

HYDRAULIC CONDUCTIVITY (PERMEABILITY) TEST: Specimen Calculations & Summary

Project Number: 0411-08-1686

Cell No.: 15

KAW 7/16/08 B-2319

File Name: B-2319_UD4dV

Task Number: NA

Specific Gravity: 2.720

☒ Measured; ☐ Assumed

Boring No.: B-2319UD

Sample No.: UD4

Specimen No.: D

Depth (ft): 25.0 - 27.0

Type Test: Permeability Vert.

Specimen: ☒ "Undisturbed"; ☐ Reconstituted;

Calculations Corr. for Salt (dissolved solids): ☒ No or, ☐ Yes, with concentration = ppm

Initial Water Contents (WC), (W_o) over Saturation, (S_o), in (%):						Calculated Mass of Dry Soil (g)	
Top, $W_{o,1}$	Bottom, $W_{o,2}$	Sides, $W_{o,3}$	Avg., $W_{o,avg}$	Select., $W_{o,s}$	Back Cal., $W_{o,bc}$	Initial Selected WC, w_o (%)	20.38
W_c 20.72	20.64		20.68	20.38	20.38	Initial, $M_{d,o}$	492.63
S_o 95.3	95.1		95.2	94.4	94.4	Final, $M_{d,at}$	492.63
Measured final mass of moist soil, $M_{t,at}$ (g)						Selected, M_d	492.63
Final mass of moist soil corrected for excess dry soil, $M_{t,at,c}$ (g)							

Consolidation Data	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Changes in Height (mm) and Volume (cm^3) Within Given Consolidation Stages/Columns	At Initial Seating Stress	During Back-Pressuring	1st Consol. Increment (1)	Column 2 or 3 to 1st Test Stage (1)	Column 4 to 2nd Test Stage	Column 5 to 3rd Test Stage	Column 6 to 4th Test Stage
Sign Convention: (+) Deformation in compression or Flow out of spec.; (-) Deformation in extension (swell) or Flow into spec.							
Change in Height, $\Delta H_{c,n}$	0.06	-1.58		1.02	NA	NA	NA
Sum of changes in (+ out) burette readings, $\Delta b_{r,n}$ (- in)	0.80			10.15	NA	NA	NA
Theoretical $\Delta V_{ct,n} = (3V_o \times \Delta H_{c,n} / H_o)$	0.75	-19.84		12.81	NA	NA	NA
Vol. Factor, $F_v = \Delta b_{r,n} / \Delta V_{t,n}$	1.00	0.75		0.79	NA	NA	NA
Corrected $\Delta V_{ct,n} = F_v \times \Delta V_{t,n}$	0.75	-14.88	NA	NA	NA	NA	NA
Selected $\Delta V_{c,n}$	0.75	-14.88		10.15	NA	NA	NA

Summary For Test Stages						Vol. Factor used to cal. $\Delta V_{HC,n}$ in perm. stage(2)=
Test Stage:	1st = 1	2nd = 2	3rd = 3	4th = 4		NA
Cell Pressure, $\sigma_{c,n}$ (psi)	100.00	NA	NA	NA		Number of Test Stages = 1
Back Pressure, $U_{b,n}$ (psi)	80.00	NA	NA	NA		
Axial Force Reading, $P_{r,n}$ (lbf)	NA	NA	NA	NA		Ht. change during permeation & removal of cell pressure, (5)
Eff. Consol. Stress (σ'_c or $\sigma'_{v,c}$) (4), (ksf)	2.88	NA	NA	NA		ΔH_{id} (mm) = -0.04
t_c , ON or in ☒ days ☐ hrs	5.00	NA	NA	NA		

At Final Test Stress/Stage - Summary of Calculation of ΔV_c (cm^3) by Different Procedures					
By Selected Volumes	By Saturation = 100 %	By Change in Mass (6)	For Diff. in Meas. Vol. ($V_o - V_{ad}$)	For Selected ΔV_c , required G_s for $S_c = 100$ %:	
$\Delta V_c = -3.98$	$\Delta V_c = -5.50$	$\Delta V_c = 10.08$	& corr. for ΔH_{id} $\Delta V_c = -11.10$	2.743	

At Final Test Stress/Stage - Consolidation Conclusions					
$\Delta H_{c,f}$ (mm) = -0.50	$\Delta V_{c,f}$ (cm^3) = -4.74	Back Cal. G_s for $S=100\%$ = 2.731	Normalized	Ht. Ch. (%) = 0.87	
$\epsilon_{ac,c}$ (%) = -0.73	$\epsilon_{vc,f}$ (%) = -1.65		Diff. in:	Vol. Ch. (%) = 2.11	

Summary of Specimen Physical Properties											
Specific Gravity: $G_s = 2.720$ Measured	Height (mm)	Volume (cm^3)	Area (cm^2)	Water Content (%)	Unit Weight (pcf)		Saturation (%)	Void Ratio e	Volumetric Water Content	Porosity n	Skempton B parameter % (7)
Condition:					Total	Dry					
Initial:	68.80	287.96	41.85	20.4	128.56	106.80	94.4	0.587	0.3493	0.370	100.0
After to 1st σ'_c	69.30	292.70	42.24	22.7	128.92	105.07	100.7	0.613	0.3827	0.380	
Consol.: to 2nd σ'_c											NA
to 3rd σ'_c											"
to 4th σ'_c											"

Notes: (1) If the consol. stress in the 1st consol. increment & 1st test stage are equal, log the data in Column 4.

(2) The ht. changes occurring within each permeation stage (1 - 4) are recorded in these rows (after Column 3).

(3) The volume changes occurring within each permeation stage (1 - 4) are calculated/recorded in these rows (after Column 3).

(4) Stresses are not corr. for membrane.

(5) Log as a negative number if change in height is upward.

(6) $\sim M_{t,o} - (M_{t,at,c} + \Delta V_{in, column 1 \& 2})$

(7) Initial value is after back pressuring

NA - Not Applicable ON - Over Night; WC - Water Content Remarks:

Calculated By: RC,jr

Reviewed By: HP

HYDRAULIC CONDUCTIVITY (PERMEABILITY) TEST: ASTM D 5084-03, METHOD F: **Using Flexible Wall Permeameter and Mercury Constant Volume - Falling Head Hydraulic System**

Project Number: 0411-08-1686 Test Type: Permeability Vert. Cell No.: 15 Boring/Exploration No.: B-2319UD
 Task Number: NA Test Stage: 1 of 1 Test Station No.: 2 Sample No.: UD4
 Project Name: Exelon (Victoria) Test No.: NA Hyd. App. No. (Permeometer): 3 Penetration/Depth (ft): 25.0 - 27.0
 Test Series No.: NA File Name: 2319_UD4dV Composite Sample No.:
 Axial Load Cell No.: NA Factor, (lbf/V/V): NA Excit. Volt, V: NA Ch. No.: NA Ht. Reading before Perm. (mm): 2.740
 Vert. Dial/DT No.: DG-026 Factor, (mm/V/V): Excit. Volt, V: Ch. No.: Ht. Reading at $\sigma_c = 0$ (mm): 2.780

Permeation & Specimen Information			
Permeant:	☒ Tap Water;	☐ Other	
Direction of Flow:	☒ Up;	☐ Down	
Perm. Orientation:	☒ Vertical;	☐ Horizontal	
Specimen:	☒ "Undisturbed;"	☐ Reconstituted;	
Back	Stage	Height, $L_{t,n}$ (mm)	Area, $A_{t,n}$ (cm ²)
Pressure, U_b (psi)	Preliminary:	69.302	42.10
= 80.0	Final:	69.302	42.24
Prelim. change in height during consol., $\Delta H_{c,p}$ (mm) = -0.5			

Hydraulic System Constants	
Mercury U-Tube Manometer	
Area headwater tube, a_{in} (cm ²):	0.7671
Area tailwater tube, a_{out} (cm ²):	0.03142
ΔH_{eq} at equilibrium (cm):	0.4
Fluid Density Const. (15-25°C):	12.57

