



Bolam & Associates Ltd  
P O Box 157  
OREWA

14 September 2001

Attention: Des Brosnahan

Dear Sir,

**RE: RESOURCE CONSENT APPLICATION R30581  
PROPOSED SUBDIVISION FOR TYLER DAVIES HOLDINGS  
TAHEKEROA ROAD, MAKARU  
Geotechnical Investigation – Proposed Lot's 1, 3 TO 7, 13 AND 14**

## 1.0 INTRODUCTION

As requested, we have carried out a geotechnical investigation on possible building sites on the proposed 1, 3 to 7, 13 and 14 of the subdivision as shown on your scheme plan, reference 6368-03, dated september 2001. The purpose of the investigation has been to assess the subsoil conditions on the designated building sites and to provide foundation recommendations as required by Rodney District Council in their fax of 18 December 2000, a copy of which has been provided to us by Forest Habitats Ltd.

It is a requirement of Rodney District Council that each lot contain a stable building site with an area of not less than 225 m<sup>2</sup>, having a least dimension of not less than 10 m. It should also be noted that for certain types of rural land, it is the current policy of Rodney District Council to only issue Building Consents for individual lots under Section 36(2) of the Building Act 1991. Councils' advice on this matter should therefore be obtained for the lots covered by this report.

## 2.0 SITE DESCRIPTIONS

The property is situated in steep hill country on the west side of Tahekeroa Road. Access to the lots is via a new concrete bridge across the Tahekeroa Stream and along a number of farm tracks. The land comprises former grazing land that has reverted to scrub. A pipeline carrying natural gas crosses the property.

The proposed Lot 1 is situated at the southeastern corner of the property just above the new bridge. The designated 225m<sup>2</sup> building site is situated on the west side of the existing metalled track on a gentle, 10° south facing slope. Below the nominated building site the slope steepens to about 15°.

The proposed Lots 3 to 7 straddle the crest of a ridge near the centre of the property. The designated 225m<sup>2</sup> building sites are just below the crest of the ridge on gentle, (about 10°) south facing slopes.

Lots 13 and 14 are situated on the northern boundary of the property. The designated building site on Lot 13 is adjacent to the gas pipeline easement and slopes gently to the north at a gradient of about  $6^{\circ}$ . The Lot 14 building site is on a moderately steep,  $13^{\circ}$  north facing slope just below the crest of a ridge.

No obvious signs of instability were observed in the vicinity of the recommended building sites with the exception of the Lot 4 site where there is an old slip head scarp about 23m below the  $225\text{m}^2$  building site. However, the slip is at the head of a gully and appears to be surficial and is not considered likely to threaten the designated building site.

### 3.0 FIELD WORK

The field work carried out during our investigation comprised an inspection of the building sites by an Engineering Geologist and the drilling of a single hand auger boreholes near the possible building site on each of Lots 1,3 to 7 and 13 and two boreholes in the vicinity of the possible building site on Lot 14. The boreholes extended to depths of between 4.2 and 5.0m and were 50 mm in diameter. The *in situ*, undrained shear strengths of the subsoils were measured in the holes at regular intervals with a hand operated Pilcon shear vane. The boreholes were terminated at 5.0 m or when the ground became too hard to auger.

The layout of the site and locations of the boreholes in relation to the proposed section boundaries and the designated  $225\text{ m}^2$  building sites is presented on Drawing 4597-1 attached. The borehole positions have been located on site by Cato Bolam Consultants. More detailed plans of the recommended buildings sites together with cross sections prepared from onsite measurements taken with a tape and clinometer, are presented on Drawings 4597-2 to 8 attached. Descriptions of the soils encountered in the boreholes along with measured undrained shear strengths are presented on the attached log sheets (BH's 1 to 9).

### 4.0 GROUND CONDITIONS

The soils encountered in the boreholes comprise firm to stiff silts and clays which are residual soils weathered from the underlying rock formation inferred to be interbedded sandstones and siltstones of the Waitemata Group. In BH's 7 and 8 drilled on Lots 3 and 5 we infer that the soils have weathered from Albany Conglomerate.

