Practice Guide for Critical Area Planting (342) (Acre)

This practice guide contains guidance and related reference tables for establishing vegetations for Critical Area Planting (342). Guidance, divided into subsections based on the following types of vegetation to be established, includes:

A. Temporary Cover or Nurse Crop
B. Permanent Cover – Seeding Grasses and Legumes
C. Permanent Cover – Establishing Sod
D. Permanent Cover – Planting Trees & Shrubs on Highly Disturbed Areas
E. Permanent Cover – Planting Shrubs on Streambanks

Seeding and planting tables include the following:

Table 1: Temporary Cover or Nurse Crop
Table 2: Permanent Cover – Grass and Legumes Seeding Rates
Table 2a: Seed Mixtures Suitable for Various Areas/Purposes
Table 2b: Seeding Dates
Table 3: Trees Suitable for Highly Disturbed Areas
Table 4: Shrubs Suitable for Highly Disturbed Areas
Table 5: Shrubs Suitable for Bioengineering Streambank Stabilization Projects

A. Temporary Cover or Nurse Crop (reference Table 1: Temporary Cover or Nurse Crop)

Mulching – Use when the period of soil exposure is less than two months, establishment of temporary vegetation is not feasible, or when seeding is delayed because of weather conditions. Follow standard and specification for Mulching (484).

Seeding Annual Grass or Grain – Use species from **Table 1: Temporary Cover or Nurse Crop** on all sediment producing areas where the period of exposed soil will be more than two months, but less than 12 months.

1. Site Preparation:

a. Install needed water control and sediment retention measures (permanent or temporary).

b. Perform all cultural operations at right angles to the slope except on slopes exceeding 3:1.

c. Apply agricultural lime according to the soil test or apply at the rate of 8,000 pounds per acre (200 pounds per 1,000 square feet) on a 100 percent calcium carbonate equivalent basis as a preliminary application and then test the soil. Apply any balance of recommended limestone when soil test results are received. If lime is to be worked into a depth of five inches or deeper, apply full amount recommended on the soil test report. If limestone is not incorporated or worked into a depth of four inches or less, apply no more than 8,000 pounds per acre at one time then apply the balance of the recommendation as the initial lime applied dissolves and works into the soil.

Where pH levels are extremely low, it may not be feasible or practical to apply the lime all at once. In these cases, apply 6,000 pounds per acre (150 pounds per 1,000 square feet) on a 100 percent calcium carbonate equivalent basis of agricultural lime for the temporary cover and the remainder of the recommended limestone when establishing the permanent cover.

2. Establishment:

a. Seed one of the species or mixtures listed in **Table 1 – Temporary Cover or Nurse Crop**.

b. Cover seed with ¼ -inch of soil by drilling, cultipacking, harrowing or other suitable equipment when site conditions permit. Cultipack or track hydroseeded areas where slopes allow.

c. Mulch all areas according to the standard and specification for Mulching (484).

B. Permanent Cover – Seeding Grasses & Legumes (reference Table 1: Temporary Cover or Nurse Crop and Table 2: Permanent Cover Grass and Legume Seeding Rates)

1. Site Preparation:

a. Install needed water control and sediment retention measures (permanent or temporary).

b. Perform all cultural operations at right angles to the slope except on slopes exceeding 3:1.

c. Where site conditions permit, prepare seedbed by tilling the soil to a depth of two to six inches with suitable equipment. Where site conditions will not permit normal seedbed preparation, loosen surface soil by dragging heavy chain or other suitable equipment over area to be seeded. On mined land the surface should be left furrowed where possible (as left by a ripper spaced 12 to 18 inches apart) when seeding herbaceous plants.

d. Apply agricultural lime according to the soil test or apply at the rate of 8,000 pounds per acre (200 pounds per 1,000 square feet) on a 100 percent calcium carbonate equivalent basis as a preliminary application and then test the soil. Apply any balance of recommended limestone when soil test results are received. If lime is to be worked into a depth of five inches or deeper, apply full amount recommended on the soil test report. If limestone is not incorporated or worked into a depth of four inches or less, apply no more than 8,000 pounds per acre at one time then apply the balance of the recommendation as the initial lime applied dissolves and works into the soil.

Where pH levels are extremely low, it may not be feasible or practical to apply the lime all at once. In these cases, apply 6,000 pounds per acre (150 pounds per 1,000 square feet) on a 100 percent calcium carbonate equivalent basis of agricultural lime for the temporary cover and the remainder of the recommended limestone when establishing the permanent cover.

e. Apply nitrogen only when the plants will be actively growing (March – May and August – October for cool season grass; June – August for warm season grass). Apply 40% of the nitrogen as slow release compounds, and no more than 40 pounds of actual nitrogen per acre (1.0 pound per 1,000 square feet) in one application.

Apply fertilizer according to soil test, or:

i. Where a seedbed is being prepared, apply 100 pounds each of actual P_2O_5 and K_2O per acre (2.5 pounds of each per 1,000 square feet) during seedbed preparation and at time of seeding. Test the soil before P_2O_5 and K_2O application and apply the balance recommended by the test when the results are received. Then, apply 40 pounds of actual N per acre (1 pound per 1,000 square feet) during the first period of active growth following the seeding[1]. Apply maintenance fertilizer the following growing season according to a soil test.

ii. Where seedbed cannot be prepared, 80 pounds of actual P_2O_5 and K_20 per acre (2 pounds of actual P_20_5 and 2 pounds of actual K_20 per 1,000 square feet) at time of seeding. Apply 40 pounds of actual N per acre (1 pound per 1,000 square feet) during the first period of active growth following the seeding. Apply maintenance fertilizer the following growing season according to a soil test.

When hydroseeding legume-containing, add four times the recommended rate of inoculant to the slurry just before seeding. Apply lime and fertilizer by any method that will give uniform distribution.

