtain Q from graph 2 in gpm/psi --> NA gal/psi

Note: Graph 2 not applicable as flow only at one pressure. Use average of Ke for Tests 3 and 5

$k_e = Q^* \ln(R/r_0)/(2\pi L H_0)$

k_e= #VALUE! cm/sec
= NA ft/year

Pressure Decay Test

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/18/2006
Boring No: B-949
Test Interval: 89 ft to 94 ft (below surface)

N.O. Not Observed
N.A. Not Aplicable

Test #1

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)

Test #2

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	7.9	41.44
0.5	5.3	38.11
1.0	3.9	36.29
1.5	2.9	34.95
2.0	2.4	33.94
2.5	1.8	33.18
3.0	1.5	32.65
3.5	1.2	32.14
4.0	1	31.8
4.5	0.8	31.52
5.0	0.7	31.29
6.0	0.6	31.12
7.0	0.5	30.97
8.0	0.4	30.89
9.0	0.4	30.81
10.0	0.3	30.76
11.0	0.3	30.72
12.0	0.3	30.7

Test #3

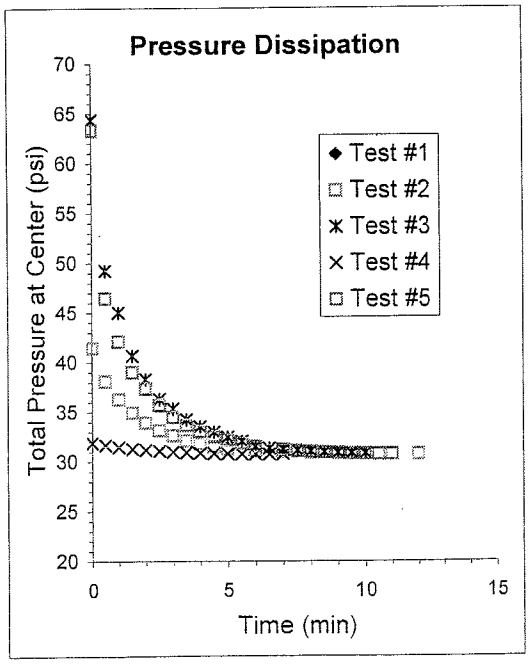
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	26.1	64.32
0.5	13.1	49.20
1.0	8.9	45.02
1.5	5.3	40.65
2.0	3.5	38.29
2.5	2	36.29
3.0	1.4	35.32
3.5	0.6	34.24
4.0	0.2	33.54
4.5	-0.1	32.98
5.0	-0.5	32.46
5.5	-0.7	32.05
6.0	-1	31.52
6.5	-1.2	31.33
7.0	-1.2	31.19
7.5	-1.3	31.10
8.0	-1.4	31.02
8.5	-1.4	30.91
9.0	-1.5	30.85
9.5	-1.5	30.82
10.0	-1.5	30.79

Test #4

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	-0.7	31.87
0.5	-0.9	31.65
1.0	-1.1	31.45
1.5	-1.2	31.28
2.0	-1.3	31.16
2.5	-1.3	31.06
3.0	-1.4	30.97
3.5	-1.4	30.91
4.0	-1.5	30.85
4.5	-1.5	30.80
5.0	-1.5	30.77
5.5	-1.6	30.75
6.0	-1.6	30.74
6.5	-1.6	30.73
7	-1.6	30.71

Test #5

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	24.7	63.27
0.5	9.6	46.44
1.0	5.8	42.11
1.5	3.0	39.00
2.0	2.1	37.36
2.5	0.9	35.71
3.0	0.1	34.49
3.5	-0.3	33.69
4.0	-0.7	33.08
4.5	-1.1	32.54
5.0	-1.3	32.21
5.5	-1.6	31.87
6.0	-1.7	31.54
66.5	-1.9	31.34
7	-2.0	31.21
7.5	-2.0	31.08
8	-2.1	30.98
8.5	-2.1	30.90
9	-2.2	30.85
9.5	-2.3	30.79
10	-2.3	30.74
10.5	-2.3	30.73
11	-2.3	30.71



IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST
IN ACCORDANCE WITH CORPS OF ENGINEERS,
WATERWAYS EXPERIMENT STATION, RTH 381-80

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/16/2006
Boring No: B-949
Test Interval: 96.1 ft to 101.1 ft (below top of casing)
Stick up length: 1.6 ft
Test Interval: 94.5 ft to 99.5 ft (from surface)
Test Type: Double Packer Technique

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Depth of Water
Table= 23.10 ft (from top of casing)
h1= 23.00 (from top of casing)
h2 = 75.50 ft (from top of casing)
ρ_w = 62.4 lb/ft^3

Abreviations:
N.O. Not Observed
N.A. Not Aplicable

P_0 Max= 66.04 psi Value on field data sheet= 66.03

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1

Actual Excess Pressure= -11.22 psi
Initial Middle Transducer Reading= 33.01 psi
Test Pressure= 21.79 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Test not conducted			

TEST #2

Actual Excess Pressure= 10.82 psi
Initial Middle Transducer Reading= 32.75 psi
Test Pressure= 43.57 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2509.7		0
0.5	2509.7	0.0	0.1
1	2510.1	0.8	10.9
1.5	2515.4	10.6	13.4
2	2520.4	10.0	3.6
2.5	2525.3	9.8	3.7
3	2529.7	8.8	3.9
3.5	2532.9	6.4	3.9
4	2538.2	10.6	3.2
4.5	2542.2	8.0	3.2
5	2546.5	8.6	3.4

TEST #3

Actual Excess Pressure= 17.03 psi
Initial Middle Transducer Reading= 32.75 psi
Test Pressure (max achievable)= 49.78 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2548		-10.3
0.5	2549.1	2.2	10.8
1	2556	13.8	14.7
1.5	2566.7	21.4	27.8
2	2575.7	18.0	28.7
2.5	2584.9	18.4	29.6
3	2593.9	18.0	31.3
3.5	2602.9	18.0	31.6
4	2611.6	17.4	31.4
4.5	2621.7	20.2	32.2
5	2631.1	18.8	32.2

Average Q: ##### gpm
Excess Pore pressure: -11.2 psi

Average Q: 9.1 gpm
Excess Pore pressure: 10.82 psi

Average Q: 18.8 gpm
Excess Pore pressure: 17.03 psi

JOZ 1-17-07

TEST #4

Actual Excess Pressure= 0.00 psi
Initial Middle Transducer 33.01 psi
Test Pressure= 33.01 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2632.1		-10.2
0.5	2632.1	0.0	-10.2
1	2632.1	0.0	-10.1
1.5	2632.2	0.2	-9.9
2	2632.3	0.2	-9.6
2.5	2632.6	0.6	-9.5
3	2632.7	0.2	-9.5
3.5	2632.8	0.2	-9.5
4	2632.9	0.2	-9.4
4.5	2633	0.2	-9.4
5	2633	0.0	-9.4
6	2633	0.0	-9.4

TEST #5

Actual Excess Pressure= 30.85 psi
Initial Middle Transducer 33.01 psi
Test Pressure (max achievable)= 63.86 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2633		-0.7
0.5	2636.8	7.6	25.2
1	2645.8	18.0	28.1
1.5	2655.9	20.2	30.3
2	2665.9	20.0	31.3
2.5	2674.3	16.8	31.5
3	2684.2	19.8	31.7
3.5	2692.8	17.2	32.5
4	2701.9	18.2	32.4
4.5	2711.3	18.8	33.1
5	2722.9	23.2	33.1
6	2737	14.1	33.1

Boring No: B-949
Test Interval: 94.5 ft to 99.5 ft
(below surface)

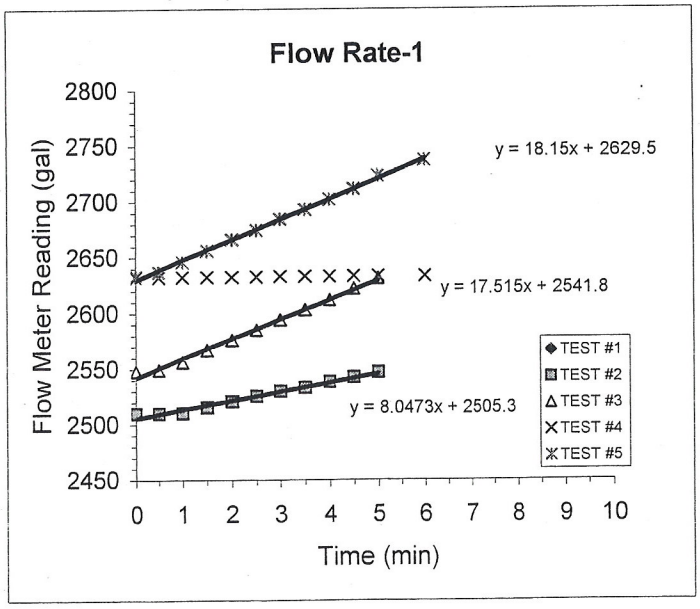
Density of water, ρ_w=62.4 lb/ft^3
= 0.0361 lb/in^3
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

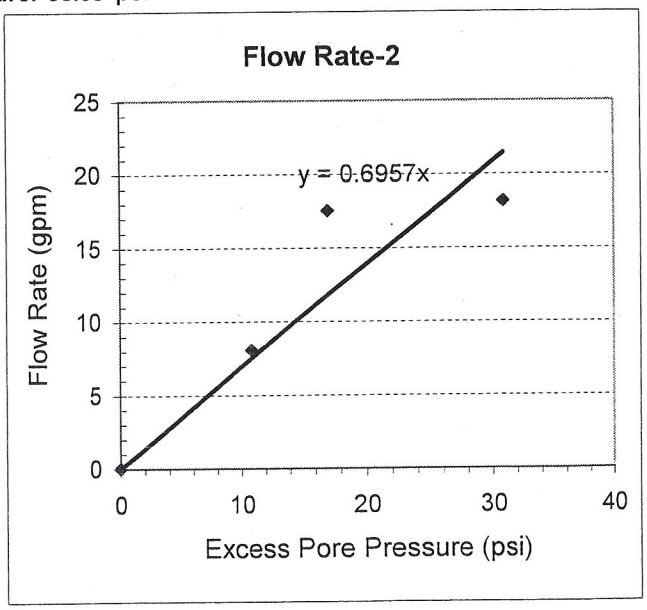
	Excess Pressure (psi)	Q* (gpm)	Test Pres. (ft)	k_e (fpy)
1	-11.22	0.000	-25.89	0
2	10.82	8.047	24.97	2452
3	17.03	17.52	39.30	3390
4	0.00	0.000	0.00	#DIV/0!
5	30.85	18.15	71.19	1939

* Q obtained from graph Flow Rate-1

Average Q: 0.2 gpm
Excess Pore pressure: 0.00 psi

Average Q: 18.7 gpm
Excess Pore pressure: 30.85 psi





obtain Q from graph 2 in gpm/psi --> 0.6957 gal/psi

$k_e = Q^* \ln(R/r_0)/(2\pi L H_0)$

k_e= **2.22E-03 cm/sec**
= **2293.17 ft/year**

Pressure Decay Test

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/16/2006
Boring No: B-949
Test Interval: 94.5 ft to 99.5 ft (from surface)

Prepared by: ZI Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Test #1

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
Test not conducted		

Test #2

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	3.4	43.62
0.5	-8.4	35.31
1.0	-8.3	34.66
1.5	-8.7	34.18
2.0	-9	33.88
2.5	-9.2	33.68
3.0	-9.4	33.52
3.5	-9.5	33.39
4.0	-9.6	33.31
4.5	-9.7	33.21
5.0	-9.8	33.15
5.5	-9.9	33.1
6.0	-9.9	33.05
6.5	-9.9	33.02
7.0	-10.0	32.98
7.5	-10.0	32.95
8.0	-10.0	32.93

Test #3

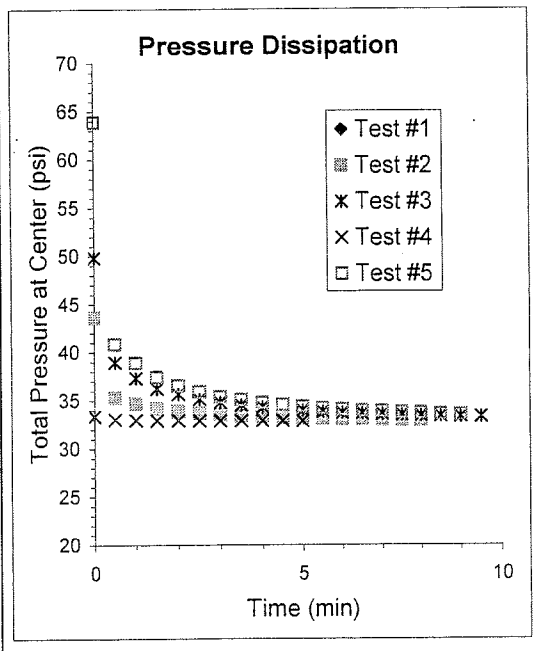
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	32.2	49.78
0.5	-3.8	38.94
1.0	-5.6	37.32
1.5	-6.6	36.22
2.0	-7.2	35.66
2.5	-7.8	35.12
3.0	-8.1	34.79
3.5	-8.5	34.50
4.0	-8.7	34.28
4.5	-8.8	
5.0	-9	33.95
5.5	-9.1	33.82
6.0	-9.2	33.69
6.5	-9.3	33.60
7.0	-9.4	33.53
7.5	-9.5	33.47
8.0	-9.5	33.40
8.5	-9.6	33.34
9.0	-9.7	33.3
9.5	-9.7	33.26

Test #4

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	-9.4	33.34
0.5	-9.8	33
1.0	-9.9	32.95
1.5	-9.9	32.92
2.0	-9.9	32.9
2.5	-9.9	32.89
3.0	-9.9	32.88
3.5	-9.9	32.88
4.0	-9.9	32.87
4.5	-10	32.86
5.0	-9.9	32.85

Test #5

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	33.1	63.86
0.5	-1.9	40.86
1.0	-3.8	38.92
1.5	-5.7	37.40
2.0	-6.3	36.56
2.5	-7.0	35.92
3.0	-7.5	35.37
3.5	-7.8	35.08
4.0	-8.1	34.78
4.5	-8.3	34.55
5.0	-8.5	34.35
5.5	-8.7	34.18
6.0	-8.8	34.05
6.5	-9.0	33.92
7	-9.1	33.83
7.5	-9.2	33.74
8	-9.3	33.67
8.5	-9.3	33.59
9	-9.4	33.52



84.0 89.0
1.6 1.6
85.6 90.6

12-5-06

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-16-06

Boring No. B949

Test Interval: 85.6 to 90.6 feet from Datum

Casing Stickup 1.6 feet

PoMAX = (h_1 x 1) + (h_2 x 0.57). h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the datum to the water level
h_2 = Distance from the water level to the center of the test interval

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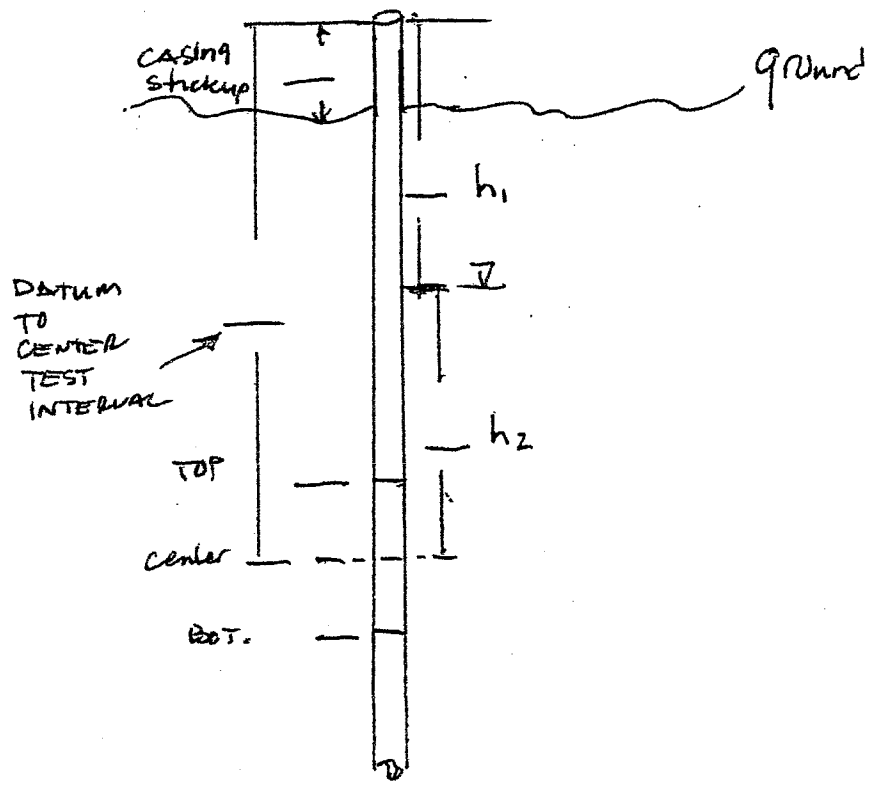
h_1 = 23.0

h_2 = 88.1 - 23.0 = 65.1

P MAX = 23.0 + 37.1 = 60.1

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-16-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 85.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 65.1 FT.

1/3 MAXIMUM TEST PRESSURE, Po 60.1 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 1 TEST PRESSURE 19.8 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.06, Middle 28.43, Bottom 31.18

Transducer Readings after initial pressurization:

Top ____, Middle ____, Bottom ____

Transducer Readings after final flow measurement:

Top ____, Middle ____, Bottom ____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS

Test was not performed due to the natural ~~Test~~ pressure by higher than Test pressure

8-17

84.0 89.0
1.6 1.6
85.6 90.6

12-5-06

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-16-06

Boring No. B949

Test Interval: 85.6 to 90.6 feet from Datum

Casing Stickup 1.6 feet

PoMAX = (h_1 x 1) + (h_2 x 0.57). h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the datum to the water level
h_2 = Distance from the water level to the center of the test interval

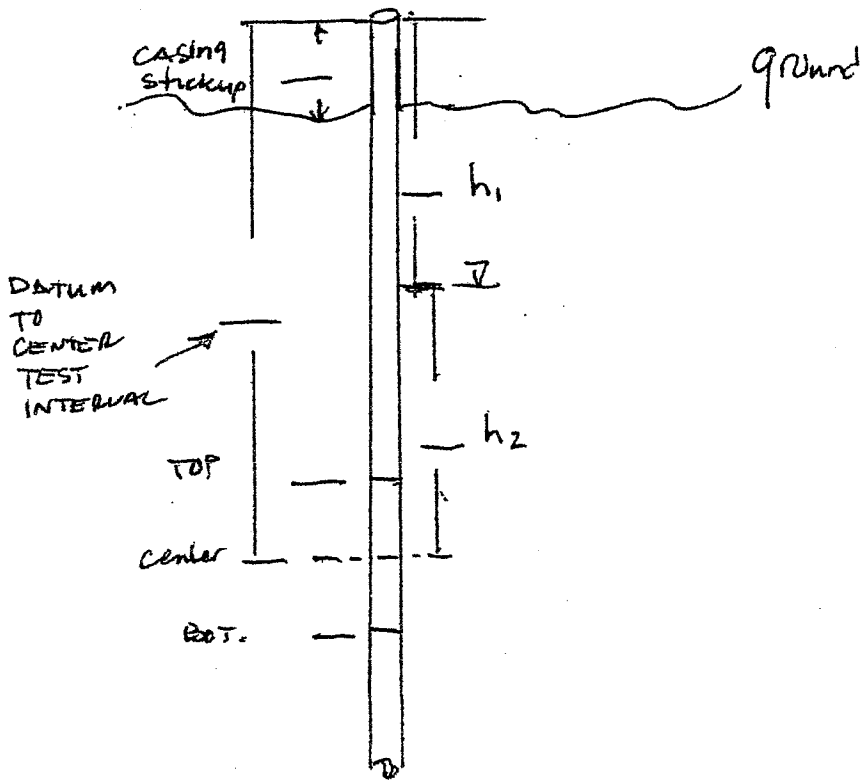
---

h_1 = 23.0

h_2 = 88.1 - 23.0 = 65.1

P MAX = 23.0 + 37.1 = 60.1

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-16-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 85.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 65.1 FT.

2/3 MAXIMUM TEST PRESSURE, Po 60.1 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 2 TEST PRESSURE 39.66 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.06, Middle 28.43, Bottom 31.18

Transducer Readings after initial pressurization:
Top 3.16, Middle 28.58, Bottom 31.23

Transducer Readings after final flow measurement:
Top 2.99, Middle 28.41, Bottom 31.21

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2752.2	/	0.2	
0.5	2752.6	.8	7.3	
1.0	2753.2	1.2	10.1	
1.5	2753.5	.6	5.8	
2.0	2753.7	.4	8.5	
2.5	2754.1	.8	8.8	
3.0	2754.5	.8	10.4	
3.5	2754.8	.6	9.1	
4.0	2754.9	.2	8.2	
4.5	2755.2	.6	8.3	
5.0	2755.4	.4	8.2	
6.0	2755.9	1.0	8.3	

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-16-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 85.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 65.1 FT.