Remarks: Stop Watch ID # SW-006

Mercury Head Settings (D 5084)			
Estimated k_t (cm/sec)	Max. Gradient ($i_o = h/L_{t,p}$)	Permeometer ΔH_g Setting (cm)	Min. Cell Pressure (psi)
1.0E-4 to 1.0E-5	≤ 5	2.4	81.0
1.0E-5 to 1.0E-6	≤ 10	5.1	82.0
1.0E-6 to 1.0E-7	≤ 20	10.7	83.9
<1.0E-7 or <3.0E-2 (m/yr)	≤ 30	16.2	85.9
For Special Gradient, i_o			

Trial No.	Read-ings By	Date y= 2008 (m/d)	Time (1) hr:min	Temp. °C	Δt (min)	Axial Force (volt)	Pressure		Dial DT Reading (mm)	Mercury Head Readings (2)		Total Head Loss (cm of water)	Initial Hyd. Gradient, i_o Preliminary Final	Hydraulic Conductivity, k Preliminary, k_t Final, $k_{20^\circ C}$		Minimum Allowable tw_r (cm)
							Cell, σ_c (psi)	Back, U_b (psi)		Tail, tw_r (cm) (3&4)	Head, hw_r (cm)			(m/yr)	(m/yr)	
1	rc,jr	4/8	8:22	21.6	26.0	NA	100.0	80.0	2.740	16.50	0.7	203.3	29.3	2.61E-03	2.51E-03	12.62
	rc,jr	4/8		21.6		NA	100.0	80.0	2.730	16.00	XXXXX	196.7	29.3	8.29E-09	7.95E-09	
2	rc,jr	4/8	8:48	21.6	50.0	NA	100.0	80.0	2.730	16.50	0.7	203.3	29.3	1.36E-03	1.30E-03	12.62
	rc,jr	4/8		21.6		NA	100.0	80.0	2.730	16.00	XXXXX	196.7	29.3	4.31E-09	4.14E-09	
* 3	rc,jr	4/8	9:39	21.6	60.0	NA	100.0	80.0	2.730	16.50	0.7	203.3	29.3	1.13E-03	1.09E-03	12.62
	rc,jr	4/8		21.6		NA	100.0	80.0	2.730	16.00	XXXXX	196.7	29.3	3.59E-09	3.45E-09	
* 4	rc,jr	4/8	10:48	21.6	62.0	NA	100.0	80.0	2.730	16.50	0.7	203.3	29.3	1.10E-03	1.05E-03	12.62
	rc,jr	4/8		21.6		NA	100.0	80.0	2.720	16.00	XXXXX	196.7	29.3	3.48E-09	3.33E-09	
* 5	rc,jr	4/8	11:51	21.6	63.5	NA	100.0	80.0	2.720	16.50	0.7	203.3	29.3	1.07E-03	1.03E-03	12.62
	rc,jr	4/8		21.6		NA	100.0	80.0	2.720	16.00	XXXXX	196.7	29.3	3.39E-09	3.26E-09	

(*) Indicates trials used for calculations of: Average $k_{20^\circ C}$, Max. Dev. from mean, and Average (i_o).

(1) If a stopwatch is used to obtain Δt , only record the initial time reading.

(2) Read both mercury levels at top of meniscus.

(3) The tailwater column is the column of mercury which is higher than the other (headwater) column.

(4) To meet the reading accuracy requirement of 5%, the drop in the tail water reading has to be > 1 cm. For CMT testing with $k < \text{about } 5 \times 10^{-8} \text{ cm/sec}$, that requirement can be reduced by about 1/2.

Average $k_{20^\circ C}$:	3.35E-09 cm/s
Max. Dev. from Mean:	3.0%
Avg. Initial Gradient (i_o):	29.3
Intrinsic (Absolute) Permeability, K :	3.43E-14 cm ²

Prelim. Calc. By: RC,jr Final Calc. By: RC,jr Reviewed By: HP



HYDRAULIC CONDUCTIVITY

Project No.	6468-07-1777	Tested By	HJ
Project Name	Exelon Texas COL (Victoria)	Test Date	4/8/2008
Boring No.	B-2319UD	Reviewed By	JW JW
Sample No.	UD-5	Review Date	5/7/08
Sample Depth	35-37 Ft.	Lab No.	8354
Sample Description	Brownish Yellow Sandy SILT (ML) Visual		

ASTM D5084 - Method F (CVFH)

Sample Type:	UD
Sample Orientation:	Vertical
Initial Water Content, %:	18.8
Wet Unit Weight, pcf:	126.1
Dry Unit Weight, pcf:	106.2
Compaction, %:	N/A
Hydraulic Conductivity, cm/sec. @20 °C	1.1E-06

Remarks: B Value = 0.96

KAW 5/9/08

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)



Project Number 6468-07-1777 Tested By HJ
 Project Name Exelon Texas COL (Victoria) Test Date 04/08/08
 Boring No. B-2319UD Reviewed By JW
 Sample No. UD-5 Review Date 5/7/08
 Sample Depth 35-37 Ft. Lab No. 8354
 Sample Description Brownish Yellow Sandy SILT (ML) Visual

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	T-3
Location 1	4.113	Location 1	2.879	Wet Soil+Pan, grams	944.58
Location 2	4.119	Location 2	2.881	Dry Soil + Pan, grams	799.14
Location 3	4.115	Location 3	2.885	Pan Weight, grams	51.18
Average	4.116	Average	2.882	Moisture Content, %	19.4
Volume, in ³	26.84	Wet Soil + Tare, grams	888.48	Dry Unit Weight, pcf	110.9
SG Measured	2.72	Tare Weight, grams	0.00	Saturation, %	99.8
Soil Sample Wt., g	888.48	Dry Soil +Tare, grams	747.96	Diameter, in.	N/M
Dry UW, pcf	106.2	Moisture Content, %	18.8	Length, in.	N/M
Saturation, %	85.3			Volume, in ³	N/M

Consolidation	
Chamber Pressure, psi	54
Back Pressure, psi	24
Confining Pressure, psi	30
Initial Burette Reading	24
Final Burette Reading	5.1
Volume Change, cc	18.9

Permeant used water

N/M - not measured due to the nature of sample

Elapsed Time (sec)	z ₀ (cm)	z _a (cm)	z _b (cm)	Δz _p (cm)	Temp (°C)	Initial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
120	1.70	9.80	8.10	1.70	24.6	9.7	7.6	1.23E-06	1.10E-06
240	1.70	9.80	6.90	2.90	24.6	9.7	6.1	1.16E-06	1.04E-06
360	1.70	9.80	5.90	3.90	24.6	9.7	4.9	1.15E-06	1.03E-06
480	1.70	9.80	5.10	4.70	24.6	9.7	3.9	1.15E-06	1.03E-06

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
4	UD	N/A	N/A	Vertical

Avg. k at 20 °C 1.1E-06 cm/sec

$$a_a = 0.76712 \text{ cm}^2$$

$$A = 42.08 \text{ cm}^2$$

$$L = 10.45 \text{ cm}$$

$$S=L/A = 0.24844 \text{ l/cm}$$

$$a_p = 0.031416 \text{ cm}^2$$

$$M_1 = 0.03018$$

$$M_2 = 1.04095$$

$$C = M_1 S / (G_{Hg} - 1) = 0.0005965 \text{ for } 15^\circ \text{ to } 25^\circ$$

Remarks: B Value = 0.96



HYDRAULIC CONDUCTIVITY

Project No.	6468-07-1777	Tested By	HJ
Project Name	Exelon Texas COL (Victoria)	Test Date	4/8/2008
Boring No.	B-2319UD	Reviewed By	JW JW
Sample No.	UD-6	Review Date	5/7/08
Sample Depth	55-57 Ft. (Top)	Lab No.	8355
Sample Description	Light Yellowish Brown Sandy SILT (ML) Visual		

ASTM D5084 - Method F (CVFH)

Sample Type:	UD
Sample Orientation:	Vertical
Initial Water Content, %:	30.7
Wet Unit Weight, pcf:	120.1
Dry Unit Weight, pcf:	91.9
Compaction, %:	N/A
Hydraulic Conductivity, cm/sec. @20 °C	1.5E-06

Remarks: B Value = 0.96

KAW 5/9/08

PERMEABILITY TEST

(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)



Project Number 6468-07-1777 Tested By HJ
 Project Name Exelon Texas COL (Victoria) Test Date 04/08/08
 Boring No. B-2319UD Reviewed By JW
 Sample No. UD-6 Review Date 5/7/08
 Sample Depth 55-57 Ft. (Top) Lab No. 8355
 Sample Description Light Yellowish Brown Sandy SILT (ML) Visual

