coffey geotechnics

Engineering Log - Piezometer

Borehole No. **BH8**

Sheet 3 of 4

Project No: **CH1613/1**

Client: ***RIDER HUNT TEROTECH***

Date started: ***1.6.2006***

Principal:

Date completed: ***1.6.2006***

Project: ***PROPOSED DEVELOPMENT - BLUE DOLPHIN RESORT***

Logged by: ***ELC***

Borehole Location: ***REFER TO FIGURE 1***

Checked by:

drill model & mounting:P120 TRUCK | Easting: 533143.425 | slope: -90° | R.L. Surface: 1.61

hole diameter: | Northing: 6744273.849 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
WB		M		SPT 23,R,- N*=R		-15	17		SP	**SAND:** fine to medium grained, grey *(continued)*	W	VD	SPT 30 blows for 120mm penetration.
				SPT 15,30,R N*=R		-16	18						SPT 30 blows for 1501mm penetration.
						-17	19						
				SPT 12,25,R N*=R		-18	20						SPT 26 blows for 105mm penetration.
				SPT 14,24,R N*=R		-19	21						SPT 26 blows for 130mm penetration.
						-20	22						
				SPT 15,R,- N*=R		-21	23						SPT 30 blows for 140mm penetration.
				SPT R,-,- N*=R		-22	24						SPT 30 blows for 115mm penetration.

PIEZOMETER CH1613-1 DEEP LOGS.GPJ COFFEY.GDT 19.10.06

Form GEO 5.10 Issue 3 Rev.0

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g. ADT

support

C casing N nil

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Borehole No. **BH8**

Sheet 4 of 4

Engineering Log - Piezometer

Project No: ***CH1613/1***

Client: ***RIDER HUNT TEROTECH***

Date started: ***1.6.2006***

Principal:

Date completed: ***1.6.2006***

Project: ***PROPOSED DEVELOPMENT - BLUE DOLPHIN RESORT***

Logged by: ***ELC***

Borehole Location: ***REFER TO FIGURE 1***

Checked by:

drill model & mounting: P120 TRUCK | Easting: 533143.425 | slope: -90° | R.L. Surface: 1.61

hole diameter: | Northing: 6744273.849 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
WB		M				-23	25		SP	**SAND:** fine to medium grained, grey *(continued)*	W	VD	
				SPT 10,21,27 N*=48								D/VD	
						-24	26			End BH8 at 25.45m due to limit of required investigation. Borehole terminated at 25.45m			
						-25	27						
						-26	28						
						-27	29						
						-28	30						
						-29	31						
						-30	32						

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex
*bit shown by suffix e.g.	ADT

support

C casing N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Borehole No. **BH1**

Sheet 1 of 1

Engineering Log - Piezometer

Project No: ***CH1613/1***

Client: ***RIDER HUNT TEROTECH***

Date started: ***9.5.2006***

Principal:

Date completed: ***9.5.2006***

Project: ***PROPOSED DEVELOPMENT AT BLUE DOLPHIN RESORT***

Logged by: ***ELC***

Borehole Location: ***REFER TO FIGURE 1***

Checked by:

drill model & mounting: MD200 TRUCK | Easting: 533265.923 | slope: -90° | R.L. Surface: 1.59

hole diameter: | Northing: 6744036.446 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
ADT		N	11.30 11/5/06	SPT 2,4,7 N*=11		1	1		SP	**SAND:** fine to medium grained, dark brown	D/M	MD	ALLUVIAL SOIL Roots to 0.05m.
											M		
										Colour change to pale brown/brown.			
						0				Colour change to pale grey.			
							2				W		
				SPT 3,9,10 N*=19		-1						D	
							3			Indurated layer at 3.25m to 3.4m, dark brown. shell fragments observed. Colour change to grey.			
						-2	4					VD	
				SPT R N=R		-3				Indurated layer at 4.4m-4.8m.			SPT carried out with solid cone. 25 blows for 50mm penetration.
							5			Thin bands of indurated sand between 4.8m and 6m			
						-4	6			End BH1 at 6.0m due to limit of required investigation. Borehole terminated at 6m			
						-5	7						
						-6	8						

