Controlling Streambank Erosion

Habitat Extension Bulletin No. 51

Running water is a very powerful force underestimated by most people. Many streambanks in Wyoming and across the West are unstable and actively eroding.

Streams eroding at an accelerated rate downcut as well as sidecut. Downcutting lowers the water table and draws water from streamside soil, resulting in a loss of bank vegetation and livestock forage. Sidecutting erodes valuable land, reduces water quality, and can threaten developments such as roads, fences, and buildings (figure 1). Unstable banks increase silt loading, ultimately shortening the life span of reservoirs, irrigation ditches, and pumps.

The ability of the stream to support fish is also reduced when banks are unstable. Badly eroded streams offer fewer pockets, pools, and undercut banks, which are used by fish for shelter. Habitat for aquatic invertebrates (favored trout food) is reduced when streambed gravels are covered with silt. Siltation of spawning gravels also reduces survival of trout eggs and young. The combined effects of reduced shelter, food, and reproduction dramatically decrease the population of fish in a stream.

Causes of Streambank Erosion

Erosion and sedimentation are natural processes that occur along all streams. The extent of erosion depends primarily on flow velocity and the size and density of material exposed to the stream current. The faster the water, the larger the material it is capable of moving. Fine silt, for example, is moved by water velocities of less than one foot per second. Flows of five feet per second will move gravel, and flows of 12 feet per second can move boulders (figure 2).

In a stream, water velocity varies both along and across the channel. Holes are scoured where flow is fastest, and sediment is deposited on point bars, where flow is slowest. Naturally stable streams usually exhibit a meandering pattern. The line of the deepest, fastest current crosses from one streambank to the other, following the outside bends. Even in straight channels, the fastest current meanders from

Figure 1. Side cutting results when vulnerable banks are exposed to water velocities great enough to move the particles in the bank. Accelerated side cutting puts valuable land, manmade structures and wildlife habitat at risk, and results in poor water quality.

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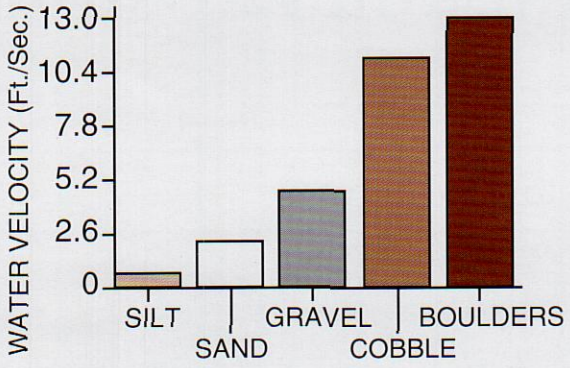


Figure 2. The faster the current in a stream, the larger the particles it will move. Shape, density, and current turbulence also affect how far a particle will move.

one side to the other. The greatest velocity occurs along the outside of each bend, just downstream of the outermost point of the bend (figure 3).

During flooding, water rises above meanders and cuts across point bars. Without meanders to slow the water, flood flows stress the banks well downstream of each bend (figure 4).

Various abuses can increase erosion vulnerability, making both normal and high water currents more threatening to bank stability than necessary. Any activity that increases stream velocity can increase erosion both upstream and downstream for several miles. Common abuses include improper timing or intensity of grazing, channeling, mechanical modification of the bank or its vegetation, and faulty installation of bridges, culverts, headgates, or dams.

