ACHIEVING SELF-REGULATION FOR DRAIN MAINTENANCE IN THE NSW SUGAR INDUSTRY

By

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Abstract

The farming and development of land where acid sulfate soils occur is an environmental issue for sustainable sugar cane production in northern NSW. An initial farm-sampling project established the acid sulfate hazard on every cane farm in NSW in order to develop effective and sustainable management. Acid hazard and drain management plans have been developed for all cane farms in NSW and the industry has progressed towards the first approved self-regulation scheme for agricultural activities in acid sulfate soil areas in Australia. NSW cane growers are aware of their responsibilities in relation to acid sulfate soils, and manage existing canelands according to best practice guidelines for acid sulfate soils. The NSW sugar industry has received commendations from the community and government for the approach taken in the understanding and management of acid sulfate soils. The project received a Gold Award and Award for Excellence from RiverCare 2000 for outstanding achievement in environmental management. Achieving self-regulation has come at a significant cost of about $1M. The industry is committed to an ongoing cost for maintaining self-regulation, but this investment has had some very positive benefits for the industry. The work undertaken is now regarded as a model for the development of good environmental management by other agricultural industries.

Introduction

The NSW sugar industry occupies 35 000 ha on the lower flood plains of the Tweed, Brunswick, Richmond and Clarence Rivers. The industry operates on less than 2% of the combined catchment areas, but the lower flood plains contain acid sulfate soils (ASS) that can release acid into river systems. Approximately 50% of NSW cane farms are underlain by ASS. Although acid releases are natural phenomena, their cause and effects have only been recognised locally in the past 20 years. The impact of farm drainage practices on strong acid release has only been recognised in the past 10 years. Although few new drains in canelands have been created in recent times, the existing drainage network provides a conduit for the movement of acid to river systems. Drain cleaning operations and the construction of new drains have the potential to remove pyrite and other acidifying substances, including iron monosulfides, from below the water table, exposing them to oxidation with the subsequent production of large quantities of acid.

This paper describes the process of raising grower awareness of the problem and the steps taken to achieve self-regulation with respect to drain maintenance operations.

Recognising the issue

Cane farmers in the Tweed Valley became aware of the ASS issue following a major incident in the river in 1987. After rain, which followed the driest period for 80 years, the river became clear and remained devoid of aquatic fauna for several months. Similar incidents were reported in 1880, 1916 and 1954 but the cause of the earlier incidents is unknown. Following the 1987 fish kill, the NSW sugar industry received concerted criticism by the Tweed fishing and oyster industries. As this concern spread to the

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Richmond and Clarence communities, awareness about ASS increased within the industry.

In 1991, the industry identified a research site on McLeods Ck, following an approach by Drs Ian White (ANU) and Mike Melville (UNSW). At the 1993 national ASS conference held at Coolangatta, the industry again came in for criticism from the fishing industry. Adverse media attention led to widespread public concern about ASS and the role of the sugar industry in exacerbating the problem. One NSW government minister mooted the introduction of strict drain water discharge requirements for canegrowers, similar to those applicable to point-source discharges from industrial sites.

By 1996, the sugar industry had 'taken ownership' of the potential problem on cane lands. The industry recognised that the release of acid was a natural phenomenon but assumed a stewardship role in the management of ASS. The industry believed that external regulation and enforcement would not be effective and that only the landholders themselves could solve potential ASS problems. At a 1996 meeting in Sydney between officers of the Premier's Department, Department of Urban Affairs and Planning, and sugar industry representatives, the possibility of self-regulation by the industry was first raised. Achieving self-regulation became an industry goal.

Awareness, extension and research activities

The existence of potential ASS underlying peat soils in Tweed cane lands was known in the early 1990s but there was little information regarding ASS in the Richmond and Clarence cane growing areas (Nielsen 1993). Growers in the Tweed River district had developed awareness through publicity relating to fish kills, surveys of pH in drain water and field trials. A number of Tweed growers attended the First National Conference on ASS at Coolangatta in 1993, and a field tour during the conference visited trial work on cane farms in the Tweed.

