USE OF REMOTE MONITORING SYSTEMS

to improve knowledge and decision making around dryland salinity management

REPORT PREPARED BY FELICITY TURNER FOR THE COORONG TATIARA LAP

Key Points:

- **Be aware of which process is causing dryland salinity in your patch, as this will need to be factored in when making management decisions**
- **The use of real time data has improved land manager confidence in the management of dryland salinity**

Background

After decades of successful management and drier years, regional dryland salinity is slowly increasing across the Coorong District Council region with large areas believed to be at risk of becoming saline in the coming years.

Since 2016, the Coorong Tatiara Local Action Plan (CTLAP) has been conducting work on new and historic saline sites to remediate these areas, and reduce the total area of degradation caused by dryland salinity. Where successful, remediation and recharge reduction has provided groundcover and reduced the amount of soil erosion occurring on these areas. Programs undertaken by the Coorong Tatiara Local Action Plan have provided opportunities to explore what is and isn't working in the management of local dryland salinity management systems. As part of this work, several observations have been made by farmers around the conditions that appear to improve results when remediating soils. In particular, the 'flushing effect' required by natural rainfall events and the importance of groundcover in these systems.

Fig 1. Shane Oster, Alpha Group Consulting installing automated weather station and probe at Elephant Lake, 2020

PROJECT DETAILS

Project ID: nbn00001

Funding Body

This project was funded through Landcare Australia by a NBN Co Sustainable Agriculture Landcare Grant

Project Duration

2020-21

Site Locations

Coomandook, Meningie East, Mount Charles

The opportunity arose to utilise automated monitoring equipment to test these observations by using automated monitoring equipment to measure the depth of the water table, soil moisture levels, soil salinity levels and environmental conditions in real time at three monitoring sites across the Coorong and Tatiara District Council regions. This data is updated via automated telemetry every 15 minutes and both real time and historical data can be viewed utilising the internet. These sites have been selected as they are viewed as 'transient' saline sites.

Initial findings from the information being generated suggest that there are two very different dryland salinity processes that are occurring across the region (even within relatively close proximity of each other). It is hoped that additional funding can be sourced to expand monitoring sites and continue the interpretation of this data into the future allowing farmers to make more informed decisions when managing saline areas (particularly those that are transient and scald one year, but may be back into production in the following year).

It is hoped that this technology can be expanded to the mitigation phase; improving our understanding of crop and pasture water use in the landscape and how much rainfall is effectively used compared with what travels through the profile and recharges into the groundwater system.

Interpreting soil moisture probe data

- Summed graphs

The summed graphs provide information around the total amount of water in the profile at any point in time. Where soil moisture probes have been in for several years (>5) e.g. soil moisture probe at Pine Hill[1] (Figure 2), we have built up an understanding around the "wettest point" – as close to full capacity as has been observed and the "driest point" observed – beyond which the crop or pasture can't extract any additional moisture. The difference between the wettest point and driest point is the maximum amount of water available to the plant within the observed depth (in this case 90 cms). This maximum amount of water should be thought of as % full as opposed to absolute numbers.

Figure 2. Summed soil moisture data at Pine Hill (2016)

- ### Stacked graphs

The stacked graphs provide information around where in the profile the soil water is located. Understanding how deep into the profile water moves after a rainfall event, at what depth plants are accessing moisture from and where the moisture is stored are all useful pieces of information that provide a lot more value when compared to the stacked graphs (and total amount of soil water available) alone.

The stacked graphs also can provide useful information around where the water is coming from; is it coming from rainfall events or the water table, is the water table rising or falling and knowing the potential impact that has on your system with regards to root growth can also aid in more informed decisions being made.

Figure 3 shows a summed graph from the Mount Charles site where it can be seen that a rainfall event in late May has pushed the soil moisture down to 20cms, with the next major rainfall event on the 16th June pushing the moisture down to 30cms.

Crop extraction at a certain depth will be represented by diurnal stepping (where the sensor drops during the day while the crop is extracting moisture and then flattens at night).