Measured, undrained shear strengths generally exceed 100 kPa although in BH's 2,(Lot 14); 5,(Lot 4); 6,(Lot 6); and 7,(Lot 3) there was a reduction in soil strength to about 75 kPa at intermediate depths. In most of the boreholes soil strengths increased towards the end of the boreholes.

Groundwater was encountered in BH's 5 and 7 and measured at 2.2 and 3.0m depths respectively. The remaining holes were dry.

## 5.0 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

On the basis of our inspection of the designated 225 m<sup>2</sup> building sites on the proposed Lots 1, 3 to 7, 13 and 14 together with the borehole results, we are of the opinion that the sites are unlikely to be affected by instability nor is residential development on the building sites likely to result in instability of the land or on any other property. The recommended building sites are on gently sloping land and have been set back from the steeper slopes.

With the exception of the proposed Lot 14 building site we are of the opinion that 'good ground conditions' as defined in NZS 3604:1999 exist on the building sites. The Lot 14 site is on a moderately steep slope and in one of the boreholes drilled on the site, (BH 2) soil strengths reduce to about 75 kPa at depths of between 1.5 and 3.0m. Thus building foundations on this site should be pile supported.

Our engineering recommendations for site development are as follows:

- Building foundations on the designated 225 m<sup>2</sup> sites on Lots 1, 3, 5 to 7, 13 and 14 may comprise conventional shallow footings in accordance with NZS 3604:1999. However, we recommend that the footings be taken down to a minimum depth of 600 mm below finished ground levels as a precaution against the settlement effects associated with seasonal soil shrinkage.
- On the Lot 14 building site building foundations should be pile supported to 3.5m depth below present ground levels. Bored Piles may be designed for an allowable end bearing pressure of 300 kPa, (900 kPa Ultimate) and a skin friction resistance of 12 kPa, (30 kPa Ultimate) ignoring friction over the top 0.6m of pile length to allow for loss of adhesion due to soil shrinkage.
- Only minimal earthworks should be carried out on the sites to create building platforms, drives etc. Cuts should be battered at 2H:1V or retained. Spoil from site excavations should be placed well away from the building platforms on gently sloping land. Fill placed on sloping land or near the building sites may have to be retained. The advice of a Geotechnical Engineer should be sought for any substantial earthworks.
- Care should be taken with disposal of stormwater to prevent uncontrolled concentrated discharges of water over the slopes. Stormwater should be discharged into watercourses well clear of the building sites.
- Ample area exists on the lots for effluent disposal from septic tanks downslope of the designated building sites. However, ground conditions appear to be unsuitable for effluent disposal by means of conventional seepage trenches owing to the likely low permeability of the near surface soils. Thus the sewerage systems should be Engineer designed or comprise a drip irrigation disposal system associated with a packaged Home Treatment plant which produces a high quality effluent. The septic tanks should be sited away from the steeper slopes and the effluent disposal hoses placed around contours well away from the building sites.
- Building elsewhere on the sections outside the designated building sites is not necessarily excluded, but would need to be subject to further geotechnical investigation.

## 6.0 LIMITATION

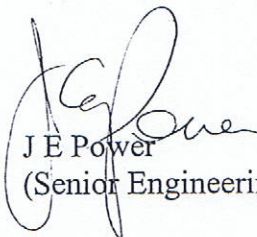
Recommendations and opinions in this report are based on data from a number of hand auger boreholes. While the nature and continuity of the subsoil conditions away from the boreholes is inferred it is possible that actual conditions could vary from those assumed. Should variations in subsoil conditions from those described in this report, be found to exist, or if the designated 225 m<sup>2</sup> building sites are altered from that shown on the scheme plan supplied then it is essential that Engineering Geology Ltd be contacted as it may affect the recommendations given above and additional borehole investigation may be required.

This report has been prepared solely for the benefit of Tyler Davies Holdings Ltd. as our clients with respect to the brief for the purposes of subdivision of the land and Engineering Geology Ltd accepts no liability to any other party in relation to this report. The reliance by other parties on the information or opinions contained in this report shall, without our prior review and agreement in writing, be at such parties' sole risk.

