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Measuring water salinity

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All farm water sources should be regularly tested as salinity levels can change over a short period of time and are therefore only accurate at the time of testing. Monitoring farm water is an important factor in maintaining long-term production.

What equipment do I use?

A pocket-sized, electrical conductivity (EC) meter (salinity meter) is accurate enough for preliminary estimates of water salinity and is suitable for most farm purposes provided it has an adequate measurement range. These salinity meters generally have a range of 0–20 dS/m, which is suitable for testing most surface water. However, some groundwater may be above 20 dS/m and will require diluting (see 'Sampling and testing tips') or laboratory testing. Laboratory testing is essential, especially if it is the first time the water is being used. Laboratory testing is also required to verify high surface-water readings.

Where do I get a salinity meter?

Purchase salinity meters from irrigation suppliers or Industry & Investment NSW (I&I NSW) as part of their 'Salt Bag' soil and water monitoring kit. Contact I&I NSW Wagga Wagga office, phone (02) 6938 1999, fax (02) 6938 1809, or visit www.dpi.nsw.gov.au/__data/assets/pdf_file/0012/168897/salt-bag.pdf

What does a salinity meter measure?

Salinity meters measure the electrical conductivity of water which is related to the total dissolved salts present. They do not provide information on the types or ratios of soluble salts present.

Salts are chemical compounds generally made up of sodium, magnesium, calcium, chloride, sulphate, bicarbonate or carbonate ions.

The intended use of the water sampled determines the acceptable salt level. Not all salts are detrimental and in appropriate proportions salts improve soil structure and do not affect water quality. For example, calcium carbonate may improve soil structure and soil pH.

An excess of one or more salts can have detrimental impacts. For example, water can be moderately saline, but have a high concentration of specific ions such as chloride, sodium or magnesium. Under spray irrigation, water with high chloride levels can cause leaf burn, while high levels of sodium or magnesium ions can cause soil structure decline.

Water salinity impacts on plants and animals to varying degrees depending on their salinity tolerance levels.

Figure 1. Testing water salinity using a salinity meter (Photo Elizabeth Madden).

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Other water factors that should be tested

Many other factors influence the quality of water such as pH, hardness, nutrients, heavy metals, odour and turbidity. For more information on water quality factors and testing, see the Agfact '*Farm water quality and treatment.'*, available at: www.dpi.nsw.gov.au/__data/assets/pdf_file/0013/164101/farm-water-quality.pdf

Laboratory testing

A water sample can be sent to a laboratory for a more comprehensive analysis. Remember to provide details on both the water source and proposed use, as these two factors will determine the water quality parameters to be tested. The I&I NSW Environmental Laboratories operate a farm water testing service for landholders to determine the suitability of their water for agricultural and domestic applications. Visit www.dpi.nsw.gov.au/aboutus/services/das/water for further details. You can also contact your local I&I NSW office for a water testing kit.

Do I need a soil salinity test as well?

Testing soil for salinity is not necessary when using water for stock and domestic purposes, providing there are no signs of soil salinity.

Along with the water test, a soil test is also required for irrigators or if the water is intended for garden use.

Soil testing assesses the amount of salt actually affecting crops and pastures. Water and soil tests provide a reading that is only accurate at the time of testing and may change throughout the season. Further information on testing soil salinity is available from I&I NSW and can be found in the Primefact 'How to texture soils and test for salinity'.

Visit http://www.agric.nsw.gov.au/reader/das-laboratory/das-soilfertility.htm for the I&I NSW Soil testing service.

When to monitor

- Before using new irrigation water sources (dams, groundwater bores and drainage water), to establish suitability and a baseline measurement.
- When irrigating with saline water which may need to be shandied to dilute salts and prevent damage to crops and pastures.
- If you have any concerns about the quality of the water supply.
- During drought periods when low water volume and high evaporation of water sources may concentrate salts.
- When the water source has not been used for an extended period of time.
- If re-using drainage water which may pick up salt as it flows over salty ground or areas with shallow watertables.
- Following 'fresh' in-river flows (a flushing event following rainfall, particularly in storms), especially when flows have been low for some time.
- If dam water appears clear, as high salinity levels will cause suspended sediment to settle out.
- If stock refuse to drink the water, are scouring for no apparent reason, or production declines.
- If watertables are high in the area, as saline groundwater may seep into dams, channels and rivers.
- If saline discharge sites occur in the areas, as salts may wash into the water source.

Under normal conditions, water testing and/or monitoring monthly should be sufficient. During extended hot dry periods, more frequent testing is advisable as water salinity can change quickly.

