APPENDIX B – PRELIMINARY BOREHOLES

- Boreholes were drilled:
  - TH 13-01 – November 6, 2013
  - TH 13-04 – November 7, 2013
  - TH 13-05 – November 15, 2013

- Boreholes from the construction of the North Kildonan Settlers Bridge:
  - TH7 – August 7, 1987
  - TH12 – August 28, 1987
  - TH19 – September 19, 1987
  - TH18 – September 21, 1987
  - TH23 – September 22, 1987
  - TH17 – October 4, 1987
  - TH20 – October 3, 1987

Sub-Surface Log

Test Hole TH13-01

Client:	Associated Engineering	**Project Number:**	0115 004 00
Project Name:	Detailed Design North Kildonan Feedermain	**Location:**	UTM N-5534866.43, E-636644.43
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	227.36 m
Method:	125 mm Solid Stem Auger, Acker SS3 Track Mount	**Date Drilled:**	7 November 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)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number
225.8	0	CLAY (FILL) - silty, trace gravel (<25mm), trace organics, trace silt inclusions (<20mm) - brown - moist, frozen - high plasticity - stiff below 1.1 m	G	G29
	1		G	G30
	1.5	CLAY (ALUVIAL) - silty, some fine to medium grained sand, trace organics (roots) - brown - stiff - intermediate plasticity	G	G31
	2		G	G32
224.6	2.7	SILT - clayey, trace fine and medium grained sand, trace organics (roots) - brown - moist - very soft - low to intermediate plasticity	G	G33
	3		T	T34
	4		G	G35
	4.6		SB	SB36A
	5	- trace clay, sandy and wet below 5.0 m	SB	SB36B
	5.5	- clayey below 5.5 m	SB	SB36C
	6	- trace clay below 6.1 m	SB	SB37A
	6.6	- loose below 6.6 m	SB	SB37B
	7	- clayey below 7.2 m - trace clay below 7.3 m	SB	SB37C
	7.3		SB	SB38A
219.0	8.3	SAND - silty, trace clay - brown - wet - loose - poorly graded, fine and medium grained sand	SB	SB38B
	9		SB	SB39
	10	- no clay, some silt below 10.7 m	SB	SB40
	11			

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

Logged By: Stephen Renner **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH13-01

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	RQD (%)	SPT (N)
215.2						
		CLAY - silty, some fine to medium grained sand, trace organics (roots) - brown - stiff - intermediate plasticity		T41		
214.6	13			SB42A		
		SAND (TILL) - silty, trace clay - brown - wet - loose - poorly graded, fine and medium grained sand		SB42B		
	14	- dense below 14.6 m				
	15			SB43		
				SS44		29
	16	- trace till inclusions (<20mm) below 15.7 m		SS45B		
				SS45A		50
	17	- boulder at 16.7 m				
209.2	18			CB56		
		LIMESTONE (BEDROCK) - white and grey, vertical and horizontal fractures containg iron staining or infilled with clay (rock flour).		CB57	75	
	19					
	20			CB58	30	
	21	- 0.1 m clay (rock flour) seams between 20.7 m and 20.8 m				
		- 0.2 m clay (rock flour) seams between 21.6 and 21.8 m - yellowish fractured limestone between 21.8 to 24.3 m		CB59	0	
	22					
	23	- red fractured rock between 23.2 m to 24.4 m				
	24			CB60	17	
	25			CB61	91	
	26	- increasing fractures and becoming porous below 26.5 m				

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type
△ Torvane △
✿ Pocket Pen. ✿
☒ Qu ☒
○ Field Vane ○

0 50 100 150 200 250

Logged By: Stephen Renner **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH13-01

Elevation (m)	Depth (m)	Soil Symbol	Standpipe	Standpipe	MATERIAL DESCRIPTION	Sample Type	Sample Number	RQD (%)	SPT (N)
	27						CB62	96	
	28						CB63	62	
	29						CB64	73	
	30								
	31						CB65	35	
	32								
	33						CB66	31	
	34				- 0.3 m thick highly fractured layer at 33.5 m				
	35				- fractures decreasing below 34.7 m		CB67	74	
	36						CB68	94	
190.5					END OF TEST HOLE At 36.9 m in LMESTONE (BEDROCK)				

Notes:
1) Power auger refusal at 16.9 m depth, then switched to HQ coring.
2) Water level at 1.5 m depth immediately after dilling prior to coring.
3) Seepage observed below 5.3 m

☐ Bulk Unit Wt (kN/m³)
16 17 18 19 20 21

Particle Size (%)
0 20 40 60 80 100

PL MC LL
0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type
△ Torvane △
✪ Pocket Pen. ✪
☒ Qu ☒
○ Field Vane ○

0 50 100 150 200 250

Logged By: Stephen Renner **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH13-04

