The City of Winnipeg RFP No. 869-2015

Appendices

Template Version: SrC120150806 - Consulting Services RFP

APPENDIX C - FEBRUARY 2015 MONITORING REPORT



February 25, 2015 File No. 0015 008 00

Mr. Kendall Thiessen, P.Eng.

Riverbank Management Engineer
City of Winnipeg, Planning, Property and Development Department
Waterways Section
15 – 30 Fort Street
Winnipeg, MB R3C 4X5

RE Lyndale Drive – Ave. Taché to Gauvin St. 2014 Riverbank Monitoring Results

Please find enclosed monitoring results for instrumentation installed along riverbank and retaining wall along Lyndale Drive from Avenue Taché to Gauvin Street. The instrumentation was installed in 2013 as part of a riverbank stabilization project from Monck Avenue to Avenue Taché to evaluate the riverbank condition for possible future stabilization works along the stretch of riverbank upstream of the 2013 stabilized zone. Monitoring instrumentation included slope inclinometer casings (SI's) and vibrating-wire piezometers (VW's) along the lower, mid and upper bank areas at three cross-sections within the upstream stretch of bank. Additional instrumentation was installed within the 2013 stabilized zone to monitor movements during construction. Results of monitoring in the 2013 stabilized zone were reported separately in our letter dated February 4, 2015 and will not be repeated herein.

The test hole locations and types of instrumentation installed are shown on the attached site plan (Figure 1) as well as in cross-section in Figures 02, 03 and 04. Figure 1 also shows the limits and types of retaining walls present, including a timber pile wall constructed in 1976 that extends upstream of the 2013 stabilized zone, ending near the intersection of Lyndale Drive and Gauvin Street. Evidence of lower to mid bank movements is apparent at various locations along this stretch of bank, based on visual site inspections and aerial photo review. The current letter summarizes monitoring results to date, while a final monitoring report will be submitted in December 2015 at the conclusion of the 2-year monitoring period. The results of instrumentation monitoring are attached along with test hole logs.

A total of seven slope inclinometers and four vibrating wire piezometers were installed along three cross-sections (XS-B to XS-D) as follows:

- SI-3 and SI-4 in the mid and lower bank in TH's 13-03 and 13-04 along XS-B
- SI-5, SI-6 and SI-7 in the upper, mid and lower bank in TH's 13-05, 13-06 and 13-07 along XS-C
- VW 5A/5B in the clay and till units in the upper bank in TH's 13-05 along XS-C
- VW 7A/7B in the clay and till units in the lower bank in TH's 13-05 along XS-C
- SI-8 and SI-9 in the mid and lower bank TH's 13-08 and 13-09 along XS-D

The upper-bank test hole (TH13-05) was drilled within the boulevard just upslope of the existing timber pile retaining wall, while mid-bank test holes were drilled just downslope of the wall and lower-bank test holes were drilled along the shoreline at the time of drilling. All drilling and instrumentation installation was completed between October 15th and 16th, 2013. Baseline readings on inclinometers were taken in late October with up to four to five subsequent monitoring events (pre and post 2014 spring flood, pre and post 2014 fall drawdown). Vibrating-wire piezometer monitoring was also completed during each monitoring event.

Groundwater Monitoring Results

The groundwater monitoring results to date are attached for piezometers VW-5A/5B and VW-7A/7B located in the upper and lower bank areas, respectively. Vibrating wire piezometers installed in the lacustrine clay maintained relatively constant piezometric levels ranging from about Elev. 226.0 m to 226.8 m in the upper bank (VW-5A) or from about Elev. 224 m. to 225.3 m in the lower bank (VW-7A). These levels ranged from about 2 to 4 m above river level in the upper bank, and from about 1 to 2 m above river level in the lower bank with the exception of flood stages when they are lower than the river level.

Piezometric levels in the till ranged from about Elev. 223.2 m to 224.7 m in the upper bank (VW-5B) and from about Elev. 221.5 m to 223.7 in the lower bank (VW-7B). Levels at the top of bank (VW-5B) were typically about 0.8 m to 1.2 m above the river level. At the lower bank area (VW-7B), levels tended to more closely match the river level. The exception to both of these observations is during flood events when river levels are higher than piezometric levels in the till.

All clay and till piezometers showed higher levels following the spring and summer flooding and lower levels during the winter months. Critical groundwater conditions typically occur during the fall and winter months where the groundwater levels in the bank exceeded the river elevation by up to 1.5 m (till) and 4 m (lacustrine clay).

Inclinometer Monitoring Results

Slope inclinometer cumulative displacement profiles as well as displacement rate plots are attached for all seven SI's. The most recent cumulative displacement profile is also shown in the stratigraphic cross-section to aid in visualization of slope movements.

Cross Section B: About 20 mm of horizontal displacement was observed at the lower bank area in SI-4 and at about 1.7 m above till contact (Elev.217.0 m) between October 2013 and December 2014. In the mid-bank area, about 2 to 3 mm of horizontal displacement was observed in SI-3 over the same time period about 1.2 m above the till contact (Elev. 216.8 m). The 20 mm of horizontal displacement observed within the upper 0.5 m of SI-3 is believed to be from environmental effects and not slope movement. Both SI-3 and SI-4 cumulative movement profiles are indicative of shear displacement within the clay just above the till contact. Visual observations and a review of aerial photography indicate active instabilities of the midbank area where SI-3 is situated are substantiated by the monitoring results. The relative displacements at SI-4 indicate retrogression of movements towards the retaining wall are occurring although these movements are not likely associated with a well defined failure surface at this time; they may be more indicative of creep movements.

Cross Section C: About 14 mm of horizontal displacement was observed at the lower bank area in SI-7 and at about 3.2 m above the till contact (Elev. 217.3 m) between October 2013 and December 2014. From August to December 2014, about 3 mm of horizontal displacement also occurred in SI-7 at Elev. 217.5 (0.3 m above till). In the mid-bank area, about 2 mm of horizontal displacement was observed in SI-6 between October 2013 and December 2014 at about Elev. 218 m (about 0.2 m above till). The 20 mm of horizontal displacement observed within the upper 0.5 m of SI-6 is believed to be from environmental effects and not slope movement. The upper bank inclinometer (SI-5) showed negligible displacement below about Elev. 227 m (approx. 3 m below existing ground downslope of wall), but about 4 to 5 mm of horizontal displacement occurring gradually (i.e. tilting) above this point.



The monitoring suggests active movement along two slip surfaces near the toe of the slope (SI-7) is occurring. Creep movements in the mid-bank area (SI-6) indicate this portion of the bank has been impacted by the lower bank movements although there is no evidence of a well defined failure surface at this location. The upper-bank movements (SI-5) can likely be attributed to deterioration and leaning of the timber pile retaining wall rather than deep-seated riverbank movements.

Cross Section D: About 15 mm of horizontal displacement was observed in the upper 4 m of SI-9 between October 2013 and December 2014. This is not considered indicative of a differential (shear) displacement associated with a deep-seated failure surface but rather may be attributed to shallow translational movement of a layer of fill at this location. In the mid-bank area, about 2 mm of horizontal displacement was observed in SI-8 over the same time period at about Elev. 218.5 m (about 1.2 m above till) along with about 5mm of near surface displacement attributable to environmental effects. The movements at SI-8 are close to the resolution of the monitoring probe and do not indicate any active riverbank instabilities at this location.

Summary and Discussion

Prior to the construction of the retaining wall and off-loading of the riverbank in 1976, upper bank head scarps accompanied by mid and lower bank instabilities were observed along this stretch of Lyndale Drive. Based on the assumption that the bank downslope of the wall was uniformly graded for off-loading, the uneven slope geometry indicates continued riverbank movements have occurred after this work was done, at least along some stretches. Slope inclinometer monitoring confirms that these movements are ongoing as evidenced by up to 20 mm of lower-bank displacements and up to 5 mm of mid-slope displacement over a period of one year. While the rate of mid-bank displacement is relatively small, retrogression of active instabilities towards the retaining wall and roadway remains a possibility, however the time frame for this to occur is uncertain. Horizontal displacement upslope of the retaining wall could possibly be attributed to deterioration of the timber piles and leaning of the wall. Significant deterioration of the timber piles was confirmed within the 2013 stabilized zone downstream of the project area.

Please don't hesitate to contact me if have you any questions or require further clarification.

Kind Regards,

TREK Geotechnical

Per:

Michael Van Helden, P.Eng.

