

# **B** Appendix B - Compensation Specifications

## APPENDIX B: COMPENSATION SPECIFICATIONS

### LIVE STAKING

#### *Construction Specifications:*

##### Harvesting:

- Stakes shall be harvested and planted when the willows, or other chosen species, are dormant. This period is generally from late fall to early spring, or before the buds start to break.
- When harvesting cuttings, select healthy, live wood that is reasonably straight.
- Use live wood at least 1 year old or older. Avoid suckers of current years growth as they lack sufficient stored energy reserves to sprout consistently. The best wood is 2-5 years old with smooth bark that is not deeply furrowed.
- Make clean cuts with unsplit ends. Trim branches from cutting as close as possible. The butt end of the cutting shall be pointed or angled and the top end shall be cut square.
- Identification of the top and bottom of cutting as accomplished by angle cutting the butt end. The top, square cut, can be painted and sealed by dipping the top 1-2 inches (25-51 mm) into a 50-50 mix of light colored latex paint and water. Sealing the top of stake will reduce the possibility of desiccation and disease caused mortality, assure the stakes are planted with the top up, and makes the stakes more visible for subsequent planting evaluations.

##### Diameter:

- Cuttings should generally be 3/4 inch (19 mm) or larger depending on the species. Highest survival rates are obtained from using cuttings 2-3 inches (51-76 mm) in diameter. Larger diameter cuttings are needed for planting into rock riprap.

##### Length:

- Cuttings of small diameter (up to 1 1/2 inches (38 mm)) shall be 18 inches (0.5 m) long minimum. Thicker cuttings should be longer.
- Cuttings should be long enough to reach into the mid-summer water table, if possible.
- No less than 1/2 total length must be into the ground.
- Stakes should be cut so that a terminal bud scar is within 1-4 inches (25-101 mm) of the top. At least 2 buds and/or bud scars shall be above the ground after planting.

##### **Installation:**

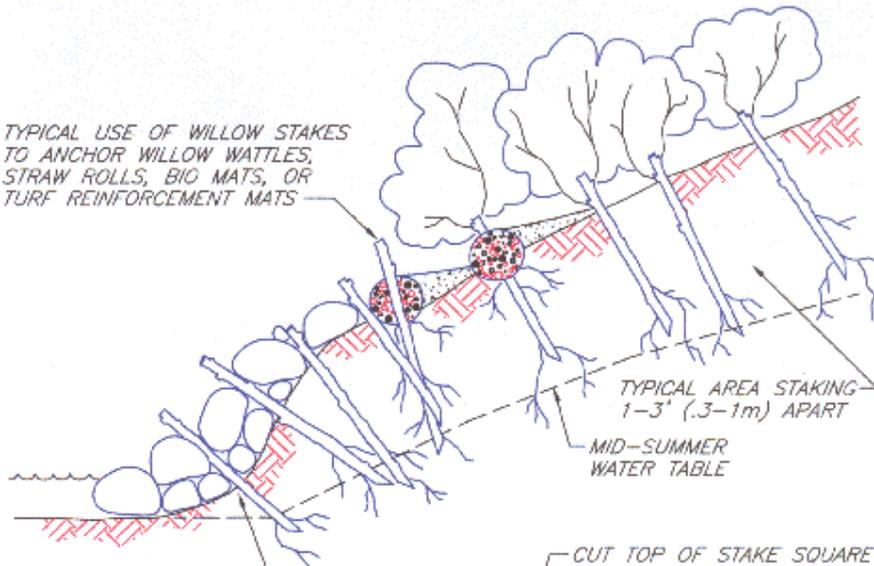
- Stakes must be planted with butt-ends into the ground. Leaf bud scars or emerging buds should always point up.

- Stakes must not be allowed to dry out. All cuttings should be soaked in water for a minimum of 24 hours. Soaking significantly increases the survival rate of the cuttings, however they may be planted the same day they are harvested.
- Plant stakes 1-3 feet (0.3-1 m) apart.
- Set the stake as deep as possible into the soil, preferably with 80 percent of its length into the soil and in contact with mid-summer water table.
- It is essential to have good contact between the stake and soil for roots to sprout. Tamp the soil around the cutting.
- Use a iron stake or bar to make a pilot hole in firm soil.
- Do not damage the buds, strip the bark or split the stake during installation.
- Split or damaged stakes shall be removed and replaced.

***Inspection and Maintenance:***

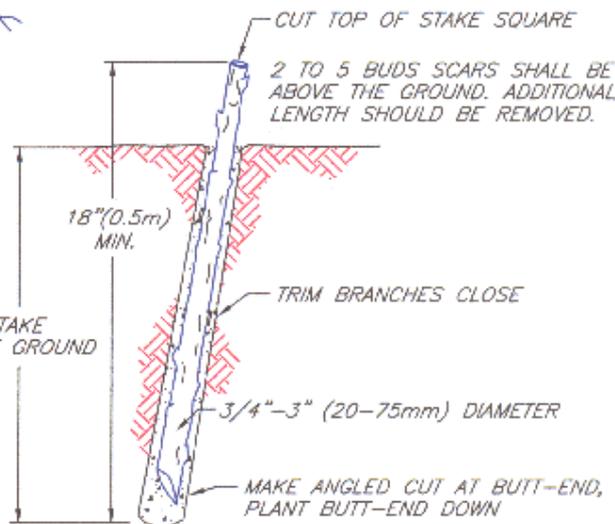
- All temporary and permanent erosion and sediment control practices shall be maintained and repaired as needed to assure continued performance of their intended function.
- Streambanks and steep slopes are highly susceptible to erosion and damage from significant storm events. Willow stakes alone provide very little initial site protection during the establishment period.
- Periodic inspection repair and maintenance will be required during the first two years or until the vegetation is established.
- All temporary or permanent erosion control practices shall be maintained and repaired as needed to assure continued performance of their intended function.

