

Acid Sulfate Soils of Cairns, North Queensland

Volume 2

Appendix 1: Summarised Analytical Data

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Published by Department of Environment and Resource Management, Indooroopilly, Queensland, Australia.

NQAS_3

ISBN: 978-1-7423-0018-4

Volume 2

Acid Sulfate Soils Cairns, North Queensland Volume 2 Appendix 1: Summarised Analytical Data, accompanies the report “NQAS_3 Acid Sulfate Soils of Cairns, North Queensland Volume 1, ISBN 978 7423 0018 4”.

June, 2009

Material from this publication may be used providing both the author and the publishers are acknowledged.

Citation of this publication should take the form:

Manders J.A. O'Brien L.E. Morrison DW (2009). *Acid Sulfate Soils of Cairns, North Queensland* -. Department of Environment and Resource Management, Indooroopilly, Queensland, Australia.

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Analytical Data Method Codes

Field Morphology Summary				
Site ID	Borehole or site number			
Hor No	Horizon number			
Upp Depth	Upper depth of horizon			
Low Depth	Lower depth of horizon			
Soil Texture	Soil texture (codes according to McDonald et al. 1990)			
Jar.	Indicates presence of Jarosite (J) in profile			
Gyp.	Indicates presence of Gypsum (Y) in profile			
Shell	Indicates presence of Shell (SS) in profile			
Field pH				
Depth (m)	Depth at which pH _F and pH _{FOX} tests were conducted			
pH _F (23Af)	pH measured in the field on saturated soil sample using pH electrode			
pH _{FOX} (23Bf)	pH measured in the field – 30% peroxide reaction, pH electrode			
Lab Sample				
No.	Sample number of sample taken for analysis			
Upp Depth	Upper depth of sample taken for analysis			
Low Depth	Lower depth of sample taken for analysis			
Action Criteria				
Depth 1st Action Level	The depth category of the upper depth of the first horizon where the texture-based ASS action criteria is exceeded. 'S' denotes potential acidity for the respective depth categories.			
Action Level Select %S	Pc, Pl or Ps indicates samples that have exceeded 0.1, 0.06 or 0.03 %S (ie. exceeded the ASS action criteria), for clays, loams and sands respectively. Note: These figures apply to disturbances up to 1000 m3; for disturbances greater than 1000 m3, the action criteria is 0.03 %S, regardless of texture			
Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) Acid Base Accounting				
s-ANC _E	$S_{POS} - ((S_{POS} + s-ANC_E) / 1.5)$ WHERE $pH_{KCl} \geq 6.5$ AND $TPA = 0$			
s-Ca+s-Mg	$S_{POS} - ((s-Ca_A + s-Mg_A) / 1.5)$ WHERE $pH_{KCl} \geq 6.5$ AND $TPA = 0$			
Laboratory results				
	SPOCAS	ALHS	Unit	Description
	ALHS			
Potential Acidity				
S _{CR} (Sulfur, chromium reducible)		22B	%S	(from Chromium Reducible Sulfur method)
S _{POS} (Peroxide oxidisable sulfur)	23Ee		%S	= S _P – S _{KCl}
TSA (Titratable sulfidic acidity)	23H		mol H ⁺ /t	= TPA – TAA
TPA (Titratable peroxide acidity)	23G		mol H ⁺ /t	= Titratable Peroxide Acidity (measured after peroxide digestion)
Retained Acidity				
a-S _{RAS} (Residual acid-soluble)	a-23Re		mol H ⁺ /t	(S _{RAS} x 0.75 x 623.7) (S _{RAS} expressed in equivalent acidity units)
a-S _{NAS} (Net acid-soluble sulfur)		a-20J	mol H ⁺ /t	((S _{HCl} – S _{KCl}) x 467.8) (calculated in equivalent acidity units)
Actual Acidity				
TAA (Titratable actual acidity)	23F		mol H ⁺ /t	= Titratable actual acidity (measured before peroxide digestion)
SPOCAS				
pH _{KCl}				pH of soil in potassium chloride (KCl) extract
pH _{OX}				pH of soil after peroxide digestion
S _{KCl}	23Ce		%S	KCl extracted sulfur
s-Ca _A +s-Mg _A	s-23Xh+s-23Um		%S	Addition of Reacted Calcium and Magnesium (in equivalent % pyrite S it will neutralise)
Neutralising Capacity				
s-ANC _{BT}		s-19A2	%S	(ANC _{BT} / 3.121) (ANC _{BT} in equivalent % pyrite S it will neutralise)
s-ANC _E	s-23Q		%S	(ANC _E / 3.121) (ANC _E in equivalent % pyrite S it will neutralise)

