

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

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)

Prepared by: ZO

Checked by: *[Signature]*

Date: 12-7-06

Date: 1-17-07

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 K_e 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 ($P_{Test} * 144 \text{ in}^2/\text{ft}^2/\gamma_w$)
 $K_e = ((Q/(H_M - P_m)) * (1/l)) * 1/2\pi * \ln(R/r_0) * (525.600 \text{ min/year}) * (0.1337 \text{ ft}^3/\text{gal})$
R = total length between packers, l
TNP = Test not performed
NM = not measured

Note:

Pressures P_t , P_m and P_b 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

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/ft³

Prepared by: ZO

Date: 12-7-06

Checked by: *[Signature]*

Date: 1-17-07

Abbreviations:

N.O. Not Observed

N.A. Not Applicable

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

TEST #2

TEST #3

Actual Excess Pressure= -8.63 psi Initial Middle Transducer Reading= 28.43 psi Test Pressure= 19.80 psi				Actual Excess Pressure= 11.23 psi Initial Middle Transducer Reading= 28.43 psi Test Pressure= 39.66 psi				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)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Test not performed				0	2752.2		0.2	0	2756		0.4
				0.5	2752.6	0.8	7.3	0.5	2757.5	3.0	26
				1	2753.2	1.2	10.1	1	2758.7	2.4	27.4
				1.5	2753.5	0.6	5.8	1.5	2759.6	1.8	27.7
				2	2753.7	0.4	8.5	2	2760.6	2.0	25.5
				2.5	2754.1	0.8	8.8	2.5	2761.5	1.8	25.3
				3	2754.5	0.8	10.4	3	2762.1	1.2	24.8
				3.5	2754.8	0.6	9.1	3.5	2762.9	1.6	24.2
				4	2754.9	0.2	8.2	4	2763.7	1.6	24
				4.5	2755.2	0.6	8.3	4.5	2764.5	1.6	23.7
				5	2755.4	0.4	8.2	5	2765.3	1.6	23.6
				6	2755.9	0.5	8.3	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

Joe 1-17-07

TEST #4

TEST #5

Actual Excess Pressure= 1.57 psi				Actual Excess Pressure= 31.67 psi			
Initial Middle Transducer 28.43 psi				Initial Middle Transducer 28.43 psi			
Test Pressure= 30.00 psi				Test Pressure= 60.1 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2767.2			0	2767.3		-2
0.5	2767.2	0.0	-2	0.5	2768.6	2.6	25.6
1	2767.2	0.0	-1	1	2769.6	2.0	23.4
1.5	2767.2	0.0	-0.8	1.5	2770.4	1.6	23.9
2	2767.2	0.0	-0.8	2	2771.2	1.6	24
2.5	2767.2	0.0	-0.5	2.5	2772	1.6	23.7
3	2767.2	0.0	-0.4	3	2772.7	1.4	23.4
3.5	2767.2	0.0	-0.6	3.5	2773.4	1.4	23.4
4	2767.2	0.0	-0.6	4	2774.2	1.6	23.3
4.5	2767.2	0.0	-0.6	4.5	2775.6	2.8	23.2
5	2767.2	0.0	-0.6	5	2776.7	2.2	23.2
6	2767.2	0.0	-0.6	6	2777.2	0.5	22.9

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

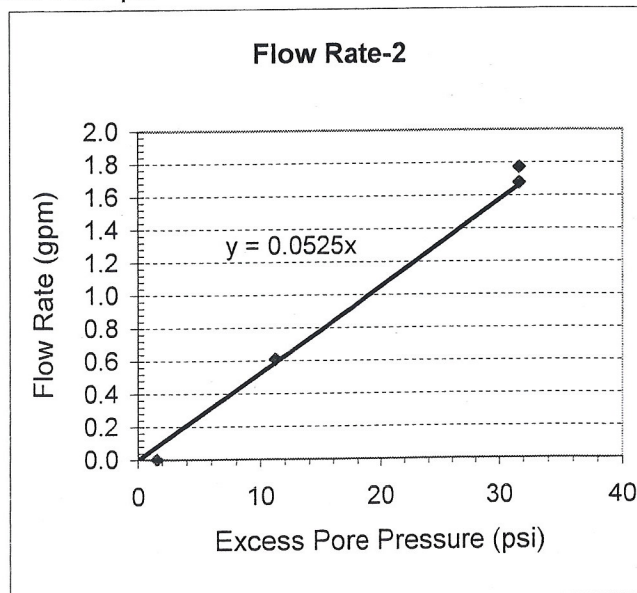
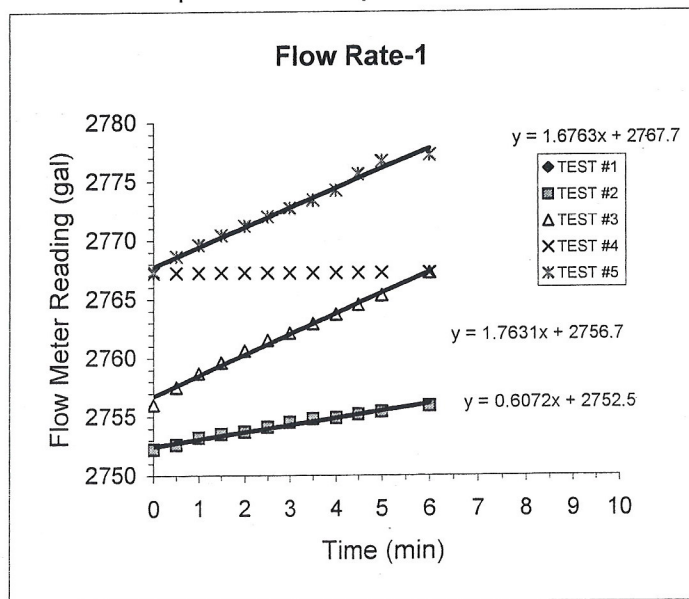
Density of water, $\rho_w = 62.4$ lb/ft³
= 0.0361 lb/in³
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft
choose R= 5 ft

	Excess Pressure (psi)	Q* (gpm)	Test Pres. (ft)	k _e (fpy)
1	-8.63	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

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

$$k_e = 1.67E-04 \text{ cm/sec}$$

$$= 173.05 \text{ ft/year}$$

Pressure Decay Test

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

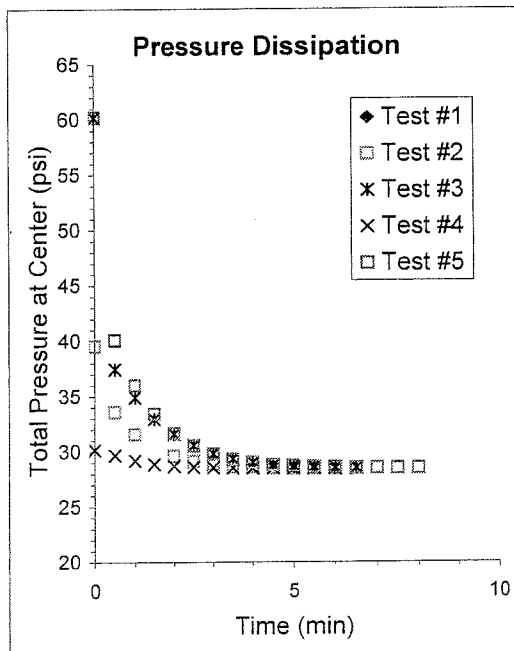
N.O. Not Observed
N.A. Not Applicable

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

(below 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)
Test not conducted			0.0	8.3	39.53	0.0	23.6	60.15
			0.5	3.5	33.58	0.5	3	37.42
			1.0	2.5	31.56	1.0	1.6	34.87
			1.5	1.7	33.39	1.5	0.5	32.94
			2.0	1.2	29.58	2.0	0.0	31.56
			2.5	0.9	29.09	2.5	-0.6	30.56
			3.0	0.8	28.84	3.0	-1.1	29.77
			3.5	0.6	28.57	3.5	-1.4	29.30
			4.0	0.6	28.57	4.0	-1.7	28.99
			4.5	0.5	28.48	4.5	-1.6	28.76
			5.0	0.5	28.45	5.0	-1.8	28.66
			5.5	0.5	28.44	5.5	-1.9	28.57
			6.0	0.5	28.43	6.0	-1.9	28.52
			6.5	0.5	28.42	6.5	-1.9	28.48

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	-0.6	30.14	0.0	22.9	60.19
0.5	-1.1	29.64	0.5	4.3	40.08
1.0	-1.4	29.15	1.0	1	35.98
1.5	-1.6	28.84	1.5	-1	33.40
2.0	-1.7	28.67	2.0	-1.8	31.61
2.5	-1.8	28.56	2.5	-2.6	30.48
3.0	-1.9	28.50	3.0	-3.0	29.75
3.5	-1.9	28.47	3.5	-3.3	29.28
4.0	-1.9	28.45	4.0	-3.5	29.01
4.5	-1.9	28.44	4.5	-3.6	28.78
5.0	-1.9	28.43	5.0	-3.7	28.68
5.5	-1.9	28.43	5.5	-3.7	28.61
6.0	-1.9	28.43	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**

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/30/2006

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

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)
 $\rho_w = 62.4 \text{ lb/ft}^3$

Abbreviations:

N.O. Not Observed
N.A. Not Applicable

$P_0 \text{ Max} = 62.96 \text{ psi}$

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

TEST #2

TEST #3

Actual Excess Pressure = -9.92 psi Initial Middle Transducer Reading = 30.62 psi Test Pressure = 20.70 psi				Actual Excess Pressure = 10.88 psi Initial Middle Transducer Reading = 30.62 psi Test Pressure = 41.50 psi				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)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Test not performed				0	2741		-0.2	0	2741.6		0
				0.5	2741.4	0.8	8.2	0.5	2743	2.8	26
				1	2741.6	0.4	7.6	1	2743.5	1.0	27.1
				1.5	2741.6	0.0	7.6	1.5	2743.9	0.8	26.8
				2	2741.6	0.0	7.9	2	2744.1	0.4	25
				2.5	2741.6	0.0	7.9	2.5	2744.4	0.6	25.7
				3	2741.6	0.0	7.9	3	2744.7	0.6	26
				3.5	2741.6	0.0	8.1	3.5	2745	0.6	26
				4	2741.6	0.0	7.9	4	2745.3	0.6	25.7
				4.5	2741.6	0.0	8	4.5	2745.5	0.4	25.5
				5	2741.6	0.0	7.9	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: gpm
Excess Pore pressure: -9.92 psi

Average Q: 0.0 gpm
Excess Pore pressure: 10.88 psi

Average Q: 0.5 gpm
Excess Pore pressure: 32.28 psi

TEST #4

TEST #5

Actual Excess Pressure= 0.78 psi				Actual Excess Pressure= 32.28 psi			
Initial Middle Transducer 30.62 psi				Initial Middle Transducer 30.62 psi			
Test Pressure= 31.40 psi				Test Pressure= 62.9 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2748.5		-1.6	0	2748.6		-1.6
0.5	2748.5	0.0	-1.6	0.5	2749.5	1.8	26.6
1	2748.5	0.0	-1.5	1	2749.7	0.4	25.6
1.5	2748.6	0.2	-0.5	1.5	2749.9	0.4	24.4
2	2748.6	0.0	-0.7	2	2750.1	0.4	24.1
2.5	2748.6	0.0	-0.9	2.5	2750.3	0.4	25.5
3	2748.6	0.0	-1	3	2750.5	0.4	26.1
3.5	2748.6	0.0	-1.2	3.5	2750.8	0.6	24.3
4	2748.6	0.0	-1.1	4	2750.9	0.2	22.2
4.5	2748.6	0.0	-0.7	4.5	2751.1	0.4	23.7
5	2748.6	0.0	-0.7	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

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

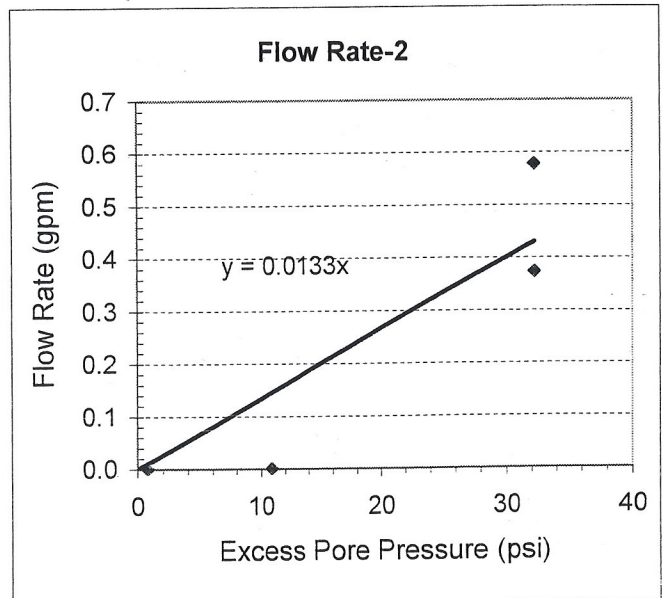
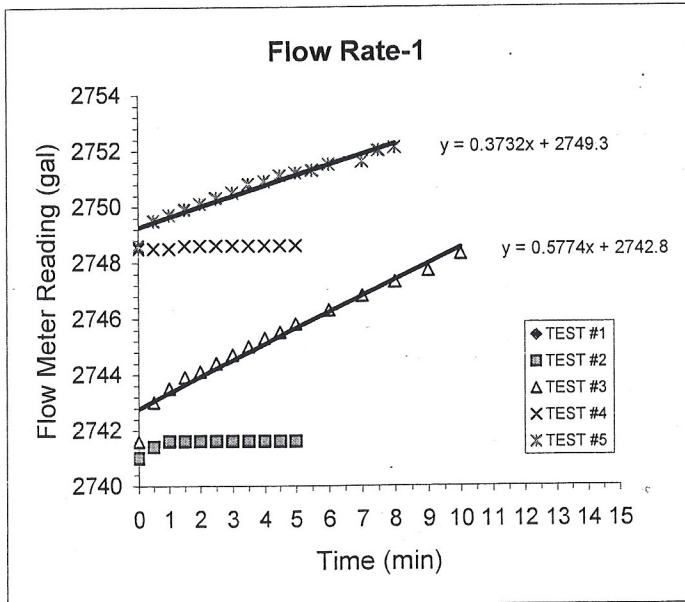
Density of water, $\rho_w = 62.4$ lb/ft³
 = 0.0361 lb/in³
 Length = 5 ft
 Borehole radius = 2.00 in
 R ranges from 5-10 ft:
 choose R = 5 ft

