Friends of the Earth Australia

An Introduction to Drinking Water Quality Issues.

February 2012

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This project was funded by the 2011 Friends of the Earth Australia Small Grants Program. It intends to be an introduction into some of the issues concerning the quality of drinking water in Australia. It hopes to enlighten the reader about the complex dynamics of drinking water quality, an issue which is sometimes at the periphery of conservation campaigns concerning water. It also hopes to shed light on which communities across Australia have been put at risk in the past few years, due to poor quality drinking water. Much of this information (outside of Victoria) was sourced from newspaper articles from around the country.

It is also a follow on from recent work undertaken by Friends of the Earth in Melbourne concerning, Pesticides in Victorian Water Supply Catchments (2008) http://baddevelopers.nfshost.com/Docs/foewaterreport.htm and Water Quality Issues Ballarat, Bendigo, Benalla (2010) http://dev.foe.org.au/sites/default/files/foewaterqualityissuesballaratbendigobenalla.pdf.

In October 2012, Friends of the Earth produced a detailed report focussing on SAWater breaches to the Australian Drinking Water Guidelines. The report can be found at: http://www.foe.org.au/sites/default/files/SAWater2012a_0.pdf

Due to budget and time constraints a lot more information could have been included in this report and the sections 4.1.3, 5, 6, 7 ,8 and 9 could have been covered in far greater depth.

As such it is hoped that the document at least inspires some interesting discussion regarding the quality of drinking water quality in Australia.

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1. Background

The quality of drinking water throughout Australia varies considerably according to location. Many larger centres, can afford 'more thorough' water treatment, whereas many smaller centres, particularly those servicing less than 15,000 people may have to settle for standard treatment or in many isolated areas, no treatment at all. People may also be reliant on rainwater tanks, pump directly from streams or bores, also meaning no treatment.

"Australia's major cities are well served with respect to drinking water treatment, while many regional areas receive no water filtration, or comparatively less sophisticated treatment." p1 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

The landuse that occurs within the catchment from where the water is sourced also has significant impacts on the quality of the water that is consumed. Most water authorities do not have the resources to address all potential supply risks. Risks can also occur regarding the treatment process used.

"Water quality compliance monitoring varies significantly across the states. For a large proportion of supply systems, testing is infrequent and the range of parameters is small, particularly in comparison to metropolitan utilities. Utilities may be missing contamination events due to the method of testing, and the risk to communities may therefore be higher than what is reflected in the water quality results" p17 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

Risk factors in relation to water supplies include: extensive agriculture, low vegetation cover, fauna defecating in supply, flooding, poor water quality source, sewerage releases upstream of offtakes, high natural mineral pollutants, industrial pollutants, aging or inadequate pipe work and associated infrastructure and algal blooms.

Friends of the Earth has been looking at drinking water issues in Victoria for some time. In Victoria, drinking water supplied by companies must meet the obligations set under the Safe Drinking Water Act 2003 and Safe Drinking Water Regulations 2005. Annual Water Quality Reports are produced by each water authority and include tables of information outlining what substances are tested for by authorities. Usually these tables include the highest level detected, the lowest level detected and a mean. This information is provided for a variety of subtances, but Friends of the Earth has noticed that in regards for pesticides (or other industrial chemicals) for example, positive samples have not been published in water quality reports, unless the sample level was higher than Guideline Limits published in the National Health and Medical Research Centre (NHMRC) Australian Drinking Water Guidelines (ADWG's). This is a concern as science is recently finding that low doses of substances, endocrine disruptors for example, can have impacts far greater than previously assumed. http://www.ourstolenfuture.com/Basics/chemlist.htm

The Australian Drinking Water Guidelines (ADWG) 2011 are used as the benchmark for drinking water across Australia but are not mandatory. The latest public consultation to update the ADWG's was undertaken by the National Health and Medical Research Council (NHMRC) between October 2009 and January 2010. According to the NHMRC *"The ADWG incorporates the Framework for the Management of Drinking Water Quality and provides the Australian community and the water supply industry which guidance about what constitutes good quality drinking water".* http://www.nhmrc.gov.au/guidelines/publications/eh34

The 2011 Australian Drinking Water Guidelines can be viewed here:
http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh52_aust_drinking_water_guidelines_111130.pdf

Safe levels of consuming potentially toxic substances in drinking water are also published in the ADWG. The guideline values used by the ADWG take their point of reference by values set by the World Health Organisation Guidelines for Drinking Water Quality. There can be differences in Guideline limits set by the WHO and ADWG. Generally these differences are that the ADWG use a 70kg body weight, whereas the WHO use a 60kg body weight *"to cater for lighter body weights in developing countries". "For genotoxic carcinogenic compounds, WHO uses a risk assessment calculation, with the guideline value set at the concentration that would give rise to a risk of one additional cancer per 100,000 people"* whereas the Australian Guideline values are set with value based threshold effect calculations and *"to a risk of one additional cancer per million people, if water containing the compound at that concentration were consumed over a lifetime".* The assumed weight of a child at 2 years in Australia is 13kg.

Safe levels for chemicals are calculated by; Guideline value = animal dose x human weight x proportion of intake from water divided by volume of water consumed x safety factor.

The animal dose is calculated usually by the No Observed Affect Limit (NOAEL). *"the highest amount of the compound that does not cause observable adverse effects in repeat dose studies on experimental animals".* If that information is not available then the LOAEL (Lowest Observed Affect Limit) is used. *"the lowest amount of the compound that does cause observable effects in studies of experimental animals".*

In regards to the proportion of intake, it is assumed that water contributes 10% of intake for chemicals that are used commercially or industrially. For compounds that are not used commercially or industrially a higher proportion of intake – usually 20% (but sometimes 80 – 100%) is assumed to come from drinking water.

The volume of water consumed in one day by an adult is assumed to be 2L and for a child 1L.

Safety factors include; a factor of ten for variations between animals of the same species, a factor of ten for variations between species, a factor of ten if data from a subchronic study are used in the absence of reliable data from chronic studies and a factor of up to ten if adverse affects have been observed at the lowest dose. All of these factors are then multiplied to give a safety factor of 100 to 1000.

Ecological issues, aside from drinking water issue are published in the 2000 ANZECC Guidelines
http://www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality

The ANZECC guidelines are of most interest in assessing water pollution or water quality incidents from an ecological perspective. These guidelines generally do not involve assessing health issues regarding drinking water quality.

2. Who Is Responsible For Drinking Water Quality Monitoring?

"Under existing legislation or regulatory instruments such as operating licenses, many urban water utilities in Australia are not required to comply with the Australian Drinking Water Guidelines beyond particular water quality targets. Where compliance mechanisms do exist, the procedures for investigating and penalising non-compliance often do not provide sufficient incentive for utilities to meet their objectives". pv Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

"Major utilities (more than 10,000 connected properties) are required to report annually in the National Water Commission's and the Water Service Association of Australia's National Performance Report. However, smaller utilities are not captured within this public reporting framework. Some regional towns are captured if they are serviced by a larger utility, however, because the reporting is performed at a whole of utility level, or at a regional level. A consequence of this is that poorer levels of service to small towns are often masked by the average service level for the utility as a whole." p2 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

2.1 NEW SOUTH WALES: NSW Health has water quality management responsibilities. There are 109 water utilities in NSW. (106 councils and 3 metropolitan utilities). Local water utilities are responsible for providing water supply and sewerage services to NSW non-metropolitan urban communities. The following utilities are exercising water supply functions under the *Water Management Act 2000*: Cobar Water Board, Country Energy, Fish Water Water Supply (water to Oberon and Lithgow), Gosford City Council and Wyong Shire Council.

99 Local Government Councils exercise water supply functions under Division 2 Part 3 Chapter 6 *Local Government Act 1993*. There are also major water utilities exercising water supply functions under the Water Management Act 2000: Delta Electricity, Eraring Energy, Hunter Water Corporation Limited, Macquarie Generation, State Water Corporation, Sydney Catchment Authority, Sydney Water Corporation. The Water Management Act 2000 also defines the following as water authorities; Benerembah Irrigation District Environment Protection Trust, Upper Parramatta River Catchment Trust, Sydney Olympic Park Authority. http://www.water.nsw.gov.au/Urban-water/Local-water-utilities/Local-water-utilities/default.aspx#water

"A recent inquiry into the sustainability of non-metropolitan urban water utilities in New South Wales uncovered some worrying trends; 17 of the 106 utilities failed to comply with Australia's water quality standards, while only half of the very small utilities had water conservation and demand management plans in place" Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

"NSW Health are responsible for the monitoring the performance of water utilities with respect to their drinking water quality. They provide a free of charge drinking water testing service to water supply authorities for indicator bacteria and health-related inorganic chemicals. NSW Health also maintains a Drinking Water Database of water quality information for each utility. NSW health has published two documents to assist water suppliers, namely NSW Health Drinking Water Monitoring Program (2005) and the Guide for Submitting Water Samples to DAL for Analysis (2003). NSW Health support and endorse the Australian Drinking Water Guidelines". pA6 Review of Regional Water Quality and Security Volume 2 AECOM

2.2 VICTORIA: *"The regulatory framework for drinking quality water in Victoria consists of the Safe Drinking Water Act 2003 (the Act) and the Safe Drinking Water Regulations 2005 (the regulations). The fluoridation of drinking water is regulated under the Health (Fluoridation) Act 1973.*
The regulatory framework is administered by the Department of Health.
The Act defines two types of water business:

- *water suppliers, which provide drinking water or regulated water to the public*
- *water storage managers, which provide water to water suppliers.*

The role of water suppliers is to manage risk in relation to the supply of drinking water to the public.
The role of water storage managers is to manage risk in relation to the supply of untreated water to water suppliers.
Victoria's water suppliers include 16 water businesses, five alpine resort management boards and Parks Victoria.
Victoria's water storage managers include Goulburn Murray Rural Water and Southern Rural Water (both supply untreated water to water suppliers), Melbourne Water (which primarily supplies treated drinking water to water suppliers) and Grampians Wimmera Mallee Water (which is both a water

supplier and a water storage manager because it supplies raw water to several water suppliers).
The Department of Human Services has water quality management responsibilities." Annual Report on Drinking Water Quality in Victoria 2010-11
Metropolitan Melbourne - Melbourne Water owned by the Victorian Government, manages Melbourne's water supply catchments and is responsible for the water quality it supplies. Three retail managers owned by the Victorian Government then provide drinking water to residents. South East Water (South East Melbourne), City West Water (Melbourne CBD, inner and western suburbs), Yarra Valley Water (Yarra Valley Catchment).
Regional Victoria - Lower Murray Water, Coliban Water, Goulburn Valley Water, Western Water, Westernport Water, Gippsland Water, South Gippsland Water, East Gippsland Water, GMW Water, Wannon Water, Barwon Water. Goulburn Murray Water & Southern Rural Water are responsible for irrigation water, stock and domestic water.

"The key piece of drinking water legislation in Victoria is the Safe Drinking Water Act 2003, which came into effect on 1 July 2004. Prior to this, drinking water quality was regulated through the Health Act 1958, the Health (Quality of Drinking Water) Regulations 2002, the Food Act 1984, and contractual and licence deeds between water businesses and the Department of Sustainability and Environment." pA9 Review of Regional Water Quality and Security Volume 2 AECOM

If breaches in terms of water quality are detected in Victoria, a s22 notification occurs, but *"... we only require a s22 notification where a health-related guideline value is exceeded."* pers comm Water authorities may also "round off" reported levels eg 0.11mg/L rounded off to 0.10mg/L, which in turn could mean that if for example the health level is 0.10mg/L, a s22 notification would not be written.

Tap samples are generally taken for a range of substances at a range of sampling locations within communities. Strict protocols are generally followed in regards to getting lab samples, including tap samples.

"It was found that 13% of the selected towns have disinfection only. The 2008-09 performance report for Victoria demonstrates that 53 localities on surface water supplies receive disinfection only. This is a high risk scenario due to potential for hazardous trihalomethane (THM) formation in the absence of filtration. The absence of treatment in one town poses an extremely high risk as there are no barriers to microbial, pathogenic, viral, or chemical contamination. Due to their accessibility, surface supplies are also more readily affected by chemical pollutants via storm-water runoff and industrial activity in comparison to groundwater supplies". Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

"Six of the 18 towns sampled in Victoria had issues with THM formation. Other disinfection byproducts such as Dichloroacetic acid and Trichloroacetic acid were detected. The detection of these contaminants in Victoria and not in other States may be attributed to the fact that Victoria generally undertakes more rigorous testing. It is possible that improved monitoring and testing practices in other States would produce similar results. Water supplies to five of the 18 selected towns in Victoria were affected by algal blooms in the 2007-08 reporting period, while three of the selected towns issued "boil water" notices." P15 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

2.3 TASMANIA: The Department of Health and Human Services has water quality management responsibilities through the Public Health Act 1997. Three bulk water authorities; Southern Water (southern Tasmania), Ben Lomond Water (Launceston/Tamar Region) and Cradle Mountain Water (north west) supply 75% of the population with fully treated water. Local councils are responsible for monitoring water quality outside of bulk water authority areas.
"Eliminating unsafe water supplies is an issue for Tasmania. There are 23 drinking water supply systems that do not have any water treatment processes. This means that about 5,000 people are on permanent boil notices." p28 Infrastructure Report Card 2010 Australia. Engineers Australia.

The central agency for water quality monitoring is the Department of Primary Industries, Parks, Water and Environment (DPIPWE), which manages the State Water Quality Data Base. *"A program to monitor Tasmanian water catchments for a range of herbicides and other pesticides was launched by the Minister for Primary Industries and Water on 19 January 2005. The baseline monitoring program measures pesticide levels in rivers and streams at a number of testing station locations across Tasmania on a quarterly basis."* http://www.dpiw.tas.gov.au/internnsf/WebPages/CART-69STWK?open

"Water quality information was not readily available for towns in Tasmania. However, utility website, reports, newsletters and news articles reported that numerous towns had been or still were on boil water alerts. The Tasmanian Water and Sewerage Industry Report revealed that in 2009 there were 38 towns on boil water alerts, 24 of which were permanent. Significant work is now underway to address historical water quality issues; the Tasmanian government has committed $1B over the next 10 years to improve water treatment, distribution and storage

systems with numerous projects already underway." P16 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

2.4 SOUTH AUSTRALIA: The Department of Health has water quality management responsibilities through the Safe Drinking Water Act 2011. [The Act provides specific legislation of drinking water quality in South Australia and will replace sections of the Food Act 2001 and Food Regulations 2002 for South Australia which previously covered drinking water supplies. The Department of Health will have primary responsibility for administering the Act]. SA Water is wholly owned by the Government of South Australia and provides water to about 1.5 million people across South Australia in Eyre Region, Outer Metropolitan Region, Metropolitan Adelaide, South East Region and Northern Region.

"Three of the 20 towns selected in South Australia had high levels of trihalomethane THMs... These were towns supplied by a reservoir thought to have high organic loads. The non-compliances with Faecal Coliforms are thought to be due to bores without disinfection being connected to the water supply networks." P16 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

The taxpayer-owned SA Water is suing private company United Water for tens of millions of dollars for alleged water overcharging. http://www.abc.net.au/news/stories/2009/08/31/2672109.htm
United Water and its 470 local workers have lost the contract to manage Adelaide pipe and sewerage network. (June 24 2010). http://www.abc.net.au/news/stories/2010/06/24/2935983.htm

2.5 WESTERN AUSTRALIA: The Department of Health has water quality management responsibilities. Western Australia has 5 water utilities (1 statewide and utility and 4 smaller local utilities). The Water Corporation is the largest water service provider in Western Australia, supplying Perth and nearly all country towns. Aqwest provides drinking water services to the City of Bunbury and Busselton Water Board supplies drinking water services to the Busselton area. For information on Aboriginal Communities: http://www.water.wa.gov.au/PublicationStore/first/88087.pdf

"Specific water quality information was not received for Western Australia. The Water Corporation in WA indicated that all of the selected towns have 100% compliance with ADWG 1987, whereas to the other States use ADWG 2004. WA's use of thermotolerant coliforms as an indicator is out-dated, with E.coli is now more commonly used to indicate microbial risk as it can be used to distinguish between environmental thermotolerant coliforms and faecal contamination." P16 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

2.6 QUEENSLAND: The Department of Environment and Resource Management has water quality management responsibilities. There are 72 water authorities in Queensland (local councils and regional water utilities. Seqwater provides bulk water storage and treatment services to the South East Queensland (SEQ) Water Grid. Seqwater has responsibility for managing 25 dams and 47 weirs across the south east Queensland, including the Wivenhoe, Somerset and North Pine Dams, Hinze Dam on the Gold Coast and Baroon Pocket Dam on the Sunshine Coast. As of July 2010, Queensland Urban Utilities provides water and wastewater services to the cities and townships of Ipswich, Lockyer Valley, Scenic Rim and Somerset. More than one million Brisbane residents are also receiving these services from Queensland Urban Utilities as a division of Brisbane City Council, since November 2009. Queensland Urban Utilities also operate 46 water treatment plants and 14 groundwater bore fields. Testing in other regions of Queensland is carried out by local government or business units of City Councils, such as Citiwater in Townsville.

"In Queensland, typical water quality results for fluoride, pH, chlorine residual, alkalinity, hardness and turbidity were provided for 6 of the 22 towns selected. This information was mostly representative of towns located in the north of the State. All of these towns were reported as 100% compliant for the reported parameters. The data gaps for Queensland are due to a widespread lack of reporting, which is presently being addressed with the introduction of the Queensland Water Supply Safety and Reliability Act 2008 and recent governance reforms. The popular tourist region of Port Douglas reportedly experienced a highly publicised drinking water contamination event in September 2008. Ecoli pollution." P15 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

"Drinking water has been regulated in Queensland since the introduction of the Water Supply (Safety and Reliability) Act 2008. Under the Act drinking water providers are required to submit draft water management plans to the Office of the Water Supply Regulator. The submission of draft water management plans are now a legislated requirement for all water providers in Queensland. Previously the water quality requirements were guidelines only and drinking water providers were not mandated by law to provide a level of service to the Australian Drinking Water Guidelines. The guidelines have now been mandated in the Water Supply (Safety and Reliability) Act 2008; however the reporting requirements are to be phased in over the next 4 years as follows:

**Large supply schemes by July 2011*
**Medium supply schemes by July 2012*
**Small supply schemes by July 2013*
Regional Queensland towns will fall under the medium and small supply schemes." pA4 Review of Regional Water Quality and Security Volume 2 AECOM

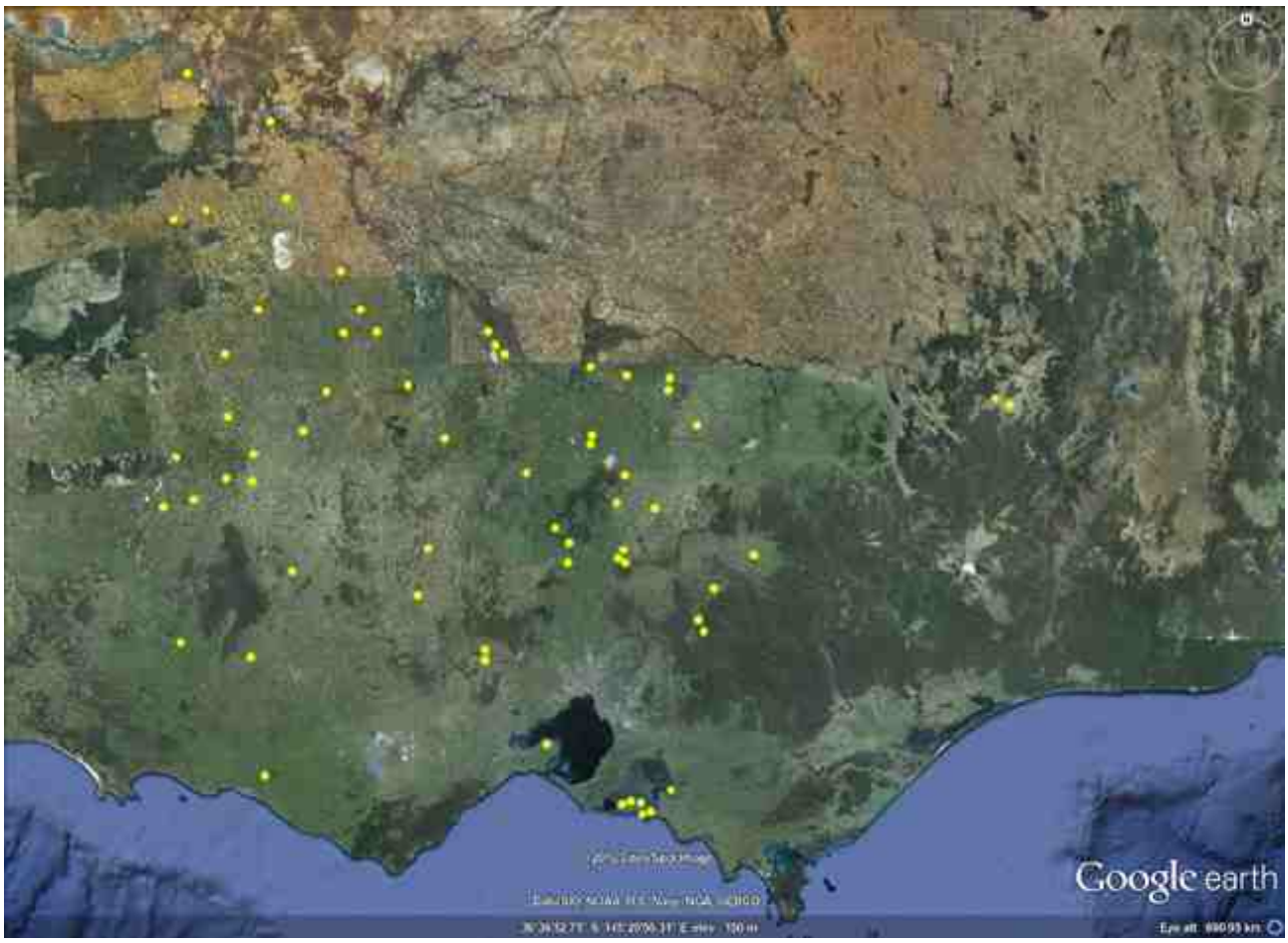
2.7 NORTHERN TERRITORY: The Department of Health and Community Services has water quality management responsibilities. The Power and Water Corporation (PWC), has the primary responsibility for providing suitable drinking water to most Northern Territory Communities. Power and Water Corporation is the sole provider of electricity, water supply and sewerage services to almost 80,000 customers across the Northern Territory – an area of more than 1.3 million square kilometres. Private water owners may also be responsible for caravan parks, school camps and tourist facilities. PWC supplies water to 20 growth towns and 52 remote communities across the Northern Territory. 61 of these communities source their water from aquifers.

*"In the Northern Territory, there are a number of urban centres where water quality does not meet the Australian Drinking Water Guidelines. While only Tennant Creek is at significant risk from microbiological contamination due to its lack of disinfection, many other centres have water that exceeds physical and chemical guidelines...While the aim of the Territory Government is to ensure that remote communities have access to high quality water, this may be difficult to achieve in the medium-term as there is a large number of small communities with aesthetic water quality problems (scale and totally dissolved solids) that will require significant infrastructure investment"*p28 Infrastructure Report Card 2010 Australia. Engineers Australia.

"DHCS set standards for drinking water quality under Water Services and Sewerage Supply Act 2001 & monitors compliance with those objectives. The minimum drinking water standards are in accordance with the ADWG (2004). The Utilities Commission regulate water supply services, which include issuing & auditing compliance against". pA16 Review of Regional Water Quality and Security Volume 2 AECOM

"Three of the seven towns selected in the Northern Territory showed non-compliance for total coliforms, indicating inadequate treatment, poor disinfection or recontamination issues. Two towns had non-compliances for E.coli, while one town had non-compliances for iodide" P17 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

2.8 AUSTRALIAN CAPITAL TERRITORY: ACT Health has water quality management responsibilities. The DWCoP specifies the technical requirements for the water supply, quality, monitoring of, and reporting on drinking water in the ACT. ACTEW provides retail water and wastewater services to residential and industrial customers in the Canberra and Queanbeyan metropolitan areas. ACTEW owns the water and wastewater assets and business in the ACT, is a 50% owner, with Singapore Power International and AGL Energy Limited, of Actew AGLand holds an 18% investment in TransACT Communications Pty Limited.



Breaches (marked with yellow dots) to Australian Drinking Water Guidelines in Victoria 2010-11 (Health Related Subtances – excluding Aluminium). 88.5% of health related breaches were from chlorine disinfection byproducts, with THM's representing 29% of all breaches. The towns of Glenthompson and Nagambie had 4 seperate breaches to the guidelines.

3. The Water Treatment Process

Most standard treatment plants in Australia would use coagulation, flocculation and sedimentation processes. Water is generally stored in storages but in some communities water is pumped and treated directly from waterways. Different treatments include: Coagulation, Clarification, Filtration, Taste Odour/Algae Toxin Removal, pH Correction, Desalination, Disinfection.

A range of substances that can be used to treat water in Australia can be found here:
http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh19b.pdf

Pre treatment of drinking water can include the use of: copper sulphate, potassium permanganate and activated carbon.

Coagulation and Floculation occurs before filtration: This process brings together particles in the raw water supply, forming floc. Coagulants such as Aluminium Sulphate and Polyelectrolytes also encourage the formation of floc. This process maximises the removal of particulates and colour later in the treatment process. Treatment of the water then removes the dosed coagulants. Substances used in this stage can include: Aluminium Sulphate (alum), Aluminium Chlorohydrate, Synthetic Organic Coagulant Polymer and Polyacrymalide (Floculant Polymer).

Filtration removes, bacteria, dirt and other materials from the water: This is the key process which removes pollutants from water which may be present in the source water. Sand filters are commonly used in Australia, and some filters also contain layers of gravel and in some cases filter coal. Coagulated water is passed through a 'floc blanket' which traps suspended particles. The floc sinks to the lower levels of the sedimentation tank and is removed off as inert slurry. The remaining water is then collected usually in a series of channels and is then passed through multimedia filters, which remove smaller particles. There are several different types of filtration processes: 1) Dissolved Air Flotation Filtration, 2) Direct Filtration, 3) Conventional Clarification/Filtration, 4) Microfiltration, 5) Reverse Osmosis.

Disinfection: The most widely used drinking water disinfectant in Australia is Chlorine. Chlorine Gas or Sodium Hypochlorite Solution are added to the water to destroy viruses or bacteria that may cause illness. Chlorine can also be added at storage tanks or pump stations along the water distribution network. Chlorine is usually maintained at levels which are below taste and odour detection levels of people, but this can change particularly in times of increased demand for water, particularly in hot weather. Disinfection Byproducts (DBP's) are created when chlorine reacts with organic molecules, such as algae. Some DBP's have been associated with cancer.

Some water supplies may also be disinfected through a process called Chloramination where ammonia is added to the water prior to the chlorine, which in turn can create Monochloramines. Sunlight does not degrade Monochloramines to the same extent as chlorine, meaning that water can be stored for longer periods of time.

Alternative forms of disinfection can include, UV irradiation (where ultraviolet light kills the cell walls of microorganisms and causes cellular death with reaction with its DNA), chlorine dioxide and ozonation.

"...the present use of disinfection products (eg chlorine) for drinking water purposes was being questioned in Europe (a myriad of potentially harmful disinfectant products have been found in drinking water) ... the use of chlorine is being replaced in Holland by extensive use of Ultra Violet processes to treat water" pers comm 18/5/11

pH Adjustment occurs to control acidity of water and to provide a neutral pH during the treatment process. This occurs to ensure that chemicals added to the water are effective and that minimal impacts occur on pipes and fittings within the water distribution network. The pH level can be adjusted at the start of the process to assist with coagulation, by adding lime and carbon dioxide or sodium carbonate. To limit final water corrosiveness, pH can be adjusted at the end of the process to ensure effective disinfection. The following substances can be added to alter pH: calcium Hydroxide (Hydrated Lime), Sodium Carbonate (Soda Ash), Sodium Hydroxide (Caustic Soda), Carbon Dioxide, Hydrochloric acid.

Fluoridation is the where a fluoride-based chemical is added to the drinking water with the goal of reducing the prevalence of dental caries (tooth decay) within the community. Fluoride is added to the water after filtration. Not all communities in Australia have a fluoridated water supply, however major cities such as Melbourne have been fluoridated since 1973. Fluoride is added to water either as fluosilicic acid (sometimes known as hydrofluosilicic acid) or sodium silicofluoride. It is sourced from superphosphate and is soluble. Naturally occurring fluoride is almost insoluble and is known as calcium fluoride.

Groundwater Supplies

44% of communities sourcing from groundwater in Australia have disinfection only. 20% have unknown treatment, 12% conventional, 4% filtration only, 4% aeration only, 4% disinfection and aeration, 12% no treatment.

3.1 Measurement:

The two most common measurements used in water monitoring in this report are Mg/L and Ug/L. A gram per litre g/L is the measurement that shows how many grams of a certain substance are present in one litre of a liquid – usually water.

Mg/L: Milligrams per litre. Parts per million. When measuring concentration in water, parts per million is an older expression of mg/L – one litre of water weighs one kilogram or one million milligrams.

Ug/L: Micrograms per litre. In the metric weight system, a microgram is a thousandth of a milligram. Since a milligram is a millionth of a kilogram, and the microgram is a thousand times smaller, it is equivalent to a billionth of a kilogram. Microgram is abbreviated ug. Thus, a part per billion of solid measure is equal to a ug/kg. Similarly, a part per billion of a solid in a liquid is equal to a ug/l. http://extoxnet.orst.edu/tibs/partperm.htm

1 part per billion equals on drop of water into 250, 200 litre drums [44 gallon] drums of water.

4. Drinking Water Testing

A range of substances are tested for by water authorities. These can be divided into Health related substances and Aesthetic related substances. Raw water can also be tested by authorities. Testing can occur at different intervals during the year. The following section is a list of the substances tested for by Victorian Water authorities. Victorian Water authorities test for the majority of these substances, with most emphasis on ecoli, chlorine disinfection byproducts (chloroacetic acid, dichloroacetic acid, trichloroacetic acid, trihalomethanes), Blue Green Algae, aluminium, turbidity, fluoride, lead, manganese, copper, colour, hardness, pH, iron etc. Substances such as pesticides may only be tested once a month in the best operating system to once a year in the worst and only for a fraction of the pesticides being used within the catchment.

4.1 Health Related Substances

4.1.1 Escherichia.coli (E.coli): E.coli is a bacterial species belonging to the Coliforms group. It is only found naturally in the digestive tract of warm blooded animals. The presence of E. coli in drinking water is indicative that faecal contamination may have occurred. Because E.coli can survive for brief periods of time outside the gut, they can be used an an indicator organism for the testing of environmental standards. The regulatory standard is that at least 98% of all samples of drinking water collected in any 12 month period contain no E.coli orgs per 100 millilitres. Sampling frequency is dependent on population and varies in each locality.

On February 18 2009, the Victorian town of Myrtleford recorded 100,000orgs/100ml.

In North East Tasmania, 16 communities are on permanent 'Boil Water Notices'. The township of Lilydale had a 0% performance rate in 2009/10 (11% in 2010/11).

"Recent examples include the apparent viral outbreak (presumed sewage-contaminated supply) affecting some thousands of individuals at Sunbury in Victoria" Drinking Water Quality Australia: State of the Environment Technical Paper Series (Inland Waters) 1997.

"In New South Wales, contamination by E.coli and Lead were the most significant health-related non-compliances recorded (Table 4). The incidences of Total Coliform contamination may indicate an inability to maintain a chlorine residual, inadequate treatment, or potential re-contamination of treated water supplies. During 2007-08, 22 "boil water" alerts were issued in NSW over the 25 months to June 2008 (Armstrong and Gellatly 2008). Boil water alerts indicate a suspected or confirmed microbial contamination. The popular ski holiday destinations of Jindabyne and Smiggin Holes experienced a highly publicised microbial contamination incident in 2009. Approximately 120 guests became ill as a direct result of contaminated drinking water at Smiggin Holes, while a sewer overflow into Jindabyne's drinking water supply went un-detected for three days". P15 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

4.1.2 Other Pathogens

Blue Green Algae: *"Four groups of cyanotoxins are described by the ADWG; Cylindrospermopsum, Microcystins, Nodularin and Saxitoxins. The potential health impacts of cyanotoxins include injury to the lining of the gastrointestinal tract and blood vessels, liver and kidney damage, haemorrhage and death. The cyanotoxin Cylindrospermopsum is believed to be the causative agent in the Palm Island "mystery disease" poisoning incident in Queensland in 1979, in which 149 people were hospitalised, and recent cattle deaths in Queensland have been attributed to this toxin. In 2000, a cyanotoxin contamination event occurred on the Yorke Peninsula in South Australia in April 2000. Bottled water was supplied to customers for drinking and cooking, and carted water was provided to hospitals and nursing homes."* p12 Infrastructure Report Card 2010 Australia. Engineers Australia.

More information on the Palm Island Mystery disease can be found here:
http://en.wikipedia.org/wiki/Palm_Island_mystery_disease

Cyanobacteria 18,695mg/L (Planktolyngbya subtili) recorded at Simpson (Wannon Water 2005/6)

Total Coliforms 2400orgs/100mL (not ecoli) Marysville (Goulburn Valley Water 2001/2)

According to East Gippsland Water: *"Department of Health must be notified under Section 22 of the Safe Drinking*

Water Act if any of the following are true. Total microcystins are detected at less than or equal to 1.3 micrograms per litre, Microcystis aeruginosa is present at less than or equal to 5000 cells permillilitre, total combined biovolume of known toxic cyanobacterial species less than or equal to 0.4 millimetres cubed per litre and total combined biovolume of all cyanobacterial species is less than or equal to 10 millimetres cubed per litre. The Department of Health must also be notified if Blue-green algae are present at levels that may cause widespread public complaint." East Gippsland Water 2010 Annual Drinking Water Quality Report.

