2. ECO-INFO – ACID SULPHATE SOILS

(Updated 19/12/01)

INTRODUCTION

Acid Sulphate soils are a type of soil which can occur on low lying sites on the Central Coast and elsewhere. They are a particular problem for developers or farmers who may seek to dig them up or drain them as part of normal land use activities. This fact sheet aims to provide basic information on these soils.

THE CAUSE AND EXTENT

Acid sulphate soils were created about 7,000 years ago, usually in ancient mangrove swamps. They are now also believed to form in modern sediments such as the mud laid down in the lakes since European settlement. Illustration 1 shows how this occurs. The formation of these soils involves bacteria, sea water and low oxygen in a complex chemical reaction. This leads over time to the formation of iron pyrite ($Fe S_2$) in the soil. This pyrite can sometimes be seen in a soil after it oxidises as yellow flecks as big as a pencil lead spread throughout the soil.

These soils only occur in low oxygen conditions such as under lakes or below the watertable. When the pyrite contacts air, it is quickly broken down by bacteria producing a dilute form of sulphuric acid as a by-product.

Our ability to predict where acid sulphate soils occur is improving. The Soil Conservation Service has mapped their location for critical areas in Wyong. Generally, any soil where the watertable is near the surface, eg swamps, marshes and coastal lakes probably have them, although their depth below the surface can vary. At times they cover large areas, but they may also occur sporadically.

In Australia, swamps and lakes containing such soils have generally not been developed extensively. Development for sugar cane growing, however, along the Tweed River combined with the right climatic conditions led to mortality of fish, worms and other gilled animal life in a large proportion of the Tweed River estuary in 1987.

In Wyong, acid sulphate soils have been found in soil dredged as part of the Lakes Restoration Project, and are known to occur in low lying areas immediately east of Wyong.

Acid sulphate soils are likely to be of increasing concern as development looks towards previously marginal low lying areas for development. Acidity of water in drains near these problem areas is leading to isolated examples of advanced corrosion of cement pipes and increased rusting of trash racks and other metal items.

THE EFFECT

Whether acid sulphate soils are a problem depends on many factors. Certainly, if left under water they pose no difficulty.

Potentially acid sulphate soils (those with pyrite) can become acid if exposed to air either by:

- dredging or digging up (eg, the Lakes Restoration Project);
- dropping the water table (eg, the construction of drains or cutting off groundwater recharge)

Whether acid sulphate soils are a problem will then depend on the soil. For example, there is sometimes a high shell content in such soil. This natural lime can neutralise the acid as it forms. Usually, however, some acid leaches out with rainwater and enters local drains and streams.

The acid can in extreme cases lead to pH in runoff less than 2 which is approaching the acidity of battery acid. More importantly, with this acidity, aluminium is released from the soil. This metal is not common in natural environments in a “free” form. It can be very toxic to fish life at sufficient levels.

Again, the toxicity of aluminium is subject to moderating effects (eg, the alkaline nature of water in the lakes in Wyong quickly neutralises and dilutes acid runoff. This leads to aluminium again becoming inactive).
Other trace metals such as cadmium, lead and zinc can also be released from soils when acid is present. These are also carried by water through the soil. The concentration of such metals depends on their levels in the soils in the first place and whether runoff collects or ponds.

The levels of trace metals found to date for the Lakes Restoration Project, for example, are very low even where they may accumulate during leaching. The levels found through scientific tests to date are similar to those you might find in a composted garden soil. There are no standards for trace metals in soils for recreational use, but the levels found appear to be below any conceivable standard.

THE CURE

The cure for acid sulphate soils is relatively straight forward. It involves the following options:

1 **Don't Disturb** - by leaving the soils under water, they cannot be a problem. This is basically being done east of Wyong where soil for a development is being brought in and placed over the top of potentially acid sulphate soils, leaving them below the water table and undisturbed.

2 **Neutralise the Soil** - by adding lime or other chemicals, soil acidity can be brought back to normal levels. Once neutralised, the aluminium and other metals become bound up again with the soil and will not leach.

3 **Re-bury** - this option is available only if the soil has not been exposed to air for a significant amount of time. If re-buried under water, it cannot create a problem.

Other methods to treat such soils are being developed and may provide cheaper solutions in the future. Monitoring of sites where acid sulphate soils have been exposed is needed, particularly while they are neutralising.

Our knowledge of acid sulphate soils, like many environmental issues, is improving all the time. Additional studies relevant to Wyong could include studying the effect of trace metals on the lakes' and streams' environments.

CONCLUSION

Acid sulphate soils can be treated and neutralised posing no further risk to the environment. This treatment can be time consuming and must be considered as a cost if development is to proceed.

Illustration 1: How Acid Sulphate Soils Form