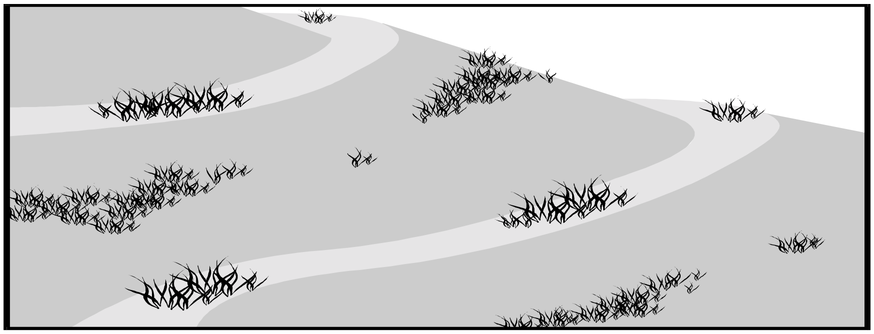
ACTIVITY: Bank Stabilization	TCP – 19



Targeted Constituents

● Significant Benefit ◗ Partial Benefit ○ Low or Unknown Benefit

● Sediment	○ Heavy Metals	○ Floatable Materials	○ Oxygen Demanding Substances	
◗ Nutrients	○ Toxic Materials	○ Oil & Grease	○ Bacteria & Viruses	○ Construction Wastes

Implementation Requirements

● High ◗ Medium ○ Low

○ Capital Costs	○ O & M Costs	○ Maintenance	○ Suitability for Slopes >5%	○ Training

Description

Prevent or reduce the discharge of sediment to the stormwater management system or to watercourses by providing slope protection and erosion reduction through the use of vegetation, regrading, and simple retaining structures. This management practice is likely to create a significant reduction in sediment and a partial reduction in nutrients by reducing velocities and erosion.

Suitable Applications

- For immediate protection of slopes against surface erosion, shallow mass wasting, cut and fill slope stabilization, and earth embankment protection (not associated with a pond, impoundment or other water detention device).

Installation/ Application Criteria

- Low retaining structures at the toe of a slope make it possible to grade the slope back to a more stable angle.

- Vegetation measures such as those mentioned in TCP-05 Temporary Seeding should be considered in combination with simple retaining structures for additional erosion control.

- Grade stabilization structures such as simple timber check dams reduce the grade above them and disperse flowing water, limiting rill and gulley erosion.

- On slopes steeper than 3:1 (H:V), stair step or groove cut grading is recommended (TCP-11 Terracing). These practices may be supported by some of the practices presented here.

Standard Earth Retaining Structures

Standard earth retaining structures may be implemented as designed by a licensed professional civil engineer and approved by the engineering department.

A properly designed retaining wall or abutment must satisfy two minimum requirements. First, to make the structure safe against failure by overturning and excessive settlement, the pressure beneath the base must not exceed the allowable soil pressure. Furthermore, the structure as a whole must have an adequate factor of safety with respect to sliding along its base or along some weak structure point below its base. The structure should be proportioned, and its overall stability checked for earth pressures unmodified by load factors. Second, the entire structure as well as each of its parts must possess adequate strength under loaded conditions.

Cribwall

These structures like standard earth retaining structures should be designed by a licensed professional civil engineer. The following briefly describes how a cribwall should be implemented. Vegetative matter can be incorporated into the cribwall creating a "live" cribwall. Depending on soils' conditions and compaction techniques necessary, "live" cribwalls have limited success. However, if the vegetative material can become established it can add to both the structural capacity/stability of the slope through extensive and intertwined root structures; and aid in improving stormwater quality through nutrient uptake.

- Starting at the lowest point of the slope, excavate loose material 2 to 3 feet (0.63 to 0.94 m) below the ground elevation until a stable foundation is reached.
- Excavate the back of the stable foundation (closest to the slope) slightly deeper than the front to add stability to the structure.
- Place the first course of reinforced concrete beams, logs or timbers, at the front and back of the excavated foundation, approximately 4 to 5 feet (1.26 to 1.57 m) apart and parallel to the slope contour.
- Place the next course of reinforced concrete beams, logs or timbers, at right angles (perpendicular to the slope) on top of the previous course to overhang the front and back of the previous course by 3 to 6 inches (7.6 to 15.2 cm).
- Each course of the cribwall is placed in the same manner and nailed or fastened to the preceding course with nails or reinforcement bars or bands.
- If a "live" cribwall is desired, then when the cribwall structure reaches the existing ground elevation, place live branch cuttings on the backfill perpendicular to the slope; then cover the cuttings with backfill and compact. Select vegetative matter that has an extensive intertwined root structure at maturity.

