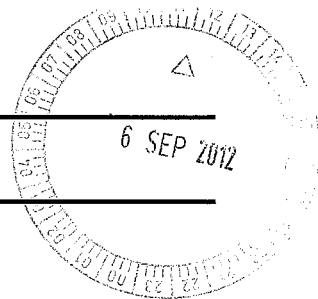

Hon. Adele Farina MLC



Member for South West Region

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12 September 2012

Hon. Brian Ellis MLC
Chairman
Standing Committee on Environment and Public Affairs
Parliament House
PERTH WA 6000

Dear Brian,

Petition No. 166 – Cessation of the Chlorination of the Busselton Water Supply

Thank you for your letter of 15 August 2012 (received on 20 August 2012) inviting me to make a submission on the petition.

The original decision to use UV filtration to disinfect Busselton Water (BW) placed weight on the obligation to provide safe drinking water, the water source being from the deep and confined groundwater of the Yarragadee and Leederville aquifers and that as the network grew booster UV stations would address the concern of recontamination in long pipes. By opting for UV filtration, the health risks associated with chlorine and disinfection by-products were avoided and the community was provided with safe drinking water. The decision had community support. UV filtration has worked - pathogens harmful to human health have not been detected in BW.

Chlorination decision by Busselton Water

The reasons for the decision to implement full-time chlorination, as stated by Busselton Water (BW) are detailed in a table together with comment/analysis on each reason at **Appendix 1**.

Details of disinfection systems used in other countries is provided at **Appendix 2**.

Use of Chlorine as a disinfectant in drinking water

While it is acknowledged that disinfection of drinking water has benefited public health by lowering the rates of infectious waterborne diseases, such as cholera and typhoid and the use of chlorine has played a role in reducing the incident of these diseases, the following is equally true:

- Chlorine is not the only disinfection option available or the most effective. Some waterborne pathogens are chlorine resistant; and
- A growing body of research shows a correlation between the consumption of chlorinated drinking water and certain types of cancer, heart problems and reproduction and developmental defects.

In Australia, a chlorine residual equal to or greater than 0.2mg/L is preferred. This means that with very lengthy water mains, customers living at the front end of the pipe will be drinking water with higher levels of chlorine and as a result are more exposed to health risks.

Chlorine by-products

When chlorine is added to our water, it combines with naturally occurring materials to form disinfection by-products (DBPs), such as haloacetic acids (HAAs) and trihalomethanes (THMs) which are known carcinogens and hazardous to health.

THMs of most concern, include chloroform which can cause dizziness, fatigue and headaches, while chronic exposure may cause damage to the liver and kidneys; trichloroacetic acid, is produced commercially as a herbicide; dichloroacetic acid is an irritant, corrosive and destructive against mucous membranes; haloacetonitriles, used as pesticides in the past but are no longer manufactured, are toxic and when present in higher concentrations affect respiration. Not all DBPs have been identified.

The *Australian Drinking Water Guidelines* (ADWG) state that when used in drinking water treatment, chlorine should be used in such a way that any DBPs formed do not exceed the guideline values specified in the ADWG. However, the ADWG do not specify guideline values for all DBPs, stating that there is insufficient data to do so despite the *World Health Organisation* (WHO) specifying guideline values for all known DBPs. In relation to THMs, the ADWG specifies a single guideline value, yet the WHO has specified guideline values for individual THMs, some of which are lower than the ADWG guideline value. The ADWG 2004 states that further reviews of the guidelines should consider THMs individually yet some seven years later this hasn't occurred, the same statement is reiterated in the ADWG 2011. This raises serious questions about the extent to which drinking water in Australia is being tested for all known carcinogenic DBPs and whether the specified guideline values are adequate to provide safe drinking water.

pH

BW states a pH of between 6.5 and 8.5 is the accepted range for efficient chlorination disinfection. The ADWG however, states chlorine disinfection efficiency is impaired above pH 8.0, while Lenntech Water Solutions state that impairment commences at levels above pH 7.5. Also, at higher pH values more THMs are formed, increasing health risks.

