5.5. Roads

The surfaces of McHughs and Mandeville Roads adjacent to the site appeared to be in reasonable condition for their age, and did not have any obvious unusual cracking, slumping or heaving.

Figure 3: Photo taken looking into the southwest corner of proposed Lot 1. Photo taken September 2013.

Figure 4 : Photo taken on the southwest part of the site, looking east. Photo taken September 2013.

Figure 5 : Photo looking east along water race located at the south boundary of Lot 2. Photo taken September 2013.

6. DESKTOP INVESTIGATION

6.1. Canterbury geotechnical database

The Canterbury Geotechnical Database (CGD) contains a large range of photographic, topographic, geological, geotechnical, land classification, survey records and field observations that relate to the Canterbury earthquake sequence, however the coverage of this data does not extend to 116 McHughs Road, Mandeville.

6.2. CERA land classification

The Ministry of Business, Innovation and Employment (MBIE) defines three technical categories for residential foundation design described in its guidance for repairing and rebuilding earthquake damaged homes in Canterbury. These categories apply to liquefaction prone flat land in the green zone in the greater Christchurch urban area and surrounding communities.

This site has been classified by CERA as 'Green Zone, Technical Category Not Applicable, Rural & Unmapped', that indicates that '*Properties in rural areas or beyond the extent of land damage mapping, and properties in parts of the Port Hills and Banks Peninsula have not been given a Technical Category'*.

6.3. Geological maps

The Geological Nuclear Science (GNS) geological map of indicates the site is underlain by '*Unweathered, brownish-grey, variable mix of*

gravels/sand/silt/clay in low river terraces; locally up to 2m silt (loess) cap'[1]. Refer to Figure 6.

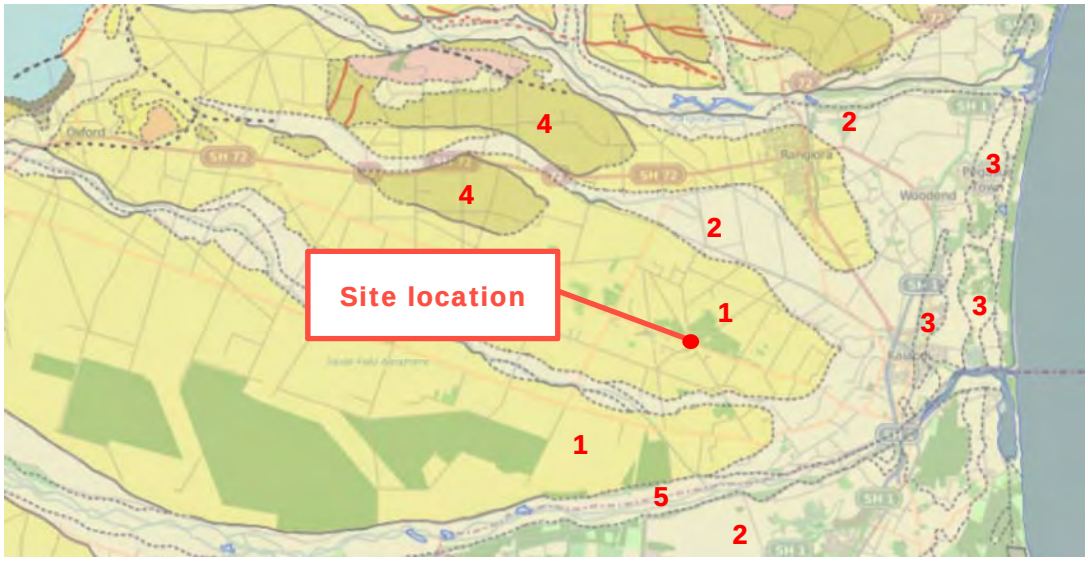


Figure 6: Geological Nuclear Science (GNS) Geological map of Christchurch.

1	*"Unweathered, brownish-grey, variable mix of gravels/sand/silt/clay in low river terraces; locally up to 2m silt (loess) cap"*
2	*Modern river floodplain/low-level degradation tce. Unweathered, variably sorted gravel/sand/silt/clay. Surfaces <2 degree slope*
3	*Dunes of unweathered, wind-deposited beach sand*
4	*Grey brown to yellow brown, slightly-highly weathered gravel/sand/silt/clay mixtures; forms dissected river terraces; loess cover*
5	*Active flood plain. Unweathered; rounded-subangular; variably sorted loose gravel/sand/silt. Associated with surfaces <2 deg. slope*

6.4. Active faults

Geological & Nuclear Science's (GNS) Active Faults Database[2] notes the Ashley Fault is located approximately 12.5km northwest of the site and has an east-west orientation, and the Loburn Fault is located approximately 14kms northwest of the site and has an east-west orientation.

Refer to Figure 7.

[1] *Geological Nuclear Science (GNS), New Zealand Geology Web Map.* Retrieved September 12, 2013, from http://data.gns.cri.nz/geology/

[2] *Geology Nuclear Science (GNS)* New Zealand Active Faults Database. Retrieved September 12, 2013, from http://maps.gns.cri.nz/website/af/viewer.htm, September 2013

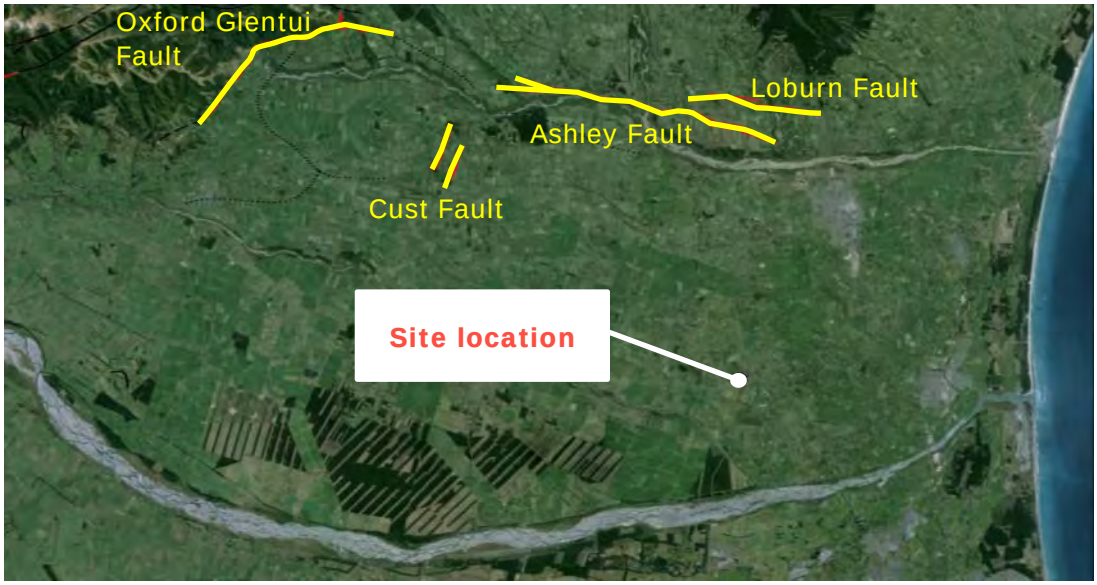


Figure 7 : Aerial photo of showing faults in the surrounding area. Source: CGD 2013

6.5. Conditional PGA for liquefaction assessment

The Ministry for Business, Innovation and Employment's (MBIE) '*Guidance for repairing and rebuilding houses affected by the Canterbury earthquakes*' (December 2012) specifies, for residential land, the peak ground acceleration ($PGA_{M7.5}$) to be adopted for liquefaction assessment in a serviceability limit state (SLS) event as $PGA_{M7.5}$ = 0.13g, and $PGA_{M7.5}$= 0.35g in an ultimate limit state (ULS) event.

The conditional median peak horizontal ground accelerations in the general area during the September 2010 event are likely to have exceeded the Serviceability Limit State (SLS) but were below the Ultimate Limit State (ULS). Refer to Table 1.

Table 1: Comparison of peak horizontal ground accelerations close to site

PGA (horizontal)	SLS (1/25, M7.5)	ULS (1/500, M7.5)	04 Sept 2010 (M7.1)	22 Feb 2011 (M6.2)	13 June 2011 (M6.0)
Design $PGA_{M7.5}$	0.13g	0.35g			
Conditional Median PGA			0.18g	0.13g	0.07g
Magnitude Scaling Factor (MSF)			1.11	1.41	1.48
Equivalent to $PGA_{M7.5}$			**0.16g**	**0.09g**	**0.05g**

6.6. Liquefaction hazard mapping

Environment Canterbury's recently completed review of the liquefaction hazard information[3] notes that the site is located in an area where '*damaging liquefaction unlikely'*.

6.7. Flood hazard

Flood hazard data provided by the Waimakariri District Council titled '*116 and 148 McHughs Road'* indicates Lots 2 and 3 are generally at a '*low'* risk from flood hazard. The northeast parts of Lot 2 are indicated to be at '*medium*' risk of flooding in a 200 year event and estimates flood depths of up to 0.5m could occur in these areas.

There are areas on Lot 2 and Lot 3 which are shown to have no risk of flooding in a 200 year event.

The majority of Lot 1 is located below the surrounding ground level, and is estimated to be at '*high'* risk of flooding in a 200 year event with flood depths of greater than 1m in this area. There is a small area at the northeast corner of Lot 1 that is estimated to be at '*low*' and '*medium*' risk of flooding in a 200 year event, with much lower estimated flood depths up to 0.5m above existing ground level.

Refer to Appendix B.

6.8. Existing well logs

Well M35/11084, located 70m south of the site, recorded '*earth gravels'* to 1m over various layers of sandy and clay-washed gravels to 24m depth where the well log terminates.

Well M35/9262, located 60m southeast of the site, recorded '*earth'* to 2.5m, '*claybound gravel, sandy gravels yellow'* to 11.5m, over layers of water-bearing and clay-bound or clay-washed gravels to 24m below ground level where the well log terminates. The initial water depth was 7.6m below ground level.

Wells M35/7620, BW23/002, M35/6309 and M35/9398 also show similar geology.

Refer to Appendix C.

[3] Brackley, H.I. (2012): Review of liquefaction hazard information in eastern Canterbury, including Christchurch City and parts of Selwyn, Waimakariri and Hurunui Districts – Environment Canterbury, Report No. R12/83

7. SITE INVESTIGATION

7.1. Shallow testing

Ten Scala penetrometer tests and ten test pits were undertaken across the site in order to confirm the nature of the shallow subsoil materials.

Groundwater was not encountered in any of the test pits.

Scala penetrometer testing below 0.4m depth returned penetration resistances well in excess of 2 blows per 75mm, and could be considered '*Good Ground*' in terms of NZS3604:2011.

7.2. Test pits

The soil type and penetration resistances encountered in the upper layers were generally consistent across the site, comprising shallow topsoil to 0.2m below ground level, over silty gravels to around 0.6m over sandy gravels. Scala penetrometer testing below this depth was not practical using hand equipment.

Lot 1 was previously used as a gravel pit/quarry and exposed gravel was visible on our site inspection undertaken in September 2013. Refer to Figure 2. This infers the geology across the site is relatively consistent.

A number of machine excavated test pits were undertaken across proposed Lots 2 and 3 in order to confirm the nature of the deeper soils to around 2.5m below ground level, and for infiltration testing of the deeper sandy gravels for disposal of roof stormwater into the ground.

Infiltration testing was performed at test pits 3, 7 and 10 by excavating a regular shape and discharging clean drinking water into the test pit from a water truck fitted with a flowmeter. The flow rate was adjusted to maintain a constant water level, and the rate of flow recorded at regular intervals.

Infiltration testing at test pit 3 could not be completed as the rate of infiltration exceeded the rate of discharge that could be achieved from the water truck, however, a falling head test was undertaken which recorded an infiltration rate of at least 1600mm/hr at the end of the test.

The testing confirmed the ultimate rate of infiltration into the sandy gravels to be used for design of ground soakage of stormwater should not exceed **1000mm/hr/m^2.**

8. LIQUEFACTION ASSESSMENT

Due to the presence of shallow silty gravels overlying deep sandy gravels, and considerable depth to groundwater, the site is not at likely risk of ground damage due to liquefaction.

8.1. Provisional land classification

Based on the nature of the subsoil materials and depth to groundwater, we conservatively assess the underlying soils across proposed lots to be consistent with the **TC1** land classification (*i.e. <15mm settlement in a SLS event, and <25mm in a ULS event*).

8.2. MBIE investigation guidelines

Section 16.2 of MBIE's guidelines requires appropriate geotechnical investigations be carried out to enable the ground forming materials to be characterised to at least 15m below ground level, unless the ground is known to be of acceptable quality from lesser depths, for example in areas known to be underlain by competent gravels or deep groundwater profiles.

At this site, the underlying geology comprises topsoil to 0.2m depth, silty gravel, overlying sandy gravel to at least 2.6m depth. Parts of the site have been used as a gravel quarry. Also, nearby well logs recorded gravels which extend to considerable depth.

Therefore, given that liquefaction is not a likely risk, and the shallow test holes and Scala penetrometers indicate compact ground conditions across the site, we consider that additional deep geotechnical investigation is not required for the proposed 3-lot subdivision.

9. RMA (1991) Section 106

9.1. Performance philosophy

In determining the requirement for future ground performance it is useful to outline the requirements of the New Zealand Building Code, Clause B1-Structure which advises that buildings, building elements and site work must;

> *(B.1.3.1) have a low probability of rupturing, becoming unstable, losing equilibrium, or collapsing during construction or alteration and throughout their lives. (Generally referred to as the Ultimate Limit State, ULS).*
>
> *(B.1.3.2) have a low probability of causing loss of amenity through undue deformations, vibratory response, degradation or other physical characteristics throughout their lives, or during construction or alteration when the building is in use (generally referred to as the Serviceability Limit State , SLS).*

Further, Appendix 3 of GNS's report[4] outlines a risk based approach to land use planning for natural hazards, and this has been used in assessing some of the natural hazards.

