M & B FRIZELL

355 DRURY HILLS ROAD, DRURY, AUCKLAND

GEOTECHNICAL ASSESSMENT FOR A PROPOSED DWELLING

REF: R2129-2A
DATE: 21 SEPTEMBER 2017

GCL
Ground Consulting Ltd

REPORT QUALITY CONTROL

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REPORT TITLE		GEOTECHNICAL ASSESSMENT REPORT FOR A PROPOSED DWELLING		
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REV	DATE	REVISION STATUS	AUTHOR	REVIEWER
A	21 SEPTEMBER 2017	ISSUED TO CLIENT	KEVIN HIHA	FRASER WALSH
APPROVAL				
AUTHOR SIGNATURE			REVIEWER SIGNATURE	
NAME		KEVIN HIHA	NAME	FRASER WALSH
TITLE		ENGINEERING GEOLOGIST	TITLE	PRINCIPAL GEOLOGIST

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

A geotechnical assessment has been undertaken by GCL for a proposed dwelling at 355 Drury Hills Road, Drury at the request of the client M & B Frizell. The site location is presented in Drawing 001.

This geotechnical assessment has been prepared for the purpose of obtaining a building consent with Auckland Council.

This report includes a summary of the investigations undertaken and provides an assessment of:

- Ground conditions.
- Groundwater conditions.
- Building platform stability.
- Foundation conditions.
- Surface water management.
- Other pertinent constraints and issues identified with the site.

1.2 PREVIOUS INVESTIGATIONS

GCL has previously conducted an investigation for a proposed house site located in the vicinity of the proposed dwelling (report ref: R2129-1A, dated 31/10/2015). The previous geotechnical report has provided the basis for the recent geotechnical assessment undertaken.

1.3 CURRENT GEOTECHNICAL INVESTIGATIONS

The investigations undertaken as part of this assessment have consisted of:

- Desktop study of the site including:
    - Published Geology.
    - Historic Aerial Photographs.
    - Google Earth Imagery.
    - Walking Access Mapping Systems.
    - Auckland Council GeoMaps.
- Site mapping and reconnaissance by an Engineering Geologist.
- Completion of six Scala Penetrometers in the vicinity of the proposed dwelling to refusal.

The investigations have been carried out in accordance with NZS3604:2011 and the Building Code. The investigation locations are shown on Drawing 002.

1.4 PROPOSED SITE DEVELOPMENT

The proposed site development will likely comprise the formation of a level building platform for a proposed dwelling located within the central portion of the property. The proposed dwelling will be accessed via. a driveway off Drury Hills Road.

The proposed dwelling consists of a one storey light weight structure with cantilevered concrete perimeter walls and internal timber framing. It is anticipated that the dwelling will be founded on a reinforced concrete floor slab with shallow foundations.

2 SITE CONDITIONS

2.1 SITE LOCATION

The site is situated within Drury of the Auckland Region, located 2.5km south east of Drury Village. The property is accessible off Drury Hills Road.

The property is currently surrounded by farmland and rural lifestyle development.

A site location map is presented on Drawing 001.

2.2 SITE SERVICES

GCL has not undertaken any specific searches of the site utilities and services for the purpose of this report. However, at the time of our site investigation, there was no evidence of any buried services in the immediate vicinity of the proposed dwelling.

2.3 SITE TOPOGRAPHY AND EARTHWORKS

The proposed dwelling is located within an old greywacke aggregate quarry. The quarry consisted of a series of cut platforms and benches with intermediary batters between 3m and 8m high. The quarry was accessed via. a metal driveway off Drury Hills Road which is located to the west of the site.

The old quarry has been landscaped in 2015 in order to tidy up the quarry site. The works have consisted of the following:

- Fill has been placed along the series of quarry batters in order to provide grades of no steeper than 1(v) on 2(h). The fill has been placed to a maximum depth of 2.0m for landscaping purposes and has been sourced from on-site batter trimmings. The fill has been topsoiled and planted on the upper batter and only topsoiled on the lower batters.
- Fill has been placed along the northern side of the access driveway within the north-western portion of the property. The fill has been placed to a maximum depth of 3.0m for landscaping purposes and has been sourced from on-site batter trimmings. The fill has been topsoiled and grassed.
- The southern potion of the upper-most quarry batter has been re-aligned and trimmed. This has enlarged the upper platform in the vicinity of the proposed dwelling.
- The access-driveway has been re-metaled to provide access to the upper quarry platform in the vicinity of the proposed dwelling.

