Human health risk from Crown water frontage licences

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September 2009
ISBN: 978-1-875100-26-2

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Summary

- Cattle faeces contain pathogens that can be transmitted to humans.
- These pathogens can survive long periods in water.
- Transmission to humans can occur directly through ingestion of contaminated water or indirectly through the use of contaminated water to grow fruit and vegetables.
- Uncontrolled water access by cattle has multiple impacts that increase the likelihood of pathogens entering the water supply:

  - Direct inputs through defecation directly onto the bank or in the water;

  - An increase in inputs from faeces located away from the stream due to loss of the riparian buffer.
- Nutrient inputs from cattle increase the potential for toxic algal blooms.
- Uncontrolled water access by cattle leads to increased costs of water treatment for human consumption, due to an increased risk of pathogen contamination and an increase in suspended solids.

Cattle access to waterways - multiple issues

In Victoria, Crown water frontage licences allow landholders to graze and water cattle in rivers and creeks [1]. The widespread environmental degradation that this causes is well documented [2-5], and the government recognises this problem (a summary of statutes and policies where this issue is mentioned can be found in [6]). Cattle cause the loss of riparian vegetation, a reduction in biodiversity, and increased nutrient inputs into rivers and downstream water storages [7]. Another factor to consider is the potential risk to human health. Cattle faeces contains pathogens that can be transmitted to humans [8], and uncontrolled access of cattle to rivers and streams in Victoria has the potential to introduce these pathogens into water sources that may be used untreated or insufficiently treated by humans, and thus lead to outbreaks of waterborne diseases.

Dead cow in the Goulburn River near Shepparton.

Cattle carry human pathogens

There are several pathogenic micro-organisms that can be transmitted from cattle faeces to humans via contaminated water. The two most common are Cryptosporidium and Giardia, both of which cause gastroenteritis (commonly known as gastro), a disease of the stomach and intestines that is characterised by diarrhoea, vomiting and other gastric complaints [9]. Cryptosporidium and Giardia generally cause short-term illnesses in otherwise healthy people, but can have severe and sometimes fatal effects in patients with compromised immune systems, such as those suffering from AIDS [10]. Both of these organisms may be found in cattle, with the highest concentrations usually found in juveniles, especially juvenile dairy cows [9-12]. Cattle faeces and/or urine can also contain a variety of potentially harmful bacteria, such as Escherichia coli (E. coli), Salmonella, Campylobacter and Leptospira [11], which can cause a variety of diseases, such as gastro and septicaemia (blood poisoning) [9].

A global problem

In developing countries, catchments are often unregulated and drinking water may receive no treatment. It is estimated that millions of people are infected by Cryptosporidium, Giardia and other waterborne micro-organisms every year [12]. People who are frequently exposed to these diseases develop resistance to the infections and will then show little or no adverse effects on subsequent exposure [12]. Gastro is, however, a major cause of illness and death in people that lack resistance, such as the young and the immunocompromised [13]. Every year there are about 4 billion cases of and 2 million deaths from diarrhoea, a significant proportion of which can be traced to contaminated drinking water [14].

In developed countries, strict water quality regulations and treatment regimes ensure that outbreaks of waterborne disease are rare.

Erosion and severely damaged Crown water frontage in north-east Victoria.

The flipside to this is that residents of these countries lack resistance, and therefore minor contaminations can lead to major outbreaks of disease; for example, Cryptosporidium contamination of the drinking water supply in Milwaukee, Wisconsin led to an estimated 400,000 people falling ill [15]. In most outbreaks, the primary cause is difficult to determine, but contamination of drinking water by cattle faeces has been implicated in a number of gastro outbreaks [16, 17]. There are no disease outbreaks in Victoria that have been directly linked to cattle faeces in drinking water, but there was an outbreak of gastro due to consumption of drinking water contaminated with Cryptosporidium and Giardia from a septic tank overflow [18]. It should be noted that the absence of identifiable outbreaks should not be used as a justification for continuing to allow cattle to access waterways. Under risk-based frameworks, a precautionary approach should be adopted, as there is sufficient evidence to establish a link between the presence of cattle faeces in waterways and human disease.

