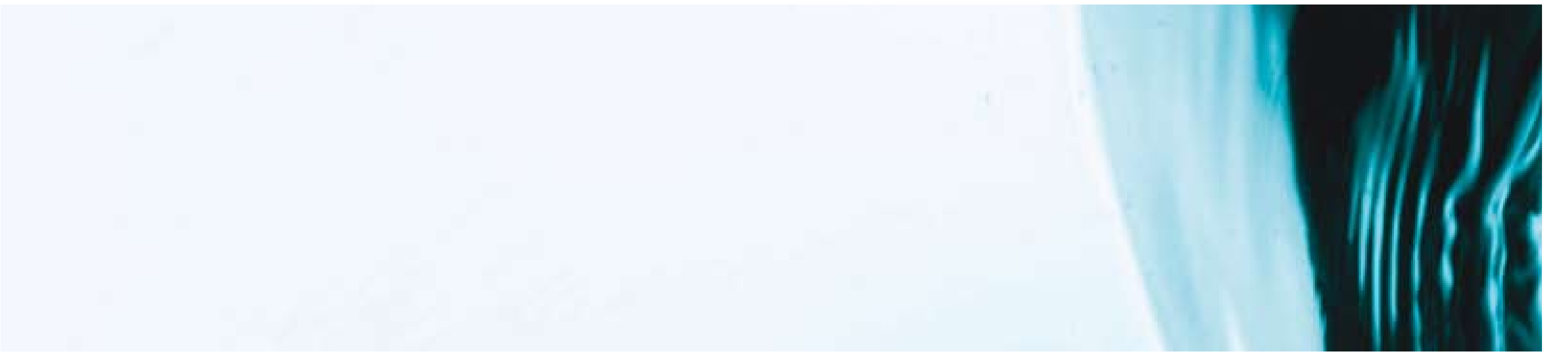
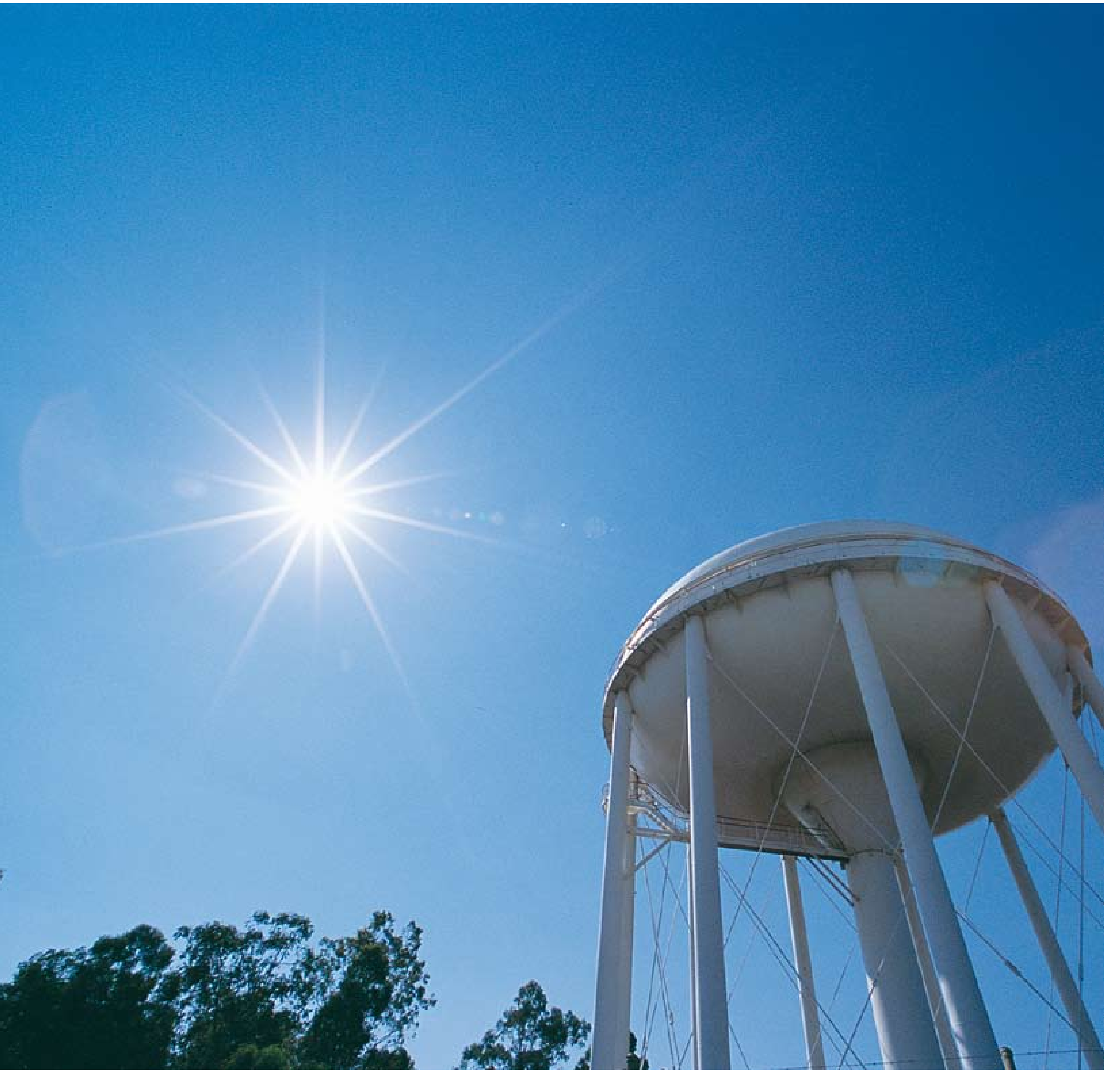
POWER AND WATER CORPORATION

DRINKING WATER QUALITY REPORT 2006

PowerWater





Power and Water is committed to being a trusted provider of safe, good quality drinking water.
Our commitment is outlined in our Drinking Water Quality Policy and Customer Contract.
A copy of the Customer Contract is available at any Power and Water office or at www.powerwater.com.au.

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From the Managing Director

I am delighted to introduce the fifth annual public report on the quality of the Northern Territory's drinking water.

Across the country people are debating water conservation issues, and the water industry is researching and implementing new ways to sustainably manage water supplies.

Sustainable water management is particularly challenging in the Northern Territory, where we have large arid areas and rainfall is only plentiful in the Top End a few months of the year. We must manage our water supplies flexibly, taking into account up-to-date scientific advancements, to ensure reliable, safe and good quality drinking water is available now and for future generations.

Power and Water Corporation supplies water to five major centres, 13 minor centres and 80 remote rural communities across the Territory.

At Power and Water we are committed to the quality of our drinking water supplies. We strive for continual improvement and work hard to maintain a high standard of reliability.

In 2006, after much effort and planning, we successfully achieved certification to three internationally recognised standards. This certification will help ensure we continually improve the quality, occupational health and safety and environmental management of our water supply systems.

We faced a number of challenges in 2006. Cyclone Monica and the Katherine flood put our emergency procedures and staff to the test. Cyclone Monica affected a number of communities, in particular Maningrida and Gunbalanya, where extensive damage to power supplies and water infrastructure occurred. Despite significant flooding, water supply infrastructure in Katherine remained relatively unscathed, largely because of the many lessons we learned from the 1998 flood.

This year's report contains, for the first time, a diagram of the water cycle including information on the different processes involved. The report also includes results from the intensive monitoring for *Naegleria fowleri* over the past 12 months; and the 95th percentile levels for health-related water quality parameters in major and minor centres instead of the average levels, which were reported in previous years.

As the Northern Territory's water service provider, we are proud to share our performance and plans for the future.

Andrew Macrides
Acting Managing Director
Power and Water Corporation

Section 1: Commitment to Drinking Water Quality Management

Power and Water is committed to being a trusted provider of safe, good quality drinking water. Our commitment is outlined in our Drinking Water Quality Policy and Customer Contract. A copy of the Customer Contract is available at any Power and Water office or at www.powerwater.com.au.

Power and Water's Drinking Water Quality Policy

We aim to provide a good quality, safe and reliable drinking water supply. We undertake to:

- Supply drinking water appropriate to the environment in which the community is located, to standards in accordance with parameters set by drinking water guidelines;
- Develop a drinking water monitoring program in consultation with the Department of Health and Community Services (DHCS), monitor the quality of drinking water supplies in accordance with the agreed program, and report annually to the Chief Health Officer;
- Implement and maintain a Drinking Water Quality Management System consistent with the 2004 Australian Drinking Water Guidelines (ADWG), to minimise risks to drinking water quality at all points along the delivery chain from source water to the consumer;
- Ensure that all managers, employees and contractors involved in the supply of drinking water understand and implement the Drinking Water Quality Management System;
- Develop and maintain a water quality incidents and complaints register to benchmark performance and to help identify and resolve water quality issues;
- Develop appropriate contingency and incident response plans to deal effectively with incidents that may adversely affect drinking water quality, including implementation of any emergency precautions notified by the Chief Health Officer, to ensure safety of supply;
- Participate in the Cooperative Research Centre for Water Quality and Treatment, to identify issues and research priorities for water quality in regional and rural areas; and
- Annually assess performance with respect to this policy, review our practices in conjunction with DHCS and consult with the community on water quality issues requiring attention.

A cornerstone of our commitment to drinking water quality is our adoption and progressive implementation of the *Framework for Management of Drinking Water Quality* developed by the National Health and Medical Research Council and included as a key component of the 2004 ADWG.

The framework is based on the adoption of a proactive approach to ensuring the safety of water supplies. The structure of this report is based on the principles in the framework. This report details our progress to date in implementing the framework and the continuous improvement of our existing systems and procedures.

While Power and Water has primary responsibility for providing safe drinking water through the *Water Supply and Sewerage Services Act*, a number of government agencies are also involved. DHCS has a key role in applying the 2004 ADWG and monitoring compliance with the guidelines in the interest of public health.

The Department of Primary Industry, Fisheries and Mines (DPIFM) independently analyses water samples we provide to its laboratories in Darwin and Alice Springs.

The Department of Planning and Infrastructure (DPI) has a major role in protecting water quality through land use planning.

The newly formed Environment Protection Agency regulates pollution control and as such also has a significant role in protecting water quality.

It is only through the coordination and cooperation of all of these agencies that the water quality objectives of all Territorians will be achieved and maintained now and in the future.

Section 2: Assessment of the Drinking Water Supply System

From the tropical north to the arid centre, Power and Water deals with a range of challenges to deliver good quality water. To understand where our water comes from, and how it moves in the environment, including our water supply systems, an understanding of the water cycle is required.

The Water Cycle

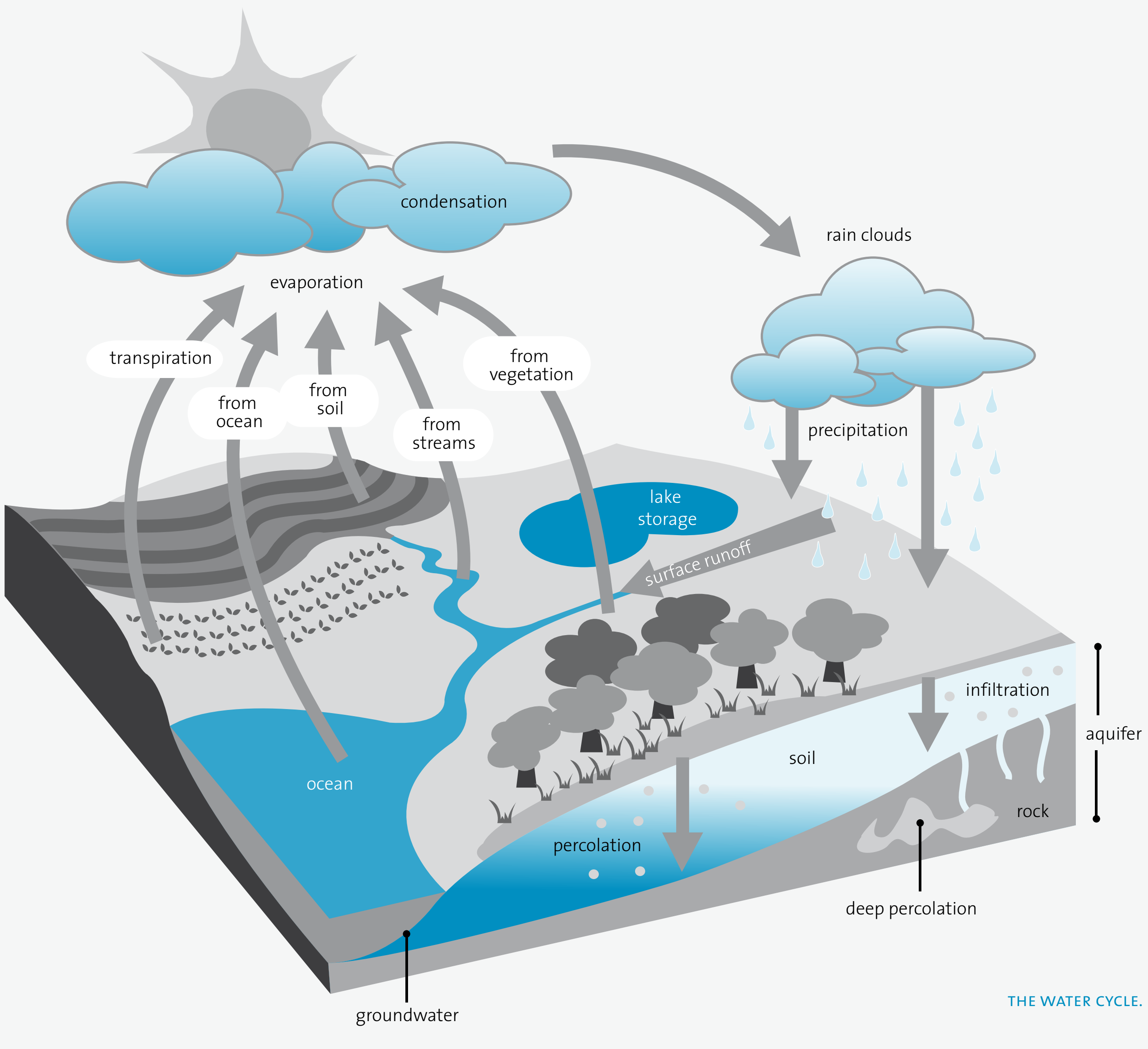
The water cycle is the movement of water from the earth's surface to the atmosphere and back again. The amount of water we have on earth doesn't actually change. There is change, though, in the amount of water available to use because the cycle is interrupted both by human intervention and natural storage. Although the majority of the earth's surface is water (about 80 per cent), only about two per cent of this is fresh water. This is why we need to use our water wisely and not waste it.

Stages in the Water Cycle

Evapotranspiration: This is the term used for evaporation (from surface water sources) and transpiration (evaporation from plants). Evapotranspiration is responsible for the movement of water from the earth (liquid form) to the atmosphere (gas form). In the Northern Territory, the rate of evaporation is particularly high - for example, the water level in the Darwin River Dam drops by almost 1.8 metres each year due to evaporation.

Condensation: Is the process that forms clouds. Condensation changes water from a gas form to a liquid form. Cloud formation can be seen in spectacular form in the Top End wet season.

Precipitation: After water is condensed in the atmosphere, the particles become large and heavy enough to fall from the atmosphere. Precipitation takes the form of rain, hail and snow.



THE WATER CYCLE.

Water Sources

Most of Darwin's water supply comes from Darwin River Dam. To ensure good quality water, no development or public access is allowed in the catchment. The reservoir is recharged during the monsoonal wet season (November to April) and is drawn down through the dry season (May to October). This supply is supplemented with about 20 per cent groundwater from the McMinns and Howard East Borefields.

DARWIN RIVER DAM.

Apart from Darwin, Katherine and Pine Creek, most other centres rely almost exclusively on groundwater, particularly in the arid centre. In some cases the groundwater is over 10,000 years old. **Table 1** outlines existing water sources for the major and minor centres in the Northern Territory.

Most source waters need some form of treatment to ensure that the water is purified and safe for drinking. More details on treatment are in Section 3.

TABLE 1: SUMMARY OF EXISTING WATER SOURCES IN MAJOR AND MINOR CENTRES

Location	Source
Adelaide River	Bore water
Alice Springs	Bore water
Batchelor	Bore water
Borroloola	Bore water
Daly Waters	Bore water
Darwin	Surface water (Darwin River Dam) + Bore water (20%)
Elliott	Bore water
Katherine	Surface water (Katherine River) + Bore water (30%)
Kings Canyon	Bore water
Larrimah	Bore water
Mataranka	Bore water
Newcastle Waters	Bore water
Pine Creek	Surface water (Copperfield Dam) + Bore water (40%)
Tennant Creek	Bore water
Timber Creek	Bore water
Ti Tree	Bore water
Yulara	Bore water

Power and Water has developed a semi-quantitative risk assessment methodology to analyse water quality risks in communities throughout the Territory. The methodology is based on water quality measurements taken in all communities in 2005-2006. The risk assessment generates a score for each community and informs us of the communities most at risk.

We use this information to allocate resources to improve water quality. The results of the risk assessment are in Section 12 – Review and Continual Improvement.

Section 3: Preventative Strategies for Drinking Water Supply

The adoption of preventive strategies for the protection of drinking water supplies is based on the barrier principle. This means using appropriate barriers to minimise the potential for water supply contamination. The barrier principle is one of the key elements of the *Framework for Management of Drinking Water Quality*, developed under the 2004 ADWG.

Table 2 summarises the current barriers used in major and minor centres. Each of the water quality barriers is discussed in more detail below.

TABLE 2: WATER QUALITY BARRIERS IN MAJOR AND MINOR CENTRES

	Catchment Protection	Detention in Reservoirs/ Aquifers	Bore Head Integrity	Alternate Sources of Supply	Coagulation Filtration or Membrane Filtration	Disinfection	Storage Tank Integrity and Cleaning	Maintenance of Positive Pressure in Reticulation	Back-flow Prevention in Reticulation	Disinfection Residual at Customers' Tap
Adelaide River		■	■			■	■	■		▒
Alice Springs		■	■			■	■	■		▒
Batchelor		■	■			■	■	■		▒
Borroloola		■	■			■	■	■		▒
Cox Peninsula		■	■			■	■	NA	NA	▒
Daly Waters		■	■			■	■	■		▒
Darwin Groundwater	▒	▒	■	■		■	■	■		▒
Darwin Surface Water	■	■	NA	■		■	■	■		▒
Elliott		▒	■			■	■	■		▒
Katherine Groundwater		▒	■	■		■	■	■		▒
Katherine Surface Water	▒	▒	NA	■	■	■	■	■		▒
Kings Canyon		■	■			■	■	■		▒
Larrimah		▒	■			■	■	■		▒
Mataranka		▒	■			■	■	■		▒
Newcastle Waters		■	■			■	■	■		▒
Pine Creek Groundwater		■	■	■		■	■	■		▒
Pine Creek Surface Water	▒	■	NA	■	▒	■	■	■		▒
Tennant Creek		■	■				■	■		
Timber Creek		■	■			■	■	■		▒
Ti Tree		■	■			■	■	■		▒
Yulara		■	■		■	■	■	▒		▒

Notes: Grey indicates only a partial barrier. Black area indicates full barrier. NA – Not Applicable.

