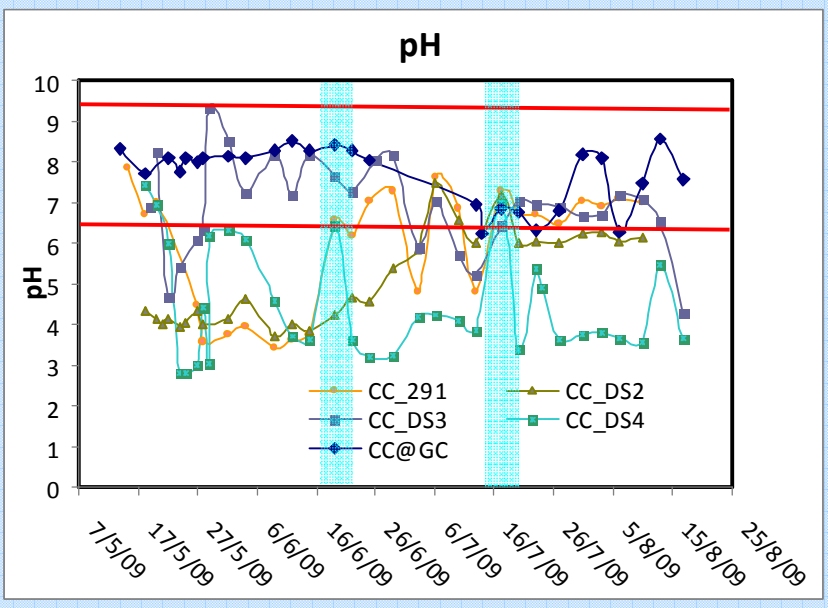
CURRENCY CREEK & FINNISS RIVER WATER QUALITY REPORT

Report 5, to 12 August 2009

OBSERVATIONS AT A GLANCE

- Limestone addition to Currency Creek increased pH to satisfactory levels at several sites. However, pH at three sites is now below the ANZECC guideline level for protection of aquatic ecosystems (pH between 6.5 and 9, see red lines on graph below and blue shading indicates time period of aerial limestone dosing).



- Alkalinity levels at most other sites in Currency Creek remain low, indicating the water body is susceptible to further acidification.
- Declining pH and alkalinity levels have been observed at two Finniss River sites.
- Pore and surface water in a wetland on the western edge of the Lower Finniss region had high acidity.

BACKGROUND

The Environment Protection Authority and Department for Environment and Heritage are monitoring to assess potential water quality impacts associated with water level decline and the exposure of acid sulfate soils in the Goolwa Channel, Currency Creek and Finniss River region (Figures 1 and 1A).

WATER QUALITY PARAMETERS

A wide range of water quality parameters are being analysed in an integrated program across the Lower Lakes (see www.epa.sa.gov.au/lower_lakes). Key field-based parameters reported herein are pH, acidity, alkalinity and salinity.

***pH** is an indicator of acidity or alkalinity. Neutral water has a pH of 7, acidic solutions have lower values and alkaline solutions have higher values. Prior to the recent drying and re-wetting, the pH in the region was between 8 – 8.5.*

***Alkalinity** is a measure of the buffering capacity of water, or the capacity of the water to neutralise acids and resist pH change. Alkalinity within water bodies is consumed as acid is released from acid sulfate soils. Adding limestone contributes alkalinity to waters helping to neutralise any acid released from the sediments. Historically alkalinity levels within this region have been between 100 – 250 mg/L as $CaCO_3$.*

***Acidity** is a measure of the acid (hydrogen ions) and dissolved metal ions (e.g. iron and aluminium) present in water bodies. Acidity is expressed as the volume of calcium carbonate (mg/L of $CaCO_3$) required to neutralise the acid. Acidity occurs when the alkalinity or buffering capacity has been consumed, and is not normally present in the Lower Lakes.*

***Salinity** is a measure of the amount of dissolved salts in the water. Saline water conducts electricity more readily than freshwater so electrical conductivity (EC) is routinely used to measure salinity. As salinity levels increase it may become toxic to native freshwater organisms. Prior to drought conditions salinity was observed between 1 and 1.2 mS/cm (1000-1200 EC) within the region.*