1/3 MAXIMUM TEST PRESSURE, Po 60.1 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 1 TEST PRESSURE 19.8 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.06, Middle 28.43, Bottom 31.18

Transducer Readings after initial pressurization:

Top ____, Middle ____, Bottom ____

Transducer Readings after final flow measurement:

Top ____, Middle ____, Bottom ____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS

Test was not performed due to the natural ~~Test~~ pressure being higher than Test pressure

8-17

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 3

BORING NO.: B949

DATE: 8-16-06

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 85.5 FT. TO 90.6 FT.

DATA COLLECTED BY: J Howard

12-2-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	8.3	39.53
0.5	3.5	33.58
1.0	2.5	31.56
1.5	1.7	33.39
2.0	1.2	29.58
2.5	.9	29.09
3.0	.8	28.84
3.5	.6	28.57
4.0	.6	28.57
4.5	.5	28.48
5.0	.5	28.45
5.5	.5	28.44
6.0	.5	28.43
6.5	.5	28.42

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B949 - M285 - 90
" B285 "
" T285 "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAZ 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-16-06

BORING NO. B948 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 85.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 65.1 FT.

MAXIMUM TEST PRESSURE, Po 60.1 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 3 TEST PRESSURE 60.1 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.06, Middle 28.43, Bottom 31.18

Transducer Readings after initial pressurization:

Top 2.99, Middle 28.41, Bottom 31.21

Transducer Readings after final flow measurement:

Top 2.95, Middle 28.42, Bottom 31.22

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2756.0	/	.4	
0.5	2757.5	3.0	26.0	
1.0	2758.7	2.4	27.4	
1.5	2759.6	1.8	27.7	
2.0	2760.6	2.0	25.5	
2.5	2761.5	1.8	25.3	
3.0	2762.1	1.2	24.8	
3.5	2762.9	1.6	24.2	
4.0	2763.7	1.6	24.0	
4.5	2764.5	1.6	23.7	
5.0	2765.3	1.6	23.6	
6.0	2767.2	1.8	23.6	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 2**

BORING NO.: B94a

DATE: 8-16-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 85.6 **FT. TO** 90.6 **FT.**

DATA COLLECTED BY: J Howard

JCZ 12-5-06

SHUT-IN TEST

PRESSURE:_____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	23.6	60.15
0.5	3.0	37.42
1.0	1.6	34.87
1.5	.5	32.94
2.0	0	31.56
2.5	-.6	30.56
3.0	-1.1	29.77
3.5	-1.4	29.30
4.0	-1.7	28.99
4.5	-1.6	28.76
5.0	-1.8	28.66
5.5	-1.9	28.57
6.0	-1.9	28.52
6.5	-1.9	28.48

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B94a - M385 - 90
" B385 "
" T385 "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-16-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING ✓ GROUND SURFACE ____

DATUM ELEVATION na

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 85.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 65.1 FT.

MAXIMUM TEST PRESSURE, Po ~~72.55~~ 65.1 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 4 TEST PRESSURE ~~72.55~~ 30.0 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.06, Middle 28.43, Bottom 31.18

Transducer Readings after initial pressurization:
Top 2.95, Middle 28.42, Bottom 31.22

Transducer Readings after final flow measurement:
Top 2.95, Middle 28.45, Bottom 31.22

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2767.2	/	-2.0	
0.5	2767.2	Ø	-1.0	
1.0	2767.2	Ø	-0.8	
1.5	2767.2	Ø	-0.8	
2.0	2767.2	Ø	-0.5	
2.5	2767.2	Ø	-0.4	
3.0	2767.2	Ø	-0.6	
3.5	2767.2	Ø	-0.6	
4.0	2767.2	Ø	-0.6	
4.5	2767.2	Ø	-0.6	
5.0	2767.2	Ø	-0.6	

Flow during this test was lower than the Flowmeter could Read

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3**

BORING NO.: B949

DATE: 8-16-06

TEST NUMBER: 4

TEST INTERVAL (FROM DATUM): FROM 85.6 **FT. TO** 90.6 **FT.**

DATA COLLECTED BY: J Howard

SHUT-IN TEST

PRESSURE:_____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	-.6	30.14
0.5	-1.1	29.64
1.0	-1.4	29.15
1.5	-1.6	28.84
2.0	-1.7	28.67
2.5	-1.8	28.56
3.0	-1.9	28.50
3.5	-1.9	28.47
4.0	-1.9	28.45
4.5	-1.9	28.44
5.0	-1.9	28.43
5.5	-1.9	28.43
6.0	-1.9	28.43

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B949-M485-90
" B485 "
" T485 "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAJ 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-16-06

BORING NO. B999 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 85.0 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 65.1 FT.

MAXIMUM TEST PRESSURE, Po 60.1 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 5 TEST PRESSURE 60.1 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.06, Middle 28.43, Bottom 31.18

Transducer Readings after initial pressurization:
Top 2.95, Middle 28.41, Bottom 31.22

Transducer Readings after final flow measurement:
Top 2.95, Middle 28.45, Bottom 31.25

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2767.3	/	-2.0	
0.5	2768.6	2.6	25.6	
1.0	2769.6	2.0	23.4	
1.5	2770.4	1.6	23.9	
2.0	2771.2	1.6	24.0	
2.5	2772.0	1.6	23.7	
3.0	2772.7	1.4	23.4	
3.5	2773.4	1.4	23.4	
4.0	2774.2	1.6	23.3	
4.5	2775.6	~~4.8~~ 2.8	23.2	
5.0	2776.7	2.2	23.2	
6.0	2777.2	1.0	22.9	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 3

BORING NO.: B949

DATE: 8-16-06

TEST NUMBER: ~~[illegible]~~ 8-16 5

TEST INTERVAL (FROM DATUM): FROM 85.5 FT. TO 90.5 FT.

DATA COLLECTED BY: S Howard

Jo J 12-6-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	22.9	60.19
0.5	4.3	40.08
1.0	1.0	35.98
1.5	-1.0	33.40
2.0	-1.8	31.61
2.5	-2.6	30.48
3.0	-3.0	29.75
3.5	-3.3	29.28
4.0	-3.5	29.01
4.5	-3.6	28.78
5.0	-3.7	28.68
5.5	-3.7	28.61
6.0	-3.7	28.57
6.5	-3.7	28.52
7.0	-3.8	28.50
7.5	-3.8	28.48
8.0	-3.7	28.48

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B949 - M585 - 90
" - T585 - "
" - B585 - "

12-5-06

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-16-06

Boring No. B949

Test Interval: 95.6 to 90.6 feet from Datum

Casing Stickup 1.6 feet

PoMAX = (h_1 x 1) + (h_2 x 0.57). h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the datum to the water level
h_2 = Distance from the water level to the center of the test interval

---

h_1 = 23.0

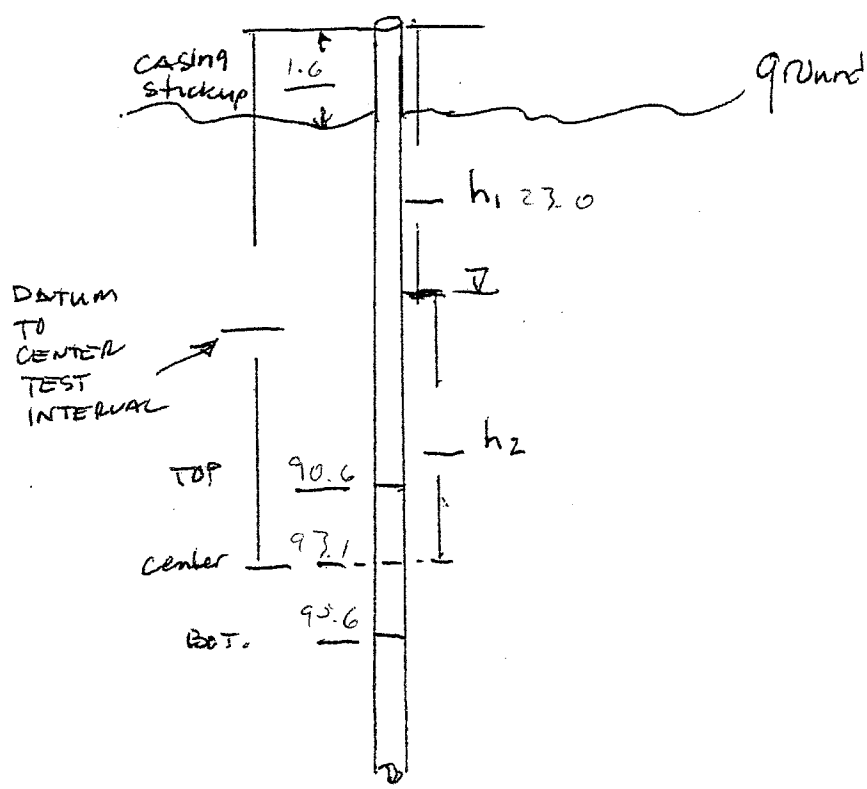
h_2 = 93.1 - 23.0 = 70.1

P MAX = 23.0 + 39.96 = 62.9

24.0
93.1 - 23.0 - 70.1
24.

63.9

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-17-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE __

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 95.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: ~~1.6~~ 8-16 FT. 1.0

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 70.1 FT.

1/3 MAXIMUM TEST PRESSURE, Po 62.9 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 1 TEST PRESSURE 20.7 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.22, Middle 30.62, Bottom 33.42

Transducer Readings after initial pressurization:

Top ____, Middle ____, Bottom ____

Transducer Readings after final flow measurement:

Top ____, Middle ____, Bottom ____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS

Test Couldn't be done due to the natural pressure being greater than the test pressure

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 3 2

BORING NO.: B949

DATE: 8-17-06

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 95.6 FT. TO 90.6 FT.

DATA COLLECTED BY: Howard

12-5-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	7.9	41.44
0.5	5.3	38.11
1.0	3.9	36.29
1.5	2.9	34.95
2.0	2.4	33.94
2.5	1.8	33.18
3.0	1.5	32.65
3.5	1.2	32.14
4.0	1.0	31.80
4.5	0.8	31.52
5.0	.7	31.29
5.5	.6	31.12
6.0	.5	30.97
6.5	.4	30.89
	.4	30.81
	.3	30.76
	.3	30.72
	.3	30.70

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B949 - M2 90 ~~6~~ 95 8-17

" B2 "

" T2 "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-17-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 95.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: ~~95.6~~ 8-16 FT. 108.0

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: ~~1.6~~ 8-16 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 70.1 FT.

2/3 MAXIMUM TEST PRESSURE, Po 62.9 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 2 TEST PRESSURE 41.5 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.22, Middle 30.62, Bottom 33.42

Transducer Readings after initial pressurization:
Top 3.19, Middle 30.69, Bottom 33.43

Transducer Readings after final flow measurement:
Top 3.12, Middle 30.36, Bottom 33.47

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2741.0	/	-0.2	
0.5	2741.4	.8	8.2	
1.0	2741.6	.4	7.6	
1.5	2741.6	Ø	7.6	
2.0	2741.6	Ø	7.9	
2.5	2741.6	Ø	7.9	
3.0	2741.6	Ø	7.9	
3.5	2741.6	Ø	8.1	
4.0	2741.6	Ø	7.9	
4.5	2741.6	Ø	8.0	
5.0	2741.6	Ø	7.9	
6.0				

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JOJ 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-17-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 95.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 70.1 FT.

MAXIMUM TEST PRESSURE, Po 62.9 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 3 TEST PRESSURE 62.9 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.22, Middle 30.62, Bottom 33.42

Transducer Readings after initial pressurization:
Top 3.12, Middle 30.63, Bottom 33.47

Transducer Readings after final flow measurement:
Top 3.03, Middle 30.70, Bottom 33.40

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2741.6	/	0.0	
0.5	2743.0	2.8	26.0	
1.0	2743.5	1.0	27.1	
1.5	2743.9	.8	26.8	
2.0	2744.1	.4	25.0	
2.5	2744.4	.6	25.7	
3.0	2744.7	.6	26.0	
3.5	2745.0	.6	26.0	
4.0	2745.3	.6	25.7	
4.5	2745.5	.4	25.5	
5.0	2745.8	.6	25.5	
6.0	2746.3	1.0	24.7	
7.0	2746.8	1.0	26.1	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 2**

BORING NO: B949

DATE: 8-~~17~~-06 17 8-17

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 95.6 **FT. TO** 90.6 **FT.**

DATA COLLECTED BY: J Howard

JAJ 12-5-06

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
8.0	2747.3	1.0	26.4	
9.0	2747.7	.8	26.4	
10.0	2748.3	1.2	26.1	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3**

BORING NO.: B949

DATE: 8-17-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 95.6 **FT. TO** 90.6 **FT.**

DATA COLLECTED BY: S Homan

12-5-06

SHUT-IN TEST

PRESSURE: _____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	26.1	64.32
.5	13.1	49.20
1.0	8.9	45.02
1.5	5.3	40.65
2.0	3.5	38.29
2.5	2.0	36.29
3.0	1.4	35.32
3.5	.6	34.24
4.0	.2	33.54
4.5	-.1	32.98
5.0	-.5	32.46
5.5	-.7	32.05
6.0	-1.0	31.52
6.5	-1.2	31.33
7.0	-1.2	31.19
7.5	-1.3	31.10
8.0	-1.4	31.02
8.5	-1.4	30.91
9.0	-1.5	30.85
9.5	-1.5	30.82
10.0	-1.5	30.79

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B949 - M390-95

" B390 "

" T390 "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAZ 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-18-06

BORING NO. B94a BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 95.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 70.1 FT.

1/2 MAXIMUM TEST PRESSURE, Po 62.4 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 4 TEST PRESSURE 31.4 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.22, Middle 30.62, Bottom 33.42

Transducer Readings after initial pressurization:

Top 3.03, Middle 30.70, Bottom 33.40

Transducer Readings after final flow measurement:

Top ____, Middle ____, Bottom ____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2748.5	/	-1.6	
0.5	2748.5	Ø	-1.6	
1.0	2748.5	Ø	-1.5	
1.5	2748.6	.2	-0.5	
2.0	2748.6	Ø	-0.7	
2.5	2748.6	Ø	-0.9	
3.0	2748.6	Ø	-1.0	
3.5	2748.6	Ø	-1.2	
4.0	2748.6	Ø	-1.1	
4.5	2748.6	Ø	-0.7	
5.0	2748.6		-0.7	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE ~~3~~ 2

BORING NO.: B949

DATE: 8-17-06

TEST NUMBER: 4

TEST INTERVAL (FROM DATUM): FROM 95.6 FT. TO 90.6 FT.

DATA COLLECTED BY: J Howard

12-5-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	-0.7	31.87
0.5	-.9	31.65
1.0	-1.1	31.45
1.5	-1.2	31.28
2.0	-1.3	31.16
2.5	-1.3	31.06
3.0	-1.4	30.97
3.5	-1.4	30.91
4.0	-1.5	30.85
4.5	-1.5	30.80
5.0	-1.5	30.77
5.5	-1.6	30.75
6.0	-1.6	30.74
6.5	-1.6	30.73
7.0	-1.6	30.71

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B949-M490-95

" B490 "

" T490 "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JDJ 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-17-06

BORING NO. B449 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING ✓ GROUND SURFACE ____

DATUM ELEVATION na

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 95.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 70.1 FT.

MAXIMUM TEST PRESSURE, Po 62.9 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 5 TEST PRESSURE 62.9 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.22, Middle 30.62, Bottom 33.42

Transducer Readings after initial pressurization:
Top 3.06, Middle 30.70, Bottom 33.42

Transducer Readings after final flow measurement:
Top 2.98, Middle 30.66, Bottom 33.44

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2748.6	/	-1.6	
0.5	2749.5	1.8	26.6	
1.0	2749.7	.4	25.6	
1.5	2749.9	.4	24.4	
2.0	2750.1	.4	24.1	
2.5	2750.3	.4	25.5	
3.0	2750.5	.4	26.1	
3.5	2750.8	.6	24.3	
4.0	2750.9	.2	22.2	
4.5	2751.1	.4	23.7	
5.0	2751.2	.2	23.6	
~~6.0~~ 5.5	2751.3	.2	23.2	
6.0	2751.5	.4	24.6	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 2**

BORING NO: 5 Hour

DATE: 8-17-06

TEST NUMBER: 5

TEST INTERVAL (FROM DATUM): FROM 95.6 **FT. TO** 90.6 **FT.**

DATA COLLECTED BY: 5 Hour

JAJ 12-5-06

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
7.0	2751.6	.2	24.5	
7.5	2752.0	.8	24.7	
8.0	2752.1	.2	24.7	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3**

BORING NO.: ~~B-16-06~~ B944

DATE: 8-17-06

TEST NUMBER: 5

TEST INTERVAL (FROM DATUM): FROM 95.6 **FT. TO** 90.6 **FT.**

DATA COLLECTED BY: Stoward

12-5-06

SHUT-IN TEST

PRESSURE: _____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	24.7	63.27
0.5	9.6	46.44
1.0	5.8	42.11
1.5	3.0	39.00
2.0	2.1	37.36
2.5	0.9	35.71
3.0	0.1	34.49
3.5	-.3	33.69
4.0	-.7	33.08
4.5	-1.1	32.54
5.0	-1.3	32.21
5.5	-1.6	31.87
6.0	-1.7	31.59
6.5	-1.9	31.34
7.0	-2.0	31.21
7.5	-2.0	31.08
8.0	-2.1	30.98
8.5	-2.1	30.90
9.0	-2.2	30.85
9.5	-2.3	30.79
10.0	-2.3	30.74
10.5	-2.3	30.73
11.0	-2.3	30.71

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B944 - M590-95
" B590 "
" T590 "

JAV 12-5-06

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-16-06

Boring No. B-949

Test Interval: ~~94.5~~ 96.1 to ~~99.5~~ 101.1 feet from Datum 96.1 - 101.1

Casing Stickup 1.6 feet

PoMAX = (h_1 x 1) + (h_2 x 0.57). h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the datum to the water level
h_2 = Distance from the water level to the center of the test interval

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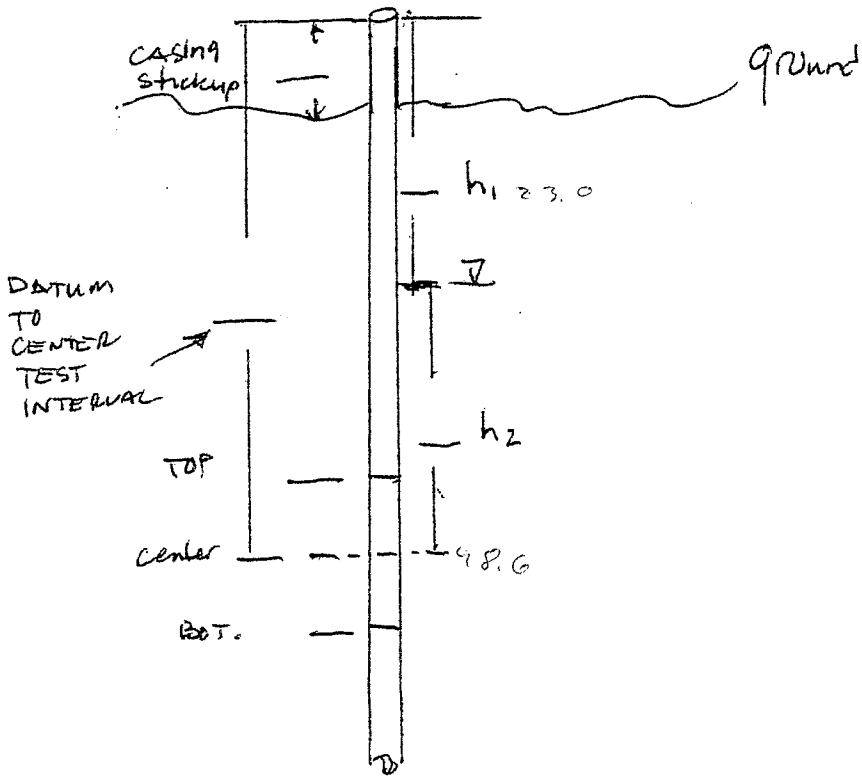
h_1 = 23.0

h_2 = 23.1 - 98.6 = 75.5

P MAX = 23.0 + 43.03 = 66.03

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAB 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: ~~8/8/06~~ S Hanan DATE COLLECTED: 8-16-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 96.1 FT. TO 101.1 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: ~~75.05~~ FT. 8-16 ~~1.6~~ 1.0

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.5 FT.

