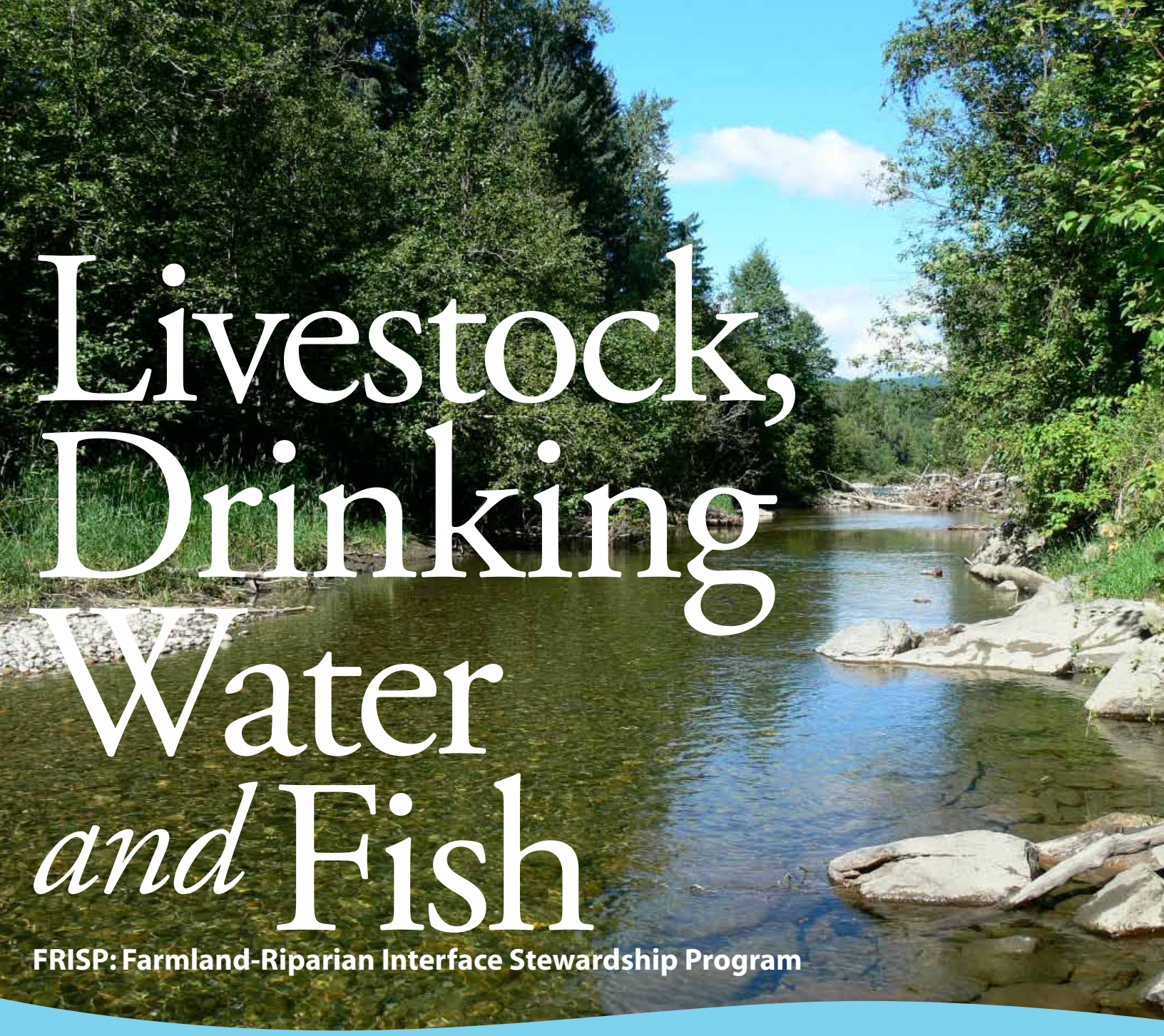


Livestock, Drinking Water *and* Fish

FRISP: Farmland-Riparian Interface Stewardship Program

BCCA

BC CATTLEMEN'S ASSOCIATION

INTRODUCTION

THE general public in British Columbia is constantly concerned about drinking water quality. When livestock are observed in rivers, streams, and lakes; thoughts about health and environmental issues are aroused. While **Provincial Regulations** allow for livestock to access natural water sources, such as a stream, there are conditions that must be met and they are the responsibility of the livestock owner. Both livestock and wildlife feces and urine can be a source of water contamination. Rain, snowmelt, and flooding runoff when passing through sites containing animal manure and other wastes have the potential to contaminate both surface and ground water. It is neither economical or practical to exclude livestock from natural watering sources, however there are measures that can be taken to reduce potential impacts.

