



RD Agritech

ENGINEERED BY NATURE

16 January 2018

Job Number: 50595

RICHARD NEWMAN
C\ CLARK FORTUNE MCDONALD AND ASSOCIATES
PO BOX 553
QUEENSTOWN
CHANSEN@CFMA.CO.NZ

STORMWATER DISPOSAL ASSESSMENT

Dear Richard,

RD Agritech were requested to write this letter providing an assessment of stormwater disposal at a proposed subdivision on McDonnell Road, Arrowtown. Richard Newman engaged RD Agritech in a signed Short Form Agreement dated 6 December 2017.

A 13 Lot residential subdivision is proposed on McDonnell Road, Arrowtown that requires a stormwater disposal assessment which will be included in the subdivision Resource Consent. The scope of work required to conduct an onsite stormwater disposal assessment included:

- A nominal 12 hand auger boreholes and associated permeameter testing.
- Reporting on the soil permeability across the lots. This would be suitable for Resource Consent and future Building Consent applications for each dwellings soakage pit sizing.

SITE INVESTIGATION

The site investigation and permeameter testing was conducted on 18 December 2017. Seven permeameter tests were conducted across the proposed subdivision and indicated variable results.

The attached site investigation plan indicates the locations where the permeameter testing was conducted. The topography of the site and site specific geotechnical investigation report provided an indication to the locations of varying units.

The site investigation identified three main units with variable soakage. Soakage testing was not conducted within the topsoil layer.

The geology across the site consists of:

- 0.0 – 0.3m Topsoil
 - SILT; dark brown; moist; organic
- 0.1 – 0.5m Loess
 - SILT; light brown; massive; no organics present; dry
- 0.3 - >2.9m Alluvial Deposit
 - Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles
- 0.3 - >3.3m Sand and Silt Alluvium
 - SAND; grey; fine grain sand; massive; very dense and SILT; brown; massive; medium dense

RESULTS

The results in Table 1 indicate the permeability/soakage of each test location conducted across the site.

TABLE 1 TEST LOCATION AND ASSOCIATED PERMEABILITY

TEST NUMBER (SK)	LOT NUMBER	SOIL TESTED	DEPTH TESTED (M)	SOAKAGE (MM/HOUR)	FACTOR OF SAFETY OF 2.0
1	14	ALLUVIAL DEPOSIT	0.45 – 0.75	65	32.5
2	2	LOESS	0.2 – 0.5	27	13.5
3	13	LOESS	0.2 – 0.5	28	14
4	9	LOESS	0.2 – 0.5	22	11
5	6	LOESS	0.35 – 0.65	18	9
6	11	SILT ALLUVIUM	0.2 – 0.5	0	0
7	13	LOESS	0.2 – 0.5	81	40.5

The results indicate the three varying soil units tested have considerably differing soakage. SK1 conducted into the Alluvial Deposit indicates it is the unit with the greatest soakage. The following tests were not conducted into the Alluvial Deposit as the auger was either unable to penetrate through cobbles within the unit or the gravelly material would collapse into the auger hole.

The Loess material had consistent moderate soakage in four tests across the site. An outlier value was gained within SK7 which indicated a permeability value of 81 mm/hour in the Loess material.

SK6 was conducted into the Silt Alluvium material which indicated no soakage after 15 minutes of a static water level in the hole.

Factor of Safety of 2.0 has been applied as the rate of soakage determined through a soakage test should have an appropriate reduction factor applied to accommodate loss of performance over time in accordance with Section 4.4.7.9 of the QLDC Land Development and Subdivision Code of Practice.

DISCUSSION AND RECOMMENDATIONS

As indicated in Table 1 above, the soakage of the three units tested was variable across the site.

Due to the high soakage value indicated in SK7, it is likely that the base of the borehole that the permeameter test was conducted in exposed the underlying Alluvial Deposit, this is the reasoning for the increased soakage value.

It is recommended that stormwater from each lot disposes into the Alluvial Deposit which is located directly below the Loess material. Disposing into the Alluvial Deposit will ensure the volume of the required soakage pits remain as minimal as possible.

Each site has a portion of the Alluvial Deposit present in some locations at varying depths. The depth of Alluvial Deposit, height of areas requiring drainage and the required stormwater pipe fall, dictates the depth of soakage pit required. Table 2 below indicates the recommended depth of soak pit base below the surface to ensure Alluvial Deposits are encountered for disposal. Note that the depth of Alluvial Deposits may vary across each Lot compared to the depth encountered in each test pit location.

TABLE 2 INDICATES DEPTH TO ALLUVIAL DEPOSIT DETERMINED FROM TEST PITS CONDUCTED

LOT	TEST PIT	DEPTH TO ALLUVIAL DEPOSIT (M)
2	2	0.4
4	9	0.7
5	9	0.7
6	9	0.7
7	6 & 5	0.4
8	5	0.4
9	4	0.3
10	7	0.2
11	8	NO SOAKAGE
12	3	0.4
13	3	0.4
14	1	0.6

Due to the lack of soakage into the Silt Alluvium, it is recommended that stormwater disposal is not conducted into that particular unit.

