GEOTECHNICAL COMPLETION REPORT
RESIDENTIAL SUBDIVISION - STAGE ONE
129 BEACHLANDS ROAD
BEACHLANDS

Prepared For:

Beachlands Junction Limited
C/- Crang Civil Limited
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Reference: 8917-5

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Geotechnical Completion Report
Residential Subdivision - Stage One
129 Beachlands Road
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Geotechnical Completion Report
Residential Subdivision - Stage One
129 Beachlands Road
Beachlands

1.0 INTRODUCTION

This Geotechnical Completion Report (GCR) has been prepared for Beachlands Junction Limited (BJL) as part of the documentation required to be submitted to Auckland Council for Stage1 of the residential subdivision of 129 Beachlands Road, Beachlands, hereinafter referred to as 'the site'. The development, covered in this report, comprised the formation of forty seven new residential Lots, together with the addition of shared private accessways over easements, a stormwater reserve Lot, and a utility Lot.

This report addresses the geotechnical engineering aspects of the subdivision development. It contains a description of the site formation works carried out and presents the As Built plans that have been prepared by the subdivision designers, Crang Civil Consulting Engineers (CCCE), as well as pre development contours for the Stage One area. In addition, this report identifies and discusses geotechnical engineering limitations that must be taken into consideration during individual Lot development. Also included is a Statement of Professional Opinion as to the suitability of the land for its intended purpose. The SOPO also contains a table entitled "Summary of Geotechnical Design Recommendations for Specific Lots". The SOPO is a separate document contained within Appendix 1 of this report.

The subdivision design was prepared by CCCE and the main contractor for the works was Dempsey Wood Civil Limited (DWL). The As Built drawing set for the subdivision was prepared by CCE, (Drawings 1 to 4) dated June 2016, and has been included with this report within Appendix 2.

Initially, Soil & Rock Consultants Limited (S&R) were engaged to observe and monitor the earthworks, with their input spanning from prior to construction until the end of September 2015, with physical site works having begun in early September 2015. Following this, KGA Geotechnical Limited (KGA) was commissioned to continue to monitor and observe the earthworks from early October 2015 until completion of the site formation works, and to undertake the appropriate testing as required in order to prepare this document for submission to Council.

The subdivision earthworks were carried out in general accordance with NZS4404:2010 Land Development and Subdivision Infrastructure, together with NZS4431:1989 Code of Practice for Earth Fill for Residential Development.

2.0 SUBDIVISION DESCRIPTION

2.1 Legal Description & Location

Prior to development, the site comprised a single Lot that was legally designated as Lot 2 DP 490742, which had a total plan area of 7.5ha. The parent Lot was approximately rectangular square in plan shape and included a narrow panhandle extending northwards from the northwestern corner of the site proper. Overall, the site was bounded by Beachlands Road and land under subdivision development to the north, Whitford-Maraetai Road to the east, land under subdivision development to the south, and paddocks to the west.

2.2 Completed Subdivision

The completed Stage One subdivision has resulted in the formation of forty seven new residential Lots, (Lots 1 - 42, 44 - 47 and 200) that upon completion of the subdivision works and certification from Council will be released for individual development. The layout of the new Lots is indicated on the CCCE drawings presented within Appendix 2, and also on our Subdivision Layout Plan, attached as Sheet KGA 1. The subdivision works also comprised the formation of two road to vest Lots (Lots 100 and 101, with the roads to be known as Seventh View Avenue, Eighth View Avenue, Mahutonga Avenue, Karo Road and George Town Drive), two access ways over easements (A, B, C and D), a stormwater reserve Lot (Lot 203), and a utility Lot (Lot 301).

2.3 Topographical Description Pre-Construction

The topography of the site prior to development is shown on the CCCE drawing 'Pre-construction Existing Contours', Drawing No. 1. Pre-Ex Contours, dated 27 June 2016, presented within Appendix 2. The topography generally comprised gently to moderately sloping land that lead down towards a main gully which was trending east to west near to the southern boundary of the site.

The main gully contained three tributary gullies on the northern side that were approximately orientated north to south, and two tributaries on the southern side that were approximately orientated southeast to northwest. The gullies on the southern side of the main gully extended beyond the southern boundary into the neighbouring property. At the southwestern end of the main gully, and extending beyond the site boundary, there was a farm pond which was fed by the watercourse within main gully and its tributaries.

Prior to development, the site was previously used as grazing pastureland, with the ground cover dominantly comprising grass. Most of the main gully area towards the southwest was vegetated with a combination of native and exotic trees. No structures were present on the property prior to development.

2.4 Topographical Description Post Construction

The site topography following completion of the subdivision earthworks is shown on the CCCE drawing 'Final Contour & Underfill Drain Level Plan', Drawing No. 2. Final Contour Plan dated 27 June 2016, presented within Appendix 2. The panhandle area, along with a narrow strip adjacent to the eastern site boundary are outside the limits of Stage One and therefore are not included in our description of the finished Stage One topography. Otherwise, much of the Stage One area has been affected by the site formation works in order to obtain the finished site profile.

A large stormwater detention pond has been created within the main gully, with an associated bund adjacent to the southwestern boundary. The remainder of the gullies have largely been filled, and some of the more elevated portions have been cut down in order to create a more gently sloping profile across each of the forty seven new residential Lots. Retaining walls have been constructed within portions of the stormwater reserve Lot in order to facilitate the gently sloping gradients on some of the Lots. The side slopes of the stormwater pond have been generally finished at gradients of approximately 1 vertical on 3 horizontal.

3.0 PREVIOUS GEOTECHNICAL INPUT

3.1 Soil & Rock Consultants Investigation

S&R previously undertook a geotechnical investigation in support of the proposed development. The findings and conclusions of that investigation were outlined in their draft report titled 'Geotechnical Investigation Proposed Commercial Development, 109 Beachlands Road, Beachlands', reference No. 09691, dated March 2010.

The S&R investigation included fifty hand auger boreholes (AH1 to AH50) and one machine borehole (MB1) spread across the site, and identified a varying veneer of alluvial soils, topsoil & non-engineered fill overlying generally stiff to very stiff Waitemata Group soils across much of the site. Stability analyses were conducted to assess the localised steepening slope land within the southern gully of the site, however stability was not considered to be a concern for the finished development due to the gently to moderately sloping nature of the proposed development.

Earthworks were recommended to be undertaken in accordance with both NZS4431:1989 and NZS 4404:2004. Various other site formation recommendations were provided, such as an assumed CBR value for pavement design of 5%. Recommendations were also provided in terms of future structure foundation and floor slab areas, along with seismic criteria as per NZS1170.5:2004.

A copy of the document referenced above has not been appended to this report as it is assumed that it is available on the Council Property File.

3.2 Stormwater Pond Assessment

KGA were engaged by another Client, who was working in conjunction with BJL, for the purposes of carrying out an assessment of the stormwater pond to support a Resource Consent application for the pond. The findings and conclusions of the KGA assessment were outlined in the report titled 'Geotechnical Engineering Assessment, Proposed Stormwater Pond, 49 Jack Lachlan Drive, Beachlands', reference No. 7169-5, dated 27 August 2013.

The report states that the design of the pond has been undertaken in accordance with the general principals of the New Zealand Society on Large Dams (NZSOLD) ' Dam Safety Guidelines, Issue No.2', and that the pond has a low Potential Impact Classification (PIC).

The design was prepared based on the geotechnical information presented within the S&R March 2010 report, as referenced in Section 3.1 above; no specific investigation data was obtained by KGA for the purposes of the pond design.

The pond was designed to operate with a permanent volume of 2,400m³ and a water depth of 0.5m (RL 27m). During storm events, the pond level would rise, and the pond was designed to have an extended detention volume of approximately 10,500m³ and a water depth of 2.3m (RL 28.8m). The maximum capacity for the pond design is a water volume of 19,600m³. The bund for the pond was designed to be 4m high, as measured from the downstream toe to the crest.

The primary spillway for the pond comprises a 1050mm manhole riser, connected to a 2100mm diameter concrete pipe that extends through the dam to a wing-wall structure on the downslope side, where the water will discharge into the existing stream channel.

The permanent water level is controlled by a 250mm diameter orifice at RL 27m, the extended detention volume controlled by a rectangular saw cut in the manhole riser at RL 28.8m, and the 100yr flood level is controlled by a spillway designated over the crest of the bund at RL 30.4m.

Earthworks criteria, consisting of optimum moisture content, maximum dry density and air voids percentages were given for the construction of the stormwater bund construction, however these were general parameters based on third party information only.

Stability analyses were undertaken on the pond design and determined that the pond side slope design could be constructed to be safe and stable under the four separate load cases analysed.

As part of our assessment, KGA also provided a letter to Council titled ‘Application For Stormwater Pond - Wetland 5, Subdivision - 49 Jack Lachlan Drive, Beachlands’, reference No. 7169-7, dated 18 September 2013. This letter was prepared in order to provide a response to queries from the Council Dam Specialist.

KGA provided another letter to Council, titled ‘Application For Stormwater pond - Wetland 5 Filter Diaphragm, Subdivision - 49 Jack Lachlan Drive, Beachlands. This letter presents the details of a filter diaphragm to be placed on the outfall pipe to control seepage along the pipe and prevent piping erosion.

3.3 Pre-Construction Earthworks Recommendations

In early October, CCCE provided KGA with a set of pre-construction earthworks laboratory compaction data and construction recommendations that were initially prepared by S&R.

The information provided included (in order of information received):

- Email correspondence dated 5 October 2015, from S&R to CCCE, subject “FW: Pine Roots”.
- Email correspondence dated 6 October 2015, from S&R to CCCE, subject “15542-Beachlands Compaction Data.
- Laboratory test results prepared by Babbage Geotechnical Laboratory for S&R, dated 2 October 2015.
- Moisture Content Report, prepared by S&R, dated 24 September 2015.
- Hand annotated CCCE plan titled ‘Earthworks’, drawing No. C200, dated 14 August 2015

For reference, copies of the S&R results and recommendations, as provided to KGA, are presented within Appendix 3.

The email from S&R, subject “FW: Pine Roots” provides comments and recommendations regarding an area of stripped soils that was observed to be root rich. This areas was identified as formerly comprising a pine plantation. General recommendations included screening soil containing roots that was otherwise intended for reuse as fill elsewhere, not using root-rich soils within the construction of the stormwater pond bund, and locations where roots may remain in situ.

The email from S&R, subject “15542-Beachlands Compaction Data” presents the results of the compaction testing undertaken by Babbage Geotechnical Laboratory, the results of the soil moisture content tests undertaken by S&R, a hand annotated CCCE plan showing the approximate locations of two test pits (TP01 and TP02), comment on the samples, and a specification for the cohesive fill to be constructed on the site.

No logs of the pits were provided, and the exact date of excavation is unknown, however the other background information included suggests that these pits were excavated on 23 September 2015. The pits appear to have been excavated for the purpose of obtaining bulk samples for the purposes of water content testing and standard compaction testing.

Four bulk samples were obtained, one shallow and one deep, from the test pits with each bulk sampling being subjected to a NZ Standard Compaction test, as per NZS4402:1986:Test 4.1.1. The testing returned a range of results of the samples tested maximum dry density and optimum water content. The testing also reported on the samples natural water content. For reference, the table of sample results (as presented within Appendix 3) has been reproduced in Table 1 below.

Table 1: Summary of NZ Standard Compaction Test Results

Sample Number	Depth (m)	Maximum Dry Density (t/m^3)	Optimum Water Content (%)	Natural Water Content (%)
TP01 / BULK	1.80 - 2.00	1.26	34	47.5
TP01 / BULK	3.70 - 4.00	1.51	22	33.7
TP02 / BULK	1.00	1.38	31	34.2
TP02 / BULK	2.90	1.51	25	27.2

(As reproduced from Babbage Geotechnical Laboratory test results report, reference No. 52091#L, dated 2 October 2015.)

The text associated with the results provides a description of each bulk sample, and this indicates that no two samples were the same. The test also indicates that varying solid density values were assumed in order to calculate each samples air voids percentages.

The Moisture Content Report provides three results from TP01, and one results from TP02. The results indicate a variable, but increasing natural soil moisture content with increased depth.

The text within the email comments on each sample as follows:

- Soils in the location of TP01 were generally considered wet of optimum and would require drying in the order of 10% before they would be suitable for compaction.
- Soils at depth in the location of TP01 were sandy and not considered suitable for use in the construction of the stormwater pond bund.
- Soils in the location of TP02 were considered to be slightly wet of the optimum moisture content and would be suitable for the construction of the stormwater pond bund.

Based on the results of the testing, a specification was provided for all of the cohesive materials to be used as bulk fill on the site, including for the pond bund. For reference, the table presenting the given specification (as presented within Appendix 3) has been reproduced in Table 2 below.

Table 2: Cohesive Earthworks Specification

	Air Voids Percentage (as defined in NZS4402:1986)		Undrained Shear Strength (Measured in-situ by IANZ calibrated vane)	
	Maximum Average Value %	Maximum Single Value %	Minimum Average Value kPa	Minimum Single Value kPa
General Fill	8	10	140	110

(As reproduced from S&R email dated 6 October 2015, subject "15542-Beachlands Compaction Data.)

In addition, S&R also stated that "… *the fill within Pond 5 Dam and base should be placed at or up to 3% wet of the optimum moisture content. i.e slightly wet not slightly dry to dry*".

4.0 SITE OPERATIONS

4.1 Construction Works Programme for Stage One

The initial site strip began in September, 2015 and construction continued through until May 2016.

The primary works comprised:

- Initial stripping of all areas that would be subject to either cutting or filling, along with stockpiling of the stripped topsoil.
- Removal of any non-engineered fill material within the development area.
- Cut/filling earthworks where required.
- Construction of timber pole retaining walls.
- Placement of topsoil across the finished Lots.
- Construction of roading and services (power, telecommunications, stormwater and wastewater sewers, town water supply).

The site formation work comprised both cut and fill earthworks, with maximum depths in the order of approximately 9m for both, as shown on the CCCE drawing 'Depth of Cut & Fill Plan Sheet 1' and 'Depth of Cut & Fill Plan Sheet 2 ', Drawing No. 3. Depth of Cut & Fill, dated August 2016, presented within Appendix 2

Services such as stormwater and wastewater were largely constructed during the earthworks operation, rather than on completion. This procedure reduced the need to trench for these services post earthworks, and as a result, reduced any potential areas of poorly compacted backfill material.

Utility services (power, telecommunications, gas, water supply etc.) were constructed on completion of the bulk earthworks. This has resulted in the formation of some shallow and narrow trenches of poorly compacted backfill material. These are generally located within the road and accessway reserves.

4.2 Extent of Site Formation Works

With the exception of the thin panhandle area, the majority of the site was affected by the formation earthworks. The extent of the cutting and filling within the development area is indicated on CCCE drawing 'Depth of Cut & Fill Plan Sheet 1' and 'Depth of Cut & Fill Plan Sheet 2 ', Drawing No. 3. Depth of Cut & Fill, dated August 2016, presented within Appendix 2.

The deepest area of cut is located in the location of Lot 203 (the stormwater reserve), in the middle of the site near Lot 10, and towards the western boundary near Lots 16 and 17.

The deepest areas of filling is located to the southeast, near Lots 25 and 41, and beneath Lot 100 where the stormwater reserve bund was constructed.

4.3 Source of Fill Material

Cohesive soil material used as bulk fill was sourced from cut areas on site. All excess spoil from the cut formation works was removed from the site.

4.4 Plant Used

During the earthworks operation, the following plant was onsite:

1x Caterpillar D5 M_{LCP} crawler Tractor	1x SAKAI SV512T pad foot compactor
1x Moxy MT41 dump truck	1x Moxy MT31 dump truck

1x Hiatchi Zaxis 160 LC excavator	1xHiatchi Zaxis 240 LC excavator
3x Wabco 252FT scraper	1x Sheepfoot HC2 Pad foot compactor
1x Sheeptfoot HC4 pad foot compactor	1x Volvo A40E dump truck
1x Sumitomu SH210 excavator	1x Sumitomu SHI excavator
1x Komatsu D85EX tilt dozer	1x Kokudo S3 scraper
1x Doosan $DX235_{LCR}$ excavator	1x Caterpillar D6 dozer
1x Caterpillar D7 dozer	1x JCB 4series wheel loader
1x John Deere 8400 tractor	1x Komatsu D61PX bulldozers
Terex TA350 dump truck	

4.5 Compaction Control Requirements

Given the natural variability in the site soils, as indicated in the pre-construction earthworks test results, as discussed in Section 3.3 above, and reference within Appendix 3, the compaction control criteria adopted for the bulk filling of the site and stormwater pond bund utilised the maximum allowable air voids and minimum allowable undrained shear strengths method, as outlined within NZS4431:1989. The specified requirements, as provided by S&R (see Section 3.3) were:

Minimum undrained Vane Shear Strength (measured in situ by hand held shear vane)

General fill:	Minimum single value (factored)	110kPa
	Minimum average value (factored)	140kPa

Maximum Air Voids Percentage (as defined in NZS 4402:1986 Part 1)

General fill:	Maximum single value	10%
	Maximum average value	8%

4.6 Field Control

Confirmation of the placement and compaction of the fill was checked by hand held shear vane by KGA staff at regular intervals during the earthworks. All hand held shear vane tests undertaken by KGA were carried out in accordance with the New Zealand Geotechnical Society Guideline for Hand Held Shear Vane Test, 2001. Where filling advanced at a rapid pace, shallow hand auger boreholes, with vane shear strengths taken at regular intervals, were drilled retrospectively in order to ascertain a strength profile with depth in spot locations.

Further confirmation of the placement and compaction of the fill was checked by Nuclear Densometer (NDM) testing during construction. The NDM testing was carried out by Opus Laboratories in accordance with NZS4407:1991, Test 4.2.1 for Direct Transmission Mode. The results of the NDM testing are contained within Appendix 4.

On completion of the subdivision earthworks, undisturbed samples were obtained by Geotek Services Ltd (GSL) for shrink/swell testing in accordance with AS1289:7.1.1. A total of five undisturbed samples were obtained for testing from the Stage One area (approximately 1 test for each 9 lots). Whilst this frequency varies from that typically required by Council, we consider that, because the ground conditions are generally consistent across the site, that the selected sampling frequency is appropriate to provide an overall indication of the AS2870 site soil classification. The shrink/swell samples were obtained from a depth of approximately 0.5m below finished ground level. The results of the shrink/swell testing are presented in Appendix 5.

An indication of the approximate locations of the shrink/swell sample locations is presented on our Test Location Plan, attached as Sheet KGA 2.