[4] *Saunders, W.S.A, Beban, J.S, 2012 "Putting R(isk) in the RMA: Technical Advisory Group recommendations on the Resource Management Act 1991 and implications for natural hazards*

9.2. Erosion

Flood modelling for a 1:200 year event indicates flow velocities of up to 1m could occur, and with some flooding across all of Lots 1 and most of Lot 3. There is a large area on Lot 2 that is not at risk of flooding. The flow depths and velocities across Lots 1 & 3 are likely to be smaller in a more frequent 1:50 year event, when inundation of the site is likely to affect a smaller area. Any proposed building platform on Lot 1, 2 or 3 shall be subject to specific engineering investigation and foundation design once the preferred location of the dwelling is known, and may need to incorporate protection from erosion and scour, particularly in areas with a moderate or high risk of flooding, and where flow velocities are estimated to exceed $1ms^{-1}$.

9.3. Falling debris

The site is flat and is not at risk of rockfall.

9.4. Landsliding

It is possible that flood flows over the sloping banks of the old quarry and Lot 1 could result in minor slumping of the small subvertical banks, although this is likely only in very large infrequent flood events.

Buildings located within the nominated building platforms on proposed Lots 1 to 3 are not at risk of slippage.

9.5. Inundation

A large part of Lot 1 has previously been quarried and is now around 2 to 3m below the surrounding land and the Waimakariri District Council 200 Year ARI Flood Level Map indicates that most parts of proposed Lot 1 are at 'high' risk of flooding, other than the northeast corner where the depth of flooding is typically around 0.5m above ground level.

There are areas on Lot 2 and Lot 3 which are not at risk of flooding in a 1:200 year event, however this does not prevent other parts of the site that are at risk being used for building providing floor levels are set at an appropriate level to avoid a likely risk of inundation.

The flood height at the building platform of proposed Lot 1 can not be easily determined from the modelling, and therefore specific engineering investigation at the time of building consent should be undertaken. Alternatively, a pragmatic level would be to adopt the nearest crown of McHughs Road as a minimum floor level for the proposed Lot 1 building platform.

The lower ground of proposed Lot 1 is located very close to the winter groundwater level, and is understood that groundwater can occasionally rise

planning", GNS Science Miscellaneous Series 48, 57p.

above the ground surface of the old gravel pit area and is therefore not suitable for residential buildings.

Refer to Appendix B.

9.6. Subsidence

9.6.1. Liquefaction

'The Ministry for Business, Innovation and Employment's guidance document[5] specified the values to be adopted for liquefaction assessment. The peak ground accelerations to be used for liquefaction assessment are 0.13g for a Serviceability Limit State (SLS) event, and 0.35g for a Ultimate Limit State (ULS) event.

The site was subjected to peak ground accelerations of 0.18g ($PGA_{M7.5}$=0.16g) in the M7.1 September 2010 earthquake, 0.13g ($PGA_{M7.5}$=0.09g) in the M6.2 February 2011 earthquake, and 0.07g ($PGA_{M7.5}$=0.05g) in the M6.0 June 2011 earthquake. The September 2010 event exceeded a Serviceability Limit State (SLS) and the February 2011 event was close to an SLS event with no record of ground damage at the site.

Based on ground performance, and the nature of the underlying geology, we consider that subsidence due to liquefaction is not likely.

9.6.2. Organic soils, fill materials, peat

There were no organic soils, peat, or uncontrolled fill materials encountered by our investigations, and therefore subsidence is unlikely.

We note it is conceivable that there may be some areas of uncontrolled fill which are present from the old quarry area, and therefore an experienced engineer shall inspect all foundation excavations on Lot 1 to ensure foundations bear onto firm insitu ground, and not historic fill.

9.7. Other

9.7.1. Stormwater disposal

All roof and driveway stormwater shall be discharged in to the ground, well away from any building foundations to avoid loss of bearing capacity and soil saturation.

Infiltration testing indicates an ultimate infiltration rate of 1000mm/hr/m^2 can be adopted where discharges of clean stormwater is made into sandy gravels.

[5] *Ministry for Business, Innovation & Employment "Guidance: Repairing and Rebuilding houses affected by the Canterbury earthquakes "Version 3, December 2012 (released 31 January 2013)*

Lower infiltration rates would occur where discharges are made into silty gravels.

9.7.2. Effluent disposal

There is sufficient land area on each lot to establish an on-site effluent disposal field, however site specific investigation and design will be required for each lot once the location and nature of a future dwelling proposal is known. Effluent disposal fields should be located away from building foundations to avoid loss of bearing capacity and soil saturation, and at Lot 1 the disposal field shall be located away from lower ground in order to provide adequate separation from groundwater.

All disposal filed shall be located on land that is not likely to be inundated in a 2% AEP rainfall event, unless authorised by Resource Consent.

9.8. Vehicle access

There are no specific geotechnical requirements for formation of vehicle access to each lot.

10. RECOMMENDATIONS

10.1. Conditions of subdivision consent

There are no conditions for this subdivision consent.

10.2. Consent Notice on Computer Freehold Register for Lot 1

In order to address the requirements of this report, we recommend the following be registered as a consent notice on the computer freehold register of Lot 1:

- All new foundations shall be subjected to specific engineering design and investigations.
- All foundation excavations shall be inspected by an experienced engineer to ensure there is no historic uncontrolled fill present.
- The ground levels in the area of the Lot 1 building platform should be raised by control filling in order to mitigate the existing risk of inundation to the Lot 1 building platform.
- Any new dwellings on Lot 1 shall be located within the nominated building platform and shall have a minimum finished floor level at, or above, the crown level of McHughs Road, nearest to the building platform, unless a lower level is determined appropriate by a future specific engineering investigation.

10.3. Consent Notice on Computer Freehold Register for Lot 2 and 3

In order to address the requirements of this report, we recommend the following be registered as a consent notice on the computer freehold register of Lot 2 and 3:

- All new foundations shall be subjected to specific engineering investigation and design.
- Any new building shall be located within the nominated building platform.
- Minimum floor levels shall be specified by the Council at time of Building Consent.

11. TYPICAL REQUIREMENTS FOR RESIDENTIAL BUILDING FOUNDATIONS

11.1. MBIE Guidelines

Based on our assessment, all foundations for future dwellings should comply with the requirements for TC1 land and shall be subject to specific engineering investigation and foundation reporting once the nature and location of a dwelling is known.

12. SUMMARY

We consider the site is not likely to be subject to liquefaction induced subsidence.

Subject to the recommendations of this report being followed, we are satisfied that from a geotechnical perspective, the site will be suitable for the proposed subdivision and the risk of erosion and inundation can be effectively mitigated.

Appendix A : PROPOSED SCHEME PLAN

Application for Subdivision Consent

Comprised in C.F.R.s CB380/236 & CB686/49

Total Area : 16.1876ha (CFR)

ZONE : RURAL
Waimakariri District Plan
(Operative)

NOTE : Areas and dimensions are subject to final survey

THIS PLAN IS PREPARED FOR THE PURPOSE OF OBTAINING A RESOURCE CONSENT FROM COUNCIL TO THE DEVELOPMENT THE INFORMATION CONTAINED HEREON SHOULD NOT BE USED FOR OTHER PURPOSES

0 10 30 50 100 150 200 300 Original size mm

BRADLEYS ROAD FINAL

FRAM ROAD

MANDEVILLE ROAD

McHUGHS ROAD

ROSCREA PLACE

MANDEVILLE PARK

TRURO CLOSE

4
Road to vest in Waimakariri District Council
5m²

1
4.5411ha
Pt RS 12395
CFR CB686/49

2
7.6724ha
Pt RS 12395
CFR CB380/236

3
4.0003ha

Existing Vehicle Entrance
Proposed Vehicle Entrance
Well
Building Platform Boundary
Boundary along Fence
Boundary approx. 10 metres off Fence

5.15 5.15 A8.51 R6.00 36.06
499.90
91.65
159.74
198.50
70.18
94.28
111.11
156.89
629.74
216.20
198.93
201.33
185.87

Lot 1 DP 303971
Lot 2 DP 303971
Lot 5 DP 303971
Lot 6 DP 303971
Lot 7 DP 303971
Lot 8 DP 303971
Lot 2 DP 448155
Lot 506 DP 448155
Lot 3 DP 448155

Sheet 1 of 1
Drawing Set 348678 C12
PLOT CTB 131112

Scale: 1:2500 (A3)
Date: 12/11/2013

Projection NZGD 2000
Circuit Pit Pleasant 2000

origin of levels BM B4AG Cnr Island Road and Tram Road R.L. 17.646m
datum December 2013 Lyttelton 1937

	surveyed	Bob Greening
		Mark Allan
	surv.date	Bob Greening
		January 2014
designed		
manager		
drawn		
checked		

no.	amendment	initial	date
	Levels added	rksg	31.01.2014

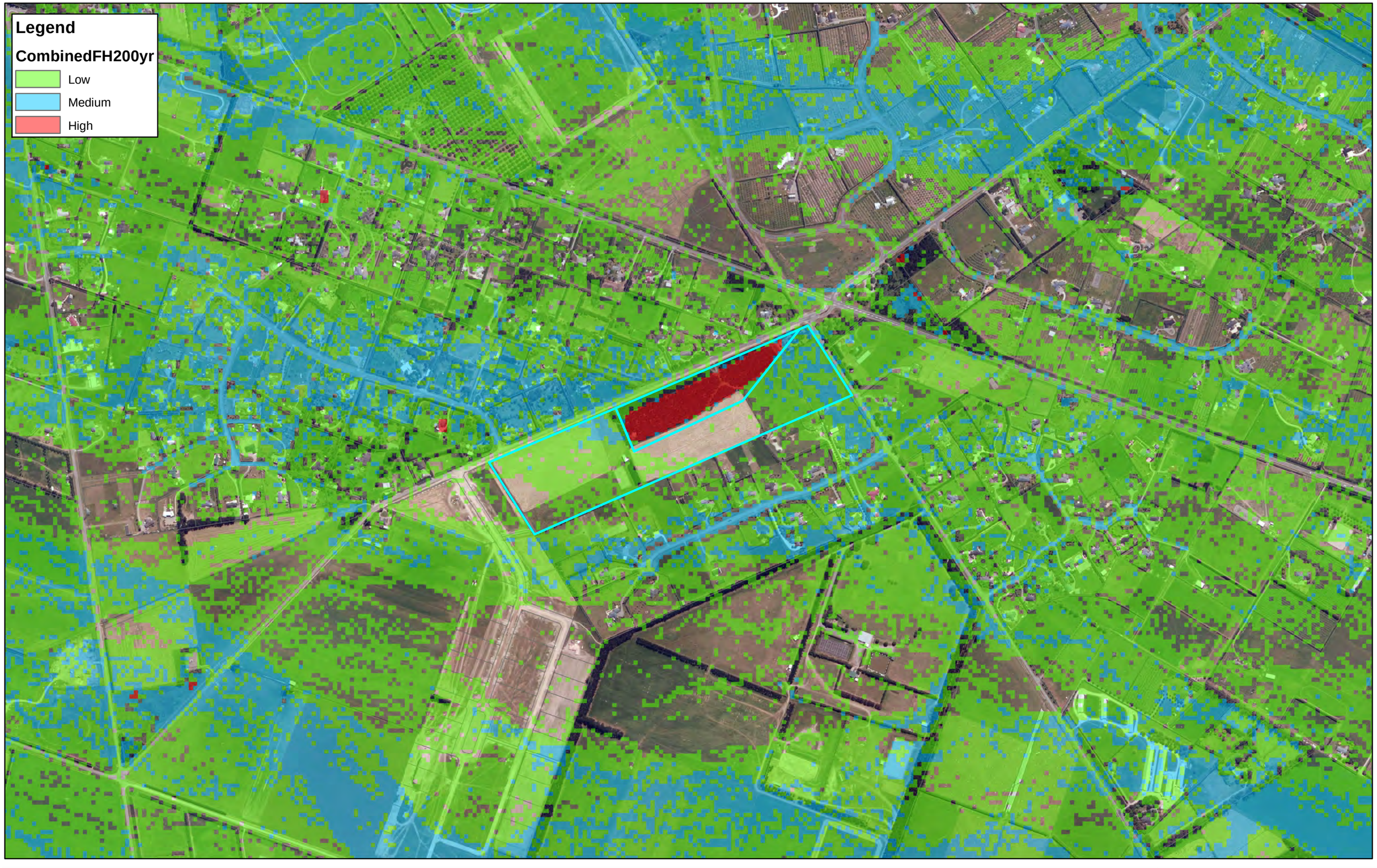
Eliot Sinclair
surveyors | engineers | planners

20 Troup Drive, PO Box 9339, Tower Junction, Christchurch 8149, Phone: 03 379-4014, Fax: 03 365-2449, info@eliotsinclair.co.nz www.eliotsinclair.co.nz

Proposed Subdivision of
116 and 148 McHughs Road, Mandeville
being Parts RS 12395
for P.G.Harris

[plotted: Wednesday, February 05, 2014 11:19:38] [computer operator: rksg] [Project: G:\Jobs\34\348678\12d\SURVEY\RCON\Proposed Subdivision McHughs Road\Proposed Subdivision McHughs Road]

