1 June 2021 Document Ref: AKL2019-0040AH Rev 0

Neil Construction Limited
PO Box 8751
Symonds Street
Auckland 1150

Attention: Trevor Canty

Dear Trevor

RE: FALLING HEAD SOAKAGE TEST RESULTS
BRIGHAM CREEK AND TRIG ROAD, WHENUAPAI

1 SCOPE AND RESULTS

CMW Geosciences (CMW) have been instructed by Neil Construction Limited to complete soakage testing at Brigham Creek and Trig Road, Whenuapai as detailed in the email sent on 7 May 2021.

We have carried out 3 falling head tests as shown on the appended site plan. The soil units within the boreholes can be characterised as both alluvial deposits and engineered fill, generally comprised of clays and silts.

The falling head percolation testing methodology is in accordance with the Auckland Council Technical Report 2013/040: Stormwater Disposal Via Soakage in the Auckland Region dated October 2016.

Based on test data, we have estimated the percolation rates with the followings methods:

- Ciria 113 Appendix 4, Control of Groundwater for Temporary Works

Auckland Council Technical Report 2013/040, Stormwater Disposal via Soakage in the Auckland Region.

The percolation rate estimates are summarised in Table 1 below.

Table 1: Percolation Rate Estimates

Location	Calculation Method	Percolation Rate	
		m/s	mm/hour
HA01-21	Ciria 113	8.67×10^{-7}	3.12
	Auckland Council Technical Report	8.46×10^{-7}	3.04
HA02-21	Ciria 113	1.65×10^{-7}	0.59

	Auckland Council Technical Report	$5.25x10^{-7}$	1.89
HA03-21	Ciria 113	$3.51x10^{-6}$	12.6
	Auckland Council Technical Report	$6.91x10^{-6}$	24.9

1.1 Stormwater Disposal

The permeability results of the falling head test are considered relatively low, particularly in HA01-21 and HA02-21 and on-site disposal of stormwater via infiltration may not be appropriate.

2 LIMITATION AND CLOSURE

This letter has been prepared for use by our client Neil Construction Limited for the development at Brigham Creek and Trig Road, Whenuapai only. Liability for its use is limited to these parties and to the scope of work for which it was prepared, as it may not contain sufficient information for other parties or for other purposes.

We trust this letter meets your current requirements. If site conditions encountered vary from those adopted as the basis for our assessment or if any construction details or sequencing change and/or any unforeseen conditions develop, CMW must be advised immediately such that we can review the design recommendations and instruct any changes that may be required.

For and on behalf of CMW Geosciences

Prepared by:

