# Appendix B Results of Laboratory Testing

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Onded     IMP ROB PEACE     Contect     : Tim Killinister     Work Order     : ED0704186       Glass     : In Anvaganotic Rous sundart Raw     Adress     : 23 stand street starting augs     Work Order     : ED0704186       Grain     : In Anvaganotic Rous sundart Raw     Email     : Services Street starting augs     Work Order     : ED0704186       Grain     : In Vintuetor     : Services Street starting augs     : In Vintuetor     : Services Street starting augs     Work Order     : ED0704186       Cold     : Services Street starting     : Email     : Services Street starting augs     : In Anvaort     : In Anvaort       Cold     : Services Street starting     : Enail     : Services Street starting augs     : In Anvaort     : In Anvaort       Cold     : Services Street starting     : Enail     : Services Street starting     : In Anvaort       Cold     : Services Street starting     : Enail     : Enail     : Enail     : In Anvaort       Cold     : Services     : Enail     : Enail     : Enail     : In Anvaort       Cold     : Services     : Enail     : Enail     : Enail     : In Anvaort       Cold     : Services     : Enail     : Enail     : Enail     : In Anvaort       Cold     : Services     : Enail     : Enail     : Enail     :	int :	COFFEY GEOTECHNICS	Laboratory	: Environmental Division Brisbane	Page	: 1 of 10	
Image: Stand Street Barford CLD Australia 405	ntact	MR ROB PEARCE	Contact	. Tim Kilmister	Work Order	/ EB0704186	
Small     : OberLgenre@cofley.com.au     Email     : Services.Brisbane@aservito.com       Teleptone     : Services.Brisbane@aservico.com     : Services.Brisbane@aservico.com       Teleptone     : Services.Brisbane@aservico.com     Date received     : 17.Apr.2007       Occ number     : Services.Brisbane@aservico.com     Date received     : 17.Apr.2007       Occ number     : Services.Brisbane@aservico.com     Date received     : 17.Apr.2007       Occ number     : Services.Brisbane@aservico.com     Date received     : 17.Apr.2007       Date received     : Services.Brisbane@aservico.com     Date received     : 17.Apr.2007       Date received     : Received     : Not provided     : Not provided     : Not provided       Distribution     : Services.Brisbane@aservico.com     Date received     : Not provided     : Not provided       Distribution     : Services.Brisbane@aservico.com     : Not of samples     : Roution     : Not provided     : Not provided       Distribution     : Not provided     : Not provided <td>Jress</td> <td>13 MANGROVE ROAD SANDGATE NSW AUSTRALIA 2304</td> <td>v Address</td> <td>; 32 Shand Street Stafford QLD Australia 4053</td> <td></td> <td></td> <td></td>	Jress	13 MANGROVE ROAD SANDGATE NSW AUSTRALIA 2304	v Address	; 32 Shand Street Stafford QLD Australia 4053			
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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 This report contains the following information: The analytical Results for Samples Submitted The analytical Results for Samples Submitted The analytical procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as hose published by the US EPA, APHA, AS and NEPM. In Use developed procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as hose published by the US EPA, APHA, AS and NEPM. In use developed procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as hose published by the US EPA, APHA, AS and NEPM. In use developed procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as hose published by the US EPA, APHA, AS and NEPM. In use developed procedures used by ALS Environmental have been activities and and the namelytical procedures are provided in parenthests.  When modiure developed from vice and the assemble and a converted standards or by clean treatile from the analytical procedures are been assemble as the results reported or a converted standards. The following report from the analytical procedures are proved to maximited in the mathweat the analytical procedures are been assemble as the results reported or a convected basis. None in a resource the analytical procedures are proved unce area with the reference. When mathweat procedures are been assemble as a transite anound from and/or from valued and reports. The may be used on the one of the aboreaction in the analytical procedures area table and transtable and the parenthas a
This report contains the following information: <ul> <li>Analytical Results for Samples Submitted</li> <li>Analytical Results for Samples Submitted</li> <li>Surrogate Recovery Data</li> <li>Enviropate Recovery Data</li> </ul> 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 ouce developed from which ALS Environmental have been developed from established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM, In ouce developed from which ALSE methods are based are provided in parenthasis. Then mosture determination has been performed, results are reported on a dry weight basis. When a reported herein, Reference methods from which ALSE methods are based are provided in parenthasis. Then mosture determination has been performed, results are reported on a dry weight basis. When a reported herein, Reference, Man material free control insuffer from standard LOR, this may be due to primary sample from this, Where LOR of reported result differ from standard LOR, this may be due to high mosture, reduced sample amount or matrix histerence. Man date(s) and/or time(s) are shown bracketed, has have been assumed by the laboratory for process. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate failed comments for Work Order EB0704186 Specific comments for Work Order EB0704186 The Conversion to immore the imported 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 the case. More the description for metals are hown bracketed, the converted on a dry weight basis assuming use of the agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor teactivity of the case. More the description for the case. More te
<ul> <li>Analytical Results for Samples Submitted</li> <li>Surrogate Recovery Data</li> <li>Surrogate Recovery Data</li> <li>Surrogate Recovery Data</li> <li>Burnoted Inter 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 ouse developed procedures used by ALS Environmental have been developed from established in parenthesis.</li> <li>Mhen misture deterning have been performed, results are reported on a dry weight basis. When a reported ress than' result is higher than the LOR, this may be due to primary sample extractisdigation dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SiVelse on ALS-OWINERS (in the absence of expectived USEPA in the LOR, this may be due to primary sample minits). Where LOR of reported result differ from standard LOR, this may be due to primary sample invitos. These have been assumed by the laboratory for process purposes. Abbreviations: cAS number = Chemical Abstract Services number. LOR = Limit of Reporting. * Indicates failed Surrogate have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of Reporting. * Indicates failed Surrogate have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of Reporting. * Indicates failed Surrogate have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of Reporting. * Indicates failed Surrogate have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of Reporting .* Indicates failed Surrogate have been assumed at the state and the agricultural line (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor r</li></ul>
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 ouse 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 esults 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 "tesult is higher than the LOR, this may be due to primary sample witractific digestion dilution and/or insufficient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWIEN38 (in the absence of specified USEPA mist). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interfreence. When date(s) and/or time(s) are shown bracketed, ness have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting.* Indicates failed Surrogate secoveries. Specific comments for Work Order EB070418 the 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 Conversion to limitgrate 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 Conversion to limit are in the prime and providen lime.
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pecific 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/ms = kg/t who set
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.

