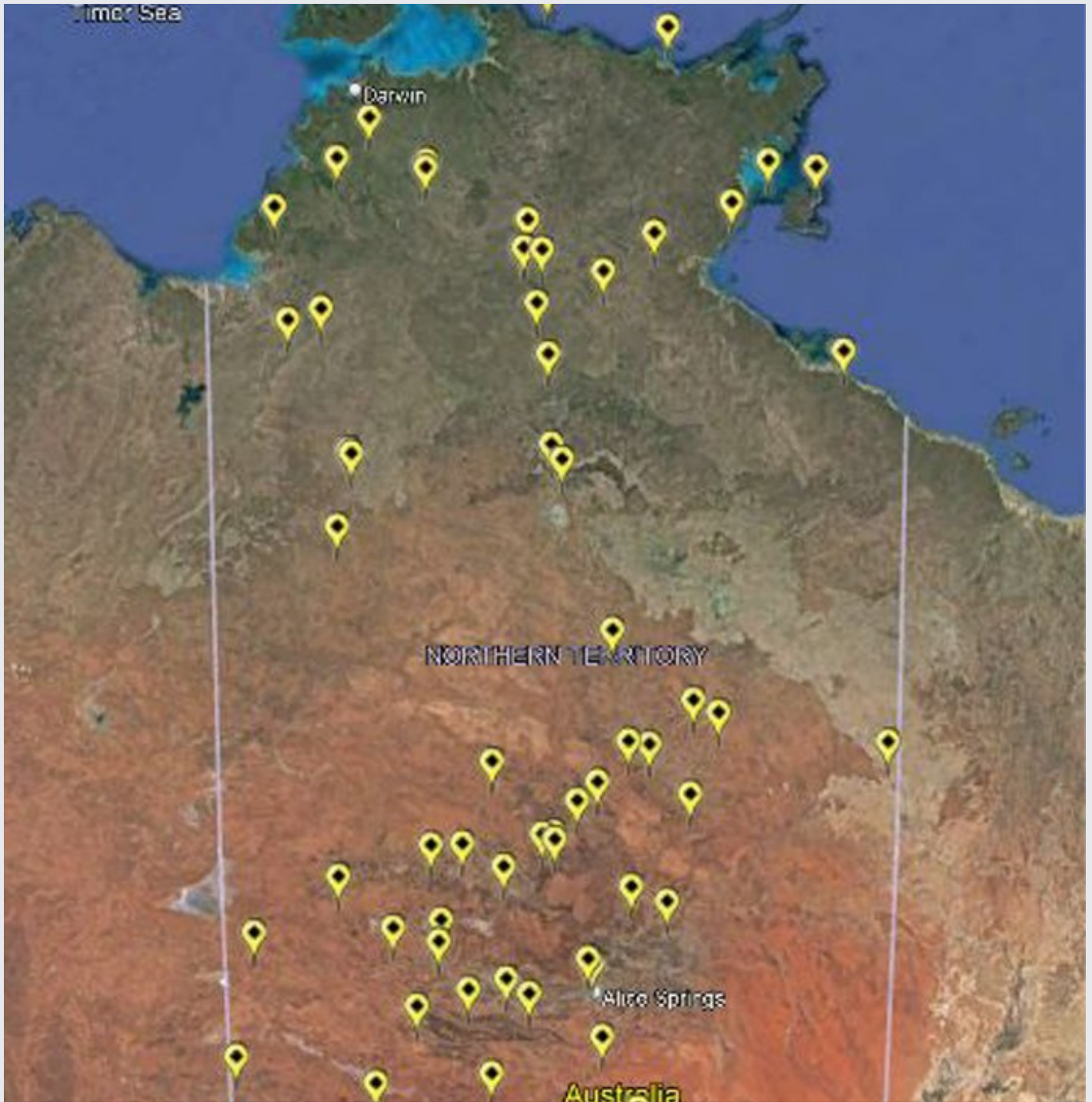


# Drinking Water Quality 2003/22

## Northern Territory

### Sodium an ignored health issue?



**Report compiled by Anthony Amis  
Land Use Researcher Friends of the Earth Australia  
January/April 2023**

# Table of Contents

<b>Introduction.....</b>	<b>Page 3</b>
<b>Findings .....</b>	<b>Page 5</b>
<b>Overview.....,</b>	<b>Page 9</b>
<b>Chemical Concerns.....,</b>	<b>Page 11</b>
<b>Main Communities of Concern.....,</b>	<b>Page 13</b>
<b>PFAS.....</b>	<b>Page 18</b>
<b>Microbiological.....</b>	<b>Page 20</b>
<b>Sodium.....</b>	<b>Page 25</b>
<b>Health Statistics.....</b>	<b>Page 29</b>
<b>Nitrate.....</b>	<b>Page 30</b>
<b>Physical and Chemical Summary.....</b>	<b>Page 31</b>
<b>Calculations.....</b>	<b>Page 35</b>
<b>Australian Drinking Water Map Statistics ..</b>	<b>Page 36</b>

# Introduction

**Friends of the Earth started an ambitious project in January 2023 with an idea to determine which communities in Australia suffer from the poorest drinking water quality. One reason for this was to reconcile a lot of the data that has accumulated on the Australian Drinking Water Map and to place key data from the map into one summary report.**

**The Australian Drinking Water map was created in 2018 as a means of gaining insight into drinking water issues across Australia. It has slowly accumulated information from around the country. There is no centralised database in Australia which keeps tabs on drinking water quality, except this volunteer-based website.**

**As a first step in a national report, FoE's research has just concluded in regards to the Northern Territory compiling data mostly between the years 2006/7\*-2021/22 (\*some larger locations had data going back to 2002/03 making 'standardisation' across all communities difficult).**

**The data in the NT study only selected substances listed under Australian Drinking Water Guidelines (ADWG) Health Guidelines and Microbiological Guidelines. Almost all aesthetic substances such as hardness\*, total dissolved solids, iron and taste and odour etc have not been included. Sodium however was included, particularly in terms of its association with health issues, where sodium as low as 20mg/L can cause problems with people suffering cardiovascular, heart and kidney issues. Under the Health Guidelines however, Sodium is regarded as an aesthetic issue only and has an aesthetic guideline of 180mg/L. Aluminium >0.5mg/L was also included in the estimations due to a supposed link to Alzheimer's Disease.**

**(\*Hardness causes scale build up due to magnesium and calcium ions. It can make plumbing and electrical appliances unusable. It can be a costly issue to resolve for many communities. Hardness is the most searched for topic on the Australian Drinking Water Map).**

**It is evident that in terms of drinking water quality, remote indigenous communities fare the worst. Recent announcements made by the Albanese Government in February 2023, to fund \$424 million into close the gap funding for indigenous communities, means that \$150 million over four years from the national water grid fund will target communities (not only in the NT) that currently do not have access to clean drinking water.**

**Water Services Association of Australia however have stated that a minimum investment of \$2.2 billion is required to bring drinking water in line with the Australian Drinking Water Guidelines.**

**It will be an interesting process to see which communities benefit from this investment and which will continue to miss out. In the Northern Territory, the communities of Laramba and Katherine have had water treatment facilities built over the past couple of years. One to deal with Uranium, the other with PFAS, however many more communities are in dire need for access to better quality drinking water.**



**The small community of Gudabijin/Bulla in the north west of the Northern Territory rated poorest quality of water due mainly to high levels of Barium between the years 2007-2022. Barium levels were up to 5 times higher than the Australian Drinking Water Guideline between 2016-2020. High levels of barium can cause changes in heart rhythm or paralysis in humans. Short period exposures may cause vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness.**

# Main Findings

**According to FoE the following communities with a total population of ~6000 people have had chemicals/minerals at chronic levels (above guideline levels) in the drinking water between 2003/4\*-2021/22:**

**Gudabijin/Bulla, Beswick, Laramba, Kings Canyon, Wilora, Timber Creek, Willowra, Tennant Creek, Nyrippi, Alpurrurulam and possibly Pine Creek.**

**In terms of microbiological concerns: Darwin, Tennant Creek, Nganmaniyanga, Areyonga, Numbulwar, Rittarangu, Laramba, Pirlangimpi, Elliott, Naviyu, Daly Waters, Wallace Rockhole, Papunya, Yarralin, Cox Peninsula, Gudabijin (Bulla) and Beswick all have had five or more microbiological incidents over the time period, although such incidents now appear to be waning.**

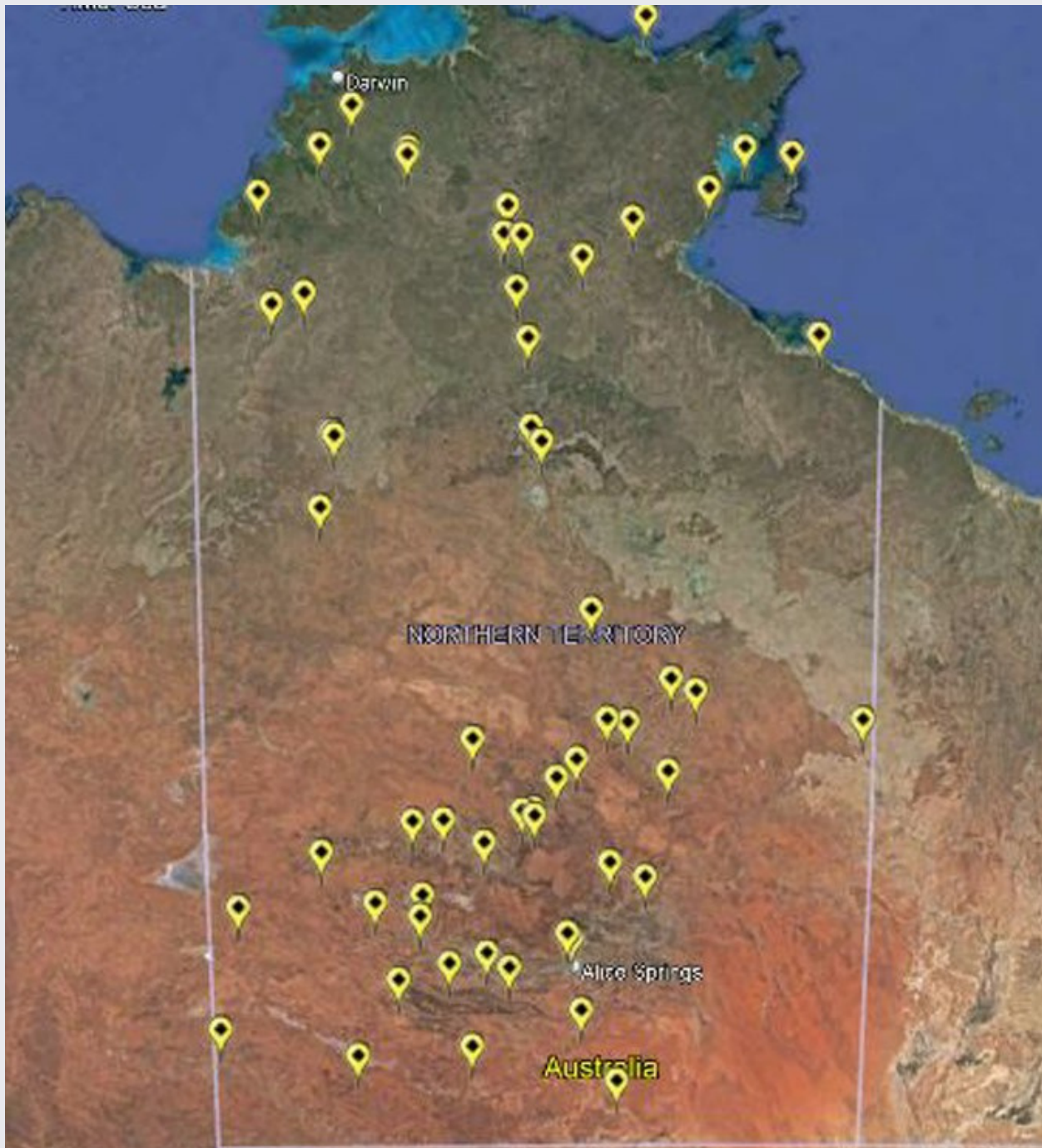
**In terms of sodium issues almost 50,000 Northern Territorians in 61 communities have been drinking sodium at rates >20mg/L for possibly decades. Sodium at these levels can impact on people with cardiovascular, heart disease, kidney problems and people on low sodium diets. These communities include (from highest sodium levels):**