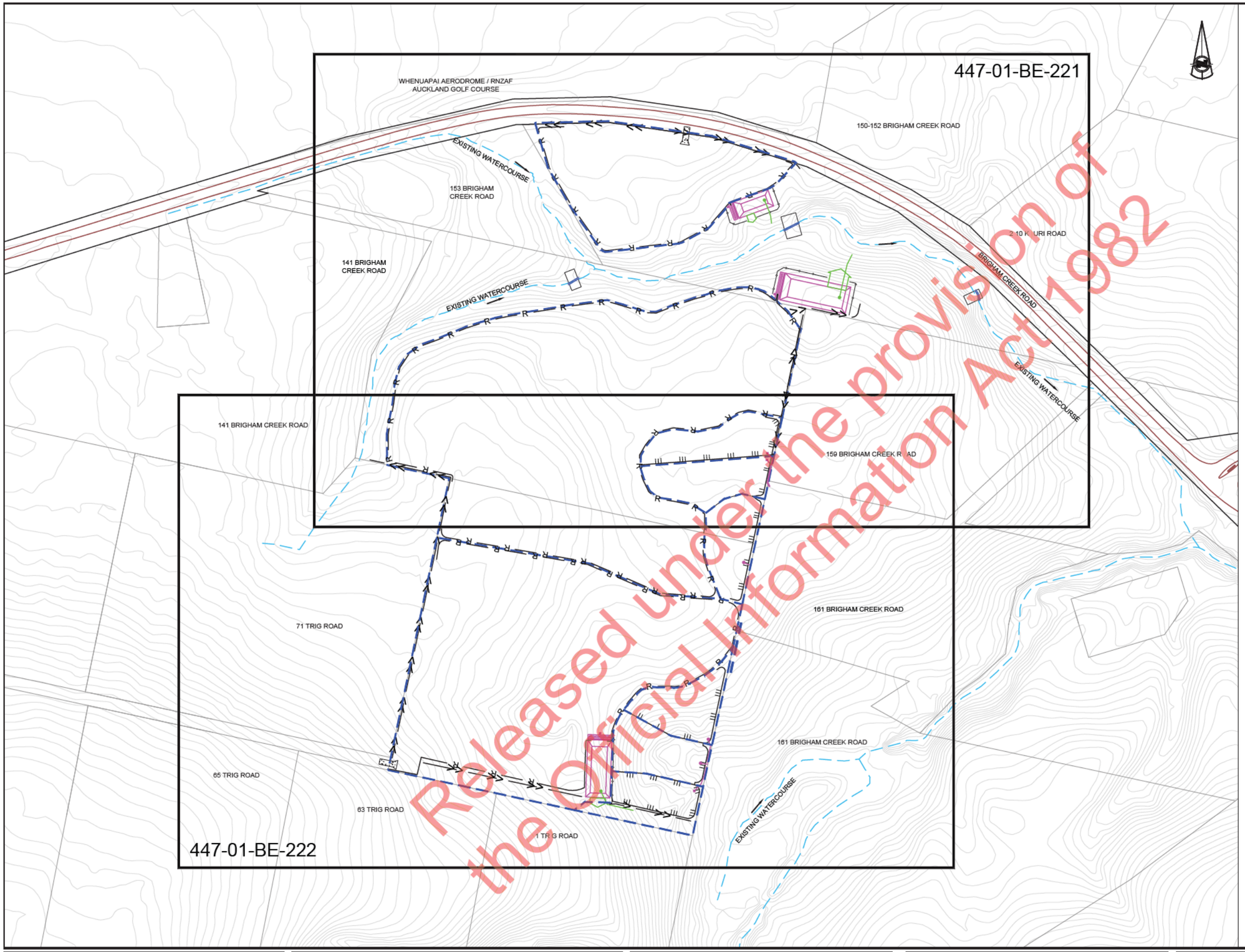
Jasmine Walden
Project Engineering Geologist

Reviewed and authorised by:

Andrew Linton
Principal Geotechnical Engineer, CPEng

Distribution: 1 electronic copy to Neil Construction Limited via email
Original held at CMW Geosciences

Attachments: Site Plan
Calculations



LEGEND

- WORKS AREAS
- WORKS AREAS - EXCLUSION ZONES
- EXISTING CONTOURS
- F NAL CONTOURS
- EARTH BUND
- SILT FENCE
- SUPER SILT FENCE
- SEDIMENT LADEN DIVERSION BUND
- CLEAN WATER DIVERSION BUND
- STAB LISED ENTRANCEWAY
- SEDIMENT RETENTION POND OUTLETS
- EARTH BUND DECANT UPSTAND OUTLET
- SEDIMENT RETENTION POND

SEE 447-01-BE-225 TO 227 FOR ADDITIONAL SED MENT AND EROSION CONTROL NOTES, DEVICE SIZING, CALCULATIONS AND DETAILS.