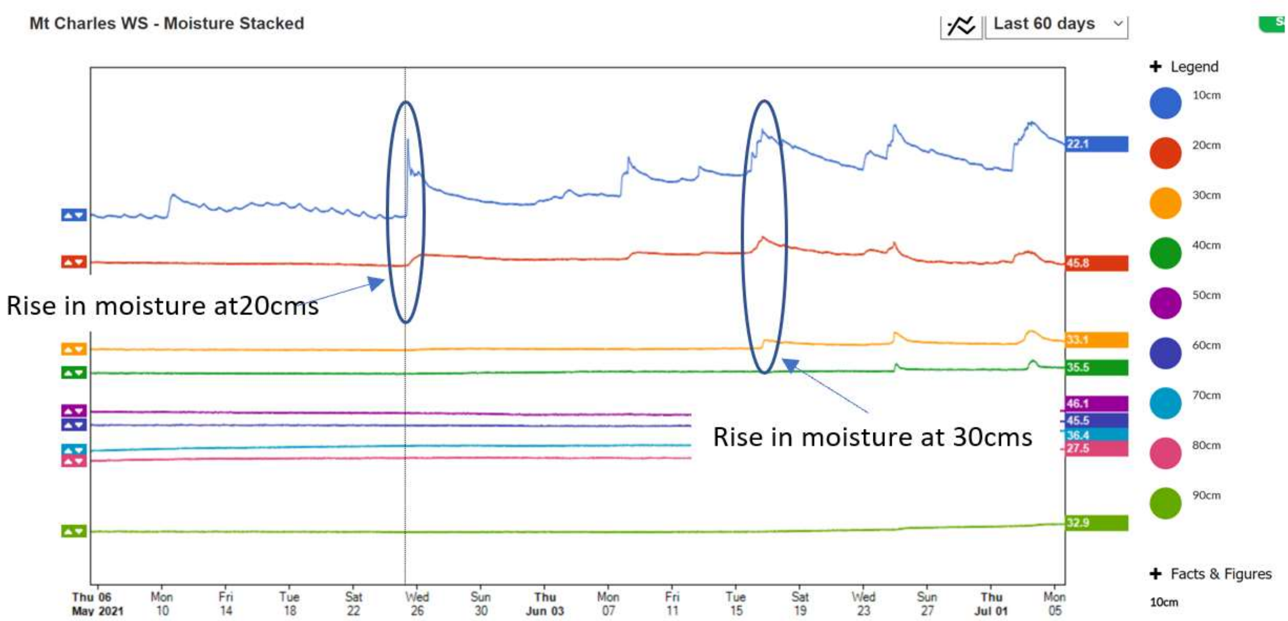

Figure 3. Stacked soil moisture at Mount Charles (June 2021)

What processes are we observing at sites across the Coorong and Tatiara District?

The equipment was installed in September and October 2021. Therefore we have limited data available with a full season at all of the observation sites yet to be collected. However given this small time-frame, we are seeing some really interesting data being generated.

There appears to be two very distinct processes occurring – possibly related to the location of the sites in the landscape, but the initial findings have already Improved knowledge around the different processes and therefore what mitigation strategies may be best put in place for each of these sites.

- ## Rising water table

Mount Charles and Elephant Lake both appear to be sites that are impacted directly by a rising water table that brings groundwater closer to the surface with the potential for soil inundation and waterlogging to occur. The water table then recedes later in the season leaving some of the dissolved salts from the saline groundwater behind. This process can be seen in Figure 4 where the observation site at Elephant Lake shows the increase in the water table in mid-June and a subsequent filling of the soil profile from the bottom up. The black line represents the water table depth and as it rises from -1.4m below surface depth to -0.7 below surface depth, the soil moisture also increases at depth with the soil moisture levels increasing up the profile through the wetting front. This process has been referred to as rising water table. A similar pattern appears to be emerging at Mount Charles (although not yet as pronounced) where the water table has just started to rise in June 2021. This will continue to be monitored to ensure that the correct process is identified at this site.

