

APPENDIX 'B'

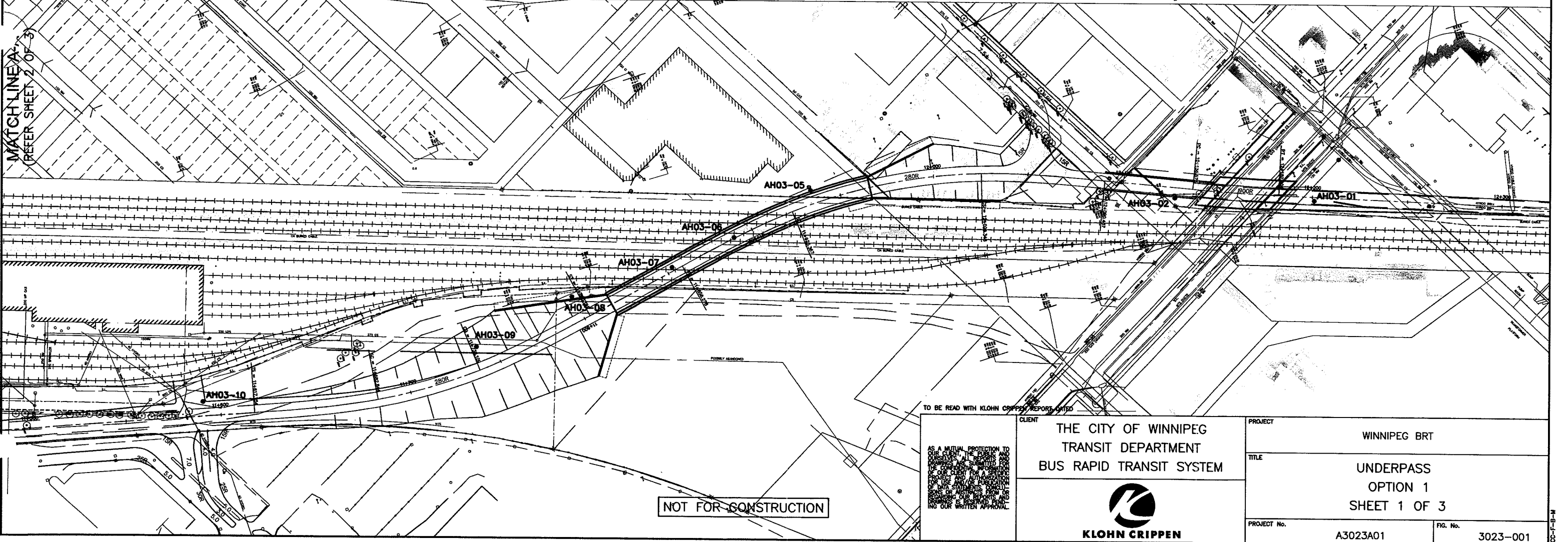
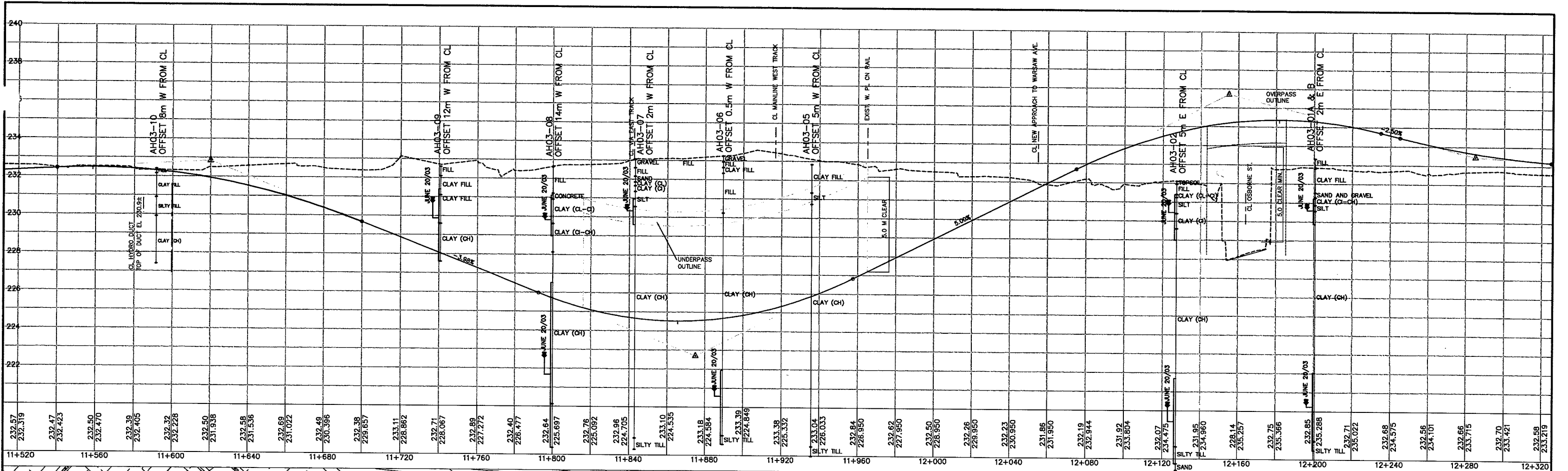
KLOHN CRIPPEN GEOTECHNICAL REPORT - MAY 10, 2004