"When livestock are observed in rivers, streams, and lakes; thoughts about health and environmental issues are aroused."

This publication attempts to address issues important to both human and livestock drinking water quality and the importance of uncontaminated surface and ground water for fish habitat and survival. It was prepared for all livestock owners having various types of domestic animals.

WHAT ARE THE PUBLIC HEALTH ISSUES?

ILLNESSES caused by drinking contaminated water are called '**Water-borne diseases**'. Contaminants commonly found in feces and urine of animals can be bacteria such as **Salmonella, Campylobacter** or **E-coli; viruses**; or **parasites** such as **Giardia** and **Cryptosporidia**, and infrequently **Toxoplasma**. Water-borne diseases are usually caused by the contamination of drinking water with feces from infected domestic animals (e.g. cows, horses, dogs) (Fig. 1), or wildlife (e.g. birds, bears, coyotes, deer, beaver, rodents) (Fig. 2 & 3), or humans, or a combination of these. A disease outbreak is more likely to occur when drinking water is obtained from surface water such as a river, stream, lake, or even from collected rainwater (Fig.4). Health concerns can become serious, very quickly, when a public drinking water system is involved that derives its water from either surface or ground sources.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

• Salmonella bacteria cause a sickness known as Salmonellosis. Symptoms may include fever, nausea, stomach cramps, vomiting, and diarrhea.

• Campylobacter is a bacterium found in the intestines of many animals including cattle. Untreated surface water may contain this bacterium if contaminated by manure containing the bacteria. The illness is known as Campylobacteriosis exhibiting symptoms similar to Salmonellosis.

• E. coli (pathogenic strains) is also a bacteria found in the intestines of animals and when contaminated fecal material gets into surface or ground water the water may become contaminated. Symptoms of illness are also similar to Salmonellosis.

• Viruses can also be found in fecal contaminated water. Many different viruses can cause illness in people. Animals can shed viruses in their urine or fecal material.

• Cryptosporidium and Giardia are microscopic parasites that can be found in both surface and ground water. Both can cause intestinal illness called Cryptosporidiosis and Giardiasis (beaver-fever). Symptoms are similar to those noted.

The above noted organisms are the more common ones found in water and are associated with numerous animal species. 'Food Poisoning' is a common term that involves illnesses caused by all the enteric pathogens mentioned.

WHAT ARE THE CONCERNS OF LIVESTOCK PRODUCERS?

Fig. 5

THERE are numerous factors that can affect livestock health and performance and water quality is one. Livestock need clean non-contaminated drinking water (Fig. 5). Considering cattle; daily feed intake is directly related to water intake. Performance problems associated with poor water quality and reduced feed intake may include reduced growth and weight gain, lower reproductive performance, and even reduced lactation. **Common issues associated with surface water and cattle include:**

• **Blue-green algae *(Cyanobacteria).*** Algae blooms can create a bad taste and odour in surface water (dugouts, sloughs etc.). Blue-green algae can produce **neurotoxins**, which can cause sudden death, or death within a couple of days, in cattle. To reduce or prevent blooms of this algae limit the amount of nutrients entering the water (Fig.6).

• **Other organisms** as noted previously can negatively impact on productivity and weight gains in cattle, particularly younger animals. One disease that affects mature cattle is **Leptospirosis** which can cause abortion problems. The disease is spread through water contaminated by Leptospirosis bacteria. The disease can spread rapidly through a herd as a result of manure entering surface water from an infected animal(s) (Fig.7).

• Cattle that are routinely entering water to get a drink may have a higher incidence of foot rot and leg injuries.

Note: Ample, clean drinking water is important to livestock health and performance.

Fig. 6

Fig. 7

WHAT ARE THE ENVIRONMENTAL CONCERNS?

How Do Nutrients Such As Nitrogen And Phosphorous Have An Impact?

While manure is an important source of nutrients for a farm or ranch, particularly nitrogen and phosphorous used as a fertilizer for forage production, excess amounts can enter surface or ground water and cause contamination. In streams, rivers, lakes, and dugouts high levels of these nutrients can promote algae growth, which can degrade water quality and have a negative impact on fish habitat. These nutrients can contaminate surface water by being directly deposited or through runoff. Dead and decomposing algae reduce the amount of dissolved oxygen in the water and this situation can frequently kill fish. Toxin producing algae can have a potential negative impact on human health. Water treatment costs increase when decomposing algae is present in a drinking water source.

