ENGEO

Expect Excellence

Geotechnical Investigation

3/144 Dunns Crossing Road

Rolleston

Christchurch

Submitted to:

Hughes Developments Ltd

Christchurch

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ENGEO Document Control:

Report Title	Geotechnical Investigation - 3/144 Dunns Crossing Road, Rolleston			
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Client	Hughes Developments Ltd	Client Contact	Kelvin Back	
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14/08/2020	Issued to Client	JT	JRW	GM

1 Introduction

ENGEO Ltd was requested by Hughes Developments Ltd to undertake a geotechnical investigation of the property at 3/144 Dunns Crossing Road, Rolleston, Christchurch, as outlined in our variation proposal (ref: P2020.004.581_01).

The purpose of this assessment was to conceptualise 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; and
- Preparation of this report outlining our findings on the ground conditions and the suitability of the site for residential subdivision, including 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.

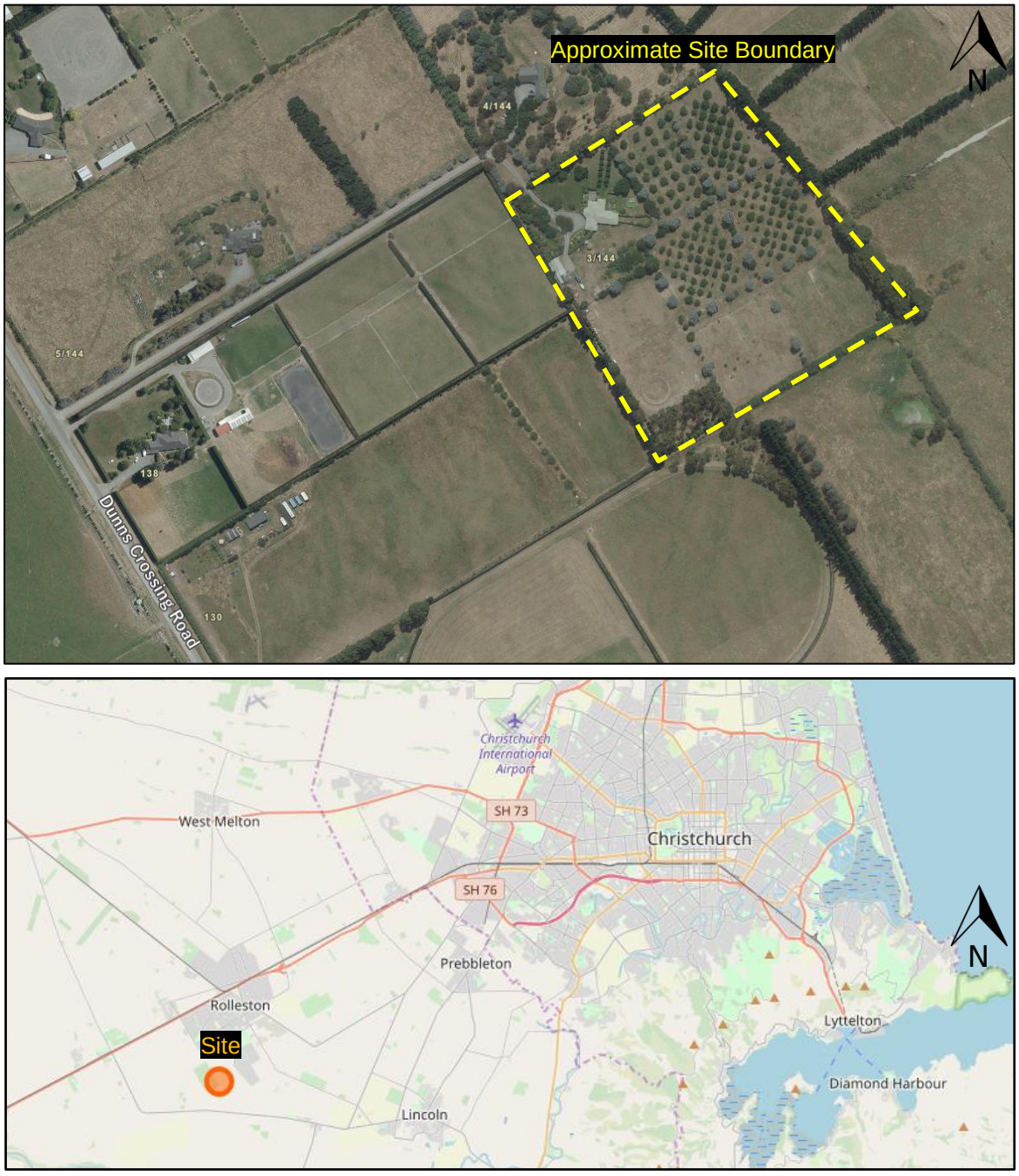
2 Site Description

The site comprises of one property with a total area of four hectares and the following legal description (Canterbury Maps):

- Lot 3 DP 70352 BLK III

The site is located approximately 3 km southwest of Rolleston town centre and is bound on all sides by rural properties (Figure 1).

Figure 1: Site Location Plan



Images sourced from Canterbury Maps and "© OpenStreetMap contributors". Not to scale.

