Appendix 5

Chandler Geotechnical Pty Ltd

Acid Sulphate Soil Investigation
April 2004

Chandler Geotechnical Pty Ltd

ABN 83 066 029 329

PO Box 5720 Port Macquarie NSW 2444 Phone (02)65810142 Fax (02)65810129

TEST BORE REPORT

CLIENT: Luke & Co Pty Ltd
PROJECT: Rainbow Beach
LOCATION: Bonny Hills

PROJECT NO: 23159
DATE: 14.4.04
LEVEL: Existing

BOREHOLE: 1
METHOD OF ADVANCE: Spiral flight auger

DEPTH METRES	SAMPLES TESTS	DESCRIPTION OF STRATA (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
0.50	"D" PM 6402	TOPSOIL. Silty SAND, dark brown, sands fine grained, low to non-plastic fines.
1.00	"D" PM 5403	SAND, pale grey, fine to medium grained.
1.50	"D" PM 5404	SAND, orange-yellow, fine to medium grained, wet.
2.00	"D" PM 5405	
2.60	"D" PM 5406	Silty CLAY, pale grey, medium to high plasticity, sands fine grained, mc >> wp.
3.00	"D" PM 5407	Silty sandy CLAY, mottled grey & red, medium to high plasticity, sands fine to medium grained, mc > wp.
3.50	"D"PM 5408	
4.00	"D" PM 5409	Borehole terminated 3.5 metres.

RIG: Jacro
GROUND WATER: None encountered
REMARKS:

LOGGED: SC

SAMPLES & TESTS

D Disturbed sample U Undisturbed tube sample
B Bulk sample pp pocket penetrometer

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TEST BORE REPORT

CLIENT: Luke & Co Pty Ltd
PROJECT: Rainbow Beach
LOCATION: Bonny Hills

PROJECT NO: 23159
DATE: 14.4.04
LEVEL: Existing

BOREHOLE: 2
METHOD OF ADVANCE: Spiral flight auger

DEPTH METRES	SAMPLES TESTS	DESCRIPTION OF STRATA (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
0.50	"D" PM 5410	TOPSOIL. Silty SAND, dark grey, sands fine to medium grained, low to non-plastic fines.
1.00	"D" PM 5411	Silty CLAY, pale grey, medium to high plasticity, sands fine grained, mc >> wp.
	"D" PM 5412	
1.50	"D" PM 5413	SAND, grey, fine to medium grained.
2.00	"D" PM 5414	SAND, orange-yellow, fine to medium grained.
2.60	"D" PM 5415	
		SAND, pale grey, fine to medium grained.
3.00	"D" PM 5416	
3.50	"D" PM 5417	
4.00	"D" PM 5418	Borehole terminated 4.0 metres.

RIG: Jacro
LOGGED: SC
GROUND WATER: None encountered
REMARKS:

SAMPLES & TESTS

D Disturbed sample U Undisturbed tube sample
B Bulk sample pp pocket penetrometer

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TEST BORE REPORT

CLIENT: Luke & Co Pty Ltd
PROJECT: Rainbow Beach
LOCATION: Bonny Hills

PROJECT NO: 23159
DATE: 14.4.04
LEVEL: Existing

BOREHOLE: 3
METHOD OF ADVANCE: Spiral flight auger

DEPTH METRES	SAMPLES TESTS	DESCRIPTION OF STRATA (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
		TOPSOIL, Silty SAND, dark grey, sands fine to medium grained.
		Silty CLAY, pale grey, medium to high plasticity, sands fine grained, mc > wp
0.50	"D" PM 5419	
1.00	"D" PM 5420	
		Sandy CLAY, grey with some orange staining, medium to high plasticity sands fine to medium grained, mc > wp.
1.50	"D" PM 5421	
		SAND, pale grey-brown, fine to medium grained.
2.00	"D" PM 5422	
2.50	"D" PM 5423	
3.00	"D" PM 5424	
3.50	"D" PM 5425	
4.00	"D" PM 5426	Borehole terminated 4.0 metres.