Problems identified by field testing during construction were dealt with by monitoring the fill material, blending, drying, or chemically stabilising where required, for reworking of the fill where deemed necessary.

On completion of the main site formation works, spot testing was carried out by KGA to measure the depths of topsoil across the site. The results are shown on our Topsoil Depth Plan, attached as Sheet KGA 3.

5.0 SPECIFIC CONSTRUCTION ITEMS

5.1 Uncertified Fill

To the best of our knowledge, all areas of bulk filling that were constructed as part of the subdivision works meet the criteria given within Section 4.5, and therefore all areas of bulk filling can be considered to comprise certified fill in accordance with NZS4431:1989.

Specific testing of the backfill material placed to reinstate the service trench excavations was not undertaken. However, we understand that all service trench back-fill material comprises either granular scoria backfill and/or cohesive trench excavated spoil. As no specific testing was undertaken on this material, it cannot be considered to meet the requirements for certified fill in accordance with NZS4431:1989. However, this material is overlain with certified fill in some locations, and is also minor in both vertical and horizontal extent (perpendicular to the service). It is also limited to surrounding public and utility services only.

5.2 Ground at Gradients of 1 Vertical on 4 Horizontal or Steeper

The finished contour information shown on the CCCE drawing 'Final Contour & Underfill Drain Level Plan', Drawing No. 2. Final Contour Plan, presented within Appendix 2, indicates the presence of ground with gradients of 1 vertical on 4 horizontal, or steeper within Lot 203, the stormwater retention pond, and also towards the northwest of Lot 200. No other portion of the subdivision has been formed at gradients of 1 vertical on 4 horizontal or steeper.

The portions of Lot 200 that are sloping at a gradient of 1 vertical on 4 horizontal, or steeper, have been included within a Restricted Development Area; as shown on our Restricted Development Areas Plan, attached as Sheet KGA 4. 'Restricted Development Zones' are discussed in further detail within Section 6.8 below

5.3 Retaining Walls

Cantilever timber pole retaining walls have been constructed in two locations on the site; one within, and towards the south of Lot 203 (the stormwater retention pond), and one on the common boundary between Lot 203 and Lots 44 - 47. The locations of these walls are shown on the CCCE drawing 'Final Contour & Underfill Drain Level Plan', Drawing No. 2. Final Contour Plan, presented within Appendix 2, and on our 'Subdivision Layout Plan', attached as Sheet KGA 1. The ground conditions exposed within the foundation excavations for the retaining walls have been certified under a separate Consent (Building Consent No. 20152992). The suitability of the ground conditions in the cantilever pole retaining wall foundations is therefore specifically excluded from this GCR. For reference, we have appended this Producer Statement (PS4) (Appendix 6).

To prevent the developments on Lots 44 - 47 from imposing undue load on the retaining walls, all developments must be designed taking into account the Auckland Council Practice Note 'Construction of retaining walls', Document No. AC2231, Version 2. Based on this, a Restricted Development Area, equal to the retained height of the wall, immediately upslope of the wall, has been imposed, as indicated on Sheet KGA4. Restricted Development Areas are discussed in further detail below in Section 6.8.

CCCE have indicated that drainage measures have been installed behind all retaining walls, and that these are designed to discharge any collected water at the ends of the walls.

5.4 Underfill Drains

An underfill drainage system, comprising perforated 110mm diameter drainage pipes wrapped in filter sock, surrounded with a gap-graded drainage medium (scoria), were constructed in the base of the existing gullies prior to the commencement of bulk filling. The layout and depth of the underfill drains at the residential Lot boundaries is shown on the CCCE drawing 'Final Contour & Underfill Drain Level Plan', Drawing No. 2. Final Contour Plan, presented within Appendix 2. Underfill drains are shown to be present, at depth, beneath Lots 7 - 9, 11, 12, 14, 23 - 27, 31, 33, 34, 41 and 45. Considering the depth of fill on these Lots (at least 2.0m), the under-fill drains themselves are unlikely to be encountered during individual Lot development, and therefore no further consideration has been given to the presence of the underfill drains.

The underfill drains constructed are considered to be maintenance free.

6.0 EVALUATION OF SITE FOR RESIDENTIAL CONSTRUCTION

6.1 Introduction

Cutting and filling took place across much of the site. In general, the earthworks carried out have resulted in re-contouring of the site to provide for a more even profile.

KGA consider that most portions of the site are generally free of significant geotechnical issues that will affect residential Lot development, however others are not. Specific items that affect individual Lot development are discussed below.

We consider that all residential Lots within the Stage One area have been affected by either filling or cutting to some extent; no Lots are situated upon unworked natural ground.

Residential Lots affected partly by Engineered Fill (fill placed during the site formation works) and partly by in situ residual soil include Lots 1, 3, 5, 9 - 15, 21, 22, 27 - 30, 35, 38 - 40, 44 - 47 and Lot 200.

Residential Lots 6 - 8, 23 - 26, 31 - 34, 36, 37, 41 and 42 are considered to be entirely underlain by Engineered Fill.

Residential Lots 2, 4 and 16 - 20 are considered to be entirely underlain by in situ residual soils.

6.2 Individual Lot Development

With the exception of the land Restricted Development Area imposed towards the western boundaries of Lots 44 - 47, and towards the west of Lot 200, we consider that the finished Lots in their current state are not subject to, nor will contribute towards or result in any of the natural hazards defined within s71(3) of the Building Act 2004, on the subject site or any of the immediately adjacent neighbouring properties provided that the recommendations within this report are followed.

Any developments that encroach into any areas that are designated as a Restricted Development Area must be subject to specific geotechnical investigation and engineered design at the Building Consent stage to ensure that the development will not contribute towards, or result in any of the natural hazards defined within S71(3) of the Building Act 2004, either on the subject Lot or any of the immediately adjacent neighbouring properties.

6.3 Expansive Soils

The underlying soils on this site comprise Engineered Fill and in situ residual Waitemata Group soils of Miocene age. Experience with similar soils elsewhere suggests that the site soils are likely to be susceptible to seasonal shrink/swell movements as the ground dries out then wets up in a cyclic manner from summer to winter.

NZS3604:2011 refers to AS2870:2011 'Residential Slabs and Footings' in this regard. This standard categorises soils into Classes (principally S, M, H1, H2, and E), each with a range of foundation solutions.

On this subdivision, the results of the shrink swell tests (attached as Appendix 5) indicate shrink/swell indices in the range between 0.6% - 1.8%. These results show that the natural, in situ and fill soils are characterised by Slightly Reactive (Class S) shrink swell properties.

In terms of AS2870, we consider that all of the residential Lots in Stage One may be designated as Class S (Slightly Reactive). It should be noted that this designation may be superseded following site specific testing for expansive soil properties on individual Lots.

6.4 Bearing Capacity

Based upon the results of our observations and testing during development, we consider that all areas of bulk filled ground on the site meet the requirements for engineered fill as per NZS4431:1989. Where the site was unaffected by the formation works, or natural in situ soil was exposed, the site materials generally comprise residual Waitemata Group soils. According to the pre-development geotechnical investigation report by S&R, as referenced within Section 3.0 above, the Waitemata Group Soils comprise very stiff silt and clay.

Considering the above, ignoring the topsoil veneer on each Lot, the near surface soils (within 2m of finished ground surface) within Lots 1 - 42, 44 - 47 and Lot 200, are generally considered to comply with the requirements of NZS3604:2011 and, if it were not for the soils expansive properties, could otherwise be designated as 'good ground'.

As a result of our testing and observations during the subdivision formation works, along with the results of the initial geotechnical investigation on the site, we consider that the founding soils within 2m of finished ground surface on each building platform area, whether cut, natural soils or engineered fill, have a ultimate unfactored bearing capacity of 300kPa. As required by the Building Code, a strength reduction factor must be applied to this value in order to determine the dependable value for use in ultimate limit state design; a reduction factor of 0.5 is recommended.

Regardless of the above, all foundations must also be design as per the recommendations given within Section 6.3.

6.5 Topsoil, Remnant Organic Material

Topsoil depths were checked following the completion of spreading and seeding. The testing identified variable topsoil thicknesses. The location of the measured topsoil depths are shown on our Topsoil Depths Plan, attached as Sheet KGA 3.

Pure topsoil depths ranged from 200mm to 350mm with an average thickness across the majority of the subdivision of approximately 250mm thick.

6.6 Lot Gradients and Stability

The side slopes within Lot 200 (the stormwater retention pond), and also towards the west of Lot 200 are found to be at a grade steeper than 1 vertical on 4 horizontal. The remaining land within Stage One is flatter, and is generally considered to be safe and stable in the undeveloped state.

Regardless of the above, as a general development recommendation in order to preserve the overall stability of the site, any proposed cut faces greater than 600mm must be either supported by engineer designed retaining walls or permanently battered at a safe grade of no steeper than 1 vertical on 3 horizontal.

Any proposed cuts greater than a nominal height of 1.0m, or fill depths greater than a nominal 0.6m must also be subjected to specific investigation and engineering design. Specific design parameters for any fills or retaining walls in individual developments must be determined at the design stage.

6.7 Public Services, Service Trenches and Underfill Drains

The As Built locations of the Council adopted piped services (stormwater and wastewater) are shown on the CCCE drawing ‘Services Layout, Drawing No. 4.Services Layout.

As shown, these services are largely restricted to road reservces, accessway easements, or near to Lot boundaries. We therefore consider it unlikely that the constructed services would be encountered during individual Lot development. Regardless, all building works on individual Lots should be laid out so as not to disturb any services.

Should building layouts that encroach near to or over these services be unavoidable, the foundations of those buildings must be designed in accordance with the current Watercare guidelines for building over services that are applicable at the time of lodging for Building Consent.

In addition to the above, any foundations that either lie above or within the zone of influence of any other service trenches (such as telecommunications, power etc.) should also be designed in accordance with the Watercare guidelines mentioned above.

An underfill drainage system has been constructed on the site. The underfill drains are buried beneath the fill on Lots 7 - 9, 11, 12, 14, 23 - 27, 31, 33, 34, 41 and 45. Given the depth of fill on the these Lots (at least 2.0m), we consider it unlikely that the underfill drainage system will be encountered during individual Lot development.

No special consideration needs to be given to the under-fill drainage measures during development on these Lots, unless, for any reason, deep piled foundations are used. Irrespective of the above, if any subsoil drain is encountered and/or damaged during individual Lot development, the drain must be reinstated under the observation and direction of a suitably qualified geotechnical engineer.

6.8 Restricted Development Areas

A Restricted Development Area has been imposed on the site where there is either:

- Land that is at a grade of 1 vertical on 4 horizontal or steeper, and/or
- Land that is within a distance equal to the retained height upslope of any retaining wall.

The purpose of the 'Restricted Development Areas' is to ensure that any development in these areas does not contribute towards, or result in any of the natural hazards defined within s71(3) of the Building Act 2004 on each affected site, or any of the immediately adjacent neighbouring properties, or undermine the stability of the constructed retaining walls.

For the Restricted Development Area where there is ground sloping at a gradient of 1 vertical on 4 horizontal, or steeper on Lot 200, we envisage that piled foundations are incorporated into the foundation design. These foundations should be designed to transfer the building loads deeper into the ground, and also design partially to resist any shallow seated, near surface soil creep movements that may be occurring in this area.

For the Restricted Development Area upslope of the retaining wall, affecting Lots 44 - 47, we recommend that piles are incorporated into the foundation design of any building that encroaches into these zones. The piles must be founded below a 45° influence line taken up from the base of the full retained height of the wall at the location of the retaining wall.

For any developments requiring specific investigation and engineering design, we envisage that the design should be supported by way of a geotechnical investigation. Sufficient geotechnical data to support the specific design should be obtainable by a typical hand auger borehole investigation, however more elaborate designs may require more intensive investigation methods, such as rotary machine boreholes.

For reference, the defined restricted development areas are shown on the attached Sheet KGA 4.

6.9 Stormwater Control

The subdivision formation works included the installation of a piped stormwater network which is directed towards the stormwater retention pond towards the southwestern corner of the development. This retention pond then discharges water in a controlled manner into the natural stormwater channel that is present to the west of the stormwater bund.

Stormwater runoff must be considered as part of individual Lot development. Under no circumstances may stormwater be disposed of by allowing it to flow directly on to, or into the ground in an uncontrolled manner at any location on the subdivision. All stormwater should be directed into the constructed network. On site disposal of stormwater via direct ground soakage methods is considered unfeasible due to the relatively impermeable nature of the sub soils on the site, and this is discouraged.

6.10 Seismicity

Reference has been made to the July 2010 New Zealand Geotechnical Society document "Geotechnical Earthquake Engineering Practice: Module 1 - Guideline for the identification, assessment and mitigation of liquefaction hazards". Based upon our observations and testing during construction, and also from the results of the initial geotechnical investigation (as referenced in Section 3.0 above), we consider that the site is unlikely to be any more adversely affected by a seismic event than any of the existing surrounding developments in the general area.

To the best of our knowledge, we consider that no materials are present that could pose a liquefaction hazard to any of the finished Lots during a significant seismic event.

Also, as per the initial geotechnical investigation (as referenced in Section 3.0 above), the site has been classified as Subsoil Class C in accordance with NZS1170.5:2004 (seismic design).

7.0 EVALUATION OF ROADWAY SUBGRADE MATERIALS

Based upon our testing and observations during the bulk earthworks construction, we consider that, prior to formal subgrade preparation, the soils exposed at the accessway subgrade levels comprised either in situ, very stiff Waitemata Group soils, or Engineered Fill as per NZS4431:1989.

Further to the above, as part of the roadway subgrade preparation, KGA undertook specific testing of the exposed subgrade soils by Scala penetrometer testing equipment in order to obtain equivalent unsoaked CBR values, against which the existing pavement design could be compared. In places, where CBR values were below the design values, these areas were undercut and reconstructed utilising imported granular materials, or were chemically dried prior to commencing the roadway subbase construction..

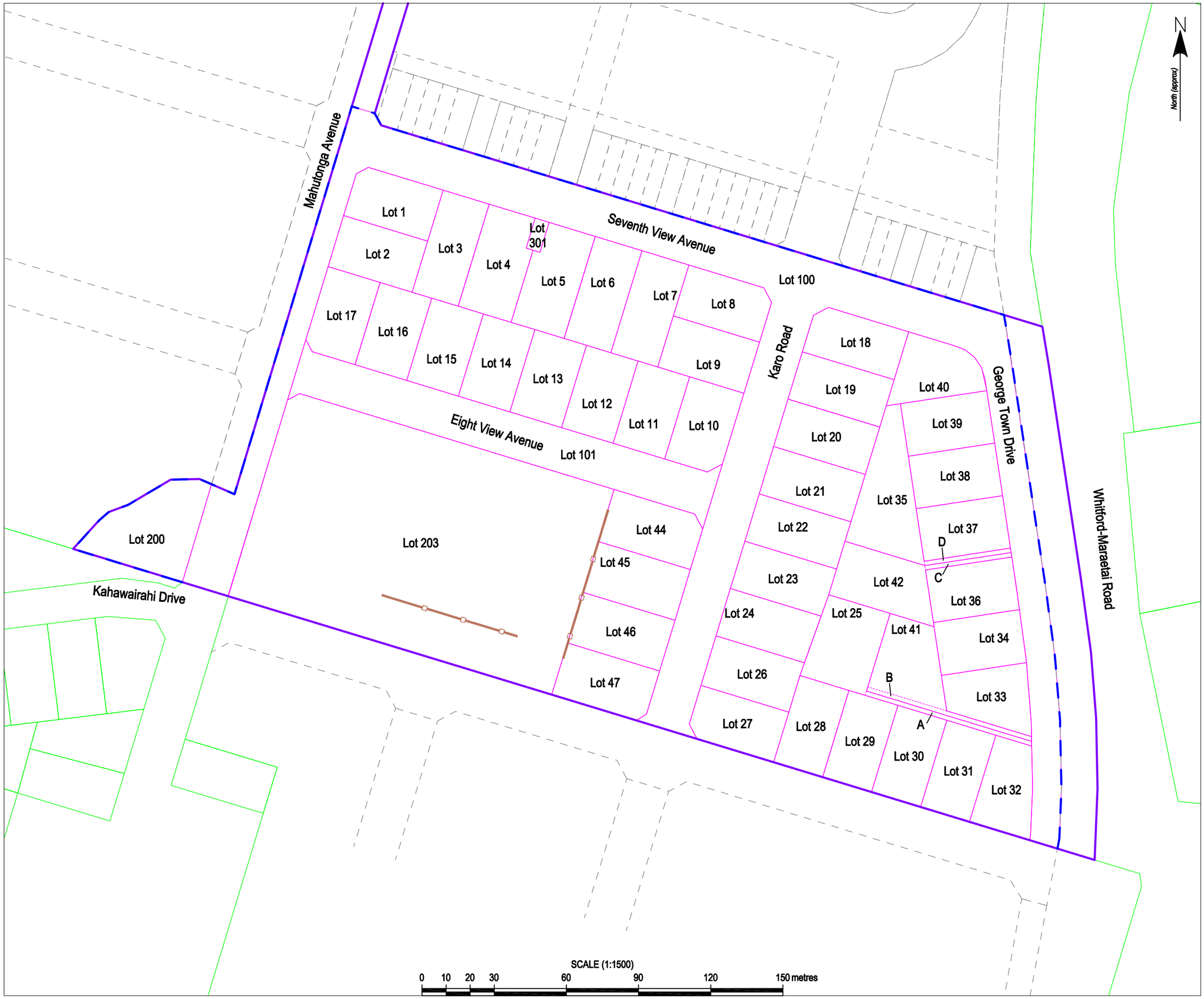
The final subgrade preparation and subsequent roadway construction and testing was carried out by DWL under the supervision and direction of CCCE and will be addressed by CCCE within their own completion documentation.

8.0 EVALUATION OF STORMWATER POND BUND CONSTRUCTION

Based upon our testing and observations during the bulk earthworks construction, we consider that the materials used to construct the stormwater pond bund meet the description and criteria given in Section 4.5 above.

9.0 LIMITATIONS

This report (including all drawings and appendices) has been specifically prepared for Auckland Council, Beachlands Junction Limited, and their selected consultants only. However, once in the public domain, this report may be relied upon by the developers of the individual Lots created by the site formation works, and may also be referenced by any other consultants or developers carrying out work on any land adjacent to the site, where applicable only. It must be appreciated however, that this report (including all drawings and appendices) does not remove the necessity for further inspection of the foundation excavations at the time of construction on individual Lots, where required. The recommendations given within this report with regards to possible foundation solutions may be circumvented provided that sufficient investigation and/or design is carried out at the Building Consent stage for the affected individual Lots.



