ASSAY

A NEWSLETTER ABOUT ACID SULFATE SOILS

No. 48 January 2009

Welcome to edition 48

Many thanks to Harry Rose for looking after ASSAY while I was on maternity leave. It's good to be back and catch up on all that has been happening.
Over the past year inland acid sulfate soils have really hit the headlines. For those of you who missed the Catalyst special on the Murray River there is a link on page 2 to the episode, which you can view on-line. The footage of Bottle Bend has to be seen to be believed. We will stay across this issue and bring you further information as it comes to light.
What the inland acid sulfate soil situation illustrates to me is how differently acid sulfate soils present themselves across the country. However, despite the differences there are valuable lessons to be learnt and experiences to share which have relevance no matter where you are located.
I hope that ASSAY continues to be one avenue in which we can share what we are all doing to address acid sulfate soils across the country.
Till next time, Chrisy

In this edition:

Basin wetlands checked for acid sulfate soils

More than 1000 wetlands throughout the Murray-Darling Basin are being assessed to determine the risk posed to them by acid sulfate soils, the Murray-Darling Basin Commission (MDBC) announced recently. Chief Executive Dr Wendy Craik AM said the MDBC was funding the project which is being carried out by State agencies, the Murray-Darling Freshwater Research Centre, CSIRO, Southern Cross University and several catchment management authorities.

"The Murray-Darling Basin Ministerial Council established this project at its March 2008 meeting and the project began immediately," Dr Craik said. "The project has been given a high priority, particularly given the scale of this issue and nature of the threats in South Australia's Lower Lakes. An interim report will be presented to the Ministerial Council at their next meeting."

Dr Craik said the project was assessing the extent of, and risk posed by, acid sulfate soils at key wetlands in Queensland, New South Wales, Victoria and South Australia. "The sites have been selected because of their environmental significance. They include the sixteen Ramsar listed wetlands in the Basin, as well as those listed on the Directory of Important Wetlands in Australia and other environmentally significant wetlands."

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Inland update

"Other sites have been chosen where there is an increased likelihood of acid sulfate soils developing which could impact on the surrounding environment and water supplies. Because of the recent drought, river levels have dropped and many wetlands have dried out. Long-submerged soils and sediments are being exposed to the air creating the potential for sulfuric acid production and other risks," Dr Craik said.

Acid sulfate soils are soils containing iron sulfide minerals. These soils form naturally when saline groundwater or other water containing sulfate mix with sediments which contain iron oxides and organic matter. When undisturbed and not exposed to air these soils pose little threat. However when exposed to oxygen these sediments have the potential to form sulfuric acid, cause deoxygenation and release contaminants such as heavy metals.

"This can cause significant harm to fish and other aquatic organisms, impact on water quality for potable water supplies, and in some cases corrode metal, concrete and other structures," Dr Craik said. "The program will also identify management options for wetlands considered at high risk from acid sulfate soils." Dr Craik said the problem has been identified as an issue for decades in coastal areas but the risk has only recently become apparent in inland wetlands and rivers.

For more information go to
www.mdbc.gov.au/__data/page/915/Acid_Sulphate_Soils_Risks_FactSheet.pdf

Catalyst highlights inland acid sulfate soils

During May last year a special edition of Catalyst investigated fire, flood and acid mud in the Murray Darling Basin. From the source to the mouth, Catalyst discovers just what's going wrong and what science suggests might be done to advert a total disaster.

Check out the edition on-line at http://www.abc.net.au/catalyst/murraydarling/

National update

Caring for our Country – new funding opportunities for acid sulfate soils

Caring for our Country is the Government's new natural resource management initiative. It aims to integrate delivery of the Commonwealth's previous natural resource management programs including the Natural Heritage Trust, the National Action Plan for Salinity and Water Quality, the National Landcare Program, the Environmental Stewardship Program and the Working on Country Indigenous land and environmental program.

The Australian Government is now calling for investment proposals for projects that will achieve the targets outlined in the Caring for our Country business plan 2009-10.

Acid sulfate soils are a priority issue in the business plan, being specifically mentioned in the target *"To address the threats affecting the environmental values of coastal hotspots over the next two years, such as declining or poor water quality, disturbance of acid sulfate soils or ecosystem disturbance leading to habitat loss and biodiversity decline"*. There are fourteen coastal hotspots identified as priority locations across the country, including Darwin Harbour, Moreton Bay, the Cooroong, Port Phillip Bay and the Peel-Harvey Inlet.