BW monitoring reports to the Department of Health for the periods ending 31 March 2012 and 30 June 2012, state treated water and distribution water testing puts BW at the high end of the pH scale, with maximum readings of 8.6pH and 8.4pH respectively for the reporting periods.

These results indicate impaired chlorine disinfection efficiency which raises serious questions about the extent to which chlorination is providing an effective disinfection protection. The results also indicate increased prospect for more THMs to be formed, potentially exposing Busselton residents to greater health risks than those usually associated with chlorine disinfection within effective pH levels.

Health effects of chlorinated drinking water

Chlorine can be toxic not only to microorganisms, but for humans as well. To humans, chlorine is an irritant to the eyes, nasal passages and respiratory system.

Concerns about chlorine and health began in the 1960's. Dr Joseph Price, author of *Coronaries, Cholesterol, Chlorine* has stated that he believes chlorine is the cause of "an unprecedented disease epidemic which includes heart attacks and strokes... Most medical researchers were led to believe it was safe, but now we are learning the hard way that all the time we thought we were preventing epidemics of one disease, we were creating another. Two decades after the start of chlorinating our drinking water in 1940, the present epidemic of heart trouble and cancer began".

According to the President of the US Council of Environmental Quality the incident of rectal, colon and bladder cancer is 44% higher among people using chlorinated drinking than among those whose water does not contain chlorine.

Studies have shown that up to two thirds of our harmful exposure to chlorine is due to inhalation of steam and skin absorption while showering. A warm shower opens up the pores of the skin and allows for accelerated absorption of chlorine and other chemicals in the water. The steam we inhale while showering can contain up to 50 times the level of chemicals than tap water due to the fact that chlorine vaporizes much faster and at a lower temperature than water. Inhalation is much a more harmful means of exposure since the chlorine gas we inhale goes directly into our blood stream. Frequent exposure to chlorine gas even at low levels found during normal activities such as showering may reduce the oxygen transfer capacity of the lungs.

Findings of some of the studies into the health effects of exposure to chlorinated drinking water are detailed in **Appendix 3**, this is not intended to be a comprehensive account.

Health effects suffered since Chlorination of Busselton Water

Since the chlorination of BW, I have received numerous representations from constituents living in Busselton distressed about the taste, smell and discoloration of the water, despite flushing as instructed by BW. This has continued for far longer than BW advised and in some areas is ongoing. Also, I have received numerous representations on the health effects constituents and their families have suffered. These have included:

- Eczema, dermatitis and rashes
- Itching skin and scalp, hot skin and skin irritations
- Stomach upset and abdominal cramps on ingestion of chlorinated water
- Ear infection, swimmers ear and hearing loss
- Headaches
- Inflammation of nasal passages and sinuses
- Throat irritations - burning
- Eye irritations – burning and running eyes
- Asthma and aggravation of Asthma
- Difficulty breathing, shortness of breath, tightness in chest especially when showering

29 Victim Impact Statements from Busselton residents detailing the health effects they and their families have suffered since the chlorination of BW have been received and are attached at **Appendix 4**. Further submissions received on Facebook blogs are attached at **Appendix 5**. Photographs showing the health effects and water quality are attached at **Appendix 6**. The statements and photos speak for themselves.

The reported health effects are real.

I live in Busselton and have experienced the foul odour and taste and water discoloration. I have suffered throat and eye irritation, dry itchy skin and difficulty breathing when showering. I do not experience these health effects when in Perth (despite Perth water being chlorinated).

Constituents have reported the health effects clear up when they have stopped using chlorinated water, opting for bottled or filtered water instead. The cost of using bottle or filtered water however is prohibitive for many Busselton residents.

