

# Lower Colorado River Multi-Species Conservation Program



*Balancing Resource Use and Conservation*

## Palo Verde Ecological Reserve Restoration Development and Monitoring Plan: Phase 5



July 2009

# Lower Colorado River Multi-Species Conservation Program

## Steering Committee Members

### Federal Participant Group

Bureau of Reclamation  
U.S. Fish and Wildlife Service  
National Park Service  
Bureau of Land Management  
Bureau of Indian Affairs  
Western Area Power Administration

### Arizona Participant Group

Arizona Department of Water Resources  
Arizona Electric Power Cooperative, Inc.  
Arizona Game and Fish Department  
Arizona Power Authority  
Central Arizona Water Conservation District  
Cibola Valley Irrigation and Drainage District  
City of Bullhead City  
City of Lake Havasu City  
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City of Somerton  
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Mohave Valley Irrigation and Drainage District  
Mohave Water Conservation District  
North Gila Valley Irrigation and Drainage District  
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Wellton-Mohawk Irrigation and Drainage District  
Yuma County Water Users' Association  
Yuma Irrigation District  
Yuma Mesa Irrigation and Drainage District

### Other Interested Parties Participant Group

QuadState County Government Coalition  
Desert Wildlife Unlimited

### California Participant Group

California Department of Fish and Game  
City of Needles  
Coachella Valley Water District  
Colorado River Board of California  
Bard Water District  
Imperial Irrigation District  
Los Angeles Department of Water and Power  
Palo Verde Irrigation District  
San Diego County Water Authority  
Southern California Edison Company  
Southern California Public Power Authority  
The Metropolitan Water District of Southern California

### Nevada Participant Group

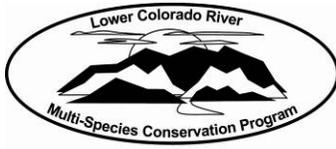
Colorado River Commission of Nevada  
Nevada Department of Wildlife  
Southern Nevada Water Authority  
Colorado River Commission Power Users  
Basic Water Company

### Native American Participant Group

Hualapai Tribe  
Colorado River Indian Tribes  
The Cocopah Indian Tribe

### Conservation Participant Group

Ducks Unlimited  
Lower Colorado River RC&D Area, Inc.



# **Lower Colorado River Multi-Species Conservation Program**

## **Palo Verde Ecological Reserve Restoration Development and Monitoring Plan: Phase 5**

**Lower Colorado River  
Multi-Species Conservation Program Office  
Bureau of Reclamation  
Lower Colorado Region  
Boulder City, Nevada  
<http://www.lcrmscp.gov>**

**July 2009**

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# Acronyms and Abbreviations

<b>CDFG</b>	California Department of Fish and Game
<b>CW</b>	Cottonwood-willow land cover type
<b>DBH</b>	Diameter at breast height
<b>LCR</b>	Lower Colorado River
<b>LCR MSCP</b>	Lower Colorado River Multi-Species Conservation Program
<b>PVER</b>	Palo Verde Ecological Reserve
<b>Reclamation</b>	Bureau of Reclamation
<b>SWFL</b>	Southwestern Willow Flycatcher
<b>YBCU</b>	Yellow-billed Cuckoo