Catchment Protection

Catchment protection is the first and most important barrier for protecting water quality. Power and Water continues to focus on protecting catchments for surface waters in Pine Creek, Katherine and Darwin as well as groundwater sources throughout the Territory.

Power and Water has been working with the Pine Creek Community Council and local landholders to manage access to Copperfield Dam and its catchment. In the past, feral animals and stock have had unlimited access to the dam, however, the recent construction of fences around the reservoir has dramatically reduced the potential risks to water quality from inside the catchment. Informative signs will be installed in close cooperation with the Council.

COPPERFIELD DAM, PINE CREEK.

The noxious aquatic weed Cabomba (*Cabomba caroliniana*) continues to be of concern for Darwin River Dam. The weed occurs downstream of the dam wall and is being monitored closely. Signs have been erected at Darwin River Dam and downstream to warn people of the presence of Cabomba and to prevent people spreading Cabomba to Darwin River Dam.

Regular weed monitoring is undertaken in the Darwin River Dam catchment and storage and no Cabomba has been detected.

This year, however, a new weed species – Olive hymenachne (*Hymenachne amplexicaulis*) – has been found in the shallow waters of one of the main inflows to Darwin River Dam. Olive hymenachne is a noxious weed of national significance that is easily spread by plant parts and birds. It is found in some tropical parts of the Northern Territory and in several places along the coast of Queensland. Olive hymenachne is now incorporated into Power and Water's weed monitoring surveys and control program.

OLIVE HYMENACHNE.
Photo courtesy of the Department of Natural Resources and Water, Queensland.

Power and Water has erected signs around the Darwin River Dam catchment and has also investigated using video surveillance for controlling illegal access.

To protect groundwater quality in the Howard East/McMinns area, Power and Water recommends 200 metre Exclusion Zones and 400 metre Active Management Zones around all Power and Water production bores. These zones have been applied to new developments in the area. Power and Water continues to work with DPI, DHCS and local land developers in this area to ensure supplies are protected.

Groundwater quality risk assessments were conducted recently for bores at Katherine, Mataranka and Larrimah. Preliminary reports indicate there are no immediate actions required, however recommendations have been made to reduce the risk of contamination of groundwater systems.

In 2006 an assessment was undertaken to determine catchment risks to the Alice Springs public water supply. The study used a semi-quantitative risk assessment approach to determine the existing and potential risks to water quality in the recharge area of the Roe Creek Borefield. The assessment found a number of existing and proposed developments that collectively produce an unacceptable level of risk to water quality, although the risks can be reduced to an acceptably low level through control measures. The findings of this study have been incorporated into the design of recent development proposals in the catchment, and Power and Water continues to work with DPI, and the Department of Natural Resources, Environment and the Arts to ensure that the groundwater system is protected.

Detention in Protected Reservoirs and Aquifers

The amount of time water is held in surface water supply reservoirs and aquifers is a key element to maintaining good water quality. In surface reservoirs, a long detention time allows sediment to settle, improving the clarity of the water, and enables the water to undergo natural disinfection through exposure to solar radiation. On average, water in Darwin River Dam has a detention time of up to six years before being used for supply.

In deep aquifers, water is filtered as it percolates from the surface to deep underground. Detention in deep aquifers is usually between 10 to 100 years.

Bore Head Integrity

The maintenance of bore head infrastructure is a critical element in protecting water quality. Bores must be properly sealed to prevent contaminated surface waters from entering the water supply. This is particularly important for bores that are prone to wet season flooding. Sometimes it is necessary to raise bores significantly above the surrounding area to ensure their protection. This has occurred for bores in the Howard East, Adelaide River and Newcastle Waters areas.

Alternative Sources of Supply

Surface water and groundwater supplies vary in their quantity and quality throughout the Territory. Developing and using alternative sources allows greater flexibility in their management and use. For example, different sources can be blended to improve the overall water quality of individual sources, or seasonal changes in surface water supplies can lead to a greater reliance on groundwater at different times.

Pine Creek is a good example where lower quality groundwater is blended with surface water during the dry season to meet demand. During the wet season, the surface water deteriorates significantly, however the lower water demand during that period means that better quality groundwater can be provided alone.

Alternative sources are also an important strategy for enabling continuity of supplies in emergencies.

Coagulation, Filtration or Membrane Filtration

Filtration is used to remove dirt, bacteria and other materials from water. It is a key treatment process for surface water supplies, which may not be adequately protected at their source.

Power and Water manages two major water treatment plants: a reverse osmosis treatment plant for desalination of groundwater supplies at Yulara and a coagulation filtration plant at Katherine.

The majority of Katherine's water supply comes from flows in the Katherine River. The quality of the river water is highly variable and therefore requires filtration to ensure a high quality water supply throughout the year.

Disinfection with Chlorine Residual

A disinfection control barrier is an essential component of good water quality management. We see this as a high priority in protecting water supplies microbiologically and maintaining good quality water throughout the distribution system.

A major challenge for water suppliers is how to balance the risks from disease-causing organisms and the potential for disinfection by-products. Section 5 – Verification of Drinking Water Quality contains further information on disinfection by-products.

Disinfection systems exist in all the major and minor centres, except Tennant Creek. Power and Water uses chlorine, as it is simple and effective and has been used around the world for more than 100 years.

All of our chlorine dosing facilities have been upgraded to improve reliability and disinfection control. McMinns chlorine facility in Darwin is the final major disinfection system upgrade and is due for completion by the end of October 2006.

Future minor disinfection upgrades are also being investigated and include:

- Additional chlorine booster points in Darwin along the distribution system to help maintain target chlorine residuals throughout the entire drinking water system;
- Installing UV (ultraviolet) disinfection on the water sourced from the Howard East and McMinns borefield as a precautionary measure to protect supplies from potential contamination of groundwater from septic tanks; and
- Installing UV disinfection at Tennant Creek as a primary disinfection method.

GASEOUS CHLORINE STORAGE FACILITY, KINGS CANYON.

Storage Tank Integrity and Cleaning

All of Power and Water's storage tanks are covered with a roof to minimise contamination from birds or animals as well as dirt, leaves and other matter. Special flaps help prevent frogs from entering the tanks. The tanks are cleaned routinely to remove any sediment accumulated on the bottom of the tank.

Distribution Pipe Cleaning and Maintenance of Positive Pressure

Protecting water supply distribution systems is a key element to ensuring good water quality. Maintaining positive pressure ensures contaminants do not enter the water supply following pipe ruptures. Following a mains break the pipe is isolated and repaired before being chlorinated, flushed and reconnected to the water supply system. This minimises any potential contamination from entering the distribution system. Any new mains that are built are also disinfected before use.

The water supply system is routinely flushed to remove build up of sediments and biofilms that accumulate in pipes. This ensures a continual quality supply is being distributed to customers.

Back-flow Prevention

Back-flow prevention is necessary to ensure potentially poor quality water does not re-enter the main supply from a customer's service. It is compulsory for back-flow prevention devices to be installed in businesses where activities pose a back-flow risk, or where potable water supplies are in someway connected to a water recycling system.

While many back-flow prevention valves have been installed on individual premises, Power and Water is currently planning a comprehensive back-flow assessment and prevention program for new consumers.

Disinfection Residual at Customers' Taps

Maintaining adequate chlorine residual at customers' taps is essential for ensuring microbiologically safe drinking water. Good control of the disinfection process is required to manage taste and odour associated with chlorination and ensuring an adequate residual is achieved for all customers. The 2004 ADWG recommends maintaining a chlorine residual of 0.2 mg/L at the end of the system and Power and Water aims to achieve this as a minimum in all its water supply systems.

The detection of *Naegleria fowleri (N. fowleri)* in 2005 in the Darwin water supply system has necessitated an increase in chlorine dose to achieve a residual of 0.5 mg/L at the end of the system. This is what the 2004 ADWG recommends for effective control. More details on *N. fowleri* are in Section 6 – Incident and Emergency Response.

Hazard Analysis Critical Control Point (HACCP)

Hazard Analysis Critical Control Point (HACCP) is an internationally recognised risk management standard that provides guidance on establishing an effective system for ensuring the safety and suitability of food for consumption. It is a logical and structured approach that is compatible with the *Framework for Management of Drinking Water Quality* in the Australian Drinking Water Guidelines.

A key part of HACCP is identifying risks to water quality, ensuring adequate controls are in place to control these risks and continuously improving. Throughout the year work on implementing HACCP in Katherine and Tennant Creek continued.

In Katherine, the groundwater contamination risk was assessed. Bore head protection zones were determined and aquifer vulnerability was mapped. These tools will guide future land use planning.

A comprehensive review of the Katherine Water Treatment Plant was undertaken to examine treatment processes and identify improvements. Water demand scenarios were also examined for a major upgrade of the facility and a preferred option will be considered for future planning.

Minor works were undertaken in Tennant Creek at the Cabbage Gum Water Supply Facility and borefield. A disused storage tank was demolished to prevent it from being used accidentally. To improve site security, vegetation management and repairs to fencing were undertaken. An investigation was also conducted to improve system hydraulics to ensure water does not sit for long periods of times in storage tanks where it can go stale. Recommendations from the investigation will be implemented in 2007.

Section 4: Operational Procedures and Process Control

Operational Procedures

Formal operational procedures are critical to ensure consistent delivery of good quality water across the Northern Territory. Work can be done in a standardised way with all data recording and reporting needs identified.

Standard procedures across the Territory include:

- Water quality failure reporting;
- Water quality testing;
- Annual cleaning of storage tanks;
- Chlorine dosing of tanks;
- Disinfection of mains prior to connection to water supply;
- Disinfection of mains following breakage;
- Flushing of water mains to remove sedimentation;
- Confined space entry procedures covering both hot and cold work in storage tanks;
- Water quality sampling of new bores for water supply; and
- Water quality sampling work instructions.

Water quality sampling work instructions provide guidance on the correct way to take water samples. All staff are trained and assessed using these work instructions.

Operational procedures have also been developed to deal with water quality issues in particular centres. These include:

- Blending of groundwater and surface water supplies in Pine Creek to ensure average guideline values for arsenic are not exceeded. A number of individual bores in the Pine Creek, Kybrook Farm area have arsenic levels above those recommended in the 2004 ADWG. When these are mixed with other bores and surface water, the average result is below guideline values; and
- Development of a water supply flushing program in Darwin, Katherine and Alice Springs to minimise water quality complaints.

Standard operating procedures are continuously being reviewed and updated in line with the implementation of HACCP for water supply systems and Power and Water's drive for continual improvement. The Environment (ISO14001), Quality (ISO9001) and OH&S (AS4801) management systems require continual improvement.

Operational Monitoring and Process Control

Operational monitoring is done in all centres. A key focus is on maintaining adequate chlorine residuals as a barrier against microbiological contamination.

Microbiological sample collection and analysis can take up to 72 hours. The long time between sampling and results has led to a focus on risk management and a proactive approach to preventing potential contamination. Section 5 – Verification of Drinking Water Quality details the results of microbiological water quality monitoring in 2005-2006.

Power and Water uses a range of on-line monitoring equipment in all major and minor centres. These include chlorine, fluoride, conductivity, turbidity and pH sensors.

Data from monitoring equipment is collected through our System Control and Data Acquisition (SCADA) system. This means that specific parameters can be continuously monitored and controlled, particularly in remote locations. This results in more effective management and reduced response times to water quality issues. SCADA also makes it easier to collect, store, analyse and report data.

On-line chlorine monitoring is also being used to fine-tune dosing in Katherine, Darwin River Dam and McMinns, where modern chlorination equipment has recently been installed. Power and Water has collaborated with the Cooperative Research Centre for Water Quality and Treatment to trial new on-line monitoring technologies.

Section 5: Verification of Drinking Water Quality

Water Quality Monitoring Program

Power and Water's Water Quality Monitoring Program is used to verify the success of current water quality management strategies. The program was reviewed this year and significant changes were made in light of the 2004 ADWG.

The 2004 ADWG have shifted the emphasis from compliance monitoring to focusing on total system management by applying preventive strategies. The current Water Quality Monitoring Program covers operational monitoring and verification monitoring in line with the 2004 ADWG, instead of 'compliance' monitoring at customers' taps that was a requirement of previous versions of the ADWG.

The new approach aims to encourage the mindset that the water quality results obtained from routine monitoring test the multiple barriers in place to protect water quality, and that maintaining these barriers is the most important form of 'compliance' to consider.

WATER QUALITY ANALYSIS AND TESTING CONDUCTED AT THE BERRIMAH FARM, DARWIN.

Microbiological Monitoring

Microbiological monitoring checks for potential disease-causing organisms. Microorganisms, some of which can cause human illness, can be difficult to detect. Indicator organisms are therefore used to show whether contamination may have occurred. The indicator organisms that Power and Water monitors are:

- *Escherichia coli (or E. coli)* – exclusively indicate faecal contamination from warm-blooded animals, and hence, potentially disease-causing microorganisms; and
- Total coliforms: a range of bacteria found in many soil and water environments. This group gives a general indication of the cleanliness of the drinking water system.

The 2004 ADWG require that, for assessment of microbiological performance:

- At least a minimum number of routine samples have been tested for thermotolerant coliforms (or alternatively E. *coli*); and
- At least 98 per cent of scheduled samples (as distinct from repeat or special purpose samples) contain no thermotolerant coliforms (or alternatively *E. coli*).

Heterotrophic plate counts are also used as a general indication of all microorganisms that may be present, and are a useful indicator of operational performance. The count shows mainly environmental organisms, as well as some faecal organisms. It is a useful measure of general water quality in addition to the indicator organisms (*E. coli*). An operational target level of <1000 cfu/mL is used for Power and Water's drinking water supply systems.

None of the microbiological parameters described above can be used as indicators for the amoeba *N. fowleri*. Monitoring programs for *N. fowleri* have been implemented in Darwin, Alice Springs, Katherine and Tennant Creek, and will occur in all major and minor centres in 2006-2007. The monitoring of *N. fowleri* has been working effectively by highlighting areas of high risk so that special efforts can be focused on these to ensure the potential risk is controlled.

Due to the difficulty of delivering samples to laboratories interstate from rural communities, Power and Water is looking at ways to test for *N. fowleri* in Darwin and Alice Springs. This may make it possible to monitor for *N. fowleri* in rural communities in 2007-2008.

In consultation with DHCS, Power and Water has established a monitoring program for the organism *Burkholderia pseudomallei*, which causes the disease Melioidosis, for the year 2006-2007. This program targets unchlorinated water supplies in both urban centres and remote areas and follows on from research into Melioidosis in water supplies by the Menzies School of Health.

Microbiological Results Summary

E. coli water quality results for major centres over the past year are shown in **Figure 1**. This figure also provides information from previous years for comparison. The bars represent the current year, whereas the symbols represent previous years. In 2005-2006 almost all the major centres complied with the *E. coli* criteria in accordance with the 2004 ADWG and as agreed to by DHCS with the exception of Tennant Creek. During 2005-2006, 97.5 per cent of samples taken in Tennant Creek had no *E. coli* detected. Full details of sample numbers, total coliforms and heterotrophic plate counts from the 2005-2006 year are in **Appendix 1**.

The risk of microbiological contamination for Tennant Creek remains higher than other centres because there is no continuous chlorination system in place.

FIGURE 1: PERCENTAGE OF SAMPLES TAKEN IN MAJOR CENTRES IN WHICH NO *E. COLI* WERE RECORDED INCLUDING TRENDS FROM 2001-2006

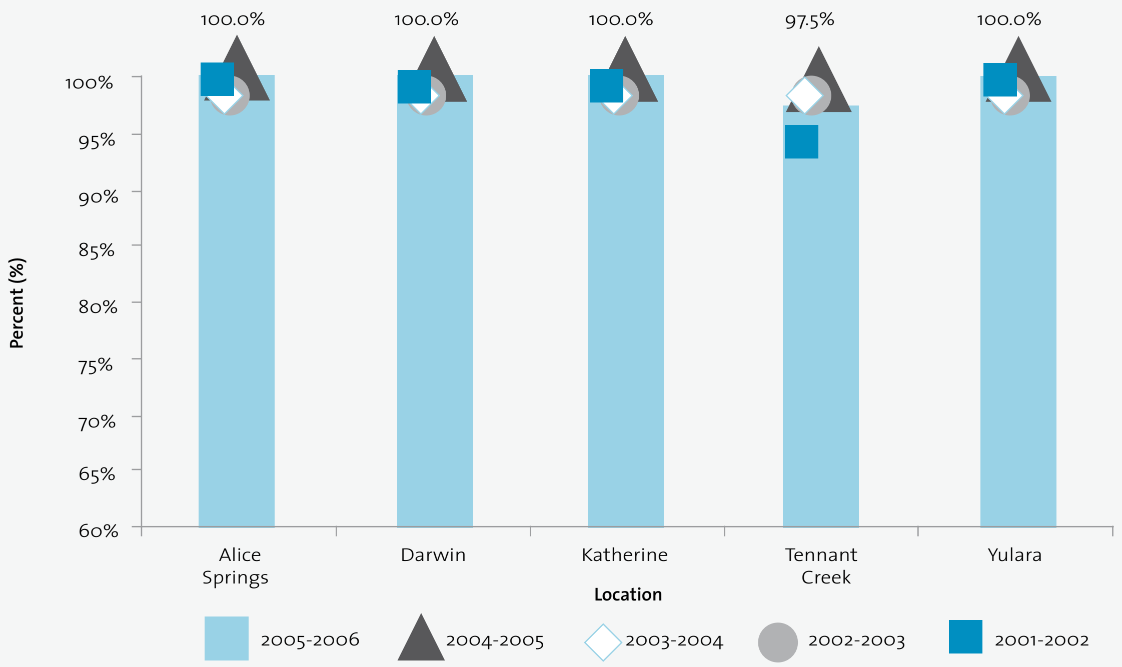


Figure 2 presents results for *E. coli* microbiological compliance for all the minor centres in the Northern Territory. The bars represent data from 2005-2006 for each centre, while symbols represent data from previous years for comparison. Full details of results including annual sample numbers, total coliforms and heterotrophic plate counts are in **Appendix 2**.

