Agriculture and Agri-Food Canada   Agriculture et Agroalimentaire Canada

Streambank Fencing in Southern Alberta

An analysis of the benefits and costs

Minimizing the impact of cattle on water quality and the health of riparian (riverbank or streambank) areas requires careful grazing management. Fencing with off-stream watering is one management option producers and ranchers use to improve or maintain the health of riparian areas and water quality.

All human activities—whether recreational, commercial or otherwise—influence water quality. Because farming practices interact closely with natural systems, producers and ranchers face increasing pressure to produce crops and raise livestock in an environmentally-conscious manner. Beneficial management practices (BMPs)—farming methods designed to minimize potential negative impact on the environment—are one way of doing so.

When considering streambank fencing as a BMP, several factors must be taken into consideration: potential benefits to water quality and riparian habitat, the cost of the fencing and off-stream watering and possible additional costs/benefits to the producer and the public at large. This fact sheet reports on a study in southern Alberta that highlights the choices, impacts and uncertainties surrounding the decisions involved. Research findings from this watershed may also be applicable to other semi-arid prairie landscapes with similar climate and soils.

Installing cattle exclusion fencing along streambanks is commonly thought to improve water quality, or at least prevent further water quality degradation, and can improve riparian health by:

- reducing or preventing direct deposits of manure and urine
- increasing riparian vegetation to create a natural buffer to help filter surface runoff, sediment and nutrients from adjacent grazed areas
- eliminating physical damage and compaction of the soil structure caused by over-grazing and trampling

The effectiveness and costs of using streambank fencing (including a fenced stream crossing and off-stream watering) are being investigated in the Lower Little Bow River Watershed, northeast of Lethbridge.

The purpose of this study is to determine the impacts on water quality, rangeland health and riparian health of excluding cattle from the river, and to determine the BMP's costs and benefits for cattle producers. Results of this ongoing study are currently based on observations from 2004 to 2009. Research is conducted under a national Agriculture and Agri-Food Canada (AAFC) program called **Watershed Evaluation of BMPs (WEBs)**. The environmental results of the first six years of this study have been published (see footnotes 1, 2 and 5 on pages 2 and 4). The study continues to assess the impact of this BMP on riparian areas and water quality over an even longer time period.

Farming in the region is diverse and includes: cow-calf pairs grazing on native rangeland, intensive confined feeding enterprises, dryland and irrigated cropping and intensive row crop operations. The pasture land in the study area is comprised primarily of loamy soils with some soil salinity, and overlays a dominant geology of coarse gravel and sand with minor silt beds. Long-term annual precipitation in the area averages 380 millimetres (15 inches).

The width of the Lower Little Bow River ranges from approximately 8-9 metres (26-30 feet) and the depth from about 0.5-1.0 metres (1.6-3 feet). River flows vary during the summer, depending on rainfall and irrigation return flows and irrigation withdrawal. Several water quality parameters in the river (e.g. sediment, nutrients, *E. coli*) frequently exceed water quality guidelines.

Figure 1. The Lower Little Bow River in southern Alberta

Canada

What is the Watershed Evaluation of Beneficial Management Practices (WEBs)?
A long-term research program initiated in 2004 by Agriculture and Agri-Food Canada, WEBs evaluates the economic and environmental performance of BMPs at a small watershed scale. To gain a regional perspective, this information is being scaled up to larger watershed areas using hydrologic models.

WEBs findings are helping researchers and agri-environmental policy and programming experts to understand how BMPs perform and interact with land and water. This knowledge will also help producers determine which BMPs are best for their operations and regions.

WEBs studies are conducted at nine watershed sites across Canada. These outdoor living laboratories bring together a wide range of experts from various government, academic, watershed and producer groups. Many valuable findings have emerged, and research continues at all sites.

How were streambank fencing and off-stream watering studied in Alberta?