FOR CONSTRUCT ON

Rev	Description	By	Date
0	ISSUED FOR CONSTRUCTION	CK	10–20

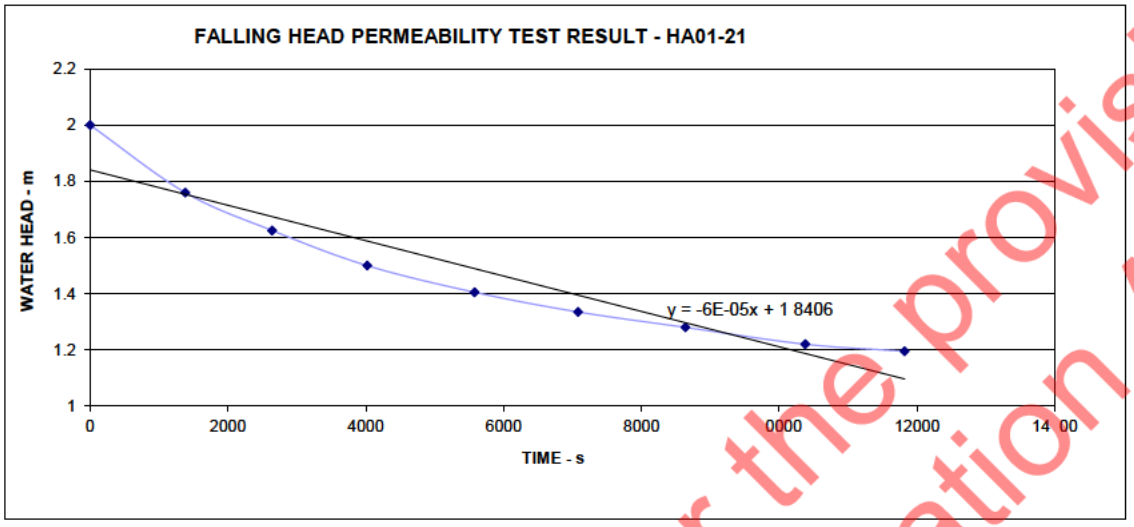
THIS DRAWING AND DESIGN REMAINS THE PROPERTY OF
THE NEIL GROUP
NEIL CONSTRUCTION LIMITED
LAND DEVELOPERS
THE NEIL GROUP LIMITED
LEVEL 3, BUILDING B
8 NUGENT STREET
GRAFTON
PO BOX 8751, SYMONDS STREET
AUCKLAND, NEW ZEALAND
TELEPHONE: +64 9 918 6565
FACSIMILE: +64 9 918 6567
WEB: www.neilgroup.co.nz

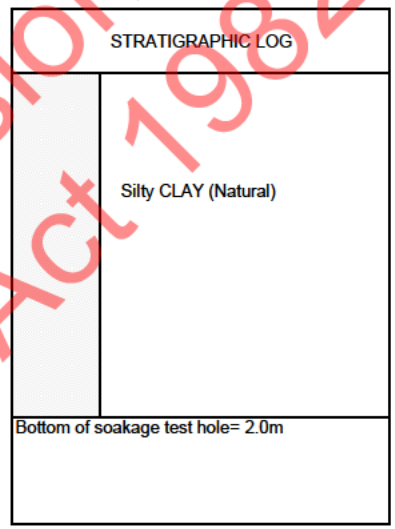
Job Title
BRIGHAM CREEK & TRIG ROAD
WHENUAPAI

Drawing Title
BULK EARTHWORKS
SEDIMENT AND EROSION
CONTROL – LOCATION PLAN

	By	Date	Scale	Job No. 447–01	
Surveyed:	DS		1: 3000@A3	Drawing No.	Rev
Designed:	CK			447–01–BE–220	0
Drawn:	CK	11/19			
Approved:	CK				
CAD FILE	F:_PROJECTS\BRIGHAM CREEK TRIG\DWG\ENG\BULK EW\FOR CONSTRUCTION\447–01–BE–220.dwg				

CLIENT	Neil Construction Limited
PROJECT	Brigham Creek and Trig Road
LOCATION	Whenuapai
JOB NUMBER	AKL2019-0040
TEST DATE	26/05/2021