"Dead and decomposing algae reduce the amount of dissolved oxygen in the water andthis situation can frequently kill fish."

Fig. 9 - Degraded Riparian Area

What About Livestock Impacts On Riparian Areas And Water Quality? (Fig. 8)

Cattle, in particular, can have a negative impact on the banks of streams, rivers, and dugouts or on the shoreline of lakes and wetlands. Heavy, long term grazing and trampling of riparian vegetation reduces the plant cover necessary for bank stability and habitat for wildlife and fish (Fig 9). Degraded riparian areas along streambanks can lead to the loss of farmland during high water events.

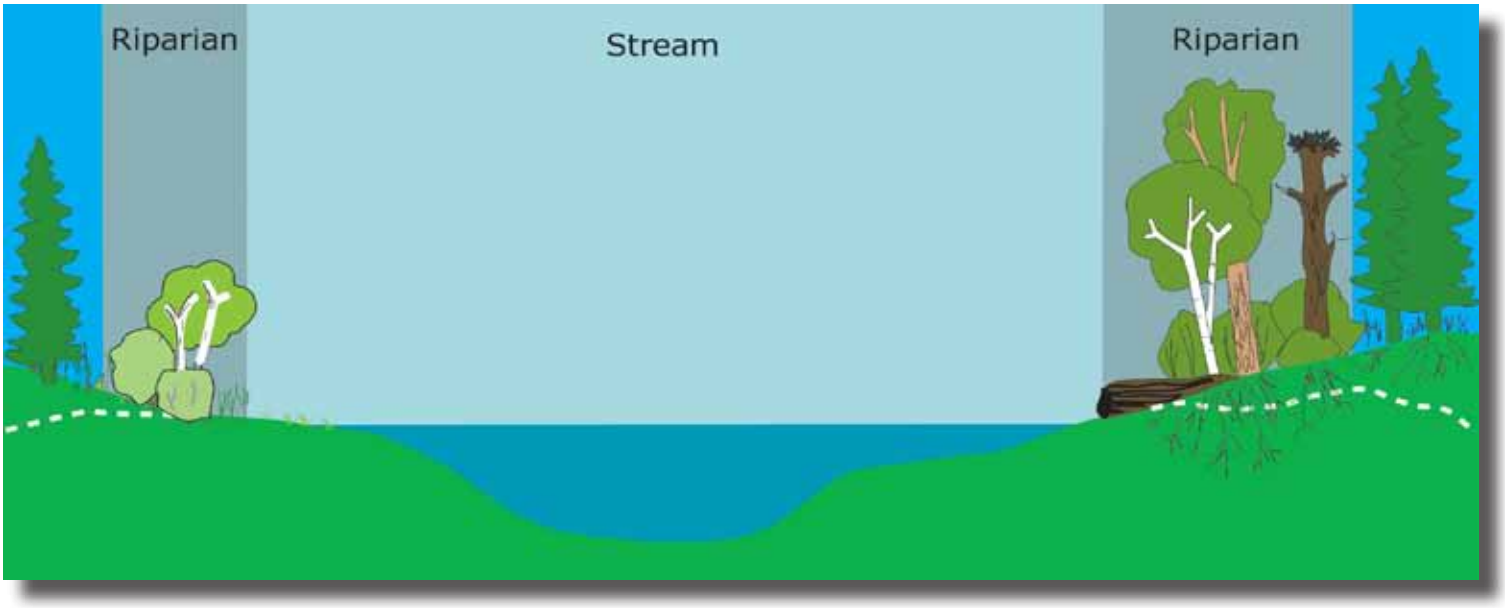


Fig. 8 - Stream and its Riparian Area

Fig.10

Healthy riparian areas are important for the following reasons:

• They provide valuable biodiverse habitat for wildlife along with shade and food (insects) for fish and native pollinators for crops (Fig.10).

• They catch and store sediment, which builds soil.

•Riparian vegetation is necessary to enhance streambank stability, which lessens the impacts of erosion by reducing water velocity and energy during high water events

• They also store water during high water occurrences and recharge aquifers, which store, hold, and slowly release water.

•Healthy riparian areas filter out contaminants so they do not readily enter a waterbody be it a stream, river, lake or wetland.

