



# Testing Groundwater Quality

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## Introduction

Whatever its origin, groundwater spends a long time in an aquifer. It has time to dissolve minute quantities of minerals, which can give it definite characteristics such as hardness or taste. Because of this many people find groundwater pleasant to drink and prefer it to stream or rainwater. It is often bottled and sold as mineral water.

Groundwater usually becomes more progressively saline as it travels away from its source. Harmful impurities can also be introduced by human activities. Testing the quality of groundwater is a precautionary measure that can prevent people and stock that drink it from becoming ill, clothes washed in it being soiled, irrigated crops from wilting and pipes carrying it from corroding.

## Aspects of Quality

**Physical** aspects of water quality can be measured directly and include those evident to the senses - colour, turbidity, temperature, taste and odour. Other physical properties are related to the chemical composition of water such as pH (a measure of acidity) and Electrical Conductivity (a measure of salinity).

Special techniques are required to determine the **chemical** aspects of water quality. The most common measure of the chemical quality of water is salinity - the salt content of water. Sodium and chloride are the dominant ions (or salts) found in groundwater.

The two most common methods of describing the salt content are EC units and TDS (total dissolved salts). EC can be conveniently measured with a hand-held meter. The values or units are usually expressed as micro Siemens per centimetre (uS/cm).

TDS is determined by evaporating a known volume of water and weighing the salts remaining. TDS is expressed as milligram per litre (mg/L). For a quick approximate conversion, EC units X 0.6 = mg/L.



Other naturally occurring ions studied in groundwater include calcium, magnesium, sodium, potassium, sulphate, iron and nitrate. The amounts and proportion of these salts affect the qualities and behaviour of the water. By analysing water for these salts it is possible to determine:

- corrosion and scaling potential of the water and its effect on pumps and plumbing equipment such as hot water services and dairy equipment.
- hardness and effect on washing;
- the potential for saline water to cause water-logging problems to plants (the sodium absorption ratio (SAR) is used by irrigators);
- unacceptable concentrations of constituents which may present a particular problem for a particular use;
- specific toxicities, such as magnesium to stock, nitrogen to young children, and other ions to plants.

**Biological** aspects of water quality relate to bacteria and viruses. Undisturbed groundwaters are often free of harmful micro-organisms except where they are in contact with the ground surface such as open wells and springs or when contaminated from structures such as septic tanks.

The biological quality is often measured by counting the numbers of E.coli organisms in a given volume of water.

## Guidelines on Water Quality

Its use, whether domestic, agricultural or industrial, places specific constraints on the quality of water that can be

tolerated. In the following tables, maximum recommended salinity as mg/L is given for a range of uses. Remember salinity is only a general guide to quality. As well, there are many factors that can affect the intended bore use:

**Irrigation** and watering of plants depends not only on salinity but on the type of soil and its drainage characteristics, as well as local climate and rainfall. Generally speaking more saline water can be used for irrigation if:

- the soil has good drainage;
- heavy and frequent applications of water are used to wash excess salts through the soil beyond the reach of plant roots;
- flood irrigation is used instead of sprinkling to reduce the amount of evaporation and risk of leaf damage;
- salt tolerant plants are used.

**Livestock** vary considerably in their ability to tolerate salts in drinking water. The important factors affecting their tolerance include:

- composition of pastures - stock can tolerate higher salt levels when on green pastures rather than dry feed;
- age and condition - pregnant, lactating or young animals require lower salinity levels than mature stock;
- habituation and variation in quality - changes from low to high salt levels must be made slowly. Stock become adjusted to lower levels and sudden changes can cause toxicity even though below maximum tolerance figures;
- composition of salts - particularly magnesium, iron and nitrate, which can cause problems;
- climate - better quality water is required during periods of high water intake, e.g. hot weather, salt diets;
- odours.

**Human consumption:** Many Australians have no choice but to consume water at high salinity levels. Tolerances to tastes and odours vary widely and depend on the specific salts present. Public water supplies are required to meet drinking water quality guidelines and are periodically analysed to ensure these standards are met. The guidelines contain concentrations of chemicals such as heavy metals, which can be toxic.

**Domestic use** includes a host of activities which are affected by water quality. They include washing, hot water services, septic tanks, concrete-making and effects on plumbing and pumps. Coloration and hardness are important considerations for washing.

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## When should water be tested?

Your new water supply should be tested by a suitable laboratory upon completion of the bore. The type of ions tested for will depend on the intended purpose of the bore.

After initial analysis, the water supply should be monitored at regular intervals to determine any undesirable trends in water quality. An EC test should suffice. Privately owned human consumption supplies should be tested at least every five years. If any unexplained change in water quality occurs, or any harmful effects are associated with the water, the supply should be tested immediately.

Usage	Upper Salinity Limit TDS (mg/L)
<b>Crops and Pastures</b>	
field peas and beans	850
clover, groundnut, rice (paddy)	1 200
berseem clover, corn, lucerne, millet, safflower, soybean, sudax	2 000
phalaria, sorghum, sunflower	2 800
fescue, perennial rye grass, sudan grass	3 200
barley, cereals (wheat), cotton, sugar beet	3 700
<b>Flowers and Shrubs</b>	
violets	300
aster, azalea, bauhinia, begonia, camellia, dahlia, fuschia, gladiolus, poinsettia, rose, zinnia	700
bougainvillea, carnation, coprosma, hibiscus, vinca	1 000
chrysanthemum, oleander, stock	13 500
<b>Fruit</b>	
loquat	300
avocado, blackberry, strawberry, walnut	700
apple, almond, apricot, grapefruit, lemon, orange, peach, pear, plum, prune, raspberry	1 000
fig, grape, olive, pomegranate	1 350
<b>Lawn grasses</b>	
bent grass	800
bluegrass, fescue, rye grass	1 200
tall fescue	3 000
santa anna couch	5 000
sun turf ( <i>Paspalum vaginatum</i> ), kikuyu	25 000
<b>Vegetables</b>	
french beans, peas	700
beans (broad and field), capsicum, celery, lettuce, potato (sweet), radish	1 000
broccoli, cantaloupe, carrot, cauliflower, cucumber, gherkins, onions, potatoes, sweet corn	1 350
artichoke, tomato	1 750
asparagus, beetroot, cabbage, spinach	2 100
<b>Livestock</b>	
poultry	3 500
pigs	4 000
horses	7 000
dairy cattle	6 000
beef cattle	10 000
sheep	13 000
<b>Fish</b>	
goldfish	8 800
rainbow trout	9 300
brown trout	3 700
<b>Human consumption</b>	
common tolerance to total dissolved salt	1 500