Appendix B
Results of Laboratory Testing

ALS Environmental

CERTIFICATE OF ANALYSIS

Client	: COFFEY GEOTECHNICS	*Laboratory*	: Environmental Division Brisbane	*Page*	: 1 of 10
Contact	: MR ROB PEARCE	*Contact*	: Tim Kilmister	*Work Order*	: EB0704186
Address	: 13 MANGROVE ROAD SANDGATE NSW AUSTRALIA 2304	*Address*	: 32 Shand Street Stafford QLD Australia 4053		
E-mail	: robert_pearce@coffey.com.au	*E-mail*	: Services.Brisbane@alsenviro.com		
Telephone	: 49676377	*Telephone*	: 61-7-3243 7222		
Facsimile	: 49675402	*Facsimile*	: 61-7-3243 7259		
Project	: GEOTSGTE 20248AA	*Quote number*	: EN/007/07	*Date received*	: 17 Apr 2007
Order number	: 2524			*Date Issued*	: 8 May 2007
C-O-C number	: 0361-0362			*No. of samples*	- *Received* : 19
Site	: - Not provided -				*Analysed* : 19

ALSE - Excellence in Analytical Testing

NATA Accredited Laboratory 825

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This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	*Position*	*Department*
Lea-Ellen Catt	Laboratory Technician - Acid Sulphate Soils	Inorganics - NATA 825 (818 - Brisbane)

ALS Environmental

Comments

This report for the ALSE reference EB0704186 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- Analytical Results for Samples Submitted
- Surrogate Recovery Data

The analytical procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

Specific comments for Work Order EB0704186

Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. Conversion to liming rate in kg/m3 = kg/t x wet bulk density in t/m3.
Excess ANC not required because pH OX less than 6.5.

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: BH36 0.5-1.0	BH36 3.5-4.0	BH37 5.0-5.5	BH37 6.5-7.0	BH38 0.5-1.0
Sample Matrix Type / Description:				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time:				11 Apr 2007 15:00	11 Apr 2007 15:00	11 Apr 2007 15:00	11 Apr 2007 15:00	11 Apr 2007 15:00
Laboratory Sample ID:				EB0704186-001	EB0704186-002	EB0704186-003	EB0704186-004	EB0704186-005
EA029-A: pH Measurements								
pH KCl (23A)		0.1	pH Unit	4.6	5.2	4.5	4.6	4.2
pH OX (23B)		0.1	pH Unit	4.2	3.8	2.7	2.7	4.1
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)		2	mole H+ / t	26	11	37	41	108
Titratable Peroxide Acidity (23G)		2	mole H+ / t	28	19	120	118	137
Titratable Sulfidic Acidity (23H)		2	mole H+ / t	<2	8	83	77	29
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.04	<0.02	0.06	0.06	0.17
sulfidic - Titratable Peroxide Acidity (s-23G)		0.02	% pyrite S	0.04	0.03	0.19	0.19	0.22
sulfidic - Titratable Sulfidic Acidity (s-23H)		0.02	% pyrite S	<0.02	<0.02	0.13	0.12	0.05
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)		0.02	% S	<0.02	<0.02	0.09	0.10	0.04
Peroxide Oxidisable Sulfur (23E)		0.02	% S	<0.02	<0.02	0.09	0.10	0.04
acidity - Peroxide Oxidisable Sulfur (a-23E)		10	mole H+ / t	<10	<10	56	63	25
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)		0.02	% Ca	0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Calcium (23Wh)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Calcium (23X)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Calcium (a-23X)		10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)		0.02	% Mg	0.02	<0.02	<0.02	<0.02	0.04
Peroxide Magnesium (23Tm)		0.02	% Mg	<0.02	<0.02	<0.02	<0.02	0.04
Acid Reacted Magnesium (23U)		0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Magnesium (a-23U)		10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-G: Retained Acidity								
Net Acid Soluble Sulfur (20Je)		0.02	% S	—	—	—	—	0.03
acidity - Net Acid Soluble Sulfur (a-20J)		10	mole H+ / t	—	—	—	—	14
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02	% pyrite S	—	—	—	—	0.02
HCl Extractable Sulfur (20Be)		0.02	% S	—	—	—	—	0.03

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: BH36 0.5-1.0	BH36 3.5-4.0	BH37 5.0-5.5	BH37 6.5-7.0	BH38 0.5-1.0
				Sample Matrix Type / Description: SOIL	SOIL	SOIL	SOIL	SOIL
				Sample Date / Time: 11 Apr 2007 15:00	11 Apr 2007 15:00	11 Apr 2007 15:00	11 Apr 2007 15:00	11 Apr 2007 15:00
				Laboratory Sample ID: EB0704186-001	EB0704186-002	EB0704186-003	EB0704186-004	EB0704186-005
EA029-H: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.04	<0.02	0.15	0.17	0.24
Net Acidity (acidity units)		10	mole H+ / t	26	11	93	104	147
Liming Rate		1	kg CaCO3/t	2	<1	7	8	11

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: BH38 6.5-7.0	TP34 1.0-1.1	TP33 1.1-1.2	TP32 1.6-1.7	TP30 1.5-1.6
Sample Matrix Type / Description:				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time:				11 Apr 2007 15:00	5 Apr 2007 15:00	5 Apr 2007 15:00	5 Apr 2007 15:00	5 Apr 2007 15:00
Laboratory Sample ID:				EB0704186-006	EB0704186-007	EB0704186-008	EB0704186-009	EB0704186-010
EA029-A: pH Measurements								
pH KCl (23A)		0.1	pH Unit	5.2	4.9	5.7	5.0	5.0
pH OX (23B)		0.1	pH Unit	4.2	2.8	3.0	2.8	3.5
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)		2	mole H+ / t	11	15	2	7	11
Titratable Peroxide Acidity (23G)		2	mole H+ / t	17	99	42	55	56
Titratable Sulfidic Acidity (23H)		2	mole H+ / t	6	84	40	47	45
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	<0.02	0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)		0.02	% pyrite S	0.03	0.16	0.07	0.09	0.09
sulfidic - Titratable Sulfidic Acidity (s-23H)		0.02	% pyrite S	<0.02	0.13	0.06	0.08	0.07
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)		0.02	% S	<0.02	0.04	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)		0.02	% S	<0.02	0.21	0.12	0.12	0.08
Peroxide Oxidisable Sulfur (23E)		0.02	% S	<0.02	0.16	0.12	0.12	0.08
acidity - Peroxide Oxidisable Sulfur (a-23E)		10	mole H+ / t	<10	102	75	76	47
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Calcium (23Wh)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Calcium (23X)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Calcium (a-23X)		10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)		0.02	% Mg	<0.02	0.03	<0.02	<0.02	<0.02
Peroxide Magnesium (23Tm)		0.02	% Mg	<0.02	0.03	0.02	<0.02	<0.02
Acid Reacted Magnesium (23U)		0.02	% Mg	<0.02	<0.02	0.02	<0.02	<0.02
acidity - Acid Reacted Magnesium (a-23U)		10	mole H+ / t	<10	<10	18	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)		0.02	% S	<0.02	<0.02	0.03	<0.02	<0.02
EA029-H: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	<0.02	0.19	0.12	0.13	0.09
Net Acidity (acidity units)		10	mole H+ / t	11	117	77	84	58
Liming Rate		1	kg CaCO3/t	<1	9	6	6	4