- A lower platform has been formed and metaled. The platform is partially retained around the southern edge with a series of concrete blocks. This platform will not be utilized as part of the proposed development.

2.4 SITE SURFACE WATER FEATURES

The site contains no surface water features in the general vicinity of the proposed dwelling. This is in agreement with the Auckland Council GeoMaps and Google Earth.

2.5 SLOPE INSTABILITY FEATURES

The cut batters in the vicinity of the proposed dwelling do not contain any slope instability features. Although, some loose soil and rock has been observed.

The aforementioned, very steep slopes which run down to a gully feature exhibit a shallow regolith type slope instability feature associated with soil creep to an observed depth of less than 0.5m. The instability is typically located along the break of slope where recent slip feature's/regression of the slope was recorded. The slope instability is located at least 15m from the proposed dwelling.

The very steep slopes did not contain any visible signs of deep-seated and/or large-scale slope instability features.

3 GROUND CONDITIONS

3.1 PUBLISHED GEOLOGY

The Geological Map of New Zealand, Sheet 3, at a scale of 1:250,000 maps the site as being underlain by the Waipapa Group. The Waipapa Group consists of massive to thin bedded, lithic volcaniclastic metasandstone and argillite, with tectonically enclosed spilite, chert and red and subsidiary rocks argillite chert spilite.

3.2 SUB-SURFACE INVESTIGATIONS

Sub-surface investigations have been undertaken in the vicinity of the proposed dwelling. The sub-surface investigations have comprised of six Scala Penetrometer tests to a maximum depth of 2.0m with all being taken to refusal. Four Scala penetrometer tests have been undertaken in the vicinity of the proposed dwelling as part of the previous geotechnical assessment undertaken by GCL (report ref: R2129-1).

The investigation logs are presented in Appendix A.

3.3 SUB-SURFACE CONDITIONS

A summary of the sub-surface conditions identified in the investigations undertaken is presented below. The sub-surface conditions have been extrapolated between the investigations undertaken. Whilst care has been taken to provide sufficient sub-surface information following best practice for the purposes of building consent, no guarantee can be given on the validity of the inference made.

3.3.1 Fill

Fill has been placed along the quarry batter forming the northern edge of the proposed building platform. The fill consists of residual greywacke bedrock soil which has been sourced from onsite trimmings of quarry batters. The fill is up to 1.0m thick along the immediate edge of the batter but may be up to 1.5m thick in places.

The fill is considered to be for landscaping purposes and not suitable for conventional residential building foundations.

3.3.2 Waipapa Group

Weathered soil derived from the Waipapa Group underlies the site.

The soil typically consists of weathered rock, with most of the residual soil excavated from the existing platform.

Scala penetrometer testing undertaken provided a blow count of between 10 to 30 per 100mm, with the blow count increasing significantly with depth. This correlates to a dense to very dense material. Similar strength soil underlies the fill placed along the batter on the northern edge of the building platform.

4 GROUNDWATER CONDITIONS

Groundwater was not encountered within any of the investigations undertaken indicating a coherent and perched groundwater depth of at least 1.5m from existing ground level in the vicinity of the proposed dwelling. This is consistent with the elevated nature of the site relative to local surface water and groundwater features.

Groundwater is susceptible to seasonal variations. The current measured groundwater during this investigation is indicative of early spring conditions. As such, it is feasible that groundwater levels may rise following a period of prolonged rainfall and during the winter months. Given the nature and topography of the site, it is unlikely, however, that a coherent groundwater table would rise significantly to the extent that it would interfere with shallow foundations.

5 BUILDING PLATFORM STABILITY

5.1 GENERAL

The assessed dwelling is shown on Drawing 002. The proposed dwelling is located predominately on a level terrace which is underlain by very competent ground conditions. The low overall slope angles and underlying competent ground conditions in the vicinity of the proposed dwelling should provide favourable overall slope stability conditions.

