THE LAKES (2012) LTD
STAGE 2P (Residential Area)
Boulder Lane
PYES PA, TAURANGA

Geotechnical Completion Report

Our ref: 20539
December 2014

S&L CONSULTANTS LTD - SURVEYORS - ENGINEERS - PLANNERS
102 Hamilton Street PO Box 231 Tauranga 3140 New Zealand Phone 07 577 6069 Fax 07 577 6065 Email slconsultants@sltga.co.nz

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LT 483125

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1.0 Introduction

This report has been prepared as a "geotechnical completion report" as described in section QA-2.2 of the Infrastructure Development Code of the Tauranga City Council.

The bulk of the earthworks for Stage 2P of The Lakes residential development at Pyes Pa were completed by the developer at that time, Grasshopper Farms Ltd, in 2008. Subsequent construction of the residential section of Stage 2P of the Lakes development has been completed by The Lakes (2012) Ltd during September to December 2014 to create twenty lots. These lots are accessed from the new cul de sac of Boulder Lane off Lakes Boulevard. The details of the subdivision were shown on the Council approved subdivision plan 136258-01-GA100 rev 5 and the dimensions of thee lots are shown on LT 483125. Both plans were prepared by Harrison Grierson Consultants Ltd and copies are in Appendix 1 of this report.

The sequence of events that have preceded the completion of Stage 2P has been

- the approval for the Lakes Development granted jointly by the Tauranga City Council and the Western Bay of Plenty District Council on 24 May 2004.
- a variation to the May 2004 approval granted by the Tauranga City Council on 18 September 2007.
- site earthworks undertaken by Hick Bros Ltd during the 2006-2008 earthworks seasons.
- construction of Lakes Boulevard and underground services during 2007-2008 which incorporated stages 2G and 2J which are adjacent to Stage 2P. With the issue of this completion certificate the Council accepted the roading and services installed the issue of a Section 224 Certificate by the City Council for DP 408042 which along Lake Boulevard and which now serve Stage 2P.

Stage 2P is located on the lower areas within The Lakes development and is located within the former flood plain of the Kopurererua Stream present to the west of the subdivision. Site works have elevated the access road and the development area above possible future flood levels.

In support of the application made for subdivision consent by The Lakes (2012) Ltd in August 2013, S&L Consultants Ltd prepared a "Geotechnical Assessment Report" in which the suitability of the land, as prepared by past earthworks, was stated and endorsed for the subsequent construction of the twenty lots. Parts of this report are included in this report for supporting information.

This report describes the earthworks undertaken in the formation of Stage 2P and summarises the suitability of the prepared ground in fill and areas of cut for future residential development. The report states the relevant standards adopted for the placement of the filling to support future buildings and recommendations for developing the sites.

During the report references are made to two drawings contained in Appendix 1.

Earthworks as built drawing 18264-AB17 shows the areas of cut and depth of filling placed in the Stage 2P residential area up to 2008.

Reference plan 20539-G01 shows the lot numbers and positions, and the locations of pre and post construction test positions, including compaction test locations, post construction boreholes of 2009 and 2014 and static cone penetrometer (CPT) tests.

2.0 Original Landform and Geology

The landform prior to the commencement of the subdivision construction comprised:

- Elevated areas along the eastern side as a central plateau described locally as the Te Ranga Tablelands. These areas have been variously used for farming and horticultural cropping. The existing Pyes Pa residential area further to the east has been established on similar level areas of the same elevation.
- Lower lying areas mainly along and adjacent to the Kopurererua Stream to the west and extending eastwards.
- Transitional slopes of varying steepness between the lower lying areas and the elevated central plateau. Re entrant erosion gullies were present on some of these slopes but most were uniform in slope gradient, albeit steep in some locations.

The geological setting for the development area can be derived from the publication:

Occasional Report 22 – Department of Earth Sciences University of Waikato
"Geology of the Tauranga Area" by Briggs et al – 1996

The geology within the Stage 2P residential area can be described as:

(i) On the sloping ground rising to the east and partly within lots 913 to 918.
- Taupo volcanic zone tephras comprising Rotoehu ash (light grey sand) overlaid by brown or yellow post Rotoehu ash being coarse grained silts, sandy silts and sands. These are collectively referred to as "younger ashes" and overlay
- "Older" ash derivative strongly weathered clay textured tephra beds and palaesols (Hamilton ash) overlaying.
- Older terrestrial and estuarine sediments deposits of the Matua subgroup of the Tauranga formation. These may comprise a wide variety of lithologies.
- Te Ranga ignimbrite being white-grey pumiceous sands and coarse silts.

(ii) At the lower areas to the west within lots 901 to 912, Lots 912 to 918 (part), lots 919 and 920 and out to the Kopurererua Stream past Takitimu Drive :
- Alluvial silts, sands and gravels transported by the stream.
- Organic peat at the existing ground surfaces or overlaid by alluvial soils at depth.
- Eroded sections of the more elevated Taupo volcanic zone tephra that have been reduced to the levels of the stream plain or rise above these levels as mounds or ridges that extend in to the stream plain area.

3.0 Pre Subdivision Investigations

Prior to obtaining subdivision approval for the total development on 24 May 2004, a comprehensive geotechnical assessment was undertaken by S&L Consultants Ltd. The subsequent report was dated October 2003.

The report describes fifty two machine drilled boreholes and twenty six excavated pits that were used to identify the subsoils that are present on the development area.

Machine bores MB13, MB14, MB17, MB23 and MB24 were located in the Stage 2P area and their positions are shown on 18264-AB18.

Borehole MB13 was located immediately south of lot 920 and showed the presence of volcanic ash derivative soils similar to those soils found in the higher ground to the east beyond Lakes Boulevard.

Boreholes 14, 17, 23 and 24 found the presence of surface peat to depths below the original ground levels of 4.6m (boreholes 14 and 17), 3.8m (borehole 23) and 4.8m (borehole 24). Underlining the peat were clayey or sandy silts. These inorganic soils were found to be of varying densities and strengths and uncorrected SPT N values were in the range of 0 (the apparatus sinking under its own weight) to 5. The borehole depths ranged from 8 to 18m. No further organic soils were encountered in the depths below the surface cover of peat.

The presubdivision investigations that related to Stage 2P concluded that:

- Areas of higher ground away from the areas of peat would be suitable for the support of additional filling and future buildings.
- The peat soils can be removed to practical depths and be replaced with filling. Depths of subexcavation would be governed by the capability of the earthmoving machinery on the site and the cost effectiveness of removing the peat and undertaking its replacement with filling obtained from elsewhere within the subdivision development area.

4.0 Scope of Subdivision Earthworks

The general earthworks undertaken in Stage 2P were:

(a) The removal of the surface peats in the area of lots 901 to 904 and 905 to 910 and the replacement of the peat with filling obtained from borrow areas within The Lakes development. Prior to placement of the filling over the stripped ground a subsoil drainage system was constructed as shown on 18264-AB18.

(b) The placement of filling to raise the general ground levels over the underlying ash soils over lots 911 to 920 to the south.

The depths of cut and filling undertaken in 2006-2008 and as shown on drawing 18264-AB18 were derived from surveyed contours of the finished surface taken on completion of the earthworks compared with topographical surveys undertaken by S&L Consultants Ltd and site staff from Grasshopper Farms Ltd prior to the subdivision construction, and also after the removal of the unsuitable surface soils and prior to the placement of the replacement filling. During the subsequent construction of the residential subdivision in September-December 2014 additional minor earthworks were undertaken by Higgins Contractors Ltd. These works required the placement of additional filling on Lots 918 to 920 to raise general ground levels by not more than 1.0m.

The earthworks in 2006-2008 and in 2014 were undertaken in compliance with consent 62387 issued by Environment Bay of Plenty.

5.0 Earthworks Standards

The performance specification required of the Contractors for the earthworks was based on the guidelines contained in NZS 4431:1989 "Code of Practice for Earthfill for Residential Development". Compliance with the compaction requirements listed below satisfies the standards listed in Section 7 of the NZS 4431.

Air voids percentage (as defined in NZS 4402: Part 1:1980)

- Average value less than 10% (any 10 tests)
- Maximum single value 12%

Undrained shear strength (measured by in situ vane)

- Average value not less than 150kPa (any 10 tests)
- Minimum single value 100kPa

Where the filling placed was clearly pumiceous sand obtained from borrow pits in the Te Ranga ignimbrite, Scala penetrometer tests were specified with blow counts of 4 or more per 100mm of penetration being required.

The earthworks of 2006-2008 were supervised by site project engineers employed by Grasshopper Farms Ltd and observed by engineering staff from S&L Consultants Ltd during specific site inspections. The minor earthworks of 2014 were observed by S&L Consultants Ltd geotechnical engineering staff.

The testing in the areas of filling in 2014 was undertaken by S&L Consultants by the recording of the undrained shear strengths that were developed by compactors, at regular depths in hand augured boreholes shown in position on 20539-G01

Compaction and strength control testing in 2006 to 2008 was undertaken by IANZ accredited Opus International Consultants Ltd both on site and in their Tauranga laboratory. The test results are listed in Appendix 3.

Post construction boreholes 1 to 6 and dated 11 February 2009 were put down by S & L Consultants on lots 912, 913, 917, 918 and 920 to check the compaction of filling on those lots. The borelogs in Appendix 3 show the undrained shear strengths of the filling as developed by compaction while placing, all exceed 150 kPa.

Post construction boreholes 1 to 5 and dated 28 November 2014 were put down by S & L Consultants to test the minor depths of filling placed on lot 920 and to assess the natural ground that is present on lots 914 to 917. The recent filling was proved to be adequately compacted on lot 920 and the natural soils under minor filling on lots 914 to 917 comprises stiff to hard clayey silts of airfall volcanic ash origin.

6.0 Summary and Recommendations

6.1 Subdivision Construction Filling

Supervised structural filling, as shown on drawing 18264-AB18 and at test sites on 20539-G01, were placed in accordance with the methods and standards quoted in NZS 4431 under the management of S & L Consultants Ltd. Compaction testing on site

confirmed that a high and uniform degree of compaction has been achieved in this filling. Compaction test results are summarised in Appendix 3.

A statement endorsing the suitability of the filled areas for the support of future buildings is contained in Appendix 2 of this report.

The observations made during the earthworks and the compaction test results show that the ultimate ground bearing capacity in the limit state for the design of foundations may be taken at 300kPa. This capacity meets the definition of "good ground" and therefore buildings may be detailed to NZS 3604:2011 where applicable.

Building will take place on a compacted raft of filling which overlays alluvial soils. The filling has now been in place for at least six years. Any consolidation of the underlying alluvial soils would be well advanced over this period. Future settlements due to imposed loadings from buildings are therefore expected to be low and well within the limits described in Appendix B, B1/VM4 of the Compliance Document for the New Zealand Building Code, Clause B1, of the Ministry of Business, Innovation and Employment (MBIE).

However, the possibility of variations of soil type and strength may exist away from observation or compaction tests locations. The normal inspections of foundation conditions during construction of buildings by competent tradespeople and by building inspectors would still be undertaken. If, for any reason, areas of low soil strength are found, professional geotechnical advice should then be sought.

6.2 Areas of Cut or Undisturbed Ground

All areas within Stage 2P were earthworked either in cut to remove peat and other soft ground, or to lower natural ground levels. Areas where unsuitable soils were removed were then subsequently filled or additional filling was placed over the original ground. Apart from the small areas within lots 912 to 919 along the frontage to Lakes Boulevard, no areas of the original topography were left unfilled during the subdivision earthworks.