Samples were analysed by Method 23 (SPOCAS). The SPOCAS method provides data on pyritic sulfur, pH, existing acidity, as well as a measure of Ca and Mg neutralising reactions. The SPOCAS is an improved and updated version of the POCASm method.

The SPOCAS Method is as per Acid Sulfate Soils Laboratory Methods Guidelines Version 2.1 June 2004 Ahern CA, McElnea AE, Sullivan LA (2004)

Sample selection and handling is as per the Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998, CR Ahern, MR Ahern and B Powell (1998).

ALHS Codes are standard analytical method codes according to the Australian Laboratory Handbook of Soil and Water Chemical Methods, GE Rayment and FR Higginson (1992), and Acid Sulfate Soils Laboratory Methods Guidelines Version 2.1 June 2004 Ahern CA, McElnea AE, Sullivan LA (2004)

Field Morphology Summary								Lab Sample		Action Criteria		SPOCAS Acid Base Accounting			Lab Results																		
Site ID	Hor No	Upp Depth (m)	Low Depth (m)	Soil Texture	Jar	Gyp	Shell	Field pH			No	Upp Depth (m)	Low Depth (m)	Depth 1st Action Level	Action Level %S	pH KCl =>6.5		Potential Acidity			Existing Acidity			SPOCAS				Neutralising Cap.					
								Depth (m)	pH _f	pH _{ox}						pH _{Ca++}	TPA = 0	SCR	S _{POS}	TSA	TPA	a-S _{RAS}	a-S _{NAS}	TAA	pH _{KCl}	pH _{ox}	S _{KCl}	%S	s-Ca _A +s-Mg _A	s-ANC _{BT}	s-ANC _E		
																																s-ANC _E	s-Ca++Mg
108	1	0.00	0.15	LC				0.10	4.6	3.0																							
								0.30	5.0	2.6																							
								0.60	5.3	3.1																							
	2	0.15	0.30	KSLMC					0.80	5.2	2.8	4	0.80	1.00																			
									1.00	5.0	2.8																						
									1.25	4.7	2.9																						
	3	0.30	1.10	LMC					1.50	4.9	3.1	5	1.30	1.50																			
									1.75	6.2	6.2																						
									2.00	6.7	6.7																						
4	1.10	1.70	LMC					2.25	7.0	7.2																							
								2.50	7.3	7.4																							
								3.00	7.5	7.1																							
5	1.70	3.60	LMC					3.50	7.3	7.3	9	3.30	3.50																				
								4.00	7.6	7.9																							
								4.50	7.6	7.6																							
6	3.60	3.80	LMC			SS		5.00	7.0	6.5	10	3.80	4.00																				
								5.50	7.1	6.1																							
								6.00	7.1	1.8																							
7	3.80	4.10	LMC					5.50	7.2	6.1	11	4.30	4.50																				
								6.00	7.1	1.8																							
								6.50	7.0	1.7																							
8	4.10	4.60	SLC					7.00	7.0	2.4																							
								7.50	6.6	2.5																							
								8.00	6.8	2.2																							
9	4.60	5.70	SLMC					8.00	6.8	2.2																							
								8.50	6.9	1.1																							
								9.00	6.9	1.1																							
109	1	0.00	0.70	CLFS				0.10	4.2	2.5																							
								0.30	4.0	2.7																							
								0.60	4.0	2.6																							
	2	0.70	1.30	S					0.80	4.1	2.3	3	0.50	0.60																			
									1.00	5.2	2.9																						
									1.25	5.2	2.8																						
	3	1.30	1.70	KS					1.50	5.2	3.5	4	0.80	1.00																			
									1.75	5.6	3.1																						
