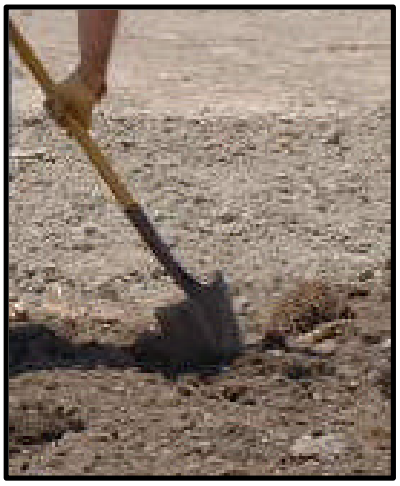
Re-Vegetation Trials

Willow Creek Floodplain

1999-2003



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Introduction

The primary objective of the re-vegetation trials was to establish any type of ground cover that would survive on the heavily disturbed, acidic site. The use of native versus indigenous seed was discussed at length, and it was decided that indigenous seed would be cost prohibitive due to the extensive acreage and that it would not be adapted to the current site since the natural conditions no longer existed.

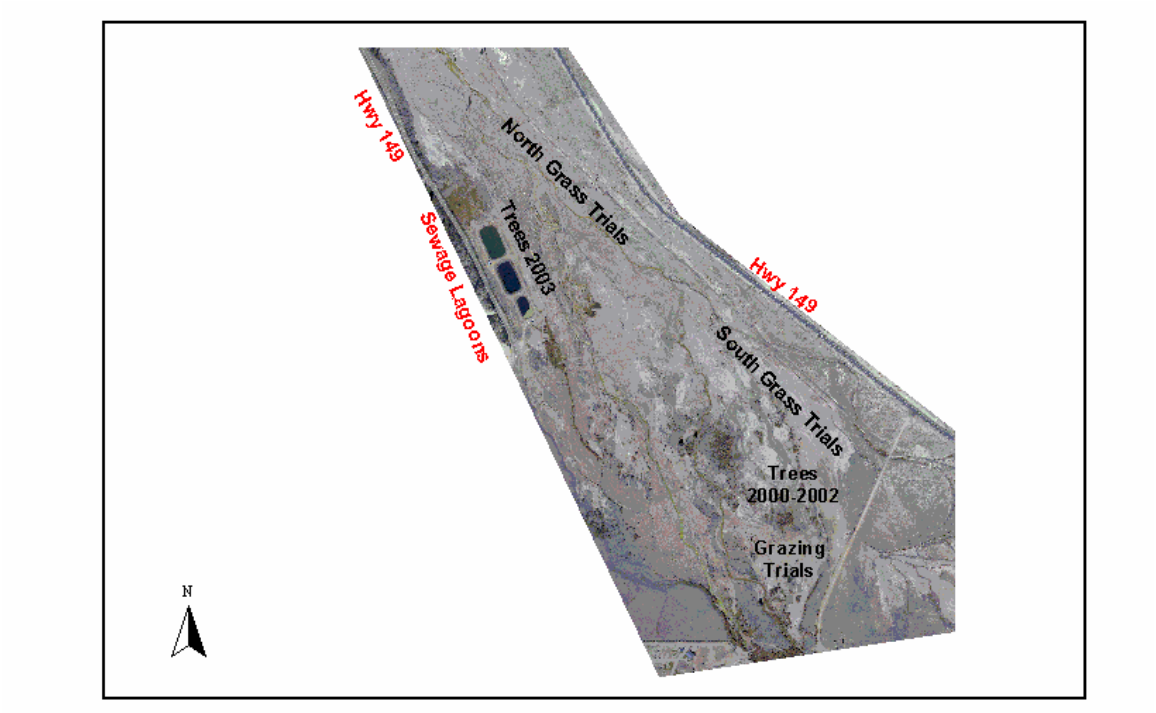


Figure 1. Map of re-vegetation activities.

1999

Plant Survey
Dean Erhard, Ecologist for the USDA Forest Service, conducted a site investigation and inventory of vegetation in the Willow Creek floodplain in June 1999. No vascular plant growth was found in areas of almost pure gravel outwash. These sites were usually at a higher elevation (by several feet in many cases) than the live water sections of Willow Creek. The higher elevation, gravelly sites had limited topsoil and might have been too acidic for plant growth. Vascular plants were found where they were relatively close to live water and could receive a certain amount of subirrigation.