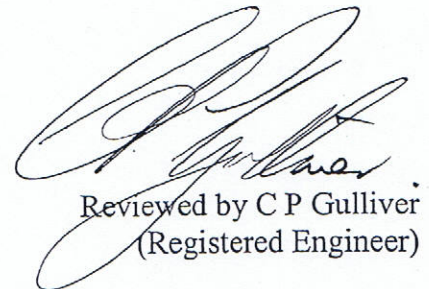
We would be pleased to provide any further advice you may.

Yours faithfully

**ENGINEERING GEOLOGY LTD**



J E Power  
(Senior Engineering Geologist)



Reviewed by C P Gulliver  
(Registered Engineer)

Enclosure: Borelogs - BH's 1 to 9  
Drawings 4597-1 to 8

# Engineering Geology Ltd

BOREHOLE No. 1

SITE: Lot 13, G.A. Tyler-Davies Holdings Ltd, Tahekeroa Road, MAKARAU

REF: 4597

Sheet 1 of 1

REDUCED LEVEL STRATA INTERPRET.	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)	
							● Field vane (BS 1377) ○ Remoulded Field vane 50    100    150	
Waitemata Group soils	TOPSOIL; silt, sl. clayey, firm, moist - wet, sl. friable, orange brown	2	0.0					
	SILT; sl. - mod. clayey, firm, moist - wet, sl. friable, orange brown	2	0.2				147	
	wet, not friable						141	
							136	
	occ. small grey silty inclusions		1.0				123	
	SILT; sl. - mod. sandy, firm, wet, mod. friable, reddish orange brown						124	
	sl. sandy						156	
	sl. - mod. friable						141	
	mod. sandy, sl. clayey		2.0				113	
	firm, mod. sandy						85	
			3.0				127	
							141	
	no clay, friable						106	
	mod. sandy		4.0				127	
	SAND; silty, stiff, wet, friable, orange brown						124	
	limonitic horizon						141	
							>200	
	E.O.B @ 5.0 m (Target depth)		5.0					

Dry: 15/8/01

NOTES

LOGGED BY: JB

DATE DRILLED: 15-Aug-01

DRILL METHOD: 50 mm Hand Auger

# Engineering Geology Ltd

BOREHOLE No. 2

SITE: Lot 14, G.A. Tyler-Davies Holdings Ltd, Tahekeroa Road, MAKARAU

REF: 4597

Sheet 1 of 1

REDUCED LEVEL STRATA INTERPRET.	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)	
							● Field vane (BS 1377) ● Remoulded Field vane	
	TOPSOIL; silty, sl. - mod. clayey, firm, wet, dark brown	2 2					50 100 150	
	SILT; mod. clayey, firm, wet, orange brown							150
	CLAY; mod. silty, firm, wet, orange brown							156
	sl. - mod. silty							112
	sl. plastic		1					113
	sl. silty							99
	sl. - mod. plastic							82
	orange brown with grey streaks		2					68
	orange brown with red streaks							71
								74
	sl. sandy, mod. silty							109
	limontic horizon with occ. silty inclusions		3					132
	SAND; sl. silty, sl. clayey, medium, wet, sl. friable, orange brown							161
	sl. - mod. silty							133
	occ. white silt inclusions		4					192
	limonitic horizon							>200
	SILT; sl. - mod. sandy, sl. clayey, firm, wet, orange brown with reddish staining							>200
	E.O.B @ 5.0 m (Target depth)		5					

Waitemata Group soils

Dry: 15/8/01

NOTES

LOGGED BY: PC

DATE DRILLED: 15-Aug-01

DRILL METHOD: 50 mm Hand Auger

# Engineering Geology Ltd

BOREHOLE No. 3

SITE: Lot 14, G.A. Tyler-Davies Holdings Ltd, Tahekeroa Road, MAKARAU

REF: 4597

Sheet 1 of 1

REDUCED LEVEL STRATA INTERPRET.	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)	
							● Field vane (BS 1377) ○ Remoulded Field vane 50 100 150	
Waitemata Group soils	TOPSOIL; silt, sl. clayey, firm, moist - wet, sl. friable, dark brown		0					
	SILT; sl. clayey, stiff, moist - wet, sl. friable, orange brown							
	wet, mod. clayey							
	CLAY; sl. - mod. silty, firm, moist - wet, sl. plastic, orange brown		1					
	limonitic horizon, with dark orange brown silty inclusions							
	SAND; mod. silty, firm, wet, friable, orange brown		2					
	sl. silty, friable							
		3						
		4						
		5						
	E.O.B @ 4.5 m							

