Water Quality And Cattle

June 2001

IMPORTANCE OF WATER QUALITY TO CATTLE

Water is the nutrient that is required in the greatest quantity for cattle. Water accounts for 50-80% of an animals live weight and is involved in every physiological process occurring within the animal. Feed intake is directly related to water intake. There are many factors which affect water intake, and also many compounds in surface and well water which can affect livestock performance and health.

Cattle are more tolerant to poor water quality than humans, but if the concentration of some compounds are high enough, cattle are also affected. Most factors affecting water quality are not fatal, and often may not show clinical signs of illness, but animal growth, lactation and reproduction may be affected, causing an economic loss to the producer.

The most common water quality problems on the Prairies associated with surface water are:

- Blue-green algae (cyanobacteria)
- Bacteria, viruses and parasites
- Sulphates
- Dissolved solids (TDS)

Groundwater problems include:

- Sulphates
- Dissolved solids (TDS)
- Nitrates
- Iron and manganese

Other parameters that may be of concern are

- Taste and odour
- Temperature

Feed intake is directly related to cattle's water intake

WATER CONSUMPTION

The following table outlines water requirements for beef cattle.

Table 1: Water Requirements for Cattle

Air Temperature	Water Requirements
> 35°C	8 - 15 L water / kg dry matter feed intake
25 - 35°C	4 - 10 L water / kg dry matter feed intake
15 - 25°C	3 - 5 L water / kg dry matter feed intake
-5 - 15°C	2 - 4 L water / kg dry matter feed intake
< -5°C	2 - 3 L water / kg dry matter feed intake

(adapted from: Effect of Environment on Nutrient Requirements of Domestic Animals, 1981, NRC)

The table rates should be adjusted within the ranges in the following ways:

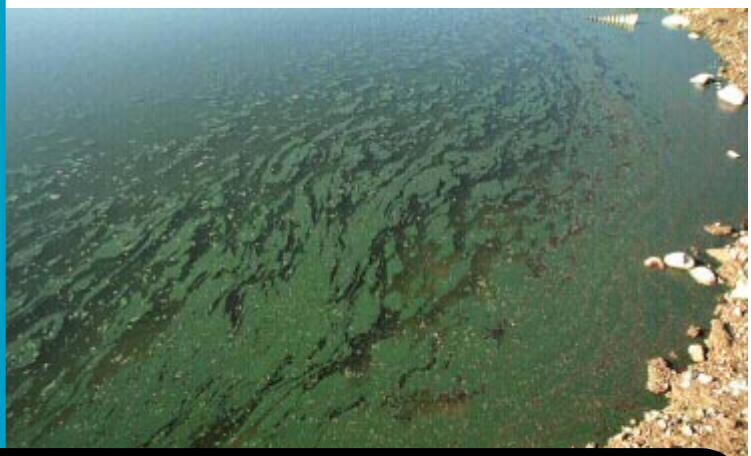
1) Poor quality feed, non-lactating and low groth periods of an animal's life cycle reduce feed intake, while high quality feed, lactation and rapid groth periods increase feed intake.

2) Lactating cows - Increase water consumption by 75%.

Agriculture and Agri-Food Canada
Prairie Farm Rehabilitation Administration
Agriculture et Agroalimentaire Canada
Administration du rétablissement agricole des Prairies
Canada

BLUE-GREEN ALGAE (CYANOBACTERIA)

Blue-green algal blooms are common in dugouts or reservoirs that are rich in nutrient. Although blooms are commonly referred to as algae, they are in fact a bacteria that produces toxins and foul taste and odour. The reason why some water bodies produce mainly non-toxic green or brown algae and others produce blue-green algae is not known. It is known is that water with excessive nutrients will cause a high population of algae in summer when the water is warm.



Algae is a common water quality problem with surface water sources on the Prairies

Blue-green algae produces two types of toxins: neurotoxins or nerve toxins that cause sudden death and hepatoxins or liver toxins that result in death within three months. Clinical signs may become apparent within 15 minutes of exposure. Although these toxins are released during growth periods, the rapid release of toxins occurs when the algae dies. Death of algae occurs from a lack of nutrients or using a chemical application, such as copper sulphate. Wind can also concentrate the blue-green algae along the downwind shores of the water body.

Positive identification of blue-green algae is difficult without a trained eye and a microscope, but some signs indicate potential problems. Often die-off is indicated by a slime on the surface appearing similar to green, green-bluish or brownish paint. Blue-green algae is composed of tiny cells clumping together and unlike green algae, cannot be hand picked from the water.

The best way to avoid blue-green algae problems is to prevent blooms by limiting nutrients from entering the water source, aerating the water and by using remote watering. To date there is no recorded animal death by blue-green algae poisoning of animals drinking from a trough. By placing the intake one metre below the water surface, the intake avoids the regions of concentrated toxins. Even with remote watering, it is recommended to use water from another source for two weeks following a treatment with copper sulphate or with the appearance of an algae die-off. Copper sulphate can be applied at a rate of one gram per square metre of surface area (a 20 m x 50 m dugout would require 1000 grams or 1 kg), but needs to be used with caution because it also kills the zooplankton that feed on the algae.