Figure 1 - Map of Sample Sites

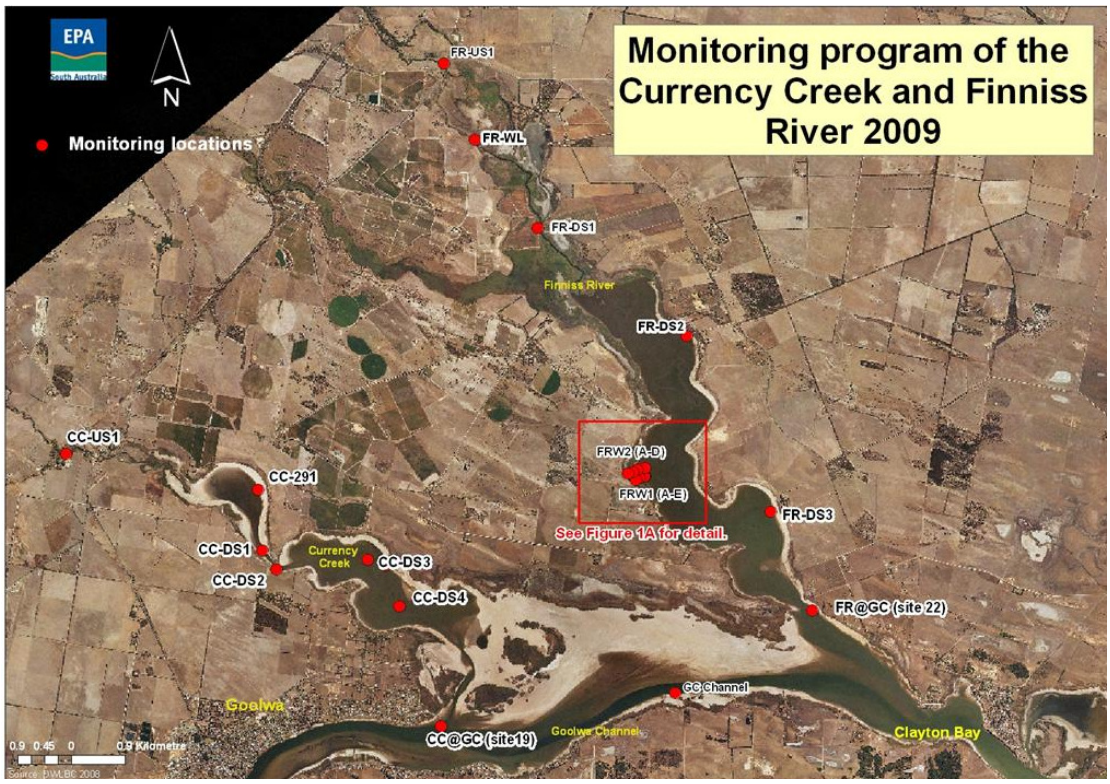


Figure 1A – Map of Finniss River Wetland Sites

A number of sites have been identified as high risk and as a result are being monitored as regularly as possible (in some instances up to 5 times per week). Table 1 includes basic descriptions and justifications for the selection of these monitoring sites within the Goolwa Channel, Currency Creek and Finniss River region.

Table 1 - Selection and description of high risk sites

Site	Location	Description
CC-291	Currency	On the northern margin of the upper Currency Creek representing the transition from creek to open channel. The site is located over sediments exposed in summer that have now been saturated or re-inundated due to rainfall events. Catchment inflows are now occurring.
CCDS2	Currency	A narrow midway bottle neck that formerly was a disconnected pool in summer. It is now reconnected to pooled water in the upper and lower Currency tributary due to rainfall events and inflows.
CCDS3	Currency	On the northern margin of the lower Currency Creek within the closest pooled water to Goolwa Channel. The site is located over sediments that were exposed in summer and now have been saturated or re-inundated due to rainfall events and inflows.
CCDS4	Currency	On the southern margin of the lower Currency Creek within the closest pooled water to Goolwa Channel. The site is located over sediments that were exposed in summer and have now been saturated or re-inundated due to rainfall events and inflows.
CC@GC	Currency/ Goolwa Channel	At the mouth of Currency Creek where it enters the Goolwa Channel. The site is located within the Goolwa Channel and has remained inundated. It is an important site to monitor the buffering capacity of Lake Alexandrina water and potential impact of outflows from the Currency Creek region.
FRUS1	Finniss	In the Finniss River before it enters into the lake system.
FRDS1	Finniss	Within the upper Finniss River and adjacent to wetlands that have shown signs of acid sulfate soil impacts upon rewetting. Minor flow in the region continued over summer and this has now increased with rainfall events and catchment inflows.
FRDS2	Finniss	On the eastern margin of the Finniss River downstream of where it initially enters Lake Alexandrina. The site remained inundated in summer although water levels declined markedly and nearly disconnected from the Goolwa channel.
FRDS3	Finniss	On the eastern margin of the Finniss River further downstream of FRDS3 and closer to where it connects with the Goolwa Channel. The site remained inundated in summer although water levels declined markedly and nearly disconnected from the Goolwa channel.
FR@GC	Finniss/ Goolwa Channel	Located at the mouth of Finniss River where it enters the Goolwa Channel. It is an important site to monitor the buffering capacity of Lake Alexandrina water and potential impact of outflows from the Finniss River region.

