Safe water on rural properties

Technical advice version 1.1, 2015

Version	Date	Summary of changes
1.0	August 2015	-
1.1	October 2015	Updated figures in column 4 of Table 1 Chlorine addition to water storage tanks

Safe water on rural properties

Published by the State of Queensland (Queensland Health), October 2015

For more information contact:
Water Unit, Health Protection Branch, Department of Health, GPO Box 48, Brisbane QLD 4001, email waterquality@health.qld.gov.au, phone (07) 3328 9310.

An electronic version of this document is available at https://www.health.qld.gov.au/public-health/industry-environment/environment-land-water/water/quality/risks/default.asp

Contents

Introduction

Water plays a key role on rural properties. It is needed for stock and human drinking purposes, household use, recreational activities, fire-fighting, irrigation and garden watering.

This booklet provides advice on identifying and managing risks to human health arising from water on rural properties in Queensland. It focuses on water used for drinking and recreational purposes.

Drinking water

Many rural properties are too remote to access town water supplies. Instead they rely on private water supplies which may include rainwater, groundwater, surface water or carted water.

These supplies need to be managed carefully to ensure they do not become contaminated and in turn cause illness.

Selecting a safe drinking water source

Some rural properties will have access to more than one type of private drinking water source. In these circumstances a risk management approach should be adopted to assess which source of water is the most suitable for drinking purposes.

The diagram on the next page shows the risk hierarchy of water sources for private drinking water supplies. It can be used to assist in selecting the safest source of drinking water if choice is available. Where quantity permits, your safest water supply should be used for drinking, food preparation, hand washing and showering.

Don’t get your pipes crossed!

If you use more than one source of water on your property (e.g. tank water for drinking and dam water for showering or toilet flushing) there is a risk that a cross-connection between the two pipe systems could occur.

Make sure anyone working on the plumbing at your property is aware of the different pipe systems.

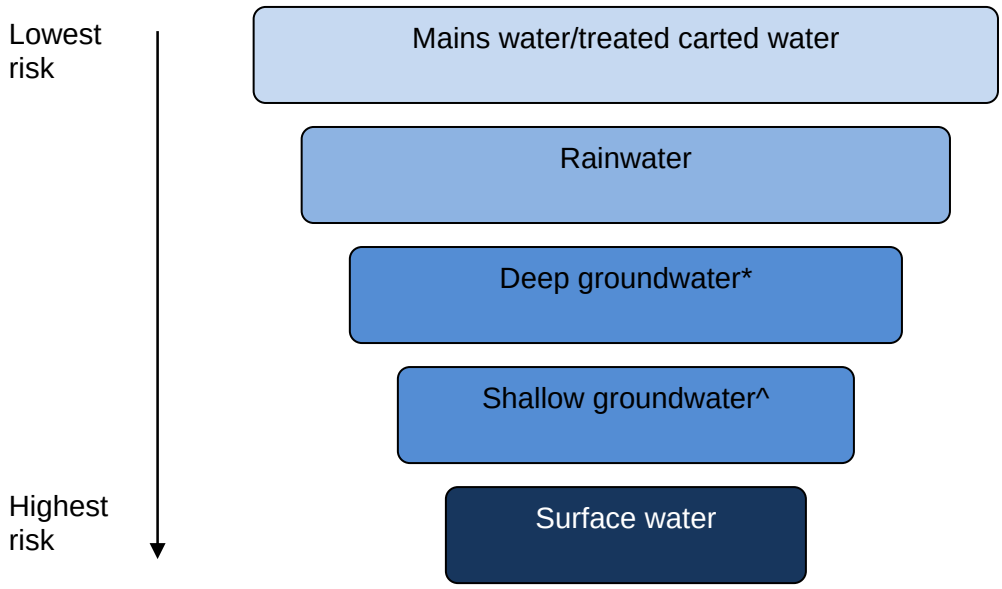
Hazards in your water supply

Contaminants in your water supply can make it unsafe causing illness for those who consume it.

Having an awareness of the common hazards that may threaten your water supply and the ways to control them can help to keep your water supply safe.

Common hazards and ways to minimise risks for rain, ground and surface water supplies are shown on the next three pages.