For further information log on to www.nrm.gov.au

Australian scientists push for international acid sulfate soil lab standards

Local scientists are another step closer in having Australia's laboratory standards for the analysis of acid sulfate soils adopted internationally. During November, scientists Glenn Barry, Col Ahern and Angus McElnea, together with Standards Australia's project leader Patricia Carreto, attended a meeting of the International Standards Organisation's technical committee on soil quality (ISO TC190). At the meeting they successfully lobbied for the creation of an official working group to oversee the development of an international standard for the analysis of acid sulfate soils. This is an important step forward in creating an international standard.

To help them further their bid, they are now asking ASSAY readers to help them identify acid sulfate soil experts from overseas, who might be interested in sitting on this working group.

At the meeting, held last November in the mediaeval Dutch city of Delft, representatives from around the world agreed to create an official working group, pending approval by the committee and agreement from five voting member countries to participate on the working group.

The difficulty for the Australian scientists was whilst acid sulfate soils have an almost global distribution; the representatives of the member countries attending the meeting were not necessarily their country's experts on acid sulfate soils. The key to gaining approval for the new working group was to convince these delegates of the importance of acid sulfate soils in their respective countries and to assist in putting the delegates in touch with their own national experts.

The working group on acid sulfate soil methods will be created under the umbrella of TC 190's sub-committee on 'Chemical Methods and Soil Characteristics', with the aim of progressing current Australian Standard AS4969 'Analysis of Acid Sulfate Soil' to an international (ISO) standard. The working group, WG13 Acid Sulfate Soils, will be supported by Standards Australia, who will provide secretarial support.

Whilst in the Netherlands, the Australian delegation also represented Australia's interests on various other technical sub-committees, and despite the cold, winter conditions did manage to sample the local culture. Col and Angus would like to acknowledge the assistance of Standards Australia and ASSSI in attending the meeting, and as was predicted by the Dutch, it did snow!

Contact Angus McElnea if you know of any overseas experts who may be interested in sitting on the working group on (07) 3896 9331 or angus.mcelnea@nrw.qld.gov.au

ASSAY via email

Did you know that you can choose to receive ASSAY electronically?

Contact the editor to change your preference.

(02) 6626 1355 or christina.clay@dpi.nsw.gov.au

Sulfate or sulphur

ph or f?

In 1990 the International Union of Pure and Applied Chemists decided that the internationally accepted standard spelling was sulfide, not sulphide. Hence acid sulfate soils, sulfuric acid and so on.

National Acid Sulfate Soil Atlas

Don't forget that you can access the national acid sulfate soil atlas on-line at

www.asris.csiro.au

The atlas now contains coastal and inland acid sulfate soils.

Acid sulfate soils short courses: 2008 and 2009

In 2008 Southern Cross GeoScience conducted two short courses in acid sulfate soils management. The course attracted 40 professionals from a range of private industry and local, state and federal government agencies from New South Wales, Queensland, South Australia and the Australian Capital Territory. The courses were held over three days at Lismore in April and November and included lectures, practical exercises and field excursions.

The course is designed to provide the knowledge and skills to develop and implement an acid sulfate soils management plan. The philosophy behind the course is to provide a common and current knowledge base to those who write and manage management acid sulfate soil management plans and those who assess and approve these plans.

The course convener, Professor Leigh Sullivan said, *"the course's primary focus is on the development and assessment of acid sulfate soil management plans and provides the most up to date and innovative best management approaches for acid sulfate soil. The course directly addresses this key aspect of acid sulfate soil management around Australia. The feedback on the usefulness of our course from participants has been uniformly very high regardless of whether they were consultants who wished to improve the acid sulfate soil management plans that they have to prepare for developments, or whether they were from government agencies that need to assess the appropriateness of acid sulfate soil management plans."*

November acid sulfate soil management course participants and lecturers.

Southern Cross GeoScience will be running an acid sulfate soils identification, assessment and management course in Brisbane on the 10-12th March 2009.

