



Dedicated to a better Brisbane

**Urban Management Division
Subdivision and Development Guidelines
Part C Water Quality Management Guidelines**

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9.0 ACID SULFATE SOILS

9.1 BACKGROUND

'Acid sulfate soils' (ASS) is the common name given to soils containing iron sulfides (usually Pyrite, FeS_2), that, if oxidised (through the exposure of pyrite to air) produce sulfuric acid that can result in soil and groundwater becoming acidic. Exposure of ASS can occur either naturally (eg during a drought), through soil disturbance (eg dredging or excavation), or from the lowering of a watertable (eg drain construction).

The impacts of ASS can include:

- elevated levels of sulphuric acid, iron, aluminium and heavy metals being leached from the soil and discharged to receiving waters, often in a concentrated 'slug' after a dry period (such discharges can be acutely toxic to aquatic species such as fin fish and shellfish);
- significant degradation of aquatic habitats, including habitat for commercial and recreational fisheries;
- increased levels of fish mortality, disease (eg red spot disease) and potentially some types of algal blooms (eg *Lyngbya mujuscula*¹);
- reduction in biodiversity in waterways and wetlands;
- decreased health of waterways and wetlands; and/or
- corrosion of infrastructure containing concrete and metal (eg culverts, bridges and stormwater drains).

Failure to take "reasonable and practicable" measures to minimise environmental harm associated with acid sulfate soils can lead to prosecution under the *Environmental Protection Act 1994* and *Environmental Protection (Water) Policy 1997*.

In Brisbane, ASS are generally found below 5m Australian Height Datum (AHD) and in Holocene sediments (organic-rich sediments and silts). They are usually associated with coastal lowlands and estuarine flood plains. Under natural conditions ASS are usually located below the watertable.

In Brisbane two sources of information can be used to gain quickly an indication of whether ASS are likely to occur in a given area. These are Council's 'BIMAP' GIS system (publicly available) and maps produced by the Department of Natural Resources (Queensland Acid Sulfate Soil Investigation Team). Note however that such maps should only be used as a guide to identify the likely location of ASS.

The purpose of this Chapter is to encourage the adoption of best management practices in the planning, design and undertaking of activities that impact on ASS, so that environmental harm and development costs can be minimised. It identifies existing policies, standards, and guidelines to aid in the identification, assessment and management of ASS.

¹

Note that this form of algae can cause severe human health effects (eg contact dermatitis).



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9.2 KEY ISSUES/DESIGN CRITERIA

Acid sulfate soils can be a constraint on development as additional actions may be required to manage potential environmental impacts (eg mixing acid sulfate soil with lime to neutralise the acid as it is generated). However, it is usually a manageable issue given early identification, the involvement of ASS experts early in the planning process and a commitment by the developer to implement the recommendations of such experts. Many environmental engineering/science consultants based in Brisbane now have significant experience in the assessment and management of ASS.

The proponent should consult with the relevant development assessment team from Council and if necessary, the Department of Natural Resources (DNR) when proposing to undertake development in areas that have been identified by Council and/or DNR as being areas likely to host acid sulfate soils. Note that maps are available from Council and DNR, but they only provide indicative guide to where such soils occur.

Under the *Integrated Planning Act (1997)*, the Integrated Development Assessment System allows for Council and other referral agencies to request additional information to assist in assessing a development proposal. Additional information, in the form of an Acid Sulfate Soil Investigation as part of the general planning report, will be requested by the assessment manager and/or a referral agency to assist in assessing proposals that:

- are proposed in an area known to host acid sulfate soils and the activity will significantly disturb these soils and/or significantly lower the watertable;
- will result in significant disturbance of soils below 5 metre Australian Height Datum (AHD) where the soil type / geology has acid sulfate potential, ie Holocene sediments;
- will result in significant lowering of watertables in soils below 5 metres AHD where the soil type / geology has acid sulfate potential;
- will result in significant disturbance of soils and/or lowering of watertables in any area highlighted on an Acid Sulfate Soil Hazard / Distribution Map; or
- are requested to supply additional information as part of a licence or permit.

