Remediating A Wastewater Lagoon to Become an Ecological and Community Asset.

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Abstract

The Swamp Road treatment lagoon (owned by Alexandrina Council) ceased, as a new sewage treatment facility became operational. Whilst the wastewater lagoon is still used intermittently as backup, it is anticipated in the future there will be cessation of sewage inputs and has prompted Council to investigate options, with a key focus on remediation and returning it to its original hydrological system and reconnect to the surrounding wetland once more.

An assessment of the existing (and future) land use and potential contaminants was undertaken with a focus on the following:

- Understanding the known ecological values of the property and the eco-hydrological history of the site.
- Undertaking a Tier 1 qualitative risk assessment.
- Understanding the hydrological behaviour of the site and how the existing wetland interacts within Burnside Creek catchment.

Three staged remediation strategies were developed for the decommissioning of the site. For each strategy, the estimate of earth works, concept design and associated cost-benefit analysis was formulated.

The project has highlighted the importance of understanding the eco-hydrological history of the site to conserve the existing ecological values into the future. Additionally, it provided the opportunity to identify potential sources of contamination (current site use) that may impact on the suitability (of the site) for re-development or warrant further investigations, and the development of eco-hydrological options for the expansion of the existing natural wetland. This project is an example of innovation and rejuvenating contaminated land for the benefit of the environment and the community.

Keywords

Lagoons, wetland, remediation

Introduction

A project was commissioned to undertake preliminary investigations into the decommissioning and repurposing of the Swamp Road sewage treatment lagoons property near Strathalbyn (Figure 1). The property provides artificial wetland habitat in the form of the treatment lagoons, which until recent times have provided near-permanently inundated habitat. Additionally, the property features a natural wetland fed by inflows from Burnside Creek and two smaller creeks to the east.

The Swamp Road Lagoon site is a habitat refuge for a variety of wildlife within a cleared agricultural and urbanised landscape. Of particular importance is the natural wetland area of the site, which provides habitat for waterbird breeding, foraging and shelter. There have been eighty-eight species of birds recorded on the site.

For the purposes of restoration planning, it is useful to consider the bird community of the site in terms of three broad guilds:

- Waterbirds of open water.
- Cryptic waterbird.
- Woodland birds.

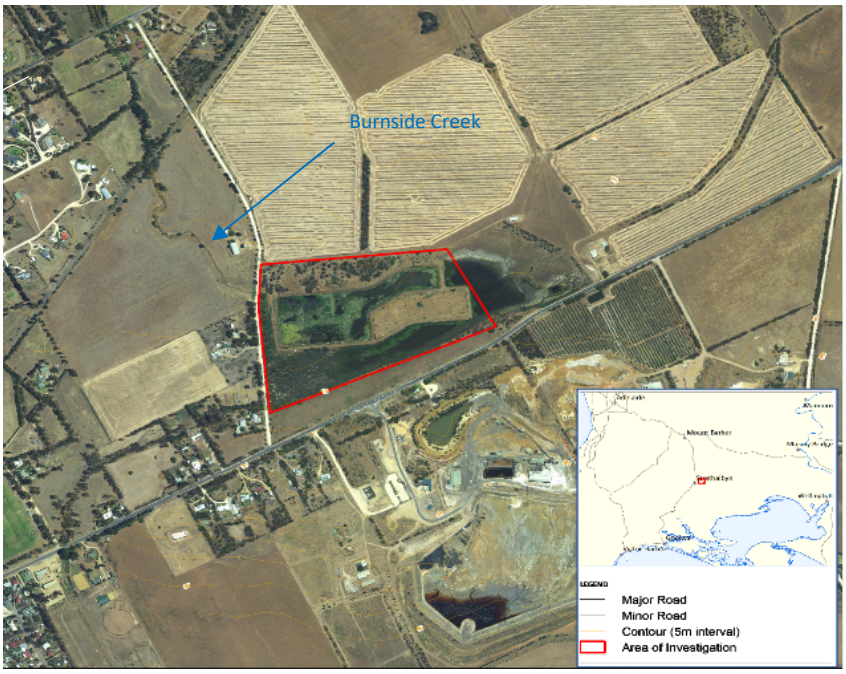

Figure 1. Map showing the property boundary of the Swamp Road site (red polygon). Source: DPTI and Alexandrina Council 2015.

