BMP: VEGETATIVE STREAM BANK STABILIZATION

Definition

The use of vegetation in stabilizing streambanks.

Purpose

To protect streambanks form the erosive forces of flowing water.

Conditions Where Practice Applies

Along banks in creeks, streams and rivers subject to erosion from excess runoff. This practice is generally applicable where bankfull flow velocity does not exceed 1.5 meters per second (5 ft./sec) and soils are erosion resistant. Above 1.5 meters per second, structural measures are generally required. This practice does not apply where tidal conditions exist.

Planning Considerations

A primary cause of stream channel erosion is the increased frequency of bank-full flows which often result from upstream development. Most natural stream channels are formed with a bank-full capacity to pass the runoff from a storm with a 11/2 to 2-year recurrence interval. However, in a typical urbanizing watershed, stream channels are subject to a 3 to 5-fold increase in the frequency of bank-full flows. As a result, stream channels that were once parabolic in shape and covered with vegetation are often transformed into wide rectangular channels with barren banks.

In recent years, a number of structural measures have evolved to strengthen and protect the banks of rivers and streams. These methods, if employed correctly, immediately insure a satisfactory protection of the banks. However, many such structures are expensive to build and to maintain and frequently cause downstream velocity problems. Without constant upkeep, they are exposed to progressive deterioration by natural agents. The materials used often prevent the re-establishment of native plants and animals, especially when the design is executed according to standard cross-sections which ignore natural variations of the stream system. Very often these structural measures destroy the appearance of the site.

In contrast, the utilization of living plants instead of or in conjunction with structures has many advantages. The degree of protection, which may be low to start with, increases as the plants grow and spread. The repair and maintenance of structures is unnecessary where self-maintaining streambank plants are established. The protection provided by natural vegetation is more reliable and effective where the cover consists of natural plant communities which are native to the site. Planting vegetation is less damaging to the environment than installing structures. Vegetation also provides habitat for fish and wildlife and is aesthetically pleasing. Plants provide erosion protection to streambanks by reducing stream velocity, binding soil in place with a root mat and covering the soil surface when high flows tend to flatten vegetation against the banks. For these reasons, vegetation should always be considered first.

One disadvantage of vegetation is that it lowers the carrying capacity of the channel, which may promote flooding. Therefore, maintenance needs and the consequences of flooding should be considered. The erosion potential for the stream needs to be evaluated to determine the' best solutions. The following items should be considered in the evaluation:

1. The frequency of bankfull flow based on anticipated watershed development.

2. The channel slope and flow velocity, by design reaches.

3. The antecedent soil conditions.

4. Present and anticipated channel roughness ("n") values.

5. The location of channel bends along with bank conditions.

6. The location of unstable areas and trouble spots. Steep channel reaches, high erosive banks and sharp bends may require structural stabilization measures such as riprap, while the remainder of the streambank may require only vegetation.

Where streambank stabilization is required and velocities appear too high for the use of vegetation, one should consider structural measures (see BMP-23, STRUCTURAL STREAMBANK STABILIZATION) or the use of permanent erosion control matting (see BMP-36, SOIL STABILIZATION MATTING). Notably, <u>any applicable approval or permits from other state or federal agencies must be obtained prior to workinq in such areas.</u>

Vegetation Zones Along Watercourses-

At the edge of all natural watercourses, plant communities exist in a characteristic succession of vegetative zones, the boundaries of which are dependent upon site conditions such as the steepness and shape of the bank and the seasonal and local variations in water depth and flow rate. Streambanks commonly exhibit the following zonation:

1. Aquatic Plant Zone - This zone is normally permanently submerged. In Mid-Atlantic states, this zone is inhabited by plants such as pondweeds and water lilies, which reduce the water's flow rate by friction. The roots of these plants help to bind the soil, and they further protect the channel from erosion because the water flow tends to flatten them against the banks and bed of the stream.

2. Reed-Bank Zone - The lower part of this zone is normally submerged for only about half the year. In Mid-Atlantic states, this zone is inhabited by rushes, reed grasses, cattails, and other plants which bind the soil with their roots, rhizomes and shoots and slow the water's flow rate by friction.

3. Shrub Zone - This zone is flooded only during periods of average high water. In Mid-Atlantic states, the shrub zone is inhabited by trees and shrubs--such as willow, alder, dogwood and viburnum--with a high regenerative capacity. These plants hold the soil with their root systems and slow water speed by friction. They also protect tree trunks from damage caused by breaking ice and help to prevent the formation of strong eddies around large trees during flood flows. Shrub zone vegetation is particularly beneficial along the impact bank of a stream meander, where maximum scouring tends to occur. Infringement of shrub vegetation into the channel tends to reduce the channel width, increasing probability of floods. However, brief flooding of riverside woods and undeveloped bottomlands does no significant damage, and the silt deposits in these wooded areas are less of a problem than failed banks.

4. Tree Zone - This zone is flooded only during periods of very high water (i.e., the 2 year bank-full flow or greater flows). Typical plants in the Mid-Atlantic states are trees in the ashelm, alder-ash, and oak-hornbeam associations. These trees hold soil in place with their root systems.

Design Criteria

Table 22-1 provides general guidelines for maximum allowable velocities in streams to be protected by vegetation.

1. Ensure that channel bottoms are stable before stabilizing channel banks.

2. Keep velocities at bankfull flow non-erosive for the site conditions.

3. Provide mechanical protection such as rip-rap on the outside of channel bends if bankfull stream velocities approach the maximum allowable for site conditions.

4. Be sure that requirements of other state or federal agencies are met in the design in the case that other approvals or permits are necessary.

TABLE 22-1
CONDITIONS WHERE VEGETATIVE
STREAMBANK STABILIZATION IS ACCEPTABLE

Frequency of Bankfull Flow	Max. Allowable Velocity in meters per second (m/sec) for Highly Erodible Soil	Max. allowable Velocity in meters per second (m/sec) for Erosion Resistant Soil
> 4 times/yr.	1.2 m/sec (4 ft/sec)	1.5 m/sec (5 ft/sec)
1 to 4 times/yr.	1.5 m/sec (5 ft/sec)	1.8 m/sec (6 ft/sec)
< 1 time/yr.	1.8 m/sec (6 ft/sec)	1.8 m/sec (6 ft/sec)

Planting Guidelines

Guidelines will be presented only for the reed-bank and shrub zones. The aquatic plant zone is difficult to implant and establish naturally when reed-bank vegetation is present. There are presently many experts in this field at the federal, state, and private sector levels who can be consulted concerning successful establishment of plants in the aquatic zone. The tree zone is least significant in terms of protecting banks from more frequent erosion-force flows, since this zone is seldom flooded. Also, shade from trees in this zone can prevent adequate establishment of vegetation in other zones.