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Project: Stonebrook Subdivision

Geotechnical Completion Report Stage 20, 21A and 21B

Reference: 224926

Prepared for: CDL Land New Zealand Ltd.

Revision: 0 – For Issue

23 May 2014

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A	19 May 2014	Draft for review	T. Mitchell	T. Mitchell	M. Davidson	
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Approval			
Author Signature		Approver Signature	
Name	T. Mitchell	Name	I. McPherson
Title	Geotechnical Engineer	Title	Technical Director CPEng 49903

Contents

Appendices

1. Executive Summary

CDL New Zealand Limited is developing Stages 20, 21A and 21B of the Stonebrook Subdivision, located between Main South Road and Burnham School Road in Rolleston, south west Christchurch. As part of this work, a geotechnical completion report is required to certify that the site works have been carried out to the required standard. We understand that Stages 20 and 21A are proposed to be residential and Stage 21B will be for commercial use. This report describes earthworks involved with Stages 20, 21A and 21B of the Stonebrook Subdivision comprising the following lots.

- Stage 20 - Lots 371 to 397 and 429
- Stage 21A - Lots 398 to 412;
- Stage 21B - Lots 413 and 515.

Geotechnical testing carried out as part of the subdivision consent stage indicated that the Stonebrook Subdivision is classified as Technical Category 1 (TC1) equivalent with a deep groundwater table and competent gravels at shallow depths.

Earthworks to form the subdivision including cutting and filling have occurred on the site. The quality assurance (QA) testing of the earthfill indicates that 95% of Maximum Dry Density or greater compaction levels were consistently achieved. Thus we believe that earthfill placed within the Stages 20, 21A and 21B areas has achieved the required compaction levels as per intent and definition of NZS4431:1989.

From the monitoring and testing undertaken as part of the development of the Stages 20, 21A and 21B areas the following is concluded:

- Bulk earthworks meet our earthworks specifications, including NZS4431:1989.
- In line with our subdivision consent assessment the site is likely to perform to the level of TC1 equivalent.
- As the land is likely to perform to a level of TC1, and the lots are underlain by earthfill that has achieved the required compaction, we consider NZS 3604:2011 type foundations will be suitable for light weight timber frame buildings.
- The usual investigations and site observations will be required for the building consent and construction phases.

This report shall be read as a whole. Our limitations are presented in Section 7.

2. Introduction

2.1 Geotechnical Completion

CDL Land New Zealand Limited is developing Stages 20, 21A and 21B of the Stonebrook Subdivision, located on Stonebrook Drive, Rolleston (See Figure 1 in Appendix A). We understand that Stages 20 and 21A is proposed to be residential and Stage 21B will be for commercial use. The site works on Stages 20, 21A and 21B have included bulk earthworks. As part of the this work, a geotechnical completion report is required to certify that the site works have been carried out to the required standard, and to provide recommendations for building development.

This report has been prepared for CDL Land New Zealand Limited and Selwyn District Council. It describes earthworks within Stages 20, 21A and 21B of the Stonebrook Subdivision (See Figure 2 in Appendix A).

The purpose of the geotechnical completion report is to present the following:

- A summary of previous investigation information carried out as part of subdivision consent investigations and detailed design;
- A summary the ground conditions;
- Extent of earthworks on the lots and compliance testing of bulk earthworks;
- A summary of the findings and recommendations for residential building development.

This report has been prepared based upon known geotechnical data and compaction testing undertaken during and after earthworks construction. All references to cut/fill depths are based on the early 2012 ground levels.

This report shall be read as a whole. Our limitations are presented in Section 7.

2.2 Site Description

The Stonebrook subdivision is located south west of the Rolleston town centre and covers an area of approximately 42ha. The site has been divided into 23 stages between Main South Road to the north and Burnham School Road to the south. This report relates to Stages 20, 21A and 21B. The site is essentially flat and currently vegetated with grass.

3. Pre-Development Geotechnical Work

3.1 Geotechnical Investigations

The subdivision consent and detailed geotechnical design for the subdivision included a series of geotechnical investigations comprising a desktop study, test pits and boreholes. The details of these investigations are presented in the Aurecon report *"Brookside Road Subdivision, Geotechnical Report"* for Subdivision Consent, Revision 1 dated 1 November 2011 (file reference, 224926).

The type and number of investigations is presented in Table 1 below.

Table 1: Subdivision Consent Investigations

Type of Investigation	Number of Investigation Locations
Test Pits (TP)	64
Borehole with SPT at 1.5m centres (BH)	2

3.2 Ground Conditions

From the geotechnical investigations the ground conditions within the Stage 20, 21A and 21B are summarised in Table 1.

Table 2: Typical ground conditions within the Stage 20, 21A and 21B

Depth to Top of Unit (m)	Depth to Base of Unit (m)	Soil Unit
0	0.15 to 0.35	TOPSOIL: dark brown, SILT.
0.15 to 0.35	>60	Alluvium: brownish grey GRAVEL and Sandy GRAVEL with occasional silt, clay and sand lenses.

Groundwater levels ranged from 10.3m to 13.1m below ground level. During the site earthworks the ground conditions summarised in Table 1 were typically encountered and groundwater was not encountered within the area of interest.

3.3 Liquefaction Potential

No evidence of liquefaction such as sand boils or other surface manifestations were encountered following earthquakes in the Canterbury region since September 2010 based on observations on site during investigations and inspection of the Selwyn District Council Liquefaction Map (Selwyn District Council, 2011). This lack of evidence is consistent with a deep water table.

4. Subdivision Earthworks

4.1 General

Bulk earthworks for Stages 20, 21A and 21B of Stonebrook Subdivision were carried out in accordance with the Selwyn District Council requirements outlined in the engineering approval letter dated 29 August 2012 and NZS4431:1989 "*Code of Practice for Earthfill for Residential Development*". The works comprised regrading of the site contours for the residential and commercial lots by predominantly engineered filling with minor areas of cutting. For the purpose of this report we have assumed that the commercial buildings will be of similar light weight construction to the residential development. We therefore consider the above standards to be generally applicable to the commercial area.

4.2 Areas of Cut and Fill

Site earthworks within the Stage 20, 21A and 21B areas includes both cut and fill. Table 3, 4 and 5 below shows the lots that have been filled or cut for each of the three stages in this report. The engineered fill comprises onsite natural gravel and compacted with a double drum roller. A layer of topsoil has been spread over the engineered fill.