RIG: Jacro
LOGGED: SC
GROUND WATER: None encountered
REMARKS:

SAMPLES & TESTS

D Disturbed sample U Undisturbed tube sample
B Bulk sample pp pocket penetrometer

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PO Box 5720 Port Macquarie NSW 2444 Phone (02)65810142 Fax (02)65810129

TEST BORE REPORT

CLIENT: Luke & Co Pty Ltd
PROJECT: Rainbow Beach
LOCATION: Bonny Hills

PROJECT NO: 23159
DATE: 14.4.04
LEVEL: Existing

BOREHOLE: 4
METHOD OF ADVANCE: Spiral flight auger

DEPTH METRES	SAMPLES TESTS	DESCRIPTION OF STRATA (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
		TOPSOIL. Silty SAND, dark grey, sands fine to medium grained.
		SAND, pale grey-white, medium grained.
0.50	"D" PM 5427	
1.00	"D" PM 5428	
1.50	"D" PM 5429	SAND, dark brown, fine to medium grained wet.
2.00	"D" PM 5430	
2.50	"D" PM 5431	
3.00	"D" PM 5432	
3.50	"D" PM 5433	
		Silty CLAY, (marine mud) grey, high plasticity, mc >> wp.
4.00	"D" PM 5434	Borehole terminated 4.0 metres.

RIG: Jacro
LOGGED: SC
GROUND WATER: None encountered
REMARKS:

SAMPLES & TESTS

D Disturbed sample U Undisturbed tube sample
B Bulk sample pp pocket penetrometer

RESULTS OF ACID SULPHATE SOIL ANALYSIS (Page 1 of 2)

30 samples supplied by Chandler Geotechnical on 23rd April, 2004 - Lab. Job No. E1988

Analysis requested by Steve Chandler.

Sample Site	Depth (m)	Texture (note 9)	FIELD SCREENING TECHNIQUE: initial pH (Water)	pH after peroxide	pH change	Reaction	Reduced Inorganic Sulphur (% chromium reducible S) (%Scr) (note 2)	TAA pH	Total Actual Acidity (TAA) mole / Kg	Lab. Bulk Density (tonne DW/m³)	Potential Acidity Neutralising Calculation Kg Lime/m³ (based on %Scr)	Actual Acidity Neutralising Calculation Kg Lime/m³ (based on TAA)	COMMENTS RE: Classification as potential acid sulphate soil (ASS) based on %Scr results)
BH1	0.5	Fine	4.10	4.35	0.25	No	..	4.27	0.106	1.24	..	6.5	NOT Potential ASS
BH1	1.0	Fine	3.71	4.07	0.36	No	0.005	4.25	0.032	1.35	0.2	2.1	NOT Potential ASS
BH1	1.2	Medium	4.32	4.40	0.08	No	..	4.66	0.018	1.49	..	1.3	NOT Potential ASS
BH1	1.8	Medium	4.25	4.57	0.32	No	..	4.83	0.007	1.79	..	0.5	NOT Potential ASS
BH1	2.2	Medium	4.11	4.40	0.29	No	..	4.71	0.008	1.44	..	0.6	NOT Potential ASS
BH1	2.5	Fine	3.89	4.20	0.31	No	..	4.31	0.023	1.46	..	1.6	NOT Potential ASS
BH1	3.0	Fine	3.61	3.95	0.34	No	0.005	4.05	0.028	1.35	0.2	1.9	NOT Potential ASS
BH1	3.5	Fine	3.79	4.10	0.31	No	0.003	4.16	0.027	1.25	0.1	1.6	NOT Potential ASS
BH2	0.5	Medium	4.43	4.28	-0.15	No	..	..	..	1.20	..	..	NOT Potential ASS
BH2	1.0	Fine	3.84	3.80	-0.04	No	0.012	4.05	0.080	1.09	0.4	4.3	NOT Potential ASS
BH2	1.3	Fine	3.73	3.74	0.01	No	0.003	3.98	0.059	1.00	0.1	2.9	NOT Potential ASS
BH2	1.5	Coarse	4.18	4.25	0.07	No	.	4.57	0.011	1.66	..	0.9	NOT Potential ASS
BH2	2.0	Coarse	4.27	4.21	-0.06	No	.	4.69	0.008	1.53	..	0.6	NOT Potential ASS
BH2	2.5	Coarse	4.62	4.60	-0.02	No	..	..	..	1.62	..	..	NOT Potential ASS
BH2	3.0	Medium	4.76	4.70	-0.06	No	..	..	..	1.52	..	..	NOT Potential ASS
BH2	3.5	Medium	4.82	3.89	-0.93	YES	0.082	..	..	1.32	3.4	..	YES Potential ASS
BH2	4.0	Coarse	4.79	3.91	-0.88	No	0.067	5.40	0.001	1.39	2.9 Refer Note 6 & 7	0.1 Refer Note 5 & 7	YES Potential ASS

