Darawakh Creek & Frogalla Swamp Wetland Management Plan

Summary Report 10 November 2003 DRAFT

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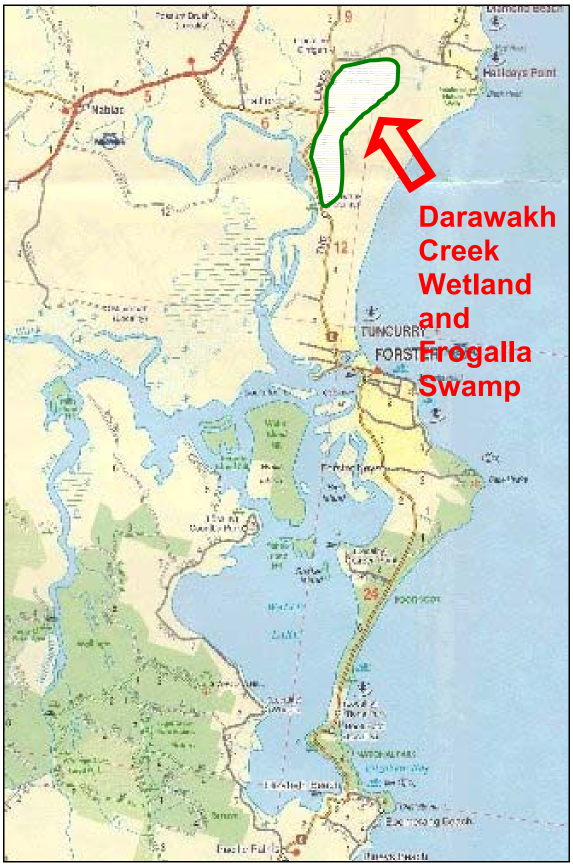
General

Wetland**Care** Australia was commissioned by Great Lakes Council to prepare the Darawakh Creek and Frogalla Swamp Wetland Management Plan in August 2003. The aim was to redesign the drainage of the area to reduce the flow of acid that was occurring as a result of past agricultural drainage works carried out in the 1960s.

The wetland is located 10 km north of Tuncurry and compromises 1000 ha of mostly freehold land. There are about 12 properties generally in the range of 20 – 90 ha that are substantially impacted by past drainage works..

Figure 1 Darawakh Creek and Frogalla Swamp



Acid Drainage

The entire wetland is underlain by acid sulfate soils (ASS), which are highly reactive, especially below 1m depth. Past construction of floodgates at the mouth of Darawakh Creek, plus a 7 km main drain and 20 km of secondary drains, combined with lift pumps lowered the groundwater sufficiently to generate the release of severely acid groundwater. The most intensive drainage has occurred in the upper reaches of the floodplain south of Frogalla Swamp.

Photo 1 Drainage plume discharging from Darawakh Ck into the Wallamba River near old floodgates

Source: Great Lakes Shire Council

Acid is released from the site via the constructed drains following rainfall. This mobilises acid groundwater or acid that has accumulated on the ground surface or lying in acid ponds. Burning of the wetlands has occurred more frequently since drainage, further exacerbating the acid problem by destroying valuable organic matter that helps immobilise the acid.

