Appendix 1

Holmes and Holmes Pty Ltd

Geotechnical Appraisal for Development Options at Lake Cathie
November 1993

HOLMES & HOLMES PTY. LTD.
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931492
25/11/93

Attn. Phil Lake
Lake and Company

Global at Lake Cairn

Here is text of report on developmental options — I would be happier if we had a contour pl[illegible] and perhaps sketch on it preliminary limitations to define areas worthy of more intense investigation.

Also the whole thing needs to be tied into the hydraulics of the area and possibilities for filling flood prone land without adverse effects on hydrau[illegible]

Maybe what we need is a workshop when all these different inputs can be got together.

Regards
Bill

PS I am doing site classification of that fill + natural ground section at south west end of site as a separate report so that it can be presented to Council for release of land for sale.

2 months

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GEOTECHNICAL APPRAISAL
FOR DEVELOPMENT OPTIONS
AT LAKE CATHIE FOR GLOBAL PTY LTD.

INTRODUCTION

Following a request from Luke & Company, Surveyors, consideration of the geotechnical constraints to the development of land south of Lake Cathie, was undertaken in October/November 1993. This Report has been prepared to determine and assess the potential geotechnical restraints to a number of development options.

In particular, preliminary assessment of the following parameters has been undertaken :-

- Acid Sulphate Soils
- Flow Characteristics
- Land Filling
- Sources of Fill Material.

It should be noted that this Report does not include the hydrological implications of flood heights, the determinations of which may effectively control some aspects of the development.

SITE GEOMORPHOLOGY

The site is essentially a silted estuarine system, with a frontal dune which has diverted drainage to the south, behind the dune line. Typical of most coastal drainage systems, a fall in sea level along this coast caused estuaries to silt up, and sand bars and dunes to build across their mouths, with swampy wetlands behind.

On this site, there is also a remnant of a former frontal dune across the estuary, located along the existing Access Road (see B.H. 34, 35, 36).

Geotechnical Appraisal
For Development Options, at Lake Cathie

The surrounding higher ground which slopes down onto this alluvial plain, is deeply weathered metasediments derived from phyllites and shales, with intrusive serpentine bands. Erosion material from the hinterland has provided a heavy clay alluvial plain which blends into the sandy deposits washed and blown in from the sea.

Much of the low lying terrain of this area, can therefore be expected to become waterlogged in wet periods and has the potential to develop acid sulphate soils.

Whilst the land has been cleared and is now mainly grassland, the alluvial flats would formerly have been vegetated with paperbarks, swamp mahogany and similar species.

Previous developmental activities on the site, including the extraction of fill material to create a large lake, clearing and drainage of the site, and the present outlet control to the drainage system, have significantly altered the groundwater regime and consequently the development of acid sulphate soils.

FIELDWORK

A total of twenty six backhoe test pits (B.H. 1 to B.H. 26) and fourteen auger holes (B.H. 27 to B.H. 40), were excavated on the site to provide subsoil information and test samples.

The borelogs of the materials encountered are attached, and the location and level of the holes have been determined by Luke & Company.

Samples from these test holes have been analysed for their potential to oxidise and form acid sulphate conditions. The physical characteristics of the subsoils have been noted on the Borelogs.

Geological Appraisal
For Development Options at Lake Cathie

COMMENTS

1) Acid Sulphate Soils

The geomorphology of the site, and physical characteristics such as the milky blue pond, are indiciative of acid sulphate soil conditions in the low areas of the site. such conditions are a major constraint on development of the site.

The initial testing of twenty samples of soil taken from various depths below ground level, confirm that the alluvial flats have significant potential to develop acid sulphate soils, particularly the material at depth and in the eastern half of the site.

This means that if the water table in the alluvial flats is to be lowered, or material excavated from the flats is to be used as fill, there is a strong possibility that significant acidification will take place, with consequent environmental problems.

These can be fish kills, vegetation damage, corrosion of underground services or concrete structures.

Accordingly the following options can be identified :-

a) Restrict residential development to the sloping surrounds of the site.

b) Fill low areas of the site with imported fill, or material won from high ground on site.

c) Prepare a detailed assessment of acid sulphate soil potential, its vertical and horizontal extent, so that a developmental strategy can be presented to the Authorities to allow drainage and/or use as fill.