Blue Green Algae presented problems for authorities in the grip of drought in the Murray Darling Basin in 2010. *"An extensive blue green algal bloom again occurred in the Murray River during the period late February 2010 in the southern area of LMW operations until early April 2010, in the northern area of operations. This followed on from the extensive bloom experienced in the months of March and May 2009. During the 2010 bloom, elevated blue green algae cell number counts were experienced at all of the Corporation's southern area water treatment plants, except for the Murrabit WTP. The plants affected included the Koondrook, Kerang, Swan Hill and Piangil treatment plants, necessitating the dosing of powdered activated carbon into the raw water supply of each plant. In mid March 2010 through to early April 2010 a bloom also affected the northern area water treatment plants, including the Robinvale, Red Cliffs, Mildura and Mildura West plants. Powdered activated carbon dosing was utilised at these plants during the bloom to address the presence of taste and odours and potentially, toxins in the water Toxin analysis was also undertaken at the height of the bloom, at the Mildura site, with both the raw and treated water samples returning a negative result."* Lower Murray Water 2010 Annual Drinking Water Quality Report.

"A. circinalis (a type of saxitoxin) is the most common organism in riverine blooms in the Murray-Darling Basin. The most publicised bloom of A. circinalis occurred in late 1991 and extended across more than 1000 km of the Darling-Barwon River system in New South Wales. A state of emergency was declared, with a focus on providing safe drinking water to towns, communities and landholders." p13 Infrastructure Report Card 2010 Australia. Engineers Australia.

"The concept of multiple barriers for water treatment is the cornerstone of safe drinking-water production. The barriers are selected so that the removal capabilities of different steps in the treatment process are duplicated. This approach provides sufficient backup to allow continuous operation in the face of normal fluctuations in performance. Having multiple barriers means that a failure of one barrier can be compensated for by effective operation of the remaining barriers, minimising the likelihood that contaminants will pass through the treatment system and harm consumers (WHO 2004). Pathogen treatment is approached in two ways: removal processes and/or inactivation (disinfection) processes. These processes form part of an over-arching "multiple-barrier" treatment strategy that ensures water source protection (using water of the highest initial quality possible), followed by appropriate pathogen removal, subsequent disinfection and final contamination protection strategies for the water distribution system (Bennet 2008). Pathogen monitoring is conducted on raw water sources and based on the risk profile of these raw water sources where, for example, cattle and dairy activities occur." North East Water Annual Water Quality Report 2010.

Cryptosporidium

Crytosporidium is a protozoan that can cause gastro-intestinal illnesses [diarrhoea] in humans. Children and people with compromised immune function can be most at risk from Crytosporidium. Cryptosporidium is highly resistant to chlorine treatment and is regarded by many water authorities as the greatest risk to water quality.

"One emerging water supply issue of concern is the growing awareness that previously undetectable organisms, including enteric viruses and Cryptosporidium parvum, may be present even in fully treated supplies".
http://www.environment.gov.au/soe/1996/publications/technical/pubs/drinking.pdf

"The biggest outbreak of cryptosporidiosis in Australia was the contamination of the Sydney drinking water supply in July-September 1998. Smaller outbreaks have been related to swimming pools in Queensland, ACT, Victoria and NSW." http://iceh.uws.edu.au/fact_sheets/FS_crypto.html

Upper Canal near Austral – about 40 south west of Sydney CBD

Sydney's Water Contamination Issues Haven't Gone Away (June 4 2010)
[1000 cases cryptosporidiosis were confirmed in 1998]
"...A review of water quality management, which has just been published, says there is an urgent need for action on the 120-year-old canal which carries one quarter of the water going into Sydney's main water treatment plant....The review has found the Upper Canal is deteriorating rapidly. Apart from posing a major risk to the purity of Sydney's raw water supply it is in danger of failing...The Upper Canal is a great piece of engineering but it was built in 1888. It runs over 60 kilometres from south of Sydney delivering water entirely by gravity from the Avon, Cataract Cordeaux and Nepean dams. It traverses what was bushland and farmland, in the fast developing south-west sector. Neighbours to the canal now include Campbelltown and Camden as well as many on-site sewage treatment plants and feedlots. The Government was warned as far back as 1998 that the Upper Canal was a contamination risk, which would worsen with urban development. The trigger for the warning was three 'boil water alerts' issued to several million Sydneysiders that year. Tap-water was deemed unsafe to drink because of the presence of a parasite called cryptosporidium, which can cause severe illnesses. In his report on the crisis, Peter McClellan QC, found that cryptosporidium had found its way from Sydney's catchment into the uncovered Upper Canal and the raw water supply after heavy rains. Potential sources included poorly treated sewage in the water catchment areas, animal droppings from farming and bushland as well as run-off from urban encroachments...In the last decade there have been 400 detections of bacteria or turbidity in the Upper Canal - despite a decade of extreme drought which has reduced runoff. The O'Keefe report says that when rains did increase so did detection of bacteria." http://www.abc.net.au/news/stories/2010/06/04/2918559.htm

Parasites in Canal, But Water Is Safe To Drink (June 29 2007)
"LOW levels of dangerous giardia and cryptosporidium parasites have been found in the Upper Canal of Sydney's water supply feeding Prospect Reservoir, health officials have confirmed...The parasites are believed to have been

washed into the canal after the heavy rainfall over the past two weeks. Giardia can cause intestinal illnesses...Mr Koperberg said the canal had been drained for maintenance for three weeks and the contaminants had been discovered during testing after it was replenished. They were contained to untreated water only and were successfully removed during filtration, he said" http://www.smh.com.au/news/national/parasites-in-canal-but-water-is-safe-to-drink/2007/06/28/1182624083319.html

"...The Atrazine contamination follows the shutdown of Hope Valley Reservoir after the parasite giardia was discovered - and the discovery of cryptosporadium in Myponga Reservoir on August 31. EPA evaluation branch manager said because Atrazine was a potent herbicide with a long life, the waterway would be contaminated for another year." The Advertiser (Adelaide) September 17, 1998 p3

Households warned to boil drinking water.
"A DIARRHOEA inducing parasite found in the faeces of sick animals has been detected in southern Cairns' water supply, prompting warnings for thousands of residents to boil their water before drinking it. An urgent notice issued by Cairns Regional Council last night advises residents between Fishery Falls and Yarrabah Rd – an estimated 1200-1500 homes including Gordonvale and Goldsborough Valley – to boil tap water before drinking it. The cryptosporidium parasite – which can also cause nausea and headaches – is resistant to chlorine used to disinfect the water supply from Behana Creek. It is one of two parasites behind the highly publicised 1998 Sydney water crisis."
http://www.cairns.com.au/article/2010/05/17/109905_local-news.html

"Cryptosporidiosis is a notifiable condition in all Australian states and territories. A case-control study of sporadic cases in Adelaide and Melbourne from 1998 to 2001 indicated that person-to-person contact and public swimming pools were the most common risk factors for infection (Robertson et al 2002). Outbreaks associated with contaminated swimming pools have occurred in several Australian states. In South Australia, a relatively large number of illnesses were recorded in 1990-91 but no source was identified (Weinstein et al 1993). The only known outbreak of illness associated with drinking water occurred in Victoria, when a mixture of infections due to Cryptosporidium and Giardia followed contamination of a private water supply by overflow from a septic tank (Lester 1992)". (Fact Sheet Cryptosporidium ADWG 2011).

No chances taken with safety – boil water alert for Meeniyan water supply June 20 2012

http://www.foster.vic.au/no-chances-taken-with-safety-boil-water-alert-for-meeniyan-water-supply/

ON Friday June 15, South Gippsland Water issued a Boil Water Alert for the township of Meeniyan. The Corporation received results from a water sample taken from the Meeniyan Water Supply System that returned a low level reading for Cryptosporidium (which is a type of protozoa, a microorganism parasite). The Meeniyan township was immediately issued with an alert, and systems activated to ensure the community was informed.
Further testing has been carried out over the weekend and South Gippsland Water is waiting to receive notification of the all clear from the Department of Health before the Boil Water Alert will be lifted...
The testing that detected the Cryptosporidium was a proactive test conducted over and above South Gippsland Water's testing requirements. The Corporation voluntarily elects to test for this microorganism and does this testing at times when the risks and likelihood of detecting it are at their highest. Due to the recent flood conditions along the Tarwin River which is the source for the Meeniyan water supply, South Gippsland Water elected to conduct extra testing for organisims such as Cryptosporidium during last week... Once a form of contamination was detected South Gippsland Water notified all businesses and homes in the area..."

In Victoria between 2007-10, Cryptosporadium was detected at; Tawonga – North East Water, Myrtleford – North East Water, Red Cliffs – Lower Murray Water with a Giardia cyst detected in 2009 at Moonee Ponds – City West Water.

Other Microorganisms

The bacteria Mycobacterium abscessus has been detected in Brisbane's water supply and is resistent to chlorine.
"Mycobacterium abscessus, ... is very resistant to antibiotics, we have found in the water supply and we have linked it to patients through their homes, and this is a fairly important finding because this infection I think it is increasing. We are seeing more of it and it is very difficult to treat, and in previous studies no one has really found a lot of it in the water supply... In Queensland, there are probably 300 new cases of mycobacterial lung disease every year. You have to be susceptible to it and this can mean people whose immune system's not working well; or tall, thin middle aged or elderly women; men with a history of smoking and lung disease, and people with cystic fibrosis."
http://www.abc.net.au/rn/backgroundbriefing/stories/2011/3272878.htm#transcript

The 2011 Australian Drinking Water Guidelines has a host of information pertaining to micro-organisms including; Microbial Indicators, Bacteria, Protozoa, Cyanobacteria and their toxins and viruses. Some of the recorded incidents of micro-organisms polluting Australian drinking water include;

"Legionella spp have been found in cooling tower waters in many parts of Australia. However, very few Legionella organisms have been isolated from drinking waters". (Fact Sheet Legionalla ADWG 2011).

"Water was a possible source of M. kansasii infection in Portland, Victoria (Huang et al 1991) and infections were linked to spa pools in Adelaide (Lumb et al 2004)". (Fact Sheet Mycobacterium ADWG 2011).

"The prevalence of notified cases of Yersinia infection varies between states. There has been a marked increase in the number of cases recorded in South Australia in recent years". (Fact Sheet Yersinia ADWG 2011).

"Amoebic keratitis has been recorded in New South Wales, Queensland, South Australia, Victoria and Western Australia (e.g. Roussel et al 1985). Currently, four cases of GAE have been diagnosed in Australia (Victoria and Western Australia, e.g. Harwood et al 1988)". (Fact Sheet Acanthamoeba ADWG 2011).

"The most publicised incident of drinking-water contamination in Australia occurred from July to September 1998 in Sydney. High numbers of Cryptosporidium (see Fact Sheet) and Giardia were reported for treated water, and boil-water notices were issued for three million residents. No increase in illness was detected in association with the contamination despite increased epidemiological surveillance. An epidemiological study in Queensland showed no correlation between infection and source of drinking water, point-of-use treatment (boiling or filtration) or recreational contact with water (Boreham and Phillips 1986). Another study identified contact with septic tank waste or contaminated soil as a possible mechanism of infection (Boreham et al 1981). An outbreak of illness associated with drinking water was reported in Victoria when mixed infections due to Cryptosporidium and Giardia followed contamination of a private water supply by overflow from a septic tank (Lester 1992)". (Fact Sheet Giardia ADWG 2011).

"PAM (primary amoebic meningoencephalitis) cases have been recorded from South Australia, Western Australia, Queensland and New South Wales; Naegleria fowleri has been detected in water in each of these states and in the Northern Territory. Australia is the only country where N. fowleri has been detected in public water supplies (Dorsch et al1983). Most of the available data on the density of N. fowleri in water relates to water supplies in South Australia (including the highest reported densities). In temperate Australia, significant seasonal cycles of density occur, from below one organism per litre to hundreds or thousands per litre in poorly disinfected water (Robinson and Christy 1984)". (Fact Sheet Naegleria fowleri ADWG 2011).

"Cylindrospermopsin is believed to have been the causative agent in the Palm Island "mystery disease" poisoning incident in Queensland in 1979, in which 148 people were hospitalised (Byth 1980). It was subsequently shown that water from Solomon Dam on Palm Island contained blooms of toxic C. raciborskii (Hawkins et al 1985). C. raciborskii has been found in many water supply reservoirs in northern, central and southern Queensland. Although C. raciborskii and A. ovalisporum are both considered to be predominantly tropical/sub-tropical in terms of habitat, with most Australian blooms occurring in Queensland, C. raciborskii also occurs in the Murray-Darling River system (Baker and Humpage 1994). In recent years there has been increasing evidence of detection in the River Murray and C. raciborskii was detected in the major blooms that affected several hundred kilometres of the River Murray on the border between New South Wales and Victoria in 2009 and 2010 (NSW Office of Water 2009, MDBA 2010). C. raciborskii is not a scum-forming organism, but forms dense bands below the water surface in stratified lakes, while A. ovalisporum may form thick brown surface scums (Shaw et al 1999). Although no reports of human poisoning attributable to cylindrospermopsin have appeared since the Palm Island incident, recent cattle deaths in Queensland are attributed to this toxin (Saker et al 1999)". (Fact Sheet Cylindrospermopsin ADWG 2011).

"Blooms of A. circinalis (D. circinalis) have been recorded in many rivers, lakes, reservoirs and dams throughout Australia, and A. circinalis (D. circinalis) is the most common organism in riverine blooms in the Murray-Darling Basin (Baker and Humpage 1994). In temperate parts of Australia blooms typically occur from late spring to early autumn. The first reported neurotoxic bloom of A. circinalis (D. circinalis) in Australia occurred in 1972 (May and McBarron 1973). The most publicised blooms occurred in the Murray-Darling System in 1991, 2009 and 2010 (NSWBGATF 1992, NSW Office of Water 2009, MDBA 2010). The first bloom extended over 1,000 kilometres of the Darling-Barwon River system in New South Wales (NSWBGATF 1992). A state of emergency was declared, with a focus on providing safe drinking water to towns, communities and landholders. Stock deaths were associated with the

occurrence of the bloom but there was little evidence of human health impacts. The blooms in 2009 and 2010 affected several hundred kilometres of the River Murray on the border between NSW and Victoria and included Anabaena, Microcystis and Cylindrospermopsin. Alerts were issued about risks to recreational use, primary contact by domestic users, livestock and domestic animals. A bloom of A. circinalis (D.circinalis) in a dam in New South Wales was shown to have caused sheep deaths (Negri et al 1995). Relatively low numbers of A. circinalis (D. circinalis) (below 2,000 cells/mL) can produce offensive tastes and odours in drinking water due to the production of odorous compounds such as geosmin". (Fact Sheet Saxitoxins ADWG 2011).

There are about 300-500 cases of Hepatitis A and 10-30 cases of Hepatitis E recorded in Australia each *year. There is little information on the occurrence of Hepatitis A or E in Australian drinking water supplies. There have been outbreaks of Hepatitis A in Australia. In 1997, 422 illnesses were caused through consumption of oysters grown in contaminated water at Wallis Lake (Kardamanidis et al 2009)".* (Fact Sheet Hepatitus Viruses ADWG 2011). Wallis Lake is located on the NSW Central Coast.

"Due to the ongoing algal bloom in the Macalister River System (February 2005 – onwards), potable water supplies for Coongulla/Glenmaggie and Maffra were reported to experience earthy and /or musty odours. These odours are caused by the microbial metabolites of Geosmin, and 2-methlyisoborneol (MIB). These compounds can cause concern to the customer as they have extremely low threshold concentrations and can persist through conventional water treatment process. Threshold concentrations for Geosmin and MIB are approximately 4 and 9 ng/L respectively. These compounds are generally removed by an additional process of activated carbon treatment at the water treatment. Extra monitoring was performed to determine the total number and type of algae present in the raw water, as well as the levels of the taste and odour compounds to determine the level of risk to the water supply." (Gippsland Water Water Quality Report 2006/7)

"... 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." "*Power and Water Water Quality Report 2006 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."*

4.1.3 Recycled Water

There has been much debate in Australia regarding the pros and cons of consuming recycled drinking water. On one hand the argument is made that on the driest continent on earth people should consume recycled water as a means of reducing pressure on precious water resources. Countries such as Singapore and Israel already drink recycled water with no observable problems, and many communities already consume 'recycled' water because they live downstream of other communities whose treated effluent may be released into rivers and streams upstream. On the other hand are those who argue that there are many unknowns, including scientists investigating pathogens and chemicals in water that may be having a harmful effect on the health of consumers.

The most famous campaign opposing drinking recycled water was probably in Toowoomba, Queensland.
http://www.toowoombawater.com.au/

The Academy of Science had another perspective 'Making Every Drop Count" http://www.science.org.au/nova/095/095key.html

Some recent published articles also shed further light on the complexities behind this issue.

Water Plan 'a Health Gamble' (The West Australian May 28 2011)

"An Internationally recognised cancer expert has likened WA plans to recycle sewage water for drinking to "playing russian roulette" with public safety. US scientist Steven Oppenheimer, director of cancer and development biology at California Northbridge University, said "toilet to tap" water posed an inherent public health risk and should be used only as a last resort. He said there were too many unknown chemicals and pathogens for the process to be foolproof... Australian National University microbiologist Peter Collignon said yesterday that current testing standards in Australia could not account for all the potential harmful agents in sewage. He cited a National Water Commission report, released this week, to argue there were shortfalls in the arrangements safeguarding public water supplies. The report warned of "emerging contaminants" in alterative supplies, including recycled effluent but found "there are outward signs that the broader regulation of urban water quality in Australia is not equivalent to best practice. To me, the fundamental issue is you only do it if you really don't have any other viable option, which for most other areas in Australia is not true," Professor Collignon said. "But if you do (have to) do it because you don't have any other choices, then I think it's really important that you do lots of tests, including those for viruses and in general they are not done very well very often..."

Risk of Contamination from 'new wave' water The Australian May 26 2011

"New water sources – including recycling schemes, rainwater harvesting and tapping dishwashers and sinks – pose a looming risk to safe supplies in Australian towns and cities. In a report obtained by The Australian, the National Water Commission urges governments to overhaul the arrangements for safeguarding urban water quality because the existing systems for doing so are coming under strain ... According to the report, new chemical and biological contaminants are "continually materialising as our scientific understanding and capability grows". Under the plan, scientific advisory commissions would also be set up under the new unit; a new legally binding national water quality risk management framework would be developed, based on existing guidelines for drinking water and recycling. While the National Health and Medical Research Council publishes the Australian Drinking Water Guidelines, these are not mandatory. According to claims cited in the report, these guidelines are based "almost entirely on the input of one key person in particular, without whom the guideline development process would probably collapse completely...According to Sydney Water, by 2015, the city will be recycling 70 billion litres of water a year – up to 12 per cent of Sydney's water needs..."

Risk of contamination from 'new wave' water The Australian May 25 2011
NEW water sources - including recycling schemes, rainwater harvesting and tapping dishwashers and sinks - pose a looming risk to safe supplies in Australian towns and cities.
In a report obtained by The Australian, the National Water Commission urges governments to overhaul the arrangements for safeguarding urban water quality because the existing systems for doing so are coming under strain. The report, to be released today, warns there are "emerging contaminants" from alternative water supply options that include "sewer mining" - where wastewater is treated then used in irrigation - water recycling, stormwater harvesting and the reuse of household wastewater from baths and laundry.
The report by PricewaterhouseCoopers for the commission also cites claims that national guidelines for managing water quality are based on a process that "entirely plagiarises" work from volunteers.

Not only had some regional utilities in NSW been forced to issue "boil-water alerts", there were also instances where recycled water was cross-connected with drinking water pipes in Sydney and Melbourne.
In 2005, a recycled water cross-connection was discovered in two houses in the northwestern suburb of Newington after a customer complained to Sydney Water about the taste of the drinking water.
In 2007, recycled water was supplied inadvertently for 19 days to a kitchen at Melbourne Water's Eastern Treatment Plant, leaving 22 people suffering upset stomachs, nausea and headaches.
Overall, the safety of the nation's drinking water remains high and there had been improvements in managing sewer overflows, the report finds.

While the National Health and Medical Research Council publishes the Australian Drinking Water Guidelines, these are not mandatory...
National Water Commissioner Chris Davis said that Australia had an "enviable record" in protecting public health and safety, but the report showed that more diversified water sources was presenting new challenges to the way water quality was regulated and managed... According to Sydney Water, by 2015, the city will be recycling 70 billion litres of water a year - up to 12 per cent of Sydney's water needs. By last year, more than 44 billion litres of recycled water was used in Sydney and Illawarra. http://www.theaustralian.com.au/national-affairs/risk-of-contamination-from-new-wave-water/story-fn59niix-1226063026759

Benzothiazoles, Benzenediamines, Dicyclohexyliamine and Benzotriazoles

An Occurrence Survey of Benzotriazoles and Benzothiazoles in an Australian Metropolitan Area
C. Loi, K. Linge, F. Busetti, C. Joll, J. Charrois Curtin Water Quality Research Centre, Curtin University, Kent Street Bentley, Perth WA 6102, Australia For more information please contact: c.loi@curtin.edu.au

"An Occurrence Survey of Benzotriazoles and Benzothiazol in an Australian Metropolitan Area" 4/2011 prepared by Curtin Water Quality Research Centre are the first to initiate a survey to measure levels of these compounds in the Australia Metropolitan Area water ways. *"Benzotriazoles (BTs) and benzothiazoles (BThs) have been found to persist through conventional wastewater treatment, and hence, have been detected in primary and secondary wastewaters and paper claims that Reverse Osmosis process [in Australia] was unable to completely remove these compounds (BT's/BThs) from WWTP's. and are highly soluble in water. BT's and BThs are widely used in industrial and household products, e.g. as corrosion inhibitors (in dishwashing detergents; brake fluids, etc.), vulcanisation inhibitors, and fungicides. In 2004-2005, Australia imported between 300-400 tonnes of BThs and up to 100 tonnes of BTs. Surveys of these compounds in Europe and the US have found concentrations between 0.01 µg L-1 (in drinking water samples) and 100 µg L-1 (in primary wastewater samples) [4,1]. No comparable data exists for the occurrence and concentrations of BTs and BThs in Australian waters. ..*

Implications for Water Industry . Currently, there are no drinking or recycled water guidelines for BTs and BThs in Australia. Therefore, results from this project will provide insights for Australian water utilities and managers into the occurrence and concentrations of these micropollutants in different water types. Analysing BTs and BThs at a variety of sites, including those known to be impacted by industrial activities, may also enable source identification and preliminary environmental risk assessments. Results from this project will also provide information on the removal efficiencies of the wastewater treatment plants surveyed, which will be of benefit to water utilities and for water authorities considering monitoring indicator compounds representing industrial and/or household chemicals .

4.2 Chlorine Based Chemicals:

Chlorine was initially added to drinking water as a means of killing disease causing bacteria including cholera which was responsible for the deaths of millions of people. Its use as a water disinfectant was *'perfected'* in the United States in the 1930's. However chlorine does have its own 'problems', such as those related to Disinfection By-Products (DBP's).

Chlorine (Free) ADWG Guideline: 5mg/L (Chlorine in chloraminated supplies 4.1mg/L). Chlorine dissociates in water to form free chlorine, which consists of aqueous molecular chlorine, hypochlorous acid and hypochlorite ion. Chlorine (Total) ADWG Guideline 5mg/L (chloraminated supplies 4.1mg/L): The term total chlorine refers to the sum of free chlorine and combined chlorine present in a sample

Highest SA Water Chlorine Free Levels 2000-12: 31/10/00 Port Pirie 23mg/L, 8/1/01 Angaston 22mg/L.
Highest SA Water Chlorine Total Levels 2000-12: 7/6/00 Meningie 7.8mg/L.

There have been over 600 DBP's identified and some have been linked with cancers, adverse birth outcomes and some birth defects. If detected, water authorities need to conduct regular air scouring, flushing of the reticulation system and powder activated carbon dosing. THM's can be present in water as a result of chlorination and to a lesser extent chloramination. Regulated THM's include trichloromethane, bromodichloromethane, dibromochloromethane and bromoform. Total THM's refer to the sum of these four compounds.

In the United States, the EPA limits the total concentration of the four chief constituents (chloroform, bromoform, bromodichloromethane, and dibromodichloromethane), referred to as total trihalomethanes (TTHM), to 80 parts per million in treated water. In Australian the limit is 250 parts per billion.

Haloacetic acids (HAA's) are also DBP's. 15 HAA's can be formed in the presence of chlorine, bromide and iodide. The most common HAA's are dichloroacetic acid and trichloroacetic acid. (Other HAA's include: bromochloroacetic acid, dibromoacetic acid, monochloroacetic acid, monobromoacetic acid.

Other DBP's can include: haloacetonitriles, halogenated furanones, halonitromethanes, cyanogen halides, haloketones, haloaldehydes, halogenated phenols.

N-Nitrosodimethylamine (NDMA) can be created through water treatment via cholorination or chloramination or organic nitrogen containing waste water. NDMA is highly toxic and a suspected carcinogen. It was widely discovered in groundwater in California in the late 1970's as a by-product unsymmetrical dimethylhydrazine (UDMH), which is a component of rocket fuel that requires NDMA for its synthesis. Eight other nitrosamines of interest in drinking and recycled water are: N-nitrosodiethylamine (MDEA) , N-nitrosodi-n-propylamine (NDPA) , N-nitrosodi-n-butylamine (NDBA) , N-nitrosomethylethylamine (NMEA) , N-nitrosomorpholine (Nmor) , N-nitrosopiperidine (Npip), N-nitrosopyrrolidine (NPyr) and N-nitrosodiphenylamine ((NDPha) . The Highest NDMA levels recorded in South Australia 2007-12 were at Keith 140ng/L 17/11/10 and Lower Lakes 130ng/L 24/2/10 and 17/11/10.

"More recently, rubber components such as valves and joiners/0-rings that are used in treatment plant pumps and in distribution systems have been found to leach significant levels of nitrosamines into the water supply (Morran et al., 2011). .. In Australia, chloramination is widely practiced and in South Australia the South Australian Water Corporation implemented a routine monitoring program for NDMA in four systems in 2007. From these results it is clear that the levels in the distribution system vary considerably with time, indicating a seasonal influence due to variations in detention time controlled by demand. There was also evidence of a strong influence of water quality during a period of high flow, colour and turbidity in the river feeding the treatment plants. However, the average concentration of NDMA of more than 750 samples analysed from 2007 to present was low, < 20ng/L. Knight et at. (2011) recently reported nitrosamine data from five drinking water treatment plants in South-East Queensland. Three of these plants practice chloramination, one uses chlorination, and the other a combination of ozone and chlorine for disinfection. " Source: NDMA ATTRACTING INTERNATIONAL ATTENTION The latest news on nitrosamines G Newcombe, J Morran, J Culbert

DBP Testing

Mandatory testing in Victoria is carried out by water authorities for the following Disinfection By-Products (DBP's). Chloroacetic Acid, Dichloracetic Acid, Trichloroacetic Acid & Trihalomethanes (THM's). Testing most likely does not regularly occur in other states. Problems reported by water authorities in Victoria are most likely also occurring in other states, but are either not properly monitored or reported.

Friends of the Earth is also disappointed that the Australian Drinking Water Guidelines, do not have guidelines for individual trihalomethanes, but rather only have guidelines for the sum of four trihalomethanes. This allows for a downgrade of the significance of individual THM compounds such as Bromodichloromethane, whose individual sample readings can effectively be *'swept under the carpet'* or *'watered down'* statistically.

"Six of the 18 towns sampled in Victoria had issues with THM formation. Other disinfection byproducts such as Dichloroacetic acid and Trichloroacetic acid were detected. The detection of these contaminants in Victoria and not in other States may be attributed to the fact that Victoria generally undertakes more rigorous testing. It is possible that improved monitoring and testing practices in other States would produce similar results. Water supplies to five of the 18 selected towns in Victoria were affected by algal blooms in the 2007-08 reporting period, while three of the selected towns issued "boil water" notices." P15 Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

The highest readings for DBP's in Victoria (2005-11) have been:

Trihalomethanes: 0.970mg/L Balmoral - Wannon Water 2007/8 (Regulatory Standard = 0.250mg/L)
Dichloracetic Acid: 0.330mg/L Lalbert – Grampians Wimmera Mallee Water 2010/11 (Regulatory Standard = 0.1mg/L)
Trichloracetic Acid: 0.860mg/L Manangatang - Grampians Wimmera Mallee Water 2010/11 (Regulatory Standard = 0.1mg/L)
Bromodichloromethane: 0.092mg/L Cowes - Westernport Water 2010/11
Trichloroacetaldehyde (chloral hydrate): 0.065mg/L Pyalong - Goulburn Valley Water 2010/11

In Victoria 2007-11:

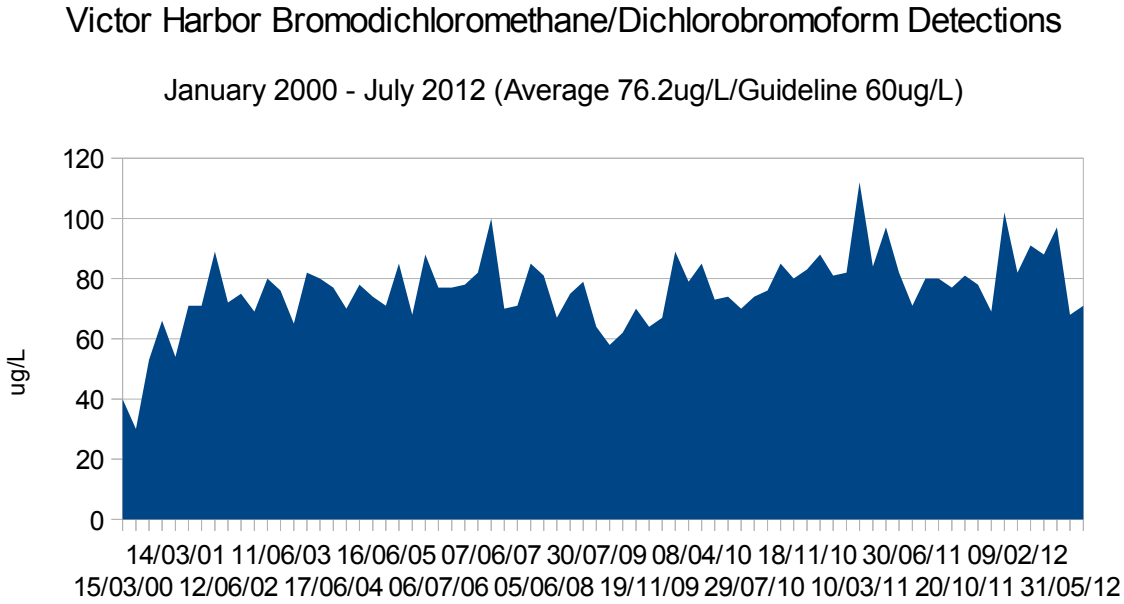
THM breaches to the Australian Drinking Water Guideline (ADWG): >128 towns
Trichloroacetic Acid breaches to ADWG: >51 towns
Dichloracetic Acid breaches to the ADWG: >18 towns
Trichloroacetaldehyde * (chloral hydrate): >35 towns

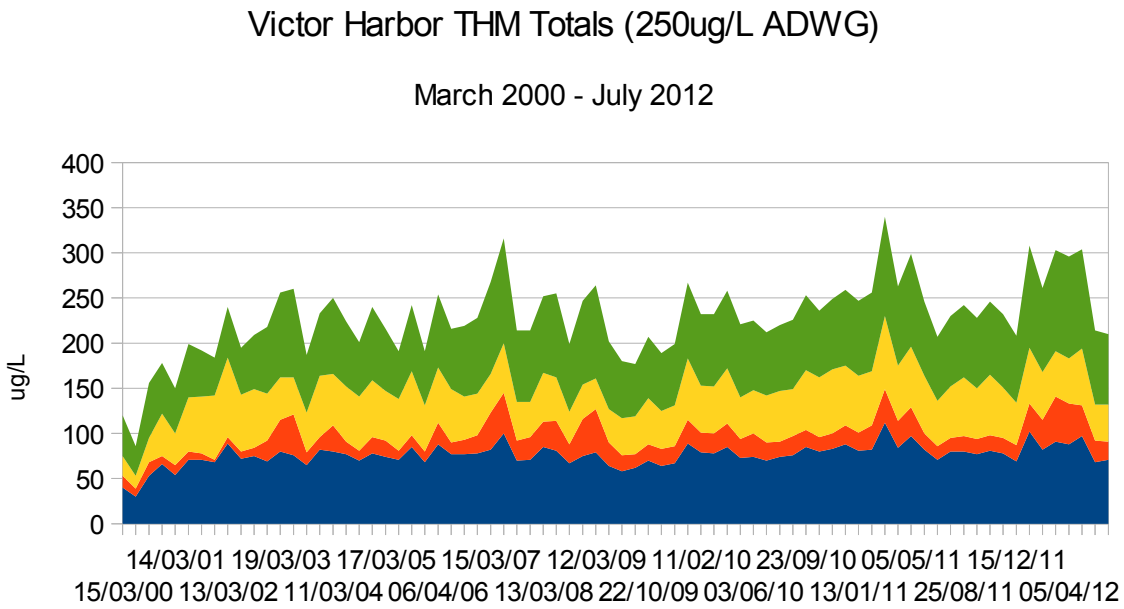
In Tasmania 2009-11:

Chloroform breaches to the Australian Drinking Water Guidelines (ADWG): 12 (all at Colebrook Southern Water – highest 550mg/L)
Total THM breaches to Australian Drinking Water Guidelines: 14 (all at Colebrook Southern Water – highest 0.570mg/L)
Dichloroacetic Acid breaches to ADWG: 9 (Hamilton 4, Ouse 4, Wayatinah 1 – highest Ouse 0.222mg/L)
Trichloroacetic Acid breaches to ADWG: 37 (Colebrook 7, Hamilton 8, Ouse 14, Wayatinah 8 – highest Colebrook 0.344mg/L)

In October 2012, Friends of the Earth produced a detailed report focussing on SAWater breaches to the Australian Drinking Water Guidelines. The report can be found at: http://www.foe.org.au/sites/default/files/SAWater2012a_0.pdf

The South Australian report found over 4000 breaches to both the Australian Drinking Water Guidelines and World Health Organisation Drinking Watre Guidelines. The substance of most concern was a THM known as Bromodichlormethane or Dichlorbromoform, with 2300 detections above WHO Guidelines. The report also detailed that for some communities, levels of Bromodichlormethane were above safe drinking water levels for the best part of a decade. The graph below shows levels of Bromodichlormethane for the past 12 years at the town of Victor Harbor. Bromodichloromethane/Dichlorobromoform detections at Victor Harbor averaged 76.2 ug/L over the 12 year period, meaning that this community was drinking this substance at an average of 27% above safe levels as determined by the World Health Organisation for the best part of a decade (see below). 60Ug/L is regarded as the safe drinking water level.