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	T-19
Location 1	4.130	Location 1	2.846	Wet Soil+Pan, grams	857.47
Location 2	4.140	Location 2	2.841	Dry Soil + Pan, grams	685.07
Location 3	4.135	Location 3	2.852	Pan Weight, grams	50.4
Average	4.135	Average	2.846	Moisture Content, %	27.2
Volume, in ³	26.31	Wet Soil + Tare, grams	829.38	Dry Unit Weight, pcf	97.4
SG Measured	2.71	Tare Weight, grams	0.00	Saturation, %	99.9
Soil Sample Wt., g	829.38	Dry Soil +Tare, grams	634.67	Diameter, in.	N/M
Dry UW, pcf	91.9	Moisture Content, %	30.7	Length, in.	N/M
Saturation, %	99.0			Volume, in ³	N/M

Consolidation	
Chamber Pressure, psi	79
Back Pressure, psi	34
Confining Pressure, psi	45
Initial Burette Reading	24.6
Final Burette Reading	0.3
Volume Change, cc	24.3

Permeant used water

N/M - not measured due to the nature of sample

Elapsed Time (sec)	z ₀ (cm)	z _a (cm)	z _b (cm)	Δz _p (cm)	Temp (°C)	Initial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
60	1.70	7.00	6.20	0.80	24.4	6.3	5.3	1.75E-06	1.58E-06
120	1.70	7.00	5.60	1.40	24.4	6.3	4.6	1.65E-06	1.48E-06
180	1.70	7.00	5.00	2.00	24.4	6.3	3.9	1.70E-06	1.53E-06
240	1.70	7.00	4.60	2.40	24.4	6.3	3.4	1.63E-06	1.47E-06
300	1.70	7.00	4.20	2.80	24.4	6.3	2.9	1.63E-06	1.47E-06

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
5	UD	N/A	N/A	Vertical

Avg. k at 20 °C 1.5E-06 cm/sec

$$a_a = 0.76712 \text{ cm}^2$$

$$A = 41.05 \text{ cm}^2$$

$$L = 10.50 \text{ cm}$$

$$S=L/A = 0.25585 \text{ 1/cm}$$

$$a_p = 0.031416 \text{ cm}^2$$

$$M_1 = 0.03018$$

$$M_2 = 1.04095$$

$$C = M_1 S / (G_{Hg} - 1) = 0.0006143 \text{ for } 15^\circ \text{ to } 25^\circ$$

Remarks: B Value = 0.96



HYDRAULIC CONDUCTIVITY

Project No. **6468-07-1777** Tested By **HJ**
Project Name **Exelon Texas COL (Victoria)** Test Date **4/21/2008**
Boring No. **B-2319UD** Reviewed By **JW**
Sample No. **UD-10** Review Date **5/9/08**
Sample Depth **95-97 Ft (Bottom)** Lab No. **8357**
Sample Description **Mottled Light Gray and Brownish Yellow Poorly Graded SAND (SP) Visual**

ASTM D5084-03 - (Method C Falling Head Rising Tail)

Sample Type:	UD
Sample Orientation:	Vertical
Initial Water Content, %:	11.2
Wet Unit Weight, pcf:	114.8
Dry Unit Weight, pcf:	103.2
Compaction, %:	N/A
Hydraulic Conductivity, cm/sec. @20 °C	7.7E-04

Remarks: B Value = 0.95

Kaw 5/9/08

PERMEABILITY TEST
(ASTM D5084 - 03) (Method C, Increasing Tailwater Level)



Project Number 6468-07-1777 Tested By HJ
Project Name Exelon Texas COL (Victoria) Test Date 04/21/08
Boring No. B-2319UD Reviewed By TW
Sample No. UD-10 Review Date 5/9/08
Sample Depth 95-97 Ft (Bottom) Lab No. 8357
Sample Description Mottled Light Gray and Brownish Yellow Poorly Graded SAND (SP) Visual

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	BC-2
Location 1	4.500	Location 1	2.865	Wet Soil+Pan, g	1047.58
Location 2	4.495	Location 2	2.860	Dry Soil + Pan, g	866.83
Location 3	4.505	Location 3	2.864	Pan Weight, g	82.15
Average	4.500	Average	2.863	Moisture Content, %	23.0
Volume, in ³	28.97	Wet Soil + Tare, g	872.90	Dry Unit Weight, pcf	104.2
SG Measured	2.72	Tare Weight, g	0.00	Saturation, %	99.7
Soil Sample Wt., g	872.9	Dry Soil + Tare, g	784.68	Diameter, in.	N/M
Dry UW, pcf	103.2	Moisture Content, %	11.2	Length, in.	N/M
Saturation, %	47.4			Volume, in ³	N/M

N/M - not measured due to the nature of sample.

Consolidation	
Chamber Pressure, psi	95
Back Pressure, psi	30
Confining Pressure, psi	65
Initial Burette Reading	23.5
Final Burette Reading	18.8
Volume Change, cc	4.7
Permeant used	Water

Time (sec)	H _a (cm)	H _i (cm)	H _b (cm)	H ₂ (cm)	Temp (°C)	Initial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
60	5.0	20.6	7.5	18.2	25.0	1.4	0.9	8.65E-04	7.69E-04
120	5.0	20.6	9.1	16.3	25.0	1.4	0.6	8.87E-04	7.88E-04
180	5.0	20.6	10.2	15.4	25.0	1.4	0.5	8.40E-04	7.47E-04
60	3.8	20.8	6.6	18.1	25.0	1.5	1.0	8.96E-04	7.97E-04
180	3.8	20.8	9.6	15.2	25.0	1.5	0.5	8.49E-04	7.55E-04

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
5	UD	N/A	N/A	Vertical

Avg. k at 20 °C 7.71E-04 cm/sec

a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

H_a = initial inlet head in cm
H_i = initial outlet head in cm
t = time in seconds

H_b = final inlet head in cm
H₂ = final outlet head in cm

a = 1.00 cm²
A = 41.53 cm²
L = 11.43 cm

Remarks: B Value = 0.95

HYDRAULIC CONDUCTIVITY (PERMEABILITY) TEST: Specimen Setup / Take Down ASTM D 5084-03

Project Number: 0411-08-1686 Test Type: Permeability Vert. Cell No.: 9 File Name: B-2321_UD3dV
 Project Name: Exelon (Victoria) Test Stress(es), σ'_c or $\sigma'_{v,c}$ = 10, NA, NA & NA psi (1)
 Task No.: NA Perm. Orientation: ☒ Vert.; ☐ Horiz. G_s = 2.710 ☒ Meas.; ☐ Assumed
 Test No.: NA Test Series No.: NA Hydraulic System Used: ☐ Hg (CV-FH) ☒ FH (Open System)
 Part of Hyd. Conductivity Series: ☒ No.; ☐ Yes; if yes with ☐ Vert.; ☐ Horiz.; ☐ Remolded
 Assig. Remarks: _____

☒ Tube	☐ Field Extruded	☐ Liner	☐ Remolded	☐ Tamping	Constant Effort: Blows/Tamps per Layer = _____
Boring No.: <u>B-2321</u>	☐ Reconstituted	☐ Impact/Rammer		Rammer Wgt. (lb) = _____	No. Layers = _____
Sample No.: <u>UD3</u>	Compostite No.: _____	☐ Pluviated:		Tamper Force (lb) = _____	Drop (in.) = _____
Depth (ft): <u>10.0 - 11.7</u>	Specimen No.: <u>D</u>	☐ Kneading		Undercompaction: U_{nl} (%) = _____	Dia. (in.) = _____
☐ Spec. Selection by X-ray;	☐ Geomarine Sample			Ref. Effort = _____	% Comp. = _____ $\pm$ Opt. = _____

Type	☒ Isotropic	☐ K_o stress path	☐ Rings	Piston: ☒ Yes ; ☐ No	Attached to top cap
Consolidation:	☐ Anisotropic	☐ 45° stress path		Piston diameter: ☐ 1/2"; ☐ 1/4"; ☒ 1/8";	

