

**MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4**

PROJECT NAME: GEOPRO, INC.	PROJECT NUMBER: 02126306.0001
LOCATION:	DATE: 3/1/2012
SAMPLE ID: GEOPRO'S THERMAL GROUT LITE 0.45 BENTONITE(Thermal Grout Lite) - 30.00% DEIONIZED WATER - 70.00%	PANEL IDENTIFICATION: Lenexa Perm Board BURETTE AREA: 0.312 cm ² BURETTE INCREMENT LENGTH: 1.000 cm VOLUME PER INCREMENT: 0.312 cm ³

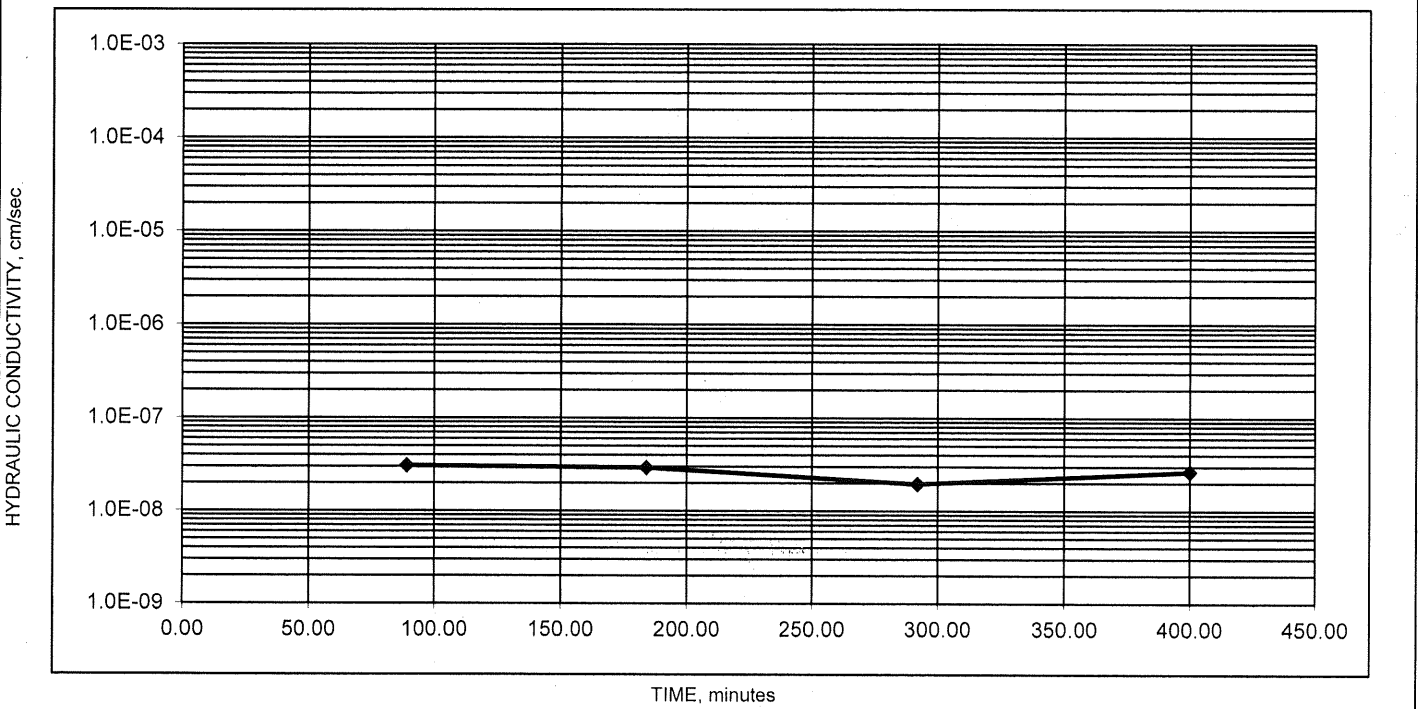
INITIAL				ADDITIONAL DATA			
MOISTURE%	DENSITY			SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	YES
W & T, g	WET WT, g	90.9		SPECIFIC GRAVITY: ASSUMED		PROCTOR, pcf:	NA
D & T, g	DIA, in	2.427	6.16	POROSITY, %:	NA	OPTIMUM, %:	NA
T, g	HT, in	0.999	2.54	SATURATION, %:	NA	COMPACTION, %:	NA
	AREA		29.85	VOID RATIO:	NA	OVER OPTIMUM, %:	NA
MOIST- URE, %	DENSITY:	74.9	PCF WET				
NA	DENSITY:	NA	PCF DRY				

