

GEOTECHNICAL REPORT

40481 / STROWAN FIELDS SUBDIVISION / TREVORS ROAD
ASHBURTON / NEXT LEVEL DEVELOPMENTS LTD

0800 999 333
hello@do.nz

Level 1, 24 Moorhouse Avenue, Addington
PO Box 589, Christchurch 8140
www.do.nz

Davis Ogilvie & Partners Ltd

QUALITY ASSURANCE

Title: Geotechnical Report: Strowan Fields, Trevors Road, Ashburton

Client: Next Level Developments Ltd

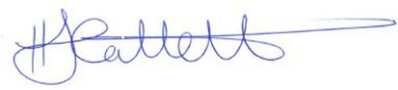
File Location: T:\projects\40s\40481 - Trevors
Road\Geotechnical\Report\210603.hc.40481.TrevorsRoad_Subdivision_Geotech.docx

Version: 1

Date: 23 September 2021

Project No: 40481

Prepared By: **Hamish Cattell**
Engineering Geologist
PhD, BSc (Hons), MEngNZ

Signature:


Reviewed & Authorised By: **Ben Parry**
Senior Engineering Geologist
PG Dip, BSc (Tech)
CMEngNZ (PEngGeol)

Signature:


DISCLAIMER

This report has been prepared at the specific instructions of Next Level Developments Ltd, and concerns the proposed Strowan Fields subdivision at Trevors Road, Ashburton. The site is legally described as Lot 17 DP 33764 (CB13B/504). This report provides a geotechnical assessment of the land underlying the site and a review of geotechnical information.

Davis Ogilvie did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. Conditions may exist which were undetectable given the limited investigation of the site. Variations in conditions may occur between test locations, and there may be conditions onsite which have not been revealed by the investigation, which have not been taken into account in the report.

Davis Ogilvie's opinions are based upon information that existed at the time of the production of the document. Assessments made in this report are based on the conditions found onsite and published sources detailing the recommended investigation methodologies described. No warranty is included; either expressed or implied that the actual conditions will conform to the assessments contained in this report.

Information herein was created from maps and/or data from the New Zealand Geotechnical Database (<https://www.nzgd.org.nz>) which were prepared and/or compiled for the Earthquake Commission (EQC) to assist in assessing insurance claims made under the Earthquake Commission Act 1993. The source maps and data were not intended for any other purpose. EQC and its engineers, Tonkin & Taylor, have no liability for any use of the maps and data or for the consequences of any person relying on them in any way.

Only Next Level Developments Ltd and the Local and Regional Territorial Authorities are entitled to rely upon this engineering report. Davis Ogilvie & Partners Ltd accepts no liability to anyone other than Next Level Developments Ltd in any way in relation to this report and the content of it and any direct or indirect effect this engineering report may have. Davis Ogilvie & Partners Ltd does not contemplate anyone else relying on this report or that it will be used for any other purpose.

Should anyone wish to discuss the content of this report with Davis Ogilvie & Partners Ltd, they are welcome to contact us on (03) 366 1653 or at Level 1/24 Moorhouse Avenue, Addington, Christchurch.

EXECUTIVE SUMMARY

Davis Ogilvie & Partners Ltd was engaged by Next Level Developments Ltd to undertake a geotechnical investigation of the site at Trevors Road, Ashburton (Lot 17; CB13B/504, DP33764). The purpose of the geotechnical investigation was to assess the underlying ground conditions, assess any geotechnical constraints, and provide preliminary geotechnical design criteria for the proposed development of approximately 265 residential lots and 48 semi-rural residential lots.

Across the 11.0 ha site, Davis Ogilvie oversaw the excavation of 22 test pits and carried out Dynamic Cone Penetrometers at each location. Results from the test pits showed a soil profile generally consisting between 0.2 – 0.4 m topsoil overlying a unit of stiff silt, followed dense to very dense and sandy gravel from 0.4 to 1.9 m below ground level (often from 1.2 – 1.4 m). Groundwater was encountered during the test pit investigations between 3.8 – >5.0 m below EGL. However, historical and preliminary monitoring evidence indicates that significant fluctuations in the groundwater levels are likely. Levels may rise to between 0.8 – 4.8 m below EGL across the site following periods of intense rain.

Based on the geotechnical testing on the site, an ultimate bearing capacity of 300 kPa was consistently achieved below the surficial topsoil unit at approximately 0.4 m below EGL. Further geotechnical testing will be required during subdivision development and geotechnical recommendations shall be provided in a geotechnical completion report compiled following the completion of earthworks.

All earthworks on site shall be subject to supervision and certification by a suitably qualified Geoprofessional. The site-won silt soils and deeper gravel soils are considered suitable for reuse as engineered fill, subject to laboratory testing approval. All fills must be placed in accordance with NZS4431:1989 and careful management of fill moisture conditions is required.

For carriageway design, pavement design should adopt a maximum subgrade CBR of 5, also requiring careful management of the near-surface silty subgrade during earthworks, especially during periods of rain. Falling-head infiltration testing showed that the sandy gravel soils have an ultimate infiltration rate ranging between 600 – 1,850 mm/hour which may be sufficient for stormwater to be discharged to-ground in the low density (semi-rural) residential area.

While no flood risk was identified from the available territorial authority sources, it is recommended that a Registered Professional Surveyor is engaged to confirm ground levels onsite. Environment Canterbury (ECan) and Ashburton District Council should be contacted to confirm any minimum finished floor levels for the development prior to construction.

The site is considered suitable for residential development under Section 106 of the Resource Management Act (1991). A statement of professional opinion on the suitability of land for subdivision is attached.

TABLE OF CONTENTS

1.0 INTRODUCTION	7
1.1 Site Description	7
1.2 Proposed Development	9
2.0 REVIEW OF PUBLISHED INFORMATION.....	10
2.1 Site Geology.....	10
2.2 Hydrogeology	10
2.3 Seismicity and Liquefaction Hazard.....	12
2.4 Flood Management Finished Floor Levels.....	12
2.5 Environment Canterbury Listed Land Use Register	13
2.6 Aerial Imagery	13
2.7 Existing Engineering Reporting.....	14
3.0 GEOTECHNICAL INVESTIGATION AND RESULTS.....	15
3.1 Shallow Testing.....	15
3.2 Groundwater and Piezometer Readings.....	18
4.0 INFILTRATION TESTING	19
4.1 Double Ring Infiltrometer	19
4.2 Falling-Head Infiltration	19
5.0 LABORATORY RESULTS	20
5.1 Particle Size Analysis.....	20
5.2 Maximum Dry Density	20
5.3 Atterberg Limit Analysis	20
5.4 California Bearing Ratio	21
5.5 Laboratory Permeability Test.....	21
5.6 Pinhole Dispersion Test.....	21
6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS	21
6.1 Design Criteria	21
6.2 Liquefaction Hazard	22
6.3 Soil Static Ultimate Bearing Capacities	22
6.4 Preliminary Foundation Recommendations	22
6.5 Indicative Soil Properties	23
6.6 Historic Channel Remediation	23
6.7 Preliminary Pavement Design.....	23
7.0 CONSTRUCTION CONSIDERATIONS	24
7.1 Earthworks	24
7.2 Material Reuse	25
7.3 Cut / Fill Recommendations	25
7.4 Dust, Erosion and Sediment Control	25

7.5	Stormwater Management.....	26
7.6	Wastewater	26
8.0	SECTION 106 RESOURCE MANAGAMENT ASSESSMENT	26
9.0	SUITABILITY FOR SUBDIVISION	27
10.0	SUMMARY OF FUTURE WORK REQUIRED.....	28
10.1	Prior to Construction	28
10.2	During Construction	29
10.3	Following Construction.....	29
 APPENDIX A – Site and Test Location Plan (DWG G01A)		
APPENDIX B – Hand Auger and DCP Logs		
APPENDIX C – FHI Infiltration Test Results		
APPENDIX D – Laboratory Reports		
APPENDIX E – Statement of Suitability for Subdivision		

1.0 INTRODUCTION

Davis Ogilvie & Partners Ltd (DO) has been engaged by Next Level Developments Ltd, to carry out a geotechnical investigation at the proposed Strowan Fields Subdivision at Trevors Road, Ashburton, legally known as Lot 17 (CB13B/504), Deposited Plan (DP) 33764. The purpose of the geotechnical investigation was to assess the underlying ground conditions, assess any geotechnical constraints, and provide preliminary geotechnical design criteria for the proposed high and low-density residential development of the site.

1.1 Site Description

The site is located approximately 1.5 km south-east of State Highway 1 and 1.1 km east of the Ashburton River (Figure 1). The total land parcel occupies a total area of 62 ha; however, the westernmost 11 ha area (Lots 9 & 10, and Part of Lot 17) is not included in this investigation (Figures 2 and 3).

The land parcel is bounded by Trevors Road to the north-west, Wakanui Road to the north-east, Beach Road East to the south-west, and similar rural farmland to the south-east. The site is undeveloped, flat with a history of farming land use (Figure 2). Two parallel ephemeral drainage channels (Marshall's Creek, also referred to elsewhere as Wakanui Creek) cross the centre of the site in a north-westerly to south-easterly direction. The channels are approximately 4 – 6 m wide and 1.2 – 2.0 m deep and were dry at the time of this investigation. The southern of the two watercourses appears on the ECan River Network¹ and is classed as a 'spring fed plains watercourse'. The channel exits the south of the site where, based on aerial imagery², it crosses farmland and roads in a south-east direction (parallel to Ashburton River) before reaching the coast 15 km south-east of the site. Farm and roadside drains appear to have diverted the flow path towards the Ashburton River at Cochranes Road.

There are no existing buildings on the site, except for a water pump shed central to the south-western boundary. Under the Ashburton District Council (ADC) District Plan, the north-west half of the site (closest to Trevors Road) is designated 'Residential C' (medium-low density), while the south-eastern half of the site is designated 'Residential D' (low density; Figure 1).

¹ <https://opendata.canterburymaps.govt.nz/datasets/ecan::ecan-river-network/about>

² Canterbury Maps Viewer available at <https://mapviewer.canterburymaps.govt.nz/>

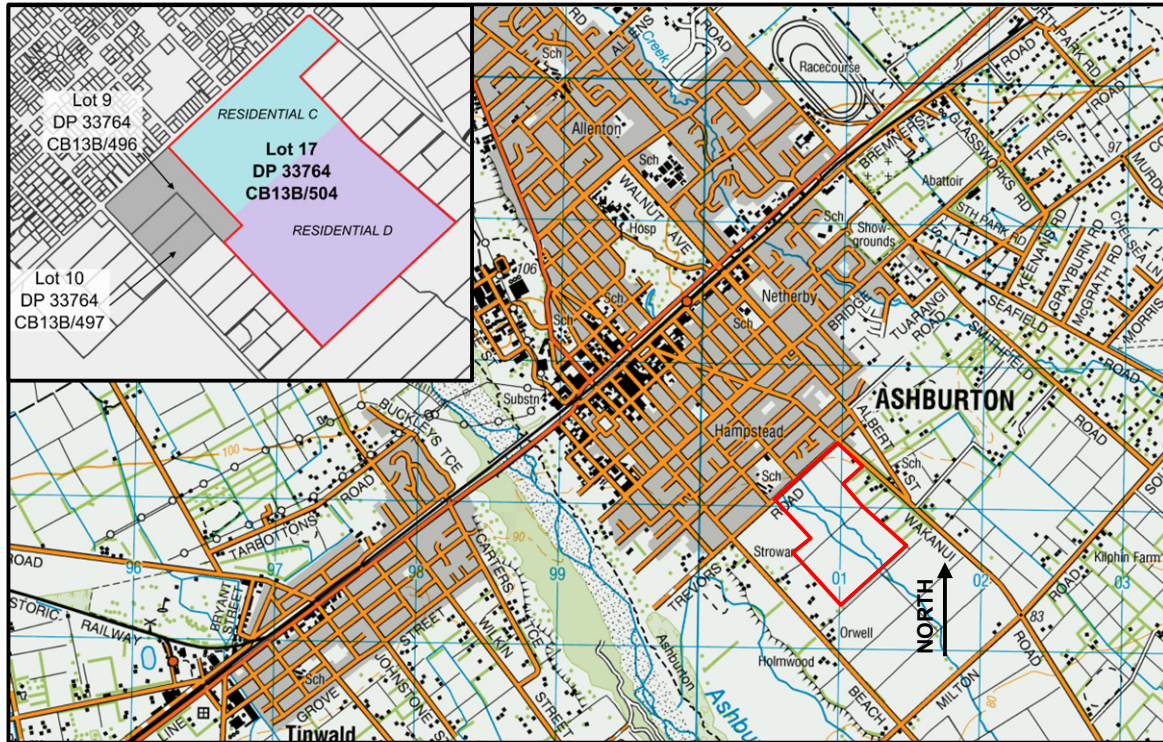


Figure 1: Location of the site shown in red. Figure cropped from Topo50 Maps³.

Insert shows the site land parcel information. Greyed areas are not included in this investigation. Blue area is District Plan zone 'Residential C', and purple is 'Residential D'.



Figure 2: Oblique aerial photograph of the site (approximate boundaries in red), looking east from near the intersection of Trevors Road and Beach Road East (western corner of the site).

³ LINZ Data Service – NZ Topo50 Maps available at <https://data.linz.govt.nz/layer/50767-nz-topo50-maps/> accessed June 2021.

1.2 Proposed Development

The proposed Strowan Fields development is to include approximately 265 high density residential lots in the north-west, 48 low density residential lots. A central reserve with stormwater processing ponds occupies the central south-east of the site. The lots will be served by a new internal road network off the existing Trevors Road in the north-west and Wakanui Road to the north-east.

It is understood the current development plan is to discharge stormwater to the existing southern Marshalls Creek channel and to several purpose-built detention ponds. The latest proposed scheme plan is show in in Figure 3.

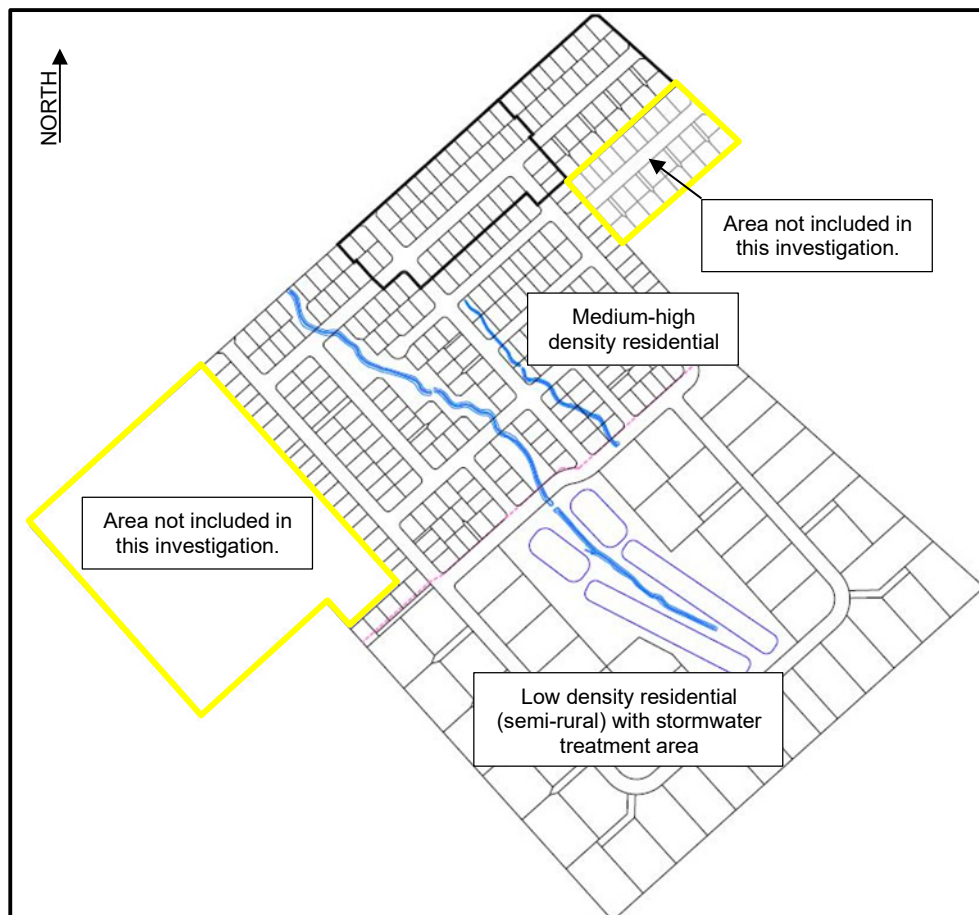


Figure 3: Proposed Strowan Fields development scheme plan showing low- and high-density lot boundaries and proposed roads. Blue lines are Marshalls Creek channels. Black bold lines are Stages 1 and 2. Yellow areas are outside of this investigation.

2.0 REVIEW OF PUBLISHED INFORMATION

A detailed review of published information regarding the site is provided in following sections.

2.1 Site Geology

The published geology of the site is identified as “brownish grey river alluvium (Q2a)”⁴.

An onsite Environment Canterbury (ECan) borehole, central to the south-western boundary (BY21/0221), includes a soil borelog which shows “topsoil” between 0.0 – 0.8 m, “clay” and “gravelly clay” between 0.8 and 7.0 m and gravel thereafter to the base of the borehole at 89.0 m depth.

ECan groundwater well borelogs surrounding the site record a similar soil profile consisting of surficial topsoil layer over “clay” and “gravelly clay”, followed by “gravel”. Gravel is encountered at shallow depths east of the site (<0.3 m), approximately 2.0 m in the north, and up to 4.0 – 5.0 m depth west of the site.

2.2 Hydrogeology

Onsite ECan well BY21/0221 records an initial water level of 6.0 m (in 2017), highest water level of 5.2 m and deepest of 7.2 m depth. ECan well L37/0191 shown in the centre of the site (Marshall's Creek channel) estimates and calculated minimum groundwater level of 4.8 m (drilled in 1977). The well casing was below the creek water level during an inspection in 2007.

The hydrology of the wider site can be inferred from nearby ECan wells, drilled between 1974 and 2021. A summary of the surrounding ECan well data within 850 m of the site (centre) is provided in Table 1. Generally, wells to the north-east of the site (along Wakanui Road and Albert Street) record depth to groundwater at between 3.2 – 3.6 m below ground level. Other readings north of the site, however, deviate from this median recording ‘initial’ groundwater depths of 4.5 m (drilled 1990) and 7.6 m (drilled 2021). South-west of the site, wells along Beach Road East record groundwater between 1.9 m (2005) and 3.1 m (2021) depth. The median depth to initial groundwater is 3.4 m. We note that ECan groundwater monitoring data (from prior to 2010) shows groundwater levels across the region are typically dropping over time and with higher fluctuations⁵.

⁴ Forsyth, P.J.; Barrell, D.J.A.; Jongens, R. (compilers) 2008. Geology of the Christchurch area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 16. 1 sheet + 67 p. Lower Hutt, New Zealand. GNS Science.

⁵ Thorley, MJ, Bidwell, VJ, and DM Scott, 2010. Land-surface recharge and groundwater dynamics – Rakaia-Ashburton Plains; Environment Canterbury technical report U09/55, 61 p.

Table 1: Summary of Selected Nearby ECan Groundwater Well Data

ECan Well	Drill/read date	Well Location (to site centre)	Depth to Gravel	Initial GWL	Min GWL	Max GWL	Fluctuation (max-min)	ECan borehole elevation (LVD37)*
BY21/0221	2016	On site (300 m SW from centre)	4.0 m	6.0 m	5.2 m	7.2 m	2.0 m	-
L37/0191	1977	Centre of site	-	0.8 m	4.8 m**	-	-	85.00 mRL
BY21/0396	2020	400 m E	0.4 m	3.3 m	-	-	-	-
L37/0370	c.1982	510 m NE	-	3.4 m	2.5 m	3.4 m	1.0 m	88.52 mRL
L37/1293	2005	530 m NE	-	4.5 m	4.2 m	5.0 m	0.8 m	88.46 mRL
L37/1033	2002	550 m NE	2.0 m	4.5 m	-	5.0 m	0.5 m	88.29 mRL
BY21/0427	2021	550 m E	0.4 m	7.6 m	-	-	-	-
L37/1340	c.2007	600 m E	-	3.6 m	-	-	-	86.43 mRL
L37/1430	2020	660 m S	-	3.1 m	1.7 m	-	-	84.32 mRL
L37/0367	1978	600 m E	-	3.5 m	2.6 m	3.5 m	1.1 m	86.46 mRL
L37/0189	1974	620 m NE	1.8 m	3.6 m	-	-	-	91.23 mRL
L37/0150	1986	650 m S	0 m	4.4 m**	1.5 m	1.7 m	0.3 m	83.00 mRL
L37/0376	1990	650 m NE	2.0 m	4.5 m	-	-	-	90.36 mRL
L37/0368	1978	700 m E	-	3.4 m	2.4 m	3.4 m	1.0 m	86.76 mRL
L37/0216	2007	740 m SE	-	4.7 m**	0.7 m	1.1 m**	0.9 m	84.00 mRL
BY21/0068	2014	740 m S	0.3 m	2.4 m	1.9 m	2.4 m	0.5 m	85.00 mRL
BY21/0457	2021	800 m SW	5.0 m	2.9 m	-	-	-	-
L37/1305	2005	840 m W	-	4.6 m**	1.8 m	2.2 m	0.1 m	87.73 mRL
* Data from ECan well database, elevation accuracy <5 m. Average elevation on site is approximately 87 mRL LVD37								
** Calculated estimate. See E2 Solutions (2008) report.								

2.3 Seismicity and Liquefaction Hazard

The nearest known active faults listed in the NZS 1170.5:2004 are the Alpine (120 km north-west of the site), Kelly (125 km, north) Kakapo (135 km, north-north-east) and Hope Faults (130 km, north). Recent research has indicated that there is an increased chance of rupture on the Central section of the Alpine Fault of 75% in the next 50 years and estimates a magnitude (M_w) of ≥ 8.0 (82% probability $M_w \geq 8.0$)⁶.

The recently active Port Hills (83 km north-east) and the Greendale Faults (42 km, north-east), and several smaller active faults, were identified from the GNS fault database⁷; however, no further details are available on these faults.

According to the Ashburton Liquefaction Susceptibility Map by Yetton & McCahon (2002)⁸, the site is mapped as part of a wider area dominantly underlain by dense gravel alluvium older than Holocene age. The area is within a mapped zone of very low [liquefaction] potential ('Zone 2') whereby there may be a *"very small risk of liquefaction of local, isolate areas"* during strong earthquake shaking. It is noted that *"much of this zone has a water table at considerable depth, and liquefaction would require a combination of perched water table as well as loose sand."*

2.4 Flood Management Finished Floor Levels

The site is not shown as being in a 'Flood Risk' area as shown on ADC planning maps⁹, being approximately 950 m north-east of the Ashburton River flood channel.

Modelling of 500-year Annual Recurrence Interval (ARI) flood flows for the North and South Branch Ashburton Rivers¹⁰ has shown that the *"Ashburton urban area has no high hazard areas [i.e., >1.0 m deep flood flows] due to breach flows from this river"*. The model shows <1 m deep flows crossing the site, mainly confined to Marshalls Creek depression and low-lying areas to the south of the site.

It is recommended that finished floor level requirements are confirmed with ECan and ADC at the building consent stage.

⁶ Howarth, J.D., Barth, N.C., Fitzsimons, S.J. *et al.* Spatiotemporal clustering of great earthquakes on a transform fault controlled by geometry. *Nat. Geosci.* 14, 314–320 (2021). <https://doi.org/10.1038/s41561-021-00721-4>

⁷ New Zealand Active Fault Database available at <https://data.gns.cri.nz/af/>

⁸ Zones have been digitised from the liquefaction potential map (Figure 7.1) in Geotech Consulting Ltd – Yetton & McCahon, 2002, Ashburton District Engineering Lifelines Project: Earthquake Hazard Assessment. Environment Canterbury report U02/55. Accessed from 'Ashburton liquefaction susceptibility (2002)' layer at <https://opendata.canterburymaps.govt.nz/datasets/ecan::ashburton-liquefaction-susceptibility-2002/about>

⁹ ADC 'Floodable Areas' (F05); and ADC Flood Map, Map U35, dated 8/03/2010.

