ASSAY
A NEWSLETTER ABOUT ACID SULFATE SOILS
No. 33. December 2002

Acid sulphate soil project wins National Young Scientist of the Year Award

Estelle Weber (pictured), a Wollumbin High Year 10 student, has won the prestigious Young Scientist of the Year (2002) award with a project using ViroSoil to grow crop wheat seedlings on severely acid scalded soils from canefields near her school in the Tweed River valley. Her project also won her first place in the Scientific Research Category, Years 10 – 12.

ViroSoil is part of the Bauxsol technology developed by Prof. David McConchie and his colleagues at Southern Cross University and marketed by Virotec International Ltd. It is prepared from modified bauxite refinery residues and although it has near neutral pH, it has a high acid neutralizing capacity and an excellent ability to trap and bind trace metals including iron and aluminium.

Estelle's project examined the effectiveness of ViroSoil in rehabilitating ASS, and the amount of ViroSoil needed to grow crops on acid scalded soil. Samples of scalded soil from Tweed Valley canefields were collected and placed in growing trays. Trays included untreated control trays, ASS trays treated with various amounts of ViroSoil and control trays that contained only regular potting mix (no ASS). All trays were seeded equally with wheat grass and subsequently fertilised and watered equally. Very little wheat sprouted in the ASS control trays and what did sprout, died quickly. Wheat sprouted and grew well in the trays of ASS mixed with 10% ViroSoil, with a strike and growth rate similar to that of the pure potting mix. The plants in the treated trays remained healthy and adding more ViroSoil to the ASS to bring the pH up to that of the potting mix did not further improve strike or growth rates. Thus, even modest additions of ViroSoil to extreme ASS can facilitate crop growth. Estelle also noted that ViroSoil was almost insoluble and could not be washed out of the soil by rain.

Professor McConchie, who supervised Estelle's winning project, said that although the Bauxsol technology had been successfully used previously to treat sulphidic mine wastes, Estelle's study was the first time that ViroSoil had been used to facilitate plant growth on severely scalded acid sulphate soil.

Her prize takes her to U.S.A., where she will compete for Australia against 62 other countries. Between now and then, Estelle will further her work by growing native plants and vegetables on much larger ViroSoil treated areas of ASS and on areas where monosulphide black oozes have been oxidising during the present drought. Her prize winning work, and that of the other 17 finalists, will tour regional NSW cities for 10 months.

Contact: Prof. David McConchie -
Email *dmcconch@scu.edu.au*
Tel (02) 6620 3632

Dr Mike Melville and a group of delegates on an informal post-conference tour showing a section of the Pacific Hghway upgrade where sulfidic mud was incorporated into the bitumen surfacing as gravel-sized lumps. It then oxidised to form jarosite pockets of pH 2.8 and iron oxide stains downstream of the points. The group (left to right: Ben MacDonald, Jodie Smith, Leen Pons, Tini van Mensvoort, Dr Tri) watching Prof. Pons make his "n-value" assessment on a piece of bitumen.

International ASS Conference Report-Back

The 5th International Acid Sulfate Soils conference was held at the Twin Towns Resort, Tweed Heads, in August 2002. Some 240 delegates from around the world attended.

The conference was run over five days and included four days of presentations, a choice of two field trips and a conference dinner.

Professor Ian White opened the conference with an excellent address, and a range of fascinating presentations followed. Some presentations are summarised in this issue of Assay. For transcripts, contact Dr Ben MacDonald 0419 624 712

or go to *http://www.out.at/acidsoil.*

The critical role of soil permeability in acid export.

Research by NSW Agriculture scientists on the Clarence River floodplain has highlighted that the hydraulic conductivity of the sulfuric horizon plays a critical role in acid export from drained ASS backswamps. It also demonstrated that soil hydraulic conductivity varies greatly and can be extraordinarily high in some backswamps. *(The* ***sulfuric*** *horizons are those which have undergone a degree of ripening and often contain iron oxides and jarosite mottles, whilst the underlying* ***sulfidic*** *horizons contain unripe grey sulfidic gels, and typically have very low hydraulic conductivity.)*

The scientists monitored two ASS backswamps with comparable soils, drainage density and soil and ground water acidity for several years. They found that acid export rates varied greatly between the sites. This variation was largely attributed to differences in ground water flow through the sulfuric horizon.