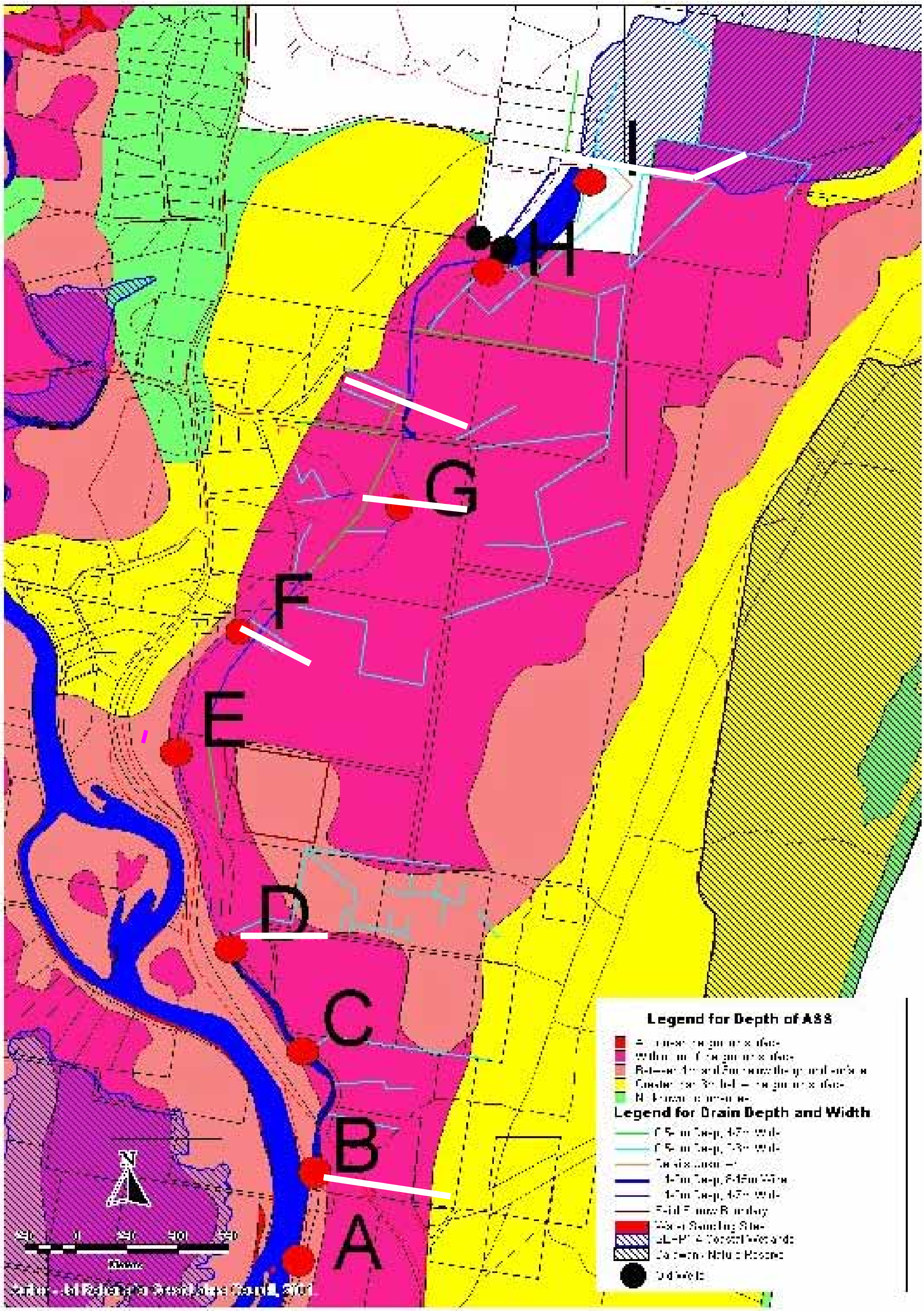
Impacts

Previous studies have established that acid drainage is flowing on a seasonal basis into the Darawakh Creek and then into the Wallamba River. Research has confirmed that such water can have lethal as well as sub-lethal impacts on oysters, prawns, fish and crabs both directly and indirectly by impacting on the estuarine food web. This is a major concern for the established commercial and recreational fisheries (inshore and offshore), as well as the Wallis Lake oyster industry.

Drainage

Survey work has confirmed that the wetland has only 20 cm of fall over its 7 km, length making it impossible to drain without deep drains. However, deep drains are the cause of the acid discharges and need to be decommissioned. Flood drainage is being impeded in a number of locations by levees constructed as farm crossings and for a 1960s water-pumping scheme. As the old drainage scheme has fallen into disrepair, these levees have resulted in ponding of acid water and the loss of reeds and rushes that can trap acid.

