APPENDICES

Appendix A : HYDRAULIC ANALYSIS EXCERPTS

Blackstone South - Domestic Water Demand Estimates

- Based on Mattamy Homes Concept Plan 2017-04-05 (160401130)

Building ID	Area (ha)	# of Units	PPU	Population	Daily Rate of Demand (L/day)	Avg Day Demand [2,3]		Max Day Demand [2,3]		Peak Hour Demand [2,3]	
						(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
High School	7.12	-	-	-	28000	138.4	2.31	207.7	3.46	373.8	6.23
Elem. School	2.23	-	-	-	28000	43.4	0.72	65.0	1.08	117.1	1.95
Condo 1	-	192	2.3	441.6	350	107.3	1.79	268.3	4.47	590.3	9.84
Condo 2	-	32	2.3	73.6	350	17.9	0.30	44.7	0.75	98.4	1.64
Singles	-	423	3.4	1438.2	350	349.6	5.83	873.9	14.57	1922.6	32.04
Towns	-	284	2.7	766.8	350	186.4	3.11	465.9	7.77	1025.1	17.08
B2B	-	92	2.3	211.6	350	51.4	0.86	128.6	2.14	282.9	4.71
Total Site :						**894.4**	**14.91**	**2054.2**	**34.24**	**4410.1**	**73.50**

1 For the purpose of this study it is predicted that commercial facilities will be operated 12 hours per day.

2 Water demand criteria used to estimate peak demand rates for commercial areas are as follows:
maximum day demand rate = 1.5 x average day demand rate
maximum hour demand rate = 1.8 x maximum day demand rate

3 Water demand criteria used to estimate peak demand rates for residential areas are as follows:
maximum day demand rate = 2.5 x average day demand rate
maximum hour demand rate = 2.2 x maximum day demand rate

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 1604-01130
Project Name: Blackstone South
Date: April 7, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 1
Building Type/Description/Name: Residential

Notes:
Worst case back-to-back type unit. Building Classification C.

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
1	**Choose Frame Used for Construction of Unit**	**Framing Material**						
		Coefficient related to type of construction (C)	Wood Frame	1.5	Wood Frame	1.5	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
2	**Choose Type of Housing (if TH, Enter Number of Units Per TH Block)**	**Floor Space Area**						
		Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	**# of Storeys**	Number of Floors/Storeys in the Unit (do not include basement):			3	3	Storeys	
3	**Enter Ground Floor Area of One Unit**	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			600 Square Metres (m2)	1,800	Area in Square Meters (m^2)	
4	**Obtain Required Fire Flow without Reductions**	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						**14,000**
5	**Apply Factors Affecting Burning**	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	**Choose Combustibility of Building Contents**	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	N/A	**11,900**
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	**Choose Reduction Due to Presence of Sprinklers**	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	None	0	N/A	**0**
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is not standard or N/A	0	N/A	**0**
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	**0**
			Sprinkler not fully supervised or N/A	0				
5.3	**Choose Separation Distance Between Units**	Exposure Distance Between Units	North Side	20.1 to 30.1m	0.1	0.6	m	**7,140**
			East Side	3.1 to 10.0m	0.2			
			South Side	20.1 to 30.1m	0.1			
			West Side	3.1 to 10.0m	0.2			
6	**Obtain Required Fire Flow, Duration & Volume**	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**19,000**
		Total Required Fire Flow (above) in L/s:						**317**
		Required Duration of Fire Flow (hrs)						**4.25**
		Required Volume of Fire Flow (m^3)						**4,845**

Figure A-8: Build-out model node IDs with new Fernbank Tank

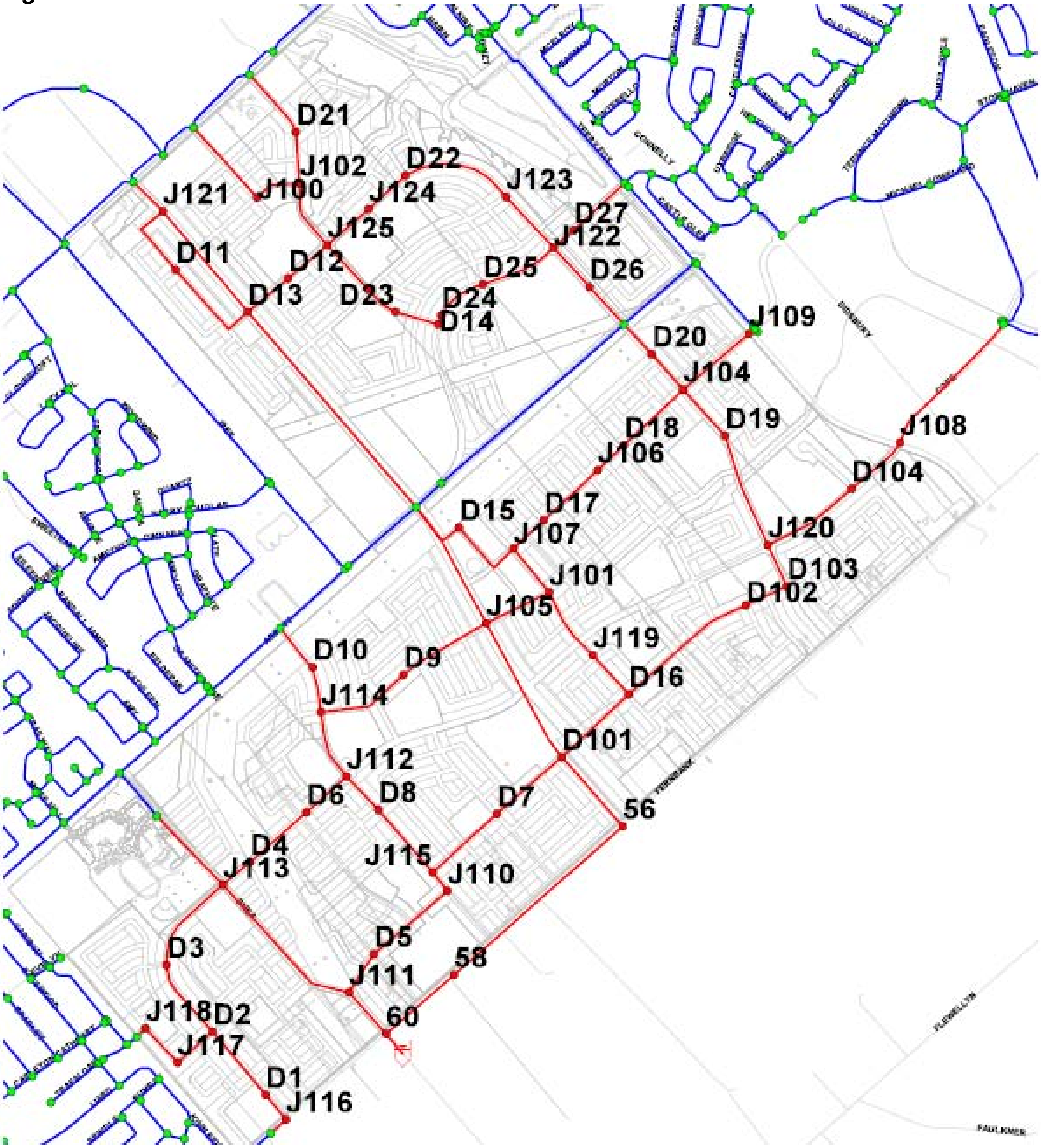


Table A-5: Build Out - MXDY + Fire flow Fernbank output results (Stittsville Tank 40% full)

ID	Available Flow @Hydrant (L/s)	Available Flow @Hydrant (L/min)
D1	346	20,789
D10	745	44,727
D101	482	28,918
D102	553	33,192
D103	598	35,874
D104	578	34,666
D11	545	32,682
D12	668	40,103
D13	572	34,344
D14	540	32,405
D15	803	48,179
D16	627	37,649
D17	586	35,138
D18	627	37,643
D19	706	42,336
D2	438	26,276
D20	973	58,360
D21	978	58,686
D22	634	38,047
D23	588	35,258
D24	549	32,917
D25	622	37,307
D26	953	57,192
D27	996	59,762
D3	451	27,048
D4	585	35,128
D5	446	26,752
D6	571	34,244
D7	478	28,687
D8	571	34,250
D9	521	31,234
J100	913	54,759
J101	684	41,069
J102	1094	65,638
J103	638	38,287
J104	1046	62,767
J105	535	32,116
J106	588	35,260
J107	733	43,993
J108	575	34,493
J109	1013	60,799
J110	519	31,119
J111	430	25,771
J112	652	39,116
J113	655	39,314
J114	725	43,523
J115	566	33,945
J116	327	19,647
J117	387	23,232
J118	380	22,789
J119	586	35,169
J120	681	40,858
J121	594	35,638
J122	1093	65,558
J123	686	41,161
J124	680	40,829
J125	832	49,927

Appendix B : SANITARY SEWER CALCULATIONS

Stantec

SUBDIVISION:

Blackstone Phases 4-8

DATE: 28/4/2017
REVISION: 1
DESIGNED BY: DT
CHECKED BY: AML

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401130

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	350 l/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	50,000 l/ha/day	MAXIMUM VELOCITY	3.00 m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000 l/ha/day	MANNINGS n	0.013
PEAKING FACTOR (COMM., INST.):	1.5	INDUSTRIAL (LIGHT)	35,000 l/ha/day	BEDDING CLASS	B
PERSONS / SINGLE	3.4	INSTITUTIONAL	50,000 l/ha/day	MINIMUM COVER	2.50 m
PERSONS / TOWNHOME	2.7	INFILTRATION	0.28 l/s/Ha		
PERSONS / DUPLEX	2.3				

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	SINGLE	UNITS TOWN	DUPLEX	POP.	CUMULATIVE AREA (ha)	POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	FLOW (l/s)	LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (l/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
R1007C, R1007A, R1007B	1007	1002	7.43	37	18	192	616	7.43	616	3.93	9.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	7.43	7.43	2.1	11.9	212.6	200	PVC	SDR 35	0.40	21.1	**56.16%**	0.67	0.59
R1002A	1002	1000	2.01	18	32	0	148	9.44	764	3.87	12.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	2.01	9.44	2.6	14.6	232.6	250	PVC	SDR 35	0.25	30.3	**48.23%**	0.61	0.52
R1008A	EX. STUB	1001	10.10	24	17	0	539	10.10	539	3.96	8.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	10.10	10.10	2.8	11.5	261.1	250	PVC	SDR 35	0.27	31.5	**36.40%**	0.63	0.49
R1001A, I1001A	1001	1000	5.37	64	48	0	347	15.47	886	3.83	13.8	0.00	0.00	0.00	0.00	0.00	0.00	2.23	2.23	0.00	0.00	1.9	7.60	17.70	5.0	20.6	232.2	250	PVC	SDR 35	0.20	27.1	**76.15%**	0.55	0.53
R1005A	1005	1004	0.79	0	16	0	43	0.79	43	4.00	0.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.79	0.79	0.2	0.9	125.3	200	PVC	SDR 35	0.40	21.1	**4.36%**	0.67	0.27
R1004A	1004	1003	0.51	3	6	0	26	1.30	70	4.00	1.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.51	1.30	0.4	1.5	84.5	200	PVC	SDR 35	0.40	21.1	**7.05%**	0.67	0.32
R1006A, R1006B	1006	1003	12.43	96	87	124	847	12.43	847	3.85	13.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	12.43	12.43	3.5	16.7	613.5	200	PVC	SDR 35	0.40	21.1	**78.82%**	0.67	0.65
R1003A	1003	1000	0.87	12	0	0	41	14.60	957	3.81	14.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.87	14.60	4.1	18.9	176.6	250	PVC	SDR 35	0.25	30.3	**62.23%**	0.61	0.56
R1000A, R1000B	1000	EX SAN STUB 1	4.25	64	0	0	218	43.76	2824	3.46	39.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.23	0.00	0.00	1.9	4.25	45.99	12.9	54.4	216.5	375	PVC	SDR 35	0.20	72.6	**75.01%**	0.69	0.67
																												450							
I2001A, R2001B	2001	2000	1.09	0	21	0	57	1.09	57	4.00	0.9	0.00	0.00	0.00	0.00	0.00	0.00	7.53	7.53	0.00	0.00	6.5	8.62	8.62	2.4	9.9	178.4	250	PVC	SDR 35	0.80	54.2	**18.19%**	1.09	0.68
R2002A	2002	2000	7.66	105	39	0	462	7.66	462	3.99	7.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	7.66	7.66	2.1	9.6	615.3	200	PVC	SDR 35	0.50	23.6	**40.69%**	0.74	0.60
	2000	EX SAN STUB 3	0.00	0	0	0	0	8.75	519	3.97	8.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.53	0.00	0.00	6.5	0.00	16.28	4.6	19.4	37.6	300	PVC	SDR 35	0.20	42.9	**45.25%**	0.61	0.51
																												300							

Stantec

SUBDIVISION:
Blackstone Subdivision (Rouncey Road Sewer)

DATE: April 28, 2017
REVISION: 1
DESIGN BY: DT
CHECKED BY: SGG

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 1604-01130

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	350 l/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	50,000 l/ha/day	MAXIMUM VELOCITY	3.00 m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000 l/ha/day	MANNINGS n	0.013
PEAKING FACTOR (COMM., INST.):	1.5	INDUSTRIAL (LIGHT)	35,000 l/ha/day	BEDDING CLASS	B
PERSONS / SINGLE UNIT	3.4	INSTITUTIONAL	50,000 l/ha/day	MINIMUM COVER	2.50 m
PERSONS / TOWNHOME	2.7	INFILTRATION	0.28 l/s/Ha		
PERSONS / MULTI RES.	2.3				

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	UNITS SINGLE	TOWN	Multi Res.	POP.	CUMULATIVE AREA (ha)	POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	FLOW (l/s)	LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (l/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Blackstone P4-8	303-1	303	43.76	318	224	316	2824	43.76	2824	3.46	39.6	0.00	0.00	0.00	0.00	0.00	0.00	2.23	2.23	0.00	0.00	1.9	45.99	45.99	12.9	54.4	94.4	450	CONCRETE	140-D	0.20	133.0	**40.93%**	0.81	0.65
	303	302	0.00	0	0	0	0	43.76	2824	3.46	39.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.23	0.00	0.00	1.9	0.00	45.99	12.9	54.4	80.8	450	CONCRETE	140-D	0.20	133.0	**40.93%**	0.81	0.65
	302	301	0.00	0	0	0	0	43.76	2824	3.46	39.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.23	0.00	0.00	1.9	0.00	45.99	12.9	54.4	59.6	450	CONCRETE	140-D	0.20	133.0	**40.93%**	0.81	0.65
	301	300	0.00	0	0	0	0	43.76	2824	3.46	39.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.23	0.00	0.00	1.9	0.00	45.99	12.9	54.4	109.9	450	CONCRETE	140-D	0.20	133.0	**40.93%**	0.81	0.65
	300	205A	0.00	0	0	0	0	43.76	2824	3.46	39.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.23	0.00	0.00	1.9	0.00	45.99	12.9	54.4	120.0	450	CONCRETE	140-D	0.20	133.0	**40.93%**	0.81	0.65
External + Blackstone P1-3	205A	222A	0.00	0	0	0	0	138.40	8868	3.01	108.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.98	0.00	0.00	9.5	0.00	149.38	41.8	159.4	116.9	600	CONCRETE	140-D	0.09	186.9	**85.28%**	0.64	0.64
	222A	221A	0.00	0	0	0	0	138.40	8868	3.01	108.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.98	0.00	0.00	9.5	0.00	149.38	41.8	159.4	103.6	600	CONCRETE	140-D	0.11	208.6	**76.41%**	0.71	0.70
	221A	FT06	0.00	0	0	0	0	138.40	8868	3.01	108.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.98	0.00	0.00	9.5	0.00	149.38	41.8	159.4	94.8	600	CONCRETE	140-D	0.12	217.3	**73.33%**	0.74	0.72
																												1200							

TABLE D-1: FERNBANK CDP LANDS - NEW TRUNK SEWER
SANITARY SEWER DESIGN SHEET (2031)

AREA			RESIDENTIAL																COMMERCIAL		INSTITUTIONAL		C+I	INFILTRATION				PIPE					
			LOW DENSITY			MEDIUM DENSITY			HIGH DENSITY			MIXED USE			TOTAL																		
ID	From	To	Area (ha)	Pop.	Accum. Pop.	Area (ha)	Pop.	Accum. Pop.	Area (ha)	Pop.	Accum. Pop.	Area (ha)	Pop.	Accum. Pop.	Pop.	Accum. Pop.	Peak Factor	Peak Flow (l/s)	Area (ha)	Accum. Area (ha)	Area (ha)	Accum. Area (ha)	Peak Flow (l/s)	Total Area (ha)	Accum. Area (ha)	Infilt. Flow (l/s)	Total Flow (l/s)	Size (mm)	Slope (%)	Length (m)	Capacity (l/s)	Full Flow Vel. (m/s)	Q/Q_{full} (%)
1	902	904	9.85	910	910	0.36	54	54	0.00	0	0	0.00	0	0	964	964	3.8	14.9	0.00	0.00	0.78	0.78	0.7	16.07	16.07	4.5	20.1	250	0.24	154	30.4	0.60	66.0%
2	904	908	11.65	1076	1986	3.10	465	519	0.00	0	0	0.00	0	0	1541	2505	3.5	35.6	0.00	0.00	0.91	1.69	1.5	22.29	38.36	10.7	47.8	300	0.24	306	49.4	0.68	96.7%
3	906	908	7.45	688	688	0.00	0	0	0.00	0	0	0.00	0	0	688	688	3.9	10.9	0.00	0.00	2.63	2.63	2.3	14.51	14.51	4.1	17.2	250	1.50	373	76.0	1.50	22.7%
4	908	912	4.45	411	3085	1.67	251	770	0.00	0	0	0.00	0	0	662	3855	3.3	52.3	0.63	0.63	0.00	4.32	4.3	16.43	69.30	19.4	76.0	300	0.61	396	78.8	1.08	96.4%
5	910	912	10.35	956	956	0.00	0	0	0.00	0	0	0.00	0	0	956	956	3.8	14.8	0.00	0.00	0.83	0.83	0.7	19.34	19.34	5.4	20.9	250	0.24	320	30.4	0.60	68.8%
6	912	920	11.15	1030	5071	0.00	0	770	0.00	0	0	0.00	0	0	1030	5841	3.2	75.3	0.00	0.63	2.50	7.65	7.2	18.11	106.75	29.9	112.4	450	0.15	207	115.2	0.70	97.5%
7	914	916	16.35	1511	1511	0.90	135	135	0.00	0	0	0.00	0	0	1646	1646	3.7	24.3	0.00	0.00	0.45	0.45	0.4	25.23	25.23	7.1	31.8	300	0.25	152	50.4	0.69	63.0%
8	916	920	10.45	966	2477	0.00	0	135	0.00	0	0	0.00	0	0	966	2612	3.5	37.0	0.00	0.00	0.85	1.30	1.1	15.69	40.92	11.5	49.5	375	0.20	314	81.8	0.72	60.6%
9	918	920	5.55	513	513	0.49	74	74	0.00	0	0	0.00	0	0	587	587	3.9	9.4	0.00	0.00	6.14	6.14	5.3	16.04	16.04	4.5	19.2	250	0.85	363	57.2	1.13	33.5%
10	920	922	0.00	0	8061	0.00	0	979	0.00	0	0	0.00	0	0	0	9040	3.0	109.8	0.00	0.63	0.00	15.09	13.6	0.00	163.71	45.8	169.3	525	0.18	265	190.3	0.85	88.9%
	922	924	12.20	1127	9188	0.09	14	993	0.00	0	0	0.00	0	0	1141	10181	2.9	121.5	0.00	0.63	1.52	16.61	15.0	27.31	191.02	53.5	190.0	525	0.23	290	215.2	0.96	88.3%
	924	934	0.00	0	9188	0.00	0	993	0.00	0	0	0.00	0	0	0	10181	2.9	121.5	0.00	0.63	0.00	16.61	15.0	0.00	191.02	53.5	190.0	525	0.79	669	398.8	1.78	47.6%
11	926	930	4.95	457	457	8.40	1260	1260	0.00	0	0	3.45	279	279	1996	1996	3.6	29.0	1.99	1.99	0.82	0.82	2.4	26.79	26.79	7.5	38.9	375	0.14	530	68.4	0.60	56.9%
12	928	930	9.35	864	864	3.55	533	533	0.00	0	0	0.00	0	0	1397	1397	3.7	20.9	0.00	0.00	3.85	3.85	3.3	22.72	22.72	6.4	30.7	200	7.00	55	90.5	2.79	33.9%
13	930	932	1.65	152	1473	2.95	443	2236	0.00	0	0	0.00	0	279	595	3988	3.3	53.9	0.34	2.33	0.80	5.47	6.8	10.54	60.05	16.8	77.4	450	0.11	308	99.1	0.60	78.2%
14	932	934	0.00	0	1473	0.00	0	2236	0.00	0	0	7.12	577	856	577	4565	3.3	60.7	3.56	5.89	6.10	11.57	15.2	17.52	77.57	21.7	97.6	525	0.10	455	141.9	0.63	68.8%
15	934	972	2.90	268	10929	1.80	270	3499	0.00	0	0	1.21	98	954	636	15382	2.8	172.4	0.61	7.12	0.40	28.58	31.0	15.08	283.67	79.4	282.8	600	0.26	1007	326.6	1.12	86.6%
16	936	938	7.58	700	700	0.70	105	105	0.00	0	0	0.00	0	0	805	805	3.9	12.6	0.00	0.00	2.17	2.17	1.9	14.42	14.42	4.0	18.5	250	1.00	108	62.0	1.22	29.8%
17	938	940	8.05	744	1444	1.00	150	255	0.00	0	0	4.41	357	357	1251	2056	3.6	29.8	2.21	2.21	0.83	3.00	4.5	25.14	39.56	11.1	45.4	300	0.35	156	59.7	0.82	76.0%
18	940	952	6.35	587	2031	0.99	149	404	0.00	0	0	0.00	0	357	736	2792	3.5	39.2	0.00	2.21	0.00	3.00	4.5	10.51	50.07	14.0	57.8	300	0.75	310	87.4	1.20	66.1%
19	942	944	7.25	670	670	4.70	705	705	0.00	0	0	0.00	0	0	1375	1375	3.7	20.6	0.00	0.00	12.67	12.67	11.0	34.19	34.19	9.6	41.2	250	0.90	516	58.9	1.16	70.0%
20	944	946	12.20	1127	1797	1.00	150	855	0.00	0	0	0.00	0	0	1277	2652	3.5	37.5	0.00	0.00	0.82	13.49	11.7	20.35	54.54	15.3	64.4	375	0.20	511	81.8	0.72	78.8%
21	946	948	4.15	383	2180	4.22	633	1488	0.00	0	0	0.00	0	0	1016	3668	3.4	50.0	0.00	0.00	3.87	17.36	15.1	17.22	71.76	20.1	85.2	375	0.50	243	129.3	1.13	65.9%
	948	950	0.00	0	2180	0.00	0	1488	0.00	0	0	0.00	0	0	0	3668	3.4	50.0	0.00	0.00	0.00	17.36	15.1	0.00	71.76	20.1	85.2	450	0.15	195	115.2	0.70	74.0%
22	950	952	5.05	467	2647	0.30	45	1533	0.00	0	0	0.00	0	0	512	4180	3.3	56.2	0.00	0.00	3.24	20.6	17.9	11.43	83.19	23.3	97.3	450	0.15	221	115.2	0.70	84.5%
23	952	972	4.15	383	5061	5.50	825	2762	0.00	0	0	0.00	0	357	1208	8180	3.0	100.8	0.00	2.21	0.00	23.60	22.4	22.72	155.98	43.7	166.8	450	0.54	282	218.6	1.33	76.3%
24	954	956	7.70	711	711	2.90	435	435	0.00	0	0	6.70	543	543	1689	1689	3.6	24.9	3.35	3.35	0.79	0.79	3.6	22.81	22.81	6.4	34.9	375	0.15	330	70.8	0.62	49.3%
25	956	958	10.70	989	1700	0.00	0	435	0.00	0	0	0.00	0	543	989	2678	3.5	37.8	0.00	3.35	6.27	7.06	9.0	23.45	46.26	13.0	59.8	450	0.20	411	133.0	0.81	44.9%
	958	960	0.00	0	1700	0.00	0	435	0.00	0	0	0.00	0	543	0	2678	3.5	37.8	0.00	3.35	0.00	7.06	9.0	0.00	46.26	13.0	59.8	450	0.15	177	115.2	0.70	51.9%
26	960	966	7.75	716	2416	0.00	0	435	0.00	0	0	0.00	0	543	716	3394	3.4	46.7	0.00	3.35	0.00	7.06	9.0	11.51	57.77	16.2	71.9	450	0.15	82	115.2	0.70	62.4%
27	962	964	2.55	236	236	4.70	705	705	5.04	680	680	0.00	0	0	1621	1621	3.7	24.0	0.00	0.00	0.00	0.00	0.0	20.97	20.97	5.9	29.9	250	0.35	479	36.7	0.72	81.4%
	964	966	0.00	0	236	0.00	0	705	0.00	0	680	0.00	0	0	0	1621	3.7	24.0	0.00	0.00	0.00	0.00	0.0	0.00	20.97	5.9	29.9	250	1.00	298	62.0	1.22	48.2%
28	966	970	1.80	166	2818	5.25	788	1928	0.00	0	680	0.00	0	543	954	5969	3.2	76.7	0.00	3.35	8.89	15.95	16.8	22.38	101.12	28.3	121.8	525	0.15	249	173.8	0.78	70.1%
29	968	970	6.90	638	638	0.00	0	0	0.00	0	0	0.00	0	0	638	638	3.9	10.1	0.00	0.00	0.99	0.99	0.9	11.03	11.03	3.1	14.1	200	0.32	82	19.4	0.60	72.7%
	970	972	0.00	0	3456	0.00	0	1928	0.00	0	680	0.00	0	543	0	6607	3.1	83.8	0.00	3.35	0.00	16.94	17.6	0.00	112.15	31.4	132.8	600	0.15	178	248.1	0.85	53.5%
	972	974	0.00	0	19446	0.00	0	8189	0.00	0	680	0.00	0	1854	0	30169	2.5	302.5	0.00	12.68	0.00	69.12	71.0	0.00	551.8	154.5	528.0	825	0.20	586	669.7	1.21	78.8%
	974	Ex	0.00	0	19446	0.00	0	8189	0.00	0	680	0.00	0	1854	0	30169	2.5	302.5	0.00	12.68	0.00	69.12	71.0	0.00	551.80	154.5	528.0	825	0.20	66	669.7	1.21	78.8%
			210.48			**54.57**			**5.04**			**22.89**																					

Design Parameters:

Avg Flow/Person =	350	l/day	Pipe Friction n = 0.013	Low Density Residential =	28	3.30	
Comm./Inst. Flow =	50,000	l/ha/day	Residential Peaking Factor = Harmon Equation (max 4, min 2)	Medium Density Residential =	60	2.50	(Multi Family Residential)
Infiltration =	0.28	l/s/ha	Peaking Factor Comm./Inst. = 1.5	High Density Residential =	75	1.80	
				Mixed Use =	90	1.80	(50% of mixed use area is residential)

(Column heads for the last group: **Units/Net ha** | **Pop/Unit**)

Project: Fernbank CDP (101108)
Designed: KJM
Checked: MAB
Dwg. Reference: 101108-SAN
Date: May 8, 2009

TABLE D-1: FERNBANK CDP LANDS - NEW TRUNK SEWER
SANITARY SEWER DESIGN SHEET (2031)

AREA			RESIDENTIAL																COMMERCIAL		INSTITUTIONAL		C+I	INFILTRATION				PIPE					
			LOW DENSITY			MEDIUM DENSITY			HIGH DENSITY			MIXED USE			TOTAL																		
ID	From	To	Area (ha)	Pop.	Accum. Pop.	Area (ha)	Pop.	Accum. Pop.	Area (ha)	Pop.	Accum. Pop.	Area (ha)	Pop.	Accum. Pop.	Pop.	Accum. Pop.	Peak Factor	Peak Flow (l/s)	Area (ha)	Accum. Area (ha)	Area (ha)	Accum. Area (ha)	Peak Flow (l/s)	Total Area (ha)	Accum. Area (ha)	Infilt. Flow (l/s)	Total Flow (l/s)	Size (mm)	Slope (%)	Length (m)	Capacity (l/s)	Full Flow Vel. (m/s)	Q/Q$_{full}$ (%)
1	902	904	9.85	910	910	0.36	54	54	0.00	0	0	0.00	0	0	964	964	3.8	14.9	0.00	0.00	0.78	0.78	0.7	16.07	16.07	4.5	20.1	250	0.24	154	30.4	0.60	66.0%
2	904	908	11.65	1076	1986	3.10	465	519	0.00	0	0	0.00	0	0	1541	2505	3.5	35.6	0.00	0.00	0.91	1.69	1.5	22.29	38.36	10.7	47.8	300	0.24	306	49.4	0.68	96.7%
3	906	908	7.45	688	688	0.00	0	0	0.00	0	0	0.00	0	0	688	688	3.9	10.9	0.00	0.00	2.63	2.63	2.3	14.51	14.51	4.1	17.2	250	1.50	373	76.0	1.50	22.7%
4	908	912	4.45	411	3085	1.67	251	770	0.00	0	0	0.00	0	0	662	3855	3.3	52.3	0.63	0.63	0.00	4.32	4.3	16.43	69.30	19.4	76.0	300	0.61	396	78.8	1.08	96.4%
5	910	912	10.35	956	956	0.00	0	0	0.00	0	0	0.00	0	0	956	956	3.8	14.8	0.00	0.00	0.83	0.83	0.7	19.34	19.34	5.4	20.9	250	0.24	320	30.4	0.60	68.8%
6	912	920	11.15	1030	5071	0.00	0	770	0.00	0	0	0.00	0	0	1030	5841	3.2	75.3	0.00	0.63	2.50	7.65	7.2	18.11	106.75	29.9	112.4	450	0.15	207	115.2	0.70	97.5%
7	914	916	16.35	1511	1511	0.90	135	135	0.00	0	0	0.00	0	0	1646	1646	3.7	24.3	0.00	0.00	0.45	0.45	0.4	25.23	25.23	7.1	31.8	300	0.25	152	50.4	0.69	63.0%
8	916	920	10.45	966	2477	0.00	0	135	0.00	0	0	0.00	0	0	966	2612	3.5	37.0	0.00	0.00	0.85	1.30	1.1	15.69	40.92	11.5	49.5	375	0.20	314	81.8	0.72	60.6%
9	918	920	5.55	513	513	0.49	74	74	0.00	0	0	0.00	0	0	587	587	3.9	9.4	0.00	0.00	6.14	6.14	5.3	16.04	16.04	4.5	19.2	250	0.85	363	57.2	1.13	33.5%
	920	922	0.00	0	8061	0.00	0	979	0.00	0	0	0.00	0	0	0	9040	3.0	109.8	0.00	0.63	0.00	15.09	13.6	0.00	163.71	45.8	169.3	525	0.18	265	190.3	0.85	88.9%
10	922	924	12.20	1127	9188	0.09	14	993	0.00	0	0	0.00	0	0	1141	10181	2.9	121.5	0.00	0.63	1.52	16.61	15.0	27.31	191.02	53.5	190.0	525	0.23	290	215.2	0.96	88.3%
	924	934	0.00	0	9188	0.00	0	993	0.00	0	0	0.00	0	0	0	10181	2.9	121.5	0.00	0.63	0.00	16.61	15.0	0.00	191.02	53.5	190.0	525	0.79	669	398.8	1.78	47.6%
11	926	930	4.95	457	457	8.40	1260	1260	0.00	0	0	3.45	279	279	1996	1996	3.6	29.0	1.99	1.99	0.82	0.82	2.4	26.79	26.79	7.5	38.9	375	0.14	530	68.4	0.60	56.9%
12	928	930	9.35	864	864	3.55	533	533	0.00	0	0	0.00	0	0	1397	1397	3.7	20.9	0.00	0.00	3.85	3.85	3.3	22.72	22.72	6.4	30.7	200	7.00	55	90.5	2.79	33.9%
13	930	932	1.65	152	1473	2.95	443	2236	0.00	0	0	0.00	0	279	595	3988	3.3	53.9	0.34	2.33	0.80	5.47	6.8	10.54	60.05	16.8	77.4	450	0.11	308	99.1	0.60	78.2%
14	932	934	0.00	0	1473	0.00	0	2236	0.00	0	0	7.12	577	856	577	4565	3.3	60.7	3.56	5.89	6.10	11.57	15.2	17.52	77.57	21.7	97.6	525	0.10	455	141.9	0.63	68.8%
15	934	972	2.90	268	10929	1.80	270	3499	0.00	0	0	1.21	98	954	636	15382	2.8	172.4	0.61	7.12	0.40	28.58	31.0	15.08	283.67	79.4	282.8	600	0.26	1007	326.6	1.12	86.6%
16	936	938	7.58	700	700	0.70	105	105	0.00	0	0	0.00	0	0	805	805	3.9	12.6	0.00	0.00	2.17	2.17	1.9	14.42	14.42	4.0	18.5	250	1.00	108	62.0	1.22	29.8%
17	938	940	8.05	744	1444	1.00	150	255	0.00	0	0	4.41	357	357	1251	2056	3.6	29.8	2.21	2.21	0.83	3.00	4.5	25.14	39.56	11.1	45.4	300	0.35	156	59.7	0.82	76.0%
18	940	952	6.35	587	2031	0.99	149	404	0.00	0	0	0.00	0	357	736	2792	3.5	39.2	0.00	2.21	0.00	3.00	4.5	10.51	50.07	14.0	57.8	300	0.75	310	87.4	1.20	66.1%
19	942	944	7.25	670	670	4.70	705	705	0.00	0	0	0.00	0	0	1375	1375	3.7	20.6	0.00	0.00	12.67	12.67	11.0	34.19	34.19	9.6	41.2	250	0.90	516	58.9	1.16	70.0%
20	944	946	12.20	1127	1797	1.00	150	855	0.00	0	0	0.00	0	0	1277	2652	3.5	37.5	0.00	0.00	0.82	13.49	11.7	20.35	54.54	15.3	64.4	375	0.20	511	81.8	0.72	78.8%
21	946	948	4.15	383	2180	4.22	633	1488	0.00	0	0	0.00	0	0	1016	3668	3.4	50.0	0.00	0.00	3.87	17.36	15.1	17.22	71.76	20.1	85.2	375	0.50	243	129.3	1.13	65.9%
	948	950	0.00	0	2180	0.00	0	1488	0.00	0	0	0.00	0	0	0	3668	3.4	50.0	0.00	0.00	0.00	17.36	15.1	0.00	71.76	20.1	85.2	450	0.15	195	115.2	0.70	74.0%
22	950	952	5.05	467	2647	0.30	45	1533	0.00	0	0	0.00	0	0	512	4180	3.3	56.2	0.00	0.00	3.24	20.6	17.9	11.43	83.19	23.3	97.3	450	0.15	221	115.2	0.70	84.5%
23	952	972	4.15	383	5061	5.50	825	2762	0.00	0	0	0.00	0	357	1208	8180	3.0	100.8	0.00	2.21	0.00	23.60	22.4	22.72	155.98	43.7	166.8	450	0.54	282	218.6	1.33	76.3%
24	954	956	7.70	711	711	2.90	435	435	0.00	0	0	6.70	543	543	1689	1689	3.6	24.9	3.35	3.35	0.79	0.79	3.6	22.81	22.81	6.4	34.9	375	0.15	330	70.8	0.62	49.3%
25	956	958	10.70	989	1700	0.00	0	435	0.00	0	0	0.00	0	543	989	2678	3.5	37.8	0.00	3.35	6.27	7.06	9.0	23.45	46.26	13.0	59.8	450	0.20	411	133.0	0.81	44.9%
	958	960	0.00	0	1700	0.00	0	435	0.00	0	0	0.00	0	543	0	2678	3.5	37.8	0.00	3.35	0.00	7.06	9.0	0.00	46.26	13.0	59.8	450	0.15	177	115.2	0.70	51.9%
26	960	966	7.75	716	2416	0.00	0	435	0.00	0	0	0.00	0	543	716	3394	3.4	46.7	0.00	3.35	0.00	7.06	9.0	11.51	57.77	16.2	71.9	450	0.15	82	115.2	0.70	62.4%
27	962	964	2.55	236	236	4.70	705	705	5.04	680	680	0.00	0	0	1621	1621	3.7	24.0	0.00	0.00	0.00	0.00	0.0	20.97	20.97	5.9	29.9	250	0.35	479	36.7	0.72	81.4%
	964	966	0.00	0	236	0.00	0	705	0.00	0	680	0.00	0	0	0	1621	3.7	24.0	0.00	0.00	0.00	0.00	0.0	0.00	20.97	5.9	29.9	250	1.00	298	62.0	1.22	48.2%
28	966	970	1.80	166	2818	5.25	788	1928	0.00	0	680	0.00	0	543	954	5969	3.2	76.7	0.00	3.35	8.89	15.95	16.8	22.38	101.12	28.3	121.8	525	0.15	249	173.8	0.78	70.1%
29	968	970	6.90	638	638	0.00	0	0	0.00	0	0	0.00	0	0	638	638	3.9	10.1	0.00	0.00	0.99	0.99	0.9	11.03	11.03	3.1	14.1	200	0.32	82	19.4	0.60	72.7%
	970	972	0.00	0	3456	0.00	0	1928	0.00	0	680	0.00	0	543	0	6607	3.1	83.8	0.00	3.35	0.00	16.94	17.6	0.00	112.15	31.4	132.8	600	0.15	178	248.1	0.85	53.5%
	972	974	0.00	0	19446	0.00	0	8189	0.00	0	680	0.00	0	1854	0	30169	2.5	302.5	0.00	12.68	0.00	69.12	71.0	0.00	551.8	154.5	528.0	825	0.20	586	669.7	1.21	78.8%
	974	Ex	0.00	0	19446	0.00	0	8189	0.00	0	680	0.00	0	1854	0	30169	2.5	302.5	0.00	12.68	0.00	69.12	71.0	0.00	551.80	154.5	528.0	825	0.20	66	669.7	1.21	78.8%
			210.48			**54.57**			**5.04**			**22.89**																					

Design Parameters:

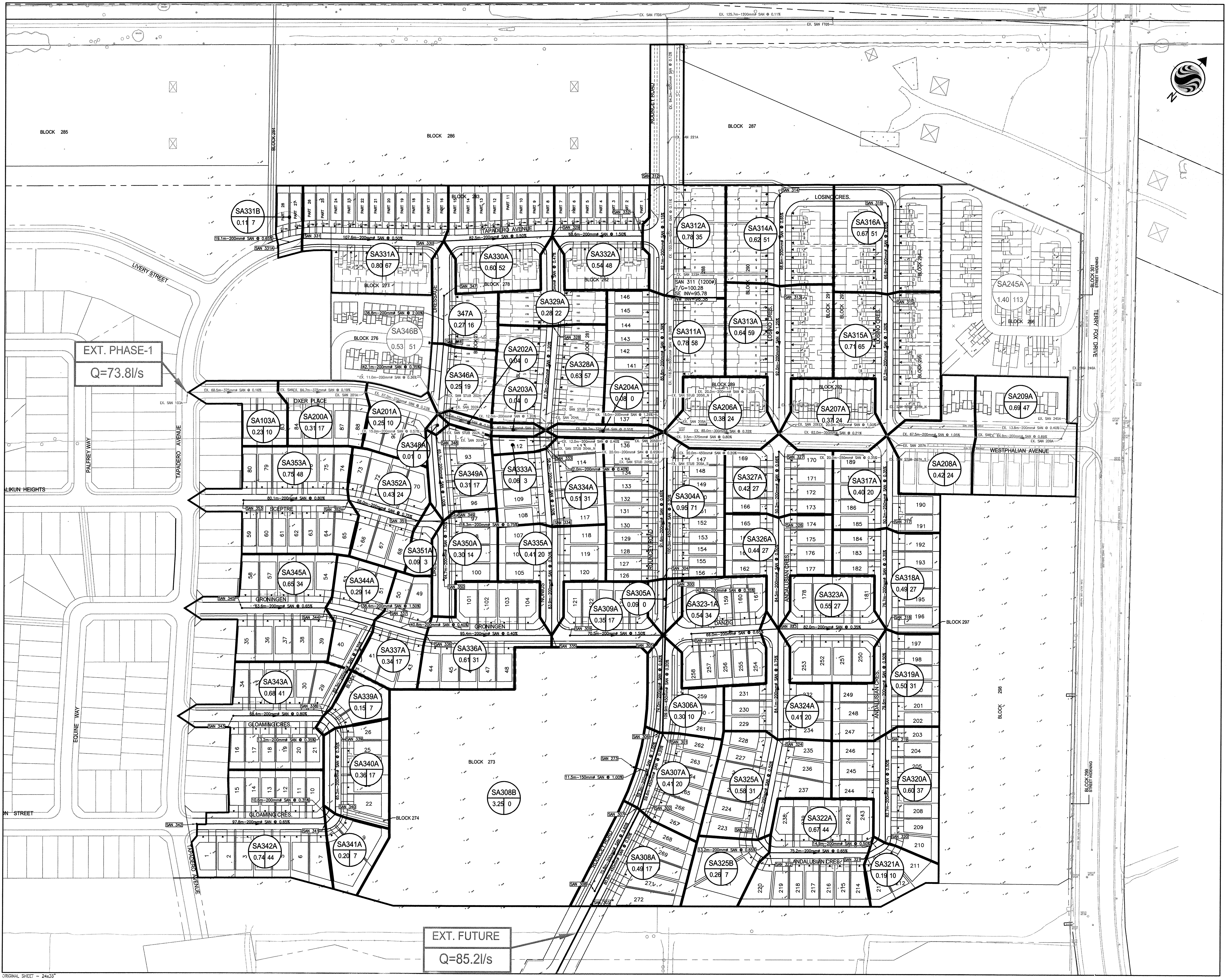
Avg Flow/Person =	350	l/day
Comm./Inst. Flow =	50,000	l/ha/day
Infiltration =	0.28	l/s/ha

Pipe Friction n = 0.013
Residential Peaking Factor = Harmon Equation (max 4, min 2)
Peaking Factor Comm./Inst. = 1.5

	Units/Net ha	**Pop/Unit**	
Low Density Residential =	28	3.30	
Medium Density Residential =	60	2.50	(Multi Family Residential)
High Density Residential =	75	1.80	
Mixed Use =	90	1.80	(50% of mixed use area is residential)

Project: Fernbank CDP (101108)
Designed: KJM
Checked: MAB
Dwg. Reference: 101108-SAN
Date: May 8, 2009

M:\2001\101108\DATA\Calculations\Sanitary\2009\20090113 Preferred Internal SAN Design Sheets.xls



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ORIGINAL SHEET - 24x33"

Stantec

Stantec Consulting Ltd.
1331 Clyde Avenue
Ottawa ON Canada
K2C 3G4
Tel. 613.722.4420
Fax. 613.722.2799
www.stantec.com

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Legend

SA205 / 0.18 | 22 — SANITARY DRAINAGE AREA ID#, POPULATION, SANITARY DRAINAGE AREA ha.

SA205 / 0.18 | 22 — FUTURE DRAINAGE AREA TO BE DEVELOPED UNDER SEPARATE SITE PLAN APPLICATON

━ SANITARY DRAINAGE AREA

─●─ PROPOSED SANITARY SEWER

▬ EXISTING PHASE

EXT. PHASE-1 / Q=73.8l/s — OFF-SITE OVERALL CONTRIBUTING AREA

Notes

D07-16-11-0023

Reviewed By
Development Review Branch
Signed:
Date: 30/09/2014

DWG#16546

8.	Revised to Include Min. USF Elevations	SG	PM	14.06.23
7.	Revised Per Block 283 Part Lot Control	SG	PM	14.06.05
6.	Revised Per Hydro One Comments	SG	PM	14.03.28
5.	Revised Losino Crescent ROW	SG	PM	14.01.15
4.	Revised per CUP coordination	SG	TW	13.10.22
3.	ISSUED FOR 3RD SUBMISSION	SG	PM	13.10.02
2.	ISSUED FOR 2ND SUBMISSION	SG	PM	13.07.25
1.	ISSUED FOR 1ST SUBMISSION	SG	PM	13.06.03
Revision		By	Appd.	YY.MM.DD

File Name: 160401009-SA	GBU	PM	DT/SG	13/05/06
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

P. MOROZ
90493552
26/09/2014

Client/Project

2129786 ONTARIO INC.

BLACKSTONE COMMUNITY
PHASE 2 and 3
Ottawa ON Canada

Title

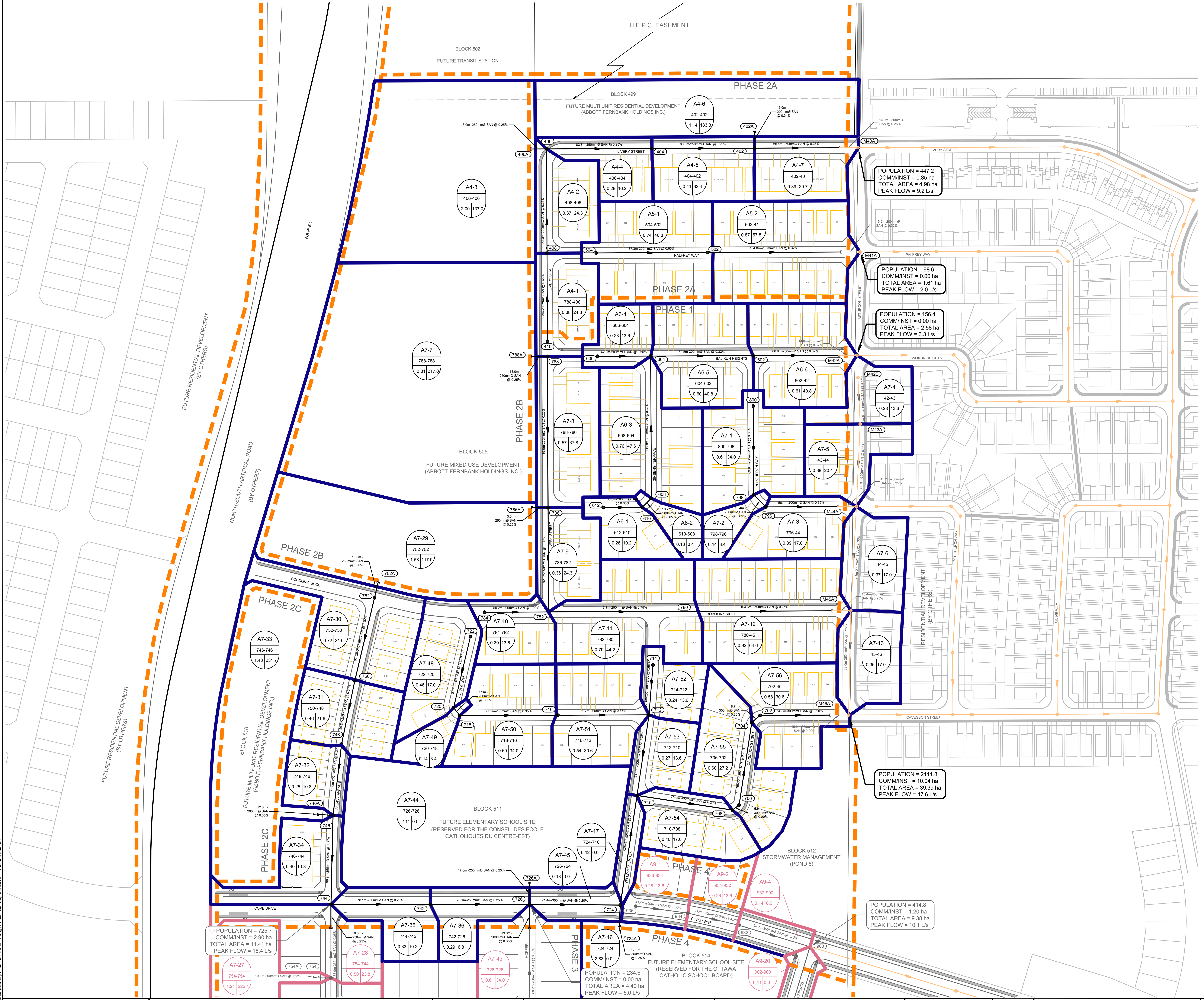
SANITARY DRAINAGE AREA

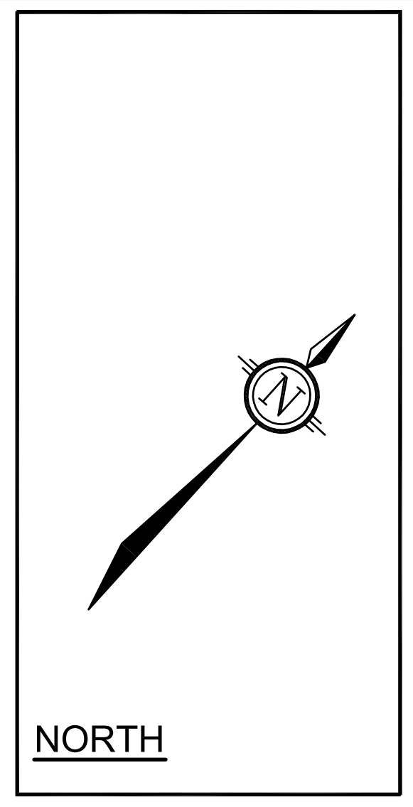
Project No.	Scale
160401009	1:1250 (0, 12.5, 37.5, 62.5m)

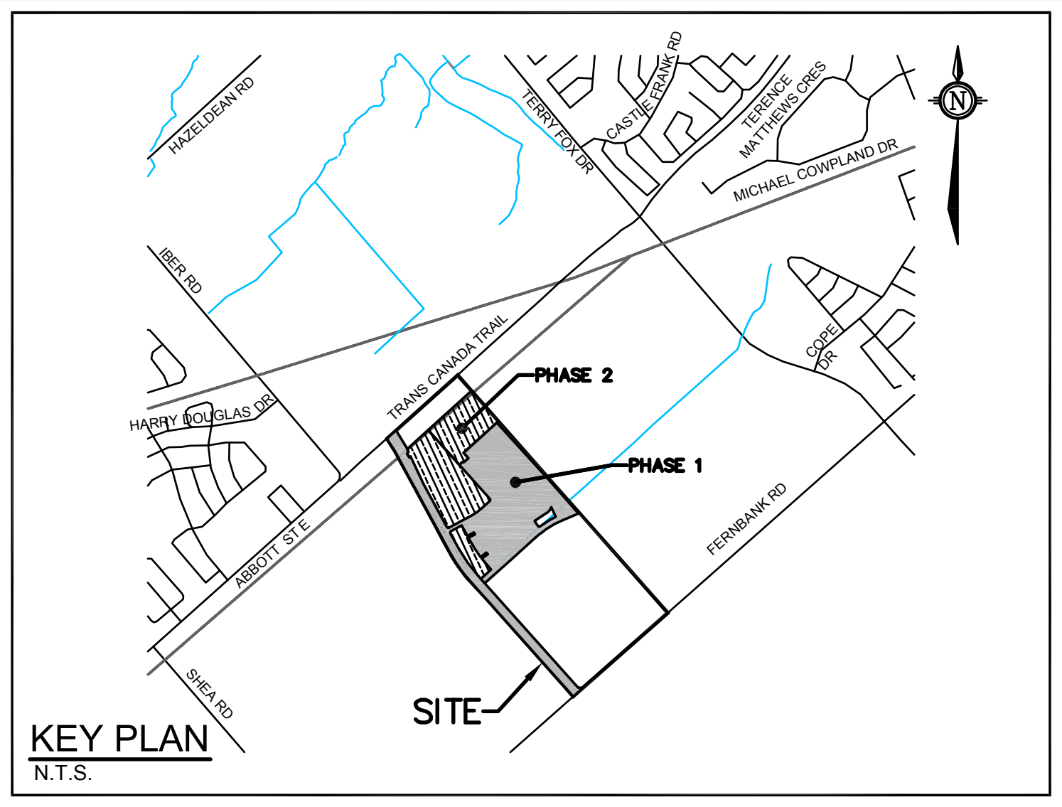
Drawing No.	Sheet	Revision
SAN-1	32 of 33	8

D07-16-11-0023

Plan #16546







LEGEND

A4-4	AREA ID
404-402	MANHOLE TO MANHOLE
0.29 19.8	POPULATION EQUIVALENT AREA IN HECTARES
A4-4	FUTURE AREA ID
404-402	FUTURE MANHOLE TO MANHOLE
0.29 19.8	FUTURE POPULATION EQUIVALENT FUTURE AREA IN HECTARES
▬	SANITARY DRAINAGE AREA BOUNDARY
▬ ▬	PHASE BOUNDARY LINE
⟶	DIRECTION OF FLOW
482	PROPOSED SANITARY SEWER AND MANHOLE
▬	FUTURE SANITARY DRAINAGE AREA BOUNDARY
⟶	FUTURE DIRECTION OF FLOW
636	FUTURE PROPOSED SANITARY SEWER AND MANHOLE

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

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ABBOTT-FERNBANK HOLDINGS INC.