2. **Establishment**

a. Where seedbed is prepared:

i. Smooth and firm seedbed with cultipacker or other similar equipment prior to seeding.

ii. Seed an adapted mixture from **Table 2a: Seed Mixtures Suitable for Various Areas/Purposes** at rates recommended in **Table 2 - Permanent Cover – Grass and Legume Seeding Rates** as a permanent

cover and, as needed, a nurse crop from **Table 1: Temporary Cover or Nurse Crop.** Uniformly drill, hyrdoseed, or broadcast seed.

iii. Cover seed with ¼ -inch of soil by drilling, cultipacking, harrowing or other suitable equipment when site conditions permit. Cultipack or track hydroseeded areas where slopes allow.

iv. Mulch all areas according to standard and specifications for Mulching (484)[2].

b. Where seedbed is not prepared:

i. Seed an adapted mixture from **Table 2a: Seed Mixtures Suitable for Various Areas/Purposes** at rates recommended in **Table 2 - Permanent Cover – Grass and Legume Seeding Rates** as a permanent cover and, as needed, a nurse crop from **Table 1: Temporary Cover or Nurse Crop.** Uniformly drill, hyrdoseed, or broadcast seed.

ii. Cultipack or track with a bulldozer where slopes allow.

iii. Mulch all areas according to standard and specifications for Mulching (484).[2]

c. Where it is essential to get quick vegetative cover to prevent gully formation, apply sod. See Section **C. Permanent Cover – Establishing Sod** in this guidance.

3. Management of Vegetation

a. For forage, manage according to the standard and specifications for Forage Harvest Management (511).

b. For wildlife, manage according to the standard and specifications for Upland Wildlife Habitat Management (645). Use Pennsylvania Wildlife Evaluation Worksheets for pasture or permanent hayland (General or Grassland Birds).

c. Control noxious or invasive weeds by mowing or by the use of herbicides.[3] Where site conditions permit, mow as needed to maintain stand of desired herbaceous vegetation.

4. Lime and Fertilizer for Maintenance of Vegetation

a. For forage, lime and fertilize according to standard and specifications for Nutrient Management (590).

b. For all other uses:

Lime according to soil test every three years. Fertilize to maintain a dense herbaceous vegetative cover. Apply fertilizer according to soil test. If soil test results are not available, apply:

Where grasses predominate, broadcast 60 pounds each of actual N, P_2O_5 and K_2O per acre (1.5 pounds each per 1,000 square feet) during the growing season to maintain desired cover. The N should be applied as ureaformaldehyde, sulfur-coated urea, or other slow-release formulation.

Where legumes predominate, broadcast every three years or as needed, 60 pounds each of actual P_20_5 and K_20 only per acre (1.5 pound each per 1 ,000 square feet) during the growing season to maintain desired cover. Do not use nitrogen fertilizer.

FOOTNOTES

[1]Cattle manure or sewage sludge can be used to meet the nutrient requirements and will add needed organic matter needs when they can be incorporated into the soil. Heavy metal content of sewage sludge should not exceed that allowed on agricultural lands.

[2]Annual grains such as barley, oats or rye can be grown on some sites and a seeding made in the standing stubble in lieu of mulching.

[3]Persons using chemical herbicides should be cautioned as follows: Herbicides should be handled and applied properly and unused portions disposed of safely to avoid injury to humans, domestic animals, desirable plants, fish, and other wildlife, and damage to crops and other vegetation. Follow the directions and heed all the precautions on the container label. Herbicides should not be used over or directly adjacent to ponds, lakes or streams.

C. Permanent Cover – Establishing Sod

1. Site Preparation

a. Install needed water control and sediment retention measures (temporary or permanent).

b. Perform all cultural operations at right angles to the slope except on slopes exceeding 3:1.

c. Till soil surface to a depth of three inches and dampen before laying sod.

d. Lime and fertilize the same as outlined for **B. Permanent Cover – Seeding Grasses and Legumes Section B.1 d – e.**

2. Selection

a. Select sod grown from certified seed of adapted varieties and under cultural practices conducive to high quality sod free of any serious thatch, weeds, insect, disease or other pest problems.

b. Select species and varieties best suited for the sites and purpose for which turf is to be used. Use varieties tested and approved by Penn State.

c. Select sod at least one-year old and no older than three years. Cultivated turf grass is usually considered ready for harvest when a cut portion of sod three feet in length and about 1 1/2 feet in width will support its own weight. The most common age of sod when cut is 15 to 24 months.

d. Select sod cuts of a width and length suited to the equipment and job. Generally, sod cuts are from 12 to 24 inches wide with 12 inches being the most common width. Lengths of cuts vary from 3 to 8 feet. Sod may be cut and rolled or folded in the middle and stacked on pallets. Folded sod is cut shorter (about 3 to 4 feet) than rolled sod. Sod should be cut with a 1/2- to 1-inch layer of soil. About 80 percent of all rhizomes are in the top 3/4-inch of soil. The thinner the sod is cut (1/2- to 3/4-inch), the more quickly it will knit to the site soil.

e. Have sod delivered to the site as soon as practical after lifting. During hot weather, delivery should be made within six hours of lifting sod and may be extended to 48 hours during cool seasons. It is not recommended to move sod during July and August. If moved during this period, sod may need to be cut 1-¼ inches thick, and it will require intensive care.

3. Establishment

a. Lay strips of sod at right angles to direction of slope or flow of water, starting at the lowest elevation. Wedge the edges and ends of the sod strips together and tamp or roll. Stagger joints. Along the outside edges, make the sod strips flush with the edges of the undisturbed ground.

b. On very steep slopes use wire staples, fine mesh wire or wood pins and baler twine to hold sod in place by sod roots.

c. Irrigate sodded area if dry conditions prevail.

4. **Manage and maintain as follows**

a. Lime according to soil test every five years.

b. Top-dress annually or as needed to maintain desired cover with fertilizer at the rate of 60 pounds each of actual N, actual P_2O_5 and actual K_2O per acre (1.5 pounds each per 1,000 square feet). The N should be applied as ureaformaldehyde, sulfur-coated urea or other slow-release formulation.

c. Mow as necessary for land use. Control weeds as needed.

D. Permanent Cover - Planting Trees & Shrubs on Highly Disturbed Areas (reference Table 3 – Trees for Highly Disturbed Areas & Table 4 – Shrubs for Highly Disturbed Areas)

1. **Site Preparation**

   a. Follow same as **B. Permanent Cover – Seeding Grass & Legumes sections 1. a - c.**

   b. Apply lime at the rate of 4,000 pounds per acre on a 100 percent calcium carbonate basis over the area to be planted.

   c. Apply fertilizer at the rate of 40 pounds of actual P_2O_5 and 40 pounds of actual K_2O per acre (1 pound per 1,000 square feet) at time of seeding. Apply 40 pounds of actual N per acre (1 pound per 1,000 square feet) during the first period of active growth following the seeding. When strip seeding on highly erosive sites (described in 3.a. below), apply all of the fertilizer in the herbaceous strips. Follow-up the following growing season and apply the same N-P_2O_5-K_2O rate over the entire area.