Stage 1: Tier 1 Qualitative Risk Assessment

A site investigations report (Hewett et al, 2019) for the proposed site was developed. Whilst strong vegetation growth, limited site access, and preliminary soil sampling results below National Environmental Protection Measures (NEPM) nominated criteria (NEPM 1999) suggest a low risk of contamination, there is high likelihood some potentially contaminating activities including biological contamination via wastewater infiltration, asbestos containing materials and naturally elevated levels of lead identified in the Site History Assessment (SHA) may have impacted the soil and/or groundwater presenting a risk to human health and/or the environment at the site.

The potential likelihood of contamination via wind-blown and surface sediment movement from the Terramin Mine (located to the immediate south of study area) is considered low. This is further supported with dust deposition levels reported (as part of quarterly reporting) indicating no instances of exceedance from dust gauges on the mine site.

The results indicate the sludge material itself is aged and relatively benign and unlikely to pose a risk to groundwater if left in place. Ongoing monitoring of groundwater is recommended, during and following site remediation work. It is also recommended the main treatment lagoon (Lagoon A) be capped using clay material won from the site.

A review of site history indicated that (1878 to present):

- The general size and shape of the natural wetland (excluding the treatment lagoons) is relatively unchanged since the 1870s and likely unchanged since pre-colonial times. This suggests that key hydrological control features, such as sill elevation, remain largely unchanged.

- Construction of the treatment lagoons in 1981 reduced the area of the natural wetland by 32.5%, from 13.0 ha to 8.78 ha.
- The area of lignum shrubland around the margins of the natural wetland has been increasing since prior to treatment lagoon construction but accelerated thereafter.
- Since treatment lagoon construction, within the remaining natural wetland area, open water habitat, which occupies the deepest areas, has been gradually displaced by emergent sedgeland and lignum shrubland. This has provided greater habitat variability at the site and increased the diversity of fauna, particularly birds, now regularly present, i.e. it is not an undesirable shift.

Figure 2 – Figure 6 provide a chronological series of aerial images (1878 – current) of the original wetland habitat and the changes over time with the inclusion of the wastewater lagoons.

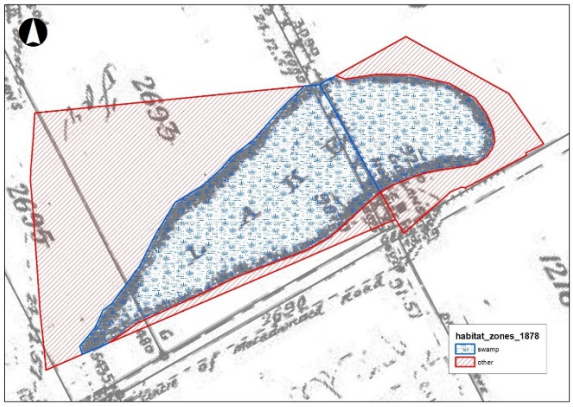

Figure 2. General habitat map of Swamp Rd based on 1878 survey map.

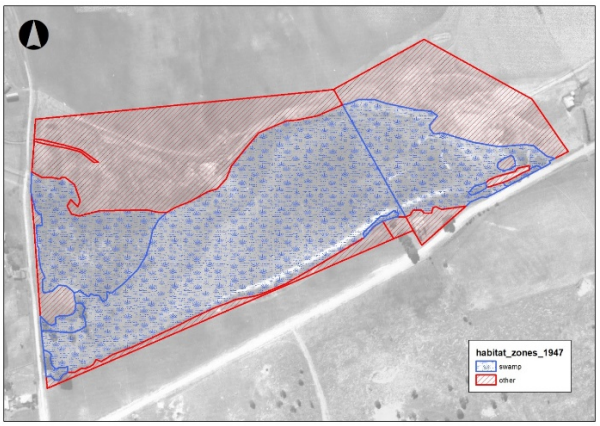

Figure 3 General habitat map of Swamp Rd based on 1947 aerial image.

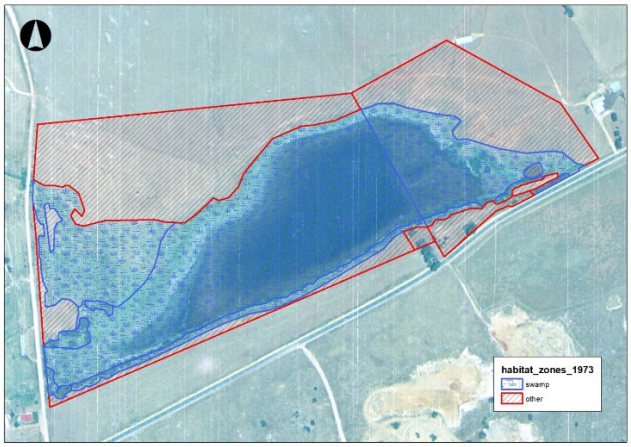

Figure 4 General habitat map of Swamp Rd based on 1973 aerial image.

