



FACT SHEET

Managing salinity

Source: AgCommunicators

High salinity is a very common issue for farm water on the Eyre Peninsula. Both groundwater from local aquifers and collected surface water that has travelled over saline ground can accumulate high levels of dissolved salts.

Salinity

The term salinity covers a wide range of salts, with sodium chloride or 'common salt' being just one of many. The term 'total dissolved solids' (TDS) is used as a measure of all inorganic salts dissolved in water including chlorides, carbonates, nitrates and sulfates of calcium, magnesium, sodium, and potassium.

Knowing the types of salts being measured can be useful when looking at addressing problems in the supply. Salts are ionic compounds. The cations are normally dominated by sodium (Na⁺) but may also include calcium (Ca²⁺), magnesium (Mg²⁺) and potassium (K⁺). The anions are usually dominated by chlorine (Cl⁻) but can also

include sulphate (SO₄²⁻), carbonate (CO₃²⁻), and bicarbonate (HCO₃⁻).

Nutrients, which can become pollutants if they are present at high levels, include nitrate (NO₃), ammonium (NH₄) and phosphorus (P). These may be problematic in runoff.

Therefore, to accurately assess the suitability or palatability of water for farm use, the individual ion concentrations should be assessed by laboratory testing.

For guidance on acceptable levels for TDS and specific ions, refer to the draft ANZG Livestock drinking water guidelines (2023)¹ and, for spray chemicals, manufacturers' recommendations.

Measuring salinity – EC

One of the basic measurements for water quality is electrical conductivity (EC).

This is usually assessed by measuring the current crossing an electrode, with the results expressed in microsiemens per centimetre (µS/cm) or 'EC units'. On some occasions, electrical conductivity is expressed as decisiemens per metre (dS/m) or millisiemens per centimetre (mS/cm), and it is important to check which of these units has been used.

Electrical conductivity is affected by the temperature of the water. EC meters usually have a temperature sensor built in to allow an automatic correction to be made to a standard temperature of 25°C. If not, water temperature will need to be measured and a temperature compensation coefficient will need to be applied to the EC result.



Source: EP Landscape Board

Measuring total dissolved solids (TDS)

Salinity can also be expressed as total dissolved solids (TDS) in milligrams per litre (mg/L), or as parts per million (ppm), which has exactly the same value as mg/L.

TDS can be estimated from EC results by multiplying the EC (in $\mu\text{S}/\text{cm}$) by a conversion factor. The conversion factor is affected by the types of salts in the water, e.g. sodium and chloride versus calcium and magnesium. The conversion factor can vary from about 0.5 to 0.7 and on Eyre Peninsula, a value of 0.56 is currently suggested (Table 1).

More accurate TDS levels can be measured in the laboratory by taking a sample and evaporating off all the liquid to very accurately weigh the salts left behind, but this approach is more expensive and may not be warranted.

Table 1. Conductivity and total dissolved solids (salinity) unit conversions.

Conductivity			Salinity	
decisiemens per metre (dS/m)	millisiemens per centimetre (mS/cm)	microsiemens per centimetre ($\mu\text{S}/\text{cm}$)	Approximate TDS (mg/L)	Approximate TDS (ppm)
1	1	1,000	560	560
6.8	6.8	6,800	3,800	3,800
8.9	8.9	8,900	5,000	5,000

Source: Eyre Peninsula Landscape Board 2022

Why salinity should be tested

Livestock performance

High levels of dissolved salt will affect livestock health and productivity and may result in livestock drinking more, resulting in reduced water efficiency. Salinity tolerances for livestock are shown in Table 2.

Spray performance

High salinity can impact the effectiveness of sprayed pesticides, including herbicides and fungicides. As there is a wide range of possible interactions, it is best to consult the label or talk to a specialist advisor before using water with elevated levels of any particular cation or anion.

Calcium, carbonate and bicarbonate are covered in more detail in our separate fact sheet on managing water hardness.

It is worth noting that dissolved iron (Fe^{2+} or Fe^{3+}) and aluminium (Al^{3+}) can also affect the performance of many spray compounds. Iron can occur in relatively high concentrations in groundwater sources while aluminium may be present in collected runoff water that has been treated with alum (aluminium sulphate) to flocculate suspended clay particles.

For more information on water quality, read our fact sheets 'Managing turbidity, cloudiness and algae' and 'Managing pH and dissolved iron.'



Source: PIRSA

Table 2. Salinity tolerances for stock animals (mg/L)

Stock	Desirable maximum concentration for healthy growth	Maximum concentration at which good condition might be expected*	Maximum concentration that may be safe for limited periods*
		Water being used for stock in these 2 categories should be used with caution and/or expert advice sought.	
Sheep (dry)	5000	5000 – 10 000	10 000 – 13 000
Sheep (lambs, pregnant, lactating)	3800	3800 – 5000	5000 – 6400
Beef cattle	4000	4000 – 5000	5000 – 10 000
Horses	4000	4000 – 6000	6000 – 7000
Pigs	4000	4000 – 6000	6000 – 8000
Poultry	2000	2000 – 3000	3000 – 4000

* The level depends on the type of feed.