2. **Selection of species:**

   a. Trees and shrubs adapted for water erosion control planting:

      Selection of the proper species is the key in reclaiming surface mines or other similar disturbed areas highly degraded by human activities. Tree species may be selected from **Table 3 – Trees Suitable for Highly Disturbed Areas**. Shrubs may be selected from **Table 4 – Shrubs Suitable for Highly Disturbed Areas**. Select species according to site and planned use. For sites that are not highly disturbed, refer to the Tree/Shrub Establishment Standard and Specifications (612).

3. **Establishment**

   a. Plant woody species in combination with herbaceous species on highly erosive sites. Seed the herbaceous species in strips with woody species planted between strips. When strip-seeding, leave a 24-inch wide strip for woody species between strips of herbaceous plants. Orient strips on the contour if site conditions permit.

   b. Plant conifers at the rate of 680 per acre (spacing 8 x 8 feet), deciduous trees at the rate of 435 per acre (spacing 10 x 10 feet), and shrubs at the rate of 2,700 per acre (spacing 4 x 4 feet). Plant vines and crowns at the rate of 4,840 per acre (spacing 3 x 3 feet).

   c. Protect root systems from drying by treating the roots with a moisture retaining gel upon arrival at the planting site.

   d. Where slopes are steep and infertile, dig planting hole 10 to 12 inches in diameter and 2 inches deeper than transplant root zone for transplanting seedlings, vines or crowns, then refilled with topsoil. Apply approximately one ounce of 10-10-10 fertilizer to each hole and thoroughly mix with the topsoil before planting. Mulch the area between plants with straw, bark, plastic or commercial mulch.

4. **Protection**

   a. Protect planted areas from trampling, browsing, grazing and fire.

E. Permanent Cover – Planting Shrubs on Streambanks (reference Table 5 – Bioengineering for Streambank Stabilization Projects)

1. Site Preparation

a. Install needed water control and sediment retention measures (temporary or permanent).

b. Grade streambank to a 2 to 1 slope or flatter.

c. Install structural slope protection measures at the toe of the slope (shrubs will only tolerate an 8-foot per second velocity). Cover the slope with an erosion control blanket installed according to the manufacturer's instructions if the stream velocity exceeds 5-feet per second. Plant seedlings, rooted cuttings, unrooted cuttings, and live stakes through the erosion control blanket. Cover wattles with the erosion control blanket. Wrap the erosion blanket around brush layers so that the soil between the brush layers is covered with the erosion control blanket.

d. Lime and fertilize the site according to the specification in **B. Permanent Cover – Seeding Grasses & Legumes sections B.1.d & B.1.e.**

2. Establishment

a. Plant a minimum three rows of rooted cuttings, seedlings, live stakes, or wattles at a 2-foot spacing and five rows of unrooted cuttings at a 1-foot spacing; one at the elevation of the normal high water line the other rows immediately upslope from it. Plant a minimum of two rows of brush layers with one row at the elevation of the normal high water line and the other 6 feet upslope from it. Install brush mattresses so that the base of the brush mattress is located at the elevation of the normal high water line.

b. Plant woody species in combination with an herbaceous ground cover mixture. Do not use mixtures with crown vetch, flatpea or perennial pea with streambank shrubs. Red fescue and dwarf varieties of perennial ryegrass are preferred as the least competitive ground covers.

c. Select species and cultivars of shrubs from **Table 5 Shrubs Suitable for Bioengineering Streambank Stabilization Projects**. All are adapted to planting sites from the normal waterline upslope to the top of the streambank. They are not adapted to excessively drained soils unless moisture from the stream keeps the root zone wet.

d. Planting may be done by unrooted cuttings, rooted cuttings, live stakes, seedlings, wattles (bundles of long unrooted cuttings), brush layering, brush mattresses depending on the species. Species' ability to be propagated by different types of plant materials is listed in **Table 5 Shrubs for Bioengineering Streambank Stabilization Projects**.

e. Unrooted cuttings will be harvested before March 1 and stored at 40°F until planting. They will be planted as early as possible but before May 1. Diameter of the cutting will be 1/4 - 1/2 inch. Length will be a minimum of 9 inches. Planting may be done by pushing the cutting into the soil, or putting it in a dug hole at least 6 inches deep. Cuttings will be spaced no more than one foot apart within rows no more than wide foot wide.

f. Live stakes will be harvested from living plants before March 1 and stored at 40°F until planting. They will be planted as early as possible but before May 1. Diameter of the cutting will be 1 - 3 inches. Length will be a minimum of 2 feet. Planting may be done by driving the stake into the soil if it can be driven without damaging the top of the stake, or putting it in a pilot hole 6 inches shallower than the length of the stake so no more than 6 inches of the stake is above ground. Live stakes will be spaced no more than two feet apart within the row. Spacing between rows can be no more than two feet.

g. Rooted cuttings will be grown for a year from unrooted cuttings as specified in (e) above. Rooted cuttings will be dug before the buds swell in the spring and stored at 40°F unless planted immediately. Length of the cutting above the roots will be a minimum of 12 inches. Protect root systems from drying by treating the roots with a moisture retaining gel upon arrival at the planting site. Planting will be done by putting it in a

dug hole to the top of the roots. Cuttings will be spaced no more than two feet apart within rows. Space rows no more than two feet apart.

h. Seedlings will be at least one year old and stored at 40°F unless planted immediately. Length of the seedling above the roots will be a minimum of 12 inches. Planting will be done by putting it in a dug hole to the top of the roots. Seedlings will be spaced no more than two feet apart within rows. Space rows no more than two feet apart.

i. **Whips** will be harvested before March 1 and stored at 40°F until planting. They will be planted as early as possible but before May 1.

Wattles. The diameter of the cuttings used in the wattles will be 1/4 to 1 inch. Diameter of the bundle will be a minimum of 4 inches. The bundles may be any length but 3 to 6 feet is most practical. The bundles will be tied at a maximum of 18 inches apart. The wattles will be planted in a continuous trench an inch deeper than the diameter of the wattle. The trenches will be 3 feet apart. The trenches will be covered immediately after planting. The slope between the trenches will be seeded with a noncompetitive grass cover, mulched, and the mulch anchored. Red fescue and dwarf varieties of perennial ryegrass are preferred as the least competitive ground covers.

Brush Layers. The diameter of the cuttings used in the brush layers will be 1/4 to 1 inch. Brush layers are layers of single whips laid on a 4 to 6- foot wide bench cut into a slope on the contour. The whips will be 4 to 6 feet long and will be placed no more than two inches apart with the base of the whip placed into the slope and the outer tip of the whip sticking out of the slope when the bench is backfilled. The benches will be no more than 6 feet apart. The slope between the benches will be seeded with a noncompetitive grass cover, mulched, and the mulch anchored. Red fescue and dwarf varieties of perennial ryegrass are preferred as the least competitive ground covers.

Brush Mattresses. The diameter of the cuttings used in the brush layers will be 1/4 to 1 inch. Brush mattresses are piles of whips three to four whips thick that are attached to the surface of the soil with notched stakes and twine or wire, backfilled to fill the voids in the whips, seeded with a noncompetitive grass cover, mulched, and the mulch anchored. Red fescue and dwarf varieties of perennial rye grass are preferred for the least competitive ground covers.

3. Management

a. Protect the planting from grazing.

b. Replace dead plants as quickly as possible.

c. Remove fallen tree limbs and trash washed up on the planting immediately.

d. Do not lime and fertilize after die establishment year. It would help the groundcover compete with the shrubs.

Critical Area Planting Seeding and Planting Requirements - Contents

TABLE 1: Temporary Cover or Nurse Crop

SPECIES OR MIXTURE	SEEDING RATE (LBS/ACRE)		RECOMMENDED SEEDING DATES PLANT HARDINESS ZONE		ADAPTATION		
	TEMPORARY COVER	NURSE	4 & 5	6 & 7	DROUGHTY	POORLY DRAINED	ACIDITY pH
Redtop	5	3	3/15 – 7/01 8/01 – 9/01	3/01 – 6/15 8/15 – 9/15	X	X	4.0 – 7.5
Annual Ryegrass	40	20	3/15 – 7/01 8/01 – 9/01	3/01 – 6/15 8/15 – 9/15	X	X	5.5 – 7.5
Spring Oats	96	48	3/15 – 7/01	3/01 – 6/15	X		5.5 – 7.0
Sudangrass	40	20	7/01 – 8/01	6/15 – 8/15	X		5.5 – 7.5
Japanese Millet (*Echinochloa frumentacea)*	30	15	7/01 – 8/01	6/15 – 8/15	X		4.5 – 7.0
Winter Rye Grain	168	56	8/01 – 11/01	8/15 – 11/15	X		5.5 – 7.5
Winter Wheat	180	90	8/01 – 11/01	8/15 – 11/15	X		5.0 – 7.0

TABLE 2 - Permanent Cover – Grass and Legume Seeding Rates

(Use a nurse crop from Table 1 selected for the site conditions)

SPECIES OR MIXTURE[1]	SEEDING RATE (LBS/ACRE)		ADAPTATION		
	PREPARED DRILLED CULTIPACKED	UNPREPARED ADVERSE SITE HYDROSEEDED	DROUGHTY	POORLY DRAINED	ACIDITY pH
1. Tall Fescue	60	75	X	X	4.0 - 8.0
2. Tall Fescue and	40	60	X		5.0 - 7.5
Red Fescue or	10	15			
Hard Fescue					
3. Tall Fescue and	20	30	X	X	5.0 - 7.5
Birdsfoot Trefoil[2/3]	6	10			
4. Birdsfoot Trefoil[2/3] and	6	10	X		5.0 - 7.5
Hard Fescue or	20	30			
Red Fescue					
5. Crownvetch[2] and	10	15		X	6.0 - 7.5
Tall Fescue or	20	30			
Red Fescue or					
Hard Fescue or					
Perennial Ryegrass[4]					
6. Crownvetch[2] and	10	15	X		6.0 -7.5
Birdsfoot Trefoil[2/3] and	6	10			
Tall Fescue	20	30			

TABLE 2 - Permanent Cover – Grass and Legume Seeding Rates cont.
(Use a nurse crop from Table 1 selected for the site conditions)

SPECIES OR MIXTURE[1]	SEEDING RATE (LBS/ACRE)		ADAPTATION		
	PREPARED DRILLED CULTIPACKED	UNPREPARED ADVERSE SITE HYDROSEEDED	DROUGHTY	POORLY DRAINED	ACIDITY pH
7. Flatpea[2/6] and	20	30	X		5.0- 7.5
Tall Fescue or	20	30			
Red Fescue or					
Hard Fescue or					
Perennial Ryegrass[4]					
8. Perennial Pea[2/6] and	40	60			5.0-7.5
Tall Fescue or	20	30			
Red Fescue or					
Hard Fescue or					
Perennial Ryegrass[4]					
9. Alfalfa and[2/5]	10	15			6.5 - 7.5
Tall Fescue or	10	15			
Orchardgrass or	3	5			
Timothy[8]	4	6			

TABLE 2 - Permanent Cover – Grass and Legume Seeding Rates cont.

(Use a nurse crop from Table 1 selected for the site conditions)

SPECIES OR MIXTURE[1]	SEEDING RATE (LBS/ACRE)		ADAPTATION		
	PREPARED DRILLED CULTIPACKED	UNPREPARED ADVERSE SITE HYDROSEEDED	DROUGHTY	POORLY DRAINED	ACIDITY pH
10. Birdsfoot Trefoil[2/3/5] and	6	10			5.0- 7.5
Tall Fescue or	6	10	X	X	
Orchardgrass or	3	5	X		
Timothy	2	3			
11. Perennial Ryegrass[4] and	25	30	X	X	5.0 - 8.0
Tall Fescue or	25	35			5.5 - 7.0
Kentucky Bluegrass	15	20			5.5 - 7.5
12. Switchgrass[5]	10	15	X	X	5.0- 7.5
13. Switchgrass and	10	15	X	X	5.0 -7.5
Birdsfoot Trefoil[2/3]	6	10			
14. Deertongue[5]	15	25	X		3.5 - 7.5
15. Deertongue[5] and	15	25	X		5.0 -7.5
Birdsfoot Trefoil[2/3]	6	10			

FOOTNOTES for Table 2

[1]Consult the Agronomy Guide for cultivar recommendations of forage and turf species. Other species:

- Crownvetch 'Penn gift'
- Flatpea 'Lathco'
- Perennial Pea 'Lancer'
- Switchgrass 'Blackwell' - Erosion control
    - 'Cave-in-Rock' - Forage
    - 'Shelter' - Wildlife
- Deertongue 'Tioga'

[2]Inoculate legume seeds, use four times the normal rate of inoculate when hydroseeding.

[3]Birdsfoot Trefoil is not recommended in MLRA 148 and 149, where crown and root rots may injure the stand.

[4]Use only the “turf-type” fine-leaved perennial ryegrass varieties

[5]Use these mixtures on gentle, less erosive slopes; must be drilled or broadcast and cultipacked.

[6]Drill ½-inch deep or broadcast flatpea and perennial pea then cultipack.

Table 2a: Seed Mixtures Suitable for Various Areas/Purposes – use with Table 2	
Area/Purpose	**Suitable Mixtures (Select One)**
Slopes and Banks – non-mowed	
Well drainage	3, 4, 5, 6, 7, 8
Variable drainage	3, 6
Slopes and Banks (mowed)	1, 2, 11
Gullies and eroded areas	3, 4, 5, 6, 7, 8
Conservation Structures	
Sod waterways, spillways, and other frequent waterflow areas	1, 2, 3
Drainage ditches	
Shallow, less than 3 feet	1, 2, 3
Deep, non-mowed	5, 6, 7, 8
Pond banks, dikes, levees, dams, diversion channels, and occasional waterflow areas	
Mowed areas	1, 2, 3, 4, 11
Non-mowed areas	5, 6, 7, 8
Hay or silage on diversion channels and occasional waterflow areas	use adapted hay mixtures or 9, 10
Sanitary landfill areas	3, 4, 5, 6, 12, 13, 14, 15
Strip-mined spoils, mine wastes, fly ash, slag, settling-basin residues, and other severely disturbed areas (lime to soil test)	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14,15
Wildlife habitat	9, 10, 12, 13, 14, 15
Effluent Disposal Areas	10, 12, 13
Sand and Gravel Pits	12, 13, 14, 15

Table 2b – SEEDING DATES for species and mixes in Table 2 Permanent Cover Grasses and Legumes		
COOL SEASON PLANTS (MIXES 1 - 12)		
	Hardiness Zone 6 & 7	**Hardiness Zone 4 & 5**
Optimum	03/01- 04/15	03/15 - 05/01
Normal Range (dormant & spring)	11/15 - 06/15	11/01 - 07/01
Normal Range (fall)	08/15 - 09/15	08/01 - 09/01
Project	11/15 - 09/15	01/01 - 09/01
WARM SEASON PLANTS (MIXES 12 - 15)		
	Hardiness Zone 6 & 7	**Hardiness Zone 4 & 5**
Optimal	03/01- 04/15	03/15 - 05/01
Normal Range	12/01 - 04/15	01/15 - 05/01

TABLE 3 – Trees suitable for highly disturbed areas

SPECIES	LOWER LIMIT pH TOLERANCE	TOLERANCE TO SHADE[1]	DRAINAGE ADAPTATION	ELEVATION[2]
CONIFERS				
Larch, Japanese	4.0	intermediate	Excessive – poor	
Pine, Austrian	4.0	intermediate	Well	
Pine, Pitch	4.0	intolerant	Excessive – well	Below 3000 feet
Pine, Red	4.0 – 4.5	intolerant	Excessive – well	Above 2000 feet
Pine, Scotch	4.0	intolerant	Well	
Pine, Virginia	4.0	intolerant	Excessive – well	Below 2500 feet
Pine, White	4.5	intermediate	Well – poor	
Spruce, Norway	4.5 – 5.0	tolerant	Well	
Spruce, White	4.5 – 5.0	tolerant	Well - poor	
HARDWOODS				
Alter, European Black	3.5	intolerant	Well-poor	Below 2500 feet
Aspen, Bigtooth	4.0	intolerant	Excessive-well	
Aspen, Quaking	4.0	intolerant	Excessive-well	
Birch, Gray	3.5	intolerant	Excessive-well	
Birch, Sweet	4.0	intermediate	Excessive-well	
Chestnut, Chinese	5.0	intermediate	Well	
Locust, Black[3] 'Steiner'	4.0	intolerant	Excessive-well	Below 3000 feet
Oak, Red	4.0	intermediate	Well	
Oak, Sawtooth 'Gobbler'	5.0	intolerant	Excessive-well	
Poplar, Hybrid	4.0 – 4.5	intolerant	Well	
Poplar, Yellow	4.5	intolerant	Well	Below 3000 feet
Sycamore	4.0 – 4.5	intolerant	Poor	Below 2500 feet

[1]Shade tolerance of species defined as follows: **Tolerant** – can withstand completely shaded conditions; **Intermediate** – partial shade is tolerated; plant requires some sunlight; **Intolerant** – plant requires full sunlight

[2]Blank spaces indicates no restriction: "Below" means that species are to be planted below this elevation

TREE PLANTING DATES: Plant as soon as frost is out of the ground but no later than April 15 in hardiness zones 6 & 7; May 1 in hardiness zones 4 & 5.

TABLE 4: Shrubs suitable for highly disturbed areas

SPECIES[1]	LOWER LIMIT pH TOLERANCE	TOLERANCE TO SHADE[2]	DRAINAGE ADAPTATION	YEARS TO FRUIT MATURITY	MONTHS OF FRUIT MATURITY
Coral berry	5.0	tolerant	excessive-well	3	September – October
Crabapple	4.5 – 5.0	intolerant	well	3	September – October
Dogwood, Gray	5.0	intermediate	excessive-well	5	September – October
Dogwood, Silky	4.0	tolerant	well-poor	4 – 5	August – September
Honeysuckle, Amur	4.5 – 5.0	intermediate	excessive-well	3 – 4	September – October
Indigobush	4.0	intermediate	excessive-well	3	August
Locust, Bristly	3.5	intolerant	excessive-well	3 – 5	September
Privet, Amur	4.5 – 5.0	tolerant	well	4	September
Sumac, Aromatic	4.5	tolerant	excessive-well	5	July – August
Sumac, Shining	4.0	intermediate	excessive-well	4	September – October
Sumac, Smooth	4.5	intermediate	excessive-well	4	September – October
Viburnurn, Arrowwood	4.5	tolerant	well-poor	3 – 5	September – October
Viburnum, Cranberrybush	4.5	intermediate	well-poor	3 – 5	August – September

