

BIOENGINEERINGS MATERIALS



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SOIL BIOENGINEERING

Soil bioengineering is the term for using plant material to arrest and prevent slope and streambank failure and erosion. The roots and stems serve as structural and mechanical elements in a slope protection system. Live cuttings and rooted plants are embedded in the ground in various arrays to serve as soil reinforcements, hydraulic drains, and barriers to earth movement. Once established, this living material effectively controls several stabilization and erosion control problems by binding the soil with its root system and creating a natural vegetative cover. Bioengineered sites are self-repairing and have the advantage of blending with natural surroundings.



Live stakes installed and sprouting new growth.

BIOENGINEERING MATERIALS & STREAM RESTORATION TECHNIQUES

Ernst Seeds is an experienced producer of common and specialized live soil bioengineering materials. We understand the unique needs of bioengineering site construction. Our material is grown, processed, and delivered to minimize on-site installation labor and maximize survival and quick establishment.

HELPFUL TIPS FOR A BIOENGINEERING PROJECT

Ernst Conservation Seeds' bioengineering products are dormant live material. Therefore, if installation cannot take place immediately upon arrival at the site, these products must be stored properly. Place in a cool, wet place out of direct sunlight, such as under straw or burlap. Open any pallets, boxes, and plastic bags so the

material can be watered thoroughly. Do not allow the material to dry out. Soaking before planting significantly increases survival and growth rate.

For best survivability, the material should be planted during the dormant season, November 1st-April 30th. We do not guarantee any of our bioengineering material from May 1st-October 31st.

Overseeding and mulching a completed bioengineered project with the appropriate seed mixes protects the soil surface from erosion while adding biodiversity to the site.

EXCELLENT MIXES FOR THIS PURPOSE

| | |
|------------------|---|
| ERNMX-137 | Specialized Wetland Mix for Shaded OBL-FACW Areas |
| ERNMX-138 | Wildlife Food & Shelter Mix |
| ERNMX-178 | Riparian Buffer Mix |



PLACING AN ORDER

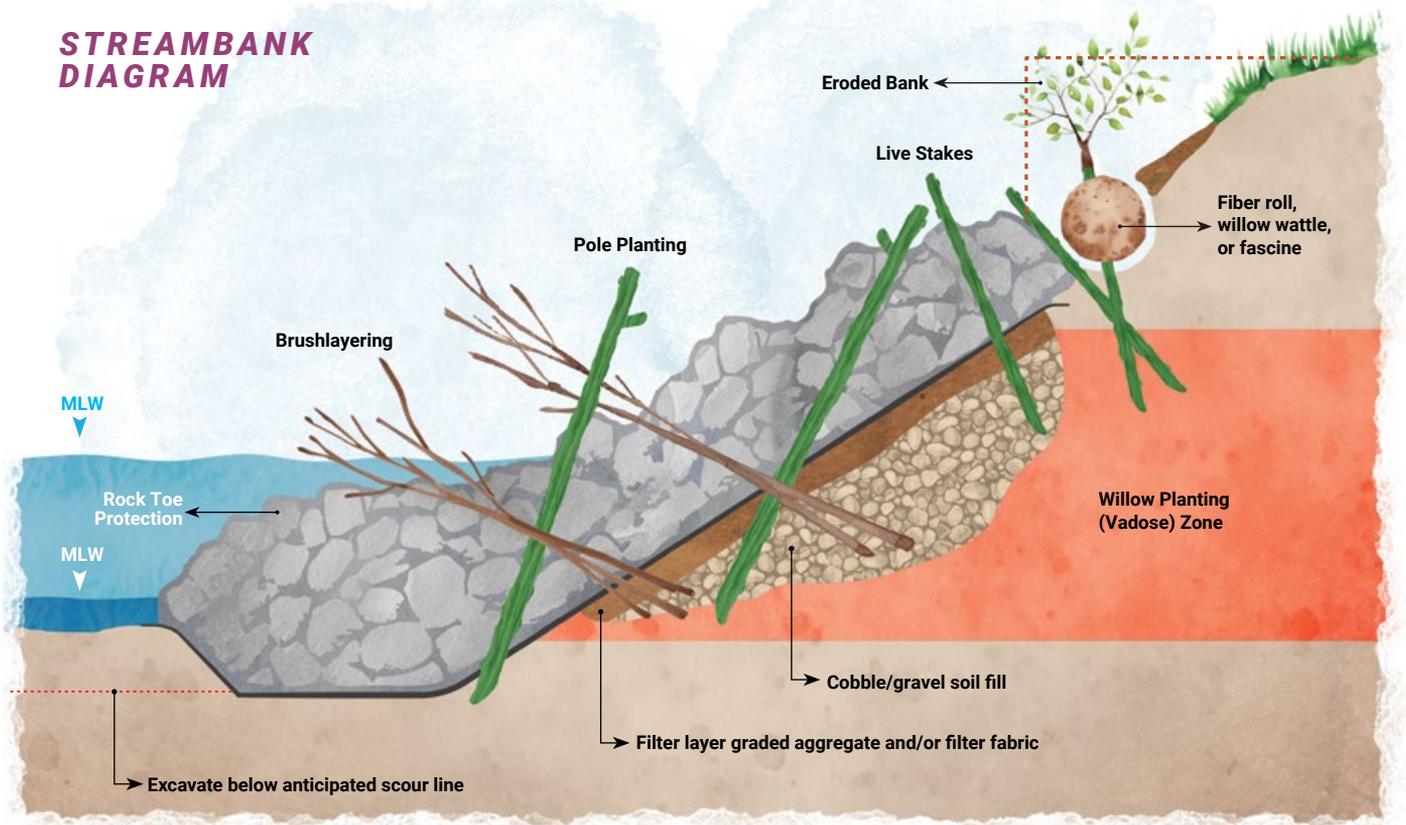
Please call for a quote as each bioengineering job and material selection is unique to a project.