LIMESTONE MANAGEMENT RESPONSE

Trials of various pre-emptive or reactive (to water acidity) limestone additions have been undertaken in the area between April and July 2009 to mitigate the risk of acidification.

Initially, up to 600 tonnes (t) of pre-emptive limestone were placed in Currency Creek and the Finniss River in late April. Approximately 200 t were placed in upper Currency Creek above CC291, 100 t at the bottle neck near CCDS2, and around 300 t in the Finniss River downstream of Wally's Landing but upstream of FRDS1. The limestone was placed in these areas prior to rainfall events in late April so that any inflows would be intercepted.

Following several rainfall events in May and acidification of water pooled in Currency Creek, a limestone barrier was constructed downstream of the Currency Creek bottle neck near CCDS2 and two limestone barriers were constructed in lower Currency Creek below CCDS4 to stop acidic water from reaching the Goolwa Channel.

Shoreline limestone dosing was first trialled from 10 to 12 June into acidic water in lower Currency Creek near CCDS4. This method proved to be slow and so other dosing methods were considered.

Aerial limestone dosing first took place between Tuesday 16th and Friday 19th June in Currency Creek with limestone dispersed over both the upper Currency Creek (above site DS1) and lower Currency Creek water bodies (below site DS2). A second phase of aerial dosing occurred between Wednesday 15th and Monday 20th July focusing on lower Currency Creek as a result of the main limestone barrier below CCDS4 breaching and an acidic pulse of water entering the Goolwa Channel.

In total, up to 1,000 t of limestone have been aerially dosed throughout Currency Creek, with an additional 2,000 t either bound up in temporary barriers or dispersed downstream by flowing water.

It should be noted that there is likely to be lag effects in the water body response following limestone dosing (e.g. slow dissolution of limestone, transfer of acidic pore water to surface water, raising of the pH in the sediment enough to stimulate bioremediation activity).

CURRENCY CREEK WATER QUALITY

Surface water quality results are discussed below for selected sites and parameters in the Currency Creek region. Please refer to graphs in Figure 2 for this section and to Figure 3 for rainfall at Currency Creek.

Alkalinity

- Site CC291 has generally shown an increasing trend in alkalinity since the most recent aerial limestone application. Alkalinity at this site currently (10th Aug) stands at 55 mg/L (as $CaCO_3$). This alkalinity level is still low and indicates the water body remains susceptible to further acidification.
- Sites CCDS2 and CCDS3 within Currency Creek show some signs of improvement following recent aerial limestone application. However, these sites have since recorded low alkalinities of 22 and 29 mg/L (10th Aug), respectively, and appear to be declining. These alkalinity levels indicate the water body is very susceptible to further acidification.
- Alkalinity continues to be absent at site CCDS4 despite the additional aerial limestone application in mid July. This is likely due to further input of acid from the sediment to the water following wind seiching and highlights the difficulty in managing acidity once it has been generated.
- CC@GC had shown improvement post limestone application but alkalinity has since fallen from a high of 135 mg/L (31st July) to 79 mg/L (10th Aug).