	Excess Pressure (psi)	Q* (gpm)	Test Pres. (ft)	k _e (fpy)
1	-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

Average Q: 0.0 gpm
 Excess Pore pressure: 0.78 psi

Average Q: 0.4 gpm
 Excess Pore pressure: 32.28 psi



Note: Graph 2 not applicable as flow only at one pressure. Use average of K_e for Tests 3 and 5
 obtain Q from graph 2 in gpm/psi --> NA gal/psi

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

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

Pressure Decay Test

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)

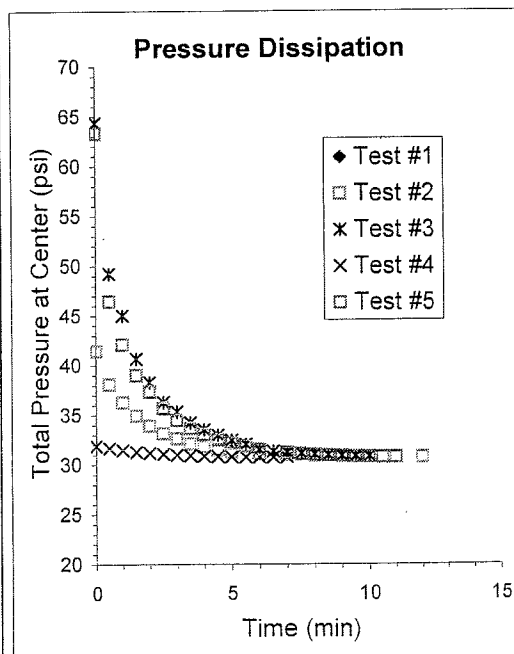
Prepared by: ZO Date: 12-7-06

Checked by: *je* Date: 1-17-07

N.O. Not Observed
N.A. Not Applicable

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	7.9	41.44	0.0	26.1	64.32
			0.5	5.3	38.11	0.5	13.1	49.20
			1.0	3.9	36.29	1.0	8.9	45.02
			1.5	2.9	34.95	1.5	5.3	40.65
			2.0	2.4	33.94	2.0	3.5	38.29
			2.5	1.8	33.18	2.5	2	36.29
			3.0	1.5	32.65	3.0	1.4	35.32
			3.5	1.2	32.14	3.5	0.6	34.24
			4.0	1	31.8	4.0	0.2	33.54
			4.5	0.8	31.52	4.5	-0.1	32.98
			5.0	0.7	31.29	5.0	-0.5	32.46
			6.0	0.6	31.12	5.5	-0.7	32.05
			7.0	0.5	30.97	6.0	-1	31.52
			8.0	0.4	30.89	6.5	-1.2	31.33
			9.0	0.4	30.81	7.0	-1.2	31.19
			10.0	0.3	30.76	7.5	-1.3	31.10
			11.0	0.3	30.72	8.0	-1.4	31.02
			12.0	0.3	30.7	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			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	-0.7	31.87	0.0	24.7	63.27
0.5	-0.9	31.65	0.5	9.6	46.44
1.0	-1.1	31.45	1.0	5.8	42.11
1.5	-1.2	31.28	1.5	3.0	39.00
2.0	-1.3	31.16	2.0	2.1	37.36
2.5	-1.3	31.06	2.5	0.9	35.71
3.0	-1.4	30.97	3.0	0.1	34.49
3.5	-1.4	30.91	3.5	-0.3	33.69
4.0	-1.5	30.85	4.0	-0.7	33.08
4.5	-1.5	30.80	4.5	-1.1	32.54
5.0	-1.5	30.77	5.0	-1.3	32.21
5.5	-1.6	30.75	5.5	-1.6	31.87
6.0	-1.6	30.74	6.0	-1.7	31.54
6.5	-1.6	30.73	6.5	-1.9	31.34
7	-1.6	30.71	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

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)

$\rho_w = 62.4 \text{ lb/ft}^3$

Prepared by: ZO

Date: 12-7-06

Checked by: *[Signature]*

Date: 1-17-07

Abbreviations:

N.O. Not Observed

N.A. Not Aplicable

$P_0 \text{ Max} = 66.04 \text{ psi}$

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

TEST #2

TEST #3

Actual Excess Pressure= -11.22 psi Initial Middle Transducer Reading= 33.01 psi Test Pressure= 21.79 psi				Actual Excess Pressure= 10.82 psi Initial Middle Transducer Reading= 32.75 psi Test Pressure= 43.57 psi				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)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Test not conducted				0	2509.7		0	0	2548		-10.3
				0.5	2509.7	0.0	0.1	0.5	2549.1	2.2	10.8
				1	2510.1	0.8	10.9	1	2556	13.8	14.7
				1.5	2515.4	10.6	13.4	1.5	2566.7	21.4	27.8
				2	2520.4	10.0	3.6	2	2575.7	18.0	28.7
				2.5	2525.3	9.8	3.7	2.5	2584.9	18.4	29.6
				3	2529.7	8.8	3.9	3	2593.9	18.0	31.3
				3.5	2532.9	6.4	3.9	3.5	2602.9	18.0	31.6
				4	2538.2	10.6	3.2	4	2611.6	17.4	31.4
				4.5	2542.2	8.0	3.2	4.5	2621.7	20.2	32.2
				5	2546.5	8.6	3.4	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

902-1-17-07

TEST #4

TEST #5

Actual Excess Pressure= 0.00 psi				Actual Excess Pressure= 30.85 psi			
Initial Middle Transducer 33.01 psi				Initial Middle Transducer 33.01 psi			
Test Pressure= 33.01 psi				Test Pressure (max achievable)= 63.86 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2632.1		-10.2	0	2633		-0.7
0.5	2632.1	0.0	-10.2	0.5	2636.8	7.6	25.2
1	2632.1	0.0	-10.1	1	2645.8	18.0	28.1
1.5	2632.2	0.2	-9.9	1.5	2655.9	20.2	30.3
2	2632.3	0.2	-9.6	2	2665.9	20.0	31.3
2.5	2632.6	0.6	-9.5	2.5	2674.3	16.8	31.5
3	2632.7	0.2	-9.5	3	2684.2	19.8	31.7
3.5	2632.8	0.2	-9.5	3.5	2692.8	17.2	32.5
4	2632.9	0.2	-9.4	4	2701.9	18.2	32.4
4.5	2633	0.2	-9.4	4.5	2711.3	18.8	33.1
5	2633	0.0	-9.4	5	2722.9	23.2	33.1
6	2633	0.0	-9.4	6	2737	14.1	33.1

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

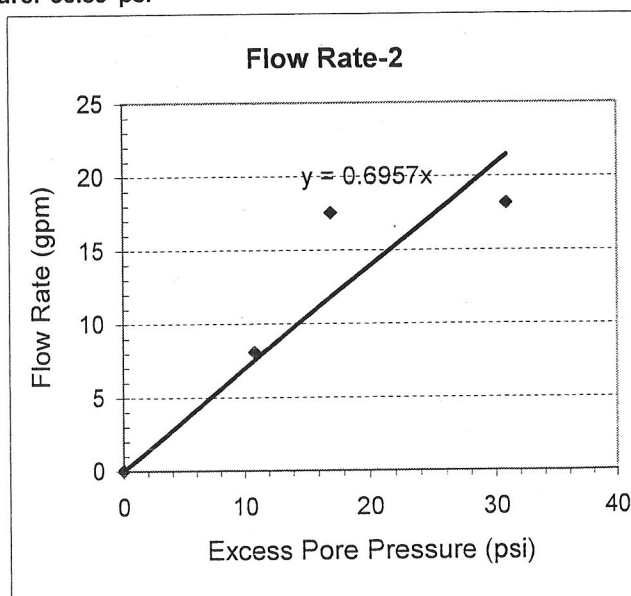
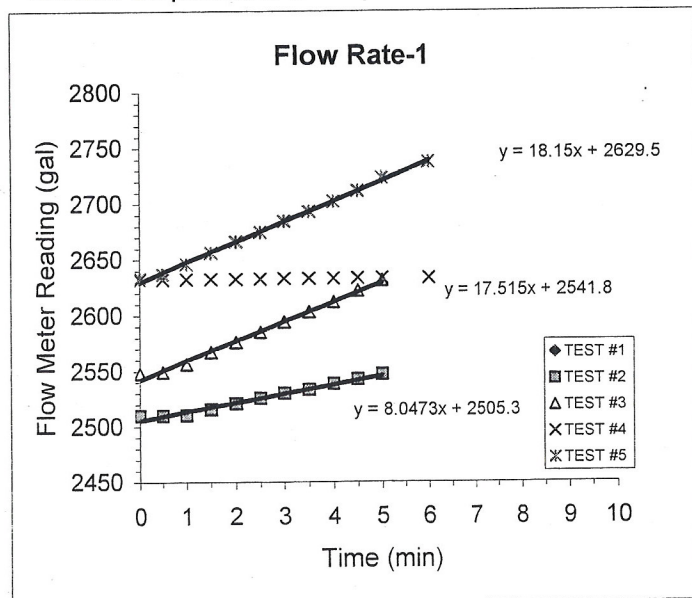
Density of water, $\rho_w = 62.4$ lb/ft³
= 0.0361 lb/in³
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

	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

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

$$k_e = 2.22E-03 \text{ cm/sec}$$

$$= 2293.17 \text{ ft/year}$$

Pressure Decay Test

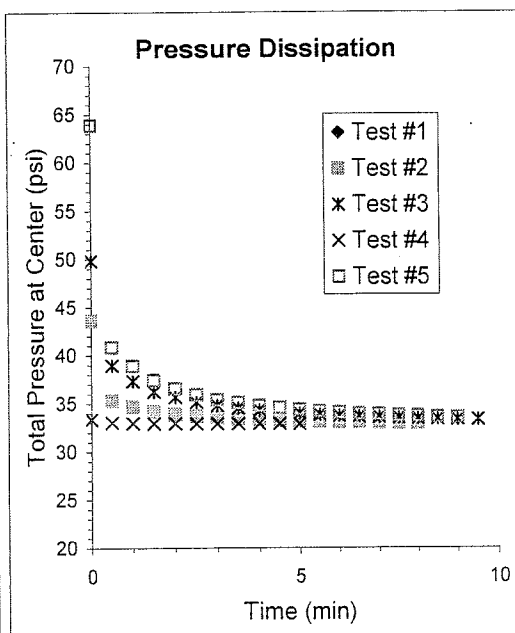
Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/16/2006

Prepared by: Z Date: 12-7-06
Checked by: *[Signature]* Date: 1-17-07

Boring No: B-949
Test Interval: 94.5 ft to 99.5 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)
Test not conducted			0.0	3.4	43.62	0.0	32.2	49.78
			0.5	-8.4	35.31	0.5	-3.8	38.94
			1.0	-8.3	34.66	1.0	-5.6	37.32
			1.5	-8.7	34.18	1.5	-6.6	36.22
			2.0	-9	33.88	2.0	-7.2	35.66
			2.5	-9.2	33.68	2.5	-7.8	35.12
			3.0	-9.4	33.52	3.0	-8.1	34.79
			3.5	-9.5	33.39	3.5	-8.5	34.50
			4.0	-9.6	33.31	4.0	-8.7	34.28
			4.5	-9.7	33.21	4.5	-8.8	
			5.0	-9.8	33.15	5.0	-9	33.95
			5.5	-9.9	33.1	5.5	-9.1	33.82
			6.0	-9.9	33.05	6.0	-9.2	33.69
			6.5	-9.9	33.02	6.5	-9.3	33.60
			7.0	-10.0	32.98	7.0	-9.4	33.53
			7.5	-10.0	32.95	7.5	-9.5	33.47
			8.0	-10.0	32.93	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			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	-9.4	33.34	0.0	33.1	63.86
0.5	-9.8	33	0.5	-1.9	40.86
1.0	-9.9	32.95	1.0	-3.8	38.92
1.5	-9.9	32.92	1.5	-5.7	37.40
2.0	-9.9	32.9	2.0	-6.3	36.56
2.5	-9.9	32.89	2.5	-7.0	35.92
3.0	-9.9	32.88	3.0	-7.5	35.37
3.5	-9.9	32.88	3.5	-7.8	35.08
4.0	-9.9	32.87	4.0	-8.1	34.78
4.5	-10	32.86	4.5	-8.3	34.55
5.0	-9.9	32.85	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



12-5-06

JA 2
12-5-06

Top _____, Middle _____, Bottom _____

[illegible]

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

84.0 89.0
 1.6 1.6
 85.6 90.6

JGJ
 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 = $(h_1 \times 1) + (h_2 \times 0.57)$. h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the datum to the water level

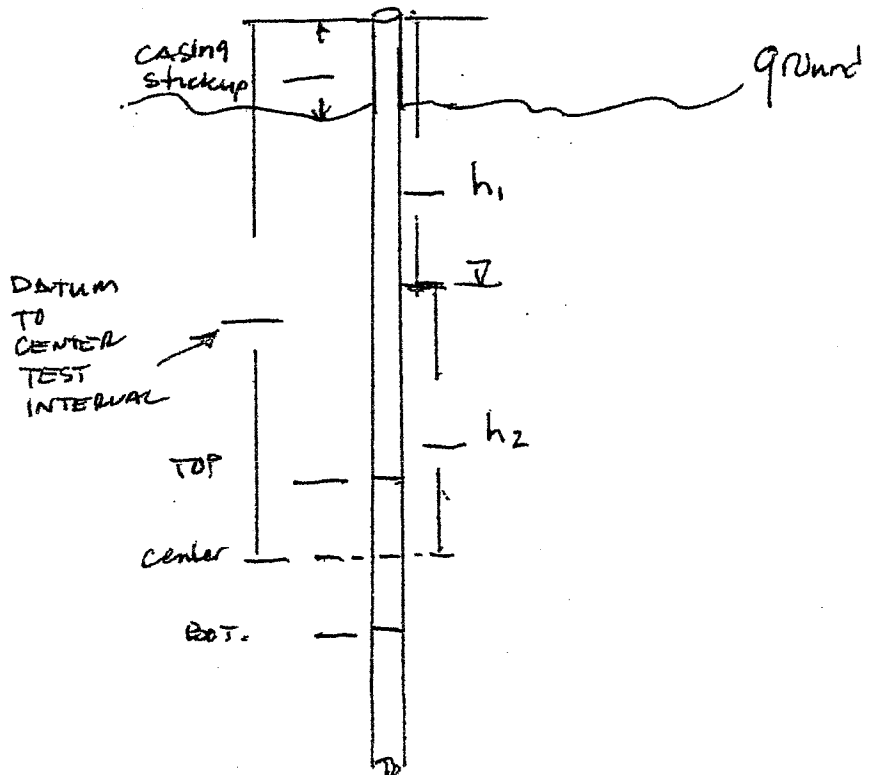
h_2 = Distance from the water level to the center of the test interval

$h_1 =$ 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 ☒ 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, P_o 60.1 ($P_o = [(A+B) * 1] + C * .57$ 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	

JA 2
12-5-06

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: S 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: 27.0 FT.

