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Assessment of Acid Sulfate Soil Materials in the Lock 1 to Wellington Region of the Murray-Darling Basin

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Cover Photograph:

Description: Clockwise from top left: Photographs taken at the following wetlands Lake Bywaters (Site LBY3), Teal Flat Hut (Site TFH2), Younghusband (Site YHD5), Henley Park (Site HEN2), and Coolcha Lagoon (Site CLG5)
Photographer: Gerard Grealish

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EXECUTIVE SUMMARY

This survey and assessment work of River Murray wetlands between Blanchetown (Lock 1) and Wellington was commissioned by the Murray-Darling Basin Authority (MDBA; previously Murray-Darling Basin Commission at the project start) as part of the basin-wide Acid Sulfate Soils Risk Assessment Project. The aims of this investigation were to conduct a Phase 1 detailed assessment to determine whether or not acid sulfate soil materials were present in the study area, provide characterisation of the properties and types of acid sulfate soil materials, determine the level of hazard, and to identify samples that would require more detailed Phase 2 laboratory analysis.

This work consisted of extensive field investigations at selected wetlands, which included visual descriptions of the soil and site, field measurements and collection of soil and water samples for laboratory analysis. Detailed Phase 1 assessments were carried out at 62 wetlands, which included a total of 210 sites, with 709 soil samples collected, including samples for laboratory analysis as well as salts and surface scraps that were not analysed.

Within this survey region there were another 14 wetlands that had been studied as part of other CSIRO work and where data is available summaries have been provided. A further 5 wetlands were not surveyed as they were determined to be not of concern or access was restricted. There is a total of 81 wetlands discussed in this report, of these 78 are below Lock1 (5 have no data for assessment and 14 have been summarised from previous CSIRO reports, and 59 were part of this field assessment survey). Three wetlands above Lock 1 were included in this survey as they were considered high priorities due to their proximity to water off-takes.

Field work was conducted between 22 August 2008 and 23 October 2008, and on 27 January 2010. A follow-up review survey was conducted between August and October 2009. A large database of field, laboratory, and photographic data was compiled during the project and interpreted to determine the hazard priority ranking for each sample, site and wetland. The wetland assessment and findings from the study are presented in this report.

Acid sulfate soil assessment reports were prepared for the 62 wetlands that were surveyed as part of this assessment plus 6 wetlands where CSIRO data was available to be summarised. All of these wetlands are written up as separate stand alone detailed reports that are included as Appendix B.

This report presents the data and findings for Phase 1 (the first part of a two-phased, detailed assessment process) of a study to determine the hazards posed by acid sulfate soil materials in wetlands along the River Murray between Lock 1 near Blanchetown and the southern end of the river near Wellington. The report identifies whether or not acid sulfate soil materials are present and indicates their general location and distribution within the assessed wetland. The soil samples were rated according to the criteria for inclusion in Phase 2 of the detailed assessment process (MDBA 2010) and a hazard assessment was determined for each wetland.

Assessment of the samples against the criteria for inclusion in Phase 2 identified that 93% (629 of the 679 samples that were assessed) met the criteria as a high priority. This confirms that most soils and wetlands in the survey region are of significant concern with regard to potential hazards from acid sulfate soils. A number of these samples were triggered by high priority criteria 2b (hypersulfidic soil material – by positive net acidity). There was also a significant number of samples that triggered high priority criteria 1 (sulfuric material – 50 samples) or criteria 2 (hypersulfidic material – by incubation – 40 samples).

The potential hazard rating at the wetland scale took into account the soil sample material assessment, the location of the sites within the wetland, and furthermore was based on expert judgement taking into account the quantitative data available. The distribution of wetlands with hazard ratings of concern occurred throughout the study area.

A total of 62 wetlands out of the 81 wetlands in the study region were assessed from the field data collected as part of this study. In addition, assessments of the data provided in previous CSIRO documentation was evaluated for a further 14 wetlands. Therefore a total of 76 wetlands have a hazard rating assigned, with 5 wetlands not assessed.

The findings and conclusions for hazard assessment are:

- Acidification: The results identified that 15 wetlands rated were of concern as high rating, 12 as medium to high, 22 as medium, 12 as low to medium, 1 as low to high, and 14 as low.
- De-oxygenation: The results identified that 72 wetlands were of concern with a high or medium rating, and 4 wetlands had a low rating.
- Metal mobilisation: The results identified that 49 wetlands were of concern with a high or medium rating.

The findings and conclusions of the report provide a strong basis for understanding the nature and distribution of acid sulfate soil materials and their associated hazards for the River Murray wetlands between Lock 1 and Wellington. This information can now be integrated with other factors including management strategies, and wetland and community assets for prioritisation for further investigation in Phase 2 of the study.

1. INTRODUCTION

The Murray-Darling Basin Authority (MDBA) commissioned CSIRO to undertake fieldwork and laboratory analysis to obtain necessary data on the nature and extent of acid sulfate soil materials in selected River Murray wetlands between Blanchetown (Lock 1) and Wellington. The project also includes three wetlands above Lock 1 between Blanchetown and Morgan that were considered to be a priority due to proximity to water off-takes. Assessments of acid sulfate soil materials were required to identify wetlands, and areas within the wetlands, that may contribute to the risks associated with acidification, de-oxygenation and metal mobilisation that would be expected to impact negatively on the water quality and environmental conditions of the wetlands and their surrounding areas.

This work consisted of extensive field investigation of selected wetlands, which included visual descriptions of the soil and site, field measurements and collection of soil and water samples for laboratory analysis. Detailed field assessment and laboratory analysis of samples were carried out at 62 wetlands, which included a total of 210 sites, with 709 soil samples collected for laboratory analysis.

There is a total of 81 wetlands discussed in this report, of these 78 are below Lock1. Five wetlands were not surveyed as they were determined not to be of concern or access was restricted while 14 have been summarised from previous CSIRO reports and 62 were part of this field assessment survey.

Field work was conducted between 22 August and 23 October 2008, and on 27 January 2010. A follow-up review survey conducted between August and October 2009. A large database of field, laboratory, and photographic data was compiled during the project and interpreted to determine the hazard priority ranking for each sample, site and wetland. The wetland assessment and findings from the study are presented in this report.

1.1. Region overview

This report describes the Phase 1 acid sulfate soil assessment activities (MDBA 2010) and presents the results for the region between Lock 1 and Wellington along the River Murray, and also includes three wetlands between Lock 1 and Morgan. Lock 1 is located near the town of Blanchetown in South Australia while Wellington is at the southern or downstream end of the River Murray, just before the river enters Lake Alexandrina. Land use in the general area includes irrigated agriculture, grazing, cropping, residential housing and recreation in public reserves.

A desktop assessment and data from earlier CSIRO studies of key wetlands in this region determined that most wetlands were likely to contain acid sulfate soil materials. There was potential for a significant risk to water quality below Lock 1 with reductions in river levels disconnecting and drying all wetlands and so a preliminary rapid assessment as carried out in other regions within the Murray-Darling Basin was not conducted. Instead all of the wetlands between Lock 1 and Wellington were selected for immediate detailed assessment.

The location of sites sampled for the entire survey are presented in Figure 1 while the 62 wetlands selected for survey and reported in this assessment are listed in Table 1.

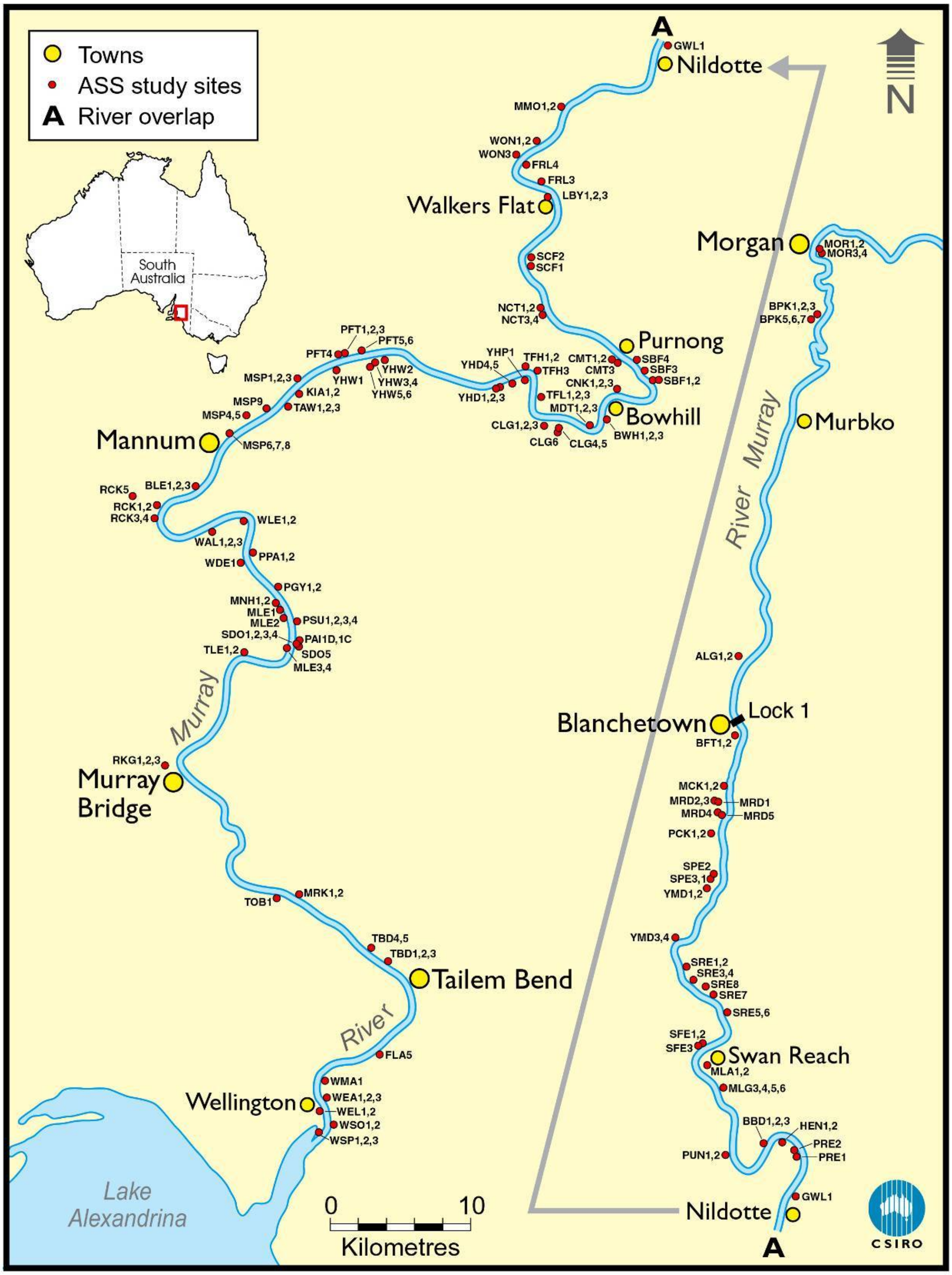


Figure 1. Map showing the acid sulfate soil assessment region and location of the surveyed site locations from Morgan to Wellington.

Table 1. List of wetlands, sampled dates and layers sampled.

Wetlands are ordered up the river from the south near Wellington to the north above Lock 1 at Blanchetown. Those wetlands not part of this field assessment, but where work has been conducted by other CSIRO projects these are identified by *CSIRO in the sampled date column.

MDBA Wetland Identification Number	ID Code	Wetland Name	Sampled Date	Area (ha)	Sites (count)	Soil Samples (count)
12700	PBY	Pomanda Bay	26-Jan-10		8	11
12701	WSP	Wellington Spit	22-Aug-08	42.8	3	9
12008	WSO	Wellington South	22-Aug-08	9.2	2	8
12007	WEL	Wellington	22-Aug-08	6.2	2	10
12702	WEA	East Wellington	20-Aug-08	11.5	3	11
12703	WMA	Wellington Marina	22-Aug-08	191	7	24
12704		Wellington North - Murrundi	*CSIRO	9.2		
12705	FLA	Fred's Landing	02-Sep-08	0.3	1	4
12022	TBD	Tailem Bend	02-Sep-08	95.7	5	17
12121	MRK	Mason Rock	02-Sep-08	25.8	2	8
12011	TOB	Tobalong	02-Sep-08	20.1	1	3
12706		Swanport	*CSIRO	13		
12707		Ukee Boat Club	*CSIRO			
12708	RKG	Mobilong Swamp (Rocky Gully)	09-Oct-08	28.2	3	12
12119		Riverglades	*CSIRO	44.6		
12710		Jury Swamp	*CSIRO	6.1		
12041	TLE	Toora Levee	10-Oct-08	2.6	2	5
12709	SDO	Sunnyside - Sunnyside Swamp (Downstream)	14-Oct-08	28	5	20
12066	MLE	Mypolonga Levee	10-Oct-08	33.2	4	15
12715	PAI	Sunnyside - Paiwalla Managed	*CSIRO	60	2	3
12118	PSU	Sunnyside - Paiwalla Swamp (Upstream)	14-Oct-08	48	4	16
12040	MNH	Mypolonga North	10-Oct-08	2.1	2	8
12120	PGY	Paiwalla Gully	14-Oct-08	0.9	2	8
12711	WDE	Woodlane	15-Oct-08	1.4	1	4
12039	PPA	Pompoota	14-Oct-08	3.4	2	8
12038	WLE	Wall Levee	15-Oct-08	5.9	2	6
12037	WAL	Wall Swamp	24-Nov-08	22.9	3	9
12712, 12713, 12720, 12721		Neeta Flat Depressions	No survey	12.8		
12017	RCK	Reedy Creek	17-Oct-08	98.6	5	22
12714	BLE	Baseby Levee	17-Oct-08	7.2	3	9

MDBA Wetland Identification Number	ID Code	Wetland Name	Sampled Date	Area (ha)	Sites (count)	Soil Samples (count)
12020		Cowirra Levee /Landing	No survey	20		
12218, 12248, 12249	MSP	Mannum Swamps	15-Oct-08	197.8	9	33
12205	TAW	Taworri	23-Oct-08	31	3	11
12030	KIA	Kia	23-Oct-08	7.7	2	6
12247	YHW	Younghusband West (Downstream)	04-Sep-08	110.1	6	20
12115, 12116	PFT	Pellaring Flat	16-Oct-08	35.7	6	19
12716		Lake Carlet	*CSIRO	348.5		
12050, 12051, 10252	YHB	Younghusband (Opposite Lake Carlet)	04-Sep-08	17.8	5	15
12717	YHP	Younhusband Point (Upstream)	04-Sep-08	4.6	1	3
12034	TFH	Teal Flat Hut (Downstream)	09-Sep-08	20.2	3	12
12005	TFL	Teal Flat (Upstream)	09-Sep-08	82	3	10
12004	CLG	Coolcha Lagoon	09-Sep-08	128.4	6	30
12299	MDT	Maidment Lagoon	10-Sep-08	66.9	3	11
12067	BWH	Bow Hill	23-Oct-08	48.1	3	12
12332	CNK	Craignook	10-Sep-08	54.7	3	11
12105, 12106, 12107	SBF	Saltbush Flat	29-Aug-08	101.6	4	14
12015	CMT	Caurnamont	10-Sep-08	90.3	3	10
12718		North Purnong	*CSIRO	94.5		
12112	NCT	North Caurnamont	10-Sep-08	73.2	4	11
12306	SCF	Scrubby Flat	29-Aug-08	48.5	1	2
12719	SCF	Scrubby Flat Creek	29-Aug-08	4.1	1	3
12029		Walker Flat South Lagoon	*CSIRO	88.8		
12028	LBY	Lake Bywaters	23-Aug-08	38.8	3	15
12027	FRL	Forster Lagoon	03-Sep-08	79.4	4	15
12026	WON	Wongulla Lagoon	28-Aug-08	124	3	10
12489		Kroehns Landing	*CSIRO	67.1		
12490	MMO	Marne River Mouth	28-Aug-08	17.1	2	7
12014		Devon Downs South	*CSIRO	53.6		
12019		Devon Downs North	*CSIRO	262.7		
12723		Devon Downs Swamp	No survey	23.1		
12724	GWL	Greenways Landing	03-Sep-08	5.8	1	4
12109	PRE	Preiss Landing	28-Aug-08	5.5	2	10
12045	HEN	Henley Park	26-Aug-08	22.4	2	11
12328	BBD	Big Bend	03-Sep-08	48.2	3	9

MDBA Wetland Identification Number	ID Code	Wetland Name	Sampled Date	Area (ha)	Sites (count)	Soil Samples (count)
12044	PUN	Punyelroo	26-Aug-08	125.4	2	7
12001	MLG	Marks Landing	22-Oct-08	192	6	16
12016	SFE	Swan Reach Ferry	26-Aug-08	67.9	3	11
12725		McCauley Swamp	No survey	3		
12168, 12169, 12170, 12173, 12194	SRE	Swan Reach Complex	25-Aug-08		8	26
12043	YMD	Yarramundi - Creek	06-Sep-08	32.65	4	16
12726		Yarramundi North - Moorundie - Morgan's Lagoon	*CSIRO	35.2		
12727		Yarramundi - Noonawirra	*CSIRO	7.95		
12729	SPE	South Portee	05-Sep-08	123.3	3	8
12730	PCK	Portee Creek	05-Sep-08	18.3	2	6
12731		Portee	No survey	46.4		
12722	MRD	Moorundie	05-Sep-08	304.8	5	11
12021	MCK	Moorundie Creek	05-Sep-08	2.4	2	7
12239	BFT	Blanchetown Flat - Sweeneys Lagoon	06-Sep-08	14.6	2	6
12010	ALG	Arlunga	22-Oct-08	166	2	4
12304	BPK	Brenda Park	22-Oct-08	98	7	16
12277, 12286	MOR	Morgan Conservation Park	22-Oct-08	100	4	11
		TOTAL COUNTS			210	709

1.2. Acid sulfate soils in the Murray-Darling Basin

Acid sulfate soil is the term commonly given to soil and sediment that contains iron sulfides, or the products of sulfide oxidation. Pyrite (FeS_2) is the dominant sulfide in acid sulfate soil, although other sulfides including the iron disulfide marcasite (Sullivan and Bush 1997; Bush 2000) and iron monosulfides (Bush and Sullivan 1997; Bush *et al.* 2000) can also be found.

Sulfidic sediments accumulate under anaerobic waterlogged (reducing) conditions where there is a supply of sulfate, the presence of metabolisable organic matter and iron containing minerals (Dent 1986). Under reducing conditions, sulfate (SO_4^{2-}) is bacterially reduced to sulfide (S^{2-}), which reacts with reduced iron (Fe^{2+}) to form iron sulfide minerals. These sulfide minerals are generally stable under reducing conditions; however, on exposure to the atmosphere, sulfuric acid is generated due to oxidation of the sulfide minerals, which can be detrimental to water quality and plant production, and can corrode concrete and steel structures (Dent 1986). In addition to the acidification of both ground and surface waters, a decrease in water quality may result from low dissolved oxygen concentrations (Sammut *et al.* 1993; Sullivan *et al.* 2002a; Burton *et al.* 2006), high concentrations of aluminium and iron (Ferguson and Eyre 1999; Ward *et al.* 2002), and the release of other potentially toxic metals (Preda and Cox 2001; Sundström *et al.* 2002; Burton *et al.* 2008a; Sullivan *et al.* 2008a).

Acid sulfate soils containing sulfide minerals form naturally in wetlands where reducing conditions exist and iron and sulfate are present. Changes to the hydrology in regulated sections of the Murray-Darling Basin system (due to higher weir pool levels), and the chemistry of rivers and wetlands have caused significant accumulation of sulfidic material in subaqueous and wetland margin soils. If left undisturbed and covered with water, sulfidic materials pose little threat of acidification. However, when sulfidic material is exposed to the air, the sulfides react with oxygen to form sulfuric acid. Without adequate buffering capacity, the soils may become sulfuric, i.e., the soils attain a pH less than 4. When these sulfuric materials are subsequently covered with water, significant amounts of acidity can be released into the water.