The site with high soil hydraulic conductivity had high ground water flow rates and exported large amounts of acidity by seepage to the drain. This seepage began as soon as most of the surface water had drained away. Acid export events were typically of high magnitude and long duration and the water also had high concentrations of toxic metals.

By contrast, the site with low soil permeability also had lower ground water flow and exported only 1% of the acidity of the other site. Acidic solutes accumulated on the surface during dry periods, and were mainly exported as surface runoff after rain.

Acid export events were highly episodic, of low magnitude and short duration and the drain water had low concentrations of acidity and toxic metals.

An important finding was that the majority of acid export at both sites occurred while the water level was within a very narrow elevation range, or 'acid export window'. This 'window' was only about 40cm wide and the upper boundary was largely defined by the upper levels of the backswamp surface and the lower boundary by tidally influenced low water levels in the drain adjacent to the backswamp. This concept may apply to other ASS backswamps and is useful in that it provides a 'target' elevation range to focus management efforts.

The sulfuric horizon in six ASS backswamps on the Clarence and Richmond floodplains was examined in a collaborative study with Kevin Trustum, an Honours student from UNE. The results show that while there is large variability, other ASS backswamps also have very high sulfuric horizon hydraulic conductivity clearly associated with macropores (ASSAY 30). For example, both the Tuckean and Rocky Mouth Creek backswamps on the Richmond (chronic acid exporting sites) also had high hydraulic conductivity values.

"*This is a significant finding as there have been comparatively few field measurements of the hydraulic properties of ASS backswamp soils*", said NSW Agriculture research scientist Scott Johnston. "*This is a very different soil hydrological context to what has been previously been reported in much of the Australian ASS literature*".

"*For example, were you to dig a hole in the ASS backswamp at McLeods Creek, it would be relatively slow to infill with ground water due to low soil permeability. Whereas in the ASS backswamps with high hydraulic conductivity described above, the ground water can literally gush in through large pores and fissures. This obviously has a significant effect upon acid export at these sites where the main flux pathway is ground water seepage, and obviously has major implications for the management and containment of acidity in such landscapes*", said Scott.

Large macropore with marker pen for scale. (Picture by Scott Johnston)

"*Soils with these properties also have higher risk of lateral seepage of saline water associated with floodgate opening. At our high hydraulic conductivity site we observed large, rapid increases in the Chloride: Sulfate ratio of shallow ground water over 50m from the drain due to sub-surface inflows of saline water associated with floodgate opening*" said Scott.

Contact Scott Johnston. Tel (02) 6640 1681

Email: - *scott.johnston@agric.nsw.gov.au*

Queensland Soils Management Guidelines

The Soil Management Guidelines, which document best practice environmental management for ASS, were released in November 2002. The Queensland Government, the Queensland ASS Management Advisory Committee, and other stakeholders developed the Guidelines in a collaborative approach, with funding assistance from the NHT.

The Guidelines were developed through an extensive consultation process. An Editorial Committee developed the draft Guidelines, which were then sent for comment to a larger Technical Committee representing consultants, industry, state and local government. Workshops (which attracted 196 participants) were also conducted to allow further consultation and input. The Guidelines represent one chapter of the proposed Queensland ASS Technical Manual. Other chapters of the Manual are being progressively finalised. Download the Guidelines at: *http://www.nrm.qld.gov.au/land/ass* or contact QASSIT on (07) 3896 9819

Inland Acid Sulfate Soils

Acid Sulfate Soils (ASS) are an important issue affecting the Australian environment. Research into the problem is well advanced, particularly in north-eastern NSW and south-east Queensland.

Until recently, the problem was thought only to affect coastal areas, which previously were under marine influence during the Holocene (the last 10,000 years). However, ASS have now been found in inland Australia. Researcher Dr Rob Fitzpatrick, from CSIRO Land & Water/ CRC for Landscape Environments & Mineral Exploration in Adelaide, has found ASS associated with salinisation in upland wetlands in the Mt Torrens area.