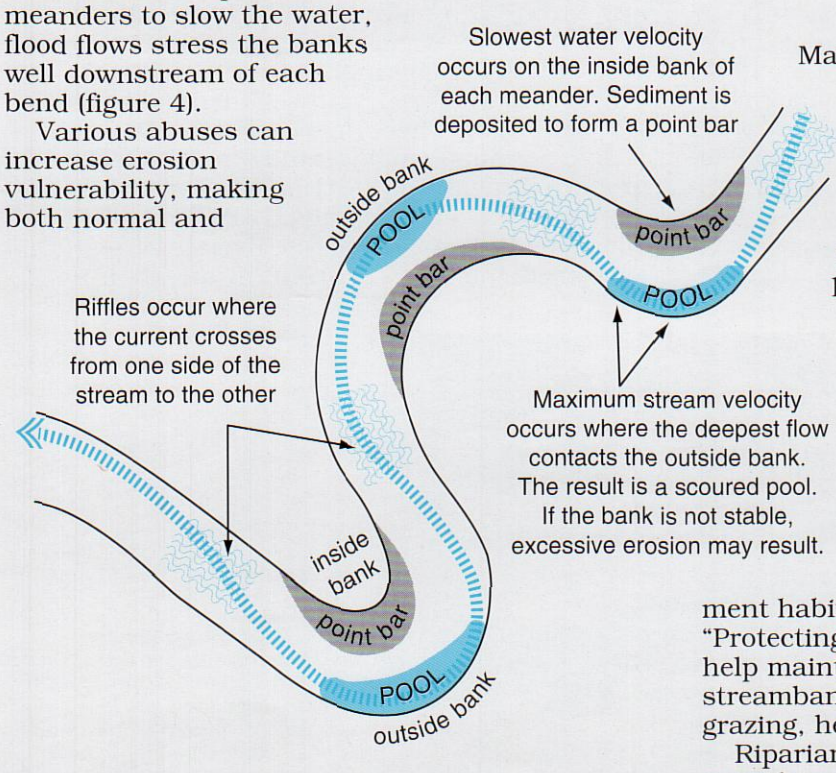


Figure 3. The deepest, fastest current alternately switches from one side of a stream to the other, scouring a pool on the outside of each turn, and depositing sediment on the inside of each turn. The greatest erosion potential is along the downstream portion of each outside bank.

Continued abuse or mismanagement can result in continued degradation, despite ongoing efforts to repair previous damage. Before spending time and money to repair a damaged streambank, check for potential problems and correct them if necessary. Preventing problems through proper management is cheaper and preferable to repairing damage cause by mismanagement.

Streambank Vegetation

Maintaining well-developed streambank (or "riparian") vegetation is perhaps the best way to protect a stream from excessive erosion. Plants slow and filter runoff from the upland areas, and their roots hold bank soil and cobbles in place. Plants shade the water, and improve habitat for fish and invertebrates. Maintaining vegetation is usually the cheapest and least labor-intensive way to provide long-term bank stability. Planting seeds or cuttings can help re-establish riparian vegetation where it has been previously eliminated. For more information regarding re-establishment of riparian vegetation, refer to Wyoming Game and Fish Department habitat extension bulletin number 9, "Protecting Streamside Wildlife Habitats." To help maintain this important vegetation, the streambank should be protected from excessive grazing, herbicides, and fire.

Riparian vegetation zones should be at least as wide as the stream itself. On small streams, the band of vegetation should be at least 15 feet wide on each bank. Damaged streambanks, however, have a reduced capacity to support the diverse mixture of herbs, shrubs, and trees capable of growing along most streams. In such cases, repair of the bank may be necessary to re-establish the vegetation.

Doing it Right

Stream channel modification using bulldozers or other heavy machinery to control erosion often results in accelerated damage. Particular