Key:

- Subject site overall boundary
- Staging boundary
- New Lots
- Other properties existing legal boundaries
- Known proposed future developments outside of subject site boundary
- Retaining walls

Notes:

1. Subdivision layout, including retaining wall locations, adapted from drawings prepared by Crang Civil Consulting Engineers Limited
2. Locations of all buried services to be verified prior to construction
3. Existing legal boundaries adapted from Quickmap

DATE	REVISION	DESCRIPTION
28 Jul 2016	A	Geotechnical Completion Report Issue

AMENDMENTS

Check all dimensions and levels on site before construction commences.
Dimensions must not be directly scaled off this drawing.
Only print copies of this drawing in full colour.

6 Omega St, Albany
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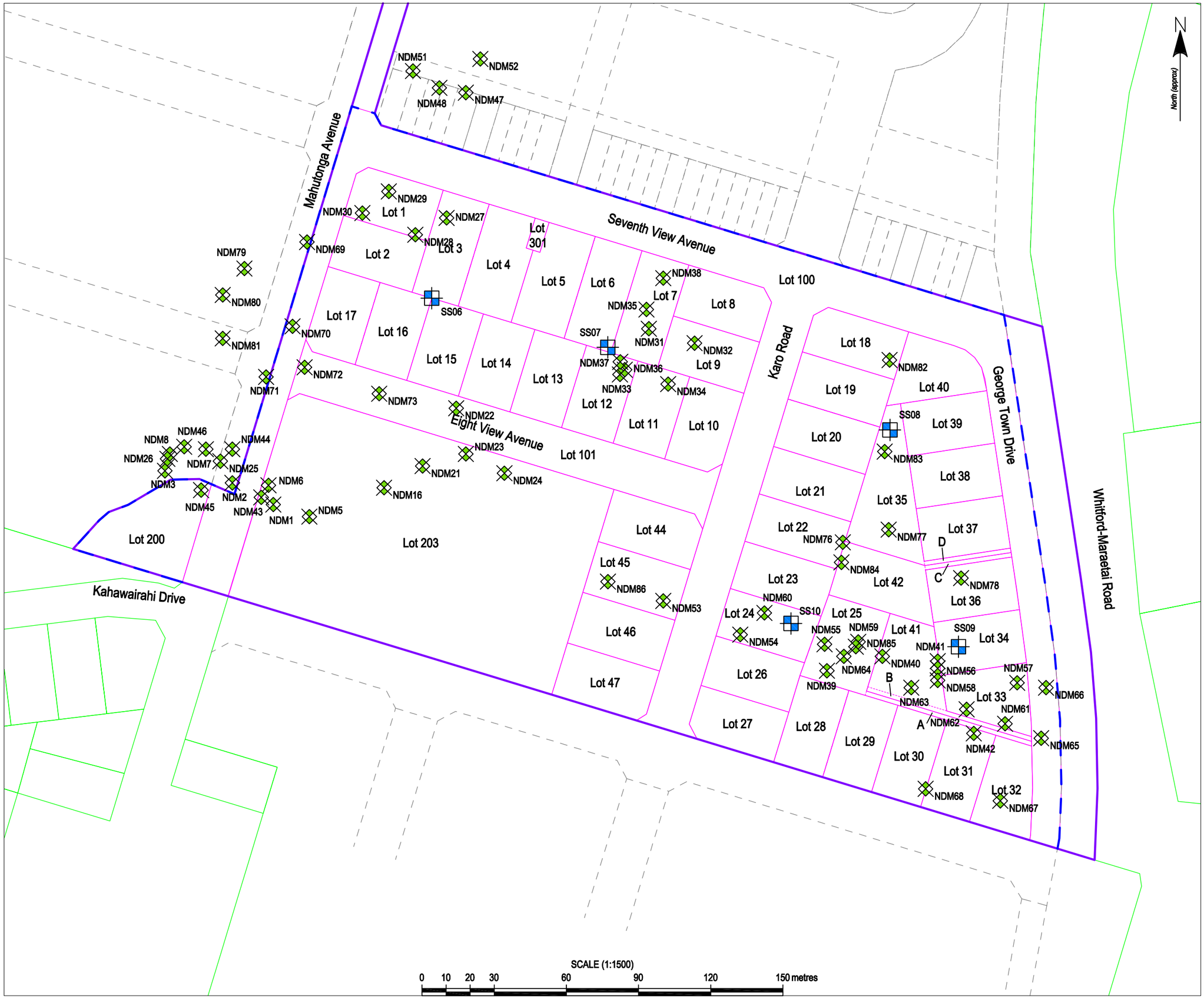
KGA GEOTECHNICAL

CLIENT
BEACHLANDS JUNCTION LIMITED

PROJECT
NEW SUBDIVISION
BEACHLANDS JUNCTION - STAGE ONE
129 BEACHLANDS ROAD, BEACHLANDS

TITLE
SUBDIVISION LAYOUT PLAN

SCALE: (A3 ORIGINAL) 1:1500	DATE: 28 Jul 2016
DRAWN BY: PH	CHECKED BY: RJH
REVISION NO: A	JOB NO: 8917
CAD REF: 8917_GCR_DWGs.dwg	SHEET NO: KGA 1



Key:

SS10 — Shrink/Swell sample location

NDM17 — Nuclear densometer test location

Notes:

1. All test and sample points located via hand held GPS by KGA Geotechnical Limited

DATE	REVISION	DESCRIPTION
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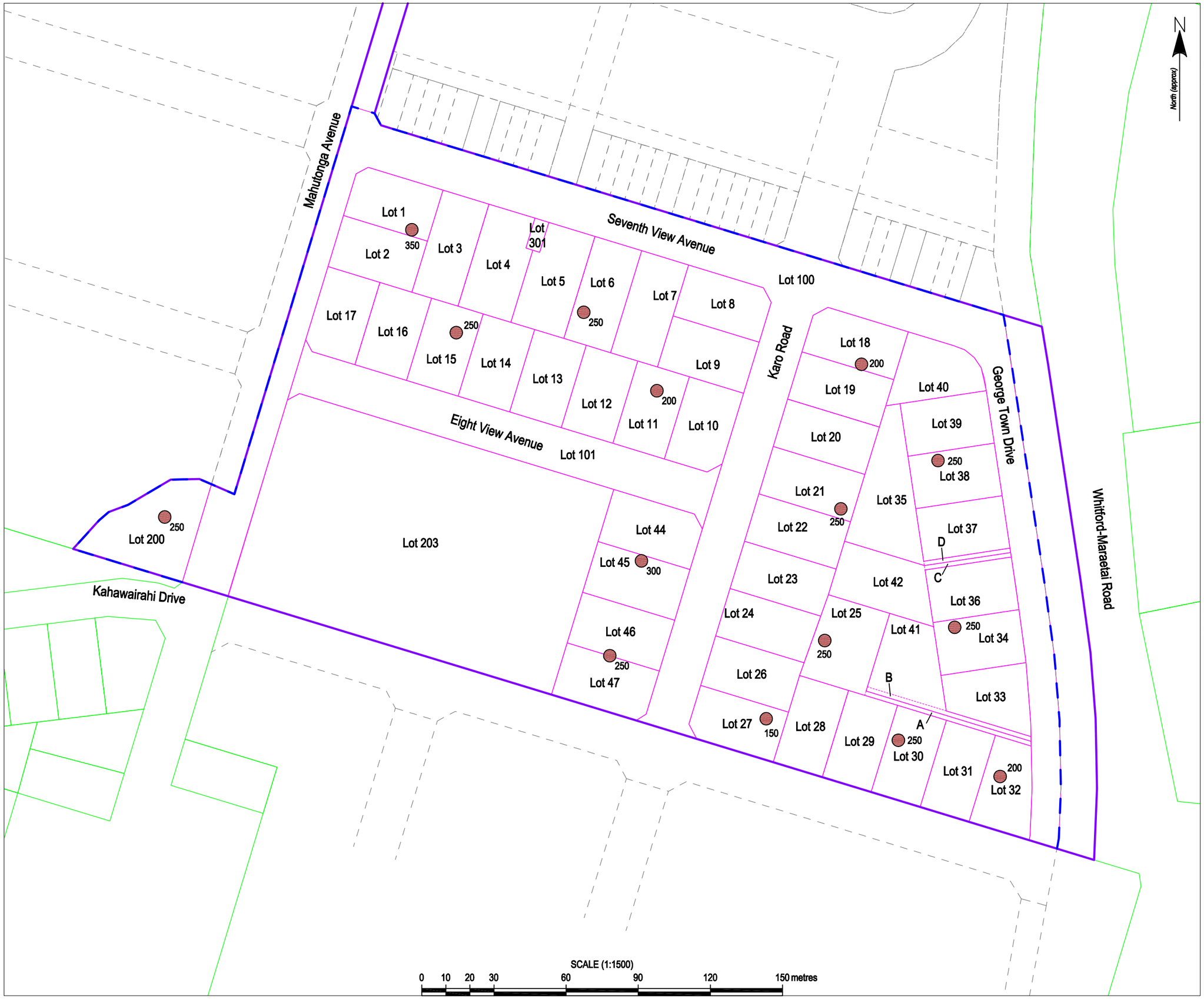
BEACHLANDS JUNCTION - STAGE ONE
129 BEACHLANDS ROAD, BEACHLANDS

TITLE
TEST LOCATION PLAN

SCALE: (A3 ORIGINAL) 1:1500	DATE: 28 Jul 2016
DRAWN BY: PH	CHECKED BY: RJH
REVISION NO: A	JOB NO: 8917
CAD REF: 8917_GCR_DWGs.dwg	SHEET NO: KGA 2



Key:

150 — Topsoil depth measurement point, measurement shown in mm

Notes:

1. Topsoil depth points located via hand held GPS by KGA Geotechnical
2. Topsoil depths measured by KGA Geotechnical

DATE	REVISION	DESCRIPTION
28 Jul 2016	A	Geotechnical Completion Report Issue

AMENDMENTS

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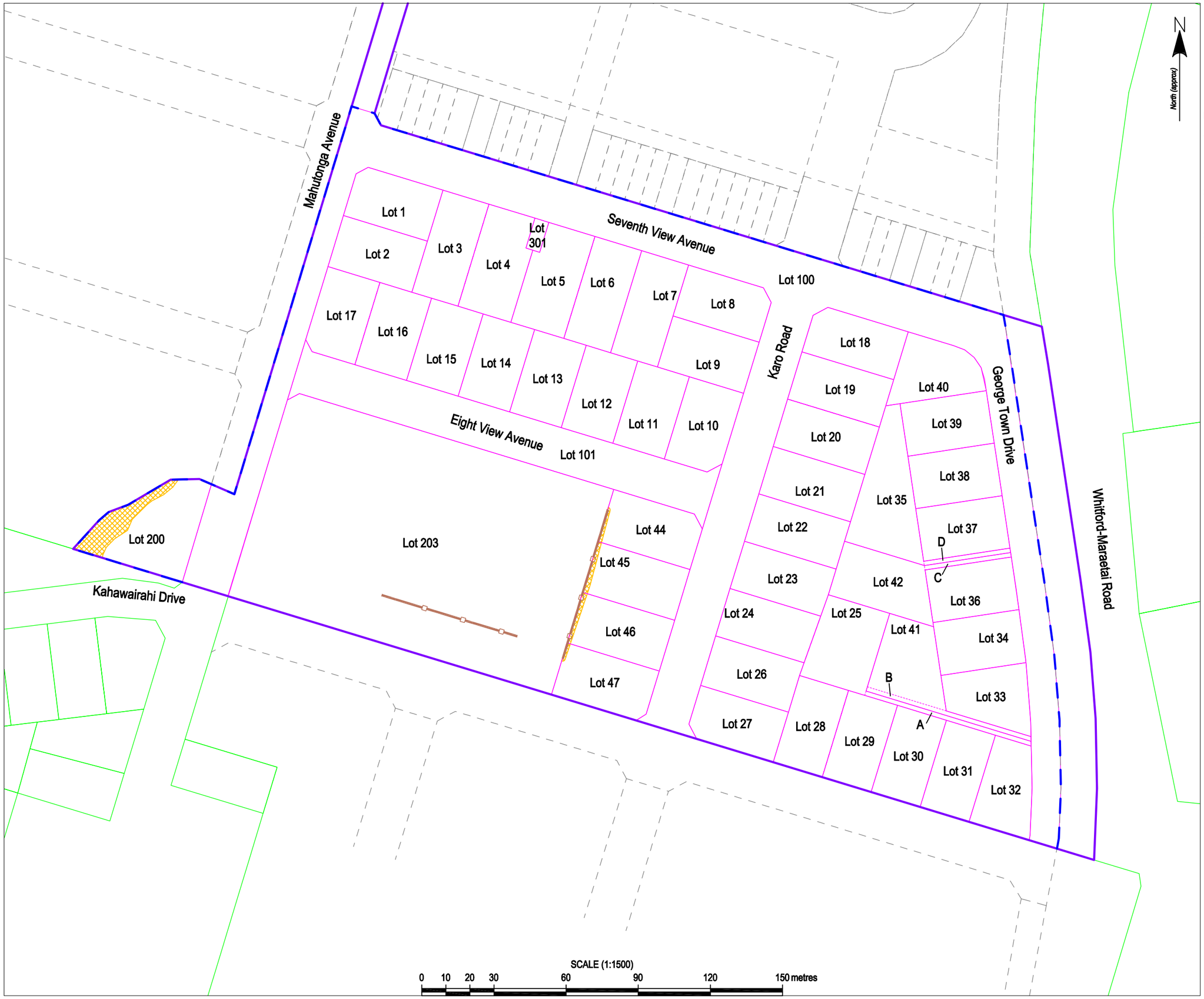
NEW SUBDIVISION
BEACHLANDS JUNCTION - STAGE ONE
129 BEACHLANDS ROAD, BEACHLANDS

TITLE
TOPSOIL DEPTHS PLAN

SCALE: (A3 ORIGINAL) 1:1500	DATE: 28 Jul 2016
DRAWN BY: PH	CHECKED BY: RJH
REVISION NO: A	JOB NO: 8917
CAD REF: 8917_GCR_DWGs.dwg	SHEET NO: KGA 3



Key:

Restricted Development Areas

Retaining walls

Notes:

1. Restricted Development Areas defined in on Residential Lots only in areas where ground slopes at 1 vertical on 4 horizontal or steeper, or up-slope of all retaining walls within a distance equal to the retained height of the retaining walls
2. Areas of ground sloping at 1 vertical on 4 horizontal or steeper adapted from As-Built drawings prepared by Crang Civil Consulting Engineers Limited
3. Retaining Wall locations adapted from drawings prepared by Crang Civil Consulting Engineers Limited

DATE	REVISION	DESCRIPTION
28 Jul 2016	A	Geotechnical Completion Report Issue

AMENDMENTS

Check all dimensions and levels on site before construction commences.
Dimensions must not be directly scaled off this drawing.
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BEACHLANDS JUNCTION LIMITED

PROJECT
NEW SUBDIVISION
BEACHLANDS JUNCTION - STAGE ONE
129 BEACHLANDS ROAD, BEACHLANDS

TITLE
RESTRICTED DEVELOPMENT AREAS PLAN

SCALE: (A3 ORIGINAL) 1:1500	DATE: 28 Jul 2016
DRAWN BY: PH	CHECKED BY: RJH
REVISION NO: A	JOB NO: 8917
CAD REF: 8917_GCR_DWGs.dwg	SHEET NO: KGA 4

APPENDIX 1

Statement of Professional Opinion as to the Suitability of Land For Building Development

STATEMENT OF PROFESSIONAL OPINION AS TO THE SUITABILITY OF LAND FOR BUILDING DEVELOPMENT

Development: Residential Subdivision

Developer: Beachlands Junction Limited

Location: Lot 2 DP 490742 - 129 Beachlands Road, Beachlands

I Rodney J. Hutchison of KGA Limited, P.O. Box 302 361 NHMC, Auckland hereby confirm that:

1. I am a geotechnical engineer as defined in Section 1.2.3 of NZS4404:2010 and was retained by the developer as the geotechnical engineer on the above development.

2. The extent of inspections undertaken either by myself or staff acting under my direction during construction and the results of all tests carried out are as described in the Geotechnical Completion Report (GCR) dated 9 August 2016, reference number 8917-5.

3. On the basis of our observations and inspections, together with information supplied by others, it is my professional opinion, not to be construed as a guarantee, that:

    a) Earth Fills

    All areas of earth fill shown on the drawings attached to the Geotechnical Completion Report have been generally placed in compliance with NZS 4431:1989. Filling has been carried out on parts of, or the entirety of Lots 1, 3, 5 - 15, 21, 22 - 42, 44 - 47 and Lot 200.

    b) Land Slope and Foundation Stability

    Most of the site has been finished at a grade flatter than 1 vertical on 4 horizontal, however some other parts of the site are at a grade of 1 vertical on 4 horizontal or steeper, or have retaining walls constructed upon them. The affected parts of the site are included within a Restricted Building Areas, as indicated on Sheet KGA 4 attached to the GCR. Specifically, the land that is affected by Restricted Building Areas comprises portions of Lots 44 - 47, and Lot 200.

In general, the soils on Lot consist of either in situ residual Waitemata Group soils, or engineered fill placed in compliance with NZS4431:1989.

c) Unworked or Excavated Ground

The original or excavated ground on Lots 1 - 5, 9 - 22, 27 - 30, 35, 38 - 40, 44 - 47 and Lot 200, where present, is suitable for the construction of buildings designed according to NZS3604:2011 provided that:

i. Foundation excavations are taken through the topsoil layer, which may be as thick as 350mm in places, to found within the underlying natural, in situ soils.

ii. Should any excessive organic material be encountered during individual Lot development, this should be removed and reinstated with suitably compacted engineered fill material (as described within Section 6.5 of the GCR).

iii. The ultimate unfactored bearing capacity for original or excavated ground applying to shallow spread foundations is limited to 300kPa (dependable bearing capacity of 150kPa) in accordance with NZS3604:2011. The minimum foundation depth may be governed by expansive soils requirements and designed for Class S soils (as set out within Section 6.3 of the GCR). Irrespective, all foundations must be taken below the base of any topsoil or organic layer, where present, into competent ground below.

iv. Construction methods employed during the subdivision formation works have generally resulted in only discrete locations associated with the construction of public services and utilities that cannot be deemed to comply with NZS4431:1989. Regardless, any foundations to be constructed in close proximity to the alignment of any public services must be designed in accordance with Auckland Council guidelines.

d) Filled Ground

The fill placed on Lots 1, 3, 5 - 15, 21, 22 - 42, 44 - 47 and Lot 200 as part of the site formation works has been placed in general compliance with NZS 4431:1989 and is suitable for the erection thereon of buildings designed according to NZS3604:2011 provided that:

i. Foundation excavations are taken through the topsoil layer, which may be as thick as 350mm in places, to found within the underlying filled soils.

ii. The ultimate unfactored bearing capacity for the filled ground applying to shallow spread foundations is limited to 300kPa (dependable bearing capacity of 150kPa) in accordance with NZS3604:2011. The minimum foundation depth may be governed by expansive soils requirements and designed for Class S soils (as set out within Section 6.3 of the GCR). Irrespective, all foundations must be taken below the base of any topsoil or organic surface layer into competent ground below.

iii. Construction methods employed during the subdivision formation works have generally resulted in only discrete locations associated with the construction of public services and utilities that cannot be deemed to comply with NZS4431:1989. Regardless, any foundations to be constructed in close proximity to the alignment of any public services must be designed in accordance with Auckland Council guidelines.

e) Erosion, Subsidence or Slippage

The original ground not affected by filling, and the filled ground, are not subject to erosion, subsidence or slippage in accordance with the provisions of Section 106 of the Resource Management Act 1991 provided that:

i. Developments on all Lots are carried out in accordance with the recommendations presented within Section 6.6 of the GCR.

f) Restricted Development Areas

A Restricted Development Area has been defined on the site, as discussed within Section 6.8 within the GCR. Portions of Lots 44 - 47 and Lot 200 are affected by Restricted Development Areas due to the presence of either ground steeper than 1 vertical on 4 horizontal or retaining walls. The portions of these Lots that are included within Restricted Development Areas are indicated on Sheet KGA 4, attached to the GCR.

