ENGEO

Expect Excellence

Geotechnical Investigation

700 Selwyn Road

Springston

Canterbury

Submitted to:

Hughes Developements Ltd.

Canterbury

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08.05.2018
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ACENZ

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ENGEO Document Control:

Report Title	Geotechnical Investigation - 700 Selwyn Road, Springston			
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Client	Hughes Developements Ltd.	Client Contact	Kelvin Black	
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1 Introduction

ENGEO Ltd was requested by Hughes Development Ltd to undertake a geotechnical investigation of the property at 700 Selwyn Road, Springston, as outlined in our variation proposal (ref. P2016.000.248).

The purpose of the assessment was to determine a geological model of the site; assess the likely future land performance; comment on the suitability of the site for residential subdivision; address the requirements of Section 106 of the Resource Management Act (RMA); and provide recommendations for subdivision works and foundations for typical timber framed residential dwellings.

Our scope of works included the following:

- Complete a desktop study of relevant available geotechnical and geological publications, including the NZ Geotechnical and Environment Canterbury Databases.
- Undertake a geotechnical site walkover.
- Undertake five hand auger boreholes with associated Scala penetrometer tests to assess the near surface material types and strength characteristics.
- Organise and technically supervise the excavation of six test pits, including geotechnical logging of the exposed soils.
- Preparation of this report outlining our findings on the ground conditions and the suitability of the site for residential subdivision. This will include geotechnical advice on the likely foundation Technical Category, conceptual foundation recommendations for typical timber framed residential dwellings, and address likely geohazards as required by Section 106 of the RMA.

2 Site Description

The site covers a total area of 4 ha, and has the legal description of 700 Selwyn Road – Lot 1 DP 341771 (Selwyn District Council). It is understood that the site is proposed to be subdivided into residential lots.

It is located approximately 3.6 km southeast of Rolleston town centre, and is bound to the southeast by Selwyn Road and by rural properties on all remaining sides (Figure 1).

Figure 1: Site Location

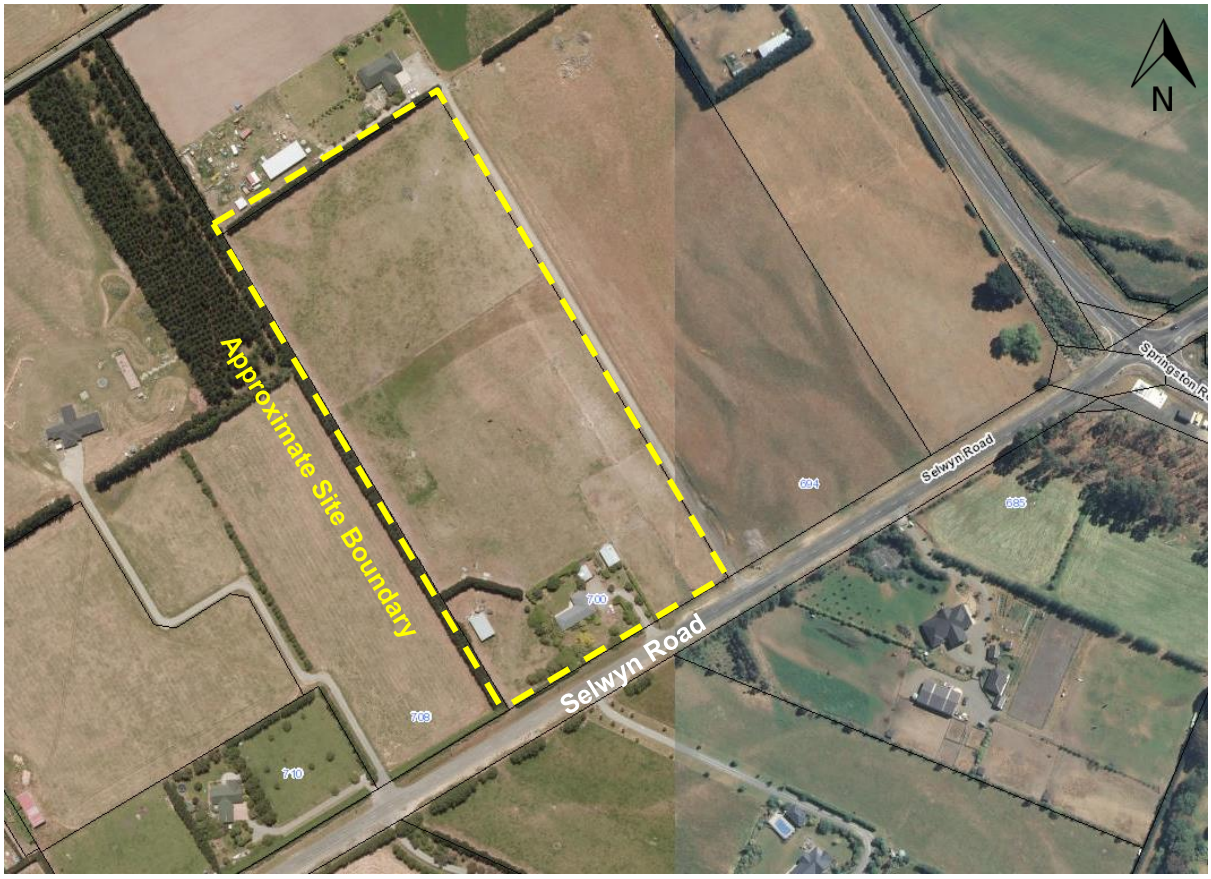

Image sourced from Canterbury Maps

The predominantly flat site is currently agricultural land and occupied by a residential dwelling with associated gardens and lawn areas, and a number of barn and shed structures.

There are no significant watercourses in the area and the site is outside of any ECan defined flood zones as indicated in the Selwyn District Council (SDC Operative District Plan (SDC, 2015).

The Canterbury Earthquake Recovery Authority (CERA, now disestablished) has categorised the site as 'N/A Rural & Unmapped', meaning future development can proceed following normal consenting processes.

3 Geological Model

3.1 Regional Geology

The site has been regionally mapped by GNS (Forsyth et al., 2008) as being underlain by grey river alluvium.

3.2 Geomorphology

The site comprises relatively flat ground, with gentle undulations and depressions in some areas. These were observed during our site walkover conducted on 20 April 2018, undulating and depressed ground can be attributed to paleo-channels, which traverse the site in a general northwest to southeast trend. Based on observations, silt and sand deposits with variable thickness (up to 0.6 m) are expected to have in filled the paleo channels where they have not remained as channel features. Paleo channels could not be accurately mapped from historical aerial photography in this location, due to agricultural developments obscuring the view of potential channels in all observed photos. However, paleo-channels are visible in the area surrounding the site, and it can be assumed that paleo-channels pass through the subject property.

3.3 Geohazards

3.3.1 Seismicity

There are no known or mapped faults in the immediate area of the site, however the site may be at risk of ground shaking induced by movement of proximal or distal faults.

The site is located between two recently discovered fault systems, the Greendale Fault and the Port Hills Fault, the ruptures of which initiated the ongoing Canterbury Earthquake Sequence (CES). The Greendale Fault has been mapped approximately 5 km northwest / west of the site and trends roughly east-west with a surface rupture of approximately 28 km (GNS, 2015), while the Port Hills Fault remains unmapped as the fault did not rupture at the surface. Movement on the Port Hills Fault is believed to have occurred at a depth of 1 km to 2 km below ground surface.

Large regional areas of faulting (GNS, 2015) namely the Ashley Fault, Porters Pass-Amberley Fault Zone, and the Hope and Alpine Faults, are further afield but present a high seismic hazard to the Christchurch area due to the anticipated size of earthquakes generated. The largest of these faults is the Alpine Fault, which has a return period of 250-300 years and is expected to produce a M8 earthquake. The last rupture on the Alpine Fault is believed to have occurred in 1717 (Pettinga et al., 2001).