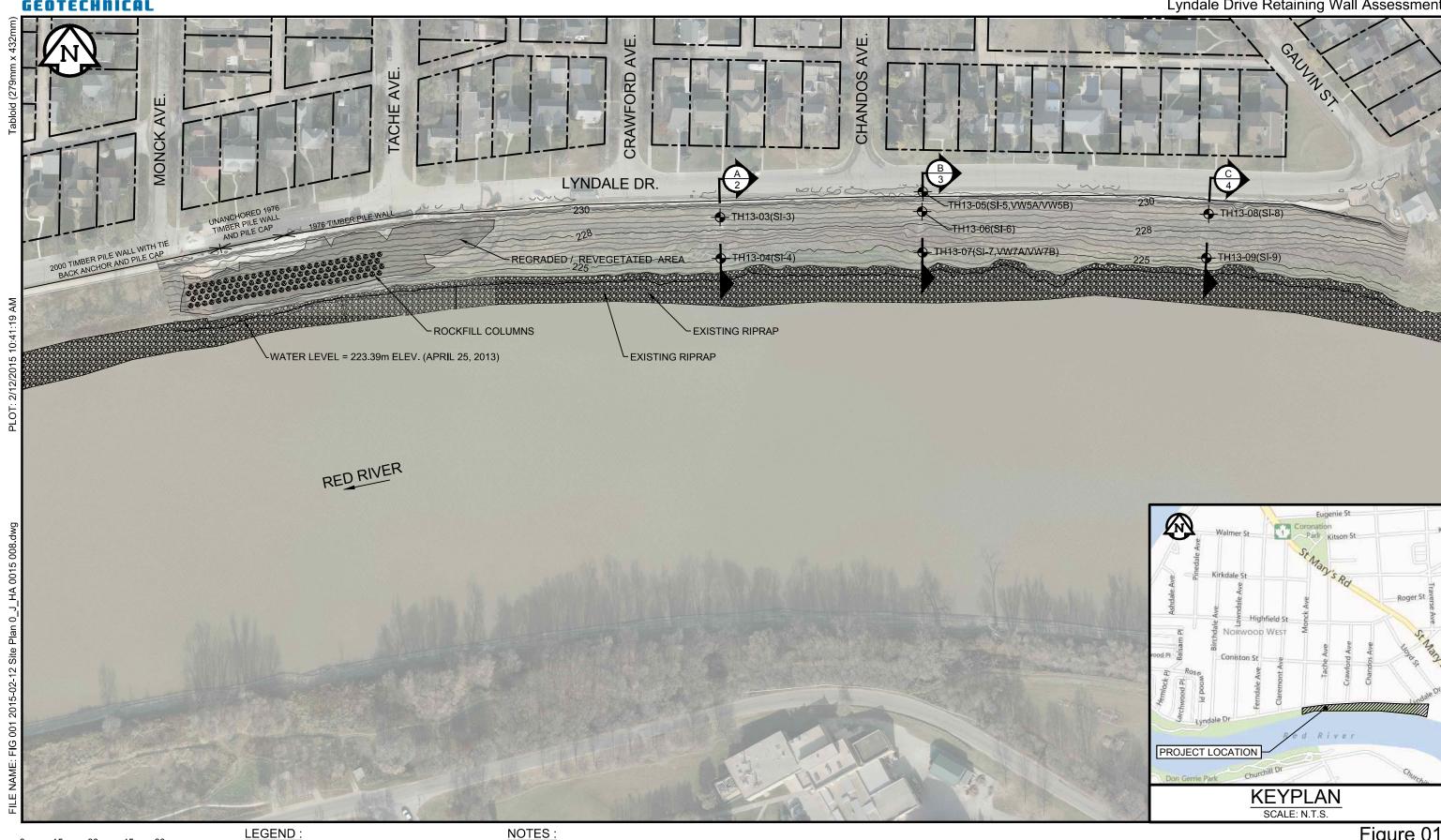
Geotechnical Engineer, Tel: 204.975.9433 ext 102

MVH/kms

Brad Neirinck, P.Eng., City of Winnipeg Public Works CC. Ken Skaftfeld, P.Eng., TREK Geotechnical Inc.

City of Winnipeg

Lyndale Drive Retaining Wall Assessment



-- APPROXIMATE PROPERTY LINE

TEST HOLE (TREK, 2013)

SCALE: 1:1500 (279mm x 432mm)

1. GROUND SURFACE TOPOGRAPHY BASED ON LIDAR SURVEYS PROVIDED BY CITY OF WINNIPEG. 3. SI-1 IN TH13-01 ABANDONED ON OCTOBER 25, 2013

2. AERIAL IMAGE TAKEN IN 2013 PROVIDED BY CITY OF WINNIPEG

4. SI-2 IN TH13-02 ABANDONED ON NOVEMBER 11, 2013

Figure 01 Site Plan

SCALE : 1:200 (279mm x 432mm)

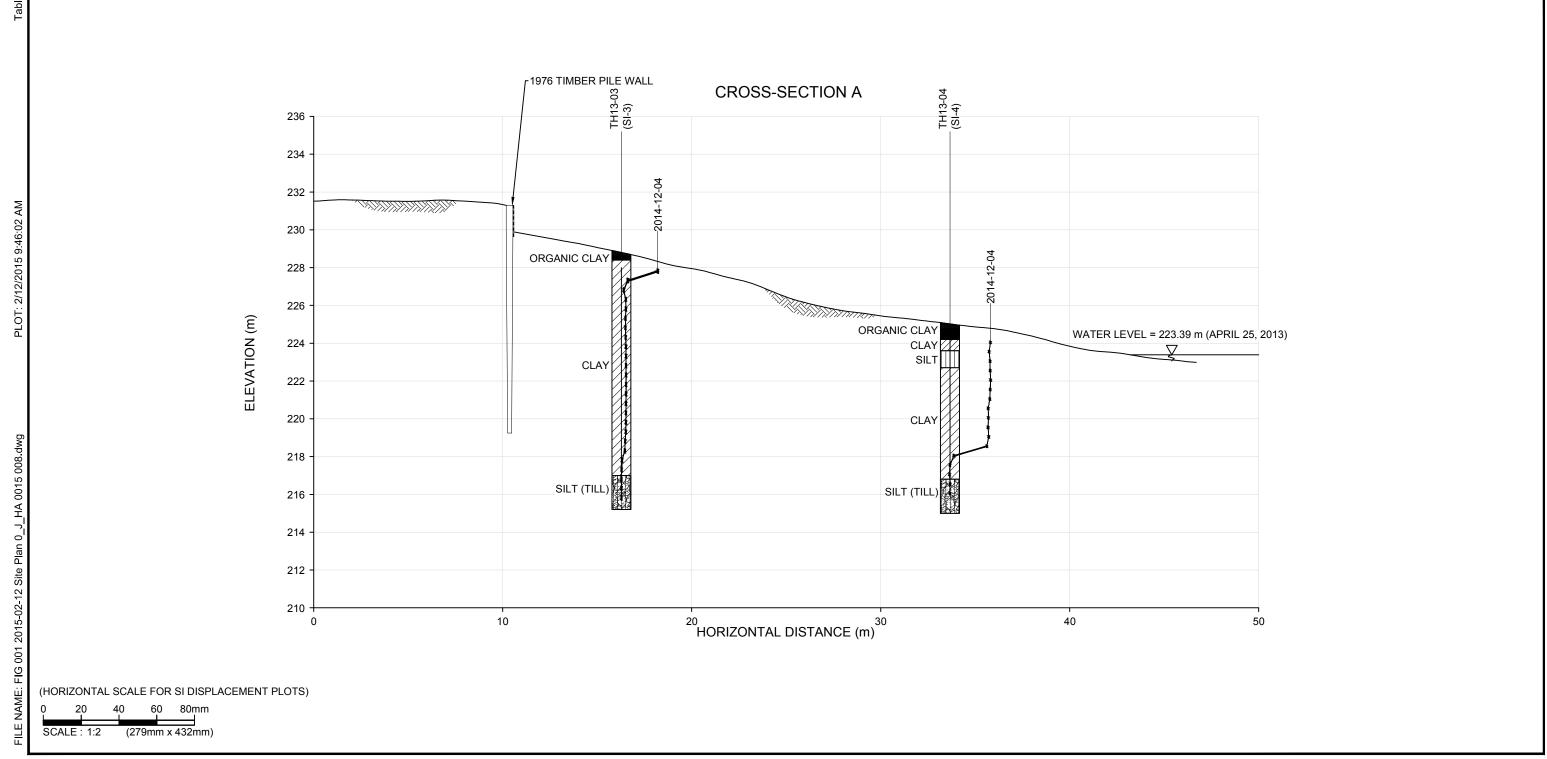


Figure 02
Cross Section A



SCALE : 1:200 (279mm x 432mm)

