CONSERVATION INNOVATION GRANTS

Final Report

Grantee Name: Montana State University Extension Water Quality	
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Grant Number (MSU):	
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Project Summary

The Armored Stanchion (AS) project was initiated to develop, build, and evaluate an alternative livestock water access method. The AS eliminates direct deposition of feces into the stream by limiting cattle access to the edge of the stream and preventing animals from turning around in the water. AS accesses were installed at study sites on Thompson Creek and Story Creek north of Belgrade, MT. Installation occurred in the fall of 2006, water quality sampling was conducted between March and August of 2007, and final fencing was constructed in the fall of 2007. Both sites provided water access for cattle using an AS, as well as a traditional water access point for comparison. Water samples were collected up and downstream from the access points to quantify water quality impairment associated with each access. At the Thompson Creek Site, the AS showed lesser impacts than the traditional access for *E. coli*, Total Kjeldahl Nitrogen (TKN), and Total Phosphorus (TP). At the Story Creek site, the suspended sediment concentration (SSC) impact from the AS access was less than that from the traditional access. This study showed that AS water access implementation can reduce water quality impairment from cattle accessing surface water. (For more detailed explanation of AS design, study sites, study design, statistical methods, and results, see MSU Master's Thesis: Sigler, 2008)

Project Objectives Review

The two AS water access points were constructed in the fall of 2006 along with a combination of permanent and temporary fence to facilitate the water quality study. The original study design was modified from comparison of three accesses at each site to two accesses. This allowed the study to better accommodate producer animal movement needs and also helped to reduce interference in water quality results between stream reaches. The result was a smoother study with higher resolution water quality data. At the Thompson Site, the AS was compared to a traditional water gap and the full access reach was eliminated. After the study, riparian fencing (1,970 ft) was completed to produce a separate riparian pasture and cross

fencing was installed. The cross fencing (2,460 ft) produced three nonriparian pastures which all utilize the AS access for livestock water. At the Story Site, the AS access was compared to a full access stream reach and the traditional water gap reach was eliminated. Riparian fencing (1,220 ft) was completed to fully isolate animals from the majority of the stream along the edge of the pasture. Riparian fencing (500 ft) was also installed to create a separate riparian pasture where the stream passes through the corner of the property. The proposed cross fencing at the Story Site was not constructed because it was intended to be a small component of a larger EQIP fencing project which the producer backed out of.

Armored Stanchion (AS) Design

The AS access is a modified water gap for cattle, installed in conjunction with riparian fencing to exclude animals from the riparian corridor. The AS includes a fenced approach to the stream and fencing along the stream bank to prohibit animals from fully entering the water. A series of fence braces are installed perpendicular to the shoreline with one post at the bank and the brace extending away from the channel approximately 6 ft (Figures 1 and 2). Redwood 2x6" lumber is bolted to the posts to create a step. Stanchions at the Thompson Site were built with a 5.5 ft inside width, which was sufficient for two animals to access the water simultaneously. Four stanchions were installed, which resulted in overall accommodation for eight animals at a time. Stanchion width was narrow enough that animals preferred to back out rather than turning around in the stall but the stanchion was sufficiently wide that animals could turn around if necessary. This increased animal access per unit of building material and seemed to reduce stress on animals. On one occasion at the Thompson Site, a dominant cow approached another cow in a stall. The less dominant cow turned around in the stall and was able to escape past the other cow head-first. If the animal had not been able to turn around, she may have bolted forward against the stanchion, causing higher stress and potentially damaging the infrastructure. For this reason, stanchion widths of approximately 5.5 ft are advisable. The installation cost was approximately 3,000 dollars per access installed. Trackhoe operation, fill, and textile materials accounted for 2,250 dollars. Posts, cattle panels, redwood footers, split rails for the approach, and hardware accounted for 750 dollars.

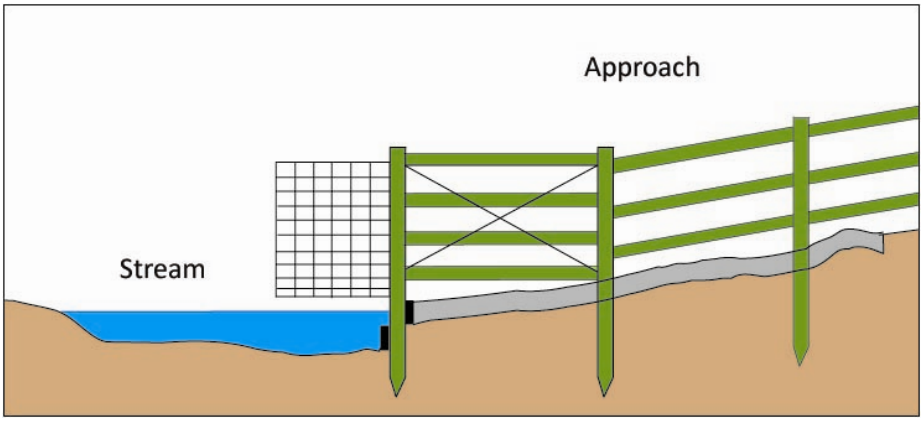

Figure 1. AS conceptual profile view.

