Hydrological Restoration of the Critically Endangered Fleurieu Peninsula Swamps Ecological Community

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Key Points

- The Fleurieu Peninsula Swamps ecological community is unique to the Fleurieu Peninsula and is critically endangered.
- Almost all FP Swamps, including the most intact examples, have been impacted by past attempts at drainage and conversion to agriculture, although further assessment is required, particularly on private land.
- Drains are negatively affecting habitat quality within FP Swamps.
- The planning and implementation of hydrological restoration at Glenshera Swamp, the largest and most intact FP Swamp, commenced in 2016 and is now well advanced, providing an example to guide similar works at other sites.

Abstract

The Fleurieu Peninsula Swamps ecological community is listed as critically endangered under the Federal *EPBC Act 1999*. This community has a very restricted geographic range and is highly biodiverse. Due to their fertility, Fleurieu Swamps were historically targeted for conversion to agriculture, involving clearance of vegetation and the excavation of drains to prevent inundation and reduce waterlogging. Recovery efforts over several decades focused on fencing to exclude livestock, weed control and, to a lesser degree, prescribed burning. More recently, Nature Glenelg Trust, in collaboration with landholders and other partners, has added hydrological restoration to the suite of recovery actions.

Many Fleurieu Swamps, including some of the most intact remnants, show clear evidence of historical drainage and its ongoing ecological impacts. On-ground works to address these legacy impacts include the placement of blocking structures within drains and complete drain backfilling. Works aim to reverse the drawdown of groundwater and reinstate natural patterns of surface inundation and flow. Dramatic and rapid improvements to swamp vegetation have been observed in important sites such as Glenshera Swamp (Stipiturus Conservation Park) as well as measurable improvements to hydrology.

Challenges to this work have included the need to balance remnant values with the short-term disturbance required for on-ground works, the erosion of works in extreme rainfall events, the difficulty of earthworks in waterlogged ground and, in some cases, uncertainty of how restoration fits within water allocation planning.

With artificial drains ubiquitous in the landscape there remains considerable scope to expand hydrological restoration throughout the geographic range of Fleurieu Swamps. Climate change reinforces the urgency of the task. The main constraints are shared by most other conservation initiatives; funding for works and ongoing monitoring and the willingness of private landholders to forego primary production for conservation outcomes.

Keywords

Fleurieu Peninsula Swamps, hydrological restoration

Introduction

Fleurieu Peninsula Swamps (FP Swamps) are a distinct ecological community with a very restricted geographic range (Figure 1) and a naturally limited extent within that range. Littlely and Cutten (1994) estimated that

2094 ha of FP Swamp originally existed, but this had been reduced, by clearance and drainage, to 1567 ha (75%) and, of this, only 545 ha (26% of the original total area, 77 individual swamps) was still in relatively good condition in 1993. Remnant FP Swamps are typically small, with an average size of 6.4 ha (DCCEEW 2021). In March 2003 the FP Swamp ecological community was listed as critically endangered under the Federal *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (Bachmann and Farrington 2016).