In 1994, the NSW sugar industry developed 'Guidelines for Drain Construction and Maintenance in Acid Sulfate Soil Areas'. These guidelines were prepared by the NSW Sugar Milling Cooperative in conjunction with the NSW Environment Protection Authority. There was extensive consultation within the industry before release of the guidelines. This was the start of the awareness stage for the majority of growers in the Richmond and Clarence River districts. The aim of the guidelines was to alert and inform cane growers of the issue and to provide advice on how to minimise the impacts of drainage works in acid sulfate areas. The guidelines were circulated to all growers and were supported by a series of articles in grower newsletters, presentations at a range of industry meetings and distribution of the booklet 'An Introduction to Acid Sulfate Soils'.

By 1996, the awareness campaign was showing positive results. In 1993, ASS did not feature in the ten high priority areas for research and extension, yet by 1995 it was a major priority for the NSW sugar industry (Nielsen, 1996). The Environment Committee of the NSW cane growing industry was formed in early 1996 and ranked ASS as one of the two high priority issues. Grower numbers attending specific field days and meetings to discuss ASS issues, and the number of requests received by mill Agricultural Officers for advice also indicated widespread awareness within the cane industry.

Undoubtedly, the research and extension activity that was most successful in increasing the knowledge base of growers with respect to ASS was the interactive farm sampling project conducted by the Co-operative Research Centre for Sustainable Sugar Production (CRC Sugar) and the NSW Sugar Milling Co-operative. The field phase of this five-year project commenced in August 1996 and involved sampling and analysing soil on almost all cane farms in NSW. As well as informing growers about ASS the project served to:

- develop a local laboratory capacity to analyse soils for actual and potential acid sulfate conditions, using nationally endorsed methodology
- establish relationships between field tests and lime requirement
- allow individual drain management plans to be produced for each farm
- better define the location of ASS in the cane growing regions of NSW.

Each farm sampling involved the project officer and grower using a farm map to first decide where soil sampling was to take place. Soil cores were usually sited in the lowest part of the farm immediately adjacent to a drain that was being maintained by the grower. The number of soil cores varied on each farm but most farms had two to three cores with some farms having up to seven cores sampled. In most cases, the grower was present during the sampling process. Growers were able to see first hand the field testing, have the nature of ASS explained by the project officer and observe the location and depth of ASS if it

was present on their property. In addition to a detailed description of the soil profile, field tests conducted included field pH, reaction to hydrogen peroxide and oxidised pH. A laboratory facility, established at the Broadwater mill as part of the CRC Sugar activity, analysed selected samples for total actual acidity, total potential acidity and peroxide oxidisable sulfur. The laboratory analysis was conducted by a post-graduate student engaged in a Master's degree with CRC Sugar as part of the project and technical supervision was provided by a scientist from the Queensland Department of Natural Resources. These laboratory parameters were used to calculate the lime requirement of drain spoil.

Towards self regulation

In 1998, the NSW Department of Urban Affairs and Planning (DUAP) advised that state planning provisions would be introduced to control drain maintenance and construction in ASS areas. DUAP also indicated that there might be an interim measure to exempt industry groups from the provisions of the planning instruments, provided the sugar industry complied with a range of performance conditions.

All growers in NSW are members of the NSW Sugar Milling Co-operative and signatories to a Memorandum of Agreement (MOA). The first alternative to the proposed planning controls was the insertion of a clause relating to earthworks in ASS areas in the Memorandum of Agreement. The Agreement now provides that a member of the Co-operative agrees to conduct land grading, drain construction and drain maintenance or other earthworks that may disturb ASS or lower the water table in accordance with the NSW Sugar Industry Best Practice Guidelines for Acid Sulfate Soils. The MOA also specifies that any new land for Production Area Entitlement will require a drain management plan that addresses any ASS hazard. The Environment Committee of the NSW Cane Growing Industry and NSW Canegrowers Association played pivotal roles in introducing this clause.

NSW local authorities have Local Environment Plans (LEP) that cover among other things development on land that contains ASS. The objective of the LEP in this regard is to require special assessment for development on land with acid sulfate risk. Under the terms of an LEP, cane growers would require development consent for most earthworks including laser grading or drain cleaning in an ASS area. Local councils would have had to deal with up to several hundred development applications per year, potentially a lengthy and expensive process for both growers and councils.