¹⁰ Ashburton and Tinwald flood investigation, Environment Canterbury Technical Report: R15/72 available at <https://apps.canterburymaps.govt.nz/FloodInvestigationAshburton/> Accessed June 2021.

2.5 Environment Canterbury Listed Land Use Register

The property is not included on the Environment Canterbury (ECan) Listed Land Use Register (LLUR). No evidence of activities consistent with the Ministry for the Environment's Hazardous Activities and Industries List (HAIL) were found during that investigation. Please note, this does not confirm that the site is not contaminated, however, it does show there are no known historical listed land uses that may have caused elevated levels of potentially harmful contaminants.

Davis Ogilvie has been engaged to undertake an environmental Detailed Site Investigation (DSI) report on site prior to any development. It is recommended that this report should be reviewed in due course, and any recommendations therein undertaken.

2.6 Aerial Imagery

The earliest available aerial imagery¹¹ of the site from 1940 shows the site used as farmland (Figure 4). The early monochromatic image clearly shows Marshalls Creek, as well as several other abandoned stream channels crossing the site in a similar orientation. Trevors Road was built by this time and residential development is in early stages to the north. Only one residential building borders the south-west site boundary at this time.

In the subsequent late 1950s imagery, the other abandoned river channels crossing the site are no longer visible, likely having been infilled. The north-western segment of the northern branch of Marshalls Creek channel has also been levelled. Residential buildings along Trevors Road are largely built by this time. Little change is noted on site between the 1980s and 2000s imagery with farming continuing on site. Some residential development has occurred on the lots surrounding the site, and the pump shed erected on site in c.2016.

¹¹ Canterbury Maps – imagery basemaps, available at <https://mapviewer.canterburymaps.govt.nz/>

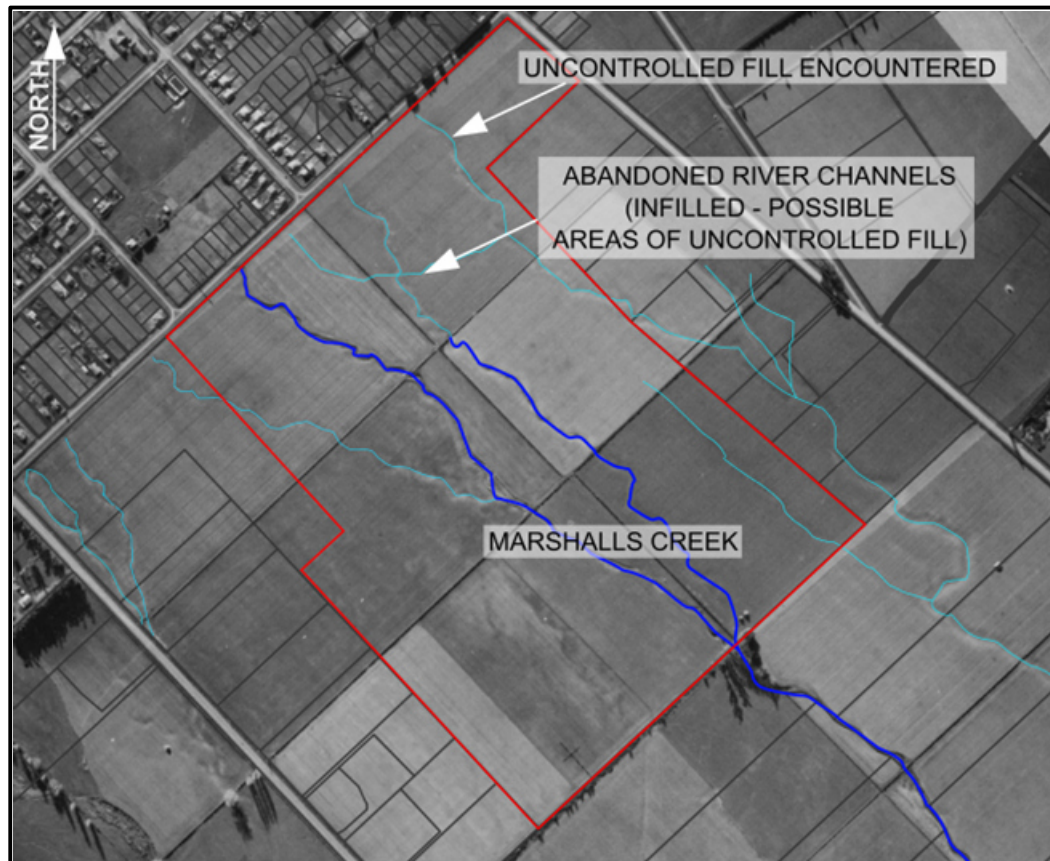


Figure 4: Imagery from 1940 showing the site (boundaries in red) used as farmland. Paleochannels observed from the imagery crossing the site are highlighted in light blue (buried channels) and are possible areas of uncontrolled fill. Dark blue line is Marshalls Creek.

2.7 Existing Engineering Reporting

Existing reporting was undertaken on the site by E2 Solutions Environmental Engineers¹² in November 2008 to assist with a stormwater discharge application. The report included results of a site investigation of the soil and groundwater conditions, consisting of six Test Pits (TPs) across the site excavated to between 2.1 – 2.8 m below ground level (shown in the site plan in Appendix A). The TPs were accompanied with Dynamic Cone Penetrometer (DCP) and percolation testing. Results are summarised in Table 2 and approximate test locations show in Appendix A. The TPs encountered topsoil overlying silt and gravel at 1.2 – 1.7 m below ground level. Groundwater was recorded at between 1.0 – 2.4 m below ground level at the time of the investigation in 2008.

¹² E2 Solutions Environmental Engineering – Graham and Anne MacPhail, Application to Discharge Contaminants to Land and Water, 13 November 2008.

Table 2: E2 Solutions (2008) Existing Test Pit Investigation at the Site

Summary of Soil Type	DCP (blows/ 100 mm)	Relative Density/ Consistency	Percolation (mm/day)	Depth Below EGL (m)**					
				E2 DCP1 +TP	E2 DCP2 +TP	E2 DCP3 +TP	E2 DCP4 +TP	E2 DCP5 +TP	E2 DCP6 +TP
TOPSOIL	<1 - 3	*	NE	0.0 – 0.2	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.4
SILT/CLAY	1.5 – 6	Soft to stiff	12 – 33 (generally 25)	0.2 – 1.4	0.3 – 1.6	0.3 – 1.5	0.3 – 1.7	0.3 – 1.2	0.4 – 0.9
GRAVEL	NE	NE	NE	1.4 – 2.8	1.6 – 2.3	1.5 – 2.3	1.7 – 2.5	1.2 – 2.1	0.9 – 2.2
Groundwater depth (m below EGL)				2.4	1.5	1.8	1.7	1.5	1.0
* Relative density not assigned to topsoil due to the propensity for settlement. ** Depths rounded to the nearest 0.1 m. NE = not encountered. Date of test pits and groundwater readings are unknown.									

3.0 GEOTECHNICAL INVESTIGATION AND RESULTS

Davis Ogilvie conducted geotechnical testing on the site between 25 to 27 May 2021. Testing comprised 22 machine excavated TP and associated DCPs located across the site. Test locations are presented in the attached site plan (DWG G01A) in Appendix A.

TPs were excavated to a maximum depth of 4.5 m below Existing Ground Level (EGL), the practical maximum reach of the excavator. DCPs were advanced to effective refusal in gravel at depths between 0.8 – 3.4 m below EGL.

3.1 Shallow Testing

Test pit excavations revealed a uniform soil profile across the site consisting of topsoil underlain by silt and gravel with interbedded sand to depth. An example of a typical soil profile revealed by the TPs is shown in Figure 5. The depth to gravel from below existing (pre-development) ground level is illustrated in Figure 6.

A summary of the soil profiles encountered at selected test locations is provided in Table 3 A-B and full logs of all test locations are included in Appendix B.

Table 3A: Summarised Soil Profile at Selected Locations DCPs 2 – 10

Summary of Soil Type	DCP (blows/ 100 mm)	Relative Density/ Consistency	Depth Below EGL (m)**					
			DCP2 +TP	DCP4 +TP	DCP6 +TP	DCP7 +TP	DCP8 +TP	DCP10 +TP
TOPSOIL	<1 – 7 (Median 3)	*	0.0 – 0.2	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3
SILT	2 – 11 (Median 4)	Generally stiff	0.2 – 0.6	0.3 – 1.0	0.3 – 1.0	0.3 – 0.8	0.3 – 1.7	0.3 – 1.5
Sandy GRAVEL	11 – 35 (Median 20)	Dense to very dense	0.6 – 4.1	1.0 – 3.7	1.0 – 3.7	0.8 – 4.0	1.7 – 4.5	1.5 – 3.8
Groundwater depth (m below EGL)			NE	NE	NE	NE	4.5	NE

* Relative density not assigned to topsoil or non-engineered fill due to the propensity for settlement.

** Depths rounded to the nearest 0.1 m and may vary across the site from the test locations. Depths are not corrected for variations in topographic elevation between test locations.

NE = standing water not encountered

Groundwater readings were undertaken at the same time as test pit excavation in May 2021.

Table 3B: Summarised Soil Profile at Selected Locations DCPs 11 – 22

Summary of Soil Type	DCP (blows/ 100 mm)	Relative Density/ Consistency	Depth Below EGL (m)**						
			DCP11 +TP	DCP12 +TP	DC14 +TP	DCP16 +TP	DCP18 +TP	DCP20 +TP	DCP22 +TP
TOPSOIL	<1 – 7 (Median 3)	*	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.4	0.0 – 0.3
SILT	2 – 11 (Median 4)	Generally stiff	0.3 – 0.9	0.3 – 1.6	0.3 – 1.1	0.3 – 1.1	0.3 – 1.4	0.4 – 1.2	0.3 – 1.2
Sandy GRAVEL	11 – 35 (Median 20)	Dense to very dense	0.9 – 3.5	1.6 – 3.8	1.1 – 4.0	1.1 – 4.0	1.4 – 4.1	1.2 – 3.8	1.2 – 4.1
Groundwater depth (m below EGL)			NE	NE	NE	3.9	3.9	3.7	4.1

* Relative density not assigned to topsoil or non-engineered fill due to the propensity for settlement.

** Depths rounded to the nearest 0.1 m and may vary across the site from the test locations. Depths are not corrected for variations in topographic elevation between test locations.

NE = standing water not encountered

Groundwater readings were undertaken at the same time as test pit excavation in May 2021.

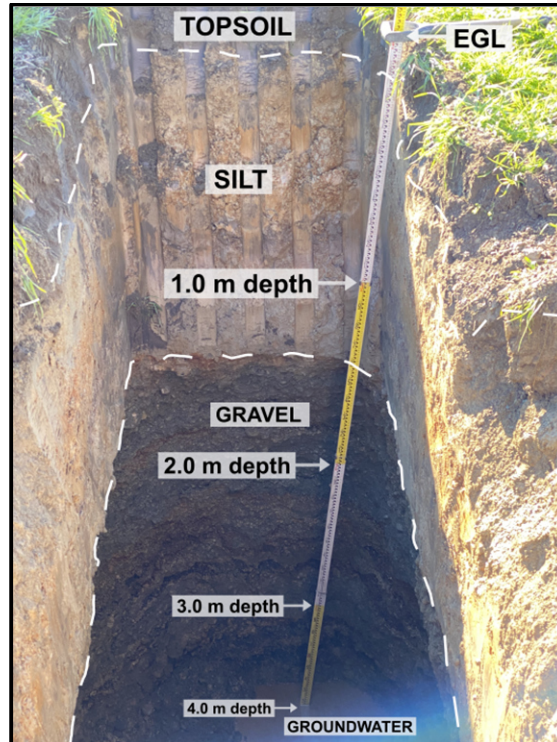


Figure 5: View of the typical subsoil profile (TP18) at Trevors Road to approximately 4.0 m below existing ground level (EGL). Photo date: 26 May 2021.

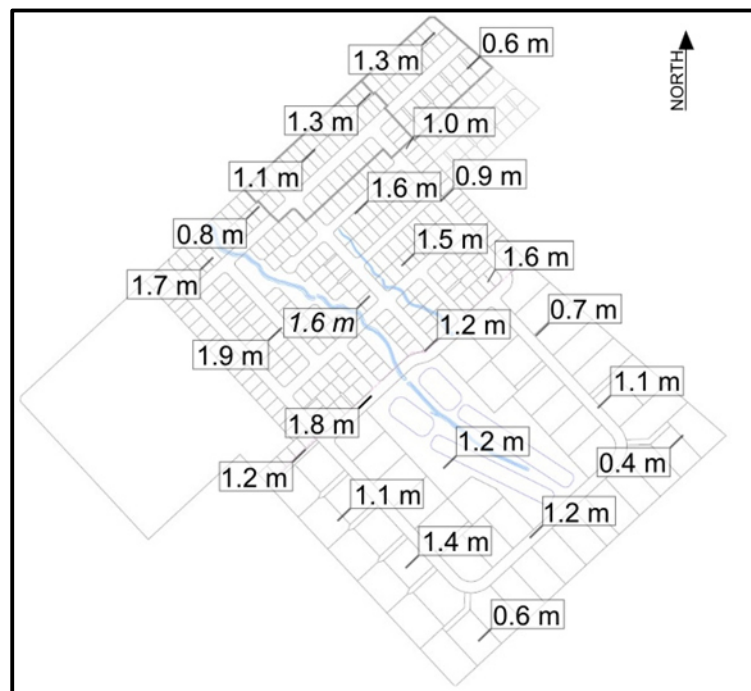


Figure 6: Annotated site concept plan showing summarised depths to gravel in meters below ground level.

3.2 Groundwater and Piezometer Readings

Variable depths to groundwater were encountered across the site. In the TPs towards the rear of the site (south-east) groundwater was encountered at 3.8 – 3.9 m below EGL (TP16, 18, 20), centrally on site at 4.1 m (TP21, 22), and a seepage was measured at the front of the site (north-west) adjacent to Trevors Road at 4.5 m below EGL. A summarised plan showing depth the groundwater across the site is shown in Figure 7. We note that the groundwater levels measured on site (May 2021) were typically 1.0 – 2.0 m deeper than those recorded by E2 Solutions in 2008¹². This lower groundwater level may account for the iron-oxide staining observed in the gravel subsoils (e.g., Figure 6) above the groundwater table.

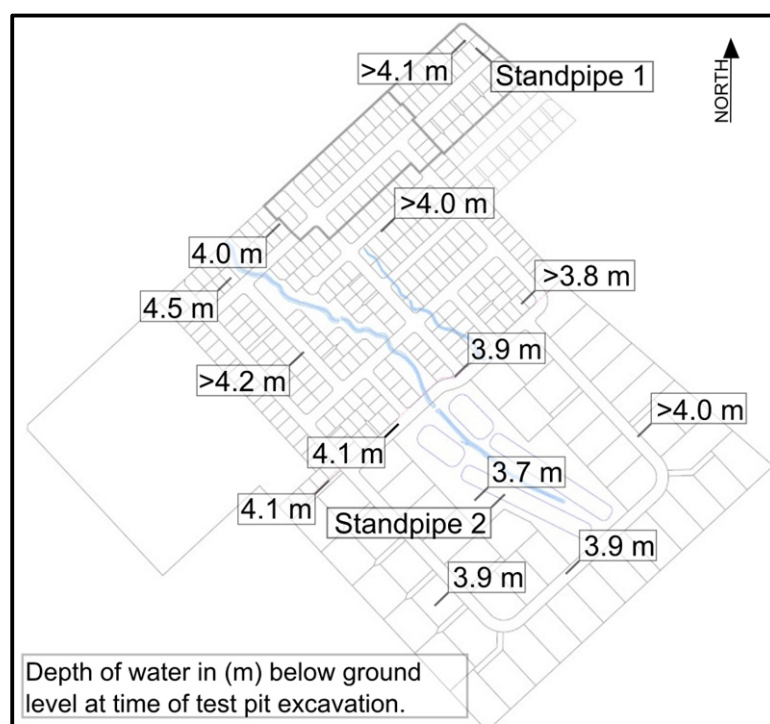


Figure 7: Annotated site concept plan showing depth to groundwater in metres below EGL in May 2021.

Two groundwater standpipes were installed to monitor seasonal groundwater variations. Locations of the standpipes are shown in Appendix A. Manual groundwater readings were taken and are presented in Table 4.

Table 4: Onsite Groundwater Recordings		
Recording	Standpipe 1 (northern) depth below EGL	Standpipe 2 (central) depth below EGL
28/05/2021	>5.0 m	3.5 m
22/06/2021	4.8 m	1.3 m
23/07/2021	4.0 m	0.9 m
13/09/2021	3.7 m	0.8 m
21/09/2021	3.8 m	0.8 m

4.0 INFILTRATION TESTING

Davis Ogilvie conducted water infiltration testing on the in-situ soils in the location of the proposed stormwater detention basin, as shown in Figure 1. The rate of infiltration was measured for near-surface topsoil and silt units using the Double Ring Infiltrometer (DRI) method, and for gravels by the Falling-Head Percolation (FHP) tests. Full test results are presented in Appendix C, and infiltration results are summarised in Table 5.

4.1 Double Ring Infiltrometer

Two DRI tests were conducted in general accordance with the ASTM standard¹³ on the silt soils 0.4 m below EGL. No significant fall of the water level (i.e., <5 mm) was observed in the internal ring water level over the 60-minute test duration. The recorded infiltration rate was 1 – 4 mm/hr in the wet silt soils. This is generally consistent with the silt subsoil infiltration rates measured by E2 Solutions (2008) of 580 – 1,580 mm/hr, generally 1,200 mm/hr (reported as 12 – 33 mm/day, generally 25 mm/day).

4.2 Falling-Head Infiltration

Three FHI tests were undertaken in approximate area of the proposed stormwater basin (at TP13, TP15 & TP17). FHP tests were repeated three times to ensure the soil matrix was completely saturated. Excavations were advanced to ~2.0 m below EGL, terminating in sandy gravel. Ultimate infiltration rates in the order of 600 – 1,850 mm/hour were recorded in the sandy gravel soils, as summarised in Table 5.

Table 5: Summarised Infiltration Parameters					
	DRI:		FHI:		
	DRI1	DRI2	FHI1 (TP15)	FHI2 (TP13)	FHI3 (TP17)
Test depth (m below EGL)	0.4 m	0.4 m	2.3 m	2.0 m	2.1 m
Soil type	Silt	Silt	Sandy gravel	Sandy gravel	Sandy gravel
(Median) ultimate infiltration rate, f_c	≤1 mm/hr	≤4 mm/hr	625 mm/hr (600 – 650)	450 mm/hr (390 – 490)	1,850 mm/hr (1,450 – 2,050)

¹³ American Society for Testing and Materials (ASTM) D3385 – 18 Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer.

5.0 LABORATORY RESULTS

A laboratory testing suite was undertaken on a representative bulk sample of silt recovered from the location of DRI1 at 0.3 – 0.4 m below EGL. The individual sample and its results are considered sufficiently representative of the shallow silt unit underlying the site for preliminary infrastructure design; however, further laboratory analysis is likely required prior to and during construction to verify the design parameters.

5.1 Particle Size Analysis

The silt sample was analysed for particle size distribution using a hydrometer to confirm the fines content by weight percent. Laboratory reports are provided in Appendix D and results are summarised in Table 6.

Table 6: Laboratory Results for Silt Sample	
Fraction / parameter	Sample
	DRI 1, 0.3 – 0.4 m
Clay (<0.002 mm)	29%
Silt (<0.06 mm)	65%
Sand (>0.06 mm)	6%
Description	"Clayey SILT with minor sand"

5.2 Maximum Dry Density

The silt sample was tested for Maximum Dry Density (MDD) using the standard compaction method in accordance with NZS 4404:1986. The clayey silt returned a MDD of 1.64 t/m^3 at an optimum water content 22 %. Results are included in Appendix D.

5.3 Atterberg Limit Analysis

The above sample was also analysed to determine Atterberg (liquid and plastic) limits in accordance with NZS 4402:1986 (Test 2.1, 2.2, 2.3, 2.4). Overall, the sample plots in the 'low to medium plasticity clay behaviour' field of the Cassagrande chart, above the A-line. Full reports are included in Appendix D and the results are summarised in Table 7.

Table 7: Atterberg Limit Analysis Results	
Parameter:	Sample
	DRI 1, 0.3 – 0.4 m
Water Content	25 %
Liquid Limit	45%
Plastic Limit	24%
Plasticity Index	21% (‘CL’ – low to medium plasticity clay behaviour)

5.4 California Bearing Ratio

A California Bearing Ratio (CBR) analysis was undertaken on the remoulded silt sample in accordance with NZS 4402:1986(6.11). The soaked sample returned a CBR of 5%. Results are included in Appendix D.

5.5 Laboratory Permeability Test

Permeability of the silt material was tested in accordance with ASTM D5084-16¹⁴. Under three constant head conditions and standard test pressures, the sample returned permeabilities between 0.0014 – 0.0017 mm/hr). Results are included in Appendix D (reported as 4.0×10^{-10} and 4.7×10^{-10} m/s).

5.6 Pinhole Dispersion Test

One silt sample, collected from beneath the topsoil unit, was tested by pinhole dispersion to classify the erodibility and permeability characteristics of the shallow soils. Tests were undertaken in accordance with ASTM D4647-93 and used standard laboratory parameters, including three stages of head.

Results show a dispersive grade of ‘ND1’ indicating a non-dispersive soil. Results are included in Appendix D.

6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

6.1 Design Criteria

In accordance with NZS 1170.5 a site soil class of D (deep or soft soils) shall apply to the site, due to the expected significant depth to bedrock.

¹⁴ ASTM D5084 – 16: Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter. <https://www.astm.org/DATABASE.CART/HISTORICAL/D5084-16.htm>

6.2 Liquefaction Hazard

The site has been observed as being uniformly underlain by a layer of stiff silt over dense gravel. Within the gravel unit, static groundwater was generally encountered approximately 4.0 m below EGL. Seasonally shallower depths to groundwater have been measured however generally a moderately deep groundwater level can be assumed.

The soil and groundwater conditions at the site are considered consistent with those described in the area of 'very low [liquefaction] potential' by Yetton & McCahon (2002)¹⁵.

Given the depth to groundwater, density of the saturated host gravels, and the consistency of the overlying silt unit, the site is unlikely to be at significant risk from liquefaction during future large seismic events. In terms of MBIE (2017)¹⁶ liquefaction risk categories, we consider the site to have an equivalent "low liquefaction vulnerability" category, whereby liquefaction damage is considered unlikely during future seismic events.

6.3 Soil Static Ultimate Bearing Capacities

Based on the in-situ DCP testing a static ultimate bearing capacity of 300 kPa has generally been achieved below the topsoil unit at depths ranging from 0.3 – 0.5 m below EGL, with a localised exception of 1.0 m below EGL in the vicinity of DCP3 (location of uncontrolled fill).

It should be noted that although testing revealed consistent subsurface soil conditions, a low density of geotechnical testing has been undertaken. The level of testing is considered suitable for general recommendations to assist with the initial consenting phase of the development; however, following earthworks and prior to building consent, further testing and supervision will be required during subdivision development.

6.4 Preliminary Foundation Recommendations

Foundations designed in accordance with NZS 3604:2011 (*Timber-Framed Buildings*) are considered appropriate for proposed buildings, subject to the recommendations provided in Section 8.0. It is noted that localised areas of uncontrolled fill were encountered on site (mainly associated with filling of natural depressions). It is likely that further areas of uncontrolled fill not identified by this investigation exist on site. These should be identified addressed during subdivision earthworks (where applicable).

For a building to comply with NZS 3604:2011, all topsoil, organic material or any other unsuitable material, including non-engineered fill, should be stripped from beneath the building footprint prior to any foundation construction onsite.

