
Appendices

Appendix A

Delta Levees Habitat Program Guide to Planting Native Grassland Habitat on a Reconstructed Landside Levee Slope (CDFW and DWR, unpublished memo)

Delta Levees Habitat Program Guide to Planting Native Grassland Habitat On a Reconstructed Landside Levee Slope



The Delta Levees Program habitat enhancement mission is to “restore and enhance sustainable and diverse habitats (particularly shaded riverine aquatic, channel margin, wetlands, riparian forest, scrub-shrub, and uplands) in a mosaic that benefits the overall ecological health of the region and its native species.” Levee slopes can meet these objectives by supporting upland native grassland habitat. Native grasslands can be a challenge to establish and maintain; however, a basic understanding of the life cycle and ecology of grasses can help us deliver a lush, weed-resistant native grass and forb cover that provides habitat for wildlife and pollinators on levees. We recommend the following steps:

Soil Preparation

- Choose native seed appropriate to the soil conditions. See recommended seed mixes in attached seed tables.
- Roots need good soil structure that allows water and oxygen to infiltrate the porous spaces. To remedy compaction, shallow chisel (1-2.5 feet deep) and then disc the soil surface or add 6 – 8” of clean, uncompacted top soil to the levee slope.

Grass-Seeding Methods

- Seed in the rainy season (late October through November), but possibly as late as mid-January depending on seed mix and irrigation options. Avoid seeding ahead of a dry spell, when a single rain may germinate and subsequent dry spells may kill shallow-rooted seedlings.
- Drill seed the grass mix on the 4:1 and flatter slopes to a depth of $\frac{1}{4}$ - $\frac{1}{2}$ inch using a no-till range drill such as a Truax drill that can handle the long awns of native grass seed. Drill-seeding requires less seed than other methods and can be more effective for establishment.
- On the 2:1 slope, broadcast grass seed mix and then using a straw blower apply rice straw at 50 bales per acre. Coverage should be 90 percent at 2 inches deep. Incorporate straw into the soil using a tracklayer pulling a bladed crimper lengthwise along the slope. The rice straw will provide erosion control to help prevent the uneven distribution of the soil and seeds.

- Fertilizer is not advised unless the top soil is lacking in basic nutrients. Nitrogen (N) fertilizer tends to benefit non-native species over native species. For more details on successful seeding of native grasses see John Anderson's "Direct Seeding of California Native Grasses in the Sacramento Valley and Foothills":
<http://www.hedgerowfarms.com/pdfs/DirectSeedingofCaliforniaNativeGrasses.pdf>

Forb-Seeding Methods (after grass establishment and control of broadleaf weeds)

- Broadcast forb seed mix into the native grasses during the fall rainy season after three years of weed control. Alternatively, any bare ground patches can be seeded with forbs by broadcasting seed and then light tilling or harrowing. See Table 2 for forb seed recommendations.
- Once the site has been seeded with forbs, herbicide use must be limited to spot spraying for invasive weeds.

Monitoring and Maintenance

Native grasses are slower to germinate and grow, needing help against fast-growing, tall weeds that can out-compete for sun and nutrients. Once native grasses and forbs take root, regular maintenance, primarily weed control such as well-timed mowing and herbicide application, will be necessary to ensure their permanency. By slightly adjusting existing levee maintenance activities, the District can ensure the development and maintenance of valuable habitat with little additional time and effort.

Year One Management Activities:

- Monitor bi-weekly during early months to assess seedling germination success, and less regularly over the year to monitor weeds. Areas can be reseeded as late as January, if germination was unsuccessful, depending on rain outlook for spring.
- Plan to use supplemental watering if dry periods develop during the typical rainy season (October-April). Use truck broadcast irrigation if soil infiltration occurs relatively quickly. Use sprinkler irrigation if water infiltration is slow and runoff would occur if a truck broadcast irrigation was used.
- Mow with the blade(s) set for a minimum of 8 inches off the ground in early spring (typically end of April) to target non-native, annual grasses (such as ripgut brome, barley, wild oats, etc.). This frees the native grasses from shade and will reduce non-native, annual grass seed production. This timing is suggested to occur just before the weedy grass seed is fully-developed and able to germinate. In order to determine viability, seed can be opened (squeezed between fingernails) and checked for a clear liquid, which indicates that the timing is right to mow. If the clear liquid has transformed into a white liquid, then the seed is near viability and mowing may be too late to reduce the seed bank for next year's growth.

- Mow again in summer and/or fall, as necessary, to target weed seed production. If broadleaf weeds are competing with native grass seedlings, spray an appropriate selective herbicide at the appropriate time for best control. Special attention is needed to head off development of invasive weed seeds. See the 2013 reference book “Weed Control in Natural Areas in the Western United States” by the UC Davis Weed Research and Information Center for control recommendations of various species.