REGIONAL
THE REGIONAL GROUP
Corporate Head Office
1737 Woodward Drive, 2nd Floor
Ottawa, Ontario K2C 0P9
Telephone: 613-230-2100
Fax: 613-230-2962

No.	REVISION	DATE	BY
4.	ISSUED FOR CONSTRUCTION (PHASE 1 & 2)	SEP 21/12	KJM
3.	ISSUED FOR APPROVAL (PHASE 1&2)	AUG 17/12	KJM
2.	ISSUED FOR APPROVAL (PHASE 1&2)	JUN 21/12	KJM
1.	ISSUED FOR APPROVAL	MAR 9/12	KJM

SCALE
1:1250
1:1250
0 10 20 30 40 50

DESIGN	KJM
CHECKED	MAB
DRAWN	RCH
CHECKED	KJM
APPROVED	MAB

FOR REVIEW ONLY

LICENSED PROFESSIONAL ENGINEER
K. J. MURPHY
100123021
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
M.A. BISSETT
PROVINCE OF ONTARIO

NOVATECH
ENGINEERING CONSULTANTS LTD.
ENGINEERS & PLANNERS
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada
K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Email: novainfo@novatech-eng.com

CITY OF OTTAWA
FERNBANK CROSSING

SANITARY DRAINAGE AREA PLAN
PHASE 1 & 2

PROJECT No. 108180-10
REV #4
DRAWING No. 108180-SAN1

PLANB1.DWG - 1000mmx707mm

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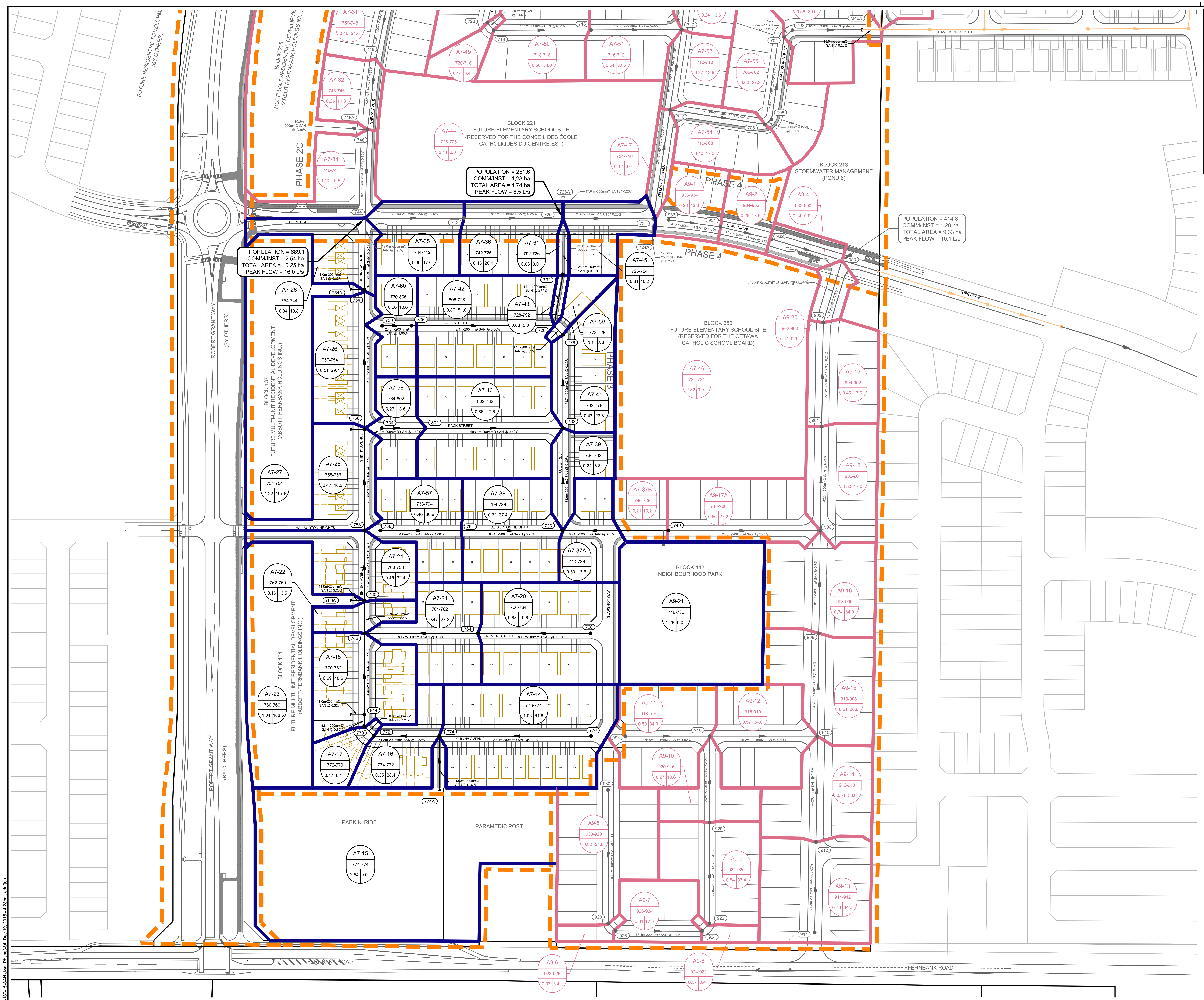

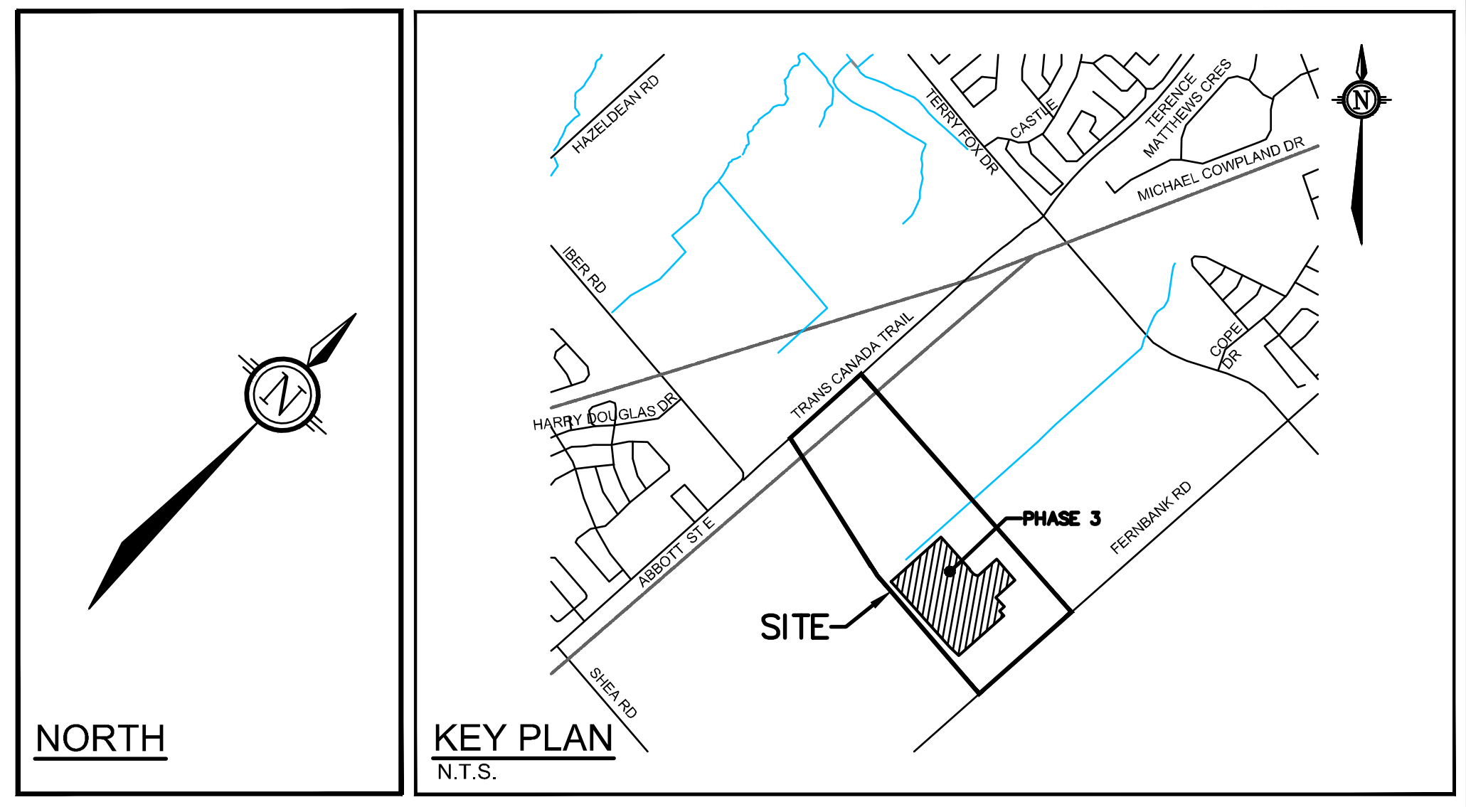

LEGEND

AREA ID	FUTURE/EXISTING AREA ID
MANHOLE TO MANHOLE	FUTURE/EXISTING MANHOLE TO MANHOLE
POPULATION EQUIVALENT	FUTURE/EXISTING POPULATION EQUIVALENT
AREA IN HECTARES	FUTURE/EXISTING AREA IN HECTARES
SANITARY DRAINAGE AREA BOUNDARY	FUTURE/EXISTING SANITARY DRAINAGE AREA BOUNDARY
DIRECTION OF FLOW	FUTURE DIRECTION OF FLOW
PROPOSED SANITARY SEWER AND MANHOLE	FUTURE PROPOSED SANITARY SEWER AND MANHOLE
PHASE BOUNDARY LINE	

D07-16-09-0034-P3

PLAN #16229

REVIEWED BY DEVELOPMENT REVIEW BRANCH

Signed

Date 2015

Plan Number 16229

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

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Fax: 613-230-2962

No.	REVISION	DATE	BY
6.	ISSUED FOR SUBDIVISION REGISTRATION	DEC 9/15	MAB
5.	ISSUED FOR MOE	JUL 13/15	MAB
4.	REVISED PER CITY COMMENTS	JUN 23/15	MAB
3.	ISSUED FOR APPROVAL	MAY 5/15	MAB
2.	ISSUED FOR APPROVAL	MAR 10/15	MAB
1.	ISSUED FOR APPROVAL	DEC 19/14	MAB

SCALE
1:1250

1:1250
0 10 20 30 40 50

DESIGN	LRW
CHECKED	MAB
DRAWN	DTD
CHECKED	MAB
APPROVED	JGR

FOR CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER
J.G. RIDDELL
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
M.A. BISSETT
DEC. 9/15
PROVINCE OF ONTARIO

NOVATECH
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Ottawa, Ontario, Canada K2M 1P6
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Facsimile (613) 254-5867
Website www.novatech-eng.com

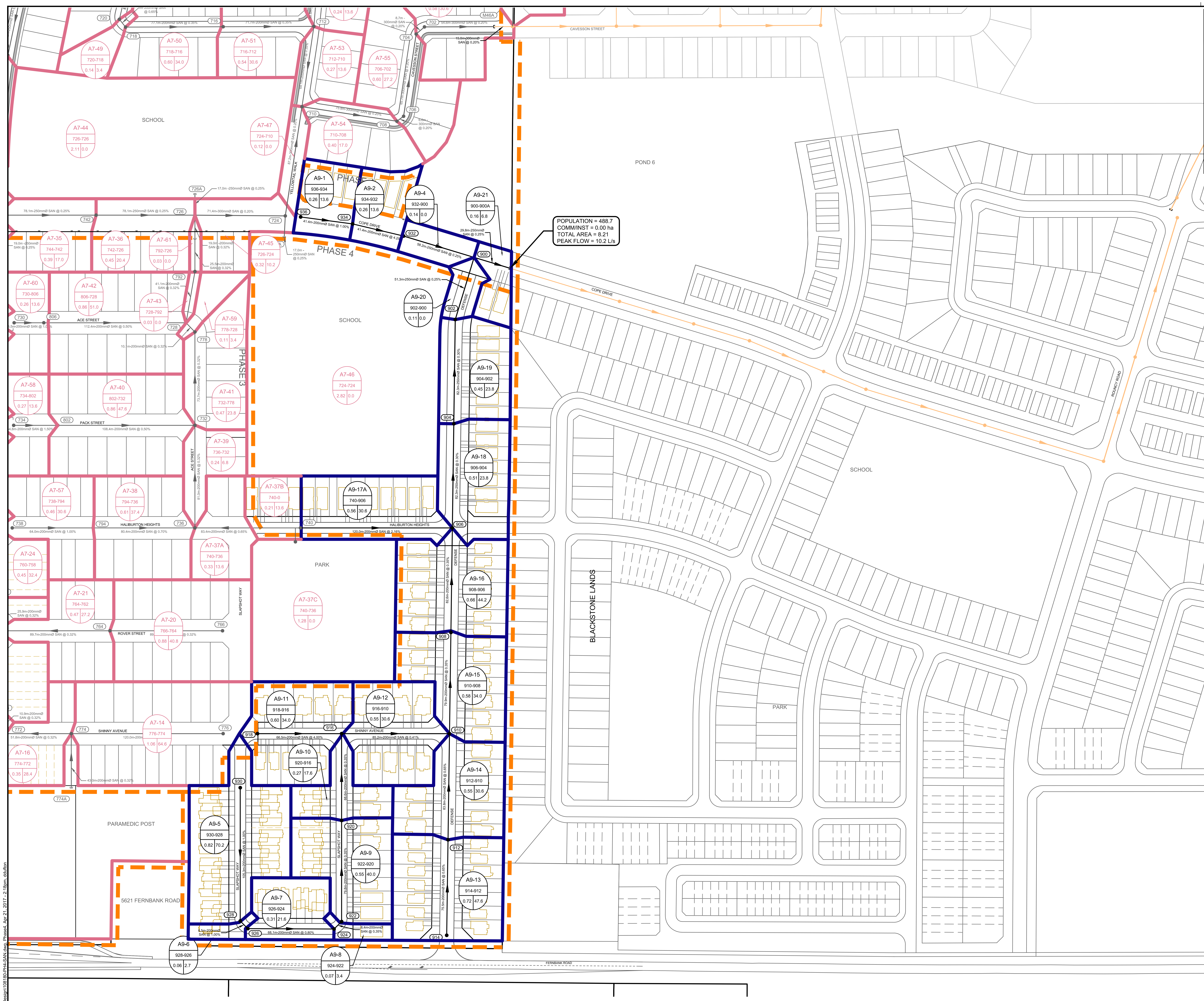
CITY OF OTTAWA
FERNBANK CROSSING - PHASE 3

SANITARY DRAINAGE AREA PLAN

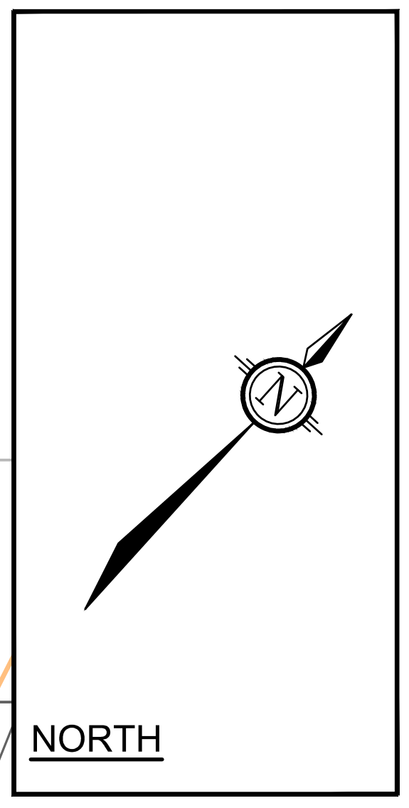
PROJECT No. 108180-15
REV REV # 6
DRAWING No. 108180-15-SAN

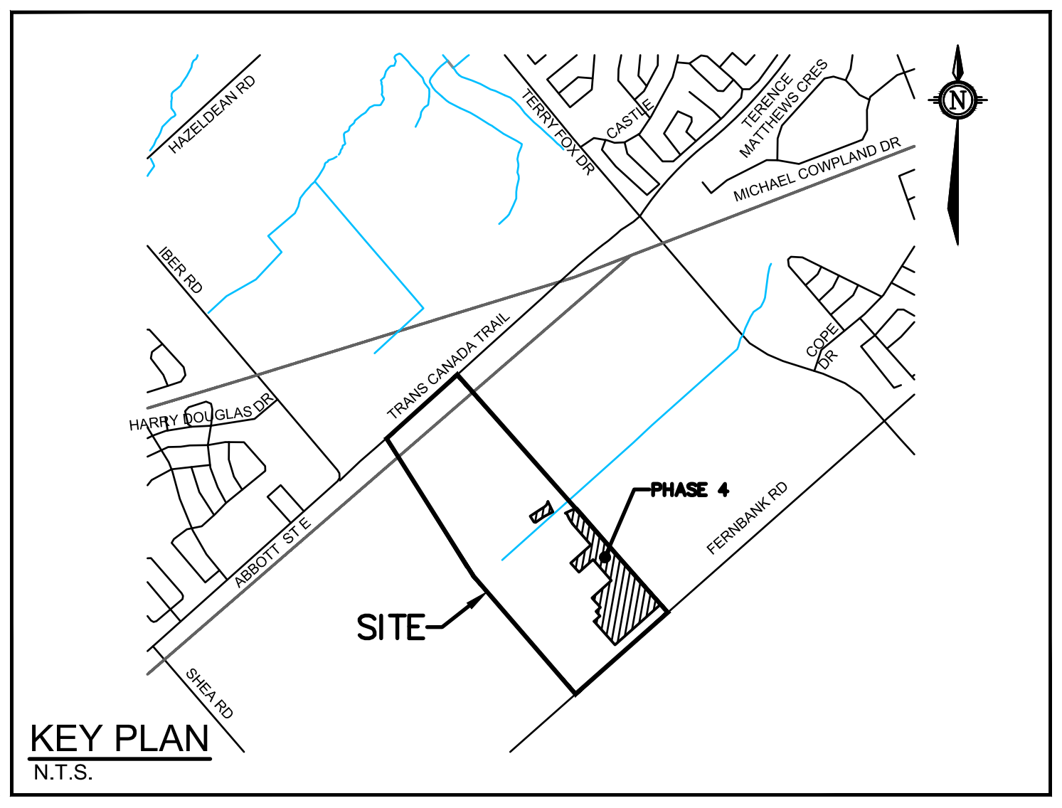
M:\2008\108180\CAD\design\Phase 3 & 4\108180-15-SAN.dwg, Phase3&4, Dec 10, 2015 - 4:28pm, ddufton

PLANB1.DWG - 1000mmx707mm



POPULATION = 488.7
COMM/INST = 0.00 ha
TOTAL AREA = 8.21
PEAK FLOW = 10.2 L/s


NORTH



KEY PLAN
N.T.S.

LEGEND

A9-4	AREA ID	A9-4	EXISTING AREA ID
904-902	MANHOLE TO MANHOLE	904-902	EXISTING MANHOLE TO MANHOLE
0.29	POPULATION EQUIVALENT	0.29	EXISTING POPULATION EQUIVALENT
19.8	AREA IN HECTARES	19.8	EXISTING AREA IN HECTARES
▬	SANITARY DRAINAGE AREA BOUNDARY	▬	EXISTING SANITARY DRAINAGE AREA BOUNDARY
→	DIRECTION OF FLOW	→	EXISTING DIRECTION OF FLOW
482	PROPOSED SANITARY SEWER AND MANHOLE	636	EXISTING PROPOSED SANITARY SEWER AND MANHOLE
▬ ▬	PHASE BOUNDARY LINE		

NOTE:
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Fax: 613-230-2962

No.	REVISION	DATE	BY
1.	UNDER DESIGN	xxx	MAB

SCALE
1:1250

DESIGN	LRW
CHECKED	MAB
DRAWN	DTD
CHECKED	MAB
APPROVED	JGR

FOR CONSTRUCTION

L. R. WILSON
100160065

M.A. BISSETT

NOVATECH
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CITY OF OTTAWA
FERNBANK CROSSING - PHASE 4

SANITARY DRAINAGE AREA PLAN

PROJECT No. 108180-17
REV REV # 1
DRAWING No. 108180-17-SAN

M:\2008\108180\Subdivision - Phase 4\CAD\Design\108180-PH4-SAN.dwg

PLANB1.DWG - 1000mmx707mm

Appendix C : STORM SEWER CALCULATIONS

Stantec

Blackstone Phase 4-8

DATE: 2017-04-28
REVISION: 1
DESIGNED BY: DT
CHECKED BY: AML

STORM SEWER DESIGN SHEET (City of Ottawa)

FILE NUMBER: 160401130

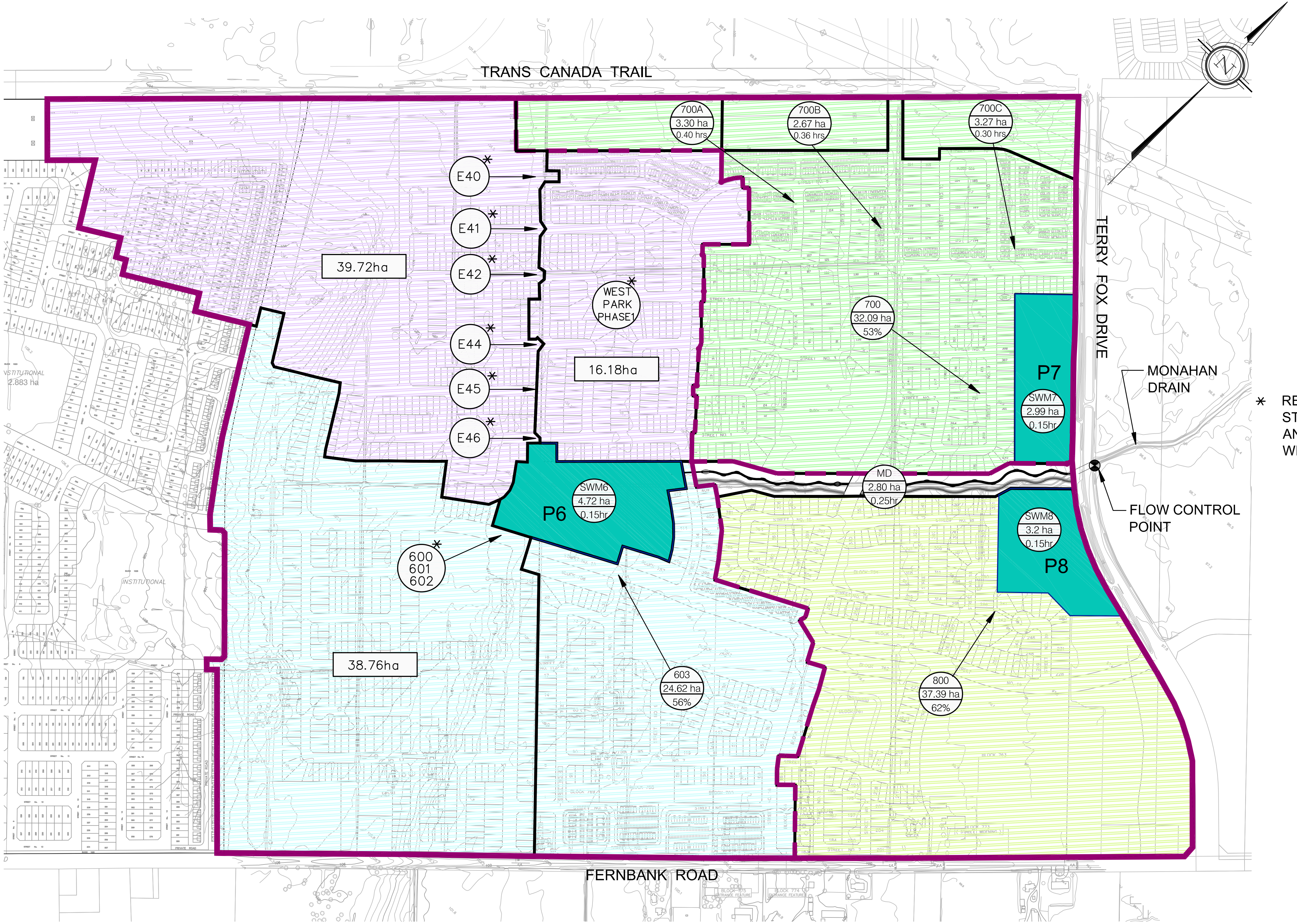
DESIGN PARAMETERS

I = a / (t+b)^c (As per City of Ottawa Guidelines, 2012)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr
a =	732.951	998.071	1174.184	1735.688
b =	6.199	6.053	6.014	6.014
c =	0.810	0.814	0.816	0.820

MANNING'S n = 0.013
BEDDING CLASS = B
MINIMUM COVER: 2.00 m
TIME OF ENTRY 10 min

LOCATION			DRAINAGE AREA																									PIPE SELECTION											
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	I_{2-YEAR} (mm/h)	I_{5-YEAR} (mm/h)	$I_{10-YEAR}$ (mm/h)	$I_{100-YEAR}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETEI (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
C104A	104	103	0.00	1.30	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.766	0.766	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	221.6	209.5	675	675	CIRCULAR	CONCRETE	-	0.15	339.6	**65.25%**	0.92	0.85	4.09
C103A	103	102	0.00	1.45	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.856	1.622	0.000	0.000	0.000	0.000	14.09	64.01	86.63	101.47	148.20	0.0	0.0	390.3	176.6	825	825	CIRCULAR	CONCRETE	-	0.10	473.6	**82.41%**	0.86	0.85	3.44
C102B, C102A	102	101	0.00	3.49	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.000	0.000	2.306	3.928	0.000	0.000	0.000	0.000	17.53	56.38	76.19	89.19	130.18	0.0	0.0	831.2	232.2	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**64.63%**	1.10	1.02	3.81
																				21.34																			
C107A	107	106	0.00	2.83	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.000	0.000	1.416	1.416	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	409.8	197.7	825	825	CIRCULAR	CONCRETE	-	0.20	669.7	**61.19%**	1.21	1.10	2.99
																				12.99																			
C109A	109	108	0.00	3.68	0.00	0.00	0.00	0.00	0.68	0.00	0.00	0.000	0.000	2.503	2.503	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	724.4	227.4	1050	1050	CIRCULAR	CONCRETE	-	0.10	900.9	**80.41%**	1.01	0.99	3.82
C108A	108	106	0.00	2.45	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	1.444	3.946	0.000	0.000	0.000	0.000	13.82	64.71	87.58	102.59	149.85	0.0	0.0	960.1	164.2	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**74.65%**	1.10	1.07	2.57
																				16.38																			
C106A	106	105	0.00	1.08	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.639	6.001	0.000	0.000	0.000	0.000	16.38	58.68	79.34	92.89	135.62	0.0	0.0	1322.5	82.0	1350	1350	CIRCULAR	CONCRETE	-	0.10	1760.8	**75.11%**	1.19	1.15	1.18
																				17.57																			
C111A	111	110	0.00	1.85	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	1.090	1.090	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	315.5	215.5	825	825	CIRCULAR	CONCRETE	-	0.10	473.6	**66.62%**	0.86	0.80	4.50
C110A	110	105	0.00	2.36	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	1.394	2.484	0.000	0.000	0.000	0.000	14.50	62.96	85.20	99.78	145.72	0.0	0.0	587.8	275.8	975	975	CIRCULAR	CONCRETE	-	0.10	739.3	**79.50%**	0.96	0.95	4.86
																				19.37																			
C105A	105	101	0.00	0.37	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.220	8.704	0.000	0.000	0.000	0.000	19.37	53.07	71.67	83.88	122.39	0.0	0.0	1732.9	86.1	1500	1500	CIRCULAR	CONCRETE	-	0.10	2332.0	**74.31%**	1.28	1.23	1.17
																				20.54																			
C112A	112	101	0.00	1.42	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.840	0.840	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	243.2	191.7	675	675	CIRCULAR	CONCRETE	-	0.15	339.6	**71.59%**	0.92	0.88	3.64
																				13.64																			
C101A	101	100	0.00	1.82	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	1.071	14.543	0.000	0.000	0.000	0.000	21.34	49.98	67.45	78.92	115.12	0.0	0.0	2724.8	137.3	1800	1800	CIRCULAR	CONCRETE	-	0.10	3792.1	**71.85%**	1.44	1.38	1.66
																				22.99									2400	2400									
C204A	204	203	0.00	2.14	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	1.263	1.263	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	365.7	209.3	825	825	CIRCULAR	CONCRETE	-	0.10	473.6	**77.22%**	0.86	0.84	4.17
																				14.17																			
C208A	208	207	0.00	0.33	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.192	0.192	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	55.6	72.8	300	300	CIRCULAR	CONCRETE	-	0.50	68.0	**81.84%**	0.97	0.96	1.27
C207B, C207A	207	206	0.00	3.53	0.00	0.00	0.00	0.00	0.62	0.00	0.00	0.000	0.000	2.197	2.389	0.000	0.000	0.000	0.000	11.27	72.26	97.94	114.78	167.75	0.0	0.0	650.1	166.8	825	825	CIRCULAR	CONCRETE	-	0.30	820.2	**79.25%**	1.49	1.46	1.91
C206A	206	205	0.00	1.18	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.000	0.825	3.215	0.000	0.000	0.000	0.000	13.18	66.44	89.95	105.37	153.94	0.0	0.0	803.3	126.5	900	900	CIRCULAR	CONCRETE	-	0.30	1034.4	**77.65%**	1.58	1.53	1.37
C205A	205	203	0.00	2.38	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	1.402	4.617	0.000	0.000	0.000	0.000	14.55	62.85	85.04	99.59	145.45	0.0	0.0	1090.7	86.2	1050	1050	CIRCULAR	CONCRETE	-	0.30	1560.3	**69.90%**	1.75	1.66	0.87
																				15.42																			
C203B, C203A	203	202	0.00	8.62	0.00	0.00	0.00	0.00	0.69	0.00	0.00	0.000	0.000	5.912	11.792	0.000	0.000	0.000	0.000	15.42	60.80	82.23	96.29	140.61	0.0	0.0	2693.7	190.6	1650	1650	CIRCULAR	CONCRETE	-	0.15	3682.6	**73.14%**	1.67	1.60	1.98
C202A	202	201	0.00	0.72	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.425	12.217	0.000	0.000	0.000	0.000	17.40	56.63	76.54	89.60	130.78	0.0	0.0	2597.3	99.6	1650	1650	CIRCULAR	CONCRETE	-	0.15	3682.6	**70.53%**	1.67	1.58	1.05
																				18.45																			
C211A	211	210	0.00	2.83	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	1.669	1.669	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	483.1	115.0	675	675	CIRCULAR	CONCRETE	-	0.50	620.1	**77.90%**	1.68	1.64	1.17
C210B, C210A	210	209	0.00	4.14	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	2.445	4.114	0.000	0.000	0.000	0.000	11.17	72.60	98.41	115.34	168.56	0.0	0.0	1124.5	257.4	1050	1050	CIRCULAR	CONCRETE	-	0.30	1560.3	**72.07%**	1.75	1.67	2.57
																				13.74																			
C212A	212	209	0.00	3.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	1.771	1.771	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	512.7	163.2	825	825	CIRCULAR	CONCRETE	-	0.30	820.2	**62.51%**	1.49	1.36	2.00
																				12.00																			
C209A	209	201	0.00	1.13	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.665	6.550	0.000	0.000	0.000	0.000	13.74	64.92	87.87	102.93	150.34	0.0	0.0	1598.7	139.9	1500	1500	CIRCULAR	CONCRETE	-	0.10	2332.0	**68.55%**	1.28	1.21	1.93
																				15.67																			
	201	200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	18.767	0.000	0.000	0.000	0.000	18.45	54.67	73.86	86.45	126.17	0.0	0.0	3850.3	38.5	1950	1950	CIRCULAR	CONCRETE	-	0.10	4694.4	**82.02%**	1.52	1.51	0.43
C200A	200	IEADWAL	0.00	3.20	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	1.886	20.653	0.000	0.000	0.000	0.000	18.87	53.92	72.83	85.24	124.39	0.0	0.0	4178.3	9.2	2100	2100	CIRCULAR	CONCRETE	-	0.10	5720.2	**73.05%**	1.60	1.54	0.10
																				18.97									2100	2100									



LEGEND:

▬	DRAINAGE BOUNDARY
▬	DRAINAGE AREA
▬	POND LOCATIONS
700 / 32.09 ha / 53%	AREA ID AREA (ha) Imp.(%)/Tp.(hr)
●	FLOW CONTROL POINT

* REFER TO "SITE SERVICING REPORT, STORMWATER SITE MANAGEMENT PLAN AND EROSION AND SEDIMENT CONTROL PLAN, WEST PARK - PHASE 1" IBI GROUP (JANUARY 2012).

J:\25853-WestPrkComm\5.9 Drawings\59SWM\25853Figures\Pond6-WPark.dwg Layout Name: FIG2 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 2/2/2012 2:51 PM Last Saved By: SVukic Last Saved At: Feb. 2, 12

IBI GROUP

Scale

1:7500

Project Title

WEST PARK POND 6
STORMWATER MANAGEMENT
REPORT AND DESIGN BRIEF

Drawing Title

POST-DEVELOPMENT
DRAINAGE AREA PLAN

Sheet No.

FIGURE 2

Appendix D : GEOTECHNICAL INVESTIGATION

patersongroup

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation

Proposed Residential Development
Blackstone Community
Terry Fox Drive - Ottawa

Prepared For

Monarch Corporation

February 9, 2016

Report: PG2233-2 Revision 2

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APPENDICES

1.0 INTRODUCTION

Paterson Group (Paterson) was commissioned by Monarch Corporation (Monarch) to conduct a geotechnical investigation for the proposed development of West Park Community to be located west of Terry Fox Drive, in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the investigation was to:

☐ determine the subsurface soil and groundwater conditions by means of boreholes, test pits and existing soils information.

☐ provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. The report contains our findings and includes geotechnical recommendations pertaining to the design and construction of the proposed development as understood at the time of this report.

Investigating the presence or potential presence of contamination on the proposed development was not part of the scope of work. Therefore, the present report does not address environmental issues.

2.0 PROPOSED DEVELOPMENT

It is understood that the proposed development consists of low rise residential dwellings and townhouse style housing. Local roadways, as well as, two (2) school sites and three (3) stormwater management ponds are further anticipated for the proposed development. It is further understood that the proposed Monahan Drain will run west from Terry Fox Drive to the SWMPs.

The subject site is located on the north side of Fernbank Road, west side of Terry Fox Drive and south of a Hydro corridor.

3.0 METHOD OF INVESTIGATION

3.1 Field Investigation

Several field programs were completed as part of our investigation and were carried out between December 2006 to March 2011. A total of sixty-five (65) boreholes and eight (8) test pits located across the subject site were completed by Paterson. The locations of the boreholes and test pits are shown on Drawing PG2233-7 - Test Hole Location Plan included in Appendix 2. A previous investigation was completed by others, the results of the previous investigation are discussed in the present report.

The boreholes were completed using a track-mounted auger drill rig operated by a two person crew. The test pits were completed using a rubber tire backhoe. All fieldwork was conducted under the full-time supervision of personnel from our geotechnical division under the direction of a senior engineer. The testing procedure consisted of augering to the required depths and at the selected locations sampling the overburden.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using a 50 mm diameter split-spoon (SS) sampler, using 73 mm diameter thin walled (TW) Shelby tubes in conjunction with a piston sampler, or from the auger flights. All soil samples were visually inspected and initially classified on site. The split-spoon samples were placed in sealed plastic bags and the Shelby tubes were sealed at both ends on site. All samples were transported to the our laboratory for examination and classification. The depths at which the split-spoon, Shelby tube and auger samples were recovered from the test holes are shown as SS, TW and AU, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was conducted in cohesive soils using a field vane apparatus.

Overburden thickness was evaluated during the course of the site investigation by dynamic cone penetration testing (DCPT) at several of the borehole locations. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed at the borehole and test pits were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1.

Groundwater

Flexible standpipes were installed in all boreholes to monitor the groundwater levels subsequent to the completion of the sampling program. Groundwater infiltration levels were noted at the time of excavation at the test pit locations.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of the report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test holes were located in the field by Annis O'Sullivan Vollebekk. It is understood that the elevations are referenced to a geodetic datum. The ground surface elevation and location of the test holes are presented on Drawing PG2233-7 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the investigation were examined in our laboratory to review field notes and soil samples.

A series of Shelby tube samples were submitted for unidimensional consolidation and Atterberg limit testing from both current and previous investigations.

The results of the consolidation and Atterberg testing are presented on the Consolidation Test sheets presented in Appendix 1 and are further discussed in Sections 4 and 5.

4.0 OBSERVATIONS

4.1 Surface Conditions

Currently, the subject site, consist of agricultural lands. The ground surface across the subject site is relatively flat and slopes gradually downwards to the northeast.

4.2 Subsurface Profile

Generally, the soil conditions encountered at the test hole locations consist of a cultivated topsoil/organic layer followed by a silty sand, and/or clayey silt layer overlying a sensitive silty clay deposit. Silty clay overlying a glacial till deposit was noted within the southwest portion of the subject site. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Based on available geological mapping, the bedrock in this area mostly consists of interbedded limestone and dolomite of the Gull River formation with an overburden drift thickness of 10 to 30 m depth.

4.3 Groundwater

The groundwater levels in the boreholes are presented in Table 1. It is important to note that groundwater readings at piezometers can be influenced by surface water perched within the borehole backfill material. Groundwater conditions can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, it is estimated that groundwater can be expected between 2 to 3 m depth. Groundwater levels are subject to seasonal fluctuations and therefore could vary during time of construction.

Table 1
Summary of Groundwater Level Readings - (Geotechnical Investigation PG1874)

Test Hole Number	Ground Elevation, m	Groundwater Levels, m		Recording Date
		Depth	Elevation	
BH 1	101.03	4.59	96.44	June 25, 2009
BH 2	100.67	1.40	99.27	June 25, 2009
BH 3	101.18	1.80	99.38	June 25, 2009
BH 4	100.73	1.55	99.18	June 25, 2009
BH 5	99.67	3.52	96.15	June 25, 2009
BH 6	99.30	1.53	97.77	June 25, 2009
BH 7	98.91	3.60	95.31	June 25, 2009
BH 8	98.94	4.63	94.31	June 25, 2009
BH 9	98.49	1.50	96.99	June 25, 2009
BH 10	98.14	3.34	94.80	June 25, 2009
BH 11	97.48	1.04	96.44	June 25, 2009
BH 12	100.31	2.73	97.58	June 25, 2009
BH 13	100.44	1.24	99.20	June 25, 2009
BH 14	97.75	1.64	96.11	November 2, 2009
BH 15	98.63	3.65	94.98	November 2, 2009
BH 16	98.98	3.50	95.48	November 2, 2009
BH 17	99.41	4.80	94.61	November 2, 2009
BH 18	99.85	0.45	99.40	November 2, 2009
BH 19	99.49	Blocked	99.49	November 2, 2009
BH 20	99.92	Blocked	99.92	November 2, 2009
BH 21	99.46	1.65	97.81	November 2, 2009
BH 22	99.32	0.00	99.32	November 2, 2009
BH 23	100.00	6.80	93.20	November 2, 2009
BH 24	100.10	0.40	99.70	November 2, 2009
TP 1	101.28	3.00	98.28	July 6, 2009
TP 2	100.72	3.30	97.42	July 6, 2009
TP 3	100.58	2.40	98.18	July 6, 2009
TP 4	100.78	2.60	98.18	July 6, 2009

Table 1 - Continued
Summary of Groundwater Level Readings - (Geotechnical Investigation PG2233)

Test Hole Number	Ground Elevation, m	Groundwater Levels, m		Recording Date
		Depth	Elevation	
BH 1	98.86	5.11	93.75	November 18, 2010
BH 2	98.88	Damaged	-	November 18, 2010
BH 3	98.62	0.47	98.15	November 18, 2010
BH 4	98.68	No Standpipe	-	November 18, 2010
BH 5	97.10	Damaged	-	November 18, 2010
BH 6	97.15	4.24	92.91	November 18, 2010
BH 7	97.49	4.96	92.53	November 18, 2010
BH 8	97.71	4.41	93.30	November 18, 2010
BH 8A	97.71	0.42	97.29	November 18, 2010

Note: Assumed geodetic elevations at the test hole locations were provided by Annis O'Sullivan Vollebekk Ltd.

5.0 DISCUSSION

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed residential development. Due to the presence of the sensitive silty clay layer, the proposed development will be subjected to grade raise restrictions.

Permissible grade raise recommendations are discussed in Subsection 5.3 and recommended permissible grade raise areas are presented in Drawing PG2233-8 - Permissible Grade Raise Areas - Housing in Appendix 2. If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

Seismic site classification recommendations are discussed in Subsection 5.5 and are presented in Drawing PG2233-9 - Seismic Site Classification Areas in Appendix 2.

Excavation for the proposed services alignment within the northeast portion of the subject site will be completed mostly through OHSA Type 3 soils with a shallow groundwater table. It is understood that the proposed services will be approximately 6 m deep. Due to the anticipated pipe depth, the potential for basal heave should be reviewed for pipe placement.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. Granular material should be tested and approved prior to delivery to the site. The fill should be placed in lifts of 300 mm thick or less and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of the Standard Proctor Maximum Dry Density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of the SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Ditch Area

The existing drainage ditches will be backfilled as part of the proposed development. The drainage ditches, regardless of whether a roadway or building is constructed above, is recommended to be backfilled by the following methodology;

- ❏ Remove the topsoil material.
- ❏ Provide benching in existing slope at a minimum of 2H:1V profile.
- ❏ Backfill in maximum 300 mm thick loose lifts and compact to 95% of the SPMDD to 1.0 m below finished grade. All material placed within 1.0 m of finished grade should be compacted to 98% of the SPMDD.
- ❏ The backfill materials should consist of site approved material or engineered fill.
- ❏ The backfilling procedure should be reviewed on-site.

The former ditch areas are indicated in Drawing PG2233-17 - Test Hole Location Plan in Appendix 2.

Park Block

For grading within the proposed park blocks, site-excavated soil can be used as general landscaping fill where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. A site specific review should be completed to provide recommendations for any settlement sensitive structures, such as splash pads or shade structures.

Fill Observations for Park along Tapadero Avenue

Based on a site inspection completed on July 30, 2013 by Paterson, a 0.9 to 1.2 m thick fill layer of silty clay mixed with glacial till was observed throughout the park area located along Tapadero Avenue. The imported fill material was excavated from the SWMP 6 excavation within the subject site and was placed by end dump trucks and levelled with a bulldozer within the park. At the time of our site visit, the surface of the fill material was noted to be in a dry state. Several temporary paths were observed within the park area with blast rock fill placed over the silty clay fill material. The blast rock was placed to provide an adequate access for the heavy trucks bringing in the silty clay fill material to the park. A topsoil material mixed with some gravel is noted placed over the fill material to bring the park up to the specified grade.

The observed fill material is considered adequate from a geotechnical perspective for landscape grading within the proposed park. A site specific review should be completed to provide recommendations for any settlement sensitive structures, such as splash pads or shade structures. Also, the fill material is not considered to be impacted from an environmental perspective based on our observations.

5.3 Foundation Design

Based on the results of the geotechnical investigation, lightly loaded structures, such as the residential buildings anticipated, could be founded on shallow footings bearing on compact sandy silt or firm to stiff clayey silt/silty clay, provided that the required grade raise is within tolerable limits.

Bearing Resistance Values

Using continuously applied loads, footings for the proposed buildings can be designed using the bearing resistance values presented in Table 2.

Table 2 - Bearing Resistance Values

Bearing Surface	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)
Compact sandy silt	60	125
Firm Clayey Silt/Silty Clay	60	125
Stiff Silty Clay/Clayey Silt	100	150
Glacial Till	150	225

Note: Footings, up to 3 m wide, can be designed using the abovenoted bearing resistance values placed over a silty clay bearing surface.

The bearing resistance values are provided on the assumption that the footings will be placed on undisturbed soil bearing surfaces. An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to the in-situ bearing medium soils above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Settlement/Grade Raise

Consideration must be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For dwellings, a minimum value of 50% of the live load is recommended by Paterson.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics of the silty clay. These characteristics are estimated in the laboratory by conducting unidimensional consolidation tests on undisturbed soil samples collected using Shelby tubes in conjunction with a piston sampler. Twenty-seven (27) site specific consolidation tests were conducted. The results of the consolidation tests from the current and previous investigations are presented in Table 3, 4 and 5 and in Appendix 1.

The value for p'_c is the preconsolidation pressure and p'_o is the effective overburden pressure of the test sample. The difference between these values is the available preconsolidation. The increase in stress on the soil due to the cumulative effects of the fill surcharge, the footing pressures, the slab loadings and the lowering of the groundwater should not exceed the available preconsolidation if unacceptable settlements are to be avoided.

The values for C_{cr} and C_c are the recompression and compression indices, respectively. These soil parameters are a measure of the compressibility due to stress increases below and above the preconsolidation pressures. The higher values for the C_c, as compared to the C_{cr}, illustrate the increased settlement potential above, as compared to below, the preconsolidation pressure.

Table 3 - Summary of Consolidation Test Results (Paterson Investigation PG2233)

Borehole	Sample	Depth	p'_c	p'_o	C_{cr}	C_c	Q
BH 1	TW 2	3.45	78	40	0.012	0.471	A
BH 2	TW 2	5.76	113	54	0.009	0.934	P
BH 3	TW 2	5.03	96	50	0.013	0.808	A
BH 4	TW 4	6.54	110	59	0.010	0.714	A
BH 6	TW 2	3.42	84	40	0.013	0.802	A
BH 9	TW5	4.19	77	45	0.015	0.290	G
BH 9	TW6	8.06	116	69	0.015	1.104	A
BH 10	TW5	3.3	70	36	0.015	0.586	A
BH 12	TW5	3.38	85	34	0.014	0.281	A
BH 14	TW4	4.27	88	45	0.012	0.304	A
BH 15	TW4	3.5	85	41	0.017	0.351	A
BH15	TW5	9.55	121	78	0.011	0.815	A
BH16	TW5	4.13	103	45	0.019	1.316	A

* - Q - Quality assessment of sample - G: Good A: Acceptable P: Likely disturbed

Table 4 - Summary of Consolidation Test Results (Paterson Investigation PG1874)

Borehole	Sample	Depth	p'_c	p'_o	C_{cr}	C_c	Q
BH 1	TW3	4.3	127	55	0.015	1.103	G
BH 2	TW5	4.99	103	56	0.019	0.672	A
BH 2	TW6	8.08	115	79	0.026	1.940	P
BH 3	TW3	5.03	119	61	0.024	2.684	A
BH 4A	TW1	4.1	118	53	0.008	0.353	G
BH 14	TW5	7.2	106	62	0.001	0.853	G
BH 19	TW3	4.22	140	52	0.012	0.608	G
BH 20A	TW1	4.19	115	53	0.016	0.552	G
BH 21	TW3	4.19	95	56	0.003	0.905	G
BH 22	TW4	4.85	108	61	0.013	0.626	G
BH 24A	TW1	4.07	121	50	0.006	0.628	P

* - Q - Quality assessment of sample - G: Good A: Acceptable P: Likely disturbed

Table 5 - Summary of Consolidation Test Results (Investigation by Others)

Borehole	Sample	Depth	p'_c	p'_o	C_{cr}	C_c
06 - 2	4	5	130	37	0.020	0.560
06 - 4	4	4.4	150	34	0.020	0.400
06 - 7	4	4.8	130	42	0.020	1.600

The values of p'_c, p'_o, C_{cr} and C_c are determined using standard engineering testing procedures and are estimates only. Natural variations within the soil deposit will affect the results. The p'_o parameter is directly influenced by the groundwater level. Groundwater levels were measured during the site investigation. Groundwater levels vary seasonally which has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Unacceptable settlements could be induced by a significant lowering of the groundwater level. The p'_o values for the consolidation tests during the investigation are based on the long term groundwater level being at 0.5 m below the existing groundwater table. The groundwater level is based on the colour and undrained shear strength profile of the silty clay.

The total and differential settlements will be dependent on characteristics of the proposed buildings. For design purposes, the total and differential settlements are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 0.5 m was assumed.

The potential post construction total and differential settlements are dependent on the position of the long term groundwater level when building are situated over deposits of compressible silty clay. Efforts can be made to reduce the impacts of the proposed development on the long term groundwater level by placing clay dykes in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge or limiting planting of trees to areas away from the buildings. However, it is not economically possible to control the groundwater level.

To reduce potential long term liabilities, consideration should be given to accounting for a larger groundwater lowering and to provide means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the dwellings, etc). Buildings on silty clay deposits increases the likelihood of movements and therefore of cracking. The use of steel reinforcement in foundations placed at key structural locations will tend to reduce foundation cracking compared to unreinforced foundations.

The recommended permissible grade raise areas are defined in Drawing PG2233-8 - Permissible Grade Raise Areas - Housing in Appendix 2.

If higher grade raises and/or higher loading conditions are required, post construction settlements can be reduced by several methods. The following options can be considered and are further discussed in Subsection 5.4:

❑ preloading and surcharging
❑ lightweight fill (LWF)

Bearing resistance values for footing designs should be determined on a per lot basis at the time of construction.

Park Block

Based on current information, a permissible grade raise of 1.5 m is recommended for settlement sensitive structures, such as splash pads or picnic shelters, located within the community park area. A permissible grade raise restriction is not required for general landscaping purposes within the park area.

5.4 Foundation Options

Based on the above discussion, several options could be considered for the foundation support of the proposed buildings:

Scenario A

Where the grade raise is close to, but below, the maximum permissible grade raise, consideration should be given to using more reinforcement in the design of the foundation (footings and walls) to reduce the risks of cracking in the concrete foundation. The use of control joints within the brick work between the garage and basement area should also be considered.

Scenario B

Where the grade raise cannot be accommodated with soil fill, the following options could be used alone or in combination.

Option 1 - Use of Lightweight Fill

Lightweight fill (LWF) can be used, consisting of EPS (expanded polystyrene) Type 19 or 22 blocks or other light weight materials which allow for raising the grade without adding a significant load to the underlying soils. However, these materials are expensive and, in the case of the EPS, are more difficult to use under the groundwater level, as they are buoyant, and must be protected against potential hydrocarbon spills. Use lightweight fill within the interior of the garage and porch areas to reduce the fill-related loads.

As an alternative to lightweight fill in the interior of the garage and porch, a structural slab can be designed to create a void beneath the floor slab and therefore reduce fill-related loads. Additional information can be provided once the design of the buildings is known.

Option 2 - Preloading or Surcharging

It is possible to preload or surcharge the proposed site in localized areas provided sufficient time is available to achieve the desired settlements based on theoretical values from the settlement analysis. If this option is considered, a monitoring program using settlement plates and electronic piezometers will have to be implemented. This program will determine the amount of settlement in the preloaded or surcharged areas. Obviously, preloading to proposed finished grades will allow for consolidation of the underlying clays over a longer time period. Surcharging the site with additional fill above the proposed finished grade will add additional load to the underlying clays accelerating the consolidation process and allowing for accelerated settlements. Once the desired settlements are achieved, the site can be unloaded and the fill can be used elsewhere on site.

With both the preloading and surcharging methods, the loading period can be reduced by installing vertical wick drains or sand drains in the silty clay layer to promote the movement of groundwater towards the ground surface. However, vertical drains are expensive for this type of residential project.

Underground Utilities

The underground services may be subjected to unacceptable total or differential settlements. In particular, the joints at the interface building/soil may be subjected to excessive stress if the differential settlements between the building and the services are excessive. This should be considered in the design of the underground services.

Once the required grade raises are established, the above options could be further discussed along with further recommendations on specific requirements.

5.5 Design for Earthquakes

Shear wave velocity testing was completed for the subject site to accurately determine the applicable seismic site classification for the proposed buildings from Table 4.1.8.4.A of the Ontario Building Code 2006. The shear wave velocity testing was completed by Paterson personnel. The shear wave velocity profile at two (2) locations are presented in Appendix 2.

Field Program

One (1) shear wave velocity test was completed within the north portion of the subject site (Test 1) and a second shear wave velocity test (Test 2) was completed within the southwest portion of the development, as presented in Drawing PG2233-9 - Seismic Site Classification presented in Appendix 2. Paterson field personnel placed 24 horizontal geophones in a straight line in roughly a northeast-southwest orientation. The 4.5 Hz. horizontal geophones were mounted to the surface by means of a 75 mm ground spike attached to the geophone land case. The geophones were spaced at 3 m intervals and were connected by a geophone spread cable to a Geode 24 Channel seismograph.

The seismograph was also connected to a computer laptop and a hammer trigger switch attached to a 12 pound dead blow hammer. The hammer trigger switch sends a start signal to the seismograph. The hammer is used to strike an I-Beam seated into the ground surface, which creates a polarized shear wave. The hammer shots are repeated between four (4) to eight (8) times at each shot location to improve signal to noise ratio. The shot locations are completed in forward and reverse directions (i.e.- striking both sides of the I-Beam seated parallel to the geophone array). The shot locations are located at the centre of the geophone array and 3, 4.5 and 30 m away from the first and last geophone.

The methods of testing completed by Paterson are guided by the standard testing procedures used by the expert seismologists at Carleton University and Geological Survey of Canada (GSC).

Data Processing and Interpretation

Interpretation for the shear wave velocity results were completed by Paterson personnel. Shear wave velocity measurement was made using reflection/refraction methods. The interpretation is performed by recovering arrival times from direct and refracted waves. The interpretation is repeated at each shot location to provide an average shear wave velocity, Vs_{30}, of the upper 30 m profile, immediately below the building's foundation. The layer intercept times, velocities from different layers and critical distances are interpreted from the shear wave records to compute the bedrock depth at each location. The bedrock velocity was interpreted using the main refractor wave velocity, which is considered a conservative estimate of the bedrock velocity due to the increasing quality of the bedrock with depth. As bedrock quality increases, the bedrock shear wave velocity also increases.

The overburden and bedrock velocities at Test 1 were noted to be 150 m/s and 2,049 m/s, respectively, based on our findings. The overburden and bedrock velocities Test 2 were noted to be 130 m/s and 2,850 m/s, respectively and bedrock was interpreted to be at a 10 m depth. It should be further noted that the bedrock depth increases towards the northeast across the subject site and based on seismic and DCPT results, the bedrock was noted to be 10 to 40 m below ground surface.

The Vs_{30} was calculated using the standard equation for average shear wave velocity calculation from the Ontario Building Code (OBC) 2006.

$$V_{s30} = \frac{Depth_{OfInterest}(m)}{\sum\left(\frac{(Depth_{Layer1}(m)}{Vs_{Layer1}(m/s)} + \frac{Depth_{Layer2}(m)}{Vs_{Layer2}(m/s)}\right)}$$

$$V_{s30} = -\frac{30m}{\sum\left(\frac{30m}{150m/s}\right)}$$

$$V_{s30} = 150m/s$$

Based on the results of the seismic testing at the Test 1 location, the average shear wave velocity, Vs_{30}, is **150 m/s**. Therefore, a **Site Class E** is applicable for foundation design within that area where similar soil conditions are encountered, as per Table 4.1.8.4.A of the OBC 2006. Based on the results of the seismic testing at Test 2 location, the average shear wave velocity of the upper 30 m profile, Vs_{30}, was calculated to be **391 m/s**. Therefore, a seismic **Site Class C** is applicable for areas with similar subsoil conditions. Based on our seismic testing results and our field investigations, the recommended seismic site classification areas are presented in Drawing PG2233-9 - Seismic Site Classification in Appendix 2.

5.6 Basement Slab

With the removal of all topsoil and deleterious fill, containing organic matter, within the footprints of the proposed buildings, undisturbed native soil surface will be considered acceptable subgrade on which to commence backfilling for floor slab construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-slab fill consist of 19 mm clear crushed stone.

5.7 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car parking areas and access lanes/local residential streets. These guidelines should be reviewed once the details of the development are known.

Table 6 - Recommended Pavement Structure - Car Parking Areas

Thickness (mm)	Material Description
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 7 - Recommended Pavement Structure - Local Residential Roadways

Thickness (mm)	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil	

Table 8 - Recommended Pavement Structure - Roadways with Bus Traffic

Thickness mm	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
600	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - Either in situ soil or OPSS Granular B Type II material placed over in situ soil

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing load carrying capacity.

Due to the low permeability of the subgrade materials consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

6.0 DESIGN AND CONSTRUCTION PRECAUTIONS

6.1 Foundation Drainage and Backfill

A perimeter foundation drainage system is recommended for proposed structures. The system should consist of a 100 to 150 mm diameter, geotextile-wrapped, perforated, corrugated, plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Platon or Miradrain G100N) connected to a drainage system is provided.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided in this regard.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 Excavation Side Slopes

The excavation for the current phase of the proposed development will be mostly through sandy silt and/or clayey silt/silty clay. Above the groundwater level, for excavations to depths of approximately 3 m, the excavation side slopes should be stable in the short term at 1H:1V. Flatter slopes could be required for deeper excavations or for excavation below the groundwater level. Where such side slopes are not permissible or practical, temporary shoring should be used. The subsoil at this site is considered to be mainly a Type 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

The slope cross-sections recommended above are for temporary slopes. Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by "cut and cover" methods and excavations will not be left open for extended periods of time.

Excavation Base Stability

The base of supported excavations can fail by three (3) general modes:

- ❑ Shear failure within the ground caused by inadequate resistance to loads imposed by grade difference inside and outside of the excavation,
- ❑ Piping from water seepage through granular soils, and
- ❑ Heave of layered soils due to water pressures confined by intervening low permeability soils.