**Wilora, Nturiya, Papunya, Imanpa, Jilkminggan, Tara, Daly Waters, Haasts Bluff, Amanbidji, Willowra, Alpurrurulam, Ali Curung, Kings Canyon, Ampilawatja, Yuendumu, Atitjere, Canteen Creek, Ngukurr, Larrimah, Amunturangu, Tennant Creek, Wallace Rockhole, Apatula, Mataranka, Nyrippi, Yuelamu, Kintore, Laramba, Lajamunu, Engawala, Elliott, Alice Springs, Hermannsburg/Ntaria, Pmara Jutunta, Areyonga, Amoonguna, Kaltukajura, Ti Tree, Nganmarriyanga, Kybrook Farm, Newcastle Waters, Wuthunugurra, Yulara, Milingimbi, Imangara, Kalkarindji, Warruwi, Pine Creek, Milyakburra, Daguragu, Titjikala, Bunbidee/Pigeon Hole, Robinson River, Adelaide River, Gudabijin/Bulla, Minyerri, Numbulwar, Umbakuma.**



Ten\* communities have faced chronic drinking water problems over the time period above Australian Drinking Water Guidelines for a variety of chemicals. (\*Pine Creek came in at 89% of the long term "chronic guideline").

**The chemicals of most concern included: Fluoride, Uranium and Selenium. Lead, Radioactivity, Barium, Antimony, Arsenic and PFAS\* were also problematic in some communities. (\*PFAS was largely under health guidelines in reticulated supplies, but well above in some bore water supplies).**



Seventy communities recorded sodium >20mg/L during the time period with 61 recording chronic levels of sodium >20mg/L.

**"We are concerned that the Australian Drinking Water Guidelines categorise sodium as an 'aesthetic' attribute of water quality as it can impart a salty taste at highly elevated concentration. This translates into an Australian guideline of 180mg/L. One of the consequences of the ADWG guideline for sodium is that water authorities regard it as a low priority. This reduces its frequency of measurement and often sodium results are not published. And worst of all, people consuming water with elevated sodium are often doing so without realising that it may be very harmful" A Wright et al 2019**



**E.coli detections in NT water supplies 2003/4-2021/22. The pins highlighted in red had multiple detections. The Australian Drinking Water Guidelines state that the greatest risk to consumers is from pathogenic microorganisms and that protection of water sources and treatment are of paramount importance and should never be compromised. See page 20 for more information.**



# Overview

**All information sourced for this report was first published by Power and Water Corporation in their annual drinking water quality reports.**

**The data was compiled into spread sheets, focusing almost entirely on breaches to the Australian Drinking Water Guidelines. Data close to the guideline levels, generally 75%-100% was also included (Nitrate as low as 40% was also included).**

**A simple mathematical calculation\* was then used to calculate an approximate total over the time period 2003/4-2021/22. (\* see page 35).**

**In many other areas around Australia, breaches to drinking water guidelines usually only happen over a short period, from less to an hour to a couple of days. Water quality breaches in these communities could be described as being “acute” and are usually sorted out quickly.**

**People consuming this water would either be exposed to a toxin/chemical above guideline levels for a short time or in the case of microbiological detections, community warnings would be sent out to residents and boil water notices/alerts issued. In some situations alternative supplies will be provided. Health Guidelines in the ADWG are based on lifetime exposure to the described substance, meaning that acute chemical issues are generally not as significant as chronic chemical issue. Most microbiological issues however can be acute potentially devastating.**

**Water testing in the Northern Territory, particularly in remote communities, can be difficult. Fixing serious problems by sending work crews to remote areas also takes longer than in an urban environment. This means that acute problems may take longer to resolve. The use of Remote Essential Services Officers (ESO's) by Power and Water Corporation has meant that many less serious issues can be "trouble-shooted" remotely.**

**Another problem in looking at the Power and Water water quality data is that the results were not standardised. Sometimes data reported by Power and Water in annual water quality reports were reported as average, sometimes as median and sometimes as 95th percentile. These discrepancies made precise estimations from existing data impossible to get entirely accurate.**

**From this process it was still possible to determine an indicative estimation about which communities in the Northern Territory had been facing the worst chronic drinking water problems based on health criteria. Aesthetic problems with drinking water were generally avoided, however sodium, and aluminium were included in the calculations.**

**Some of the larger communities have had water data published by Power and Water since 2003/04, whilst smaller and remote communities have had information published since 2007. This has made an overall picture over 20 years difficult and many of the smaller communities had information going back only 15 years. There does appear to be a slow improvement in some communities, however it is unacceptable for some communities to be facing chronic water issues for decades. This situation would not be tolerated in larger urban centres throughout Australia.**

**In 2006/7, Power and Water Corporation embarked on a strategy focusing on better data collection and analysis,**

**“The Strategy for the Provision of Safe Drinking Water for Indigenous Communities 2007-2010 (Strategy for Safe Water) was developed to specifically focus on the improvement of quality of the water supplied in Indigenous communities consistent with the ADWG by 2010-11”. The main focus over 2007-09 was to improve microbiological standards of drinking water with 2008-10 targets focusing on improving chemical, physical and radiological quality of drinking water in Aboriginal communities.” Power and Water Corporation 2006/7**

# 'Chemical' Concerns

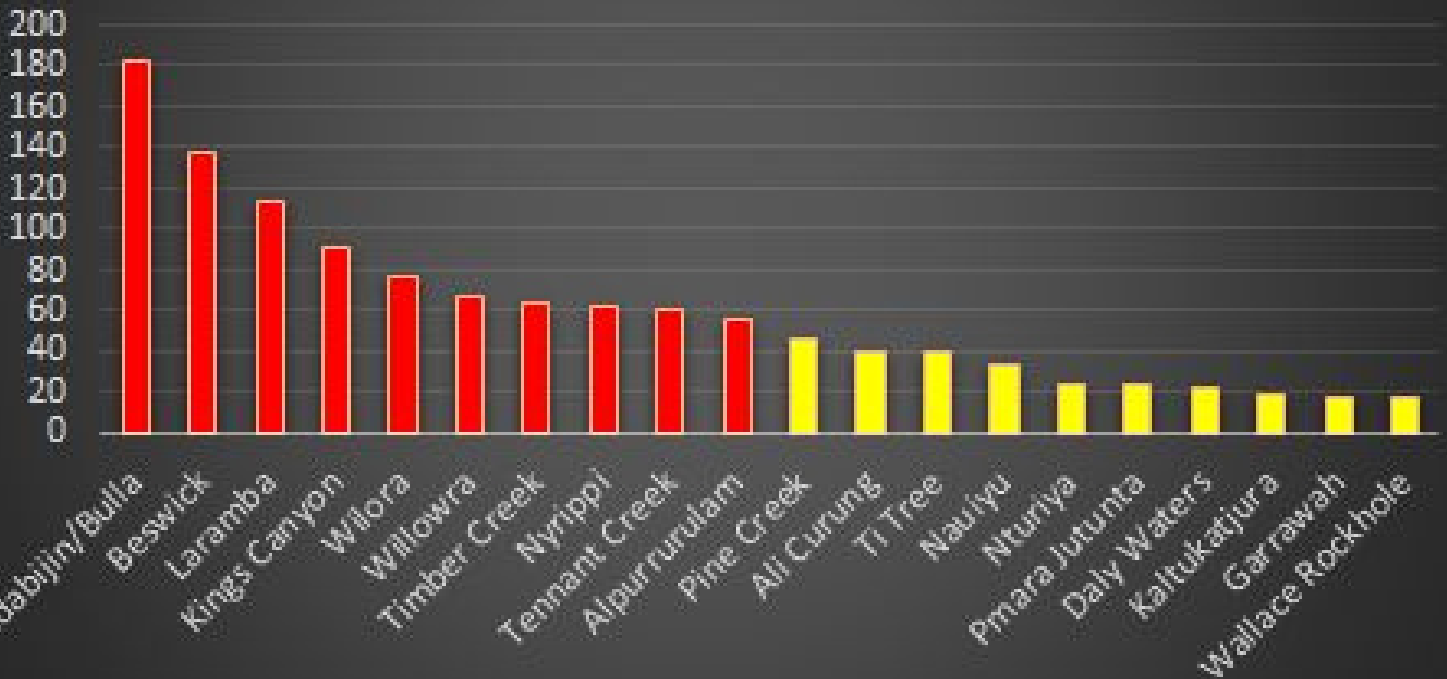


**The community of Wilora faced serious chronic water problems including Uranium and Sodium. Health impacts from uranium in drinking water can lead to renal damage and nephritis. According to the Australian Drinking Water Guidelines: "People with severe hypertension or congestive heart failure may need to restrict their overall dietary intake of sodium further if the concentration in drinking water exceeds 20 mg/L."**

Add a little bit of body text



**Chronic Drinking Water Problem Communities.  
Northern Territory 2003/22. Red indicates highest  
concern based on health related guidelines.**



**A score of 52 (see page 35 for calculation) on the scale infers at least one substance breaching ADWG for every week over the reporting periods. What this graph implies is that the community of Gudabijin/Bulla (with a combination of Fluoride, Barium and Manganese) was exposed to drinking water at ~three times higher than the ADWG for almost the past 15 years.**

**Ten other communities, Beswick (Antimony, Arsenic), Laramba (Uranium\*), Kings Canyon\*\* (Radioactivity, Selenium, Lead), Wilora (Uranium, Aluminium, Lead), Willowra (Uranium), Timber Creek (Fluoride, Barium), Nyrippi (Fluoride), Tennant Creek (Fluoride) and Alpurrurulum (Fluoride) were also exposed to (combined) drinking water above the ADWG for the past 20 years. [^Pine Creek came in at 89% of the 52 score due to Arsenic between 50%-100% of guideline levels].**

**(Nitrate was also included in the calculation, as was Aluminium which has been associated to Alzheimers. An aluminium level of 0.5mg/L was regarded as breaching the ADWG even though there is no health guideline for aluminium in the ADWG).**

The total population of these communities (including Pine Creek) is about 6,000 people. (\*Laramba had a new water treatment plant constructed in late 2022. Hopefully this will mean the end of decades of high uranium detections. \*\*Kings Canyon also had very high levels of Iodide in their drinking water supply. The 2004 Iodide guideline was 0.1mg/L, this was raised in 2011 to 0.5mg/L. The 2011 Guideline level was used in this report).