These sulfidic sediments were found in stream source wetlands, as well as small upland dams. When disturbed, the sediments oxidised, releasing sulfuric acid, a range of iron compounds and toxic heavy metals. The changes in soil chemistry also contribute to the wetlands moving up the slope, with the sub-sequent formation of erosion gullies. Rob Fitzpatrick's group have reported on acid leachate outbreaks from southwest Victoria (Dundas Tableland), the WA wheatbelt, Eyre Peninsula, the Yass valley in NSW and south-east Queensland. However, the properties, origin (e.g. groundwater geochemistry), national spatial significance and risk of inland ASS are poorly understood.

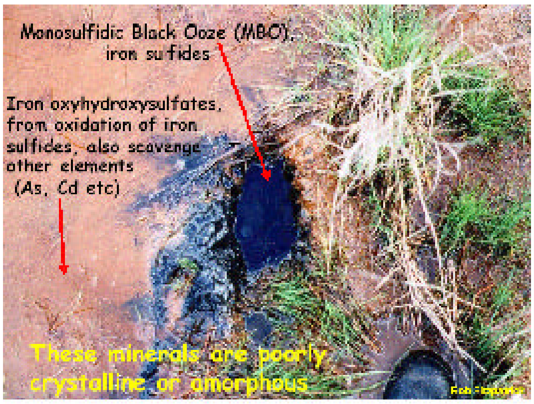
In another study, Dr Richard Bush of the NSW Department of Land and Water Conservation, in association with Associate Prof. Leigh Sullivan of Southern Cross University, also found black ooze monosulfides in inland streams near Kerang in Victoria and the Macquarie marshes in NSW. Black oozes are oily gels, greatly enriched with iron monosulfide minerals and can form thick accumulations in waterways in ASS landscapes. Similarly, Rob Fitzpatrick has identified the formation of black ooze (MBO) in the 30M$ drainage system used to drain saline soils in the South East of South Australia.

It is not yet known exactly how these inland ASS were formed. Whilst some areas, like the lower reaches of the Murray River in the south-east of South Australia, have been under marine influence in the past, these other areas have never been under marine influence in the time periods usually associated with the formation of ASS. Dr Fitzpatrick suggests that these sulfidic sediments may have one of two possible origins, either from sulfate-containing windblown sediments or from groundwater contact with primary pyrite in the underlying fractured geological strata. In this case, heavy metals, which are often released in association with sulfuric acid, could prove valuable indicators of mineral bearing rocks, such as arsenic, often found in association with gold.

This research has some serious implications for wetland management and rehabilitation. Not only do managers have to take into account the impacts of salinisation, but also acidic water. The acidic water also has health implications, as the sulfuric acid mobilises heavy metals, which are toxic to humans and livestock, and cause skin irritations.

Dr Fitzpatrick has developed a series of guidelines for farmers who have land that might be affected by ASS. These guidelines include; not draining wetlands, planting native wetland species (not trees), fencing, and not using gypsum.

For further information,
Contact Dr Rob Fitzpatrick on
(08) 803 8511 or 0408 824 215.



Monosulfide black ooze formation in inland landscapes.
(Image copyright Dr Rob Fitzgerald)

Excavation to the watertable in the Perth suburb of Stirling exposed groundwater with a pH of 2.4. In the foreground is a tomato crop killed after being irrigated with groundwater from a shallow bore.

Acid sulfate soils in Western Australia – an update

Until recently, the National Strategy for Managing Coastal ASS lacked much input from WA. ASS was not thought to be significant for the heavily populated southern part of the State. This limited the development of management policies.

All this changed early in 2002 with the discovery of acidic ground water in garden bores in the Perth suburb of Stirling. Subsequent investigations indicated that garden bores and some lakes in a public park had pHs as low as 2.6; and a pH of 1.9 was found in a monitoring bore. Bore water also contained elevated arsenic, iron and aluminium concentrations. The plant deaths in gardens watered by bores were most likely due to the high aluminium concentrations.

The Stirling incident received extensive media coverage because of the arsenic contamination, and a number of government agencies had to work closely together to ensure that there were no impacts on public health.