2) Drainage Characteristics

The sloping areas of the site, (generally around the perimeter) are slopes which provide naturally well drained ground. The bulk of the site, however, is a poorly drained alluvial flat fed by two drainage depressions on the western side. The clayey nature of this flat, particularly in the western half, and the flat gradients create poorly drained conditions which are unsuitable for residential development, unless improved, either by filling or by drainage.

The question of significant drainage is untenable unless the potential to create acid sulphate soils is addressed (see Item (1) above).

In order to best manage the potential acid sulphate soils, it is preferable to maintain a high water table in the areas of low elevation. This is the antithesis of conditions required for residential allotments.

3) Land Filling

The option of large scale filling of the low lying areas of the site to provide suitable residential land is feasible, but considered to be impractical.

This is because imported fill will be uneconomical and to win large quantities of material from the high ground of the site will result is significant reshaping of the land forms, and destruction of the soil profile, in many cases resulting in weathered rock being left at surface level.

However, more restricted filling of selected areas of the site could be undertaken, particularly if such works enable a more appropriate block layout to be developed.

Such areas considered as suitable for filling, occur around the foot slopes of the northern high ground, and include the northwest corner (between BH. 11 and BH. 15) and the drainage depression down to BH.

Geological Appraisal
Development Options at Lake Cathie

In the lower (eastern end) of the site, the old dune line area (BH. 34, 35, 36) and the slope extensions to BH. 24 to BH. 33, can be filled to provide better drained residential land.

Along the back of the frontal dune, the sandy ground is suitable for residential development, and could be filled if necessary to be flood free.

4) Sources of Fill Material

As indicated above, fill material can only be won from the low areas of the site if a detailed assessment of the potential to create acid sulphate soils is undertaken, and stringent management and monitoring plans are incorporated into the Development.

The investigation indicates that the ridge lines on the northern side of the site are underlain by weathered rock at relatively shallow depth. Thus, whilst providing a suitable source of fill material, it should be recognised that stripping the hill tops off to rock will leave these areas devoid of a soil profile suitable for urban type blocks. This preliminary investigation suggests that no more than 1.2m depth of cutting should be stripped for fill material.

There is a limited amount of suitable clay fill material to be won from the knob at BH.37 Such material could be used economically if it were to be spread in the area immediately to the north, to provide flood free land on the old dune.

Geological Appraisal
Development Options at Lake Cathie

SUMMARY & RECOMMENDATIONS

1) The high ground surrounding the perimeter of the site provides suitable land for residential development, with a general Site Classification of Class M (A.S. 2870)

2) The base of these slopes can be extended out onto the alluvial flats by a filling operation. The extent of the fill will be largely determined by the extent to which the land form of the high ground is to be reshaped to provide the fill material.

It is recommended that such filling work be generally restricted to about the length of a block.

3) The low alluvial flood plain areas have the potential to develop acid sulphate soils. The development of such land is severely limited by the undesirability of lowering the water table by drainage works.

4) Hydraulic consisiderations and flood levels will dictate the available land for development in the eastern end of the site. Filling operations can be undertaken to create more flood free land in this area, provided hydraulic conditions are met.

5) It is recommended that the water level in the lake be maintained at least at its current level, to minimise the development of acid sulphate soils in the surrounding area.

W.H.G. HOLMES, B.E., MIE(AUST)
HOLMES & HOLMES PTY. LTD,

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Date of boring

Type of boring: BACKHOE TEST PIT Casing tubes

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D. Level	Description of Strata
BH 1						Light grey clay
				1.0		Mottled light grey clay with yellow stainings A.S.S
						Fine grey silty sand P.A.S.S
				2.0	W.T	Dirty grey sand with yellow stainings
BH 2						Topsoily clay FILL
				1.0		Mottled light grey clay with yellow stainings A.S.S
				2.0	W.T	Yellow & grey clayey sand P.A.S.S

Key to type of sample

U (50) - 50 mm dia. undisturbed sample

D - disturbed sample

S.P.T. - standard penetration test

Remarks (Observations on groundwater, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: Date of boring

