DRRP ACTIVE REVEGETATION:
MOVING FORWARD

Background:

During the past five years, partners from the Dolores River Restoration Partnership (DRRP) have initiated dozens of active revegetation projects as part of a collective effort to restore the river's riparian corridor. Of these projects, which span two states, four BLM field offices, and five counties, we have had successes, total failures, and projects somewhere in the middle. From these experiences, we have learned a great deal.

Given how expensive revegetation projects are (e.g. cost & time) and the importance of preventing re-encroachment of invasive plants as we work towards DRRP's ecological goals, we are taking revegetation projects on in thoughtful ways that build on past experience. This document is a step in that process.

While there are many commercial products and technical resources available to support active revegetation projects, we have created this document to share *some* of what we have learned through our efforts to date. Sources of this information include partners' anecdotal observations, DRRP monitoring reports, and several manuals and journal articles that we have pulled information from (see References).

This document is organized into what we consider to be some of the key components of revegetation:

- Passive versus Active Revegetation
- Site Selection
- Species Size and Selection
- Planting and Seeding
- Maintenance

Passive versus Active Revegetation

Working along 200 miles of the Dolores River and its tributaries, partners must prioritize where and whether active revegetation should occur. On many sites, passive revegetation (passive recruitment) may be sufficient once the weedy component of the vegetation has been controlled; on other sites active revegetation will be necessary to ensure that the site does not become reinvaded by weedy species.

Passive recruitment following weed treatments has been documented at restoration sites in all four BLM field offices. Partners are seeing the following native species passively recruit at sites: coyote willow (*Salix exigua*), big sage (*Artemisia tridentata*), New Mexico privet (*Forestiera neomexicana*), alkali pepper weed (*Lepidium crenatum*), suaeda (*Suaeda Forssk*), greasewood (*Sarcobatus vermiculatus*), inland saltgrass (*Distichlis spicata*), three-leaf sumac (*Rhus trilobata*), alkali sacaton (*Sporobolus airoides*), rabbit brush (*Ericameria nauseosa*), Fremont cottonwood (*Populus fremontii*), and sand dropseed (*Sporobolus cryptandrus*).

Where seed sources of native plants are close and sizeable, generally deferring to passive recruitment (with continued monitoring) makes sense. If there is more than 10% of remnant native plant community composition in wet areas, and/or more than 25% composition in drier sites (>10 ft. groundwater depth), then deferring to passive recruitment may be appropriate. Researchers in California advise that if the area cleared of woody invasive species is wide and large (e.g. > 1 hectare), then some form of active revegetation may be warranted.

Site Selection:

Here are important conditions needed for selecting appropriate sites for active revegetation; <u>together</u>, these considerations should form the basis for a site-based active revegetation plan.

- For plant species that need a shallow water table, groundwater does not drop more than 10 feet below the soil surface (ideally, no more than 6 feet) at the site.[1]
- Given the arid climate and high summer temperatures, sites where containerized plantings of riparian and/or mesic species will be planted must have seasonal inundation from overbank flows, be connected to the underlying water table throughout the year, and/or receive supplemental watering during spring-summer to minimize severe desiccation and mortality.[2]
- For most riparian tree and shrub species, soil salinity millisiemens (mS) should be less than 4-6 (for cottonwoods, less than 2.3 mS).[3]
- If area cleared of tamarisk is wide and large (e.g. > 1 hectare) and the manager has decided to plant containerized stock, consider planting this stock in 'islands' (multiple plantings grouped together) across the site (rather than single plants spread apart) to increase shared soil moisture and mutual protection to increase chances of survival and make it easier for supplemental watering efforts.
- Livestock and/or recreationists are managed effectively (e.g. rotational grazing, exclusions such as fencing).
- Generally soils should have a good mix of sand and clay (e.g. sandy loam, silty loam, sandy clay loam, sandy clay, clay loam, loamy sand) to provide an optimal combination of moisture and nutrient availability for plantings, although different plant species requirements can vary.