[1]Recommended varieties are:

- Crabapple - 'Midwest', 'Roselow'
- Dogwood, Silky - 'Indigo'
- Honeysuckle, Amur - 'Rem Red'
- Locust, Bristly - 'Arnot'
- Sumac, Aromatic - 'Konza'

[2]Shade tolerance of species defined as follows;

- Intermediate - partial shade is tolerated; plant requires some sunlight
- Intolerant - plant requires full sunlight
- Tolerant - can withstand completely shaded conditions

PLANTING DATES: Plant as soon as frost is out of the ground but no later than:

HARDINESS ZONE	DATE
6 & 7	04/15
4 & 5	05/01

TABLE 5: Shrubs suitable for bioengineering streambank stabilization projects

Species	Habitat [1]	Adaptation to PHZ [2]	Soil Moisture Requirement/ Tolerance [3]	Plant Material Form [4]	Shade Tolerance [5]	Flood Tolerance [6]	pH Range [7]	Comments
Alder, Smooth *Alnus serrulata*	Nontidal	4-7	Saturated to Moist	Seedling	Medium	Regular	5.5-7.5	Nitrogen-Fixer Weak-wooded
Azalea, Swamp *Rhododendron viscosum*	Forested Wetlands	6-7	Saturated	Rooted	Medium	Seasonal-Regular	4.0-6.0	Susceptible to Disease
Bayberry *Morella pennsylvania*	Tidal Fresh, Brackish, Nontidal	6-7	Moist to Dry	Seedling	High	Irregular-Seasonal	5.0-6.5	Drought Tolerant, Nitrogen-Fixing
Buttonbush *Cephalanthus occidentalis*	Nontidal Tidal fresh	4-7	Saturated to Moist	Seedling Rooted, Unrooted	High	Permanent	6.0-8.5	Tolerates Brief Drought.
Cherry, Dwarf Sand 'Catskill' *Prunus pumila var. depressa*	Streamside, Sandbars	5-7	Moist to Dry	Rooted	Low	Irregular-Seasonal	5.5-8.5	Native to Northern Delaware. River, Drought Tolerant
Chokeberry, Black *Photinia melanocarpa*	Nontidal	4-7	Moist to Dry	Seedling	Low	Irregular Seasonal	5.1-6.5	Drought Tolerant
Chokeberry, Red *Photinia pyrifolia*	Nontidal	4-7	Moist	Seedling	Medium	Irregular Seasonal	5.1-6.5	Drought Tolerant
Doghobble, Swamp *Eubotrys racemosa*	Forested Wetlands, Moist Woods	6-7	Saturated to Moist	Seedling	High	Regular	5.0-6.0	Tolerates Some Dry-Down
Dogwood, Grey *Cornus racemosa*	Streambanks Pond Edges	4-7	Saturated to Moist	Seedling	High	Seasonal	5.5-8-5	Drought Tolerant
Dogwood, Redosier 'Ruby' *Cornus sericea*	Streambanks Pond Edges	4-7	Saturated to Moist	Rooted, Unrooted	Medium	Regular, Seasonal	5.5-8.5	Drought Tolerant
Dogwood, Silky 'Indigo' *Cornus amomum*	Streambanks Pond Edges	4-7	Saturated to Moist	Seedling, Rooted, Unrooted	Medium	Seasonal	5.5-8.5	Drought Tolerant
Groundsel Bush *Baccharis halimifolia*	Tidal Tidal fresh	6-7	Moist to Dry	Seedling, (Unrooted)	High	Seasonal	7.0-8.5	Male and Female Separate Plants
Hawthorn, Cockspur *Crataegus crus-galli*	Disturbed Banks/ Dry Sites	5-7	Dry	Seedling	Low	Irregular	4.5-7.2	Good Wildlife Food and Cover

TABLE 5: Shrubs suitable for bioengineering streambank stabilization projects

Species	Habitat [1]	Adaptation to PHZ [2]	Soil Moisture Requirement/ Tolerance [3]	Plant Material Form [4]	Shade Tolerance [5]	Flood Tolerance [6]	pH Range [7]	Comments
Hawthorn, Washington *Crataegus phaenopyrum*	Disturbed Banks/ Dry Sites	6-7	Dry	Seedling	Low	Irregular	4.3-7.0	Good Wildlife Food and Cover
Holly, Winterberry *Ilex verticulata*	Tidal Fresh Forested Wetland	4-7	Saturated to Moist	Seedling	High	Seasonal	4.5-8.0	Drought Tolerant
Indigo, False *Amorpha fruticosa*	Nontidal Tidal Fresh	6-7	Moist	Seedling, Rooted, Unrooted	Low	Seasonal	5.9-8.5	Requires Full Sun Drought Tolerant
Maleberry *Lyonia ligustrina*	Open Woods	5-7	Saturated to Moist	Seedling	Low	Seasonal	4.0-6.0	Acid Tolerant
Meadowsweet *Spiraea tomentosa*	Forested Wetlands	4-7	Moist to Dry	Seedling, Rooted	Low	Irregular	5.1-6.0	
Ninebark *Physocarpus opulifolius*	Streamsides, Wood Edges	4-7	Saturated to Moist	Seedling Rooted, Unrooted	Medium	Seasonal	4.5-6.5	
Pepperbush, Sweet *Celthra alnifolia*	Tidal Nontidal	6-7	Moist to Dry	Seedling	High	Seasonal	4.5-6.5	Some Salinity and Drought Tolerance
Rose, Swamp *Rosa palustris*	Tidal Fresh, Forested Wetlands, Streambanks	4-7	Saturated	Seedling Rooted	Low	Seasonal-Regular	4.0-7.0	Prefers Full Sun
Spicebush *Lindera benzoin*	Seasonal Wetlands, Floodplains	4-7	Saturated to Moist	Seedling	High	Seasonal	4.5-6.5	Tolerates Some Drought
Steeplebush *Spiraea tomentosa*	Forested Wetlands	4-7	Moist to Dry	Seedling, Rooted	Low	Irregular	5.1-6.0	
Sumac, Smooth *Rhus glabra*	Disturbed Banks/ Dry Sites	4-7	Dry	Seedling	Low	Irregular	6.1-7.0	Tolerates Some Drought
Sumac, Staghorn *Rhus typhina*	Disturbed Banks/ Dry Sites	4-7	Dry	Seedling	Low	Irregular	6.1-7.0	Tolerates Some Drought

