

APPENDIX D

RIPARIAN VEGETATION

RIPARIAN RE-VEGETATION

1.1 General Recommendations

For restoration from an ecological stand point revegetation should be performed using a mix of trees and shrubs, with grasses and forbs as appropriate for site conditions. Trees and shrubs should be planted within the riparian area to a depth that establishes a connection between the roots and the subsurface flows to/from the river (e.g., pole plantings at a depth to hit groundwater). This will reduce a need for irrigation and help their survival rate. Seeding should be done in the early spring to benefit from late winter snow and spring rains, or in late summer when temperatures drop and fall moisture increases. There is risk that the rainfall is not sufficient and irrigation would be beneficial.

The best restoration method should be based on conditions such as the severity of damage, slope, aspect, and soil type. Only native seed should be used for restoration projects in order to prevent the spread of invasive plant species. Several suggested seed mixes for various areas are provided in **Tables D-1** and **D-2** at the end of this appendix.

The type of desired vegetation should be considered before starting re-vegetation. For example, the desired vegetation is cottonwood and/or willow, or the desired vegetation is mostly varied low laying grasses and forbs. Generally, grasses and forbs are at the toe of the stream and cottonwood and willow are further up the bank.

1.2 Avoiding Weeds

It is important to realize that most invasive plant species (weeds) threatening restoration projects in Colorado easily invade established native plant communities, particularly following disturbance in the existing vegetation from such things as floods and fires. Weed management is an on-going process that can have varying results (Colorado Natural Areas Program 2000). Landowners should prioritize weeds that are already established, difficult to control, or have the greatest impact (Colorado Natural Areas Program 2000).

It is important when buying seed to ensure that there are no invasive species within the seed mix (Forest Service 2004). While many mixes say that they are weed free, there could still be some species of noxious weeds. A complete list of species listed as noxious weeds can be found at: http://www.colorado.gov/cs/Satellite/ag_Conservation/CBON/1251618874438.

Prevention of the spread of weeds is the easiest and most cost effective method of controlling weeds. If weeds are found in the restoration area, immediate removal/treatment will reduce the spread of seeds to surrounding areas. Hand pulling, digging, and spot herbicide treatments should be used to eradicate weeds before seeding to prevent spread (Forest Service 2004). Chemical or mechanical control can also be used to disrupt weed growth. These techniques should be used in conjunction with other treatments and only certain herbicide products should be used for weed management prior to revegetation in order to minimize soil persistence, which can lower establishment rates of seeded vegetation.

The Colorado Weed Management Association publishes a field guide of noxious weeds including photos to help with identification. The guide can be purchased from CWMA at <http://www.shop.cwma.org/>. Also available is the Larimer County Weed Management Guide and Weed District website www.larimer.org/weeds/.

1.3 Seeding

Time of Seeding

Seeding success is influenced by the temperature and precipitation at the time of seeding. Seeding should not be done while the ground is frozen. For cool season species (applies to grasses, such as wheatgrass), early spring and late fall usually have characteristics that support germination (CPW 1998). For warm season species (such as buffalo grass, blue grama, big and little blue stem), seeding in late spring or early summer is conducive to support germination. Warm season grasses should only be seeded in the upland areas not in the riparian areas.

Site Preparation

A well-prepared site is a critical step in a seeding restoration project. This step will prepare the soil for seeding. Soil may be too compacted (firm) or too loose. The soil should be firm enough that the seed is in contact with the soil and the soil will not be easily blown or washed away. Additionally, the soil should be loose enough for the sprout to penetrate the soil.

If the soil is too loose, actions should be taken to compact the soil to prevent erosion. If soil is too compacted, the topsoil should be ripped, chiseled, or broken up by raking the soil surface. Site preparation should be done across the slope to prevent soil erosion from surface water runoff.

Seeding generally works best when buried under 0.13 to 0.5 inch of soil (CPW 1998). Therefore, soil should be raked or otherwise prepared to create an enhanced location that seeds can fall into. Without seedbed preparation, seeds would be vulnerable to grazing by small mammals and birds.