6.3 Stability Considerations

There are no global land stability considerations that would create natural hazards that would affect building development in Stage 2P. Extensive earthworks were undertaken on the rising ground to the east beyond Lakes Boulevard to ease original slopes. The stability of these modified slopes was discussed in the summary geotechnical report of S & Consultants Ltd reference 18264 and dated August 2008 which referred to Stage 2J of the Lakes development.

7.0 Assessment of Liquefaction Potential

As a result of the ground damage caused by liquefaction from significant earthquakes in Christchurch in September 2010 and February 2011, the policy of the Tauranga City Council is to require a report on the effects of liquefaction on all greenfields subdivisions developed since the 2011 earthquake.

For the study of the liquefaction potential in the Stage 2P area, 8 cone penetrometer (CPT) tests were undertaken by Perry Geotechnics Ltd at locations shown on 18264–AB18. Test positions 6, 7, and 8 were located in the residential area where building development will take place. Test position 6 was located close to slopes beyond the local purpose reserve that lead down to the drain alongside Takitimu Drive, so that the lateral spreads could be determined due to the presence of those slopes during a seismic event.

At each probe position the static groundwater level depths were recorded as

CPT 6 - not recorded CPT 7 - 4.8m CPT 8 - 4.0m

Liquefaction can occur in saturated sands or low plasticity silts during intense cyclic seismic loadings when porewater pressures reduce effective strengths and drainage takes place so that soil particles are resorted to a more dense state with subsequent reductions in soil volumes. The main effects of liquefaction are that ground settlement can occur with some settlement being differential. Where slopes or watercourses are present lateral spread may also take place.

The liquefaction assessment methodology adopted is that described by the New Zealand Geotechnical Society, July 2010 "Geotechnical Earthquake Engineering Practice – Module 1, Guidelines for the Identification, Assessment and Mitigation of Liquefaction Hazards".

NZS 1170.0:2004 "Structural Design Actions" requires that two seismic events be considered namely

- In the ultimate limit state (ULS) with a 1 in 500 year return period event whereby buildings should not collapse but may be beyond economic repair, and

- In the serviceability limit state (SLS) with a 1 in 25 year return period event whereby buildings should remain functional and not require significant repair

Specific liquefaction analyses have been undertaken for each CPT position using the software package CLiq (Geologismiki 2011). The factors input into this software were

- an earthquake magnitude of 7.5 to the Richter Scale
- class D – Deep Soil – subsoil class condition as described in NZS 1170.5:2004
- a site response factor of 1.12 (class D soil)
- a return period factor of 1.0 for the ULS and 0.25 for SLS
- a base peak ground acceleration of 0.2g (Tauranga)
- an importance level of 2

From this data the design peak ground accelerations are:

- in the ULS, 0.22g
- in the SLS, 0.06g

The results of the analyses are shown on the summary sheets in Appendix 4.

Estimated vertical settlements in the ultimate limit state range from 145 mm (CPT 6) to 280 mm (CPT 8). Plots showing these settlements are in Appendix V.

The significant liquefaction potential is below 12.5 m at CPT 6, 9.7 m at CPT 7 and 6.6 m at CPT8. The effects of liquefaction immediately below these levels and in the lower strata in the ULS would be suppressed due to the presence of the surface raft of unsaturated silts and clays which will be present naturally or as placed as part of the subdivision earthworks. Ishihara (1985) indicated that in layered deposits, a liquefied layer below a non-liquefied layer does not contribute to settlements at the ground surface provided that that the liquefiable layer is less thick than the upper non liquefied layer, such as would be present at the ground surfaces within Stage 2P. The raft of unsaturated ground of at least 6.6 m above possible depths at which liquefaction may take place in ULS conditions should therefore ensure that any settlements at the ground surface will be uniform.

Buildings on the 20 lots in Stage 2P should therefore be constructed on **concrete raft type** (rib raft) **foundations**. These structures would be resistant to the effects of any differential settlements so that the possibility of excessive or injury risk deformations would be low.

Alternatively, the use of a **timber framed subfloor on shallow piles** in accordance with NZS 3604:2011, can be adopted.

Both forms of construction are intended to limit damage to the buildings so that they can be rebuilt if damaged in a seismic event.

CPT 6 was located close to the embankment leading down to Takitimu Drive. The profile of the embankment was input into the liquefaction assessment software from which a lateral spread distance of 150 mm was derived. Such a displacement is minor.

The analyses were extended to consider the serviceability limit state for the CPT data. No significant liquefaction would be likely under SLS conditions with factors of safety all in excess of 1.0. Predicted ground settlements are less than 10 mm. Therefore, under SLS conditions, no damage to buildings is likely in a 1 in 25 year return period seismic event.

8.0 Professional Opinion

A statement in the format of Council's IDC (Form G2), advises that the proposed lots shown on LT 483125 are considered suitable for building development. This statement is contained in Appendix 2. This statement is accompanied by form G3 which summarises the information and recommendations within this report.

9.0 Applicability

Recommendations contained in this document are based on data from pre and post subdivision boreholes, observations of soil exposures during earthworks, and the results of tests in filling placed. Inferences about the nature and continuity of subsoils away from these locations are made but cannot be guaranteed.

In all circumstances, if variations in the subsoils occur which differ from those described or are assumed to exist, the site should be inspected by an engineer suitably qualified to make an informed judgement and provide advice on appropriate improvement measures.

This report has been prepared specifically for the subdivision development of 20 lots within the Stage 2P development of the Lakes Subdivision as shown on LT 483125 and no responsibility is accepted by S & L Consultants Ltd for the use of any part of this report for other development sites without their written approval.

