facts Natural Resources and Water
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land series

Measuring salinity

Salinity is the accumulation of salt in soil and water. High salt levels can adversely affect plant growth, soil structure, water quality and infrastructure.

High salt levels occur naturally in many parts of the Australian landscape but in many cases have been exacerbated where human activities accelerate the mobilisation and accumulation of salt.

Methods for measuring salinity

It is important to identify saline areas so they can be appropriately managed. There are a range of methods for measuring salinity. Two common ways are by using an electrical conductivity (EC) meter or by measuring how much salt is in a solution of soil or water.

An EC meter measures how much electricity moves through a solution—the saltier the solution, the more electricity moves through it, and the higher the conductivity reading. EC can be easily measured in the field or in a laboratory. A wide range of EC meters are available, ranging in price and size.

Electrical conductivity can be expressed in different units—for soil, EC is measured in dS/m (deci-Siemens/metre), while water is measured in µS/cm (micro-Siemens/centimetre). It is important to always calibrate the EC meter before use.

Another way to detect salinity is by measuring how much salt is in a solution—this measurement is called total dissolved solids (TDS) or total dissolved ions (TDI). It is measured in units of mg/l (milligrams/litre) or ppm (parts per million). Higher readings mean more salt is present in the solution.

Measuring salinity in water

Salinity in surface water and groundwater can be easily measured in the field by collecting a water sample, inserting an EC probe into the sample and reading the value shown on the meter.

Alternatively, a water sample can be collected and forwarded to a laboratory for testing of salinity and chemical composition. The container should be entirely filled with the water sample to exclude air. Samples for laboratory analysis should be forwarded as quickly as possible. Delays and high temperatures will change the composition of salts in the sample, affecting the results. Typical salinity values for water are given in Table 1.

Measuring salinity in soil

EC is usually measured in the field using a 1:5 soil:water suspension ($EC_{1:5}$), or in a laboratory using a soil saturation extract EC (EC_{se}) or a 1:5 solution.

To measure $EC_{1:5}$ in the field, put approximately 10ml of distilled water, rainwater or tank water into a jar, container or tube. Add small soil particles until the contents of the container increase by 5ml to bring the volume to 15ml. Add additional water to bring the total volume to 30ml. Shake intermittently for five minutes and allow it to settle for five minutes. Dip an EC probe into the solution and take a reading. Remember to wash the EC probe after using it.

The interpretation of EC values to determine soil salinity levels depends on the texture of the soil. Salts are readily dissolved out of sandy soils whereas salts are more tightly held by clay soils. This means that the same amount of salt will have a greater impact on sandy soils then it will on clay soils. As a guide, sandy or loamy soils are moderately saline if $EC_{1:5}$ is above 0.3 dS/m, and clay soils are moderately saline if $EC_{1:5}$ is above 0.6 dS/m.

As the $EC_{1:5}$ is measured on a diluted sample, a more realistic measurement of the actual salt levels that a plant will encounter can be measured on a saturated extract (EC_{se}). This can be done by some laboratories. As a guide, soils are generally considered saline if their EC_{se} is greater than 2–4 dS/m.

Salinity tolerance ratings for soils are usually based on EC_{se} values, rather than $EC_{1:5}$. To convert $EC_{1:5}$ to EC_{se}, identify the texture of the soil, and use the following guide:

Soil type	Multiply $EC_{1:5}$ by
Sand	23
Sandy loam	14
Loam	10
Clay loam	9
Light clay	7.5
Heavy clay	6

For example, sand with an $EC_{1:5}$ of 0.3 dS/m is equivalent to an EC_{se} of 6.9 dS/m, while a heavy clay with an $EC_{1:5}$ of 0.3 dS/m is equivalent to an EC_{se} of 1.8 dS/m. Soil salinity classes are shown in Table 2.

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Table 1. Guide to typical salinity limits for waters. It is important to also check other water quality parameters (e.g. chemical composition, sodium absorption ratio, metals etc) before use.

		Electrical Conductivity (EC)		TDS
		(µS/cm)	(dS/m)	(mg/l or ppm)
Distilled water		1	0.001	0.67
Rainfall		30	0.03	20
Sewage effluent		840	0.84	565
Freshwater		0–1500	0–1.5	0–1000
Great Artesian Basin water		700–1000	0.7–1.0	470–670
Brackish water		1500–15 000	1.5–15	1000–10 050
Upper limit recommended for drinking		1600	1.6	1070
Tolerances of livestock to salinity in drinking water (at these values, animals may have an initial reluctance to drink, but stock should adapt without loss of production)	Beef cattle	5970–7460	5.9–7.5	4000–5000
	Dairy cattle	3730–5970	3.7–5.9	2500–4000
	Sheep	7460–14 925	7.5–14.9	5000–10 000
	Horses	5970–8955	5.9–8.9	4000–6000
	Pigs	5970–8955	5.9–8.9	4000–6000
	Poultry	2985–4475	2.9–4.4	2000–3000
General limits for irrigation	Salt sensitive crops	650	0.65	435
	Moderately salt sensitive crops	1300	1.3	870
	Salt tolerant crops	5200	5.2	3485
	Generally too saline for crops	8100	8.1	5430
Salt water swimming pool		5970–8955	5.9–8.9	4000–6000
Seawater		55 000	55	36 850
Dead Sea		110 000	110	73 700

Note: To convert from µS/cm to dS/m, divide by 1000. To approximately convert from µS/cm to mg/l, multiply by 0.67.

Table 2. Approximate soil salinity classes.

Salinity Rating	EC_{se} (dS/m)	
Slightly saline	1.5–2	Salinity effects usually minimal
Moderately saline	2–6	Yield of salt sensitive plants restricted
Highly saline	6–15	Only salt tolerant plants yield satisfactorily
Extremely saline	>15	Few salt tolerant plants yield satisfactorily

Salinity tolerance of crops

As a general guide, salt tolerant crops include barley, canola, cotton, beetroot, soybean, wheat, olives and sorghum. Moderately salt tolerant crops include lucerne, tomato, cabbage, potato and carrots. Low salt tolerant crops include maize, sugar cane, celery, lettuce and pumpkin.

References

The information in this fact sheet came from the following references:

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Further information

For more information on salinity, refer to the *Salinity Management Handbook*—available from the NRW Service Centre – phone 07 3896 3216—or visit the NRW website <www.nrw.qld.gov.au>.