Dillon Consulting Limited

The City of Winnipeg Bus Rapid Transit System – Southwest Corridor Geotechnical Investigation and Preliminary Recommendations *Report*

A03023A01.01

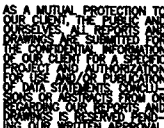

May 2004



MATCHLINE A (REFER SHEET 2 OF 3)

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN REPORTS LIMITED

 <p>AS A MUTUAL PROTECTION TO OUR CLIENTS, WE REQUEST THAT YOU OBTAIN OUR WRITTEN APPROVAL FOR ANY REVISIONS TO THIS DRAWING.</p>	<p>CLIENT</p> <p>THE CITY OF WINNIPEG TRANSIT DEPARTMENT BUS RAPID TRANSIT SYSTEM</p>	<p>PROJECT</p> <p>WINNIPEG BRT</p>
	 <p>KLOHN CRIPPEN</p>	<p>TITLE</p> <p>UNDERPASS OPTION 1 SHEET 1 OF 3</p>
<p>PROJECT No. A3023A01</p>		<p>FIG. No. 3023-001</p>

TEST HOLE LOG

Su - kPa

20 60 100 140 180

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: June 27, 2003 FINISHED: June 27, 2003		INSTRUMENT	DETAILS	Su - kPa					
					DRILL METHOD: Solid Stem Auger				VANE PEAK	FIELD	LAB	UC/2		
					GROUND ELEV. (m): 232.84				REMOLD	◇	□	△ P.PEN/2		
					COORDINATES (m): N 5525985.5 E 633502.1				* % FINES	● SPT N	W _p %	W%	W _L %	
DESCRIPTION OF MATERIALS														
1				[Symbol]	CLAY FILL Silty, trace to some fine gravel, low plasticity, firm, black, moist, surface covered by 50 mm of crushed limestone (20mm diam)									
		Bag	1		0.9 - 1.2 m: sand seam, wet									
		Bag	2											
				[Symbol]	1.50									
2		Bag	3		231.34	SILT (ML) Low plasticity, soft, light brown, moist								
				[Symbol]	2.10									
		Bag	4		230.74	CLAY (CH) High plasticity, firm, mottled brown with olive grey, trace silt inclusions								
3		Shelby	5			Unconfined Compressive Strength = 57.0 kPa								
4	2 2 3	SPT	6			Some silt inclusions below 3.8 m								
5		Shelby	7			Trace sulphates below 4.6 m								
6	2 2 4	SPT	8			Trace oxidation below 5.8 m								
7		Shelby	9											
8				[Symbol]		8.20 m: becoming grey								
9	1 1 3	SPT	10											
10				[Symbol]										

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KC_TEST_HOLE-SI SW



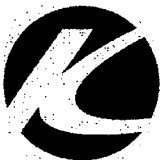
KLOHN CRIPPEN

PROJECT NO.: A03023A01	
PROJECT: Winnipeg BRT	
LOCATION: Southwest Corridor - CNR Underpass	
LOGGED BY: NTL	CHECKED BY: DWR
SHEET 1 OF 2	HOLE NO.: AH03-05