# Main communities of concern

**Gudabijin/Bulla** (estimated population 50?). Drinking Water Supply: East Baines River + Groundwater (Katherine Region). The East Baines River has elevated levels of iron and manganese. The groundwater has high levels of Barium. A new treatment of disinfection process has allowed reduced levels of groundwater being used. Barium levels in the water supply peaked to around 5 times the ADWG between 2016-20, but appear to have dropped back to the ADWG over 2020/22. These are lowest barium levels since 2007/08. High levels of barium can cause changes in heart rhythm or paralysis in humans. Short period exposure may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness.

**Beswick** (estimated population 531). Drinking Water Supply: Groundwater Remote Community (Katherine Region). Listed as a community where new works will occur after initial 8 communities receive new works in 2021. See Chief Minister's April 2021 Press Release. Biggest problems have related to Arsenic (averaging around 70% of ADWG) and Antimony occurring at double the ADWG. Short term exposure to Antimony can lead to nausea, vomiting and diarrrahea with long term expsoure linked to cancer.

**Long term consumption of arsenic can lead to an increased risk of cancers of the bladder, lungs, liver, and other organs. Arsenic can also contribute to cardiovascular and respiratory disease, reduced intelligence in children, and skin problems, such as lesions, discoloration, and the development of corns.**



**The small community of Beswick**

**Laramba** (estimated population 239). Drinking Water Supply: Groundwater. Remote Community (Southern Region). Laramba has been the source of a lot of media attention due to high levels of uranium. The community has been vocal in their concerns. The chronic uranium levels have been the highest recorded in a drinking water supply in Australia.

**A new water treatment facility was constructed in 2022/23 and is expected to be operational by March 2023. The new CleanTeQ Water facility has a capacity of 360 kilolitres per day, the plant uses an ion-exchange resin process to reduce the amount of uranium in the water.**

**Health impacts from uranium in drinking water can lead to renal damage and nephritis. Sodium is also an issue.**



**Laramba.** Hopefully their drinking water problems will be resolved with the completion of a new water treatment plant in early 2023.

**Kings Canyon** (estimated population 400?). Minor Urban Centre. Water Supply: Groundwater (Southern Region). Two new supply bores connected during 2003/04. The primary water quality issue for Kings Canyon up to 2011 was iodide which had a 2004 guideline of 0.1mg/L. This guideline was increased to 0.5mg/L in 2011, meaning that overnight Kings Canyon iodide issue went from over ~3-4 times the guideline level to only 80% of the level. Kings Canyon also has the Territory's highest radioactivity levels. Selenium was also an issue until 2010.

Radioactivity can increase risk of cancer and kidney problems. Exposure to high levels of Selenium can lead to hair and fingernail changes, damage to the peripheral nervous system, fatigue and irritability. Excess iodide can lead to thyroid dysfunction which in turn can lead to a number of health concerns. Sodium is also an issue.

**Wilora** (estimated population 95). Water Supply: Groundwater. Remote Community (Southern Region). Community has tried to fundraise to purchase water tanks and a filtration system. The main drinking water problem for Wilora has been Uranium. Health impacts from uranium in drinking water can lead to renal damage and nephritis. Wilora also has excessive on ongoing sodium issues.

**Timber Creek** (estimated population 278). Water Supply: Groundwater Minor Urban Centre (Katherine Region). Fluoride and to a lesser extent Barium are the key chemical issues at Timber Creek. Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems. High levels of barium can cause changes in heart rhythm or paralysis in humans. Short period exposure may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness.

**Willowra** (estimated population 301). Water Supply: Groundwater Remote Community (Southern Region). In 2008-09, a disinfection system was upgraded from calcium hypochlorite to sodium hypochlorite. Uranium is the major concern for the Willowra drinking water supply. Health impacts from uranium in drinking water can lead to renal damage and nephritis. Sodium is also an issue.

**Nyrippi** (estimated population 251). Water Supply: Groundwater Remote Community (Southern Region). Disinfection of the water supply was achieved using both calcium hypochlorite and sodium hypochlorite in 2008/09. Detections of E.coli resulted in Precautionary Advice for Drinking Water (Water Boil Alerts) being issued in 2008/09. Fluoride appears to be the main chemical of concern for Nyrippi. Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems. Sodium is also an issue.

**Alpurrurulum** (estimated population 420). Water Supply: Groundwater Remote Community (Southern Region). Sodium hypochlorite treatment was proposed 2007/08. Fluoride appears to be the main chemical of concern for Alpurrurulum. Water softening to reduce hardness, via a Calgon Dosing Machine installed by community in 2015. Sodium is also an issue.



**Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems. Alpururulum's water woes can be best seen [here](#).**

**Tennant Creek** (estimated population 3080). Water Supply: Groundwater. Major Urban Centre (Kelly Well, Kelly Well West and Cabbage Gum Borefields) “Blending of groundwater bores occurs at Tennant Creek to ensure guideline values for fluoride are not exceeded”. The water supply had to be hand-dosed with chlorine 27 times in 2003/4 due to absence of continuous disinfection.

**In 2004 the NT Government directed Power and Water not to install continuous chlorination following a referendum in the community. The referendum was held on 29 May 2004 and resulted in 75% of people rejecting chlorine as a means of disinfecting drinking water.**

**Tennant Creek has also been monitored since 2006/07 for Burkholderia pseudomallei which causes the disease melioidosis. During 2011/12 Tennant Creek suffered from nine separate E.coli contamination incidents. Power and Water partnered with the Department of Health (DoH) eventually installed continuous chlorination for the Tennant Creek community in April 2015. Since that time it would appear that the water supply is less likely to be vulnerable to microbial contamination.**

**Fluoride and Iodide were also major issues at Tennant Creek. Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems. Excess Iodide can lead to thyroid dysfunction which in turn can lead to a number of health concerns.**

**Pine Creek** (estimated population 328). Water source: Surface water. (Copperfeld Reservoir – emergency) + groundwater (100%) Groundwater and surface water supplies have been blended to reduce arsenic levels. Arsenic was a particular problem in 2016/17. Long term consumption of arsenic can lead to an increased risk of cancers of the bladder, lungs, liver, and other organs. Arsenic can also contribute to cardiovascular and respiratory disease, reduced intelligence in children, and skin problems, such as lesions, discoloration, and the development of corns.

# PFAS

**Per and poly-fluoroalkyl substances (PFAS) have been linked to decreased fertility and high blood pressure in pregnant women, developmental delays in children, increased risk of some cancers (thyroid and testicular), reduced ability of immune system to fight infections, interference with hormones and increased cholesterol levels.**

**Katherine's drinking water has been impacted from polluted groundwater from nearby Tindal RAAF base. PFAS fire fighting foam had been used at the nearby Tindal RAAF base between 1988-2004. Residents of Katherine only found out that PFAS had contaminated groundwater in 2016. Groundwater supplies <10% of the local water supply, with the Katherine River supplying ~90%. People relying on bore water were most impacted with levels as high as 4.6µg/L recorded.**

**The issue was seen to be so serious that a temporary plant to treat groundwater started operation in October 2017 and new water treatment facility was built in Katherine after being shipped from the United States. It will be commissioned in 2023 and will process 10ML of water per day as a supplement to Katherine's water supply. It uses a technology adsorption and ion-exchange technology built by Emerging Compounds Treatment Technologies.**

**The ABC reported some exceedences to the drinking water quality guideline at Katherine in 2017, but generally, reticulated water levels appeared to be mostly under guideline levels. But who really knows what levels were being recorded previous to this. It is highly likely that groundwater had been polluted for decades and probably at levels higher than what has been recently reported. A very conservative estimate of PFAS level of 0.004µg/L between 2002-2022 has been estimated for Katherine reticulated water in this report based on averages for Katherine sourced from Power and Water. The highest levels recorded at Katherine in 2021/22 however were 0.05µg/L, with a yearly average of 0.004µg/L.**

**(If an assumption was to be made that Katherine residents were drinking PFAS at guideline levels of 0.07µg/L since 2002/3, Katherine would come in at around 11th in terms of all communities exposed to toxins in their water supplies in the Northern Territory in this report).**

**“The Power and Water Corporation has previously revealed the town’s water supply had levels of PFAS above those guidelines on four occasions since testing began last year. But the corporation and the Health Minister both refused to explain how high those results were on the grounds that monthly rolling averages, and not daily averages, are more relevant when assessing health impacts. The data shows average individual results were also above the guideline in late April (0.095) and late June (0.085). A fourth individual recording in mid-June was below the average, but some of the samples included in the recording were above the guideline.”**  
**ABC 2017.**

**The other issue with PFAS is that although the ADWG have guideline levels of PFOS and PFHxS of 0.07µg/L and PFOA of 0.56µg/L. Recent guidelines in the US however could go as low as 0.004µg/L for PFOA + PFOS. **If the Australian guideline is lessened over the next few years, then it is likely that the PFAS issue at Katherine is alot more serious than what the Government has been saying.** The new ‘temporary’ treatment plant at Katherine started in December 2017. All treated water since that date has been <0.01µg/L.**