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Page Number Client Work Order

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•	oampi	e Matrix Type / Description :	SOIL	SOIL	SOIL	SOIL	SOIL
		sample Date / Time ;	11 Apr 2007	11 Apr 2007	11 Apr 2007	11 Apr 2007	11 Apr 2007
		Laboratory Sample ID :	00.01	00:61	00:01	15,08	15:00
Analyte	CAS number	LOR Units	EB0704186-001	EB0704186-002	EB0704186-003	EB0704186-004	EB0704186.006
EA029-A: pH Measurements							開催には 構成の に に の に に の に 、 に い の に し の に し い の に し い の に し い の に し い の い し い の い し い い い い い い い い い い い い い
PH KCI (23A)	an management of the state of the	0.1 pH Unit	4,6	5.2	<b>4.5</b>	4.6	
pH OX (23B)		0.1 pH Unit	4.2	3.8	2.2	24	
EA029-B: Acidity Trail						and the second	日本のであるというなどのであるというであるというです。
Titratable Actual Acidity (23F)		2 mole H+ / 1	26		(2) 「「「「」」」、「」」、「」」、「」、「」、「」、「」、「」、「」、「」、「」、	1	
Titratable Peroxide Acidity (23G)		2 mole H+/f	28	19	120	118	147
Titratable Suffidic Acidity (23H)		2 male H+ / t	2	8	8	44	101
sufficite - Titratable Actual Acidity		0.02 % pvrite S	0.04	<0.02	0.06	900	0.47
(s-23F)				-		22.2	21.0
sufficie - Titratable Peroxide Acidity (s-23G)		0.02 % pyrite S	0,04	0.03	0.19	0,19	0.22
suffidic - Titratable Suffidic Acidity (s-23H)		0.02 % pyrite S	<0.02	<0.02	0.13	0,12	0.05
EA029-C: Sulfur Trail					いたというないな思想においていたからいたという		
KCI Extractable Sulfur (23Ce)	-	0.02 % S	<0.02	<ul> <li>&lt;0.02</li> </ul>	<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	60.0	0.10	0.04
acidity - Peroxide Oxidisable Sulfur (a-23E)		10 mole H+/1	<10	<10	56	63	25
EA029-D; Calcium Values				「非常になる」になってないです。			
KCI 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	<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		•					
KCI Extractable Magneslum (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	410	<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	E	1	-		14
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02 % pyrite S	1	1	1	]	0.02
HCI Extractable Sulfur (20Be)		0.02 % S		]	1		0.03

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Page Number : 4 Client : C Work Order : E	t of 10 COFFEY GEOTECHNICS EB0704186				-	i		4	
Analytical Resu	ults	Sample Mat	Client Sa rix Type / De	ample ID : sscription :	BH36 0.5-1.0 SOIL	soll	IIOS	SOIL SOIL	Solt Solt
		-	sample La	: emil / em	11 Apr 2007 15:00				
Andres			Laboratory S	ample ID :	EB0704486_004	CD0704498 000	50704486 002		1120704400 00F
Arterity	CAS RU	under	TUR	ants		200-001 +0 /0000	CUU-001401002	COU/U4180-004	EEU/04186-005
EA029-H: Actd Base A	scounting								教育の副語語においたという
ANC Fineness Factor		J	).5		1.5	1.5	1.5	1.6	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 i	++ / t	26	11	93	104	147
Liming Rate			1 kg Cai	CO3/t	2	4	2	8	11

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: 5 of 10 : COFFEY GEOTECHNICS : EB0704186 Page Number Client

Work Order Analytical Pos

Work Order : EB0704186							ALS Environmental
Analytical Results	Sample	Client Sample ID :	BH3865.7.0	SOIL	SOIL.	1001 1001 1001 1001 1001	TE301151416
		Sampte 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 :					
Analyte	CAS number	LOR Units	EB0704186-006	EB0704186-007	EB0704186-008	EB0704186-009	EB0704186-010
EA029-A: pH Measurements							
pH KCI (23A)		0.1 pH Unit	5.2	6,4	5.7	5.0	6,0
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		15	2	, <b>7</b>	
Titratable Peroxide Acidity (23G)		2 mole H+/t	17	66	42	55	56
Titratable Sufficic Acidity (23H)	***	2 mole H+/t	9	84	40	47	45
sufficio - 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	20.0	0.08	0.0
sulfidic - Titratable Sulfidic Acidity (s-23H)		0.02 % pyrite S	<0.02	0.13	0.06	0.08	0,07
EA029-C: Sulfur Trail				11.11.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.			
KCI Extractable Sultur (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 Sultur (a-23E)		10 mole H+ / t	<10	102	75	76	47
EA029-D; Calcium Values				人名 「 「 「 」 「 」 「 」 「 」 」 「 」 」 「 」 」 「 」 」 」 」 」 」 」 」 」 」 」	などの変要な変要なな		
KCI 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			CC E				
Peroxide Magnesium (23Tm)		BM 9/ 70'0	<0.02	0.03	20,02	<0.02	<0.02 <0.02
Acid Reacted Magnesium (23U)		0.02 % Ma	<0.05	<0.02	0.00	<0.02	20.02
acidity - Acid Reacted Magnestum (a-23U)		10 mole H+ / t	<10	<10	18	<10	<10
sulfidic - Acid Reacted Magneslum (s-23U)		0.02 % S	<0.02	<0.02	0.03	<0,02	<0,02
EA029-H: Acid Base Accounting						Salar and an and a shake	
ANC Fineness Factor	المراجع	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	22	84	58
Liming Rate	í	1 kg CaCO3/t	₹	σ	Φ	Ŷ	4

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: 6 of 10 : COFFEY GEOTECHNICS : EB0704186 Page Number Cilent