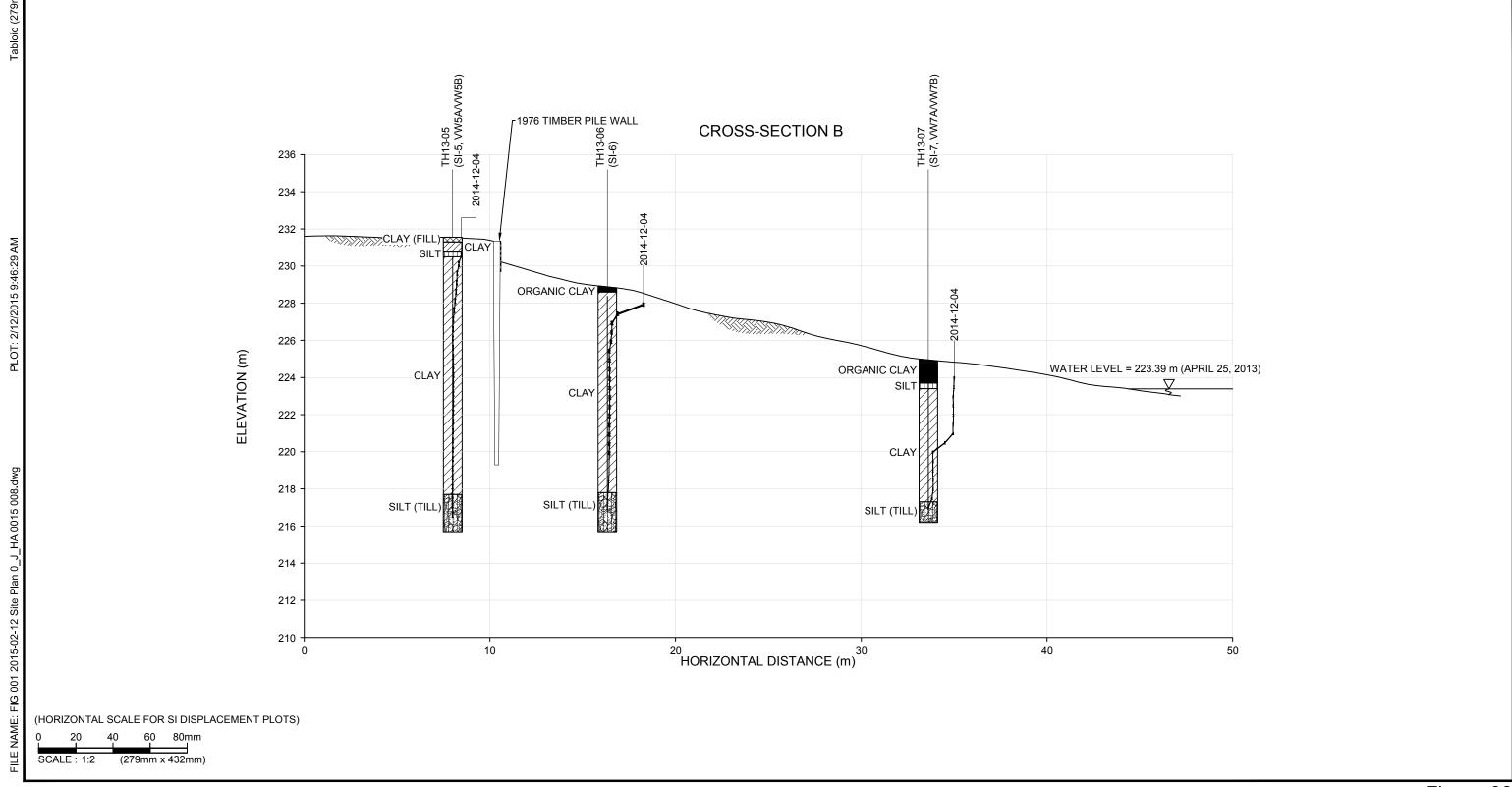


Figure 03
Cross Section B



SCALE : 1:200 (279mm x 432mm)

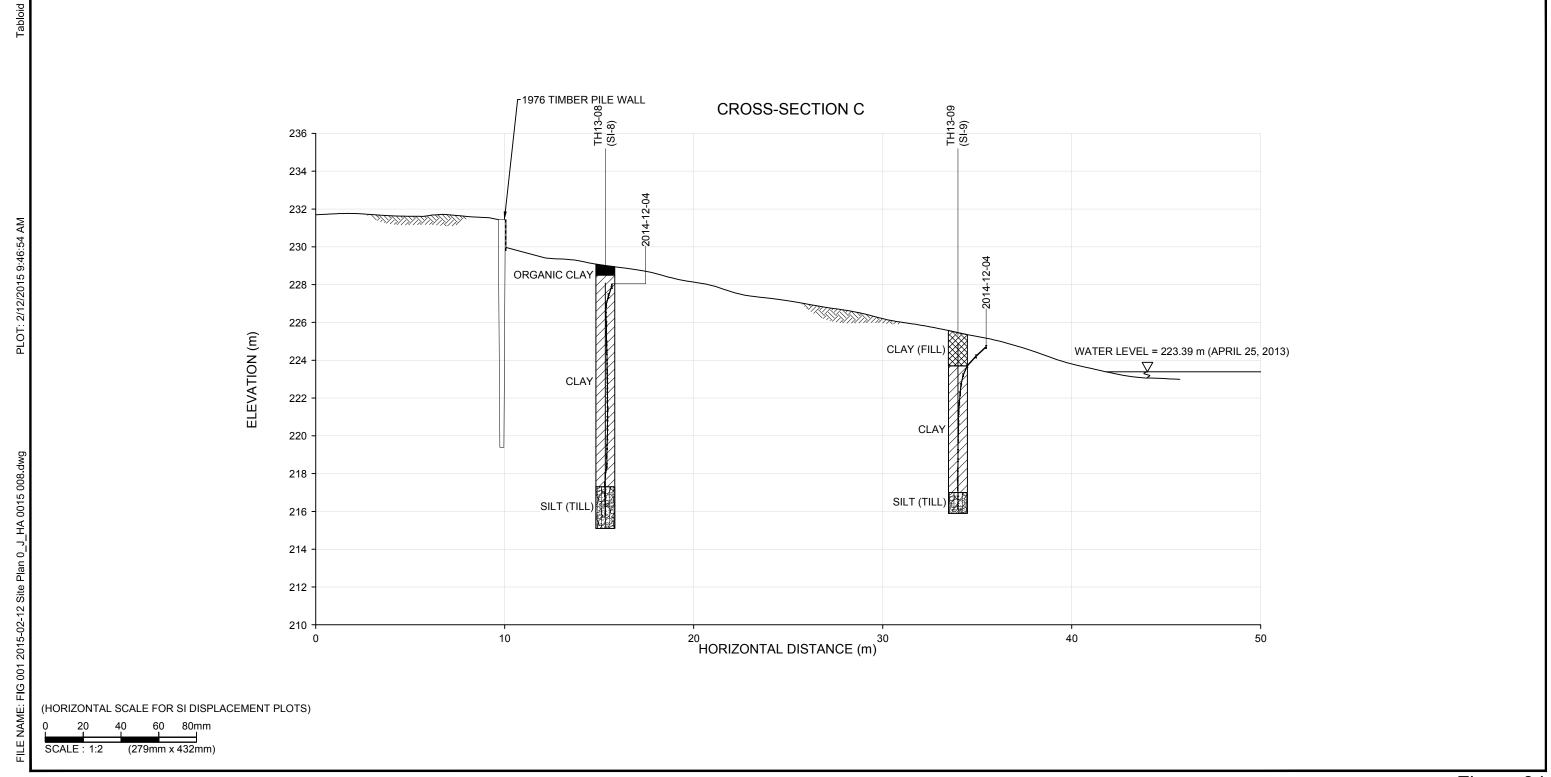


Figure 04 Cross Section C



Cli	ient:		City	of W	'innipeg - F	Public Work	s			Project Number:	0015	008 (00							
Pr	oject N	lame:	Lync	lale	Drive Reta	ining Wall A	ssessment			Location:	Lynda	ale Dr	. betv	veen N	lonck .	Ave. a	nd Ga	uvin S	t	
Co	ntract	or:	Мар	le Le	eaf Drilling					Ground Elevation:	228.6	60 m								
Me	ethod:		_125 r	nm Sc	olid Stem Aug	er, Acker MP5-	-T Track Mount			Date Drilled:	_15 Oc	ctobe	r 2013	3						
	Sar	nple T	уре:			Grab (G)		Shelby	Tube (T)	Split Spoon (S	SS)	S	plit Ba	arrel (S	SB)	Co	ore (C)		
	Par	ticle S	Size L	egen	d:	Fines	Clay		Silt	Sand		Gra	ıvel	52	Cob	bles	H	Boul	ders	
	Bac	kfill L	egen	d:		Bentonite	∭ c	ement		Drill Cuttings	Filter Pa Sand	ack		Gı	out	Ē		Slougl	1	
Elevation		(m)	Soll Symbol	Inclinometer			MATERIA				Sample Type	Sample Number	0 2	PL	MC I	20 21	•	Jndraine Strengt <u>Test</u> △ Ton Pocke ⊠ C ⊃ Field 100	h (kPa Type rane ∆ t Pen. u ⊠ Vane () •
SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15 Sub-surface Log 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15	8.4				- blace CLAY - sili - brov - mois - stiff - high - firm and	k and grey, ty, trace san wn st n plasticity trace silt inc	ce gravel, tra moist, firm to id, trace orga slusions (<10	o stiff, fria anics (woo	ble ody), trace	dation e precipitates (<5mm		G01 G02 G03 G04 G06 G07 G08 T09						△ - Φ-		
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2 of 2

Sub-Surface Log

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Elev.	Depth (m)	Soil S	Slope Inclinometer	WATERIAL DESCRIPTION	Sample	Sample	0	20 PL	MC		80 100 LL		0 F	ocket F ⊠ Qu I ield Va	☑ ne ○
						0)	0	20	40	60	80 100	0 5	0 1	100 1	50 2002
217.0	12-			SILT (TILL) - some clay, some gravel, trace oxidation - light grey and grey - moist to wet - loose to compact		G11	,)							
	-13-			 low plasticity trace gravel (subrounded <35mm diameter), trace oxidation, and cobbles (<80mm diameter) below 12.8 m 											
215.2		ЫЧК				G12	\perp	\perp							

END OF HOLE AT 13.4 m IN SILT TILL

Notes:

- 1) Power auger refusal (PAR) on suspected boulder at 13.4 m. 2) Seepage observed below 11.9 m. 3) No sloughing observed.

- 4) Water level at 12.2 m upon completion of drilling. 5) Slope inclinometer SI-03 installed in test hole.

SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15

Logged By: Martial Lemoine Reviewed By: Ken Skaftfeld Project Engineer: Ken Skaftfeld



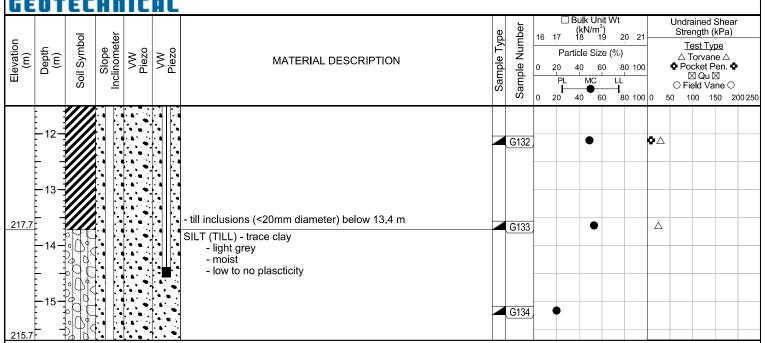
Clie	nt:	City	of Win	nipeg - P	ublic Works	6			Project Number:	0015	008 (00							
Proj	ect Nan	ne: Lynd	ale Dr	ive Retaiı	ning Wall A	ssessment			Location:	Lynd	ale Dr	r. betv	ween	Monc	κ Ave. a	and G	auvin	St.	
Con	tractor:	Pado	dock D	rilling Ltd	l.				Ground Elevation	224.	80 m								
Met	hod:	_125 m	m Solid	Stem Auge	er, Acker MP5-	T Track Mount			Date Drilled:	_15 O	ctobe	r 201	3						
	Samp	е Туре:			Grab (G)		Shelby	y Tube (T)	Split Spoon (SS)	S	plit Ba	arrel ((SB)		ore (C)		
	Particl	e Size Le	egend:		Fines	Clay		Silt	 Sand	• 📉	Gra	avel	50	月 c	obbles	• 7	Во	ulders	
	Backfi	ll Legend	:		Bentonite	₩ c	ement		Drill Cuttings	Filter F Sand	ack			 Grout			Slou	ah	
Elevation (m)	Depth	Soil Symbol	Inclinometer			MATERIA	L DES	CRIPTION	لتنتين	Sample Type	Sample Number	16 1	□ Bu 17 1 17 1 17 17 18 19 19 19 19 19 19 19	ulk Unit kN/m³) 8 19 ———— de Size	20 2	0	Undra Strer Te A To Pool E	ined Sh ngth (kP st Type orvane ⊿ ket Pen l Qu ⊠ ld Vane	a) △ ı. •
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222.	7 2 -				t, soft plasticity						G23		•						
1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15 D1 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15 D1 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15	3 - 3 - 5 - 6 - 7 - 8 - 8 - 8 - 8			- brow - stiff, irm belov	n, moist, high plastic			cs			G24 G25 SS27A	\ \		•		•	A.	Δ	
0 LYNDALE DRIVE LOGS -	9		SI	- light - mois	grey	id, trace grav	/el			X	SS27E								
SURFACE LOG 0015 008 0		Michae	No 1) 2) at 3) 4) 5)	otes: Power a Solid ste ugers due Seepage Sloughir Slope in	uger refusa em augers v e to sloughir e observed ng was obse	ng. below 15.8 r erved below SI-04 installe	8 m 4.6 m d n 1.2 m ed in tes				Projec	ct Ene	ginee	r: K	en Skaf	tfeld			



Client:City of Winnipeg - Public Works	Project Number: 0015 008 00
Project Name: Lyndale Drive Retaining Wall Assessment	Location: Lyndale Dr. between Monck Ave. and Gauvin St.
Contractor: Maple Leaf Drilling	Ground Elevation: 231.41 m
Method: 125 mm Solid Stem Auger, Acker MP5-T Track Mount	Date Drilled: 16 October 2013
Sample Type: Grab (G) Shelby Tube (T)	Split Spoon (SS) Split Barrel (SB) Core (C)
Particle Size Legend: Fines Clay Silt	Sand Gravel Cobbles Boulders
Backfill Legend: Bentonite Cement	Drill Cuttings Filter Pack Sand Grout Slough
Elevation (m) (m) (m) (m) Soil Symbol Soil Symbol VW Piezo VW Piezo	0 20 40 60 80 100
231.3 SAND AND GRAVEL (FILL) - trace sand moist, dense	well graded, yellow, G121 G122 G122
230.8 230.5 CLAY - silty, trace sand, trace gravel, trace organics, trace oxidation, dark grey, mois plasticity SILT - trace sand, trace oxidation, light gravely trace oxidation, light gravely trace oxidation, light gravely trace sand, trace oxidation, dark grey, mois plasticity	ce rootlets, trace t, firm to stiff, high
CLAY - silty, trace oxidations, trace silt in	
diameter) - partial diameter - mottled brown and grey - moist, firm to stiff - high plasticity	
	G125
	G126
	G 127 →
	G128
- 9	G 129.
	G130, T131 ← Φ △
Logged By: Martial Lemoine Reviewed By: Ken Skaf	tfeld Project Engineer: Ken Skaftfeld

2 of 2

Sub-Surface Log



END OF HOLE AT 15.7 m IN SILT TILL

Notes:

1) Power auger refusal (PAR) at 15.7 m

2) No seepage observed 3) No sloughing observed.

4) Slope inclinometer SI-05 installed in test hole.

5) Vibrating wire piezometers VW-5A and VW-5B installed on tremie line next to slope inclinometer at depths of 9.1 m and 14.5

SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT GPJ TREK GEOTECHNICAL GDT 25/2/15

Logged By: Martial Lemoine Reviewed By: Ken Skaftfeld Project Engineer: Ken Skaftfeld



Clien	t:	_Cit	ty o	f Wi	nnipeg - Pu	blic Work	s				Project	Number:	0015	008 (00								
Proje	ct Nan	ne: <u>Ly</u>	nda	le D	rive Retaini	ing Wall A	Assessm	ent			Locatio	n:	Lynd	ale Dr	. bet	ween	Mond	ck Av	e. an	ıd Ga	uvin S	St.	
Cont	ractor:				af Drilling						Ground	l Elevation:	228.7	76 m									
Meth	od:	_125	5 mn	1 Soli	d Stem Auger,	Acker MP5	-T Track M	lount			Date Di	rilled:	<u>16 O</u>	ctobe	r 201	3							
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	Partic	e Size	Leg	gend	l: 	Fines		Clay		Silt	****	Sand	·X	Gra	ıvel	5	<u>'</u> ∂ c	obbl	es	H	Βοι	ılders	;
	Backf	II Lege	nd:			Bentonite	X	Cen	nent		Drill Cutt	ings	Filter P Sand	ack		. (Grout			99	Sloug	gh	
														e		□В	ulk Uni (kN/m³)					ned Sh gth (kF	
u O	ے	Soil Symbol	Slope	leter									Sample Type	Sample Number	16		(kN/m³) 18 19 cle Size		21		Tes	t Type	1
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Test Hole TH13-06

2 of 2



Sub-Surface Log

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ation n)	Depth (m)	Symbol	pe	ı	MATERIAL DESCRIPTION	- ⊢-	Number	10	Particle			<u>Test∃</u> ∆ Torva		
Elevation (m)	De (r	Soil S	Slope Inclinometer	'	MATERIAL DESCRIPTION	Sample	ample	0	20 40 PL	60 MC	80 100 LL	Pocket	u 🛛	
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	12-	20		- low to non-plastic			G50	•						
								1						
		2												
215.7	<u> 13</u>	PH P					G51							_

END OF HOLE AT 13.4 m IN TILL

Notes:

- 1) Power auger refusal (PAR) on suspected boulder at 13.4 m.
 2) Test hole open to 12.8 m due to sloughing in silt till.
 3) No seepage observed.
 4) Slope inclinometer SI-06 installed in test hole.

SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15

Logged By: Martial Lemoine Reviewed By: Ken Skaftfeld Project Engineer: Ken Skaftfeld



1 of 1



	Clien	ıt:	City	of Win	nipeg	- Pi	ublic Works				F	Project Number:	0015	800	00							
	Proje	ct Name	: Lynd	ale Dr	ive Re	tair	ning Wall As	sessmen	t		L	_ocation:	Lynd	ale D	r. betv	veen M	lonck /	Ave. ar	id Ga	uvin	St.	
	Cont	ractor:	Padd	lock D	rilling	Ltd					. (Ground Elevation:	224.8	31 m								
	Meth	od:	_108 m	m Solid	l Stem A	uge	r / Yanmar C25	5R Rubber T	Track Moun	t		Date Drilled:	16 O	ctobe	r 2013	3						
		Sample	Type:		4	4	Grab (G)		Shelb	by Tube (T)	Split Spoon (S	S) 🕨	S	plit Ba	arrel (S	В)	Co	re (C)		
		Particle	Size Le	gend:			Fines	CI	ay [Silt		Sand		Gr	avel	52	Cob	bles	H	Βοι	ulders	
		Backfill	Legend	:			Bentonite		Cement		Dr		Filter P Sand	ack	• •	Gr	out	72	\$	Slou	gh	
	Elevation (m)	Depth (m)	Soil Symbol Slope	Inclinometer	Piezo	Piezo				L DESCRI			Sample Type	Sample Number	0 2	Particle 0 40	60 //C L	20 21	•	Streng Tes	ned She gth (kPa st Type rvane △ ket Pen. Qu ⊠ d Vane) 150	a) ^
SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT GPJ TREK GEOTECHNICAL GDT 25/2/15	223.4 223.4 217.3	2 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 -					rootlets, tra - dark - mois - intern SILT - trace - light CLAY - silty (<10 mm d - mottl - mois - high - silt layer (SILT (TILL) mm dia.) - light - mois - mois	disce organ brown are to soft to formediate to e clay, trace is ia.), trace is ia.), trace led grey att, stiff plasticity 10 mm the organization of the company of the comp	ics Id grey Id grey Irm In high pla Ice or organ Ist, soft, k It inclusic It inclusic It organics Ind brown Ick) light In high It inclusic It inclusion It	asticity ics ow plasticity ons (<5 mn s, trace oxi n brown, and	ty n dia datio d mo	ist below 2.4 m		G61 G62 G63 G64 G65 G66								
B-SURFACE LOG 0015 008 00 LYND	l ess	and Dr.	Mout: -1	l or-	sinc.			7.0 m de evel at 6.1 e was bac 7 lithology	pth due to m depth ckfilled w based o	o squeezir , water fro ith auger c n TH14-07	m SII :utting 'A loo	LT (TILL). gs to the surface. cated 1.2 m at 290		Dua!:	at For	Nimes	V	Cleans	ماط			
SUE	Logg	ed By:	Martial	Lemo	ine			Revie	ewed By:	Ken Ska	aftfel	d ————————————————————————————————————	-	Proje	ct Eng	gineer:	_Ken	Skaftf	eld			-