¹⁵ Zones have been digitised from the liquefaction potential map (Figure 7.1) in Geotech Consulting Ltd – Yetton & McCahon, 2002, Ashburton District Engineering Lifelines Project: Earthquake Hazard Assessment. Environment Canterbury report U02/55. Accessed from 'Ashburton liquefaction susceptibility (2002)' layer at <https://opendata.canterburymaps.govt.nz/datasets/ecan::ashburton-liquefaction-susceptibility-2002/about>
¹⁶ MBIE (2017), Planning and engineering guidance for potentially liquefaction-prone land, published 26 September 2017.

It is recommended that a Registered Professional Surveyor confirm ground levels onsite, and ECan/ADC confirm the minimum Finished Floor Levels prior to construction.

6.5 Indicative Soil Properties

Estimated soil properties for preliminary design purposes are provided in Table 8.

Table 8: Estimated Shallow Soil Properties				
Soil Description	Unit Weight ¹⁷ (γ)	Internal Angle of Friction ¹⁸ (ϕ)	Cohesion (c) ¹⁷	Modulus of Subgrade Reaction (k_s) ¹⁹
SILT	15 – 17 kN/m ³	26 – 28°	3 – 5 kPa	45 – 55 kPa/mm
GRAVEL	19 – 21 kN/m ³	35°	0	100 – 150 kPa/mm

6.6 Historic Channel Remediation

A review of historic aerial imagery shows that the site was crossed by multiple paleochannel depressions, as illustrated in Figure 4. Most of the depressions, with the exception of Marshalls Creek, appear to have been backfilled or levelled during farming land use. Only one test pit (TP3) coincided with the location of a backfilled channel, encountering approximately 1.0 m of uncontrolled fill. Based on the estimated paleochannel locations shown in Figure 4, areas of uncontrolled fill (or overly thick topsoil) should be expected in these (and other) locations during earthworks.

An earthworks allowance should be considered for over-excavating and appropriately backfilling any areas of deep fill or topsoil encountered on site. It is recommended that the channels are backfilled with engineered site won (silt) fill to achieve similar soil conditions (i.e., permeability) to that of the adjacent natural soils. Careful consideration must be given to the use of subsoil drains due to the likelihood of damage to these drains from future trenching and piping infrastructure.

6.7 Preliminary Pavement Design

Based on DCP test of the shallow subgrade soils (silt), and correlations provided in NZS 4404:2010²⁰, a CBR of 5 is recommended for preliminary pavement design. It must be noted that the silty subgrade soils will be sensitive to moisture variations and vehicle loading. Excessive moisture or vehicles tracking over the subgrade will have an adverse impact on the subgrade conditions and must be carefully managed during the earthworks phase.

¹⁷ Look, B.G. (2007) Handbook of Geotechnical Investigation and Design Tables, Taylor & Francis Group, London, UK.

¹⁸ Bowles, J.E. (2001) Foundation Analysis and Design, McGraw-Hill International Editions – 5th Edition, Table 2-6 pp108.

¹⁹ Figure 3.1 in NZS 4404:2010

²⁰ NZS 4404:2010 Land development and subdivision infrastructure.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Earthworks

Earthworks must be carried out in accordance with the NZS 4431:1989²¹. The recommendations should be incorporated into the subdivision engineering plans and into an earthworks specification developed specifically for the site. Important aspects of the earthworks operation include but are not limited to the following:

- All areas on which the fill is to be placed is to be stripped of all vegetation, topsoil, soft, organic or otherwise unsuitable soils. Topsoil onsite is approximately 0.2 – 0.4 m thick. All stripped subgrade areas are to be inspected by a suitably experienced geo-professional prior to placing of any fill.
- The engineer is to be notified of all weak soils, soft or organic material, uncontrolled or historic fill.
- The subgrade surface must be adequately surveyed by the contractor (under the supervision of a Registered Professional Surveyor), and the information provided to Davis Ogilvie.
- The subgrade should be protected from water ponding and from rutting or weaving as a result of vehicle or machine loadings. Careful management of the silty subgrade will be required during earthworks, especially during periods of rain.
- Target engineered fill Maximum Dry Density (MDD) values (1 per 4,000 m³ of fill) must be obtained prior to placement of fill and shall be retested in accordance with NZS 4431, or as directed at any stage by the engineer. Fill shall be placed in lifts no thicker than 230 mm (un-compacted) and is to be compacted to 95% of its MDD.
- Nuclear Density (ND) testing shall be carried out on every 230 mm lift of filling at max 20 m spacing, 400 m² to confirm sufficient compaction, or unless otherwise specified by the Engineer. Direct transmission mode shall be used on silt and sands fills. Backscatter mode may be adopted for testing of aggregates.
- The site location and subject lift of ND tests must be appropriately recorded (e.g., GPS surveyed), and is to be provided along with the test results to Davis Ogilvie.
- The Engineer may require and/or undertake additional DCP testing on the compacted engineered fill. Fill is to achieve the requirements of NZS 3604:2011 “Good Ground” defined as a minimum 5 blows/100mm. This requirement must be conformed before the placement of any subsequent lifts or topsoil.
- All filling records are to be provided to the engineer for review and to support the fill certificate and as-built completion report. Fills not achieving the required conformance shall be reworked or replaced with conforming material.

²¹ NZS 4431:1989 Code of practice for earth fill for residential development.

7.2 Material Reuse

Bulk samples of the shallow silt unit have been laboratory tested to help inform recommendations for material reuse. Particle size distribution (PSD), Atterberg Limits and maximum dry density/optimum moisture content (MDD/OMC) tests were carried out by Opus Laboratories, Christchurch. Test results are discussed in Section 5.0, and laboratory reports are attached.

It must be noted that while placement of silt fill is considered appropriate, the material is highly sensitive to moisture variations and will be difficult to achieve the conformance requirements. It is recommended that material is only placed under favourable weather conditions and that extreme care is taken to protect both the subgrade surfaces and placed silt fill. Care must also be taken to protect fill stockpiles from moisture ingress.

7.3 Cut / Fill Recommendations

Specific recommendations for earthworks shall be provided in a site-specific earthworks specification and Earthworks Management Plan (EMP). General requirements for fill placement are provided below:

- All engineered fills to be used on site are subject to further laboratory validation testing and examination by the Geoprofessional during earthworks. Testing shall include but not be limited to PSD, Atterberg limits, and MDD.
- Compaction field trials / plateau tests of the selected fill material shall be undertaken to ensure adequate density of the fill material can be achieved in the field.
- Prior to approval by the Geoprofessional, any imported fill must be tested to obtain, as a minimum, PSD, MDD and OMC.
- To enable fill certification at the earthworks completion stage, all fill must be placed and validated to NZS 4431:1989 'Earthfill for Residential Development' and the requirements of the site-specific earthworks specification EMP developed by the appointed Geoprofessional.
- The founding condition of the natural ground must be inspected and tested by a suitability qualified Geoprofessional prior to filling.

7.4 Dust, Erosion and Sediment Control

The subdivision contains an ephemeral waterway which crosses and exists the site to the south. Stormwater runoff must be adequately controlled both during subdivision development and in the long term to prevent localised erosion, overland flow and sedimentation. It is recommended that appropriate drainage means are incorporated in the design of the development to manage runoff.

Fine silt/clay soils can be highly dispersive in water and have the potential to create significant quantities of dust during earthworks. A stringent erosion and sediment control plan should be in place prior to earthworks commencing. It is recommended that site stripping is undertaken in small, manageable sections, and the areas covered with mulch and or topsoil and vegetation as soon as is possible to reduce the potential for erosion and dust on the site.

7.5 Stormwater Management

The ultimate development will drain to a single stormwater management area (first flush basins and wetlands), which will discharge to the southern existing watercourses on the site. It is proposed that the northern watercourse will be infilled and all flow directed to the southern watercourse. The southern watercourse is larger, more defined and recognised by ECan. As part of Stage 1, preliminary designs indicate a temporary first flush basin and wetland will be constructed for treatment and attenuation in the location of the ultimate SMA. Allowing the temporary first flush basin and wetland to be enlarged in the future for the ultimate SMA.

7.6 Wastewater

It is understood that the sewer main in Trevors Road is currently near maximum capacity. ADC is in the development stage of adding a relief sewer for Ashburton to take flows from Albert Street and an area of Ashburton to the north-east of the proposed development. Once the relief sewer is in place, we understand that there will be capacity available in the Trevors Road sewer for Stage 1 Strowan Fields, which will drain to the existing main in Trevors Road. Future stages are expected to drain directly to the relief sewer via a new pump station.

With robust engineering design, and a suitable level of construction observation, the shallow soils on the site are considered competent and non-liquefiable to support a gravity-fed wastewater system.

8.0 SECTION 106 RESOURCE MANAGEMENT ASSESSMENT

Section 106 of the Resource Management Act (RMA) requires that the site of a subdivision be assessed for potential material damage from erosion, falling debris, subsidence, slippage, or inundation of the Proposed Lots. These hazards are discussed in Table 9.

Table 9: Resource Management Act Considerations

Natural Hazard	Potential Effects on Developed Site
Erosion	Erosion is not considered a significant risk to the subdivision due to its flat topography. All surface water on the site should be managed to minimise potential erosion and suitable landscaping and stormwater management systems are required ensure overland flows are controlled to prevent erosion and scouring of surface soils.
Falling Debris	Due to the flat topography of the subdivision and surrounding area it is considered there is an extremely low risk of falling debris impacting the site.
Subsidence	Seismically-induced liquefaction is unlikely to affect the site as the soils below the water table generally consist of coarse-grained materials of low liquefaction potential. With reference to MBIE (2017) ²² , the site is considered to have an equivalent “very low liquefaction vulnerability” category, whereby liquefaction damage is considered unlikely. Natural soils on site are considered sufficiently competent for the proposed development and are considered to present low risk in terms of static settlement/subsidence. All earthworks filling proposed to be undertaken across the site is to be carried out in accordance with NZS 4431:1989, inspected and certified by a suitably qualified Geoprofessional.
Slippage	Due to the flat topography of the subdivision site, ground slippage is not anticipated.
Inundation	The site is not located within an identified flood zone. Inundation of the site during floods is considered to be of low risk. It is recommended that a Registered Professional Surveyor confirm ground levels onsite and ADC should be contacted to confirm minimum floor levels for the site. The proposed development must be appropriately designed to manage, contain and discharge stormwater so as to manage the inundation risk to the site and also to adjacent sites. Overland flow paths must be identified and preserved as part of the subdivision design.

9.0 SUITABILITY FOR SUBDIVISION

Provided the recommendations presented in this report are followed, it is determined that the site is suitable under Section 106 of the RMA for the proposed subdivision into approximately 265 high density residential lots and 48 low density residential lots. It is considered that the risk of the hazards discussed in this report can be mitigated or managed to an acceptable level. A statement of professional opinion on the suitability of land for subdivision is attached as Appendix E. The granting of subdivision consent is supported, subject to the following conditions:

1. All earthworks shall be undertaken under the supervision of a suitably qualified Geoprofessional with experience in land development.

²² MBIE (2017), Planning and engineering guidance for potentially liquefaction-prone land, published 26 September 2017.

2. All fill placed as part of the subdivision development or under future building footprints must be placed in accordance with NZS4431:1989 and inspected and certified by a chartered professional engineer.
3. All uncontrolled fill, infilled channels, backfilled test pits, low strength soils, organic soils or otherwise unsuitable soils within foundation excavations or beneath civil infrastructure or structural fill will require remediation by excavation and engineered filling in accordance NZS4431:1989.
4. Any new foundations onsite must be founded below the organic topsoil, uncontrolled fill, or any other unsuitable material.
5. It is recommended that all future building foundation excavations are inspected/confirmed by a suitably qualified person at time of construction.
6. Minimum floor levels as per New Zealand Building Code E1 and ADC and ECan requirements.
7. Stormwater must be appropriately managed during subdivision development and longer term to limit the influence of surface water erosion on the site. Any overland flow paths must be identified and preserved as part of the subdivision design.

10.0 SUMMARY OF FUTURE WORK REQUIRED

10.1 Prior to Construction

10.1.1 Engineering Plans – Review

The full set of engineering plans are to be reviewed by or under the direction of a Chartered Professional Geotechnical Engineer. The review shall include but not be limited to the following:

- Scheme plan with proposed topography.
- Earthworks plans to show proposed cut and fill areas.

10.1.2 Earthworks Specification

In addition to the civil specification, a standalone earthworks specification should be compiled. The specification should be tailored to the site, proposed earthworks and the CMP. The specification shall be compiled by the Geoprofessional.

10.1.3 Construction Methodology Plan (Review)

Prior to earthworks a site-specific CMP shall compiled by the Contractor and submitted to the appointed Geoprofessional for approval.

10.1.4 Earthworks Management Plan (EMP)

Prior to construction, the appointed Geoprofessional shall develop a site/stage specific EMP which will be in addition to the Earthworks Specification.

10.1.5 Dust, Erosion and Settlement Control Plan (DESCP) (Review)

The DESCP is to be submitted by the Contractor and approved by a Geoprofessional prior to any earthworks taking place on the site.

10.2 During Construction

10.2.1 Construction Monitoring

All fill shall be placed in accordance with NZS4431:1989 Earthfill for Residential Development and all earthworks on the site will be subject to construction monitoring. It is anticipated that a Construction Monitoring (CM) 3 level of geotechnical supervision will be appropriate for the bulk earthworks.

10.2.2 Well Decommissioning

Decommission of all existing standpipe piezometers and groundwater wells to the requirements of NZS 4411: 2001 "Environmental Standards for drilling of soil and rock".

10.3 Following Construction

10.3.1 As-built Surveys

Plans drawn by a Registered Professional Surveyor showing as-built surfaces and an iso-contour (cut/fill) plans and drainage plans are to be supplied to the Geoprofessional.

10.3.2 Construction Monitoring Results

All construction monitoring results including all independent nuclear densometer testing, laboratory testing and any other tests undertaken or arranged by the contractor are to be supplied to the Geoprofessional.

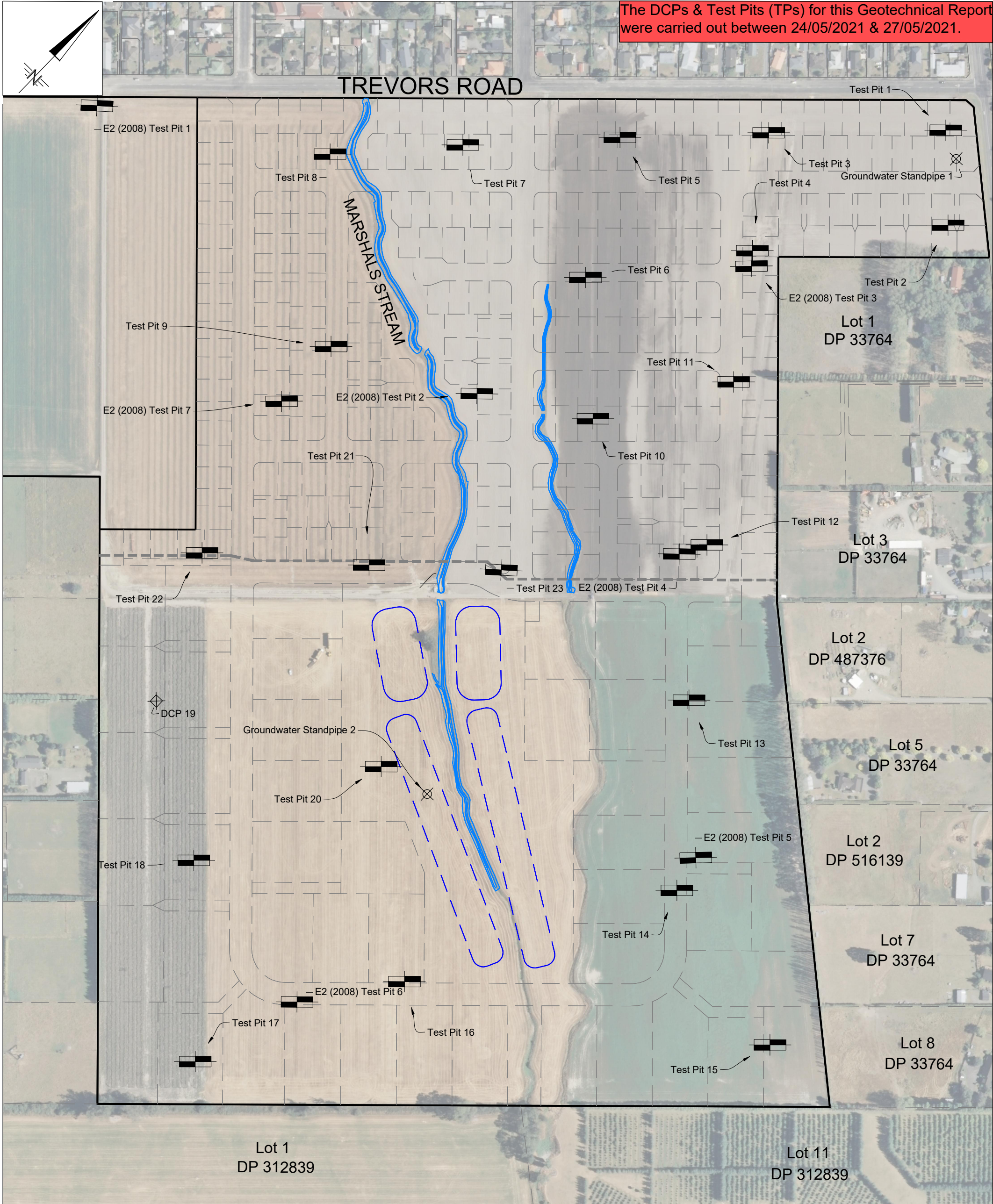
10.3.3 Geotechnical Reporting and Certification

At the completion of the earthworks an Earthworks Completion Report (ECR) shall be prepared by the Geoprofessional. Subject to satisfactory completion the report will contain the following:

- A NZS 4404:2010 Statement of Professional Opinion on the suitability for residential development (Schedule 2A).
- Fill certification in terms of NZS 4431:1989.
- As-built drawings for earthworks.
- Lot-specific development conditions.

APPENDIX A

Site and Test Location Plan (DWG G01A)



CAD ref: 210517.40481.Geotechnicalsiteplan.dwg



Davis Ogilvie & Partners Ltd - Ph. 0800 999 333

Geotechnical Site Plan
Proposed subdivision of Trevors Road
Lot 17 DP 33764

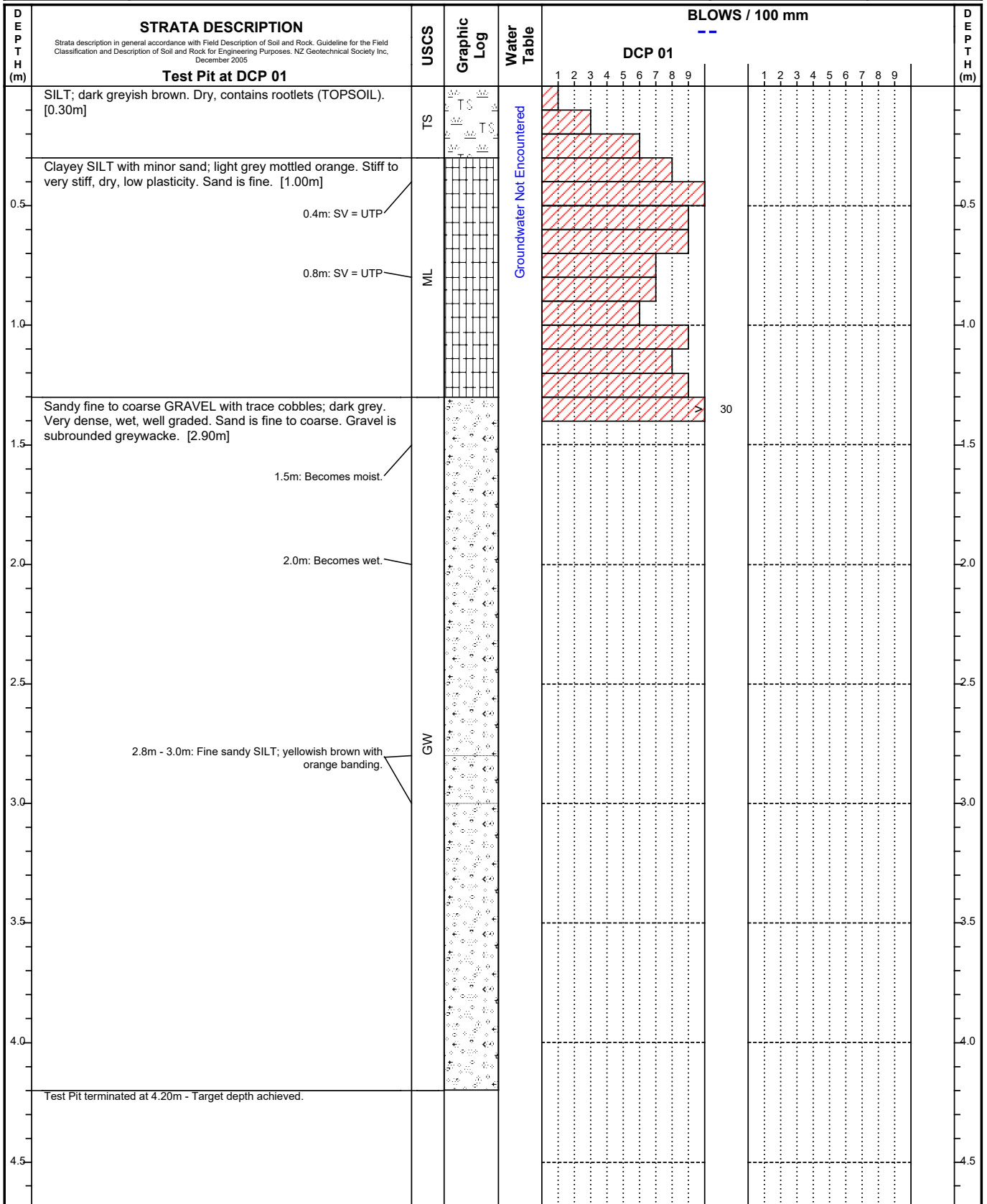
/ design	/ drawn	/ QA check	/ dwg
HC	IZ	HC	G01
/ scale @ A3	/ date	/ file	/ issue
1:5000	07/21	40481	A

APPENDIX B

Hand Auger and DCP Logs

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)
Client: Next Level Developments Ltd
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 26/05/21
Time: 9:00 a.m.
Excavation Method: EX + DCP



Logged By: HC
Plotted By: KL
Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