Shallow groundwater was exposed within the depression through Lot 7, 8, 10, 11 and 12. It is recommended that stormwater is not disposed into the low lying depression area as groundwater has the potential to inundate the specified soak pit. As indicated on the attached site investigation plan, Lot 11 is indicated to be positioned within poor draining silt alluvium within the low lying depression. It is recommended that a specific design is conducted for stormwater disposal in Lot 11 which could include stormwater harvesting systems or a detention system.

CONCLUSIONS

Based on the permeability results encountered across the site, there are soils across the subdivision suitable for residential stormwater disposal. Due to the depression throughout the northern portion of the site, it is suggested that the recommendations within the previous sections of this report are adhered to, to ensure a suitable stormwater disposal area is selected.

APPLICABILITY

This report is only to be used by the parties named above for the purpose that it was prepared and shall not be relied upon or used for any other purpose without the express written consent of the principal and RDAgritech Ltd.

The extent of testing associated with this assessment is limited to discrete locations and variations in ground conditions can occur between and away from such locations. If subsurface conditions encountered during construction differ from those given in this report further advice should be sought without delay.

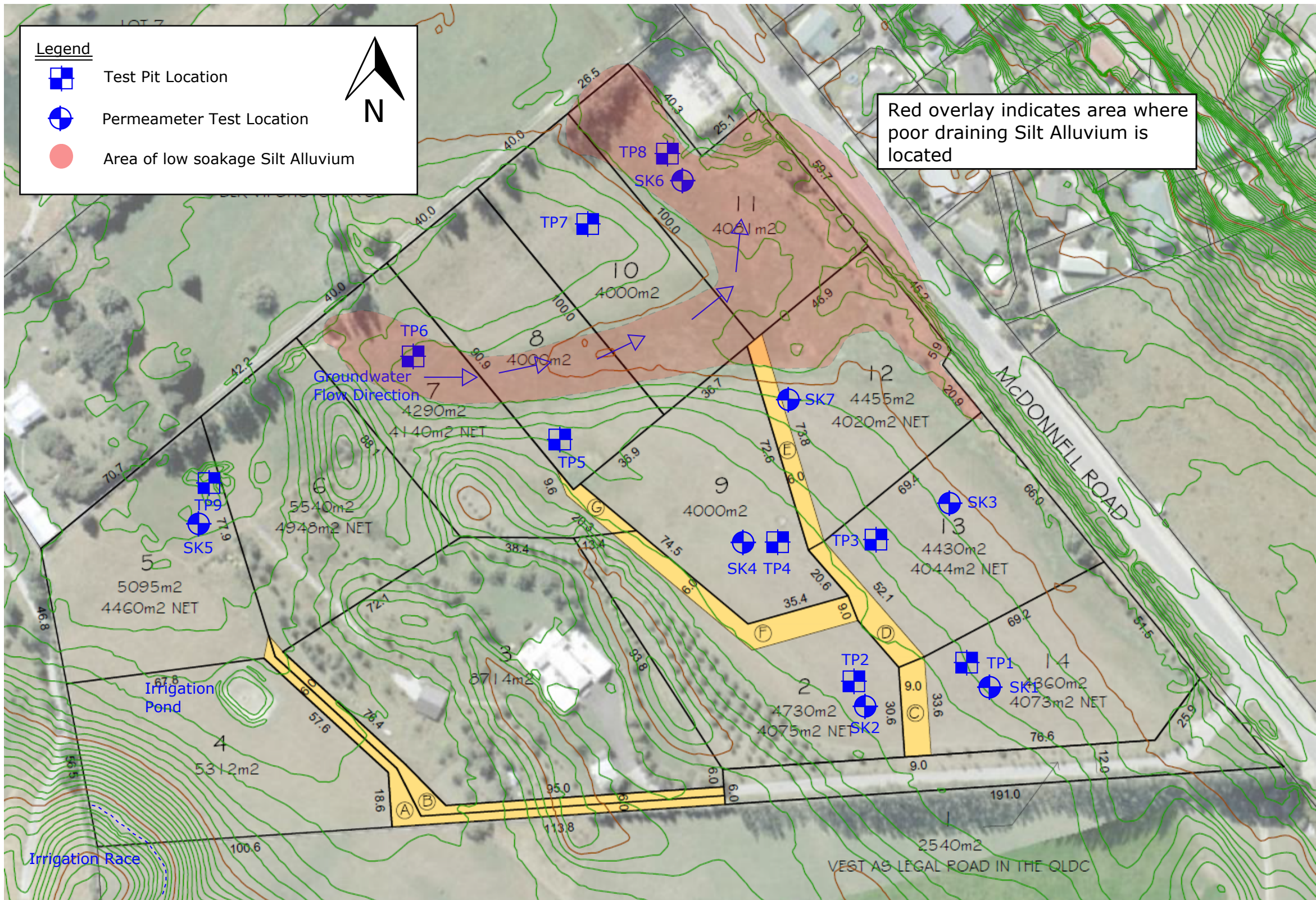
Yours sincerely



Ollie Behrent
Engineering Geologist

Reviewed by: Alan Hopkins

Attachments: Site Investigation Plan, Permeameter and Borehole Logs SK1-SK7/BH1-BH7, Test Logs TP1-9