Rock Gabions

These structures like standard earth retaining structures should be designed by a licensed professional civil engineer. The following briefly describes how a gabion should be implemented. Vegetative matter can be incorporated into the gabion creating a "live" gabion. Depending on soils conditions and compaction techniques necessary, "live" gabions have limited success. However, if the vegetative material can become established it can add to both the structural capacity/stability of the slope through extensive and intertwined root structures; and aid in improving stormwater quality through nutrient uptake.

- Starting at the lowest point of the slope, excavate loose material 2 to 3 feet (0.63 to 0.94 m) below the ground elevation until a stable foundation is reached.
- Excavate the back of the stable foundation (closest to the slope) slightly deeper than the front to add stability to the structure. This will provide additional stability to the structure.
- Place the fabricated wire baskets in the bottom of the excavation and fill with rock (by hand).
- Place backfill between and behind the wire baskets.
- Repeat the construction sequence until the structure reaches the required height.
- Vegetation can be added to gabions generally with less success than with cribwalls.

General

- Refer to TCP-20 Rip-rap for use of rock materials for bank stabilization.
- For more permanent stabilization options, refer to the Soil Bioengineering BMP.

Maintenance

- Inspect structures and slopes prior to and after major rainfall events. Make repairs where necessary, consulting/notifying the design engineer.

Limitations

- Stabilization measures can be costly in terms of labor required.

Primary References

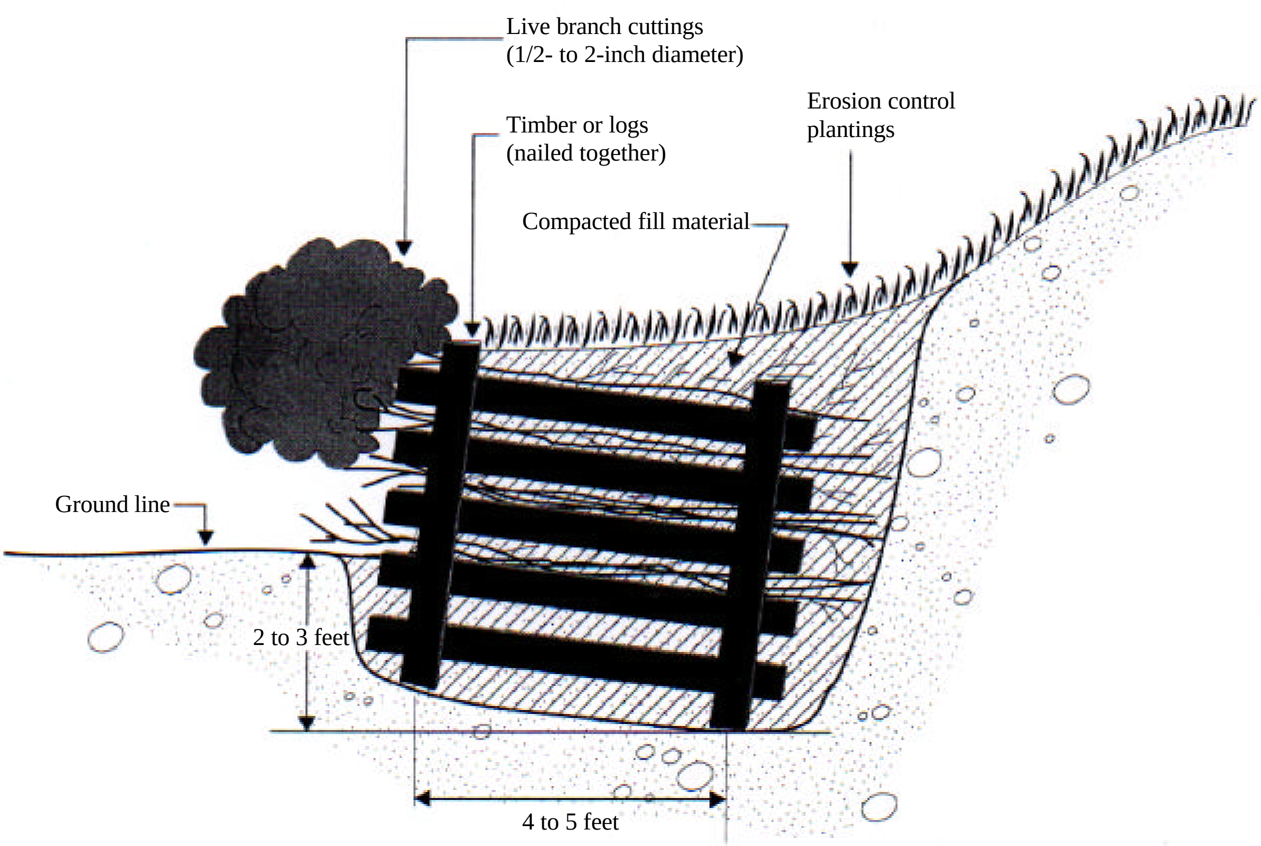
Engineering Field Handbook, Chapter 18, Soil Bioengineering for Upland Slope Protection and Erosion Reduction, Soil Conservation Service, October 1992.