NOTE:

1 - All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2 - Samples analysed by POCAS method (ie Peroxide Oxidation - Combined Acidity and Sulphate Version 3 (updated published method) and 'Chromium Reducible Sulphur' technique (Scr - Method 22B)

3 - Methods from Stone, Y, Ahern CR and Blunden B (998). Acid Sulphate Soil Manual 1998. ASSMAC. Wollongbar, NSW.

4 - Total carbon and total sulphur determined using a LECO CNS 2000 analyser

5 - Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)

6 - Neutralising Requirement (based on NAGP, chromium reducible sulphur or total sulphur) = Kg H_2SO_4/tonne x bulk density

7 - The neutralising requirement does not include a safety margin for complete neutralisation (a factor of 1.5 is often recommended)

8 - Conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm

9 - For Texture: coarse = sands to loamy sands, medium = sandy loams to light clays; fine = medium to heavy clays and silty clays

10 - Neutralisation Calculation for neutralisation of actual and potential acidity (ie sum of calculation based on Crs and TAA)

11 - The acid sulphate screening technique is currently NOT NATA registered

(Classification of potential acid sulphate material if: coarse Scr≥0.03%S; medium Scr≥0.06%S; fine Scr≥0.1%S)

(equivalent conversions - 0.03%S = 9.019 mole/ Kg; 0.06%S = 0.037 mole/ Kg; 0.1%S = 0.062 mole/ Kg)

*Projects that disturb >1000 tonnes of ASS soils with ≥0.03% S, a detailed management plan may be required.

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RESULTS OF ACID SULPHATE SOIL ANALYSIS (Page 2 of 2)

33 samples supplied by Chandler Geotechnical on 23rd April, 2004 - Lab Job No. E1988
Analysis requested by Steve Chandler.