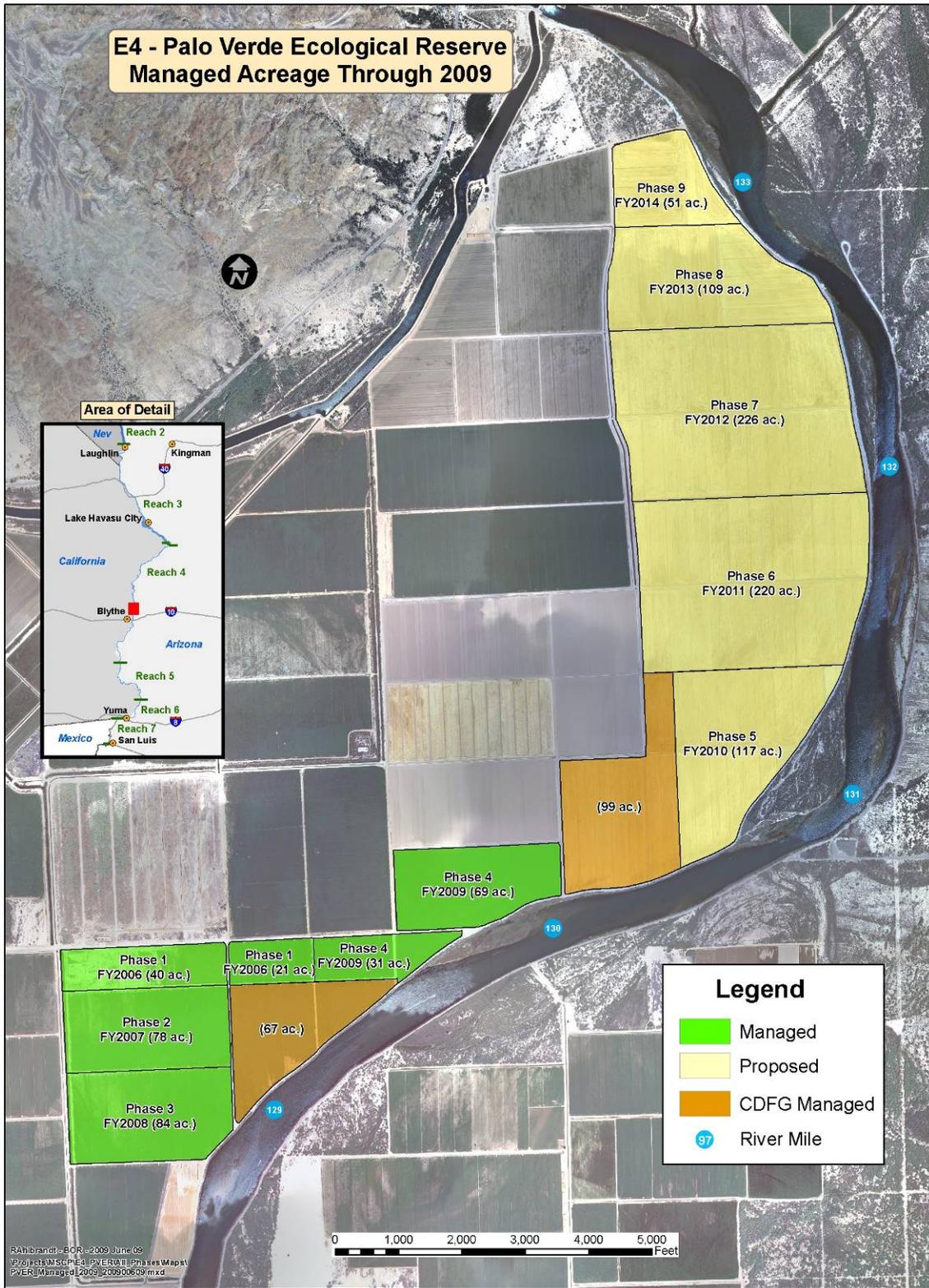
# Background

The Palo Verde Ecological Reserve (PVER) encompasses 1,352 acres of the historical floodplain of the Colorado River near Blythe, California. Formerly, the property was known as the Riverview Ranch and was owned by the Travis family. The ranch was acquired by the Trust for Public Lands in 2004 to offset degradation of wildlife habitat along the lower Colorado River. On September 3, 2004, the property was conveyed to the State of California. California has identified a minimum of 1,100 acres of active agricultural lands on this property for habitat restoration under the Lower Colorado River Multi-Species Conservation Program (LCR MSCP), a 50-year multi-partner program administered by the Bureau of Reclamation (Reclamation).

The California Department of Fish and Game (CDFG) and the LCR MSCP are jointly planning the conversion of portions of PVER from agricultural crops to a mix of native plant species. After planting is complete, the created habitats will be managed for species covered under the MSCP throughout the 50-year life of the program.

The proposed development of the property is shown in Figure 1. Additional site information can be found on the LCR MSCP Web site ([www.lcrmscp.gov](http://www.lcrmscp.gov)) in the report, *Palo Verde Ecological Reserve Restoration Development Plan: Overview*.