An 800-metre (2,625-feet) stretch of barbed wire fencing was erected in a straight line along both sides of the Lower Little Bow River in 2001. The fence is between 40-80 metres (130-260 feet) from the meandering river's edge (Figures 2 and 3). The fencing created a cattle-excluded area of approximately 10 hectares (25 acres), comprising both riparian zone and upland pasture rangeland).[1,2] Cattle were able to freely graze in the remaining 184 hectares (455 acres) of pasture. An off-stream watering source was provided on either side of the river to supply drinking water for cattle. The cattle stocking rate during the study period ranged from 0.4-0.5 animal unit months per hectare. This rate was at or lower than recommended guidelines for pastures in poor condition.

Water monitoring sites were established both upstream (control) and downstream (BMP impact) of the fenced-off area. Sampling occurred weekly from April to October and monthly in the winter from 2004 through 2007. Samples were analyzed for sediment, nutrients and bacteria.

Because natural runoff events can be sporadic during the summer grazing months in this semi-arid watershed, rainfall simulations to mimic runoff events were applied in both the cattle-excluded pasture and the grazed pasture from 2005 to 2007.

Rangeland health was assessed within the upland cattle-excluded (fenced) and grazed upland pastures in 2007.[3] Five criteria were evaluated: ecological status, plant community structure, litter abundance, site stability and noxious weeds. Sampling of selected vegetation and soil properties of upland pastures was conducted from 2005-2007. As well, a riparian health assessment of the river, riverbank and adjacent riparian zone was conducted before and after BMP implementation (2001, 2005 and 2009) using eleven vegetation, soil and hydrology factors.[4] The rangeland and riparian areas were then classified into one of three categories based on percentage health scores: healthy, healthy but with problems and unhealthy.

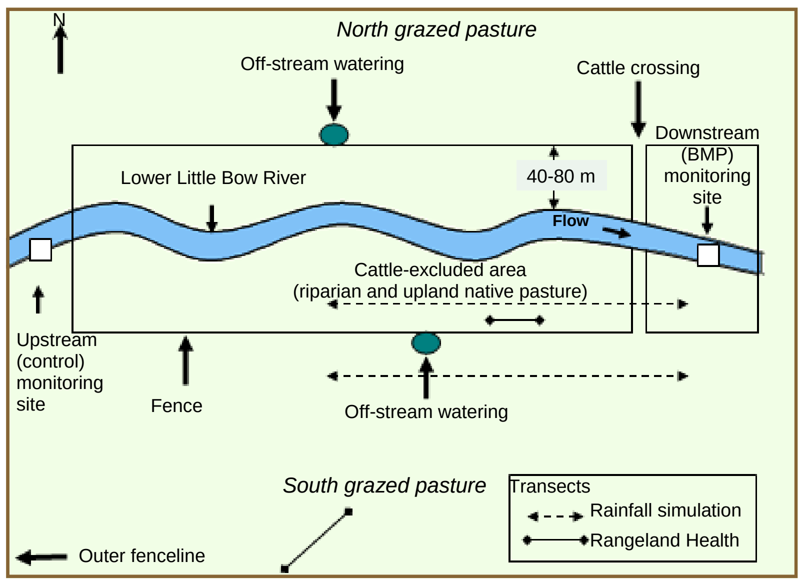

Figure 2. Schematic diagram of streambank fencing with cattle crossing

[1]Miller, J. 2010. **Influence of streambank fencing on the environmental quality of cattle-excluded pastures**. *Journal of Environmental Quality* 39, pp. 991-1000.
[2]Miller, J., D. Chanasyk, T. Curtis, T. Entz and W. Willms. 2010. **Influence of streambank fencing with a cattle crossing on riparian health and water quality of the Lower Little Bow River in Southern Alberta, Canada**. *Agricultural Water Management* 97 (2), pp. 247-258.
[3]Adams, B. W., G. Ehlert, C. Stone, M. Alexander, D. Lawrence, M. Willoughby, D. Moisey, C. Hincz, and A. Bogen. **Range Health Assessment for Grassland, Forest and Tame Pasture**. Public Lands Division, Alberta Sustainable Resource Development. Pub. No. T/044 105 pages.
[4]Fitch, L., B.W. Adams and G. Hale, 2001. **Riparian Health Assessment for Streams and Small Rivers - Field Workbook.** Lethbridge, Alberta: Cows and Fish Program. 90 pages.