Figure 1: Risk hierarchy of sources for private drinking water supplies



*** Deep groundwater** – accessed via a bore, can be tens to hundreds of metres below the ground surface, usually stored in confined aquifers which recharge very slowly over long periods of time, isolated from surface conditions therefore less prone to contamination although can contain high levels of minerals.

^Shallow groundwater – accessed via a bore, can be very close to the ground surface, usually stored in an unconfined aquifer which recharges quickly over days and weeks, prone to contamination from organic pollutants and effluents.

Supply options

Rainwater

Rainwater contamination hazards include:

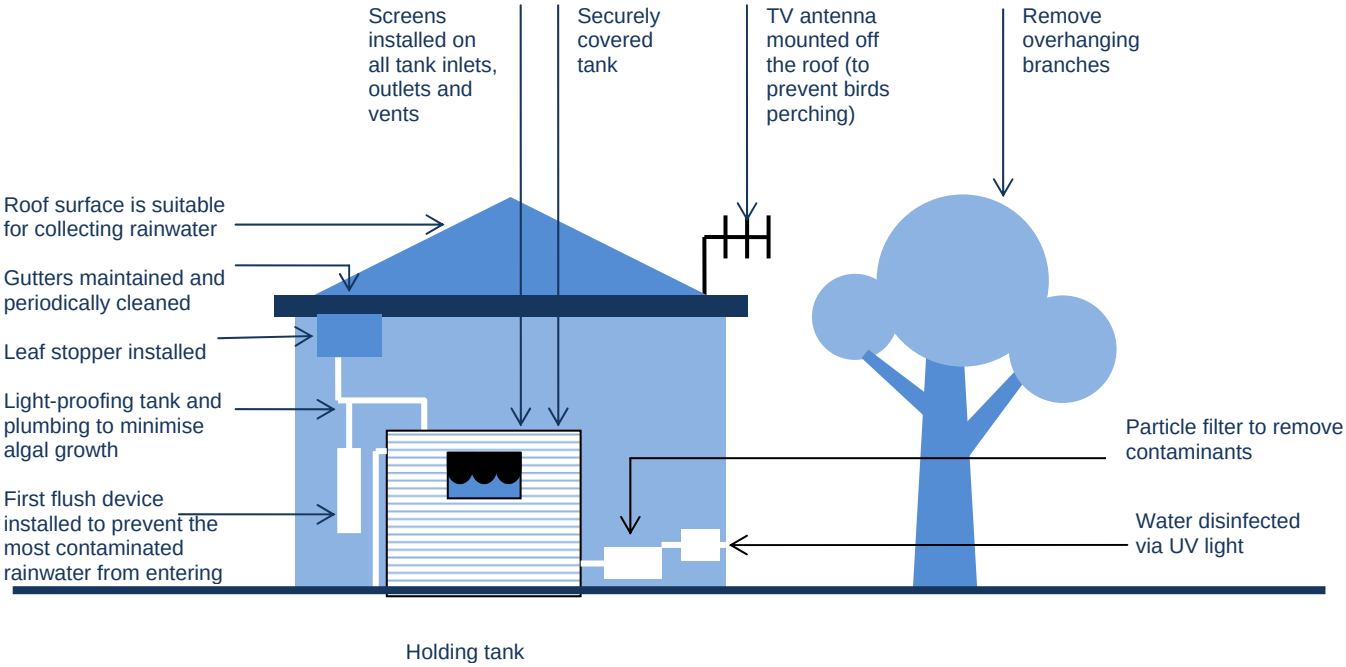
- roof materials such as roofs coated in bitumen products or lead based paints
- animal faeces
- leaves and debris
- ash and chemicals from wood heaters (for example in instances where chimneys and flues are not installed properly or the burning of inappropriate fuel)
- pesticides and fertilisers from aerial spraying.

Wet-system designs, where pipework runs from the roof and then underground prior to entering the tank, should be avoided where possible. Where this design is unavoidable it is important to consider filtering the water before it enters the pipework and to install the system such that pipework is able to drain following rainfall.

Where tanks are located below the ground additional contamination hazards include:

- sewage effluent from septic tanks
- industrial and agricultural run-off (such as pesticides, fertilisers and animal faeces)
- seepage from rubbish
- polluted stormwater
- chemical spills.