The course consists of lectures, practical exercises and field excursions. It is designed to equip professional officers charged with the management of acid sulfate soils with the knowledge and skills to develop and administer an acid sulfate soil management plan in accordance with Queensland legislative requirements.

The course will be led by Professor Leigh Sullivan. Cost is AU$1500.00 (plus GST).

For more information contact the Centre for Acid Sulfate Soil Research at cassr@scu.edu.au

Drain remodelling to reduce the impact of acid sulfate soils

In a project funded by the Northern Rivers Catchment Management Authority, Richmond River County Council has been working with landholders in the Bora Ridge area (north coast of NSW) to remodel a section of Haughwoods Canal.

Haughwoods Canal is a flood mitigation drain, constructed during the 1960's. The drain is very deep, not only draining surface water, but also draining groundwater from surrounding land. Haughwoods Canal intersects an area of high risk acid sulfate soils and as a result large areas of sulfidic sediments have been exposed to air and oxidised. Acidic groundwater now chronically discharges into the drain, impacting on downstream water quality and aquatic habitats.

To reduce these impacts, Council and landholders have worked together to raise the floor of the drain above the acid sulfate horizon, whilst still maintaining the flood mitigation properties of the canal. This will help maintain a high watertable, preventing further oxidation, and minimise the movement of acid groundwater into the drainage system, and downstream waterways.

A survey of the drain was conducted prior to remodelling to determine the drains capacity and limiting factors. Prior to remodelling, sections of this drain were measured to have a width of 4m and a depth up to 1.4m.

Drain spoil at the site was used to reduce the depth of the drain to a maximum of 500mm. The result was a drain with a bed width of 2.5m, batters of 4:1 or flatter, and a grade of 1 in 10,000. As with all works in acid sulfate soils, lime was applied to the finished surface.

For more information contact Richmond River County Council on 02 6621 8314 or floodplain@rrcc.nsw.gov.au

Haughwoods Canal prior to remodelling.

During the remodelling.

Haughwoods Canal remodelling completed, with fencing for stock control.

Highly varied K_s rules: hydraulic conductivity in coastal floodplain acid sulfate soils

A recent study assessing the saturated hydraulic conductivity (K_s) of coastal floodplain sulfuric horizons has demonstrated that K_s can not only be very high, but can be extremely variable within individual floodplains. The study highlights the need for site specific assessments of soil hydraulic properties in coastal acid sulfate soils in order to ensure appropriate design and application of acid management techniques.

In order to effectively manage broad-acre coastal acid sulfate soils it is vital to have an understanding of their hydrological characteristics. Of particular importance is the K_s of sulfuric horizons. This is because K_s exerts a fundamental control on the connectivity between shallow acidic groundwater and adjacent drains, strongly influencing rates of lateral seepage towards or from field drains.

The study assessed the K_s of sulfuric horizons on seven major coastal floodplains of eastern Australia using an *in situ* recovery technique. Duplicate tests were conducted at a total of 148 sites located in 32 separate geomorphic units across seven coastal floodplains.

The sulfuric horizons targeted in this study were generally within 0.7 m of the ground surface and most sites were located in clayey soils with acidic (pH <4.0) shallow groundwater. Results demonstrate that K_s in sulfuric horizons spanned four orders of magnitude, ranging from <0.5 m day^{-1} to >500 m day^{-1} (Figure 1). Six of the seven floodplains surveyed had sites with maximum values >100 m day^{-1} (Figure 2). The median K_s was ~15.4 m day^{-1} and importantly, over 40% of sites had values >20 m day^{-1}. This challenges the widely held assumption that K_s in sulfuric horizons in coastal acid sulfate soil landscapes is generally low. Pedological observations confirm that high K_s values were strongly associated with large macropores.