Appendix B : FLOOD HAZARD MAPPING



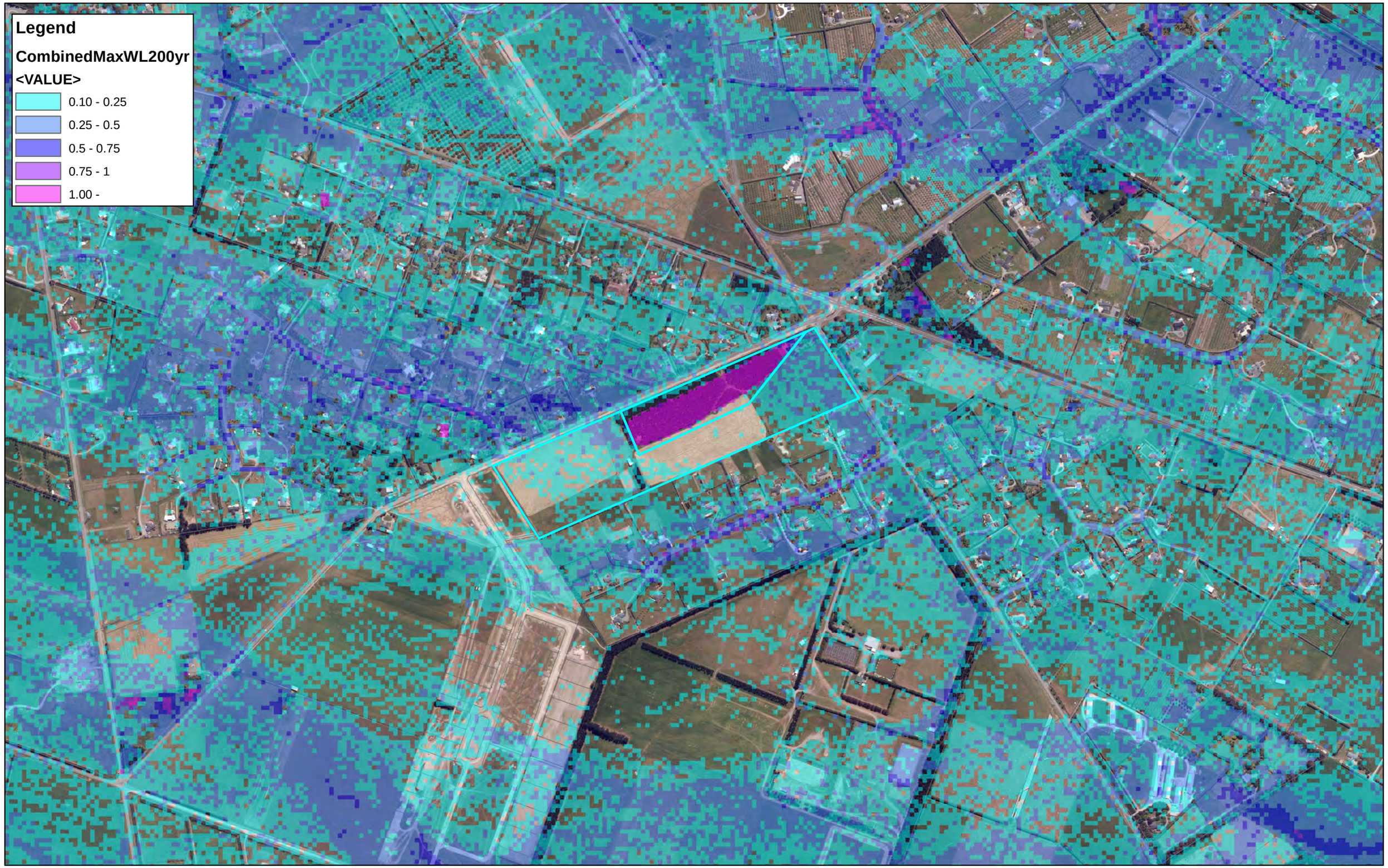
WAIMAKARIRI DISTRICT COUNCIL

116 and 148 MCHUGHS ROAD

200 Year ARI Flood Hazard
Data derived from WDC South Ashley Full-Catchment Model

SCALE (A3)
1:8,000

DATE
29/10/2013



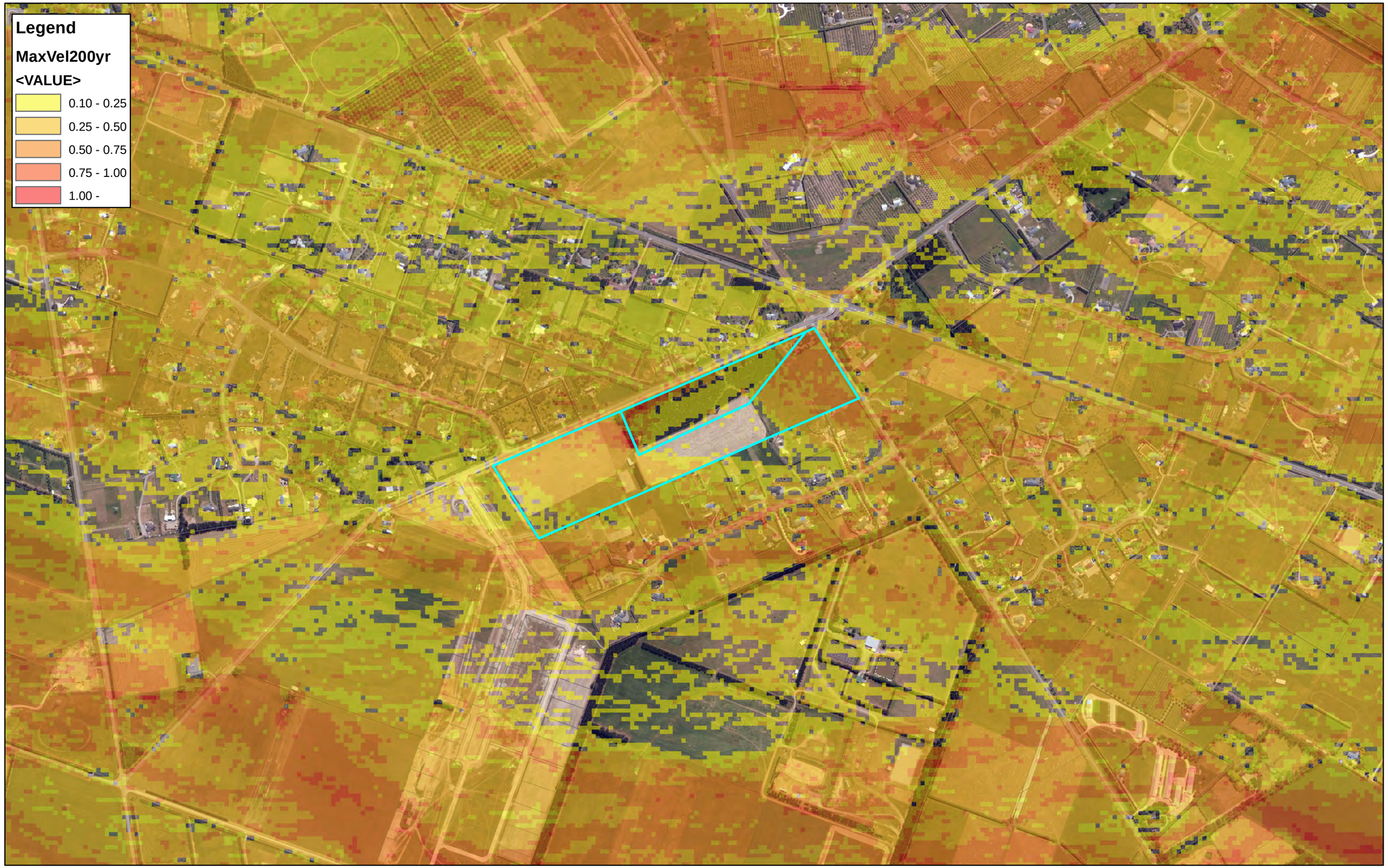
WAIMAKARIRI DISTRICT COUNCIL

116 and 148 MCHUGHS ROAD

200 Year ARI Maximum Flood Depth
Data derived from WDC South Ashley Full-Catchment Model

SCALE (A3)
1:8,000

DATE
29/10/2013



WAIMAKARIRI DISTRICT COUNCIL

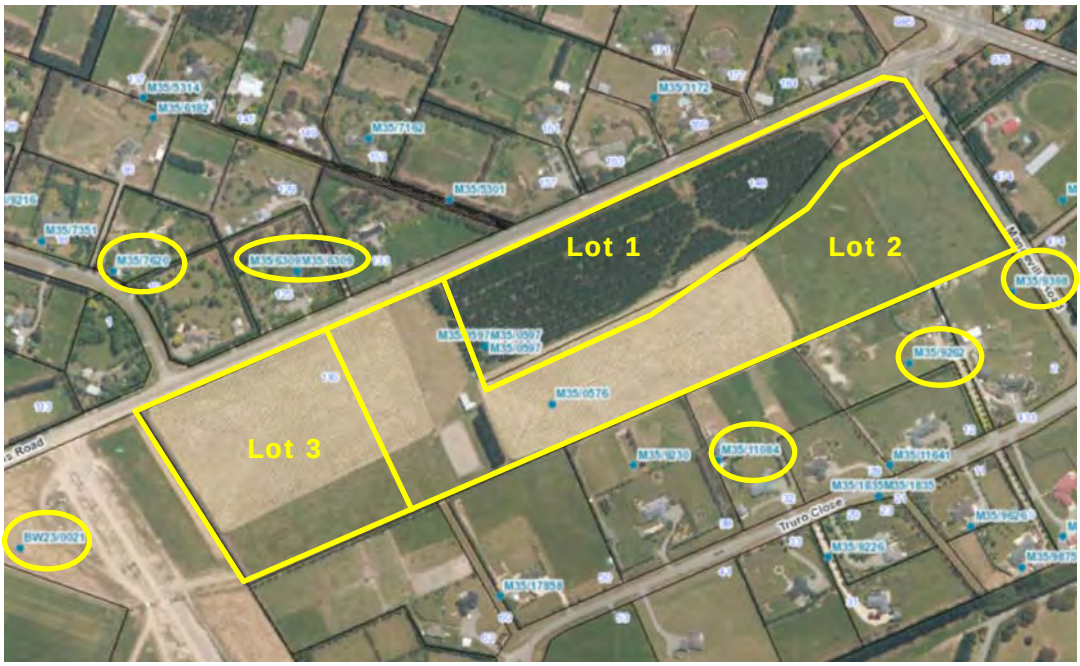
116 and 148 MCHUGHS ROAD

200 Year ARI Maximum Velocity
Data derived from WDC South Ashley Full-Catchment Model

SCALE (A3)
1:8,000

DATE
29/10/2013

Appendix C : WELL LOGS



Bore or Well No: M35/9262
Well Name:
Owner: Mr G D & Mrs L J Wall

Environment Canterbury
Your regional council

Street of Well: Truro Close
Locality: Rangiora
NZGM Grid Reference: M35:7225-5824 QAR 3
NZGM X-Y: 2472250 - 5758240
Location Description:
ECan Monitoring:
Well Status: Active (exist, present)

File No: CO6C/19031
Allocation Zone: Eyre River
Uses: Domestic Supply

Drill Date: 25 May 2002
Well Depth: 21.40m -GL
Initial Water Depth: -7.60m -MP
Diameter: 150mm

Water Level Count: 0
Strata Layers: 7
Aquifer Tests: 0
Isotope Data: 0
Yield/Drawdown Tests: 1

Measuring Point Ait: 39.68m MSD QAR 4
GL Around Well: -0.30m -MP
MP Description: ToC

Highest GW Level:
Lowest GW Level:
First Reading:
Last Reading:

Driller: Clemence Drilling Contractors
Drilling Method: Rotary/Percussion
Casing Material: STEEL
Pump Type:
Yield: 3 l/s
Drawdown: 1 m
Specific Capacity: 2.31 l/s/m

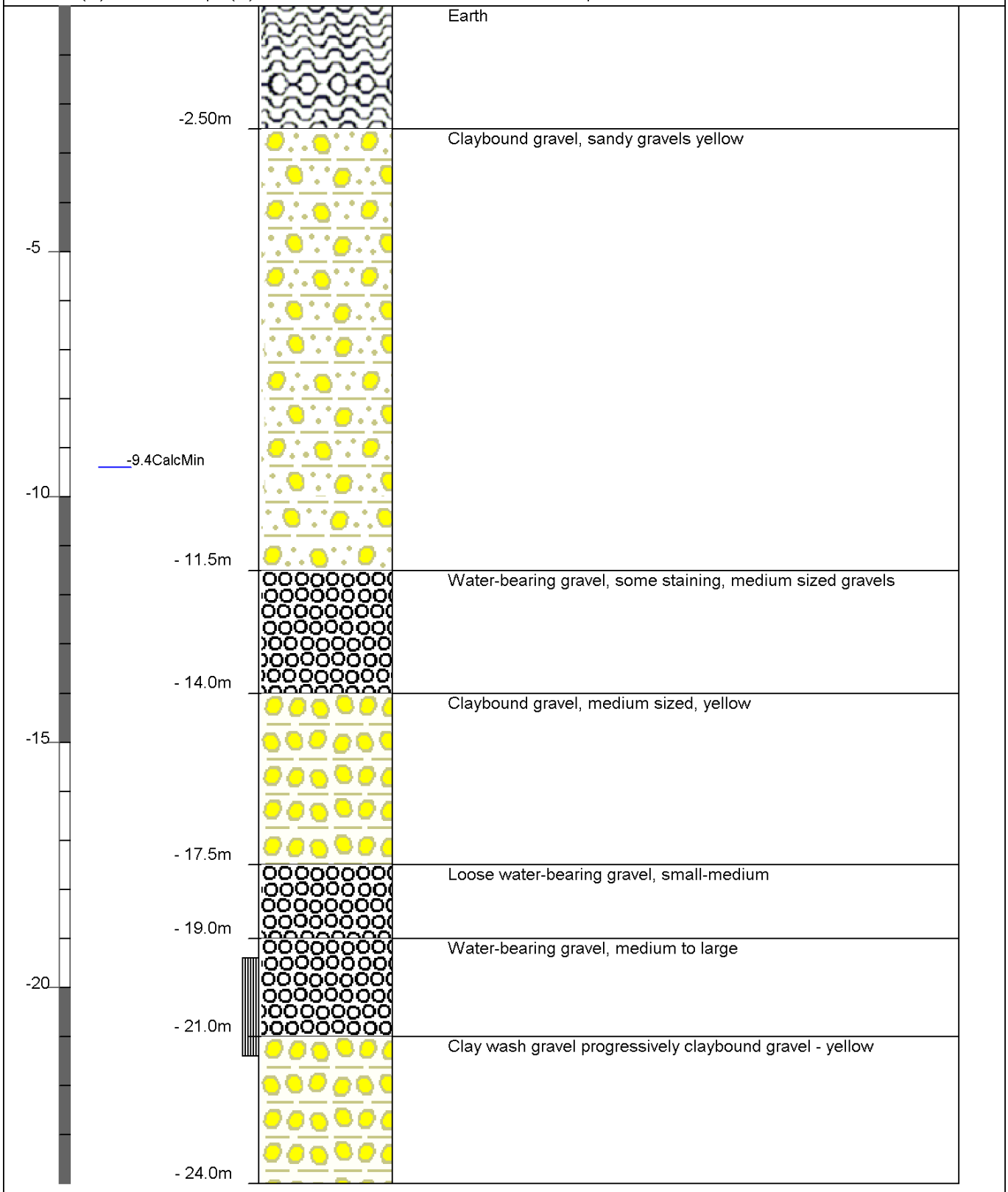
Calc. Min. GWL: -9.70m -MP
Last Updated: 25 Jun 2003
Last Field Check:

Screens:
Screen Type: Stainless steel
Top GL: 19.40m
Bottom GL: 21.40m

Aquifer Type:
Aquifer Name:

Borelog for well M35/9262

Gridref: M35:7225-5824 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 40 +MSD
Driller : Clemence Drilling Contractors
Drill Method : Rotary/Percussion
Drill Depth : -24m Drill Date : 25/05/2002



Bore or Well No: M35/7620
Well Name:
Owner: OAKLEY, W.R & ROGERS, J.A

Environment Canterbury
Your regional council

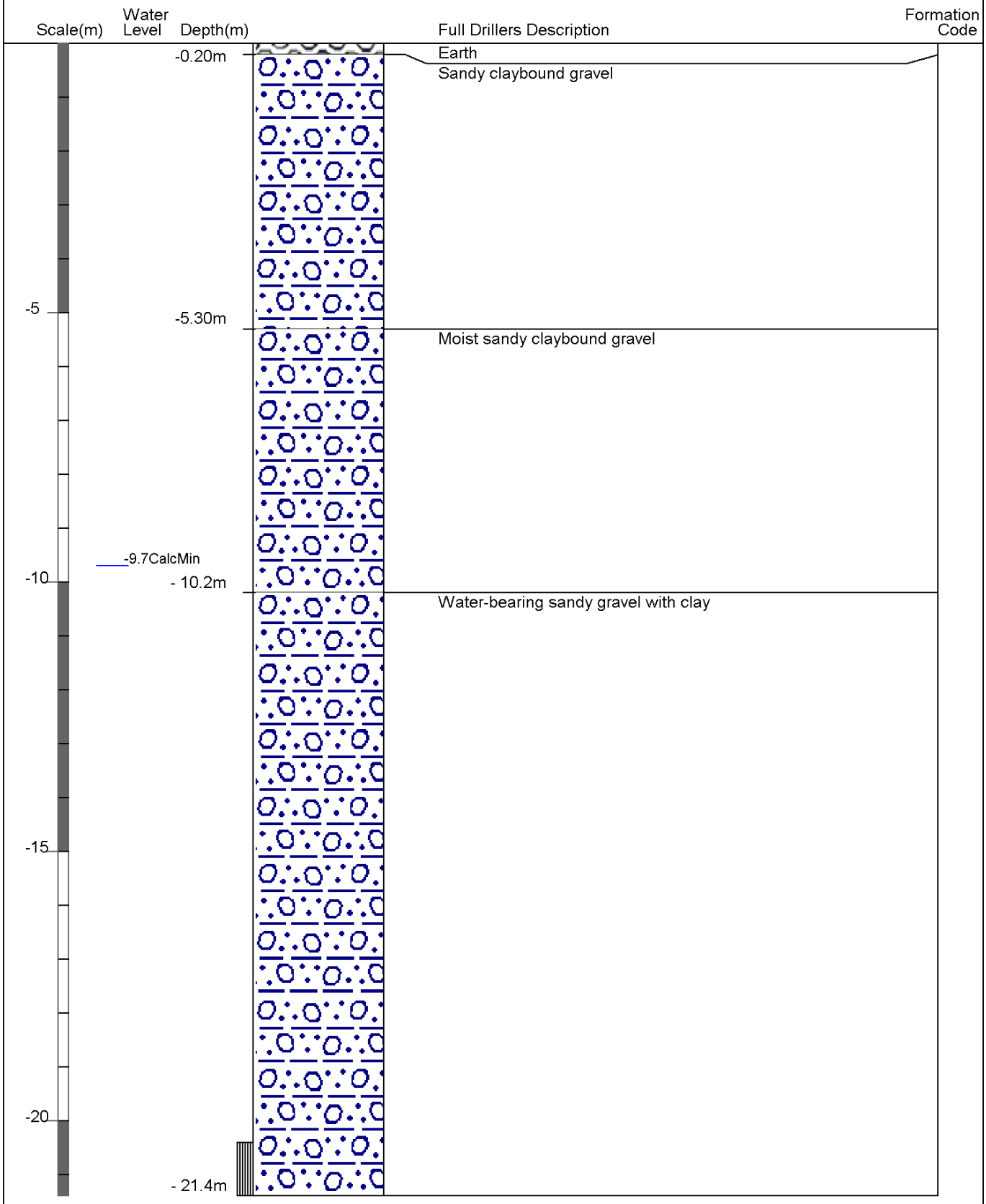
Street of Well: ROSCREA PLACE
File No: CO6C/12439
Locality: MANDEVILLE
Allocation Zone: Eyre River
NZGM Grid Reference: M35:7147-5833 QAR 4
NZGM X-Y: 2471470 - 5758330
Location Description: BESIDE HOUSE
Uses: Domestic and Stockwater
ECan Monitoring:
Well Status: Active (exist, present)

Drill Date: 29 Nov 1996
Water Level Count: 0
Well Depth: 21.40m -GL
Strata Layers: 4
Initial Water Depth: -5.80m -MP
Aquifer Tests: 0
Diameter: 125mm
Isotope Data: 0
Yield/Drawdown Tests: 1

Measuring Point Ait: 41.66m MSD QAR 4
Highest GW Level:
GL Around Well: 0.00m -MP
Lowest GW Level:
MP Description:
First Reading:
Last Reading:
Driller: McMillan Water Wells Ltd
Calc. Min. GWL: -9.70m -MP
Drilling Method: Rotary Rig
Last Updated: 08 Jan 1997
Casing Material: STEEL
Last Field Check:
Pump Type: Unknown
Yield: 2 l/s
Screens:
Drawdown: 1 m
Screen Type: Stainless steel
Specific Capacity: 2.11 l/s/m
Top GL: 20.40m
Bottom GL: 21.40m
Aquifer Type: Unknown
Aquifer Name:

Borelog for well M35/7620

Gridref: M35:7147-5833 Accuracy : 4 (1=best, 4=worst)
Ground Level Altitude : 42 +MSD
Driller : McMillan Water Wells Ltd
Drill Method : Rotary Rig
Drill Depth : -21.4m Drill Date : 29/11/1996



Bore or Well No: BW23/0021
Well Name:
Owner: MRS B N RICHARDSON

Environment Canterbury
Your regional council

Street of Well: MANDEVILLE PARK DRIVE
File No: CO6C/33360
Locality: MANDEVILLE
Allocation Zone: Eyre River
NZGM Grid Reference: M35:71379-58059 QAR 3
NZGM X-Y: 2471379 - 5758059
Location Description:
Uses: Domestic and Stockwater
ECan Monitoring:
Well Status: Active (exist, present)

Drill Date: 28 May 2012
Water Level Count: 0
Well Depth: 24.00m -GL
Strata Layers: 4
Initial Water Depth: -8.10m -MP
Aquifer Tests: 0
Diameter: 150mm
Isotope Data: 0
Yield/Drawdown Tests: 0

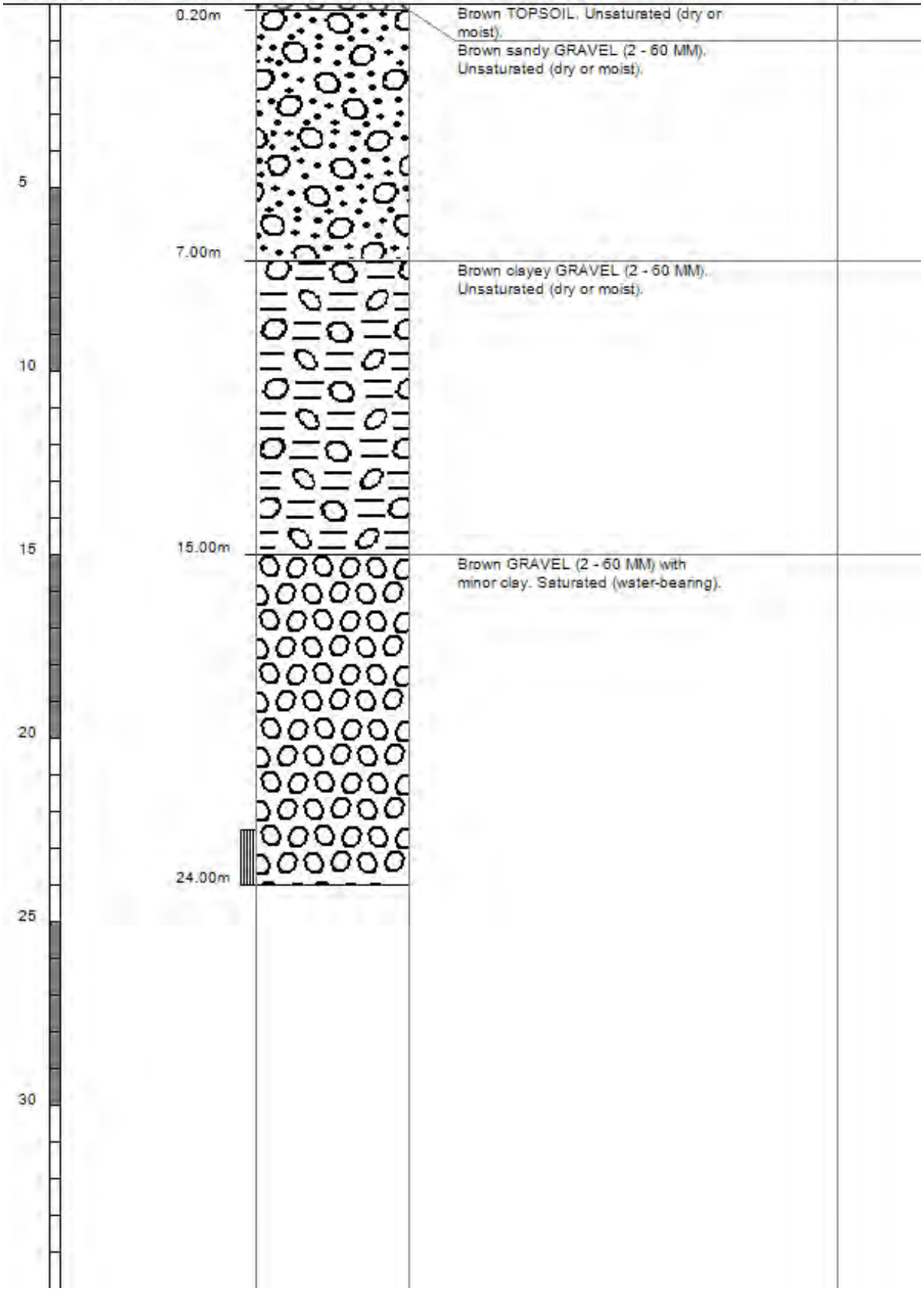
Measuring Point Ait:
Highest GW Level:
GL Around Well: -0.40m -MP
Lowest GW Level:
MP Description: Top of Casing
First Reading:
Last Reading:
Driller: East Coast Drilling
Calc. Min. GWL:
Drilling Method: Rotary/Percussion
Last Updated: 18 Jul 2012
Casing Material: Steel
Last Field Check:
Pump Type:
Yield:
Screens:
Drawdown:
Screen Type: Stainless steel
Specific Capacity:
Top GL: 22.50m
Bottom GL: 24.00m
Aquifer Type:
Aquifer Name:

Date	Comments
17 Jul 2012	NZTM Easting/Northing updated from:1561440-5196480 shifted 69m

Borelog for well BW23/0021

Map Reference (NZMG): 2471379 mN, 5758059 mE
QAR Accuracy: 3
Ground Level Altitude: +MSD
Driller: East Coast Drilling
Drill Method: Rotary/Percussion
Well Depth: 24m Drill Date: 28/05/2012

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha



Bore or Well No: M35/6309
Well Name:
Owner: ROSCOE .M.