Field Auger/Permeameter Test Sheet

Project: Newman Subdivision Geotech	
Site Location: McDonnell Road	
Test Number: SK-1 in BH-1	Test Date: 14-Dec-17
Operator: OMB	Test Time: 9:00 a.m.
Auger Ø: 10 cm	Permeameter Ø ID: 4.2 cm
Depth of Auger Hole: 0.5	Average Hole Ø: 11.5 cm



Auger Log


DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
0.1	ψψψψψψ	Silt; dark brown; organic	M	Topsoil	none
0.2	ψψψψψψ				
0.3	ψψψψψψ				
0.4	xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx	SILT; light brown; moist		Loess	
0.5	x.oox.oox.oo x.oox.oox.oo x.oox.oox.oo x.oox.oox.oo	Silty Sandy GRAVEL; light brown; fine to medium grain sand; fine to coarse angular gravel		Alluvial Gravel	
0.6	x.oox.oox.oo				
0.7	x.oox.oox.oo	Borehole unable to be conducted as pit walls collapsing			

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left\{ \left(\frac{r}{H^2} \right) + 0.25 \right\} + \frac{r}{H}} \right]}{2\pi H^2}$$

Ksat = mm/hr

Permeameter Readings

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)	Permeameter test was conducted between 0.45m and 0.75m	Water Level in hole 300mm
4:51:00 p.m.	0	785	0		
4:51:30 p.m.	0:00:30	748	37		
4:52:00 p.m.	0:00:30	712	36		
4:52:30 p.m.	0:00:30	676	36		
4:53:00 p.m.	0:00:30	636	40		
4:53:30 p.m.	0:00:30	600	36		
4:54:00 p.m.	0:00:30	556	44		
4:54:30 p.m.	0:00:30	514	42		
4:55:00 p.m.	0:00:30	470	44		
4:55:30 p.m.	0:00:30	425	45		
4:56:00 p.m.	0:00:30	376	49		
4:56:30 p.m.	0:00:30	322	54		

Field Auger/Permeameter Test Sheet				
Project: Newman Subdivision Geotech				
Site Location: McDonnell Road				
Test Number: SK-2 in BH-2		Test Date: 14-Dec-17		
Operator: OMB		Test Time: 9:15 a.m.		
Auger Ø: 10 cm		Permeameter Ø ID: 4.2 cm		
Depth of Auger Hole: 0.5		Average Hole Ø: 11.5 cm		

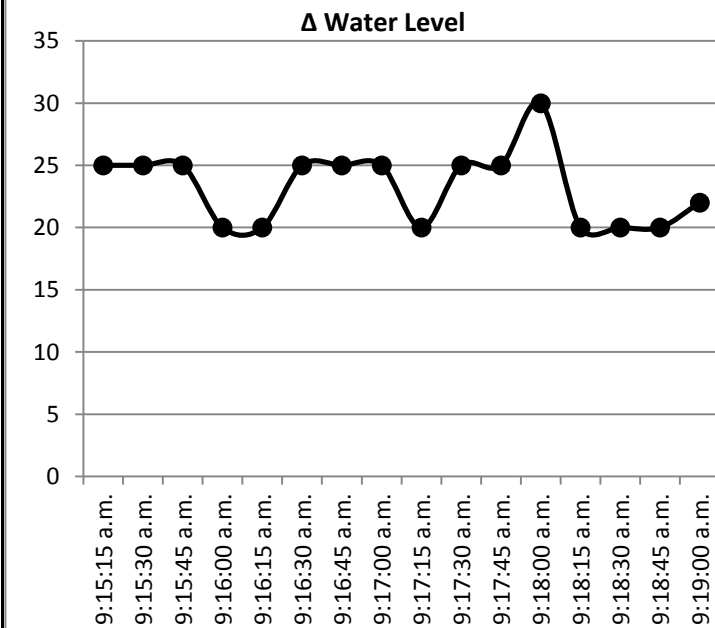
Auger Log

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
0.1	ψψψψψψ	SILT; dark brown; organic	M	Topsoil	none
0.2	ψψψψψψ				
0.3	xxxxxxxxxx	SILT; light brown; massive; no organics present	D	Loess	
0.4	xxxxxxxxxx				
0.5	xxxxxxxxxx				
0.6		End of Borehole			
0.7					

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left\{ \left(\frac{r}{H^2} \right) + 0.25 \right\} + \frac{r}{H}} \right]}{2\pi H^2}$$