Work Order

		Client Samula (D · T	The second s				
Analytical Results	Sample	Matrix Type / Description :	SOIL	, an su <b>nter an entro</b> se a se sou	₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩		TP1905.06
	-	Samole Date / Time -	5 Apr 2007			SUL	SOL
			15:00	15:00	75-00	5 API 2007	5 Apr 2007
		Laboratory Sample ID :					00.01
Analyto	CAS number	LOR Units	EB0704186-011	EB0704186-012	EB0704186-013	EB0704186-014	EB0704186-016
EA029-A: pH Measurements							
pH KCI (23A)		0.1 pH Unit	4.4	5.0	5.4	[4.3	4.6
PH OX (23B)		0.1 pH Unit	3.1	2.8	3.3	2.2	36
EA029-B: Acidity Trail							
Titratable Actual Acidity (23F)		2 mole H+ / t	53	a transmere provinsi na 21	7	1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - 1000 - AR	
Titratable Peroxide Acidity (23G)		2 mole H+ / f	94	33	197	19	00
Titratable Sulfidic Acidity (23H)		2 male H+/t	40	12	189	×	09
sufficie - Titratable Actual Acidity		0.02 % pyrite S	0.08	0.03	<0.02	20'0	0,06
suffictic - Tifratable Peroxide Acidity (s-23G)		0.02 % pyrite S	0.15	0,05	0.32	0.08	0,16
sulfidic - Titratable Sulfidic Acidity (s-23H)		0.02 % pyrite S	0.06	<0.02	0:30	<0.02	0.09
EA029-C: Sulfur Trail							
KCI Extractable Sulfur (23Ce)		0.02 % S	<0.02	<pre>city = 1 ≤ 0.02 &lt;0.02</pre>	<pre></pre>	<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		10 male H+ / t	<10	<10	<10	30	13
EA020-D: Calairuu Valuaa							
CAUZA-D: Calcium Values	The second second second second second						
		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
Add 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							「「「「「「「「」」」」「「「」」」」」」」」」」」」」」」」」」」」」」」
KCI Extractable Magnesium (23Sm)		0.02 % Mg	<0.02	<0.02	<b>50.02</b>	<ul> <li>40,02</li> </ul>	0.02
Peroxide Magneslum (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 Magneslum (a-23U)		10 mole H+ / t	<10	<10	<10	<10	<10
sulfidio - Acid Reacted Magnesium (s-23U)		0.02 % S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-G: Retained Acidity			1992 - 1 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1992 - 1 1992 - 199 - 1992 - 199 - 1992	このでの思いていたいです。 これでは、これでは、これでは、これでは、これでは、これではないです。	語を見たいであることであっている		
Net Acid Soluble Sulfur (20Je)	<ul> <li>The set a production is subscription.</li> </ul>	0.02 % S	<0.02	[		<0.02	
acidity - Net Acid Soluble Sulfur (a-20J)		10 mole H+ / t	<10	1	I	<10	ł
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02 % pyrite S	<0.02	-		<0.02	
HCI Extractable Sulfur (20Be)		0.02 % S	<0.02			<0,02	1

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Page Number Cllent

: 7 of 10 : COFFEY GEOTECHNICS : EB0704186 Work Order

Work Order : EB0704	186						4	its Equipmentation
Analytical Results	Sar	Citent Sa mple Matrix Type / De Sample Dai Laboratory Ss	mpla (D : scription : le / Time : ample ID :	TP28066-0.7 SOIL 5 Apr 2007 15:00	. 4 38 TP2710 12.4 5.4 5.4 5.4 5.4 5.4 5.4 5.4 5.4 2.0 7.5 15.00 15.00	TP261,5166	() () () () () () () () () () () () () (	· · · · TP39.0.506
Analyte	CAS number	LOR	Units	EB0704186-011	EB0704186-012	EB0704186-013	EB0704186-014	EB0704186-015
EA029-H: Acid Base Account	lng							的情况都是不是是是一些的问题。
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02 % S		0,08	0.03	<0.02	0.12	0.08
Net Actidity (actidity units)		10 mole h	+//	53	21	<10	76	49
Liming Rate		1 kg Ca(	203/1	4	2	থ	ę	4

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: 8 of 10 : COFFEY GEOTECHNICS : EB0704186 Page Number Client

Work Order

Analytical Results	Sample M	Client Sample ID : atrix Type / Description : Sample Date / Time :	.TP14.0.6-0.7	5 Apr 2007 5 Apr 2007 5 Apr 2007	(5 Apr 2007)	801L SOIL (5 Apr 2007)	
		Laboratory Sample ID :	A0101	10,00	( 10:01 )	(15:00)	
Analyte	CAS number	LOR Units	EB0704186-016	EB0704186-017	EB0704186-018	EB0704186-019	
EA029-A: pH Measurements				にもないたいで、「「「「「「」」」では、「」」」では、「」」」では、「」」」」では、「」」」」」」」			
pH KCI (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	3.9	
EA029-B: Acidity Trail					日期がたいの時代のであったとうというたいが、		「部分開始には武器には大学に開きたからになっていいった。」と
Titratable Actual Acidity (23F)		2 mole H+/t }	70		21	PG	
Titratable Peroxide Acidity (23G)		2 mole H+/t	22	15	601	50F	
Tilratable Suffidic Acidity (23H)		2 mole H+ / t	2		88	78	
sulfidic - Titratable Actual Acidity (s-23F)		0.02 % pyrite S	0.11	0.02	0,02	0.04	
suffidic - Titratable Peroxide Acidity		0.02 % nurite S	0.04	0.07			
(s-23G)	-		+7°0	70'0	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							
KCI Extractable Sulfur (23Ce)	-	0.02 % S	0,04	<pre>&lt; </pre>	0.00 - 20.00 - 20.00 - 20.00 - 20.00 <b>&lt;0.02</b>	<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					and the second difference of the second of the second seco		en andere en
KCI Extractable Calcium (23Vh)		0.02 % Ca	<ul> <li></li> <li><td></td><td></td><td></td><td>第二次になっていた。</td></li></ul>				第二次になっていた。
Peroxide Calcium (23Wh)		0.02 % Ca	<0.02	<0.02	20,02	20.02	
Acid Reacted Calcium (23X)		0.02 % Ca	<0.02	<0.02	<0.02	<0.02	
acidity - Acld 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				「「「「「」」「「「「「「「「」」」」「「」」」「「」」」」」」」」」」」			
KCI 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		0.02 % S	<0.02	<0.02	<0,02	<0.02	
(s-23U)			-				
EA029-G: Retained Acidity				の意思を読むないようで		이 나는 가는 것이 가지 않는 것을 가장하는 생활 등을 통하는 것이 같이 없다.	
Net Acid Soluble Sulfur (20Je)		0.02 % S	<0.02		1		
acidity - Net Acid Soluble Sulfur (a-20J)		10 mole H+ / t	<10	ł	1		
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02 % pyrite S	<0.02	I	I		
HCI Extractable Sulfur (20Be)		0.02 % S	0,05				

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Page Number Client Work Order	: 9 of 10 : COFFEY GEOTECHN : EB0704186	lics							
Analytical Re	sults	Sample	Client S Client S e Matrix Type / D Sample D: Laboratory S	sample ID : Description : ate / Time : Sample ID :	TP140:6-0.7 SOIL 5 Apr 2007 15:00	TP6.2.02215 SOL 5 Apr 2007 15:00	例示:2001 SOIL (5 Apr 2007) (15:00)	4 (5 Apr 2007) (15:00)	
Anaiyte	CA	S number	70R	Units	EB0704186-016	EB0704186-017	EB0704186-018	EB0704186-019	
EA029-H: Acid Base	Accounting	a constanti a constanti da const							
NAVO TIRERESS FACTOR			0.5		1.5	1,5	1.5	1.5	
Net Acially (sulfur units			0.02 % S		0.14	0.02	0.02	0.07	
Net Acially (acially unit	(S)		10 mole	H+ /1	84	16	14	44	
Liming Kate			- Kg C	aco3/t	9	1	1	3	