PIEZOMETER CH1613-1 SHALLOW LOGS.GPJ COFFEY.GDT 19.10.06

Form GEO 5.10 Issue 3 Rev.0

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g. ADT

support

C casing N nil

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Borehole No. **BH2**

Sheet 1 of 1

Engineering Log - Piezometer

Project No: **CH1613/1**

Client: ***RIDER HUNT TEROTECH***

Date started: ***9.5.2006***

Principal:

Date completed: ***9.5.2006***

Project: ***PROPOSED DEVELOPMENT AT BLUE DOLPHIN RESORT***

Logged by: ***ELC***

Borehole Location: ***REFER TO FIGURE 1***

Checked by:

drill model & mounting: MD200 TRUCK | Easting: 533105.125 | slope: -90° | R.L. Surface: 1.56

hole diameter: | Northing: 6744107.829 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
ADT			1.50PM 9/5/06	SPT 2,2,2 N*=4		1	1			**SAND:** fine to medium grained, dark brown	D/M	L	ALLUVIAL SOIL Roots to 0.05m.
										Colour change to pale brown/brown.			
						0	2			Colour change to pale brown.	W		
										Colour change to grey.		MD	
				SPT 3,6,10 N*=16		-1	3			Possible indurated sand layer at 3.3m			
						-2	4					D	
				SPT 25,R N*=R		-3	5			Possible indurated sand layer at 4.45m Shell fragments observed			SPT carried out with solid cone. 25 blows for 140mm penetration.
						-4	6			Indurated dark brown sand.			
						-5	7			End BH2 at 6.0m due to limit of required investigation. Borehole terminated at 6m			
						-6	8						

PIEZOMETER CH1613-1 SHALLOW LOGS.GPJ COFFEY.GDT 19.10.06

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method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g. ADT

support

C casing N nil

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Borehole No. **BH3**

Sheet 1 of 1

Engineering Log - Piezometer

Project No: **CH1613/1**

Client: ***RIDER HUNT TEROTECH***

Date started: ***9.5.2006***

Principal:

Date completed: ***9.5.2006***

Project: ***PROPOSED DEVELOPMENT AT BLUE DOLPHIN RESORT***

Logged by: ***ELC***

Borehole Location: ***REFER TO FIGURE 1***

Checked by:

drill model & mounting: MD200 TRUCK | Easting: 533004.455 | slope: -90° | R.L. Surface: 1.47

hole diameter: | Northing: 6744176.818 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
ADT			3pm 9/5/06	SPT 2,2,2 N*=4		1 0	1			**SAND:** fine to medium grained, dark brown.	D	MD	ALLUVIAL SOIL Roots to 0.05m.
											M		
										Colour change to pale brown and brown at 0.7m			
										Colour change to pale grey at 1.0m.			
											W		
				SPT 3,6,10 N*=16		-1	2			Colour change to grey at 2.0m.		D	
						-2	3			Indurated layer from 3.25 to 3.4m, dark brown. Shell fragments observed Colour change to grey at 3.4m.			
							4					D/VD	
				SPT 25,-,- N*=R		-3	5			Indurated layer from 4.4m to 4.8m.			SPT carried out with solid cone. 25 blows for 140mm penetration
						-4				Possibly becomes gravelly sand			
						-5	6 7			End BH3 at 6m due to limit of required investigation. Borehole terminated at 6m			
						-6	8						

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex
*bit shown by suffix e.g.	ADT

support

C casing N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Borehole No. **BH4**

Sheet 1 of 1

Engineering Log - Piezometer

Project No: **CH1613/1**

Client: ***RIDER HUNT TEROTECH***

Date started: ***9.5.2006***

Principal:

Date completed: ***9.5.2006***

Project: ***PROPOSED DEVELOPMENT AT BLUE DOLPHIN RESORT***

Logged by: ***ELC***

Borehole Location: ***REFER TO FIGURE 1***

Checked by:

drill model & mounting: MD200 TRUCK | Easting: 533147.421 | slope: -90° | R.L. Surface: 1.82

hole diameter: | Northing: 6744309.382 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
ADT			11:20am 11/5/06	SPT 2,5,9 N*=14		1	1			**SAND:** fine to medium grained, brown to dark brown.	D	MD	ALLUVIAL SOIL
											M		
										Colour change to PG at 0.8m.		D	
						0	2				W		
												MD	
				SPT 1,2,6 N*=8		-1	3			Shell fragments observed			
						-2	4					D/VD	
				SPT 8,12,17 N*=29		-3	5						
						-4	6						
						-5	7			End BH4 at 6.0m due to limit of required investigation. Borehole terminated at 6m			
						-6	8						