Based on the plant survey, species were suggested for planting efforts in particular areas. Tufted hairgrass was common in the moist areas of the floodplain and could be a good candidate for planting in areas receiving some degree of subirrigation. Water sedge and redtop were found right at the water's edge, while western wheatgrass was found in drier sites. Although it was not prominent in the area overall, Geyer willow was the most common willow in the area.

A complete list of vascular flora in the Willow Creek floodplain in June 1999 is presented in Table 1.


Tufted hairgrass (Deschampsia caespitosa)

Table 1. Vascular flora of the Willow Creek floodplain in June 1999.

Scientific Name	Common Name
Adenolinum lewsii	blue flax
Agrostis gigantea	redtop
Calamagrostis canadensis	blue-joint reedgrass
Carex aquatilis	water sedge
Carex obtusata	sedge
Cerastium strictum	mouse-ear chickweed
Chondrosum gracile	blue grama
Deschampsia caespitosa	tufted hairgrass
Elymus longifolius	squirreltail
Elymus trachycaulus	slender wheatgrass
Erigeron vetensis	fleabane
Eriogonum flavum	buckwheat
Festuca arizonica	Arizona fescue
Ipomopsis aggregata	scarlet gilia
Juncus balticus	Baltic rush
Koeleria macrantha	junegrass
Mertensia lanceolatum	bluebells
Muhlenbergia filiculmis	slimstem muhly
Muhlenbergia sp.	possible mat muhly
Packera dimorphophylla	groundsel
Pascopyrum smithii	western wheatgrass
Pediocactus simpsonii	ball cactus
Penstemon strictus	beardtongue
Pentaphylloides floribunda	shrubby cinquefoil
Picea pungens	Blue spruce
Poa pratensis	Kentucky bluegrass
Potentilla ambigens	cinquefoil
Potentilla hippiana	cinquefoil
Ranunculus sp.	buttercup
Ribes cereum	squaw current
Rosa woodsi	wild rose
Salix geyeriana	Geyer willow
Salix monticola	mountain willow
Taraxacum offinale	dandelion

1999 Soil Survey

John Rawinski, Forest Soil Scientist for the USDA Forest Service, conducted a site investigation and soil sampling in the Willow Creek floodplain on June 24, 1999. Field notes are included as Appendix A. Typical soil pedon was a very deep soil consisting of very gravelly and cobbly, stratified loamy sands. There were lenses of other materials as well, including an 8-inch thick layer of loam. The pH was 5.4 to 5.6, which was consistent with the soil pedon described by Yenter in 1977. As a monitoring point, there seemed to be no change in pH for the site. Tests for lime requirement showed that about 1000 pounds of $CaCO_3$/acre were needed on the site. Depth to the water table on a secondary bench was greater than 5 feet.

Surface salinity measurements revealed areas of inert salts that may be to such levels that a plant has little chance of surviving in a drouthy surface layer. This decreased opportunity for survival is due to the salts making moisture less available to plants by osmotic pressure.

The soils did not have much surface organic matter, and nutrient analyses showed low natural levels of nitrogen, phosphorus, and potassium. The soils suggest that mine tailings and workings were co-mixed with native material bedload and outwash. This conclusion was based on the extraction from depth of slag (burned coal) that was possibly used to power mine equipment. Mine workings likely were washed into the soils as easily as the slag near the mines.

1999 Grass Plantings

Re-vegetation trials were initiated on July 8, 1999, and consisted of plantings in two areas, one on Wason Ranch property and one on land belonging to Creede Resources, Inc. Treatments were designed to evaluate the influence of lime, fertilizer, compost, and topsoil alone and in various combinations. Treatment descriptions are shown in Table 2. Individual plots were 10'x10' and aligned adjacent to each other in a north/south direction. Plot assignments are shown in Table 3.

Ground preparation was minimal, with surface scarification by a front-end loader. Seed was broadcast and then treatments were added. Individual plots were mixed slightly with a small harrow. Species used in the seed mixture are presented in Table 4.