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ECHNICS	S this report.			
: 10 of 10 : COFFEY GEOT : EB0704186	:ontrol Limit rogates present on			
Page Number Client Work Order	Surrogate C			Kaport Versilos ; COAVA 3.22

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coffey specialists managing the EARTH

job no: GEOTSGTE20248AA sheet 1 of 1

acid	sulf	ate s	oil scre	eninç	) tes	št		office: N	lewcastle	(LABTSGTE00	173AA)	
client:		TATTE	ERSAL SURVE	YORS				date:	12/0	4/07		
príncipal:								test location:	New	castle		
project:		RIVER	SIDE ESTATE	PROJEC	ST APF	LICAT	NOL	tested by:	NH/O	SR		
location:		TEA G	ARDENS					checked by:				
date sam	ples recov	ered:	Ηď	meter	sed/seri	al Hor	iba	date of calibr	ation:			
hydroger	r peroxide μ	oH prior to	use: <b>5.46</b>			hydroge	in perox	ide temperature pric	or to use:	22.3		
				μ					oxidation	eHeox in 30% hvdroc	en peroxide)	
sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	Hợ Xộc	(°C)	Effervescence (see note below)	Odour	Colour change during reaction	PH Change (le pHr-pHrox)	Additional comments
TP3	1.0-1.1		Sand/ Clay	5.60	10	3.85	25	q	۲	N	1.75	
TP27	1.1-1.2		Sand	4.47	10	3,35	25	ca	z	N	1.12	
TP28	0.6-0.7		Sand / Clay	4.95	10	3.55	25	q	Y	N	1.4	
TP22	1.8-1.9		Sand	5.59	10	4.68	25	ta ta	z	N	0.91	
TP6	1.5-1.6		Sand	4.71	10	2.60	25	s	N	N	2.11	
TP9	1.9-2.0		Sand	5.25	10	4.15	25	g	N	N	1.1	
TP24	0.5-0.6		Clay / Sand	5.03	10	3.63	24	ō	v	N	1.4	
TP24	1.0-1.1		Sand	5.11	10	3.88	24	a a	z	N	1.23	
TP24	1.9-2.0		Sand	5.56	10	5.24	24	s	N	N	0.32	
										-		
NOTES:	~ I (VI	. Observe . Strong (	ed Reaction: 6 Odour:	a. No visible	efferves	scenceb.	Slight t	o moderate efferves	cence	c. Vigorous	effervescent read	ction

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coffey specialists managing the Earth

Job no: LABTSGTE00173AA sheet 1 of 1

acid	sulfa	ate s	oil scre	<u>eninç</u>	) tes	ĭť		office: N	lewcastle			
client:		TATTE	ERSAL SURVE	YORS				date:	13/04	1/07		
principal:								test location:	New	castle		
project:		RIVER	SIDE ESTATE	PROJEC	Х АРР	LICAT	lon	tested by:	ΗN			
location:		Tea Gi	ardens					checked by:				
date sarr	iples recovi	ered:	Ηq	meter u	sed/seri	al Hor	iba	date of calibra	ation:			
hydroger	n peroxíde p	oH prior to	use: <b>5.46</b>			hydroge	an perox	ide temperature pric	or to use:	22.3		
-				μĘ					oxidation	PHFOX in 30% hydroi	den peroxide)	
sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	PH Fox	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	PH Change (ie pHF-pHrox)	Additional comments
TP18	0.6-0.7		Sand	4.81	10	4.17	23	А	z	N	0.64	
TP18	1.8-1.9		Sand	5.27	10	4.45	23	A	z	N	0.82	
TP6	0.6-0.7		Silty Sand	4.76	10	4.15	23	A	z	N	0.61	
TP6	1.0-1.1		Sand	4.80	10	4.15	23	A	z	Z	0.65	
TP4	0.5-0.6		Clay	5.62	10	4.13	23	A	۲	N	1.49	
TP47	1.1-1.2		Sand	5.46	10	5.21	23	A	z	z	0.25	
TP11	1.0-1.1		Sand	5.70	10	5.37	24	А	z	N	0.33	
TP22	0.5-0.6		Silty Sand	5.83	10	5.40	24	q	z	N	0.43	
NOTES:	<b>№</b>	. Observe . Strong (	<u>ed Reaction:</u> a <u>Defour:</u>	ı. No visible	efferves	cenceb.	Slight t	o moderate efferves	cence	c. Vigorous	effervescent react	ion

Coffey geotechnics

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

acid	sulfa	ate s	oil scree	sning	l tes	ţ		office:	ewcastle			
client:		TATTE	ERSAL SURVEY	YORS				date:	12/04	/07		
principal;								test location;	Newc	astle		
project:		RIVER	SIDE ESTATE	PROJEC	T APP	LICAT	NO	tested by:	ΗN			
location:		TEA G	ARDENS					checked by:				
date sam	ples recove	ered: 16	04-07 pH	meter	ised/seria	al Hor	iba	date of calibre	ation:			
hydroger	n peroxide p	oH prior to	use: <b>5.46</b>			hydroge	an perox	ide temperature pric	or to use:	22.3		
				PHr					oxidation	PHFox in 30% hydro	gen peroxide)	
sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	H XOL	(°C) temp	Effervescence (see note bélow)	Odour	Colour change during reaction	PH Change (le. PHr-PHrox)	Additional comments
TP12	0.6-0.7		Sand	5.99	10	3.98	52		z	z	2.01	
TP12	1.1-1.2		Sand	5.66	10	4.13	22		z	z	1.53	
TP12	1.9-2.0		Sand	6.44	10	4.71	23		z	z	1.73	
TP13	1.1-1.2		Sand	5.30	10	4.28	23		z	N	1.02	
TP14	0.6-0.7		Clay	5.20	10	3.26	23		z	N	1.94	
TP14	1.7-1.8		Clay	4.89	10	3.42	23		z	N	1.47	
TP15	1.1-1.2		Sand	4.84	10	3.85	23		z	Z	0.99	
TP34	1.9-2.0		Sand	6.33	10	5.45	23		z	z	0.88	
TP31	0.6-0.7		Sand	6.56	10	4.80	23		z	N	1.76	
TP30	0.6-0.7		Sand	6.00	10	4.90	23		z	N	1.1	
TP32	1.6-1.7		Sand	6.40	10	1.43	30		۲	z	4.97	
NOTES:	N	. Observe	<u>ed Reaction:</u> a <u>Odour:</u>	. No visible	efferves	cenceb.	Slight to	o moderate efferves	cence	c. Vigorous	effervescent read	ction