Foundation Engineers, R.B. Peck, W.E. Hanson, T.H. Thornburn, John Wiley & Sons Publishing, Second Edition, 1976.

Inspection Checklist

Be sure that the earth retention structure is constructed per the plans stamped by a licensed professional civil engineer and that any changes in site conditions are transmitted to the design engineer for review.

Cross section
Not to scale



Note:
Rooted/leafed condition of the living plant material is not representative of the time of installation.

Figure TCP-19-1
Live Cribwall

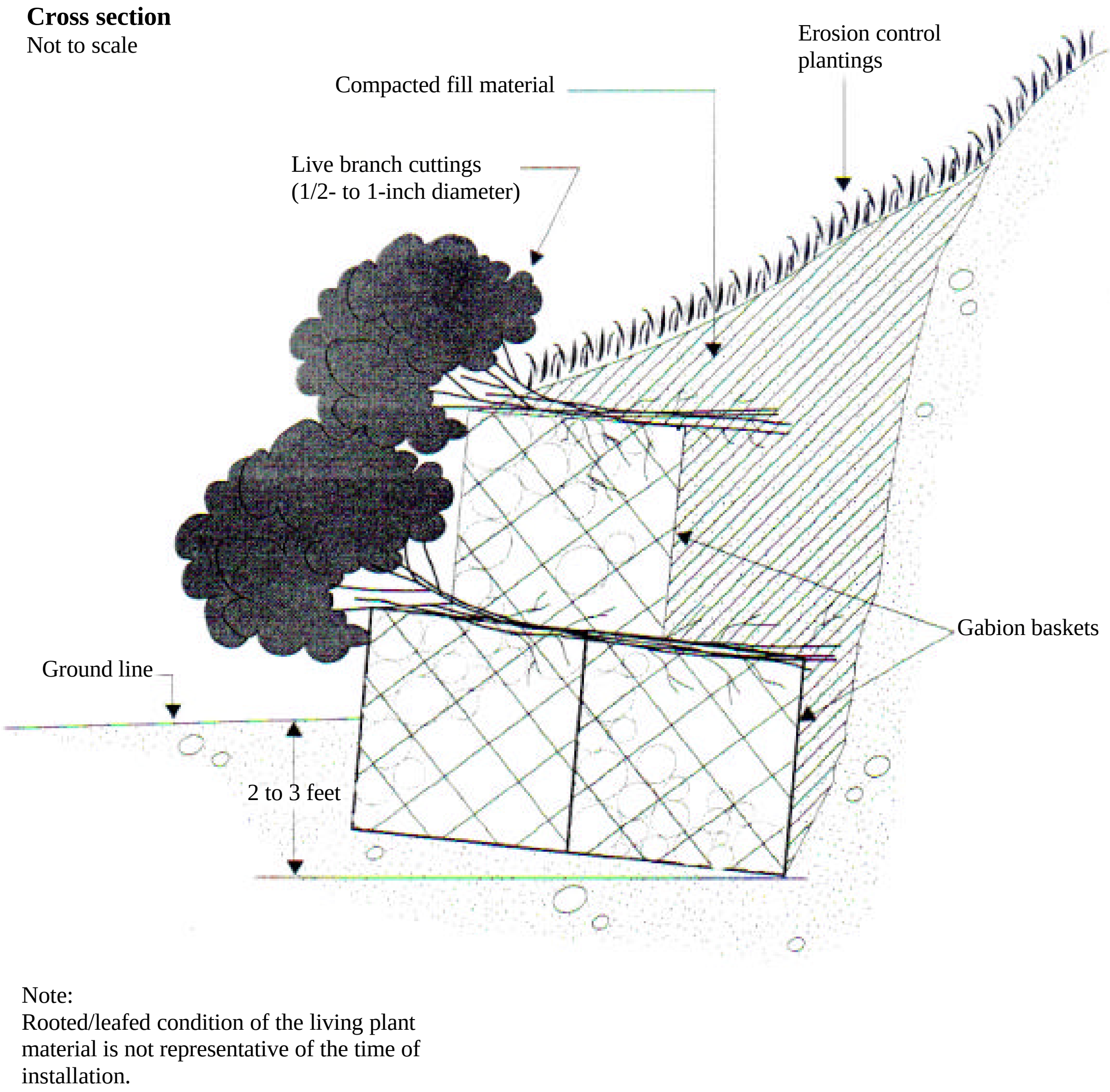


Figure TCP-19-2
Vegetated Rock Gabion