SATURATION:	LATERAL PRESS.: 104.0 psi	BACK PRESSURE (=UPPER=LOWER): 100.0 psi	
DURING TEST:	LATERAL PRESS.: 104.0 psi	H2: 100.0 psi	H1: 100.0 psi
		BIAS PRESSURE (=H1-H2) 0.0 psi	

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H, cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm ³	IN FLOW cm ³	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP. C	TEMP. CORR.:
7.4	65.1	0.00	57.7									
7.8	64.7	89.00	56.9	0.013962	3.07E-08	0.12	0.12	1.00	22.4	16	25.3	0.883
8.2	64.3	184.00	56.1	0.014160	2.92E-08	0.12	0.12	1.00	22.1	10	25.2	0.885
8.5	64.0	292.00	55.5	0.010753	1.95E-08	0.09	0.09	1.00	21.9	26	25.1	0.887
8.9	63.6	400.00	54.7	0.014519	2.64E-08	0.12	0.12	1.00	21.6	0	25.1	0.887

HYDRAULIC CONDUCTIVITY (k₂₀) = **AVERAGE 2.6E-08 cm/sec**

MAXIMUM HYDRAULIC GRADIENT	1.0E-03 TO 1.0E-07	2	0.75<	30	% < 25 AT
	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC OR	
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



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ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4**

PROJECT NAME: GEOPRO, INC.	PROJECT NUMBER: 02126306.0002B
LOCATION:	DATE: 3/12/2012
SAMPLE ID: GEOPRO'S THERMAL GROUT LITE 0.57 BENTONITE(Thermal Grout Lite) - 22.65% SAND (5010) - 22.65% DEIONIZED WATER - 54.70%	PANEL IDENTIFICATION: Lenexa Perm Board BURETTE AREA: 0.312 cm ² BURETTE INCREMENT LENGTH: 1.000 cm VOLUME PER INCREMENT: 0.312 cm ³