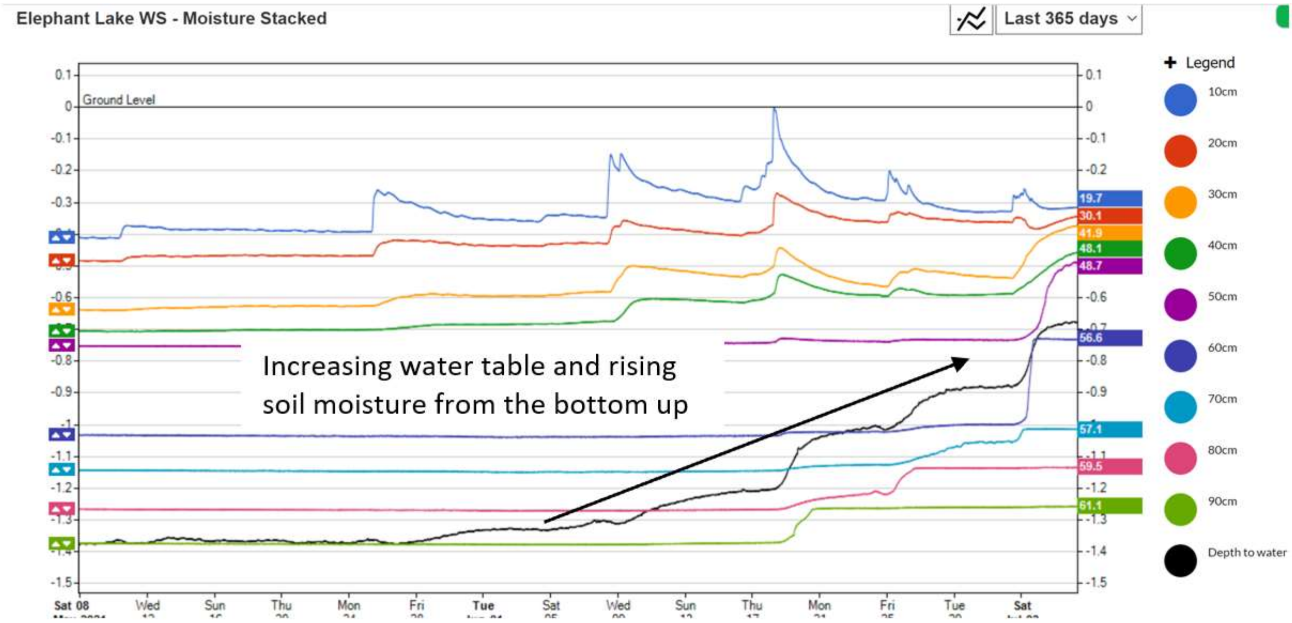

Figure 4. Stacked soil moisture and water table data, Elephant Lake (June 2021)

- ## Wicking effect

Coomandook has a very different process occurring with the water table appearing to be relatively stable throughout the season (although this is only an initial finding that will continue to be monitored). The salinity at this site appears to be driven by warm conditions over summer and wicking of the soil moisture up through the profile (in the event of no rainfall or rising water table events). This is shown in Figure 5 and is referred to as the Wicking Effect (a similar process to wax or oil moving up a candle wick). As the water rises to the surface, it brings with it salts that are deposited as the profile dries out. As more data is collated, it will be interrogated against climatic conditions, and the overall processes will become better understood. The depth that the soil water is rising from is quite surprising, but after installation the site may have been bared out slightly at the surface with the disturbance from the probe placement. As groundcover is re-established at this site, it is hoped that the wicking effect will not be as pronounced.

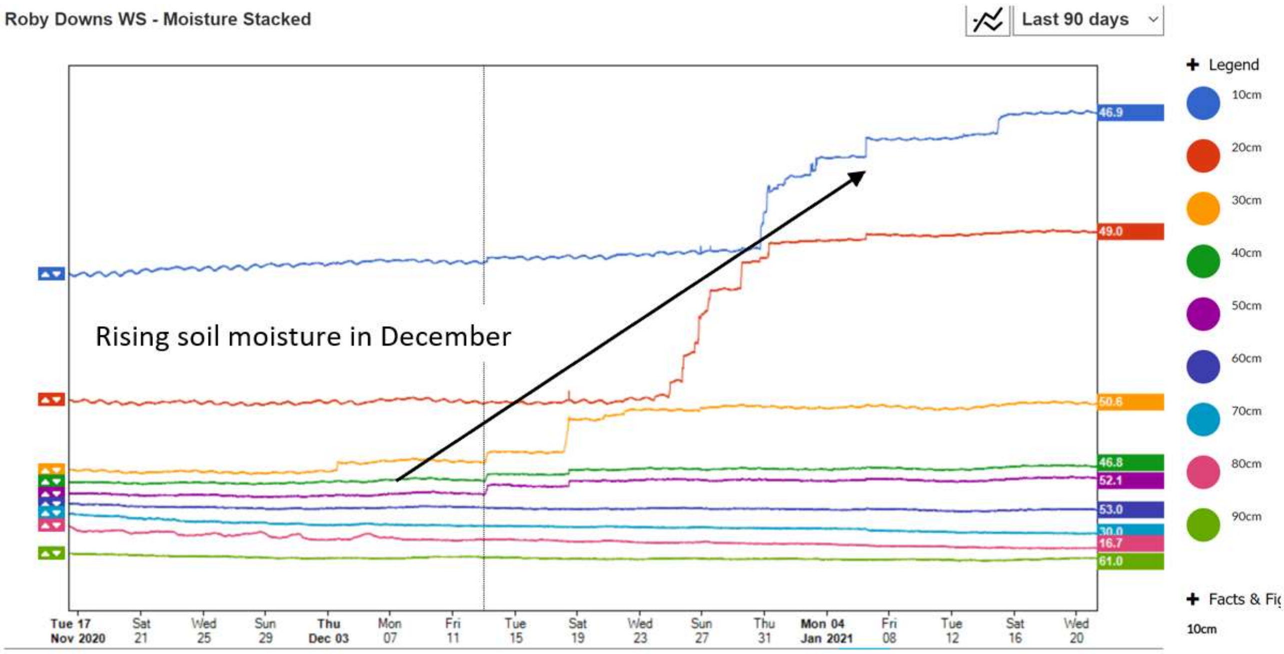

Figure 5. Stacked soil moisture graph, Commandook (December 202)

Environmental data

Additional data being collected includes rainfall, wind speed and direction, air temperature, soil temperature and relative humidity as well as other environmental derivatives (Figure 6). It is hoped that as more data is collected some of these indicators like soil or air temperature may be linked to the wicking of water through the soil allowing the data to be transferrable across to other locations.