Other hazards associated with acid sulfate soils include: (i) mobilisation of metals, metalloids and non-metals, (ii) decrease in oxygen in the water column when monosulfidic materials are mobilised into the water column, and (iii) production of noxious or malodorous gases. In severe cases, these risks can potentially lead to damage to the environment, and have impacts on water supplies, and human and livestock health.

Record low inflows and river levels, as well as evaporative water loss from disconnected water bodies, in recent years have led to the drying of many wetlands in the Murray-Darling Basin, resulting in the exposure to oxygen of sulfidic material in acid sulfate soil, and soil acidification in a number of wetlands. The extent and potential threat posed by acid sulfate soil requires urgent assessment.

Despite decades of scientific investigation of the ecological (e.g., Living Murray Icon Site Environmental Management Plan: MDBC 2006a,b,c), hydrological, water quality (salinity) and geological features of wetlands in the MDB, we have only recently advanced far enough to appreciate the wide spectrum of acid sulfate soil subtypes and processes that are operating in these contemporary environmental settings - especially from continued lowering of water levels (e.g. Lamontagne *et al.* 2004; Fitzpatrick *et al.* 2008a,b; 2009; Shand *et al.* 2008a,b; 2009; Simpson *et al*. 2008; Sullivan *et al*. 2008a; Baker *et al.* 2010). Currently less is known about the impacts of metal mobilisation (Simpson *et al*. 2010; Shand *et al*. 2010). Hence, the Murray-Darling Basin Ministerial Council, at its meeting in March 2008 directed the then Murray-Darling Basin Commission (MDBC) to undertake an assessment of acid sulfate soil risk at key wetlands in the Murray-Darling Basin.

The MDBC (now the Murray-Darling Basin Authority – MDBA), in partnership with its Partner Governments and scientists, designed the MDB ASS Risk Assessment Project, which aims to assess the spatial extent of, and risks posed by acid sulfate soil in the Murray-Darling Basin. The project also aims to identify and assess broad management options.

Wetlands were identified for assessment based on their environmental significance as well as those that may pose a risk to surrounding waters. Through consultation with jurisdictions more than 19,000 wetlands within the MDB were identified. Due to their ecological significance, the decision was made to prioritise Ramsar-listed wetland complexes of the Murray-Darling Basin for immediate detailed acid sulfate soil assessment. In addition, due to the risk profile, wetlands along the River Murray between Blanchetown (Lock 1) and Wellington were also selected for immediate detailed acid sulfate soil assessment. For all other wetlands, a three tiered assessment process was developed, commencing with a desktop assessment, followed by on-ground rapid assessment and then detailed on-ground assessment at sites identified as high priority or having a risk profile. Through this three tiered assessment process a total of 100 wetlands were identified and selected for further detailed assessment (shown in Figure 2). These wetlands were divided for logistical reasons into the following seven regions:

• River Murray, Lock 1 to Lock 3, SA (25 wetlands).

• River Murray, Lock 3 to Lock 5, SA (31 wetlands).

• Mildura region, NSW and Vic (8 wetlands).

• Edward and Wakool Rivers, NSW (12 wetlands).

• River Murray, Hume to Yarrawonga, NSW and Vic (6 wetlands).

• Talwood-Mungindi, Queensland (1 wetland).

• Victorian Northern Flowing Rivers (17 wetlands).

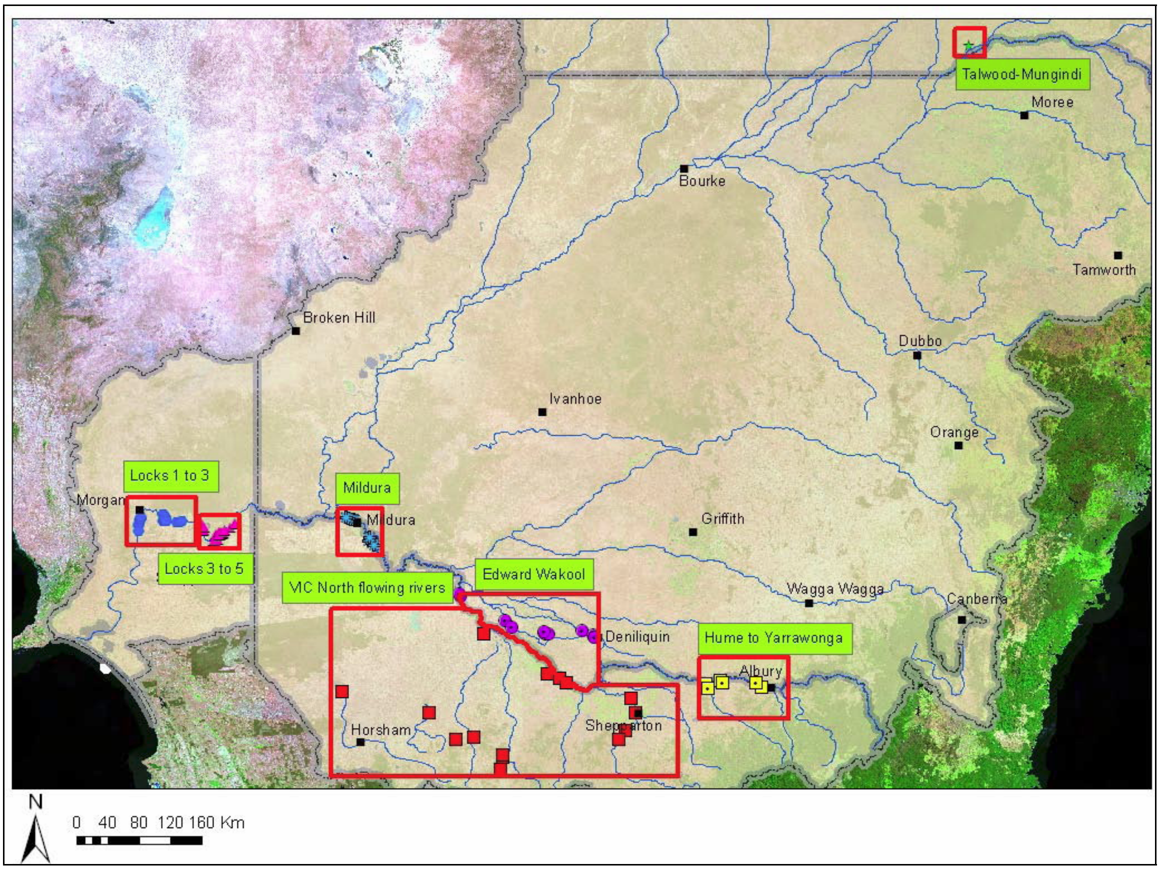


Figure 2. Map showing priority wetland regions surveyed in the Murray-Darling Basin (source: MDBA, 2010).

1.3. Detailed acid sulfate soil assessments using two phases

The detailed assessment stage of the Murray-Darling Basin Acid Sulfate Soils Risk Assessment Project involved comprehensive analyses using a set of established and tested field and laboratory methods to determine the presence and extent of acid sulfate soil materials and associated hazards, including potential for acidification, metal mobilisation and deoxygenation.

In summary, the protocol developed by the Scientific Reference Panel of the Murray-Darling Basin Acid Sulfate Soils Risk Assessment Project requires a two-phase procedure.

Phase 1 investigations determine whether or not acid sulfate soil materials are present for the study area, and provide characterisation of the properties and types of acid sulfate soil materials.

Phase 1 activities include:

- site selection
- site and profile description
- sample collection and storage
- laboratory analysis (of soil and water)
- identification of acid sulfate soil materials
- prioritisation and selection of Phase 2 samples
- interpretation and reporting.

Phase 2 investigations will only be conducted if the acid sulfate soil materials from Phase 1 are determined to be a priority concern for the study area and, based on Phase 1 recommendations, samples will undergo further investigations to determine their nature and severity and the specific risks associated with the acid sulfate soil materials.

Phase 2 activities include:

- laboratory analysis (of soil) to confirm and refine the hazards associated with contaminant mobilisation and/or deoxygenation
- risk assessment
- interpretation and reporting, including discussion on broad acid sulfate soil management options.

The soil samples to be analysed for Phase 2 will have been collected as part of the Phase 1 field assessment and then put into storage. Based on the Phase 1 report recommendations the client will identify samples and the analyses to be conducted on each of the samples for Phase 2.

1.4. Methodologies used to assess acid generation potential

Sulfide minerals are generally stable under reducing conditions, however, on exposure to the atmosphere the acidity produced from sulfide oxidation can be detrimental to water quality and plant production, and can corrode concrete and steel structures (Dent 1986). In addition to the acidification of both ground and surface waters, a reduction in water quality may result from low dissolved oxygen levels (Sammut *et al.* 1993; Sullivan *et al.* 2002a; Burton *et al.* 2006), high concentrations of aluminium and iron (Ferguson and Eyre 1999; Ward *et al.* 2002), and the release of other potentially toxic metals (Preda and Cox 2001; Sundström *et al.* 2002; Burton *et al.* 2008; Sullivan *et al.* 2008a).

In nature, a number of oxidation reactions of sulfide minerals (principally pyrite: FeS_2) may occur which produce acidity, by the following chemical reactions:

$$2FeS_2 + 7O_2 + 2H_2O \text{ ---> } 2Fe^{2+} + 4SO_4^{2-} + 4H^+$$

$$4FeS_2 + 15O_2 + 10H_2O \text{ ---> } 4FeOOH + 8H_2SO_4$$

A range of secondary minerals, such as jarosite, sideronatrite and schwertmannite may also form, which act as stores of acidity, i.e., they may produce acidity upon dissolution (re-wetting). The methodologies used here aim to characterise the potential for, and actual production of soil acidity, along with related effects on water quality and oxygenation.

1.4.1. Acid-base accounting

Acid-base accounting is used to assess both the potential of a soil material to produce acidity from sulfide oxidation and also its ability to neutralise any acid formed (e.g. Sullivan *et al*. 2001, Sullivan *et al.* 2002b).

The standard acid based accounting applicable to acid sulfate soils is described in Ahern *et al*. (2004) and summarised here. The following equation shows the components considered in calculation of Net Acidity (NA).

Net Acidity (NA) = Potential Sulfidic Acidity + Titratable Actual Acidity + Retained Acidity – Acid Neutralising Capacity / Fineness Factor

The components in this acid base accounting are further discussed below and by Ahern *et al*. (2004).

- Potential Sulfidic Acidity (PSA) also known as the ‘acid generation potential’ (AGP) is most easily and accurately determined by assessing the chromium reducible sulfur (S_{CR} or CRS) and then converting this to Potential Sulfidic Acidity (Acid Generating Potential) as described in Ahern *et al*. 2004.
- Titratable Actual Acidity (TAA) is a measure of the actual acidity in acid sulfate soil materials that have already undergone some oxidation. It measures the sum of both soluble and exchangeable acidity.
- Retained Acidity (RA) is the acidity ‘stored’ in minerals such as jarosite, schwertmannite and other hydroxysulfate minerals. Although these minerals may be stable under dry, acidic conditions, they can release acidity to the environment when moist conditions are encountered.
- Acid Neutralising Capacity (ANC) is measured in soils with pH_{KCl} values > 6.5. These soils may potentially have Acid Neutralising Capacity in the form of (usually) carbonate minerals, principally of calcium, magnesium and sodium. The alkalinity in carbonate minerals present are estimated by titration, and is expressed in $CaCO_3$ equivalents. By accepted definition (Ahern *et al*. 2004), any acid sulfate soil material with a pH_{KCl} < 6.5 has a zero Acid Neutralising Capacity.
- Fineness Factor (FF) is defined by Ahern *et al*. (2004) as 'A factor applied to the acid neutralising capacity result in the acid base account to allow for the poor reactivity of coarser carbonate or other acid neutralising material. The minimum factor is 1.5 for finely divided pure agricultural lime, but may be as high as 3.0 for coarser shell material'. Fine grinding of soil materials may lead to an overestimate of Acid Neutralising Capacity when carbonates are present in the form of hard nodules or shells. In the soil environment, they may provide little effective Acid Neutralising Capacity as exposure to acid may result in the formation of surface crusts (iron

oxides or gypsum), preventing or slowing further neutralisation reactions. For reasons including those above, the use of the Fineness Factor also applies to those naturally occurring alkalinity sources in soil materials as measured by the Acid Neutralising Capacity methods.

The following Net Acidity thresholds are used when discussing the data:

- low net acidity (<19 mole H^+/tonne)
- moderate net acidity (19 – 100 mole H^+/tonne)
- high net acidity (>100 mole H^+/tonne).

1.5. Classification of soil materials

Recently, the Acid Sulfate Soils Working Group of the International Union of Soil Sciences agreed to adopt in principle the following five descriptive terminology and classification definitions of acid sulfate soil materials proposed by Prof. Leigh Sullivan and co-authors in a plenary lecture and Acid Sulfate Soils Working Group meeting at the 6th International Acid Sulfate Soil and Acid Rock Drainage Conference in September 2008 in Guangzhou, China (Sullivan *et al*. 2008b). This new classification system for acid sulfate soil materials (Sullivan *et al*. 2009) has also been recently (October 2008) adopted by the Scientific Reference Panel of the Murray–Darling Basin Acid Sulfate Soils Risk Assessment Project for use in the detailed assessment of acid sulfate soils in the Murray–Darling Basin.

The criteria to define the soil materials are as follows:

1. **Sulfuric materials** – soil materials currently defined as sulfuric by the Australian Soil Classification (Isbell 2002). Essentially, these are soil materials with a pH_W < 4 as a result of sulfide oxidation.
2. **Sulfidic materials*** – soil materials containing detectable sulfide minerals (defined as containing greater than or equal to 0.01% sulfidic S). The intent is for this term to be used in a descriptive context (e.g. sulfidic soil material or sulfidic sediment) and to align with general definitions applied by other scientific disciplines such as geology and ecology (e.g. sulfidic sediment). The method with the lowest detection limit is the Cr-reducible sulfide method, which currently has a detection limit of 0.01%; other methods (e.g. X-ray diffraction, visual identification, Raman spectroscopy or infra red spectroscopy) can also be used to identify sulfidic materials.

   **This term differs from previously published definitions in various soil classifications (e.g. Isbell, 2002).*
3. **Hypersulfidic material** – Hypersulfidic material is a sulfidic material that has a field pH of 4 or more and is identified by experiencing a substantial* drop in pH to 4 or less (1:1 by weight in water, or in a minimum of water to permit measurement) when a 2–10 mm thick layer is incubated aerobically at field capacity. The duration of the incubation is either:
   1. until the soil pH changes by at least 0.5 pH unit to below 4; or
   2. until a stable** pH is reached after at least 8 weeks of incubation.

   **A substantial drop in pH arising from incubation is regarded as an overall decrease of at least 0.5 pH unit.*

   ***A stable pH is assumed to have been reached after at least 8 weeks of incubation when either the decrease in pH is < 0.1 pH unit over at least a 14 day period, or the pH begins to increase.*
4. **Hyposulfidic material** – Hyposulfidic material is a sulfidic material that (i) has a field pH of 4 or more and (ii) does not experience a substantial* drop in pH to 4 or less (1:1

by weight in water, or in a minimum of water to permit measurement) when a 2–10 mm thick layer is incubated aerobically at field capacity. The duration of the incubation is until a stable** pH is reached after at least 8 weeks of incubation

**A substantial drop in pH arising from incubation is regarded as an overall decrease of at least 0.5 pH unit.*

***A stable pH is assumed to have been reached after at least 8 weeks of incubation when either the decrease in pH is < 0.1 pH unit over at least a 14 day period, or the pH begins to increase.*

5. **Monosulfidic materials** – soil materials with an acid volatile sulfide content of 0.01% S or more.

   Non-Acid Sulfate Soil materials - In addition the Scientific Reference Panel of the Murray–Darling Basin Acid Sulfate Soil Risk Assessment Project agreed to identify the other acidic soil materials arising from the detailed assessment of wetland soils in the Murray–Darling Basin, even though these materials may not be the result of acid sulfate soil processes (e.g. the acidity developed during ageing may be the result of Fe^{2+} hydrolysis, which may or may not be associated with acid sulfate soil processes). Also the acidity present in field soils may be due to the accumulation of acidic organic matter and/or the leaching of bases. Of course, these acidic soil materials may also pose a risk to the environment and would be identified during the present course of the Phase 1 detailed assessment. The definition of these other acidic soil materials for the detailed assessment of acid sulfate soils in the Murray–Darling Basin is as follows:

   1. Other acidic soil materials – either:
      a. non-sulfidic soil materials that acidify by at least a 0.5 pH_W unit to a pH_W of < 5.5 during moist aerobic incubation.
      b. soil materials with a pH_W ≥ 4 but < 5.5 in the field.
   2. Other soil materials – soils that do not have acid sulfate soil (or other acidic) characteristics.

2. METHODS AND MATERIALS

The approach followed is consistent with the guidelines provided in the report prepared by the Murray-Darling Basin Acid Sulfate Soils Scientific Reference Panel "Detailed Assessment of Acid Sulfate Soils in the Murray-Darling Basin: Protocols for sampling, field characterisation, laboratory analysis and data presentation" (MDBA 2010). This report should be referred to for information on the rationale and protocols for conducting this work. Readers are referred to this 'Protocol' report to obtain details regarding methods and procedures and the following sections here provide a summary of key relevant features for this study.

The 'Protocol' report was completed in 2010 after this wetland assessment field survey had been conducted in 2008, but the principles, approach and methods are somewhat the same as both works were conducted with the same objectives in mind. This wetland assessment field survey was used to test and refine the methods that were proposed and ultimately included in the protocol document. The main deviation of this work to the 'Protocol' document is in the number of sites placed per wetland area, selecting the location of the sites, and the depth range for collecting samples. Comments on the impact of the differences are:

- The 'Protocols' specify that a certain number of sites are to be analysed per wetland area, generally this field survey placed less sites per wetland than the number required. However, the wetlands surveyed in this study were all dry and therefore more information about the surface conditions, vegetation pattern, and soil features could be visually observed and this extra information assisted with targeting site locations for sampling. Normally, the wetland would be covered with surface water and changes in the soil surface condition would not be observed, therefore requiring more sites to improve the likelihood of optimising the assessment of the wetland soils. After the initial field survey was conducted in 2008 a follow-up field visit was conducted in September and October 2009 to review the characterisation of the wetland soils, their distribution and assessment of acid sulfate soil materials. This follow-up survey confirmed that the initial survey with a low density of sites provided a good representation of the wetland soils and therefore adequately matched the improvements that were later made to the protocol document.
- The 'Protocols' specify that a number of sites should be located along transects, and that these transects should form a cross-section through the wetland from the high elevated margins to the lower elevation areas. As discussed in the point above, because these wetlands were dry with no surface water, the sites could be more efficiently located based on surveyor experience, and the follow-up survey confirmed that the site locations were reasonably representative. Where possible the transect approach was used but the flexibility to locate sites elsewhere was also used.
- The 'Protocols' specify that samples are to be collected from defined depth ranges down the soil profile (0 to 5 cm, 5 to 10 cm, 10 to 20 cm, 20 to 40 cm, and 40 to 90 cm), generally this field survey collected samples from depth ranges that more corresponded with changes in soil layers observed, with the aim to collect samples from the surface (about 0 to 5 cm), subsurface (about 5 to 20 cm), subsoil (about 20 to 50 cm) and deep subsoil (about 50 to 100 cm). As the wetlands were dry and the soils clayey textured, the subsoils occasionally had a very hard consistence that made it impossible to extract with hand sampling tools.
- The 'Protocols' specify that where sample value for pH_{KCL} <4.5 then retained acidity should be measured and included as part of the acid-base accounting. For samples that meet this criterion, retained acidity was not measured as part of Phase 1 during this survey. This requirement was a later change made to the protocol document to incorporate all components of acid-base accounting in the Phase 1 analysis.