FIGURE 2: PERCENTAGE OF SAMPLES TAKEN IN MINOR CENTRES IN WHICH NO *E. COLI* WERE RECORDED INCLUDING TRENDS FROM 2001-2006

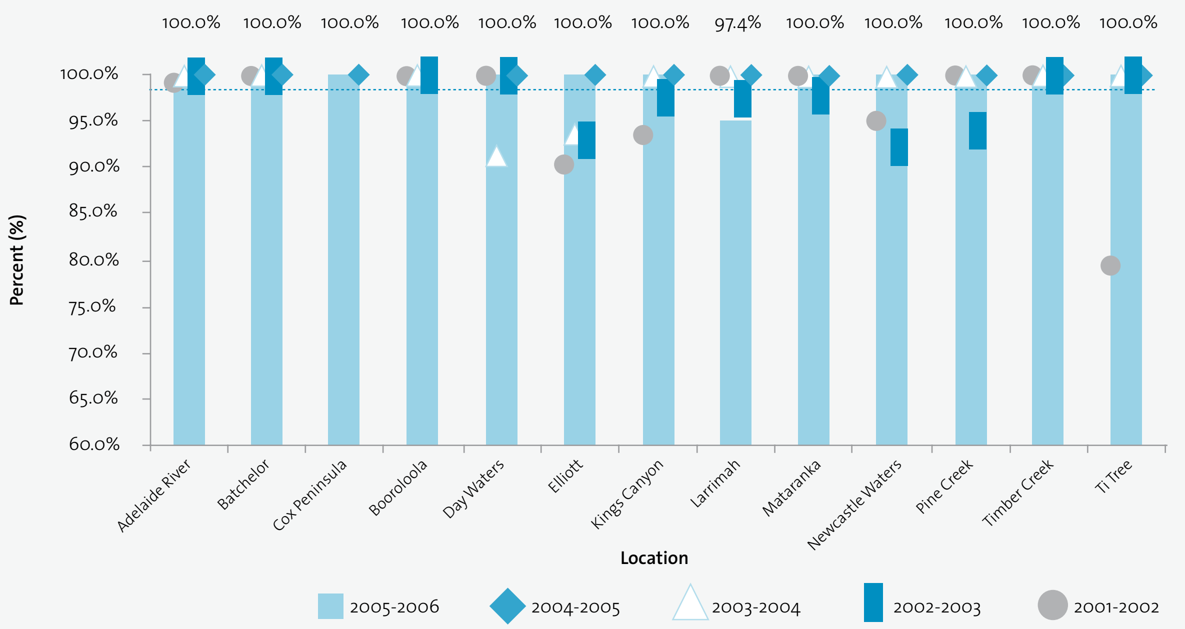


Figure 2 shows that all minor centres except Larrimah passed *E. coli* performance targets in 2005-2006. Pine Creek, Daly Waters, Elliott, Newcastle Waters and Ti Tree maintained 100 per cent compliance for this reporting period. This reflects the upgraded chlorine dosing and monitoring facilities installed in these centres in the past three years, as well as improved system operation and maintenance. The Cox Peninsula water supply system was completed in 2004-2005 period and thus only two years of data are presented.

FIGURE 3: PERCENTAGE OF SAMPLES TAKEN IN DARWIN AND TENNANT CREEK THAT DID NOT EXCEED THE TRIGGER VALUE OF TWO ORGANISIMS/L OF *NAEGLERIA FOWLERI* IN 2005-2006

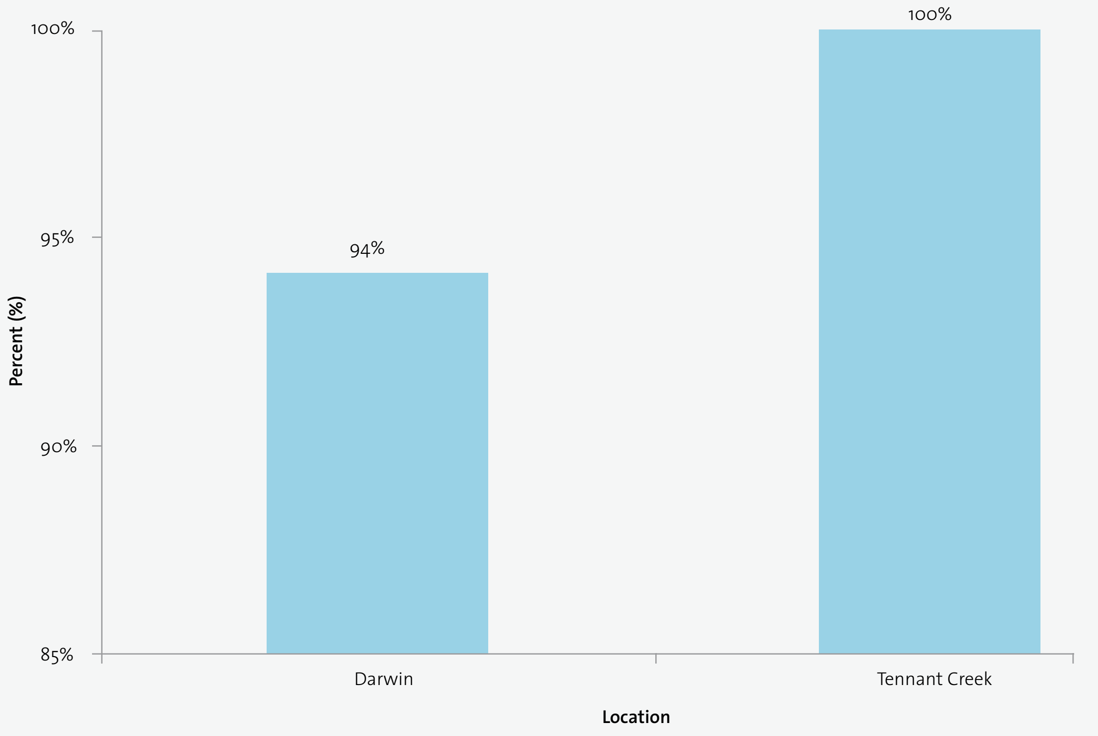


Figure 3 illustrates that, in Darwin, six per cent of samples from the routine monitoring for *N. fowleri* exceed the 2004 ADWG trigger value of two organisms per litre in the treated water system. Regular monitoring was undertaken in Darwin for the full 12 months of this reporting period after starting in July 2005. Tennant Creek began routine monitoring in September 2005 and has had no exceedances in this reporting period. Trials were undertaken in Katherine and Alice Springs over the summer/wet season months and there were no exceedances in the distribution systems following chlorination. All major and minor centres have begun regular monitoring for *N. fowleri* as part of the revised microbiological program.

In the past 12 months *N. fowleri* has been intensively monitored in Darwin and controlled through increased chlorine concentrations. The ADWG recommend controlling *N. fowleri* by maintaining a constant chlorine concentration level of 0.5 mg/L. Power and Water has aimed to do so throughout the distribution system in Darwin.

Apart from *N. fowleri*, monitoring for protozoa was not conducted in 2005-2006. Protozoa are naturally occurring aquatic organisms, some of which can be potentially infectious to human beings if ingested. *Cryptosporidium* and *Giardia* are the most commonly known. Surface water supplies are most at risk from these, which are most appropriately controlled through catchment management programs. In previous years, monitoring has not detected any viable protozoa other then amoebae from surface waters. A quantitative risk assessment of the Katherine catchment indicated that protozoa do not pose a significant risk.

Chemical and Physical Monitoring

Microbiological parameters are the key concern from a human health perspective. The risk from these can vary from day to day within water supplies. We also monitor a wide range of chemical and physical parameters under our Water Quality Monitoring Program to ensure that drinking water is safe. These parameters are unlikely to significantly alter each year, but are characteristic of each supply source.

For the first time, health related water quality parameters are being reported as a 95th percentile, while aesthetic parameters are reported as an average as required by 2004 ADWG.

Aesthetic Parameter Results Summary

Aesthetic parameters are those that pose no threat to human health but can affect drinking water appearance, palatability and odour. In water supplies in central Australia, high Total Dissolved Solids (salts) and hardness (calcium) are common, which can cause calcification on hot water systems and fixtures. Full details of the aesthetic parameters for each major and minor centre are in **Appendices 3** and **4**.

Total Dissolved Solids (TDS) is a measure of all the dissolved material in water. The level of salts in the water affects the taste, however salt-free water is regarded as unpalatable. Generally, water containing a TDS of less than 500 mg/L is desirable; however there is no evidence of harmful effects in consumers drinking water up to 1000 mg/L. Less than 800 mg/L is considered a reasonable quality by the DHCS. It is difficult to remove dissolved solids from drinking water. Technologies such as distillation and reverse osmosis can be used, but require considerable energy, are expensive to operate and waste up to 30 per cent of the water supply.

At Yulara, where natural TDS levels are in the range of 1500–2000 mg/L and no other water supply exists, reverse osmosis is used. This has enhanced the taste of the water and eliminated staining problems.

Hardness relates to the specific concentrations of calcium and magnesium in the water. Hardness comes from water in contact with limestone and other similar rock formations. It has no known detrimental effect on human health but causes scaling in hot water systems. Hardness between 60–200 mg/L is generally considered good quality, while between 200–500 mg/L can be associated with increasing scaling.

Figures 4 and **5** indicates typical levels of TDS and hardness in the drinking water supplies of the major and minor centres respectively.

FIGURE 4: AVERAGE HARDNESS AND TOTAL DISSOLVED SOLIDS IN MAJOR CENTRES 2002-2006

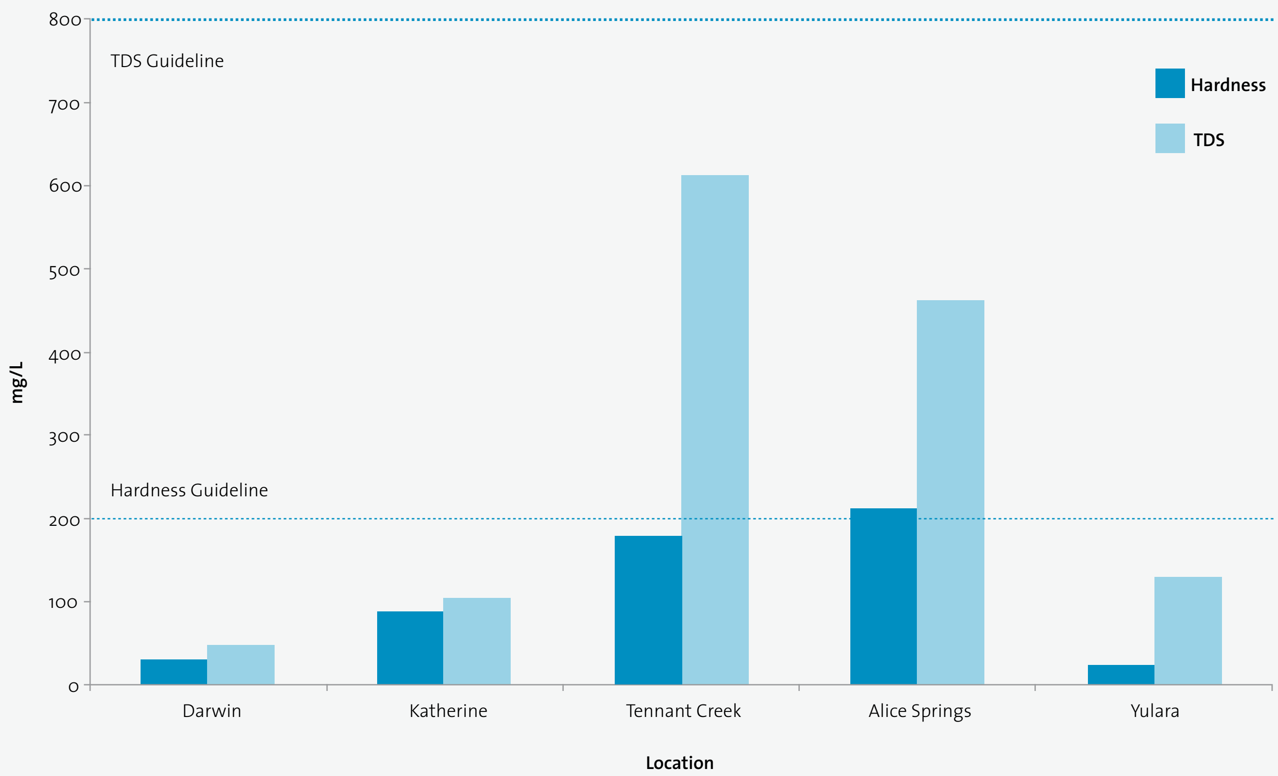
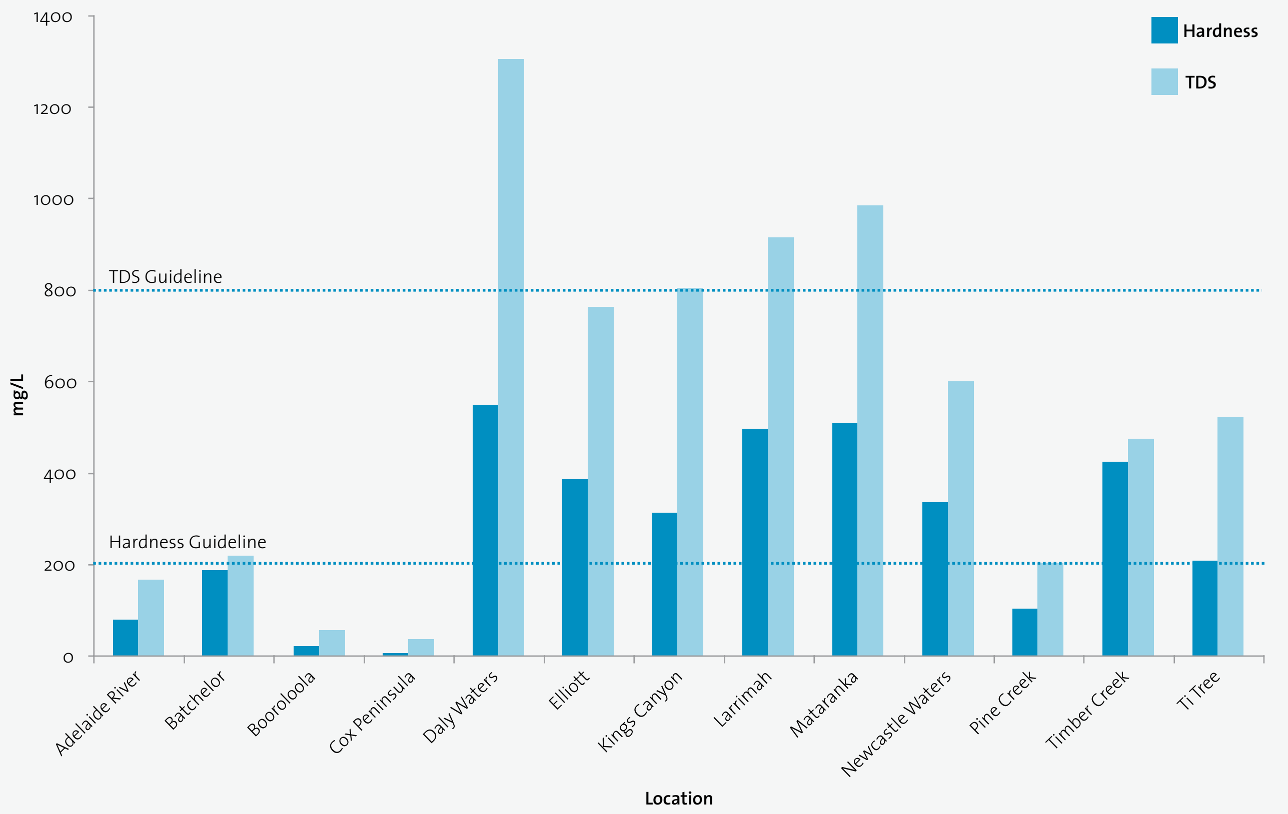


FIGURE 5: AVERAGE HARDNESS AND TOTAL DISSOLVED SOLIDS IN MINOR CENTRES 2002-2006



A number of minor centres have elevated levels of TDS and hardness. While these are problematic, these issues are of lower priority than microbiological water quality and other chemical constituents that potentially have health impacts. TDS however is included in the risk assessment for prioritisation of actions outlined in Section 12 – Review and Continuous Improvement.

Iron and manganese are naturally occurring minerals that can stain clothes, fixtures and bathroom fittings. Power and Water generally prevents iron and manganese building up by flushing pipelines regularly.

Figures 6 and **7** display average iron and manganese concentrations in the drinking water supplies of the major and minor centres respectively.

FIGURE 6: AVERAGE IRON AND MANGANESE CONCENTRATIONS IN MAJOR CENTRES 2002-2006

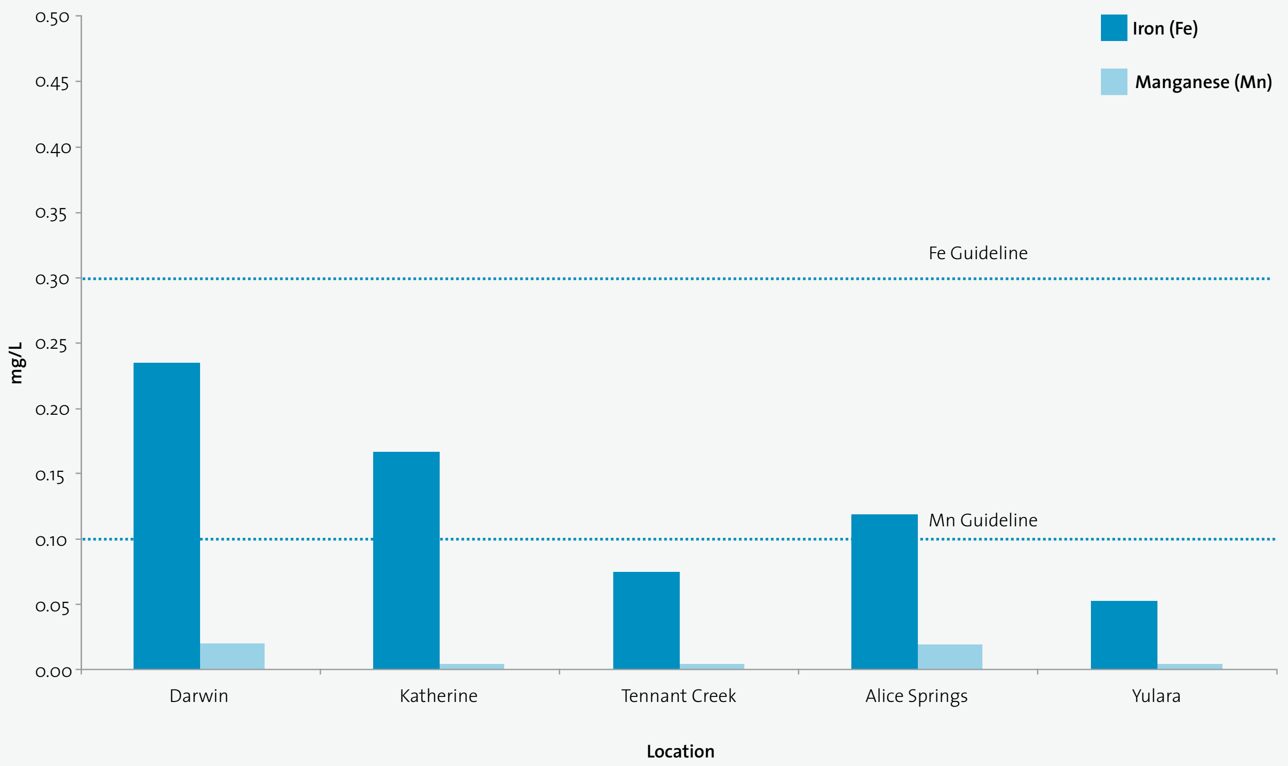
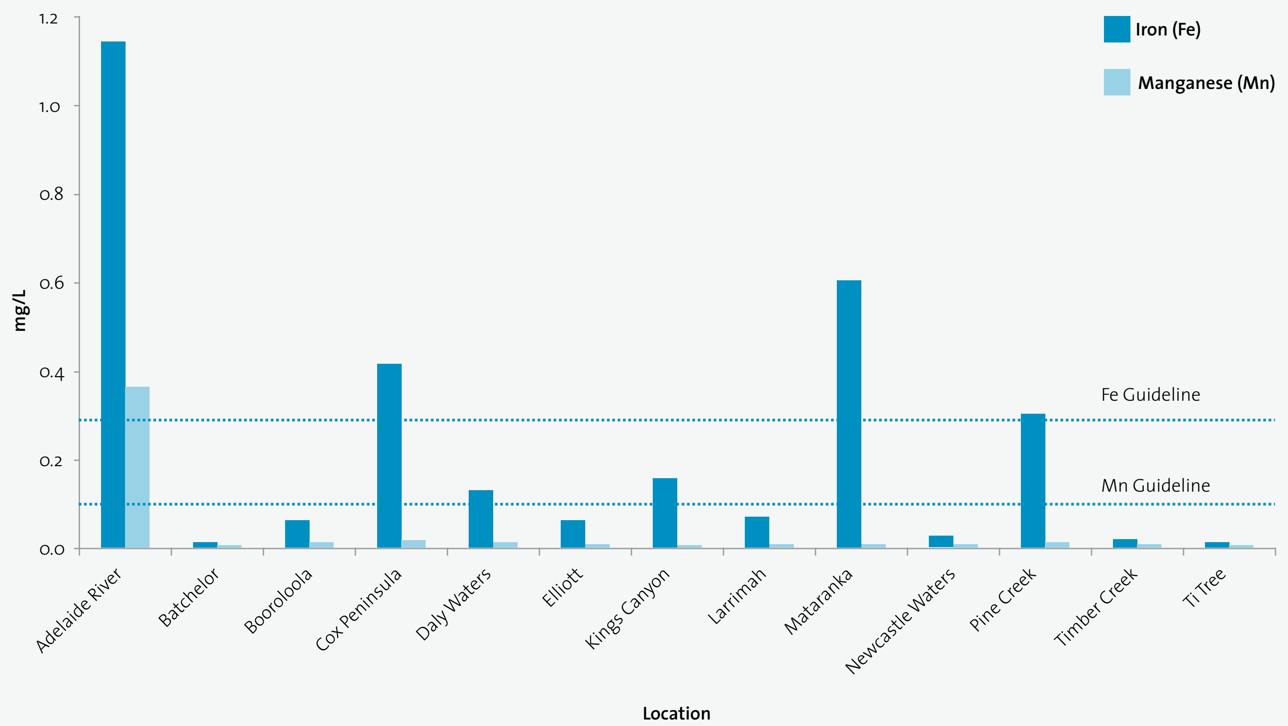