Seeding

Broadcast seeding is the best method for most land owners, though site preparation is especially important (CPW 1998). During broadcast seeding, seed is distributed by hand or a handheld seed dispenser. This method can be used on slopes, somewhat rocky areas, and remote or inaccessible areas. The suggested seed mixes are recommended at a rate of 120 seeds per square foot (Big Thompson River Restoration Coalition 2014). After broadcasting the seed, cover the seed by immediately raking or using a similar technique. Raking and other soil-disturbing activities should be done across the slope to prevent soil erosion from surface water runoff. Drilling can also be used to seed and will typically have a higher success rate as compared to broadcasting, but it is labor intensive and more expensive than broadcasting.

Soil Amendments

The Colorado State University (CSU) Extension has had success without using fertilizer and suggests it may not always be necessary. CSU Extension and Pawnee Butte Seeding recommend using compost and manure versus traditional fertilizers. It is less costly and equally effective as traditional fertilizers. Use of manure and composts will improve water retention and potentially improve seeding success, however, these substances can have high salt content which can prevent water from entering the root of the plants. Additionally, these substances may contain weed seed so weeding practices should be utilized. If using fertilizer when seeding, an organic natural fertilizer is recommended such as Biosol. Commercial fertilizer isn't recommended until grass is mature.

The use of soil amendments are recommended on sand bars in particular, although it is not necessary, is recommended given the loss of organics in these features.

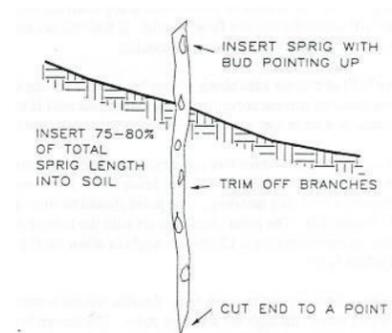
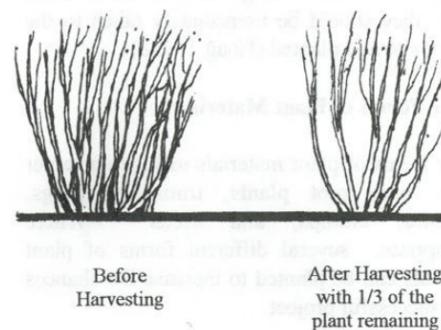
Post Seeding Care

After seeding, many locations will benefit from placement of a protective cover, such as mulch. This will protect soil and seeds from wind and water erosion while conserving soil moisture. Mulches or hay can be used cover the ground completely and have sufficient durability to survive until the seeds germinate (CPW 1998). Care should be taken to avoid mulches and hay with seeds as this can introduce weeds into the restoration site. It is suggested that native woody debris left from the flood are used as mulch. Additionally, the restoration site should be monitored for weeds and actions should be taken to eradicate or control weeds if necessary.

1.4 Cottonwood and Willow Woodlands

Cottonwood and willow germinate on the bare sandbars formed by meandering streams. These are used extensively for revegetation on stream banks because they are easily established from stem cuttings. Stem cuttings and purchased container stock are both appropriate for most revegetation projects, though stem cuttings are more cost effective. Additionally, stem cuttings from cottonwood or willow stands near the restoration site have adapted to local conditions.

Establishment of cottonwoods and willows is most successful when cuttings are taken from dormant plants, meaning either after leaf fall in late fall, winter, or very early spring before budding. Cuttings may be harvested when plants are in full leaf, though the establishment rate may decrease by about 50 percent. If cuttings are taken during full leaf, consider planting more cuttings to compensate for the lower establishment rate.