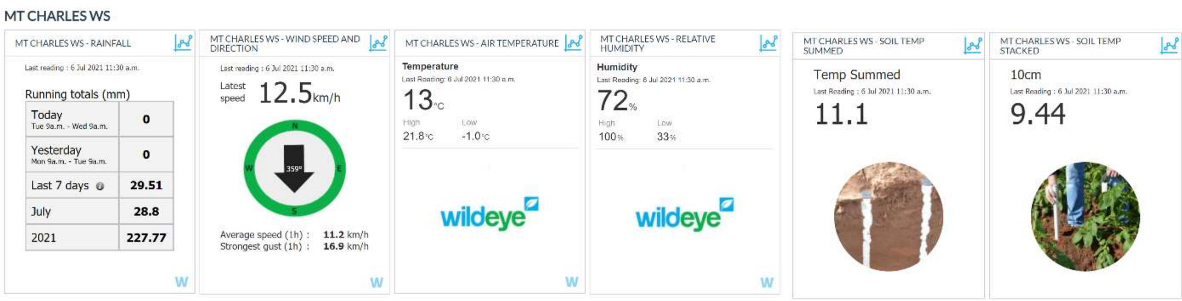

Figure 6. Environmental data being collected at Mt.Charles

Dashboard of implications for management

Initial findings suggest that knowing the cause of salinity (waterlogging or wicking) has the potential to have implications on the way that the site is remediated and managed. More work is required on understanding how widespread each of the different processes (wicking or waterlogging) are, and if the different processes operate within a local catchment area or if it depends on the location of the site in the landscape.

If groundwater is rising from below the ground, then ensuring groundcover is established early before the area becomes too wet will assist in establishing and maintaining groundcover and potentially reducing the area that becomes scalded. It may also be beneficial to minimise stock numbers over the period that the water table is high to reduce pugging, damage to groundcover and soil structure.

Conversely, those areas that experience wicking will need water to flush down through the profile to reduce the salt concentration prior to establishment. At these sites, knowing that the water table is at depth, there may be the opportunity to look at ripping to assist in providing a passage for the salts to flush through, however once this has occurred, maintaining groundcover to reduce wicking and evapotranspiration over summer will be critical.

The depth from which the groundwater is wicking over summer was also surprising, as it rose over 1m on what is a loamy soil. Further investigation may be required to determine the maximum height that the water will rise to on these soils and explore what is happening on sites that are more slightly elevated in the landscape to see if the process changes.

As the data continues to be collected, it is hoped that in consultation with farmers and the Saltland Redemption Project Working Group, that more recommendations around management options utilising this technology will be made.

Conclusion

From the data that has been generated since the projects inception (September 2020) there appears to be some really interesting relationships between soil moisture, soil salinity through the profile and its relationship with the groundwater with some sites (Elephant Lake) having strong correlations, and another (Coomandook) appearing to have little or no relationship with the groundwater levels.

As more data is collected, it is hoped that the environmental data (in particular temperature - both ambient and soil, and rainfall) may provide additional insight into how these factors impact on the movement of water and salts through the profile. The late start to the season, and moisture only just starting to move through the profile suggest that it will be later in the season that we start to get an indication of the impacts of rainfall etc. on the soil salinity levels.

As these relationships become clearer, it is hoped that farmers will utilise the data to make better decisions to reduce the impacts of salinity across the region. Waiting until the salts are observed to have flushed from the topsoil (or alternatively seeing moisture move through the profile) will ensure better germination on transient sites. Knowing when the soil is starting to become waterlogged on those sites where the water table is rising will ensure that groundcover is maintained at those times so that scalding doesn't occur.

References

[1] F.Turner, MacKillop Farm Mangement Group, 2021. SAGIT MFM_218 "Utilising soil moisture probes in dryland cropping systems"

This project was funded through Landcare Australia by a NBN Co Sustainable Agriculture Landcare Grant and is an initiative of the Meningie East-Field Healthy Soils Group with support from the Coorong and Tatiara District Councils.