coffey specialists managing the Earth

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

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		ומ		ווווא				office: Nev	vcastle			
client:		TATTE	ERSAL SURVE	YORS				date:	12/04	4/07		
principat								test location:	New	castle		
project:		RIVER	SIDE ESTATE	PROJEC	TAPF	LICAT	NOI	tested by:	ΗN			
location:		TEA G	ARDENS					checked by:				
date san	thes recovere	sd: 1	<b>7-04-07</b> pH	meter	Ised/seri	al Hon	ba	date of calibra	ation:			
hydrogei	n peroxide pH	prior to u	se: <b>5.46</b>			hydroge	n peroxi	ide temperature pric	or to use:	22.3		
-				PHF					oxìdation	PHFox in 30% hvdroc	len peroxide)	
sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	РН	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	PH Change (le aHr-aHrox)	Additional comments
TP31	1.0 - 1.1		Sand	6.00	10	3.63	24	A	z	z	2.37	
TP34	0.55 - 0.65		Sand	6.76	10	4.51	25	ß	Yes	z	2.25	
<i>TP</i> 32	0.7 - 0.8		Sand	5.20	10	3.91	24	s	z	z	1.29	
TP33	1.1-1.2		Sand	6.34	10	1.45	30	£	Yes	z	4.89	
TP34	1.0 - 1.1		Sand	6.35		1.36	33	•	Yes	Yes	4.99	Lighter in peroxide
TP30	1.5 - 1.6		Sand	5.25	10	2.81	25	Ą	Yes	z	2.44	
NOTES:	- 6	Observed Strong Oc	Reaction: a. l	Vo visible et	ffervesce	enceb. S	light to n	noderate effervesce	nce	c. Vigorous et	fervescent reactio	

coffey Specialists MANAGING THE EARTH

job no: LABTSGTE00173AA sheet 1 of 1

acid	sulf	ate s	soil scree	ening	) tes	ĩt		office:	Newcastle				
client:		TATTE	ERSAL SURVE	YORS				date:	13/0.	4/07			
principal:								test location:	New	castle			
project:		RIVER	RSIDE ESTATE	PROJEC	ст АРР	LICAT	NOL	tested by:	ΗN				
location:		TEA G	ARDENS					checked by:					
date san	Iples recove	ered: 1(	0-04-07 pH	meter L	Ised/seri	al Hor	iba	date of calibr	ration:				
hydroger	η peroxide μ	oH prior to	use: <b>5,49</b>			hydrog€	sn peroxi	ide temperature pri	or to use:	22.0			
	· • •	- -		μF					oxidation	PHFOX in 30% hydroi	gen peroxide)		1989
sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	PH Fox	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	ьН Change (ie ьНетьНеох)	Additional comments	
TP4	2.0-2.1		Sand	5.75	10	1.65	58	en.	≻	۲	4.1	Lighter After Reaction	
TP19	1.1-1.2		Clay	5.20	10	3.50	23	A	z	z	1.7		
TP9	1.0-1.1		Sand	4.90	10	3.60	23	A	z	z	1.3		
TP25	0.6-0.7		Sand	4.55	10	3.25	22	A	z	z	1.3		
TP25	1.9-2.0		Clay	4.36	10	3.26	23	A	z	z	1.1		
TP6	2.0-2.1		Sand	4.94	10	4.06	52	A	z	z	0.88		}
NOTES:	-i vi	Observe Strong (	<u>ed Reaction:</u> a. <u>Odour:</u>	. No visible	efferves	cenceb.	Slight to	) moderate efferves	scence	c. Vigorous	effervescent rea	iction	

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coffey Specialists MANAGING THE EARTH

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

acid	sulfa	ate s	oil scree	eninç	l tes	st		office: h	Vewcastle			
client:		TATTE	ERSAL SURVE	YORS			-	date:	13/0	4/07		
principal:								test location:	New	castle		
project:		RIVER	SIDE ESTATE	PROJEC	T APP	LICAT	NOL	tested by:	NH/G	R		
location:		TEA G	ARDENS					checked by:				
date sam	iples recov	ered:	Hd	meter u	ised/seri	al Hoi	riba	date of calibr	ation:			
hydroger	η peroxide μ	oH prior to	use: <b>5.28</b>			hydroge	en perox	ide temperature pri	or to use:	21.0		
				Ħa					oxidation	PHFOX In 30% hydro	gen peroxide)	
sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	PH Fox	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	PH Change Additional cor (le pHr-pHrox)	mments
TP16	0.5-0.6		Sand	4.96	10	4.72	21.5	ea	z	z	0.24	
TP16	1.7-1.8		Sand	4.93	10	3.83	21,5	13	N	Z	1.1	
TP3	1.7-1.8		Sand	5.65	10	5.42	21.0	rs	z	N	0.23	
TP5	1.5-1.6		Sand	5.25	10	4.50	21.5	IJ	N	z	0.75	
TP5	0.9-1.0		Sand	5.78	10	4.98	21.5	g	N	z	0.8	
TP2	1.0-11		Sand	5.53	10	3.36	21.5	a	ï	N	2.17	
TP10	0.5-0.6		Sand	5.25	10	4.60	21	8	Z	Z	0.65	
TP10	1.8-1.9		Sand	5.50	10	4.60	21	n,	z	z	6.0	
TP1	1.0-1.1		Sand	5.60	10	4.79	21	IJ	z	z	0.81	
TP262	0.5-0.6		Sand	4.90	10	4.70	21	а	N	N	0.2	
TP26	1.0-1.1		Sand	4.75	10	4.28	21	8	N	N	0.47	
NOTES:	-1 NI	. Observe	<u>ed Reaction:</u> a <u>Odour:</u>	a. No visible	efferves	cenceb,	. Slight t	o moderate efferves	scence	c. Vigorous	effervescent reaction	

coffey specialists MANAGING THE EARTH

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

acid	sulfa	ate s	oil scree	aning	tes	sť		office:	ewcastle			
client:		TATTE	ERSAL SURVE	YORS				date:	13/0	4/07		
principal								test location:	New	castle		
project:		RIVER	SIDE ESTATE	PROJEC	TAPF	LICAT	NOL	tested by:	NH/O	SR		
location:		TEA G	ARDENS					checked by:				
date san	Iples recove	ered:	Ηq	meter u	sed/seri	al Hor	iba	date of calibr	ation:			
hydrogei	1 peroxide p	ht prior to	use: <b>5.46</b>			hydroge	en perox	ide temperature pric	or to use:	22.3		
				ъЧ					oxidation	PHFox in 30% hydroi	gen peroxide)	
sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	pH	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	ьН Change (Ie ьНьНғох)	Additional comments
TP21	1.1-1.2		Sand	5.30	10	5.20	21	а	z	N	0.1	
TP10	1.1-1.2		Sand	5.30	10	4.80	23	ŋ	z	N	0.5	
TP20	0.6-0.7		Sand	5.03	10	4.17	22	63	z	z	0.86	
TP20	1.6-1.7		Sand	5.10	10	5.01	22	c3	z	z	0.09	
TP29	1.1-1.2		Sand	5.20	10	4.03	22	q	۲	z	1.17	
TP28	1.7-1.8		Sand	5.10	10	4.60	22	ŋ	z	z	0.5	
TP19	0.5-0.6		Sand	4.96	10	3.70	22	٩	7	z	1.26	
TP1	0.5-0.6		Sand	7.28	10	5.32	24	77	z	z	1.96	
NOTES:	N	. Observe	<u>ed Reaction:</u> a Odour:	. No visible	efferves	scenceb.	Slight to	o moderate efferves	cence	c. Vigorous	effervescent reac	flon