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: TP28 0.6-0.7 SOIL 5 Apr 2007 15:00 Laboratory Sample ID: EB0704186-011	TP27 1.1-1.2 SOIL 5 Apr 2007 15:00 EB0704186-012	TP26 1.5-1.6 SOIL 5 Apr 2007 15:00 EB0704186-013	TP25 1.9-2.0 SOIL 5 Apr 2007 15:00 EB0704186-014	TP19 0.5-0.6 SOIL 5 Apr 2007 15:00 EB0704186-015
EA029-A: pH Measurements								
pH KCl (23A)		0.1	pH Unit	4.4	5.0	5.4	4.3	4.5
pH OX (23B)		0.1	pH Unit	3.1	2.8	3.3	2.2	3.6
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)		2	mole H+ / t	53	21	7	46	36
Titratable Peroxide Acidity (23G)		2	mole H+ / t	94	33	197	53	95
Titratable Sulfidic Acidity (23H)		2	mole H+ / t	40	12	189	8	59
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.08	0.03	<0.02	0.07	0.06
sulfidic - Titratable Peroxide Acidity (s-23G)		0.02	% pyrite S	0.15	0.05	0.32	0.08	0.15
sulfidic - Titratable Sulfidic Acidity (s-23H)		0.02	% pyrite S	0.06	<0.02	0.30	<0.02	0.09
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)		0.02	% S	<0.02	<0.02	<0.02	0.05	0.02
Peroxide Oxidisable Sulfur (23E)		0.02	% S	<0.02	<0.02	<0.02	0.05	0.02
acidity - Peroxide Oxidisable Sulfur (a-23E)		10	mole H+ / t	<10	<10	<10	30	13
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Calcium (23Wh)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Calcium (23X)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Calcium (a-23X)		10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)		0.02	% Mg	<0.02	<0.02	<0.02	<0.02	0.02
Peroxide Magnesium (23Tm)		0.02	% Mg	<0.02	<0.02	<0.02	<0.02	0.02
Acid Reacted Magnesium (23U)		0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Magnesium (a-23U)		10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-G: Retained Acidity								
Net Acid Soluble Sulfur (20Je)		0.02	% S	<0.02	—	—	<0.02	—
acidity - Net Acid Soluble Sulfur (a-20J)		10	mole H+ / t	<10	—	—	<10	—
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02	% pyrite S	<0.02	—	—	<0.02	—
HCl Extractable Sulfur (20Be)		0.02	% S	<0.02	—	—	<0.02	—

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: TP28 0.6-0.7 Sample Matrix Type / Description: SOIL Sample Date / Time: 5 Apr 2007 15:00 Laboratory Sample ID: EB0704186-011	TP27 1.1-1.2 SOIL 5 Apr 2007 15:00 EB0704186-012	TP26 1.5-1.6 SOIL 5 Apr 2007 15:00 EB0704186-013	TP25 1.9-2.0 SOIL 5 Apr 2007 15:00 EB0704186-014	TP19 0.5-0.6 SOIL 5 Apr 2007 15:00 EB0704186-015
EA029-H: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.06	0.03	<0.02	0.12	0.08
Net Acidity (acidity units)		10	mole H+ / t	53	21	<10	76	49
Liming Rate		1	kg CaCO3/t	4	2	<1	6	4

ALS Environmental

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: TP14 0.6-0.7	TP6 2.0-2.1	BH37 0.5-1.0	BH37 2.0-2.5	
Sample Matrix Type / Description:				SOIL	SOIL	SOIL	SOIL	
Sample Date / Time:				5 Apr 2007 15:00	5 Apr 2007 15:00	(5 Apr 2007) (15:00)	(5 Apr 2007) (15:00)	
Laboratory Sample ID:				EB0704186-016	EB0704186-017	EB0704186-018	EB0704186-019	
EA029-A: pH Measurements								
pH KCl (23A)		0.1	pH Unit	4.1	4.9	5.1	5.0	
pH OX (23B)		0.1	pH Unit	4.1	3.9	4.1	3.2	
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)		2	mole H+ / t	70	16	14	24	
Titratable Peroxide Acidity (23G)		2	mole H+ / t	22	15	102	102	
Titratable Sulfidic Acidity (23H)		2	mole H+ / t	<2	<2	88	78	
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.11	0.02	0.02	0.04	
sulfidic - Titratable Peroxide Acidity (s-23G)		0.02	% pyrite S	0.04	0.02	0.16	0.16	
sulfidic - Titratable Sulfidic Acidity (s-23H)		0.02	% pyrite S	<0.02	<0.02	0.14	0.12	
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)		0.02	% S	0.04	<0.02	<0.02	<0.02	
Peroxide Sulfur (23De)		0.02	% S	0.06	<0.02	<0.02	0.03	
Peroxide Oxidisable Sulfur (23E)		0.02	% S	<0.02	<0.02	<0.02	0.03	
acidity - Peroxide Oxidisable Sulfur (a-23E)		10	mole H+ / t	10	<10	<10	21	
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	
Peroxide Calcium (23Wh)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	
Acid Reacted Calcium (23X)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02	
acidity - Acid Reacted Calcium (a-23X)		10	mole H+ / t	<10	<10	<10	<10	
sulfidic - Acid Reacted Calcium (s-23X)		0.02	% S	<0.02	<0.02	<0.02	<0.02	
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)		0.02	% Mg	0.08	<0.02	<0.02	<0.02	
Peroxide Magnesium (23Tm)		0.02	% Mg	0.09	<0.02	<0.02	<0.02	
Acid Reacted Magnesium (23U)		0.02	% Mg	<0.02	<0.02	<0.02	<0.02	
acidity - Acid Reacted Magnesium (a-23U)		10	mole H+ / t	12	<10	<10	<10	
sulfidic - Acid Reacted Magnesium (s-23U)		0.02	% S	<0.02	<0.02	<0.02	<0.02	
EA029-G: Retained Acidity								
Net Acid Soluble Sulfur (20Je)		0.02	% S	<0.02	—	—	—	
acidity - Net Acid Soluble Sulfur (a-20J)		10	mole H+ / t	<10	—	—	—	
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02	% pyrite S	<0.02	—	—	—	
HCl Extractable Sulfur (20Be)		0.02	% S	0.05	—	—	—	

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : TP14 0.6-0.7 Sample Matrix Type / Description : SOIL Sample Date / Time : 5 Apr 2007 15:00 Laboratory Sample ID : EB0704186-016	TP6 2.0-2.1 SOIL 5 Apr 2007 15:00 EB0704186-017	BH37 0.5-1.0 SOIL (5 Apr 2007) (15:00) EB0704186-018	BH37 2.0-2.5 SOIL (5 Apr 2007) (15:00) EB0704186-019	
EA029-H: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	
Net Acidity (sulfur units)		0.02	% S	0.14	0.02	0.02	0.07	
Net Acidity (acidity units)		10	mole H+ / t	84	16	14	44	
Liming Rate		1	kg CaCO3/t	6	1	1	3	

ALS Environmental

Surrogate Control Limits

- No surrogates present on this report.

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: GEOTSGTE20248AA
sheet *1* of *1*

acid sulfate soil screening test

office: Newcastle (LABTSGTE00173AA)

client: *TATTERSAL SURVEYORS* date: *12/04/07*

principal: test location: *Newcastle*

project: *RIVERSIDE ESTATE PROJECT APPLICATION* tested by: *NH/GR*

location: *TEA GARDENS* checked by:

date samples recovered: pH meter used/serial **Horiba** date of calibration:

hydrogen peroxide pH prior to use: *5.46* hydrogen peroxide temperature prior to use: *22.3*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH_{FOX} Change (ie pH_F-pH_{FOX})	Additional comments
TP3	*1.0-1.1*		*Sand/ Clay*	*5.60*	*10*	*3.85*	25	b	Y	N	1.75	
TP27	*1.1-1.2*		*Sand*	*4.47*	*10*	*3.35*	25	a	N	N	1.12	
TP28	*0.6-0.7*		*Sand / Clay*	*4.95*	*10*	*3.55*	25	b	Y	N	1.4	
TP22	*1.8-1.9*		*Sand*	*5.59*	*10*	*4.68*	25	a	N	N	0.91	
TP6	*1.5-1.6*		*Sand*	*4.71*	*10*	*2.60*	25	a	N	N	2.11	
TP9	*1.9-2.0*		*Sand*	*5.25*	*10*	*4.15*	25	a	N	N	1.1	
TP24	*0.5-0.6*		*Clay / Sand*	*5.03*	*10*	*3.63*	24	a	N	N	1.4	
TP24	*1.0-1.1*		*Sand*	*5.11*	*10*	*3.88*	24	a	N	N	1.23	
TP24	*1.9-2.0*		*Sand*	*5.56*	*10*	*5.24*	24	a	N	N	0.32	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
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job no:
LABTSGTE00173AA
sheet *1* of *1*