TYPICAL USE OF WILLOW STAKES TO ANCHOR WILLOW WATTLES, STRAW ROLLS, BIO MATS, OR TURF REINFORCEMENT MATS



TYPICAL - DRIVE OR PLANT WILLOW STAKES THROUGH OPENINGS IN RIPRAP OR GABIONS

PLANT 80% OF STAKE LENGTH INTO THE GROUND



NOTES:

1. HARVEST AND PLANT STAKES DURING THE DORMANT SEASON.
2. USE HEALTHY, STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
3. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION, USE A PILOT BAR IN FIRM SOILS.
4. SOAK CUTTINGS FOR 24 HOURS (MIN.) PRIOR TO INSTALLATION.
5. TAMP THE SOIL AROUND THE STAKE.

NOT TO SCALE

LIVE STAKING

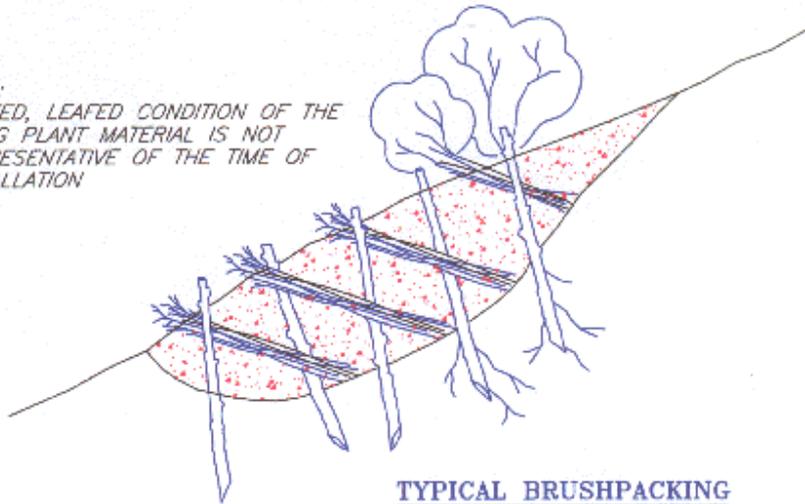
## **BRUSH LAYERING**

### ***Construction Specifications:***

- Cuttings shall be harvested and planted when the willows, or other chosen species, are dormant. This period is generally from late fall to early spring.
- Choose plant materials that are adapted to the site conditions from species that root easily.
- Branch cuttings shall be 4-8 feet (1.2-2.5 m) long, 3/4-2 inches (20-50 mm) in diameter.
- Pre-soak cuttings for a minimum of 24 hours before installing.
- The surface of the bench shall be sloped so the outside edge is higher than the inside so the butt ends angle down slightly into the slope.
- Place branch cuttings, 3-8 inches (76-203 mm) thick, in a crisscross or overlapping configuration. The growing tips shall protrude 6-12 inches (152-305 mm) from the slope face with the butt end dipping into the slope.
- Immediately cover brushlayer with 6 inches (152 mm) of fill soil and compact according to construction specifications. Water the soil cover immediately to wet the cuttings and achieve adequate compaction.
- Earth moving equipment shall not travel directly over the cuttings. Six inches (152 mm) of soil must be maintained between the brushlayer and equipment at all times.
- Fill and compact the soil placed above the brushlayer in successive lifts, maximum 6-8 inches (152-203 mm) deep.
- Install the next brushlayer 3-8 feet (1-2.5 m) above the previous row.
- Seed and mulch slope. Shallow slopes, generally 3:1 or flatter may be seeded and mulched by hand. Steeper slopes should have seed applied hydraulically and the mulch shall be anchored with tackifier or other approved methods.