Type of boring: BACKHOE TEST PIT Casing tubes

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: AHD Level	Description of Strata
BH5						Clayey Topsoil
						Mottled yellow & grey silty clay
				1.0		Mottled brown & yellow residual silty clay
				2.0		
BH6						Dk grey clayey Topsoil
				1.0		Dk grey clay with yellow stainings ASS
				2.0		Light grey and yellow brown mottled sandy clay PASS

of sample

Remarks (Observations on ground water etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Date of boring

Type of boring: BACK-HOE TEST PIT Casing tubes

Borehole number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D. Level	Description of Strata
BH 7						Dk. grey Topsoil
	Sample pH change on oxidation 4.9 → 4.1			1.0		Light grey clay with yellow mottlings A.S.S
				2.0		Mottled light grey and red brown clay
BH 8						Clayey Topsoil
						Yellow brown clay.
				1.0		Mottled grey & red brown clay.
					◄ WT	
				2.0		Mottled grey and orange brown clay.

Type of sample

G Grab disturbed sample

Undisturbed sample

Standard penetration test

Remarks (Observations and special water, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY
PROJECT: LAKE CATHIE PROJECT

Ground level: .... Date of boring ....

Type of boring: BACKHOE TEST PIT Lining tubes ....

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH 9						Clayey Topsoil
						Yellow brown silty clay
				1.0		Mottled yellow brown & grey residual clay
				2.0		
BH 10						Clayey Topsoil
				1.0		Mottled grey & yellow clay
						A.S.S
				W.T. 2.0		Yellow & grey sandy clay
						Grey sandy clay with gravel.

Key to type of sample
U 50mm - 50 mm dia undisturbed sample
D disturbed sample
N ( ) - standard penetration test
... brackets given

Remarks (Observations on ground water etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY
PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Date of boring

Type of boring: BACK-HOE TEST PIT Casing tubes

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH 11						Grey Topsoil
	Sample pH change on oxidation 8.6 → 8.6			1.0		Mottled yellow brown and grey silty clay with white concretions (calcification)
				2.0		Mottled. yellow brown serpentine clay (with blue green blotches)
BH 12						Clayey Topsoil
						Yellow brown clay
				1.0 WT		Mottled grey & red brown clay
				2.0		

Key to type of sample
U 50 - 50 mm dia undisturbed sample
D - disturbed sample
S - standard penetration test

Remarks (Observations on ground water etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Date of boring

Type of boring: BACKHOE TEST PIT Casing tubes

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D. Level	Description of Strata
BH 13 (in old dam area.)						Dk grey clayey fill (or sediment deposit) wet.
				1.0		Grey and yellow mottled silty clay
				2.0		Mottled grey and red brown clay
BH 14						Clayey Topsoil
						Grey gravelly clay, hillwash
				1.0		Mottled yellow and grey residual clay
				2.0		Mottled yellow & brown clay with greenish blotches

Remarks (Observations on ground water, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Date of boring: .....

Type of boring: BACKHOE TEST PIT Casing tubes: .....

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH 15						Grey clayey Topsoil
						Yellow brown clay with grey mottlings
				1.0		Mottled Grey and yellow brown clay
				WT 2.0		
BH 16						Grey clayey Topsoil
				1.0		Dk. grey clay with yellow mottlings.
						A.S.S
				2.0		Light grey clay with yellow mottlings

Key to type of sample

U 50 - 50 mm dia undisturbed sample

D - disturbed sample

S.P.T - standard penetration test

Remarks (Observations on ground water etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY
PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Date of boring

Type of boring: BACKHOE TEST PIT Casing tubes

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D. Level	Description of Strata
BH17						Dk grey clayey topsoil & humus
	Sample pH change on oxidation 5.4 → 4.0			1.0		Dk grey clay wet soft
	Sample pH change 5.0 → 4.2					Grey clay with yellow mottlings
				2.0		
	pH change 5.3 → 4.2			W.T		Light grey & yell. br. sandy clay
BH18						Grey topsoil
						Yellow & brown clay
						Mottled grey and yellow brown clay
				1.0		Grey & yellow clayey sand
				2.0		