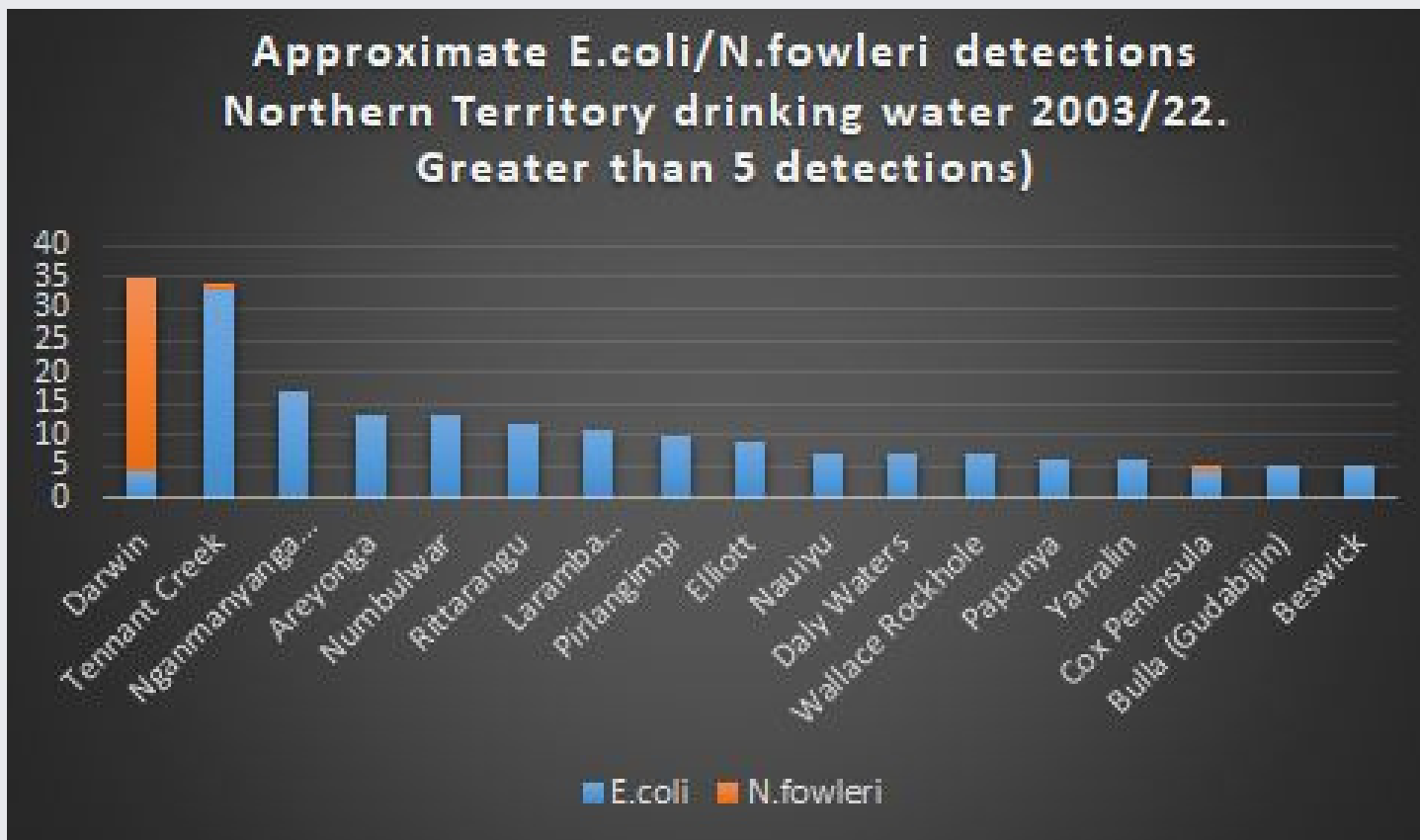
**PFAS chemicals (eg PFHxS+PFOS) have also been detected in other NT water supplies at average levels higher than Katherine. The averages for 2021/22 were: Alice Springs (0.005µg/L), Adelaide River (0.006µg/L), Batchelor (0.008µg/L) and Pine Creek (0.002µg/L). The source of this contamination has not been published by Power and Water.**

# Microbiological

The ADWG state that the greatest risk to consumers is from pathogenic microorganisms and that protection of water sources and treatment are of paramount importance and should never be compromised.

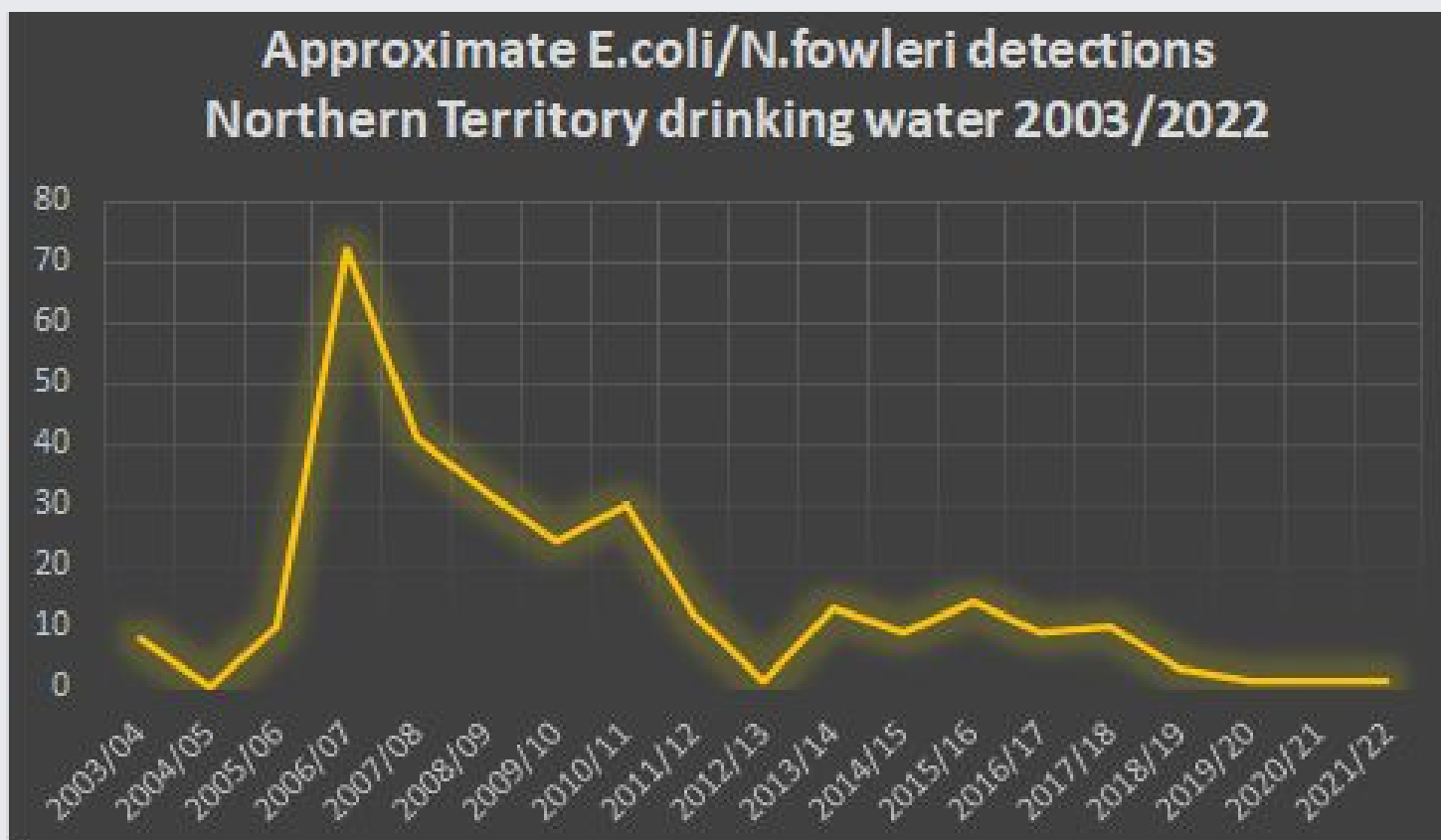
**E.coli** is used as the primary indicator of faecal contamination of drinking water because it is prevalent in warm blooded animals. Whilst most **E.coli** are non-pathogenic (not causing disease), there are a number that can cause disease, including serious disease. **E.coli** are highly sensitive to disinfection, particularly with chlorine.

In terms of microbiological concerns: Darwin (mainly **N.fowleri**), Tennant Creek, Nganmaniyanga, Areyonga, Numbulwar, Rittarangu, Laramba, Pirlangimpi and Elliott recorded the most microbiological detections over the 20 year period.



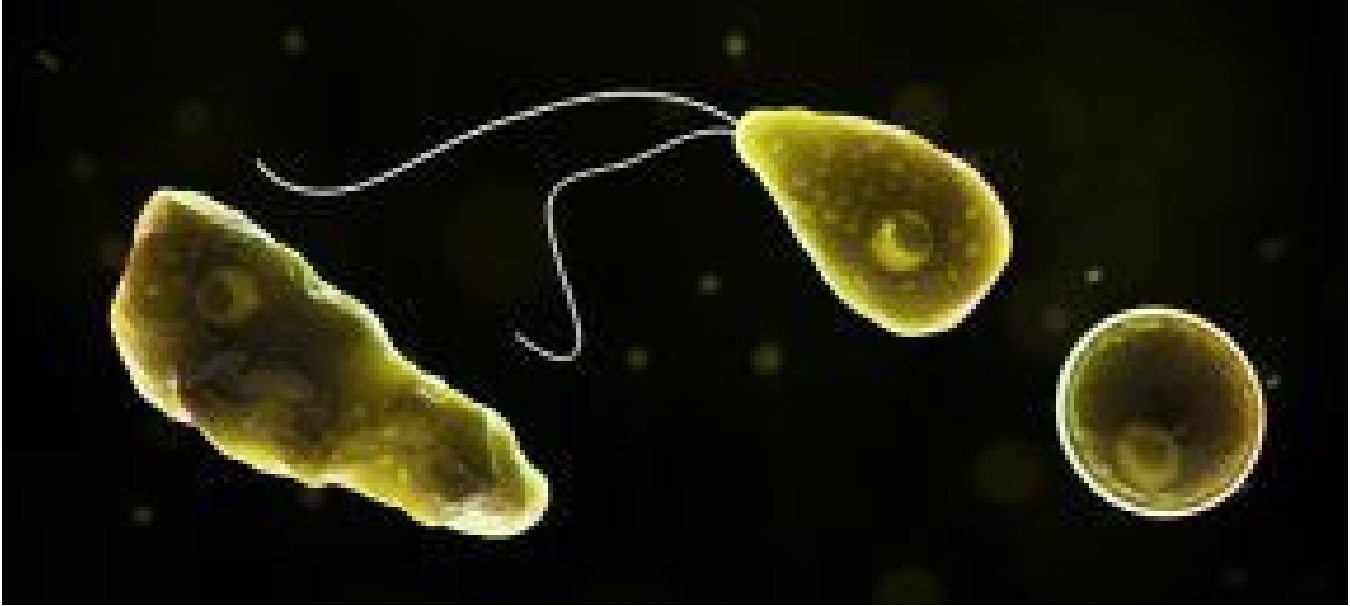
**“In 2016 Power and Water conducted a comprehensive review of chlorine disinfection systems across all 91 communities in the Northern Territory and identified opportunities for improvement through the upgrading and standardisation of systems. As a result of this review, Power and Water is in the first tranche of a four tranche improvement program to upgrade disinfection systems across the Northern Territory. For remote sites, the \$12 million program is funded by the Department of Territory Families, Housing and Communities...For the 2020-21 reporting period, disinfection upgrades have been completed at seven remote communities. **These are Acacia Larakia, Amanbidji, Belyuen, Bulla, Jilkminggan, Lajamanu and Nauiyu (Daly River).** Spending for these sites has so far totalled \$3.4 million.”**

