



ASSAY

A NEWSLETTER ABOUT ACID SULFATE SOILS

No. 40 October 2006

Welcome to edition number 40

ASSAY heads into 'middle age' filled with examples of how acid sulfate soils are being managed across the country. In this edition we feature Australia's presence at the 18th World Congress of Soil Science and the latest happenings at East Trinity near Cairns.

All reports suggest Australia's expertise in acid sulfate soils shone at the World Congress. Congratulations to all who attended and presented papers.

Col Ahern's paper discussing the development of Queensland's acid sulfate soil management guidelines should be of interest to other states that are in the process of reviewing or compiling their own.

Also included in this edition is a research update highlighting a number of recent scientific papers. A paper from Western Australia documenting the human health hazard of contaminated domestic bore water should be an alarm bell for us all.

As always ASSAY welcomes any articles, stories or notices about what's happening in your neck of the woods. Feel free to drop us a line or forward through any items for future editions.

Happy reading
Chrisy



In this edition

- 18th World Congress of Soil Science
- NSW risk maps reviewed
- Port Stephens acid event
- East Trinity update
- \$1.9 million project in WA

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Acid Sulfate Soils featured at the 18th World Congress of Soil Science

During July the 18th World Congress of Soil Science was held in Philadelphia, USA. A symposium on the theme 'Acid Sulfate Soils: Technological Advances Enabling Better Management' was chaired by Prof Leigh Sullivan and attended by over 120 delegates. Australia's Dr Rob Fitzpatrick, Dr Richard Bush and Col Ahern presented as part of the symposium, summaries of their abstracts can be found on pages 2 & 3. A further 10 Australians also presented during theatre or poster sessions.

Feedback suggests the Australian delegates made a lasting impression, demonstrating the depth of knowledge that exists in our country on acid sulfate soils. Delegates were also impressed with the level of regulatory controls currently being adopted in Australia. The collaborative nature of many acid sulfate soil initiatives across different sectors of the community, as well as across the states and territories, was held up as a model for other countries to follow.

For further information on the 18th World Congress of Soil Science visit www.18wcso.org

Col Ahern

“Acid Sulfate Soils Management Guidelines – the Queensland, Australian perspective”

In Queensland there are an estimated 2.3 million hectares of acid sulfate soils located along the coastline. Given that more than 85% of Queensland's population live in the coastal zone; sampling, assessment and management of acid sulfate soils has become an important issue for the development industry and regulatory authorities.

Queensland's acid sulfate soil management guidelines were developed through extensive consultation with researchers, industry, community, government and interstate representatives. This has resulted in widespread adherence and acceptance of the Guidelines by environmental consultants, developers and earthmovers disturbing acid sulfate soils.

The development of the soil management guidelines is an excellent example of government cooperating with industry, and coming up with scientifically defensible, practical approaches to managing an important issue. There is now clear documentation of management techniques that have been shown to be effective at various sites in Queensland, and there is clear guidance on processes to be followed if alternative or higher risk management strategies are being proposed. This guideline along with other technical guidelines has helped facilitate consistency in acid sulfate soils sampling, analysis, assessment and management state wide that has been adopted by other Australian states.

The Soil Management Guidelines are available at

<http://www.nrm.qld.gov.au/land/ass/products.html>

To read the full abstract visit

<http://a-c-s.confex.com/crops/wc2006/techprogram/P17760.HTM>

Dr Richard Bush
“Elemental sulfur dynamics in acid sulfate soil landscapes”

Dr Richard Bush from Southern Cross University presented a paper on the sulfur cycle in acid sulfate soil landscapes. The paper examined the role of elemental sulfur, particularly when found in monosulfidic black ooze (known as MBO). New information on the occurrence and dynamics of elemental sulfur was presented. This new understanding of the sulfur cycle has particular relevance when understanding water quality in acid sulfate soil landscapes.

To read the full abstract visit

<http://a-c-s.confex.com/crops/wc2006/techprogram/P12187.HTM>

Pre-conference field trip well attended

The World Soils Congress pre-conference field trip highlighted acid sulfate soil issues in the Chesapeake Bay region. This tour was organised by Emeritus Prof Del Fanning of the University of Maryland with assistance from Prof Marty Rabenhorst (also University of Maryland) and Prof Leigh Sullivan.