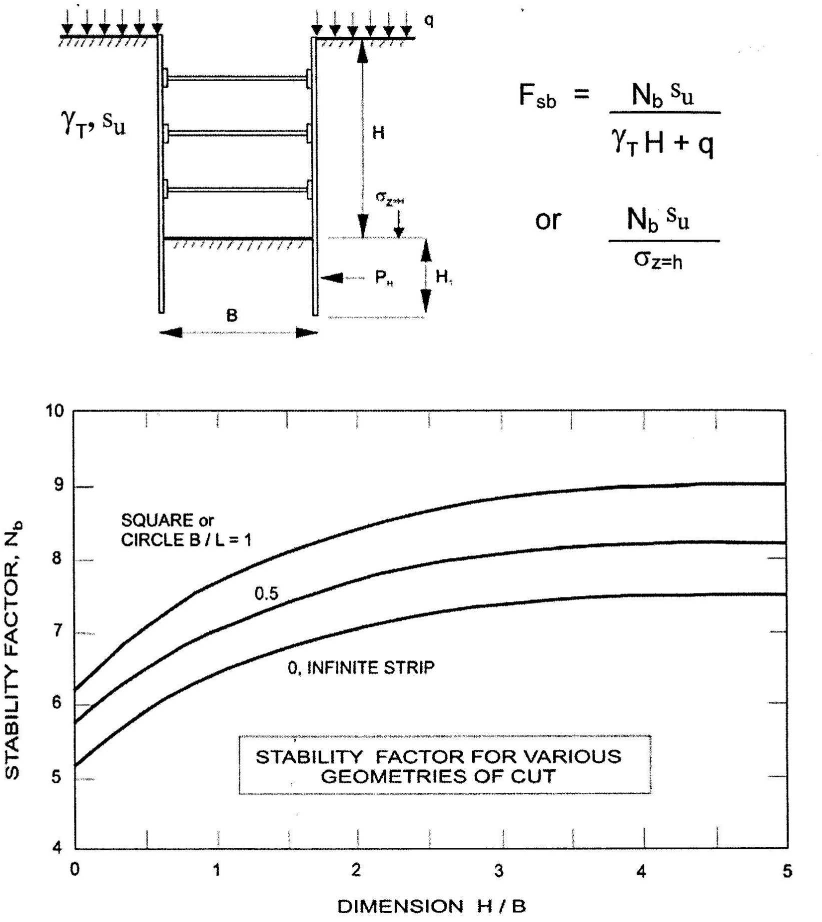
Shear failure of excavation bases is typically rare in granular soils if adequate lateral support is provided. Inadequate dewatering can cause instability in excavations made through granular or layered soils. The potential for base heave in cohesive soils should be determined for stability of flexible retaining systems.

The factor of safety with respect to base heave, FS_b, is:

$$FS_b = N_b s_u / \sigma_z$$

where:

N_b - stability factor dependent upon the geometry of the excavation and given in Figure 1 on the following page.
s_u - undrained shear strength of the soil below the base level
σ_z - total overburden and surcharge pressures at the bottom of the excavation



$$F_{sb} = \frac{N_b s_u}{\gamma_T H + q} \quad \text{or} \quad \frac{N_b s_u}{\sigma_{z=h}}$$

Figure 1 - Stability Factor for Various Geometries of Cut

In the case of soft to firm clays, a factor of safety of 2 is recommended for base stability.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the City of Ottawa.

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extent at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

Generally, it should be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. The seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

Due to the relatively impervious nature of the silty clay/clayey silt materials, it is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. A perched groundwater condition may be encountered within the sandy silt deposit which may produce significant temporary groundwater infiltration levels. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations.

A temporary MOE permit to take water (PTTW) will be required for this project if more than 50,000 L/day are to be pumped during the construction phase. At least 3 to 4 months should be allowed for completion of the application and issuance of the permit by the MOE.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

6.6 Winter Construction

The subsurface conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur. Precautions should be taken if winter construction is considered for this project.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters, tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be constructed in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Landscaping Considerations

Tree Planting Restrictions

The proposed development is located in an area of medium sensitive silty clay deposits for tree planting. For the proposed development, it is expected that final grade raises will be approximately 1 to 2 m above existing grades. Therefore, it is expected that the combination of the proposed finished grades and the thickness of the underlying weathered clay crust will provide approximately 3 to 4 m thick buffer to the underlying firm silty clay deposit.

Tree planting for this subject development should be limited to low water demand trees. The minimum permissible distance from the foundation will depend on the nature of the tree, the depth of the clay crust and the final grade raise in relation to the permissible grade raise. A minimum permissible distance of 4.5 m from the foundation wall is recommended for a tree planting.

It is well documented in the literature, and is our experience, that fast-growing trees located near buildings founded on cohesive soils that shrink on drying can result in long-term differential settlements of the structures. Tree varieties that have the most pronounced effect on foundations are seen to consist of poplars, willows and some maples (i.e. Manitoba Maples) and, as such, they should not be considered in the landscaping design.

Swimming Pools

The in-situ soils are considered to be acceptable for swimming pools. Above ground swimming pools must be placed at least 4 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer`s requirements.

Aboveground Hot Tubs

If consideration is given to construction of an aboveground hot tub, a geotechnical consultant should be retained by the homeowner to review the site conditions. Additional grading around the hot tub should not exceed permissible grade raises. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer’s specifications.

Installation of Decks or Additions

If consideration is given to construction of a deck or addition, a geotechnical consultant should be retained by the homeowner to review the site conditions. Additional grading around proposed deck or addition should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

6.8 Stormwater Management Facility

It is our understanding that the proposed stormwater management facility (SWMF) will consist of the following:

- ☐ Pond bottom elevation. . . . . 94 m
- ☐ Permanent water elevation. . . . . 95.7 m
- ☐ 100 year water elevation. . . . . 98.35 m
- ☐ Elevation of top of pond. . . . . 100 m

From a geotechnical perspective, the construction of the proposed SWMF is possible based on the details provided in the construction drawings. The main areas of concern will be:

- ☐ the groundwater infiltration rate within the excavation side slopes and along the bottom of the pond
- ☐ the permeability of the subsoil materials
- ☐ the stability of the excavation side slopes

The proposed SWMF will be located in an area where water infiltration from the granular glacial till deposit, where encountered, will be important to manage during the construction phase. Based on the test pit program carried out as part of our investigation, water infiltration rates in the test holes was moderate to low and could easily be managed during the construction program. Based on the field observations, the long term groundwater level is expected to be between elevations 97 and 96 m.

The excavated silty clay encountered at this site should be stockpiled on site for re-use as a possible clay liner for the remainder of the pond especially in the areas where compact to loose sandy glacial till will be penetrated. This glacial till deposit is most likely considered to be saturated due to its moderate permeability. It is recommended that periodic inspections be carried out to assess the groundwater infiltration rates and determine if a clay liner is required.

Where the glacial till deposit is pervious, consideration should be given to placing a clay liner of approximately 500 mm in thickness. The clay liner will improve the imperviousness of the excavation side slope during fluctuations in the pond water level. From a geotechnical perspective, the construction of the proposed SWMF is possible and its long term performance will depend on the stability of its excavation side slopes. Based on the available drawings of the SWMF, it appears that the excavation side slopes are approximately 3H:1V. From a geotechnical perspective, sidewalls shaped to a 3H:1V slope are considered to be stable in the long term and are adequate for SWMP construction at the subject site. Based on the preliminary observations during the test pit program, the excavation side walls appeared to be relatively stable when excavated close to vertical. No sloughing of the excavation side wall was noted during the field program.

The proposed concrete structures can be founded within the stiff silty clay deposit or the glacial till. The following allowable bearing capacities are provided for design purposes and should be confirmed in the field prior to pouring concrete footings:

❑ Stiff silty clay	125 kPa
❑ Very stiff silty clay	150 kPa
❑ Loose glacial till.	75 kPa
❑ Compact to dense glacial till	150 to 200 kPa

Proposed Monahan Drain

The following drawings prepared by IBI Group for the proposed Monahan Drain were reviewed from a geotechnical perspective:

- Project No. 25853, Drawing 708 - Monahan Drain Layout and Profile from Section 0+000 to Section 0+335. Revision 1 dated November 2, 2010
- Project No. 25853, Drawing 709 - Monahan Drain Layout and Profile from Section 0+335 to Section 0+696. Revision 1 dated November 2, 2010
- Project No. 2583, Drawing 711 - Details II. Revision 1 dated November 3, 2010

Based on our review, the proposed Monahan Drain details are acceptable from a geotechnical perspective.

7.0 RECOMMENDATIONS

It is recommended that the following be completed once the master plan and site development are determined:

☐ Review detailed grading plan(s) from a geotechnical perspective.

☐ Observation of all bearing surfaces prior to the placement of concrete.

☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

☐ Observation of all subgrades prior to placing backfilling materials.

☐ Field density tests to ensure that the specified level of compaction has been achieved.

☐ Sampling and testing of the bituminous concrete including mix design reviews.

☐ Suggest foundation alternatives based on the potential long term settlements.

A report confirming that these works have been conducted in general accordance with Paterson's recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 STATEMENT OF LIMITATIONS

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Monarch Corporation or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

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PROVINCE OF ONTARIO

Carlos P. Da Silva, P.Eng.

Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

CONSOLIDATION TEST RESULTS

ATTERBERG LIMITS’ TESTING RESULTS

patersongroup **Consulting Engineers**

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG2233**

REMARKS

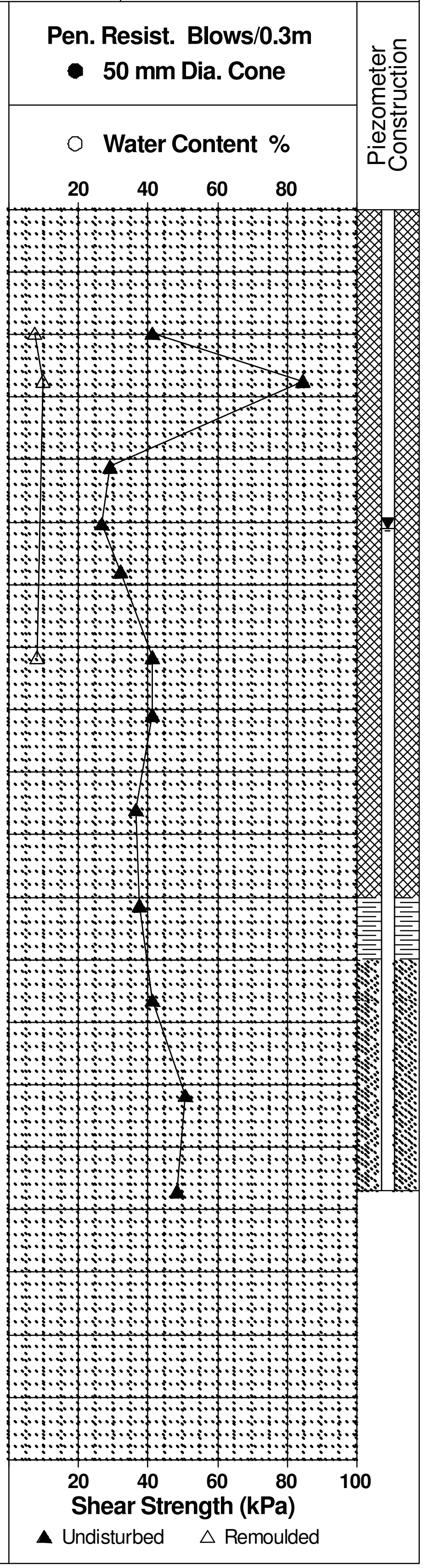
HOLE NO. **BH 1**

BORINGS BY CME 75 Power Auger

DATE 5 November 2010

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.36				
Very loose, brown **SILTY SAND** 1.45	SS	1	92	2
Stiff to firm, brown interlayered **SILTY CLAY** and **CLAYEY SILT** - grey by 2.2m depth	TW	2	100	
	TW	3	100	
(GWL @ 5.11m-Nov. 11/10) 15.70				
Dynamic Cone Penetration Test commenced @ 15.70m depth. Cone push to 28.35m and hit refusal at 28.50m depth				

DEPTH (m)	ELEV. (m)
0	98.86
1	97.86
2	96.86
3	95.86
4	94.86
5	93.86
6	92.86
7	91.86
8	90.86
9	89.86
10	88.86
11	87.86
12	86.86
13	85.86
14	84.86
15	83.86
16	82.86
17	81.86
18	80.86
19	79.86
20	78.86



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 75 Power Auger

DATE 8 November 2010

FILE NO. PG2233

HOLE NO. BH 2

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.46
Very loose, grey-brown **SILTY SAND**	1.45
Stiff to firm, grey-brown **SILTY CLAY,** some silt seams - grey by 4.4m depth	14.94
Dynamic Cone Penetration Test commenced @ 14.94m depth. Cone push to 31.1m and hit refusal at 31.60m depth 31.09m - 36 31.39m - 45 31.60m - 100+	

TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1		3
TW	2	100	
TW	3	100	

DEPTH (m)	ELEV. (m)
0	98.88
1	97.88
2	96.88
3	95.88
4	94.88
5	93.88
6	92.88
7	91.88
8	90.88
9	89.88
10	88.88
11	87.88
12	86.88
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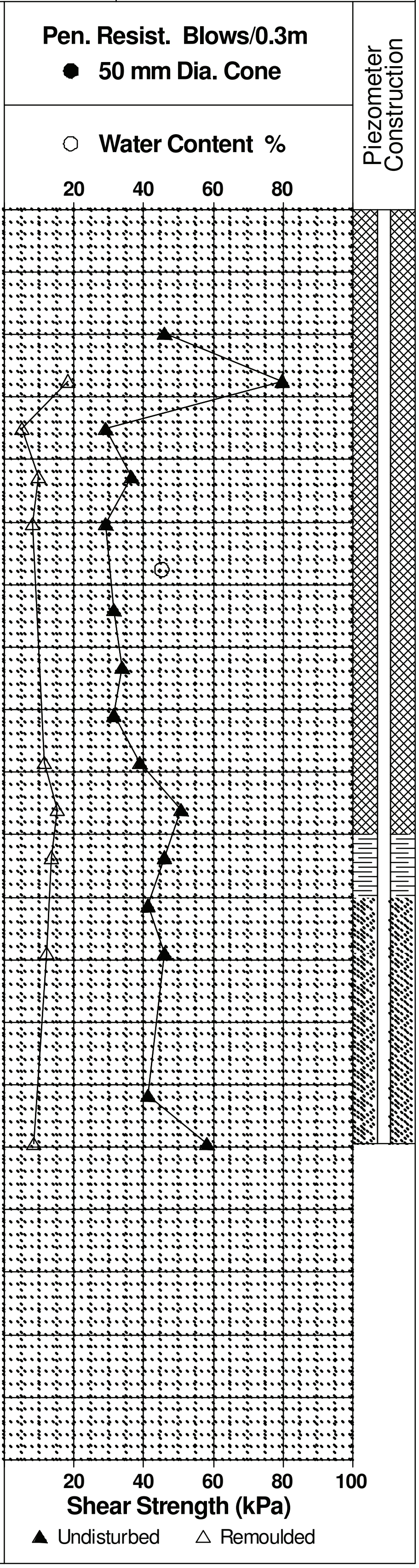
14	84.88
15	83.88
16	82.88
17	81.88
18	80.88
19	79.88
20	78.88



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 75 Power Auger

DATE 4 November 2010

FILE NO. PG2233

HOLE NO. BH 3

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.20				
Very loose, brown **SILTY SAND**	1.45	SS	1		3
Firm, brown **SILTY CLAY,** some sand	2.97				
Firm to stiff, grey-brown **SILTY CLAY,** some silt seams - grey by 4.5m depth (GWL @ 0.47m-Nov. 18/10)	15.70	TW TW	2 3	100 100	
Dynamic Cone Penetration Test commenced @ 15.70m depth. Cone push to 27.43m and hit refusal at 28.32m depth 27.74m - 50 28.04m - 54 28.32m - 100+					

DEPTH (m)	ELEV. (m)
0	98.62
1	97.62
2	96.62
3	95.62
4	94.62
5	93.62
6	92.62
7	91.62
8	90.62
9	89.62
10	88.62
11	87.62
12	86.62
13	85.62
14	84.62
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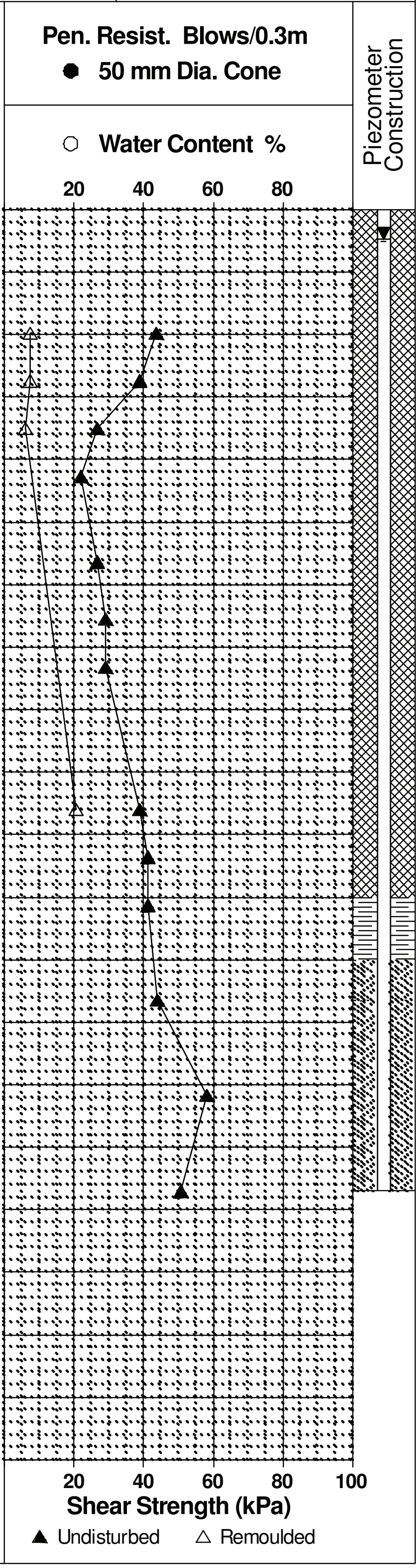
17	81.62
18	80.62
19	79.62
20	78.62



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

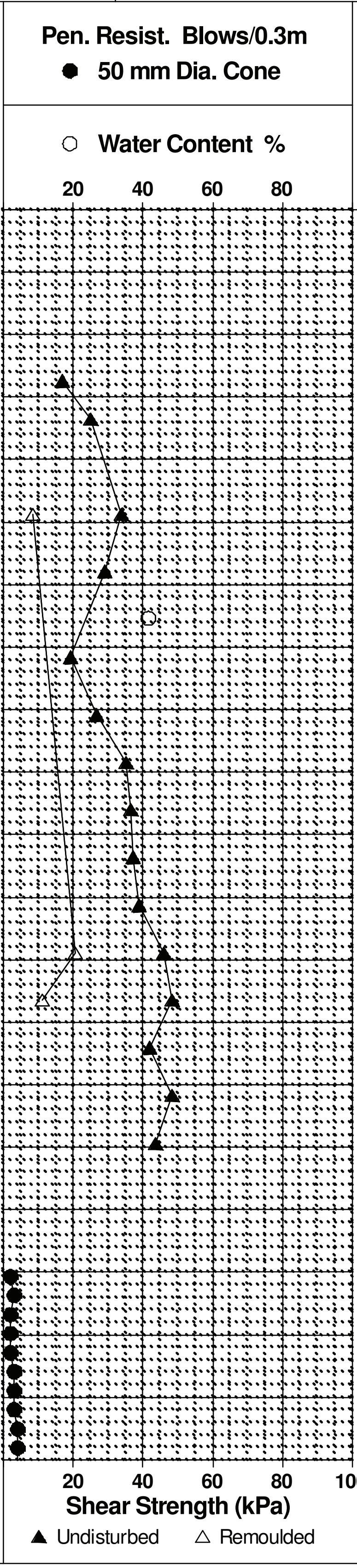
BORINGS BY CME 75 Power Auger

DATE 3 November 2010

FILE NO. PG2233

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.68
TOPSOIL 0.30							
Soft to firm, brown **SILTY CLAY,** some silt seams - grey by 2.2m depth		SS	1	92	4	1	97.68
		SS	2		2	2	96.68
						3	95.68
		TW	3	100		4	94.68
						5	93.68
		TW	4	100		6	92.68
						7	91.68
						8	90.68
						9	89.68
						10	88.68
						11	87.68
						12	86.68
						13	85.68
						14	84.68
14.94						15	83.68
Dynamic Cone Penetration Test commenced @ 14.94m depth. Cone pushed to 16.76m depth						16	82.68
						17	81.68
						18	80.68
						19	79.68
						20	78.68



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

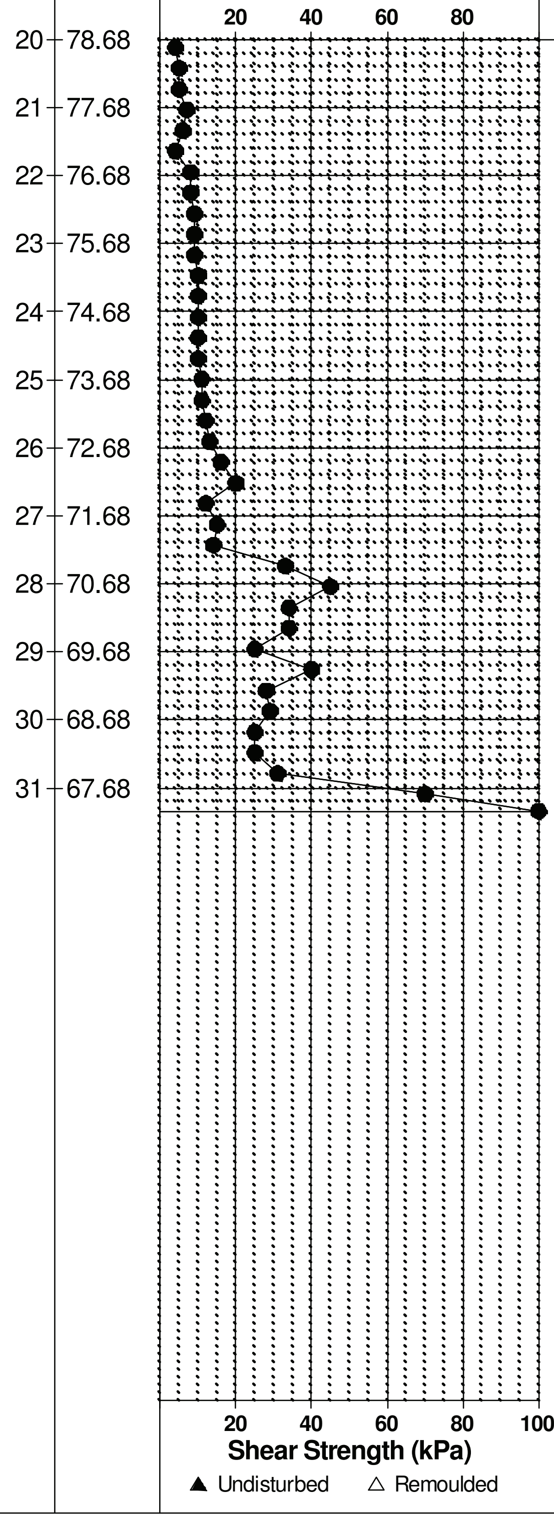
BORINGS BY CME 75 Power Auger

DATE 3 November 2010

FILE NO. PG2233

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE									
31.34									
End of Borehole Practical DCPT refusal @ 31.34m depth									



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

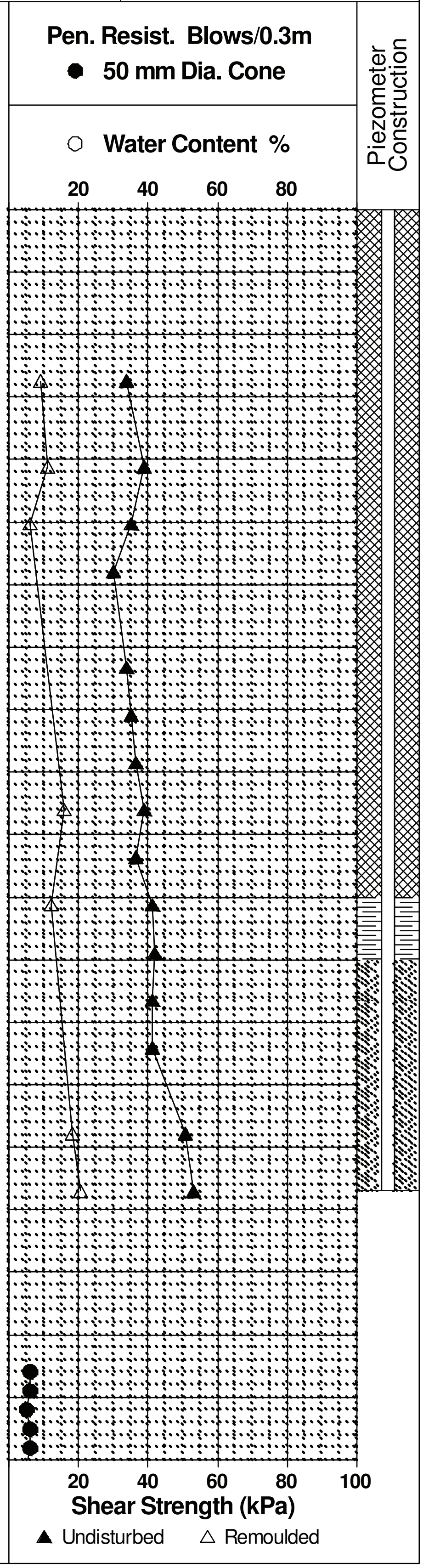
BORINGS BY CME 75 Power Auger

DATE 2 November 2010

FILE NO. PG2233

HOLE NO. BH 5

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	97.10
TOPSOIL 0.28						
	SS	1	75	2	1	96.10
	SS	2	92	2	2	95.10
	TW	3	100		3	94.10
					4	93.10
					5	92.10
	SS	4	100	1	6	91.10
Firm, grey **SILTY CLAY,** some silt seams					7	90.10
					8	89.10
					9	88.10
					10	87.10
					11	86.10
					12	85.10
					13	84.10
	TW	5	100		14	83.10
15.70					15	82.10
Dynamic Cone Penetration Test commenced @ 15.70m depth. Cone pushed to 17.98m depth,					16	81.10
					17	80.10
					18	79.10
					19	78.10
					20	77.10



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

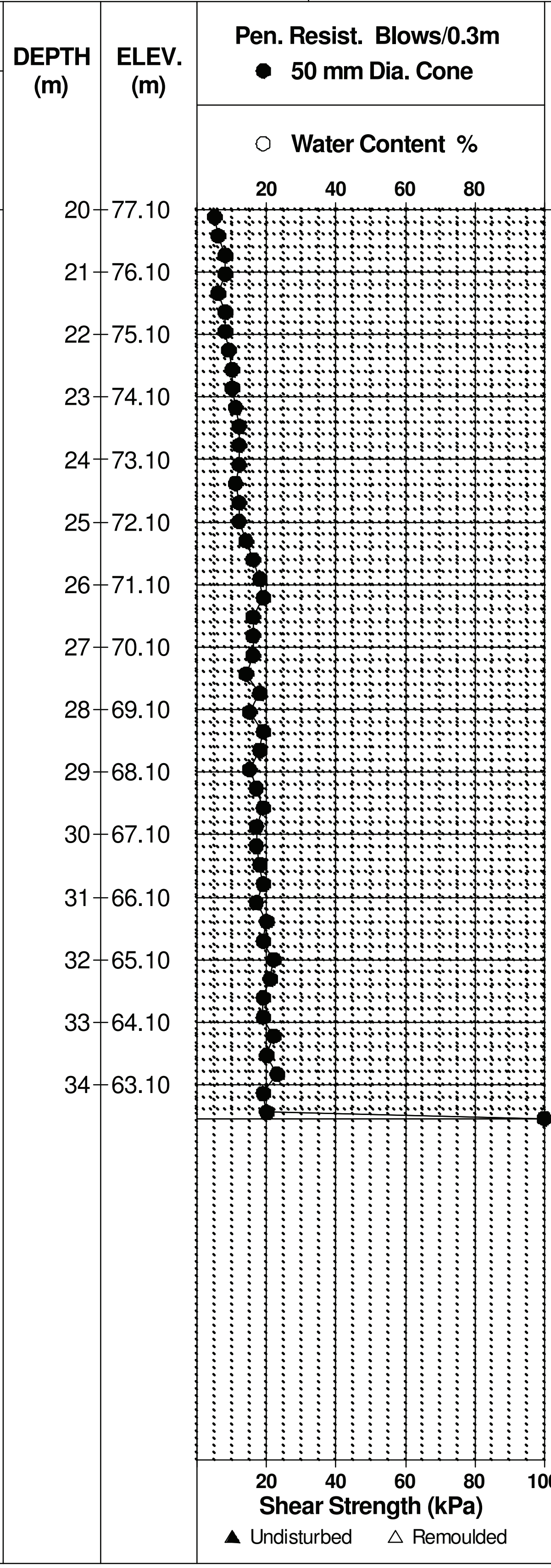
BORINGS BY CME 75 Power Auger

DATE 2 November 2010

FILE NO. PG2233

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
34.54					
End of Borehole Practical DCPT refusal @ 34.54m depth					



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

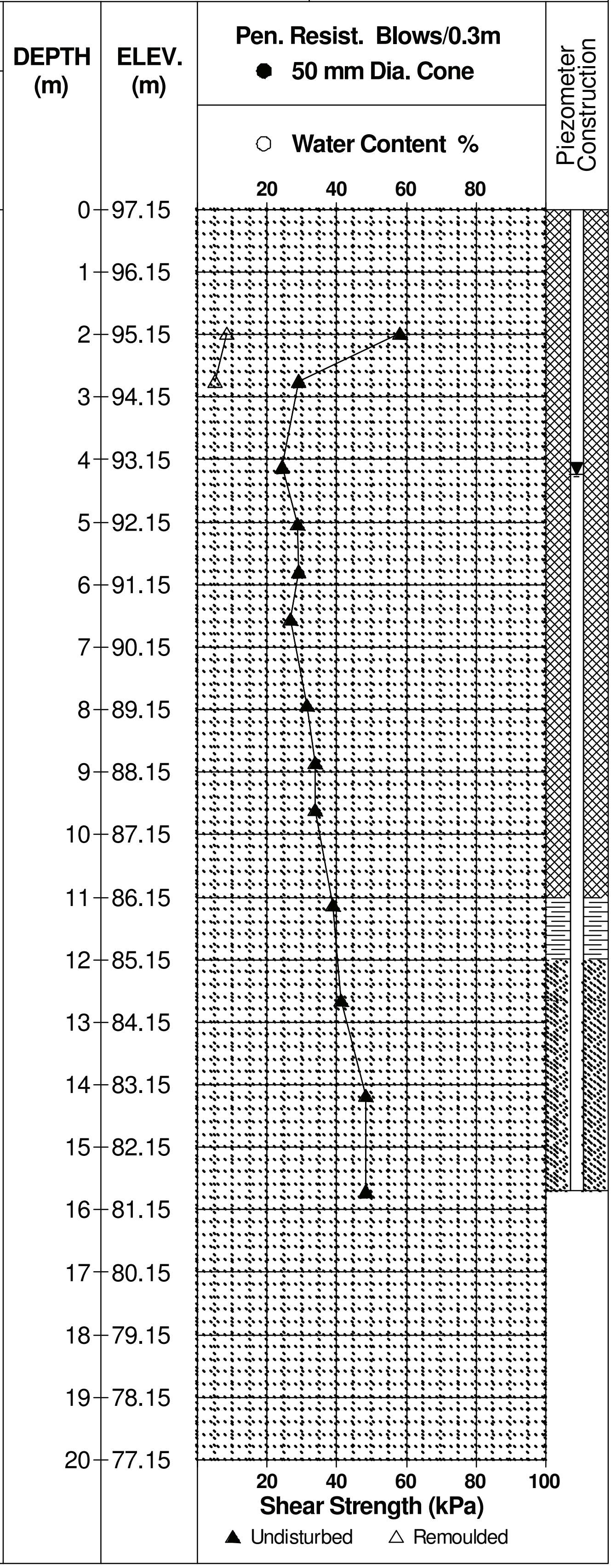
BORINGS BY CME 75 Power Auger

DATE 4 November 2010

FILE NO. PG2233

HOLE NO. BH 6

SOIL DESCRIPTION		STRATA PLOT	SAMPLE			
			TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE						
TOPSOIL	0.41					
Very loose, brown **SILTY SAND**	1.45		SS	1		2
Stiff, brown **CLAYEY SILT,** some sand	2.21					
Firm, grey **SILTY CLAY,** some silt seams (GWL @ 4.24m-Nov. 18/10)	15.70		TW TW	2 3	100 100	
Dynamic Cone Penetration Test commenced @ 15.70m depth. Cone push to 33.83m and hit refusal at 34.77m depth 34.14m - 26 34.44m - 45 34.75m - 53 34.77m - 100+						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 75 Power Auger

DATE 9 November 2010

FILE NO. PG2233

HOLE NO. BH 7

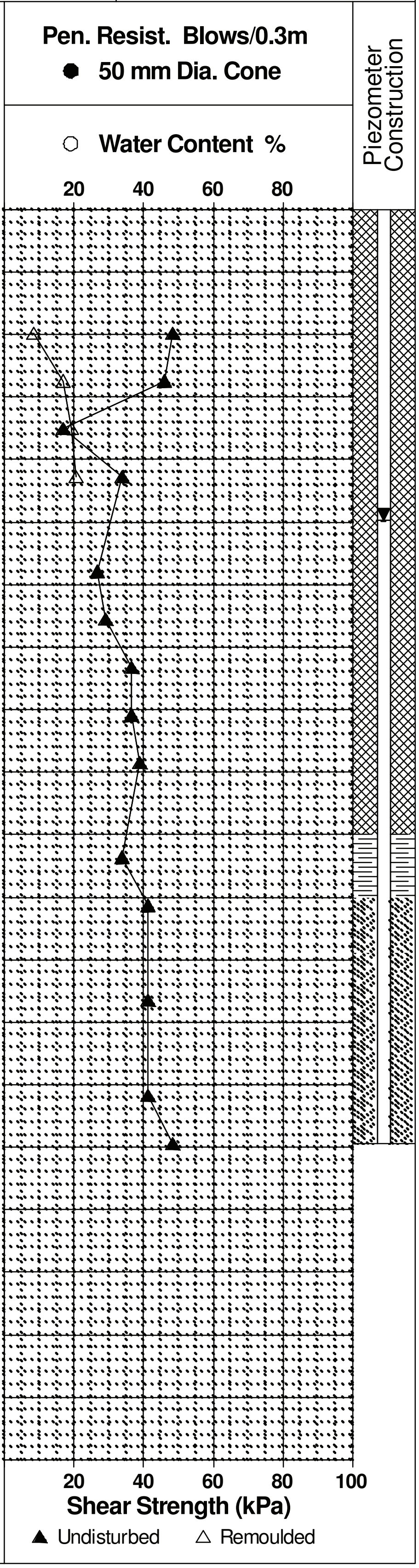
SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.36				
Very loose, brown **SILTY SAND** 4.26	SS	1		3
Firm, grey **SILTY CLAY,** some silt seams 14.94	TW	2	100	
	TW	3	100	

Dynamic Cone Penetration Test commenced @ 14.94m depth. Cone push to 39.32m and hit refusal at 39.88m depth

39.62m - 29
39.93m - 57
39.88m - 100+

(GWL @ 4.96m-Nov. 18/10)

DEPTH (m)	ELEV. (m)
0	97.49
1	96.49
2	95.49
3	94.49
4	93.49
5	92.49
6	91.49
7	90.49
8	89.49
9	88.49
10	87.49
11	86.49
12	85.49
13	84.49
14	83.49
15	82.49
16	81.49
17	80.49
18	79.49
19	78.49
20	77.49



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG2233**

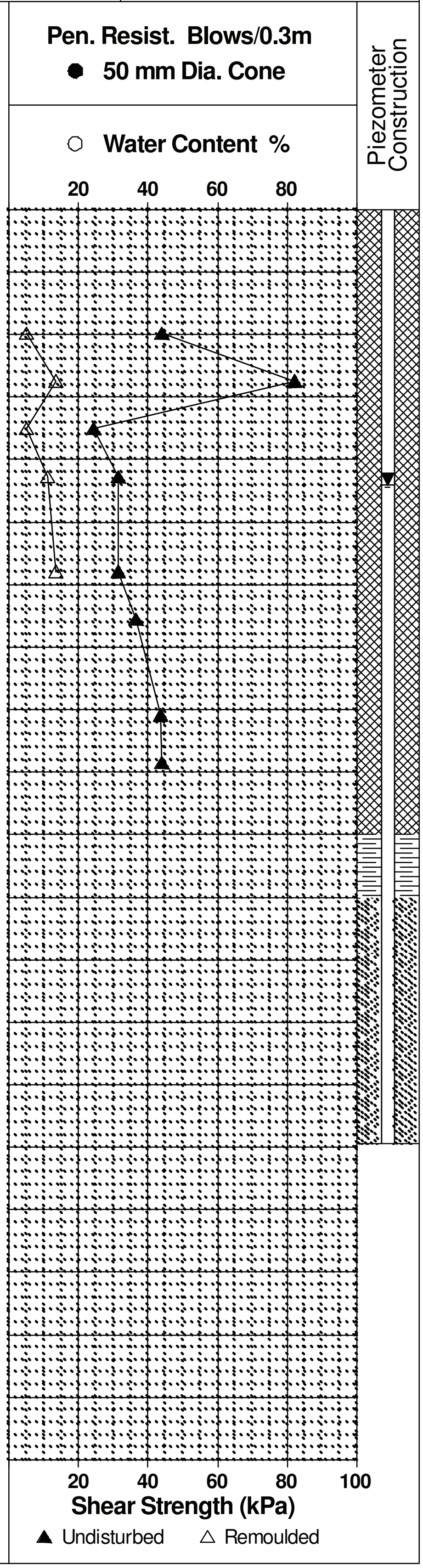
REMARKS

HOLE NO. **BH 8**

BORINGS BY CME 75 Power Auger

DATE 9 November 2010

SOIL DESCRIPTION	SAMPLE				DEPTH (m)	ELEV. (m)
	TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE					0	97.71
TOPSOIL 0.51						
Very loose, grey-brown **SILTY SAND** 1.52	SS	1	92	3	1	96.71
					2	95.71
					3	94.71
					4	93.71
	TW	2	100		5	92.71
					6	91.71
Firm to stiff, grey **SILTY CLAY,** some silt seams throughout	TW	3	100		7	90.71
					8	89.71
					9	88.71
					10	87.71
					11	86.71
					12	85.71
					13	84.71
					14	83.71
14.94						
Dynamic Cone Penetration Test commenced @ 14.94m depth. Cone push to 44.20m. (GWL @ 4.41m-Nov. 18/10)					15	82.71
					16	81.71
					17	80.71
					18	79.71
					19	78.71
					20	77.71



SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

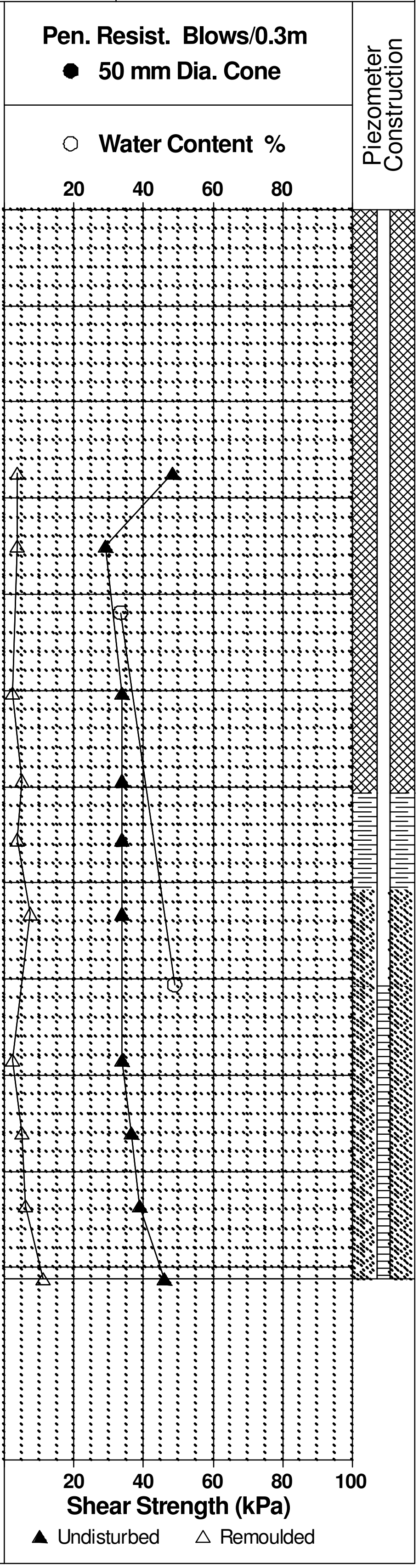
BORINGS BY CME 55 Power Auger

DATE 7 March 2011

FILE NO. PG2233

HOLE NO. BH 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.30		AU	1			0	98.36
		AU	2				
Very loose, brown **SILTY SAND**, increasing clay content with depth		SS	3	12	6	1	97.36
		SS	4	0	4		
2.21						2	96.36
						3	95.36
		TW	5	100		4	94.36
						5	93.36
Firm to stiff, grey **SILTY CLAY**, occasional silt seams to 5 m depth						6	92.36
						7	91.36
		TW	6	100		8	90.36
						9	89.36
						10	88.36
11.12						11	87.36
End of Borehole							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

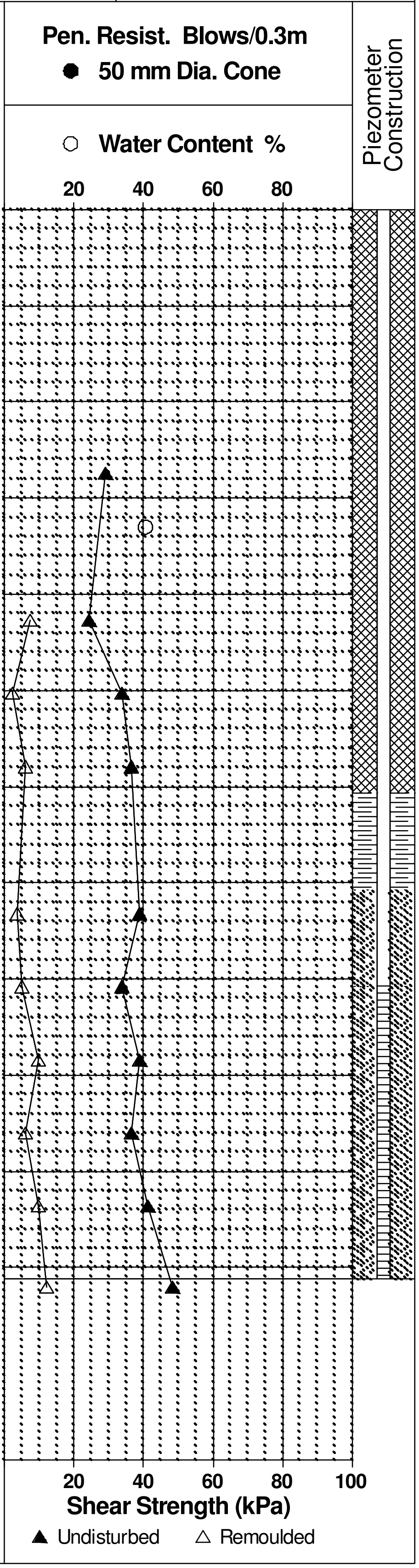
BORINGS BY CME 55 Power Auger

DATE 7 March 2011

FILE NO. PG2233

HOLE NO. BH10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.11
TOPSOIL 0.30		AU	1				
Very loose, brown **SILTY SAND**, increasing clay content with depth		AU	2				
		SS	3	12	6	1	97.11
2.20		SS	4	8	2	2	96.11
Firm to stiff, grey **SILTY CLAY**, occasional silt seams to 6 m depth						3	95.11
		TW	5	100			
						4	94.11
						5	93.11
						6	92.11
		TW	6	100			
						7	91.11
						8	90.11
						9	89.11
						10	88.11
11.12						11	87.11
End of Borehole							



SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

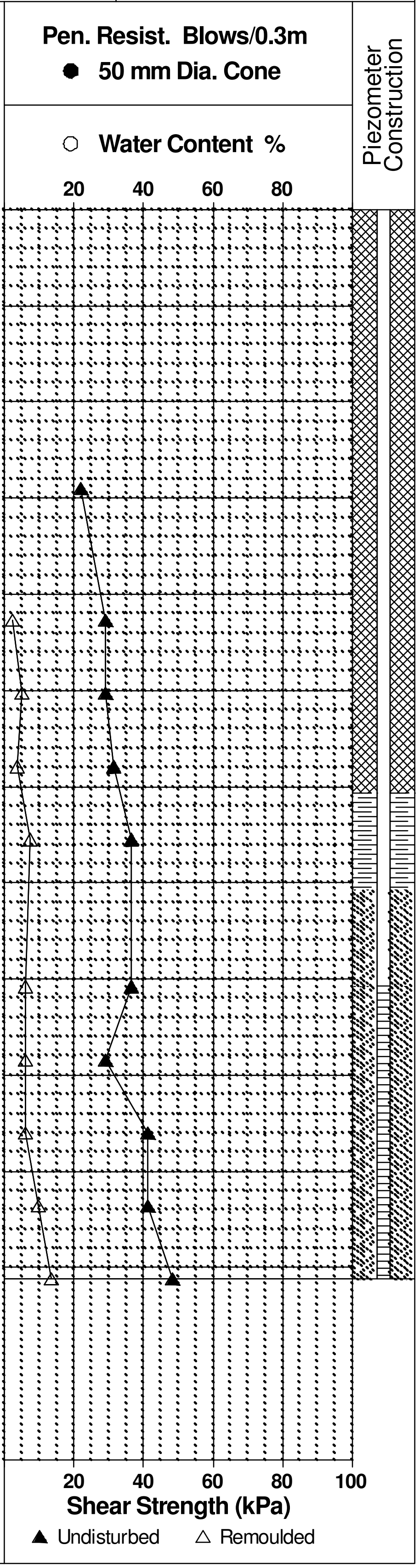
BORINGS BY CME 55 Power Auger

DATE 4 March 2011

FILE NO. PG2233

HOLE NO. BH11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.13
TOPSOIL 0.30		AU	1				
		AU	2				
Very loose, brown **SILTY SAND**, increasing clay conent with depth		SS	3	75	6	1	97.13
		SS	4	100	1		
2.20						2	96.13
						3	95.13
Firm to stiff, grey **SILTY CLAY**, occasional silt seams to 6 m depth		TW	5	100			
						4	94.13
						5	93.13
						6	92.13
		TW	6			7	91.13
						8	90.13
						9	89.13
						10	88.13
11.12						11	87.13
End of Borehole							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG2233**

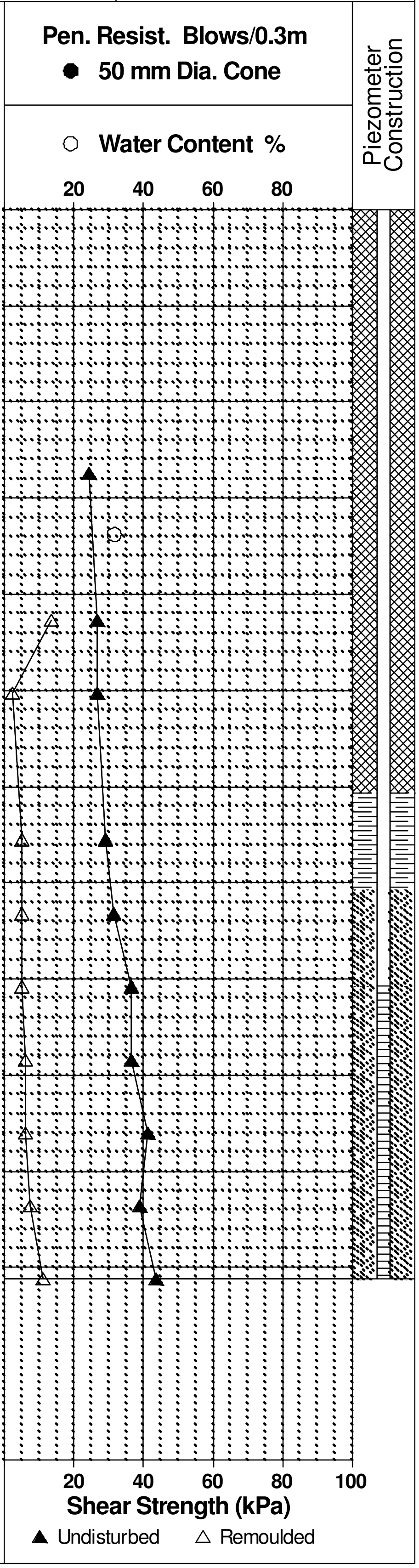
REMARKS

HOLE NO. **BH12**

BORINGS BY CME 55 Power Auger

DATE 4 March 2011

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	98.43
TOPSOIL 0.30	AU	1				
	AU	2				
Very loose, brown **SILTY SAND**, increasing clay content with depth	SS	3	75	5	1	97.43
	SS	4	92	1		
2.21					2	96.43
					3	95.43
	TW	5	100			
					4	94.43
Firm to stiff, grey **SILTY CLAY**, occasional silt seams to 6 m depth					5	93.43
	TW	6	100			
					6	92.43
					7	91.43
					8	90.43
					9	89.43
					10	88.43
11.12					11	87.43
End of Borehole						



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

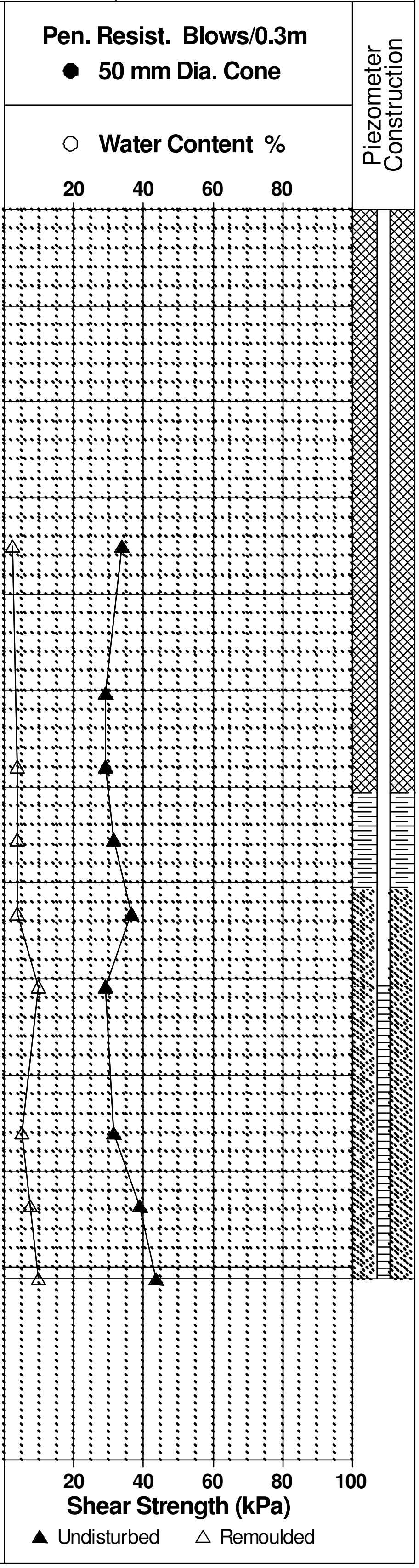
DATE 2 March 2011

FILE NO. PG2233

HOLE NO. BH13

SOIL DESCRIPTION	Layer bottom (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.30	AU	1		
Very loose, brown **SILTY SAND**, increasing clay content with depth	2.21	AU	2		
		SS	3	50	8
		SS	4	25	3
Firm to stiff , grey **SILTY CLAY**, occasional silt seams to 6 m depth	11.12	SS	5	75	W
		TW	6	100	
		TW	7	100	
End of Borehole					

DEPTH (m)	ELEV. (m)
0	98.27
1	97.27
2	96.27
3	95.27
4	94.27
5	93.27
6	92.27
7	91.27
8	90.27
9	89.27
10	88.27
11	87.27



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG2233**

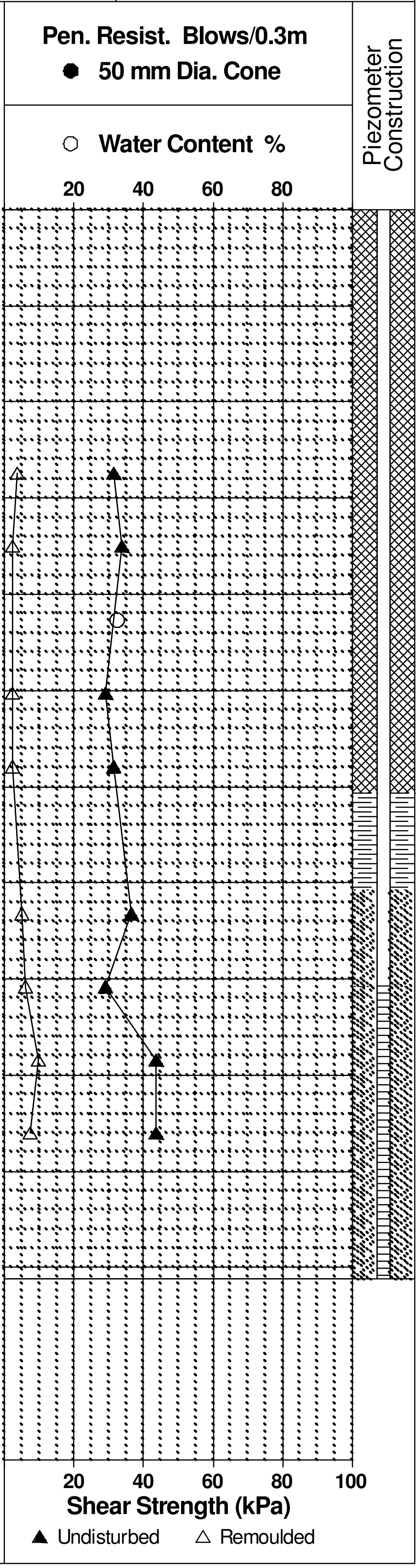
REMARKS

HOLE NO. **BH14**

BORINGS BY CME 55 Power Auger

DATE 2 March 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.69
TOPSOIL 0.40							
		AU	1				
Loose to very loose, brown **SILTY SAND**, increasing clay content with depth		SS	2	67	7	1	97.69
		SS	3		2	2	96.69
2.21							
						3	95.69
		TW	3	100		4	94.69
						5	93.69
Firm to stiff, grey **SILTY CLAY**, occasional silt seams to 6 m depth		TW	4	100		6	92.69
						7	91.69
						8	90.69
						9	89.69
						10	88.69
11.12						11	87.69
End of Borehole							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