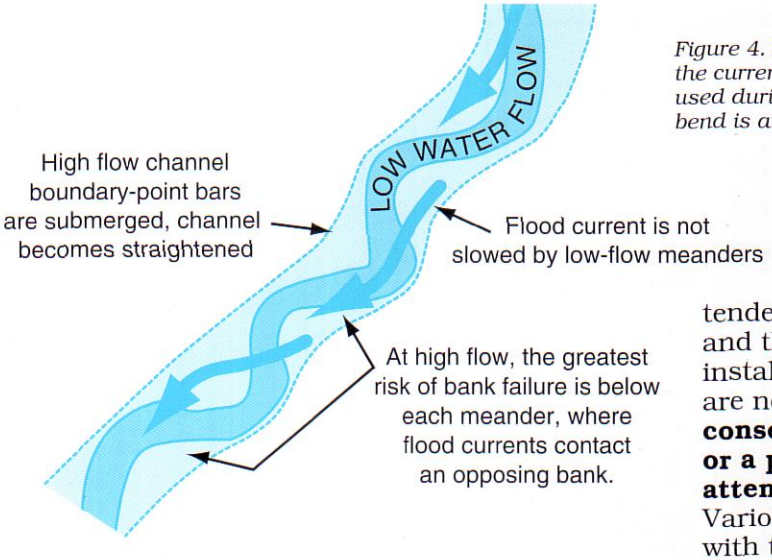


Figure 4. During high water, point bars are submerged and the current is not slowed by the normal meandering channel used during low water flow. The bank below each outside bend is at greatest risk of failure.

tended to illustrate various instream structures and their functions, and are not intended as an installation guide. Many details for installation are not included. **Please seek assistance from conservation or land management agencies or a private engineering consultant before attempting to install any of these structures.** Various agencies and companies can also help with the permitting process. Other booklets are also available. Sources of help are listed at the end of this bulletin.

care must be taken to avoid increasing stream velocity. Any project affecting water velocity is likely to affect stream velocity both upstream and downstream, sometimes for miles. This can result in extensive damage if velocity is increased by a poorly planned stream project or incorrectly installed structure.

Examples of improper methods that can increase stream velocity include channeling or straightening or shortening a stream channel, cutting of a bend in a stream, pushing river cobble up against one bank in an attempt to protect it, and mechanically sloping the bank. Unarmored dikes constructed of river cobbles rarely withstand the flows of the next spring's high water.

Proper methods of streambank protection are described below. Building these structures, however, involves placing dredged or foreign material in the stream. Federal law forbids such action unless a dredge and fill permit (404 Certification) is first obtained from the Army Corps of Engineers. A water quality permit (401 Certification) from the Wyoming Department of Environmental Quality may also be required. **Contact the Corps of Engineers before doing any work in a stream.** Addresses and phone numbers are given at the end of this bulletin.

Instream work is best done during low water periods, and not during spring or fall fish spawning. Check with a Wyoming Game and Fish Department fishery biologist for local spawning dates before beginning any instream project.