NOTES	LOGGED BY: JB DATE DRILLED: 15-Aug-01 DRILL METHOD: 50 mm Hand Auger
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REDUCED LEVEL STRATA INTERPRET.	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)	
							● Field vane (BS 1377) ● Remoulded Field vane	50100150
	TOPSOIL; organic silt; sl. clayey, stiff, moist, brown	~ ~						
	SILT; mod. clayey, stiff, moist, lt. orange brown with occ. brown streaks and mottles	~ ~					176	
	sl. friable, occ. black specks						165	
	no. clay, friable						173	
			1				173	
	sl. clayey						>200	
	sl. sandy(m)						110	
			2				142	
	increasing sand						198	
	mod. sandy(m-c)						>200	
	no sand, sl. - mod. clayey		3				142	
							142	
	sl. sandy, wet						110	
	no sand, mod. clayey, orange brown with dark orange brown banding		4				157	
							151	
	brownish grey						113	
							110	
	E.O.B @ 5.0 m (Target depth)		5					

SITE: Lot 4, G.A. Tyler-Davies Holdings Ltd, Tahekeroa Road, MAKARAU

REF: 4597

Sheet 1 of 1

REDUCED LEVEL STRATA INTERPRET.	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)		
							● Field vane (BS 1377)	○ Remoulded Field vane	
	TOPSOIL; organic silt, sl. clayey, stiff, moist, brown	2							
	SILT; sl. clayey, stiff, moist, dark orange brown with occ. brown mottles	2							
	wet								
	sl. - mod. sandy(f), mod. friable		1						189
	occ. friable silty horizon, lt. brown								186
	water seepage								110
	sandy(f), saturated, dark orange brown		2						189
	no sand, friable, lt. orange brown								>200
	sl. sandy(f)								107
	no sand, no clay, firm		3						>200
	sandy(f), dark grey								79
	no sand								79
	sandy								71
	no sand		4						110
	mod. sandy(f)								134
	no sand								173
	E.O.B @ 4.5 m (Too hard to auger)								>200
			5						>200