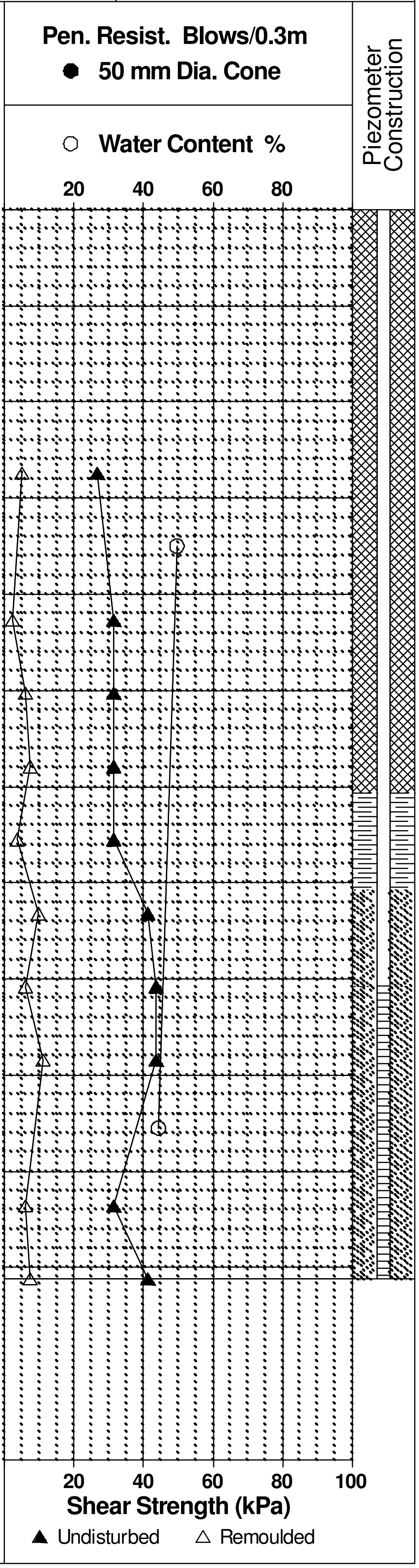
BORINGS BY CME 55 Power Auger

DATE 2 March 2011

FILE NO. PG2233

HOLE NO. BH15

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	97.92
TOPSOIL 0.40	AU	1				
Very loose to loose, brown **SILTY SAND**, increasing clay content with depth	SS	2	58	7	1	96.92
2.21	SS	3	50	3	2	95.92
Firm, grey **SILTY CLAY**, occasional silt seams to 6 m depth					3	94.92
	TW	4	100			
					4	93.92
					5	92.92
					6	91.92
					7	90.92
					8	89.92
					9	88.92
	TW	5	100			
					10	87.92
11.12					11	86.92
End of Borehole						



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

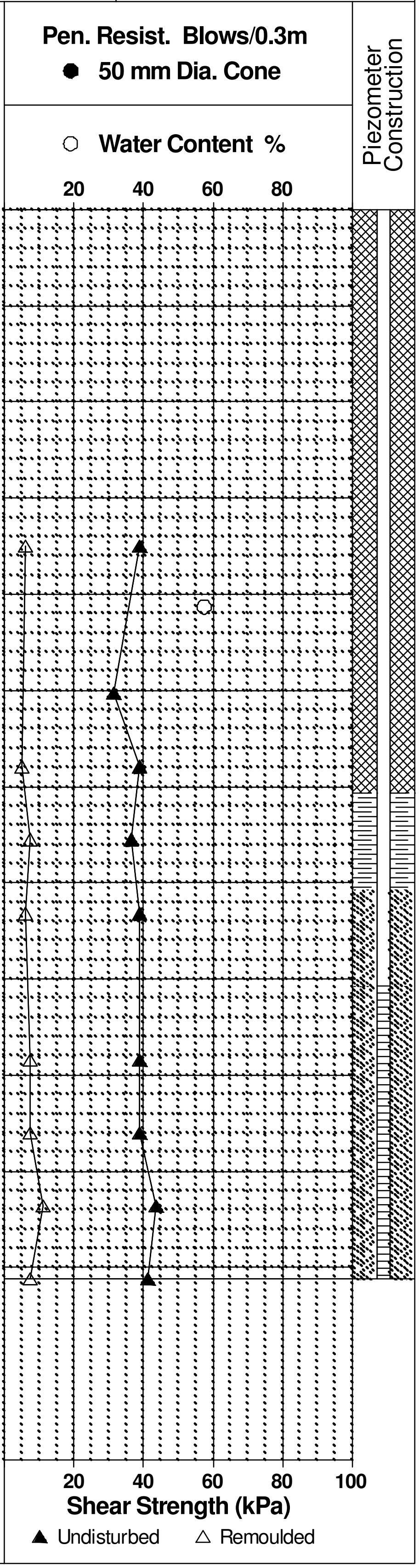
BORINGS BY CME 55 Power Auger

DATE 2 March 2011

FILE NO. PG2233

HOLE NO. BH16

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	98.30
TOPSOIL 0.40	AU	1				
Very loose to loose, brown **SILTY SAND**, increasing clay content with depth	SS	2	38	7	1	97.30
2.21	SS	3	62	2	2	96.30
Firm to stiff, grey **SILTY CLAY**, occasional silt seams to 6 m depth	SS	4	92	W	3	95.30
	TW	5	100		4	94.30
					5	93.30
					6	92.30
					7	91.30
	TW	6	100		8	90.30
					9	89.30
					10	88.30
11.12					11	87.30
End of Borehole						



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 3 March 2011

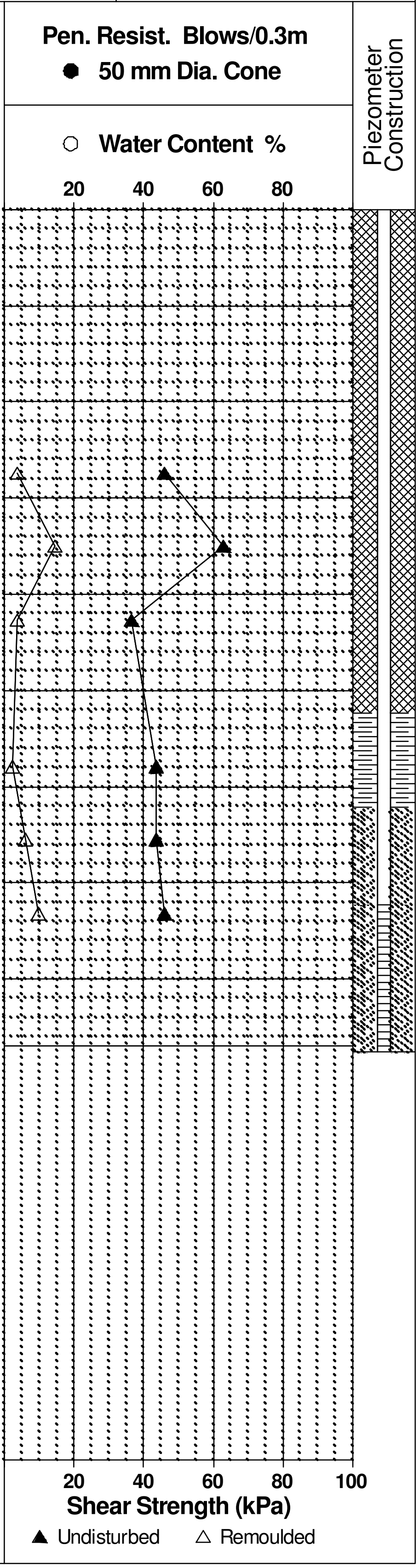
FILE NO. PG2233

HOLE NO. BH17

SOIL DESCRIPTION	
GROUND SURFACE	
TOPSOIL	0.30
Stiff to firm, brown **SILTY SAND**, increasing clay content with depth	2.21
Firm to stiff, grey **SILTY CLAY**	7.47
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders	8.76
End of Borehole Power auger broke @ 8.76m on inferred boulder	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
AU	2		
SS	3	33	4
SS	4	75	2
TW	5		
SS	6		7

DEPTH (m)	ELEV. (m)
0	101.10
1	100.10
2	99.10
3	98.10
4	97.10
5	96.10
6	95.10
7	94.10
8	93.10



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG2233**

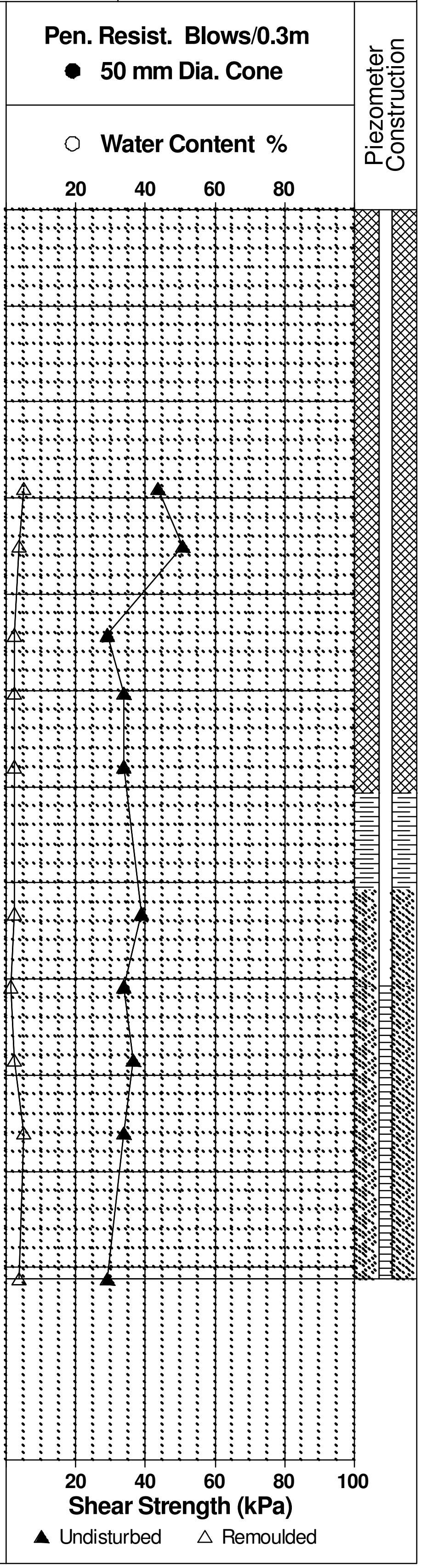
REMARKS

HOLE NO. **BH18**

BORINGS BY CME 55 Power Auger

DATE 3 March 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.86
TOPSOIL 0.30		AU	1				
		AU	2				
Very loose, brown **SILTY SAND**, increasing clay content with depth		SS	3	25	5	1	99.86
2.00		SS	4	100	3	2	98.86
Stiff to firm, grey **SILTY CLAY**, occasional silt seams to 6 m depth						3	97.86
						4	96.86
						5	95.86
						6	94.86
		TW	5	100			
						7	93.86
						8	92.86
						9	91.86
						10	90.86
		SS	6	75			
11.12						11	89.86
End of Borehole							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
West Park Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

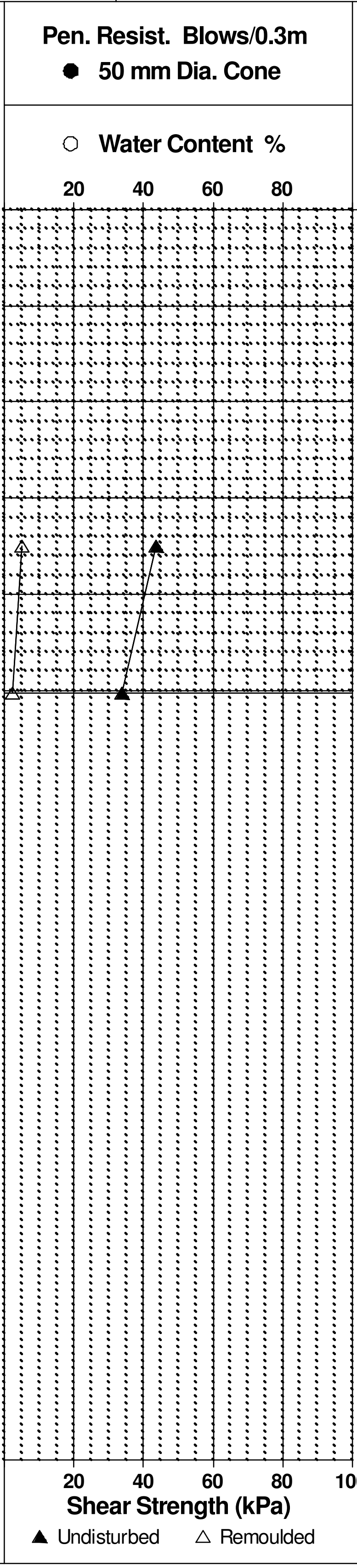
BORINGS BY CME 55 Power Auger

DATE 3 March 2011

FILE NO. PG2233

HOLE NO. BH18A

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.30						0	100.86
						1	99.86
Firm, grey **SILTY CLAY**						2	98.86
						3	97.86
		TW	1			4	96.86
5.03						5	95.86
End of Borehole							



Piezometer Construction

patersongroup **Consulting Engineers**

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-West Park Phase I
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

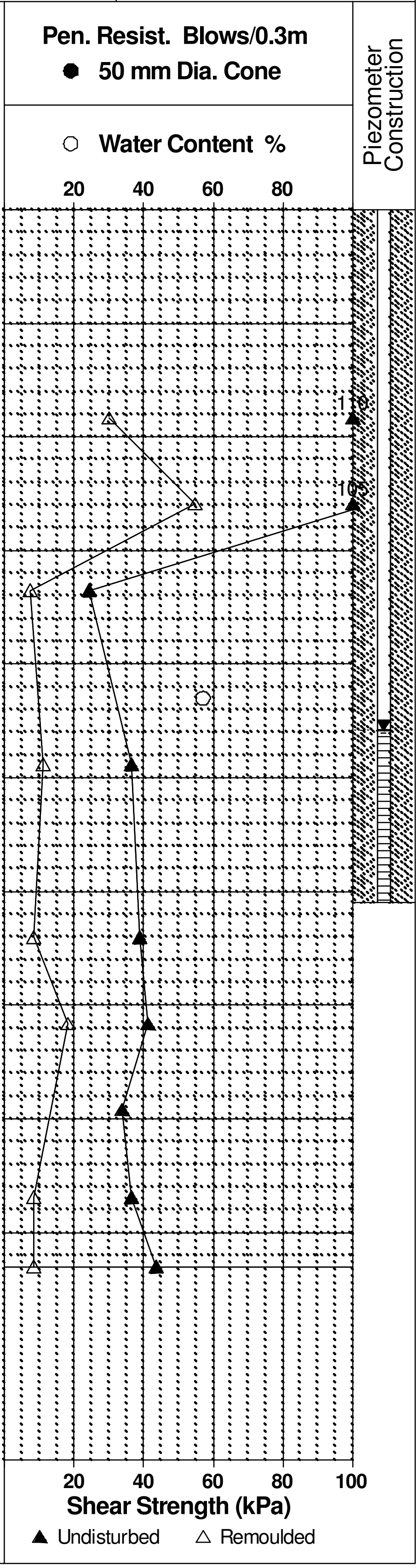
BORINGS BY CME 850 Power Auger

DATE 17 Jun 09

FILE NO. **PG1874**

HOLE NO. **BH 1**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	101.03
Dark brown **CLAYEY SILT**, some sand	▨	AU	1				
0.69							
- brown by 0.4m depth							
Very stiff to stiff, brown **SILTY CLAY**	▨	SS	2		4	1	100.03
						2	99.03
- firm and grey by 3.0m depth						3	98.03
		TW	3	100		4	97.03
						5	96.03
		TW	4	100		6	95.03
						7	94.03
						8	93.03
						9	92.03
9.30							
End of Borehole (GWL @ 4.59m-June 25/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-West Park Phase I
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

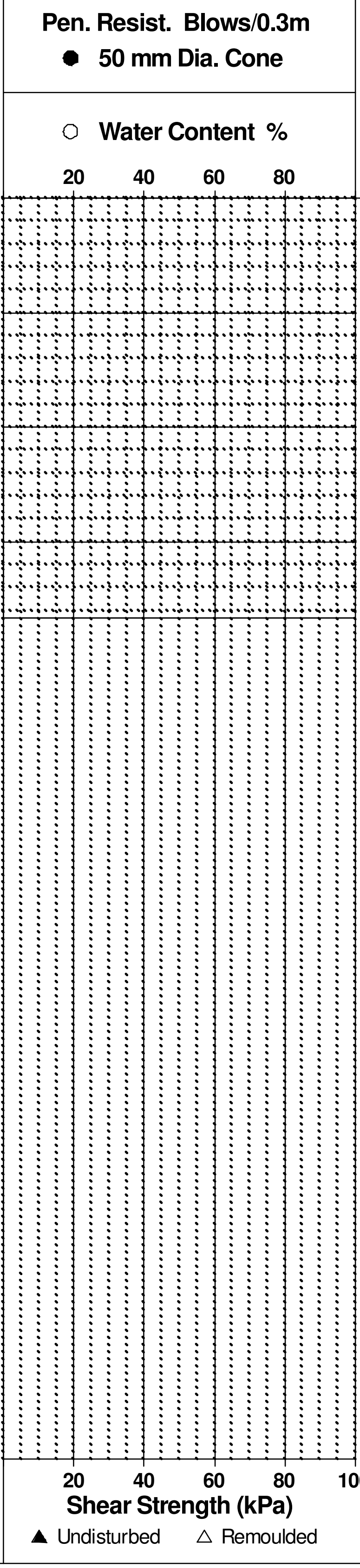
BORINGS BY CME 850 Power Auger

DATE 17 Jun 09

FILE NO. PG1874

HOLE NO. BH 1A

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	101.03	
OVERBURDEN						1	100.03	
						2	99.03	
3.05						3	98.03	
SILTY CLAY	▨	TW	1	100				
3.66								
End of Borehole								



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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 850 Power Auger

DATE 16 Jun 09

FILE NO. PG1874

HOLE NO. BH 2

SOIL DESCRIPTION

GROUND SURFACE

Dark brown **CLAYEY SILT** , some sand

- brown by 0.5m depth

1.45

Stiff, grey-brown **CLAYEY SILT** to **SILTY CLAY,** trace sand

- firm and grey by 3.0m depth

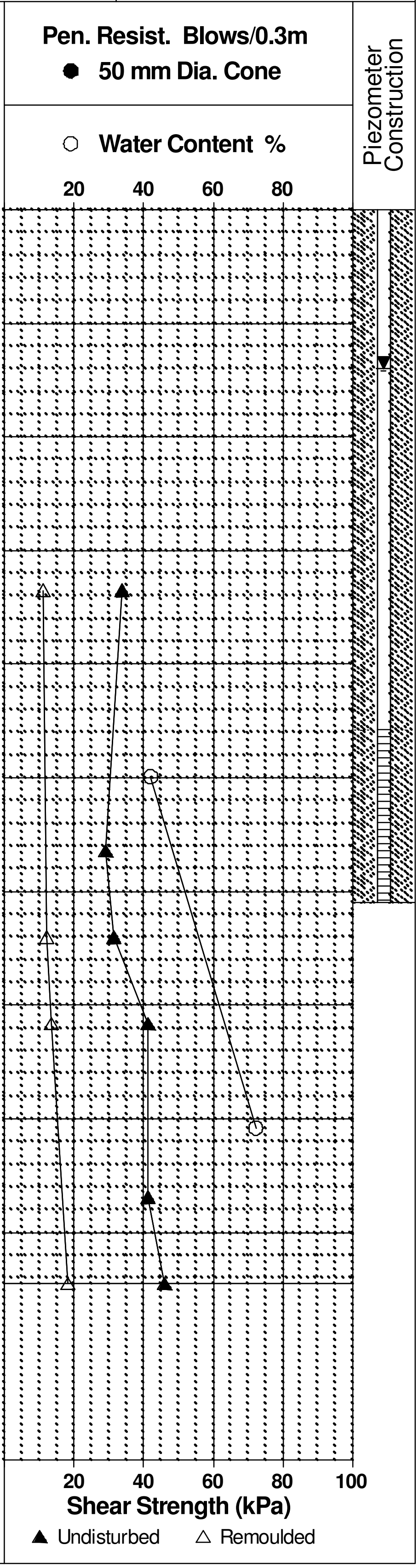
9.45

End of Borehole

(GWL @ 1.40m-June 25/09)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	58	4
SS	2	100	3
SS	3	100	2
SS	4	100	
TW	5	100	
TW	6	100	

DEPTH (m)	ELEV. (m)
0	100.67
1	99.67
2	98.67
3	97.67
4	96.67
5	95.67
6	94.67
7	93.67
8	92.67
9	91.67



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REMARKS

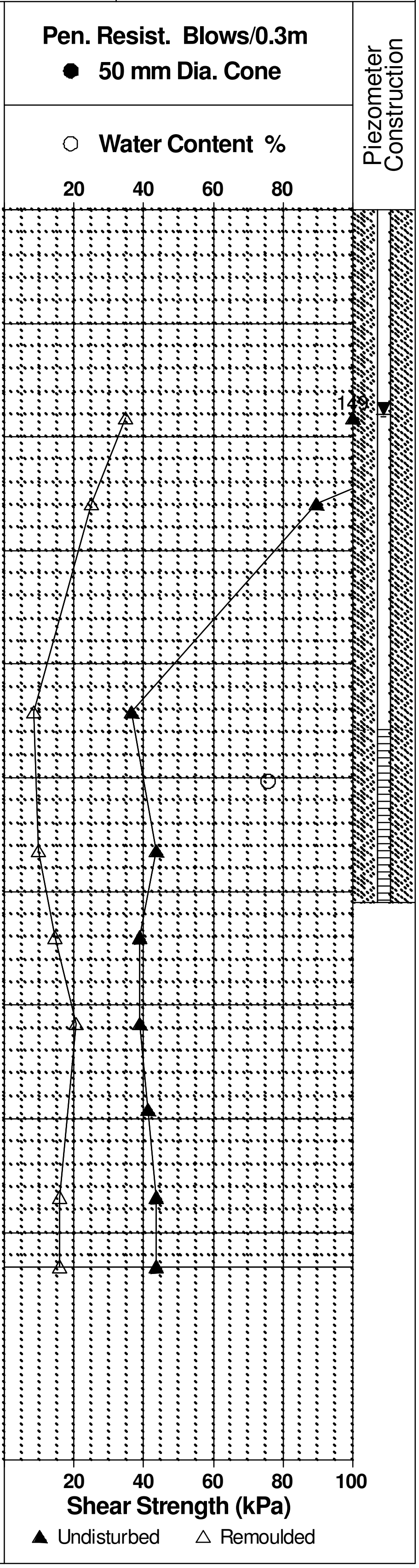
BORINGS BY CME 850 Power Auger

DATE 17 Jun 09

FILE NO. PG1874

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	101.18
Dark brown **SILTY CLAY** , some sand 0.69	▨						
- brown by 0.5m depth	▨	SS	1	75	4	1	100.18
Very stiff to stiff, brown **SILTY CLAY**, some sand seams	▨					2	99.18
- firm and grey-brown by 2.0m depth	▨	TW	2	100		3	98.18
- grey by 3.4m depth	▨					4	97.18
	▨	TW	3	100		5	96.18
	▨					6	95.18
	▨					7	94.18
	▨					8	93.18
9.30	▨					9	92.18
End of Borehole (GWL @ 1.80m-June 25/09)							



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REMARKS

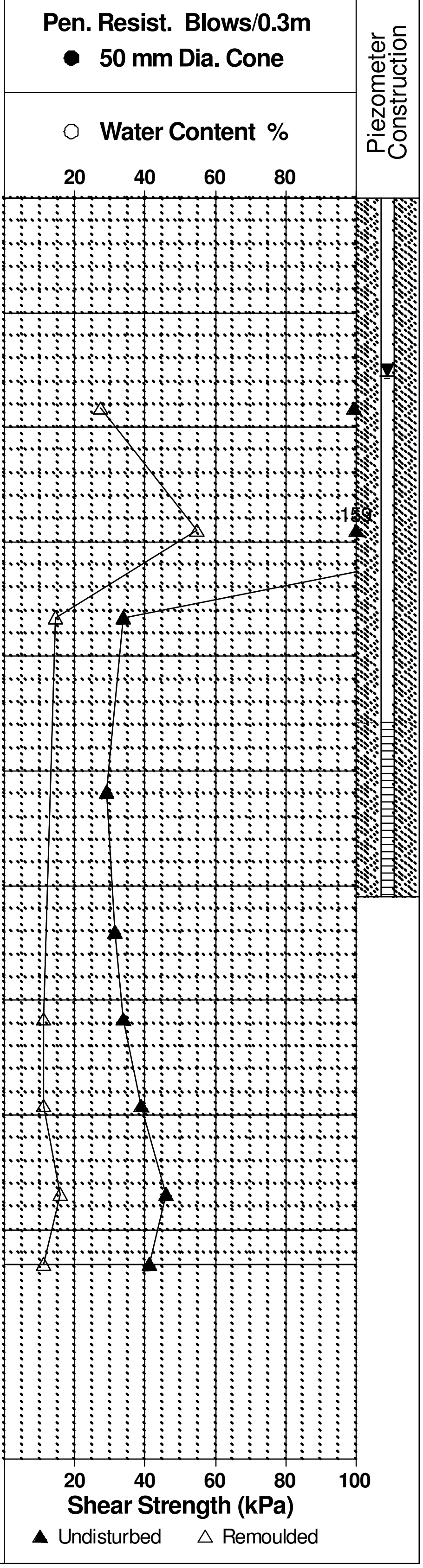
BORINGS BY CME 850 Power Auger

DATE 17 Jun 09

FILE NO. **PG1874**

HOLE NO. **BH 4**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.73
Dark brown **CLAYEY SILT**, some sand 0.69							
- brown by 0.5m depth		SS	1		4	1	99.73
						2	98.73
Very stiff to stiff, brown **SILTY CLAY**, some sand seams						3	97.73
- firm and grey by 3.0m depth							
		TW	2	100		4	96.73
						5	95.73
		TW	3	100			
						6	94.73
						7	93.73
						8	92.73
						9	91.73
9.30							
End of Borehole							
(GWL @ 1.55m-June 25/09)							



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REMARKS

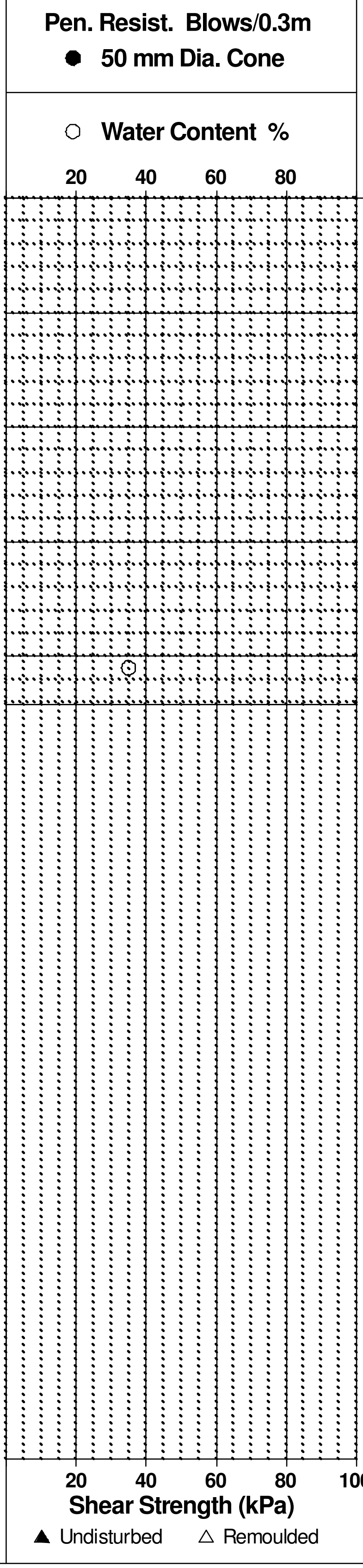
BORINGS BY CME 850 Power Auger

DATE 17 Jun 09

FILE NO. **PG1874**

HOLE NO. **BH 4A**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	100.73
Dark brown **CLAYEY SILT** , some sand							
0.69							
- brown by 0.4m depth							
						1	99.73
						2	98.73
SILTY CLAY							
						3	97.73
						4	96.73
		TW	1	100			
4.42							
End of Borehole							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

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REMARKS

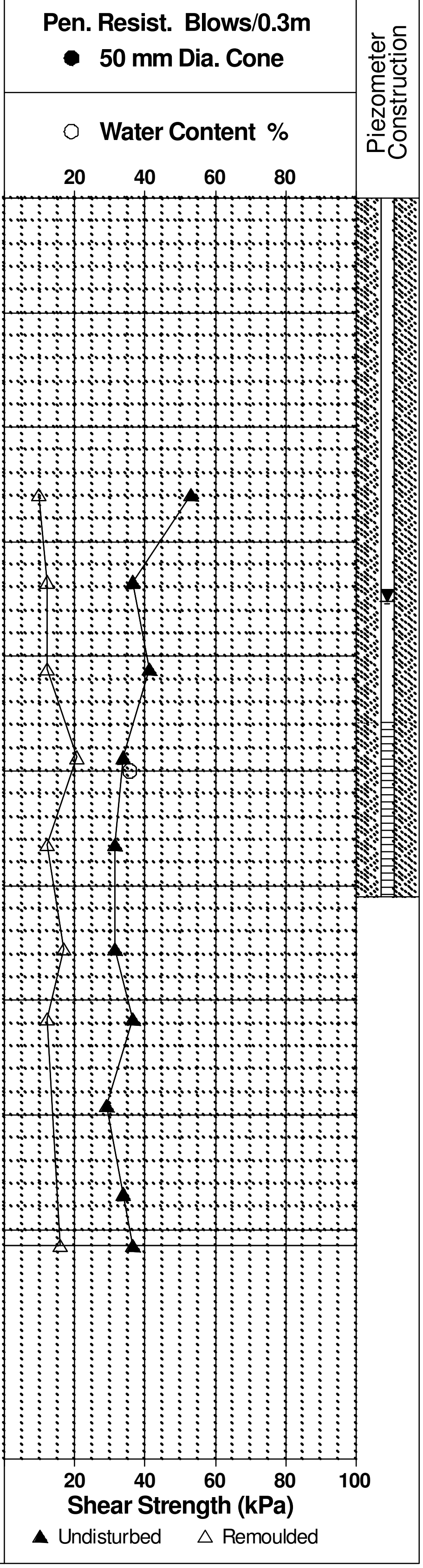
BORINGS BY CME 850 Power Auger

DATE 16 Jun 09

FILE NO. **PG1874**

HOLE NO. **BH 5**

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	99.67
Black **CLAYEY SILT**, some sand - brown by 0.4m depth 0.69	AU	1				
Very stiff to stiff, grey-brown interlayered **SILTY CLAY** and **CLAYEY SILT,** some sand seams - silt content increasing with depth - firm and grey by 2.8m depth	SS	2	100	3	1	98.67
	SS	3	100	3	2	97.67
					3	96.67
					4	95.67
	SS	4	100		5	94.67
					6	93.67
					7	92.67
					8	91.67
9.14					9	90.67
End of Borehole (GWL @ 3.52m-June 25/09)						



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REMARKS

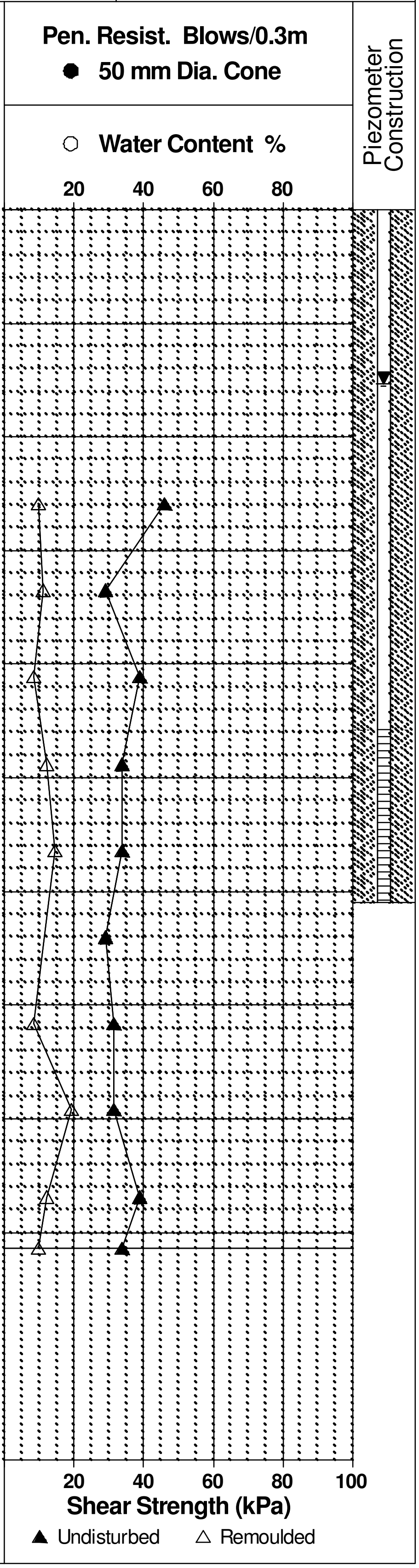
BORINGS BY CME 850 Power Auger

DATE 16 Jun 09

FILE NO. PG1874

HOLE NO. BH 6

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
Dark brown **CLAYEY SILT** , some sand 0.69 - brown by 0.5m depth					0	99.30
Grey-brown **SILTY SAND,** trace clay	SS	1	58	6	1	98.30
2.13	SS	2	75	2	2	97.30
Stiff, grey-brown **CLAYEY SILT** - increasing clay content with depth					3	96.30
					4	95.30
					5	94.30
					6	93.30
7.32					7	92.30
Firm, grey **SILTY CLAY**					8	91.30
	SS	3	100			
9.14					9	90.30
End of Borehole (GWL @ 1.53m-June 25/09)						



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REMARKS

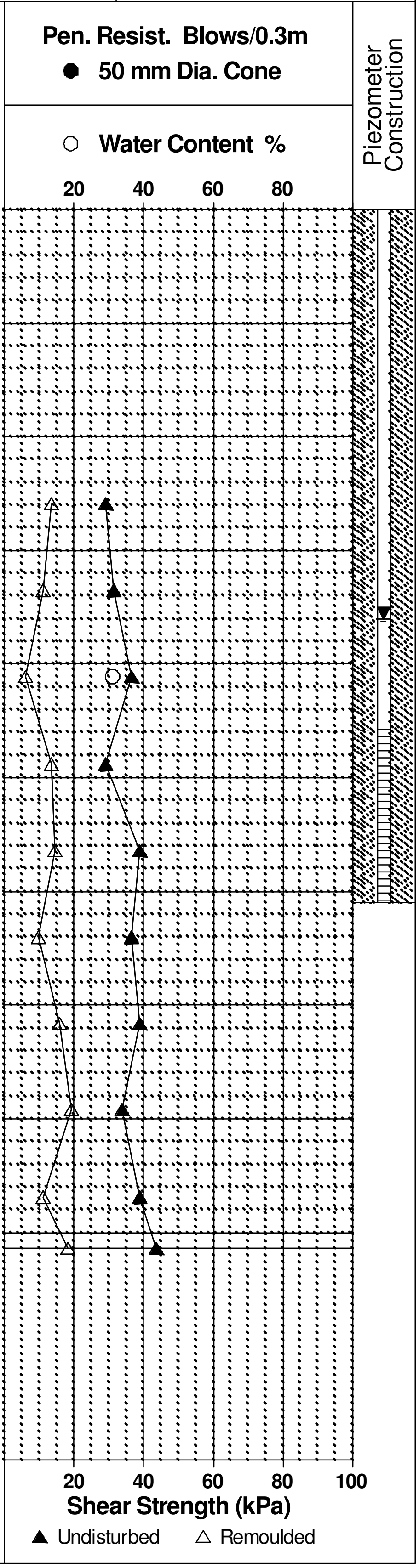
BORINGS BY CME 850 Power Auger

DATE 16 Jun 09

FILE NO. PG1874

HOLE NO. BH 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.91
Dark brown **CLAYEY SILT**, some sand and organic matter in upper 300mm — 0.69		AU	1				
Loose, grey-brown **SANDY SILT**, trace clay — 1.45		SS SS	3 2	50 67	2 7	1	97.91
						2	96.91
Firm, grey **CLAYEY SILT,** some sand seams — 3.35						3	95.91
						4	94.91
						5	93.91
Firm, grey **SILTY CLAY**						6	92.91
						7	91.91
						8	90.91
— 9.14						9	89.91
End of Borehole (GWL @ 3.60m-June 25/09)							



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REMARKS

BORINGS BY CME 850 Power Auger

DATE 16 Jun 09

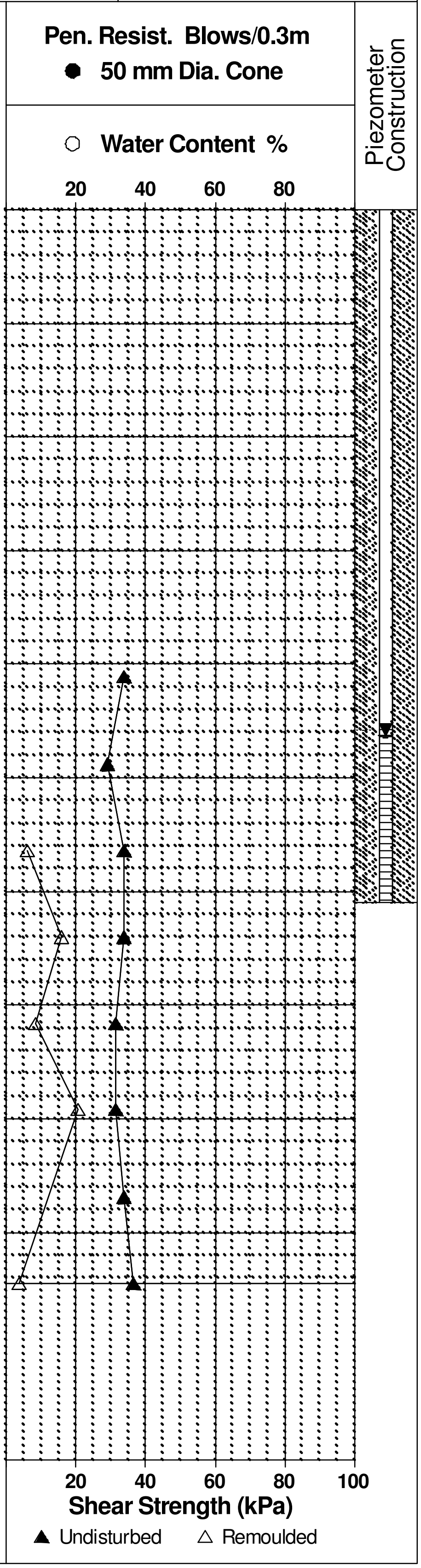
FILE NO. PG1874

HOLE NO. BH 8

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
Loose, brown **SANDY SILT,** some organics in upper 400mm and trace clay	1.45
Firm, grey **CLAYEY SILT**	4.88
Firm, grey **SILTY CLAY**	9.45
End of Borehole (GWL @ 4.63m-June 25/09)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	71	9
SS	2	83	2
SS	3	100	W
SS	4	100	W

DEPTH (m)	ELEV. (m)
0	98.94
1	97.94
2	96.94
3	95.94
4	94.94
5	93.94
6	92.94
7	91.94
8	90.94
9	89.94



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SOIL PROFILE AND TEST DATA

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REMARKS

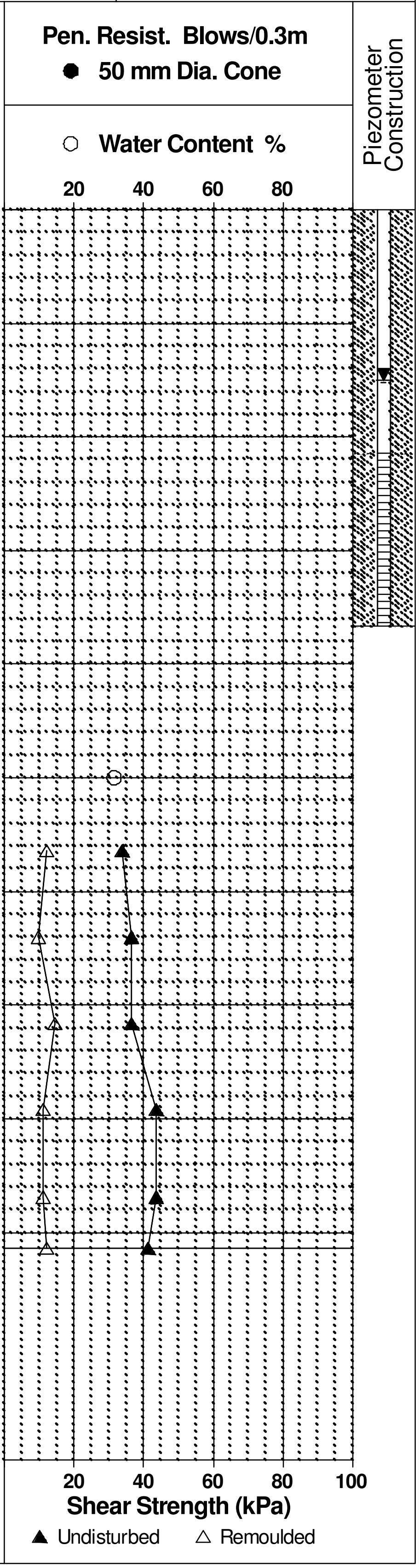
BORINGS BY CME 850 Power Auger

DATE 15 Jun 09

FILE NO. PG1874

HOLE NO. BH 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.49
Brown **SILTY CLAY,** some sand and organic matter in upper 400mm 0.69							
Loose, brown **SANDY SILT**, some clay 1.45		SS	1	58	6	1	97.49
Firm, grey **CLAYEY SILT**		SS	2	100	2	2	96.49
		SS	3	100	W		
		SS	4	100	W	3	95.49
4.42		SS	5	100	W	4	94.49
Firm, grey **SILTY CLAY,** some silt seams		SS	6	100	W	5	93.49
						6	92.49
						7	91.49
						8	90.49
9.14						9	89.49
End of Borehole (GWL @ 1.50m-June 25/09)							



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REMARKS

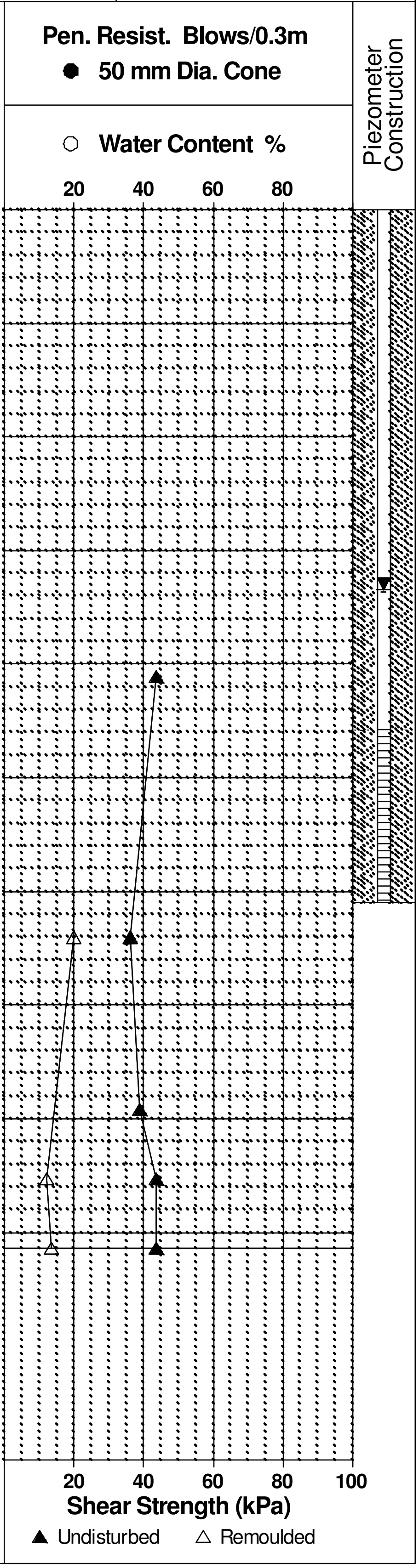
BORINGS BY CME 850 Power Auger

DATE 15 Jun 09

FILE NO. PG1874

HOLE NO. BH10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Brown **CLAYEY SILT,** some sand, some organic matter in upper 300mm — 0.69						0	98.14
Loose to very loose, brown **SANDY SILT**, some clay — 2.21		SS	1	50	10	1	97.14
		SS	2	58	3	2	96.14
Firm, grey interlayered **SILTY CLAY** and **CLAYEY SILT** — 9.14		SS	3	83	1	3	95.14
		SS	4	100	1	4	94.14
		SS	5	100	W	5	93.14
		SS	6	100	W	6	92.14
		SS	7	100	W	7	91.14
						8	90.14
						9	89.14
End of Borehole (GWL @ 3.34m-June 25/09)							



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REMARKS

BORINGS BY CME 850 Power Auger

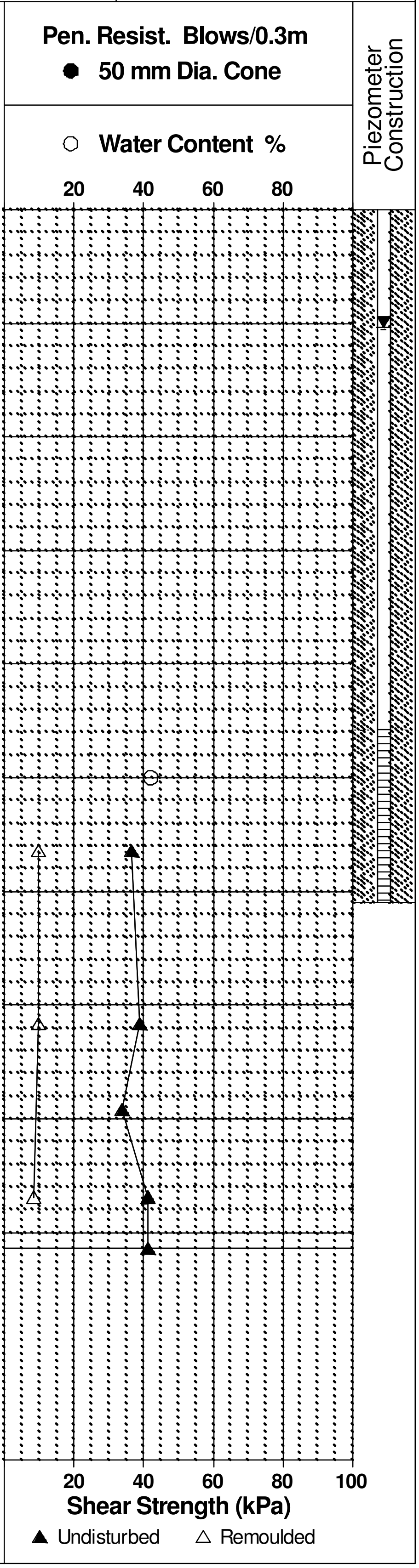
DATE 15 Jun 09

FILE NO. PG1874

HOLE NO. BH11

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
Loose to very loose, brown **SANDY SILT**, some clay and organic matter in upper 450mm depth	AU	1		
	SS	2	25	8
1.93	SS	3	42	2
Firm, grey **CLAYEY SILT**	SS	4	54	1
	SS	5	67	W
4.42	SS	6	100	1
Firm, dark grey **SILTY CLAY**	SS	7	100	1
	SS	8	100	1
9.14				
End of Borehole				
(GWL @ 1.04m-June 25/09)				

DEPTH (m)	ELEV. (m)
0	97.48
1	96.48
2	95.48
3	94.48
4	93.48
5	92.48
6	91.48
7	90.48
8	89.48
9	88.48



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REMARKS

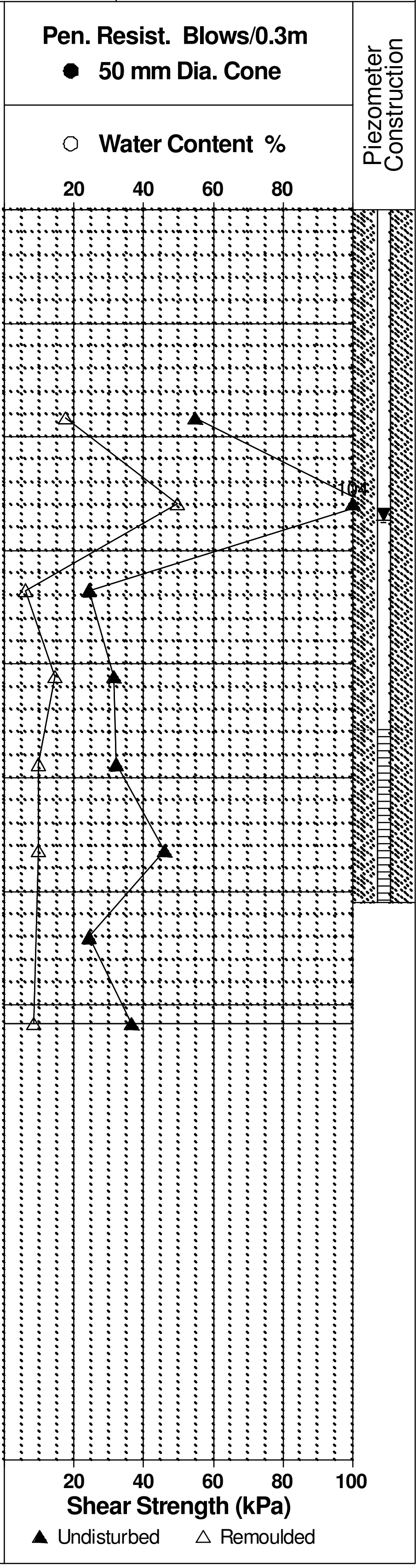
BORINGS BY CME 850 Power Auger

DATE 18 Jun 09

FILE NO. PG1874

HOLE NO. BH12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.31
Brown **SILTY SAND,** some clay and organic matter in upper 300mm 0.69							
		SS	1		3	1	99.31
						2	98.31
Very stiff to stiff, brown **SILTY CLAY,** some sand seams - firm and grey by 3.3m depth						3	97.31
						4	96.31
						5	95.31
						6	94.31
7.16						7	93.31
End of Borehole (GWL @ 2.73m-June 25/09)							



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REMARKS

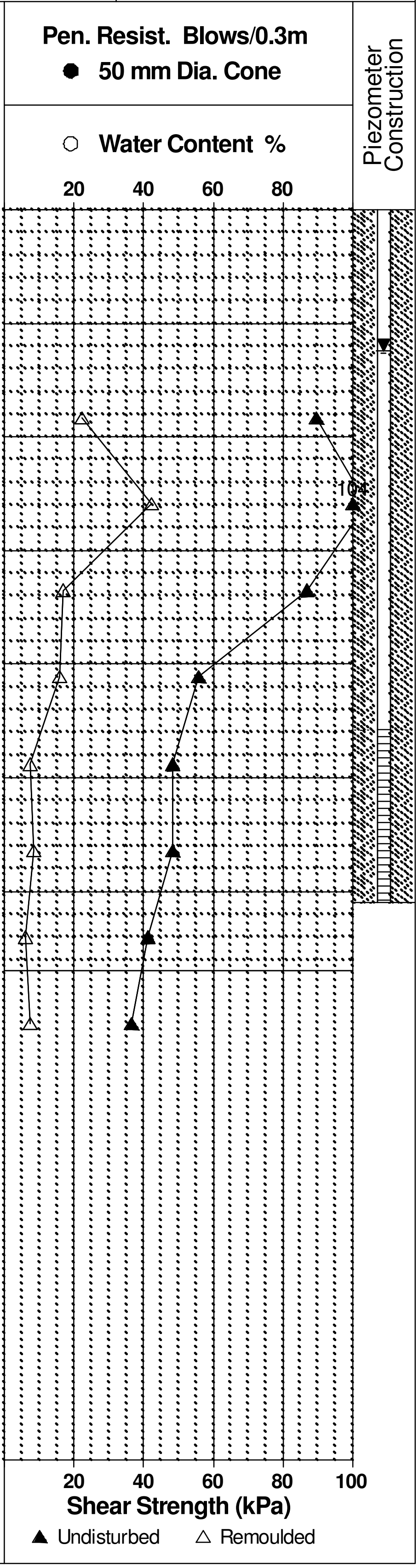
BORINGS BY CME 850 Power Auger

DATE 18 Jun 09

FILE NO. PG1874

HOLE NO. BH13

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	100.44
Brown **CLAYEY SILT**, some sand and organic matter in upper 400mm 0.69						
	SS	1	33	3	1	99.44
					2	98.44
Very stiff to stiff, grey-brown **SILTY CLAY,** silt seams throughout					3	97.44
-stiff to firm and grey by 2.8m depth					4	96.44
					5	95.44
					6	94.44
	AU	2				
7.16						
End of Borehole (GWL @ 1.24m-June 25/09)						



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REMARKS

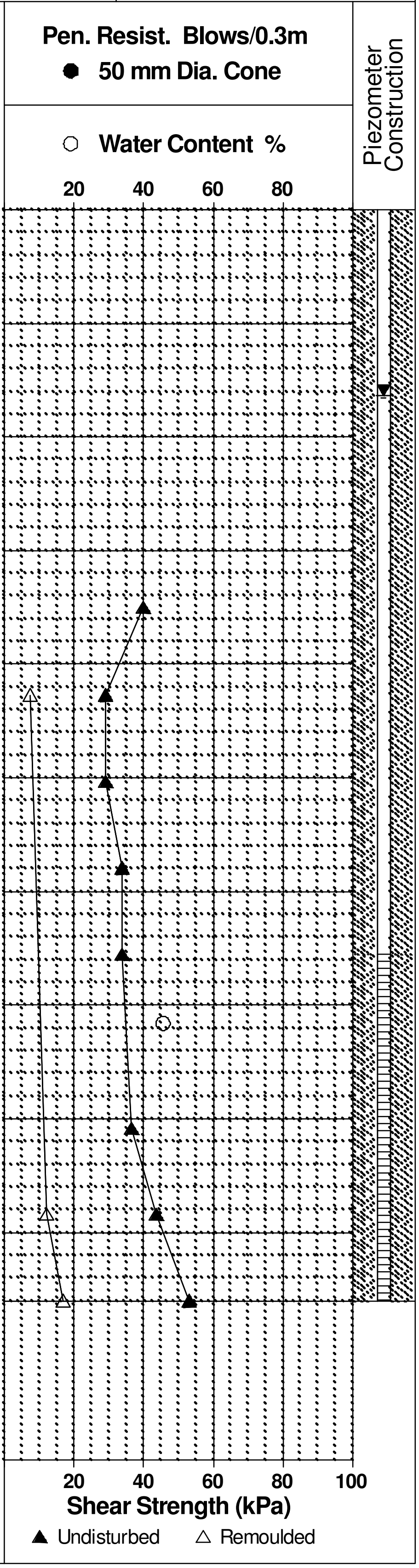
BORINGS BY CME 55 Power Auger

DATE 13 Oct 09

FILE NO. **PG1874**

HOLE NO. **BH14**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	97.75
TOPSOIL 0.10		AU	1				
Loose, brown **SANDY SILT,** trace clay		SS	2	50	7	1	96.75
- grey-brown by 1.1m depth		SS	3	50	4		
2.10						2	95.75
Grey **CLAYEY SILT**		SS	4	58	1		
3.66						3	94.75
						4	93.75
						5	92.75
Firm to stiff, grey **SILTY CLAY**						6	91.75
		TW	5	100		7	90.75
						8	89.75
						9	88.75
9.60							
End of Borehole							
(GWL @ 1.64m-Nov. 2/09)							