1/3 MAXIMUM TEST PRESSURE, Po 66.03 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 1 TEST PRESSURE -21.79 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top ~~2.13~~ 3.15, Middle ~~32.90~~ 33.01 (32.78), Bottom 35.72

Transducer Readings after initial pressurization:

Top —, Middle 32.90 (32.81), Bottom —

Transducer Readings after final flow measurement:

Top —, Middle —, Bottom —

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	25197		0.0	
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

Test Pressure is exceeded by natural Pressure
Skip & go to test 2

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JLJ 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL **PROJECT NO.:** 6468-06-1472

DATA COLLECTED BY: S Howard **DATE COLLECTED:** 8-16.06

BORING NO. B949 **BOREHOLE DIAMETER:** 4" **IN.**

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 **FT.**

CHECK DATUM USED: TOP OF CASING X **GROUND SURFACE** ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 **FT.**

TEST INTERVAL DEPTH (FROM DATUM): FROM 96.1 **FT. TO** 101.1 **FT.**

TOTAL BORING DEPTH FROM DATUM: 108.0 **FT.**

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 **FT.**

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: ~~1.6~~ 8-16 **FT.** 1.0

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.5 **FT.**

2/3 **MAXIMUM TEST PRESSURE, Po** 66.03 **(Po = [(A+B) *1] + C*.57 psi)**

TEST NUMBER: 2 **TEST PRESSURE** 43.57 **psi PACKER PRESSURE:** 100 **psi**

Initial Transducer Readings: Top 3.1~~5~~1 8-17, **Middle** 3~~3.01~~ 2.75 8-17 **Bottom** 35.~~72~~ 54 8-17

Transducer Readings after initial pressurization:

Top 3.08, **Middle** 32.75, **Bottom** 35.56

Transducer Readings after final flow measurement:

Top 3.00, **Middle** 32.76, **Bottom** 35.63

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2509.7	/	0.0	
0.5	2509.7	Ø	.1	
1.0	2510.1	0.8	10.9	
1.5	2515.4	10.6	13.4	
2.0	2520.4	10.0	3.6	
2.5	2525.3	9.8	3.7	
3.0	2529.7	8.8	3.9	
3.5	2532.9	6.4	3.9	
4.0	2538.2	10.6	3.2	
4.5	2542.2	8.0	3.2	
5.0	2546.5	8.6	3.4	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 3

BORING NO.: B949

DATE: 8-16-06

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 96.1 FT. TO 101.1 FT.

DATA COLLECTED BY: J. Howard

2

8-16-06

SHUT-IN TEST

PRESSURE: 43.62 psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	3.4	43.62
0.5	-8.4	35.31
1.0	-8.3	34.66
1.5	-8.7	34.18
2.0	-9.0	33.88
2.5	-9.2	33.68
3.0	-9.4	33.52
3.5	-9.5	33.39
4.0	-9.6	33.31
4.5	-9.7	33.21
5.0	-9.8	33.15
5.5	-9.9	33.10
6.0	-9.9	33.05
6.5	-9.9	33.02
7.0	-10.0	32.98
7.5	-10.0	32.95
8.0	-10.0	32.93

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B949-M296-101

B949-T296-101

B949-B296-101

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JH 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-16-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 96.1 FT. TO 101.1 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: ~~1.6~~ 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 73.5 FT.

MAXIMUM TEST PRESSURE, Po 66.03 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 3 TEST PRESSURE 66.03 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.151, Middle ~~35.01~~ 27.5, Bottom ~~35.42~~ 35.4

Transducer Readings after initial pressurization:

Top 3.00, Middle 32.76, Bottom 35.63

Transducer Readings after final flow measurement:

Top 2.97, Middle 32.88, Bottom 35.84

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2548.0	/	-10.3	
0.5	2549.1	2.2	+10.8	
1.0	2556.0	13.8	14.7	
1.5	2566.7	21.4	27.8	
2.0	2575.7	18.0	28.7	
2.5	2584.9	18.4	29.6	
3.0	2593.9	18.0	31.3	
3.5	2602.9	18.0	31.6	
4.0	2611.6	17.4	31.4	
4.5	2621.7	20.2	32.2	
5.0	2631.1	18.8	32.2	
6.0				

Flow was maxed & couldnot match stablization
Stopped @ 5 min

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE ~~3~~ 2**

BORING NO.: B9419

DATE: 8-16-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 96.1 **FT. TO** 101.1 **FT.**

DATA COLLECTED BY: J Howard

12-5-06

SHUT-IN TEST

PRESSURE: 49.78 **psi**

use this for calculation for

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	32.2	49.78
0.5	-3.8	38.94
1.0	-5.6	37.32
1.5	-6.6	36.22
2.0	-7.2	35.66
2.5	-7.8	35.12
3.0	-8.1	34.79
3.5	-8.5	34.50
4.0	-8.7	34.28
4.5	-8.8	~~37.90~~ 8.17 missed
5.0	-9.0	33.95
5.5	-9.1	33.82
6.0	-9.2	33.69
6.5	-9.3	33.60
7.0	-9.4	33.53
7.5	-9.5	33.47
8.0	-9.5	33.40
8.5	-9.6	33.34
9.0	-9.7	33.30
9.5	-9.7	33.26

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Test: B949-M3 96-101
B949-B3 96-101
B949 T3 96-101

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JBJ 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-16-06

BORING NO. B949 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 96.1 FT. TO 101.1 FT.

TOTAL BORING DEPTH FROM DATUM: 108.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: ~~1.6~~ 2-14-8-16 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.5 FT.

1/2 MAXIMUM TEST PRESSURE, Po 66.03 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 4 TEST PRESSURE 33.01* psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.15, Middle 33.01, Bottom 35.72

Transducer Readings after initial pressurization:
Top 2.97, Middle 32.88, Bottom 35.84

Transducer Readings after final flow measurement:
Top 2.94, Middle 32.84, Bottom 35.64

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	~~2610~~ 2632.1	/	-10.2	
0.5	2632.1	Ø	-10.2	
1.0	2632.1	Ø	-10.1	
1.5	2632.2	.2	-9.9	
2.0	2632.3	.2	-9.6	
2.5	2632.6	.6	-9.5	
3.0	2632.7	.2	-9.5	
3.5	2632.8	.2	-9.5	
4.0	2632.9	.2	-9.4	
4.5	2633.0	.2	-9.4	
5.0	2633.0	Ø	9.4	
6.0	2633.0	Ø	-9.4	

Tried to keep Mid Transducer @ 33.4 or 33.5 since the test was so close to the nature pressure

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE ~~3~~ 2

BORING NO.: B949

DATE: 8-16-06

TEST NUMBER: 4

TEST INTERVAL (FROM DATUM): FROM 96.1 FT. TO 101.1 FT.

DATA COLLECTED BY: J Howard

12-5-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	-9.41	33.34
0.5	-9.8	33.00
1.0	-9.9	32.95
1.5	-9.9	32.92
2.0	-9.9	32.90
2.5	-9.9	32.89
3.0	-9.9	32.88
3.5	-9.9	32.88
4.0	-9.9	32.87
4.5	-10.0	32.86
5.0	-9.9	32.85

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Test: B949-M496-101

B949-B496-101

B949-T496-101

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JHJ 12-5-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL **PROJECT NO.:** 6468-06-1472

DATA COLLECTED BY: S Howard **DATE COLLECTED:** 8-16-06

BORING NO. B949 **BOREHOLE DIAMETER:** 4 **IN.**

SURFACE CASING HEIGHT ABOVE GROUND: 1.6 **FT.**

CHECK DATUM USED: TOP OF CASING X **GROUND SURFACE** ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 **FT.**

TEST INTERVAL DEPTH (FROM DATUM): FROM 96.1 **FT. TO** 101.1 **FT.**

TOTAL BORING DEPTH FROM DATUM: 108.0 **FT.**

(A) DEPTH TO WATER TABLE FROM DATUM: 23.0 **FT.**

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: ~~1.6~~ 1.0 **FT.**

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.5 **FT.**

MAXIMUM TEST PRESSURE, Po 66.03 **(Po = [(A+B) *1] + C*.57 psi)**

TEST NUMBER: 5 **TEST PRESSURE** 66.03 **psi PACKER PRESSURE:** 100 **psi**

Initial Transducer Readings: Top 3.15 **, Middle** 33.01 **, Bottom** 35.72

Transducer Readings after initial pressurization:

Top 2.94 **, Middle** 32.84 **, Bottom** 35.64

Transducer Readings after final flow measurement:

Top 3.02 **, Middle** 33.33 **, Bottom** 36.22

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2633.0	/	-0.7	
0.5	2636.8	7.6	25.2	
1.0	2645.8	18.0	28.1	
1.5	2655.9	20.2	30.3	
2.0	2665.9	20.0	31.3	
2.5	2674.3	16.8	31.5	
3.0	2684.2	19.8	31.7	
3.5	2692.8	17.2	32.5	
4.0	2701.9	18.2	32.4	
4.5	2711.3	18.8	33.1	
5.0	2721.9	21.2	33.1	
6.0	2737.0	30.2	33.1	

JHJ * same as test 3, couldnot reach max pressure

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3** 2

BORING NO.: B949

DATE: 8-16-06

TEST NUMBER: 5

TEST INTERVAL (FROM DATUM): FROM 96.1 **FT. TO** 101.1 **FT.**

DATA COLLECTED BY: J Howard

Jer 12-5-06

SHUT-IN TEST

PRESSURE: _____ **psi**

use this for calculator

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	33.1	63.86
0.5	-1.4	40.86
1.0	-3.8	38.42
1.5	-5.7	37.40
2.0	-6.3	36.56
2.5	-7.0	35.92
3.0	-7.5	35.37
3.5	-7.8	35.08
4.0	-8.1	34.78
4.5	-8.3	34.55
5.0	-8.5	34.35
5.5	-8.7	34.18
6.0	-8.8	34.05
6.5	-9.0	33.92
7.0	-9.1	33.83
7.5	-9.2	33.74
8.0	-9.3	33.67
8.5	-9.3	33.54
9.0	-9.4	33.52

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Test: B949 - M596-101
B949 - B596-101
B949 - T596-101

(2)

511

8-15-06
James Howard

700 Arrive
730 Saftymeet
8am - 1245 Ready Packer tests
~~Work Inst~~ 8-15
~~8~~ 8-15 1245 - 1 Saftymeet
1 - 4:30 Packer Standby & setup B949

1.5 hrs standby

(3)

JH

8-16-06

James Howard

Miller: Mark Hughs, Tim Garland

7am Arrive

730-745 Safty meeting

745-10 Setup For Packers-B949

10-1130 Water Run

1130-1245 Standby

1245-115 Water run

115-430 More setup

430-445 Break Down for night

Had issues w/ Packers & Pressure test & talked w/ Garrett ~~Rd~~ Jan 8-16

Also had issue a Nitrogen Leak

Garrett will look at pressure issue tonight & will run test tomorrow at 2/3rds max

445-5 Paperwork

(4)

8-17-06

James Howard

Miller: Mark Hughes, Tim Garland

B949

7am	arrive
730	saftymeeting
745-815	Setup
815-10	Test B949 101-96
10-1030	Move up to next interval
1030-1	Stand by Drillers looking for splice for Nitrogen line
1-130	Fix line
130-345	Packer 90-95
345-5	Packer 85-90
5-~~5.30~~ 6	Paperwork

Static water level @ 23.0 from Datum.

MACTEC

MACTEC ENGINEERING AND CONSULTING, INC.

RALEIGH, NORTH CAROLINA

IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST IN ACCORDANCE WITH CORPS OF ENGINEERS, (WATERWAYS EXPERIMENT STATION, RTH 381-80

PROJECT NAME: NORTH ANNA COL
PROJECT NUMBER: 6468-06-1472
REPORT DATE: 12/7/2006 Revised 1-13-07
BORING NO: B-950

Given Parameters

Prepared by: ZQ Date: 12-7-06
Checked by: Date: 1-17-07

Test Section Length, ℓ, ft: 5
Radius of Borehole r_0, in: 2.00
GW Depth, ft: 23.00 (from top of casing) 21.00 (from ground surface)

Test Number	Q (GPM)	P_{Test} (psi)	P_T (psi)	P_M (psi)	P_B (psi)	Q (cfs)	H_M (ft)	K_e (fpy)
Interval 1, ft:	**55 - 60**	(from ground surface)						
1	0.00	17.41	0.03	7.41	10.11	0.00	40.18	0.00
2	0.00	34.82	0.03	7.41	10.11	0.00	80.35	0.00
3	0.00	52.77	0.03	7.41	10.11	0.00	121.78	0.00
4	TNP	26.3					60.69	
5	TNP	52.77					121.78	
							K_e, ft/year:	**0.00**
Interval 2, ft:	**60 - 65**	(from ground surface)						
1	0.00	18.35	0.24	9.64	12.42	0.00	42.35	0.00
2	0.00	36.17	0.24	9.64	12.42	0.00	83.47	0.00
3	0.00	55.62	0.24	9.64	12.42	0.00	128.35	0.00
4	0.00	27.81	0.24	9.64	12.42	0.00	64.18	0.00
5	0.00	55.62	0.24	9.64	12.42	0.00	128.35	0.00
							K_e, ft/year:	**0.00**
Interval 3, ft:	**82 - 87**	(from ground surface)						
1	0.00	30.96	8.52	26.36	29.14			0.00
2	0.00	44.98	8.52	26.49	29.14	0.00000	103.80	0.00
3	0.00	68.16	8.52	26.36	29.14	0.00000	157.29	0.00
4	0.00	34.08	8.52	26.36	29.14	0.00000	78.65	0.00
5	0.00	68.16	8.52	26.36	29.14	0.00000	157.29	0.00
							K_e, ft/year:	**0.0**

Notations:

Q = flow rate
P_{Test} = total test pressure
P_T = pressure above top packer, near water surface
P_M = pressure in the test section
P_B = pressure below bottom packer

H_M = P_{Test} converted to feet of head (P_{Test}*144in^2/ft^2/γ_W)
K_e = ((Q/(H_M-P_m))*(1/ℓ))*1/2π*ln(R/r_0)*(525,600 min/year)*(0.1337ft^3/gal)
R = total length between packers, ℓ
TNP = Test not performed
NM = not measured

Note: Pressures Pt, Pm and Pb taken from initial data for transducers.
Outside diameter of boring is 4 in.

IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST IN ACCORDANCE WITH CORPS OF ENGINEERS, WATERWAYS EXPERIMENT STATION, RTH 381-80

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/21/2006
Boring No: B-950
Test Interval: 57.0 ft to 62 ft (from Datum)
Stick up length: 2 ft
Test Interval: 55.0 ft to 60 ft (from surface)
Test Type: Double Packer Technique

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Depth of Water
Table= 42.70 ft (from top of casing)
h1= 43.20 (from top of casing)
h2 = 16.80 ft (from top of casing)
ρ_w = 62.4 lb/ft^3

Abreviations:
N.O. Not Observed
N.A. Not Aplicable

P_0 Max= 52.78 psi Value on field data sheet=

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1

Actual Excess Pressure= 10.00 psi
Initial Middle Transducer Reading= 7.41 psi
Test Pressure= 17.41 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2792.6		1.5
0.5	2792.6	0.0	1.5
1	2793.1	1.0	7.1
1.5	2793.1	0.0	7.1
2	2793.1	0.0	7.1
2.5	2793.1	0.0	7.0
3	2793.1	0.0	7.0
3.5	2793.1	0.0	6.9
4	2793.1	0.0	6.9
4.5	2793.1	0.0	6.9
5	2793.1	0.0	6.8

Average Q: 0.0 gpm
Excess Pore pressure: 10.00 psi

TEST #2

Actual Excess Pressure= 27.41 psi
Initial Middle Transducer Reading= 7.41 psi
Test Pressure= 34.82 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2793.1		6
0.5	2793.2	0.2	6
1	2793.5	0.6	15.6
1.5	2793.5	0.0	16.9
2	2793.5	0.0	16.9
2.5	2793.5	0.0	16.9
3	2793.5	0.0	16.9
3.5	2793.5	0.0	16.9
4	2793.5	0.0	16.9
4.5	2793.5	0.0	16.9
5	2793.5	0.0	16.9

Average Q: 0.0 gpm
Excess Pore pressure: 27.41 psi

TEST #3

Actual Excess Pressure= 45.36 psi
Initial Middle Transducer Reading= 7.41 psi
Test Pressure= 52.77 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2793.5		15.8
0.5	2793.9	0.8	29.8
1	2793.9	0.0	29.9
1.5	2793.9	0.0	29.9
2	2793.9	0.0	31.5
2.5	2793.9	0.0	31.5
3	2793.9	0.0	31.2
3.5	2793.9	0.0	32.1
4	2793.9	0.0	32.2
4.5	2793.9	0.0	32.1
5	2793.9	0.0	32.1

Average Q: 0.0 gpm
Excess Pore pressure: 45.36 psi

JAZ 1-17-07

TEST #4

Actual Excess Pressure= NA psi
Initial Middle Transducer 7.41 psi
Test Pressure= psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole is not taking any water --> Test not performed			

Average Q: gpm
Excess Pore pressure: psi

TEST #5

Actual Excess Pressure= NA psi
Initial Middle Transducer 7.41 psi
Test Pressure= psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole is not taking any water --> Test not performed			

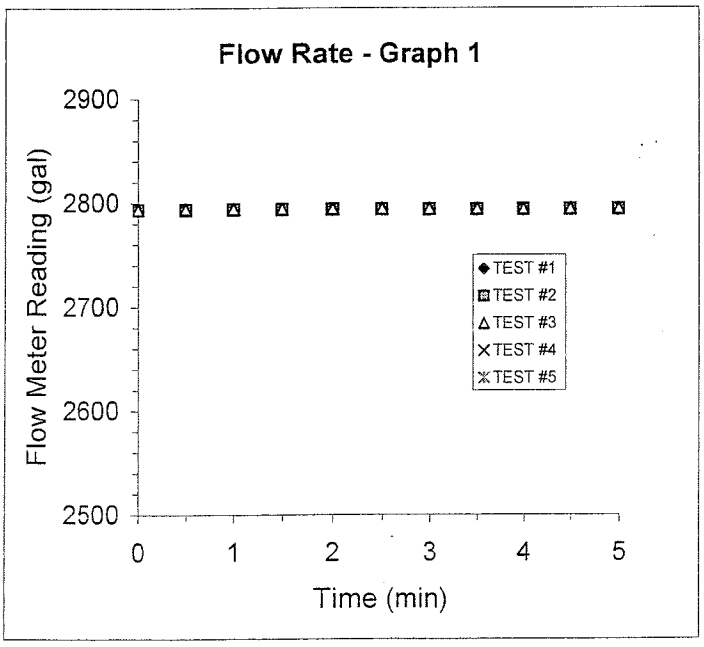
Average Q: gpm
Excess Pore pressure: psi

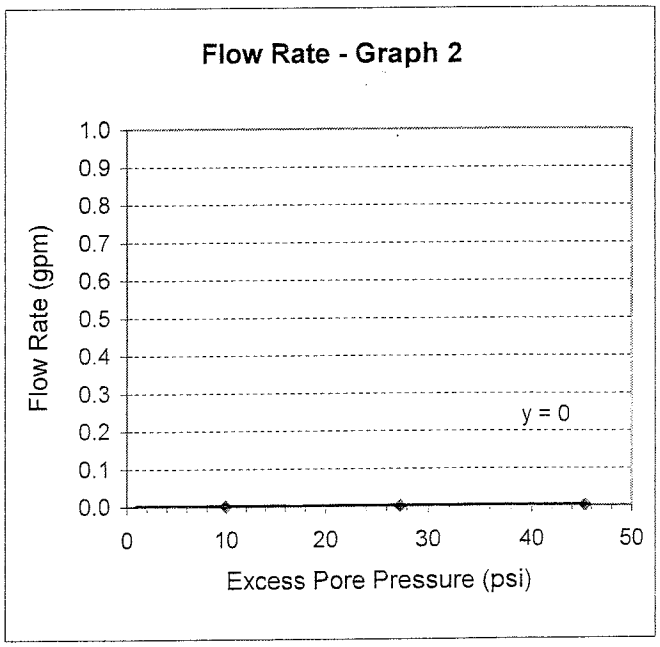
Boring No: B-950
Test Interval: 55 ft to 60 ft
(from surface)

Density of water, ρ_w=62.4 lb/ft^3
= 0.0361 lb/in
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

	Excess Pressure (psi)	Q* (gpm)	Test Pres. (ft)	k_e (fpy)
1	10.00	0.00	23.08	0.00
2	27.41	0.00	63.25	0.00
3	45.36	0.00	104.68	0.00
4				
5				