3 Geological Model

3.1 Regional Geology

The site has been regionally mapped by GNS (Forsyth et al., 2008) as being underlain by brownish grey river alluvium (Q2a).

3.2 Geomorphology

The site comprises relatively flat ground, with gentle undulations and depressions in some areas. As evident on aerial imagery (Canterbury Maps, 2019) and observed during our site walkover conducted on 5 August 2020, undulating and depressed ground can be attributed to paleo-channels, which traverse the site in a general northwest to southeast direction (Figure 2). Based on observations, sandy silt deposits with variable thickness are expected to have in-filled the paleo-channels where they have not remained as channel features. Inferred paleo-channels have been mapped to give an indication of areas with potential channel in-fill (Appendix 1).

Figure 2: Historical Aerial Photo – 1990 - 1994

Image sourced from Canterbury Maps. Not to scale.

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 6 km north / northwest of the site and trends roughly east-west with a surface rupture length 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 extended to within 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 in an area mapped where “damaging liquefaction is unlikely” (NZGD Map CGD5140, 2012), and a “zone of very low liquefaction potential” (GNS, 2006).

3.4 Site Investigation

Site investigations to assess the shallow subsurface material types and strength characteristics were undertaken by ENGEO on 7 August 2020. Six test pits and five hand auger investigations with associated Scala Penetrometer tests were completed to a maximum depth of 2.3 m below ground level.

The investigations revealed subsurface conditions across the site are consistent with the published geological mapping, as summarised in Table 1. Hand auger and test pit logs are attached as Appendix 2 of this report.

Table 1: Summary of Subsurface Investigations

Soil Type	Depth to Top of Layer (m)	General Layer Thickness (m)	Density / Consistency	Additional Comments
TOPSOIL	0.0	0.1 – 0.3	Stiff to Very Stiff	-
Sandy GRAVEL	0.3	Unknown	Medium Dense to Very Dense	Tightly packed and consistent across the site. A thin lens of loosely packed fine to medium gravel was encountered at approximately 1 m depth across the test pit locations.

3.5 ECan Boreholes

A review of six deep ECan borehole logs was conducted. The first (M36/4449 & M36/4387), are located on-site, and appear to be water wells providing the properties irrigation and domestic supply. The other boreholes are located to the north (M36/4450), east (M36/20535), south (BX23/0895) and west (M36/7416) of the site.

Well logs from the six holes of interest are attached to this report as Appendix 3 and summarised in Table 2.

Table 2: Generalised Summary of ECan Boreholes

ECan Borehole	Total Depth (m)	Water Level Below Ground Level (m)	Generalised Borelog as Logged by Driller
M36/5041	34	9.73	Gravel with silt and sand to 34 m depth.
M36/0016	15.2	9.85	Sandy gravel to 15.2 m depth.
M36/5042	32.5	9.97	Sandy gravel to 32.5 m depth.
M36/5038	32	9.58	Sandy gravel to 32 m depth.

Figure 3: Nearby ECan Borehole Locations

Aerial photograph sourced from Canterbury Maps. Not to scale.

3.6 Groundwater

Groundwater is recorded in the surrounding boreholes between approximately 9 to 10 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 Analysis

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 future land performance to be in line with Technical Category 1 (TC1), whereby future land damage from liquefaction is 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 it considers that:

- There is a significant risk from natural hazards; or
- Sufficient provision has not been made for legal or physical access to each allotment to be created by the subdivision.

An assessment of the risk from natural hazards as required by the RMA includes the following:

- The likelihood of natural hazards occurring (whether individually or in combination);
- The material damage to land in respect of which the consent is sought, other land, or structures that would result from natural hazards; and
- Any likely subsequent use of the land in respect of which the consent is sought that would accelerate, worsen, or result in material damage of the kind referred to in paragraph (b).

We have assessed the risk of natural hazards at the site in accordance with Section 106 of the Resource Management Act (RMA) and considered the risk to the site from rockfall, inundation (debris), slope stability, subsidence, flooding and tsunami. 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 natural hazards such as rockfall, inundation (debris), slope stability, subsidence, flooding and tsunami. 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 Earth filling for Residential Development. In particular, any areas to receive fill should be stripped of all 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 2V:1H 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 no steeper than 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 shallow 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 sandy gravel or engineered fill, below any topsoil. All topsoil shall be stripped from within building footprints, we anticipate this to be typically below 0.3 m depth based on our subsurface investigations.

7 References

Canterbury Maps, Groundwater. Retrieved August 2020, from http://canterburymaps.govt.nz/Viewer.

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Forsyth, P., Barrell, D. J., & Jongens, R. (2008). Sheet 16 - Geology of the Christchurch Area 1:250,000. Lower Hutt: Institute of Geological and Nuclear Sciences.

GNS Science (2015). New Zealand Active Faults Database. Retrieved August 2020, from http://data.gns.cri.nz /af.

Pettinga J.R., Yetton M.D., Van Dissen R.J., & Downes G. (2001). Earthquake Source Identification and Characterisation for the Canterbury Region, South Island, New Zealand. Bulletin of the New Zealand Society for Earthquake Engineering, Vol 34, No. 4, pp 282-317.