I am not a chemist or a doctor, so I cannot say for certain whether the health effects are from the chlorine, chlorine by-products, overdosing of chlorine or some other chemical reaction occurring as a result of the high pH value of BW. What I can say for certain is that something isn't right and needs to be investigated. One or more of these factors is causing the health effects suffered by Busselton residents.

The health effects suffered by Busselton residents and the chronic health risks associated with long term exposure to chlorinated water and DBPs cannot be ignored and warrant cessation of chlorination of BW, pending investigation and further consideration of disinfection options.

Busselton Water's response to health effects since chlorination

The ADWG acknowledge that water quality testing has limitations, consumers are the ultimate assessors of water quality and consumer complaints may provide valuable information on potential problems not detected by testing water quality or monitoring treatment processes. This has been ignored by BW.

Efforts by Busselton residents to lodge complaints with BW have been stonewalled. In relation to smell, taste and discoloration, residents have been told to flush their taps and live with it. In relation to health effects, residents have been told this has nothing to do with BW and such complaints should be directed to the Minister for Health and the Department of Health. Neither, the Minister or the Department will agree to meet with residents and take appropriate action.

Concluding comments

Chlorine, is essentially, bleach. When we drink chlorinated water, we are drinking a mild bleach solution. We don't use chlorine because it is the safest or even the most effective means of disinfection, we use it because it is the cheapest.

Safe drinking water is essential to sustain life. The community expects, and has a right to expect, drinking water suppliers will provide drinking water that is safe to use.

The community expects, and has a right to expect, its elected representatives will do everything in their ability to ensure our drinking water is safe and to act swiftly when concerns are raised. They do not expect their elected representatives and drinking water suppliers, in the guise of public health, to use disinfections which are harmful to human health.

The community assumes if chlorine is being used for disinfection, that it is safe. A growing body of research has found that this is not the case. It is negligent to discount this research while also failing to invest in whatever further research is needed to satisfy any doubt on this issue, and in the meantime continue to use chlorination when other safer options are available.

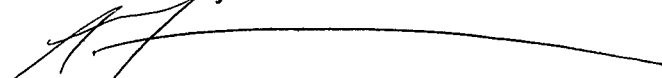
Many in the community do not accept the argument that the health risks of not disinfecting our water with chlorine outweighs the health risks associated with chlorination, especially when the water source is deep confined underground water aquifers, as is the case with BW and alternative options are available, and have worked to date.

It is abhorrent to me, and to many in the community, that government would determine that the use of cancer causing chemicals is acceptable as the health effects are only evident after long term exposure and can, over that length of time, arguably be attributed to a number of other factors.

A public inquiry into the decision of BW to move away from a proven effective water treatment method (UV) to one that places human health at risk (chlorination), whether chlorination is being correctly implemented and is providing effective disinfection and the cause of the health effects suffered by Busselton residents, is warranted if we are to maintain public confidence in our water supply and decision makers.

I would be happy to appear before the Committee to advance the case for an inquiry into this matter and thank you in anticipation for your favourable consideration of this submission.

Yours sincerely



Hon. Adele Farina MLC
Member for South West Region

Reasons for Decision by Busselton Water to Chlorinate our drinking water

The table below details the reasons presented by Busselton Water in justification of its decision to implement full-time chlorination and provides comment on each of the reasons.