When councils advertised and sought comment on the LEP, the NSW Sugar Milling Co-operative Ltd made submissions seeking an exemption from the consent process in order to permit self-regulation in the management of ASS. It was argued by the industry that self-regulation would allow a more practical regime for cane growers given the constraints of weather. It was also argued that the issue could be managed most effectively by all growers adopting an individual assessment of acid hazard and drain management plan, and by adopting the Best Practice Guidelines for Acid Sulfate Soils. Compliance would be monitored by an annual audit of drain management practices by the Co-operative and relevant council.

Self-regulation was accepted by five of the nine local authorities on the north coast of NSW. Other Councils are currently advertising the model LEP and the sugar industry self-regulation clauses will be adopted. Under the terms of the clause, consent for earthworks in acid sulfate soil areas is not required if a Production Area Entitlement (assignment) covers the land in question and the works are carried out according to a drain management plan issued by the NSW Sugar Milling Co-operative Ltd (Appendix 1). In order for this process to be formally adopted by councils, the Best Practice Guidelines for Acid Sulfate Soils needed formal approval by DUAP and the NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC). Endorsement of the guidelines was received from ASSMAC, and DUAP's approval was in the form of a Memorandum of Understanding. This latter document sets out the obligations of DUAP, the Co-operative and its members plus the audit, compliance and review process. This document was signed off in July 2000 and will be reviewed in July 2001.

The Best Practice Guidelines for Acid Sulfate Soils were prepared by the Co-operative in conjunction with industry partners, BSES, Queensland DNR and CRC Sugar.

Drain management plans and responsibilities

The NSW sugar industry has produced individual 'Assessment of acid hazard and drain management' plans for all NSW cane farms (Appendix 1). These plans provide information on location, depth and intensity of ASS and also indicate the circumstances where further

sampling is required. The plans also give the amounts of lime required to neutralise any acid hazard in the drain spoil and indicate the circumstances where lime is required following laser grading. The location of sampling sites is shown on a farm plan and field and laboratory data for individual soil depths are presented. These drain management plans are used in conjunction with the best practice guidelines.

Growers are aware of their responsibilities in relation to ASS as indicated by their willingness to accept new terms relating to ASS in their contract with the sugar mill. Under this arrangement members of the Co-operative are required to manage their existing cane lands according to the best practice guidelines for ASS. The contract includes a requirement that any proposed new cane land must be assessed for an acid hazard and, where relevant, a management plan developed to address the actual or potential hazard.

Attitudinal changes

Woodhead (1999) surveyed cane farmers, tea tree growers, beef producers and dairy farmers in NSW in relation to their knowledge and understanding of ASS best practices and their attitudes to these practices. The survey showed that the cane industry in NSW was ahead of other industries in awareness and knowledge levels on ASS. Cane farmers generally felt in control of ASS management and were proud of the way the industry had responded to ASS. The majority of cane farmers (60%) thought that farm planning and management of ASS was very important, whereas only a minority of beef (30%) and dairy (20%) farmers considered it important (Woodhead and Hughes, 1999).

In a more recent survey of grower attitudes to canegrowing, sustainability and environmental issues, O'Grady and Christiansen (2000) noted that the highest response rate was from NSW growers. They suggested that this may indicate a higher level of awareness and interest in environmental management in NSW and that the acid sulfate soil management program in NSW may have stimulated greater interest in and acceptance of environmental issues. Almost all NSW growers (95%) are aware of the Best Practice Guidelines for ASS and 95% are in agreement with the ASS guidelines. A large proportion of NSW cane growers (78%) believe that laser grading is of benefit and about a quarter of farms have had more than 75% of the area graded (O'Grady and Christiansen, 2000).

Recognition and publicity

In late 1998, the interactive farm sampling project won a Gold Award in the NSW RiverCare 2000 Awards. These awards recognise the highest standards of work carried out by community, education and business groups to improve water quality and river restoration.

The NSW acid sulfate project won the primary industry category in the NSW statewide competition. The award recognised the sugar industry's efforts in managing these soils to reduce the outflow of acid and to improve the quality of the rivers. Receipt of this award was widely publicised in the media on the north coast of NSW and raised the awareness of the community and other industries to the work undertaken in the canelands of NSW. The project also received in December 2000 an Award for Excellence from RiverCare 2000 for activities continuing to provide ongoing environmental sustainability.

