

TECHNICAL NOTE

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Vertical Bundles: a streambank bioengineering treatment to establish willows and dogwoods on streambanks

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Establishing woody riparian species on a streambank is an important way to reduce bank erosion, improve water quality, increase fish and wildlife habitat, improve aesthetics, enhance the riparian buffer, and increase the strength and structure of the soil. In some cases, especially where the soil is gravelly and cobbly, it can be difficult to dig a hole in the streambank to plant unrooted cuttings, which is the most common way to establish riparian woody species (Hoag, 2007). Several methods are used to establish riparian woody species when the soil is too coarse to easily dig a hole. These include vertical bundles, fascines, single cuttings and cluster plantings. This Technical Note describes how to build and install a vertical bundle.

Background

Vertical bundles are long unrooted cuttings bound together and placed vertically in a shallow trench up the streambank with the base of the cutting in the water and the tops sticking above the top of the bank. The bundles are staked into the bank so they won't float or wash away during high flows. The bundles are then covered with soil and the soil is washed in around the cuttings to ensure good soil to stem contact. The parts of the stems that are in contact with the soil will grow roots and the parts that are exposed to the air and sunlight will sprout leaves and stems.

Vertical bundles differ from a fascine in that fascines are staked and established horizontally at the streambank toe rather than vertically up the streambank. Fascines are used extensively in high precipitation areas, but are difficult to establish in western streams, due to fluctuating water levels and prolonged dry seasons. In many cases, if the fascine is established at the toe of the streambank, it is possible to either drown the cuttings early in the growing season or kill them through drought later in the season. Vertical bundles are designed to lay vertically up the bank which typically gives them an advantage on stream systems that have rapidly fluctuating water levels because no matter where the water level of the stream is, some part of the vertical bundle will be in the water.

Another technique is to lay single cuttings vertically up the bank. Single cuttings use the same principle as the vertical bundles, but cannot be staked effectively, so there is no way to hold them on the bank when there are high velocity flows or a high water event. This limits the treatment to slow velocity areas where stream currents are gentle or around large structures and behind rock work where the stream flows do not hit them directly. Use caution when planting single cuttings on an exposed streambank, as they often have low establishment rates.

Vertical bundles are extremely effective for establishing riparian woody species on a streambank especially when the soils are very coarse and difficult to dig. Vertical bundles can be used in many different applications especially around structures. The key to making this treatment work is to: 1) have good quality unrooted cuttings of riparian species that can adventitiously root from hardwood cuttings (USDA NRCS Chapter 16) and 2) provide good soil to stem contact to ensure extensive rooting.

Description

A vertical bundle is composed of live unrooted cuttings bound together into a long cigar or sausage-shaped bundle that is tied tightly at uniform distances along the entire length of the bundle. The bundles are placed in trenches that are perpendicular to the water surface and secured to the bank with stakes. The technique provides immediate streambank protection through increased roughness. The live cuttings will eventually root and provide permanent soil reinforcement.



Building a Vertical Bundle

Bundle diameter may vary between 3- 18 inches and should average about 3- 5 stems. The exact diameter of the bundle is related to the project objectives; however, cuttings inside the bundle that do not have good soil to stem contact will not sprout. In early planting projects, enough cuttings were used in the bundle to make the diameter about 8- 10 inches. However, it was determined that the cuttings inside the bundle were not getting good soil to stem contact and were not sprouting. Our field experience indicates that the diameter of most vertical bundles should be about 3- 6 inches, or an average of 3- 5 stems to ensure good soil stem contact.

Harvest willow or dogwood cuttings from healthy vigorous plants during the dormant season, defined as the period between leaf fall to bud swell. Soak the cuttings for 10- 14 days (see Interagency Riparian/Wetland Information Series 24, *Effects of pre-plant soaking treatments on hardwood cuttings of peachleaf willow*). Take 3- 5 dormant unrooted cuttings and place them with all the butts down and all the tops up. Make sure the butts are even on the ground to ensure that no butts will be out of water when you place them in the bottom of the trench. Try to build uniform bundles of the required length. Tie bundles with pre-stretched cotton string, sisal rope, cord or non-galvanized tie wire (do not use jute or plastic twine) at 1- 2 feet above the ground and about 2/3 the height of the bank. If the streambank is taller, stake at uniform intervals to ensure they are held tightly to the slope.



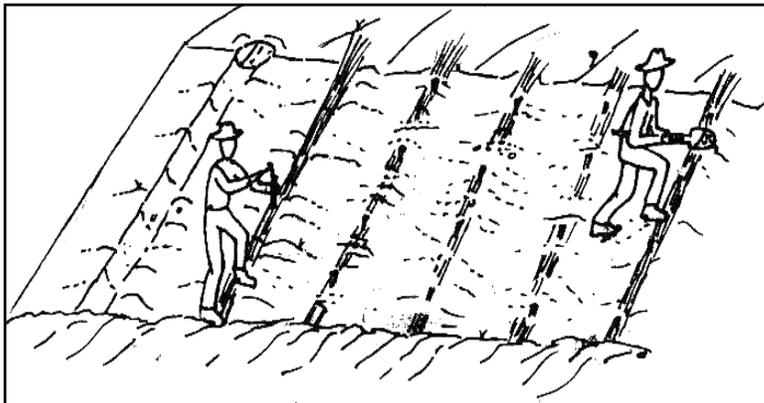
Place 3-5 cuttings together with all the butts even on the ground