Environment Canterbury
Your regional council

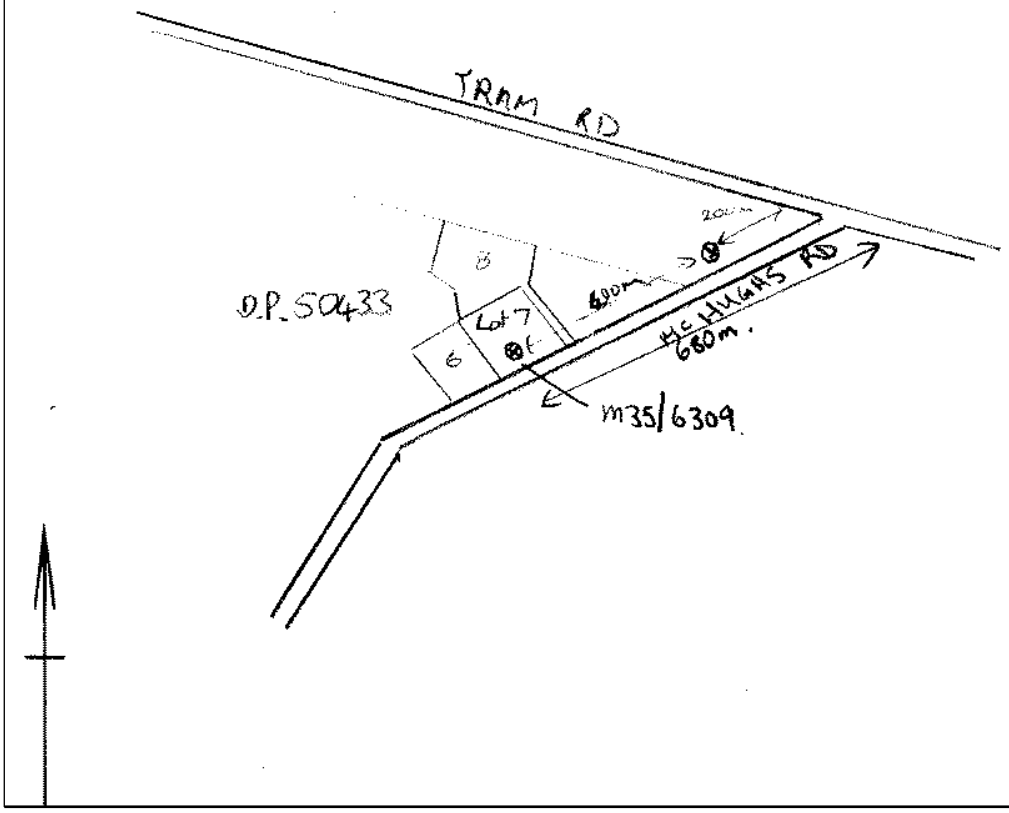
Street of Well: MCHUGHS RD
File No: CO6C/01701
Locality: MANDEVILLE NORTH
Allocation Zone: Eyre River
NZGM Grid Reference: M35:7165-5833 QAR 4
NZGM X-Y: 2471650 - 5758330
Location Description:
Uses: Irrigation
ECan Monitoring:
Well Status: Not Used

Drill Date: 23 Oct 1990
Water Level Count: 0
Well Depth: 23.70m -GL
Strata Layers: 4
Initial Water Depth: -11.00m -MP
Aquifer Tests: 0
Diameter: 125mm
Isotope Data: 0
Yield/Drawdown Tests: 1

Measuring Point Ait: 40.97m MSD QAR 4
Highest GW Level:
GL Around Well: 0.00m -MP
Lowest GW Level:
MP Description:
First Reading:
Last Reading:
Driller: McMillan Water Wells Ltd
Calc. Min. GWL: -9.50m -MP
Drilling Method: Rotary/Percussion
Last Updated: 15 May 1998
Casing Material: STEEL
Last Field Check:
Pump Type: Unknown
Yield: 2 l/s
Screens:
Drawdown: 7 m
Screen Type: Stainless steel
Specific Capacity: 0.20 l/s/m
Top GL: 22.70m
Bottom GL: 23.70m
Aquifer Type: Unknown
Aquifer Name:

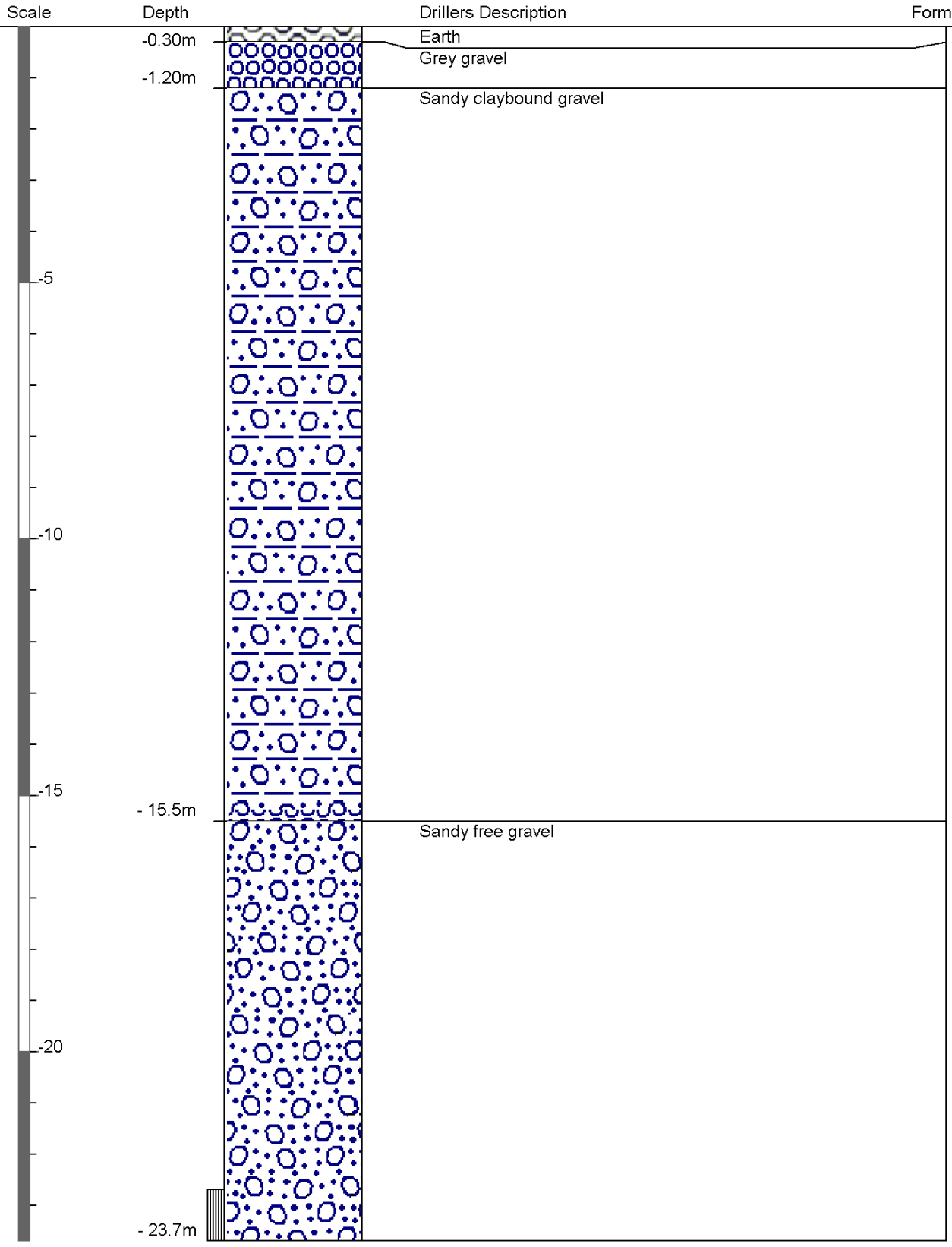
LOCATION SKETCH

1704



Borelog for well M35/6309

Gridref: M35:7165-5833
Ground Level Altitude 41 +MSD
Driller : McMillan Water Wells Ltd.
Drill Method: Rotary/Percussion
Drill Depth : -23.7m Drill Date : 23/10/1990



Bore or Well No: M35/9398
Well Name:
Owner: MR D A BOARD & MS S A HODGES-BOARD

Environment Canterbury
Your regional council

Street of Well: TRURO CLOSE
Locality: MANDEVILLE ROAD
NZGM Grid Reference: M35:7235-5831 QAR 4
NZGM X-Y: 2472350 - 5758310
Location Description:
ECan Monitoring:
Well Status: Active (exist, present)

File No: CO6C/19639
Allocation Zone: Eyre River
Uses: Domestic Supply

Drill Date: 08 Dec 2002
Well Depth: 17.80m -GL
Initial Water Depth: -7.05m -MP
Diameter: 150mm

Water Level Count: 0
Strata Layers: 7
Aquifer Tests: 0
Isotope Data: 0
Yield/Drawdown Tests: 1

Measuring Point Ait: 38.89m MSD QAR 4
GL Around Well: 0.00m -MP
MP Description:

Highest GW Level:
Lowest GW Level:
First Reading:
Last Reading:

Driller: Clemence Drilling Contractors
Drilling Method: Rotary Rig
Casing Material: STEEL
Pump Type:
Yield: 2 l/s
Drawdown: 8 m
Specific Capacity: 0.26 l/s/m

Calc. Min. GWL: -9.30m -MP
Last Updated: 09 Oct 2003
Last Field Check:

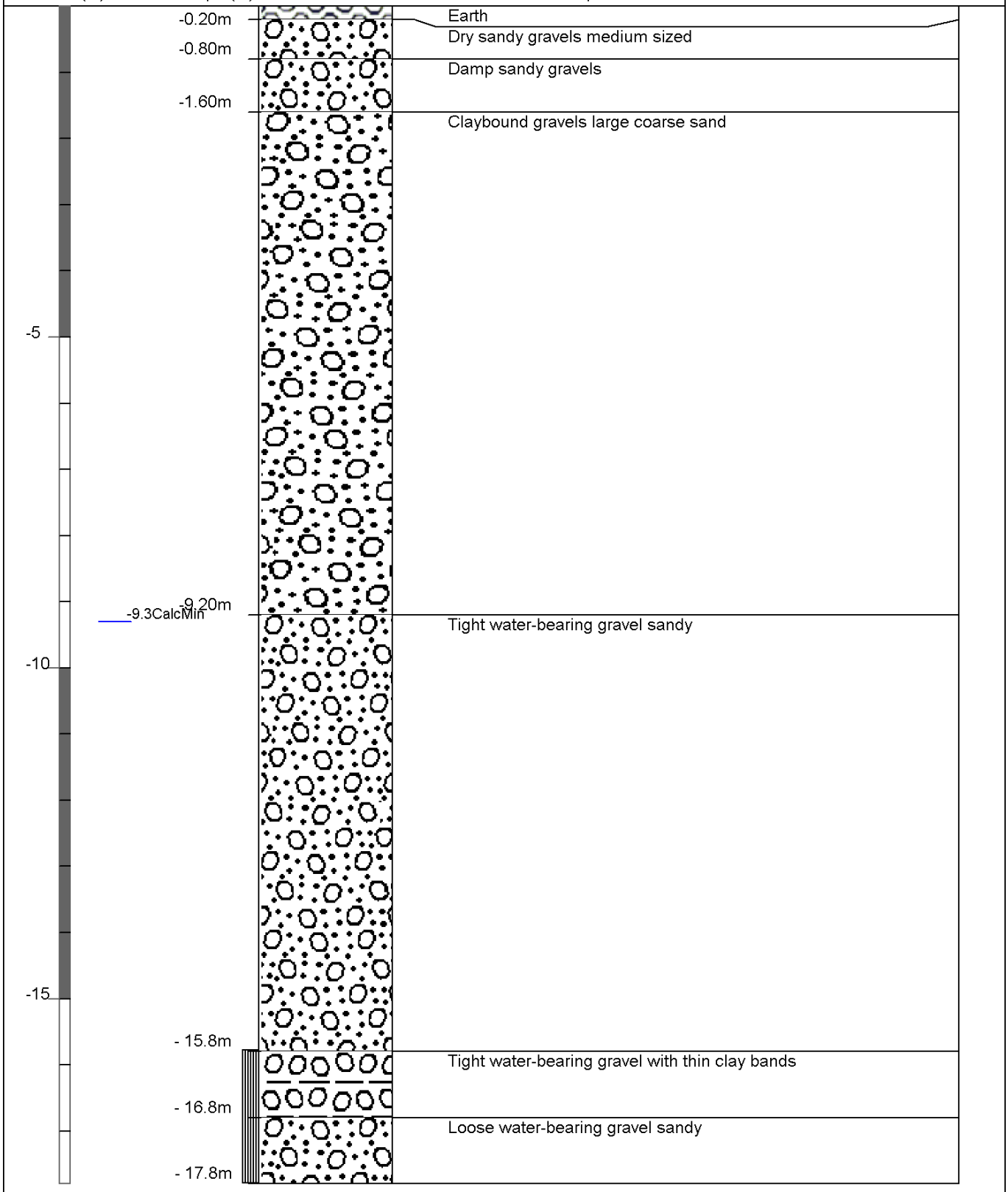
Screens:
Screen Type: Stainless steel
Top GL: 15.78m
Bottom GL: 17.78m

Aquifer Type:
Aquifer Name:

Date	Comments
09 Oct 2003	Remark on drillers report: Casing slotted from 16m to 20m ?? Bore is only 17.8m deep

Borelog for well M35/9398

Gridref: M35:7235-5831 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 39 +MSD
Driller : Clemence Drilling Contractors
Drill Method : Rotary Rig
Drill Depth : -17.8m Drill Date : 8/12/2002



Appendix D : SHALLOW SITE INVESTIGATION RESULTS

Application for Subdivision Consent

Comprised in C.F.R.s CB380/236 & CB686/49

Total Area : 16.1876ha (CFR)

ZONE : RURAL
Waimakariri District Plan
(Operative)

NOTE : Areas and dimensions are subject to final survey

THIS PLAN IS PREPARED FOR THE PURPOSE OF OBTAINING A RESOURCE CONSENT FROM COUNCIL TO THE DEVELOPMENT THE INFORMATION CONTAINED HEREON SHOULD NOT BE USED FOR OTHER PURPOSES

