Overcoming increasing degradation from mallee seeps on Eyre Peninsula

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Key messages

- New trials demonstrate clear methods for farmers to identify, assess and rehabilitate mallee seeps land back to production.
- Farmers must differentiate between localised mallee seeps, highly saline stream systems and dry saline "magnesia" land, before applying management strategies.
- Strategic lucerne or *Puccinellia* establishment and pumping water for farm use are under investigation as management strategies within various farming systems.

Why do the trials?

The number and severity of mallee seeps have been increasing across the EP in recent years due to the removal of deep rooted summer weeds in modern farming systems, and exacerbated by very high rainfall periods such as experienced through 2010/11 and 2016. While wet periods drive the issue of excess water flowing into seep prone areas, it is often the drier periods with high evaporation that accelerate the capillary rise of salts and concentrate them in the surface soil layers, resulting in large, bare salt-scalded patches.

Trials in the SA Mallee have shown that seep areas can be restored to production if the flow of water from surrounding deep sands can be intercepted and utilised, and soil cover is re-established on bare scalded or water-logged areas.

This article summarises methods used to assess seeps and mange seeps. It describes the establishment of multiple demonstration sites across EP to improve our understanding of how seeps operate locally and which management strategies can be most effective.

How was it done?

Five sites were established in 2020 with consultant Chris McDonough, EP Landscape Board and AIR EP officers working with local farmers at Kimba, Lock and Rudall. The sites ranged from large, well established salt scalds to areas only very recently beginning to bare out. These areas were often surrounded by crop growing twice as well as the remainder of the paddock due to increased water availability.

At each site the area was first assessed to determine the:

1. ***Recharge Zones*** (where the water is coming from). This was achieved by looking for adjacent deep sand areas with poor water holding capacity, compaction or limited plant growth, and evaluating whether this is simply a direct flow out of a single sandhill, or part of a larger catchment system. NDVI imagery proved very useful for this purpose (see guide of how to do this at http://www.malleeseeps.msfp.org.au/).
2. ***Discharge Zones*** (surface areas being currently affected as well as the areas under future threat). An initial visual assessment noting types of any

vegetation, surface saline crystals and increases in surrounding crop growth was made. Soil samples were taken from surface and deeper soil layers to determine salinity levels. Finding the depth and quality of the perched water table was vitally important. This was achieved at each site using a post hole digger and/or soil auger. The areas under threat of further degradation were also quantified using NDVI images of the site, as surrounding areas stay greener for longer where a perched water table exists.

3. ***Potential Interception Zones*** (where strategic management could be effectively applied to reduce water flows). These were determined after reviewing the information gained in steps 1 and 2 and after discussion with the farmers. In some cases a further auger hole was dug to assess the depth and quality of the perched water table in these zones.

What happened and what was done?

Kimba lucerne over sandhill to bring recent seep scalds back to cropping in mixed farming.

This site was established on the farm of Tola Ag near Kimba in May 2020. There were 2 bare scalds on either side of a sand hill that had suffered wind erosion following dry conditions early in the season. The north eastern scald was 0.3 ha in area with a perched water table at 55 cm below the surface and wet clay to 160 cm, underlain with a drier impervious clay layer. Soil salinity was slight at the surface (0.33 dS/m) but increased to 0.58 dS/m at 20-30 cm, and pH (water) increased from 9.8 to 10.2.

As livestock are an important part of the Tola Ag farming system, and this sandhill has presented many challenges for achieving consistent yields and has high susceptibility to wind erosion, it was decided to establish lucerne over most of this hill (approx. 1000 m X 50m). This will provide valuable fodder and reduce water flow into the growing scald area. On the scald, *Puccinellia*, a salt tolerant grass, will be established to provide permanent soil cover and stop surface salt accumulation. After a few years it is hoped that the scalded area can be returned to normal cropping.

The lucerne was sown in July and suffered erosion due to strong winds and limited soil protection, so while there are patches of reasonable establishment, Tola Ag will look to re-establish the lucerne in 2021. A successful summer crop mix planted in October 2020 over the sides of this sandhill helped to utilise the spring and summer rainfall. *Puccinellia* was spread with a baitlayer in July 2020 with reasonable plant densities at establishment. This is expected to thicken up across the scald this season.

This site has piezometers placed within the scald and 30 m up the slope within the lucerne area, along with a soil moisture probe. All have continuous data logging to monitor the success of the lucerne in reducing the height of the water table. Ongoing soil measurements will be taken within the scald to estimate when the site may be restored to cropping, or whether an extra sand layer may be required to ensure successful crop establishment, once the extra flow of recharge water into the site has been halted.