The source of the acidity was dewatering and peat excavation for new residential developments, and the excavation of lakes to enhance the amenity of parks. The peat also contained up to a massive 15% of oxidisable sulfur. Thus, not only did Western Australia have an acid sulfate soil problem, but (as befits the largest State) it had a bigger problem than anywhere else in Australia!

The supreme irony is that ASS in Australia were first described in the south-west of WA in the 1930s, but somehow the memory of this was lost. However, the occurrence of ASS in the southwest of the State does not fit the conceptual model promoted in the National Strategy, because ASS in WA is not associated with low-lying coastal areas currently or formerly covered with mangroves.

With the exception of one isolated occurrence at Bunbury, mangroves do not occur in the southern part of WA. Although mangroves had a much more widespread distribution in the past, it is unlikely they were ever been as extensive on the exposed west coast as on the eastern and northern seaboards.

Similarly, the ASS near Perth do not only occur at less than 5m AHD. These ASS occur at elevations up to 70m AHD (on the Swan Coastal Plain), and at even higher elevations (in the State's wheatbelt).

Although WA probably has a very large proportion of Australia's mangrove-associated ASS, these are mostly undisturbed and are unlikely to cause significant acidity problems. The limited work so far carried out suggests that ASS in the south-west of WA occurs in four distinct environments:

1. Low lying estuarine environments – sandy clays often associated with saltmarsh vegetation. Fairly limited distribution, but may be very sulfidic. Former estuarine clays near the Swan River foreshore in the Perth CBD have recently been found to have an oxidisable sulfur content averaging 0.7% up to 2% S.

2. Former strand lines – pyrite is often associated with heavy mineral deposits on former strand lines (previous water levels).

3. Ground water-dependent wetlands – peaty deposits associated with ground water wetlands are locally very sulfidic and have caused the acidity problems in Stirling and other sites on the Swan Coastal Plain.

4. Secondary ASS associated with dryland salinity – ground water in parts of the wheatbelt naturally contains very high concentrations of dissolved iron. This may cause acidity problems due the oxidation and hydrolysis of ferrous ions when ground water is drained. Where ground water discharges into waterlogged environments, sulfides can accumulate, creating secondary ASS.

Of most immediate concern to residents in Perth, where most of the State's population lives, is the potential impact of wetland ASS on water supplies. Ground water is extremely important for Perth's water supply, and provides about half of the drinking water supply, and about 70% of all water used in the region. The watertable in many areas has fallen significantly due to a prolonged period of low rainfall and heavy ground water pumping. There is a risk that other areas in Perth could suffer from ground water acidity and arsenic contamination problems without careful management of water usage and of urban development in sensitive areas. Despite a slow start, Western Australia is making inroads into acknowledging and managing ASS. The Department of Environmental Protection (DEP) has released a draft guidance document on managing ASS to assist local government planners and developers deal with the issue, and the DEP have adopted the Queensland site assessment guidelines.

The DEP and the Department of Planning and Infrastructure are currently working on a draft planning policy for ASS that should be released for public comment next February. An interim ASS risk map based on existing geological and soil information is also currently being compiled to accompany the planning policy. This map will provide some guidance on the distribution of ASS in the State until finance can be secured to undertake a comprehensive program of ground-truthed risk mapping. Contact: Steve Appleyard, DEP/WRC(08) 9278 0517

Email: *steve.appleyard@wrc.wa.gov.au*

Permanent ASS Officer for Hastings Council.

Hastings Council has created a permanent ASS officer position with additional catchment management responsibilities. Thor Aaso, Council's current ASS officer, says "this places Hastings Council in a very good position to attract significant funds for long-term ASS management and general catchment management for the Hastings Camden Haven Catchments. Council will also be in the position to provide continued ASS extension to help drive the long-term process of facilitating sustainable backswamp farming."

Contact Thor Aaso, Tel: (02) 6581 8692

Email: *thor.aaso@hastings.nsw.gov.au*

Farmor Delver Plough used for wet pasture management in the Hastings.

Hastings Council recently purchased a Farmor Delver Plough and have successfully used it to create a containment wall for wet pasture establishment at Rossglen. The Delver Plough is a combination of a chisel plough and a small grader, allowing a earthen containment wall and shallow dish drain to create a clear delineation between wet and dry management regimes in backswamps.

