

Appendix D. Assumptions Used to Conduct the Benefits Analysis of Alternatives

This appendix summarizes the assumptions used to conduct the benefits analysis for each alternative. Assumptions describe the restoration measures and design employed and how habitats are expected to develop under each alternative. Descriptions of how habitats are expected to develop describe only the development of structural characteristics of the habitats that are evaluated in the habitat quality and habitat suitability index models. Table D-1 identifies the models and associated variable used to assess each habitat type.

GENERAL ASSUMPTIONS

The following general assumptions were used to conduct the benefits analysis of the Project Alternatives:

- The project area, as identified in the Final Plan, is the same for all alternatives.
- Under the No-Project Alternative, the quality and quantity of habitats currently present in the project area will not change during the 50-year evaluation period.
- The restoration construction period is 1 year for Alternatives 1 and 2.
- Habitat values are assessed over a 50-year period.

ALTERNATIVE 1

The assumptions used to assess habitat conditions under Alternative 1 are based on the restoration design described in the Final Plan. Assumptions about how habitats would be restored and how they will develop over time are presented in Table D-2.

Table D-2. Assumptions Used to Conduct the Analysis of Alternative 1

Habitat Type	Restoration Methods	Habitat Development
Mixed riparian woodland	Plant tree and shrub species as seedlings. Seedlings to be installed as Dee-Pots.	Riparian tree and shrub plantings will be planted along graded channels and backwater sloughs. It is anticipated that the depth to groundwater and absence of surface water during parts of the year may be limiting factors in providing optimal growth for riparian vegetation.
	Plants installed 10 feet on center.	Riparian species with relatively fast growth rates (e.g., willows and cottonwoods) will be restricted to the lower-elevation planting areas. The upper elevation planting areas will be dominated by slower growing species.
	Provide irrigation for 2 years following initial plant installation.	Percent shrub canopy cover initially increases to the optimal habitat value in target year (TY) 11, but then decreases over time as the overstory canopy develops.
	Provide weed maintenance of herbaceous weeds for 2 years following initial plant installation.	The optimal values for tree height and canopy layering are achieved in TY11 and are maintained through TY50.
	Provide weed maintenance of woody, non-native, invasive species 5 years following initial plant installation.	The percent of the site in woody riparian vegetation is 22% of the total project area.
Seasonal wetland	Use no plant protection tubes.	
	Grade to provide and maintain supporting surface hydrology.	The optimal habitat value for average vegetation height and percent herbaceous cover is achieved in TY6 and is maintained through TY50.
	Control seed bank of existing grasslands or agricultural land by grading.	Beginning in TY6 and continuing through TY50, 50% of the herbaceous cover is assumed to be provided by native seasonal wetland species.
	Inoculate with native seasonal wetland seed mix.	

Habitat Type	Restoration Methods	Habitat Development
Permanent marsh	Grade permanent wetland areas to create shallow-sloping sides.	The assumption for average water depth is based on water levels historically observed during May. Some areas within the permanent marsh zones will dry out completely in late spring or summer. The average water depth for all permanent marsh areas throughout the year is 1 foot.
	Plant plugs of emergent vegetation 5 feet on center. No maintenance or other weed control efforts.	Beginning in TY11 and continuing through TY50, the overall habitat value of the permanent marsh remains constant. Emergent marsh vegetation will be completely established in all suitable planting areas by TY6. The optimal habitat value for the number of emergent marsh species comprising at least 10% of the total cover is not achieved until TY11. None of the remaining variables achieves the optimal habitat value.
Valley oak/sycamore woodland	Oaks will be installed 20 feet on center within the woodland habitat areas. Fifty percent of the oak planting sites will be planted with acorns, the remaining 50% will be planted with seedlings.	Oak planting survival is assumed to be 40% of the original number planted in TY50.
	Shrubs will be installed 40 feet on center. Shrub seedlings will be installed as Dee-Pots.	The optimal habitat value for percent canopy cover by trees greater than 11 inches diameter at breast height (dbh) is achieved in TY31 and is maintained through TY50.
	Provide irrigation for 3 years following initial plant installation.	The optimal habitat value for percent groundcover provided by non-invasive grasses is achieved in TY6 and is maintained through TY50.
	Provide weed maintenance of herbaceous weeds for 3 years following initial plant installation.	The optimal habitat value for percent shrub canopy cover is achieved in TY11 and is maintained through TY50.
	Install plant protection tubes.	The growth rates assumed for oak plantings under Alternatives 1, 2, and 3 are the same.
	Disk and plow existing habitats and seed with a native perennial and annual seed mix.	
	Provide 1 year of post-seeding weed control treatment.	