0 10 30 50 100 150 200 300 Original size mm

N

BRADLEYS ROAD FINAL

TRAM ROAD

MANDEVILLE ROAD

McHUGHS ROAD

ROSCREA PLACE

MANDEVILLE PARK

TRURO CLOSE

4 Road to vest in Waimakariri District Council 5m²

1 4.5411ha Pt RS 12395 CFR CB686/49

2 7.6724ha Pt RS 12395 CFR CB380/236

3 4.0003ha

499.90 Existing Vehicle Entrance

94.28 Existing Vehicle Entrance

216.20 Proposed Vehicle Entrance

Boundary along Fence 111.11

Boundary approx. 10 metres off Fence 156.89

Building Platform Boundary 629.74

Boundary approx. 10 metres off Fence 70.18

Boundary along Fence 91.65

198.50

159.74

198.93

201.33

185.87

5.15 5.15 A8.51 R6.00 36.06

Well W

Lot 1 DP 303971

Lot 2 DP 303971

Lot 5 DP 303971

Lot 6 DP 303971

Lot 7 DP 303971

Lot 8 DP 303971

Lot 2 DP 448155

Lot 506 DP 448155

Lot 3 DP 448155

Geotech Legend

Soakage Test (S)

Test Pit (T)

Sheet 1 of 1

Drawing Set 348678 G1 PLOT G1 140211

Scale: 1:2500 (A3)
Date: 11/2/2014

Projection NZGD 2000
Circuit Pit Pleasant 2000

origin of levels BM B4AG Cnr Island Road and Tram Road R.L. 17.646m datum December 2013 Lyttelton 1937

surveyed Chris Benns
surv.date January 2014

designed Bob Greening
manager Mark Allan

drawn Bob Greening
checked

no.	amendment	initial	date

Eliot Sinclair
surveyors | engineers | planners

20 Troup Drive, PO Box 9339, Tower Junction, Christchurch 8149, Phone: 03 379-4014, Fax: 03 365-2449, info@eliotsinclair.co.nz www.eliotsinclair.co.nz

Geotech Test Location Plan
116 and 148 McHughs Road, Mandeville
being Parts RS 12395
for P.G.Harris

[plotted: Tuesday, February 11, 2014 16:41:45] [computer operator: rksg] [Project: G:\Jobs_34_348678_12d_SURVEY_RCONN\Proposed Subdivision McHughs Road\Proposed Subdivision McHughs Road]

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20 Troup Drive, Tower Junction
PO Box 9339, Christchurch 8149
Ph. (03) 379-4014 Fax. (03) 365-2449

Job Number: 348678
Date Tested: 11-Sep-2013

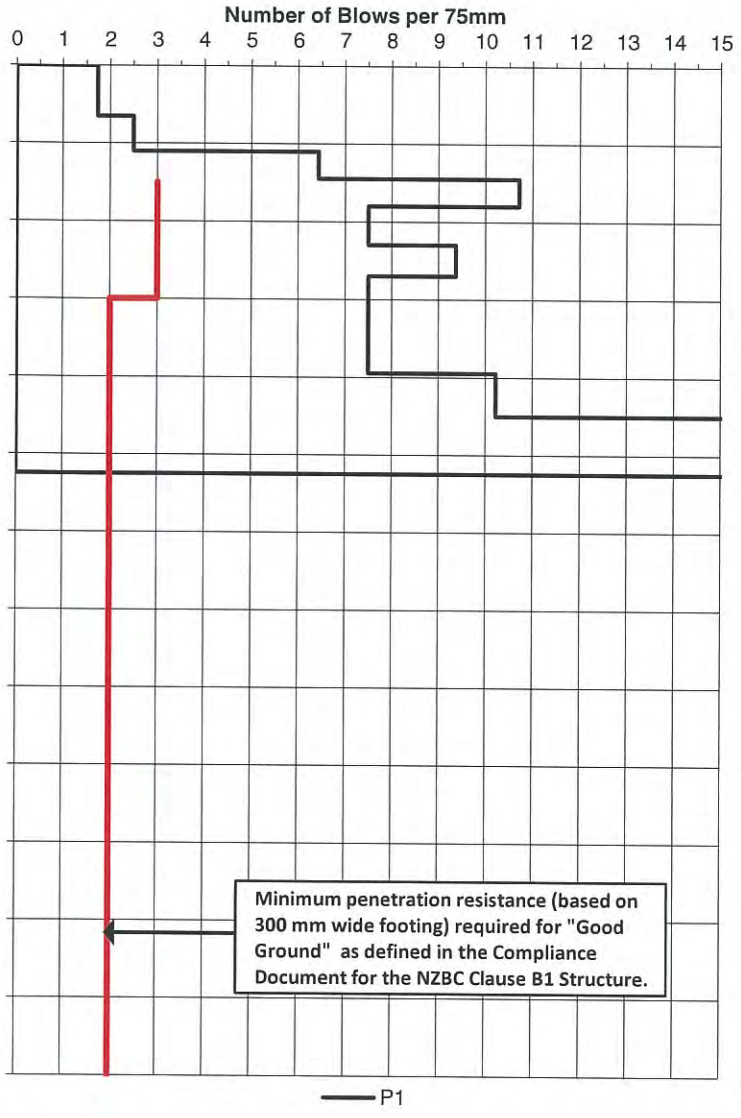
D.P
Lot
Technical Category: N/A - Rural

SITE INVESTIGATION RECORD

Client: Peter Harris

Site: 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

(Test Pit @ 1)

DEPTH [m]	
GL	Dark brown silty TOPSOIL, moist
0.2	
0.4	Brown silty GRAVEL, moist, stones < 50mmØ
0.6	
0.8	Greyish brown SAND, moist
1.0	
1.2	Greyish brown sandy GRAVEL, moist, stones < 50mm Ø
1.4	
1.6	
1.8	
2.0	Greyish brown sandy GRAVEL, moist, stones < 50mmØ, some cobbles
2.2	
2.4	STOP
2.6	
2.8	
3.0	
3.2	
3.4	

SITE PLAN (Not to Scale)

COMMENTS

Civil Engineer: J. Armour Date: Sep 2013

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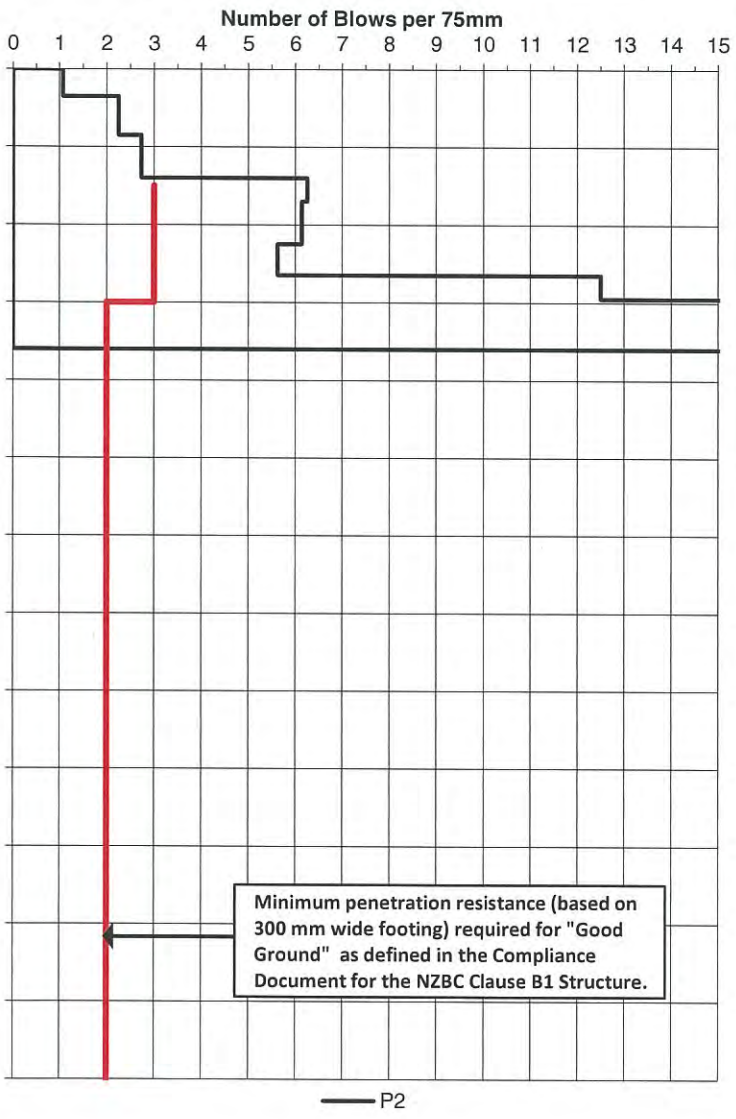
Job Number	348678
Date Tested	11-Sep-2013
Page	2 of 10
D.P	
Lot	
Technical Category	N/A - Rural

SITE INVESTIGATION RECORD

Client Peter Harris

Site 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



SITE PLAN (Not to Scale)

BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

(Test Pit @ 2)

DEPTH [m]	
GL	Dark brown Silty TOPSOIL, moist, some stones
0.2	
0.4	Brown silty GRAVEL, moist, stones < 50mmØ
0.6	
0.8	Brown silty sandy GRAVEL, moist, stones < 50mmØ
1.0	
1.2	Greyish brown sandy GRAVEL, moist, stones < 50mmØ
1.4	
1.6	Greyish brown sandy GRAVEL, moist, stones < 50mmØ, some fine gravel
1.8	
2.0	
2.2	Greyish brown sandy GRAVEL, moist, stones < 50mmØ, some cobbles
2.4	
2.6	STOP
2.8	
3.0	
3.2	
3.4	

COMMENTS

Civil Engineer J. Chamberlain **Date:** Sep 2013

Eliot Sinclair
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Job Number	348678
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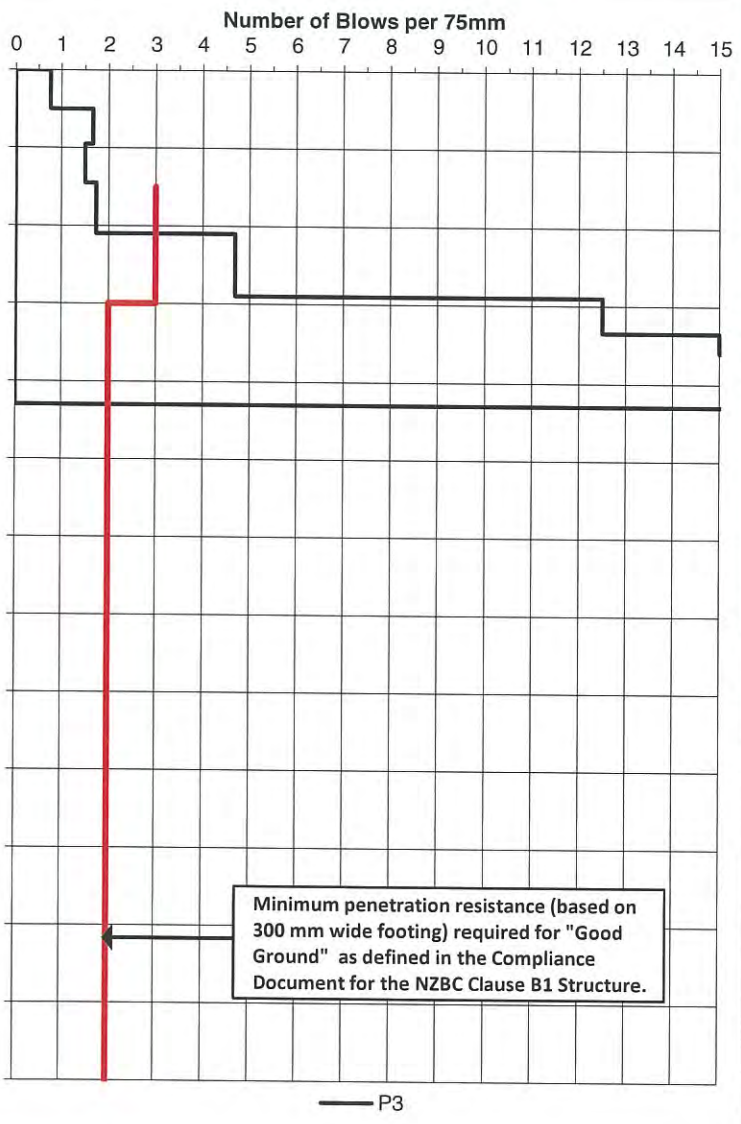
D.P	
Lot	
Technical Category	N/A - Rural

SITE INVESTIGATION RECORD

Client Peter Harris

Site 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



SITE PLAN (Not to Scale)

BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

DEPTH [m]	(Test Pit @ 3)
GL	Dark brown silty TOPSOIL, moist
0.2	Brown SILT, moist, some stones
0.4	Brown sandy silty GRAVEL, moist, stone < 50mmØ
0.6	
0.8	Greyish brown sandy GRAVEL, moist, stones < 50mmØ
1.0	Greyish brown SAND, moist
1.2	Grey sandy GRAVEL, moist, stones < 50mmØ
1.4	
1.6	Greyish brown sandy GRAVEL, moist, stones < 50mmØ , some cobbles
1.8	
2.0	STOP
2.2	
2.4	
2.6	
2.8	
3.0	
3.2	
3.4	