Waitemata Group soils

15/8/01

LOGGED BY: PC  
DATE DRILLED: 15-Aug-01  
DRILL METHOD: 50 mm Hand Auger

Engineering Geology Ltd

BOREHOLE No. 6

SITE: Lot 6, G.A. Tyler-Davies Holdings Ltd, Tahekeroa Road, MAKARAU

REF: 4597

Sheet 1 of 1

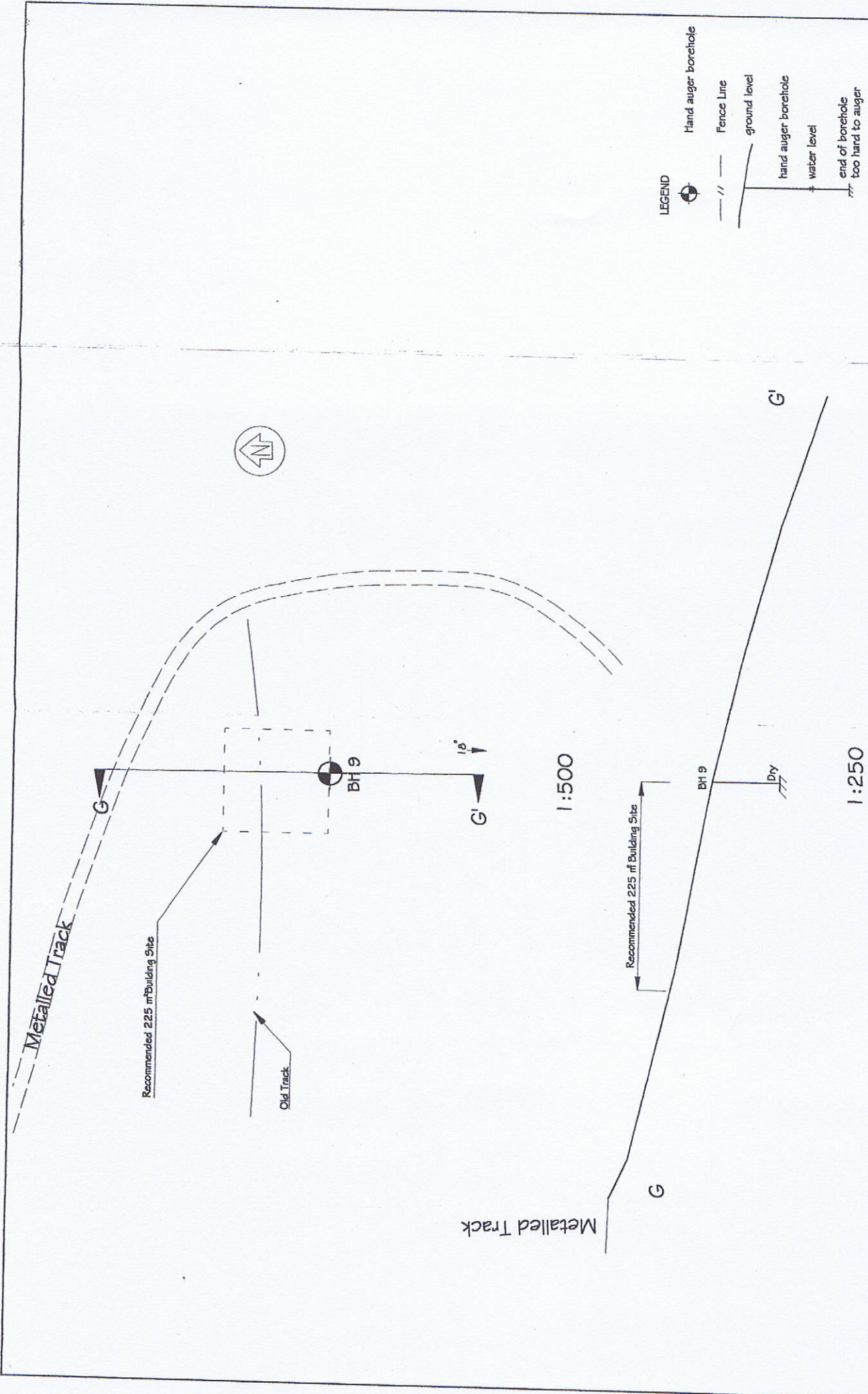
REDUCED LEVEL STRATA INTERPRET.	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)	
							● Field vane (BS 1377) ○ Remoulded Field vane	
							50100150	
Waitemata Group soils	TOPSOIL: silty, sl. clayey, firm, moist, friable, dk. brown	~ ~ ~						
	SILT, mod. clayey, stiff, moist, lt. grey and lt. brown with orange brown staining						● 140	
							● 135	
	occ. sl. to mod. sandy(f-m) horizons		1				● 120	
							● 91	
	lt. grey with orange brown staining						● 132	
	occ. thin wet mod. sandy(f-m) horizons		2				● 102	
							● 114	
	thin mod. sandy(f-m) horizons						● 88	
	SILT, mod. sandy(f-m), sl. clayey, firm, moist, lt. grey with orange brown staining		3				● 79	
	sl. water seepage						● 91	
	occ. thin clayey silt horizons						● 91	
	decreased sand, stiff						● 143	
	SILT, mod. clayey, stiff, moist, lt. grey with orange brown staining		4				● 114	
							● 102	
	thin mod. sandy(f-m) horizons						● 91	
	alternating sand(f-m) and mod. clayey silts						● 102	
	dk. grey						● 110	
	E.O.B. 5.0 m		5					
					Dry : 15/8/01			