The selection of the wetlands for acid sulfate soil field work and sampling was pre-determined to include all wetlands that had not been previously surveyed as part of the Nine Wetlands survey (Fitzpatrick *et al.*, 2008c) and other investigations (Fitzpatrick *et al.*, 2008d). The survey was conducted in two groupings of wetlands, one group comprised mainly of the wetlands identified as being associated with SA Water off-takes while the other group comprised the remaining wetlands. This sampling program in combination with the previous CSIRO studies provides a complete assessment of all wetlands between the town of Blanchetown (Lock1) and Wellington on the River Murray. A few wetlands immediately up river of Blanchetown were also surveyed as part of this project due to their proximity to water off-takes and the information and results for these wetlands are included in this report.

2.1. Field sampling of soils and waters

The number of sample sites and their locations within a wetland was determined by the experience of the field soil surveyor. A number of factors were taken into consideration, including, but not limited to, the following: safe access and working area, ease of access (farm tracks, gates, proximity from public roads and permission from landholders), observed variability at the wetland (vegetation habitat changes, soil surface condition changes, water on the surface, topography changes, shape of wetland, proximity to the river), variability on the remotely sensed image maps, and information and knowledge about the wetland supplied by the landholders and Natural Resource Management staff.

In general, sites for sampling were located to represent a low, mid and high part of the wetland topography, and where possible these sites formed a topographic transect within the wetland which covered the wetland centre (low), edge of the wetland (high), and a point in between (mid). Additional sites could be placed near the wetland inlet, or where salts were observed on the surface, or surface water was present. Mapping of the soil distribution within the wetland was not considered, given the few observation sites that were made at each of the wetlands.

Sample site location coordinates were obtained using a Global Positioning System (GPS), for WGS 84 Datum: UTM Zone 54 South. At dry sites, soil sampling was conducted from soil pits dug to approximately 0.6 m deep, and then with a gouge auger below the base of the pit down to about 1 m or to auger refusal. Where soils were below water (i.e. subaqueous soils), samples were obtained by wading and using a gouge auger, to approximately 0.9 m depth or to auger refusal.

Irrespective of the sampling method to extract soil material, soil profiles were sampled on a layer-by-layer basis where changes in the soil material were identified. About 4 to 6 layers were sampled per soil profile and generally the layers consisted of a surface (about 0 to 5 centimetres), subsurface (5 to 20 centimetres), subsoil (about 20 to 50 centimetres), deep subsoil (50 to 100 centimetres), subdivisions of the above intervals and a deeper layer below if extracted.

The samples were described according to standard methodology (NCST, 2009; Schoeneberger *et al*. 2002). Layer depth ranges were recorded, and for each layer the morphology and physical properties described, including colour (matrix and mottles), texture, structure, consistence and occasional other identifiable features such as stickiness, plant material, odour and concentrations.

The following soil sampling procedure was followed: firstly, bulk soil samples (typically > 500 g) for each layer taken were placed in pre-labelled plastic bags and mixed. Next, from the bag, sub-samples were taken and placed in two 70 ml screw-top plastic jars, with care taken in wet samples to exclude air by filling the jars to the maximum level to limit sulfide oxidation during transit and storage. Sub-samples from the layers were also placed in two chip-trays, with the first used to display morphologically representative aggregates for each of the sampled layers for later visual reference (e.g. during report writing) and placed in the CSIRO archival soil storage system), while the second chip-tray was used for acid sulfate soil incubation in the laboratory. Sample recovery at some locations was difficult due to the physical limitations of the soil materials such as, unconsolidated coarse (sandy layers), extremely hard dry layers or deep water. However, the samples obtained during this study were adequate to characterise materials likely to be exposed with further decreases in water levels.

Water samples were not collected as wetlands were dry and on the occasions water was present in the pit it generally was not possible to sample. Routine collection of water samples was not a requirement for this survey and was only introduced into the 'Protocols' later once this survey was completed.

2.2. Laboratory analysis of soil samples

Soil and water samples were stored and transported to two laboratories.

- The Southern Cross University Laboratory conducted the acid-base accounting analysis on soil samples and water soluble sulfate analysis.
- The CSIRO Land and Water Laboratories, Waite Institute conducted pH_W, pH_{OX}, and pH_{INC} soil sample analysis.

The protocol report (MDBA 2010) identifies the analyses to be conducted. A summary of the soil analyses and methods are presented in Table 2.

Table 2. Laboratory analysis conducted on soil samples.

Parameter	**Units**	**Method or Method Code**	**Method Reference**
Soil Samples			
Soil pH_W	pH unit	pH meter; 1:1 soil:water	Rayment and Higginson 1992
Soil pH_{OX}	pH unit	pH meter; Method 4E1	Rayment and Higginson 1992
Soil pH_{INC}	pH unit	See Appendix 4 of MDBA 2010	Sullivan *et al*. 2009 Fitzpatrick *et al*. 2008
Moisture content (of soil sample)	Weight%	80^oC drying	Ahern *et al.* 2004
Chromium reducible sulfur (S_{CR})	sulfide %S	Method 22B	Ahern *et al.* 2004
pH_{KCl}	pH unit	Method 23A	Ahern *et al.* 2004
Titratable actual acidity	mole H^+/tonne	Method 23F	Ahern *et al.* 2004
Retained acidity	mole H^+/tonne	Method 20J	Ahern *et al.* 2004
Acid neutralising capacity (where pH_{KCl} >6.5)	$\%CaCO_3$	Method 19A2	Ahern *et al.* 2004
Water extractable sulfate (1:5 soil:water extract)	mg SO_4^{2-}/kg	Method 14F Conducted on surface soil sample	Rayment and Higginson 1992

2.3. Quality Assurance / Quality Control (QA/QC)

2.3.1. Site selection and sample collection

The senior soil surveyor for the project was Mr Grealish who determined site locations and conducted the collection of soil samples. Throughout the field survey, the work activities were constantly under review by accompanying senior CSIRO staff member Dr Fitzpatrick, who ensured work was conducted according to best-practice methods.

There were no major issues of concern identified.

Minor issues requiring alternative actions included:

- At Kia Wetland the soils were described but Landholder permission for collection of soil samples for analysis was not provided and therefore analytical data is not available for this wetland. For interpretation purposes, hazard assessments were based on consideration of similar soil results from the surrounding area.

2.3.2. Laboratory analysis

For all tests and analyses conducted at the Southern Cross University Laboratories, the Quality Assurance and Quality Control Procedures were equivalent to those endorsed by NATA (National Association of Testing Authorities).

2.3.3. Data management

To ensure that the data was correct, the following were conducted: i) data checked for internal consistency by comparisons of similar data fields to others to ensure a satisfactory match, ii) data checked to ensure data values were within range, iii) data checked to ensure that outlier values in comparison to the population as a whole were correct, iv) checked that within wetlands and soil profiles the data trends were acceptable and unusual trends were investigated more closely to ensure they were correct, v) data peer reviewed.

All inconsistencies were checked and data values were updated where required. No major issues of concern were identified, and no data was removed from the data set.

2.3.4. Data interpretation and reporting

Reporting of information was conducted by a team of people, who as part of the on-going process provided internal review of work as it was prepared. Senior staff (and external reviewers) conducted an overall evaluation of the work. Review comments were evaluated and the report updated where necessary.

2.4. Criteria for ranking soil materials for inclusion in Phase 2 of the detailed assessment process

The Scientific Reference Panel of the Murray-Darling Basin Acid Sulfate Soils Risk Assessment Project agreed to recommend that soil materials be assigned the following priorities to undertake the Phase 2 detailed assessment (MDBA 2010):

High Priority

1. All sulfuric materials.
2. All hypersulfidic materials (as recognised by either i) incubation of sulfidic materials or ii) a positive net acidity result with a Fineness Factor of 1.5 being used).
3. All hyposulfidic materials with S_{CR} contents ≥ 0.10% S.
4. All surface soil materials (i.e. within 0-20 cm) with water soluble sulfate (1:5 soil:water) contents >100 mg SO_4 kg^{-1}.
5. All monosulfidic materials.

Moderate Priority

All hyposulfidic materials with S_{CR} contents < 0.10% S.

No Further Assessment

1. Other acidic soil materials.
2. All other soil materials.

It is important to note, while the criteria identifying samples for Phase 2 analysis is clearly defined, samples only go through to Phase 2 when consideration is given to the wetland as a whole, i.e., the soils of concern are representative of a portion of the wetland large enough to impact on water quality.

3. RESULTS

This work consisted of extensive field investigation of selected wetlands, which included visual descriptions of the soil and site, field measurements and collection of soil and water samples for laboratory analysis. Detailed field assessments and collection of samples for laboratory analysis were carried out at 62 wetlands (59 wetlands below Lock 1 and 3 wetlands above), which included a total of 210 sites, with 709 soil samples collected. Some of these samples included collection of salts, surface scraps and other soil material and therefore did not have laboratory testing, hence the reduced total number of samples listed under the laboratory analysis results.

Within this survey region there were another 14 wetlands that have been studied as part of other CSIRO reports and where data is available summaries have been provided. A further 5 wetlands were not surveyed as they were determined to be not of concern or access was restricted. There is a total of 81 wetlands discussed in this report, of these 78 are below Lock1 (5 have no data for assessment and 14 have been summarised from previous CSIRO reports, and 59 were part of this field assessment survey), and three wetlands above Lock 1 were included in this survey as they were considered high priorities due to their proximity to water off-takes.

Field work was conducted between 22 August 2008 and 23 October 2008, and on 27 January 2010. A follow-up review survey was conducted between August and October 2009. A large database of field, laboratory, and photographic data was compiled during the project and interpreted to determine the hazard priority ranking for each sample, site and wetland. The wetland assessment and findings from the study are presented in this report.

Samples obtained in this survey provided a baseline for the wide range of soil conditions present in the wetlands. Recorded locations and long-term archival storage of the samples in CSIRO will allow for future re-sampling and analysis, if required.

An accompanying data file provides a database of the site locations, morphological descriptions and laboratory measurements for all the soils sampled at the wetlands and a comprehensive set of digital photographs for each site and chip-tray sample was catalogued and provided separately as a photographic library.

3.1. Summary of field results

The wetland descriptions and assessment for acid sulfate soil materials and potential hazards have been compiled in such a way that these can be used as stand-alone short wetland description reports for each wetland. Assessment of the data was conducted on a wetland by wetland basis and this is reported in Appendix B.

3.2. Summary of soil laboratory results

Summary data are shown for the laboratory analyses of soils in Figure 3 to Figure 8 as cumulative frequency plots. Such plots display the ranges of data in soil chemistry for pH testing, acid-base accounting and water soluble sulfate and can be used to assess different data populations. Tables are provided to highlight the statistical distributions of data.

The data analysed here is for the samples collected as part of this field assessment study of 62 wetlands and does not incorporate data from previous studies.

3.2.1. pH testing (pH_W, pH_{OX}, pH_{KCl} and pH_{INC})

A total of 685 samples from the 709 samples collected were submitted for pH analysis. The data are summarised in Table 3 and shown as cumulative frequency plots in Figure 3. There was a wide range in pH_W values from pH 2.43 to pH 9.08, with a median pH of 5.89.

Table 3. Statistical summary of pH and pH testing in soils.

	units	minimum	median	mean	maximum	n
pH_W	activity	2.43	5.89	5.91	9.08	676
pH_{OX}	activity	0.92	2.89	3.51	8.91	667
$pH_{INC\ 28\ weeks}$	activity	1.30	4.70	4.86	7.29	675
pH_{KCl}	activity	2.95	5.37	5.61	9.78	685

The pH_{KCl} values were slightly lower than pH_W with a median of pH 5.37, similar to differences typically encountered using this measurement caused by different soil to solution ratios and ionic strengths of the suspending solutions. The pH changes during peroxide testing were significant, with pH_{OX} values varying from pH_{OX} 0.92 to 8.91, with a median of pH_{OX} 3.51.

The data identified about 7% (50 samples) of samples had a pH_W of <4 indicating sulfuric material and a further 6% (40 samples) decreased to pH < 4 on incubation, the threshold value normally used to indicate a high likelihood of sulfuric materials potentially forming. During incubation testing over the 28 week period, the range of pH remained similar, and the average values decreased slightly and the minimum was significantly lower (from pH 2.43 to pH 1.30). About 75% (509 samples) had an incubation pH of less than pH 5.5, where trace elements such as aluminium can be mobilised to concentrations of concern.

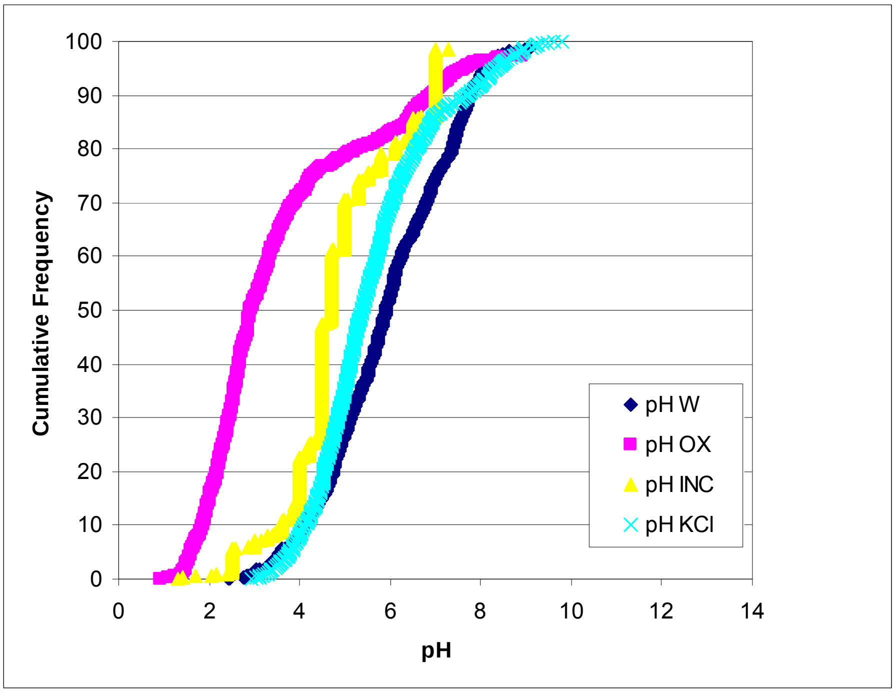


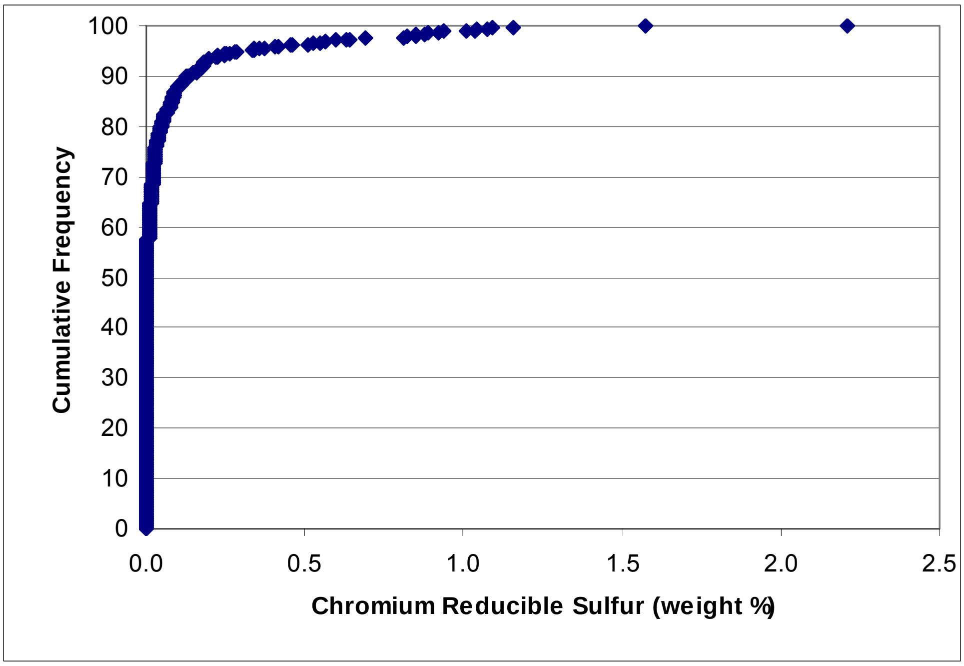
Figure 3. Cumulative frequency plots for pH data pH_W, pH_{OX}, pH_{KCl}, and pH_{INC}.

3.2.2. Chromium reducible sulfur

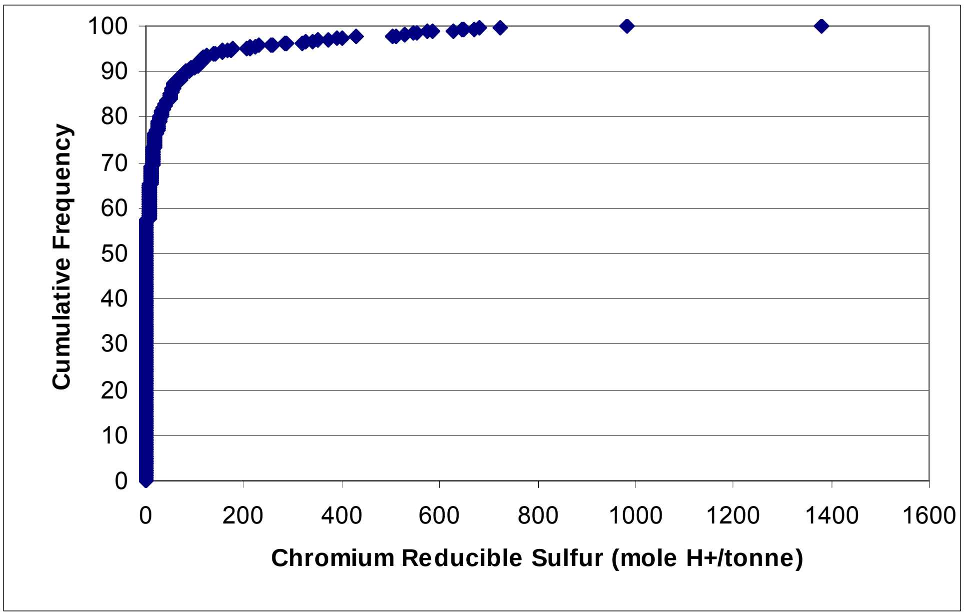
There was a large range in chromium reducible sulfur (S_{CR}) concentrations from less than detection limit (<0.01 weight %) to a maximum of 2.21 weight % (Table 4 and Figure 4). Nearly 58% (395 samples) of the samples had S_{CR} below the limit of detection.

Table 4. Statistical summary of chromium reducible sulfur analyses for soils.

	units	minimum	median	mean	maximum	n
RIS (S_{CR})	weight %	<0.01	0.00	0.06	2.21	687
RIS (S_{CR})	mole H^+/tonne	<6.24	0.00	38.37	1379	687



(a)



(b)

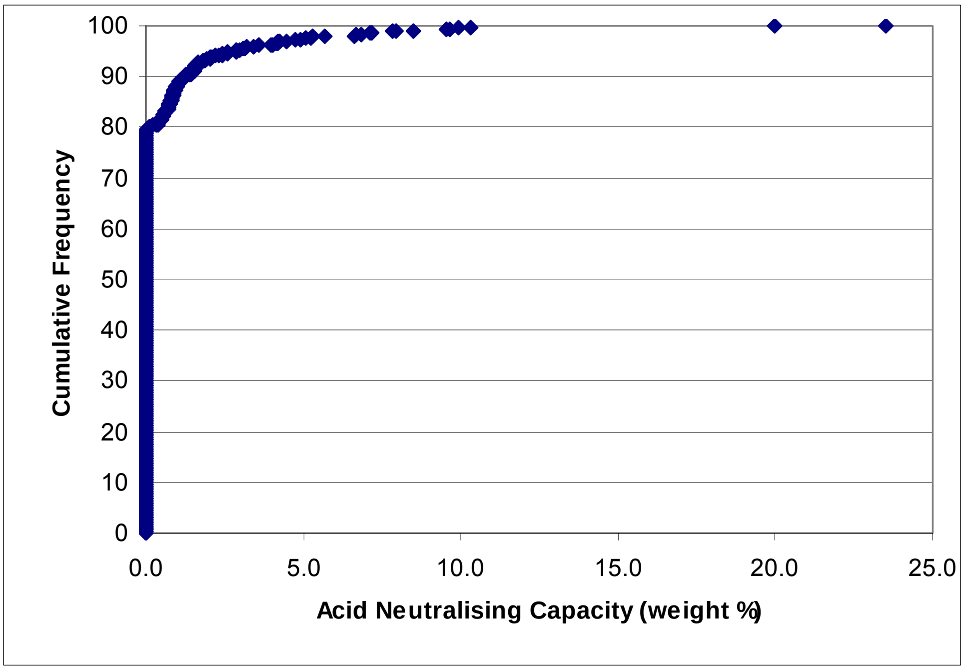
Figure 4. Cumulative frequency plots for chromium reducible sulfur data: (a) S_{CR} (weight %); (b) S_{CR} (mole H^+/tonne).