The northern edge and eastern corner of the proposed dwelling, however, encroach close to or on steep batters which have been mantled with landscaping fill. Any on-going consolidation and creep within the landscaping fill may affect building foundations and this is addressed in Section 5.2 of this report.

5.2 SLOPE STABILITY

As discussed in Section 5.1 of this report, the northern edge and eastern corner of the proposed dwelling encroach close to or on steep batters which have been mantled with landscaping fill. Any on-going consolidation and creep within the landscaping fill may affect building foundations and as such we recommend the following remedial measures be undertaken:

- The northern edge of the proposed dwelling facing the steep batter should be protected with an in-ground barrier pile retaining wall designed to withstand a soil instability depth of 1.0m from existing ground level. The extent of the buried retaining wall is shown on Drawing 002.
- Any landscaping fill placed on the dwelling side of the buried retaining wall should be removed and replaced with engineered fill as inspected and certified by a suitably qualified person.
- The northern barrier retaining wall can be incorporated into the proposed dwelling foundations (designed for a calculated k_o value) or constructed as a separate down-slope structure (designed for a calculated k_a value).
- The central portion of the dwelling which extends over the northern batter can be either cantilevered over the northern barrier retaining wall or be supported by piles designed to accommodate a soil instability depth of 1.5m from existing batter level.
- The batter located within 3m of the eastern corner of the dwelling should be retained with an engineered retaining wall to a minimum height of 1.5m as shown on Drawing 002.
- Parameters for the required engineered retaining wall design are provided in Section 6.6 of this report and should include a pile spacing of no more than three pile diameters.

All building platform development works should be in accordance with recommendations and constraints provided in Section 6 and 7 of this report in order to maintain existing safe and stable conditions.

6 FOUNDATION CONDITIONS

6.1 GENERAL

The proposed dwelling consists of a light weight single story timber framed structure with weatherboard and/or brick cladding. It is anticipated that the structure will be founded on shallow foundations.

As discussed in Section 5.1 of this report, the site is underlain by competent ground conditions. The competent ground conditions are considered to provide the following in regards to NZS 3604:2011:

- "Good ground" according to NZS 3604:2011 is achieved in terms of soil bearing capacity.
- "Good ground" according to NZS 3604:2011 is achieved in terms of overall slope stability conditions.

- "Good ground" according to NZS 3604:2011 **is not** achieved in terms of seasonal soil shrink/swell.

As such in accordance with NZS3604:2011, specific engineered foundation design is required. Sections 6.2 and 6.3 of this report provide recommendations for specific engineered foundation design.

Furthermore foundations require protection from slope instability features and this is addressed in Section 5.2 of this report.

6.2 SHALLOW FOUNDATION DESIGN PARAMETERS

6.2.1 General

To be compliant with ultimate limit state design methods outlined in AS/NZS 1170, this report provides ultimate bearing capacity values and a strength reduction factor in order to allow calculation of design foundation bearing capacity.

We have adopted a strength reduction factor of 0.5 (ie. a factor of safety of 2) which is in general accordance with the requirements of AS/NZS 1170.

We have also adopted a design c_u value of 100kPa which is based on the site specific testing undertaken.

6.2.2 Shallow Pad/Strip Footings

Table 1 outlines design bearing capacities for a shallow pad/strip footing solution. The design capacities are based on a minimum foundation embedment depth of 450mm from cleared ground level. The embedment depth requirement for this foundation will be subject to formal engineering design and in general accordance to AS 2870 which is outlined in Section 6.3 of this report.

TABLE 1: Shallow Pad/Strip Footing Design Parameters

LOAD CASE	DESIGN CU	ULTIMATE BEARING CAPACITY	STRENGTH REDUCTION FACTOR	DEPENDABLE BEARING CAPACITY
ULTIMATE LIMIT STATE DESIGN	100kPa	600kPa	0.5	300kPa

6.2.3 Shallow Pile Foundations

Table 2 outlines design bearing capacities for a shallow pile foundation solution for light weight timber structures and appurtenant structures. The design capacities are based on a minimum foundation embedment depth of 450mm from cleared ground level. The embedment depth requirement for this foundation will be subject to formal engineering design and in general accordance to AS 2870 which is outlined in Section 6.3 of this report.