Selwyn District Council, Property Search, retrieved August 2020, from https://www.selwyn.govt.nz/my-property/rates/search-properties.

Standards Association of New Zealand (1989). NZS 4431:1989. Code of Practice for Earthfilling for Residential Development.

Standards Association of New Zealand (2004). NZS 1170.5:2004. Structural Design Actions Part 5: Earthquake Actions – New Zealand.

Standards Association of New Zealand (2010). NZS 3604:2010. Timber Framed Buildings.

Standards Association of New Zealand (2010). NZS 4404:2010. Land Development and Subdivision Infrastructure.

The Ministry of Business, Innovation, and Employment (2016). New Zealand Geotechnical Database. Retrieved August 2020, from https://www.nzgd.org.nz.

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 Developments 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 Engineering 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

Jed Watts

Engineering Geologist

Report reviewed by

Greg Martin, CMEngNZ (PEngGeol)

Principal Engineering Geologist

APPENDIX 1:

Site Plan and Inferred Paleo Channels

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Tauranga Office
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Mount Maunganui, Tauranga 3116
Tel: 07 777 0209, www.engeo.co.nz

Title:

Geotechnical Site Plan

Aerial: LINZ and Eagle Technology, CC BY 4.0.
Map image: Eagle Technology.

PROJECTION: NZGD 2000 New Zealand Transverse Mercator

Client: Hughes Developments Ltd		Figure No: 1
Project: 3/144 Dunns Crossing Road Rolleston	Designed: NF Drawn: JW Checked: GM Date: Aug 20	Size: A4
Proj No: 12903.000.003	Scale: 1:2,000	Revision: A

ORIGINAL FIGURE PRINTED IN COLOUR

APPENDIX 2:

ENGEO Hand Auger and Test Pit Logs

LOG OF AUGER HA01

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Client Ref. : N/A
Date : 07/08/2020
Hole Depth : 0.4 m
Hole Diameter : mm

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.3744
Longitude : -43.62188

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TS	ML	Sandy SILT with trace rootlets and gravel; brown. Low plasticity. Sand, fine to medium. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].				D	F-St	
	A	GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse.					D	
0.5			End of Hole Depth: 0.4 m Termination Condition: Target depth						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand auger met practical refusal at 0.4 m.
Scala Penetrometer met target depth at 0.5 m.
Standing groundwater was not encountered.
TS = TOPSOIL

A = ALLUVIUM

GEOTECH HAND AUGER 2020.08.07 - 3-144 DUNNS CROSSING ROAD.GPJ NZ DATA TEMPLATE 2.GDT 11/8/20

LOG OF AUGER HA02

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Client Ref. : N/A
Date : 07/08/2020
Hole Depth : 0.35 m
Hole Diameter : mm

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.37531
Longitude : -43.62104

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TS	ML	Sandy SILT with trace rootlets and gravel; brown. Low plasticity. Sand, fine to medium. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].				D	F-St	
	A	GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse.						
0.5			End of Hole Depth: 0.35 m Termination Condition: Target depth						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand auger met practical refusal at 0.35 m.
Scala Penetrometer met target depth at 0.5 m.
Standing groundwater was not encountered.
TS = TOPSOIL

A = ALLUVIUM

GEOTECH HAND AUGER 2020.08.07 - 3-144 DUNNS CROSSING ROAD.GPJ NZ DATA TEMPLATE 2.GDT 11/8/20

LOG OF AUGER HA03

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Client Ref. : N/A
Date : 07/08/2020
Hole Depth : 0.3 m
Hole Diameter : mm

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.37435
Longitude : -43.62136

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TS	ML	Sandy SILT with trace rootlets and gravel; brown. Low plasticity. Sand, fine to medium. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].				D	F-St	
	A	GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse.					MD	
0.5			End of Hole Depth: 0.3 m Termination Condition: Target depth						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand auger met practical refusal at 0.3 m.
Scala Penetrometer met target depth at 0.5 m.
Standing groundwater was not encountered.
TS = TOPSOIL

A = ALLUVIUM

GEOTECH HAND AUGER 2020.08.07 - 3-144 DUNNS CROSSING ROAD.GPJ NZ DATA TEMPLATE 2.GDT 11/8/20

LOG OF AUGER HA04

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Client Ref. : N/A
Date : 07/08/2020
Hole Depth : 0.35 m
Hole Diameter : mm

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.3746
Longitude : -43.62035

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TS	ML	Sandy SILT with trace rootlets and gravel; brown. Low plasticity. Sand, fine to medium. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].				D	F-St	
	A	GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse.					MD	
0.5			End of Hole Depth: 0.35 m Termination Condition: Target depth						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand auger met practical refusal at 0.35 m.
Scala Penetrometer met target depth at 0.6 m.
Standing groundwater was not encountered.
TS = TOPSOIL