Figure 1. Proposed Phasing Map



The number of acres established each fiscal year is shown in Table 1 below. In Phase 1, during fiscal year 2006 (FY06) 61 acres of riparian nursery (to include cottonwood-willow (CW) and mesquite) were established (Table 1). In Phase 2 (FY07), 78 acres were established. In Phase 3, 45 acres were established in FY08 and 39 acres were established in FY09. In Phase 4 (FY09), 100 acres were established.

Additional information on the design, planting, and monitoring of Phases 1-4 can be found in the reports, *Palo Verde Ecological Reserve Restoration Development Plan: Phase 1*, *Palo Verde Ecological Reserve Restoration Development Plan: Phase 2*, *Palo Verde Ecological Reserve Restoration Development Plan: Phase 3*, and *Palo Verde Ecological Reserve Restoration Development Plan: Phase 4*, available on the LCR MSCP Web site.

**Table 1. Phase 1-4 Managed Acres**

Phase	Fiscal year	Acres managed	Land cover type	Cumulative Total
1	2006	61	CW	61
2	2007	78	CW	139
3	2008	45	CW	184
3	2009	39	CW	223
4	2009	100	CW	323

## 1.0 Purpose

The objective of Phase 5, to be developed in FY10, is to create, develop, and maintain approximately 216 acres of CW seral stages I, II, III, and IV. Each phase builds upon previously created habitat mosaics within the site, with the eventual goal of creating approximately 1,100 acres of riparian habitat.

Phase 5 will be managed for the Southwestern willow flycatcher (SWFL), and will benefit other species covered under the LCR MSCP (LCR MSCP 2004) that utilize CW. Vegetation specifically identified as important for habitat and foraging for the Colorado River cotton rat and MacNeill’s sootywing skipper will be planted in several checks of Phase 5.

## 2.0 Design and Planting Plan

In Phase 5 of PVER development, 216 acres of CW will be developed with the intent of creating habitat using both mass transplanting and hand planting techniques. Riparian species composition and density will mimic a natural riparian landscape. The design incorporates cottonwood, willow, and *Baccharis* species, and open areas of native grasses, *Atriplex* spp., and mesquite (Tables 2 and 3). The acreage will be divided into 26 checks (areas between borders) for water management. After the initial growing season, it is anticipated that irrigation schedules for vegetation species with higher water requirements, such as cottonwood and willow, will be kept on the same schedule,

whereas vegetation with lower water requirements, such as mesquite and *Atriplex*, will be placed on a reduced schedule.

**Table 2. Phase 5 Native Plant Species List**

Scientific Name	Common Name
<i>Populus fremontii</i>	Cottonwood
<i>Salix exigua</i>	Coyote willow
<i>Salix gooddingii</i>	Goodding's willow
<i>Prosopis glandulosa</i> var. <i>torreyana</i>	Honey mesquite
<i>Baccharis sarothroides</i>	Desertbroom
<i>Atriplex lentiformis</i>	Quailbush
<i>Baccharis salicifolia</i>	Mule-fat

**Table 3. Phase 5 Proposed Native Plant and Grass Species Ground Cover List**

Scientific Name	Common Name
<i>Heliotropium curassavicum</i>	Salt heliotrope
<i>Sesuvium verrucosum</i>	Seapurslane
<i>Sporobolus airoides</i>	Alkali sacaton
<i>Bouteloua curtipendula</i>	Sideoats grama
<i>Aristida purpurea</i>	Purple threeawn
<i>Polygonum lapathifolium</i>	Curlytop knotweed
<i>Paspalum</i> spp.	Knotgrass

The entire acreage will be disked and prepared for planting using standard farming techniques. Borders will be disked and placed, separating the fields into 26 checks (Figure 2). Prior to tree planting, a cover crop of alfalfa/rye grass will be seeded in all checks except 1, 12, 18 and 26. In these checks native grasses and shrubs will be seeded as an understory. Cover crops planted in previous restoration sites have proven effective for reducing the amount of invasive weeds.