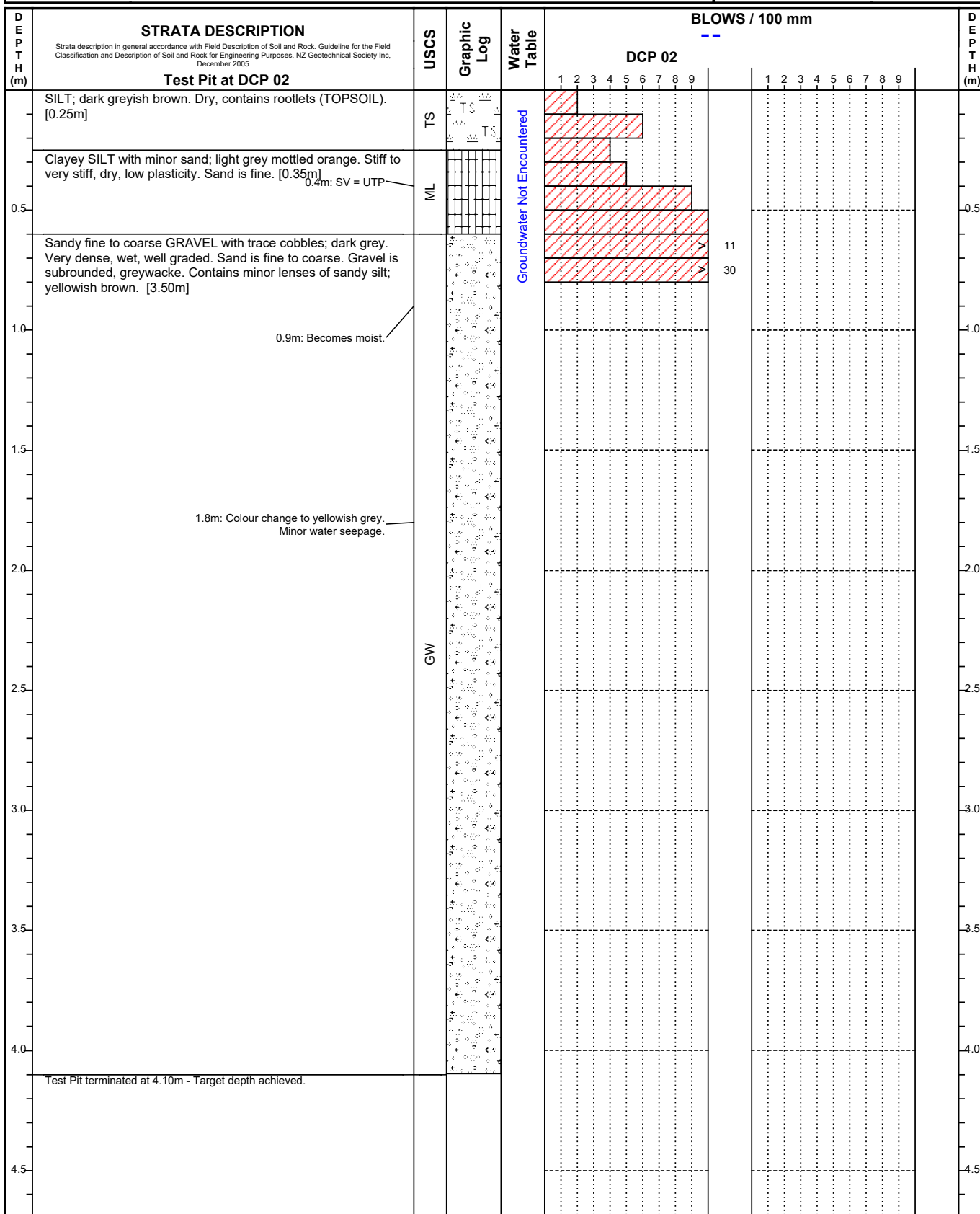
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 26/05/21

Time: 9:30 a.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: KL

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)
Client: Next Level Developments Ltd
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21
Time: 2:00 p.m.
Excavation Method: EX + DCP

DEPTH (m)	STRATA DESCRIPTION	USCS	Graphic Log	Water Table	BLOWS / 100 mm																		DEPTH (m)
	Test Pit at DCP 03				DCP 03																		
					1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	
	SILT; dark greyish brown. Dry, contains rootlets (TOPSOIL). [0.20m]	TS		Groundwater Not Encountered																			
	SILT; dark grey. Moist, low plasticity (FILL). [0.70m]	FILL																					
0.5																							
	1.0m: SV = 186+ = 186+ = 178/56																						
	SILT; blackish brown. Moist (BURIED TOPSOIL). [0.10m]	TS																					
1.0	Clayey SILT with minor sand; light grey with orange mottling. Stiff, moist, low plasticity. Sand is fine. [0.30m]	ML																					
	Sandy fine to coarse GRAVEL; grey. Dense to very dense, wet to saturated. Sand is fine to coarse. Gravel is subrounded to rounded greywacke. [2.00m]																						
1.5																							
	1.5m: Colour change to brownish grey. Becomes saturated.																						
2.0																							
2.5																							
3.0																							

Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

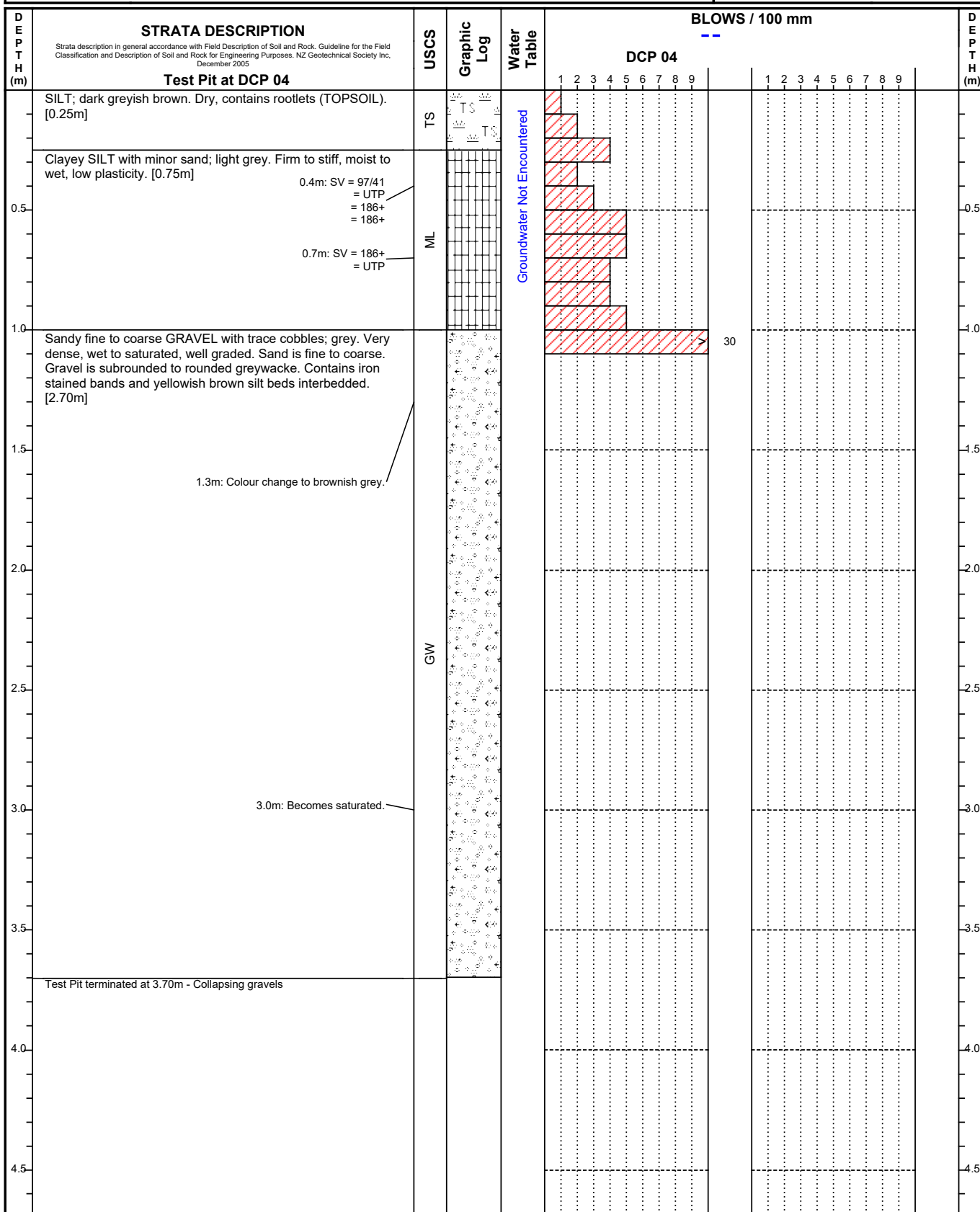
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21

Time: 1:00 p.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

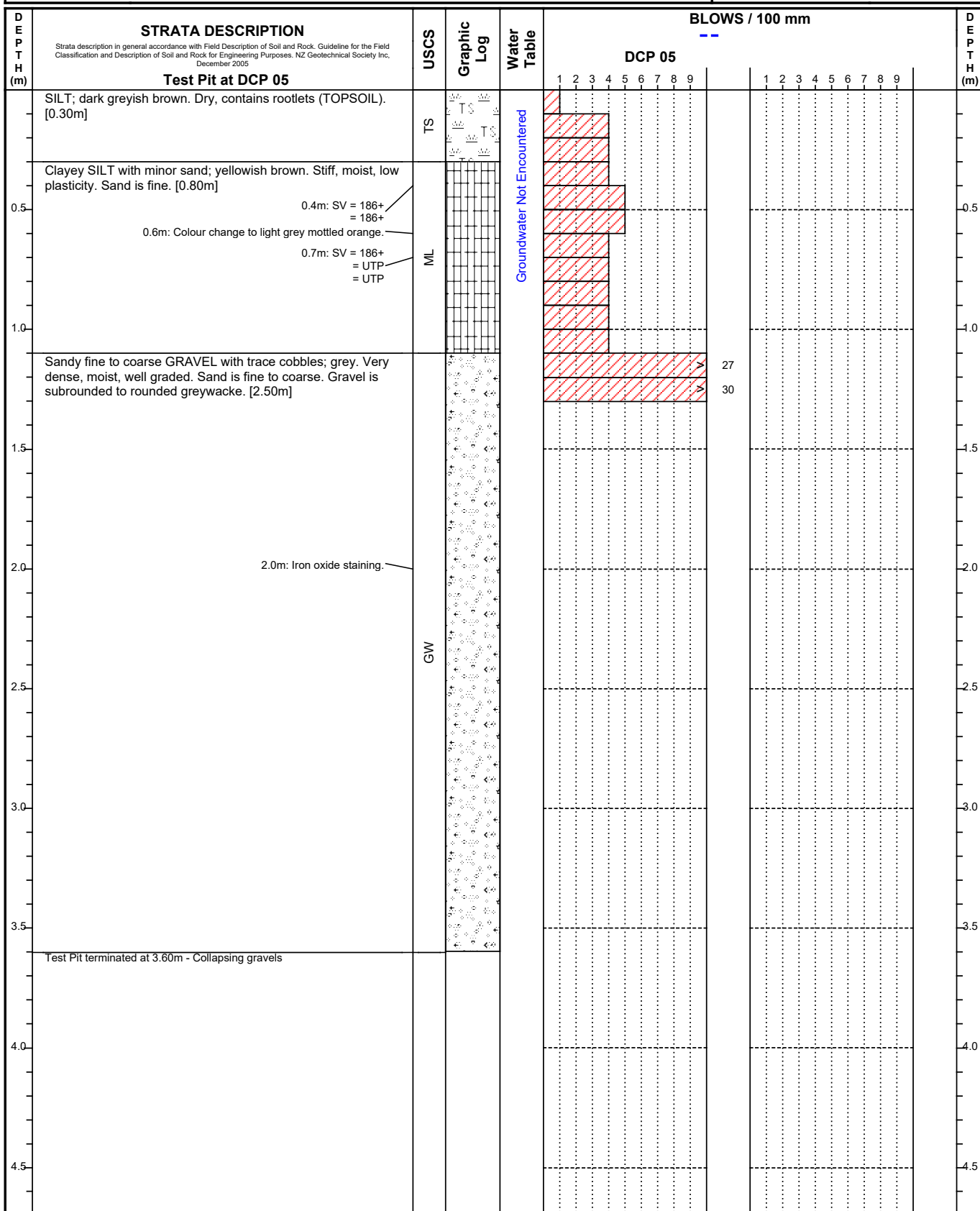
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)
Client: Next Level Developments Ltd
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21
Time: 3:00 p.m.
Excavation Method: EX + DCP



Logged By: HC
Plotted By: IZ
Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

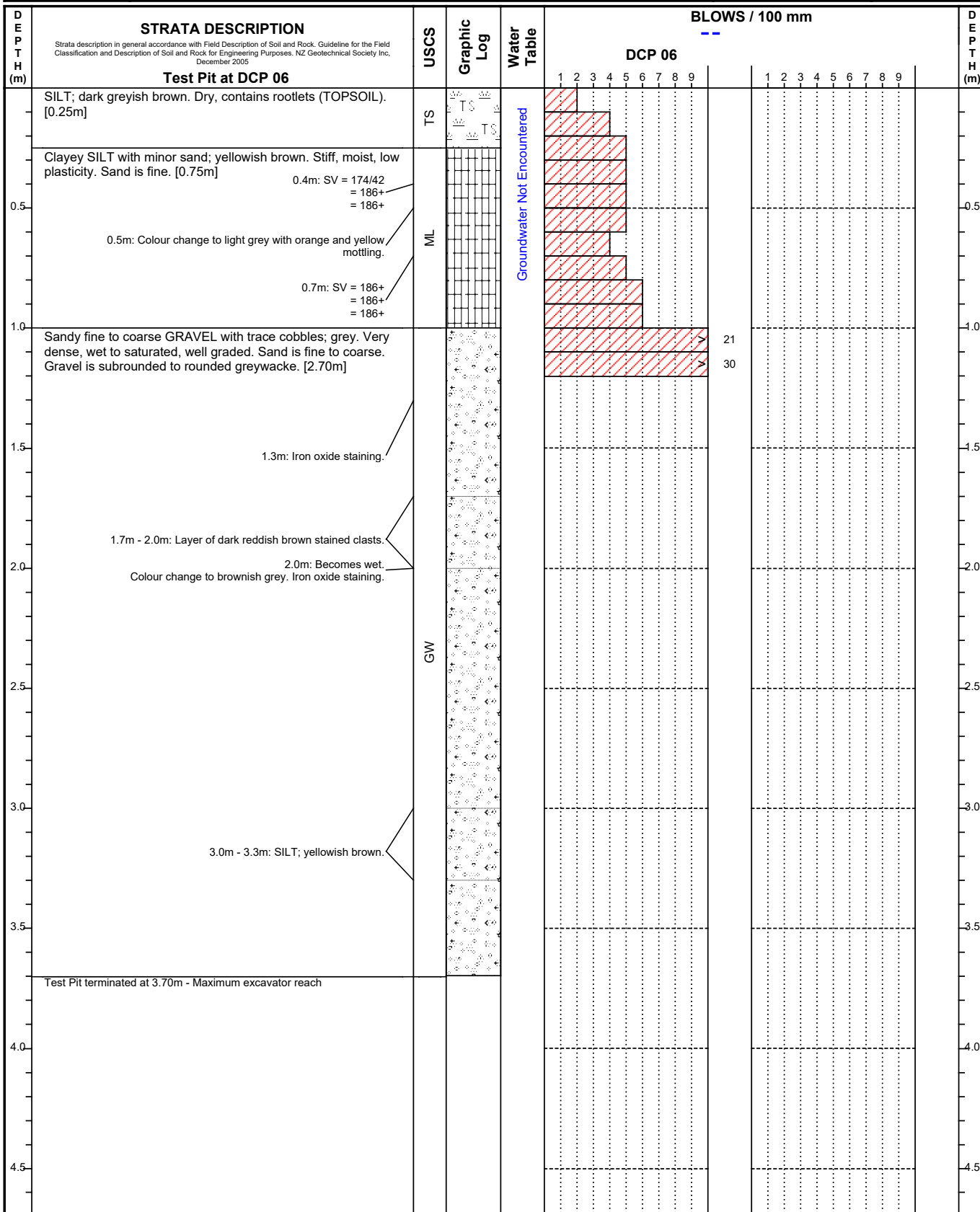
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21

Time: 1:30 p.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

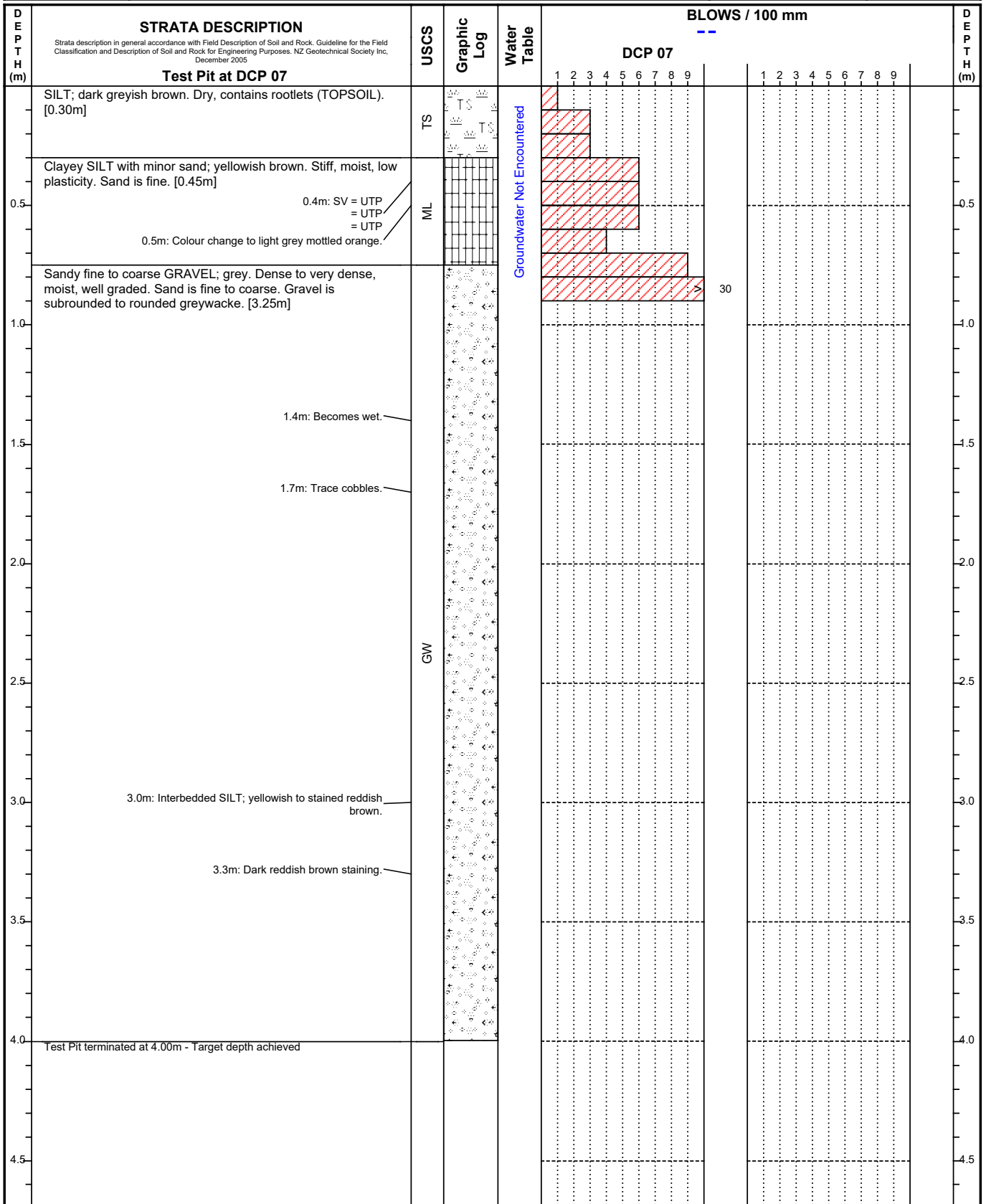
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)
Client: Next Level Developments Ltd
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21
Time: 2:30 p.m.
Excavation Method: EX + DCP



Logged By: HC
Plotted By: IZ
Checked By: HC

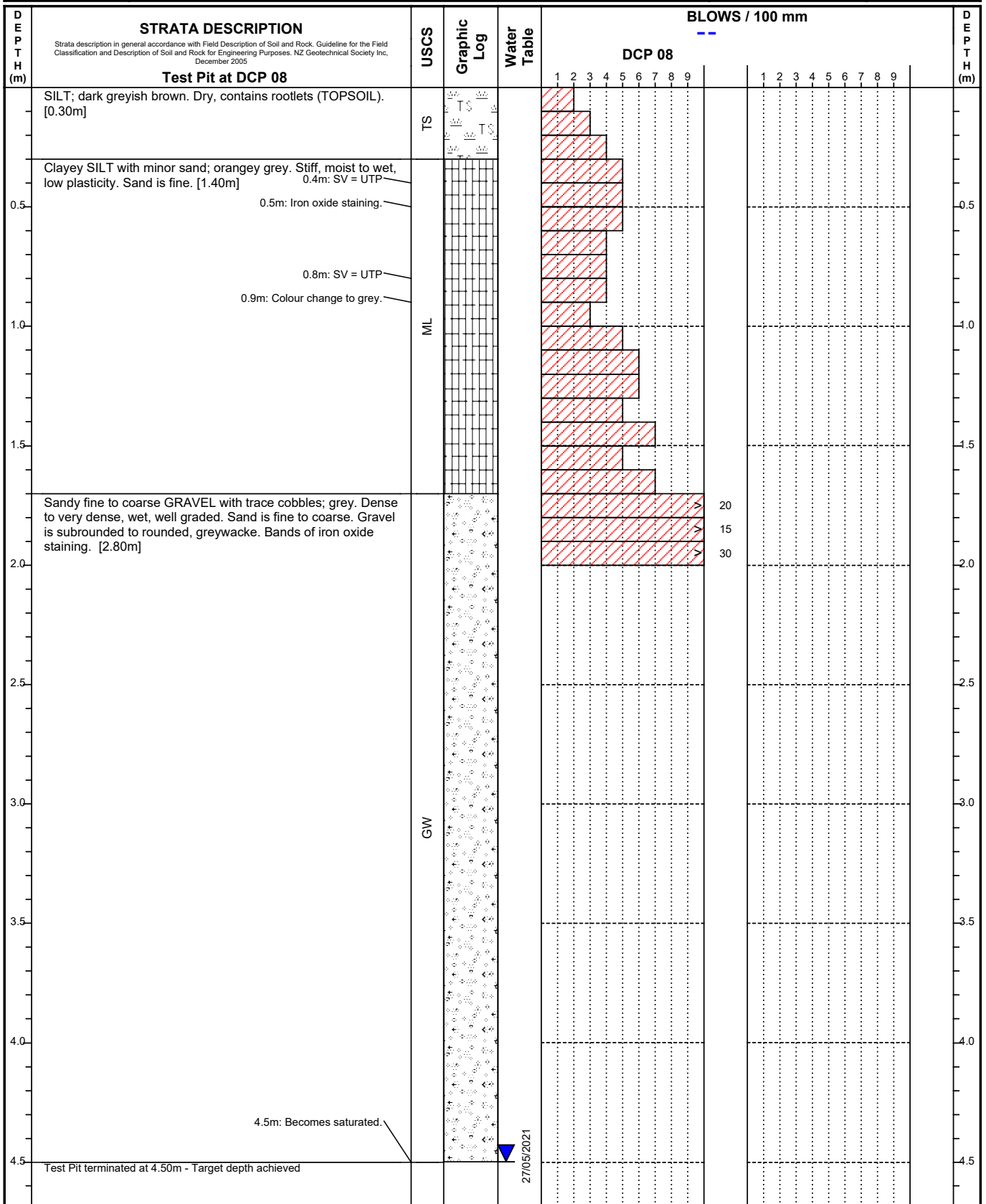
Notes: Shear vane (SV) = peak/remoulded (kPa)
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)
Client: Next Level Developments Ltd
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21
Time: 2:45 p.m.
Excavation Method: EX + DCP