The following descriptions are in-

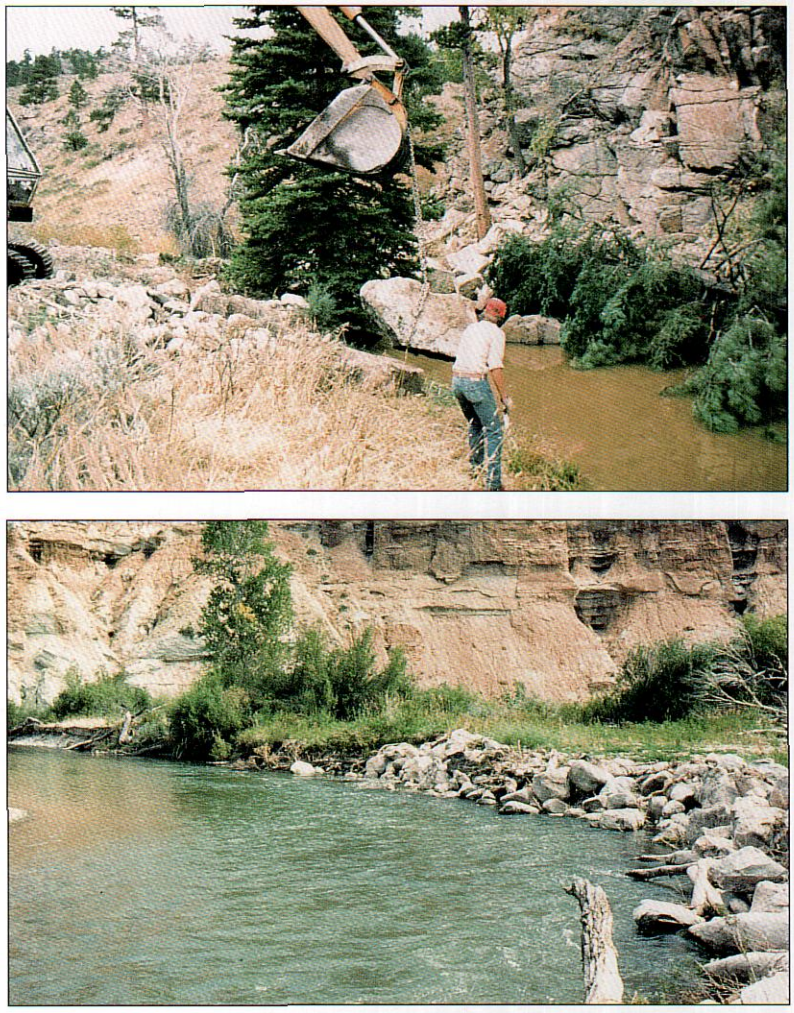


Figure 5. Streambank erosion is effectively halted when riprap is properly placed along the bank.

Rock Riprap

Often the quickest way to stabilize an eroding streambank is to armor it with a layer of large, hard rocks (figure 5). Angular chunks of granite or other hard rock are piled along the outside bends of a river or stream, where water velocity is highest and erosion vulnerability greatest.

Rocks a foot or more in diameter are the minimum size for small streams. Larger rocks are required for larger streams, to avoid washout during flood periods. The rock should be obtained from outside the stream. Rounded river rocks or flat slabs should never be used, because they are easily moved by the stream. Angular chunks of rock are more stable and offer the best protection.

To prevent the river from eroding behind the riprap, the rock must be extended both upstream and downstream from the eroding bank. Old cars, unanchored lumber or logs, and other junk are sometimes used along streams to slow erosion. Such material is inadequate, unsightly, toxic, and illegal.

Properly installed riprap protects the streambank, traps soil, promotes revegetation, and provides fish cover. It is long-lasting and often the best solution for repairing a streambank. Rock cannot replace the value of well-developed vegetation, however. Soil can be added, then planted with seeds or willow cuttings to speed revegetation. Cuttings of willow or other shrubs should be anchored among the rocks, even if soil is not added. The cuttings should be long enough to reach water or moist soil.

Tree Revetments

Eroding banks (figure 6) can also be protected by anchoring cut trees along the eroding bank. Tree revetments reduce water velocities, trap sediment, provide better fish cover than rocks alone, and encourage establishment of willows and other vegetation. Willow cuttings and grasses can be planted to speed revegetation. The area should be protected from livestock for a few years to allow the woody vegetation to become established.

Large, bushy conifers such as pine, spruce, fir, or juniper slow water flow best and last longest. Aspen and cottonwood should not be used. These species may be attacked by beavers, and they decay faster than conifers. Use of green trees minimizes branch damage during installation.

The trees are layered, shingle-like, with the treetops pointed downstream. Each tree must be solidly secured so it will not move. Anchor each tree by attaching one cable to the base of the tree and the other to the top third of the tree using cable clamps. The cables are anchored to fence posts or logs, which are then buried to make "deadmen." Large rocks should be added to help hold the trees in place and provide additional bank protection.

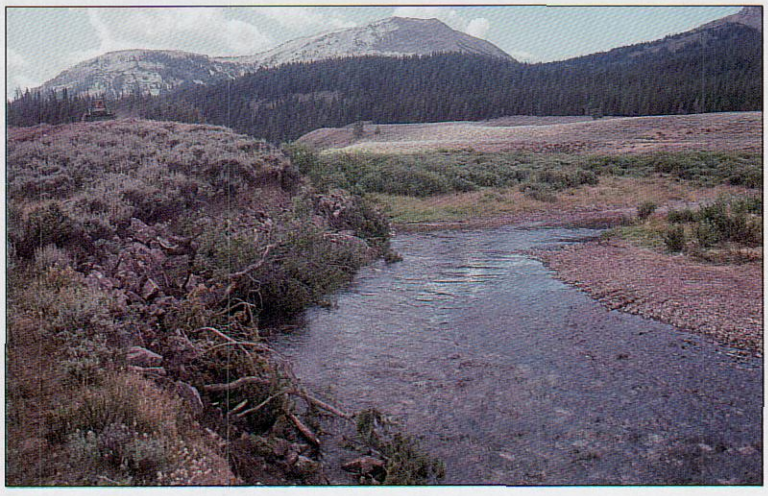


Figure 6. Tree revetments have a relatively natural look and provide shade and cover for fish as well as support for the streambank. Conifers make the best revetments.