TEST HOLE LOG

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS	Su - kPa												
							20	60	100	140	180								
STARTED: June 27, 2003 FINISHED: June 27, 2003 DRILL METHOD: Solid Stem Auger GROUND ELEV. (m): 232.84 COORDINATES (m): N 5525985.5 E 633502.1						VANE PEAK FIELD LAB REMOLD ◊ ◻ ▲ UC/2 * % FINES ● SPT N W _p % W% W _L % x - - - - - o - - - - - x 20 40 60 80													
11	1	Shelby	11	/ / / / /															
12	1	SPT	12	/ / / / /															
13				/ / / / /															
14		Shelby	13	/ / / / /	13.7 m: trace till inclusions														
15	4 DNF	SPT	14	/ / / / /	14.90 217.94 SILT (ML) Gravely (fine to coarse), dense, light reddish brown, wet (TILL-LIKE) 15.40 217.44 15.4 m: auger refusal, suspect boulder on bedrock														
16				/ / / / /	End of Hole at: 15.4 m														
17				/ / / / /	Hole drilled under supervision of National Test Labs														
18				/ / / / /															
19				/ / / / /															
20				/ / / / /															

J ROCK_008.GDT 24/10/03
KC_TEST_HOLES1.SVL



KLOHN CRIPPEN

PROJECT NO.: A03023A01	
PROJECT: Winnipeg BRT	
LOCATION: Southwest Corridor - CNR Underpass	
LOGGED BY: NTL	CHECKED BY: DWR
SHEET 2 OF 2	HOLE NO.: AH03-05

TEST HOLE LOG

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT	DETAILS	Su - kPa				
								20	60	100	140	180
					STARTED: June 18, 2003 FINISHED: June 18, 2003							
					DRILL METHOD: Hollow Stem Auger							
					GROUND ELEV. (m): 233.24							
					COORDINATES (m): N 5525939.3 E 633513.3							
					DESCRIPTION OF MATERIALS							
1 2 3 4 5 6 7 8 9 10	6 16 DNF 3 5 5 2 2 2 2 2 3 3 3 4	Grab SPT SPT Bulk SY SPT Bulk SY SPT SY SPT SPT	1 2 3 14 4&5 6 15 7 8 9 10		0.30 Coarse, trace cobbles, poorly graded, track bed							
					232.94 FILL							
					0.60 Cinders, some sand, trace gravel, trace silt, black, moist							
					232.64 CLAY FILL (CL)							
					0.90 Silty, low plasticity, stiff, dark grey, dry to moist							
					232.34 FILL							
					Sand, silty, some cinders, some gravel, light brown, black in some zones, moist							
					1.50							
					231.74 CLAY, SAND and GRAVEL (FILL)							
					- no quality samples obtained with Shelby tubes or SPT - no auger flight samples with hollow stem 1.5 m: poor sample recovery (SPT on top of rock) ~1.5 - 2.2 m: appear to have drilled through an abandoned wooden sewer - wood fragments in samples 3,4&5; visible cavern on side of borehole, trickling water, surrounded by sand. No recovery in Shelby tubes pushed at 2.25 m and 2.45 m.							
3.00												
230.24												
2.45 m: Clay in SPT sample (possibly native but highly disturbed by a sloughed rock caught in shoe - explains high SPT N)												
CLAY (CH)												
High plasticity, firm to stiff, brown mottled with olive grey, occasional salt/silt inclusions (light brown, powdery)												
3.00 m: Standard Proctor Results - Maximum Dry Density = 1400 kg/m ³ Optimum Moisture Content = 23.5%												
3.05 m: Sample 5 repushed over same depth as Sample 4												
4.25 m: Standard Proctor Results - Maximum Dry Density = 1390 kg/m ³ Optimum Moisture Content = 28.0%												
4.55 m: becoming spotted with rusty brown Sample 7: 1.63% sulphate by weight												
6.10 m: occasional salt deposits (white crystals), mottling of olive grey and brown in horizontal seams.												
Sample 9: Consolidation test performed Direct shear test performed												
8.15 m - becoming drier.												
9.15 m: becoming trace spots of silt (light brown), trace gravel (fine - coarse, subangular)												