Reasons for decision to chlorinate	Comment
<p><i>Naegleria fowleri</i>, which is harmful to humans, thrives in warm environments with reticulation networks that have water temperatures of 25°C or more for 4 months a year – Busselton falls into this category.</p>	<p><i>Naegleria fowleri</i> grows in water supplies that seasonally exceed 30°C or that continually exceed 25°C.</p> <p>Busselton bore water is consistently about 24°C, while this presents a health concern it does not strictly meet the criteria for the growth of <i>Naegleria fowleri</i> and it has never been detected in Busselton Water (BW).</p>
<p><i>Naegleria lovaniensis</i>, which is harmless, has been found in some BW samples taken over the last few years.</p>	<p>This has been effectively treated with spot chlorination and flushing.</p>
<p>A French study indicated that the presence of <i>Naegleria</i> in the warm waters of a nuclear plant indicates it is likely that <i>Naegleria fowleri</i> is also present.</p>	<p>This is one study only. The warm waters of a nuclear power plant cannot be compared with the pristine waters of the Yarragadee and Leederville aquifers (Busselton's water source) and the temperatures conditions differ.</p> <p>Although the harmless <i>Naegleria lovaniensis</i> has been detected in BW, <i>Naegleria fowleri</i> has never been detected.</p>
<p>As BW did not use a disinfection residual, the major contamination risk is after the water leaves the UV treatment plant and travels within the reticulation system (the pipes). With the growth of this system, the risk increases.</p>	<p>BW had implemented a number of programs to reduce the risk of contamination occurring in the reticulation system including super chlorination of pipes after maintenance and installation, fitting non-return valves to connections to prevent backflow and portachlors for spot chlorination.</p> <p>Hutt City, New Zealand obtains its water from an underground aquifer and does not chlorinate its water prior to distribution, it relies on emergency disinfection systems and plans which have been effective to date.</p>
<p>Only full-time chlorination provides a residual and offers protection throughout the reticulation system.</p>	<p>The ADWG state that chlormine also provides a residual and offers protection throughout the reticulation system and it produces considerably lower concentrations of THMs and other by-products (harmful to human health) than does chlorination.</p>

<p>Only chlorination provides effective protection against <i>Naegleria</i>.</p>	<p><u>UV systems</u> operating at 70mWs/cm² provide effective disinfection against <i>Naegleria</i> at treatment. To date <i>Naegleria fowleri</i> has not been detected in BW.</p> <p><u>Ozone</u> provides effective disinfection against <i>Naegleria</i> at treatment.</p> <p><u>Chlormine</u> provides effective protection against <i>Naegleria</i> at treatment and throughout the reticulation system.</p>
<p>Alternative disinfection methods such as ozone and ultra violet light do not provide ongoing protection.</p>	<p><u>UV systems</u> - Upgrade of the BW UV system would have provided protection at treatment. Installation of UV booster stations would largely address the issue of recontamination in long pipes. To date <i>Naegleria fowleri</i> has not been detected in BW existing network, which has grown significantly in recent years.</p> <p><u>UV or Ozone</u> together with use of porto-chlors or an emergency chlorination facility would enable BW to act if <i>Naegleria</i> were detected or in the event of a contamination event without subjecting Busselton residents to the health risks associated with carcinogenic chlorine by-products.</p> <p><u>UV or Ozone</u> together with either chlorine or chlormine treatment would significantly reduce the amount of chlorine or chlormine that would need to be used, significantly reducing the risk to human health and the environment. Studies have shown that the use of UV and preformed chlormine results in negligible THMs being formed. Also, this would ensure protection against pathogens which are chlorine resistant. The 1993 Milwaukee drinking water outbreak affecting over 400,000 people and resulting in more than 100 deaths was due to a chlorine resistant pathogen.</p> <p><u>Chlormine</u> provides effective protection against <i>Naegleria</i> at point of treatment and throughout the reticulation system.</p>

Appendix 2**Drinking water disinfection treatments used in other Countries**

Unfortunately this information is not located on a database and sourcing the information is a laborious process. The following is what I have been able to identify in relation to water treatment systems used in other countries.

Hundreds of municipalities around the world are using alternative disinfection technologies such as ozone, UV and improved filtration.

Europe

Several large cities in Europe are relying on these methods to deliver safe, chlorine-free drinking water to their communities. These include Amsterdam, Nice, Paris, Berlin, Munich, Muenster, Dortmund and Stockholm, to name just a few.