3.3.2 Liquefaction and Lateral Spreading

The site is located within an area mapped as ‘damage due to liquefaction unlikely’ (NZGD Map CGD5140, 2012).

3.4 Site Investigation

Site investigations to assess the shallow subsurface material types and strength characteristics were undertaken by ENGEO on 20 April 2018. The investigations comprised five hand auger boreholes and six test pit investigations with associated Scala penetrometer tests.

Topsoil depths were recorded in the subsurface tests completed at site, which we believe are indicative of the site topsoil balance across the site. It should be noted that the hand auger topsoil depths are less accurate than the test pit topsoil depths as gravel depth is inferred due to the grainsize limitations of hand auger borehole testing.

The investigations revealed subsurface conditions across the site are consistent with the published geological mapping, as summarised in Table 1.

Table 1: Generalised Summary of Subsurface Conditions

Soil Type	Depth to Top of Layer (m)	Layer Thickness	Density/ Consistency	Comment
TOPSOIL	0.0	0.1 to 0.4	Stiff	-
SILT	0.2 to 0.4	0.1 to 0.3	Stiff to Hard	Not encountered in all test locations
Sandy GRAVEL and GRAVEL	0.2 to 0.6	Unknown	Very Dense	-

"Good ground" (as defined in NZS 3604:2010) under static conditions was typically encountered immediately beneath the topsoil layer (typically 0.3 m) and at a maximum depth of 0.4 m below ground level.

Test pit and hand auger hole logs, showing detailed soil descriptions are presented in Appendix 1. Test locations are presented in Appendix 2.

3.5 ECan Boreholes

A review of four deep ECan borehole logs, located 200 m southwest (4553), 150 m north (7928), 180 m north east (1683), 260 m south east (8334). A borehole well has also been completed within the site boundary, at the southeastern end (4398). The location of these boreholes is presented in Figure 2 and includes the well points on site that have no log data available. The logs from the four boreholes of interest are presented in Appendix 3 and indicate the site is broadly underlain by a mixture of sandy gravels to depths of at least 48 m below ground level.

Figure 2: ECan Borehole Locations

Image sourced from Canterbury Maps.

3.6 Groundwater

Groundwater is recorded in the surrounding boreholes between approximately 5.8 m and 8.2 m depth.

3.7 Site Seismic Class

In accordance with NZS 1170.5:2004, Class D applies to this particular site, defining it as a 'deep soft soil site'.

4 Liquefaction Assessment

Based on our site investigation and observations, and owing to the nature of the subsurface materials and depth to groundwater at the site, we consider the potential for liquefaction and lateral spreading on the site to be very low.

We therefore consider the site of the proposed subdivision to have Technical Category 1 (TC1) future land performance whereby future land damage from liquefaction unlikely, and ground settlements are expected to be within normally accepted tolerances.

5 RMA Section 106 Requirements and Suitability to Subdivide

Section 106 of the Resource Management Act 1991 states a consent authority may refuse to grant a subdivision consent, or may grant a consent subject to specific consent conditions if the land is likely to be subject to the following:

- Erosion, including surface and subsurface erosion, associated with water and wind.
- Falling debris, including rockfall that could impact the site from upslope sources.
- Subsidence, which involves the removal of underlying support by natural or artificial means.
- Slippage, which is defined as the downslope transfer of materials by sliding and / or flowage.
- Inundation, which may be sourced from streams, coastal processes or excess precipitation.

Based on our observations and the nature of the site, its performance during the CES, and the site's distance from the nearest significant watercourse, we consider it is unlikely for the site to be subject to any of the above hazards and, as such, the site is considered suitable for subdivision from a geotechnical perspective.

6 Geotechnical Recommendations

6.1 Earthworks

Earthworks carried out for the subdivision shall be in accordance with NZS 4404:2010, Land Development and Subdivision Infrastructure and NZS 4431:1989, Code of Practice for Earthfilling for Residential Development. In particular, any areas to receive fill should be stripped of any vegetation, topsoil, non-engineered fill, soft or organic soils prior to fill placement.

Fill may comprise clean natural sandy gravel or silty soils, or clean imported soils and / or granular fill, compacted to achieve no less than 95% of maximum dry density. Fill faces steeper than 1V:2H and higher than 600 mm should be retained and referred back to ENGEO. Although unlikely, where any springs or groundwater seeps are encountered they should be intercepted with suitable drainage and discharged to a Council approved outlet.

All unretained batters of pond and stormwater drains constructed with the native sandy gravel material should be at an inclination of 1V:3H, with protection schemes in place to control erosion of the formed batters within the waterways.

A comprehensive earthworks specification should be provided to the earthworks contractor prior to starting excavations and an inspection / testing regime agreed, along with a robust erosion and sediment control plan.

6.2 Subdivision Roading

Vegetation, any organic or deleterious material, topsoil and non-engineered fill should be removed from the site under pavement areas prior to aggregate placement. Based on our observations during testing, we consider the natural ground below the topsoil at the site should provide an adequate subgrade for the proposed pavement areas.

6.3 Stormwater Control

Concentrated stormwater flows from all impermeable areas must be collected and carried in sealed pipes to the Council system or an alternative disposal point subject to approval from Council. Uncontrolled stormwater must not be allowed to saturate the ground as this will potentially affect future foundation performance both statically and during future seismic activity.

6.4 Foundations

Foundations for future proposed residential dwellings within the subdivision may comprise pad, strip or slab foundations designed in accordance with the provisions of NZS 3604 Timber Framed Buildings.

Site specific testing will be required for Building Consent, to confirm the bearing materials and capacity. For preliminary design, we anticipate that a geotechnical Ultimate Bearing Capacity of 300 kPa may be assumed for foundations bearing on natural silt, sandy gravel or engineered fill, below any topsoil. We anticipate this to be typically below 0.4 m depth based on our subsurface investigations.

6.5 Additional Works

Future geotechnical work at the site will include a detailed subsurface exploration to support design of all earthwork and development concepts, including specific foundation recommendations appropriate for the proposed structures. Subject to the proposed development concept and timeline, this exploration can be tailored to inform the earthworks design, and to support building consent applications to the Selwyn District Council.

7 References

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We also acknowledge the New Zealand GeoNet project and its sponsors EQC, GNS Science and LINZ, for providing data used in this report.

8 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Hughes Developements Ltd., their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineers NZ / ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by