Species Size & Selection:

Based on plantings by the Uncompahgre and Moab BLM Field Offices along the Dolores River, we have anecdotally seen some species do better than others; species that have done well are listed in Table 1.

While more expensive, we have seen larger sized plantings (e.g. containerized, 1 qt) have higher survival rates than smaller tubes. Poles and cuttings have had mixed results, based on abiotic factors such as soil salinity.

Table 1: Active revegetation species that have done well along the Dolores River

Riparian Species	Upland Species
Three-leaf sumac (*Rhus trilobata*)	Four-wing saltbush (*Atriplex canescens*)
New Mexico privet (*Forestiera neomexicana*)	Sulphur flower buckwheat (*Eriogonum umbellatum*)
Wood's rose (*Rosa woodsia*)	Sand dropseed (*Sporobolus cryptandrus*)
Golden currant (*Ribes aureum*)	
Sand dropseed (*Sporobolus cryptandrus*)	

[1] Several sites have water wells that will inform groundwater depth; for those lacking water wells, use existing plant community (e.g. presence of coyote willow, phragmites) and knowledge of site hydrology to estimate the depth.

[2] While seeding may not need it, a very compelling case will need to be made for containerized plantings if water is not available at the site, based on recent monitoring of 2015 plantings.

[3] Sites where the DRRP cottonwood suitability assessment was conducted have a wealth of soil information that should be referred to. NRCS soil maps and pit samplings are other good sources of information.

Planting and Seeding:

Shade: Based on findings from the DRRP pilot-project study near Bedrock, CO, we have seen that some shade benefits plantings in this semi-arid system. Building on these findings, several DRRP projects in Montrose County, CO and Grand County, UT have called for a mosaic treatment, effectively leaving some tamarisk intact when conducting removal so as to provide shade and protection for new containerized plantings. Whether leaving some tamarisk structure intact, creating berms around plantings, installing vertical structures (e.g. dead shrubs) next to your containerized plantings, or placing sticks over/across a planting (see photos below), shading may make the difference for survival of these plantings especially in upper drier terraces.

Left: A good example of vertical structure installed around a three-leaf sumac planting in Bedrock, CO. Right: A good example of protective cover and shading around and over a cottonwood planting. Both instances use tamarisk slash from previous control work as the source of the protective woody material.

Water: When digging holes for planting, create large basins that will collect surface water; berms may be added on the down-hill side of the planting also to capture surface run-off.

Preparing for a Seeding:

- When seeding, ensure good seed-to-mineral soil contact (whether it is using an excavator, rake, trailing cattle, or boot heel). Keep in mind that too much tamarisk slash/mulch (e.g. 8 inches) over a broadcast seeding may inhibit seed germination.
- If seeding a burn-site, use salt-tolerant plant species and soil from outside the burned area to reintroduce micro-biotic community.
- When using a drill seeder, test equipment before mobilizing to ensure proper functionality.
- Consider using a mix of warm and cool season species.

Planting and Protecting Containerized Plantings:

- Consider planting in groups or 'islands' as mentioned above, which makes follow-up maintenance & monitoring easier.
- If planting in 'islands', consider either documenting the assemblage of species in a field journal or distinguishing species by color-coded flagging to facilitate later monitoring of species vigor and survival.
- Always mark plantings so you can easily find them later to monitor and maintain them – they can be very hard to find otherwise, and impossible to distinguish from naturally established plantings.
- Once a planting hole is dug, fill it with water; let the water absorb into the soil and then install planting; once soil is placed back in the hole and the plant is planted, gently compact the soil, then water again.
- Do not assume that crews or individuals conducting planting efforts know how to install plantings correctly; it is the responsibility of the land manager to educate and oversee the planting crew (and re-train if necessary) until the land manager feels confident in the ability of the crew to plant stock correctly. We have seen money and time wasted and significant plant mortality because planting crews were not trained correctly/had too little oversight during the planting process.

- If herbivory (e.g. from beaver, livestock, elk, deer) is a concern, use appropriate caging materials (e.g. 12.5 or 14 gauge welded wire fencing, hog rings, and rebar). Some partners have also had success painting a mixture of coarse mason's sand and exterior latex paint on the base of trees to deter beaver. Protective devices (caging, coats of paint) warrant follow-up maintenance.