Ksat = mm/hr

Permeameter Readings

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)	Permeameter test was conducted between 0.2m and 0.5m	Water Level in hole 300mm
9:15:00 a.m.	0	1175	0		
9:15:15 a.m.	0:00:15	1150	25		
9:15:30 a.m.	0:00:15	1125	25		
9:15:45 a.m.	0:00:15	1100	25		
9:16:00 a.m.	0:00:15	1080	20		
9:16:15 a.m.	0:00:15	1060	20		
9:16:30 a.m.	0:00:15	1035	25		
9:16:45 a.m.	0:00:15	1010	25		
9:17:00 a.m.	0:00:15	985	25		
9:17:15 a.m.	0:00:15	965	20		
9:17:30 a.m.	0:00:15	940	25		
9:17:45 a.m.	0:00:15	915	25		
9:18:00 a.m.	0:00:15	885	30		
9:18:15 a.m.	0:00:15	865	20		
9:18:30 a.m.	0:00:15	845	20		
9:18:45 a.m.	0:00:15	825	20		
9:19:00 a.m.	0:00:15	803	22		

Field Auger/Permeameter Test Sheet

Project: Newman Subdivision Geotech	
Site Location: McDonnell Road	
Test Number: SK-3 in BH-3	Test Date: 14-Dec-17
Operator: OMB	Test Time: 9:30 a.m.
Auger Ø: 10 cm	Permeameter Ø ID: 4.2 cm
Depth of Auger Hole: 0.5	Average Hole Ø: 11.5 cm



Auger Log

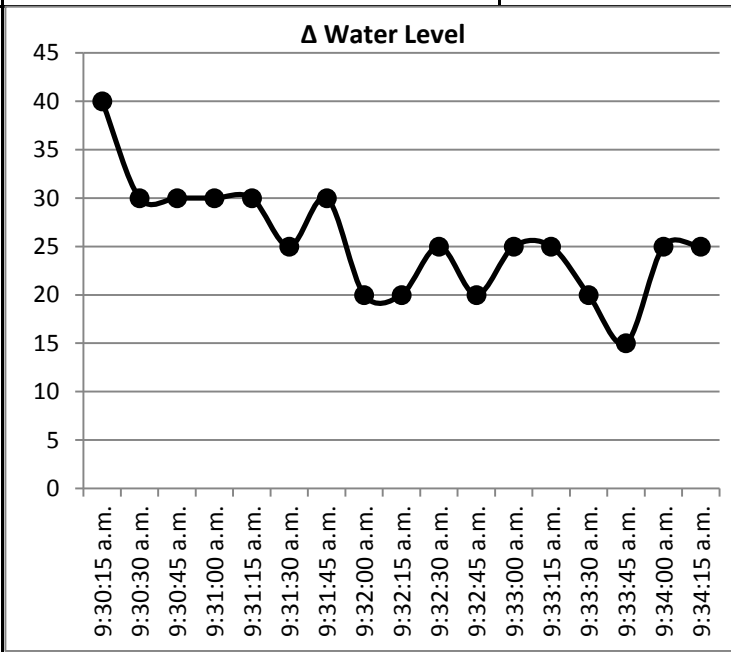
DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
0.1	ψψψψψψ	SILT; dark brown; organic	M	Topsoil	none
0.2	ψψψψψψ				
0.3	xxxxxxxxxx	SILT; light brown; massive; no organics present	D	Loess	
0.4	xxxxxxxxxx				
0.5	xxxxxxxxxx				
0.6		End of Borehole			
0.7					

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left\{ \left(\frac{r}{H^2} \right) + 0.25 \right\} + \frac{r}{H}} \right]}{2\pi H^2}$$

Ksat = mm/hr

Permeameter Readings

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)	Permeameter test was conducted between 0.2m and 0.5m	Water Level in hole 300mm
9:30:00 a.m.	0	1100	0		
9:30:15 a.m.	0:00:15	1060	40		
9:30:30 a.m.	0:00:15	1030	30		
9:30:45 a.m.	0:00:15	1000	30		
9:31:00 a.m.	0:00:15	970	30		
9:31:15 a.m.	0:00:15	940	30		
9:31:30 a.m.	0:00:15	915	25		
9:31:45 a.m.	0:00:15	885	30		
9:32:00 a.m.	0:00:15	865	20		
9:32:15 a.m.	0:00:15	845	20		
9:32:30 a.m.	0:00:15	820	25		
9:32:45 a.m.	0:00:15	800	20		
9:33:00 a.m.	0:00:15	775	25		
9:33:15 a.m.	0:00:15	750	25		
9:33:30 a.m.	0:00:15	730	20		
9:33:45 a.m.	0:00:15	715	15		
9:34:00 a.m.	0:00:15	690	25		
9:34:15 a.m.	0:00:15	665	25		



Field Auger/Permeameter Test Sheet

Project: Newman Subdivision Geotech	
Site Location: McDonnell Road	
Test Number: SK-4 in BH-4	Test Date: 14-Dec-17
Operator: OMB	Test Time: 9:45 a.m.
Auger Ø: 10 cm	Permeameter Ø ID: 4.2 cm
Depth of Auger Hole: 0.5	Average Hole Ø: 11.5 cm