Hugh Brenstrum

Field Representative

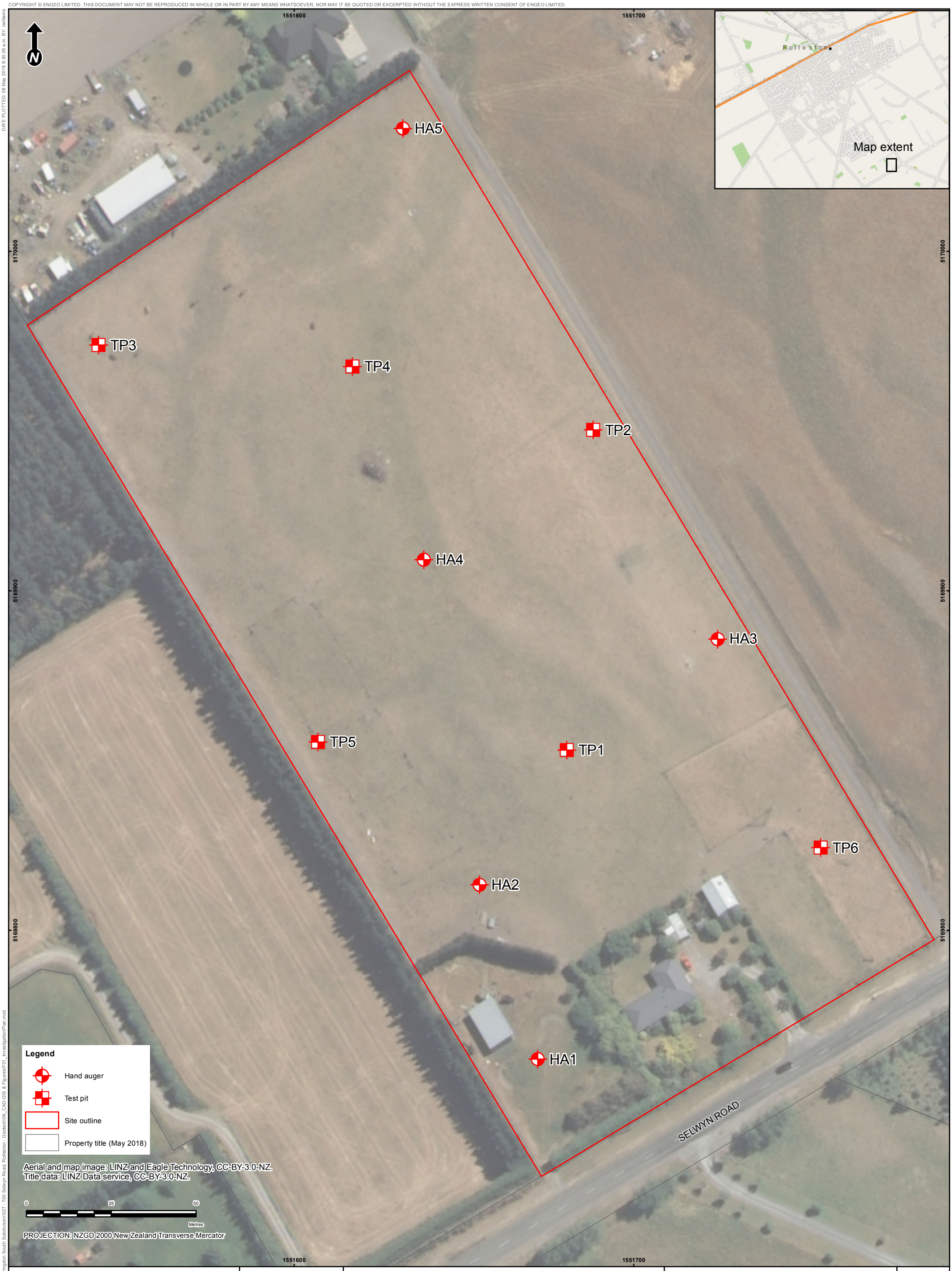
Report reviewed by

Greg Martin, CMEngNZ (PEngGeol)

Principal Engineering Geologist

APPENDIX 1:

Site Plan and Test Locations



ENGEO Expect Excellence

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Tel: 03 328 9012
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Title: Investigation Location Plan

Client: HUGHES DEVELOPMENTS LIMITED

Project: 700 Selwyn Road Geotechnical Investigation

Proj No: 12903.000.000/27

Designed: HB
Drawn: RW
Checked: GM
Date: May 18

Scale: 1:1,000

Figure No: 1

Size: A3

Revision: A

APPENDIX 2:

Test Pit and Hand Auger Logs

LOG OF TEST PIT TP01

Geotechnical Investigation

700 Selwyn Road
Springston
12903.000.000_27

Client : Hughes Developements Ltd
Date : 20/4/18
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 500 mm
Shear Vane No :
Logged By : HB
Reviewed By : JW
Latitude : -43.622882
Longitude : 172.401208

Depth (m)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0.0	TOPSOIL		ML	SILT with minor fine sand, trace gravel and rootlets; brown. Low plasticity [TOPSOIL].				St		
0.5	ALLUVIUM		GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to coarse.			M	D - VD		>>
1.0										
1.5										
2.0				Depth of Excavation: 2 m Termination Condition: Target depth						
2.5										
3.0										

Excavator met taget depth. at 2 m.
Scala Penetrometer met practical refusal at 0.7 m depth.
Standing groundwater was not encountered

GEOSCIENCE TEST PIT LOG - PHOTOS TEST PIT LOGS - 700 SELWYN ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 7-5-18

LOG OF TEST PIT TP02

Geotechnical Investigation

700 Selwyn Road
Springston
12903.000.000_27

Client : Hughes Developements Ltd
Date : 20/4/18
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 500 mm
Shear Vane No :
Logged By : HB
Reviewed By : JW
Latitude : -43.622006
Longitude : 172.401351

Depth (m)	Material	Excavatability (Relative Scale) Easier / Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0.0	TOPSOIL		ML	SILT with minor fine sand, trace gravel and rootlets; brown. Low plasticity [TOPSOIL].				St		
0.5	ALLUVIUM		GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to coarse. Trace cobbles encountered from 0.9 m depth.			M	D - VD		>>
1.0										
1.5										
2.0				Depth of Excavation: 2 m Termination Condition: Target depth						
2.5										
3.0										

Excavator met taget depth. at 2 m.
Scala Penetrometer met practical refusal at 0.7 m depth.
Standing groundwater was not encountered

GEOSCIENCE TEST PIT LOG - PHOTOS TEST PIT LOGS - 700 SELWYN ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 7-5-18

LOG OF TEST PIT TP03

Geotechnical Investigation

700 Selwyn Road
Springston
12903.000.000_27

Client : Hughes Developements Ltd
Date : 20/4/18
Max Test Pit Depth : 2.1 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 500 mm
Shear Vane No :
Logged By : HB
Reviewed By : JW
Latitude : -43.621702
Longitude : 172.399385

Depth (m)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0.0	TS		ML	SILT with some fine sand and trace rootlets; brown. Low plasticity [TOPSOIL].				St - VSt		
0.3	ALLUVIUM		GM	Silty fine to coarse GRAVEL with some fine sand; light brown. Well graded, rounded to sub-rounded.				D		
0.5			GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.			M	VD		
1.5				Becomes wet from 1.5 m depth.			W			
2.0				Depth of Excavation: 2.1 m Termination Condition: Target depth						
3.0										

Excavator met taget depth. at 2.1 m.
Scala Penetrometer met practical refusal at 0.4 m depth.
Standing groundwater was not encountered

TS=TOPSOIL

GEOSCIENCE TEST PIT LOG - PHOTOS TEST PIT LOGS - 700 SELWYN ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 7-5-18

LOG OF TEST PIT TP04

Geotechnical Investigation

700 Selwyn Road
Springston
12903.000.000_27

Client	: Hughes Developements Ltd	**Shear Vane No**	:
Date	: 20/4/18	**Logged By**	: HB
Max Test Pit Depth	: 2.2 m	**Reviewed By**	: JW
Digger Type/Size	: Bucket Excavator	**Latitude**	: -43.621757
Bucket Type/Size	: 500 mm	**Longitude**	: 172.400284

Depth (m)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0	TS		ML	SILT with some fine sand and trace rootlets; brown. Low plasticity [TOPSOIL].				St		
0.5	ALLUVIUM		ML	SILT with some sand; light brown. Low plasticity. Sand, fine to medium.				VSt		
1.0			GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded, sub-angular to sub-rounded. Sand, fine to coarse, poorly graded.			M			
1.5				Minor cobbles encountered from 1.3 m depth.				VD		
2.0				Trace boulders encountered from 1.7 m depth.						
2.5				Depth of Excavation: 2.2 m Termination Condition: Target depth						
3.0										

Excavator met taget depth. at 2.2 m.
Scala Penetrometer met practical refusal at 0.9 m depth.
Standing groundwater was not encountered

TS=TOPSOIL

GEOSCIENCE TEST PIT LOG - PHOTOS TEST PIT LOGS - 700 SELWYN ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 7-5-18

LOG OF TEST PIT TP05

Geotechnical Investigation

700 Selwyn Road
Springston
12903.000.000_27

Client : Hughes Developements Ltd
Date : 20/4/18
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 500 mm
Shear Vane No :
Logged By : HB
Reviewed By : JW
Latitude : -43.622699
Longitude : 172.400141