BACTERIA, VIRUSES AND PARASITES

Bacteria, viruses and parasites are common in dugouts and reservoirs that collect runoff from a manure source or that allow cattle access. There are a large variety of these organisms that can produce a number of different symptoms and production loss. A contaminated water source will rapidly spread a pathogen throughout the herd because of the daily need and large volumes of water ingested by cattle. Guideline recommendations for maximum levels of coliforms vary from 10 to 5000 counts/ 100 mL, with the lower range for calves and higher range for cows. Direct entry dugouts can reach coliform concentrations exceeding 15,000 per mL.

Water contaminated by feces can also be an important route for transmission of diseases such as *E.coli*, *Cryptosporidia*, *Salmonella* and *Giardia*. These diseases generally affect young animals and have less effect on mature animals. One disease which does affect mature animals is Leptospirosis. *Leptospirosis* can be spread though contact with water contaminated with *Leptospirosis* bacteria. *Leptospirosis* will result in increased rates of abortion usually occurring 2-5 weeks after initial infection. Cattle have often built resistance to many of these contaminants but the introduction of an uncommon pathogen can rapidly spread through the herd and cause diseases especially to young animals. Young animals are

provided some immunity from mothers milk but are more susceptible to high concentrations of pathogens.

The easiest way to minimize these pathogens in a water source is to prevent inflow from manure sources and prevent direct entry of animals. The ultraviolet rays from the sun are effective in killing pathogens in water that is relatively clear. Direct entry of animals stirs up particles and prevents ultraviolet rays from destroying the pathogens.

Table 2: Effects of Sulphate on Cattle

Sulphate Concentration	Effects
500 mg/L	May affect calves
1000 mg/L	Canadian Water Quality Guideline
2500mg/L	Affects copper metabolism - deficiency of zinc, iron and manganese - poor conception
7000 mg/L	Death

Sulphates

High concentrations of sulphates are common in groundwater on the Prairies, but can also be found in groundwater fed dugouts. Table 2 summarizes the effects of sulphates on cattle.

Treatment of sulphates is costly. Present treatment technologies include ion exchange and nanofiltration, but treatment cost is about $1 per cubic metre ($4 per 1000 Imp. gal) and is difficult to justify. The best option is usually to find another source with a lower sulphate concentration and use a pipeline to distribute the water to the point of use.

TOTAL DISSOLVED SOLIDS (TDS)

TDS,sometimes known as salinity refers to the mineral quantity of the water. TDS includes common salts such as sodium chloride, calcium, magnesium, sulphates and bicarbonates. If TDS is high enough, cattle will refuse to drink the water for days then drink a large amount at one time and become sick and die. Water with TDS higher than 5000 mg/L should not be used for lactating or pregnant cows, and most animals will reduce intake at this level. The main symptom of effects from saline water is diarrhea. Water with TDS greater than 7,000 mg/L makes water unsuitable for all cattle. As with most contaminants, calves are more sensitive than grown animals to salts in the water.

Treatment of high TDS water requires a membrane system such as reverse osmosis. The best option is to find another water source.

A combination of nitrates in feed and water can reach toxic levels and result in death as soon as 3-5 hours after consuming lethal levels

NITRATES

Nitrates are occasionally found in groundwater that has been contaminated by manure or fertilizer. In dugouts and reservoirs, high nitrate concentrations are rarely found, except following direct runoff from a manure pile or chemical fertilizer source. Bacteria in the ruman converts nitrates to nitrites, which reduce the oxygen carrying capacity of the blood. With very high nitrate concentrations in the water, cattle will suffocate from lack of oxygen.

Recommended limits on nitrates plus nitrites in water for cattle is 100 mg/L as nitrogen (N) or 450 mg/L as nitrates (NO_3). This level is rarely seen on the Prairies except for extreme contamination. Feed may also contain nitrates. therefore the additive effect of the water and feed source should be considered. If nitrate levels in the combined intake of water and feed exceed 0.5 to 1 per cent of intake either the feed or water source or both should be changed depending on the level of nitrates in the individual source.

A combination of nitrates in feed and water can reach toxic levels and result in death as soon as 3-5 hours after consuming lethal levels. Chronic nitrate toxicity can also occur, where clinical signs are not observed but weight gain and appetite are depressed, a greater susceptibility to

infection and abortion. Chronic nitrate toxicity would be more common from contaminated water than acute poisoning.

Removal of nitrates requires an ion exchange, membrane or biological treatment system. Prevention of water source contamination is inexpensive and essential for viable and sustainable farm management.

IRON AND MANGANESE

Iron and manganese are common in groundwater, but can also be found in dugouts that are poorly aerated. They are not considered a toxic, but can often causes blockage in pipes. Iron and manganese precipitates when exposed to air and accumulates in pipes. The iron is a nutrient source for iron bacteria that can further compound the problem.

