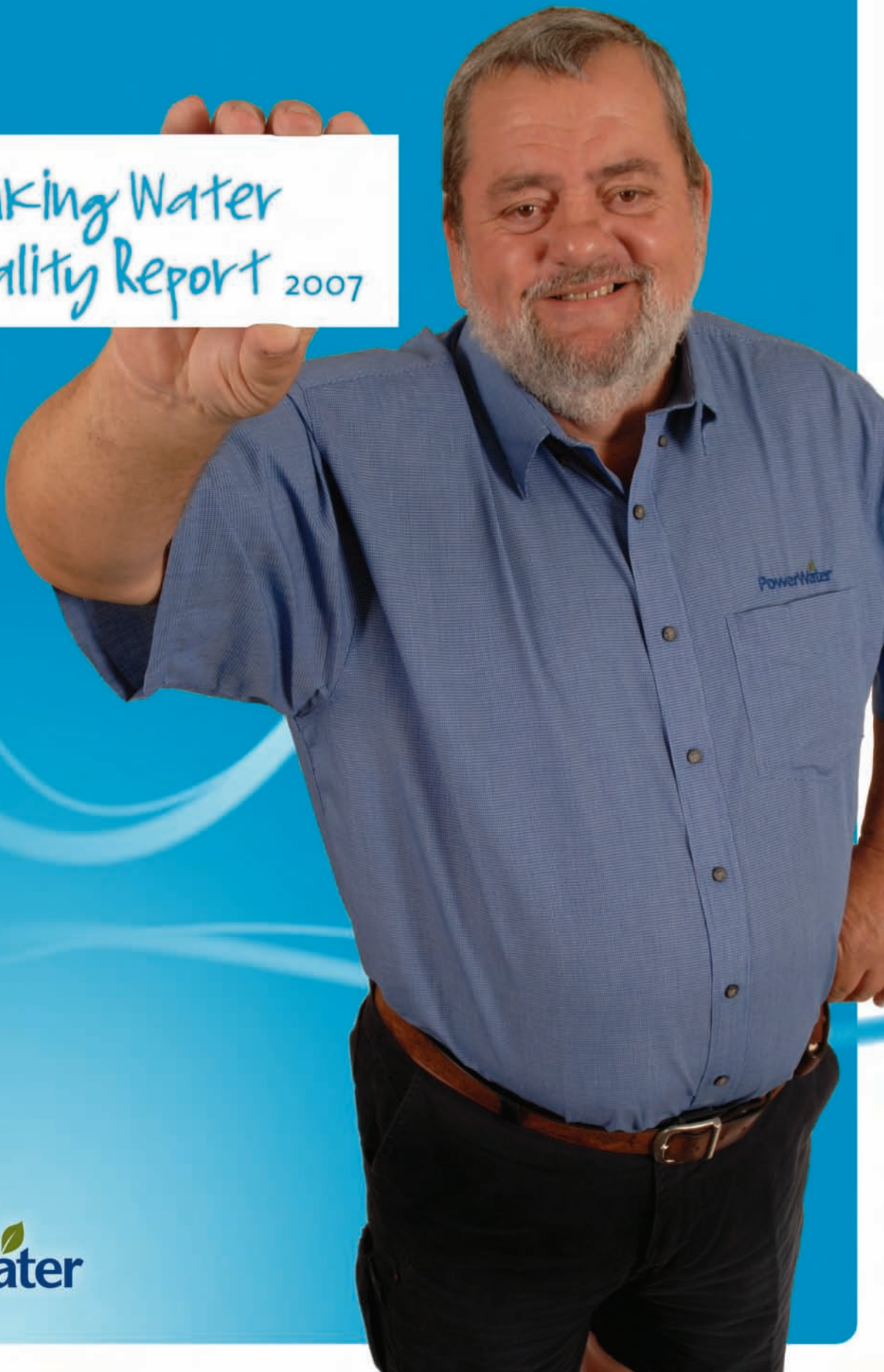
POWER AND WATER CORPORATION

Drinking Water Quality Report 2007



PowerWater

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From the Managing Director

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

This is the sixth annual public Drinking Water Quality Report and it summarises our performance for delivering safe water across the Northern Territory's major and minor centres.

Water conservation is a widely debated issue throughout Australia and the world, 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, with large arid areas in the south and variable rainfall in the Top End. We must manage our water supplies flexibly; taking into account up-to-date scientific knowledge to ensure reliable, safe and good quality drinking water for current and future generations.

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. From 2006 to 2007 Power and Water successfully achieved 100 per cent compliance of *Escherichia coli* monitoring in our major centres. Only three samples from minor centres across the Northern Territory detected *Escherichia coli*. This is an improvement on the result from the previous year and illustrates the success of improved management strategies and recent upgrades to disinfection facilities in many of our water supplies.

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.

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

Andrew Macrides
MANAGING DIRECTOR

Section 1: Framework for Drinking Water Quality Management

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 Australian Drinking Water Guidelines (ADWG).

There are 12 elements to the Framework for Drinking Water Quality which are based on a proactive approach to ensuring the safety of water supplies by managing all steps in water production from catchment to consumer. The 12 elements are outlined below.

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 Policy

We aim to provide you with a good quality, safe and reliable water supply. We will:

- Supply drinking water, appropriate to the environment in which the community is located, in accordance with parameters set by the ADWG.
- Monitor the quality of drinking water in line with the Drinking Water Operational and Verification Monitoring Program and report the results to the Chief Health Officer, Department of Health and Community Services (DHCS).
- Develop contingency and response plans to deal with incidents that may adversely affect drinking water quality.
- Implement any arrangements notified by the Chief Health Officer in an emergency, to ensure the safety of supply.
- Respond promptly to any problem we identify.
- Consult with the community where health-related physical, chemical or radiological parameters exceed ADWG.

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. The 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 Natural Resources, Environment and the Arts (NRETA) undertakes a number of functions in protecting water quality, including the regulation and management of water resources and the regulation of pollution control.

The Department of Primary Industry, Fisheries and Mines (DPIFM) provides independent analysis of water samples through 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.

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.

2. Assessment of the Drinking Water Supply System

The five major centres and 13 minor centres that Power and Water supply water to are illustrated in FIGURE 1.

Figure 1: Major and minor centre water supply licence areas

Water Sources

Apart from Darwin, Katherine and Pine Creek, other centres rely 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 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 drawn down throughout the year, with the majority of draw down occurring in the dry season (May to October). The reservoir is recharged during the monsoonal wet season (November to April). This supply is supplemented with approximately 10 per cent groundwater from the McMinns and Howard East Borefields.

DARWIN RIVER DAM INTAKE TOWER

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 (10%)
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 from 2002 to 2007. 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.

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.*

Table 2 summarises the current barriers in major and minor centres used to ensure the safe supply of drinking water.

REPAIRS AND CLEANING OF KARAMA WATER STORAGE TANK

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 Customer's 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: Dark shading indicates only a partial barrier. Lightshading area indicates full barrier. NA – Not Applicable.

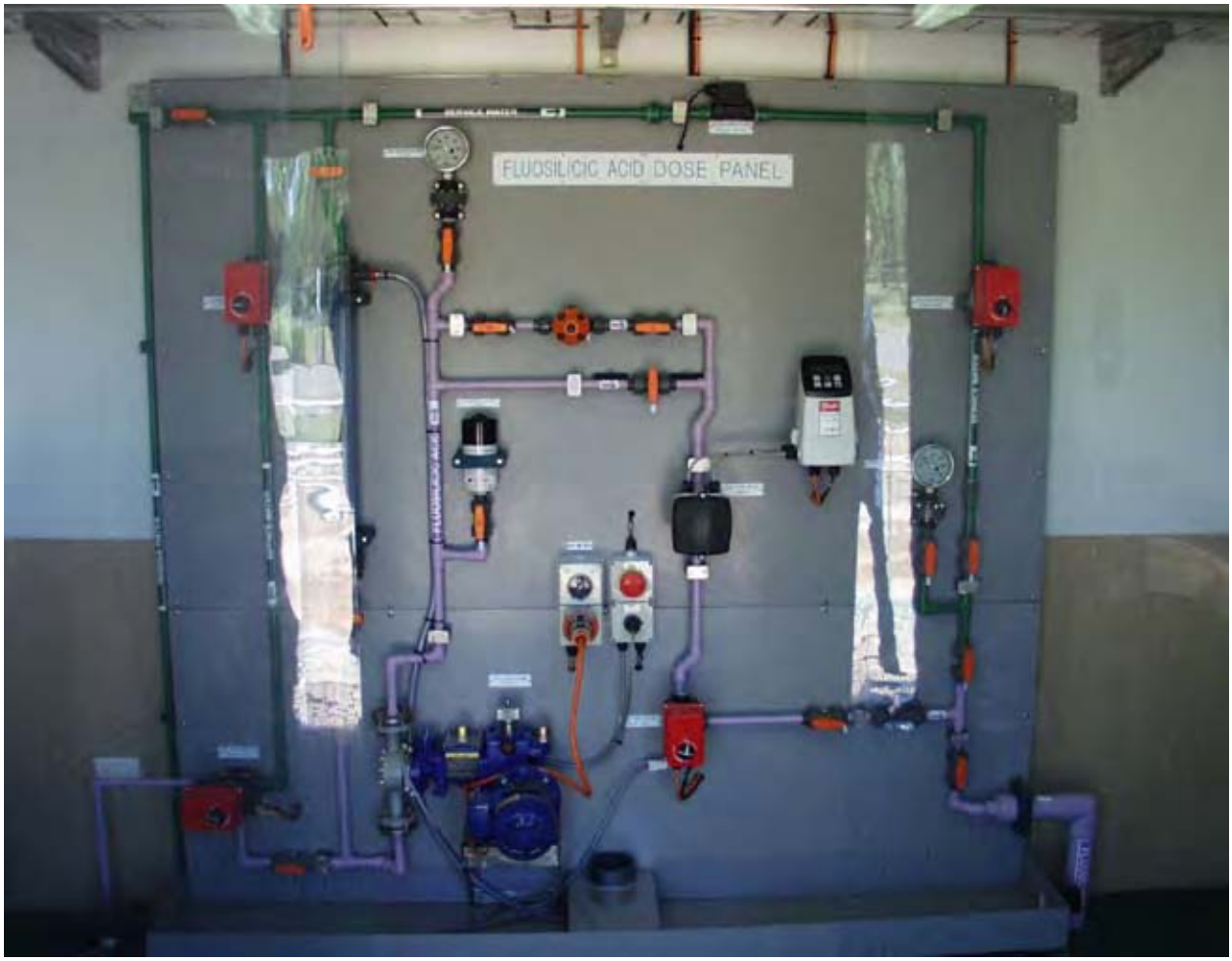
4. Operational Procedures and Process Control

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

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

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

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.



FLUORIDE DOSING AND MONITORING AT DARWIN RIVER DAM

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.

Microbiological, physical, chemical and radiological monitoring is routinely undertaken in Northern Territory water supplies. The frequency of water quality monitoring is based on recommendations set out in the ADWG, however, expert knowledge of local conditions may influence the monitoring program.

A three-year monitoring program from 2006 to 2009, which was approved by the Department of Health and Community Services, is currently being implemented by Power and Water. A summary of the types of monitoring undertaken in the program is given below:

Microbiological Monitoring

Waterborne disease causing organisms (pathogens) are the key concern from a human health perspective. The risk from these can vary from day to day within water supplies. We use microbiological monitoring to check for potential disease-causing organisms. These organisms can be difficult to detect, so indicator organisms are often used to show whether contamination may have occurred. The indicator organisms Power and Water monitors are:

- *Escherichia coli* (or *E. coli*) – indicate faecal contamination from warm-blooded animals, and hence, potentially disease-causing microorganisms.
- 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 *E. coli* (or alternatively thermotolerant coliforms).
- At least 98 per cent of scheduled samples (as distinct from repeat or special purpose samples) contain no *E. coli* (or alternatively thermotolerant coliforms).

None of the microbiological parameters described above can be used as indicators for the amoeba *Naegleria fowleri*. *N. fowleri* is a small, free-living amoeba that is found in the environment in damp soil and warm water. The organism causes primary amoebic meningoencephalitis (PAM), a very rapid and on most occasions fatal infection.

Water supply authorities in South Australia and Western Australia regularly monitor for *N. fowleri* in their water supplies. Power and Water implemented an extensive monitoring program for *N. fowleri* in all major and minor centres in 2006-2007.

The 2004 ADWG sets a guideline value of two *N. fowleri* organisms per litre in the treated water system. 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 all distribution systems (except Tennant Creek, where chlorination is not practiced).

Another microorganism of concern is *Burkholderia pseudomallei,* the organism that causes the disease Meliodosis (commonly known as Nightcliff Gardeners Disease). In consultation with DHCS, Power and Water undertook a monitoring program for the organism *Burkholderia pseudomallei* in 2006-2007. The program targeted the unchlorinated water supply in Tennant Creek and follows on from research into Melioidosis in water supplies by the Menzies School of Health. Further monitoring will be undertaken in remote communities in 2007-2008.

WATER SERVICE WORKER SAMPLING A BORE

Chemical and Physical Monitoring

Power and Water monitors a wide range of chemical and physical parameters as part of our Water Quality Monitoring Program to ensure that drinking water is safe and pleasant to drink. These parameters are unlikely to significantly alter each year, but are characteristic of each supply source.

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 substances from other sources.

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 monitoring was undertaken for a number of major and minor centres in 2006-2007 and is scheduled for all minor and major centres in 2007-2008 as part of the three year water monitoring program agreed with DHCS.

Disinfection by-products are formed when disinfectants react with organic material 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 potential products, most commonly trihalomethanes (THMs).

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. THM monitoring is scheduled for all minor and major centres in 2007-2008 as part of the three year water monitoring program agreed with DHCS.

Pesticides (insecticides and herbicides) are sometimes used in our catchments for controlling insects and weeds. DHCS requires testing for pesticides in the Northern Territory where a potential exists for a water supply to be at risk from contamination. Pesticide monitoring was undertaken in Darwin River Dam as part of the catchment weed control program. No pesticide sampling in drinking water supplies was scheduled for 2006-2007, however pesticide monitoring is scheduled at all major and minor centres in early 2008.

Aesthetic parameters are water quality measures that pose no threat to human health but can affect drinking water appearance, palatability (taste), feel and odour. This includes parameters such as Total Dissolved Solids (salts), hardness (calcium and magnesium), colour and pH.

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.

A microbiological incident response procedure exists for any microbiological sample that exceeds the agreed limit. The Chief Medical Officer, DHCS, approves the procedure. Responses by Power and Water include re-sampling, flushing and hand disinfection with chlorine. DHCS is notified immediately of any substantial microbiological failures.

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

7. Employee Awareness and Training

Power and Water is committed to ensuring that all employees are appropriately trained and aware of their responsibilities. We use a corporate wide system called VETtrak to manage our employees training requirements. There is no room for compromising on this commitment where the community's health is at stake.

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
- Report water quality incidents.

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 and minor centres in the Northern Territory.

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

POWER AND WATER STALL AT THE GARDEN EXPO

9. Research and Development

Power and Water is an active member of the Cooperative Research Centre for Water Quality and Treatment (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
- 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, including:

- Application of Hazard Analysis and Critical Control Point (HACCP) for distribution system protection
- Understanding the Growth of Opportunistic Bacterial Pathogens within Distribution Mains
- Disinfection Control within Distribution Systems
- Drinking Water and Melioidosis
- Investigation into Water Quality and Supply Issues in Indigenous Communities through a Technology Transfer Officer
- Remote Community Water Management
- Investigating the Defluoridation of Water Supplies
- Case Studies Using On-line Monitoring Systems

10. Documentation and Reporting

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

All documentation is routinely reviewed and updated in line with 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 in 2006.