S & L Consultants Ltd
Consulting Engineers, Surveyors, Planners

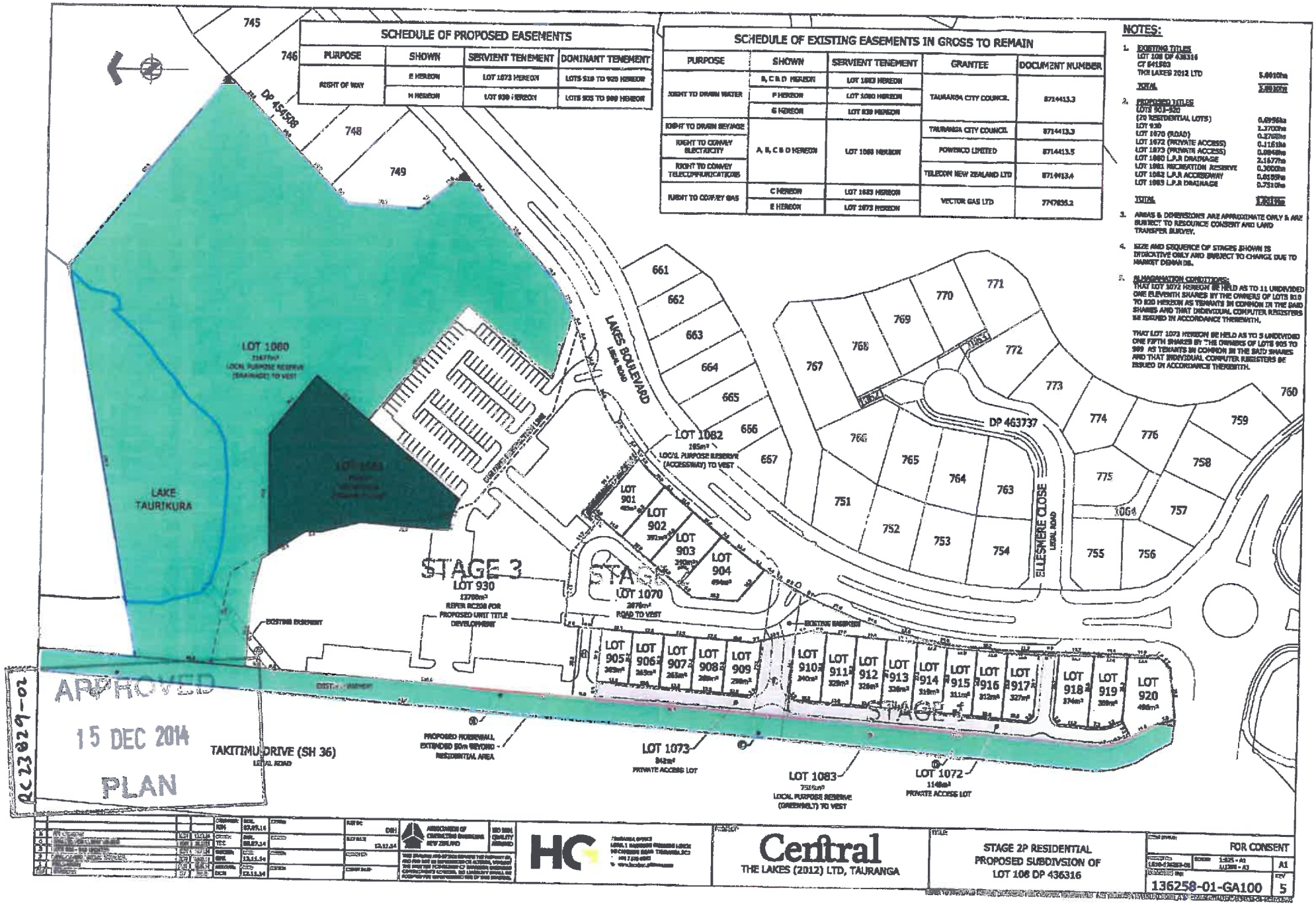
M W Hughes CPEng
Geotechnical Engineer

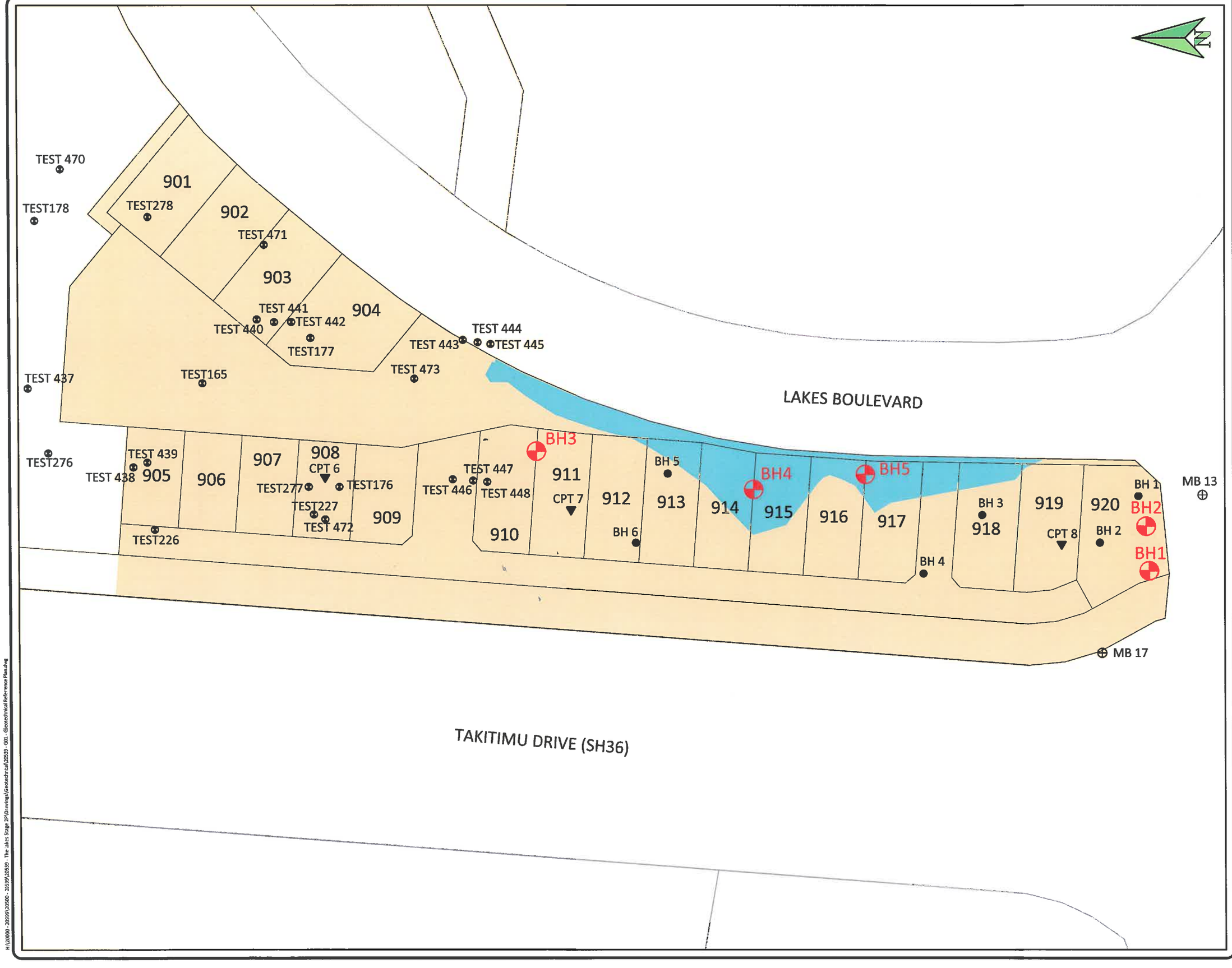
15 December 2013

Appendix One

Drawings

Subdivision Plan 136258-01-100 rev 5 (Harrison Grierson)
ReferencePlan 20539-G01
As Built Plan 18264-AB18
LT 483125


SCHEDULE OF PROPOSED EASEMENTS
PURPOSE | SHOWN | SERVIENT TENEMENT | DOMINANT TENEMENT
RIGHT OF WAY | E HEREON | LOT 1073 HEREON | LOTS 910 TO 920 HEREON
RIGHT OF WAY | H HEREON | LOT 930 HEREON | LOTS 905 TO 909 HEREON
SCHEDULE OF EXISTING EASEMENTS IN GROSS TO REMAIN
PURPOSE | SHOWN | SERVIENT TENEMENT | GRANTEE | DOCUMENT NUMBER
RIGHT TO DRAIN WATER | B, C & D HEREON | LOT 1083 HEREON | TAURANGA CITY COUNCIL | 8714413.3
RIGHT TO DRAIN WATER | F HEREON | LOT 1080 HEREON | TAURANGA CITY COUNCIL | 8714413.3
RIGHT TO DRAIN WATER | G HEREON | LOT 930 HEREON | TAURANGA CITY COUNCIL | 8714413.3
RIGHT TO DRAIN SEWAGE | A, B, C & D HEREON | LOT 1080 HEREON | POWERCO LIMITED | 8714413.5
RIGHT TO CONVEY ELECTRICITY | A, B, C & D HEREON | LOT 1080 HEREON | TELECOM NEW ZEALAND LTD | 8714413.4
RIGHT TO CONVEY TELECOMMUNICATIONS | A, B, C & D HEREON | LOT 1080 HEREON | VECTOR GAS LTD | 7707835.2
RIGHT TO CONVEY GAS | C HEREON | LOT 1083 HEREON | VECTOR GAS LTD | 7707835.2
RIGHT TO CONVEY GAS | E HEREON | LOT 1073 HEREON | VECTOR GAS LTD | 7707835.2
NOTES:
1. EXISTING TITLES
LOT 106 DP 436316 5.6910ha
CT 641583
THE LAKES 2012 LTD
TOTAL 5.6910ha
2. PROPOSED TITLES
LOTS 901-920
(20 RESIDENTIAL LOTS) 0.6956ha
LOT 930 1.3700ha
LOT 1070 (ROAD) 0.2760ha
LOT 1072 (PRIVATE ACCESS) 0.1161ha
LOT 1073 (PRIVATE ACCESS) 0.0842ha
LOT 1080 L.P.R DRAINAGE 2.1677ha
LOT 1081 RECREATION RESERVE 0.3000ha
LOT 1082 L.P.R ACCESSWAY 0.0185ha
LOT 1083 L.P.R DRAINAGE 0.7510ha
TOTAL 5.6910ha
3. AREAS & DIMENSIONS ARE APPROXIMATE ONLY & ARE SUBJECT TO RESOURCE CONSENT AND LAND TRANSFER SURVEY.
4. SIZE AND SEQUENCE OF STAGES SHOWN IS INDICATIVE ONLY AND SUBJECT TO CHANGE DUE TO MARKET DEMAND ETC.
5. AMALGAMATION CONDITIONS:
THAT LOT 1072 HEREON BE HELD AS TO 11 UNDIVIDED ONE ELEVENTH SHARES BY THE OWNERS OF LOTS 910 TO 920 HEREON AS TENANTS IN COMMON IN THE SAID SHARES AND THAT INDIVIDUAL COMPUTER REGISTERS BE ISSUED IN ACCORDANCE THEREWITH.
THAT LOT 1073 HEREON BE HELD AS TO 5 UNDIVIDED ONE FIFTH SHARES BY THE OWNERS OF LOTS 905 TO 909 AS TENANTS IN COMMON IN THE SAID SHARES AND THAT INDIVIDUAL COMPUTER REGISTERS BE ISSUED IN ACCORDANCE THEREWITH.
745
746
748
749
DP 454508
LOT 1080
LOCAL PURPOSE RESERVE (DRAINAGE) TO VEST
LAKE TAURIKURA
LAKES BOULEVARD
661
662
663
664
665
656
657
LOT 1082
LOCAL PURPOSE RESERVE (ACCESSWAY) TO VEST
767
768
769
770
771
772
773
774
776
759
760
DP 463737
766
765
764
763
751
752
753
754
ELLESMERE CLOSE
LOCAL ROAD
775
1068
758
757
755
756
LOT 901
LOT 902
LOT 903
LOT 904
STAGE 3
LOT 930
13700m²
REFER RC208 FOR PROPOSED UNIT TITLE DEVELOPMENT
STAGE 1
LOT 1070
2870m²
ROAD TO VEST
EXISTING EASEMENT
LOT 905
LOT 906
LOT 907
LOT 908
LOT 909
LOT 910
LOT 911
LOT 912
LOT 913
LOT 914
LOT 915
LOT 916
LOT 917
LOT 918
LOT 919
LOT 920
STAGE 2
APPROVED
15 DEC 2014
PLAN
RC 23829-01
TAKITIMU DRIVE (SH 36)
LOCAL ROAD
PROPOSED ROCKWALL EXTENDED 50m BEYOND RESIDENTIAL AREA
LOT 1073
842m²
PRIVATE ACCESS LOT
LOT 1083
7515m²
LOCAL PURPOSE RESERVE (GREENBELT) TO VEST
LOT 1072
1148m²
PRIVATE ACCESS LOT
HG
Central
THE LAKES (2012) LTD, TAURANGA
STAGE 2P RESIDENTIAL
PROPOSED SUBDIVISION OF
LOT 106 DP 436316
FOR CONSENT
1:625 - A3
1:1250 - A3
A1
136258-01-GA100
5



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CKD BY	REV No.	DESCRIPTION	DATE

	NAME	DATE	SIGNED
Surveyed			
Designed	NI	12/14	
Drawn	NP	12/14	
Checked			
Approved	MWH	12/14	

REFERENCES

S & L CONSULTANTS LTD
SURVEYORS - ENGINEERS
PLANNERS
102 Hamilton Street, Tauranga
New Zealand
P.O. Box 231 Ph.(07)577-6069
Fax(07)577-6065
Email: slconsultants@sltga.co.nz
Web Site: www.sltga.co.nz

TITLE

The Lakes (2012) Ltd Stage 2P Residential Area

Reference Plan for Geotechnical Report

ORIGINAL SCALES	DATE
1:750 @ A3	12/14

DRAWING No
20539 - G01

REVISION: 0

METRIC DESIGN

H:\20000 - 20999\20500 - 20599\20539 - The Lakes Stage 2P\Drawings\Geotechnical\20539 - G01 - Geotechnical Reference Plan.dwg

Takitimu Drive

Reserve

FILL

Extent of Residential Area

CUT

Gas Easement

FILL

Lakes Boulevard

Building Restriction Line

FILL

(Not suitable for the support of buildings)

Building Restriction Line

CUT

Lake

CUT

Lot 520
Stage 2G

MB 17
MB 13
MB 21
MB 23
MB 14

BH 1
BH 2
BH 3
BH 4
BH 5
BH 6

CPT 1
CPT 2
CPT 3
CPT 4
CPT 5
CPT 6
CPT 7
CPT 8

SM1
SM2
SM3
SM4
SM5

TEST 427
TEST 426
TEST330
TEST331
TEST332
TEST289
TEST288
TEST279
TEST203
TEST20
TEST171
TEST286
TEST22
TEST24
TEST202
TEST172
TEST280
TEST166
TEST126
TEST23
TEST286
TEST 450
TEST 449
TEST 470
TEST200
TEST333
TEST 429
TEST 428
TEST 430
TEST 431
TEST 468
TEST 434
TEST 433
TEST 432
TEST 462
TEST332
TEST336
TEST273
TEST274
TEST 5
TEST201
TEST335
TEST1334
TEST178
TEST272
TEST 471
TEST165
TEST 473
TEST177
TEST 442
TEST 441
TEST 440
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TEST 443
TEST 445
TEST 446
TEST 447
TEST 448
TEST175
TEST277
TEST 472
TEST227
TEST226
TEST 439
TEST 438
TEST276
TEST 437
TEST 436
TEST 466
TEST223
TEST224
TEST225
TEST275
TEST 435
TEST338
TEST 469

3	Issued with Report		12/14
2	CPT Added		07/13
1	Issued with Report		08/08
checked by	Rev. No.	Description	DATE

	NAME	DATE	SIGNED
Surveyed			
Designed			
Drawn	GR	02/09	
Checked			
Approved	MWH	12/14	

REFERENCES

S&L Consultants Ltd

S & L CONSULTANTS LTD
SURVEYORS - ENGINEERS - PLANNERS

102 Hamilton Street, Tauranga
P.O. Box 231 Ph.(07)577-6069
Fax(07)577-6065
Email: slconsultants@sltga.co.nz

TITLE

The Lakes (2012) Ltd

Stage 2P

Geotechnical Report Reference Plan

(Earthworks Updated 2006-2008)