Key to type of sample
U50 - 50 mm dia. undisturbed sample
D - disturbed sample
... standard penetration test

Remarks (Observations on ground water, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Type of boring: BACK-HOE TEST PIT

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D. Level	Description of Strata
BH 19						Clayey Topsoil
	Sample pH change on oxidation 4.5 → 3.7			1.0		Dk grey clay with yellow mottlings
				2.0		A.S.S
						Light grey and yellow sandy clay.
BH 20						Clayey Topsoil
						Dk grey and yellow brown clay
				1.0		A.S.S.
						Light grey and yellow brown clayey SAND.
				WT		
				2.0		Mottled grey and yellow brown clay with red-br ironstone pieces. Slightly sandy

Key to type of sample

U (100) 50 mm dia undisturbed sample

D disturbed sample

S standard penetration test

Remarks (Observations on ground water, etc.)

OV-93 FRI 5:35 HOLMES & HOLMES PTY. LTD P.01

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: .... Date of boring

Type of boring.... BACKHOE TEST PIT Lining tubes

Borehole Number	Samples or Core Recovery: Depth	Type or %	Change of Strata: Legend	Depth	A.H.D Level	Description of Strata
BH21						Grey clayey Topsoil
	Sample pH change on oxidation 4.7 → 4.1			1.0		Dk grey clay with yellow mottlings. A.S.S.
	pH change 5.2 → 4.3			2.0		Dk. grey clay P.A.S.S
						Mottled light yellow and brown sandy clay with greenish blotches (serpentine)
BH22						Clayey Topsoil
						Yellow brown clay & orange ironstone.
				1.0		Yellow clay.
						Yell. clay with grey streaks.
				2.0		

Key to type of sample
- 50 mm dia undisturbed sample
- Disturbed sample
- [illegible]

Remarks (Observations on ground water, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Date of boring: .....

Type of boring: BACKHOE TEST PIT Casing tubes: .....

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: AHD Level	Description of Strata
BH23						Topsoil
						Yellow brown clay
				1.0		Mottled light yellow and brown clay
						Very weathered claystones
				2.0		
BH24						Topsoil
						Dk. grey clay with yellow mottlings A.S.S
				1.0		
				2.0		Mottled yellow and brown, with greenish tinge serpentine clay

Type of sample

Remarks (Observations on ground water, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Date of boring .....

Type of boring: BACK HOE TEST PIT Casing tubes .....

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH 25						Topsoil
						Ironstone nodules and yellow brown clay
				1.0		Mottled yellow brown & brown clay
						Mottled greeny yellow and yellow brown serpentine clay
				2.0		
BH 26						Grey topsoil
	Sample pH change on oxidation 4.6 → 3.4					Grey clay with yellow mottlings A.S.S
	pH change 5.5 → 4.0			1.0		Grey clayey sand with yellow mottlings P.A.S.S
						Yellow sand with grey & white blotches
				◄ WT		
				2.0		

Key to type of sample

- U50 - 50 mm dia undisturbed sample
- D - disturbed sample
- SPT - standard penetration test

Remarks (Observations on ground water, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level:

Dia of boring: 80 mm

Type of boring: FLIGHT AUGER

Lining tubes: NIL

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: AHD Level	Description of Strata
						silty Topsoil
BH27						Yellow br. silty clay dry stiff
						Grey-br. v. weathered rock
				1·0		TC Refusal on weathered fractured claystones
				2·0		
BH28						Yellow brown plastic CLAY moist, stiff.
				1·0		Yell br. gravelly CLAY dry. stiff
						Grey clay and weathered mudstones, soft & hard bands
				2·0		Serpentine seam.
						TC Refusal

Key to type of sample

U (50) – 50 mm dia undisturbed sample

D – disturbed sample

N ( ) – standard penetration test No in brackets gives

Remarks (Observations on ground water etc.)

RECORD OF BOREHOLES

CLIENT GLOBAL P/L % LUKE & COMPANY

PROJECT. LAKE CATHIE PROJECT

Ground level.