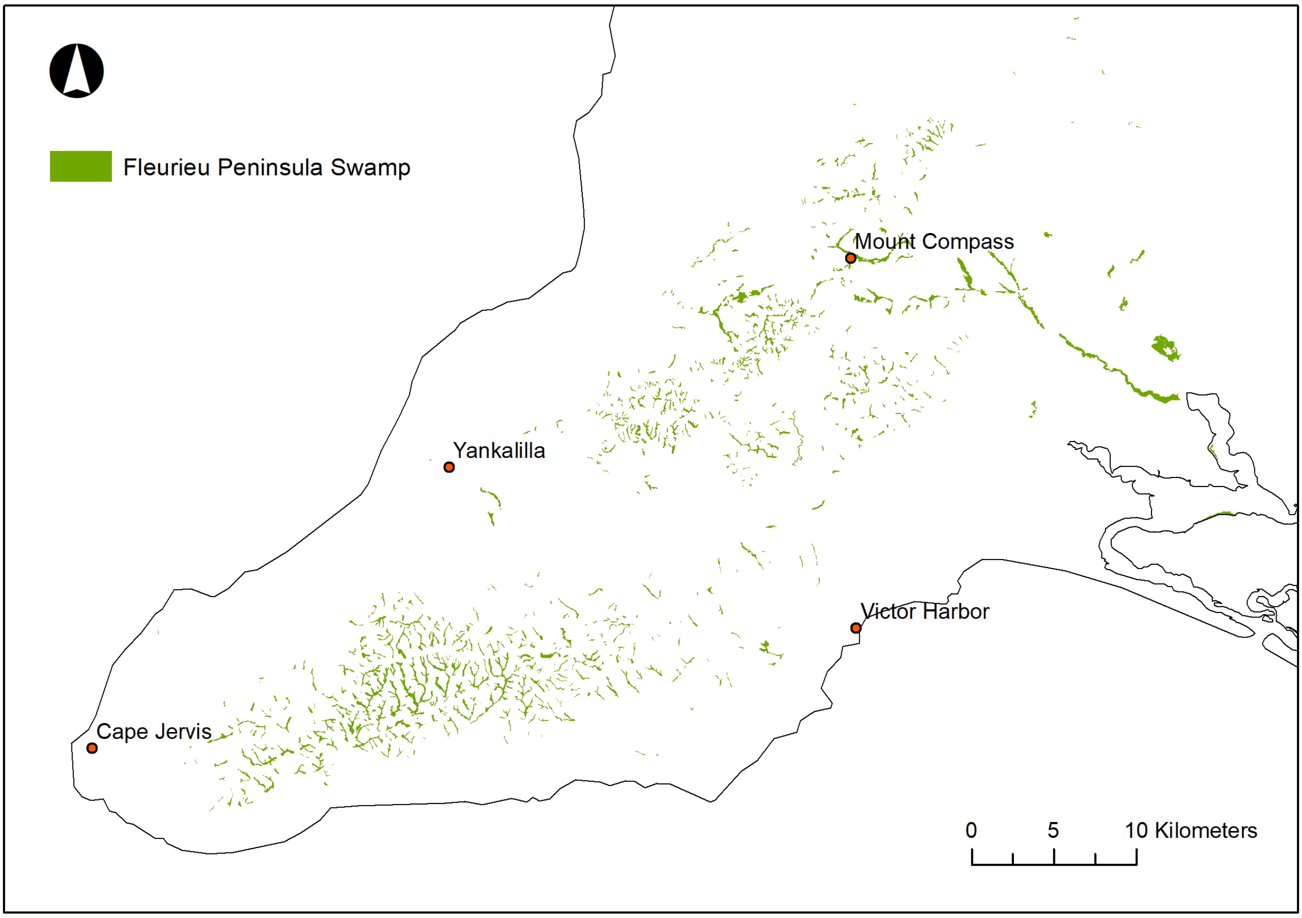

Figure 1. The geographic range of FP Swamps.

FP Swamps occur in or adjacent to permanently waterlogged soil on peat, silt, peat silt, or black clay soils (DEW 2023). Waterlogging is maintained by the surface expression of groundwater, although surface inflows play a role in the hydrology of some sites. On the Fleurieu Peninsula, groundwater expression can occur on sloping ground elevated above the valley floor and consequently FP Swamps can occur in these elevated, sloping locations. Thus, the persistence of standing surface water is not essential, although it occurs at some sites.

FP Swamps have high biodiversity compared to other remnant native vegetation on the Fleurieu Peninsula. They are known to support 170 species of native flora, over half of which are rare or threatened at the national, state or regional level (Natural Resources SAMDB 2015). FP Swamps are critical habitat for the endangered Mount Lofty Ranges southern emu-wren (*Stipiturus malachurus intermedius*) and support a range of other rare and threatened fauna species.

The conservation advice that led to the listing of FP Swamps as a critically endangered ecological community in 2003 included a list of threats contributing to the decline of FP Swamps (DCCEEW 2021). Notably, this list did not include artificial drainage. With the implementation of a recovery program from 1993 (CCSA 2020), recovery actions focussed on livestock exclusion (fencing), revegetation, weed management and fire management. More recently, the perceived drying of many FP Swamps raised community concern (Bachmann and Farrington 2016).

Hydrological restoration was not a focus of FP Swamp recovery for some years, yet water regime is a fundamental driver of wetland ecosystems and anthropogenic alteration of natural water regimes has occurred in many remnant FP Swamps, including some of the largest and most intact remnant sites. For example, Hesperilla Conservation Park (proclaimed 2010), a relatively intact FP Swamp, has an extensive history of drainage and clearance (Bachmann and Farrington 2017). The earliest aerial image of Hesperilla (1949) shows the swamp largely clear of native vegetation and featuring a network of drains (Figure 2). Analysis of historic aerial imagery in other parts of the Fleurieu Peninsula has revealed similar evidence of intensive efforts to drain swamps for conversion to agriculture (Bachmann and Farrington 2016, Farrington et al. 2017). Without remediation, these drains continue to adversely affect swamp hydrology and therefore swamp ecosystems.

Figure 2. 1949 aerial image of contemporary Hesperilla Conservation Park (yellow polygon).