acid sulfate soil screening test

office: Newcastle

client: *TATTERSAL SURVEYORS* date: *13/04/07*

principal: test location: *Newcastle*

project: *RIVERSIDE ESTATE PROJECT APPLICATION* tested by: *NH*

location: *Tea Gardens* checked by:

date samples recovered: pH meter used/serial Horiba date of calibration:

hydrogen peroxide pH prior to use: *5.46* hydrogen peroxide temperature prior to use: *22.3*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP18	*0.6-0.7*		*Sand*	*4.81*	*10*	*4.17*	23	A	N	N	0.64	
TP18	*1.8-1.9*		*Sand*	*5.27*	*10*	*4.45*	23	A	N	N	0.82	
TP6	*0.6-0.7*		*Silty Sand*	*4.76*	*10*	*4.15*	23	A	N	N	0.61	
TP6	*1.0-1.1*		*Sand*	*4.80*	*10*	*4.15*	23	A	N	N	0.65	
TP4	*0.5-0.6*		*Clay*	*5.62*	*10*	*4.13*	23	A	Y	N	1.49	
TP17	*1.1-1.2*		*Sand*	*5.46*	*10*	*5.21*	23	A	N	N	0.25	
TP11	*1.0-1.1*		*Sand*	*5.70*	*10*	*5.37*	24	A	N	N	0.33	
TP22	*0.5-0.6*		*Silty Sand*	*5.83*	*10*	*5.40*	24	b	N	N	0.43	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no:
LABTSGTE00173AA
sheet 1 of 1

acid sulfate soil screening test

office: Newcastle

client: *TATTERSAL SURVEYORS* date: *12/04/07*

principal: test location: *Newcastle*

project: *RIVERSIDE ESTATE PROJECT APPLICATION* tested by: *NH*

location: *TEA GARDENS* checked by:

date samples recovered: *10-04-07* pH meter used/serial Horiba date of calibration:

hydrogen peroxide pH prior to use: *5.46* hydrogen peroxide temperature prior to use: *22.3*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP12	*0.6-0.7*		*Sand*	*5.99*	*10*	*3.98*	22		N	N	2.01	
TP12	*1.1-1.2*		*Sand*	*5.66*	*10*	*4.13*	22		N	N	1.53	
TP12	*1.9-2.0*		*Sand*	*6.44*	*10*	*4.71*	23		N	N	1.73	
TP13	*1.1-1.2*		*Sand*	*5.30*	*10*	*4.28*	23		N	N	1.02	
TP14	*0.6-0.7*		*Clay*	*5.20*	*10*	*3.26*	23		N	N	1.94	
TP14	*1.7-1.8*		*Clay*	*4.89*	*10*	*3.42*	23		N	N	1.47	
TP15	*1.1-1.2*		*Sand*	*4.84*	*10*	*3.85*	23		N	N	0.99	
TP34	*1.9-2.0*		*Sand*	*6.33*	*10*	*5.45*	23		N	N	0.88	
TP31	*0.6-0.7*		*Sand*	*6.56*	*10*	*4.80*	23		N	N	1.76	
TP30	*0.6-0.7*		*Sand*	*6.00*	*10*	*4.90*	23		N	N	1.1	
TP32	*1.6-1.7*		*Sand*	*6.40*	*10*	*1.43*	30		Y	N	4.97	

NOTES: 1. Observed Reaction: a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no:
LABTSGTE00173AA
sheet 1 of 1

acid sulfate soil screening test

office: Newcastle

client: *TATTERSAL SURVEYORS* date: *12/04/07*

principal: test location: *Newcastle*

project: *RIVERSIDE ESTATE PROJECT APPLICATION* tested by: *NH*

location: *TEA GARDENS* checked by:

date samples recovered: *10-04-07* pH meter used/serial Horiba date of calibration:

hydrogen peroxide pH prior to use: *5.46* hydrogen peroxide temperature prior to use: *22.3*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP31	*1.0 – 1.1*		*Sand*	*6.00*	*10*	*3.63*	24	A	N	N	2.37	
TP34	*0.55 – 0.65*		*Sand*	*6.76*	*10*	*4.51*	25	B	Yes	N	2.25	
TP32	*0.7 – 0.8*		*Sand*	*5.20*	*10*	*3.91*	24	S	N	N	1.29	
TP33	*1.1-1.2*		*Sand*	*6.34*	*10*	*1.45*	30	B	Yes	N	4.89	
TP34	*1.0 – 1.1*		*Sand*	*6.35*		*1.36*	33	B	Yes	Yes	4.99	Lighter in peroxide
TP30	*1.5 – 1.6*		*Sand*	*5.25*	*10*	*2.81*	25	b	Yes	N	2.44	

NOTES: 1. Observed Reaction: a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: LABTSGTE00173AA
sheet 1 of 1

acid sulfate soil screening test

office: Newcastle

client: *TATTERSAL SURVEYORS* date: *13/04/07*

principal: test location: *Newcastle*

project: *RIVERSIDE ESTATE PROJECT APPLICATION* tested by: *NH*

location: *TEA GARDENS* checked by:

date samples recovered: *10-04-07* pH meter used/serial Horiba date of calibration:

hydrogen peroxide pH prior to use: *5.49* hydrogen peroxide temperature prior to use: *22.0*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP4	*2.0-2.1*		*Sand*	*5.75*	*10*	*1.65*	28	B	Y	Y	4.1	Lighter After Reaction
TP19	*1.1-1.2*		*Clay*	*5.20*	*10*	*3.50*	23	A	N	N	1.7	
TP9	*1.0-1.1*		*Sand*	*4.90*	*10*	*3.60*	23	A	N	N	1.3	
TP25	*0.6-0.7*		*Sand*	*4.55*	*10*	*3.25*	22	A	N	N	1.3	
TP25	*1.9-2.0*		*Clay*	*4.36*	*10*	*3.26*	23	A	N	N	1.1	
TP6	*2.0-2.1*		*Sand*	*4.94*	*10*	*4.06*	22	A	N	N	0.88	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no:
LABTSGTE00173AA
sheet *1* of *2*

acid sulfate soil screening test

office: Newcastle

client: *TATTERSAL SURVEYORS* date: *13/04/07*

principal: test location: *Newcastle*

project: *RIVERSIDE ESTATE PROJECT APPLICATION* tested by: *NH/GR*

location: *TEA GARDENS* checked by:

date samples recovered: pH meter used/serial Horiba date of calibration:

hydrogen peroxide pH prior to use: *5.28* hydrogen peroxide temperature prior to use: *21.0*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP16	*0.5-0.6*		*Sand*	*4.96*	*10*	*4.72*	21.5	a	N	N	0.24	
TP16	*1.7-1.8*		*Sand*	*4.93*	*10*	*3.83*	21.5	a	N	N	1.1	
TP3	*1.7-1.8*		*Sand*	*5.65*	*10*	*5.42*	21.0	a	N	N	0.23	
TP5	*1.5-1.6*		*Sand*	*5.25*	*10*	*4.50*	21.5	a	N	N	0.75	
TP5	*0.9-1.0*		*Sand*	*5.78*	*10*	*4.98*	21.5	a	N	N	0.8	
TP2	*1.0-11*		*Sand*	*5.53*	*10*	*3.36*	21.5	a	N	N	2.17	
TP10	*0.5-0.6*		*Sand*	*5.25*	*10*	*4.60*	21	a	N	N	0.65	
TP10	*1.8-1.9*		*Sand*	*5.50*	*10*	*4.60*	21	a	N	N	0.9	
TP1	*1.0-1.1*		*Sand*	*5.60*	*10*	*4.79*	21	a	N	N	0.81	
TP262	*0.5-0.6*		*Sand*	*4.90*	*10*	*4.70*	21	a	N	N	0.2	
TP26	*1.0-1.1*		*Sand*	*4.75*	*10*	*4.28*	21	a	N	N	0.47	