Reference: Appendix 4, Control of Groundwater for Temporary Works (CIRIA Repo t N 11)

Borehole diameter = 100 mm

Hydraulic conductivity $k = \left(\frac{log\left(\frac{h_1}{h_2}\right) - log\left(\frac{\alpha h_1 + 1}{\alpha h_2 + 1}\right)}{(t_2 - t_1)}\right) \times I$

where I = average piezometric head over chosen time nterval

$= \frac{(h_1 + h_2)}{2}$

h_1 = piezometric head at start of chose interval (m)

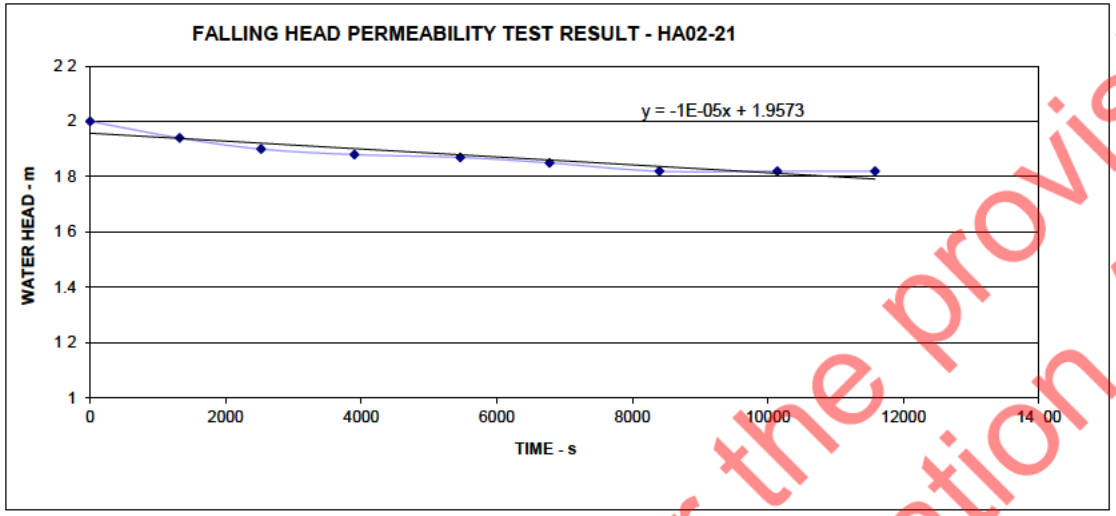
h_2 = piezometric head at end of chosen int rval (m)

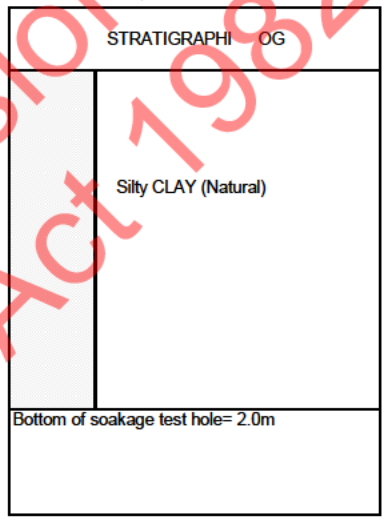
$t_2 - t_1$ = chosen time interval (se onds

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)}$ = 20 0

E sed Time (s)	t2 - 1 (sec)	Piezometric Head h (m)	I (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
1380	1380	1.76	1.88	0.06	1.96E-06	1.70E-01
26 0	260	1.625	1.69	0.03	1.34E-06	1.16E-01
402	1380	1.5	1.56	0.03	1.22E-06	1 06E-01
5 80	1560	1.405	1.45	0.03	8.81E-07	7 61E-02
708	1500	1.335	1.37	0.02	7.14E-07	6.17E-02
640	1560	1 28	1.31	0.02	5.64E-07	4 87E-02
10380	1740	1 22	1.25	0.02	5.76E-07	4 98E-02
11820	1440	1.195	1.21	0.01	3.00E-07	2 59E-02
13260	1440	1.175	1.19	0.01	2.44E-07	2.11E-02
				Average =	8.67E-07	8.16E-02