When cattle have uncontrolled access to water bodies, particularly on winter feeding grounds (seasonal), or intensively managed domestic pastures, or grazing areas, they can contaminate them with manure and sediment (trampling) from damaged streambanks. Sediment due to erosion reduces water quality and habitat for fish and other aquatic life forms. Increased sediment into a stream, river or lake can smother fish spawning gravels. Increased sediment can also decrease the clarity of water and increase the turbidity. Turbidity is related to the level of suspended particles such as silt, clay, and fine organic and inorganic matter found in surface water. These particles can harbour pathogens and compromise drinking water treatment efficacy and treatment costs. Both large and small livestock operations can have an impact if riparian management is neglected (Fig.10).

Winter storms in the coastal areas of the province can frequently cause watercourses to exhibit high flows, have saturated soils, and be very sensitive to livestock impacts.

Fig. 11

Fig. 12

What About Research On Water Quality And Livestock Grazing In Watersheds?

There has been a substantial amount of research done on the impacts to water quality from livestock grazing in watersheds, both in the U.S. and Canada. It is not the intent of this publication to provide an overview of the research, however research done in the North Okanagan area of BC during 2003 and 2004 provided some interesting information.

The work, which involved North Okanagan streams, revealed that even when cattle are grazing watersheds they are not necessarily the prime contributors of fecal contamination; in this case Escherichia coli (E. coli). The study was able to identify what species of animal contributed the E. coli found in the surface water; for example, birds, (Fig.11), Canine (coyotes, wolves, dogs), bears, rodents, deer or elk, and also cattle. In 2003 most of the E. coli came from wildlife: ungulates (deer, elk) at 22.1%, canine at 19.9%. Cattle contributed between 1.3 and 9.2%, depending on the stream.

During 2004 the highest percentage of E. coli was attributed to birds at 26.4%, followed by rodents at 16.9%. Cattle contributed to 18.3% of the E. coli identified in the water samples. The researchers noted that the primary contributors of fecal material varied from one year to another; however, in general wildlife contributed most of the E. coli, 84+% in 2003 and 73+% in 2004[1].

[1]Meays, C. Ph.D. 2007. Cattle – Grazing Our Watersheds. North Okanagan Livestock Association

Note: Cattle that are grazed on large extensive areas of Crown land under a Grazing License should not pose a concern with regards to water contamination from feces and urine as long as the cattle are managed for adequate distribution and are not allowed to congregate and loiter around water which can cause manure build-up and increase the risk of water contamination. Livestock that loiter around water will often graze and regraze the riparian vegetation before moving off and grazing the uplands. Animal behaviour is influenced by 'creature comforts', thus livestock are frequently more attracted to riparian areas during drier and hotter summers (Fig.12).

How Does Ground Water Impact Fish Survival?

Groundwater helps keep streams flowing throughout the year by releasing water into the streams. This is critical for fish and other aquatic life (Fig.13). Most groundwater is stored in aquifers, which supply a major portion of drinking and irrigation water in the province.

Salmon depend on sustained stream flows; low flows cause increased stream temperatures that are detrimental to their survival (Fig.14). Sockeye salmon are very susceptible to low water flows and high water temperatures. Ground water can be a temperature moderator for salmonids in BC watersheds, particularly in degraded riparian areas where lack of shade from foliar cover increases water temperature.

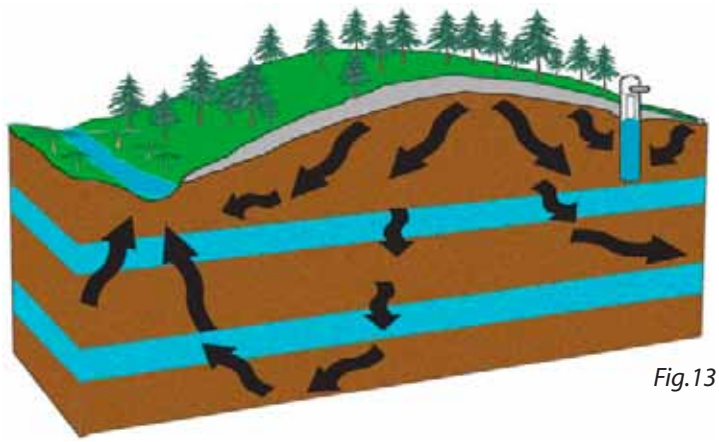
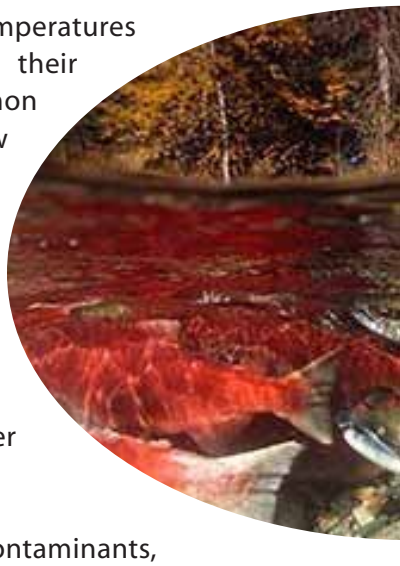