Residential development may occur or encroach into the Restricted Development Areas, provided that the recommendations provided in Section 6.8 of the GCR are adhered to during design and development.

g) Accessway and Public Roads

Prior to formal subgrade preparation, the soils exposed at the roadway subgrade levels comprised either in situ, very stiff to hard Waitemata Group soils, or Engineered Fill as per NZS4431:1989.

4. This professional opinion has been specifically prepared for Auckland Council, Beachlands Junction Limited and their selected consultants only. However, once in the public domain, this report may be relied upon by the developers of the individual Lots created by the site formation works, and may also be referenced by any consultants or developers carrying out work on any land adjacent to the site, where applicable. It must be appreciated however, that this professional opinion does not remove the necessity for further inspection of the ground conditions exposed in foundation excavations at the time of construction on individual Lots, where required.

5. This professional opinion is based upon the results of an initial geotechnical investigation undertaken by Soil & Rock Consultants Limited, site observations, and periodic earthworks control testing during construction by KGA Geotechnical Limited. It is therefore possible that local variations in ground conditions may be present. In the unlikely event of unfavourable ground conditions or variations from the conditions described in the GCR are encountered, it may be necessary to modify the foundation design on that particular Lot to accommodate the variation.

6. This professional opinion must be read in conjunction with the Geotechnical Completion Report (GCR) referred to in Clause 2 above and shall not be copied or reproduced except in conjunction with the full GCR.

The attached Summary of Geotechnical Design Recommendations for Specific Lots table summarises the status of each residential Lot covered by this Statement of Professional Opinion.

Signed:  Date: 09 August 2016

R.J. Hutchison
BE, MSc, DIC, FIPENZ, MICE, CEng,
Chartered Professional Engineer

SUMMARY OF GEOTECHNICAL DESIGN RECOMMENDATIONS FOR SPECIFIC LOTS

Subdivision:	129Beachlands Road, Beachlands
Client:	Beachlands Junction Limited
Job No.:	8917-5
Date:	12 July 2016

Residential Lot	Total Area (Net Area)	Anticipated Soil Type	Subdivision cut ground present within Lot?		Subdivision filled ground present within Lot?		Unworked natural ground present within Lot?	Topsoil Depth	Foundations may be designed to NZS3604:2011?	Shallow Foundation Ultimate Unfactored bearing capacity	Expansive soils present?	AS2870 Site soil classification	Lot contains ground that is at a grade of 1V:4H or steeper?	Restricted Development Area present within Lot?	Comments
	m²	Natural Soil/Fill	Y/N	Max. Depth (m)	Y/N	Max. Depth (m)	Y/N	(mm)	Y/N	(kPa)	Y/N	(A, S, M, H1, H2, E)	Y/N	Y/N	
1	800	Natural Soil/Fill	Y	< 0.5	Y	< 0.5	N	350	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
2	808	Natural Soil	Y	2.0	N	0.0	N	300 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
3	886	Natural Soil/Fill	Y	2.0	Y	< 0.5	N	300 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
4	980	Natural Soil	Y	2.0	N	0.0	N	300 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
5	980	Natural Soil/Fill	Y	1.5	Y	0.5	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
6	901	Fill	N	0.0	Y	1.0	N	250	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
7	901	Fill	N	0.0	Y	3.5	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
8	816	Fill	N	0.0	Y	3.5	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
9	829	Natural Soil/Fill	Y	1.5	Y	3.5	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
10	830	Natural Soil/Fill	Y	2.5	Y	0.5	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
11	800	Natural Soil/Fill	Y	2.5	Y	3.5	N	200	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
12	800	Natural Soil/Fill	Y	1.5	Y	3.5	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
13	800	Natural Soil/Fill	Y	1.5	Y	0.5	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
14	800	Natural Soil/Fill	Y	1.5	Y	2.0	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
15	800	Natural Soil/Fill	Y	2.5	Y	0.5	N	250	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.

Residential Lot	Total Area (Net Area)	Anticipated Soil Type	Subdivision cut ground present within Lot?		Subdivision filled ground present within Lot?		Unworked natural ground present within Lot?	Topsoil Depth	Foundations may be designed to NZS3604:2011?	Shallow Foundation Ultimate Unfactored bearing capacity	Expansive soils present?	AS2870 Site soil classification	Lot contains ground that is at a grade of 1V:4H or steeper?	Restricted Development Area present within Lot?	Comments
	m²	Natural Soil/Fill	Y/N	Max. Depth (m)	Y/N	Max. Depth (m)	Y/N	(mm)	Y/N	(kPa)	Y/N	(A, S, M, H1, H2, E)	Y/N	Y/N	
16	800	Natural Soil	Y	3.0	N	0.0	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
17	800	Natural Soil	Y	3.0	N	0.0	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
18	815	Natural Soil	Y	1.0	N	0.0	N	200	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
19	819	Natural Soil	Y	2.0	N	0.0	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
20	819	Natural Soil	Y	2.5	N	0.0	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
21	819	Natural Soil/Fill	Y	2.5	Y	1.5	N	250	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
22	815	Natural Soil/Fill	Y	2.0	Y	2.0	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
23	815	Fill	N	0.0	Y	1.5	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
24	800	Fill	N	0.0	Y	7.0	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
25	1111	Fill	N	0.0	Y	8.0	N	250	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
26	820	Fill	N	0.0	Y	6.5	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
27	816	Natural Soil/Fill	Y	1.5	Y	2.5	N	150	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
28	800	Natural Soil/Fill	Y	1.5	Y	5.5	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
29	800	Natural Soil/Fill	Y	1.5	Y	5.5	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
30	800	Natural Soil/Fill	Y	1.5	Y	6.0	N	250	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
31	800	Fill	N	0.0	Y	8.0	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
32	800	Fill	N	0.0	Y	6.0	N	200	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
33	800	Fill	N	0.0	Y	8.5	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.

Residential Lot	Total Area (Net Area)	Anticipated Soil Type	Subdivision cut ground present within Lot?		Subdivision filled ground present within Lot?		Unworked natural ground present within Lot?	Topsoil Depth	Foundations may be designed to NZS3604:2011?	Shallow Foundation Ultimate Unfactored bearing capacity	Expansive soils present?	AS2870 Site soil classification	Lot contains ground that is at a grade of 1V:4H or steeper?	Restricted Development Area present within Lot?	Comments
	m²	Natural Soil/Fill	Y/N	Max. Depth (m)	Y/N	Max. Depth (m)	Y/N	(mm)	Y/N	(kPa)	Y/N	(A, S, M, H1, H2, E)	Y/N	Y/N	
34	800	Fill	N	0.0	Y	8.5	N	250	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
35	1289	Natural Soil/Fill	Y	0.5	Y	2.5	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
36	800	Fill	N	0.0	Y	4.5	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
37	800	Fill	N	0.0	Y	2.0	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
38	800	Natural Soil/Fill	Y	< 0.5	Y	0.5	N	250	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
39	800	Natural Soil/Fill	Y	< 0.5	Y	0.5	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
40	810	Natural Soil/Fill	Y	0.5	Y	0.5	N	200 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
41	982	Fill	N	0.0	Y	8.5	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
42	997	Fill	N	0.0	Y	5.0	N	250 *	Y Δ	300	Y	S	N	N	Class S expansive soil conditions present.
44	891	Natural Soil/Fill	Y	1.5	Y	3.5	N	250 *	Y Δ	300	Y	S	N	Y	Restricted development area present on Lot due to retaining wall on western site boundary. Class S expansive soil conditions present.
45	880	Natural Soil/Fill	Y	0.5	Y	5.0	N	300	Y Δ	300	Y	S	N	Y	Restricted development area present on Lot due to retaining wall on western site boundary. Class S expansive soil conditions present.
46	880	Natural Soil/Fill	Y	2.0	Y	3.5	N	250	Y Δ	300	Y	S	N	Y	Restricted development area present on Lot due to retaining wall on western site boundary. Class S expansive soil conditions present.
47	892	Natural Soil/Fill	Y	2.5	Y	1.5	N	250	Y Δ	300	Y	S	N	Y	Restricted development area present on Lot due to retaining wall on western site boundary. Class S expansive soil conditions present.
200	1388	Natural Soil/Fill	Y	< 0.5	Y	4.0	N	250	Y Δ	300	Y	S	Y	Y	Restricted development area present on Lot due to land at a grade of 1 vertical on 4 horizontal. Class S expansive soil conditions present.

* = Indicates topsoil depth estimated based on nearby measurements

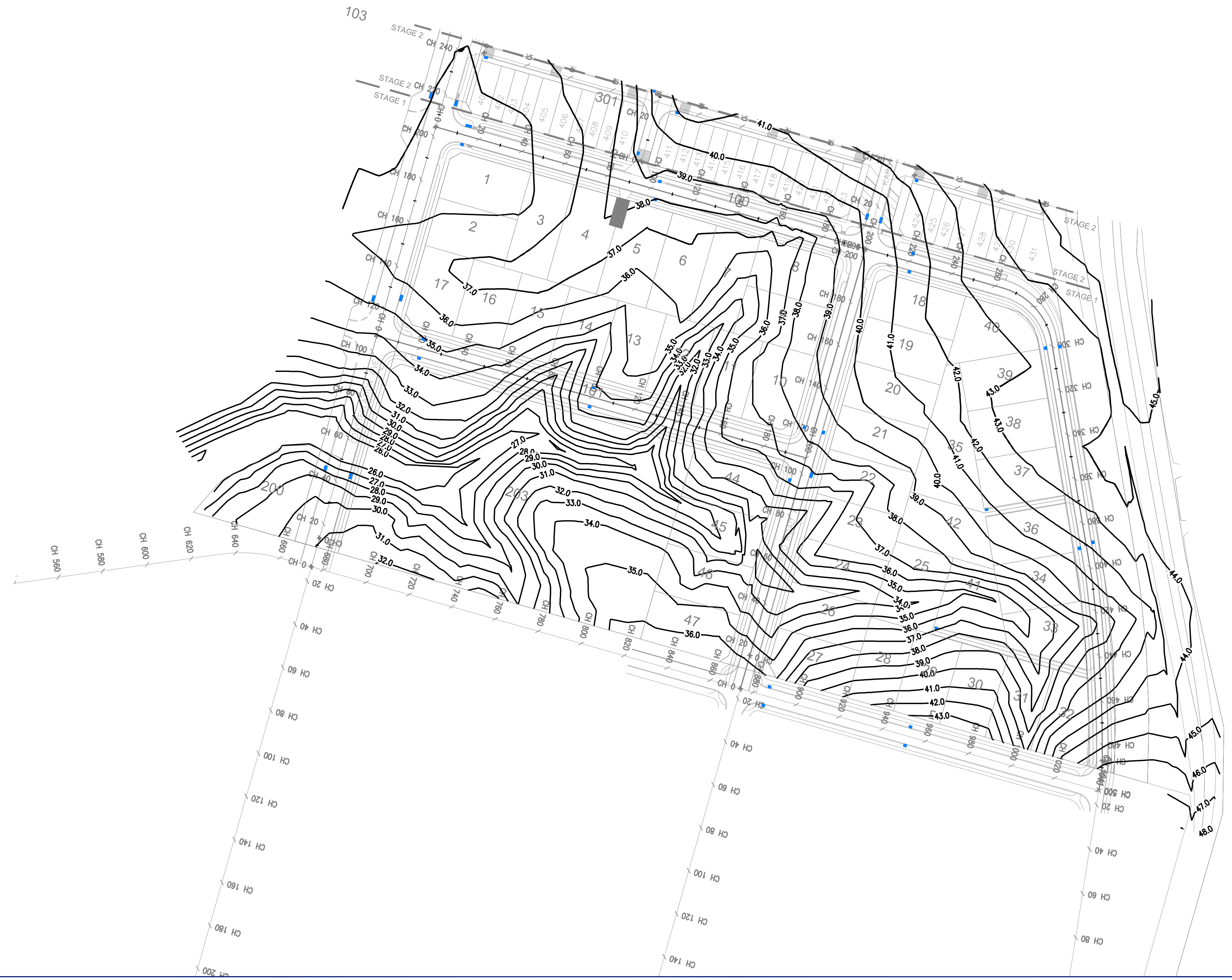
Δ = Provided expansive soil conditions are accommodated during design

‡ = Foundations located within Restricted Development Areas may not be designed in accordance with NZS3604:2011. Instead they must be designed as per Section 6.8 within the GCR

APPENDIX 2

Crang Civil Consulting Engineers Limited As Built Drawing Set

Title	Drawing Reference No.	Date	Rev
Pre- Construction Existing Contours	1. Pre-EX Contours	27-06-2016	0
Final Contour & Underfill Drain Level Plan	2. Final Contour	27-06-2016	0
Depth Of Cut & Fill Plan Sheet 1	3. Depth of Cut & Fill	03-08-2016	0
Depth Of Cut & Fill Plan Sheet 2	3. Depth of Cut & Fill	03-08-2016	0
Services Layout	4.Services Layout	27-06-2016	0



0	ORIGINAL ISSUE	TL	27/06/16
REVISION	CHANGES	CHECKED	DATE

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CLIENT
GRAPHITE MANAGEMENT

PROJECT
BEACHLANDS

TITLE
PRE- CONSTRUCTION
EXISTING CONTOURS

DATE	JUNE 2016	SCALE	
DRAWN	DW	A1	1:1000
DESIGNED		A3	1:2000
DRAWING No 1. Pre-EX Contours	SHEET 1 of 1	REVISION	0

0	ORIGINAL ISSUE	TL	27/06/16
REVISION	CHANGES	CHECKED	DATE

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GRAPHITE MANAGEMENT

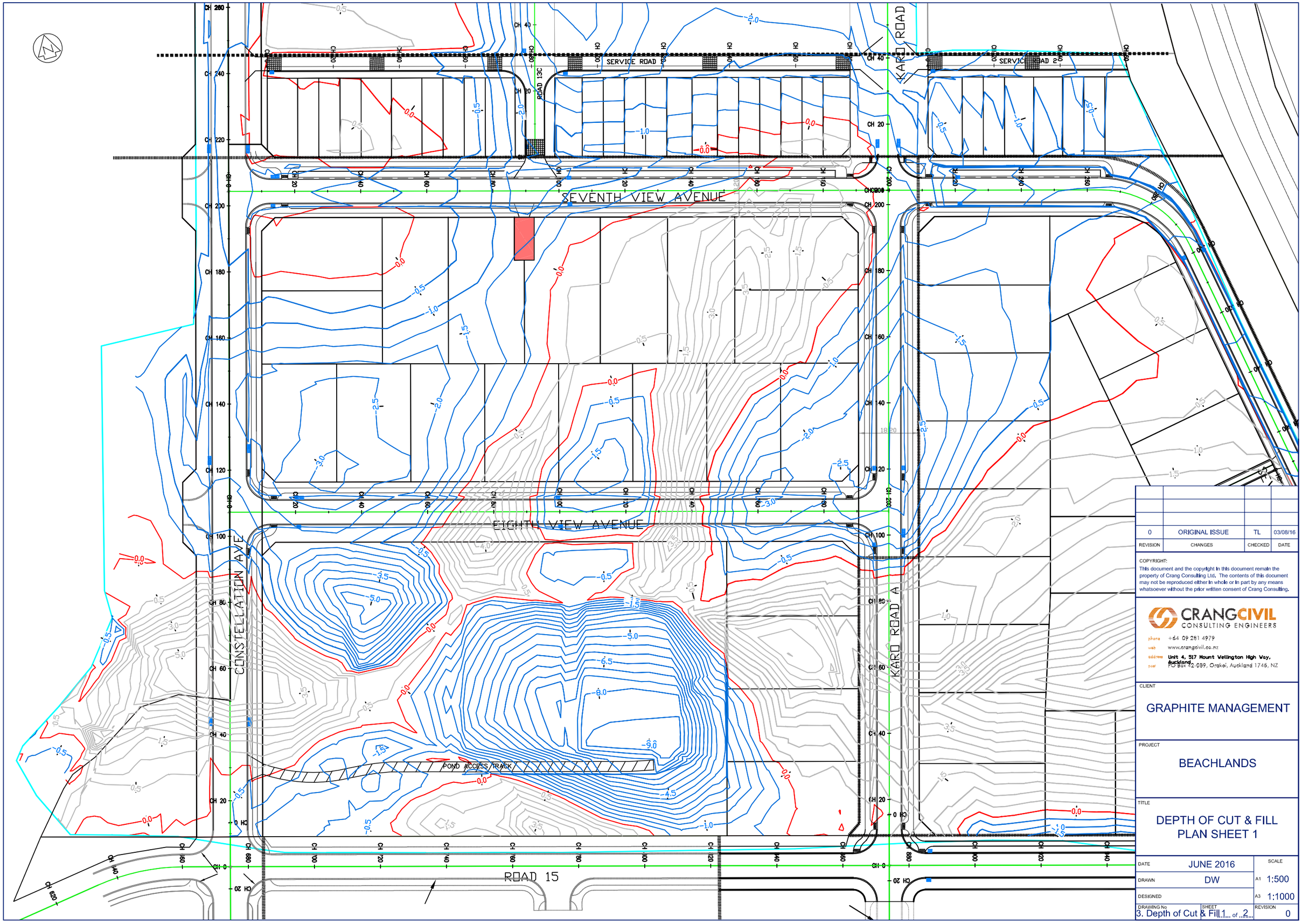
PROJECT

BEACHLANDS

TITLE

FINAL CONTOUR & UNDERFILL DRAIN LEVEL PLAN

DATE	JUNE 2016	SCALE	
DRAWN	DW	A1	1:1000
DESIGNED		A3	1:2000
DRAWING No	SHEET	REVISION	
2. Final Contour Plan	1 of ... 1		0