**2020/21 Power and Water**

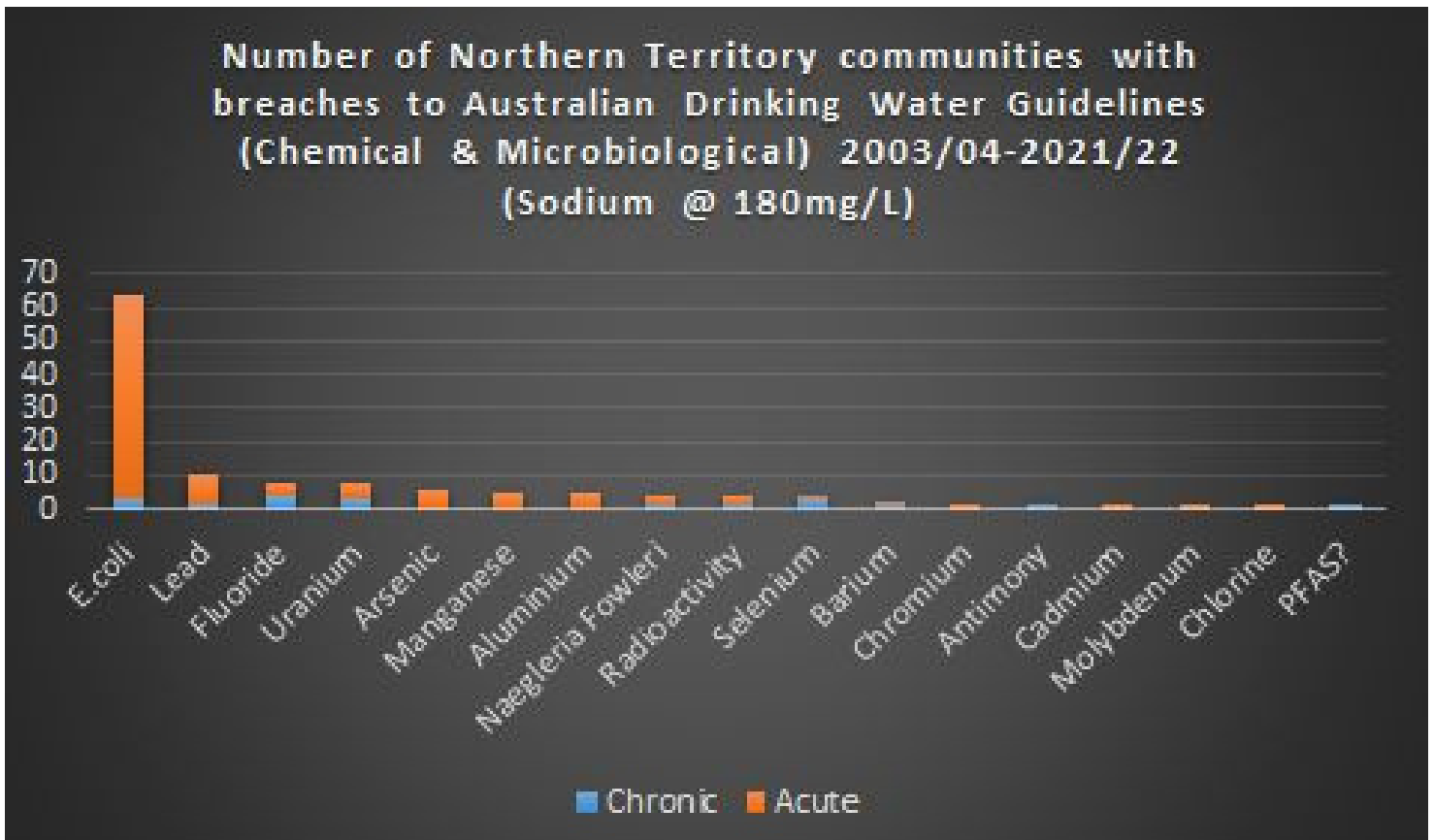


**The spike in detections in 2006/07 can be partially explained by a more thorough testing and detection regime being implemented across remote communities. In 2003/4 bacteriological samples for 15% of consumers (in minor centres) were taken monthly, with weekly samples taken in major centres. By 2007/08 population centres with a population of over 1000 required weekly microbiological testing. Comprehensive chlorination was introduced to all remote communities in 2008. It is evident that microbiological detections have declined substantially since 2006/07.**

**"In 2006/07 Power and Water introduced a monitoring program for Naegleria fowleri (a free-living amoeboflagellate) after it was detected in South Australia and Western Australia. N.fowleri is not associated with faecal contamination and it requires separate monitoring. It was first detected in the Darwin water supply in 2005. It causes a rapid and usually fatally infection, usually amoebic meningoencephalitis when contaminated water is forced into nasal passages. "**



**Approximately 94% of N.fowleri detections were in Darwin area. N. fowleri were detected in Darwin in reticulation, storage, distribution, tank sediments and hydrant flushing.**



**A combination of all breaches to the ADWG shows that E. coli was the widest spread issue in the Northern Territory over the time period, but in terms of chronic issues impacting the most communities, fluoride, uranium, and selenium were most widespread.**



### **E.coli**

**E.coli problems are usually dealt with quickly in most areas of Australia. Once detected, boil water alerts are sent out to members of the public or alternate drinking water sources are provided and water authorities carry out. Water authorities also carry out increased monitoring and response flushing. Boil Water Alerts can also occur during flood events when water treatment plants are overwhelmed.**

**E.coli detections trigger remedial action and investigation into the source. Microbiological indicators can pose an immediate risk to public health. Total coliforms are also tested for by Power and Water and are a range of bacteria found in soil and water environments. Coliforms give a general indication about cleanliness of the drinking water system.**

**By 2020/21 almost 2,500 samples were collected for bacteriological verification from 20 centres around the Northern Territory. In 2019/20 E.coli samples would have been taken between 26-156 times per year, depending on the location or possibly once every two weeks to two days depending on the community.**

**Burkholderia pseudomallei (was first detected in a Darwin private supply in 2010) and N. fowleri are treated by setting a minimum chlorine residue of 0.5mg/L in major and minor urban centres and remote communities in the northern and Katherine regions. A residue has been set at 0.3mg/L in the Barkly and Southern region. Burkholderia pseudomallei is responsible for the disease melioidosis. Over 11,000 samples from 20 communities were tested over 2016/17. Between 2013-16 B.pseudomallei was detected in untreated water from the Katherine, the Darwin River Reservoir, McMinns borefields and the Adelaide River.**

## **2015: Yuelamu Issue**

**In November 2015, routine inspections identified the presence of high levels of blue-green algae (*Cylindrospermopsis raciborskii*) and associated toxins in the dam at Yuelamu. No toxins were apparently detected in the reticulation system. The use of the dam water was stopped and an alternative supply was sought from the community's AWT plant (Advanced Water Treatment).**

**“Following assessment of options, the construction of a second drinking water reticulation system, drilling of a backup bore to improve security and improving the reliability of the AWT was the most feasible. Safe drinking water will be provided to one tap in the kitchen of each house through the new second reticulation system. The existing water reticulation system will continue to be filled with brackish groundwater for toilet flushing, showering and other purposes. The project is funded for construction in 2016-17” 2015/16 Power and Water ADWQR**





# The unstated and often ignored health issue of Sodium

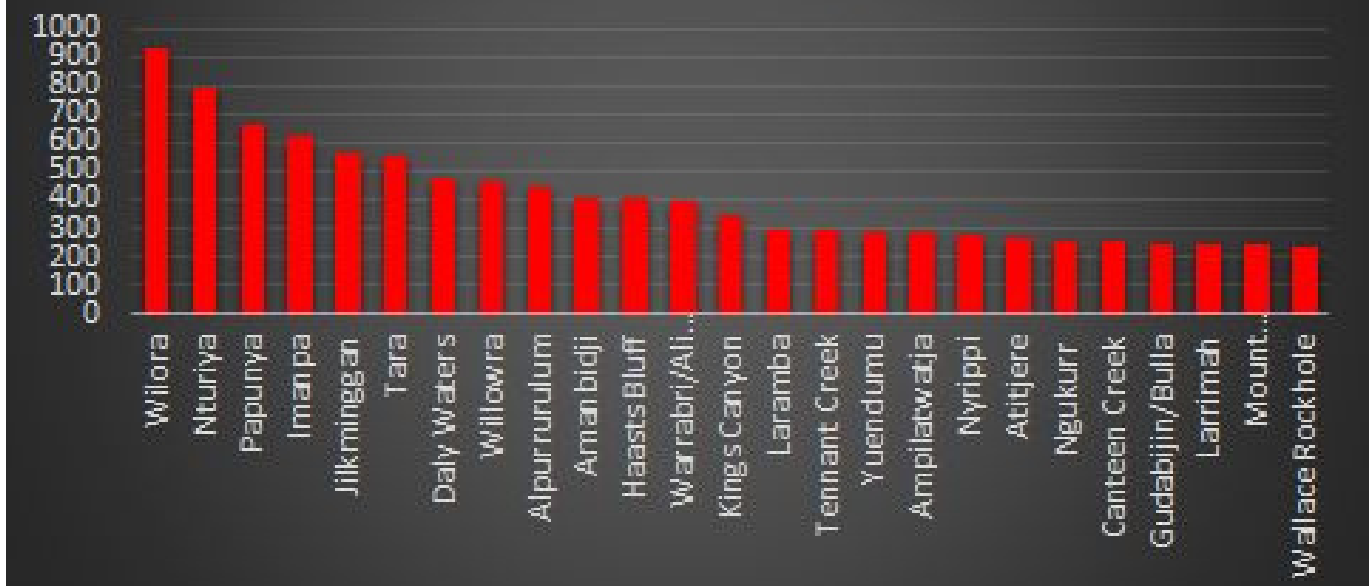
Sodium has two separate guideline levels under the ADWG. 180mg/L is an aesthetic guideline only meaning it has limited impacts on health of most people. However, the ADWG also state that:

“While there is evidence linking excess sodium intake with cardiovascular disease, it must be recognised that sodium intake via the water supply makes only a modest contribution to total intake. Nevertheless, water authorities are strongly encouraged to keep sodium concentrations as low as possible. **People with severe hypertension or congestive heart failure may need to restrict their overall dietary intake of sodium further if the concentration in drinking water exceeds 20 mg/L.** Medical practitioners treating people with these conditions should be aware of the sodium concentration in the patient’s drinking water”.

The West Australian Government add: “However, the following people should be aware of the level of sodium (salt) in drinking water when the level is greater than 20 milligrams per litre: **Persons who are monitoring their salt intake for high blood pressure, Persons with cardiovascular or heart disease, Persons with kidney problems or Persons on low sodium diets...**Elevated levels of sodium (salt) will not make babies ill but it is recommended you talk to your local District Nurse if you bottle feed your baby.”

The USA EPA add “Those that are under treatment for sodium-sensitive hypertension should consult with their health care provider regarding sodium levels in their drinking water supply and the advisability of using an alternative water source or point-of-use treatment to reduce the sodium. For individuals on a very low sodium diet (500 mg/day), EPA recommends that drinking-water sodium not exceed 20 mg/L.”