Dia of boring 80 mm

Type of boring FLIGHT AUGER

Casing tubes NIL

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type of S.	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH 29						Silty Topsoil
						Brown plastic CLAY moist firm.
				1.0		Grey-green serpentine CLAY stiff, moist
				2.0		Grey clay and grey-green serpentine, broken & fractured with some harder bands.
				3.0		Fractured hard Serpentine rock
						TC Refusal.
BH 30						Clayey gravel road
						Grey brown plastic clay and broken rock stiff dry
				1.0		Hard broken claystone.
						TC Refusal

Key to type of sample

U (50) - 50 mm dia undisturbed sample

D - disturbed sample

N ( ) - standard penetration test

No. in brackets gives

No. of blows/300 mm penetration

Remarks (Observations on ground water etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: — Dia of boring: 80 mm

Type of boring: FLIGHT AUGER Casing tubes: NIL

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: AHD Level	Description of Strata
BH 31						clayey Topsoil
						Yellow brown silty clay
				1.0		Grey clayey sand with yellow mottlings. wet
				◂ WT		
	Sample pH change 5.6 → 3.7					Grey clayey sand
				2.0		
BH 32						clayey Topsoil
						Brown sandy clay
				1.0		Brown clayey sand
				◂ WT		Grey - brown clayey sand
				2.0		
						Grey br. sand, slightly clayey

Key to type of sample

U [50] - 50 mm dia undisturbed sample

D - disturbed sample

N [ ] - standard penetration test

No in brackets gives No of blows/300 mm penetration

Remarks (Observations on ground water etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Dia of boring 80 mm

Type of boring FLIGHT AUGER Casing tubes NIL

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: AHD Level	Description of Strata
BH33						Yellow brown plastic clay moist firm
				1.0		Light grey brown sandy clay
	Sample pH change on oxidation 4.9 → 3.4					Light brown grey clean fine sand ASS
				2.0		Clean grey sand fine & slightly silty
	Sample pH change 5.7 → 4.6					Black fine sand
BH34						Black sandy topsoil
						Dk. brown fine sand
				1.0		Fine grey sand slightly silty
	Sample pH change on oxidation 4.1 → 2.1			2.0		Fine black sand. PASS

Key to type of sample

U (50) - 50 mm dia undisturbed sample

D - disturbed sample

N ( ) - standard penetration test ... in brackets gives

Remarks (Observations on ground water, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level:

Dia of boring: 80 mm

Type of boring: FLIGHT AUGER

Casing tubes: NIL

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH35						Grey sandy Topsoil
						Yellow brown clayey sand
				1.0		Dirty white fine sand.
						Dk grey fine silty sand.
				2.0		P.A.S.S
BH36						Fine grey silty sand
				1.0		
	Sample pH change 5.3 → 3.9					Fine grey sand
				2.0		P.A.S.S
	Sample pH change 3.7 → 2.1					Fine black sand.

Key to type of sample

U (50) – 50 mm dia undisturbed sample

D – disturbed sample

N ( ) – standard penetration test

No. in brackets gives

Remarks (Observations on ground water, etc.)

RECORD OF BOREHOLE

CLIENT: GLOBAL P/L C/O LUKE & COMPANY

PROJECT: LAKE CATHIE DEVELOPMENT

Ground level: ..... Dia of boring: 80 mm

Type of boring: FLIGHT AUGER Lining tubes: NIL

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: AHD Level	Description of Strata
BH 37						Brown sandy topsoil
						Brown sandy CLAY
				1.0		Red brown CLAY moist, firm
				2.0		Mottled yellow br. and red br CLAY moist, stiff
				3.0		Mottled red br, yellow and grey stiff CLAY, with residual rock structure. Completely weathered claystones
				4.0		
				5.0		
				6.0		Weathered claystones. Red br. & grey, hard, dry. Rippable by large dozer.
				7.0		

Key to type of sample

U (50) – 50 mm dia undisturbed sample

B – disturbed sample

N ( ) – standard penetration test No in brackets gives

Remarks: (Observations on ground water, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Dia of boring 80 mm

Type of boring: FLIGHT AUGER Lining tubes NIL

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH38						clayey Topsoil
				1.0		Dk grey clay wet soft A.S.S
	Sample pH change on oxidation 5.1 → 4.1			2.0		Light grey sandy clay
						Light grey clayey sand with yellow blotches
BH39						clayey Topsoil
				1.0		Dk grey clay wet soft A.S.S
				2.0		Gray sandy clay
						Light grey sandy clay with yellow blotches and gravel

Key to type of sample

U (50) – 50 mm dia undisturbed sample

D – disturbed sample

N ( ) – standard penetration test

No. in brackets gives

no. of blows/300 mm penetration

Remarks (Observations on ground water, etc.)