Depth (m)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0.0	TS		SM	Sandy SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				F - St		
0.5	ALLUVIUM		GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to coarse.			M	D - VD		>>
1.0				Cobbles cease between 1.2 to 1.3 m depth.						
1.5				Cobbles become some from 1.5 m depth.						
2.0				Depth of Excavation: 2 m Termination Condition: Target depth						
2.5										
3.0										

Excavator met taget depth. at 2 m.
Scala Penetrometer met practical refusal at 0.7 m depth.
Standing groundwater was not encountered

TS=TOPSOIL

GEOSCIENCE TEST PIT LOG - PHOTOS TEST PIT LOGS - 700 SELWYN ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 7-5-18

LOG OF TEST PIT TP06

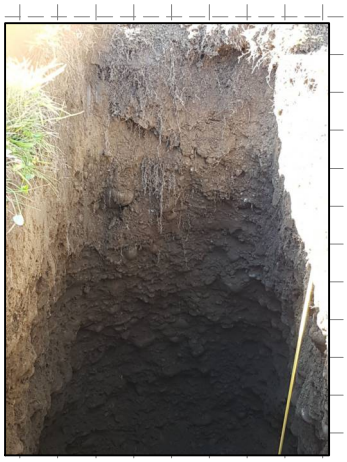
Geotechnical Investigation

700 Selwyn Road
Springston
12903.000.000_27

Client : Hughes Developements Ltd
Date : 20/4/18
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 500 mm
Shear Vane No :
Logged By : HB
Reviewed By : JW
Latitude : -43.623028
Longitude : 172.40204

Depth (m)	Material	Excavatability (Relative Scale) Easier / Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0.0	TS		ML	SILT with some fine sand and trace rootlets; brown. Low plasticity [TOPSOIL].				F - St		
0.3	ALLUVIUM		ML	SILT with some fine sand; light brown. Low plasticity.				F - St		
0.5			GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, sub-rounded. Sand, fine to coarse.			M	D - VD		
1.6				Becomes wet at 1.6 m depth			W			
1.8				Trace boulders encountered from 1.8 m depth.						
2.0				Depth of Excavation: 2 m Termination Condition: Target depth						
2.5										
3.0										

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12 >>



Excavator met taget depth. at 2 m.
Scala Penetrometer met practical refusal at 0.6 m depth.
Standing groundwater was not encountered

TS=TOPSOIL

GEOSCIENCE TEST PIT LOG - PHOTOS TEST PIT LOGS - 700 SELWYN ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 7-5-18

LOG OF AUGER HA01

Geotechnical Investigation
700 Selwyn Road
Springston, Canterbury
12903.000.000_27

Client : Hughes Developments
Client Ref. :
Date : 20/4/2018
Hole Depth : 0.5 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude : -43.623598
Longitude : 172.40097

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TOPSOIL	ML	SILT with minor fine sand, trace gravel and rootlets; brow. Low plasticity [TOPSOIL].			M	F - St	
	ALLUVIUM	ML	SILT with trace fine sand; brownish grey with orange mottles. Low plasticity.				H	
0.5			End of Hole Depth: 0.5 m Termination Condition: Practical refusal					
1.0								

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand auger met practical refusal at 0.5 m depth on inferred gravel.
Standing groundwater was not encountered

LOG OF AUGER HA02

Geotechnical Investigation
700 Selwyn Road
Springston, Canterbury
12903.000.000_27

Client : Hughes Developments
Client Ref. :
Date : 20/4/2018
Hole Depth : 0.4 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude : -43.623163
Longitude : 172.400725

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
0	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			M	St - VSt		
0.4			End of Hole Depth: 0.4 m Termination Condition: Practical refusal						
0.5									
1.0									

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12; >>

Hand auger met practical refusal at 0.4 m depth on inferred gravel.
Standing groundwater was not encountered

GEOSCIENCE HAND AUGER HAND AUGER LOGS - 700 SELWYN ROAD.GPJ NZ DATA TEMPLATE 2.GDT 7-5-18

LOG OF AUGER HA03

Geotechnical Investigation
700 Selwyn Road
Springston, Canterbury
12903.000.000_27

Client : Hughes Developments
Client Ref. :
Date : 20/4/2018
Hole Depth : 0.6 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude : -43.622513
Longitude : 172.401676

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TOPSOIL	ML	SILT with minor fine sand and trace gravel and rootlets; brown. Low plasticity [TOPSOIL].				F - St	
0.5	ALLUVIUM	ML	SILT with minor fine sand; brownish grey with orange mottles. Low plasticity.			M	St - VSt	
			End of Hole Depth: 0.6 m Termination Condition: Practical refusal					
1.0								

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand auger met practical refusal at 0.6 m depth on inferred gravel.
Standing groundwater was not encountered

LOG OF AUGER HA04

Geotechnical Investigation
700 Selwyn Road
Springston, Canterbury
12903.000.000_27

Client : Hughes Developments
Client Ref. :
Date : 20/4/2018
Hole Depth : 0.4 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude : -43.621118
Longitude : 172.400509

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
0	TOPSOIL	ML	SILT with some fine sand, trace gravel and rootlets; brown. Low plasticity [TOPSOIL].			M	VSt - H		
			End of Hole Depth: 0.4 m Termination Condition: Practical refusal						
0.5									
1.0									

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12; >>

Hand auger met practical refusal at 0.4 m depth on inferred gravel.
Standing groundwater was not encountered

LOG OF AUGER HA05

Geotechnical Investigation
700 Selwyn Road
Springston, Canterbury
12903.000.000_27

Client : Hughes Developments
Client Ref. :
Date : 20/4/2018
Hole Depth : 0.4 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude : -43.622217
Longitude : 172.400626

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
	TOPSOIL	ML	SILT with minor fine sand and trace rootlets; brown. Low plasticity [TOPSOIL].				F		
	ALLUVIUM	ML	SILT with trace fine sand; greyish brown with orange mottles. Low plasticity.			M	St - VSt		>>
			End of Hole Depth: 0.4 m Termination Condition: Practical refusal						
0.5									
1.0									

Hand auger met practical refusal at 0.4 m depth on inferred gravel.
Standing groundwater was not encountered

APPENDIX 3:

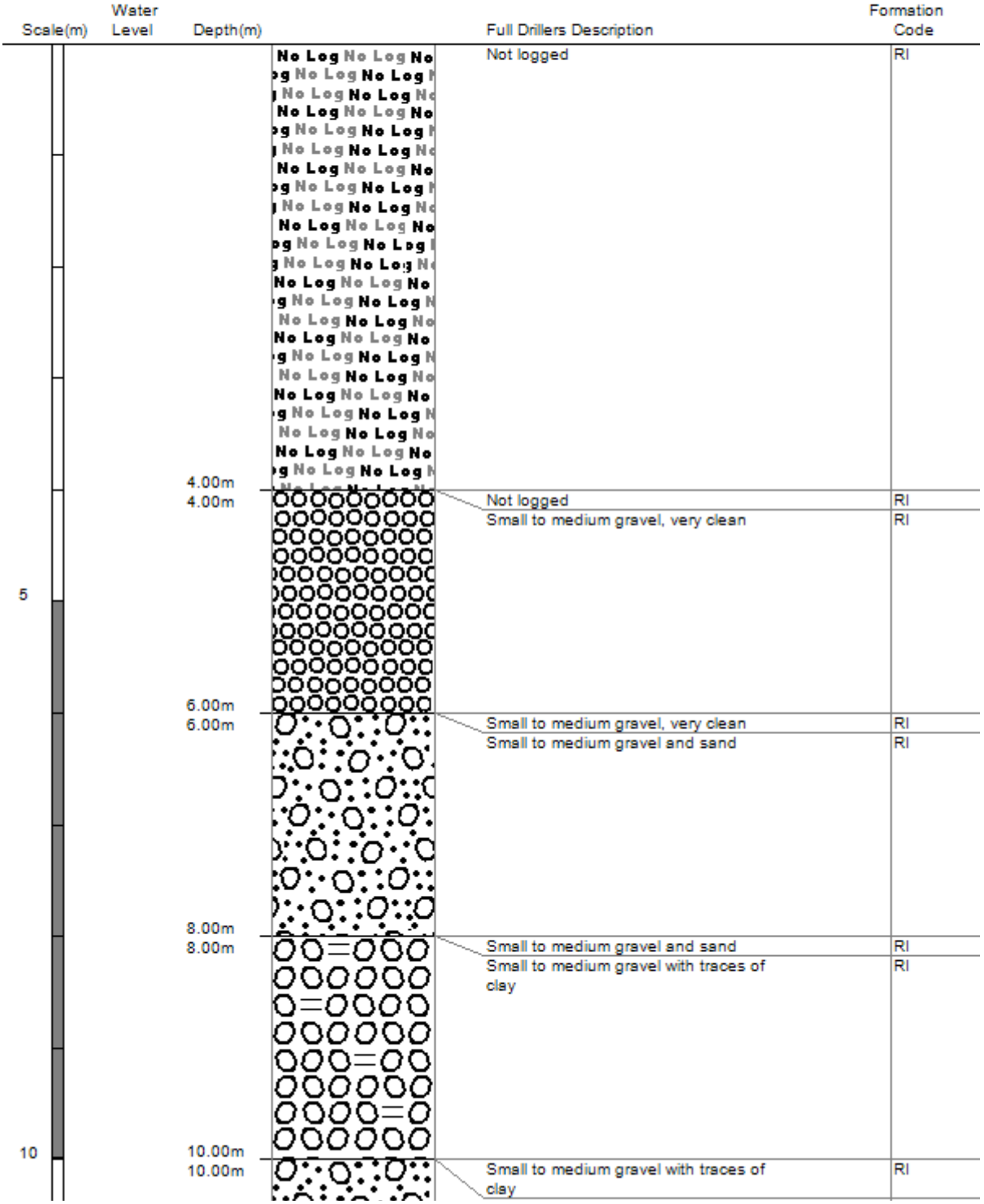
ECan Well Logs

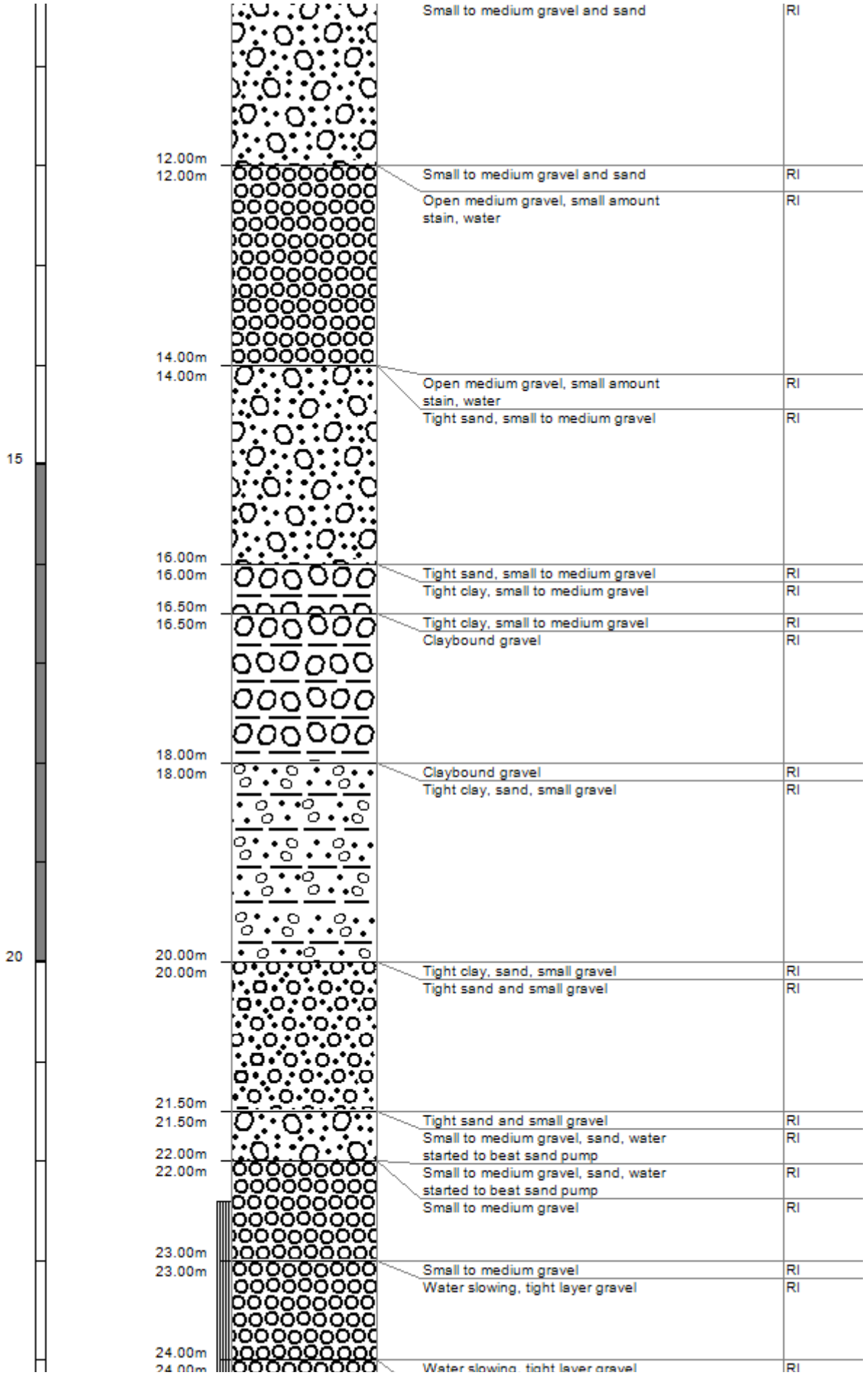
Bore Log

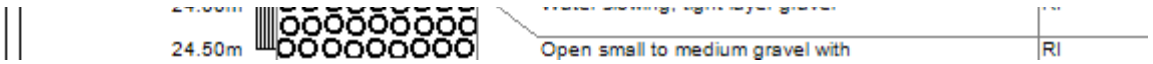
Borelog for well M36/4398

Grid Reference (NZTM): 1551707 mE, 5169821 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 33.7 m +MSD Accuracy: < 0.5 m
Driller: Dynes Road Drilling
Drill Method: Cable Tool
Borelog Depth: 24.5 m Drill Date: 01-Oct-1991

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha




15
20
Small to medium gravel and sand RI
12.00m
12.00m
Small to medium gravel and sand RI
Open medium gravel, small amount stain, water RI
14.00m
14.00m
Open medium gravel, small amount stain, water RI
Tight sand, small to medium gravel RI
16.00m
16.00m
Tight sand, small to medium gravel RI
Tight clay, small to medium gravel RI
16.50m
16.50m
Tight clay, small to medium gravel RI
Claybound gravel RI
18.00m
18.00m
Claybound gravel RI
Tight clay, sand, small gravel RI
20.00m
20.00m
Tight clay, sand, small gravel RI
Tight sand and small gravel RI
21.50m
21.50m
Tight sand and small gravel RI
Small to medium gravel, sand, water started to beat sand pump RI
22.00m
22.00m
Small to medium gravel, sand, water started to beat sand pump RI
Small to medium gravel RI
23.00m
23.00m
Small to medium gravel RI
Water slowing, tight layer gravel RI
24.00m
Water slowing, tight layer gravel RI