Maintenance:

Watering containerized plantings: Kassy Skeen, manager of the Williams Conservatory at the University of Wyoming and former restoration manager at the Grand Canyon National Park recommends watering:

- Once per week during the first growing season
- Once every other week during the second growing season
- Once per month during the third growing season
- No additional watering during the fourth growing season
- Backcountry and/or riparian areas may be watered less frequently (e.g. twice a month for the first two growing seasons, once per month during the third growing season)

While each site and revegetation project has its own unique set of conditions and water needs (e.g. perhaps infrequent watering during fall and/or winter may be needed), Wildland Scapes Plant Nursery in Moab, UT underscores the importance of always checking soil moisture before watering (e.g. to avoid overwatering or determine if greater watering frequency is needed). The nursery notes that rain in summer rarely changes your watering frequency, whereas rain during the spring and fall may allow you to skip a watering; also watering should get to where the plants need it (i.e. at least one to two feet deep, to the roots). The slower and deeper the watering, the deeper roots will grow and then the watering frequency ultimately can be decreased.

Controlling herbaceous weeds:

- Avoid/minimize damage to plantings with follow-up herbicide treatments: flag plantings and communicate with herbicide application crews so they know where plantings are and to avoid them. Also make sure that herbicide application crews are especially careful/knowledgeable regarding 'drift' of herbicides on windy days, volatilization of herbicides in warm temperatures, and avoid overspray (i.e. spraying a weed in the foreground but also hitting desirable plants growing directly behind the weed).
- If weed treatments are warranted within a planting site, consider hand-pulling or mowing weeds (e.g. with a weed whacker or brush cutter) or using a wick applicator (i.e. wipe an herbicide like Roundup on individuals plants to avoid or minimize non-target impacts).
- For kochia and Russian thistle, if spraying is not preferred, a first mowing in late July-early August (i.e. pre-seeding) is advised, with potential follow-up mowing needed in September or October. If herbicide application is prioritized, consider treating kochia with VISTA when it is 3- 4 inches tall.
- If you will be continuing to conduct herbaceous weed control in an area after seeding, it can be useful to focus on seeding grasses/plant species that will be minimally impacted by continued herbicide application to protect expensive seeding efforts.

DOLORES·RIVER
RESTORATION PARTNERSHIP

Resources:

DRRP Partners & Resources: Kara Dohrenwend (Wildland Scapes Plant Nursery); Amanda Clements and Ann Marie Aubrey (BLM); Shannon Hatch, Julie Knudson, and Daniel Oppenheimer (Tamarisk Coalition); DRRP Annual Rapid Monitoring Reports and Cottonwood Suitability Assessment.

Palenscar, K. 2012. The Role of Native Riparian Vegetation in Resisting Invasion by Giant Reed, *Arundo donax*. Available at http://escholarship.org/uc/item/6sg133ht#page-139.

Shafroth et al. 2008. Planning Riparian Restoration in the Context of Tamarix Control in Western North America. *Restoration Ecology* Vol. 16, No. 1, pp. 97–112.

Skeen, K. 2014. Dryland Restoration: Tips, Tricks, and Techniques for Restoring Native Habitats in the Southwest. Available at: https://docs.google.com/a/tamariskcoalition.org/file/d/0B-4EhbXW17CENTdPUzl1VnFEVU0/edit

Sher et al. 2010. Best Management Practices for Revegetation after Tamarisk Removal in the Upper Colorado River Basin. Available at: http://tamariskcoalition.org/resource-center/documents/best-management-practices-revegetation-after-tamarisk-removal-0

Questions about this Document?

This is intended to be a concise reference that distills select DRRP findings. To delve into more revegetation specifics, please contact Julie Knudson, TC Staff Scientist (jknudson@tamariskcoalition.org), or Daniel Oppenheimer, TC Restoration Coordinator (doppenheimer@tamariskcoalition.org), at 970-256-7400. Thanks!