Although the FP Swamp vegetation has naturally regenerated within Hesperilla CP, and other sites with similar land-use history, our contention is that the network of old drains within these swamps is having an ongoing hydrological impact that is compromising the FP Swamp ecosystem. Ongoing impacts are likely to include:

- Reduced swamp area due to reduced maximum area of inundation and/or waterlogging;
- The drying of swamps compared to their original condition, with reduced abundance or loss of the most water sensitive species;
- Reduced resistance to weed invasion, particularly by weed species favoured by slightly drier conditions;
- Reduced water holding capacity of swamps leading to reduced streamflow downstream during dry spells.

Hydrological Restoration Works at Glenshera Swamp

Glenshera Swamp, located in the headwaters of the Myponga River, is approximately 40 ha in size and is the largest remaining intact peat swamp ecosystem on the Fleurieu Peninsula (DEW 2023). Glenshera is supported by permanent groundwater discharge and seasonal surface inflows from a small catchment to the east. The swamp supports several of the iconic threatened species of FP Swamp habitats including the MLR southern emu-wren (*Stipiturus malachurus intermedius*). In 2003, 68 ha of land that included most of Glenshera Swamp was purchased by the South Australian Government, and in December 2006, the government-owned property was proclaimed as Stipiturus Conservation Park (Bachmann and Farrington 2016). The swamp and the greater property were far from intact at the time of reservation, with cleared areas, weed invasion and evidence of historic drainage. Following several years of restoration work focussed on weed management and revegetation, in 2015 Nature Glenelg Trust was invited to develop hydrological restoration options for the Reserve (Bachmann and Farrington 2016).

Using a combination of archival research, historic aerial imagery, a LiDAR-based digital elevation model (DEM) and field observations, we mapped 8.8 km of drains in and around Glenshera Swamp (Figure 3). This included private land into which the swamp extended immediately west of the Reserve.