With minimal hands-on training, a farmer can use the delver plough to quickly and accurately form containment walls 60-80cm above the ground surface. Thor Aaso, Hastings Council's ASS Officer says, "after 0.5km of containment wall construction, the delver plough has already paid for itself. It can easily work in backswamp environments, as it is operated by a 75hp tractor with three-point linkage and hydraulic lines."

Together with in-drain structures, Hastings Council will use the plough to contain surface water and promote wet pasture over 36ha of backswamp in Rawdon Island.

Hastings Council will make the Delver Plough available to all north coast councils and agencies.

Contact: Thor Aaso, Hastings Council. Telephone (02) 6581 8692

Email - *thor.aaso@hastings.nsw.gov.au*

Delver plough at Rossglen - simultaneous creation of containment wall & dish drain.

Containment wall formed by Delver Plough.

Appeal for information on biodiversity in highly acidic water bodies.

Phillip Ford of CSIRO Land and Water recently attended a meeting on Disturbed Landscapes in Germany. Many presentations centred on the difficulties of rehabilitating enormous areas of land and the water bodies left after open-cut mining of brown coal. Because of pyrite in the overburden, which is now exposed to the air, the drainage water is quite acidic (pH 2.5 -5.0). There are thus close similarities between these areas and ASS landscapes and their drainage waters.

While the landscape is being "rebuilt" and artificial lakes and streams formed, there is uncertainty how the biology of these water bodies will develop. There is only limited data available in the European literature about the phytoplankton and zooplankton in such systems. The delegates requested access to Australian data, much of which is held in 'grey literature', theses and reports, and generally inaccessible.

Phillip is looking for data (published or unpublished) on the biology of highly acidic waters, especially the phytoplankton and zooplankton species, and quantitative data on the abundance and biodiversity of such water bodies. He will collate the information and pass it on to his German colleagues as well as distributing the collated summary to Australian information providers.

Send material to Phillip W. Ford, CSIRO land and Water, Canberra, ACT 2601,

or by Email : *Phillip.Ford@csiro.au*

Peat fires at Bora Ridge

On 25 September 2002, a bushfire started 100 or so separate peat fires at Bora Ridge near Coraki on the NSW Far North Coast. The fires are now burning on five separate parcels of land. The areas are separated by a ridge, and total about four square kilometres. The area was once a large coastal backswamp, but was cleared and drained early last century, and is known to contain acid sulfate soils. The tidal drains empty into the Richmond River.

Residents within several kilometres of the fires have reported discomfort to their eyes, skin, and upper respiratory tracts and sinuses. Bora Ridge was once a major tobacco growing area and various arsenic poisons were used extensively as fungicides and insecticides throughout the area. Residents expressed concern that arsenic may be present in the clouds of peat fire smoke. Various government and independent agencies are now undertaking analyses of the soils and gases.

Rural Fire Service volunteers used six firefighting units and several hundred thousand litres of water in two separate attempts to extinguish the fires. Even though the volunteers worked two very long days, both attempts were unsuccessful.

Richmond Valley Council's environment department is involved with the crisis. Graham Budd, an Environmental Protection Authority agent, has described the fires as "potentially a catastrophic environmental disaster".

The fires were digitally photographed with an aerial infra red camera on 10 October by the RFS. The photos were translated into visual information and overlayed on a standard topographical map of the district. The map reveals a total fire area of 28,500 square metres with a total perimeter of almost four kilometres. The RFS re-photographed the fires on 29 October, following 28 mm of rain at Bora Ridge on 27&28 October. Despite the rain, there has been no abatement of the fires.

This crisis could evolve in any of several different directions until the wetlands are flooded again and the fires are extinguished. Most locals consider that 200 mm over a two days to be the minimum amount of rain needed. According to long range forecasters, that amount of rain is unlikely for months.

Those directions will be determined by:

- the length of El Nino
- the use of floodgates
- liming of exposed areas
- will arsenic become an issue?
- cooperation between agencies
- cooperation of the landowners.

Many Bora Ridge people believe this is the first drought since the drains were built that has the severity to allow 100 peat fires.