Figure 2: Contamination hazards and ways to minimise risks to a rainwater supply system

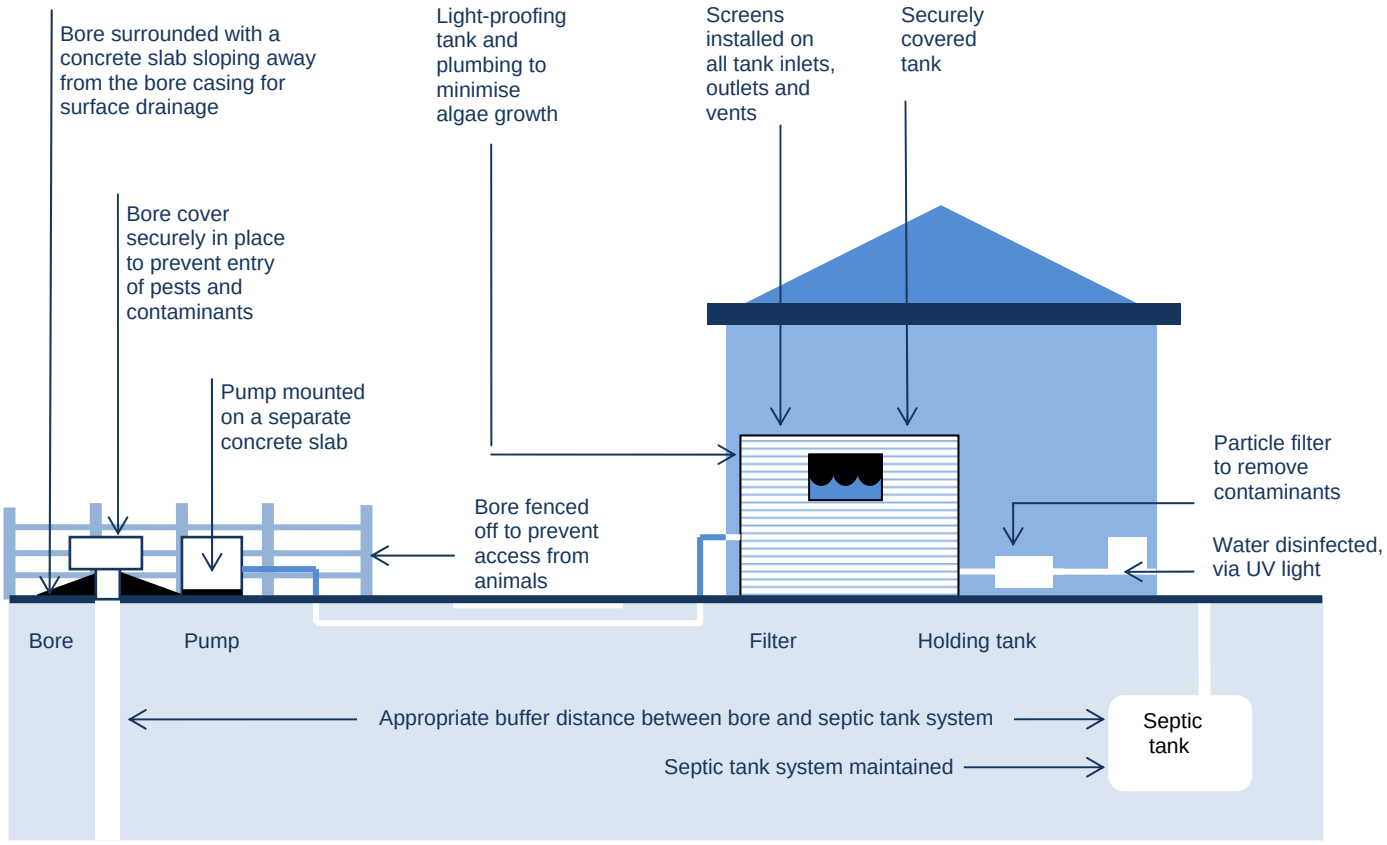


Ground water

Groundwater contamination hazards include:

- sewage effluent from septic tanks
- animal faeces
- industrial and agricultural run-off (such as pesticides and fertilisers)
- seepage from rubbish
- polluted stormwater
- chemical spills
- naturally occurring chemicals (such as arsenic).