FIGURE 7: AVERAGE IRON AND MANGANESE CONCENTRATIONS IN MINOR CENTRES 2002-2006



A number of minor centres have high iron concentrations. The high levels of iron and manganese in Adelaide River are managed by the addition of sodium silicate in a process called sequestering, which retains the iron and manganese in solution and prevents staining.

It should be noted that the 95th percentile value for manganese in Adelaide River from 2002-2006 is 0.6 mg/L. This exceeds the health guideline level of 0.5 mg/L.

Health Parameter Results Summary

Health parameters are those where the risk of potential human health impacts increases as concentration increases. The 2004 ADWG values are based on various assumptions, including how much water is consumed and the level of intake of particular parameters from other sources. It also assumes that a person is exposed to these levels over a lifetime. Full details of the health parameters for each major and minor centre are in **Appendices 3** and **4**.

A new groundwater supply became operational for Ti Tree in 2004-2005. This was in response to elevated uranium concentrations detected in previous years from the old groundwater supply. This new supply has both uranium and total dissolved solids below 2004 ADWG values.

Arsenic, iodide, fluoride and nitrate all occur naturally in groundwater sources. While the levels for reporting this year have changed to displaying the 95th percentile instead of the mean, the water quality in the minor and major centres has not changed from previous years. Power and Water plans to investigate ways to control these parameters in centres of interest.

FIGURE 8: 95TH PERCENTILE LEVELS OF ARSENIC IN THE MAJOR CENTRES 2002-2006

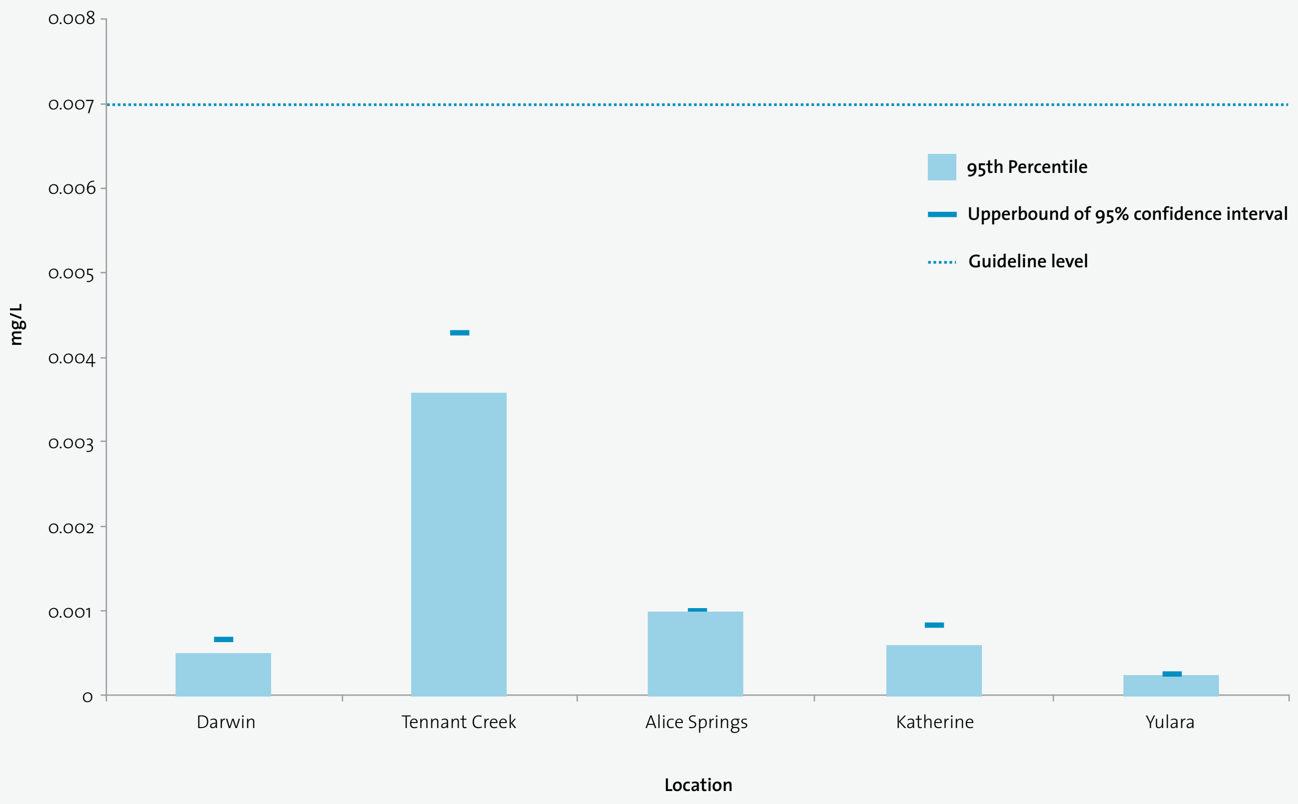
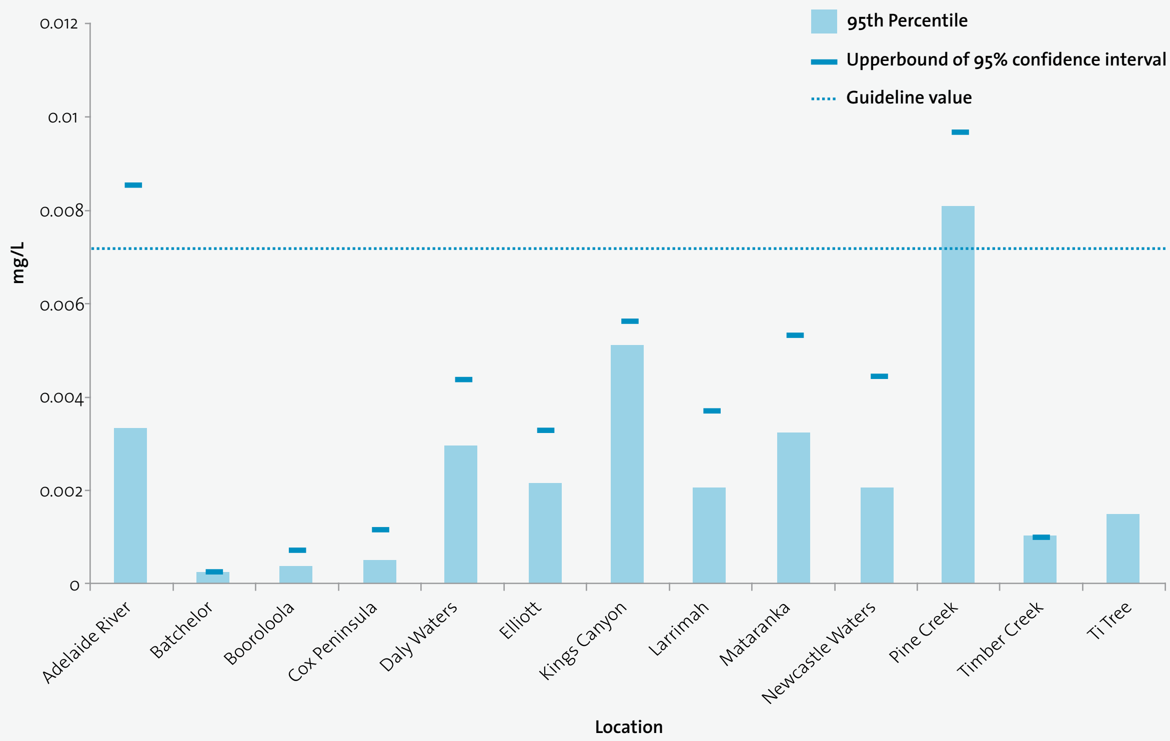


FIGURE 9: 95TH PERCENTILE LEVELS OF ARSENIC IN THE MINOR CENTRES 2002-2006



At Pine Creek, bore water continues to be blended with surface water to reduce the arsenic concentration in water supplied to customers. The average arsenic concentration in the blended water is less than the 2004 ADWG value of 0.007 mg/L, however the 95th percentile level is just above ADWG value at 0.008 mg/L.

Fluoride occurs naturally in various water supplies, particularly in the southern region of the Northern Territory. Fluoride levels from 2002-2006 are displayed in **Figures 10** and **11** for the major and minor centres respectively.

FIGURE 10: 95TH PERCENTILE FLUORIDE LEVELS IN MAJOR CENTRES 2002-2006

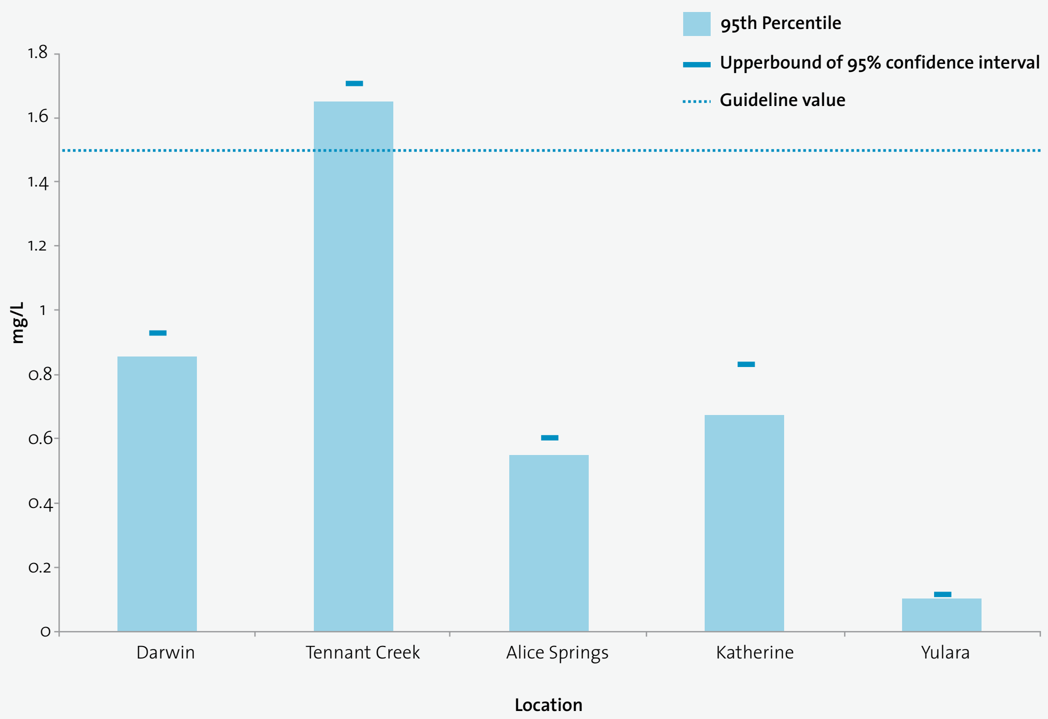
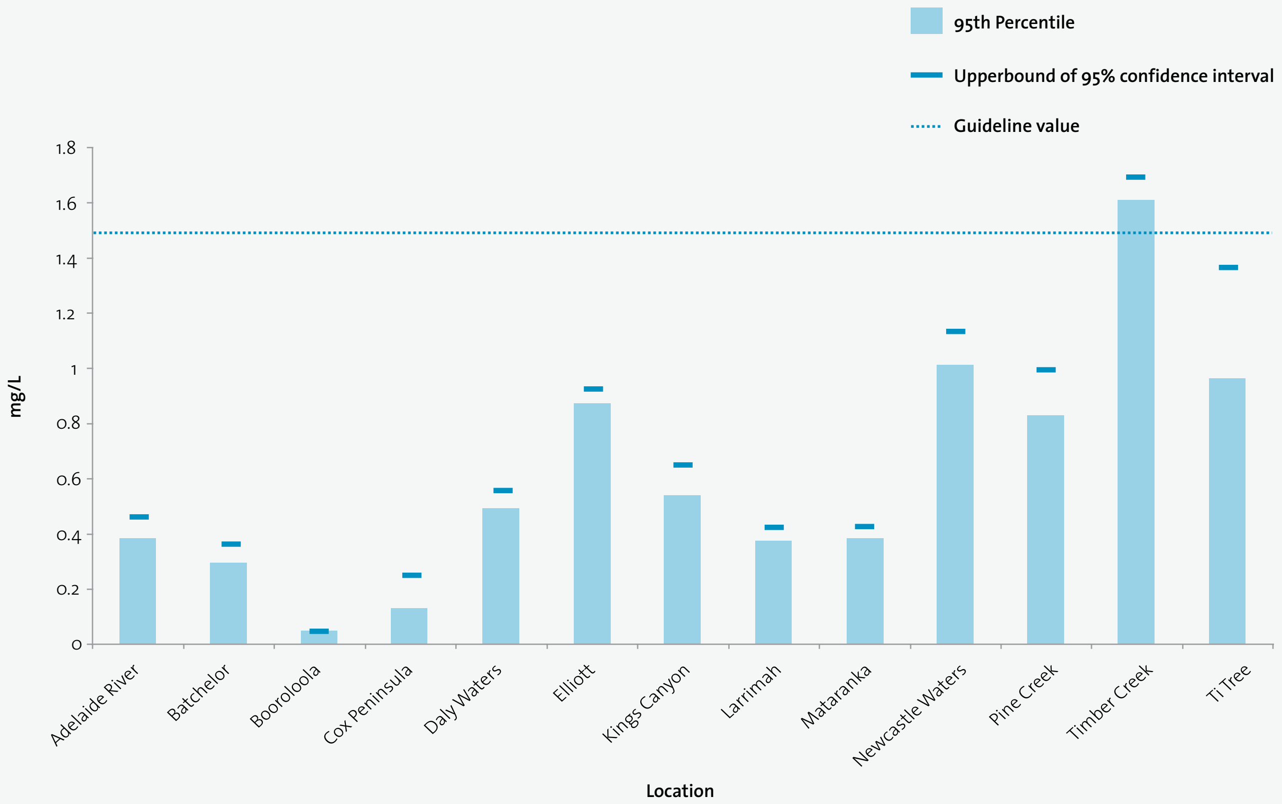


FIGURE 11: 95TH PERCENTILE FLUORIDE LEVELS IN MINOR CENTRES 2002-2006



Fluoride is added to the water in both Darwin and Katherine, as recommended by DHCS to protect against dental caries. Fluoride in the Tennant Creek water supply is managed to achieve an average below 1.5 mg/L, as recommended by the ADWG. This year's average for Tennant Creek was 1.4 mg/L; however, as seen in **Figure 10**, the 95th percentile is above the guideline value. Timber Creek also has natural fluoride in the water supply. The average concentration level is below the guideline at 1.4 mg/L; however, Timber Creek has a 95th percentile level of 1.6 mg/L similar to Tennant Creek.

Fluoride also occurs naturally in Alice Springs' drinking water supply at a level of about 0.4 mg/L, which is enough to protect dental health.

Iodide is widespread in the groundwater of Central Australia and has been detected at a number of drinking water supplies in the Northern Territory. Iodide is an essential nutrient and some countries add iodide to table salt to compensate for iodide deficient diets. The ADWG state that long term consumption of iodinated drinking water has not been associated with adverse health effects in people, however a precautionary guideline of 0.1 mg/L has been developed.