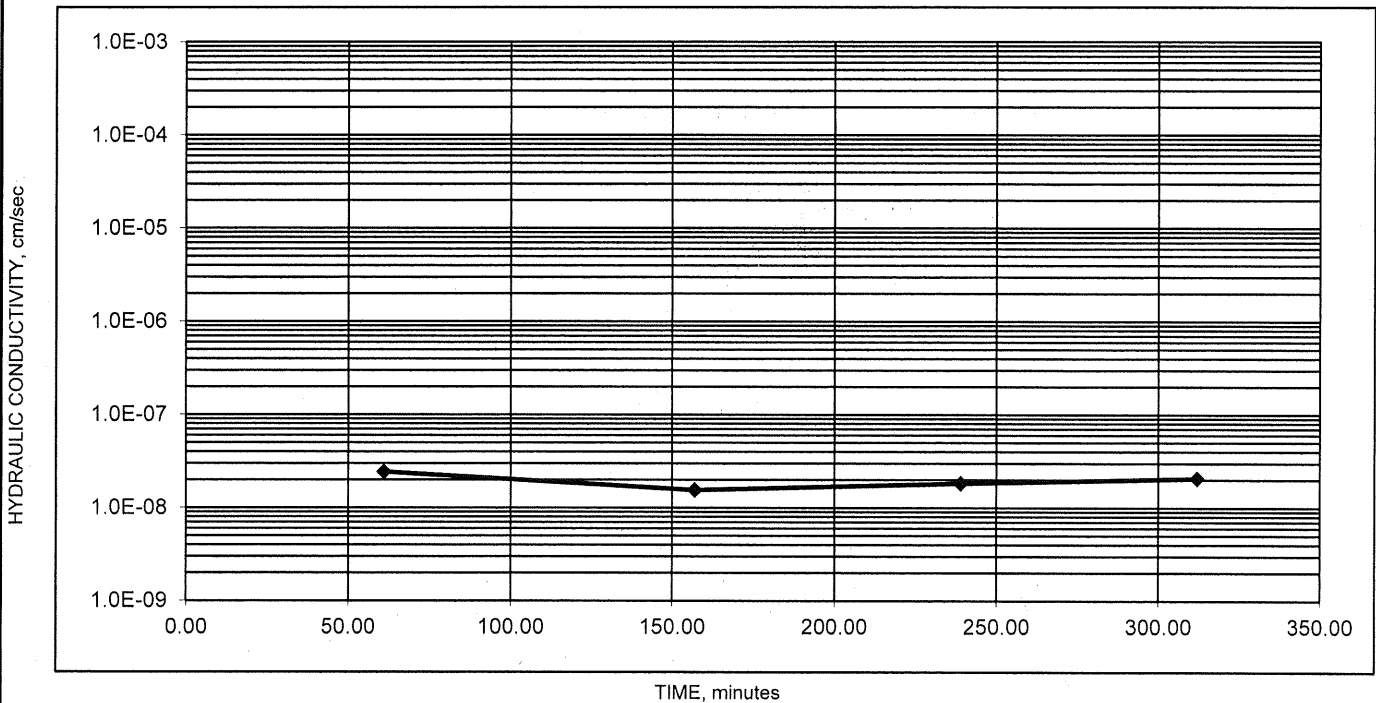
INITIAL				ADDITIONAL DATA			
MOISTURE%	DENSITY			SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	YES
W & T, g	WET WT, g	121.9		SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
D & T, g	DIA, in	2.425	6.16	POROSITY, %:	NA	OPTIMUM, %:	NA
T, g	HT, in	1.003	2.55	SATURATION, %:	NA	COMPACTION, %:	NA
	AREA		29.80	VOID RATIO:	NA	OVER OPTIMUM, %:	NA
MOIST- URE, %	DENSITY:	100.2	PCF WET				
NA	DENSITY:	NA	PCF DRY				

SATURATION:	LATERAL PRESS.: 104.0 psi	BACK PRESSURE (=UPPER=LOWER): 100.0 psi		
DURING TEST:	LATERAL PRESS.: 104.0 psi	H2: 100.0 psi	H1: 100.0 psi	BIAS PRESSURE (=H1-H2) 0.0 psi

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H, cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm ³	IN FLOW cm ³	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP. C	TEMP. CORR.:
8.2	61.9	0.00	53.7									
8.4	61.7	61.00	53.3	0.007477	2.43E-08	0.06	0.06	1.00	20.9	23	25.0	0.889
8.6	61.5	157.00	52.9	0.007533	1.55E-08	0.06	0.06	1.00	20.8	21	25.1	0.887
8.8	61.3	239.00	52.5	0.007590	1.83E-08	0.06	0.06	1.00	20.6	7	25.1	0.887
9.0	61.1	312.00	52.1	0.007648	2.07E-08	0.06	0.06	1.00	20.4	5	25.1	0.887

HYDRAULIC CONDUCTIVITY (k₂₀) = **AVERAGE 2.0E-08 cm/sec**

MAXIMUM HYDRAULIC GRADIENT	1.0E-03 TO 1.0E-07	2	0.75<	30	% < 25 AT
	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC	OR
	1.0E-06 TO 1.0E-07	20		GRADIENT	% < 50 AT
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



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ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4**

PROJECT NAME: GEOPRO, INC.	PROJECT NUMBER: 02126306.0003B
LOCATION:	DATE: 3/1/2012
SAMPLE ID: GEOPRO'S THERMAL GROUT LITE 0.88 BENTONITE(Thermal Grout Lite) - 12.60% SAND (5010) - 50.50% DEIONIZED WATER - 36.90%	PANEL IDENTIFICATION: Lenexa Perm Board BURETTE AREA: 0.312 cm ² BURETTE INCREMENT LENGTH: 1.000 cm VOLUME PER INCREMENT: 0.312 cm ³