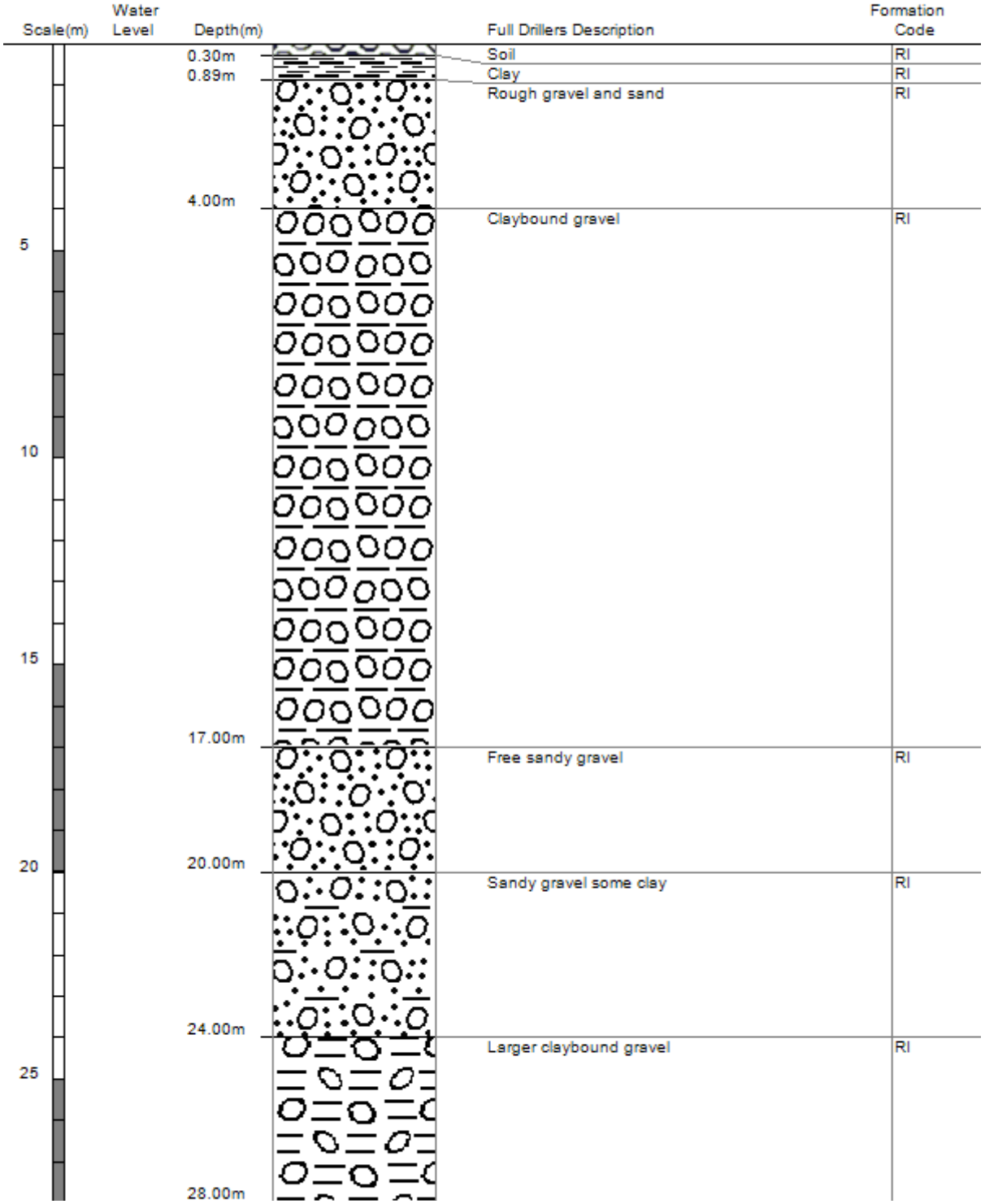

24.50m
Open small to medium gravel with
RI

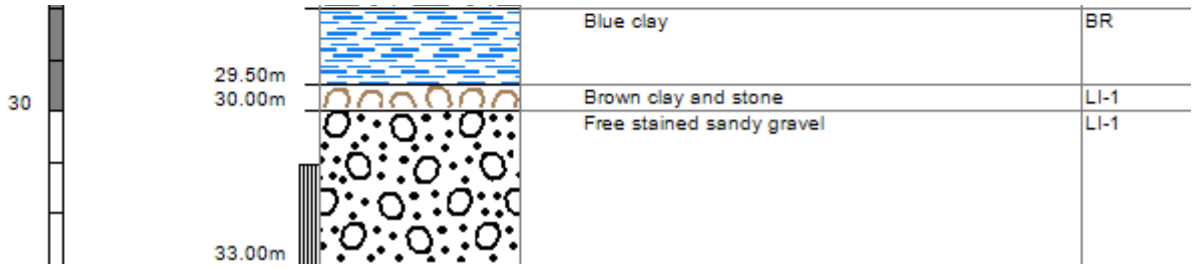
Bore Log

Borelog for well M36/4553

Grid Reference (NZTM): 1551477 mE, 5169781 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 35.2 m +MSD Accuracy: < 2.5 m
Driller: Smiths Welldrilling
Drill Method: Unknown
Borelog Depth: 33.0 m Drill Date: 01-Nov-1992

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha




30
29.50m
30.00m
33.00m
Blue clay
BR
Brown clay and stone
LI-1
Free stained sandy gravel
LI-1

Bore Log

Borelog for well M36/7928

Grid Reference (NZTM): 1551567 mE, 5170041 mN
Location Accuracy: 10 - 50m
Ground Level Altitude: 34.1 m +MSD Accuracy: < 0.5 m
Driller: Dynes Road Drilling
Drill Method: Cable Tool
Borelog Depth: 37.0 m Drill Date: 01-Jun-2005