RECORD OF BOREHOLES

CLIENT: GLOBAL P/L % LUKE & COMPANY

PROJECT: LAKE CATHIE PROJECT

Ground level: ..... Dia of boring: 80 mm

Type of boring: FLIGHT AUGER Casing tubes: NIL

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH 40				1.0		Fine grey sand
	Sample PH change on oxidation 3.9 → 3.6			2.0		
						Light grey clay
				1.0		
				2.0		

Key to type of sample

U (50) – 50 mm dia undisturbed sample

D – disturbed sample

N ( ) – standard penetration test (No. in brackets gives

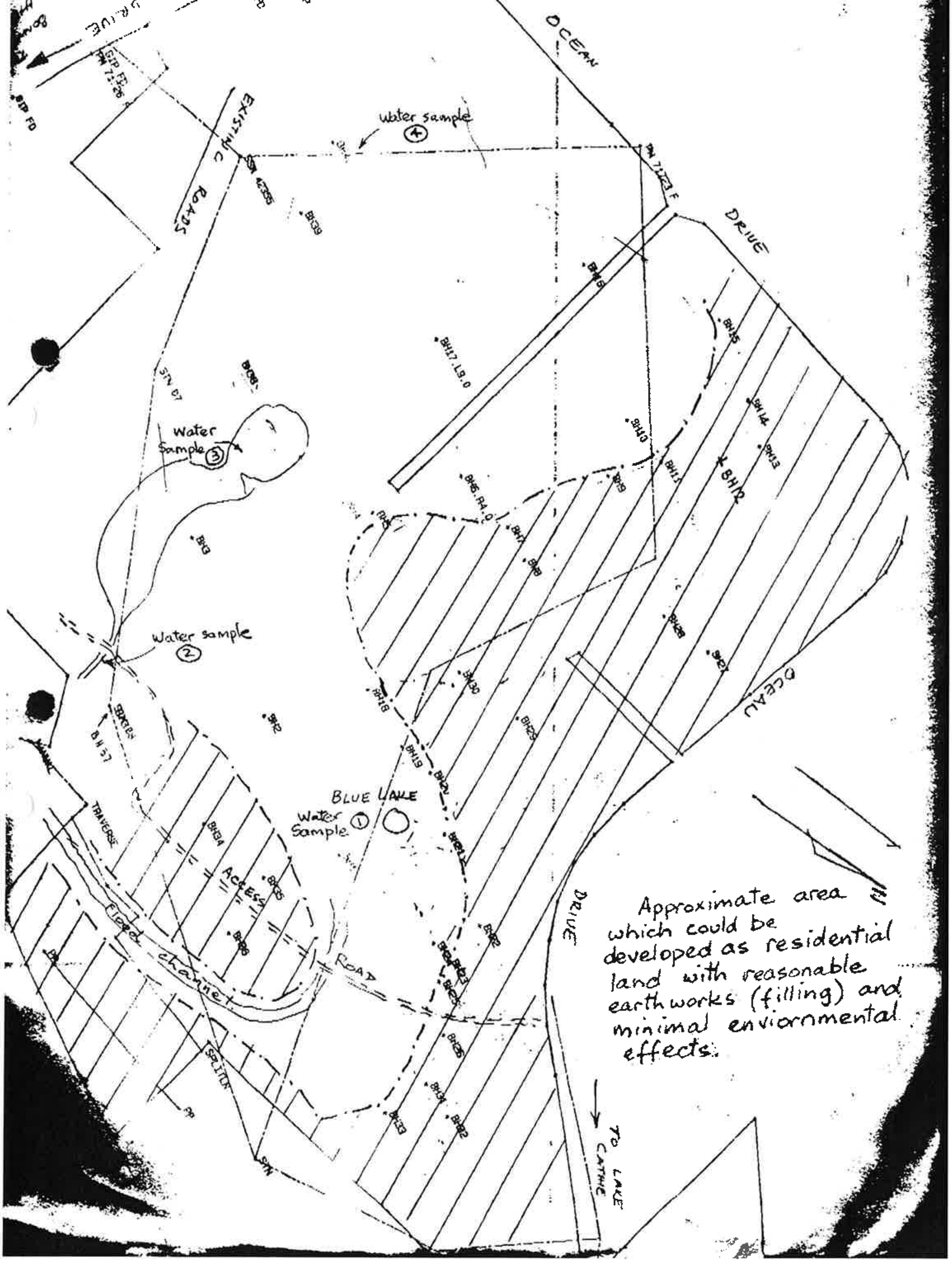
Remarks (Observations on ground water etc.)