Figure 3: Contamination hazards and ways to minimise risks to a groundwater supply system



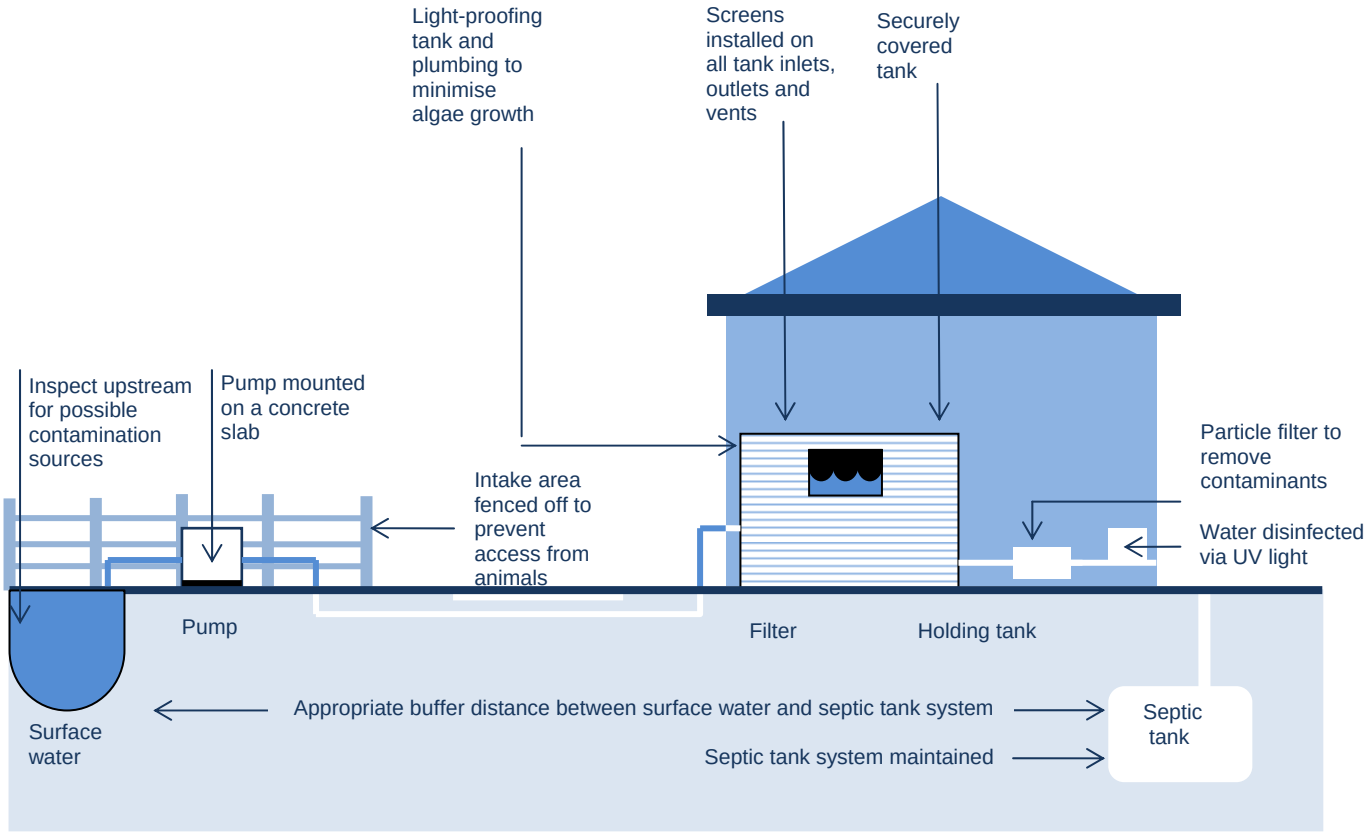
Surface water

Surface water contamination hazards include:

- sewage effluent from septic tanks
- animal faeces
- industrial and agricultural run-off (such as pesticides and fertilisers)
- seepage from rubbish
- polluted stormwater
- chemical spills.