A meeting of residents and staff from the Richmond Valley Council; the Rural Fire Service and NSW Agriculture was held in late October. The meeting was addressed by resident and affected landholder, Bill McGilvray. Bill is a metallurgist and a chemist and is well versed in local soils. Many issues were discussed at the meeting, and these included; the cost, potential environmental impacts and OH&S.

Contact Roger Wood,
at Tel (02) 6683 2778

Catchment Management Boards and ASS

In 1999, the Minister for the Department of Land and Water Conservation (DLWC) announced the establishment of 18 new Catchment Management Boards. This was a significant change to the future allocations of natural resource management funding in NSW.

Boards have spent two years developing Blueprints for natural resource management in their region. Blueprints identify priority issues, set targets and outline actions required to achieve targets. Once endorsed by Government, the Blueprints will determine how investment and resources are allocated in each region.

This is a notable change from the operation of the previous Catchment Management Committees, perceived as reactive and lacking strategic direction. The recently established Boards will determine priority issues and broker investment towards these.

ASS have been included in all coastal Blueprints. Each Board's ranking of ASS closely aligns with current initiatives such as the DLWC's Hotspot Program and ASSPRO.

In the Central Coast (Lake Macquarie, Tuggerah Lake & Brisbane Waters), lower-order management actions focus on implementing educational programs and development controls. In the Northern Rivers (Tweed, Brunswick & Richmond) and Mid North Coast (Hastings & Macleay), ASS have been identified as one of five priority issues, alongside biodiversity, water and land use. Actions cover awareness-raising, capacity building, best management practice and monitoring.

The Boards are currently preparing projects for the next three years. Local stakeholders are encouraged to become familiar with their Blueprint and make contact with local representatives. For further details contact your nearest office of the DLWC or log on to *http://www.dlwc.nsw.gov.au/care/cmb/index.html*

Contact Chrisy Collins (02) 6626 1355

Email: *christina.collins@agric.nsw.gov.au*

Coastal Acid Sulfate Soils Directory ECMS.

Many groups can disseminate as well as access information through the internet. However, a fundamental problem many organisations face is the sheer amount of information available on-line. Organisations need to locate, upload, sort and manage this information.

Two systems have been developed to effectively use information and communication technology in ASS management, thus providing a framework for improved communication and information dissemination. The first is the Electronic Content Management System (ECMS) for information and document management. The second system is a Geographic Decision Support System (GDSS) developed primarily for researchers and land managers in the Tweed Valley *(featured in next Assay)*. Both systems were developed using open source software (non proprietary software, with code freely available to all).

Many different organisations involved in ASS issues provide information on their web sites relating to legislation, technical information and funding opportunities. A need was seen for a web portal to help coordinate and manage electronic information from various sources. For this reason, an ECMS for coastal catchments with acid sulfate soils was developed, and the portal site *www.cassdirectory.org* was established.

The aim of the CASS ECMS is not to duplicate existing information but provide a well structured portal site to help the user access information more effectively than by using standard search engines.

The system has a database to assist in the effective publishing, updating and archiving of information such as scientific publications and reports. A web crawler searches other previously selected websites for key words relating to ASS and then indexes these new web pages . The web crawler also notifies the administrator of broken links. These features will be operational at a later date when the site contains sufficient content and metadata.

A major advantage in using the ECMS is that site administrator does not require any knowledge of the Internet or web coding. The site is accessible to all, from catchment management groups to researchers and farmers. Depending on demand, the inclusion of discussion boards and mailing lists is also possible thus providing a further opportunity to network and share information.

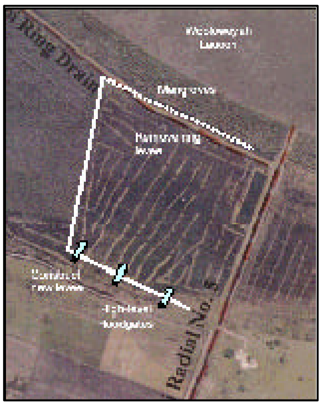
An important feature of the ECMS is the "cascading" classification system, which assists in locating information by category, and allows for the indexing of new and existing information. The categories used were modelled on those who are most affected by acid sulfate soils or play a leading role in their management and rehabilitation. A standardised classification system is essential as it provides a sound basis for creating suitable metadata to classify and index electronic information. Furthermore, it also improves search function capabilities by allowing searches using more than one parameter (ie. author, subject, description or date).