NOTES: 1. Observed Reaction: a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

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SPECIALISTS MANAGING THE EARTH

job no:
LABTSGTE00173AA
sheet 2 of 2

acid sulfate soil screening test

office: Newcastle

client: *TATTERSAL SURVEYORS*
date: *13/04/07*
principal:
test location: *Newcastle*
project: *RIVERSIDE ESTATE PROJECT APPLICATION*
tested by: *NH/GR*
location: *TEA GARDENS*
checked by:

date samples recovered: pH meter used/serial Horiba date of calibration:

hydrogen peroxide pH prior to use: *5.46* hydrogen peroxide temperature prior to use: *22.3*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP21	*1.1-1.2*		*Sand*	*5.30*	*10*	*5.20*	21	a	N	N	0.1	
TP10	*1.1-1.2*		*Sand*	*5.30*	*10*	*4.80*	22	a	N	N	0.5	
TP20	*0.6-0.7*		*Sand*	*5.03*	*10*	*4.17*	22	a	N	N	0.86	
TP20	*1.6-1.7*		*Sand*	*5.10*	*10*	*5.01*	22	a	N	N	0.09	
TP29	*1.1-1.2*		*Sand*	*5.20*	*10*	*4.03*	22	b	Y	N	1.17	
TP28	*1.7-1.8*		*Sand*	*5.10*	*10*	*4.60*	22	a	N	N	0.5	
TP19	*0.5-0.6*		*Sand*	*4.96*	*10*	*3.70*	22	b	Y	N	1.26	
TP1	*0.5-0.6*		*Sand*	*7.28*	*10*	*5.32*	24	a	N	N	1.96	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

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SPECIALISTS MANAGING THE EARTH

job no:
LABTSGTE00173AA
sheet 1 of 1

acid sulfate soil screening test

office: Newcastle

client: *TATTERSAL SURVEYORS*
date: *12/04/07*
principal:
test location: *Newcastle*
project: *RIVERSIDE ESTATE PROJECT APPLICATION*
tested by: *NH*
location: *TEA GARDENS*
checked by:

date samples recovered: *10-04-07* pH meter used/serial Horiba date of calibration:

hydrogen peroxide pH prior to use: *5.46* hydrogen peroxide temperature prior to use: *22.3*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP31	*1.0-1.1*		*Sand*	*6.00*	*10*	*3.63*	24	a	N	N	2.37	
TP34	*0.55-0.65*		*Sand*	*6.76*	*10*	*4.51*	25	b	Y	N	2.25	
TP32	*0.7-0.8*		*Sand*	*5.20*	*10*	*3.91*	24	a	N	N	1.29	
TP33	*1.1-1.2*		*Sand*	*6.34*	*10*	*1.45*	30	b	Y	N	4.89	
TP34	*1.0-1.1*		*Sand*	*6.35*	*10*	*1.36*	33	b	Y	Y	4.99	Lighter in Peroxide
TP30	*1.5-1.6*		*Sand*	*5.25*	*10*	*2.81*	25	b	Y	N	2.44	

NOTES: 1. Observed Reaction: a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

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SPECIALISTS MANAGING THE EARTH

job no:
LABTSGTE00173AA
sheet 1 of 2

acid sulfate soil screening test

office: Newcastle

client: *TATTERSAL SURVEYORS*
date: *13/04/07*
principal:
test location: *Newcastle*
project: *RIVERSIDE ESTATE PROJECT APPLICATION*
tested by: *NH/*
location: *TEA GARDENS*
checked by:

date samples recovered: *11/04/07* pH meter used/serial Horiba date of calibration:

hydrogen peroxide pH prior to use: *5.47* hydrogen peroxide temperature prior to use: *23.0*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
BH23	*0.5-1.0*		*Sand*	*5.83*	*10*	*5.01*	22	a	N	N	0.82	
BH35	*2.0-2.5*		*Sand*	*6.15*	*10*	*4.30*	23	b	N	N	1.85	
BH35	*3.5-4.0*		*Sand*	*6.45*	*10*	*5.18*	22	a	N	N	1.27	
BH36	*0.5-1.0*		*Sand*	*5.03*	*10*	*4.24*	23	b	Y	N	0.79	
BH36	*2.0-2.5*		*Sand*	*5.26*	*10*	*3.78*	22	a	N	N	1.4	
BH36	*3.5-4.0*		*Sand*	*5.75*	*10*	*3.26*	22	a	N	N	2.49	
BH36	*5.0-5.5*		*Sand*	*6.19*	*10*	*4.22*	23	a	N	N	1.97	
BH37	*0.5-1.0*		*Sand*	*5.85*	*10*	*4.67*	23	b	N	N	1.18	
BH37	*2.0-2.5*		*Sand*	*5.55*	*10*	*3.92*	22	a	N	N	1.63	
BH37	*3.5-4.0*		*Sand*	*5.80*	*10*	*4.25*	22	a	Y	N	1.55	
BH37	*5.0-5.5*		*Sand*	*5.83*	*10*	*3.27*	22	b	N	N	2.56	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no:
LABTSGTE00173AA
sheet 2 of 2

acid sulfate soil screening test

office: Newcastle

client: *TATTERSAL SURVEYORS*
date: *13/04/07*
principal:
test location: *Newcastle*
project: *RIVERSIDE ESTATE PROJECT APPLICATION*
tested by: *NH/GR*
location: *TEA GARDENS*
checked by:

date samples recovered: pH meter used/serial Horiba date of calibration:

hydrogen peroxide pH prior to use: *5.46* hydrogen peroxide temperature prior to use: *22.3*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							Additional comments
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	
BH37	*6.5-7.0*		*Sand*	*5.73*	*10*	*3.07*	23	b	N	N	2.66	
BH58	*0.5-1.0*		*Sand / Clay*	*5.19*	*10*	*4.20*	22	b	N	N	0.99	
BH38	*2.0-2.5*		*Sand / Clay*	*5.50*	*10*	*4.15*	22	a	Y	N	1.35	
BH38	*3.5-4.0*		*Sand*	*5.53*	*10*	*4.38*	21	a	N	N	1.15	
BH38	*5.0-5.5*		*Sand*	*5.93*	*10*	*4.55*	22	a	N	N	1.38	
BH38	*6.5-7.0*		*Sand*	*5.63*	*10*	*4.26*	22	a	Y	N	1.39	

NOTES: 1. Observed Reaction: a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

RESULTS OF ACID SULFATE SOIL ANALYSIS (Page 1 of 1)

9 samples supplied by Coffey on 14th June, 2007 - Lab. Job No. E7466
Analysis requested by Warabrook. - Your Project: Proposed subdivision

Sample Site	Depth (m)	EAL lab code	Texture (note 6)	Moisture Content (% moisture)	Lab. Bulk Density tonne DW/m³	TAA pH_{KCl}	Titratable Actual Acidity (TAA) mole H⁺/tonne (to pH 6.5)	Reduced Inorganic Sulfur (% chromium reducible S) (%Scr) (note 2)	Reduced Inorganic Sulfur (Scr) mole H⁺/tonne	NET ACIDITY Chromium Suite mole H⁺/tonne (based on %Scrs)	LIME CALCULATION Chromium Suite kg $CaCO_3/m^3$ (includes 1.5 safety Factor)
Method No:						*23A*	*23F*	*22B*	*a: 22B*	*note 5*	*note 5*
TP 39	1.0 - 1.1	*E7466/1*	Fine	24.9	1.2	4.27	52	0.006	4	56	5
TP 40	1.5 -1.6	*E7466/2*	Coarse	15.9	1.3	4.83	9	<0.005	0	9	1
TP 41	0.5 - 0.6	*E7466/3*	Fine	18.0	1.6	4.42	39	<0.005	0	39	5
TP 42	1.0 - 1.1	*E7466/4*	Fine	21.9	1.1	4.63	33	0.007	4	37	3
TP 43	1.7 - 1.8	*E7466/5*	Coarse	11.7	1.4	5.13	7	<0.005	0	7	1
BH 45	5.5 - 5.9	*E7466/6*	Coarse	16.0	1.6	5.04	16	0.011	7	22	3
BH 46	1.0 - 1.1	*E7466/7*	Coarse	18.5	1.3	5.38	3	0.028	17	20	2
BH 46	2.5 - 3.0	*E7466/8*	Coarse	17.8	1.4	5.23	9	0.016	10	18	2
BH 46	5.5 - 6.0	*E7466/9*	Coarse	18.3	1.4	5.91	2	0.013	8	10	1