Blue = Bromodichloromethane
Red = Bromoform
Yellow = Chloroform
Green = Dibromochloroform

Average Trihalomethane (THM) totals 2000-2012 for Victor Harbor were 228.3ug/L. Although the 12 year average for Bromodichloromethane (marked in blue in graph) exceeded World Health Organisation Standards over a 12 year period by on average 27% a year, THM's overall were 8.7% under Australian Drinking Water Guidelines averaged out over the same period of time. Under the ADWG therefore, high detections of one of these chemicals can in effect be 'diluted' in the sum of the four.

In South Australia January 2000 – July 2012:

Highest THM's: Wudinna 1064ug/L 20/2/01, Ceduna 996ug/L 19/2/01, Ceduna 994ug/L 19/3/01.

Highest Bromodichloromethane/Dichlorbromoform levels: Kingscote 138ug/L 20/3/00, Swan Reach 131ug/L 11/1/01, 29/12/09 Port Wakefield 125ug/L.

Highest Bromoform levels: Ceduna 818ug/L 19/2/01, Wudinna 812ug/L 20/2/01, Ceduna 781ug/L 19/3/01.

Highest Chloroform levels: Paringa 390ug/L 18/1/11, Cooltong 372 ug/L 16/2/11, Cooltong 351ug/L 13/3/12.

Highest Dibromochloromethane/Dibromochloroform: Brownlow 175ug/L 21/2/11, Brownlow 156ug/L 7/3/11, Emu Bay 148ug/L 14/2/11.

Dichloroacetic Acid breaches (2): Highest reading Balaklava 106ug/L 18/6/01.

Trichloroacetic Acid breaches (1): Highest reading Mannum 116ug/L 17/5/12.

In Western Australia 2002-11:

27 THM readings above 0.250mg/L. Highest readings Ballingup 0.417mg/L (2002/3), Brookton 0.361mg/L (2003/4), Pingelly 0.341mg/L (2003/4).

ADWG Guideline Levels For Chlorine Disinfection By-Products

Chloroacetic acid: 0.15 mg/L
Dichloroacetic acid: 0.1 mg/L
Trichloroacetic acid: 0.1 mg/L

Trihalomethanes (THMs): 0.25mg/L THM's refer to a compound (due to chlorination) found in water and consist of a suite of 4 compounds: bromoform, dibromochloromethane (DBCM), chloroform, bromodichloromethane. The suite of 4 compounds are sometimes referred to TTHM's (Total Trihalomethanes).
Trichloromethane: (chloroform) 0.3mg/L (WHO standard)
Bromodichloromethane: 0.06mg/L (WHO Standard)
Dibromochloromethane: 0.1mg/L (WHO Standard)
Tribromomethane (bromoform): 0.1mg/L (WHO Standard)

Haloacetonitriles
dichloroacetonitrile: No guideline levels set.
trichloroacetonitrile: No guideline levels set.
dibromoacetonitrile: No guideline levels set.
bromochloroacetonitrile: No guideline levels set.
Carbon Tetrachlorine: (chlorine disinfection) 0.003mg/L

Chlorophenols (Chlorophenols may be present in drinking water as a result of chlorination of water that contains phenol or lower chlorophenols, or from contamination of water sources. Chlorination of water containing natural organic compounds can produce very low concentrations of chlorophenols. Degradation of phenoxy herbicides such as 2,4,5-T and 2,4-D also generates chlorophenols):
2-chlorophenol: 0.3mg/L health value
2,4-dichlorophenol: 0.2mg/L health value
2,4,6-trichlorophenol: 0.02mg/L health value

Trichloroacetaldehyde (chloral hydrate): 0.02mg/L

"Chloral hydrate is a disinfection by-product, arising from chlorination of water containing naturally occurring organic material (NOM). Chloral hydrate has only been detected by Goulburn Valley Water since changing to a new contract testing laboratory in November 2007. The Department of Health is currently conducting a study into the detection of chloral hydrate across Victoria." p55 Water Quality Annual Report Goulburn Valley Water.

Highest Chloral Hydrate levels recorded by SA Water 2000-2012: 0.088mg/L Balaklava 18/3/02.
Highest Chloral Hydrate levels recorded in Victoria 2007-2011: 0.065mg/L Pyalong 2010/11.

Westernport Water also test for Dibromochloromethanes, Bromoforms, Chloroform and Bromodichloromethane. In 2009/10 five communities supplied by Westernport Water breached WHO Guideline levels for Bromodichloromethane.

"Trichloroacetaldehyde, cyanogen chloride, chlorophenols were monitored at customer taps (and following disinfection) on a quarterly basis. Trichloroacetaldehyde was also monitored on a weekly basis in Cavendish and Purnim at the request of the Department of Health, as part of a research project on the prevalence of trichloroacetaldehyde in Victorian drinking water supplies. Of the 276 trichloroacetaldehyde samples collected for the year the only locality to exceed the 0.02 mg/L health related guideline value in the 2004 Australian Drinking Water Guidelines was Purnim. Four of the sixteen samples collected during 2009/10 exceeded 0.02 mg/L. Epichlorohydrin, chlorinated furanonex, chloroketones (chloropropones), chloropicrin were monitored on an annual basis following disinfection at each of Wannon Water's treatment / disinfection plants." Wannon Water Water Quality Report 2010

"Nitrosamines, particularly N-nitrosodimethylamine (NDMA), are receiving increased attention from water authorities, as emerging disinfection by-products of concern in potable water supplies....The results of this study to date gives support for achieving reduction of NDMA levels by reducing the amount of polyDADMAC dosing in normal plant operation. The most effective strategy to reduce the product water NDMA levels was to employ an extended chlorine contact time prior to ammonia addition during the chloramination process. This proved most effective for the water supply in this study and resulted in only a small increase in trihalomethane formation.In addition, this study has identified the filters as a potential major source of NDMA precursor material which may outweigh the impact of optimising the coagulation process on NDMA reduction." PLANT TRIAL OF NDMA REDUCTION STRATEGIES Australian Water Quality Centre, SA Water Corporation, Adelaide, SA, Australia

"The study results show that that contact of polyDADMAC (coagulant) with ozone will lead to release of the more potent NDMA precursor DMA but may not generate a significant amount of NDMA under typical drinking water treatment conditions due to low yield." PolyDADMAC and Dimethylamine as Precursors of N-Nitrosodimethylamine during Ozonation: Reaction Kinetics and Mechanisms. Environ. Sci. Technol. (April 19 2011).

Chemical in South Australian drinking water above recommended health guidelines May 22 2011 [The article also failed to mention that in 2008 Goolwa, Victor Harbor & Clare exceedeed THM levels].

PEOPLE are drinking water that is regularly contaminated with a chemical at levels above safe guidelines.
Trihalomethane in water for homes in the Barossa, Fleurieu, Riverland and Kangaroo Island last year regularly rose above the Australian Drinking Water Guideline of 250 micrograms per litre (ug/l).
A guideline of 100ug/l for THMs is set by the EU. A THM, Dibromochloromethane, was one of the compounds of concern detected in Edwardstown groundwater after 2200 residents were warned by SA Health and the Environment Protection Authority in February to not use the water, contaminated by the former Hills Industries site. In the worst case, water from [samples] at the Barossa water treatment plant had a maximum THM level of 368ug/l. The Barossa plant failed to meet the health compliance target in 23 per cent of the tests.
Water from the Happy Valley treatment plant did not comply with the THM guideline 30 per cent of the time, while Myponga water treatment plant water failed test 26 per cent of the time and had an average THM level of 230ug/l - marginally below the accepted level.
But SA Water and SA Health say the water is safe and while action is being taken to reduce THMs in our water, it will not be done in a way that compromises disinfection. SA Water head of Water Quality and Environment Dr John Howard said reducing THMs is "encouraged, but must not compromise disinfection, as nondisinfected water poses significantly greater risks than THMs". "SA Water has a close working relationship with SA Health," Dr Howard said. "Throughout the 2009-10 reporting period SA Health advised us that, 'appropriate responses were instituted to all reported incidents and as such none of the incidents associated with drinking water supplies were considered to represent a public health risk, or to require public notification'."
SA's Chief Scientist, Professor Don Bursill, said it was considered good practice to keep to below the guideline levels with regard to THMs, but the priority for drinking water was disinfection.
He said that in the mid-1970s, it was thought that chloroform, one of four compounds in the group of THMs, was a carcinogen and that triggered tough standards for THMs in drinking water.
"The health community is less concerned with (THMs) than they used to be," Prof Bursill said. "It started as a concern about 40 years ago and as research has progressed, it has been found to be less of a risk."There is debate over the actual health risk posed by THMsand while there is a belief by some health agencies that they could cause some forms of cancer, research has not been able to prove this.SA Water has moved to reduce the level of THMs in water on Kangaroo Island and from Myponga reservoir by aerating it.
Dr Howard said elevated levels of THMs were generally caused by warmer weather and unique characteristics of the

source water, including the amount of natural organic matter.
SA Water recently modified the offtake at Middle River Reservoir and installed an aeration system at Kingscote.
A statement from SA Health said: "The concentrations of THMs in South Australian drinking water supplies will not result in health impacts for consumers." http://www.adelaidenow.com.au/news/south-australia/chemical-in-south-australian-drinking-water-above-recommended-health-guidelines/story-e6frea83-1226060712014

"Only one notification during the period was known to be associated with illness. In May 2011 an excess amount of chlorine was dosed into the drinking water system that supplies the township of Tooborac. At least three young children, including an 11-week old baby, displayed health effects associated with consuming the affected water. " p2 Annual Report on Drinking Water Quality in Victoria 2010-11. Department of Health April 2012

4.2.1 Monochloramines (from Chloramination – ammonia added to chlorine).

Some water supplies may also be disinfected through a process called Chloramination where ammonia is added to the water prior to the chlorine, which in turn can create Monochloramines. Sunlight does not degrade Monochloramines to the same extent as chlorine, meaning that water can be stored for longer periods of time. Chloramination is also used to reduce levels of chlorine disinfection byproducts. One byproduct of chloramination, NDMA is increasingly being detected in chloraminated water supplies.

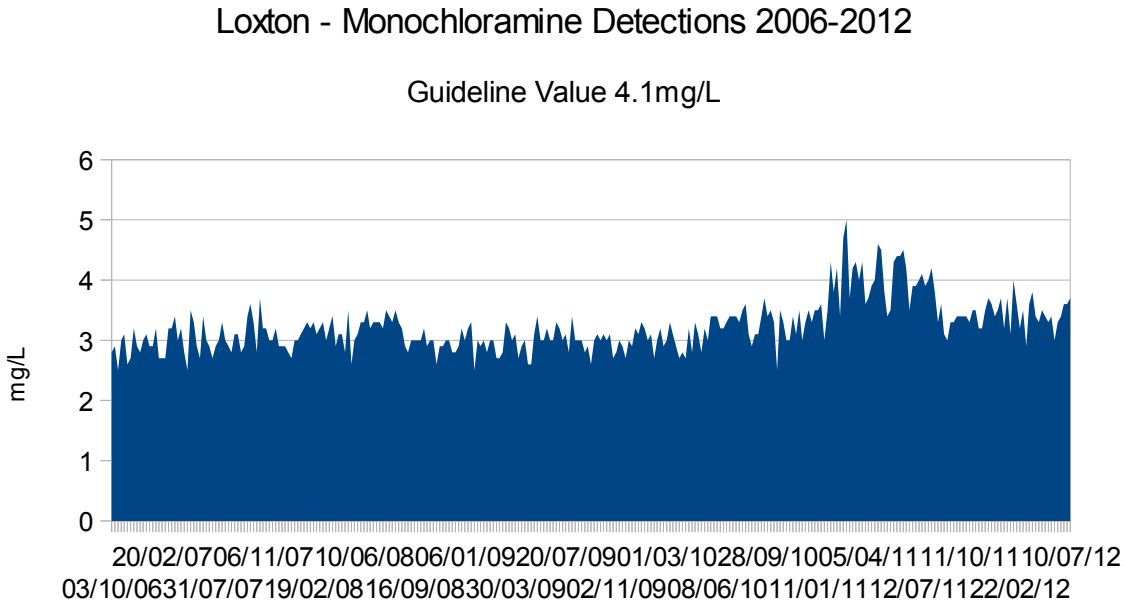
ADWG Guideline Limits

Cyanogen chloride. ADWG Guideline 0.08mg/L. By product of chloramination.
Monochloramine: ADWG Guideline 3mg/L (equivalent to 4.1mg/L Total Chlorine)

The following towns use Chloramination in Victoria (FoE is unsure at this stage how many communities in Australia receive chloraminated water);

Allansford – Wannon Water, Avoca – Central Highlands Water, Ballarat – Central Highlands Water, Balmoral – Wannon Water, Beechworth – North East Water, Benalla – North East Water, Camperdown Rural – Wannon Water, Cavendish – Wannon Water, Corinella – Westernport Water (Trial), Emerald – Yarra Valley Water, Glenthompson – Wannon Water, Hamilton – Wannon Water, Kilcunda – Westernport Water (Trial), Lexton – Central Highlands Water, Loch – South Gippsland Water, Maryborough – Central Highlands Water, Meredith – Barwon Water, Mortlake – Wannon Water, Noojee – Gippsland Water, Noorat/Glenormiston – Wannon Water, Ridge/Monbulk – Yarra Valley Water, Romsey – Western Water, Seville – Yarra Valley Water, Tarrington – Wannon Water, Terang – Wannon Water, Warrnambool – Wannon Water, Willow Grove – Gippsland Water, Wonthaggi – South Gippsland Water, Woodend – Western Water, Yarram – South Gippsland Water.

Highest Monochloramine level recorded in Victoria 2010/11: 1.02mg/L unidentified location (most likely Beechworth) North East Water.



Average Monochloramine levels for Loxton, South Australia, over 6 year period are 3.219mg/L – 21% below the 4.1mg/L ADWG guideline. February – July 2011 marked above guideline levels at Loxton.

Highest Monochloramine levels recorded by SA Water 2000/12: 29/12/05 Morgan 5mg/L, 22/2/11 Loxton 5mg/L.

"WHAT IS CHLORAMINE?
... Today, most public water providers in the United States (80%) use chlorine to kill those bacteria. But almost 20%

use a combination of chlorine and ammonia known as monochloramine or chloramine... Chloramine.org claims that the chemical mixture (ammonia and chlorine) can cause various health problems and aggravate existing ones, primarily skin, digestive and respiratory ailments... "I had had acid reflux before, but never anything as bad as this," says Saltzman. "This was far worse. I had no idea what was causing it until I read about the chloramine."
She says she stopped drinking her water, and the symptoms immediately went away. But she hasn't found a way to completely avoid chloramine: she says she and her husband both suffer from red, irritated eyes after they get out of the shower.
Chris Klein moved from Greer to Duncan just to get away from the water. He says his skin would often look red and inflamed after he took a shower. "I had this rash on my back and on my hands that just wouldn't go away," says Klein. "It was like an extreme sunburn." But he says after moving to Duncan, his skin cleared up almost immediately. He says his digestive problems also went away. Michelle says her stomach problems also ended when she stopped drinking her water.

"TOXIC CONSEQUENCES"
Dr. Michael Plewa says chloramine may pose a far greater health risk than stomach aches and rashes.
Plewa is a geneticist at the University of Illinois, Urbana-Champaign. He is considered one of the nation's foremost experts on the toxicity of disinfection byproducts in drinking water, having conducted numerous studies and published several papers on the subject. He is currently studying a group of byproducts called nitrosamines.
"Nitrosamines are highly toxic carcinogens that you would like not to have in drinking water," says Plewa.
Nitrosamines usually occur in water that contains chloramine. The most toxic nitrosamine is nitrosodimethylamine, or NDMA. NDMA has caused liver cancer in lab animals and is listed as a "probable human carcinogen" by EPA.
"It can be metabolized by enzymes into a form that then can cause damage to DNA, which ultimately can lead to cancer," says Plewa." Source: http://www2.wspa.com/news/2011/nov/10/tap-water-running-risk-ar-2685246/
The following communities in Victoria drink water that is chloraminated. http://www2.wspa.com/news/2011/nov/10/tap-water-running-risk-ar-2685246/

4.3 Non Chlorine Type Water Treatment Chemicals

Ozone Based Chemicals: Ozone is an alternative to chlorine disinfection. Ozone can create the by-products Bromate and Formaldehyde if it reacts with organic matter.

Bromate: Regulatory Standard = 0.02mg/L (Also see section of desalination). Is a suspected carcinogen.
In 2010/11 the highest Bromate level in Victoria was detected at Clunes – Central Highlands Water 0.03mg/L.
2004/5 The highest Bromate level in Victoria was detected at Mt Beauty – North East Water 0.2mg/L

Chlorite: ADWG Health 0.3mg/L. Chlorite and chlorate are disinfection by-products of chlorine dioxide disinfection process. The ADWG health limit for chlorine dioxide is 1 mg/L and the aesthetic limit is 0.4 mg/L.
Highest level recorded in Victoria 2007-10 was in the western Victorian community of Watchem 4.2mg/L.

"... industry are having serious problems meeting chlorite/chlorate limits that were proposed in the new Australian Drinking Water Guidelines, especially for disinfection in long distance pipelines that are dosed with sodium hyptochlorite" pers comm 18/5/11.

"The use of chlorine dioxide for disinfection at the Marysville water treatment plant has occasionally resulted in elevated chlorite levels in the Marysville water sampling locality. This is primarily due to the levels of naturally-occurring organic materials and iron in the water source, which hinder the effective and efficient use of chlorine dioxide in this particular system. The Department of Health has been informed of the levels of chlorite at Marysville water sampling locality under section 22 of the Safe Drinking Water Act 2003. The chlorine dioxide dosing patterns and supply demands have changed in Marysville since the February 2009 bushfires, and may be contributing to the occurrence of chlorite. An Undertaking is in place for addressing issues related to the levels of chlorite and disinfection by-products at Marysville and Buxton. p55 Water Quality Annual Report Goulburn Valley Water

Chlorate: No Health Guideline

Victorian Readings 2004/5 included: Buxton 2.4mg/L (Goulburn Valley Water 2006/7)
Highest SA Water Readings: 22/2/12: Blanchetown 0.85mg/L

Oxidised Nitrogen (nitrate and nitrite): ADWG Health Guideline:Nitrate/Nitrite 50mg/L (Bottle Fed Infants) 100mg/L. A level of 80mg/L was detected in the community of Warrabri in the Northern Territory in 2010.
http://www.powerwater.com.au/__data/assets/pdf_file/0003/47820/IES_Water_Quality_Summary_Final_Art_web_version.pdf
Koroit 2.70mg/L Wannon Water 2009/10. Highest level South Australia 09/10: Port Lincoln 6.52mg/L.

"High nitrate levels may cause a condition (methaemoglobinaemia) in which the capacity of the blood to carry oxygen is reduced (NHMRC-ARMCANZ 1996). This is especially a concern for newly born infants with other complicating conditions" p9 http://www.environment.gov.au/soe/1996/publications/technical/pubs/drinking.pdf

4.4 Other Health Related Substances Tested By Water Authorities

Tonnes of chemicals needed to make SA drinking water safe (November 15 2011)
"AN extra 15,384 tonnes of chemicals were added to SA's drinking water in the past year to make it safe.
Water Department figures show the use of treatment chemicals increased to a record 47,452 tonnes in 2010-11, up from 32,068 tonnes the previous year. UniSA Centre for Water Management and Reuse director Professor Christopher Saint said water quality experts had never before faced such a serious contamination of the state's water sources.
SA Water had feared the state was facing unprecedented poor water quality levels. It had expected drought- breaking flows to wash years of accumulated organic waste, acid, bacteria and salt into the River Murray and reservoir system.
"Authorities have not seen the sort of problems posed by by the blackwater event which came downstream because of the length and extent of the drought in the Murray-Darling Basin," Professor Saint said.
The problem is that all the water cut off in water holes during the drought is added back into the river system and the contaminants left as waters receded during the drought are also added back into the river and make their way downstream," Prof Saint said.
The largest chemical increase was in the use of caustic soda to make the water less acidic - 5259 tonnes in 2010-11, compared with 2574 tonnes in 2009-10. Aluminium sulphate use, employed to make impurities clump together so they can be removed, increased from 21,886 tonnes to 33,281 tonnes. Disinfecting aqueous ammonia use increased from 118 tonnes to 203 tonnes.
http://www.adelaidenow.com.au/chemical-cleanup-is-a-mouthful/story-e6frea6u-1226194964232

Aluminium: ADWG Guideline = 0.2mg/L(acid soluble).
Extremely high levels of aluminium (up to 19mg/L – 95 times higher than the regulatory standard) were recorded in the Victorian town of Hamilton between 2007-2010. The highest Aluminium reading in Tasmania in 2009/10 was 4.85mg/L recorded at Distillery Creek (part of Launceston's water supply).

Elevated Aluminium content in drinking water is quite common in Victoria. According to Wannon Water *"Typically the raw water entering the Hamilton Water Treatment Plant has been from surface run-off, but due to the drought, water was required to be sourced from groundwater bores located in the catchment area. To sustain water reserves, water harvesting from the catchment focussed on capturing as much water as possible. As a result, the quality of raw water entering the water treatment plant has deteriorated to the point where it is outside the design specifications for the water treatment plant. Design issues with the water treatment plant have also hindered optimum performance"* Wannon Water Water Quality Report 2009.

"The major concern with aluminium is related to the association between the intake of aluminium and the neurodegenerative diseases such as Parkinson's disease. Higher than average levels of aluminium have also been found in the brains of Alzheimer patients, but the World Health Organization (WHO) has expressed strong reservations about drawing a causal relationship between aluminium in drinking water and Alzheimer's disease as there are many confounding factors. Aluminium in water can be a problem for people undergoing kidney dialysis.
But Mr Evans said that South Gippsland Water was bound by strict standards and could only use a prescribed measure of the chemical. "The flows we get from the Agnes are very turbid just in normal times. We have in place our treatment plant. The treatment plant deals with clarification and filtration" he said. Yes, we do use alum, however that's to put in the raw water to drop out the solids and turbidity. At the end of the day though we're under very strict guidelines. "We use what we need, but the national and state drinking guidelines state an amount we can't go over in relation to alum. There's just no concern it's going to blow out because we've got turbidity coming down". Mr Evans said that if the river's turbidity levels were "massively high" there was "the ability to turn that water off". "We could use the water that is stored in the service basin and we could continue that for one or two weeks" he said. "An event might happen where the water becomes massively turbid, but we just wouldn't keep hitting it with chemicals." (The Star April 5 2011 – In response to Friends of the Earth Press Release regarding logging in the Agnes River Catchment, South Gippsland).

Water company fined over Barossa chemical spill (31/8/10)
"United Water has been fined $80,000 over a chemical spill that harmed a Barossa Valley creek. The Environment Court in Adelaide heard 40,000 litres of aluminium sulfate solution leaked from the Barossa water treatment plant at Williamstown into Yettie Creek, a pristine natural watercourse, killing small animals and plant life. Plant operator United Water pleaded guilty to causing environmental harm. The court was told a PVC pipe ruptured in February 2007, letting chemical solution leak onto a floor overnight. It got into a drainage system leading to the creek. The court heard the company was aware of the potential risk but failed to implement precautions."
http://www.abc.net.au/news/stories/2010/08/31/2998319.htm?site=adelaide

Antimony: ADWG Guideline 0.003mg/L. Antimony shows similar toxic effects as arsenic. Can be a problem with

antimony-tin solder. Highest levels recorded in Victoria 2007-10: Merrigum 2008/9 Antimony 0.003mg/L Goulburn Valley Water. 0.0075mg/L recorded at Beswick in the Northern Territory in 2008 and 0.0074mg/L in 2009.
One reading in South Australian breached ADWG between 2000-2012: Penneshaw 29/9/10 0.0031mg/L.

Concerns have recently been made concering antimony mining in the water supply for Coffs Harbour (June 21 2011). Headwaters of the Nymboida River by Anchor Resources.
http://www.abc.net.au/news/2011-06-21/no-to-antimony-mining-in-nymboida-river-headwaters/2765438

Arsenic: ADWG Guideline = 0.01mg/L
Arsenic is bioaccumulative and symptoms may take 10-15 years to develop after expsoure at high levels. Drinking water can be contaminated with inorganic arsenic through wind blown dust, leaching or runoff from soil, rocks and sediment. Groundwater sources such as bores will usually have higher arsenic levels than surface water. In major Australian reticulated water supplies concentrations of arsenic range up to 0.015mg/L, with typical values less than 0.005mg/L. http://www.health.qld.gov.au/ph/documents/ehu/2676.pdf

There has been much attention focussed internationally on the arsenic pollution in drinking water wells in Bangladesh. *"In 2006, UNICEF reported that 4.7 million (55%) of the 8.6 million wells in Bangladesh had been tested for arsenic of which 1.4 million (30% of those tested) had been painted red, showing them to be unsafe for drinking water: defined in this case as more than 50 parts per billion (UNICEF 2006). 50 parts per billion = 0.050mg/L."*
www.irc.nl/content/download/29654/.../TOP17_**Arsenic**_07.pdf

The small community of Royal George in North Eastern Tasmania. High levels of lead, arsenic and cadmium have been detected in the drinking water here.

Highest Australian reading - Royal George Tasmania: <1.4mg/L Arsenic (2010) *"Government tests this week revealed the St Pauls River at Royal George (population 20) contained more than 200 times the Australian drinking-water limit*

of arsenic, more than 50 times the limit of lead and high levels of cadmium. The heavy metals that leached into the river during recent heavy rain are believed to originate from a tin mine that ceased production in 1928, raising concerns that the exposure may be long-standing. Exposure to the heavy metals is linked to health risks including cancer, stunted intellectual development, kidney damage and vascular disease..."
http://www.themercury.com.au/article/2010/09/05/170811_tasmania-news.html

Highest Victorian reading 2005-10: Merino 0.13mg/L *"Merino was previously sourced from the Mocamboro bore supply. Water form this aquifer contains naturally high levels of Arsenic. To reduce the level of Arsenic, a new pipeline was constructed to supply Merino from the Casterton Water Treatment Plant."* Wannon Water Annual Drinking Water Report 2005/6
(Wannon Water 2005/6), Macarthur 0.07mg/L (Wannon Water 2007/8), [both levels due to groundwater geology], Nathalia 0.03mg/L (Goulburn Murray Water 2002/3).

Highest SA Water levels 2000-12: 12/8/03 Penola 0.039mg/L and 0.02mg/L 13/7/04.

Highest Northern Territory reading 2005-11: Nauiyu Nambiyu 0.013mg/L (2009).

Other readings in Northern Territory 2005-11: Belyuen 0.0096mg/L 2008, Beswick 0.009mg/L 2008, Beswick 0.0079mg/L 2009. The community of Kybrook Farm in the Northern Territory recorded a level of 0.0115mg/L in 2010.http://www.powerwater.com.au/__data/assets/pdf_file/0003/47820/IES_Water_Quality_Summary_Final_Art_web_version.pdf

"MACARTHUR resident and business woman Merilyn Cook says she will not even wash her clothes in the town's drinking water, despite Wannon Water's announcement that the mains supply is now drinkable. 'People are not dancing in the streets about this announcement,' Ms Cook said. "The quality of the water hasn't actually changed; it's not a good quality for domestic use." Former Victorian Health Minister Bronwyn Pike declared the town's water supply – sourced from a local bore - unpotable in August 2006, when World Health Organisation standards changed, reducing the amount of arsenic permitted in potable water to be less than 0.007mg/L or less than seven parts per million; the ruling was gazetted by the government in September that year. Arsenic is a residual substance, occurring naturally and lingering in areas of high volcanic activity and, poisonous to humans and animals, it remains a problem in many parts of the world. For the past four years, signs have existed at all public water points across the town, warning visitors not to drink the town's water supply. On May 18, Health Minister David Davis declared Macarthur's water drinkable, after Wannon Water completed installation of a new water treatment facility..." http://www.spec.com.au/?sp=2&id=12219 (Macarthur Arsenic 0.031mg/L Wannon Water 2011/12)

Arsenic can also pollute local environments. Issues have recently been raised in Rosebery Tasmania: In October 2008 three residents of Rosebery contacted the Rosebery mine owner Oz Minerals after they had received results from testing for heavy metals of ground water and soil by a Government laboratory. http://tasmaniantimes.com/index.php/article/arsenic-and-lead-contamination-in-tasmanian-west-coast-mining-town

Arsenic issues are also a continuing problem in the Northern Territory. *"Natural arsenic has previously been identified in some bores in Pine Creek slightly above the Australian Drinking Water Guideline value. These bores have since been decommissioned from supply."* Power and Water Corporation Water Quality Report 2004 "*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"* Power and Water Corporation Water Quality Report 2006 0.01mg/L arsenic recorded at Pine Creek 2006/7

Arsenic Tests Find Safe Levels in Drinking Water July 14 2011 *"...A 2008 report found a number of water holes around the Territory had excessive arsenic in them. Mount Bundy was covered by the report. Environment Department director of water services, Ian Lancaster, says it is not unusual to find arsenic in drinking water. "They are very, very low levels," he said. "Levels are found a lot higher in other parts of the world and (the water is) used for palatable drinking water. "The levels that we find ... are extremely unlikely to have any impact at all on human health." But Mr Lancaster says the levels of heavy metals in the ground around the Territory can fluctuate dramatically. "They fluctuate quite a lot between wet and dry season, and between different areas," he said. "It is also about the raising and lowering of groundwater tables, which sometimes can produce these particular heavy metals in the bore water."*
http://www.abc.net.au/news/stories/2011/06/14/3243284.htm?site=darwin

Barium: ADWG Guideline 2mg/L. Barium is a machineable metal and exists naturally only in ores containing mixtures of elements.

Highest readings from the Northern Territory: The community of Gudabijin (Bulla) recorded a Barium level of 6.89mg/L in 2010.
http://www.powerwater.com.au/__data/assets/pdf_file/0003/47820/IES_Water_Quality_Summary_Final_Art_web_version.pdf
Barium 4.6mg/L was recorded at Bulla (NT) 2008.

Boron: ADWG Guideline 4mg/L. Between 2009-11, the National Health and Medical Research Council (NHMRC) reviewed the Australian Drinking Water Guidelines.

There have been claims that; *"Although boron is an essential trace element for plants, certain plants (e.g. citrus fruit, stone fruit, some nut trees) are sensitive to the toxic effects of boron if irrigation water has concentrations higher than about 0.5 mg/L" (Lazarova and Bahri 2005). WHO (2006) indicates that this concentration is below the level that can be achieved by practical treatment methods. Application of waste water containing 0.8–1.3 mg/L to young orange trees for three years was well tolerated (Reboll et al 2000)".*

"The ADWG overlook the impact of emerging technologies where levels of Boron found in drinking water from desalination plants (using reverse osmosis) are critical. Levels of 4mg/l of Boron are fatal when directly applied to many plant species in agriculture industry. The ADWG overlooks the myriad of crops & ornamental plants that are sensitive to concentrations of boron less than 4 mg/l Refer Oct 2005 Draft Australian National Guidelines water Recycling pages 277 Table A 7.3 & 275 Table A7.4 See Appendix C for full list of plant tolerance to boron.
Levels of Boron set in these 2008 National Guidelines Water Recycled has recognised this issue & set maximum concentrations at 0.9 mg/l. Moreover, this critical Boron level is recognised by SA Water at the Bolivar Waste Water Recycling Plant. SA Water has set the levels of Boron in their recycled water at less than 1mg/l to supply local market gardens at Virginia.

The ADWG does not refer "specifically" to WHO studies on health affects of Boron (done as early as 2003) which then recommend 0.5 mg/l (provisional) Refer page 10 "Boron in Drinking-water- Background document for development of Guidelines for Drinking-water Quality WHO/SDE/WSH/03.04/54. And in a later WHO 2005 document "Nutrients in Drinking Water, Sanitation and Health Protection and the Human Environment" Section 12 on 'HEALTH RISKS FROM DRINKING DEMINERALISED WATER' states on Page 149 "After evaluating the available health, organoleptic, and other information, the team recommended that demineralised water ---contain boron (0.5 mg/L). Recommend BORON: For 2009 ADWG adopt the 2008 WHO Drinking Water Guidelines 0.5mg/L (provisional)." Pers comm.

Cadmium: ADWG Guideline. 0.002mg/L, Royal George Tasmania: <0.1mg/L Cadmium (2010). The primary route of exposure of cadmium is via contaminated water or food. Fertiliser can be a source of excessive cadmium as can rainwater tanks. It has been linked to cancer, lung disorders, kidney disease and autoimmune disease.