NOTES

LOGGED BY: MLW  
DATE DRILLED: 15-Aug-01  
DRILL METHOD: 50 mm Hand Auger

REDUCED LEVEL STRATA INTERPRET.	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)	
							● Field vane (BS 1377) ○ Remoulded Field vane	
							50100150	
	TOPSOIL: silty, sl. clayey, firm, moist, friable, dk. brown	~ ~ ~						
	SILT, mod. clayey - clayey, occ. sl. sandy(f), firm - stiff, moist, lt. grey and lt. brown with orange brown staining						● 117	
							● 91	
	clayey, no sand, mod. plastic, lt. grey with orange brown mottling		1				● 120	
							● 113	
	occ. dk. orange brown limonitic nodules, occ. sl. sandy(f-m) horizons						● 102	
	mod. clayey, sl. sandy(f), lt. grey with orange brown staining		2				● 105	
							● 102	
	occ. sl. to mod. sandy(f-m) horizons							
	mod. sandy(f-m), firm, increased moisture						● 82	
							● 73	
	occ. limonitic nodules							
	water seepage		3			15/8/01	● 76	
	abundant CW-HW well rounded silt and sandy inclusions							>200
	SILT, sandy(f-m), v. stiff, moist, lt. grey with orange brown staining							>200
								>200
	occ. dk. grey streaks							>200
	v. sandy(f-m), 'gritty', dk. grey with grey well rounded inclusions		4					
	E.O.B. 4.2 m							● 187
			5					

REDUCED LEVEL STRATA INTERPRET.	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)	
							● Field vane (BS 1377) ○ Remoulded Field vane	
							50100150	
	TOPSOIL: silty, sl. clayey, firm, moist, friable, dk. brown	~ ~ ~						
	SILT, mod. clayey, sl. sandy(f), stiff, moist, lt. brown with orange brown staining						● 129	
	thin dk. orange brown limonitic horizon						● 173	
	mod. sandy(f-m)						● 161	
	orange brown and red brown		1				● 146	
	abundant dk. orange brown limonitic staining						● 120	
	SILT, mod. sandy(f-m), stiff, moist, lt. brown and red/brown, occ. black MnO <sub>2</sub> staining						● 113	
			2				● 126	
	sl. increase in moisture						● 135	
	occ. large lt. grey silt inclusions						● 102	
	decreased sand(f), lt. pink and grey with small CW silt inclusions		3				● 117	
	increased sand						● 105	
	occ. dk. orange brown limonitic staining						● 105	
	increased moisture		4				● 102	
							● 146	
	sandy(f-m), friable						● 155	
	E.O.B. 5.0 m		5				● 190	



**ENGINEERING GEOLOGY LTD**  
 2 Esmonde Rd, PO Box 33-426, Takapuna  
 Ph (09)486-2546, Fax (09)486-2556

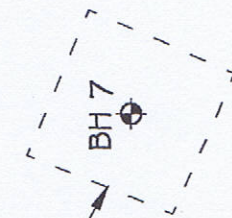
Proposed Lot 1, G.A. Tyler-Davis Holdings LTD, Tahakeroa Road,  
**MAKARAU**  
 Sketch Site Plan & Cross Section G-G'

Drawing No. 4597-8  
 Date: August 2001  
 Drawn: PC  
 Scale: As Shown  
 Filename: 4597-8



Track

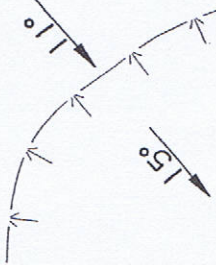
Recommended 225 m<sup>2</sup>  
building site



Top of Slope

~25°

1:500



E

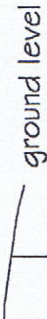
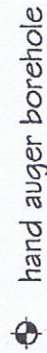
Recommended Building site

BH 7

E'

1:200

LEGEND



hand auger borehole  
ground level  
hand auger borehole  
water level  
end of borehole