Auger Log


DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
0.1	ψψψψψψ	SILT; dark brown; organic	M	Topsoil	none
0.2	ψψψψψψ				
0.3	xxxxxxxxxx	SILT; light brown; massive; no organics present	D	Loess	
0.4	xxxxxxxxxx				
0.5	xxxxxxxxxx				
0.6		End of Borehole			
0.7					

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left(\left(\frac{r}{H^2} \right) + 0.25 \right)} + \frac{r}{H} \right]}{2\pi H^2}$$

Ksat = mm/hr

Permeameter Readings

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)	Permeameter test was conducted between 0.2m and 0.5m	Water Level in hole 300mm
9:45:00 a.m.	0	930	0		
9:45:15 a.m.	0:00:15	910	20		
9:45:30 a.m.	0:00:15	890	20		
9:45:45 a.m.	0:00:15	870	20		
9:46:00 a.m.	0:00:15	850	20		
9:46:15 a.m.	0:00:15	830	20		
9:46:30 a.m.	0:00:15	810	20		
9:46:45 a.m.	0:00:15	790	20		
9:47:00 a.m.	0:00:15	775	15		
9:47:15 a.m.	0:00:15	758	17		
9:47:30 a.m.	0:00:15	740	18		
9:47:45 a.m.	0:00:15	725	15		
9:48:00 a.m.	0:00:15	709	16		
9:48:15 a.m.	0:00:15	690	19		
9:48:30 a.m.	0:00:15	675	15		
9:48:45 a.m.	0:00:15	657	18		
9:49:00 a.m.	0:00:15	640	17		

Field Auger/Permeameter Test Sheet				
Project: Newman Subdivision Geotech				
Site Location: McDonnell Road				
Test Number: SK-5 in BH-5		Test Date: 14-Dec-17		
Operator: OMB		Test Time: 10:00 a.m.		
Auger Ø: 10 cm		Permeameter Ø ID: 4.2 cm		
Depth of Auger Hole: 0.65		Average Hole Ø: 11.5 cm		

Auger Log

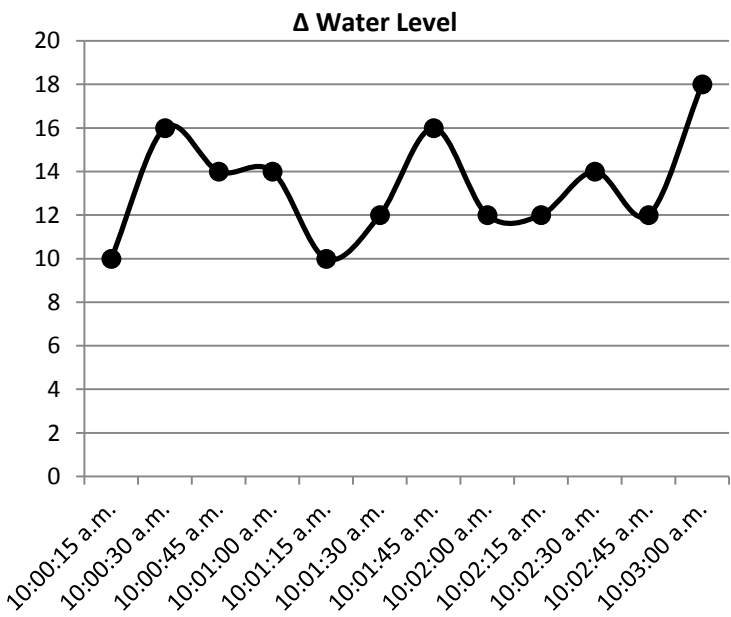
DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
0.1	ψψψψψψ	SILT; dark brown; organic	M	Topsoil	none
0.2	ψψψψψψ				
0.3	ψψψψψψ				
0.4	ψψψψψψ				
0.5	xxxxxxxxxx	SILT; light brown; massive	D	Loess	
0.6	xxxxxxxxxx				
0.7	xxxxxxxxxx				
0.7		End of Borehole			


$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left\{ \left(\frac{r}{H^2} \right) + 0.25 \right\} + \frac{r}{H}} \right]}{2\pi H^2}$$

Ksat = mm/hr

Permeameter Readings

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)	Permeameter test was conducted between 0.35m and 0.65m	Water Level in hole 300mm
10:00:00 a.m.	0	854	0		
10:00:15 a.m.	0:00:15	844	10		
10:00:30 a.m.	0:00:15	828	16		
10:00:45 a.m.	0:00:15	814	14		
10:01:00 a.m.	0:00:15	800	14		
10:01:15 a.m.	0:00:15	790	10		
10:01:30 a.m.	0:00:15	778	12		
10:01:45 a.m.	0:00:15	762	16		
10:02:00 a.m.	0:00:15	750	12		
10:02:15 a.m.	0:00:15	738	12		
10:02:30 a.m.	0:00:15	724	14		
10:02:45 a.m.	0:00:15	712	12		
10:03:00 a.m.	0:00:15	694	18		