**Figure 2. Typical Riparian Planting**



Trees and shrubs with similar water requirements are planted between borders for control of irrigation. A typical check is planted with Goodding's willow, coyote willow, and *Baccharis*.

## Check Size and Infrastructure

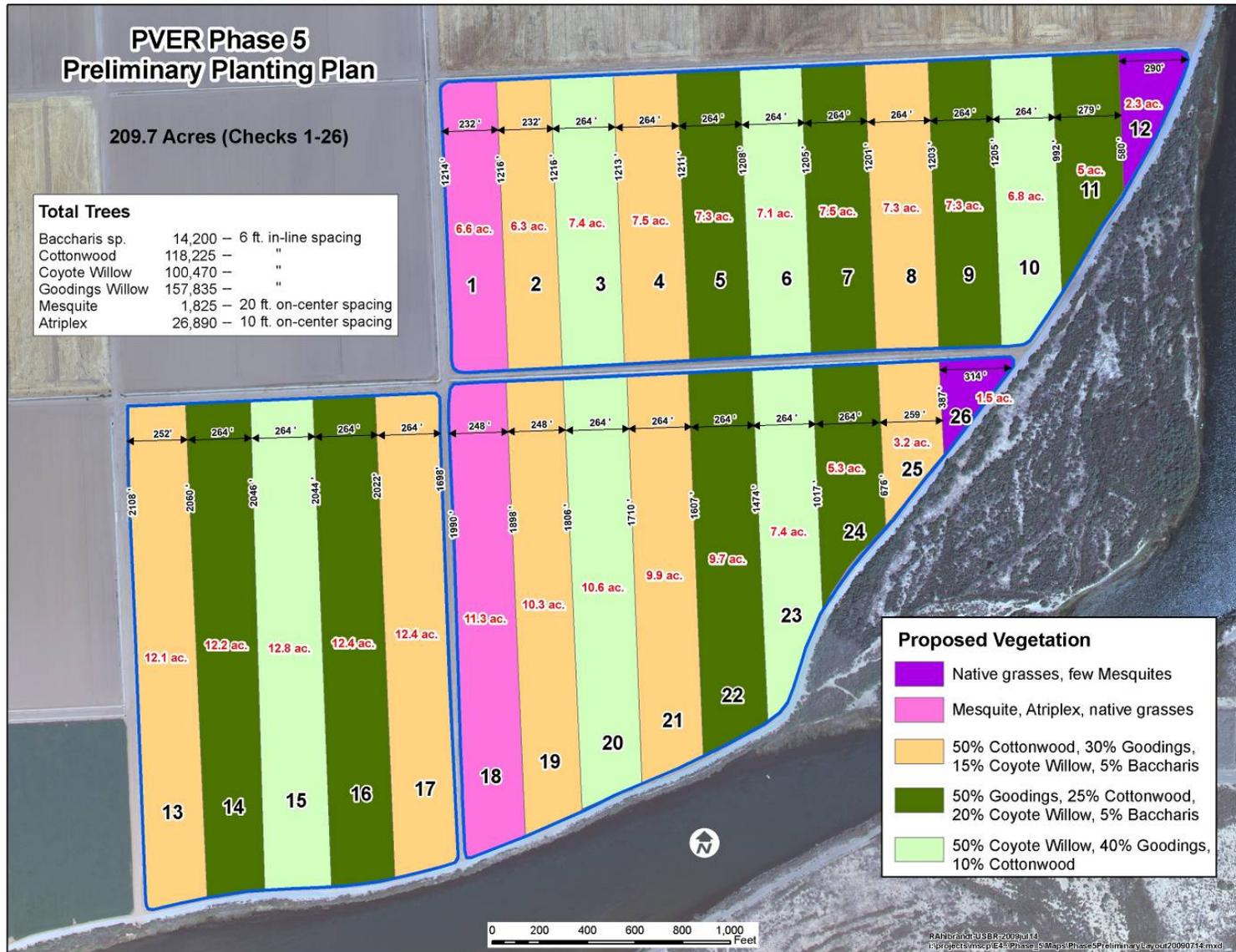
Checks 1-12 are 264 feet wide and vary in length from 1210 feet to 580 feet. Checks 13-26 vary in length from 2100 feet to 675 feet, and range from 280 feet to 314 feet wide. Each check has four slide gates to control irrigation water to each field. When planted, Phase 5 will include approximately 216 acres of CW cover type (Figure 3).

