OHIO STREAM MANAGEMENT GUIDE

Deflectors

Guide No. 19

DESCRIPTION

Deflectors, also called hard points or wing deflectors, are spurs of rocks, logs or gabions that extend from the bank into the stream. They stabilize streambanks by directing current away from the banks, which creates slack water adjacent to the banks and dissipates the stream's energy. They also add diversity to the channel by concentrating the flow and creating deep pools. Alternating deflectors in a straight channel can encourage a meandering pattern with a narrower, deeper flow. Double deflectors, spaced opposite each other, can cause a long, deep scour hole to form downstream.

CONDITIONS WHERE PRACTICE APPLIES

Deflectors are described here for use in modified channels having uniform shape and little cover or in small streams with unstable banks. There is a much wider range of applications for deflectors but they are beyond the scope of these standards.

DESIGN CRITERIA

Materials:

Rock--The best materials for deflectors are often large rocks, preferably angular in shape to allow interlocking. The larger rocks should be arranged near the point of the deflector. Soil may be filled around the rocks and willow post may then be planted.

Logs--Logs and timber also may be used for deflectors. Because the logs, which are not continually submerged, will eventually decay, the design should incorporate live plant material to take over the deflectors' function.

Effect on Direction of Flow--All deflectors direct the flow toward the opposite bank at low-stream stages; however, during high stages, their effect may be different as shown in Figure 1. When deflectors are submerged the flow will be directed perpendicular from the downstream edge. If the downstream edge of a deflector faces the streambank, it will force the current into the bank immediately downstream and cause erosion or "back-cutting." To avoid erosion of the adjacent bank, the downstream edge of deflectors must always face directly downstream. This can be achieved with triangular or wedge-shaped deflectors. It can also be achieved with linear deflectors but only if it is angled upstream. These are sometimes called vanes and should form a 20-degree angle with the upstream bank.

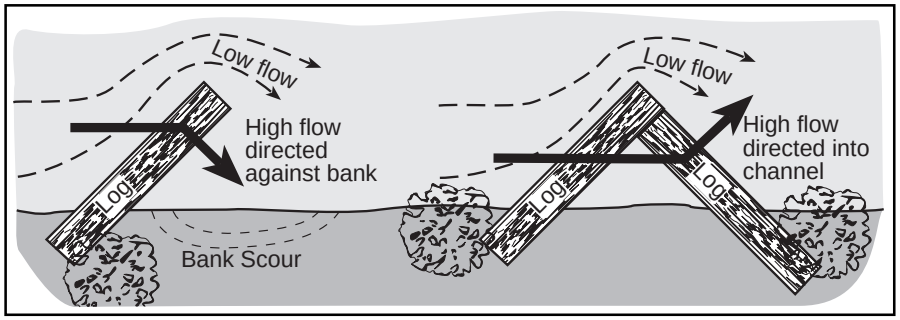


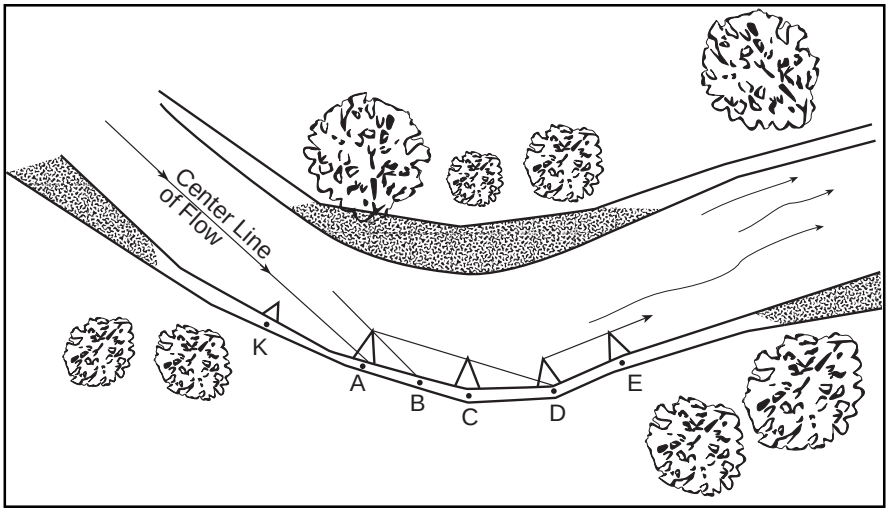
Figure 1: Deflector design to avoid directing high flow against streambank