<h2>Field Auger/Permeameter Test Sheet</h2>				 <p>RD Agritech ENGINEERED BY NATURE</p>
Project: Newman Subdivision Geotech				
Site Location: McDonnell Road				
Test Number: SK-6 in BH-6		Test Date: 14-Dec-17		
Operator: OMB		Test Time: 10:15 a.m.		
Auger Ø: 10 cm		Permeameter Ø ID: 4.2 cm		
Depth of Auger Hole: 0.5		Average Hole Ø: 11.5 cm		

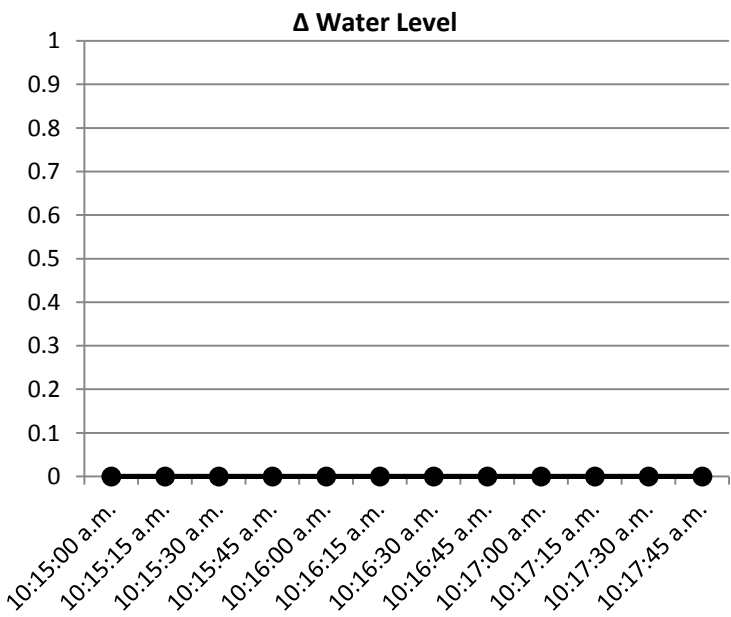
Auger Log

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
0.1	ψψψψψ	SILT; dark brown; organic; 50 mm rootlets	M	Topsoil	none
0.2	ψψψψψ				
0.3	xxxxxxxxx	SILT; light brown; massive; rootlets throughout		Silt Alluvium	
0.4	xxxxxxxxx				
0.5	xxxxxxxxx				
0.6	comment	End of Borehole			
0.7		Unable to drain. Dispose stormwater into gravels located within Test Pit 7			

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left\{ \left(\frac{r}{H^2} \right) + 0.25 \right\} + \frac{r}{H}} \right]}{2\pi H^2}$$

Ksat = mm/hr

Permeameter Readings

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)	Permeameter test was conducted between 0.2m and 0.5m	Water Level in hole 300mm
10:15:00 a.m.	0	1100	0		
10:15:15 a.m.	0:00:15	1100	0		
10:15:30 a.m.	0:00:15	1100	0		
10:15:45 a.m.	0:00:15	1100	0		
10:16:00 a.m.	0:00:15	1100	0		
10:16:15 a.m.	0:00:15	1100	0		
10:16:30 a.m.	0:00:15	1100	0		
10:16:45 a.m.	0:00:15	1100	0		
10:17:00 a.m.	0:00:15	1100	0		
10:17:15 a.m.	0:00:15	1100	0		
10:17:30 a.m.	0:00:15	1100	0		
10:17:45 a.m.	0:00:15	1100	0		

Field Auger/Permeameter Test Sheet

Project: Newman Subdivision Geotech	
Site Location: McDonnell Road	
Test Number: SK-7 in BH-7	Test Date: 14-Dec-17
Operator: OMB	Test Time: 10:30 a.m.
Auger Ø: 10 cm	Permeameter Ø ID: 4.2 cm
Depth of Auger Hole: 0.5	Average Hole Ø: 11.5 cm



Auger Log

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	GROUND WATER
0.1	ψψψψψψ	SILT; dark brown; organic	M	Topsoil	none
0.2	ψψψψψψ				
0.3	xxxxxxxxxx	SILT; light brown; massive; no organics present	D	Loess	
0.4	xxxxxxxxxx				
0.5	xxxxxxxxxx				
0.6	comment	End of Borehole			
0.7					

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left\{ \left(\frac{r}{H^2} \right) + 0.25 \right\} + \frac{r}{H}} \right]}{2\pi H^2}$$