TABLE 2: Shallow Pile Foundation Design Parameters

END BEARING CASE				
LOAD CASE	DESIGN CU	ULTIMATE BEARING CAPACITY	STRENGTH REDUCTION FACTOR	END DEPENDABLE BEARING CAPACITY
ULTIMATE LIMIT STATE DESIGN	100kPa	600kPa	0.5	300kPa
AUGURED PILE SKIN FRICTION				
LOAD CASE	DESIGN CU	-	STRENGTH REDUCTION FACTOR	DEPENDABLE SKIN FRICTION
ULTIMATE LIMIT STATE DESIGN	30kPa	-	0.5	15kPa

6.3 SOIL EXPANSIVENESS

The site soil is not considered to be expansive according to AS 2870 based on the logging of recovered hand auger bore core samples.

6.4 FOUNDATION CONSTRUCTION

We recommend that all foundation excavations are inspected by a suitably qualified person.

Care should be taken to ensure that all unsuitable material such as the topsoil layer, weak ground, areas of non-engineered fill and or hard spots are removed from the building platform prior to building construction. Where such material is excavated, this shall be replaced with suitably compacted granular material or 10MPa site concrete.

This includes landscaping fill located along the northern edge of the proposed building platform which should be removed and replaced with engineered fill as inspected and certified by a suitably qualified person.

6.5 FOUNDATION SERVICE BRIDGING

We recommend that where a service line and associated backfilled trench are located within a 45° loading line taken from the base of a load bearing structure foundation bridging is required.

Service line trenching and backfilling should be in accordance with recommendations provided in Section 7 of the report.

6.6 RETAINING WALLS

Engineered retaining walls will be required on site under the following circumstances:

- where the retention height is greater than 1.5m;
- where retaining wall supports any surcharged loads such as sloping ground and structure/traffic loads; and
- where retaining wall failure will affect the stability and integrity of adjacent structures and neighbouring properties.

We recommend the following geotechnical parameters for the engineered retaining wall design as required:

- Cohesion (c') = 5kPa
- Friction angle (ϕ') = 35°
- Undrained shear strength (c_u) = 100kPa
- Unit weight (γ) = 18kN/m3

Anchors (and soil nails) that may be installed into greywacke rock a bond value of 400kPa should be assumed, with a strength reduction factor of 0.5 for ultimate limit state design.

All retaining walls should be constructed with appropriate toe drainage and backfilled to their full height with lightly compacted free draining granular material or other appropriate drainage solution. Toe drainage should be discharged at a point that will not impact or influence the construction works on site or alternatively be connected to the reticulated stormwater system.

6.7 SEISMIC CONSIDERATIONS

Site investigations have identified dense to very dense soils associated with the Waipapa Group. As such, we consider the site sub soil class B is appropriate according to NZS1170.5.

7 SITE DEVELOPMENT CONSTRAINTS

7.1 TEMPORARY EARTHWORKS

The proposed site development works may require excavation and or temporary batters prior to the construction of formal retaining structures. As such, there is the risk of batter collapse during construction especially if left unsupported for an extended period of time and or left exposed during prolonged period of rainfall. Therefore, we recommend the following:

- Cut faces should not be left unsupported for a period in excess of three days and may require additional protection with polythene sheeting during inclement weather.
- Where excavations are immediately adjacent to or situated on a property boundary, then further precautions may be required to ensure stability through the construction of temporary buttressing. These works should be assessed and approved by a suitably qualified person.
- The contractor is expected to employ the appropriate plant and machinery to undertake the excavation and retaining wall construction.
- The contractor is responsible at all times to ensure that all necessary precautions are undertaken to protect exposed temporary batters.
- Appropriate silt and stormwater control measures should be employed.
- Any loose rock and soil located on the batters should be removed.