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

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 63.1 FT.

MAXIMUM TEST PRESSURE, P_o 60.1 ($P_o = [(A+B) * 1] + C * .57$ 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 2.45, Middle 28.42, Bottom 31.22

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	27 56.0	/	.4	
0.5	27 57.5	3.0	26.0	
1.0	27 58.7	2.4	27.4	
1.5	27 59.6	1.8	27.7	
2.0	27 60.6	2.0	25.5	
2.5	27 61.5	1.8	25.3	
3.0	27 62.1	1.2	24.8	
3.5	27 62.9	1.6	24.2	
4.0	27 63.7	1.6	24.0	
4.5	27 64.5	1.6	23.7	
5.0	27 65.3	1.6	23.6	
6.0	27 67.2	1.8	23.6	

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

for 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. B 949 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 51.0 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, P_o 32.55 (Po = [(A+B) * 1] + C * .57 psi)

TEST NUMBER: 4 TEST PRESSURE 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 29.5, Middle 28.42, Bottom 31.22

Transducer Readings after final flow measurement:
Top 29.5, 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 BOREHOLE PERMEABILITY TEST DATA SHEET

Jed
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. B 949 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: 5 TEST PRESSURE 60.1 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.06, Middle 28.03, 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	/	22.0	
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: TSB8-16 5

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

DATA COLLECTED BY: J. Haver

J. Haver
12-5-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	22.9	40.19
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	28.518

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 - " "

PACKER TESTING CALCULATIONS FOR P(MAX)

JS
12-5-06

Date: 8-16-06

Boring No. B949

Test Interval: 95.6 to 90.6 feet from Datum

Casing Stickup 1.6 feet

PoMAX = $(h_1 \times 1) + (h_2 \times 0.57)$. 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

$h_1 = \underline{23.0}$

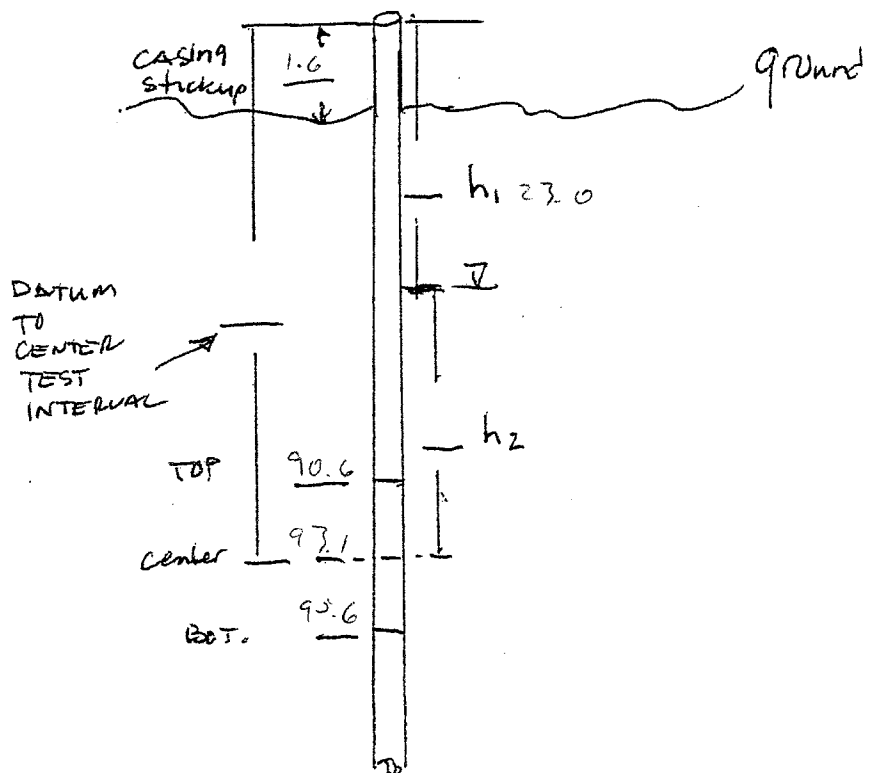
$h_2 = \underline{93.1} - \underline{23.0} = \underline{70.1}$

P MAX = $\underline{23.0} + \underline{39.96} = \underline{62.9}$

24.0
93.1 - 23.0 = 70.1
24.0

(63.9)

SKETCH



12-5-06

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

PAGE 3

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

2
JY
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-MZ 90.6-95.6
8-17

" BZ "

" T2 "

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: 8-17-06

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 95.6 FT. TO 90.6 FT.

TOTAL BORING DEPTH FROM DATUM: 95.6 FT. ²⁴⁸⁻¹⁶ 108.0

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

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.6 FT. ²⁴⁸⁻¹⁶ 1.0 FT.

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

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

MACTEC ENGINEERING AND CONSULTING, INC.

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

DATA COLLECTED BY: Shaw and DATE COLLECTED: 8-12-06

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, P_o 62.9 ($P_o = [(A+B) * 1] + C * .57$ 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	27 41.6	/	0.0	
0.5	27 43.0	2.8	26.0	
1.0	27 43.5	1.0	27.1	
1.5	27 43.9	.8	26.8	
2.0	27 44.1	.4	25.0	
2.5	27 44.4	.6	25.7	
3.0	27 44.7	.6	26.0	
3.5	27 45.0	.6	26.0	
4.0	27 45.3	.6	25.7	
4.5	27 45.5	.4	25.5	
5.0	27 45.8	.6	25.5	
6.0	27 46.3	1.0	24.7	
7.0	27 46.8	1.0	26.1	

BORING NO: B949

DATE: 8-13-06 17 *FB*

TEST NUMBER: 3

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

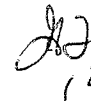
DATA COLLECTED BY: J Howard

12-5-04

[illegible]

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

PAGE 3

BORING NO.: B949DATE: 8-18-06TEST NUMBER: 3TEST INTERVAL (FROM DATUM): FROM 90.6 FT. TO 90.6 FT.DATA COLLECTED BY: Shoman


 12-5-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	26.1	64.72
.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

8-12-06
125-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL

PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: T Howard

DATE COLLECTED: 8-12-06

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 95.4 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, P_o 62.4 ($P_o = [(A+B) * 1] + C * .57$ 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	2748.5	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 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: 8-17-06

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 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, P_o 62.9 ($P_o = [(A+B) * 1] + C * .57$ 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 2.06, Middle 30.670, 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	23.5	
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	

BORING NO: 5 Howard

DATE: 8-17-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 98.6 FT. TO 90.6 FT.

DATA COLLECTED BY: J. H. ...

JA7
12-5-06

[illegible]

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

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BORING NO.: B-25-16 B449

DATE: 8-17-06

TEST NUMBER: 5

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

DATA COLLECTED BY: Stewart

12-5-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	24.7	67.27
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	31.59
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: B449 - M590-95
 " B590 "
 " T590 "

PACKER TESTING CALCULATIONS FOR P(MAX)

JAZ
12-5-06

Date: 8-16-06

Boring No. B-949

Test Interval: ~~24.85~~²⁴ to ~~99.85~~^{8.15} feet from Datum 96.1 - 101.1

Casing Stickup 1.6 feet

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

h_1 = Distance from the datum to the water level

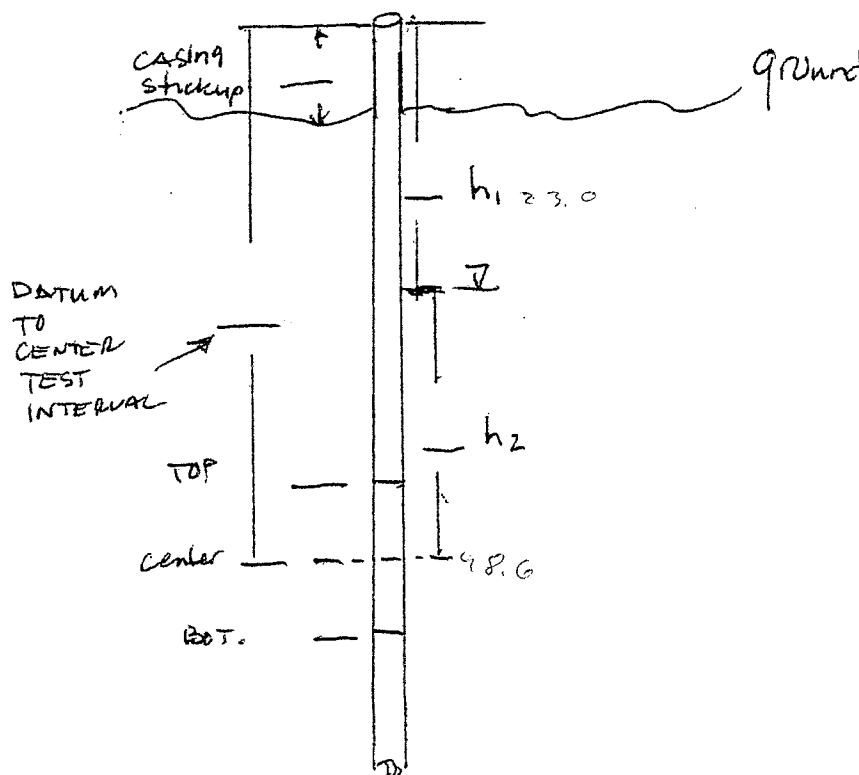
h_2 = Distance from the water level to the center of the test interval

$h_1 = \underline{23.0}$

$h_2 = \underline{23.1} - \underline{98.6} = \underline{75.5}$

P MAX = 23.0 + 43.03 = 66.03

SKETCH



JA 12-5-06

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

Handwritten: 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 94.1 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 FT. 1.0

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

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

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

Initial Transducer Readings: Top 3.151, Middle 32.01, Bottom 35.72

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	0	.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: S. Howard

2
J2 5-06

SHUT-IN TEST

PRESSURE: 43.62 psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	43.62	43.62
0.5	-8.4	35.21
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

JG
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 FT.

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

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

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

Initial Transducer Readings: Top 3.15, Middle 35.04, Bottom 35.84

Transducer Readings after initial pressurization:

Top 3.00, Middle 32.76, Bottom 35.63

Transducer Readings after final flow measurement:

Top 2.47, 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	27.2	
2.0	2575.7	18.0	28.7	
2.5	2584.9	18.4	29.6	
3.0	2593.4	18.0	31.3	
3.5	2602.9	18.0	31.6	
4.0	2611.6	17.4 20.2	31.4	
4.5	2621.7	20.2	32.2	
5.0	2631.1	18.8	32.2	
6.0				

JG Flow was mixed & could not match stabilization
Stopped @ 5 min

BORING NO.: B944DATE: 8-16-06TEST NUMBER: 3TEST INTERVAL (FROM DATUM): FROM 96.1 FT. TO 101.1 FT.DATA COLLECTED BY: J HowardJH
12-5-06

SHUT-IN TEST

PRESSURE: 49.78 psiUse this
for calculations
for

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	32.2	49.78
0.5	- 7.8	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	33.95 8.17 missed
5.0	- 9.0	33.95
5.5	- 9.1	33.82
6.0	- 9.2	33.69
6.5	- 9.7	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: B944-M3 96-101
 B944-B3 96-101
 B944-T3 96-101

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: 27.5-16
1.6 1.0 FT.

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

$\frac{1}{2}$ MAXIMUM TEST PRESSURE, P_o 66.03 ($P_o = [(A+B) * 1] + C * .57$ 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	26 26 32.1	/	-10.2	
0.5	26 32.1	/	-10.2	
1.0	26 32.1	/	-10.1	
1.5	26 32.2	.2	-9.9	
2.0	26 32.3	.2	-9.6	
2.5	26 32.6	.6	-9.5	
3.0	26 32.7	.2	-9.5	
3.5	26 32.8	.2	-9.5	
4.0	26 32.9	.2	-9.4	
4.5	26 33.0	.2	-9.4	
5.0	26 33.0	/	9.4	
6.0	26 33.0	/	-9.4	

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

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: 8-16-00

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 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 FT.