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g. ADT

support

C casing N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Borehole No. **BH5**

Sheet 1 of 1

Engineering Log - Piezometer

Project No: **CH1613/1**

Client: ***RIDER HUNT TEROTECH***

Date started: ***9.5.2006***

Principal:

Date completed: ***9.5.2006***

Project: ***PROPOSED DEVELOPMENT AT BLUE DOLPHIN RESORT***

Logged by: ***ELC***

Borehole Location: ***REFER TO FIGURE 1***

Checked by:

drill model & mounting: MD200 TRUCK | Easting: 533192.849 | slope: -90° | R.L. Surface: 1.80

hole diameter: | Northing: 6744254.937 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
ADT			12:10 11/5/06	SPT 1,0,2 N*=2		1	1			**SAND:** Fine to medium grained, brown.	M	L	ALLUVIAL SOIL
						0	2			Colour change to pale brown at 0.4m.			
						-1	3			Colour change to grey at 1.2m.	W	MD	
				SPT 2,2,5 N*=7		-2	4			Numerous shell fragments throughout profile.		D/VD	
				SPT 6,13,17 N*=30		-3	5						
						-4	6						
						-5	7			End BH5 at 6.0m due to limit of required investigation. Borehole terminated at 6m			
						-6	8						

PIEZOMETER CH1613-1 SHALLOW LOGS.GPJ COFFEY.GDT 19.10.06

Form GEO 5.10 Issue 3 Rev.0

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g. ADT

support

C casing N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Appendix B

Laboratory Test Results

RESULTS OF ACID SULFATE SOIL ANALYSIS (Page 1 of 3)

30 samples supplied by Coffey Geosciences Pty Ltd on 6th June 2006 - Lab. Job No. E5757
Analysis requested by Matt Rowbotham. - **Your Project: CH1613/1**

Sample Site	Depth (m)	EAL lab code	FIELD/ LAB PEROXIDE SCREENING TECHNIQUE				TPA	TPA	Titratable Potential Acidity (TPA)	Reduced Inorganic Sulfur	Reduced Inorganic Sulfur	NET ACIDITY Chromium Suite	NET ACIDITY TPA Only	LIME CALCULATION Chromium Suite	LIME CALCULATION TPA Only
			Initial pH_F water	pH_{FOX} peroxide	pH change	Reaction	pH_{OX}	pH_{TPA}	mole H^+/tonne (to pH 6.5)	(% chromium reducible S) (%Scr) (note 2)	(Scr) mole H^+/tonne	mole H^+/tonne (based on %Scrs)	mole H^+/tonne (based on TPA)	kg $CaCO_3$/tonne DW (includes 1.5 safety Factor)	kg $CaCO_3$/tonne DW (includes 1.5 safety Factor)
Method No.							*23B*		*23G*	*22B*	*a- 22B*	*note 5*	*note 5*	*note 5*	*note 5*
BH6	0.5m	*E5757/1*	5.38	3.52	-1.86	High	..	..	..	..	..	..	..	..	..
BH6	1.0m	*E5757/2*	5.24	4.14	-1.10	Medium	..	..	..	0.005	3	3	..	0	..
BH6	1.5m	*E5757/3*	6.11	4.09	-2.02	Low	..	..	..	<0.005	0	0	..	0	..
BH6	2.5m	*E5757/4*	8.59	6.14	-2.45	Low	..	..	..	..	..	..	..	..	..
BH6	3.5m	*E5757/5*	8.90	6.02	-2.88	Low	7.72	0.00	0	0.030	19	19	0	1	0
BH6	4.0m	*E5757/6*	8.70	6.33	-2.37	Low	..	..	..	..	..	..	..	..	..
BH6	4.5m	*E5757/7*	8.37	6.10	-2.27	Medium	7.00	0.00	0	0.031	19	19	0	1	0
BH6	5.5-5.8m	*E5757/8*	7.44	4.75	-2.69	Medium	..	..	..	0.011	7	7	..	1	..
BH6	7.0-7.15m	*E5757/9*	6.42	4.50	-1.92	Low	..	..	..	..	..	..	..	..	..
BH6	10-10.15m	*E5757/10*	6.09	3.13	-2.96	Low	3.99	4.95	45	0.030	19	19	45	1	3

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 of 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: .....