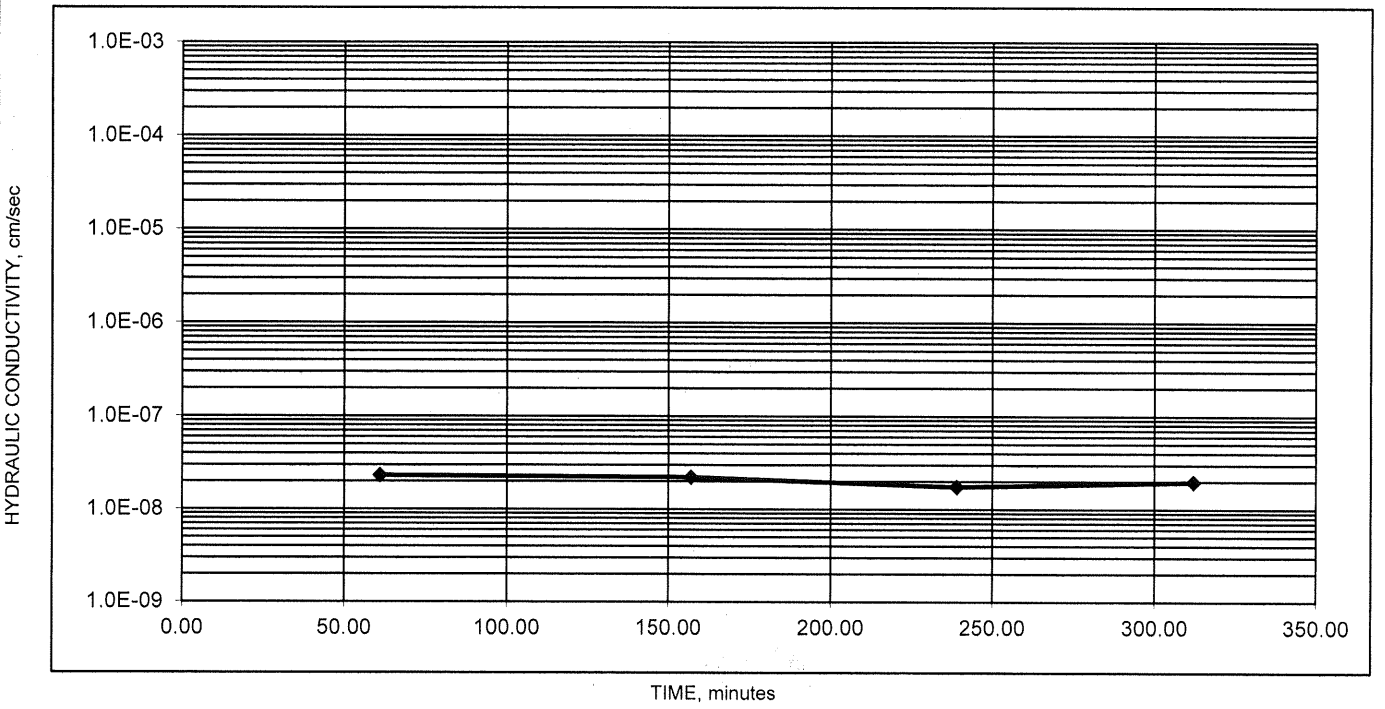
INITIAL				ADDITIONAL DATA			
MOISTURE%	DENSITY			SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	YES
W & T, g	WET WT, g	121.9		SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
D & T, g	DIA, in	2.426	6.16	POROSITY, %:	NA	OPTIMUM, %:	NA
T, g	HT, in	0.994	2.52	SATURATION, %:	NA	COMPACTION, %:	NA
	AREA		29.82	VOID RATIO:	NA	OVER OPTIMUM, %:	NA
MOIST- URE, %	DENSITY:	101.0	PCF WET				
NA	DENSITY:	NA	PCF DRY				