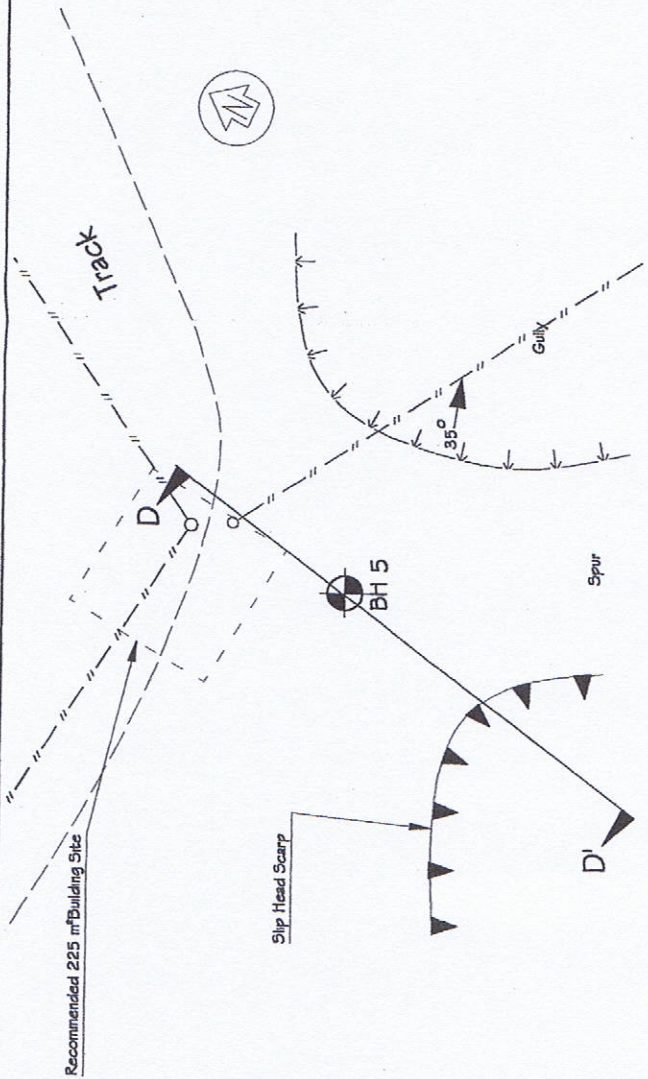


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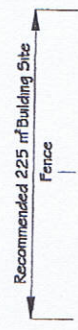
Lot 3, G.A. Tyler-Davies Holdings Ltd, Tahekeroa Road, MAKARAU

Sketch Borehole Location Plan & Cross-Sections E - E'

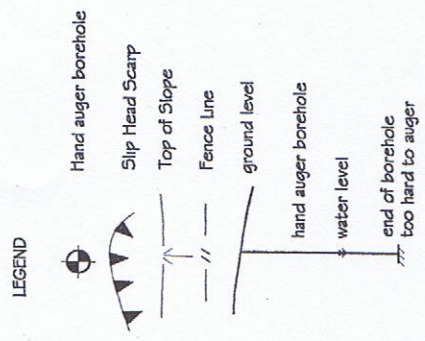
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Date: Aug 2001  
Drawn: MLW  
Scale: as shown  
Filename: 4597-6



D



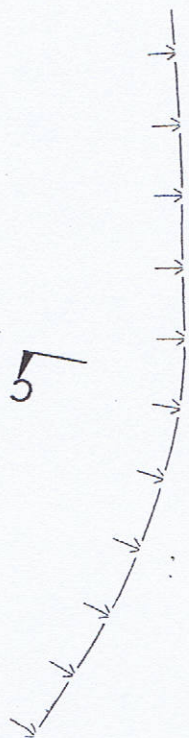
D'



**ENGINEERING GEOLOGY LTD**  
 2 Esmonde Rd, PO Box 33-426, Takapuna  
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Proposed Lot 4, G.A. Tyler-Davis Holdings LTD, Tahakeroa Road,  
**MAKARAU**  
 Sketch Site Plan & Cross Section D-D'

Drawing No. 4597-5  
 Date: August 2001  
 Drawn: PC  
 Scale: As Shown  
 Filename: 4597-5