CLIENT	Neil Construction Limited
PROJECT	Brigham Creek and Trig Road
LOCATION	Whenuapai
JOB NUMBER	AKL2019-0040
TEST DATE	26/05/2021





Reference: Appendix 4, Control of Groundwater for Temporary Works (CIRIA Report No. 113)

Borehole diameter = 100 mm

Hydraulic conductivity $k = \left(\frac{log\left(\frac{h_1}{h}\right) - log\left(\frac{\alpha h_1 + 1}{\alpha h + 1}\right)}{(t_2 - t_1)} \right) \times I$

where I = average piezometric head over chosen time interval $= \frac{(h_1 + h_2)}{2}$

h_1 = piezometric head at start of chosen interval (m)

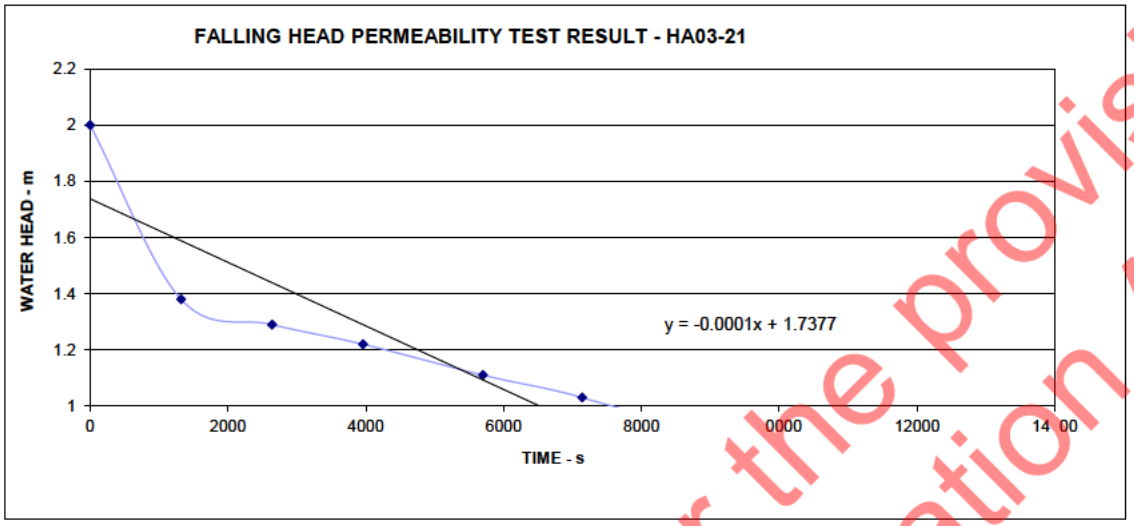
h_2 = piezometric head at end of chosen interval (m)

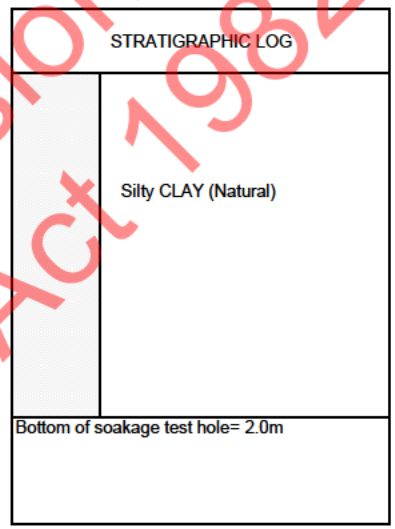
$t_2 - t_1$ = chosen time interval (seconds)