* Q obtained from graph Flow Rate-1





obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$k_e = Q^* \ln(R/r_0)/(2\pi L H_0)$

k_e= 0.00E+00 cm/sec
= 0.00 ft/year

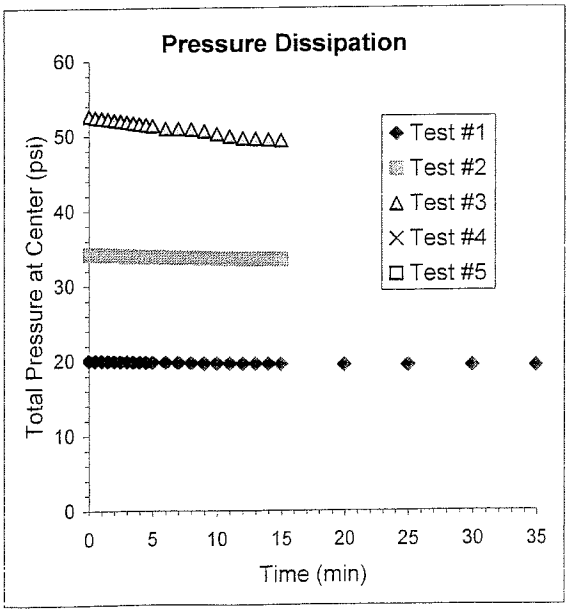
Pressure Decay Test

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07
N.O. Not Observed
N.A. Not Aplicable

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/21/2006
Boring No: B-950
Test Interval: 55 ft to 60 ft (from surface)

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	6.8	20	0.0	16.9	34.26	0.0	32.1	52.67
0.5	6.8	19.97	0.5	16.9	34.23	0.5	31.9	52.50
1.0	6.8	19.96	1.0	16.7	34.2	1.0	31.8	52.40
1.5	6.7	19.94	1.5	16.7	34.16	1.5	31.7	52.27
2.0	6.7	19.92	2.0	16.7	34.12	2.0	31.6	52.14
2.5	6.7	19.9	2.5	16.6	34.08	2.5	31.5	52.02
3.0	6.7	19.87	3.0	16.6	34.04	3.0	31.4	51.88
3.5	6.7	19.85	3.5	16.6	34.00	3.5	31.2	51.76
4.0	6.6	19.83	4.0	16.5	33.98	4.0	31.1	51.64
4.5	6.6	19.8	4.5	16.5	33.94	4.5	31.0	51.51
5.0	6.6	19.79	5.0	16.5	33.91	5.0	30.9	51.37
6.0	6.6	19.75	6.0	16.4	33.85	6.0	30.6	51.00
7.0	6.5	19.72	7.0	16.4	33.79	7.0	30.5	50.96
8.0	6.5	19.68	8.0	16.3	33.74	8.0	30.4	50.87
9.0	6.5	19.65	9.0	16.3	33.69	9.0	30.2	50.63
10.0	6.4	19.62	10.0	16.2	33.64	10.0	29.9	50.25
11.0	6.4	19.58	11.0	16.2	33.61	11.0	29.5	49.90
12.0	6.4	19.56	12.0	16.1	33.52	12.0	29.3	49.65
13.0	6.3	19.53	13.0	16.1	33.53	13.0	29.2	49.54
14.0	6.3	19.5	14.0	16.1	33.51	14.0	29.1	49.44
15.0	6.3	19.47	15.0	16.0	33.48	15.0	29.1	49.34
20.0	6.2	19.38						
25.0	6.1	19.31						
30.0	6.1	19.24						
35.0	6.0	19.19						

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
No data Test not conducted			No data Test not conducted		



IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST IN ACCORDANCE WITH CORPS OF ENGINEERS, WATERWAYS EXPERIMENT STATION, RTH 381-80

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/18/2006
Boring No: B-950
Test Interval: 62 ft to 67 ft
Stick up length: 2 ft
Test Interval: 60.0 ft to 65 ft (from surface)
Test Type: Double Packer Technique

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Depth of Water
Table= 42.70 ft (from top of casing)
h1= 43.20 (from top of casing)
h2 = 21.80 ft (from top of casing)
ρ_w = 62.4 lb/ft^3

Abreviations:
N.O. Not Observed
N.A. Not Aplicable

P_0 Max= 55.63 psi Value on field data sheet=

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1

Actual Excess Pressure= 8.71 psi
Initial Middle Transducer Reading= 9.64 psi
Test Pressure= 18.35 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2787		1.0
0.5	2787	0.0	1.0
1	2787.4	0.8	1.4
1.5	2788.1	1.4	10.6
2	2788.1	0.0	10.5
2.5	2788.1	0.0	6.1
3	2788.1	0.0	5.9
3.5	2788.1	0.0	5.8
4	2788.1	0.0	5.8
4.5	2788.1	0.0	5.8
5	2788.1	0.0	5.7

Average Q: 0.2 gpm
Excess Pore pressure: 8.71 psi

TEST #2

Actual Excess Pressure= 32.25 psi
Initial Middle Transducer Reading= 9.64 psi
Test Pressure= 41.89 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2788.1		4.1
0.5	2788.8	1.4	8.9
1	2789.1	0.6	18.9
1.5	2789.2	0.2	17.9
2	2789.2	0.0	17.6
2.5	2789.2	0.0	17.3
3	2789.2	0.0	17.1
3.5	2789.2	0.0	16.9
4	2789.2	0.0	16.7
4.5	2789.2	0.0	17.4
5	2789.2	0.0	17.3

Average Q: 0.0 gpm
Excess Pore pressure: 32.25 psi

TEST #3

Actual Excess Pressure= 45.98 psi
Initial Middle Transducer Reading= 9.64 psi
Test Pressure= 55.62 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2789.2		8.3
0.5	2790.4	2.4	39.3
1	2790.4	0.0	38.2
1.5	2790.5	0.2	31.1
2	2790.5	0.0	32.9
2.5	2790.5	0.0	33.2
3	2790.5	0.0	33.3
3.5	2790.5	0.0	32.6
4	2790.5	0.0	32.5
4.5	2790.5	0.0	33.1
5	2790.5	0.0	33.2

Average Q: 0.0 gpm
Excess Pore pressure: 45.98 psi

JAB 1-17-07

TEST #4

Actual Excess Pressure= 18.17 psi
Initial Middle Transducer 9.64 psi
Test Pressure= 27.81 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2790.5		2.2
0.5	2791.2	1.4	10.6
1	2791.2	0.0	10.8
1.5	2791.2	0.0	10.6
2	2791.2	0.0	10.5
2.5	2791.2	0.0	10.7
3	2791.2	0.0	10.9
3.5	2791.2	0.0	11.0
4	2791.2	0.0	11.1
4.5	2791.2	0.0	11.3
5	2791.2	0.0	11.4

TEST #5

Actual Excess Pressure= 45.98 psi
Initial Middle Transducer 9.64 psi
Test Pressure= 55.62 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2791.2		2.9
0.5	2792.6	2.8	32.8
1	2792.6	0.0	37.2
1.5	2792.6	0.0	35.7
2	2792.6	0.0	34.2
2.5	2792.6	0.0	32.6
3	2792.6	0.0	33.5
3.5	2792.6	0.0	34
4	2792.6	0.0	33.8
4.5	2792.6	0.0	33.9
5	2792.6	0.0	33.4

Boring No: B-950
Test Interval: 60 ft to 65 ft
(from surface)

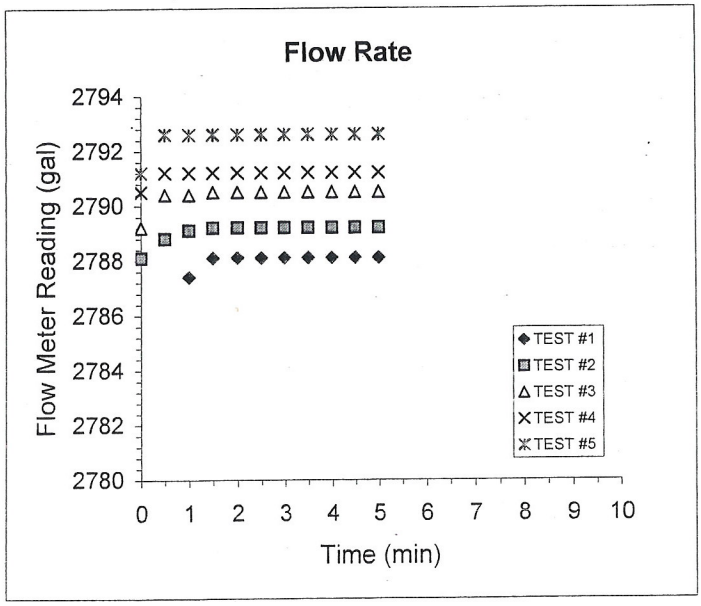
Density of water, ρ_w=62.4 lb/ft^3
= 0.0361 lb/in^3
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

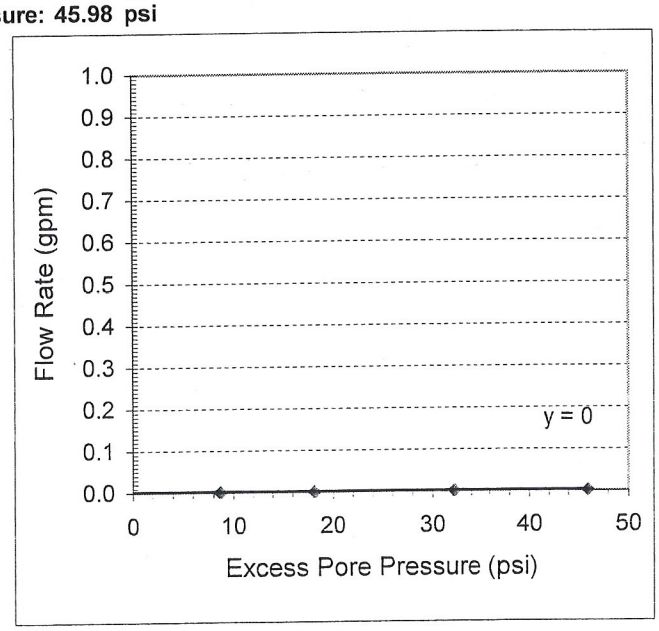
	Excess Pressure (psi)	Q* (gpm)	Test Pres. (ft)	k_e (fpy)
1	8.71	0.000	20.10	0.00
2	32.25	0.000	74.42	0.00
3	45.98	0.000	106.11	0.00
4	18.17	0.000	41.93	0.00
5	45.98	0.000	106.1	0.00

* Q obtained from graph Flow Rate-1

Average Q: 0.0 gpm
Excess Pore pressure: 18.17 psi

Average Q: 0.0 gpm
Excess Pore pressure: 45.98 psi





obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$k_e = Q^* \ln(R/r_0)/(2\pi L H_0)$

k_e= **0.00E+00 cm/sec**
= **0.00 ft/year**

Pressure Decay Test

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07
N.O. Not Observed
N.A. Not Aplicable

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/18/2006
Boring No: B-950
Test Interval: 60 ft to 65 ft

Test #1

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	5.7	19.07
0.5	5.7	19.00
1.0	5.7	18.93
1.5	5.6	18.85
2.0	5.6	18.79
2.5	5.6	18.71
3.0	5.5	18.65
3.5	5.4	18.57
4.0	5.4	18.5
4.5	5.4	18.46
5.0	5.4	18.4
6.0	5.3	18.28
7.0	5.2	18.17
8	5.2	18.07
9	5.1	17.98
10	5.1	17.88
11	5.0	17.78
12	5.0	17.69
13	4.9	17.59
14	4.9	17.5
15	4.8	17.4
16	4.8	17.31
20	4.6	16.95
25	4.3	16.54

Test #2

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	17.3	36.29
0.5	17.0	36.04
1.0	16.8	35.68
1.5	16.6	35.47
2.0	16.3	35.19
2.5	16.1	35.00
3.0	16.0	34.68
3.5	15.7	34.31
4.0	15.5	34.16
4.5	15.4	33.9
5.0	15.4	33.48
6.0	14.8	33.15
7.0	14.4	32.65
8.0	14.1	32.22
9.0	13.8	31.82
10.0	13.5	31.34
11.0	13.2	30.94
12.0	12.9	30.52
13.0	12.6	30.11
14.0	12.4	29.75
15.0	12.1	29.39
20.0	10.9	27.68
25.0	9.9	26.18

Test #3

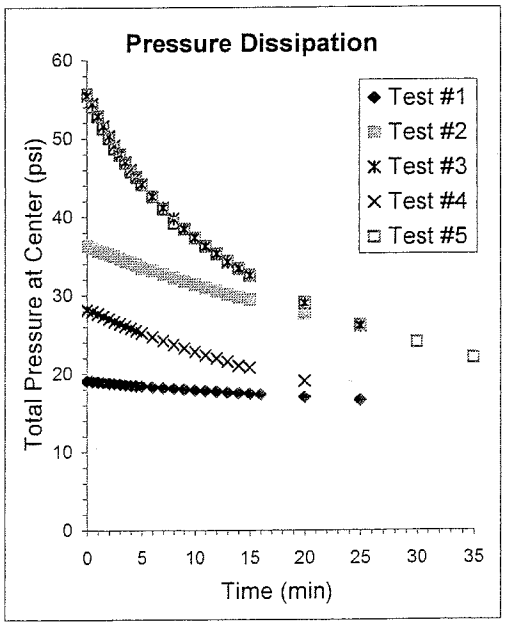
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	33.2	55.42
0.5	31.8	54.44
1.0	30.4	52.83
1.5	29.3	51.55
2.0	28.1	50.28
2.5	27.2	49.08
3.0	26.2	47.96
3.5	25.3	46.98
4.0	24.5	45.99
4.5	23.6	45.07
5.0	22.8	44.15
6.0	21.7	42.60
7.0	20.5	41.13
8.0	19.3	39.74
9.0	18.3	38.43
10.0	17.3	37.32
11.0	16.5	36.25
12.0	15.8	35.29
13.0	15.0	34.23
14.0	14.4	33.4
15.0	13.7	32.52
20.0	11.1	28.93
25.0	9.0	26.02

Test #4

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	11.4	28.1
0.5	11.2	27.92
1.0	11	27.62
1.5	10.8	27.29
2.0	10.5	26.98
2.5	10.3	26.62
3.0	10.1	26.35
3.5	9.9	26.07
4.0	9.7	25.76
4.5	9.4	25.49
5.0	9.3	25.18
6.0	9	24.69
7.0	8.6	24.16
8	8.3	23.69
9	8.1	23.23
10	7.7	22.78
11	7.4	22.34
12	7.1	21.92
13	6.1	21.51
14	6.6	21.00
15	6.4	20.74
20	5.4	19.00

Test #5

Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	33.4	55.64
0.5	32.0	54.03
1.0	30.9	52.81
1.5	29.5	51.22
2.0	28.5	49.99
2.5	27.7	48.70
3.0	26.6	47.91
3.5	25.7	46.85
4.0	24.6	45.79
4.5	24.0	45.04
5.0	23.4	44.10
6.0	22.1	42.58
7.0	20.9	41.00
8	19.9	39.20
9	18.8	38.46
10	17.9	37.29
11	17.2	36.28
12	16.4	35.30
13	15.8	34.35
14	15.1	33.40
15	14.4	32.58
20	11.9	29.06
25	9.8	26.14
30	8.4	23.98
35	2.1	22.02



IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST IN ACCORDANCE WITH CORPS OF ENGINEERS, WATERWAYS EXPERIMENT STATION, RTH 381-80

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/18/2006
Boring No: B-950
Test Interval: 84 ft to 89 ft
Stick up length: 2 ft
Test Interval: 82.0 ft to 87 ft (from surface)
Test Type: Double Packer Technique

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 12-17-07

Depth of Water
Table= 42.70 ft (from top of casing)
h1= 43.20 (from top of casing)
h2 = 43.80 ft (from top of casing)
ρ_w = 62.4 lb/ft^3

Abreviations:
N.O. Not Observed
N.A. Not Aplicable

P_0 Max= 68.17 psi Value on field data sheet=

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1

Actual Excess Pressure= 4.60 psi
Initial Middle Transducer Reading= 26.36 psi
Test Pressure= 30.96 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2777.6		-1.4
0.5	2777.6	0.0	-1.0
1	2779.1	3.0	8.2
1.5	2779.3	0.4	9.1
2	2779.3	0.0	8.9
2.5	2779.3	0.0	8.6
3	2779.3	0.0	8.4
3.5	2779.3	0.0	8.1
4	2779.3	0.0	7.8
4.5	2779.3	0.0	7.6
5	2779.3	0.0	7.4

Average Q: 0.3 gpm
Excess Pore pressure: 4.60 psi

TEST #2

Actual Excess Pressure= 18.49 psi
Initial Middle Transducer Reading= 26.49 psi
Test Pressure= 44.98 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2780.3		2.1
0.5	2781.0	1.4	4.5
1	2781.0	0.0	23.3
1.5	2781.0	0.0	21.1
2	2781.0	0.0	19.4
2.5	2781.0	0.0	17.8
3	2781.0	0.0	16.3
3.5	2781.0	0.0	15.5
4	2781.0	0.0	14.7
4.5	2781.0	0.0	19.7
5	2781.0	0.0	18.8
6	2781.0	0.0	18.7

Average Q: 0.0 gpm
Excess Pore pressure: 18.49 psi

TEST #3

Actual Excess Pressure= 29.26 psi
Initial Middle Transducer Reading= 26.36 psi
Test Pressure= 55.62 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2781.3		3.8
0.5	2783	3.4	33.9
1	2783.1	0.2	38.2
1.5	2783.2	0.2	35.5
2	2783.3	0.2	39
2.5	2783.3	0.0	36.3
3	2783.3	0.0	37.1
3.5	2783.3	0.0	38.1
4	2783.3	0.0	35.9
4.5	2783.3	0.0	37.8
5	2783.4	0.2	37.1
6	2783.5	0.1	34.4
7	2783.5	0.0	38.1

Average Q: NA gpm
Excess Pore pressure: 29.26 psi

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TEST #4

Actual Excess Pressure= 7.72 psi
Initial Middle Transducer 26.36 psi
Test Pressure= 34.08 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2783.5		2.8
0.5	2783.9	0.8	6.5
1	2784.7	1.6	16.7
1.5	2784.7	0.0	15.7
2	2784.7	0.0	14.5
2.5	2784.7	0.0	13.4
3	2784.7	0.0	12.5
3.5	2784.7	0.0	11.7
4	2784.7	0.0	11.1
4.5	2784.7	0.0	10.5
5	2784.7	0.0	10.0

TEST #5

Actual Excess Pressure= 41.80 psi
Initial Middle Transducer 26.36 psi
Test Pressure= 68.16 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2784.7		2.3
0.5	2785.6	1.8	14
1	2786.6	2.0	34.3
1.5	2786.6	0.0	35.6
2	2786.7	0.2	38.1
2.5	2786.8	0.2	40
3	2786.8	0.0	36.6
3.5	2786.8	0.0	36.9
4	2786.9	0.2	38
4.5	2786.9	0.0	38.1
5	2786.9	0.0	37.7
6	2787.0	0.1	37.3

Boring No: B-950
Test Interva 82 ft to 87 ft
(from surface)

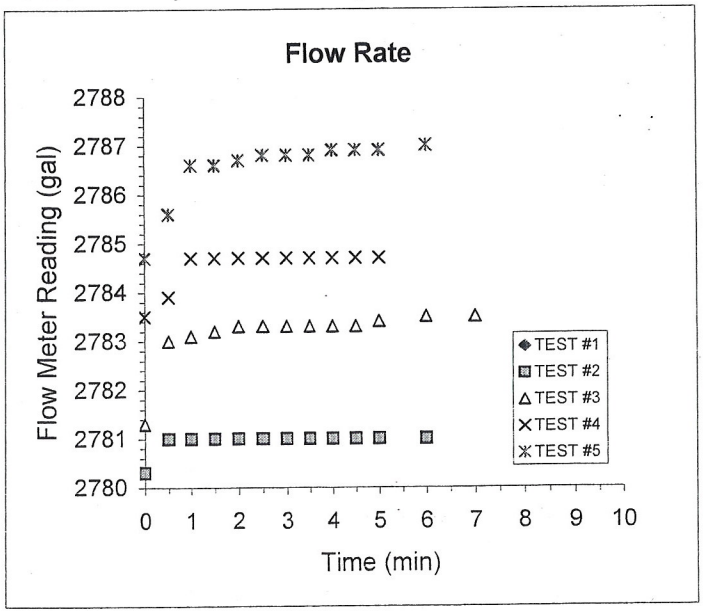
Density of water, ρ_w=62.4 lb/ft^3
= 0.0361 lb/in^3
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