A = ALLUVIUM

GEOTECH HAND AUGER 2020.08.07 - 3-144 DUNNS CROSSING ROAD.GPJ NZ DATA TEMPLATE 2.GDT 11/8/20

LOG OF AUGER HA05

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Client Ref. : N/A
Date : 07/08/2020
Hole Depth : 0.3 m
Hole Diameter : mm

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.37354
Longitude : -43.62115

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TS	ML	Sandy SILT with trace rootlets and gravel; brown. Low plasticity. Sand, fine to medium. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].				D	F-St	
	ALLUVIUM	GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse.					MD-D	
0.5			End of Hole Depth: 0.3 m Termination Condition: Target depth						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand auger met practical refusal at 0.3 m.
Scala Penetrometer met target depth at 0.3 m.
Standing groundwater was not encountered.
TS = TOPSOIL

A = ALLUVIUM

GEOTECH HAND AUGER 2020.08.07 - 3-144 DUNNS CROSSING ROAD.GPJ NZ DATA TEMPLATE 2.GDT 11/8/20

LOG OF TEST PIT TP01

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Date : 07/08/2020
Max Test Pit Depth : 2.3 m
Digger Type/Size : 24 Tonne
Bucket Type/Size : Bucket Excavator

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.37377
Longitude : -43.62161

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0	TS		ML	Sandy SILT with minor gravel and rootlets; brown. Low plasticity. Sand, fine to coarse. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].					St-VSt		
0.5	ALLUVIUM			Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse. Trace silt encountered from 0.3 to 0.5 m depth.				D			
1.0			GW	150 mm lens of loosely packed fine to medium gravel encountered at 1 m depth.					Tightly Packed		
1.5								M			
2.0											
2.5				Depth of Excavation: 2.3 m Termination Condition: Target depth							

Test pit met target depth.

Standing groundwater was not encountered.

TS = TOPSOIL

GEOTECH TEST PIT LOG 2020.08.07 - 3-144 DUNNS CROSSING ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 13/8/20

LOG OF TEST PIT TP02

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Date : 07/08/2020
Max Test Pit Depth : 2 m
Digger Type/Size : 24 Tonne
Bucket Type/Size : Bucket Excavator

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.37494
Longitude : -43.62163

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0	TS		ML	Sandy SILT with minor gravel and rootlets; brown. Low plasticity. Sand, fine to coarse. Gravel, fine to medium, subrounded to subangular [TOPSOIL].					St-VSt		
0.5	ALLUVIUM		GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse.				D	Tightly Packed		
1.0			SW	Gravelly fine to coarse SAND; grey. Well graded. Gravel, fine to coarse.					MD-D		
1.5			GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse. 100 mm to 150 mm lens of loosely packed fine to medium gravel encountered at 1 m depth.				M	Tightly Packed		
2.0				Depth of Excavation: 2 m Termination Condition: Target depth							
2.5											

Test pit met target depth.

Standing groundwater was not encountered.

TS = TOPSOIL

LOG OF TEST PIT TP03

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Date : 07/08/2020
Max Test Pit Depth : 2.1 m
Digger Type/Size : 24 Tonne
Bucket Type/Size : Bucket Excavator

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.37575
Longitude : -43.62133

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0.0	TS		ML	Sandy SILT with minor gravel and rootlets; brown. Low plasticity. Sand, fine to coarse. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].				D	St-VSt		
0.5	ALLUVIUM		GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse. Trace silt encountered from 0.3 to 0.5 m depth.							
1.0				100 mm lens of loosely packed fine to medium gravel encountered at 1.2 m depth.				M	Tightly packed		
1.5											
2.0				Depth of Excavation: 2.1 m Termination Condition: Target depth							
2.5											

Test pit met target depth.

Standing groundwater was not encountered.

TS = TOPSOIL

LOG OF TEST PIT TP04

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Date : 07/08/2020
Max Test Pit Depth : 2.3 m
Digger Type/Size : 24 Tonne
Bucket Type/Size : Bucket Excavator

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.37497
Longitude : -43.62056

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0	TS		ML	Sandy SILT with some gravel and trace rootlets; brown. Low plasticity. Sand, fine to medium. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].				D	St-VSt		
0.5	ALLUVIUM		GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse. Rootlets encountered up to 0.6 m depth.							
1.0											
1.5				<100 mm lens of loosely packed fine to medium gravel encountered at 1.2 m depth.				M	Tightly Packed		
2.0											
2.5				Depth of Excavation: 2.3 m Termination Condition: Target depth							

Test pit met target depth.

Standing groundwater was not encountered.

TS = TOPSOIL

LOG OF TEST PIT TP05

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Date : 07/08/2020
Max Test Pit Depth : 2 m
Digger Type/Size : 24 Tonne
Bucket Type/Size : Bucket Excavator

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.37453
Longitude : -43.62077

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier / Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0	TS		ML	Sandy SILT with some gravel and trace rootlets; brown. Low plasticity. Sand, fine to medium. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].				D	St-VSt		
0.5	ALLUVIUM		GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse. Trace silt encountered from 0.3 to 0.6 m depth. 200 to 300 mm lens of loosely packed fine to medium gravel encountered at 0.7 m depth.				M	Tightly Packed		
1.0											
1.5											
2.0				Depth of Excavation: 2 m Termination Condition: Target depth							
2.5											

Test pit met target depth.