TABLE 5: Shrubs suitable for bioengineering streambank stabilization projects

Species	Habitat [1]	Adaptation to PHZ [2]	Soil Moisture Requirement/ Tolerance [3]	Plant Material Form [4]	Shade Tolerance [5]	Flood Tolerance [6]	pH Range [7]	Comments
Sumac, Winged *Rhus copallinum*	Disturbed Banks/ Dry Sites	4-7	Dry	Seedling	Low	Irregular	5.3-7.5	Tolerates Some Drought
Viburnum American Cranberrybush *Viburnum trilobum*	Forested Wetlands	4-7	Saturated to Moist	Seedling, (Unrooted)	Low	Irregular-Seasonal	5.5-7.5	Drought Tolerant
Viburnum, Blackhaw *Viburnum prunifolium*	Forested Wetlands	5-7	Dry	Seedling, (Unrooted)	Medium	Irregular	6.5-7.0	
Viburnum, Nannyberry *Vibrurnum lentago*	Forested Wetlands	4-7	Moist to Dry	Seedling, (Unrooted)	Medium	Seasonal	6.0-7.0	Forms Dense Tickets
Viburnum, Southern Arrowwood *Viburnum dentatum*	Tidal Fresh, Nontidal, Forested Wetlands	6-7	Moist to Dry	Seedling, (Unrooted)	Medium	Seasonal	5.1-7.0	Drought Tolerant
Willow, Coastal Plain *Salix caroliniana*	Streambanks	5-7	Saturated to Moist	Rooted, Unrooted	Medium	Regular-Permanent	4.5-8.8	
Willow, Dwarf *Salix X cottetii*	Streambanks	4-7	Saturated to Moist	Rooted, Unrooted	Medium	Regular-Permanent	5.0-7.5	Introduced Male Hybrid, Noninvasive
Willow, Peachleaf *Salix amygdaloides*	Streambanks, Forested Wetlands	4-5	Saturated to Moist	Rooted, Unrooted	Low	Regular-Permanent	6.0-8.0	
Willow, Pussy *Salix discolor*	Streambanks, Forested Wetlands	4-7	Saturated to Moist	Rooted, Unrooted	Medium	Regular-Permanent	5.0-7.5	Attractive Landscaping Plant
Willow, Sandbar 'Greenbank' *Salix exigua*	Streambanks, Sandbars	4-7	Saturated to Moist	Rooted, Unrooted	Low	Regular-Permanent	5.0-7.5	Aggressive, Root-Suckering, Salt Tolerance
Willow, Shining *Salix lucida*	Streambanks	4-7	Saturated to Moist	Unrooted, Rooted	Medium	Regular, Permanent	5.2-7.0	
Willow, Silky *Salix sericea*	Streambanks	4-7	Saturated	Unrooted, Rooted	Medium	Regular, Permanent	5.2-7.0	
Willow, Purpleosier 'Streamco' *Salix purpurea*	Streambanks	4-7	Saturated to Moist	Unrooted, Rooted	Medium	Regular, Permanent	6.0-7.0	Introduced Noninvasive Shrub

FOOTNOTES

[1] **Habitat**	The natural community in which the plant is found.
[2] **Adaptation by PHZ**	Pennsylvania has 4 plant hardiness zones (PHZ) numbered 4 through 7 from the northwest to the southeast.
[3] **Moisture Tolerance/Requirement**	Recommended moisture regime on the bank slope. Some banks are moist or saturated from the toe to the top. Some banks have only a few feet of moist or saturated soil and most of the slope is droughty.
[4] **Plant Materials Form**	Seedling - a seedling sold as a bare root (1-0 or 2-0) seedling or containerized plant. Rooted – a plant sold as a rooted cutting or containerized plant Unrooted – good-excellent rooting from a dormant hardwood cutting, live stake, or whip (Unrooted) - fair-poor success from a dormant hardwood cutting, live stake, or whip
[5] **Shade Tolerance**	The relative value in relation to other species. A shade tolerant species may prefer partial shade to full sun.
[6] **Flood Tolerance**	**Semipermanently to permanently:** tolerates inundation or saturation from 76% - 100% of the growing season. **Regularly:** tolerates in inundation or saturation from 26% - 75% of the growing season. **Seasonally:** tolerates inundation or saturation from 13% - 25% of the growing season. **Semipermanently to permanently:** tolerates inundation or saturation **Irregularly:** tolerates inundation or saturation from 5% - 12% of the growing season.
[7] **pH Range**	Tolerance range of soil acidity.