3.2.3. Acid neutralising capacity

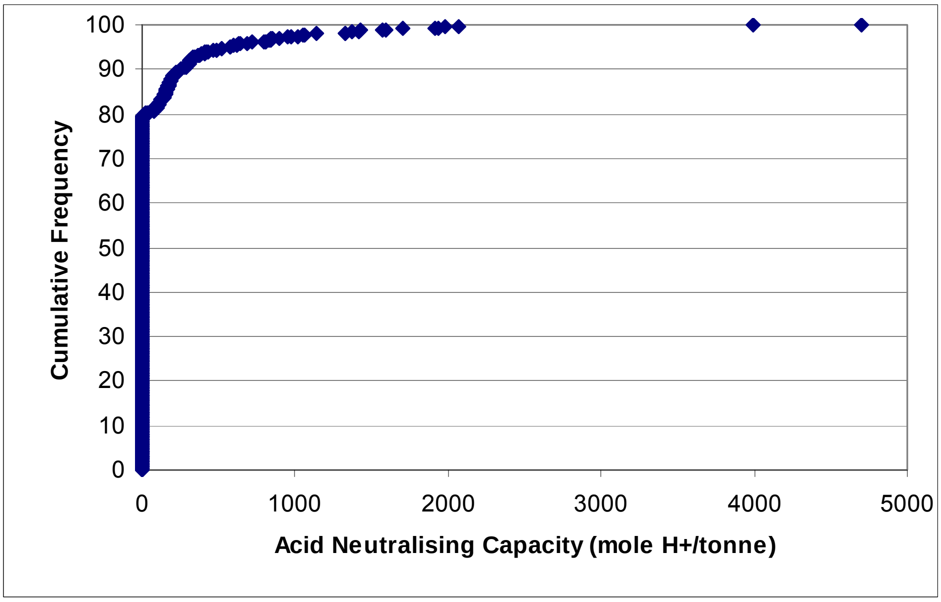
The amount of acid neutralising capacity (largely controlled by the amount of carbonate materials) varied over several orders of magnitude, from 0 to 23 weight %. A statistical summary is shown in Table 5 and shown on cumulative frequency plots on Figure 5. More than 79% (544 samples) had a zero acid neutralising capacity value.

Table 5. Statistical summary of acid neutralising capacity analyses for soils.

	units	minimum	median	mean	maximum	n
ANC	weight %	0.00	0.00	0.50	23.51	687
ANC	mole H^+/tonne	0.00	0.00	99.12	4697.91	687



(a)



(b)

Figure 5. Cumulative frequency plots for acid neutralising capacity data: (a) ANC (weight %); (b) ANC (mole H^+/tonne).

3.2.4. Titratable actual acidity

Titratable actual acidity varied significantly in the soils from zero up to a maximum of 425 mole H^+/tonne (Table 6 and Figure 6). About 21% (145 samples) of the samples had a value of zero, and graded up to some very high concentrations.

Table 6. Statistical summary of titratable actual acidity.

	units	minimum	median	mean	maximum	n
Titratable actual acidity	mole H^+/tonne	0.00	9.59	25.06	425.25	685

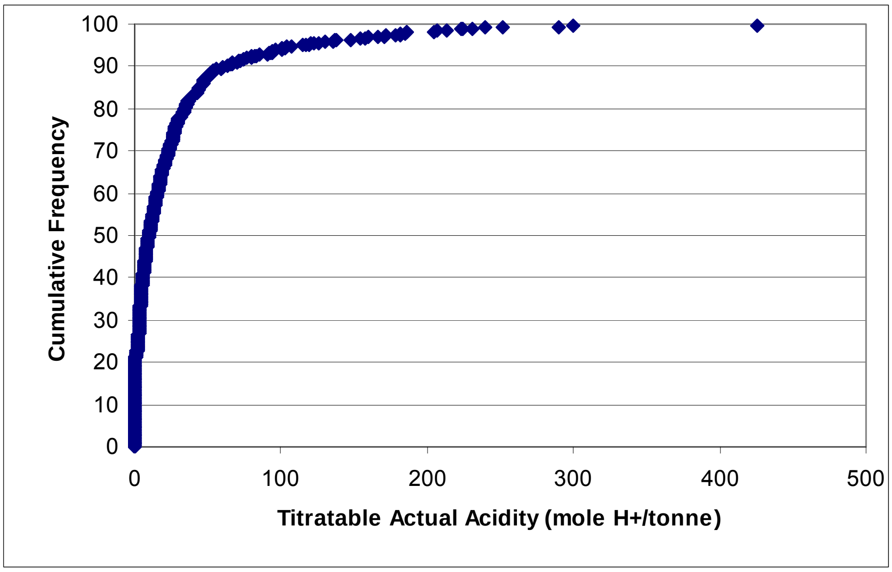


Figure 6. Cumulative frequency plot for titratable actual acidity in soils.

3.2.5. Retained acidity

Retained acidity was not measured on the soil samples, however pH_{KCl} data indicated that 120 samples had values of below 4.5 that indicates concentrations of retained acidity may be present.

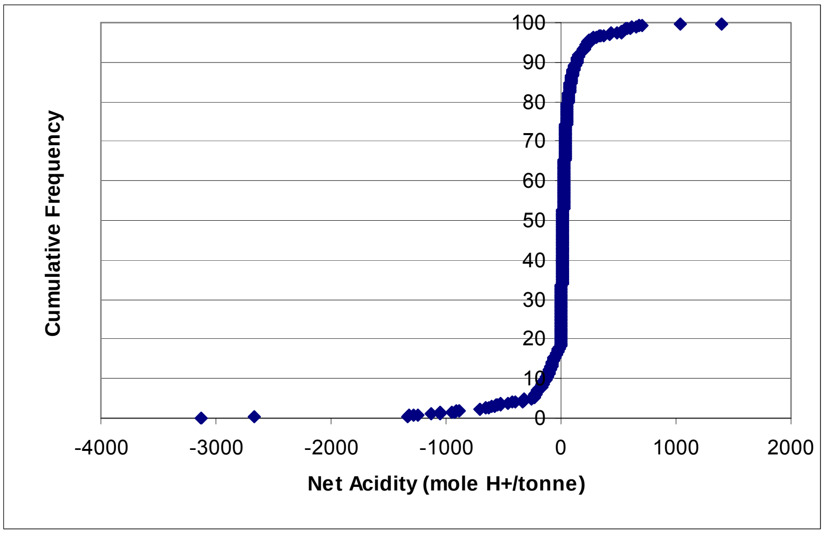
3.2.6. Net acidity

The range of net acidities was very large, varying from -3131 to 1402 mole H^+/tonne, with a median of 17 mole H^+/tonne and mean of -3 mole H^+/tonne (Table 7).

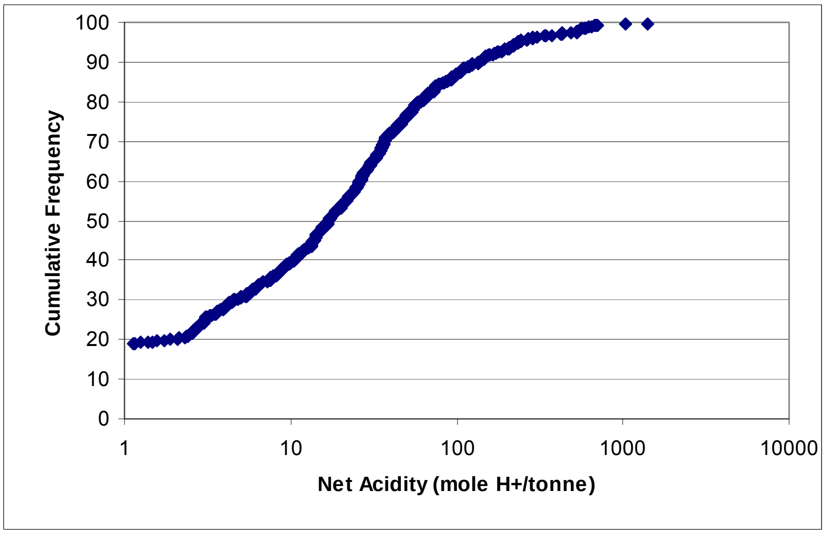
The full range of data is shown on a cumulative frequency plot in Figure 7 (a). About 19% of samples had negative net acidities, hence are defined as no hazard for acidification. Note, however, that other hazards may be present (e.g. metalloid release) even if the soils are well buffered with high contents of carbonate. Those samples with a degree of hazard (i.e. net acidity >0) have been plotted on Figure 7 (b). Note that the x-axis is a log scale. The proportions of samples in each category are 34% of samples are classed as low hazard (<19 mole H^+/tonne), 34% as moderate hazard (19 to 100 mole H^+/tonne), and 13% as high hazard (>100 mole H^+/tonne).

Table 7. Statistical summary of net acidity.

	units	minimum	median	mean	maximum	n
Net acidity	mole H^+/tonne	-3131	17	-3	1402	685



(a)



(b)

Figure 7. Cumulative frequency plots for net acidity showing (a) all data, and (b) positive data only, plotted on a log scale (note that about 81% of data had positive net acidity).

3.2.7. Water soluble sulfate (SO_4)

Water soluble sulfate concentrations extracted from the soils varied by nearly three orders of magnitude (Table 8 and Figure 8).

Concentrations of water soluble sulfate varied from 1.31 mg kg^{-1} to 29,582 mg kg^{-1} with a median concentration of 832 mg kg^{-1}. More than 93% of the samples were above the trigger value of 100 mg kg^{-1} for monosulfide formation potential as defined in the protocol (MDBA 2010).

Table 8. Statistical summary of water soluble sulfate data.

	units	minimum	median	mean	maximum	n
Water soluble sulfate	SO_4^{2-} mg kg^{-1}	1.31	832	1930	29,582	656

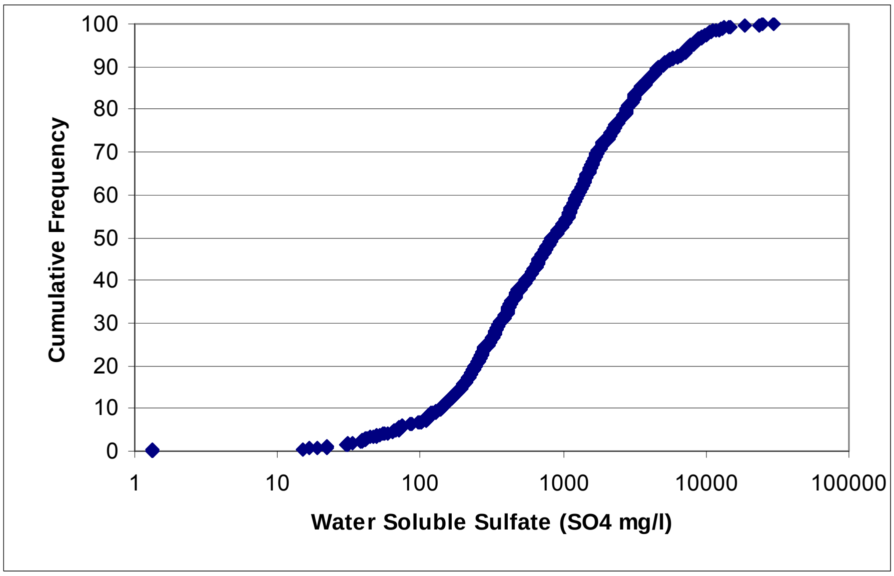


Figure 8. Cumulative frequency plots for water soluble sulfate data (note log scale for SO_4 concentration).

4. DISCUSSION

The field and laboratory data highlight a large degree of heterogeneity in the soil characteristics of wetlands below Lock 1. Although the study covers a large area, it provides a synoptic picture and changes in wetlands are likely to occur over intermediate (seasonal) and longer term cycles. The data are representative of a very dry period, where record low inflows have occurred over a number of years and water levels have been relatively low and nearly all wetlands at the time of the survey were dry with no surface water.

The soil measurements for pH and acid base accounting showed a wide range of values and hazards. Although each of the methods (net acidity, peroxide pH and incubation pH) produced data that show similar trends, there is considerable scatter.

Although peroxide pH (pH_{OX}) and incubation pH (pH_{INC}) correlate, there is a considerable degree of scatter (Figure 9). The vast majority of samples with a pH_{INC} of less than pH 4 (i.e. sulfuric materials) had a pH_{OX} < 2.5, but a considerable number of peroxide tested samples with pH_{OX}<2.5 did not incubate to sulfuric materials.

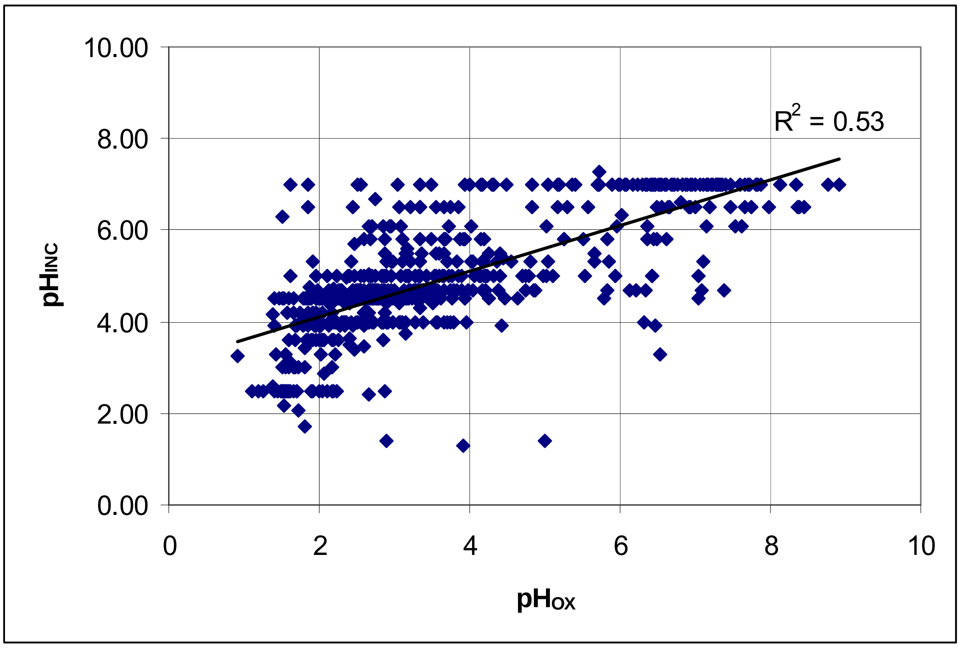
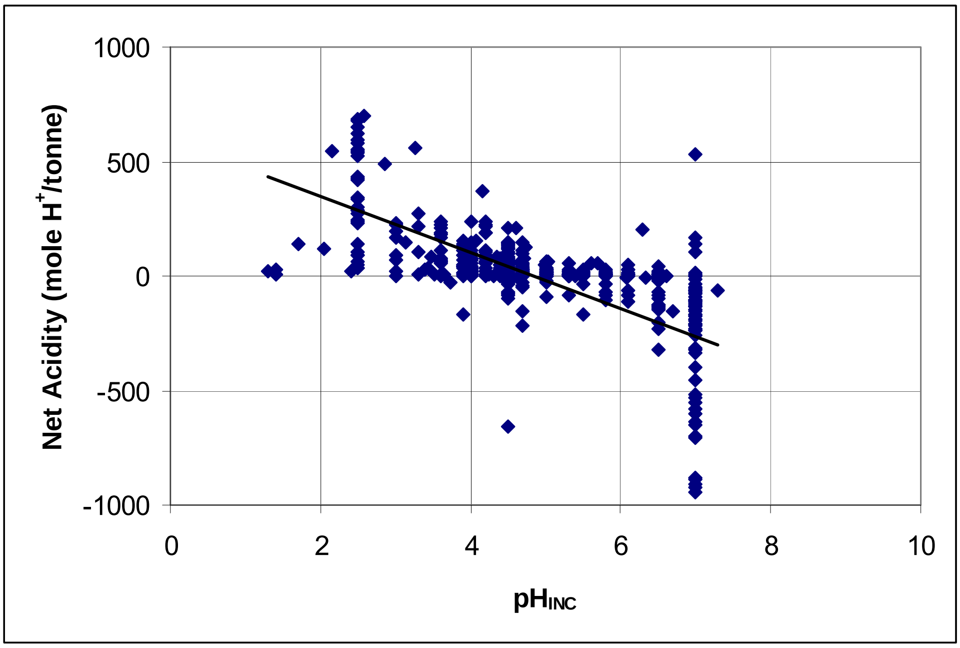


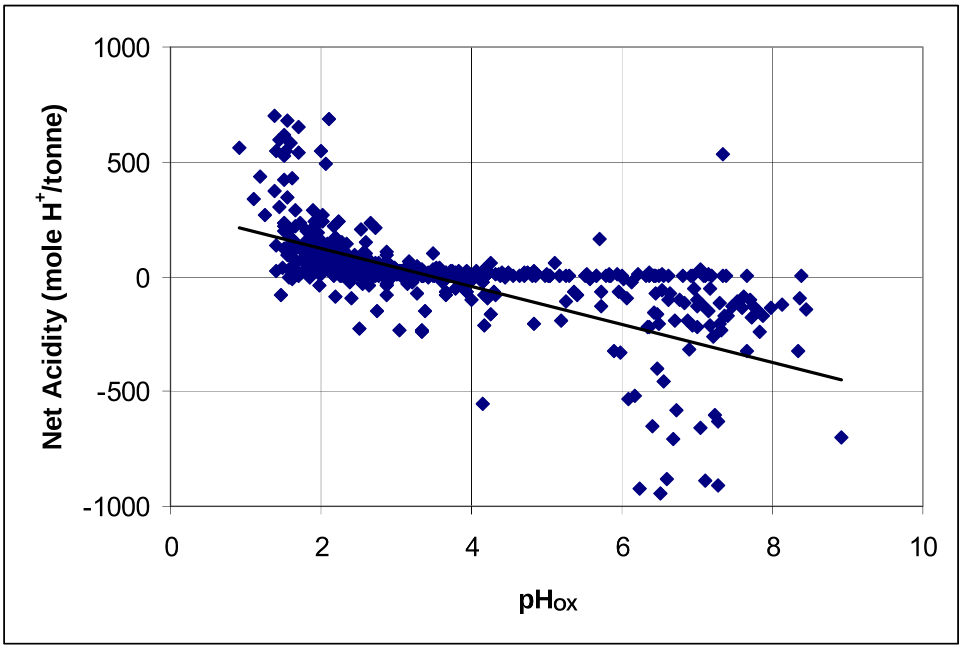
Figure 9. Plot of pH_{OX} vs. pH_{INC} for all soil samples.

The plots of net acidity vs. pH_{INC} and pH_{OX} are shown on Figure 10. Although there is a general correlation and trend between net acidity and these values, it is clear that some samples with negative net acidities incubated to low pH and some samples with positive net acidities incubated to high pH.

Further work is required to assess in detail the weaknesses of the various methods, but the general correlations mean that the hazard rating system developed in the protocol is effective for most samples, and where trigger values have been breached, the samples should be considered as potential hazards.