RESULTS OF ACID SULFATE SOIL ANALYSIS (Page 2 of 3)

30 samples supplied by Coffey Geosciences Pty Ltd on 6th June 2006 - Lab. Job No. E5757
Analysis requested by Matt Rowbotham. - **Your Project: CH1613/1**

Sample Site	Depth (m)	EAL lab code	FIELD/ LAB PEROXIDE SCREENING TECHNIQUE				TPA	TPA	Titratable Potential Acidity (TPA)	Reduced Inorganic Sulfur	Reduced Inorganic Sulfur	NET ACIDITY Chromium Suite	NET ACIDITY TPA Only	LIME CALCULATION Chromium Suite	LIME CALCULATION TPA Only
			Initial pH_F water	pH_{FOX} peroxide	pH change	Reaction	pH_{ox}	pH_{TPA}	mole H^+/tonne (to pH 6.5)	(% chromium reducible S) (%Scr) (note 2)	(Scr) mole H^+/tonne	mole H^+/tonne (based on %Scrs)	mole H^+/tonne (based on TPA)	kg $CaCO_3$/tonne DW (includes 1.5 safety Factor)	kg $CaCO_3$/tonne DW (includes 1.5 safety Factor)
Method No.							*23B*		*23G*	*22B*	*a- 22B*	*note 5*	*note 5*	*note 5*	*note 5*
BH7	1.0m	*E5757/11*	6.99	4.84	-2.15	Low	..	..	..	<0.005	0	0	..	0	..
BH7	1.5m	*E5757/12*	8.05	6.42	-1.63	Low	8.00	0.00	0	0.056	35	35	0	3	0
BH7	2.0m	*E5757/13*	7.73	2.96	-4.77	Low	4.40	5.67	5	0.052	32	32	5	2	0
BH7	3.0m	*E5757/14*	8.60	6.64	-1.96	Nil	..	..	..	..	..	..	..	..	..
BH7	3.5m	*E5757/15*	9.04	6.48	-2.56	Nil	..	..	..	..	..	..	..	..	..
BH7	4.0m	*E5757/16*	8.72	6.14	-2.58	Nil	..	..	..	..	..	..	..	..	..
BH7	5.0m	*E5757/17*	6.78	5.22	-1.56	Medium	..	..	..	..	..	..	..	..	..
BH7	5.5-5.7m	*E5757/18*	6.57	4.74	-1.83	Low	..	..	..	0.005	3	3	..	0	..
BH7	7.0-7.3m	*E5757/19*	6.52	4.26	-2.26	Low	..	..	..	..	..	..	..	..	..
BH7	8.5-8.8m	*E5757/20*	6.62	4.04	-2.58	Low	..	..	..	<0.005	0	0	..	0	..

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 of 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)

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RESULTS OF ACID SULFATE SOIL ANALYSIS (Page 3 of 3)

30 samples supplied by Coffey Geosciences Pty Ltd on 6th June 2006 - Lab. Job No. E5757
Analysis requested by Matt Rowbotham. - **Your Project: CH1613/1**

Sample Site	Depth (m)	EAL lab code	FIELD/ LAB PEROXIDE SCREENING TECHNIQUE				TPA	TPA	Titratable Potential Acidity (TPA)	Reduced Inorganic Sulfur	Reduced Inorganic Sulfur	NET ACIDITY Chromium Suite	NET ACIDITY TPA Only	LIME CALCULATION Chromium Suite	LIME CALCULATION TPA Only
			Initial pH_F water	pH_{ox} peroxide	pH change	Reaction	pH_{ox}	pH_{TPA}	mole H^+/tonne (to pH 6.5)	(% chromium reducible S) (%Scr) (note 2)	(Scr) mole H^+/tonne	mole H^+/tonne (based on %Scrs)	mole H^+/tonne (based on TPA)	kg $CaCO_3$/tonne DW (Includes 1.5 safety Factor)	kg $CaCO_3$/tonne DW (Includes 1.5 safety Factor)
Method No.							*23B*		*23G*	*22B*	*a- 22B*	*note 5*	*note 5*	*note 5*	*note 5*
BH8	0.5m	*E5757/21*	7.50	6.17	-1.33	High	..	..	..	0.005	3	3	..	0	..
BH8	1.0m	*E5757/22*	7.16	2.96	-4.20	High	4.56	4.98	20	0.248	155	155	20	12	2
BH8	1.5m	*E5757/23*	8.27	5.90	-2.37	Low	..	..	..	..	..	..	..	..	..
BH8	2.5m	*E5757/24*	8.48	6.49	-1.99	Low	..	..	..	..	..	..	..	..	..
BH8	3.5m	*E5757/25*	8.20	6.21	-1.99	Low	..	..	..	..	..	..	..	..	..
BH8	4.0m	*E5757/26*	8.53	6.52	-2.01	Low	..	..	..	..	..	..	..	..	..
BH8	4.5m	*E5757/27*	8.62	6.27	-2.35	Low	..	..	..	..	..	..	..	..	..
BH8	5.5-5.7m	*E5757/28*	6.17	4.51	-1.66	Medium	..	..	..	..	..	..	..	..	..
BH8	7.0-7.3m	*E5757/29*	6.01	4.34	-1.67	Medium	..	..	..	..	..	..	..	..	..
BH8	11.5-11.65m	*E5757/30*	6.55	3.79	-2.76	Medium	..	..	..	<0.005	0	0	..	0	..