1999 Compost treatment in grass plots

1999 Results

The summer and fall of 1999 were relatively wet and the plots did well. Several field visits were made during the summer to evaluate growth. The plots with topsoil, N, P, K, and lime had the highest success in terms of vegetative growth, but were by far the most expensive. Topsoil plots did second best, but were likewise expensive (cost roughly equal to $7500/acre). Other plots that did well were 1) N,P,K and lime, and 2) compost, with the former being the best from an economic standpoint. The remainder of the plots did not have an adequate response. Species response was not evaluated in 1999.

Table 2. Treatment descriptions for 1999 trials.

Treatment	Description
Lime	(Quick Release Powder) 1000 #/acre, which translates to 2.3 #/plot.
Fertilizer	Nitrogen (46-0-0)- 50 #/acre, which translates to 0.3 #/plot.
	Phosphate- 25 #/acre
	Potassium- 25 #/acre
Compost	Mushroom; 1 cubic foot/plot.
Topsoil	3” thick, which translates to 1.5 tons/plot.

Table 3. Plot assignments order for areas at Wason Ranch and Creede Resources, Inc in 1999. Plots are listed from north to south.

Wason Ranch	Creede Resources, Inc.
Topsoil	Topsoil
Lime	Lime
Compost	Nitrogen
Control (Seed only)	Control
Nitrogen	N,P, and K
Vacant (No seed or treatment)	N,P,K and Lime
N,P,K and Lime	Vacant
P and K	Topsoil
Topsoil	Lime
Compost	Nitrogen
Control (Seed only)	Control
Nitrogen	Compost
Lime	N,P, and K
N,P,K and Lime	N,P,K and Lime
N,P, and K	Topsoil, N,P,K, and Lime

Table 4. Species used in 1999 grass plots.

Species
Tufted Hair Grass
Durar Hard Fescue
Manchar Smooth Brome
Arriba Western Wheatgrass
Revenue Slender Wheatgrass
Redtop
Lewis Blue Flax
Rocky Mountain Penstemon
Alsike Clover
Sodar Streambank Wheatgrass
Redondo Arizona Fescue

2000

2000 Grass Plantings

Ground preparation and planting for 2000 were done on July 6. Trials in 2000 primarily evaluated lime, compost, and fertilizer, with modifications based on preliminary assessments of success of these treatments in 1999. Fertilizer sources were urea (N), phosphate (P), and potash (K). Application ratios of P:N were changed to 2:1. Due to the cost-effectiveness of compost, it was used in the greatest number of plots. Planting areas were south of those used in 1999 on Creede Resources and Wason Ranch property. The treatment descriptions and plot assignments are shown in Table 5, and plots were the same at both sites. The remaining seed mix from 1999 was used for the plantings (Table 6). Ground preparation on the Wason Ranch property involved hand tilling the surface to a depth of approximately 3 inches. Tilling on the Creede Resources property was not possible due to rocky conditions.

2000 Tree Plantings

Re-vegetation trials in 2000 included tree planting in the form of fascines, poles, and potted trees. Sources for the poles and fascines were: 1) Wason ditch, where the hatchery road crosses the ditch (Drummond Willow) and 2) Near Hatchery parking lot (Drummond and Booth Willows). Drummond willows from the hatchery parking lot were distinguished by orange flagging. Cottonwood poles were imported from a location in Conejos County. Potted trees included 15 narrowleaf cottonwoods provided by the Colorado State University seedling tree program.

All trees were planted on Creede Resources property. At the southern end of the property, fascines included, from north to south, Drummond (ditch), Drummond (hatchery), and Booth. Poles and potted trees were planted in various locations. The northern tree planting area was on the east side of Willow Creek, adjacent to the grass plots and near the railroad flatbed. Fascines, from north to south, were Drummond (hatchery), Booth, and Drummond (ditch). Poles and potted trees were planted in various locations.

2000 Fascine plantings

2000 Results

Most of the grass and forbs that were planted did not survive the winter. The potted cottonwood seedlings had the highest survival rate. The pole plantings that were midway up the bank performed the best. The higher poles apparently suffered from lack of water, while those near the streambed apparently were too wet, and rotted.

Table 5. Treatment descriptions and plot assignments for 2000. Plots are listed from north to south.