The pre-conference field trip was held over two full days and was well attended by around fifty people. Potential acid sulfate soils examined on the field trip included subaqueous soils and tidal marsh soils, ie 'submerged uplands'. Active acid sulfate soils shown on the tour were the result of human disturbance, such as dredge spoil disposal areas and in uplands where sulfidic materials have been exposed by construction activities.

Post-active acid sulfate soils consisting of native upland soils were also examined. These post-active soils contained jarosite accumulations that are thought to have formed millions of years ago when these soils were active acid sulfate soils.

Emeritus Prof Del Fanning has indicated that he is happy to send a pdf copy of the field trip guidebook to anyone who is interested. Email requests to DelvinDel@aol.com

Dr Rob Fitzpatrick

“Recent advances in formation mechanisms of minerals in precipitates, salt efflorescences and sulfidic materials in acid sulfate weathering environments.”

Dr Rob Fitzpatrick from CSIRO Land and Water and CRC - LEME presented a paper highlighting a number of sulfate assemblages previously unreported in natural environments. These new assemblages give significant insight into the soil and groundwater geochemistry at the time when they were formed. To help understand these conditions, models were created integrating information on soils, ground and surface water, soil biology, climate and land use.

The mineralogy of sulfidic material largely depends on what can be found in surrounding bedrock, eg “in the vicinity of mineralised zones in bedrock, sulfidic materials may contain Cu, Pb and Zn sulfides, native gold, barite and Mn oxides (containing minor Co, Zn and I). These minerals tend to be intimately associated with, and incorporated in, organic matter” A detailed understanding of the soil water processes operating in specific landscapes can be useful for land management and mineral exploration.

To read the full abstract visit <http://crops.confex.com/crops/wc2006/techprogram/P17990.HTM>

**Strong presence from
Centre for Acid Sulfate Soil Research, Southern Cross University**

In July, five PhD candidates from the Centre for Acid Sulfate Soil Research, Southern Cross University attended the World Congress in Philadelphia. Diane Fyfe, Scott Henderson, Nadia Toppler, Salirian Claff and Crystal Maher presented posters showcasing components of their research to the international soils’ community.

An innovation of this conference was the opportunity to orally present poster presentations research in short theatre sessions. Gauging by the audience numbers and mix of disciplines, this was a popular inclusion in the conference.

The Southern Cross postgraduates presented on a wide range of acid sulfate soil research topics including, iron monosulfide formation and behaviour, schwertmannite behaviour and influence, jarosite compositional variability, development of a sequential procedure for acid sulfate soil metal extraction, field based reduced inorganic sulfide analysis and sulfur isotope investigations.

The abstracts can be found at <http://a-c-s.confex.com/crops/wc2006/techprogram/MEETING.HTM>



Some of the CASSR delegates who attended the 18th World Congress of Soil Science – L-R Crystal Maher, Scott Henderson, Nadia Toppler, Dr Richard Bush and Dr Ed Burton.

More from the pre-conference field tour

Pictured left is an area of saltmarsh on the edge of Chesapeake Bay visited during the acid sulfate soil pre-conference field tour. The land surface in this region is sinking at the rate of nearly 1 cm per year allowing tidal waters to encroach onto the former upland landscape resulting in the rapid contemporary formation of acid sulfate soils in these saltmarshes. These acid sulfate soils are morphologically very similar to the 6,000 yr old acid sulfate soil materials along the east coast of Australia. Note in the background the dead pine trees as the salty estuarine waters rapidly encroach on the former 'upland' pine forests.



Delegates on the pre-conference field tour.

ASS working group activities at the World Congress of Soil Science

Major items of business addressed at the World Congress by the Acid Sulfate Soil Working Group included:

1. An application to hold the 6th International Acid Sulfate Soil Conference at the South China Agricultural University Conference Facility, Guangzhou with a proposed date of mid 2008 was favourably received from Prof Chuxia Lin and South China Agricultural University. A steering committee has been established and further details on the 6th International Acid Sulfate Soil Conference will be distributed in the near future.
2. A proposal to establish an acid sulfate soil classification working party within the Working Group was put forward by Prof Leigh Sullivan and Dr Rob Fitzpatrick and approved. In essence this working party is examining the potential to establish a more uniform system for the classification of acid sulfate soil materials and horizons. At present the classification of acid sulfate soil materials varies greatly between taxonomies used by different countries. Enquiries on the activities acid sulfate soil classification working party are welcomed and can be made via email to leigh.sullivan@scu.edu.au.
3. Dr Rob Fitzpatrick outlined his plans to prepare a proposal for an international acid sulfate soil atlas. The Working Group gave its strong support to this endeavor and undertook to provide such support as is available for this project.