Highest SA Water Reading 2000-12: 0.0033mg/L 12/12/01 and 0.0031mg/L 14/2/05 at Warooka
High Tasmanian reading (outside of Royal George) 0.004mg/L at Avoca in November 2011 – caused by flooding which washed cadmium from mining areas upstream into water supply. Tullah 0.00293mg/L June 2011. (Drinking Water Quality of Public Water Supplies in Tasmania Annual Report 1 July 2010-30 June 2011).
Highest Victorian Reading 2004-10: 0.0003mg/L Numurkah Goulburn Valley Water 2004/5.

Chlorine: ADWG 5mg/L (Chlorine in chloraminated supplies 4.1mg/L). Chlorine dissociates in water to form free chlorine, which consists of aqueous molecular chlorine, hypochlorous acid and hypochlorite ion. Chlorine and hypochlorites are toxic to microorganisms and are used extensively as disinfectants for drinking water supplies. Chlorine is also used to disinfect sewage and wastewater, swimming pool water, in-plant supplies, and industrial cooling water. Highest Victorian Reading 2005-11: Sarsfield-Bruthen 1.72mg/L East Gippsland Water (2008/9).

Chromium: ADWG Guideline 0.05mg/L Cr(VI) (Hexavalent Chromium) Cr (VI) also known as Hexavalent chromium. The more common form of chromium is Trivalent chromium Cr (III), which unlike Hexavalent Chromium is not transported into cells via sulphate transport mechanisms. Hexavalent chromium was made famous in the US via the work of Erin Brockovich. Levels in groundwater at Hinkley reached 0.58mg/L.

"In major Australian reticulated supplies, total chromium concentrations range up to 0.03mg/L, with typical concentrations being less than 0.005mg/L" http://www.apvma.gov.au/products/review/docs/arsenic_tox.pdf

Highest Reading Goulburn Valley Water 2001-4: Nathalia 0.017mg/L

Cyanide: ADWG Guideline 0.08mg/L. Cyanide salts are mainly used in electroplating, metallurgy, the production of organic chemicals (acrylonitrile, methyl methacrylate, adiponitrile), photographic development, the extraction of gold

and silver from ores, tanning leather and in the making of plastics and fibres. They are also used to manufacture fumigation chemicals, insecticides and rodenticides. Cyanide can also be sourced from industrial waste, some plants and bacteria.

Cyanide is a substance that is found in combination with other chemicals in the environment. The more common ones are Hydrogen cyanide; sodium cyanide; potassium cyanide and calcium cyanide.
http://www.npi.gov.au/substances/cyanide/index.html

Highest recorded levels in Victoria 2002-10: were recorded at Nathalia 0.06mg/L in 2002/3, 2007/8 and Swifts Creek 0.05mg/L in 2007/8, Upper Delatite 0.05mg/L 2011/12.

Cyanide pollution is also frequently reported.

Cyanide disaster hungary (2000) http://www.abc.net.au/science/articles/2000/02/10/98714.htm
http://oj.hss.uts.edu.au/oj1/oj1_s2004/DirtyGold/index.htm
http://www.rainforestinfo.org.au/gold/spills.htm (cyanide)
http://www.smarterscience.com/cyanide-paper2000.html
http://www.abc.net.au/rn/science/earth/stories/s52029.htm
http://www.theage.com.au/news/national/gold-prospecting-in-catchments-sparks-water-fears/2007/08/27/1188067032772.html

Copper: ADWG Guideline = 2.0mg/L Aesthetic Guideline 1.0 mg/L
The widespread use of copper pipes can be a major source of copper pollution. At high levels in drinking water copper can make the water taste metallic and can lead to blue-green stains on plumbing fixtures. High levels of copper can cause stomach and intestinal problems such as cramping and diarrhea.

Highest Victorian Reading 2004/10: Dookie 0.41mg/L (Goulburn Valley Water 2004/5), Dookie 0.34mg/L (North East Water 2006/7)

Fluoride: ADWG Guideline: non-fluoridated water 1.5 milligrams per litre of drinking water
Fluoridated water 1.0 milligrams per litre of drinking water (rolling annual average). In Victoria, the Health (Fluoridation) Act 1973 states that the annual average for fluoride in drinking water shall not exceed a level of 1mg/L. It can be added to water supplies through the 'Flurodose' process. Fluoride is added to water either as fluosilicic acid (sometimes known as hydrofluosilicic acid) or sodium silicofluoride. It is sourced from superphosphate and is soluble. Naturally occurring fluoride is almost insoluble and is known as calcium fluoride.

Use of Fluoride in water remains controversial. http://www.fluoridealert.org/

The highest fluosilicic levels recorded in Australia: 1.96mg/L Ali Curung 2008 (1.9mg/L 2009), 1.8mg/L Tennant Creek 2006/7, 2007/8
The highest 'fluosilicic' levels recorded in Victoria 2002-10;
Shepparton 1.49mg/L Goulburn Valley Water 2003/4
Toolamba 1.46mg/L Goulburn Valley Water 2002/3
Traralgon South/Hazelwood North 1.4mg/L 0.94mg/L[mean] Gippsland Water 2009/10
Highest Fluoride Levels recorded by SA Water 2000-12: Millicent 9/3/04 1.5mg/L.

"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." Power and Water Annual Report 2006

In terms of naturally occurring 'Calcium Fluoride', in 2007/8 the towns of Waubra and Learmonth who both source their drinking water from bores recorded Fluoride levels of 2.1mg/L and 1.8mg/L respectively. The highest level recorded in the Northern Territory was 2.1mg/L at Warrabri (Ali Curung) in 2010.

However in a suburb of Brisbane, fluoride levels were over 20 times higher than the regulatory standard in June 2009.

June 26 2009: *"Queensland Natural Resources Minister Stephen Robertson has blasted SEQ Water for its role in a fluoride overdose in water supplies, north of Brisbane. After initial confusion about the date, suburbs and dosage involved, the State Government confirmed the contamination happened in April, with up to 400 homes affected in the suburb of Joyner, as well as 200 children at a school camp. Premier Anna Bligh ordered an independent report to find*

out what caused a malfunction at the North Pine water treatment plant."
http://www.abc.net.au/news/stories/2009/06/26/2609506.htm

"The Premier was unavailable last night but SEQ Water Grid Manager director Nicole Davis confirmed the water entered supplies in the Brendale and Warner areas on May 2 for three hours between 9am and midday.
It means the water flowed on the Saturday morning putting many more residents at risk...While Ms Bligh had earlier refused to speculate on compensation for the 4000 homes exposed to the water, lawyers believe Section 94 of the Water Fluoridation Act ruled out civil suits from the public. A person does not have any civil right or remedy against a public potable water supplier in relation to the fluoridation of a public potable water supply under this Act," the law reads.
The water contained 30 to 31mg/L of fluoride instead of the maximum allowable 1.5mg/L...
http://www.lithgow-info.com/news/30-brisbane-given-fluoride-overdose-on-may-2

Formaldehyde: ADWG Guideline 0.5mg/L.

Highest Victorian Level 2006/7: Tawonga 0.2mg/L (North East Water)
According to the National Pollution Inventory; *"Formaldehyde is used in the manufacture of formaldehyde-based resins and plastics used in many industries, but mostly in the wood-products industry. Formaldehyde-based resins are also used as adhesives. Formaldehyde is also used in a number of industries including agriculture, the building industry (to water- and grease-proof concrete and plaster), medicine-based industries (forensics, hospitals and pathology laboratories), embalming fluid in funeral homes and crematoria, film processing, textile treatments, leather tanning and a wide range of personal care and consumer products."*Formaldehyde has a half life in water of between 2-20 days. http://www.npi.gov.au/substances/formaldehyde/index.html

Iodide: Can be found in mineral/salt deposits. Iodide is widespread in the groundwater of Central Australia and has been detected at a number of drinking water supplies in the Northern Territory. (Highest Average Readings: Daly Waters 0.2mg/L, 0.17mg/L Tennant Creek 2005). It was also detected in Western Australia at Salmon Gums 0.3mg/L (2002/3) and Kununurra 0.2mg/L (18/2/03). *"Iodide is one of the largest (monoatomic) anions. It is assigned a radius of around 220 picometers.For comparison, the lighter halides are considerably smaller: bromide(196 pm), chloride (181 pm), and fluoride (133 pm). In part because of its size, iodine forms relatively weak bonds with most elements. Most iodide salts are soluble in water, but often less so than the related chlorides and bromides. Iodide, being large, is less hydrophilic than are the smaller anions. One consequence of this is that sodium iodide is highly soluble in acetone, whereas sodium chloride is not. The low solubility of silver iodide and lead iodide reflects the covalent character of these metal iodides. A test for the presence of iodide ions is the formation of yellow precipitates of these compounds upon treatment of a solution of silver nitrateor leadII nitrate"* http://en.wikipedia.org/wiki/Iodide

Lead: ADWG Guideline = 0.01mg/L
Unlike most water contaminants, lead gets into water after it leaves a water treatment plant. Often this contamination is the result of water treatment changes meant to improve water quality that end up altering the water chemistry, destabilising lead-bearing mineral scales that coat service lines and corroding lead solder, pipes, faucets and fixtures. Lead in water has been seen to be a major source of lead exposure. Corrosion from lead based solders in brass fittings and copper pipes is often the source of lead in drinking water. This problem is often worsened by people drinking and cooking with corroded water after a first use particularly in the morning. Lead based solder has been banned in Australia since 1989 so problems are most likely to be associated in businesses and homes with water fittings pre-dating 1989. Lead has been linked to impaired cognitive development in children and a number of other health problems. (Lead can also be a result of dissolution from natural sources).

"Further studies conducted in Perth (WA) in 1993 on cold water from kitchen taps have indicated that 5% of samples were above the acceptable lead level as defined by the National Health and Medical Research Council (NHMRC), 2% were above the limit for cadmium and 12% above the limit for copper...." http://www.lead.org.au/lanv8n1/l8v1-11.html

The highest recorded level in Australia in recent years was recorded in South Australia
"In Mannahill, their highest reading was 0.104, more than 10 times the recommended safe level."
http://www.theflindersnews.com.au/news/local/news/general/contaminated-water-issue-to-be-investigated/2480332.aspx

Highest level recorded by SA Water 2000-12: Port Neill 0.03mg/L 18/9/00, Cowirra-Neeta Lead 0.0272mg/L 20/12/07

The highest recorded level 2005-11 in Victoria was recorded in the central Victorian community of Koriot 0.094mg/L (Wannon Water 2006/7), Gordon Lead 0.065mg/L (Central Highlands Water 8 October 2008), Camperdown 0.049mg/L (2006/7), Port Fairy 0.047mg/L (2006/7), Warrnambool 0.036mg/L (2005/6). The highest Melbourne level was recorded in the eastern suburbs of Melbourne at Mitcham 2007/8 at 0.028mg/L. Also see

http://www.lead.org.au/lanv8n1/l8v1-11.html

During December 2006 - March 2007, people in Esperance, Western Australia, noticed a significant number of bird deaths in the area. Tests later revealed their bodies contained high levels of lead. The highest level recorded in the Northern Territory in 2010 was 0.055mg/L at Kaltukatjura (Docker River) 2010.

Lead has also breached ADWG's at Queenstown and Gormanston in south west Tasmania. Breaches occurred three times in Gormanston in 2011 (highest reading 0.0295mg/L) and twice in Queenstown (highest reading 0.0.0118mg/L). In 2009-11, the following Tasmanian communities also had lead readings above the ADWG, Whitemark 0.017mg/L, Pioneer 0.015mg/L & 0.0109mg/L and Avoca 0.0106mg/L.

Esperance Rainwater Samples 2007: Highest Lead Reading 0.68mg/L (27% of samples above ADWG)
http://www.dec.wa.gov.au/content/view/3484/1729/

"Sampling and testing by DEC and the Department of Health (DoH) found that some rainwater tanks in Esperance had lead and nickel levels exceeding Australian Drinking Water Guidelines and a number of residents had elevated lead levels in their blood. With lead and nickel found in the soil, air, dust and/or rainwater in Esperance, concerns were raised that people and animals spending time in Esperance might be exposed to unacceptable health risks. The shipping of lead through Esperance Port was stopped in March 2007 and a stockpile of lead carbonate was quarantined until a safe removal plan could be agreed upon." http://www.dec.wa.gov.au/content/view/3484/1729/

Highest level recorded in Australia could be that of Royal George Tasmania: <0.5mg/L Lead (2010).

Too Much Lead In Drinking Water (9 Feb 2012) *"Lead levels are said to be too high in the drinking water of four outback towns on the Barrier Highway in South Australia. MP Dan van Holst Pellekaan says about 130 samples were checked from Manna Hill, Olary, Oodlawirra and Yunta last financial year. He says seven were above the recommended level of 0.01 micrograms per litre and one sample from Manna Hill was more than 10 times the level. Residents say they were not notified of any testing, nor the results. Mr van Holst Pellekaan says he asked SA Water Minister Paul Caica late last year for an explanation".* http://www.abc.net.au/news/2012-02-09/lead-levels-drinking-water-barrier-highway/3820014?section=sa%E2%80%8F

The lead pollution issue at Mount Isa Queensland has made national news in recent times.
http://www.abc.net.au/news/2010-08-02/study-confirms-mt-isa-lead-poisoning-risk/928728

There have also been recent concerns from Rosebery Tasmania regarding lead pollution of ground water and soil:
http://tasmaniantimes.com/index.php/article/arsenic-and-lead-contamination-in-tasmanian-west-coast-mining-town

Lead is also been in the media in South Australia in 2012:
"Lead levels are said to be too high in the drinking water of four outback towns on the Barrier Highway in South Australia. MP Dan van Holst Pellekaan says about 130 samples were checked from Manna Hill, Olary, Oodlawirra and Yunta last financial year. He says seven were above the recommended level of 0.01 micrograms per litre and one sample from Manna Hill was more than 10 times the level. Residents say they were not notified of any testing, nor the results. Mr van Holst Pellekaan says he asked SA Water Minister Paul Caica late last year for an explanation."
http://www.abc.net.au/news/2012-02-09/lead-levels-drinking-water-barrier-highway/3820014

Manganese: ADWG Guidelines 0.5mg/L. ADWG Aesthetic Guideline 0.1mg/L = 0.5mg/L
Manganese is found in the natural environment. Manganese in drinking water above 0.1mg/L can give water an unpleasant taste and stain plumbling fixtures and laundry.

The highest level recorded in Victoria 2006-8 was 2.1mg/L in the north eastern Victorian town of Springhurst (North East Water 2006/7).

The highest level recorded by SA Water 2000-12: 9/3/10 Kingcote (Kangaroo Island) 0.0266mg/L.

Mercury: ADWG Guideline 0.001mg/L

Highest Victorian Reading 2005-11: Maryborough 0.002mg/L Central Highlands Water 2009/10, Picola 0.0008mg/L, Yarroweah 0.0006mg/L 2011/12.

Highest SA Water Readings 2000-12: 19/12/06 Port Lincoln Mercury 0.001mg/L, 8/5/12 Renmark Mercury 0.001mg/L.

Highest Tasmanian Reading 2009-11: Cornwall 0.0017mg/L Ben Lomond Water
Mercury, if it enters the ecosystem can transform into the more toxic methylmercury where it can bioaccumulate. Methylmercury is highly toxic to human embryos, fetuses, infants and children. Mercury has numerous sources including old gold mines, where mercury was used in gold recovery process. It has been estimated that 950 tonnes of mercury was deposited into Victorian soil, rivers and streams during the various gold rushes.
http://ntn.org.au/wp-content/uploads/2010/05/mercury_brief20101.pdf

Molybdenum: ADWG Guideline 0.05mg/L. A group 6 chemical element, which forms carbides and is often used in high strength steel alloys. Also used in pigments and catalysts. Higher concentrations have been reported in the vicinity of molybdenum mining operations. Fly ash deposited onto soils from coal-fired power stations can be a significant source of molybdenum. Application of fertilisers may also increase the concentration of molybdenum in ground and surface water. In August/September 2010 the Tasmanian town of Zeehan recorded levels of Molybdenum at 0.0638 and 0.0575mg/L (Drinking Water Quality of Public Water Supplies in Tasmania Annual Report 1 July 2010-30 June 2011)

Nickel: ADWG Health Guideline 0.02mg/L. A chemical element and silvery white corrosion resistant metal with a golden tinge. 60% of nickel production is used in nickel steel (particularly stainless steel). In water, mainly a problem with nickel plated fittings. Main releases to the environment are from the burning of fossil fuels and in waste discharges from electroplating industries.

Esperance Rainwater Samples 2007: Highest Nickel Reading 0.95mg/L (32% of samples above ADWG)
http://www.dec.wa.gov.au/content/view/3484/1729/
Highest Victorian Level: Swifts Creek 0.003mg/L
Highest SA Water Level: 20/12/07 Cowirra-Neeta 0.0282mg/L

"Sampling and testing by DEC and the Department of Health (DoH) found that some rainwater tanks in Esperance had lead and nickel levels exceeding Australian Drinking Water Guidelines and a number of residents had elevated lead levels in their blood. With lead and nickel found in the soil, air, dust and/or rainwater in Esperance, concerns were raised that people and animals spending time in Esperance might be exposed to unacceptable health risks. The shipping of lead through Esperance Port was stopped in March 2007 and a stockpile of lead carbonate was quarantined until a safe removal plan could be agreed upon." http://www.dec.wa.gov.au/content/view/3484/1729/

Nitrate: ADWG Guideline 50mg/L. Nitrate is the product of oxygenated nitrogen created from the breakdown of organic matter; lightning strikes; inorganic pesticides; or explosives. The Australian Drinking Water Guidelines recommend that nitrate levels between 50-100mg/L are a health consideration for infants less than three months, although levels up to 100mg/L can be safely consumed by adults. Mainly a problem in Northern Territory and some communities in Western Australia. *"Cue, Meekatharra, Mount Magnet, New Norcia, Sandstone, Wiluna and Yalgoo have been granted an exemption from compliance with the nitrate guideline by the Department of Health. The water supplied is harmless to adults and children over the age of 3 months of age. Carers of infants younger than three months should seek advice from the Community Health Nurse regarding the use of alternative water sources for the preparation of bottle feeds. The Water Corporation provides bottled water free of charge for this purpose."* Water Corporation WA 2004/5 Annual Water Quality Report
95.6mg/L recorded at Kintore (2009). 75mg/L recorded at Ali Curung NT in 2008 &76.9mg/L in 2009.
Highest levels recorded in Western Australia 2002-11: 22mg/L Wiluna 2005/6.

Oxidised Nitrogen (nitrate and nitrite): ADWG Health Guideline:Nitrate/Nitrite 50mg/L (Bottle Fed Infants) 100mg/L. A level of 80mg/L was detected in the community of Warrabri in the Northern Territory in 2010.
http://www.powerwater.com.au/__data/assets/pdf_file/0003/47820/IES_Water_Quality_Summary_Final_Art_web_version.pdf
Koroit 2.70mg/L Wannon Water 2009/10. Highest level South Australia 09/10: Port Lincoln 6.52mg/L.

"High nitrate levels may cause a condition (methaemoglobinaemia) in which the capacity of the blood to carry oxygen is reduced (NHMRC-ARMCANZ 1996). This is especially a concern for newly born infants with other complicating conditions" p9 http://www.environment.gov.au/soe/1996/publications/technical/pubs/drinking.pdf

Selenium: ADWG Guideline 0.01mg/L. An element and non-metal mainly found in sulphide ores such as pyrite. 50% of selenium used in the world, is for glass production. *"Selenium and selenium salts are widespread in the environment. Selenium is released from natural and human-made sources, with the main source being the burning of coal. Selenium is also a by-product of the processing of sulfide ores, chiefly in the copper refining industry. The major use of selenium is in the manufacture of electronic components. It is used in several other industries, and selenium compounds are used in some insecticides, in hair shampoos as an anti-dandruff agent, and as a nutritional feed additive for poultry and livestock."* ADWG 2011

Highest Level Power and Water Corporation Northern Territory 2006/7: 0.012mg/L Daly Waters & Mataranka.
Highest Level Goulburn Valley Water 2005/6: 0.006mg/L Kilmore.
Highest Level SA Water 2000-12: 13/03/2000 Warooka 0.015 mg/L, 11/9/00 Warooka 0.013mg/L.

Silver: ADWG Guideline 0.1mg/L. A metallic chemical element, long valued as a precious metal. Silver can be used as a disinfectant.

Turbidity: *Chlorine-resistant pathogen reduction: Where filtration alone is used as the water treatment process to address identified risks from Cryptosporidium and Giardia, it is essential that filtration is optimised and consequently the target for the turbidity of water leaving individual filters should be less than 0.2 NTU, and should not exceed 0.5 NTU at any time. Disinfection: A turbidity of less than 1 NTU is desirable at the time of disinfection with chlorine unless a higher value can be validated in a specific context. Aesthetic: Based on aesthetic considerations, the turbidity should not exceed 5 NTU at the consumer's tap.*

Regulatory Standard: Based on aesthetic considerations, the turbidity should not exceed 5 NTU at the consumer's tap. 5.0 Nephelometric Turbidity Units (NTU's). High levels of turbidity can impact on the disinfection process. (2011 Australian Drinking Water Guidelines)

The highest turbidity reading according to Victorian water quality reports 2007-10 was recorded at the town of Ultima (Grampians Wimmera Mallee Water) 190NTU – 29.6[mean] over the year 2009/10. Highest turbidity levels in Murray River (South Australia) 2009-10, 270 NTU at Mannum WTP and 270 NTU at Mt Pleasant. Highest turbidity level in northern Tasmania 2010/11 was 46NTU in the Lady Barron System.

However North East Water reported immediately after the 2003 bushfires that a staggering turbidity reading of 123,000NTU was recorded at Buckland, in North East Victoria. http://www.wioa.org.au/conference_papers/04/paper9.htm

Dirty Water Costs Taxpayers $1.7m July 18 2011
Seqwater has had to spend an extra $1.7 million to produce Brisbane's drinking water due to the amount of sediment washed into nearby lakes during January's floods.
The organisation has revealed to brisbanetimes.com.au the cost to chemically treat water at the Mt Crosby plants has more than doubled due to the sediment washed into Wivenhoe Dam earlier this year.
Seqwater has stressed the rise in chemical costs from up to $30 per ML to up to $79 per ML would not impact set bulk water prices as both Seqwater and the Water Grid Manager would carry the cost.
But the financial burden on taxpayers may continue for some time, with Water Utilities Minister Stephen Robertson admitting in Parliament last month water quality at Wivenhoe Dam may not improve for another year, "perhaps longer".
Healthy Waterways science director James Udy said the sediment washed into local waterways during the floods was so fine that more chemicals than usual would be needed to properly treat it.
"What has happened now is the entire Wivenhoe is full of this very, very fine particular matter that can take anything up to 50 days to settle," he said.
"[Water treatment plants] are having to use a lot more alum and flocculating agents to actually clean the water up."
http://www.brisbanetimes.com.au/environment/dirty-water-costs-taxpayers-17m-20110715-1hh9v.html

Summary Table – Highest Breaches for Various Health Related Substances (* aesthetic substance)

Substance	Location	Date	Amount	Times over ADWG
Turbidity*	Buckland (Vic)	2003	123,000	24,600
Arsenic	Royal George (Tas)	2010	1.4mg/L	1400
Aluminium*	Hamilton (Vic)	2007-2010	19mg/L	95
Cadmium	Royal George (Tas)	2010	<0.1mg/L	50
Nickel	Esperance (WA)	2007	0.95mg/L	47.5
Fluoride	Brendale, Warner (Qld)	June 2009	30-31mg/L	20 - 20.667
Chlorite	Watchem (Vic)	2007/10	4.2mg/L	14
Bromate	Mt Beauty (Vic)	2004/5	0.2mg/L	10

Lead	Koroit (Vic)	2006/7	0.094mg/L	9.4
Trichloroacetic Acid	Manangatang (Vic)	2010/11	0.860	8.6
Manganese	Springhurst (Vic)	2006/7	2.1mg/L	4.2
THM's	Balmoral (Vic)	2007/8	0.970mg/L	3.88
Barium	Gudabijin (NT)	2010	6.89mg/L	3.445
Dichloracetic Acid	Lalbert (Vic)	2010/11	0.330mg/L	3.3
Chloral Hydrate	Pyalong (Vic)	2010/11	0.065mg/L	3.25
Uranium	Laramba (Napperby NT)	2009	0.044mg/L	2,588
Antimony	Beswick (NT)	2008	0.0075mg/L	2.5
Mercury	Maryborough (Vic)	2009/10	0.002mg/L	2
Nitrate	Kintore (NT)	2009	95.6mg/L	1.912
Acrylamide	Hamilton (Vic)	August 4 2009	0.3mg/L	1.5
Molybdenum	Zeehan (Tas)	2010/11	0.0638mg/L	1.276
Selenium	Daly Waters & Mataranka (NT)	2006/7	0.012mg/L	1.2

4.5 Aesthetic Related Substances

Most breaches to the Australian Drinking Water Guidelines in Victoria, and most likely Australia, are aesthetic breaches.

Alkalinity: No Guideline. Total Alkalinity is a measure of the amount of 'buffering' capacity in water. It acts as a *'shock absorber'* for the pH. If Total Alkalinity is too low, the water is acidic and can corrode plumbing fixtures. If Total Alkalinity is too high, the water is alkaline and scale buildup and cloudy water can result.

Ammonia: Levels should not exceed 0.5mg/L. Ammonia is a nutrient that contains nitrogen and hydrogen. It can cause corrosion to pipes and fittings. Natural factors can affect the concentration of ammonia and include: algal growth, decay of plant or animal material, and fecal matter. Other aspects of nitrogen cycling can also affect the amount of ammonia present. Ammonia can also come from domestic, industrial or agricultural pollution, primarily from fertilizers, organic matter or fecal matter.
Highest Victorian Reading 2005-10. Balmoral 1.2mg/L Wannon Water

Calcium: Calcium is a metallic chemical element which appears commonly found in numerous compounds in the Earth's crust.

Chloride: ADWG Guideline Value. 250 milligrams per litre of drinking water. Chloride is present in natural waters from the dissolution of salt deposits, and contamination from effluent disposal. Sodium chloride is widely used in the production of industrial chemicals such as caustic soda, chlorine, and sodium chlorite and hypochlorite. Potassium chloride is used in the production of fertilisers.
Highest Victorian Reading 2005-10: Coleraine 1300mg/L Wannon Water

Chlorine Dioxide: Should not exceed 0.4mg/L. Used primarily as a disinfectant in water supplies, but is also used in a number of manufacturing industries, including paper production and the leather tanning industry.
Highest Victorian Reading 2005-10: Bemm River 0.64mg/L

Chlorite: Should not exceed 0.8mg/L. Chlorite is used in the production of paper, textiles and straw products, and in the manufacture of waxes, shellacs and varnishes.

Colour: ADWG value 15Hu. True colour is the colour of water after particulate matter has been removed. Colour is mainly due to the presence of dissolved organic matter including humic and fulvic acids.
Highest Victorian Reading 2005-11: Cavendish 200 Wannon Water (2005/6).
Highest Tasmanian Reading 2009-11: Lady Barron 406 (July 2010) & Whitemark 331 (July 2010)

Electrical Conductivity: ADWG value = 1000uS/cm *"The electrical conductivity of water, measured in EC units, increases with the concentration of dissolved solids. Electrical conductivity may be converted to total dissolved solids (TDS) by halving the value (An EC of 1000uS/cm is equivalent to a TDS of 500mg/L)"* Barwon Water Water Quality Report 2010. Highest Victorian Reading 2005-10: Brim 3810EC GWMWater (2008/9)

Hardness: ADWG value = 200mg/L. Hardness is caused primarily by the presence of calcium and magnesium ions. Hard water requires more soap than soft water to obtain lather and can cause scale to form on hot water pipes and fittings. The ADWG states that total hardness (as calcium carbonate) should not exceed 200 mg/L to minimise build-up of scale. Highest Victorian Reading 2005-10: Daisy Hill 940mg/L Central Highlands Water (2007/8)

Iron: ADWG Aesthetic Guideline. 0.3mg/L of drinking water. Iron occurs in soil and rocks and is present in water in oxidised forms. High iron concentrations can give water an undesirable rust-brown appearance and can cause staining of laundry and plumbing fittings.
Highest Victorian Reading 2006-10: Merino 9.4mg/L Wannon Water (2006/7).
Highest Tasmanian Reading 2009-11: Lady Barron System 4.24mg/L March 11

Magnesium: ADWG Aesthetic Guideline Value 0.1m/L, ADWG Health Guideline 0.5mg/L

pH: ADWG value = 6.5 to 8.5 *"The pH value is a measure of hydrogen ion concentration in water. A pH value of 7.0 is neutral, values lower than 7.0 are acidic and values higher than 7.0 are basic. The ADWG (2004) guideline range*

for pH is based on management of assets and is not related to health. According to current literature, a direct relationship between pH and human health is difficult to determine..." Barwon Water Water Quality Report 2010.
Highest Victorian Reading 2005-10: Lethbridge 10.5 (2007/8)
Lowest Victorian Reading 2005-10: Balmoral 4.4 Wannon Water (2007/8)

Sodium: ADWG Aesthetic Guideline Value. 180 milligrams per litre of drinking water. (20mg/L for people with severe hypertension or congestive heart failure).
Highest Victorian Reading 2005-10: Bridgewater 510mg/L Coliban Water (2007/8)

In Aboriginal communities in the Northern Territory *"There are eight communities with average sodium levels above 180mg/L"* Power and Water Corporation 2008

Water quality in remote Aboriginal communities, particularly in Central Australia is of concern. Tap water in Central Australia can be of poor quality due to high water temperature, disinfectant levels, dissolved oxygen and salt problems. Higher temperatures can mean more microbial activity, also meaning more chlorine disinfectant. Water monitoring in these communities does not include monitoring for by the potentially dangerous by-products of chlorine.

Water supplies in remote communities in Central Australia can also be high in salts. The reason being that water is now sourced from 'old water' in deep bores, where the salt content is higher than the traditional water sources which were shallow rain fed springs 'new water' which contained less mineral and salt content. Many communities in the Northern Territory are drinking water with salt content higher than 1000mg/ml – double the guideline set in the ADWG. Other contaminants in water can include uranium, fluoride, iodine and calcium and sodium. High calcium, sodium and phosphate levels have been linked with kidney disease.

Sulphate: ADWG 2011 Guideline: 250mg/L. *Sulphate can occur naturally, but is also used commercially to manufacture numerous products including chemicals, dyes, glass, paper, soaps, textiles, fungicides and insecticides.Sulfate, including sulfuric acid, is also used in mining, pulping, and the metal and plating industries. Barium sulfate is used as a lubricant in drilling rigs for groundwater supply. In the water industry, aluminium sulfate (alum) is used as a flocculant in water treatment, and copper sulfate is used for the control of blue-green algae (cyanobacteria) in water storages.* (ADWG 2011). Sulphate levels of 256mg/L were recorded at the Northern Terrritorian community of Ikuntji (Haasts Bluff) in 2010.

Total Dissolved Solids: Should not exceed 600mg/L. A measure of the combined content of organic and inorganic substances in water. The most common constituents of TDSs are calcium, phosphates, nitrates, sodium, potassium and chloride. Highest Victorian Reading 2005-10: Coleraine 2300mg/L Wannon Water (2008/9). Highest South Australian levels 2009-10, Hawker 2400mg/l.

Zinc: ADWG Aesthetic Guideline 3mg/L. Zinc is a metallic chemical element found in reasonable abundance around the world. It is classified in the transition metals, along with nickel and mercury, among others.

4.6 Pesticides/Pollutants:

"Pesticides and herbicides are not included in compliance testing for many regional towns. The ADWG recommends monthly testing where pesticides have been previously detected or where their use indicates detection would be likely. Considering the proximity to agricultural areas for many of the selected towns, contamination events may be going un-noticed, jeopardising the health of the community. Herbicides were detected in one drinking water supply in Tasmania and the likely source was an adjacent pine plantation. Herbicides have also been detected in water supplies in other parts of Australia." Review of Regional Water Quality and Security Volume 1. Infrastructure Australia October 2010.

Water testing can occur infrequently for pesticides. The range of pesticides used within catchments can also vary widely and users of pesticides are under no obligation to explain to authorities what they are using – although in Victoria records of use have to be maintained for 2 years. Not all pesticides used in Australia have a guideline level under the Australian Drinking Water Standards, however the 2011 ADWG's increased significantly the amount of pesticide guidelines substantially from the 2004 ADWG's.

These concerns were expressed in May 2006 in Gippsland Water's submission to the Review of the Agriculture and Veterinary Chemicals (Control of Use) Regulation 1996; *"Records are kept for the application of restricted chemical products, but not for the other commonly used products that have environmental or health implications. Gippsland Water has had difficulty in obtaining information on the chemicals in use within a catchment area upstream of a Water Treatment plant and town water supply...Currently there is no common record of chemical products that are likely to be applied in agricultural areas within potable water catchments."*

Top Twenty Substances with Lowest Guideline Levels Under 2011 Australian Drinking Water Guidelines (13 are pesticides).