Illustrations of Low and High Gradient Stream Banks and Channels

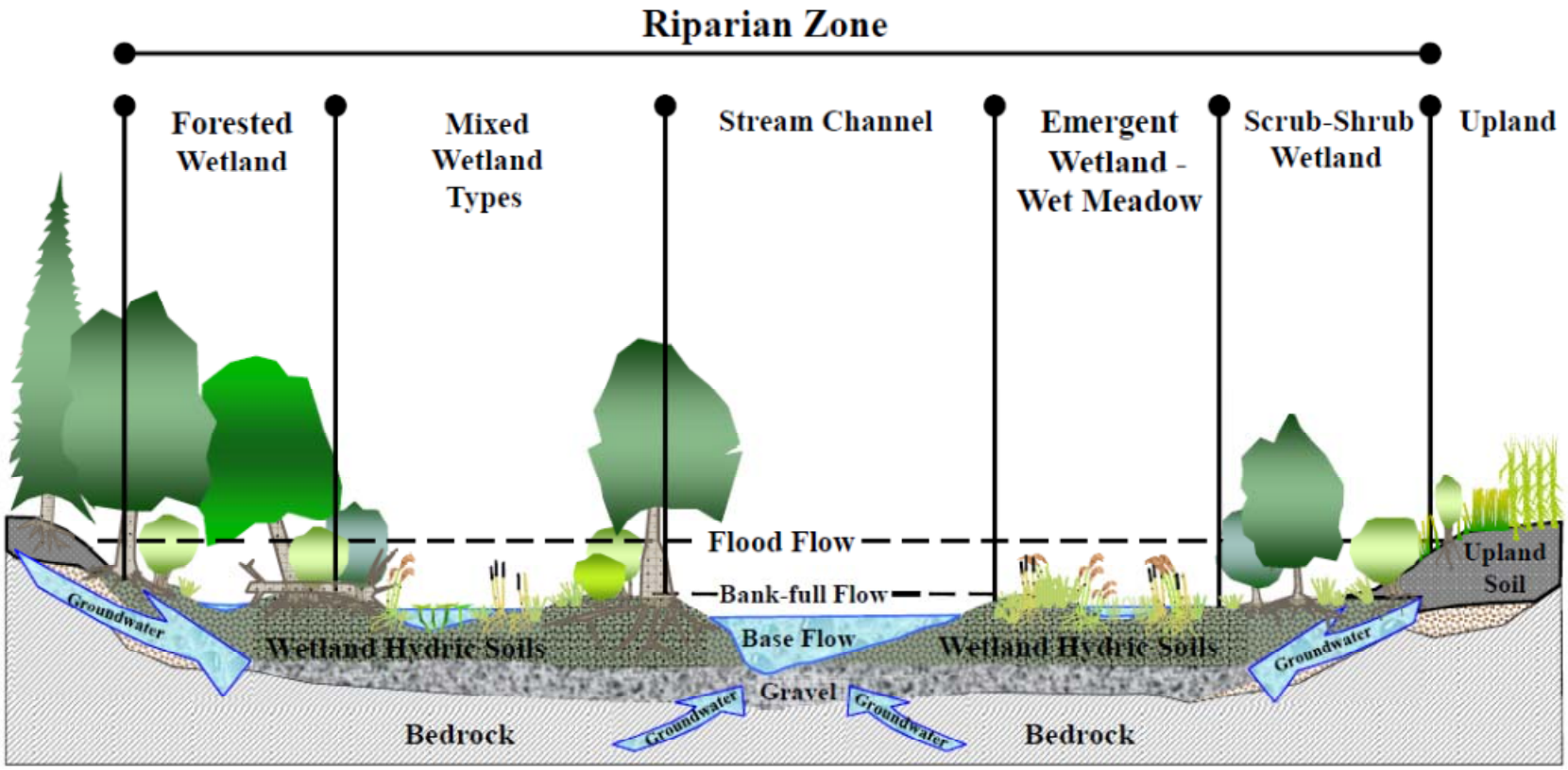

Figure 1 Natural Floodplain Stream and Riparian Wetland typical of low gradient stream

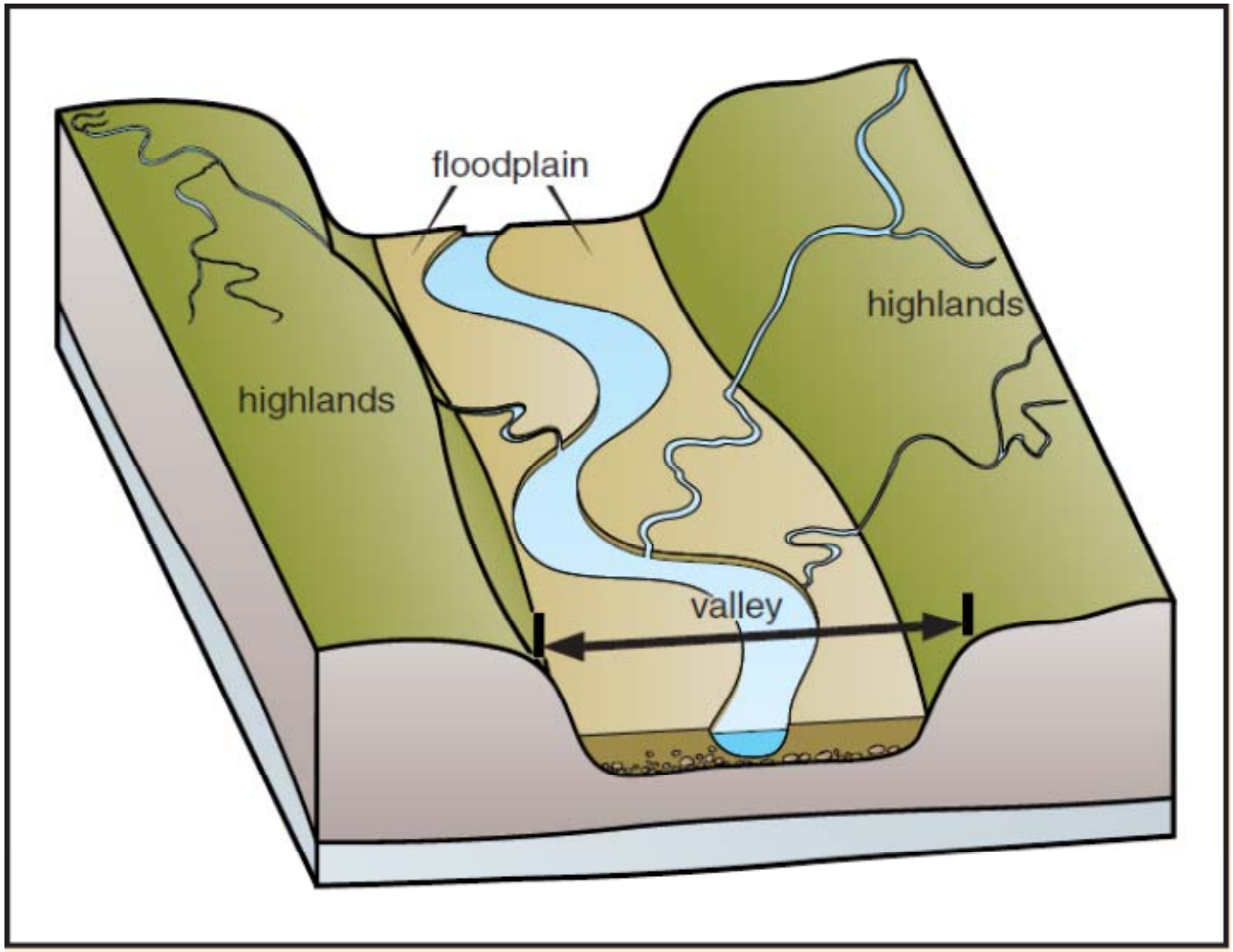

Figure 2 Illustration of high-gradient streams in the highlands and a low-gradient stream forming a broad valley below.