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

MAXIMUM TEST PRESSURE, P_o 66.03 ($P_o = [(A+B) * 1] + C * .57$ 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 2.44, 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	2646.8	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	

J * Same as test 3, could not reach max pressure

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

PAGE 3

BORING NO.: B949DATE: 8-16-06TEST NUMBER: 5TEST INTERVAL (FROM DATUM): FROM 96.1 FT. TO 101.1 FT.DATA COLLECTED BY: J Howard

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	38.92
1.5	- 5.7	37.40
2.0	- 6.7	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	- 8.7	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	33.87
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

DATA REPORT Rev. 0

700 Arrive
730 safety meet
8am - 1245 Ready Packer tests

~~Work Inst~~

~~8-15-06~~ 1245-1 Safety meet

1- 4:30 Packer stand by & setup 3949

1.5 hrs stand by

MACTEC ENGINEERING & CONSULTING, INC.

1/23/07

③

54

8-16-06

James Howard

Miller: Mark Hughes, Tim Garland

7am Arrive

730-745 Safety meeting

745-10 Setup For Packer-B949

10-1130 Water Run

1130-1215 Standby

1245-115 Water run

115-430 More setup

430-445 Breakdown for night

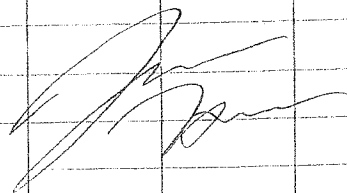
Had issues w/ Packer & Pressure
test & talked w/ Garrett ⁸⁻¹⁶ Ret Jan

Also had issue w/ Nitrogen leak

Garrett will look at pressure issue
tonight & will run test tomorrow

at 2/3 rds max

445-5 Paperwork



(4)

8-17-06

James Howan

Miller, Mark Hughes, Tim Garland
B949

Tam arrive

730 safety meeting

745-805 Setup

815-10 Test B949 101-96

10-1030 Move up to next interval

1030-1 Stand by Driller looking for splice
for Nitrogen line

1-130 Fix line

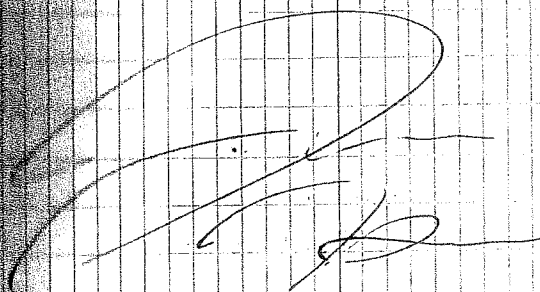
130-345 Packer 90-95

345-5 Packer 85-90

5-5306 Paperwork

2-10
8-7

51

Standing level @ 23.0 from
Datum.



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

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)

Prepared by: ZQ
Checked by: *Je*

Date: 12-7-06
Date: 1-17-07

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 ($P_{Test} * 144 \text{ in}^2/\text{ft}^2 / \gamma_w$)
 $K_e = ((Q / (H_M - P_M)) * (1/l)) * 1/2\pi * \ln(R/r_0) * (525,600 \text{ min/year}) * (0.1337 \text{ ft}^3/\text{gal})$
R = total length between packers, l
TNP = Test not performed
NM = not measured

Note: Pressures P_t , P_m and P_b 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

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)

$\rho_w = 62.4 \text{ lb/ft}^3$

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

Abbreviations:

N.O. Not Observed

N.A. Not Applicable

$P_0 \text{ Max} = 52.78 \text{ psi}$

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

TEST #2

TEST #3

Actual Excess Pressure= 10.00 psi Initial Middle Transducer Reading= 7.41 psi Test Pressure= 17.41 psi				Actual Excess Pressure= 27.41 psi Initial Middle Transducer Reading= 7.41 psi Test Pressure= 34.82 psi				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)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2792.6		1.5	0	2793.1		6	0	2793.5		15.8
0.5	2792.6	0.0	1.5	0.5	2793.2	0.2	6	0.5	2793.9	0.8	29.8
1	2793.1	1.0	7.1	1	2793.5	0.6	15.6	1	2793.9	0.0	29.9
1.5	2793.1	0.0	7.1	1.5	2793.5	0.0	16.9	1.5	2793.9	0.0	29.9
2	2793.1	0.0	7.1	2	2793.5	0.0	16.9	2	2793.9	0.0	31.5
2.5	2793.1	0.0	7.0	2.5	2793.5	0.0	16.9	2.5	2793.9	0.0	31.5
3	2793.1	0.0	7.0	3	2793.5	0.0	16.9	3	2793.9	0.0	31.2
3.5	2793.1	0.0	6.9	3.5	2793.5	0.0	16.9	3.5	2793.9	0.0	32.1
4	2793.1	0.0	6.9	4	2793.5	0.0	16.9	4	2793.9	0.0	32.2
4.5	2793.1	0.0	6.9	4.5	2793.5	0.0	16.9	4.5	2793.9	0.0	32.1
5	2793.1	0.0	6.8	5	2793.5	0.0	16.9	5	2793.9	0.0	32.1

Average Q: 0.0 gpm
Excess Pore pressure: 10.00 psi

Average Q: 0.0 gpm
Excess Pore pressure: 27.41 psi

Average Q: 0.0 gpm
Excess Pore pressure: 45.36 psi

TEST #4

TEST #5

Actual Excess Pressure= NA psi				Actual Excess Pressure= NA psi			
Initial Middle Transducer 7.41 psi				Initial Middle Transducer 7.41 psi			
Test Pressure= psi				Test Pressure= psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole is not taking any water --> Test not performed				Hole is not taking any water --> Test not performed			

Boring No: B-950

Test Interval: 55 ft to 60 ft
(from surface)

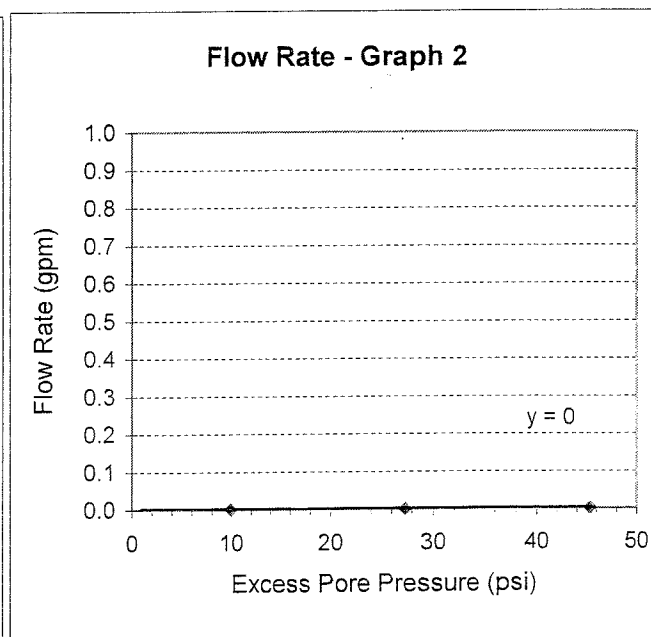
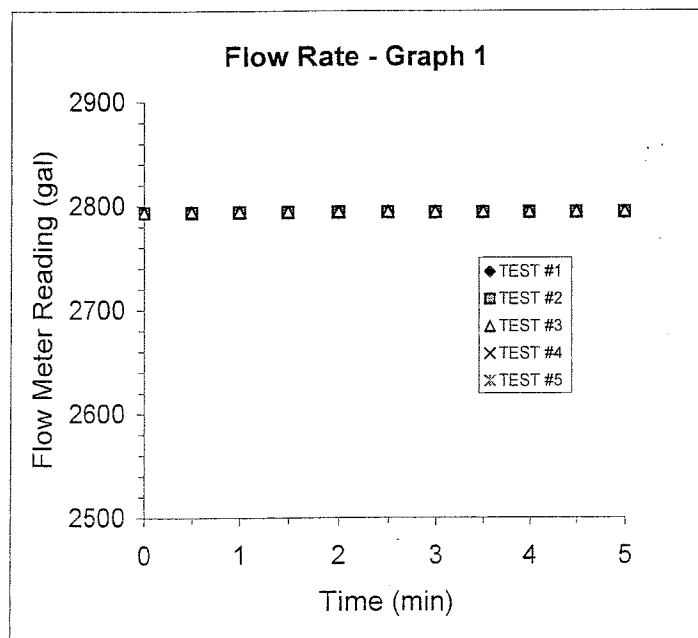
Density of water, $\rho_w = 62.4$ lb/ft³
 = 0.0361 lb/in
 Length= 5 ft
 Borehole radius= 2.00 in
 R ranges from 5-10 ft:
 choose R= 5 ft

	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

Average Q: gpm
 Excess Pore pressure: psi

Average Q: gpm
 Excess Pore pressure: psi



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

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

$$k_e = 0.00E+00 \text{ cm/sec}$$

$$= 0.00 \text{ ft/year}$$

Pressure Decay Test

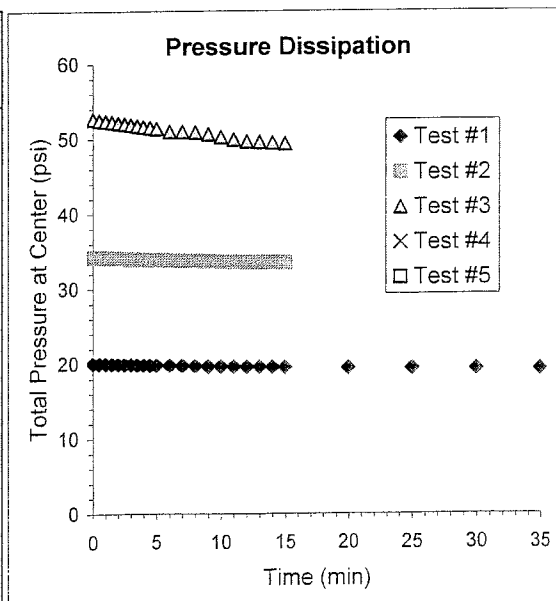
Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/21/2006
Boring No: B-950
Test Interval: 55 ft to 60 ft

Prepared by: ZO Date: 12-7-06
Checked by: Date: 1-17-07
N.O. Not Observed
N.A. Not Applicable

(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

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)

$\rho_w = 62.4 \text{ lb/ft}^3$

Prepared by: ZO

Date: 12-7-06

Checked by: *[Signature]*

Date: 1-17-07

Abbreviations:

N.O. Not Observed

N.A. Not Applicable

$P_0 \text{ Max} = 55.63 \text{ psi}$

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

TEST #2

TEST #3

Actual Excess Pressure= 8.71 psi Initial Middle Transducer Reading= 9.64 psi Test Pressure= 18.35 psi				Actual Excess Pressure= 32.25 psi Initial Middle Transducer Reading= 9.64 psi Test Pressure= 41.89 psi				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)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2787		1.0	0	2788.1		4.1	0	2789.2		8.3
0.5	2787	0.0	1.0	0.5	2788.8	1.4	8.9	0.5	2790.4	2.4	39.3
1	2787.4	0.8	1.4	1	2789.1	0.6	18.9	1	2790.4	0.0	38.2
1.5	2788.1	1.4	10.6	1.5	2789.2	0.2	17.9	1.5	2790.5	0.2	31.1
2	2788.1	0.0	10.5	2	2789.2	0.0	17.6	2	2790.5	0.0	32.9
2.5	2788.1	0.0	6.1	2.5	2789.2	0.0	17.3	2.5	2790.5	0.0	33.2
3	2788.1	0.0	5.9	3	2789.2	0.0	17.1	3	2790.5	0.0	33.3
3.5	2788.1	0.0	5.8	3.5	2789.2	0.0	16.9	3.5	2790.5	0.0	32.6
4	2788.1	0.0	5.8	4	2789.2	0.0	16.7	4	2790.5	0.0	32.5
4.5	2788.1	0.0	5.8	4.5	2789.2	0.0	17.4	4.5	2790.5	0.0	33.1
5	2788.1	0.0	5.7	5	2789.2	0.0	17.3	5	2790.5	0.0	33.2

Average Q: 0.2 gpm
Excess Pore pressure: 8.71 psi

Average Q: 0.0 gpm
Excess Pore pressure: 32.25 psi

Average Q: 0.0 gpm
Excess Pore pressure: 45.98 psi

Joe 1-17-07

TEST #4

TEST #5

Actual Excess Pressure= 18.17 psi				Actual Excess Pressure= 45.98 psi			
Initial Middle Transducer 9.64 psi				Initial Middle Transducer 9.64 psi			
Test Pressure= 27.81 psi				Test Pressure= 55.62 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2790.5		2.2	0	2791.2		2.9
0.5	2791.2	1.4	10.6	0.5	2792.6	2.8	32.8
1	2791.2	0.0	10.8	1	2792.6	0.0	37.2
1.5	2791.2	0.0	10.6	1.5	2792.6	0.0	35.7
2	2791.2	0.0	10.5	2	2792.6	0.0	34.2
2.5	2791.2	0.0	10.7	2.5	2792.6	0.0	32.6
3	2791.2	0.0	10.9	3	2792.6	0.0	33.5
3.5	2791.2	0.0	11.0	3.5	2792.6	0.0	34
4	2791.2	0.0	11.1	4	2792.6	0.0	33.8
4.5	2791.2	0.0	11.3	4.5	2792.6	0.0	33.9
5	2791.2	0.0	11.4	5	2792.6	0.0	33.4