Logged By: HC

Plotted By: KL

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

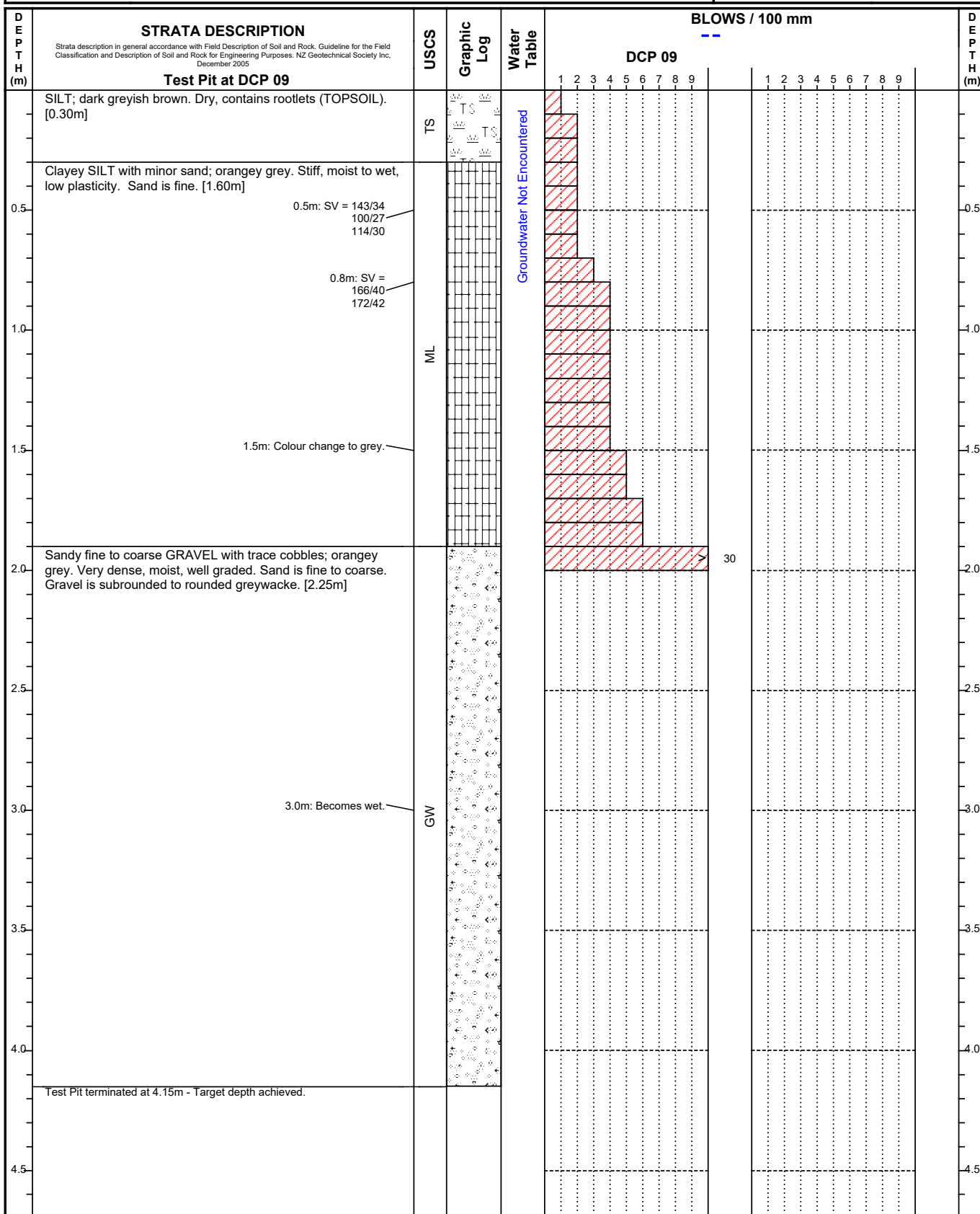
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 26/05/21

Time: 4:00 a.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: KL

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

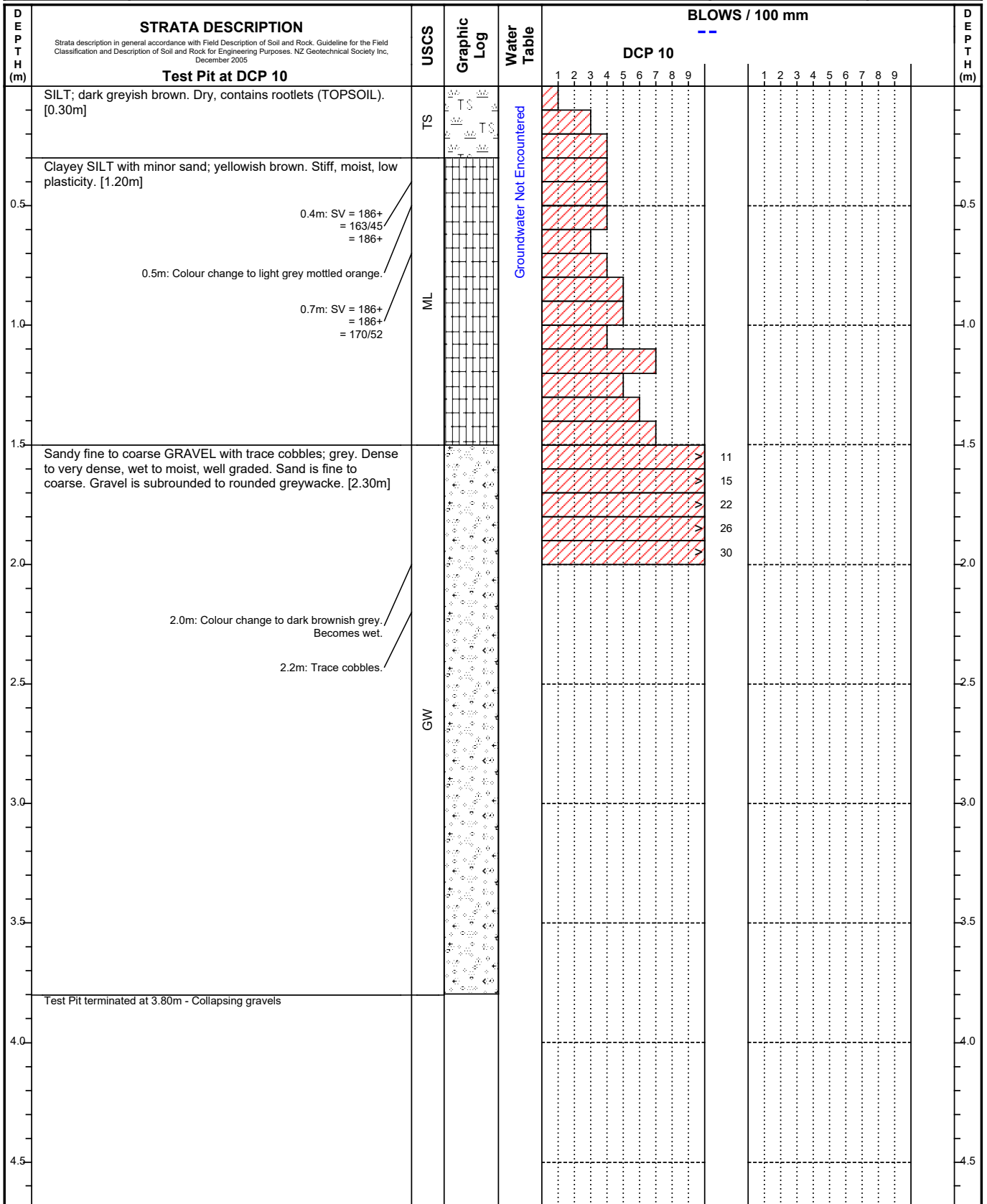
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)
Client: Next Level Developments Ltd
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21
Time: 11:00 a.m.
Excavation Method: EX + DCP



Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

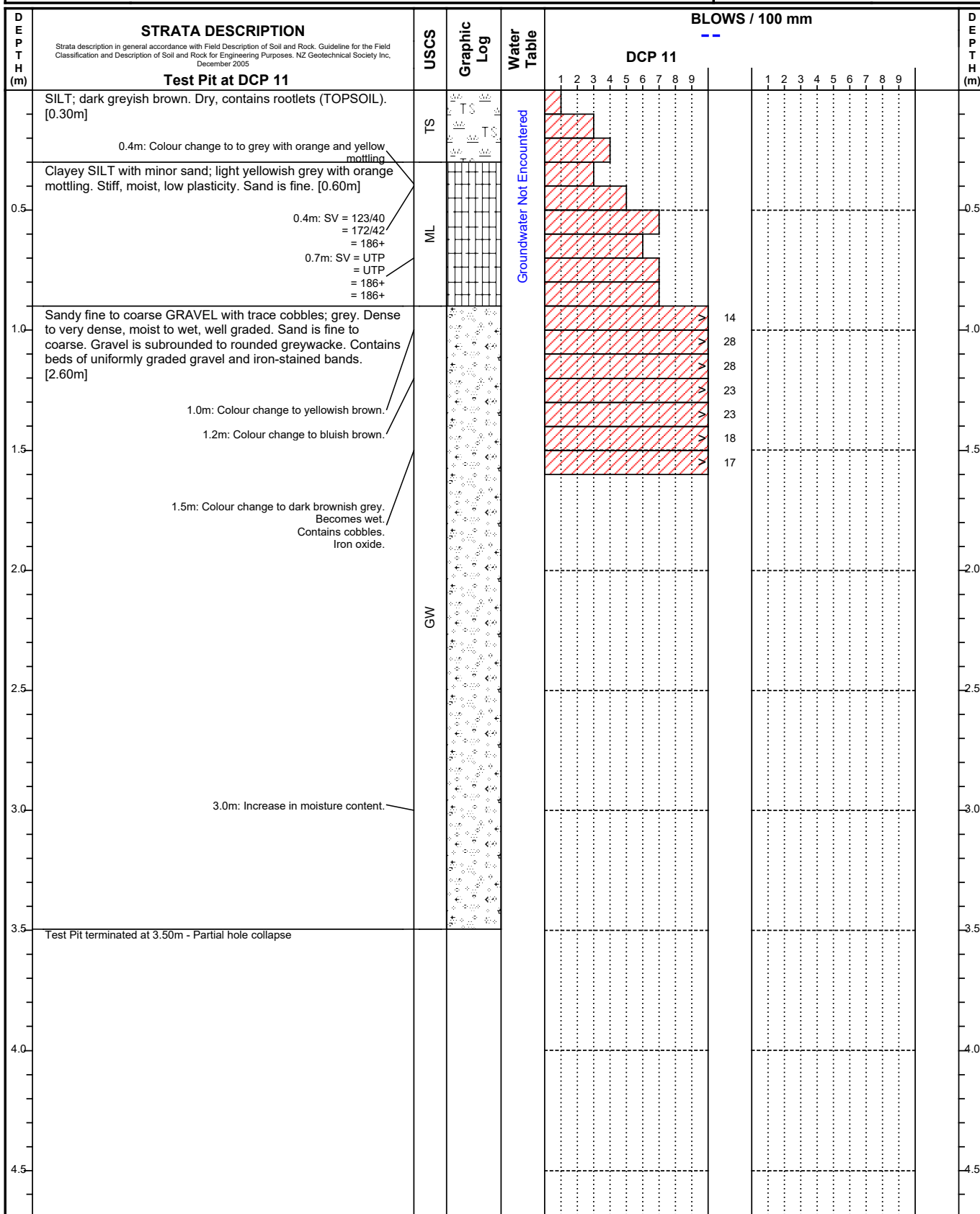
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21

Time: 11:30 a.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

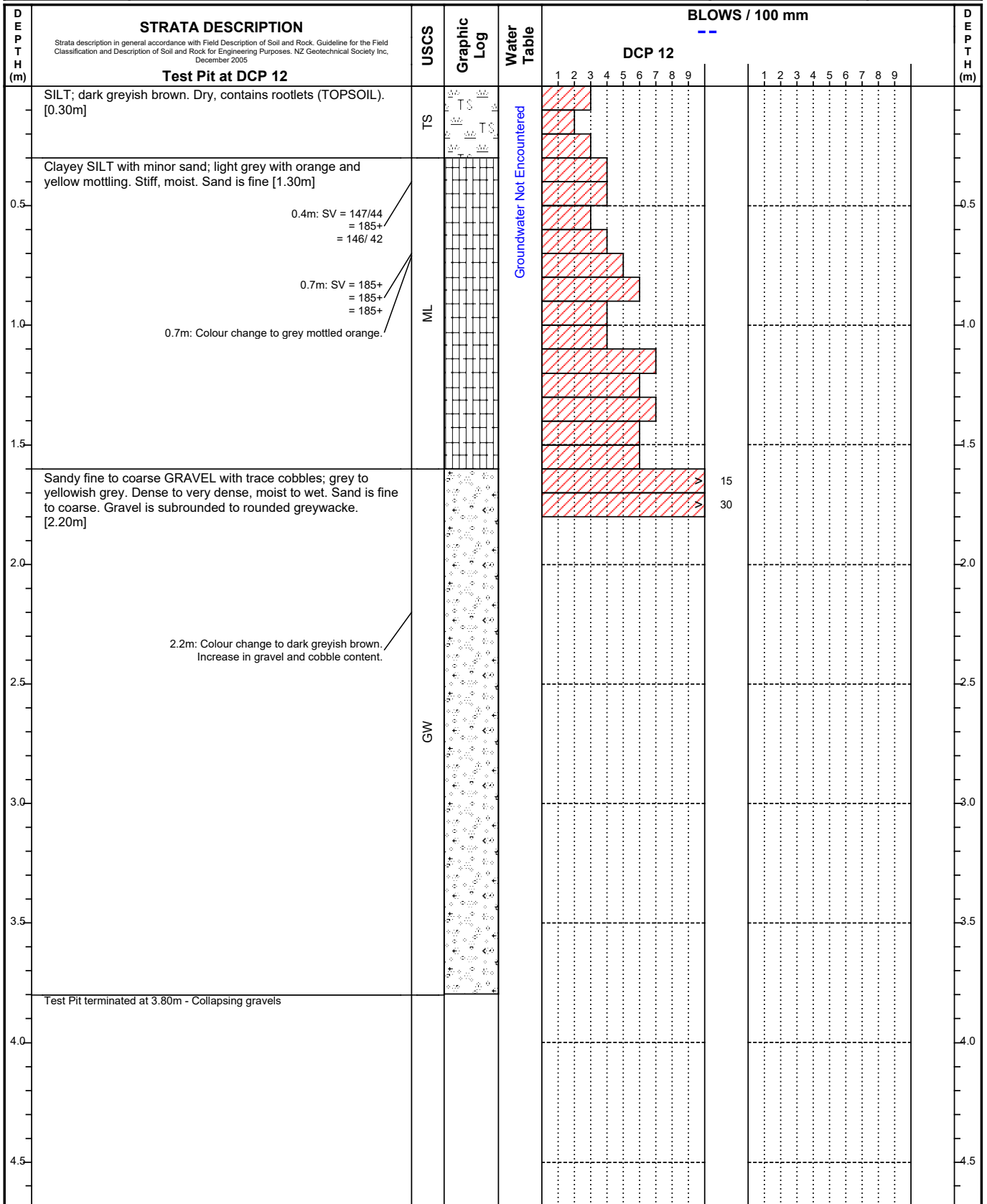
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21

Time: 10:30 a.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

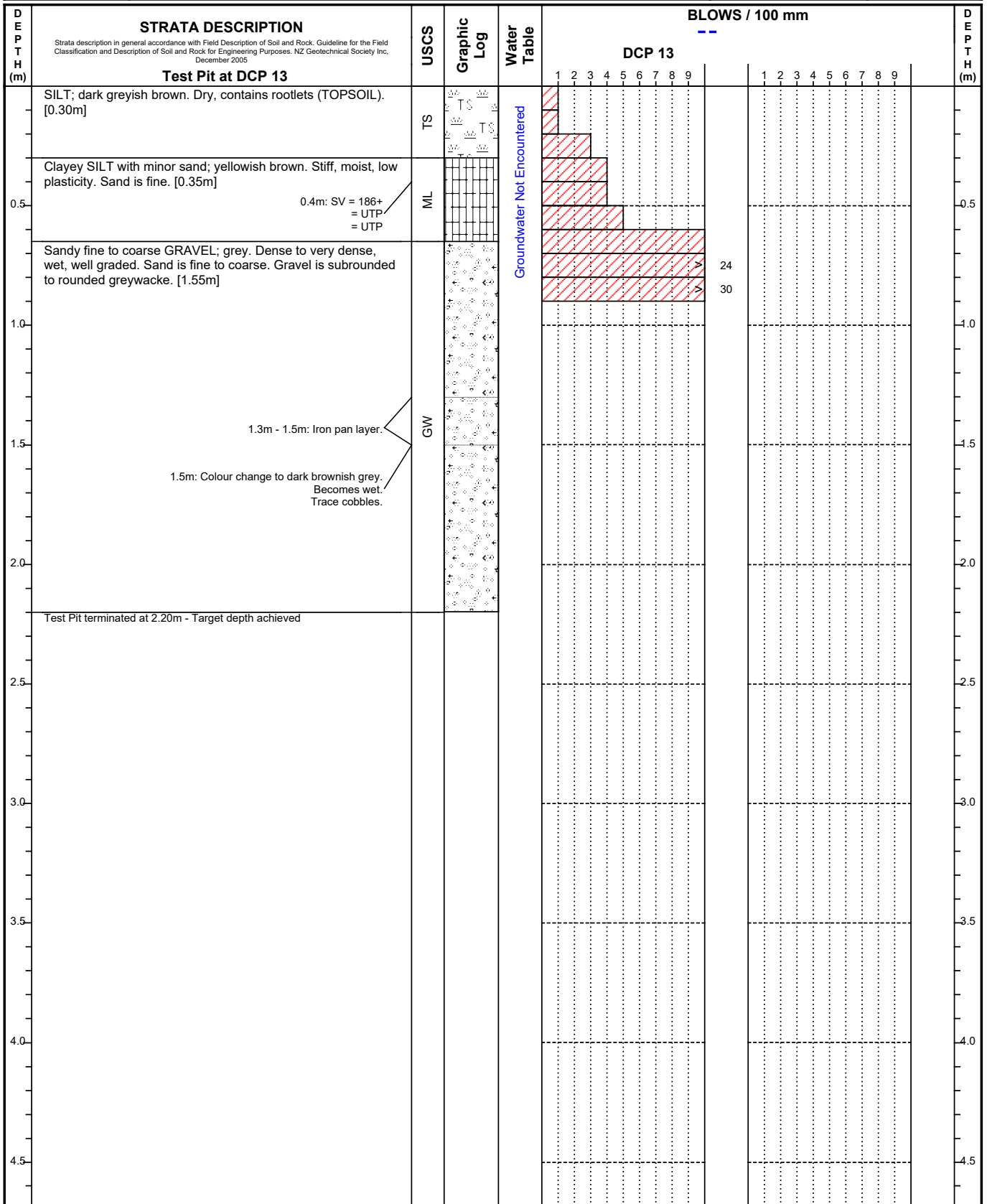
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21

Time: 12:30 p.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

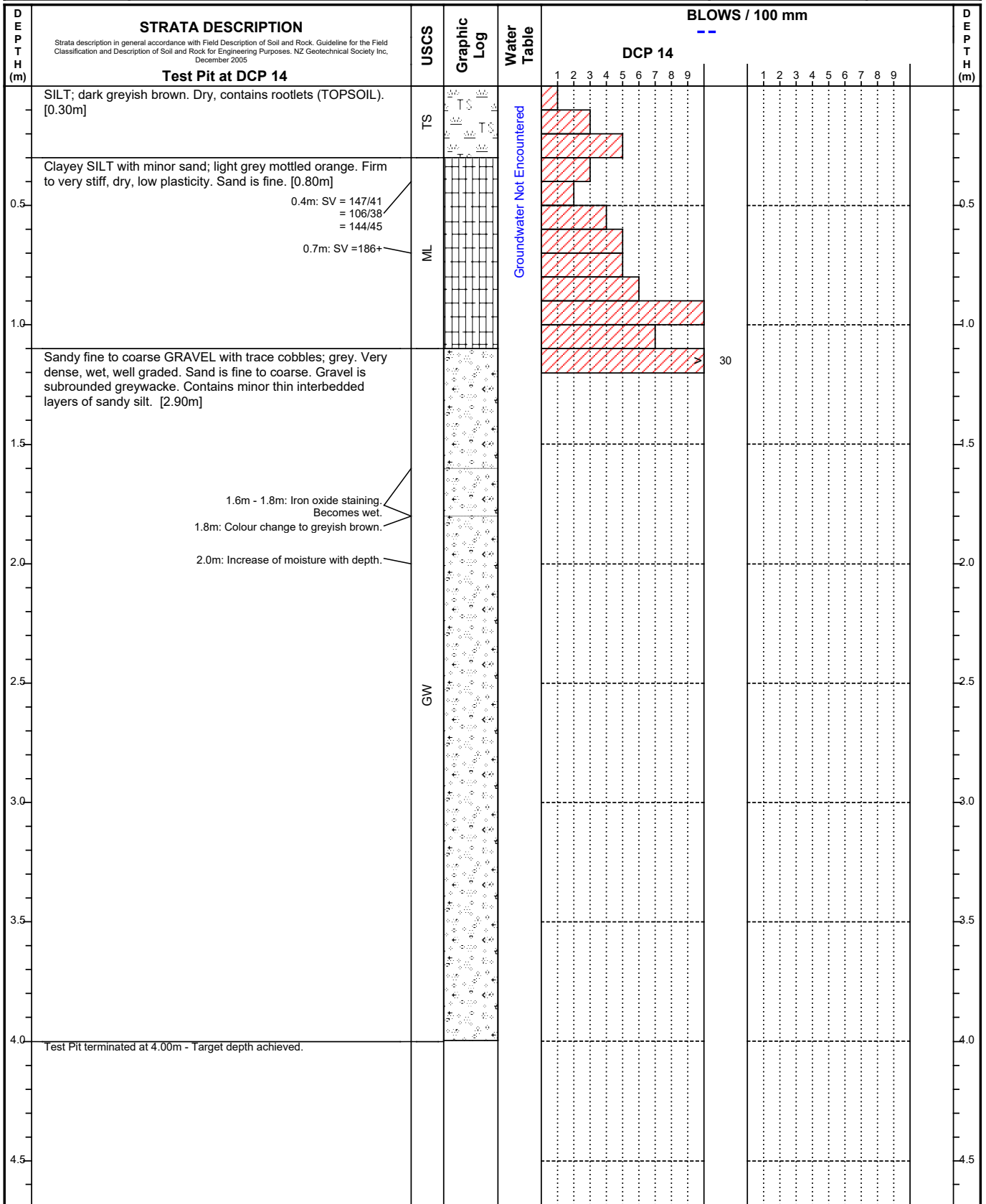
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)
Client: Next Level Developments Ltd
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date:
Time:
Excavation Method: EX + DCP



Logged By: HC
Plotted By: KL
Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21

Time: 12:00 p.m.