**Top 25 Sodium Impacted Drinking Water Communities Northern Territory 2003-22 based on sodium >20mg/L**



If one combines sodium >20mg/L (with other substances >ADWG), communities facing chronic drinking water problems increases from 10 to 61. The above graph only shows the highest 25. Note that Wilora drinking water was close to a combined total 18 times higher than the combined ADWG (sodium and uranium) over period where testing has been published. A score on 52 means a community has been exposed to a chemical at drinking water guideline levels for many years. Anything over 52 is cause for concern.

The highest maximum level of sodium in drinking water in the NT were at Wilora (411mg/L) or 20 times higher than 20mg/L. Wilora's sodium levels averaged at between 14-16 times the 20mg/L level for 15 years.

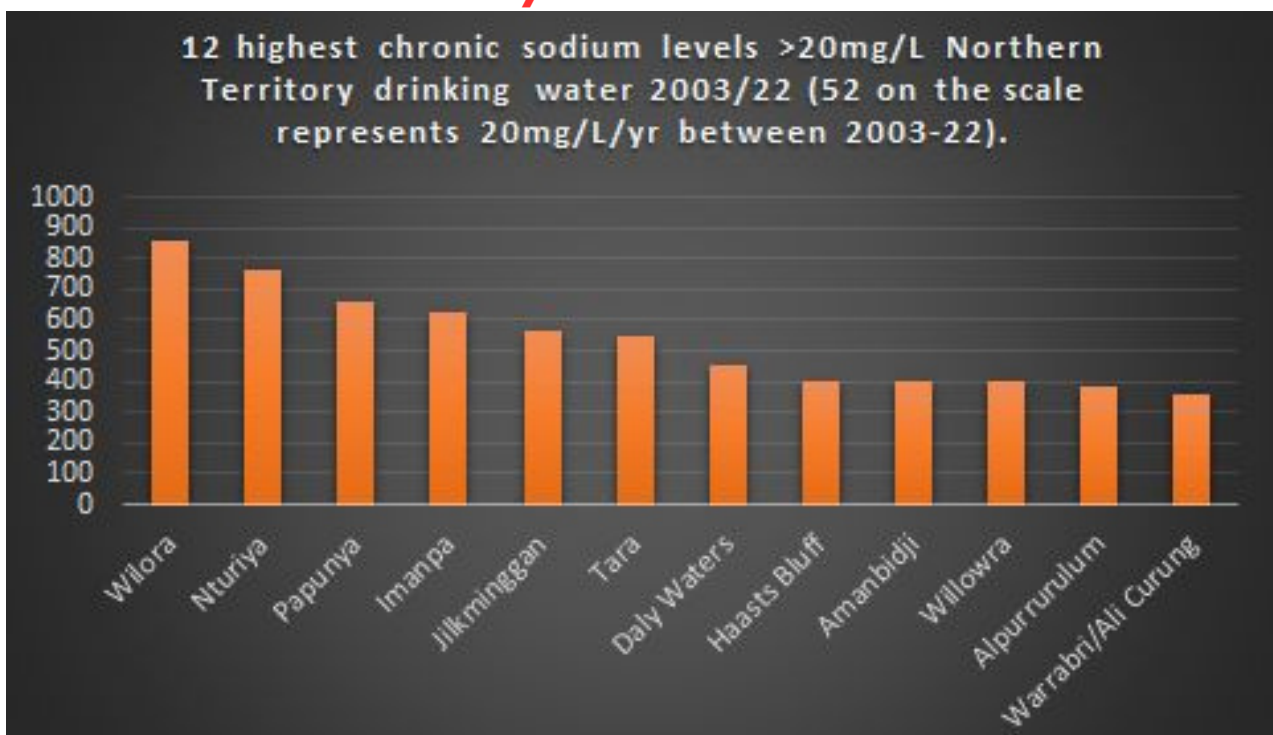
**“Those that are under treatment for sodium-sensitive hypertension should consult with their health care provider regarding sodium levels in their drinking water supply and the advisability of using an alternative water source or point-of-use treatment to reduce the sodium. For individuals on a very low sodium diet (500 mg/day), EPA recommends that drinking-water sodium not exceed 20 mg/L.”**

**“Drinking water may contribute 10% to one's total sodium intake; for patients on sodium restricted regimens, drinking water may account for 64% of total intake.”**

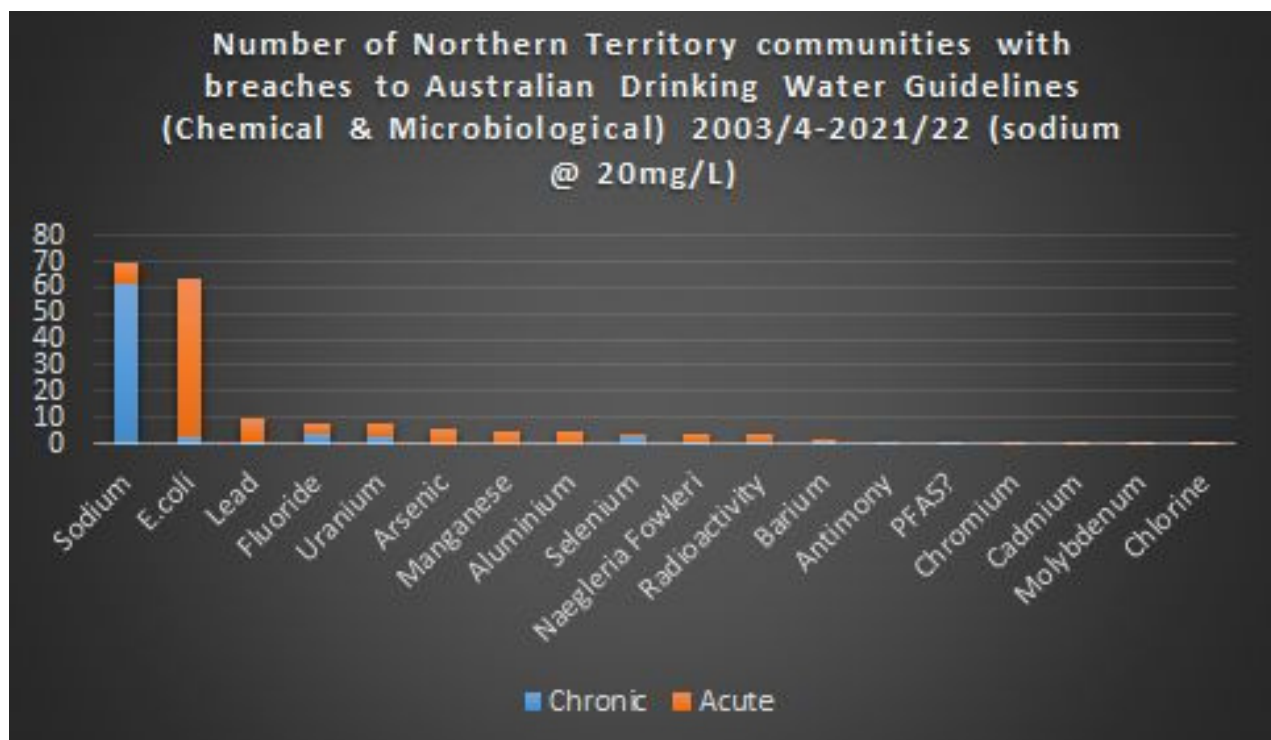
**A Wright et al published in 2019: “Hypertension is high blood pressure and is a major health issue in Australia. It is a well-established risk factor for cardiovascular disease, kidney disease and strokes.... People suffering high blood pressure, cardiovascular disease or kidney disease need to consider all sources of dietary sodium, including drinking water.**

**It is generally recommended that people on low sodium diets drink water with less than 20 mg/L of sodium... For example, research in coastal Bangladesh have found that both pregnant women and the wider population consuming water with higher sodium content had significantly higher blood pressure... Cardiovascular disease was an underlying cause of approximately 29% of all deaths in Australia in 2015...**

**We are concerned that the Australian Drinking Water Guidelines categorise sodium as an ‘aesthetic’ attribute of water quality as it can impart a salty taste at highly elevated concentration. This translates into an Australian guideline of 180 mg/L. One of the consequences of the ADWG guideline for sodium is that water authorities regard it as a low priority. This reduces its frequency of measurement and often sodium results are not published. And worst of all, people consuming water with elevated sodium are often doing so without realising that it may be very harmful”**



**Sodium only graph (not combining other chemicals) indicating communities facing highest chronic levels. Wilora for example averaged 16 times the 20mg/L limit. 8 of these communities are within 300km of Alice Springs in the south of the Territory.**



**If one assumes accepting a sodium guideline of 20mg/L, based on potential cardiovascular and heart problems, sodium becomes the number 1 health relate issue in regards to drinking water in the Northern Territory, impacting over 50,000 people or almost 20% of the NT population.**

**The main communities impacted are: Wilora, Nturiya, Papunya, Imanpa, Jilkminggan, Tara, Daly Waters, Haasts Bluff, Amanbidji, Willowra, Alpurrurulam, Ali Curung, Kings Canyon, Ampilawatja, Yuendumu, Atitjere, Canteen Creek, Ngukurr, Larrimah, Amunturangu, Tennant Creek, Wallace Rockhole, Apatula, Mataranka, Nyrippi, Yuelamu, Kintore, Laramba, Lajamunu, Engawala, Elliott, Alice Springs, Hermannsburg/Ntaria, Pmara Jutunta, Areyonga, Amoonguna, Kaltukajura, Ti Tree, Nganmarriyanga, Kybrook Farm, Newcastle Waters, Wuthunugurra, Yulara, Milingimbi, Imangara, Kalkarindji, Warruwi, Pine Creek, Milyakburra, Daguragu, Titjikala, Bunbidee/Pigeon Hole, Robinson River, Adelaide River, Gudabijin/Bulla, Minyerri, Numbulwar, Umbakuma.**

**Several other communities also recorded sodium >20mg/L but these events were not as chronic as the communities listed above.**

# Health Statistics

According to this [webpage](#) between 2015-2019, cardiovascular disease was the second leading cause of death among indigenous Australians. Coronary heart disease (56%) and cerebrovascular disease (15%) (stroke 12.6%) were the leading causes of death from cardiovascular disease. **The highest rates of cardiovascular disease were in the Northern Territory including the highest rate of hospitalisation. Indigenous Australians suffering cardiovascular disease death were at 1.5 times the rate of non-indigenous Australians (2.3 times the rate in remote areas).**

The number of people drinking water with sodium >20mg/L in the NT would be ~51,000 with about 50% of these people living in Alice Springs (who averaged sodium between 74-85mg/L between 2004-2022). There are a number of water treatment options that can reduce sodium in drinking water, including reverse osmosis.