Treatment		Coverage Calculations (amount/acre)	Plot Coverage (amount/10'x10' plot)
	Nitrogen	60# N/acre	0.3# urea
	Phosphorus	120# P/acre	0.6# phosphate
	Potassium	110# K/acre	0.3# potash
#1	Lime	1000# lime/acre	2.3# lime
	Lime	2000#/acre lime	4.6# lime
#2	Compost	5 tons/acre compost	25# compost
#3	Compost	10 tons/acre compost	50# compost
#4	Compost	20 tons/acre compost	100# compost
	Nitrogen	60# N/acre	0.3# urea
	Phosphorus	120# P/acre	0.6# phosphate
	Potassium	110# K/acre	0.3# potash
	Lime	1000# lime/acre	2.3# lime
#5	Compost	20 tons/acre compost	100# compost

Table 6. Species used in 2000 grass plots (same as 1999).

Species
Tufted Hair Grass
Durar Hard Fescue
Manchar Smooth Brome
Arriba Western Wheatgrass
San Luis Slender Wheatgrass
Redtop
Lewis Blue Flax
Rocky Mountain Penstemon
Alsike Clover
Sodar Streambank Wheatgrass
Redondo Arizona Fescue

2001

2001 Grass Plantings

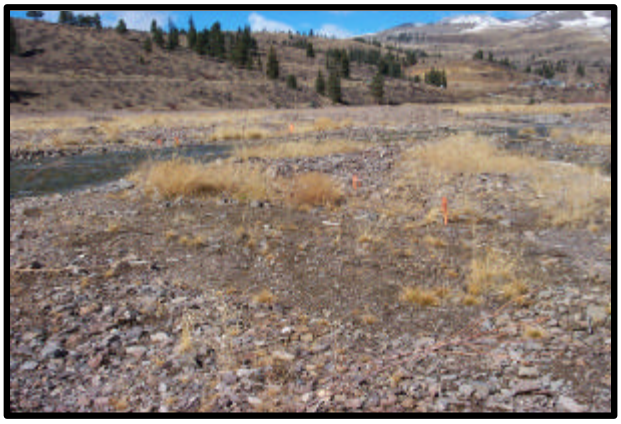
On June 11-12, 2001, the re-veg subcommittee and volunteers constructed 15 grass test plots. Based on tests conducted by the Forest Service the previous winter, soils in the test plot area had high sulfate content. The primary goal of the grass test plots in 2001 was to evaluate the effectiveness of lime in neutralizing the soil to a pH around 6.8. Other treatments used in combination with lime were fertilizer, compost, and polyacrilimide. Treatment descriptions are shown in Table 7. Figure 2 presents a schematic of the test plots and treatment combinations. All sites were rototilled prior to planting to break up surface soil crusts. Plots (10'x10') were delineated with blue stubble plastic markers. The species of seed used on the test plots are shown in Table 8. Seed species were generally the same as in 1999 and 2000, with the addition of Jose Tall Wheatgrass and Nezpar Indian Ricegrass.

2001 Intensive Grazing Trials

A new experimental treatment was initiated in 2001 which involved the use of cattle on test plots. The expected result of the grazing trial was that hoof action would help incorporate the seed and disperse organic matter and fertilizer (i.e. cow manure). The enclosure was 300' by 300' and surrounded by electric fencing. The cattle (17 cows and 11 calves) were left on the area for 25 days and were fed certified weed-free hay. Following removal of the cattle, barley straw mulch was spread across the enclosure. In the subsequent days, strong winds blew away all of the mulch. Although the grazing and manure distribution went as anticipated, there was essentially no summer moisture, so the seeds did not germinate and survive. An unexpected benefit of the intensive grazing was the removal of much of the decadent plant material on the existing vegetation along the north side of the trial. This area greened up in the spring of 2002 and was much more vigorous than the vegetation outside the fenced trial area.

2001 Tree Plantings

Tree species planted in 2001 included 50 cottonwoods, 150 willows, and 30 blue spruce.



2001 Cottonwood pole plantings

2001 Results

The potted cottonwoods once again did the best, although some of the spruce also survived. Survival seemed to be very location/aspect dependent. Trees that had some protection from the sun and wind seemed to fare the best. These were typically located on the side slope between the top and bottom. It was decided to try sun/wind barriers on any future tree plantings. Those that had supplemental water supplied by a volunteer, J.B. Alexander, also experienced enhanced survival.

Table 7. Treatment descriptions for 2001 trials.