SC093/276 Holmes & Holmes Pty Ltd

Rainbow Pacific Lake Cathie

93/492

Sample		C1A/3 EC (dS/m)	C2A/2 pH	C2C/1 pH H_2O_2
1	TP3 0.2-1.2	0.36	5.6	4.2
2.	2.0-2.5	0.16	4.3	2.5
3.	TP7 0.3-1.7	1.03	4.9	4.1
4.	TP11 0.3-1.8	0.48	8.6	8.6
5.	TP17 0.4-1.0	0.20	5.4	4.0
6.	1.0-1.8	0.36	5.0	4.2
7.	2.3-2.6	0.16	5.3	4.2
8.	TP19 0.3-2.0	0.92	4.5	3.7
9.	TP21 0.5-1.5	0.64	4.7	4.1
10.	1.8-2.0	0.82	5.2	4.3
11.	TP26 0.3-1.0	0.69	4.6	3.4
12.	1.2-1.4	0.60	5.5	4.0
13.	TP31 1.8-2.0	0.12	5.6	3.7
14.	TP33 1.3-1.5	0.06	4.9	3.4
15.	2.3-2.5	0.12	5.7	4.6
16.	TP34 2.3-2.5	0.05	4.1	2.1
17.	TP36 1.4-1.6	0.01	5.3	3.9
18.	2.3-2.5	0.06	3.7	2.1
19.	TP38 2.2-2.5	0.81	5.1	4.1
20.	TP40 1.5-2.0	0.16	3.9	3.6


DRIVE
EXISTING ROADS
OCEAN
DRIVE
Water sample 4
BH39
BH16
BH17 L9.0
BH15
BH14
BH13
BH12
BH11
BH10
BH9
BH8
BH7
BH6 R4.0
BH3
Water Sample 3
Water sample 2
BH 37
BH30
BH18
BH2
BH19
BH20
BH29
BH28
BH27
OCEAN
BLUE LAKE
Water Sample 1
BH34
BH35
BH36
ACCESS
ROAD
Flood channel
TRAVERSE
DRIVE
BH22
BH25
BH32
BH33
TO LAKE CATHIE
Approximate area which could be developed as residential land with reasonable earthworks (filling) and minimal enviornmental effects.

ID587-18

COFFS HARBOUR CITY COUNCIL

WATER AND WASTEWATER LABORATORY

Name: HOLMES & HOLMES PTY LTD — Bill Holmes

Postal Address: P.O. Box J159 CH. JETTY

Telephone: 536457 Facsimile: 536457 19/11/93

TYPE OF SAMPLE		TESTS REQUIRED
Water BLUE LAKE	(1)	pH Al Fe SO4
TOP DRAIN	(2)	on all please
TOP DAM	(3)	
BELOW DAM OUTLET	(4)	

RESULTS:	pH	mg/L Al	mg/L Fe	mg/L SO4
(1)	3.99	1.1	0.15	210
(2)	5.15	0.21	3.8	280
(3)	6.45	0.01	0.89	110
(4)	6.65	0.03	0.31	62

A Holmes B Wright — 12.11.93

Technical Officer, Coffs Harbour City Council — Date