Wood that is two years to seven years old with smooth bark is best for cutting. No more than one third of any individual plant should be used, and no more than 40 to 50 percent of a stand should be used (CPW 1998). Branches that would impair the source willows health should not be used, and cuttings from inside of the crown are preferred over the more obvious exterior area. Depending on the species, cuttings should be 0.75 inch diameter or larger. All side branches should be removed so the cutting is a single stem. Larger diameter cuttings have more energy and stored reserves than smaller cuttings. Larger diameter and longer cuttings should be used for more severely eroding sites and areas where the water table is deeper. When planting in rockier areas, cuttings should be at least

three to five inches in diameter. Additionally, cutting length should be long enough to reach into the mid-summer water table and cuttings should extend two to three feet above the ground so it leafs out (Colorado Parks and Wildlife 1998). This will help reduce bank erosion.

Prior to planting, cuttings can be soaked for a minimum of 24 hours and as long as 14 days to improve root and shoot production (Colorado Parks and Wildlife 1998). During this time, the entire cutting should be covered with water. Soaking can occur anywhere water is deep enough to cover as long as cuttings are protected from sun and wind exposure.

When planting cuttings, identify the top of the cutting. The top of the cutting can be identified by looking at the emerging buds. These will point up and the stem is usually smaller in diameter near the top of the

cutting. If the top of the cutting is misidentified establishment rate will greatly decreased. Plant cuttings should be planted approximately one to two feet apart for creeping species to maximize bank stabilization, and three to eight feet apart for cottonwoods (CPW 1998). Multiple stems may be planted together.

After planting, management of land should allow for long-term restoration, and the site should be monitored annually. Replanting in succeeding years may be necessary. Monitoring of the site is also necessary to remove any in-stream dead organic material that has accumulated at the restoration site. If livestock grazing occurs near the restoration site, proper management techniques should be developed to allow for further growth. These techniques may include fencing with water gaps to allow for access to the stream or reduced grazing near the stream.

Trees and shrubs such as cottonwood and willow can be established from seed. Seeds should be collected from parent plants in locations with several plants of the same species because cottonwood and willow species rely on cross pollination for reproduction (Gough 1996).

Cottonwood and willow seeds should be collected by hand in the spring. Broadcast seeding can be used to establish cottonwood and willow species. Cottonwood seed germination generally occurs within 24 hours on moist surfaces. Seeding will likely fail if the upper layer of soil dries within the first three weeks and remain vulnerable to drought in the first year following establishment (Oregon State Extension Service 2002). Once roots have established, cottonwood and willow become more resistant of flooding and drought.

1.5 Irrigation

One of the challenges the landowners will all be facing in the re-vegetation of the river corridor will be irrigating the revegetated lands particularly in the overbank sections. Although some property owners with areas designated for reseeding will have access to irrigation water, most will not. Where possible the use of temporary irrigation water should be considered. Although this is a highly regulated river system, there are periods of the year with no calls, or 'free water' during which it may be possible to use the flows for irrigation. There may also be opportunities for people to shift their water rights to the river corridor on a short term basis (legal hurdles may be required). The LTWRC may be able to help coordinate this effort.

1.6 Tree Seeding

Landowners can purchase tree seedlings through the Big Thompson Water Conservation District who offers low-cost trees & shrubs. Proceeds from this program will help support the Conservation District. Visit their website at www.bigthompson.org for order forms and prices. Landowners can also purchase tree seedlings through CSU Extension Survive and Colorado State Forest Service. Landowners need to fill out an [Application for Seedlings](#) form. The only requirement for tree seedling purchase is that the trees be used for conservation purposes, such as windbreaks, preventing erosion, or to enhance wildlife habitat. Trees purchased from CSU Extension Service offices are usually lower in price than trees from private nurseries, but are limited in quantity. CSU Extension Service publishes a [tree buyer's guide](#) and a [species suitability guide for Colorado](#). A list of the local contacts for CSU Extension Service tree buying is listed in the **Suggested Vendors** below. **Wildlands Restoration Volunteers** may be able to help coordinate volunteer efforts for revegetation projects and assist with technical restoration questions (www.wlrv.org/).