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GRAPHITE MANAGEMENT

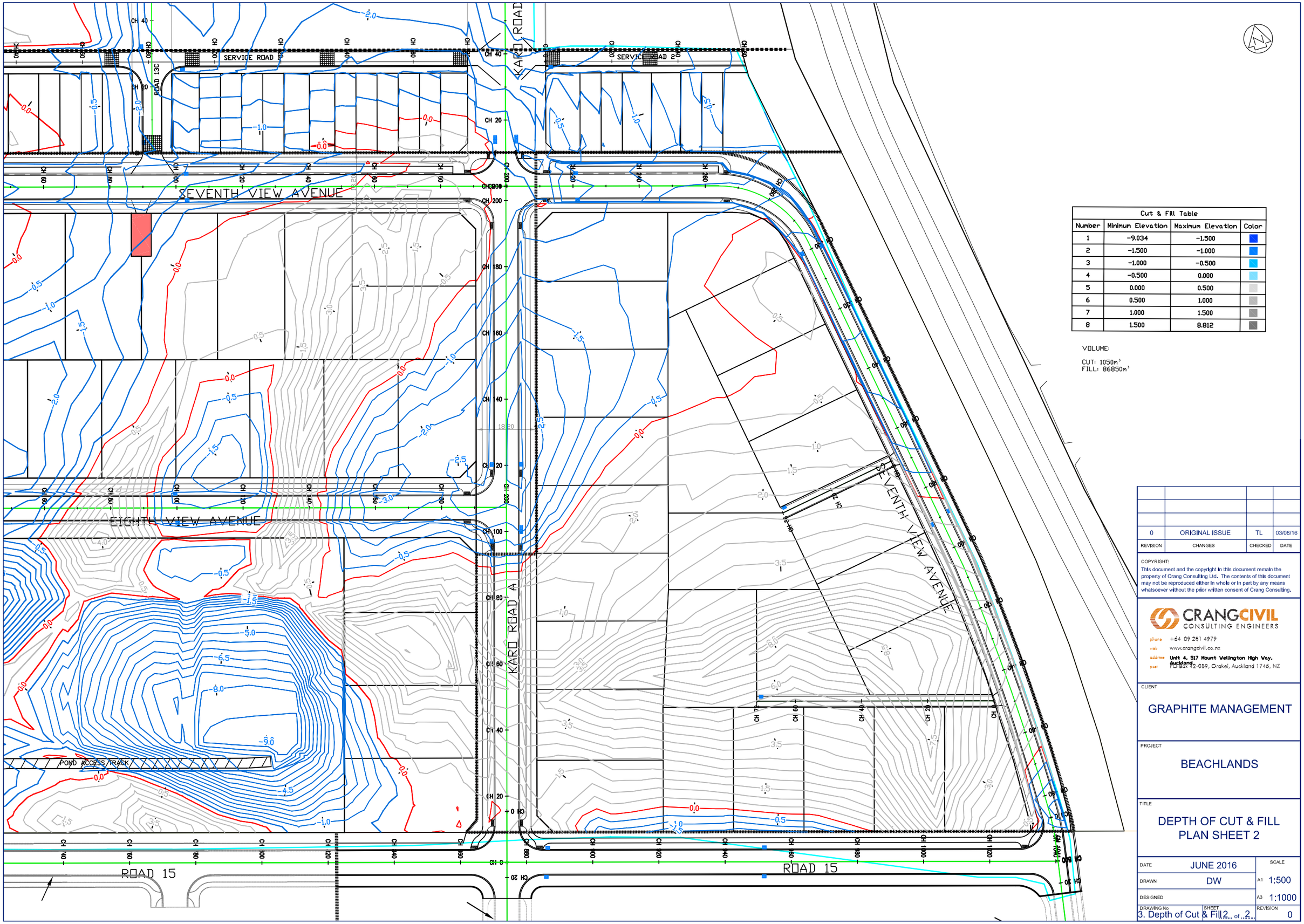
PROJECT

BEACHLANDS

TITLE

DEPTH OF CUT & FILL
PLAN SHEET 1

DATE	JUNE 2016	SCALE	
DRAWN	DW	A1	1:500
DESIGNED		A3	1:1000
DRAWING No	SHEET	REVISION	
3. Depth of Cut & Fill	1 of 2		0



Cut & Fill Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-9.034	-1.500	
2	-1.500	-1.000	
3	-1.000	-0.500	
4	-0.500	0.000	
5	0.000	0.500	
6	0.500	1.000	
7	1.000	1.500	
8	1.500	8.812	

VOLUME:

CUT: 1050m³
FILL: 86850m³

REVISION	CHANGES	CHECKED	DATE
0	ORIGINAL ISSUE	TL	03/08/16

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GRAPHITE MANAGEMENT

PROJECT

BEACHLANDS

TITLE

DEPTH OF CUT & FILL
PLAN SHEET 2

DATE	JUNE 2016	SCALE	
DRAWN	DW	A1	1:500
DESIGNED		A3	1:1000
DRAWING No.	SHEET	REVISION	
3. Depth of Cut & Fill	2 of 2		0

0	ORIGINAL ISSUE	TL	27/06/16
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GRAPHITE MANAGEMENT

PROJECT

BEACHLANDS

TITLE

SERVICES LAYOUT

DATE	JUNE 2016	SCALE
DRAWN	DW	A1 1:1000
DESIGNED		A3 1:2000
DRAWING No	SHEET	REVISION
4. Services Layout	1 of 1	0

APPENDIX 3

Soil & Rock Consultants Limited Pre-Construction Laboratory Test Results & Earthworks Recommendations

Tony Lovelock

From: Vaughan Crang
Sent: Monday, 5 October 2015 6:01 p.m.
To: Michael Lunjevich; Craig Rota; Conal Dempsey
Cc: Tony Lovelock
Subject: FW: Pine Roots

See below. Good solution.
Vaughan

From: Bruce Green [mailto:Bruce@soilandrock.co.nz]
Sent: Monday, 5 October 2015 5:59 p.m.
To: Vaughan Crang <Vaughan@crangcivil.co.nz>
Cc: Greg Hill <Greg@soilandrock.co.nz>
Subject: Pine Roots

Vaughan,

Following on from our conversation this afternoon we have reviewed photographs taken of the areas of pine roots. Our comments are as follows:

- The pine roots are not everywhere. They are grouped in distinct areas which should be reasonably avoidable or alternatively easily targetable by earthmoving equipment
- Any clay excavated from the root-rich area should not be used for dam fill unless the roots are fully screened out. This is due to the fact that the roots will rot over a few years and the result would be a highly porous dam. The spoil could be used for bulk fill in other locations provided some effort was put into removing the roots, the fill was placed deep and the material could be well spread-out. i.e. no thick layers of root-rich fill are permissible.
- The roots may be left in place in cases where the overlying fully engineered dam fill will be more than 1.0m thick. That would give a reasonable depth of engineered low-permeability cap over the root area.
- The root-rich clay may be left in-situ where the area comprises pond reserve where no structural filling will take place.

We have attempted here to provide a practical solution to an area that was always going to be root rich given that it was a pine plantation – no surprises there. We will be strong on ensuring only good quality fill is used in the dam and can be slightly more lenient across other locations provided the guidelines established by the bullet points above are observed. *We will not accept placement of thick layers of root-rich fill* at any location.

Lastly the contractor should put some effort into stick-raking the roots or otherwise reasonable effort into screening the material as is standard practice for organic-rich fill sources.

Trust that helps – please call should you require further clarification.

Best regards,

Bruce Green
MIPENZ Chartered Professional Engineer (Geotechnical)

PH: (09) 835 1740 Mobile: 021 462 726
bruce@soilandrock.co.nz www.soilandrock.co.nz

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Geotechnical Engineering Ltd T/A Soil & Rock Consultants
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Tony Lovelock

From: Greg Hill <Greg@soilandrock.co.nz>
Sent: Tuesday, 6 October 2015 5:34 p.m.
To: Vaughan Crang
Cc: Tony Lovelock; Craig.rota@dempseywood.co.nz; Gavin McCullough (gavin@dempseywood.co.nz); Bruce Ansley (bruce@graphiteman.co.nz)
Subject: 15542-Beachlands Compaction Data
Attachments: BGL Beachlands Junction Compaction Curve Report.pdf; 15542 Moisture Contents TP01-TP02 24.9.15.pdf; 15542-test pit locations.pdf

Hi Vaughan,

Please find attached the results of 4 NZSC test and moisture content test results carried out at the above site at selected depths. Testpit locations are as shown on the drawing attached.

The soil at the location of TP01 , with the exception of a surface 1m thick layer which is assessed as near optimum moisture content, are significantly wet of the optimum water content and will require drying to meet the earthworks specification (Drying in the order of 10%).

The soils at the location of TP02 are slightly wet of optimum moisture content and should require little or no drying.

The material below 0.5m (TP02) is generally moderately to highly plastic and is suitable for the Pond 5 dam and base.

Deeper material on site (TP01 at 3.7m) becomes sand/sandy and is not suitable for water retaining fills.

The cohesive fill should meet the following specification:

Table 1: Cohesive Earthworks Specification

	Air Voids Percentage (as defined in NZS 4402:1986)		Undrained Shear Strength (Measured in-situ by IANZ calibrated vane)	
	Maximum Average Value %	Maximum Single Value %	Minimum Average Value kPa	Minimum Single Value kPa
General Fill	8	10	140	110

In addition the above table, the fill within Pond 5 Dam and base should be placed at or up to 3% wet of the optimum moisture content. i.e slightly wet not slightly dry to dry.

Regards

Greg Hill
Geotechnical Project Manager
PH: (09) 835 1740 Mobile: 021 781 067
greg@soilandrock.co.nz www.soilandrock.co.nz

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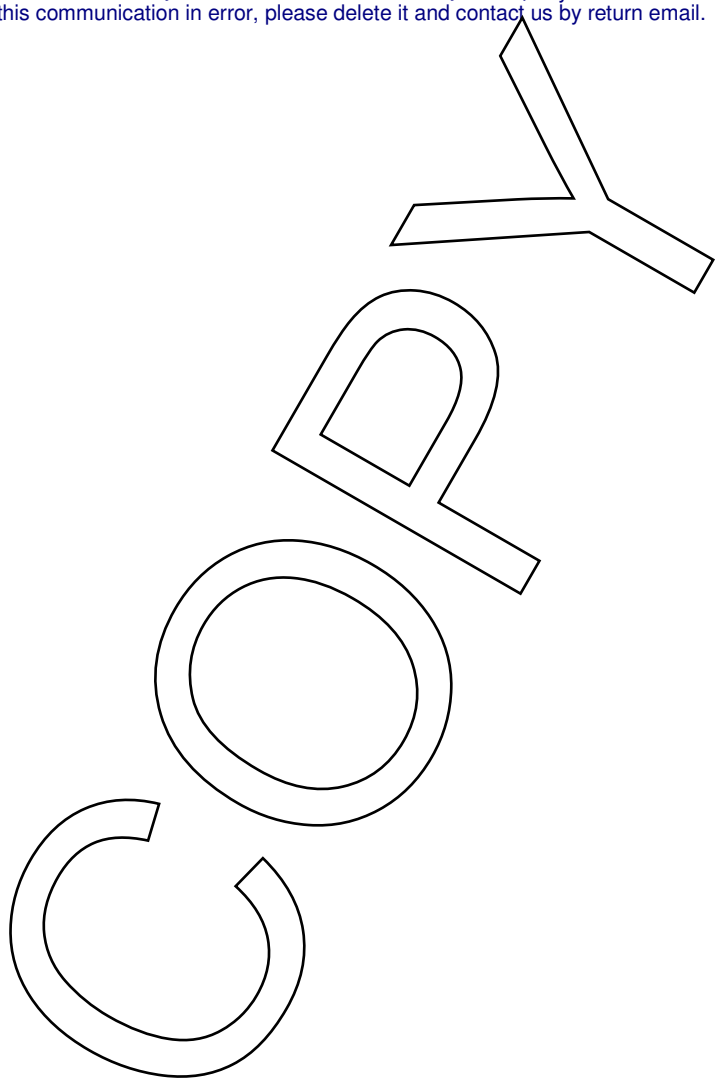

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Level 4
68 Beach Road
Auckland 1010
P O Box 2027
New Zealand
Telephone 64-9-367 4954
E-mail wec@babbage.co.nz

Please reply to: W.E. Campton

Geotechnical Engineering Ltd.
PO Box 21 424
Henderson
Auckland 0650

Job Number: 52091#L
BGL Registration Number:
Checked by: WEC

Attention: **GREG HILL**

2nd October 2015

DRY DENSITY / WATER CONTENT RELATIONSHIP TESTING

Dear Sir,

Re: BEACHLANDS JUNCTION

Report Number: 52091#L/CC

The following report presents the results of compaction curve testing of bulk soil samples delivered to this laboratory on the 23rd of September 2015. Test results are summarised below, with the following pages showing graphs and detailed results.

A single shear vane test was carried out on each compacted sample while it was still in the proctor mould, and these results are included on the results tables and water content / density graphs. The shear vane results are included for your information only, and are not included in the IANZ endorsement for this report.

Test standards used were:

Water Content: NZS4402:1986:Test 2.1
NZ Standard Compaction: NZS4402:1986:Test 4.1.1
Vane Shear Strength: NZ Geotechnical Society Guideline 2001

Sample Number	Depth (m)	Maximum Dry Density (t/m^3)	Optimum Water Content (%)	Natural Water Content (%)
TP01 / BULK	**1.80 – 2.00**	**1.26**	**34**	**47.5**
TP01 / BULK	**3.70 – 4.00**	**1.51**	**22**	**33.7**
TP02 / BULK	**1.00**	**1.38**	**31**	**34.2**
TP02 / BULK	**2.90**	**1.51**	**25**	**27.2**

Sample Descriptions (*not part of BGL IANZ Accreditation*)

TP01 / BULK / 1.80 – 2.00m:	CLAY with silty pockets & bands, moderately to highly plastic, light grey with brownish orange patches & bands.
TP01 / BULK / 3.70 – 4.00m:	SAND, fine, silty, non-plastic, grey to dark grey, slightly moist.
TP02 / BULK / 1.00m:	CLAY, silty, highly plastic, orange with light grey mottles, slightly moist.
TP02 / BULK / 2.90m:	SILT, clayey, moderately plastic, mottled light yellow & grey, slightly moist.

For calculating the air voids percentages a solid density of 2.65t/m^3 was assumed for TP01 / 1.80 – 2.00m, a solid density of 2.52t/m^3 was assumed for TP01 / 3.70 – 4.00m, a solid density of 2.60t/m^3 was assumed for TP02 / 1.00m and a solid density of 2.60t/m^3 was assumed for TP02 / 2.90m. Note that these assumed values are not part of the IANZ endorsement for this report.

Please note that the test results relate only to the samples tested.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report, please contact the undersigned at your convenience.

Yours faithfully,

Justin Franklin
Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory

IANZ
ACCREDITED LABORATORY
ACCREDITATION Nº: 126

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.

Babbage Geotechnical Laboratory

Job No:	52091#L	Reg. No:	2235	Version No:	2
Report No:	52091#L/CC			Issue Date:	Aug-12
PROJECT:	BEACHLANDS JUNCTION				

Determination of the Dry Density / Water Content Relationship by Standard Compaction

Test Method: NZS4402: 1986: Test 4.1.1

Tested By:	WEC / JH	Sept 2015
Compiled By:	JF	2/10/2015
Checked By:	JF	2/10/2015

Sample No: TP01 / BULK **Sample Depth: 1.80 - 2.00m**

Sample History: Air-dried and wetted from natural moisture content.