According to this [webpage](#) chronic kidney disease (kidney conditions lasting 3 months or longer) accounted for 2.5% of total disease burden for Aboriginal people in 2018. There were 475,000 hospitalisations for indigenous Australians between July 2017 and June 2019, which were the leading cause of hospitalisation for indigenous Australians (44% of hospitalisations). The hospitalisation rate for care involving dialysis is 11 times as high for indigenous Australians as for non-indigenous Australians. Indigenous women were twice as likely to be hospitalised.

“Between 2009–2010 and 2013–2014, there was a 42% increase in dialysis treatments delivered in central Australia, due in part to establishment of a mobile dialysis bus (the Purple Bus) in 2010. This helped to facilitate a substantial increase (360%) in the number of dialysis treatments delivered in remote settings”.

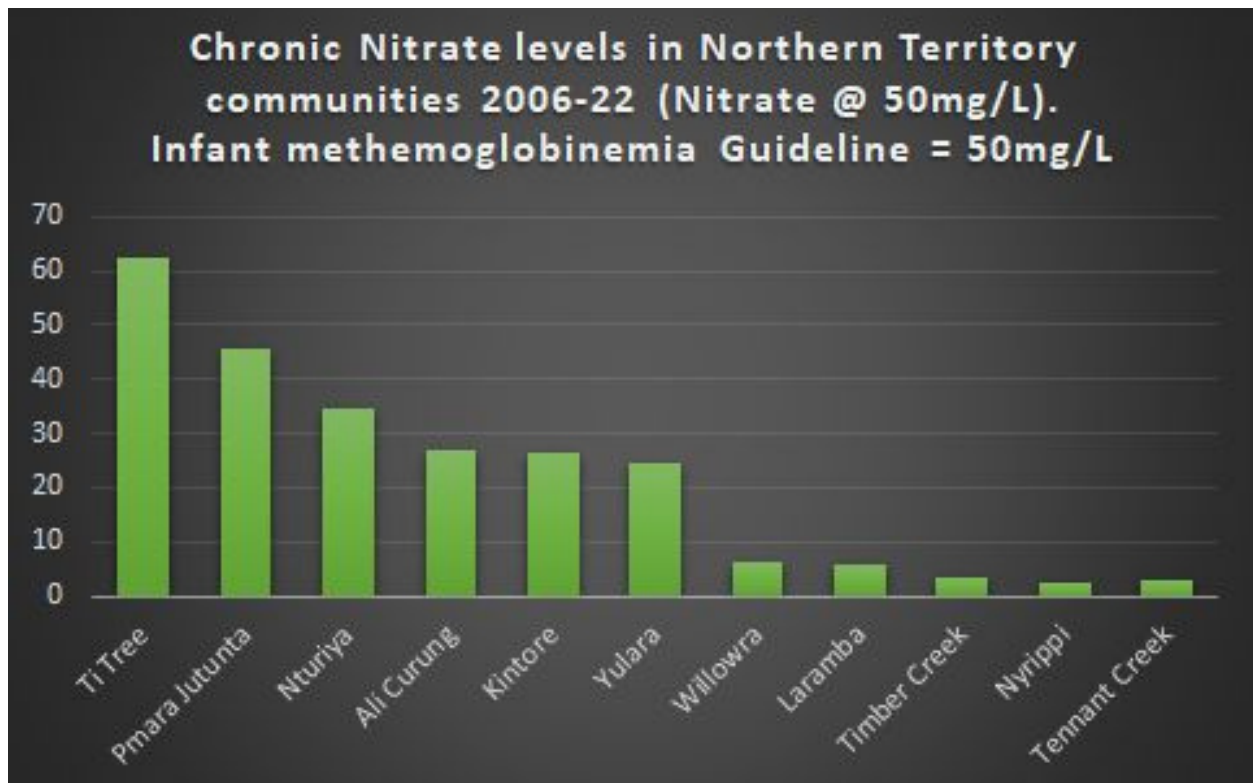
**The death rate due to kidney disease for indigenous Australians was highest in the Northern Territory as were hospitalisations. Kidney disease can also contribute to deaths from other diseases (including diabetes and circulatory disease).**

# Nitrate

Nitrate has two guideline levels under the ADWG, 50mg/L is set for infants under the age of three months and 100mg/L is set for the general population. Infant Methemoglobinemia ‘blue baby syndrome’ is linked to Nitrate levels >50mg/L. Nitrate-nitrogen >10mg/L have also been associated with Thyroid Disease, Birth Defects and Cancer.

“To ensure that drinking water supply meets the ADWG in three high risk communities (Ali Curung, Kintore and Yuelamu), Power and Water operates an Advanced Water Treatment (AWT) plant at each community. The AWT reduce levels of naturally occurring nitrate, fluoride and uranium, as well as salinity and hardness.” P24 Power and Water Drinking Water Quality Report 2020/21

The only community consistently breaching the 50mg/L Nitrate value was Ti Tree.



Ti-Tree is consistently over the Infant Methemoglobinemia guideline of 50mg/L. The ADWG has a Nitrate health guideline for the general population of 100mg/L with Ti Tree just over 60% of that guideline level. It is unclear why Ti Tree doesn't have an advanced water treatment plant.

# Physical and Chemical Summary

The Australian Drinking Water Guidelines have a number of guideline levels for Physical and Chemical substances. The guidelines are based on a life time exposure to the levels specified.

## Aluminium

**Acute (short term issue) for Wallace Rockhole 2010/11 +2013/14, Warruwi 2016/17, Wilora 2020/21 and Yuelamu 2007/08.**

Elevated concentrations of aluminium may pose a potential risk to human health, resulting in brain changes characteristic of Alzheimer's disease.

## Antimony

**Chronic Issue for Beswick**

Short term exposure can lead to nausea, vomiting and diarrhoea. Carcinogenicity on humans are insufficient to evaluate the relationship between people exposed to Antimony and human cancer risk.

## Arsenic

**Chronic Issue for Beswick and Pine Creek (but under guideline levels).**

**Acute (short term issue) for Belyuen 2007/08, Garrawa 2012/13, Kybrook Farm 2009/11, Nauiyu 2008/09**

Long term consumption of arsenic can lead to an increased risk of cancers of the bladder, lungs, liver, and other organs. Arsenic can also contribute to cardiovascular and respiratory disease, reduced intelligence in children, and skin problems, such as lesions, discoloration, and the development of corns.

## **Barium**

**Chronic Issue for Gudjabijin/Bulla. Timber Creek was consistently 50-90% of ADWG).**

**High levels of barium can cause changes in heart rhythm or paralysis in humans. Short period may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness.**

## **Cadmium**

**Acute short term issue for Gunn Point 2020/21**

**Children are at increased risk. Can impact on bone density and delay bone development. Longer term exposure can lead to kidney disease.**

## **Chlorine**

**Acute short term issue for Gunn Point 2016/17, Darwin 2021/22, Pmara Jutunta 2021/22**

**Short term exposure to Chlorine can cause Stomach aches, vomiting and diarrhea and Dry itchy skin.**

## **Chromium**

**Acute short term issue for Bulla/Gudjabijin 2020/21, Wallace Rockhole 2020/21**

**Can cause irritation to the stomach lining and damage to the male reproductive system.**

## **Fluoride**

**Chronic Issue for Ali Curung 2008/14, Alpururulam, Nyrippi, Tennant Creek and Timber Creek. Acute short term issue for Bulla/Gudabijin 2016/18, Maningrida 2016/17, Yuelamu 2017/19 +2021/22.**

**Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems.**



## **Iodide**

**Chronic Issue for Kings Canyon 2006/11, Tennant Creek 2006-11**

Iodide was also problematic 2006-11 because the 2004 ADWG guideline was set at 0.1mg/L. In 2011 that was increased to 0.5mg/L, meaning that for a number of communities previous to 2011, iodide would have been the major health concern. In terms of this study the 2011 iodide guideline was used which lessened the potential health impacts from iodide by 80%. Excess iodide can lead to thyroid dysfunction which in turn can lead to a number of health concerns.

## **Lead**

**Chronic issue for Garrawah 2012/17, Kings Canyon 2006/11. Acute short term issue for Ali Curung 2020/22, Alpurrurulum 2021/22, Amanbidji 2016/17, Amoonguna 2014/17, Elliott 2020/21, Gapuwiyak 2014/15, Kaltukatjura 2009/10, Wilora 2019/20, Yuendumu 2020/21.**

There is no safe level of lead in children's blood. Young children and foetus's are particularly vulnerable and lead consumption can lead to physical and behavioural effects.

## **Manganese**

**Acute short term issue for Bulla/Gudabijin 2019/22, Naviyu 2008/09, 2018/22, Nganmarriyanga 2020/21, Numbulwar 2020/21, Pine Creek 2021/22, Warruwi 2019/21.**

High levels of Manganese can be problematic for infants and can be associated with neurological and behavioural problems and deficits in memory, attention and motor skills.

## **Molybdenum**

**Acute short term issue for Katherine 2002/06**

high levels of molybdenum can damage the kidneys and liver and affect reproduction and development.

## **Nickel**

**Acute short term issue for Daly Waters 2021/22**

**Nickel can be carcinogenic in high doses**

## **Nitrate**

**See above section Page 30**

## **PFAS**

**See above section Page 18**

## **Radioactivity**

**Chronic issue for Kings Canyon 2009/22. Acute short term issue for Alice Springs 2009/10, Amoonguna 2021/22, Binjari 2019/20, Borroloola 2009/10.**

**Radioactivity an increase risk of cancer and kidney problems.**

## **Selenium**

**Chronic issue for Daly Waters 2002-09, Mataranka, 2002-07, Kings Canyon 2002-10) Acute short term issue Ngukurr 2007/08.**

**Exposure to high levels of Selenium can lead to hair and fingernail changes, damage to the peripheral nervous system, fatigue and irritability.**

## **Uranium**

**Chronic issue for Laramba, Willowra, Wilora. Acute short term problem for Imangara 2019/20, Nturiya 2008/09 + 2019/22, Papunya 2008/09, Pmara Jutunta 2017/18, Ti Tree 2002/04, Yuendumu 2018/19 + 2020/21.**

**Health impacts from uranium in drinking water can lead to renal damage and nephritis. Uranium had its guideline increased from 0.017mg/L to**

**0.02mg/L (an increase of 17.6%) in recent years so the more recent guideline level was used in this study, lessening the occurrence of uranium breaches. Communities with acute issues, may have uranium in their drinking water at "chronic levels" but under guideline level.**