The maximum depth of both cutting and filling was 0.5m. The gravel fill was sourced from areas of cut close to each of the lots to minimise transportation. The extent of cutting and filling for each stage is shown on Figure 3 in Appendix A.

Table 3: Areas of Cut and Fill Stage 20

Earthwork	Lot Number
Fill	371 to 377, 381 to 397 and 429
Cut	371 to 375, 379 and 380

Table 4: Areas of Cut and Fill Stage 21A

Earthwork	Lot Number
Fill	398 to 402 and 408 to 412
Cut	399, 400 and 402 to 412

Table 5: Areas of Cut and Fill Stage 21B

Earthwork	Lot Number
Fill	None
Cut	413 and 515

4.3 Compaction Quality Control Testing

Independent testing of earthfill compaction was carried out by City Care Limited Laboratory (City Care) using a Nuclear Densometer (NDM). The acceptance criterion was based on the Selwyn District Council earthworks specification as follows:

- Compaction of fill is to be in accordance with NZS 4431: 1989 *"Code of Practice for Earthfill for Residential Development"*.
- Compaction standard is 95% Maximum Dry Density (MDD) for all areas in accordance with NZS4402:1986 "*Methods of Testing Soils for Civil Engineering Purposes*".

The location of the soil samples obtained for laboratory compaction testing (Test Sites A, B and C) is shown on Figure 2. The results of the nuclear density tests were compared to the compaction tests to confirm the adequacy of the site compaction.

The compaction test results and the compaction curve for Test Sites A, B and C are presented in Appendix B.

Stage 20

We understand that fill placed across Lots 376 to 380 and 381 to 389 was sourced from the northern end of the reserve (marked on Figure 2) located near Test Site A, therefore the MDD achieved at Test Site A has been used as the target for Lots 376 to 380 and 381 to 389. Our understanding is that the remaining lots within Stage 20 were filled from sources near Test Site B and C and the MDD's achieved at Test Site B and C have been used as a target for remaining lots.

City Care carried out thirty eight density tests on lots that had been filled with a test frequency of one test per lot on Lots 376 to 380, 384, 385 387, 389 to 391, 393 and 429, two tests per lot on Lots 392 and 394 to 397, four tests were carried out on Lot 373 with two tests following the second lift. Lot 372 was tested eleven times with two tests following the second lift. One test within Lot 372 produced a lower result and was re-compacted and re-tested. The remaining lots with fill have not been tested due to limited depth and extent of filling.

Stage 21A

We understand that fill placed across Stage 21A was sourced from cuts north of Stage 21A and the MDD achieved at Test Site A gives a better representation of the fill used across Stage 21A.

City Care carried out ten nuclear density tests on filled lots within Stage 21A with a frequency of two tests on Lots 408 to 412. The remaining lots with fill have not been tested due to limited depth and extent of filling.

Stage 21B

Lots 413 and 515 within Stage 21B have been cut and no fill placed across the lots and compaction testing has not been carried out.

4.4 Compaction Results

The results presented in Appendix C generally indicate that 95% MDD or greater compaction has been consistently achieved with an exception to Lots 372 and 373 where 95% MDD was not consistently achieved. However, due to the limited depth of fill on the lots (0.1m) and compaction achieved we consider that the fill placed on Lots 372 and 373 to have achieved adequate compaction. Therefore, the earthfill placed within Stages 20, 21A has generally achieved the target compaction.

4.5 Certification

A statement of suitability of earth fill for residential development indicating the standard of bulk earthworks generally meet our earthworks specification and the applicable codes, including NZS4431:1989 is included in Appendix D.

5. Building Development

5.1 Technical Category

Geotechnical investigations including 64 test pits and two boreholes have been carried out by Aurecon as part of the wider subdivision development and encountered no potentially liquefiable material. The ECan/GNS report *"Review of liquefaction hazard information in eastern Canterbury and parts of Selwyn, Waimakariri and Hurunui Districts" dated December 2012*, identifies the site to be non-liquefiable. Therefore the lots within the Stages 20, 21A, 21B are likely to perform to the level of TC1 equivalent.

5.2 Earthworks on Building Lots

The extent of earthfill on Lots within Stages 20, 21A and 21B is shown on Figure 3 in Appendix A.

The fill areas have been constructed using materials and processes that have been measured by independent testing. The testing shows that the placement of filling is generally in accordance with the specification.

5.3 Soil Suitability Criteria

Section 3 of New Zealand Standard NZS 3604:2011 "*Timber Framed Buildings not requiring specific Engineering Design*" provides several criteria for defining foundation soil suitability for lightweight timber framed residential buildings.

Clauses 3.1.3 and 3.3 provide criteria for determining strength and suitability of founding soils.

Clauses 3.4.1 and 3.4.2 discuss depths to founding. For purposes of this report, we have interpreted these clauses as meaning that for sound bearing at depths of 200 to 600mm, standard shallow type foundations can be utilised. For depths greater than this, the use of 10MPa concrete or special foundations such as driven timber piles is to be used or alternatively excavations to "good" ground.

5.4 Building Considerations

As the land is likely to perform to a level of TC1 equivalent and fill has been compacted to the required standard, we consider NZS 3604:2011 type foundations are likely to be suitable for the construction of residential dwellings. Commercial building foundations should be designed following further site specific testing on the proposed allotments.

We note that at the time of writing this report the location and structural form of the future dwelling on the lots are unknown, but we infer that a NZS3604:2011 type lightweight timber framed houses will be constructed for the residential dwellings.

5.5 Future Earthworks

We do not anticipate that future earthworks will be required on the majority of the lots however should such work be required the following should be noted.

- All earthworks should be carried out in accordance with the Health and Safety and Employment Act 1992 and the Ministry of Building, Innovation and Employment (MBIE) approved Code of Practice for Safety in Excavations and Shafts for Foundations, 1995.
- Cuts that exceed 0.6m high around any of the house sites that support any loads must be retained by a suitable retaining wall designed by a Chartered Professional Engineer.
- We recommend that no more than 450mm of fill is placed on the allotment without detailed engineering design. Fill placement should only occur away from the timber retaining wall, unless specifically designed.

Any development where excavations greater than 1.5m in depth are proposed, must be subject to specific investigation and design to confirm these works will have no adverse effect on land stability and/or structures on adjacent lots.

5.6 Stormwater

All stormwater collected by impermeable surfaces (dwelling and pavement) and grassed areas shall be collected by lined channel drains and sumps etc. and be piped away from the lots to discharge into the Council vested infrastructure.