Compaction Used: New Zealand Standard Compaction

Test Performed On: Whole Soil / ~~Fraction Passing the 19mm Sieve~~

Solid Density of Soil Particles: 2.65 t/m^3 (~~measured~~ / assumed)

Natural Moisture Content (%): 47.5

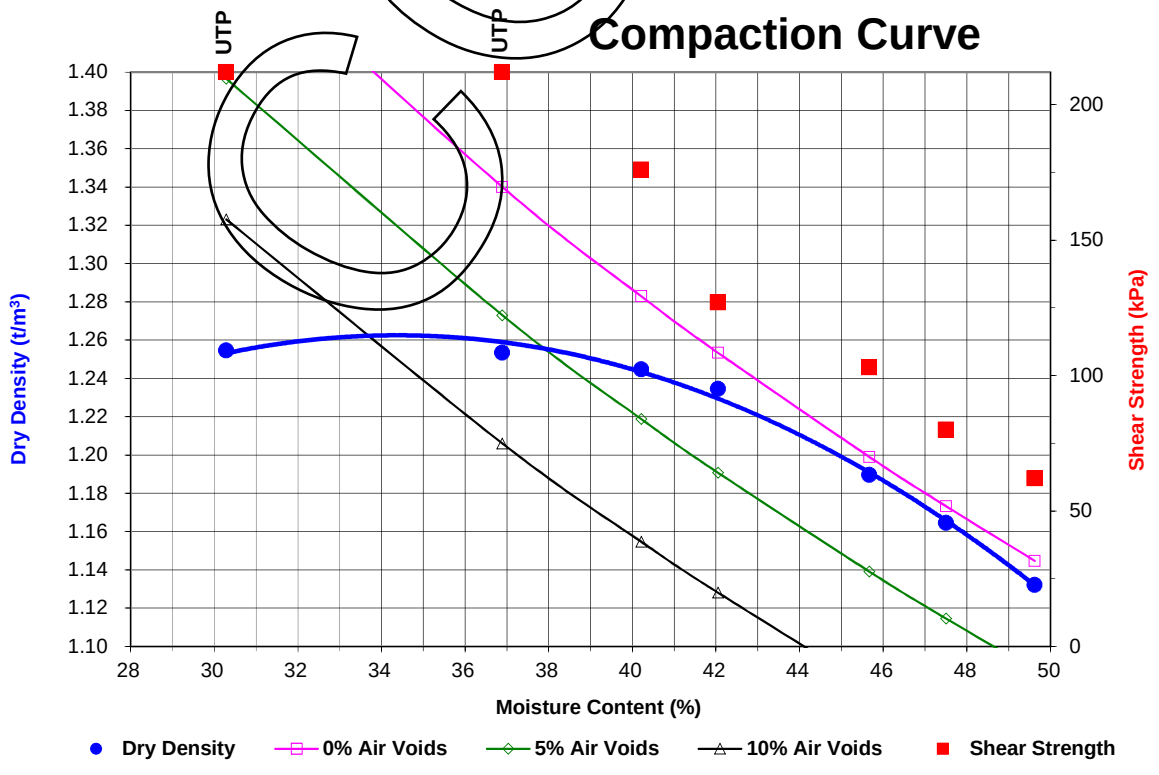
TEST RESULTS

Water Content (%)	30.3	36.9	40.2	42.1	45.7	47.5	49.6
Bulk Density (t/m^3)	1.63	1.72	1.75	1.75	1.73	1.72	1.69
Dry Density (t/m^3)	1.25	1.25	1.24	1.23	1.19	1.16	1.13
Air Voids (%)	14.7	6.5	3.0	1.5	0.8	0.7	1.1
Shear Strength (kPa)	UTP*	UTP*	176	127	103	80	62

**UTP = unable to penetrate sample with the shear vane.*

Maximum Dry Density:	1.26 t/m^3	Optimum Water Content:	34 %

Compaction Curve



Babbage Geotechnical Laboratory	Job No:	52091#L	Reg. No:	2235	Version No: 2
	Report No:	52091#L/CC			Issue Date: Aug-12
	PROJECT:	BEACHLANDS JUNCTION			

Determination of the Dry Density / Water Content Relationship by Standard Compaction
Test Method: NZS4402: 1986: Test 4.1.1

Tested By:	WEC / JH	Sept 2015
Compiled By:	JF	2/10/2015
Checked By:	JF	2/10/2015

Sample No: TP01 / BULK **Sample Depth: 3.70 - 4.00m**

Sample History: Air-dried from natural moisture content.
Compaction Used: New Zealand Standard Compaction
Test Performed On: Whole Soil / ~~Fraction Passing the 19mm Sieve~~
Solid Density of Soil Particles: 2.52 t/m^3 (~~measured~~ / assumed)

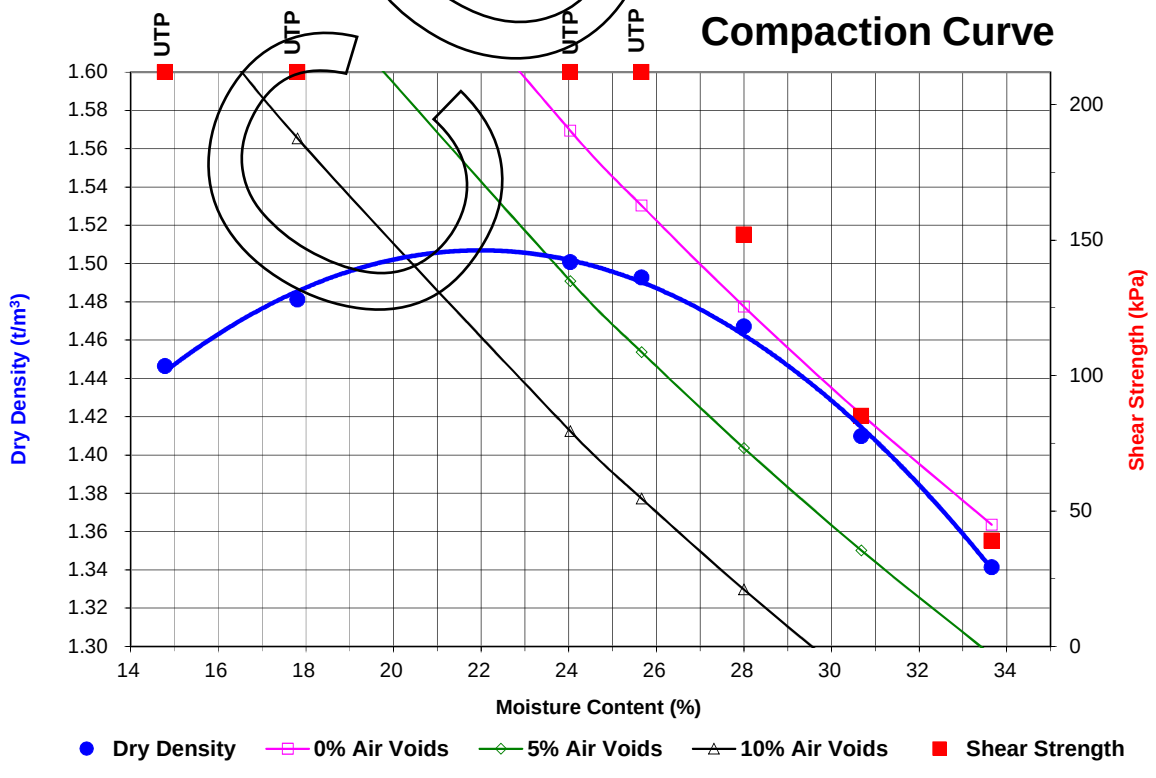
Natural Moisture Content (%): 33.7

TEST RESULTS

Water Content (%)	14.8	17.8	24.0	25.7	28.0	30.7	33.7
Bulk Density (t/m^3)	1.66	1.74	1.86	1.88	1.88	1.84	1.79
Dry Density (t/m^3)	1.45	1.48	1.50	1.49	1.47	1.41	1.34
Air Voids (%)	21.2	14.8	4.4	2.5	0.7	0.8	1.6
Shear Strength (kPa)	UTP*	UTP*	UTP*	UTP*	152	85	39

**UTP = unable to penetrate sample with the shear vane.*

Maximum Dry Density:	1.51 t/m^3	Optimum Water Content:	22 %



Babbage Geotechnical Laboratory

Job No:	52091#L	Reg. No:	2235	Version No:	2
Report No:	52091#L/CC			Issue Date:	Aug-12
PROJECT:	BEACHLANDS JUNCTION				

Determination of the Dry Density / Water Content Relationship by Standard Compaction

Test Method: NZS4402: 1986: Test 4.1.1

Tested By:	WEC / JH	Sept 2015
Compiled By:	JF	2/10/2015
Checked By:	JF	2/10/2015

Sample No: TP02 / BULK **Sample Depth: 1.00m**

Sample History: Air-dried and wetted from natural moisture content.

Compaction Used: New Zealand Standard Compaction

Test Performed On: Whole Soil / ~~Fraction Passing the 19mm Sieve~~

Solid Density of Soil Particles: 2.60 t/m^3 (~~measured~~ / assumed)

Natural Moisture Content (%): 34.2

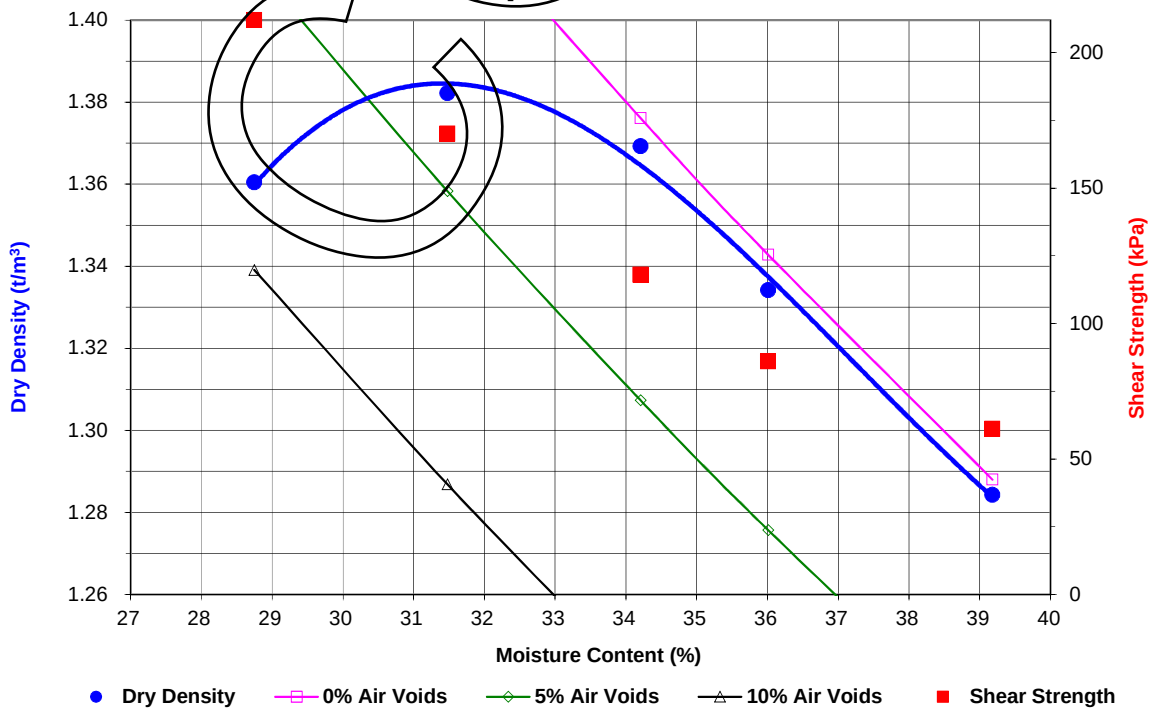
TEST RESULTS

Water Content (%)	28.7	31.5	34.2	36.0	39.2
Bulk Density (t/m^3)	1.75	1.82	1.84	1.81	1.79
Dry Density (t/m^3)	1.36	1.38	1.37	1.33	1.28
Air Voids (%)	8.6	3.3	0.5	0.6	0.3
Shear Strength (kPa)	UTP*	170	118	86	61

**UTP = unable to penetrate sample with the shear vane.*

Maximum Dry Density:	1.38 t/m^3	Optimum Water Content:	31 %

Compaction Curve



BGL Babbage Geotechnical Laboratory	Job No:	52091#L	Reg. No:	2235	Version No: 2
	Report No:	52091#L/CC			Issue Date: Aug-12
	PROJECT:	BEACHLANDS JUNCTION			

Determination of the Dry Density / Water Content Relationship by Standard Compaction

Test Method: NZS4402: 1986: Test 4.1.1

Tested By:	WEC / JH	Sept 2015
Compiled By:	JF	2/10/2015
Checked By:	JF	2/10/2015

Sample No: TP02 / BULK **Sample Depth: 2.90m**

Sample History: Air-dried and wetted from natural moisture content.

Compaction Used: New Zealand Standard Compaction

Test Performed On: Whole Soil / ~~Fraction Passing the 19mm Sieve~~

Solid Density of Soil Particles: 2.60 t/m^3 (~~measured~~ / assumed)

Natural Moisture Content (%): 27.2

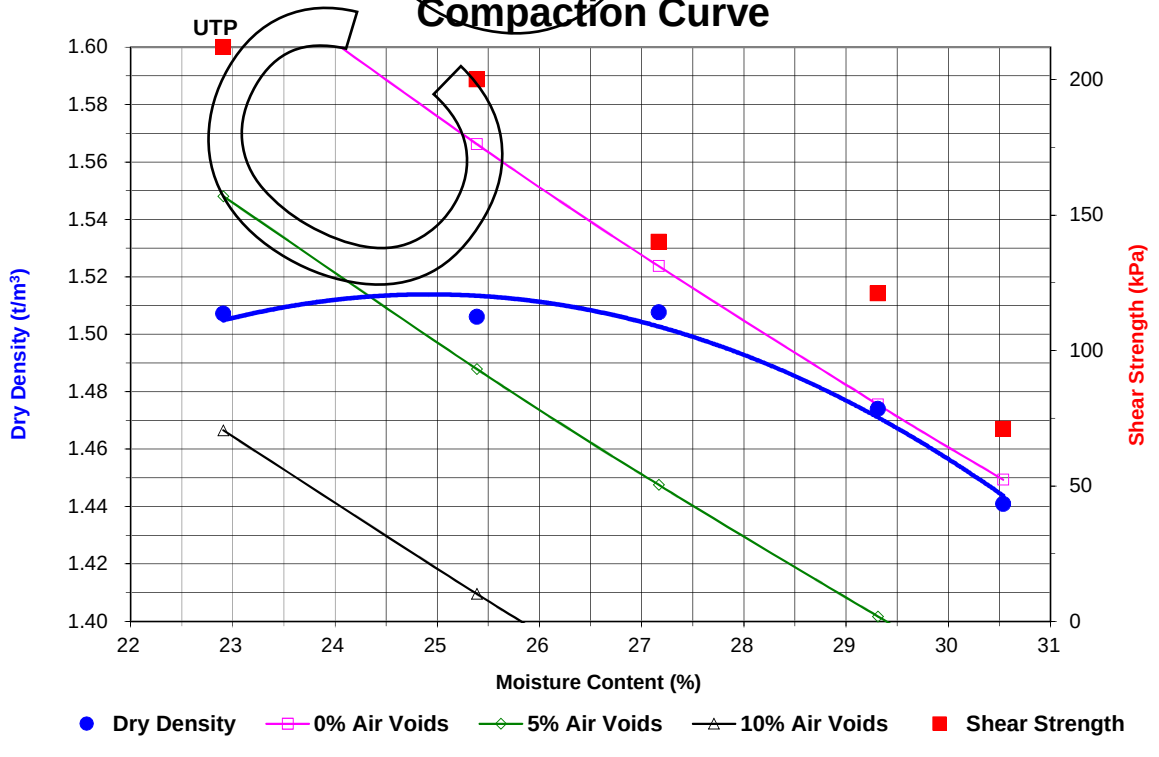
TEST RESULTS

Water Content (%)	22.9	25.4	27.2	29.3	30.5
Bulk Density (t/m^3)	1.85	1.89	1.92	1.91	1.88
Dry Density (t/m^3)	1.51	1.51	1.51	1.47	1.44
Air Voids (%)	7.5	3.8	1.1	0.1	0.6
Shear Strength (kPa)	UTP*	200	140	121	71

**UTP = unable to penetrate sample with the shear vane.*

Maximum Dry Density:	1.51 t/m^3	Optimum Water Content:	25 %

Compaction Curve



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CONSULTING GEOTECHNICAL ENGINEERS

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PO Box 21-424 Henderson, Waitakere 0650
09 835 1740 Fax 09 835 1847
www.soilandrock.co.nz

MOISTURE CONTENT DETERMINATION

PROJECT NAME: Beachlands Junction, Beachlands

PROJECT No: 15542

DATE: 24/09/2015

Auger Hole	Depth (metres)	MOISTURE CONTENT (%)
TP01	1.0	26
	2.5	41
	3.0	39
TP02	1.9	37

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Testing Method: Soil&Rock Test 1-Based on NZS 4402:1986 Test 2.1 Determination of Water Content

Approx test pit locations Soil & Rock Consultants

REVISION	CHANGES	CHECKED	DATE
B	UPDATED BDY	VC	14/08/15
A	ADDED ROUNDABOUT & AMENDED POND ACCESS	VC	08/07/15
0	ORIGINAL ISSUE	VC	24/06/15

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CLIENT
GRAPHITE MANAGEMENT

PROJECT
BEACHLANDS

TITLE
EARTHWORKS PLAN

DATE	FEB 2015	SCALE	
DRAWN	DW	A1	1:1000
DESIGNED		A3	1:2000
DRAWING No	C200	SHEET	1 of 1
REVISION	B		

APPENDIX 4

Direct Transmission Nuclear Densometer Test Results

EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**8917 - 129 Beachlands Road.**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - D Boodle**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**13/10/15**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**221-224/15**
Client Ref No :	**PO000742**

Nuclear Densometer Test Results

Test Number	221/15	222/15	223/15	224/15
Test Position	1	2	3	4
Probe Depth (mm)	200			
Wet Density (t/m³)	1.88	1.92	1.87	1.88
Dry Density (t/m³)	1.40	1.53	1.35	1.45
Water Content (%)	34.7	26.0	38.4	29.8
Air Voids (%)	0.0	4.0	-1.7	3.4
% of MDD	Not Calculated			

Oven Corrected Test Results

Dry Density (t/m³)	1.44	1.55	1.41	1.50
Water Content (%)	30.9	24.2	32.4	25.1
Air Voids (%)	2.6	5.4	2.1	6.8
% of MDD	Not Calculated			

Test Methods	Notes
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 15/10/15

Date reported : 15/10/15

IANZ ACCREDITED LABORATORY

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

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**	
Location :	**8917 - 129 Beachlands Road**	Sample condition :	**In Situ**	
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**	
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**
Tested by :	**Opus - D Boodle**	Max dry density (assumed) :	**-**	**t/m³**
Date tested :	**16/10/15**	Opt. water content (assumed) :	**-**	**%**

Project No :	**1-LA009.15**
Lab Ref No :	**227-230/15**
Client Ref No :	**PO 000744**

Nuclear Densometer Test Results

Test Number	227/15	228/15	229/15	230/15										
Test Position	5	6	7	8										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.77	1.82	1.82	1.77										
Dry Density (t/m³)	1.24	1.33	1.34	1.23										
Water Content (%)	42.4	36.7	35.6	43.3										
Air Voids (%)	1.4	1.9	2.5	1.2										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.20	1.44	1.39	1.29										
Water Content (%)	47.6	26.3	30.9	37.4										
Air Voids (%)	-1.4	8.8	5.6	4.5										
% of MDD	Not Calculated													

Test Methods	Notes
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 19/10/15

Date reported : 19/10/15

IANZ ACCREDITED LABORATORY

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**	
Location :	**As per clients request**	Sample condition :	**In Situ**	
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**	
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**
Tested by :	**Opus - A Brown**	Max dry density (assumed) :	**-**	**t/m³**
Date tested :	**21/10/15**	Opt. water content (assumed) :	**-**	**%**

Project No :	**1-LA009.15**
Lab Ref No :	**239-242/15**
Client Ref No :	**PO 000748**

Nuclear Densometer Test Results

Test Number	239/15	240/15	241/15	242/15										
Test Position	9	10	11	12										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.93	1.93	1.88	1.94										
Dry Density (t/m³)	1.45	1.42	1.43	1.46										
Water Content (%)	32.8	35.5	31.5	32.1										
Air Voids (%)	-1.3	-3.0	2.0	-1.1										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.45	1.49	1.46	1.47										
Water Content (%)	33.2	29.1	28.9	31.6										
Air Voids (%)	-1.6	1.5	3.8	-0.7										
% of MDD	Not Calculated													

Test Methods	Notes
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 23/10/15

Date reported : 23/10/15

IANZ ACCREDITED LABORATORY

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**As per clients request**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - A Brown**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**23/10/15**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**247-250/15**
Client Ref No :	**PO 000751**