What effect did streambank fencing have on water quality?

The focus of this BMP was not necessarily to improve water quality, but to determine if excluding cattle from waterways with fencing could prevent water quality degradation by cattle. Specific water quality parameters measured included: turbidity, sediment, dissolved oxygen, temperature, chlorophyll-a (an indicator of algae), nitrogen (N), phosphorus (P), *E. coli* and fecal coliform bacteria.

The study found that streambank fencing was successful at preventing further degradation of water quality in terms of the amount of nutrient (N and P), and sediment loading, and that the cattle crossing did not contribute to water quality degradation downstream. The impact of the fencing BMP on other water quality variables was less clear.

The rainfall simulation trials detected less runoff from the cattle-excluded pasture than from the grazed pasture. There were no significant differences in runoff volume or water quality between the two pastures during the first year of the study, which was also the year with the highest rainfall. However, differences were observed in years two and three, suggesting that the fenced-off area does provide a buffer zone that reduces nutrient runoff in certain years, with the amount of nutrient runoff likely related to yearly climatic changes.

What effect did streambank fencing have on pasture and riparian health?

Rangeland health of upland pastures

“What's very interesting is how much we learned about the entire ecosystem of the area during this study,” says Dr. Jim Miller, the AAFC research scientist leading the Lower Little Bow River WEBs project. “We found that this ecosystem approach of studying streambank fencing by examining riparian and rangeland health, river water quality, soil and vegetation properties and rainfall simulation runoff allowed for a better understanding of the effect of the BMP on the environment—compared to just studying one of these components.”

Dr. Miller and his team found that six years of fencing (from 2001 to 2007 when the rangeland health assessment was conducted) improved the score of the cattle-excluded upland pasture from 55% to 72%. This increase was due to improvements in ecosystem status, plant (or ecological) community structure and abundance of plant (or crop) litter.

Vegetation and soil properties of upland pastures

Streambank fencing also significantly improved several aspects of local vegetation and soil properties in the cattle-excluded pasture—such as vegetative cover and standing litter—in all three years of the health assessment study. The fenced-off area had fewer patches of bare soil, improved live-plant area and reduced soil compaction in the latter two years. These improvements seemed to protect the soil surface from water erosion and acted as a buffer for potential contaminants. On the other hand, excluding cattle did not significantly impact other aspects of vegetation and soil, such as the chemical properties of surface soil.

Riparian health

The first riparian health assessment following implementation of the BMP showed that riparian health increased after four years of fencing. However, a follow-up assessment in 2009 showed the health of the fenced-off riparian area had declined from ’healthy’ to ‘healthy but with problems’. This decrease in riparian health was due to an increase in invasive plant species and possibly the residual effects of soil compaction caused by cattle on the ability of preferred trees and shrubs, such as willows, to establish along the streambank. The results of the riparian health assessment would have been more favourable had the assessments stopped after four years, emphasizing the merit in long-term evaluations. The study will continue to monitor future changes in types of riparian vegetation, including weeds, to improve our understanding of the BMP’s impacts over the long term.