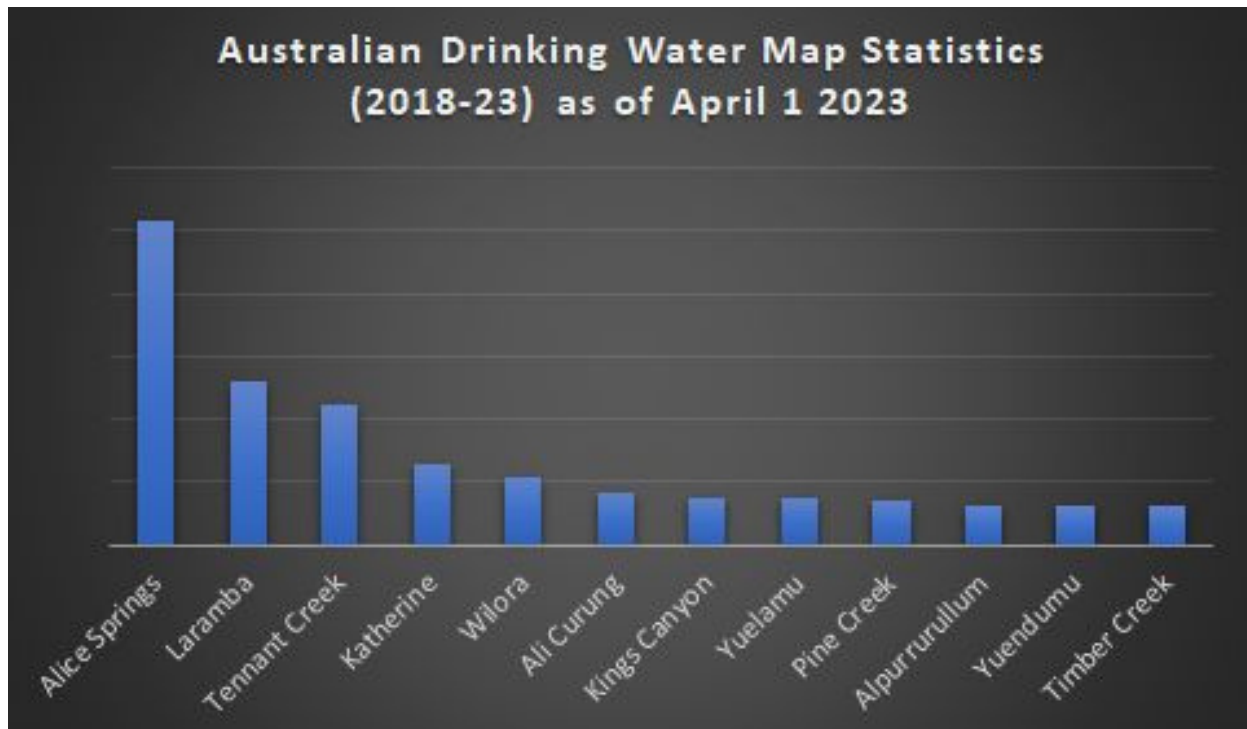
# Calculations

All information was sourced from Power and Water Annual Drinking Water Quality Reports 2003-04/2021-22. Data could be gained from some (mainly larger) locations as far back as 2002/03, whereas the bulk of the information sourced dated back to 2007. All data breaching ADWG's was added to spreadsheets, as well as detections at ~70-80% of ADWG and Nitrate at ~40-60% of ADWG and Aluminium >0.5mg/L. A separate spread sheet was also collated for Sodium >20mg/L. Data was then formulated on a town by town/year by year basis. Because the data sometimes reported by Power and Water varied from average, mean and 95th%, as a means of "standardising" it was easier to generalise these into the standard 'average\*' number, leading to slight data inaccuracies.

Data was then differentiated into chronic and acute detections, with acute detections (less than one year) removed to a separate dataset. All location/chronic data was then calculated by dividing the recorded 'average' number with the ADWG for that particular substance. (Eg 'Average' fluoride detected in a community during 2010/11 at 1.6mg/L would be divided by 1.5mg/L (guideline level) = 1.0667). The "1.0667" was then multiplied by 52 (numbers of weeks of the year) which would, in this example give a number of 55.4684. This process was followed for every chemical close or over the ADWG for all of the Power and Water reports and tallied for each specific community. Acute detections (or short term maximums) followed the same process but were multiplied by only 2 (not 52) representing a shorter time exposure of two weeks.

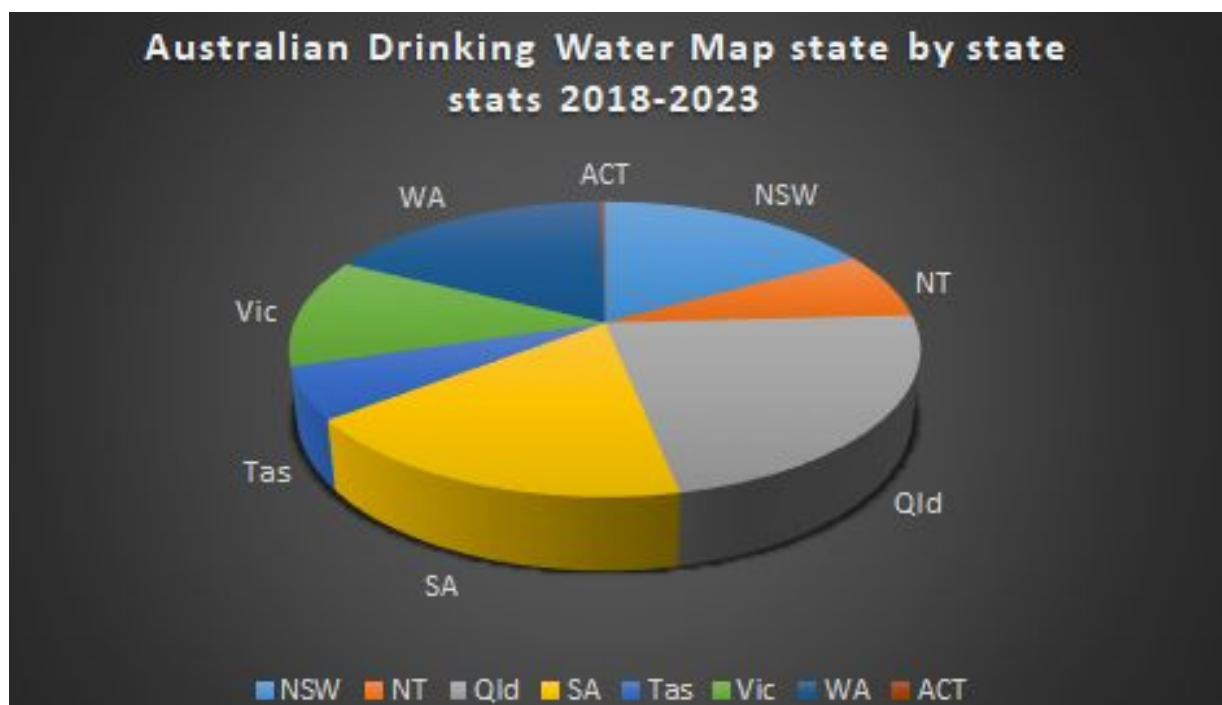
After the tallied data from both the acute and chronic spreadsheets was combined, that final calculation for all years was then divided by either 20 or 15 depending on which communities had data going back 20 years or 15 years. Generally, larger communities had data going back for ~20 years. **In the final tally amount, any calculation above 52 would indicate chronic breaches in that particular community over the 15 or 20 year time period.** Gudabjin/Bulla for example ended up with a combined 2006/7-2021/22 score (excluding sodium) of 182.4 or 3.5 times the amount needed for chronic water issues of 52. Of the Gudabijin total, Barium accounted for 91% of the chronic total, plus fluoride, manganese and a one off acute detection of chromium.

# Australian Drinking Water Map Statistics

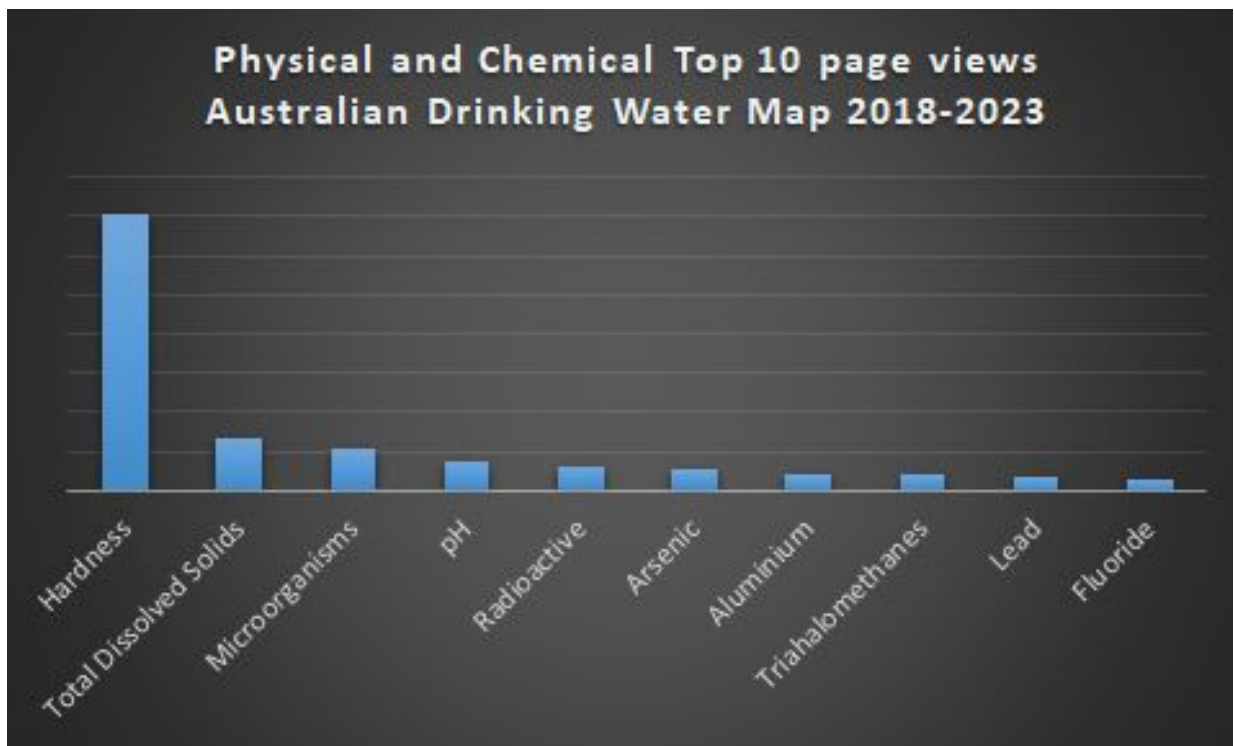


In terms of Australian wide page views (1809 communities are listed), with highest Northern Territory page views in graph above:

In terms of national rankings based on page views: Alice Springs 8th, Laramba 18th, Tennant Creek 26th, Katherine 57th, Wilora 72nd, Ali Curung 101st, Kings Canyon 118th, Yuelamu 119th, Pine Creek 126th, Alpururullum 146th, Yuendumu 152nd, Timber Creek 156th.



**Northern Territory accounts for 7.3% of all visits to the Australian Drinking Water Map, despite having <1% of Australian population.**



**It is worth noting that the most interest to the Australian Drinking Water Map, in terms of Physical and Chemical page views are for aesthetic issues, particularly hardness, which is a costly and annoying problem to deal with by water customers. It would appear that health related issues are secondary, probably because health issues with drinking water often can't be seen. Sodium appears to be a lesser known issue in communities.**