Water Content (WC);	Initial - Trimming Location			Final (W_{at}) (see below)	SOIL MASSES:	Initial	Final
	Top ($W_{o,1}$)	Bottom ($W_{o,2}$)	Sides ($W_{o,3}$)				
Container No	814	833		4120	Moist + Tare (etc.) (g):	623.92	633.95
Mass Moist Soil + Cont. (g)	87.85	126.56		148.68	Tare (etc.) (g):	0.00	0.00
Mass Dry Soil + Cont. (g)	80.08	113.03		130.26	Spec. Moist Mass (g):	623.92	633.95
Mass Container (g)	31.92	31.51		30.12	EXCESS DRY SOIL (soil stuck to stones, filter paper, membrane, etc.)		
Water Content, $W_{o,n}$ (%)	16.13	16.60		18.39	Container No:		
Avg. Initial WC, $W_{o,avg}$ (%)	16.37	Final (W_{at});	☒ Slice;	Whole Spec.	Mass Dry Soil + Container (g):		
See attached data sheet(s) for additional water contents					Mass Container (g):		
					Mass Excess Dry Soil (g):	0.00	

Specimen Dimensions					
Height (mm)			Diameter (mm)		
	Initial (H_o)	Final (H_{at})		Initial (D_o)	Final (D_{at})
GB	70.000	70.000	T	73.00	73.10
1	1.47	1.32	M	73.00	73.00
2	1.79	1.26	B	73.00	73.00
3	1.38	1.32	T'		
4	1.39	1.16	M'		
5	1.42	1.49	B'		
Avg.	71.49	71.31	Avg.	73.00	73.03

Measuring Devices:		A_o (cm ²) =	41.85
PI Tape: ☒ Dia.		V_o (cm ³) =	299.21
Calipers: ☐ Ht.; ☐ Dia.		A_{at} (cm ²) =	41.89
Dial Comparator: ☒ Ht.; ☐ Dia.		V_{at} (cm ³) =	298.73

Estimated Initial Unit Weight:	
Total, $\gamma_{t,o}$ (lb/ft ³) =	130.17
Dry, $\gamma_{d,o}$ (lb/ft ³) =	111.87

Membrane / Filter Paper / Platens			
Membrane (mm)		Top	Bottom
Thickness:	☐ Single	0.67	0.75
	☒ Double	0.68	0.77
Circumference (C_m)		216.00	216.00
Summary:		Thickness	Diameter
Nominal Value	Average:	0.36	68.75
Filter Paper : Top + Bottom : ☒ Yes ; ☐ No			
Whatman No. 54: ☒ Yes ; ☐ Other:			
Mass top cap, M_{tc} (g) =		+ 454 = _____ lb	
Mass (cap, dial, piston, etc.) (g) =		NA ; NA lb	

NA - Not Applicable; UK - Unknown; GB - Gage Block

Note: (1) Each Test Stress is identified as a Test Stage on other data sheets.

Final Specimen Description (USCS group name & symbol, color, layering, max. part. size, slickensided, fissured, blocky, honeycombed, etc.):
 Mottled Very Pale Brown and Brownish Yellow Fat CLAY (CH)

☐ Photo taken (internal sliced surface & outside surface)

Other Remarks _____

Trimmed / Reconstituted By: RC,jr
 Date: 3/27/2008

Setup By: RC,jr
 Date: 3/27/2008

Take Down By: RC,jr
 Date: 4/9/2008

Prelim. Calc. By: RC,jr Calculated By: RC,jr

Reviewed By: HP

KAW 7/16/08

HYDRAULIC CONDUCTIVITY (PERMEABILITY) TEST: Specimen Calculations & Summary

Project Number: 0411-08-1686 Cell No.: 9
 Task Number: NA Specific Gravity: 2.710 ☒ Measured; ☐ Assumed
 Boring No.: B-2321 Sample No.: UD3 Specimen No.: D Depth (ft): 10.0 - 11.7
 Type Test: Permeability Vert. Specimen: ☒ "Undisturbed"; ☐ Reconstituted;
 Calculations Corr. for Salt (dissolved solids): ☒ No or, ☐ Yes, with concentration = ppm

Initial Water Contents (WC), (W_o) over Saturation, (S_o), in (%):						Calculated Mass of Dry Soil (g)	
Top, $W_{o,1}$	Bottom, $W_{o,2}$	Sides, $W_{o,3}$	Avg., $W_{o,avg}$	Select., $W_{o,s}$	Back Cal., $W_{o,bc}$	Initial Selected WC, w_o (%)	16.37
W_o 16.13	16.60		16.37	16.37	16.52	Initial, $M_{d,o}$	536.15
S_o 86.3	87.7		87.0	87.0	87.5	Final, $M_{d,at}$	535.46
Measured final mass of moist soil, $M_{t,at}$ (g)						Selected, M_d	535.80
Final mass of moist soil corrected for excess dry soil, $M_{t,at,c}$ (g)							

Consolidation Data	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Changes in Height (mm) and Volume (cm^3) Within Given Consolidation Stages/Columns	At Initial Seating Stress	During Back-Pressuring	1st Consol. Increment (1)	Column 2 or 3 to 1st Test Stage (1)	Column 4 to 2nd Test Stage	Column 5 to 3rd Test Stage	Column 6 to 4th Test Stage
Sign Convention: (+) Deformation in compression or Flow out of spec.; (-) Deformation in extension (swell) or Flow into spec.							
Change in Height, $\Delta H_{c,n}$	0.19	-0.17		0.33	NA	NA	NA
Sum of changes in burette readings, $\Delta b_{r,n}$ (+ out) (- in)	1.50	-14.06	NA	3.72	NA	NA	NA
Theoretical $\Delta V_{ct,n} = (3V_o \times \Delta H_{c,n} / H_o)$	2.39	-2.13		4.14	NA	NA	NA
Vol. Factor, $F_v = \Delta b_{r,n} / \Delta V_{t,n}$	0.50	0.50		0.90	NA	NA	NA
Corrected $\Delta V_{ct,n} = F_v \times \Delta V_{t,n}$	1.19	-1.07	NA	NA	NA	NA	NA
Selected $\Delta V_{c,n}$	1.19	-1.07		3.72	NA	NA	NA

Summary For Test Stages						Vol. Factor used to cal. $\Delta V_{HC,n}$ in perm. stage(2)= Consol.Val.	
Test Stage:	1st = 1	2nd = 2	3rd = 3	4th = 4			
Cell Pressure, $\sigma_{c,n}$ (psi)	90.00	NA	NA	NA		Number of Test Stages = 1	
Back Pressure, $U_{b,n}$ (psi)	80.00	NA	NA	NA		Ht. change during permeation & removal of cell pressure, (5)	
Axial Force Reading, $P_{r,n}$ (lbf)	NA	NA	NA	NA		ΔH_{td} (mm) = -0.04	
Eff. Consol. Stress (σ'_c or $\sigma'_{v,c}$) (4), (ksf)	1.44	NA	NA	NA			
t_c , ON or in ☒ days ☐ hrs	5.00	NA	NA	NA			

At Final Test Stress/Stage - Summary of Calculation of ΔV_c (cm^3) by Different Procedures				
By Selected Volumes $\Delta V_c =$ 3.85	By Saturation = 100 % $\Delta V_c =$ 2.82	By Change in Mass (6) $\Delta V_c =$ 4.00	For Diff. in Meas. Vol. ($V_o - V_{a,1}$) & corr. for ΔH_{td} $\Delta V_c =$ 0.18	For Selected ΔV_c , required G_s for $S_c = 100$ %: 2.724

At Final Test Stress/Stage - Consolidation Conclusions				
$\Delta H_{c,f}$ (mm) = 0.35	$\Delta V_{c,f}$ (cm^3) = 3.33	Back Cal. G_s for $S=100\%$ = 2.717	Normalized	Ht. Ch. (%) = 0.18
$\epsilon_{ac,c}$ (%) = 0.49	$\epsilon_{vc,f}$ (%) = 1.11		Diff. in:	Vol. Ch. (%) = 0.95