ORIGINAL SCALES	DATE
1:500 @ A1 1:1000 @ A3	02/09

DRAWING No

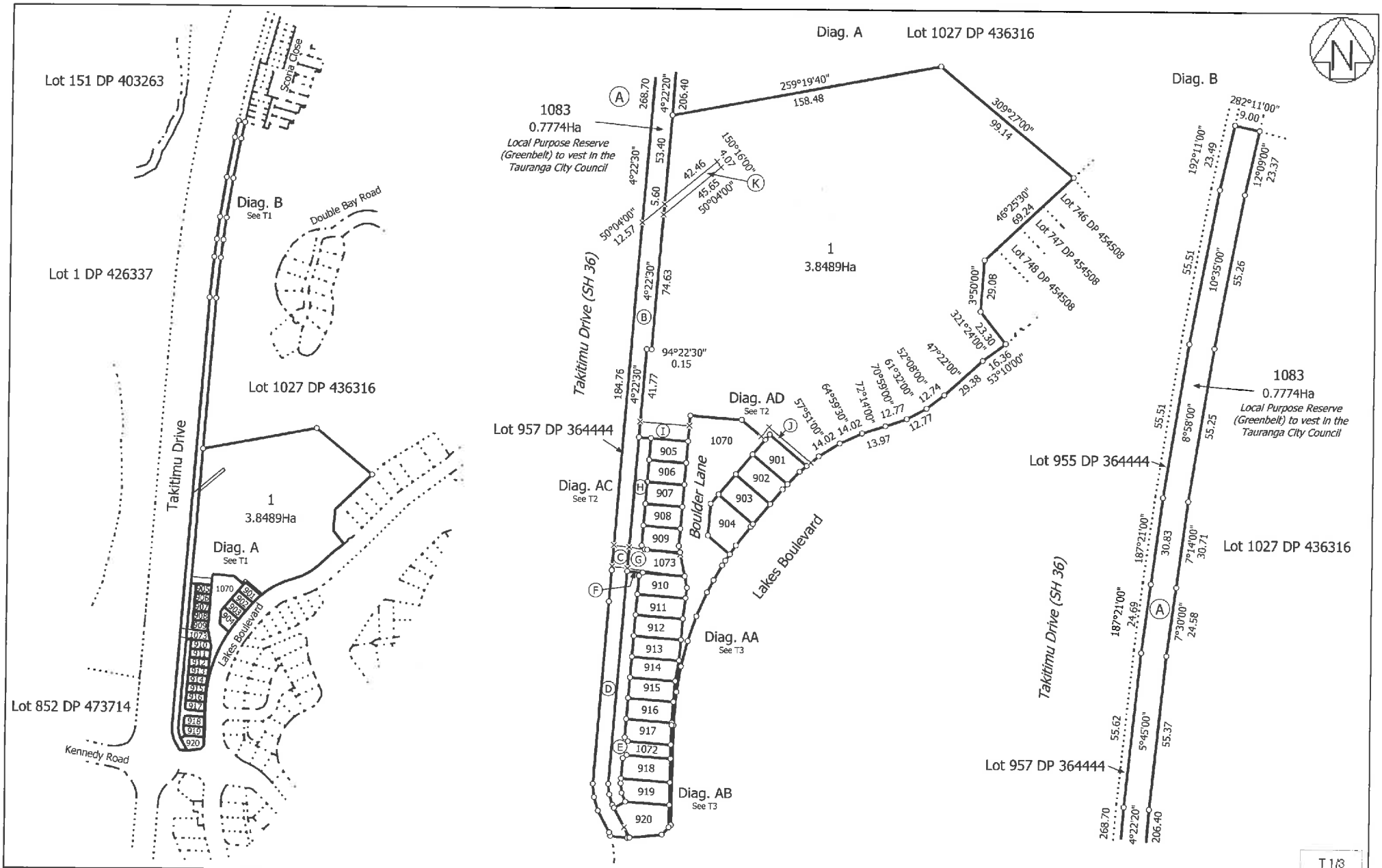
18264 - AB18

Revision: 1 2 3

METRIC DESIGN

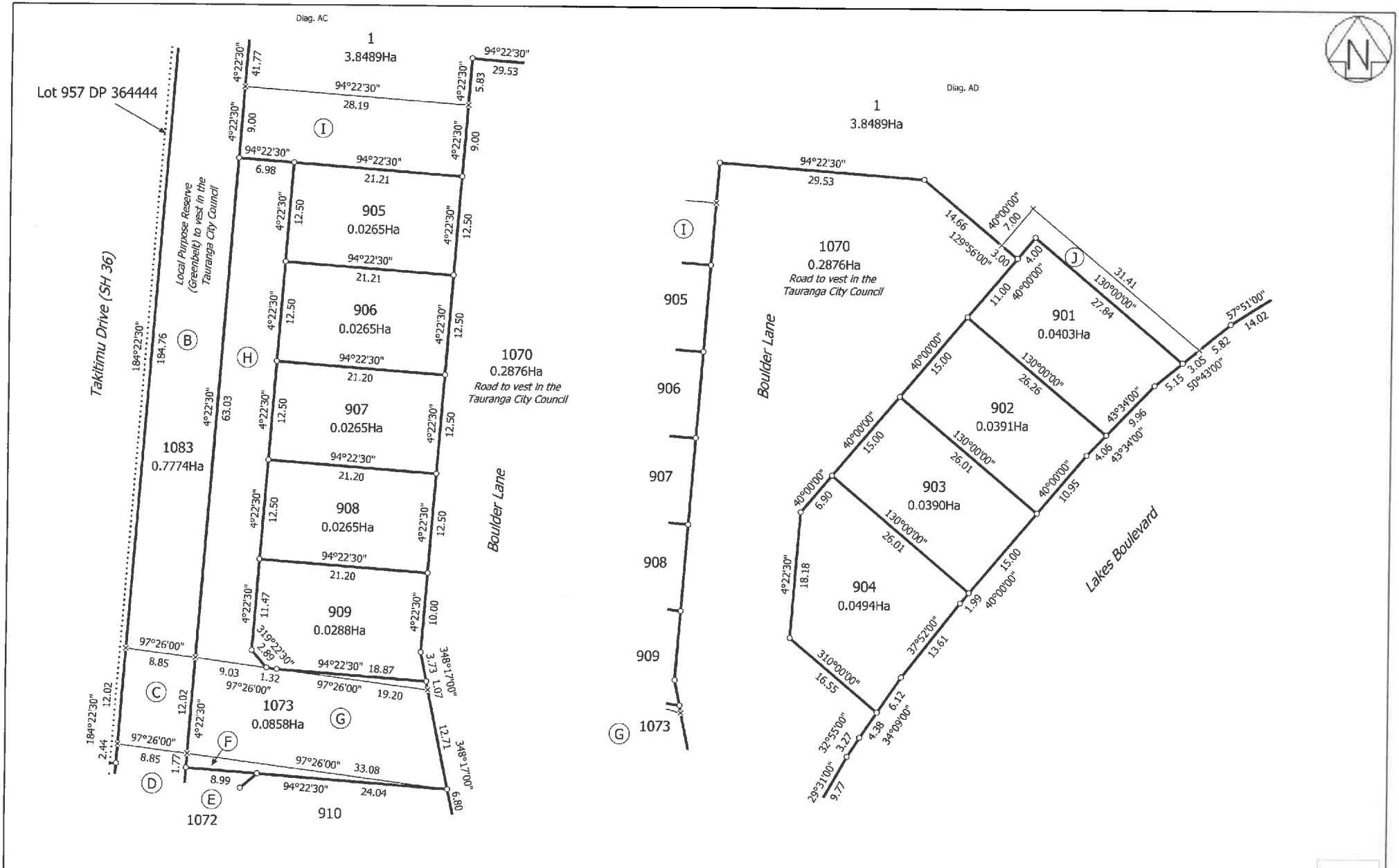
Key

- Fill Compaction Test
- Pre-subdivision Test Site
- Settlement Control Marker
- Post Earthwork Borehole
- CPT 7/13
- Subsoil Drain
- Building Restriction Line
- FILL / CUT Subdivision Cut and Fill Areas
- Fill Contour
- Cut Contour



Land District: South Auckland Digitally Generated Plan Generated on: 05/12/2014 11:02am Page 5 of 7	Lots 1, 901-920, 1072-1073 & 1083 being a subdivision of Lot 108 DP 436316	Surveyor: Michael Peter Dewhirst Firm: Harrison Grierson Consultants Ltd	Title Plan LT 483125 DRAFT

T1/3



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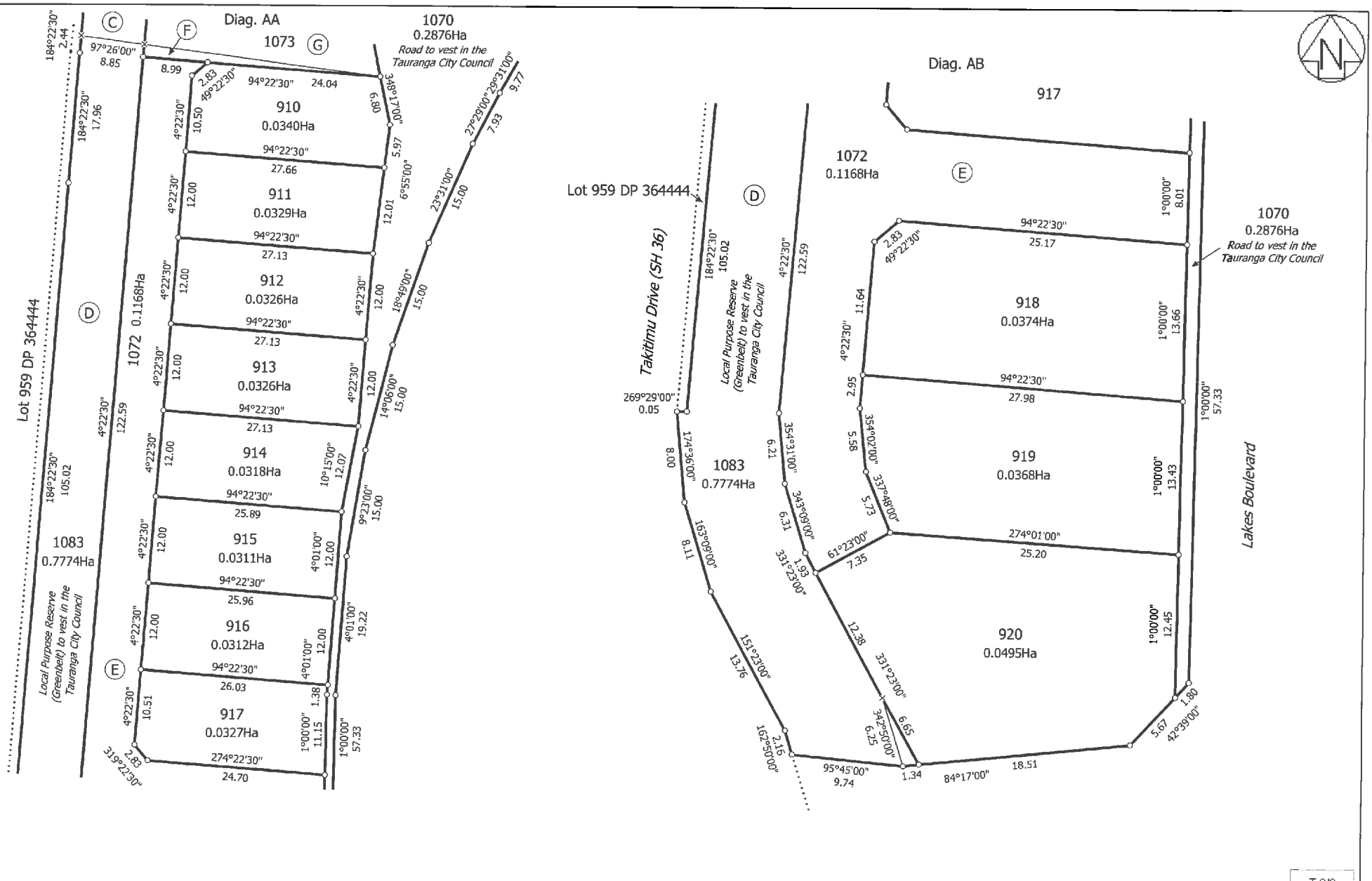
Land District: South Auckland Digitally Generated Plan Generated on: 05/12/2014 11:02am Page 6 of 7	Lots 1, 901-920, 1072-1073 & 1083 being a subdivision of Lot 108 DP 436316	Surveyor: Michael Peter Dewhirst Firm: Harrison Grierson Consultants Ltd	Title Plan LT 483125 DRAFT