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J ROCK_008.GDT 24/10/03

KC_TEST_HOLE-SI_SW



KLOHN CRIPPEN

PROJECT NO.: A03023A01

PROJECT: Winnipeg BRT

LOCATION: Southwest Corridor - CNR Underpass









LOGGED BY: JNH

CHECKED BY: DWR

SHEET 1 OF 2

HOLE NO.: AH03-06

TEST HOLE LOG

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS	Su - kPa							
							20	60	100	140	180			
STARTED: June 18, 2003 FINISHED: June 18, 2003 DRILL METHOD: Hollow Stem Auger GROUND ELEV. (m): 233.24 COORDINATES (m): N 5525939.3 E 633513.3						VANE PEAK REMOLD FIELD LAB UC/2 P.PEN/2 * % FINES SPT N W _p % W% W _L % x - - - - - o - - - - - x 20 40 60 80								
11		SY	11		10.65 m: frequent spots of silt									
12	2 2 2	SPT	12		12.20 m: more frequent spots of silt									
13														
14		SY	13											
15					14.75 218.49 SILT (ML) - No sample retrieved, assumed to be gravelly from SPT (TILL-LIKE, inferred from drill action) 15.20 15.20 m: Auger refusal 218.04 15.25 m: SPT bouncing on rock End of Hole at: 15.2 m 25 mm standpipe installed with flush mount cover Recess = 0.20 m Initial water level = 12.34 m bgl									
16														
17														
18														
19														
20														

J ROCK_006.GDT 24/10/03
KC_TEST_HOLE-SI_SWL



KLOHN CRIPPEN

PROJECT NO.: A03023A01
 PROJECT: Winnipeg BRT
 LOCATION: Southwest Corridor - CNR Underpass
 LOGGED BY: JNH CHECKED BY: DWR
 SHEET 2 OF 2 HOLE NO.: AH03-06

TEST HOLE LOG

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS	Su - kPa				
							20	60	100	140	180
					STARTED: June 17, 2003 FINISHED: June 17, 2003	VANE PEAK REMOLD					
					DRILL METHOD: Solid Stem Auger	FIELD LAB					
					GROUND ELEV. (m): 233.05	UC/2 P.PEN/2					
					COORDINATES (m): N 5525903.1 E 633518.1	* % FINES SPT N					
						Wp% W% Wl%					
						x - - - - - o - - - - - x					
						20 40 60 80					
1		Grab	1	0.45 232.60	GRAVEL / CRUSHED ROCK (GM) Coarse, silty, trace cobbles, subrounded, track bed						
		Grab	2	0.90 232.15	FILL Cinders, sandy, black, saturated						
		SPT	3	1.20 231.88	SAND (SW) Fine to medium, trace fine gravel, trace silt, brown, saturated (FILL)						
2	1			231.65	CLAY (CL) Organic, black, rootlets, soft, wet						
2	1			1.70 231.35	CLAY (CI) Medium plasticity, firm to stiff, grey mottled with some rusty brown, moist						
		SY	4	2.50 230.55	SILT (ML) Nonplastic to low plasticity, soft, light brown, saturated - bottom contact is somewhere between 2.25 and 2.8 (within Shelby tube)						
3	3	SPT	5		CLAY (CH) High plasticity, firm to stiff, mottled brown and grey, moist 3.00 m: major gypsum deposits and rusty zones						
4	1										
4	2	Grab	6		3.75 m: no recovery in Shelby tube (hole is wet - making clay slick)						
5	2	SPT	8								
5	3										
5	4										
6		SY	9		Unconfined Compressive Strength = 52.1						
7											
8	3	SPT	10		7.60 m: becoming medium plasticity, trace silt						
8	3										
8	4										
9		SY	11		9.15 m: becoming medium to high plasticity, soft to firm, wetter (possibly from seepage above)						
10											