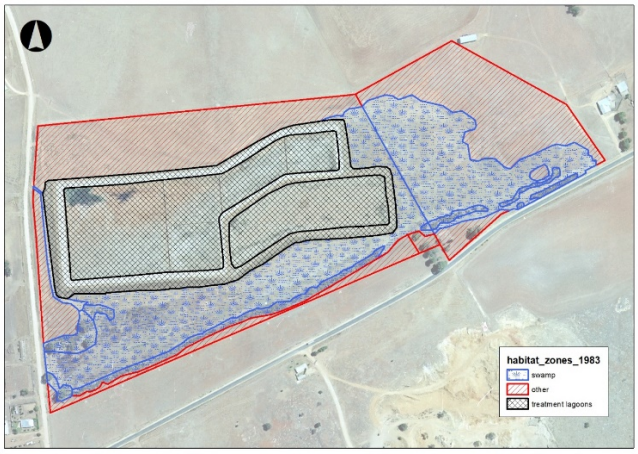

Figure 5 General habitat and infrastructure map of Swamp Rd based on 1983 aerial image.

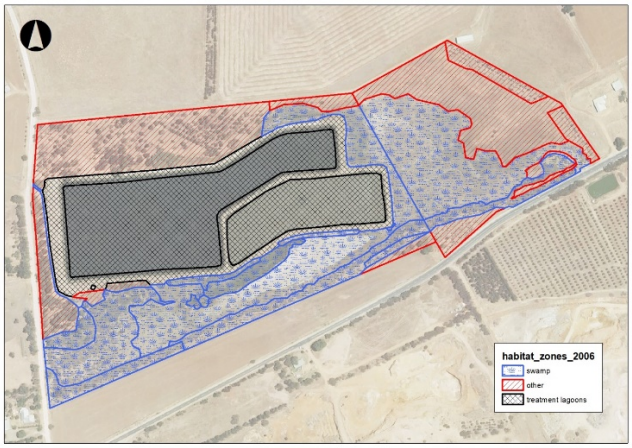

Figure 6 General habitat and infrastructure map of Swamp Rd based on 2006 aerial image.

Stage 2: Ecological and Hydrological Assessment

The existing hydrology of the natural wetland must be maintained to ensure the condition of remnant wetland vegetation including the health of remnant redgums and the vigour of lignum shrubland. This could be achieved by the following:

- Ensuring all natural inflows to the site from Burnside Creek and the two smaller tributaries to the east are maintained.
- Ensuring these inflows continue to be directed into the lowest lying areas of the existing natural wetland as a priority, rather than having to fill and spill through any additional waterbodies that may be created, before entering the natural wetland.
- Maintaining the current sill elevation of the natural wetland.

With wastewater inputs to the site set to cease, aquatic habitat at Swamp Road will be provided only by natural inflows from Burnside Creek and the two smaller tributaries to the east. Climate change is predicted to lead to reduced annual rainfall but increased frequency of intense rainfall events (CSIRO, 2018) with greater risk of erosion and flooding. In-stream wetlands such as Swamp Road can play a valuable role in protecting downstream assets from such risks, by capturing and storing large volumes of water and reducing peak flow rates downstream. The boom/bust ecology of episodic inundation is likely to cause rapid, dramatic increases in waterbird abundance and diversity when water is present, which in turn is likely to stimulate considerable community interest. However, there may be extended dry periods that could persist for several years. Waterbirds will be absent during dry times but woodland birds, or other features of the site, such as well-designed walking trails through attractive vegetation, can play a role in supporting passive recreation and nature appreciation during the dry phase. However, remediation should focus on priming the site for episodic inundation events and the biota they attract.

A MUSIC model of runoff generated from the Swamp Road catchment was developed. The average annual runoff from the Burnside Catchment (only) was 506 ML/annum, while the estimated average annual runoff from all contributing catchments (Burnside and eastern tributaries) was 666 ML/annum. The natural wetland, as it currently exists, has a volume of 24.1 ML when full. The water balance modelling indicated that approximately 40 ML of flow could be bypassed on average each year by the low-flow bypass (installed November 2018), with potentially 15 to 20 days each year where inflows to the natural swamp may be prevented by the bypass device. The low flow device was installed by the SA Government Department for Environment and Water (DEW). The device causes low flows (≤9.4 L/s) to bypass the natural swamp to discharge back into the Burnside Creek at its outflow point from the Swamp Road natural wetland (located immediately south of the treatment lagoons).

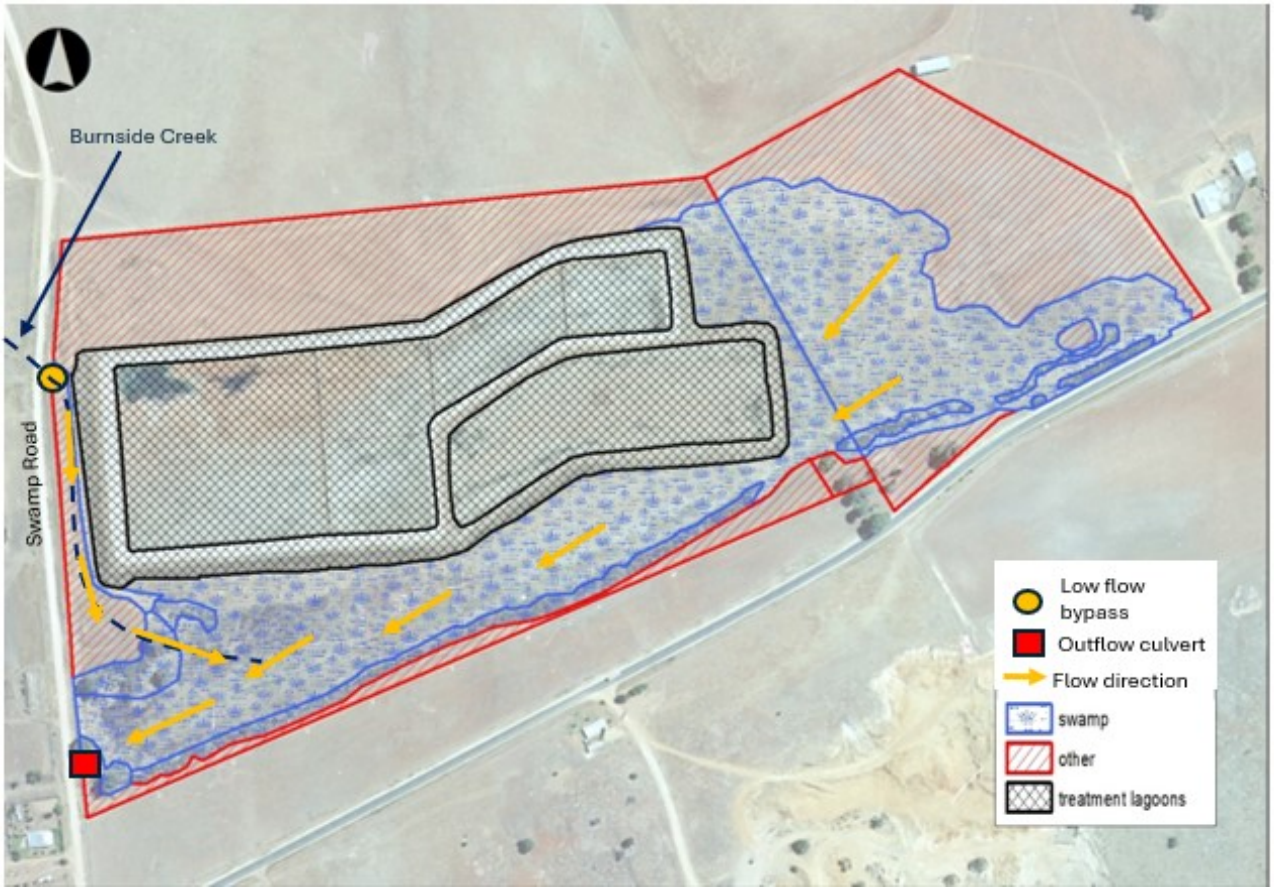

Figure 7 Existing hydrodynamics of Swamp Road Lagoon Site

For the remediation options, further discussions would be required with regulatory authorities to examine the decommissioning of the low flow device; whether that be removing it completely or closing the orifice on the device to allow all flows to be directed into the natural wetland. The removal of the low flow bypass device would increase the flows into the proposed wetland option(s) and improve the functionality of the wetland system.