Sampling and testing tips

- If the field test readings using the salt bag and salinity meter are high for the required use, sampling procedures from irrigation officers or agronomist are recommended before sampling for laboratory testing. Sampling and testing at depth may be necessary as saline water and fresh water can remain in layers within water bodies. Re-sampling can be expensive and time consuming, so advice on individual sampling requirements will assist in obtaining more accurate results
- Mix the water thoroughly before taking a sample to test.
- Rinse the sample container with the sample water before collection.
- *Sampling from a dam:* collect a sample from any channel entry point, and at several other locations around the dam. Avoid collecting muddy sediment.
- *Sampling from a channel, creek or river:* try to collect a sample from the middle of the stream flow and near your pump intake.
- *Sampling from a bore:* collect a sample from a turbulent area near the outlet pipe after pumping for at least 30 minutes.
- *Sampling from a monitoring bore:* bail out the monitoring bore to ensure that all stagnant water is removed. Allow the monitoring bore to refill overnight before taking the sample. (You will

Table 1. Converting between common units used to report salinity levels. Source: Gibbs (2000).

1 deciSiemens per metre (dS/m) = 1 milliSiemens per centimetre (mS/cm) = 1000 microSiemens per centimetre (µS/cm or EC units) = approx. 640 parts per million in water (ppm or mg/L)		
To convert **From**	**To**	
µS/cm (EC)	dS/m	Divide by 1000
ppm (mg/L)	dS/m	Divide by 640
ppm (mg/L)	µS/cm (EC)	Multiply by 1.56
dS/m	ppm (mg/L)	Multiply by 640
dS/m	µS/cm (EC)	Multiply by 1000

need to do this because some water in the monitoring bore will have evaporated, concentrating the salts in the remaining water and giving an artificially high reading.)

- If the sample's salinity level is out of the meter's range (i.e. > 20 dS/m) add an equal volume of distilled water to the sample to halve the total salinity. Then double the reading to find the actual salinity of the sample.
- Regularly calibrate your salinity meter to ensure accuracy.

Collecting and testing water salinity using a salinity meter

1. Collect the water sample

- Thoroughly mix the water to be tested before taking a sample.
- Dip a sample container into the water being tested and rinse thoroughly.
- Allow the container to half fill with water.

2. Test the water using the salinity meter

- Calibrate the meter before any testing. For further information on salinity meters refer to the Primefact Understanding salinity meters and the calibration information supplied with the meter.
- Remove the meter cap and switch on the meter.
- Immerse the salinity meter about 25 mm into the sample, so that the meter electrodes are covered. (If testing free water in the paddock do not rest the end of the meter in the sediment on the bottom.)
- Swirl the meter slowly and allow the display to stabilise (it takes up to 20 seconds to adjust for the temperature), then read the number on the meter.
- Record this result and convert it to the desired units (refer to Table 1).
- Wash electrodes of the meter with de-ionised or rain water, dry, switch off and replace the cap.
- Compare the result to the salinity yardsticks in Tables 2–3 to determine if the water is suitable for its intended purpose.

Salinity yardsticks

Salinity yardsticks indicate the tolerance limit for the particular purpose of the water. They are a guide only and actual tolerance limits will vary due to a range of factors.

General yardsticks

Some general yardsticks and comparisons are provided in Table 2.

Table 2. General water quality yardsticks. Source: Taylor (1996).

Water	EC_w (dS/m)
Dead sea	550.0
Sea water (typical)	50.0
Maximum for mixing herbicides	4.7
Maximum for human consumption	2.5
Desirable limit for humans	0.8

Animal yardsticks

If the only water animals have access to is above the levels in Table 3, their health and productivity may decline. Factors such as the feed type, animal age and condition, and climatic conditions modify

Table 3. Animal yardsticks for water salinity. Source: Yiasoumi, Evans et al (2005)

Animals	Desirable limit for healthy growth (dS/m)	Maximum concentration at which good condition might be expected (dS/m)*	Maximum concentration that may be safe for limited periods (dS/m)*
Sheep	5	5–10	10–13
Beef cattle	4	4–5	5–10
Dairy cattle	2.5	2.5–4	4–7
Horses	4	4–6	6–7
Pigs	4	4–6	6–8
Poultry	2	2–3	3–4

*The levels depend on the type of feed and the type of salts present in the water.

these limits. See Primefact 533 *Water for livestock: interpreting water quality tests* at www.dpi.nsw.gov.au/__data/assets/pdf_file/0018/111348/water-for-livestock-interpreting-water-quality-tests.pdf

See also Primefact 326, Water requirements for sheep and cattle at www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/96273/water-requirements-for-sheep-and-cattle.pdf.

Crop and pasture yardstick

There are a number of factors that combine to influence the salinity tolerance of crops and pastures. These include climate, soil type and internal soil drainage, variety or rootstock, irrigation method, stage of growth, presence of a watertable within the root zone and irrigation management.

Tolerance tables are available but caution is needed in their interpretation. It is wise to contact the I&I NSW agronomists and irrigation officers for assistance in sourcing and interpreting these tables to ensure relevance to your specific situation.

It is also important to understand the relationship between salinity and sodicity (sodium hazard). If your irrigation water has a high sodium adsorption ratio (SAR), potential problems with soil structure stability may arise. For more information on the relationship between salinity and sodicity see the Primefact *Salinity tolerance in irrigated crops and pastures* and the 'Soil & water salinity calculator', available at I&I NSW Wagga Wagga Office.

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