Standing groundwater was not encountered.

TS = TOPSOIL

LOG OF TEST PIT TP06

Geotechnical Investigation
3/144 Dunns Crossing Road
Rolleston
12903

Client : Hughes Developments Ltd
Date : 07/08/2020
Max Test Pit Depth : 2 m
Digger Type/Size : 24 Tonne
Bucket Type/Size : Bucket Excavator

Shear Vane No : N/A
Logged By : JC
Reviewed By : JW
Latitude : 172.37404
Longitude : -43.62051

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0	TS		ML	Sandy SILT with some gravel and trace rootlets; brown. Low plasticity. Sand, fine to medium. Gravel, fine to coarse, subrounded to subangular [TOPSOIL].				D	St-VSt		
0.5	ALLUVIUM		GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subangular to subrounded. Sand, fine to coarse. Trace silt encountered from 0.3 to 0.6 m depth.				M	Tightly Packed		
1.0				100 mm lens of loosely packed fine to medium gravel encountered at 1.3 m depth.							
1.5											
2.0				Depth of Excavation: 2 m Termination Condition: Target depth							
2.5											

Test pit met target depth.

Standing groundwater was not encountered.

TS = TOPSOIL

APPENDIX 3:

ECan Borelogs

Bore or Well No	M36/5041
Well Name	DUNNS CROSSING ROAD
Owner	KAJENS TRADING DEVELOPMENT LTD

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	M36/5041	**File Number**	CO6C/10302
Owner	KAJENS TRADING DEVELOPMENT LTD	**Well Status**	Active (exist, present)
Street/Road	DUNNS CROSSING ROAD	**NZTM Grid Reference**	BX23:49507-69990
Locality	ROLLESTON	**NZTM X and Y**	1549507 - 5169990
Location Description		**Location Accuracy**	50 - 300m
CWMS Zone	Selwyn - Waihora	**Use**	Domestic Supply,
Groundwater Allocation Zone	Selwyn-Waimakariri	**Water Level Monitoring**	--
Depth	32.00m	**Water Level Count**	0
Diameter	150mm	**Initial Water Level**	6.80m below MP
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	40.47m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	10	**Calc Min 80%**	9.73m below MP (Estimated)
Aquifer Name		**Aquifer Tests**	0
Aquifer Type	Unknown	**Yield Drawdown Tests**	1
Drill Date	01 Feb 1997	**Max Tested Yield**	5 l/s
Driller	Dynes Road Drilling	**Drawdown at Max Tested Yield**	13 m
Drilling Method	Cable Tool	**Specific Capacity**	0.40 l/s/m
Casing Material	STEEL	**Last Updated**	08 Nov 2013
Pump Type	Unknown	**Last Field Check**	
Water Use Data	No		

Screens

Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	30	32				

Step Tests

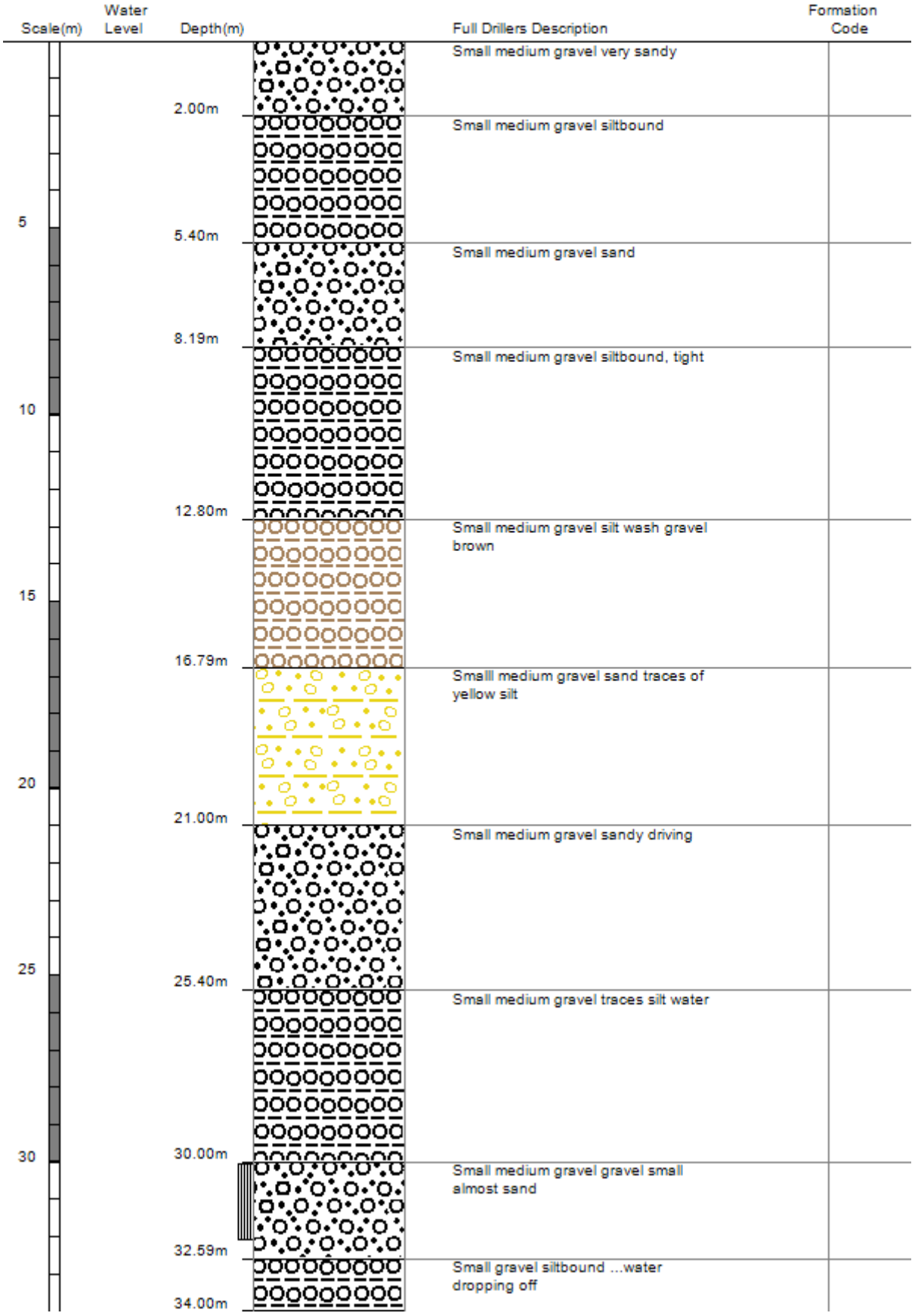
Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
01 Feb 1997	1	5.1	67.31074	12.8	2