Summary of Specimen Physical Properties											
Specific Gravity: $G_s = 2.710$ Measured	Height (mm)	Volume (cm^3)	Area (cm^2)	Water Content (%)	Unit Weight Total (pcf)	Dry (pcf)	Saturation (%)	Void Ratio e	Volumetric Water Content	Porosity n	Skempton B parameter % (7)
Condition:											
Initial:	71.49	299.21	41.85	16.4	130.17	111.79	87.3	0.511	0.2950	0.338	99.0
After to 1st σ'_c	71.14	295.88	41.59	18.3	133.76	113.05	100.5	0.494	0.3323	0.331	
Consol.: to 2nd σ'_c											NA
to 3rd σ'_c											"
to 4th σ'_c											"

Notes: (1) If the consol. stress in the 1st consol. increment & 1st test stage are equal, log the data in Column 4.
 (2) The ht. changes occurring within each permeation stage (1 - 4) are recorded in these rows (after Column 3).
 (3) The volume changes occurring within each permeation stage (1 - 4) are calculated/recorded in these rows (after Column 3).
 (4) Stresses are not corr. for membrane. (5) Log as a **negative** number if change in height is upward.
 (6) $\sim M_{t,o} - (M_{t,at,c} + \Delta V_{in, column 1 \& 2})$ (7) Initial value is after back pressuring
 NA - Not Applicable ON - Over Night; WC - Water Content Remarks: _____

Calculated By: RC,jr

Reviewed By: HP HP

HYDRAULIC CONDUCTIVITY (PERMEABILITY) TEST: ASTM D 5084-03, METHOD C (Falling Head/Rising Tail Method):
Flexible Wall Permeameter Using Water/"Fluid" Open Faling Head Hydraulic System - First Sheet

Project No.: 0411-08-1686 Test Type: Permeability Vert. Cell No.: 9 Boring/Exploration No.: B-2321
 Task Number: NA Test Stage: 1 of 1 Test Station No.: 1 Sample No.: UD3
 Project Name: Exelon (Victoria) Test No.: NA File Name: B-2321_UD3dV Penetration/Depth (ft): 10.0 - 11.7
 Test Series No.: NA Test Sheet: 1 of Composite Sample No.:
 Material Description: Mottled Very Pale Brown and Brownish Yellow Fat CLAY (CH) Specimen No.: D
 Axial Load Cell No.: NA Factor, (lbf/V/V): NA Excit. Volt, V: NA Ch. No.: NA Ht. Reading before Perm. (mm): 2.170
 Vert. Dial/DT No.: Factor, (mm/V/V): Excit. Volt, V: Ch. No.: Ht. Reading at $\sigma_c = 0$ (mm): 2.21

Permeation & Specimen Information			
Permeant:	☒ Tap Water;	☐ Other	
Direction of Flow:	☒ Up;	☐ Down	
Perm. Orientation:	☒ Vertical;	☐ Horizontal	
Specimen:	☒ "Undisturbed;"	☐ Reconstituted;	
Required Units:	Calc. Stage:	Height, $L_{t,n}$ (mm)	Area, $A_{t,n}$ (cm ²)
☒ cm/s	Preliminary:	71.140	41.69
☐ m/yr	Final:	71.140	41.59
Prelim. change in height during consol., $\Delta H_{c,p}$ (mm) = 0.35			
Applied back pressure, U_b (psi) = 80.0			
Bladder Interface: H_t & H_b in cm, with H_t = NA H_b = NA			

Test Station Constants/App. Info.	
Area headwater tube, a_{in} (cm ²):	0.1969
Area tailwater tube, a_{out} (cm ²):	0.1969
Permeant/Fluid Density, Accum.	NA
at 22°C, $\rho_{r,n}$ (g/cm ³):	System 0.9978
Elev. Heads by:	☒ Vol. (1) ☐ Elev.
If by Vol.:	☒ Case 2 ☐ Case 3
Differential Pressure Head System	
☐ Differential Manometer (cm Hg):	
☐ U-tube; ☐ Vert. Column	
☒ Pressure Trans./Gage (psi):	☐ Differential

Pressure Head Settings (D 5084)			
Estimated k_t (cm/sec)	Max. Initial Gradient, i_0 ($i_0 = h/Lc,p$)	Max. Press. Head Setting (psi)	Min. Cell Pressure (psi)
1.0E-4 to 1.0E-5	≤5	80.15	80.6
1.0E-5 to 1.0E-6	≤10	80.65	81.1
1.0E-6 to 1.0E-7	≤20	81.66	82.2
<1.0E-7 or <3.0E-2 (m/yr)	≤30	82.67	83.4
For Special Gradient, i			

Remarks: Stop Watch # SW-012

Trial No.	Read-ings By	Date y= 2008 (m/d)	Time hr:min	Temp. °C	Δt (min)	Axial Force		Pressure		Dial Reading (mm)	Head Readings				Flow Ratio; outflow to inflow	Total Head Loss (cm of water)	Initial Hyd. Gradient, i ₀ Preliminary Final	Hyd. Conductivity, k Preliminary, k _i Final, k _{20°C} cm/s
						X	(volt)	Cell, σ _c (psi)	Back, U _b (psi)		Pressure (2)		Fluid (3)					
											Differential or Head	Tail	Head, hw _r cm^3	Tail, tw _r cm^3				
1	RC,jr	4/8	11:33	21.6	6.3		NA	90.00	80.00	2.170	80.00	80.00	3.00	7.00	1.00	20.32	2.9	1.27E-05
	RC,jr	4/8		21.6			NA	90.00	80.00	2.170	80.00	80.00	3.50	6.50		15.24	2.9	1.23E-05
* 2	RC,jr	4/8	11:40	21.6	8.5		NA	90.00	80.00	2.170	80.00	80.00	3.00	7.00	1.00	20.320	2.9	9.47E-06
	RC,jr	4/8		21.6			NA	90.00	80.00	2.170	80.00	80.00	3.50	6.50		15.240	2.9	9.16E-06
* 3	RC,jr	4/8	11:49	21.6	9.5		NA	90.00	80.00	2.170	80.00	80.00	3.00	7.00	1.00	20.32	2.9	8.48E-06
	RC,jr	4/8		21.6			NA	90.00	80.00	2.160	80.00	80.00	3.50	6.50		15.24	2.9	8.20E-06
* 4	RC,jr	4/8	11:59	21.6	9.8		NA	90.00	80.00	2.160	80.00	80.00	3.00	7.00	1.00	20.32	2.9	8.26E-06
	RC,jr	4/8		21.6			NA	90.00	80.00	2.160	80.00	80.00	3.50	6.50		15.24	2.9	7.99E-06
* 5	RC,jr	4/8	12:11	21.6	10.0		NA	90.00	80.00	2.160	80.00	80.00	3.00	7.00	1.00	20.32	2.9	8.05E-06
	RC,jr	4/8		21.6			NA	90.00	80.00	2.160	80.00	80.00	3.50	6.50		15.24	2.9	7.79E-06

(*) Indicates trials used for calculations (Average $k_{20^\circ C}$, Max. Dev. from mean, Average (i)).

Notes: (1) If by vol.: Case 2-Burettes have equal areas, scales & elev.; while for Case 3 they are not equal & see attached sheet.

(2) A manometer reads differential pressure between the headwater and tailwater burettes, while gage does not (unless differential).

(3) Make sure the SCF in Cells A51, A54, A57, A60 & A63 are correct.

Average $k_{20^\circ C}$:	8.28E-06 cm/s
Max. Dev. from mean:	10.6%
Avg. Initial Gradient (i_0):	2.9
Intrinsic (Absolute) Permeability, K :	8.48E-11 cm ²

Prelim. Calc. By: RC,jr Final Calc. By: RC,jr Reviewed By: HP

501.3a (12/01/07)

B-2321_UD3dV.xls, Test_FH 6/20/2008

FUGRO CONSULTANTS, INC.