7.2 PERMANENT EARTHWORKS

We recommend the following constraints for the construction of permanent and long term site earthworks carried out the vicinity of the proposed dwelling:

- All unretained cut batters should be graded at no steeper than 1(v) on 2(h) and be no higher than 1.5m (ie. a maximum cut depth of 1.5m from existing ground level).
- Cut batters should be located at least the cut batter height from the dwelling and a property boundary.
- All unretained fill batters should be graded at no steeper than 1(v) on 2(h) and be no higher than 0.5m (ie. a maximum fill depth of 0.5m from existing ground level).
- Fill batters should be located at least the fill batter height from the dwelling and a property boundary.
- Fill providing structural support to the dwelling should be placed in an engineered manner as inspected and certified by a suitably qualified person.
- All cut and fill batters should be topsoiled & grassed and/or weed matted & planted on completion.
- Earthworks which does not comply with the above recommendations should be assessed by a suitably qualified person and may require retention and/or stabilization with an engineered structure.

7.3 SERVICES

We recommend that all underground services are backfilled with adequately compacted clay backfill to minimise the risk of significant trench consolidation and settlement.

Trench excavations should be shored or battered appropriately in accordance with the OSH/DOL Approved Code of Practice for Safety in Excavations and Shafts for Foundations (April 2000).

The contractor is expected to employ the appropriate plant and machinery to undertake the excavation and retaining wall construction.

8 STORMWATER MANAGEMENT

Stormwater disposal should be in compliance with the operative District & Regional Plans and the Building Code. In summary this requires the following:

- Hydrogeological neutrality should be provided on the property boundary and within receiving environments (such as overland flowpaths) with the addition of impervious surfaces. In addition, the disposal of stormwater should not provide a nuisance to neighbouring properties and public infrastructure.
- Stormwater should be managed in such a way as to avoid slope erosion, earthworks batters, retaining walls, building structures and effluent disposal areas.
- Stormwater should be managed in such a way as to have no significant effect on overall slope stability conditions.
- Stormwater should be directed to a public reticulated stormwater system where possible.
- Site development should be mindful of existing surface water features including overland flowpaths and appropriate remedial measures should be provided where required.

9 LIMITATIONS

9.1 GENERAL

Ground Consulting Ltd has undertaken this assessment in accordance with the brief as provided, based on the site and dwelling location, as shown on Drawing 002. This report has been provided for the benefit of our client, and for the authoritative council to rely on for the purpose of processing the consent for the specific project described herein. No liability is accepted by this firm or any of its directors, servants or agents, in respect of its use by any other person, and any other person who relies upon information contained herein does so entirely at their own risk.

The sub-surface conditions have been extrapolated between the investigations undertaken. Whilst care has been taken to provide sufficient sub-surface information following best practice, no guarantee can be given on the validity of the inference made and it must be appreciated that actual conditions could vary from the assumed model.

9.2 FURTHER INVESTIGATIONS REQUIRED

This assessment has been undertaken for the proposed site development to date. Any structural changes, alterations and additions made to the proposed development should be checked by a suitably qualified person and may require further investigations and analysis.

Geotechnical inspections will be required during construction to assess site slopes, foundation excavations, retaining walls and other geotechnical aspects of the development. This is to ensure ground conditions encountered are in accordance with the findings of this assessment. If ground conditions differ from those presented in this report, advice on design and construction modifications should be sought from a suitably qualified person.