Check Dams

Small check dams (figure 7) also known as weirs or overpours, made from logs or wooden beams will slow water velocity and raise water tables immediately upstream. Check dams can reduce bank erosion, increase plant growth, create pools for fish habitat, or eliminate a waterfall below a culvert. The current usually scours a hole below each dam, creating additional fish pools.

A check dam is a simple beam or log crossing the stream just below water level. The structure must be **firmly** anchored at least three feet into each bank, securely moored with large rocks, then back-filled to prevent scouring under the dam. The bottom of the log should be well embedded in the stream

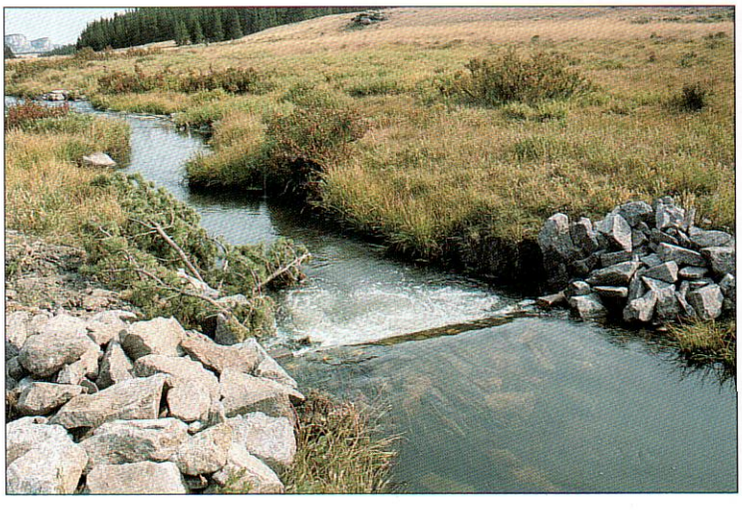


Figure 7. A check dam mimics the kind of natural obstacles that improve stream habitat. A pool forms above and below the dam, providing fish habitat and raising the water table in the valley nearby. Make sure to protect the ends of the dam with adequate riprap–high water will attack the ends first.

bottom. More than one log can be stacked to increase upstream water level, but the associated waterfall should be no greater than eight to ten inches high. A notch or opening about one-half the width of the structure and about four inches deep in the center of the top log will channel water during low flows.

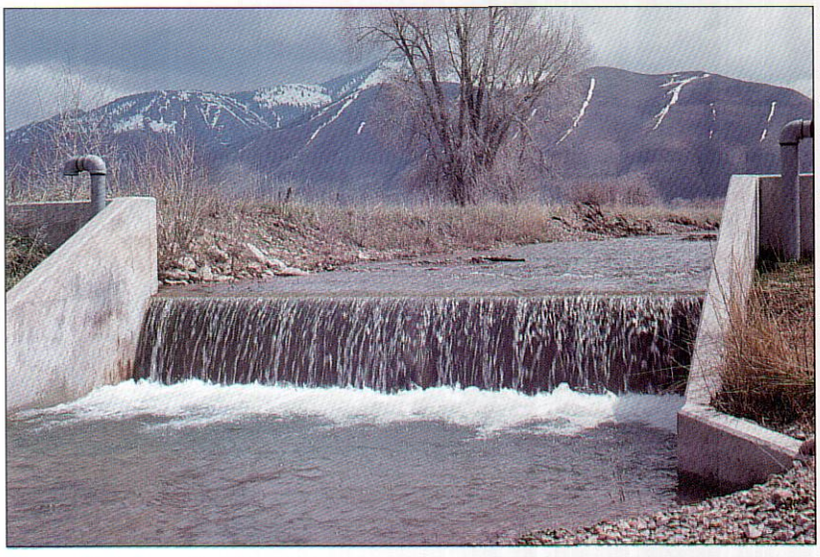
Incorrect installation can damage the streambed and result in structural failure of the dam and/or the adjacent banks. The banks above and below the check dam must be riprapped with angular chunks of rock to protect them from side-cutting and scouring, which can occur as the current seeks a path around the dam. Periodic repairs may be necessary, especially after high water.