Habitat Type	Restoration Methods	Habitat Development
Valley oak/sycamore savanna	<p>Plants to be installed in clusters that are 200 feet on center with the savanna habitat areas. Plantings will be 40 feet on center within each cluster.</p> <p>Each cluster will consist of an average of 8 oak and 7 shrub plantings. Fifty percent of the oak planting sites will be planted with acorns, the remaining 50% will be planted with seedlings.</p> <p>Seedlings to be installed as Dee-Pots.</p> <p>Provide irrigation for 3 years following initial plant installation.</p> <p>Provide weed maintenance of herbaceous weeds for 3 years following initial plant installation.</p> <p>Install plant protection tubes.</p> <p>Disk and plow existing habitats and seed with a native perennial and annual seed mix.</p> <p>Provide 1 year of post-seeding weed control treatment.</p>	<p>Oak planting survival is assumed to be 40% of the original number planted in TY50.</p> <p>The optimal habitat value for percent groundcover provided by non-invasive grasses is achieved in TY6 and is maintained through TY50.</p> <p>The optimal habitat value for percent shrub canopy cover is achieved in TY50. The optimal value is not reached until TY50 because the planting density of shrubs does not result in enough canopy cover to receive value in the model until TY50.</p> <p>The growth rates for oak plantings under Alternatives 1 and 2 are the same.</p>
Herbaceous upland	<p>Disk and plow existing irrigated pasture and annual grassland.</p> <p>Provide 1 year of weed seed bank control prior to seeding [pre-treat with herbicide and disc twice (spring, summer) before planting].</p> <p>Seed with a native perennial and annual seed mix.</p> <p>Provide 2 years of post-seeding weed control treatment.</p>	<p>The optimal habitat value for percent herbaceous cover provided by grasses is achieved in TY6 and is maintained through TY50.</p> <p>The optimal habitat value for percent herbaceous cover provided by native perennial grasses is achieved in TY10 and is maintained through TY50.</p> <p>The habitat value for the distance to the nearest tree remains constant from TY0 through TY6 and then increases to the maximum value as woody vegetation plantings in other habitat areas mature.</p>

ALTERNATIVE 2

The assumptions used to assess habitat conditions under Alternative 2 are based on the restoration design described in Chapter 3 of the Final Plan. Under Alternative 2, assumptions used to analyze seasonal wetland, valley oak/sycamore woodland, valley oak/sycamore savanna and herbaceous upland are the same as described for Alternative 1 (Table D-2). Assumptions about how mixed riparian woodland would be restored and how it will develop over time are presented in Table D-3.

Table D-3. Assumptions Used to Conduct the Analysis of Mixed Riparian Woodland under Alternative 2

Habitat Type	Restoration Methods	Habitat Development
Mixed riparian woodland	Same as Alternative 1 (Table D-2), but some of the planting areas have less favorable hydrology (i.e., they are not located along permanent or temporarily inundated channels or sloughs)	<p>Riparian tree and shrub plantings will be planted along graded channels and backwater sloughs. It is anticipated that the depth to groundwater and absence of nearby surface water may be limiting factors in providing optimal growth for riparian vegetation</p> <p>Riparian species with relatively fast growth rates (e.g., willows and cottonwoods) will be restricted to the lower-elevation planting areas. The upper-elevation planting areas and those areas not adjacent to permanent or temporary water sources will be dominated by slower-growing species</p> <p>Percent shrub canopy cover initially increases to the optimal habitat value in TY6 but then decreases over time as the overstory canopy develops</p> <p>The optimal habitat value for average height of overstory trees and canopy layering is achieved in TY11 and is maintained through the life of the project</p> <p>The percent of the site in woody riparian vegetation is 15% of the total project site</p>

ALTERNATIVE 3

The assumptions used to assess habitat conditions under Alternative 3 are based on the restoration design described in Chapter 5. Under Alternative 3, the assumptions used to analyze seasonal wetland, valley oak/sycamore woodland, and herbaceous upland are the same as described for Alternative 1 (Table D-2). Assumptions about how mixed riparian woodland, permanent marsh,

and herbaceous upland would be restored and how they will develop over time are presented in Table D-4.

The analysis of Alternative 3 assumes that the project area will be mined for a 10-year period and that restoration measures will be implemented in the year after the mining has ended. Consequently, restored habitats are only present in the project area for 40 years of the 50-year evaluation period.

Table D-4. Assumptions Used to Conduct the Analysis of Mixed Riparian Woodland, Permanent Marsh, and Herbaceous Upland under Alternative 3

Habitat Type	Restoration Methods	Habitat Development
Mixed riparian woodland	Same as Alternative 1 (Table D-2), except the planting areas have more favorable hydrology and are expected to have better growth rates.	Riparian tree and shrub plantings will be planted on a lowered floodplain surface that will be regularly inundated during the rainy season and will be closer to groundwater.
	The floodplain is lowered by mining gravel to an elevation that provides optimal hydrology for supporting riparian vegetation.	Riparian species with relatively slow growth rates will be restricted to the upper-elevation planting areas.
	Following cessation of mining activities, the floodplain is graded to create optimal surfaces for planting riparian vegetation.	Percent habitat shrub canopy cover initially increases in value, then decreases over time as the overstory canopy develops.
		The optimal habitat value for percent tree canopy cover and canopy layering is achieved in TY20 and is maintained through TY50.
		The optimal habitat value for tree height is achieved in TY15 and is maintained through TY50.
		The percent of the site in woody riparian vegetation is 60% of the total project area.
Permanent marsh	Grade permanent wetland areas. The side slopes will be steeper and the average water depth and channel width are greater than those in Alternative 1 (Table D-2).	Average water depth is based on historically observed water levels during May. Average water depth for all permanent marsh areas throughout the year is 3 feet.
	Plant plugs of emergent plant 5 feet on center.	Beginning in TY15 and continuing through TY50, the habitat value of the permanent marsh remains constant.
	No maintenance or other weed control efforts.	Emergent marsh vegetation will be established completely by TY15
		The optimal habitat value for the number of emergent marsh species comprising at least 10% of total cover is not achieved until TY20.

Habitat Type	Restoration Methods	Habitat Development
Herbaceous upland	Same as Alternative 1 (Table D-2).	<p>The optimal habitat value for percent herbaceous cover provided by grasses is achieved in TY16 and is maintained through TY50.</p> <p>The optimal habitat value for percent herbaceous cover provided by native perennial grasses is achieved in TY20 and is maintained through TY50.</p> <p>The habitat value for the distance to the nearest tree remains constant from TY10 through TY16 and then increases as woody vegetation plantings in other habitats mature.</p>