Benzo(a)pyrene	0.00001mg/L	Polycyclic aromatic hydrocarbons (PAHs) found in coal tar, car exhaust fumes, particularly from diesel engines and any smoke.
N-Nitrosodimethylamine (NDMA)	0.0001mg/L	Industrial Solvent.
Acrylamide	0.0002mg/L	Impurity in polyacrylamide -a polymer.
Aldrin/Dieldrin	0.0003mg/L	Organochlorine insecticide. Dieldrin banned 1988, Aldrin banned 1994. Can remain in sediment decades after use.
Heptachlor/Heptachlor Expoxide	0.0003mg/L (limit of determination 0.00005mg/L)	Organochlorine insecticide, banned in Australia in 1997.
Profenofos	0.0003mg/L	Organophosphorus insecticide and miticide, once commonly used on cotton.
Vinyl Chloride	0.0003mg/L	Organochloride also known as VCM or chloroethene. A chemical intermediate.
Fenamiphos	0.0005mg/L	Organophosphorus insecticide particularly used on nematodes and insects.
Epichlorohydrin	0.0005mg/L	Organochlorine compound used in production of glycerol, plastics, epoxy resins and elastomers.
Fipronil	0.0007mg/L	Phenyl pyrazole insecticide used in agricultural and veterinary situations. Used commonly against locusts.
Hexachlorobutadiene	0.0007mg/L	Solvent in chlorine gas production.
Parathion-Methyl	0.0007mg/L	Organophosphate insectide. To be phased out in Australia by 26 July 2013.
Amitrole	0.0009mg/L	Triazol herbicide, used to control grasses, broadleaved weeds, cumbungi and blackberries.
Terbufos	0.0009mg/L	Organophospate insecticide and nematicide and soil fumigant used in agriculture.
Mercury	0.001mg/L	Chemical element used in electric switches, float valves and scientfic equipment eg

		barometers.
Ethoprophos	0.001mg/L	Organophosphorus Insecticide/Nematicide.
Haloxyfop	0.001mg/L	Aryloxyphenoxy Herbicide for control on annual and perennial grasses.
Metham	0.001mg/L	Organophosphorus Insecticide used against nematodes, symphylids and fungal disease. Also used a soil fumigant.
Methyl Bromide	0.001mg/L	Halogenated Organic Fumigant/Herbicide/Insecticide/Nematicide. Used mainly on strawberries.
Omethoate	0.001mg/L	Organophosphorus Insecticide. Metabolite of Dimethoate.
Benzene	0.001mg/L	Organic chemical compound, a basic petrochemical and natural constituent of crude oil.
Tribulatalin Oxide	0.001mg/L	TBTO is an organotin and mainly used as a biocide (fungicide & molluscide), especially for wood treatment.

Guideline Levels For Pesticides Under The 2011 Australian Drinking Water Guidelines.

Acephate 0.008mg/L,	Aldicarb 0.004mg/L,	Aldrin/Dieldrin 0.0003mg/L,	Ametryn 0.07mg/L,
Amitraz 0.009mg/L,	Amitrole 0.0009mg/L,	Asulam 0.07mg/L,	Atrazine 0.02mg/L,
Azinphos-Methyl 0.03mg/L,	Benomyl 0.09mg/L,	Bentazone 0.4mg/L,	Bioresmethrin 0.1mg/L,
Bromacil 0.4mg/L,	Bromoxynil 0.01mg/L,	Captan 0.4mg/L,	Carbaryl 0.03mg/L,
Carbendazim/Thiophanate Methyl 0.09mg/L,	Carbofuran 0.01mg/L,	Carboxin 0.3mg/L,	Carfentrazone-ethyl 0.1mg/L,
Chlorantraniliprole 6mg/L,	Chlordane 0.002mg/L,	Chlorfenvinphos 0.002mg/L,	Chlorothalonil 0.05mg/L,
Chlorpyrifos 0.01mg/L,	Chlorsulfuron 0.2mg/L,	Clopyralid 2mg/L,	Cyfluthrin, Beta-Cyfluthrin 0.05mg/L,
Cypermethrin isomers 0.2mg/L,	Cyprodinil 0.09mg/L,	2,4-D 0.03mg/L,	DDT 0.009mg/L,
Deltamethrin 0.04mg/L,	Diazinon 0.004mg/L,	Dicamba 0.1mg/L,	Dichlorprop/Dichlorprop-P 0.1mg/L,
Dichlorvos 0.005mg/L,	Diclofop-Methyl 0.005mg/L,	Dicofol 0.004mg/L,	Diflubenzuron 0.07mg/L,
Dimethoate 0.007mg/L,	Diquat (ion), Diquat dibromide 0.007mg/L,	Disulfoton 0.004mg/L,	Diuron 0.02mg/L,
2,2-DPA 0.5mg/L,	Endosulfan 0.02mg/L,	Endothal 0.1mg/L,	EPTC 0.3mg/L,
Esfenvalerate 0.03mg/L,	Ethion 0.004mg/L,	Ethoprophos 0.001mg/L,	Etridiazole 0.1mg/L,
Fenamiphos 0.0005mg/L,	Fenarimol 0.04mg/L,	Fenitrothion 0.007mg/L,	Fenthion 0.007mg/L,
Fenvalerate 0.06mg/L,	Fipronil 0.0007mg/L,	Flamprop-Methyl 0.004mg/L,	Fluometuron 0.07mg/L,
Flupropanate 0.009mg/L,	Glyphosate 1mg/L,	Haloxyfop 0.001mg/L,	Heptachlor/Heptachlor Expoxide 0.0003mg/L (limit of determination 0.00005mg/L),
Hexazinone 0.4mg/L,	Imazapyr 9mg/L,	Iprodione 0.1mg/L,	Lindane 0.01mg/L,
Maldison/Malathion 0.07mg/L,	Mancozeb 0.009mg/L,	MCPA 0.04mg/L,	Metaldehyde 0.02mg/L,
Metham 0.001mg/L,	Methidathion 0.006mg/L,	Methiocarb 0.007mg/L,	Methomyl 0.02mg/L,
Methyl Bromide 0.001mg/L,	Metiram 0.009mg/L,	Metolachlor/s-Metolochlor 0.3mg/L,	Metribuzin 0.07mg/L,
Metsulfuron-Methyl 0.04mg/L,	Mevinphos 0.005mg/L,	Molinate 0.004mg/L,	Napropamide 0.4mg/L,
Nicarbazin 1mg/L,	Norflurazon 0.05mg/L,	Omethoate 0.001mg/L,	Oryzalin 0.4mg/L,
Oxamyl 0.007mg/L,	Paraquat 0.02mg/L,	Parathion 0.02mg/L,	Parathion-Methyl 0.0007mg/L,
Pebulate 0.03mg/L,	Pendimethalin 0.4mg/L,	Pentachlorophenol 0.01mg/L,	Permethrin 0.2mg/L,
Picloram 0.3mg/L,	Piperonyl Butoxide 0.6mg/L,	Pirimicarb 0.007mg/L,	Pirimiphos Methyl 0.09mg/L,

Profenofos 0.0003mg/L,	Propachlor 0.07mg/L,	Propanil 0.7mg/L,	Propargite 0.007mg/L,
Propazine 0.05mg/L,	Propiconazole 0.1mg/L,	Propyzamide 0.07mg/L,	Pyrasulfotole 0.04mg/L,
Pyrazophos 0.02mg/L,	Pyroxsulam 4mg/L,	Quintozene 0.03mg/L,	Simazine 0.02mg/L,
Spirotetramat 0.2mg/L,	Sulprofos 0.01mg/L,	Temephos 0.4mg/L,	Terbacil 0.2mg/L,
Terbufos 0.0009mg/L,	Terbuthylazine 0.01mg/L,	Terbutryn 0.4mg/L,	Thiobencarb 0.04mg/L,
Thiometon 0.004mg/L,	Thiram 0.007mg/L,	Toltrazuril 0.004mg/L,	Triadimefon 0.09mg/L,
Trichlorfon 0.007mg/L,	Triclopyr 0.02mg/L,	Trifluralin 0.09mg/L,	Vernolate 0.04mg/L,

Perhaps the most 'stringent' pesticide testing in Australia occurred at the Yarra River offtake to Sugarloaf Reservoir by Melbourne Water for a period of approximately one year. In July 2010 Melbourne Water expanded their testing regimes to over 130 pesticides and numerous pharmaceuticals/antiobiotics. Even so, this range of pesticides may only be half the total of pesticides used within the upper Yarra catchment. Each test would cost Melbourne Water $500 and if carried out once a month over a period of a year, such testing would cost ~$800,000. In many areas of Australia such monitoring would have to be done by local shires who would have to increase water charges to pay for tests. Since implementing the new testing regimes Melbourne Water has detected low levels of the herbicides Triclopyr, MCPA, Metolachlor, Simazine, Atrazine and 2,4-D, plus the insecticide DEET. In January 2011 the first study into pesticides used in the upper Yarra catchment for 30 years detected over 40 pesticides, making the Yarra River arguably the most polluted river in Australia in regards to pesticides. Even so, Melbourne Waters' new pesticide testing range would only detect about 50% of the pesticides detected in the January 2011 study.

Water Supply for Melbourne's Sugarloaf Reservoir includes some of the most intensively farmed land in Australia. Sugarloaf Reservoir can be seen in this image ~25km in the distance.

Utilities Fear The Costs of New Pesticide Testing (November 11 2010)
(The Australian Natasha Bita)
"Water utilities are fighting plans to test for 140 pesticides in the nation's drinking supplies.
A National Health and Medical Research Council committee has set out new pesticide limits in draft drinking water guidelines to be considered by federal, state and territory governments early next year.
Even though testing is not obligatory under the guidelines, utilities are worried about the cost.
Water Quality Research Australia - a national oganisation of water utilities and universities - has complained the draft guidelines include 140 new pesticide values "without any guidance on what to monitor or what pesticides are of concern".
"It would be cost-prohibitive for utilities to monitor all of these," the WQRA says in a submission to the NHMRC's water quality committee.
"If assessment was through evaluating land use, it would be useful/necessary to include pesticides that are for ... specific land uses (and) management practices in each climate zone."
The utilities also object to the cost of providing clearer drinking water, under the NHMRC committee's plan to tighten controls on water turbidity. "There is justfied concern that in order to meet this revised target many water authorities would require substantial capital and operational changes," the WQRA says.
"This significant expenditure would only result in marginal reductions in the risk to public health."
WQRA chairman Michael Moore said yesterday the draft guidelines included new pesticides, and reduced the allowable limits on others.
But he said water authorities in Victoria should not be required to test for pesticides used on banana farms in North Queensland.
"If there's no evidence the pesticide has been used in a particular area, there is no need for a utility to test for it," Professor Moore said.
"We're asking for a rational justification of these (pesticide) measurements."
The Australian revealed yesterday that the NHMRC water quality committee had ditched a new "zero tolerance" plan to prevent faecal contamination of the nation's drinking supplies, after utilities complained that 100 per cent purity would be unrealistic.
The committee had wanted to define water quality as "satisfactory" only if all samples taken had been totally free of E.coli, a bacteria that can indicate sewage in the water."

Pesticides tested by Melbourne Water at the Yarra River Offtake in July 2010. Monitoring for pesticides in the Yarra River since the early 1980's, when Sugarloaf Reservoir was commissioned was essentially non-existent, meaning no records are available showing exactly what is coming down the river. It is highly likely that no other water authority in Australia tests for this range of pesticides. Melbourne Water also tests for pharmaceuticals.

Aldicarb	Aldrin	Allethrin	Ametryn	AMPA	Asulam
Atrazine	Azinphos Methyl	Benalaxyl	Bendiocarb	BHC	Bifenthrin
Bioresmethrin	Bitertinol	Bromacil	Bromophos	Bromoxynil	Cadusafos
Captan	Carbaryl	Carbofenthion	Carbofuran	Chlordane	Chlorpyrifos
Chloropicrin	Chlorothanlonil	Chlorfenvinphos	Chlorpyrifos	Coumaphos	Cypermethrin
Cyfluthrin	Cyprodinil	Dalapon	DDT	DEET	Deltamethrin
Diazinon	Dicamba	Dichloran	Dichlorfluanid	Dichlorvos	Diclofop-Methyl
Dicofol	Dieldrin	Dimethoate	Diquat	Diuron	Endosulfan
Endrin	Esfenvalerate	Ethion	Ethoprophos	Etrimifos	Famphur
Fenamiphos	Fenchlorphos	Fenitrothion	Fenthion	Fenvalerate	Fipronil
Fluometuron	Fluroxypyr	Fluvalinate	Furalaxyl	Glyphosate	Haloxyfop
Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Hexazinone	Iprodione	Isophenphos
lambda-Cyhalothrin	Lindane	Malathion	MCPA	MCPB	Mecoprop
Metalaxyl	Metham	Methidathion	Methiocarb	Methomyl	Metolachlor
Methoxychlor	Methyl Bromide	Metiram	Metribuzin	Nonachlor	Oxadiazon
Oxamyl	Oxychlordane	Oxyfluorfen	Paraquat	Parathion	PCB
Pendimethalin	Permethrin	Phenol	Phenothrin	Phorate	Phosmet
Picloram	Piperonyl Butoxide	Pirimicarb	Pirimphos Methyl	Procymidone	Profenofos

Prometryn	Propanil	Propazine	Propiconazole	Prothiofos	Pyrazophos
Pyrimethanil	Simazine	Sulprofos	Tebuthiuron	Terbufos	Terbutryn
Terbuthylazine	Tetrachlorvinphos	Tetradifon	Tetramethrin	Transfluthrin	Triclopyr
Tri-allate	Trifluralin	Vinclozolin	1,3 dichloropropene	2,4-D	2,4-DP
2,4-DB	3 4 Dichloroaniline				

In terms of water treatment, reverse osmosis filtration and the use of powder activated carbon are regarded as the best options for limiting pesticides in water. However these filtration options are not used by all water authorities across Australia. Indeed the Winneke water treatment plant at Melbourne's Sugarloaf Reservoir, a water supply for 1.5 million people is a conventional treatment plant, not using powder activated carbon or reverse osmosis.

A study conducted in the United States in 2001, Office of Pesticide Programs Science Policy - The Incorporation of Water Treatment Effects on Pesticide Removal and Transformations in Food Quality Protection Act (FQPA) Drinking Water Assessments October 25, 2001. Office of Pesticide Programs United States Environment Protection Agency Washington, D.C. 20460, found that *"EPA's preliminary review of the literature indicates that conventional treatment (such as coagulation/flocculation, sedimentation and filtration) has little or no effect on the removal of mobile (hydrophilic or lipophobic) pesticides. Disinfection and softening can faciltate alteration in the chemical structure of the pesticide, or transformation...Granular activated carbon (GAC), under the SDWA (Safe Drinking Water Act) is the best available technology (BAT) for removing synthetic organic chemicals (SOC); virtually all pesticides are SOCs. Other recommended BATs are aeration technologies for removal of dibromochloropropane and chlorination or ozonation for removal of glyphosate."*

It is also evident that water authorities will not generally test tap water for pesticides. *"SA Water monitors for pesticides in the catchments and raw water sources and only escalates monitoring to the distribution system when relevant levels of pesticides are detected".* SA Water letter 21/9/11

Friends of the Earth has compiled a list of pesticide readings detected in surface waters across Australia from a wide range of scientific paper. The highest pesticide readings for each state are included below

Highest Readings Per State (non domestic water supplies) – according to FoE Research (ug/L refers to parts per billion).

Northern Territory	2001 Darwin	Triclopyr	34ug/L
Queensland	1990 Condamine-Balomee River	Atrazine	2,400ug/L
South Australia	1986 Groundwater Bores	Dieldrin	1.2ug/L
Tasmania	1989-1992 Forestry North West Tasmania	Atrazine	53,000ug/L
Victoria	December 1978 Nufarm (Laverton) Discharge	2,4-D	173,000ug/L
Western Australia	May 1970 – Milk Concentrations - Witchcliffe	Dieldrin	900ug/L
New South Wales	01/10/93 Willbriggie Irrigation (Rice Floodwater)	Molinate	4000ug/L

Willbriggie (20km south of Griffith), located in the Riverina region of NSW in the Murrumbidgee Irrigation District.

Highest Readings Per State Detected in Domestic Water Supply* (based on FoI data from Victoria, South Australia and Western Australia)

State	When and Where	Pesticide	Total	ADWG 2011 Guideline
Northern Territory	?	?	?	?
Queensland	Feb 2002 Dumbleton Weir (Mackay)	Diuron	8.5ug/L	20ug/L
South Australia*	1998 SA Streams draining plantation surrounding Warren Reservoir.	Atrazine	150ug/L	20ug/L
Tasmania	(6/8/93 Advocate Newspaper) Lorinna [In December 2010 5 pesticides were detected in one day in the South Esk system].	Atrazine	12.6ug/L	20ug/L
Victoria	1981/2 Woori Yallock Creek discharge from carrot and potato washing plants approx 40km upstream of Sugarloaf reservoir offtake	Dieldrin	10.36ug/L	0.3ug/L
Western Australia	1980 Lower Helena Catchment	Dieldrin	0.16ug/L	0.3ug/L
New South Wales	1986/7 Coffs Harbour Water Tanks	Dieldrin	1.9ug/L	0.3ug/L

*In terms of pesticide pollution in reservoirs in Australia, an incident in South Australian between 1997-2000, is probably the worst. The herbicides Atrazine and Hexazinone were sprayed onto recently cut logged plantations by

Forestry South Australia. A large portion of the herbicides were washed into surrounding reservoirs after rainfall. The contamination of three reservoirs (Warren, South Para and Barossa) continued through 1997, 1998, 1999 and into 2000. SA Water had to implement treatment using Powder Activated Carbon as a means of filtering out the pesticides, costing $30,000 a month. Barossa Reservoir supplies drinking water to a number of communities to the North of Adelaide, including Gawler. Atrazine was recorded at 150ug/L in streams feeding into Warren Reseroir. The highest level recorded in a reservoir was 43.6ug/L in South Para Reservoir in July 1998. Mean levels of atrazine recorded in Barossa, South Para and Warren Reservoirs between 1998 and 2000 was between 0.7 ug/L and 4.36ug/L.

In terms of atrazine, "*But gender deformities were present among frogs exposed to as little as 0.1 part per billion (picture a thousandth of a grain of salt in a half gallon of water). That's 30 times less than the 3 ppb the USEPA allows in our drinking water."* http://motherjones.com/environment/2011/11/tyrone-hayes-atrazine-syngenta-feud-frog-endangered

Cairns' tap water checked for farming chemicals March 29 2011
CAIRNS will be one of several cities and towns in Queensland whose water supply will be checked for traces of toxic farming chemicals. Scientists from James Cook University are compiling a list of major cities and towns along the central and north Queensland coastline where they believe the drinking water could have potentially harmful chemical residue from herbicides and pesticides. Of particular concern are small towns whose dams are near farming land, where the chemicals are likely to have been used. The researchers will assess the drinking water at each location over the coming dry and next wet season. http://www.cairns.com.au/article/2011/03/29/156311_local-news.html

Green group backs Great Barrier Reef protection Bill (June 5 2009)
By Penny Timms and Cathy van Extel
"An environmental group has welcomed the introduction of the Great Barrier Reef Protection Bill.

The Queensland Government has introduced the Bill into Parliament to regulate farm practices and pesticide use. World Wildlife Fund spokesman Nick Heath says the legislation will help the environment and farmers. "The Government's just released a new estimate that there's over $30 million worth of fertiliser and pesticide going onto the reef every year," he said. "It's going to be great if we can keep that, those really expensive fertilisers and pesticides on the paddock where they can grow a crop, not on the reef turning it into rubble."

Reservoir Pollution first of its kind (The Advertiser 29 January 2001)

"CONTAMINATION of a reservoir by herbicides from a nearby State Government-owned forest was the biggest incident of its kind in Australia, it has been revealed. An SA Water investigation into the pollution throughout 1997 of the Warren Reservoir by chemicals used by Forestry SA could find no comparable incidents interstate or overseas. The inquiry traced large quantities of Atrazine and Hexazinone in the reservoir to clay pellets dropped by helicopters on new pine plantations at the nearby Mt Crawford Forest...Confidential briefings were provided to Dr Armitage, who agreed with departmental advisers that no public notification was required as levels of the herbicides were below guidelines set by the National Health and Medical Research Council. ...The EPA later issued a public warning after levels of Atrazine and Hexazinone in creeks and streams feeding into the reservoir system were found to be six times above the NHMRC guidelines."

State Water Monitoring Coordinating Sub-committee Nov 2000 (South Australia)

"Contamination of the Warren catchment and the Warren, South Para and Barossa Reservoirs by atrazine and hexazinone had been featured in media reports in 1998. Through 1999 and 2000 the concentrations of the two pesticides decreased gradually in the reservoirs. Although activated carbon was used at the Barossa Water Treatment Plant to remove the pesticides low concentrations were detected in some samples.

By September 1999 concentrations at the inlet to the Barossa Water Treatment Plant were consistently below 1.6ug/L and the use of activated carbon was discontinued. The health related guideline value for atrazine was 20ug/L and for hexazinone is 300ug/L. In the latest samples collected in mid August 2000 the concentrations were below detection limits at most most locations and including the inlet and outlet of the Barossa Water Treatment Plant.

There were occasional detections of pesticides throughout the period. The most common were of:

** simazine which was detected in four samples from Gumeracha Weir and in single samples from Little Para River and Reservoir, Torrens Gorge Weir and Tod Reservoir; and*

**hexazinone which was detected in single samples from Little Para River and the River Murray at Murray Bridge, Mannum, Lock 9 and Loxton.*

** Atrazine was detected in one samples of product water from the Hope Valley Water Treatment Plant, endosulfan sulfate in one sample from Gumeracha Weir and dieldrin which is no longer registered for use was detected in one sample from Mt Bold Reservoir.*

The detection of atrazine and hexazinone in product water from the Barossa Treatment Plant, atrazine, in product water from the Hope Valley Treatment Plant (0.5ug/L), dieldrin in Mt Bold Reservoir (0.07ug/L) and the concentrations of hexazinone detected in the Little Para River (5.9ug/L) and the River Murray at Mannum (2.5ug/L) and Lock 9 (2.1ug/L) represented Type 1 incidents. However, the concentrations detected were well below the health related guideline values (atrazine 20ug/L; dieldrin 0.3ug/L; hexazinone 300ug/L) and DHS considered in each case that there was no risks to human health. Except for the results from the Barossa Treatment Plant the pesticide detections were gnerally isolated samples. The remaining detections represented Type 2 incidents."

Atrazine in North Queensland towns water supplies

"Recently, a team from the Australian Centre for Tropical Freshwater Research in Townsville was looking for sources of pollution on the Great Barrier Reef and stumbled across traces of pesticide in the drinking water of some north Queensland towns... The team's leader is researcher Jon Brodie.

***Jon Brodie**: We took some tap water in some places to use as a blank, really, to run through our tests to see that we got zero. And unfortunately we didn't get zero. And so we've got these results, actually, from towns along the coast where we've collected tap water and run it through our analytical procedures. We really don't know what to do with them. They're not part of our project and they're inflammable results.*

***Ian Townsend**: They're inflammable because what they found was atrazine, a weed killer. There's a big debate around the world about whether atrazine is harmful at all, but it's been linked to all sorts of things, from cancer to birth defects. It's banned in Europe because it tends to turn up in drinking water."*

http://www.abc.net.au/rn/backgroundbriefing/stories/2011/3272878.htm#transcript

Herbicide in Drinking Water Safe

"The Burdekin Shire Council says it does have traces of the farm chemical Atrazine in its town water supply, but well below safe drinking guidelines. The Australian Centre for Tropical Freshwater Research (ACTFR) says Atrazine has been found in large quantities in north Queensland rivers and poses a public health risk because it has polluted town water supplies. The chemical is used by cane farmers to control weeds and is also a known carcinogen."

http://www.abc.net.au/news/stories/2009/04/22/2549181.htm?site=farnorth

Weed firm axed after trees die (The West Australian 17/8/07)
"Joondalup City Council has sacked its weed sprayer amid investigations into thousands of tree deaths and concerns that groundwater in the northern suburbs may have been contaminated by strong herbicides.
The weed spraying contractor, Turfmaster, has refused to comment on the termination of its contract.
The council has refused to release a report on an investigation into the deaths of trees and vegetation.
The Department of Environment and Conservation is continuing a seperate inquiry after a spate of tree deaths in Joondalup and Stirling, including reports of dying mature tuarts possibly up to 200 years old.
Stirling also contracts its weed spraying to Turfmaster, with a council report in June revealing historic trees had been killed after its switched to the longer-lasting chemical herbicide hexazinone in May last year.
The DEC said the departments of health, agriculture and water, as well as the Water Corporation, were involved in its investigation.
The inquiry was examining whether the use of hexazinone, which was sprayed in drainage sumps in Joondalup and Stirling, had caused the tree deaths. There was also a detailed groundwater testing program.
The DEC said there did not appear to be any health concerns "at this stage" and all councils had been advised of the potential problems with the chemical, which was expected to break down over a few months."
http://www.highbeam.com/doc/1G1-167672956.html

Top Dozen Australian Pesticides In Drinking Water Catchments Events (Draft)

Date	Location	Pesticide	Comparison to 2011 ADWG
June 1982-August 1982	Woori Yallock Creek - Vic (Highest Reading) Washing Flow (discharge from carrot [+potato] washing plants)	Dieldrin 10.36ug/L	34.5 x 2011ADWG
1998	Warren Reservoir – stream draining recently sprayed pine plantation	Atrazine 150ug/L (highest level recorded in downstream reservoir 43.6ug/L)	7.5 x 2011 ADWG
1986-87	Coffs Harbour NSW Tank Water	Dieldrin 1.9ug/L	6.333 x 2011 ADWG
1986-87	Coffs Harbour NSW Tank Water	Dieldrin 1.3ug/L	4.333 x 2011 ADWG
20/8/07	Wingecarribee WFP NSW	Triclopyr 80ug/L	4 x 2011 ADWG
1986	SA Engineers & Water Supply Department Bores	Dieldrin 1.2ug/L	4 x 2011 ADWG
1986-87	Coffs Harbour NSW Tank Water	Dieldrin 1.15ug/L	3.833 x 2011 ADWG
June 1982-August 1982	Woori Yallock Creek Storm Highest Reading - Vic	Dieldrin 1.14ug/L	3.8 x 2011ADWG
1977	SA Engineers & Water Supply Department Bores	Aldrin 1.2ug/L	3.333 x 2011 ADWG
1986-87	Coffs Harbour NSW Tank Water	Dieldrin 1ug/L	3.333 x 2011 ADWG
June 1982-August 1982	Woori Yallock Creek Low Flow Highest Reading - Vic	Dieldrin 0.96ug/L	3.2 x 2011ADWG
1982	SA Engineers & Water Supply Department Rainwater Tanks	Dieldrin 0.88ug/L	2.933 x 2011 ADWG

"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". Power and Water Annual Report 2007

"In 2007 the herbicide glyphosate was used to control the noxious aquatic weed Olive hymenachne in Darwin River Reservoir. The reservoir's water was monitored during and after this exercise and glyphosate was not detected". Power and Water Water Quality Report 2008

"Dicamba (Banvel, 3,6-dichloro-2-methoxybenzoic acid) is a moderate to low toxicity herbicide used to control weeds and mimosa in the Darwin River Reservoir catchment. Dicamba is moderately persistent in soil and breaks down to very simple substances such as carbon dioxide and water. Its reported half-life in soil ranges from one to six weeks. This herbicide is applied two - three times a year as part of the mimosa control program. usually pesticide monitoring is executed in conjunction with weed management programs to ensure pesticide levels remain within 2004 ADWG values, but this was not achieved during the 2008-09 period.Dicamba is also used in the Manton River Reservoir catchment and monitoring of this reservoir showed Dicamba levels to be below the level of detection". Power and Water Corporation Water Quality Report 2009

Herbicides are also registered for use to control aquatic weeds in irrigation regions throughout Australia.

Table 2.10: Chemicals used for weed control by Murray Irrigation (NSW) 2002/03-2006/07

Chemical		2001/2	2002/3	2003/4	2004/5	2005/6	2006/7
Propon*	Kg	250	400				
Dye	L	35	25	17	250	45	95
Amitrole T	L	1,940	0	160	740	2,900	200
Roundup CT	L	1,360	420	640	1,460	2,040	1,540
Roundup Max*	L	640	0	200			
Roundup 360	L	-	-	-	-	540	80
Kamba	L	-	200	200	320	540	380
Amicide	L	1,000	40	-	-	-	-
Roundup Biactive	L	4,700	920	1,360	1,880	3,860	2,100
Grazon	L	80	0	0	0	0	20
Surpass*	L	600	0	680	-	-	-
Simazine	L	-	-	-	-	200	120
Arsenal	L	-	-	-	-	960	1,040
Acrolein	Kg	7,235	0	5,880	5,350	7,392	187

*Chemical no longer in use
Source: http://www.murrayirrigation.com.au/files/3291065.pdf

4.6.1 Other Organic Compounds in Source Water

Water authorities can test for a range of organic compounds in source water. As with pesticides, such testing can occur on a monthly basis, an annual basis or not at all. Organic compounds include a range of industrial chemicals as well as by-products from the petroleum industry. With the increase of gas exploration occurring across Australia, a range of these substances occurring in drinking water is a distinct possibility.

Top 20 Substances with Lowest Guideline Levels Under 2011 Australian Drinking Water Guidelines (excluding pesticides*)

Benzo(a)pyrene	0.00001mg/L	Polycyclic aromatic hydrocarbons (PAHs) found in coal tar, car exhaust fumes, particularly from diesel engines and any smoke.
N-Nitrosodimethylamine (NDMA)	0.0001mg/L	Industrial solvent.
Acrylamide	0.0002mg/L	Impurity in polyacrylamide - a polymer.
Vinyl Chloride	0.0003mg/L	Organochloride also known as VCM or chloroethene. A chemical intermediate.
Epichlorohydrin	0.0005mg/L	Organochlorine compound used in production of glycerol, plastics, epoxy resins and elastomers.
Hexachlorobutadiene	0.0007mg/L	Solvent in chlorine gas production.
Mercury	0.001mg/L	Chemical element used in electric switches, float valves and scientfic equipment eg barometers. Was also used in old goldmines.
Benzene	0.001mg/L	Organic chemical compound, a basic petrochemical and natural constituent of crude oil.
Tribulatalin Oxide	0.001mg/L	TBTO is an organotin and mainly used as a biocide (fungicide & molluscide), especially for wood treatment.
Cadmium	0.002mg/L	Chemical element. Byproduct of zinc production.
Carbon Tetrachlorine	0.003mg/L	Chlorine disinfection byproduct
Antimony	0.003mg/L	Chemical element. Additive with chlorine and bromine containing fire retardants. Allot material for lead and tin.
1,2-dichloroethane	0.003mg/L	Chemical compound used mainly to produce vinyl chloride monomer.
Styrene (Vinyl Benzene)	0.004mg/L	Organic compound derivative of benzene. Precursor to poly styrene.
Dichloromethane (methylene chloride)	0.004mg/L	Organic compound commonly used as a solvent.
Arsenic	0.01mg/L	Chemical element which occurs commonly with many minerals.
Lead	0.01mg/L	Main group element in the carbon group.
Selenium	0.01mg/L	Chemical element, used commonly in glassmaking and pigment production.
Di(2-ethylhexyl) phthalate	0.01 mg/L	Placticiser
Trichloroacetaldehyde (chloral hydrate)	0.02mg/L	Sedative and chemical reagent. Chlorine Disinfection byproduct.
2,4,6-trichlorophenol*	0.02mg/L	Chlorinated phenol and has been used as a fungicide, herbicide, insecticide, antiseptic, defoliant and glue preservative.
Bromate	0.02mg/L	Chemical compound formed in water supplies through ozone and bromide.
Nickel	0.02mg/L	Chemical element commonly used in production of nickel steel and in magnets

Guideline Levels for contaminants under the 2011 ADWG. (descriptions sourced from 2011 Australian Drinking Water Guidelines).

Acrylamide	0.0002mg/L	Impurity in polyacrylamide
Benzene	0.001mg/L	Benzene is present in petrol, and motor vehicle emissions constitute the main source of benzene in the environment. The major sources of benzene in water are atmospheric deposition, chemical plant effluent and underground petrol storage tank leakage. When released to surface waters, benzene rapidly volatilises to the air.
Beryllium	0.06mg/L	

Chlorobenzene	0.3mg/L	A Solvent
Dichlorobenzenes		Dichlorobenzenes are widespread in the environment and may be present in drinking water though spills and discharges, from atmospheric deposition, or by contact with contaminated soils. 1,4-DCB is used in toilet blocks to deodorise air, and as a moth repellent, and is widely diffused in the environment. 1,3-DCB is a minor fumigant and insecticide and can be formed from incomplete combustion of waste. 1,2-DCB is used primarily as a chemical intermediate for dyestuffs and pesticides:
1,2-dichlorobenzene (1,2-DCB)	1.5mg/L	
1,3-dichlorobenzene (1,3-DCB)		
1,4-dichlorobenzene (1,4-DCB)	0.04mg/L	
Dichloroethanes		The major use for 1,2-dichloroethane is in the production of vinyl chloride. It is also used in the production of other solvents, and can be used as a lead scavenger in petrol. 1,1-dichloroethane is used in the commercial production of 1,1,1-trichloroethane, as a solvent in paints, and as a varnish and finish remover).
1,1-dichloroethane		
1,2-dichloroethane	0.003mg/L	
Dichloroethenes		(1,1-DCE is used as a chemical intermediate in the manufacture of chloroform and polyvinylidene (PVDE) polymers. 1,2-DCE is also used as an intermediate in the manufacture of chlorinated solvents, and as a solvent. It can occur as two isomers, the *cis* and *trans* forms).
1,1-dichloroethene (1,1-DCE)	0.03mg/L	
1,2-dichloroethene (1,2-DCE)	0.06mg/L	
Dichloromethane (methylene chloride)	0.004mg/L	Dichloromethane is a widely used organic solvent. It can be found in paints, insecticides, degreasing agents, cleaning fluids and paint strippers.
1,3-Dichloropropene	0.1mg/L	
Epichlorohydrin	0.0005mg/L	Used in the manufacture of glycerine and unmodified epoxy resins, including resins used in water treatment (polyelectrolytes).
Ethylbenzene	0.3mg/L	Ethylbenzene occurs naturally as a component of crude oil and is present in petrol, but in small quantities. It may be present in drinking water following pollution of source water. Ethylbenzene is produced commercially by the alkylation of benzene with ethylene, and by fractionation of petroleum. It is a major component of commercial xylene and is used commercially in paints,insecticides and blends of petrol. It can also be found as a constituent of asphalt and naphtha.
Ethylenediamine tetraacetic acid (EDTA)	0.25mg/L	EDTA is a metal-complexing agent and may act to mobilise some heavy metals in the environment. EDTA is used widely in industry and agriculture. It is used in laundry detergents, water softening,electroplating, textile and paper production, as a food additive, and in cosmetics. Most of these uses will result in the release of EDTA to the aquatic environment. It is also used as a drug in chelation therapy, particularly in cases involving lead poisoning.
Formaldehyde	0.5mg/L	Formaldehyde is used industrially in the wood, paper and textile industries. It is also used in the production of a number of chemicals and for the preservation of biological material. It is occasionally used as a disinfectant, sometimes to disinfect water filters. Other sources of exposure include cigarette smoke and food.
Hexachlorobutadiene	0.0007mg/L	Hexachlorobutadiene is used as a solvent in chlorine gas production, an intermediate in the manufacture of rubber compounds, a lubricant, a pesticide and a fumigant.
Hydrogen Sulphide	0.05mg/L	Hydrogen sulfide is formed in drinking water by the hydrolysis of soluble sulfides, or through the reduction of sulfate by the action of microorganisms. Both processes require anoxic conditions. In well-oxygenated water, sulfide will be chemically or biologically oxidised to sulfate or elemental sulfur, and concentrations are extremely low. Higher concentrations can occur in anoxic water drawn from deep storages.
Iodine/Iodine	0.5mg/L	The element iodine is present naturally in seawater, nitrate minerals and seaweed, mostly in the form of iodide salts. It may be present in water due to leaching from salt and mineral deposits. Iodide can be oxidised to molecular iodine with strong disinfectants such as chlorine. Molecular iodine solutions are used as antiseptics and as sanitising agents in hospitals and laboratories. Iodine is occasionally used for the emergency disinfection of water for field use but is not used for disinfecting larger drinking water supplies. Iodide is used in pharmaceutical and photographic materials.