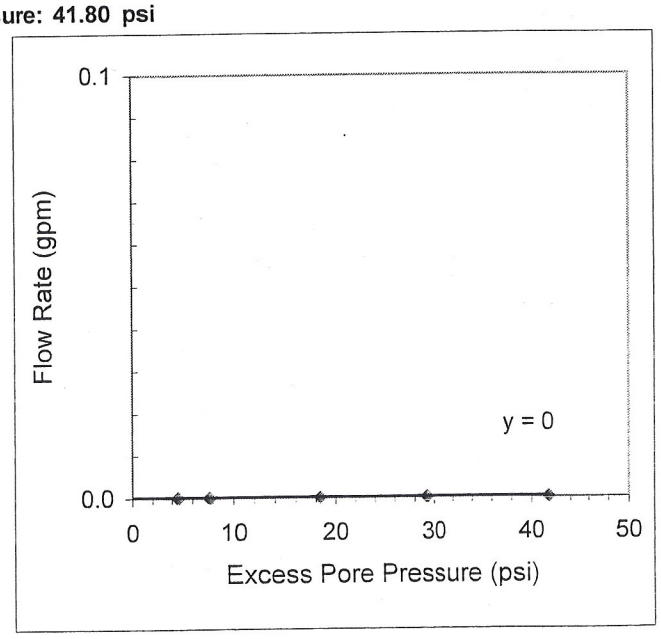
	Excess Pressure (psi)	Q* (gpm)	Test Pres. (ft)	k_e (fpy)
1	4.60	0.000	10.62	0.00
2	18.49	0.000	42.67	0.00
3	29.26	0.000	67.52	0.00
4	7.72	0.000	17.82	0.00
5	41.80	0.000	96.5	0.00

* Q obtained from graph Flow Rate-1

Average Q: 0.0 gpm
Excess Pore pressure: 7.72 psi

Average Q: NA gpm
Excess Pore pressure: 41.80 psi





obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$k_e = Q^* \ln(R/r_0)/(2\pi L H_0)$

k_e= 0.00E+00 cm/sec
= 0.00 ft/year

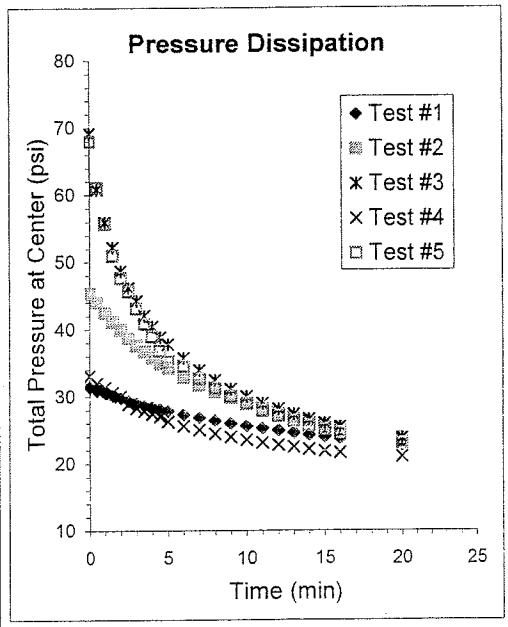
Pressure Decay Test

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07
N.O. Not Observed
N.A. Not Aplicable

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/18/2006
Boring No: B-950
Test Interval: 82 ft to 87 ft (from surface)

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	7.4	31.39	0.0	18.7	45.29	0.0	38.1	69.10
0.5	7.1	30.87	0.5	17.8	44.03	0.5	30	60.80
1.0	7	30.53	1.0	16.6	42.47	1.0	26.7	55.91
1.5	6.8	30.15	1.5	15.6	41.08	1.5	23.7	52.15
2.0	6.6	29.75	2.0	14.7	39.92	2.0	21.2	48.64
2.5	6.4	29.34	2.5	13.9	38.69	2.5	18.8	46.13
3.0	6.2	28.96	3.0	13.1	37.58	3.0	17.4	44.17
3.5	6	28.62	3.5	12.5	36.65	3.5	15.7	42.01
4.0	6	28.38	4.0	11.9	35.77	4.0	14.6	40.36
4.5	5.8	28.05	4.5	11.4	34.89	4.5	13.7	38.80
5.0	5.7	27.77	5.0	10.9	34.24	5.0	12.8	37.74
6.0	5.4	27.26	6.0	10	32.84	6.0	11.4	35.70
7.0	5.2	26.77	7.0	9.3	31.67	7.0	10.2	33.84
8	4.9	26.36	8.0	8.7	30.65	8.0	9.3	32.40
9	4.7	25.94	9.0	8.1	29.71	9.0	8.5	31.05
10	4.6	25.56	10.0	7.6	28.9	10.0	7.8	29.93
11	4.4	25.2	11.0	7.2	28.15	11.0	7.2	28.95
12	4.3	24.85	12.0	6.9	27.47	12.0	6.7	28.05
13	4.1	24.54	13.0	6.5	26.87	13.0	6.2	27.29
14	3.9	24.21	14.0	6.2	26.3	14.0	5.8	26.6
15	3.8	23.91	15.0	5.9	25.78	15.0	5.5	25.97
16	3.6	23.64	16.0	5.6	25.31	16.0	5.2	25.41
20	3.1	22.66	20.0	4.8	23.76	20.0	4.2	23.62

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	10	33.07	0.0	37.3	67.95
0.5	9.3	31.94	0.5	31.1	61.05
1.0	8.9	31.28	1.0	26.4	55.67
1.5	8.4	30.56	1.5	22.7	50.91
2.0	8	29.97	2.0	20.1	47.61
2.5	7.4	28.82	2.5	18.1	45.60
3.0	7	28.23	3.0	16.2	43.04
3.5	6.8	27.81	3.5	15.0	40.78
4.0	6.5	27.37	4.0	13.6	38.89
4.5	6.3	26.97	4.5	12.1	36.76
5.0	5.8	26.21	5.0	11.4	35.16
6.0	5.4	25.53	6.0	10.7	34.52
7.0	5.1	24.97	7.0	9.3	32.63
8	4.8	24.39	8	8.6	31.22
9	4.6	23.93	9	7.9	30.00
10	4.7	23.47	10	7.3	28.88
11	4.1	23.07	11	6.6	27.85
12	3.9	22.71	12	6.2	27.05
13	3.7	22.41	13	5.7	26.31
14	3.6	22.10	14	5.4	25.61
15	3.4	21.83	15	5.0	25.05
16	3.3	21.58	16	4.8	24.52
20	2.9	20.95	20	3.9	22.97



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JBL 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-21-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 57.0 FT. TO 62.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 16.8 FT.

1/3 MAXIMUM TEST PRESSURE, Po 52.77 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 1 TEST PRESSURE 17.41 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .03, Middle 7.41, Bottom 10.11

Transducer Readings after initial pressurization:
Top .24, Middle 11.09, Bottom 9.40

Transducer Readings after final flow measurement:
Top .23, Middle 19.15, Bottom 9.19

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2792.6		1.5	
0.5	2792.6	Ø	1.5	
1.0	2793.1	1.0	7.1	
1.5	2793.1	Ø	7.1	
2.0	2793.1	Ø	7.1	
2.5	2793.1	Ø	7.0	
3.0	2793.1	Ø	7.0	
3.5	2793.1	Ø	6.9	
4.0	2793.1	Ø	6.9	
4.5	2793.1	Ø	6.9	
5.0	2793.1	Ø	6.8	
6.0				

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3** 2

BORING NO.: B950

DATE: 12-21-06

TEST NUMBER: 1

TEST INTERVAL (FROM DATUM): FROM 57.0 **FT. TO** 62.0 **FT.**

DATA COLLECTED BY: S Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	6.8	20.00
0.5	6.8	19.97
1.0	6.8	19.96
1.5	6.7	19.94
2.0	6.7	19.92
2.5	6.7	19.90
3.0	6.7	19.87
3.5	6.7	19.85
4.0	6.6	19.83
4.5	6.6	19.80
5.0	6.6	19.79
6.0	6.6	19.75
7.0	6.5	19.72
8.0	6.5	19.68
9.0	6.5	19.65
10.0	6.4	19.62
11.0	6.4	19.58
12.0	6.4	19.56
13.0	6.3	19.53
14.0	6.3	19.50
15.0	6.3	19.47
20.0	6.2	19.38
25.0	6.1	19.31
30.0	6.1	19.24
35.0	6.0	19.19

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M1 57-62
" - B1 57 - "
" - T1 57 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAJ 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-21-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING Y GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5'-0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 57.0 FT. TO 62.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 16.8 FT.

2/3 MAXIMUM TEST PRESSURE, Po 52.77 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 2 TEST PRESSURE 34.82 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .03, Middle 7.41, Bottom 10.11

Transducer Readings after initial pressurization:
Top .23, Middle 19.15, Bottom 9.19

Transducer Readings after final flow measurement:
Top .23, Middle 33.34, Bottom 9.19

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2793.1	/	6.0	
0.5	2793.2	.2	6.0	
1.0	2793.5	.6	15.6	
1.5	2793.5	Ø	16.9	
2.0	2793.5	Ø	16.9	
2.5	2793.5	Ø	16.9	
3.0	2793.5	Ø	16.9	
3.5	2793.5	Ø	16.9	
4.0	2793.5	Ø	16.9	
4.5	2793.5	Ø	16.9	
5.0	2793.5	Ø	16.9	
6.0				

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3** 2

BORING NO.: B950

DATE: 8-21-06

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 57.0 **FT. TO** 62.0 **FT.**

DATA COLLECTED BY: J Howard

Jb 12-3-06

SHUT-IN TEST

PRESSURE:_____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	16.9	34.26
0.5	16.9	34.23
1.0	16.7	34.20
1.5	16.7	34.16
2.0	16.7	34.12
2.5	16.6	34.08
3.0	16.6	34.04
3.5	16.6	34.00
4.0	16.5	33.98
4.5	16.5	33.94
5.0	16.5	33.91
6.0	16.4	33.85
7.0	16.4	33.79
8.0	16.3	33.74
9.0	16.3	33.69
10.0	16.2	33.64
11.0	16.2	33.61
12.0	16.1	33.57
13.0	16.1	33.53
14.0	16.1	33.51
15.0	16.0	33.48

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M257 - G2
" - B257 - "
" - T257 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAJ 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-21.06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 57.0 FT. TO 62.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 16.8 FT.

MAXIMUM TEST PRESSURE, Po 52.77 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 3 TEST PRESSURE 52.77 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .03, Middle 7.41, Bottom 10.11

Transducer Readings after initial pressurization:
Top .23, Middle 33.34, Bottom 9.19

Transducer Readings after final flow measurement:
Top .23, Middle 49.34, Bottom 9.19

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2793.5	/	15.8	
0.5	2793.9	.8	29.8	
1.0	2793.9	Ø	29.9	
1.5	2793.9	Ø	29.9	
2.0	2793.9	Ø	29.9	
2.5	2793.9	Ø	31.5	
3.0	2793.9	Ø	31.2	
3.5	2793.9	Ø	32.1	
4.0	2793.9	Ø	32.2	
4.5	2793.9	Ø	32.1	
5.0	2793.9	Ø	32.1	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3**

BORING NO.: B950

DATE: 8-21-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 57.0 **FT. TO** 62.0 **FT.**

DATA COLLECTED BY: J Howell

2

12-3-06

SHUT-IN TEST

PRESSURE:_____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	32.1	52.67
0.5	31.9	52.50
1.0	31.8	52.40
1.5	31.7	52.27
2.0	31.6	52.14
2.5	31.5	52.02
3.0	31.4	51.88
3.5	31.2	51.76
4.0	31.1	51.64
4.5	31.0	51.51
5.0	30.9	51.37
6.0	30.6	51.10
7.0	30.5	50.96
8.0	30.4	50.87
9.0	30.2	50.63
10.0	29.9	50.25
11.0	29.5	49.90
12.0	29.3	49.65
13.0	29.2	49.54
14.0	29.1	49.44
15.0	29.1	49.34

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M3 57-62

" - B3 57- "

" - T3 57- "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAD 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL **PROJECT NO.:** 6468-06-1472

DATA COLLECTED BY: J Howard **DATE COLLECTED:** 8-21-06

BORING NO. B 950 **BOREHOLE DIAMETER:** 4 **IN.**

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 **FT.**

CHECK DATUM USED: TOP OF CASING X **GROUND SURFACE** ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 **FT.**

TEST INTERVAL DEPTH (FROM DATUM): FROM 57.0 **FT. TO** 62.0 **FT.**

TOTAL BORING DEPTH FROM DATUM: 102.0 **FT.**

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 **FT.**

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 **FT.**

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 16.8 **FT.**

1/2 **MAXIMUM TEST PRESSURE, Po** 52.77 **(Po = [(A+B) *1] + C*.57 psi)**

TEST NUMBER: 4 **TEST PRESSURE** ~~52.77~~ 8-21 26.75 **psi PACKER PRESSURE:** 100 **psi**

Initial Transducer Readings: Top_____**, Middle** _____**, Bottom** _____

Transducer Readings after initial pressurization:

Top_____**, Middle** _____**, Bottom** _____

Transducer Readings after final flow measurement:

Top_____**, Middle** _____**, Bottom** _____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

Test Skipped, Hole wont take water

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JHS 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: JHoward DATE COLLECTED: 8-21-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 57.0 FT. TO 62.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 16.8 FT.

MAXIMUM TEST PRESSURE, Po 52.77 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 5 TEST PRESSURE 52.77 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top ____, Middle ____, Bottom ____

Transducer Readings after initial pressurization:
Top ____, Middle ____, Bottom ____

Transducer Readings after final flow measurement:
Top ____, Middle ____, Bottom ____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

Test skipped, hole wont take water

JCJ 12-3-06

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-18-06

Boring No. B 950

Test Interval: 57.0 to 62.0 feet from Datum

Casing Stickup 2.0 feet

PoMAX = (h_1 x 1) + (h_2 x 0.57). h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the ~~datum~~ same to the water level
h_2 = Distance from the water level to the center of the test interval

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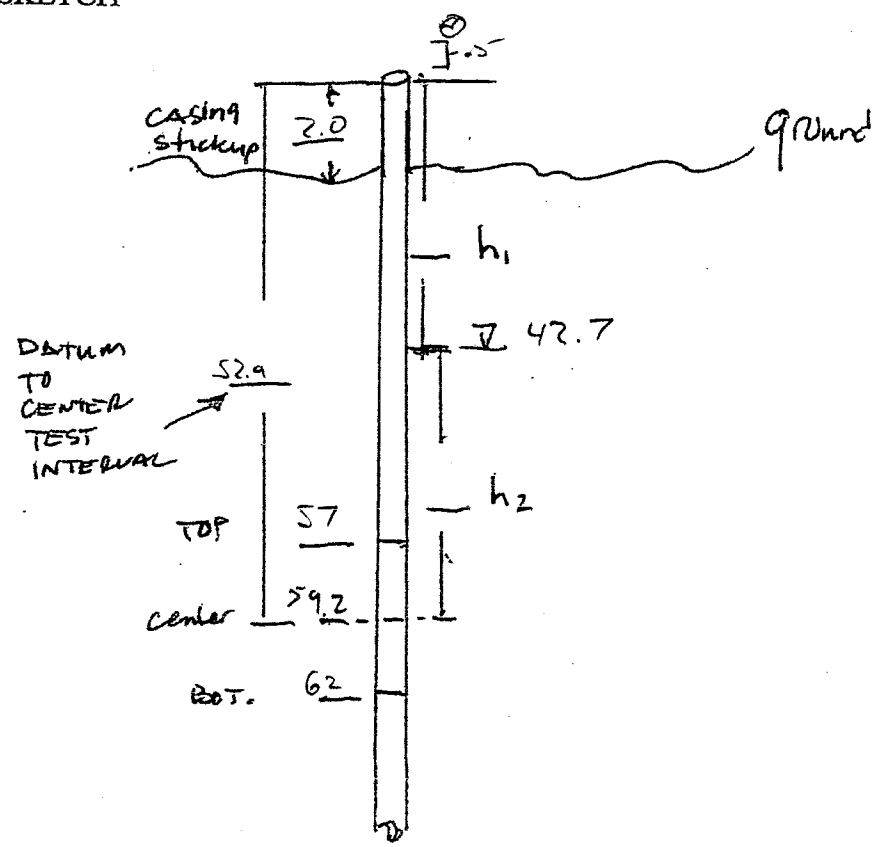
h_1 = 43.2

h_2 = 59.2 - 42.7 = 16.8

P MAX = 43.2 + 9.57 = 52.77

SKETCH



PACKER TESTING CALCULATIONS FOR P(MAX)

JBJ 12-3-06

Date: 8-18-06

Boring No. B950

Test Interval: 62.0 to 67.0 feet from Datum

Casing Stickup 2.0 feet

PoMAX = (h_1 x 1) + (h_2 x 0.57). h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the ~~datum~~ gage to the water level
h_2 = Distance from the water level to the center of the test interval

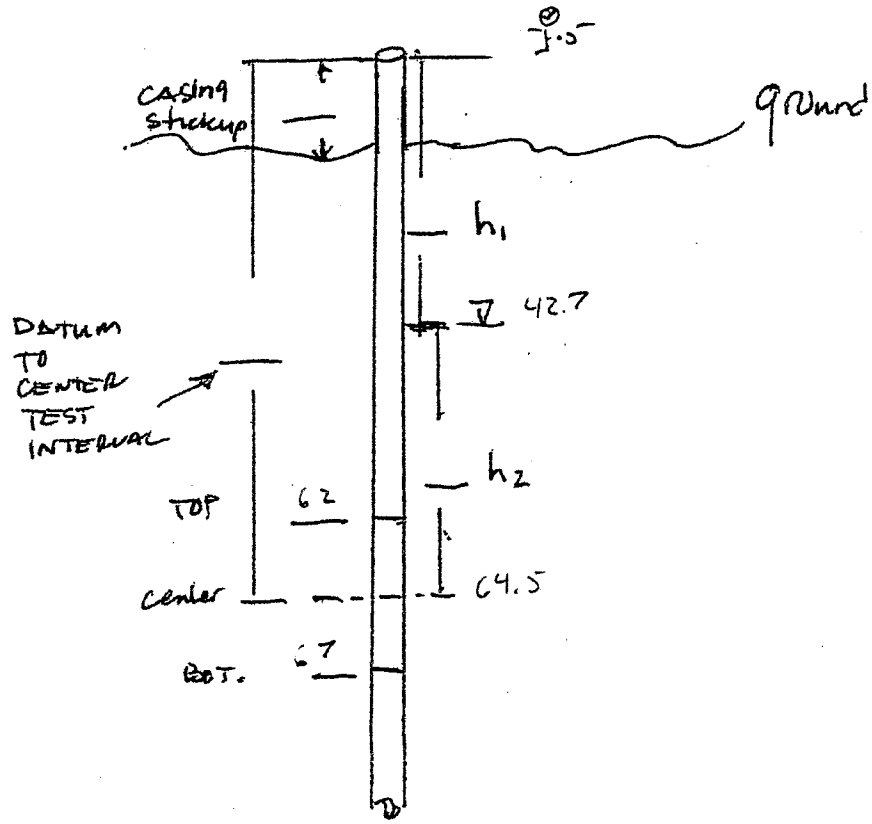
---

h_1 = 43.2

h_2 = 64.5 - ~~43.2~~ 8-18 42.7 = 21.8

P MAX = 43.2 + 12.412 = 55.62

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JJ 1-23-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-18-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 21.8 FT.

1/3 MAXIMUM TEST PRESSURE, Po 55.62 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 1 TEST PRESSURE 18.35 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .24, Middle 9.64, Bottom 12.42

Transducer Readings after initial pressurization:
Top .22, Middle 12.63, Bottom 11.62

Transducer Readings after final flow measurement:
Top .24, Middle 16.46, Bottom 11.38

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2787.0	/	1.0	
0.5	2787.0	Ø	1.0	
1.0	2787.4	.8	1.4	
1.5	2788.1	1.4	10.6	
2.0	2788.1	Ø	10.5	
2.5	2788.1	Ø	6.1	
3.0	2788.1	Ø	5.9	
3.5	2788.1	Ø	5.8	
4.0	2788.1	Ø	5.8	
4.5	2788.1	Ø	5.8	
5.0	2788.1	Ø	5.7	
6.0				

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3** 2

BORING NO.: B950

DATE: 8-18-06

TEST NUMBER: 1

TEST INTERVAL (FROM DATUM): FROM 62.0 **FT. TO** 67.0 **FT.**

DATA COLLECTED BY: S Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	5.7	19.07
0.5	5.7	18.00
1.0	5.7	18.93
1.5	5.6	18.85
2.0	5.6	18.79
2.5	5.6	18.71
3.0	5.5	18.65
3.5	5.4	18.57
4.0	5.4	18.50
4.5	5.4	18.46
5.0	5.4	18.40
6.0	5.3	18.28
7.0	5.2	18.17
8.0	5.2	18.07
9.0	5.1	17.98
10.0	5.1	17.88
11.0	5.0	17.78
12.0	5.0	17.69
13.0	4.9	17.59
14.0	4.9	17.50
15.0	4.8	17.40
16.0	4.8	17.31
20.0	4.6	16.95
25.0	4.3	16.54

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M162 - 67
" - B162 - "
" - T162 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

AJ 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-18-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 21.8 FT.