Excavation Method: EX + DCP

DEPTH (m)	STRATA DESCRIPTION Strata description in general accordance with Field Description of Soil and Rock, Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, December 2005	USCS	Graphic Log	Water Table	BLOWS / 100 mm																		DEPTH (m)
					DCP 15																		
	Test Pit at DCP 15				1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9
	SILT; dark greyish brown. Dry, contains rootlets (TOPSOIL). [0.30m]	TS		Groundwater Not Encountered																			
	0.3m: SV = UTP = 186+																						
	Clayey SILT with minor sand; light grey with orange mottling. Stiff, moist, low plasticity. Sand is fine. [0.10m]	ML																					
0.5	Sandy fine to coarse GRAVEL with trace cobbles; grey. Dense to very dense, moist to wet, well graded. Sand is fine to coarse. Gravel is subrounded to rounded greywacke. [2.00m]													15									
														26									
														30									
1.0	0.9m: Becomes wet. Colour change to brownish grey.																						
1.5		GW																					
2.0	1.7m: Iron oxide.																						
2.5	Test Pit terminated at 2.40m - Target depth achieved																						
3.0																							
3.5																							
4.0																							
4.5																							

Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

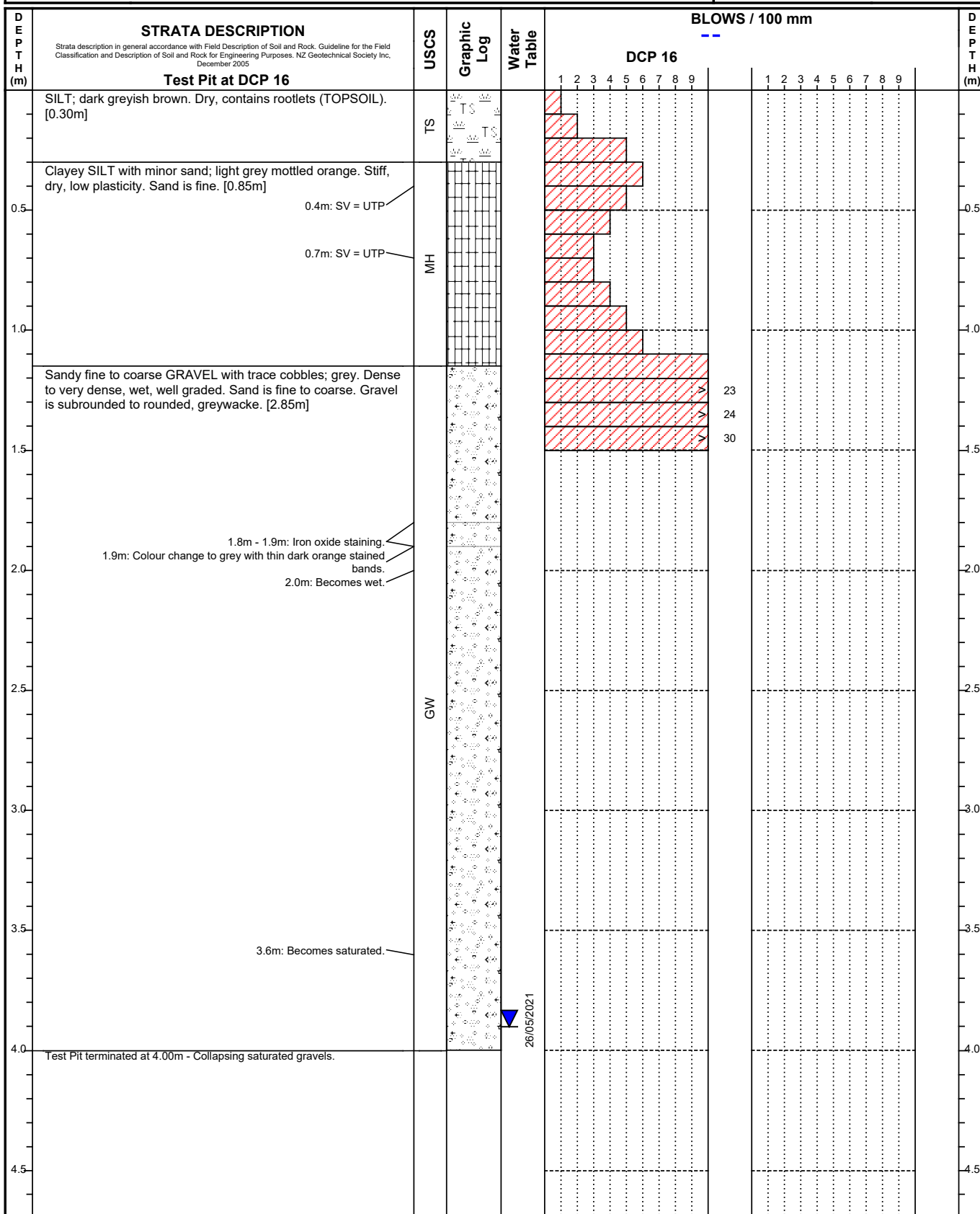
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 26/05/21

Time: 12:00 p.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: KL

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21

Time: 3:00 p.m.

Excavation Method: EX + DCP

DEPTH (m)	STRATA DESCRIPTION	USCS	Graphic Log	Water Table	BLOWS / 100 mm																		DEPTH (m)
	Test Pit at DCP 17				DCP 17																		
	SILT; dark greyish brown. Dry, contains rootlets (TOPSOIL). [0.25m]	TS		Groundwater Not Encountered																			
0.5	Clayey SILT with minor sand; yellowish brown. Stiff, moist, low plasticity. Sand is fine. [0.35m] 0.4m: SV = 186+ = 186+ 0.6m: SV = 186+ = UTP = UTP	ML																					
1.0	Sandy fine to coarse GRAVEL; grey. Dense to very dense, moist, well graded. Sand is fine to coarse. Gravel is rounded to subrounded greywacke. [1.40m] 0.7m: Colour change to grey. 1.1m: Iron staining. 1.4m: Colour change to dark greyish brown mottled orange.	GW																					
1.5																							
2.0	Test Pit terminated at 2.00m - Target depth achieved																						
2.5																							
3.0																							
3.5																							
4.0																							
4.5																							

Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

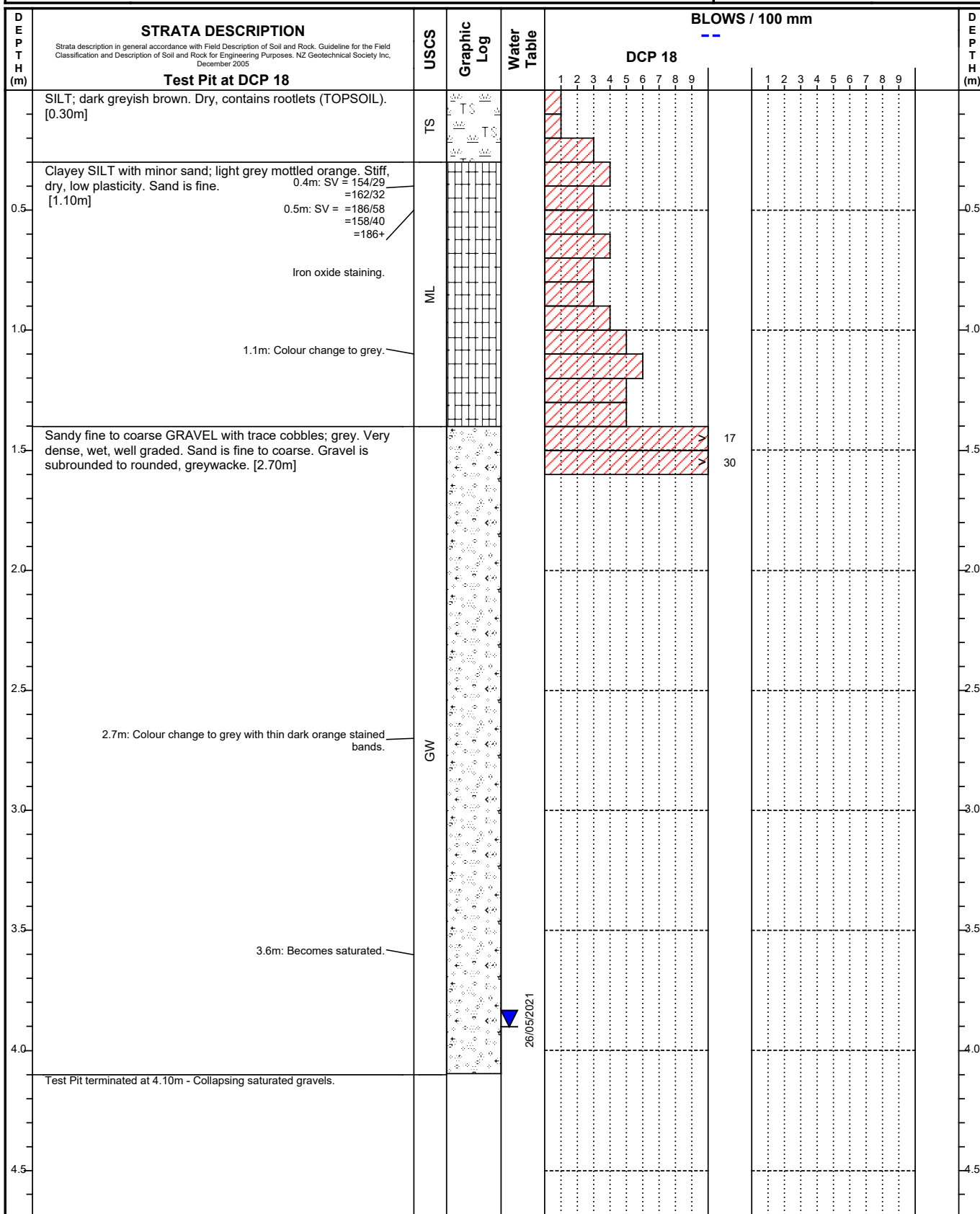
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)
Client: Next Level Developments Ltd
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 26/05/21
Time: 12:30 p.m.
Excavation Method: EX + DCP



Logged By: HC
Plotted By: KL
Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date:

Time:

Excavation Method: EX + DCP

DEPTH (m)	STRATA DESCRIPTION Strata description in general accordance with Field Description of Soil and Rock, Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, December 2005	USCS	Graphic Log	Water Table	BLOWS / 100 mm																		DEPTH (m)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
					DCP 19																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
					1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	No Associated Log			Groundwater Not Encountered																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

Logged By: HC

Plotted By: KL

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

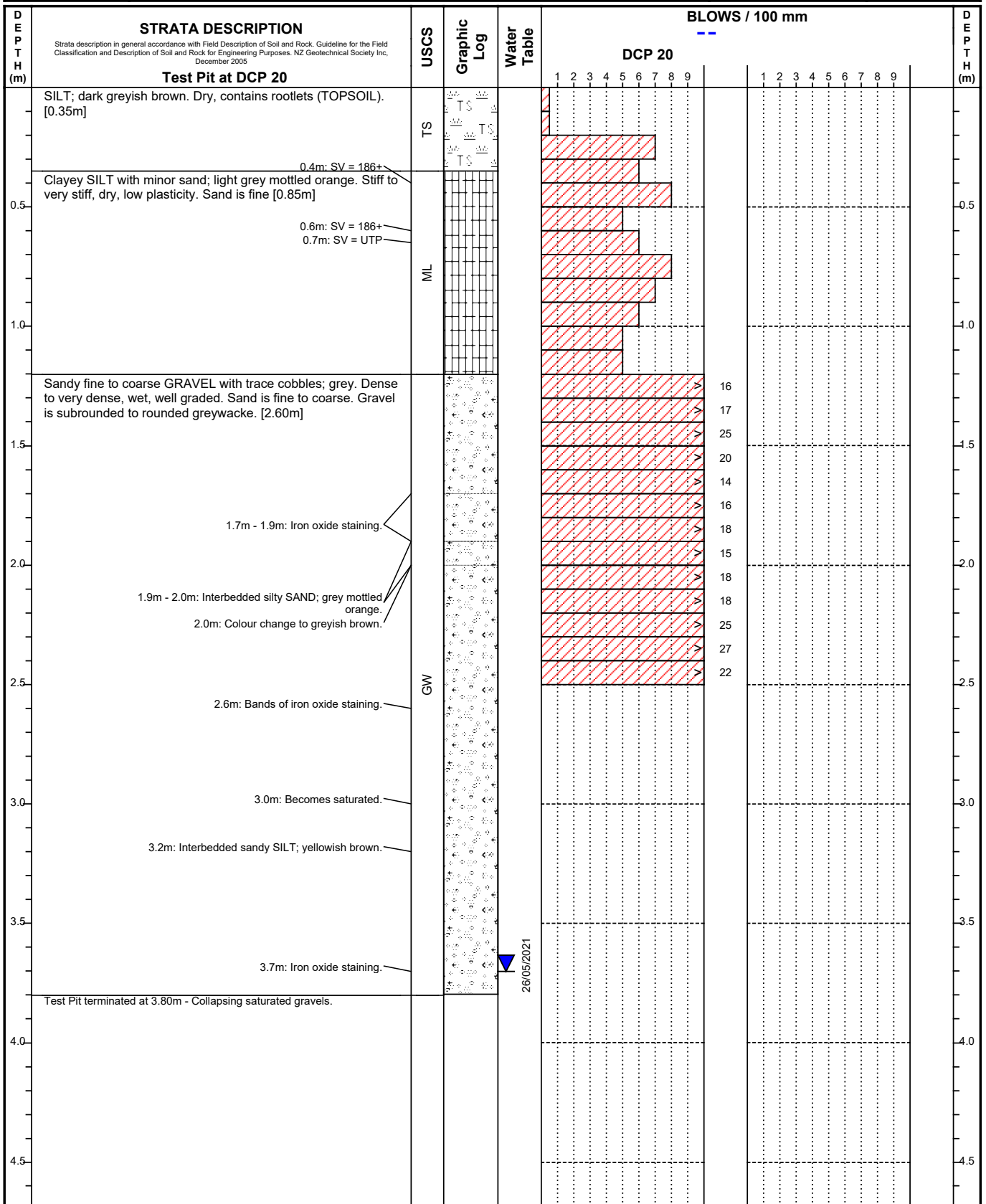
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 26/05/21

Time: 11:00 a.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: KL

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

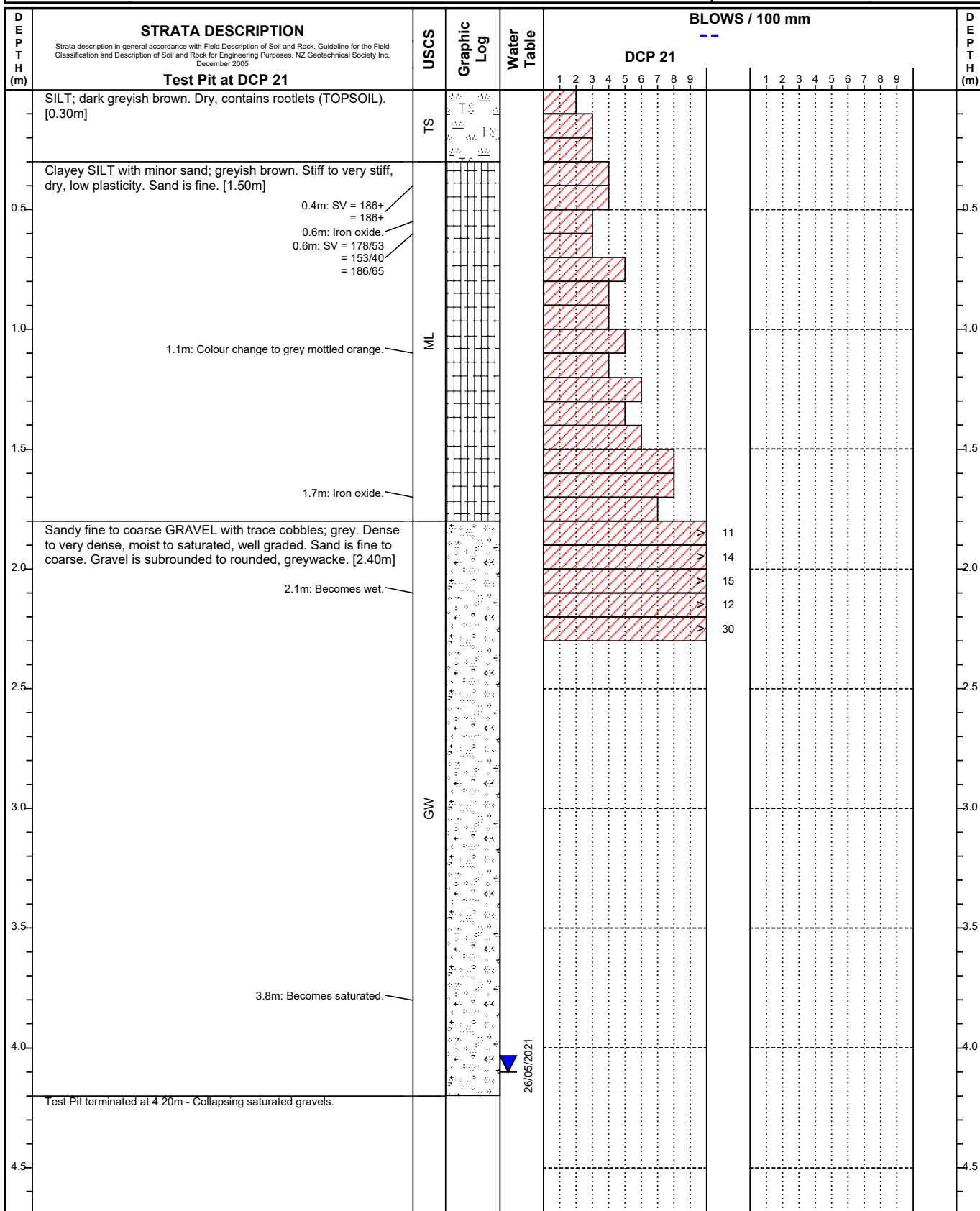
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)
Client: Next Level Developments Ltd
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 26/05/21
Time: 1:30 p.m.
Excavation Method: EX + DCP



Logged By: HC
Plotted By: KL
Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)
UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 26/05/21

Time: 1:00 p.m.

Excavation Method: EX + DCP

D E P T H (m)	STRATA DESCRIPTION	USCS	Graphic Log	Water Table	BLOWS / 100 mm																		D E P T H (m)
	Test Pit at DCP 22				DCP 22																		
					1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	
	SILT; dark greyish brown. Dry, contains rootlets (TOPSOIL). [0.30m]	TS																					
0.5	Clayey SILT with minor sand; orangey brown. Firm to stiff, dry, low plasticity. Sand is fine. [0.90m] 0.4m: SV = 93/25 = 117/32 = 155/38	ML																					
	0.7m: Colour change to grey mottled orange.																						
	0.8m: SV = 186+ = 186+ = 170/42																						
1.0	1.2m: Colour change to light grey.																						
1.5	Sandy fine to coarse GRAVEL with trace cobbles; grey. Dense to very dense, moist to saturated, well graded. Sand is fine to coarse. Gravel is subrounded to rounded, greywacke. [2.90m]	GW																					
	2.0m: Becomes wet. Colour change to dark grey mottled faint orange.																						
2.0																							
2.5																							
3.0																							
3.5																							
4.0	Test Pit terminated at 4.10m - Target depth achieved.																						
4.5																							

Logged By: HC

Plotted By: KL

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

Project: Strown Fields Subdivision, Trevors Road, Ashburton (Lot 17 DP 33764)

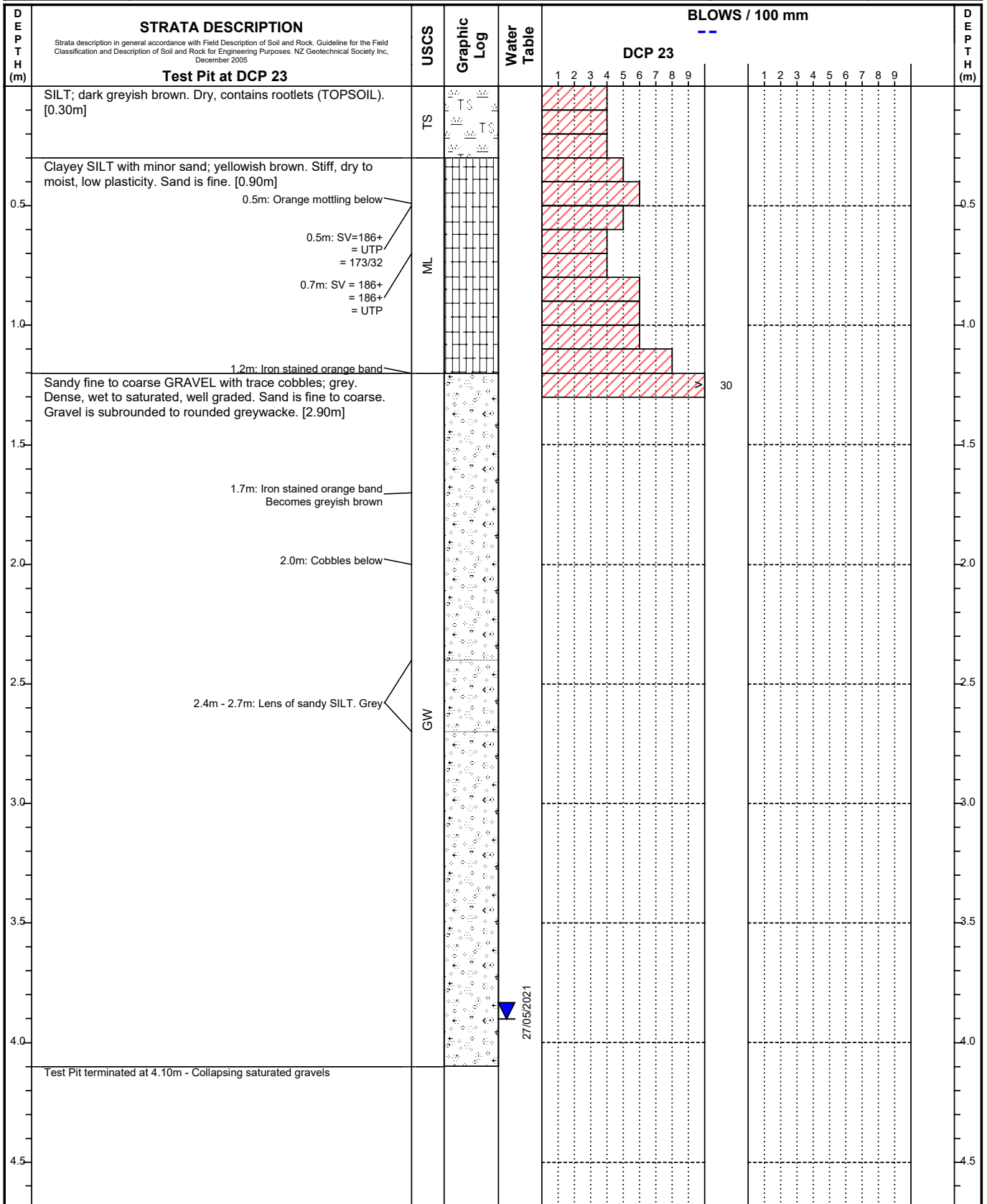
Client: Next Level Developments Ltd

Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 27/05/21

Time: 10:00 a.m.