NOTE:
1 - All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)
2 - Samples analysed by SPOCAS method 23 (ie Suspension Peroxide Oxidation Combined Acidity & sulfate) and 'Chromium Reducible Sulfur' technique (Scr - Method 22B)
3 - Methods from Ahern, CR, McElnea AE , Sullivan LA (2004). *Acid Sulfate Soils Laboratory Methods Guidelines.* QLD DNRME.
4 - Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)
5 - ABA Equation: Net Acidity = Potential Sulfidic Acidity (ie. Scrs or Sox) + Actual Acidity + Retained Acidity - measured ANC/FF
6 - For Texture: coarse = sands to loamy sands; medium = sandy loams to light clays; fine = medium to heavy clays and silty clays
7 - .. Denotes not requested or required
8 - CRS, TAA and ANC are NATA certified but other SPOCAS segments are currently not NATA certification
9- Results at or below detection limits are replaced with '0' for calculation purposes.
10 - Projects that disturb >1000 tonnes of soil, the ≥0.03% S classification guideline would apply.

Lab. Accred. No.: 14960

(Classification of potential acid sulfate material if: coarse Scr≥0.03%S or 19mole H+/t; medium Scr≥0.06%S or 37mole H+/t; fine Scr≥0.1%S or 62mole H+/t)

checked: .....

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: GEOTSGTE20248AA

sheet 1 of 5

acid sulfate soil screening test

office: NEWCASTLE

client: *TATTERSALL SURVEYORS PTY LTD*

principal:

project: *RIVERSIDE ESTATE PROJECT APPLICATION TEA GARDENS*

location: *REFER TO FIGURE 1*

date: *08-06-07*

test location: *NEWCASTLE*

tested by: *SB*

checked by:

date samples recovered: *01-04-07* pH meter used/serial HORIBA date of calibration: *08-06-07*

hydrogen peroxide pH prior to use: *5.45* hydrogen peroxide temperature prior to use: *20.4*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP39	*0.5-0.6*		*Clay*	*7.47*	*20*	*4.38*	*20.6*	*B*	*A*		3.09	
TP39	*1.0-1.1*		*Clay*	*6.75*	*25*	*3.86*	*20.7*	*B*	*A*		2.89	
TP39	*1.5-1.6*		*Sand*	*7.29*	*15*	*5.46*	*20.3*	*A*	*A*		1.83	
BH46	*1.0-1.5*		*Sand*	*6.57*	*22*	*2.28*	*20.3*	*B*	*B*		4.29	
BH46	*2.5-3.0*		*Sand*	*6.70*	*21*	*4.38*	*20.2*	*B*	*A*		2.32	
BH46	*4.0-4.5*		*Sand*	*7.67*	*20*	*4.66*	*20.2*	*A*	*A*		3.01	
BH46	*5.5-6.0*		*Sand*	*7.68*	*19*	*5.33*	*20.0*	*A*	*A*		2.35	
BH46	*7.0-7.5*		*Sand*	*7.25*	*18*	*5.77*	*19.9*	*A*	*A*		1.48	

NOTES: 1. Observed Reaction: a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

job no: GEOTSGTE20248AA

sheet 2 of 5

acid sulfate soil screening test

office: NEWCASTLE

client: *TATTERSALL SURVEYORS PTY LTD* date: *08-06-07*

principal: test location: *NEWCASTLE*

project: *RIVERSIDE ESTATE PROJECT APPLICATION TEA GARDENS* tested by: *SB*

location: *REFER TO FIGURE 1* checked by:

date samples recovered: *01-04-07* pH meter used/serial HORIBA date of calibration: *08-06-07*

hydrogen peroxide pH prior to use: *5.15* hydrogen peroxide temperature prior to use: *20.2*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP41	*0.5-0.6*		*Clay*	*5.20*	*42*	*3.86*	*20.8*	*B*	*B*		*1.34*	
TP41	*1.0-1.1*		*Sandy Clay*	*5.18*	*43*	*4.06*	*20.8*	*B*	*A*		*1.12*	
TP41	*1.5-1.6*		*Clayey Sand*	*5.02*	*44*	*4.35*	*21.0*	*A*	*A*		*0.67*	
TP41	*2.4-2.5*		*Sand*	*6.02*	*46*	*4.67*	*20.7*	*A*	*A*		*1.35*	
TP40	*0.5-0.6*		*Clay*	*6.17*	*55*	*4.64*	*20.4*	*B*	*A*		*1.53*	
TP40	*1.0-1.1*		*Clay*	*5.65*	*56*	*4.50*	*20.4*	*A*	*A*		*1.15*	
TP40	*1.5-1.6*		*Sand*	*5.90*	*57*	*4.73*	*20.3*	*A*	*A*		*1.17*	

NOTES: 1. Observed Reaction: a. No visible effervescenceb. Slight to moderate effervescence c. Vigorous effervescent reaction

2. Strong Odour:

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job no: GEOTSGTE20248AA

acid sulfate soil screening test

office: NEWCASTLE

client: *TATTERSALL SURVEYORS PTY LTD* date: *08-06-07*

principal: test location: *NEWCASTLE*

project: *RIVERSIDE ESTATE PROJECT APPLICATION TEA GARDENS* tested by: *SB*

location: *REFER TO FIGURE 1* checked by:

date samples recovered: *01-04-07* pH meter used/serial HORIBA date of calibration: *08-06-07*

hydrogen peroxide pH prior to use: *5.55* hydrogen peroxide temperature prior to use: *20.6*

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide)							
					time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
TP43	*0.5-0.6*		*Sand*	*4.09*	*15*	*4.94*	*21.2*	*B*	*A*		-	
TP43	*1.0-1.1*		*Sand*	*5.26*	*16*	*4.90*	*20.9*	*A*	*A*		*0.36*	
TP43	*1.7-1.8*		*Sand*	*5.83*	*18*	*5.18*	*20.7*	*A*	*A*		*0.65*	
TP42	*0.5-0.6*		*Clay*	*5.71*	*30*	*4.24*	*20.7*	*B*	*A*		*1.47*	
TP42	*1.0-1.1*		*Sandy Clay*	*5.25*	*30*	*4.19*		*A*	*A*		*1.06*	
TP42	*1.5-1.6*		*Sand*	*5.44*		*4.15*	*20.8*	*B*	*A*		*1.29*	

NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction

2. Strong Odour:

Appendix C

Acid Sulfate Soils Management Plan

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PROPOSED SUBDIVISION - RIVERSIDE ESTATE PROJECT APPLICATION AND CONCEPT PLAN AREA, TEA GARDENS
ACID SULFATE SOIL MANAGEMENT PLAN

Tattersall Lander Pty Ltd

GEOTWARA21006AB-Appendix C
4 April 2011

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
19 Warabrook Boulevard Warabrook NSW 2304 Australia

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

4 April 2011

Tattersall Lander Pty Ltd
PO Box 54
RAYMOND TERRACE NSW 2324

Attention: Bob Lander

Dear Bob

RE: PROPOSED SUBDIVISION

RIVERSIDE ESTATE PROJECT APPLICATION AND CONCEPT PLAN AREA

TEA GARDENS

ACID SULFATE SOIL MANAGEMENT PLAN

Please find enclosed an acid sulfate soils management plan for the above project.

If you have any questions regarding this matter please contact the undersigned.