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

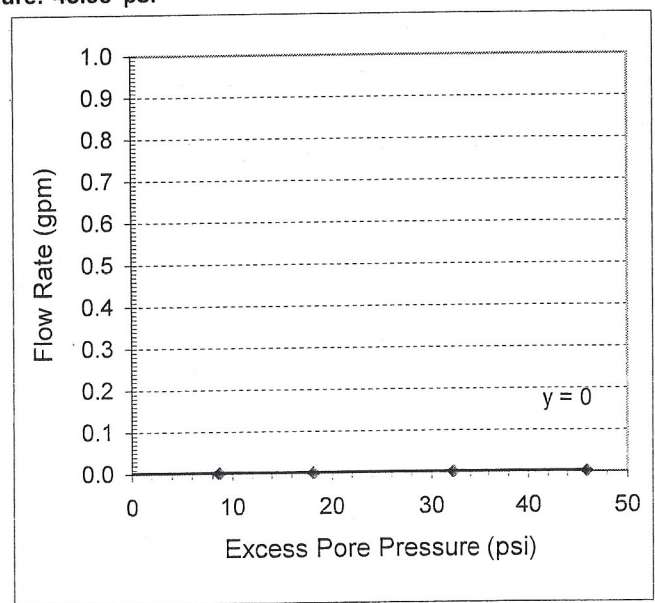
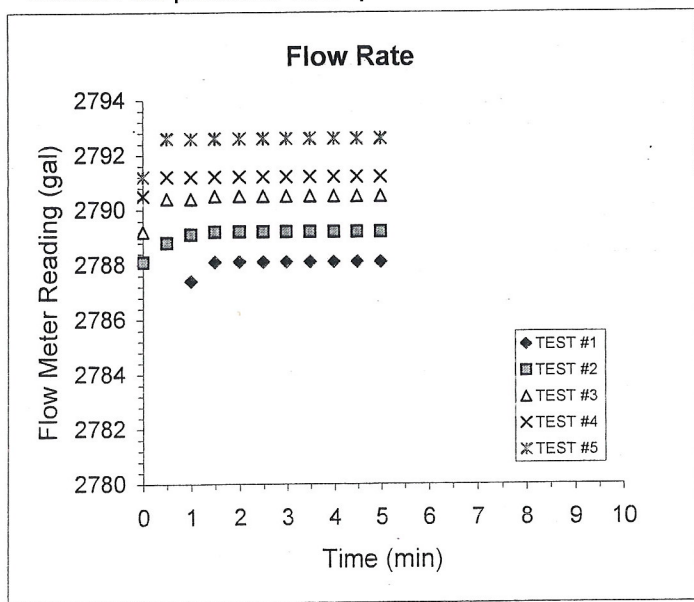
Density of water, $\rho_w = 62.4$ lb/ft³
= 0.0361 lb/in³
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

	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

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

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

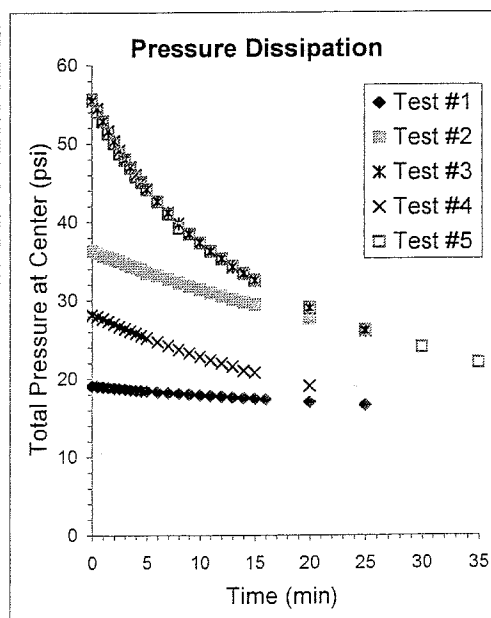
Pressure Decay Test

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

Prepared by: ZO Date: 12-7-06
Checked by: JA Date: 1-17-07
N.O. Not Observed
N.A. Not Applicable

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Transducer (psi)	Time (min)	Surface Gauge (psi)	Center Transducer (psi)	Time (min)	Surface Gauge (psi)	Center Transducer (psi)
0.0	5.7	19.07	0.0	17.3	36.29	0.0	33.2	55.42
0.5	5.7	19.00	0.5	17.0	36.04	0.5	31.8	54.44
1.0	5.7	18.93	1.0	16.8	35.68	1.0	30.4	52.83
1.5	5.6	18.85	1.5	16.6	35.47	1.5	29.3	51.55
2.0	5.6	18.79	2.0	16.3	35.19	2.0	28.1	50.28
2.5	5.6	18.71	2.5	16.1	35.00	2.5	27.2	49.08
3.0	5.5	18.65	3.0	16.0	34.68	3.0	26.2	47.96
3.5	5.4	18.57	3.5	15.7	34.31	3.5	25.3	46.98
4.0	5.4	18.5	4.0	15.5	34.16	4.0	24.5	45.99
4.5	5.4	18.46	4.5	15.4	33.9	4.5	23.6	45.07
5.0	5.4	18.4	5.0	15.4	33.48	5.0	22.8	44.15
6.0	5.3	18.28	6.0	14.8	33.15	6.0	21.7	42.60
7.0	5.2	18.17	7.0	14.4	32.65	7.0	20.5	41.13
8	5.2	18.07	8.0	14.1	32.22	8.0	19.3	39.74
9	5.1	17.98	9.0	13.8	31.82	9.0	18.3	38.43
10	5.1	17.88	10.0	13.5	31.34	10.0	17.3	37.32
11	5.0	17.78	11.0	13.2	30.94	11.0	16.5	36.25
12	5.0	17.69	12.0	12.9	30.52	12.0	15.8	35.29
13	4.9	17.59	13.0	12.6	30.11	13.0	15.0	34.23
14	4.9	17.5	14.0	12.4	29.75	14.0	14.4	33.4
15	4.8	17.4	15.0	12.1	29.39	15.0	13.7	32.52
16	4.8	17.31	20.0	10.9	27.68	20.0	11.1	28.93
20	4.6	16.95	25.0	9.9	26.18	25.0	9.0	26.02
25	4.3	16.54						

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Transducer (psi)	Time (min)	Surface Gauge (psi)	Center Transducer (psi)
0.0	11.4	28.1	0.0	33.4	55.64
0.5	11.2	27.92	0.5	32.0	54.03
1.0	11	27.62	1.0	30.9	52.81
1.5	10.8	27.29	1.5	29.5	51.22
2.0	10.5	26.98	2.0	28.5	49.99
2.5	10.3	26.62	2.5	27.7	48.70
3.0	10.1	26.35	3.0	26.6	47.91
3.5	9.9	26.07	3.5	25.7	46.85
4.0	9.7	25.76	4.0	24.6	45.79
4.5	9.4	25.49	4.5	24.0	45.04
5.0	9.3	25.18	5.0	23.4	44.10
6.0	9	24.69	6.0	22.1	42.58
7.0	8.6	24.16	7.0	20.9	41.00
8	8.3	23.69	8	19.9	39.20
9	8.1	23.23	9	18.8	38.46
10	7.7	22.78	10	17.9	37.29
11	7.4	22.34	11	17.2	36.28
12	7.1	21.92	12	16.4	35.30
13	6.1	21.51	13	15.8	34.35
14	6.6	21.00	14	15.1	33.40
15	6.4	20.74	15	14.4	32.58
20	5.4	19.00	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

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)

$\rho_w = 62.4 \text{ lb/ft}^3$

Prepared by: ZO Date: 12-7-06

Checked by:  Date: 12-17-07

Abbreviations:

N.O. Not Observed

N.A. Not Applicable

$P_0 \text{ Max} = 68.17 \text{ psi}$

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				TEST #2				TEST #3			
Actual Excess Pressure = 4.60 psi				Actual Excess Pressure = 18.49 psi				Actual Excess Pressure = 29.26 psi			
Initial Middle Transducer Reading = 26.36 psi				Initial Middle Transducer Reading = 26.49 psi				Initial Middle Transducer Reading = 26.36 psi			
Test Pressure = 30.96 psi				Test Pressure = 44.98 psi				Test Pressure = 55.62 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2777.6		-1.4	0	2780.3		2.1	0	2781.3		3.8
0.5	2777.6	0.0	-1.0	0.5	2781.0	1.4	4.5	0.5	2783	3.4	33.9
1	2779.1	3.0	8.2	1	2781.0	0.0	23.3	1	2783.1	0.2	38.2
1.5	2779.3	0.4	9.1	1.5	2781.0	0.0	21.1	1.5	2783.2	0.2	35.5
2	2779.3	0.0	8.9	2	2781.0	0.0	19.4	2	2783.3	0.2	39
2.5	2779.3	0.0	8.6	2.5	2781.0	0.0	17.8	2.5	2783.3	0.0	36.3
3	2779.3	0.0	8.4	3	2781.0	0.0	16.3	3	2783.3	0.0	37.1
3.5	2779.3	0.0	8.1	3.5	2781.0	0.0	15.5	3.5	2783.3	0.0	38.1
4	2779.3	0.0	7.8	4	2781.0	0.0	14.7	4	2783.3	0.0	35.9
4.5	2779.3	0.0	7.6	4.5	2781.0	0.0	19.7	4.5	2783.3	0.0	37.8
5	2779.3	0.0	7.4	5	2781.0	0.0	18.8	5	2783.4	0.2	37.1
				6	2781.0	0.0	18.7	6	2783.5	0.1	34.4
								7	2783.5	0.0	38.1

Average Q: 0.3 gpm
Excess Pore pressure: 4.60 psi

Average Q: 0.0 gpm
Excess Pore pressure: 18.49 psi

Average Q: NA gpm
Excess Pore pressure: 29.26 psi

JA21-17-07

TEST #4

TEST #5

Actual Excess Pressure= 7.72 psi				Actual Excess Pressure= 41.80 psi			
Initial Middle Transducer 26.36 psi				Initial Middle Transducer 26.36 psi			
Test Pressure= 34.08 psi				Test Pressure= 68.16 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2783.5		2.8	0	2784.7		2.3
0.5	2783.9	0.8	6.5	0.5	2785.6	1.8	14
1	2784.7	1.6	16.7	1	2786.6	2.0	34.3
1.5	2784.7	0.0	15.7	1.5	2786.6	0.0	35.6
2	2784.7	0.0	14.5	2	2786.7	0.2	38.1
2.5	2784.7	0.0	13.4	2.5	2786.8	0.2	40
3	2784.7	0.0	12.5	3	2786.8	0.0	36.6
3.5	2784.7	0.0	11.7	3.5	2786.8	0.0	36.9
4	2784.7	0.0	11.1	4	2786.9	0.2	38
4.5	2784.7	0.0	10.5	4.5	2786.9	0.0	38.1
5	2784.7	0.0	10.0	5	2786.9	0.0	37.7
				6	2787.0	0.1	37.3

Boring No: B-950

Test Interval 82 ft to 87 ft
(from surface)

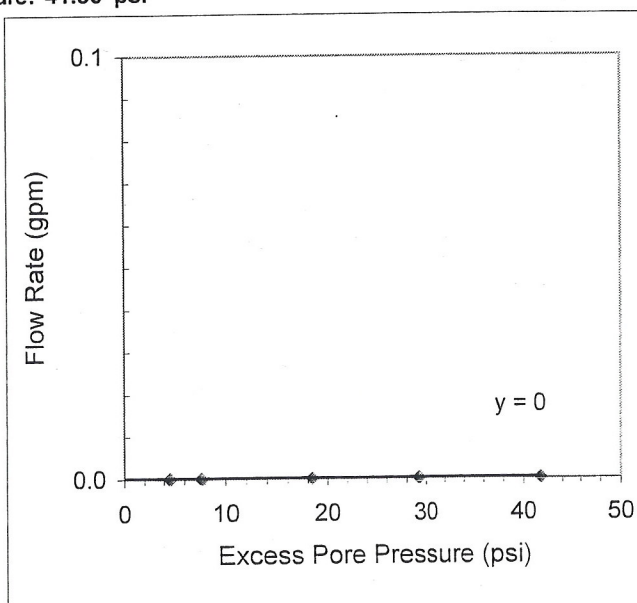
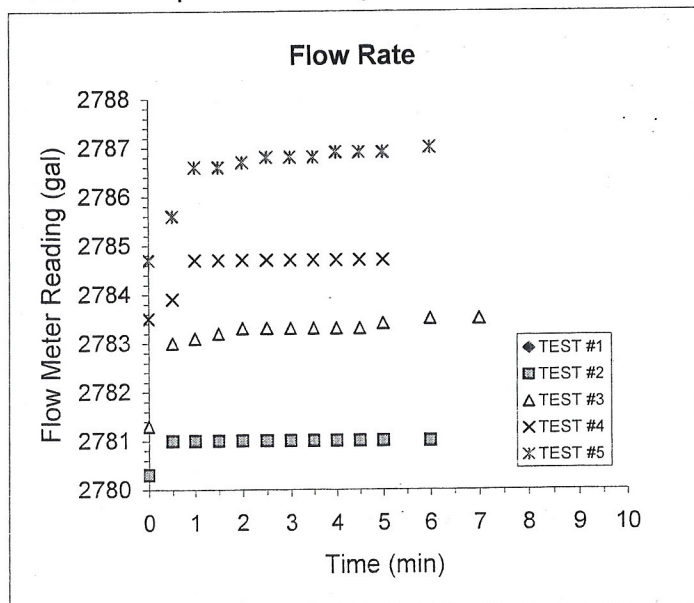
Density of water, $\rho_w = 62.4$ lb/ft³
 $= 0.0361$ lb/in³
 Length = 5 ft
 Borehole radius = 2.00 in
 R ranges from 5-10 ft:
 choose R = 5 ft

	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

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

$$k_e = 0.00E+00 \text{ cm/sec}$$

$$= 0.00 \text{ ft/year}$$

Pressure Decay Test

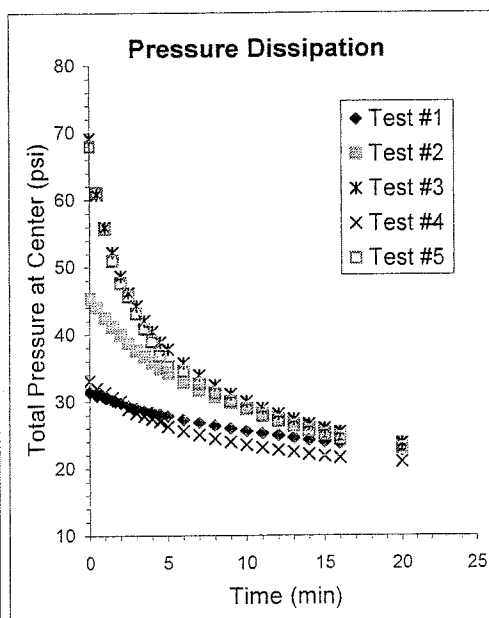
Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/18/2006

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

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

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

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.