Ksat = mm/hr

Permeameter Readings

Time	Δ Time (hr)	Water Level (mm)	Δ Water Level (mm)	Permeameter test was conducted between 0.2m and 0.5m	Water Level in hole 300mm
10:30:00 a.m.	0	1100	0		
10:30:15 a.m.	0:00:15	1000	100		
10:30:30 a.m.	0:00:15	930	70		
10:30:45 a.m.	0:00:15	860	70		
10:31:00 a.m.	0:00:15	790	70		
10:31:15 a.m.	0:00:15	720	70		
10:31:30 a.m.	0:00:15	655	65		
10:31:45 a.m.	0:00:15	590	65		
10:32:00 a.m.	0:00:15	530	60		
10:32:15 a.m.	0:00:15	460	70		
10:32:30 a.m.	0:00:15	400	60		
10:32:45 a.m.	0:00:15	340	60		
10:33:00 a.m.	0:00:15	280	60		

TP-1

TEST PIT LOG



JOB NUMBER: 50595

PROJECT: Newman Subdivision Geotech

LOCATION: McDonnell Road, Arrowtown

CO-ORDINATES:
Refer Investigation Site Plan

HOLE STARTED: 14-Dec-17

HOLE FINISHED: 14-Dec-17

ELEVATION: m

OPERATOR: Luke


DATUM:

COMPANY: C'n'R Earthwork

EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS

GEOLOGICAL

STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	ψψψψψψ ψψψψψψ xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.8	xOooxOoo xOooxOoo xOooxOoo xOooxOoo	SILT; light brown; massive; rootlets throughout; medium dense to dense		Loess Colluvium
			1.2	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; very dense		Alluvial Deposit
			1.6	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.			Alluvial Deposit
			2.0	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.			
			2.4	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.			
			2.8		End of test pit, unable to excavate further due to sides of test pit collapsing		
			3.2				
			3.6				
			4.0				

OTHER COMMENTS:

Logged By: MJD

Checked Date: 13-Feb-18

PHOTO REF.:

Sheet: 1 of 1

TP-3

TEST PIT LOG



JOB NUMBER: 50595

PROJECT: Newman Subdivision Geotech

LOCATION: McDonnell Road, Arrowtown

CO-ORDINATES:
Refer Investigation Site Plan

HOLE STARTED: 14-Dec-17

HOLE FINISHED: 14-Dec-17

ELEVATION: m

OPERATOR: Luke

DATUM:

COMPANY: C'n'R Earthwork

EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS

GEOLOGICAL

STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	ψψψψψψ ψψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
				xxxxxxxx xxxxxxxx	SILT; light brown; massive; rootlets throughout; medium dense		Loess Colluvium
			0.8	xOooxOoo xOooxOoo xOooxOoo xOooxOoo	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to dense		Alluvial Deposit
				xOooxOoo xOooxOoo				Alluvial Deposit
			1.2	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to very dense		
			1.6	.Ooo.Ooo. .Ooo.Ooo.			
			2.0		End of test pit, unable to excavate further due to test pit walls collapsing		
			2.4				
			2.8				
			3.2				
			3.6				
			4.0				



OTHER COMMENTS:

Logged By: MJD

Checked Date: 13-Feb-18

PHOTO REF.:

Sheet: 1 of 1

TP-4

TEST PIT LOG



JOB NUMBER: 50595

PROJECT: Newman Subdivision Geotech

LOCATION: McDonnell Road, Arrowtown

CO-ORDINATES:
Refer Investigation Site Plan

HOLE STARTED: 14-Dec-17

HOLE FINISHED: 14-Dec-17

ELEVATION: m

OPERATOR: Luke

DATUM:

COMPANY: C'n'R Earthwork

EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS

GEOLOGICAL

STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	ψψψψψψ ψψψψψψ xxxxxxx	SILT; brown; organic; 50 mm rootlets throughout, organic SILT; light brown; massive; rootlets throughout; medium dense	D	Topsoil Loess Colluvium Alluvial Deposit
			0.8	xOooxOoo xOooxOoo .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; dense Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to very dense		Alluvial Deposit
			1.2	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.			
			1.6	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.			
			2.0	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	End of test pit, unable to excavate further, test pit walls collapsing		
			2.4				
			2.8				
			3.2				
			3.6				
			4.0				

OTHER COMMENTS:

Logged By: MJD

Checked Date: 13-Feb-18

PHOTO REF.:

Sheet: 1 of 1

TP-5

TEST PIT LOG



JOB NUMBER: 50595

PROJECT: Newman Subdivision Geotech

LOCATION: McDonnell Road, Arrowtown

CO-ORDINATES:
Refer Investigation Site Plan

HOLE STARTED: 14-Dec-17

HOLE FINISHED: 14-Dec-17

ELEVATION: m

OPERATOR: Luke

DATUM:

COMPANY: C'n'R Earthwork

EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS

GEOLOGICAL

STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	ψψψψψψ ψψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
				xxxxxxxx xxxxxxxx	SILT; light brown; massive; rootlets throughout; medium dense		Loess Colluvium
			0.8	xOooxOoo xOooxOoo xOooxOoo xOooxOoo	Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; dense		Alluvial Deposit
				1.2	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; dense to very dense		Alluvial Deposit
			1.6		.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.		
				2.0	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.		
			2.4		.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.		
				2.8	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.		
			3.2		.Ooo.Ooo. .Ooo.Ooo.	End of test pit, unable to excavate further due to boulder in base of test pit	
				3.6			
			4.0				