5.7 Construction Observations

The suitability of foundation conditions must be verified at the time of construction (refer Requirements of NZS 3604:2011). Foundation inspections by a Building Inspector who is familiar with this report or a Chartered Professional Engineer is needed and must be carried out to ensure the adequacy of the foundation subgrade prior to the placement of granular hardfill or the construction of foundations.

6. References

NZS 3604:2011. *Timber Framed Buildings*. Standards New Zealand, Wellington, New Zealand.

NZS 4402:1986. *Methods of Testing Soils for Civil Engineering Purposes*. Standards New Zealand, Wellington, New Zealand.

NZS 4431:1989. *Code of practice for earth fill for residential development*. Standards New Zealand, Wellington, New Zealand.

Brackley, H. L. (compiler). 2012; *Review of liquefaction hazard information in eastern Canterbury including Christchurch City and parts of Selwyn, Waimakariri and Hurunui Districts.* GNS Science Consultancy Report 2012/218. 99 p.

7. Limitations

We have prepared this report in accordance with the brief as provided. The contents of the report are for the sole use of the Client and no responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without our prior review and agreement.

This report has been prepared as part of the development of the Stonebrook Stage 20, 21A and 21B Subdivision. It has been prepared to report on the management of the earthworks during construction, including compaction standards of fills.

This report does not remove the responsibility of the Owner / Builder / Building Certifier to satisfy themselves of foundation depth and suitability at the finally selected house location.

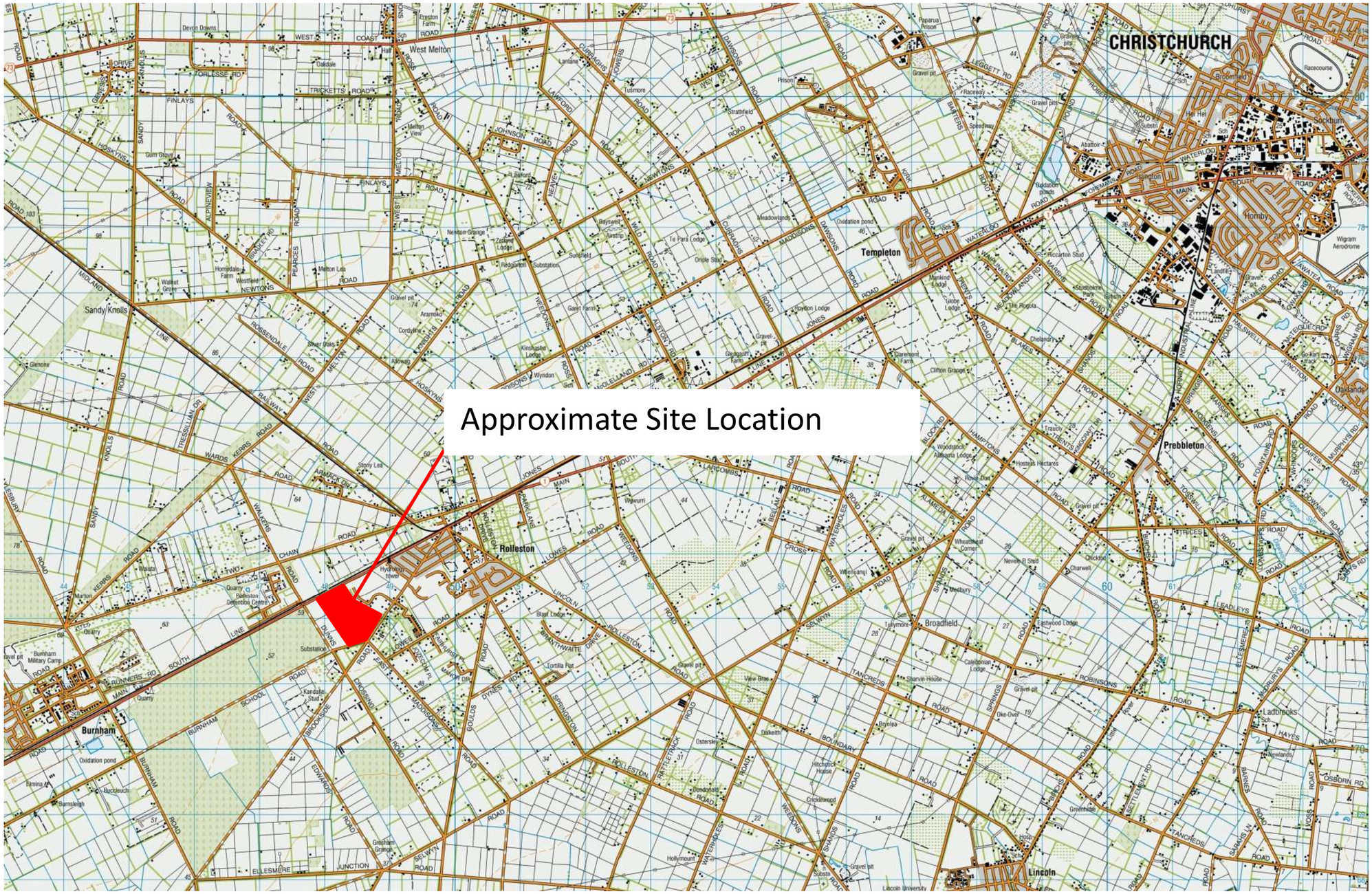
Subsurface conditions relevant to construction works should be assessed by experienced contractors and designers who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes. Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay or in wet weather.

It is strongly recommended that any plans and specifications prepared by others and relating to the content of this report, or amendments to the original plans and specifications, are reviewed by Aurecon to verify that the intent of our recommendations is properly reflected in the design. During construction we request the opportunity to review our interpretations if the exposed site conditions are significantly different from those inferred in this report.