									2.00	5.1	1.0																						
4	1.70	1.80	LC					2.25	5.1	1.0	5	1.30	1.50																				
								2.50	5.5	1.2																							
								2.75	5.9	1.3																							
5	1.80	3.30	LC					3.00	6.3	1.1	6	1.80	2.00		S2	Pc																	
								3.25	6.5	1.4																							
								3.50	6.6	1.2																							
6	3.30	4.60	CL					3.75	6.9	1.1	7	2.30	2.50			Pc																	
								4.00	6.9	1.6																							
								4.25	6.7	1.1																							
7	4.60	7.30	KSLC					4.50	6.9	1.0	8	2.80	3.00			Pc																	
								4.75	6.9	1.7																							
								5.00	6.9	1.3																							
8	7.30	7.90	SLC					5.50	6.9	2.0	9	3.40	3.60																				
								6.00	7.1	1.8																							
								6.50	7.0	1.7																							
9	7.90	8.00	KS					7.00	7.0	2.4	10	7.90	8.00																				
								7.50	6.6	2.5																							
								8.00	6.8	2.2																							
10	8.00	8.40	KSLC					8.00	6.8	2.2	18	7.90	8.00																				
								8.50	6.9	1.1																							
								9.00	6.9	1.1																							
110	1	0.00	0.50	KSCL				0.10	5.0	2.6																							
								0.30	5.4	2.9																							
								0.60	5.0	2.6																							
	2	0.50	0.80	KSCL					0.80	4.5	3.4	3	0.50	0.60																			
									1.00	5.3	3.2																						
									1.25	5.8	3.5																						
	3	0.80	1.20	LMC					1.50	5.4	3.8	4	0.80	1.00																			
									1.75	6.2	4.9																						
									2.00	6.6	5.1																						
4	1.20	2.50	LMC					2.25	6.8	6.6	5	1.30	1.50																				
								2.50	6.9	6.2																							
								2.75	7.0	5.4																							
5	2.50	3.60	LMC					3.00	6.7	7.0	8	2.80	3.00																				
								3.25	7.0	7.0																							
								3.50	7.2	6.8																							
111	1	0.00	0.30	KSLC				0.10	5.7	4.3																							
								0.30	5.4	2.9																							
								0.60	5.0	2.6																							
	2	0.30	0.60	CLFS					0.80	4.7	2.7	4	0.80	1.00																			
									1.00	4.9	3.1																						
									1.25	5.4	3.8																						
	3	0.60	1.30	KSLC					1.50	5.7	4.8	5	1.30	1.50																			
									1.75	6.1	7.0																						
									2.00	6.5	6.7																						
4	1.30	1.70	KSCL					2.25	6.7	6.4	6	1.80	2.00																				
								2.50	6.9	7.1																							
								3.00	7.0	7.2																							
5	1.70	2.90	FSLC					3.50	6.9	7.0	7	2.30	2.50																				
								3.75	7.3	7.7																							
								4.00	7.3	7.2																							
6	2.90	3.80	FSLC					4.50	7.1	7.0	8	2.80	3.00																				
								4.75	7.2	7.2																							
								5.00	7.2	7.7																							
7	3.80	4.50	FSLC					5.50	7.2	7.6	10	3.80	4.00																				
								6.00	7.1	1.8																							
								6.50	7.0	1.7																							
8	4.50	5.60	LMC					7.00	7.0	2.4	11	4.30	4.50																				
								7.50	6.6	2.5																							
								8.00	6.8	2.2																							
1																																	