Source: Eyre Peninsula Landscape Board (2022). Water testing - Salinity and pH fact sheet, Landscape South Australia Eyre Peninsula.

Correcting excess salinity

There are ways to reduce salt concentration to improve the water quality and its agricultural suitability. Depending on the salinity levels and intended use, desalination or shandying with fresh water may be needed to achieve the required quality or quantity of water.

On-farm desalination

The most common desalination process is reverse osmosis, where a semi-permeable membrane separates the salt from the water. It is best suited to a groundwater supply because there is less suspended material, and the water quality is typically more predictable. A separate pre-treatment step such as coagulation, filtration or microfiltration may be needed to improve the water quality entering the plant and reduce the risk of a membrane failure. A de-scaling system is also needed to prevent scale build up on the membrane.

The water is forced through the membrane at very high pressure. The energy required to do this increases with salinity. As a result, the process is usually energy-intensive and requires significant investment in the system, and energy use.

The system will produce a concentrated brine waste that needs to be stored and disposed of appropriately. The amount of brine will be proportional to the salinity of the source water and production volume.

The systems can be adjusted to cater for the water quality going in and the required quality being produced. Generally, stock water can be left with a higher salinity level than water for spraying or domestic use. For more details, see the salinity information in Table 2 .

Most on-farm reverse osmosis units operate in the 2,000-7,500 mg/L salinity range. Systems operating up to the 12,000 to 18,000 mg/L range are available – but only with significantly higher operating costs and brine waste output.

Typical on-farm desal plants will process up to 100 kL of water per day and are designed for groundwater only (i.e. not seawater). While they do not require a licence to operate (an Environment Protection Authority (EPA) licence is needed if production capacity is >200 kL/day), there are regulations that control



Source: Eyre Peninsula Landscape Board

how the resulting brine is managed and the Eyre Peninsula Landscape Board should be contacted early in the planning process.

The water source should be tested by a laboratory before installing a desalination system, as knowing the salt and mineral levels is critical for choosing appropriate equipment and settings, as well as assessing the set-up and ongoing costs.

Shandying

One of the simplest ways to manage water quality issues, especially moderate salinity, is by mixing the ‘problem’ water with fresh water captured from a clean source – such as rainwater runoff from infrastructure roofing or a lined catchment.

Often called ‘shandying’, this mixing can be used to reduce the overall concentration of dissolved salts in the final water supply. A good understanding of both water sources, derived from testing, is essential to manage the shandying ratio of saline to fresh water and achieve a suitable result for the intended use.

How to calculate the approximate mineral concentration of shandied water

The calculations can be simplified by following the guidance below:

- When one water source is relatively pure, shandying equal quantities will halve the concentration of dissolved mineral in the final mix.

- When shandying water sources with different mineral content levels, the milligrams per litre (mg/L) – which equals parts per million (ppm) – for each should be added together then divided by the ratio of volumes being mixed.

For example, to shandy waters with TDS of 9,000 mg/L and 600 mg/L:

- Mix 1 to 1 (2 equal volumes): $9,000 + 600 = 9,600$.
Divided by 2 volumes = 4,800 mg/L
- Mix 1 to 2 (3 volumes): $9,000 + (2 \times 600) = 10,200$.
Divided by 3 volumes = 3,400 mg/L
- Mix 1 to 3 (4 volumes): $9,000 + (3 \times 600) = 10,800$.
Divided by 4 volumes = 2,700 mg/L

While the salinity of shandied water is usually quite predictable, other key properties can depend on the nature of the two waters and their sources. For example, a higher salinity groundwater and a low salinity surface catchment can have very different levels of hardness, dissolved minerals and turbidity.

If the ratio of different waters in the shandy is not known, it can help if you measure the salinity of the different source waters. This can inform the likely ratio in the mix based on its final salinity, along with how well the source waters are being mixed and if additional mixing procedures need to be implemented.

Water testing

As water quality is critical to agricultural performance and productivity, water sources should be tested regularly.

Water for livestock should be tested at least once each season to assess its qualities and any changes. Water for spraying and irrigation should ideally be checked for at least salinity, pH and hardness before mixing, particularly where quality is variable.

Simple, effective test kits are available for testing water salinity. These kits can be



Source: Source: SA Water

purchased from most hardware or farm suppliers, or online.

Electronic salinity meters are also widely available, and these will give a more specific value than a test kit. Some manufacturers offer multipurpose meters that will measure hardness, salinity, pH and more. If the salinity of a critical water source is highly variable, a continuous metering unit can be used for ongoing monitoring.

However, the best test results will be achieved by submitting water samples to a laboratory for more sophisticated testing across a range of parameters. The results of these tests can be used to benchmark water quality for each source and to calibrate the results of at-home tests for more frequent monitoring.

For more information on testing options, sampling methods and water quality parameters, see our 'Water testing' fact sheet.

Managing other water quality issues

The colour and smell of water can provide important clues to its quality. Additionally, reduced flow rates may indicate blockages in farm water infrastructure, potentially caused by poor water quality. The cause of these should be addressed along with the impact.