For and on behalf of Coffey Geotechnics Pty Ltd.

Arthur Love

Principal Geotechnical Engineer

CONTENTS

1 INTRODUCTION

As requested Coffey Geotechnics Pty Ltd (Coffey) has prepared an Acid Sulfate Soil (ASS) Management Plan for earthworks associated with the proposed Riverside Estate Project Application and Concept Plan area development, Tea Gardens.

The ASS Management Plan has been prepared using field and laboratory test results reported in Coffey Report No. GEOTWARA21006AB-AA, dated 4 April 2009.

2 SITE CONDITIONS

The site is located at Tea Gardens, on the New South Wales mid north coast, within the Great Lakes Council local government area. The site is bounded by Toonang Drive and an existing residential subdivision to the north, undeveloped low lying land adjoining the Myall River to the east, the recently constructed Myall Quays Estate to the south and Myall Way to the west.

The total site area is 222.5 ha and comprises the proposed development over approximately half of this area within a concept plan application.

Topographically the site is located on a low sand plain. The site is flat to slightly sloping and is subject to prolonged water logging during periods of wet weather. Surface elevations across the site range from about RL0.75m AHD in the south eastern corner of the site to about RL5m near the northern site boundary.

The majority of the site has been cleared, with vegetation comprising an established cover of medium to tall grasses and scattered medium sized eucalypts.

Geologically, the site is located within a region of windblown sand deposits probably of Pleistocene age (i.e. greater than 20,000 years old). The subsurface profile encountered in Coffey's report referenced above revealed four material types:

- TOPSOIL – Silty Clayey SAND, Silty SAND and Silty CLAY / Silty Sandy CLAY, root affected;
- CLAY – A discontinuous layer of Sandy CLAY, CLAY and Clayey SAND, typically encountered to a maximum depth of <2.0m;
- SAND – fine to medium grained, pale grey to white, pale grey brown, grey brown and dark brown;
- INDURATED SAND – Clayey SAND and Silty SAND, fine to medium grained, dark brown, pale brown and orange brown.

Groundwater or groundwater inflows were encountered at depths of between 0.3m to 2.3m.

Test pit and borehole locations are shown on Figure 1.

3 PROPOSED DEVELOPMENT

The proposed Riverside Estate Project Application is understood to involve the subdivision of the site into a total of 390 dwellings, including dual occupancy dwellings and small lot / medium density development and construction of associated subdivision roads.

The proposed Riverside Estate Concept Plan area is located to the north and north east of the Riverside Estate Project Application and is understood to involve the subdivision of the site.Development of residential lots will involve filling to raise surface levels above a minimum requirement of RL 2.1m AHD.Excavations proposed as part of the development are associated with the creation of numerous drainage basins and will be to a minimum level of RL-2.7m AHD, involving excavation up to a maximum depth of about 5m.

Plans showing the extent, depth and volume of proposed excavations are attached to Coffey's report referenced above.

4 PRESENCE OF ACID SULFATE SOILS

Acid sulfate soils (ASS) are soils which contain significant concentrations of pyrite which, in the presence of sufficient moisture, oxidises when exposed to oxygen, resulting in the generation of sulfuric acid. For the purposes of assessment, potential ASS are indicated by pH<3 upon oxidation in hydrogen peroxide or laboratory test results which exceed a range of Action Criteria presented in the ASS Assessment Guidelines.

Engineering logs of test pits and boreholes are presented in Appendix A of Coffey's report referenced above. The results of screening tests and laboratory SPOCAS / SCR technique analysis are presented in Appendix B of the same report.

Laboratory test results for samples sent for SPOCAS / SCR technique analysis are summarised in Table 1. These results indicate that some samples tested from both the clay layer and sands show low ASS potential and that their occurrence across the site is sporadic.

TABLE 1 – SUMMARY OF ASS TEST RESULTS

TEST LOCATION	**SAMPLE DEPTH (m)**	**GEOTECH. UNIT**	**SCREENING TEST RESULT**		**S_{POS} / S_{CR} (%)**	**TPA / NET ACIDITY (mol H+ / tonne)**
			pH_F	pH_{FOX}		
TP6	2.0 – 2.1	UNIT 3	4.94	4.06	0.02	16
TP14	0.6 – 0.7	**UNIT 2**	5.20	3.26	**0.14**	**84**
TP19	0.5 – 0.6	UNIT 2	4.96	3.70	**0.08**	**49**
TP25	1.9 – 2.0	**UNIT 4**	4.36	3.26	**0.12**	**76**
TP26	1.5 – 1.6	UNIT 3	4.71	**2.60**	<0.02	<10
TP27	1.1 – 1.2	**UNIT 3**	4.47	3.35	**0.03**	**21**
TP28	0.6 – 0.7	**UNIT 4**	4.95	3.55	**0.08**	**53**

TEST LOCATION	SAMPLE DEPTH (m)	GEOTECH. UNIT	SCREENING TEST RESULT		S_{POS} / S_{CR} (%)	TPA / NET ACIDITY (mol H+ / tonne)
			pH_F	pH_{FOX}		
TP30	1.5 – 1.6	**UNIT 3**	5.25	**2.81**	**0.09**	**58**
TP32	1.6 – 1.7	**UNIT 2**	6.40	**1.43**	**0.13**	**84**
TP33	1.1 – 1.2	**UNIT 2**	6.34	**1.45**	**0.12**	**77**
TP34	1.0 – 1.1	**UNIT 2**	6.35	**1.36**	**0.19**	**117**
BH36	0.5 – 1.0	**UNIT 3**	5.03	4.24	**0.04**	**26**
BH36	3.5 – 4.0	UNIT 3	5.75	3.26	<0.02	11
BH37	0.5 – 1.0	UNIT 3	5.85	4.67	0.02	14
BH37	2.0 – 2.5	**UNIT 3**	5.55	3.92	**0.07**	**44**
BH37	5.0 – 5.5	**UNIT 4**	5.83	3.27	**0.15**	**93**
BH37	6.5 – 7.0	**UNIT 4**	5.73	3.07	**0.17**	**104**
BH38	0.5 – 1.0	**UNIT 2**	5.19	4.20	**0.24**	**147**
BH38	6.5 – 7.0	UNIT 3	5.63	4.26	<0.02	11
TP39	1.0 – 1.1	**UNIT 2**	6.75	3.86	0.006	**56**
TP40	1.5 – 1.6	UNIT 3	5.90	4.73	<0.005	9
TP41	0.5 – 0.6	**UNIT 2**	5.20	3.86	<0.005	**39**
TP42	1.0 – 1.1	**UNIT 2**	5.25	4.19	0.007	**37**
TP43	1.7 – 1.8	UNIT 3	5.83	5.18	<0.005	7
BH45	5.5 – 5.9	**UNIT 3**	6.17	4.80	0.011	**22**
BH46	1.0 – 1.1	**UNIT 3**	6.57	**2.28**	0.028	**20**
BH46	2.5 – 3.0	**UNIT 3**	6.70	4.38	0.016	**18**

TEST LOCATION	SAMPLE DEPTH (m)	GEOTECH. UNIT	SCREENING TEST RESULT		S_{POS} / S_{CR} (%)	TPA / NET ACIDITY (mol H+ / tonne)
			pH_F	pH_{FOX}		
BH46	5.5 – 6.0	UNIT 3	7.68	5.33	0.013	10
ASSMAC Action Criteria	-	-	-	-	0.1* 0.03**	62* 18**
Levels of Concern for Screening Test	-	-	4	3	-	-

NOTE:

** Action criteria shown are those for fine textured soils (ie clays) and management of excavations involving disturbance of less than 1000 tonnes of soil;*

*** Action criteria shown are those for course textured soils (ie sands) and management of excavations involving disturbance of more than 1000 tonnes of soil;*

S_{POS} – Percentage of oxidisable Sulfur;

S_{CR} – Percentage of chromium reducible Sulfur;

TPA – Total Potential Acidity.