No comments for this well

Borelog for well M36/5041

Grid Reference (NZTM): 1549508 mE, 5169991 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 40.5 m +MSD Accuracy: < 2.5 m
Driller: Dynes Road Drilling
Drill Method: Cable Tool
Borelog Depth: 34.0 m Drill Date: 01-Feb-1997

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha



Bore or Well No	M36/0016
Well Name	Goulds Road
Owner	WADE.A.

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Well Number	M36/0016	**File Number**	
Owner	WADE.A.	**Well Status**	Not Used
Street/Road	Goulds Road	**NZTM Grid Reference**	BX23:49707-70190
Locality	ROLLESTON	**NZTM X and Y**	1549707 - 5170190
Location Description		**Location Accuracy**	50 - 300m
CWMS Zone	Selwyn - Waihora	**Use**	,
Groundwater Allocation Zone	Selwyn-Waimakariri	**Water Level Monitoring**	--
Depth	14.00m	**Water Level Count**	0
Diameter	51mm	**Initial Water Level**	
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	40.62m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	3	**Calc Min 80%**	9.85m below MP (Estimated)
Aquifer Name		**Aquifer Tests**	0
Aquifer Type	Unknown	**Yield Drawdown Tests**	0
Drill Date	29 Aug 1932	**Max Tested Yield**	
Driller	Pearson	**Drawdown at Max Tested Yield**	
Drilling Method	Unknown	**Specific Capacity**	
Casing Material	STEEL	**Last Updated**	06 Mar 2001
Pump Type	Unknown	**Last Field Check**	
Water Use Data	No		

No screen data for this well

No step tests for this well

No comments for this well

Borelog for well M36/0016

Grid Reference (NZTM): 1549708 mE, 5170191 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 40.6 m +MSD Accuracy: < 2.5 m
Driller: Pearson
Drill Method: Unknown
Borelog Depth: 15.2 m Drill Date: 29-Aug-1932