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KC_TEST_HOLE-SI SW



KLOHN CRIPPEN

PROJECT NO.: A03023A01

PROJECT: Winnipeg BRT

LOCATION: Southwest Corridor - CNR Underpass

LOGGED BY: JNH

CHECKED BY: DWR

SHEET 1 OF 2

HOLE NO.: AH03-07

TEST HOLE LOG

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: June 17, 2003 FINISHED: June 17, 2003		Su - kPa						
					DRILL METHOD: Solid Stem Auger		VANE PEAK	FIELD	LAB	UC/2			
					GROUND ELEV. (m): 233.05		REMOLD	★ % FINES	● SPT N	○ W _p %	○ W%	○ W _L %	
					COORDINATES (m): N 5525903.1 E 633518.1					x	x	x	
					DESCRIPTION OF MATERIALS					20	40	60	80
11	2 2	SPT	12	[Symbol]									
12		Grab	13	[Symbol]	11.40 m: Hole is squeezing in preventing retrieval of a Shelby sample								
13				[Symbol]	12.50 m: Very soft clay (driller can push drill in without rotating) - could be due to infiltration of water from above								
14		Grab	14	[Symbol]									
15		Grab	15	[Symbol]	14.70 218.35 SILT (ML) Low plasticity to non-plastic, some fine gravel, trace sand, trace clay, light pinkish brown, wet (TILL-LIKE) 15.30 m: Auger refusal 15.30 217.75								
16				[Symbol]	End of Hole at: 15.3 m								
17				[Symbol]	Hole backfilled with cuttings. Top 3.0 m sealed with bentonite chips.								
18				[Symbol]									
19				[Symbol]									
20				[Symbol]									

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KC_TEST_HOLE-SI.SV



PROJECT NO.: A03023A01	
PROJECT: Winnipeg BRT	
LOCATION: Southwest Corridor - CNR Underpass	
LOGGED BY: JNH	CHECKED BY: DWR
SHEET 2 OF 2	HOLE NO.: AH03-07

TEST HOLE LOG

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS	Su - kPa							
							20	60	100	140	180			
					STARTED: June 19, 2003 FINISHED: June 19, 2003	VANE PEAK REMOLD								
					DRILL METHOD: Solid Stem Auger	FIELD LAB								
					GROUND ELEV. (m): 232.62	UC/2 P.PEN/2								
					COORDINATES (m): N 5525848.3 E 633516.7	* % FINES SPT N								
						W _p % W% W _L %								
						x - - - - o - - - - x								
						20 40 60 80								
1		Grab	1*	▨	FILL Silt, clay, some gravel, trace sand, low plasticity to non-plastic, dry to moist 0.75 m: sample of fill was taken from a failed hole ~ 13m NEE of AH03-08	▨								
2		Grab	1	▨	1.40 231.22 CONCRETE - probably a basement foundation, surface and basement foundations prevalent to the east of AH03-08 1.70 230.92 CLAY (CL-CI) Low to medium plasticity, trace gravel, trace silt, firm, grey mottled with brown, moist (POSSIBLY FILL)	▨								
3				▨	3.00 229.62 CLAY (CI-CH) Medium to high plasticity, firm to stiff, brown mottled with olive grey, moist to wet	▨								
4		SY	2	▨		▨								
5	2 4 4	SPT	3	▨	4.50 228.12 CLAY (CH) High plasticity, firm to stiff, mottled brown and olive grey, moist, occasional salt inclusions	▨								
6		SY	4	▨		▨								
7				▨		▨								
8	4 7 7	SPT	5	▨	7.60 m: SPT N high due to sloughed rock (sample showed rock fragments, clay was twisted) 8.00 m: more frequent silt inclusions	▨								
9		SY	6	▨	9.00 m: becoming soft to firm, occasional pebbles PP/2 < 25 kPa	▨								
10				▨		▨								

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KLOHN CRIPPEN

PROJECT NO.: A03023A01

PROJECT: Winnipeg BRT

LOCATION: Southwest Corridor - CNR Underpass

LOGGED BY: JNH

CHECKED BY: DWR

SHEET 1 OF 2

HOLE NO.: AH03-08

TEST HOLE LOG

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	STARTED: June 19, 2003 FINISHED: June 19, 2003		Su - kPa			
					DRILL METHOD: Solid Stem Auger		20	60	100	140
					GROUND ELEV. (m): 232.62		VANE PEAK	FIELD	LAB	UC/2
					COORDINATES (m): N 5525848.3 E 633516.7		REMOLD	◆	□	▲ P.PEN/2
					DESCRIPTION OF MATERIALS		* % FINES		● SPT N	
							W _p %	W%	W _L %	
							X	○	○	X
							20	40	60	80
11	3	SPT	7							
12										
13		SY	8		12.50 220.12	SILT (ML) Non-plastic to low plasticity, some gravel, trace sand, trace clay, soft, light grey, wet (TILL-LIKE)				
14	3 5	SPT	9			13.90 m: becoming gravelly, trace to some sand, light pinkish brown 14.80 m: Auger refusal				
15					14.80 217.82	End of Hole at: 14.8 m 2 x 25 mm standpipes installed in one lockable steel casing Stick-up = 0.87 m for both AH03-08A: Initial water level = 7.84 m bgl June 20/03 water level = 9.87 m bgl AH03-08B: Initial water level = 3.17 m bgl June 20/03 water level = 2.70 m bgl				
16										
17										
18										
19										
20										