COMMENTS

Civil Engineer J. Hammond **Date:** Sep 2013

Eliot Sinclair
surveyors | engineers | planners

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Job Number	348678
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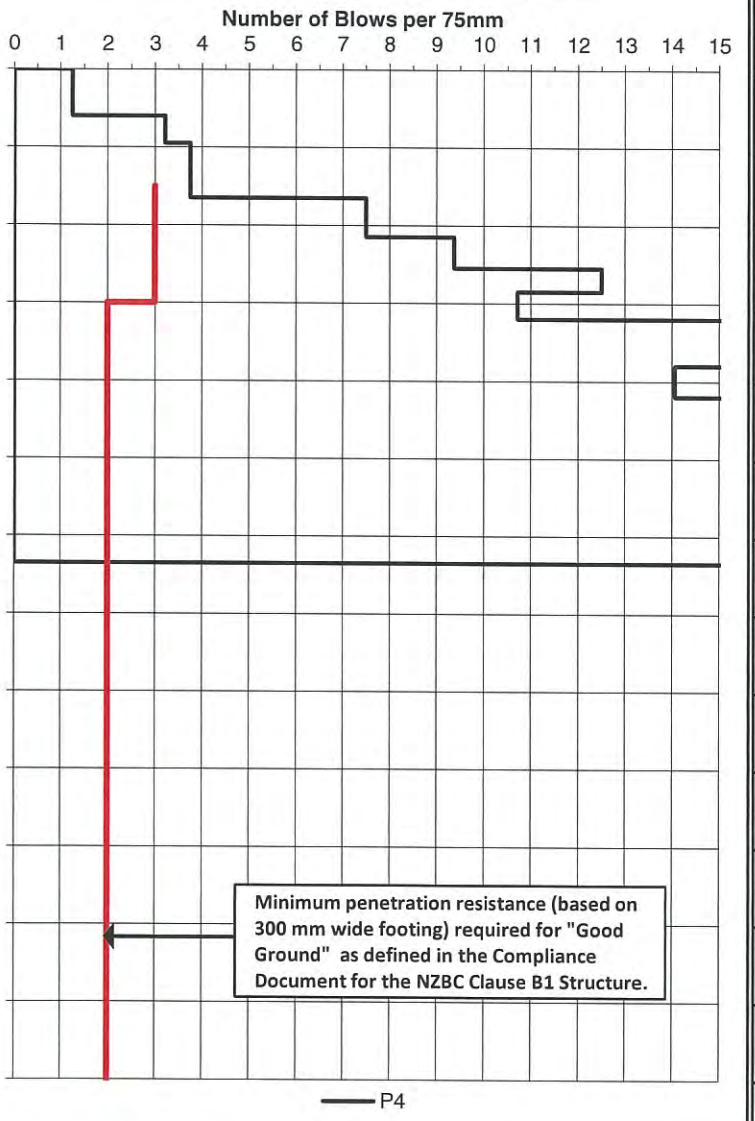
D.P	
Lot	
Technical Category	N/A - Rural

SITE INVESTIGATION RECORD

Client Peter Harris

Site 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

(Test Pit @ 4)

Depth [m]	
GL	Dark brown silty TOPSOIL, moist
0.2	
0.4	Brown silty GRAVEL, stones < 50mm
0.6	
0.8	
1.0	Greyish brown sandy GRAVEL, moist, stones < 50mm
1.2	
1.4	Greyish brown sandy GRAVEL, moist/wet, stones < 50mm , some fine gravel
1.6	
1.8	
2.0	Greyish brown sandy GRAVEL, moist/wet, stones < 50mm , some cobbles
2.2	
2.4	
2.6	STOP
2.8	
3.0	
3.2	
3.4	

SITE PLAN *(Not to Scale)*

COMMENTS

Civil Engineer J. Chamorro **Date:** Sep 2013

Eliot Sinclair
surveyors | engineers | planners

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Job Number	348678
Date Tested	11-Sep-2013
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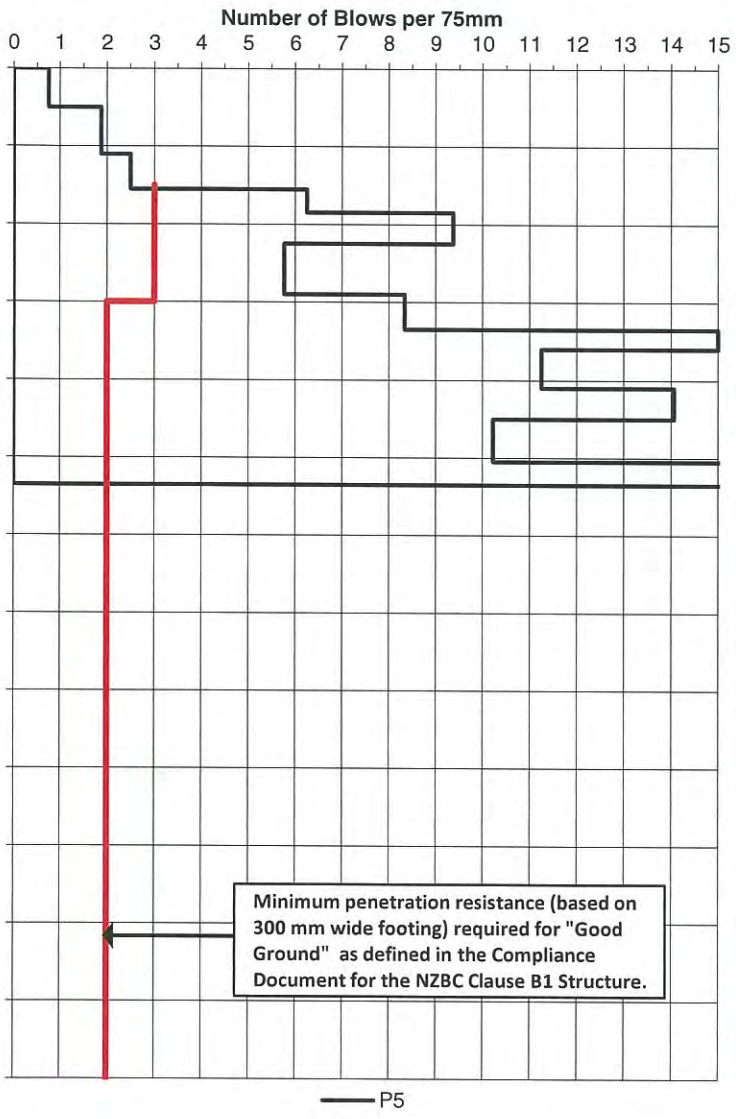
Lot	
Technical Category	N/A - Rural

SITE INVESTIGATION RECORD

Client Peter Harris

Site 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



SITE PLAN (Not to Scale)

BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

DEPTH [m]	
GL	(Test Pit @ 5)
0.2	Dark brown silty TOPSOIL, moist
0.4	Brown silty GRAVEL, moist, stones < 50mmØ
0.6	
0.8	
1.0	
1.2	Greyish brown sandy GRAVEL, moist, stones < 50mmØ
1.4	
1.6	Grey sandy GRAVEL, moist, stones < 50mmØ
1.8	Greyish brown sandy GRAVEL, moist, stones < 50mmØ
2.0	
2.2	Greyish brown sandy GRAVEL, moist, stones < 50mmØ, some fine gravel, some cobbles
2.4	STOP
2.6	
2.8	
3.0	
3.2	
3.4	

COMMENTS

Civil Engineer J. Cranmore **Date:** Sep 2013

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Job Number	348678
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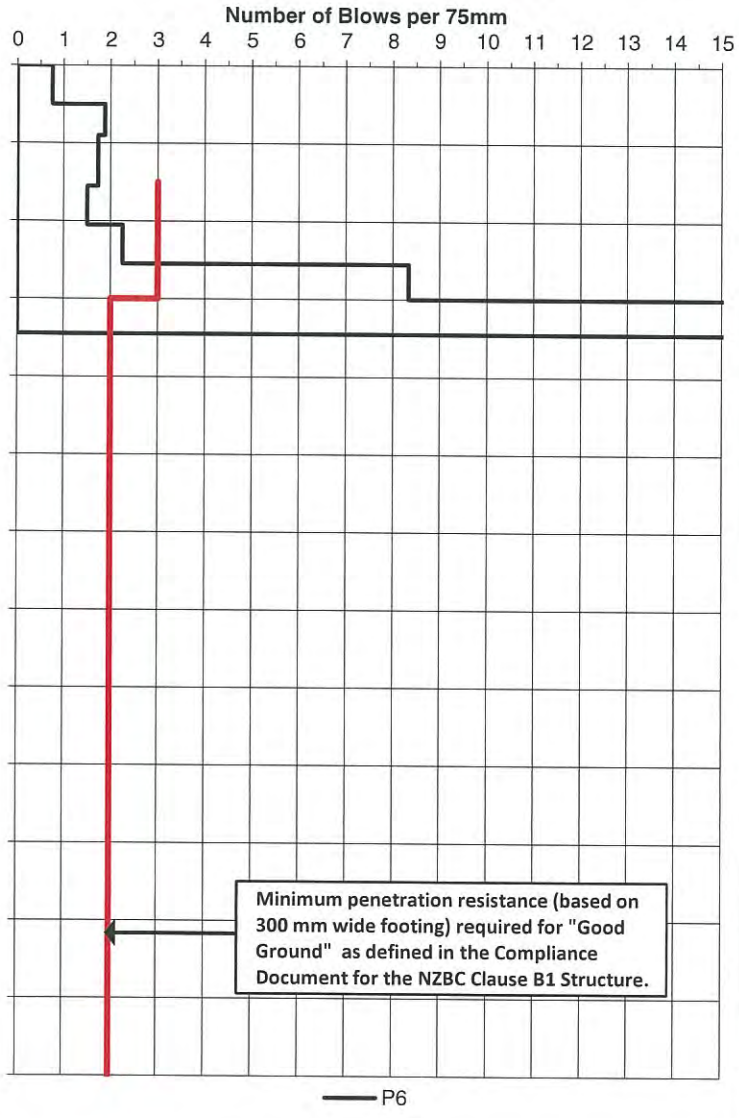
Lot	
Technical Category	N/A - Rural

SITE INVESTIGATION RECORD

Client Peter Harris

Site 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

(Test Pit @ 6)

DEPTH [m]	
GL	Dark brown silty TOPSOIL, moist
0.2	
0.4	
0.6	Brown silty GRAVEL, moist, stones < 50mmØ
0.8	
1.0	Brown sandy GRAVEL, moist, stones < 50mmØ
1.2	
1.4	
1.6	
1.8	Greyish brown sandy GRAVEL, moist/wet, stones < 50mm Ø, some fine gravel
2.0	
2.2	
2.4	STOP
2.6	
2.8	
3.0	
3.2	
3.4	

SITE PLAN *(Not to Scale)*

COMMENTS

Civil Engineer J. Manning **Date:** Sep 2013

Eliot Sinclair
surveyors | engineers | planners

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Job Number	348678
Date Tested	11-Sep-2013
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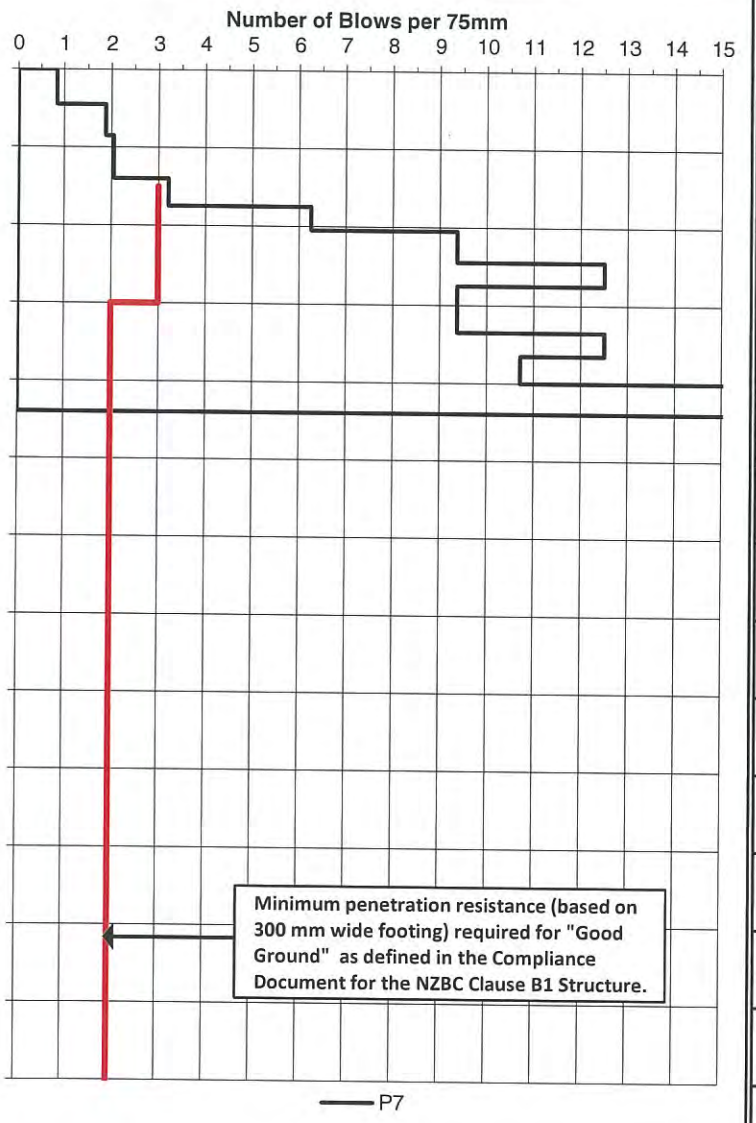
D.P	
Lot	
Technical Category	N/A - Rural

SITE INVESTIGATION RECORD

Client Peter Harris

Site 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

(Test Pit @ 7)

DEPTH [m]	
GL	Dark brown silty TOPSOIL, moist
0.2	
0.4	Brown Silt, moist
0.6	Brown silty sandy GRAVEL, moist, stones < 50mmØ
0.8	Brown sandy GRAVEL, moist, stones < 50mmØ
1.0	
1.2	Greyish brown sandy GRAVEL, moist/wet, stones < 50mmØ
1.4	Brown sandy GRAVEL, moist/wet, stones < 50mmØ
1.6	STOP
1.8	
2.0	
2.2	
2.4	
2.6	
2.8	
3.0	
3.2	
3.4	

SITE PLAN *(Not to Scale)*

COMMENTS

Civil Engineer J. Aramowicz **Date:** Sep 2013

Eliot Sinclair
surveyors | engineers | planners

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Job Number: 348678
Date Tested: 11-Sep-2013