MAXIMUM TEST PRESSURE, P_0 52.77 ($P_0 = [(A+B) * 1] + C * .57$ 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 .22, 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

BORING NO.: B950

DATE: 2-21-06

TEST NUMBER: 1

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

DATA COLLECTED BY: S. How

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-M157-62
 " - B157-11
 " - T157-11

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JP
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-50 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 0.0 FT.

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

TOTAL BORING DEPTH FROM DATUM: 162.0 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, P_o 52.77 ($P_o = [(A+B) * 1] + C * .57$ 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	2797.2	.2	6.0	
1.0	2797.5	.6	15.6	
1.5	2797.5	Ø	16.9	
2.0	2797.5	Ø	16.9	
2.5	2797.5	Ø	16.9	
3.0	2797.5	Ø	16.9	
3.5	2797.5	Ø	16.9	
4.0	2797.5	Ø	16.9	
4.5	2797.5	Ø	16.9	
5.0	2797.5	Ø	16.9	
6.0				

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

PAGE 3

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: Howard

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-M257-62
 " - B257 - "
 " - T257 - "

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: 8-21-06

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 2.0

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, P_0 52.77 ($P_0 = [(A+B) * 1] + C * .57$ 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 Howard

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 N/A

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, P_0 52.77 ($P_0 = [(A+B) * 1] + C * .57$ psi)

TEST NUMBER: 4 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 won't take water

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

John
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. 0950 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 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 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, P_o 52.77 ($P_o = [(A+B) * 1] + C * .57$ 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 won't take water

JAG
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 = $(h_1 \times 1) + (h_2 \times 0.57)$. h_1 and h_2 are in feet, see sketch. PoMAX is in psi

h_1 = Distance from the ^{same} datum to the water level

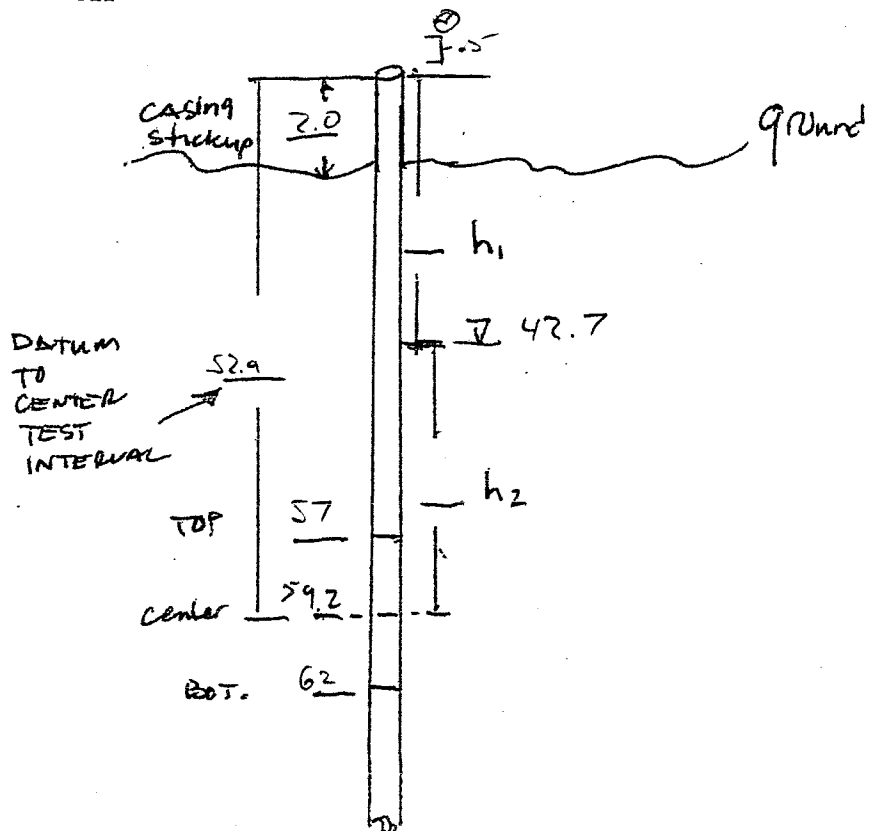
h_2 = Distance from the water level to the center of the test interval

$$h_1 = \underline{43.2}$$

$$h_2 = \underline{59.2} - \underline{42.7} = \underline{16.5}$$

$$P \text{ MAX} = \underline{43.2} + \underline{9.57} = \underline{52.77}$$

SKETCH



PACKER TESTING CALCULATIONS FOR P(MAX)

JGJ
12-3-06

Date: 8-18-06

Boring No. 13950

Test Interval: 62.0 to 67.0 feet from Datum

Casing Stickup 2.0 feet

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

h_1 = Distance from the ⁵⁻³⁰ datum to the water level

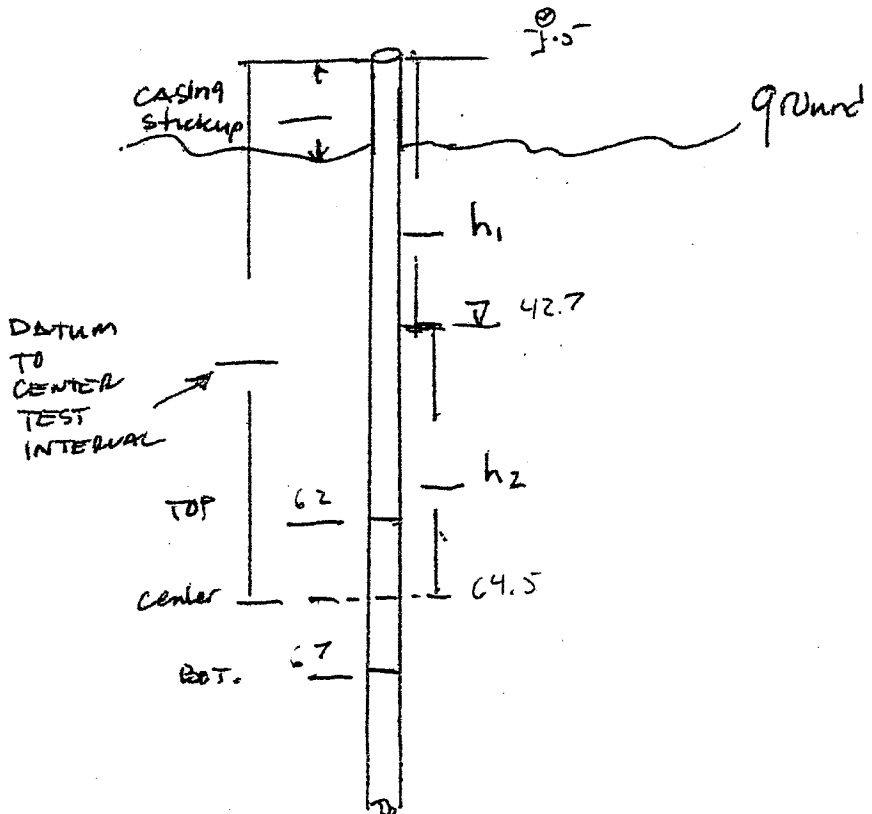
h_2 = Distance from the water level to the center of the test interval

$h_1 =$ 43.2

$h_2 =$ 64.5 - ^{21.7}~~42.7~~ 42.7 = 21.8

P MAX = 43.2 + 12.62 = 55.62

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: 8-18-06

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 122

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: 0.5 FT.

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

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

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

J2
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	18.97
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

Handwritten: 12-306

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.

MAXIMUM TEST PRESSURE, P_o 55.62 ($P_o = [(A+B) * 1] + C * .57$ 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 25.18, 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

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

Handwritten: 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

Handwritten: Tests: B950 - 8262-67
 " - T262-11
 " - M262-11

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JV 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 ☒ 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.

MAXIMUM TEST PRESSURE, P_o 55.62 ($P_o = [(A+B) * 1] + C * .57$ 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	0	38.2	
1.5	2790.5	.2	31.1	Bleed at some pressure
2.0	2790.5	0	32.9	
2.5	2790.5	0	33.2	
3.0	2790.5	0	33.3	
3.5	2790.5	0	32.6	
4.0	2790.5	0	32.5	
4.5	2790.5	0	33.1	
5.0	2790.5	0	33.2	
6.0				

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

PAGE 3

BORING NO.: B 950

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
JH
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	23.6 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
 " - T3 62 - 11
 " - B3 62 - 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: 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, P_o 55.62 ($P_o = [(A+B) * 1] + C * .57$ 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

JA 8
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: 162.0 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, P_o 55.62 ($P_o = [(A+B) * 1] + C * .57$ psi)

TEST NUMBER: 5 TEST PRESSURE 55.62 psi 18.35 psi 21.85 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 024, Middle 9.64, Bottom 17.42

Transducer Readings after initial pressurization:

Top .20, Middle 14.86, Bottom 11.36

Transducer Readings after final flow measurement:

Top 14.2, Middle 21.41, Bottom 11.36
14.2 21.41 11.36
14.2 21.41 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	37.8	
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

BORING NO.: B950DATE: 8-18-06TEST NUMBER: 5TEST INTERVAL (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.DATA COLLECTED BY: Sho wad2
12-306

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	39.00 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.: B950DATE: 8-17-06TEST NUMBER: 4TEST INTERVAL (FROM DATUM): FROM 62.0 FT. TO 67.0 FT.DATA COLLECTED BY: Steward2
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	27.20
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	25.42
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	6.4	19.00
25.0	7.4 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 - 11
 " - B462 - 11

PACKER TESTING CALCULATIONS FOR P(MAX)

82
11-3-06

Date: 8-18-06

Boring No. B 950

Test Interval: 84.0 to 89.0 feet from Datum

Casing Stickup 2.0 feet

PoMAX = $(h_1 \times 1) + (h_2 \times 0.57)$. 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 Gage above Datum.

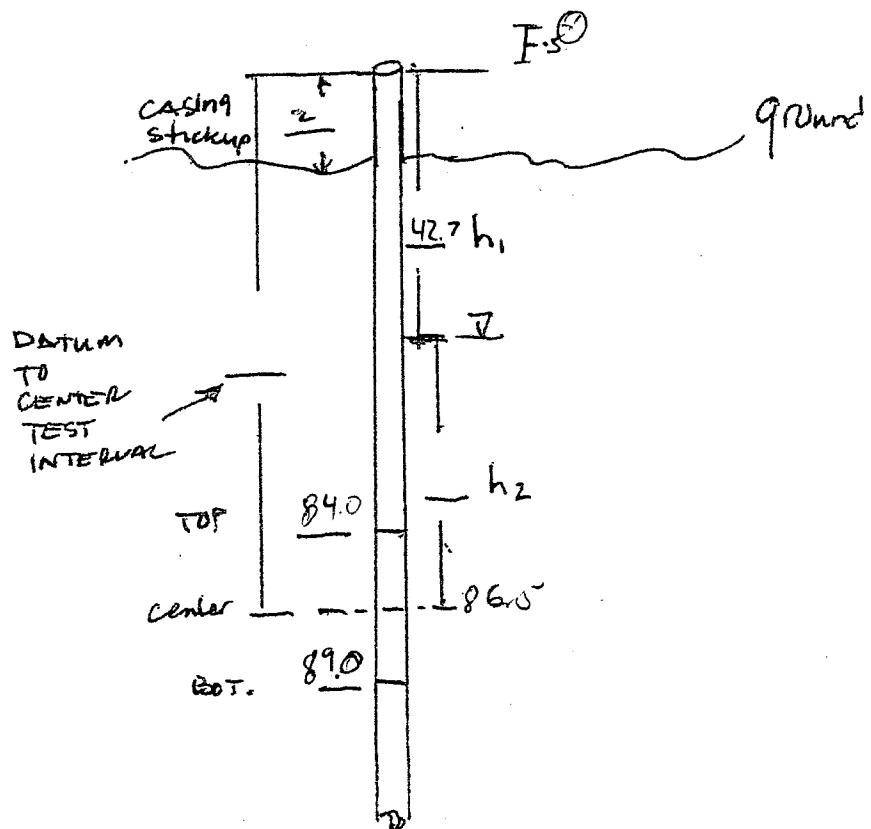
h_2 = Distance from the water level to the center of the test interval

$$h_1 = 42.7 + .5 = 43.2$$

$$h_2 = 86.5 - 42.7 = 43.8$$

$$P_{MAX} = 43.2 + 24.9 = 68.16$$

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

88
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, P_o 68.16 ($P_o = [(A+B) * 1] + C * .57$ psi)

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

Initial Transducer Readings: Top 8.52, Middle 26.36, 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	0	-1.0	
1.0	2779.1	3.0	+8.2	
1.5	2779.3	.4	9.1	
2.0	2779.3	0	8.9	
2.5	2779.3	0	8.6	
3.0	2779.3	0	8.4	
3.5	2779.3	0	8.1	
4.0	2779.3	0	7.8	
4.5	2779.3	0	7.6	
5.0	2779.3	0	7.4	
6.0				

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

BORING NO.: B950DATE: 8-18-06TEST NUMBER: 1TEST INTERVAL (FROM DATUM): FROM 89.0 FT. TO 84.0 FT.DATA COLLECTED BY: J Howard2
12-3-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
6.0	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
	4.1	24.67

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

13.8 24.54
13.5 24.76
14.0 24.21
14.5 24.05

Tests: B950-M184-P9

11 - B184 - 11

11 - T184 - 11

15.0 23.91
15.5 23.77
16.0 23.64
16.5 23.50
17.0 23.37
20.0 22.66

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JSJ
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. 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 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, P_o 68.16 ($P_o = [(A+B) * 1] + C * .57$ 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 27.29

Transducer Readings after final flow measurement:

Top 6.50, Middle 22.54, Bottom 28.17

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	27779.3	/	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	

BORING NO.: B 950DATE: 8-18-06TEST NUMBER: 2TEST INTERVAL (FROM DATUM): FROM 84.0 FT. TO 89.0 FT.DATA COLLECTED BY: J Howard

J 11-3-06

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: B 950 - M284-89
 " - T284-"
 " - B284-"

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: 5-18-06

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, P_o 68.16 ($P_o = [(A+B) * 1] + C * .57$ psi)

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

Initial Transducer Readings: Top 852, Middle 278.36, 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

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: SHAW

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	12.3	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	5.8	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
 " - B384-11
 " - T384-11

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JGJ
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 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, P_o 68.16 ($P_o = [(A+B) * 1] + C * .57$ psi) 24
TEST NUMBER: 4 TEST PRESSURE 34.08 psi PACKER PRESSURE: 100 psi 24
8.18 125

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

Transducer Readings after initial pressurization:
Top 5.45, 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 1

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: Shawed

2
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
 11 B484 11
 11 T484 11

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

Handwritten: 12-306

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: 125 psi

Initial Transducer Readings: Top 8.56, Middle 26.36, Bottom 24.14

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

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: J. Howard

2
8/12-3-06

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
16.0	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 - M584-89
 " - T584-11
 " - B584-11

(5)

51

8-18-06

James Howan

M.ller: Mark Hughes, Tom Garin
B949 & 950

Arrive 7

Safety meeting 730

Breakdown: Chart test on B949 8-830

Move & Setup on B950 830-930

Get water 930-10

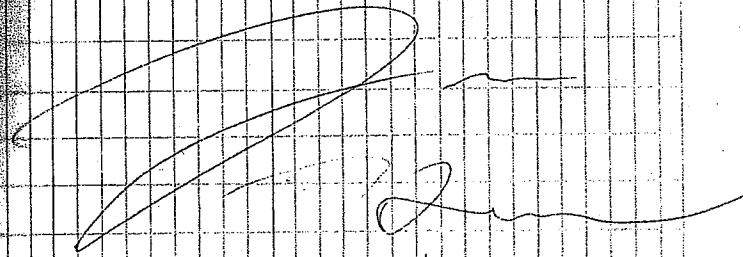
More setup 10-1115

Lunch 1115-1145

Packer tests 1145-345 (84-89)

BD 345-4

Paperwork 4-4130



⑥ 8-10-06
James Howard
Miller, Mark Hughes, Tim Garland
B 950

8 arrive

830 meeting

9-Packages setup

10-130 Packages @ ~~170~~ 8-21 62-67

130-430 Packages @ 57-62

430-5 Paperwork

1-62 47.2

[Handwritten signature]



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

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)

Prepared by: ZO
Checked by: *[Signature]*

Date: 12-7-06
Date: 1-17-07

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 ($P_{Test} * 144 \text{ in}^2 / \text{ft}^2 / \gamma_w$)
 $K_e = ((Q / (H_M - P_m)) * (1/l)) * 1/2\pi * \ln(R/r_0) * (525,600 \text{ min/year}) * (0.1337 \text{ ft}^3/\text{gal})$
R = total length between packers, l
TNP = Test not performed
NM = not measured

Note: Pressures P_t , P_m and P_b 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

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)

$\rho_w = 62.4 \text{ lb/ft}^3$

Prepared by: ZO

Date: 12-7-06

Checked by: *[Signature]*

Date: 1-17-07

Abbreviations:

N.O. Not Observed

N.A. Not Applicable

$P_0 \text{ Max} = 45.07 \text{ psi}$

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				TEST #2				TEST #3			
Actual Excess Pressure= 6.09 psi				Actual Excess Pressure= 8.09 psi				Actual Excess Pressure= 13.52 psi			
Initial Middle Transducer Reading= 31.54 psi				Initial Middle Transducer Reading= 31.54 psi				Initial Middle Transducer Reading= 31.54 psi			
Test Pressure= 37.63 psi				Test Pressure= 39.63 psi				Test Pressure= 45.06 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2795.1		0.2	0	2795.2		2.1	0	2795.4		1.8
0.5	2795.1	0.0	0.2	0.5	2795.4	0.4	8.2	0.5	2795.7	0.6	9
1	2795.2	0.2	5.5	1	2795.4	0.0	9.4	1	2795.7	0.0	13.4
1.5	2795.2	0.0	6.2	1.5	2795.4	0.0	8.7	1.5	2795.7	0.0	14.8
2	2795.2	0.0	6	2	2795.4	0.0	8.5	2	2795.7	0.0	13.8
2.5	2795.2	0.0	6.5	2.5	2795.4	0.0	8	2.5	2795.7	0.0	13.4
3	2795.2	0.0	6.8	3	2795.4	0.0	10.5	3	2795.7	0.0	13.4
3.5	2795.2	0.0	6.6	3.5	2795.4	0.0	9.8	3.5	2795.7	0.0	13.6
4	2795.2	0.0	6.7	4	2795.4	0.0	9.3	4	2795.7	0.0	13.2
4.5	2795.2	0.0	6.5	4.5	2795.4	0.0	8.9	4.5	2795.7	0.0	13.7
5	2795.2	0.0	6.6	5	2795.4	0.0	8.4	5	2795.7	0.0	13.2

Average Q: 0.0 gpm
Excess Pore pressure: 6.09 psi

Average Q: 0.0 gpm
Excess Pore pressure: 8.09 psi

Average Q: 0.0 gpm
Excess Pore pressure: 13.52 psi

82-17-07

TEST #4

TEST #5

Actual Excess Pressure= 22.53 psi				Actual Excess Pressure= 45.07 psi			
Initial Middle Transducer 31.54 psi				Initial Middle Transducer 31.54 psi			
Test Pressure= psi				Test Pressure= psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole is not taking any water --> Test not performed				Hole is not taking any water --> Test not performed			

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

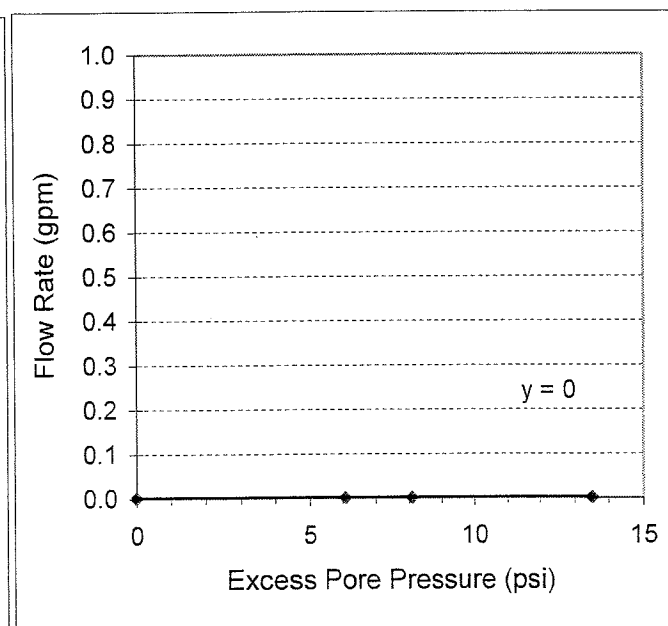
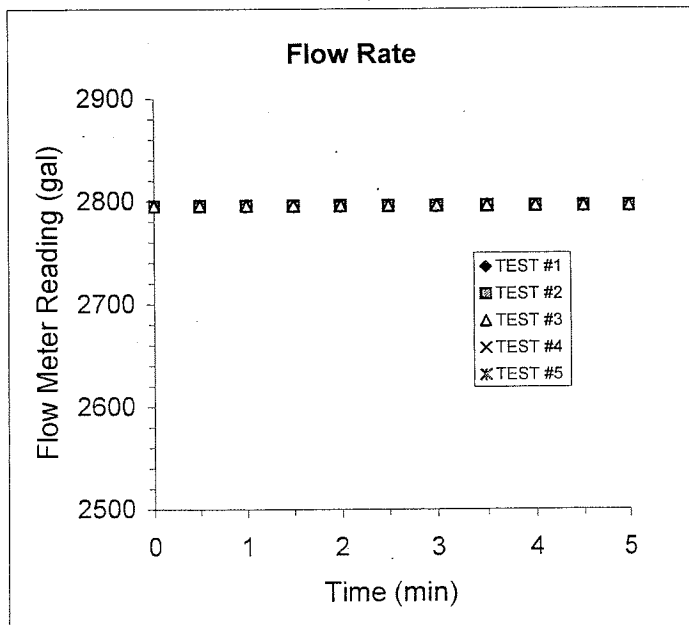
Density of water, $\rho_w = 62.4$ lb/ft³
= 0.0361 lb/in
Length= 5 ft
Borehole radius= 2.00 in
R ranges from 5-10 ft:
choose R= 5 ft

	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

Average Q: gpm
Excess Pore pressure: psi

Average Q: gpm
Excess Pore pressure: psi



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

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

$$k_e = 0.00E+00 \text{ cm/sec}$$

$$= 0.00 \text{ ft/year}$$

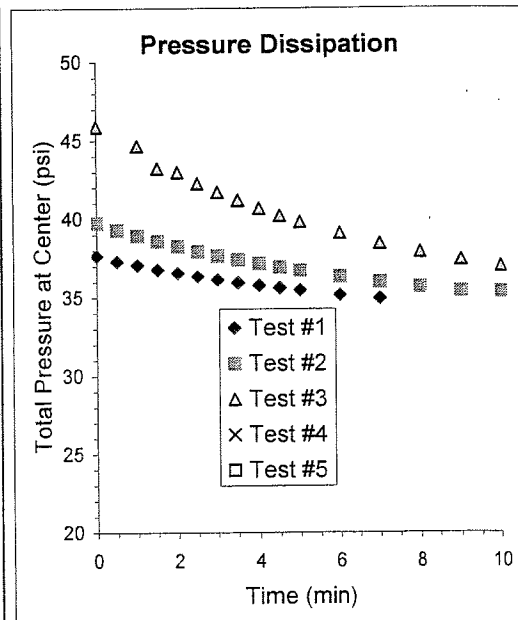
Pressure Decay Test

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)

Prepared by: ZQ Date: 12-7-06
Checked by: J Date: 1-17-07
N.O. Not Observed
N.A. Not Applicable

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**

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)

$\rho_w = 62.4 \text{ lb/ft}^3$

Prepared by: ZO

Date: 12-7-06

Checked by: *[Signature]*

Date: 1-17-07

Abbreviations:

N.O. Not Observed

N.A. Not Applicable

$P_0 \text{ Max} = 49.06 \text{ psi}$

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				TEST #2				TEST #3			
Actual Excess Pressure= 16.35 psi				Actual Excess Pressure= 32.71 psi				Actual Excess Pressure= 14.31 psi			
Initial Middle Transducer Reading= 34.74 psi				Initial Middle Transducer Reading= 34.74 psi				Initial Middle Transducer Reading= 34.7 psi			
Test Pressure= 39.67 psi				Test Pressure= 41.89 psi				Test Pressure= 49.05 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2793.9		0.2	0	2794.3		0	0	2794.5		-0.1
0.5	2793.9	0.0	0.5	0.5	2794.3	0.0	0.2	0.5	2794.8	0.6	9.1
1	2794.3	0.8	3.8	1	2794.5	0.4	4.7	1	2795.1	0.6	13.2
1.5	2794.3	0.0	3.7	1.5	2794.5	0.0	5.5	1.5	2795.1	0.0	13.1
2	2794.3	0.0	3.7	2	2794.5	0.0	5.6	2	2795.1	0.0	13.1
2.5	2794.3	0.0	3.7	2.5	2794.5	0.0	5.5	2.5	2795.1	0.0	13.1
3	2794.3	0.0	3.7	3	2794.5	0.0	5.5	3	2795.1	0.0	13.1
3.5	2794.3	0.0	3.7	3.5	2794.5	0.0	5.5	3.5	2795.1	0.0	13.1
4	2794.3	0.0	3.7	4	2794.5	0.0	5.5	4	2795.1	0.0	13.2
4.5	2794.3	0.0	3.7	4.5	2794.5	0.0	5.6	4.5	2795.1	0.0	13.1
5	2794.3	0.0	3.7	5	2794.5	0.0	5.5	5	2795.1	0.0	13.1

Average Q: 0.0 gpm
Excess Pore pressure: 4.93 psi

Average Q: 0.0 gpm
Excess Pore pressure: 7.15 psi

Average Q: 0.0 gpm
Excess Pore pressure: 14.31 psi

1-17-07

TEST #4

TEST #5

Actual Excess Pressure= NA psi Initial Middle Transducer 34.74 psi Test Pressure= NA psi				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)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole is not taking any water --> Test not performed				Hole is not taking any water --> Test not performed			

Boring No: B-951
 Test Interval 78 ft to 83 ft
 (from surface)