Nitrilotriacetic acid (NTA)	0.2mg/L	NTA is a chelating agent and forms soluble metal complexes with a number of metal ions including calcium and magnesium. It is used in laundry detergents as a replacement for phosphate, particularly in countries where legislation restricts the use of phosphate-based detergents. It is also used in the treatment of boiler water to prevent scale formation, and in the photographic, metal plating, textile manufacturing, and paper and cellulose industries.
N-Nitrosodimethylamine (NDMA)	0.0001mg/L	NDMA is used as an industrial solvent, an anti-oxidant, a rubber accelerator, and in the preparation of polymers, where it may be used as an initiator or a plasticiser. The compound has been used in the production of rocket fuel, as a biocide for nematodes, and an intermediate for 1,1-dimethylhydrazine to inhibit nitrification of soils.
Tribulatalin Oxide	0.001mg/L	The dialkyltins are widely used as stabilisers in plastic, and may leach out of PVC water pipes for a short time after installation.Tributyltins are used as biocides and have occasionally been detected in raw water in Canada, the United States, the United Kingdom and Switzerland, probably because of their use as antifouling agents on boats. The use of tributyl-organotin compounds, particularly tributyltin oxide, in antifouling paints has now been banned in a number of countries because it is extremely toxic to aquatic life. Tributyltin is also used as a biocide in boiler waters.
Plasticisers Di(2-ethylhexyl) phthalate	0.01 mg/L	DEHP is the most widely used plasticiser. It is also used as a replacement for polychlorinated biphenyls (PCBs) in electrical capacitors. DEHA is used as a lubricant and in hydraulic fluids. Exposure to DEHP and DEHA is widespread because of the broad range of products using these plasticisers. Food is the major source of exposure, and it has been estimated that adult daily intake of DEHP and DEHA, as a result of consumption of food in contact with plastic products, is 0.2 mg to 16 mg.
Polyhexanide	0.7mg/L	Polihexanide is a disinfectant used to control microorganisms in veterinary hospitals and animal accommodations, and as a sanitiser for milk-handling equipment.
Polycyclic aromatic hydrocarbons (PAHs)		
Benzo(a)pyrene	0.00001mg/L	The polycyclic aromatic hydrocarbons are a large group of organic compounds with two or more fused aromatic rings. Several hundred have been identified in air, emitted from various combustion and pyrolysis sources. The principal PAHs include phenanthrene, fluoranthene, pyrene, anthracene, benzo(a) pyrene, benzofluoranthene, chrysene, anthanthrene and naphthalene. PAHs are widespread throughout the environment. They are formed in forest fires and in the combustion of fossil fuels, and are present in emissions from coke ovens, aluminium smelters and motor vehicles. Contamination of drinking water can occur by direct atmospheric deposition and by leaching from bituminous liners in water distribution systems.
Silica	80mg/L	The deposition of silica from solutions can occur via various mechanisms. The deposition of silica that can cause the most problems for the water industry is via silica's ability to deposit on solid surfaces that have hydroxyl (OH) groups present. Surfaces that commonly have hydroxyl groups present are glass and metallic surfaces. For example, dissolved silica will react with the surfaces of glass and begin to form a white precipitate. The silica forms silicates on the surface, resulting in silica build-up. In cases where customer complaints occur due to scale build-up, water hardness and silica concentrations should be investigated to determine the cause. Styrene (Vinylbenzene) 0.004mg/L Styrene is used in the production of plastics and resins. It has been detected in food packaged in polystyrene containers. However, improvements in the use of polystyrene since 1980 have resulted in substantial decreases in the release of the monomer. Tetrachloroethene 0.05mg/L Tetrachloroethene is used as a solvent in the dry-cleaning industry. It may be present in drinking water through contamination of water sources by spills or discharges. Toulene 0.025mg/L Toluene occurs naturally as a component of crude oil and is present in petrol. It can enter water sources through atmospheric deposition, by leaching from synthetic coatings used to protect storage tanks, and by point-source pollution.
Styrene (Vinyl Benzene)	0.004mg/L	Styrene is used in the production of plastics and resins. It has been detected in food packaged in polystyrene containers.
Tetrachloroethene (also known as tetrachloroethylene or perchloroethylene)	0.05mg/L	Tetrachloroethene is used as a solvent in the dry-cleaning industry. In the US water authorities in Massachusetts installed vinyl-lined (VL) asbestos-cement (AC) water pipes to solve alkalinity problems in their distribution systems .
1,1,1-Trichloroethane		It is widely used as a cleaning solvent, and is used to clean electrical equipment, motors, electronic components, printed circuit boards, photographic film, and various metal and plastic parts. It is also used as a lubricant in metal-cutting oils and as a component in inks, correction fluid and drain cleaners.
Trichlorobenzenes	0.03mg/L	

1,2,3-trichlorobenzene (1,2,3-TCB)		
1,2,4-trichlorobenzene (1,2,4-TCB)		
1,3,5-trichlorobenzene (1,3,5-TCB)		
1,3,5-trichlorobenzene (1,3,5-TCB)		Industrial-grade TCB is more than 90% 1,2,4-TCB with the remainder 1,2,3-TCB. The compound has a wide variety of uses. It is used as a solvent for high-melting products, an electrical coolant, a lubricant and an insecticide, and in polyester dyeing and termiticide preparations.
Toulene	0.8mg/L	Toluene occurs naturally as a component of crude oil and is present in petrol.
Vinyl Chloride	0.0003mg/L	Vinyl chloride is used industrially in the production of poly vinyl chloride (PVC), which has wide application in the plastics, rubber, paper and glass industries. Vinyl chloride may be present in drinking water through pollution of water sources by chemical spills. Water bottled and stored for long periods in PVC containers may contain very low concentrations of vinyl chloride. It has occasionally been detected in drinking water supplies that use PVC pipes in the United States and Germany, with a maximum reported concentration of 0.01 mg/L. In Australia there are stringent requirements on the maximum permissible residual vinyl chloride concentrations in PVC pipes and fittings.
Xylenes	0.6mg/L	Xylenes occur naturally as a component of crude oil and are present in petrol, but in small quantities. They can enter water from accidental spills and from solvents used in adhesives for bonding plastic drinking water fittings. Studies overseas have reported drinking water concentrations in the range 0.0001 mg/L to 0.01 mg/L. Xylenes are produced in the petroleum refining process and are used in the manufacture of insecticides, pharmaceuticals, detergents, paints, adhesives and other products. They are readily biodegraded in surface waters and they volatilise to air very quickly.

Benzo(a)pyrene has been detected at least two times in Victorian water supplies over the past few years. It was detected in the Goulburn Valley Water network at Kyabram 13/4/05 at 0.003ug/L and Pyalong 14/2/06 at 0.003ug/L. *"The issue has also been raised with the Department of Health who has advised that their senior water quality manager can only recall one incident where BAP's have been found in drinking water. It was found in this case to be an issue with coal-tar lined water mains leaching small amounts of BAP's into the drinking water"* [pers comm 14 September 2009]. Goulburn Valley Water also detected Carbon Tetrachloride 0.5ug/L (Nathalia offtake 19/10/05) – major use in the commercial production of chlorofluorocarbons which are used in refrigerants, foam-blowing agents and solvents. It is also used in the manufacture of paint and plastics. In regards to Carbon tetrachloride, as of 14 September 2009, 20 results across Victoria had been detected at <3ug/L, with many more results <1ug/L.

These substances were also detected by Wannon Water;

Acrylamide at 0.3ug/L at Hamilton on August 4 2009 (1.5x the Australian Drinking Water Guideline). Ethyl Benzene was detected at 0.001mg/L at Sandford and Casterton on November 9 2011, at the Australian Drinking Water Guideline. M&P-Xylene at Dartmoor (0.0003mg/L) and o-Xylene at Dartmoor (0.002mg/L) on November 3 2009.

1,1,1-Trichloropropan-2-one 4ug/L [mean 1ug/L] (Exact Location?)
1,1-Dichloropropan-2-one 4ug/L [mean 1ug/L] (Exact Location?)
1,3-Dichloropropan-2-one 1ug/L [mean 1ug/L] (Exact Location?)
Tributyltin as Sn at Warrnambool Headworks and Storage 10ng/L August 9 2011.
Chloropicrin 1ug/L [mean 1ug/L] (fumigant and nematicide) (Exact Location?)

The following list shows the range of organic compounds that Victorian water authority, Goulburn Valley Water test for and are an example of the extent of testing that should be done by all water authorities. Note that many of these substances do not have guidelines set under the Australian Drinking Water Guidelines.

Polycyclic Aromatic Hydrocarbons (PAH's), Organic Chemicals/Compounds, Trihaolmethanes, Organochlorides, Chlorinated Hydrocarbons, chlorinate derivative of phenols, aromatic hydrocarbons, Polychlorinated Biphenols (PCB's), chlorocarbons, halomethanes, chlorinated phenol.

Acenaphthene, Acenapthylene, Anthracene, Benzene, Benzo-[a]-pyrene, Benzo-[a]-anthracene, Benzo-[b,k]-fluoranthene, Benzo-[g,h,i]-perylene, Bromodichloromethane, Carbon tetrachloride, 2-chlorophenol, Chrysene, Dibenzo-[a,h]-anthracene, Dibromochloromethane, 1,1-dichloroethene, 1,2-dichloroethane, 2,4-dichlorophenol, Ethyl Benzene, Fluoranthene, Fluorene, Indeno-[1,2,3-cd]-pyrene, 1-methylnapthalene, 2-methylnapthalene, Napthalene, PCB Congener C101, PCB Congener C118, PCB Congener C138, PCB Congener C153, PCB Congener C180, PCB

Congener C28, PCB Congener C52, Phenanthrene, Pyrene, Tetrachloroethene, Toluene, Tribromomethane (Bromoform), Trichloromethane (Chloroform), 2,4,6-trichlorophenol, Xylene, meta & para, Xylene, ortho.

Water pollution known for months (Adelaide Now March 31 2010)
"INVESTIGATIONS show groundwater in Edwardstown was contaminated 18 months before the public was warned. It has also been revealed that AEC Environmental, the company testing residential groundwater for the Environmental Protection Authority, is also employed by developers of the former Hills site...EPA consultants had found groundwater contamination at 24 times the acceptable drinking water standard in residential Edwardstown on August 29, 2009...Both the EPA and Environment Minister Paul Caica, defending an 18-month delay in informing 2200 households of the contamination and health risk, have stated it was in August 2009 that they first became aware of only the "potential for contamination" due to the detection of polluted groundwater at the former Hills Industries site...WATER samples taken from a purpose-sunk test site at Railway Tce, Edwardstown, on August 29, 2009, found tetrachlorohene at a rate of 0.960mg/litre, 24 times the acceptable level of 0.04mg/l. THE same site revealed excessive levels of two more trihalomethane (THM) compounds at that time and is the only site where the dangerous carcinogen, vinyl chloride, has been detected outside the former Hills Industries site. The vinyl chloride level was 0.0009mg/l, three times the acceptable level of 0.0003mg/l. TESTS at the site on March 1, commissioned by The Advertiser, found a chemical, dibromochloromethane, at twice the acceptable level. That chemical was not detected in any of the testing by AEC. The discovery led to a request from the EPA to testing lab CRC CARE to promptly notify the authority of the findings or face a potential fine. A TEST site in Ingliss St, two residential blocks west of the former Hills site, on July 22, 2010, revealed tetrachloroethene at a rate of 0.210mg/l, more than four times the drinking standard guideline. TRIHALOMETHANE compounds have been found at eight other sites in the residential area in testing which began last July. TESTING in December found tetrachloroethene and 1.2dichlorethene at unacceptable levels in Daly St, west of Towers Tce - at the outer limit of the testing zone to date. TEST results for the Hills site dating back to November 2008 show a number of areas where the concentration of vinyl chloride was significantly above acceptable levels - up to 23 times over - with a reading of 0.0069mg/l just metres from the site's western boundary."

Tap water warning for residents of The Gap
Residents of the Brisbane suburb The Gap have been asked to avoid drinking tap water over concerns that fire fighting foam may have contaminated the supply.It's believed the foam may have infiltrated the water supply after Queensland Fire and Rescue attended a house fire on Dungory Street last night...CEO of Queensland Urban Utilities Ian Maynard says they were alerted to the potential contamination when residents in the area reported foamy water running from their taps early on Wednesday." http://www.abc.net.au/local/stories/2011/09/21/3322890.htm

Infrastructure damage hits drinking water supply January 14 2011
"Parts of southeast Queensland are running out of drinking water with the flood damaging vital water-delivery infrastructure. There are four main dams in the Lockyer Valley, all of which get their main water supply from Wivenhoe Dam, but treatment plants at all of them have been affected by the floodwaters."
http://www.theaustralian.com.au/news/nation/infrastructure-damage-hits-drinking-water-supply/story-e6frg6nf-1225987410700

Other Organic Compound Issues:

PFOS/PFOA (Perfluorooctanoic acid) Used in the production of Teflon and Gore-Tex.

"It appears little or no studies have been done on testing levels PFOS/PFOA's in drinking water supplies in Australia". pers comm. PFOA has been found in the blood of 98% of Americans.

Concentrations of PFOS, PFOA and other perfluorinated alkyl acids in Australian drinking water
Health Streams Issue 63 Public Health Newsletter of Water Quality Research Australia September 2011
Thompson, J., Eaglesham, G. and Mueller, J. (2011) Chemosphere, 83(10); 1320-1325.

"Perfluorinated alkyl acids (PFAAs) and their anions such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) are persistent anthropogenic chemicals which are ubiquitous in the environment. Concerns have been raised regarding their bioaccumulation and possible health effects and therefore understanding routes of human exposure is necessary. Australia does not have a record of local PFAA manufacturing and has a relatively small inventory of PFAAs, however measurements of human serum in Australia suggests a background contamination similar to that found internationally, including countries that are more populous and those with a history of PFAA manufacturing. PFAAs may be resistant to water treatment processes, making drinking water a potential source of human exposure...Samples were collected directly from drinking water taps in several batches between August and November 2010 at 34 locations ... PFOS and PFOA were the most commonly detected PFAAs and were quantifiable in

49% and 40% of samples respectively, and were typically found at the highest concentrations of the PFAAs. PFHxS was also detected in 27% of samples and at concentrations generally less than PFOS but higher than PFOA. All samples showed low concentrations of PFAAs, with a greater percentage of non-detects... relative to detection. There were three sites in Sydney: Blacktown, Quakers Hill and North Richmond that all had relatively high PFAAs concentrations, up to 36 ngL-1 in North Richmond and 12 ng L-1 in Quakers Hill. Two samples from regional NSW, Gundagai and Yass also had relatively high concentrations with PFAAs around 12 ngL-1. Samples collected from Glenuga, SA had an average ΣPFAAs of 28 ngL-1 due to relatively high concentrations of PFHxS (13 ngL-1) and PFOA (15 ngL-1).

The concentrations found in this study were well below the currently available provisional guidelines suggested by the US EPA (500 ng L-1 and 200 ng L-1 for PFOA and PFOS respectively), as well as those set by the German Drinking Water Commission (300 ng L-1 for combined concentrations of PFOS and PFOA) and other international authorities. The concentrations measured in this study were on par with those measured in China, USA and Brazil, corresponding with the lower ranges of concentrations measured in these international studies"

Method and application of Environmental Impact Assessment for Emissions from Tires
Elin Einarson Thesis 2009-05-07 Department of Technology and Society Environmental and Energy Systems Faculty of Engineering Lunds Tekniska Högskola

The environmental risks with emissions of the chemicals
6PPD [N-(1,3-Dimethylbutyl)-N'-Phenyl-1,4-PhenyleneDiamine],
IPPD [N-Isopropyl-N'-Phenyl-p-PhenyleneDiamine] and benzo(a) pyrene are in this case study were assessed with help of OMNIITOX and emission calculations.
The results shows:
- Car tyre issuance of 6PPD contributes to a four times larger potential freshwater Ecotoxicity compared to benzo(a)pyrene.
- The biggest party of the particle emissions are released to water, this is probably also true for the molecular fraction.
- Benzo(a)pyrene tyre emission contributes to 4% of all particle emissions from the traffic. This is the biggest non-exhaust emission source.
- Tyre emissions are a potentially big source of the aromatic amines 6PPD and IPPD, as they occur in large amounts .

Study links chemical to Cape vision woes cmccormick@capecodonline.com
http://www.capecodonline.com/apps/pbcs.dll/article?AID=/20120716/NEWS/207160316
July 16, 2012

Cape Codders who were exposed during childhood to a chemical solvent in their drinking water have an increased likelihood of vision problems, according to Boston University researchers.

The study, which was published Wednesday in the journal Environmental Health Perspectives, is the latest in a BU series that has explored links to birth defects, mental health problems and addictions among people exposed to tetrachloroethylene (PCE) through drinking water in eight Cape towns.

It found exposed individuals exhibited poorer color-discrimination abilities than unexposed people. The 29 exposed subjects, who were all born between 1969 and 1983, had more problems lining up a group of colored caps on a full color spectrum than the 25 who were not exposed, lead researcher Ann Aschengrau said.

She recommends further investigation into the visual impairments associated with PCE exposure, which appear to be lifelong.

A neurotoxin, PCE was used to apply the vinyl liner of hundreds of miles of drinking water pipes in Massachusetts, mainly in the 1970s.

The pipes in Cape towns in the study were all fitted with a vinyl liner that was improperly cured, BU officials say.

Exposure to PCE came not just by drinking water carried by the pipes but also by inhaling vapor during showering and even absorbing water through the skin while bathing, researchers say.

Aschengrau, a professor of epidemiology at Boston University School of Public Health, has focused her PCE studies on people exposed from gestation through age 5.

Previously released studies showed that the leaching pipes were linked to an increased risk of some types of birth defects as well as illicit drug use and post-traumatic stress disorder.

"This adds to a number of different effects she's observed," said Julia Brody, executive director of the Silent Spring

Institute in Newton, which is studying whether Cape breast cancer rates are linked to contaminants in the environment and water.

Aschengrau's studies did not find a connection to low birth weight, prematurity, miscarriage, learning disorders or depression.

"This accidental exposure on the Cape luckily is over," Brody said. But "this is a chemical people can be exposed to many other ways."

The Cape's pipes were flushed and no longer leach PCE, but the solvent is still used in dry cleaning and metal degreasing solutions, Aschengrau said.

From there it ends up in drinking water supplies.

Although the pool of people studied by Aschengrau is small, the sampling represents a unique opportunity in environmental research to examine the effects of toxic exposure in a defined period of time, Brody said.

The connection between PCE and eye problems has been noticed by other scientists as well.

"Visual abnormalities have been seen among (people) occupationally exposed to" PCE, including people living above a dry-cleaning store in New York City, Aschengrau said.

She called the new study "another piece of evidence" showing PCE to be a dangerous chemical.

The acceptable level of PCE in drinking water used to be 40 parts per billion; it has now decreased to 5ppb, she said.

"We just need to remain vigilant about the quality of our drinking water," Aschengrau said.

Supported by the National Institute of Environmental Health Sciences Superfund Research Program, the study focused on the towns of Barnstable, Bourne, Brewster, Mashpee, Chatham, Falmouth, Provincetown and Sandwich.

5. Endocrine Disruption

Endocrine Disruptors are chemicals that infer with the endocrine or hormone system in animals and humans. Disruptions to the hormone system can create health problems including increasing risk of cancer, developmental changes and even birth defects. The most critical period for animals and humans in regards to hormone product is the transition from fertilised egg to fully formed infant. According to Wikipedia, *"Endocrine disruptors are substances that "interfere with the synthesis, secretion, transport, binding, action, or elimination of natural hormones in the body that are responsible for development, behavior, fertility, and maintenance of homeostasis (normal cell metabolism)."They are sometimes also referred to as hormonally active agents, endocrine disrupting chemicals,or endocrine disrupting compounds (EDCs)".*

The herbicide Atrazine induces gonadal malformations in males. The testes in this Northern leopard frog have been feminized. Not only have eggs developed,but they have accumulated yolk and are bursting through the surface of the testes. (Source: http://www.atrazinelovers.com/m4.html – website of Professor Tyrone B Hayes – Univeristy of California).

An increasing body of scientific research is finding endocrine disruptors in a range of materials including pharmaceuticals, components in plastics such as bisphenyl A, dioxin and dioxin like products, some pesticides, Polychlorinated Biphenyls, Perflurooctanoic Acid (PFOA) and phthalates. Everyday items such as plastic bottles, non-stick cookware, metal food cans, detergents, flame retardants, food additives, toys, cosmetics and pesticides may act as endocrine disrupters. The interference can cause problems with natural hormones in regards to synthesis, secretion, transport, activity, or elimination for natural hormones. This interference or hormone blocking/mimicking in turn can alter hormone signaling.

In June 2009 The Endocrine Society, released its influential report 'An Endocrine Society Statement. Endocrine Disrupting Chemicals'. Writing that: *"The evidence for adverse reproductive outcomes (infertility, cancers, malformations) from exposure to endocrine disrupting chemicals is strong, and there is mounting evidence for effects on other endocrine systems, including thyroid, neuroendocrine, obesity and metabolism, and insulin and glucose homeostasis" and "Effects of endocrine disrupting chemicals may be transmitted to further generations through germline epigenetic modifications or from continued exposure of offspring to the environmental insult."* http://www.endo-society.org/journals/ScientificStatements/upload/EDC_Scientific_statement.pdf Web article links to report; Diamanti-Kandarakis E et al. 2009 Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement. Endocrine Reviews 30(4):293-342. http://www.endo-society.org/journals/ScientificStatements/upload/EDC_Scientific_Statement.pdf

The American Medical Association adopted the Endocrine Society Resolution in October 2009, calling for new policies to decrease public exposure to endocrine disrupting chemicals. http://www.newswise.com/articles/ama-adopts-endocrine-society-resolution-calling-for-new-policies-to-decrease-public-exposure-to-endocrine-disrupting-chemicals

In late October 2009, the US EPA then announced "*the first test orders for pesticide chemicals to be screened for their potential effects on the endocrine system...EPA made available the battery of scientific assays and test guidelines for conducting the assays, as well as a schedule for issuing test orders to manufacturers for 67 chemicals during the next four months".* http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/d60590e519ce3c2e8525765e0053f331!OpenDocument

This list was then expanded by 134 pesticides in November 2010. http://www.epa.gov/endo/pubs/prioritysetting/list2facts.htm

The screening program will determine if the pesticides alter estrogen, androgens or thyroid hormones. The push is also on in the United States, to legislate against EDC's, The Endocrine-Disrupting Chemicals Exposure Elimination Act of 2011. http://www.endocrinedisruption.org/endocrine.edlaw11.php

Perhaps the most controversial herbicide over the last few years in regards to EDC is atrazine and related triazine herbicides such as simazine (simazine also continues to be registered for use in swimming pools). Atrazine is one of the most commonly applied herbicides in the world. In Australia, its popularity is second only to Glyphosate. In Australia, Atrazine is registered for use primarily in many cropping situations and some tree plantations. Research conducted by many scientists is finding that atrazine infereres *"with the hormone systems that guide development in fish, birds, rats and frogs. In many cases, the result has been "feminized" males, with behaviors or body parts more like those of females...When they were tadpoles, he put them in water tainted with 2.5 parts per billion of atrazine -- still within the EPA's drinking water standards. About 10 percent of the frogs that developed in the water became "functionally female..."* http://www.washingtonpost.com/wp-dyn/content/article/2010/03/01/AR2010030102331_pf.html

The Australian Drinking Water Guideline for Atrazine was recently reduced from 40 parts per billion, to 20 parts per billion. Essentially atrazine inhibits the production of testosterone and induces estrogen production, which upsets the natural balance between these hormones. Atrazine has also been seen to cause immune failure in animals.

"It's been shown that it increases production of (the stress hormone) cortisol. It's been shown that it inhibits key enzymes in steroid hormone production while increasing others. It's been shown that it somehow prevents androgen from binding to its receptor." The review also consolidates the evidence that atrazine undermines immune function in a variety of animals, in part by increasing cortisol.
http://www.newsroomamerica.com/story/195601/herbicide_spurs_reproductive_problems_in_many_animals:_research.html

Thyroid hormones, testosterone, estrogens, and the stress hormones are identical in all animals, including humans and serve similar functions regardless of the species. The brain neurohormones are identical in all animals and the sequence of prolactin is very similar in all animals. Therefore if animals have been found to be having problems after being exposed to these pesticides, then it is also likely that humans will also be impacted if they are exposed.

Problems can also occur when treated wastewater is released into the environment, with hormonal development problems associated with feminisation of wildlife occurring downstream of sewage facilities for example. Melbourne Water testing for pharmaceuticals has been detecting low levels of pharmaceuticals in the Yarra River. These pharmaceuticals are being released most likely through the sewage system.

Similar problems that have been observed in animals are replicating themselves in people, with some pesticides linked to the blocking of testesterone. A recent study conducted by the University of London found that 30 out of 37 pesticides tested pesticides, altered male hormones. *"Sixteen of the 30 had no known hormonal activity until now, while there was some previous evidence for the other 14, ...This underlines the glaring problem that many of the chemicals that are most widely used today, including pesticides, are simply not adequately tested and may have serious long-term impacts on health and development ....Fetuses and infants may be particularly at risk when exposed in the womb or through breast milk because the hormones control masculinization of the reproductive tract. Some research has linked pesticides to abnormal genitals in baby boys, such as cryptorchidism and hypospadias, and decreased sperm counts in men...*

....Of the tested compounds, the most potent in terms of blocking androgens was the insecticide fenitrothion, an organophosphate insecticide ... Others with hormonal activity include fludioxonil, fenhexamid, dimethomorph and imazalil, which are all fungicides. Fungicides are often applied close to harvest, so they are frequently found as residue in food... Due to estimated anti-androgenic potency, current use, estimated exposure, and lack of previous data, we strongly recommend that dimethomorph, fludioxonil, fenhexamid, imazalil, ortho-phenylphenol and pirimiphos-methyl be tested for anti-androgenic effects in vivo." For the first four pesticides, they called it "a matter of urgency." They are used on strawberries, lettuce, grapes and other fruits and vegetables.
http://www.environmentalhealthnews.org/ehs/news/pesticides-block-male-hormones

Web article links to report; Widely Used Pesticides with Previously Unknown Endocrine Activity Revealed as in Vitro Antiandrogens. Frances Orton, Erika Rosivatz, Martin Scholze, Andreas Kortenkamp. Environmental Health Perspectives 119(6) Jun 2011. http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info%3Adoi%2F10.1289%2Fehp.1002895

More information on Endocrine Disruptors can be found here:

The Blackmountain Declaration on Endocrine Disrupting Chemicals
http://www.clw.csiro.au/conferences/ourwater/EDC-conference-declaration.pdf

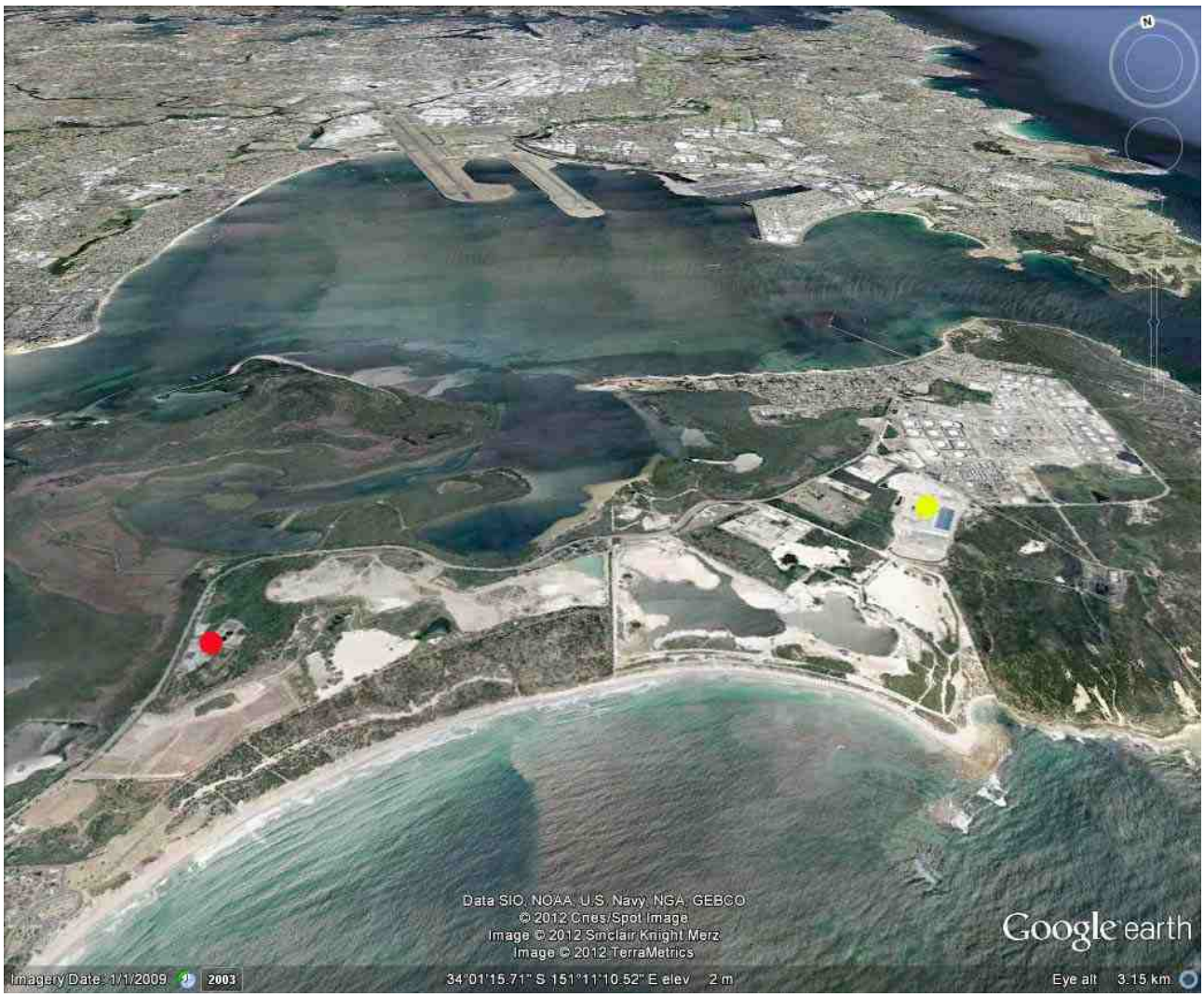
Blissfully Unaware of Bisphenyl A
http://dev.foe.org.au/sites/default/files/BisphenolA_report_OZversion.pdf#overlay-context=bisphenol

6.0 Desalination

In the past decade Australian Governments have committed to building desalination plants, as a means of providing drinking water to service cities in times and low rainfall and also to meet extra demand through population growth. Many of these plants have attracted a great deal of public scrutiny, probably none more than the Wonthaggi Desalination Plant in Victoria which is reported to eventually cost $24 billion and use 90-100mW of electricity. Much of the information pertaining to Wonthaggi can be seen at the following website.
http://baddevelopers.nfshost.com/Docs/Wonthaggidesal.htm

Desalination Plants In Australia

Name	Location	Capacity - day	Start Up Date	Supply Volumes
Perth Seawater Desalination Plant	Kwinana, Western Australia	130ML	November 2006	
Gold Coast Desalination Plant	South East Queensland	125ML	2009	Upgrade capacity 167ML
Kurnell Desalination Plant	New South Wales	250ML	2010	Upgrade capacity 500ML
Southern Seawater Desalination Plant	Binningup, Western Australia	100ML	2012	50 ML supplied September 2011
Port Stanvac Desalination Plant	South Australia	270ML	Late 2012	135 ML supplied in April 2011
Wonthaggi Desalination Plant	Victoria	410ML	2013?	Upgrade capacity 550ML
Point Paterson Desalination Plant	Port Augusta, South Australia	15ML	?	Upgrade to 123ML
Point Lowly BHP Billiton Desalination Plant	Spencer Gulf, South Australia	280ML (200ML for the open cut mine)	?	To supply water for the Olympic Dam Uranium Mine Expasion



Location of Kurnell Salination Plant – with yellow dot, Cronulla Treatment Plant with red dot.