Prof Leigh Sullivan

Chair, International Union of Soil Sciences Acid Sulfate Soil Working Group

Ten years ago in ASSAY

Edition No.11 October 1996

- The second national conference on acid sulfate soils was held in September. Almost 300 delegates attended the two day conference which was held at Coffs Harbour.
- The National Working Party on acid sulfate soils held its third meeting in conjunction with the national conference. The group is developing a national strategy for the management of acid sulfate soils.



Revision of NSW ASS risk maps

The risk of encountering coastal acid sulfate soils in NSW was mapped in 1995 and further revised in 1997. Based on these risk maps a series of planning maps were produced which formed the basis of regulating development on acid sulfate soils. Two general areas of error have since been recognised in the risk maps. The first is that the mapping used models of Holocene sea level assumed that sea levels over the past 6000 years were approximately the same as today. Current understandings of mid Holocene sea-levels suggest that they may have been 1 – 1.5 m higher than at present, therefore acid sulfate soils may be more widely distributed than previously mapped.

The second area of error is in absolute elevation. Recent surveys using differential GPS have shown that many of the backswamps are in fact lower than mapped in 1995. More high resolution elevation data is becoming available including airborne laser coverage of some areas.

In addition, many thousands of drill holes have been dug and tests undertaken in the last 10 years which can now be used to refine the mapping.

The NSW Department of Natural Resources will revise the risk maps over the next three years, led by Glenn Atkinson. Southern Cross University will collaborate on the project. Initially the work will concentrate on areas with available airborne laser scanning data but it is hoped to be extended later in the program. Revised planning maps will be issued on completion of the program.

For further information contact Glenn Atkinson (02) 6561 4969 or glenn.atkinson@dnr.nsw.gov.au

Port Stephens experiences a significant acid event

Following heavy rains in June this year, Wallis Creek and Fenninghams Island Creek, turned a milky green colour indicating that a significant acid event was occurring.

Wallis Creek receives most of the discharge waters from a drainage network in the Anna Bay catchment area and enters Fenninghams Island Creek a short distance from the Port Stephens Fisheries Centre. Previous studies identified high risk acid sulfate soils in the Anna Bay catchment and have measured low pH (4-6) in the drainage system. Nonetheless, it is very unusual for the creek water to discolour following heavy rainfall. At this stage it has not been determined whether the acid event was caused by climatic factors or disturbance of acid sulfate soils in the catchment or both. The prevailing weather conditions prior to the event may have been conducive for oxidising the catchment's acid sulfate soils after a dry summer, and then flushing the acid products into the estuary with heavy rainfall in autumn and early winter. Drain water of pH 3.3 containing very high levels of both iron (70.65 mg L^{-1}) and aluminium (60.40 mg L^{-1}) were measured at the main floodgate on the Anna Bay drain. Very high aluminium and iron concentrations and low pHs were also recorded in estuarine waters of Fenninghams Island Creek, an area used for oyster production. At this location aluminium and iron levels of 5.76 mg L^{-1} and 9.75 mg L^{-1} , respectively, were measured at a pH of 4.83 and a salinity of 22 ppt. Numerous dead eel-tailed catfish were observed and oysters turned to a rusty red colour from the large amounts of iron floc deposited in this area.

The sudden appearance of acid sulfate soil runoff in this creek system is of concern because the Wallis Creek system has not discoloured or shown any evidence of impact from acid sulfate soil runoff to this extent previously. Additionally, Wallis Creek and Fenninghams Island Creek have been designated as a 'sanctuary' zone in the Port Stephens-Great Lakes Marine Park Draft Zoning Plan 2006. A task force comprised of five government agencies and Port Stephens Council are presently investigating the problem.

For further information contact Scott Carter or Michael Dove, NSW Department of Primary Industries (02) 4982 1232.

East Trinity ASS remediation showcased

On the 1st of July, 90 people toured East Trinity near Cairns to inspect the works being done to rehabilitate some 700 ha of acid sulfate soils at the site. A technical information forum was held the day before, which was opened by the Honourable Desley Boyle, Minister for Environment. In her associated media release Minister Boyle outlined the problem and the acid sulfate soil remediation strategy being implemented by the Qld Department of Natural Resources and Water; and the Government's actions to further protect the scenic green backdrop to Cairns.