To prevent problems in the pipelines, guidelines recommend iron concentrations less than 0.3 mg/L and manganese concentrations less than 0.05 mg/L. Options to remove these vary. Often aerating a tank or spraying water into a tank can remove significant amounts of iron. A softener can also be used for concentrations less than 2 mg/L. Other options include oxidants such as chlorine or ozone, or treatment systems involving manganese green sand or biological activity.

ALKALINITY

Water pH ranging from 6.0 to 8.5 is considered acceptable as a water source for most livestock. Water with a pH less than 5.5 may cause acidosis in cattle, leading to reduced feed intake and performance. However it is uncommon to find acidic waters in the Prairie provinces. Mildly alkaline waters contain bicarbonates, but no carbonates. Highly alkaline waters (pH around 10) will contain carbonates. Most waters have alkalinities below 800ppm, which is measured as calcium carbonate ($CaCO_3$), and is not harmful to cattle. Excessive alkalinity in water can cause physiological and digestive upset in livestock. Alkalinity can also increase the laxative effects of water with high sulfate levels.

TASTE AND ODOUR

It appears that cattle are sensitive to certain taste and odours. Humans identify taste and odours related to blue-green algae, organic matter decay without the presence of oxygen and the presence of various minerals. Whether cattle have similar sensitivities is unknown, but cattle do seem to respond differently to different water types. Some farmers and research observations have identified a sensitivity to chlorine. Good management of water bodies such as grassed waterways, fencing of dugouts and aerating dugouts is an inexpensive way to minimize tastes and odours and ensure a good quality water source. Treatment is expensive but prevention is affordable.

Fresh manure in the water will impact taste and odour. Cattle have shown a preference to drink at clean water sources over contaminated ones. If there is no choice, cattle will not reduce consumption of water until contamination rates exceed 0.25%.

Iron and manganese can both affect the odour and taste of water. Since cattle are sensitive to both odour and taste, high levels of iron and manganese would cause them to show preference for one water source over another. It is unknown what levels would result in reduced water intake.

WATER TEMPERATURE

Water temperature may affect water intake. Cooler water assists cattle in maintaining a proper body temperature and can increase weight gains. Research has shown that cool water compared to warm water increases water intake and weight gains in cattle. If it is possible to maintain cool drinking water, there is a performance advantage to the producer.

Table 3: Water Constituents Affect Beef Cattle Performance

Constituent	Reduced Performance	Unsuitable for Beef Cattle
Nitrate (ppm)	450 - 1300	>1300
Salinity/TDS (ppm)	3000 - 7000	>7000
Sulphate (ppm)	500 - 3300	>3300
Fecal coliform (No./100ml)	1000 - 2500	>5000
pH	>8.5	>10

Groundwater is cool when it comes out of the ground and maintenance of this temperature may be beneficial. Dugouts maintain a constant temperature during the day, but the temperature does rise with warm air temperature. Deep dugouts would not warm up enough to have an effect on intake. Small water troughs in the summer and shallow sloughs and dugouts may be a concern. Water in a trough heats up at the end of the day, but cools down during the night.

A solar-powered remote water system is becoming a common practice on the Prairies

WATER QUALITY AND WEIGHT GAINS

A few studies have been conducted which examine the effect of water quality and weight gains. It is accepted that the more water an animal intakes the more feed it can consume, which leads to greater weight gains.

One study conducted in Alberta showed 9% greater weight gains on calves with cows drinking water pumped to a trough than those drinking directly from a pond. Steers in the same study showed a 16-19% increase in weight gains on the pumped water.

A study under way in Saskatchewan examined four different treatments of improving water quality and the effect this had on intake and weight gains. This study found that aerating or coagulating water can increase water intake by 10 - 20% over unaerated water. The impact on weight gains has been variable though, and the study is on-going. It is hypothesized that the aeration and coagulation are removing many contaminants thus improving taste and odour which improves intake.

THE BIG PICTURE

Water is the most important nutrient to cattle. It can have many health and production effects. There are definite economic gains to providing an unlimited supply of high quality water. Management of water quality should become as important as the feed source and ration planning in a beef cattle management program.

For further information on rural Prairie water quality issues:

- read the other publications in PFRA's **Water Quality Matters** series;
- visit the PFRA Web site at www.agr.gc.ca/pfra;
- read Prairie Water News available from PFRA, or on the Internet at www.quantumlynx.com/water; or
- **contact your local Prairie Farm Rehabilitation Administration Office** (PFRA is a branch of Agriculture and Agri-Food Canada)

AUTHORED BY: L. Braul and B. Kirychuk, PFRA

FUNDING: Strategic support and funding for this project has been provided by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF).

Agriculture and Agri-Food Canada
Prairie Farm Rehabilitation Administration

Agriculture et Agroalimentaire Canada
Administration du rétablissem agricole des Prairies

Canada