Acidity

- CC291, CCDS2 and CCDS3 have no observed acidity as a consequence of aerial limestone dosing and increased dilution flow.
- CCDS4 acidity levels remain relatively stable. The last four times this site has been monitored the acidity has ranged within 64 and 81 mg/L (as $CaCO_3$). Currently acidity level stands at 81 mg/L (10th Aug).

pH

- The pH (3.6 on 10th Aug) at CCDS4 remains well below the ANZECC guideline levels for protection of aquatic organisms (pH 6.5 to 9.0). Figure 2 shows that the pH at the site appears to have levelled out between 3 and 4 after previously showing some initial signs of improvement post aerial limestone application (e.g. pH of 7 on 17th July).
- pH has also decreased well below the guidelines recently at CCDS3 and the pH of 6.1 at CCDS2 is also just below the ANZECC guidelines.
- pH at CC@GC (pH of 7.5) and CC291 (pH of 7.0) remains above the ANZECC guidelines.

Salinity (EC)

- Salinity levels at all sites within the Currency Creek region (excluding CC@GC) have stabilised and range between 3.67 and 6.7 mS/cm (3670-6700 EC).
- Salinity levels at CC@GC are influenced by both catchment inflows and mixing with Goolwa Channel water (higher salinity influence). The salinity level at this site has been variable in recent weeks and currently stands at 12.9 mS/cm (10th Aug).

Figure 2 - Currency Creek Water Quality

(Blue shading indicates time period of aerial limestone dosing program)

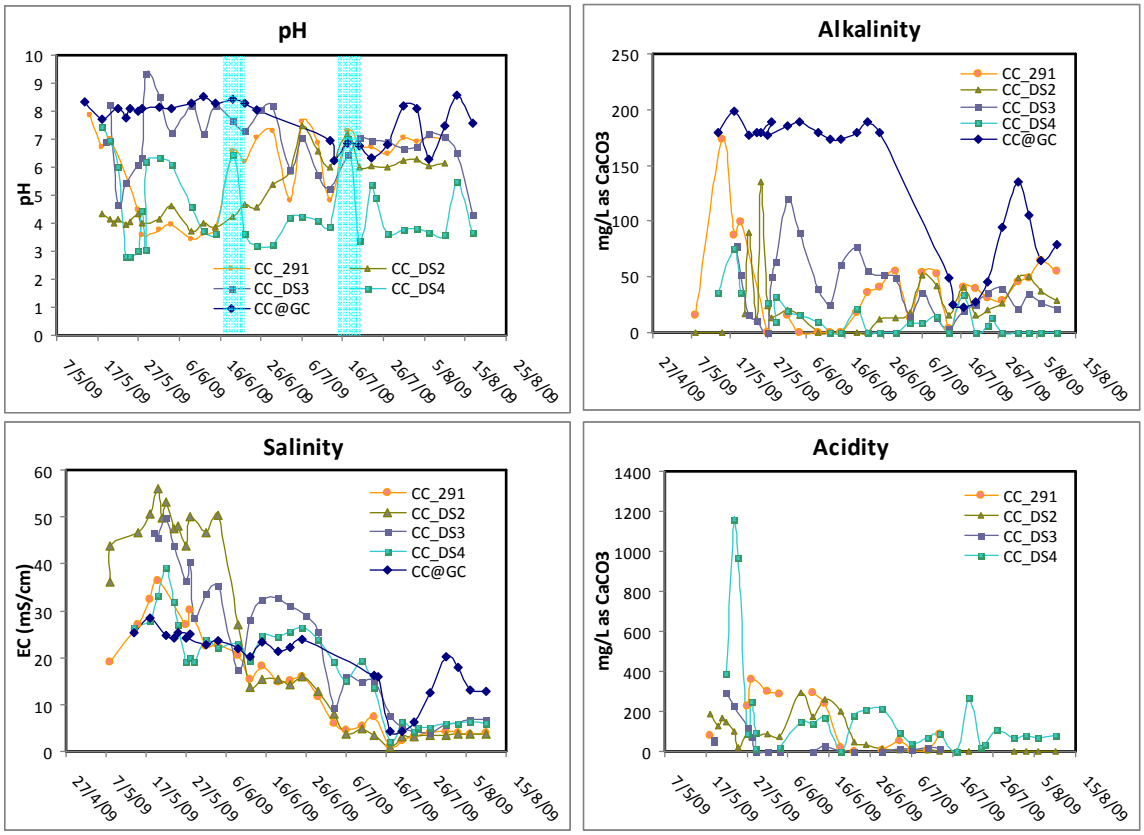
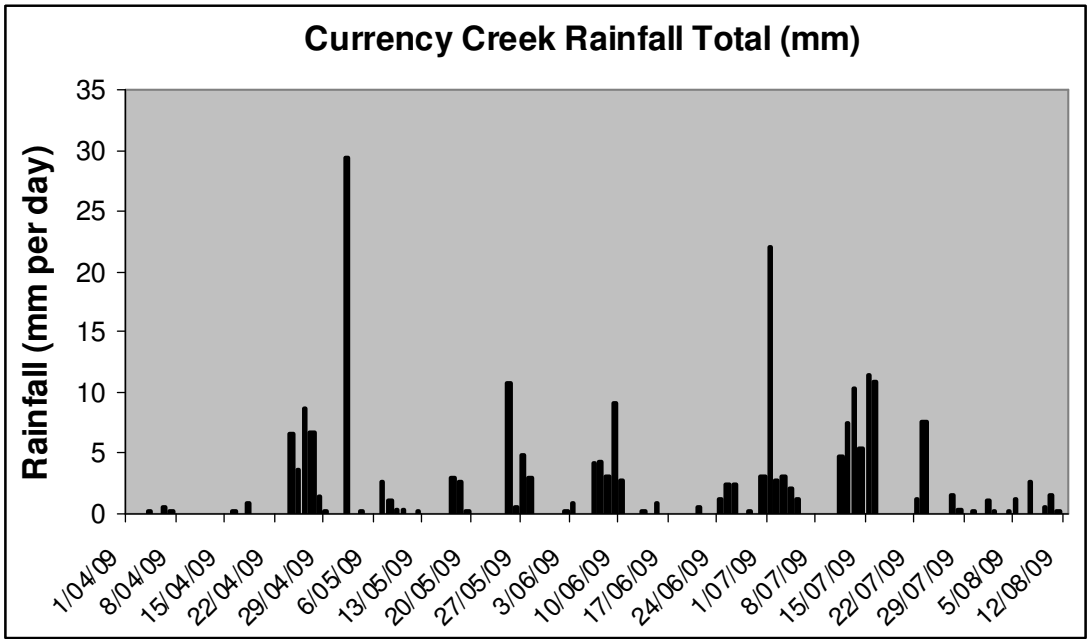