Recommended 225 m<sup>2</sup>  
building site

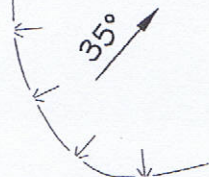
BH 6



1:500

track

BH 5



C

Recommended Building site

BH 6

Dry

1:200

LEGEND

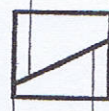
hand auger borehole

Top of Slope

ground level

hand auger borehole

end of borehole



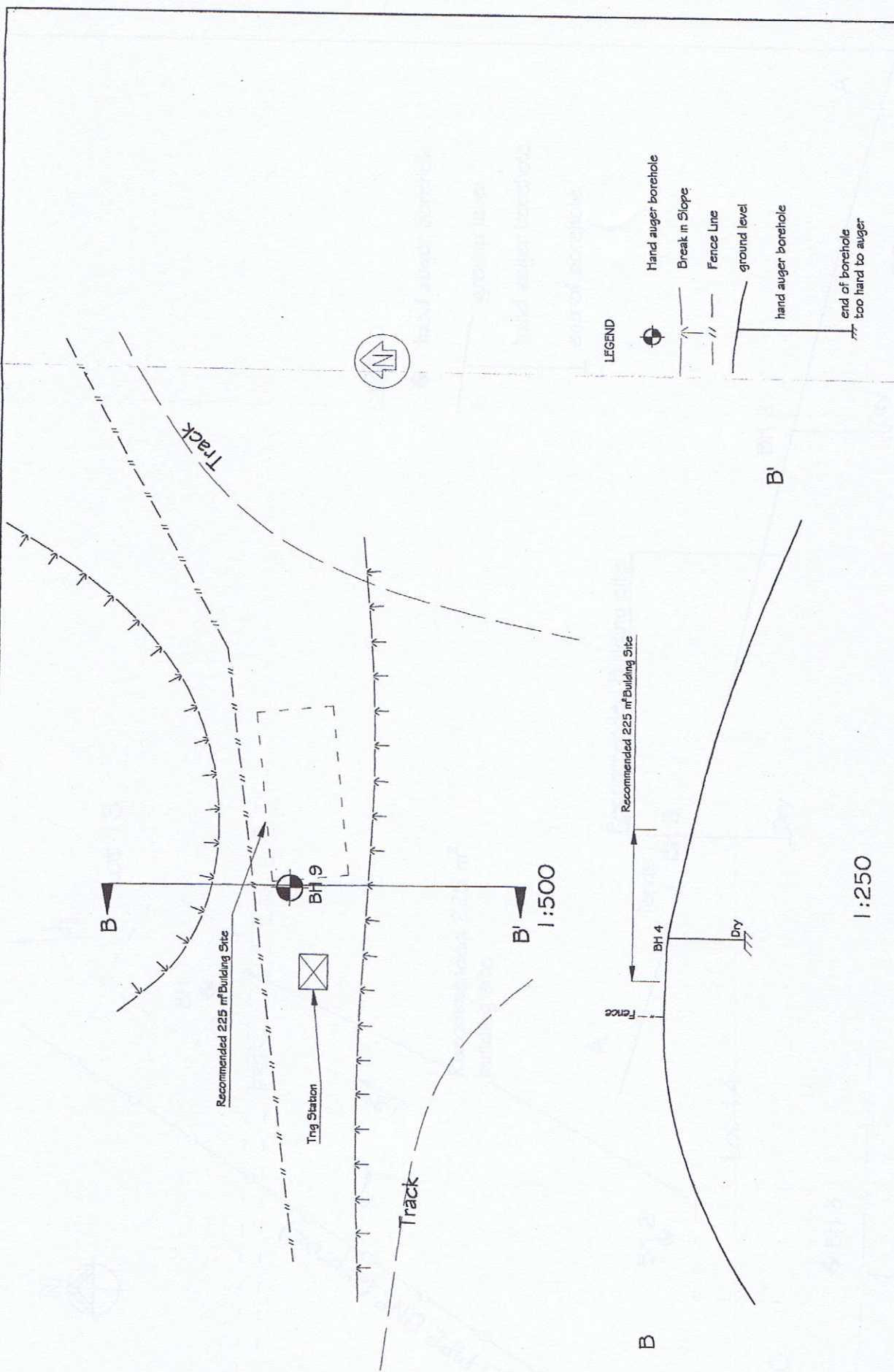
ENGINEERING GEOLOGY LTD

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Lot 6, G.A. Tyler-Davies Holdings Ltd, Tahekeroa Road, MAKARAU

Sketch Borehole Location Plan & Cross-Sections C - C'

Drawing No. 4597-4  
Date: Aug 2001  
Drawn: MLW  
Scale: as shown  
Filename: 4597-4



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Proposed Lot 7, G.A. Tyler-Davis Holdings LTD, Tahekeroa Road,  
**MAKARAU**  
 Sketch Site Plan & Cross Section B-B'

Drawing No: 4597-3  
 Date: August 2001  
 Drawn: PC  
 Scale: As Shown  
 Filename: 4597-3