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

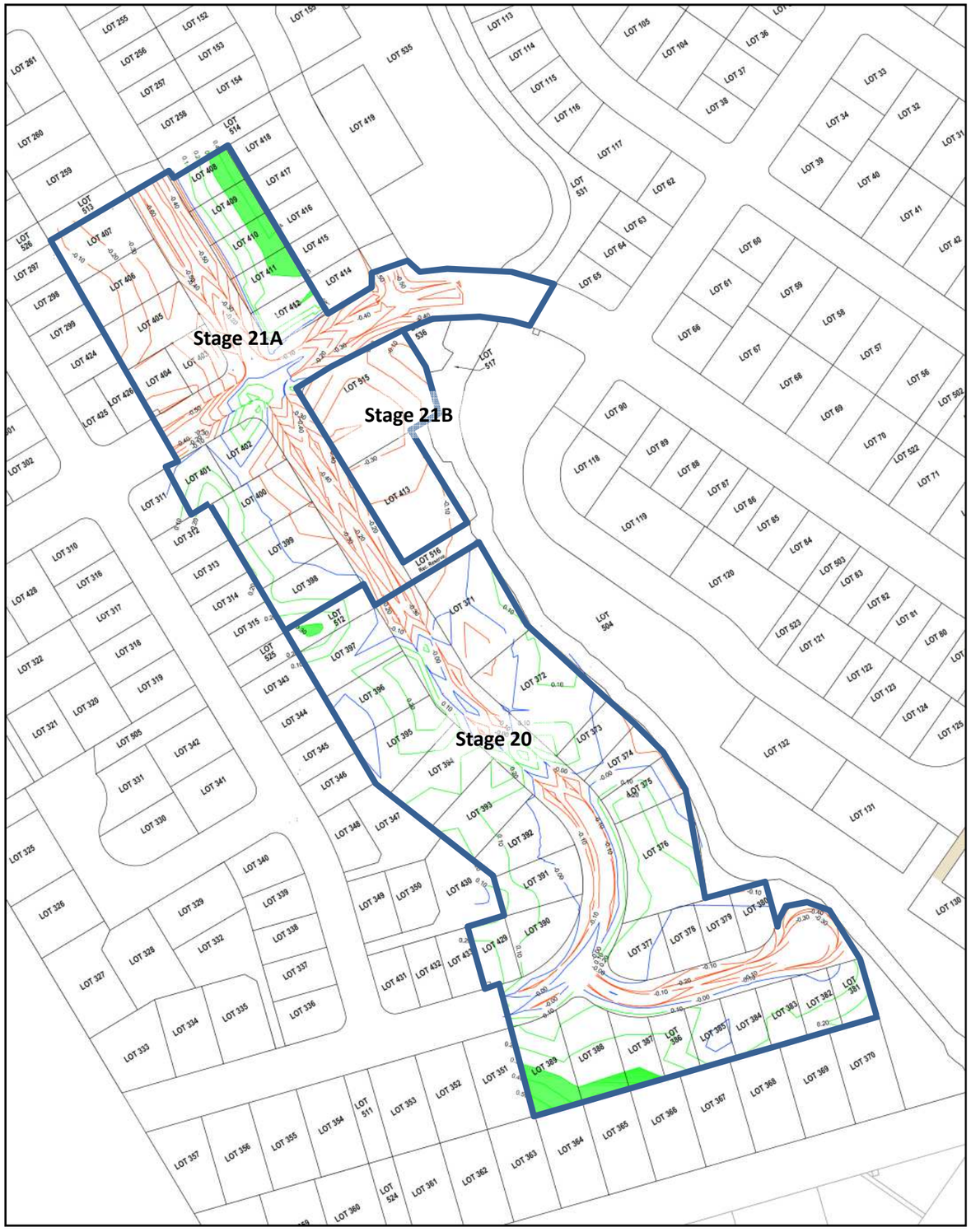
Appendix A

Figures



CLIENT	PRELIMINARY NOT FOR CONSTRUCTION	ALL DIMENSIONS APPROXIMATE ONLY	SCALE	SIZE	TITLE	REGIONAL SITE LOCATION PLAN	
aurecon www.aurecongroup.com			NTS	A4			
CDL LAND NEW ZEALAND LIMITED	FIGURE	FIGURE 1	BY T. MITCHELL		REFERENCE	STONEBROOK SUBDIVISION	
	PROJECT	STONEBROOK SUBDIVISION STAGE 20, 21A AND 21B	APPROVED M. DAVIDSON				
			DATE 23 MAY 2014		FIGURE No.	PROJECT 224926 / WBS 003 / TYPE FIG / DISC TRA / NUMBER 01 / REV 0	

CLIENT	PRELIMINARY NOT FOR CONSTRUCTION	ALL DIMENSIONS APPROXIMATE ONLY	SCALE	SIZE	TITLE	STONEBROOK SUBDIVISION LAYOUT				
aurecon www.aurecongroup.com	FIGURE	FIGURE 2	NTS	A4						
CDL LAND NEW ZEALAND LIMITED			BY T. MITCHELL		REFERENCE	STONEBROOK SUBDIVISION				
	PROJECT	STONEBROOK SUBDIVISION STAGE 20, 21A AND 21B	APPROVED M. DAVIDSON		FIGURE No.	PROJECT 224926	WBS 003	TYPE FIG	DISC TRA	NUMBER 02	REV 0
			DATE 23 MAY 2014							



NOTES

ALL WORKS TO COMPLY WITH SELWYN DISTRICT COUNCIL INFRASTRUCTURE DESIGN STANDARDS FIRSTLY THEN CHRISTCHURCH CITY COUNCIL'S CIVIL ENGINEERING CONSTRUCTION STANDARD SPECIFICATIONS CSS: PARTS 1-7: 2010.

ALL EARTHWORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH NZS 4431:1989.

METALCOURSE DEPTHS TO BE CONFIRMED BY TESTING SUBGRADE PRIOR TO PLACING BASECOURSE MATERIAL AND CONFIRMED BY ENGINEER.

NO STORMWATER RUN OFF IS TO LEAVE THE SITE DURING EARTHWORKS, THE SEDIMENT CONTROL PLAN IS TO BE IMPLEMENTED TO COMPLY WITH THE EROSION AND SEDIMENT CONTROL MANAGEMENT PLAN FOR THIS PROJECT AND THE ECAN GUIDELINES

LEVELS ARE IN TERMS OF MEAN SEA LEVEL (1937) LYTLETON DATUM.
ORIGIN OF LEVELS AND BENCHMARKS TO BE PROVIDED BY ENGINEER AT THE START OF THE CONTRACT.