Sample Site	Depth (m)	Texture (note 9)	FIELD SCREENING TECHNIQUE: Initial pH (Water)	pH after peroxide	pH change	Reaction	Reduced Inorganic Sulphur (% chromium reducible S) (%Scr) (note 2)	TAA pH	Total Actual Acidity (TAA) mole / Kg	Lab. Bulk Density tonne DW/m³	Potential Acidity Neutralising Calculation Kg Lime/m³ (based on %Scr)	Actual Acidity Neutralising Calculation Kg Lime/m³ (based on TAA)	COMMENTS RE: Classification as potential acid sulphate soil (ASS) (based on %Scr results)
BH3	0.5	Fine	4.23	4.19	-0.04	No	0.007	4.20	0.044	1.14	0.2	2.5	NOT Potential ASS
BH3	1.0	Medium	4.30	4.36	0.06	No	..	4.62	0.011	1.76	..	0.9	NOT Potential ASS
BH3	1.5	Medium	3.94	3.95	0.0	No	0.005	4.20	0.028	1.59	0.2	2.1	NOT Potential ASS
BH3	2.0	Coarse	4.02	4.09	0.07	No	0.005	4.38	0.015	1.56	0.2	1.1	NOT Potential ASS
BH3	2.5	Coarse	4.63	4.84	0.21	No	..	..	..	1.59	..	..	NOT Potential ASS
BH3	3.0	Coarse	4.54	4.65	0.11	No	0.005	4.86	0.008	1.67	0.3	0.5	NOT Potential ASS
BH3	3.5	Coarse	4.72	4.95	0.23	No	..	..	..	1.73	..	..	NOT Potential ASS
BH3	4.0	Coarse	4.80	4.70	-0.10	No	..	..	..	1.68	..	..	NOT Potential ASS
BH4	0.5	Coarse	4.77	4.98	0.21	No	.	..	..	1.47	..	..	NOT Potential ASS
BH4	1.0	Coarse	5.04	5.95	0.91	No	..	..	..	1.45	..	..	NOT Potential ASS
BH4	1.5	Coarse	4.41	4.35	-0.06	No	0.005	4.64	0.025	1.20	0.2	1.5	NOT Potential ASS
BH4	2.0	Coarse	4.46	4.50	0.04	No	..	..	..	1.49	..	..	NOT Potential ASS
BH4	2.5	Coarse	4.53	4.60	0.07	No	..	..	..	1.49	..	..	NOT Potential ASS
BH4	3.0	Coarse	4.58	4.58	0.00	No	0.007	4.98	0.005	1.48	0.3	0.4	NOT Potential ASS
BH4	3.5	Coarse	4.56	3.10	-1.46	YES	0.247	4.79	0.008	1.59	12.3	0.7	YES Potential ASS
BH4	4.0	Coarse	4.04	1.99	-2.05	YES	1.677	4.40	0.019	1.30	68.3	1.2	YES Potential ASS
											Refer Note 6 & 7	Refer Note 6 & 7	

NOTE:
1 - All analysis is Dry Weight (DW) - Samples dried and ground immediately upon arrival (unless supplied dried and ground)
2 - Samples analysed by POCAS method (ie Peroxide Oxidation - Combined Acidity and Sulphate - Version 3 updated published method) and 'Chromium Reducible Sulphur' technique (Scr - Method 22B)
3 - Methods from Stone, Y, Ahern CR, and Blunden B (1998). Acid Sulphate Soil Manual 1998. ASSMAC, Wollongbar, NSW.
4 - Total carbon and total sulphur determined using a LECO CNS 2000 analyser
5 - Bulk density was determined immediately on arrival to laboratory (in situ bulk density is preferred)
6 - Neutralising Requirement (based on NAGP, chromium reducible sulphur or total sulphur) = Kg H_2SO_4/tonne x bulk density
7 The neutralising requirement does not include a safety margin for complete neutralisation (a factor of 1.5 is often recommended)
8 - Conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm
9 - For Texture: coarse = sands to loamy sands, medium = sandy loams to light clays; fine = medium to heavy clays and silty clays
10 - Neutralisation Calculation for neutralisation of actual and potential acidity (ie. sum of calculation based on Cr and TAA)
11 - The acid sulphate screening technique is currently NOT NATA registered

(Classification of potential acid sulphate material if: coarse Scr≥0.03%S; medium Scr≥0.06%S; fine Scr≥0.1%S)
(equivalent conversions - 0.03%S = 0.019 mole/ Kg; 0.06%S = 0.037 mole/ Kg; 0.1%S = 0.062 mole/ Kg)
* Projects that disturb >1000 tonnes of ASS soils with ≥0.03% S, a detailed management plan may be required.

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Environmental Analysis Laboratory

Rainbow Beach Estate.

Client Luke & Co Project 25036

Date 25/10/5 Technician Captain Navas. Able Seaman Chook.

Sample Location Bonny hills Lots.