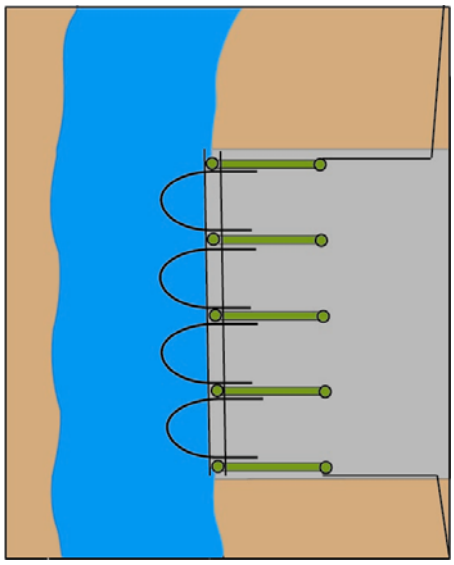
Figure 2. AS conceptual plan view.

Water Quality Results

Water samples were collected above and below each access for each sampling event. The difference in concentration was multiplied by stream discharge to calculate contaminant loads. Samples were taken when animals were actively using the reaches and when animals were in the pasture but not using the water points. Samples were also taken upstream and downstream from a control reach at each site for reference.

When animals were not actively using the accesses, none of the access points demonstrated contaminant loads significantly greater (p value 0.05) than the control reach. For the AS accesses, the water quality when animals were drinking was not significantly different from that when animals were not drinking. In contrast, the traditional access at the Thompson Site revealed significantly greater median loads of *E. coli*, TKN, and TP when animals were using the access versus not using the access. Instantaneous *E. coli* load difference increased by 8.0 E10 CFU day^{-1}, TKN by 5679.2 g day^{-1}, and TP by 708.3 g day^{-1} when animals were using the traditional access. At the Story Site, the traditional access demonstrated a significantly greater SSC load when animals were present versus absent in the reach. The median load difference was 107.9 kg day^{-1} greater when animals were drinking. The results were more pronounced at the Thompson Site, which is probably partially explained by the greater stocking density at this site relative to the Story Site.

Considerations for AS Implementation

This study revealed significant loading of *E. coli*, SSC, TKN, and TP associated with traditional accesses with animals present, but detected no impacts from the AS accesses. However, evaluation of water quality effects during precipitation events was not conducted. When animals use the AS accesses, feces is deposited adjacent to the stream. With precipitation leading to runoff, some contaminants from this waste could be transported to the stream. For this reason, off-stream water developments may provide more protection to water quality resources during heavy precipitation.

Another consideration is the amount of fencing the AS requires to be installed adjacent to the stream. An AS should not be installed on streams where dramatic changes in stream stage are expected. High stage conditions could pose a risk to infrastructure during flooding. Low stage conditions are also a consideration for installation of AS accesses, because low discharge could result in water not moving through the stanchions, depriving animals of water. For this reason, it is important to determine the likely changes in stage at a proposed installation location. Ideally, sites should experience less than 30 cm of stage change during the season animals will be using the AS.

Potential formation of ice at the edges of the stream needs to be considered if animals will use the AS access for water in the winter. The spring fed streams utilized in this study remain free from ice for all but the coldest days in the winter.

Locations should be chosen where the banks remain as dry as possible. Seepage from the bank at the Thompson AS site resulted in muddy conditions which complicated installation. The seepage also resulted in the surface remaining moist, which could increase the potential for contamination to reach the stream.

The number of cattle to be accommodated simultaneously must be considered when designing an AS access. If stanchions are constructed with a 5.5 ft internal width, two 1100 lbs cattle can access the water at the same time. The four stanchion access installed at the Thompson Site could accommodate up to eight animals simultaneously. The livestock producer at the Thompson Site thought this would be sufficient access for his herd of approximately 100 head of cattle. At the Thompson Site, Black Angus bulls, cows, calves, and horses successfully used the AS access. At the Story Site, Horned Scottish highlander cattle and Black Angus cattle and calves successfully used the AS access.

Conclusion

The AS water accesses designed, constructed, and evaluated in this study were found to contribute lesser loads of *E. coli*, SSC, TKN, and TP than adjacent traditional water accesses. This indicates that the AS access can effectively mitigate water quality impairment while allowing animals access to surface water. Surface grading was implemented to minimize potential for overland flow to enter the AS area from higher ground. However, with heavy precipitation, overland flow could initiate on the AS and transport feces into the stream. For this reason, the AS is presented as a surface water access improvement option, but off-stream water is recommended as a preferred first alternative.