

Water for livestock: interpreting water quality tests

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Summary

When considering whether a water source is suitable for livestock, it is essential to test:

- pH
- salinity, and
- chloride levels.

This Primefact also discusses:

- symptoms of salt poisoning
- additional water testing services, and
- interpreting results from the water sampling kit.

NSW Department of Primary Industries offers a water quality testing service, 'The Water Sampling Kit', one of several water testing services available.

Results from this testing may be used to assess how suitable a water source is for livestock use. The following measurements are critical when considering whether the water is suitable for livestock:

- pH
- salinity, measured as electrical conductivity (EC)
- chloride level.

Other water quality measurements (hardness, calcium carbonate saturation index, total alkalinity and sodium absorption ratio) do not directly affect use for livestock.

Turbidity is a measure of water clarity, and is an indicator of how much solid matter (such as clay, silt, organic matter and micro-organisms) is suspended in the water. Extreme turbidity may

affect the use of water for livestock, depending on what the suspended matter is; algae, bacteria or chemical pollutants would obviously be significant.

pH

Water for domestic and stock use should be in the pH range of 6.5 to 8.5.

- If the pH is highly acidic (less than 5.5), acidosis and reduced feed intake may occur.
- Highly alkaline water (over 9) may cause digestive upsets and diarrhoea, lower feed conversion efficiency and reduce intake of water and feed.

Salinity

Salinity is the sum of all mineral salts present in the water, including sodium, calcium, magnesium, chloride, sulfate and carbonate.

The effect of salinity on stock health and productivity depends on:

- the species, breed and age of the animals drinking the water;
- the water and mineral content of the feed the animals are consuming;
- temperature (climatic temperature, and water temperature); and
- which minerals are present in the water.

These factors must be considered when determining the suitability of a water source.

Important warnings: If water causes diarrhoea or ill health, it should be analysed to determine the concentrations of specific ions.

If the salinity is high (around EC 4000 $\mu\text{S}/\text{cm}$) but chloride levels are normal, an ion analysis is advised to determine which salts are contributing to the high reading. The key anion test or standard test of 19 elements may be appropriate. Consult your adviser from NSW DPI.



Table 1. Saline drinking water: general effects for livestock

Salinity ** (EC in $\mu\text{S/cm}$)	Effects/cautions for livestock
Less than 1600	Relatively low level of salinity. Should not present any serious burden to any livestock.
1600 to 4700	Should be satisfactory but may cause temporary and mild diarrhoea in unaccustomed livestock. Should have no other effects on health or performance.
4700 to 7800	Should be satisfactory but may be refused, at first, by animals unaccustomed to it. May cause temporary diarrhoea. Unacceptable for poultry.
7800 to 10,900	Can be used with reasonable safety for dairy and beef cattle, sheep, pigs and horses. For pregnant or lactating animals, or horses in work, avoid using water with salinity at the higher levels in this range. Unacceptable for poultry.
10,900 to 15,600	Considerable risk in using this water for pregnant or lactating stock, young animals, or any animals subjected to heavy heat stress or water loss. Unacceptable for poultry. Unsuitable for pigs and horses. In general, should be avoided for use by livestock, although older livestock may subsist on these waters in conditions of low stress.
15,600 to 23,400	Risky. Cannot use for stock other than adult, dry sheep (see Table 2 below).
around 30,000	Toxic: effects will vary depending on the type of salts present.

The measure of salinity is given as an electrical conductivity (EC) reading in microsiemens per centimetre ($\mu\text{S/cm}$).

Tables 1 and 2 may be used as a general guide for assessing water suitability for livestock. Note that precise water EC values (backed up by research) for livestock tolerance are not available.

Table 1 shows the general effects of saline water for all types of livestock.

Table 2 shows how different levels of saline drinking water can affect different livestock.

Notes to tables

* Sheep on lush green feed may tolerate salinity up to an EC value of 20,300 $\mu\text{S/cm}$ without loss of condition or production.

** Electrical conductivity (EC) value is obtained by dividing the mg/L or ppm value given in the reference literature by 0.64 to give $\mu\text{S/cm}$.

Chloride

Chloride has a number of functions in the body, including the regulation of osmotic pressure and pH balance (along with sodium and potassium). It also has an important role in digestion.

An excess of chloride is synonymous with salt (sodium chloride) toxicity. In ruminants, excessive chloride levels increase osmotic pressure in the rumen. This causes a decrease in microbial population and metabolic activity, so there is a reduction in the animal's food intake.

In all animals, excess sodium chloride can result in dehydration, kidney failure, nervous system dysfunction and death.

The maximum acceptable levels of chloride in water for different livestock are:

Table 2. Effects of saline drinking water for various livestock types

Livestock	No adverse effects on animals expected.	Animals may have initial reluctance to drink or there may be some diarrhoea, but stock should adapt without loss of production.	Loss of production and a decline in animal condition and health would be expected. Stock may tolerate these levels for short periods if introduced gradually.
	EC in $\mu\text{S/cm}$	EC in $\mu\text{S/cm}$	EC in $\mu\text{S/cm}$
Poultry	0 to 3100	3100 to 4700	4700 to 6300
Beef cattle	0 to 6300	6300 to 7800	7800 to 15,600
Dairy cattle	0 to 3900	3900 to 6300	6300 to 10,900
Sheep	0 to 7800	7800 to 15,600	15,600 to 20,300*
Horses	0 to 6300	6300 to 9400	9400 to 10,900
Pigs	0 to 6300	6300 to 9400	9400 to 12,500

- dairy cattle: 1600 mg/L
- beef cattle: 4000 mg/L
- ewes and lambs: 2400 mg/L
- adult dry sheep: 5600 mg/L
- horses: 1200 mg/L

Symptoms of salt poisoning

Within a population of animals, the individual animal's tolerance to salinity will vary. The above tables and acceptable levels of chloride are intended as a general guide only.