1.7 Grazing Management

In general, grazing should be restricted from riparian areas using fencing. Often ranchers will construct fencing to move livestock to focal access points in the river. These access points usually have a low grade to minimize erosion and are devoid of much vegetation due to use. Traditionally salt cedar and Russian olive have been used to plant in areas occupied by livestock as the animals will not eat either plant. However, both are non-native invasive species that provide limited habitat and have relatively high evapotranspiration rates. These species are not recommended. Native riparian species, such as willows and cottonwoods, can tolerate south facing exposures and heat as long as their roots are able to access the water table. Cows will feed on young plants but once mature, most bushes will be resistant or able to survive mild grazing. Thus, young plantings should be fenced off from grazing until mature. Chokecherry and wild plums should be avoided because they contain low concentrations of cyanide. Other good references include the following:

- EPA Guide to Grazing in Riparian Areas.
- NRCS Chapter 5: <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/?cid=stelprdb1045811>).

Table D.1. Suggested Seed Mixes for Little Thompson River Re-Vegetation*		
Foothills and Plains Reaches		
Common Name	Scientific Name	Percent of Mix
Blue grama	<i>Chondrosum gracile</i>	5
Canada wildrye	<i>Elymus canadensis</i>	6
bottlebrush squirreltail	<i>Elymus elymoides</i>	7
prairie sandreed	<i>Calamovilfa longifolia</i>	15
sand bluestem	<i>Andropogon hallii</i>	15
yellow indiagrass	<i>Sorghastrum nutans</i>	10
slender wheatgrass	<i>Elymus trachycaulus</i>	11
alkali sacaton	<i>Sporobolus airoides</i>	5
switchgrass	<i>Panicum virgatum</i>	8
western wheatgrass	<i>Pascopyrum smithii</i>	9
little bluestem	<i>Schizachyrium scoparium</i>	5
Triticale		4
Foothills and Plains Reaches		
Western yarrow	<i>Achillea lanulosa</i>	4
smooth blue aster	<i>Aster laevis</i>	4
fringed brome	<i>Bromus ciliatus</i>	9
blue grama	<i>Chondrosum gracile</i>	6
Canada wildrye	<i>Elymus canadensis</i>	10

Table D.1. Suggested Seed Mixes for Little Thompson River Re-Vegetation*		
bottlebrush squirreltail	<i>Elymus elymoides</i>	8
thickspike wheatgrass	<i>Elymus lanceolatus</i>	8
Slender Wheatgrass	<i>Elymus trachycaulus</i>	11
Arizona fescue	<i>Festuca arizonica</i>	7
prairie junegrass	<i>Koeleria macrantha</i>	7
Western wheatgrass	<i>Pascopyrum smithii</i>	7
little bluestem	<i>Schizachyrium scoparium</i>	7
green needlegrass	<i>Stipa viridula</i>	7
Triticale		5
Canyon Reach		
Western yarrow	<i>Achillea lanulosa</i>	4
Aster laevis	<i>smooth blue aster</i>	4
fringed brome	<i>Bromus ciliatus</i>	9
blue grama	<i>Chondrosum gracile</i>	6
Canada wildrye	<i>Elymus canadensis</i>	10
bottlebrush squirreltail	<i>Elymus elymoides</i>	8
thickspike wheatgrass	<i>Elymus lanceolatus</i>	8
slender wheatgrass	<i>Elymus trachycaulus</i>	11
Festuca arizonica	<i>Arizona fescue</i>	7
prairie junegrass	<i>Koeleria macrantha</i>	7
Western wheatgrass	<i>Pascopyrum smithii</i>	7
little bluestem	<i>Schizachyrium scoparium</i>	7
green needlegrass	<i>Stipa viridula</i>	7
Triticale		5

*Seed mixes compiled from Wildlands Restoration Volunteers, NRSI, and Big Thompson River Restoration Coalition 2014

Table D.2. Suggested Seed Mixes for Little Thompson River Re-Vegetation.
Seed mixes provided by Pawnee Buttes Seed Inc.