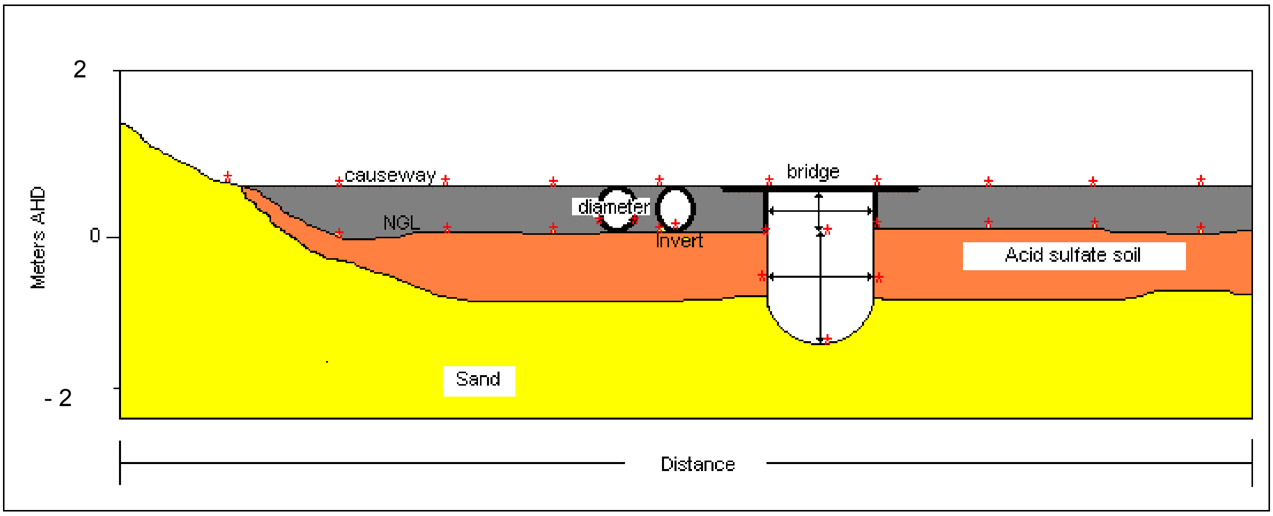
Figure 1 ASS Risk Map, Drainage Network, Water Sampling Sites and Elevation Transects



White = elevation survey transect

Source: Great Lakes Shire Council and DIPNR

Figure 2 Sample section of Darawakh floodway illustrating elevation survey



Land Use

The 1000 ha wetland has been mostly abandoned for agricultural use as a result of wetness, acid problems and invasion by swamp oak. The area now supports about 100 head of cattle. Because of the wetness of the site and the presence of highly reactive ASS and the sensitivity of the estuary to acid discharges, there are virtually no alternative land uses possible on the site apart from ecotourism, should the area be rehabilitated.

Vegetation

The wetland comprises reed and rush 'swamp', wet 'heath' and invasive 'swamp oak' forest. The draining of the wetland has triggered the invasion by swamp oak, which is now posing a severe fire hazard. This native species has also been found to concentrate acid groundwater and may be exacerbating the acid discharge problem. The wetter areas have much fewer swamp oaks and tend to be covered in a dense bed of reeds or rushes.

Management Options

Three management options have been considered, including:

1. *Do nothing* – will allow moderate to severe acid discharges to continue for many decades but rates may decline as drains become less and less efficient with siltation and weed growth. This option would continue the trend out of agriculture.
2. *Dig deep drains* – will produce much more severe flows than at present with the potential for acid flows to continue for millennia if the drains are maintained. Agricultural benefits would be very marginal; impacts on estuarine-dependant industries would be devastating.
3. *Fill in the drains* – will reduce acid flows by 60 – 80%, keep the area wetter for longer under an improved cover of reeds. Will also require removal of farm crossings that are blocking natural overland flood flows leaving the area. This would require a change of land ownership as agricultural activities would need to cease and the wetland parts of properties brought under an integrated wetland management plan.

Preferred Option – Fill in Drains

The preferred option is to develop a wetland rehabilitation 'package' that meets the following objectives.

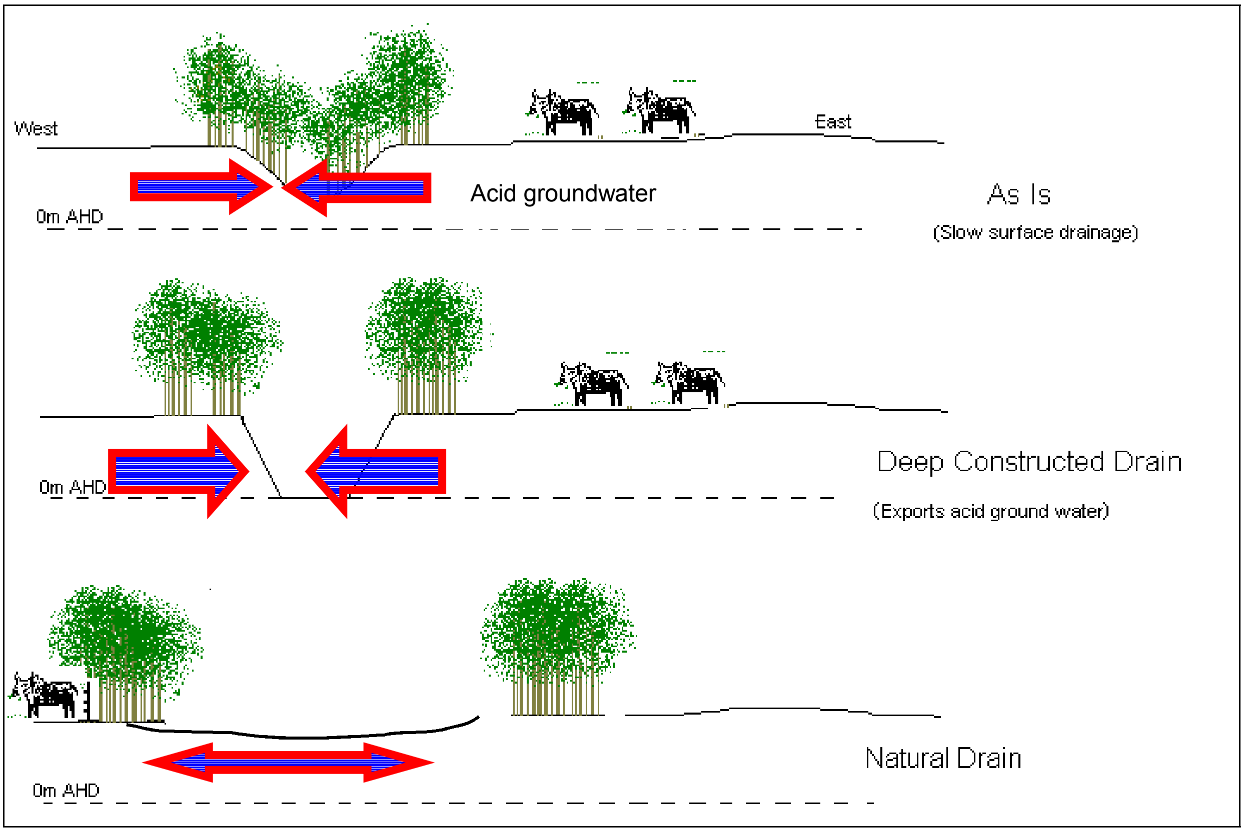
Objective 1: *Provide landholders with **equitable incentives**, such as development entitlements on the dryland parts of their holdings, to participate in the transfer of ownership and rehabilitation of the Darawakh and Frogalla wetlands*

Objective 2: *Reduce **acid groundwater flows** leaving Darawakh Creek by 60-80%, requiring backfilling of the main drains*

Objective 3: *Improve the rate of **surface floodwater drainage** from the site by removing farm crossings that are currently blocking overland flows*

Objective 4: *Improve **fish passage and water quality** in the tidal reaches of Darawakh Creek by removal of the concrete headwall at the mouth of Darawakh Creek*

Figure 3 Darawakh wetland shallow constructed drainage design option.



'Development Offsets'

Some landholders have expressed interest in divesting themselves of the wetland components of their holdings, and most are interested in enhancing the development prospects of their flood-free land as an offset to giving up the use of wetland areas. Some have expressed the view that if they cannot strike a deal that is acceptable, they will hold land for the future. Most have concerns about any changes to property access afforded by the farm crossings constructed across the wetland, while they own the land.

Both GLC and GTCC are considering a system of 'development offsets' to provide landholders with the opportunity to increase their development opportunities in return for dedicating environmentally sensitive land to public use for environmental rehabilitation purposes.

This scheme offers the opportunity to regenerate extensive areas of the 'swamp', and 'heath' wetland communities that are most affected by drainage with potentially little or no public expense. However, about 20% of properties with no land with development potential, may require outright acquisition in the future if landholders wish to divest themselves of the wetlands.

All landholders contacted thus far have expressed considerable interest in the 'development offsets' concept as a means of rationalising land use in the Darawakh Creek wetland and Frogalla Swamp.

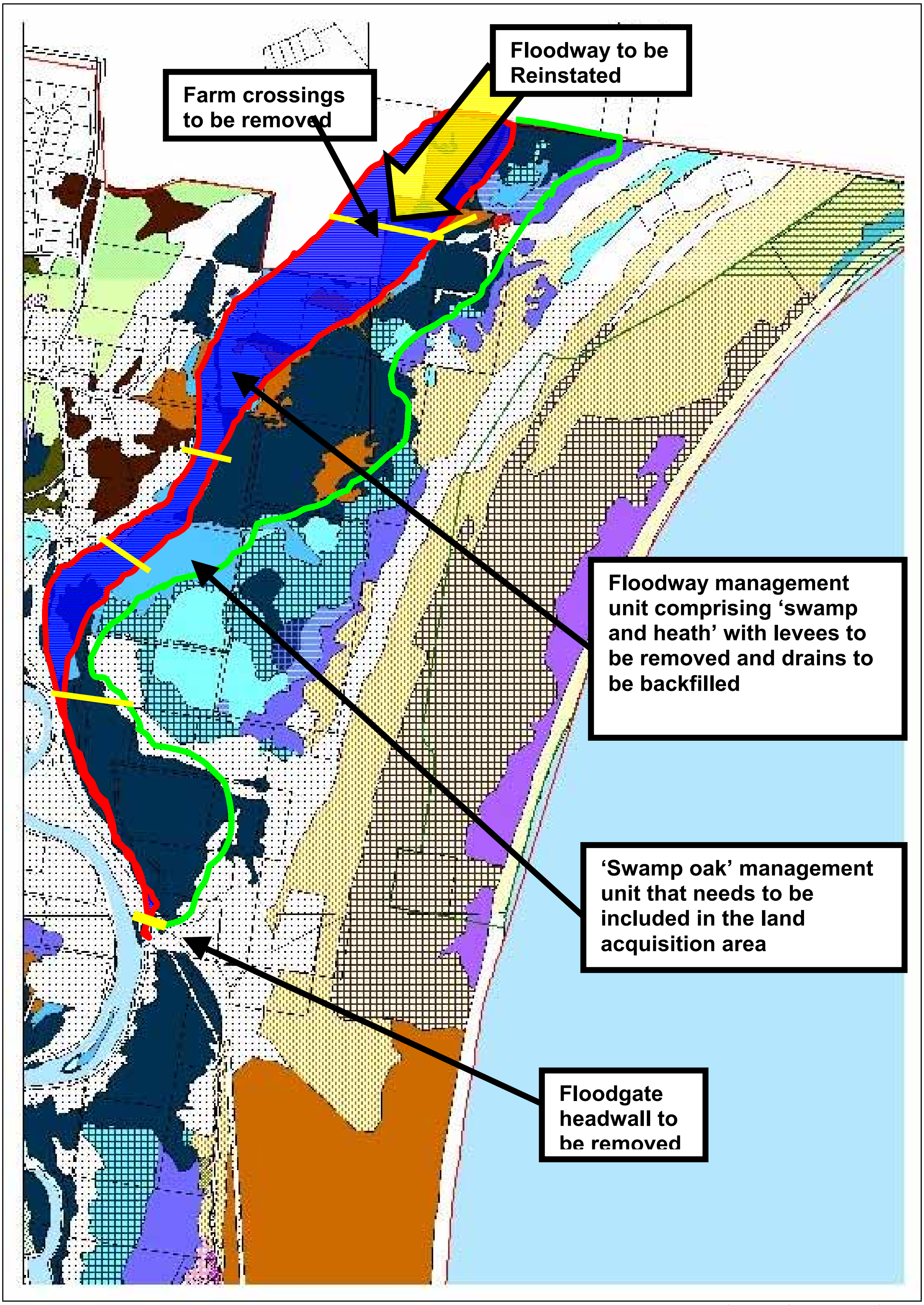
Acquisition Costs?