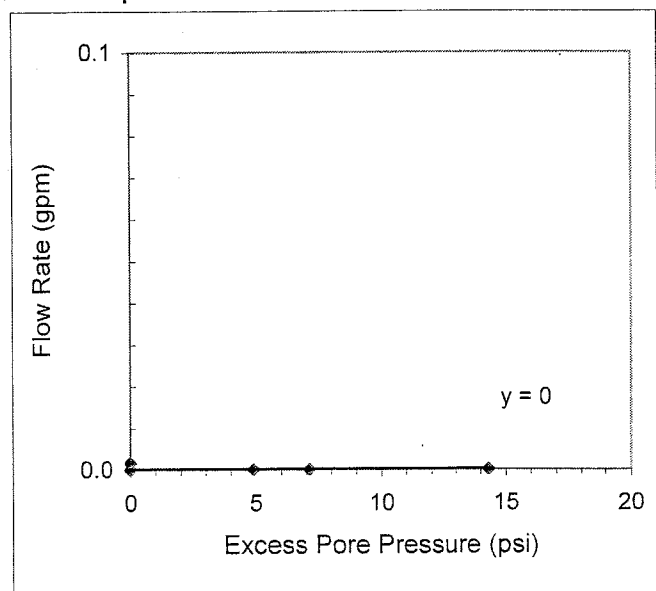
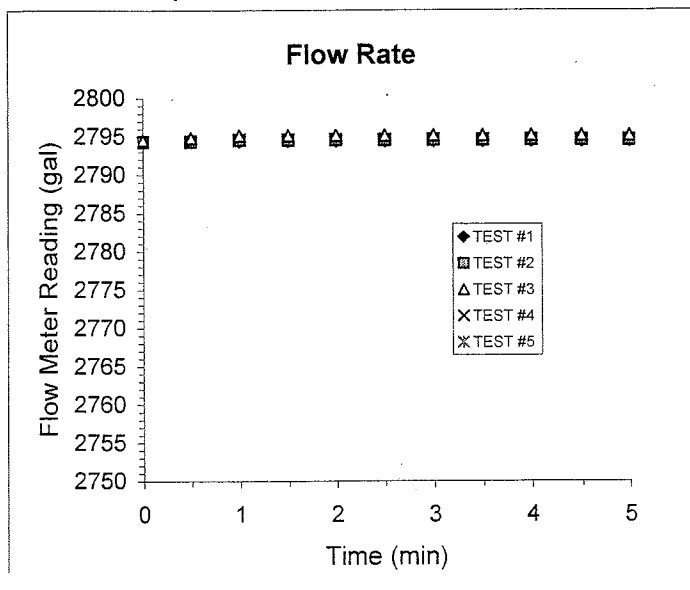
Density of water, $\rho_w = 62.4 \text{ lb/ft}^3$
 $= 0.0361 \text{ lb/in}^3$
 Length= 5 ft
 Borehole radius= 2.00 in
 R ranges from 5-10 ft:
 choose R= 5 ft

	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
 Excess Pore pressure: psi

Average Q: gpm
 Excess Pore pressure: psi



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

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

$$k_e = 0.00E+00 \text{ cm/sec}$$

$$= 0.00 \text{ ft/year}$$

Pressure Decay Test

Project Name: NORTH ANNA COL
Project Number: 6468-06-1472
Date: 8/23/2006
Boring No: B-951
Test Interval: 78 ft to 83

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

Test #1

Test #2

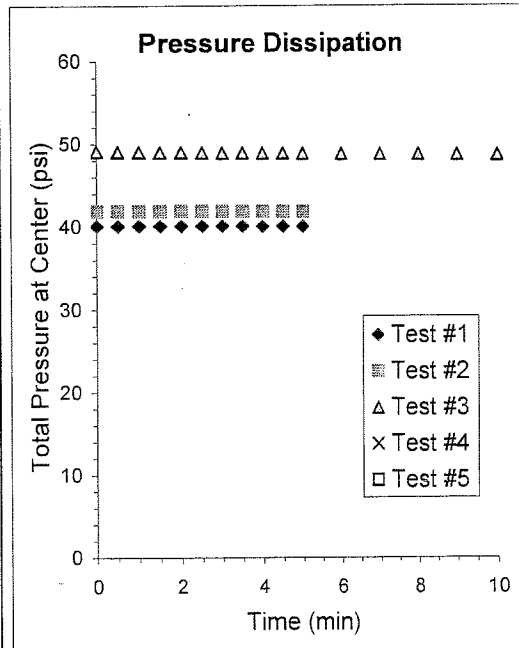
Test #3

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)



PACKER TESTING CALCULATIONS FOR P(MAX)

Joe
12-3-06

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

h_1 = Distance from the ^{stage} datum to the water level

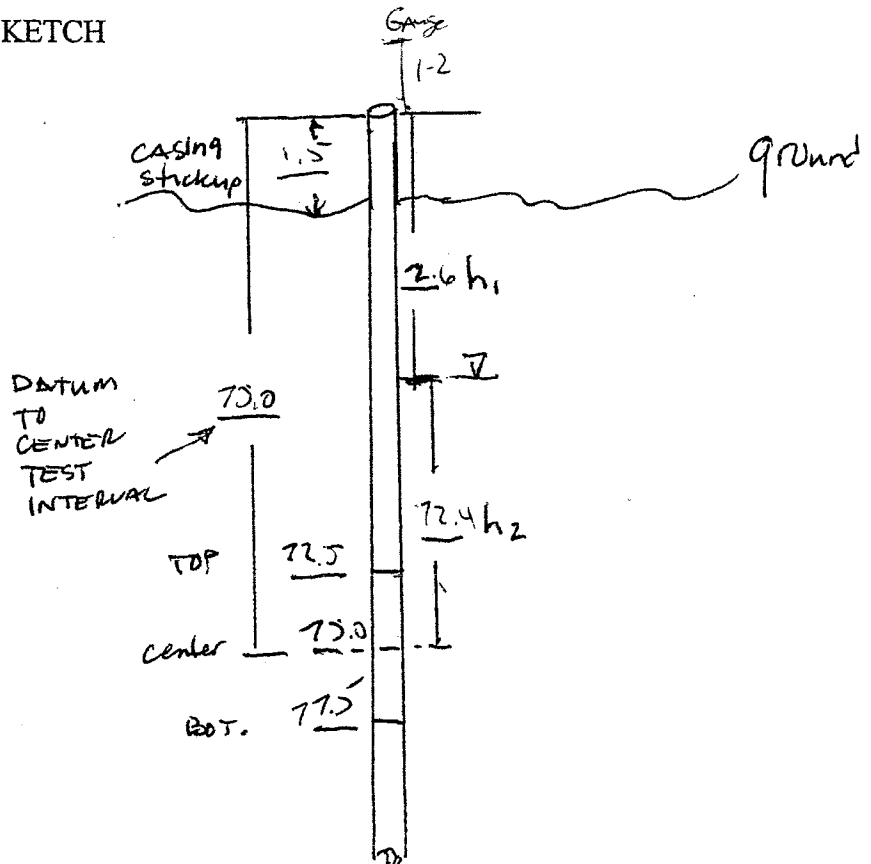
h_2 = Distance from the water level to the center of the test interval

$h_1 =$ 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

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. B 951

BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE

DATUM ELEVATION 120

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, P_o 45.06 ($P_o = [(A+B) * 1] + C * .57$ 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 5.63, Middle 33.04, Bottom 34.50

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	27 95.1	✓	1.4 .2	
0.5	27 95.1	0	.2	
1.0	27 95.2	.2	5.5	
1.5	27 95.2	0	6.2	
2.0	27 95.2	0	6.0	
2.5	27 95.2	0	6.5	
3.0	27 95.2	0	6.8	
3.5	27 95.2	0	6.6	
4.0	27 95.2	0	6.7	
4.5	27 95.2	0	6.5	
5.0	27 95.2	0	6.6	

Test pressure increased due to the natural pressure being higher than the test pressure, per ALTire's instructions * 37.63

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

PAGE 3

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: J Howard

2
12-3-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	6.6	37.63
0.5	6.1	37.29
1.0	5.9	37.04
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	34.67
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

11 - B172 - 11

11 - T172 - 11

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, P_o 45.06 ($P_o = [(A+B) * 1] + C * .57$ psi)

TEST NUMBER: 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

BORING NO.: B 951DATE: 8-23-06TEST NUMBER: 2TEST INTERVAL (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.DATA COLLECTED BY: Stowardfor
12-3-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	8.11	39.74
0.5	8.0	39.70
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	35.33
11.0	4.0	34.85
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: B 951 - M272 - 77
 " - B272 - " "
 " - T272 - " "

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: 8-23-06

BORING NO. 13951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 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 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, P_0 45.06 ($P_0 = [(A+B) * 1] + C * .57$ 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	4.0	
1.0	2795.7	0	13.4	
1.5	2795.7	0	14.8	
2.0	2795.7	0	13.8	
2.5	2795.7	0	13.4	
3.0	2795.7	0	13.4	
3.5	2795.7	0	13.6	
4.0	2795.7	0	13.2	
4.5	2795.7	0	13.7	
5.0	2795.7	0	15.2	

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

PAGE 2

BORING NO.: B951

DATE: 8-23-06

TEST NUMBER: 7

TEST INTERVAL (FROM DATUM): FROM 72.5 FT. TO 77.5 FT.

DATA COLLECTED BY: Howard

AS
12-3-06

SHUT-IN TEST

PRESSURE: _____ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	15.2	45.87
0.5		
1.0	12.8	44.64
1.5	12.8	43.72
2.0	11.4	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	5.4	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	3.4	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 - M972 - 77
 " - B972 - 11
 " - T972 - 11

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: 8-1-06

BORING NO. B951

BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 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 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, P_0 45.06 ($P_0 = [(A+B) * 1] + C * .57$ 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 performed

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. B 951 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 77.5 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, P_0 45.06 ($P_0 = [(A+B) * 1] + C * .57$ 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 performed

78 P3
 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

PoMAX = (h₁ x 1) + (h₂ x 0.57). h₁ and h₂ are in feet, see sketch. PoMAX is in psi

h₁ = Distance from the ^{Gauge}~~datum~~ to the water level

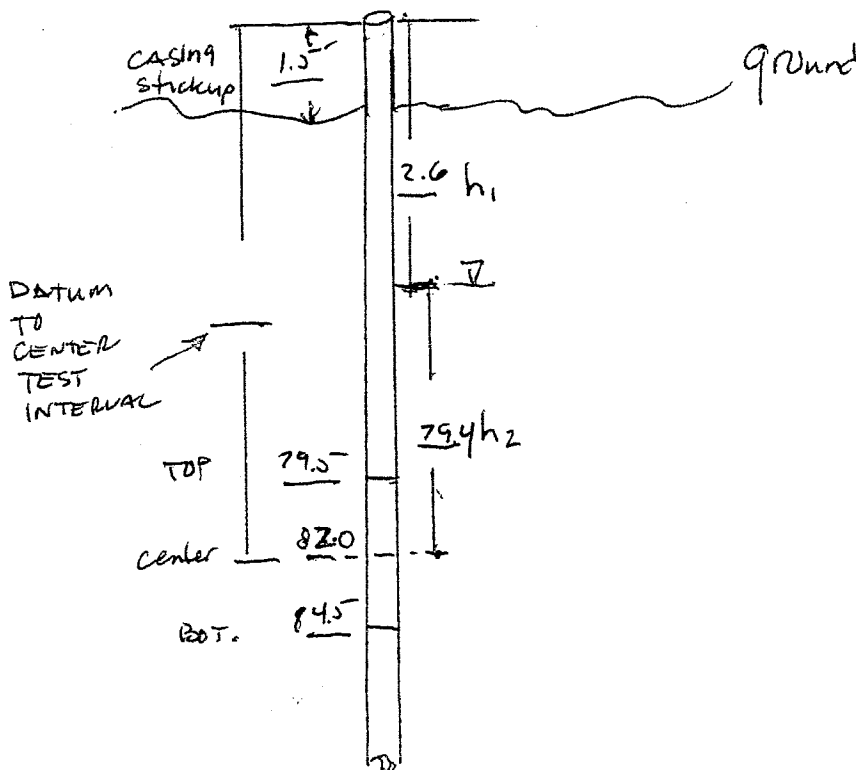
h₂ = Distance from the water level to the center of the test interval

$$h_1 = \underline{3.8}$$

$$h_2 = \underline{82.0} - \underline{2.6} = \underline{79.4}$$

$$P\ MAX = \underline{3.8} + \underline{45.25} = \underline{49.05}$$

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

22, 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. 5951

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, P_o 49.05 ($P_o = [(A+B) * 1] + C * .57$ 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	0	.5	
1.0	2794.3	.8	3.8	
1.5	2794.3	0	3.7	
2.0	2794.3	0	3.7	
2.5	2794.3	0	3.7	
3.0	2794.3	0	3.7	
3.5	2794.3	0	3.7	
4.0	2794.3	0	3.7	
4.5	2794.3	0	3.7	
5.0	2794.3	0	3.7	

Pressure raised per ALTice's instructions; Test pressure below natural pressure

39.67*

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2

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12-3-06

DATA COLLECTED BY: J. Howan

PRESSURE: _____ psi

[illegible]

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: B957 - M179 - 84
 " - B179 - "
 " - T179 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

Joe J
12-3-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL

PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Sheward

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, P_0 49.05 ($P_0 = [(A+B) * 1] + C * .57$ psi)

TEST NUMBER: 2 TEST PRESSURE 32.37 * psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 5.24, 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 Sec. test 1

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: 8-22-06

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, P_o 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 9.80, 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

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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: Howard

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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	48.80
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 - 11
 " - T379 - 11

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JS
12-306

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, P_o 49.05 ($P_o = [(A+B) * 1] + C * .57$ 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 BOREHOLE PERMEABILITY TEST DATA SHEET

87
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. B 951 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.5 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE

DATUM ELEVATION no

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, P_0 49.05 ($P_0 = [(A+B) * 1] + C * .57$ 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*

BORING NO.: B951DATE: 8-22-06TEST NUMBER: 3TEST INTERVAL (FROM DATUM): FROM 84.5 FT. TO 79.5 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	48.00
1.5	13.1	48.46
2.0	13.1	48.46
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 - 11

" - T379 - 11

8-22-06

James Howard

Miller, Mark Hughes, Tim Garland

B950 & 951

8-22-06
A12

Arrival 7am

Meeting 730-8

Break Pouch B950 8-9

Stand b. for Planks to cross ditch at B951

9-1030-11

Lunch 11-1130

1130-1230 looked at guys making cut steel bridge

1230-1 Safety meeting

1-2 Setup packs

2-345 Packer test B951 ⁸⁷79.5-84.5

345-4 Break down + Move packer up

4-430 Paper work

8/11/66

James Howard

Willie; Mark Hughes, Tim Garland

1931

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 Dr. 11 B914 w/George Alkin

6006 to 80.8 (Rockco.)

430-5 Breakdown/clean up

5-530 Paper work