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)
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Appendix C

Preliminary Acid Sulphate Soil Management Plan

PRELIMINARY ACID SULPHATE SOIL MANAGEMENT PLAN

C.1.1 Additional Investigation

In terms of acid sulphate soils, the scope of work undertaken thus far for the assessment has been preliminary and further investigation work should be undertaken prior to development of the site.

The NSW ASSMAC "Acid Sulfate Soil Manual" (August 1998) suggests that for an extensive development on a site greater than 4ha in area, two investigation holes per hectare would be required to provide adequate site coverage. On this basis, sampling and testing in up to about eight additional boreholes is recommended prior to construction. The number and depth of additional boreholes should be assessed by an experienced consultant based on the proposed area and depth of soil disturbance at the site.

The depth of the additional investigations should be at least 1m beyond the proposed depth of excavation or depth of groundwater drawdown, or at least 2m below the ground surface, whichever is greater. Soil samples should be collected every 0.5m. All samples taken during the investigation should be screened for the presence of potential ASS using laboratory methods 21Af and 21Bf of Ahern CR, Blunden B and Stone Y (eds) (1998), Acid Sulfate Soil Laboratory Methods Guidelines, ASSMAC. The results of the screening tests should be assessed by an experienced consultant, and POCAS, SPOCAS or CRS tests carried out as considered appropriate.

The results of the additional investigation work should be assessed, and a final acid sulphate soil management plan prepared for the development.

C.1.2 Neutralisation by Lime

C.1.2.1 General

ASS stockpile / treatment areas must be completely surrounded by bunds designed to be of sufficient capacity to accommodate a critical storm event. Due to the granular nature of the near surface soils at this site and the likely infiltration of surface waters into the soils, the area within the bund should be evenly covered with lime at a rate of about 50kg/m^2. Bunds should be constructed of imported material and be of sufficiently low permeability to ensure that uncontrolled loss of water to the surrounding area does not occur. This could generally be achieved by use of clay fill. The bund should be compacted by rolling with a pad foot roller or similar to bind the material into a cohesive earth fill. A target density of about 95% Standard Compaction is recommended in all earth bunds constructed for environmental protection. Bunded areas should be graded to allow water within the bunded area to flow to a sump area, where the water may be assessed and treated as necessary.

Excavated Potential Acid Sulfate Soils (PASS) should be spread within the bunded area in layers of workable depth (typically not more than 0.3m loose thickness) and be thoroughly mixed with lime through use of a rotary hoe, pulvi-mixer or some similar mechanical process nominated by the contractor to achieve a thorough mix. The liming should be confined to areas of manageable size. Liming areas should remain bunded to allow collection of all leachate and stormwater runoff until test results indicate acceptable levels of neutralisation have been achieved.

Alternatively, the soils may be mixed with lime prior to excavation. This could be achieved by spreading the required amount of lime over the surface of the excavation, assuming a depth of about 300mm will

be treated after each application. The lime should be thoroughly mixed with the soil through use of a rotary hoe, pulvi-mixer or some similar mechanical process nominated by the contractor to achieve a thorough mix. After mixing, the material could then be excavated and stockpiled in a bunded area until test results indicate acceptable levels of neutralisation were achieved.