SATURATION:	LATERAL PRESS.: 104.0 psi	BACK PRESSURE (=UPPER=LOWER): 100.0 psi	
DURING TEST:	LATERAL PRESS.: 104.0 psi	H2: 100.0 psi	H1: 100.0 psi
	BIAS PRESSURE (=H1-H2) 0.0 psi		

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H, cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm ³	IN FLOW cm ³	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP. C	TEMP. CORR.:
8.0	63.9	0.00	55.9									
8.2	63.7	61.00	55.5	0.007181	2.31E-08	0.06	0.06	1.00	22.0	12	25.0	0.889
8.5	63.4	157.00	54.9	0.010870	2.21E-08	0.09	0.09	1.00	21.7	7	25.1	0.887
8.7	63.2	239.00	54.5	0.007313	1.74E-08	0.06	0.06	1.00	21.6	15	25.1	0.887
8.9	63.0	312.00	54.1	0.007367	1.97E-08	0.06	0.06	1.00	21.4	4	25.1	0.887

HYDRAULIC CONDUCTIVITY (k₂₀) = **AVERAGE 2.1E-08 cm/sec**

MAXIMUM HYDRAULIC GRADIENT	1.0E-03 TO 1.0E-07 less than 1.0E-07	2 5 10 20 30	0.75< RATIO <1.25	30 MAX HYDRAULIC OR GRADIENT ALLOWED	% < 25 AT > 1.0E-8
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ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO₄**

PROJECT NAME: GEOPRO, INC.	PROJECT NUMBER: 02126306.0004
LOCATION:	DATE: 3/1/2012
SAMPLE ID: GEOPRO'S THERMAL GROUT LITE 1.00 BENTONITE(Thermal Grout Lite) - 11.00% SAND (5010) - 55.00% DEIONIZED WATER - 34.00%	PANEL IDENTIFICATION: Lenexa Perm Board BURETTE AREA: 0.312 cm ² BURETTE INCREMENT LENGTH: 1.000 cm VOLUME PER INCREMENT: 0.312 cm ³

INITIAL				ADDITIONAL DATA			
MOISTURE%	DENSITY			SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	YES
W & T, g	WET WT, g	126.0		SPECIFIC GRAVITY: ASSUMED		PROCTOR, pcf:	NA
D & T, g	DIA, in	2.428	6.17 cm	POROSITY, %:	NA	OPTIMUM, %:	NA
T, g	HT, in	0.999	2.54 cm	SATURATION, %:	NA	COMPACTION, %:	NA
	AREA		29.87 cm ²	VOID RATIO:	NA	OVER OPTIMUM, %:	NA
MOIST- URE, %	DENSITY:	103.8	PCF WET				
NA	DENSITY:	NA	PCF DRY				

SATURATION:	LATERAL PRESS.: 104.0 psi	BACK PRESSURE (=UPPER=LOWER): 100.0 psi		
DURING TEST:	LATERAL PRESS.: 104.0 psi	H2: 100.0 psi	H1: 100.0 psi	BIAS PRESSURE (=H1-H2) 0.0 psi

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H, cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm ³	IN FLOW cm ³	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP. C	TEMP. CORR.:
7.1	66.0	0.00	58.9									
7.2	65.9	89.00	58.7	0.003401	7.46E-09	0.03	0.03	1.00	23.1	11	25.3	0.883
7.3	65.8	184.00	58.5	0.003413	7.03E-09	0.03	0.03	1.00	23.1	4	25.2	0.885
7.4	65.7	292.00	58.3	0.003425	6.22E-09	0.03	0.03	1.00	23.0	8	25.1	0.887
7.5	65.6	400.00	58.1	0.003436	6.24E-09	0.03	0.03	1.00	22.9	7	25.1	0.887

HYDRAULIC CONDUCTIVITY (k₂₀) = **AVERAGE 6.7E-09 cm/sec**

MAXIMUM HYDRAULIC GRADIENT	1.0E-03 TO 1.0E-07	2	0.75<	30	% < 25 AT
	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC GRADIENT	OR
	1.0E-06 TO 1.0E-07	20		% < 50 AT	
	less than 1.0E-07	30		ALLOWED	< 1.0E-8