Based on the results shown in Table 1, expected acid generation rates for oxidation of sand and clay are summarised in Table 2, together with ratios of lime which would be required to neutralise the effects of acid production.

TABLE 2 – SUMMARY OF POTENTIAL ACID GENERATION RATES

MATERIAL	SAND	CLAY
ACID GENERATION (kgH_2SO_4/tonne)		
Maximum	5.2	7.4
Minimum	1.0	1.8
Mean*	2.5	3.8

MATERIAL	SAND	CLAY
LIME RATIOS** (kg/tonne)		
Maximum	7.8	11.1
Minimum	1.5	2.7
Mean*	3.8	5.7
NOTES:		
** - Arithmetic mean value, not weighted to take into account expected volume or mass;*		
*** - Based on a factor of safety of 1.5.*		

Assuming a bulk density of 1.8 tonne/m^3 in the sands and 1.6 tonne/m^3 in the clays, the neutralisation treatment of the sand and clay would require an average of 7kg lime/m^3 and 9kg lime/m^3.

5 PROPOSED CONSTRUCTION METHOD

In summary the proposed development involves filling of residential lots and associated roads and excavating numerous drainage basins. It is understood that excavations are proposed to be carried out in the dry. Dry excavation is preferred over dredging for the following reasons:

- A cutter suction dredge would have difficulty achieving the required batters;
- Local contractors are more experienced in dry excavation;
- Previous excavations on the adjoining Myall Quays Estate were constructed in the dry;
- The costs of excavation in the dry are much lower than dredging;
- The dry excavation could be carried out more quickly and efficiently;
- Dry excavation allows visible recognition of clay during excavation, promoting easier separation and treatment.

A shallow excavation of about 0.9m maximum depth and 60m^3 volume associated with a proposed extension of an existing outlet drain is also proposed immediately to the south of the site. This excavation is located adjacent to an existing saline lake that was previously excavated as part of the adjoining Myall Quays Estate development.

Construction works will be staged and will comprise the creation of drainage basins and branches initially as indicated on the Tattersall Lander's Construction Activity Staging Plan attached to Coffey's report referenced above. The duration of the works is not known, however based on previous experience construction of each of the larger drainage basins is expected to take less than about two months.

6 BASIS OF MANAGEMENT PLAN

6.1 Acid Sulfate Soils (ASS) Issues

The proposed method of construction raises the following ASS related issues that need to be addressed:

- The oxidation of potential ASS exposed in the excavation spoil;
- The oxidation of potential ASS exposed on the walls of the excavation;
- Possible oxidation of potential ASS within the dewatering zone;
- Migration of ASS impacted groundwater from the dewatering zone to off site receptors;
- Disposal of possibly ASS affected leachate and excavation water.

6.2 ASS Management Rationale

The majority of excavated spoil is expected to comprise sands, however clays will also be excavated in some areas. Sands are more readily workable from an engineering perspective and are more easily treated by the addition of lime from an ASS neutralisation perspective than clays. For this reason, it is understood that sands are proposed to be reused as fill and clays are proposed to be disposed of on site below the water table, hence preventing exposure and oxidation. This was also the rationale used during construction of the adjoining Myall Quays Estate.

It is therefore proposed to excavate sands from a suitably located on site borrow and disposal area to sufficient depth to provide adequate storage volume below the water table for disposal of clays encountered. The sand excavated from the proposed disposal area could then be treated with lime and reused as fill material.

Short term oxidation of ASS exposed at the face of the excavation is generally confined to that soil located within a few millimetres of the excavation face. The thickness of the oxidation zone varies, being generally thinner in clays than sands. The oxidation and acidification process is not completely understood but it is known that the process does not occur instantaneously in natural conditions, instead requiring some time. Therefore, significant acid production from the potential ASS at the face of excavations is not likely to occur during the expected construction timeframe. It is considered that the small amount of acid generation which would be expected to occur could be managed by pH monitoring at the face of the excavation with a standby supply of lime provided to allow implementation of contingency measures should unacceptable monitoring results occur.

Other potential ASS within the dewatering zones would be overlain by at least 0.5m of soil cover and are considered unlikely to oxidise to a degree that would produce acid sulfate conditions within the proposed construction timeframe. This risk can be managed by monitoring of groundwater and surface water pH during construction.

The dewatering process will lower the water table in the excavation areas and this will have the effect of drawing surrounding groundwater towards the excavation during construction. Off site migration of groundwater during construction is therefore not expected during the works.

7 ACID SULFATE SOIL MANAGEMENT PLAN

7.1 Preventing Oxidation of ASS

This method of management will apply to clays excavated from proposed detention basins and involves disposal of the material back into an anaerobic environment (below RL 0m AHD) within proposed drainage reserve areas. The spoil will be carted directly from excavation to disposal. The clay will probably excavate as large blocks, which retain the shape of the excavator bucket on disposal. Attempts will be made to achieve some degree of light compaction such as pressing the material down with an excavator bucket to reduce the occurrence of large voids, thereby reducing potential for oxidation during the construction process and also avoiding excessive bulking and subsequent settlements. It is anticipated that bulking of the order of 20% would occur due to the loose dumping of the material into the excavation and a bulking factor of at least 20% to 30% will be allowed for in estimating the volume required for clay ASS disposal.

7.2 Neutralisation by Lime

This method will apply to sands excavated from below the water table. Sands should be taken directly from the excavation to the placement site and spread in layers not more than 300mm thick. Lime should be spread over each layer immediately after placement and be thoroughly mixed through the sand using a rotary hoe or similar. The liming should be confined to areas of a manageable size (maximum 1 ha). Fill placement and liming areas should be bunded to allow collection of all leachate and stormwater runoff until test results indicate acceptable levels of neutralisation have been achieved. The collected water should be pumped to a treatment pond as discussed in Section 7.4 of this plan.

Good quality fine agricultural lime should be used. Based on the results of SPOCAS / SCR technique analysis it is recommended that sands be treated with lime at a rate of between 1.5kg/tonne to 8kg/tonne. This quantity of lime includes a factor of safety of 1.5 to take into account the rate of lime reactivity and the possibility of inhomogeneous mixing. Liming ratios should be confirmed by testing and monitoring at the time of construction. The limed sand may impact on future plant growth and it is recommended that a capping of topsoil be placed over this sand for landscaping purposes.

7.3 Management of Stockpiles

The proposed work program should avoid the necessity to stockpile potential ASS. If circumstances are such that stockpiling becomes necessary, temporary stockpiles should be located in specific approved areas and fully bunded to allow collection and control of leachate. Leachate collected in the bund should be monitored for pH levels and should be pumped to a treatment pond to be neutralised prior to release. Stockpiles should be shaped to minimise the exposed surface area and promote runoff rather than infiltration of rainwater. Bunds are to be constructed from non-ASS material.

7.4 Neutralisation of Leachate and Excavation Water

All leachate from bunded areas, water collected from inflows into excavations and stormwater collected from the excavation and stormwater collected from excavation areas is to be collected and pumped to treatment ponds. Once acceptable water quality is achieved, the treated water will be released. It is anticipated that the short time frame of the works and the construction management practices discussed in this document should result in low concentrations of acid leachate requiring treatment.

The method of neutralisation is either to add lime as a slurry to the water within the treatment pond (depending on the salinity of the water to be treated) or to use a mechanical lime speader to spread lime over a 25m semi circle close to the inlet point of the treatment pond.

The preferred method of neutralisation should be confirmed once salinity of the water can be assessed from background data collected. The addition of lime should be carried out in conjunction with monitoring to avoid achieving excessively high pH levels. The quality of the water to be finally discharged must meet appropriate guidelines for release to the wetland. These guidelines should be based on statistical evaluation of background water quality data. The size of treatment ponds should be designed to accommodate expected flows from dewatering, excavation inflow and stormwater runoff likely to occur over the period of excavation.

7.5 Monitoring Program

Monitoring will be required in the following areas:

- In each layer of neutralised fill;
- In excavations;
- In treatment ponds.