"Back in the 70's, a wall was built to keep out the tides and the area was drained for sugar cane farming. That lowered the water table and exposed naturally occurring sulfur in the soil to oxygen. That exposure to oxygen started a process that created acid. Acid sulfate soils are very destructive to the environment as they contaminate water and can kill plants and animals."

"Since buying the land, the Government has transferred the high country to national park. For the cleared land, we have installed an extensive water monitoring

network and developed a strategy to manage the acid problem. Put simply, this involves adding lime to the water that drains away from the site to reduce its acidity."



Tidal flow restored through Hills Creek floodgates.



Attendees of the Open Day arrived by boat.

"The original bund wall contains floodgates designed to allow fresh water to flow off the site into Trinity Inlet but to prevent tidal water from coming in. These floodgates will be replaced with a new design that slowly, progressively allows some of the tide back in. This will prevent further lowering of the water table and the creation of more acid sulfate soil."

"Just knocking down the bund wall and allowing tides back in an uncontrolled way is not an option – it would create more problems. Firstly

there would be a mass release of acid. Secondly, the soil level has shrunk after being drained. Allowing the tides back in would flood areas previously not exposed to seawater, possibly including neighbouring properties".

"We are already seeing some wildlife returning to the site, and there is great potential for the property to become home to a significant variety of local plants and animals."

"Thanks to the hard work and dedication of many people, this former eyesore will become another jewel in the crown of Cairns and Far North Queensland," she said.

Minister for Environment, Local Government, Planning and Women The Honourable Desley Boyle Media release - June 2006

NOTE: A Queensland State Election has been held since this time & Ministers & Departments have changed.

East Trinity: centre for learning

East Trinity is fast becoming a centre for learning, with many conference papers and scientific journal articles being published in recent months.

At the 'Catchments to Coast' The Society of Wetland Scientists' 27th International Conference and the Australian Marine Sciences' Association 44th Annual Meeting, 9–14 July, 2006 four papers were presented on East Trinity, they included:

- *Wasteland to Wetland – Remediating the Acid Sulfate Soil Legacy at East Trinity, Cairns, Australia* presented by Department of Natural Resources and Water staff,
- *Mobility of Environmentally Significant Elements in Actual Acid Sulfate Soils, East Trinity, Cairns* presented by James Cook University PhD candidate John Broughton,
- *Remediation of Acid Sulfate Soils at East Trinity, North Queensland: Effects on Fisheries and Water Quality* outlining long-term monitoring undertaken by John Russell, Qld Department of Primary Industries and Fisheries, and
- *Towards a Wetland Park at East Trinity Inlet, Cairns* where Dennis Walls presented the vision of the Cairns' Wetland Park Committee.

At the 18th World Congress of Soil Science held in Philadelphia, USA, East Trinity was again highlighted through a paper presented by Col Ahern, *Using lime-assisted tidal exchange to remediate 700 ha of extremely acidified acid sulfate soil in tropical Australia.*

CSIRO have also recently submitted two journal articles based on research undertaken at East Trinity:

- Hicks, W.S., Bowman, G.M. and Fitzpatrick, R.W. *Estimation of carbon loss and acid mobilisation following drainage of a tropical wetland using paired acid sulfate soil profiles; &*
- Hicks, W.S., Bowman, G.M. and Fitzpatrick, R.W. *A landscape geochemical process model of aluminium activity and its controls in tropical acid sulfate soil leachate.*

For more information on East Trinity or any of these reports contact QASSIT (07) 3896 9819.

Fish flourishing

When the bund wall was built around the site by CSR in the 1970s, tidal gates were included where creeks passed through it. These allowed water to leave the site, while preventing tidal salt water from moving back upstream. Water quality inside the wall became so contaminated with acid and heavy metals that very few fish could survive and each year, following pre-wet season storms, this contaminated water would flow out of the site through the tidal gates causing fish kills downstream of the wall. The water quality in the creeks at East Trinity has dramatically improved since the rehabilitation work began. Proof of this is the discovery, in the latest survey, of 38 species of estuarine and marine fish, including important angling species such as barramundi and mangrove jack, in the previously barren creeks. They also hold healthy stocks of juvenile mud crabs. As mangroves recolonise the creek banks and lower areas of East Trinity, fish nursery habitats are extended, promising increased stocks of healthy fish and happy fishers!

As appeared in East Trinity Newsletter Edition 4 acknowledgements to John Russell, Qld Department of Primary Industries and Fisheries.