T 3/3

Land District: South Auckland Digitally Generated Plan Generated on: 05/12/2014 11:02am Page 7 of 7	Lots 1, 901-920, 1072-1073 & 1083 being a subdivision of Lot 108 DP 436316	Surveyor: Michael Peter Dewhirst Firm: Harrison Grierson Consultants Ltd	Title Plan LT 483125 DRAFT

Appendix Two

Suitability of Land for Building (IDC form G2)
Lot Summary Report (IDC form G3)

CERTIFICATION **G2**

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

NAME OF SUBDIVISION	The Lakes Stage 2P (residential)
COUNCIL FILE NUMBER RC No:	23829*02
ENGINEER RESPONSIBLE FOR INVESTIGATION:	M W Hughes
QUALIFICATIONS:	BE CPEng MIPENZ

I Michael William Hughes of S & L Consultants Ltd

Hereby confirm that

1. I am a professional person, appropriately qualified with experience in geotechnical engineering to ascertain the suitability of the land for building development and was retained as the Soils Engineer to the above development.
2. An appropriate level of site investigation and construction supervision has been carried out under my direction and is described in my development evaluation report dated 15 December 2014.
3. In my professional opinion, not to be construed as a guarantee, I consider that
   a) The areas shown in my report dated 15 December 2014 of each new allotment are suitable for the erection thereon of the building types appropriate to the zoning of the land.
   b) The completed works give due regard to all land slope and foundation stability considerations
   c) The earth fills described in the report have been placed in accordance with the requirements of the Infrastructure Development Code.
   d) The filled ground and the original ground not affected by filling is suitable for the erection thereon of residential buildings detailed with "rib raft" type concrete foundations or with timber framed subfloors detailed to NZS 3604:2011 as described in section 7.0 (page 9) of my report.
4. This professional opinion is furnished to the Council and the owner for their purposes alone, on the express condition that it will not be relieved upon by any other person and does not remove the necessity for normal inspections of foundation conditions at the time of erection for any dwelling.

Signed: ..... Date: 15 December 2014

SUMMARY OF GEOTECHNICAL DATA/RECOMMENDATIONS FOR INDIVIDUAL LOTS
FROM IDC _ G3

Subdivision: The Lakes Stag age 2P (residential) TCC Ref: 23829*02
Location: Lakes Boulevard S&L Ref: 20539

The comments and notations included on this summary sheet are outlined in the support documents
These shall be read in conjunction with this summary.

		Subsurface Data						Foundations		Building Restriction Line	S/W Specific Design	S/W Soakage	S/W Reticulate	Designated Building Platform	Minimum Building Platform	Compressible Soils	on-site effluent disposal	consent notice	Recommendations /Restrictions *
		Shear Strength	Subdivision Filling		Natural Topography Unworked	Natural Topography Cut		Conventional shallow	Specific Detail										
Lot No.	Area (m2)	(kPa)	Y/N	Depth (m)	Y/N	Y/N	Cut Depth (m)	* Y/N/NA	* Y/N										
901	403	>150	Y	0-2	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	see below
902	391	>150	Y	1.5-2	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	see below
903	390	>150	Y	2-2.5	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
904	494	>150	Y	0-2.5	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
905	265	>150	Y	3	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
906	265	>150	Y	3	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
907	265	>150	Y	3	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
908	265	>150	Y	3	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
909	288	>150	Y	1-3	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
910	340	>150	Y	0-2	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
911	329	>150	Y	0-1.5	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
912	326	>150	Y	0-1	N	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
913	326	>150	Y	0-1	N	Y	0.5	Y	Y	N	N	N	Y	N	NA	N	N	Y	"
914	318	>150	Y	0-1	N	Y	0.5	Y	Y	N	N	N	Y	N	NA	N	N	Y	"
915	311	>150	Y	0-1	N	Y	0.5	Y	Y	N	N	N	Y	N	NA	N	N	Y	"
916	312	>150	Y	0-1	N	Y	0.5	Y	Y	N	N	N	Y	N	NA	N	N	Y	"
917	327	>150	Y	0-1	N	Y	0.5	Y	Y	N	N	N	Y	N	NA	N	N	Y	"
918	374	>150	Y	0-1	N	Y	0.5	Y	Y	N	N	N	Y	N	NA	N	N	Y	"
919	368	>150	Y	0-3.5	N*	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"
920	495	>150	Y	1-4	N*	N		Y	Y	N	N	N	Y	N	NA	N	N	Y	"

* Rib raft concrete foundations refer to Section 7.0 of report

Tauranga City

SUMMARY OF GEOTECHNICAL DATA FOR INDIVIDUAL LOTS

INFRASTRUCTURE DEVELOPMENT CODE

G3
VERSION

Appendix Three

Compaction Test Results

Our ref: 20539

Summary of Compaction Test Results (2006/2008)
Residential Area Stage 2P

Test no.	Date	Location	Soil Type	% Air Voids	Undrained Shear Strength
165	25.01.2007	Road	ash	4.2	162
176	14.02.2007	Lot 908	ash	0.1	160
177	14.02.2007	Lot 903	ash	3.4	183+
226	27.02.2007	Lot 905	ash	6.5	153
227	27.02.2007	Lot 907	ash	3.4	UTP
276	22.03.2007	Lot 905	ash	3.2	UTP
277	22.03.2007	Lot 907	ash	5.4	UTP
278	22.03.2007	Lot 901	ash	6.2	UTP
436	18.01.2008	Road	ash	8.0	UTP
437	18.01.2008	Road	ash	7.1	UTP
438	18.01.2008	Lot 905	ash	3.2	187+
439	18.01.2008	Lot 905	ash	5.3	189+
440	18.01.2008	Lot 902	ash	7.7	UTP
441	18.01.2008	Lot 903	ash	0.9	UTP
442	18.01.2008	Lot 903	ash	2.5	UTP
443	18.01.2008	Road	ash	3.8	UTP
444	18.01.2008	Road	ash	5.4	UTP
445	18.01.2008	Road	ash	4.6	UTP
446	18.01.2008	Road	ash	3.5	UTP
447	18.01.2008	Road	ash	2.6	UTP
448	18.01.2008	Road	ash	3.6	UTP
471	18.02.2008	Lot 902	ash	0.5	UTP
472	18.02.2008	Lot 908	ash	7.4	UTP
473	18.02.2008	Lot 904	ash	7.7	UTP

Appendix Four

Pre and Post Construction Borehole Logs

SHRIMPTON & LIPINSKI

BH 1&2

The Lakes 2012; Stage 2P

Sheet: 1 Of: 1

Job No. 20539 | Date Excavated: 28/11/14 | RL m Moturiki Datum | Logged By: N.I

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa) 50 100 150
BH 1						
SAND(f-m) silty; medium dense; moist; light brown FILL	FILL		3	not found		
SILT; sandy; hard; moist; friable; light brown grey FILL			6		UTP	>
			9			
			9		UTP	>
		0.5	8			
SAND (f-m) silty; medium dense; moist; light brown FILL			6		UTP	>
			R			
					UTP	>
SILT; clayey; slightly sandy; hard; moist; slightly cohesive light brown FILL		1.0			UTP	>
EOBH 1.0 m						
		1.5				
		2.0				
BH 2						
SAND (f-m) silty; medium dense; moist; light brown FILL	FILL		4	not found		
SILT; sandy; hard; moist; friable; light brown grey FILL contains some gravels (f-m)			7		UTP	>
			12			
			R		UTP	>
		0.5				
SAND(f-m) silty; dense; moist; light brown FILL					UTP	>
EOBH 1.0 m		1.0				
		1.5				
		2.0				

EXCAVATION METHOD: 50mm Diameter Hand Auger

SHRIMPTON & LIPINSKI

BH 3&4

The Lakes 2012; Stage 2P

Sheet: 1 Of: 1

Job No. 20539	Date Excavated: 28/11/14	RL m Moturiki Datum	Logged By: N.I

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)
BH 3					
SILT; sandy; hard; moist; friable; light brown dark brown mottles FILL	Fill	0.5		not found	UTP
					UTP
		1.0			UTP
					UTP
too hard to further borehole					UTP
EOBH 1.0 m		1.5			
		2.0			
BH 4					
SILT; sandy; hard; moist; friable; light brown dark brown mottles FILL	FILL	0.5		not found	UTP
SILT; clayey; hard; moist; slightly cohesive; orange brown					200+
		1.0			200+
					143
		1.5			146
SILT; sandy; stiff; wet; slightly cohesive; orange brown					83
		2.0			95
					65
					62
EOBH 2.0 m					62

Undrained Shear Strength (kPa): 50 100 150

EXCAVATION METHOD: 50mm Diameter Hand Auger

SHRIMPTON & LIPINSKI

BH 5

The Lakes 2012; Stage 2P

Sheet: 1 Of: 1

Job No. 20539 | Date Excavated: 28/11/14 | RL m Moturiki Datum | Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa) 50 100 150
BH 5							
TOPSOIL 200 mm	FILL				not found		
SILT; sandy; hard; moist; friable; light brown dark brown mottles FILL						UTP	>
SILT; clayey; hard; moist; slightly cohesive; orange brown			0.5			UTP	>
becomes moderately plastic						UTP	>
becomes very stiff			1.0			193	•
SILT; sandy; very stiff; moist; friable; light brown						122	•
becomes stiff						56	•
SILT; clayey; slightly sandy; stiff; wet; low plasticity orange brown			1.5			77	•
						80	•
			2.0			101	•

EXCAVATION METHOD: 50mm Diameter Hand Auger

SHRIMPTON & LIPINSKI

BH 1&2

Site: The Lakes Subdivision; Stage 2P

Sheet: 1 Of: 1

Job No. 18264 | Date Excavated: 11/02/2009 | Logged By: N.I

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa) 50 100 150
BH 1						
SILT; clayey; slightly sandy; hard; moist; friable; brown dark brown, light grey and orange mottles FILL rare gravels to 30 mm diameter	Fill	0.5		not found	utp	>
					utp	>
		1.0			utp	>
					utp	>
					utp	>
SAND; silty; moist; fine to medium grained; medium dense; light brownish grey; pumiceous		1.5			utp	>
End of borehole 1.6 m		2.0				
BH 2						
SILT; clayey; slightly sandy; very stiff; moist; friable; dark brown, light grey and orange mottles FILL rare gravels to 30 mm diameter	Fill	0.5		not found	167	•
					167	•
					173	•
hard		1.0			200+	>
					utp	>
sandy		1.5			utp	>
					utp	>
SAND; silty; moist; fine to medium grained; medium dense; light brownish grey; pumiceous		2.0				
End of borehole 2.0 m						

EXCAVATION METHOD: 50mm Diameter Hand Auger

SHRIMPTON & LIPINSKI

BH 3&4

Site: The Lakes Subdivision; Stage 2P

Sheet: 1 Of: 1

Job No. 18264 | Date Excavated: 11/02/2009

Logged By: N.I

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)
BH 3					
SILT; clayey; slightly sandy; hard; moist; friable; brown dark brown, light grey and orange mottles FILL rare gravels to 30 mm diameter	Fill	0.5		not found	utp
SAND; silty; moist; dense; light greyish brown FILL	Fill	1.0		not found	utp
SILT; clayey; slightly sandy; hard; moist; friable; brown dark brown, light grey and orange mottles FILL	Fill			not found	utp
SILT; clayey; hard; moist; friable; orangey brown	Fill	1.5		not found	200+
End of borehole 1.6 m	Fill	2.0		not found	200+
BH 4					
SILT; clayey; slightly sandy; hard; moist; friable; brown dark brown, light grey and orange mottles FILL rare gravels to 30 mm diameter	Fill	0.5		not found	utp
sandy	Fill	1.0		not found	utp
	Fill			not found	utp
	Fill	1.5		not found	utp
SILT; clayey; hard; moist; friable; orangey brown moderately plastic	Fill	2.0		not found	utp
End of borehole 2.0 m	Fill			not found	200+
					200+
					200+