TURNAROUND TIME

Since we custom cut your order, we require at least two-weeks' notice when bioengineering orders are placed.

STREAMBANK DIAGRAM



WE PRODUCE BIOENGINEERING MATERIALS IN THESE FAST-ROOTING SPECIES:

| BOTANICAL NAME | COMMON NAME | PLANT TYPE |
|-----------------------------------|-----------------------|-------------------|
| <i>Cephalanthus occidentalis</i> | Buttonbush | Native Shrub |
| <i>Cornus amomum</i> | Silky Dogwood | Native Shrub |
| <i>Cornus sericea</i> | Red Osier Dogwood | Native Shrub |
| <i>Platanus occidentalis</i> | American Sycamore | Native Tree |
| <i>Salix amygdaloides</i> | Peachleaf Willow | Native Tree |
| <i>Salix discolor</i> | Pussy Willow | Native Tree |
| <i>Salix exigua ssp. interior</i> | Sandbar Willow | Native Shrub |
| <i>Salix lucida</i> | Shining Willow | Native Shrub |
| <i>Salix nigra</i> | Black Willow | Native Tree |
| <i>Salix purpurea</i> | Streamco Willow | Naturalized Shrub |
| <i>Salix sericea</i> | Silky Willow | Native Shrub |
| <i>Salix x cottetii</i> | Bankers' Dwarf Willow | Naturalized Shrub |
| <i>Sambucus canadensis</i> | Elderberry | Native Shrub |
| <i>Viburnum dentatum</i> | Arrowwood | Native Shrub |
| <i>Viburnum lentago</i> | Nannyberry | Native Shrub |

For more information on the species listed above, refer to *Partially Shaded Sites*, p. 46.

Live Stake and Branch Layering Cross-Sections courtesy of United States Department of Agriculture, Natural Resources Conservation Service (NRCS), *Engineering Field Handbook*, December 1996, Chapter 16, "Streambank and Shoreline Protection", pp. 16-13 and 16-20.

Special thanks to John McCullah, Salix Applied Earthcare, for allowing us to use the information in his Bio-Draw software. More information is available at www.biodraw.com.

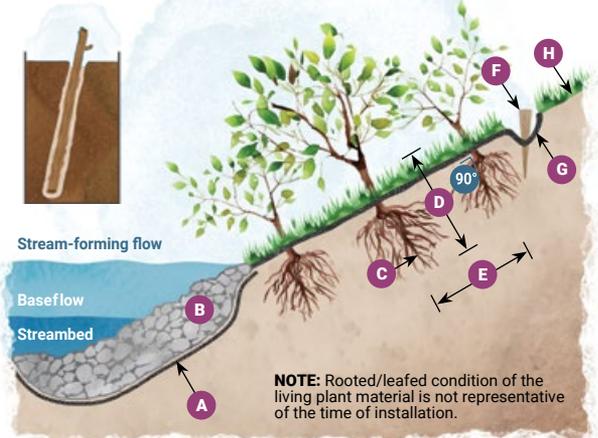
LIVE STAKES

Stakes are dormant, live woody cuttings of a species with the branches trimmed off. Live staking performs an important function in creating a root mat that stabilizes the soil by reinforcing and binding soil particles together. Stake establishment also improves aesthetics and provides a habitat for wildlife. Live stakes may be used on their own to secure other bioengineering materials or as an anchor for erosion control and geo-fabric. Stakes or poles may also be inserted or driven through openings in rock structures, such as gabions, riprap, and other retaining structures.

INSTALLATION NOTES: Install stakes during their dormancy (late fall to early spring). Do not allow the material to dry out. Soaking before planting significantly increases survival and growth rate. Drive a pilot hole into firm soil and plant at right angles (buds oriented up) with at least two-thirds of its length underground. Plant stakes randomly or 3'-6' apart on triangular spacing. Tamp the soil down around the cuttings before watering. Irrigation may be necessary if a long dry spell or hot weather is expected following installation.

SIZES: 1/4"-1" diameter; 2'-4' lengths.