Common Name	Scientific Name	% of Mix	Cool/Warm	Ht (ft)
Blue Grama	<i>Bouteloua gracilis</i>	10	Warm	<2'
Sand Dropseed	<i>Sporobolus cryptandrus</i>	5	Warm	2-3'
Little Bluestem	<i>Schizachyrium scoparium</i>	15	Warm	1-4'
Sideoats Grama	<i>Bouteloua curtipendula</i>	15	Warm	1-3'
Big Bluestem	<i>Andropogon gerardii</i>	10	Warm	3-6'
Switchgrass	<i>Panicum virgatum</i>	25	Warm	2-4'
Western Wheatgrass	<i>Pascopyrum smithii</i>	15	Cool	1-3'
Sand Lovegrass	<i>Eragrostis trichodes</i>	5	Warm	1-3'

Percentages of species and/or species may change somewhat due to availability.

Seeding rate:

- 3.7-7.4 PLS lb / acre drilled
- 7.4-14.8 PLS lb / acre broadcast seeded
- 0.5 PLS lb/1000 sq. ft. for smaller areas

Notes on Pawnee Buttes Seed Inc, Flood Recovery Mix

Blue Grama is one of the most widely distributed of all native grasses. It is very drought tolerant and works well in areas with good drainage. This warm season, perennial grass is an open sod forming short grass.

Sand Dropseed is widely distributed throughout the United States. It occurs naturally on sandy open sites and is drought tolerant. This native, warm season, perennial bunch grass establishes quickly.

Little Bluestem grows on thins soil, steeps slopes, and does very well on gravel and sand. It is a primary species of midwestern prairies. Little Bluestem is a native, warm season, long-lived, perennial bunchgrass.

Sideoats Grama grows on thins soil, steeps slopes, and does very well on gravel and sand. It is native to U.S. and widely distributed eastward from Rocky Mountains. Sideoats Grama is a warm season, bunchy sod forming grass.

Big Bluestem is native to most areas east of the Rocky Mountains and a primary species of tall grass prairies. This tall, long-lived, warm season, bunchy sod former grows well in a variety of situations.

1.8 Suggested Vendors

Pawnee Buttes Seed Co.
PO Box 100
Greeley, CO 80632
800-782-5947
www.pawneebuttesseed.com

Western Native Seed
PO Box 188
Coaldale 81222
719-942-3935
www.westernnativeseed.com

Southwest Seed
13260 County Road 29
Dolores, CO 81323
800-543-1279

Sharp Brothers Seed Co.
104 East 4th Street Rd.
Greeley, CO 80631
970-356-4710
www.sharpseed.com

Arkansas Valley Seed Co.
4625 Colorado Blvd.
Denver, CO 80216
877-957-3337
peck@avseeds.com

Applewood Seed Co
5380 Vivian St.
Arvada, CO 80002
303-431-7333
www.applewoodseed.com

The Tree Farm
11868 Mineral Rd
Longmont, CO 80504
303-652-2961
www.thetreefarm.com

Loveland Garden Center & Nursery
1801 S Lincoln Ave
Loveland, CO 80537
970-669-3577
www.lovelandgardencenter.com

Creekside Tree Nursery
3283 61st St
Boulder, CO 80301
303-668-7647
www.creeksideboulder.com

CSU Extension Tree Seedings***Boulder County Residents***

Longmont Conservation District <http://www.longmontcd.org/>
Boyd Byelich
9595 Nelson Road Suite D
Longmont, CO 80501
303-776-4034

Larimer Count Residents

CSFS Nursery <http://csfs.colostate.edu/pages/seedling-tree-nursery.html>
5060 Campus Delivery Building 1060
Fort Collins, CO 80524
Big Thompson Conservation District <http://www.bigthompson.org/>
PO Box 441
Berthoud, CO 80513
970-667-1052
Fort Collins Conservation District <http://www.ftcollinscd.org/>
1415 N. College Avenue#3
Fort Collins, CO 80524
970-221-0611

Weld County Residents

West Adams Conservation District
57 West Bromley Ln
Brighton, CO 80601
303-637-8157

West Greely Conservation District <http://www.wgcd.org/>
4302 W 9th St Rd
Greeley, CO 80634
970-356-8097