DRAWINGS

GCL Ground Consulting Ltd

MILES & BROWYN FRIZELL

355 Drury Hills Road, Drury, Auckland

SITE LOCATION PLAN

Rev	Date	Status	Drafted	Reviewer
A	18/09/2017	Issued	K.H	F.W

File Ref. MAC://Projects_2000/2129/R2129-1/R2129-1-DRW001.cdr

Scale (A4) 1:20,000

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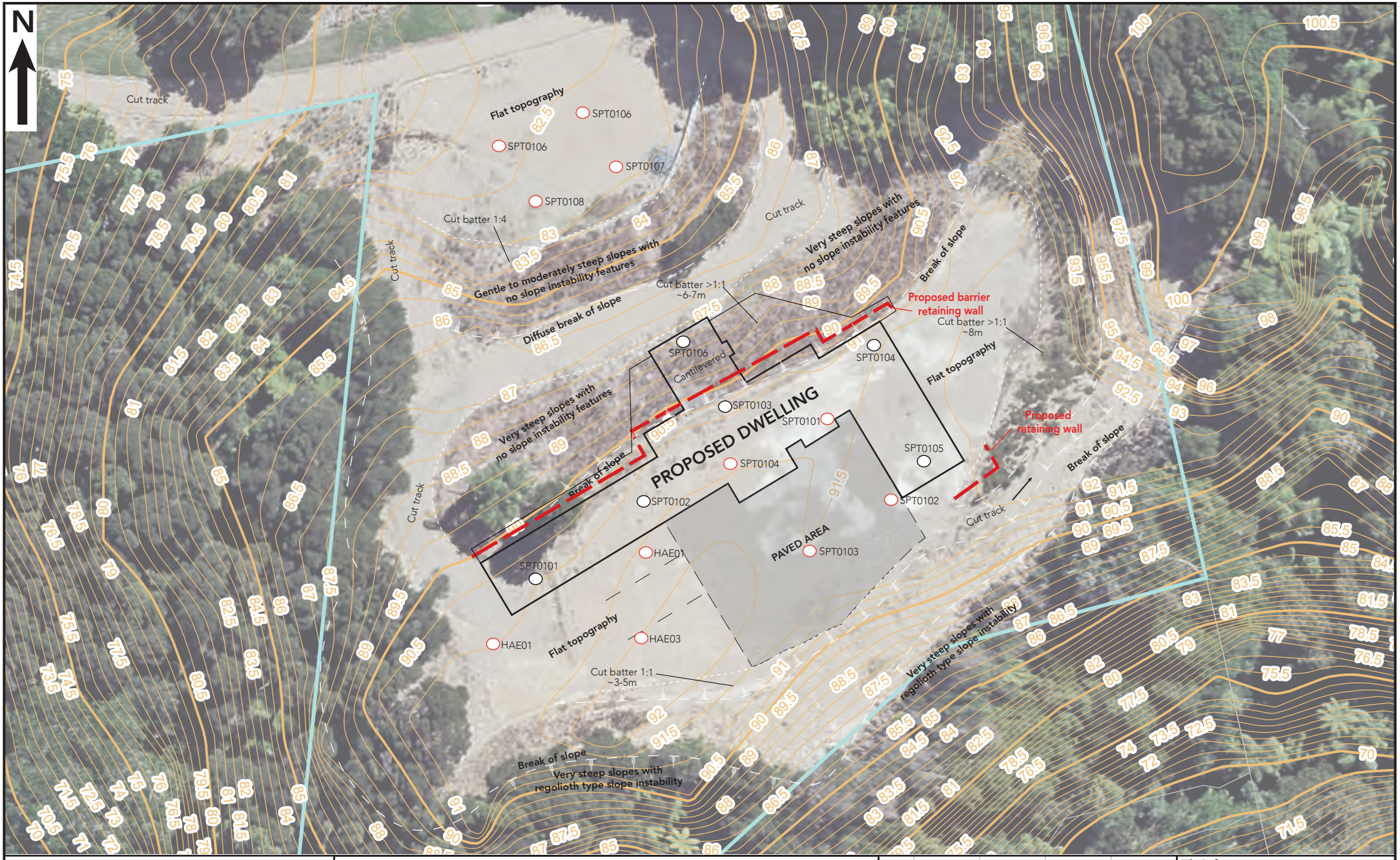
Project No. 2129-2

Report Ref. R2129-2

Drawing No. 001



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MILES & BROWYN FRIZELL

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INVESTIGATION LOCATION PLAN

Rev	Date	Status	Drafted	Reviewer
A	18/09/2017	Issued	K.H	F.W

File Ref. MAC://Projects_2000/2129/R2129-1/R2129-1-DRW002cdr

Scale (A4) 1:500

0 2 10 20m

Project No. 2129-2

Report Ref. R2129-2

Drawing No. 002

APPENDIX A: INVESTIGATION LOGS

SCALA PENETROMETER LOG

Report No	R2129-2A
	SPT01
Start Date:	15/09/17
End Date:	15/09/17
Client	Miles & Browyn Frizell
Coordinates (NZTM2000)	
Location Method	MAP
Location	355 Drury Hills Road, Drury, Auckland
Logged By	K.H
Checked By	F.W