Clier	nt:	_Cit	y of \	Vinnipeg	- Public Wor	ks			Project Number:	0015	008	00									
Proje	ect Nam	ne: Lyr	ndale	Drive Re	taining Wall	Assessment			Location:	Lynd	ale D	r. be	twee	n Mor	nck A	ve. ar	nd Ga	auvin	St.		
Cont	ractor:	_Ma	ple L	eaf Drillir.	ıg				Ground Elevation	ı: <u>228.</u> 8	83 m										_
Meth	od:	125	mm S	Solid Stem A	uger, Acker MP	5-T Track Mour	nt		Date Drilled:	<u>16 O</u>	ctobe	r 201	13								_
	Sampl	е Туре			Grab (G)		Shelb	y Tube (T)	Split Spoon ((SS)	s	plit E	Barre	I (SB)		Co	re (C	;)			
	Particl	e Size	Lege	nd:	Fines	Cla	у	Silt	المنظق Sand	• •	Gra	avel	R	F.	Cobb	les	H	Во	ulder	s	
	Backfil	II Leger	nd:		Bentonite		Cement		Drill Cuttings	Filter P	ack			Grou	t	<u> </u>		Slou	ıgh		
									<u> </u>		<u></u>			Bulk Ur	nit Wt	LE	37340	Undra	ined S		
l e	_	loge	Slope Inclinometer							Sample Type	Sample Number	16		(kN/m 18		20 21			ngth (k est Typ		
Elevation (m)	Depth (m)	Soil Symbol	ope nom			MATER	IAL DES	CRIPTION		<u> </u>	<u> Z</u>	0	Pari 20	ticle Siz		30 100		Poc	orvane ket Pe	en. 👨	,
🛎		Soil								Sam	amp		PL	MC	LL			\boxtimes	l Qu.⊠ eld Var	3	
										- 0,		+	20	40 6	60 E	30 100	0 5		0 15		00 25
228.5					IC CLAY - tra ack, moist, fr		race sand	d, trace roo	tlets	4	G81		•								
	= =			CLAY -		nd. trace silt	inclusion	ns (<10mm), trace precipitates												
	- 1 -			bı - bı	own	ilics (Tootiets), liace c	Xidation													
				- so	oist oft to firm						G82							^₽			
	: :			- hi - la	gh plasticity minated clay	and silt (<2r	mm)				302	1									
	2 -			•	·	,	,														
				.]																	
											000						•	,			
	- 3 -										G83	1						_			
	+ -			•																	
	4																				
1	: :									4	G84	7		•			•				
	5 -																				
					ravel (20mm	dia.) below	5 . 2 m														
5	: :			- grey b	elow 5.5 m																
	6 -									4	G85	\downarrow		•			♣△				
	= =			•																	
				- firm be	low 6.7 m																
5	- / -																				
\$										4	G86			•			••^				
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	F11-																				
1			<u>.] .</u>			P	und D	Ver Object	Hfold		D				Ver 1	2k = 65	اداه				
Logo	ged By:	_iviarti	aı Le	emoine		Kevie	wea By:	Ken Skat	illeia		rroje	ct Er	igine	er: _	nen S	экапп	eid				



u	U I			ILHL									
		10	je.)e	ber	16	☐ Bulk Unit (kN/m³) 17 18 19	Wt 20 21—		Indraine Strengt		
Elevation (m)	Depth (m)	Symbol	ope omete	MATERIAL DESCRIPTION	e Type	Z		Particle Size			△ Torv		Δ
Elev	De L	Soil S	Slope Inclinometer	WATERWE BESOMI FISH	Sample	Sample	0	20 40 60 PL MC	80 100 LL		Pocke ⊠ C ⊃ Field	Qu 🛛	
					0,	Š	0	20 40 60	80 100 0	50	100	150	200 250
217.3/	-12-			SILT (TILL) - trace clay, trace gravel, trace sand - light grey - moist - compact - low to non-plastic		G89		•					
215.1				END OF HOLE AT 40.7 ··· IN OUT TILL		G 90	ر					<u> </u>	

END OF HOLE AT 13.7 m IN SILT TILL

Notes:

- 1) Power auger refusal (PAR) at 13.7 m depth.
 2) Test hole open to 13.1 m depth due to sloughing.
 3) No seepage observed.
 4) Slope inclinometer SI-08 installed in test hole.

SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15

Logged By: Martial Lemoine Reviewed By: Ken Skaftfeld Project Engineer: Ken Skaftfeld

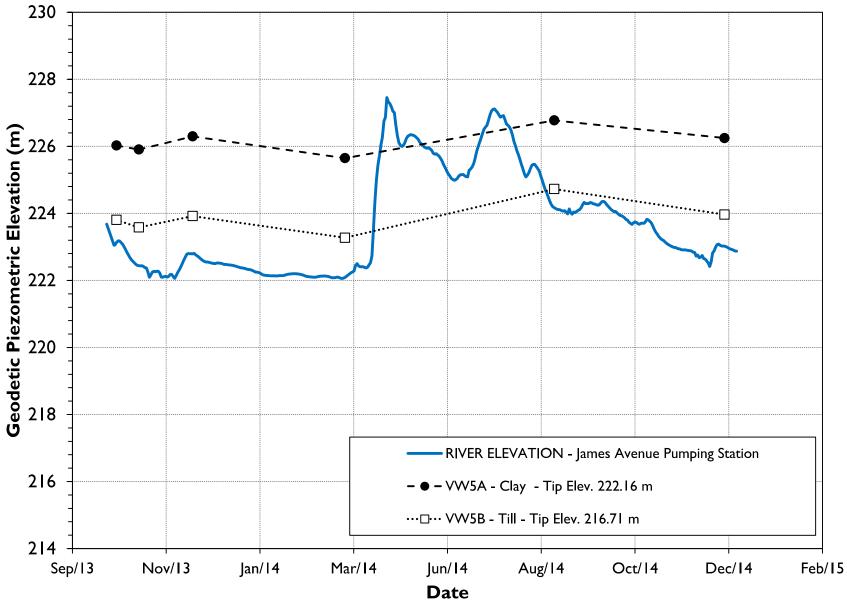


Clie	ent:		City	of W	'innipeg - P	ublic Works	3			Project Number:	0015	0 800	0						
Proj	ject	Nam	: Lyn	dale l	Drive Retai	ning Wall A	ssessment			Location:	Lynda	le Dr.	betwe	een Mo	nck Ave	. and G	auvin	St.	
Con	ntrac	tor:	Pad	ldock	Drilling Ltd	l			_	Ground Elevation:	225.39	9 m							
Met	hod	:	108	mm Sc	olid Stem Auge	er / Yanmar C2	5R Rubber Track	Mount		Date Drilled:	16 Oct	tober	2013						
	Sa	ample	Туре:			Grab (G)		Shelby Tube	(T)	Split Spoon (S	S) 📐	Sp	lit Bar	rrel (SB)	Core (C)		
	Pa	article	Size L	.egen	d:	Fines	Clay	∭ s	ilt	Sand		Grav	/el		Cobble	s 📄	Во	oulders	i
	Ва	ackfill	Legen	d:		Bentonite	Ce	ment			Filter Pad Sand	ck	•				Slou	ıgh	
Elevation	(III)	(m)	Soil Symbol	Slope Inclinometer			MATERIAL	_ DESCRIPTI	ON		Sample Type	Sample Number	16 17 F 0 20	Particle S	n ³) 19 20 ize (%) 60 80	100	Stre	ained Sh ngth (kF est Type orvane cket Per ☑ Qu ☑ eld Vane	Pa) } ∆ n. Ф
SEOTECHNICAL.GDT 25/2/15		1 — 1 — 2 — — 3 — — 4 — — 5 — — 6 — — 6 — —			roots, trace - grey - mois - inter - black and - sand and below 1.4 r CLAY - silt dia.), trace - mott - mois - high	e organics, t st, firm mediate to h I grey, high gravel laye m y, trace silt i organics, tr led grey and st, stiff plasticity	race oxidation nigh plasticity plasticity belo r (300 mm thin nclusions (<5 race oxidation d brown <15 mm dia.)	w 0.6 m ck), trace bou mm dia.), tra	lder	trace rootlets, trace s, moist, very dense precipitates (<10 mm		G101 G102 G103 G104 G105 T106				Δ	0		
- 1-9 - DRAFT.GPJ TREK		7 -				m below 6.9 e till inclusio	m ns (<20mm di	ia.) below 7.8	m			T108		•		Δ.	•		
217. ADALE DRIVE LOGS 217. 215.	.9	9			- light - mois - low p	grey, st, compact to plasticity		<u> </u>	<19	mm dia.)		G110,	•						
SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15 C	ıged	By:	Martia		Notes: 1) Power a 2) No sloug 3) Seepag 4) Water le 5) Test hol 6) TH13-09	uger refusa ghing obser e observed evel at 8.4 m e was backt		i m 9.5 m depth. yer. from SILT (T er cuttings to	the 2.1	surface. m at 300 degrees N.			t Engi	ineer:	Ken Sk	aftfeld			