Environment Canterbury Regional Council
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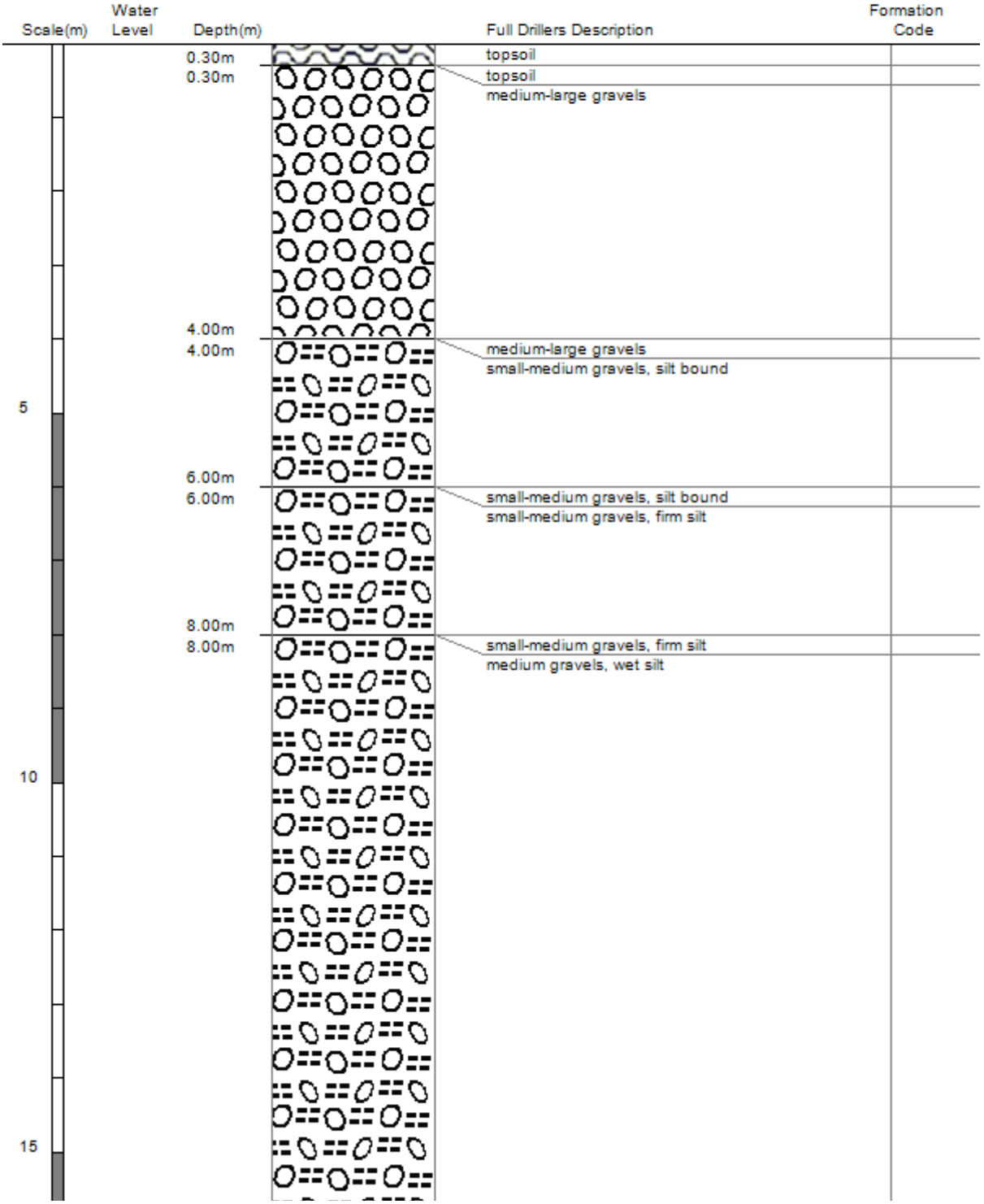
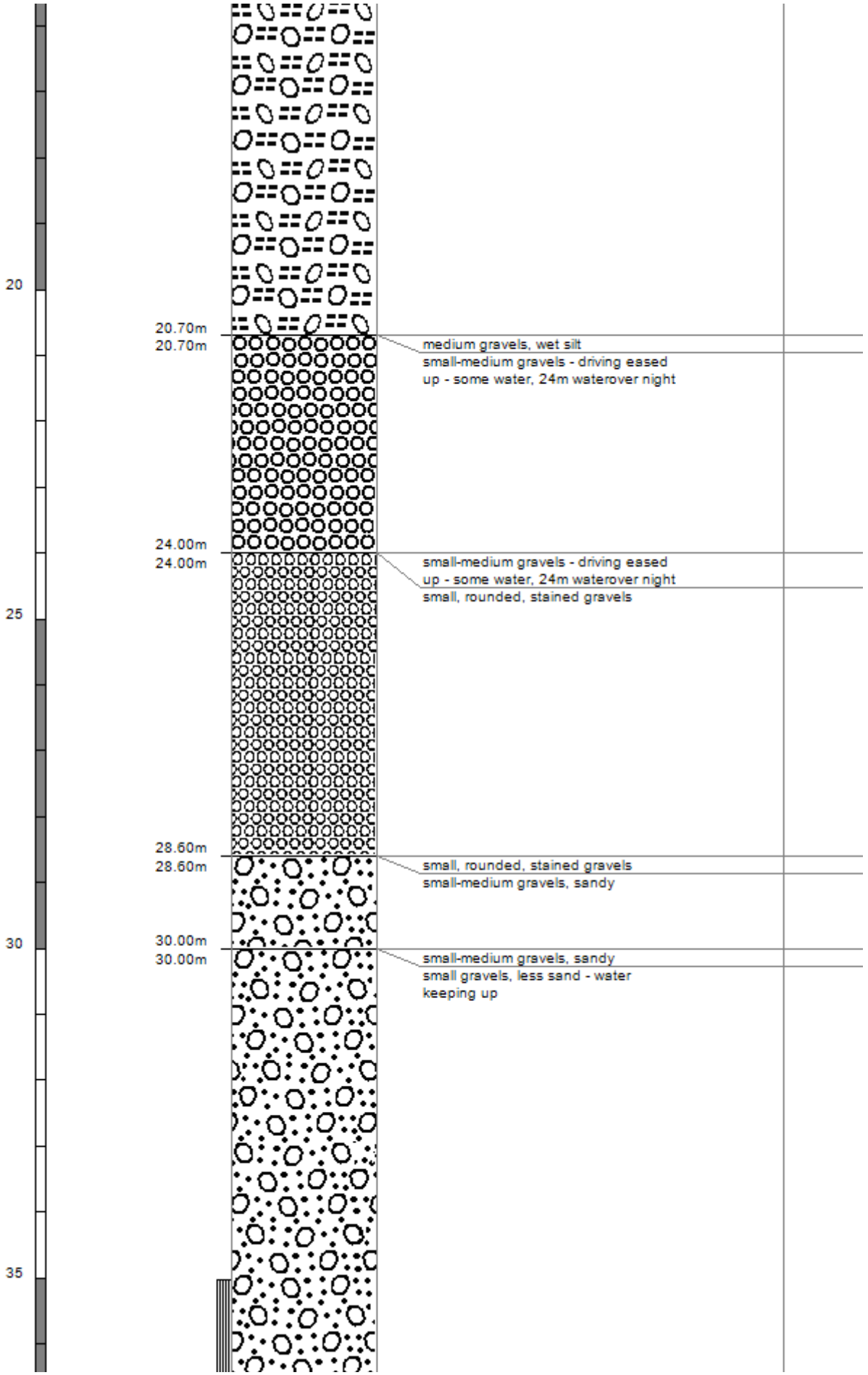



20
25
30
35
20.70m
20.70m
medium gravels, wet silt
small-medium gravels - driving eased up - some water, 24m waterover night
24.00m
24.00m
small-medium gravels - driving eased up - some water, 24m waterover night
small, rounded, stained gravels
28.60m
28.60m
small, rounded, stained gravels
small-medium gravels, sandy
30.00m
30.00m
small-medium gravels, sandy
small gravels, less sand - water keeping up