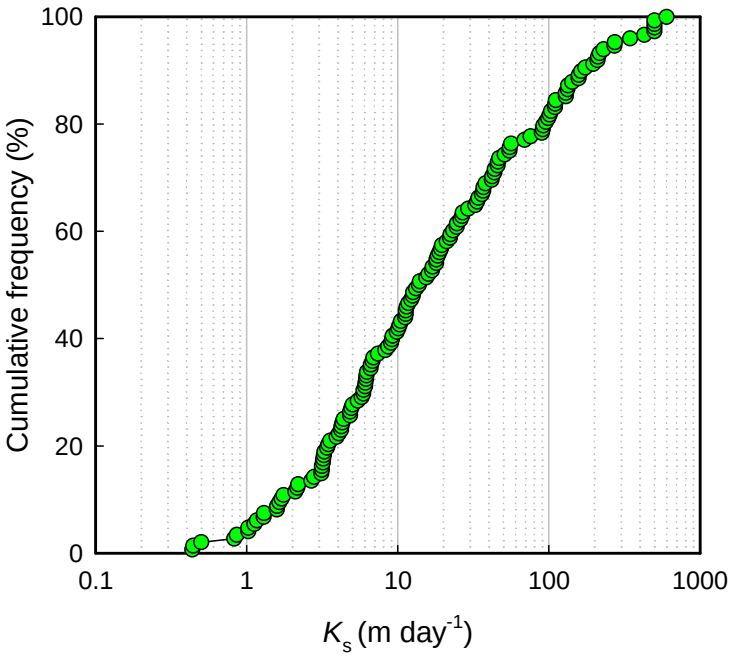

Figure 1: Cumulative frequency histogram of K_s for all individual sites, n = 148. Data points are the mean of duplicate tests.

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K_s is a notoriously variable soil property. "*Surprisingly, knowledge of the range and variability of K_s within sulfuric horizons in coastal acid sulfate soils is very limited*" said Dr Scott Johnston, a research associate from Southern Cross University. "*Until now, there have been no systematic spatial surveys of K_s within coastal acid sulfate soil floodplains in Australia using consistent methodology. The few compilations of existing data suggest that coastal floodplain sulfuric horizon K_s values span several orders of magnitude. However, sample numbers are relatively low and insufficient to ascertain if these values are representative. This represents a major knowledge gap in the current management of coastal acid sulfate soils*" said Dr Scott Johnston.

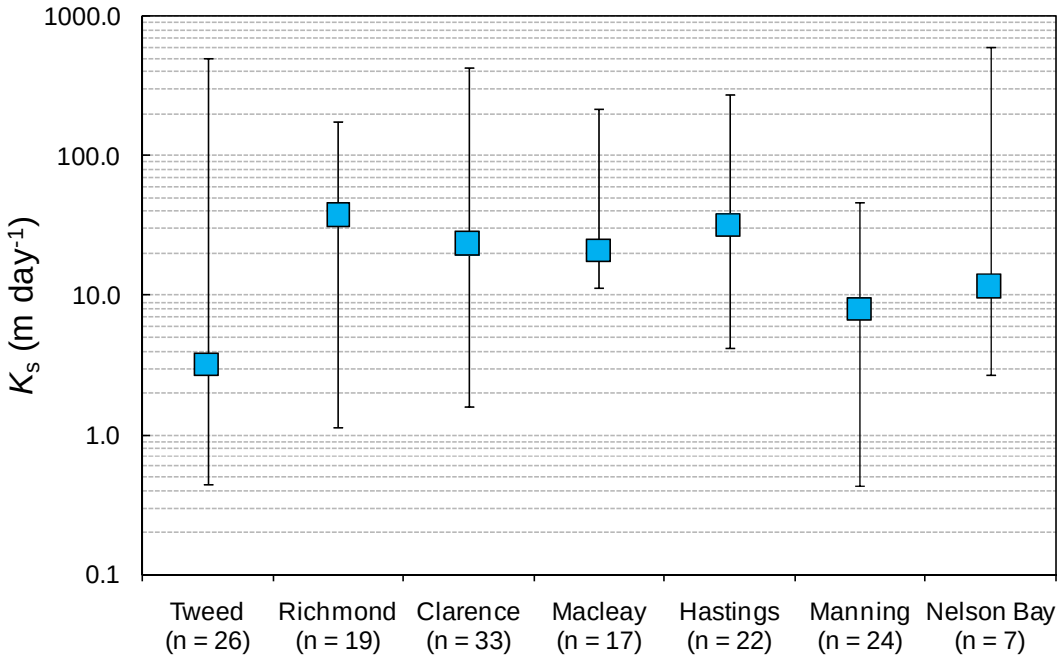


Figure 2: A comparison of the median (box) and range (error bars) of K_s for all floodplains surveyed, where (n) = number of individual K_s pits per floodplain.