Field Morphology Summary									Lab Sample			Action Criteria		Lab Results																									
Site ID	Hor No	Upp Low Depth (m)	Soil Texture	Jar	Gyp	Shell	Field pH		No	Upp Low Depth (m)	Depth	Action	Action Level	SPOCAS Acid Base Accounting			Potential Acidity			Existing Acidity			SPOCAS			Neutralising Cap.													
							Depth (m)	pH _f						pH _{rox}	pH KCl →6.5	TPA = 0	%S	TPA	S _{CR}	S _{POS}	TSA	a-S _{RAS}	a-S _{NAS}	TAA	pH _{KCl}	pH _{ox}	S _{KCl}	%S	s-Ca _A +s-Mg _A	s-ANC _{BT}	s-ANC _E								
													TPA = 0	%S	mol H+/t	mol H+/t	mol H+/t	%S	%S	%S	%S	%S																	
													a-ANC _E	a-Ca+s-Mg	22B	23Ee	23H	23G	a-23Re	a-20J	23F	23A	23B	23C6	s-23Xh+s-23Um	s-19A2	s-23O												
131	1	0.00 0.40	KSL				0.10	6.3	4.2	2	0.50	0.60																											
							0.30	6.3	4.8																														
							0.60	6.6	5.1																														
							0.80	6.5	5.5																														
							1.00	6.5	5.3																														
3	1.20	2.20	S				1.25	6.5	4.5	4	1.30	1.50																											
							1.50	6.1	5.2																														
							1.75	6.3	5.2																														
							2.00	5.6	5.0																														
							2.25	5.4	5.0																														
4	2.20	3.20	KS				2.50	5.6	4.2	6	2.20	2.40																											
							3.00	5.5	5.0																														
							3.25	5.7	2.0																														
							3.50	6.2	2.7																														
5	3.20	4.60	KSHC				3.75	6.5	3.4	8	3.40	3.60	S4	Pc																									
							4.00	6.6	4.5																														
							4.25	6.5	4.4																														
							4.50	6.6	4.5																														
							4.75	6.6	4.5																														
132	1	0.00 0.15	LC				0.10	6.2	4.6	1	0.00	0.10																											
							0.30	5.4	4.5																														
							0.60	5.4	4.3																														
							0.80	5.8	4.6																														
							1.00	6.2	2.4																														
133	1	0.00 0.15	LC				0.10	6.4	7.5	1	0.00	0.10																											
							0.30	5.1	3.1																														
							0.60	6.4	1.6																														
							0.80	6.7	6.4																														
							1.00	7.0	7.2																														
134	1	0.00 0.10	CL				0.10	6.6	3.2	1	0.00	0.10	S0	Pc																									
							0.30	6.7	1.5																														
							0.60	6.7	1.5																														
							0.80	6.8	1.3																														
							1.00	6.8	1.9																														
135	1	0.00 0.30	CLS				0.10	4.9	2.8	2	0.30	0.50																											
							0.30	4.6	3.1																														
							0.60	4.7	4.3																														
							0.80	4.7	3.9																														
							1.00	4.3	3.1																														