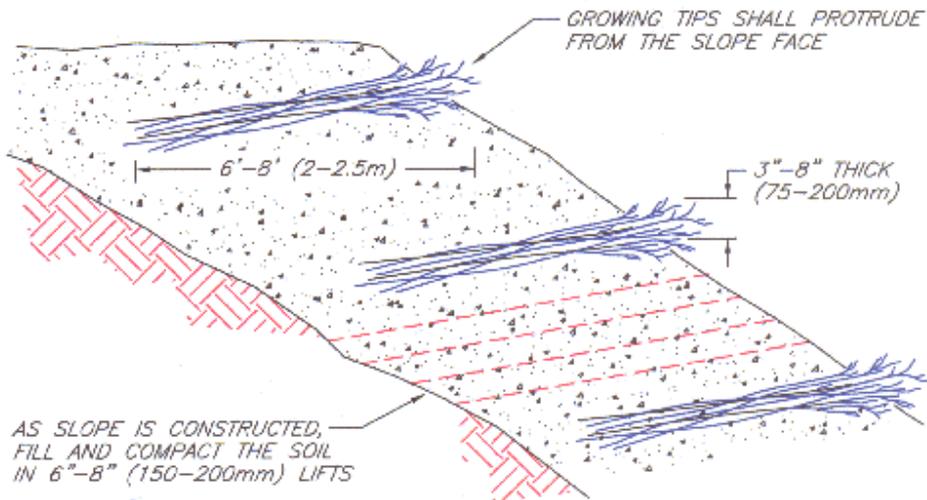
*Inspection and Maintenance:* Regular inspection and maintenance of bioengineering installations should be conducted, particularly during the first year. Prompt correction of any failures is essential to prevent major problems from developing.

NOTE:  
 ROOTED, LEAFED CONDITION OF THE  
 LIVING PLANT MATERIAL IS NOT  
 REPRESENTATIVE OF THE TIME OF  
 INSTALLATION



**TYPICAL BRUSHPACKING**

COVER BRUSHLAYER IMMEDIATELY WITH  
 6" (150mm) OF FILL SOIL, WATER AND  
 COMPACT ACCORDING TO SPECIFICATIONS



AS SLOPE IS CONSTRUCTED,  
 FILL AND COMPACT THE SOIL  
 IN 6"-8" (150-200mm) LIFTS

**TYPICAL BRUSHLAYERING  
 WITH SLOPE CONSTRUCTION**

**BRUSHLAYERING**

## **Rootwad Revetment with Vegetated Riprap**

Native material revetments are viable alternatives to riprap armoring and gabion type structures. Root wads and logs are constructed to protect the streambank from erosion, provide in-stream and overhead cover for fish. The practice discussed here combines root wads with a layer of stones and/or boulder armoring, generally referred to as riprap revetment. The root wads and riprap are placed along a streambank and will be vegetated with pole planting, brushlayering, and live staking (joint planting).

### *Conditions Where Practice Applies*

The implementations of root wad revetments are beneficial if these type of structures are naturally-occurring in adjacent stream reaches or in similar stream types. Analysis of channel morphology and stream type should be performed to determine if natural material revetments will achieve the desired results. Vegetated riprap techniques should be considered with project in streams with fishery resources. See Vegetated Riprap. The inclusion of root wads and other large woody

debris will enhance the fishery habitat. The root wads are intended to produce scour pools while the overhanging wood and vegetation will provide cover and shade.

### *Materials*

The root wad should have the bole (trunk) attached to allow anchoring into the bank. The length of the bole is dependent on site conditions, however, it should be a 2-m (6 foot) minimum. For the riprap component, the size and weight is dependant on design velocity or slope

stability analysis. A filter layer, either graded aggregate or filter fabric, placed under the riprap will prevent the washout (piping) of fines through the armor layer. Willow material for brushlayers and pole planting will be required. The length of the cuttings will depend on the depth through the riprap and filter layer to the native soil. Live cuttings can be included and should consist of relatively straight willow branches, 25-40 mm (1-1.5 inches) diameter and long enough to reach beyond the riprap and filter layer and into native ground.

### *Advantages*

By combining boulders, logs and live plant materials to armor a streambank fish habitat is enhanced, in addition to creating a natural looking stabilization structure. Root wad revetments can be used for a wide range of fishery enhancement structures for various stream types. Vegetated rootwads combined with vegetated riprap can protect the streambank, provide in-stream and overhead cover for fish, provide shade, provide detritus and terrestrial insect habitat, look natural, and provide habitat diversity.

### *Disadvantages*

The woody materials will probably not have the durability of other structural components. However, the inclusion of live woody vegetation, along with the accompanying root reinforcement, may make these structures stronger and more durable.

### *Implementation*

Use a backhoe or excavator to set a "footer" log in a trench excavated below the thalweg (lowest point in the channel), running roughly parallel with the bank. A second log with the root wad attached is set on top of the footer log diagonally, forming an "X". The root wad end is set pointing upstream into the flow and the butt end lying downstream 45-60° degrees. The butt end of the root wad should be set in a trench excavated into the bank. Large boulders and willow poles should be used to secure the root wad, especially at the apex. Placement of the willow poles into the excavations will ensure they are deeply embedded and able to contact the water table. Further incorporation of live woody cuttings (brush layering and pole planting) will enhance the structure.

**NOTES:**

1. Willow pole planting and brushlayering shall be installed during bank grading and riprap placement to ensure good contact with 'native ground' and soil fill.
2. Willow poles and brush layers shall extend down into expected soil moisture zones (vadose).
3. Cut small holes or slits in filter fabric as necessary.
4. Place soil fill (cobbles, gravel, soil) around cuttings.
5. Place riprap carefully, do not end dump. Some damage to brush layers and willow poles is unavoidable and acceptable. Deeply planted willow material will regenerate.