The study, which was jointly conducted by NSW Department of Primary Industries, Northern Rivers Floodplain Network and Southern Cross University, has now provided valuable information on the variability of K_s. The project was conducted with funding and on-ground assistance from six participating local government member councils (see ASSAY no. 47).

For further information on this study, contact: Phillip Hirst on (02) 6640 1673 or phillip.hirst@dpi.nsw.gov.au OR Scott Johnston on (02) 6620 3401 or scott.johnston@scu.edu.au

'Restoring the Balance' available on –line

NSW Department of Primary Industries still receives numerous requests for the booklet 'Restoring the Balance – guidelines for managing floodgates and drains on coastal floodplains'.

While there are no hardcopies available for distribution, you can download an electronic copy from

http://www.dpi.nsw.gov.au/agriculture/resources/soils/ass/general/balance

Red spot and acid sulfate soils*:* bream are fish, but not all fish are bream!

Epizootic ulcerative syndrome (or EUS, better known by its colloquial name of 'red spot disease') was detected in bony bream (*Nematalosa erebi*) sampled from the Darling River at Bourke during May 2008. This represents the first confirmed record of EUS west of the Great Dividing Range.

Many cases of red spot were also reported from the coastal area of NSW during 2008, including from a number of northern NSW rivers where acid sulfate soils are well known. Red spot was also confirmed in sea mullet (*Mugil cephalus*) and sand whiting (*Sillago ciliata*) from the Myall Lakes and in mullet (*Myxus* sp.), narrow-banded sole (*Aseraggodes macleayanus*) and yellowfin bream (*Acanthopagrus australis*) in the Hawkesbury River with no evidence of an association with acid sulfate soils.

The identification of red spot in the Darling River, Myall Lakes and Hawkesbury River highlights the importance of considering a range of factors, not only the involvement of acid sulfate soils, in the expression of this disease. Water quality data from sampling undertaken on the Darling River at the time the fish were caught indicates that pH was approximately 7.6-7.9, and suggests that the predisposing factor was unlikely to be an association with acid sulfate soils. Similarly, in the case of Myall Lakes and the Hawkesbury River, there was no evidence of low pH or of acid sulfate soils. While leaching from acid sulfate soils, such as those associated with some northern NSW estuaries, are a known predisposing factor for the development of EUS, other predisposing stressors such as crowding, prolonged cool temperatures, and conditions associated with drought can also enable the fungus to penetrate into the fish and produce clinical disease.

Bony bream from the Darling River sampled in May 2008 showing lesion associated with EUS

Photo: courtesy Tony Fowler, NSW DPI

It is unclear whether the detection in the Darling River represents a recent incursion of this fungus into the Darling River, or if this fungus is actually more widespread than previously believed. Historical reports exist of ulcerative lesions in bony bream (*N. erebi*) in the Balonne River and golden perch (*Macquaria ambigua*) in the Diamantina River, both west of the Great Dividing Range in Queensland. However, those cases precede the discovery of *Aphanomyces. invadans* as the causative agent of EUS and it is not known whether these cases represent EUS caused by *A. invadans*, or other ulcerative conditions. Development of additional diagnostic techniques may enable such material to be re-examined in the future and reveal more about the distribution of EUS.

So while leaching from acid sulfate soils is a known predisposing factor for development of EUS, it is very important to remember that not all cases of EUS are associated with acid sulfate soils. Similarly, while fish affected by EUS typically demonstrate red spots (hence the common name) it is most important to keep in mind that not all fish with red spots are suffering from EUS, and samples need to submitted to a veterinary diagnostic laboratory for confirmation. So remember that while bream are fish, not all fish are bream!

For further information contact Jeffrey Go from Department of Primary Industries on (02) 4640 6310 or jeffrey.go@dpi.nsw.gov.au

Targeting MBOs for study in Geographe Bay

The environmental impacts of MBOs (monosulfidic black oozes) will be the subject of an investigation in the Geographe Bay region of Western Australia. The study is being commissioned by the Department of Environment and Conservation, Department for Planning and Infrastructure and the Shire of Busselton in response to increased coastal development pressures at Geographe Bay.

Department of Environment and Conservation's acid sulfate soils section manager Stephen Wong said development in the popular coastal setting had caused considerable stress to the Vasse–Wonnerup Estuarine System, a nominated wetland habitat for migratory birds under the RAMSAR Convention.