On the south western side of the sandhill, the surface soil was a heavier clay loam, but no perched water table was detected. This scald did not have high soil salinity or pH at the surface or in deeper soil layers. It is thought that poor growth on this patch and other clay areas in the paddock, is not driven by a perched water table, but is more indicative of dry saline land often referred to as “magnesia patches”. So this site is not likely to be impacted by the strategic placement of deep rooted perennial vegetation to reduce water flows.

Kimba 2. Establish sump to pump out perched water for farm use & rehabilitate seep scald

This site is also at Tola Ag, with a 1 ha bare scald within a 5 ha area identified from NDVI images as being under threat of degradation (Figure 1). The water flows into this area are mainly from the north-west, through a larger basin of sandy catchment which appears to channel water into this seep area. The scald contained saturated sand to a depth of around 2.5 m filling right up to the surface after rainfall events. Surface soil salinity was at a level where crop growth might be impacted (0.5 dS/m). Fortunately, water quality is still reasonable at 2.8 dS/m (1700 ppm) and is suitable for stock water and farm use.

It was decided to install a lined sump filled with stone (Figure 2) with a solar pump to be attached in 2021 to move water to an existing tank for stock water and possible other farm uses. This sump will soon be covered, to avoid salinity increasing in the open dam water and becoming unsuitable for use. It is hoped that the removal of water will be enough to lower the perched water table, stop the scald spread and in time restore the scald back to cropping. *Puccinellia* was successfully established over much of the bare scald area to halt surface salt accumulation and help restore the soil back to conditions suitable for cropping.

Figure 1. NDVI image of Kimba 2 scald, threatened area (dark).

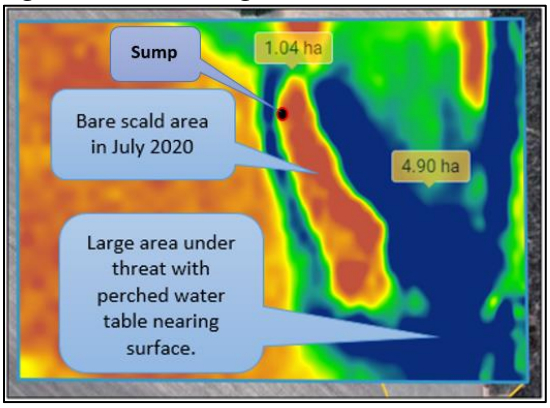


Figure 2. Sump under construction at Kimba 2.

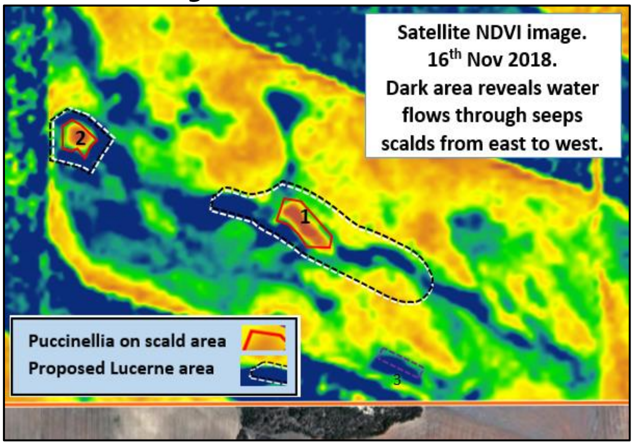
Piezometers have been set at 20 m, 40 m and 80 m away from the sump with continuous data-loggers, as well as one in the sump itself. Rates of water removal will also be recorded which should lead to an excellent understanding as to how quickly water can be removed, how quickly it will refill, and how wide the impact on the water table will be. If successful, this could provide an innovative and effective method of not only draining seep areas but also enhancing farm water supplies.

Kimba south. Using NDVI to identify areas for lucerne to stop water flows through linked, developing seeps

This site is on Jericho's farm, south of Kimba and is a large white saline scald that has been farmed around for many years but is expanding to the west. Further west is a recently formed but rapidly expanding scald area nearby. Soil from the large scald is highly saline at 1.2-1.4 dS/m in the top 30 cm, with a pH (water) of 10.2. The salinity of the perched water in the centre of the scald measured 15 dS/m (9000 ppm), while edge areas were very shallow and less saline (3-6 dS/m).

The second more recent seep (first observed in 2016) has toxic levels of salinity at the soil surface (0.8 dS/m) but very low salinity below this. Salinity of the perched water table at 30 cm was 4.5 dS/m (2700 ppm). Thirty metres from the scald edge in the adjacent sand hill there is a water table at 220 cm with salinity of 3.3 dS/m (2000 ppm).