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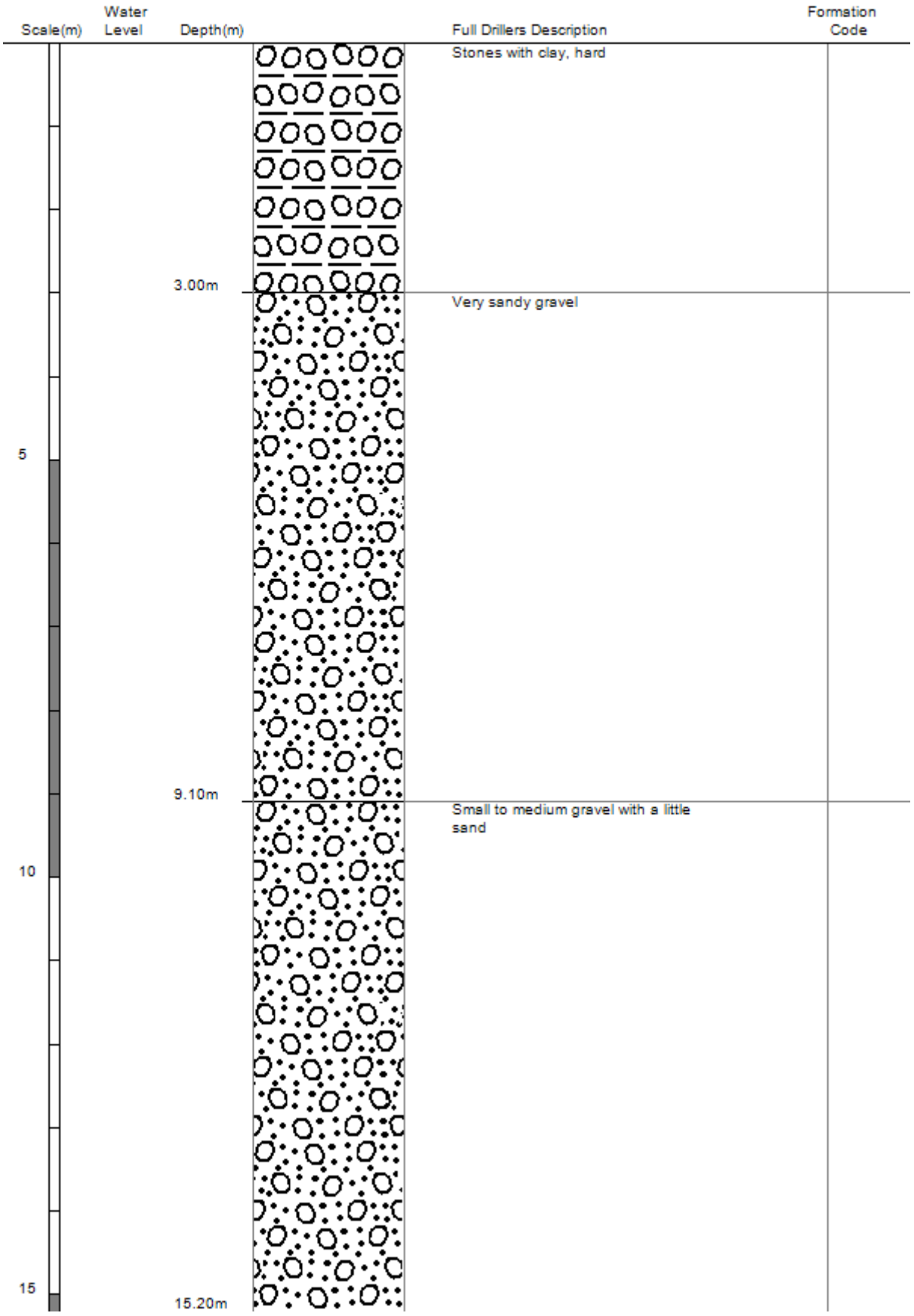

Bore or Well No	M36/5042
Well Name	DUNNS CROSSING ROAD
Owner	KAJENS TRADING DEVELOPMENT LTD

Environment Canterbury Regional Council
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Well Number	M36/5042	**File Number**	CO6C/10303
Owner	KAJENS TRADING DEVELOPMENT LTD	**Well Status**	Active (exist, present)
Street/Road	DUNNS CROSSING ROAD	**NZTM Grid Reference**	BX23:49378-70190
Locality	ROLLESTON	**NZTM X and Y**	1549378 - 5170190
Location Description		**Location Accuracy**	50 - 300m
CWMS Zone	Selwyn - Waihora	**Use**	Domestic Supply,
Groundwater Allocation Zone	Selwyn-Waimakariri	**Water Level Monitoring**	--
Depth	32.10m	**Water Level Count**	0
Diameter	150mm	**Initial Water Level**	6.00m below MP
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	42.04m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	8	**Calc Min 80%**	9.97m below MP (Estimated)
Aquifer Name		**Aquifer Tests**	0
Aquifer Type	Unknown	**Yield Drawdown Tests**	1
Drill Date	01 Nov 1996	**Max Tested Yield**	5 l/s
Driller	Dynes Road Drilling	**Drawdown at Max Tested Yield**	12 m
Drilling Method	Cable Tool	**Specific Capacity**	0.41 l/s/m
Casing Material	STEEL	**Last Updated**	08 Nov 2013
Pump Type	Unknown	**Last Field Check**	
Water Use Data	No		

Screens

Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	30.1	32.1				

Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
01 Nov 1996	1	5	65.99092	12.2	2

No comments for this well

Borelog for well M36/5042

Grid Reference (NZTM): 1549378 mE, 5170191 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 42.0 m +MSD Accuracy: < 2.5 m
Driller: Dynes Road Drilling
Drill Method: Cable Tool
Borelog Depth: 32.5 m Drill Date: 01-Nov-1996