CONTOUR INTERVALS ARE SHOWN AT 0.1m

KEY:

CUT CONTOUR - RED
FILL CONTOUR - GREEN
ZERO CONTOUR - BLUE

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CLIENT	PRELIMINARY NOT FOR CONSTRUCTION	ALL DIMENSIONS APPROXIMATE ONLY	SCALE	SIZE	TITLE	EARTHWORKS STAGE 20, 21A AND 21B CUT/FILL CONTOURS	
			NTS	A4			
FIGURE	FIGURE 3		BY				
			T. MITCHELL		REFERENCE	STONEBROOK SUBDIVISION	
PROJECT	STONEBROOK SUBDIVISION STAGE 20, 21A AND 21B		APPROVED				
			M. DAVIDSON				
			DATE		FIGURE No.	PROJECT / WBS / TYPE / DISC / NUMBER / REV	
			23 MAY 2014			224926 / 003 / FIG / TRA / 03 / 0	

Appendix B

Compaction Test Results

City Care Ltd Laboratory, 205 Springs Road, Christchurch 8042
T: 03 941 7616 F: 03 941 7618 www.citycare.co.nz

DETERMINATION OF THE DRY DENSITY / WATER CONTENT RELATIONSHIP
New Zealand Standard Compaction Test

Client: K B Contracting & Quarries Limited
Contact Name: Mr A. Hodgson

Sample Type: Sand and aggregate
Sample Source: Rolleston CDL, Test Site A

Sampled By: M. Foster, L. Sim
Date Sampled: 11 December 2013
Tested By: M. Foster
Date of Test: 18 December 2013

Sample Method: Dug from hole at site specified by Client (sampling is not IANZ Accredited)
Test Method: NZS 4402:1986 Test 4.1.1(Standard Compaction)

Results:

Moisture Content (% by dry mass)	Wet Density (kg/m3)	Dry Density (kg/m3)
2.6	2110	2060
3.8	2170	2090
4.8	2170	2070
6.2	2200	2070
7.5	2280	2120
8.0	2290	2120

Maximum Dry Density could not be determined by this method.
Maximum Density achieved = 2120 kg/m3 @ 8.0%
Note: Natural Water Content = 2.6 %

Sample History: Natural. Test performed on fraction <19.0mm

Date of Issue: 19 December 2013

Approved Signatory: _____
(T. O'Regan, Laboratory Manager)

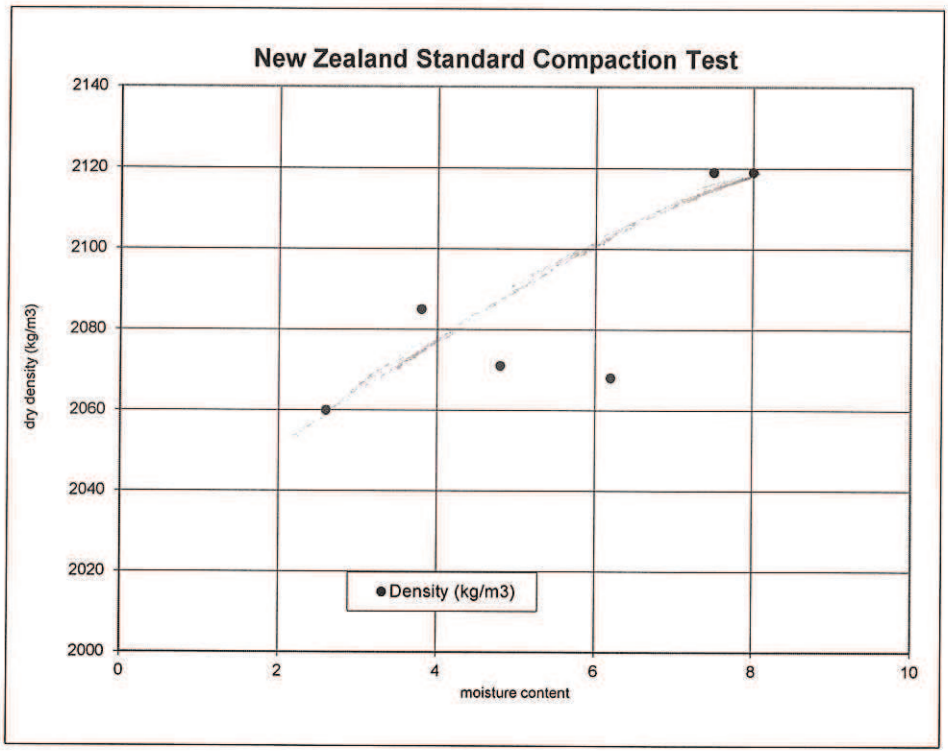
Checked By: J. Kedelington

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

new zealand accredited laboratory

DETERMINATION OF THE DRY DENSITY / WATER CONTENT RELATIONSHIP
New Zealand Standard Compaction Test

Sample Type: Sand and aggregate
Sample Source: Rolleston CDL, Test Site A



This report relates only to the sample tested and may only be reproduced in full.

Date of Issue: 19 December 2013

Approved Signatory: _____
(T. O'Regan, Laboratory Manager)

Checked By: T. Kerrington

City Care Ltd Laboratory, 205 Springs Road, Christchurch 8042
T: 03 941 7616 F: 03 941 7618 www.citycare.co.nz

DETERMINATION OF THE DRY DENSITY / WATER CONTENT RELATIONSHIP
New Zealand Standard Compaction Test

Client: K B Contracting & Quarries Limited
Contact Name: Mr A. Hodgson

Sample Type: Sand and aggregate
Sample Source: Rolleston CDL, Test Site B

Sampled By: M. Foster, L. Sim
Date Sampled: 11 December 2013
Tested By: M. Foster
Date of Test: 17 December 2013

Sample Method: Dug from hole at site specified by Client (sampling is not IANZ Accredited)
Test Method: NZS 4402:1986 Test 4.1.1(Standard Compaction)

Results:

Moisture Content (% by dry mass)	Wet Density (kg/m3)	Dry Density (kg/m3)
3.3	2110	2040
4.5	2190	2100
5.4	2230	2120
7.0	2340	2190
7.6	2420	2250
7.8	2400	2230

Maximum Dry Density could not be determined by this method.
Maximum Density achieved = 2250 kg/m3 @ 7.6%
Note: Natural Water Content = 3.3 %

Sample History: Natural. Test performed on fraction <19.0mm

Date of Issue: 19 December 2013

Approved Signatory: _____
(T. O'Regan, Laboratory Manager)