(a)



(b)

Figure 10. Plots of net acidity vs. pH_{INC} (plot a) and net acidity vs. pH_{OX} (plot b) for samples with net acidities between +1000 and -1000 (range plotted for clarity).

5. HAZARD ASSESSMENT

5.1. Assessment of samples according to Phase 2 selection criteria

The field and laboratory data for each soil sample was assessed against the criteria presented in Section 2.5 that ranks soil materials for inclusion in Phase 2 of the detailed assessment process. The soil materials were assessed against each of the criteria and then a rating of high, moderate, or no further assessment category was given for the sample. The results of this assessment for each sample against the criteria are listed in Appendix A. The total number of samples that met each of the criteria are summarised in Table 9.

Note the following when interpreting the table, as the criteria are not mutually exclusive and, therefore, samples can trigger multiple criteria:

- The number against the criteria shows the actual total number of samples that meet that criterion.
- Where a sample triggers more than one criterion in a different priority category then only the highest category has been counted. This may occur in some cases e.g. when a sample triggered both a high and a moderate priority, e.g. where the sample is hyposulfidic S_{CR}<0.10% S (moderate priority) and has positive net acidity (high priority) or is a monosulfidic material (high priority).
- Where a sample triggers more than one criterion in the same priority category, then only one count has been included for the category. This may occur, e.g. when in some cases a sample may trigger a positive net acidity and is hyposulfidic S_{CR}>0.10% S and/or water soluble sulfate > 100mg SO_4 kg^{-1} (within 0-20cm)

The summary Table 9 shows that a very high proportion of total samples, 93%, meet the high priority criteria and would be of concern confirming that most soils and wetlands in the survey region are of significant concern with regard to potential hazards from acid sulfate soils. A number of these samples were triggered by high priority criteria 2b (hypersulfidic soil material – by positive net acidity). There was also a significant number of samples that triggered high priority criteria 1 (sulfuric material) or criteria 2 (hypersulfidic material – by incubation).

Table 9. Sample count for samples that meet the different Phase 2 categories.

	Criteria	Number of samples	Percentage of total
High Priority		**629**	**93**
1	Sulfuric material	50	
2a	Hypersulfidic material – by incubation	40	
2b	Hypersulfidic material – by positive net acidity	551	
3	Hyposulfidic material – $S_{CR} \geq 0.10\%$ S	42	
4	Water soluble sulfate > 100mg SO_4 kg^{-1} (within 0-20cm)	428	
5	Monosulfidic material	0	
Moderate Priority		**11**	**2**
	Hyposulfidic material – $S_{CR} < 0.10\%$ S	168	
No further assessment		**39**	**5**
	Other acidic – drops 0.5 unit to $pH_W < 5.5$ during incubation	184	
	Other acidic – $pH_W > 4$ and < 5.5	81	
	Other soil material	112	
Total		**679**	**100**

5.2. Assessment of Wetlands

The previous section describes identification of samples of concern based on the assessment criteria to select samples for Phase 2 analysis. The next step in the hazard assessment is to place this level of concern in context with:

- the position of the sample in the soil profile, that is, if it is a surface sample it is more likely to be at the soil water interface and, therefore, to have an impact on surface water in the wetland than a sample deeper in the profile.
- the extent and distribution of the sample, that is, based on information available, e.g. whether the sample is representative of a widespread area of the wetland and therefore more likely to have an impact on the wetland water than an isolated local occurrence.

Three potential hazards were considered: acidification, de-oxygenation, and metal mobilisation. A discussion of the assessment is provided for each wetland in Appendix B and the findings are summarised in Table 10 where they have been rated as low, low to medium, medium, medium to high or high level of concern (for one wetland a rating of low to high is used because of the large variation across the wetland). It should be noted that this assessment is based on the field and analytical data that was obtained during the August to November 2008 field assessment survey, and from the follow-up survey conducted in August to October 2009, and the survey of two wetlands (Pomanda Bay and Wellington Marina) in January 2010. A total of 62 wetlands out of the 81 wetlands in the study region were assessed from the field data collected as part of this study. In addition, assessments of the data provided in previous CSIRO documentation was evaluated for a further 14 wetlands. Therefore a total of 76 wetlands have a hazard rating assigned, with 5 wetlands not assessed.

For acidification hazard, a high rating generally indicates that sulfuric or hypersulfidic acid sulfate soil material was found. A medium rating generally indicates that hypersulfidic or hyposulfidic acid sulfate soil material was found. A low rating generally indicates that no acid sulfate soil material or occasionally other acidic soil material was identified, and a low to medium rating indicates that hyposulfidic acid sulfate soil material was identified. The results identified that the number of wetlands were normally distributed around the medium level of concern, with 15 wetlands rated as high, 12 as medium to high, 22 as medium, 12 as low to medium, 1 as low to high, and 14 as low.

For de-oxygenation hazard, a high rating generally indicated that all surface sample concentrations for water soluble sulfate were above the trigger value of 100 mg/kg SO_4 and/or monosulfidic material was observed. A medium rating generally indicated that some of the surface samples were above the trigger value. A low rating generally indicated that samples were below the trigger value and monosulfidic material was not observed. The results identified that 72 wetlands had a high or medium rating, and 4 wetlands had a low rating. Field observation did not identify monosulfidic material even though analytical data indicates it may be present and it was observed only in a few wetlands (from CSIRO studied wetlands). This is possibly due to the wetlands in this survey region being dry and therefore the monosulfidic material was not easily observed, compared with wet conditions where the black soft monosulfidic material are more likely identified.

For metal mobilisation hazard ratings, there was no data from Phase 1 analysis, and therefore, the hazard rating was inferred from the acidification hazard rating and the pH data when the pH value was sufficiently low to suggest metal mobilisation could occur. The results identified that 49 wetlands were of concern with a high, medium or low to high rating.

To assist in the future evaluation of the wetlands, Table 10 also includes information on the count of samples analysed and those that met the criteria for Phase 2 high priority category. Table 10 also includes other information about the wetland size, surface water and type of connection with the river. There are some apparent discrepancies between the assessment from the count of samples that meet the Phase 2 high priority criteria and the corresponding acidification hazard level of concern, for example whereby a low or medium acidification hazard results where 100% of samples meeting the Phase 2 high priority criteria. The reason for this is that the count of samples is only considering data from the sampling locations whereas the acidification hazard level of concern also takes into account where the sites are located, their inferred spatial extent, and potential impact on wetland inundation. Therefore while it might be possible for a sample site to have many high priority samples, it may be that the site is placed in a small ‘hot-spot’ area and that it is not necessarily representative of the wetland as a whole.

Wetlands in Table 10 are ordered up the river from south near Wellington to the north above Lock 1 at Blanchetown. Those wetlands shaded grey were not part of this field assessment, but where work has been conducted by other CSIRO projects these are identified by *CSIRO in the sampled date column, otherwise they are wetlands not surveyed.

Table 10. Summary table showing the wetland hazard assessment ratings for acidification, de-oxygenation and metal mobilisation.

Wetland Identification Number	ID Code	Wetland Name	Sampled Date	Acidification Hazard	De-oxygenation Hazard	Metal Mobilisation Hazard	Surface water present	Connected to river at pool level (0.75 m AHD)	Area (ha)	Sites (count)	Soil Samples (count)	High Priority Category Samples (count)	High Priority (% of total)
12700	PBY	Pomanda Bay	26-Jan-10	medium	Low	low	isolated	yes		8	11	11	100
12701	WSP	Wellington Spit	22-Aug-08	medium	Medium	medium	no	yes	42.8	3	9	7	78
12008	WSO	Wellington South	22-Aug-08	high	High	high	isolated	yes	9.2	2	8	8	100
12007	WEL	Wellington	22-Aug-08	high	High	high	no	no	6.2	2	10	9	90
12702	WEA	East Wellington	20-Aug-08	high	High	high	no	no	11.5	3	11	11	100
12703	WMA	Wellington Marina	22-Aug-08	medium to high	High	high	yes	yes	191	7	24	24	100
12704		Wellington North - Murrundi	*CSIRO	high	High	high	isolated	yes	9.2				
12705	FLA	Fred's Landing	2-Sep-08	low to medium	medium	low	no	no	0.3	1	4	4	100
12022	TBD	Tailem Bend	2-Sep-08	medium	high	medium	isolated	yes	95.7	5	17	15	88
12121	MRK	Mason Rock	2-Sep-08	low to medium	high	low	no	yes	25.8	2	8	8	100
12011	TOB	Tobalong	2-Sep-08	medium	medium	medium	no	yes	20.1	1	3	3	100
12706		Swanport	*CSIRO	high	high	high			13				
12707		Ukee Boat Club	*CSIRO	high	high	high							
12708	RKG	Mobilong Swamp (Rocky Gully)	9-Oct-08	low	high	low	yes	yes	28.2	3	12	10	83
12119		Riverglades	*CSIRO	high	high	high	isolated	yes	44.6				
12710		Jury Swamp	*CSIRO	High	high	high			6.1				
12041	TLE	Toora Levee	10-Oct-08	medium	medium	medium	no	yes	2.6	2	5	4	80
12709	SDO	Sunnyside - Sunnyside Swamp (Downstream)	14-Oct-08	high	high	high	no	yes	28	5	20	18	90
12066	MLE	Mypolonga Levee	10-Oct-08	high	high	high	no	yes	33.2	4	15	14	93

Wetland Identification Number	ID Code	Wetland Name	Sampled Date	Acidification Hazard	De-oxygenation Hazard	Metal Mobilisation Hazard	Surface water present	Connected to river at pool level (0.75 m AHD)	Area (ha)	Sites (count)	Soil Samples (count)	High Priority Category Samples (count)	High Priority (% of total)
12715	PAI	Sunnyside - Paiwalla Managed	*CSIRO	low to medium	high	low	yes	yes	60	2	3	3	100
12118	PSU	Sunnyside - Paiwalla Swamp (Upstream)	14-Oct-08	medium to high	high	medium	no	yes	48	4	16	15	94
12040	MNH	Mypolonga North	10-Oct-08	high	medium	high	no	yes	2.1	2	8	8	100
12120	PGY	Paiwalla Gully	14-Oct-08	high	medium	medium	no	yes	0.9	2	8	8	100
12711	WDE	Woodlane	15-Oct-08	medium	medium	medium	no	yes	1.4	1	4	4	100
12039	PPA	Pompoota	14-Oct-08	medium	medium	medium	no	yes	3.4	2	8	8	100
12038	WLE	Wall Levee	15-Oct-08	medium	medium	medium	no	yes	5.9	2	6	6	100
12037	WAL	Wall Swamp	24-Nov-08	medium	medium	medium	no	yes	22.9	3	9	9	100
12712, 12713, 12720, 12721		Neeta Flat Depressions	No survey						12.8				
12017	RCK	Reedy Creek	17-Oct-08	low	high	low	no	yes	98.6	5	22	19	86
12714	BLE	Baseby Levee	17-Oct-08	medium	medium	medium	no	yes	7.2	3	9	9	100
12020		Cowirra Levee /Landing	No survey						20				
12218, 12248, 12249	MSP	Mannum Swamps	15-Oct-08	low to high	high	low to high	isolated	yes	197.8	9	33	30	91
12205	TAW	Taworri	23-Oct-08	medium to high	medium	medium	no	yes	31	3	11	10	91
12030	KIA	Kia	23-Oct-08	low to medium	medium	low	no	yes	7.7	2	6		
12247	YHW	Younghusband West (Downstream)	4-Sep-08	low to medium	high	low	isolated	yes	110.1	6	20	20	100
12115, 12116	PFT	Pellaring Flat	16-Oct-08	low	medium	low	no	no	35.7	6	19	15	79
12716		Lake Carlet	*CSIRO	medium to high	high	medium	isolated	yes	348.5				

Wetland Identification Number	ID Code	Wetland Name	Sampled Date	Acidification Hazard	De-oxygenation Hazard	Metal Mobilisation Hazard	Surface water present	Connected to river at pool level (0.75 m AHD)	Area (ha)	Sites (count)	Soil Samples (count)	High Priority Category Samples (count)	High Priority (% of total)
12050, 12051, 10252	YHB	Younghusband (Opposite Lake Carlet)	4-Sep-08	low to medium	high	low	no	yes	17.8	5	15	14	93
12717	YHP	Younhusband Point (Upstream)	4-Sep-08	low	medium	low	no	yes	4.6	1	3	2	67
12034	TFH	Teal Flat Hut (Downstream)	9-Sep-08	medium	high	medium	no	yes	20.2	3	12	11	92
12005	TFL	Teal Flat (Upstream)	9-Sep-08	low	high	low	no	yes	82	3	10	7	70
12004	CLG	Coolcha Lagoon	9-Sep-08	high	high	high	no	yes	128.4	6	30	27	90
12299	MDT	Maidment Lagoon	10-Sep-08	medium	medium	medium	no	yes	66.9	3	11	8	73
12067	BWH	Bow Hill	23-Oct-08	low to medium	high	low	no	yes	48.1	3	12	11	92
12332	CNK	Craignook	10-Sep-08	medium to high	high	medium	isolated	yes	54.7	3	11	10	91
12105, 12106, 12107	SBF	Saltbush Flat	29-Aug-08	medium to high	high	medium	no	yes	101.6	4	14	11	79
12015	CMT	Caurnamont	10-Sep-08	low to medium	high	low	no	yes	90.3	3	10	10	100
12718		North Purnong	*CSIRO	medium to high	high	medium			94.5				
12112	NCT	North Caurnamont	10-Sep-08	medium to high	medium	medium	no	yes	73.2	4	11	11	100
12306	SCF	Scrubby Flat	29-Aug-08	low	medium	low	no	yes	48.5	1	2	2	100
12719	SCF	Scrubby Flat Creek	29-Aug-08	low	low	low	no	no	4.1	1	3	0	0
12029		Walker Flat South Lagoon	*CSIRO	medium	high	medium	no	yes	88.8				
12028	LBY	Lake Bywaters	23-Aug-08	high	high	high	no	yes	38.8	3	15	11	73
12027	FRL	Forster Lagoon	3-Sep-08	medium to high	high	medium	isolated	yes	79.4	4	15	14	93
12026	WON	Wongulla	28-Aug-08	low	low	low	isolated	yes	124	3	10	6	60

Wetland Identification Number	ID Code	Wetland Name	Sampled Date	Acidification Hazard	De-oxygenation Hazard	Metal Mobilisation Hazard	Surface water present	Connected to river at pool level (0.75 m AHD)	Area (ha)	Sites (count)	Soil Samples (count)	High Priority Category Samples (count)	High Priority (% of total)
		Lagoon											
12489		Kroehns Landing	*CSIRO	medium to high	high	medium			67.1				
12490	MMO	Marne River Mouth	28-Aug-08	medium	medium	medium	isolated	yes	17.1	2	7	7	100
12014		Devon Downs South	*CSIRO	low to medium	medium	low			53.6				
12019		Devon Downs North	*CSIRO	high	high	high	no	yes	262.7				
12723		Devon Downs Swamp	No survey						23.1				
12724	GWL	Greenways Landing	3-Sep-08	low	medium	low	no	yes	5.8	1	4	3	75
12109	PRE	Preiss Landing	28-Aug-08	medium	high	medium	yes	yes	5.5	2	10	7	70
12045	HEN	Henley Park	26-Aug-08	medium	high	medium	no	yes	22.4	2	11	11	100
12328	BBD	Big Bend	3-Sep-08	low	medium	low	no	yes	48.2	3	9	7	78
12044	PUN	Punyelroo	26-Aug-08	medium	medium	medium	no	yes	125.4	2	7	7	100
12001	MLG	Marks Landing	22-Oct-08	low to medium	high	low	no	yes	192	6	16	12	75
12016	SFE	Swan Reach Ferry	26-Aug-08	medium	medium	medium	no	yes	67.9	3	11	11	100
12725		McCauley Swamp	No survey						3				
12168, 12169, 12170, 12173, 12194	SRE	Swan Reach Complex	25-Aug-08	medium	medium	medium	no	yes		8	26	26	100
12043	YMD	Yarramundi – Creek	6-Sep-08	medium	medium	medium	yes	yes	32.65	4	16	16	100
12726		Yarramundi North (Morgan's Lagoon)	*CSIRO	medium to high	high	medium			35.2				
12727		Yarramundi - Noonawirra	*CSIRO	medium to high	medium	medium			7.95				

Wetland Identification Number	ID Code	Wetland Name	Sampled Date	Acidification Hazard	De-oxygenation Hazard	Metal Mobilisation Hazard	Surface water present	Connected to river at pool level (0.75 m AHD)	Area (ha)	Sites (count)	Soil Samples (count)	High Priority Category Samples (count)	High Priority (% of total)
12729	SPE	South Portee	5-Sep-08	low	medium	low	no	yes	123.3	3	8	6	75
12730	PCK	Portee Creek	5-Sep-08	low to medium	medium	low	yes	yes	18.3	2	6	3	50
12731		Portee	No survey						46.4				
12722	MRD	Moorundie	5-Sep-08	low to medium	medium	low	no	no	304.8	5	11	10	91
12021	MCK	Moorundie Creek	5-Sep-08	medium	medium	medium	no	yes	2.4	2	7	5	71
12239	BFT	Blanchetown Flat - Sweeneys Lagoon	6-Sep-08	low	medium	low	no	no	14.6	2	6	5	83
12010	ALG	Arlunga	22-Oct-08	low	low	low	yes	yes	166	2	4	3	75
12304	BPK	Brenda Park	22-Oct-08	medium	medium	medium	no	yes	98	7	16	15	94
12277, 12286	MOR	Morgan Conservation Park	22-Oct-08	low	medium	low	no	yes	100	4	11	10	91
		TOTAL COUNTS								210	709	629	89

6. CONCLUSIONS AND RECOMMENDATIONS

This report presents the data and findings for Phase 1 (the first part of a two-phased, detailed assessment process) of a study to determine the hazards posed by acid sulfate soil materials in wetlands along the River Murray between Lock 1 and Wellington. The report identifies whether or not acid sulfate soil materials are present and indicates their general location and distribution within the assessed wetland. The soil samples are given a rating according to the criteria for inclusion in Phase 2 of the detailed assessment process (MDBA 2010) and also a hazard rating was determined for each wetland.

Assessment of the samples against the criteria for inclusion in Phase 2 identified that 93% (629 of the 679 samples that were assessed) met the criteria as a high priority. This confirms that most soils and wetlands in the survey region are of significant concern with regard to potential hazards from acid sulfate soils. A number of these samples were triggered by high priority criteria 2b (hypersulfidic soil material – by positive net acidity). There was also a significant number of samples that triggered high priority criteria 1 (sulfuric material – 50 samples) or criteria 2 (hypersulfidic material – by incubation – 40 samples).

The potential hazard rating at the wetland scale took into account the soil sample material assessment, the location of the sites within the wetland, and furthermore was based on expert judgement taking into account the quantitative data available. The distribution of wetlands with hazard ratings of concern occurred throughout the study area.

A total of 62 wetlands out of the 81 wetlands in the study region were assessed from the field data collected as part of this study. In addition, assessments of the data provided in previous CSIRO documentation was evaluated for a further 14 wetlands. Therefore a total of 76 wetlands have a hazard rating assigned, with 5 wetlands not assessed.

The findings and conclusions for hazard assessment are:

- Acidification: The results identified that the number of wetlands were normally distributed around the medium level of concern, with 15 wetlands rated as high, 12 as medium to high, 22 as medium, 12 as low to medium, 1 as low to high, and 14 as low.
- De-oxygenation: The results identified that 72 wetlands were of concern with a high or medium rating, and 4 wetlands had a low rating.
- Metal mobilisation: The results identified that 49 wetlands were of concern with a high or medium rating.

The findings and conclusions of the report provide a strong basis for understanding the nature and distribution of acid sulfate soil materials and their associated hazards for the wetlands in the Lock 1 to Wellington region of the River Murray. This information can now be integrated with other factors including management strategies, and wetland and community assets for prioritisation for further investigation in Phase 2 of the study.