Conclusions

Three remediation options for the Swamp Road site were developed in collaboration with stakeholder attendees at a workshop in Goolwa on 20th February 2019. The key assumption with all these options (presented below) is the low flow bypass device would be removed and/or the orifice is closed to increase flows from the Burnside Creek into the wetland system.

The key elements of the three remediation options for the site are as follows:

Remediation Option 1 (Minimum works to meet EPA requirements)

- Inflows from Burnside Creek via existing culverts under Swamp Rd (north-west corner) into existing inlet channel between Swamp Rd and Lagoon A, and from eastern tributaries located to the east of the site.
- Removal of the south-east bund associated with Lagoon B.
- Lowering the floor of Lagoon B (to 69.7 mAHD) to increase the area of the deepest part of the natural wetland.

- Trimming of northern and southern bund of Lagoon A to provide capping material for Lagoon A.
- Lagoon A remains a depression, fed only by rainfall and hydrologically isolated from the natural wetland.
- Active revegetation required of former Lagoon A area.

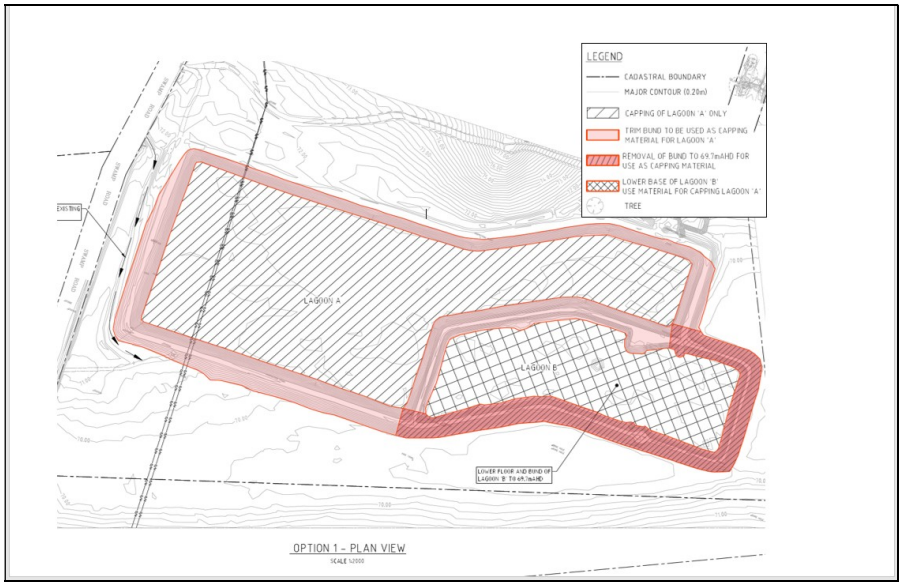

Figure 8 Remediation Option 1

Remediation Option 2 (Reinstate the natural pre lagoon site topography)

- Inflows from Burnside Creek via existing culverts under Swamp Rd (north-west corner) and eastern tributaries located to the east of the site.
- Removal of all wastewater bunds associated with Lagoon A and Lagoon B.
- Original 'delta' of Burnside creek could be recreated (optional).
- Lower part of the floor of Lagoon B (to 69.7 mAHD) to extend the natural wetland area.
- Import additional fill material to grade the existing wastewater lagoon footprint (A and B) up to the natural level.

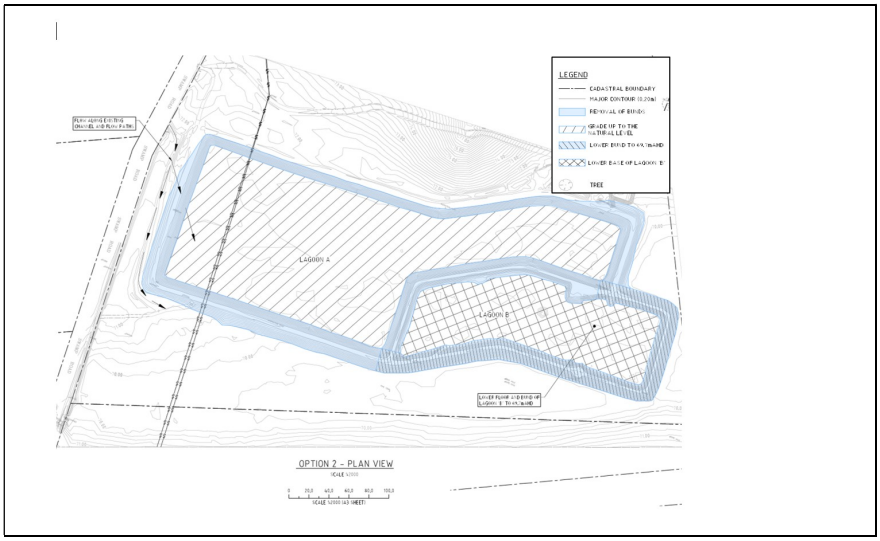

Figure 9 Remediation Option 2

Remediation Option 3 (High flow overflow to extended inundation area)