Undrained Shear Strength (kPa)

50 100 150

EXCAVATION METHOD: 50mm Diameter Hand Auger

SHRIMPTON & LIPINSKI

BH 5&6

Site: The Lakes Subdivision; Stage 2P

Sheet: 1 Of: 1

Job No. 18264 | Date Excavated: 11/02/2009 | Logged By: N.I

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa) 50 100 150
BH 5						
SILT; clayey; slightly sandy; hard; moist; friable; brown dark brown, light grey and orange mottles FILL rare gravels to 30 mm diameter	Fill	0.5		not found	utp utp utp utp	> > > >
SILT; clayey; hard; moist; friable; orangey brown		1.0			200+ 200+	> >
End of borehole 1.4 m		1.5			200+	>
		2.0				
BH 6						
SILT; clayey; slightly sandy; hard; moist; friable; brown dark brown, light grey and orange mottles FILL rare gravels to 30 mm diameter	Fill	0.5		not found	utp utp utp utp utp	> > > > >
sandy		1.0			utp 200+	> >
SILT; clayey; hard; moist; friable; orangey brown		1.5			200+ 200+	> >
End of borehole 2.0 m		2.0			200+	>

EXCAVATION METHOD: 50mm Diameter Hand Auger

SHRIMPTON & LIPINSKI

Borehole Log. MB13

Site: Pyes Pa West Urbanisation

Sheet: 1 Of: 4

Job No. 16944 | Date Excavated: 17/4/03 | RL Ground: | Logged By: MH

Description of Soil	Soil Symbol	Depth (m)	SPT		CORE RECOVERY	Undrained Shear Strength (kPa) 50 100 150
TOPSOIL						
SICT : Very clayey, moderately cohesive brown yellow, very stiff		0.5			100%	
		1.0				
SPT 450 : RECOVERY Clayey Silt		1.5	1	NK1		
Pumiceous fine Silt, non cohesive, cream stiff (Medium dense), sensitive dilatent.		2.0			100%	
SAND : Very silty, rustic brown, medium dense		2.5				
Pumiceous Silt sensitive, dilatent		3.0				
fine grained cream Silt stiff (medium dense)			1			
Loose Sand			1			
Silt, stiff (Medium Dense but sensitive and dilatent		3.5		NK1		
		4.0			100%	
SILT : Very Sandy, brown yellow Medium Dense		4.5				

EXCAVATION METHOD: 100mm ϕ Machine Auger Et Hollow SPT.

SHRIMPTON & ELPINSKI

Borehole Log. MB 13

Sheet: 2 Of: 4

Site: Pyes Pa West Urbanisation

Job No. 6944 | Date Excavated: 17/4/03 | RL Ground: | Logged By: MA

Description of Soil	Soil Symbol	Depth (m)			Undrained Shear Strength (kPa) 50 100 150
SPT 450 RECOVERY Silty brown yellow medium dense sand		4.5	1 2 3	N=5	
SAND : Silty, pale brown yellow		5.0			
Puniceous fine grained Silt, slightly cohesive white cream, very stiff, medium Dense.	P P P	5.5		100%	
SPT 450 RECOVERY : Fine grained, white cream medium Dense Silt Sensitive and Dilatent	P P	6.0	1 1	N=1	
cream Silt similar to that seen in SPT 6.0-6.5m : Excellent core recovery	P P P	6.5 7.0		100%	
SPT 450 RECOVERY puniceous Silt Sand, pale brown yellow, dense	P P	7.5	1 2 4	N=6	
SAND : Silty, pale brown yellow, Dense		8.0			
Puniceous fine grained Soft, slightly cohesive cream, medium Dense - Dense Sensitive, Dilatent	P P P P	8.5 9.0		100%	

EXCAVATION METHOD: 100mm ϕ Machine Auger & Hollow SPT

S&L SKEMPTON & LIPINSKI

Borehole Log. MB 13

Site: Pyes Pa West Urbanisation

Sheet: 3 Of: 4

Job No. 6944 | Date Excavated: 17/4/03 | RL Ground: | Logged By: MH

Description of Soil	Soil Symbol	Depth (m)			Core Recovery	Undrained Shear Strength (kPa) 50 100 150
SEAT SPT BY FLUSHING HOLE		9.0				
SPT 450 : fine grained cream pumicite RECOVERY Dense but sensitive and Dilatent	P P P		2 6 5	N=11		
PUMICITE : fine grained, cream grey Dense, sensitive, Dilatent.	P P P	9.5 10.0			20 %	
SEAT SPT BY FLUSHING HOLE	P P	10.5				
SPT 450 Pumicite RECOVERY coarse grained sand, grey, medium Dense.			2 2 3	N=5		
Sand : Very Silty, Cream grey, Dense		11.0 11.5			10 %	
SEAT SPT BY FLUSHING HOLE		12.0				
SPT 450 grey Silty Sand RECOVERY grey sand with rustic limonite bands			5 13 18	N=31		
rustic limonite bands pale grey sand, dense		12.5 13.0 13.5			40 - 50 %	

EXCAVATION METHOD: 100 mm ϕ Machine Auger & Hollow SPT

SHRIMPTON & LIPINSKI

Borehole Log. MB 13

Site: Pyes Pa West Urbanisation

Sheet: 4 Of: 4

Job No. 6944 | Date Excavated: 17/4/03 | RL Ground: | Logged By: MH

Description of Soil	Soil Symbol	Depth (m)			Undrained Shear Strength (kPa) 50 100 150
SEAT SPT BY FLUSHING		13.5			
SPT 400 : Medium grained pumice sand RECOVERY Pale grey, dense			11 23 25/100mm	N>48	
SAND : pumice, grey, Dense		14.0			
		14.5		0%	
SEAT SPT WITH FLUSHING					
SPT 350 : fine grained pumice sand RECOVERY grey, Dense		15.0	7 33 10/50mm	N>43	
fine grained pumice sand, Dense		15.5			
		16.0		30-40%	
SEAT SPT BY FLUSHING WITH WATER					
SPT 450 fine grained pumice sand RECOVERY grey, Dense		16.5	5 17 30	N=47	
SAND : Pumice, fine grained, grey Dense. Poor recovery this run		17.0			
		17.5		10%	
EOB @ 18.0M : TARGET DEPTH		18.0			

EXCAVATION METHOD: 100 mm ϕ Machine Auger & Hollow SPT

SHRIMPTON & SIPINSKI

Borehole Log. MB 17

Site: Pyes Pa West Urbanisation

Sheet: 1 Of: 2

Job No. 16944 | Date Excavated: 17/4/03 | RL Ground: | Logged By: MH

Description of Soil	Soil Symbol	Depth (m)	Core Recovery	Undrained Shear Strength (kPa) 50 100 150
70% Poorly Decomposed stringy wood 30% Dark brown silt soft ; highly compressible	ORGANIC SEDIMENTS	0.5 1.0	100%	
mostly spongy golden brown wood		1.5 2.0		
highly organic dark brown silt, soft : organic material is amorphous matrix		2.5 3.0	100%	
stringy wood 50-60% with brown silt		3.5 4.0	100%	
PUMICITE	PP	4.5		

EXCAVATION METHOD: 100mm ϕ Machine Auger & Hollow SPT.

SKRIMPTON & LIPINSKI

Borehole Log. MB 17

Sheet: 2 Of: 2

Site: Pyes Pa West Urbanisation

Job No. 16944 | Date Excavated: 17/4/03 | RL Ground: | Logged By: MA

Description of Soil	Soil Symbol	Depth (m)	SPT		CORE RECOVERY	Undrained Shear Strength (kPa) 50 100 150
ORGANIC SOILS		0				
PUMICITE: Fine grained, slightly cohesive, cream, medium Dense, Sensitive, Dilatent	PP		1 2 3	N=5	100%	
	P	5.0				
	PP				80%	
	P	5.5				
	PP	6.0	1 2 4	N=6	100%	
SPT 450 : Pumicite: Fine grained RECOVERY Silt, cream, Dense but Sensitive and Dilatant	P					
pumicite		6.5			60-80%	
	PP					
	P	7.0				
	PP					
		7.5	2 3 3	N=6	100%	
SPT 450 : Compact/Dense cream RECOVERY Pumicite, Dense	P					
		8.0				
EOB @ 8.0m: TARGET DEPTH						

NON ORGANIC SEDIMENTS

EXCAVATION METHOD: 100mm ϕ Machine Auger & Hollow SPT

S&L
SHRIMPTON & LIPINSKI

Borehole No. MB24

Site: Pyes Pa West Urbanisation

Sheet: 1 Of: 3

Job No. 16944 | Date Excavated: W 30/4/03 | RL Ground: | Logged By: MHt

Description of Soil	Soil Symbol	Depth (m)	SPT	GROUNDWATER	CORE RECOVERY	Undrained Shear Strength (kPa) 50 100 150
SILT: very clayey, pumiceous, non cohesive, brown with 10% stringy wood, soft, highly compressible	ORGANIC SOILS	0.5		GWL ▼ DURING DRILLING	100%	
non organic cream, soft	NON ORGANIC	1.0				
No recovery SPT		1.5	SINKS UNDER HAMMER WEIGHT			
cream brown silt with 10% wood		2.0				
100% spongy brown wood					100%	
Pale brown silt with 10% stringy poorly decomposed wood		2.5				
		3.0	1			
10-20% stringy wood	ORGANIC SOILS	3.5	N<1			
		4.0				
grey silt mixed with topsoil		4.5				

EXCAVATION METHOD: 100mm ϕ MACHINE AUGER & HOLLOW SPT

SINCLAIR & LIPINSKI

Borehole No. MB24

Site: Pyes Pa West Urbanisation

Sheet: 2 Of: 3

Job No. 16944 | Date Excavated: W 30/4/03 | RL Ground: | Logged By: MH.