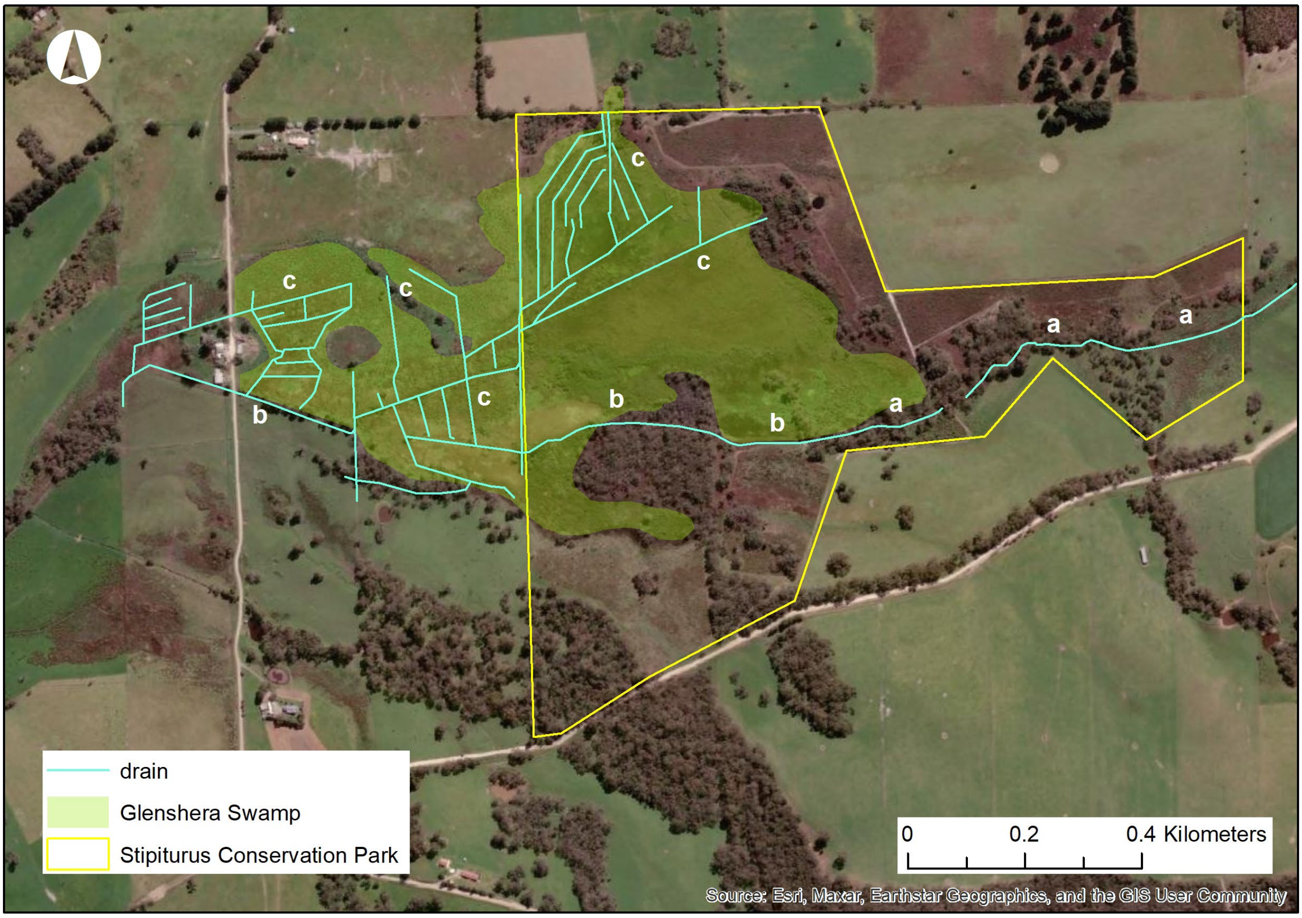

Figure 3. Drains within and around Glenshera Swamp overlain upon the contemporary aerial image. The general direction of flow is from east to west.

The key features of artificial drainage included (as labelled in Figure 3):

a) An inflow drain carrying seasonal surface inflows from the east that straightened the original inflow creek, therefore bypassing the natural creek meanders. This drain was actively eroding;

b) the extension of the above drain, which causes seasonal surface inflows from the east to bypass Glenshera Swamp;

c) a network of groundwater drains within the swamp and extending upslope on its northern margins.

Plans to remediate these drains were developed (Bachmann and Farrington 2016) and have been implemented in a staged manner since autumn 2017. Initially, with the assistance of volunteers, a series of geofabric sandbag structures were installed along the inflow drain to lift water out of the drain and re-engage the natural creek meanders (Figure 4). These structures also directed seasonal surface flows back into Glenshera Swamp for the first time in around 70 years (Figure 5). The advantages of sandbag structures are their low cost and ease of adjustment, by adding or subtracting bags, enabling hydrological restoration concepts to be trialled and, where required, modified. However, these structures are prone to damage by high flows, as has occurred at Glenshera, and the geofabric eventually degrades in sunlight.

Figure 4. Community volunteers and a recently completed sandbag structure, 5/4/2017. A cutting has been made through the spoil mound of the drain, to the right of the structure, to facilitate lateral flow into the natural creek meanders.

Figure 5. Surface inflows redirected back into Glenshera Swamp by Structure 5, winter 2017.

A second phase of works involved the use of a small excavator to bury the sandbag structures, i.e. to make them permanent. For erosion control, coir netting was placed over the buried structures; complete overtopping of these structures is likely to occur in extreme flow events. Complete backfilling of the inflow/bypass drain was not possible because erosion over c.70 years had increased drain volume so that the remnant spoil originally excavated, which lies parallel with the drain long its length, was of insufficient volume. However, complete backfilling was achieved in some strategic locations where sufficient spoil could be gained without disturbing native vegetation or creating an erosion risk.

Another phase of works involved the use of a small excavator to backfill the network of groundwater drains within the swamp itself (areas labelled “c” in Figure 3) on both the Reserve and adjoining private land. Here, drains originally cut into peat and spoil mounds could be completely backfilled because little erosion had occurred. Some temporary disturbance of native vegetation was unavoidable, however natural regeneration of FP Swamp vegetation generally occurred soon after the works, particularly if the works were located within areas of low weed cover (Figure 6). Additionally, weeds (e.g. *Phalaris aquatica* (Figure 7)) and terrestrial (non-swamp) native plants (e.g. bracken, *Pteridium esculentum*) reduced in cover following the works and were replaced by true FP Swamp species. Before-and-after monitoring of outflows from Glenshera Swamp (Figure 8) suggests that hydrological restoration has made winter flows more sustained (less flashy) and has increased summer baseflow, with likely benefits for downstream ecological values.

As at June 2024 a total of 4.04 km of drains within Glenshera had been remediated via complete backfilling and an additional 0.5 km remediated via instream structures. The task is almost complete for the current extent of the swamp, although more could be done if some adjoining land use changed from farming to conservation.

Figure 6. A recently backfilled drain within the heart of Glenshera Swamp (left) and the same view two years later (right) showing dense natural regeneration of prickly tea-tree (*Leptospermum continentale*) and other native plants within the works footprint (inset).