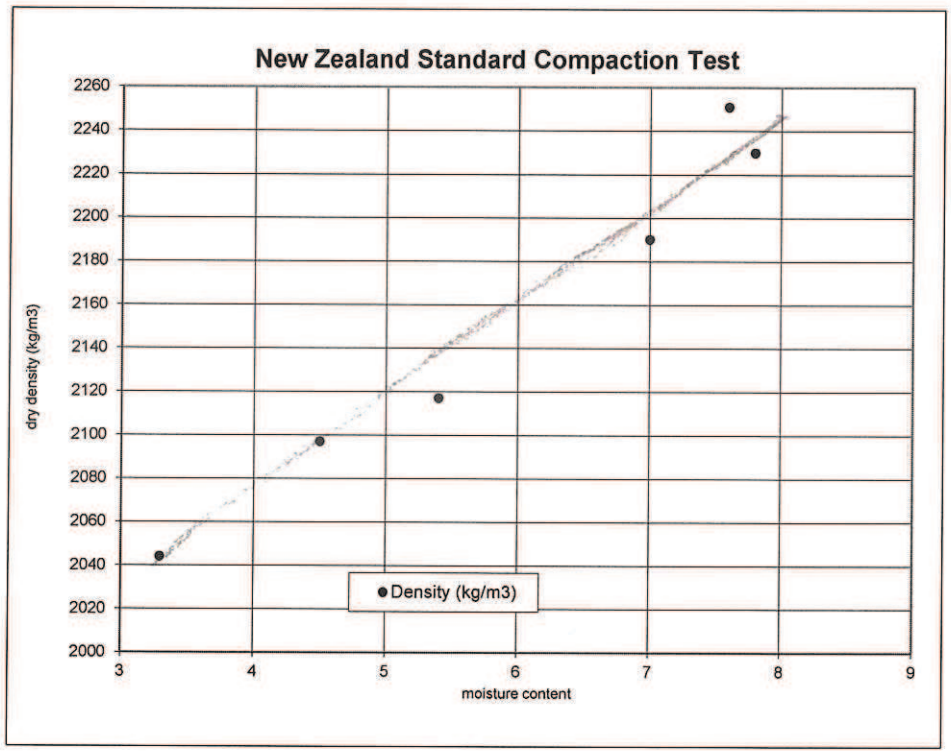
Checked By: J. Pendlington

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

new zealand accredited laboratory

DETERMINATION OF THE DRY DENSITY / WATER CONTENT RELATIONSHIP
New Zealand Standard Compaction Test

Sample Type: Sand and aggregate
Sample Source: Rolleston CDL, Test Site B



This report relates only to the sample tested and may only be reproduced in full.

Date of Issue: 19 December 2013

Approved Signatory: _____
(T. O'Regan, Laboratory Manager)

Checked By: T. Moddington

City Care Ltd Laboratory, 205 Springs Road, Christchurch 8042
T: 03 941 7616 F: 03 941 7618 www.citycare.co.nz

DETERMINATION OF THE DRY DENSITY / WATER CONTENT RELATIONSHIP
New Zealand Standard Compaction Test

Client: K B Contracting & Quarries Limited
Contact Name: Mr A. Hodgson

Sample Type: Sand and aggregate
Sample Source: Rolleston CDL, Test Site C

Sampled By: M. Foster, L. Sim
Date Sampled: 11 December 2013

Tested By: M. Foster
Date of Test: 18 December 2013

Sample Method: Dug from hole at site specified by Client (sampling is not IANZ Accredited)
Test Method: NZS 4402:1986 Test 4.1.1(Standard Compaction)

Results:

Moisture Content (% by dry mass)	Wet Density (kg/m3)	Dry Density (kg/m3)
1.2	2130	2100
2.3	2130	2180
3.5	2240	2160
4.5	2270	2170
5.6	2300	2180
6.2	2360	2200
6.6	2400	2250

Maximum Dry Density could not be determined by this method.
Maximum Density achieved = 2250 kg/m3 @ 6.6%
Note: Natural Water Content = 2.3 %

Sample History: Natural. Test performed on fraction <19.0mm

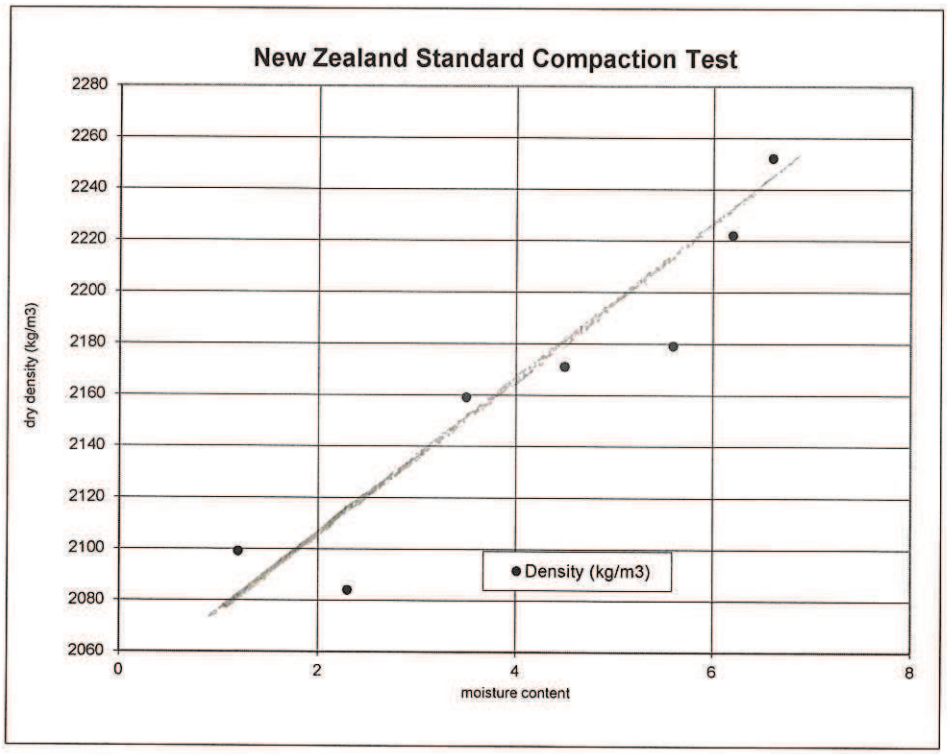
Date of Issue: 19 December 2013

Approved Signatory: _____
(T. O'Regan, Laboratory Manager)

Checked By: _____

DETERMINATION OF THE DRY DENSITY / WATER CONTENT RELATIONSHIP
New Zealand Standard Compaction Test

Sample Type: Sand and aggregate
Sample Source: Rolleston CDL, Test Site C



This report relates only to the sample tested and may only be reproduced in full.