Treatment	Description	
Lime	(Quick Release Powder) 3000 #/acre, which translates to 6.7 #/plot.	
Fertilizer	Lawn Starter (9-13-7)	Nitrogen- 100 #/acre, which translates to 2.5 #/plot.
		Phosphate- 130 #/acre
		Potassium- 70 #/acre
Compost	Mushroom; 6.25 cubic feet/plot.	
Polyacrylamide	Pellets; 4 #/plot	

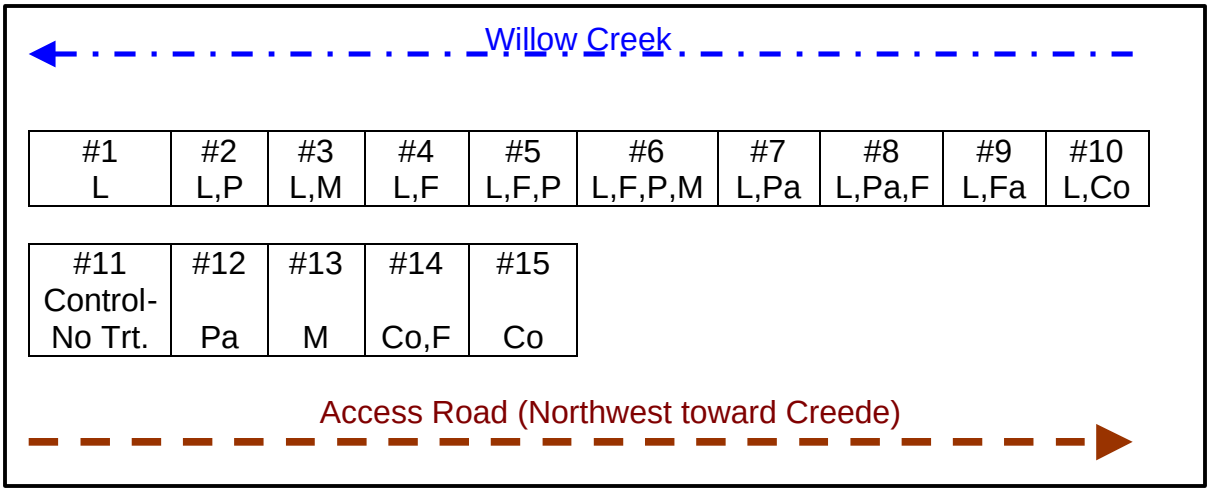


Figure 2. Map showing 2001 grass plots and treatment combinations. Codes: L=Lime; F=Fertilizer; M=Straw Mulch; P=Pitted; Pa=Polyacrylamide; Co=Mushroom Compost; and Fa=Rolanka BioD Mat coir fabric.

Table 8. Species used in 2001 grass plots.

Species
Tufted Hair Grass
Durar Hard Fescue
Manchar Smooth Brome
Arriba Western Wheatgrass
San Luis Slender Wheatgrass
Redtop
Lewis Blue Flax
Rocky Mountain Penstemon
Alsike Clover
Sodar Streambank Wheatgrass
Redondo Arizona Fescue
Jose Tall Wheatgrass
Nezpar Indian Ricegrass

2002

2002 Grass Plantings

2002 Irrigated grass plots

The primary treatment evaluated in 2002 was supplemental water provided through irrigation. New soil treatments included crushed potatoes and straw. A description of the treatments is shown in Table 9. Permission was granted by Wason Ranch to use their water right to draw out of their irrigation ditch below the measuring station. This area was historically irrigated by Wason Ranch, so were not any problems from a water right standpoint. Grass was planted on June 11. Plots (10'x10') were placed in a 4x3 square to maximize irrigation efficiency with a circular sprinkler set in the middle of the area. The plots were replicated 100 yards to the south but were not irrigated. Plot assignments are shown in Figure 3. All amendments were incorporated into the soil with rakes and shovels.

2002 Tree and Shrub Plantings

Trees and shrubs were planted on May 24. Shrub plantings included 60 choke cherry, 50 wild rose, and 50 Red-osier dogwood. Potted trees included 30 Englemann spruce, 30 bristlecone pine, and 30 lodgepole pine. Potted trees were planted with polyacrilimide and sunscreens on southern and western sides. Polyacrilimide and sunscreens were provided by the Colorado State Forest Service.