Do not try to accomplish too much with one structure. Several smaller structures will trap more sediment and are less likely to wash out during flood flows. Check dams and other structures for improving fish habitat are described in Wyoming Game and Fish Department habitat extension bulletin number 22, "Sport Fishery Habitat Requirements."

Drop Structures

A stream flowing through cultivated cropland may become heavily laden with silt, especially if the natural bank vegetation has been reduced or eliminated. Drop structures (figure 8) effectively slow water velocity, raise water tables, and trap silt.

Several types of pre-cast or custom-poured concrete structures are available. Gabions (wire baskets filled with rock) can also be used to make drop structures, but these are often more expensive and less desirable. Drop structures should not impede the upstream movement of fish; a drop of six inches or less is usually acceptable. Correct installation requires an understanding of stream hydraulics and, heavy equipment. The Natural Resource Conservation Service (formerly Soil Conservation Service) can provide personnel and expertise on installing drop structures.



Natural Resource Conservation Service photo

Figure 8. A drop structure slows water upstream, allowing sediment to drop to the bottom. The fall over the structure helps aerate water downstream, improving conditions for trout and other fish.

Sources of Help

Wyoming Game & Fish Department: Biologists are available on a limited basis statewide to help landowners plan projects on both public and private land. The department's fishery biologists should be consulted before attempting any stream-related project. Depending on the amount of public benefit, the department may also be able to assist with money, manpower, equipment, or materials through their Habitat Extension Program. Other brochures are also available. Contact your nearest Wyoming Game and Fish Department office.

Jackson	1-800-423-4113
Laramie	1-800-843-2352
Cody	1-800-654-1178
Lander	1-800-654-7862
Sheridan	1-800-331-9834
Casper	1-800-233-8544
Green River	1-800-843-8096
Cheyenne	1-800-842-1934
Pinedale	1-800-452-9107

Natural Resource Conservation Service (formerly Soil Conservation Service) in association with local conservation districts: Technical and financial assistance, materials, and manpower may be available for projects to improve stream stability or reduce erosion. Offices are located throughout the state. Check the phone book under U.S. Government, Department of Agriculture.

Bureau of Land Management: The BLM maintains riparian demonstration areas, showing how some streams have been protected and improved. Several publications are also available. Offices are located in Cheyenne, Rawlins, Rock Springs, Worland, Casper, Cody, Lander, Pinedale, Kemmerer, Buffalo, and Newcastle. Check the phone book under U.S. Government, Department of the Interior.

Wyoming Riparian Association: This group of professional society and agency representatives, private agricultural groups, and environmental organizations offers advice and educational materials promoting the proper management and use of streamsides and lakeside areas statewide. For further information, contact the Wyoming Association of Conservation Districts at (307) 632-5716.

U. S. Army Corps of Engineers: Projects involving placement of material in a stream or other water or wetland require a permit from the Army Corps. Write to: 2232 Dell Range Boulevard, Suite 210, Cheyenne, WY 82009-4942, or phone (307) 772-2300.

Private Consultants: Several consulting firms specializing in hydrology, environmental engineering, and habitat development operate in Wyoming. These companies can assist with virtually all aspects of habitat work. Check the phone book or contact local conservation agencies for information about consultants.

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This publication is one in a series of habitat extension bulletins produced by the Wyoming Game and Fish Department. Call 1-800-842-1934 for additional information or assistance.