Geological Interpretation (from Scala Penetrometer Test)	Depth (m)	Legend	Values (Blows/100mm)	Scala Penetrometer (Blows / 100mm)	Ground Water
	0		7		
			16		
			22		
			25		
			30		
			30		
EOH: 0.7m Effective refusal			30		
	1				

Associated Test Points

Water

- Standing Water Level
- Out flow
- In flow

SCALA PENETROMETER LOG

Report No	R2129-2A
	SPT02
Start Date:	15/09/17
End Date:	15/09/17
Client	Miles & Browyn Frizell
Coordinates (NZTM2000)	
Location Method	MAP
Location	355 Drury Hills Road, Drury, Auckland
Logged By	K.H
Checked By	F.W

Geological Interpretation (from Scala Penetrometer Test)	Depth (m)	Legend	Values (Blows/100mm)	Scala Penetrometer (Blows / 100mm)	Ground Water
	0		12		
			18		
			25		
			22		
			28		
			30		
EOH: 0.7m Effective refusal			30		
	1				

Scala Penetrometer (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Associated Test Points

Water

- Standing Water Level
- Out flow
- In flow

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SCALA PENETROMETER LOG

Report No	R2129-2A
	SPT03
Start Date:	15/09/17
End Date:	15/09/17

Client	Coordinates (NZTM2000)	Location Method
Miles & Browyn Frizell		MAP

Location	Logged By	Checked By
355 Drury Hills Road, Drury, Auckland	K.H	F.W

Geological Interpretation (from Scala Penetrometer Test)	Depth (m)	Legend	Values (Blows/100mm)	Scala Penetrometer (Blows / 100mm)	Ground Water
	0		10		
			14		
			16		
			22		
			23		
			28		
			30		
EOH: 0.8m Effective refusal			30		
	1				

Scala Penetrometer (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Associated Test Points

Water

- Standing Water Level
- Out flow
- In flow

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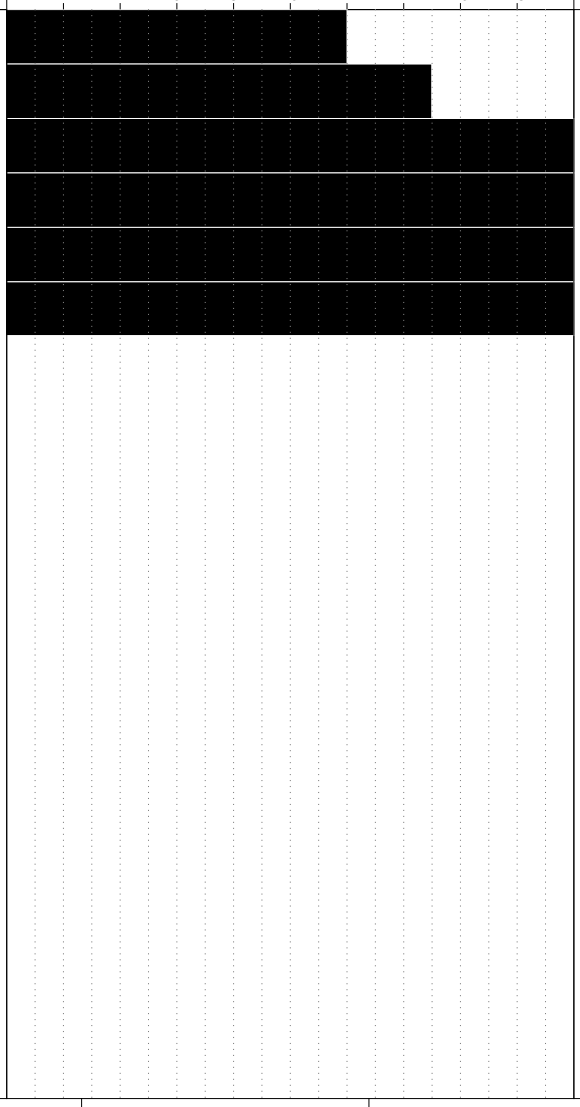
SCALA PENETROMETER LOG

Report No	R2129-2A
	SPT04
Start Date:	15/09/17
End Date:	15/09/17
Client	Miles & Browyn Frizell
Coordinates (NZTM2000)	
Location Method	MAP
Location	355 Drury Hills Road, Drury, Auckland
Logged By	K.H
Checked By	F.W