Desal Plant Sucks in Sewage (November 7 2010)
http://www.dailytelegraph.com.au/news/desal-plant-sucks-in-sewage/story-e6frewt0-1225948832232

"SYDNEY'S $1.9 billion desalination plant is sucking in sea water containing 400 times more sewage bacteria than dam water. In a major shock, the first Sydney Water quarterly report on desalinated water produced from these raw supplies found it contained E. coli bacteria and failed to meet Australian guidelines for drinking water. The report, published on the Sydney Water website, revealed the Kurnell facility was the only one of 10 Sydney filtration plants not to get a "100 per cent" pass during the September quarter...Tests showed that Kurnell's raw water samples contained as many as 390 bacteria per 100ml, with an average reading of 22... A Department of Planning assessment of the desalination plant, published in the lead-up to its construction, acknowleged concerns that "intakes may draw in the discharges from [sewage treatment plant] outfalls, effectively meaning the plant would be recycling treated effluent".The document calculated the Potter Point outfall, where treated sewage pours straight from the cliffs into the ocean, could impact on the Kurnell plant up to 26 per cent of the time..."

"THE current off Sydney's $1.9 billion desalination plant takes sewage from an outflow only 2.5km away directly past its intake about a third of the time. The environmental study used to justify the Kurnell plant's location relied in part on an assumption that because the prevailing current runs south, there would be little danger of E.coli from the sewage being sucked into its inflow, to the north. But CSIRO scientists who monitor the current yesterday told The Australian that it sweeps north about a third of the time, and yesterday was one such day. It has been established that on some days, the amount of E.coli in intake water is more than double the guidelines for safe bathing...As reported yesterday, professor of infectious diseases and microbiology at the Australian National University, Peter Collignon, has claimed poor water quality at the Kurnell plant could create a public health disaster if filtering systems were ever to fail. ..However, Ms Schott's claims are contradicted by her organisation's most recent quarterly drinking water report. The

report showed that of 53 samples collected between 1 July and 30 September, the maximum number of E.coli organisms per 100ml of unprocessed water was 390, with a minimum 1 and an average of 22. The annual average was 16."
http://www.theaustralian.com.au/national-affairs/sewage-flowing-past-desal-plant/story-fn59niix-1225950382175

DESALINATION plants built near sewage outfalls are not protected by the natural purification that occurs in dams. This is because the water is not stored long enough for the bugs to die. In the wake of concerns about the quality of Sydney's drinking water, experts told The Australian yesterday that the short distance between the Kurnell desalination plant and the Cronulla sewage outfall had the potential to diminish water quality. Parasites such as E.coli, cryptosporidium and giardia are killed by prolonged exposure to light, oxygen and temperature fluctuations, University of NSW water quality expert David Waite told The Australian.
"If they're exposed to conditions different to what they're used to then they won't last long. And that's the case in dams," Professor Waite said. As reported on Wednesday, cryptosporidium can survive in seawater for up to 12 weeks. But the time taken for sewage discharged from Sydney's Cronulla outfall to reach the Kurnell desalination plant's intake, just 2.5km away, could be as little as two hours, CSIRO oceanographer David Griffin said..."
http://www.theaustralian.com.au/news/nation/desal-plant-not-protected-from-ecoli/story-e6frg6nf-1225952323853

Used Membrane & Toxic Sludge Concerns

"Reuse of Old Reverse Osmosis (RO) Membranes" . These RO membranes to be replaced after 3-4 years. At present RO membranes are all disposed to a landfill.

SA Desal Plant at Pt Stanvac will have 17,000 RO Membrane tubes to dispose after 3-4 years [its a 100 MGL/day] So my guess is that the Vic desal plant (with 150 MGL/day) would after 3-4 years need to dispose of approx 25,000 RO membranes to landfill" pers comm.

"CASEY residents are furious an estimated 30,000 tonnes of iron-rich sludge and other toxic sediments from Victoria's desalination plant are likely to end up in Lyndhurst every year. Last year, Melbourne Water spokesman Ben Pratt said about four truckloads - or 80 tonnes a day - of solid waste would be produced from the desalination plant when up and running and it would be taken to a suitably licensed landfill site."
http://www.caseyweeklycranbourne.com.au/news/local/news/general/lyndhurst-tipped-to-take-desal-sludge/196920.aspx

Concerns in South Australia.

The State MP for the Eyre Pensinsula seat of Flinders, Peter Treloar, says his constituents are overwhelmingly opposed to a proposed desalination plant at Point Lowly. This week, fishermen released a report concluding BHP Billiton's plant on the Upper Spencer Gulf would cause environmental damage.
http://www.abc.net.au/news/stories/2011/07/08/3264392.htm?site=northandwest

Fishermen Query BHP Report
BHP's environmental assessment of its proposed desalination plant at Point Lowly on South Australia's upper Spencer Gulf is flawed, a fishermen's group says. The plant is part of BHP's expansion of its Olympic Dam mine.
The company released its final Environmental Impact Statement in May, taking into account more than 4000 submissions. The Spencer Gulf and West Coast Prawn Fishermen's Association has released its own report into the company's environmental assessment. The Association says the mining giant has failed to consider the impact on the breeding cycle of prawns. Environmental scientist Dr Gary Morgan was a member of the review team and says BHP's conclusion that there will be no effects on the local ecosystem is unjustifiable. He says the discharge of hypersaline water into the Gulf could damage the local prawn industry. "What the science is showing by BHP's own assessment, they have identified in the new science that they've done an additional threat of the pooling of toxic, high-saline water at the bottom of the Spencer Gulf and of course that's where prawns live," he said.
BHP says it did not need to consider all stages of the species' life cycle but only the adult stage, which it says is the most sensitive. http://www.abc.net.au/news/stories/2011/07/06/3262668.htm?site=northandwest

7. Nuclear Issues

Uranium (Information Sourced From 2011 Australian Drinking Water Guidelines)

"Based on health considerations, the concentration of uranium in drinking water should not exceed 0.017 mg/L.

Uranium may be present in the environment as a result of leaching from soils, rocks and natural deposits, release in mill tailings, combustion of coal and other fuels, and use of phosphate fertilisers (which can contain as much as 150 mg/kg uranium). Naturally occurring uranium is a mixture of three radionuclides, U-238, U-234, and U-235. U-238 and U-234 decay predominantly by alpha particle emission, whereas U-235 emits both gamma rays and alpha particles. Natural uranium consists almost entirely of the U-238 isotope, the other isotopes being less than 1% abundant. Uranium is used primarily as a fuel in nuclear power plants.

Conventional treatment processes are not effective in removing uranium from water supplies. Some laboratory or pilot scale studies have found that coagulation using ferric sulfate at optimal pH dosages can achieve 80–95% removal of uranium, whereas at least 99% removal can be achieved using lime softening, anion exchange resin or reverse osmosis processes (WHO 2004).

Average absorption of dietary uranium by the gastrointestinal tract is 1-2%, but may be as low as 0.1% or as high as 5-6% depending on the solubility of the uranium compound ingested. Uranium rapidly appears in the bloodstream and is primarily associated with red blood cells. Uranyl compounds readily combine with proteins and nucleotides to form stable complexes. Clearance of uranium from the blood is rapid but it accumulates in the kidney and bone, with little in the liver. Once equilibrium in the skeleton has occurred, uranium is excreted in the urine and faeces. The half life of uranium in rat and rabbit kidney is of the order of 5–15 days, but in bone it is 100–300 days (Health Canada 2001).

In humans and experimental animals, the main toxic effect of short-term exposure to high concentrations of uranium is inflammation of the kidney. Little information is available on the effects of long-term exposure to low concentrations. Epidemiological studies report increases in urinary markers of possible kidney proximal tubule damage at drinking water concentrations between 0.1 and 1 mg/L, but not at lower concentrations (Moss et al 1983, Mao et al 1995, Zamora et al 1998, Kurttio et al 2002, Kurttio et al 2006, Seld et al 2009, Magdo et al 2007).

A tolerable daily intake (TDI) of 0.0006 mg per kg bodyweight (µg/kg bw) has been derived by WHO (2004) and Health Canada (2001). This is based on a lowest-observed-adverse-effect level (LOAEL) of between 0.06 (males) and 0.09 (females) mg/kg bw/day in a 91-day rat drinking water study (Gilman et al 1998) and application of an uncertainty factor of 100 (10 for interspecies extrapolation and 10 for intraspecies variation). The critical effect was degenerative kidney lesions, noted by the authors as not being severe. Although these represented a clear adverse effect, they were not dose-related, and in addition, because the effects were minimal, it is considered the dose at which they occurred may be close to the no-observed-adverse-effect level (NOAEL) (WHO 2004, COT 2006, Health Canada 2001). Thus an uncertainty factor to extrapolate from a LOAEL to a NOAEL was not applied in the derivation of the TDI.

No data are available on chemically induced mutagenic effects in relation to uranium. Studies have shown high specific activity uranium isotopes to be carcinogenic in animals, causing malignant tumours in mice and bone sarcomas in rats. Similar studies using natural uranium (uranium- 238) have not shown similar effects, possibly due to the lower radiation doses involved. Epidemiological data are inadequate to show whether exposure to uranium in drinking water will lead to an increased risk of cancer". ADWG 2011 Uranium Fact Sheet.

Highest Uranium levels recorded recently in breach of Australian Drinking Water Guidelines in Northern Territory:

Laramba (Napperby)	0.044mg/L	2009
Laramba (Napperby)	0.04mg/L	2008
Willowra	0.03mg/L	2008
Laramba (Napperby)	0.02895mg/L	2010
Willowra	0.026mg/L	2009
Willowra	0.02538mg/L	2010
Wilora	0.025mg/L	2009

Papunya	0.24mg/L	2009
Wilora	0.02078mg/L	2010
Nturiya	0.02mg/L	2009

Approximate Locations of communities in Northern Territory with levels of uranium or radionuclides above Australian Drinking Water Guidelines

Radionuclides (Other beta- and gamma-emitting). (sourced from 2011 Australian Drinking Water Guidelines)

"No specific guideline values are set for beta- or gamma-emitting radionuclides. Specific beta- or gamma-emitting radionuclides should be identified and determined only if gross beta radioactivity (after subtracting the contribution of potassium-40) exceeds 0.5 Bq/L (27.6 Bq of beta activity per gram of stable potassium).

Several radionuclides that are classified as beta-particle or gamma-ray emitters may occasionally be present in drinking water. The significant long-lived nuclides in this group are the naturally occurring isotopes potassium-40, lead-210 and radium-228, and artificial radionuclides caesium-137 and strontium-90. Tritium, another nuclide in this group, is present in the environment both from natural sources and as a result of nuclear fall-out and nuclear power generation.

Levels of strontium-90 and caesium-137 in the Australian environment have decreased substantially since atmospheric testing of nuclear weapons ceased, and these radionuclides are not detectable in drinking water. In the absence of a nuclear power industry in Australia, these nuclides are likely to be present in significant concentrations in drinking

water only as a result of transient contamination following an event such as a nuclear accident.

Potassium-40 occurs naturally in a fixed ratio to stable potassium. Potassium is an essential element for humans, and is absorbed mainly from ingested food. Potassium-40 does not accumulate in the body but is maintained at a constant level independent of intake. The average concentration of potassium in an adult male is about 2 g/kg of bodyweight, which gives an activity mass concentration of potassium-40 of 60 Bq per kg of bodyweight. The corresponding value for females is slightly less. Lead-210, like radium-226, is a decay product of the uranium-238 series. Food is the most important route by which lead-210 enters the human body, and the annual intake depends on diet: highest concentrations are found in fish and other aquatic species. Generally, lead-210 concentrations in drinking water are considerably less than concentrations of either radium-226 or radium-228." 2011 ADWG Fact Sheets Radionuclides (Other beta- and gamma-emitting)

"Concentrations of potassium-40 in Australian drinking water supplies vary widely, from below 0.05 Bq/L in surface water sources to more that 1 Bq/L in some supplies drawn from groundwater. There are only limited data on concentrations of other beta- or gamma-emitting radionuclides such as lead-210, strontium-90 and caesium-137 in Australian drinking water supplies. Lead-210 concentrations are probably below 0.05 Bq/L and concentrations of artificial radionuclides are negligible." 2011 ADWG 2011 Fact Sheets Radionuclides (Other beta- and gamma-emitting).

"Lead-210 can concentrate in bone, where it remains for many years. The radiation dose from lead-210 is due mainly to the emission of alpha particles from its progeny, polonium-210. In principle, lead-210 may increase the risk of bone cancers; however, no link has been demonstrated, either in animal studies or epidemiological studies. Much of what is known of the health effects of ingested strontium-90 and caesium-137 comes from animal studies. Caesium-137, when ingested, is distributed throughout the body, mainly to soft tissues. The organ most at risk is the liver. Dogs exposed to high concentrations of caesium-137 showed an increased incidence of liver cancer. The risks of bone cancer have been estimated from extensive lifespan studies of dogs injected intravenously with strontium-90. The studies showed the dose-response relationship to be non-linear for chronic exposure to strontium-90. Potassium-40 is not considered to be of significance to health because it is present naturally with the stable potassium isotope. The average contribution of this nuclide to the annual effective dose from background radiation is estimated to be 0.18 mSv (UNSCEAR 2000)." 2011 ADWG 2011 Fact Sheets Radionuclides (Other beta- and gamma-emitting).

Radium 226 and Radium 228 (sourced from 2011 Australian Drinking Water Guidelines)

"Radium-226 and Radium-228 should be determined if the gross alpha radioactivity in drinking water exceeds 0.5 Bq/L, or the gross beta activity (with the contribution of potassium-40 subtracted) exceeds 0.5 Bq/L.

Radium isotopes are formed as a result of radioactive decay of uranium-238 and thorium-232, both of which occur naturally in the environment. The two most significant isotopes in this process, in terms of radiological health, are radium-226 (uranium series) and radium-228 (thorium series), which have half-lives of 1620 years and 5.8 years, respectively. Radium-226 is an alpha emitter. It has been used, separated from its parent uranium, in cancer therapy. Of the radionuclides that comprise the natural thorium and uranium series, radium-226 and radium-228 are those most likely to be found in drinking water, and this occurs more commonly in supplies derived from groundwater. Concentrations in surface water are likely to be extremely low. Concentrations of radium isotopes in groundwater vary according to the type of aquifer minerals and dissolved anions such as chloride, carbonate, and sulfate anions, which tend to increase the mobility of radium. Radium is widespread in the environment and trace amounts are found in many foods. The average dietary intake is estimated to be 15 Bq per year (UNSCEAR 2000).

In supplies derived from groundwater sources, radium-226 and radium-228 concentrations vary considerably depending on the aquifer, and it is not uncommon in small supplies to find concentrations up to, or exceeding, 0.5 Bq/L. Radium concentrations in Australian surface water supplies are generally below 0.02 Bq/L.

The metabolic behaviour of radium is similar to that of calcium, and an appreciable fraction of ingested radium is deposited in bone tissue, where it is retained for a long time. High levels of exposure to radium have been shown to be carcinogenic. Epidemiological studies of 2000 radium dial painters, and studies of the medical use of the short-lived isotope radium-224, have both shown an increased incidence of bone sarcomas. Animal experiments have also established an association between radium exposure and bone sarcoma. Studies of populations in the United States exposed to radium in drinking water have produced no conclusive evidence linking cancer with ingestion of radium. Apart from cancer, the only other health effect resulting from ingestion of radium observed in the studies of radium dial painters was bone necrosis." 2011 ADWG Fact Sheets Radium 226 and Radium 228

Radon 222 (sourced from 2011 Australian Drinking Water Guidelines)

"Based on a consideration of the potential health impact from radon released from tap water to the air inside a dwelling, the activity concentration of radon-222 in drinking water should not exceed 100 Bq/L.

Radon-222 is a radioactive gas produced from the decay of radium-226 in soil and minerals. It has a half-life of 3.8 days. Elevated concentrations of radon-222 may occur in drinking water derived from groundwater, due to the release of radon from aquifer rocks and minerals, particularly in granitic areas. In Finland, for example, the weighted average radon concentration in drinking water is 25 Bq/L. Radon concentrations in surface water supplies are very low because the gas is rapidly lost to the atmosphere. Studies from Canada, Finland and the United States have shown that dissolved radon-222 in drinking water may be released to air during domestic use and contribute to indoor radon concentrations. The data on the concentrations of radon-222 in Australian drinking water supplies are limited, but sufficient to indicate that radon may be significant in some rural supplies.

The main health risk from radon arises from inhalation of the gas, particularly when it accumulates inside dwellings. Radon-222 has several short-lived radioactive progeny that can give rise to an increased risk of lung cancer. Epidemiological studies of underground miners in the uranium mining industry overseas have established a relationship between the incidence of lung cancer and occupational exposure to radon.

No link has been demonstrated, however, in either experimental or epidemiological studies, between ingestion of radon in drinking water and increased cancer rates." 2011 ADWG Fact Sheets Radon 222.

Australia

In 2008, the following report was published http://www.arpansa.gov.au/pubs/technicalreports/tr148.pdf

33 testing sites were included in the study (30.3% surface water, 69.7% ground water), with most testing occuring in Western Australia (57.6%).

State	Surface Water Testing Locations	Ground Water Testing Locations
Western Australia	3	16
Northern Territory	4	6
South Australia	2	1
New South Wales	1	-

"Thirty three drinking water samples from across Australia were collected and analysed for their radioactive content by ARPANSA. Of these, 23 were from groundwater sources while the remaining 10 were from surface-water sources... However, it was noted that the highest levels were found in ground water samples and the lowest levels were found in surface water samples. An indicative comparison between samples from two central Australian town showed that ground waters may have considerably higher levels of radioactivity.

The calculated radiation doses arising from drinking the waters showed that most of the dose arises from Radium-228.

Comparison with the UNSCEAR reference data indicate that Australian drinking waters may have considerably higher levels of radioactivity than the world-wide average and, therefore, the radiation doses arising from these waters may be considerably higher".

Northern Territory

Highest radioactivity levels recorded recently (2010) in the Northern Territory are; 0.95mSv/yr Laramba (Napperby) 0.9mSv/yr Binjari, 0.828258mSv/yr Willowra, 0.81mSv/yr Warrabri (Ali Curung).

"Naturally occurring uranium concentrations above the guideline value have been identifi ed in the drinking water supply at Ti Tree and Pmara Jutunta. The community has been informed and the Department of Health and Community Services has stated that there is no immediate threat to public health. A new groundwater supply has been developed close to Pmara Jutunta that has both uranium and total dissolved solids below guideline values. Power and Water is in the process of building a pipeline that will connect the new bore water supply to Ti Tree/Pmara Jutunta. The new

borewater supply will be operational in 2004-2005." Power And Water Quality Report 2004

"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" Power and Water Annual Report 2006

"Nine of the 14 bores supplying Alice Springs were below the gross alpha and gross beta activity concentration screening value of 0.5 Bq/L. Five bores exceeded 0.5 Bq/L for gross alpha but all were below 0.5 Bq/L for K-40 corrected gross beta.

Although Alice Springs supply was correctly monitored and samples collected some radiological parameters needed for the determination of annual dosage were not measured during analysis.In the absence of these parameters the annual dosage is calculated assuming all gross alpha radioactivity is radium 226 and all gross beta is radium 228. When this calculation is applied to data from all bores the potential maximum radiological dose is 0.41 mSv/yr, below the 2004 ADWG value of 1.0 mSv/yr.

Kings Canyon water supply has radioactivity levels higher than other Northern Territory water supplies. In July 2007, Queensland Health Scientific Services completed a report on the radiological properties of the water used for domestic and industrial purposes and subsequent wastewater treatment.This study determined the combined total average dose per annum to be 0.69 mSv/yr. Although this value exceeds the guideline level for intervention (0.5 mSv/yr) the total annual dose guideline value (1.0 mSv/yr) has not been exceeded.

In response, the supply was sampled monthly during 2007-08. The annual radiological dose can be estimated from the average of the potential maximums calculated for each monitoring point within the supply. Using this approach, the potential maximum annual radiological dosage (95th percentile) is 0.88 mSv/yr. Power and Water will improve aeration at Kings Canyon and investigate advanced treatment systems to further reduce radionuclide levels" **Power and Water Annual Report 2008**

Victoria

Highest Victorian Readings 2005-10:
Gross Alpha activity Screening level of 0.5 Bq/L: (Port Fairy 0.6Bq/L (Wannon Water 2005/6), Brown Creek Grampians 0.3Bq/L (Hamilton Water Supply - Wannon Water 2008/9), Headworks Surface Water Streams Grampians 0.19Bq/L(Hamilton Water Supply - Wannon Water 2008/9)).
Gross Beta activity Screening level of 0.5 Bq/L (corrected for Potassium-40): 0.32Bq/L Hamilton Headworks Bore – Grampians Wannon Water 2008/9.

South Australia

"Between Jan 86 to Aug 89 there were at least 9 exceedences of the Safety Guideline Maximum for the 'old' Beta Radiation (100 Millibecquerels/Litre) in South Australian Reservoirs including; Mount Bold (3), Clarendon Weir, Happy Valley Reservoir, Barossa Reservoir, Millbrook Reservoir (2), Hope Valley." (Source: The Office of the South Australian Minister For Infrastructure, SA Water Corp Ref MFI 100876, SA Water 10713/95) [New Guideline would be 500 Millibecquerelsm(0.5Bq/L)].

"The 1985 recommended levels were 0.1 Bq/L for both alpha and beta activity (excluding the natural beta emitting isotope K-40). A new standard being development recommends that these be changed to 0.1Bq/L for alpha and 0.5 Bq/L for beta. This standard is based on a maximum radiation dose (from any one radionuclide in drinking water) of 0.1mSv per annum – approximately one twentieth of the average annual dose from all sources of natural radiation... In October 1975 The Australian Ionising Radiation Advisory Council (AIRAC) published "Fallout over Australia from nuclear tests". This publication gives some data on fallout levels in Adelaide in the 1970's. Only Cs-137 and Sr-90 concentrations in rainwater are reported: the highest reported is 12 pCi/L (0.4 Bq/L) of Cs-137 in January 1971. As there would have been little intake to the reservoirs at that season, this would probably have not affected the concentration in the mains supply. Neither Cs-137 or Sr-90 concentrations in rainwater were high in June 1972 (both approx 1 pCi/L or .04 Bq/L). The isotope which usually shows up most quickly in fallout following nuclear weopons test is I-131. Concentrations in water are not reported is the AIRAC publication: it is not usually a problem in reservoir water as its half life is so short (8 days) that it usually decays in storage)". Letter from Radiation Protection Branch – South Australia Health Commission 3 February 1995.

"From 1965 to the present time, the South Australian Government carried out monitoring of all reservoirs for nuclear fallout. The graphs created from the data are contained in an earlier report (The Monitoring of the Radiological Contamination of SA Drinking Water, by P. Langley). This data has not received wide publicity. Dr Helen Caldicott and others have however spoken on this theme over a period of many years. Results of British water catchment monitoring of South Australian water, carried out prior to 1965, remains unavailable to Australians. SA Water Corp confirms that Australian radiological monitoring commenced only in 1965 – after the cessation of nuclear weapons testing by the UK in Australia. Although the SA Government does not possess records earlier than 1965, involved ex-servicemen state that British monitoring of water commenced in the 1950s. The records of this early monitoring are unavailable in Australia." http://antinuclear.net/2011/04/13/atomic-bomb-tests-radiation-kept-secret-from-australians/

Angela Pamela Uranium Mine (Alice Springs)

"The mine site is in Alice Springs' Water Catchment – where surface water filters into our drinking aquifers – and sits above the Amadeus basin groundwater. Leaks from the tailings dam, or from pipes etc, could make it to our water – geologists have said we can't be sure about the connections beneath the Brewer. Floods could move radioactive into our town water or break the tailings dam – floods of different sizes have always hit the Angela Pamela site"
http://www.alec.org.au/eng/archive__1/asap/finke_about_it

Community Stops Angela Pamela Uranium Mine 28 Sept 2010
"Chief Minister of the Northern Territory Government, Paul Henderson, announced this morning that his government no longer supports the development of a uranium mine at Angela Pamela - 23 km from Alice Springs. Community opposition has been constant and growing since exploration was permitted in 2008. With a by-election on October 9 for the local seat of Araluen, the government "has listened" and understands the proposed mine is a liability. Recognition is now widespread that this mine would damage the tourism industry, the local economy, the water supply, and the unique character of Alice Springs."

Roxby Downs Uranium Mine (South Australia).

http://www.foe.org.au/anti-nuclear/issues/oz/u/roxby/
http://baddevelopers.nfshost.com/Docs/roxby.htm
http://www.foe.org.au/anti-nuclear/issues/oz/u/roxby/Keane%20Mound%20Springs%2097.pdf/view
http://www.foe.org.au/anti-nuclear/issues/oz/u/roxby/Mound%20Springs%20Mudd%201998.pdf/view

Ranger Uranium Mine (Northern Territory).

The Age May 24 2010: *Millions of litres of radioactive water from the Ranger uranium mine have flowed into world heritage-listed wetlands in Kakadu National Park...The Rio Tinto-owned company has attempted to downplay an unexplained spike in contaminated water flowing from the mine into Kakadu's Magela Creek between April 9 and 11, the Herald can reveal. About 40 Aboriginal people live downstream from a site where a measure probe recorded up to five times the warning level of electrical conductivity, which is a measure of contaminants including uranium, sulphate and radium. The environmental group Environment Centre NT has been leaked evidence detailing the spike, which ERA representatives claimed had originated upstream from the mine and was not the company's fault....In another unreported mishap at the mine in December, a poorly engineered dam collapsed, spilling 6 million litres of radioactive water into the Gulungul Creek, which flows into Kakadu...Scientists confirmed last year that the mine's tailings dam was leaking 100,000 litres of radioactive water into the earth and rock fissures below Kakadu every day.ERA has denied any serious seepage from the dam, which contains 10 million litres of radioactive water. The mine, which was originally scheduled to close in 2008, has had more than 150 spills, leaks and licence breaches since it opened in 1981.*
http://www.acfonline.org.au/uploads/res/Ranger-Uranium-Mine-Kakadu-Acid-Test-Report_12-4-11.pdf

The Age May 20 2009: *In 2005 ERA was fined for accidentally exposing its employees to low-level radiation when water that workers used to drink and wash with was contaminated. It was one of 150 estimated environmental incidents since the mine began operating in 1980.*

The Age March 12 2009: *THE Ranger uranium mine inside the World Heritage-listed Kakadu National Park is leaking 100,000 litres of contaminated water into the ground beneath the park every day, a Government appointed scientist has revealed. Alan Hughes, the Commonwealth supervising scientist appointed to monitor the mine's environmental impact, confirmed at a Senate committee hearing that about 100 cubic metres a day — the equivalent of 100,000 litres or three petrol tankers — of contaminant were leaking from the mine's tailings dam into rock fissures beneath Kakadu. There have been more than 150 leaks, spills and licence breaches at the Ranger uranium mine since it opened in 1981. The mine's owner, Energy Resources of Australia, has been repeatedly warned about its management*

of the mine, with a previous government-appointed scientist declaring in 2004 that ERA was "complacent" about protecting workers and people living near the mine. The mine was originally scheduled to cease mining last year but there are now plans to tunnel under flood plains from an open pit in a move that would extend mining to 2021.

8.0 Climate Change

A host of water quality issues will emerge from climate change (too many to mention here). Two examples of changes to drinking water quality relate to lack of rainfall and what can occur when the drought breaks.

Reductions in water can cause problems in regards to water quality. Including increases in algae (through low water levels and elevated levels of nutrients, nitrogen phosphorus) water taken from lowest offtake, can mean potentially higher levels of managenese, iron, colour and turbidity. Algal growth can also increase, Methylisoborneol (MIB) and geosim can be created by algae requiring dosing with Powder Activated Carbon (PAC). Aeration Installations may also be required.

"Stratification is occurring where a distinct separation of a layer of warmer water at the top and colder layer of anaerobic water at the bottom. When outside temperature drops eg at autumn, the two layers mixm with manganese oxidised during this process" p21 Water Quality Issues Friends of the Earth Bendigo Ballarat, Benalla. January 2005 – March 2010.

"In Ballarat the drought brought different challenges. Reservoir levels were critically low, resulting in poor water quality prior to treatment. This increased increased alkalinity and organic content and a high level of manganese, which can contribute to water quality issues...including dirty water, taste and odour" p21Water Quality Issues Friends of the Earth Bendigo Ballarat, Benalla. January 2005 – March 2010

"In March 2007, Goulburn Murray Water announced a blue green algal alert for Lake Eppalock and Laanecoorie Reservoir". The incident lasted 5 weeks. "During April 2007, water pumping from Lake Eppalock ceased due to high levels of Manganese, ten times higher than normal being detected in the lake" "The increased level of manganese (and iron) in some systems. These levels have increased either as a result of low storage levels..." p30 Water Quality Issues Friends of the Earth Bendigo Ballarat, Benalla. January 2005 – March 2010

"Alert Level 2 for the Potentially toxic BGA Microcystis was reached in May 2003 as a result of low water levels, increased water temperatures and increased nutrients" p37 Water Quality Issues Friends of the Earth Bendigo Ballarat, Benalla. January 2005 – March 2010

"Nitrogen levels peaked in September 2003. By June 2004, water storage levels dropped to 4.6% of capacity and Microcystis was again detected during the year, with turbidity and electrical conductivity of the reservoir increasing" - increases in salinity, nutrients and turbidity... toxigenic blue green algae low dissolved oxygen, possible sulphide toxicity responsible for fish kills. increases of aquatic weeds, pesticide applications (mexican water lily, cabomba)" p46 Water Quality Issues Friends of the Earth Bendigo Ballarat, Benalla. January 2005 – March 2010

Impacts of floods

Interesting example from Grampians Wimmera Mallee Water in their 2010/11 Annual Report;

"1. During August and September 2010 flooding in the Murray River gave rise to increased turbidity and colour concentrations in raw water sourced from the river. The rises in the turbidity concentration led GWMWater, in consultation with the Department of Health (DH), to issued Boil Water Notices (BWN) at Lalbert, Manangatang and Ultima. The BWNs were issued on 7 October 2010. GWMWater has since constructed a filtration system at Manangatang which allowed for the BWN to be lifted. The notices remain in place at Lalbert and Ultima.

2. In January 2011 further heavy rains gave rise to flooding across much of GWMWater north eastern operational area. The flooding was on such a scale that many towns were without road access and electricity for prolonged periods. Due to the loss of power at these towns there was uncertainty on whether the water supplies could be assured as safe. For this reason GWMWater, in consultation with DH issued BWNs at Birchip, Charlton, Donald, St Arnaud, Wycheproof and Quambatook. The BWNs were issued on 15 January 2011. Once GWMWater and DH could be confident that the supplies no longer presented a risk the BWNs were lifted. This occurred at Birchip, Charlton, St Arnaud and Quambatook. Notices remain in place at Donald and Wycheproof.

3. As part of the same January heavy rainfall event a large number of landslides and significant erosion occurred in the Grampians National Park. The erosion caused the trunk main supplying Halls Gap and Pomonal to be washed out and severed. In close proximity to the trunk main a large sewer main was also washed out and severed. Even though

the WTP remained operational GWMWater could not be certain that stormwater and wastewater had entered the trunk main. On 15 January BWNs were issued at Halls Gap and Pomonal. Once GWMWater and DH could be confident that the supplies no longer presented a risk the BWNs were lifted.

4. The land slides which occurred in the Grampians also gave rise to a massive deterioration in the water quality in Lake Bellfield. Because Lake Bellfield provides water to Supply systems 1 to 4 and 6 of the Wimmera Mallee Pipeline (WMP) deteriorating water quality in the pipeline was soon evident. The event led to large increases in the turbidity and colour in unfiltered disinfection only supplies. Because of the increased turbidity concentration at the unfiltered supplies GWMWater and DH decided to keep the BWNs in place at Donald and Wycheproof. New notices were issued at Minyip and Rupanyup on 3 February, Jung on 7 February and at Beulah and Woomelang on 18 February. The BWNs remain in place at all of these towns."

Global Warming Favors Proliferation Of Toxic Cyanobacteria July 3, 2012

"Cyanobacteria are among the most primitive living beings, aged over 3,500 million years old. These aquatic microorganisms helped to oxygenate the earth's atmosphere. At present their populations are increasing in size without stopping. It appears that global warming may be behind the rise in their numbers and may also lead to an increase in the amount of toxins produced by some of these populations.

"Cyanobacteria love warm water, therefore an increase in temperature during this century may stimulate their growth, especially that of the cytotoxic varieties, which could even produce more toxins and become more harmful", says Rehab El-Shehawy, a researcher from IMDEA Agua and co-author of the study published in the journal, Water Research. Her team is working on developing efficient tools to monitor the number of cyanobacteria in water.

Blooms of these microorganisms in lakes, reservoirs and rivers all over the world, and in estuaries and seas, such as the Baltic, are becoming a more and more frequent phenomenon. According to the experts, this poses an economic problem – as it affects water sanitation, shipping and tourism, for example – and an environmental problem...

Risk to human health

"These toxins may affect the liver and other organs (hepatotoxins), the nervous system (neurotoxins), different cells (cytotoxins), the eyes and mucous membranes, as well as causing dermatitis and allergies", explains Francisca F. del Campo, another co-author and researcher at the Autonomous University of Madrid.