Wherever possible water supply systems using raw surface water should have a full water treatment system installed which includes coagulation and flocculation (not shown), filtration and disinfection. The treatment system should be able to cope with varying raw water qualities.

Figure 4: Contamination hazards and ways to minimise risks to a surface water supply system



Treatment options

If you are not sure that your drinking water supply can consistently remain free of contamination you should consider installing some simple treatment measures. Treating your drinking water is particularly important if you have vulnerable household members or visitors such as children, the elderly or those with compromised immunity. If your property is also a work place and you employ staff, you have a duty of care to protect their health and safety, and that of visitors, and therefore should ensure that the drinking water you provide is safe.

Treatment options for private drinking water supplies generally consist of one of, or a combination of, filtration, ultraviolet disinfection and chlorination.

Filtration

There are many different types of filters available therefore specialist advice should be sought when designing your system.

Filters can remove particulate contaminants within the water including some sediment, chemicals, algal toxins (which are a specific type of chemical) and microorganisms. They are normally used in combination with ultraviolet light and/or chlorine disinfection.

If there is a filter fitted to your system it should be checked, maintained and replaced in accordance with the manufacturer's advice. Filters should be free from build-up, and allow a clean, steady flow of water to pass through.

Water quality should be regularly checked after filtration. If flow is decreased or the water becomes dirty or cloudy the filter needs to be checked and may need replacing. In these circumstances, if you are not already doing so you may need to consider implementing a disinfection step.

Ultraviolet light disinfection

Ultraviolet (UV) light is a common and effective form of disinfection. It relies on the use of UV lamps which emit light with wavelengths that kill or inactivate bacteria, viruses and protozoa and prevent them from causing illness or infection.

UV treatment is most effective when preceded by filtration because UV light cannot penetrate dirty or 'cloudy' water. UV disinfection units have to be checked and maintained regularly, following the manufacturer's instructions, to ensure the lamps are working and they remain effective. UV lamps have a limited life and most need replacing every 12 months.

For best results, UV disinfection should be used either at point of use or in combination with chlorination. Where this does not occur there is potential for biofilms to grow in pipework located after the UV unit, particularly in areas of pipework that get limited use or after shut down periods.

UV disinfection systems need to be designed and installed by a water treatment specialist. If used in combination with chlorination, UV disinfection needs to precede chlorination as UV light can break down chlorine making it ineffective.

Chlorine

Chlorine treatment is a low cost method of disinfection that is effective against a wide range of contaminants. To be effective in eliminating all contaminants, it should be preceded by filtration to remove sediments and larger particles from the water supply. Water can be chlorinated either through an automatic dosing system within your regular plumbing or manually by adding to the tank.

If you decide to use chlorine as a regular source of disinfection for your drinking water, or if you need to use chlorine to shock dose your drinking water following a known contamination event, you should be aware that it is a hazardous chemical that can cause harm to people, property and the environment. Chlorine should only be used in accordance with instructions on labels and after arrangements have been made for safe handling and storage.

There are various types of chlorine that you can use to disinfect your tank. Options include liquid household bleach, sodium hypochlorite and calcium hypochlorite.

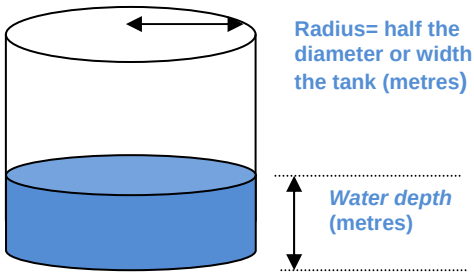
Liquid household bleach can be purchased at a supermarket or hardware store. Check that the product has at least 4 per cent available chlorine and has no additives such as fragrances or detergents. Sodium hypochlorite and calcium hypochlorite can be purchased from large supermarkets, hardware stores or swimming pool suppliers. Stabilised chlorine (which contains isocyanuric acid) is not effective in enclosed tanks and should not be used.

It usually takes about 5 mg of chlorine per litre of water to disinfect your tank. As chlorine is available in a number of different forms, the per cent available chlorine must be known before it is added to the water.

