Approaches to remediation of acid sulfate soils in Barker Inlet, South Australia

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Abstract

Large tracts of intertidal wetlands surrounding Barker Inlet, near Adelaide, South Australia, have been progressively drained by bunding over the last 150 years. This area (20 km^2) contains approximately 12 km^2 of potential acid sulfate soils (PASS) and 2.5 km^2 of actual ASS and has been selected to conduct different remediation strategies to gauge their suitability to various types of ASS and subsequent land uses and development. The effects of bunding and inadvertent management of ASS in the area have not been quantified. In particular, the production, export and fate of leachate associated with ASS are poorly understood in the area. Strategies do not currently exist to appropriately manage these soils, curtail pyrite oxidation and neutralize or leach existing acidity, and at the same time manage the release of acidic water and oxidation products entering Barker Inlet.

Management strategies can only be successful if based on adequate mapping of the sulfide contents, soil reactivity and depths to which sulfuric and sulfidic horizons occur. Understanding the distribution, evolution, nature and inter-relationships of the coastal sediments is also vital for effective planning of ASS management and selecting appropriate remediation strategies. However, the development plans for land affected by ASS also dictates remediation options available to achieve a desired environmental outcome.

ASS-affected land at Gillman is largely vacant, but controlled by many different private and public organisations and housing amenities such as: a major municipal waste dump, salt evaporation ponds, storm water retention basins with open drains and constructed freshwater and saline (tidal) wetlands. Segments of the land are constantly changing hands along with development plans. The area will soon host a major arterial freeway, and is under pressure for industrial subdivisions and other industrial developments.

A soil map and schematic cross sections were created to characterize the soils and locate suitable sites for monitoring and conducting remediation trials. An integrated program of quantitative pedological work, including good interpretative descriptions, chemical

and physical investigations (e.g., redox measurement using Pt Eh electrodes and site hydrology) and environmental assessment has been carried out to better understand the spatial distribution of soils and contaminants (e.g. heavy metals, arsenic and oxyhydroxysulfates). This information has provided the basis for devising trial experiments and management options. The ASS in the bunded areas have been compared with PASS in adjacent, relatively undisturbed mangrove, samphire and sea grass flats.

The following remediation trials appropriate to the use of land and soil type are being conducted on the most degraded ASS in the area:

- Re-flooding trials utilizing existing freshwater, tidal and saline ponds in constructed wetlands and brackish water in a storm-water ponding basin.
- Bioremediation trial to re-establish reducing conditions to stop pyrite oxidation by the addition of sulfate-reducing bacteria and various organic wastes, in effect re-establishing the sulfide formation processes that operate in the mangrove soils outside the bund wall.
- Slotting trial using soda lime by-product to treat acidic discharging meteoric water or groundwater leachate.
- Tidal flushing/drainage trial in highly reducing, eutrophic potential ASS where mangrove dieback is occurring at St Kilda.

This paper presents some preliminary results of the remediation trials and some broad guidelines to assist in making the most appropriate decision on utilisation and remediation of a variety of ASS affected lands in South Australia.