The author wishes to acknowledge the following groups for their help and contribution. Tweed Shire Council, Natural Heritage Trust, DLWC, ASSMAC, Australian National University, University of New South Wales, NSW Agriculture, Cubok Pty Ltd.

http://www.cassdirectory.org

Contact Lance Heath Email: *lheath@cres20.anu.edu.au*

Rehabilitation area on the foreshores of Wooloweyah Lagoon.



Salt Marsh Rehabilitation Area

Clarence River County Council will shortly commence work on a 50 Ha pilot wetland rehabilitation project on the foreshores of Wooloweyah Lagoon. The area has been identified as an ASS Management Priority Area by the Department of Land & Water Conservation.

The land, owned by Max Carson and his family, was formerly drained by the construction of a ring drain and floodgates fronting Wooloweyah Lagoon. The spoil was used to construct a ring levee, which prevented tidal inundation of the area. The reclaimed area was subsequently invaded by sheoaks and tea tree and was never productive agricultural land.

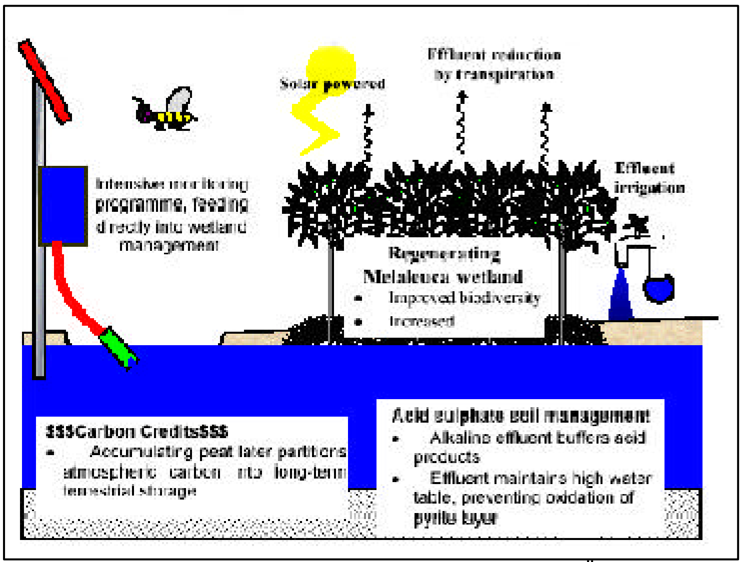
The landholder recently agreed to the removal of the ring levee to allow the return to tidal inundation of the area. As part of a drainage redesign package, a replacement levee will be constructed 700m inland. This levee will have high-level floodgates fitted to allow more rapid discharge of surface floodwaters from the adjacent canefields.

Project Manager, Bob Smith from Wetland Care Australia, said the project represents a substantial win-win outcome. Caneland will have improved surface drainage; discharge waters will be filtered through the wetland; fish and prawns will benefit from access to the salt marsh; and migratory birds will have a substantially improved feeding area.

Further details contact:

RobLloyd, CRCC Tel. 6642 3277, or

Bob Smith WCA Tel. 6628 3472



The Byron Bay Effluent Reuse wetland.

Introduction

Byron Bay supports both tourist and rural industries. These industries are threatened by serious environmental and social problems caused by ASS disturbance, wetland destruction and effluent disposal, culminating in degraded water quality and fish kills.

Extensive Melaleuca (*M. quinquenervia*) wetlands once occupied the low-lying areas behind the coastal dunal ecosystems, providing a rich source of biodiversity. These peat-based wetlands are embedded with a shallow pyrite layer. An extensive drainage network keeps wetland water tables artificially low, resulting in pyrite oxidation and the episodic discharge of damaging acid products into the local waterways. The Belongil estuary increasingly runs red with iron floccules from acid sulfate discharge, and there is little marine life - even the hardy introduced gambusia struggle.