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)} = 20.0$

Elapsed Time (s)	t2 - t1 (seconds)	Piezometric Head h (m)	I (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
1320	320	1.94	1.97	0.01	4.89E-07	4.22E-02
2520	1200	1.9	1.92	0.01	3.67E-07	3.17E-02
3900	380	1.88	1.89	0.00	1.62E-07	1.40E-02
5460	1560	1.87	1.88	0.00	7.23E-08	6.25E-03
6780	1320	1.85	1.86	0.00	1.72E-07	1.49E-02
8400	1620	1.82	1.84	0.01	2.13E-07	1.84E-02
10140	1740	1.82	1.82	0.00	0.00E+00	0.00E+00
11580	1440	1.82	1.82	0.00	0.00E+00	0.00E+00
12960	1380	1.805	1.81	0.00	1.27E-07	1.09E-02
14280	1320	1.8	1.80	0.00	4.44E-08	3.84E-03
				Average =	1.65E-07	1.59E-02

CLIENT	Neil Construction Limited
PROJECT	Brigham Creek and Trig Road
LOCATION	Whenuapai
JOB NUMBER	AKL2019-0040
TEST DATE	26/05/2021





Reference: Appendix 4, Control of Groundwater for Temporary Works (CIRIA Repo t N 11)

Borehole diameter = 100 mm

Hydraulic conductivity $k = \left(\frac{log\left(\frac{h_1}{h_2}\right) - log\left(\frac{\alpha h_1 + 1}{\alpha h_2 + 1}\right)}{(t_2 - t_1)}\right) \times I$

where I = average piezometric head over chosen time nterval

$= \frac{(h_1 + h_2)}{2}$

h_1 = piezometric head at start of chose interval (m)

h_2 = piezometric head at end of chosen int rval (m)

$t_2 - t_1$ = chosen time interval (se onds

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)}$ = 20.0

E sed Time (s)	t2 - 1 (sec)	Piezometric Head h (m)	I (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
1320	1320	1 38	1.69	0.16	6.06E-06	5 24E-01
26 0	320	1 29	1.34	0.03	1.07E-06	9 25E-02
396	1320	1 22	1.26	0.02	8.83E-07	7 63E-02
5700	1740	1.11	1.17	0.04	1.13E-06	9.78E-02
714	1440	1 03	1.07	0.03	1.08E-06	9 32E-02
580	1440	0.9	0.97	0.06	1.94E-06	1 68E-01
10320	1740	0 57	0.74	0.20	5.51E-06	4.76E-01
11880	1560	0 31	0.44	0.26	8.02E-06	6 93E-01
13260	1380	0.2	0.26	0.19	5.91E-06	5.10E-01
				Average =	3.51E-06	2.77E-01

Project: Brigham Creek & Trig Road		Designed: JW
Client: Neil Construction Limited		Checked:
Project No: AKL2019-0040	Date: 28/5/21	Page: 1 of 1

CMW Geosciences

Percolation Rate Estimate - Auckland Council Method

$$P_1 = \frac{D \times gradient \times 1000}{4 \times d}$$

D = diameter of borehole

d = distance between the midpoint of the last two readings and the base of the borehole.

HA01-21(P) = $\frac{0.1 \times 2.38E^{-3} \times 1000}{4 \times 1.1725}$

= $5.07E^{-3}$ L/m²/min

= $8.457E^{-7}$ m/s = 3.04 mm/hr

HA02-21(P) = $\frac{0.1 \times 2.27E^{-3} \times 1000}{4 \times 1.8025}$

= $3.15E^{-3}$ L/m²/min = $5.25E^{-7}$ m/s

~~0.189~~ 1.89 mm/hr

HA03-21(P) = $\frac{0.1 \times 4.23E^{-3} \times 1000}{4 \times 0.255}$

= 0.415 L/m²/min

= $6.912E^{-6}$ m/s = 24.9 mm/hr