Checks 2-12 and 13-25 will be planted with cottonwood, Goodding's willow, coyote willow, and *Baccharis* at percentage rates listed in Table 4. All mass-transplanted trees will be spaced 6 feet in-line with 40-inch rows in between. This spacing allows for tree growth and density of vegetation identified for LCR MSCP covered species.

Checks 1 and 18 will be planted with mesquite trees 20 feet on-center with *Atriplex* planted in between the trees (Figure 4). Native ground will be seeded at the same time.

Checks 12 and 26 will be seeded with a native seed mix and a random planting of 100 mesquite trees.

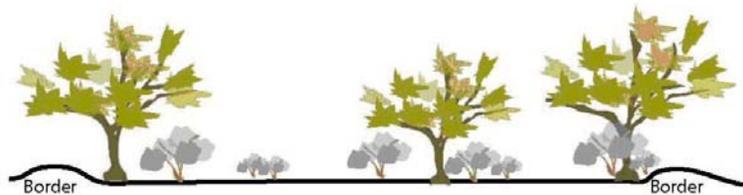
Figure 3. Phase 5 Riparian Habitat Design



**Table 4. Phase 5 Check Planting Percentage Rates and Spacing**

Check	Cottonwood	Goodding's Willow	Coyote Willow	<i>Baccharis</i>	Mesquite	<i>Atriplex</i>	Native Seed	6-ft inline 40-in rows	20-ft on center	Total Plants
1					575	11,540	X		X	12,115
2	50%	30%	15%	5%				X		11,760
3	10%	40%	50%					X		15,040
4	50%	30%	15%	5%				X		15,250
5	25%	50%	20%	5%				X		15,455
6	10%	40%	50%					X		15,040
7	25%	50%	20%	5%				X		14,575
8	50%	30%	15%	5%				X		15,455
9	25%	50%	20%	5%				X		15,015
10	10%	40%	50%					X		15,040
11	25%	50%	20%	5%				X		13,250
12					100		X			100
13	50%	30%	15	5%				X		24,350
14	25%	50%	20%	5%				X		24,675
15	10%	40%	50%					X		26,825
16	25%	50%	20%	5%				X		24,845
17	50%	30%	15%	5%				X		25,475
18					1100	19,550	X		X	20,650
19	50%	30%	15%	5%				X		23,755
20	10%	40%	50%					X		22,220
21	50%	30%	15%	5%				X		20,850
22	25%	50%	20%	5%				X		20,280
23	10%	40%	50%					X		15,300
24	25%	50%	20%	5%				X		10,675
25	50%	30%	15%	5%						6,100
26					50		X		X	50

**Figure 4. Typical Mesquite and/or Atriplex Planting**



Plants with similar water requirements, such as honey Mesquite and/or *Atriplex*, are planted together in the same check for irrigation control. Typically, these areas will include honey mesquite, *Atriplex*, and grasses.

## Weed Management

If necessary, invasive weeds such as morning glory, pigweed, and dodder will be managed by a Certified Pesticide Applicator or controlled by manual hand picking.

## Grading/Contouring

The fields will be laser-leveled to ensure efficient flood irrigation and drainage. No grading or contouring is expected on Phase 5. Borders will be reworked for efficient water control and delivery.

## Irrigation

The anticipated irrigation schedule for the first calendar year is shown in Table 5 for CW and in Table 6 for Mesquite and/or *Atriplex*. Irrigation regimes may be modified due to climatic conditions such as rain, wind, and high temperatures, or to ensure vegetation moisture requirements are met.

Irrigation water will be delivered by two canals. Checks 1-12 will be irrigated with flows of water from north to south. The second lateral irrigation ditch will irrigate checks 13-26, north to south.