Planting--Live plantings should be incorporated into current deflectors. Some of the best examples of current deflectors are the ones that old sycamore trees have formed naturally where the streambank has eroded slightly and the remaining lattice of roots acts as an anchor to the soil. Live plantings are not only beneficial in decreasing streambank erosion but also restore a more natural biotic habitat and moderate temperature regimes in streams.

Riprap—To prevent erosion of the streambank, riprap may be needed to protect the bank upstream and downstream from the deflector. Depending on the bank configuration, riprap should extend in each direction one to two times as far as the deflector extends into the channel .

Length--The deflectors should project into the stream channel about one-fifth to one-third the width of the channel.

Depth--To prevent undermining, the body of the deflector should be



Fgure 2. Deflector spacing on outside of bends.

embedded into stable streambed substrate. Where a lot of scour is anticipated, the deflector's tip may be supported with large footer rocks entrenched beneath and slightly downstream of the deflector.

Height--Deflectors should project above the water surface during low flows and be submerged during high flows or when flows are at bankfull. If less turbulence and bed scour are desired, the deflector may be sloped from the bankfull elevation at the bank, down to the elevation of normal low flow at the tip.

Configuration and Spacing--Depending on the purpose of the deflector, the following spacing criteria should be used:

1.Alternating--Deflectors used to create meanders or narrow the width of a low-flow channel should be placed on alternating banks a distance equal to five to seven stream widths apart or based on meander spacing of similar undisturbed portion of the stream. Alternating deflectors should not be used in unstable channels or where erosion is likely to be a problem on the opposite banks from the deflector. Keeping the deflectors low will lessen this potential.

2.Streambank Protection--Deflectors can be used to control streambank erosion on the outside bends of meanders. Note that deflectors constructed for this purpose usually require about the same amount of rock as armoring the bank with riprap. To position the deflectors, see Figure 2 and use the following procedure:

- First, identify the centerline of flow before it enters the eroding bend. Point A is located by extending the center line to intersect the eroding bank.

- Next, draw a line parallel to the center line of flow and through the tips of the deflector to be constructed at Point A. The intersection of this line with the bank is Point B. The distance from deflector A to the next deflector, C, is twice the distance from Point A to B.

- The location of deflector D is determined by drawing a line through the tips of deflectors A and C to the line's intersection with the eroding bank. Each successive deflector is located the same way.

- An additional deflector, K, should be constructed upstream from deflector A. The distance upstream should be the same as the spacing between deflectors A and C. Deflector K should be about half the length of the other deflectors.

- The entire section of bank instability should be protected by the deflectors. If erosion occurs upstream of point K, additional deflectors are needed.

3.Opposite--Deflectors can be constructed one on each bank opposite each other. The restricted flow will create a scour hole downstream and narrow the stream.