Description of Soil	Soil Symbol	Depth (m)	SPT	CORE RECOVERY	Undrained Shear Strength (kPa) 50 100 150
ORGANIC					
SILT : Grey mixed with topsoil					
SAND : Very silty, cream, loose	NON ORGANIC SOILS	5.0		100%	
		5.5			
SPT 450 RECOVERY		6.0			
pale grey Sand, loose			1	100%	
Very clayey cohesive grey Silt > firm			NC1		
SILT : Very clayey, moderately cohesive grey, firm, Sensitive, Dilatent		6.5			
		7.0		70%	
SPT NO RECOVERY		7.5			
			1	0.00	
		8.0	NC1		
PUMICITE : fine grained, cream medium Dense, Sensitive Dilatent.	PP				
	P	8.5		60-70%	
	PP	9.0			

EXCAVATION METHOD: 100mm ϕ MACHINE AUGER & HOLLOW SPT

SHRIMPTON & LIPINSKI

Borehole No. MB 24

Site: Pyes Pa West Urbanisation

Sheet: 3 Of: 3

Job No. 16944 | Date Excavated: W 30/4/03 | RL Ground: | Logged By: MH

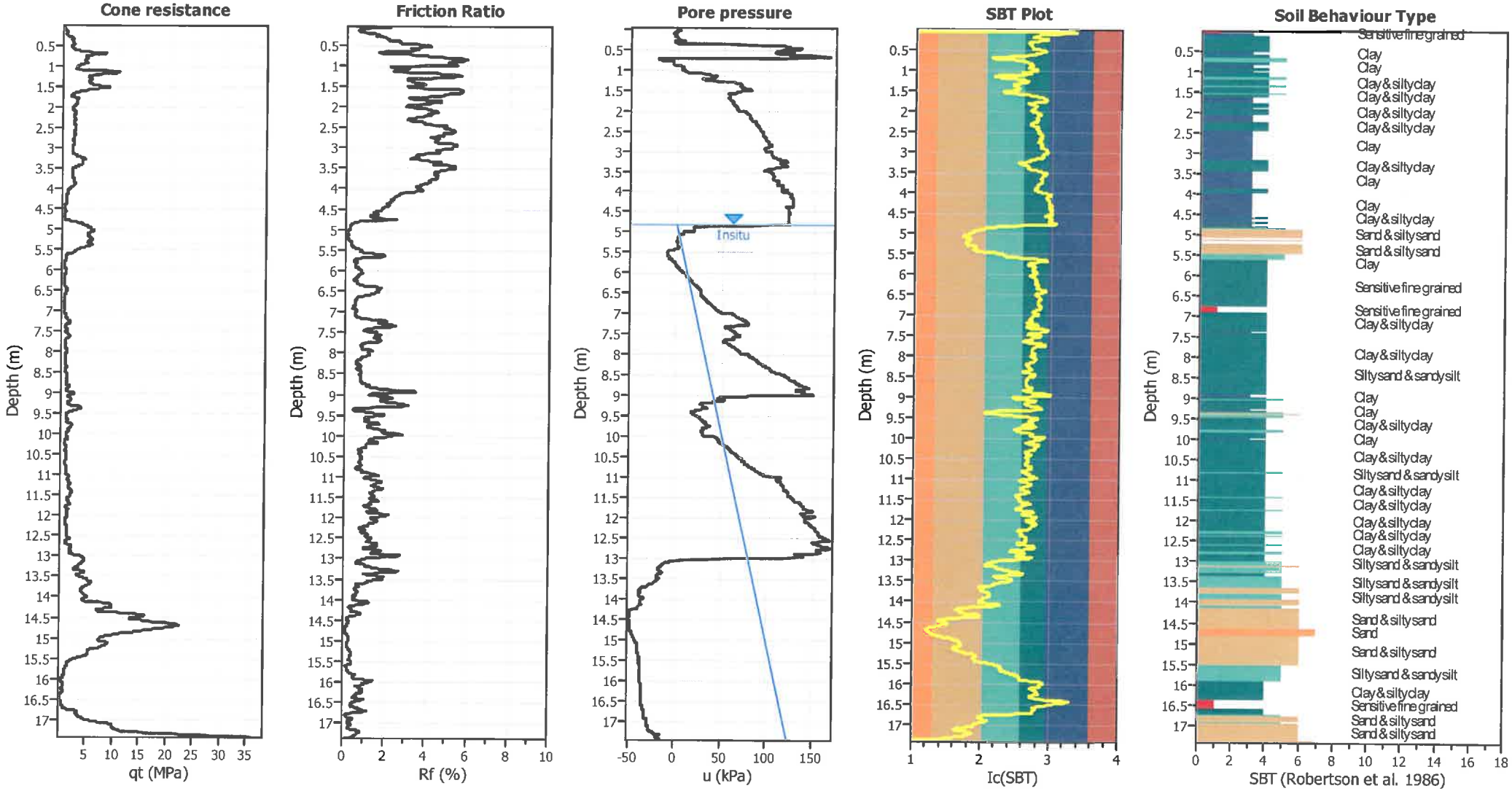
Description of Soil	Soil Symbol	Depth (m)	SPT	Undrained Shear Strength (kPa) 50 100 150
SPT NO RECOVERY		9.5	NKI	
EOB@ 9.5m : TARGET DEPTH				

EXCAVATION METHOD: 100mm ϕ MACHINE AUGER & HOLLOW SPT

Appendix Five

Liquefaction Analysis Plots

CPT basic interpretation plots



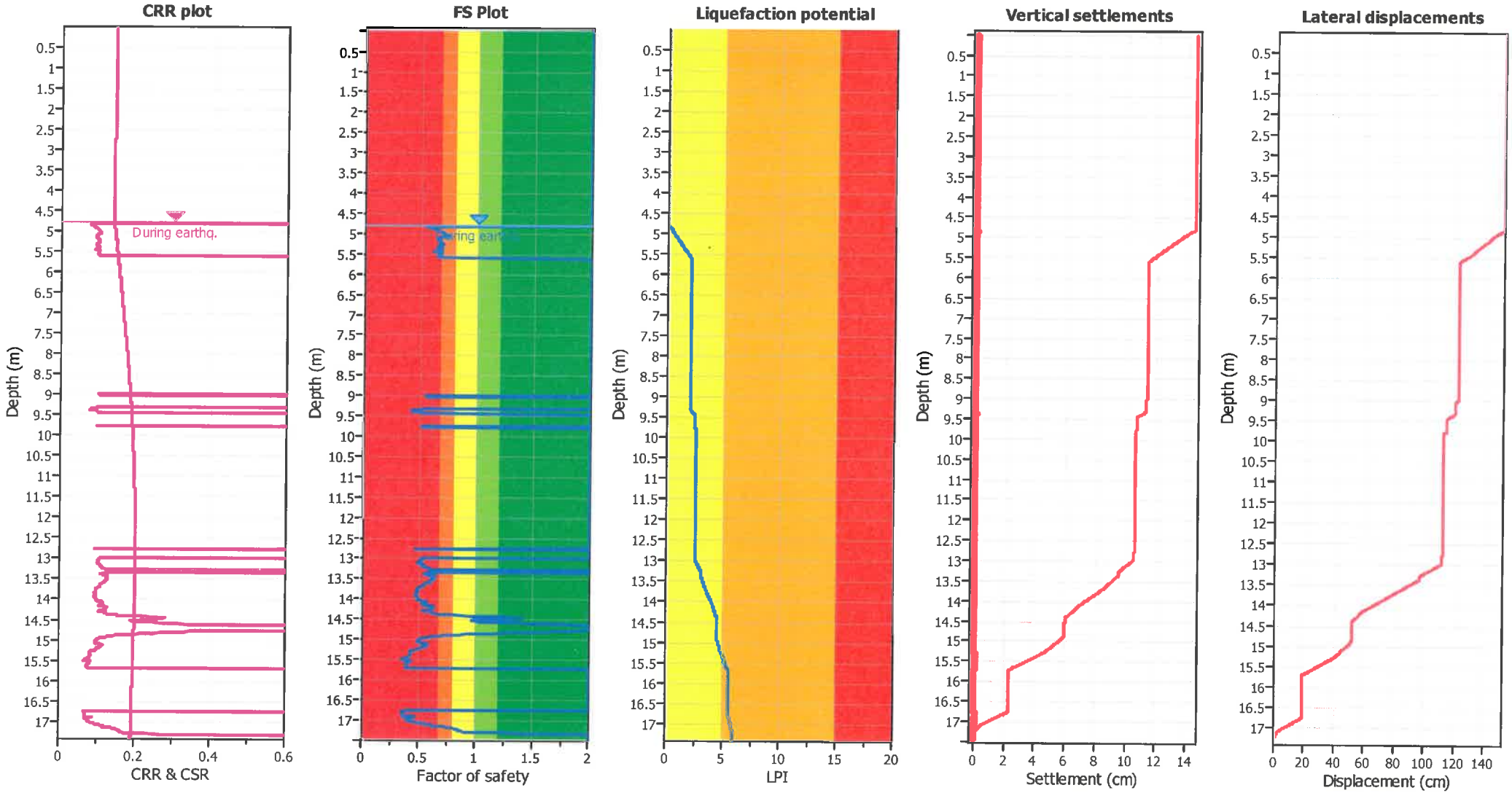
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.80 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.22	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	4.80 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



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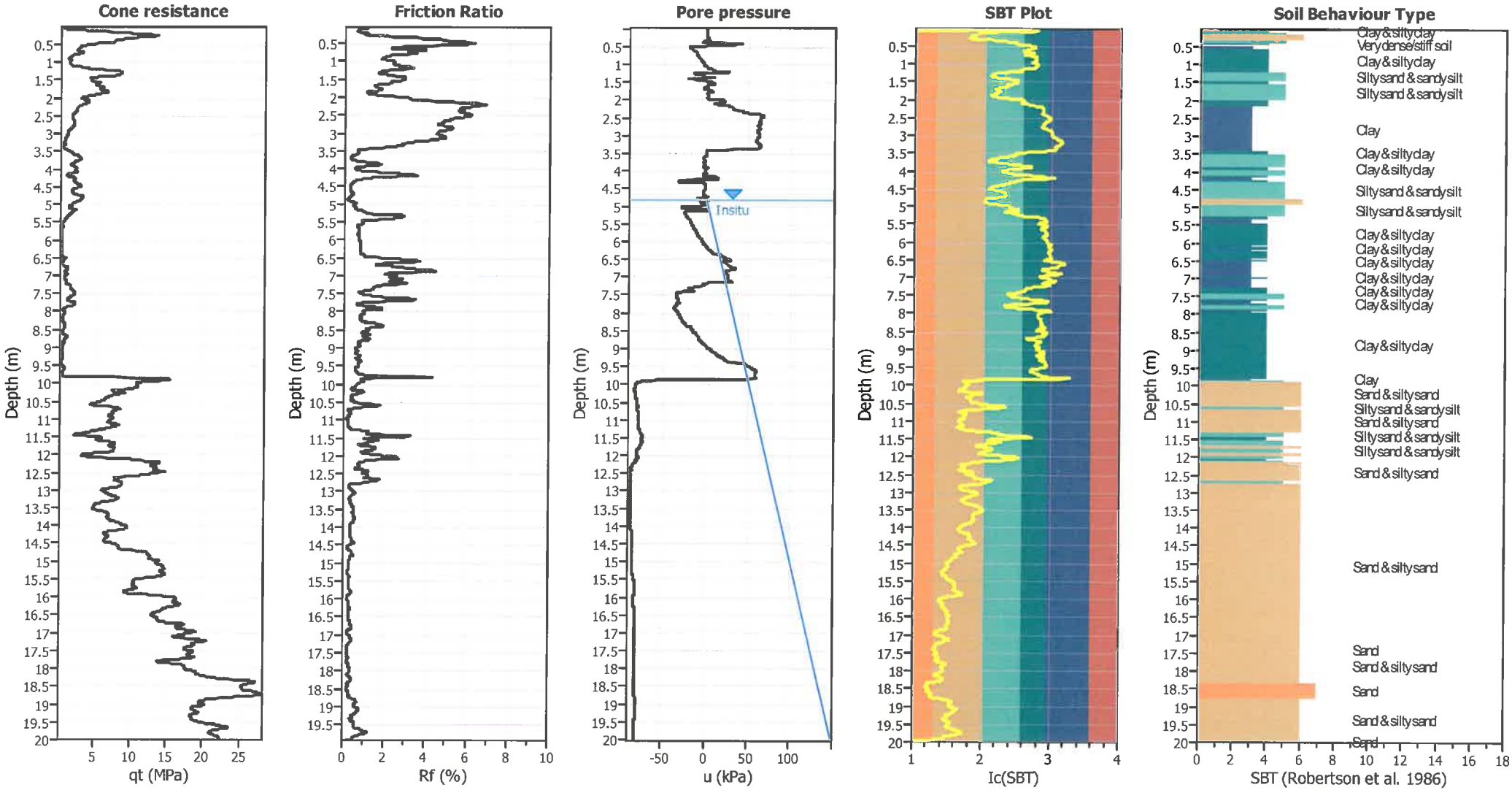
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liquefaction are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