For more information on managing:

- **Hardness**
- **pH, dissolved iron**
- **Cloudiness, turbidity and algae**
- **Water testing**

see the Further resources section to access our other water quality fact sheets.

Further resources

Additional EP Farm Water Security information and fact sheets
pir.sa.gov.au/sardi/projects/eyre-peninsula-farm-water-security-project



EP Landscape Board
landscape.sa.gov.au/ep/water



Water testing fact sheet, EP Landscape Board
cdn.environment.sa.gov.au/landscape/docs/ep/Water-Testing-fact-Feb2022.pdf



SA Water – Your drinking water profile, SA Water
sawater.com.au/water-and-the-environment/safe-and-clean-drinking-water/your-drinking-water-profile



EP Water Security Response Plan, SA Water
sawater.com.au/_data/assets/pdf_file/0004/1017625/EP-Water-Security-Response-Plan.pdf



Water affecting activities resources and policy guide, EP Landscape Board
landscape.sa.gov.au/ep/water/water-affecting-activities



Handy links to local councils on the EP, Eyre Peninsula Local Government Association
eplga.com.au/about/councils



Australian Water Quality Centre (AWQC) Water testing available from independent business unit within SA Water
awqc.com.au



GRDC Spray Water Quality Fact Sheet (October 2019)
grdc.com.au/resources-and-publications/all-publications/publications/2019/spray-water-quality



Flocculants and water testing instructions, Water Quality Solutions
stage.waterqualitysolutions.com.au/how-to-clear-muddy-water/#:~:text=What%20is%20floccing%3F,particles%20together%20and%20binds%20them



Measuring the turbidity of water supplies
wedc-knowledge.lboro.ac.uk/resources/booklets/G031-Measuring-turbidity-in-water-supplies-online.pdf



A quick way of measuring the turbidity of water
wedc-knowledge.lboro.ac.uk/resources/posters/P023_A_quick_way_of_measuring_turbidity.pdf



Glyphosate and the Effect of Hard Water
eurekaag.com.au/glyphosate-effect-hard-water/



Source: PIRSA

About EP Farm Water Security

EP Farm Water Security is a project to promote better capture, storage and management of water on EP farms. It is led by Primary Industries and Regions SA (PIRSA), with project partners SA Water, the Eyre Peninsula Landscape Board, AWI Extension SA, SA Department for Environment and Water and AgCommunicators.

Agriculture is the dominant force in Eyre Peninsula land use and economic activity. It is also the largest user of mains water, accounting for up to 40 percent of local SA Water supply. By acting now to enhance water capture, storage and infrastructure, farmers have the power to underwrite their own water security, save money and reduce their reliance on mains water.

References

1. ANZG (2023). Livestock drinking water guidelines (currently in draft form). <https://www.waterquality.gov.au/sites/default/files/documents/livestock-drinking-water-guidelines-draft.pdf>

ANZECC & ARMCANZ (2000) Water quality guidelines. <https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol1.pdf>

Acknowledgements

NSW DPIRD Water quality for chemical spraying, 2012 (https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/433691/Water-quality-for-chemical-spraying.pdf)

Decision checklist:

- | | |
|---|---|
| <input type="checkbox"/> Consult with experts to assess the water test parameters needed. | <input type="checkbox"/> Ensure samples will be dispatched for testing promptly after collection. |
| <input type="checkbox"/> Identify a suitable water testing laboratory and confirm the test package covers all required results. | <input type="checkbox"/> Regularly check and monitor water quality to ensure it is safe and fit for purpose, especially prior to using for crop spraying or watering livestock. |
| <input type="checkbox"/> Prepare sampling supplies, including containers labels, courier arrangements, etc. | <input type="checkbox"/> Make sure your water quality tests check for salt, chemical and bio-contaminants such as bacteria and algae. |
| <input type="checkbox"/> Identify suitable sampling locations. | |
| <input type="checkbox"/> Plan for any other requirements, such as running a new bore pump for three hours before sampling. | |

Legal considerations

On-farm construction activities designed to access water resources are subject to State Government legal requirements in South Australia. These requirements are designed to protect the water resources, other water users and the natural environment.

The legal requirements are affected by factors such as the location, size and type of the works, for example:

- Large dams and large, highly visible water harvesting structures (e.g. sheeted catchments) may be subject to the need for development approval via your local Council, under the state's planning regulations.
- A permit is required from the Eyre Peninsula Landscape Board for a range of water affecting activities that may impact on watercourses, including the construction or modification of small to medium sized dams in watercourses in some catchments across southern Eyre Peninsula.
- A permit is required from the Department for Environment and Water (DEW) to construct or modify a groundwater well or to discharge water into a well. A licensed well driller must carry out or supervise the drilling or modifications.

Landholders should seek information from their local Council, Landscape Board and DEW when in the early planning stage of their proposal, so that the activity can be located and designed to meet legal requirements and to streamline any approvals process that applies.

For more information, see the Resources and further reading section.

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