To determine how much chlorine to add you must first calculate the volume of water in the tank. This can be done using the following formulae:

Rectangular/square tanks: Volume (litres) = depth of water in tank (metres) x tank width (metres) x tank length (metres) x 1,000

Cylindrical tanks: Volume (litres) = depth of water in tank (metres) x tank radius (metres) x tank radius (metres) x 3140



Then, use the table below to estimate the amount of different preparations of chlorine that should be added to various volumes of water to provide an initial concentration of 5 mg/L.

Table 1. Chlorine addition to water storage tanks

Volume of water in tank (litres)	Amount of chlorine to add to achieve 5 mg/L in tank		
	4% liquid bleach (mL)	12.5% liquid sodium hypochlorite (mL)	65% granular or powdered calcium hypochlorite (g)
1000	125	40	8
2000	250	80	15
5000	625	200	38
6000	750	240	46
7500	938	300	58
10000	1250	400	77
16000	2000	640	123
20000	2500	800	154
30000	3750	1200	231

When adding the chlorine to the tank first mix the chlorine solution with cold water in a plastic bucket in the open air, then add to the tank and let it stand for at least one hour (ideally 24 hours) before use.

Always add chlorine to water, never water to chlorine, avoid inhalation and use appropriate protective equipment including gloves and goggles. Always follow the manufacturer's handling and storage instructions.

The chlorine will dissipate (disappears) from the water quite rapidly. The concentration of chlorine remaining in the water after 30 minutes should be at least 0.5 mg/L, but no more than 5 mg/L. This can be measured using a swimming pool chlorine test kit to make sure that disinfection has been effective.

If the water quality in the tank is poor, the amount of chlorine added to the tank may need to be increased to above 5 mg/L in order to achieve 0.5 mg/L after 30 minutes.

For routine (i.e. non-emergency) treatment of good-quality water, an initial dose of less than 5 mg/L may be sufficient to achieve 0.5 mg/L after 30 minutes.

Monitoring and maintenance

The list below identifies typical monitoring and maintenance activities that rural property owners can implement to help keep their for private water supply systems. The recommended frequency for each activity is provided in brackets.

Water source: rainwater	Clean gutters (3-monthly and after storms)
	Clear first flush device of debris (monthly and after storms)
	Check and trim overhanging branches (annual)
	Inspect and repair downpipes (annual)
	Check condition of the roof (annual)
Water source: groundwater	Check the bore head and any other mechanisms installed are water tight and protected from surface flows (monthly)
	Check bore is securely protected e.g. fences, locks (monthly)
	Check maintenance and operation of the pump and piping (monthly)
Water source: surface water	Check the (upstream) catchment for new developments (e.g. land use changes) and other possible sources of contamination (monthly)
	Check maintenance and operation of the pump and piping (monthly)
	Check inlet screen on pump for debris (monthly)
Tank	Check inlet and outlet screens are intact (3-monthly)
	Check access covers (monthly)
	Clear strainer for debris (monthly and after storms)
	Check structural condition (annual)
	Check sludge level and internal cleanliness (every two years or as required)
Distribution system	Check plumbing and piping is fully operational and well maintained (annual)
	If you have more than one water supply, check for cross connections after any significant plumbing work.
Treatment system	Replace filters (as per manufacturer's advice or earlier if a decrease in water flow is noticed)
	Where chlorine is used, test chlorine level is between 0.2 and 0.5mg/L (at least weekly or after heavy rains)
	Where chlorine is used test pH level is between 6.5 and 8.5 (monthly)
	Check UV light is operating - indicator light (weekly)
	Clean scum from UV light (3-monthly)
	Replace UV lamps every 12 months (or as per manufacturer's instructions)
Water quality testing	Speak to your local council environmental health officer or a water testing laboratory (listed in the telephone directory) to determine the availability of water quality testing in your area*.

*Assess results against guideline values in the *Australian Drinking Water Guidelines (latest edition)*

Recreational water

After a hot day it can be tempting to jump into or use any water to cool off.

Sources of recreational water on and around rural properties include:

- Swimming pools
- Dams
- Tanks/troughs
- Rivers/creeks/waterholes
- Hoses/sprinklers.