FIGURE 12: 95TH PERCENTILE IODIDE LEVELS IN MAJOR CENTRES 2002-2006

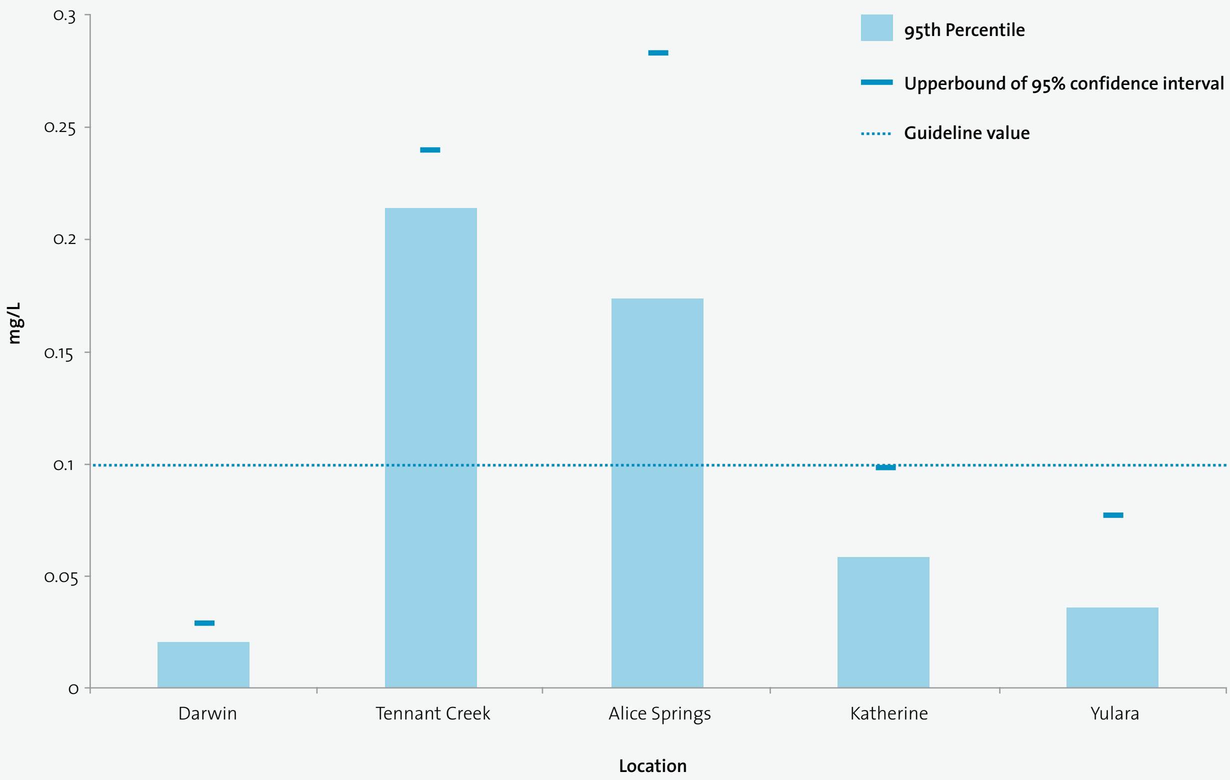
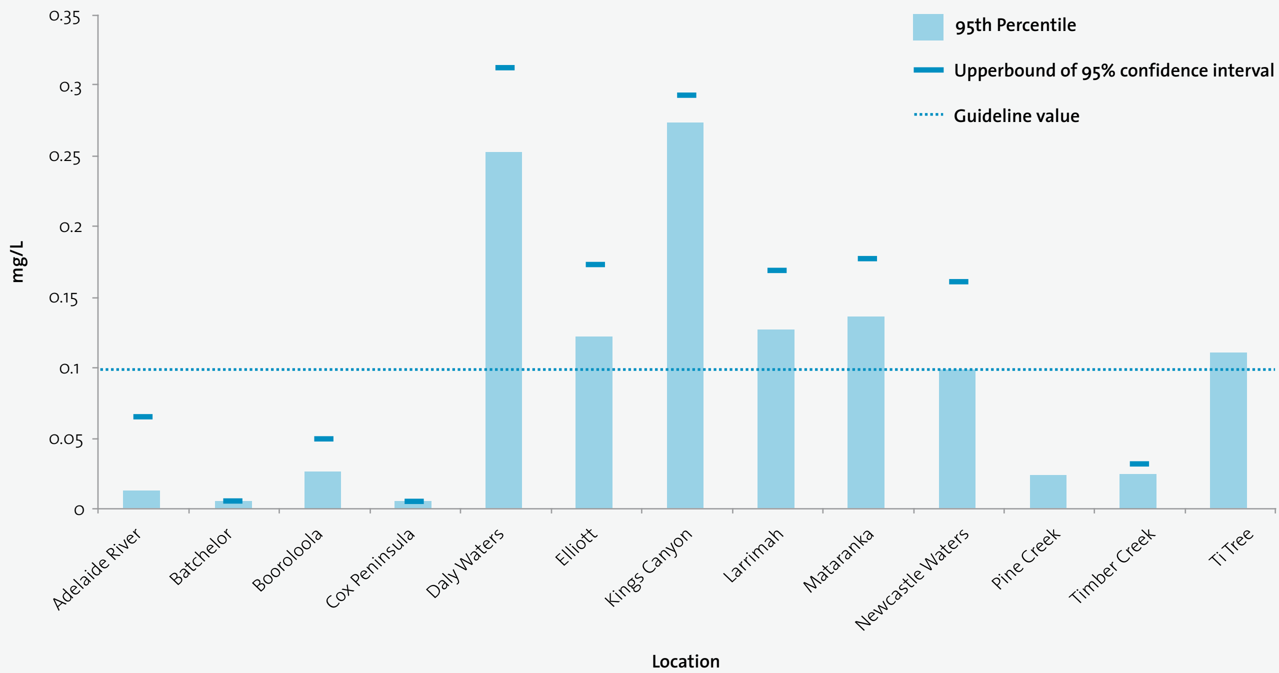


FIGURE 13: 95TH PERCENTILE IODIDE LEVELS IN MINOR CENTRES 2002-2006



Radionuclides or radiation emitting elements are sometimes found in drinking water supplies. In the Northern Territory these elements are natural to the environment and are characteristic of the local hydrogeology. In the 2004 ADWG, the measurement of these parameters is not based on concentration as with other parameters, but in terms of risk associated with annual dose per year. Under the 2004 ADWG, a dose above the trigger value of 0.5 mSv/Yr requires ongoing monitoring and investigation. A dose above the guideline value of 1.0 mSv/Yr requires some intervention.

Radionuclide samples were not collected routinely in 2004-2006 in major centres, however average total annual radiological dose has been calculated from previous years and presented in **Figure 14**.

FIGURE 14: AVERAGE TOTAL ANNUAL RADIOLOGICAL DOSE IN MAJOR CENTRES 2002-2003

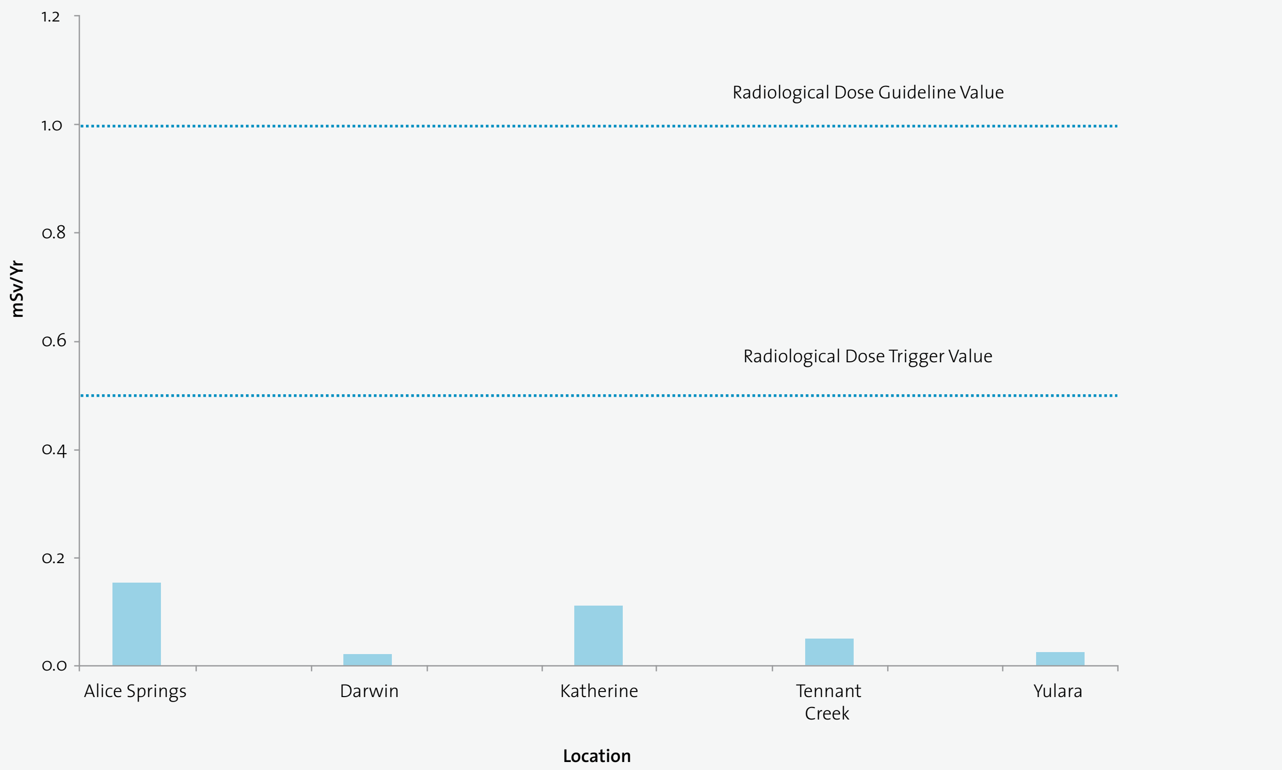
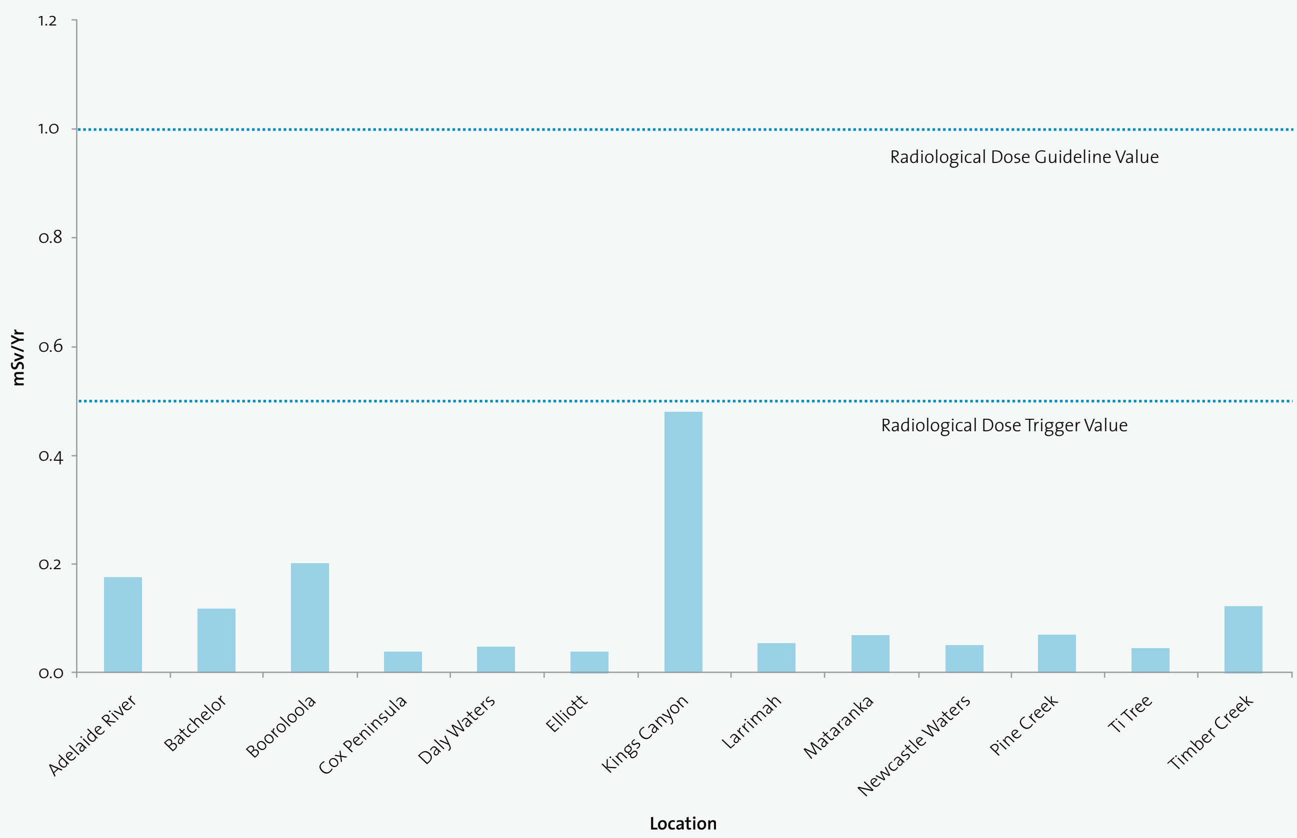


Figure 15 shows total annual radiological dose for the minor centres. No routine monitoring was carried out in minor centres except at Kings Canyon, however average total annual radiological dose has been calculated from previous years. Intensive radiological sampling was undertaken at three locations in the distribution system in Kings Canyon during 2004-2006 in light of elevated results detected in the previous year. The average result is just below the 2004 ADWG trigger value. Power and Water will continue to monitor Kings Canyon over the coming year and is currently investigating treatment options to reduce the total annual radiological dose.

FIGURE 15: AVERAGE TOTAL ANNUAL RADIOLOGICAL DOSE IN MINOR CENTRES 2002-2006



Pesticides are used for controlling insects in agricultural areas. DHCS requires testing for pesticides in the Northern Territory where a potential exists for a water supply to be at risk from contamination. No pesticide sampling in drinking water supplies was conducted in 2005-2006.

Disinfection by-products are formed when disinfectants react with organic materials in the water supply. Chlorine is the primary defence against disease-causing microbiological contaminants in public water systems. However, chlorine reacts with naturally occurring organic matter such as dissolved leaves and other vegetation, to produce a range of products, most commonly trihalomethanes (THMs). THMs include the compounds chloroform, bromodichloromethane, dibromochloromethane and bromoform.

As the concentration of THMs measured is typically proportional to the amount of organic material in the water, surface water supplies typically have higher THM levels than that of groundwater supplies, following disinfection with chlorine.

The 2004 ADWG has set a guideline value for THMs of 0.25 mg/L. THMs measured in Power and Water supplies range from less than 0.08 mg/L in Darwin to less than 0.004 mg/L in Alice Springs, concentrations that are well below the recommended 2004 ADWG level.

Figures 16 and **17** indicate concentrations of THMs in the drinking water supplies of the major and minor centres respectively. Due to low records from previous years, THM samples were not collected in 2005-2006. No THM data has been collected for Tennant Creek in any year because the water supply is not continually chlorinated.

FIGURE 16: 95TH PERCENTILE OF TOTAL TRIHALOMETHANES IN MAJOR CENTRES 2002-2003

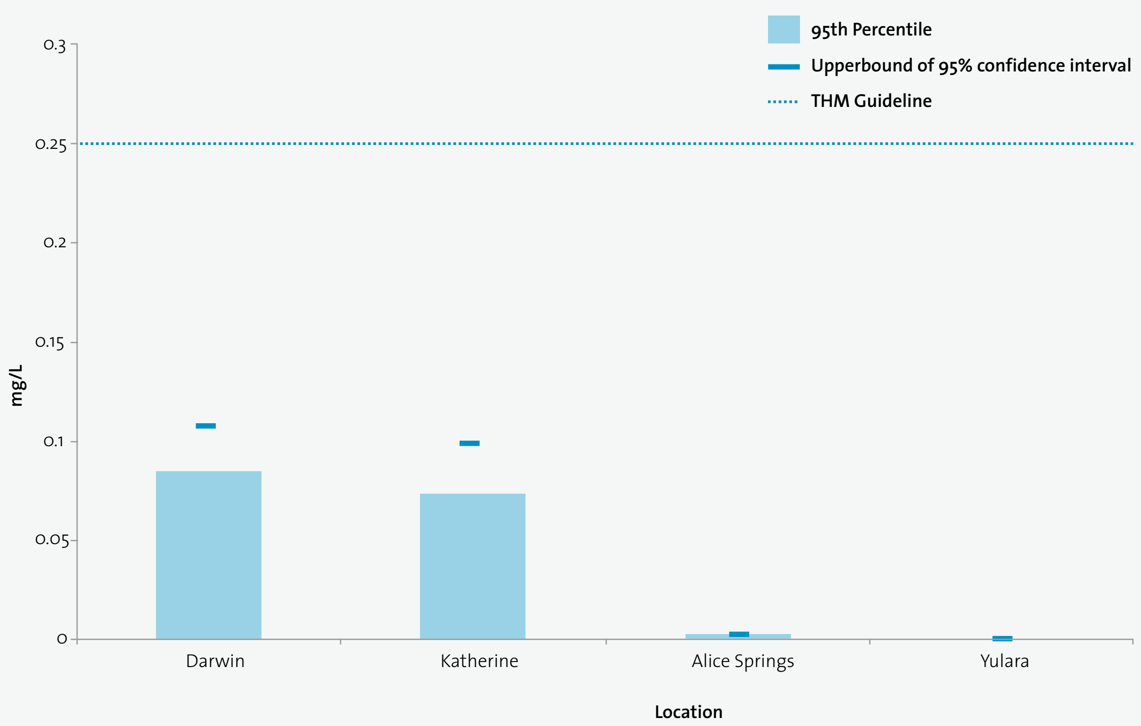
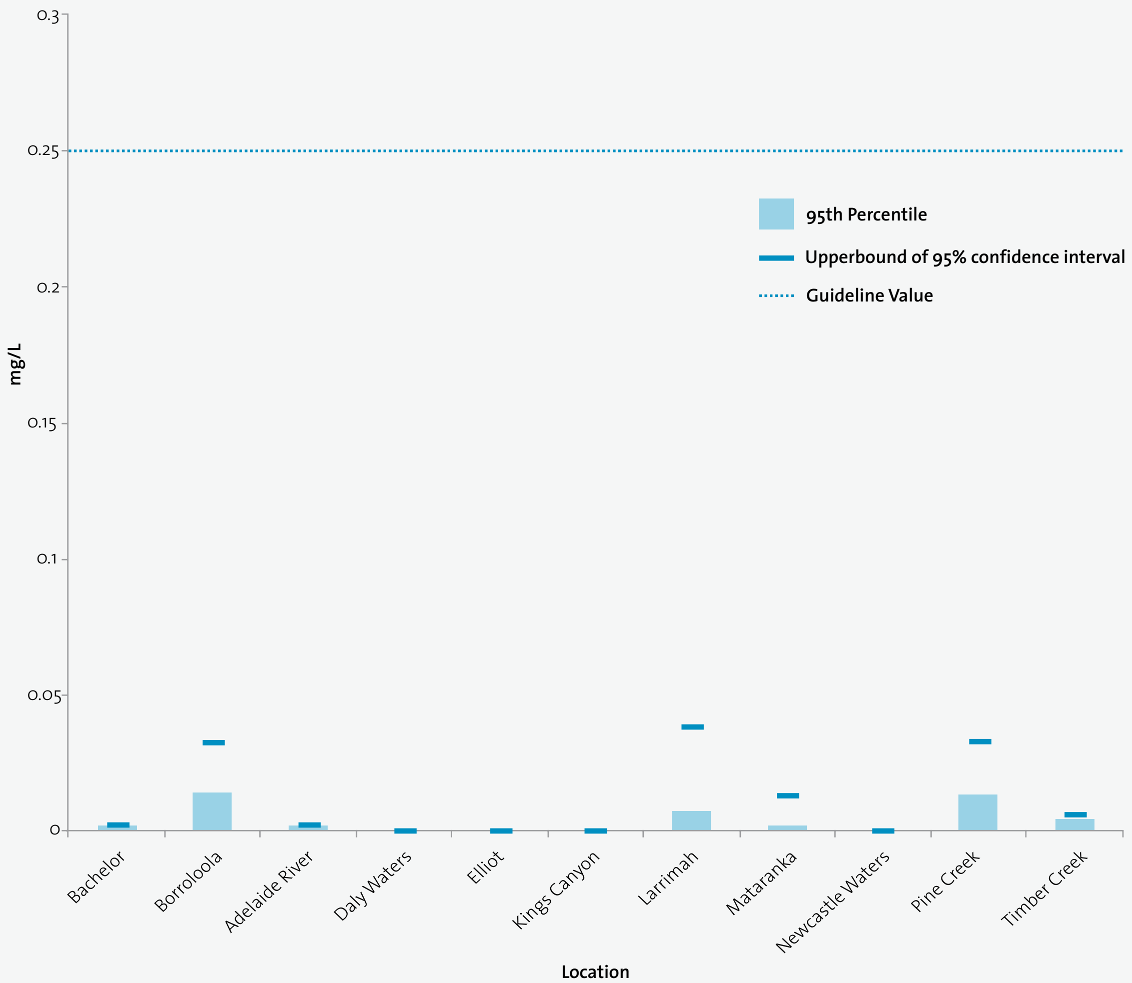


FIGURE 17: 95TH PERCENTILE OF TOTAL TRIHALOMETHANES IN MINOR CENTRES 2002-2003



Customer Satisfaction

Water Quality Customer Complaints

Power and Water records customer complaints on water quality for the Darwin, Katherine and Alice Springs regions. **Table 3** shows the total number of complaints and the number of complaints per 1,000 customer properties.