**Table 5. Phase 5 Irrigation Schedule—Cottonwood-Willow**

Day/Week/Month	Frequency	Comments
Planting day	Immediately post-planting	
Week 1-4: April, May	Once per week	Or as necessary to keep root ball moist
Week 5-9	Every 10 days	Or as necessary to keep root ball moist
Week 10-12	Every 10-14 days	
Week 12 through August	Every 14 days	
September	Twice	
October	Twice	
November	Once	
December	No water	

**Table 6. Phase 5 Irrigation Schedule—Mesquite and/or Atriplex**

Day/Week/Month	Frequency	Comments
Planting day	Immediately post-planting	
Week 1-4: April, May	Once every 3 weeks	Or less if plants show signs of overwatering
June, July, August	Once per month	Or less if plants show signs of overwatering
September	No water	
October	Once	Immediately after planting mesquite
November	Once	
December	No water	

## 3.0 Monitoring

Conservation area monitoring plans are based on elements described in the LCR MSCP Habitat Conservation Plan (LCR MSCP 2004) and Final Science Strategy (LCR MSCP 2007). Monitoring at PVER is structured into four main categories:

- Pre-development Monitoring
- Implementation Monitoring
- Habitat/Species Monitoring
- Vegetation Monitoring

### Pre-development Monitoring

Pre-development monitoring is designed to establish baseline data for evaluating post-development and to identify whether covered species inhabit PVER prior to implementation of each phase. Pre-development monitoring is divided into abiotic (soil features) and biotic (vegetation and covered species) factors.

- Abiotic Monitoring
  - Soil
    - Past planting results at PVER do not indicate problems with soils; therefore, pre-development soil samples will not be taken unless conditions warrant.
- Biotic Monitoring
  - Vegetation
    - Prior to planting of cottonwood, willow, mesquite, or any other habitat type, all fields at PVER are planted with agricultural crops; no riparian or marsh habitat is present except for possible small patches of *Atriplex* spp. When present, these areas are isolated and too small to support the MacNeill's sootywing skipper.
  - Avian
    - Marshbirds will not be monitored, as marsh habitat is not present.
    - Pre-development monitoring for neo-tropical avian species has been conducted sufficiently on agricultural fields and in 1-year-old planted fields at PVER; no more surveys of these land cover types will be conducted.
    - Cavity nesting birds will not be monitored, as the required structure of riparian habitat is not present.
    - Species-specific SWFL pre-development surveys will not be conducted, as the required structure of riparian habitat is not present.

- Species-specific YBCU pre-development surveys will not be conducted, as the required structure of riparian habitat is not present.
- Small Mammals
  - The agricultural fields do not provide habitat for the LCR MSCP covered species; therefore, pre-development monitoring for small mammals will not be conducted.
- Bats
  - Pre-monitoring: Bats are being monitored acoustically for two nights quarterly per year using Anabat bat detectors at three locations in different agricultural fields, which will serve as pre-development monitoring for all future phases.
  - Post-monitoring: Bats are being monitored acoustically for two nights quarterly per year using Anabat bat detectors. One detector is placed in the nursery area and two detectors are placed at opposite ends of Phase 2. These three locations will serve as post-development monitoring for CW cover types for all phases. An additional three Anabat bat detectors are also being deployed at the same time within monotypic saltcedar habitat adjacent to PVER to compare differences in bat activity between saltcedar, agricultural fields, and CW cover types. Additional detectors may be placed within mesquite cover types once those areas have become established. In the future, at least one permanent long-term bat detector station will be placed at PVER.
- Amphibian and Reptile
  - Monitoring will not be conducted because PVER is outside the known range of the covered amphibian species and does not currently meet covered reptile species habitat requirements.
- MacNeill's Sootywing Skipper
  - The agricultural fields and 1-year-old planted fields do not provide habitat for this species.

## Implementation Monitoring

Implementation monitoring will be conducted to assess whether land cover type creation and management actions have been implemented as designed. Implementation monitoring quantifies changes immediately after treatments and evaluates whether actions were completed as prescribed.