Nuclear Densometer Test Results

Test Number	247/15	248/15	249/15	250/15										
Test Position	13	14	15	16										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.80	1.95	1.91	2.00										
Dry Density (t/m³)	1.28	1.50	1.47	1.59										
Water Content (%)	40.7	29.9	30.5	25.6										
Air Voids (%)	0.9	-0.2	1.1	0.4										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.32	1.50	1.50	1.61										
Water Content (%)	36.3	29.5	27.4	24.3										
Air Voids (%)	3.5	0.1	3.4	1.5										
% of MDD	Not Calculated													

Test Methods	**Notes**
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 27/10/15

Date reported : 27/10/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**	
Location :	**As per clients request**	Sample condition :	**In Situ**	
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**	
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**
Tested by :	**Opus - A Brown**	Max dry density (assumed) :	**-**	**t/m³**
Date tested :	**29/10/15**	Opt. water content (assumed) :	**-**	**%**

Project No :	**1-LA009.15**
Lab Ref No :	**255-260/15**
Client Ref No :	**PO 000766**

Nuclear Densometer Test Results

Test Number	255/15	256/15	257/15	258/15	259/15	260/15								
Test Position	17	18	19	20	21	22								
Probe Depth (mm)	200													
Wet Density (t/m³)	1.90	1.93	1.89	1.93	1.90	1.86								
Dry Density (t/m³)	1.40	1.50	1.39	1.46	1.43	1.35								
Water Content (%)	35.2	28.0	35.5	32.2	32.8	37.6								
Air Voids (%)	-1.2	2.3	-0.8	-0.9	0.5	-0.9								
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.40	1.52	1.42	1.51	1.48	1.36								
Water Content (%)	35.1	26.8	32.4	28.1	28.4	37.1								
Air Voids (%)	-1.2	3.2	1.3	2.0	3.6	-0.6								
% of MDD	Not Calculated													

Test Methods	**Notes**
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 30/10/15

Date reported : 30/10/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**As per clients request**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-7**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - R Carlyle**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**02/11/15**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**270-273/15**
Client Ref No :	**PO 000770**

Nuclear Densometer Test Results

Test Number	270/15	271/15	272/15	273/15										
Test Position	23	24	25	26										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.82	1.83	1.75	1.99										
Dry Density (t/m³)	1.34	1.34	1.32	1.58										
Water Content (%)	35.6	36.1	32.3	25.6										
Air Voids (%)	2.6	1.9	8.6	1.2										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.40	1.35	1.36	1.63										
Water Content (%)	30.5	35.9	28.9	21.6										
Air Voids (%)	5.9	2.0	10.8	4.5										
% of MDD	Not Calculated													

Test Methods	Notes
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 04/11/15

Date reported : 04/11/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**Fill 2 (as per clients request)**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - D Boodle**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**06/11/15**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**277-280/15**
Client Ref No :	**PO 000776**

Nuclear Densometer Test Results

Test Number	277/15	278/15	279/15	280/15										
Test Position	27	28	29	30										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.96	1.90	2.03	1.87										
Dry Density (t/m³)	1.51	1.46	1.65	1.34										
Water Content (%)	29.5	30.6	23.5	39.1										
Air Voids (%)	-0.5	1.6	0.6	-2.0										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.54	1.47	1.69	1.35										
Water Content (%)	27.2	29.9	20.5	38.0										
Air Voids (%)	1.2	2.1	3.2	-1.3										
% of MDD	Not Calculated													

Test Methods	**Notes**
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 09/11/15

Date reported : 09/11/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**As per clients request**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - D Boodle**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**10/11/15**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**281-284/15**
Client Ref No :	**PO 000779**

Nuclear Densometer Test Results

Test Number	281/15	282/15	283/15	284/15
Test Position	31	32	33	34
Probe Depth (mm)	200			
Wet Density (t/m³)	1.87	1.86	1.86	1.90
Dry Density (t/m³)	1.34	1.36	1.40	1.45
Water Content (%)	39.8	36.4	33.1	31.3
Air Voids (%)	-2.4	0.1	2.2	1.4
% of MDD	Not Calculated			

Oven Corrected Test Results

Dry Density (t/m³)	1.31	1.39	1.42	1.47
Water Content (%)	42.4	33.7	30.5	29.3
Air Voids (%)	-4.0	1.8	4.0	2.8
% of MDD	Not Calculated			

Test Methods	Notes
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 13/11/15

Date reported : 13/11/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**	
Location :	**As per clients request**	Sample condition :	**In Situ**	
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**	
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**
Tested by :	**Opus - R Carlyle**	Max dry density (assumed) :	**-**	**t/m³**
Date tested :	**11/11/15**	Opt. water content (assumed) :	**-**	**%**

Project No :	**1-LA009.15**
Lab Ref No :	**289-292/15**
Client Ref No :	**PO 000782**

Nuclear Densometer Test Results

Test Number	289/15	290/15	291/15	292/15										
Test Position	35	36	37	38										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.90	1.89	2.08	1.91										
Dry Density (t/m³)	1.50	1.45	1.76	1.48										
Water Content (%)	27.3	30.4	18.2	29.1										
Air Voids (%)	4.0	2.6	3.2	2.5										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.51	1.49	1.72	1.50										
Water Content (%)	25.8	26.6	20.9	27.0										
Air Voids (%)	5.1	5.4	0.7	4.0										
% of MDD	Not Calculated													

Test Methods	Notes
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 13/11/15

Date reported : 13/11/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**As per clients request**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-5**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - R Carlyle**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**18/11/15**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**309-318/15**
Client Ref No :	**PO 000783**

Nuclear Densometer Test Results

Test Number	309/15	310/15	311/15	312/15	313/15	314/15	315/15	316/15	317/15	318/15				
Test Position	39	40	41	42	43	44	45	46	47	48				
Probe Depth (mm)	200													
Wet Density (t/m³)	1.89	1.92	1.94	1.92	1.86	1.99	1.80	1.92	1.93	1.88				
Dry Density (t/m³)	1.48	1.49	1.51	1.48	1.41	1.61	1.33	1.46	1.45	1.38				
Water Content (%)	28.2	29.5	28.5	29.9	31.6	23.5	35.7	31.4	33.0	36.5				
Air Voids (%)	3.8	1.3	1.4	1.3	3.4	2.8	3.6	0.0	-1.3	-1.1				
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.39	1.52	1.49	1.46	1.43	1.61	1.41	1.48	1.41	1.36				
Water Content (%)	36.0	26.6	30.1	31.7	29.8	23.7	27.6	30.2	37.0	38.6				
Air Voids (%)	-1.5	3.5	0.2	0.0	4.7	2.7	8.9	0.8	-3.9	-2.5				
% of MDD	Not Calculated													

Test Methods	Notes
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 20/11/15

Date reported : 20/11/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**As per clients request**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - D Boodle**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**23/11/15**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**323-326/15**
Client Ref No :	**PO 000796**

Nuclear Densometer Test Results

Test Number	323/15	324/15	325/15	326/15										
Test Position	49	50	51	52										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.92	1.96	1.87	1.92										
Dry Density (t/m³)	1.49	1.55	1.32	1.44										
Water Content (%)	29.0	26.5	41.8	33.2										
Air Voids (%)	1.9	1.8	-3.5	-0.8										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.53	1.58	1.36	1.53										
Water Content (%)	25.4	24.2	37.3	24.9										
Air Voids (%)	4.6	3.6	-0.8	5.2										
% of MDD	Not Calculated													

Test Methods	**Notes**
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 25/11/15

Date reported : 25/11/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**As per clients request**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-5**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - D Boodle**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**03/12/15**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**346-349/15**
Client Ref No :	**PO 000814**

Nuclear Densometer Test Results

Test Number	346/15	347/15	348/15	349/15										
Test Position	53	54	55	56										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.96	1.94	1.89	1.91										
Dry Density (t/m³)	1.56	1.51	1.40	1.44										
Water Content (%)	25.7	28.0	35.2	32.6										
Air Voids (%)	2.5	1.7	-0.8	-0.1										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.57	1.50	1.45	1.49										
Water Content (%)	24.4	29.1	30.0	28.2										
Air Voids (%)	3.5	0.9	2.7	3.1										
% of MDD	Not Calculated													

Test Methods	**Notes**
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request on site.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 03/12/15

Date reported : 03/12/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**	
Location :	**As per clients request**	Sample condition :	**In Situ**	
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-8**	
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**
Tested by :	**Opus - T Whyte**	Max dry density (assumed) :	**-**	**t/m³**
Date tested :	**08/12/15**	Opt. water content (assumed) :	**-**	**%**

Project No :	**1-LA009.15**
Lab Ref No :	**353-356/15**
Client Ref No :	**PO 000816**

Nuclear Densometer Test Results

Test Number	353/15	354/15	355/15	356/15										
Test Position	57	58	59	60										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.93	1.88	1.85	1.90										
Dry Density (t/m³)	1.51	1.47	1.43	1.51										
Water Content (%)	27.7	28.1	28.8	25.6										
Air Voids (%)	2.2	4.6	5.7	5.5										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.53	1.48	1.48	1.54										
Water Content (%)	26.1	27.4	24.7	23.6										
Air Voids (%)	3.4	5.1	8.7	7.0										
% of MDD	Not Calculated													

Test Methods	**Notes**
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode ~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~ Water Content : NZS: 4402:1986: Test 2.1 for soils	SD from client

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date : 10/12/15

Date reported : 10/12/15

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**As per clients request**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-5**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - T Whyte**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**15/12/2015**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**361-364/15**
Client Ref No :	**PO 000820**

Nuclear Densometer Test Results

Test Number	361/15	362/15	3363/15	364/15										
Test Position	61	62	63	64										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.91	1.89	1.74	1.86										
Dry Density (t/m³)	1.50	1.45	1.30	1.43										
Water Content (%)	27.2	30.6	34.1	29.9										
Air Voids (%)	3.9	2.3	7.9	4.6										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.48	1.40	1.34	1.38										
Water Content (%)	28.9	35.5	30.3	34.9										
Air Voids (%)	2.7	-1.0	10.3	1.2										
% of MDD	Not Calculated													

Test Methods	**Notes**
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Rowan Carlyle

Designation : *Laboratory Manager*

Date reported : 15/12/2015 Date : 15/12/2015

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**	Sample description :	**Clay Fill**		
Location :	**As per clients request**	Sample condition :	**In Situ**		
Client :	**KGA Geotechnical Ltd**	Nuclear densometer no :	**FTS/1-7**		
Contractor :	**Dempsey Wood Civil Ltd**	Solid density (assumed) :	**2.71**	**t/m³**	
Tested by :	**Opus - T Whyte**	Max dry density (assumed) :	**-**	**t/m³**	
Date tested :	**22/12/2015**	Opt. water content (assumed) :	**-**	**%**	

Project No :	**1-LA009.15**
Lab Ref No :	**369-372/15**
Client Ref No :	**PO000837**

Nuclear Densometer Test Results

Test Number	369/15	370/15	371/15	372/15										
Test Position	65	66	67	68										
Probe Depth (mm)	200													
Wet Density (t/m³)	1.99	1.94	1.98	1.99										
Dry Density (t/m³)	1.60	1.52	1.59	1.61										
Water Content (%)	24.3	28.0	24.3	23.6										
Air Voids (%)	2.3	1.6	2.7	2.7										
% of MDD	Not Calculated													

Oven Corrected Test Results

Dry Density (t/m³)	1.62	1.55	1.63	1.64										
Water Content (%)	22.9	25.1	21.2	21.5										
Air Voids (%)	3.4	3.8	5.2	4.5										
% of MDD	Not Calculated													

Test Methods	**Notes**
Insitu Density : NZS 4407 :1991: Test 4.2.1 for Direct Transmission Mode	SD from client
~~Insitu Density : NZS 4407 :1991: Test 4.2.2 for Backscatter Mode~~	Test positions as per clients request.
Water Content : NZS: 4402:1986: Test 2.1 for soils	

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IANZ Approved Signatory

Ben Richardson

Designation : *Senior Civil Engineering Technician*

Date : 24/12/2015

Date reported : 24/12/2015

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**
Location :	**As per clients request**
Client :	**KGA Ltd**
Contractor :	**Not Stated**
Tested by :	**Opus - M Swinbourn**
Date tested :	**20/01/16**
Sample description :	**Clay Fill**
Sample condition :	**In Situ**
Nuclear densometer no :	**FTS/1-5**

Solid density (assumed) :	**2.70**	**t/m³**
Max dry density (tested) :	**-**	**t/m³**
Optimum water content (tested) :	**-**	**%**

Project No :	**1-LA009.16**
Lab Ref No :	**015-019/16**
Client Ref No :	**PO000851**

Nuclear Densometer Test Results							
Test Number	015/16	016/16	017/16	018/16	019/16		
Test Position	69	70	71	72	73		
Test Probe Depth (mm)	200						
Wet Density (t/m³)	2.03	1.95	1.93	1.90	1.93		
Dry Density (t/m³)	1.68	1.55	1.56	1.52	1.50		
Water Content (%)	20.8	25.8	23.3	25.4	28.1		
Air Voids (%)	2.9	2.6	5.7	5.3	2.1		
% of MDD	Not Calculated						

Oven Corrected Test Results							
Dry Density (t/m³)	1.62	1.58	1.58	1.52	1.55		
Water Content (%)	25.4	23.6	21.7	24.8	23.9		
Air Voids (%)	-1.0	4.3	7.0	5.8	5.3		
% of MDD	Not Calculated						

Test Method	Notes
~~Insitu Density : NZS 4407 : 1991, Test 4.2.1 for Direct Transmission Mode~~	Solid Density from client.
Insitu Density : NZS 4407 : 1991, Test 4.2.2 for Backscatter Mode	Air Voids are not IANZ accredited.
Water Content : NZS:4402 : 1986, Test 2.1 for soils	

Date reported : 25/01/16

IANZ Approved Signatory
Rowan Carlyle
Designation : *Laboratory Manager*
Date : 25/01/16

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**		
Location :	**As per clients request**		
Client :	**KGA Ltd**		
Contractor :	**Not Stated**		
Tested by :	**Opus - B Harfield**		
Date tested :	**28/01/16**		
Sample description :	**Clay Fill**		
Sample condition :	**In Situ**		
Nuclear densometer no :	**FTS/1-8**		
Solid density (assumed) :	**2.70**	**t/m³**	
Max dry density (tested) :	**-**	**t/m³**	
Optimum water content (tested) :	**-**	**%**	

Project No :	**1-LA009.16**
Lab Ref No :	**032-036/16**
Client Ref No :	**PO000862**

Nuclear Densometer Test Results							
Test Number	032/16	033/16	034/16	035/16	036/16		
Test Position	74	75	76	77	78		
Test Probe Depth (mm)	200						
Wet Density (t/m³)	1.93	1.95	1.95	2.04	1.93		
Dry Density (t/m³)	1.50	1.51	1.55	1.67	1.53		
Water Content (%)	28.3	28.5	25.6	22.3	25.8		
Air Voids (%)	1.9	0.8	3.0	0.8	3.8		
% of MDD	Not Calculated						

Oven Corrected Test Results							
Dry Density (t/m³)	1.54	1.54	1.56	1.67	1.55		
Water Content (%)	24.9	25.9	24.9	22.2	24.5		
Air Voids (%)	4.4	2.8	3.5	0.9	4.8		
% of MDD	Not Calculated						

Test Method	Notes
Insitu Density : NZS 4407 : 1991, Test 4.2.1 for Direct Transmission Mode	Solid Density from client.
~~Insitu Density : NZS 4407 : 1991, Test 4.2.2 for Backscatter Mode~~	Air Voids are not IANZ accredited.
Water Content : NZS:4402 : 1986, Test 2.1 for soils	

Date reported : 29/01/16

IANZ Approved Signatory

Ben Richardson

Designation : *Senior Civil Engineering Technician*

Date : 03/02/16

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**
Location :	**As per clients request**
Client :	**KGA Ltd**
Contractor :	**Not Stated**
Tested by :	**Opus - B Harfield**
Date tested :	**6/04/16**
Sample description :	**Clay Fill**
Sample condition :	**In Situ**
Nuclear densometer no :	**FTS/1-7**

*This report replaces Project No: 1-LA009.16; lab ref no: 090-092/16

Solid density (assumed) :	**2.70**	**t/m³**
Max dry density (tested) :	**-**	**t/m³**
Optimum water content (tested) :	**-**	**%**

Project No :	**1-LA009.16**
Lab Ref No :	**090-092/16R***
Client Ref No :	**PO000921**

Nuclear Densometer Test Results							
Test Number	090/16R	091/16R	092/16R				
Test Position	79	80	81				
Test Probe Depth (mm)	200						
Wet Density (t/m³)	1.99	1.95	1.93				
Dry Density (t/m³)	1.59	1.50	1.49				
Water Content (%)	25.2	29.6	29.2				
Air Voids (%)	1.0	-0.3	1.0				
% of MDD	Not Calculated						

Oven Corrected Test Results							
Dry Density (t/m³)	1.61	1.56	1.55				
Water Content (%)	23.5	24.9	24.9				
Air Voids (%)	2.3	3.3	4.2				
% of MDD	Not Calculated						

Test Method	Notes
Insitu Density : NZS 4407 : 1991, Test 4.2.1 for Direct Transmission Mode	Solid Density from client.
~~Insitu Density : NZS 4407 : 1991, Test 4.2.2 for Backscatter Mode~~	Air Voids are not IANZ accredited.
Water Content : NZS:4402 : 1986, Test 2.1 for soils	

Date reported : 5/08/16

IANZ Approved Signatory

Ben Richardson

Designation : *Senior Civil Engineering Technician*

Date : 5/08/16

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EARTHWORKS COMPACTION CONTROL TEST RESULTS

OPUS

Project :	**Beachlands Junction**
Location :	**As per clients request**
Client :	**KGA Ltd**
Contractor :	**Not Stated**
Tested by :	**Opus - E Govender**
Date tested :	**9/05/16**
Sample description :	**Clay Fill**
Sample condition :	**In Situ**
Nuclear densometer no :	**FTS/1-8**

*This report replaces Project No 1-LA009.16 lab ref no: AL62/1-5

Solid density (assumed) :	**2.7**	**t/m³**
Max dry density (tested) :	**-**	**t/m³**
Optimum water content (tested) :	**-**	**%**

Project No :	**1-LA009.16**
Lab Ref No :	**AL62/1-5R***
Client Ref No :	**PO 000964**