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REMARKS

BORINGS BY CME 55 Power Auger

DATE 15 Oct 09

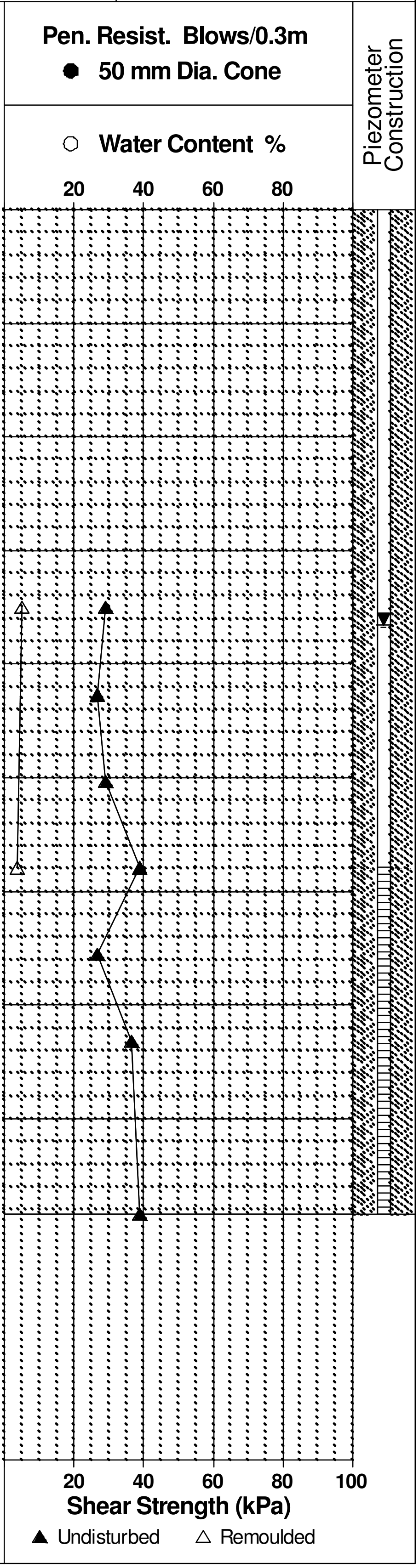
FILE NO. PG1874

HOLE NO. BH15

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	98.63
TOPSOIL 0.10						
Compact to loose, brown **SANDY SILT,** some clay	SS	1	50	16	1	97.63
	SS	2	17	6	2	96.63
2.44	SS	3		1		
Firm, grey **SILTY CLAY**					3	95.63
					4	94.63
					5	93.63
					6	92.63
					7	91.63
	TW	4	100		8	90.63
8.84						

End of Borehole

(GWL @ 3.65m-Nov. 2/09)



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REMARKS

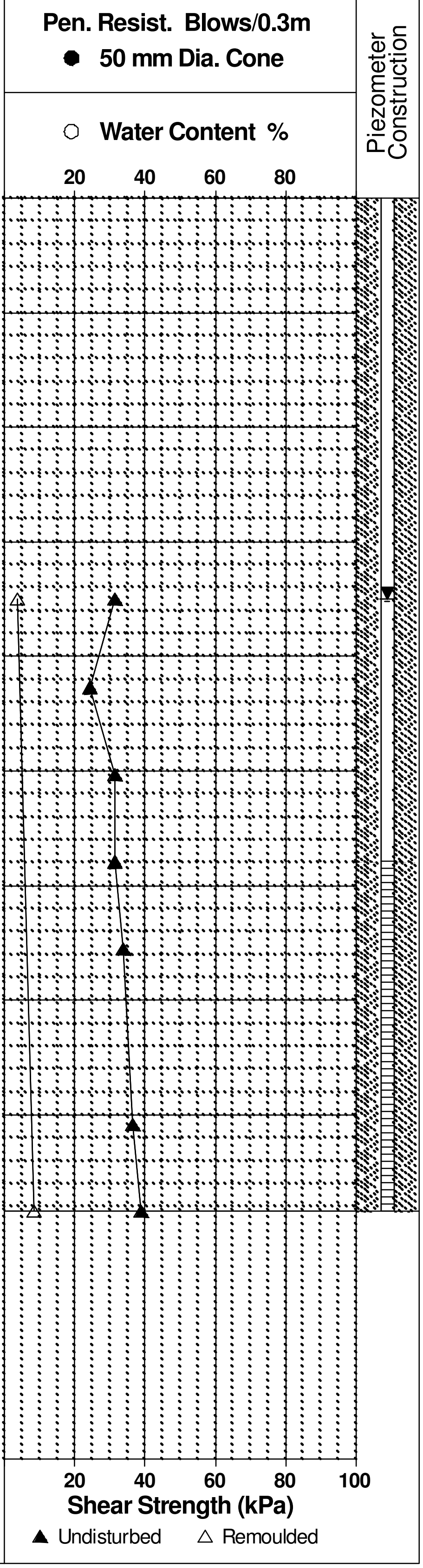
BORINGS BY CME 55 Power Auger

DATE 14 Oct 09

FILE NO. PG1874

HOLE NO. BH16

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	98.98
TOPSOIL 0.08	AU	1				
Loose to very loose, brown **SANDY SILT**	SS	2	33	7	1	97.98
	SS	3	0	2	2	96.98
2.59	SS	4	58	1		
Firm, grey **SILTY CLAY,** trace sand					3	95.98
					4	94.98
					5	93.98
					6	92.98
	TW	5	100		7	91.98
					8	90.98
8.84						
End of Borehole (GWL @ 3.50-Nov. 2/09)						



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

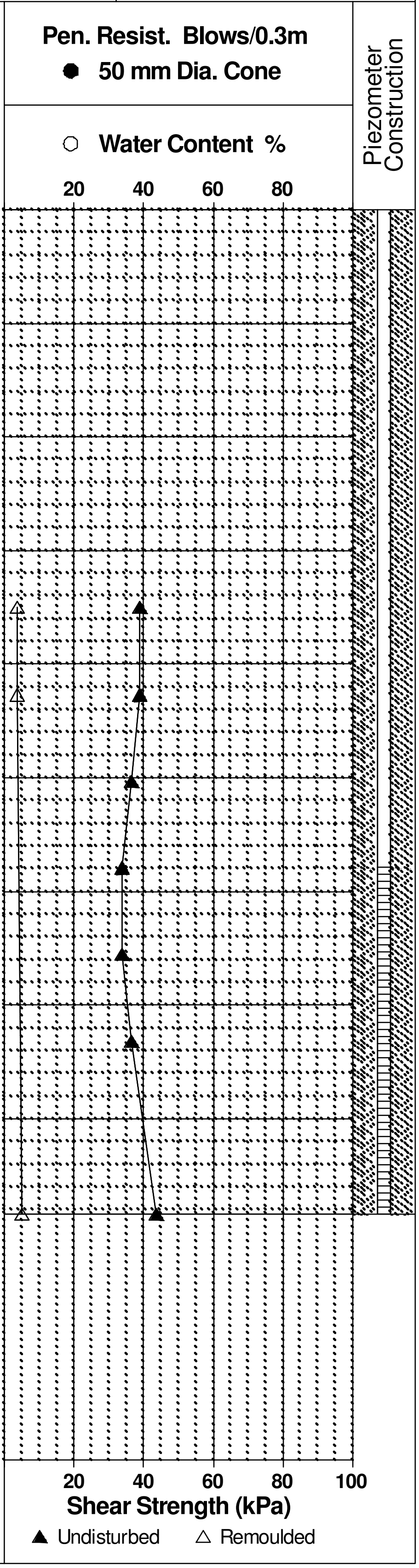
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.
REMARKS
BORINGS BY CME 55 Power Auger
DATE 14 Oct 09

FILE NO. PG1874
HOLE NO. BH17

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.41
TOPSOIL 0.08		AU	1				
Stiff to firm, brown **CLAYEY SILT,** trace sand		SS	2	50	5	1	98.41
		SS	3	67	5	2	97.41
2.59		SS	4	100	2		
Firm, grey-brown **SILTY CLAY,** trace sand						3	96.41
- grey by 3.4m depth						4	95.41
						5	94.41
						6	93.41
						7	92.41
		TW	5	100		8	91.41
8.84							
End of Borehole (GWL @ 4.80m-Nov. 2/09)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 14 Oct 09

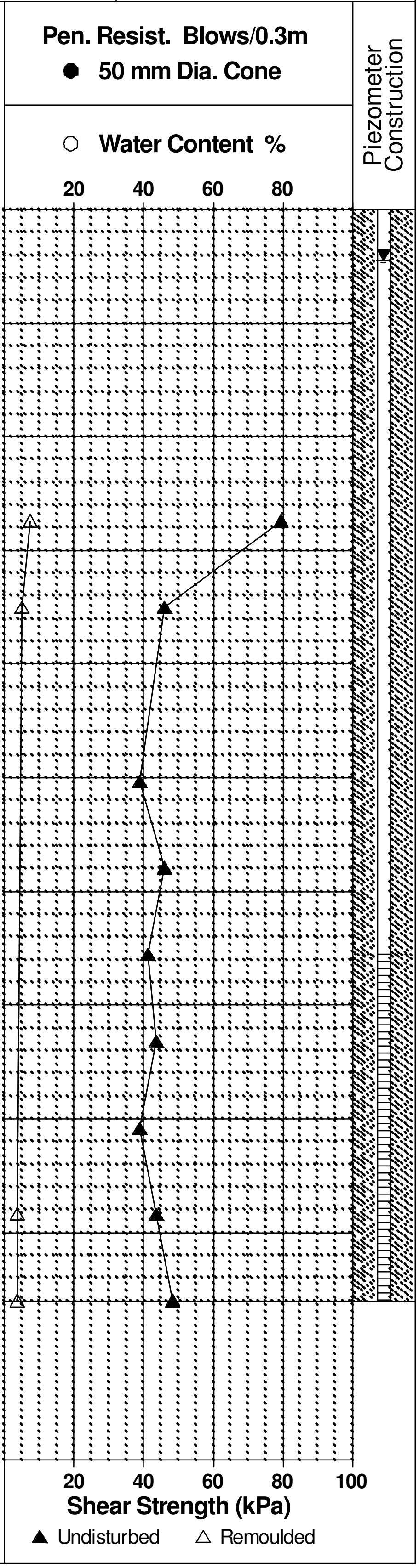
FILE NO. PG1874

HOLE NO. BH18

SOIL DESCRIPTION	
GROUND SURFACE	
TOPSOIL	0.10
Stiff to firm, brown **CLAYEY SILT,** trace sand	3.20
Firm, grey **SILTY CLAY**	9.60
End of Borehole (GWL @ 0.45m-Nov. 2/09)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	75	4
SS	2	75	5
TW	3	100	

DEPTH (m)	ELEV. (m)
0	99.85
1	98.85
2	97.85
3	96.85
4	95.85
5	94.85
6	93.85
7	92.85
8	91.85
9	90.85



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

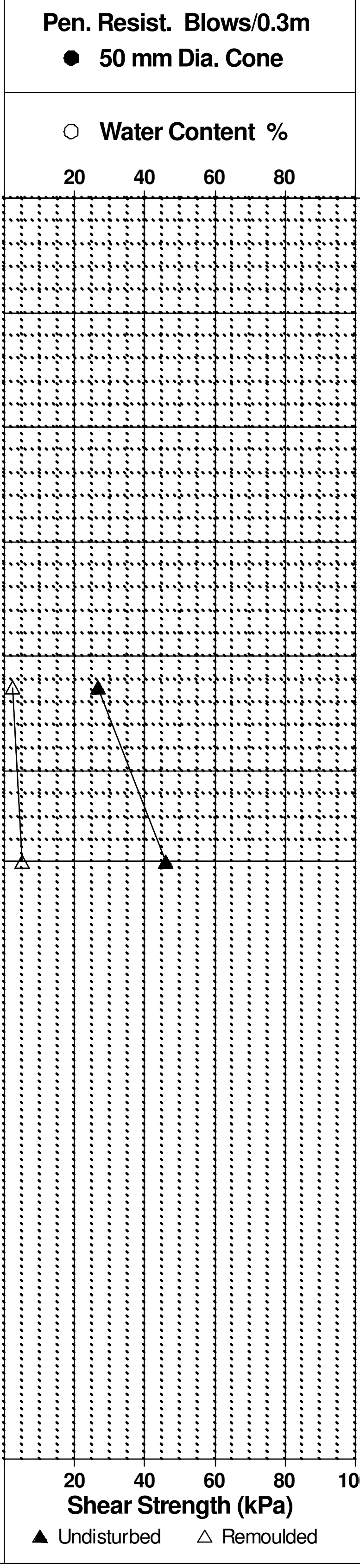
BORINGS BY CME 55 Power Auger

DATE 14 Oct 09

FILE NO. PG1874

HOLE NO. BH18A

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.85
TOPSOIL 0.10							
						1	98.85
Brown **CLAYEY SILT,** trace sand						2	97.85
3.20						3	96.85
Firm, grey **SILTY CLAY**						4	95.85
		TW	1	100		5	94.85
5.79 End of Borehole							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 14 Oct 09

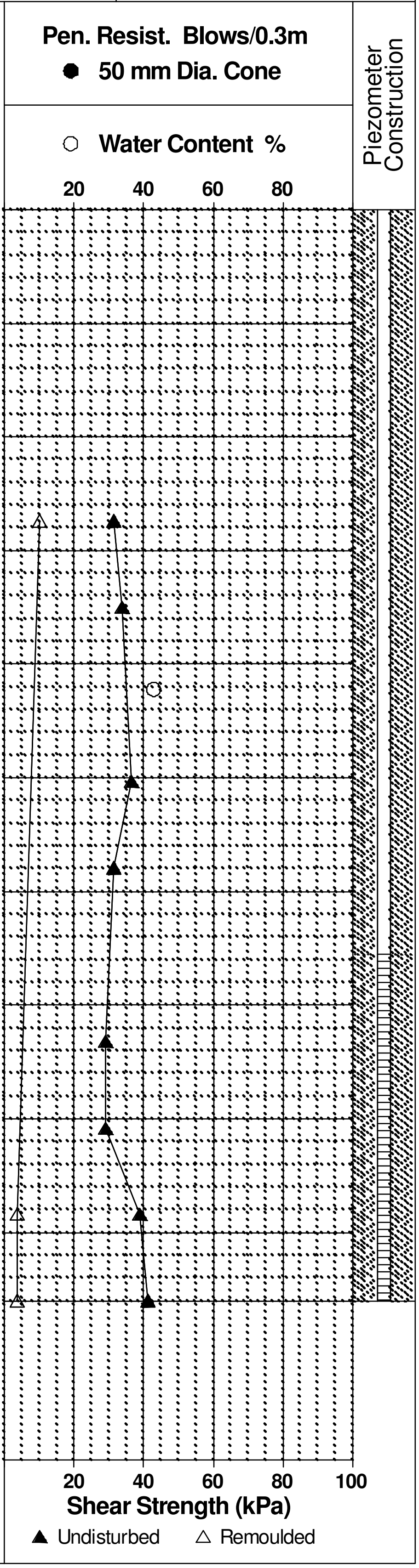
FILE NO. PG1874

HOLE NO. BH19

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.10
Stiff to firm, brown **CLAYEY SILT** - grey-brown by 1.7m depth	2.29
Firm, grey **SILTY CLAY**	9.60
End of Borehole (Piezometer blocked @ surface - Nov. 2/09)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	50	6
SS	2	75	2
TW	3	83	
TW	4		

DEPTH (m)	ELEV. (m)
0	99.49
1	98.49
2	97.49
3	96.49
4	95.49
5	94.49
6	93.49
7	92.49
8	91.49
9	90.49



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

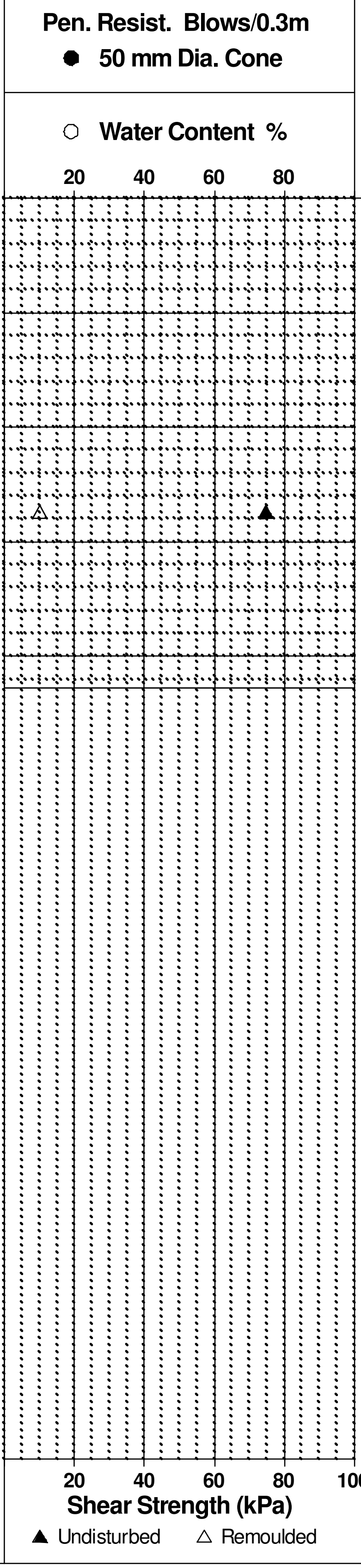
BORINGS BY CME 55 Power Auger

DATE 14 Oct 09

FILE NO. PG1874

HOLE NO. BH19A

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	99.49	
TOPSOIL 0.10								
Stiff to firm, brown **CLAYEY SILT** - grey-brown by 1.7m depth 2.29						1 2	98.49 97.49	
Stiff to firm, grey **SILTY CLAY** 4.27		TW	1	79		3 4	96.49 95.49	
End of Borehole								



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

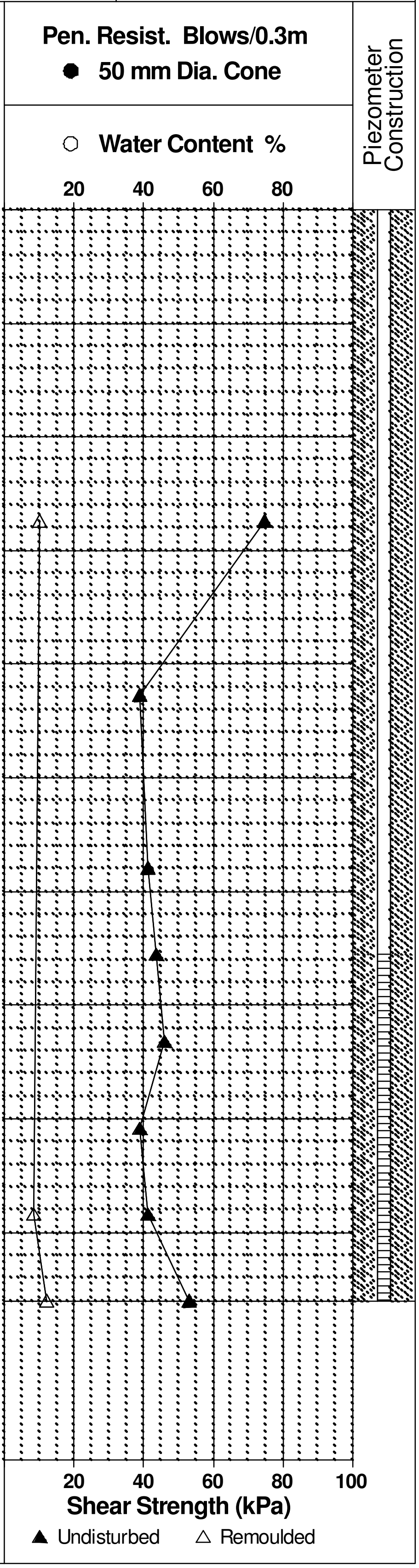
DATE 15 Oct 09

FILE NO. PG1874

HOLE NO. BH20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	99.92
TOPSOIL 0.10	AU	1				
Stiff, brown **CLAYEY SILT,** trace sand	SS	2	58	5	1	98.92
	SS	3	75	3	2	97.92
3.05					3	96.92
Firm, grey **SILTY CLAY**	TW	4	79		4	95.92
	TW	5	100		5	94.92
					6	93.92
					7	92.92
					8	91.92
					9	90.92
9.60 End of Borehole						

(Piezometer blocked @ 2.8m depth - Nov. 2/09)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

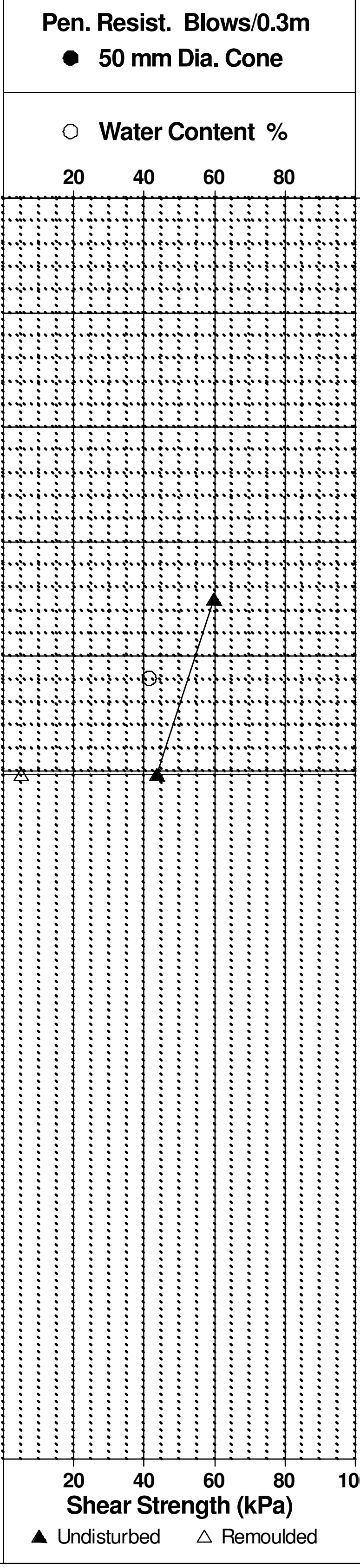
DATE 15 Oct 09

FILE NO. PG1874

HOLE NO. BH20A

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.92
TOPSOIL 0.10							
Stiff, brown **CLAYEY SILT,** trace sand						1	98.92
						2	97.92
3.05						3	96.92
Stiff to firm, grey **SILTY CLAY**		TW	1	94		4	95.92
5.03						5	94.92
End of Borehole							

Piezometer Construction



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

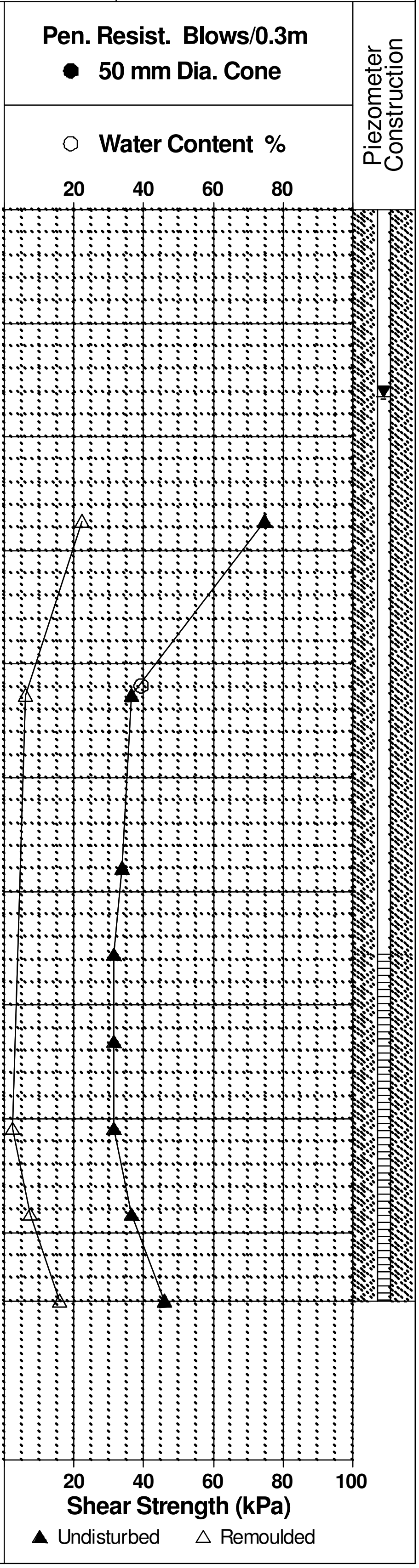
BORINGS BY CME 55 Power Auger

DATE 16 Oct 09

FILE NO. PG1874

HOLE NO. BH21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.46
TOPSOIL 0.08							
Stiff, brown **CLAYEY SILT,** trace sand		SS	1	33	9	1	98.46
		SS	2	100	4	2	97.46
2.90							
Firm, grey **SILTY CLAY**		TW	3	100		3	96.46
						4	95.46
		TW	4	96		5	94.46
						6	93.46
						7	92.46
						8	91.46
						9	90.46
9.60							
End of Borehole (GWL @ 1.65m-Nov. 2/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

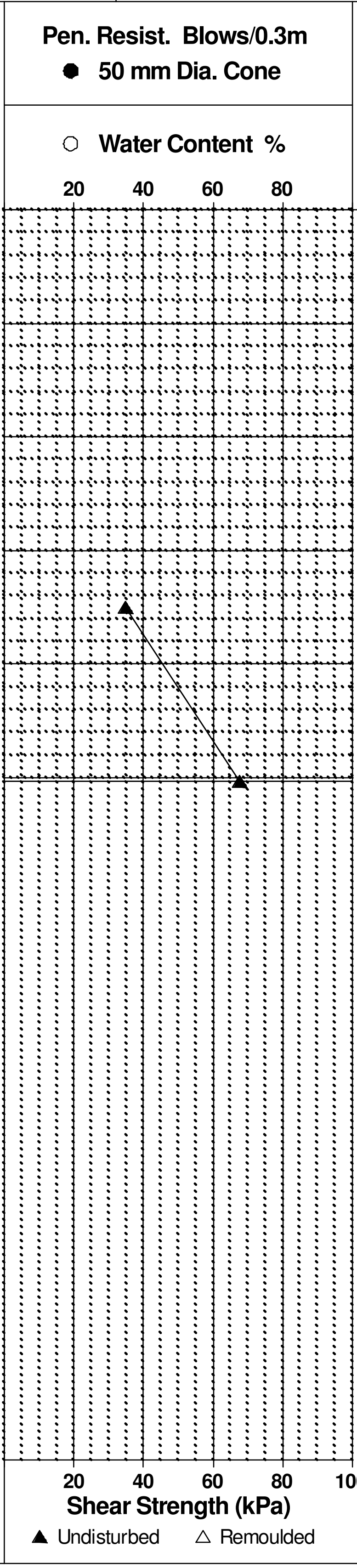
BORINGS BY CME 55 Power Auger

DATE 16 Oct 09

FILE NO. PG1874

HOLE NO. BH21A

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	99.46	
TOPSOIL 0.08								
Stiff, brown **CLAYEY SILT,** trace sand						1 2	98.46 97.46	
2.90								
Firm to stiff, grey **SILTY CLAY**		TW	1	96		3 4	96.46 95.46	
5.03						5	94.46	
End of Borehole								



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

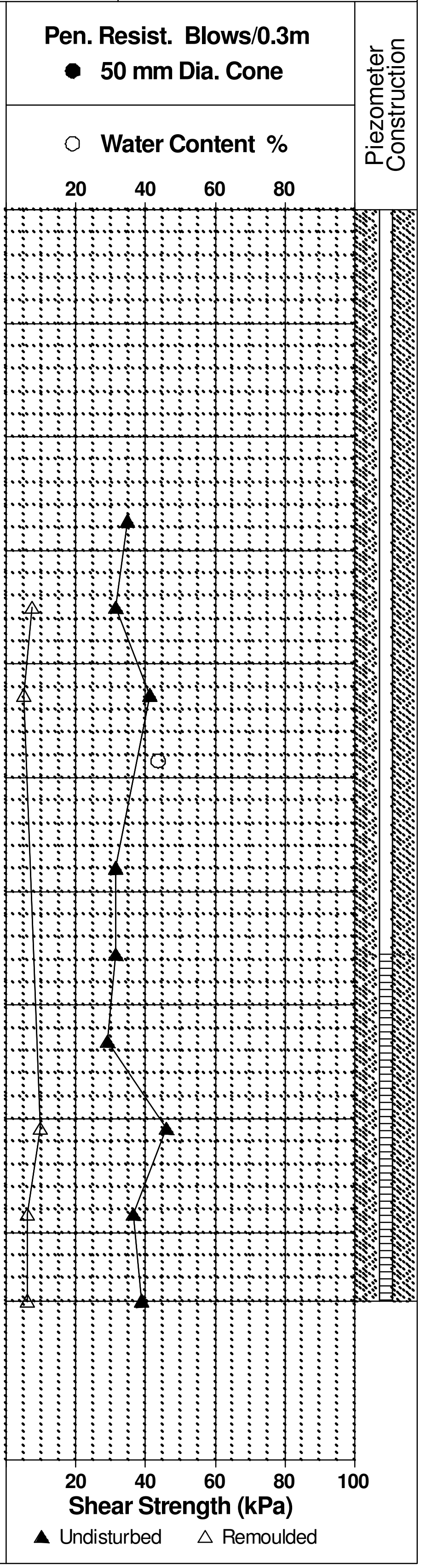
BORINGS BY CME 55 Power Auger

DATE 16 Oct 09

FILE NO. PG1874

HOLE NO. BH22

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	99.32
TOPSOIL 0.10	AU	1				
Firm, brown **CLAYEY SILT,** trace sadn	SS	2	58	3	1	98.32
1.98	SS	3	75	3	2	97.32
Firm, grey **SILTY CLAY**					3	96.32
					4	95.32
	TW	4	96		5	94.32
					6	93.32
					7	92.32
					8	91.32
9.60					9	90.32
End of Borehole (BH wet @ surface - Nov. 2/09)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

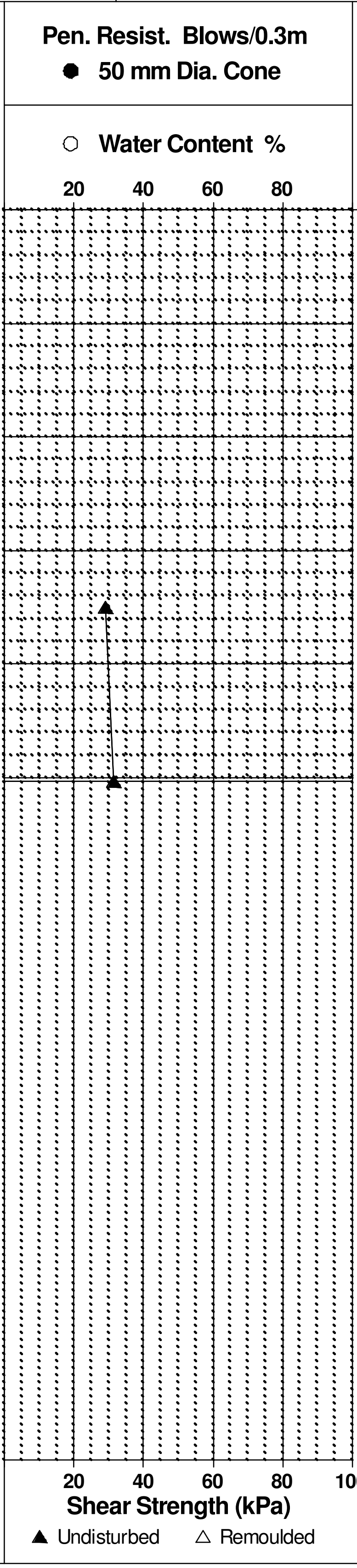
BORINGS BY CME 55 Power Auger

DATE 16 Oct 09

FILE NO. PG1874

HOLE NO. BH22A

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.32
TOPSOIL 0.10							
Firm, brown **CLAYEY SILT,** trace sand						1	98.32
1.98						2	97.32
Firm, grey **SILTY CLAY**						3	96.32
		TW	1	92		4	95.32
5.03						5	94.32
End of Borehole							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

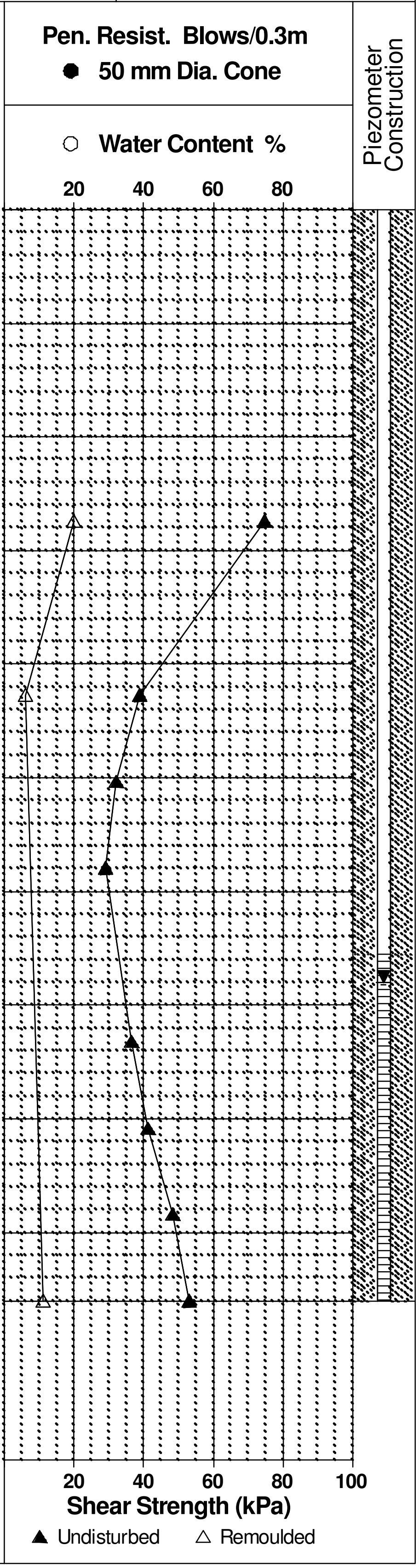
BORINGS BY CME 55 Power Auger

DATE 19 Oct 09

FILE NO. PG1874

HOLE NO. BH23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.00
TOPSOIL 0.08							
Stiff, brown **CLAYEY SILT,** trace sand		SS	1	50	5	1	99.00
		SS	2		5	2	98.00
2.90							
Firm to stiff, grey **SILTY CLAY**		TW	3	83		3	97.00
						4	96.00
						5	95.00
						6	94.00
		TW	4	100		7	93.00
						8	92.00
						9	91.00
9.60							
End of Borehole (GWL @ 6.80m-Nov. 2/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

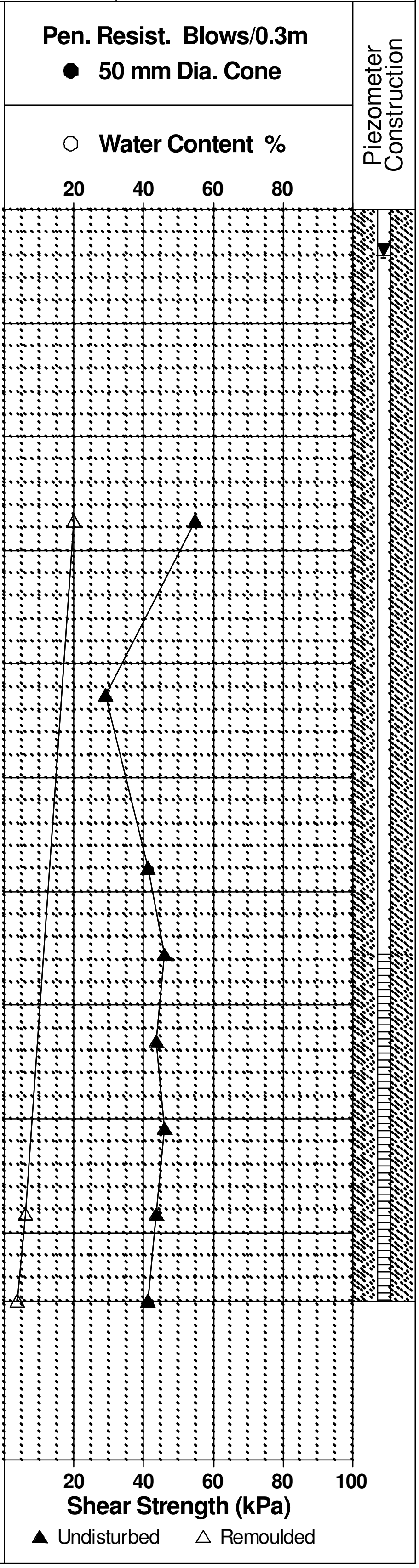
DATE 19 Oct 09

FILE NO. PG1874

HOLE NO. BH24

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.10
TOPSOIL 0.10							
Stiff, brown **CLAYEY SILT,** trace sand		SS	1	0	6	1	99.10
		SS	2	58	4	2	98.10
2.59							
Firm, grey **SILTY CLAY**						3	97.10
		TW	3	77			
						4	96.10
		TW	4	100			
						5	95.10
						6	94.10
						7	93.10
						8	92.10
						9	91.10
9.60							
End of Borehole							

(GWL @ 0.40m-Nov. 2/09)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - West Park
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

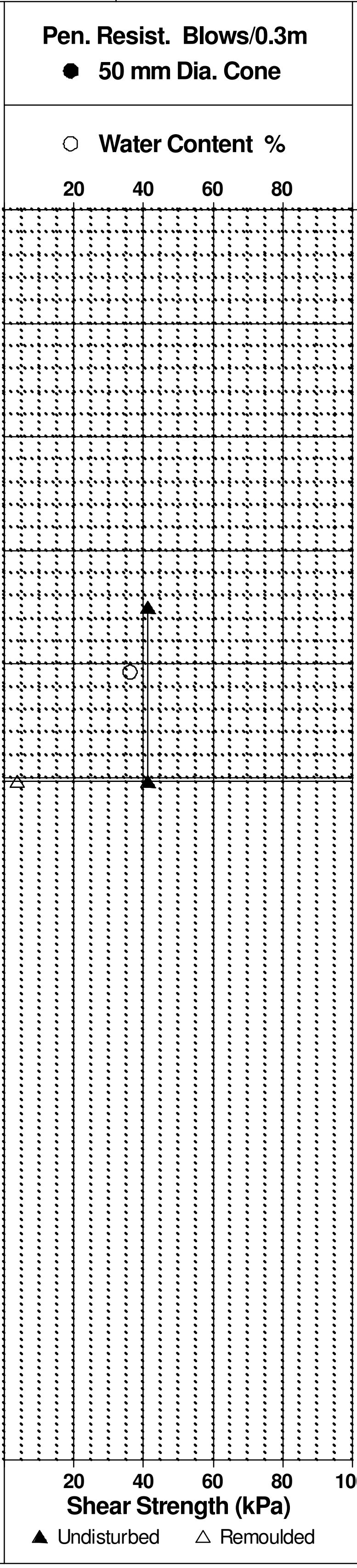
BORINGS BY CME 55 Power Auger

DATE 19 Oct 09

FILE NO. PG1874

HOLE NO. BH24A

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	100.10	
TOPSOIL 0.10								
Stiff, brown **CLAYEY SILT,** trace sand	▨					1	99.10	
	▨					2	98.10	
2.59								
Firm, grey **SILTY CLAY**	▨					3	97.10	
	▨	TW	1	92		4	96.10	
5.03						5	95.10	
End of Borehole								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-West Park Phase I
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

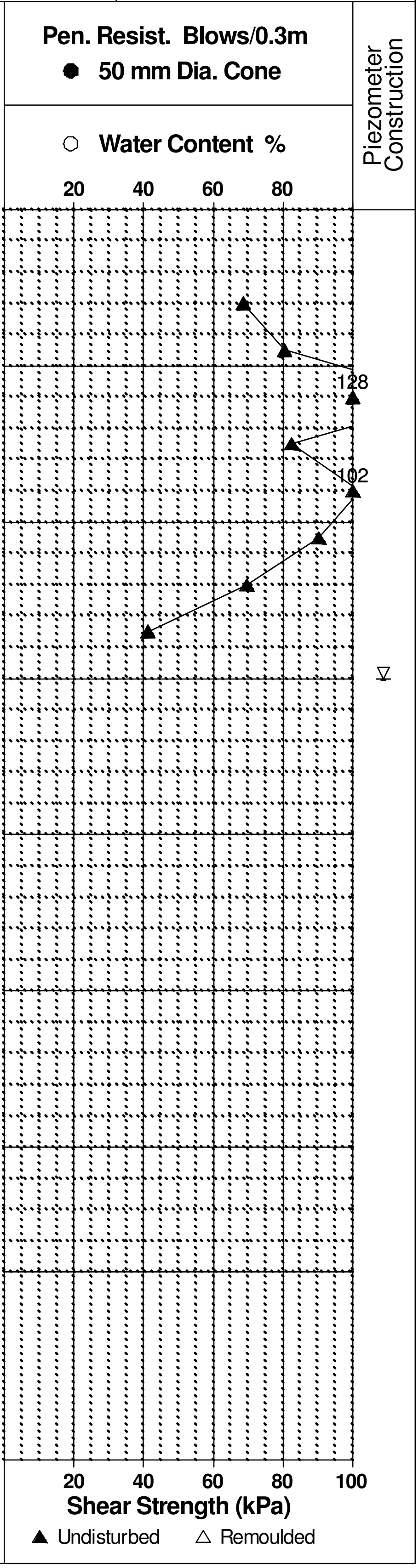
BORINGS BY Hydraulic Shovel

DATE 6 Jul 09

FILE NO. PG1874

HOLE NO. TP 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	101.28
TOPSOIL 0.40		G	1				
Very stiff to stiff, brown **SILTY CLAY** with some sand - grey-brown by 2.0m depth		G	2				
						1	100.28
		G	3				
						2	99.28
3.00		G	4				
						3	98.28
GLACIAL TILL: Grey silty sand with gravel, cobbles and boulders						4	97.28
		G	5				
		G	6				
						5	96.28
						6	95.28
6.80		G	7				
End of Test Pit (Open hole GWL @ 3.0m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-West Park Phase I
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY Hydraulic Shovel

DATE 6 Jul 09

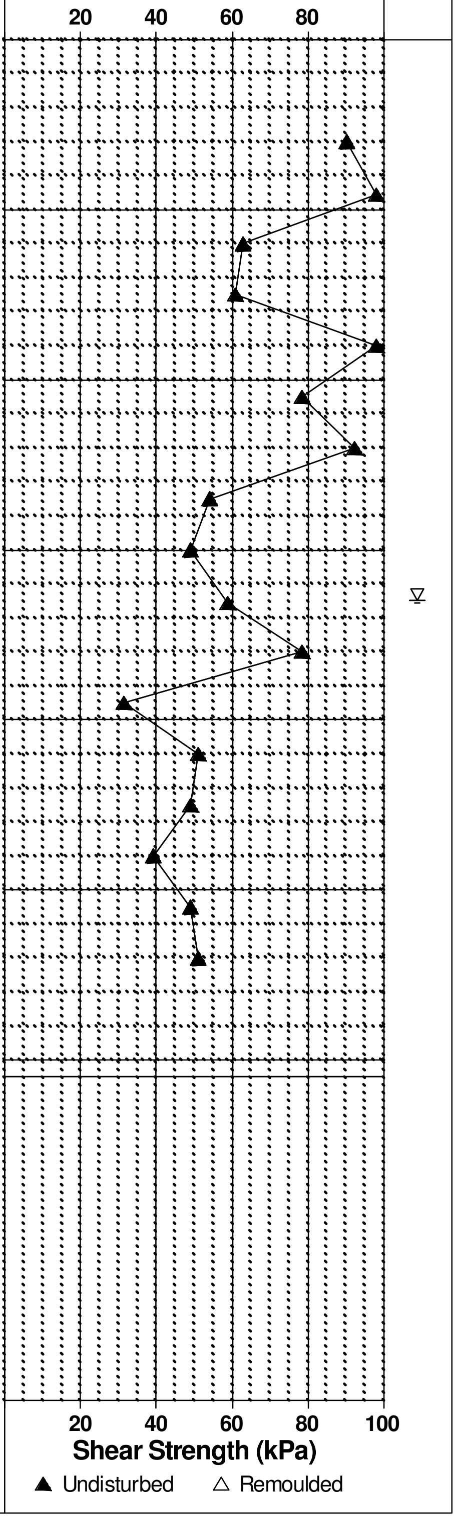
FILE NO. PG1874

HOLE NO. TP 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.72
TOPSOIL 0.40							
		G	1			1	99.72
		G	2			2	98.72
Stiff, grey-brown **SILTY CLAY** with some sand						3	97.72
- grey by 3.3m depth		G	3				
		G	4			4	96.72
						5	95.72
6.10						6	94.72
End of Test Pit (Open hole GWL @ 3.3m depth)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %

Piezometer Construction



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-West Park Phase I
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

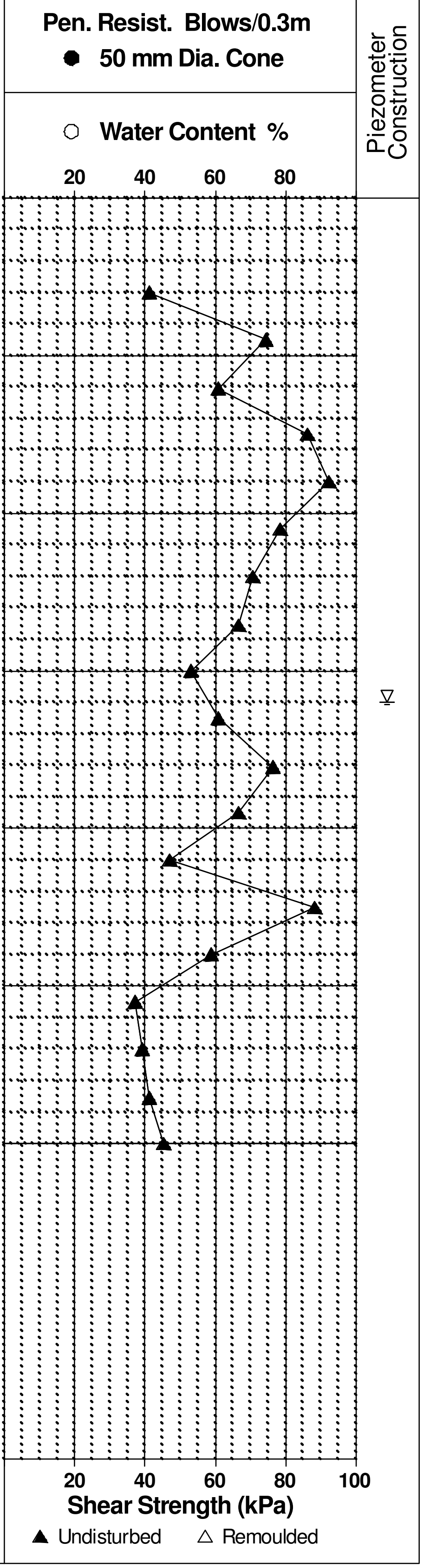
BORINGS BY Hydraulic Shovel

DATE 6 Jul 09

FILE NO. PG1874

HOLE NO. TP 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.58
TOPSOIL 0.45	■						
Stiff, grey-brown **SILTY CLAY** with some sand seams - grey by 3.2m depth 6.00	▨					1	99.58
		G	1				
						2	98.58
		G	2				
						3	97.58
		G	3				
						4	96.58
						5	95.58
		G	4				
						6	94.58
End of Test Pit (Open hole GWL @ 2.4m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-West Park Phase I
Ottawa, Ontario

DATUM Ground surface elevations at test pit locations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

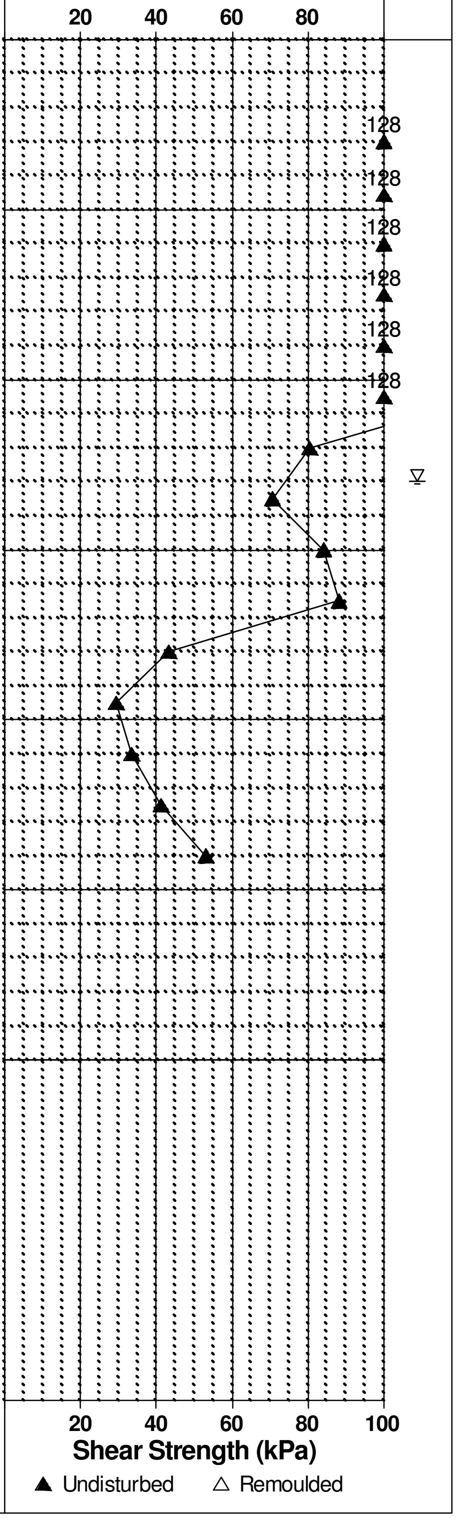
BORINGS BY Hydraulic Shovel

DATE 6 Jul 09

FILE NO. PG1874

HOLE NO. TP 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	100.78		
TOPSOIL 0.35									
Very stiff to stiff, grey-brown **SILTY CLAY** with some sand - stiff to firm and grey by 1.9m depth 4.80		G G G	1 2 3			1 2 3 4	99.78 98.78 97.78 96.78		
GLACIAL TILL: Compact to dense, grey silty sand with clay, gravel, cobbles and boulders 6.00		G	4			5 6	95.78 94.78		
End of Test Pit (Open hole GWL @ 2.6m depth, 2 hours after excavation)									



PROJECT: 08-1121-0001

RECORD OF BOREHOLE: BH 08-1

SHEET 1 OF 1

LOCATION:

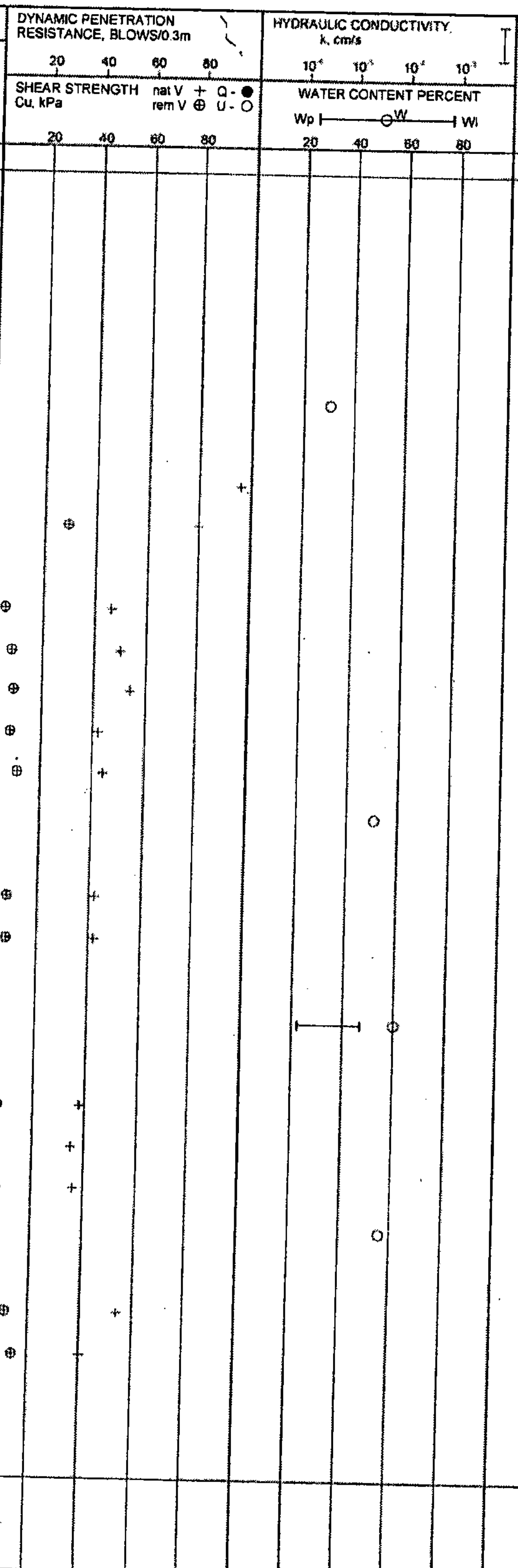
BORING DATE: 28 January 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		
		DESCRIPTION	STRATA PLOT	ELEV DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
0	Power Auger 200 mm Diam. (Hollow Stem)	Ground Surface		100.31			
		TOPSOIL		0.00			
		Stiff grey brown SILTY CLAY, with sandy silt and silty fine sand layers and seams (Weathered Crust)		100.09 0.22			
1					1	50 DO	3
					2	50 DO	2
2		Stiff to firm grey SILTY CLAY		97.87 2.44			
3							
4							
					3	50 DO	WH
5							
6					4	50 DO	WH
7							
					5	50 DO	WH
8							
9		Loose grey SANDY SILT, some gravel, trace clay (GLACIAL TILL)		91.35 8.96			
					6	50 DO	7
		End of Borehole		90.71 9.60			
10							



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: P.A.H.
CHECKED: S.A.T.

PROJECT: 08-1121-0001

RECORD OF BOREHOLE: BH 08-2

SHEET 1 OF 1

LOCATION:

BORING DATE: 29 January 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	 TYPE	 BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 20 40 60 80	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam. (Hollow Stem)	Ground Surface		100.68							
		Dark brown TOPSOIL		0.00							
		Very stiff grey brown SILTY CLAY, with sandy silt layers (Weathered Crust)		100.41 0.27							
1					1	50 DO	6				
		Loose grey brown SANDY SILT, some gravel, trace clay (GLACIAL TILL)		99.22 1.46							
2					2	50 DO	7				
		Dense grey SANDY SILT, some gravel, trace clay, with cobbles (GLACIAL TILL)		98.39 2.29							
					3	50 DO	57				
3		End of Borehole		97.63 3.05							
4											
5											
6											
7											
8											
9											
10											

BOREHOLE 0811220001.GPJ HYDROGEO.GDT 4/3/08

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: P.A.H.
CHECKED: S.A.T.