C.1.2.2 Liming Ratios

Good quality fine agricultural lime should be used. In calculating liming ratios, a factor of safety of 1.5 is recommended above the theoretical requirement to take into account the rate of lime reactivity and the possibility of inhomogeneous mixing.

The test results from the previous work and of the additional recommended investigations should be considered in assessing liming ratios for PASS. Liming ratios should also be confirmed by testing at the time of construction.

The time required for applied lime to neutralise ASS is widely variable and depends on the specific properties of the neutralised soil, although the lime will begin to neutralise the acid soils from the time of application. Monitoring of the neutralisation rates of the ASS to be removed should be undertaken to provide an indication of the rate of neutralisation and to confirm that the process is working effectively.

C.2.1 Management of Leachate and Excavation Water

Groundwater samples should be obtained to assess the background pH of the groundwater prior to excavation of PASS at the site. Results of this testing should be forwarded to the ASS Consultant for the project, as a review of recommended pH values for groundwater monitoring during construction may be required.

Water pumped out during dewatering should be monitored on a regular basis during the dewatering period. It is suggested that water pH be checked several times throughout the day. At a minimum, pH testing should be carried out three times per day with a minimum of four hours between readings. The results of pH monitoring should be noted, and records kept on site throughout dewatering. If pH levels are found to become consistently lower over several tests, and the pH value approaches the minimum allowable pH of 6.5, all water should be contained and treated prior to release. Once an acceptable water quality is achieved, the treated water may be released. It is recommended that monitoring of turbidity, and dissolved oxygen be carried out immediately upon beginning of pumping and then daily for a period of at least two weeks. Depending on results, monitoring of these parameters should be carried out on a maximum weekly basis thereafter. A shorter timeframe may apply depending on the results of the ongoing testing. The testing interval could be revised at a later date should no significant changes in groundwater quality be evident.

All water runoff from bunded or other treatment areas is to be collected, monitored and then neutralised prior to release. We understand that no dewatering is proposed at this time. The method of neutralisation of leachate water is either to add lime as a slurry to the collected leachate water (depending on the salinity of the water to be treated) or to use a mechanical lime spreader to spread lime over an area close to the inlet point of the collection area. The addition of lime will be undertaken in conjunction with field testing to avoid achieving excessively high pH levels. The quality of the water to be finally discharged must meet appropriate guidelines for release.

C.2.2 Monitoring Program

C.2.2.1 Materials Treated in Bunded Areas

Field testing of the pH of lime treated materials will be required to assess whether pH values are being held at greater than 4. The pH testing should be supplemented with standard ASS laboratory tests from the excavated soil. 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 containing up to 0.5kg H_2SO_4/tonne would be acceptable. The laboratory samples should each be made up of a minimum of 10 sub-samples from different parts of the stored materials to provide an average value of TPA.

Delivery dockets for the agricultural lime should be kept with other site records to demonstrate that adequate neutralising agent was used on site.

C.2.2.2 Excavation Monitoring

Natural soils exposed in the walls and floor of all excavations during should be checked on a regular basis for the generation of acid conditions, using an approved field pH screening test. Lime should be added to the exposed surface of the soils if values of pH<4 occur. The liming ratio for the soil units should be used, assuming the outer 100mm of soil within the exposed face will be affected. Any water collected in the excavation should also be checked for indications of acid production. Contingency measures should be put in place in accordance with this plan if water pH values of less than pH 6.5 occur.

Soils exposed within the excavation, including those above the water table, shall be maintained in a wet condition by frequent irrigation to restrict oxygen entry into the soil within the excavation. The effects of irrigation on the stability of the excavations should be assessed by a suitably experienced consultant.

C.3.1 Contingency Measures

Soil acidity in disturbed materials should be monitored. Should the field pH tests and the laboratory tests show that the soil acidity has not achieved the minimum required standard, then the material must be reworked and additional lime treatment carried out until it is verified that the soil meets the required standard.

If monitoring of the collected water at the point of discharge indicates the pH is below acceptable discharge limits then discharge must immediately cease and further treatment carried out. Hydrated lime may only be applied in the presence of the ASS Consultant who shall ensure that it is added in small increments so as not to cause unduly high water pH levels (i.e. above 8.5).

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

Sufficient lime is to be stored in a dry location on-site to permit the immediate implementation of the above contingency measures. The lime shall be stored in a covered and bunded area to prevent accidental release to waters.