Years Two-Three Management Activities:

- Monitor the site in early spring (February/March) and again in the fall to determine the appropriate time to mow or plan for herbicide applications. Spray invasive weeds with a selective herbicide during the appropriate time of the year.
- Mow (8-inch minimum blade height) in early April (typically) to target non-native, annual grass seed production and to manage weed seed production as necessary during early to late summer. Avoid mowing in late May-early June to protect native grass seed production.

Long-Term Management Activities:

- Monitor the site in the early spring and in the fall to determine the appropriate time to mow or control for weeds using herbicide.
- Continue to mow (8-inch minimum blade height) in early April to avoid non-native grass seed production. Additional mowing of invasive broad-leaf weeds is sometimes necessary in summer or fall.
- Spot spray invasive weeds with a selective, broad-leaf herbicide to prevent their spread, since boom-spraying of these herbicides will kill desired seeded forbs.

Table 1: Grass seed mix recommendation.

<i>Species name</i>	Common name	Pounds	Pure Live Seed (PLS) per LB (average)
<i>Elymus triticoides</i>	Creeping wildrye	3	130,000
<i>Elymus glaucus</i>	Blue wildrye	6	125,000
<i>Distichilis spicata</i>	Salt grass	4	500,000
<i>Hordeum brachyantherum ssp. Californicum</i>	California barley	4	130,000
<i>Muhlenbergia rigens</i>	Deergrass	1	500,000
<i>Stipa pulchra</i>	Purple needlegrass	2	58,000
	Total	20 lbs	

Table 2: Forb seed mix recommendation.

<i>Forb Species</i>	Common name	Flowering time	Pounds	PLS per LB (average)
<i>Croton setigerus</i>	Dove weed	May-Oct	3	18,000
<i>Asclepias</i> spp.	Milkweed	April-July	3	64,000 (<i>A. fascicularis</i>)
<i>Grindelia camporum</i>	Gumplant	May-Oct	4	80,000
<i>Calindrinia ciliata</i>	Redmaids	Feb-May	1	900,000
<i>Acmispon glaber</i>	Deerweed	May-August	3	158,000
<i>Eriogonum</i> spp.	Buckwheat	May-August	2	Varies
		Total	16 lbs	

The Xerces Society's web site provides details on forb seed mixes appropriate to California and other informational resources such as suppliers and seeding strategies.
<http://www.xerces.org/pollinators-california-region/>

California Native Plant Link Exchange <http://www.cnplx.info/index.html> provides supplier and horticulture information.

For more information on this guidance document, please contact either Alec Strachan of CDFW at Alexander.Strachan@wildlife.ca.gov 209-234-3454 or Molly Ferrell of DWR's Delta Ecosystem Enhancement section at Molly.Ferrell@water.ca.gov 916-651-0853.

Appendix B

Delta Levees Grass Seed Trial Options 2015 (DWR, unpublished memo)

Delta Levees Grass Seed Trial Options 2015

- A.**
1. Prep the ground
 2. Seed, then incorporate the seeds into the ground as best as possible (e.g., drag a harrow)
 3. Blow straw, ideally native grass straw (native grass straw is \$10/bale, need 40 bales per acre, cost is \$400 per acre).
 4. Hydroseed with mulch and sticker to cover the seeded area (the mulch keeps the moisture down and protect the seeds from bird predation)

This technique adds to the cost but it works well as it adds organic matter to the site and straw + mulch provide a good moisture retention cover.

This method is different than the typical hydro-seeding technique, which is to mix water, mulch, sticker and seeds together then to spray the mixture onto the site. The issues regarding this practice are:

- Since the seeds are wet, they start to germinate right away so unless it rains soon after, you will lose the seeds that will dry out
- Many seeds are in suspension in the mixture and don't get in contact with soil thus die soon after they germinate because the roots are exposed

- B.** Borrow SAFCA's ridge roller seeder RRS and implement techniques used along Natomas levees a medium disk will break up, smooth over and fill in the rip gaps. When the Ridger Roller Seeder follows this, the "seed grooves" act as a parallel enhancement to stabilize the surface.



Figure 1 RRS seeded slope

Other options for seeding could include:

- C.** Broadcast seed with ATV and follow with harrow (attached to ATV).
- D.** Hire a pilot/plane to aerial seed.