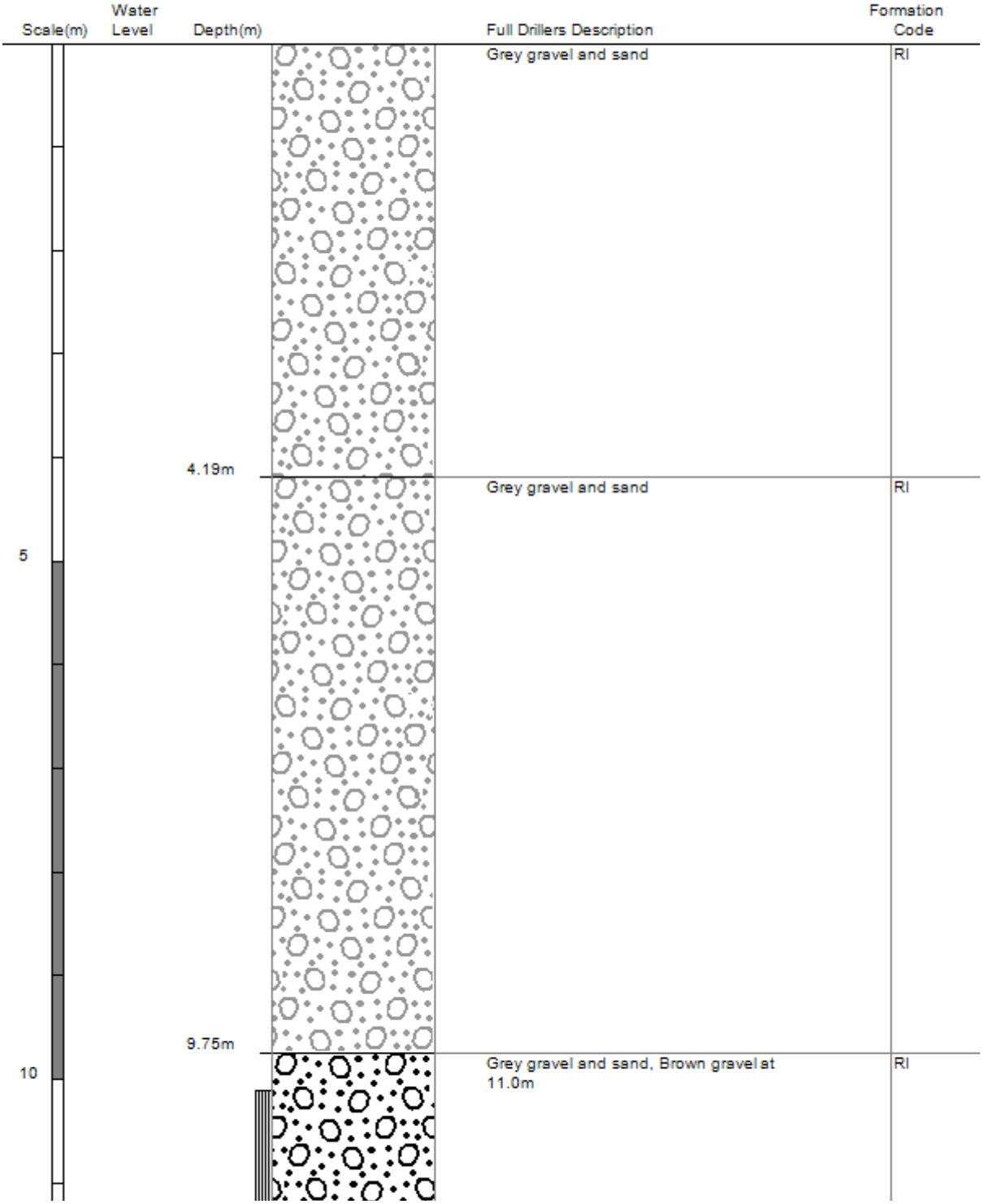

37.00m

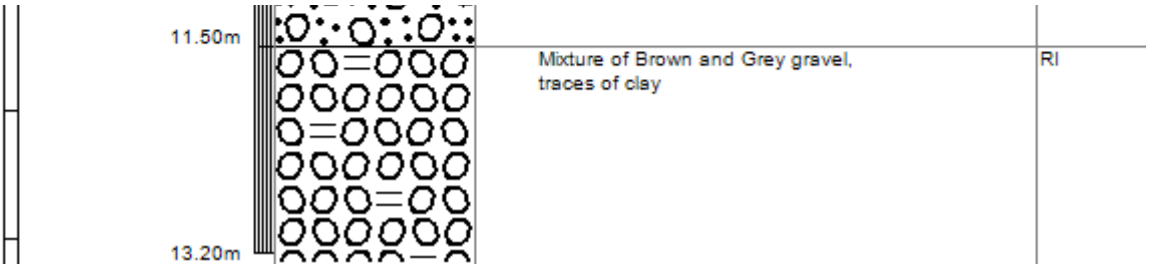
Bore Log

Borelog for well M36/1683

Grid Reference (NZTM): 1551807 mE, 5169991 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 34.8 m +MSD Accuracy: < 2.5 m
Driller: Smith, J R & I G
Drill Method: Unknown
Borelog Depth: 13.2 m Drill Date:

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha



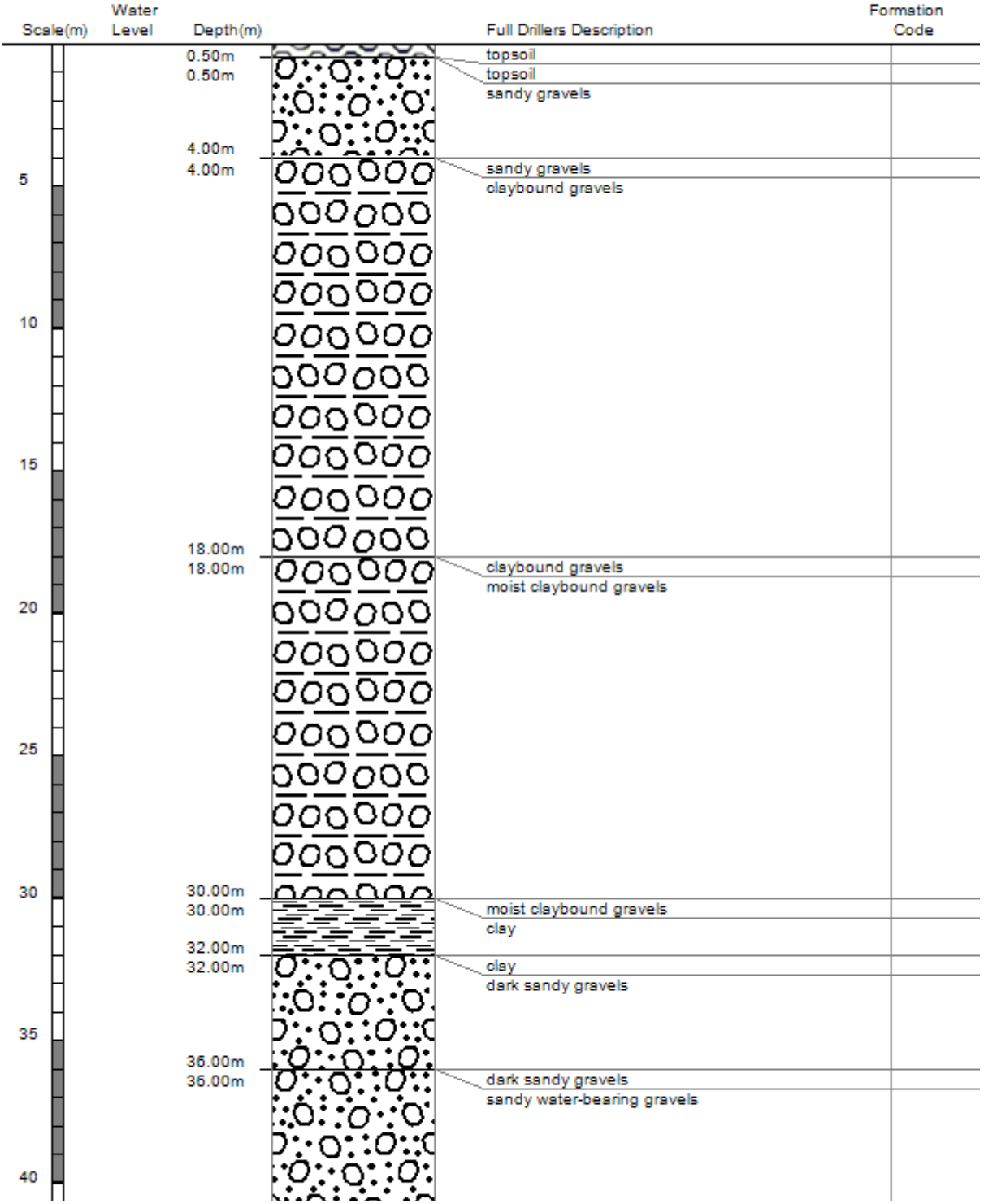

11.50m
13.20m
Mixture of Brown and Grey gravel, traces of clay
RI

Bore Log

Borelog for well M36/8334

Grid Reference (NZTM): 1551898 mE, 5169777 mN
Location Accuracy: 10 - 50m
Ground Level Altitude: 33.3 m +MSD Accuracy: < 0.5 m
Driller: East Coast Drilling
Drill Method: Rotary/Percussion
Borelog Depth: 48.0 m Drill Date: 13-Apr-2007

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha




45
48.00m