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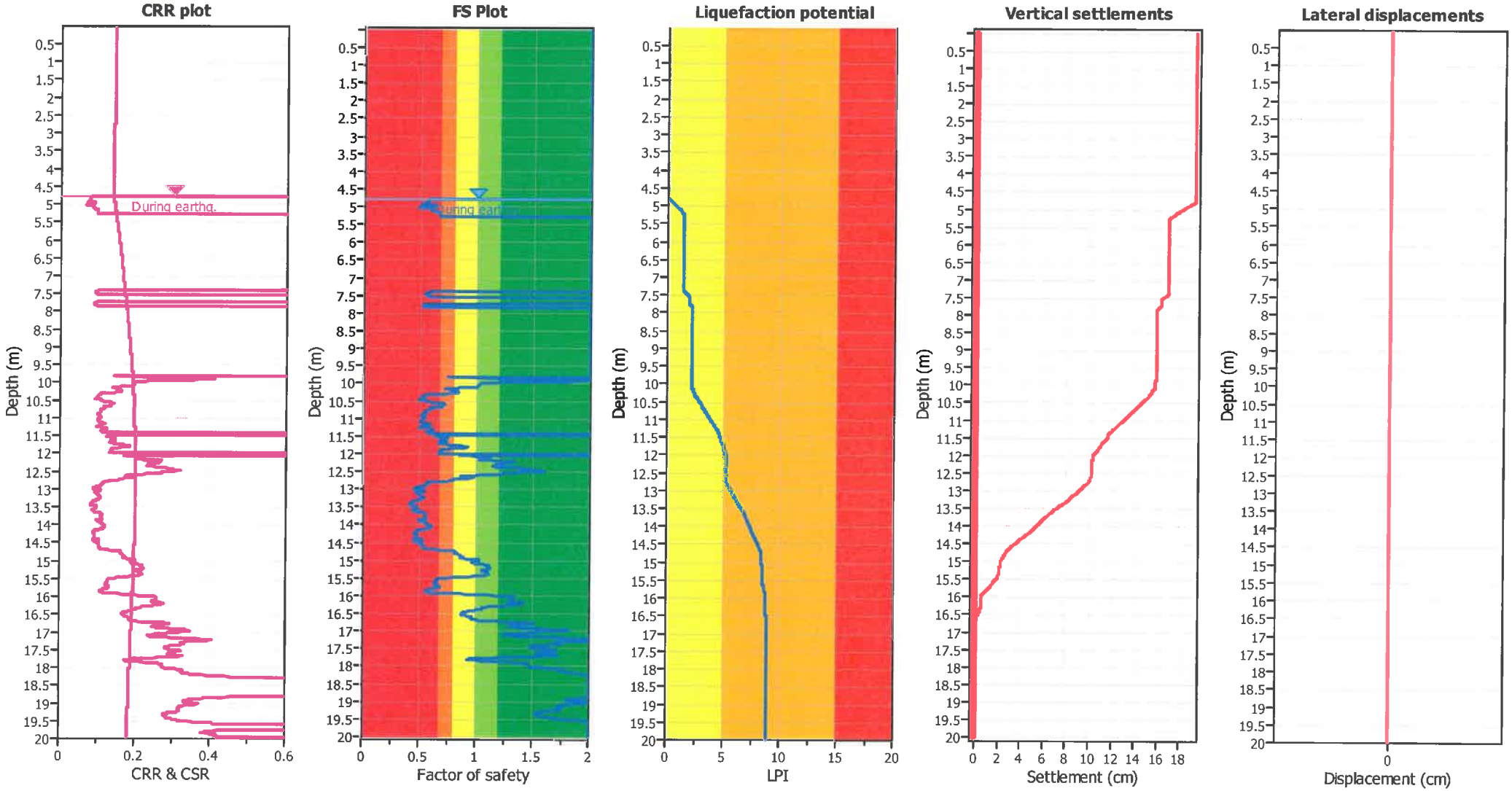

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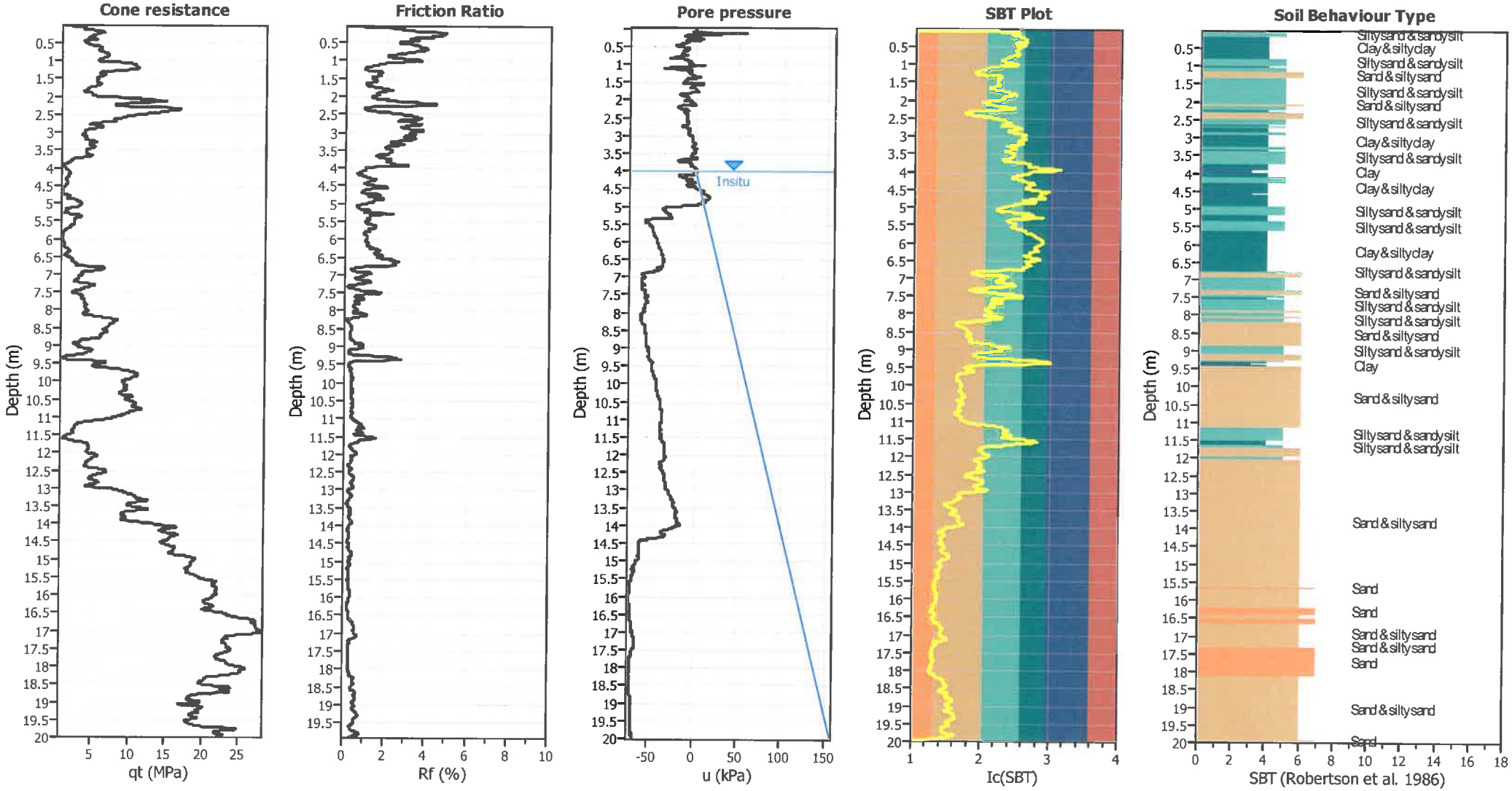

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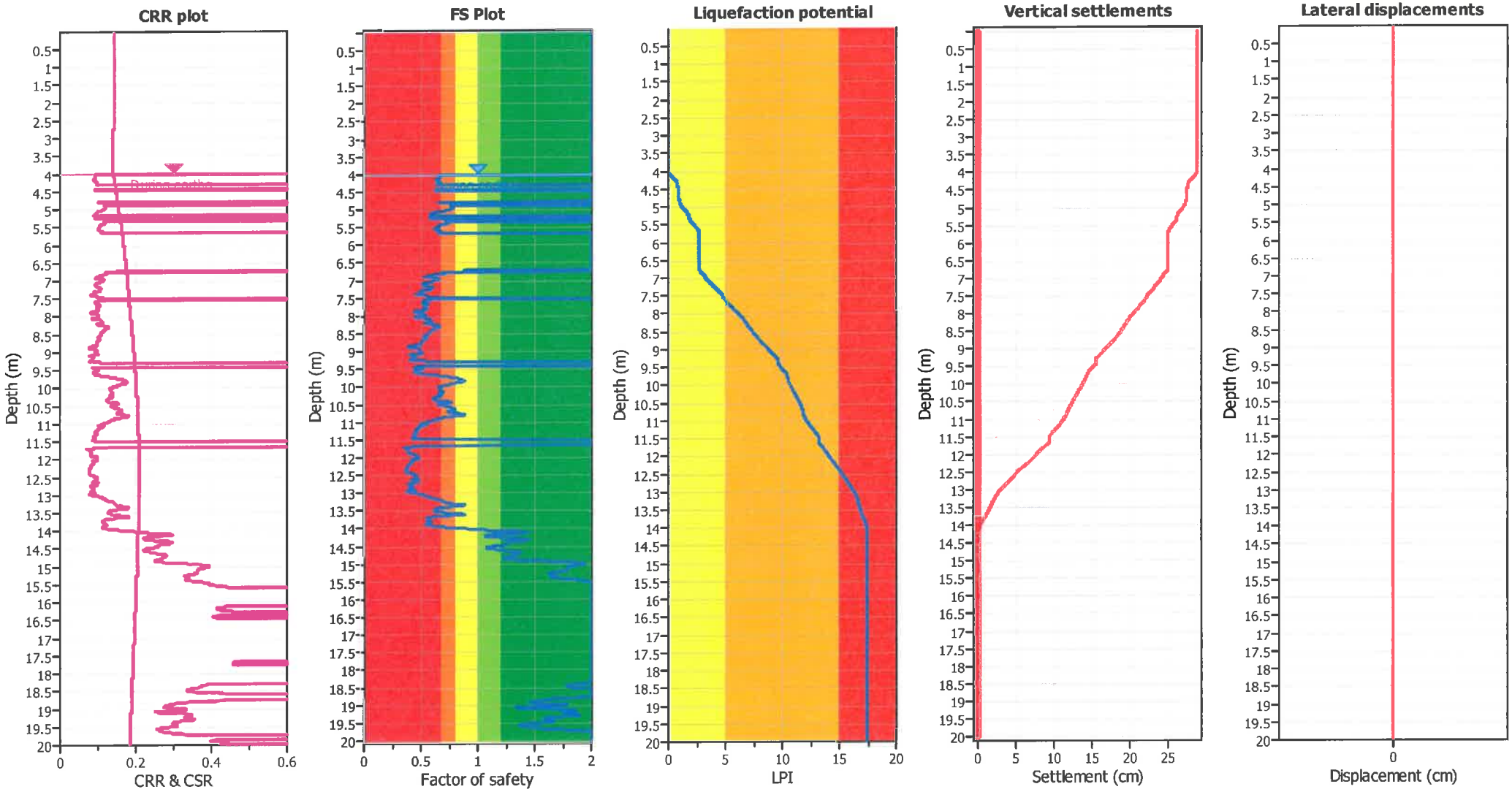

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