Fig.13



When ground water contaminants, nitrogen and phosphorous, are transferred to surface water algae growth can be stimulated. As mentioned previously decomposing algae remove dissolved oxygen and this situation threatens fish survival.

Simply put, fish need a steady supply of clean, uncontaminated water for their survival.

WHAT ARE THE ACTS AND REGULATIONS RESPECTING LIVESTOCK, DOMESTIC DRINKING WATER, AND FISH?

THERE are various Acts and Regulations that address water quality and they include

• The **BC Drinking Water Protection Act**. The act has requirements respecting drinking water quality and defines "**drinking water**" as "water used or intended to be used for domestic purposes". Under the **Act** a "**drinking water health hazard**" refers to "(a) a condition or thing in relation to drinking water that does or is likely to (i) endanger the public health, or (ii) prevent or hinder the prevention or suppression of disease". The **Act** also states that a "**drinking water source**" is defined as a "stream, reservoir, well or aquifer from which drinking water is taken". A "**stream**" or "**well**" is as defined in the **Water Act**. **Section 23** of the **Act** states that "a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur, if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system".

A person who contravenes the "**Drinking Water Protection Act**" can, upon conviction, be subject to substantial fines and/or other penalties.

• The **Water Act** is under the control of the **BC Ministry of Environment**, which is charged with regulating water resources. Under the **Act** a "**stream**" "includes a natural watercourse or source of water supply, whether usually containing water or not and includes ground water, lakes,

Fig.14

rivers, creeks, springs, ravines, swamps or gulches". This **Act** is responsible for surface and ground water protection. **Part 5** of the **Act** regulates wells and ground water protection under the **Ground Water Protection Regulation**. Wells must be properly installed, covered, operated, maintained, and at the end of their use deactivated to prevent ground water contamination.

• **The Environmental Management Act (EMA)** defines "**pollution**" as "the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment" and refers to "**water**" as including ground water, as defined in the **Water Act**, and ice. The "**Code of Agricultural Practice for Waste Management**" (Code) comes under the **EMA.**

1. Under the **Code** a "**confined livestock area**" "means an outdoor, non-grazing area where livestock …is confined by fences, other structures or topography including feedlots, paddocks, corrals, exercise yards and holding areas…"(Fig.15).

2. The **Code** states that a "**seasonal feeding area**" "means an area (a) used for forage or other crop production, and (b) used seasonally for feeding livestock…"(Fig.16).

3. A "**grazing area**" is defined as "a pasture or rangeland where livestock…is primarily sustained by direct consumption of feed growing on the area"(Fig.17).

4. The **Code** defines "**groundwater**" as " water below the surface of the ground".

5. A "**watercourse**" "means a place that perennially or intermittently contains surface water, including a lake, river, creek, canal, spring, ravine, swamp, salt water marsh, or bog, and including a drainage ditch leading into any of the foregoing".

NOTE: Under the EMA a permit is required from BCMOE in order to discharge a substance into the environment, however agricultural producers are exempt from this requirement if they follow the Code of Agricultural Practice for Waste Management as

• The **Fisheries Act** provides for the protection of fish habitat. **Fish habitat** is defined as the "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes". The **Act** states that: "no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish". Fines and penalties for violations, upon conviction, under the **Act** can be substantial.

The above noted Acts and Regulations are quite specific as to the requirements under law respecting the contamination of both surface and ground water.

Fig.15

Fig.16

ARE LIVESTOCK ALLOWED TO ACCESS WATERCOURSES? YES & NO!

Fig. 17

THE **Code of Agricultural Practice for Waste Management** allows livestock to access watercourses providing certain management practices are employed.