Transfer of ownership of the wetland to public ownership is planned to be revenue neutral for those holdings with dryland capable of supporting additional rural residential or other compatible development. For other properties with no development potential (estimated 200 ha x $2500/ha = $0.5m over 5 years), it is envisaged that land acquisition would be undertaken by public authorities (Council, NPWS) as properties come onto the market.

Rehabilitation Costs

A preliminary costing of $355,000 is required to backfill 7 km of main drain, 3 km of farm crossings and remove the floodgate headwall.

Figure 4 Concept of reinstated floodway with levees to be removed and drains backfilled



Base Map Source: Great Lakes Council

Table 1 Recommended Management Strategies and Remedial Works

Management Issue	Recommended Management Strategy	Remedial Works Proposed	*Cost Estimate /Time Frame*
Land Ownership / Land Use: *The need for constructed drainage and access across the swamp for grazing management purposes severely compromises the management needs of the wetland to reduce acid drainage discharges*	1. GLC and GTCC adopt a policy to change the use of the Darawakh Creek wetland and Frogalla Swamp from agriculture to 'environmental rehabilitation' 2. Seek DIPNR endorsement for special planning dispensation to allow for landholders or Council to apply for rural residential or other development 'offsets' on flood free land in return for landholders dedicating in perpetuity, the wetland to Council for 'environmental rehabilitation' purposes or 3. Council acquire such properties as they are placed on the market, undertake the same type of subdivision *(as per Item 1 above),* excise the wetland and resell the usable land to recover costs.	***Item 1: GLC and GTCC negotiate the necessary agreement with DIPNR*** *NOTE: WORKS OUTLINED BELOW ARE ONLY TO BE UNDERTAKEN AFTER GLC/GTCC ACQUIRE THE WETLAND*	***$10,000***
Acid Sulfate Soils: *Past disturbance and drainage of ASS has increased the generation of sulfuric acid and toxic metals*	4. Do not allow further drain cleaning or pumping of water that will mobilise groundwater and trigger further acid reaction both in the soil and downstream 5. Reinstate the natural wet hydrology and reed vegetation to the area, ensuring ASS are kept wet for much of the year	**See Item 2 below**	***$0***
Acid Groundwater: *- The major store of acid is in the groundwater* *- There is also an accumulation of labile monosulfidic ooze (MSO) / iron deposits in drains and on ground surface and in open ponded water*	6. Bury MSO in drains by backfilling with spoil (levee) material 7. Remove all livestock to prevent pugging, overgrazing and trampling of reeds and rushes which bind acid products 8. Encourage the regrowth of reeds and rushes in degraded areas to immobilize MSO / iron, reduce evapotranspiration and to reduce MSO re-oxidisation	***Item 2: Contractor to backfill 7 km of main drains in the 'swamp' and 'heath' vegetation associations to prevent acid groundwater flows and to create a natural floodway with a minimum width of 250m. (Most drains are between D and I, Figure 2)***	***$140,000***
Acid Transport: *- Acid is transported mainly via constructed drain flows but also surface flow across poorly vegetated areas* *- Constructed drains lower groundwater and collect acid*	*9.* Decommission the major drains by strategic backfilling *(see Item 2)* 10. Promote reed growth in deep ponded open water areas by removing barriers (farm crossings) that are impeding natural flows (i.e. lower water levels)	***Item 3: Contractor remove 3 km (min 250m wide) of those sections of farm crossings that are obstructing flood flows and are creating deep ponding with limited reed growth***	***$45,000***