As part of an effort to streamline data processing time and to improve data exchange between Power and Water Corporation and DPIFM Laboratories, a new water quality database 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 2008.

Power and Water remains in close communication with DHCS. In addition to internal reporting, DHCS is immediately notified of any exceedance of water quality targets as outlined in the agreement between Power and Water and DHCS. This report also forms an integral component of documentation required by DHCS on water quality performance.

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 a vital part of the review and evaluation process. We continuously review our Water Quality Monitoring Program to evaluate the success of the program and to update it if required. Audits ensure that operational procedures and processes are in place so that accurate water quality data is collected and appropriate management systems are maintained.

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 of our water quality management system in June 2006.

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.

Power and Water, along with SA Water (South Australia) and Water Corporation (Western Australia) has recently formed a Water Quality Network. The network provides a forum to share information, knowledge and discuss emerging issues. This sharing of information allows us to benchmark our performance and identify other ways to improve drinking water quality.

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 has been used as a guide to improve our water supply systems, particularly in Katherine. It provides a rigorous format for review of our drinking water quality systems and will continue to be developed for major centres.

Aquality Tool

Aquality is a systematic process to examine, in detail, the implementation of the Australian Drinking Water Guidelines – Framework for the Management of Drinking Water. It is an internet based tool which defines and scores a number of measures which reflect the level of implementation of the Framework. Overall scores are calculated for each of the 12 elements of the Framework and a final score for implementation of the whole framework can also be calculated. *Aquality* allows water utilities to undertake the scoring process online and compare scores at an element level with other utilities around Australia.

In 2008, Power and Water will use *Aquality* to assess implementation of the Framework for elements 1 2 3 and 4.

Microbiological Risk Assessment

Microbiological water quality is the highest priority and is best protected via assessment of the number and effectiveness of preventative barriers to the introduction of potential disease-causing organisms. Table 2 clearly illustrates that Tennant Creek has the fewest protective barriers and is thus a priority focus for risk reduction over the coming 12 months. Power and Water is in the process of implementing UV disinfection in Tennant Creek, as well as for groundwater supplies in Darwin and Katherine. This will provide an additional preventative barrier against microbiological contamination.

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 exceedence 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
- 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 aesthetic parameters and the average annual dose for radiological water quality. As Table 3 shows, Daly Waters, Kings Canyon and Tennant Creek have the highest risk scores. Investigations into improving the water quality at these locations are currently underway.

Table 3: Relative risk scoring

Rank	Location	Relative Risk Score	Parameters Exceeding 2004 ADWG Value
1	Daly Waters	23.9	Iodide, Selenium, TDS
2	Kings Canyon	22.9	Iodide, TDS
3	Tennant Creek	22.7	Fluoride, Iodide
4	Mataranka	15.8	Iodide, Selenium, TDS
5	Timber Creek	13.8	Barium, Fluoride
6	Pine Creek	13.7	Arsenic
7	Larrimah	9.7	Iodide, TDS

Section 2: Drinking Water Quality & Performance

Microbiological Results Summary

One thousand three hundred and ninety seven (1397) *E.Coli* samples were collected and analysed across the Northern Territory in 2006-2007 as part of the ADWG compliance monitoring program. Of these samples 99.8 per cent did not detect any *E.Coli*. This is a slight improvement on the previous year and well exceeds the limits required to comply with the ADWG.

Figure 2 indicates that 100 per cent of samples taken over the past year in major centres detected no E.Coli. This exceeds the 98 per cent limit required to comply with the 2004 ADWG guideline value, and as agree to by the DHCS.

Figure 2: Percentage of samples taken in major centres in which no E. Coli were detected including trends from 2003-2007

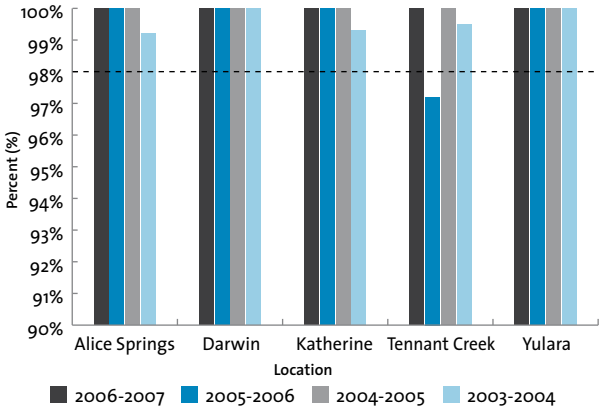
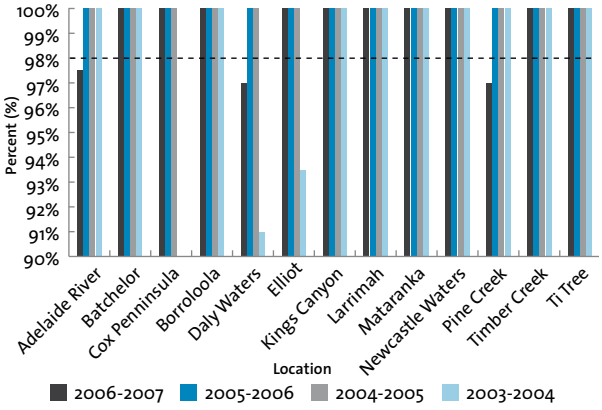


Figure 3 presents results for *E. Coli* microbiological compliance for all the minor centres in the Northern Territory. All minor centres except Adelaide River, Daly Waters and Pine Creek passed *E. Coli* performance targets in 2006-2007. *E.Coli* was detected in one sample in each of these locations. All other minor centres achieved 100 per cent compliance which 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.