A planned program of press releases and media days was implemented to promote the industry approach to ASS. There were successful and other not so successful encounters with the media. It was difficult to get good news stories into prime position in newspapers and television. However, the industry considers that the program was worthwhile and will be continued.

Government agencies have reviewed the project, which is now held throughout the Australian sugar industry as the model for tackling a major environmental issue such as ASS.

The cost of self-regulation

The direct cost of achieving self-regulation is estimated at about $1M. While the industry took the lead role and has borne most of the cost, other organisations have contributed significantly. These include the CRC for Sustainable Sugar Production, QDNR, BSES, National Heritage Trust and the NSW government. Recognising the inputs of time of personnel of north coast shire councils, county river councils, ASSMAC, and NSW state government departments would take the cost over $1M. The largest cost components for the industry were soil sampling ($184 000) and analysis of the samples ($200 000). The best practice guidelines required extensive consultation and took over two years to develop. From 1998 until the final format was agreed upon in March 2000, more than 20 drafts were reviewed involving extensive negotiation with five NSW government agencies. The cost of developing the guidelines is estimated at more than $100 000. Preparing individual drain

management plans is estimated at $63 500 or approximately $100 per farm. The ongoing cost of maintaining self-regulation is estimated at $80 000 per year. This comprises annual audit costs of $60 000 and ongoing support for research of $20 000.

The benefit-cost ratio for the soil survey and analysis components was estimated at 7:1 in a study commissioned by the CRC for Sustainable Sugar Production (Agtrans Research and eSYS Development, 2000). This study considered both the benefits to the environment and the costs of regulation avoided by the introduction of drain management plans. It undoubtedly overlooked less tangible environmental and community benefits.

Conclusions

The NSW sugar industry was the first Australian rural industry to achieve self-regulation in the management of an environmental issue. The work of the sugar industry in NSW is being used as a model for other agricultural industries in the development of environmental management. Despite the costs in money and time, the approach of the NSW sugar industry has had positive benefits for the industry. It has enabled self-regulation with respect to drain management, given the industry positive publicity in the community, demonstrated to the wider community the NSW sugar industries' ability to handle environmental issues and raised grower confidence in the industries' ability to deal with environmental concerns. Recognition of ASS and the development of Best Practice Guidelines for Acid Sulfate Soils have resulted in changes to the way drains are managed. A current water quality project monitoring a range of water quality parameters including nutrients and pesticides in caneland drain waters has naturally followed on from the acid sulfate farm sampling project and has the support of growers.

Acknowledgments

Gaining self regulation by the NSW sugar industry for ASS is the result of commitment and good will by a wide range of people from industry, academia, state and local government. Those deserving special mention include Julian Collins, Tim Shapter and Tony Meston (Project Environmental Technicians), T Balakrishnan (Master's student/lab analyst), Myriam Raymond (CRC Sugar/Qld Dept of Natural Resources), Yolande Stone and Mike Svikis (DUAP), Mike Melville (UNSW), Ian White (ANU), Douglas Jardine and Mark Tunks (Tweed Shire Council), John Williams (NSW Agriculture/ASSMAC), Graham Martin (NSW Canegrowers Assoc) and Robert Hawken (farmer).

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APPENDIX 1
ASSESSMENT OF ACID HAZARD & DRAIN MANAGEMENT PLAN

Name: LL & ST LIMESTONE

Farm: 1999 in the Harwood Mill Area

The assessment is part of the NSW Sugar Industry Acid Sulfate Soil Sampling Project (see footnote). The assessment was prepared by Bob Aitken (BSES, Harwood) using field and laboratory data collected during the project.

This farm will be managed in accordance with the current NSW sugar industry best practice document in relation to Acid Sulfate Soil.

Field sampling was carried out on 18/3/99.

Methodology

Two cores were obtained from this farm as indicated on the attached map. The soil was sampled to a depth of 1.5 metres and selected depths subjected to field tests. Samples from core 1 were analysed in the laboratory at Broadwater Mill.

The sites selected were in the lowest sections of this farm (see attached farm plan). Drains marked as follows:

- green—farm drains 0.5 m to 0.7 m deep;
- red—farm drains greater than 0.7 m deep;
- blue—flood mitigation drains.

Results

Field and laboratory results are shown in the attached tables.

The field tests can only be used as an approximate guide to the presence of acid sulfate material. A possible indicator of the presence of significant amounts of acid sulfate material is pH values less than 3 after oxidation with peroxide (pHox).