Natural Drainage: *- The old floodgate headwall partially obstructs flood and tidal flows* *- Farm crossings and drain spoil heaps obstruct natural overland flows*	11. Increase the rate of floodwater discharge by removing all structures built in the floodway (old floodgate headwall, farm crossings, levees) that block the natural course of Darawakh Creek wetland and Frogalla Swamp *(see 16. below)*		***$0***
Frogalla Discharges *- While no significant increase WWTP flows into Frogalla Swamp is predicted, and urban development impacts not*	12. Decommission drains in the southern end of Frogalla Swamp by strategic backfilling by removal of levees 13. Rely on the reinstated natural floodway to remove floodwaters	***Item 4: GLS / GTCC / MCW fill all drains in Frogalla Swamp that may possibly intercept groundwater and surface runoff flows from all***	***$50,000***

quantified, a precautionary approach is suggested		***sources***	
Drainage Intensity: *The concentration of constructed drains in the northern sector is creating a local ASS 'hot spot' and a means of acid export*	14. Fill all main drains in the northern sector that penetrate the 'swamp and 'heath' vegetation associations	***See Item 2: above***	***$0***
Water Quality: *- Acid from the Darawakh Creek wetland is flowing into the Wallamba River impacting on aquatic life* *- Most acid is collected and transported via the constructed drains*	15. Increase tidal flushing of Darawakh Creek by removal of the floodgated headwall at the mouth of the Darawakh Creek to allow some neutralising and dilution of any residual acid flows as well as improve habitat values	***Item 5: NSW Fisheries/GLC remove the old floodgated headwall at the mouth of Darawakh Creek***	***$25,000***
Vegetation: *Invasion of wetlands by swamp oak is occurring due to past drainage. Swamp oak concentrates acid groundwater, increases fire risk and can obstruct flood flows when growing in the floodway*	16. Reinstating natural drainage may reduce the rate of swamp oak invasion in the long-term and thus reduce acid accumulation in the soil, reduce the severity of swamp forest fires and improve overland flood flows	***Item 6: Contractors undertake strategic poisoning of swamp oaks that obstruct the natural flows through Darawakh wetland***	***$5,000***
Fish & Invertebrates: *Poor water quality severely limits healthy aquatic life in Darawakh Creek and seasonally in parts of the Wallamba River*	17. Containment of acid flows in the wetland areas and improvement in tidal flows by removal of the headwall will allow more natural marine recruitment and less acid impacts	***See Items 1-15 above***	***$0***
Monitoring: *Extensive research has established the interrelationship between drainage, ASS, aquatic impacts etc. Therefore, gross indicators such as works completed, vegetation recovery, management changes etc., are considered adequate*	18. Map vegetation change at 5 yearly intervals using aerial photography and ground truthing to reliably indicate the effectiveness of rehabilitation 19. Indicators of success include increase in reed and rush cover, decrease in open water and decrease in swamp oaks 20. Other indicators of success include change in ownership (land use), removal of impediments to natural drainage, length of drains backfilled.		***$5000***
Contingency: *It may be necessary to undertake other minor works as required during the rehabilitation of the wetland eg fencing*	21. Include a 15% contingency item in the budget		***$45,000***
Project Supervision: *Wetland rehabilitation works are a relatively specialised operation requiring experienced supervision*	22. Appoint a project supervisor with expertise in wetland rehabilitation to assist GLC/GTCC during the implementation phases of the project (prepare specifications, engage contractors, supervise field work, audit compliance with Management Plan, report on achievement of targets, recommend follow-up actions.		***$30,000***
TOTAL	**Estimate of funding required (subject to further discussion)**		***$355,000.00 + 10% GST***