Mud crabs are returning to East Trinity.

Acidic drainage investigations on the West Australian coast

Location: south west of Western Australia

Funded: \$1.96M (NAP and NHT Strategic Reserve)

This project will investigate the impact of acidic discharges arising from the disturbance of acid sulfate soils on ground and surface water resources in the south west of Western Australia. The impacts of acid discharge on waterways include heavy metal contamination, fish kills and loss of habitat and have been linked to the appearance of harmful algal blooms and increasing mosquito populations. Given the lack of information relating to acid sulfate soils and acid drainage in the state a surveillance program will aim to identify and categorise wetlands and estuarine systems under threat of acid drainage. Information will be gathered using aerial photographs of coastal catchments from Perth to Albany. In addition historical and new information will be generated on surface and ground water quality and soil type to develop a database of water resources, their catchments and potential threats. This information will provide a preliminary assessment tool for the management of acid drainage and water resources in the state.

At a local scale the project will also identify and quantify the source of acid drainage delivered to receiving waterways at two different sites, Baigup Reserve in the Swan River Estuary and South Yunderup in the Peel-Harvey Estuary. Contaminants (eg metals) entering these estuarine environments will be determined using enclosed chambers to assess their movement into the water column from sediments, whilst groundwater flow measurements will determine anticipated loads. These studies will be followed by ecological investigations in the estuarine environment to determine environmental impacts of acid drainage. Toxicity tests will aim to detect and evaluate the effects of key contaminants associated with acidic drainage on aquatic organisms.

Finally this project will investigate potential links between acid sulfate soil disturbance and human health, focussing on issues such as: a) human consumption of fish, crabs and mussels collected from acid sulfate soil disturbed waterways, b) human health risks of MBO (monosulfidic black ooze) and hydrogen sulphide gas and c) human health risks of acidic drainage in suburban environments on children.

For further information contact Malcolm Robb (08)9364 6601 or malcolm.robbs@water.wa.gov.au



One aspect of a new WA project is to investigate the potential health hazard of acid sulfate soils.

NatCASS visits Perth

In August the National Committee for Acid Sulfate Soils (NatCASS) held their bi-annual meeting in Perth, Western Australia. During the visit the committee learnt about the many positive initiatives occurring in Western Australia to help identify and manage acid sulfate soils. As part of their visit the committee visited Baigup Reserve, the Cedric Street Wetlands, Lake Gwelup and Lake Gnangara.

Acidified bore water may affect home grown produce

Hinwood A.L., Horwitz P., Appleyard S., Barton C. & Wajrak M. (2005) *Acid sulfate soil disturbance and metals in groundwater: implications for human exposure through home grown produce* Environmental Pollution 143:100-105

An emerging environmental issue for Western Australia is groundwater acidification from the disturbance and oxidisation of acid sulfate soils. Groundwater has become an important water source for Perth, providing 70% of all water used. In the grip of a prolonged dry spell, Perth has come to rely on groundwater bores for garden irrigation and other domestic outside activities. Oxidised sulfidic material and heavy metals have been recorded in residential bores, some at very high concentrations. Arsenic and aluminium in particular have been recorded at high, toxic levels. A survey of bore uses found that a high proportion of groundwater is used on home grown produce. The potential for human exposure to heavy metals via consumption of home grown produce that have been irrigated with acidified groundwater is high.

For a copy of the paper contact the Information Officer (02) 6626 1355 or christina.clay@dpi.nsw.gov.au

Acid sulfate scalds: are they salty as well?

Rosicky M.A., Slavich P., Sullivan L. & Hughes M. (2006) *Surface and sub-surface salinity in and around acid sulfate soil scalds in the coastal floodplains of New South Wales, Australia* Australian Journal of Soil Research 44:17-25

Usually acidity is considered the main problem associated with draining low lying coastal floodplains. The possibility that drainage may also produce elevated salinity levels is less well known. Apart from acidic salts (iron and aluminium) accumulating in the soil surface and sub-surface, another potential source of soil salinity is that from the estuarine sediments laid down approximately 6,000-10,000 years ago. Even today these estuarine muds can still contain saline groundwater. This underlying saline groundwater is an important consideration for land managers, as whilst the majority of scalds are remediated through shallow freshwater ponding, half of the scalds studied had elevated chlorine concentrations in their soil profiles. This makes those sites more susceptible to surface salinisation and vegetation die off in dry weather than sites with lower chlorine concentrations. Groundcover plays a critical role in reducing the build up of salinity on the soil surface. Vegetation helps reduce any surface evaporation and the capillary action that transports available salt from the groundwater to the soil surface. Intentional or accidental inundation with saline water should also be avoided on freshwater managed land. Freshwater paddock vegetation can be killed and chronically excluded by one application of saline water. The management of acid sulfate scalds must incorporate techniques to minimise surface salinity as well as managing existing acidity and inhibit further pyrite oxidisation.