Figure 3: Percentage of samples taken in minor centres in which no E. Coli were detected including trends from 2003-2007



Full details of microbiological results from the 2006-2007 year are given in Appendix 1.

Naegleria fowleri

Figure 4 illustrates that, in Darwin, six per cent (14 samples) of routine monitoring samples for N. fowleri exceed the 2004 ADWG trigger value of two organisms per litre in the treated water system. An intensive monitoring program was carried out in other major centres during the 12 month monitoring period, with over 800 samples collected. No exceedances were detected in other major centres.

Figure 4: Percentage of samples taken in major centres that did not exceed the trigger value of two organisims/l of Naegleria fowleri in 2006-2007

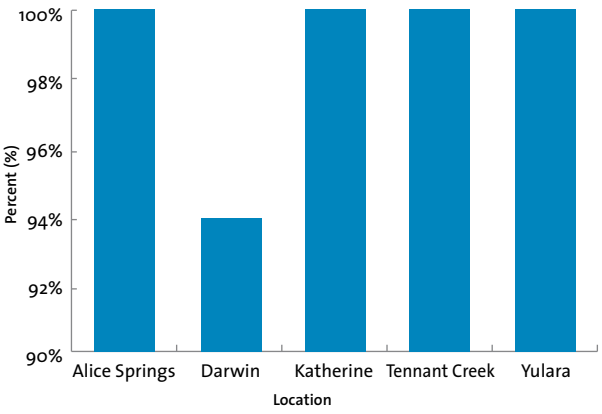


Figure 5: Percentage of samples taken in minor centres that did not exceed the trigger value of two organisims/l of Naegleria fowleri in 2006-2007

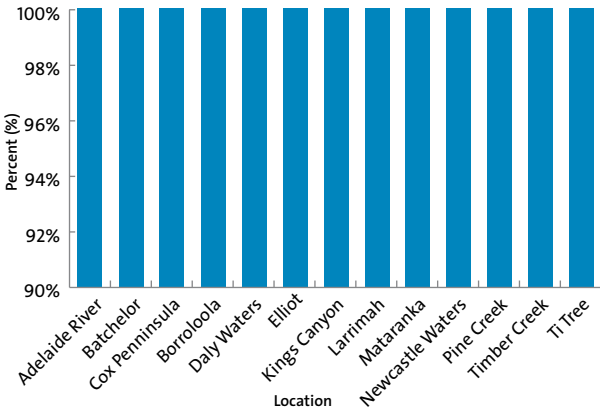


Figure 5 illustrates that no exceedances were detected in minor centres during the 12 month monitoring period, where over 300 water samples were collected in an intensive monitoring program.

Burkholderia pseudomallei

Burkholderia pseudomallei was not detected in any of the four water samples analysed from the Tennant Creek Water Supply System during 2006-2007.

Chemical and Physical Results Summary

Health related water quality parameters are reported as a 95th percentile, while aesthetic parameters are reported as an average as specified in the 2004 ADWG.

Analysis of radionuclides in all minor and major centres in 2002-2003 found that all locations, other than Kings Canyon, were well below the trigger value of 0.5 mSv/Yr. While still below the 2004 ADWG trigger value, a routine monitoring program was undertaken in Kings Canyon in 2006-2007. The results of the monitoring program, indicating an average concentration of 0.486 mSv/yr (n=195 samples). This confirms that the radionuclide levels in Kings Canyon remained below the ADWG value. Treatment options are currently being investigated to reduce the total annual radiological dose at Kings Canyon.

The 2004 ADWG has set a guideline value for THMs of 0.25 mg/L. THMs measured in Power and Water supplies, in 2002-2003, 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.

The herbicide glyphosate was used to control the noxious aquatic weed *Olive hymenachne* in Darwin River Dam. Special testing for glyphosate was undertaken throughout the Dam during 2006-2007, however it was not detected in any of the samples collected.

Full details of the health and aesthetic parameters for each major and minor centre are in Appendix 1.

WATER SERVICE WORKER TAKING FIELD MEASUREMENTS AT MANTON DAM

Customer Satisfaction

Water Quality Customer Complaints

Power and Water records water quality customer complaints. Table 4 shows the total number of complaints and the number of complaints per 1,000 customer properties.