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APPENDIX A – HAZARD ASSESSMENT FOR COLLECTED SOIL SAMPLES

The following table shows the priority rating for each sample based on the criteria presented in Section 2.5.

- High priority summary column is an aggregate of the 6 criteria that could be used to identify a high priority sample.
  - o A value of '0' indicates a sample is not a high priority.
  - o A value of "1, 2, 3, or 4" indicates the number of criteria that have triggered a high priority.
- Moderate priority column is based on one criterion. Therefore a value of '0' equates to not a priority or '1' a moderate priority.
- No further assessment columns identify samples that are acid (but not acid sulfate soil materials) or other soil materials.

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1 -** sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3 -** hyposulfidic - $S_{CR} \geq 0.10\%S$	**4 -** water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5 -** monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
ALG1.1	0 - 20	0	0	0	0	0	1	0	0	0	0	1
ALG2.1	0 - 5	**2**	0	0	0	1	1	0	0	0	0	0
ALG2.2	5 - 30	**1**	0	0	0	0	1	0	0	1	0	0
ALG2.3	30 - 80	**1**	0	0	1	0	0	0	0	1	0	0
BBD1.1	0 - 5	**1**	0	0	0	0	1	0	0	0	0	1
BBD1.2	5 - 20	**2**	0	0	1	0	1	0	0	0	0	1
BBD1.3	20 - 45	0	0	0	0	0	0	0	0	0	0	1
BBD2.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
BBD2.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
BBD2.3	20 - 60	**1**	0	0	1	0	0	0	1	0	0	0
BBD3.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
BBD3.2	5 - 20	**2**	0	0	1	0	1	0	0	0	0	1
BBD3.3	20 - 80	0	0	0	0	0	0	0	0	0	0	1
BFT1.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
BFT1.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
BFT1.3	20 - 45	**1**	0	0	1	0	0	0	0	1	0	0
BFT2.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
BFT2.2	5 - 25	**1**	0	0	0	0	1	0	0	0	0	1
BFT2.3	25 - 45	0	0	0	0	0	0	0	0	0	0	1
BLE1.1	0 - 10	**2**	0	0	1	0	1	0	0	1	0	0
BLE1.2	10 - 25	**2**	0	0	1	0	1	0	0	0	1	0
BLE2.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
BLE2.2	10 - 20	**2**	0	0	1	0	1	0	0	0	1	0
BLE2.3	20 - 35	**1**	0	0	1	0	0	0	0	0	1	0
BLE2.4	35 - 60	**1**	0	0	1	0	0	0	0	0	1	0
BLE3.1	0 - 15	**2**	0	0	1	0	1	0	0	0	1	0
BLE3.2	15 - 30	**2**	0	0	1	0	1	0	0	0	1	0
BLE3.3	30 - 60	**1**	0	0	1	0	0	0	0	0	1	0
BPK1.1	0 - 5	**2**	0	0	1	0	1	0	0	0	0	1
BPK1.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
BPK1.3	20 - 45	**1**	0	0	1	0	0	0	0	1	0	0
BPK1.4	45 - 130	**1**	0	0	1	0	0	0	0	1	0	0
BPK2.1	0 - 10	**2**	0	0	1	0	1	0	0	0	0	1
BPK2.2	10 - 35	**2**	0	0	1	0	1	0	0	0	0	1
BPK2.3	35 - 65	0	0	0	0	0	0	0	0	0	0	1
BPK3.1	0 - 10	**2**	0	0	1	0	1	0	0	0	0	1
BPK3.2	10 - 30	**2**	0	0	1	0	1	0	0	1	0	0

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
BPK3.3	30 - 35	**1**	0	0	1	0	0	0	0	0	0	1
BPK4.1	0 - 3	**2**	0	0	0	1	1	0	0	0	0	0
BPK4.2	3 - 25	**2**	0	0	1	0	1	0	1	0	0	0
BPK4.3	25 - 90	**2**	0	0	1	1	0	0	0	0	0	0
BPK6.1	0 - 5	**2**	0	0	1	0	1	0	0	0	0	1
BPK6.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
BPK6.3	20 - 55	**1**	0	0	1	0	0	0	0	1	0	0
BWH1.1	0 - 10	**3**	1	0	1	0	1	0	0	0	0	0
BWH1.2	10 - 20	**2**	0	0	1	0	1	0	0	1	0	0
BWH1.3	20 - 40	**2**	0	0	1	1	0	0	0	0	0	0
BWH1.4	40 - 80	0	0	0	0	0	0	0	0	1	0	0
BWH1.5	80 - 120	0	0	0	0	0	0	0	0	0	0	1
BWH2.1	0 - 13	**2**	0	0	1	0	1	0	1	0	0	0
BWH2.2	13 - 25	**2**	0	0	1	0	1	0	0	1	0	0
BWH2.3	25 - 50	**1**	0	0	1	0	0	0	0	1	0	0
BWH2.4	50 - 100	**1**	0	0	1	0	0	0	1	0	0	0
BWH3.1	0 - 15	**2**	0	0	1	0	1	0	0	0	0	1
BWH3.2	15 - 30	**2**	0	0	1	0	1	0	0	1	0	0
BWH3.3	30 - 60	**1**	0	0	1	0	0	0	0	1	0	0
BWH3.4	60 - 100	**1**	0	0	1	0	0	0	1	0	0	0
CLG1.1	0 - 10	**2**	0	0	1	0	1	0	0	0	1	0
CLG1.2	10 - 20	**2**	0	0	1	0	1	0	1	0	0	0
CLG1.3	20 - 40	**1**	0	0	1	0	0	0	0	1	0	0
CLG1.4	40 - 60	**1**	0	0	1	0	0	0	0	1	0	0
CLG2.1	0 - 2	**2**	0	0	1	0	1	0	0	0	1	0
CLG2.2	2 - 15	**2**	0	0	1	0	1	0	0	0	1	0
CLG2.3	15 - 45	**2**	0	0	1	0	1	0	0	1	0	0
CLG2.4	45 - 110	**1**	0	0	1	0	0	0	0	1	0	0
CLG3.1	0 - 5	**3**	0	0	1	1	1	0	0	0	0	0
CLG3.2	5 - 10	**2**	0	0	1	0	1	0	1	0	0	0
CLG3.3	10 - 25	**2**	0	0	1	0	1	0	0	0	1	0
CLG3.4	25 - 50	**1**	0	0	1	0	0	0	0	0	1	0
CLG3.5	50 - 130	**1**	0	0	1	0	0	0	0	1	0	0
CLG4.1	0 - 3	**2**	0	0	1	0	1	0	1	0	0	0
CLG4.2	3 - 15	**3**	1	0	1	0	1	0	0	0	0	0
CLG4.3	15 - 30	**2**	0	0	1	0	1	0	1	0	0	0
CLG4.4	30 - 50	**1**	0	0	1	0	0	0	1	0	0	0
CLG4.5	50 - 110	**1**	0	0	0	1	0	0	0	0	0	0
CLG5.1	0 - 5	**3**	0	1	1	0	1	0	0	0	0	0
CLG5.2	5 - 15	**2**	0	0	1	0	1	0	0	0	1	0
CLG5.3	15 - 30	**3**	1	0	1	0	1	0	0	0	0	0
CLG5.4	30 - 70	**1**	0	0	1	0	0	0	0	0	0	1
CLG5.5	70 - 100	0	0	0	0	0	0	0	0	0	0	1
CLG6.1	0 - 5	**2**	0	0	1	0	1	0	0	0	1	0
CLG6.2	5 - 20	**3**	1	0	1	0	1	0	0	0	0	0
CLG6.3	20 - 50	**2**	1	0	1	0	0	0	0	0	0	0
CLG6.4	50 - 80	**1**	0	0	1	0	0	0	1	0	0	0
CLG6.5	80 - 110	**2**	0	1	1	0	0	0	0	0	0	0
CMT1.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
CMT1.2	5 - 15	**2**	0	0	1	0	1	0	0	1	0	0
CMT1.3	15 - 40	**2**	0	0	1	0	1	0	0	0	1	0
CMT1.4	40 - 60	**1**	0	0	1	0	0	0	1	0	0	0
CMT2.1	0 - 3	**1**	0	0	0	0	1	0	0	0	0	1
CMT2.2	3 - 15	**1**	0	0	0	0	1	0	0	0	0	1
CMT2.3	15 - 50	**2**	0	0	1	0	1	0	0	1	0	0
CMT3.1	0 - 2	**2**	0	0	1	0	1	0	0	1	0	0
CMT3.2	2 - 20	**2**	0	0	1	0	1	0	0	1	0	0
CMT3.3	20 - 45	**1**	0	0	1	0	0	0	0	1	0	0
CNK1.1	0 - 10	**3**	0	0	1	1	1	0	0	0	0	0
CNK1.2	10 - 20	**2**	0	0	1	0	1	0	1	0	0	0
CNK1.3	20 - 50	**1**	0	1	0	0	0	0	0	0	0	0
CNK1.4	50 - 100	**2**	0	1	1	0	0	0	0	0	0	0

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
CNK2.1	0 - 5	**3**	1	0	1	0	1	0	0	0	0	0
CNK2.2	5 - 35	**3**	1	0	1	0	1	0	0	0	0	0
CNK2.3	35 - 50	0	0	0	0	0	0	0	0	0	0	1
CNK2.4	50 - 75	**2**	0	1	1	0	0	0	0	0	0	0
CNK3.1	0 - 20	**2**	0	0	1	0	1	0	1	0	0	0
CNK3.2	20 - 40	**1**	0	0	1	0	0	0	1	0	0	0
CNK3.3	40 - 100	**1**	0	0	0	1	0	0	0	0	0	0
FLA1.1	0 - 5	**3**	1	0	1	0	1	0	0	0	0	0
FLA1.2	5 - 20	**3**	1	0	1	0	1	0	0	0	0	0
FLA1.3	20 - 80	**2**	1	0	1	0	0	0	0	0	0	0
FLA1.4	80 - 100	**2**	0	0	1	1	0	0	0	0	0	0
FLA2.1	0 - 20	**2**	0	0	1	0	1	0	1	0	0	0
FLA2.2	20 - 40	**1**	1	0	0	0	0	0	0	0	0	0
FLA2.3	40 - 60	**2**	1	0	1	0	0	0	0	0	0	0
FLA2.4	60 - 100	**2**	0	0	1	1	0	0	0	0	0	0
FLA5.1	0 - 5	**1**	0	0	0	0	1	0	1	0	0	0
FLA5.2	5 - 15	**1**	0	0	0	0	1	0	1	0	0	0
FLA5.3	15 - 70	**1**	0	0	0	0	1	0	1	0	0	0
FLA5.4	70 - 100	**2**	0	0	1	1	0	0	0	0	0	0
FRL1.1	0 - 3	**3**	0	1	1	0	1	0	0	0	0	0
FRL1.2	3 - 20	**2**	0	0	1	0	1	0	1	0	0	0
FRL1.3	20 - 40	**1**	0	0	0	1	0	0	0	0	0	0
FRL1.4	40 - 100	**1**	0	0	1	0	0	0	0	0	0	1
FRL2.1	0 - 5	**2**	0	0	1	0	1	0	0	0	1	0
FRL2.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
FRL2.3	20 - 45	**1**	0	0	1	0	0	0	0	1	0	0
FRL3.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
FRL3.2	10 - 40	**3**	0	1	1	0	1	0	0	0	0	0
FRL3.3	40 - 60	**1**	0	0	1	0	0	0	1	0	0	0
FRL3.4	60 - 100	0	0	0	0	0	0	0	1	0	0	0
FRL4.1	0 - 1	**2**	0	0	0	1	1	0	0	0	0	0
FRL4.2	1 - 15	**3**	0	1	1	0	1	0	0	0	0	0
FRL4.3	15 - 45	**1**	0	0	0	0	1	0	0	0	0	1
FRL4.4	45 - 120	**2**	0	1	1	0	0	0	0	0	0	0
GWL1.1	0 - 1	**1**	0	0	0	0	1	0	1	0	0	0
GWL1.2	1 - 15	**1**	0	0	0	0	1	0	0	0	0	1
GWL1.3	15 - 40	**1**	0	0	0	0	1	0	0	0	0	1
GWL1.4	40 - 55	0	0	0	0	0	0	0	0	0	0	1
HEN1.1	0 - 2	**3**	1	0	1	0	1	0	0	0	0	0
HEN1.2	2 - 32	**2**	0	0	1	0	1	0	1	0	0	0
HEN1.3	32 - 37	**1**	0	0	1	0	0	0	0	1	0	0
HEN1.4	37 - 45	**1**	0	0	1	0	0	0	1	0	0	0
HEN1.5	45 - 52	**1**	0	0	1	0	0	0	0	1	0	0
HEN1.6	52 - 160	**1**	0	0	1	0	0	0	0	0	0	1
HEN2.1	0 - 2	**3**	1	0	1	0	1	0	0	0	0	0
HEN2.2	2 - 15	**2**	0	0	1	0	1	0	0	0	1	0
HEN2.3	15 - 20	**2**	0	0	1	0	1	0	0	1	0	0
HEN2.4	20 - 50	**1**	0	0	1	0	0	0	0	1	0	0
HEN2.5	50 - 80	**1**	0	0	1	0	0	0	0	1	0	0
LBY1.1	0 - 2	**3**	1	0	1	0	1	0	0	0	0	0
LBY1.2	2 - 10	**3**	1	0	1	0	1	0	0	0	0	0
LBY1.3	10 - 40	**2**	0	0	1	0	1	0	0	0	1	0
LBY1.4	40 - 80	**1**	0	0	1	0	0	0	0	1	0	0
LBY1.5	80 - 100	0	0	0	0	0	0	0	0	0	0	1
LBY2.1	0 - 8	**3**	0	0	1	1	1	0	0	0	0	0
LBY2.2	8 - 20	**2**	0	0	1	0	1	0	1	0	0	0
LBY2.3	20 - 50	**2**	1	0	1	0	0	0	0	0	0	0
LBY2.4	50 - 80	0	0	0	0	0	0	0	0	0	0	1
LBY3.1	0 - 5	**3**	0	1	1	0	1	0	0	0	0	0
LBY3.2	5 - 25	**3**	1	0	1	0	1	0	0	0	0	0
LBY3.3	25 - 30	**1**	0	0	1	0	0	0	0	1	0	0
LBY3.4	30 - 55	**1**	0	0	1	0	0	0	0	1	0	0

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
LBY3.5	55 - 80	0	0	0	0	0	0	0	0	0	0	1
MCK1.2	5 - 25	**2**	0	0	1	0	1	0	0	0	1	0
MCK1.3	25 - 40	**1**	0	0	1	0	0	0	1	0	0	0
MCK2.1	0 - 10	**2**	0	0	1	0	1	0	0	0	1	0
MCK2.2	10 - 20	**2**	0	0	1	0	1	0	0	0	1	0
MCK2.3	20 - 40	**1**	0	0	1	0	0	0	0	1	0	0
MDT1.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
MDT1.2	5 - 15	**2**	0	0	1	0	1	0	0	0	0	1
MDT1.3	15 - 30	**2**	0	0	1	0	1	0	0	1	0	0
MDT1.4	30 - 65	0	0	0	0	0	0	0	1	0	0	0
MDT2.1	0 - 5	**2**	0	0	1	0	1	0	0	0	1	0
MDT2.2	5 - 20	**1**	0	0	0	0	1	0	0	0	0	1
MDT2.3	20 - 35	0	0	0	0	0	0	0	1	0	0	0
MDT2.4	35 - 55	0	0	0	0	0	0	0	0	0	0	1
MDT3.1	0 - 2	**2**	0	0	1	0	1	0	0	1	0	0
MDT3.2	2 - 12	**2**	0	0	1	0	1	0	0	0	1	0
MDT3.3	12 - 40	**2**	0	0	1	0	1	0	0	1	0	0
MLA1.1	0 - 5	**3**	0	0	1	1	1	0	0	0	0	0
MLA1.2	5 - 15	**2**	0	0	1	0	1	0	1	0	0	0
MLA1.3	15 - 50	**2**	0	0	1	0	1	0	1	0	0	0
MLA1.4	50 - 110	0	0	0	0	0	0	0	0	0	0	1
MLA2.1	0 - 10	**3**	1	0	1	0	1	0	0	0	0	0
MLA2.2	10 - 30	**2**	0	0	1	0	1	0	0	0	1	0
MLA2.3	30 - 50	0	0	0	0	0	0	0	1	0	0	0
MLA2.4	50 - 80	0	0	0	0	0	0	0	0	1	0	0
MLE1.1	0 - 3	**3**	1	0	1	0	1	0	0	0	0	0
MLE1.2	3 - 13	**3**	1	0	1	0	1	0	0	0	0	0
MLE1.3	13 - 25	**3**	1	0	1	0	1	0	0	0	0	0
MLE1.4	25 - 60	**2**	1	0	1	0	0	0	0	0	0	0
MLE1.5	60 - 140	**1**	0	0	1	0	0	0	1	0	0	0
MLE2.1	0 - 30	**3**	1	0	1	0	1	0	0	0	0	0
MLE2.2	30 - 45	**2**	1	0	1	0	0	0	0	0	0	0
MLE2.3	45 - 90	**2**	1	0	1	0	0	0	0	0	0	0
MLE3.1	0 - 1	**3**	1	0	1	0	1	0	0	0	0	0
MLE3.2	1 - 15	**2**	0	0	1	0	1	0	0	0	1	0
MLE3.3	15 - 45	**2**	0	0	1	0	1	0	0	0	1	0
MLE3.4	45 - 100	**1**	0	0	1	0	0	0	0	0	1	0
MLE4.1	0 - 10	**3**	1	0	1	0	1	0	0	0	0	0
MLE4.2	10 - 45	**2**	0	0	1	0	1	0	0	0	1	0
MLG4.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
MLG4.2	5 - 20	**2**	0	0	1	0	1	0	1	0	0	0
MLG4.3	20 - 50	**1**	0	0	1	0	0	0	0	1	0	0
MLG4.4	50 - 100	**1**	0	0	1	0	0	0	1	0	0	0
MLG5.2	5 - 25	**2**	0	0	1	0	1	0	1	0	0	0
MLG6.1	0 - 3	**2**	0	0	1	0	1	0	0	0	1	0
MLG6.2	3 - 25	**2**	0	0	1	0	1	0	0	1	0	0
MMO1.1	0 - 3	**2**	0	0	0	1	1	0	0	0	0	0
MMO1.2	3 - 15	**1**	0	0	0	0	1	0	1	0	0	0
MMO1.3	15 - 35	**2**	0	0	1	0	1	0	1	0	0	0
MMO1.4	35 - 100	**1**	0	0	0	1	0	0	0	0	0	0
MMO1.5	100 - 160	**2**	0	1	1	0	0	0	0	0	0	0
MMO2.1	0 - 10	**1**	0	0	0	0	1	0	1	0	0	0
MMO2.2	10 - 50	**1**	0	0	0	0	1	0	1	0	0	0
MNH1.1	0 - 2	**3**	1	0	1	0	1	0	0	0	0	0
MNH1.2	2 - 20	**3**	0	1	1	0	1	0	0	0	0	0
MNH1.3	20 - 30	**2**	1	0	1	0	0	0	0	0	0	0
MNH1.4	30 - 100	**1**	0	0	1	0	0	0	1	0	0	0
MNH2.1	0 - 2	**3**	1	0	1	0	1	0	0	0	0	0
MNH2.2	2 - 30	**3**	1	0	1	0	1	0	0	0	0	0
MNH2.3	30 - 100	**1**	0	0	1	0	0	0	0	1	0	0
MNH2.4	100 - 130	**2**	0	1	1	0	0	0	0	0	0	0
MOR1.1	0 - 5	**2**	0	0	1	0	1	0	0	0	0	1