GROUNDWATER MONITORING REPORT

Lyndale Drive Retaining Wall Assessment Piezometer Summary Plot (TH13-05)





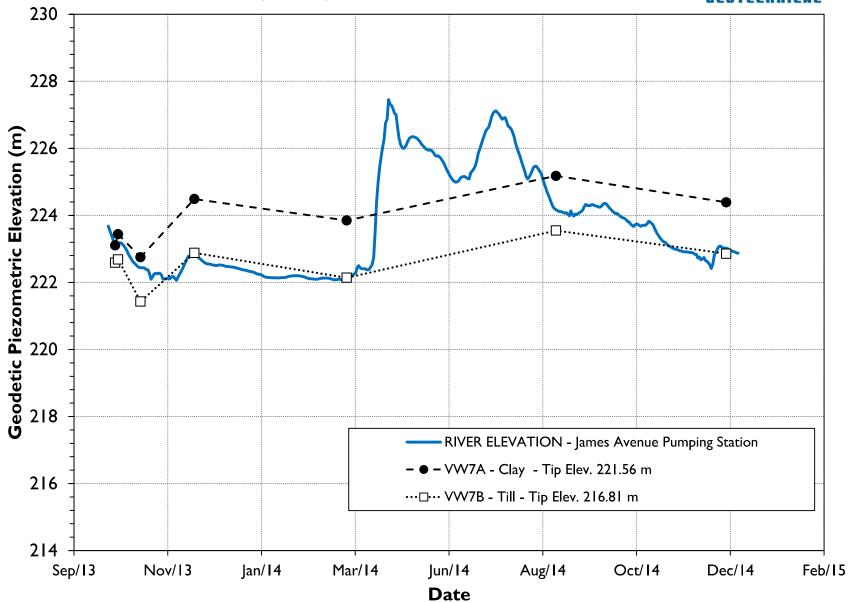
Z:\Projects\0015 City of Winnipeg\0015 008 00 Lyndale Drive Retaining Wall Assessment\2 Design\2.5 Monitoring\SI and VW's\LYNDAL- VW\Lyndale Drive Vibrating Wires SI_5 04/02/2015 11:27 AM

Page 1 of 1

GROUNDWATER MONITORING REPORT

Lyndale Drive Retaining Wall Assessment Piezometer Summary Plot (TH13-07)



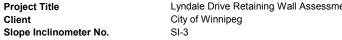


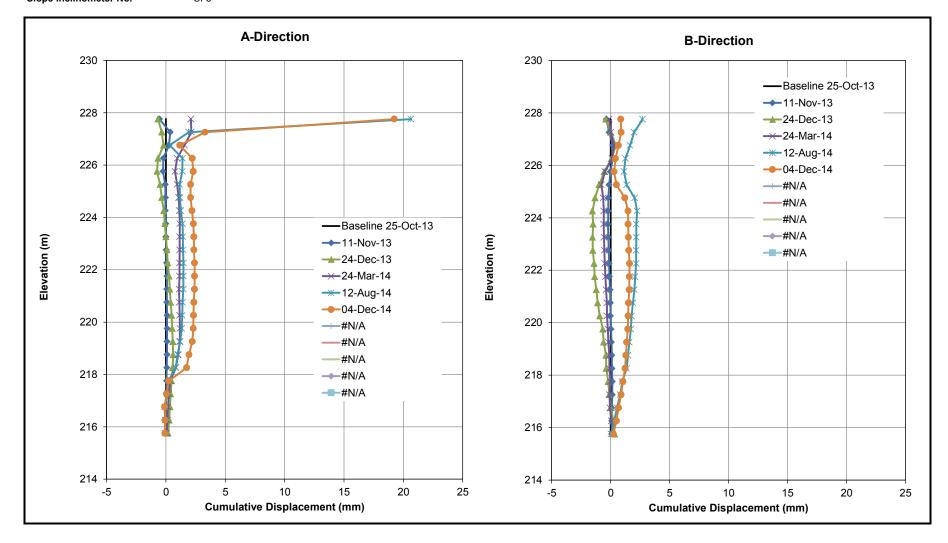
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Page 1 of 1

INSTALLATION DATA Project No. Project Title Client

0015 008 00 Lyndale Drive Retaining Wall Assessment City of Winnipeg





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Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

INSTALLATION DATA Project No. Project Title

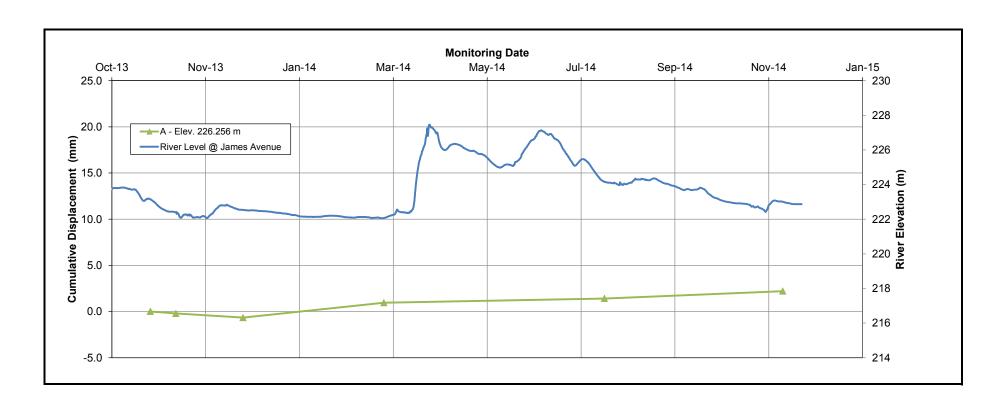
roject No. 0015 008 00

Project Title Lyndale Drive Retaining Wall Assessment

City of Winnipeg SI-3

Client City
Slope Inclinometer No. SI-

			Cumulative Di	isplacement (n	nm) vs. Monito	ring Date					
Elevation	on Range (m)	Axis	25-Oct-13	11-Nov-13	24-Dec-13	24-Mar-14	12-Aug-14	4-Dec-14			
		Α	0.0	-0.2	-0.7	1.0	1.4	2.2			
Bot	226.3	В	0.0	0.2	0.1	0.1	1.3	0.4			
		Resultant	0.0	0.3	0.7	1.0	1.9	2.2			

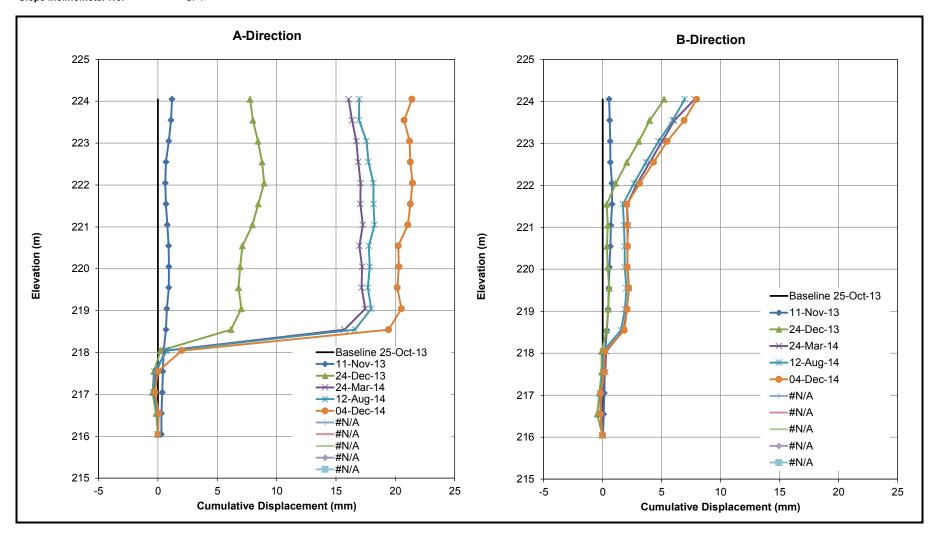


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INSTALLATION DATA Project No. Project Title Client

0015 008 00 Lyndale Drive Retaining Wall Assessment City of Winnipeg

Slope Inclinometer No. SI-4



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Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

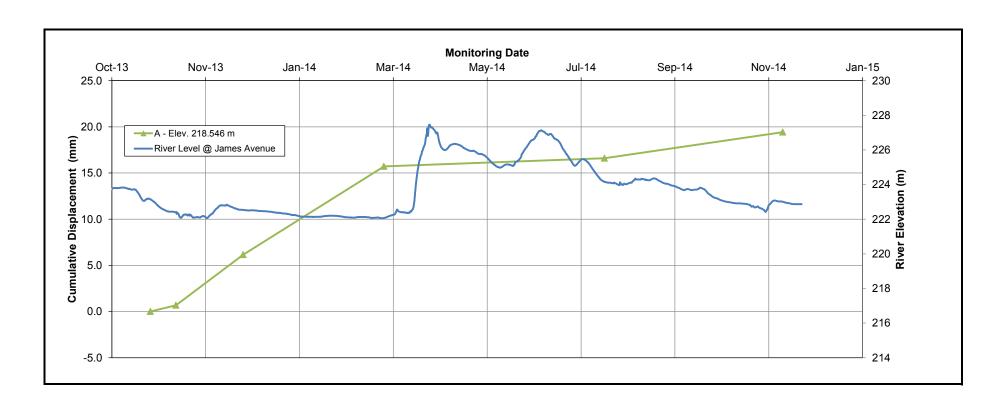
INSTALLATION DATA Project No. Project Title