HYDRAULIC CONDUCTIVITY (PERMEABILITY) TEST: Specimen Setup / Take Down ASTM D 5084-03

Project Number: 0411-08-1686 Test Type: Permeability Vert. Cell No.: 8 File Name: B-2321_UD6cV
 Project Name: Exelon (Victoria) Test Stress(es), σ'_c or $\sigma'_{v,c}$ = 25, NA, NA & NA psi (1)
 Task No.: NA Perm. Orientation: ☒ Vert.; ☐ Horiz. G_s = 2.720 ☒ Meas.; ☐ Assumed
 Test No.: NA Test Series No.: NA Hydraulic System Used: ☒ Hg (CV-FH) ☐ FH (Open System)
 Part of Hyd. Conductivity Series: ☒ No.; ☐ Yes; if yes with ☐ Vert.; ☐ Horiz.; ☐ Remolded
 Assig. Remarks: _____

☒ Tube	☐ Field Extruded	☐ Liner	☐ Remolded	☐ Tamping	Constant Effort: Blows/Tamps per Layer = _____
Boring No.: <u>B-2321</u>	☐ Reconstituted			Impact/Rammer	Rammer Wgt. (lb) = _____ No. Layers = _____
Sample No.: <u>UD6</u>	Compostite No.: _____			Pluviated:	Tamper Force (lb) = _____ Drop (in.) = _____
Depth (ft): <u>28.5 - 36.2</u>	Specimen No.: <u>C</u>			Kneading	Undercompaction: U_{ni} (%) = _____ Dia. (in.) = _____
☐ Spec. Selection by X-ray;	☐ Geomarine Sample				Ref. Effort = _____ % Comp. = _____ $\pm$ Opt. = _____

Type	☒ Isotropic	☐ K_o stress path	☐ Rings	Piston: ☒ Yes ; ☐ No	Attached to top cap
Consolidation:	☐ Anisotropic	☐ 45° stress path		Piston diameter: ☐ 1/2"; ☐ 1/4"; ☒ 1/8";	

Water Content (WC);	Initial - Trimming Location			Final (W_{at}) (see below)	SOIL MASSES:	Initial	Final
	Top ($W_{o,1}$)	Bottom ($W_{o,2}$)	Sides ($W_{o,3}$)				
Container No	692	723		4125	Moist + Tare (etc.) (g):	524.68	529.39
Mass Moist Soil + Cont. (g)	123.87	123.88		141.67	Tare (etc.) (g):	0.00	0.00
Mass Dry Soil + Cont. (g)	105.26	104.96		118.46	Spec. Moist Mass (g):	524.68	529.39
Mass Container (g)	31.54	31.29		30.35	EXCESS DRY SOIL (soil stuck to stones, filter paper, membrane, etc.)		
Water Content, $W_{o,n}$ (%)	25.24	25.68		26.34	Container No:		
Avg. Initial WC, $W_{o,avg}$ (%)	25.46	Final (W_{at}); ☒ Slice; ☐ Whole Spec.			Mass Dry Soil + Container (g):		
See attached data sheet(s) for additional water contents					Mass Container (g):		
					Mass Excess Dry Soil (g):	0.00	

Specimen Dimensions					
Height (mm)			Diameter (mm)		
	Initial (H_o)	Final (H_{at})		Initial (D_o)	Final (D_{at})
GB	70.000	70.000	T	73.00	73.25
1	-5.30	-5.87	M	73.00	73.00
2	-5.29	-5.73	B	73.00	73.15
3	-5.36	-6.04	T'		
4	-5.24	-6.08	M'		
5	-5.34	-5.74	B'		
Avg.	64.69	64.11	Avg.	73.00	73.13

Measuring Devices:		A_o (cm ²) = <u>41.85</u>
Pi Tape: ☒ Dia.		V_o (cm ³) = <u>270.77</u>
Calipers: ☐ Ht.; ☐ Dia.		A_{at} (cm ²) = <u>42.01</u>
Dial Comparator: ☒ Ht.; ☐ Dia.		V_{at} (cm ³) = <u>269.30</u>

Estimated Initial Unit Weight:	
Total, $\gamma_{t,o}$ (lb/ft ³) = <u>120.97</u>	Dry, $\gamma_{d,o}$ (lb/ft ³) = <u>96.42</u>

Membrane / Filter Paper / Platens			
Membrane (mm)		Top	Bottom
Thickness:	☐ Single	0.66	0.75
	☒ Double	0.67	0.74
Circumference (C_m)		216.00	216.00
Summary:		Thickness	Diameter
Nominal Value	Average:	0.35	68.75
Filter Paper : Top + Bottom : ☒ Yes ; ☐ No			
Whatman No. 54: ☒ Yes ; ☐ Other:			
Mass top cap, M_{tc} (g) = _____		; $\div 454$ = _____ lbf	
Mass (cap, dial, piston, etc.) (g) = <u>NA</u>		; <u>NA</u> lbf	

NA - Not Applicable; UK - Unknown; GB - Gage Block

Note: (1) Each Test Stress is identified as a Test Stage on other data sheets.

Final Specimen Description (USCS group name & symbol, color, layering, max. part. size, slickensided, fissured, blocky, honeycombed, etc.):
 Mottled Brownish Yellow and Light Gray Fat CLAY (CH)

☐ Photo taken (internal sliced surface & outside surface)

Other Remarks _____

Trimmed / Reconstituted By: <u>RC,jr</u>	Setup By: <u>RC,jr</u>	Take Down By: <u>RC,jr</u>
Date: <u>3/28/2008</u>	Date: <u>3/28/2008</u>	Date: <u>4/9/2008</u>
Prelim. Calc. By: <u>RC,jr</u>	Calculated By: <u>RC,jr</u>	Reviewed By: <u>HP</u>

HYDRAULIC CONDUCTIVITY (PERMEABILITY) TEST: Specimen Calculations & Summary

LA 7/16/08 B-2321

Project Number: 0411-08-1686

Cell No.: 8

File Name: B-2321_UD6cV

Task Number: NA

Specific Gravity: 2.720

☒ Measured; ☐ Assumed

Boring No.: B-2321

Sample No.: UD6

Specimen No.: C

Depth (ft): 28.5 - 36.2

Type Test: Permeability Vert.

Specimen: ☒ "Undisturbed"; ☐ Reconstituted;

Calculations Corr. for Salt (dissolved solids): ☒ No or, ☐ Yes, with concentration = ppm

Initial Water Contents (WC), (W_o) over Saturation, (S_o), in (%):						Calculated Mass of Dry Soil (g)	
	Top, $W_{o,1}$	Bottom, $W_{o,2}$	Sides, $W_{o,3}$	Avg., $W_{o,avg}$	Select., $W_{o,s}$	Back Cal., $W_{o,bc}$	Initial Selected WC, w_o (%)
W_o	25.24	25.68		25.46	25.46	25.22	Initial, $M_{d,o}$
S_o	91.0	91.8		91.4	91.4	90.9	Final, $M_{d,at}$
Measured final mass of moist soil, $M_{t,at}$ (g)						529.39	Selected, M_d
Final mass of moist soil corrected for excess dry soil, $M_{t,at,c}$ (g)						529.39	418.61

Consolidation Data	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Changes in Height (mm) and Volume (cm^3) Within Given Consolidation Stages/Columns	At Initial Seating Stress	During Back-Pressuring	1st Consol. Increment (1)	Column 2 or 3 to 1st Test Stage (1)	Column 4 to 2nd Test Stage	Column 5 to 3rd Test Stage	Column 6 to 4th Test Stage
Sign Convention: (+) Deformation in compression or Flow out of spec.; (-) Deformation in extension (swell) or Flow into spec.							
Change in Height, $\Delta H_{c,n}$	0.22	0.07		1.11	NA	NA	NA
Sum of changes in burette readings, $\Delta b_{r,n}$	(+ out) 1.60			9.34	NA	NA	NA
	(- in)	-13.52	NA	NA	NA	NA	NA
Theoretical $\Delta V_{ct,n} = (3V_o \times \Delta H_{c,n} / H_o)$	2.76	0.88		13.94	NA	NA	NA
Vol. Factor, $F_v = \Delta b_{r,n} / \Delta V_{t,n}$	0.25	1.00		0.67	NA	NA	NA
Corrected $\Delta V_{ct,n} = F_v \times \Delta V_{t,n}$	0.69	0.88	NA	NA	NA	NA	NA
Selected $\Delta V_{c,n}$	0.69	-3.52		9.34	NA	NA	NA

Summary For Test Stages						Vol. Factor used to cal. $\Delta V_{Hc,n}$ in perm. stage(2)= NA	
Test Stage:	1st = 1	2nd = 2	3rd = 3	4th = 4			
Cell Pressure, $\sigma_{c,n}$ (psi)	105.00	NA	NA	NA		Number of Test Stages = 1	
Back Pressure, $U_{b,n}$ (psi)	80.00	NA	NA	NA		Ht. change during permeation & removal of cell pressure, (5)	
Axial Force Reading, $P_{r,n}$ (lbf)	NA	NA	NA	NA		ΔH_{td} (mm) = -0.07	
Eff. Consol. Stress (σ'_c or $\sigma'_{v,c}$) (4), (ksf)	3.60	NA	NA	NA			
t_c , ON or in	days	hrs	5.00	NA	NA		