Figure 3 – Rainfall at Currency Creek



Data from South Australian Murray-Darling Basin NRM Board weather station (refer to http://www.samdbnrm.sa.gov.au/Portals/7/AWMN/awsview.php)

FINNISS RIVER WATER QUALITY

Water quality results are discussed below for selected sites and parameters in the Finniss River region. Please refer to the graphs in Figure 4 for this section.

Alkalinity

- Alkalinity at the Finniss River sites FRUS1, FRDS2 and FRDS3 remains relatively stable between 58 and 73 mg/L (7th Aug).
- Alkalinity at the Goolwa channel site (FR@GC) has declined and currently stands at 49 mg/L (7th Aug). Site FRDS1 has also declined with current alkalinity standing at 61 mg/L (10th Aug).

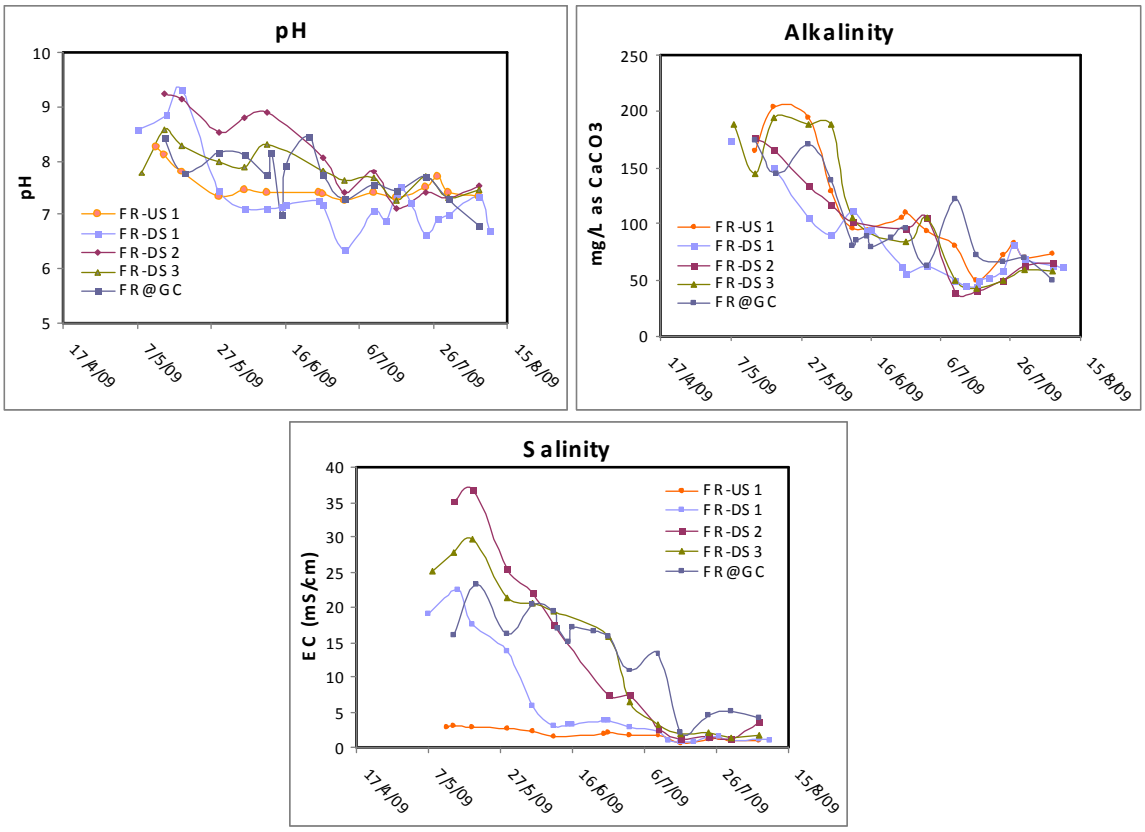
pH

- pH levels at all Finniss River sites remain within the ANZECC guidelines for aquatic ecosystems. However, sites FR@GC and FRDS1 have exhibited recent declines in pH.

Salinity (EC)

- Salinity levels at all Finniss River sites have stabilised between 0.9 and 4.16 mS/cm (900-4160 EC).

Figure 4 - Finniss River Water Quality



FINNISS RIVER WETLAND TRANSECTS

On the 4th of August, surface, pore and crack water quality were analysed along two transects in a wetland on the western bank of the lower Finniss River (see Figures 1 and 1A for location). This wetland had a large area of exposed and cracked acid sulfate soils (see Photos 1 and 2). The monitoring results (Table 2) show low pH and high acidities in surface, crack and pore waters, highlighting the risk posed by acid sulfate soils in the lower Finniss River region.

Table 2 - Finniss River Wetland Transect Data

Sample Name	Sample Type	pH	Acidity (mg/L as $CaCO_3$)
FRW1-A	Surface	2.96	285
FRW1-B	Pore	3.19	700
FRW1-C	Crack	3.44	425
FRW1-D	Crack	3.07	1115
FRW1-E	Crack	2.37	2890
FRW2-A	Surface	3.00	290
FRW2-B	Crack	3.02	910
FRW2-C	Crack	3.09	1630
FRW2-D	Crack	2.66	2930

A recent CSIRO report has been released on the soils in Finniss River, Currency Creek, Black Swamp and Goolwa Channel (see website http://www.clw.csiro.au/acidsulfatesoils/murray.html) indicating the region's acid generating potential.

Acid in the sediments continues to pose a high risk to water quality throughout the region. Pumping of water from Lake Alexandrina into the Goolwa Channel (as part of the Goolwa Water Level Management Project) will commence shortly and further limestone dosing may be required as the surrounding sediments are rewet.

Photo 1 - Finniss River wetland exposed sediments

Photo 2 - Pale yellow mottles (acid sulfate soil minerals - jarosite/natrojarosite) with acidic water in cracks

Further information on water quality and quantity, and acid sulfate soils, can be found on the following websites:

- **Department for Environment and Heritage** http://www.environment.sa.gov.au/cllmm/
- **River Murray Data** http://data.rivermurray.sa.gov.au/ (real-time data)
- **Environment Protection Authority** www.epa.sa.gov.au
- **Department of Water, Land and Biodiversity Conservation** www.dwlbc.sa.gov.au
- **South Australian Murray–Darling Basin Natural Resource Management Board** www.samdbnrm.sa.gov.au
- **Murray–Darling Basin Authority** www.mdba.gov.au
- **Waterwatch** www.waterwatch.org.au
- **CSIRO acid sulfate soils** www.clw.csiro.au/acidsulfatesoils/murray.html