0015 008 00

Lyndale Drive Retaining Wall Assessment

Client
Slope Inclinometer No. City of Winnipeg SI-4

			Cumulative D	isplacement (n	nm) vs. Monito	ring Date					
Elevation	on Range (m)	Axis	25-Oct-13	11-Nov-13	24-Dec-13	24-Mar-14	12-Aug-14	4-Dec-14			
		Α	0.0	0.7	6.2	15.7	16.6	19.4			
Mid	218.5	В	0.0	0.4	0.4	1.8	1.6	1.8			
		Resultant	0.0	0.8	6.2	15.8	16.7	19.5			



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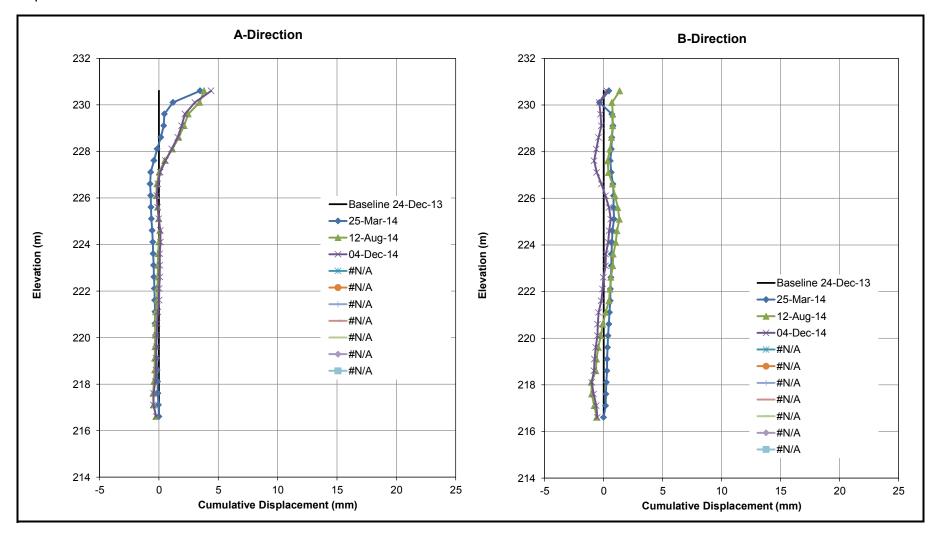


Cumulative Displacement in A and B Directions (Movement)

INSTALLATION DATA Project No. Project Title Client

0015 008 00 Lyndale Drive Retaining Wall Assessment City of Winnipeg

Slope Inclinometer No. SI-5



06/02/2015 2:12 PM



Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

INSTALLATION DATA Project No. Project Title

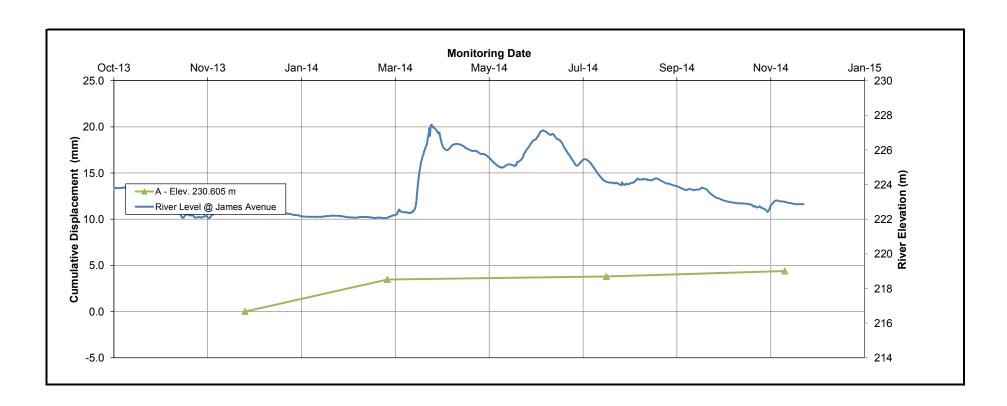
0015 008 00

Project Title Lyndale Drive Retaining Wall Assessment

City of Winnipeg SI-5

Client Slope Inclinometer No.

			Cumulative Displacement (mm) vs. Monitoring Date										
Elevation Range (m)		Axis	24-Dec-13	25-Mar-14	12-Aug-14	4-Dec-14							
	230.6	Α	0.0	3.5	3.8	4.4							
Тор		В	0.0	0.4	1.4	0.3							
		Resultant	0.0	3.5	4.0	4.4							

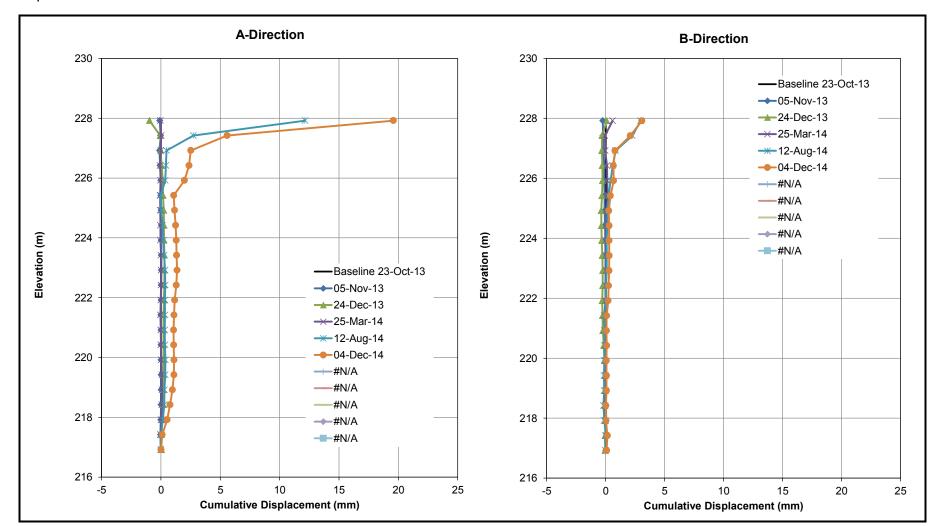


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INSTALLATION DATA Project No. Project Title Client

0015 008 00 Lyndale Drive Retaining Wall Assessment City of Winnipeg





05/02/2015 2:42 PM



Project Title

Client

SLOPE INCLINOMETER WORKSHEET

Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

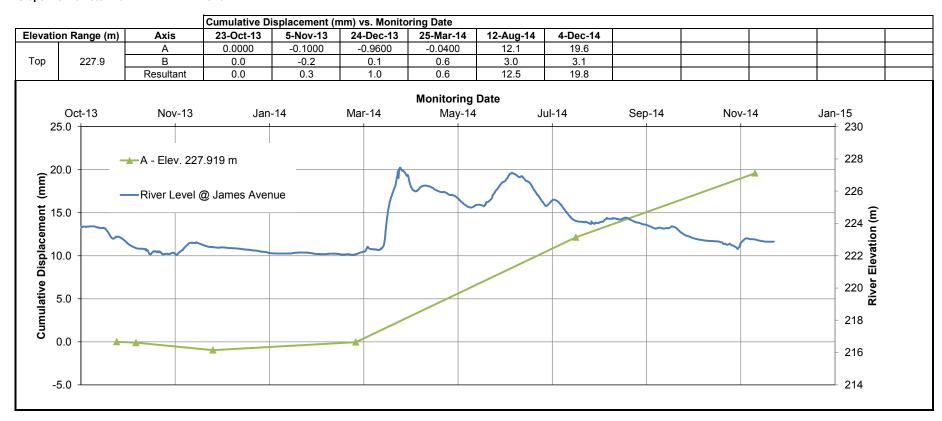
INSTALLATION DATA

Project No.

0015 008 00 Lyndale Drive Retaining Wall Assessment

City of Winnipeg

Slope Inclinometer No. SI-6



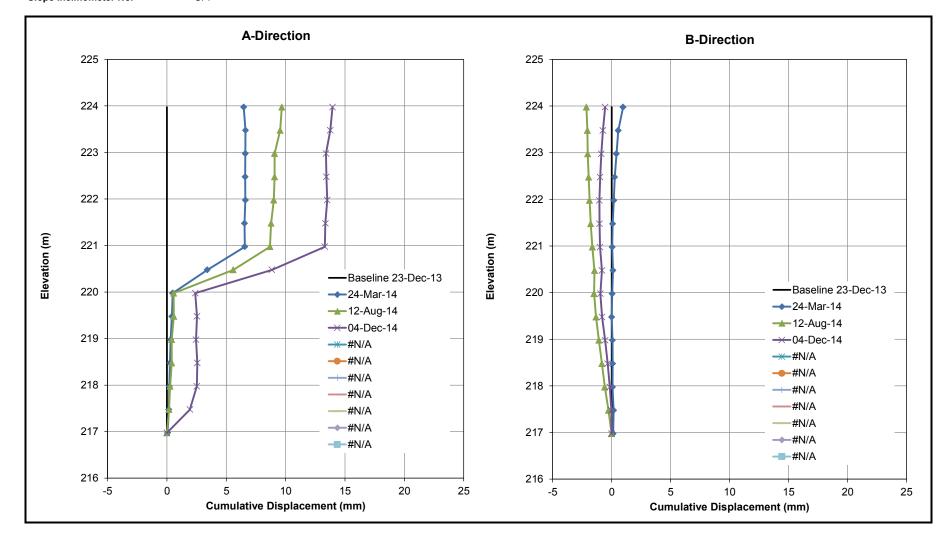
05/02/2015 2:42 PM

Cumulative Displacement in A and B Directions (Movement)