1.**Yes & No**: In a **confined livestock area (pen or feedlot)** "livestock … may not have access to a watercourse, (Fig.15) with the exception of a holding area on rangeland where (a) livestock is held no longer than 72 hours, (b) the watercourse is not a source of water used for domestic purposes at a location downstream from the confined livestock area, and (c) the access is located and maintained as necessary to prevent pollution".

2.**Yes**: In a **seasonal feeding area** "livestock … may have access to watercourses". However, livestock must be fed "at least 30 m from a … watercourse or the bank of a watercourse" and that feeding be done "throughout the area to ensure that manure from the feeding of livestock … is spread … and that no accumulation of manure causes pollution"(Fig.16).

3.**Yes:** In a **grazing area** "livestock may have access to watercourses, provided that the agricultural waste produced … does not cause pollution"(Fig.17).

WHAT CAN BE DONE TO HELP PREVENT WATER CONTAMINATION FROM LIVESTOCK?

THE ranching and farming industry has become increasingly involved in the use of **Best Management Practices (BMPs)** that reduce impacts to water quality. Every site is distinct and management practises will vary. What works for one site may not work for another.

Grazing and Feeding Areas.

1. Large Range Grazing Areas: Livestock can have access to a watercourse and often the water source is a river, stream, or lake with an associated riparian area. Because riparian areas filter out and store sediments and contaminants, that may contain harmful bacteria and other organisms, it is important to keep them healthy. Unhealthy riparian areas cannot do the job. Therefore it is a good practice to:

a. **Encourage** and maintain a healthy, diverse vegetative

Fig.18

cover of herbaceous and woody plants in riparian areas (Fig.10). It is important that the plant material varies in size and age.

b. **Employ** sound range management practices that include providing enough rest for plants to maintain vigour, balancing animal needs with available forage while maintaining a sustainable forage supply.

c. **Distribute** livestock evenly over the grazing area by herding, placing salt, mineral, and any feed supplements away from water and riparian areas. Drift fences, and selecting the appropriate class of livestock (e.g. yearlings vs. cow/calf) may be helpful (Fig.18).

d. **Control** grazing intensity and avoid grazing periods that allow livestock to graze where and when they want for too long.

e. **Consider** other practices including livestock water developments to help distribute animals and reduce pressure on other natural watering access points. (Fig. 19).

f. **Design** a grazing use plan that works for your grazing area. A grazing plan should be designed to improve livestock performance and at least maintain and/or improve range plant communities. Commonly a plan would include rotational grazing which allows for periods of rest for plant communities. ***Remember that livestock prefer to graze and hang-around riparian areas for shade and shelter, thus manure can build up and become a potential problem along with the associated loss of riparian vegetation.***

Fig. 19

Fig.20

Fig. 21

2. **Small Range Grazing Areas and Domestic Pastures:** As previously mentioned, livestock can have access to a watercourse providing that acceptable management practices are employed. Additional **BMP**s can frequently be implemented for these areas and may include:

a. **Fencing off the riparian corridor and creating a riparian pasture** that would be subject to special management objectives. This practice would likely include short duration (flash) grazing. Livestock control and rest from grazing is critical. Avoid grazing when streambanks are saturated with water and vulnerable to trampling and erosion (Fig.20).

b. **Fencing off watercourses and dugouts to eliminate livestock access.** (Fig.21). Fencing protects streambanks from trampling and erosion, and protects riparian vegetation. Fencing also allows, for easier riparian vegetation regrowth and for the development of

Fig. 22

Fig. 23

a diverse plant community. This approach frequently improves livestock health by reducing contact with water borne organisms. Fencing livestock out of dugouts also increases the longevity of dugout use. Exclusion fencing requires an alternate livestock watering system. ***Note: Maintain a good vegetative cover next to dugouts and streams etc. to help filter nutrients.***

c. **Controlled livestock watering sites** when a riparian corridor is fenced off. These sites allow for livestock to access drinking water from a stream, river, lake, or dugout (Fig.22). Design these sites so that livestock are reluctant to loiter, therefore the system should not be too large. Provide adequate and easy access for cattle such as using gravel or geogrids material in the design.

d. **Off-site watering systems**. Cattle will frequently select a source of water from a trough rather than from a natural watercourse, even if the watercourse is not fenced off (Fig.23). Off-site watering systems reduce the potential for fecal contamination of a watercourse and reduce, or eliminate, livestock impact on the riparian corridor.