"Visual inspection has identified the accumulation of organic debris including excessive aquatic weeds and algae," said Mr Wong. "This major source of organic matter is driving the MBO formation. Understanding the dynamic of MBO formation is an important step towards better management of the risks associated with canal and marina development and a future maintenance dredging regime," he said.

"The changes in the flushing characteristics of the area due to development have the potential to increase MBO accumulation. Poorly flushed areas may indirectly result in exacerbated eutrophication, deoxygenation and metal release."

Mr Wong said recent groundwater assessment had seen an increase in iron precipitates which was often associated with other toxic metals and metalloids that had the potential to enter the aquatic environment. "This project will bridge a knowledge gap by developing a clear understanding of sulfidic-rich ooze formation in Geographe Bay," said Mr Wong. Investigations and sampling will take place during January and detailed results from the study will be available later in the year.

Water quality improvements at East Trinity documented

Johnston, S.G. Bush, R.T. Sullivan, L.A. Burton, E.D. Smith, D. Martens, M.A. McElnea, A.E. Ahern, C.R. Powell, B. Stephens, L.P. Wilbraham, S.T. van Heel, S. (2009) Changes in water quality following tidal inundation of coastal lowland acid sulfate soil landscapes. Estuarine, Coastal and Shelf Science 81:257-266

The improvements that have been made to water quality at East Trinity, as highlighted in edition 46, have been formally documented in a recently released scientific paper.

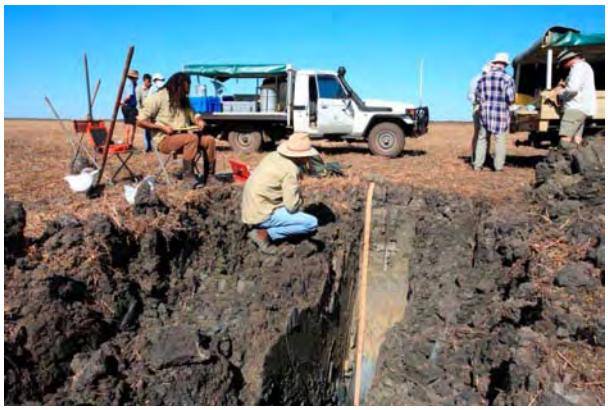
The paper presents water quality data collected over five years and shows that the re-introduction of marine tidal waters has been successful in remediating the low lying area. As a result less acidity is being exported via waterways, soil acidity has decreased and the soil geochemistry appears to be changing in favour of reductive, acid-consuming geochemical processes.

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

Acid Sulfate Soils of the Darwin Region - A Report Preview

The first comprehensive acid sulfate soil mapping project in the territory is coming to a close. The project jointly funded by the NT and Commonwealth Governments focuses on Darwin Harbour, a national water quality hotspot, but also makes use of historical soil information from the Finniss River to the Adelaide River floodplains. Soil mapping in the region and vegetation mapping in mangrove environments of Darwin and Bynoe Harbours and the Adelaide River estuary and floodplain system have been appended and this has provided the basis for field survey.

The findings have revealed two interesting points, the extremely high oxidisable sulfur in the mangrove soils of Darwin Harbour and the importance of historical soil profile information on the Adelaide floodplain.



Officers prepare to describe and sample an excavated soil profile on the Adelaide River floodplain.

One site in the harbour produced 9.6% reducible sulfur, 6033 moleH^+/tonne net acidity with a neutralising requirement of 656kg/m^3. The information is timely considering the NT government has recently announced one of the largest investments in the Northern Territory's history, a major INPEX LNG plant to be located in the harbour. The demand for the report has already proved its investment, providing consultants with the information required to develop comprehensive management plans if areas are to be disturbed.

The other component has been the discovery and capture of old data across the Adelaide floodplain. John Martin, a retired land resource officer, was probably one of the first officers to identify hydrogen sulfide in the Adelaide River floodplain soils in 1964. Believing that most of his data was lost in Cyclone Tracey, he has produced copies of his site data records and made these available to be included in the report.

The final report and mapping products will be released on the NRETAS website in the next month or two.

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ACID SULFATE SOILS
information and awareness