Table 4: Water quality complaints 2003-2007

	Total Number of Complaints				
Location	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Darwin	167	78	121	112	147
Alice Springs	5	8	3	8	5
Katherine	N/A	N/A	6	7	2
Total	172	86	131	137	154
Complaints per 1000 properties	5.14	2.46	3.24	2.29	2.44*

N/A – No data collected

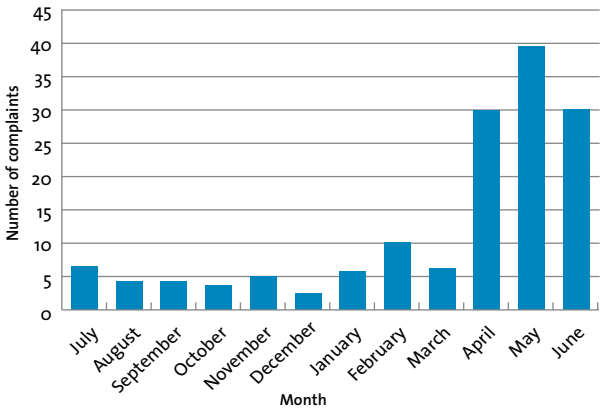
* calculated number of properties in 2006/2007 based on WSAA reporting guidelines.

Power and Water reports its number of customer complaints to the Water Services Association of Australia publication (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 after the wet season as shown in Figure 6. Organic material can also get stirred up as more water flows through the pipes at the start of the dry season.

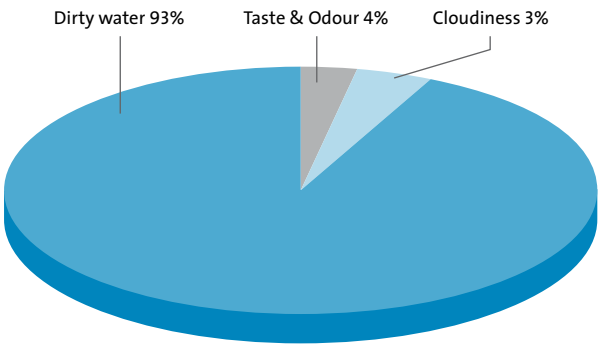
Power and Water works proactively to reduce complaints, chiefly through a mains flushing program in all major centres. Mains are flushed prior to increased demands associated with seasonal changes or if several complaints are received from any one street or suburb. The levels of iron and manganese found in the drinking water do not constitute a health risk, due to the usually short nature of dirty water events.

Figure 6: Number of monthly drinking water customer complaints for Darwin 2006-2007



Less common customer complaints relate to chlorine odour and taste, cloudy water or floating particles. Figure 7 shows a breakdown of customer complaints for 2006-2007.

Figure 7: Type of drinking water customer complaints for Darwin 2006-2007



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 sometimes associated with dissolved oxygen coming out of solution or entrainment of air.

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.

Recorded Emergencies/Incidents

No water quality emergencies were recorded in 2006-2007. However significant investment in upgrading of facilities and security systems continues to occur to further reduce risks.

There were fourteen incidents where *N. fowleri* exceeded the 2004 ADWG trigger value of two organisms per litre in the Darwin Water Supply.

In addition there were three incidents in which *E.Coli* was detected in one sample in Adelaide River, Daly Waters and Pine Creek.

Responses to these incidents followed the protocol as agreed with DHCS and included corrective action such as hand chlorination of tanks, flushing of mains and re-sampling of the water supply.

WATER SERVICE WORK FLUSHING A WATERMAIN

Appendices

Appendix 1: Water Quality Results tables

Table A1: Microbiological parameters in major centres 2006-2007

Location / Parameter (cfu/100mL)	Target level	Total no. of samples required	Total no. of samples collected*	Total Exceedence (no.)	Samples passing reporting level (%)
Alice Springs					
E coli	<1 in 98% samples	104	98	0	100.0%
Total coliforms	<10 in 95% samples	104	98	1	99.0%
Darwin					
E coli	<1 in 98% samples	364	335	0	100.0%
Total coliforms	<10 in 95% samples	364	335	4	98.8%
Katherine					
E coli	<1 in 98% samples	104	135	0	100.0%
Total coliforms	<10 in 95% samples	104	135	7	94.8%
Tennant Creek					
E coli	<1 in 98% samples	104	106	0	100.0%
Total coliforms	<10 in 95% samples	104	106	16	84.9%
Yulara					
E coli	<1 in 98% samples	52	52	0	100.0%
Total coliforms	<10 in 95% samples	52	52	0	100.0%

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

Table A2: Microbiological parameters in minor centres 2006-2007

Location / Parameter (cfu/100mL)	Target level	Total no. of samples required	Total no. of samples collected*	Total Exceedence (no.)	Samples passing reporting level (%)
Adelaide River					
E coli	<1 in 98% samples	36	40	1	97.5%
Total coliforms	<10 in 95% samples	36	40	0	100.0%
Batchelor					
E coli	<1 in 98% samples	104	107	0	100.0%
Total coliforms	<10 in 95% samples	104	107	0	100.0%
Cox Penninsula					
E coli	<1 in 98% samples	52	55	0	100.0%
Total coliforms	<10 in 95% samples	52	55	1	98.2%
Borroloola					
E coli	<1 in 98% samples	36	36	0	100.0%
Total coliforms	<10 in 95% samples	36	36	0	100.0%
Daly Waters					
E coli	<1 in 98% samples	36	38	1	97.4%
Total coliforms	<10 in 95% samples	36	38	1	97.4%
Elliott					
E coli	<1 in 98% samples	36	36	0	100.0%
Total coliforms	<10 in 95% samples	36	36	0	100.0%
Kings Canyon					
E coli	<1 in 98% samples	104	137	0	100.0%
Total coliforms	<10 in 95% samples	104	137	0	100.0%
Larrimah					
E coli	<1 in 98% samples	36	35	0	100.0%
Total coliforms	<10 in 95% samples	36	35	1	97.1%
Mataranka					
E coli	<1 in 98% samples	36	35	0	100.0%
Total coliforms	<10 in 95% samples	36	35	0	100.0%
Newcastle Waters					
E coli	<1 in 98% samples	36	34	0	100.0%
Total coliforms	<10 in 95% samples	36	34	1	97.1%
Pine Creek					
E coli	<1 in 98% samples	36	34	1	97.1%
Total coliforms	<10 in 95% samples	36	34	2	94.1%
Timber Creek					
E coli	<1 in 98% samples	36	36	0	100.0%
Total coliforms	<10 in 95% samples	36	36	0	100.0%
Ti Tree					
E coli	<1 in 98% samples	36	48	0	100.0%
Total coliforms	<10 in 95% samples	36	48	0	100.0%