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Coffey geotechnics

Job no: LABTSGTE00173AA sheet 1 of 1

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	Suns	מרממ	010010		ן נפי	25		office:	lewcastie				
client:		TATT	ERSAL SURVE	YORS				date:	12/0	4/07			<u> </u>
príncipal	<u>.</u> .							test location:	New	castle			
project:		RIVEF	SIDE ESTATE	PROJE	CT APF	LICA	NOL	tested by:	ΗN				
location:		TEA G	ARDENS					checked by:					
date san	nples recove	ered: 1	0-04-07 pl-	l meter	used/seri	al Ho	riba	date of calibr	ation;				T
hydroge	n peroxide p	oH prior to	use: <b>5.46</b>			hydrog	en pero)	kide temperature priv	or to use:	22.3			
				μ					oxidation	PHFOX I In 30% hydroc	jen peroxide)		1.000
sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	PH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	ьН Change (ie рНғ-рНғох)	Additional comments	1
TP31	1.0-1.1		Sand	6.00	10	3.63	24	ញ	z	N	2.37		1
TP34	0.55-0.65		Sand	6.76	10	4.51	25	q	۲	N	2.25		1
TP32	0.7-0.8		Sand	5.20	10	3.91	24	æ	N	N	1.29		
TP33	1.1-1.2		Sand	6.34	10	1.45	30	ą	Y	N	4.89		
TP34	1.0-1.1		Sand	6.35	10	1.36	33	q	Y	Y	4.99	Lighter in Peroxide	
TP30	1.5-1.6		Sand	5.25	10	2.81	25	q	Y	N	2.44		
NOTES:	-10	. Observ	ed Reaction: Odour:	a. No visible	efferve:	scenceb	. Slight t	o moderate efferves	cence	c. Vigorous	effervescent rea	ction	

coffey specialists managing the Earth

LABTSGTE00173AA sheet 1 of 2 job no:

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acia	suns	ate s	SCLE	Suine	Sel 1	16		office: N	lewcastle			
client:		TATTE	ERSAL SURVE	YORS				date:	13/04	4/07		
principal								test location:	New	castle		
project:		RIVER	RSIDE ESTATE	PROJEC	T APP	LICA	NOL	tested by:	/H/			
location:		TEA G	ARDENS					checked by:				
date sarr	1ples recove	ered: 1	1/04/07 pH	meter u	sed/seri.	ai Hoi	riba	date of calibr	ation:			
hydroger	n peroxíde p	oH prior to	use: <b>5.47</b>			hydrogi	en perox	kide temperature prik	or to use:	23.0		
				ΡΗF					oxidation	PHFOX in 30% hydrog	ten peroxide)	
sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	PH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	PH Change (ie PHr-pHrox)	Additional comments
BH23	0.5-1.0		Sand	5.83	10	5.01	52	ניז	z	z	0.82	
BH35	2.0-2.5		Sand	6, 15	10	4.30	23	q	z	z	1.85	
BH35	3.5-4.0		Sand	6.45	10	5.18	22	53	z	z	1.27	
BH36	0.5-1.0		Sand	5.03	10	4.24	23	q	7	Z	0.79	
BH36	2.0-2.5		Sand	5.26	10	3.78	22	ß	z	z	1.4	
BH36	3.5-4,0		Sand	5.75	10	3.26	22	ស	z	z	2.49	
BH36	5.0-5.5		Sand	6.19	10	4.22	23	ત્વ	z	z	1.97	
BH37	0.5-1.0		Sand	5.85	10	4.67	23	٩	z	Z	1.18	
BH37	2.0-2.5		Sand	5.55	10	3.92	22	IJ	z	N	1.63	
BH37	3.5-4.0		Sand	5.80	10	4.25	22	ŋ	7	N	1.55	
BH37	5.0-5.5		Sand	5.83	10	3.27	22	a	z	N	2.56	
NOTES:	린	. Observi	ed Reaction; ¿ Odour:	I. No visible	efferves	cenceb	. Slight t	o moderate efferves	cence	c. Vigorous	effervescent rea	action