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
MOR1.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
MOR1.3	20 - 55	**1**	0	0	1	0	0	0	0	1	0	0
MOR2.1	0 - 5	0	0	0	0	0	1	0	0	0	0	1
MOR2.2	5 - 20	**2**	0	0	1	0	1	0	0	0	0	1
MOR2.3	20 - 55	**1**	0	0	1	0	0	0	0	0	0	1
MOR3.1	0 - 10	**2**	0	0	1	0	1	0	0	0	0	1
MOR3.2	10 - 30	**2**	0	0	1	0	1	0	0	1	0	0
MOR4.1	0 - 10	**1**	0	0	1	0	1	0	0	1	0	0
MOR4.2	10 - 30	**2**	0	0	1	0	1	0	0	1	0	0
MOR4.3	30 - 80	**1**	0	0	1	0	0	0	0	1	0	0
MRD1.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
MRD1.2	5 - 25	**2**	0	0	1	0	1	0	1	0	0	0
MRD2.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
MRD2.2	5 - 15	**2**	0	0	1	0	1	0	0	1	0	0
MRD2.3	15 - 35	**2**	0	0	1	0	1	0	0	1	0	0
MRD3.2	5 - 25	**1**	0	0	1	0	1	0	0	1	0	0
MRD4.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
MRD4.2	5 - 25	**2**	0	0	1	0	1	0	0	1	0	0
MRD5.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
MRD5.2	5 - 25	**2**	0	0	1	0	1	0	0	1	0	0
MRK1.1	0 - 1	**1**	0	0	0	0	1	0	0	0	0	1
MRK1.2	1 - 15	**1**	0	0	0	0	1	0	0	0	0	1
MRK1.3	15 - 50	**2**	0	0	0	1	1	0	0	0	0	0
MRK1.4	50 - 120	**2**	0	1	1	0	0	0	0	0	0	0
MRK2.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
MRK2.2	5 - 20	**2**	0	0	1	0	1	0	1	0	0	0
MRK2.3	20 - 60	**1**	0	0	1	0	0	0	1	0	0	0
MRK2.4	60 - 120	**2**	0	1	1	0	0	0	0	0	0	0
MSP1.1	0 - 5	**1**	0	0	0	0	1	0	1	0	0	0
MSP1.2	5 - 20	**1**	0	0	0	0	1	0	1	0	0	0
MSP1.3	20 - 60	0	0	0	0	0	0	0	1	0	0	0
MSP1.4	60 - 100	0	0	0	0	0	0	0	1	0	0	0
MSP2.1	0 - 5	**1**	0	0	0	0	1	0	1	0	0	0
MSP3.1	0 - 5	**1**	0	0	0	0	1	0	1	0	0	0
MSP3.2	5 - 15	**1**	0	0	0	0	1	0	1	0	0	0
MSP3.3	15 - 50	**1**	0	0	0	0	1	0	1	0	0	0
MSP3.4	50 - 100	**1**	0	0	0	1	0	0	0	0	0	0
MSP3.5	100 - 130	**1**	0	0	0	1	0	0	0	0	0	0
MSP4.1	0 - 3	**2**	0	0	1	0	1	0	1	0	0	0
MSP4.2	3 - 15	**3**	1	0	1	0	1	0	0	0	0	0
MSP4.3	15 - 35	**3**	0	1	1	0	1	0	0	0	0	0
MSP4.4	35 - 70	**1**	0	0	1	0	0	0	1	0	0	0
MSP4.5	70 - 150	**1**	0	0	1	0	0	0	1	0	0	0
MSP5.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
MSP5.2	10 - 25	**3**	1	0	1	0	1	0	0	0	0	0
MSP6.1	0 - 3	**2**	0	0	1	0	1	0	0	0	1	0
MSP6.2	3 - 15	**2**	0	0	1	0	1	0	0	0	1	0
MSP6.3	15 - 45	**2**	0	0	1	0	1	0	0	1	0	0
MSP6.4	45 - 80	**2**	0	0	1	1	0	0	0	0	0	0
MSP6.5	80 - 150	**2**	0	1	1	0	0	0	0	0	0	0
MSP7.1	0 - 10	**2**	0	0	1	0	1	0	0	1	0	0
MSP7.2	10 - 30	**2**	0	0	1	0	1	0	0	1	0	0
MSP7.3	30 - 50	**1**	0	0	1	0	0	0	0	1	0	0
MSP7.4	50 - 110	**1**	0	0	1	0	0	0	0	0	0	1
MSP8.1	0 - 5	**2**	0	0	1	0	1	0	0	0	1	0
MSP8.2	5 - 100	**2**	0	0	1	0	1	0	0	1	0	0
MSP8.4	110 - 160	**1**	0	0	1	0	0	0	1	0	0	0
MSP9.1	0 - 5	**2**	0	0	1	0	1	0	0	0	0	1
MSP9.2	5 - 30	**2**	0	0	1	0	1	0	0	1	0	0
MSP9.3	30 - 90	**1**	0	0	1	0	0	0	0	0	0	1
NCT1.1	0 - 3	**2**	0	0	1	0	1	0	1	0	0	0
NCT1.2	3 - 15	**2**	0	0	1	0	1	0	0	1	0	0

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg[-1] (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
NCT1.3	15 - 45	**2**	0	0	1	0	1	0	0	1	0	0
NCT2.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
NCT2.2	10 - 20	**2**	0	0	1	0	1	0	0	1	0	0
NCT2.3	20 - 50	**1**	0	0	1	0	0	0	0	1	0	0
NCT3.1	0 - 3	**2**	0	0	1	0	1	0	1	0	0	0
NCT3.2	3 - 23	**2**	0	0	1	0	1	0	0	1	0	0
NCT4.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
NCT4.2	5 - 20	**2**	0	0	1	0	1	0	1	0	0	0
NCT4.3	20 - 35	**1**	0	0	1	0	0	0	1	0	0	0
PAI4c.0.1	0 - 10	**2**	0	0	0	1	1	0	0	0	0	0
PAI4c.0.2	10 - 15	**2**	0	0	1	0	1	0	1	0	0	0
PAI4c.0.3	15 - 25	**2**	0	0	1	0	1	0	0	1	0	0
PBY1.1	0 - 2	**2**	0	0	1	0	1	0	0	1	0	0
PBY1.2	2 - 10	**3**	0	1	1	0	1	0	0	0	0	0
PBY1.3	10 - 40	**3**	0	1	1	0	1	0	0	0	0	0
PBY2.1	0 - 5	**1**	0	0	0	0	1	0	1	0	0	0
PBY2.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
PBY2.3	20 - 35	**1**	0	0	1	0	0	0	1	0	0	0
PBY2.4	35 - 70	**1**	0	0	1	0	0	0	1	0	0	0
PBY5.1	0 - 3	**1**	0	0	0	0	1	0	0	0	0	1
PBY5.2	3 - 15	**1**	0	0	0	0	1	0	0	1	0	0
PBY6.1	0 - 2	**1**	0	0	0	0	1	0	1	0	0	0
PBY6.2	2 - 20	**3**	0	1	1	0	1	0	0	0	0	0
PCK1.1	0 - 20	**1**	0	0	0	0	1	0	1	0	0	0
PCK1.2	20 - 60	**1**	0	0	1	0	0	0	1	0	0	0
PCK2.2	1 - 20	**1**	0	0	0	0	1	0	1	0	0	0
PFT1.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
PFT1.2	5 - 40	**2**	0	0	1	0	1	0	0	0	0	1
PFT2.1	0 - 5	**1**	0	0	0	0	1	0	0	0	0	1
PFT2.2	5 - 30	**1**	0	0	0	0	1	0	0	0	0	1
PFT2.3	30 - 80	0	0	0	0	0	0	0	0	0	0	1
PFT2.4	80 - 140	0	0	0	0	0	0	0	0	0	0	1
PFT3.1	0 - 3	**1**	0	0	0	0	1	0	1	0	0	0
PFT3.2	3 - 15	**1**	0	0	0	0	1	0	0	0	0	1
PFT3.3	15 - 50	**1**	0	0	0	0	1	0	0	0	0	1
PFT3.4	50 - 65	0	0	0	0	0	0	0	0	0	0	1
PFT4.1	0 - 10	**1**	0	0	0	0	1	0	0	0	0	1
PFT4.2	10 - 25	**1**	0	0	0	0	1	0	0	0	0	1
PFT4.3	25 - 110	0	0	0	0	0	0	0	0	0	0	1
PFT5.1	0 - 3	**2**	0	0	1	0	1	0	0	1	0	0
PFT5.2	3 - 25	**2**	0	0	1	0	1	0	0	0	0	1
PFT5.3	25 - 50	**1**	0	0	1	0	0	0	0	0	0	1
PFT6.1	0 - 3	**2**	0	0	1	0	1	0	0	0	1	0
PFT6.2	3 - 20	**2**	0	0	1	0	1	0	0	1	0	0
PFT6.3	20 - 45	**1**	0	0	1	0	0	0	1	0	0	0
PGY1.1	0 - 2	**2**	0	0	1	0	1	0	1	0	0	0
PGY1.2	2 - 10	**3**	1	0	1	0	1	0	0	0	0	0
PGY1.3	10 - 20	**2**	0	0	1	0	1	0	0	1	0	0
PGY1.4	20 - 100	**1**	0	0	1	0	0	0	0	1	0	0
PGY2.1	0 - 10	**3**	1	0	1	0	1	0	0	0	0	0
PGY2.2	10 - 40	**3**	1	0	1	0	1	0	0	0	0	0
PGY2.3	40 - 75	**2**	0	1	1	0	0	0	0	0	0	0
PGY2.4	75 - 100	**1**	0	0	1	0	0	0	0	1	0	0
PPA1.1	0 - 10	**3**	1	0	1	0	1	0	0	0	0	0
PPA1.2	10 - 40	**3**	1	0	1	0	1	0	0	0	0	0
PPA1.3	40 - 110	**1**	0	0	1	0	0	0	0	0	1	0
PPA1.4	110 - 160	**1**	0	0	1	0	0	0	1	0	0	0
PPA2.1	0 - 10	**3**	1	0	1	0	1	0	0	0	0	0
PPA2.2	10 - 30	**3**	0	1	1	0	1	0	0	0	0	0
PPA2.3	30 - 80	**1**	0	0	1	0	0	0	0	1	0	0
PPA2.4	80 - 110	**1**	0	0	1	0	0	0	0	1	0	0
PRE1.1	0 - 10	**2**	0	0	1	0	1	0	0	1	0	0

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1 -** sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3 -** hyposulfidic - $S_{CR} \geq$ 0.10%S	**4 -** water soluble sulfate>100mg SO4 kg[-1] (within 0-20cm)	**5 -** monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
PRE1.2	10 - 20	**1**	0	0	0	0	1	0	0	0	0	1
PRE1.3	20 - 40	0	0	0	0	0	0	0	0	0	0	1
PRE1.4	40 - 100	0	0	0	0	0	0	0	1	0	0	0
PRE1.5	100 - 140	**1**	0	0	0	1	0	0	0	0	0	0
PRE2.1	0 - 10	**3**	1	0	1	0	1	0	0	0	0	0
PRE2.2	10 - 25	**2**	0	0	1	0	1	0	1	0	0	0
PRE2.3	25 - 55	**1**	0	0	1	0	0	0	1	0	0	0
PRE2.4	55 - 100	**1**	0	0	1	0	0	0	0	1	0	0
PSU1.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
PSU1.2	10 - 25	**2**	0	0	1	0	1	0	1	0	0	0
PSU1.3	25 - 90	**1**	0	0	1	0	0	0	1	0	0	0
PSU1.4	90 - 120	**1**	0	0	1	0	0	0	1	0	0	0
PSU2.1	0 - 10	**2**	0	0	1	0	1	0	0	1	0	0
PSU2.2	10 - 35	**2**	0	0	1	0	1	0	1	0	0	0
PSU2.3	35 - 120	**2**	0	1	1	0	0	0	0	0	0	0
PSU3.1	0 - 2	**2**	0	0	1	0	1	0	0	0	0	1
PSU3.2	2 - 15	**2**	0	0	1	0	1	0	0	0	0	1
PSU3.3	15 - 35	**2**	0	0	1	0	1	0	0	0	0	1
PSU3.4	35 - 90	**1**	0	0	1	0	0	0	0	0	0	1
PSU3.5	90 - 140	0	0	0	0	0	0	0	1	0	0	0
PSU4.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
PSU4.2	5 - 25	**2**	0	0	1	0	1	0	1	0	0	0
PSU4.3	25 - 100	**1**	0	0	1	0	0	0	0	0	1	0
PSU4.4	100 - 150	**1**	0	0	1	0	0	0	1	0	0	0
PUN1.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
PUN1.2	10 - 30	**2**	0	0	1	0	1	0	0	1	0	0
PUN1.3	30 - 60	**1**	0	0	1	0	0	0	0	0	0	1
PUN1.4	60 - 90	**1**	0	0	1	0	0	0	0	0	0	1
PUN1.5	90 - 120	**1**	0	0	1	0	0	0	0	0	0	1
PUN2.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
PUN2.2	5 - 25	**2**	0	0	1	0	1	0	0	0	0	1
RCK1.1	0 - 3	**2**	0	0	1	0	1	0	0	0	0	1
RCK1.2	3 - 20	**2**	0	0	1	0	1	0	0	0	0	1
RCK1.3	20 - 50	**1**	0	0	1	0	0	0	0	0	0	1
RCK1.4	50 - 90	**1**	0	0	1	0	0	0	0	0	0	1
RCK2.1	0 - 3	**2**	0	0	1	0	1	0	0	1	0	0
RCK2.2	3 - 10	**2**	0	0	1	0	1	0	0	0	1	0
RCK2.3	10 - 25	**2**	0	0	1	0	1	0	0	0	1	0
RCK2.4	25 - 90	**1**	0	0	1	0	0	0	0	0	1	0
RCK3.1	0 - 10	**2**	0	0	1	0	1	0	0	1	0	0
RCK3.2	10 - 20	**2**	0	0	1	0	1	0	0	1	0	0
RCK3.3	20 - 40	**1**	0	0	1	0	0	0	0	1	0	0
RCK3.4	40 - 90	**1**	0	0	1	0	0	0	1	0	0	0
RCK4.1	0 - 2	**2**	0	0	1	0	1	0	0	1	0	0
RCK4.2	2 - 15	**2**	0	0	1	0	1	0	0	1	0	0
RCK4.3	15 - 40	**2**	0	0	1	0	1	0	0	1	0	0
RCK4.4	40 - 80	**1**	0	0	1	0	0	0	0	1	0	0
RCK5.1	0 - 3	**1**	0	0	0	0	1	0	1	0	0	0
RCK5.2	3 - 20	**1**	0	0	0	0	1	0	0	0	0	1
RCK5.3	20 - 40	0	0	0	0	0	0	0	0	0	0	1
RCK5.4	40 - 60	0	0	0	0	0	0	0	0	0	0	1
RCK5.5	60 - 150	**1**	0	0	1	0	0	0	0	0	0	1
RKG1.1	0 - 5	**1**	0	0	0	0	1	0	0	0	0	1
RKG1.2	5 - 20	**1**	0	0	0	0	1	0	0	0	0	1
RKG1.3	20 - 30	0	0	0	0	0	0	0	1	0	0	0
RKG1.4	30 - 70	**1**	0	0	0	1	0	0	0	0	0	0
RKG1.5	70 - 140	**1**	0	0	0	1	0	0	0	0	0	0
RKG2.1	0 - 40	**1**	0	0	0	0	1	0	0	0	0	1
RKG2.2	40 - 80	**1**	0	0	0	1	0	0	0	0	0	0
RKG2.3	80 - 100	**1**	0	0	0	1	0	0	0	0	0	0
RKG3.1	0 - 5	**2**	0	0	0	1	1	0	0	0	0	0
RKG3.2	5 - 70	**1**	0	0	0	0	1	0	1	0	0	0

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
RKG3.3	70 - 110	**1**	0	0	0	1	0	0	0	0	0	0
SBF1.1	0 - 5	**2**	0	0	1	0	1	0	0	0	0	1
SBF1.2	5 - 15	**2**	0	0	1	0	1	0	0	0	0	1
SBF1.3	15 - 50	**1**	0	0	0	0	1	0	0	0	0	1
SBF2.1	0 - 20	**3**	0	0	1	1	1	0	0	0	0	0
SBF2.2	20 - 50	**2**	0	0	1	1	0	0	0	0	0	0
SBF2.3	50 - 100	**2**	0	1	1	0	0	0	0	0	0	0
SBF3.1	0 - 15	**2**	0	0	1	0	1	0	1	0	0	0
SBF3.2	15 - 50	**2**	0	0	1	0	1	0	0	1	0	0
SBF3.3	50 - 90	**1**	0	0	1	0	0	0	0	1	0	0
SBF4.1	0 - 5	**3**	0	1	1	0	1	0	0	0	0	0
SBF4.2	5 - 25	**2**	0	0	1	0	1	0	1	0	0	0
SBF4.3	25 - 110	0	0	0	0	0	0	0	0	0	0	1
SBF4.4	110 - 130	0	0	0	0	0	0	0	0	0	0	1
SCF1.1	0 - 15	**2**	0	0	1	0	1	0	0	0	0	1
SCF1.2	15 - 30	**2**	0	0	1	0	1	0	0	1	0	0
SCF2.1	0 - 10	0	0	0	0	0	1	0	0	0	0	1
SCF2.2	10 - 20	0	0	0	0	0	1	0	0	0	0	1
SCF2.3	20 - 40	0	0	0	0	0	0	0	0	0	0	1
SDO1.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
SDO1.2	5 - 15	**2**	0	0	1	0	1	0	0	1	0	0
SDO1.3	15 - 30	**2**	0	0	1	0	1	0	0	1	0	0
SDO1.4	30 - 70	**1**	0	0	1	0	0	0	0	1	0	0
SDO1.5	70 - 140	**1**	0	0	1	0	0	0	1	0	0	0
SDO2.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
SDO2.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
SDO2.3	20 - 60	**1**	0	0	1	0	0	0	0	1	0	0
SDO2.4	60 - 80	**1**	0	0	1	0	0	0	0	1	0	0
SDO3.1	0 - 5	**3**	1	0	1	0	1	0	0	0	0	0
SDO3.2	5 - 25	**2**	0	0	1	0	1	0	1	0	0	0
SDO3.3	25 - 40	**1**	0	0	1	0	0	0	0	0	1	0
SDO3.4	40 - 42	**1**	0	0	1	0	0	0	0	0	1	0
SDO4.1	0 - 10	**1**	0	0	0	0	1	0	1	0	0	0
SDO4.2	10 - 60	**1**	0	0	0	0	1	0	1	0	0	0
SDO4.3	60 - 100	0	0	0	0	0	0	0	1	0	0	0
SDO5.1	0 - 30	**2**	0	0	1	0	1	0	0	0	1	0
SDO5.2	30 - 70	**2**	0	0	1	1	0	0	0	0	0	0
SDO5.3	70 - 90	**2**	1	0	1	0	0	0	0	0	0	0
SFE1.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
SFE1.2	5 - 25	**2**	0	0	1	0	1	0	1	0	0	0
SFE1.3	25 - 40	**1**	0	0	1	0	0	0	0	1	0	0
SFE1.4	40 - 110	**1**	0	0	1	0	0	0	0	1	0	0
SFE2.1	0 - 15	**2**	0	0	1	0	1	0	1	0	0	0
SFE2.2	15 - 60	**2**	0	0	1	0	1	0	1	0	0	0
SFE2.3	60 - 90	**1**	0	0	1	0	0	0	1	0	0	0
SFE3.1	0 - 8	**2**	0	0	1	0	1	0	1	0	0	0
SFE3.2	8 - 25	**2**	0	0	1	0	1	0	0	1	0	0
SFE3.3	25 - 40	**1**	0	0	1	0	0	0	1	0	0	0
SFE3.4	40 - 90	**1**	0	0	1	0	0	0	0	0	0	1
SPE1.1	0 - 10	**2**	0	0	1	0	1	0	0	1	0	0
SPE2.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
SPE2.2	5 - 25	**2**	0	0	1	0	1	0	0	1	0	0
SPE3.1	0 - 5	**1**	0	0	0	0	1	0	0	0	0	1
SPE3.2	5 - 15	**1**	0	0	0	0	1	0	0	0	0	1
SPE3.3	15 - 45	**2**	0	0	1	0	1	0	0	1	0	0
SRE1.1	0 - 3	**2**	0	0	1	0	1	0	1	0	0	0
SRE1.2	3 - 25	**2**	0	0	1	0	1	0	0	0	1	0
SRE1.3	25 - 35	**1**	0	0	1	0	0	0	0	1	0	0
SRE1.4	35 - 70	**1**	0	0	1	0	0	0	0	1	0	0
SRE2.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
SRE2.2	5 - 25	**2**	0	0	1	0	1	0	0	0	1	0
SRE2.3	25 - 50	**1**	0	0	1	0	0	0	0	0	1	0