3. Seasonal Feeding Areas (Over wintering, calving areas): As with small grazing areas and domestic pastures, livestock can have access to a watercourse providing that 'BMPs, as mentioned under 2 above, are followed. Further requirements and recommendations for ground and surface water protection from manure contamination through runoff and infiltration are as follows:

a. **Feed** livestock at least 30 m from any watercourse (Code) or dugout.

b. **Feed** over the whole area so that manure is evenly spread to prevent accumulation in any given site.

c. **Locate** winter feeding areas as far from watercourses and dugouts as possible.

d. **Provide** shelter away from any watercourse(s) including dugouts.

e. **Establish** feeding areas on gently sloping ground to help control runoff. The steeper the slope the further away feeding should take place from a watercourse and the fewer the livestock numbers on the site.

f. **Feed** livestock 30 m away from any sources of groundwater (Code) such as wells and springs.

g. **Divert** uncontaminated water around pens, corrals, exercise yards and feeding areas where contamination may occur. This may require the construction of berms, ditches, and/or storage ponds etc. if some contamination is likely to occur.

h. **Feed** beyond the floodplain of any river or stream and avoid high water table areas.

i. **Avoid** feeding on porous soils such as gravel or sand, which have a high infiltration capacity. If feeding on porous soils increase the size of the feeding area or reduce the livestock numbers.

j. **Harrow** or break up and disperse the manure in the spring.

k. **Allow** for good vegetative cover to hold nutrients.

l. **Consider** growing crops that have a high nutrient requirement.

Fig. 24

Fig. 25

Note: Every site has it's own characteristics and variable management practices are used throughout the province to control water contamination that might originate from seasonal feeding areas.

4. Confined Livestock Areas (pen, feedlot, or holding area on rangeland): Livestock confined to pens must be supplied with a source of water as they are not allowed access to a watercourse (**Code**) (Fig. 24). The exception is holding areas on rangeland where livestock can have access to a watercourse provided the livestock are held for no longer than 72 hours, as mentioned previously. In situations where contaminated runoff from pens may enter a watercourse, the use of ditches, berms and holding ponds can be advantageous and prevent or at least reduce potential problems (Fig. 25). This material could be used as a fertilizer at a later date.

WHAT ABOUT MECHANICAL SPREADING OF MANURE?

AGRICULTURE **Waste under the Code (e.g. manure spreading)** ... "must not be directly discharged into a watercourse or groundwater" and ... "waste must not be applied to the land if, due to meteorological, topographical or soil conditions or the rate of application, runoff or the escape of agricultural waste causes pollution of a watercourse or groundwater". Excess nutrients in runoff from fields subject to manure spreading can result in reduced water quality for drinking by both humans and livestock, and have a negative impact on fish.

Manure must only be applied to land as a fertilizer or a soil conditioner and ranchers/farmers are responsible to ensure that any contaminated runoff does not enter a watercourse or groundwater. The following recommendations should be considered when spreading manure:

- **Spread** manure more than 5 m from any slope or bank that leads to a watercourse.
- **Spread manure** at least 30 m away from a well, spring, or stream that is used as a domestic source of water. Increase the distance from the water source as the slope of the ground increases (Fig.26).
- **Do not spread** on steep slopes or long shallow slopes

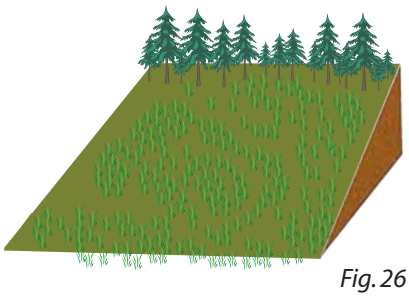


Fig. 26

where surface runoff and/or soil erosion may well occur. Bare and steep slopes are particularly subject to erosion. Soil erosion can occur during a heavy rainstorm or fast snow melt which increases the sediments entering surface water. Nutrients such as nitrogen and phosphorus, and even micro-organisms, can be attached to the sediment particles in the runoff and enter a watercourse. Therefore do not spread manure on land that is subject to erosion from water or where a water flow is concentrated.

• **Do not spread on water-saturated soils or in areas of standing water (Fig.27).** When this water moves down through the soil into the ground water strata, nutrients and micro-organisms can be carried along.

"Contamination of ground water can occur from runoff going directly down a well if the well is not properly capped, or as seepage down the side of the well casing if the well is not properly sealed."

Fig. 27

• **Avoid spreading** below high water marks where direct runoff is a potential risk factor.

• **Uncontaminated runoff** should be diverted around fields that have been spread with manure.