2/3 MAXIMUM TEST PRESSURE, Po 55.62 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 2 TEST PRESSURE 36.17 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .21, Middle 9.64, Bottom 12.42

Transducer Readings after initial pressurization:
Top .24, Middle 16.46, Bottom 11.38

Transducer Readings after final flow measurement:
Top .21, Middle 23.18, Bottom 11.36

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2788.1	/	4.1	
0.5	2788.8	1.4	8.9	
1.0	2789.1	.6	18.9	
1.5	2789.2	.4	17.9	
2.0	2789.2	Ø	17.6	
2.5	2789.2	Ø	17.3	
3.0	2789.2	Ø	17.1	
3.5	2789.2	Ø	16.9	
4.0	2789.2	Ø	16.7	
4.5	2789.2	Ø	17.4	
5.0	2789.2	Ø	17.3	
6.0				

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE ~~3~~ 2

BORING NO.: B950

DATE: 8-18-06

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.

DATA COLLECTED BY: J Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	17.3	36.29
0.5	17.0	36.04
1.0	16.8	35.68
1.5	16.6	35.47
2.0	16.3	35.19
2.5	16.1	35.00
3.0	16.0	34.68
3.5	15.7	34.31
4.0	15.5	34.16
4.5	15.4	33.90
5.0	15.4	33.48
6.0	14.8	33.15
7.0	14.4	32.65
8.0	14.1	32.22
9.0	13.8	31.80
10.0	13.5	31.34
11.0	13.2	30.94
12.0	12.9	30.52
13.0	12.6	30.11
14.0	12.4	29.75
15.0	12.1	29.35
20.0	10.9	27.68
25.0	9.9	26.18

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - B262-67
" - TI 62- "
" - M262- "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JD 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-18-06

BORING NO. B 950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 21.85 FT.

MAXIMUM TEST PRESSURE, Po 55.62 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 3 TEST PRESSURE 55.62 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .24, Middle 9.64, Bottom 12.42

Transducer Readings after initial pressurization:
Top .21, Middle 25.18, Bottom 11.36

Transducer Readings after final flow measurement:
Top .18, Middle 25.50, Bottom 11.37

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2789.2	/	8.3	
0.5	2790.4	2.4	39.3	
1.0	2790.4	Ø	38.2	
1.5	2790.5	.2	31.1	Bleed at some pressure
2.0	2790.5	Ø	32.9	
2.5	2790.5	Ø	33.2	
3.0	2790.5	Ø	33.3	
3.5	2790.5	Ø	32.6	
4.0	2790.5	Ø	32.5	
4.5	2790.5	Ø	33.1	
5.0	2790.5	Ø	33.2	
6.0				

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3**

BORING NO.: B950

DATE: 8-18-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 62.0 **FT. TO** 67.0 **FT.**

DATA COLLECTED BY: J Howard

2

12-3-06

SHUT-IN TEST

PRESSURE:_____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	37.2	55.42
0.5	31.8	54.44
1.0	30.4	52.83
1.5	29.3	51.55
2.0	28.1	50.28
2.5	27.2	49.08
3.0	26.2	47.96
3.5	25.3	46.98
4.0	24.5	45.99
4.5	~~45.07~~ 23.6	45.07
5.0	22.8	44.15
6.0	21.7	42.60
7.0	20.5	41.13
8.0	19.3	39.74
9.0	18.3	38.43
10.0	17.3	37.32
11.0	16.5	36.25
12.0	15.8	35.29
13.0	15.0	34.23
14.0	14.4	33.40
15.0	13.7	32.52
20.0	11.1	28.93
25.0	9.0	26.02

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M362-67
" - T362 - "
" - B362 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAJ 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-18-06

BORING NO. B 950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 21.8 FT.

1/2 MAXIMUM TEST PRESSURE, Po 55.62 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 4 TEST PRESSURE 27.81 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .24, Middle 9.64, Bottom 12.42

Transducer Readings after initial pressurization:

Top .18, Middle 25.50, Bottom 11.36

Transducer Readings after final flow measurement:

Top .20, Middle 14.86, Bottom 11.36

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2790.5	/	2.2	
0.5	2791.2	1.4	10.6	
1.0	2791.2	Ø	10.8	
1.5	2791.2	Ø	10.6	
2.0	2791.2	Ø	10.5	
2.5	2791.2	Ø	10.7	
3.0	2791.2	Ø	10.9	
3.5	2791.2	Ø	11.0	
4.0	2791.2	Ø	11.1	
4.5	2791.2	Ø	11.3	
5.0	2791.2	Ø	11.4	
6.0				

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAY 12-3 06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-18.06

BORING NO. B 950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION na

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 47.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 21.8 FT.

MAXIMUM TEST PRESSURE, Po 55.62 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 5 TEST PRESSURE ~~18.55~~ 55.62 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .024, Middle 9.64, Bottom 12.42

Transducer Readings after initial pressurization:

Top .20, Middle 14.86, Bottom 11.36

Transducer Readings after final flow measurement:

Top ~~.142~~ .14, Middle ~~23.84~~ 21.41, Bottom ~~11.36~~ 11.36

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2791.2	—	2.9	
0.5	2792.6	2.8	32.8	
1.0	2792.6	Ø	37.2	
1.5	2792.6	Ø	35.7	
2.0	2792.6	Ø	34.2	
2.5	2792.6	Ø	32.6	
3.0	2792.6	Ø	33.5	
3.5	2792.6	Ø	34.0	
4.0	2792.6	Ø	33.8	
4.5	2792.6	Ø	33.9	
5.0	2792.6	Ø	33.4	
6.0				

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE ~~3~~ 2

BORING NO.: B950

DATE: 8-18-06

TEST NUMBER: 5

TEST INTERVAL (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.

DATA COLLECTED BY: SHO ward

12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	33.4	55.64
0.5	32.0	54.03
1.0	30.9	52.81
1.5	29.5	51.22
2.0	28.5	49.99
2.5	27.7	48.70
3.0	26.6	47.91
3.5	25.7	46.85
4.0	24.6	45.79
4.5	24.0	45.04
5.0	23.4	44.10
6.0	22.1	42.58
7.0	20.9	41.00
8.0	19.9	39.70
9.0	18.8	38.46
10.0	17.9	37.29
11.0	17.2	36.28
12.0	16.4	35.30
13.0	15.8	34.35
14.0	15.1	33.40
15.0	14.4	32.58
20.0	11.9	29.06
25.0	9.8	26.14
30.0	8.4	23.98
35.0	7.1	22.02

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M562-67
" - T562 - "
" - B562 - "

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 3

BORING NO.: B950

DATE: 8-17-06

TEST NUMBER: 4

TEST INTERVAL (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.

DATA COLLECTED BY: J Howard

2 12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	11.4	28.10
0.5	11.2	27.92
1.0	11.0	27.62
1.5	10.8	27.29
2.0	10.5	26.98
2.5	10.3	26.62
3.0	10.1	26.35
3.5	9.9	26.07
4.0	9.7	25.76
4.5	9.4	25.49
5.0	9.3	25.18
6.0	9.0	24.69
7.0	8.6	24.16
8.0	8.3	23.69
9.0	8.1	23.23
10.0	7.7	22.78
11.0	7.4	22.34
12.0	7.1	21.92
13.0	6.9	21.51
14.0	6.6	21.00
15.0	6.4	20.74
20.0	5.4	19.00
~~25.0~~ 8-21		

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M462 - 67
" - T462 - "
" - B462 - "

PACKER TESTING CALCULATIONS FOR P(MAX)

JJ 11-3-06

Date: 8-18-06

Boring No. B950

Test Interval: 84.0 to 89.0 feet from Datum

Casing Stickup 2.0 feet

PoMAX = (h_1 x 1) + (h_2 x 0.57). h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the datum to the water level + Height of Casing above Datum
h_2 = Distance from the water level to the center of the test interval

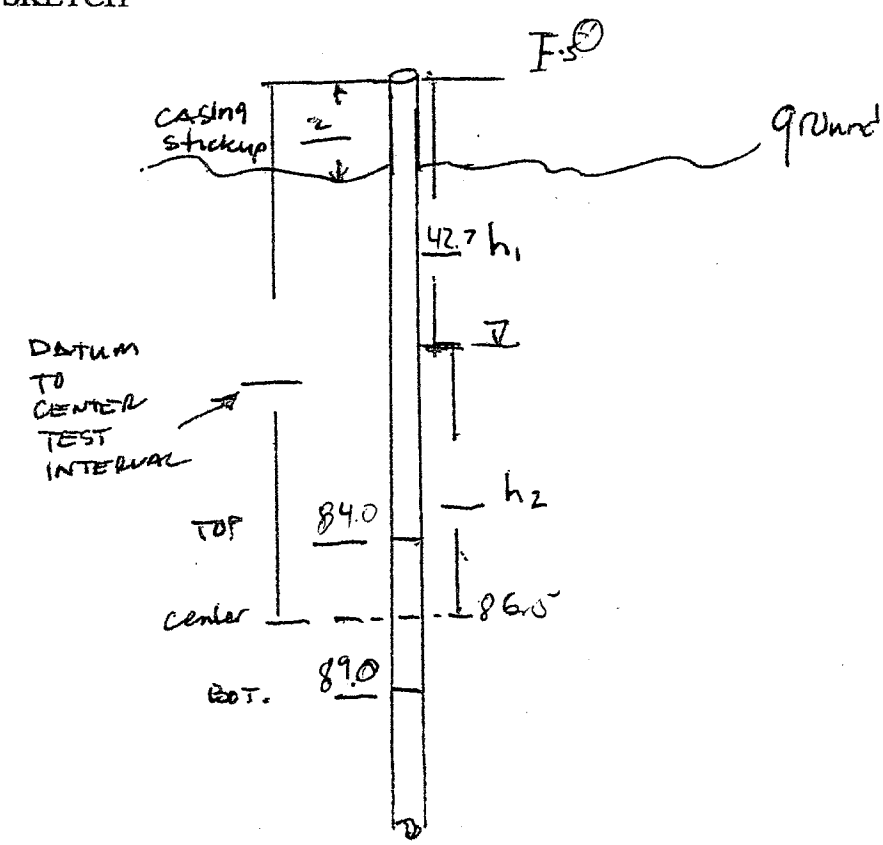
---

h_1 = 42.7 + .5 = 43.2

h_2 = 86.5 - 42.7 = 43.8

P MAX = 43.2 + 24.9 = 68.16

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JD 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-18-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 84.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 43.8 FT.

1/3 MAXIMUM TEST PRESSURE, Po 68.16 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 1 TEST PRESSURE 22.49* psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 8.52, Middle 26.36 ~~26.36~~ ~~28.15~~ 8-18, Bottom 29.14

Transducer Readings after initial pressurization:

Top 9.07, Middle 28.15, Bottom 37.29

Transducer Readings after final flow measurement:

Top 7.85, Middle 22.66, Bottom 26.86

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2777.6	/	-0.4	
0.5	2777.6	Ø	-1.0	
1.0	2779.1	3.0	+8.2	
1.5	2779.3	.4	9.1	
2.0	2779.3	Ø	8.9	
2.5	2779.3	Ø	8.6	
3.0	2779.3	Ø	8.4	
3.5	2779.3	Ø	8.1	
4.0	2779.3	Ø	7.8	
4.5	2779.3	Ø	7.6	
5.0	2779.3	Ø	7.4	
6.0				

* Per ATice's instructions we will be using 1.1x the natural Pressure instead of the 1/3 Max PO, which is below Nat. Pressure 30.96

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3**

BORING NO.: B950

DATE: 8-18-06

TEST NUMBER: 1

TEST INTERVAL (FROM DATUM): FROM 89.0 **FT. TO** 84.0 **FT.**

DATA COLLECTED BY: J Howard

2

12-3-06

SHUT-IN TEST

PRESSURE:_____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	7.4	31.39
0.5	7.1	30.87
1.0	7.0	30.53
1.5	6.8	30.15
2.0	6.6	29.75
2.5	6.4	29.34
3.0	6.2	28.96
3.5	6.0	28.62
4.0	6.0	28.38
4.5	5.8	28.05
5.0	5.7	27.77
5.5	5.5	27.50
6.0	5.4	27.26
6.5	5.3	27.00
7.0	5.2	26.77
7.5	5.0	26.56
8.0	4.9	26.36
8.5	4.8	26.14
9.0	4.7	25.94
9.5	4.7	25.75
10.0	4.6	25.56
10.5	4.5	25.36
11.0	4.4	25.20
11.5	4.3	25.03
12.0	4.2	24.85
12.5	4.1	24.67
13.0	4.1	24.54
13.5	4.0	24.36
14.0	3.9	24.21
14.5	3.8	24.05
15.0	3.8	23.91
15.5	3.7	23.77
16.0	3.6	23.64
16.5	3.6	23.50
17.0	3.5	23.37
20.0	3.1	22.66

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M184 - 89

" - B184 - 11

" - T184 - 11

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-18-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 84.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 43.8 FT.

2/3 MAXIMUM TEST PRESSURE, Po 68.16 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 2 TEST PRESSURE 44.98 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 8.52, Middle 26.49, Bottom 29.14

Transducer Readings after initial pressurization:
Top 7.85, Middle 22.66, Bottom 37.29

Transducer Readings after final flow measurement:
Top 6.50, Middle 22.54, Bottom 28.12

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2779.3	/	2.1	
0.5	2781.0	1.4	4.5	
1.0	2781.0	Ø	23.3	
1.5	2781.0	Ø	21.1	
2.0	2781.0	Ø	19.4	
2.5	2781.0	Ø	17.8	
3.0	2781.0	Ø	16.3	
3.5	2781.0	Ø	15.5	
4.0	2781.0	Ø	14.7	
4.5	2781.0	Ø	19.7	
5.0	2781.0	Ø	18.8	
6.0	2781.0	Ø	18.7	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 3 2

BORING NO.: B950

DATE: 8-18-06

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 84.0 FT. TO 89.0 FT.

DATA COLLECTED BY: J Howard

JH 12-3-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	18.7	45.29
0.5	17.8	44.03
1.0	16.6	42.47
1.5	16.6	41.08
2.0	14.7	39.92
2.5	13.4	38.69
3.0	13.1	37.58
3.5	12.5	36.65
4.0	11.9	35.77
4.5	11.4	34.89
5.0	10.9	34.24
6.0	10.0	32.84
7.0	9.3	31.67
8.0	8.7	30.65
9.0	8.1	29.71
10.0	7.6	28.90
11.0	7.2	28.15
12.0	6.9	27.47
13.0	6.5	26.87
14.0	6.2	26.30
15.0	5.9	25.78
16.0	5.6	25.31
20.0	4.8	23.76

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M284-89
" - T284 - "
" - B284 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-18-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 84.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 43.8 FT.

MAXIMUM TEST PRESSURE, Po 68.16 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 3 TEST PRESSURE 68.16 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 8.52, Middle 28.36, Bottom 29.14

Transducer Readings after initial pressurization:

Top 6.50, Middle 22.54, Bottom 28.12

Transducer Readings after final flow measurement:

Top 5.45, Middle 29.91, Bottom 35.70

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2781.3	—	3.8	
0.5	2783.0	3.4	33.4	
1.0	2783.1	.2	38.2	
1.5	2783.2	.2	35.5	
2.0	2783.3	.2	34.0	
2.5	2783.3	Ø	36.3	
3.0	2783.3	Ø	37.1	
3.5	2783.3	Ø	38.1	
4.0	2783.3	Ø	35.9	
4.5	2783.3	Ø	37.8	
5.0	2783.4	.2	37.1	
6.0	2783.5	.2	34.4	
7.0	2783.5	Ø	38.1	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE ~~3~~ 2

BORING NO.: B950

DATE: 8-18-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 84.0 FT. TO 89.0 FT.

DATA COLLECTED BY: J Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	38.1	69.10
0.5	30.0	60.80
1.0	26.7	55.91
1.5	23.7	52.15
2.0	21.2	48.64
2.5	18.8	46.13
3.0	17.4	44.17
3.5	15.7	42.01
4.0	14.6	40.36
4.5	13.7	38.80
5.0	12.8	37.74
6.0	11.4	35.70
7.0	10.2	33.84
8.0	9.3	32.40
9.0	8.5	31.05
10.0	7.8	29.93
11.0	7.2	28.95
12.0	6.7	28.05
13.0	6.2	27.29
14.0	5.8	26.60
15.0	5.5	25.97
16.0	5.2	25.41
20.0	4.2	23.62

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M384-89
" - D384-"
" - T384-"

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAJ 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-18-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 84.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 43.8 FT.

1/2 MAXIMUM TEST PRESSURE, Po 68.16 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 4 TEST PRESSURE 34.08 psi PACKER PRESSURE: ~~100~~ 125* psi

Initial Transducer Readings: Top 8.52, Middle 26.36, Bottom 29.14

Transducer Readings after initial pressurization:
Top 3.45, Middle 29.91, Bottom 35.70

Transducer Readings after final flow measurement:
Top 4.64, Middle 19.63, Bottom 35.70

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2783.5	/	2.8	
0.5	2783.9	.8	6.5	
1.0	2784.7	1.2	16.7	
1.5	2784.7	Ø	15.7	
2.0	2784.7	Ø	14.5	
2.5	2784.7	Ø	13.4	
3.0	2784.7	Ø	12.5	
3.5	2784.7	Ø	11.7	
4.0	2784.7	Ø	11.1	
4.5	2784.7	Ø	10.5	
5.0	2784.7	Ø	10.0	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE ~~3~~ 2**

BORING NO.: B950

DATE: 8-18-06

TEST NUMBER: 4

TEST INTERVAL (FROM DATUM): FROM 84.0 **FT. TO** 89.0 **FT.**

DATA COLLECTED BY: J Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	10.0	33.07
0.5	9.3	31.94
1.0	8.9	31.28
1.5	8.4	30.56
2.0	8.0	29.97
2.5	7.4	28.82
3.0	7.0	28.23
3.5	6.8	27.81
4.0	6.5	27.37
4.5	6.3	26.97
5.0	5.8	26.21
6.0	5.4	25.53
7.0	5.1	24.94
8.0	4.8	24.39
9.0	4.6	23.93
10.0	4.3	23.47
11.0	4.1	23.07
12.0	3.9	22.71
13.0	3.7	22.41
14.0	3.6	22.10
15.0	3.4	21.83
~~20.0~~ 16.0	3.3	21.58
20.0	2.9	20.95

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M484 - 89
" B484 "
" T4 89 "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-18-06

BORING NO. B950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 84.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 102.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 42.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: .5 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 43.8 FT.

MAXIMUM TEST PRESSURE, Po 68.16 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 5 TEST PRESSURE 68.16 psi PACKER PRESSURE: ~~100~~ 125* psi

Initial Transducer Readings: Top 8.56, Middle 26.36, Bottom 29.14

Transducer Readings after initial pressurization:
Top 4.64, Middle 19.63, Bottom 35.70

Transducer Readings after final flow measurement:
Top 4.09, Middle 22.78, Bottom 36.50

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2784.7	/	2.3	
0.5	2785.6	1.8	14.0	
1.0	2786.6	2.0	34.3	
1.5	2786.6	Ø	35.6	
2.0	2786.7	.2	38.1	
2.5	2786.8	.2	40.0	
3.0	2786.8	Ø	36.6	
3.5	2786.8	Ø	36.9	
4.0	2786.9	.2	38.0	
4.5	2786.9	Ø	38.1	
5.0	2786.9	Ø	37.7	
6.0	2787.0	.2	37.3	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 3 2

BORING NO.: B950

DATE: 8-18-06

TEST NUMBER: 5

TEST INTERVAL (FROM DATUM): FROM 84.0 FT. TO 89.0 FT.

DATA COLLECTED BY: S Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	37.3	67.95
0.5	31.1	61.05
1.0	26.4	55.67
1.5	22.7	50.91
2.0	20.1	47.61
2.5	18.1	45.6
3.0	16.2	43.04
3.5	15.0	40.78
4.0	13.6	38.89
4.5	12.1	36.76
5.0	11.4	35.16
6.0	10.7	34.52
7.0	9.5	32.63
8.0	8.6	31.22
9.0	7.9	30.00
10.0	7.3	28.88
11.0	6.6	27.85
12.0	6.2	27.05
13.0	5.7	26.31
14.0	5.4	25.61
15.0	5.0	25.05
18.0	4.8	24.52
20.0	3.9	22.97

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B950 - M 84-89
" - T 84-"
" - B 84-"

(5)

8-18-06

James Howard

Miller: Mark Hughes, Tom Gardner

B949 & 950

Arrive 7

Safety meeting 730

Breakdown & checktest on B949 8-830

Move & setup on B950 830-930

Get water 930-10

More setup 10-1115

lunch 1115-1145

Packer tests 1145-345 (84-89')

BD 345-4

Paperwork 4-430

(6) 8-11-06

James Howard
Miller, Mark Hughes, Tim Garland
B 950

8 arrive
830 meeting
9-Packers set up
10-130 Packers @ ~~130~~ 8-21 62-67
130-430 Packers @ 57-62
430-5 Paperwork

MACTEC

MACTEC ENGINEERING AND CONSULTING, INC.