Treatment and monitoring for water-borne pathogens is not always perfect

Many of these pathogenic organisms can survive in water or faeces for weeks, months or even years [17]. Drinking water that is potentially exposed to these organisms must therefore be treated to remove them. Most bacteria are killed by standard chlorination, but this is ineffective against Cryptosporidium and Giardia [8], and filtration is required [18]. Sydney Water has instigated an independently verified Cryptosporidium and Giardia monitoring program following the reported contamination of their drinking water supply by these organisms in 1998, which led to a city-wide boil-water notice [18]. Most water companies, however, do not routinely test for many of the micro-organisms listed above, instead relying on turbidity readings or reference organisms – such as E. coli as a marker of faecal contamination – to assess potential contamination [18]. These indicators are not 100% effective at predicting contamination, and the Australian Drinking Water Guidelines [18] stresses the importance of maintaining effective barriers against faecal contamination to reduce the risk of undetected pathogens entering the drinking water supply. The risk management plans of both Goulburn-Murray Water and Westernport Water were recently audited and they were criticised for inadequately addressing risks relating to the possible presence of Cryptosporidium and Giardia in their water supplies [19]. The state government's Annual report on drinking water quality in Victoria 2007-8 [19] identified a number of locations that had failed to meet minimum standards for drinking water quality as set out in the Safe Drinking Water Act 2003 and the Safe Drinking Water Regulations 2005. Gabo Island Light Station Reserve, Lake Eildon National Park: Lakeside / Candlebark, Tawonga and Tooborac all failed to comply with E. coli standards in 2007-2008 and in at least one of the three previous years. Likewise, Jung, Lalbert, Manangatang, Nullawil, Quambatook, Sea Lake, Ultima, Woomelang, Beulah and Wycheproof – all of which are supplied by Grampians Wimmera Mallee Water – were non-compliant with respect to turbidity in 2007-8 and all but two were also non-compliant in 2006-7. High levels of E. coli – itself potentially pathogenic – or turbidity are markers for increased risk of the presence of other pathogens, such as Cryptosporidium and Giardia.

Protected catchments = less reliance on water treatment

Most of Melbourne's drinking water comes from protected catchments, where few pathogens are found in the water supply [20]. This water is therefore minimally treated, with chlorination but no filtration [21]. The cost of water treatment increases as the quality of the water entering it decreases. Cattle access to streams has multiple impacts on water quality, from increased sedimentation to increased pathogen loads. In 1994, the Tarago Reservoir was disconnected from Melbourne's water supply due to water quality concerns. Unlike most of Melbourne's water catchments, the Tarago catchment contains areas where cattle have direct access to streams [22, 23]. It is only after the completion of a $97 million treatment plant in July 2009 that this water is again being used to supply water to Melbourne.

In Victoria, many communities rely on drinking water from rivers into which cattle are allowed access. Rural water companies mostly take water from open catchments, and so full treatment – including filtration – is required. Vigilance by water companies ensures that the potential for contamination of drinking water is low; however, the negative impact of any contamination is likely to be large. This is because pathogens entering water supplies will

rapidly disperse, and disease outbreaks are often characterised by infection across an entire community [18]. The lack of an effective barrier to faecal contamination of waterways increases this risk.

Risks from untreated water

While most water supplied to residents is fully treated, some communities receive water that has only had basic disinfection (e.g. Molesworth and Strathbogie in the Goulburn valley, [24]). As mentioned, disinfection does not effectively remove Cryptosporidium or Giardia and though this water is regarded as non-potable, there is always a risk of unintentional consumption.

The use of water bodies for recreation that are downstream of cattle access points is another cause for concern. Also, while direct ingestion of contaminated water can lead to illness, so too can indirect contact with contaminated water, such as consumption of fruit and vegetables watered or washed with untreated water [8, 14].

Removing cattle from streams greatly reduces the risk of contamination

Direct access to streams increase the risk of contamination of water in two ways. Firstly, cattle spend large parts of their time close to water bodies, and large quantities of faeces are deposited near or in streams that they have access to [3, 5, 25]. For example, cattle have direct access to much of the Rous River catchment in NSW, and one study found that 89% of the waterways were not suitable for use as potable water, and 24% were designated not suitable for primary contact [26]. Secondly, cattle trample and eat vegetation around stream access points, creating bare ground [3, 4]. Pathogens from faeces deposited away from the stream can be washed over bare ground much more readily than over vegetated ground [2, 27]. It has been demonstrated that a vegetated buffer strip 3m wide will remove 99.9% of Cryptosporidium spores from agricultural runoff after a rainfall event [28]. Other authors note that faeces deposition outside of riparian areas is unlikely to cause problems from either pathogens or nutrients [11, 29, 30].

Erosion and pollution on a public stream near Numurkah.

Cattle increase risk of algal blooms

An indirect health risk from cattle access to streams is that cattle increase nutrients entering waterways – through their excrement and increased erosion – which leads to an increased risk of toxic algal blooms [3, 29, 31]. Also,

increased sedimentation from cattle activity puts a strain on water treatment plants, which may fail or be forced to shut down after heavy rain, for example [15].

The case for protecting waterways from cattle

The Australian Drinking Water Guidelines state that pathogenic micro-organisms are the greatest risk to consumers of drinking water. These guidelines strongly recommend a multiple barrier approach, protecting water from contamination at each step from catchment to tap. Whilst water treatment is one effective barrier, the guidelines explicitly state, however, that:

> "Prevention of contamination provides greater surety than removal of contaminants by treatment, so the most effective barrier is protection of source waters to the maximum degree practical".

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