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

Table A3: Health, aesthetic and other parameters in major centres 2006-2007

			Measured Level[1]				
Parameter/Location	ADWG level[2]	Units	Alice Springs	Darwin	Katherine	Tennant Creek	Yulara
Health Parameters			**95th Percentile Values**				
Antimony	0.003	mg/L	0.0001	0.0001	0.0006	0.0001	0.0001
Arsenic	0.007	mg/L	0.001	0.0005	0.0005	0.0032	0.0003
Barium	0.7	mg/L	0.1	0.025	0.025	0.07	0.025
Boron	4	mg/L	0.14	0.01	0.02	0.47	0.66
Cadmium	0.002	mg/L	0.0001	0.0001	0.0001	0.0005	0.0004
Chromium	0.05	mg/L	0.003	0.003	0.003	0.003	0.003
Fluoride	1.5	mg/L	0.5	0.8	0.6	**1.80**	0.1
Iodide	0.1	mg/L	**0.14**	0.02	0.05	**0.33**	0.06
Lead	0.01	mg/L	0.007	0.002	0.001	0.001	0.001
Mercury	0.001	mg/L	0.0001	0.0002	0.0001	0.0001	0.0001
Molybdenum	0.05	mg/L	0.003	0.003	0.003	0.003	0.003
Nickel	0.02	mg/L	0.005	0.001	0.001	0.001	0.001
Nitrate	50	mg/L	8.9	4.2	1.0	43.0	31.8
Radiological	0.5	mSv/yr	0.15	0.06	0.11	0.05	0.03
Selenium	0.01	mg/L	0.004	0.001	0.001	0.007	0.001
Silver	0.1	mg/L	0.005	0.005	0.005	0.005	0.005
THMS	0.25	mg/L	0.002	0.08	0.07	NA	0.003
Uranium	0.02	mg/L	0.010	0.000	0.000	0.009	0.000
Aesthetic Parameters			**Mean Values**				
Aluminium	0.2	mg/L	0.02	0.02	0.02	0.01	0.01
Chloride	250	mg/L	72	4	5	93	41
Copper	1	mg/L	0.10	0.02	0.02	0.01	0.06
Hardness	200	mg/L $CaCO_3$	**224**	37.8	98.2	177	27.4
Iron	0.3	mg/L	0.029	0.09	0.038	0.017	0.018
Manganese	0.1	mg/L	0.006	0.020	0.003	0.003	0.003
pH	6.5 - 8.5	pH units	7.5	7.2	7.5	7.8	6.9
Sodium	180	mg/L	78.4	3.0	6.2	103	32.3
Sulphate	250	mg/L	63.3	3.8	6.2	51.8	46.8
TDS	800	mg/L	456	53.8	112	614	145
Zinc	3	mg/L	0.05	0.01	0.15	0.01	0.03
Other Parameters			**Mean Values**				
Alkalinity	*	mg/L	244	52.7	88.9	273	14.6
Beryllium	*	mg/L	0.001	0.001	0.001	0.001	0.001
Bromide	*	mg/L	0.42	0.03	0.29	0.83	0.22
Calcium	*	mg/L	48.2	6.9	20.6	28.5	6.6
Electrical Conductivity	*	µS/cm	790	91.5	190	942	251
Magnesium	*	mg/L	25.1	5.0	9.1	26.1	2.5
Potassium	*	mg/L	6.5	0.8	1.0	29.7	4.1
Silica	*	mg/L	11.4	5.3	8.9	42.3	4.0
Tin	*	mg/L	0.005	0.005	0.005	0.005	0.005

Legend

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

[1] 95% of all health related values from 2003-2007, mean of all aesthetic values from 2003-2007.

[2] 2004 ADWG Value for health and aesthetic parameters. TDS value set by DHCS.