Tie the bundles together with double wraps of cotton string or sisal rope

Installation

- Remove loose, failed or failing soil from face of the slope.
- Excavate a vertical trench into a slope that is 2H:1V (2 ft horizontally for each 1 vertical foot, or flatter) and perpendicular to the flow of water. The bottom of the trench must be under water during low flows for a successful installation. The trenches should be on 3- 5 feet centers and wide enough to accommodate 2/3 of the bundle diameter.
- Determine the required length of the bundle. Measure the length of the trench and add about 12- 16 inches so that the growing end of the bundle extends above the crest of the slope and the bottom of the bundle is about 6- 8 inches into the bed of the stream to ensure it is always in water.
- Place bundle in trench and stake (use wedge shaped dead stout stakes, see below) through the bundle at approximately 1/3 and 2/3 the height of the bank. Allow stake to protrude approximately 6 inches or more above top of bundle.
- A dead stout stake is a diagonally cut, kiln dried 2x4. The length depends on the soil texture. Use 3 feet long stakes in fine textured soils. Use 4 feet long stakes in sandy soils because the stake needs to go deeper to hold in sand. In rocky soils, metal stakes, rebar, or t-posts may be necessary.



Dead Stout Stake: Cut 2x4 to create wedge stake



Dig trench vertically up the bank at about 2/3 the diameter of the bundle. Dig about 6-8 inches into the bed to ensure year long water.



Place the bundle in the trench. Ensure the top of the bundle is above the top of the bank and the bottom of the bundle is in year long water.

- Cover the bundle with soil and then water the backfilled trench to wash fine soils in and around the bundled poles to assure good soil to stem contact and to reduce sub-soil air pockets around the bundles. Some of the stems should remain exposed to sunlight to promote sprouting. The covered parts of the stem will promote rooting into the bank.
- A modification of this treatment is to use rock riprap or toe rock over the bundles. The bundles are installed as described above and then rock is placed over the top of them, always ensuring good soil-stem contact.



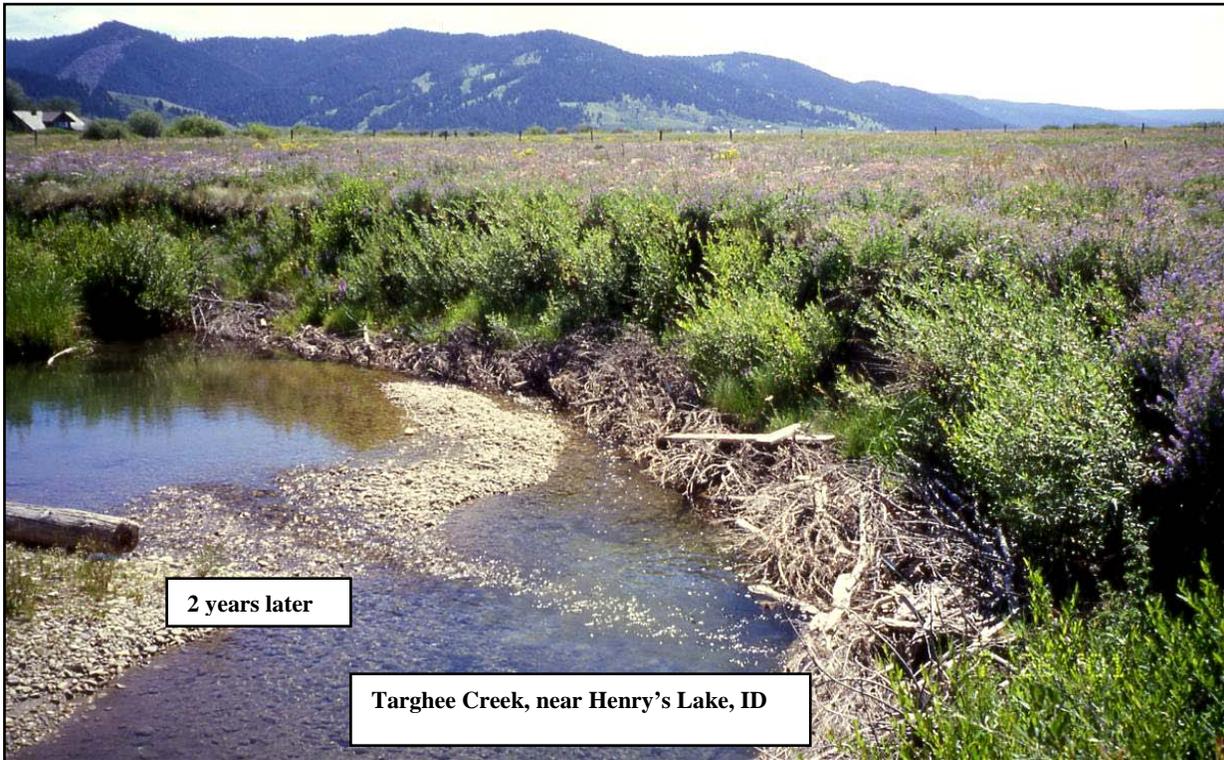
Stake in the middle of the bundle at about 1/3 and 2/3 the slope height.



Cover with soil and wash in with water to ensure good soils to stem contact.

Final Installation

Once the vertical bundles are installed on the streambank and the soil is washed into the bundle, the bottoms of the bundles need to be protected from high flows. By themselves, the bundles will grow and root into the streambank. However, the entire treatment along the bank should be protected at the toe. There are a variety of treatments that can be used to accomplish this end, including fascines, brush revetment (Hoag and Fripp 2002), and toe rock. Project objectives, stream size, slope, and geomorphic context of the vertical bundle placement will be helpful in determining the type of toe slope treatments used to secure the vertical bundles. This final treatment will protect the planting as the willows or dogwoods grow and become established.



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