When saline water is used, livestock should be monitored for symptoms of salt poisoning.

Symptoms include:

- excessive thirst
- abdominal pain
- increased urination
- nasal discharge
- lack of appetite
- vomiting
- diarrhoea
- nervous signs (such as star gazing, tremors, blindness, circling, walking backwards, head pressing, wobbly in the legs; knuckling at the fetlocks)
- lying down
- convulsions
- death.

Additional water quality tests

You can also request these additional tests. Test kits are available at all NSW DPI district offices.

1. **Standard test:** a test is available which measures 19 different elements in water in addition to pH, TDS, chloride, hardness, calcium carbonate saturation index, total alkalinity and sodium absorption ratio. The additional elements measured in this test are in the table below.
2. **Key anions test:** a test to measure key anions that may affect livestock health and productivity:
 - chloride
 - sulfate
 - phosphate
 - nitrite
3. A test for nitrogen (as ammonia and nitrate)
4. A test for the presence of blue-green algae (cyanobacteria). (See Primefact 414 *Managing blue-green algae in farm dams* for further information on blue-green algae.)

Al	aluminium
As	arsenic
B	boron
Ca	calcium
Cd	cadmium
Co	cobalt
Cr	chromium
Cu	copper
Fe	iron
K	potassium
Mg	magnesium
Mn	manganese
Mo	molybdenum
Na	sodium
Ni	nickel
P	phosphorus
Pb	lead
S	sulfur
Zn	zinc

Interpreting results from the water sampling kit

For simplicity, temperature and other environmental stressors have not been included in these examples, but they do influence the tolerance of livestock to water salinity and need to be taken into consideration.

Example 1: Bore water for yearling beef cattle

Feed: short, dry pasture and cottonseed meal with wheat straw.

Analysis	Results	Interpretation
pH	6.9	Acceptable.
EC	13,300 μ S/cm	High. Not suitable for young, growing animals. Older stock may tolerate this water for a short time if not under other stress, but even then, loss in production and a decline in health may occur. As feed is dry and water intake will be increased, it would be advisable to dilute with less saline water for older stock. Not recommended for yearling cattle.
Alkalinity	306 mg CaCO ₃ /L	
Hardness	1930 mg CaCO ₃ /L	
Chloride	4257 mg/L	Chloride level is just over the guide given for maximum acceptable. For older stock, this water could be used, with caution: the chloride level should be acceptable if it was diluted with less saline water. Due to the EC value, this water is not suitable for yearling cattle.

Example 2: Bore water for dry merino ewes and horses (not in work)

Feed: on pasture.

Analysis	Results	Interpretation
pH	7.1	Acceptable.
EC	8200 µS/cm	Should be safe for both sheep and horses. They may be reluctant to drink it at first. It may cause gastrointestinal upsets initially. Would not expect any loss in production.
Alkalinity	860 mg CaCO ₃ /L	
Hardness	1090 mg CaCO ₃ /L	
Chloride	2002 mg/L	Chloride level is acceptable for sheep. This level may be a problem for horses. Horses may refuse this water. There is a risk of metabolic disturbances and kidney problems if used long term.

Example 3: Bore water for lambing crossbred ewes and heavily pregnant beef cattle

Feed: pasture and supplementary silage.

Analysis	Results	Interpretation
pH	7.1	Acceptable.
EC	19,300 µS/cm	Very high. Risky to use for stock. Would only consider use for dry, adult sheep in the short term. Unacceptable for pregnant and lactating animals. Use is NOT recommended.
Alkalinity	662 mg CaCO ₃ /L	
Hardness	2760 mg CaCO ₃ /L	
Chloride	6489 mg/L	Very high. Exceeds maximum acceptable levels for sheep and cattle. Use is NOT recommended.

Example 4: Bore water for mature merino wethers

Feed: short, dry pasture and a supplement ration of wheat + 1.5% lime, 2% sodium chloride and 2% sodium bentonite.

Analysis	Results	Interpretation
pH	7.1	Acceptable.
EC	15,500 µS/cm	Can be used safely in adult, dry sheep. They may be reluctant to drink it at first. Could get gastrointestinal upsets initially. Advisable to dilute with less saline water if possible.
Alkalinity	917 mg CaCO ₃ /L	
Hardness	3680 mg CaCO ₃ /L	
Chloride	4851 mg/L	Exceeds maximum acceptable levels for sheep and may affect acceptance. May be used short-term. Advisable to dilute with less saline water if possible. Stop adding sodium chloride to the grain ration.

Further reading

For further information on salinity and livestock, see Primefact 326 *Water requirements for sheep and cattle*.

Acknowledgments

The authors would like to acknowledge the advice of Peter Olson, Technical Manager, Diagnostic and Analytical Services, Wagga Wagga.

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www.deh.gov.au/water/quality/nwqms/introduction/references

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ISSN 1832-6668

Replaces Agnote DAI-299

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Job number 7451