coffey specialists MANAGING THE EARTH

LABTSGTE00173AA sheet 2 of 2 ;on doį

date:tion:TATTERSAL SURVEYORSprincipa:tats SURVEYORSprincipa:tats STATE PROJECT APPLICATIONtest locationproject:RIVERSIDE ESTATE PROJECT APPLICATIONtest locationproject:TEA GARDENSchecked bytotation:TEA ARDENSchecked bytotation:TEA ARDENSchecked bytotation:TEA ARDENSchecked bytotation:TEA ARDENSchecked bytotation:TEA ARDENSchecked bytotation:TEA ARDENState of calltotation:TEA ARDENState of calltotation:TEA ARDENStotationtotation:TEA ARDENStotationtotation:TEA ARDENStotationtotation:TEA ARDENStotationtotation:TEA ARDENStotationtotation:TEA ARDENStotationtotation:TEA ARDENSTotationtotation:Totation:Totation </th <th></th> <th></th>		
test to call         Project:       RYJERSIDE ESTATE PROJECT APPLICATION       test to call         TEA GARDENS       test to call         to call       test colspan="6">test to call         TEA GARDENS       checked by         to call       test colspan="6">test colspan="6">test colspan="6">test colspan="6">test colspan="6"         the samples recorrence:       phr       the colspan="6"         the samples recorrence:       phr       the colspan="6"         test colspan="6"       test colspan="6"       test colspan="6"         test colspan="6"       test colspan="6"       test colspan="6"       test colspan="6"       test colspan="6"         test colspan="6"       stand       test colspan="6"       test colspan="6"       test colspan="6"         test colspan="6"           test colspan="6"          test colspan="6" <t< td=""><td>13/04/07</td><td></td></t<>	13/04/07	
project:       RIVERSIDE ESTATE PROJECT APPLICATION       tested by:         location:       TEA GARDENS       checked by:         date samples recovered:       pH       meter       used/serial       Horlba       checked by:         hydrogen peroxide pH prior to use: $5.46$ pH $1.5$ $2.6$ checked by:         sample       depth       (m)       (mAHD)       soil description       pH in 1:5 $1.6$ $1.6$ $2.0^{-2}$ $2.6^{-7.0}$ $2.90^{-2.5}$ $2.0^{-2.5}$ $2$	Newcastle	
Increation: TEA GARDENS       TEA GARDENS       date samples recovered:     pH     checked by       hydrogen peroxide pH prior to use:     5.46     hydrogen peroxide temperature f       hydrogen peroxide pH prior to use:     5.46     hydrogen peroxide temperature f       hydrogen peroxide pH prior to use:     5.46     hydrogen peroxide temperature f       fight     depth     RL     solid description     pHn     times     pHn     times     pHn     times       BH37     6.5-7.0     Sand / Clay     5.19     10     4.20     23     b       BH38     2.0-2.5     Sand / Clay     5.50     10     4.15     22     a       BH38     5.0-5.5     Sand / Clay     5.53     10     4.55     23     a       BH38     5.0-5.5     Sand     5.33     10     4.55     22     a       BH38     5.0-5.5     Sand     5.63     10     4.26     23     a       BH38     6.5-7.0     Sand     5.63     10     4.26     22     a       BH38     6.5-7.0     Sand     5.63     10     4.26     23     a       BH38     6.5-7.0	NH/GR	
date samples recovered:pHmeterused/serialHoribadate of callhydrogen peroxide pH prior to use: $5.46$ $\gamma$ $\gamma$ $\gamma$ $\gamma$ $\gamma$ $\gamma$ sample(m)(m)(m)(m) $m^{H_{T}}$ $m^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $\gamma$ $\gamma$ sample(m)(m)(m)(m) $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ sample(m)(m)(m) $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ sample(m)(m) $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ $p^{H_{T}}$ BH376.5-7.0Sand/Clay5.19 $p^{10}$ $q^{10}$ $q^{12}$ $2^{2}$ $a^{2}$ BH38 $3.5-4.0$ Sand/Clay5.50 $10$ $q^{12}$ $2^{2}$ $a^{2}$ $a^{2}$ BH38 $3.5-4.0$ Sand/Clay $5.53$ $10$ $q^{12}$ $2^{2}$ $a^{2}$ $a^{2}$ BH38 $3.5-4.0$ Sand/Clay $5.63$ $10$ $q^{12}$ $2^{2}$ $a^{2}$ $a^{2}$ BH38 $5.0-5.5$ Sand/Clay $5.63$ $10$ $q^{12}$ $2^{2}$ $a^{2}$ $a^{2}$ BH38 $5.7.0$ Sand/Clay $5.63$ $10$ $q^{12}$ $2^{2}$ $a^{2}$ $a^{2}$ BH39 $6.5.7.0$ Sand/Clay $5.63$ $10$ $q^{12}$ $2^{2}$ <td< td=""><td></td><td></td></td<>		
Inductor to use: 5.46       inductor peroxide temperature functor to use: 5.46         sample (m)       RL       RL       soil description distilled (mins) $pH_{\rm In}$ $pH_{\rm In}$ $pH_{\rm In}$ sample (m)       (m)       (m)       (mAHD)       soil description distilled (mins) $pH_{\rm In}$	ation:	
sample location (m)         (mAHD) (m)         soil description (mAHD)         pH in 1:5 vater         mathe (mins)         pH (mode)         femp (mode)         Effervescence           BH37         6.5-7.0         Sand         5.73         10         3.07         23         b           BH38         0.5-1.0         Sand         5.19         70         4.20         23         b           BH38         0.5-1.0         Sand/Clay         5.19         70         4.20         23         b           BH38         0.5-1.0         Sand/Clay         5.19         70         4.15         23         b           BH38         0.5-1.0         Sand/Clay         5.50         70         4.15         23         b           BH38         5.0-2.5         Sand/Clay         5.53         70         4.55         23         a           BH38         5.0-5.5         Sand         5.93         70         4.26         23         a           BH38         5.0-5.5         Sand         5.63         70         4.26         22         a           BH38         6.5-7.0         Sand         5.63         70         4.26         22         a           BH38	r to use: 22.3	
sample         depth         RL.         soil description         pH in 1:5 distilled (mins)         pH frox         (°C)         genp frox         Effervescence           BH37         6.5-7.0         >         Sand         5.73         10         3.07         23         b           BH38         0.5-7.0         >         Sand/Clay         5.19         10         4.20         23         b           BH38         0.5-7.0         Sand/Clay         5.50         10         4.20         23         b           BH38         0.5-7.0         Sand/Clay         5.50         10         4.15         22         b           BH38         2.0-2.5         Sand/Clay         5.53         10         4.15         22         a           BH38         2.0-2.5         Sand/Clay         5.53         10         4.55         22         a           BH38         5.0-5.5         Sand         5.93         10         4.56         22         a           BH38         5.0-5.5         Sand         5.63         10         4.26         22         a           BH38         5.0-5.5         Sand         5.63         10         4.26         22         a	PHEOX Dxidation in 30% hydrogen	beroxide)
BH37       6.5-7.0       Sand       5.73       70       3.07       23       b         BH38       0.5-1.0       Sand/Clay       5.19       70       4.20       22       b         BH38       2.0-2.5       Sand/Clay       5.50       70       4.15       22       a         BH38       3.5-4.0       Sand/Clay       5.50       70       4.15       22       a         BH38       3.5-4.0       Sand/Clay       5.50       70       4.15       22       a         BH38       3.5-4.0       Sand/Clay       5.50       70       4.15       22       a         BH38       5.0-5.5       Sand       5.93       70       4.55       22       a         BH38       6.5-7.0       Sand       5.63       70       4.26       22       a         BH38       6.5-7.0       Sand       5.	Colour Change Ph dour during (ie reaction	Change Change He-pH <sub>Fox</sub> )
BH58       0.5-1.0       Sand/Clay       5.19       10       4.20       22       b         BH38       2.0-2.5       Sand/Clay       5.50       10       4.15       22       a         BH38       2.0-2.5       Sand/Clay       5.50       10       4.15       22       a         BH38       3.5-4.0       Sand       5.53       10       4.38       21       a         BH38       5.0-5.5       Sand       5.93       10       4.55       22       a         BH38       5.0-5.5       Sand       5.93       10       4.55       22       a         BH38       6.5-7.0       Sand       5.63       10       4.26       22       a         BH38       6.5-7.0       Sand       5.63       10       4.26       22       a         IBH38       6.5-7.0       Sand       5.63 <td>Z</td> <td>2.66</td>	Z	2.66
BH38       2.0-2.5       Sand/Clay       5.50       10       4.15       22       a         BH38       3.5-4.0       Sand       5.53       10       4.38       21       a         BH38       3.5-4.0       Sand       5.53       10       4.55       22       a         BH38       5.0-5.5       Sand       5.93       10       4.55       22       a         BH38       5.0-5.5       Sand       5.63       10       4.55       22       a         BH38       6.5-7.0       Sand       5.63       10       4.26       22       a         BH38       6.5-7.0       Sand       5.63       10       4.26       22       a         H38       6.5-7.0       Sand       5.63       10 <td>Z</td> <td>66'0</td>	Z	66'0
BH38       3.5-4.0       Sand       5.53       10       4.38       21       a         BH38       5.0-5.5       Sand       5.93       10       4.55       22       a         BH38       5.0-5.5       Sand       5.93       10       4.55       22       a         BH38       6.5-7.0       Sand       5.63       10       4.26       22       a         H38       6.5-7.0       Sand       5.63       10       4.26       22       a	Y N	1.35
BH38       5.0-5.5       Sand       5.93       10       4.55       22       a         BH38       6.5-7.0       Sand       5.63       10       4.26       22       a         H38       6.5-7.0       Sand       5.63       10       4.26       22       a         H38       6.5-7.0       Sand       5.63       10       4.26       22       a         H38       0.5-7.0       Sand       5.63       10       4.26       22       a         H38       0.5-7.0       Sand       5.63       10       4.26       22       a	N	1.15
BH38 6.5-7.0 Sand 5.63 10 4.26 22 a	N	1.38
	YN	1.39
NOTES: <u>1. Observed Reaction:</u> a. No visible effervescenceb. Slight to moderate efferv <u>2. Strong Odour:</u>	cence c. Vigorous effe	vescent reaction