Nuclear Densometer Test Results							
Test Number	1R	2R	3R	4R	5R		
Test Position	82	83	84	85	86		
Test Probe Depth (mm)	200						
Wet Density (t/m³)	1.92	1.92	1.95	1.90	1.84		
Dry Density (t/m³)	1.57	1.51	1.54	1.50	1.41		
Water Content (%)	22.4	27.1	26.5	26.9	30.2		
Air Voids (%)	6.8	3.3	2.1	4.2	5.0		
% of MDD	Not Calculated						

Oven Corrected Test Results							
Dry Density (t/m³)	1.56	1.54	1.51	1.51	1.46		
Water Content (%)	22.8	24.7	29.4	26.3	26.3		
Air Voids (%)	6.4	5.1	-0.1	4.6	7.8		
% of MDD	Not Calculated						

Test Method	Notes
Insitu Density : NZS 4407 : 1991, Test 4.2.1 for Direct Transmission Mode	Solid Density from Client
~~Insitu Density : NZS 4407 : 1991, Test 4.2.2 for Backscatter Mode~~	Air Voids are not IANZ accredited.
Water Content : NZS:4402 : 1986, Test 2.1 for soils	

Date reported : 5/08/16

IANZ Approved Signatory
Ben Richardson
Designation : *Senior Civil Engineering Technician*
Date : 5/08/16

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APPENDIX 5

Shrink/Swell Test Results

FORM R8

AS1289:7.1.1. Shrink-Swell Index

Laboratory Test Report

Client:	KGA Geotechnical Ltd		
Job Name:	129 Beachlands Rd	Job Number:	5734
Date Sampled:	17.05.16	Date Tested:	26.05.16
Sample Number:	6	Tested By:	GM
Sampling Depth (m):	0.5	Checked By:	SWJ
Sample Condition:	Good,		
Sample Description:	Natural: Inorganic, v. sl pl, orange, grey, clayey SILT		
Inert Inclusions (%):	0		
Cracking (%):	5		
Crumbling (%):	0		

SWELL TEST

Initial Water content (%):	29.0
Final Water content (%):	31.2
ε_{sw} = Magnitude of Swelling Strain (%) :	0.00

(-ve value means sample has undergone consolidation)

SHRINK TEST

Water content (%):	29.1
ε_{sh} = Magnitude of Shrinkage Strain (%) :	1.94

SHRINK SWELL INDEX (Iss)

Formula

$$I_{ss} = \frac{(\varepsilon_{sw}/2) + \varepsilon_{sh}}{1.8}$$

Iss (%) : 1.1
strain per ΔpF

GEOTEK SERVICES LIMITED

THOROUGH ANALYSIS *DEPENDABLE ADVICE*

1/55 Druces Road, Manukau Central PO Box 217-172, Botany Junction, Auckland 2164
Phone (64-9) 261-0169 Facsimile (64-9) 261-0548 E-mail enquiries@geotek.co.nz

FORM R8

AS1289:7.1.1. Shrink-Swell Index

Laboratory Test Report

Client:	KGA Geotechnical Ltd		
Job Name:	129 Beachlands Rd	Job Number:	5734
Date Sampled:	17.05.16	Date Tested:	30.05.16
Sample Number:	7	Tested By:	GM
Sampling Depth (m):	0.5	Checked By:	SW
Sample Condition:	Good,		
Sample Description:	Fill: Inorganic, sl pl, orange, grey, silty CLAY		
Inert Inclusions (%):	0		
Cracking (%):	2		
Crumbling (%):	0		

SWELL TEST

Initial Water content (%):	26.0
Final Water content (%):	27.8
ε_{sw} = Magnitude of Swelling Strain (%) :	0.24

(-ve value means sample has undergone consolidation)

SHRINK TEST

Water content (%):	24.6
ε_{sh} = Magnitude of Shrinkage Strain (%) :	2.23

SHRINK SWELL INDEX (Iss)

Formula

$$I_{ss} = \frac{(\varepsilon_{sw}/2) + \varepsilon_{sh}}{1.8}$$

Iss (%) : 1.3

strain per ΔpF

GEOTEK SERVICES LIMITED

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FORM R8

AS1289:7.1.1. Shrink-Swell Index

Laboratory Test Report

Client:	KGA Geotechnical Ltd		
Job Name:	129 Beachlands Rd	Job Number:	5734
Date Sampled:	17.05.16	Date Tested:	30.05.16
Sample Number:	8	Tested By:	GM
Sampling Depth (m):	0.5	Checked By:	SW
Sample Condition:	Good,		
Sample Description:	Fill: Inorganic, v. sl pl, grey, orange, clayey SILT		
Inert Inclusions (%):	0		
Cracking (%):	5		
Crumbling (%):	0		

SWELL TEST

Initial Water content (%):	21.5
Final Water content (%):	22.2
ε_{sw} = Magnitude of Swelling Strain (%) :	0.24

(-ve value means sample has undergone consolidation)

SHRINK TEST

Water content (%):	22.3
ε_{sh} = Magnitude of Shrinkage Strain (%) :	0.99

SHRINK SWELL INDEX (Iss)

Formula $$I_{ss} = \frac{(\varepsilon_{sw}/2) + \varepsilon_{sh}}{1.8}$$

Iss (%) : 0.6
strain per ΔpF

GEOTEK SERVICES LIMITED

THOROUGH ANALYSIS *DEPENDABLE ADVICE*

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FORM R8

AS1289:7.1.1. Shrink-Swell Index

Laboratory Test Report

Client:	KGA Geotechnical Ltd		
Job Name:	129 Beachlands Rd	Job Number:	5734
Date Sampled:	17.05.16	Date Tested:	31.05.16
Sample Number:	9	Tested By:	GM
Sampling Depth (m):	0.5	Checked By:	SWJ
Sample Condition:	Good,		
Sample Description:	Fill: Inorganic, sl pl, grey, orange, brown, silty CLAY		
Inert Inclusions (%):	5		
Cracking (%):	2		
Crumbling (%):	0		

SWELL TEST

Initial Water content (%):	26.6
Final Water content (%):	28.2
ε_{sw} = Magnitude of Swelling Strain (%) :	0.29

(-ve value means sample has undergone consolidation)

SHRINK TEST

Water content (%):	23.9
ε_{sh} = Magnitude of Shrinkage Strain (%) :	3.07

SHRINK SWELL INDEX (Iss)

Formula

$$I_{ss} = \frac{(\varepsilon_{sw}/2) + \varepsilon_{sh}}{1.8}$$

Iss (%) : 1.8
strain per ΔpF

GEOTEK SERVICES LIMITED

THOROUGH ANALYSIS *DEPENDABLE ADVICE*

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FORM R8

AS1289:7.1.1. Shrink-Swell Index

Laboratory Test Report

Client:	KGA Geotechnical Ltd		
Job Name:	129 Beachlands Rd	Job Number:	5734
Date Sampled:	17.05.16	Date Tested:	31.05.16
Sample Number:	10	Tested By:	GM
Sampling Depth (m):	0.5	Checked By:	SW
Sample Condition:	Good,		
Sample Description:	Fill: Inorganic, sl pl, grey, orange, silty CLAY		
Inert Inclusions (%):	0		
Cracking (%):	4		
Crumbling (%):	0		

SWELL TEST

Initial Water content (%):	24.8
Final Water content (%):	27.7
ε_{sw} = Magnitude of Swelling Strain (%) :	0.39

(-ve value means sample has undergone consolidation)

SHRINK TEST

Water content (%):	28.3
ε_{sh} = Magnitude of Shrinkage Strain (%) :	2.92

SHRINK SWELL INDEX (Iss)

Formula $$I_{ss} = \frac{(\varepsilon_{sw}/2) + \varepsilon_{sh}}{1.8}$$

Iss (%) : 1.7
strain per ΔpF

GEOTEK SERVICES LIMITED

THOROUGH ANALYSIS *DEPENDABLE ADVICE*

1/55 Druces Road, Manukau Central PO Box 217-172, Botany Junction, Auckland 2164
Phone (64-9) 261-0169 Facsimile (64-9) 261-0548 E-mail enquiries@geotek.co.nz

APPENDIX 6

Completion Documentation for Retaining Wall Construction

IPENZ ENGINEERS NEW ZEALAND | NEW ZEALAND INSTITUTE OF ARCHITECTS INCORPORATED | ACENZ

Building Code Clause(s) B1

PRODUCER STATEMENT – PS4 – CONSTRUCTION REVIEW

(Guidance notes on the use of this form are printed on page 2)

ISSUED BY: KGA Geotechnical Limited
(Construction Review Firm)

TO: Beachlands Junction Limited
(Owner/Developer)

TO BE SUPPLIED TO: Auckland Council
(Building Consent Authority)

IN RESPECT OF: New Timber Pole Retaining walls
(Description of Building Work)

AT: 129 Beachlands Road, Beachlands 2018
(Address)
LOT 2 **DP** 490742 **SO**

KGA Geotechnical Limited *(Construction Review Firm)* has been engaged by Dempsey Wood Civil Limited

To provide ☐CM1 ☐CM2 ☐CM3 ☐CM4 ☐CM5 *(Engineering Categories)* or ☐ observation as per agreement with owner/developer

or ☒other Observation of ground conditions in foundation excavations for timber pole retaining walls highlighted on plan within schedule attached only. Confirm ground conditions consistent with Soil & Rock Consultants report dated 15 March 2010, reference 09691 services
(Extent of Engagement)

in respect of clause(s) B1 of the Building Code for the building work described in documents relating to Building Consent No. 20152992 and those relating to Building Consent Amendment(s) Nos. Nil issued during the course of the works. We have sighted these Building Consents and the conditions of attached to them.

Authorised instructions / variations(s) No. Nil (copies attached) or by the attached Schedule ☒ have been issued during the course of the works.

On by the basis of ☒this ☐these review(s) and information supplied by the contractor during the course of the works and **on behalf of the firm** undertaking this Construction Review, **I believe on reasonable grounds** that ☐All ☒Part only of the building works have been completed in accordance with the relevant requirements of the Building Consent and Building Consent Amendments identified above, with respect to Clause(s) B1 of the Building Code. I also believe on reasonable grounds that the persons who have undertaken this construction review have the necessary competency to do so.

I, Rodney J Hutchison am: ☒CPEng No. 38987
(Name of Construction Review Professional)
☐Reg Arch No.

I am a Member of : ☒IPENZ ☐NZIA and hold the following qualifications: BE, MSc, DIC, MICE, CEng (UK), FIPENZ, CPEng

The Construction Review Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than $200,000*.
The Construction Review Firm is a member of ACENZ : ☒

SIGNED BY Rodney J Hutchison **ON BEHALF OF** KGA Geotechnical Limited

Date: 08 August 2016 Signature:

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of $200,000.*

This form is to accompany **Forms 6 or 8 of the Building (Form) Regulations 2004** for the issue of a Code Compliance Certificate.

THIS FORM AND ITS CONDITIONS ARE COPYRIGHT TO ACENZ, IPENZ AND NZIA

GUIDANCE ON USE OF PRODUCER STATEMENTS

Producer statements were first introduced with the Building Act 1991. The producer statements were developed by a combined task committee consisting of members of the New Zealand Institute of Architects, Institution of Professional engineers New Zealand, Association of Consulting Engineers New Zealand in consultation with the Building Officials Institute of New Zealand. The original suit of producer statements has been revised at the date of this form as a result of enactment of the Building Act (2004) by these organisations to ensure standard use within the industry.

The producer statement system is intended to provide Building Consent Authorities (BCAs) with reasonable grounds for the issue of a Building Consent or a Code Compliance Certificate, without having to duplicate design or construction checking undertaken by others.

PS1 Design Intended for use by a suitably qualified independent design professional in circumstances where the BCA accepts a producer statement for establishing reasonable grounds to issue a Building Consent;

PS2 Design Review Intended for use by a suitably qualified independent design professional where the BCA accepts an independent design professional's review as the basis for establishing reasonable grounds to issue a Building Consent;

PS3 Construction Forms commonly used as a certificate of completion of building work are Schedule 6 of NZS 3910:2013 or Schedules E1/E2 of NZIA's SCC 2011[2]

PS4 Construction Review Intended for use by a suitably qualified independent design professional who undertakes construction monitoring of the building works where the BCA requests a producer statement prior to issuing a Code Compliance Certificate.

This must be accompanied by a statement of completion of building work (Schedule 6).

The following guidelines are provided by ACENZ, IPENZ and NZIA to interpret the Producer Statement.

Competence of Design Professional

This statement is made by a Design Firm that has undertaken a contract of services for the services named, and is signed by a person authorised by that firm to verify the processes within the firm and competence of its designers.

A competent design professional will have a professional qualification and proven current competence through registration on a national competence based register, either as a Chartered Professional Engineer (CPEng) or a Registered Architect.

Membership of a professional body, such as the Institution of Professional Engineers New Zealand (IPENZ) or the New Zealand Institute of Architects (NZIA), provides additional assurance of the designer's standing within the profession. If the design firm is a member of the Association of Consulting Engineers New Zealand (ACENZ), this provides additional assurance about the standing of the firm.

Persons or firms meeting these criteria satisfy the term "suitably qualified independent design professional".

*Professional Indemnity Insurance

As part of membership requirements, ACENZ requires all member firms to hold Professional Indemnity Insurance to a minimum level.

The PI Insurance minimum stated on the front of this form reflects standard, small projects. If the parties deem this inappropriate for large projects the minimum may be up to $500,000.

Professional Services during Construction Phase

There are several levels of service which a Design Firm may provide during the construction phase of a project (CM1-CM5 for Engineers[3]). The Building Consent Authority is encouraged to require that the service to be provided by the Design Firm is appropriate for the project concerned.

Requirement to provide Producer Statement PS4

Building Consent Authorities should ensure that the applicant is aware of any requirement for producer statements for the construction phase of building work at the time the building consent is issued as no design professional should be expected to provide a producer statement unless such a requirement forms part of the Design firm's engagement.

Attached Particulars

Attached particulars referred to in this producer statement refer to supplementary information appended to the producer statement.

Refer Also:

1 Conditions of Contract for Building & Civil Engineering Construction NZS 3910: 2013

2 NZIA Standard Conditions of Contract SCC 2011

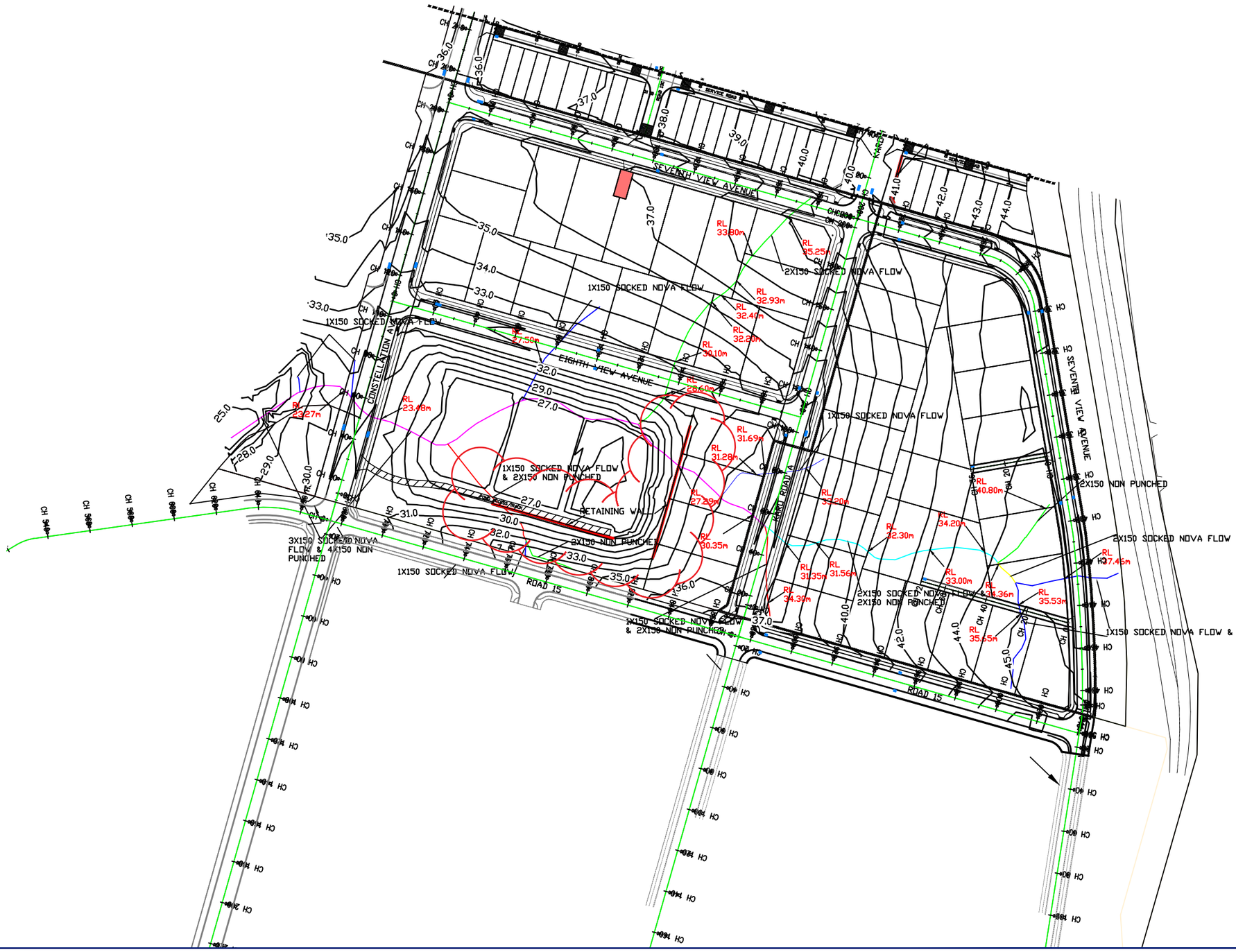
3 Guideline on the Briefing & Engagement for Consulting Engineering Services (ACENZ/IPENZ 2004)

4 PN Guidelines on Producer Statements

www.acenz.org.nz
www.ipenz.org.nz
www.nzia.co.nz

Schedule attached to KGA Geotechnical Producer Statement dated 08 August, 2016, Building Consent No. 20152992

Producer Statement PS4 applies to retaining walls within clouded area on this plan, only.



0	ORIGINAL ISSUE	TL	27/06/16
REVISION	CHANGES	CHECKED	DATE

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CLIENT

GRAPHITE MANAGEMENT

PROJECT

BEACHLANDS

TITLE

FINAL CONTOUR & UNDERFILL DRAIN LEVEL PLAN

DATE	JUNE 2016	SCALE	
DRAWN	DW	A1	1:1000
DESIGNED		A3	1:2000
DRAWING No	SHEET	REVISION	
2. Final Contour Plan	1 ... of ... 1		0