P:\ROCK_008.GDT 24/1/03

KC_TEST_HOLE-SI SW



KLOHN CRIPPEN

PROJECT NO.: A03023A01	
PROJECT: Winnipeg BRT	
LOCATION: Southwest Corridor - CNR Underpass	
LOGGED BY: JNH	CHECKED BY: DWR
SHEET 2 OF 2	HOLE NO.: AH03-08

TEST HOLE LOG

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS	Su - kPa				
							20	60	100	140	180
					STARTED: June 17, 2003 FINISHED: June 17, 2003	VANE PEAK REMOLD					
					DRILL METHOD: Solid Stem Auger	FIELD LAB					
					GROUND ELEV. (m): 232.60	* % FINES					
					COORDINATES (m): N 5525792.1 E 633526.2	● SPT N					
						W _p % W% W _L %					
						x - - - - - o - - - - - x					
						20 40 60 80					
1		Grab	1	0.50 232.10	FILL Silty clay and coarse gravel, low plasticity, firm to stiff, dark brown, moist, rootlets CLAY (CL) Silty, low plasticity, trace gravel, trace cinders, trace organic clay (black), firm to stiff, brown, fragments of wood (probably old lumber) (FILL)						
2	2 2 1	SPT	2	1.50 231.10	CLAY (CL) Clay (as above) mixed with silt (light brown, soft, wet), low plasticity, trace coarse gravel, light brown mottled with brown, moist (FILL)						
		Grab	3								
3	2 1 3	SPT	4	3.00 229.60	CLAY (CH) High plasticity, firm to stiff, brown to olive grey mottled with grey, moist, occasional gypsum deposits, occasional deposits (possibly organic, dark brown, angular)						
		Grab	5								
5	3 3 4	SPT	6	5.00 227.60	4.50 m: more frequent salt inclusions, occasional rust spots, occasional spots of silt (thin seams, near vertical)						
6					End of Hole at: 5.0 m 25 mm standpipe installed in lockable steel casing Stick-up = 0.91 m Initial water level = no water June 20/03 water level = 1.73 m bgl						

PJ ROCK_006.GDT 24/10/03

KC_TEST_HOLE-SW



KLOHN CRIPPEN

PROJECT NO.: A03023A01

PROJECT: Winnipeg BRT

LOCATION: Southwest Corridor - Test Section

LOGGED BY: JNH

CHECKED BY: DWR

SHEET 1 OF 1

HOLE NO.: AH03-09

TEST HOLE LOG

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE	SAMPLE No.	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS	Su - kPa											
							20	60	100	140	180							
					STARTED: June 17, 2003 FINISHED: June 17, 2003	VANE PEAK REMOLD												
					DRILL METHOD: Solid Stem Auger	FIELD LAB												
					GROUND ELEV. (m): 232.40	UC/2 P.PEN/2												
					COORDINATES (m): N 5525647 E 633509.5	* % FINES SPT N												
						W _p % W% W _L %												
						X - - - - - O - - - - - X												
						20 40 60 80												
1		Grab	1	0.25 232.15	FILL Clay, sand, cinders, black, moist													
2	2 1 1	SPT	2	1.50 230.90	FILL Silt (light grey, nonplastic to low plastic) mixed with clay (grey, medium to high plasticity), soft, wet													
		Grab	3	2.50 229.90	2.25 m: some organic clay mixed in													
3	2 1 4	SPT	4		CLAY (CH) High plasticity, firm to stiff, olive grey mottled brown, moist, gypsum deposits													
4		Grab	5															
5	2 3 3	SPT	6	5.00 227.40														
6					End of Hole at: 5.0 m													
7					Hole backfilled with cuttings to 2.5 m and sealed with bentonite chips from 0 to 2.5 m.													
8					Survey coordinates are approximate. Hole was moved 10m NNE prior to drilling.													
9																		
10																		

PJ ROCK_006.GDT 24/10/03

KC_TEST_HOLE-SI_SW



KLOHN CRIPPEN

PROJECT NO.: A03023A01

PROJECT: Winnipeg BRT

LOCATION: Southwest Corridor - Test Section

LOGGED BY: JNH

CHECKED BY: DWR

SHEET 1 OF 1

HOLE NO.: AH03-10