Field Morphology Summary										Lab Sample		Action Criteria		SPOCAS Acid Base Accounting	Lab Results																			
Site ID	Hor No	Upp Depth (m)	Low Depth (m)	Soil Texture	Jar	Gyp	Shell	Field pH			No	Upp Depth (m)	Low Depth (m)	Depth Action Level	Action Select %S	pH KCl =>6.5	TPA =>0	Potential Acidity				Existing Acidity			SPOCAS					Neutralising Cap.				
								Depth (m)	pH _f	pH _{rox}								23Af	23Bf	S _{CR}	S _{POS}	TSA	TPA	a-S _{RAS}	a-S _{NAS}	TAA	pH _{KCl}	pH _{ox}	S _{KCl}	s-Ca _A +s-Mg _A	s-ANC _{BT}	s-ANC _E	s-19A2	s-23O
189	1	0.00	0.25	CL				0.10	4.9	2.6							22B	23Ee	23H	23G	a-23Re	a-20J	23F	23A	23B	23Cc	s-23Xn+s-23Um	s-19A2	s-23O					
	2	0.25	0.55	CL				0.30	4.1	2.8	2	0.30	0.40				0.007	0	97				110	3.8	4.7	0.02	0.009							
	3	0.55	0.70	KSCL				0.60	4.0	2.2																								
	4	0.70	1.10	LC				0.80	3.9	2.3	4	0.80	1.00																					
	5	1.10	1.50	KS				1.00	4.0	2.8																								
								1.25	5.1	2.8	5	1.30	1.40																					
								1.50	5.3	2.9																								
	6	1.50	1.65	MCS				1.75	5.9	3.2	6	1.50	1.60																					
	7	1.65	1.85	S				2.00	6.1	1.3	8	1.90	2.10	S2	Pc																			
	8	1.85	2.35	LMC				2.25	5.4	1.2																								
	9	2.35	2.70	LC				2.50	6.4	1.2	10	2.50	2.70		Pc																			
								2.75	6.6	1.2																								
								3.00	6.9	1.5																								
	11	3.10	3.40	MC				3.25	7.1	2.1	12	3.20	3.40		Pc																			
	12	3.40	3.60	MHC				3.50	6.5	3.2																								
								3.75	7.1	2.1																								
								4.00	9.4	3.6																								
190	1	0.00	0.15	S				0.10	5.6	2.5																								
	2	0.15	0.65	S				0.30	5.9	3.0																								
								0.60	5.9	3.0																								
	3	0.65	0.85	S				0.80	6.0	2.6	3	0.70	0.80																					
	4	0.85	1.15	LC				1.00	4.8	3.0	4	0.90	1.00																					
	5	1.15	2.20	KS		SS		1.25	5.7	4.5																								
								1.50	6.1	4.9																								
								1.75	4.2	4.8																								
								2.00	6.1	2.4	6	1.80	2.00																					
	6	2.20	2.80	S		SS		2.25	6.6	2.5																								
								2.50	7.5	2.0																								
								2.75	8.5	2.0	7	2.50	2.70	S3	Ps																			
								3.00	8.7	6.8	8	2.90	3.10		Pc	-0.111	0.259	1.224	0	0			0	8.0	7.5	0.06	1.448	0.78						
								3.25	9.2	7.3																								
	8	3.40	5.20	LMC		SS		3.50	9.1	4.2																								
								3.75	8.6	2.4																								
								4.00	9.4	3.6																								
								4.25	8.9	3.2																								
								4.50	8.7	4.5																								
								4.75	8.7	1.8																								
								5.00	8.9	4.8																								
	9	5.20	6.00	MHC				5.25	8.8		14	5.20	5.40		Pc																			
								5.50	8.8	2.2																								
								5.75	8.6	5.0																								
								6.00	5.7	5.9																								
191	1	0.00	0.20	CL				0.10	3.9	2.7																								
	2	0.20	0.35	MHC				0.30	3.7	2.4	2	0.20	0.30																					
	3	0.35	0.75	MC				0.60	3.4	2.2	3	0.50	0.60																					
	4	0.75	1.00	MC				0.80	3.3	1.8																								
								1.00	3.5	1.6	4	0.80	1.00																					
	5	1.00	1.40	MC				1.25	3.4	1.3	5	1.00	1.40																					
	6	1.40	1.60	MC				1.50	3.6	1.3	6	1.40	1.60																					
	7	1.60	1.80	MC				1.75	3.6	1.2	7	1.60	1.80	S2	Pc																			
	8	1.80	2.40	MHC				2.00	5.2	2.6																								
								2.25	5.3	2.9	8	2.00	2.20																					
								0.10	4.7	2.3																								
192	1	0.00	0.10	CL				0.30	5.1	2.9	2	0.20	0.30																					
	2	0.10	0.40	CL				0.60	6.1	3.2	3	0.50	0.60																					
	3	0.40	0.80	MC				0.80	6.4	2.2																								
								1.00	6.7	1.1	4	0.80	1.00																					
								1.25	6.5	1.3																								
								1.50	6.7	1.3																								
								1.75	6.7	1.2																								
								2.00	6.7	1.4	6	1.80	2.00		Pc																			
								2.25	6.8	1.3																								
	5	2.30	4.30	ZLMC				2.50	6.6	1.5																								
								2.75	6.8	1.6																								
								3.00	6.9	1.5	8	2.80	3.00		Pc				</															