PROJECT: 08-1121-0001

RECORD OF BOREHOLE: BH 08-3

SHEET 1 OF 1

LOCATION:

BORING DATE: 29 January 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		100.31							
	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Very stiff to stiff grey brown SILTY CLAY (Weathered Crust)		100.06 0.25							
1					1	50 DO	6				
2					2	50 DO	4				
					3	50 DO	3				
3		Stiff grey SILTY CLAY, with clayey silt layers		97.26 3.05							
					4	50 DO	2				
		Compact grey SANDY SILT, some gravel, trace clay (GLACIAL TILL)		96.59 3.72							
4					5	50 DO	18				
		End of Borehole		95.89 4.42							
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: S.A.T.

BOREHOLE 0811220001.GPJ HYDROGEO.GDT 4/3/08

PROJECT: 08-1121-0001

RECORD OF BOREHOLE: BH 08-4

SHEET 1 OF 1

LOCATION:

BORING DATE: 29 January 2008

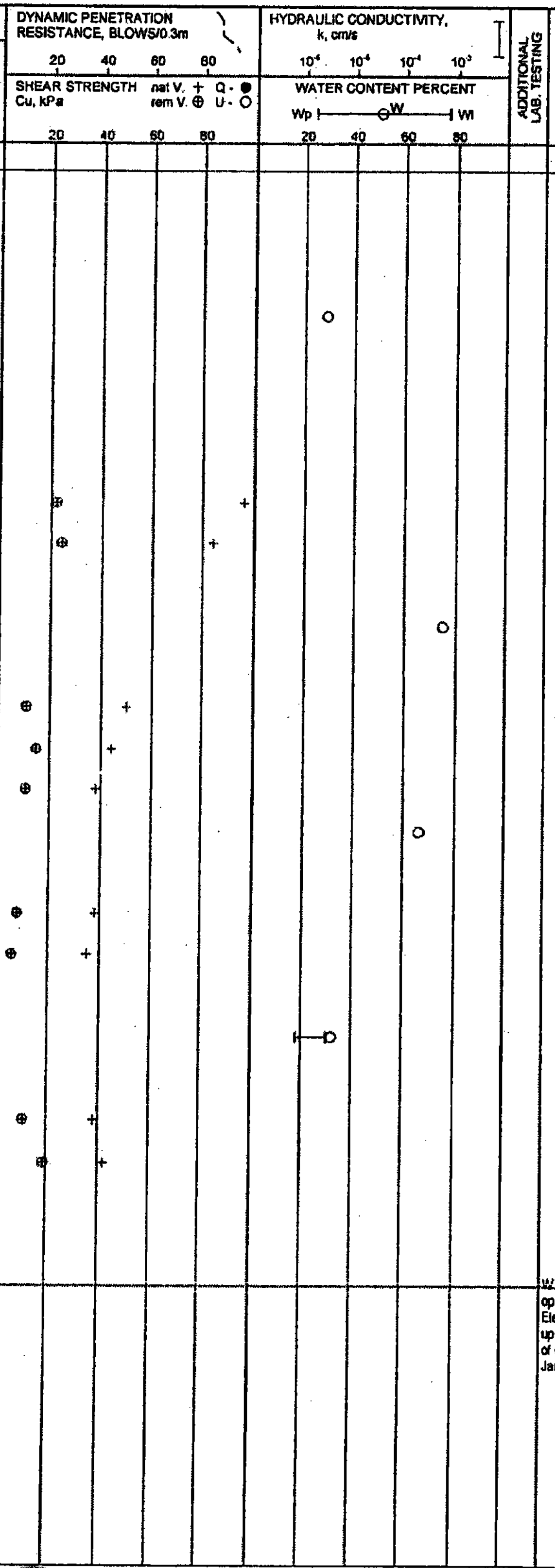
DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
0	Ground Surface	101.04			
	TOPSOIL	0.00			
	Very stiff to stiff grey brown SILTY CLAY, with silty fine sand layers and seams (Weathered Crust)	100.79 0.25			
1			1	50 DO	5
2			2	50 DO	3
	Stiff to firm grey SILTY CLAY	98.45 2.59			
3			3	50 DO	WH
4					
5			4	50 DO	WH
6			5	50 DO	WH
7					
	Compact grey SANDY SILT, some gravel, trace clay (GLACIAL TILL)	93.51 7.53			
8			6	50 DO	28
	End of Borehole	92.81 8.23			
9					
10					



PIEZOMETER OR STANDPIPE INSTALLATION

▽

W.L. in open hole at Elev. 99.21 m upon completion of drilling Jan. 29, 2008

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: S.A.T.

BOREHOLE 0811220001.GPJ HYDROGEO.GDT 4/3/08

PROJECT: 08-1121-0001

LOCATION:

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: BH 08-5

BORING DATE: 31 January 2008

SHEET 1 OF 1

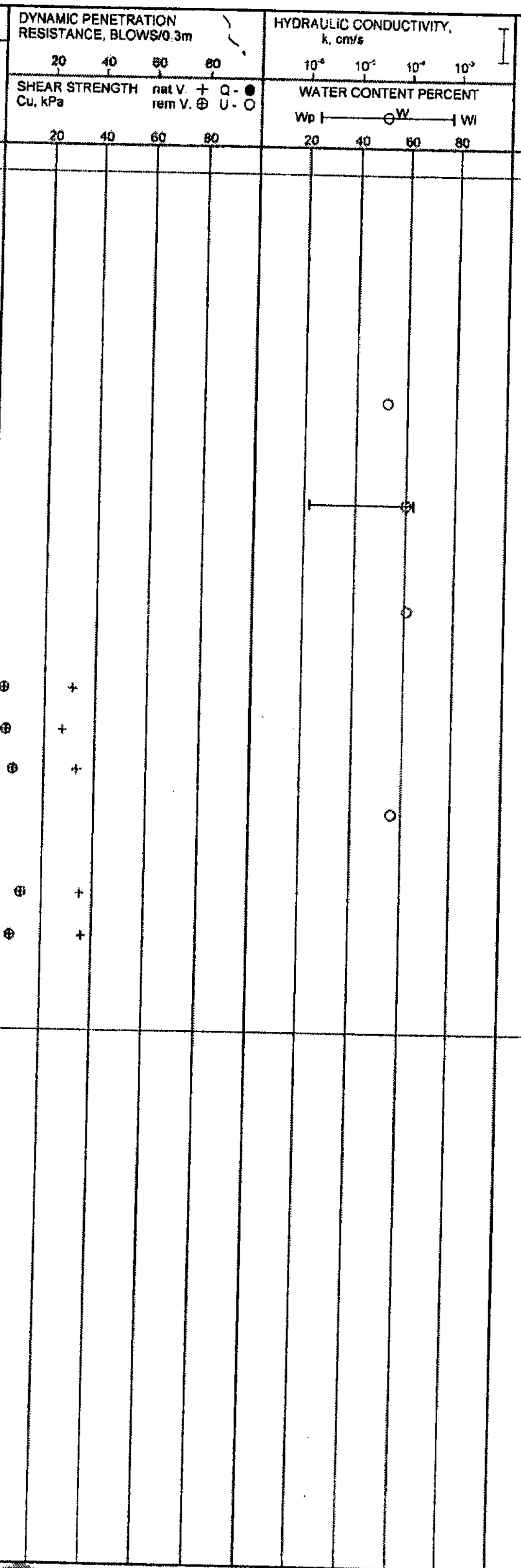
DATUM: Geodetic

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
0	Ground Surface	100.71 0.00
0	TOPSOIL	100.49 0.22
0.22	Very stiff, grey brown SILTY CLAY (Weathered Crust)	
2.13	Stiff to firm grey SILTY CLAY	98.58 2.13
6.34	Possibly Sandy Silt (GLACIAL TILL)	94.46 6.34
	End of Borehole Sampler Refusal	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	8
2	50 DO	5
3	50 DO	1
4	50 DO	WH
5	50 DO	PM
6	50 DO	2



ADDITIONAL LAB TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: S.A.T.

BOREHOLE 0811220001.GPJ HYDROGEO.GDT 4/3/08

PROJECT: 08-1121-0001

RECORD OF BOREHOLE: BH 08-6

SHEET 1 OF 1

LOCATION:

BORING DATE: 31 January 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diam. (Hollow Stem)	Ground Surface		101.28							
		TOPSOIL		0.00							
		Grey brown layered CLAYEY SILT and fine SILTY SAND		101.06 0.22	1	AS					
		Compact grey brown SANDY SILT, trace to some gravel and clay (GLACIAL TILL)		100.67 0.61							
1					2	50 DO	25				
					3	50 DO	14				
2		End of Borehole		99.30 1.98							
3											
4											
5											
6											
7											
8											
9											
10											

BOREHOLE 08112200001.GPJ HYDROGEO.GDT 4/3/08

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: P.A.H.
CHECKED: S.A.T.

PROJECT: 08-1121-0001

LOCATION:

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: BH 08-7

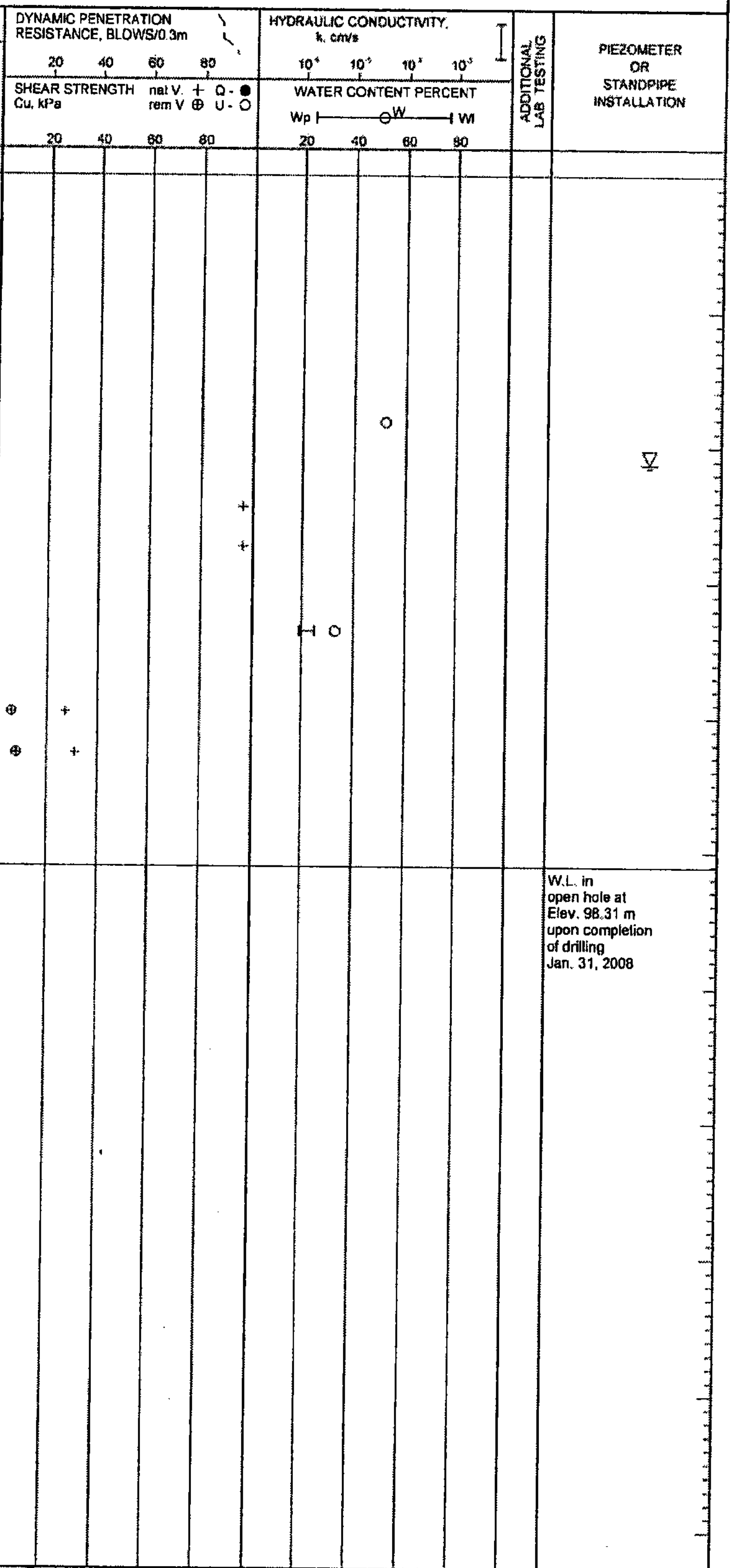
BORING DATE: 31 January 2008

SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
0		Ground Surface	100.44			
	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL	0.00			
		Very stiff grey brown SILTY CLAY (Weathered Crust)	100.19 0.25			
1						
2				1	50 DO	5
3		Stiff layered SILTY CLAY and grey CLAYEY SILT, occasional band of send and gravel	97.67 2.77	2	50 DO	3
4		Firm grey SILTY CLAY	96.78 3.66			
5		Dense grey SANDY SILT, some gravel, trace clay (GLACIAL TILL)	95.96 4.48	3	50 DO	>50
		End of Borehole Sampler Refusal	95.33 5.11			
6						
7						
8						
9						
10						



W.L. in open hole at Elev. 98.31 m upon completion of drilling Jan. 31, 2008

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: S.A.T.

PROJECT: 08-1121-0001

RECORD OF BOREHOLE: BH 08-8

SHEET 1 OF 1

LOCATION:

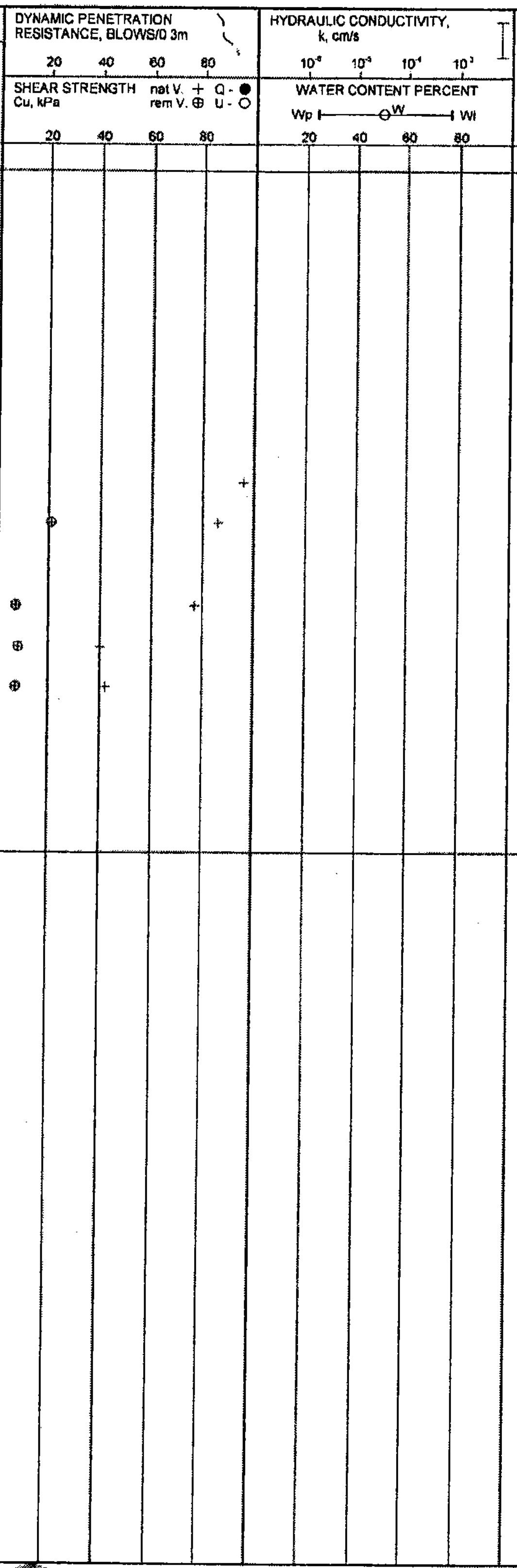
BORING DATE: 31 January 2008

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m
0		Ground Surface		100.63			
	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00			
		Stiff grey brown SILTY CLAY, with sandy silt and clayey silt layers and seams (Weathered Crust)		100.41 0.22			
1					1	50 DO	3
					2	50 DO	2
2							
		Stiff to firm grey brown to grey SILTY CLAY		98.19 2.44			
3							
4		Very dense grey SANDY SILT and SILTY SAND, some gravel, trace clay with cobbles (GLACIAL TILL)		96.73 3.90			
					3	50 DO	69
5		End of Borehole		95.60 5.03			
6							
7							
8							
9							
10							



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

∇

W.L. in
open hole at
Elev. 99.78 m
upon completion
of drilling
Jan 31, 2008

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: P.A.H.
CHECKED: S.A.T.

PROJECT: 08-1121-0001

RECORD OF BOREHOLE: BH 08-9

SHEET 1 OF 1

LOCATION:

BORING DATE: 1 February 2008

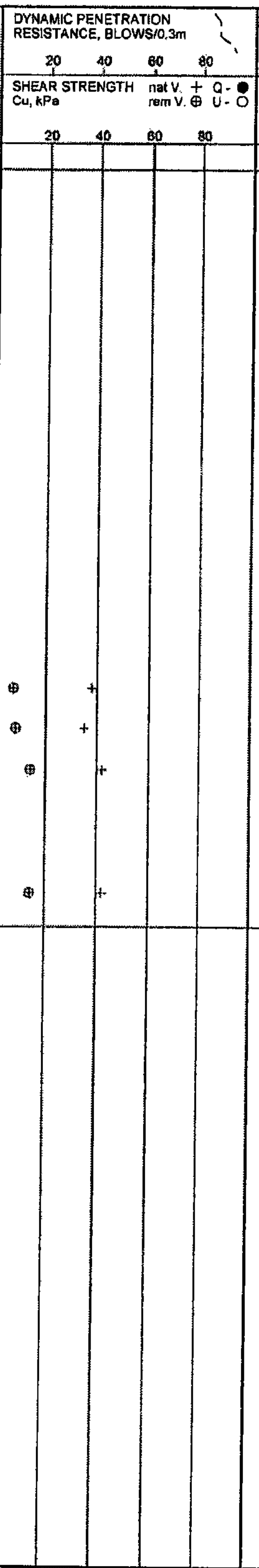
DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		
		DESCRIPTION	STRATA PLOT	ELEV DEPTH (m)
0		Ground Surface		100.62
	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		100.42
		Very stiff to stiff grey brown SILTY CLAY (Weathered Crust)		0.20
2		Firm grey SILTY CLAY		98.49 2.13
5		End of Borehole Auger Refusal		95.04 5.58

SAMPLES		
NUMBER	TYPE	BLOWS/0.3m
1	50 DO	7
2	50 DO	2
3	50 DO	WH
4	50 DO	WH
5	50 DO	WH



HYDRAULIC CONDUCTIVITY, k, cm/s

10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT

Wp ⊢——○W——⊣ Wl

20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: S.A.T.

BOREHOLE 0811220001.GPJ HYDROGEO.GDT 4/3/08

PROJECT: 08-1121-0001

LOCATION:

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: BH 08-10

BORING DATE: 1 February 2008

SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}) WATER CONTENT PERCENT (Wp ⊢ ○W ⊣ Wl) (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diam. (Hollow Stem)	Ground Surface		101.10							
		TOPSOIL		0.00							
		Very stiff grey brown SILTY CLAY with clayey silt layers (Weathered Crust)		100.80 0.30							
1											
2					1	50 DO	7				
		Dense grey SANDY SILT and SILTY SAND, some gravel, trace clay (GLACIAL TILL)		98.85 2.25							
					2	50 DO	35				
3		End of Borehole		98.20 2.90							
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: P.A.H.
CHECKED: S.A.T.

RECORD OF TEST PIT 37

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	GROUNDWATER OBSERVATIONS
0	Ground Surface	101.02	
	TOPSOIL	100.72 0.30	
	Very stiff to stiff grey brown SILTY CLAY weathered crust		
2		98.62 2.40	Native Backfill
	Grey SILTY CLAY		
3			
4	Grey brown silty sand, some clay, gravel, cobbles and boulders (GLACIAL TILL)	97.22 3.80	
	End of test pit	97.02 4.00	Groundwater inflow observed at 2.50 metres below ground surface on November 20, 2006
5			
6			Groundwater level in standpipe at 0.86 metres below ground surface on January 3, 2007

Notes
1 Substantial ground water inflow observed
2 Sides of test pit collapsedduring excavating

Houle Chevrier Engineering Ltd.

RECORD OF TEST PIT 38

PROJECT [illegible]
LOCATION [illegible]
DATE OF EXCAVATION [illegible]

DATE [illegible]
[illegible]
[illegible]

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH Cu kPa Natural ⊕ Remoulded V ⊕ 20 40 60 80	WATER CONTENT PERCENT Wp — W — Wl 20 40 60 80	ADDITIONAL LAB TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
1	Very stiff to stiff grey brown SILTY CLAY (weathered crust)	▨	[illegible]					
2 3 4	Grey brown silty sand with gravel (GLACIAL TILL)	▨	1.40					
5 6 7 8	End of test pit		4.20					No groundwater inflow observed on completion of excavating on December 5, 2006

Houle Chevrier Engineering Ltd.

[illegible]
CHECKED [illegible]

RECORD OF TEST PIT 48

0	Ground Surface	[illegible]
	TOPSOIL	[illegible]
1	Very stiff to stiff grey brown SILTY CLAY (weathered crust)	
2		
	Grey SILTY CLAY	97.69 2.10
3		
4		
5	End of test pit	95.49 4.90

Groundwater inflow observed at 2.80 metres below ground surface on December 5, 2006

Houle Chevrier Engineering Ltd.

PROJECT: 06-1120-392

RECORD OF BOREHOLE: BH 06-1

SHEET 1 OF 1

LOCATION: See Site Plan

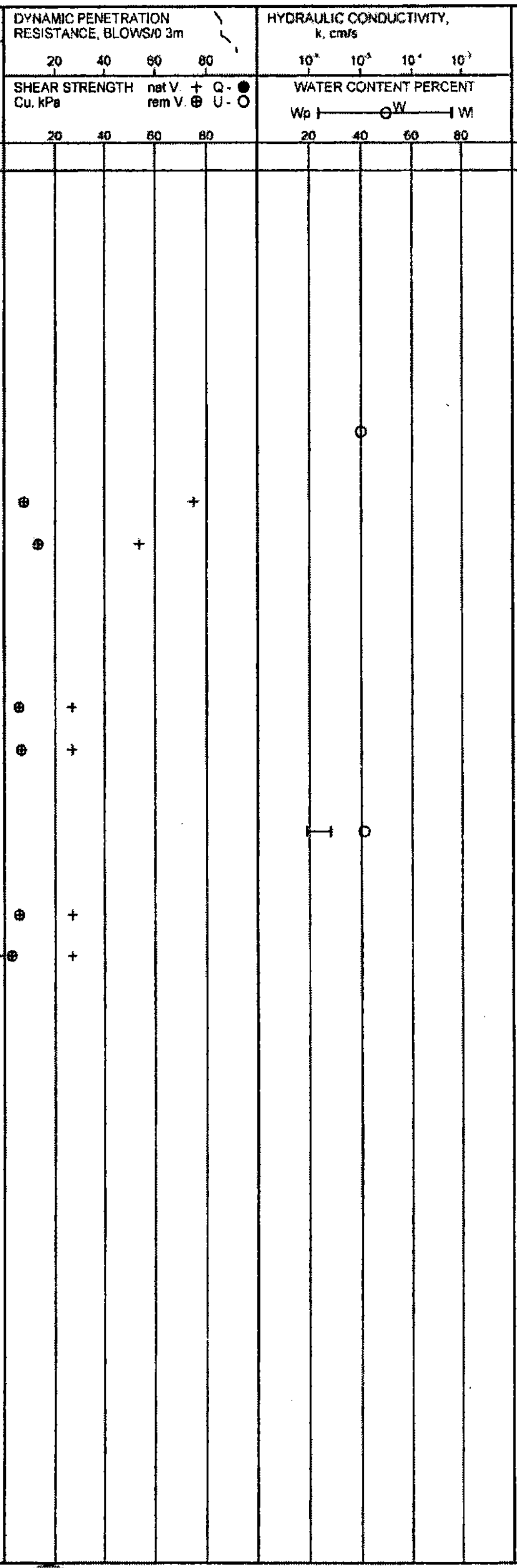
BORING DATE: Dec. 12, 2006

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		100.02					
0	Power Auger 200mm Diam. (Hollow Stem)	Dark brown TOPSOIL		0.00					
		Stiff grey brown SILTY CLAY, some sand seams, trace organic matter (Weathered Crust)		99.79 0.23					
1					1	50 DO	2		
2					2	50 DO	1		
3		Firm grey SILTY CLAY with black streaking		96.97 3.05	3	50 DO	1		
4									
5					4	50 DO	PH		
		End of Borehole		94.23 5.79					
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: J.A.S.

CHECKED: J.A.S.

PROJECT: 06-1120-392

RECORD OF BOREHOLE: BH 06-2

SHEET 1 OF 1

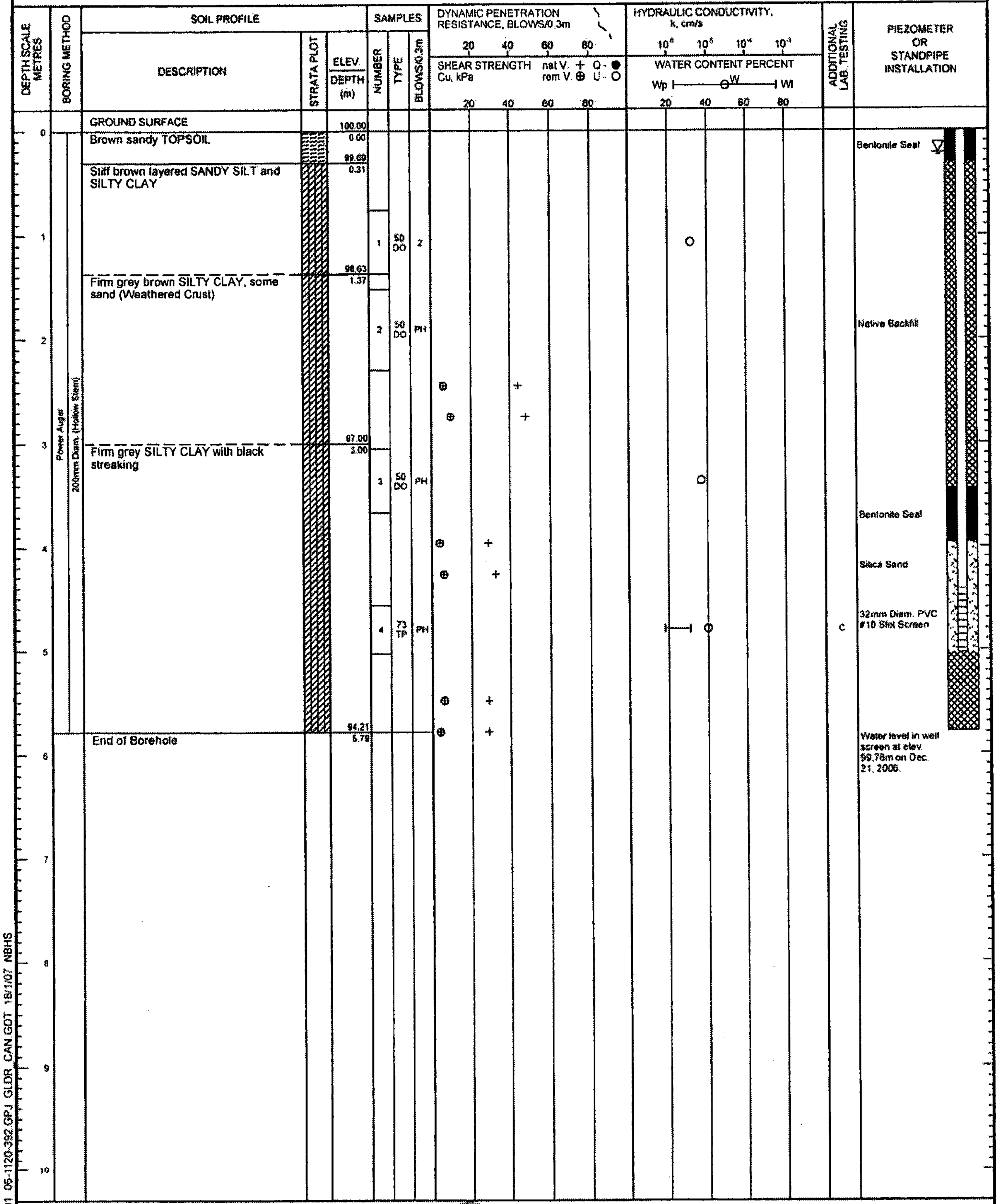
LOCATION: See Site Plan

BORING DATE: Dec. 12, 2006

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm



SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	100.00					
Brown sandy TOPSOIL	0.00					Bentonite Seal ▽
Stiff brown layered SANDY SILT and SILTY CLAY	99.69 0.31					
		1	50 DO	2		
Firm grey brown SILTY CLAY, some sand (Weathered Crust)	98.63 1.37					
		2	50 DO	PH		Native Backfill
Firm grey SILTY CLAY with black streaking	97.00 3.00					
		3	50 DO	PH		
						Bentonite Seal
						Silica Sand
		4	73 TP	PH	C	32mm Diam. PVC #10 Slot Screen
End of Borehole	94.21 5.79					Water level in well screen at elev. 99.78m on Dec. 21, 2006.

MIS-BHS 001 06-1120-392.GPJ GLDR_CAN.GDT 18/1/07 NBHS

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: J.A.S.

CHECKED: J.A.S.

PROJECT: 06-1120-392

RECORD OF BOREHOLE: BH 06-3

SHEET 1 OF 1

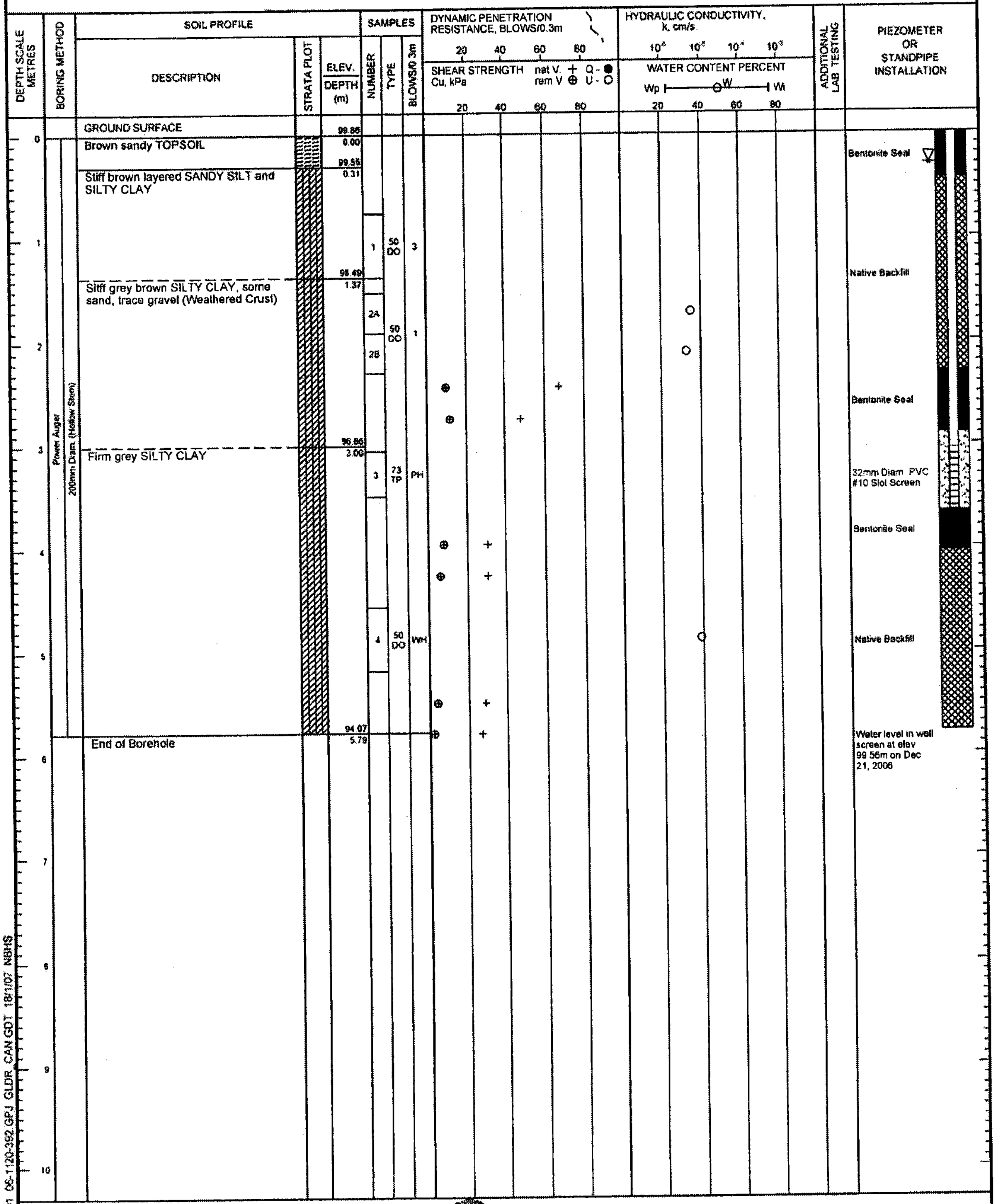
LOCATION: See Site Plan

BORING DATE: Dec. 12, 2006

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm



DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	99.86			
Brown sandy TOPSOIL	0.00			
Stiff brown layered SANDY SILT and SILTY CLAY	99.55 0.31	1	50 DO	3
Stiff grey brown SILTY CLAY, some sand, trace gravel (Weathered Crust)	98.49 1.37	2A 2B	50 DO	1
Firm grey SILTY CLAY	96.86 3.00	3 4	73 TP 50 DO	PH WH
End of Borehole	94.07 5.79			

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: J.A.S.

CHECKED: J.A.S.

PROJECT: 06-1120-392

RECORD OF BOREHOLE: BH 06-4

SHEET 1 OF 1

LOCATION: See Site Plan

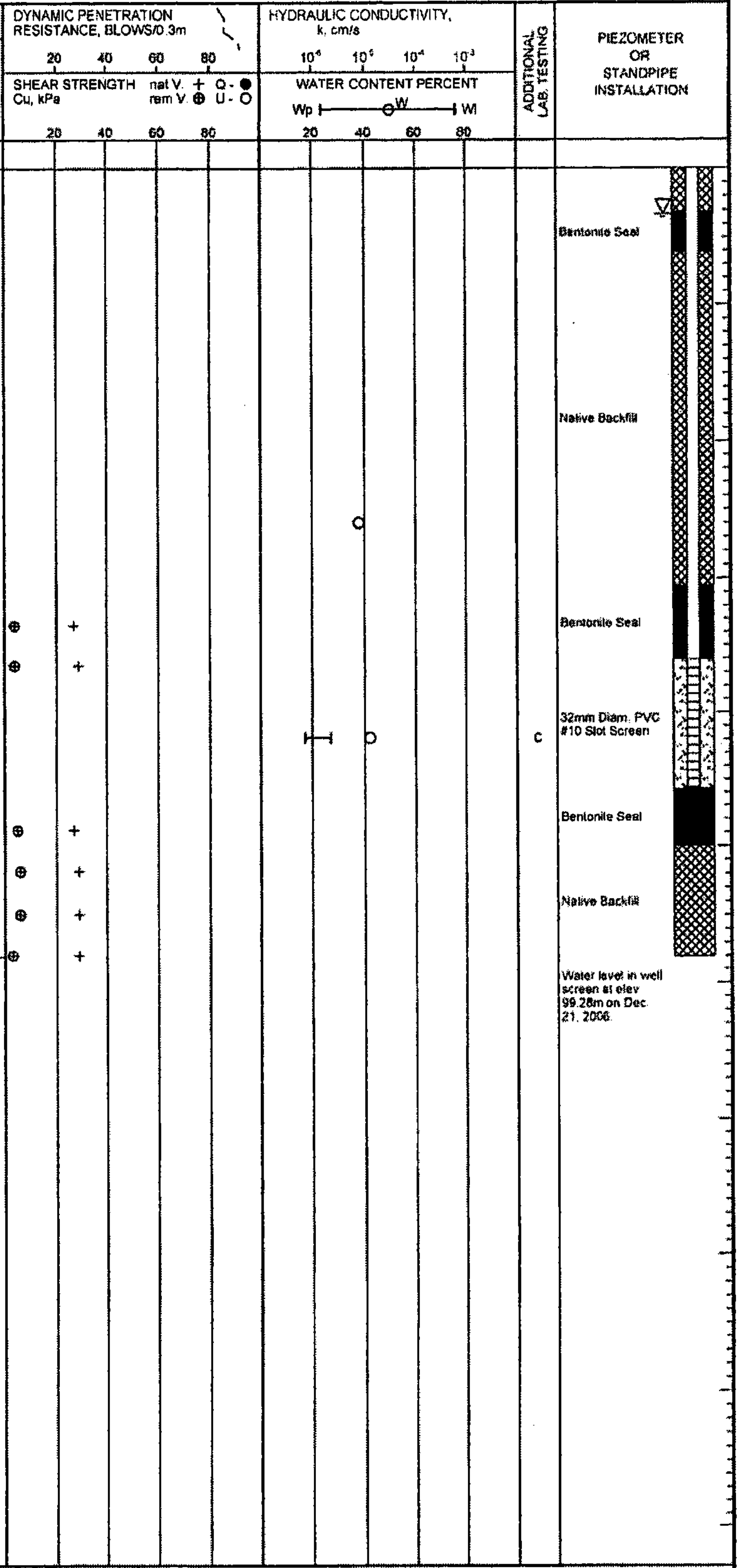
BORING DATE: Dec. 12, 2006

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		99.61			
0	Power Auger 200mm Diam. (Hollow Stem)	Brown sandy TOPSOIL	▤	0.00			
		Stiff to firm grey brown SILTY CLAY, some sand (Weathered Crust)	▨	99.30 0.31			
1					1	50 DO	2
2					2	50 DO	2
					3	50 DO	1
3		Firm grey SILTY CLAY	▨	96.61 3.00			
4					4	73 TP	PH
5							
		End of Borehole		93.81 5.80			
6							
7							
8							
9							
10							



Water level in well screen at elev 99.28m on Dec. 21, 2006.

MIS-BHS 001 06-1120-392.GPJ GLDR_CAN.GDT 18/1/07 NBHS

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: J.A.S.

CHECKED: J.A.S.

PROJECT: 06-1120-392

RECORD OF BOREHOLE: BH 06-5

SHEET 1 OF 1

LOCATION: See Site Plan

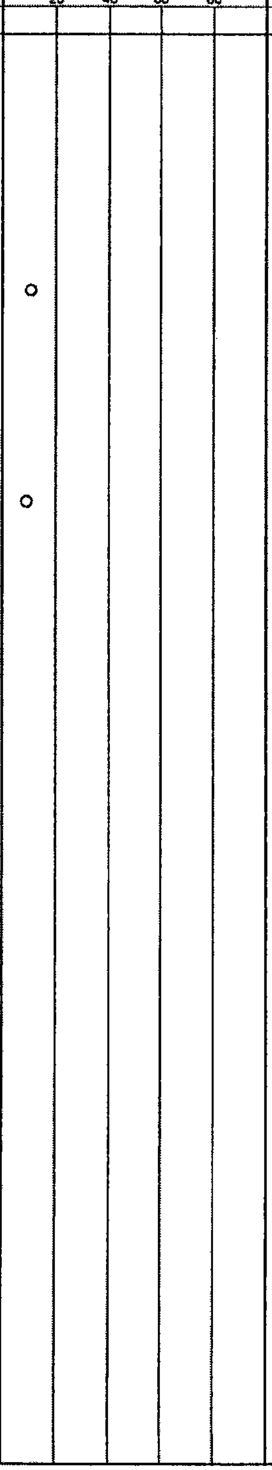
BORING DATE: Dec. 13, 2006

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - O 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10⁻⁶ 10⁻⁵ 10⁻⁴ 10⁻³ / WATER CONTENT PERCENT Wp ⊢—O^W—⊣ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		101.19							
0	Power Auger 200mm Diam (Hollow Stem)	Dark brown sandy TOPSOIL		0.00							
		Compact brown CLAYEY SILT, some sand, gravel (GLACIAL TILL)		100.88 0.31							
1					1	50 DO	16				
2					2	50 DO	22		O		
		Compact grey SANDY SILT, some gravel, trace clay (GLACIAL TILL)		98.60 2.59	3	50 DO	18				
3					4	50 DO	24		O		
4					5	50 DO					
		End of Borehole Auger Refusal		97.08 4.11							
5											
6											
7											
8											
9											
10											



MIS-BHS 001 06-1120-392.GPJ GLDR_CAN.GDT 11/1/07 NBHS

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.N.
CHECKED: J.A.S.

PROJECT: 06-1120-392

RECORD OF BOREHOLE: BH 06-6

SHEET 1 OF 1

LOCATION: See Site Plan

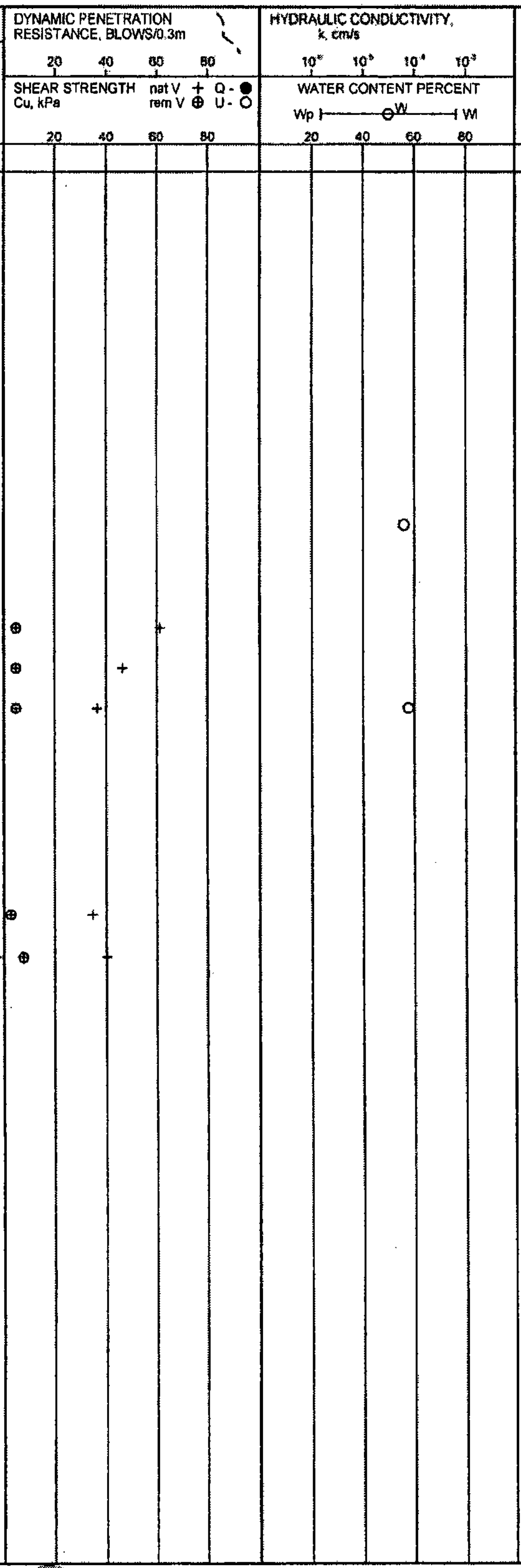
BORING DATE: Dec. 13, 2006

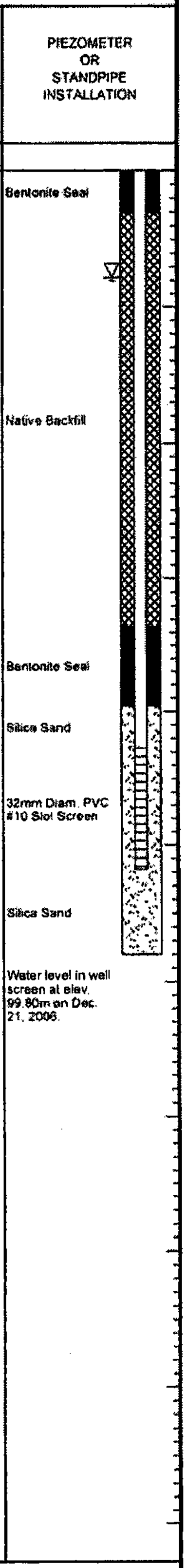
DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m
		GROUND SURFACE		100.52			
0	Power Auger 200mm Diam (Hollow Stem)	Brown sandy TOPSOIL		0.00			
		Stiff brown SILTY CLAY and CLAYEY SILT, some sand		100.21 0.31			
1					1	50 DO	2
		Stiff grey brown SILTY CLAY (Weathered Crust)		99.02 1.50			
					2	50 DO	4
2							
					3	50 DO	2
3		Stiff to firm grey SILTY CLAY		97.52 3.00			
4					4	50 DO	PH
					5	73 TP	PH
5							
		End of Borehole		94.72 5.80			
6							
7							
8							
9							
10							





Water level in well screen at elev. 99.80m on Dec. 21, 2006.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.N.
CHECKED: J.A.S.

MIS-BHS 001 06-1120-392.GPJ GLDR_CAN.GDT 11/1/07 NBHS

PROJECT: 06-1120-392

RECORD OF BOREHOLE: BH 06-7

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Dec. 13, 2006

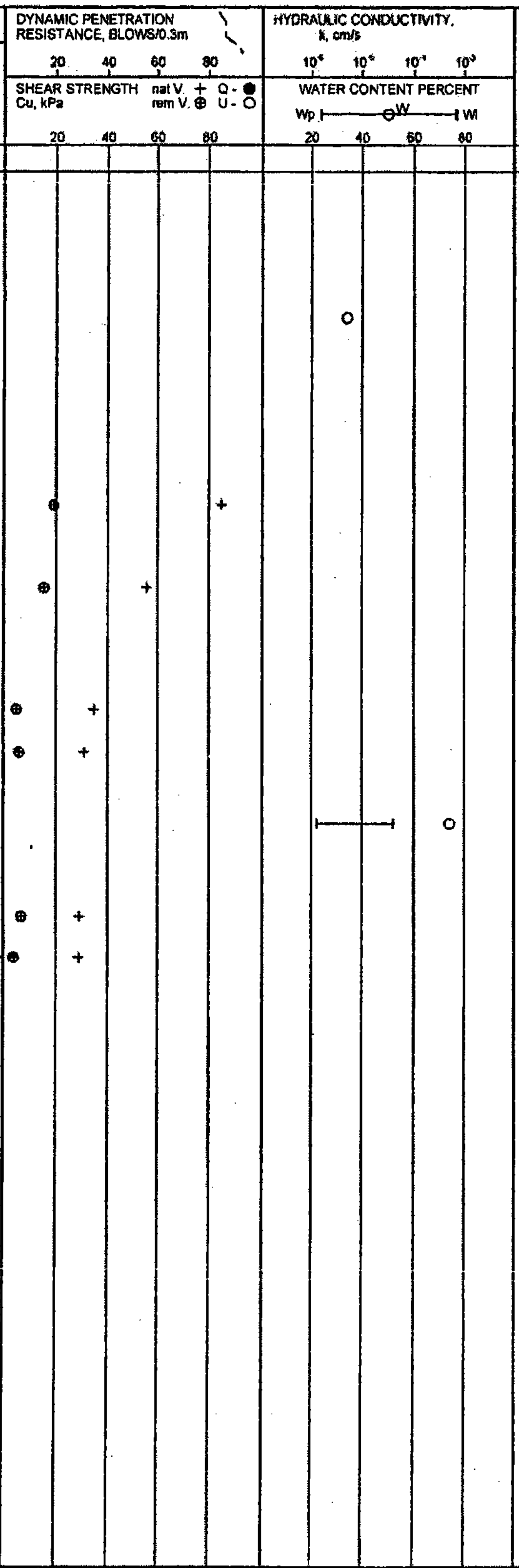
DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	100.85					
Power Auger 200mm Diam. (Hollow Stem)	Dark brown sandy TOPSOIL	0.00					
	Stiff brown CLAYEY SILT and SILTY CLAY with some sand seams, trace organic matter	100.54 0.31	1	50 DO	2		∇
	Stiff grey brown SILTY CLAY with some sand seams (Weathered Crust)	99.48 1.37	2	50 DO	3		
			3	50 DO	1		
	Firm grey SILTY CLAY	97.19 3.66	4	73 TP	PH	C*	
	End of Borehole	95.06 5.79					Water level in open hole at 1.30m depth below ground surface upon completion of drilling December 13, 2006.

*FOREIGN ODOUR NOTED IN SAMPLE



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: J.A.S.
CHECKED: J.A.S.

MIS-BHS 001 06-1120-392.GPJ GLDR_CAN.GDT 18/1/07 NBHS

PROJECT: 06-1120-392

RECORD OF BOREHOLE: BH 06-8

SHEET 1 OF 1

LOCATION: See Site Plan

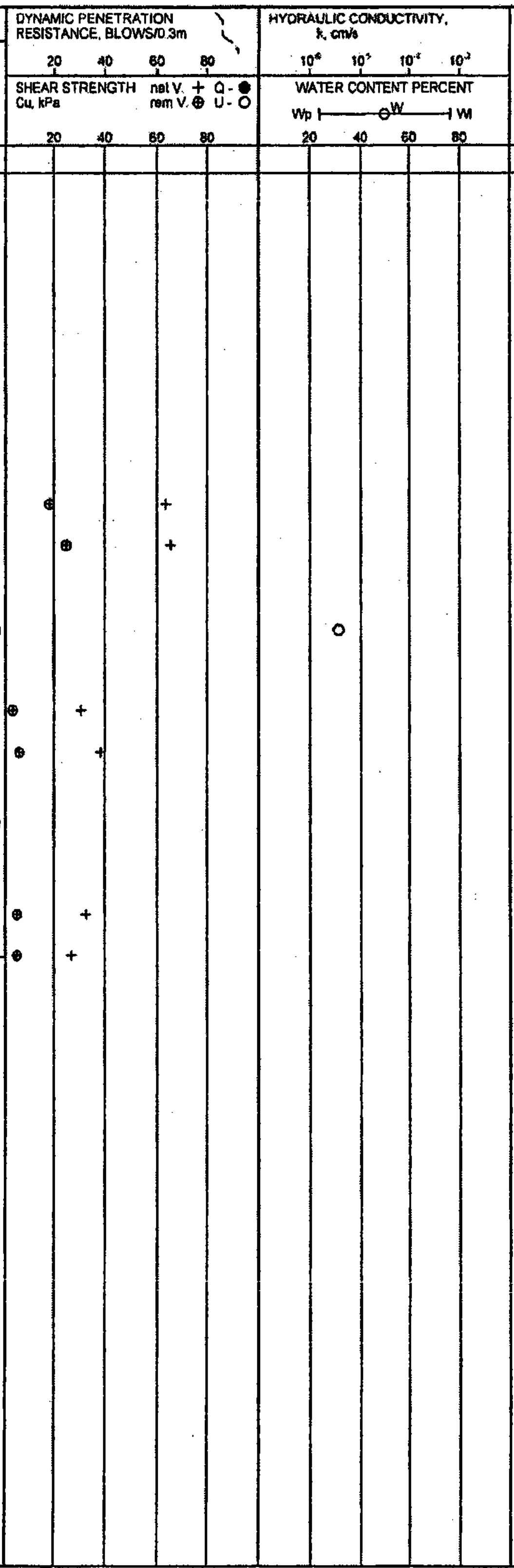
BORING DATE: Dec. 13, 2006

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		100.77					
0	Power Auger 200mm Diam. (Hollow Stem)	Brown sandy TOPSOIL	▤	0.00					
		Stiff grey brown SILTY CLAY with sand seams, some shells (Weathered Crust)	▨	100.53 0.24					
1					1	50 DO	3		
2					2	50 DO	3		∇
3		Firm grey SILTY CLAY, occasional sandy silt seam	▨	97.72 3.05	3	50 DO	PH		
4									
5					4	73 TP	PH		
				94.97 5.80					Water level in open hole at 1.63m depth below ground surface upon completion of drilling December 13, 2006.
6									
7									
8									
9									
10									



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: J.A.S.
CHECKED: J.A.S.