RALEIGH, NORTH CAROLINA

IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST IN ACCORDANCE WITH CORPS OF ENGINEERS, (WATERWAYS EXPERIMENT STATION, RTH 381-80

PROJECT NAME: NORTH ANNA COL
PROJECT NUMBER: 6468-06-1472
REPORT DATE: 12/7/2006 Revised 1-13-07
BORING NO: B-951

Given Parameters

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Test Section Length, ℓ, ft:	5			
Radius of Borehole r_0, in:	2.00			
GW Depth, ft:	23.00	(from top of casing)	21.50	(from top of casing)

Test Number	Q (GPM)	P_{Test} (psi)	P_T (psi)	P_M (psi)	P_B (psi)	Q (cfs)	H_M (ft)	K_e (fpy)
Interval 1, ft:	**71 - 76**	(from ground surface)						
1	0.00	37.63	5.63	31.54	34.26	0.0	86.8	0.00
2	0.00	39.63	5.63	31.54	34.26	0.0	91.5	0.00
3	0.00	45.06	5.63	31.54	34.26	0.0	104.0	0.00
4	TNP	22.53	-	-	-	-	52.0	
5	TNP	45.06	-	-	-	-	104.0	
							K_e, ft/year:	**0.00**
Interval 2, ft:	**78 - 83**	(from ground surface)						
1	0.00	39.67	5.94	34.74	37.33	0.0	91.5	0.00
2	0.00	32.37	5.94	34.74	37.33	0.0	74.7	0.00
3	0.00	49.05	5.94	34.74	37.33	0.0	113.2	0.00
4	TNP	24.52	-	-	-	-	56.6	#VALUE!
5	TNP	49.05	-	-	-	-	113.2	#VALUE!
							K_e, ft/year:	**0.00**

Notations:

Q = flow rate
P_{Test} = total test pressure
P_T = pressure above top packer, near water surface
P_M = pressure in the test section
P_B = pressure below bottom packer

H_M = P_{Test} converted to feet of head (P_{Test}*144in^2/ft^2/γ_W)
K_e = ((Q/(H_M-P_m))*(1/ℓ))*1/2π*ln(R/r_0)*(525,600 min/year)*(0.1337ft^3/gal)
R = total length between packers, ℓ
TNP = Test not performed
NM = not measured

Note: Pressures Pt, Pm and Pb taken from initial data for transducers.
Outside diameter of boring is 4 in.

IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST
IN ACCORDANCE WITH CORPS OF ENGINEERS,
WATERWAYS EXPERIMENT STATION, RTH 381-80

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/23/2006
Boring No: B-951
Test Interval: 72.5 ft to 77.5 ft (from Datum)
Stick up length: 1.5 ft
Test Interval: 71.0 ft to 76 ft (from surface)
Test Type: Double Packer Technique

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Depth of Water
Table= 2.60 ft (from top of casing)
h1= 3.80 (from top of casing)
h2 = 72.40 ft (from top of casing)
ρ_w = 62.4 lb/ft^3

Abreviations:
N.O. Not Observed
N.A. Not Aplicable

P_0 Max= 45.07 psi Value on field data sheet= 45.06

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1

Actual Excess Pressure= 6.09 psi
Initial Middle Transducer Reading= 31.54 psi
Test Pressure= 37.63 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2795.1		0.2
0.5	2795.1	0.0	0.2
1	2795.2	0.2	5.5
1.5	2795.2	0.0	6.2
2	2795.2	0.0	6
2.5	2795.2	0.0	6.5
3	2795.2	0.0	6.8
3.5	2795.2	0.0	6.6
4	2795.2	0.0	6.7
4.5	2795.2	0.0	6.5
5	2795.2	0.0	6.6

Average Q: 0.0 gpm
Excess Pore pressure: 6.09 psi

TEST #2

Actual Excess Pressure= 8.09 psi
Initial Middle Transducer Reading= 31.54 psi
Test Pressure= 39.63 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2795.2		2.1
0.5	2795.4	0.4	8.2
1	2795.4	0.0	9.4
1.5	2795.4	0.0	8.7
2	2795.4	0.0	8.5
2.5	2795.4	0.0	8
3	2795.4	0.0	10.5
3.5	2795.4	0.0	9.8
4	2795.4	0.0	9.3
4.5	2795.4	0.0	8.9
5	2795.4	0.0	8.4

Average Q: 0.0 gpm
Excess Pore pressure: 8.09 psi

TEST #3

Actual Excess Pressure= 13.52 psi
Initial Middle Transducer Reading= 31.54 psi
Test Pressure= 45.06 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2795.4		1.8
0.5	2795.7	0.6	9
1	2795.7	0.0	13.4
1.5	2795.7	0.0	14.8
2	2795.7	0.0	13.8
2.5	2795.7	0.0	13.4
3	2795.7	0.0	13.4
3.5	2795.7	0.0	13.6
4	2795.7	0.0	13.2
4.5	2795.7	0.0	13.7
5	2795.7	0.0	13.2

Average Q: 0.0 gpm
Excess Pore pressure: 13.52 psi

JAZ 1-17-07

TEST #4

Actual Excess Pressure= 22.53 psi
Initial Middle Transducer 31.54 psi
Test Pressure= psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole is not taking any water --> Test not performed			

Average Q: gpm
Excess Pore pressure: psi

TEST #5

Actual Excess Pressure= 45.07 psi
Initial Middle Transducer 31.54 psi
Test Pressure= psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole is not taking any water --> Test not performed			

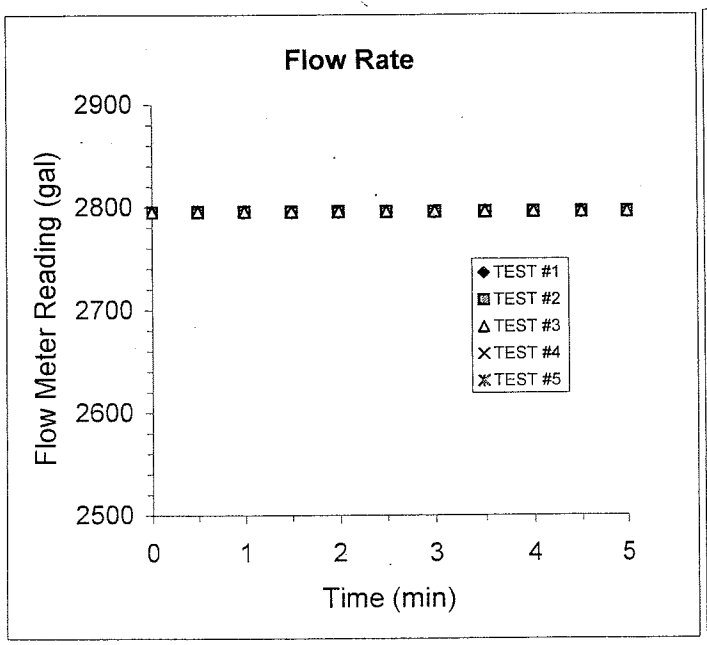
Average Q: gpm
Excess Pore pressure: psi

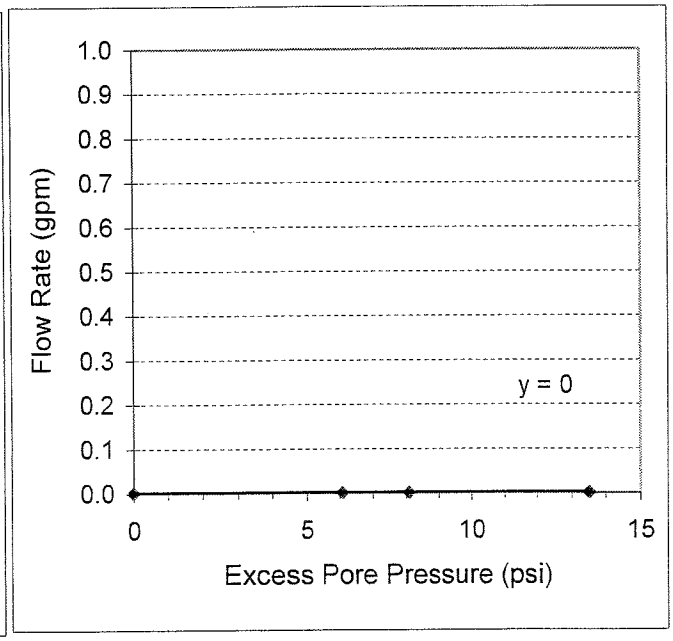
Boring No: B-951
Test Interva 71 ft to 76 ft
(from surface)

Density of water, ρ_w=62.4 lb/ft^3
= 0.0361 lb/in
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

	Excess Pressure (psi)	Q (gpm)	Test Pres. (ft)	k_e (fpy)
1	6.09	0.00	14.05	0.00
2	8.09	0.00	18.67	0.00
3	13.52	0.00	31.2	0.00
4	0.00	0.00	0.0	
5	0.00	0.00	0.0	

* Q obtained from graph Flow Rate-1





obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$k_e = Q^* \ln(R/r_0)/(2\pi L H_0)$ k_e= 0.00E+00 cm/sec
= 0.00 ft/year

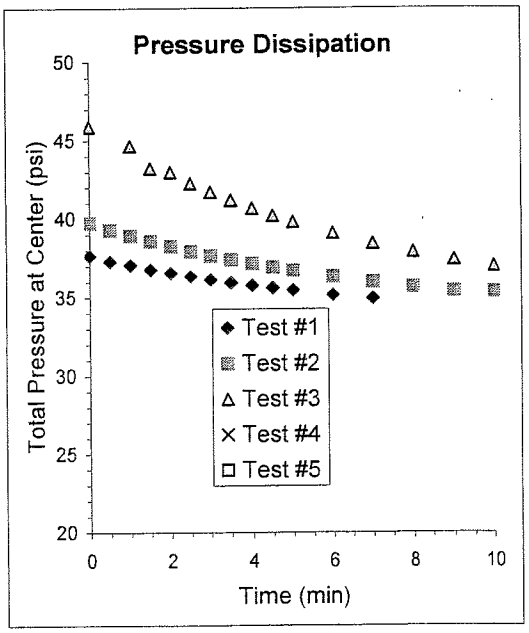
Pressure Decay Test

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07
N.O. Not Observed
N.A. Not Aplicable

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/23/2006
Boring No: B-951
Test Interval: 71 ft to 76 ft (from surface)

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	6.6	37.63	0.0	8.4	39.74	0.0	15.2	45.87
0.5	6.1	37.29	0.5	8	39.3	0.5		
1.0	5.9	37.04	1.0	7.6	38.92	1.0	12.8	44.64
1.5	5.6	36.76	1.5	7.3	38.57	1.5	12.1	43.22
2.0	5.4	36.53	2.0	7	38.24	2.0	11.4	42.97
2.5	5.3	36.32	2.5	6.7	37.92	2.5	10.8	42.26
3.0	5.1	36.13	3.0	6.5	37.63	3.0	10.2	41.71
3.5	4.9	35.92	3.5	6.2	37.4	3.5	9.7	41.18
4.0	4.7	35.75	4.0	6	37.15	4.0	9.2	40.66
4.5	4.6	35.59	4.5	5.8	36.91	4.5	8.8	40.19
5.0	4.4	35.44	5.0	5.6	36.7	5.0	8.5	39.80
6.0	4.2	35.14	6.0	5.3	36.31	6.0	7.8	39.08
7.0	4	34.89	7.0	5	35.96	7.0	7.2	38.42
8.0	3.8	34.69	8.0	4.7	35.64	8.0	6.7	37.88
9.0	3.6	34.47	9.0	4.4	35.36	9.0	6.2	37.40
10.0	3.4	34.28	10.0	4.3	35.33	10.0	5.4	36.98
11.0	3.3	34.11	11.0	4	34.88	11.0	5.5	36.58
12.0	3.2	33.96	12.0	3.8	34.67	12.0	5.2	36.2
13.0	3	33.81	13.0	3.7	34.49	13.0	4.9	35.93
14.0	2.9	33.68	14.0	3.5	34.3	14.0	4.7	35.64
15.0	2.8	33.57	15.0	3.4	34.16	15.0	4.5	35.39
20.0	2.4	33.11	20.0	2.8	33.5	20.0	3.6	34.4

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
No data Test not conducted?			No data Test not conducted?		



IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST IN ACCORDANCE WITH CORPS OF ENGINEERS, WATERWAYS EXPERIMENT STATION, RTH 381-80

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/23/2006
Boring No: B-951
Test Interval: 79.5 ft to 84.5 ft
Stick up length: 1.5 ft
Test Interval: 78.0 ft to 83 ft (from surface)
Test Type: Double Packer Technique

Depth of Water
Table= 2.60 ft (from top of casing)
h1= 3.80 (from top of casing)
h2 = 79.40 ft (from top of casing)
ρ_w = 62.4 lb/ft^3

Abreviations:
N.O. Not Observed
N.A. Not Aplicable

P_0 Max= 49.06 psi Value on field data sheet=

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1

Actual Excess Pressure= 16.35 psi
Initial Middle Transducer Reading= 34.74 psi
Test Pressure= 39.67 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2793.9		0.2
0.5	2793.9	0.0	0.5
1	2794.3	0.8	3.8
1.5	2794.3	0.0	3.7
2	2794.3	0.0	3.7
2.5	2794.3	0.0	3.7
3	2794.3	0.0	3.7
3.5	2794.3	0.0	3.7
4	2794.3	0.0	3.7
4.5	2794.3	0.0	3.7
5	2794.3	0.0	3.7

Average Q: 0.0 gpm
Excess Pore pressure: 4.93 psi

TEST #2

Actual Excess Pressure= 32.71 psi
Initial Middle Transducer Reading= 34.74 psi
Test Pressure= 41.89 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2794.3		0
0.5	2794.3	0.0	0.2
1	2794.5	0.4	4.7
1.5	2794.5	0.0	5.5
2	2794.5	0.0	5.6
2.5	2794.5	0.0	5.5
3	2794.5	0.0	5.5
3.5	2794.5	0.0	5.5
4	2794.5	0.0	5.5
4.5	2794.5	0.0	5.6
5	2794.5	0.0	5.5

Average Q: 0.0 gpm
Excess Pore pressure: 7.15 psi

TEST #3

Actual Excess Pressure= 14.31 psi
Initial Middle Transducer Reading= 34.7 psi
Test Pressure= 49.05 psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2794.5		-0.1
0.5	2794.8	0.6	9.1
1	2795.1	0.6	13.2
1.5	2795.1	0.0	13.1
2	2795.1	0.0	13.1
2.5	2795.1	0.0	13.1
3	2795.1	0.0	13.1
3.5	2795.1	0.0	13.1
4	2795.1	0.0	13.2
4.5	2795.1	0.0	13.1
5	2795.1	0.0	13.1

Average Q: 0.0 gpm
Excess Pore pressure: 14.31 psi

1-17-07

TEST #4

Actual Excess Pressure= NA psi
Initial Middle Transducer 34.74 psi
Test Pressure= NA psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole is not taking any water --> Test not performed			

TEST #5

Actual Excess Pressure= NA psi
Initial Middle Transducer 34.74 psi
Test Pressure= NA psi

Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole is not taking any water --> Test not performed			

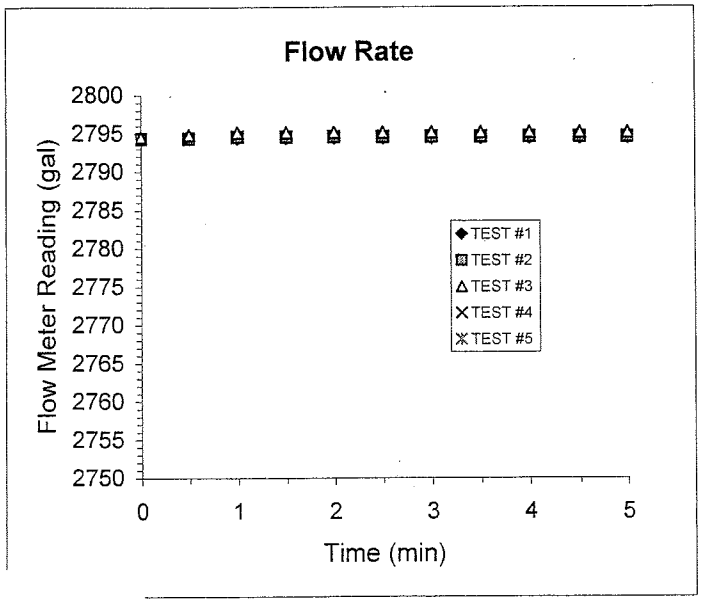
Boring No: B-951
Test Interva 78 ft to 83 ft
(from surface)

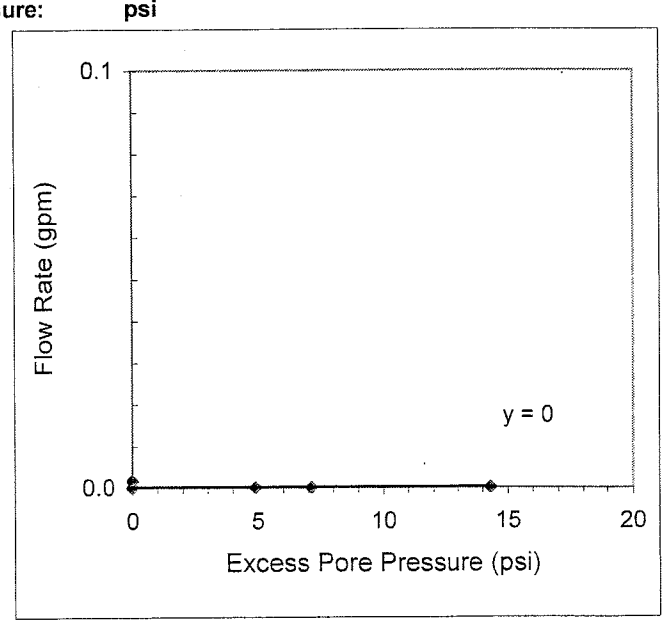
Density of water, ρ_w=62.4 lb/ft^3
= 0.0361 lb/in^3
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

	Excess Pressure (psi)	Q (gpm)	Test Pres. (ft)	k_e (fpy)
1	4.93	0.000	37.74	0.00
2	7.15	0.000	75.47	0.00
3	14.31	0.000	33.02	0.00
4	0.00	0.000	######	#VALUE!
5	0.00	0.002	######	#VALUE!