Geological Interpretation (from Scala Penetrometer Test)	Depth (m)	Legend	Values (Blows/100mm)	Scala Penetrometer (Blows / 100mm)	Ground Water
	0		12		
			15		
			28		
			22		
			29		
EOH: 0.6m Effective refusal			30		
	1				



Associated Test Points

Water

- Standing Water Level
- Out flow
- In flow

SCALA PENETROMETER LOG

Report No	R2129-2A
	SPT05
Start Date:	15/09/17
End Date:	15/09/17

Client	Coordinates (NZTM2000)	Location Method
Miles & Browyn Frizell		MAP

Location	Logged By	Checked By
355 Drury Hills Road, Drury, Auckland	K.H	F.W

Geological Interpretation (from Scala Penetrometer Test)	Depth (m)	Legend	Values (Blows/100mm)	Scala Penetrometer (Blows / 100mm)	Ground Water
	0		12		
			16		
			25		
			30		
EOH: 0.5m Effective refusal			30		
	1				

Scala Penetrometer axis: 2, 4, 6, 8, 10, 12, 14, 16, 18

Associated Test Points

Water

- Standing Water Level
- Out flow
- In flow

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SCALA PENETROMETER LOG

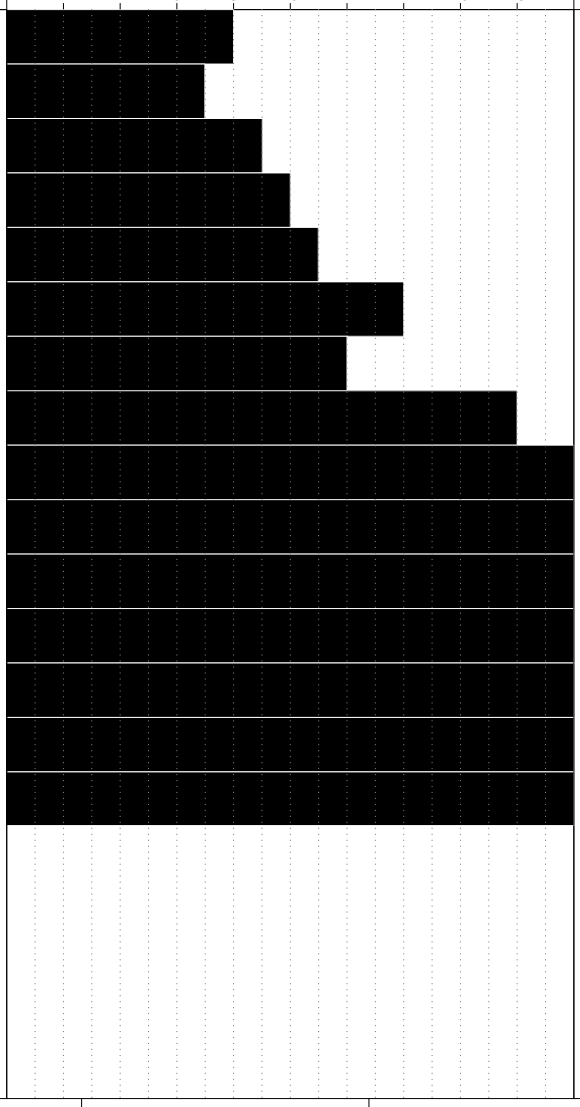
Report No	R2129-2A
	SPT06
Start Date:	15/09/17
End Date:	15/09/17

Client	Coordinates (NZTM2000)	Location Method
Miles & Browyn Frizell		MAP

Location	Logged By	Checked By
355 Drury Hills Road, Drury, Auckland	K.H	F.W

Geological Interpretation (from Scala Penetrometer Test)	Depth (m)	Legend	Values (Blows/100mm)
	0		8
			7
			9
			10
			11
			14
			12
			18
			20
			23
	1		26
			29
			30
			30
EOH: 1.5m Effective refusal			30

Scala Penetrometer (Blows / 100mm)



Ground Water

Associated Test Points

Water

- Standing Water Level
- Out flow
- In flow

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