TABLE 1 (continued)

RECORD OF TEST PITS

Test Pit Number	Depth (metres)	Soil Description	
TP 94-3	~~0.00 - 0.10~~	~~Dark brown silty sand (TOPSOIL)~~	
	~~0.10 - 1.70~~	~~Brown SILTY SAND~~	
	~~1.70 - 2.00~~	~~Grey SILTY SAND, trace clay~~	
	~~2.00 - 2.20~~	~~Grey layered CLAYEY SILT and SANDY SILT~~	Cu @ 2.65m = 24 kPa Cu @ 3.3m = 31 kPa
	~~2.20 - 3.30~~	~~Grey layered SILTY CLAY and SANDY SILT~~	
		Notes: Groundwater inflow at 0.6 metres	
TP 94-4	~~0.00 - 0.20~~	~~Dark brown silty sand (TOPSOIL)~~	
	~~0.20 - 1.70~~	~~Brown fine to medium SAND, some silt~~	
	~~1.70 - 2.70~~	~~Grey brown SILTY CLAY, trace sand (WEATHERED CRUST)~~	Cu @ 2.1m = 29 kPa Cu @ 2.4m = 33 kPa Cu @ 2.7m = 32 kPa
	~~2.70 - 3.20~~	~~Grey SILTY CLAY, trace sand~~	Cu @ 2.9m = 25 kPa Cu @ 3.2m = 30 kPa
	3.20	End of test pit	
		Notes: Groundwater inflow at 1.7 metres	
TP 94-5	0.00 - 0.20	Dark brown sandy silt (TOPSOIL)	
	0.20 - 1.70	Grey brown SILTY fine SAND, trace clay	
	1.70 - 3.50	Grey brown SILTY CLAY, trace sand (WEATHERED CRUST)	Cu @ 1.9m = 43 kPa Cu @ 2.2m = 49 kPa Cu @ 2.4m = 49 kPa
	3.50	End of test pit	Cu @ 2.7m = 44 kPa Cu @ 3.1m = 47 kPa
		Notes: Groundwater inflow at 1.7 metres	Cu @ 3.5m = 42 kPa

TABLE 1 (continued)

RECORD OF TEST PITS

Test Pit Number	Depth (metres)	Soil Description	
TP 94-6	0.00 - 0.25	Dark brown silty sand (TOPSOIL)	
	0.25 - 1.20	Brown SILTY SAND	
	1.20 - 1.90	Brown SILTY SAND, trace clay	
	1.90 - 2.7	Grey brown SILTY CLAY (WEATHERED CRUST)	Cu @ 2.1m = 35 kPa Cu @ 2.4m = 44 kPa Cu @ 2.7m = 42 kPa
	2.7 - 4.0	Grey SILTY CLAY	Cu @ 3.0m = 39 kPa Cu @ 3.2m = 38 kPa Cu @ 3.5m = 49 kPa
	4.0	End of test pit	Cu @ 3.7m = 38 kPa
		Notes: Groundwater inflow at 1.9 metres	
TP 94-7	~~0.00 - 0.35~~	~~Dark brown silty sand (TOPSOIL)~~	
	~~0.35 - 2.00~~	~~Brown SILTY fine SAND, trace shells~~	
	~~2.00 - 2.70~~	~~Grey brown SILTY CLAY (WEATHERED CRUST)~~	Cu @ 2.3m = 47 kPa Cu @ 2.7m = 24 kPa
	~~2.70 - 3.30~~	~~Grey SILTY CLAY~~	Cu @ 3.0m = 25 kPa Cu @ 3.3 m =29 kPa
	3.30	End of test pit	
		Notes: Soil wet below 1.2 metres	
TP 94-8	0.00 - 0.35	Dark brown silty clay (TOPSOIL)	
	0.35 - 3.30	Grey brown SILTY CLAY (WEATHERED CRUST)	Cu @ 1.8m = 37 kPa Cu @ 2.1m = 59 kPa
	3.30	End of test pit	Cu @ 2.4m = 63 kPa Cu @ 2.7m = 44 kPa Cu @ 3.0 m = 45 kPa
		Notes: Groundwater inflow at 1.5 metres	

TABLE 1 (continued)

RECORD OF TEST PITS

Test Pit Number	Depth (metres)	Soil Description
TP 94-9	0.00 - 0.30	Dark brown silty sand (TOPSOIL)
	0.30 - 1.10	Grey brown SILTY CLAY, some sand (WEATHERED CRUST)
	1.10 - 3.20	Grey brown silty sand, some gravel, trace clay, numerous cobbles and boulders (GLACIAL TILL)
	3.20	End of test pit
		Notes: Test pit dry
TP 94-10	~~0.00 - 0.20~~	~~Dark brown silty sand (TOPSOIL)~~
	~~0.20 - 3.10~~	~~Grey brown SILTY CLAY (WEATHERED CRUST)~~
	~~3.10 - 3.40~~	~~Grey SILTY CLAY~~
	~~3.40~~	~~End of test pit~~
		~~Notes: Groundwater inflow from weeping tile at 1.0 metres~~

Cu @ 1.6m = 48 kPa
Cu @ 1.9m = 42 kPa
Cu @ 2.2m = 49 kPa
Cu @ 2.4m = 41 kPa
Cu @ 2.7m > 49 kPa
Cu @ 3.0m = 39 kPa
Cu @ 3.3m = 45 kPa
Cu @ 3.6m = 37 kPa
Cu @ 3.9m = 45 kPa

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their "sensitivity". The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called "mechanical breaks") are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu - Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

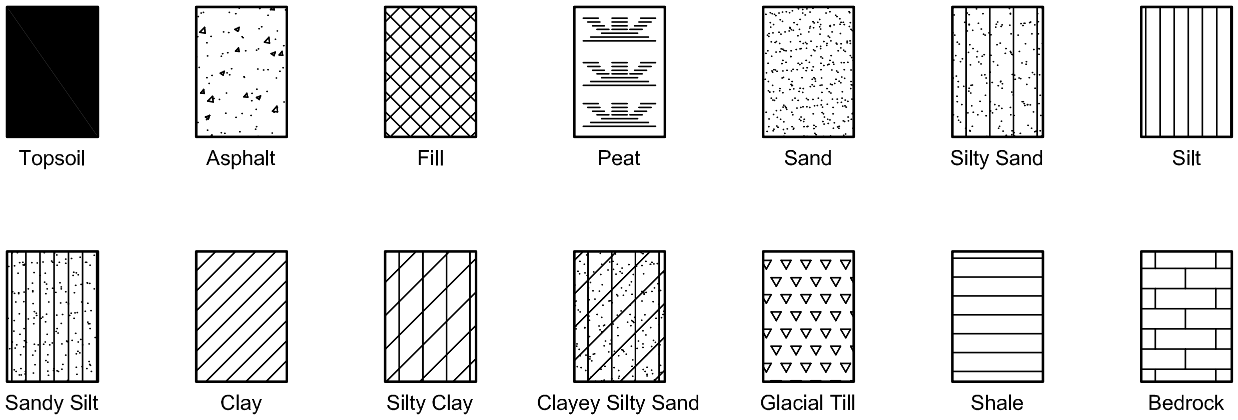
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

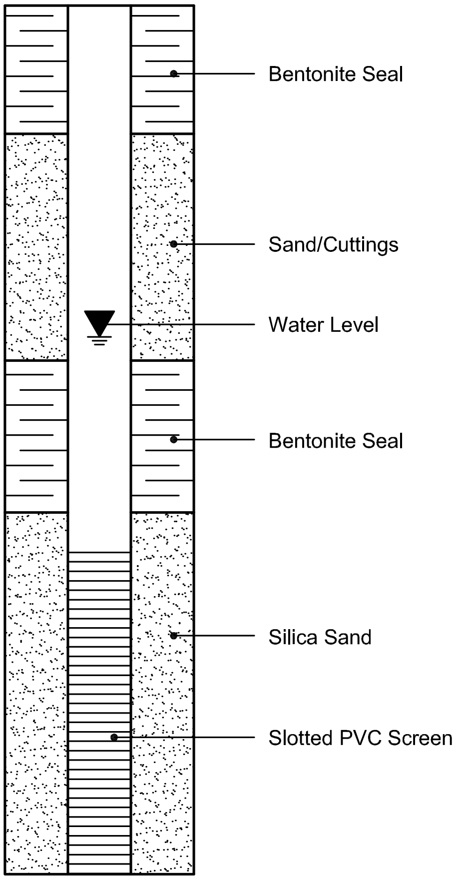
SYMBOLS AND TERMS (continued)

STRATA PLOT

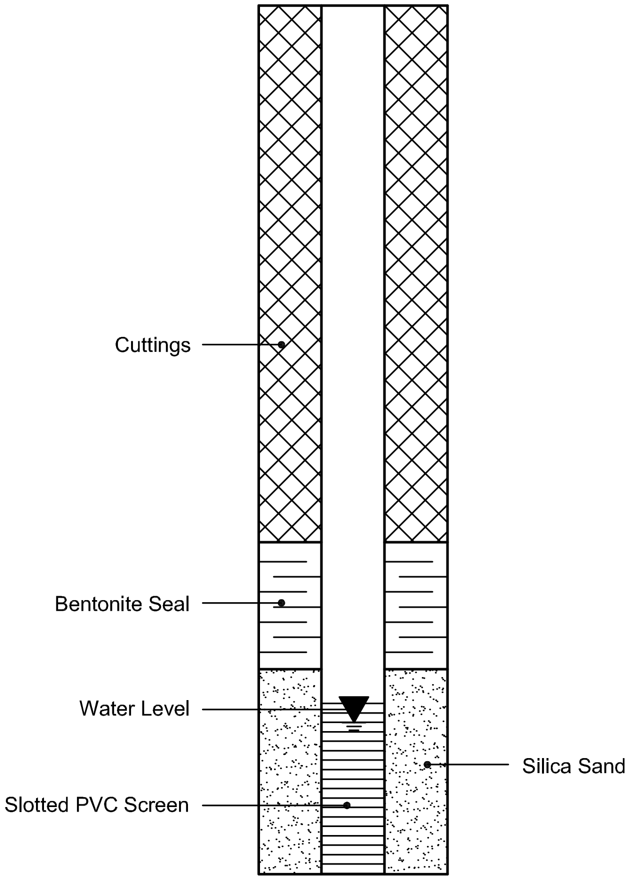


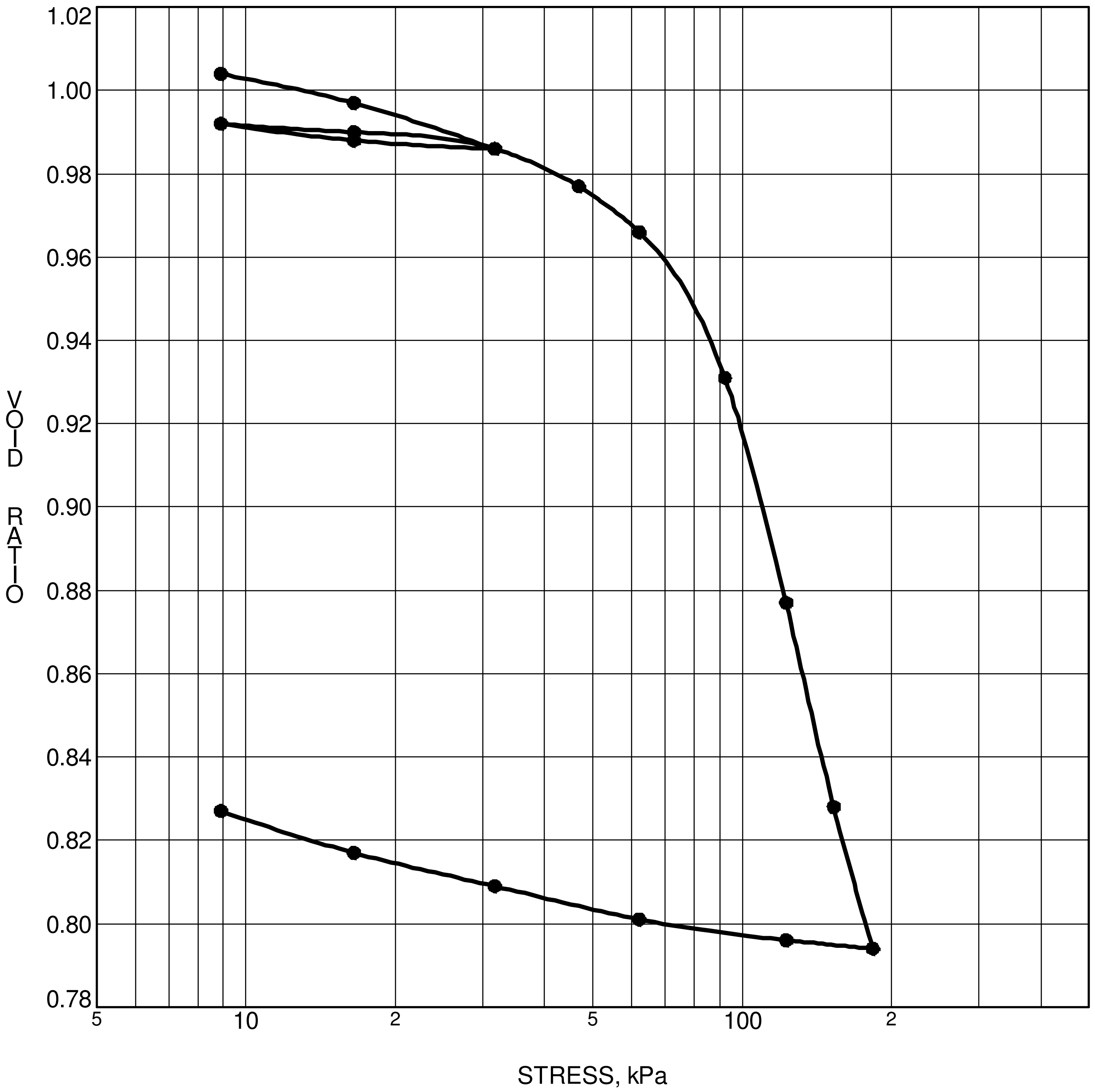
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





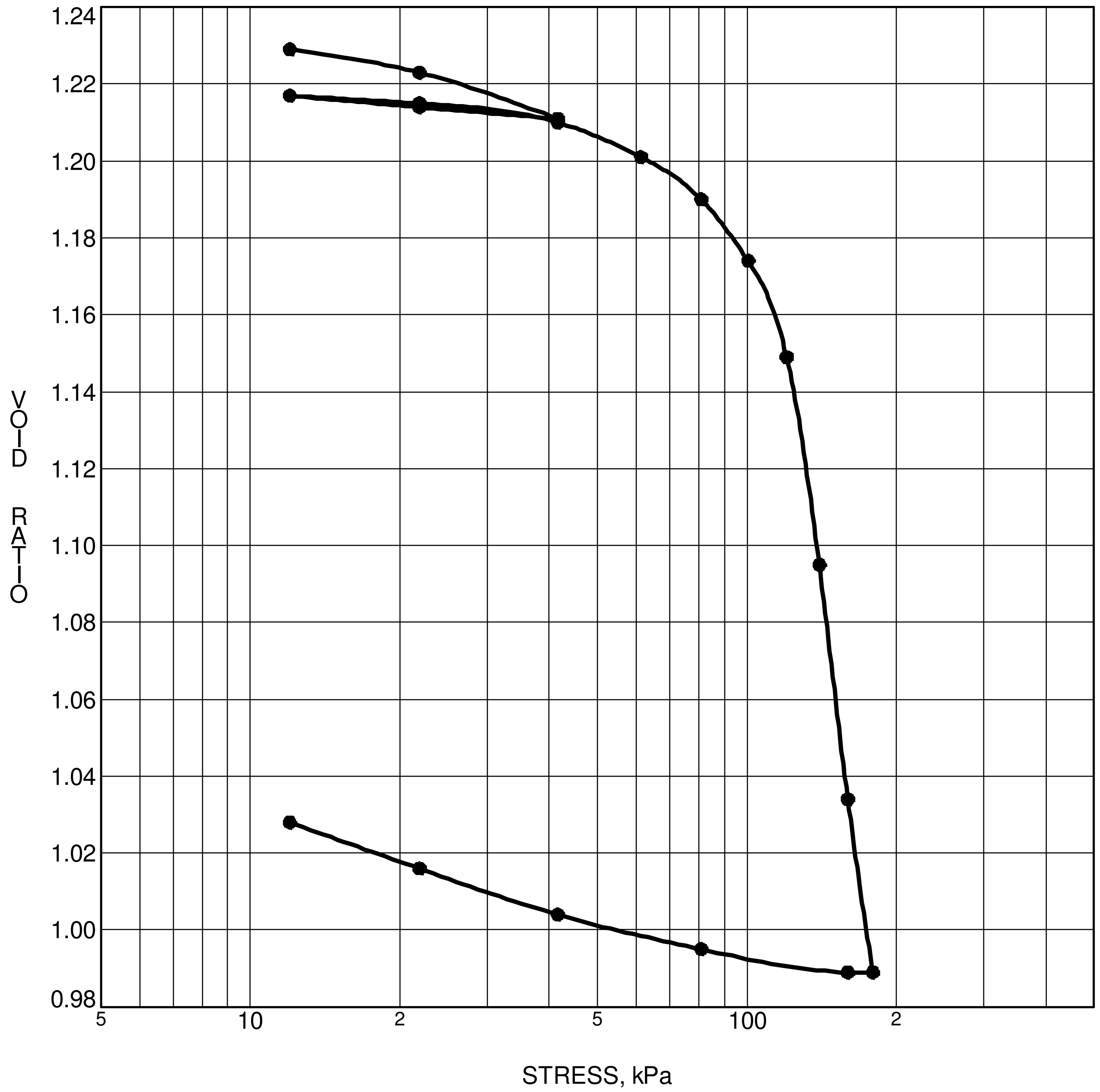
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 1**	p'_o	**40** kPa	Ccr	**0.012**
Sample No.	**TW 2**	p'_c	**78** kPa	Cc	**0.471**
Sample Depth	**3.45** m	OC Ratio	**2.0**	Wo	**36.7** %
Sample Elev.	**95.41** m	Void Ratio	**1.01**	Unit Wt.	**18.6** kN/m^3

CLIENT	**Monarch Group**	FILE NO.	**PG2233**
PROJECT	**Supplemental Geotechnical Investigation - West Park Residential Development**	DATE	**11/20/2010**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 2**	p'_o	**54** kPa	Ccr	**0.009**
Sample No.	**TW 2**	p'_c	**113** kPa	Cc	**0.934**
Sample Depth	**5.76** m	OC Ratio	**2.1**	Wo	**45.2** %
Sample Elev.	**93.12** m	Void Ratio	**1.242**	Unit Wt.	**17.5** kN/m ^{3}

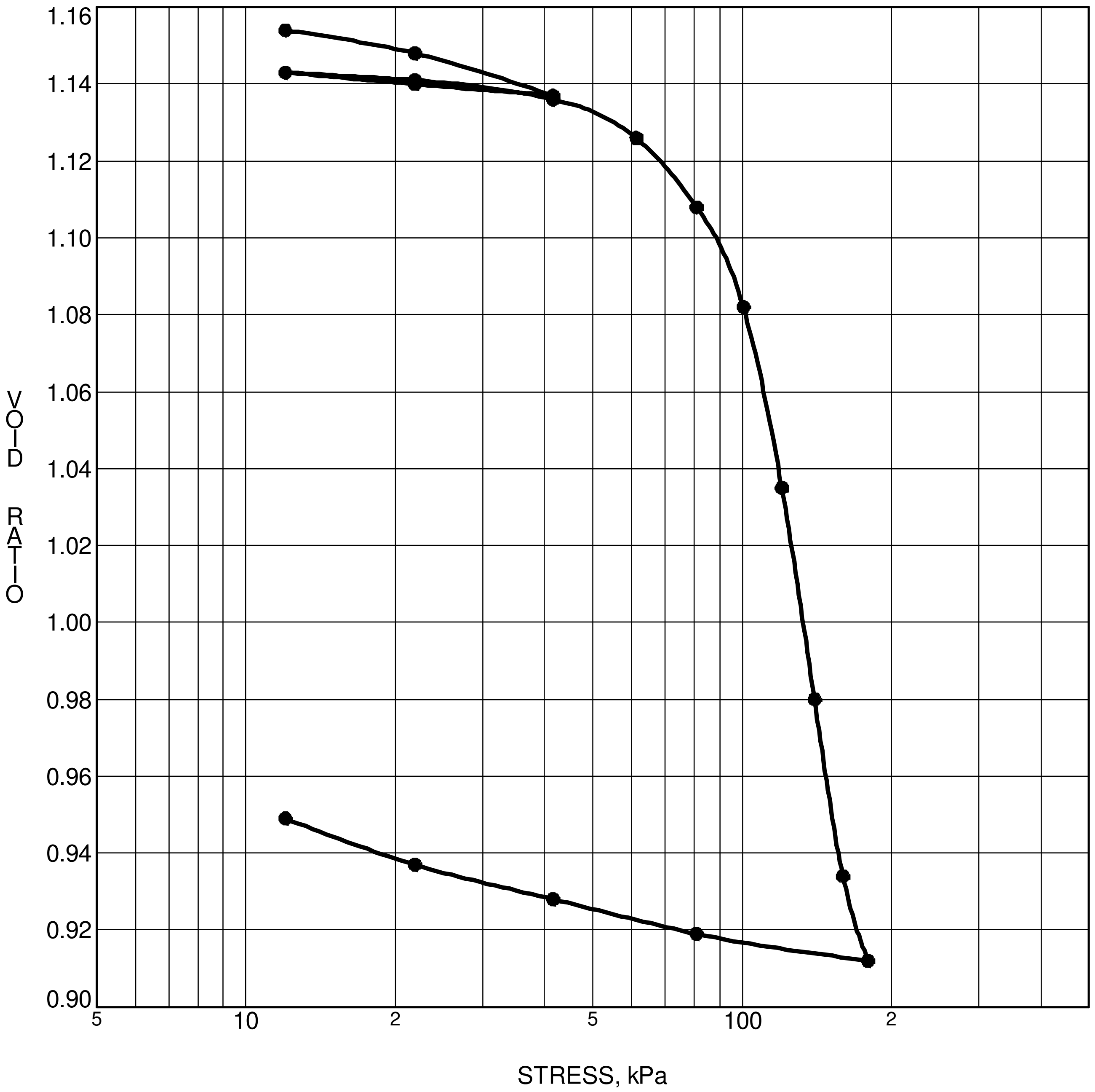
CLIENT **Monarch Group** FILE NO. **PG2233**

PROJECT **Supplemental Geotechnical Investigation - West Park Residential Development** DATE **11/19/2010**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



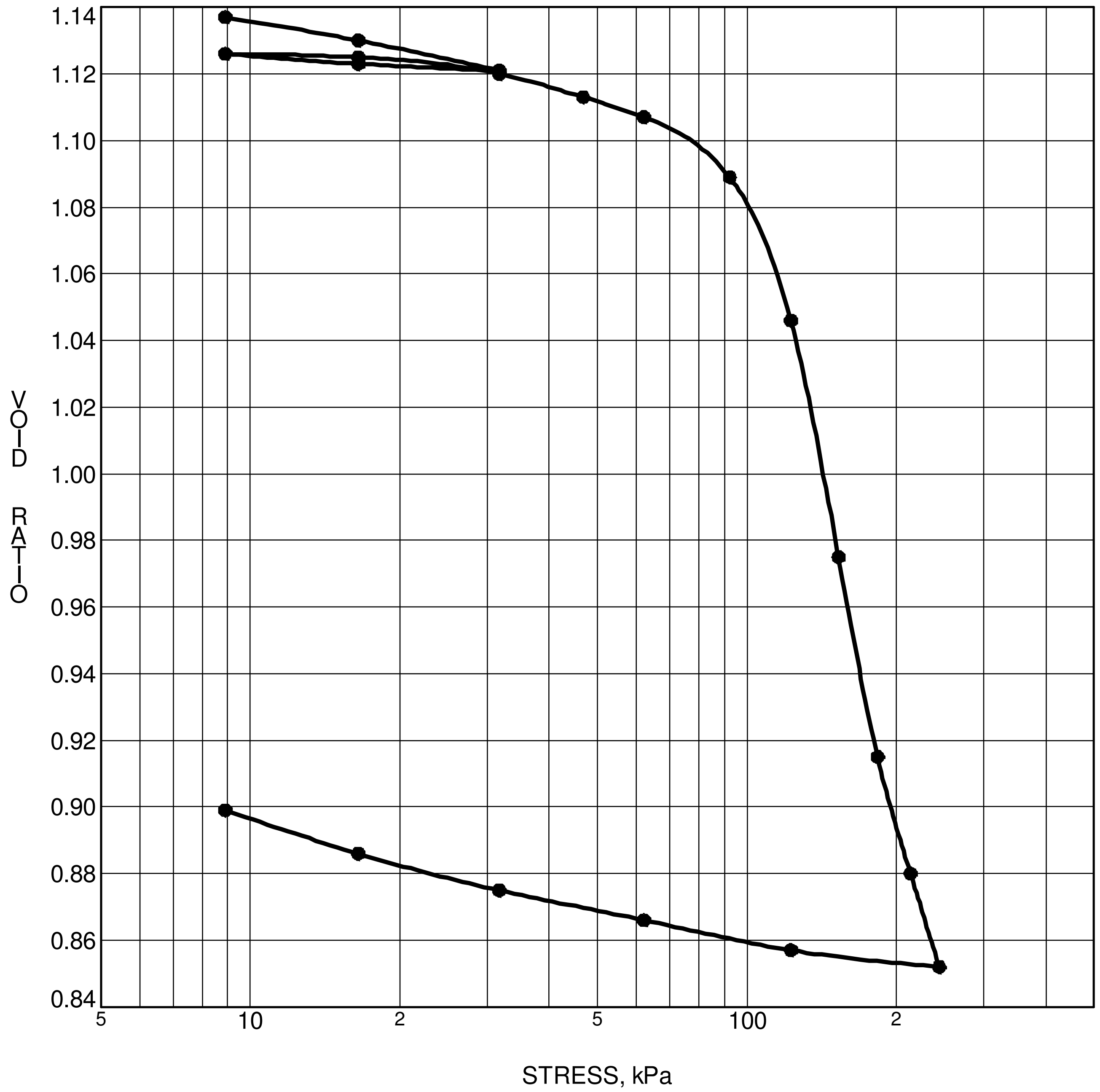
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 3**	p'_o	**50** kPa	Ccr	**0.013**
Sample No.	**TW 2**	p'_c	**96** kPa	Cc	**0.808**
Sample Depth	**5.03** m	OC Ratio	**1.9**	Wo	**42.5** %
Sample Elev.	**93.59** m	Void Ratio	**1.167**	Unit Wt.	**17.9** kN/m ^{3}

CLIENT	**Monarch Group**	FILE NO.	**PG2233**
PROJECT	**Supplemental Geotechnical Investigation - West Park Residential Development**	DATE	**11/25/2010**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 4**	p'_o	**59** kPa	Ccr	**0.010**
Sample No.	**TW 4**	p'_c	**110** kPa	Cc	**0.714**
Sample Depth	**6.54** m	OC Ratio	**1.9**	Wo	**41.6** %
Sample Elev.	**92.14** m	Void Ratio	**1.143**	Unit Wt.	**17.8** kN/m^3

CLIENT **Monarch Group**

PROJECT **Supplemental Geotechnical Investigation - West Park Residential Development**

FILE NO. **PG2233**

DATE **11/19/2010**

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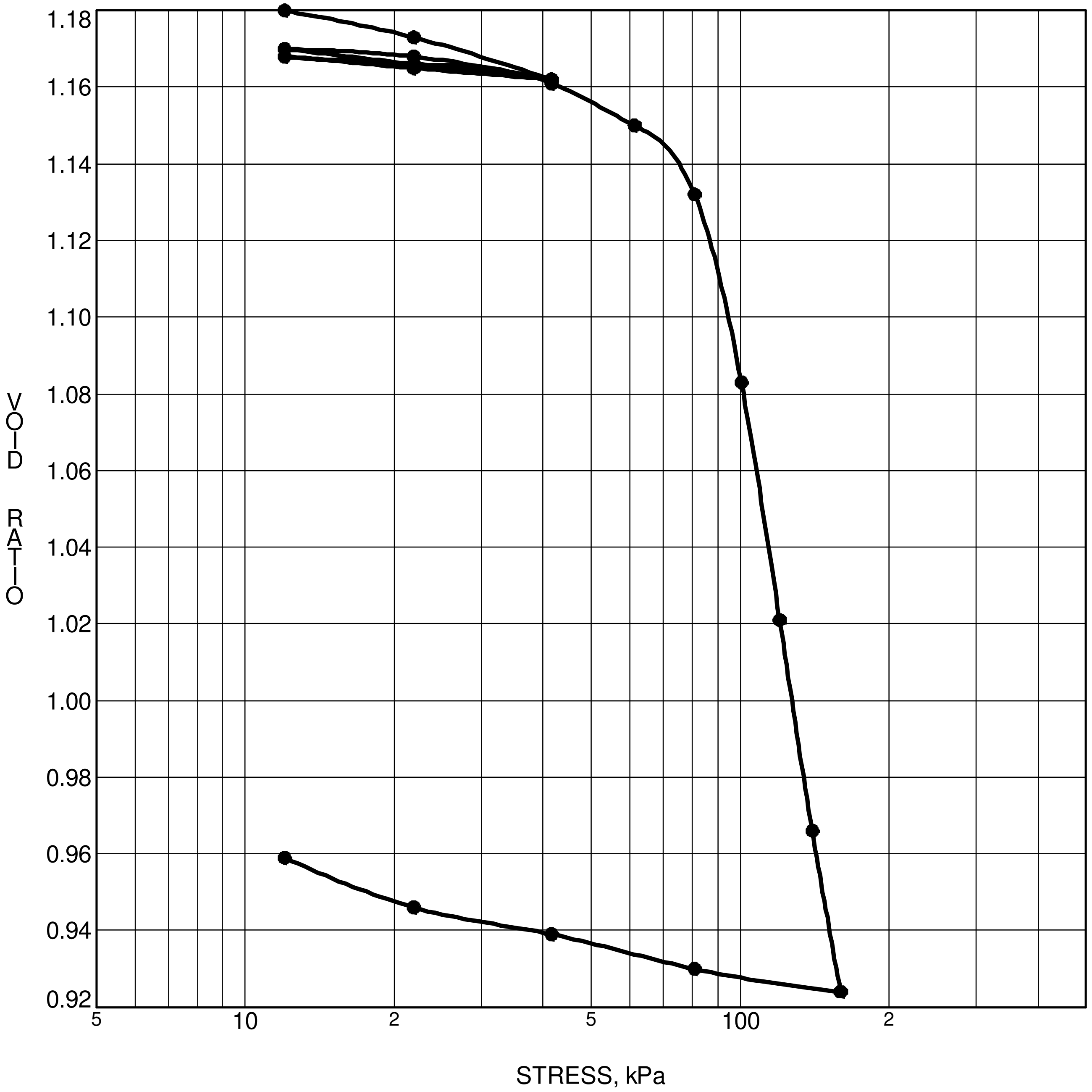
CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 6**	p'_o	**40** kPa	Ccr	**0.013**
Sample No.	**TW 2**	p'_c	**84** kPa	Cc	**0.802**
Sample Depth	**3.42** m	OC Ratio	**2.1**	Wo	**43.3** %
Sample Elev.	**93.73** m	Void Ratio	**1.192**	Unit Wt.	**17.8** kN/m ^{3}

CLIENT **Monarch Group**

FILE NO. **PG2233**

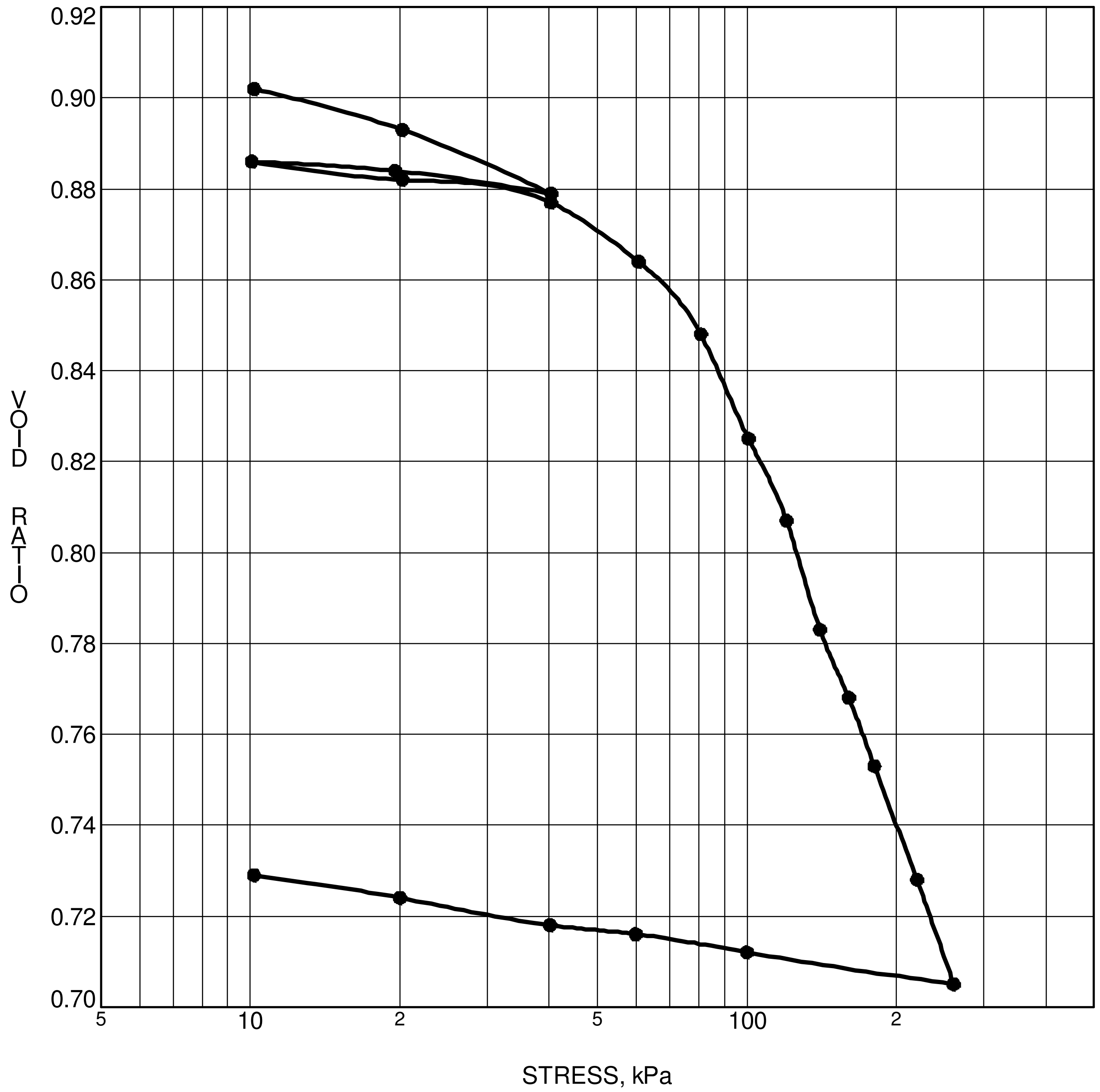
PROJECT **Supplemental Geotechnical Investigation - West Park Residential Development**

DATE **11/22/2010**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 9**	p'_o	**45** kPa	Ccr	**0.015**
Sample No.	**TW 5**	p'_c	**77** kPa	Cc	**0.290**
Sample Depth	**4.19** m	OC Ratio	**1.7**	Wo	**33.3** %
Sample Elev.	**94.17** m	Void Ratio	**0.902**	Unit Wt.	**19.0** kN/m ^{3}

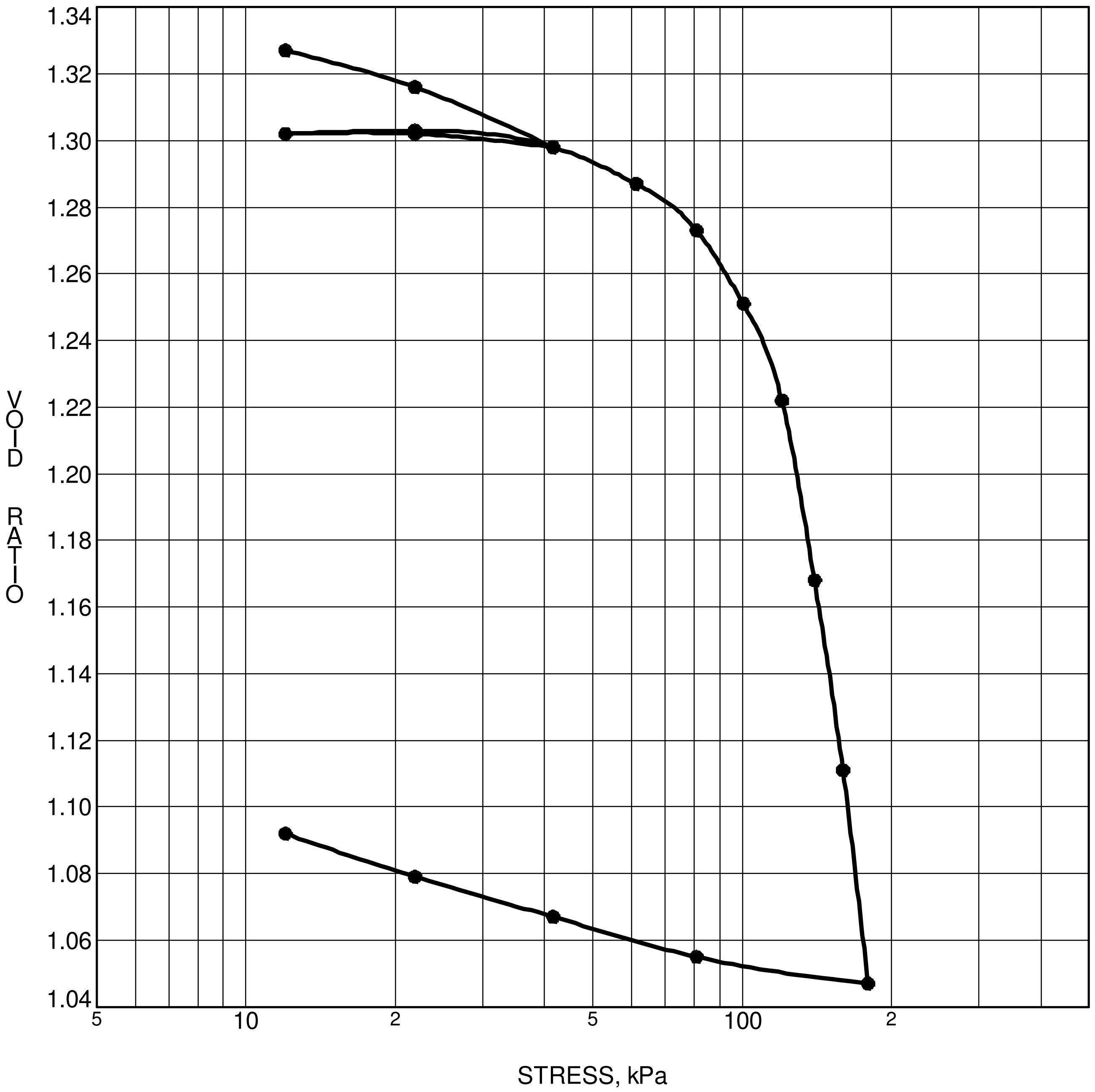
CLIENT **Monarch Group** FILE NO. **PG2233**

PROJECT **Supplemental Geotechnical Investigation - West Park Residential Development** DATE **03/18/2011**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



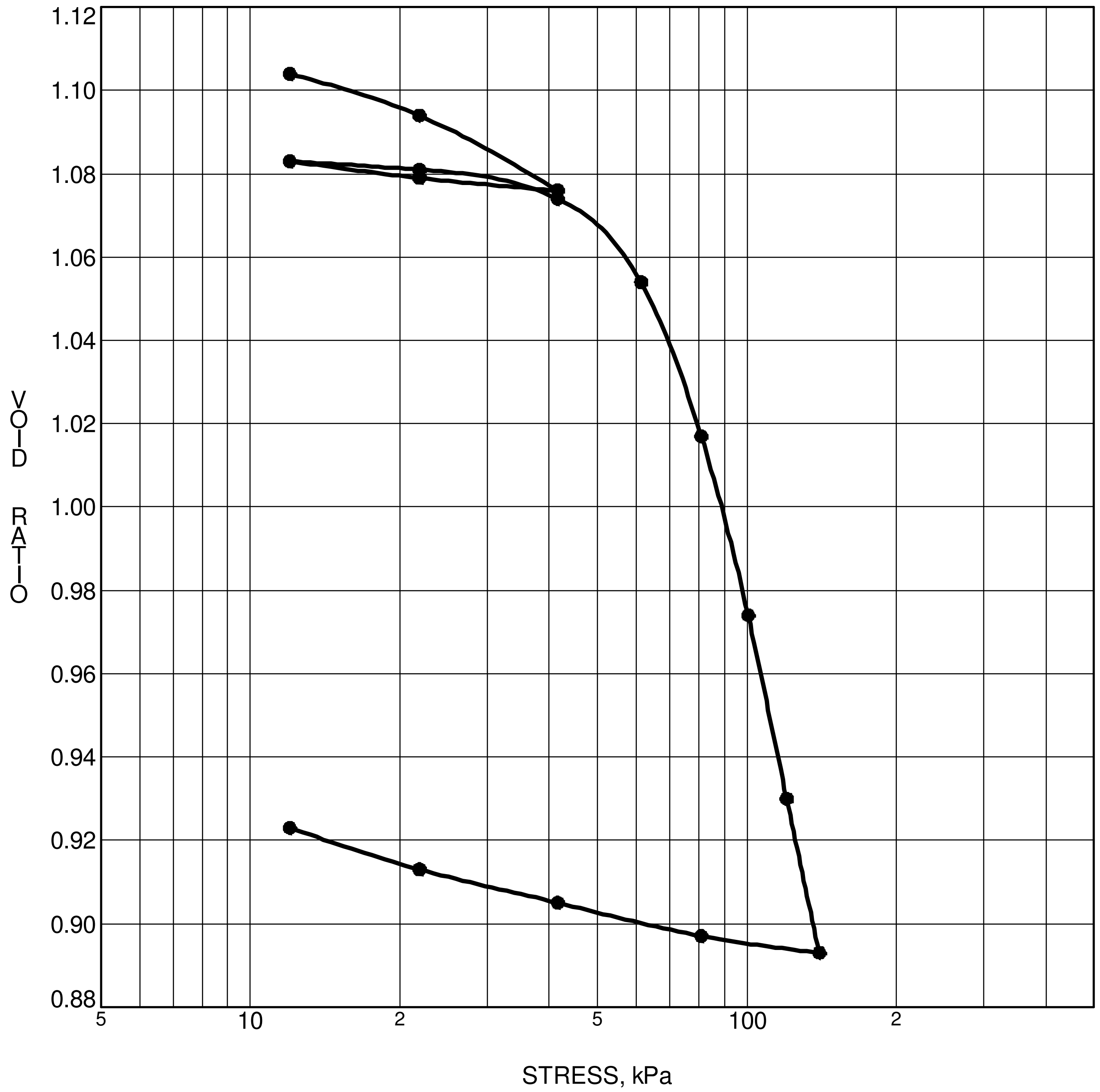
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 9**	p'_o	**69** kPa	Ccr	**0.015**
Sample No.	**TW 6**	p'_c	**116** kPa	Cc	**1.104**
Sample Depth	**8.06** m	OC Ratio	**1.7**	Wo	**48.9** %
Sample Elev.	**90.30** m	Void Ratio	**1.327**	Unit Wt.	**17.6** kN/m ^{3}

CLIENT	**Monarch Group**	FILE NO.	**PG2233**
PROJECT	**Supplemental Geotechnical Investigation - West Park Residential Development**	DATE	**03/09/2011**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH10**	p'_o	**36** kPa	Ccr	**0.015**
Sample No.	**TW 5**	p'_c	**70** kPa	Cc	**0.586**
Sample Depth	**3.30** m	OC Ratio	**1.9**	Wo	**40.6** %
Sample Elev.	**94.81** m	Void Ratio	**1.104**	Unit Wt.	**18.4** kN/m ^{3}

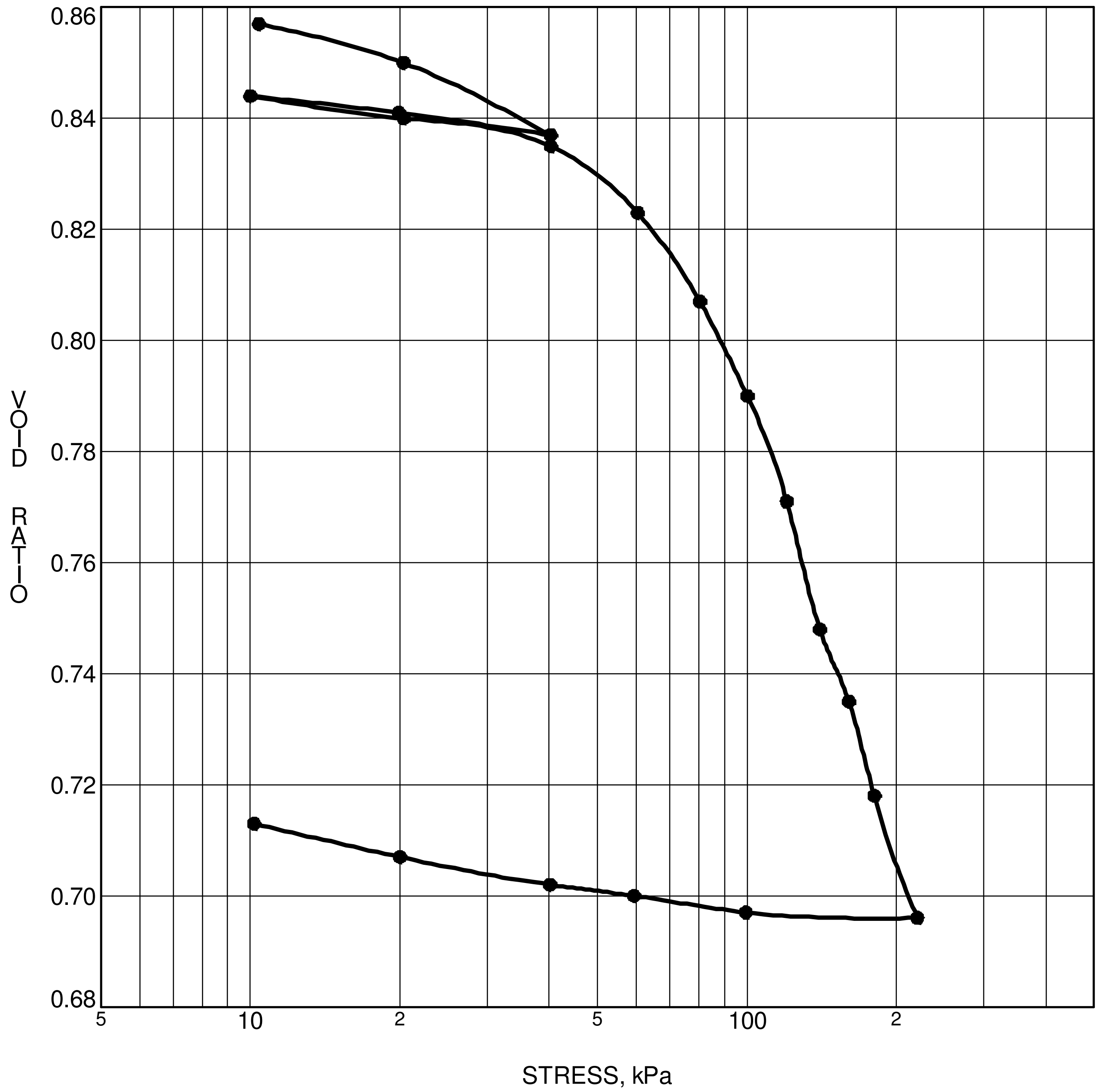
CLIENT **Monarch Group** FILE NO. **PG2233**

PROJECT **Supplemental Geotechnical Investigation - West Park Residential Development** DATE **03/24/2011**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



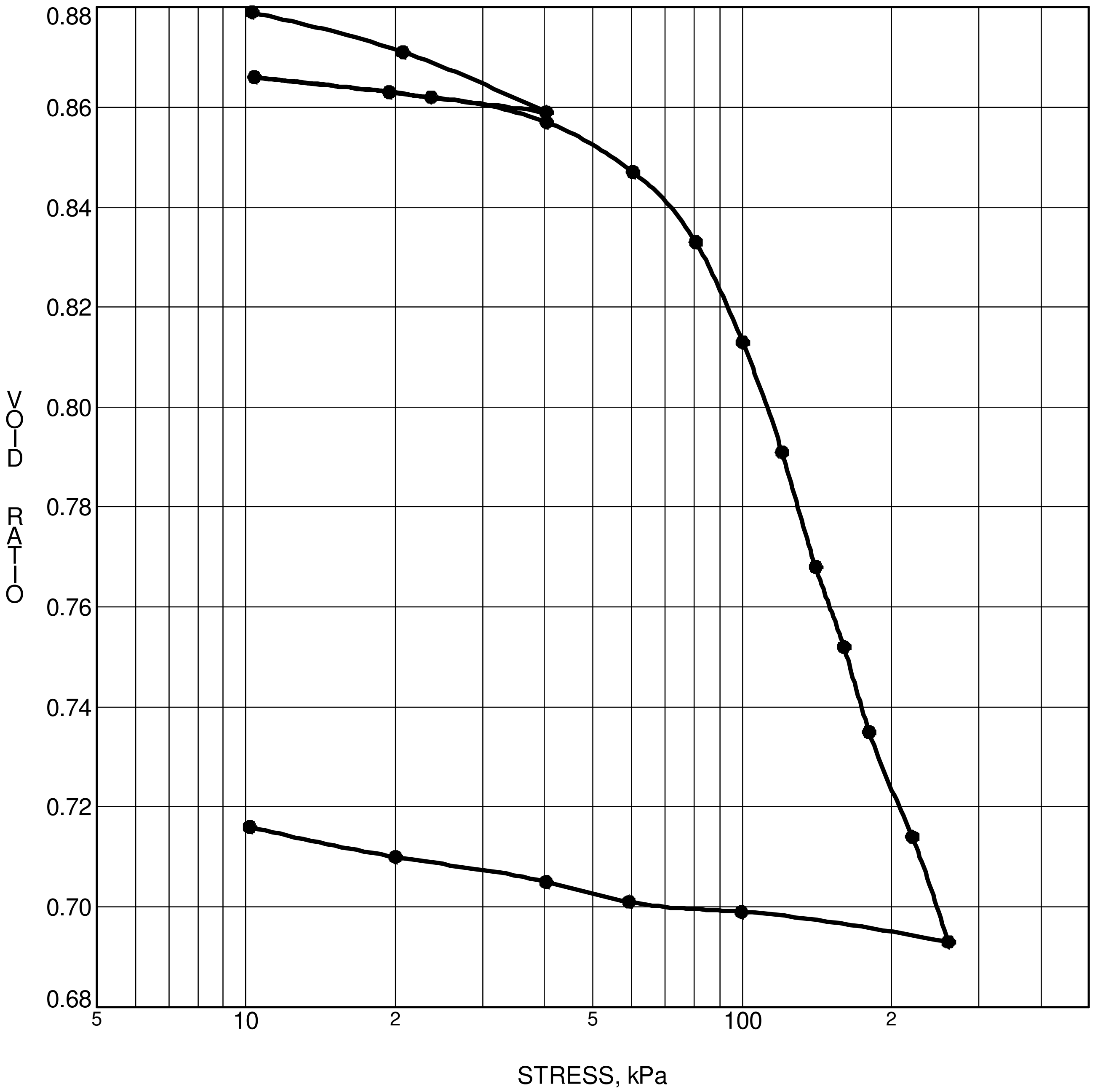
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH12**	p'_o	**34** kPa	Ccr	**0.014**
Sample No.	**TW 5**	p'_c	**85** kPa	Cc	**0.281**
Sample Depth	**3.38** m	OC Ratio	**2.5**	Wo	**31.6** %
Sample Elev.	**95.05** m	Void Ratio	**0.857**	Unit Wt.	**19.5** kN/m ^{3}

CLIENT	**Monarch Group**	FILE NO.	**PG2233**
PROJECT	**Supplemental Geotechnical Investigation - West Park Residential Development**	DATE	**03/10/2011**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH14**	p'_o	**45** kPa	Ccr	**0.012**
Sample No.	**TW 4**	p'_c	**88** kPa	Cc	**0.304**
Sample Depth	**4.27** m	OC Ratio	**2.0**	Wo	**32.4** %
Sample Elev.	**94.42** m	Void Ratio	**0.879**	Unit Wt.	**19.4** kN/m ^{3}

CLIENT **Monarch Group**

FILE NO. **PG2233**

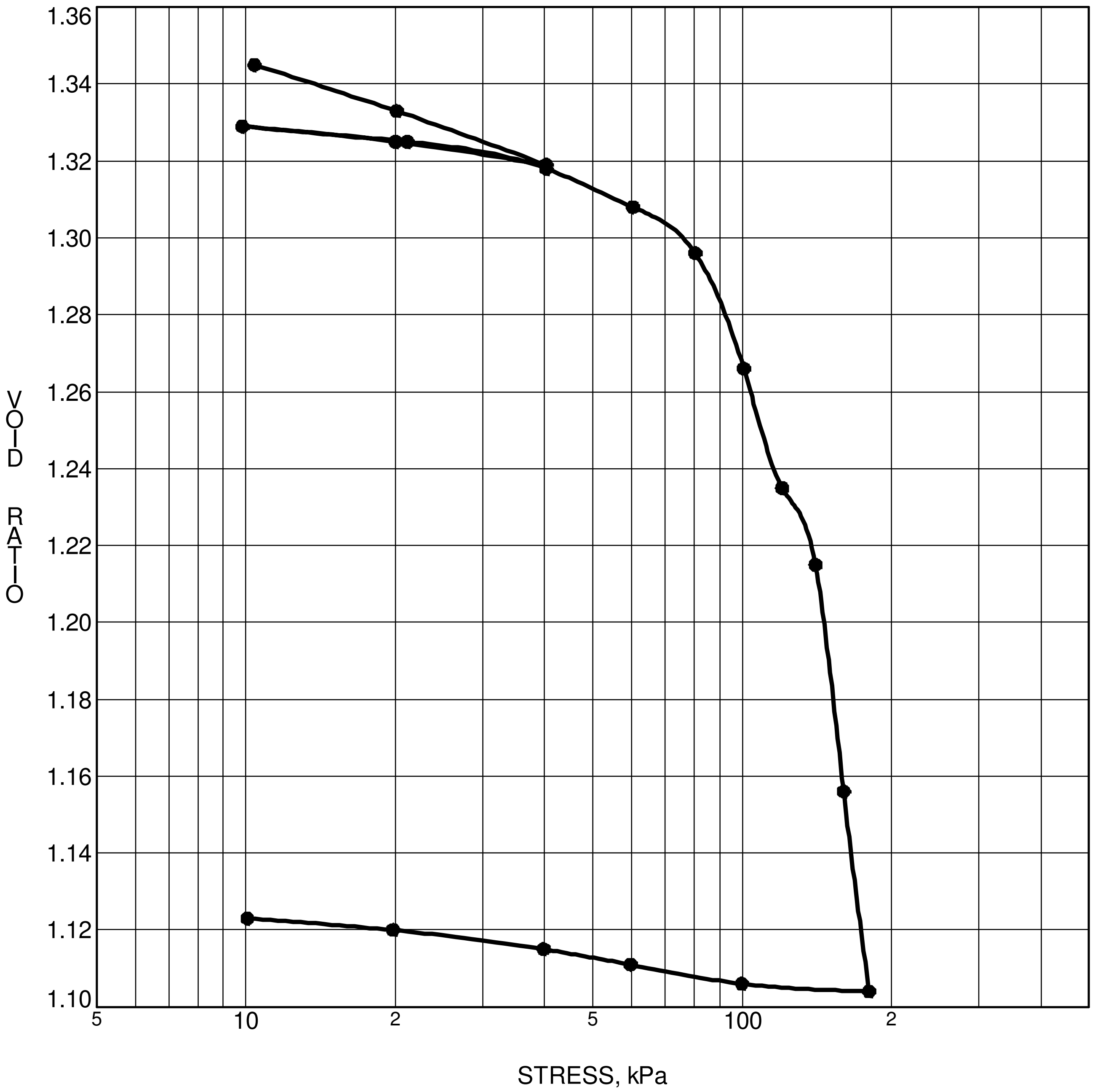
PROJECT **Supplemental Geotechnical Investigation - West Park Residential Development**

DATE **03/21/2011**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH15**	p'_o	**41** kPa	Ccr	**0.017**
Sample No.	**TW 4**	p'_c	**85** kPa	Cc	**0.351**
Sample Depth	**3.50** m	OC Ratio	**2.1**	Wo	**49.6** %
Sample Elev.	**94.42** m	Void Ratio	**1.345**	Unit Wt.	**12.6** kN/m^3