Excavation Method: EX + DCP



Logged By: HC

Plotted By: IZ

Checked By: HC

Notes: Shear vane (SV) = peak/remoulded (kPa)

UTP = Unable to penetrate.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

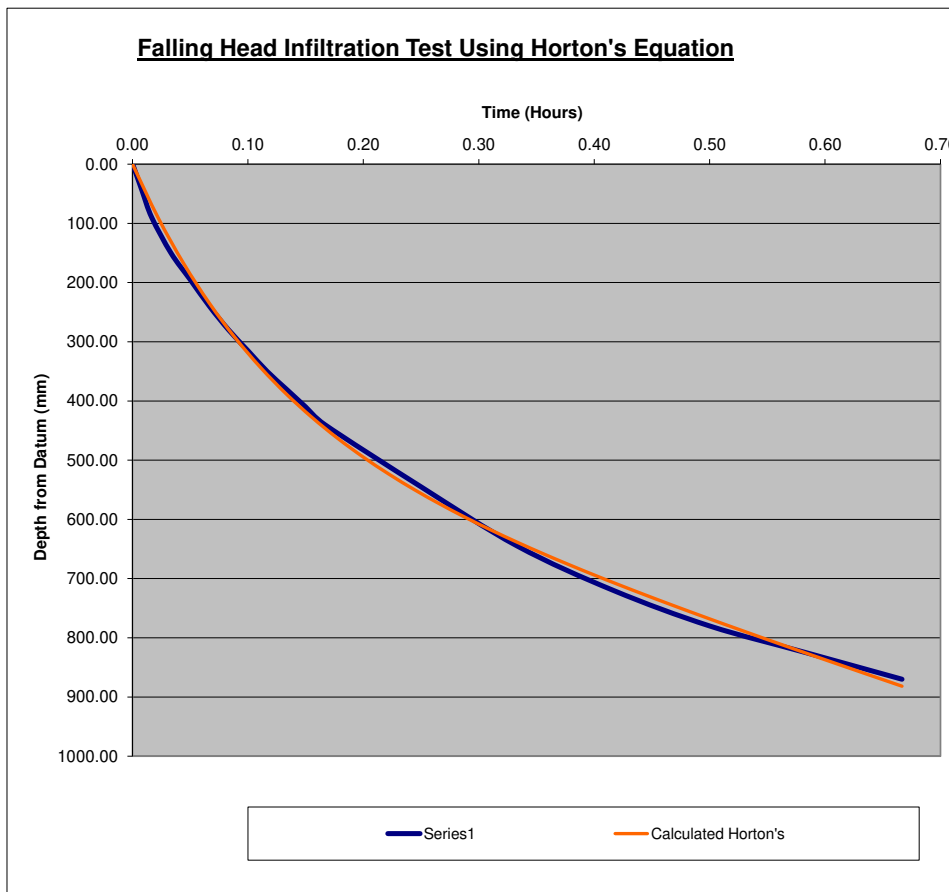
Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

APPENDIX C

FHI Infiltration Test Results

Issued to:	File	Job name:	Strowan Fields
Date:	27 May 2021	Job no:	40481
Time:			
People/equipment/materials on site:	IZ		
Weather/ground conditions:			
Test/photographs taken:	FHI at DCP/TP15 - TEST 1		
Health and safety:			

Timestep	Time (mins)	Depth from Datum (mm)
0	0.01	0.00
1	0.50	45.00
2	1.00	90.00
3	2.00	150.00
4	3.00	195.00
5	4.00	240.00
6	5.00	280.00
7	6.00	315.00
8	7.00	350.00
9	8.00	380.00
10	9.00	410.00
11	10.00	440.00
12	15.00	545.00
13	20.00	645.00
14	25.00	720.00
15	30.00	780.00
16	35.00	825.00
17	40.00	870.00
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		



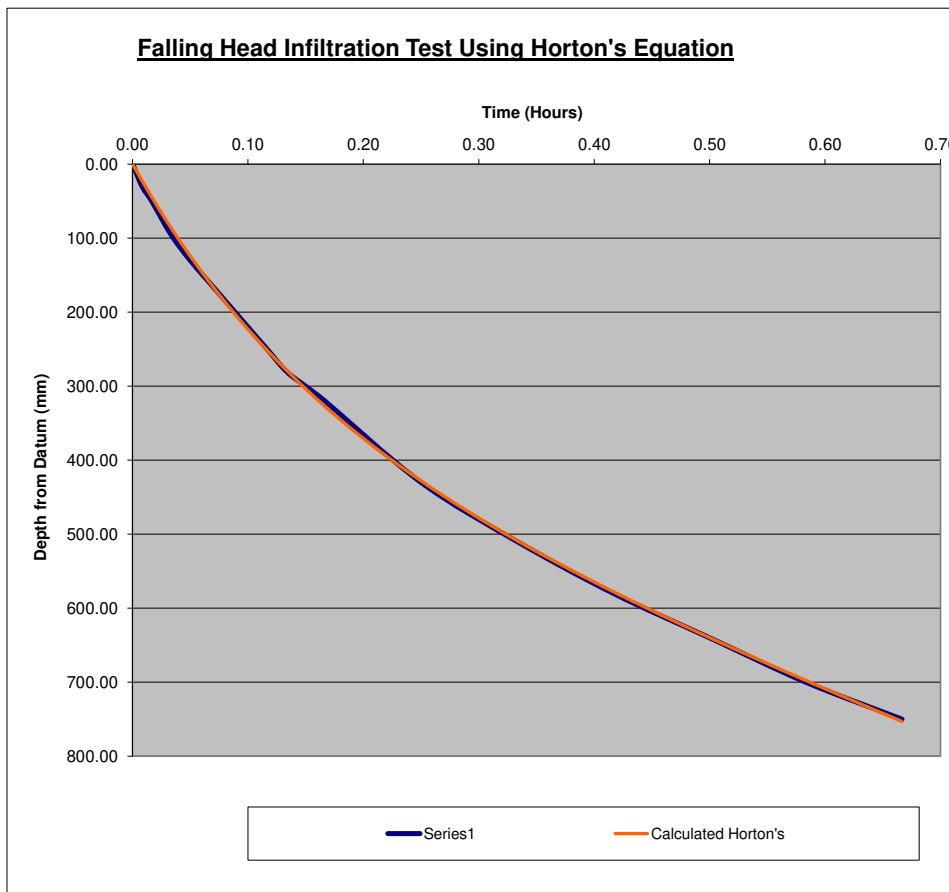
Initial Infiltration Rate: **4396.29** mm per hour

Ultimate Infiltration Rate: **650.57** mm per hour

Horton's Decay Coefficient: **8.33** per hour

Issued to:	File	Job name:	Strowan Fields
Date:	27 May 2021	Job no:	40481
Time:			
People/equipment/materials on site:	IZ		
Weather/ground conditions:			
Test/photographs taken:	FHI at DCP/TP15 - TEST 2		
Health and safety:			

Timestep	Time (mins)	Depth from Datum (mm)
0	0.01	0.00
1	0.50	30.00
2	1.00	50.00
3	2.00	95.00
4	3.00	130.00
5	4.00	160.00
6	5.00	190.00
7	6.00	220.00
8	7.00	250.00
9	8.00	280.00
10	9.00	300.00
11	10.00	320.00
12	15.00	430.00
13	20.00	510.00
14	25.00	580.00
15	30.00	640.00
16	35.00	700.00
17	40.00	750.00
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		



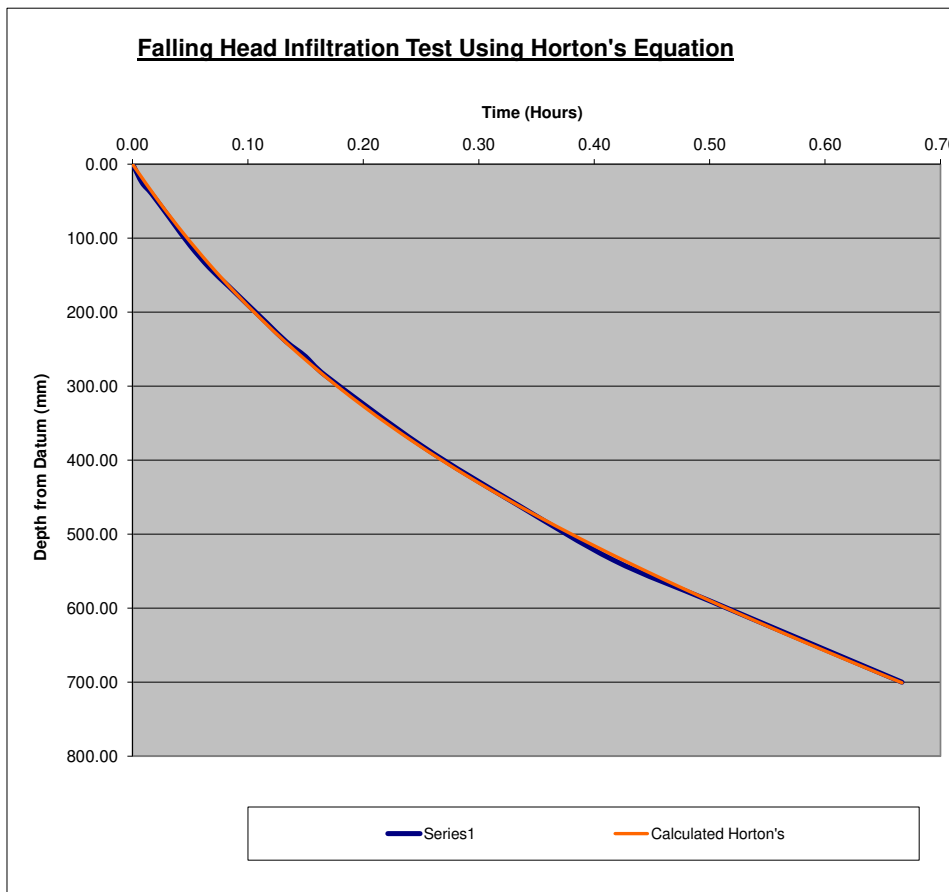
Initial Infiltration Rate: **2789.32** mm per hour

Ultimate Infiltration Rate: **622.82** mm per hour

Horton's Decay Coefficient: **6.32** per hour

Issued to:	File	Job name:	Strowan Fields
Date:	27 May 2021	Job no:	40481
Time:			
People/equipment/materials on site:	IZ		
Weather/ground conditions:			
Test/photographs taken:	FHI at DCP/TP15 - TEST 3		
Health and safety:			

Timestep	Time (mins)	Depth from Datum (mm)
0	0.01	0.00
1	0.50	25.00
2	1.00	40.00
3	2.00	75.00
4	3.00	110.00
5	4.00	140.00
6	5.00	165.00
7	6.00	190.00
8	7.00	215.00
9	8.00	240.00
10	9.00	260.00
11	10.00	285.00
12	15.00	380.00
13	20.00	460.00
14	25.00	535.00
15	30.00	590.00
16	35.00	645.00
17	40.00	700.00
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		



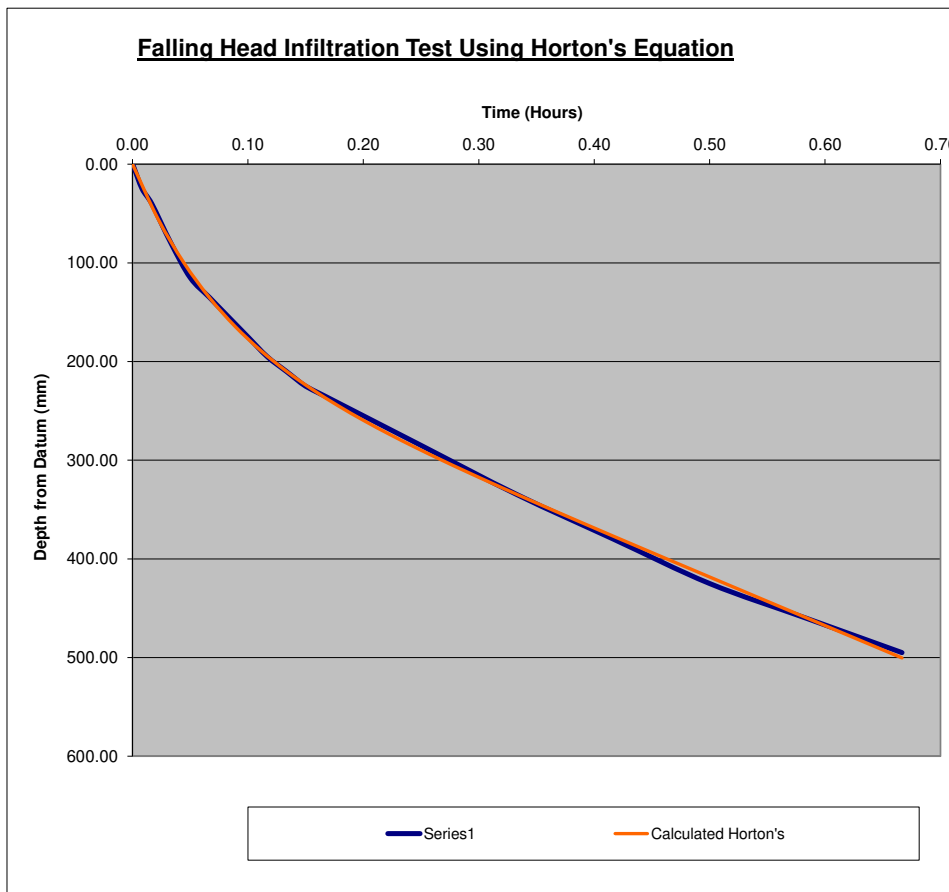
Initial Infiltration Rate: **2309.80** mm per hour

Ultimate Infiltration Rate: **594.43** mm per hour

Horton's Decay Coefficient: **5.49** per hour

Issued to:	File	Job name:	Strowan Fields
Date:	27 May 2021	Job no:	40481
Time:			
People/equipment/materials on site:	IZ		
Weather/ground conditions:			
Test/photographs taken:	FHI at DCP/TP13 - TEST 1		
Health and safety:			

Timestep	Time (mins)	Depth from Datum (mm)
0	0.01	0.00
1	0.50	25.00
2	1.00	40.00
3	2.00	80.00
4	3.00	115.00
5	4.00	135.00
6	5.00	155.00
7	6.00	175.00
8	7.00	195.00
9	8.00	210.00
10	9.00	225.00
11	10.00	235.00
12	15.00	285.00
13	20.00	335.00
14	25.00	380.00
15	30.00	425.00
16	35.00	460.00
17	40.00	495.00
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		



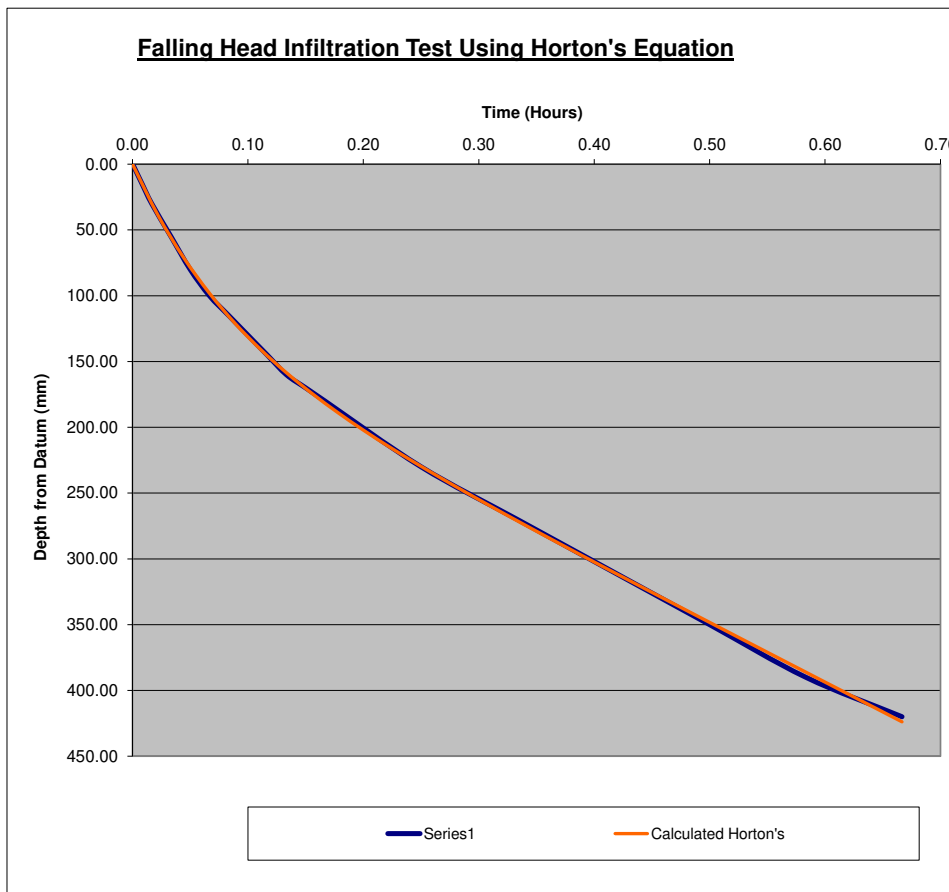
Initial Infiltration Rate: **2819.87** mm per hour

Ultimate Infiltration Rate: **490.96** mm per hour

Horton's Decay Coefficient: **13.45** per hour

Issued to:	File	
Date:	27 May 2021	Job name: Strowan Fields
Time:		Job no: 40481
People/equipment/materials on site:	IZ	
Weather/ground conditions:		
Test/photographs taken:	FHI at DCP/TP13 - TEST 2	
Health and safety:		

Timestep	Time (mins)	Depth from Datum (mm)
0	0.01	0.00
1	0.50	15.00
2	1.00	30.00
3	2.00	55.00
4	3.00	80.00
5	4.00	100.00
6	5.00	115.00
7	6.00	130.00
8	7.00	145.00
9	8.00	160.00
10	9.00	170.00
11	10.00	180.00
12	15.00	230.00
13	20.00	270.00
14	25.00	310.00
15	30.00	350.00
16	35.00	390.00
17	40.00	420.00
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		



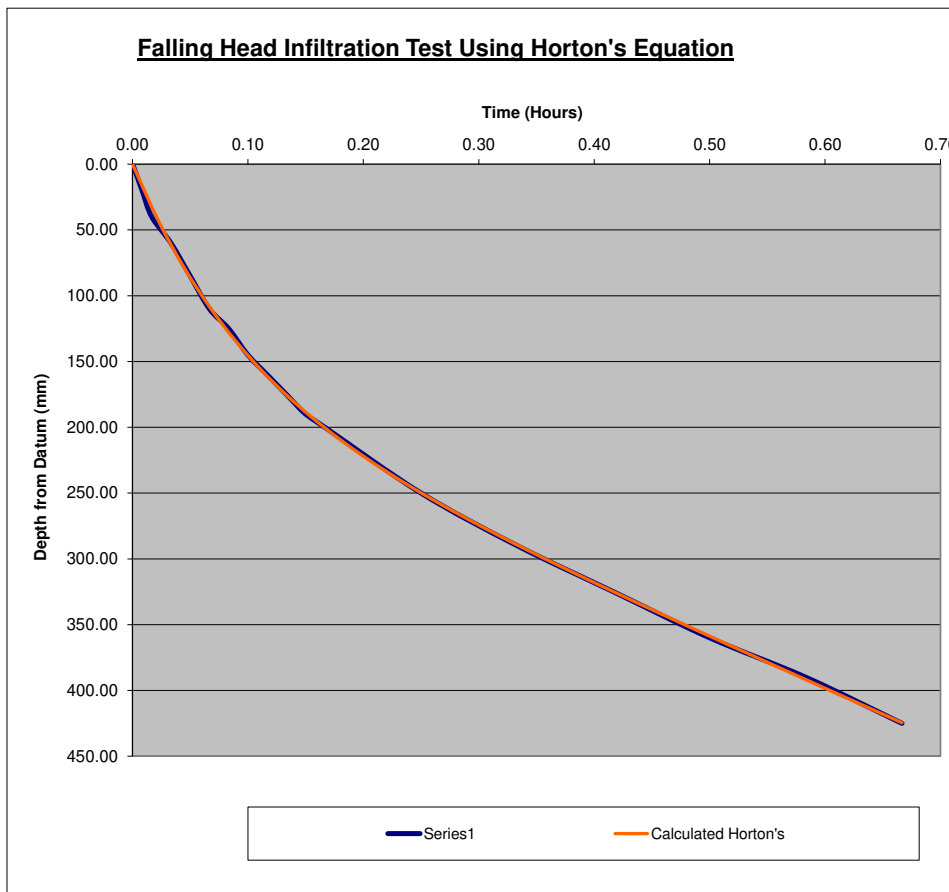
Initial Infiltration Rate: **1937.95** mm per hour

Ultimate Infiltration Rate: **451.94** mm per hour

Horton's Decay Coefficient: **12.12** per hour

Issued to:	File	Job name:	Strowan Fields
Date:	27 May 2021	Job no:	40481
Time:			
People/equipment/materials on site:	IZ		
Weather/ground conditions:			
Test/photographs taken:	FHI at DCP/TP13 - TEST 3		
Health and safety:			

Timestep	Time (mins)	Depth from Datum (mm)
0	0.01	0.00
1	0.50	20.00
2	1.00	40.00
3	2.00	60.00
4	3.00	85.00
5	4.00	110.00
6	5.00	125.00
7	6.00	145.00
8	7.00	160.00
9	8.00	175.00
10	9.00	190.00
11	10.00	200.00
12	15.00	250.00
13	20.00	290.00
14	25.00	325.00
15	30.00	360.00
16	35.00	390.00
17	40.00	425.00
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		



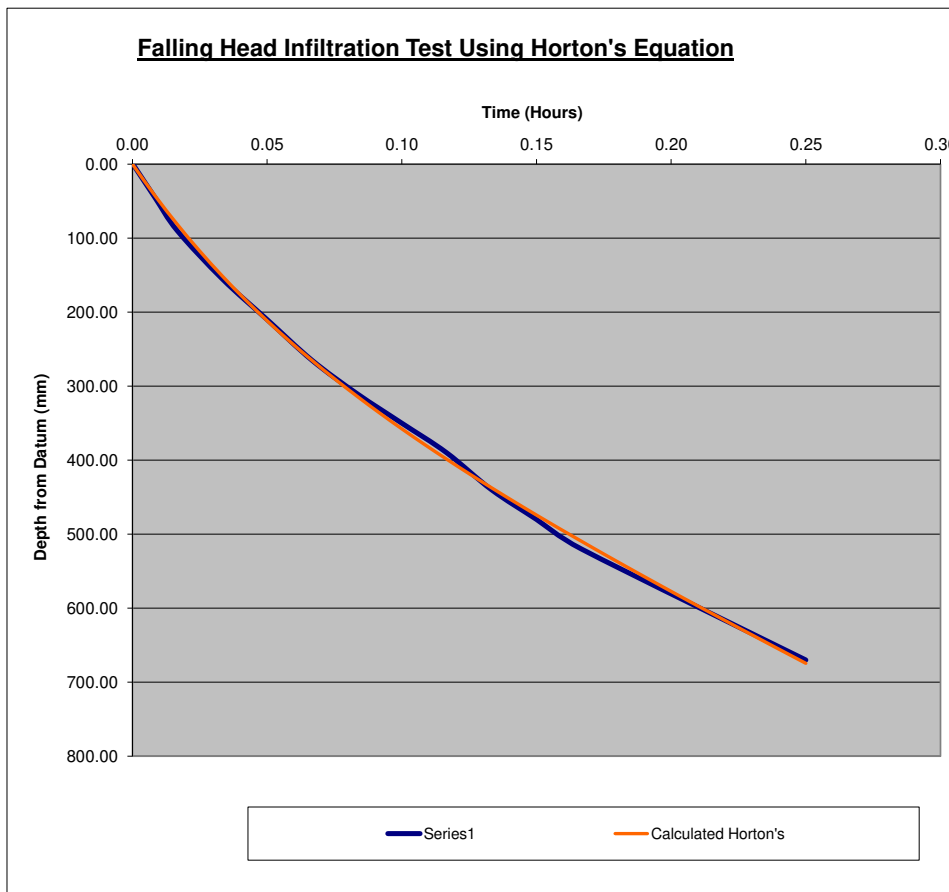
Initial Infiltration Rate: **2101.33** mm per hour

Ultimate Infiltration Rate: **390.57** mm per hour

Horton's Decay Coefficient: **10.41** per hour

Issued to:	File	Job name:	Strowan Fields
Date:	27 May 2021	Job no:	40481
Time:			
People/equipment/materials on site:	IZ		
Weather/ground conditions:			
Test/photographs taken:	FHI at DCP/TP17 - TEST 1		
Health and safety:			

Timestep	Time (mins)	Depth from Datum (mm)
0	0.01	0.00
1	0.50	45.00
2	1.00	90.00
3	2.00	155.00
4	3.00	210.00
5	4.00	265.00
6	5.00	310.00
7	6.00	350.00
8	7.00	390.00
9	8.00	440.00
10	9.00	480.00
11	10.00	520.00
12	15.00	670.00
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		



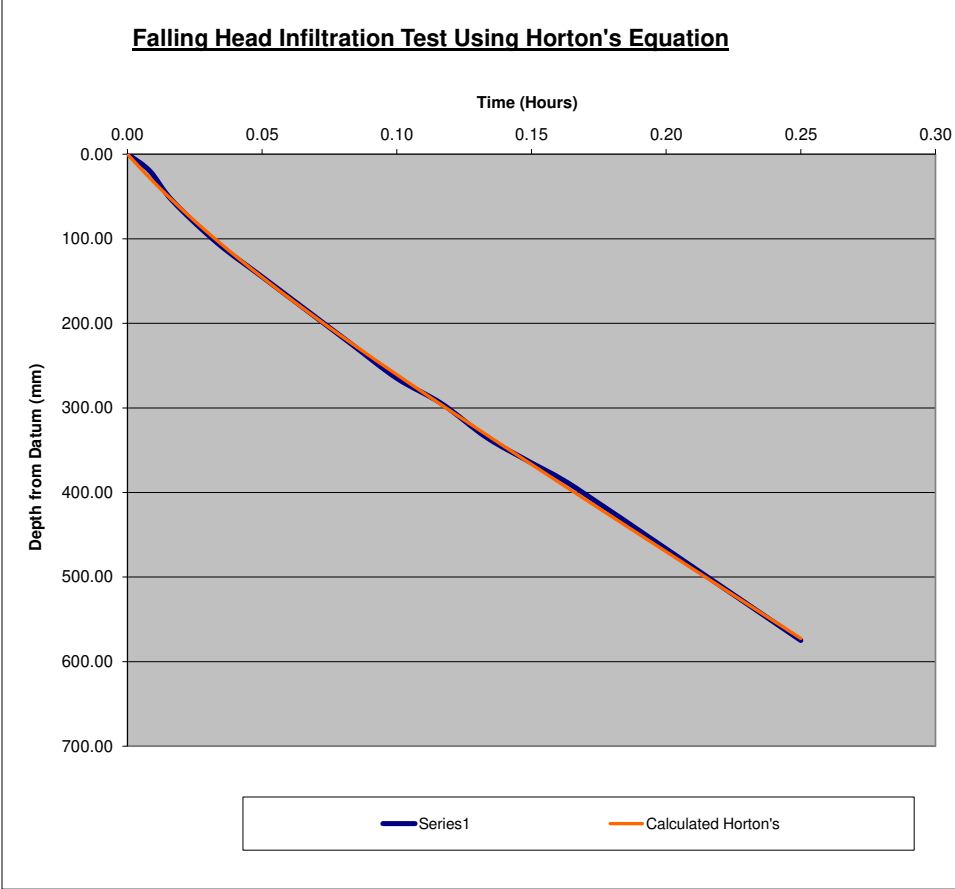
Initial Infiltration Rate: **5309.10** mm per hour