2002 Results

The flow in Willow Creek became so low due to the drought that the Wason Ranch water right was shut down. This effectively terminated the irrigation portion of the trial. This trial needs more evaluation, but it is quite likely that the irrigated portion will actually fare worse than the dryland site. This is because the irrigation water was sufficient to germinate the seed, but did not last long enough for establishment, whereas the dryland site probably did not even get enough moisture for germination. If this is the case, that seed should still be onsite in a dormant stage. The irrigation trial should be done again in a year with a more positive water outlook.

Table 9. Treatment descriptions for 2002 trials.

Treatment		Description
#1	Grass Plugs	Obtained from other areas of the floodplain and re-planted
#2	Potatoes	Crushed on site and incorporated as a nutrient source
#3	Compost	Mushroom
#4	Compost and Lime	Mushroom; 2.3 # lime/plot
#5	Native Seed	
#6	Compost and PAM	Polyacrilimide
#7	Compost and Lime	Mushroom; 2.3 # lime/plot
#8	Straw	
#9	Fertilizer	
#10	Topsoil	1" deep across plot
#11	Topsoil	2" deep across plot
#12	Erosion fabric, PAM, Compost	Polyacrilimide; Mushroom

Figure 3. Schematic showing 2002 grass plots and treatments.

2003

Survival Survey

On May 20, 2003, the re-veg subcommittee conducted a survey of the previous years' plantings. Of the trees planted in 2002, 50 spruce and pine were found to be in good condition as indicated by partial to full green coloration and some new growth. This represented >50% survival. Sunscreens were removed from the dead trees for future use. Based on the surviving trees, characteristics of many of the sites were: sunscreens on both south and west sides; nearby presence of larger trees or shrubs; and location midway up west-facing slopes. There were several trees, however, that had only some or none of these characteristics. Evaluation of the 2002 shrubs was difficult because the growing season had just begun; however, it was evident that some of the roses did well. In most cases, willows and cottonwoods planted in previous years did not survive.

Grass plots had little growth at the end of May, but it appeared that the plots that had done well in previous years, such as the topsoil and fertilizer, were continuing to have new growth.

Tree Planting

On May 23, 2003, the following numbers and species of trees and shrubs were planted: 50 chokecherry; 50 service berry; 50 mountain mahogany; 12 cottonwood poles; 30 potted bristle cone pine; and 10 local willow poles. All trees and shrubs were marked with flags and planted on the western side of the floodplain near the Creede sewage lagoons and the hiking trail. Planting holes were prepared with approximately 8 ounces of wetted polyacrilimide and gelatinous polyacrilimide provided by the Colorado State Forest Service. Topsoil was also placed in the holes where sufficient native soil was not available. This topsoil was purchased by the WCRC in the summer of 2002 as bottom material from Rob Deacon's pond outside Creede. Pines were planted on the higher and drier areas near the trail with sunscreens placed on both southern and western sides. The chokecherry, service berry, and mountain mahogany were planted in various moisture and slope conditions. The willow poles were cut on site below the sewage lagoons. Cottonwood and willow poles were around 2-inches in diameter and 10 feet in length. Holes for the willow and cottonwood

2003 shrub plantings

poles reached approximately one foot below the water table (2-3 feet down), and were dug by an excavator and operator provided by the city of Creede.

Conclusions

Evaluation of the success of re-vegetation trials is an ongoing effort. Due to dry summers in 2001 and 2002, the water table in the floodplain has dropped and many ephemeral channels have been dry. This drought has inhibited the growth of trees, and in many cases they were unable to develop sufficient root systems to support them. Each spring and summer will bring opportunities to continue monitoring old plots and plantings for new growth, and to support tree development whenever possible with supplemental water. It is evident that water is the a key component is re-vegetation success, and further trials involving supplemental water will be planned in years that promise to be wet. Some of the treatments tested in 2002 will likely be repeated in future due to the overwhelming drought of that growing season. Although topsoil, fertilizer, lime, and compost have shown the most promise, future efforts will continue to evaluate the most cost-effective combinations and alternatives that incorporate several beneficial qualities, such as the potatoes in 2002. Evaluation of the success of the 2003 plantings will be conducted in 2004.