The following Table summarises the results and indicates any likely acid hazard.

Sampling site	Comments
1	Field and laboratory data indicate an acid hazard below a depth of 0.35 m
2	Field data did not indicate any acid hazard to a depth of 1.5 m

Cleaning of drains

The location of drains is shown on the attached farm map.

Any mechanical cleaning of drains with an acid hazard should remove a minimum of spoil. The acid hazard in the spoil needs to be neutralised with lime as shown in the following Table.

Site	Kg lime per cubic metre spoil	If the spoil is spread 0.1 m deep:	
		Kg lime per square metre	T lime per ha
1	70	7	70
2	None	None	None

Liming recommendations have been made considering the depth of drains, depth of a severe acid hazard and allowing a buffer between the bottom of the drain and the acid hazard.

No liming of spoil (to 1.5 m depth) is required around site 2.

For 'spinner drains' it is best to lime the spoil and the drain after cleaning.

When using an excavator or similar it is best to apply lime *before* drain cleaning. Half the lime should be applied to the drain and half applied to the area on which the spoil will be placed.

All drainage works on this property will be managed according to the current NSW Sugar Industry Best Practice Guidelines for ASS. If mechanical cleaning is required an open (slotted) weed bucket is recommended to minimise the amount of spoil removed and drains should not be deepened beyond their original depth during cleaning. A laser-guided excavator should be considered as an option for removing spoil.

New drains

No new drains should be constructed without further assessment of acid hazard, and if necessary, modification to this plan.

Laser grading

Site 1—an acid hazard occurs 500 mm from the soil surface. If laser grading occurs near this site, any cuts deeper than 300 mm will be treated with lime at 5 to 10 t/ha to the cut area.

DH Parsons
NSW Sugar Milling Cooperative

LL & ST Limestone
Owners and Managers

This assessment and plan was developed by the property manager in conjunction with staff of the NSW Sugar Milling Cooperative Limited and BSES. The analysis was performed at Broadwater Mill as an activity of the Co-operative Research Centre for Sustainable Sugar Production.

ACID SULFATE FARM REPORT

Mill Area: Harwood Farm No: 1999
Grower: LIMESTONE, L.L. & S.T., HARWOOD NSW 2469
Phone No: 02 9999 9999

See attached glossary for explanation of units and testing procedures

Paddock No 130 Core No: 1
Field Data:
***Sample Date:* 18-Mar-99**

Depth (m)	Colour	Texture	Jarosite	Mottles	Reaction	pH (H_2O)	pH ox	Horizon(cm)
0.40	Dark Brown	Clay	No		Moderate	5.35	2.7	0–35
0.70	Dark Brown	Clay	No		Moderate	6.10	2.0	35–90
1.00	Dark Grey	Silt	No		Vigorous	7.41	1.8	90–150
1.50	Dark Grey	Silt	No		Vigorous	7.35	1.7	

Laboratory Data 130 Core No: 1

Depth (m)	PH (KCl)	PH (ox)	EC 1:5pH 1:5	TAA	TPA	TSA	%S (KCl)	%S (ox)	%S	Lime requirement (kg lime/tonne soil)
0.4	5.25	4.80		0.0	1.0	1.0	0.03	0.13	0.10	6
0.7	5.15	2.30		0.0	18.2	18.2	0.08	0.82	0.73	38
1.0	5.08	2.00		0.0	36.9	36.9	0.08	1.47	1.40	68
1.5	4.92	2.10		0.0	34.9	34.9	0.08	1.45	1.37	66

Paddock No 700 Core No: 2
Field Data:
***Sample Date:* 18-Mar-99**

Depth (m)	Colour	Texture	Jarosite	Mottles	Reaction	pH (H_2O)	pH ox	Horizon (cm)
0.40	Light Blue/Grey	Medium Clay	No	40% OR	Slight	7.00	5.79	0–15
0.70	Light Blue/Grey	Fine Sandy Silt	No		Slight	7.08	5.38	15–50
1.00	Medium Blue/Grey	Fine Sandy Silt	No	20% OR	Slight	7.20	5.67	50–90
1.50	Medium Blue/Grey	Fine Sandy Silt	No	40% OR	Vigorous	7.30	5.78	90–150