Ultimate Infiltration Rate: **1845.36** mm per hour

Horton's Decay Coefficient: **15.95** per hour

Issued to:	File	
Date:	27 May 2021	Job name: Strowan Fields
Time:		Job no: 40481
People/equipment/materials on site:	IZ	
Weather/ground conditions:		
Test/photographs taken:	FHI at DCP/TP17 - TEST 2	
Health and safety:		

Timestep	Time (mins)	Depth from Datum (mm)
0	0.01	0.00
1	0.50	20.00
2	1.00	55.00
3	2.00	105.00
4	3.00	145.00
5	4.00	185.00
6	5.00	225.00
7	6.00	265.00
8	7.00	295.00
9	8.00	335.00
10	9.00	365.00
11	10.00	395.00
12	15.00	575.00
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		



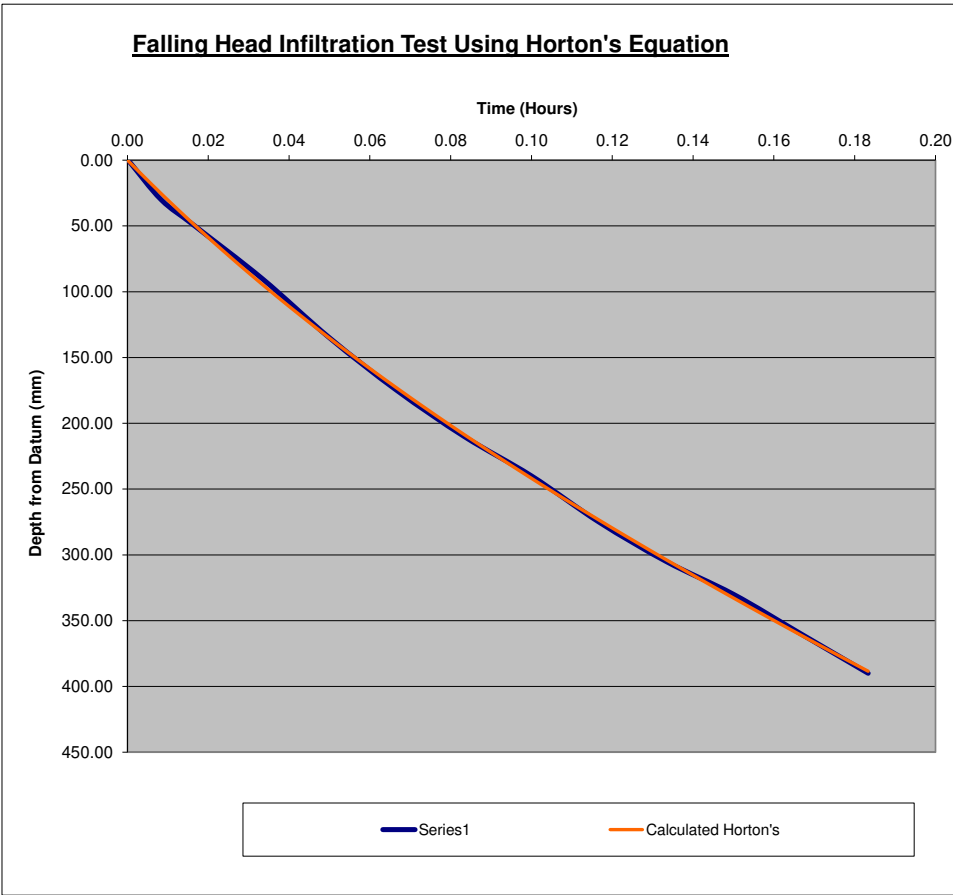
Initial Infiltration Rate: 3540.70 mm per hour

Ultimate Infiltration Rate: 2043.36 mm per hour

Horton's Decay Coefficient: 24.21 per hour

Issued to: File
 Date: 27 May 2021 Job name: Strowan Fields
 Time: Job no: 40481
 People/equipment/materials on site: IZ
 Weather/ground conditions:
 Test/photographs taken: FHI at DCP/TP17 - TEST 3
 Health and safety:

Timestep	Time (mins)	Depth from Datum (mm)
0	0.01	0.00
1	0.50	30.00
2	1.00	50.00
3	2.00	90.00
4	3.00	135.00
5	4.00	175.00
6	5.00	210.00
7	6.00	240.00
8	7.00	275.00
9	8.00	305.00
10	9.00	330.00
11	10.00	360.00
12	11.00	390.00
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		



Initial Infiltration Rate: **3129.83** mm per hour
 Ultimate Infiltration Rate: **1450.87** mm per hour
 Horton's Decay Coefficient: **12.26** per hour

APPENDIX D

Laboratory Results

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)

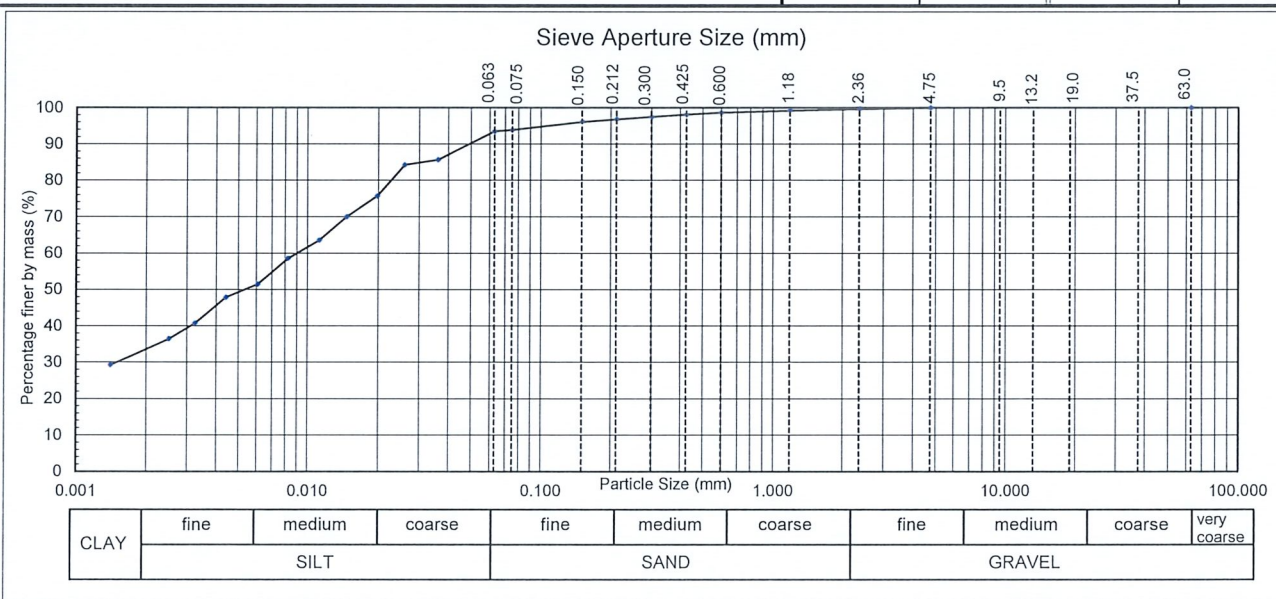
TEST REPORT



Project : Material Investigation
 Location : DRI-1 Trevors Road, Ashburton
 Client : Davis Ogilvie & Partners
 Client/Sample Ref : PO 4081
 Contractor : Not Advised
 Source : Onsite Stock Pile
 Sampled by : Hamish Cattell
 Date received : 29 May 2021
 Sampling method : NZS 4402:1986 (Fine)
 Sample condition : Damp as received
 Sample description : Clayey SILT with minor sand
 Solid Particle Density (t/m³): 2.68 Assumed
 Water Content (as received): 24.7 %

Project No: 6-JDOPL16/6LC
 Lab Ref No: CH8012
 Client Ref: PO 40481

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	98	0.0361	86	0.0061	51
37.5	--	2.36	100	0.212	97	0.0259	84	0.0044	48
19.0	--	1.18	99	0.150	96	0.0198	76	0.0032	41
13.2	--	0.600	99	0.075	94	0.0147	70	0.0025	36
9.5	--	0.425	98	0.063	94	0.0112	64	0.0014	29
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0082	59		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	All information supplied by Client

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date Tested: 26 June 2021

This report may only be reproduced in full

Date Reported: 1 July 2021

IANZ Approved Signatory

Designation : Laboratory Manager

Date : 1 July 2021



Test results indicated as not accredited are outside the scope of the laboratory's accreditation

DRY DENSITY / WATER CONTENT RELATIONSHIP STANDARD COMPACTION

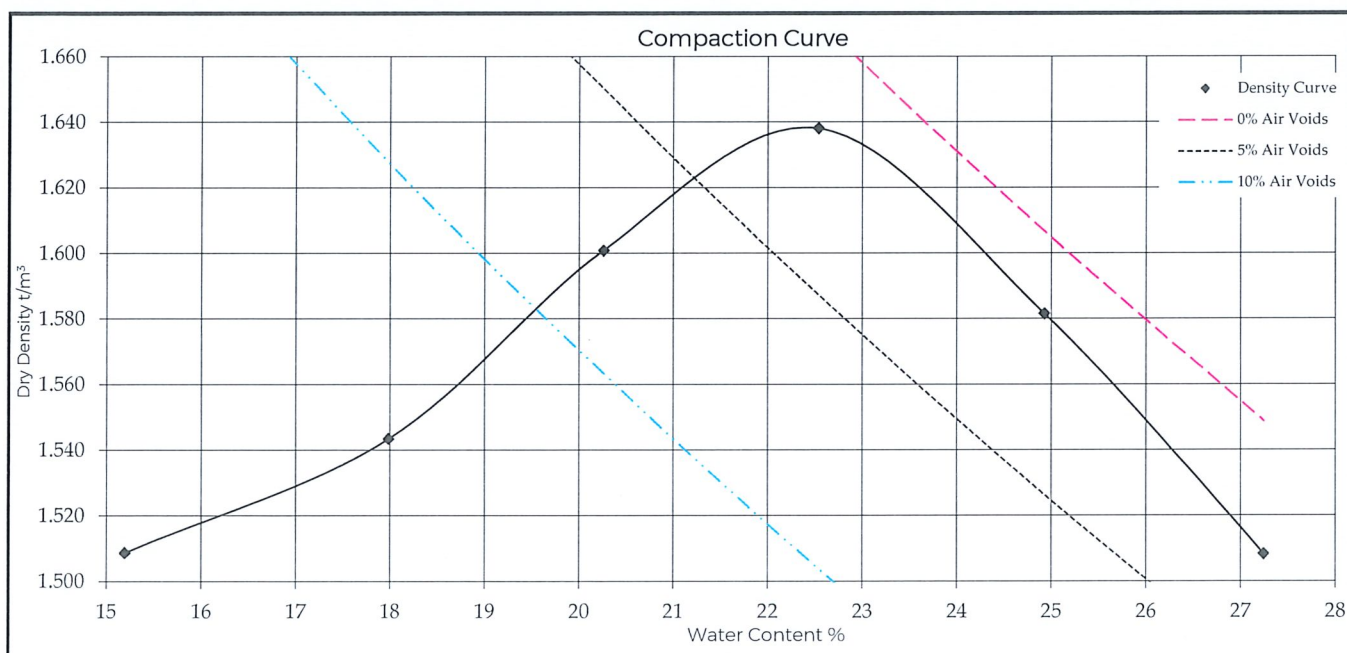


Project : Material Investigation
 Location : DRI-1 Trevors Road, Ashburton
 Client : Davis Ogilvie & Partners Limited
 Contractor : Not Advised
 Sampled by : Hamish Cattell
 Date sampled : 28 May 2021
 Sampling method : NZS 4402: 1986 (Fine)
 Sample description : SILT
 Sample condition : Damp as received
 Solid density : 2.68 t/m³ (Assumed)
 Source : DRI-1 Onsite Stock Pile

Project No : 6-JDOPL.16/6LC
 Lab Ref No : CH8012
 Client Ref No : PO 40481

Test Results

Test Results							
Maximum dry density	1.64	t/m³		Natural water content	22.5	%	
Optimum water content	22.0	%		Fraction tested	Whole		
Sample ID	-6%	-4%	-2%	NAT	+2%	+4%	
Bulk density t/m³	1.738	1.821	1.925	2.007	1.976	1.919	
Water content %	15.2	18.0	20.3	22.5	24.9	27.3	
Dry density t/m³	1.509	1.543	1.601	1.638	1.581	1.508	
Sample condition	Dry Hard	Dry Hard	Dry Hard	Dry Firm	Moist Firm	Wet Soft	



Test Methods	Notes
Compaction NZS 4402 : 1986 Test 4.1.1 (Standard)	All information supplied by Client

Date tested : 17 June 2021
 Date reported : 1 July 2021

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
 This report may only be reproduced in full

IANZ Approved Signatory

Designation : Laboratory Manager
 Date : 1 July 2021



Test results indicated as not accredited are outside the scope of the laboratory's accreditation

CALIFORNIA BEARING RATIO (REMOULDED)
TEST REPORT



Project : Material Investigation
Location : DRI-1 Trevors Road, Ashburton
Client : Davis Ogilvie & Partners Limited
Contractor : Not Advised
Sampled by : Hamish Cattell
Date sampled : 28 May 2021
Sampling method : NZs 4402: 1986 (Fine)
Sample description : Clayey SILT
Sample condition : Damp as received

Project No : 6-JDOPL16/6LC
Lab Ref No : CH8012
Client Ref No : PO 40481

Test Results

Sample ID		1
Location		Stockpile
Sample condition at compaction		Damp
Sample condition at test		Soaked
Sample description		Clayey SILT
Curing time	days	-
Soaking time	days	4
Passing 19mm	%	100
Surcharge mass	kg	4.0
Lime additive	%	-
Cement additive	%	-
Swell	%	1.0
Penetration	mm	2.5
Water content as received	%	-
Water content as compacted	%	20.6
Water content after testing	%	23.9
Dry density	t/m ³	1.62
CBR value	%	5.0

Test Methods	Notes
CBR NZS : 4402 : 1986 : 6.1.1	Material Used Whole Soil
Water Content NZS : 4402 : 1986 : 2.1	Rate of penetration 1mm/min
Compaction NZS : 4402 : 1986 : 4.1.1 (Standard)	All information supplied by Client

Date tested : 28 June 2021

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date reported : 1 July 2021

This report may only be reproduced in full

IANZ Approved Signatory

Designation : Laboratory Manager

Date : 1 July 2021



Test results indicated as not accredited are outside the scope of the laboratory's accreditation

PLASTICITY INDEX FOR SOILS
TEST REPORT



Project : Material Investigation
Location : DRI-1 Tervors Road, Ashburton
Client : Davis Ogilvie & Partners
Contractor : Not Advised
Sampled by : Hamish Cattel
Date sampled : 28 May 2021
Sampling method : NZS 4402:1986 (Fine)
Sample description : Clayey SILT with minor sand
Sample condition : Damp as received

Project No : 6-JDOPL16/6LC
Lab Ref No : CH8012
Client Ref No : PO 40481

Test Results	
Liquid Limit :	45
Plastic Limit :	24
Plasticity Index :	21
Natural Water Content :	24.7

Test Methods	Notes
Liquid Limit NZS 4402 : 1986, Test 2.2	Materials used: Passing 425um sieve
Plastic Limit NZS 4402 : 1986, Test 2.3	
Plasticity Index NZS 4402 : 1986, Test 2.4	
Water Content NZS 4402 : 1986, Test 2.1	All information supplied by Client

Date tested : 30 June 2021
Date reported : 1 July 2021

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
This report may only be reproduced in full

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 1 July 2021

RPL



Test results indicated as not accredited are outside the scope of the laboratory's accreditation

**CONSTANT HEAD PERMEABILITY
TEST REPORT**



Project: Material Investigation
 Location: DRI-1 Trevors Road, Ashburton
 Client: Davis Ogilvie & Partners Limited
 Source: DRI-1
 Sampled by: Hamish Cattell Date: 28/05/21
 Sample Condition: Bulk Sample
 Sample Method: As Shown

Sample Target (NZ Std): $P_b = 2.00 \text{ t/m}^3$, $P_d = 1.64 \text{ t/m}^3$, $W/C = 22 \%$

Project No: 6-JDOPL16/6LC
 Lab Ref No: CH8012_Perm
 Client No: PO 40481

Lab Sample No.	CH8012_Perm -1				
Sample ID:	DRI-1				
Depth:	N/A				
Client Reference:	N/A				
Description:	SILT				
Date of Test:	18-25/06/21				
Specimen Status	Initial	Final			
Specimen length (mm)	141.89	142.01			
Specimen diameter (mm)	70.71	70.57			
Specimen mass (g)	1076.9	1097.9			
As rec'd water content (%)	22.8	-			
Water content of test sample (%)	22.8	25.1			
Wet density (t/m^3)	1.93	1.98			
Dry density (t/m^3)	1.57	1.58			
Saturation by calculation (%)	90	100			
Assumed Solid Density=	2.62				
Saturation by pore pressure response (B value)=	1.00				
	Head (kPa)	Permeability (m/s)			
	20	4.7×10^{-10}			
	40	4.0×10^{-10}			
	80	4.8×10^{-10}			
Sample Test Conditions					
Sample No:	CH8012			Permeant liquid used: Deaired Tap Water	
Cell Pressure (kPa):	500			Notes: 1. 1kPa Head = 0.10m H ₂ O	
Saturation Backpressure (kPa):	400			2. (m/s) = metres per second	
Effective Confining Pressure (kPa):	100				
Temperature during Test (°C):	20				

Test Methods	Notes
Permeability Test : ASTM D5084-16: Method A - Constant Head Method Water Content : NZS 4402 : 1986 Test 2.1	1. The sample was tested using the ELE test apparatus to enable back pressure saturation. 2. Tested in constant temperature conditions (20°C)

Date tested : 18-25/06/21
 Date reported : 28/06/21

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
 This report may only be reproduced in full
 All information supplied by Client

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
 Date : 28/06/21



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

**PINHOLE DISPERSION
TEST REPORT**



Project : Material Investigation
 Location : DRI-1 Trevors Road, Ashburton
 Client : Davis Ogilvie & Partners Limited
 Sample Location ID : DRI-1
 Sampled by : Hamish Cattell
 Date sampled : 28/05/21
 Sample description : SILT
 Sample condition : Wetted Up to Client Specifications
 Sample compaction : Client Spec (Pd=1.64t/m³ at W/C=22%)

Depth : N/A

Project No : 6-JDOPL16/6LC
 Lab Ref No : CH8012_pinhole
 Client Ref No : PO 40481

Test Results

Test Sample Condition at Test

Diameter of test specimen (mm)	33.18
Length of test specimen (mm)	38.23
Mass of compacted specimen (g)	66.59

	As Rec'd	Target	As Tested	Post Test
Wet Density (t/m³)	-	2.00	2.01	-
Water Content (%)	22.8	22.0	22.8	26.4
Dry Density (t/m³)	-	1.64	1.64	-

Pinhole Test Observations

Head (mm)	Flow rate (ml/s)	Colour of outflow (Cloudiness)	Falling Particles
50	0.18	Clear	None
180	0.37	Clear	None
380	0.83	Clear	None
1020	2.27	Clear	None

Pinhole dimensions

Hole Diameter at start of test (mm)	1.0
Hole Diameter at end of test (mm)	1.0

Note : The pinhole when observed at the end of the test showed NO CHANGE in diameter.

PINHOLE TEST RESULT

ND1

Test Method	Notes
ASTM D4647-93 (Reapproved 2006) Method A	Soil tested : Whole soil (-2.36mm fraction)

Date tested : 29/06/21

Date reported : 02/07/21

This report may only be reproduced in full
 All information supplied by Client

Approved

Designation : Senior Civil Engineering Technician

Date : 02/07/21

APPENDIX E

Statement of Suitability

STATEMENT OF PROFESSIONAL OPINION ON THE SUITABILITY OF LAND FOR SUBDIVISION

Issued By: Davis Ogilvie & Partners Ltd
(Geotechnical engineering firm or suitably qualified geoprofessional)

To: Next Level Developments Ltd
(Owner/Developer)

To be supplied to: Ashburton District Council
(Territorial authority)

In respect of: Subdivision of Lot 17 DP 33764 (CB13B/504)
(Description of infrastructure/land development)

At: Trevors Road, Hampstead, Ashburton (Strowan Fields development)
(Address)

I, Ben Parry, on behalf of Davis Ogilvie & Partners Ltd hereby confirm:

1. I am a suitably qualified and experienced geoprofessional employed by Davis Ogilvie & Partners Ltd and the geotechnical firm named above was retained by the owner/developer as the geoprofessional on the above proposed development.
2. The geotechnical assessment report, dated 23 September 2021, has been carried out in accordance with the *Ministry of Business, Innovation and Employment Part D – Guidelines for the geotechnical investigation and assessment of subdivisions in the Canterbury region* and the *Christchurch City Council Infrastructure Design Standard – Part 4: Geotechnical Requirements* and includes:
 - (i) Details of and the results of the site investigations.
 - (ii) An assessment of the ground bearing capacity confirming the location and appropriateness of building sites.
 - (iii) Recommendations proposing measures to avoid, remedy or mitigate any potential hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.

3. In my professional opinion, not to be construed as a guarantee, I consider that Council is justified in granting consent incorporating the following conditions:
 - A. All earthworks shall be undertaken under the supervision of a suitably qualified Geoprofessional with experience in land development.
 - B. All fill placed as part of the subdivision development or under future building footprints must be placed in accordance with NZS4431:1989 and inspected and certified by a chartered professional engineer.
 - C. All uncontrolled fill, infilled channels, backfilled test pits, low strength soils, organic soils or otherwise unsuitable soils within foundation excavations or beneath civil infrastructure or structural fill will require remediation by excavation and engineered filling in accordance NZS4431:1989.
 - D. Any new foundations onsite must be founded below the organic topsoil, uncontrolled fill, or any other unsuitable material.
 - E. It is recommended that all future building foundation excavations are inspected/confirmed by a suitably qualified person at time of construction.
 - F. Minimum floor levels as per New Zealand Building Code E1 and ADC and ECan requirements.
 - G. Stormwater must be appropriately managed during subdivision development and longer term to limit the influence of surface water erosion on the site. Any overland flow paths must be identified and preserved as part of the subdivision design.
4. This professional opinion is furnished to the territorial authority and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.
5. This statement shall be read in conjunction with the geotechnical report referred to in Clause 2 above, and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.
6. Liability under this statement accrues to the geotechnical firm only and no liability shall accrue to the individual completing this statement.
7. The geotechnical engineering firm issuing this statement holds a current policy of professional indemnity insurance of no less than \$2,000,000.00. (Minimum amount of insurance shall be commensurate with the current amounts recommended by EngNZ, ACENZ, NZTA, INGENIUM.)

Ben Parry



.....
(Signature of Engineer)

For and on behalf of Davis Ogilvie & Partners Ltd.

Date: 23 September 2021

Qualifications and experience:

Senior Engineering Geologist

PG Dip, BSc (Tech), CEngNZ (PEngGeol)