TABLE 3: WATER QUALITY COMPLAINTS 2001-2006

	Total Number of Complaints				
	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Darwin	226	167	78	121	112
Alice Springs	11	5	8	3	8
Katherine	N/A	N/A	N/A	6	7
Borroloola	N/A	N/A	N/A	1	N/R
Total	**237**	**172**	**86**	**131**	**137**
Complaints per 1,000 properties	5.16	5.14	2.46	3.24	2.29

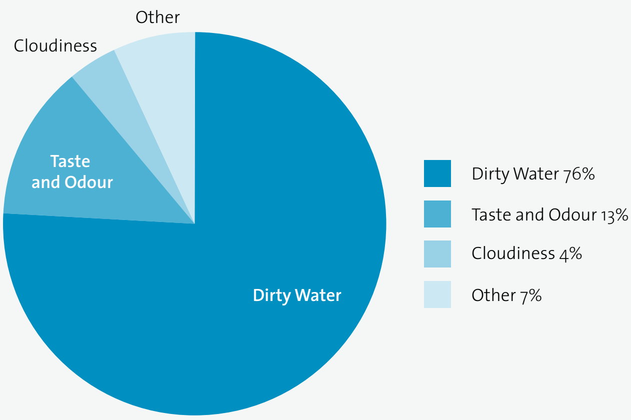
N/A – No data collected N/R – No complaints reported

Power and Water reports its number of customer complaints to the Water Services Association of Australia (WSAA), as do other water utilities around Australia.

The pattern of water quality complaints in the Darwin water supply is largely governed by changes in water demand associated with the wet and dry seasons. Changing demand often mobilises iron and manganese in the water supply, resulting in more dirty water complaints. Power and Water works proactively to reduce complaints, chiefly through a mains flushing program in all major centres. Mains are flushed prior to increased demands associated with seasonal changes or if several complaints are received from any one street or suburb. The levels of iron and manganese found in the drinking water do not constitute a health risk, as dirty water events do not usually last long.

Less common customer complaints relate to chlorine odour and taste, cloudy water or floating particles. **Figure 18** shows a breakdown of customer complaints for 2005-2006.

FIGURE 18: TYPE OF DRINKING WATER CUSTOMER COMPLAINTS FOR DARWIN 2005-2006



Taste and odour complaints are often related to fluctuating chlorine levels due to changing water demand. The chlorine residual throughout the reticulation network is regularly monitored and adjusted when required. On-line water quality monitoring units have been installed in most major and minor centres to improve water quality monitoring across the whole network.

Another complaint sometimes received is cloudy or milky water. This is usually associated with dissolved oxygen coming out of solution. It is common following pipe flushing or repairs and is a result of aeration of the water within the pipe.

In the Darwin supply, a harmless white algae can also sometimes be observed. Neither the algae nor aeration presents a health risk. If there is some doubt as to the cause of a water quality problem, an investigation is carried out and, if necessary, water samples are taken and analysed.

Power and Water is continuously updating and expanding the customer complaint register for all major centres to better measure and benchmark customer feedback and satisfaction.

A national customer satisfaction survey on water quality was conducted in 2003 on all the capital cities in Australia. Darwin was included in the national survey.

Section 6: Incident and Emergency Response

Considered and controlled responses to incidents or emergencies that can compromise the safety of water quality are essential for protecting public health, as well as maintaining consumer confidence.

While we use preventive strategies, such as security and disinfection facilities, some events cannot be anticipated or controlled. Having a planned response is critical to minimising potential consequences.

Incident Response

A microbiological incident response procedure exists for any microbiological sample that exceeds the agreed limit. The Chief Health Officer, DHCS, approves the procedure.

DPIFM laboratories in Darwin and Alice Springs immediately notify Power and Water if they identify a microbiological failure. This process is governed by a formal three-year agreement between the two agencies.

Responses by Power and Water include re-sampling, flushing and hand disinfection with chlorine. DHCS is notified immediately of any substantial microbiological failures.

Emergency Response

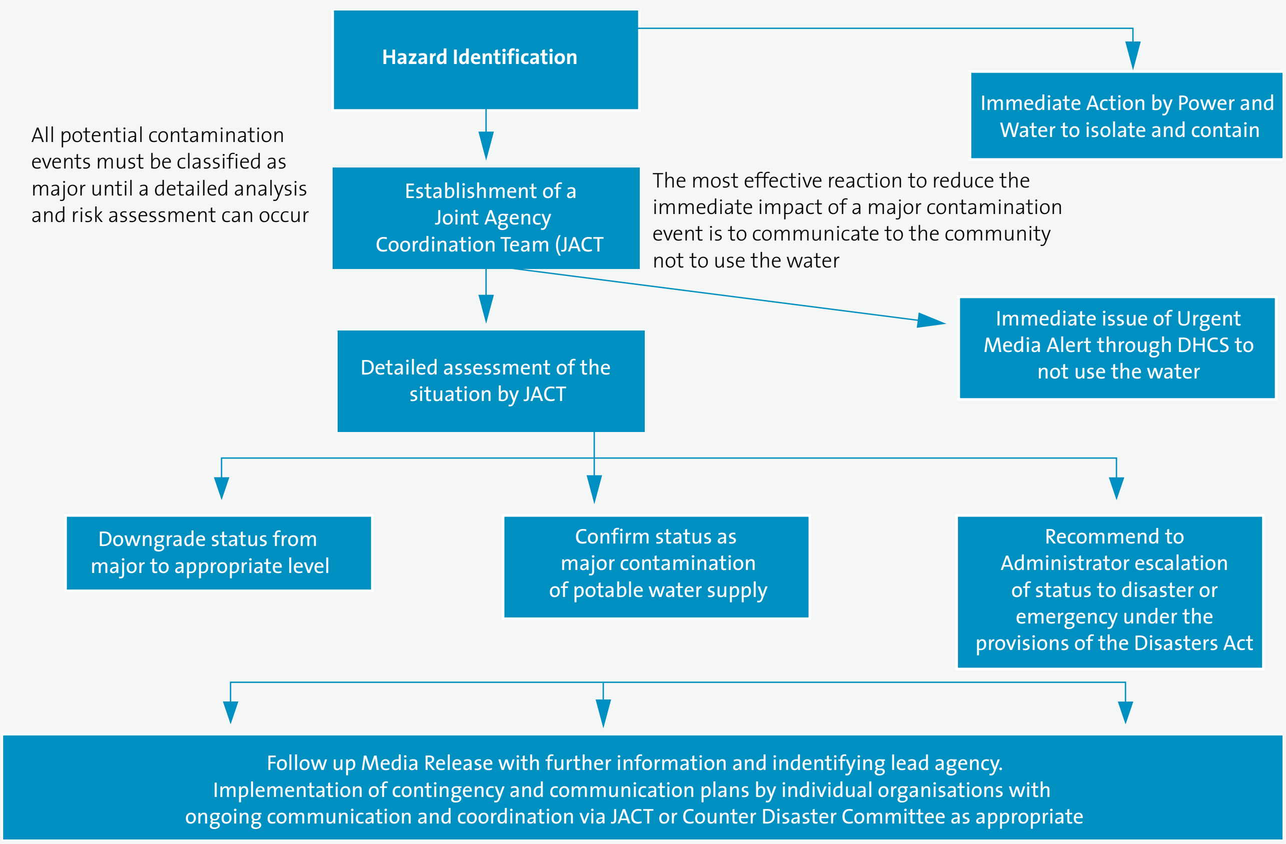
Power and Water, the Police and DHCS have a protocol in place for dealing with potential contamination of potable water supplies.

In an emergency, a Joint Agency Coordination Team is established. The response team consists of the General Manager Water Services, Chief Health Officer and Assistant Commissioner, Police Operations Command.

The team's role is to evaluate and manage the incident as well as to provide initial advice to the community.

Supporting documents to the protocol have been developed on Hazard Identification, which outlines what specific events would constitute an emergency and what actions should be taken in particular emergencies. An outline of the emergency response is shown below.

TABLE 4: EMERGENCY RESPONSE



Recorded Emergencies/Incidents

No water quality emergencies were recorded in 2005-2006. However significant investment in upgrading of facilities and security systems continues to occur to further reduce risks.

Naegleria fowleri

N. fowleri has recently been detected within the Darwin water supply system. It was first discovered in 1965 in Australia by two researchers from Adelaide. It is a small, free-living amoeba that is found in the environment in damp soil and warm water. It thrives in water temperatures of up to 42˚C.

The organism causes primary amoebic meningoencephalitis (PAM), a very rapid and on most occasions fatal infection. PAM is difficult to diagnose and treatment needs to be administered promptly. Symptoms can occur from the next day to two weeks after infection and include severe headache, neck pain, lethargy, photophobia, vomiting, seizure and can result in death and unconsciousness.

Fortunately *N. fowleri* infections are rare, and only about 200 cases have been reported worldwide to date with several of those occurring in Australia. Infection is caused by the exposure of contaminated water up the nasal passage. Swimming, diving, bathing and other water recreational activities where water can be pushed up the nasal passage have been associated with the infection. Primary places of *Naegleria* isolation include artificially and naturally heated pools, spas, naturally heated surface waters and water reticulation systems.

Over the past six years, the Parks and Wildlife Commission has closed the Douglas Hot Springs every second year due to the detection of *N. fowleri*. An initial investigation into the potential of *N. fowleri* occurring in Darwin's drinking water system was undertaken in 1983 but it was not found.

There is no guideline for *N. fowleri*, however 2004 ADWG recommend a detection of two organisms per litre requires action to be taken. It also recommends that a free chlorine residual up to 0.5 mg/L is adequate to kill the amoeba.

Water supply authorities in South Australia and Western Australia regularly monitor for *N. fowleri* in their water supplies, and a similar program has been introduced in the Northern Territory over the past year.

Section 7: Employee Awareness and Training

Power and Water is committed to ensuring that all employees are appropriately trained and aware of their responsibilities. There is no room for compromising on this commitment where the community's health is at stake.

Awareness Opportunities and Strategies

We use a range of strategies to ensure staff appreciate, reinforce and further develop awareness of the way their duties may impact on water quality. These strategies include:

- Monthly section meetings;
- Periodic 'toolbox' meetings of work groups;
- Rotation of staff to other sections/centres;
- Management feedback sessions;
- Presentations on water quality issues;
- Support for further education of employees;
- Employee development and learning plans;
- Employee performance management processes; and
- Development and implementation of job models for service workers.

A POWER AND WATER WORKER MONITORING AN OPERATING MACHINE.

Training

Normal operational activities - for example, refitting a bore pump, cleaning a tank, dosing of chemicals or the repair of a main break - may adversely affect water quality if not performed correctly.

Procedures are continually revised due to new equipment or techniques. Ongoing training and re-skilling is required to ensure employees' safety and that of the communities. Such safety training includes:

- Handling dangerous goods and chemicals such as chlorine and fluoride;
- Operating self-contained breathing apparatus;
- Entering confined spaces;
- Performing rescues from tanks and trenches;
- Electric shock avoidance and response;
- First aid;
- Cardio-pulmonary resuscitation;
- Fire and emergency evacuation;
- Managing unauthorised access situations;
- Operating dangerous equipment in public places;
- Performing water sampling;
- Performing basic water tests;
- Monitoring, identifying and responding to water quality problems;
- Monitoring, operating and reporting on disinfection systems;
- Coordinating and monitoring application of environmental plans and procedures (catchment staff);
- Environmental response and clean up procedures; and
- SCADA system operation.

Our staff or agents taking water samples across the Territory are trained to ensure successful sampling. We give a booklet to all water samplers with initial training and provide refresher courses. In smaller centres, the agents are often employed by the Community Council and are referred to as Essential Service Officers or ESOs.

Other broader skills training, such as the Public Sector Management Program, Frontline Management Initiative and Service Worker Job Model related training, are also important in maintaining water quality, as are developed skills for effective management and completion of job responsibilities.

Section 8: Community Involvement and Awareness

We seek community involvement in, and awareness of, water quality issues as a high priority. We would like the community to:

- Understand issues associated with their drinking water quality;
- Help Power and Water to ensure the security and integrity of their supply; and
- Have confidence in the water supply meeting their needs.

POWER AND WATER STAFF MANNING A WATER DISPLAY.

Community Awareness

We encourage the community to be aware of the quality of their drinking water supply. We produce water quality brochures to help this awareness, including a summary of water quality details for all the major centres in the Northern Territory.

This information, as well as our previous water quality reports, can be viewed at www.powerwater.com.au.

Community Involvement

Power and Water participated in a public forum in the Darwin rural area to discuss water resource issues. Over the next year there will be continuing public interest and consultation regarding groundwater resources.

This year Power and Water also took part in the steering committee for the Alice Springs water resource strategy, which involved representatives from various interest groups.

Section 9: Research and Development

To enhance research and development capacity, Power and Water became a participant of the Cooperative Research Centre for Water Quality and Treatment on 1 July 2001 (CRCWQT, Mark II).

The CRCWQT, established in 1995, undertakes national research into reducing health risks and improving water quality.

Power and Water is an active member of the CRCWQT and leads the Regional and Rural Water Supplies Program. This program aims to:

- Address key issues that impact on the provision of good quality drinking water to regional and rural communities in Australia;
- Identify research that will provide affordable and sustainable solutions to water supply problems; and
- Assist with representation of the regional and rural water supply areas in setting industry policy, regulation and strategic directions.

Power and Water has been directly involved in a range of research projects that help improve water quality throughout the Territory. Each of these is described below:

Application of HACCP for Distribution System Protection

The American Water Works Association Research Foundation awarded funding to the CRCWQT for a joint project involving the application of HACCP for water quality risk management. We have developed and successfully implemented a HACCP Plan for the Katherine water supply system and reported the outcomes to the project managers.

The HACCP program has proved to be successful in Katherine and Power and Water will continue to manage the Katherine water supply using the HACCP framework. Power and Water has also been working hard at implementing HACCP in Tennant Creek. In 2005-2006, minor works were carried out in Tennant Creek to improve site security and water safety. Power and Water plans to introduce HACCP to all major centres progressively over the coming years.

Understanding the Growth of Opportunistic Bacterial Pathogens within Distribution Mains

This project investigated the potential for the growth of bacterial pathogens in Australian distribution mains under normal operating conditions. The information gained from this project will be used to determine health risks to customers and to assess any relationship with other organisms such as amoebae. Power and Water's involvement has been beneficial in many ways. Of particular importance was the initial detection of *N. fowleri* in the Darwin reticulation system. In response to the detection, Power and Water has implemented a management plan and has extended testing for *N. fowleri* to all major centres. Power and Water is one of a number of water utilities from across Australia that has been actively involved in the project, which is due for completion towards the end of 2006.

Disinfection Control within Distribution Systems

This project examines chlorine demand during disinfection and develops tools to improve control of disinfection residual in distribution systems. Power and Water provided information and applied the disinfection tools developed to our distribution systems. This leading edge technology provides Power and Water and the water industry with an effective way to improve the effectiveness of chlorine dosing.

Drinking Water and Melioidosis

This project examined the dynamics of the organism *Burkholderia psuedomallei* that causes the disease Melioidosis and its potential to enter water supplies. The benefits from this project have included the improved diagnosis and treatment of the disease and a better understanding of the potential impact and behaviour of the organism under different levels of chlorine treatment in water supplies.

Investigation into Water Quality and Supply Issues in Indigenous Communities through a Technology Transfer Officer

Despite efforts by a variety of governments and organisations over the years, health outcomes for Indigenous Australians continue to be poor. It is uncertain to what extent the quality and quantity of water supplies available to remote Indigenous communities contribute to this situation. This project enables the CRCWQT to contribute to improving water supplies in Indigenous communities, particularly in rural and remote locations. The Centre for Appropriate Technology hosts a full time technology transfer officer in Alice Springs who is funded through the Regional and Rural Water Supplies Program of the CRCWQT.

Activities include:

- Developing research proposals to clarify the relationship between poor Indigenous health and the quality and quantity of water supplies in Indigenous communities;
- Developing strategies to improve access to good quality water in remote areas; and
- Providing information and technical advice to remote communities, local government and the Department of Family and Community Services on policy and practice for improving the quality of water supplies.

Power and Water provides support to the position through the role of program leader and technical water quality advice for specific communities.

Remote Community Water Management

This project is a collaboration between the Desert Knowledge CRC and the CRCWQT. Core organisations involved include the Department of Family, Community Services and Indigenous Affairs and the Centre for Appropriate Technology.

The project aims to identify ways for small remote Indigenous communities who self-manage their water supply to implement the *Framework for Management of Drinking Water Quality* in the 2004 ADWG. The action-based research uses a case study approach to work with four remote communities in different states and territories.

The research will use the framework on a case-by-case basis to deliver the most appropriate management regime, suited to the needs of each community. Lessons learnt from the process will provide information and resources to develop management plans in other remote Indigenous communities.

As part of the project, Power and Water hosted a summer student for three months in 2006. The project trialled the application of the Community Water Planner to develop drinking water management plans for 12 communities in the Territory with populations of 50 to 1000 people.

Investigating the Defluoridation of Water Supplies

This project aims to identify a robust, low cost, low maintenance and centralised defluoridation system that may be implemented within rural and remote communities in Australia. Laboratory experiments are being carried out on a number of defluoridation 'media' that may be suitable for the development of a column sorption system to treat elevated fluoride levels.

Power and Water is leading the research that will recommend and demonstrate appropriate options to manage elevated fluoride concentrations in drinking water and improve water quality in rural and remote communities.