Prevent drowning and injury

Care should be taken to supervise all children and poor swimmers around recreational water sources on rural properties to ensure they do not get into difficulty.

Owners of properties that are home to children or are visited by children should fence the area around the homestead to prevent children accessing water sources unsupervised.

All persons should take care when entering dams, creeks and rivers as depths can be variable and currents unpredictable. Water in these recreational water sources may also be discoloured hiding hazards, such as submerged branches and sharp rocks, below the water's surface.

Flood waters should never be entered for recreational purposes.

Prevent illness

Recreational water sources can also be the cause of illness amongst users. They can be easily contaminated by environmental debris such as soil and leaves, by animals and their faeces, by other users, and by chemicals and substances used on and around rural properties.

Recreational water users should attempt to not swallow water and to prevent water from entering cuts and breaks in the skin by ensuring these are appropriately covered. Users should also prevent water from being forced up the nose.

Users who have suffered diarrhoea or upset stomach in the past 48 hours should not enter the water to prevent spreading illness. Users diagnosed as suffering cryptosporidiosis should not enter the water for 2 weeks after diarrhoea has stopped.

Domestic swimming pool water quality

All swimming pools should be subject to regular checks to ensure that the water is safe to swim in. If the water is not properly maintained bacteria, viruses and treatment chemicals may build up and cause health problems such as upset stomachs, rashes and ear, nose and throat infections.

As a minimum, pH and chlorine levels should be checked weekly.

The ideal pH level should be between 7 and 7.6. Levels above 8 increase the risk of skin rashes and levels lower than 7 can sting eyes.

Chlorine is the most effective disinfectant for destroying germs rapidly in water. In outdoor pools, free chlorine levels (the amount of chlorine that remains in the water as a residual and is available to destroy any new germs) of 2mg/L should be maintained if the temperature is less than 26°C. Where temperatures exceed 26°C, 3mg/L free chlorine should be maintained. If there is a strong smell of chlorine from your pool, contrary to popular belief, it means that there is not enough chlorine in the pool and chloramines are forming which can irritate the eyes and skin.

Other regular activities that should be undertaken to help maintain the quality of pool water include:

- Routine checking and cleaning of filters
- Routine brushing/vacuuming of the pool
- Regular total alkalinity calculations
- Regular calcium hardness calculations

Further advice on maintaining your pool can be obtained from a pool chemical supplier or pool maintenance company.

Inflatable and toddler pools should only be filled with water from a disinfected supply and should be emptied daily after use.

Hoses and sprinklers

Hoses and sprinklers can be particularly attractive to young children wishing to play with water or cool off. They are also often located in close proximity to the home and therefore allow for easy access.

Both hoses and sprinkler fittings can be a breeding ground for illness-causing bacteria and other pathogens as they are often stored with stagnant water within them and many are not used on a regular basis. Before every use they should be well flushed while minimising generation of spray.

To help prevent illness people should not drink directly from hoses and when playing with water from hoses or sprinklers care should be taken not to swallow water or introduce water to the nose.

Specific hazards

Naegleria

Naegleria fowleri is a single-celled amoeba that occurs naturally in untreated warm (25°C to 40°C) water. It can grow in warm dams, poorly managed swimming pools and in untreated water lying in long distance above ground pipelines and hoses.

Water drawn from deep artesian bores in rural Queensland is particularly at risk from *Naegleria fowleri*. This type of groundwater often exits the ground at elevated temperatures and is typically cooled in open dams before being transported via above ground pipelines to homesteads and tank storage.

Naegleria fowleri can cause primary amoebic meningoencephalitis (PAM). PAM is a rare but severe illness. Infection occurs when water containing the amoeba goes up the nose. Once in the nose, *Naegleria* makes its way to the brain where it causes destruction of the brain tissue and lining which is usually fatal.

Testing water for *Naegleria fowleri* is very specialised and expensive and, even if it is not found, does not necessarily indicate or guarantee that the water is free of *Naegleria fowleri* all the time. As *Naegleria fowleri* occurs and grows naturally in warm waters, it should be assumed that any warm freshwater body could contain *Naegleria fowleri* at some time.