INSTALLATION DATA Project No. Project Title Client

0015 008 00 Lyndale Drive Retaining Wall Assessment City of Winnipeg

Slope Inclinometer No. SI-7



05/02/2015 2:38 PM



Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

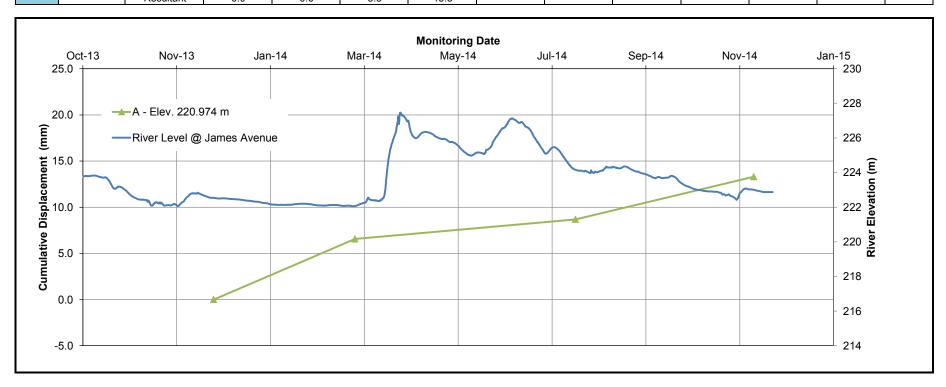
INSTALLATION DATA Project No. Project Title

oject No. 0015 008 00

Project Title Lyndale Drive Retaining Wall Assessment

Client City of Winnipeg
Slope Inclinometer No. SI-7

	Cumulative Displacement (mm) vs. Monitoring Date													
Elevation Range (m) Axis		Axis	23-Dec-13	24-Mar-14	12-Aug-14	4-Dec-14								
		Α	0.0	6.6	8.7	13.3								
	221.0	В	0.0	0.0	-1.6	-1.0								
		Resultant	0.0	6.6	8.8	13.3								



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Cumulative Displacement in A and B Directions (Movement)

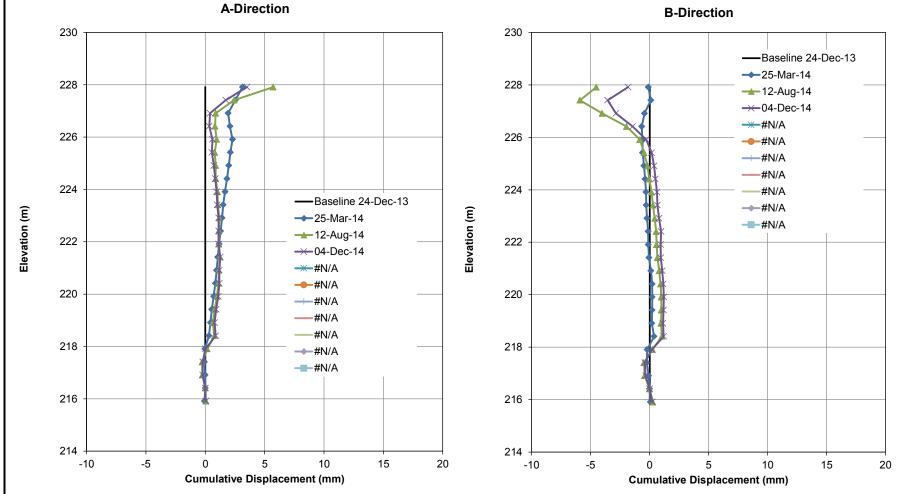
INSTALLATION DATA Project No.

0015 008 00

Project Title

Lyndale Drive Retaining Wall Assessment City of Winnipeg





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Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

INSTALLATION DATA Project No. Project Title

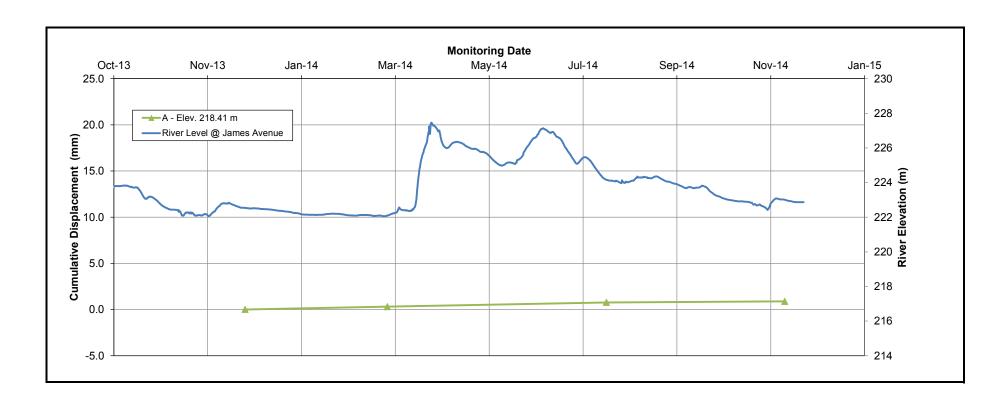
0015 008 00

Project Title Lyndale Drive Retaining Wall Assessment

City of Winnipeg SI-8

Client Slope Inclinometer No.

Cumulative Displacement (mm) vs. Monitoring Date												
Elevation Range (m) Axis		24-Dec-13	25-Mar-14	12-Aug-14	4-Dec-14							
	218.4	Α	0.0	0.3	0.8	0.9						
Bot		В	0.0	0.4	1.1	1.2						
		Resultant	0.0	0.5	1.3	1.5						



05/02/2015 2:49 PM



Cumulative Displacement in A and B Directions (Movement)

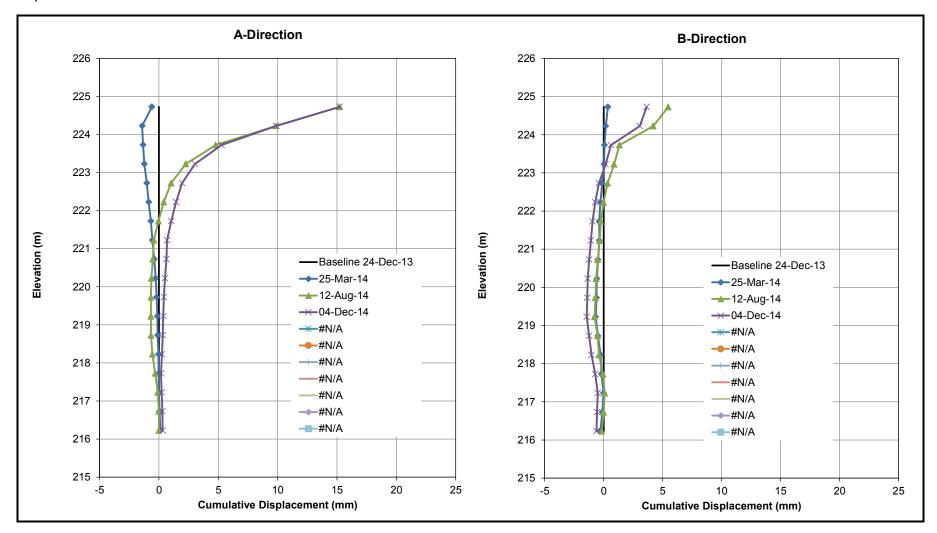
INSTALLATION DATA

Project No. Project Title Client

0015 008 00

Lyndale Drive Retaining Wall Assessment City of Winnipeg

Slope Inclinometer No. SI-9



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Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

INSTALLATION DATA Project No. Project Title

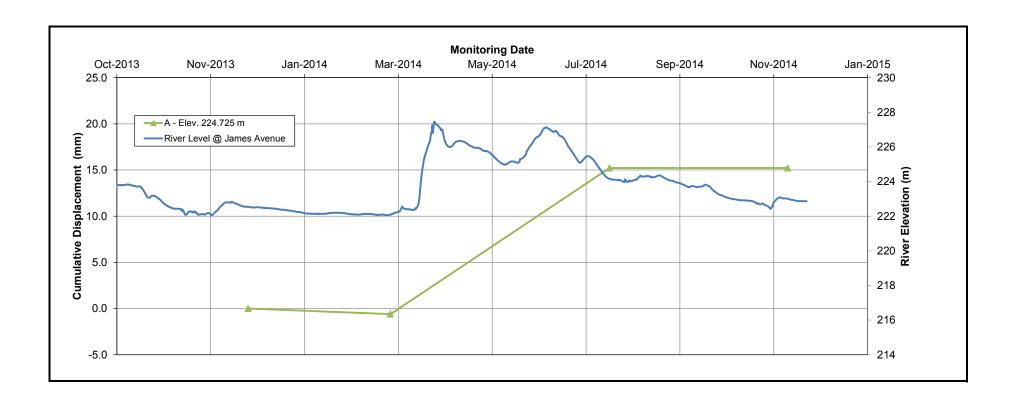
0015 008 00

Project Title Lyndale Drive Retaining Wall Assessment

City of Winnipeg SI-9

Client Slope Inclinometer No.

Cumulative Displacement (mm) vs. Monitoring Date												
Elevation Range (m)		Axis	24-Dec-13	25-Mar-14	12-Aug-14	4-Dec-14						
	224.7	Α	0.0	-0.6	15.2	15.2						
Top		В	0.0	0.4	5.5	3.6						
		Resultant	0.0	0.7	16.2	15.7						



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