Table A4: Health, aesthetic and other parameters in minor centres 2006-2007

			Measured Level[1]												
Parameter/Location	ADWG level[2]	Units	Adelaide River	Batchelor	Borroloola	Cox Peninsula	Daly Waters	Elliot	Kings Canyon	Larrimah	Mataranka	Newcastle Waters	Pine Creek	Ti Tree	Timber Creek
Health Parameters			95th percentile Values												
Antimony	0.003	mg/L	0.0001	0.0001	0.0001	0.0001	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Arsenic	0.007	mg/L	0.003	0.0003	0.0003	0.0005	0.003	0.0015	0.005	0.002	0.003	0.002	**0.01**	0.002	0.001
Barium	0.7	mg/L	0.03	0.03	0.03	0.03	0.08	0.15	0.03	0.05	0.10	0.24	0.03	0.10	**1.22**
Boron	4	mg/L	0.02	0.01	0.04	0.04	0.48	0.34	0.32	0.23	0.37	0.34	0.01	0.30	0.12
Cadmium	0.002	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0004	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium	0.05	mg/L	0.003	0.003	0.005	0.003	0.003	0.003	0.01	0.003	0.005	0.003	0.003	0.003	0.003
Fluoride	1.5	mg/L	0.32	0.20	0.05	0.10	0.35	0.86	0.50	0.33	0.40	1.00	0.70	0.89	**1.55**
Iodide	0.1	mg/L	0.01	0.005	0.02	0.005	**0.262**	0.10	**0.395**	**0.117**	**0.129**	0.088	0.02	**0.11**	0.024
Lead	0.01	mg/L	0.003	0.001	0.005	0.001	0.001	0.001	0.009	0.001	0.004	0.001	0.001	0.001	0.004
Mercury	0.001	mg/L	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0004	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001
Molybdenum	0.05	mg/L	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.000	0.003	0.003
Nickel	0.02	mg/L	0.001	0.001	0.001	0.001	0.005	0.010	0.009	0.004	0.011	0.001	0.000	0.001	0.016
Nitrate	50	mg/L	0.50	1.14	1.00	0.50	8.57	43.0	9.00	4.00	3.00	9.90	1.00	**52.1**	1.00
Radiological	0.5	mSv/yr	0.09	0.09	0.19	0.04	0.06	0.04	0.49	0.06	0.07	0.05	0.08	0.05	0.12
Selenium	0.01	mg/L	0.001	0.001	0.001	0.001	**0.012**	0.008	0.010	0.007	**0.012**	0.007	0.001	0.003	0.001
Silver	0.1	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01
THM's	0.25	mg/L	0.002	0.002	0.01	NA	0.002	0.01	0.002	0.007	0.003	0.01	0.01	NA	0.005
Uranium	0.02	mg/L	0.000	0.000	0.000	0.000	0.009	0.006	0.002	0.003	0.004	0.005	0.000	0.007	0.002
Aesthetic Parameters			Mean Values												
Aluminium	0.2	mg/L	0.01	0.01	0.01	0.10	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Chloride	250	mg/L	18	6	9	3	337	142	246	184	189	74	7	60	26
Copper	1	mg/L	0.33	0.01	0.02	0.01	0.01	0.01	0.08	0.01	0.02	0.01	0.01	0.01	0.03
Hardness	200	mg/L $CaCO^3$	78	**202**	18	3	**567**	**395**	**332**	**513**	**512**	331	102	**206**	**427**
Iron	0.3	mg/L	1.13	0.01	0.06	**0.41**	0.11	0.05	0.13	0.07	**0.60**	0.02	0.30	0.01	0.10
Manganese	0.1	mg/L	0.33	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.05
pH	6.5 - 8.5	pH units	6.8	7.5	**6.3**	**5.2**	7.5	7.8	7.1	7.6	7.6	7.8	7.4	8.0	7.4
Sodium	180	mg/L	19	5	5	5	**222**	87	131	120	143	56	27	64	21
Sulphate	250	mg/L	4	5	1	1	217	181	181	122	147	38	6	36	11
TDS	800	mg/L	170	219	54	35	**1320**	768	**832**	**885**	**939**	580	204	524	479
Zinc	3	mg/L	0.07	0.05	0.03	0.20	0.01	0.02	0.08	0.03	0.21	0.02	0.02	0.01	0.04

			Measured Level[1]												
Parameter/Location	ADWG level[2]	Units	Adelaide River	Batchelor	Borroloola	Cox Peninsula	Daly Waters	Elliot	Kings Canyon	Larrimah	Mataranka	Newcastle Waters	Pine Creek	Ti Tree	Timber Creek
Other Parameters			Mean Values												
Alkalinity	*	mg/L	102	206	19	8	431	354	120	450	469	368	156	214	445
Beryllium	*	mg/L	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Bromide	*	mg/L	0.08	0.02	0.04	0.02	2.1	0.96	1.39	1.13	1.49	0.66	0.04	0.43	0.14
Calcium	*	mg/L	13.9	27.3	5.5	0.4	122.0	83.3	68.7	118.5	114.3	73.4	16.1	46.3	62.5
Electrical Conductivity	*	µS/cm	256	383	73	40	2132	1273	1328	1516	1622	950	315	738	853
Magnesium	*	mg/L	12.4	34.0	1.0	0.5	64.0	45.7	43.3	54.0	55.6	35.3	15.4	22.3	65.5
Potassium	*	mg/L	1.0	0.6	1.1	1.50	27.6	22.9	23.9	12.3	18.7	26.7	1.8	18.7	6.8
Silica	*	mg/L	17.3	17.7	1.1	23.5	23.5	34.6	12.9	26.1	25.5	36.8	24.2	47.7	15.1
Tin	*	mg/L	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

Legend

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

[1] 95% of all health related values from 2003-2007, mean of all aesthetic values from 2003-2007.

[2] 2004 ADWG Value for health and aesthetic parameters. TDS value set by DHCS.

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
NRETA	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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