- CROSS-SECTION DIAGRAM**
(not to scale)
- A. Geotextile fabric
 - B. Toe protection
 - C. Live cutting 1/2" to 1 1/2" dia.
 - D. 2' to 3'
 - E. 2' to 3' (triangular spacing)
 - F. Dead stout stake
 - G. Erosion control fabric
 - H. Stream bank

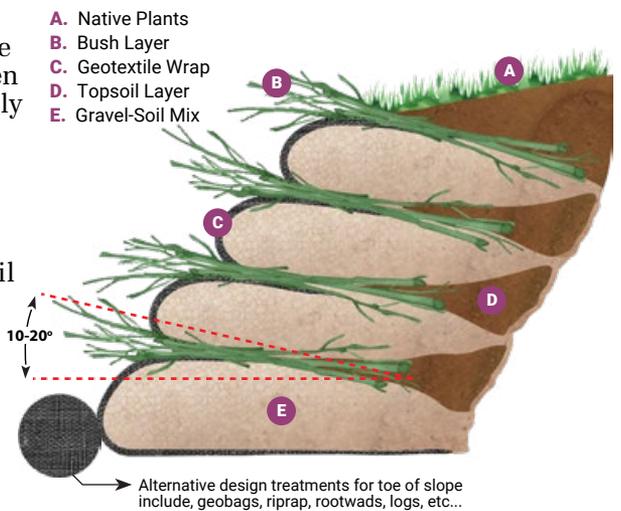


BRUSH (BRANCH) LAYERS

Brush (branch) layers are living branches placed on a terrace along the contours of a streambank and interspersed between layers of soil. This technique is used to repair a slump or gully and is most effective for revegetating scour holes.

INSTALLATION NOTES: Brush (branch) layers are placed on terraced benches with two-thirds of the basal material tilted into the slope and covered with soil. Branches should protrude beyond the face of the terrace. Before installing, soil terraces can be additionally protected by putting down geotextile. Starting at the bottom of the slope, secondary brush (branch) layers may be added every 3'-4' proceeding up the slope. Straw mulching the finished surface is recommended for moisture retention and additional erosion control. Planting should be during the dormant season.

SIZES: 3 linear ft per bundle, 3'-6' lengths, 28-36 branches per bundle.

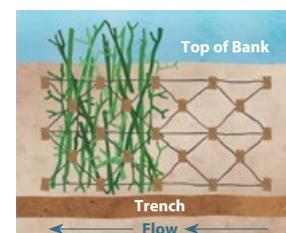


BRUSH MATTRESSES

Brush mattresses are living branches layered 1-2 branches thick in a crisscross pattern on a streambank to form a living ground cover. The mattress formed protects the bank surface until the branches root and native vegetation is established. This living system normally roots in the entire bank face, encouraging natural infiltration and immediately acting as a sediment trap.

INSTALLATION NOTES: Place material with the basal ends located toward the bottom of the slope. Using 3' square spacing, drive dead wedge stakes into the plant material. Stretch wire or biodegradable twine or rope diagonally around the dead stakes and finish driving the stakes in to tighten the wire, twine, or rope and secure the mattress. Place a thin layer of soil over the entire area to encourage rooting. Irrigation is necessary immediately following installation.

SIZES: 1/4"-3" diameter x random length x 1-2 or 3-4 branches thick.





A 5' Wattle, ready to ship.

WATTLES/FASCINES

Wattles or fascines are living branches bound together in long tubular bundles. When placed in shallow trenches across the slope of a bank, these structures provide protection from erosion and create a sediment trap that provides immediate bank support even prior to root growth. Once established, this live rooting material grows into a living fence-like erosion barrier. Within one growing season, roots and shoots grow along the entire length of the structure and quickly stabilize the bank.

INSTALLATION NOTES: This technique is simple, effective, and installed with little site disturbance. Material is placed in 6" wide trenches on banks or slopes parallel to the stream contour and partially covered with soil. Wedge-like dead stakes secure them in place at 2'-3' intervals. Live stakes may also be used in conjunction with dead stakes to secure the material. Straw mulching the site following installation retains moisture and reduces surface erosion. Irrigation is necessary after installation if the soil is dry.

SIZES: 5' or 6' lengths are recommended for ease of handling; available in the following diameters: 4"-5", 6"-8", 9"-12" (custom lengths and diameters are available).



Dead Wedge Stakes

DEAD WEDGE STAKES

Dead wedge stakes are pieces of hardwood cut into long wedges to secure wattles, brush mattresses, and other applications of soil bioengineering and erosion control measures.

SIZES: 1-1/4" x 3-1/4" x 2-1/2' long.

LIVE WHIPS

Whips are slender, live woody shrub material well-suited for very moist areas of stream edges, commonly used in conjunction with gabion structures, riprap, and geo-fabric.

INSTALLATION NOTES: Push whips into the ground as far as they will go without breaking. At least two-thirds of the whip should be covered with soil. Whips may be installed either by laying them on an angle or planting them erect in the soil. When using whips with hard structures, be sure they are long enough to reach into the soil and moisture behind or below the structure. (Example: If installing whips through riprap, consider the 3' depth; therefore, install a 6' whip at least 2' into the moist soil behind the stone and 1' above the surface of the riprap).

SIZES: 3/8"-1" diameter; 4'-6' lengths.