Date of Issue: 19 December 2013

Approved Signatory: _____
(T. O'Regan, Laboratory Manager)

Checked By: _____

Appendix C

Nuclear Density Test Results

Test results supplied by City Care for K B Construction and Quarries Ltd and reproduced by Aurecon for the Stonebrook Subdivision Stages 20, 21A and 21B Geotechnical Completion Report.

The material comprising onsite gravel was tested in accordance with NZS 4407:1991 Test 4.2.2 (backscatter mode).

Table 6 Stonebrook Subdivision Stage 20 Nuclear Densometer Test Results (9 August 2013)

Lot Number	Dry Density (kg/m^3)	Wet Density (kg/m^3)	Moisture (%)	Compaction (%)
Lot 384	2060	2180	6.0	97.2
Lot 385	2170	2280	5.0	102.4
Lot 387	2100	2210	5.5	99.1
Lot 389	2110	2220	5.0	99.5

Table 7 Stonebrook Subdivision Stage 20 Nuclear Densometer Test Results (22 August 2013)

Lot Number	Dry Density (kg/m^3)	Wet Density (kg/m^3)	Moisture (%)	Compaction (%)
Lot 372	2190	2300	5.5	97.3
Lot 372	2060	2180	5.5	91.6
Lot 372	2120	2240	5.5	94.2
Lot 372	2050	2180	6.0	91.1

Table 8 Stonebrook Subdivision Stage 20 Nuclear Densometer Test Results (26 August 2013)

Lot Number	Dry Density (kg/m^3)	Wet Density (kg/m^3)	Moisture (%)	Compaction (%)
Lift 1				
Lot 372	2150	2290	6.5	95.6
Lot 372	2070	2200	6.5	92.0
Lot 372	2010	2100	5.0	89.3
Lot 372#	2080	2180	5.0	92.4
Lot 372	2190	2310	5.5	97.3
Lot 373	2120	2230	5.0	94.2
Lot 373	2100	2220	5.5	93.3
Lift 2				
Lot 372	2180	2310	6.0	96.9
Lot 372	2100	2210	5.0	93.3
Lot 373	2170	2270	4.5	96.4

Lot Number	Dry Density (kg/m^3)	Wet Density (kg/m^3)	Moisture (%)	Compaction (%)
Lot 373	2140	2240	5.0	95.1

Notes: # Test location re-compacted and re-tested.

Table 9 Stonebrook Subdivision Stage 20 Nuclear Densometer Test Results (17 September 2013)

Lot Number	Dry Density (kg/m^3)	Wet Density (kg/m^3)	Moisture (%)	Compaction (%)
Lot 376	2050	2150	5.0	96.7
Lot 377	2140	2260	5.5	100.9
Lot 378	2040	2170	6.5	96.2
Lot 379	2120	2210	4.5	100.0
Lot 380	2040	2150	5.5	96.2

Table 10 Stonebrook Subdivision Stage 20 Nuclear Densometer Test Results (28 February 2013)

Lot Number	Dry Density (kg/m^3)	Wet Density (kg/m^3)	Moisture (%)	Compaction (%)
Lot 390	2230	2360	6.0	99.1
Lot 391	2150	2260	5.0	95.6
Lot 392	2180	2320	5.0	96.9
Lot 392	2160	2280	505	96.0
Lot 393	2150	2270	6.0	95.6
Lot 394	2160	2310	6.5	96.0
Lot 394	2170	2270	4.5	96.4
Lot 395	2260	2320	5.5	100.4
Lot 395	2270	2370	4.5	100.9
Lot 396	2150	2280	6.5	95.6
Lot 396	2150	2270	5.5	95.6
Lot 397	2150	2270	5.0	95.6
Lot 397	2150	2260	5.0	95.6
Lot 429	2220	2330	5.0	98.7

Table 11 Stonebrook Subdivision Stage 21A Nuclear Densometer Test Results (12 July 2013)

Lot Number	Dry Density (kg/m^3)	Wet Density (kg/m^3)	Moisture (%)	Compaction (%)
Lot 408	2150	2260	5.0	101.4
Lot 408	2080	2260	8.5	98.1
Lot 409	2040	2140	4.5	96.2
Lot 409	2160	2290	6.5	101.9
Lot 410	2050	2210	8.0	96.7
Lot 410	2150	2270	5.5	101.4
Lot 411	2210	2340	6.0	104.2
Lot 411	2060	2190	6.5	97.2
Lot 412	2080	2230	7.0	98.1
Lot 412	2180	2320	6.5	102.8

Notes: We understand fill placed on Lots 384 to 389 and 376 to 380 was sourced from the northern reserve close to Test Site A, therefore a Maximum Dry Density (MDD) of $2120kg/m^3$ was used. Fill placed over Stage 21A was sourced from north of the site $2020kg/m^3$ MDD was used. The remaining Lots were filled from sources near Test Site B and C and a MDD of $2250kg/m^3$ has been used.

The Maximum Dry Density was determined by New Zealand Standard Compaction completed on 11 December 2013 by City Care from onsite samples (Test Site A, B and C). Test Site B and C are located near Stage 20 and 21A and Test Site A is located north of Stages 20 and 21A. The locations of the test sites are shown on Figure 2 and the compaction curves provided by City Care are attached.

Appendix D

Certification

NZS 4431 : 1989

STATEMENT OF SUITABILITY OF EARTH FILL FOR RESIDENTIAL DEVELOPMENT

To *Selwyn District Council*
PO Box 90
Rolleston 7643

STATEMENT OF SUITABILITY OF EARTH FILL FOR RESIDENTIAL DEVELOPMENT

Subdivision	*CDL – Stonebrook, Rolleston – Stage 20, 21A and 21B*
Owner / Developer	*CDL Land New Zealand Ltd*
Location	*Stonebrook Drive, Rolleston*

The earth filling, with depths of fill across each Stage are shown on the attached plan LINEAR PARK (STAGE 21A, 21B and 20) ASBUILTS CUTT/FILL COUTOURS 224926-DW-LD-S2-CF-20.21ab [A], have been placed in compliance with the terms of NZS 4431:1989.

While work was in progress I, Ian McPherson c/- Aurecon NZ Ltd, P O Box 1061, Christchurch, acted as consulting Geotechnical Engineer.

During the work, the inspecting engineer and his staff made periodic visits of inspection to the site. Details of the soil testing carried out to check the quality of the fill by the inspecting engineer can be made available upon request.

The attached plan, LINEAR PARK (STAGE 21A, 21B and 20) ASBUILTS CUTT/FILL COUTOURS 224926-DW-LD-S2-CF-20.21ab [A] show those lots affected by filling and the extent of the fill as part of the development works.