Field Morphology Summary							Lab Sample			Action Criteria		Lab Results																													
Site ID	Hor No	Upp Depth (m)	Low Depth (m)	Soil Texture	Jar	Gyp	Shell	Field pH			No	Upp Depth (m)	Low Depth (m)	Depth 1st Action Level	Action Level Select %S	SPOCAS Acid Base Accounting				Potential Acidity			Existing Acidity			SPOCAS				Neutralising Cap.											
								Depth (m)	pH _f	pH _{rox}						pH KCl =>6.5	TPA =>0	%S	s-ANC _e	s-Ca+s-Mg	22B	23Ee	23H	23G	a-S _{RAS}	a-S _{NAS}	TAA	pH _{KCl}	pH _{ox}	S _{KCl}	%S	s-Ca _A +s-Mg _A	s-ANC _{BT}	s-ANC _E							
															mol H+/t	mol H+/t	mol H+/t	mol H+/t	23A	23B	23C6	s-23Xh+s-23Um	s-19A2	s-23O																	
208	1	0.00	0.10	CL				0.10	5.7	2.7																															
	2	0.10	0.30	CL				0.30	5.1	5.2	2	0.20	0.30																												
	3	0.30	0.90	FSCL				0.60	5.7	5.6																															
	4	0.90	1.60	SL				0.80	5.7	4.5																															
	5	1.60	2.10	SL				1.00	5.4	4.0	4	1.30	1.50																												
	6	2.10	3.60	KSL				1.25	5.3	3.9																															
	7	3.60	6.00	LMC				1.50	5.3	4.0																															
								2.00	5.3	4.0																															
								2.25	5.5	5.0																															
								2.50	5.5	4.8	6	2.30	2.50																												
								2.75	6.0	6.2																															
								3.00	5.8	6.2																															
								3.25	5.9	6.6																															
								3.50	5.7	5.1																															
								3.75	5.6	4.3																															
								4.00	5.6	4.9																															
								4.25	5.6	5.0																															
								4.50	5.4	4.1																															
								4.75	5.5	4.1																															
								5.00	5.5	5.1	11	4.80	5.00																												
								5.25	5.8	4.8																															
								5.50	5.8	6.1																															
								5.75	5.9	5.7																															
								6.00	5.9	6.6																															
209	1	0.00	0.20	FSL				0.10	6.0	3.2																															
	2	0.20	0.40	FSL				0.30	6.0	3.7	2	0.20	0.40																												
	3	0.40	1.55	FSL				0.60	6.1	4.6																															
								0.80	5.7	4.7																															
								1.00	5.9	3.9	3	0.80	1.00																												
								1.25	5.9	3.9																															
								1.50	5.6	4.8																															
	4	1.55	3.25	FSL				1.50	5.7	4.2																															
								2.00	5.8	5.0	5	1.80	2.00																												
								2.25	5.8	4.6																															
								2.50	5.8	4.8																															
								2.75	6.1	4.4																															
								3.00	6.4	5.2																															
								3.25	6.3	3.8																															
	5	3.25	3.90	SL				3.50	5.9	4.0	8	3.30	3.50																												
	6	3.90	4.40	SL				3.75	6.0	6.4																															
								4.00	6.0	5.9																															
								4.25	6.1	3.7	10	4.20	4.40																												
	7	4.40	4.60	CL				4.50	5.9	3.6	11	4.40	4.60																												
	8	4.60	5.20	CS				4.75	6.2	2.8																															
								5.00	6.2	2.6	12	4.80	5.00																												
	9	5.20	5.90	KS				5.25	6.2	3.0																															
								5.50	6.3	3.4	13	5.30	5.50																												
								5.75	6.4	5.2																															
								6.00	6.5	4.9																															
	10	5.90	6.10	KS				6.25	6.1	2.8																															
	11	6.10	6.50	CL				6.50	6.1	3.0	16	6.30	6.50																												