The scientist demands more attention from the authorities and the general population be given to this health and environmental problem about which little is known and to which little interest is paid.

"We suspect that these cytotoxins may be behind some gastrointestinal disorders and other illnesses, but epidemiological studies are required to confirm this", says Del Campo...

SOURCE: FECYT - Spanish Foundation for Science and Technology

9.0 Gas/Coal Fracking

Water contamination from fracking activities has mainly been reported in the United States. Increasingly, pollution of drinking water could become more widespread. As in the United States, it is likely that polluted groundwater could impact in regions with relatively small populations. In the United States the majority of pollution evens have been detected in well water, often in isolated farming communities, 1km from well sites. Likewise in Australia polluted drinking water could eventuate if local groundwater is contaminated and local people rely on groundwater for drinking water. At this stage it is unclear if communities relying on surface water flows in Australia have been impacted by fracking chemicals and the gas industry – although concerns have been raised in Western Australia and the Illawarra catchment, part of Sydney's drinking water supply.

According to: Hydraulic Fracturing in Coal Seam Gas Mining:The Risks to Our Health, Communities, Environment and Climate produced by the National Toxics Network in September 2011 http://ntn.org.au/wp-content/uploads/2011/09/NTN-CSG-Report-Sep-2011.pdf

"A review of 980 chemical products used in the gas industry in the USA found that 27:

• A total of 649 chemicals were used in the 980 products. Specific chemical names and CAS numbers could not be determined for 286 (44%).

• Less than 1% of the total composition of the product was reported on the MSDS for 421 of the 980 products (43%), less than 50% of the composition was reported for 136 products (14%), and between 51% and 95% of the composition was reported for 291 (30%) of the products. Only 133 products (14%) had information on more than 95% of their full composition."

"...the most widely used chemical in hydraulic fracturing as measured by the number of compounds containing the chemical was methanol. Methanol was used in 342 hydraulic fracturing products ... Other widely used chemicals were isopropyl alcohol (used in 274 products), 2- butoxyethanol (used in 126 products), and ethylene glycol (used in 119 products). Between 2005 and 2009, hydraulic fracturing products contained 29 chemicals that were either known or possible human carcinogens, regulated under the Safe Drinking Water Act for their risks to human health, or listed as hazardous air pollutants under the Clean Air Act. These 29 chemicals were components of more than 650 different products used in hydraulic fracturing.

A chemical and biological risk assessment for natural gas extraction by the Chemistry and Biochemistry Department from the State University of New York in March 2011, identified chemical products in widespread use, including in exploratory wells that pose significant hazards to humans or other organisms, "because they remain dangerous even at concentrations near or below their chemical detection limits. These include the biocides glutaraldehyde, 2,2-dibromo-3-nitrilopropionamide (DBNPA) and 2,2 dibromoacetonitrile (DBAN), the corrosion inhibitor propargyl alcohol, the surfactant 2-butoxyethanol (2-BE), and lubricants containing heavy naphtha."

According to an article published in the Green Left in September 2011;

In April this year, the US House of Representatives Committee on Energy and Commerce reported that formaldehyde, lead, hydrogen chloride, hydrogen fluoride and ethylene glycol were being used by hydraulic fracturing companies in the US.

A submission this year to the US Congress identified more than 750 different chemicals and compounds known to have been used in fracking. Most are not disclosed by CSG miners.

Likewise, in Australia there is no requirement for CSG companies to say what compounds will be added. The Australian Petroleum Production and Exploration Association (APPEA) lists only 20 of the 750 as in use in Australia.

However, contamination cases provide some information about what is in the fracking fluid.

For example, this year the Queensland government found the toxic chemicals benzene, toluene and xylene in 14 CSG wells run by Arrow Energy. http://www.greenleft.org.au/node/48936

Research Separates Frack From Fiction

AWA Water July 2012 Industry News page 18-19

Hydraulic fracturing, or "fracking has generated controversy in the past few years. Recent research from the Pacific Institute finds the real issues around its impacts on water are shared by stakeholders from government to industry to environmental groups - and a point to the need for better and more transparent information in order to clearly assess the key water - related risks and develop sound policies to minimise those risks.

Much of the public attention on hydraulic fracturing has centred on the use of chemicals in the fracturing fluids and the risk of groundwater contamination. However the new study finds that while chemical disclosure can be useful for tracking contamination, risks associated with fracking chemicals are not the only issues that must be addressed. The massive water requirements for fracking and the potential conflicts with other water needs, including for agriculture and for ecosystems, pose major challenges. Methane contamination of drinking water wells is also a concern according to some field studies, as are the serious challenges associated with storing,transporting, treating and disposing of wastewater,

The report, *Hydraulic Fracturing and Water Resources.Separating the Frack from the Fiction, is* a detailed assessment and synthesis of existing research on fracking as well as the results of interviews with representatives from state and federal agencies, industry, academia, environmental groups, and community based organisations. Interviewees identified a broad set of social, economic and environmental concerns, foremost among which are impacts of hydraulic fracturing on the availability and quality of water resources.

"Despite the diversity of viewpoints among the stakeholders interviewed, there was surprising agreement about the range of concerns associated with hydraulic fracturing. Among the most commonly cited were concerns about spills and leaks, wastewater management, and water withdrawals," said Heather Cooley, codirector of the Pacific Institute Water Program and lead author of the report. "in addition to concerns about impacts on water resources, social and economic concerns were identified as well, such as worker health and safety, and community impacts associated with rapidly inclustrialising rural environments."

Hailed by some as a game changer that promises increased energy independence, job creation and lower energy prices, fracking has led others to call for a temporary moratorium or a complete ban due to concern over potential environmental, social and public health impacts. The research finds that the lack of credible and comprehensive data and information is a major impediment to a robust analysis of the real concerns associated with hydraulic fracturing.

"Much of what has been written about the interaction of hydraulic fracturing and water resources is either industry or advocacy reports that have not been peer reviewed, and the discourse around the issue to date has been marked by opinion and obfuscation," said Cooley. "More and better research is needed to clearly assess the key water related risks and develop sound policies to minimise those risks."

The report can be downloaded free of charge from the Pacific Institute website at:
www.pacinst.org/reports/fracking/index.htm.

"Groundwater contamination from shale gas operations can occur through a variety of mechanisms. Natural gas is located at varying depths, often (but not always) far below underground sources of drinking water (Figure 8). The well bore, however, must be drilled through these drinking water sources in order to access the gas. Vibrations and pressure pulses associated with drilling can cause short-term impacts to groundwater quality, including changes in color, turbidity, and odor (Groat and Grimshaw 2012). Chemicals and natural gas can escape the well bore if it is not properly sealed and cased. While there are state requirements for well casing and integrity, accidents and failures can still occur, as was demonstrated by an explosion in Dimock, Pennsylvania (see Box 2 for more information). Old, abandoned wells can also potentially serve as migration pathways (U.S. EPA 2011b) for contaminants to enter groundwater systems. States have estimated that there are roughly 150,000 undocumented and abandoned oil and gas wells in the United States (IOGCC 2008). Natural underground fractures as well as those potentially created during the fracturing process could also serve as conduits for groundwater contamination (Myers 2012). Finally, coalbed methane is generally found at shallower depths and in closer proximity to underground sources of drinking water and therefore accessing the natural gas from this source might pose a greater risk of contamination. ..

Methane is not currently regulated in drinking water, although it can pose a public health risk. Jackson et al. (2011) note that methane is not regulated in drinking water because it is not known to affect water's potability and does not affect its color, taste, or odor. Methane, however, is released from water into the atmosphere, where it can cause explosions, fires, asphyxiation, and other health or safety problems. The New Year's Day 2009 drinking-water well explosion in Dimock, Pennsylvania, for example, was due to methane build-up in the well associated with natural gas production. The Department of the Interior recommends taking mitigative action when methane is present in water at concentrations exceeding 10 milligrams per liter (mg/l) (Eltschlager et al. 2001). A recent study, however, notes that research on the health effects are limited and recommends that "an independent medical review be initiated to evaluate the health effects of methane in drinking water and households" (Jackson et al. 2011, 5)... Real analysis about the likelihood and extent of groundwater contamination is hindered by a lack of baseline data and confusion about definitions. Without baseline data, it is difficult to confirm or deny reports of groundwater contamination.

The following chemicals have been associated with fracking in the United States. Only 8 are listed under the 2011 Australian Drinking Water Guidelines.

Wikipedia also has a more detailed list of additives used for hydraulic fracturing at this link.

http://en.wikipedia.org/wiki/List_of_additives_for_hydraulic_fracturing

Acetaldehyde		Organic chemical compound which occurs naturally and is also made industrially. Used as a precursor to acetic acid, used to urea to make resin, also a precursor to vinyl acetate.
Acetate		Derivative of acetic acid. Most industry produced acetate is used in production of acetates usually taking the form of polymers.
Acetic Acid		Organic compound, the main ingredient of vinegar. Mainly used as a precursor to cellulose acetate and polyvinylacetate.
Acetone		Organic compound, mainly used as a solvent and in production of methyl methacrylate and bisphenyl A.
Ammonium persulfate		An oxidising agent, used to etch copper on printed circuit boards. Used with sulphuric acid to clean laboratory glassware. Commonly used in hair bleach and western blot gels.
Benzene	0.001mg/L	Benzene is present in petrol, and motor vehicle emissions constitute the main source of benzene in the environment. The major sources of benzene in water are atmospheric deposition, chemical plant effluent and underground petrol storage tank leakage. When released to surface waters, benzene rapidly volatilises to the air.
Benzoic Acid		Simplest aromatic carboxylic acid, its salts are used as a food preservative and the synthesis for many other organic substances.
Benzopyrene	0.00001mg/L(Benzo(a)pyrene.	Organic compound – closely related to benzo(a)pyrene and benzo(e)pyrene. A common component of tar pitch (bitumen). They are considered carconigens and pollutants. Associated with gas/coal industry with flare stacks
Borate Salts		Borates are chemical compounds. Common borate salts include sodium metaborate and borax (a component of detergents, cosmetics and enamel glaze etc).
Boric Acid		An acid of boric, commonly used as an antiseptic, insecticide, flame retardant and neutron absorber.
Calcium Chloride		A salt of calcium and chlorine. Used as brine for refrigeration plants, ice and dust control on roads and dessication.
Chloride		Formed when the element chlorine, gains an electron to form an anion. Salts of hydrochloric acid can also be known as chlorides. Chlorides used to form salts and preserve foods – sodium chloride.
Chlorine	5mg/L (Chlorine in chloraminated supplies 4.1mg/L).	Chemical element – strong oxidizing agent. Is a component of tabel salt and also used as a bleach and disinfectant.
Choline Chloride		Organic compound. Is mass produced and is an important feed additive (esp for chickens). With urea it forms a deep eutectic solvent.
Citric acid		A weak organic acid used to add acidic or sour taste to soft drinks. Also used as an acidfier and flavouring or chelating agent.
Copolymer of Acrylamide		Also known as Polyacrylamide, highly water absorbant and forms a soft gel when hydrated. Used in contact lenses. Also used as a flocculant in the water industry. Also used in subsurface applications in Enhanced Oil Recovery.
Diesel		Liquid fuel for diesel engines. Also used as an extraction agent for liquid-liquid extraction.
Diethylene Glycol		An organic compound, which is miscible in water, alchol, ester, acetone or ethylene glycol. Also widely used as a solvent for oils etc. Has been associated with mass poisoning around the world.

DBAN (Dibromoacetonitrile)		Chlorine disinfection byproduct.
DPNBA (2,2-Dibromo-3-nitrilopropionamide)		Biocide used in hydraulic fracturing wells. Quickly kills and degrades ammonia and bromine ions.
Ethanol		Used as alcohol, fuel and a solvent.
Ethoxylated 4-nonylphenol		Organic compound, subset of alkylphenols. Can be formed in waterwater treatment plants and can be persistent in the environment.
Ethyl Benzene	0.3mg/L	Ethylbenzene occurs naturally as a component of crude oil and is present in petrol, but in small quantities. It may be present in drinking water following pollution of source water. Ethylbenzene is produced commercially by the alkylation of benzene with ethylene, and by fractionation of petroleum. It is a major component of commercial xylene and is used commercially in paints,insecticides and blends of petrol. It can also be found as a constituent of asphalt and naphtha.
Ethylene glycol		An organic compound commonly used as automotive antifreeze and a precursor to polymers (PET Polyethylene terephthalate). Historically used in explosives.
Formaldehyde	0.5mg/L	According to the National Pollution Inventory; *"Formaldehyde is used in the manufacture of formaldehyde-based resins and plastics used in many industries, but mostly in the wood-products industry. Formaldehyde-based resins are also used as adhesives. Formaldehyde is also used in a number of industries including agriculture, the building industry (to water- and grease-proof concrete and plaster), medicine-based industries (forensics, hospitals and pathology laboratories), embalming fluid in funeral homes and crematoria, film processing, textile treatments, leather tanning and a wide range of personal care and consumer products."*Formaldehyde has a half life in water of between 2-20 days.
Formamide		Also known as methanamide, an amide derived from formic acid. Can be used as a solvent.
Formate		Also known as methanoate.
Formic Acid		Also known as methanoic acid. The simplest carboxylic acid. Can occur naturally in bee and ant stings. Used primarily as a preservative and antibacterial agent for livestock feed, in the tanning industry and production of rubber. Also can be used as a cleaning agent.
Gasoline		Petroleum derived liquid, used as fuel in internal combustion engines.
Glutaraldehyde		An organic compound used to disinfect medical and dental equipment. Also used as a chemical preservative in industrial water treatment. Also used as an algaecide.
Glycol		Class of organic compounds belonging to the alcohol family.
Guar gum		The ground endosperm of guar beans. Used in hydraulic fracking by oil and gas industry as an emulsifer to prevent oil droplets coalescing.
Hydrochloric Acid		A solution of hydrogen chloride that is highly corrosive with many industrial uses. Also found naturally in gastric acid. Used in the chemical industry as a chemical reagent in the production of vinyl chloride, PVC plastic and polyurethane. It can stimulate oil production through injection into rock formations.
Hydrogen Chloride		Compound which forms hydrochloric acid in contact with atmospheric humidity. Most of its manufactured use is for the production of hydrochloric acid.
Hydrotreated Light Petroleum Distillate		Mineral turpentine commonly used as a paint thinner and an organic solvent.
Isopropanol		A chemical compound also known as rubbing alcohol. Used primarily as a solvent for coating and industrial processes. Used as a cleaning fluid for dissolving oils.
Isopropyl		Organic compound.
Lactate		A chemical compound also known as lactic acid.

Lauryl Sulfate		An organic compound used in cleaning and hygiene products. Commonly found in engine degreasers.
Lead	0.01mg/L	Unlike most water contaminants, lead gets into water after it leaves a water treatment plant. Often this contamination is the result of water treatment changes meant to improve water quality that end up altering the water chemistry, destabilising lead-bearing mineral scales that coat service lines and corroding lead solder, pipes, faucets and fixtures. Lead in water has been seen to be a major source of lead exposure. Corrosion from lead based solders in brass fittings and copper pipes is often the source of lead in drinking water. This problem is often worsened by people drinking and cooking with corroded water after a first use particularly in the morning. Lead based solder has been banned in Australia since 1989 so problems are most likely to be associated in businesses and homes with water fittings pre-dating 1989. Lead has been linked to impaired cognitive development in children and a number of other health problems. (Lead can also be a result of dissolution from natural sources).
Magnesium Oxide		A mineral used widely in the refractory industry.
Magnesium Peroxide		A fine powder used in bleaching, disinfecting and deodourising. Used to reduce contamination in groundwater.
Methane		The simplest alkane, the principle component of natural gas. A potent greenhouse gas. The major source of methane are natural gas fields.
Methanol		The simplest alcohol used as an antifreeze, solvent and fuel.
Mineral oil		Usually a liquid by-product of petroleum distillation. Can be used as a hydraulic fluid in hydraulic machinery and vehicles.
Muriatic Acid		Historic name from hydrochloric acid.
Naptha		A liquid mixture of hydrocarbons. A component of natural gas, petroeum, coal tar or peat boiling in a certain range and containing hydrocarbons. Used as a feedstock in gasloline. Also as a diluent in the bitumen mining industry, a solvent in the chemical industry and in the petrochemical industry to produce olefins in steam crackers.
Heavy Naptha		Boils between 90 C and 200 C. and consists of molecules with 6-12 carbons. Light Naptha boils between 30 C and 90 C and consists of molecules that with 5-6 carbon atoms. Heavy naptha is used in the petrochemical industry, but is commonly used as a feedstock for refinery catalytic reformers.
Napthalene		Organic compound, (polycyclic aromatic hydrocarbon) best known as the ingredient in mothballs. Mostly derived from coal tar. Napthalene commonly used as a chemical intermediate, a wetting agent/surfactant and a fumigant.
n,n-dimenthyl formamide		Commonly known as DMF is an organic compound and is used commonly as a solvent in chemical reactions. Has been linked with cancers and is thought to cause birth defects.
Petroleum Distillate		Petroleum products can be divided into 3 main categories. 1: Light distillates (LPG, Gasoline, Naptha). 2: Middle distillates (kerosene, diesel). 3. Heavy distillates and residuum (heavy fuel oil, lubricating oils, wax, asphalt).
Nonyl Phenol		A family of organic compounds, a subset of alkylphenols. Precursors to commercially important detergents. Considered to be an endocrine disruptor.
pH		A measure of acidity in an aqueous solution. Pure water has a pH of 7.0. Solutions with a pH less than 7 are acidic. PH greater than 7 is regarded as being basic or alkaline.
Phenol		Organic compound also known as carbolic acid and phenic acid. Phenol was extracted as coal tar and its major users are involved in conversion to plastics or related materials. Also used in building polycarbonates, epoxies, bakelite, nylon, detergents and drugs, herbicides and pharmaceuticals. A strong neurotoxin.
Phosphonic Acid Salt		A mineral in(organic) acid. Used in rust removal and as an

		ingredient in processed food (addititive E338). Has been linked to lower bone density.
Polyacrylamide		A polymer, which is highly water absorbant forming a soft gel when hydrated. Used as a flocculant.
Potassium (K)		Chemical Element, chemically similar to sodium. 95% of potassium production used in the fertiliser industry. Reacts violently with oxygen and water in air. Prinicple source of potassium is potash.
Potassium carbonate		A white salt, highly soluble in water which forms a strong alkaline solution. Used in the production of soap and glass. Also used as a fire retardant.
Potassium chloride		A metal halide salt composed of potassium and chlorine. Majority used in fertilisers, but also used in medicine, scientific applications and food processing.
Potassium Hydroxide		800,000 tonnes produced annually and used a precursor to soft and liqud soaps as well as numerous potassium containing chemicals.
Propargyl Alcohol, 2-BE (2-Butoxyethanol (2-BE), also known as ethylene glycol monobutyl ether (EGBE)		Organic compound and simple alcohol. Used as a corrosion inhibitor, a metal complex solution, a solvent stabiliser and eletroplating brightener additive.
Propionate		Proponic acid minus a carbon atom.
Quaternary Ammonium Chloride		Used as disinfectants, surfactants, fabric softeners and anti-static agents.
Sodium	Aesthetic considerations (taste) 180mg/L. People suffering from hypertension or congestive heart failure should not drink water >20mg/L.	Chemical element existing in many minerals such as feldspars, sodalite and rock salt. Highly soluble in water. Average values in Australia are 50mg/L and typically range from 3mg/L to 300mg/L.
Sodium Carbonate		
Sodium Polycarboxylate		
Sodium Chloride		Common salt. Found abundantly in the earth's oceans.
Sodium Hydroxide		Also known as lye or caustic soda. Used as a strong base in the chemical industry. 56% of sodium hydroxide used in the chemical industry with 25% of this amount used in the paper industry. Can also be used as an additive to drilling mud to increase alkalinity.
Sodium Persulfate		Chemical compound that is a strong oxidiser. Used as a hair bleach and as a detergent component.
Sodium Tetraborate		Also known as borax. Used in cosmetics, detergents and enamel glazes.
Tert-Butyl-Alcohol		A tertiary alcohol, used as a solvent. Also can be an additive in ethanol, paint removers, an octane booster in gasoline and a chemical intermediate.
Tetraethylene Glycol		One of several glycols derived from ethylene oxide.
Tetrakis (hydroxymethyl) phosphonium sulfate (THPS)		Tetrakis Hydroxymethyl Phosphonium Sulfate acts as an iron sulfide scavenger in oilfield waters by turning it into a water soluble complex. It has been shown that the addition of small quantities of THPS 75% to produced water containing iron sulfide will effectively reduce the level of iron sulfide in the water and remove deposits from pipe surfaces, filter media, and other equipment. The benefits include reduced corrosion of pipes and pump components, improved filter life, improved permeability at the well bore, increased efficiency of oil/water separation, and reduced sheen formation in offshore discharge of produced waters.
Tetramethyl ammonium chloride		A quaternary ammonium salt, used in organic synthesis for methylation.
Thioglycolic Acid		An organic compound used in the making of tin stabilisers, and in vinyl siding.

Toulene	0.8mg/L	Toluene occurs naturally as a component of crude oil and is present in petrol. It also occurs in natural gas. According to the ADWG Toulene has not been detected in Australian Drinking Water, although it has been detected in the Netherlands (Rhine River) averaging 0.002mg/L. It has also been detected in 1% of all groundwater supplies in the United States at >0.005mg/L.
Triethanolamine Zirconate		Organic compound used as a emulsifier and surfactant. Zirconate is a mixed oxide containing zirconium.
Triethylene Glycol		Colourless liquid used as a plasticiser for vinyl. Also used to dehydrate natural gas, by stripping water out of the gas. Also used as a mild disinfectant.
1,2,4 Trimethylbenzene		A colourless liquid which occur naturally in petroleum and coal tar. Used in the manufactuer of dyes, perfumes, resins and a gasoline addititive.
1,3,5 Trimethylbenzene		Also known as Mesitylene, is a derivative of benzene. Used primarily in laboratories and is also a major urban volatile organic carbon.
2-Butanone		Also known as methyl ethyl ketone (MEK), an organic compound used as a solvent and welding agent.
2-Butoxyethanol		An organic solvent used in paints, surface coatings cleaning products and inks.
Xylenes	0.6mg/L	Xylenes occur naturally as a component of crude oil and are present in petrol, but in small quantities. They can enter water from accidental spills and from solvents used in adhesives for bonding plastic drinking water fittings. Studies overseas have reported drinking water concentrations in the range 0.0001 mg/L to 0.01 mg/L. Xylenes are produced in the petroleum refining process and are used in the manufacture of insecticides, pharmaceuticals, detergents, paints, adhesives and other products. They are readily biodegraded in surface waters and they volatilise to air very quickly. According to the ADWG, Xylenes have not been found in Australian drinking water, but M&P-Xylene was detected at Dartmoor (0.0003mg/L) and o-Xylene at Dartmoor (0.002mg/L) on November 3 2009. [Wannon Water FoI application]
Zirconium Complex		A chemical element. Zircon is a by-product of the mining and processing of titanium minerals ilmenite, rutile and tin mining. Zircon is refractory and hard and resistant to chemical attack.

Fracking 20km north of Chinchilla, south eastern Queensland

Issues Arising From Fracking in the United States

Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing AWWA Streamlines May 17, 2011 Volume 3, Number 10 http://www.pnas.org/content/early/2011/05/02/1100682108.full.pdf+html

Methane levels in water supplies close to shale gas extraction sites in Pennsylvania and upstate New York are up to 17 times higher than normal, according to research. A study on the impact of drilling in the region found that about 85% of drinking water wells within 1km of a natural gas well were contaminated...About a million homes in Pennsylvania get their water from private wells, and today's study is bound to deepen safety fears. Under current Pennsylvania state law, the industry is allowed to drill within 200ft of a private water well.
http://www.guardian.co.uk/environment/2011/may/09/shale-gas-methane-drinking-water?

Pavillion Wyoming – Town Supply
"The findings are consistent with water samples the EPA has collected from at least 42 homes in the area since 2008, when ProPublica began reporting on foul water and health concerns in Pavillion and the agency started investigating reports of contamination there. Last year -- after warning residents not to drink or cook with the water and to ventilate their homes when they showered -- the EPA drilled the monitoring wells to get a more precise picture of the extent of the contamination." http://www.msnbc.msn.com/id/45246260/ns/us_news-environment/#.Ty-LV2HX_b9

Fracking 'will' cause drinking water pollution, warns DEC expert 10 January 2012
"An environmental engineering technician has warned that fracking will poison New York's water supply through contamination of its aquifers. Paul Hetzler a former employee from the Department for Environmental Conservation

(DEC) warned that the controversial gas drilling process hydraulic fracking poses a serious risk to the city's drinking water supplies. In a letter printed recently in the Watertown Daily Times he writes: "Hydraulic fracturing as its practiced today will contaminate our aquifers. "Not might contaminate our aquifers. hydraulic fracturing will contaminate New York's aquifers. If you were looking for a way to poison the drinking water supply, here in the Northeast you couldn't find a more chillingly effective and thorough method of doing so than with hydraulic fracturing." http://www.edie.net/news/news_story.asp?id=21647&title=Fracking+%27will%27+cause+drinking+water+pollution%2C+warns+DEC+expert+

The below website lists a number (36) of drinking water contamination incidents in the United States – all localised drawing from local wells (not large population centres). Arkansas (5), Colorado (3), New Mexico (1), New York (2), North Dakota (1), Ohio (1), Pennsylvania (7), Texas (11), West Virginia (3), Wyoming (1).
http://switchboard.nrdc.org/blogs/amall/incidents_where_hydraulic_frac.html

The major concern with shale gas drilling is the chemicals used in the process. Because the federal Energy Policy Act of 2005 exempted hydraulic fracturing from regulation under the Safe Drinking Water Act, shale gas drillers don't have to disclose what chemicals they use. A study conducted by Theo Colburn, PhD, the director of the Endocrine Disruption Exchange in Paonia, Colorado, has so far identified 65 chemicals that are probable components of the fracking fluids used by shale gas drillers. These chemicals included benzene, glycol-ethers, toluene, 2-(2-methoxyethoxy) ethanol, and nonylphenols...Concerns are growing that many of the chemicals used in shale gas drilling are seeping into groundwater. While some of the injection fluid used in the process comes back to the surface, 30 to 40 percent is never recovered, according to the industry's own estimates. People living in the vicinity of shale gas drilling have reported foul smells in their tap water. In some instances gas well pipes have broken, resulting in leakage of contaminants into the surrounding ground...There have also been cases of improper disposal of potentially toxic wastewater from fracking operations. In 2011, for example, The New York Times reported that some Pennsylvania Marcellus shale natural gas drillers were shipping potentially toxic and radioactive hydraulic fracking wastewater to sewage treatment plants not equipped to treat it. This fracking wastewater, which has only been partially treated, is later released into rivers and streams used as sources of drinking water by millions of Pennsylvanians. http://www.water-contamination-from-shale.com/

9 Dec 2011: Impacts mainly on domestic wells sourcing groundwater.
"In a first, federal environment officials Thursday scientifically linked underground water pollution with hydraulic fracturing, concluding that contaminants found in central Wyoming were likely caused by the gas drilling process."
http://insideclimatenews.org/news/20111209/epa-natural-gas-fracking-drinking-water-contamination-chemicals-pavillion-wyoming

Detections: pH, K, Cl, CH4, Benzene, Toulene, Ethyl Benzene, Xylenes, 1,2,4 Trimethylbenzene, 1,3,5 Trimethylbenzene, Diesel, Gasoline, Phenol, Napthalene, Isopropanol, Tert-Butyl-Alcohol, 2-Butanone, Diethylene Glycol, Triethylene Glycol, Tetraethylene Glycol, 2-Butoxyethanol, Acetone, Benzoic Acid, Acetate, Formate, Lactate, Propionate. Elevated Potassium, Chloride. http://www.epa.gov/region8/superfund/wy/pavillion/EPA_ReportOnPavillion_Dec-8-2011.pdf

Australia

Setback for CSG as Santos exposes sector standards February 23 2012 (The Australian)

THE coal-seam gas industry's campaign to win over farmers and environmentalists has suffered an inside blow, with claims from Santos one operator regularly ignored spills, was not open with its partners and potentially cleared land without approvals...The gas giant made the claims about Eastern Star Gas, its operating partner in the Pilliga State Forest, in a report to the NSW government yesterday...Green groups seized on the report, which comes after the January admission by Santos that 10,000 litres of salty CSG waste water had spilled in the state forest when Eastern Star was the operator...Santos's report said it found an "unacceptable culture in Eastern Star of accepting minor spills, failures in reporting and the possibility of unapproved land clearing". But it argued against claims the spill was toxic.

Coal Seam Gas Companies Begin Water Study May 17 2011
A group of eight coal seam gas companies working in the Galilee Basin in Queensland have begun a detailed study on the region's water resources to determine how they might be affected by future developments. Representatives from the Galilee Basin Operators Forum spoke to outback Queensland mayors at a meeting in Longreach in the states central-west yesterday. The forum included companies such as AGL, Cornet Ridge Limited and Exoma Energy... Tor McCaul said 'As an industry, we probably haven't done a great job in being clear and explaining what we are doing and why, and that really is part of the reason for starting with a clean slate at Galilee...'
http://www.abc.net.au/news/stories/2011/05/17/3218707.htm

Coal Seam Gas Highlights Planning Flaws May 18 2011
"... Coal seam gas (CSG)mining involved extracting methane gas from coal seams hundreds of metres underground. Numerous wells are sunk to tap the gas, and the removal of underground water to trigger gas flow to the surface.

To make extraction more economical a process called 'fracking' (hydraulic fracture stimulation) is also used. This involves pumping a fluid containing sand and chemicals underground to help open the cracks in tight coal seams to release the gas..." It's likely to be breaking some of the barriers between good and bad water and putting the good water at risk." says Dr John Williams (head of NSW Natural Resources Commission).

And he says there are also questions over how to deal with contaminated surface water generated by the mining. Williams says while there is much uncertainty around the industry's impact on the environment, there is some evidence that it has already damaged aquifers and contaminated water supplies.
http://www.abc.net.au/science/articles/2011/05/18/3219385.htm

Growing industry

The CSG industry is most advanced in Queensland where three out of four major projects have been given the green light. But the forum this week heard exploration has also begun in New South Wales including the Sydney suburb of St.Peters. "It's not just a country problem, it's a city problem. It's wherever there is gas underground" says Williams. Other exploration areas include agricultural land on the Liverpool Plains, near Gunnedah, and sites around the Illawarra. "The Illawarra system above the escarpment all serves to supply Sydney's water...It's a sensitive area and you don't want to compromise water supply for coal seam gas, he says. You have to adopt the precautionary principle.

...Williams says under the current system mining has special treatment and is not subject to the same restrictions as other activities, including farming, when it comes to issues such as protection of native vegetation. And he says the current reliance on environmental impact statements and court cases, which only look at the impact of one mine at a time, miss the potential cumulative effect of mines on a catchment. For the projects already begun in Queensland, Williams says the only option now is to monitor mining activities and try to fix up problems along the way.

Power generation can also create a host of environmental problems. The following information refers to Delta Electricity's power plant near Lithgow.

River 'Killed' by pollution feeds city water supply – SMH December 2 2008
A section of the Cox's River in the Blue Mountains that supplies drinking water to Sydney is so polluted by industrial run-off, that it is effectively dead, independent water quality tests show. The contaminated river has high levels of heavy metals including zinc, copper and manganese, 125 times more sulphate than surrounding streams and just 5 per cent of the oxygen that most fish need to survive. Those results were obtained by testing river water next to Delta Electricity's Wallerawang coal-fired power station...The river's pH levels, which measure the acidity of the water, are up to 1,000 times higher than nearby creeks... http://www.smh.com.au/news/environment/water-issues/river-killed-by-pollution-feeds-city-water-supply/2008/12/01/1227979933075.html

Labor Knew About Toxic Water Threat – Sydney Morning Herald June 19 2009.
The State Government knew more than two years ago that a river feeding Sydney's water supply was being contaminated with high levels of toxic metals and poisons including arsenic...Cox's River near Lithgow... 'We are concerned that there is no requirement for monitoring by Springvale Colliery... of water pumped from underground workings and transferred into Sydney drinking water catchment' the catchment management authority told the department in 2007... independent tests on water discharged from the power station have found high levels of heavy metals including copper, boron, aluminium and arsenic. Aquatic ecosystems in the river have suffered severely, but there is no known risk to human health...The environmental licence held by Delta Electricty has been modified in the past two years to reduce some of the discharges and the company had to pay a pollutant fee of $397,000 for releasing 6500 tonnes of salt into the water in 2007... http://www.smh.com.au/environment/water-issues/labor-knew-about-toxic-water-threat-20090618-cm02.html

Plant Still Polluting River Beyond Guidelines April 20 2010.
The New South Wales Government has tightened the pollution licence of a coal-fired power plant near Lithgow that is releasing toxic metals into a river that feeds Sydney's drinking water supply. Delta Electricity, the owner of the Wallerawang power plant, must now monitor heavy metals and pollutants such as arsenic flowing into a channel that enters the Cox's River and report back to the government every three months. But the latest results show that Delta is still polluting the river above safe guideline levels in some instances, more than two years after the government was warned that discharges from the plant were killing aquatic life. The amount of copper leaching into the river remains

above the Australian and New Zealand Environment and Conservation Council guidelines, at levels that can be deadly for fish and other river creatures...The latest discharge results come as Delta appeals against a Land and Environment Court ruling that could allow it to be prosecuted by a local environment group, in a test case for emissions around the state... http://www.brisbanetimes.com.au/environment/water-issues/plant-still-polluting-river-beyond-guidelines-20100419-spef.html

Water Polluters near you: Coal Fired Power Plants May 18 2011
http://projects.nytimes.com/toxic-waters/polluters/power-plants