In the opinion of the inspecting engineer the following special limitations should be observed:

Nil

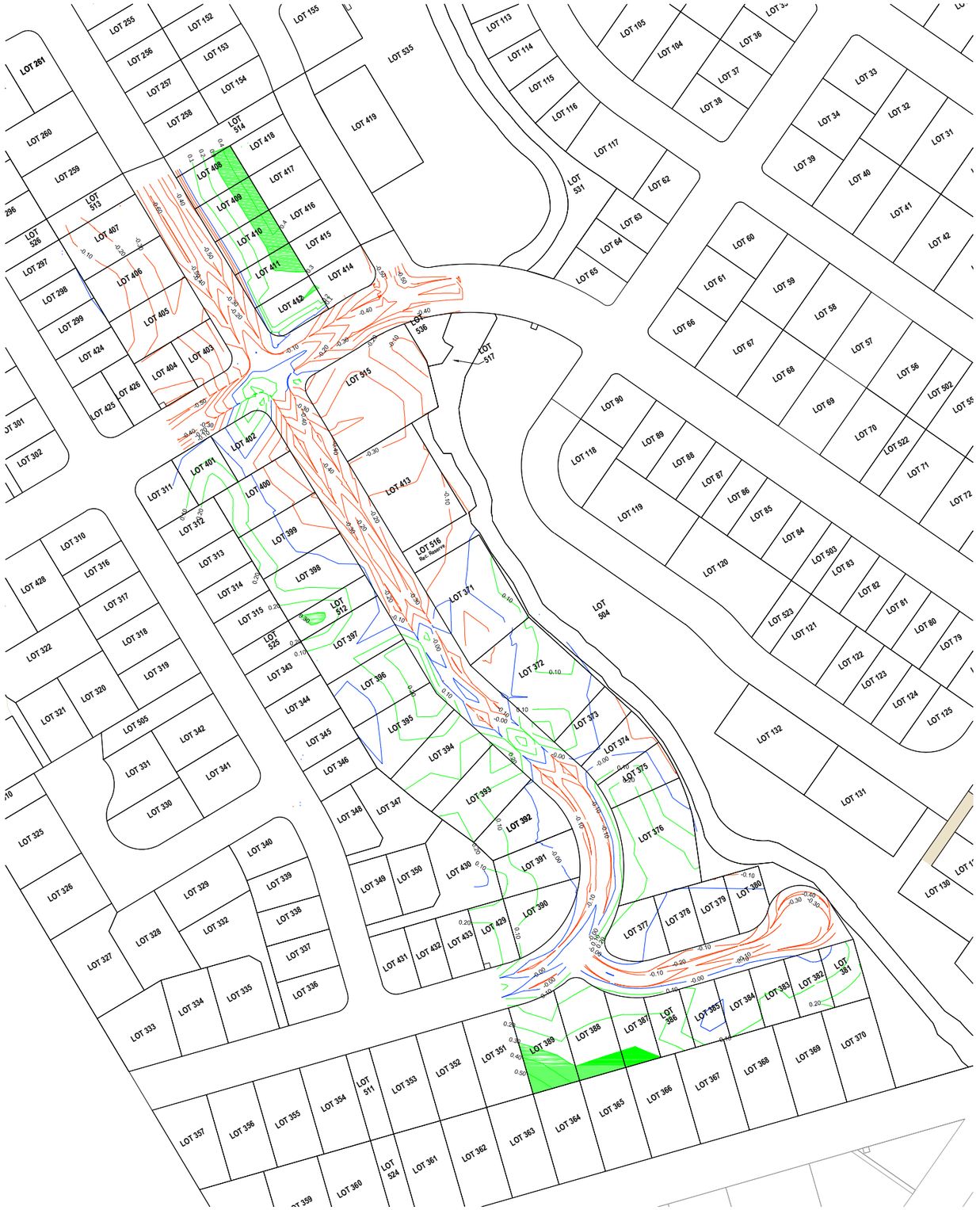
This certification, that the earth fills have been placed in compliance with the terms of NZS 4431:1989 does not remove the necessity for the normal inspection and design of foundations as would be made in natural ground.

..... (signature)

Technical Director (position)

28/5/14 (date)

On behalf of *CDL Land New Zealand Ltd*



NOTES

ALL WORKS TO COMPLY WITH SELWYN DISTRICT COUNCIL INFRASTRUCTURE DESIGN STANDARDS FIRSTLY THEN CHRISTCHURCH CITY COUNCIL'S CIVIL ENGINEERING CONSTRUCTION STANDARD SPECIFICATIONS CSS: PARTS 1-7: 2010.

ALL EARTHWORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH NZS 4431:1989.

METALCOURSE DEPTHS TO BE CONFIRMED BY TESTING SUBGRADE PRIOR TO PLACING BASECOURSE MATERIAL AND CONFIRMED BY ENGINEER.

NO STORMWATER RUN OFF IS TO LEAVE THE SITE DURING EARTHWORKS, THE SEDIMENT CONTROL PLAN IS TO BE IMPLEMENTED TO COMPLY WITH THE EROSION AND SEDIMENT CONTROL MANAGEMENT PLAN FOR THIS PROJECT AND THE ECAN GUIDELINES

LEVELS ARE IN TERMS OF MEAN SEA LEVEL (1937) LYTLETON DATUM.
ORIGIN OF LEVELS AND BENCHMARKS TO BE PROVIDED BY ENGINEER AT THE START OF THE CONTRACT.

CONTOUR INTERVALS ARE SHOWN AT 0.1m

KEY:

CUT CONTOUR - RED
FILL CONTOUR - GREEN
ZERO CONTOUR - BLUE

aurecon
www.aurecongroup.com

CLIENT

CDL LAND
NEW ZEALAND LIMITED

REV	DATE	REVISION DETAILS	APPROVED
A	01/05/14	ISSUE FOR APPROVAL	

DRAWN	SURVEYED
M CROWE	H DAWSON
CHECKED	
D WATSON	
APPROVED	
DATE 14/11/12	
B TOMS	

PROJECT
STONEBROOK ROLLESTON

TITLE
LINEAR PARK (STAGE 21A, 21B and 20) ASBUILTS CUT/FILL CONTOURS

FOR CONSTRUCTION

PROJECT No.
224926

SCALE	SIZE
1:1000	A1

DRAWING No.	REV
LD-S2-CF-20.21ab	A

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