- Belgium has converted from chlorination to UV and also uses ozone in some facilities.
- Holland is converting from chlorination to ozone and UV.
- France uses mainly ozone.
- Austria, Finland, Germany, Great Britain and Holland all have some ozone and UV treatment facilities.
- Italy use ozone or chlorine dioxide as a primary oxidant and disinfection, with chlorine used for residual disinfection.
- Great Britain uses use chloramines for residual disinfection.
- Finland, Spain and Sweden use chloramines for disinfection occasionally.
- Spain has some ozone treatment facilities.

United States

Since 1996 the US EPA has been encouraging municipalities to use less chlorine in the treatment of drinking water.

A number of cities in the US have moved to using UV or Ozone as the primary treatment system for drinking water – for example, New York City, City of Henderson in Nevada, City of Carnation in King County WA and City of San Francisco, Washington DC and Cincinnati use UV. Seattle Cedar Water treatment Facility oxidate and radiate the water. Many of these retain limited use of chlorine as a residual disinfection, however the germ-neutralizing power of UV means the amount of chlorine used is greatly reduced and the formation of carcinogenic by-products is also greatly reduced.

Canada

Some Canadian cities have abandoned chlorination in favour of ozone and UV.

- Alberta, British Columbia, Manitoba, Ontario Quebec and Saskatchewan all use UV.
- Prince Edwards Island, Labrader, Newfoundland, Nova Scotia and Nunavut have UV filtration facilities which also use residual chlorination (lower amounts).
- Quebec also uses ozone.
- Vancouver has both UV and ozone treatment facilities with residual chlorination

Other

- Carriibbean Island of Aruba just off the coast of Venezuela uses UV and is chlorine free.

A selection of studies establishing an association between drinking chlorinated water and health impacts

The most respected cancer study is a compilation of 10 separate epidemiological studies on chlorinated drinking water and cancer known as the Morris study. It found disinfection by-products in chlorinated water to be responsible for 9% of all bladder cancers and 15% of rectal cancers in the US. This translates into 10,000 additional deaths per year for just these two organs, a figure the Morris researchers believe to be an under-estimation.

A study carried out in Hartford Connecticut found that women with breast cancer have 50% to 60% higher levels of chlorination DBPs in their breast tissue than women without breast cancer.

A 1998 California Department of Health Study found that pregnant women with high exposure to chlorinated drinking water nearly doubled their risk of miscarriage, from a rate of 9.5% to 16%.

In 1990 and 1991 in Colorado a population research was carried out on the relation between disinfection of drinking water with chlorine and the occurrence of bladder cancer. The study showed that a relation exists between years of exposure to chlorinated drinking water and the development of bladder cancer. This risk increased after more years of exposure. After exposure of thirty years the risk of bladder cancer was 1.8 times bigger than when no exposure had occurred.

In a 1992 study researchers at the Medical College of Wisconsin in Milwaukee found that people who regularly drink tap water containing high levels of chlorine BPs have a greater risk of developing bladder and rectal cancers than people who drink unchlorinated water.

A study undertaken at Oak Ridge Associated Universities of colon cancer victims and non-cancer patients concluded that the drinking of chlorinated water for 15 years or more was conducive to a high rate of colon cancer.

A study published in the Journal of National Cancer Institute found that long term drinking of chlorinated water appears to increase a person's risk of developing bladder cancer as much as 80%.

A study in Finland showed that for men there was a relation between exposure to chlorinated drinking water and the risk of renal cancer and for both men and women the connection between exposure and bladder cancer was significant.

A study carried out in Iowa in 1986 and 1989 indicated there is an elevated risk of anal cancer after long time exposure to chlorinated drinking water.

A study published in the Journal of the National Cancer Institute found that long-term drinking of chlorinated water increases a person's risk of developing bladder cancer as much as 80%.

Studies in Norway, Canada and the US have reported higher levels of birth defects in areas where chlorine is used to treat drinking water.

A study in Jersey City found that the severity of heart disease among people over the age of 50 correlated with the amount of chlorinated tap water they consumed. A statistically significant correlation demonstrated that those persons over 50 who did not suffer from heart disease drank mostly unchlorinated fluids such as bottled water or boiled water.