For a copy of the above paper contact the Information Officer (02) 6626 1355 or christina.clay@dpi.nsw.gov.au

Australian Research Council funding success for acid sulfate soil research

Dr Ed Burton, Dr Richard Bush and Prof Leigh Sullivan at the Centre for Acid Sulfate Soil Research (CASSR) Southern Cross University, have recently been awarded \$277,000 over three years by the Australian Research Council for a Discovery Project. The new project will examine the oxidation processes that occur when monosulfidic black oozes (MBO) are disturbed in acid sulfate soil landscapes. This ARC-Discovery project builds from recent findings of other ARC Discovery projects at CASSR that the oxidation of a newly identified sulfide mineral, nanoparticulate mackinawite, in MBOs is likely to exert a dominant effect on contaminant mobilisation and the consequent degradation of waterways in acid sulfate soil landscapes. This 2007 ARC-Discovery project will enhance our understanding of the iron, sulfur and trace metal dynamics in acid sulfate soil landscapes.

The impact of ASS on fish

Callinan R.B., Sammut J. & Fraser G.C. (2005) *Dermatitis, bronchitis and mortality in empire gudgeon *Hypseleotris compressa* exposed naturally to runoff from acid sulfate soils* Diseases of Aquatic Organisms Vol.63:247-253

The impact of acid sulfate soil runoff on empire gudgeons living in the Tuckean Swamp (North Coast of NSW) is investigated in the above paper. The empire gudgeon is the most common fish in the Tuckean Swamp and although thought to tolerate acid conditions, this study suggests short term depressions in pH may cause mortalities in exposed, non-acclimated fishes.

After 2 days of exposure to pH <4 and up to 7 days exposure to pH <6 fifty percent of the fish sampled had moderate to severe skin lesions. Fish with severe skin lesions had subsequent infections which lead to the onset of epizootic ulcerative syndrome (EUS). After 8 days of exposure to pH <4 and up to 13 days exposure to pH <6 large numbers of empire gudgeon were found dead. The potential lethal effect of acid sulfate soil runoff on aquatic life is clearly demonstrated through this study. The study also suggests a mechanism where lesions of EUS or red spot may be initiated in estuarine fish by a combination of sublethal exposure to acid sulfate soil runoff and subsequent infection.

For a copy of the above paper contact the Information Officer (02) 6626 1355 or christina.clay@dpi.nsw.gov.au

Metals found in aquaculture ponds

Gosavi K., Sammut J., Gifford S. & Jankowski J. (2004) *Macroalgal biomonitors of trace metal contamination in acid sulfate soil aquaculture ponds* Science of the Total Environment 324:25-39

Earthen shrimp aquaculture can be impacted by acid sulfate soils, leading to increased outbreaks of disease or in some cases eventual death of the shrimp. These production losses have been attributed to either low pH or to elevated levels of toxic metals, both direct products of acid sulfate soil oxidation.

To minimise the impact of acid sulfate soils it is standard industry practice to use lime to maintain pond water pH above 5, based on the assumption that toxic dissolved metals occur at low concentrations or are absent above this pH. Although liming is standard practice, decreases in farm productivity have been observed. Four different types of waterplants or macroalgae commonly found in shrimp aquaculture ponds were sampled to test the effectiveness of liming and see whether toxic heavy metals are the cause of observed decreases in farm productivity. Results showed all plants sampled had accumulated appreciable quantities of iron, aluminium, zinc, cadmium, arsenic and lead. Iron and aluminium, the most common metals mobilised from acid sulfate soils were found in all plants, at concentrations three orders of magnitude greater than all other metals analysed. These results indicate dissolved metals present in earth shrimp aquaculture may be higher than previously thought. For a copy of the above paper contact the Information Officer (02) 6626 1355 or christina.clay@dpi.nsw.gov.au



Australian Government



ACID SULFATE SOILS
Information and awareness

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