Effluent reuse strategy

In response to these pressing problems, Byron Shire Council and Centre for ASS Research at Southern Cross University, have developed an effluent reuse strategy (Bolton, 2001) that incorporates effluent reuse with ASS management, wetland regeneration and carbon credits. A 24-hectare site adjacent to the West Byron Sewage Treatment Works was selected for the effluent reuse project.

The site is underlain by a 1.5 m depth peat layer, embedded midway with a pyrite layer containing high Chromium Reducible Sulfide concentrations.

In November 2001, a three-year planting phase commenced. 100,000 Melaleuca saplings have been planted to date, and a total of 500,000 saplings will be planted by December 2003. Saplings are irrigated with tertiary treated effluent, and the 24 ha area receives up to 7 ML of effluent per day.

The effluent is used to manage ASS in two ways:

(i) the alkaline effluent (pH 8.0) buffers existing acid products, increasing the pH of the groundwater and;

(ii) effluent maintains water levels above the pyrite layer, preventing oxidation, and the subsequent production of acid products.

Furthermore, effluent will provide water and nutrients for the regenerating Melaleuca wetland, ensuring optimal conditions for their growth. High rates of litterfall occur in stands of Melaleuca trees irrigated with effluent (Bolton and Greenway, 1999), transferring atmospheric carbon into the long-term peat sink at accelerated rates. This provides the potential to cash-in on the carbon credit scheme. The Melaleuca trees "pump and polish" the effluent, transpiring water to the atmosphere, and treating the remaining effluent to an environmental standard.

Methods and Materials

Groundwater monitoring. A total of 29 groundwater wells have been installed throughout the experimental site to a depth of 1.8 m. Wells are monitored weekly for pH, electrical conductivity, redox, and dissolved oxygen.

Soil sampling and analysis. Three experimental sites were selected: (1) Planted site, which is planted with 100,000 saplings, and irrigated with effluent (2) Long-term waterlogged site, which has remained waterlogged with effluent for 10 years, and (3) Control site, which is unplanted and non-irrigated.

Results and Discussion

Groundwater pH of the long-term water-logged site was close to neutral prior to the construction of a berm. In contrast, the planted site decreased almost 2 pH units during a 9-month period when water tables decreased due to the construction of a berm. In contrast, groundwater pH in the planted and irrigated site increased approximately 0.5 pH units during the 9-month period.

Soil analysis demonstrated that there are actionable levels of pyrite throughout the soil profiles. In the control site, pyrite is concentrated between 80 cm and 140 cm below the ground surface, and is lowest in the top 20 cm of the profile. In contrast, the waterlogged site contains a thin layer of high-concentration pyrite up to 1.2% CRS between 2.5 – 7.5 cm below the ground surface.

The high pyrite concentrations in the top layer of the waterlogged site provide strong evidence for pyrite reformation occurring in response to long-term waterlogging with effluent potential for discharge of acid into downstream environments.

Contact Dr. Keith Bolton, Southern Cross University. *kbolton@scu.edu.au*

Water Quality Monitoring Info Sheet

An information sheet has been developed to assist people monitoring water quality in acid sulfate soil areas. Designed for anyone involved in small scale remediation projects, the information sheet highlights important aspects of monitoring that often influence the accuracy of data collected.

Issues covered include;

- the timing and frequency of sampling
- what to sample for
- where to sample
- sampling groundwater, and
- use of indicators.

Developed by NSW Agriculture's Acid Sulfate Soil Project Officers, Chrisy Collins and Scott Henderson, the information sheet is free of charge. To receive a copy please call

(02) 6626 1355 or (02) 6562 6244

Editor:
Heather Shearer
Internet Website:
http://www.agric.nsw.gov.au/reader/8632
Address:
Assay Editor, NSW Agriculture
Wollongbar Agricultural Institute
Bruxner Highway, WOLLONGBAR, 2477
Tel: - 02 6626 1344
Fax: (02) 6628 1744
Email:
heather.shearer@agric.nsw.gov.au

ASSAY is published quarterly for the acid soils information and awareness program which is funded by the Federal Government's Natural Heritage Trust.

Typeset & design by Sharon Bailey