Client:	Associated Engineering	**Project Number:**	0115 004 00
Project Name:	Detailed Design North Kildonan Feedermain	**Location:**	UTM N-5534987.21, E-636455.82
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	227.19 m
Method:	170 mm Hollow Stem Auger, Acker SS3 Track Mount	**Date Drilled:**	6 November 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)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	RQD (%)	SPT (N)
	0	CLAY (ALLUVIAL) - silty, some gravel, trace fine sand, trace roots, trace rootlets - dark brown - moist, very stiff - high plasticity		G46		
225.7	1			G47		
	2	CLAY (LACUSTRINE) - silty, some gravel, trace fine sand, trace roots, trace rootlets, trace oxidation - dark brown - moist, soft to firm - high plasticity - soft to firm below 1.8 m - trace silt inclusions (<15mm), no oxidation, soft below 2.7 m		G48 SB01 SB02		
	3			G49 T03		
	4	- firm to stiff, trace to some oxidation, laminated (<2mm) below 3.7 m		SB04		
	5			SB05 SB06		
	6	- trace coarse sand below 5.8 m		SB07 T08		
	7			SB09		
	8	- trace gravel (<25mm) below 7.3 m - trace to some silt inclusions (<5mm), soft to firm below 7.9 m		SB10 SB11		
	9	- trace gravel (<25mm), firm below 8.5 m		SB12 T13		
	10			SB14		
	11	- trace till inlcusions (<75mm) below 10.4 m		SB15 SB16 SB17		

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

Logged By: Brent Hay **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH13-04

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	RQD (%)	SPT (N)
	13	- trace to some till inclusions below 14.0 m		SB18		
				SB19		
	14			SB20		
				SB21		
212.2	15			SB22		
211.8		SILT (TILL) - trace clay, trace gravel (<25mm), trace sand - light brown, moist, loose, low plasticity		SS23		
211.3		CLAY - silty, trace gravel - grey, moist, soft to firm, high plasticity				
	16	SILT (PUTTY TILL) - trace clay, trace gravel (<25mm), trace sand (poorly graded) - light brown, moist, loose, low plasticity - dense below 16.4 m		SB24		
				SB25		
210.1	17	LIMESTONE (BEDROCK) - white and grey, vertical and horizontal fractures containg iron staining or infilled with clay (rock flour).		CB26	86	
	18					
	19			CB27	100	
	20					
	21			CB28	100	
205.5						

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type
△ Torvane △
✤ Pocket Pen. ✤
☒ Qu ☒
○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE at 21.6 m in LIMESTONE (BEDROCK)

Notes:
1) Power auger refusal at 16.7 m depth, then switched to HQ coring.
2) water level at 4.2 m depth immediately after drilling prior to coring.
3) Depths of 0 - 3.0 m, logged from adjacent test hole (TH13 04B).

Logged By: Brent Hay **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH13-05

Client:	Associated Engineering	**Project Number:**	0115 004 00
Project Name:	Detailed Design North Kildonan Feedermain	**Location:**	UTM N-5534979.78, E-636465.14
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	226.26 m
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	15 November 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)	Depth (m)	Soil Symbol	Standpipe	MATERIAL DESCRIPTION	Sample Type	Sample Number	RQD (%)	SPT (N)	Bulk Unit Wt (kN/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Test Type △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
	0			- overburden soils not logged - drilling advanced to refusal for coring						
	1									
	2									
	3									
	4									
	5									
	6									
	7									
	8									
	9									
	10									
	11									

Logged By: Martial Lemoine **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH13-05

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	RQD (%)	SPT (N)
210.1	16	SILT (TILL) - trace clay, trace sand, trace gravel - light grey, moist, loose, no to low plasticity	SS	SS69		
210.0	16		CB	CB70	0	
	17	LIMESTONE (BEDROCK) - white and grey, vertical and horizontal fractures containg iron staining or infilled with clay (rock flour).	CB	CB71	38	
	18		CB	CB72	73	
	19					
	20		CB	CB73	95	
	21					
	22		CB	CB74	83	
	23	- visible hairline fractures between 22.9 m to 24.4 m	CB	CB75	98	
	24					
	25		CB	CB76	92	
	26		CB	CB77	75	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✪ Pocket Pen. ✪ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

Logged By: Martial Lemoine **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH13-05

Elevation (m)	Depth (m)	Soil Symbol	Standpipe	MATERIAL DESCRIPTION	Sample Type	Sample Number	RQD (%)	SPT (N)
	27							
				- porous, increased fractures, mottled light brown and grey below 27.4 m		CB78	69	
	28							
				- 0.1 m thick clay (rock flour) seam at 28.7 m		CB79	92	
	29							
	30					CB80	100	
	31					CB81	100	
	32							
	33					CB82	99	
	34							
191.2	35					CB83	85	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL

0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type

△ Torvane △

✤ Pocket Pen. ✤

☒ Qu ☒

○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE At 35.1 m in LMESTONE (BEDROCK)

Notes:

1) Power auger refusal at 16.2 m depth, then switched to HQ coring using casing.

2) Water level at 3.7 m depth immediately after dilling prior to coring.

Logged By: Martial Lemoine **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira