

23 January 2015

Our Ref: 45095-GEO4-Rev A

Lot 6 is 6 Wenz Bayer Road
Information in relation to other lots has been deleted

**RE: WENZ BAYER ROAD, PUHOI
GEOTECHNICAL REPORT FOR SUBDIVISION (LOTS 2 TO 6)**

1.0 INTRODUCTION

Engineering Design Consultants Ltd (EDC) has been requested to undertake a geotechnical investigation to assess potential building platform locations for a potential subdivision. The initial investigation for all 15 potential building platforms was included in our report "Wenz Bayer Road, Puhoi, Geotechnical Investigation" ref 45095-GEO3, dated 17/12/2014. That report detailed generic information for the site but did not make recommendations for individual lots as the decision had not been made regarding which potential lots would be included in the subdivision. Initial slope stability analysis of the 15 potential building platforms was then undertaken (Sections A-J inclusive). After this further assessment and discussion with the client, we have prepared this report to cover five of the potential lots. See attached drawing 45095/G01.

Please refer to our previous report for further details of the investigation. This report will discuss the geotechnical conditions, slope stability analyses and recommendations for Lots 2 to 6 only. The proposed subdivision scheme plan by Cato Bolam is included in Appendix A.

6.0 LOT 6

6.1 Site Description

The proposed building platform for Lot 6 is located on a shallow sloping ledge extending out into a ridge below a steep bank (approx. 29°) from Wenz Bayer Road onto the site. An overland flow path runs east from south of the potential building platform, and some marsh reeds were observed on the platform, possibly identifying poor drainage or springs.



Figure 5: Proposed area of Lot 6 building platform.

During the site investigation, exploratory holes HA24 and HA25 were undertaken in the area of the proposed building platform.

6.2 Subsoil Conditions

The site is generally covered with a 0.2m thick layer of topsoil underlain by >4.0m of residually weathered Pakiri Formation soils consisting of interbedded very stiff silt with variable clay content and medium dense sand with variable silt content. The majority of the shear vane tests recorded a shear strength of 40-130kPa, with an average shear strength of 83kPa.

Groundwater was encountered at a depth of 2.9m and 3.5m bgl in the exploratory holes for this potential lot.

Copies of the exploratory hole logs are included in Appendix B.

6.3 Slope Stability Analysis

6.3.1 Visual Assessment

The site is located towards the top end of a ridge which extends to the east below a steep slope (approximately 29°) from Wenz Bayer Road. The area of the proposed

building platform slopes to the northeast at approximately 14°, and the slope below (off the ridge) increases to approximately 21°.

There are no indications of any existing deep seated slope instability in the area of the proposed building platform. There is some indication of shallow soil creep on the ridge slopes.

6.3.2 Slope Stability Analysis

The slope stability of the site has been analysed using Slide v6.0 by Rocscience. Contours from the Auckland Council's GIS system have been used for this preliminary assessment of the slope. The slope is labelled Section J of the initial analyses we have undertaken.

The slope stability of the site has been carried out by adopting the following soil parameters based on the site investigation and our experience with similar materials:

Table 9: Adopted Soil Parameters for Slope Stability Analysis

Material	Unit Weight γ (kN/m ³)	Apparent Cohesion c' (kPa)	Internal Friction Angle Φ' (degree)
Topsoil	18	3	28
Firm silt	18	3	28
Stiff silt	18	5	30
Very stiff silt	18	7	32
Competent material	20	Infinite Strength	

Table 10: Summary of Slope Stability Analysis Results

Analysis name	Analysis Description	GWT depth range (m bgl)	FoS	Minimum Allowable FoS
Section J - Existing Slope	Existing slope profile	3.5-4.0	1.6	1.5
Section J - Proposed Development	Existing slope profile with the proposed building platform loads	3.5-4.0	1.6	1.5
Section J - Saturated	Proposed development with extreme groundwater scenario (raised groundwater level and saturated topsoil)	2m	1.4	1.3

Notes: FoS = Factor of Safety

Minimum allowable factor of safety for slope stability under **normal** GWT conditions = 1.5

Minimum allowable factor of safety for slope stability under **saturated** GWT conditions = 1.3

The location of the analysed cross-section and our analysis results are attached in Appendix C.

Generally for slopes supporting buildings, the acceptable minimum factors of safety are 1.5 under normal groundwater condition and 1.3 under extreme groundwater condition.

Our slope stability analyses suggest that the slopes supporting and above the proposed building platform can meet these requirements.

6.4 Site Access

The scheme plan indicates that access is likely to be from some point along Wenz Bayer Road or Krippner Road, as no Right of Way easement has been allowed for. The slope down from Wenz Bayer Road directly above the site is considered to be too steep to provide safe access.

6.5 Recommendations

6.5.1 Foundations

The site is generally suitable for NZS3604:2011 type foundations except due to potential for shrinkage and swelling, the soil lies outside of the definition of "good ground" as defined by NZS3604:2011. Foundation depths shall be min. 600mm below cleared ground level or in accordance with AS2870:2011 **Class M**. We consider the site is suitable for following type of shallow foundations:

- Continuous strip or pad foundations
- Slab-on-grade
- Waffle (Rib-raft) slab foundations

Or

- Piled foundations at a minimum depth of 2.5m bgl.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Slope Stability

The slope stability analyses detailed above indicate that the proposed building platforms for Lots 2 to 6 have a sufficient Factor of Safety to conclude the following:

- The proposed building platform locations on Lots 3 to 6 are considered to be supported by stable ground. No additional ground improvements are required.
- The proposed building platform location on Lot 2 is considered to be supported by stable ground however, it is considered necessary that a Building Restriction Line is located a minimum of 10m from the crest of the steeply sloping ground, as identified on Drawing 45095/G02.
- Earthworks cutting into the upper slopes (retained by specifically engineer designed retaining walls) would usually reduce the load on a slope, and therefore would be unlikely to adversely affect the stability of the slope. However if a major cut (>1m) is proposed at the toe of a slope, the slope stability must be reviewed by a CPEng geotechnical engineer.

- Filling greater than 0.5m high is not allowed without specific engineering design and review of the slope stability.

The contours for the slope stability analyses were taken from Auckland Council's GIS, which is based on Lidar readings. As such, these may be incorrect. Survey of individual lots will be required to confirm the topography. If confirmed contours vary from those used for this investigation, EDC should be informed and provided the opportunity to update this report.

7.2 Foundations

For shallow foundations, all topsoil/organic material/soft spots below the building platform shall be removed and replaced by well compacted GAP40 to the required ground formation level. A geotechnical ultimate bearing capacity (unfactored) of 300kPa may be assumed for shallow foundations on the natural stiff to very stiff silt and medium dense sand (i.e. following application of the strength reduction factor $\Phi = 0.5$, a dependable bearing capacity of 150kPa will be available).

The following pile design parameters may be used for piled foundations:

Ultimate end bearing capacity (unfactored)	720kPa from 900mm bgl on Lots 2 to 5 and 2.5m on Lot 6
Skin friction (unfactored)	20kPa ignoring top 600mm
Minimum founding depth	900mm on Lots 2 to 5 and 2.5m on Lot 6

The natural stiff to very stiff silt will in our opinion exhibit only low compressibility under the relatively light foundation loads associated with residential development undertaken in accordance with the requirements of NZS 3604:2011. Settlement of foundations in this material should most likely be within accepted limits, provided that the inspection and design of foundations are carried out in accordance with the requirements of NZS3604:2011 and the recommendations made in this report.

7.3 Site Access

Civil engineering works will be required to finalise the access routes to each proposed site from either Krippner Road or Wenz Bayer Road.

7.4 Retaining Walls

Retaining walls are likely to be needed during development of these sites. When retaining structures are proposed, EDC should be contacted to provide additional specific advice in relation to the design of these walls.

7.5 Earthworks

Earthworks (either cut or fill) may be required to create a larger reasonably flat building platform area. In this case, further geotechnical advice should be sought to ensure stability of the building platform is maintained as well as provide advice.

7.6 Construction Inspections

It is recommended that a Chartered Professional Engineer with appropriate geotechnical experience and who is familiar with this report is appointed to supervise the site works. Where site conditions are different from those anticipated from the visual and exploratory holes, EDC should be contacted so that an appropriate solution can be suggested along with confirming the applicability of the design to the site.

For any strip or pad, slab-on-grade or waffle-slab type foundations, all subgrade (removal of topsoil to suitable original ground) and subbase (compacted GAP40 formation to underside of slab) shall be inspected by a Chartered Professional Engineer familiar with the findings of this report

For piled foundations, all drilled holes (for bored piles) or pile driving sets (for driven piles) shall be inspected by a Chartered Professional Engineer familiar with the findings of this report.

7.7 Stormwater

Civil engineering design will be required to confirm the volume of stormwater requiring disposal (dependant on the proposed area of impermeable surfaces and overflow for the individual house plan). Stormwater collected from roofs should be used for domestic purposes. Stormwater from impermeable surfaces and overflow from domestic tanks shall be collected and disposed of to appropriate points in accordance with Council requirements. These points shall be protected from erosion due to the concentrated discharge of water, usually by the use of spreader bars. It is considered likely that there is sufficient space on each lot to provide adequate stormwater disposal, although further calculations will be required to confirm this following finalisation of the house plans for each lot.

7.8 On-Site Wastewater Disposal

It is proposed that each individual lot utilises on-site disposal for the generated wastewater. We consider there is likely to be sufficient space available on each lot for both main and reserve on-site wastewater disposal fields, in accordance with Auckland Council's TP58. Further calculations will need to be undertaken to confirm this following finalisation of the house plans for each lot.

There are a number of aspects of both the treatment process and the disposal system that must be given appropriate consideration in the context of this development. Of key significance is the potential for contamination of the streams adjacent to the site, overland flow and any potential high groundwater level. This will need to be addressed during detailed design of the individual disposal system.

REPORT PREPARED BY:

Christina McPherson
BEng(Hons) GIPENZ MEIANZ
Geotechnical Engineer

REPORT CHECKED BY:

Gareth B Williams
CP Eng IntPE(NZ) MIPENZ
MAusIMM AMIoD MEIANZ
Snr Geotechnical Engineer, Director

8.0 LIMITATIONS

Except where required by law, the findings presented as part of this report are for the sole use of our client, as noted above. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses.

Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report; in regard to its accuracy or completeness.

The recommendations and opinions contained in this report are based on our visual reconnaissance of the site, information from geological maps and upon data from the field investigation as well as the results of in situ testing of soil. Inferences are made about the nature and continuity of subsoils away from and beyond the exploratory holes which cannot be guaranteed. The descriptions detailed on the exploratory hole logs are based on the field descriptions of the soils encountered. Slope stability analysis contours are based on Auckland Council GIS contours, which are taken from Lidar readings which are possibly incorrect.

This report has been prepared for the particular project described to us and no responsibility is accepted for the use of any part of this report in any other context or for any other purposes. Except as required by law, no third party (excluding the local authority) may use or rely upon this report unless authorised by EDC in writing. To the extent permitted by law, EDC expressly disclaims and excludes liability for any loss, damage, cost or expense suffered by any third party relating to or resulting from the use of, or reliance upon any information contained in this report. It is the responsibility of third parties to independently make enquiries or seek advice in relation to their particular requirements.

No other warranty, expressed or implied, is made as to the professional advice included in this report. Our opinions and recommendations are based on our comprehension of the current regulatory standards and must not be considered legal opinions. For legal advice, please consult your solicitor. This opinion is not intended to be advice that is covered by the Financial Advisors Act 2010.

This report includes the following Appendices:

Appendix A – Proposed Subdivision Scheme Plan

Appendix B – Exploratory Hole Logs

Appendix C – Slope Stability Results

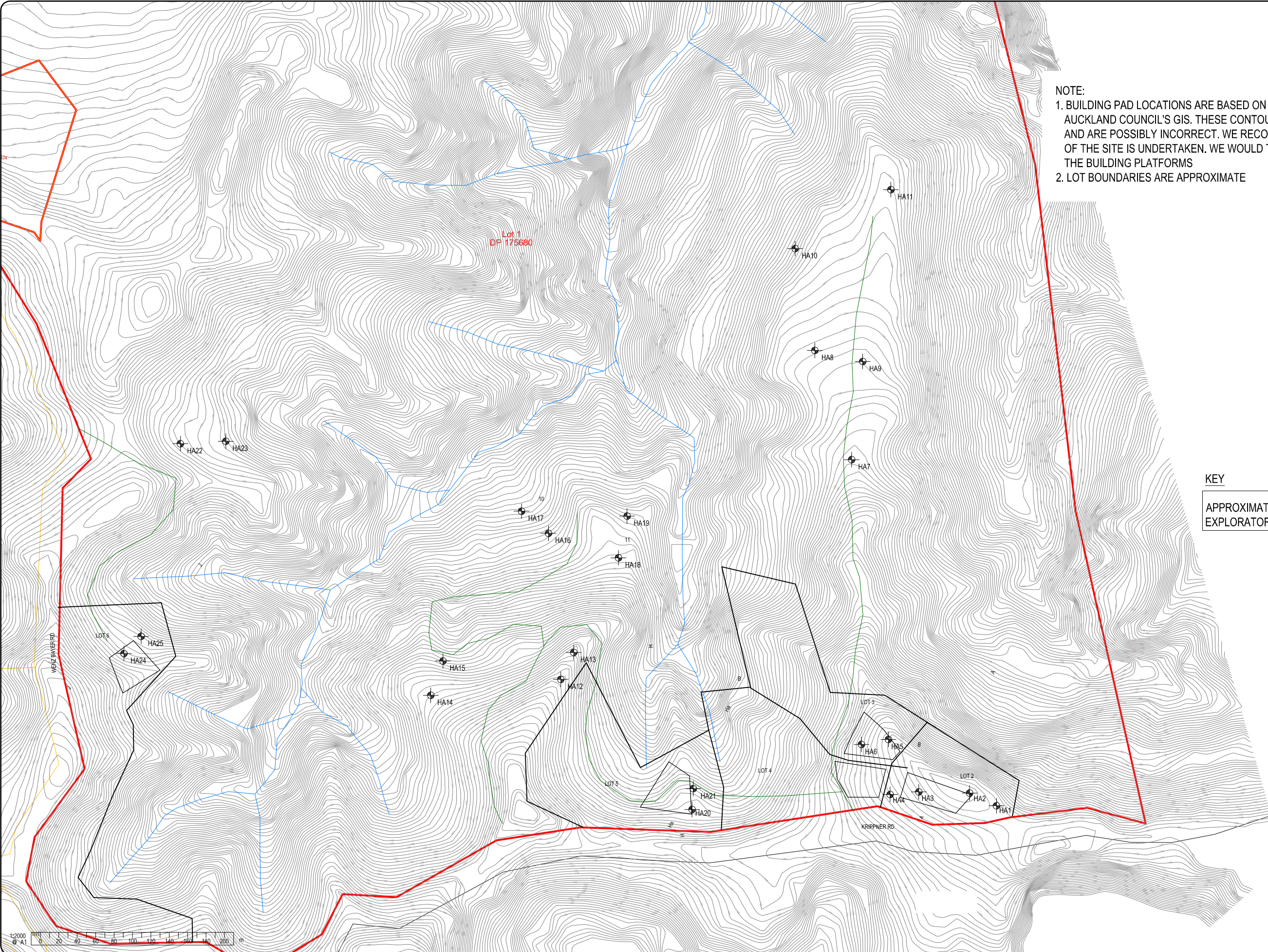
These Appendices should be read in conjunction with the main part of the report and this report should not be considered complete without them.

APPENDIX A

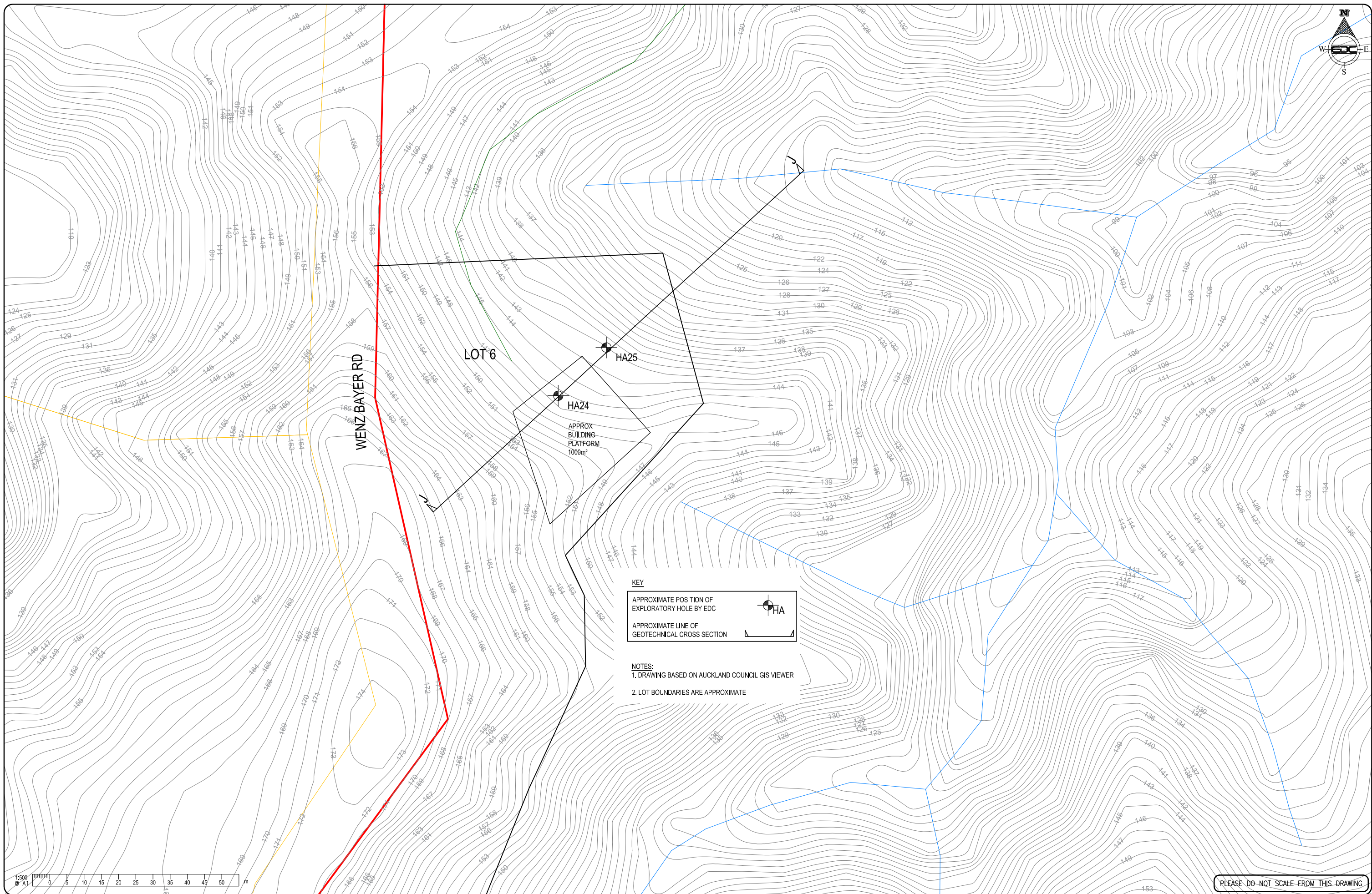
PROPOSED SUBDIVISION SCHEME PLAN

APPENDIX B

EXPLORATORY HOLE LOGS



PROJECT	45095	DRAWING	G01	REVISION	.
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.	AS DATED	PRELIMINARY ONLY	--	--	
	DATE	REVISION	BY	CHK	



PROJECT:

**PROPOSED SUBDIVISION
WENZ BAYER RD, PUHOI
FOR CHRIS MAIN**

DRAWING TITLE:

EXPLORATORY HOLE LOCATION PLAN - LOT 6

DESIGNED	CMcP
DRAWN	SG
REVIEWED	GBW
DATE	DEC 2014

A1 SCALE	1:500
A3 SCALE	1:1000
PAPER SPACE SIZE 1:1 @ A1	

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DEPTH (m)	SOIL DESCRIPTION	Strength/density, colour, structure, minor, MAJOR, plasticity, moisture content, other comments	LEGEND	GROUND WATER	SHEAR STRENGTH (kPa) ○ Residual ● Peak	SOIL SENSITIVITY	SCALA BLOWS (PER 50 mm)
GL					40 80 120 160		5 10 15
	TOPSOIL		TS				
	Very stiff, pale grey, mottled orange, clayey SILT, non-friable, moist (Pakiri Formation)					1.8	
	patches of brown						
1	pale grey, streaked orange, occasional rootlets						
	orange, mottled pale grey, moist/very moist					3.4	
	pale grey, streaked orange, cohesive, occasional small pockets of sand and fine gravels					2.1	
	slightly sandy						
2	pale grey, trace orange, very moist/wet, slightly friable					1.9	
	some silt nodules						
	'Medium dense' pale grey, SAND, very moist (Pakiri Formation)					5.9	
	pockets of limonite sand and fine gravels						
3	much limonite sand and fine gravels					5.2	
	Very stiff, orange/dark orange, SILT, pockets of limonite sands and fine gravels (Pakiri Formation)						
	End of Hand Auger (Target Depth)						
4							

EOH @ 4.50 m

NOTES:

GROUNDWATER WAS ENCOUNTERED DURING DRILLING

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www.edc.co.nz
team@edc.co.nz

1st FLOOR, UNIT 1, 100 BUSH ROAD,
ALBANY, AUCKLAND
PO BOX 118 ALBANY, AUCKLAND 0755

PH (09) 451 9044
FAX (09) 415 1280

1st FLOOR, UNIT 1, 100 BUSH ROAD,
ALBANY, AUCKLAND

PH (09) 451 9044



DRILLED: 18/11/2014 FILE: 45095

HAND AUGER NO.:

HA25

SHEET 1 OF 1

PROJECT: PROPOSED SUBDIVISION

CLIENT: CHRIS MAIN

ADDRESS: WENZ BAYER ROAD, PUHOI

LOGGED

SG

PROCESSED

DM

CHECKED

CMcP

BH LOCATION: COORDS: 1744277mE, 5955622mN

RL GROUND:

SHEAR VANE ID#:

266

DEPTH (m)	SOIL DESCRIPTION	Strength/density, colour, structure, minor, MAJOR, plasticity, moisture content, other comments	LEGEND	GROUND WATER	SHEAR STRENGTH (kPa)				SOIL SENSITIVITY	SCALA BLOWS (PER 50 mm)		
					40	80	120	160		5	10	15
GL					○ Residual	● Peak						
1	TOPSOIL		TS									
	Very stiff, yellowish orange, clayey SILT, friable, moist (Pakiri Formation)							5.1				
	trace white											
	slightly sandy							3.1				
	pale grey, trace orange, tree rootlets							2.9				
2	'Medium dense', pale grey/orange, SAND, slightly moist (Pakiri Formation)											
	Very stiff, pale grey, SILT, slightly moist (Pakiri Formation)							3.1				
	alternating 100 mm layers of silt and sand sand is dilatant, silt is wet and friable							4.5				
3	occasional silt nodules							3.5				
	pockets of limonite sand and fine gravels											
	very moist/wet							3.0				
	speckles of black ash (sand)											
4	'Medium dense', orange, silty SAND, much fine gravel, friable, wet (Pakiri Formation)							5.3				
	End of Hand Auger (Target Depth)							5.4				

EOH @ 4.90 m

NOTES:

GROUNDWATER WAS ENCOUNTERED DURING DRILLING

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FIRE ENGINEERSwww.edc.co.nz
team@edc.co.nz1st FLOOR, UNIT 1, 100 BUSH ROAD,
ALBANY, AUCKLAND
PO BOX 118 ALBANY, AUCKLAND 0755PH (09) 451 9044
FAX (09) 415 12801st FLOOR, UNIT 1, 100 BUSH ROAD,
ALBANY, AUCKLAND

PH (09) 451 9044

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APPENDIX C

SLOPE STABILITY ANALYSIS RESULTS