7.5.1 Fill Monitoring

Field monitoring of the pH of each layer of completed fill will be required and is to be initially supplemented with a minimum of one standard ASS laboratory test per 1000m^3 of fill placed, with the rate of testing reduced once greater confidence in correlations between field and laboratory test results is achieved. Testing will be required to produce Total Potential Acidity (TPA) results of zero, or indicating a small amount of excess lime. Laboratory results indicating soil layers containing up to 0.5kg H_2SO_4/tonne would be acceptable provided the subsequent layer produces an excess lime result to avoid a cumulative TPA build up.

No layer of fill is to covered by a subsequent layer until field screen tests indicate that the minimum soil acidity level has been achieved.

As a guide during construction, field screening tests should be carried out on the fill placed on the site to check for ASS conditions in accordance with methods 21Af and 21Bf of Reference 2.

7.5.2 Excavation Monitoring

The soils exposed in the walls and floor of the excavation should be checked daily for the generation of acid conditions, using an approved field pH screening test. Lime should be added to the exposed surface of the excavation if values of less than pH 4 occur. Water collected in the excavation should also be checked for indications of acid production occurring within the dewatering zone. Contingency measures should be put in place in accordance with Section 7.6 of this plan if water pH values of less than pH 4 occur.

7.5.3 Water Quality Monitoring

Recording of water entering and leaving the proposed treatment pond must be implemented. The following information should be recorded:

- Flow and pH measurements of water pumped into the treatment pond;
- Flow and pH measurements of water discharged from the site as well as general water quality parameters including turbidity, TDS, salinity, chloride / sulfate ratio, aluminium, iron.

Water pumped into the pond will include dewatering pump water, stormwater collected over the construction area, seepages collected in the excavation and leachate collected from the unfinished areas of fill. The pH of the discharged water should be within the range of pH 6 to pH 9 or otherwise within two pH points of the background pH of the receiving water body.

Prior to discharge, laboratory testing should be carried out on water samples, with the testing suite based on the water quality monitoring program carried out in surrounding water bodies. The results should be statistically evaluated against background water quality. Background water quality parameters therefore need to be established prior to the work, as direct comparison against environmental guidelines might be misleading if existing water quality does not compare favourably with such guidelines. The water quality in surrounding water bodies should also be monitored during construction, with the results statistically evaluated against background levels to assess the need for further action.

7.5.4 Contingency Measures

Soil acidity in the completed fill layers will be monitored. Should the field pH tests and the laboratory tests (initially one lab test per 1000m3) show that the soil acidity has not achieved the minimum required standard, then that layer must be reworked and additional lime treatment carried out until it is verified that the layer comes up to the required standard. No layer of fill is to be covered by a subsequent layer until the field screening tests indicate that the minimum soil acidity level has been achieved.

If monitoring of the water in the ponds at the point of discharge indicates the pH is below acceptable discharge limits then discharge from the ponds must immediately cease and further treatment be carried out. Monitoring of leachate entering the ponds is to be carried out to detect discharges of acid leachate to the ponds, in which event the lime neutralisation of the leachate should occur in isolation tanks or small ponds before discharge back into the main pond.

In the event that pH measurements of exposed soils in the excavation does not meet required levels, lime shall be spread over the affected area and the pH levels monitored.

Sufficient lime is to be stored in a dry location on site to permit the immediate implementation of the above contingency measures. Lime should be stored adjacent to the treatment ponds, excavations and fill areas.

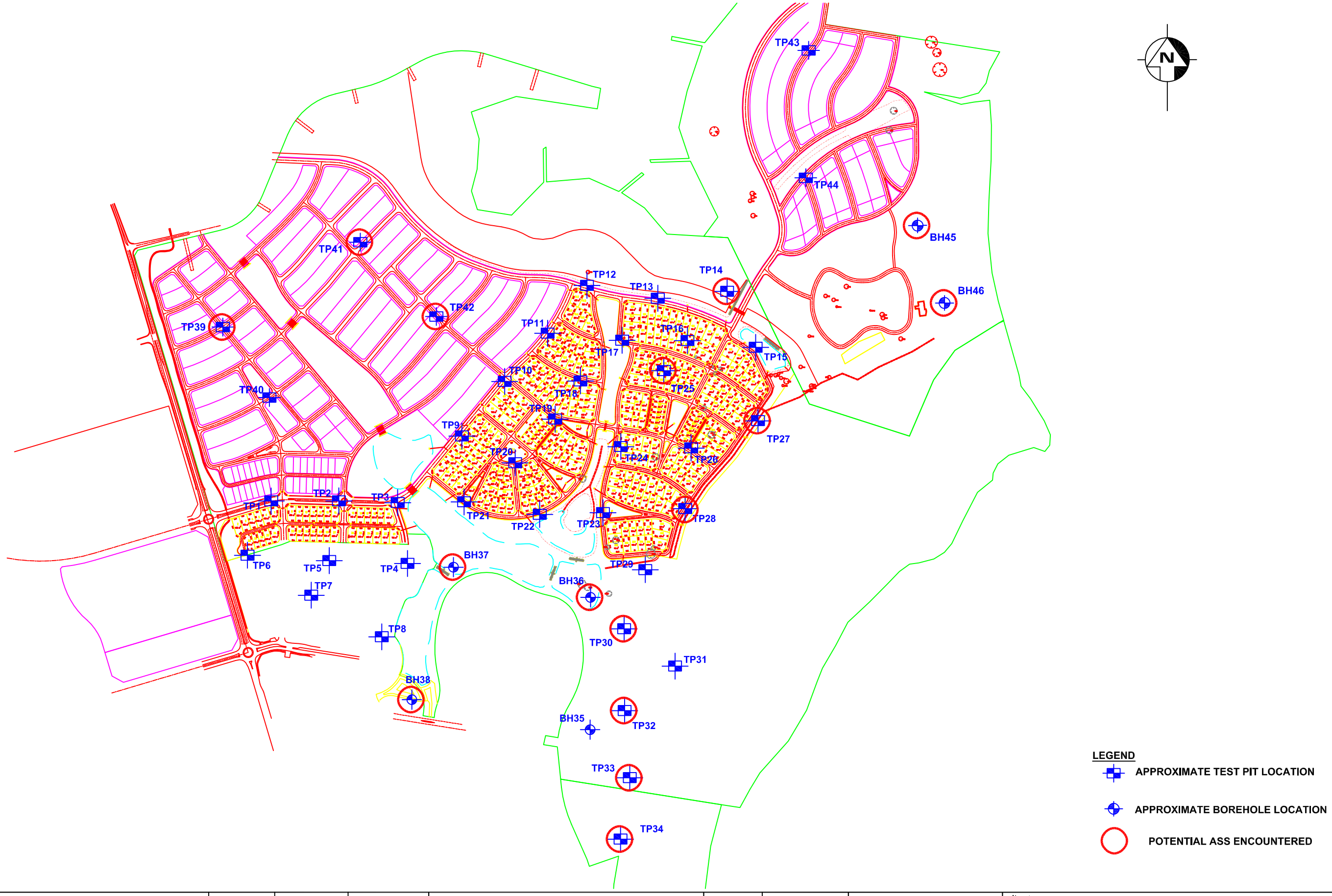
It is recommended that the works be carried out in the presence of a suitably qualified environmental consultant who can document the procedures carried out and assist with the monitoring and implementation of contingency measures during the works.

For and on behalf of Coffey Geotechnics Pty Ltd

Arthur Love

Principal Geotechnical Engineer

Figures



revision	description	drawn	approved	date

0 80 160 320 480

Scale (metres)

drawn	NLS
approved	ABL
date	05-04-11
scale	1:8000
original size	A3

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SPECIALISTS MANAGING THE EARTH

client: TATTERSALL SURVEYORS PTY LTD

project: PROPOSED SUBDIVISION
RIVERSIDE ESTATE PROJECT APPLICATION
AND CONCEPT PLAN AREA, TEA GARDENS

title: TESTPIT/BOREHOLE LOCATION PLAN

project no: GEOTWARA21006AB

figure no: 1 - Appendix C