OTHER COMMENTS:

Logged By: MJD

Checked Date: 13-Feb-18

PHOTO REF.:

Sheet: 1 of 1

TP-6

TEST PIT LOG



JOB NUMBER: 50595

PROJECT: Newman Subdivision Geotech

LOCATION: McDonnell Road, Arrowtown

CO-ORDINATES:
Refer Investigation Site Plan

HOLE STARTED: 14-Dec-17

HOLE FINISHED: 14-Dec-17

ELEVATION: m

OPERATOR: Luke

DATUM:

COMPANY: C'n'R Earthwork

EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS

GEOLOGICAL

STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	ψψψψψψ ψψψψψψ	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
				xxxxxxx xxxxxxx xxxxxxx xxxxxxx	Silty GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; medium dense	M	Alluvial Deposit
			0.8	xxxxxxx xxxxxxx xxxxxxx xxxxxxx	SILT; brown; massive; medium dense		Silt Alluvium
				xxxxxxx xxxxxxx xxxxxxx xxxxxxx			
			1.2	xxxxxxx xxxxxxx xxxxxxx xxxxxxx			
				xxxxxxx xxxxxxx xxxxxxx xxxxxxx			
			1.6	xxxxxxx xxxxxxx xxxxxxx xxxxxxx			
				xxxxxxx xxxxxxx xxxxxxx xxxxxxx			
			2.0	..... ..... ..... .....	SAND; grey; fine grain sand; massive; very dense	W	Sand Alluvium
				2.4		End of test pit, unable to excavate further due to possibly encountering bedrock. Base of test pit not visible as groundwater inflow occurred	
			2.8				
			3.2				
			3.6				
			4.0				

OTHER COMMENTS:

Logged By: MJD

Checked Date: 13-Feb-18

PHOTO REF.:

Sheet: 1 of 1

TP-7

TEST PIT LOG



JOB NUMBER: 50595

PROJECT: Newman Subdivision Geotech

LOCATION: McDonnell Road, Arrowtown

CO-ORDINATES:
Refer Investigation Site Plan

HOLE STARTED: 14-Dec-17

HOLE FINISHED: 14-Dec-17

ELEVATION: m

OPERATOR: Luke


DATUM:

COMPANY: C'n'R Earthwork

EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS

GEOLOGICAL

STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	ψψψψψψ ψψψψψψ xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo	SILT; brown; organic; 50 mm rootlets throughout, organic Silty cobbly GRAVEL; light brown; fine to coarse, sub angular to sub rounded gravel; sub angular to sub rounded cobbles; medium dense to dense	D	Topsoil Alluvial Deposit
			0.8	xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo xOooxOoo			
			1.2	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.	Sandy Cobbly GRAVEL; grey/brown; medium to coarse grain sand; fine to coarse sub angular to sub rounded gravel; sub angular to sub rounded cobbles; very dense		Alluvial Deposit
			1.6	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.			
			2.0	.Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo. .Ooo.Ooo.			
			2.4		End of test pit, unable to excavate further due to dense material		
			2.8				
			3.2				
			3.6				
			4.0				

OTHER COMMENTS:

Logged By: MJD

Checked Date: 13-Feb-18

PHOTO REF.:

Sheet: 1 of 1

TP-8

TEST PIT LOG



JOB NUMBER: 50595

PROJECT: Newman Subdivision Geotech

LOCATION: McDonnell Road, Arrowtown

CO-ORDINATES:
Refer Investigation Site Plan

HOLE STARTED: 14-Dec-17

HOLE FINISHED: 14-Dec-17

ELEVATION: m

OPERATOR: Luke

DATUM:

COMPANY: C'n'R Earthwork

EQUIP.: 8T excavator

ENGINEERING DESCRIPTIONS

GEOLOGICAL

STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	ψψψψψψ ψψψψψψ xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx	SILT; brown; organic; 50 mm rootlets throughout, organic	D	Topsoil
			0.8	xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx	SILT; light brown; massive; rootlets throughout; dense to very dense		Loess Colluvium
			1.2	..... ..... ..... ..... ..... ..... .....	SAND; grey; fine grain sand; massive	W	Sand Allivium
			1.6	..... ..... ..... ..... ..... ..... .....		
			2.0	..... ..... ..... ..... ..... ..... .....		
			2.4	..... ..... ..... ..... ..... ..... .....	End of test pit, test pit filled with groundwater to 800 mm below the surface whilst logging.		
			2.8	..... ..... ..... ..... ..... ..... .....		
			3.2	..... ..... ..... ..... ..... ..... .....		
			3.6	..... ..... ..... ..... ..... ..... .....		
			4.0	..... ..... ..... ..... ..... ..... .....		



OTHER COMMENTS:

Logged By: MJD

Checked Date: 13-Feb-18

PHOTO REF.:

Sheet: 1 of 1