At Final Test Stress/Stage - Summary of Calculation of ΔV_c (cm^3) by Different Procedures						
By Selected Volumes	By Saturation = 100 %	By Change in Mass (6)	For Diff. in Meas. Vol. ($V_o - V_{at}$)	For Selected ΔV_c , required G_s for $S_c = 100$ %:		
$\Delta V_c = 6.51$	$\Delta V_c = 5.61$	$\Delta V_c = 8.79$	& corr. for ΔH_{td} $\Delta V_c = 0.94$	2.736		

At Final Test Stress/Stage - Consolidation Conclusions					
$\Delta H_{c,f}$ (mm) = 1.40	$\Delta V_{c,f}$ (cm^3) = 6.06	Back Cal. G_s for $S=100\%$ = 2.728	Normalized	Ht. Ch. (%) = 1.15	
$\epsilon_{ac,c}$ (%) = 2.16	$\epsilon_{vc,f}$ (%) = 2.24		Diff. in:	Vol. Ch. (%) = 1.69	

Summary of Specimen Physical Properties											
Specific Gravity: $G_s = 2.720$ Measured	Height (mm)	Volume (cm^3)	Area (cm^2)	Water Content (%)	Unit Weight Total (pcf)	Dry (pcf)	Saturation (%)	Void Ratio e	Volumetric Water Content	Porosity n	Skempton B parameter % (7)
Condition:											
Initial:	64.69	270.77	41.85	25.3	120.97	96.51	91.1	0.756	0.3924	0.431	98.0
After to 1st σ'_c	63.29	264.71	41.82	26.5	124.85	98.72	100.4	0.717	0.4192	0.418	
Consol.: to 2nd σ'_c											NA
to 3rd σ'_c											"
to 4th σ'_c											"

- Notes: (1) If the consol. stress in the 1st consol. increment & 1st test stage are equal, log the data in Column 4.
 (2) The ht. changes occurring within each permeation stage (1 - 4) are recorded in these rows (after Column 3).
 (3) The volume changes occurring within each permeation stage (1 - 4) are calculated/recorded in these rows (after Column 3).
 (4) Stresses are not corr. for membrane. (5) Log as a negative number if change in height is upward.
 (6) $\sim M_{t,o} - (M_{t,at,c} + \Delta V_{in, column 1 \& 2})$ (7) Initial value is after back pressuring

NA - Not Applicable ON - Over Night; WC - Water Content Remarks:

Calculated By: RC,jr

Reviewed By: HP

HYDRAULIC CONDUCTIVITY (PERMEABILITY) TEST: ASTM D 5084-03, METHOD F:
Using Flexible Wall Permeameter and Mercury Constant Volume - Falling Head Hydraulic System

Project Number: 0411-08-1686 Test Type: Permeability Vert. Cell No.: 8 Boring/Exploration No.: B-2321
 Task Number: NA Test Stage: 1 of 1 Test Station No.: 3 Sample No.: UD6
 Project Name: Exelon (Victoria) Test No.: NA Hyd. App. No. (Permometer): 1 Penetration/Depth (ft): 28.5 - 36.2
 Test Series No.: NA File Name: 2321_UD6cV Composite Sample No.:
 Axial Load Cell No.: NA Factor, (lbf/V/V): NA Excit. Volt, V: NA Ch. No.: NA Ht. Reading before Perm. (mm): 0.790
 Vert. Dial/DT No.: Factor, (mm/V/V): Excit. Volt, V: Ch. No.: Ht. Reading at $\sigma_c = 0$ (mm): 0.860

Permeation & Specimen Information			
Permeant:	☒ Tap Water;	☐ Other	
Direction of Flow:	☒ Up;	☐ Down	
Perm. Orientation:	☒ Vertical;	☐ Horizontal	
Specimen:	☒ "Undisturbed;"	☐ Reconstituted;	
Back	Stage	Height, L_{tn} (mm)	Area, A_{tn} (cm ²)
Pressure, U_b (psi)	Preliminary:	63.294	41.11
= 80.0	Final:	63.294	41.82
Prelim. change in height during consol., $\Delta H_{c,p}$ (mm) = 1.4			

Hydraulic System Constants	
Mercury U-Tube Manometer	
Area headwater tube, a_h (cm ²):	0.7671
Area tailwater tube, a_{wt} (cm ²):	0.03142
ΔH_{eq} at equilibrium (cm):	0.4
Fluid Density Const. (15-25°C):	12.57
Remarks: <u>Stop Watch # SW-005</u>	

Mercury Head Settings (D 5084)			
Estimated k_t (cm/sec)	Max. Gradient ($i_o = h/L_{tp}$)	Permometer ΔH_g Setting (cm)	Min. Cell Pressure (psi)
1.0E-4 to 1.0E-5	≤ 5	2.1	80.9
1.0E-5 to 1.0E-6	≤ 10	4.7	81.8
1.0E-6 to 1.0E-7	≤ 20	9.7	83.6
<1.0E-7 or <3.0E-2 (m/yr)	≤ 30	14.7	85.4
For Special Gradient, i_o			

Trial No.	Read-ings By	Date y= 2008 (m/d)	Time (1) hr:min	Temp. °C	Δt (min)	Axial Force (volt)	Pressure		X Dial DT Reading (mm)	Mercury Head Readings (2)		Total Head Loss (cm of water)	Initial Hyd. Gradient, i_o Preliminary Final	Hydraulic Conductivity, k		Minimum Allowable tw_r (cm)
							Cell, σ_c (psi)	Back, U_b (psi)		Tail, tw_r (cm) (3&4)	Head, hw_r (cm)			Preliminary (m/yr) (cm/s)	Final, $k_{20^\circ C}$ (m/yr) (cm/s)	
	rc,jr	4/8	8:26	21.6	19.8	NA	105.0	80.0	0.790	15.00	1.2	178.1	28.1	8.26E-03	7.81E-03	11.60
1	rc,jr	4/8		21.6		NA	105.0	80.0	0.790	13.90	XXXXX	163.7	28.1	2.62E-08	2.48E-08	
	rc,jr	4/8	8:47	21.6	23.5	NA	105.0	80.0	0.790	15.00	1.2	178.1	28.1	6.97E-03	6.59E-03	11.60
2	rc,jr	4/8		21.6		NA	105.0	80.0	0.790	13.90	XXXXX	163.7	28.1	2.21E-08	2.09E-08	
	rc,jr	4/8	9:11	21.6	33.0	NA	105.0	80.0	0.790	15.00	1.2	178.1	28.1	6.39E-03	6.05E-03	11.60
* 3	rc,jr	4/8		21.6		NA	105.0	80.0	0.790	13.60	XXXXX	159.8	28.1	2.03E-08	1.92E-08	
	rc,jr	4/8	9:45	21.6	43.0	NA	105.0	80.0	0.790	15.00	1.2	178.1	28.1	6.03E-03	5.70E-03	11.60
* 4	rc,jr	4/8		21.6		NA	105.0	80.0	0.790	13.30	XXXXX	155.9	28.1	1.91E-08	1.81E-08	
	rc,jr	4/8	10:29	21.6	46.8	NA	105.0	80.0	0.790	15.00	1.2	178.1	28.1	5.54E-03	5.25E-03	11.60
* 5	rc,jr	4/8		21.6		NA	105.0	80.0	0.790	13.30	XXXXX	155.9	28.1	1.76E-08	1.66E-08	

(*) Indicates trials used for calculations of: Average $k_{20^\circ C}$, Max. Dev. from mean, and Average (i_o).

(1) If a stopwatch is used to obtain Δt , only record the initial time reading.

(2) Read both mercury levels at top of meniscus.

(3) The tailwater column is the column of mercury which is higher than the other (headwater) column.

(4) To meet the reading accuracy requirement of 5%, the drop in the tail water reading has to be > 1 cm. For CMT testing with k < about 5×10^{-8} cm/sec, that requirement can be reduced by about ½.