• **Manure application rates** should not exceed the total annual nutrient requirements for the crop grown. Excess nutrients may leach into the ground water.

• **Fields** where manure is being spread should have a good vegetative cover or crop residue present. A lack of vegetative cover increases the risk of soil and manure contaminants entering a watercourse during runoff.

• **Some Application Principles:**

1. A good time to apply manure to corn or grassland sites is in the fall on unfrozen ground. This practice allows for manure nutrients to be available for the crop the following spring.

2. It is not recommended to spread manure on frozen ground in the fall or winter on most fields. The risk of runoff being contaminated is high.

3. It is not recommended to spread manure on snow covered ground. This practice has the highest risk for creating contaminated runoff. Due to the snow cover there is limited potential for the manure to adhere to the soil, forage base, or crop residue, thus the risk is high for contaminated runoff to enter a watercourse during snow melt.

WHAT ABOUT WELLS AND GROUND WATER?

IN November of 2005 the **Ground Water Protection Regulation (GWPR)** came into affect in British Columbia. The **GWPR** sets standards for protecting ground water by requiring water wells in the province to be properly constructed and maintained, and properly deactivated and closed when they are no longer used. Contamination of ground water can occur from runoff going directly down a well if the well is not properly capped, or as seepage down the side of the well casing if the well is not properly sealed (Fig.28).

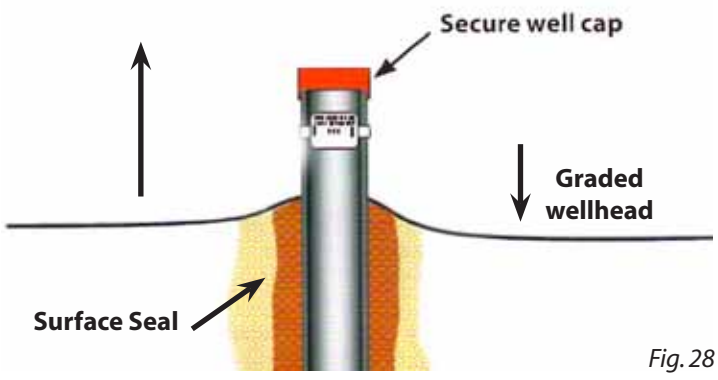


Fig. 28

Currently all new wells, either drilled or dug, are required by law to meet the minimum construction standards as set out in the **GWPR**. Every well must have the following to prevent ground water contamination:
• A **surface seal** at the top of the well casing to prevent any contaminants from surface runoff and/or shallow ground water. The minimum thickness of the seal must be at least 2.5 cm.
• A **secure cap** to prevent any water, contaminated or not, from entering the well.
• A **well casing** that is constructed to extend at least 30 cm (1 ft) above the level of the surrounding land to prevent runoff or flood water from entering the well (Fig.28).
• A **graded wellhead** to divert surface water away from the well.

Water well owners must also:
• **Deactivate** any wells that have not been used for 5 years.
• **Close down** any deactivated wells that have not been used for 10 years.

The following practices are recommended:
• **Locate wells** as far away as possible from any potential source of contamination.
• **Establish new wells** at least 30.5 m from any manure storage.
• **Site new wells** in higher areas to prevent runoff problems.
• **Place wells** above the 100 year floodplain.
• **Use berms** where necessary to direct runoff around wells.
• **Maintain** a good vegetative cover around wells to filter out any runoff contaminants.
• **Do not establish wells** in seasonal feeding areas, feedlots, or any other location where manure accumulates.
• **Build fences** around wells, if necessary, to keep livestock away.

WHAT ABOUT ROUTINE DISINFECTION PRACTICES?

COMMUNITY water systems are regularly sampled and tested to confirm that the treatment and disinfection program is performing appropriately for removing bacteria and viruses (Fig. 29). Disinfection processes can be compromised by cross contamination when particles of manure or sediments enter the water source. Disinfection by chlorination alone will not remove parasites such as *Cryptosporidia* and *Giardia*. To remove these parasites requires a filtration process. The prevention of these parasites from being introduced into a source of drinking water is a big step in helping to control water borne diseases and maintain water quality.

Any drinking water derived from surface water, such as lakes or streams, or dugouts should be treated before use ant tested frequently.

Thus it is important for all livestock owners to apply '**due diligence**' and protect the water resources of BC from contamination so there is ample clean water that is essential for humans, livestock, wildlife and critical for fish.

Fig. 29

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