Sample time 3:42

Depth	2.5m	2.0m	1.5m	1.0m	0.5m	0.0m.	3 <
Temp	19.97	21.31	25.26	25.47	25.52	25.55	19.
Dissolved Oxygen	74.5	88.4	127.4	128.2	128.3	128.5	88.
Ph	6.49	6.50	7.07	7.08	7.10	7.09.	6.5
ORP	139.8	143.7	139.6	141.0	141.8	141.3	132
ms/cm²	0.200.	0.218.	0.201	0.199.	0.199.	-0.203.	0.2

Notes:

Rainbow Beach Estate.

Client Luke & Co Project 25036

Date 13-10-5 Technician Chook & Mumy.

Sample Location Buoy Centre of Lake.

Sample time 12:00

Depth	2.5m	2.0m	1.5m	1.0m	0.5m	0.0m.
Temp	19.72	23.2	23.36	23.42	23.44	23.42
Dissolved Oxygen	78.4	127.2	129.1	127.5	129.5	128.0.
Ph	6.40	6.94	6.99	7.00	7.01	7.00
ORP	197.2	186.5	186.8	185.1	186.0	185.8.
ms/cm²	0.169	0.169	0.169	0.169	0.169	0.169.

Notes:

Rainbow Beach Estate.

Client Luke & Co Project 25036

Date 29/9/05 Technician Woods & Chuck.

Sample Location Bay Centre of Lake.

Sample time 13:00

Depth	2.5m	2.0m	1.5m	1.0m	0.5m	0.0m.
Temp	17.45	18.75	19.85	21.20	21.50	22.0
Dissolved Oxygen	63.5	88.8	104.0	117.7	116.7	120.1
Ph	6.34	6.44	6.60	6.78	6.80	6.83
ORP	310.6	287.1	261.2	222.0	211.7	200.0
ms/cm³	0.165	0.165	0.165	0.165	0.164	0.165

Notes:

Coffey Geosciences Pty Ltd

trading as

Chandler Geotechnical

Unit 1/37 Jindalee Road, Port Macquarie NSW 2444

Telephone (02) 65810142 Fax (02) 65810129

WATER TEST RESULTS

CLIENT :	Luke & Co	**PROJECT No :**	PML032
PROJECT :	Rainbow Beach Lake	**REPORT No :**	PML032-1
LOCATION :	Bonny Hills	**DATE :**	17.2.06

Depth (metres)	Surface	0.5m	1.0m	1.5m	2.0m	2.5m
Temperature °c		24.7	24.7	24.7	24.7	24.6
Dissolved Oxygen %		74.4	81.2	70.6	72.1	45.5
pH		6.96	7.07	6.91	7.40	7.01
ORP		53.0	82.1	50.9	76.2	74.3
Conductivity mS/cm		0.221	0.216	0.221	0.217	0.219

Equipment Used
YSI 556 Multi Probe System/Data Logger

S.Chandler

RESULTS OF WATER ANALYSIS (Page 1 of 1)

1 sample supplied by Chandler Geotechnical Pty Ltd on the 23rd February 2006 - Lab. Job No. E5292

Analysis requested by Steve Chandler - Your Project: **PML032, Rainbow Beach**

PARAMETER	METHODS REFERENCE	Sample 1 PM6873
	Job No.	*E5292/1*
TOTAL PHOSPHORUS (mg/L P)	APHA 4500 P-H	0.02
TOTAL NITROGEN (mg/L N)	APHA 4500 N-C	0.62

Notes:

1. 1 mg/L (milligram per litre) = 1 ppm (part per million) = 1000 µg/L (micrograms per litre)= 1000 ppb (part per billion)
2. Analysis performed according to APHA, 1998, "Standard Methods for the Examination of Water & Wastewater", 20th Edition, except where stated otherwise.
3. Analysis conducted between sample arrival date and Report provision date
4. ** denotes these test procedures are as yet not NATA registered but quality control data is available

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