		EAL		Moisture	Lab. Bülk	14년	Intratable Actual	Reduced Inordanic	Rediced homenic	<b>NET ACIDITY</b>	ST CR EINER AR CHINATION TEACH
Sample Site	Depth (m)	ab code	Texture (note 6)	Content (96 moisture)	Density tonne DW/m <sup>a</sup>	PHe B	Actoficy. (TAA) mole H <sup>+</sup> /come (to pH 6.5)	Surfuc Surfuc (%.chromium) (educable S) (%.csc.r.) ( rose 3)	Salfa (Scr)	Chromium Suite Inole HY/torme	Chronium Suite
Method No.						23,4	23F		mole H1/tonne a. 228	(based on %Sers)	(includes 1.5 safety Factor)
TP 39	1.0 - 1.1	E7466/1	Fine	24.9	1.2	4.27	52	0 006	V	U	L
TP 40	1.5 -1.6	E7466/2	Coarse	15.9	1.3	4.83	ე თ	<0.005	r c	0 0 0	<del>،</del> ۵
TP 41	0.5 - 0.6	E7466/3	Fine	18.0	1.6	4,42	39	20 0V	> C		— L
TP 42	1.0 - 1.1	E7466/4	Fine	21.9	1.1	4.63	6.00	0.007		50	"იი
TP 43	1.7 - 1.8	E7466/5	Coarse	11.7	1.4	5.13	~	<0.005	r c	7C 7	·
									>	-	_
BH 45	5.5 - 5.9	E7466/6	Coarse	16.0	1.6	5.04	16	0.017	~	52	с
BH 46	1.0 - 1.1	E7466/7	Coarse	18.5	1.3	5.38		0.028	- [-	2 C 2 C	'nι
BH 46	2.5 - 3.0	E7466/8	Coarse	17.8	1.4	5 23	ο σ	0.016	~ C	2	
BH 46	5.5 - 6.0	E7466/9	Coarse	18.3	1.4	5.91		0.013	<u></u> 2α	0 0	7 -
							1	2.00	o	2	
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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

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Report Page 2 of 2



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TP41	1.5-1.6		Clayey Sand	5.02	44	4,35	21.0	А	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	8	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	А		1.17	
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Coffey geotechnics SPECIALISTS MANAGING THE EARTH

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TP43	0.5-0.6	Sand	4.09	15	1.94 21	.2	8	А			
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TP43	1.7-1.8	Sand	5.83	18 4	5.18 20.	.7	А	A		0.65	
TP42	0.5-0.6	Clay	5.71	30	1.24 20.	.7	ß	4		1.47	
TP42	1.0-1.1	Sandy Clay	5.25	30 4	1.19		А	A		1.06	
TP42	1.5-1.6	Sand	5.44		1.15 20.	8	8	A		1.29	
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# Appendix C Acid Sulfate Soils Management Plan



# 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



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.

Author lano

Arthur Love Principal Geotechnical Engineer

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Important Information About Your Coffey Report

### Figures

Figure 1: Test Pit / Borehole Location Plan

# 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;</li>
- 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.

TEST	SAMPLE DEPTH	GEOTECH.	SCREENI RES	NG TEST	S <sub>POS</sub> / S <sub>CR</sub>	TPA / NET ACIDITY
LOCATION	(m)	UNIT	рН <sub>F</sub>	рН <sub>FOX</sub>	(%)	(mol H+ / tonne)
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

TABLE 1 – SUMMARY OF ASS TEST RESULTS

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

TEST	SAMPLE DEPTH	GEOTECH.	SCREEN RES	ING TEST SULT	S <sub>POS</sub> / S <sub>CR</sub>	TPA / NET ACIDITY
LOCATION	(m)	UNIT	рН <sub>F</sub>	рН <sub>FOX</sub>	(%)	(mol H+ / tonne)
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

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

TEST	SAMPLE DEPTH	GEOTECH.	SCREEN RES	ING TEST SULT	S <sub>POS</sub> / S <sub>CR</sub>	TPA / NET ACIDITY
LOCATION	(m)	UNIT	рН <sub>F</sub>	рН <sub>FOX</sub>	(%)	(mol H+ / tonne)
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<sub>POS</sub> – Percentage of oxidisable Sulfur;

S<sub>CR</sub> – 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.

MATERIAL	SAND	CLAY
ACID GENERATION		
(kgH <sub>2</sub> SO <sub>4</sub> /tonne)		
Maximum	5.2	7.4
Minimum	1.0	1.8
Mean*	2.5	3.8

TABLE 2 -	SUMMARY	OF POTENTIAL	ACID GENER	ATION RATES
	•••••••			

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<sup>3</sup> in the sands and 1.6 tonne/m<sup>3</sup> in the clays, the neutralisation treatment of the sand and clay would require an average of 7kg lime/m<sup>3</sup> and 9kg lime/m<sup>3</sup>.

# 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<sup>3</sup> 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

Authon land

Arthur Love Principal Geotechnical Engineer

Figures