Environment Canterbury Regional Council
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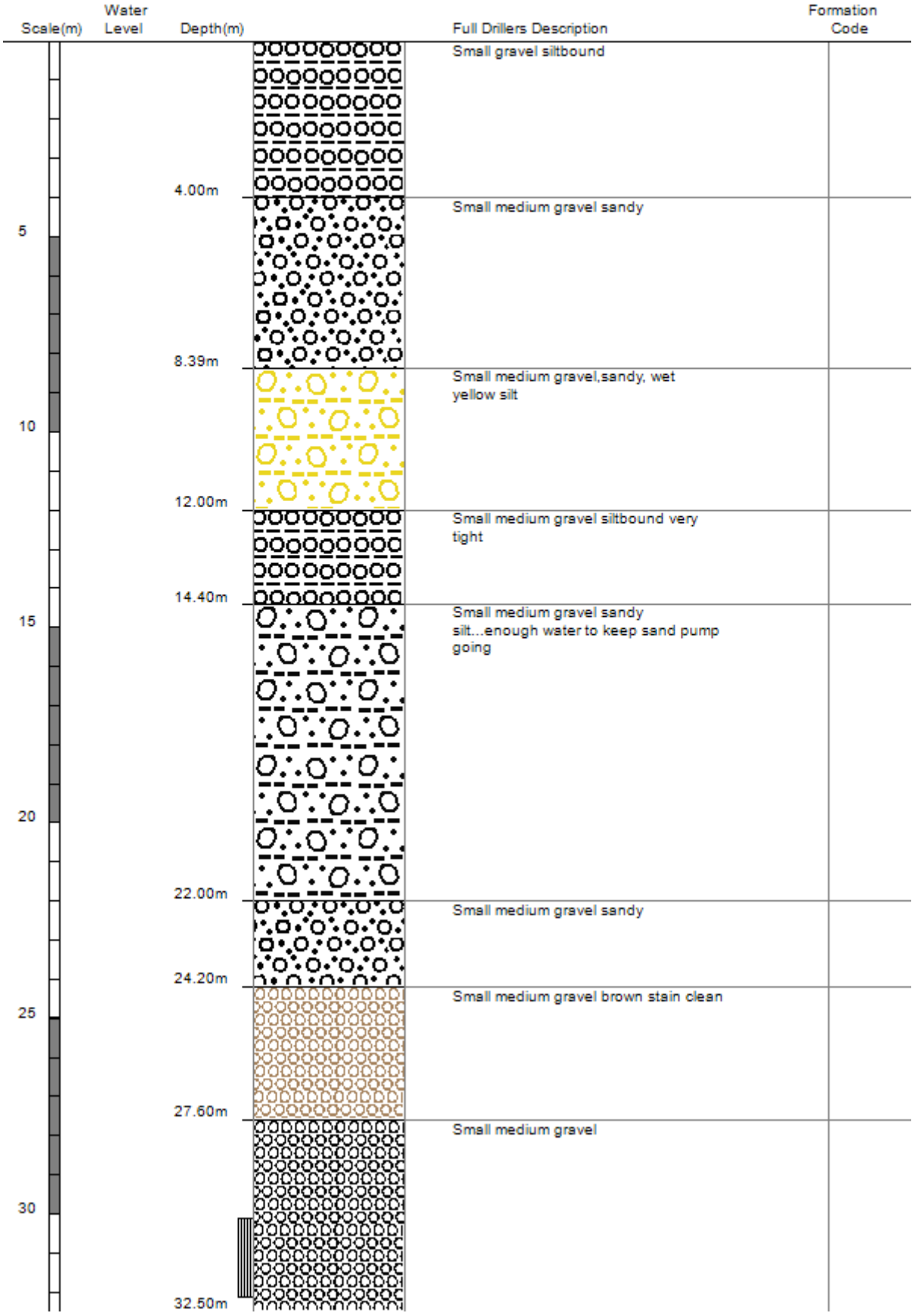

Bore or Well No	M36/5038
Well Name	DUNNS CROSSING ROAD
Owner	KAJENS TRADING DEVELOPMENT LTD

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	M36/5038	**File Number**	CO6C/10010
Owner	KAJENS TRADING DEVELOPMENT LTD	**Well Status**	Active (exist, present)
Street/Road	DUNNS CROSSING ROAD	**NZTM Grid Reference**	BX23:49278-69840
Locality	ROLLESTON	**NZTM X and Y**	1549278 - 5169840
Location Description		**Location Accuracy**	50 - 300m
CWMS Zone	Selwyn - Waihora	**Use**	Domestic Supply,
Groundwater Allocation Zone	Selwyn-Waimakariri	**Water Level Monitoring**	--
Depth	32.10m	**Water Level Count**	0
Diameter	150mm	**Initial Water Level**	6.30m below MP
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	40.38m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	7	**Calc Min 80%**	9.58m below MP (Estimated)
Aquifer Name		**Aquifer Tests**	0
Aquifer Type	Unknown	**Yield Drawdown Tests**	1
Drill Date	01 Nov 1996	**Max Tested Yield**	24 l/s
Driller	Dynes Road Drilling	**Drawdown at Max Tested Yield**	9 m
Drilling Method	Cable Tool	**Specific Capacity**	2.84 l/s/m
Casing Material	STEEL	**Last Updated**	08 Nov 2013
Pump Type	Unknown	**Last Field Check**	
Water Use Data	No		

Screens

Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	30.1	32.1				

Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
01 Nov 1996	1	24.1	318.076233	8.5	2

No comments for this well

Borelog for well M36/5038

Grid Reference (NZTM): 1549278 mE, 5169841 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 40.4 m +MSD Accuracy: < 2.5 m
Driller: Dynes Road Drilling
Drill Method: Cable Tool
Borelog Depth: 32.0 m Drill Date: 01-Nov-1996

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