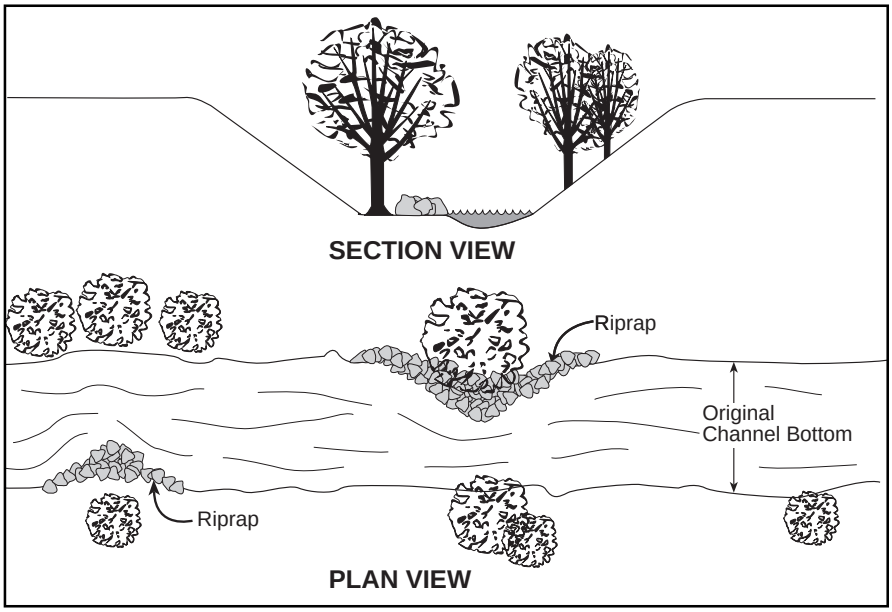


Figure 3: Alternating patterns of deflectors in straight channel

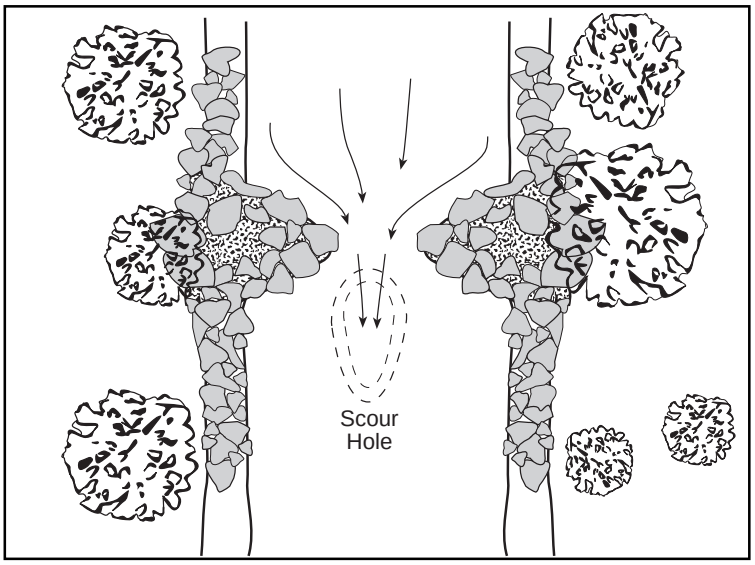


Figure 4: Opposite pattern of deflectors

SPECIFICATIONS FOR DEFLECTORS

1.Logs and timbers used in the deflector should be untreated hardwood in good condition. They should be placed in a trench cut into the channel bank so that half the log is buried and half projects into the channel. The trench shall be backfilled and compacted.

2.The height of deflectors should allow them to project above the water surface during low flows and be submerged during high flows.

3.Rock used in the deflectors should be large enough to be stable for high flows. The largest rocks should be arranged near the point of the deflector. Riprap used to protect the bank should be ODOT Type C rock. With a diameter of 6"-18" on average.

4.The voids in the rock and riprap shall be filled with soil and aquatic vegetation should be planted.

REFERENCES:

Firehock, K. and J. Doherty, 1995, A Citizen's Streambank Restoration Handbook, Izaak waltonLeague.

Gough, S., "Tree Revetments for Streambank Stabilization," Missouri Department of Conservation, Fisheries Division.

USDA, Natural Resource Conservation Service, 1996, "Streambank and Shoreline Protection", Engineering Field Handbook, Chapter 16.

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This Guide is one of a series of Ohio Stream Management Guides covering a variety of watershed and stream management issues and methods of addressing stream related problems. The first several guides in the series are overview guides intended to give the reader an understanding of the functions and values of streams. For more information about stream management programs, issues and methodologies, see *Guide 05 Index of Titles* or call the ODNR Division of Water at 614/265-6739. All Guides are available from the Ohio Department of Natural Resources. Single copies are available free of charge and may be reproduced. Please contact:

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