CLIENT **Monarch Group**

FILE NO. **PG2233**

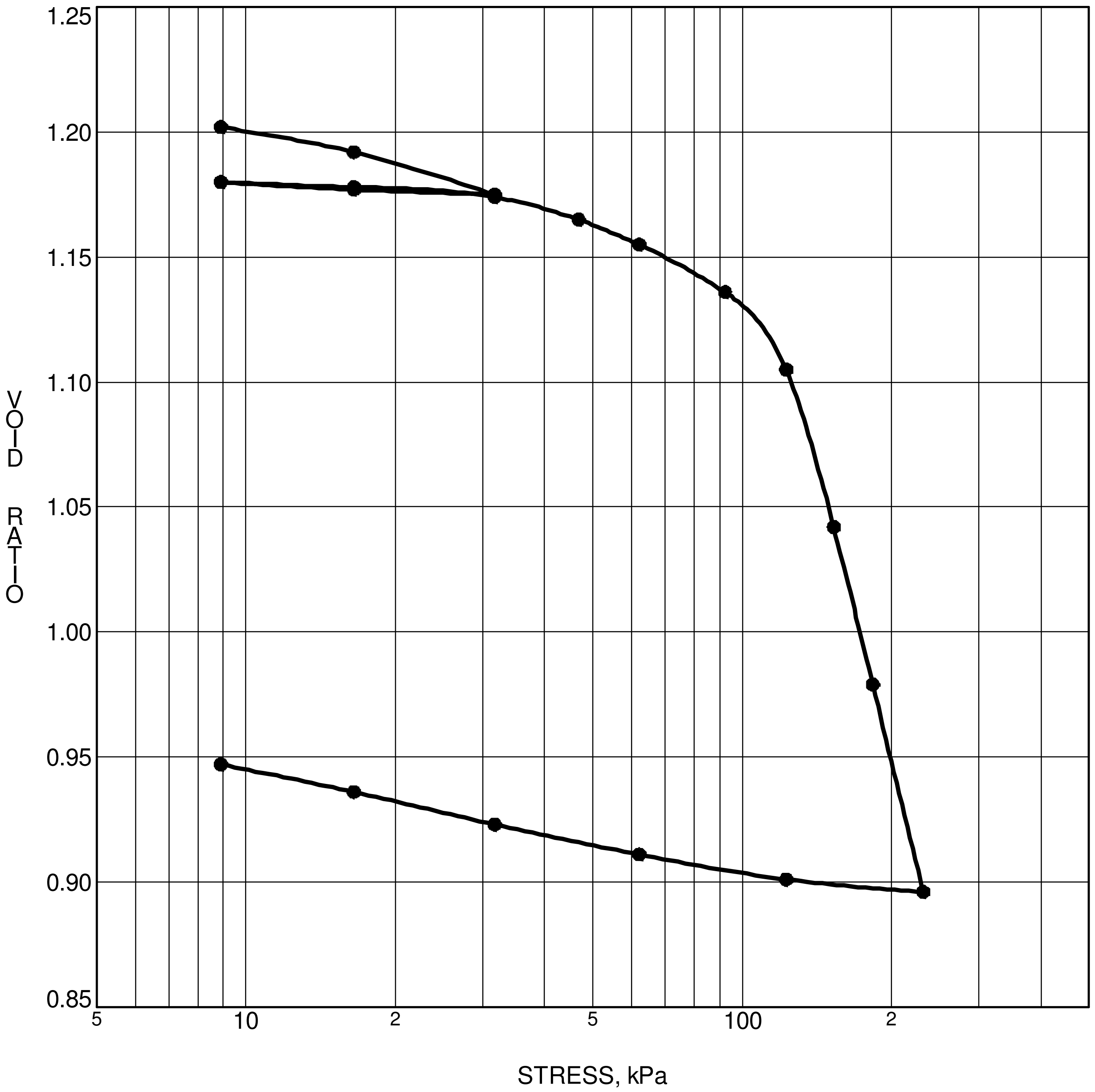
PROJECT **Supplemental Geotechnical Investigation - West Park Residential Development**

DATE **03/21/2011**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH15**	p'$_o$	**78** kPa	Ccr	**0.011**
Sample No.	**TW 5**	p'$_c$	**121** kPa	Cc	**0.815**
Sample Depth	**9.55** m	OC Ratio	**1.6**	Wo	**44.2** %
Sample Elev.	**88.37** m	Void Ratio	**1.202**	Unit Wt.	**17.5** kN/m ^{3}

CLIENT **Monarch Group**

FILE NO. **PG2233**

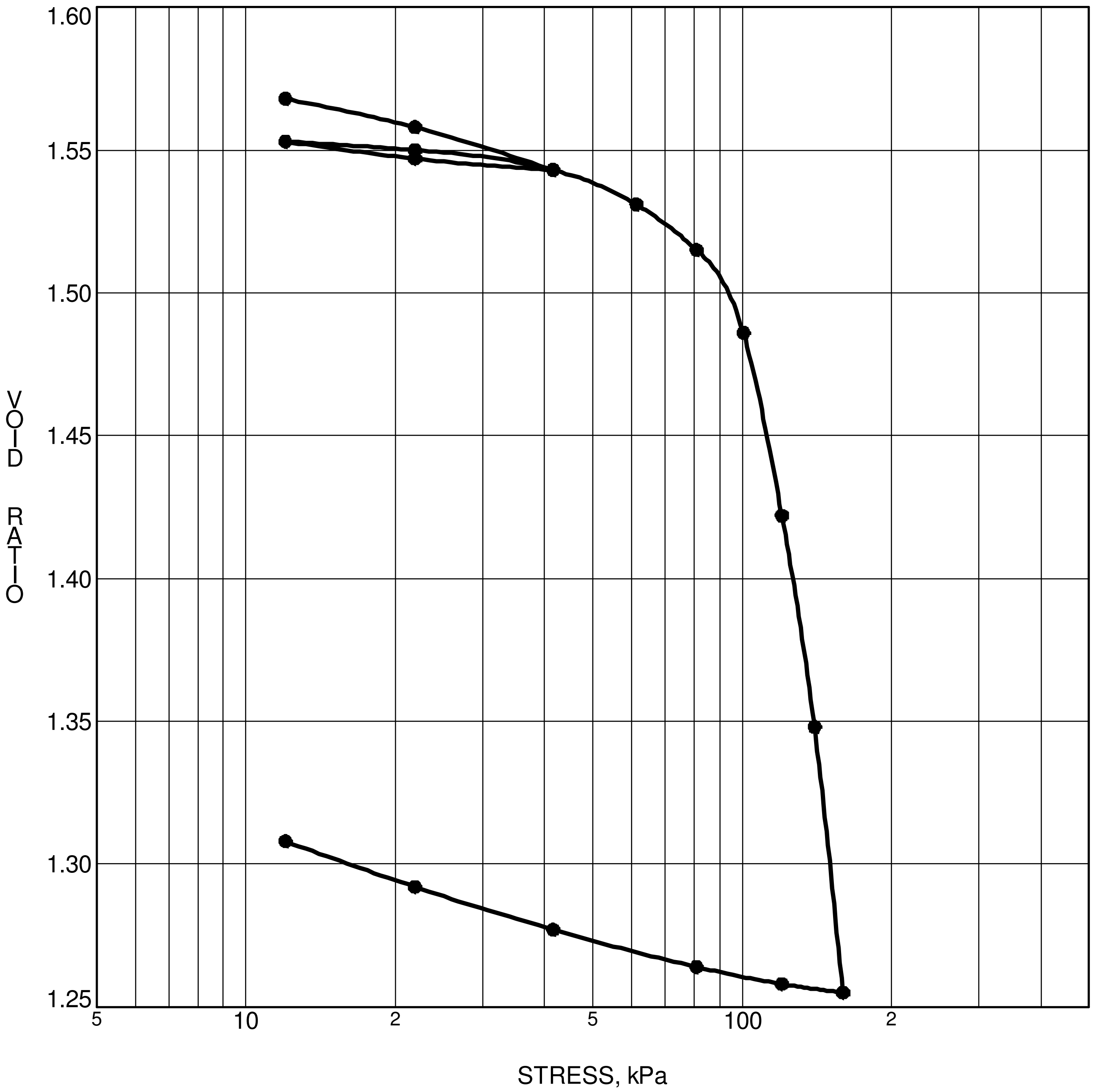
PROJECT **Supplemental Geotechnical Investigation - West Park Residential Development**

DATE **03/09/2011**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



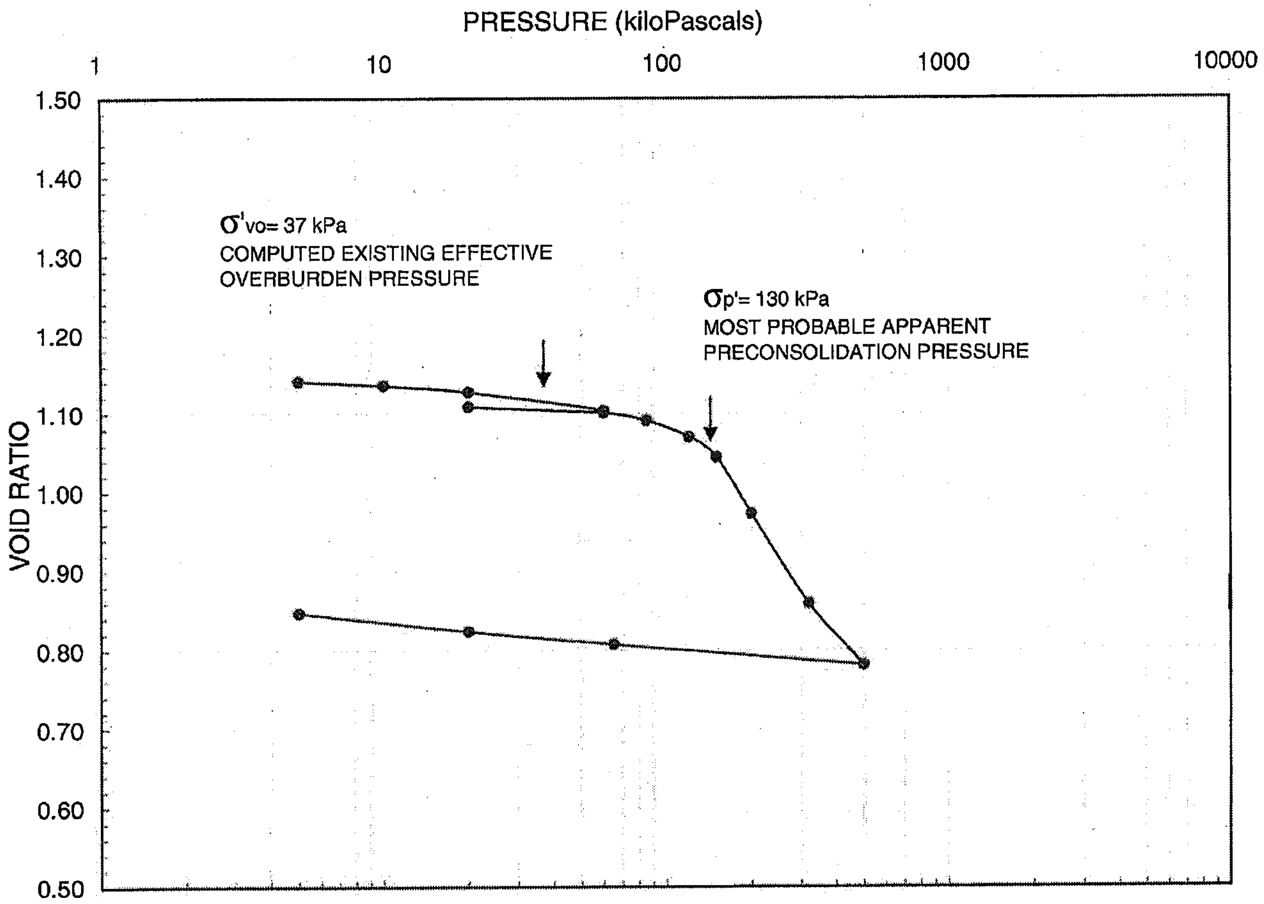
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH16**	p'_o	**45** kPa	Ccr	**0.019**
Sample No.	**TW 5**	p'_c	**103** kPa	Cc	**1.316**
Sample Depth	**4.13** m	OC Ratio	**2.3**	Wo	**57.4** %
Sample Elev.	**94.17** m	Void Ratio	**1.568**	Unit Wt.	**16.8** kN/m ^{3}

CLIENT	**Monarch Group**	FILE NO.	**PG2233**
PROJECT	**Supplemental Geotechnical Investigation - West Park Residential Development**	DATE	**03/09/2011**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



LEGEND

Borehole:	06-2	w_i = 40%	S_o = 98%
Sample:	4	w_f = 31%	C_c = 0.56
Depth (m):	5.00	w_l = 31%	C_r = 0.02
		w_p = 18%	γ= 18.2 kg/m^3

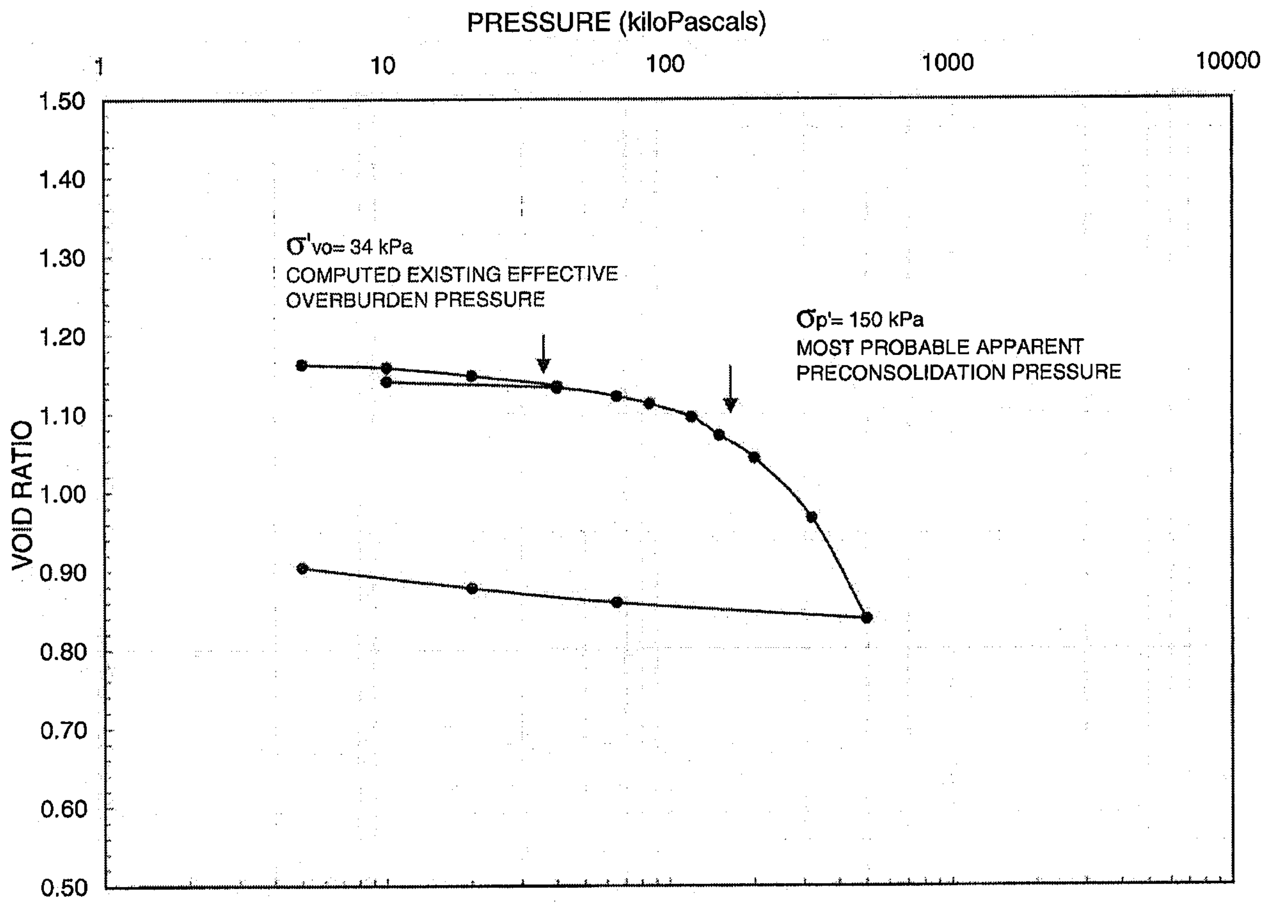
Golder Associates

SCALE	AS SHOWN	TITLE	
DATE	01/11/07		
DESIGN	NA		
CADD	NA		
CHECK			
REVIEW		FIGURE	3

CONSOLIDATION TEST RESULTS

FILE No. Consolidation summary

PROJECT No. 061120392 REV. 0



σ'vo= 34 kPa
COMPUTED EXISTING EFFECTIVE
OVERBURDEN PRESSURE

σp'= 150 kPa
MOST PROBABLE APPARENT
PRECONSOLIDATION PRESSURE

LEGEND

Borehole: 06-4
Sample: 4
Depth (m): 4.40

w_i = 42%
w_f = 33%
w_l = 27%
w_p = 17%

S_o = 99%
C_c = 0.40
C_r = 0.020
γ= 17.9 kg/m^3

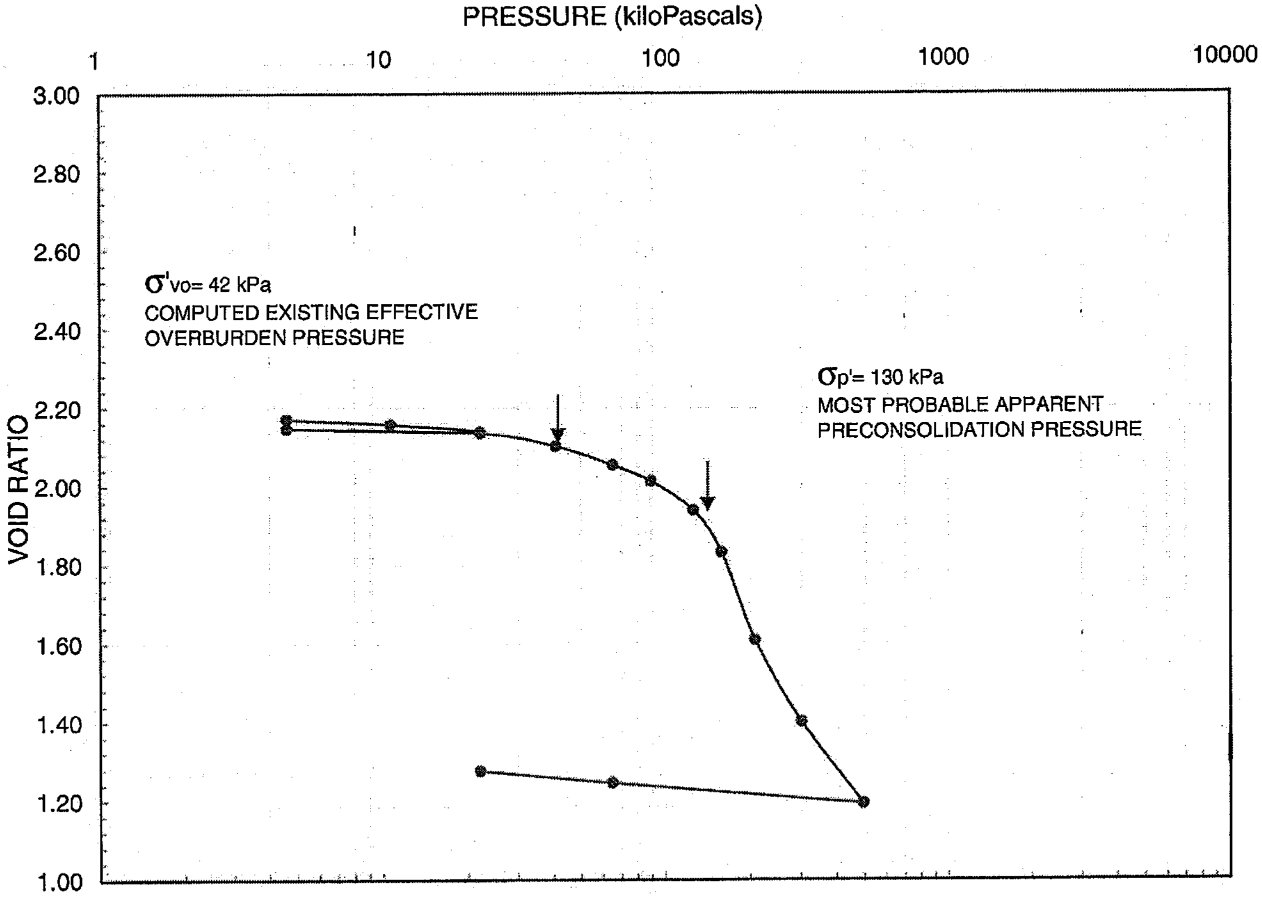
Golder Associates

FILE No. Consolidation summary
PROJECT No. 061120392 REV. 0

SCALE AS SHOWN
DATE 01/11/07
DESIGN NA
CADD NA
CHECK
REVIEW

TITLE
CONSOLIDATION TEST RESULTS

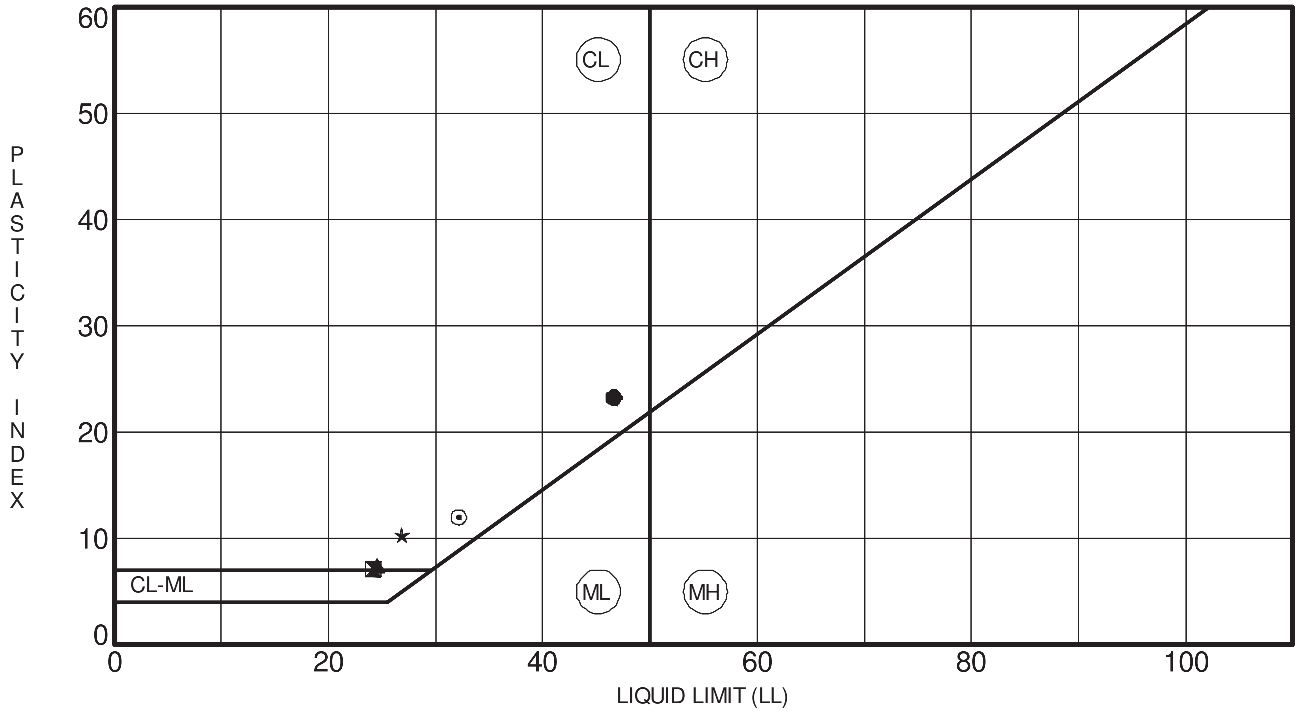
FIGURE 4



LEGEND

Borehole: 06-7	w_i = 74%	S_o = 95%
Sample: 4	w_f = 47%	C_c = 1.60
Depth (m): 4.8	w_l = 52%	C_r = 0.02
	w_p = 22%	γ= 15.3 kg/m^3

Golder Associates	SCALE AS SHOWN	TITLE
	DATE 01/11/07	**CONSOLIDATION TEST RESULTS**
	DESIGN NA	
	CADD NA	
FILE No. Consolidation summary	CHECK	
PROJECT No. 61120392 REV. 0	REVIEW	FIGURE **5**



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH 1**	**TW 3**	**47**	**23**	**23**		**CL-Inorganic clays of low plasticity**
⊠	**BH 2**	**SS 4**	**24**	**17**	**7**		**CL-Inorganic clays of low plasticity**
▲	**BH 2**	**TW 5**	**24**	**17**	**7**		**CL-Inorganic clays of low plasticity**
★	**BH 4A**	**TW 1**	**27**	**17**	**10**		**CL-Inorganic clays of low plasticity**
⊙	**BH19**	**TW 3**	**32**	**20**	**12**		**CL-Inorganic clays of low plasticity**

CLIENT **Monarch Corporation**

FILE NO. **PG1874**

PROJECT **Geotechnical Investigation - Proposed Residential Development - West Park**

DATE **14 Oct 09**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

ATTERBERG LIMITS' RESULTS

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURES 2 AND 3 - SHEAR WAVE VELOCITY PROFILES

DRAWING PG2233-7 - TEST HOLE LOCATION PLAN

DRAWING PG2233-8 - PERMISSIBLE GRADE RAISE AREAS - HOUSING

DRAWING PG2233-9 - SEISMIC SITE CLASSIFICATION

DRAWING PG2233-17 - TEST HOLE LOCATION PLAN

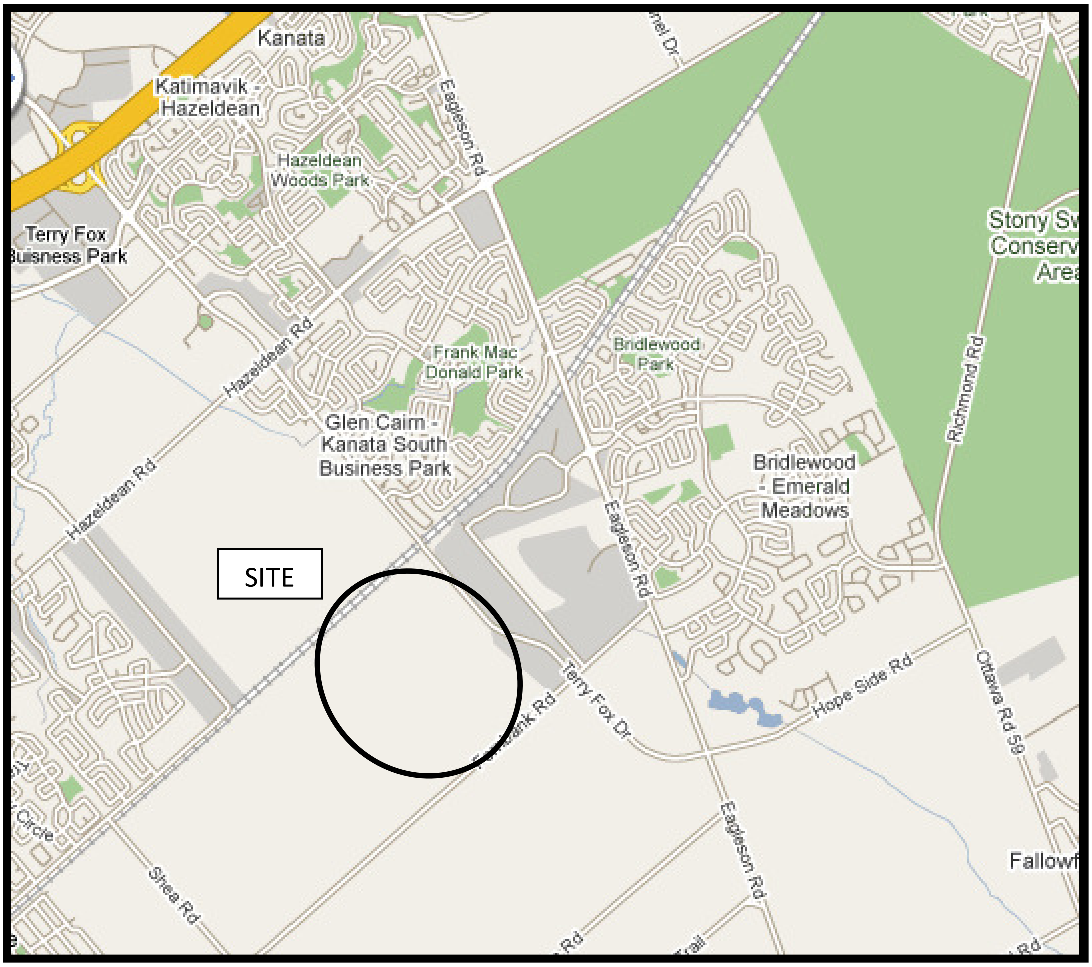


FIGURE 1

KEY PLAN

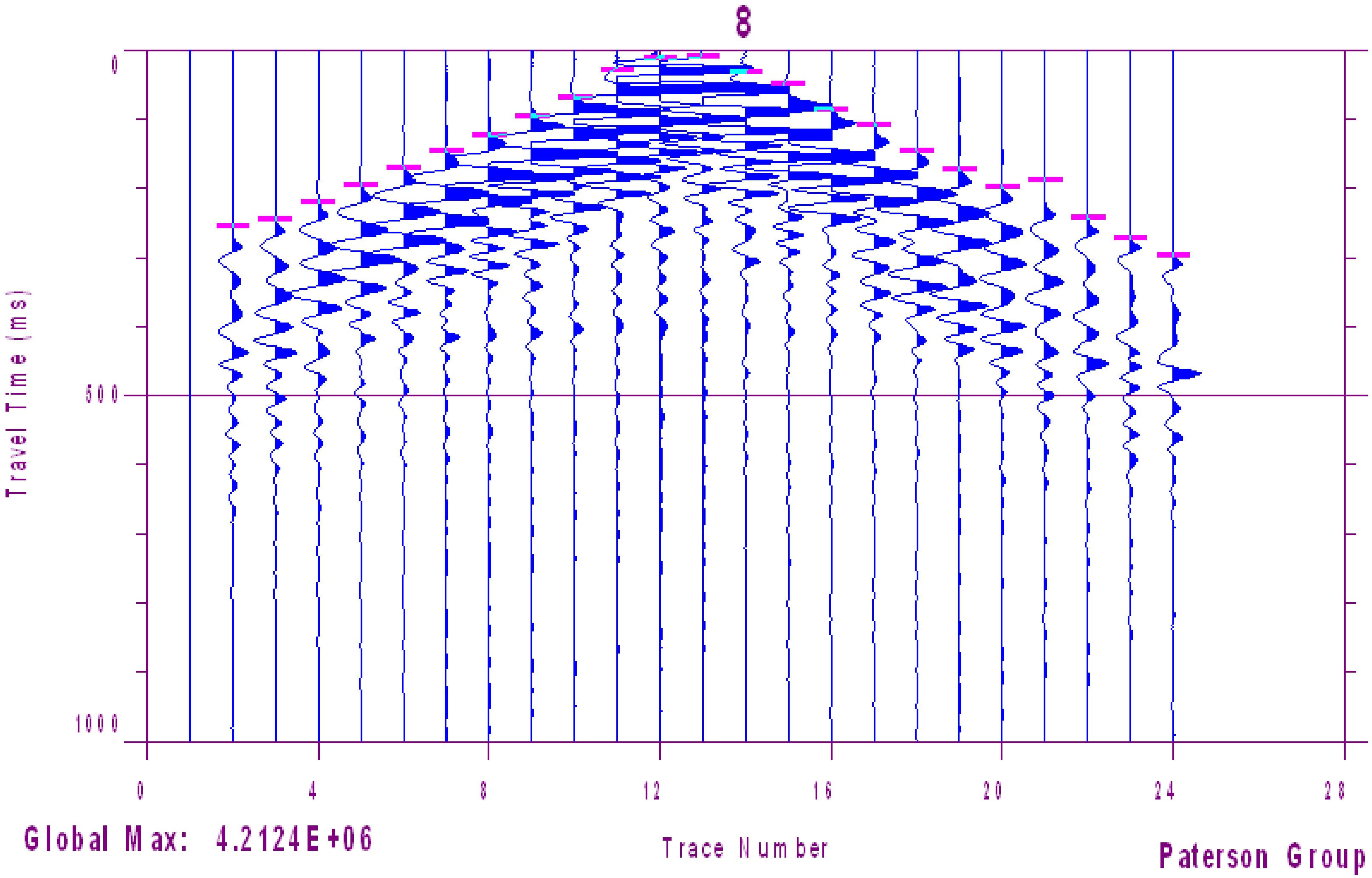


Figure 2 – Shear Wave Velocity Profile at Shot Location 34.5 m

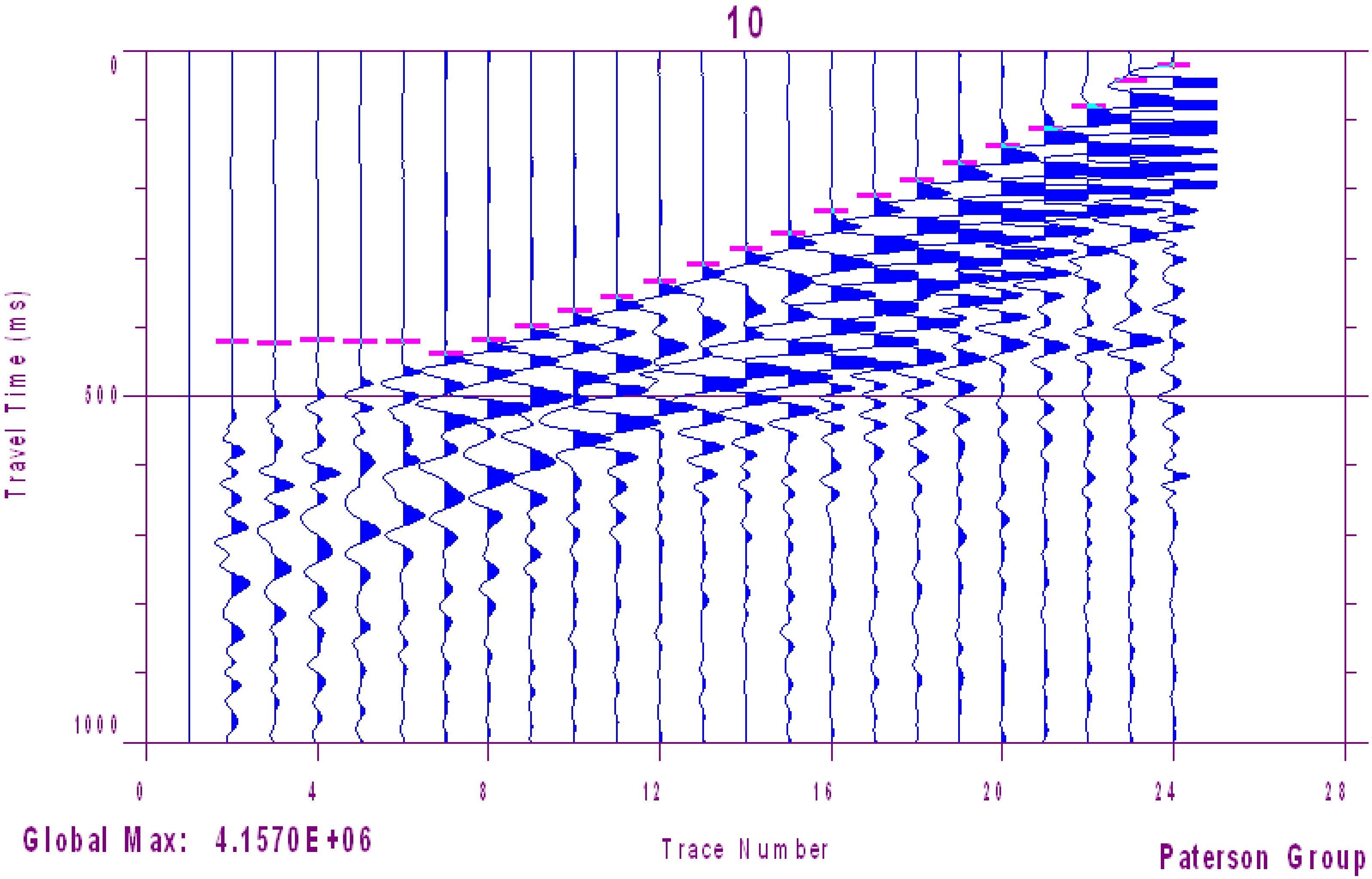
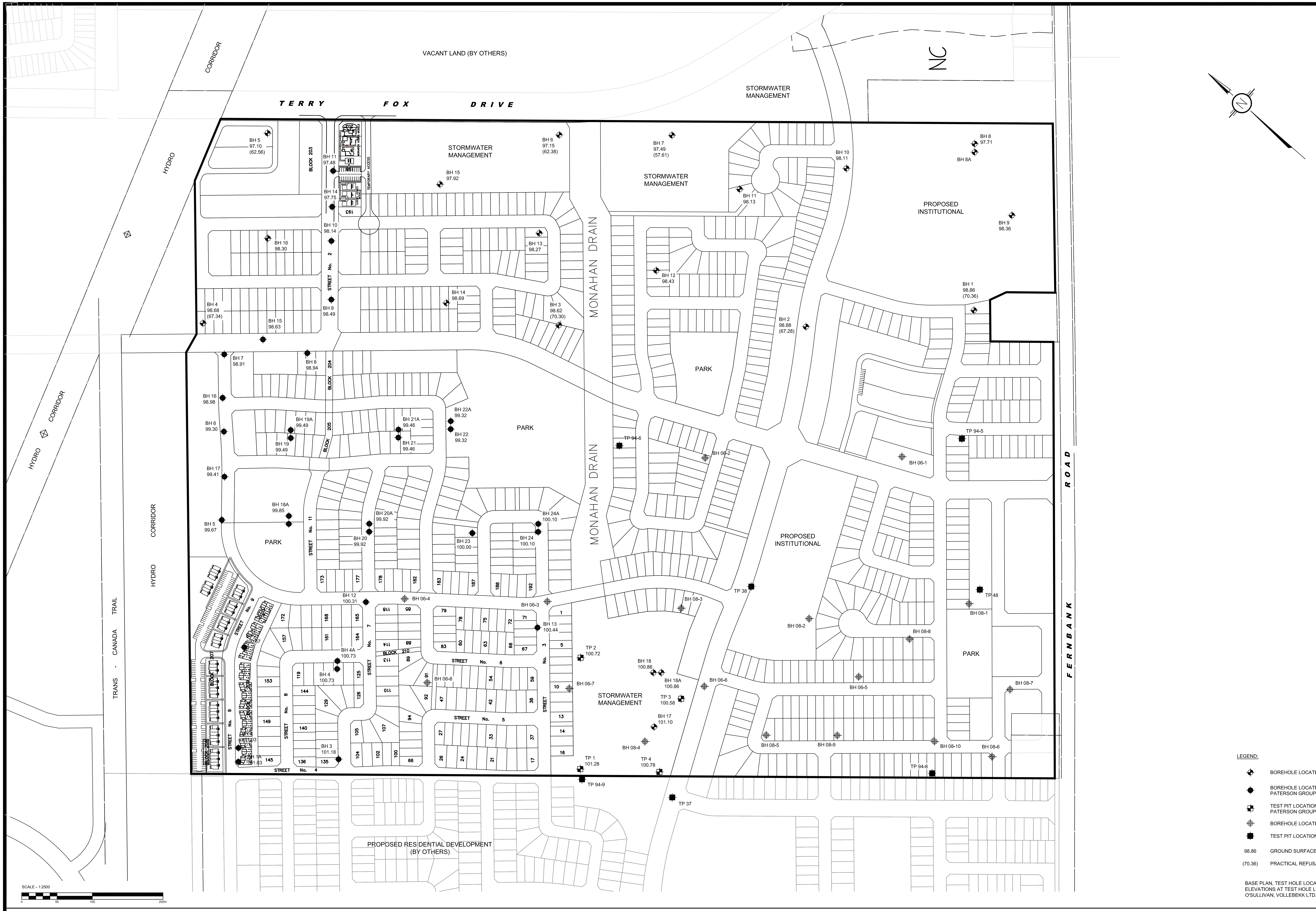


Figure 3 – Shear Wave Velocity Profile at Shot Location 72 m



LEGEND:

⊕	BOREHOLE LOCATION
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT NO. PG1874
▨	TEST PIT LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT NO. PG1874
◎	BOREHOLE LOCATION BY OTHERS
■	TEST PIT LOCATION BY OTHERS
98.86	GROUND SURFACE ELEVATION (m)
(70.36)	PRACTICAL REFUSAL TO DCPT ELEVATION (m)

BASE PLAN, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

NO.	REVISIONS	DATE	INITIAL

patersongroup
consulting engineers
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

SCALE: 1:2500
DESIGN: RG
DRAWN: MPG
CHECKED: DG
DATE: 06/2011

WESTPARK RESIDENTIAL DEVELOPMENT
FERNBANK ROAD
OTTAWA (KANATA), ONTARIO

DWG. NO. PG2233-7

MONARCH HOMES

TEST HOLE LOCATION PLAN

PG2233-GENERAL.DWG

PERMISSIBLE GRADE RAISE:

▨	AREAS WHERE GRADE RAISE UP TO 0.7m ARE PERMITTED
🟥	AREAS WHERE GRADE RAISE UP TO 0.8m ARE PERMITTED
▨	AREAS WHERE GRADE RAISE UP TO 1.0m ARE PERMITTED
🟩	AREAS WHERE GRADE RAISE UP TO 1.3m ARE PERMITTED
▒	AREAS WHERE GRADE RAISE UP TO 1.4m ARE PERMITTED
▨	AREAS WHERE GRADE RAISE UP TO 1.6m ARE PERMITTED
🟦	AREAS WHERE GRADE RAISE UP TO 1.8m ARE PERMITTED
🟪	AREAS WHERE GRADE RAISE UP TO 2.0m ARE PERMITTED

LEGEND:

◐	BOREHOLE LOCATION
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT NO. PG1874
▣	TEST PIT LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT NO. PG1874
⊕	BOREHOLE LOCATION BY OTHERS
■	TEST PIT LOCATION BY OTHERS
98.86	GROUND SURFACE ELEVATION (m)
(70.36)	PRACTICAL REFUSAL TO DCPT ELEVATION (m)

BASE PLAN, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

NO.	REVISIONS	DATE	INITIAL

patersongroup
consulting engineers
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

SCALE: 1:2500
DESIGN: RG
DRAWN: MPG
CHECKED: DG
DATE: 06/2011

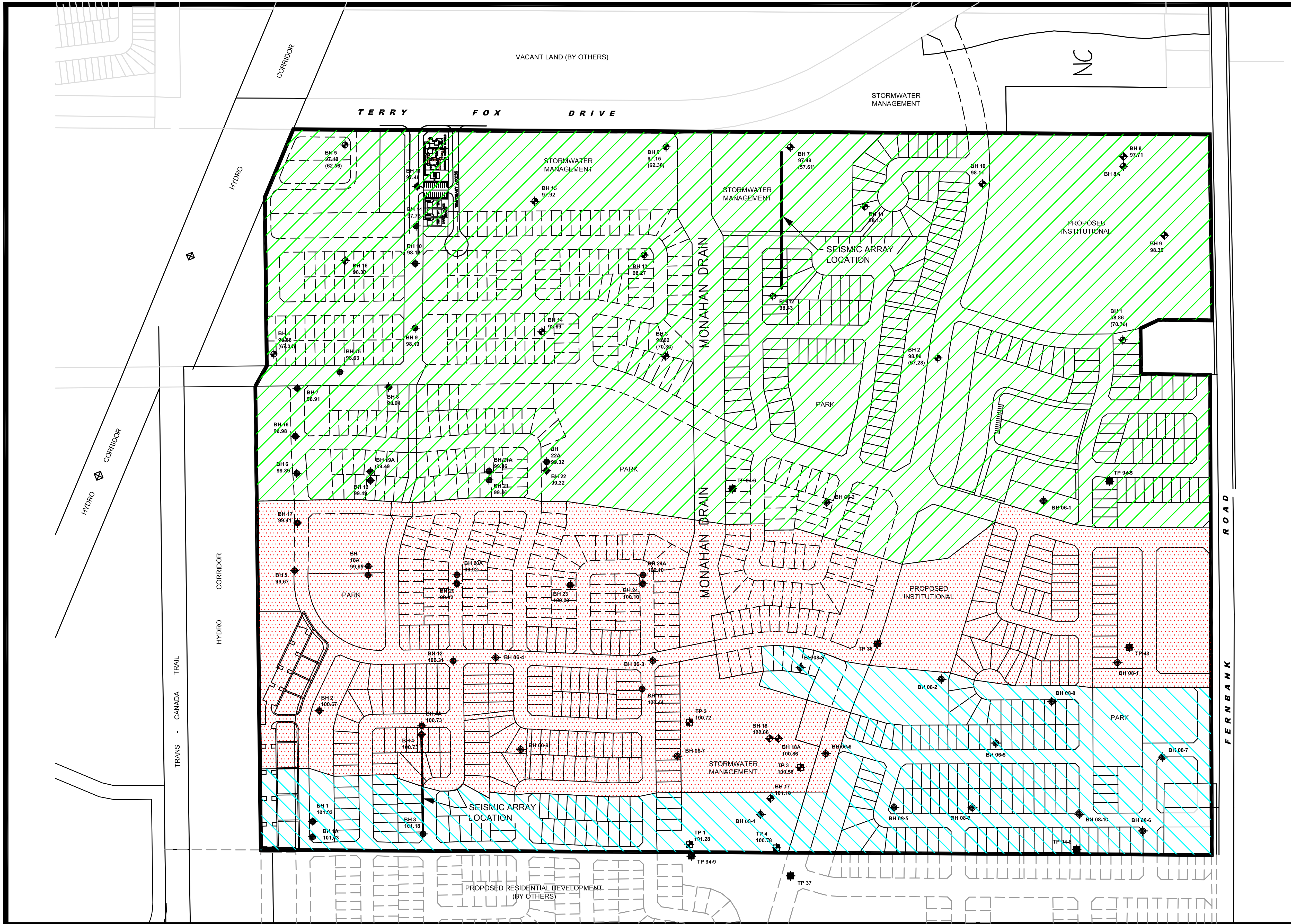
WESTPARK RESIDENTIAL DEVELOPMENT
FERNBANK ROAD
OTTAWA (KANATA), ONTARIO

DWG. NO. PG2233-8

MONARCH HOMES

PERMISSIBLE GRADE RAISE AREAS - HOUSING

PG2233-8 PERMISSIBLE GRADE.DWG



▨ CLASS C

▨ CLASS D

▨ CLASS E

LEGEND:

⊕	BOREHOLE LOCATION
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION, PATERSON GROUP REPORT NO. PG1874
▣	TEST PIT LOCATION, PREVIOUS INVESTIGATION, PATERSON GROUP REPORT NO. PG1874
⊕	BOREHOLE LOCATION BY OTHERS
■	TEST PIT LOCATION BY OTHERS
98.86	GROUND SURFACE ELEVATION (m)
(70.36)	PRACTICAL REFUSAL TO DCPT ELEV. (m)

BASE PLAN, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

paterson group
consulting engineers
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

Scale: 1:5000
Des.: JAF
Dwn: MPG
Chkd: DG

MONARCH HOMES
GEOTECHNICAL INVESTIGATION
WESTPARK RESIDENTIAL DEVELOPMENT-TERRY FOX DR.
OTTAWA, ONTARIO

SEISMIC SITE CLASSIFICATION

Dwg. No. PG2233-9
Report No.: PG2233
Date: 06/2011

LEGEND:

◐	BOREHOLE LOCATION
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT PG1874
⊕	BOREHOLE LOCATION BY OTHERS
97.15	GROUND SURFACE ELEVATION (m)
(62.38)	PRACTICAL REFUSAL TO DCPT ELEV. (m)

BASE PLAN, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LIMITED.

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario, K2E 7J5
Tel: (613)226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

MONARCH HOMES

GEOTECHNICAL INVESTIGATION
BLACKSTONE RESIDENTIAL DEVELOPMENT - PHASES 2 AND 3
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Drawn by: MPG
Checked by: DJG
Date: 04/2014
Scale: 1:1500
Report No.: PG2233
Drawing No.: PG2233-17

APPENDIX 3

MEMORANDUMS AND ADDENDUMS

patersongroup

Consulting Engineers

154 Colonnade Road South
Ottawa, Ontario
K2E 7J5
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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
Building Science
Archaeological Services

www.patersongroup.ca

February 9, 2016
PG2233-LET.02R

Mattamy Homes
51 Hines Road
Ottawa, Ontario
K1P 1J1

Attention: **Mr. Kris Haynes**

Subject: **Response to City of Ottawa Review Comments**
Proposed Blackstone Development
Terry Fox Drive - Ottawa

Dear Sir,

Further to your request, Paterson Group (Paterson) has prepared the current memorandum to respond to latest City of Ottawa review comments issued January 11, 2016 regarding the proposed development located at the aforementioned site. Paterson's responses to the relevant geotechnical comments are presented below.

The present letter should be read in conjunction with Paterson Report PG2233-2 Revision 2 dated February 9, 2016.

Item 26:

Comment: *Please expand on the specific lightweight fill requirement identified in the Geotechnical report as it relates to this site.*

Response: Please refer to the attached Table 1: Summary of Design Details.

Item 27

Comment: *Certification by Geotechnical Engineer will be required as it relates to Grade Raise limits and Grading for the site.*

Response: Please refer to the attached Table 1: Summary of Design Details.

Item 28

Comment: *A note should be included on servicing drawings reflecting Geotechnical recommendations for decommissioning any agricultural subdrains / tile drains.*

Response: Stantec to address.

Item 29

Comment: *Geotechnical report is to include a borehole location map.*

Response: Our geotechnical report includes a test hole location plan.

Item 30

Comment: *As per Geotechnical recommendations, a condition shall be drafted as it relates to swimming pools.*

Response: Response by others.

Item 31

Comment: *Please expand on the potential for basal heave due to pipe depth.*

Response: Based on excavations completed throughout the subject site. Basal heave within the servicing excavation trenches has not occurred on site.

Item 32

Comment: *Please reference the Geotechnical recommendations relating to pavement structure on the servicing drawings i.e.(car parking, roads, etc..).*

Response: Stantec to address.

Item 33

Comment: *With grade raise limits reviewed, please further review differential settlement of service connection and buildings.*

Response: Based on our review of the proposed grades, the grade raise limits have not been exceeded and excessive settlement is not anticipated between the buildings and service connections.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

Richard Groniger, C. Tech.

LICENSED PROFESSIONAL ENGINEER
Feb. 9, 2016
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P. Eng.

patersongroup
consulting engineers

memorandum

to:	Mattamy Homes - **Mr. Kris Haynes** - kris.haynes@mattamycorp.com
re:	Geotechnical Design Summary and Grading Plan Review **Proposed Blackstone Residential Development - Block 296**
date:	February 9, 2016
file:	PG2233-MEMO.46R
from:	David Gilbert

Further to your request and authorization, Paterson Group (Paterson) prepared the current memo report to provide a geotechnical design summary and a grading plan review for Block 296 to be constructed at Blackstone residential development. The following memorandum should be read in conjunction with Paterson Report PG2233-2 Revision 2 dated February 9, 2016.

Bearing Resistance Values

Footings, up to 3 m wide, placed over an undisturbed, compact silty sand or a firm silty clay bearing surface can be designed with a bearing resistance value at SLS of **60 kPa** and a factored bearing resistance value at ULS of **125 kPa**.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

The proposed buildings to be located within Block 296 of the residential development should be designed as per Part 4 of the Ontario Building Code. The bearing resistance values provided for footings placed over an undisturbed, silty sand or silty clay bearing surface assume a 0.5 m long term groundwater lowering. The footings designed with the above bearing resistance value at SLS should experience up to 25 mm of total settlement and 20 mm of differential settlement.

Grading Plan Review

Paterson reviewed the following grading plan prepared by Stantec for Block 296 of the aforementioned residential development:

☐ Grading Plan - Drawing No. GP-1 - Project 160401009 - Revision 3 dated January 22, 2016

Based on the grading plan provided, the grading for the proposed blocks does not exceed our permissible grade raise recommendations. Table 1 attached provides a grading summary for the subject buildings.

Design for Earthquakes

As indicated on Drawing PG2233-9 - Seismic Site Classification presented in Report PG2233-2R dated October 1, 2015, a seismic site **Class E** is applicable for foundation design for the subject lots. The soils underlying the subject lots are not susceptible to liquefaction.

Applicable City of Ottawa Sensitive Silty Clay Protocols

Frost Protection

The proposed finished grade and proposed footing depth are considered to provide an adequate depth for frost protection for the proposed buildings.

Groundwater Table

Based on field observations during the geotechnical investigation and proposed grading for the current phase of development, it is expected that an adequate separation distance is available between the groundwater table and the proposed footing depth. Therefore, under-floor drains are not required for the proposed buildings.

Geotechnical Considerations

Swimming Pools

The in-situ soils are considered to be acceptable for swimming pools. Above ground swimming pools must be placed a minimum of 4 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer`s requirements.

Aboveground Hot Tubs

If consideration is given to construction of an aboveground hot tub, a geotechnical consultant should be retained by the homeowner to review the site conditions. Additional grading around the hot tub should not exceed permissible grade raises. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer’s specifications.

Installation of Decks or Additions

If consideration is given to construction of a deck or addition, a geotechnical consultant should be retained by the homeowner to review the site conditions. Additional grading around proposed deck or addition should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

Tree Planting Restrictions

Block 296 of the proposed residential development is located in a moderate sensitivity area with respect to planting trees over a silty clay deposit. Trees placed within 4.5 m of the foundation wall should consist of low water demanding trees with shallow roots systems that extend less than 1.5 m below ground surface. Trees placed greater than 4.5 m from the foundation wall could consist of typical street trees, which are of moderate water demand species with roots extending to a maximum depth of 2 m below ground surface.

It is well documented in the literature, and is our experience, that fast-growing trees located near buildings founded on cohesive soils that shrink on drying could result in long-term differential settlements of the structures. Tree varieties that have the most pronounced effect on foundations are seen to consist of poplars, willows, and some maples (i.e. Manitoba Maples) and, as such, should not be considered in the landscaping design.

We trust that this information satisfies your immediate requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Feb. 9, 2016
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Joe Forsyth, P.Eng

David J. Gilbert, P.Eng

Table 1 - Summary of Current Grading Details

Block 296 - Blackstone Residential Development

	Original GS Front (m)	Proposed GS Front (m)	Original GS Rear (m)	Proposed GS Rear (m)	Permissible Grade Raise (m)	Above Permissible Grade Raise Front (m)	Above Permissible Grade Raise Rear (m)	Minimum Thickness LWF In Garage and Front Porch (m)	Minimum Thickness LWF extending 2.4 m Beyond the building face (m)
Block 1 - Unit 1 to 5	97.53	99.15	97.60	99.45	2.10	n/a	n/a	n/a	n/a
Block 2 - Unit 6 to 10	97.37	99.00	97.70	99.30	2.10	n/a	n/a	n/a	n/a
Block 3 - Unit 11 to 15	97.62	98.95	97.72	99.25	2.10	n/a	n/a	n/a	n/a
Block 4 - Unit 16 to 18	97.61	99.05	97.72	99.35	2.10	n/a	n/a	n/a	n/a
Block 5 - Unit 19 to 22	97.55	98.90	97.55	99.20	2.10	n/a	n/a	n/a	n/a
Block 6 - Unit 23 to 26	97.41	98.82	97.30	99.10	2.10	n/a	n/a	n/a	n/a
Block 7 - Unit 27 to 30	97.24	98.82	97.26	99.12	2.10	n/a	n/a	n/a	n/a
Block 8 - Unit 31 to 33	97.47	98.85	97.55	99.15	2.10	n/a	n/a	n/a	n/a
Block 9 - Unit 34 to 37	97.40	98.90	97.07	99.20	2.10	n/a	0.03	n/a	n/a
Block 10 - Unit 38 to 42	97.15	99.05	96.96	99.15	2.10	n/a	0.09	n/a	n/a
Block 11 - Unit 43 to 46	96.96	98.65	97.00	98.95	2.10	n/a	n/a	n/a	n/a
Block 12 - Unit 47 to 49	96.96	98.85	97.00	99.15	2.10	n/a	0.05	n/a	n/a

Notes:

- Proposed grade raise information was based on the following grading plan prepared by Stantec:
- Project Number 160401009 - Drawing GP-1 - Grading Plan - Block 296 - Revision 3 dated January 22, 2016.

Appendix E : DRAWINGS