Appendix C

Bacon Island Levee Rehabilitation Project Planting Design

BACON ISLAND PLANTING PLAN

SAN JOAQUIN COUNTY, CA

Stillwater Sciences

2855 TELEGRAPH AVENUE, SUITE 400
BERKELEY, CA 94705 P: (510) 848-8098



PROJECT NUMBER: 167.49
SCALE: AS NOTED
DATE: 10/18/2017

DESIGN: NJ
DRAWN: CL
CHECKED: RT
APPROVED: ----

PLANTING PLAN
OVERVIEW

SHEET 1 OF 4

IF BAK DOES NOT MEASURE 1" DRAWING IS NOT TO SCALE - QUOTE ACCORDINGLY
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BACON ISLAND PLANTING PLAN

SAN JOAQUIN COUNTY, CA

Stillwater Sciences

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Planting Zone	Scientific Name	Common Name	Life Form	Container plant size	Average Spacing (feet on-center)	Percent Fill	Number of Plants				Pounds of Seed Levee Slope 68.3ac	TOTAL
							HEA1 1.3ac	HEA2 0.2ac	HEA3 1.1ac	HEA4 1.4ac		
Levee Grassland	Levee grassland seed mix	various	graminoids and forbs	seed							750.16	
Riparian Forest	<i>Acer negundo</i>	box elder	tree	treeband	20	5%	4		6			10
	<i>Fraxinus latifolia</i>	Oregon ash	tree	deepot 16	20	5%	4					10
	<i>Populus fremontii</i> subsp. fremontii	Fremont cottonwood	tree	cutting	20	30%	23		36			59
	<i>Salix gooddingii</i>	Goodding's black willow	tree	cutting	20	30%	23		36			59
	<i>Salix lasiolepis</i>	arroyo willow	shrub or small tree	cutting	20	20%	15		24			39
	<i>Rosa californica</i>	California rose	shrub	treeband 9	12	5%	11		17			28
	<i>Vitis californica</i>	California wild grape	shrub/vine	treeband 9	12	5%	11		17			28
	Total Riparian Forest					100%	91		142			233
Scrub-shrub	<i>Salix exigua</i>	narrowleaf willow	shrub or small tree	cutting	12	15%	27	9		64		100
	<i>Salix laevigata</i>	red willow	shrub or small tree	cutting	20	15%	10	3		23		36
	<i>Salix lasiolepis</i>	arroyo willow	shrub or small tree	cutting	20	15%	10	3		23		36
	<i>Rosa californica</i>	California rose	shrub	treeband 9	12	5%	9	3		21		33
	<i>Baccharis salicifolia</i> subsp. salicifolia	mule fat	shrub	treepot 4 or treeband	12	20%	36	12		85		133
	<i>Cephalanthus occidentalis</i>	California button willow	shrub	treeband	12	3%	5	2		13		20
	<i>Cornus sericea</i> subsp. sericea	American dogwood	shrub	deepot 16	12	10%	18			42		60
		Total Scrub-shrub					83%	115	32		271	

Levee Grassland Seed Mix					
Scientific Name	Common Name	Life Form	Seeding Rate (lbs/acre) mixed	Area of Planting Zone (acres)	Qty (lbs)
Graminoids					
<i>Elymus glaucus</i>	blue wild-rye	perennial grass	0.80	68.3	54.64
<i>Elymus triticoides</i>	beardless wild rye	perennial grass	3.60	68.3	245.88
<i>Poa secunda</i> subsp. secunda	one-sided blue grass	perennial grass	0.10	68.3	6.83
<i>Stipa pulchra</i>	purple needle grass	perennial grass	0.90	68.3	61.47
<i>Bromus carinatus</i>	California brome	perennial grass	3.60	68.3	245.88
Forbs (after year 3)					
<i>Achillea millefolium</i>	yarrow	Annual herb	0.07	68.3	4.55
<i>Eschscholzia californica</i>	California poppy	Annual herb	0.58	68.3	39.84
<i>Lupinus bicolor</i>	miniature lupine	Annual herb	1.33	68.3	91.07
	TOTAL:				750.16



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PLANTING & SEED MIX TABLE

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BACON ISLAND PLANTING PLAN

SAN JOAQUIN COUNTY, CA

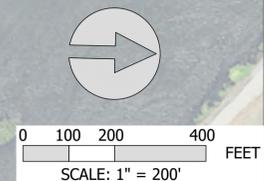
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LEGEND

-  LEVEE GRASSLAND
-  RIPARIAN FOREST
-  SCRUB-SHRUB



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PLANTING PLAN
HEA1 & HEA2

SHEET 3 OF 4

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BACON ISLAND PLANTING PLAN

SAN JOAQUIN COUNTY, CA

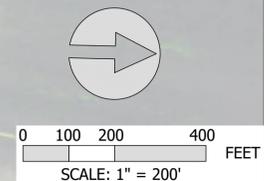
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LEGEND

-  LEVEE GRASSLAND
-  RIPARIAN FOREST
-  SCRUB-SHRUB



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PLANTING PLAN
HEA3 & HEA4

SHEET 4 OF 4

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