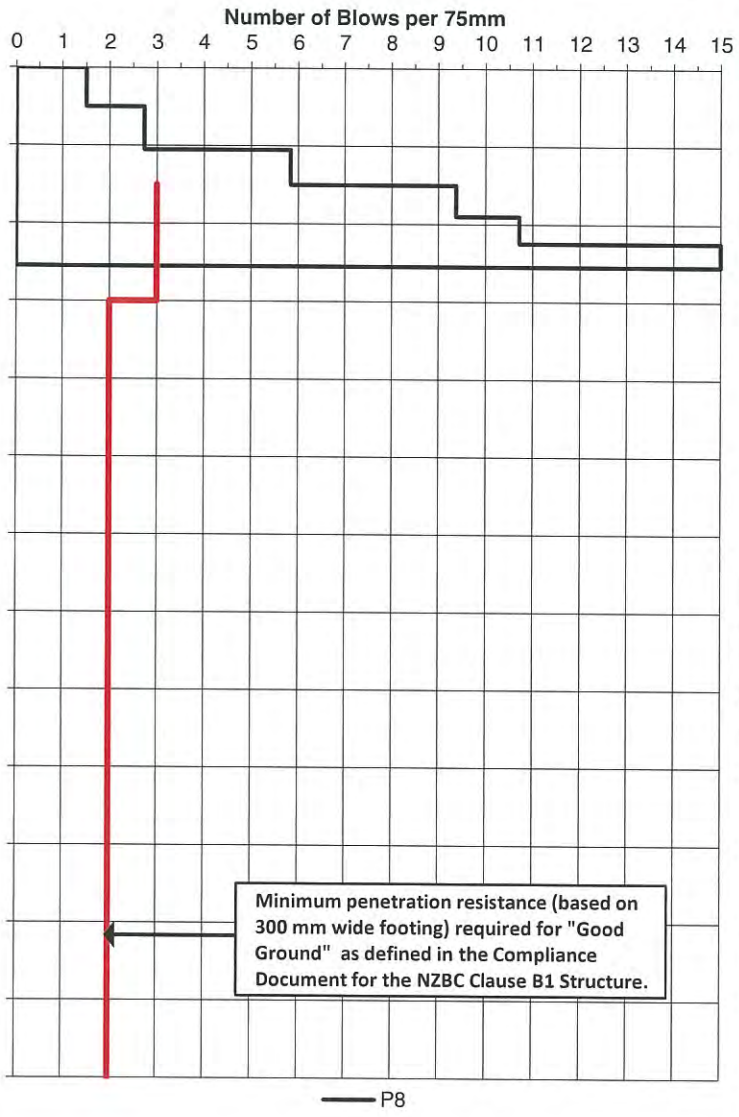
D.P
Lot
Technical Category: N/A - Rural

SITE INVESTIGATION RECORD

Client: Peter Harris

Site: 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



SITE PLAN (Not to Scale)

BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

DEPTH [m]	(Test Pit @ 8)
GL	
0.2	Dark brown silty TOPSOIL, moist, some stones
0.4	
0.6	Brown silty GRAVEL, moist, stones < 50mmØ
0.8	
1.0	Greyish brown sandy GRAVEL, moist, stones < 50mmØ
1.2	
1.4	Greyish brown sandy GRAVEL, moist, stones < 50mmØ, some cobbles
1.6	
1.8	
2.0	Grey sandy GRAVEL, moist/wet, stones < 50mmØ, some cobbles
2.2	
2.4	STOP
2.6	
2.8	
3.0	
3.2	
3.4	

COMMENTS

J. Mamouney
Civil Engineer

Date: Sep 2013

Eliot Sinclair
surveyors | engineers | planners

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Ph. (03) 379-4014 Fax. (03) 365-2449

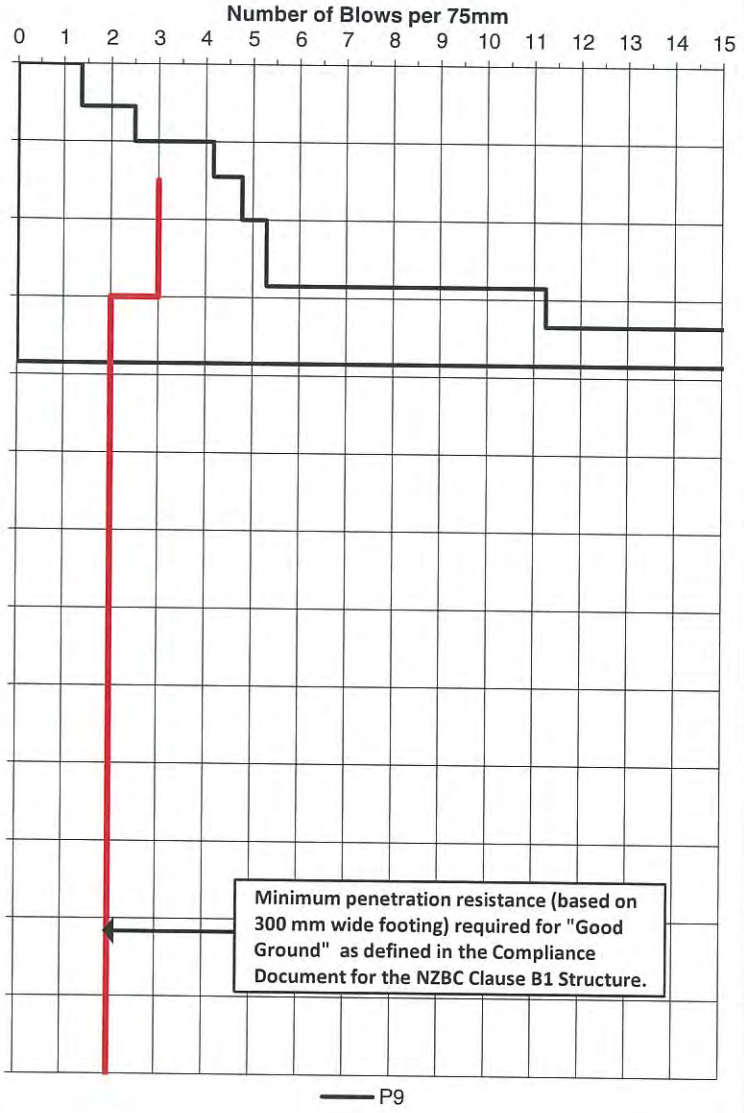
Job Number	348678
Date Tested	11-Sep-2013
Page	9 of 10
D.P	
Lot	
Technical Category	N/A - Rural

SITE INVESTIGATION RECORD

Client Peter Harris

Site 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



SITE PLAN (Not to Scale)

BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

DEPTH [m]	(Test Pit @ 9)
GL	
0.2	Dark brown silty TOPSOIL, moist, some stones, fine rootlets
0.4	
0.6	Brown silty GRAVEL, moist, stones < 50mmØ , fine rootlets
0.8	
1.0	Brown sandy GRAVEL, moist, stones < 50mmØ, somes cobbles, very compact
1.2	
1.4	
1.6	
1.8	Grey sandy GRAVEL, moist/wet, stones < 50mmØ , some fine gravel
2.0	
2.2	
2.4	STOP
2.6	
2.8	
3.0	
3.2	
3.4	

COMMENTS

Civil Engineer J. Chamorro **Date:** Sep 2013

Eliot Sinclair
surveyors | engineers | planners

20 Troup Drive, Tower Junction
PO Box 9339, Christchurch 8149
Ph. (03) 379-4014 Fax. (03) 365-2449

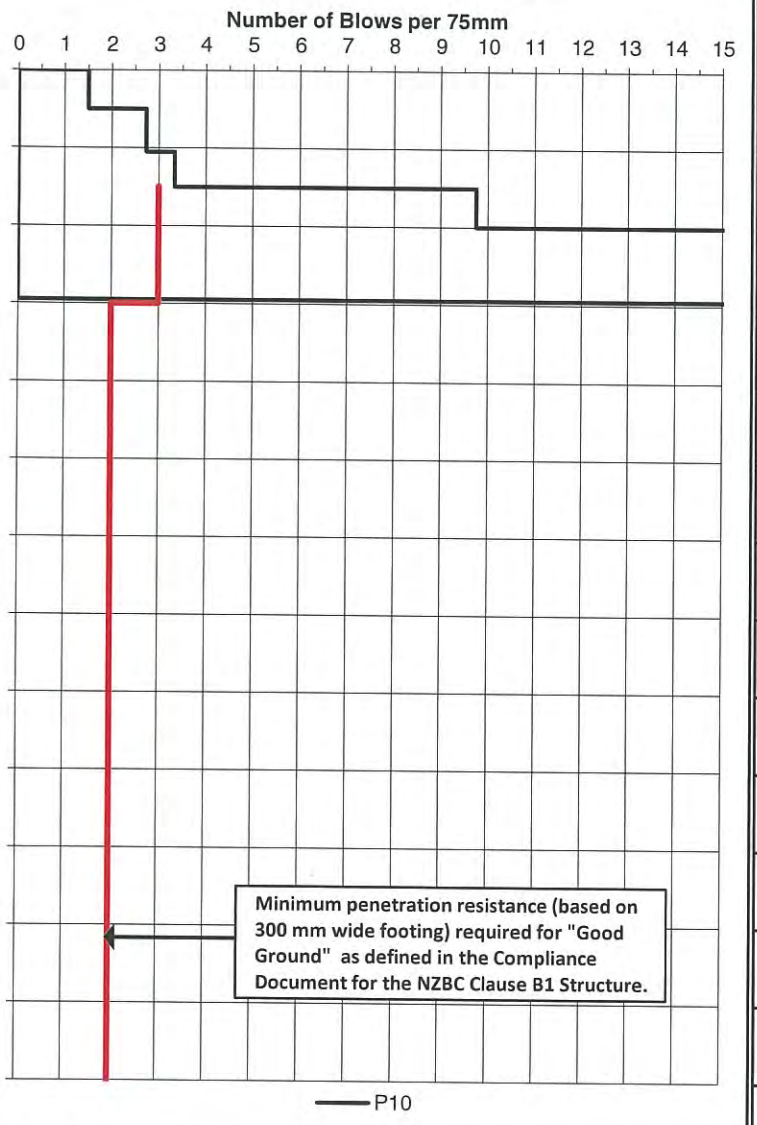
Job Number	348678
Date Tested	11-Sep-2013
Page	10 of 10
D.P	
Lot	
Technical Category	N/A - Rural

SITE INVESTIGATION RECORD

Client Peter Harris

Site 116 & 148 McHughs Road, Manderville

SCALA PENETROMETER TESTS



SITE PLAN *(Not to Scale)*

BORE LOGS

Hand Auger ☐ Machine Auger ☐ Test Pit ☒

DEPTH [m]	(Test Pit @ 10)
GL	Dark brown silty TOPSOIL, some stones
0.2	
0.4	Brown silty GRAVEL, moist, stones < 50mmØ
0.6	
0.8	
1.0	Brown sandy GRAVEL, moist, stones < 50mmØ
1.2	
1.4	Light brown SAND, moist/wet
1.6	Grey sandy GRAVEL, moist, stones < 50mmØ STOP
1.8	
2.0	
2.2	
2.4	
2.6	
2.8	
3.0	
3.2	
3.4	

COMMENTS

Civil Engineer J. Aramowicz **Date:** Sep 2013

Paul Thompson

From:	John Aramowicz
Sent:	Friday, 13 June 2014 5:57 p.m.
To:	Paul Thompson
Subject:	FW: [#348678] 116 and 148 McHughs Rd, Mandeville - groundwater
12d Synergy Job:	348678
12d Synergy Project:	348678
12dSynergySendGUID:	cd3367d6-20be-48ce-90aa-ea4f70036bd6

Paul,

1. Introduction

I understand the risk of groundwater resurgence (sometimes known as undercurrents) may need to be addressed for the above site.

2. History

I note from my previous investigations for another property in Mandeville, near the corner of No 10 and Tram Roads, that historic records from existing wells indicate that groundwater can periodically rise close to the ground surface and in some cases can discharge as a temporary spring. This appears to be the result of temporary increases in flow in the Waimakariri or Ashley Rivers, and is unlikely to result in a persistent long-term issue.

The above average rainfall of early 2014 has resulted in elevated flows of the nearby rivers and groundwater levels, and is now causing 'groundwater resurgence' to nearby areas. Photographs provided to Eliot Sinclair on 13 June 2014 show that groundwater has risen to within a metre or so of the surrounding ground surface, and is now discharging as a shallow overland flow across the eastern corner of the site.

3. Regional Policy Statement

Policy 11.3.2 of Environment Canterbury's Regional Policy Statement (2013) recommends any new subdivision, use or development be avoided unless there is no increased risk to life, and will not suffer material damage in an inundation event, unless buildings can be constructed with an appropriate floor level above the 0.5% AEP design flood event.

4. Risk at this site

In my view, there is a small risk predominantly to Lot 1 that ' groundwater resurgence' could result in shallow ground saturation under building foundations, but this is unlikely to result in bearing capacity failure. There is also a small risk of inundation.

However, where building foundations are subject to specific engineering design and minimum floor levels are specified to be constructed above the 200 year ARI flood level, I am satisfied that these risks will be effectively mitigated by default. As usual in rural areas, it would be prudent to locate building foundations on higher ground to avoid risk of inundation, and to maximise the separation distance to groundwater.

There is a much higher risk of material damage and inundation due to surface stormwater runoff from heavy rainfall than there is from infrequent groundwater resurgence.

I also note that disposal of roof and driveway stormwater to ground during periods of groundwater resurgence is unlikely to be practical, resulting in overland flow to surrounding land. However, rainfall runoff on bare land in similar circumstances would also result in the same surface runoff, as infiltration into the ground would not occur. Therefore, formation of roof and driveway surface is likely to have a neutral effect during periods of 'groundwater resurgence', and will not increase the risk of inundation to surrounding land compared to that of bare land.

I trust this answers any questions you may have had about this issue.

Kind regards

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Appendix E:

Site Investigation Assessment

Please note that as this assessment was finalised before 4 February 2016 and as such refers to the legal descriptions and post addresses for the subject site that were in existence at that time.

GROUND CONTAMINATION ASSESSMENT

116/148 McHughs Road, Mandeville, Canterbury

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348678/**January 2014**