* Q obtained from graph Flow Rate-1

Average Q: **gpm** **Average Q:** **gpm**
Excess Pore pressure: **psi** **Excess Pore pressure:** **psi**





obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$k_e = Q^* \ln(R/r_0)/(2\pi L H_0)$ **k_e= 0.00E+00 cm/sec**
= 0.00 ft/year

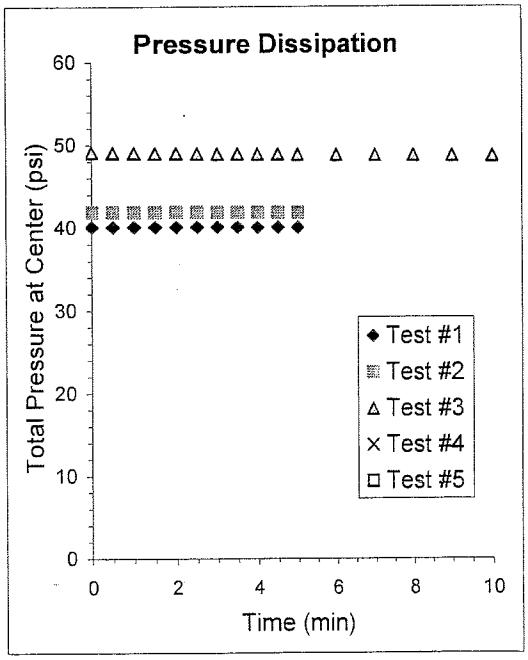
Pressure Decay Test

Prepared by: ZO Date: 12-7-06
Checked by: [illegible] Date: 1-17-07
N.O. Not Observed
N.A. Not Aplicable

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/23/2006
Boring No: B-951
Test Interval: 78 ft to 83 ft (from surface)

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	3.7	40.04	0.0	5.5	41.89	0.0	13.1	49.06
0.5	3.7	40.04	0.5	5.5	41.87	0.5	13.1	49.02
1.0	3.7	40.05	1.0	5.5	41.87	1.0	13.1	49.00
1.5	3.7	40.04	1.5	5.5	41.86	1.5	13.1	48.96
2.0	3.7	40.04	2.0	5.5	41.86	2.0	13.1	48.96
2.5	3.7	40.04	2.5	5.5	41.86	2.5	13.0	48.92
3.0	3.7	40.04	3.0	5.5	41.85	3.0	13.0	48.89
3.5	3.7	40.04	3.5	5.5	41.84	3.5	13.0	48.87
4.0	3.7	40.03	4.0	5.5	41.83	4.0	13.0	48.85
4.5	3.7	40.03	4.5	5.5	41.81	4.5	13.0	48.84
5.0	3.7	40.03	5.0	5.5	41.81	5.0	13	48.82
						6.0	12.9	48.77
						7.0	12.9	48.73
						8.0	12.9	48.69
						9.0	12.9	48.67
						10.0	12.8	48.63

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)



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12-3-06

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-22-06

Boring No. B951

Test Interval: 72.5 to 77.5 feet from Datum

L = 5'

Casing Stickup 1.5 feet

PoMAX = (h_1 x 1) + (h_2 x 0.57). h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the ~~datum~~ gage to the water level
h_2 = Distance from the water level to the center of the test interval

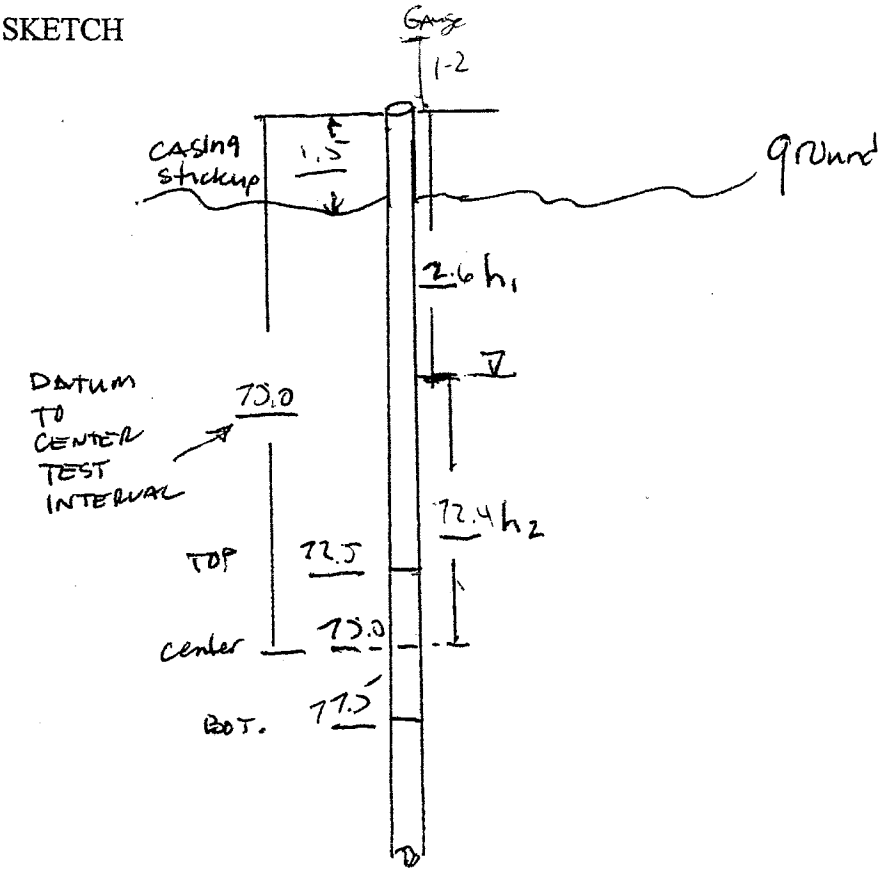
---

h_1 = 3.8

h_2 = 2.6 - 75.0 = 72.4

P MAX = 3.8 + 41.26 = 45.06

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

/07 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-23-06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.

TOTAL BORING DEPTH FROM DATUM: 102.5 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 72.4 FT.

1/3 MAXIMUM TEST PRESSURE, Po 45.06 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 1 TEST PRESSURE 14.87* psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 5.62, Middle 31.54, Bottom 34.26

Transducer Readings after initial pressurization:
Top 6.09, Middle 34.21, Bottom 34.99

Transducer Readings after final flow measurement:
Top 3.63, Middle 33.04, Bottom 34.50

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2795.1	—	~~1.4~~ .2	
0.5	2795.1	Ø	.2	
1.0	2795.2	.2	5.5	
1.5	2795.2	Ø	6.2	
2.0	2795.2	Ø	6.0	
2.5	2795.2	Ø	6.5	
3.0	2795.2	Ø	6.8	
3.5	2795.2	Ø	6.6	
4.0	2795.2	Ø	6.7	
4.5	2795.2	Ø	6.5	
5.0	2795.2	Ø	6.6	

VJ 8-23 Test pressure increased due to the natural pressure being higher than the test pressure, per Al Tice's instructions

* 37.63

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE ~~3~~ 2

BORING NO.: B951

DATE: 8-27-06

TEST NUMBER: 1

TEST INTERVAL (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.

DATA COLLECTED BY: S Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	6.6	37.65
0.5	6.1	37.29
1.0	5.9	37.041
1.5	5.6	36.76
2.0	5.4	36.53
2.5	5.3	36.32
3.0	5.1	36.13
3.5	4.9	35.92
4.0	4.7	35.75
4.5	4.6	35.59
5.0	4.4	35.44
6.0	4.2	35.14
7.0	4.0	34.89
8.0	3.8	34.69
9.0	3.6	34.47
10.0	3.4	34.28
11.0	3.3	34.11
12.0	3.2	33.96
13.0	3.0	33.81
14.0	2.9	33.68
15.0	2.8	33.57
20.0	2.4	33.11

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B951 - M172 - 77

" - B172 - "

" - T172 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAV 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-23-06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.

TOTAL BORING DEPTH FROM DATUM: 102.5 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 77.4 FT.

2/3 MAXIMUM TEST PRESSURE, Po 45.06 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: ~~3~~ 2 TEST PRESSURE 29.74* psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 5.62, Middle 31.54, Bottom 34.26

Transducer Readings after initial pressurization:
Top 5.63, Middle 33.04, Bottom 34.50

Transducer Readings after final flow measurement:
Top 5.62, Middle 32.80, Bottom 34.49

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2795.2	✓	2.1	
0.5	2795.4	.4	8.2	
1.0	2795.4	Ø	9.4	
1.5	2795.4	Ø	8.7	
2.0	2795.4	Ø	8.5	
2.5	2795.4	Ø	8.0	
3.0	2795.4	Ø	10.5	
3.5	2795.4	Ø	9.8	
4.0	2795.4	Ø	9.3	
4.5	2795.4	Ø	8.9	
5.0	2795.4	Ø	8.4	

See test #1

*39.63

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 3 2

BORING NO.: B951

DATE: 8-23-06

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.

DATA COLLECTED BY: SHoward

JBS 12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	8.4	39.74
0.5	8.0	39.30
1.0	7.6	38.92
1.5	7.3	38.57
2.0	7.0	38.24
2.5	6.7	37.92
3.0	6.5	37.63
3.5	6.2	37.40
4.0	6.0	37.15
4.5	5.8	36.91
5.0	5.6	36.70
6.0	5.3	36.31
7.0	5.0	35.96
8.0	4.7	35.64
9.0	4.4	35.36
10.0	4.3	35.13
11.0	4.0	34.88
12.0	3.8	34.67
13.0	3.7	34.49
14.0	3.5	34.30
15.0	3.4	34.16
20.0	2.8	33.50

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B951 - M272 - 77
" - B272 - "
" - T272 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-23-06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.

TOTAL BORING DEPTH FROM DATUM: 102.5 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 72.4 FT.

MAXIMUM TEST PRESSURE, Po 45.06 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 3 TEST PRESSURE 45.06 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 5.62, Middle 31.54, Bottom 34.26

Transducer Readings after initial pressurization:

Top 5.62, Middle 32.80, Bottom 34.49

Transducer Readings after final flow measurement:

Top 5.62, Middle 34.30, Bottom 34.51

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2795.4	✓	1.8	
0.5	2795.7	.6	9.0	
1.0	2795.7	Ø	13.4	
1.5	2795.7	Ø	14.8	
2.0	2795.7	Ø	13.8	
2.5	2795.7	Ø	13.4	
3.0	2795.7	Ø	13.4	
3.5	2795.7	Ø	13.6	
4.0	2795.7	Ø	13.2	
4.5	2795.7	Ø	13.7	
5.0	2795.7	Ø	15.2	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 2

BORING NO.: B951

DATE: 8-23-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.

DATA COLLECTED BY: J Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	13.2	45.87
0.5		
1.0	12.8	44.64
1.5	12.4	43.72
2.0	11.6	42.97
2.5	10.8	42.26
3.0	10.2	41.72
3.5	9.7	41.18
4.0	9.2	40.66
4.5	8.8	40.19
5.0	8.5	39.80
6.0	7.8	39.08
7.0	7.2	38.42
8.0	6.7	37.88
9.0	6.2	37.40
10.0	5.9	36.98
11.0	5.5	36.58
12.0	5.2	36.20
13.0	4.9	35.93
14.0	4.7	35.64
15.0	4.5	35.39
20.0	3.6	34.40

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Test: B951 - MB72-77

" - BB72 - "

" - TB72 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8- -06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.

TOTAL BORING DEPTH FROM DATUM: 102.5 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 72.4 FT.

1/2 MAXIMUM TEST PRESSURE, Po 45.06 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 4 TEST PRESSURE 22.53 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top____, Middle ____, Bottom ____

Transducer Readings after initial pressurization:

Top____, Middle ____, Bottom ____

Transducer Readings after final flow measurement:

Top____, Middle ____, Bottom ____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

Hole not taking water, so test not preformed

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JHD 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-23-06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.

TOTAL BORING DEPTH FROM DATUM: 102.5 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 72.41 FT.

MAXIMUM TEST PRESSURE, Po 45.06 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 5 TEST PRESSURE 45.06 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top ____, Middle ____, Bottom ____

Transducer Readings after initial pressurization:

Top ____, Middle ____, Bottom ____

Transducer Readings after final flow measurement:

Top ____, Middle ____, Bottom ____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

Hole not taking water, so test not preformed

78 83
-1.5 +1.5
79.5 84.5

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-22

Boring No. B951

Test Interval: 79.5 to 84.5 feet from Datum

Casing Stickup 1.5 feet

12-3-06

PoMAX = (h_1 x 1) + (h_2 x 0.57). h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the ~~datum~~ Gauge to the water level
h_2 = Distance from the water level to the center of the test interval

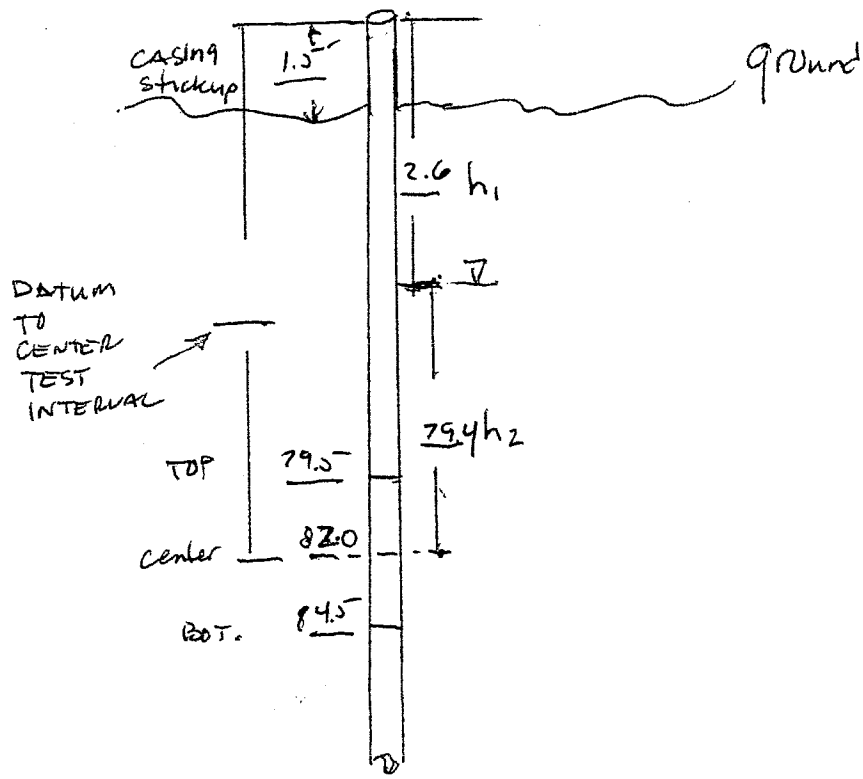
---

h_1 = 3.8

h_2 = 82.0 - 2.6 = 79.4

P MAX = 3.8 + 45.25 = 49.05

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JJ 1/23-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-22-06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.5 FT. TO 84.5 FT.

TOTAL BORING DEPTH FROM DATUM: 1025 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 79.4 FT.

1/3 MAXIMUM TEST PRESSURE, Po 49.05 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 1 TEST PRESSURE 16.18* psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 5.94, Middle 34.74, Bottom 37.33

Transducer Readings after initial pressurization:

Top 6.13, Middle 36.07, Bottom 37.74

Transducer Readings after final flow measurement:

Top 5.80, Middle 40.05, Bottom 37.48

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2793.9	/	.2	
0.5	2793.9	Ø	.5	
1.0	2794.3	.8	3.8	
1.5	2794.3	Ø	3.7	
2.0	2794.3	Ø	3.7	
2.5	2794.3	Ø	3.7	
3.0	2794.3	Ø	3.7	
3.5	2794.3	Ø	3.7	
4.0	2794.3	Ø	3.7	
4.5	2794.3	Ø	3.7	
5.0	2794.3	Ø	3.7	

Pressure raised per AlTice's instuctions; Test pressure ~~and~~ below natural Pressure

39.67*

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE 2

BORING NO.: B951

DATE: 8-22-06

TEST NUMBER: 1

TEST INTERVAL (FROM DATUM): FROM 79.5 FT. TO 84.5 FT.

DATA COLLECTED BY: J Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	3.7	40.04
0.5	3.7	40.04
1.0	3.7	40.05
1.5	3.7	40.04
2.0	3.7	40.04
2.5	3.7	40.04
3.0	3.7	40.04
3.5	3.7	40.04
4.0	3.7	40.03
4.5	3.7	40.03
5.0	3.8	40.03

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B951 - M1 79 - 84

" - B1 79 - "

" - T1 79 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JKG 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-22-06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.5 FT. TO 84.5 FT.

TOTAL BORING DEPTH FROM DATUM: 102.5 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 79.4 FT.

2/3 MAXIMUM TEST PRESSURE, Po 49.05 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 2 TEST PRESSURE 32.37* psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 5.94, Middle 34.74, Bottom 37.33

Transducer Readings after initial pressurization:
Top 5.80, Middle 35.83, Bottom 37.46

Transducer Readings after final flow measurement:
Top 5.80, Middle 41.81, Bottom 37.46

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2794.3	—	00.0	
0.5	2794.3	Ø	0.2	
1.0	2794.5	.4	4.7	
1.5	2794.5	Ø	5.5	
2.0	2794.5	Ø	5.6	
2.5	2794.5	Ø	5.5	
3.0	2794.5	Ø	5.5	
3.5	2794.5	Ø	5.5	
4.0	2794.5	Ø	5.5	
4.5	2794.5	Ø	5.6	
5.0	2794.5	Ø	5.5	

* 41.89 See test 1

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE ~~3~~ 2

BORING NO.: B951

DATE: 8-22

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM ~~84~~ 79 FT. TO 84.5 FT.

DATA COLLECTED BY: J Howard

BJ 12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	5.5	41.89
0.5	5.5	41.87
1.0	5.5	41.87
1.5	5.5	41.86
2.0	5.5	41.86
2.5	5.5	41.86
3.0	5.5	41.85
3.5	5.5	41.84
4.0	5.5	41.83
4.5	5.5	41.81
5.0	5.5	41.81

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B951 - M2 79 - 84
" - B2 79 - "
" - T2 79 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-22-06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.5 FT. TO 84.5 FT.

TOTAL BORING DEPTH FROM DATUM: 102.5 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 79.4 FT.

MAXIMUM TEST PRESSURE, Po 49.05 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 3 TEST PRESSURE 49.05 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 5.94, Middle 34.74, Bottom 37.33

Transducer Readings after initial pressurization:
Top 5.80, Middle 35.61, Bottom 37.45

Transducer Readings after final flow measurement:
Top 5.79, Middle 48.58, Bottom 37.47

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2794.5	—	-0.1	
0.5	2794.8	0.6	9.1	
1.0	2795.1	0.6	13.2	
1.5	2795.1	Ø	13.1	
2.0	2795.1	Ø	13.1	
2.5	2795.1	Ø	13.1	
3.0	2795.1	Ø	13.1	
3.5	2795.1	Ø	13.1	
4.0	2795.1	Ø	13.2	
4.5	2795.1	Ø	13.1	
5.0	2795.1	Ø	13.1	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE ~~3~~ 2

BORING NO.: B951

DATE: 8-22-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 84.5 FT. TO 79.5 FT.

DATA COLLECTED BY: J Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	13.1	49.06
0.5	13.1	49.02
1.0	13.1	48.00
1.5	13.1	48.96
2.0	13.1	48.96
2.5	13.0	48.92
3.0	13.0	48.89
3.5	13.0	48.87
4.0	13.0	48.85
4.5	13.0	48.84
5.0	13.0	48.82
6.0	12.9	48.77
7.0	12.9	48.73
8.0	12.9	48.69
9.0	12.9	48.67
10.0	12.8	48.63

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06 Tests: B951 - M379 - 84

" - B379 - "

" - T379 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 8-22-06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.5 FT. TO 84.5 FT.

TOTAL BORING DEPTH FROM DATUM: 102.5 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 79.4 FT.

1/2 MAXIMUM TEST PRESSURE, Po 49.05 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 4 TEST PRESSURE 24.52 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top____, Middle ____, Bottom ____

Transducer Readings after initial pressurization:

Top____, Middle ____, Bottom ____

Transducer Readings after final flow measurement:

Top____, Middle ____, Bottom ____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

No Test, Hole not taking water

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 PAGE ~~3~~ 2

BORING NO.: B951

DATE: 8-22-06

TEST NUMBER: 4

TEST INTERVAL (FROM DATUM): FROM 79.5 FT. TO 84.5 FT.

DATA COLLECTED BY: Howard

12-3-06

SHUT-IN TEST

PRESSURE:_____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0		
0.5		
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B951- M479-84
" - T479 - "
" - B479 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

PJ 12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-22-06

BORING NO. B951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE ____

DATUM ELEVATION n/a

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 5.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.5 FT. TO 84.5 FT.

TOTAL BORING DEPTH FROM DATUM: 102.5 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 2.6 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.2 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 79.4 FT.

MAXIMUM TEST PRESSURE, Po 49.05 (Po = [(A+B) *1] + C*.57 psi)

TEST NUMBER: 5 TEST PRESSURE 49.05 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top____, Middle ____, Bottom ____

Transducer Readings after initial pressurization:

Top____, Middle ____, Bottom ____

Transducer Readings after final flow measurement:

Top____, Middle ____, Bottom ____

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

No test Hole not taking water

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472 **PAGE 3**

BORING NO.: B951

DATE: 8-22-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM ~~84.5~~ 79.5 **FT. TO** ~~79.5~~ 84.5 **FT.**

DATA COLLECTED BY: S Howard

SHUT-IN TEST

PRESSURE: _____ **psi**

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	13.1	49.06
0.5	13.1	49.02
1.0	13.1	48.99
1.5	13.1	48.96
2.0	13.1	48.96
2.5	13.0	48.92
3.0	13.0	48.89
3.5	13.0	48.87
4.0	13.0	48.85
4.5	13.0	48.84
5.0	13.0	48.82
6.0	12.9	48.77
7.0	12.9	48.73
8.0	12.9	48.69
9.0	12.9	48.67
10.0	12.8	48.63

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B951 - M379 - 84
" - B379 - "
" - T379 - "

8 22-06

James Howard

Miller: Mark Hughes, Tim Garland

B950 & 951

~~Ma~~ 8-22

Arrival 7am

Meeting 730-8

Break Punch B950 8-9

Stand by for Planks to cross ditch at B951

9 - ~~1030~~ 11

lunch 11-1130

1130 - 1230 look for guys making cut steel bridge

1230 - 1 Safty meeting

1 - 2 Setup packers

2 - 345 Packer test B957 ~~7-8-22~~ 79.5 - 845

345-4 Break down & Move packer up

4 - 430 Paperwork

(3)

[illegible]

[illegible] Howard

[illegible] Mark Hughes, Tim Gorland

[illegible]

Arrive 7am

Safety Meeting 730am

8-830 set up packer tests

830-1030 Test Interval 72.5-77.5

1030-1130 Breakdown

1130-1230 lunch

1230-145 Breakdown

145-430 Drill B914 w/George Akin

60.6 to 80.8 (Rock core)

430-5 Breakdown/Clean up

5-530 Paperwork