Figures 3. Satellite NDVI image at Kimba south showing water flow links between seeps & targeted Lucerne.



Figures 4. *Puccinellia* growing well on salt scald near piezometer at Kimba south.

By assessing the landscape along with the NDVI satellite images (Figure 3), it became clear that the 2 sites were linked, and there was a strong potential for them to expand towards each other. While recharge was coming from the sandy rises on the northern side, there are clear indications of water accumulating and flowing through the landscape from east to west through each seep. As the water table salinities were well within the lucerne tolerance levels, it was decided to establish lucerne along this zone and around each seep. This should be highly productive and limit the flow of water into these expanding seep scald areas (as shown in Figure 3). The Jericho's have sheep and were happy to utilise lucerne within this paddock. *Puccinellia* was also established on the scald areas by planting seedlings, throwing seed out by hand and machine sowing, with all methods providing reasonable results.

This site has 2 piezometers set in the lower and western seep, along with a soil moisture probe to monitor the impact from the lucerne. It is hoped that this seep will be restored to cropping once the water flow is stopped. Some sand amelioration may also be done. A good outcome for the highly saline main seep would be complete coverage with salt tolerant pasture and stopping the seep from spreading, then seeing what is possible at a later date.

Lock. Using a narrow Lucerne strip and sand amelioration to stop an early stage seep.
This site on Glover's focusses on 2 important seep management strategies. The first strategy is recognising and taking action whilst the area is still growing significantly more biomass due to the presence of the rising perched water table and before it becomes a major salt scald. The second strategy is sowing a narrow lucerne strip to lower the water table. Lucerne should lower the water table, despite being in a continuous cropping paddock, because it will also use water during summer. This should reverse the scalding trend and protect a far greater area of highly productive land.

This site has been set up with piezometers, a moisture probe and a rain gauge, ready for the 20-30 m wide lucerne strip to be established in 2021. The landholder will undertake some sandhill amelioration to improve root penetration, soil fertility and moisture retention for crop use. Previous mallee trials have shown this can greatly increase in-season water use and crop production in the recharge zone, but it is the deep rooted perennials in the interception zone that will have the largest and most likely impacts on mallee seep recovery.

Rudall. Aiming for rapid restoration of 4 year old seep scald back to cropping.
This site on the Wiess property has gone from a small waterlogged patch in late 2016 to a 0.6 ha bare scald in 2020. The water table is at 1 m from the surface, with salinity at 3.5-4.3 dS/m (2200-3000 ppm). The top half of the paddock is a gentle rise of coarse sand with poor water holding capacity. The scalded area has mid-range salinity in the surface soil (0.55 dS/m). This suggests that if the flow of water can be stopped with a lucerne strip between the sand and the scald and salt tolerant grass can be established to provide year round cover, then this site may return to cropping soon. The salt tolerant grass will reduce evaporation and allow leaching of surface salts in any future seasons which have high rainfall events. A return to cropping would depend on a consistent lowering of the water table below 2m, and a reduction in surface soil salinity to around 0.2 dS/m. Adding sand to the surface may also be considered to accelerate topsoil rehabilitation.

What does this mean for farmers?

It is important farmers understand the 3 distinct types of saline land issues on EP (often appearing on the same farm) as they have different causes and management strategies:

1. Mallee seeps, driven by localised perched water tables, are able to be managed with high water use strategies as described within this article.
2. Highly saline stream soaks (water table induced salinity) that are driven by rising water tables associated with river systems of regional catchments. These need major district works to improve them.
3. Dry saline land or "magnesia patches" are often found on heavy clay areas and shallow stony ground, exacerbated by dry periods, but not driven by perched water tables. They can be improved through addition of organic matter. If one is located near a sandy rise and you are unsure if it is a mallee seep, it is worth auguring a posthole to 1-2m. If you hit a sloppy layer of clay (perched water table), then this excess water should become your focus of remedial management.

Famers and consultants are advised to follow a similar method of identifying the key zones within their seep landscape. Management strategies centre on stopping the flow of water into the seep area and establishing cover over scalded areas. Digging holes to find the presence, depth and quality of perched water is critical to making informed and effective management decisions, and utilising NDVI imagery (follow the MSF guide) can guide where strategic action is most needed.

Establishing salt tolerant grasses on scalds is a vital step to break the spread of degradation. Lucerne strips have proven to lower water tables in the SA Mallee and can fit within farming systems to help bring land back to production. Mallee Seeps can be turned around, and early recognition and action is more effective and easier than just watching them grow!

If any farmer is interested to learn more about seep issues, contact the EP Landscape Board on 8688 33200 or Amy Wright 0467 004 555, AIR EP Regional Agricultural Landcare Facilitator.

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