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
SRE2.4	50 - 90	**1**	0	0	1	0	0	0	0	1	0	0
SRE3.1	0 - 5	**1**	0	0	1	0	1	0	0	1	0	0
SRE3.2	5 - 30	**1**	0	0	1	0	1	0	0	1	0	0
SRE4.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
SRE4.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
SRE4.3	20 - 50	**1**	0	0	1	0	0	0	0	1	0	0
SRE4.4	50 - 90	**1**	0	0	1	0	0	0	0	0	0	1
SRE5.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
SRE5.2	5 - 45	**2**	0	0	1	0	1	0	1	0	0	0
SRE6.1	0 - 5	**1**	0	0	1	0	1	0	0	1	0	0
SRE6.2	5 - 30	**2**	0	0	1	0	1	0	0	1	0	0
SRE6.3	30 - 45	**1**	0	0	1	0	0	0	0	1	0	0
SRE7.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
SRE7.2	5 - 30	**2**	0	0	1	0	1	0	0	1	0	0
SRE7.3	30 - 60	**1**	0	0	1	0	0	0	0	1	0	0
SRE7.4	60 - 90	**1**	0	0	1	0	0	0	0	1	0	0
SRE8.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
SRE8.2	10 - 30	**2**	0	0	1	0	1	0	0	1	0	0
SRE8.3	30 - 80	**1**	0	0	1	0	0	0	0	1	0	0
TAW1.1	0 - 2	**2**	0	0	1	0	1	0	1	0	0	0
TAW1.2	2 - 15	**3**	0	0	1	1	1	0	0	0	0	0
TAW1.3	15 - 30	**2**	0	0	1	0	1	0	0	0	1	0
TAW1.4	30 - 100	**1**	0	0	1	0	0	0	0	0	1	0
TAW1.6	110 - 140	**1**	0	0	1	0	0	0	0	1	0	0
TAW2.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
TAW2.2	5 - 35	**2**	0	0	1	0	1	0	0	0	0	1
TAW3.1	0 - 5	**3**	1	0	1	0	1	0	0	0	0	0
TAW3.2	5 - 40	**2**	0	0	1	0	1	0	0	1	0	0
TAW3.3	40 - 90	**1**	0	0	1	0	0	0	1	0	0	0
TBD1.1	0 - 15	**1**	0	0	1	0	1	0	1	0	0	0
TBD1.2	15 - 60	**1**	0	0	1	0	1	0	0	0	0	1
TBD1.3	60 - 100	**2**	0	1	1	0	0	0	0	0	0	0
TBD2.1	0 - 15	**1**	0	0	1	0	1	0	0	1	0	0
TBD2.2	15 - 70	**1**	0	0	1	0	1	0	0	1	0	0
TBD2.3	70 - 90	**1**	0	0	1	0	0	0	1	0	0	0
TBD2.4	90 - 100	**2**	0	1	1	0	0	0	0	0	0	0
TBD3.1	0 - 5	**1**	0	0	1	0	1	0	0	1	0	0
TBD3.2	5 - 20	0	0	0	0	0	1	0	0	0	0	1
TBD3.3	20 - 80	0	0	0	0	0	0	0	1	0	0	0
TBD3.4	80 - 100	**2**	0	0	1	1	0	0	0	0	0	0
TBD4.1	0 - 10	**2**	0	0	1	0	1	0	0	0	1	0
TBD4.2	10 - 50	**2**	0	0	1	0	1	0	1	0	0	0
TBD4.3	50 - 100	**2**	0	1	1	0	0	0	0	0	0	0
TBD5.1	0 - 10	**2**	0	0	1	0	1	0	0	1	0	0
TBD5.2	10 - 50	**2**	0	0	1	0	1	0	1	0	0	0
TBD5.3	50 - 100	**2**	0	1	1	0	0	0	0	0	0	0
TFH1.1	0 - 5	**3**	1	0	1	0	1	0	0	0	0	0
TFH1.2	5 - 10	**3**	1	0	1	0	1	0	0	0	0	0
TFH1.3	10 - 30	**3**	1	0	1	0	1	0	0	0	0	0
TFH1.4	30 - 60	**1**	0	0	1	0	0	0	1	0	0	0
TFH1.5	60 - 130	**1**	0	0	0	1	0	0	0	0	0	0
TFH2.1	0 - 5	**3**	1	0	1	0	1	0	0	0	0	0
TFH2.2	5 - 20	**2**	1	0	1	0	1	0	0	0	0	0
TFH2.3	20 - 50	0	0	0	0	0	0	0	0	0	1	0
TFH2.4	50 - 100	**1**	0	0	1	0	0	0	1	0	0	0
TFH3.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
TFH3.2	5 - 20	**2**	0	0	1	0	1	0	1	0	0	0
TFH3.3	20 - 50	**1**	0	0	1	0	0	0	0	0	1	0
TFL1.1	0 - 10	**2**	0	0	1	0	1	0	0	0	1	0
TFL1.2	10 - 20	**2**	0	0	1	0	1	0	0	0	1	0
TFL1.3	20 - 50	**1**	0	0	1	0	0	0	0	1	0	0
TFL2.1	0 - 3	**2**	0	0	1	0	1	0	1	0	0	0

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to $pH_W < 5.5$ during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
TFL2.2	3 - 15	**2**	0	0	1	0	1	0	0	0	1	0
TFL2.3	15 - 25	0	0	0	0	0	1	0	0	0	1	0
TFL2.4	25 - 70	0	0	0	0	0	0	0	0	0	0	1
TFL3.1	0 - 5	0	0	0	0	0	1	0	0	1	0	0
TFL3.2	5 - 15	**2**	0	0	1	0	1	0	0	1	0	0
TFL3.3	15 - 55	**2**	0	0	1	0	1	0	1	0	0	0
TLE1.1	0 - 10	**1**	0	0	0	0	1	0	0	0	0	1
TLE1.2	10 - 25	**1**	0	0	0	0	1	0	0	0	0	1
TLE2.1	0 - 30	**2**	0	0	1	0	1	0	0	0	1	0
TLE2.2	30 - 95	**1**	0	0	1	0	0	0	0	0	1	0
TOB1.1	0 - 20	**2**	0	0	1	0	1	0	0	1	0	0
TOB1.2	20 - 80	**1**	0	0	1	0	0	0	0	1	0	0
TOB1.3	80 - 100	**1**	0	0	1	0	0	0	0	1	0	0
WAL1.1	0 - 2	**2**	0	0	1	0	1	0	1	0	0	0
WAL1.2	2 - 20	**2**	0	0	1	0	1	0	1	0	0	0
WAL1.3	20 - 70	**1**	0	0	1	0	0	0	1	0	0	0
WAL2.1	0 - 2	**2**	0	0	1	0	1	0	1	0	0	0
WAL2.2	2 - 15	**2**	0	0	1	0	1	0	1	0	0	0
WAL2.3	15 - 45	**2**	0	0	1	0	1	0	1	0	0	0
WAL3.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
WAL3.2	10 - 25	**2**	0	0	1	0	1	0	1	0	0	0
WAL3.3	25 - 40	**1**	0	0	1	0	0	0	1	0	0	0
WDE1.1	0 - 10	**2**	0	0	1	0	1	0	0	0	1	0
WDE1.2	10 - 35	**2**	0	0	1	0	1	0	0	1	0	0
WDE1.3	35 - 90	**1**	0	0	1	0	0	0	0	0	1	0
WDE1.4	90 - 130	**1**	0	0	1	0	0	0	0	1	0	0
WEA1.1	0 - 25	**2**	0	0	1	0	1	0	0	0	1	0
WEA1.2	25 - 40	**1**	0	0	1	0	0	0	0	0	1	0
WEA1.3	40 - 100	**1**	0	0	1	0	0	0	0	0	1	0
WEA1.4	100 - 160	**2**	1	0	1	0	0	0	0	0	0	0
WEA2.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
WEA2.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
WEA2.3	20 - 40	**1**	0	0	1	0	0	0	0	0	1	0
WEA2.4	40 - 65	**1**	0	0	1	0	0	0	0	1	0	0
WEA3.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
WEA3.2	5 - 20	**2**	0	0	1	0	1	0	0	0	1	0
WEA3.3	20 - 45	**1**	0	0	1	0	0	0	0	0	1	0
WEL1.1	0 - 5	**2**	0	0	1	0	1	0	0	0	1	0
WEL1.2	5 - 20	**1**	0	0	1	0	1	0	0	0	1	0
WEL1.3	20 - 40	**1**	0	0	1	0	0	0	0	1	0	0
WEL1.4	40 - 60	**1**	0	0	1	0	0	0	0	0	1	0
WEL1.5	60 - 65	**1**	0	0	1	0	0	0	0	1	0	0
WEL2.1	0 - 5	**2**	0	0	1	0	1	0	0	0	1	0
WEL2.2	5 - 20	**2**	0	0	1	0	1	0	0	0	1	0
WEL2.3	20 - 60	**1**	0	0	1	0	0	0	0	1	0	0
WEL2.4	60 - 110	**2**	0	1	1	0	0	0	0	0	0	0
WLE1.1	0 - 3	**2**	0	0	1	0	1	0	0	0	1	0
WLE1.2	3 - 30	**2**	0	0	1	0	1	0	0	0	1	0
WLE1.3	30 - 100	**1**	0	0	1	0	0	0	0	0	1	0
WLE2.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
WLE2.2	5 - 30	**2**	0	0	1	0	1	0	0	0	1	0
WLE2.3	30 - 50	**1**	0	0	1	0	0	0	0	0	1	0
WMA1.1	0 - 10	**2**	0	0	1	0	1	0	0	0	0	1
WMA1.2	10 - 30	**3**	1	0	1	0	1	0	0	0	0	0
WMA1.3	30 - 50	**2**	1	0	1	0	0	0	0	0	0	0
WMA1.4	50 - 110	**2**	1	0	1	0	0	0	0	0	0	0
WMA1.5	110 - 160	**2**	0	1	1	0	0	0	0	0	0	0
WMA2.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
WMA2.2	5 - 10	**3**	0	1	1	0	1	0	0	0	0	0
WMA2.3	10 - 60	**3**	0	1	1	0	1	0	0	0	0	0
WMA3.1	0 - 3	**2**	0	0	1	0	1	0	1	0	0	0
WMA3.2	3 - 10	**3**	0	0	1	1	1	0	0	0	0	0

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to $pH_W < 5.5$ during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
WMA3.3	10 - 20	**3**	0	0	1	1	1	0	0	0	0	0
WMA3.4	20 - 80	**2**	0	1	1	0	0	0	0	0	0	0
WMA4.1	0 - 3	**1**	0	0	0	0	1	0	1	0	0	0
WMA4.2	3 - 10	**3**	0	1	1	0	1	0	0	0	0	0
WMA4.3	10 - 30	**3**	0	0	1	1	1	0	0	0	0	0
WMA4.4	30 - 40	**2**	0	0	1	1	0	0	0	0	0	0
WMA5.1	0 - 10	**3**	0	1	1	0	1	0	0	0	0	0
WMA5.2	10 - 50	**3**	0	0	1	1	1	0	0	0	0	0
WMA5.3	50 - 90	**2**	0	1	1	0	0	0	0	0	0	0
WMA6.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
WMA6.3	20 - 40	**1**	0	0	1	0	0	0	1	0	0	0
WMA7.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
WMA7.2	5 - 40	**2**	0	0	1	0	1	0	1	0	0	0
WMA7.3	40 - 80	**1**	0	0	1	0	0	0	1	0	0	0
WON1.1	0 - 3	**1**	0	0	1	0	1	0	0	1	0	0
WON1.2	3 - 25	**2**	0	0	1	0	1	0	0	1	0	0
WON1.3	25 - 50	0	0	0	0	0	0	0	0	0	0	1
WON1.4	50 - 100	0	0	0	0	0	0	0	0	0	0	1
WON2.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
WON2.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
WON2.3	20 - 50	0	0	0	0	0	0	0	0	0	0	1
WON3.1	0 - 10	**1**	0	0	1	0	1	0	0	0	0	1
WON3.2	10 - 60	**1**	0	0	1	0	1	0	0	0	0	1
WON3.3	60 - 100	0	0	0	0	0	0	0	0	0	0	1
WSO1.1	0 - 5	**3**	0	1	1	0	1	0	0	0	0	0
WSO1.2	5 - 35	**3**	0	1	1	0	1	0	0	0	0	0
WSO1.3	35 - 80	**2**	0	1	1	0	0	0	0	0	0	0
WSO1.4	80 - 120	**2**	0	1	1	0	0	0	0	0	0	0
WSO2.1	0 - 4	**2**	0	0	1	0	1	0	0	1	0	0
WSO2.2	4 - 50	**2**	0	0	1	0	1	0	1	0	0	0
WSO2.3	50 - 100	**1**	0	0	1	0	0	0	1	0	0	0
WSO2.4	100 - 135	**2**	0	0	1	1	0	0	0	0	0	0
WSP1.1	0 - 100	**2**	0	0	1	0	1	0	1	0	0	0
WSP1.2	100 - 160	**1**	0	0	1	0	0	0	0	1	0	0
WSP2.1	0 - 100	**2**	0	0	1	0	1	0	1	0	0	0
WSP3.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
WSP3.2	5 - 20	**2**	0	0	1	0	1	0	1	0	0	0
WSP3.3	20 - 110	**1**	0	0	1	0	0	0	0	1	0	0
WSP3.4	110 - 160	**1**	0	0	1	0	0	0	1	0	0	0
YHD1.1	0 - 10	**2**	0	0	1	0	1	0	0	1	0	0
YHD1.2	10 - 35	**2**	0	0	1	0	1	0	0	0	1	0
YHD2.1	0 - 10	**2**	0	0	1	0	1	0	0	0	1	0
YHD2.2	10 - 35	**2**	0	0	1	0	1	0	0	1	0	0
YHD3.1	0 - 10	**2**	0	0	1	0	1	0	0	1	0	0
YHD3.2	10 - 25	**2**	0	0	1	0	1	0	0	1	0	0
YHD3.3	25 - 80	**1**	0	0	1	0	0	0	0	1	0	0
YHD4.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
YHD4.2	5 - 20	**2**	0	0	1	0	1	0	0	0	1	0
YHD4.3	20 - 60	**1**	0	0	1	0	0	0	0	1	0	0
YHD5.1	0 - 15	**2**	0	0	1	0	1	0	1	0	0	0
YHD5.2	15 - 30	**3**	1	0	1	0	1	0	0	0	0	0
YHD5.3	30 - 80	**1**	0	0	1	0	0	0	0	1	0	0
YHD5.4	80 - 100	**1**	0	0	1	0	0	0	0	1	0	0
YHP1.1	0 - 10	**1**	0	0	0	0	1	0	1	0	0	0
YHP1.2	10 - 20	**1**	0	0	0	0	1	0	0	0	0	1
YHP1.3	20 - 35	0	0	0	0	0	0	0	0	0	0	1
YHW1.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
YHW1.2	5 - 20	**2**	0	0	1	0	1	0	0	1	0	0
YHW1.3	20 - 80	**1**	0	0	1	0	0	0	0	1	0	0
YHW2.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
YHW2.2	10 - 25	**2**	0	0	1	0	1	0	0	1	0	0
YHW2.3	25 - 100	**1**	0	0	1	0	0	0	0	0	0	1

Wetland, Site and Sample ID (number)	**Depth range**	**High Priority Summary**	**1** - sulfuric material	**2a** - hypersulfidic - incubation	**2b** - hypersulfidic - positive net acidity	**3** - hyposulfidic - $S_{CR} \geq$ 0.10%S	**4** - water soluble sulfate>100mg SO4 kg^{-1} (within 0-20cm)	**5** - monosulfidic material	**Moderate Priority** hyposulfidic - SCR< 0.10% S	**No Further Assessment** Other acidic - drops 0.5 unit to pH_W < 5.5 during incubation	Other acidic - $pH_W \geq 4$ but < 5.5	Other soil materials
YHW3.1	0 - 10	**2**	0	0	1	0	1	0	1	0	0	0
YHW3.2	10 - 25	**2**	0	0	1	0	1	0	0	1	0	0
YHW3.3	25 - 50	**1**	0	0	1	0	0	0	0	0	0	1
YHW3.4	50 - 100	**1**	0	0	1	0	0	0	0	0	0	1
YHW4.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
YHW4.2	5 - 15	**2**	0	0	1	0	1	0	0	0	1	0
YHW4.3	15 - 30	**2**	0	0	1	0	1	0	1	0	0	0
YHW4.4	30 - 80	**1**	0	0	1	0	0	0	0	1	0	0
YHW5.1	0 - 5	**2**	0	0	1	0	1	0	1	0	0	0
YHW5.2	5 - 15	**3**	1	0	1	0	1	0	0	0	0	0
YHW5.3	15 - 30	**3**	0	0	1	1	1	0	0	0	0	0
YHW6.1	0 - 10	**2**	0	0	1	0	1	0	0	0	0	0
YHW6.2	10 - 60	**3**	0	0	1	1	1	0	0	0	0	0
YHW6.3	60 - 100	**2**	0	0	1	1	0	0	0	0	0	0
YMD1.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
YMD1.2	5 - 15	**2**	0	0	1	0	1	0	0	1	0	0
YMD1.3	15 - 45	**2**	0	0	1	0	1	0	0	1	0	0
YMD1.4	45 - 70	**1**	0	0	1	0	0	0	0	1	0	0
YMD2.1	0 - 1	**1**	0	0	0	0	1	0	0	0	0	1
YMD2.2	1 - 4	**1**	0	0	0	0	1	0	0	1	0	0
YMD2.3	4 - 30	**1**	0	0	0	0	1	0	1	0	0	0
YMD2.4	30 - 60	**1**	0	0	1	0	0	0	0	1	0	0
YMD3.1	0 - 5	**2**	0	0	1	0	1	0	0	0	1	0
YMD3.2	5 - 15	**2**	0	0	1	0	1	0	0	0	1	0
YMD3.3	15 - 35	**2**	0	0	1	0	1	0	0	1	0	0
YMD3.4	35 - 65	**1**	0	0	1	0	0	0	1	0	0	0
YMD4.1	0 - 5	**2**	0	0	1	0	1	0	0	1	0	0
YMD4.2	5 - 15	**2**	0	0	1	0	1	0	0	0	1	0
YMD4.3	15 - 40	**2**	0	0	1	0	1	0	0	0	1	0
YMD4.4	40 - 55	**1**	0	0	1	0	0	0	0	1	0	0

APPENDIX B – WETLAND DESCRIPTIONS FOR ACID SULFATE SOIL ASSESSMENT

This appendix because of its large file size has been separated and is provided in 5 accompanying files:

Appendix B1 – Descriptions for assessed wetlands from Pomanda Bay to Sunnyside – Paiwalla managed wetland

Appendix B2 – Descriptions for assessed wetlands from Sunnyside – Paiwalla Swamp to Teal Flat Hut wetland

Appendix B3 – Descriptions for assessed wetlands from Teal Flat wetland to Devon Downs Swamp

Appendix B4 – Descriptions for assessed wetlands from Greenways Landing wetland to Yarramundi Creek

Appendix B5 – Descriptions for assessed wetlands from Yarramundi North (Morgan's Lagoon) wetland to Morgan Conservation Park wetland

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