Figure 7. Time series showing displacement of introduced pasture grasses (mostly *Phalaris aquatica*) by native sedgeland (mostly *Juncus sarophorus*) facilitated by hydrological restoration.

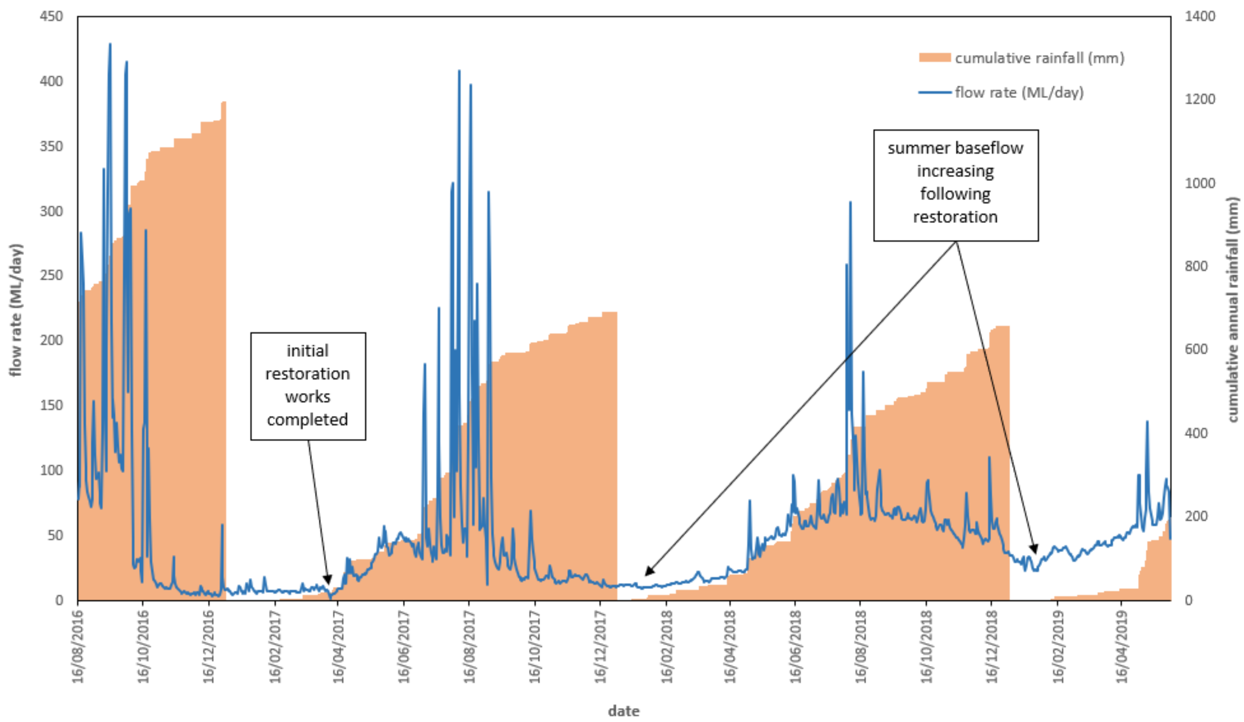

Figure 8. Outflows from Glenshera Swamp, measured before and after the initial works in autumn 2017, suggest summer baseflow has increased and winter flows may have become more sustained (less flashy).

Conclusions

- Hydrological restoration works at Glenshera Swamp to date have:
  - Partially restored the natural meandering inflow creek hydrology, which has restored creek habitat, reduced erosion and likely improved the water quality of surface inflows to Glenshera;
  - Restored seasonal surface inflows to the heart of the swamp;
  - Remediated groundwater drains through the heart of the swamp, ensuring groundwater and surface water inflows spread broadly across the bed of the swamp in these areas;
  - Caused the replacement of weed and terrestrial native plants with true FP Swamp species.
- Given that water regime is a fundamental driver of wetland ecosystems, hydrological restoration should be a first order priority of wetland restoration. Other restorative actions such as weed management and revegetation, while important, are lower order priorities because a restored hydrology can strongly influence how they are undertaken or even render them unnecessary.
- Hydrological restoration trials, using soft infrastructure (e.g. sandbag structures) provide a low-cost, reversible and readily adjustable approach to test concepts and demonstrate outcomes before committing to permanent works.
- The legacy of historic attempts at drainage is widespread within FP Swamps, including the most intact remnant examples. Hydrological restoration to date has focused mainly on the larger swamps on public land. Hydrological restoration of FP Swamps on private land presents an opportunity to make significant gains in the condition of this critically endangered ecological community.
- Hydrological restoration is likely to become increasingly necessary to maintain the ecological values of FP Swamps given the drying climate.

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