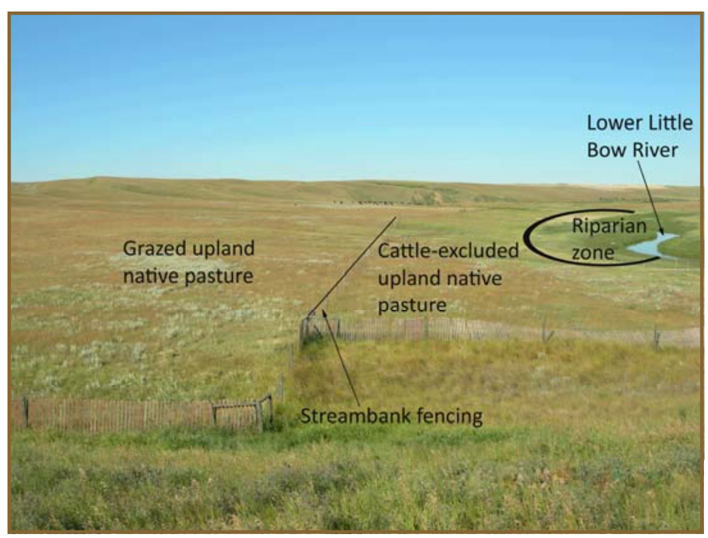

Figure 3. Excluding cattle by fencing off the riparian area and adjacent upland riparian pasture preserved water quality downstream.

Economic considerations

Costs

The costs of conventional fencing could act as a barrier to the adoption of this BMP by cattle producers. Fencing costs in this project were estimated at $2/metre ($0.67/foot) or $2,000/ kilometre ($3,225/mile) for a standard four-strand barbed wire fence installation.

It is estimated that streambank fencing, with its immediate reduction of available pasture area and added costs, could cause a 2-7% decrease in farm cash flow. However, the practice may result in benefits (largely unquantified to date in this study) that could partially offset the costs.

Potential benefits

Research elsewhere has shown that providing access to clean water, as with an off-stream watering source, may result in higher water consumption and cattle weight gains compared to lower-quality water accessed directly from the river. Access to higher-quality water may also lead to a decrease in herd health problems. And providing access to off-stream watering, with or without fencing, may result in increased grazing and pasture utilization.

The economic analysis conducted by Dr. Carlyle Ross, the AAFC lead economist on this project, suggests that as little as a 3% increase in utilization or productivity of pasture land could offset the cost of a new off-stream watering system (referred to earlier) but may be insufficient to offset the cost of the fencing. The WEBs study also showed that fencing was effective in shifting manure nutrient distribution away from the river bank to the off-stream watering sites where the nutrients can benefit pastures and soils. This WEBs study has yet to examine such on-farm benefits in detail, and the possible off-farm (public) benefits of the BMP have not yet been assessed.

Alternative practices

An alternative BMP—off-stream watering without streambank fencing—was also tested in this watershed and was found to be more cost-effective than fencing.[5] However, in such a semi-arid area, this BMP only slightly decreased the frequency of cattle entering the river and was not as effective as streambank fencing at protecting and regenerating riparian vegetation. As a compromise, streambank fencing might be targeted to more ecologically-sensitive or more severely-degraded stream reaches, with the less expensive and less-effective off-stream watering without fencing BMP applied in less critical areas.

Another alternative to total cattle exclusion is periodic, short-term grazing of the riparian pasture to achieve a balance between using the forage resource and protecting water quality. This practice may also help to control the invasive plant species that entered the cattle-excluded pasture after several years of fencing, but should only be used when the riparian zone soil is dry enough to prevent compaction and damage to the soil by cattle.

Credit: Dwayne Rogness, County Lethbridge

Figure 4. Off-stream cattle watering system

[5]Miller, J.J., T. W. Curtis, E. Bremer, D. S. Chanasyk, and W. D. Willms. 2010. **Soil test phosphorus and nitrate adjacent to artificial and natural cattle watering sites in southern Alberta**. *Canadian Journal of Soil Science* 90 (2), pp 331-340.

AAFC leads the national WEBs program and provides funding under its **Growing Forward** ***initiative.***
Ducks Unlimited Canada has been a key contributing partner.
Other partners at the Lower Little Bow River project include: the County of Lethbridge, the University of Alberta, and Alberta Sustainable Resource Development.

More information

Visit www.agr.gc.ca/webs or contact WEBs at webs@agr.gc.ca.

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Aussi offert en français sous le titre : *Installation de clôtures le long des berges dans le sud de l'Alberta*