- Inflows from Burnside Creek via existing culverts under Swamp Rd (north-west corner) into existing inlet channel between Swamp Rd and Lagoon A, and from eastern tributaries located to the east of the site.
- Lowering of the south-eastern bund associated with Lagoon A to the sill level of approximately 70.4 mAHD.
- Trimming of northern and southern bund of Lagoon A to provide capping material for Lagoon A.
- Possible inclusion of outlet pipe from Lagoon A.
- Lagoon A becomes an overflow area when water levels in the natural wetland approach full supply level.
- Removal of the south-east bund associated with Lagoon B to incorporate Lagoon B into the natural wetland.
- Lowering the floor of Lagoon B to 69.7 mAHD to increase the area of the deepest part of the natural wetland.
- Active revegetation required of former Lagoon A area, which will present a weed management challenge due to the intermittent inundation regime.

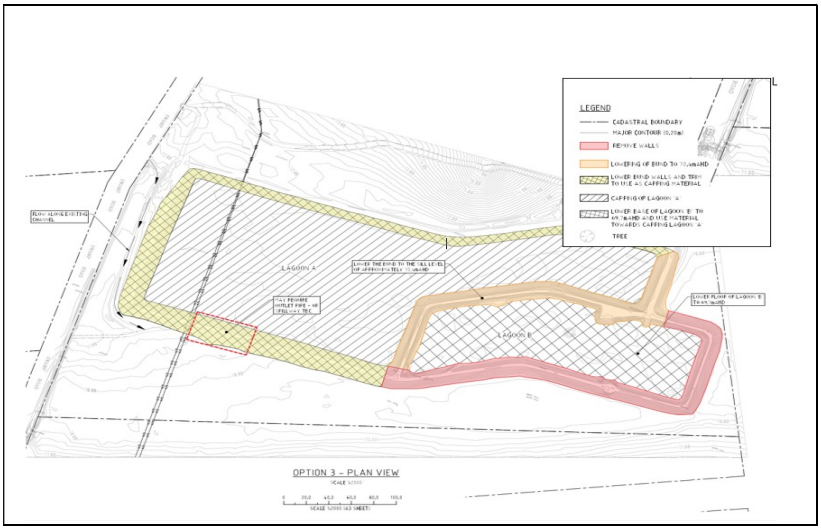

Figure 10 Remediation Option 3

Currently the Swamp Road wastewater lagoon is still required for wastewater contingency, i.e. major network failure and will remain until an alternative wastewater storage can be found to mitigate the risk.

The remediation option(s) provide strategic opportunities for the site once wastewater inflows cease. Before deciding on the preferred option, additional consolation and investigations are required which include the following (but not limited to):

- Consulting with the Hills and Fleurieu Landscape Board/ DEW regarding the status and operation of the low -flow bypass and the possibility for decommissioning of the device for the purposes of increasing inflows from the Burnside Creek into the proposed wetland system.

- Further consultation with Council and other stakeholders such as the Strathalbyn community and other representatives to further "flesh" out the options considered.

- **Detailed geotechnical investigations** - There is limited geotechnical information available for the site, which could limit the excavation of Lagoon B proposed under all three remediation options. It is recommended that detailed investigations be undertaken.

- **Groundwater at shallow depths** – Groundwater monitoring data has indicated shallow groundwater, particularly in the vicinity of proposed excavation works associated with Lagoon B. Possible de-watering strategies may need to be considered/implemented before excavation commences.

- **Soil testing of bunds and base coarse material below Lagoon B** – The site history assessment process and visual inspections indicate that the material in the bunds and beneath Lagoon B should be suitable for use as capping material for Lagoon A. Testing of the material will however still be required to confirm the use of these materials in this way, particularly for remediation Option 3.

- Refining the revegetation plan for any detailed design phase for the remediation options.

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