Average $k_{20^\circ C}$:	1.80E-08 cm/s
Max. Dev. from Mean:	7.4%
Avg. Initial Gradient (i_o):	28.1
Intrinsic (Absolute) Permeability, K :	1.84E-13 cm ²

Prelim. Calc. By: RC,jr Final Calc. By: RC,jr Reviewed By: HP



HYDRAULIC CONDUCTIVITY

Project No. **6468-07-1777** Tested By **HJ**
Project Name **Exelon Texas COL (Victoria)** Test Date **4/8/2008**
Boring No. **B-2321UD** Reviewed By **JW SW**
Sample No. **UD-7** Review Date **5/7/08**
Sample Depth **38.5-40.2 Ft** Lab No. **8358**
Sample Description **Very Pale Brown Mottled Brownish Yellow Fat CLAY (CH)**

ASTM D5084 - Method F (CVFH)

Sample Type:	UD
Sample Orientation:	Vertical
Initial Water Content, %:	21.0
Wet Unit Weight, pcf:	124.4
Dry Unit Weight, pcf:	102.8
Compaction, %:	N/A
Hydraulic Conductivity, cm/sec. @20 °C	8.4E-09

Remarks: B Value = 0.97

KAW 5/12/08

PERMEABILITY TEST

(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)



Project Number 6468-07-1777

Tested By HJ

Project Name Exelon Texas COL (Victoria)

Test Date 04/08/08

Boring No. B-2321UD

Reviewed By JW

Sample No. UD-7

Review Date 5/7/08

Sample Depth 38.5-40.2 Ft

Lab No. 8358

Sample Description Very Pale Brown Mottled Brownish Yellow Fat CLAY (CH)

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	N-11
Location 1	3.010	Location 1	2.844	Wet Soil+Pan, grams	682.31
Location 2	3.000	Location 2	2.865	Dry Soil + Pan, grams	570.28
Location 3	3.020	Location 3	2.867	Pan Weight, grams	48.97
Average	3.010	Average	2.859	Moisture Content, %	21.5
Volume, in ³	19.32	Wet Soil + Tare, grams	630.78	Dry Unit Weight, pcf	108.4
SG Measured	2.78	Tare Weight, grams	0.00	Saturation, %	99.6
Soil Sample Wt., g	630.78	Dry Soil +Tare, grams	521.31	Diameter, in.	N/M
Dry UW, pcf	102.8	Moisture Content, %	21.0	Length, in.	N/M
Saturation, %	84.9			Volume, in ³	N/M

N/M - not measured due to the nature of sample

Elapsed Time (sec)	z ₀ (cm)	z _a (cm)	z _b (cm)	Δz _p (cm)	Temp (°C)	Initial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
17820	1.70	15.00	11.10	3.90	23.6	21.9	15.2	9.06E-09	8.32E-09
40860	1.70	15.00	7.55	7.45	23.6	21.9	9.1	9.49E-09	8.72E-09
148074	1.70	15.00	2.80	12.20	23.6	21.9	1.0	9.27E-09	8.52E-09
176040	1.70	15.00	2.65	12.35	23.6	21.9	0.7	8.56E-09	7.86E-09

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
4	UD	N/A	N/A	Vertical

Avg. k at 20 °C 8.4E-09 cm/sec

$$a_s = 0.76712 \text{ cm}^2$$

$$A = 41.41 \text{ cm}^2$$

$$L = 7.65 \text{ cm}$$

$$S = L/A = 0.18464 \text{ 1/cm}$$

$$a_p = 0.031416 \text{ cm}^2$$

$$M_1 = 0.03018$$

$$M_2 = 1.04095$$

$$C = M_1 S / (G_{Hg} - 1) = 0.0004433 \text{ for } 15^\circ \text{ to } 25^\circ$$

Remarks: B Value = 0.97

Consolidation

Chamber Pressure, psi	69
Back Pressure, psi	34
Confining Pressure, psi	35
Initial Burette Reading	24
Final Burette Reading	7.5
Volume Change, cc	16.5

Permeant used water



HYDRAULIC CONDUCTIVITY

Project No. **6468-07-1777** Tested By **HJ**
Project Name **Exelon Texas COL (victoria)** Test Date **4/10/2008**
Boring No. **B-2321UD** Reviewed By **SW**
Sample No. **UD-12** Review Date **5/7/08**
Sample Depth **93-95.7 ft** Lab No. **8359**
Sample Description **Light Yellowish Brown Poorly Graded SAND with silt (SP-SM) Visual**

ASTM D5084-03 - (Method B Falling Head Constant Tail)

Sample Type:	UD
Sample Orientation:	Vertical
Initial Water Content, %:	21.3
Wet Unit Weight, pcf:	123.5
Dry Unit Weight, pcf:	101.9
Compaction, %:	N/A
Hydraulic Conductivity, cm/sec. @20 °C	1.1E-04

Remarks: B Value = 0.96

KAW 5/12/08

PERMEABILITY TEST (ASTM D5084 - 03) (Method B, Falling Head, Constant Tail)



Project Number 6468-07-1777

Tested By HJ

Project Name Exelon Texas COL (victoria)

Test Date 04/10/08

Boring No. B-2321UD

Reviewed By Jw

Sample No. UD-12

Review Date 5/2/08

Sample Depth 93-95.7 ft

Lab No. 8359

Sample Description Light Yellowish Brown Poorly Graded SAND with silt (SP-SM) Visual

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	AB-25
Location 1	4.110	Location 1	2.876	Wet Soil+Pan, g	959.75
Location 2	4.120	Location 2	2.849	Dry Soil + Pan, g	792.06
Location 3	4.130	Location 3	2.857	Pan Weight, g	84.18
Average	4.120	Average	2.861	Moisture Content, %	23.7
Volume, in ³	26.48	Wet Soil + Tare, g	858.33	Dry Unit Weight, pcf	103.6
SG Measured	2.69	Tare Weight, g	0.00	Saturation, %	102.8
Soil Sample Wt., g	858.33	Dry Soil + Tare, g	707.88	Diameter, in.	N/M
Dry UW, pcf	101.9	Moisture Content, %	21.3	Length, in.	N/M
Saturation, %	88.2			Volume, in ³	N/M

N/M - not measured due to the nature of sample.

Consolidation	
Chamber Pressure, psi	84
Back Pressure, psi	24
Confining Pressure, psi	60
Initial Burette Reading	24.0
Final Burette Reading	16.6
Volume Change, cc	7.4
Permeant used	Water

Time (sec)	Division Start	Division Finish	H ₀ (cm)	H _f (cm)	Temp (°C)	Initial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
425	0.0	24.0	146.40	122.4	23.6	14.0	11.7	1.06E-04	9.76E-05
324	0.0	20.0	146.40	126.4	23.6	14.0	12.1	1.14E-04	1.05E-04
296	0.0	20.0	146.40	126.4	23.6	14.0	12.1	1.25E-04	1.15E-04
303	0.0	20.0	146.40	126.4	23.6	14.0	12.1	1.22E-04	1.12E-04

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
4	UD	N/A	N/A	Vertical

Avg. k at 20 °C 1.08E-04 cm/sec

a = area of burette in cm²H_a = initial inlet head in cmH_b = final inlet head in cma = 1.00 cm²

Remarks: B Value = 0.96

L = length of sample in cm

H_i = initial outlet head in cmH₂ = final outlet head in cmA = 41.47 cm²A = area of sample in cm²

t = time in seconds

L = 10.46 cm



HYDRAULIC CONDUCTIVITY

Project No.	6468-07-1777	Tested By	HJ
Project Name	Exelon Texas COL (Victoria)	Test Date	4/15/2008
Boring No.	B-2321UD	Reviewed By	JW <i>[Signature]</i>
Sample No.	UD-14	Review Date	5/7/08
Sample Depth	128.5-130.25 ft	Lab No.	8360
Sample Description	Pale Yellow Fat Clay with SAND (CH)		

ASTM D5084 - Method F (CVFH)

Sample Type:	UD
Sample Orientation:	Vertical
Initial Water Content, %:	25.0
Wet Unit Weight, pcf:	121.3
Dry Unit Weight, pcf:	97.0
Compaction, %:	N/A
Hydraulic Conductivity, cm/sec. @20 °C	2.5E-09

Remarks: B Value = 0.97

KAW 5/9/08