Case Studies Using On-line Monitoring Systems

The project aim is to evaluate the potential benefits of using on-line UV-Vis spectrometers for the water industry via case studies of different treatment or distribution system applications. Case studies will be selected to cover a range of water quality and management issues including selection of source water, coagulant control, disinfection management, disinfection by-product formation and distribution network maintenance.

Power and Water is one of a number of utilities taking part in the project and has been involved in the pilot trial of the UV-Vis spectrometer at a number of Darwin sites. The trial aimed to identify changes in raw water quality to improve the management of the chlorine demand of the water in the distribution system, giving Power and Water the chance to test the equipment and determine if it is useful for our water quality management.

Section 10: Documentation and Reporting

Recording water quality data and reporting of water quality performance is an integral component of any water quality management system.

All documentation is routinely reviewed and updated in line with HACCP for water supply systems and Power and Waters' quality management system. The quality management system is part of the Integrated Management System we are now implementing after successfully achieving certification to Environment (ISO14001), Quality (ISO9001) and OH&S (AS4801) management systems this year.

Several projects were undertaken in 2005-2006 to improve water quality documentation and reporting.

Water Quality Database

Power and Water has been using the Works Information Management System (WIMS) as the centralised Water Quality Database. As part of an effort to streamline data processing time and to improve data exchange between Power and Water and DPIFM Laboratories, a new system is being developed to ensure water quality data is easily accessible at all major centres across the Territory. The system will allow automated data validation and will be progressively implemented in early 2007.

Reporting

The following reporting currently occurs:

- Microbiological water quality data is reported internally on a monthly basis;
- This report forms an integral component of documentation required by DHCS on water quality performance; and
- DHCS is advised of any exceedance of water quality targets in accordance with Power and Water's Water Quality Monitoring Program.

Section 11: Evaluation and Audit

Evaluating and auditing of water quality management systems is an important way to ensure the successful management of water quality data and processes.

This report is an integral part of the review and evaluation process. Audits ensure that operational procedures and processes are in place so that accurate water quality data is collected and appropriate management systems are maintained.

External Audits

SAI Global conducted a series of external audits on Power and Water as part of the process to achieve triple certification. This included an audit on our water quality management system in June 2006.

Internal Audits

As part of Power and Water's triple certification process, a comprehensive internal audit was conducted on the procurement of drinking water chemicals. As a result of the audit, a number of recommendations were made including internal quality assurance checks for chemicals supplied. A procedure for quality assurance checks is now close to being finalised. Power and Water continues to follow up on issues identified in previous audits including adequate management of production bore exclusion and active management zones.

Water Quality Monitoring Program

We continuously review our Water Quality Monitoring Program to evaluate the success of the program and to update it, if required.

Major modifications have been made to the program in line with recommendations in the 2004 ADWG. This includes a review of sample locations and water quality measures based on a statistically rigorous analysis of historical and recent data.

Section 12: Review and Continual Improvement

Power and Water is committed to the ongoing development and improvement of the drinking water quality management system and the safety of drinking water supplies.

A POWER AND WATER WORKER CHECKING FACILITIES AT MCMINNS PUMP STATION.

Review of Drinking Water Quality System

This annual report is an important way of identifying water quality issues and facilitating improvements.

The implementation of HACCP for water supply systems provides a rigorous format for review of our drinking water quality systems and will continue to be developed for major centres over the coming year.

Microbiological Risk Assessment

Microbiological water quality is Power and Water's highest priority and is best protected through assessing preventative barriers. **Table 2** in Section 3 clearly illustrates that Tennant Creek has the fewest protective barriers and is thus a priority focus for risk reduction over the coming 12 months. The primary mechanisms for risk reduction will be identified through the current HACCP process.

Chemical, Physical and Radiological Risk Assessment

A methodology has been developed to help prioritise improvements in chemical and physical water quality. It focuses on a scoring system for centres that exceed the 2004 ADWG values for one or more chemical, physical or radiological parameters.

Risk is a product of likelihood and consequences. The likelihood of a parameter resulting in a problem is assumed to be proportional to the ratio of the measured value to the guideline value. That is, where a recorded value exceeds a guideline value by double, then the likelihood is given a value of two.

The consequence of any exceedance is given a weighting according to its relative importance in affecting human health. Weightings were developed in conjunction with DHCS and are based on:

- Relatively significant health impact – 10;
- Relatively minor health impact – 5; and
- Relatively significant aesthetic impact – 3.

For example under this system, arsenic is given a weighting of 10, whereas salinity (TDS) is given a weighting of 3.

Finally, the total risk score for any particular centre is assumed to be equal to the sum of the scores for each individual parameter.

A priority list has been produced based on the 95th percentile for chemical health parameters, the average concentrations for physical parameters and the average annual dose for radiological water quality. As **Table 5** shows, Daly Waters and Kings Canyon have the highest risk scores. These two water supply systems will be prioritised for investigation in the coming year.

TABLE 5: RELATIVE RISK SCORING

1	Daly Waters
2	Kings Canyon
3	Mataranka
4	Tennant Creek
5	Timber Creek
6	Pine Creek

Drinking Water Quality Improvement

Various water quality investigations and improvement works will be part of the capital works program for the coming year. **Table 6** summarises the projects.

TABLE 6: PLANNED WATER QUALITY INVESTIGATIONS AND IMPROVEMENTS

Location	Planned Works
Adelaide River	No major works planned. Investigations into a new water storage and treatment facility will occur over the coming year.
Alice Springs	No major works planned. Bore augmentation planned to begin during 2006-2007.
Batchelor	No major works planned.
Borroloola	Investigation into improved water treatment options, including aeration, is due for completion by the end of 2006.
Cox Peninsula	Improved water treatment options, including aeration, are being investigated.
Daly Waters	Investigations into chemical and physical water quality improvements.
Darwin	The secondary disinfection system upgraded in November 2006. Further improvements to the disinfection system are being investigated. Further risk assessment of the potential contamination pathways for the groundwater supply is also being undertaken. There are also planned works for the East Arm water storage tank and pumpstation.
Elliott	A new groundwater supply will begin development in 2006.
Katherine	Optimisation of the Katherine Water Treatment Plant is being investigated. A risk assessment on the groundwater supply has been completed and preliminary reports indicate no immediate actions are required. Future work is planned to reduce potential risk of contamination to the groundwater supply.
Kings Canyon	Investigation of improved water treatment options is currently underway.
Larrimah	A risk assessment on the groundwater supply has been completed and preliminary reports indicate no immediate actions are required. Future work is planned to reduce potential risk of contamination to the groundwater supply.
Mataranka	A risk assessment on the groundwater supply has been completed and preliminary reports indicate no immediate actions are required. Future work is planned to reduce potential risk of contamination to the groundwater supply.
Newcastle Waters	No major works planned. A new groundwater supply was developed last year.
Pine Creek	Measures are being implemented to protect the catchment of Copperfield Dam. This includes constructing a catchment boundary fence and completing signs in 2007.
Tennant Creek	Development of a HACCP plan will continue and will identify a range of potential investigations and actions. However, construction of a new water supply pumpstation at Cabbage Gum is planned in the coming year.
Timber Creek	Water quality improvement is being investigated.
Ti Tree	No major works planned. A new groundwater supply was developed in 2003.
Yulara	No major works planned. Upgrade of potable and non-potable water pumpstations and installation of a new water storage tank. Also planned is the construction of a new bore and rising main.

Appendix 1: Microbiological Parameters in Major Centres 2005-2006*

Parameter/Location	Target level	Total no. of cycles required (2004 ADWG)	Total no. of samples per cycle	Total no. of cycles taken	Total no. of samples	Total Exceedence (no.)	Samples passing reporting level (%)
Alice Springs							
E coli (org/100ml)	<1 in 98% samples	52	3	51	156	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	52	3	51	156	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	52	3	51	156	1	99.4%
Darwin							
E coli (org/100ml)	<1 in 98% samples	52	8	52	543	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	52	8	52	543	9	98.3%
Plate Count (cfu/100ml)	<1000 in all samples	52	8	52	543	60	89.0%
Katherine							
E coli (org/100ml)	<1 in 98% samples	52	3	53	169	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	52	3	53	169	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	52	3	53	169	1	99.4%
Tennant Creek							
E coli (org/100ml)	<1 in 98% samples	52	5	50	248	6	97.6%
Total coliforms org/100ml)	<10 in 95% samples	52	5	50	248	11	95.6%
Plate Count (cfu/100ml)	<1000 in all samples	52	5	50	248	4	98.4%
Yulura							
E coli (org/100ml)	<1 in 98% samples	52	2	51	152	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	52	2	51	152	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	52	2	51	152	0	100.0%

*Centres with cycles below the required number fell short due to lab closures and logistical error.

Appendix 2: Microbiological Parameters in Minor Centres 2005-2006*

Parameter/Location	Target level	Total no. of cycles required per year (ADWG 2004)	Total no. of samples per cycle	Total no. of cycles taken	Total no. of samples	Total Exceedence (no.)	Samples passing reporting level (%)
Adelaide River							
E coli (org/100ml)	<1 in 98% samples	12	1	12	37	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	12	37	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	12	37	0	100.0%
Batchelor							
E coli (org/100ml)	<1 in 98% samples	12	1	12	36	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	12	36	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	12	36	0	100.0%
Borroloola							
E coli (org/100ml)	<1 in 98% samples	12	1	12	36	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	12	36	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	12	36	0	100.0%
Daly Waters							
E coli (org/100ml)	<1 in 98% samples	12	1	12	36	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	12	36	2	94.4%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	12	36	0	100.0%
Elliot							
E coli (org/100ml)	<1 in 98% samples	12	1	12	36	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	12	36	2	94.4%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	12	36	3	91.7%
Kings Canyon							
E coli (org/100ml)	<1 in 98% samples	12	1	11	41	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	11	41	3	92.7%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	11	41	6	85.4%

*Centres with cycles below the required number fell short due to lab closures and logistical error.

Parameter/Location	Target level	Total no. of cycles required per year (ADWG 2004)	Total no. of samples per cycle	Total no. of cycles taken	Total no. of samples	Total Exceedence (no.)	Samples passing reporting level (%)
Larrimah							
E coli (org/100ml)	<1 in 98% samples	12	1	12	39	1	97.4%
Total coliforms org/100ml)	<10 in 95% samples	12	1	12	39	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	12	39	0	100.0%
Mataranka							
E coli (org/100ml)	<1 in 98% samples	12	1	12	36	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	12	36	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	12	36	0	100.0%
Newcastle Waters							
E coli (org/100ml)	<1 in 98% samples	12	1	11	33	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	11	33	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	11	33	1	97.0%
Pine Creek							
E coli (org/100ml)	<1 in 98% samples	12	1	12	36	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	12	36	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	12	36	2	94.4%
Timber Creek							
E coli (org/100ml)	<1 in 98% samples	12	1	12	34	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	12	34	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	12	34	0	100.0%
Ti Tree							
E coli (org/100ml)	<1 in 98% samples	12	1	11	44	0	100.0%
Total coliforms org/100ml)	<10 in 95% samples	12	1	11	44	0	100.0%
Plate Count (cfu/100ml)	<1000 in all samples	12	1	11	44	3	93.2%

*Centres with cycles below the required number fell short due to lab closures and logistical error.

Appendix 3: Health, Aesthetic and other Parameters in Major Centres 2005-2006

Drinking Water Quality in Alice Springs

Parameter/Location	Trigger level [1]	Units	Actual level [2]
ALICE SPRINGS			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.001
Barium	0.7	mg/L	0.1
Boron	4	mg/L	0.1
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.005
Fluoride	1.5	mg/L	0.5
Iodide	0.1	mg/L	0.15
Lead	0.01	mg/L	0.005
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.006
Nitrate	50	mg/L	8
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.15
Selenium	0.01	mg/L	0.004
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.002
Uranium	0.02	mg/L	0.01
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.02
Chloride	250	mg/L	70
Copper	1	mg/L	0.11
Hardness	200	mg/L	213
Iron	0.3	mg/L	0.12
Manganese	0.1	mg/L	0.02
pH	6.5 - 8.5	pH units	7.6
Sodium	180	mg/L	74
Sulphate	250	mg/L	61
TDS	800	mg/L	462
Zinc	3	mg/L	0.08
Other Parameters [4]			
Alkalinity	*	mg/L	256
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.5
Calcium	*	mg/L	45
Electrical Conductivity	*	µS/cm	807
Magnesium	*	mg/L	25
Potassium	*	mg/L	6.6
Silica	*	mg/L	16.8
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Alice Springs for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Darwin

Parameter/Location	Trigger level [1]	Units	Actual level [2]
DARWIN			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.0005
Barium	0.7	mg/L	0.03
Boron	4	mg/L	0.01
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.85
Iodide	0.1	mg/L	0.02
Lead	0.01	mg/L	0.002
Mercury	0.001	mg/L	0.0002
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	1
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.017
Selenium	0.01	mg/L	0.001
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.08
Uranium	0.02	mg/L	0.00003
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.02
Chloride	250	mg/L	3.4
Copper	1	mg/L	0.02
Hardness (total)	200	mg/L	31
Iron	0.3	mg/L	0.23
Manganese	0.1	mg/L	0.02
pH	6.5 - 8.5	pH units	6.9
Sodium	180	mg/L	2
Sulphate	250	mg/L	1
TDS	800	mg/L	48
Zinc	3	mg/L	0.01
Other Parameters [4]			
Alkalinity	*	mg/L	31
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.03
Calcium	*	mg/L	6
Electrical Conductivity	*	µS/cm	79
Magnesium	*	mg/L	4
Potassium	*	mg/L	1
Silica	*	mg/L	6
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Darwin for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Katherine

Parameter/Location	Trigger level [1]	Units	Actual level [2]
KATHERINE			
Health Parameters			
Antimony	0.003	mg/L	0.0005
Arsenic	0.007	mg/L	0.0005
Barium	0.7	mg/L	0.03
Boron	4	mg/L	0.02
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.6
Iodide	0.1	mg/L	0.05
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.1
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	1
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	MSv/yr	0.1
Selenium	0.01	mg/L	0.001
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.07
Uranium	0.02	mg/L	0.0002
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.02
Chloride	250	mg/L	4
Copper	1	mg/L	0.02
Hardness	200	mg/L	90
Iron	0.3	mg/L	0.17
Manganese	0.1	mg/L	0.003
pH	6.5 - 8.5	pH units	7.4
Sodium	180	mg/L	6
Sulphate	250	mg/L	6
TDS	800	mg/L	106
Zinc	3	mg/L	0.2
Other Parameters [4]			
Alkalinity	*	mg/L	84
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.3
Calcium	*	mg/L	20
Electrical Conductivity	*	µS/cm	181
Magnesium	*	mg/L	8
Potassium	*	mg/L	1
Silica	*	mg/L	10
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

1 Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

2 Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Katherine for 2002-2006.

3 Readily oxidises to Nitrate and therefore not tested.

4 With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Tennant Creek

Parameter/Location	Trigger level [1]	Units	Actual level [2]
TENNANT CREEK			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.003
Barium	0.7	mg/L	0.1
Boron	4	mg/L	0.5
Cadmium	0.002	mg/L	0.0003
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	1.65
Iodide	0.1	mg/L	0.21
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	44
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.05
Selenium	0.01	mg/L	0.007
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	DNA
Uranium	0.02	mg/L	0.01
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	94
Copper	1	mg/L	0.007
Hardness	200	mg/L	179
Iron	0.3	mg/L	0.07
Manganese	0.1	mg/L	0.003
pH	6.5 - 8.5	pH units	7.8
Sodium	180	mg/L	97
Sulphate	250	mg/L	52
TDS	800	mg/L	611
Zinc	3	mg/L	0.01
Other Parameters [4]			
Alkalinity	*	mg/L	274
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.8
Calcium	*	mg/L	29
Electrical Conductivity	*	μS/cm	944
Magnesium	*	mg/L	26
Potassium	*	mg/L	29
Silica	*	mg/L	42
Strontium		mg/L	0.44
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	μS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

1 Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

2 Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Tennant Creek for 2002-2006.

3 Readily oxidises to Nitrate and therefore not tested.

4 With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Yulara

Parameter/Location	Trigger level [1]	Units	Actual level [2]
YULARA			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.0003
Barium	0.7	mg/L	0.03
Boron	4	mg/L	0.7
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.1
Iodide	0.1	mg/L	0.03
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	20
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.02
Selenium	0.01	mg/L	0.001
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.003
Uranium	0.02	mg/L	0.0001
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	42
Copper	1	mg/L	0.1
Hardness	200	mg/L	26
Iron	0.3	mg/L	0.05
Manganese	0.1	mg/L	0.003
pH	6.5 - 8.5	pH units	6.8
Sodium	180	mg/L	30
Sulphate	250	mg/L	15
TDS	500	mg/L	130
Zinc	3	mg/L	0.02
Other Parameters [4]			
Alkalinity	*	mg/L	14
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.2
Calcium	*	mg/L	6
Electrical Conductivity	*	µS/cm	237
Magnesium	*	mg/L	2.3
Potassium	*	mg/L	4.1
Silica	*	mg/L	3.6
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Yulara for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Appendix 4: Health, Aesthetic and other Parameters in Minor Centres 2005-2006

Drinking Water Quality in Adelaide River

Parameter/Location	Trigger level [1]	Units	Actual level [2]
ADELAIDE RIVER			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.003
Barium	0.7	mg/L	0.03
Boron	4	mg/L	0.02
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.3
Iodide	0.1	mg/L	0.01
Lead	0.01	mg/L	0.003
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	0.5
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.1
Selenium	0.01	mg/L	0.001
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.002
Uranium	0.02	mg/L	0.00003
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	16
Copper	1	mg/L	0.3
Hardness	200	mg/L $CaCO_3$	78
Iron	0.3	mg/L	1.14
Manganese	0.1	mg/L	0.35
pH	6.5 - 8.5	pH units	6.8
Sodium	180	mg/L	17
Sulphate	250	mg/L	4
TDS	800	mg/L	164
Zinc	3	mg/L	0.07
Other Parameters [4]			
Alkalinity	*	mg/L	98
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.08
Calcium	*	mg/L	13
Electrical Conductivity	*	µS/cm	242
Magnesium	*	mg/L	12
Potassium	*	mg/L	1
Silica	*	mg/L	18
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Adelaide River for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Batchelor

Parameter/Location	Trigger level [1]	Units	Actual level [2]
BATCHELOR			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.0003
Barium	0.7	mg/L	0.03
Boron	4	mg/L	0.01
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.25
Iodide	0.1	mg/L	0.01
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	1
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.1
Selenium	0.01	mg/L	0.001
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.002
Uranium	0.02	mg/L	0.0003
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	5
Copper	1	mg/L	0.01
Hardness (total)	200	mg/L	186
Iron	0.3	mg/L	0.01
Manganese	0.1	mg/L	0.00025
pH	6.5 - 8.5	pH units	7.4
Sodium	180	mg/L	5
Sulphate	250	mg/L	5
TDS	800	mg/L	217
Zinc	3	mg/L	0.07
Other Parameters [4]			
Alkalinity	*	mg/L	202
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.02
Calcium	*	mg/L	25.5
Electrical Conductivity	*	µS/cm	377
Magnesium	*	mg/L	33
Potassium	*	mg/L	0.6
Silica	*	mg/L	14
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Batchelor for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Borroloola