Summary of Anticipated Outcomes

Less severe acid discharges from Darawakh Creek

How? By backfilling the main constructed drains with adjacent spoil heap material, it is anticipated that:

- *Acid groundwater discharge via drains will be reduced by 60 -80% (100% if all drains were backfilled)*
- *Discharges that do occur will be for a shorter duration and be mostly surface waters containing less concentrated acid and dissolved metals*
- *Ground surface will dry out less frequently releasing less acid from surface MSO*
- *The only source of acid discharges will be limited volumes of acidified surface water held beneath reed beds (above the soil surface)*

Less acid stored in drains

How? Backfilling drains immobilises a pool of acid products that has collected as monosulfidic ooze (MSO). This will result in:

- *Acid products being locked up in a non - toxic form 1 m below ground surface*
- *Prevention of chemical oxygen demand when MSO from drains is washed into the Wallamba River*
- *Prevention of the classic 'slug' of acid water being flushed out of the wetland following heavy rainfall events*
- *Removal of a site (sump) for future acid groundwater accumulation*

Less flooding

How? The removal of farm crossings and the old headwall at the mouth of Darawakh Creek will:

- *Reduce the numerous obstructions to natural flows through wetlands*
- *Improve flood flow velocities and therefore will assist with natural scouring of the lower reaches of Darawakh Creek*
- *Remove pressure from landholders to clean existing drains which would trigger worse acid export than is currently occurring*
- *Necessitate progressive public acquisition of the wetland allowing more efficient wetland management*
- *Require removal of livestock from the wetland resulting in damage to wetland vegetation and pugging of ASS*

Less artificial ponding, more reed beds and less acid export

How? Removal of farm crossings and levees will allow:

- *Ponded water levels to resume natural (lower) levels*
- *Reeds to recolonise these areas in shallower less acid water*
- *Removal of a 'slug' of acid water waiting to be flushed out with next rain*
- *More acid products to be held under mat of reeds bound by organic material*

Less livestock damage to wetlands

How? Removal of livestock will achieve:
- *Less pugging of soil*
- *Less damage to wetland vegetation*
- *Better ground cover*
- *Less disturbance of acid products in soil*
- *Improved bird nesting and feeding habitat*

More reeds and rushes = nature's acid trap

How? Reeds and rushes will:
- *Trap and filter acid and other pollutants*
- *Lock up acid products and keep them immobilised at ground level*
- *Reduce the potential for 'black' water discharges by reducing overdrainage*
- *Prevent acid from leaving the Darawakh Creek and entering the Great Lakes waterways damaging aquatic life*
- *Provide habitat for wetland wildlife*

More fish, prawns and oysters

How? Removal of the old floodgated headwall at mouth of Darawakh Creek will:
- *Improve fish and prawn access*
- *Dilute and neutralise residual acid flows from the wetland*
- *Improve fish, prawn and crab habitat upstream*
- *Improve floodwater removal (less 'black water')*
- *Improve natural scouring of channel*

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