Water treatment processes such as chlorination, filtration and UV treatment are able to kill or remove *Naegleria fowleri* however expert advice should be sought on the most suitable water treatment process for a household's untreated water supply.

Controlling *Naegleria fowleri* in a natural environment, e.g. lakes and farm dams, is difficult and impractical. Modification of activities when in contact with untreated warm water is the most feasible method to prevent infection with *Naegleria fowleri.*

To prevent infection:

- Avoid jumping or diving into any warm fresh water or thermal pools
- Keep the head above water in spas, thermal pools and warm fresh water bodies
- During recreational activity in shallow warm water bodies, minimise stirring up the sediments.
- Avoid recreational activity in warm water bodies during high temperatures and low water levels
- Empty and clean small collapsible wading pools daily
- Ensure swimming pools and spas are adequately chlorinated and well maintained
- Flush stagnant water from hoses before allowing children to play with hoses or sprinklers
- If using unchlorinated water:
  - Don't allow water to go up the nose when bathing, showering or face washing
  - Supervise children playing with hoses or sprinklers and teach them not to squirt water up the nose
- Only use uncontaminated water for irrigating, flushing or rinsing nasal passages and sinuses.

Legionella

Legionella are a class of bacteria found in the natural environment around the world. Most *Legionella* species, including *Legionella pneumophila*, thrive in warm water, and need the presence of other organisms (e.g. amoebae) to multiply. They grow readily in man-made environments such as inside plumbing fixtures and pipes, where warm temperatures and the build-up of nutrients and microorganisms on surfaces (called biofilm) provide an ideal environment.

Legionellosis is a collective term for diseases caused by *Legionella* bacteria including the most serious, Legionnaires' disease, as well as the less serious condition of Pontiac fever. Legionnaires' disease is a type of pneumonia caused by the *Legionella* bacteria. Humans might contract this disease by inhaling microscopic/invisible droplets (aerosols) of contaminated water from man-made systems such as hot or warm water systems, showerheads, spa baths, or evaporative air coolers.

You can reduce the risks of Legionnaires' disease by taking some simple steps when installing and maintaining water pipes, plumbing fittings and some water filled appliances/fixtures such as hot water systems (including solar) and evaporative air coolers.

Hot water systems

Hot water systems, (including shower roses, hot water taps, hot water tanks, pipework and the associated fittings) have the potential to harbour the *Legionella* bacteria where there may be stagnant or warm water (25-50°C). The following precautions will help reduce the risk:

- Hot water tanks are required by Queensland law to store water at 60°C or more to reduce the risk of *Legionella* multiplying in the hot water system and plumbing. However this temperature may cause scalding so water used for washing and bathing should be delivered at 45-50°C through the use of water temperature controllers such as thermostatic mixing valves or thermostats that can be regulated (for instantaneous water heaters). Do not turn down hot water systems. Any adjustment to the thermostat settings should be done by a licensed electrician or a licensed plumber with restricted electrical certification.

- Hot water systems should not be turned off unnecessarily. Boosters for solar hot water systems should not be turned off during cloudy days. Hot water systems that are turned on after prolonged absences from home should heat water to 60°C for at least half an hour prior to use of the hot water.

- Hot and mixed showers and taps that are not in regular use should be flushed with hot water at full flow for at least 15 seconds every week. Flushing will help eliminate stagnant water and minimise the multiplication of bacteria that may be present. Showers and taps that are not used for extended periods of time (e.g. due to absence from home) require longer flushing to remove the stagnant water from the pipes. Caution should be taken when flushing to prevent inhalation of the water aerosols (tiny airborne water droplets).

- Maintain your hot water systems. Use a registered plumber and refer to manufacturer's instructions or check the manufacturer's website for information.

Evaporative air conditioners

Domestic air conditioners (refrigerated/reverse cycle integrated and split systems that remove heat and moisture from the air without using water) **do not** harbour *Legionella* bacteria.

Evaporative air conditioners use water to cool air. There is little risk of Legionnaires' disease from these appliances (built-in or portable) but there are some steps you can take to reduce risks:

- follow the manufacturer's maintenance and cleaning instructions
- use a clean and fresh water supply
- contact an air conditioning company for regular cleaning and maintenance services.