Parameter/Location	Trigger level [1]	Units	Actual level [2]
BORROLOOLA			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.0003
Barium	0.7	mg/L	0.03
Boron	4	mg/L	0.04
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.005
Fluoride	1.5	mg/L	0.05
Iodide	0.1	mg/L	0.02
Lead	0.01	mg/L	0.006
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	1
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.2
Selenium	0.01	mg/L	0.001
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.01
Uranium	0.02	mg/L	0.0002
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	9
Copper	1	mg/L	0.02
Hardness	200	mg/L	20
Iron	0.3	mg/L	0.06
Manganese	0.1	mg/L	0.01
pH	6.5 - 8.5	pH units	6.3
Sodium	180	mg/L	5
Sulphate	250	mg/L	1
TDS	800	mg/L	56
Zinc	3	mg/L	0.06
Other Parameters [4]			
Alkalinity	*	mg/L	21
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.05
Calcium	*	mg/L	6.2
Electrical Conductivity	*	µS/cm	76
Magnesium	*	mg/L	1
Potassium	*	mg/L	1
Silica	*	mg/L	8.4
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Borroloola for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Cox Peninsula

Parameter/Location	Trigger level [1]	Units	Actual level [2]
COX PENINSULA			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.0005
Barium	0.7	mg/L	0.03
Boron	4	mg/L	0.04
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.1
Iodide	0.1	mg/L	0.01
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	0.5
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.04
Selenium	0.01	mg/L	0.001
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	DNA
Uranium	0.02	mg/L	0.00005
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.1
Chloride	250	mg/L	3
Copper	1	mg/L	0.005
Hardness	200	mg/L	3
Iron	0.3	mg/L	0.41
Manganese	0.1	mg/L	0.02
pH	6.5 - 8.5	pH units	5.2
Sodium	180	mg/L	5
Sulphate	250	mg/L	1
TDS	800	mg/L	35
Zinc	3	mg/L	0.2
Other Parameters [4]			
Alkalinity	*	mg/L	8.3
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.02
Calcium	*	mg/L	0.4
Electrical Conductivity	*	µS/cm	40
Magnesium	*	mg/L	0.5
Potassium	*	mg/L	1.5
Silica	*	mg/L	24
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected from bores in Cox Peninsula for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Daly Waters

Parameter/Location	Trigger level [1]	Units	Actual level [2]
DALY WATERS			
Health Parameters			
Antimony	0.003	mg/L	0.0003
Arsenic	0.007	mg/L	0.003
Barium	0.7	mg/L	0.05
Boron	4	mg/L	0.5
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.5
Iodide	0.1	mg/L	0.24
Lead	0.01	mg/L	0.002
Mercury	0.001	mg/L	0.0002
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.005
Nitrate	50	mg/L	11
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.05
Selenium	0.01	mg/L	0.012
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.002
Uranium	0.02	mg/L	0.009
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	334
Copper	1	mg/L	0.007
Hardness	200	mg/L	547
Iron	0.3	mg/L	0.13
Manganese	0.1	mg/L	0.005
pH	6.5 - 8.5	pH units	7.5
Sodium	180	mg/L	221
Sulphate	250	mg/L	218
TDS	800	mg/L	1304
Zinc	3	mg/L	0.009
Other Parameters [4]			
Alkalinity	*	mg/L	435
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	1.6
Calcium	*	mg/L	117
Electrical Conductivity	*	µS/cm	2117
Magnesium	*	mg/L	63
Potassium	*	mg/L	28
Silica	*	mg/L	21
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Daly Waters for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Elliott

Parameter/Location	Trigger level [1]	Units	Actual level [2]
ELLIOTT			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.002
Barium	0.7	mg/L	0.2
Boron	4	mg/L	0.3
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.8
Iodide	0.1	mg/L	0.1
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.01
Nitrate	50	mg/L	16
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.04
Selenium	0.01	mg/L	0.008
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.01
Uranium	0.02	mg/L	0.006
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	159
Copper	1	mg/L	0.01
Hardness	200	mg/L	386
Iron	0.3	mg/L	0.06
Manganese	0.1	mg/L	0.003
pH	6.5 - 8.5	pH units	7.7
Sodium	180	mg/L	82
Sulphate	250	mg/L	64
TDS	800	mg/L	762
Zinc	3	mg/L	0.03
Other Parameters [4]			
Alkalinity	*	mg/L	352
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	1
Calcium	*	mg/L	81
Electrical Conductivity	*	µS/cm	1244
Magnesium	*	mg/L	46
Potassium	*	mg/L	23
Silica	*	mg/L	28
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Elliott for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Kings Canyon

Parameter/Location	Trigger level [1]	Units	Actual level [2]
KINGS CANYON			
Health Parameters			
Antimony	0.003	mg/L	0.0002
Arsenic	0.007	mg/L	0.005
Barium	0.7	mg/L	0.03
Boron	4	mg/L	0.3
Cadmium	0.002	mg/L	0.0006
Chromium	0.05	mg/L	0.01
Fluoride	1.5	mg/L	0.5
Iodide	0.1	mg/L	0.26
Lead	0.01	mg/L	0.008
Mercury	0.001	mg/L	0.0005
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.01
Nitrate	50	mg/L	9
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.48
Selenium	0.01	mg/L	0.011
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.002
Uranium	0.02	mg/L	0.002
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.03
Chloride	250	mg/L	237
Copper	1	mg/L	0.1
Hardness	200	mg/L	312
Iron	0.3	mg/L	0.17
Manganese	0.1	mg/L	0.005
pH	6.5 - 8.5	pH units	7
Sodium	180	mg/L	132
Sulphate	250	mg/L	177
TDS	800	mg/L	803
Zinc	3	mg/L	0.1
Other Parameters [4]			
Alkalinity	*	mg/L	116
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	1.2
Calcium	*	mg/L	67
Electrical Conductivity	*	µS/cm	1303
Magnesium	*	mg/L	43
Potassium	*	mg/L	24
Silica	*	mg/L	12
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Kings Canyon for 2002-2006.

[3] Readily oxidises to Nitrate therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Larrimah

Parameter/Location	Trigger level [1]	Units	Actual level [2]
LARRIMAH			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.002
Barium	0.7	mg/L	0.05
Boron	4	mg/L	0.2
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.4
Iodide	0.1	mg/L	0.12
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.004
Nitrate	50	mg/L	4
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.06
Selenium	0.01	mg/L	0.007
Silver	0.1	mg/L	0.005
Total THMs	0.25	mg/L	0.007
Uranium	0.02	mg/L	0.003
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.02
Chloride	250	mg/L	179
Copper	1	mg/L	0.007
Hardness	200	mg/L	497
Iron	0.3	mg/L	0.07
Manganese	0.1	mg/L	0.003
pH	6.5 - 8.5	pH units	7.5
Sodium	180	mg/L	118
Sulphate	250	mg/L	121
TDS	800	mg/L	915
Zinc	3	mg/L	0.04
Other Parameters [4]			
Alkalinity	*	mg/L	451
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	1.15
Calcium	*	mg/L	115
Electrical Conductivity	*	µS/cm	1508
Magnesium	*	mg/L	54
Potassium	*	mg/L	12
Silica	*	mg/L	21
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Larrimah for 2002-2006.

[3] Readily oxidises to Nitrate therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Mataranka

Parameter/Location	Trigger level [1]	Units	Actual level [2]
MATARANKA			
Health Parameter			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.003
Barium	0.7	mg/L	0.1
Boron	4	mg/L	0.4
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.005
Fluoride	1.5	mg/L	0.4
Iodide	0.1	mg/L	0.13
Lead	0.01	mg/L	0.004
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.01
Nitrate	50	mg/L	3
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.07
Selenium	0.01	mg/L	0.01
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.003
Uranium	0.02	mg/L	0.004
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	192
Copper	1	mg/L	0.02
Hardness	200	mg/L	506
Iron	0.3	mg/L	0.6
Manganese	0.1	mg/L	0.003
pH	6.5 - 8.5	pH units	7.5
Sodium	180	mg/L	144
Sulphate	250	mg/L	152
TDS	800	mg/L	984
Zinc	3	mg/L	0.2
Other Parameters [4]			
Alkalinity	*	mg/L	469
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	1.5
Calcium	*	mg/L	112
Electrical Conductivity	*	µS/cm	1636
Magnesium	*	mg/L	56
Potassium	*	mg/L	19
Silica	*	mg/L	22
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Mataranka for 2002-2006.

[3] Readily oxidises to Nitrate therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Newcastle Waters

Parameter/Location	Trigger level [1]	Units	Actual level [2]
NEWCASTLE WATERS			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.002
Barium	0.7	mg/L	0.2
Boron	4	mg/L	0.3
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	1
Iodide	0.1	mg/L	0.09
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	8
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.05
Selenium	0.01	mg/L	0.007
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.01
Uranium	0.02	mg/L	0.005
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	86
Copper	1	mg/L	0.02
Hardness	200	mg/L	334
Iron	0.3	mg/L	0.03
Manganese	0.1	mg/L	0.003
pH	6.5 - 8.5	pH units	7.7
Sodium	180	mg/L	58
Sulphate	250	mg/L	44
TDS	800	mg/L	597
Zinc	3	mg/L	0.03
Other Parameters [4]			
Alkalinity	*	mg/L	361
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.8
Calcium	*	mg/L	73
Electrical Conductivity	*	µS/cm	984
Magnesium	*	mg/L	36
Potassium	*	mg/L	25
Silica	*	mg/L	25
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Newcastle Waters for 2002-2006. .

[3] Readily oxidises to Nitrate therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Pine Creek

Parameter/Location	Trigger level [1]	Units	Actual level [2]
PINE CREEK			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.0084
Barium	0.7	mg/L	0.03
Boron	4	mg/L	0.01
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.7
Iodide	0.1	mg/L	0.02
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	1
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.07
Selenium	0.01	mg/L	0.001
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.01
Uranium	0.02	mg/L	0.0001
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	7
Copper	1	mg/L	0.005
Hardness	200	mg/L	101
Iron	0.3	mg/L	0.3
Manganese	0.1	mg/L	0.01
pH	6.5 - 8.5	pH units	7.4
Sodium	180	mg/L	26
Sulphate	250	mg/L	6.4
TDS	800	mg/L	202
Zinc	3	mg/L	0.02
Other Parameters [4]			
Alkalinity	*	mg/L	156
Beryllium	*	mg/L	0.0005
Bromide	*	mg/L	0.04
Calcium	*	mg/L	16
Electrical Conductivity	*	µS/cm	313
Magnesium	*	mg/L	15
Potassium	*	mg/L	1.9
Silica	*	mg/L	22
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

1 Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.
2 Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Pine Creek for 2002-2006.
3 Readily oxidises to Nitrate and therefore not tested.
4 With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Timber Creek

Parameter/Location	Trigger level [1]	Units	Actual level [2]
TIMBER CREEK			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.001
Barium	0.7	mg/L	1.2
Boron	4	mg/L	0.1
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	1.61
Iodide	0.1	mg/L	0.02
Lead	0.01	mg/L	0.004
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.016
Nitrate	50	mg/L	1
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.12
Selenium	0.01	mg/L	0.001
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	0.005
Uranium	0.02	mg/L	0.002
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.01
Chloride	250	mg/L	26
Copper	1	mg/L	0.03
Hardness	200	mg/L	422
Iron	0.3	mg/L	0.02
Manganese	0.1	mg/L	0.003
pH	6.5 - 8.5	pH units	7.4
Sodium	180	mg/L	20
Sulphate	250	mg/L	13
TDS	800	mg/L	476
Zinc	3	mg/L	0.014
Other Parameters [4]			
Alkalinity	*	mg/L	447
Beryllium	*	mg/L	0.5
Bromide	*	mg/L	0.1
Calcium	*	mg/L	61
Electrical Conductivity	*	µS/cm	854
Magnesium	*	mg/L	65
Potassium	*	mg/L	7
Silica	*	mg/L	14
Tin	*	mg/L	0.005

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Timber Creek for 2002-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Drinking Water Quality in Ti Tree

Parameter/Location	Trigger level [1]	Units	Actual level [2]
TI TREE			
Health Parameters			
Antimony	0.003	mg/L	0.0001
Arsenic	0.007	mg/L	0.002
Barium	0.7	mg/L	0.1
Boron	4	mg/L	0.3
Cadmium	0.002	mg/L	0.0001
Chromium	0.05	mg/L	0.003
Fluoride	1.5	mg/L	0.9
Iodide	0.1	mg/L	0.11
Lead	0.01	mg/L	0.001
Mercury	0.001	mg/L	0.0001
Molybdenum	0.05	mg/L	0.003
Nickel	0.02	mg/L	0.001
Nitrate	50	mg/L	52.1
Nitrite [3]	3	mg/L	DNA
Radiological	0.5	mSv/yr	0.05
Selenium	0.01	mg/L	0.003
Silver	0.1	mg/L	0.01
Total THMs	0.25	mg/L	DNA
Uranium	0.02	mg/L	0.007
Aesthetic Parameters			
Aluminium	0.2	mg/L	0.05
Chloride	250	mg/L	53
Copper	1	mg/L	0.01
Hardness	200	mg/L	203
Iron	0.3	mg/L	0.03
Manganese	0.1	mg/L	0.005
pH	6.5 - 8.5	pH units	7.6
Sodium	180	mg/L	67
Sulphate	250	mg/L	38
TDS	800	mg/L	490
Zinc	3	mg/L	0.01
Other Parameters [4]			
Alkalinity	*	mg/L	211
Beryllium	*	mg/L	0.001
Bromide	*	mg/L	0.18
Calcium	*	mg/L	46
Electrical Conductivity	*	µS/cm	442
Magnesium	*	mg/L	22
Potassium	*	mg/L	19
Silica	*	mg/L	133
Tin	*	mg/L	0.01

Legend

N/A	Not applicable	*	No guideline value applicable
DNA	Data not available	µS/cm	Microsiemens per centimetre
mg/L	Milligrams per litre	mSv/year	Millisieverts per year

[1] Australian Drinking Water Guideline (ADWG 2004) values for health and aesthetic parameters. TDS guideline value set by DHCS.

[2] Actual level is the 95th percentile levels of results obtained for health parameters and average of results obtained for the aesthetic and other parameters including radiological yearly dose from samples collected in the reticulation system in Ti Tree for 2005-2006.

[3] Readily oxidises to Nitrate and therefore not tested.

[4] With the exception of Beryllium and Tin all other parameters are not included in the ADWG and tests are conducted for analytical purposes and to assist in providing a complete set of water quality results.

Glossary of Terms

ADWG	Australian Drinking Water Guidelines
AwwaRF	American Water Works Association Research Foundation
CRC	Cooperative Research Centre
DPI	Department of Planning and Infrastructure
DHCS	Department of Health and Community Services
ESO	Essential Services Officer
GIS	Geographical Information Systems
HACCP	Hazard Analysis and Critical Control Point
mg/L	milligrams per Litre
mSv	millisieverts
ML	megalitres
NT	Northern Territory
NREATA	Natural Resources, Environment and the Arts
SCADA	Supervisory Control and Data Acquisition
TDS	Total Dissolved Solids
THMs	Trihalomethanes
WIMS	Work Information Management System
μg/L	micrograms per Litre

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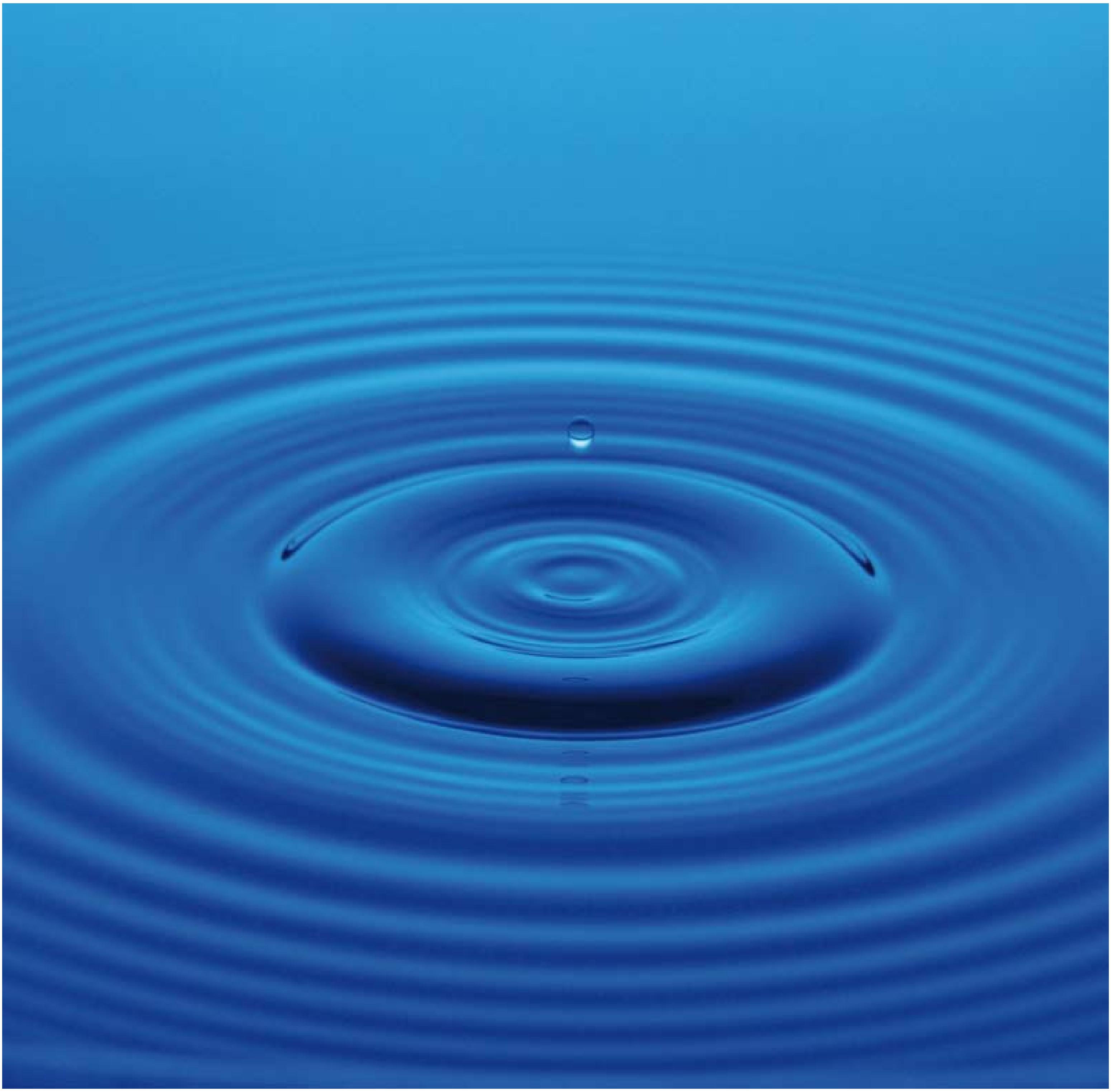

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