Typical elements of an ASS investigation include:

- a desktop study of the likelihood of ASS;
- inspection of the site with a person who can identify the field indicators for ASS and/or undertake preliminary testing in the field;
- review of any soil or water tests undertaken in the vicinity of the development site;
- sampling and analysis of soils, surface water and/or groundwater in accordance with current and locally acceptable technical guidelines;
- detailed mapping of ASS within the area to be disturbed;
- a risk assessment based on the proposed works and the findings of the sampling and analysis program; and
- submission of an Investigation Report prior to any works commencing on the site.



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The Investigation Report should recommend whether a Management Plan is required to manage the ASS issues on the site for the proposed development. This Plan sets out the actions that will be taken to manage and monitor the impacts of the development on receiving waters.

An ASS investigation must be undertaken in strict accordance with current and locally acceptable technical guidelines such as the *Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998* (or later version), produced by the DNR's Queensland Acid Sulfate Soil Investigation Team (QASSIT). Suitably qualified and experienced persons must manage the investigation. These persons must be familiar with the current DNR guidelines.

Note that in most cases, ASS can be managed effectively through the implementation of appropriate Management Plans.

Typical management techniques for ASS include (in order of preference):

- avoidance of disturbing areas containing soils with high levels of oxidisable sulfur (note that this management technique requires the development's design to draw upon information obtained during the ASS investigation);
- control of surface water drainage (eg the use of shallow swales that do not significantly lower the watertable);
- prevention of oxidation of potential ASS by placing the material below the water table;
- neutralisation of ASS material with calculated quantities of lime;
- removal of pyritic material via techniques such as sluicing; and
- controlled oxidation followed by treatment of the acidic leachate (a high risk strategy).

For larger projects where potentially high risk management strategies are proposed (such as mechanical separation of pyrite through sluicing or controlled oxidation/leaching of soils) site specific experimental data will usually be required along with pilot projects, close supervision and comprehensive monitoring regimes.

Whilst several remediation and management strategies are possible for the majority of sites, there may be additional constraints imposed by site conditions or the nature of the ASS material, including:

- the presence of stiff clays which can be difficult to homogeneously mix with lime;
- limited availability of ASS treatment or storage areas; and
- proximity to highly sensitive environments (eg natural wetlands, areas with shellfish).



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9.3 ACID SULFATE SOIL MANAGEMENT PLAN

ASS Management Plans typically form part of an overall 'Environmental Management Plan' for the site that addresses all significant environmental issues.

An ASS Management Plan must be prepared prior to soil disturbance and should include:

- At least a two dimensional map of acid sulfate soil distribution to the depth of proposed disturbance.
- Details of potential on-site and off-site impacts due to the disturbance of the soil and/or the groundwater levels.
- The method(s) that will be used to avoid, treat or otherwise manage acid sulfate soils. Note that in some cases, staging of the development will be needed to minimise potential impacts.
- Details of how the height of the groundwater table on and off the site will be managed during and after construction.
- Details of contained on-site treatment and management of potentially contaminated stormwater run-off, surface waters, leachate and groundwater associated with the works both in the short term and long term.
- Details of all soil and water monitoring, both manual and automated, to be performed during and after treatment. This includes verification testing of treated soils.
- Details of handling and storage of neutralising agents (eg lime).
- A description of contingency procedures to be implemented on and off the site if the management procedures prove to be unsuccessful and acid is generated and/or leachate problems occur.

9.4 REFERENCES

1. Ahern, C.R., Ahern, M. R., and Powell, B., 1998. *Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998*. QASSIT, Department of Natural Resources, Resources Sciences Centre, Indooroopilly, Queensland, Australia.
2. Brisbane City Council, 1999. *A Guide to the Likely Location of Acid Sulfate Soils in Brisbane (1:50000)*. Brisbane City Council, Brisbane.
3. Department of Natural Resources, 1999. *Acid Sulfate Soils. Tweed Heads to Redcliffe, Map 1. 1:100000*. Ref No. DNR-SEA-1-A0-3234.
4. Stone, T, Ahern, C. R., and Blunden, B., 1998. *Acid Sulfate Soils Manual 1998*. Acid Sulfate Soils Management Advisory Committee, Wollongbar, NSW, Australia.