After planting has been completed, the site will be continually assessed through the first growing season to detect potential issues that may impact early development of the site. Qualitative assessments will be made to evaluate planting results, weed infestations,

irrigation problems, or plant/soil disease and pathogens. If potential implementation or management issues are observed by the Project Manager or other parties, these issues will be discussed with the Monitoring Coordinator to determine whether action is needed.

Implementation monitoring will focus on the habitat (biotic) and conditions therein (abiotic):

- Abiotic Monitoring
  - Water
    - Water deliveries will be documented.
- Biotic Monitoring
  - At the onset of dormancy following the first growing season, vegetation parameters (height, diameter at breast height (DBH), density by species, groundcover species and abundance, crown/canopy closure, total vegetation volume/foilage height diversity) for overstory trees, shrubs, intermediate sized trees, and groundcover, will be monitored using a standardized monitoring protocol based on a nested, random sample plot design.
  - Vegetation monitoring plots will be selected using a stratified random sample based on the Anderson and Ohmart vegetation classification system (1976, 1984), and the initial planting design. Plot locations will be chosen randomly within each stratum. Plots will be added as needed as each phase of PVER is planted.

## Habitat/Species Monitoring

Habitat/Species monitoring is designed to determine whether each phase is providing the habitat requirements needed for the targeted covered species as defined by reference conditions, whether any covered species are utilizing the created habitat, and whether there are differences in wildlife use of the habitat depending on planting design, composition, and watering regimes. Monitoring protocols have been developed for documenting habitat characteristics and species response to created land cover types.

- Habitat Monitoring
  - Abiotic Monitoring
    - Soil
      - Soil samples will be analyzed, if conditions warrant, for moisture, salinity, textural classification, and nutrients, including nitrate, ortho-phosphate, and ammonia.
      - Once the CW has developed into structural class IV, soil moisture measurements will be conducted to determine average moisture content, area with saturated soils or standing water, and length of time soils remain moist between irrigations.

- Water
      - Deliveries to each phase will be recorded and analyzed to determine whether the scheduled timings were sufficient to grow the requisite habitat.
    - Microclimate
      - HOBO H8 Pro data loggers will be placed within each randomly placed vegetation plot to record temperature and relative humidity. Data loggers will be downloaded approximately every 4 months.
  - Biotic Monitoring
    - Vegetation
      - Vegetation parameters (height, DBH, density by species, groundcover species and abundance, crown/canopy closure, total vegetation volume/foilage height diversity) for overstory trees, shrubs, intermediate sized trees, and groundcover will be monitored using a standardized monitoring protocol based on a nested, random sample plot design.
      - Plots will be selected using a stratified random sample based on the Anderson and Ohmart vegetation classification system (1976, 1984), and the initial planting design. Plot locations will be chosen randomly within each stratum. Plots will be added as each phase of PVER is planted.
      - Vegetation monitoring will occur on an annual basis from year 1 through year 6 and continue every other year for years 6-10. After year 10, PVER will be sampled every 5 years to monitor successional change through the LCR MSCP period. If a catastrophic disturbance (fire, flood, etc.) occurs to the stand, post-disturbance monitoring will be determined based on acreage involved, type of disturbance, and restoration methods implemented. At a minimum, post-disturbance monitoring will occur for the first two growing seasons after the disturbance.
- Covered Species Monitoring
  - MacNeill's Sootywing Skipper
    - Quailbush planted at PVER will be surveyed for MacNeill's sootywing beginning when the plants are in their second year of growth and will continue indefinitely. The entire quailbush-planted areas will be examined for adult sootywings twice during April-August, and arbitrarily selected plants will be sampled for sootywing eggs and larvae.

- Marshbirds
  - Monitoring will not be conducted because no marshbird habitat has been created at PVER.
- Neotropical Birds
  - A standardized intensive area search survey methodology will be utilized. Surveys will be conducted annually during the breeding season (May-July) beginning in April of the second growing season. No covered bird species are known to use habitat in its first year of growth.
  - If covered species are observed, species-specific surveys, nest searches, and mistnetting/banding may be conducted.
- Cavity Nesting Birds
  - Elf owl presence/absence surveys will be conducted once appropriate habitat is present. Because elf owls are secondary cavity nesters, the habitat will need to mature and cavities or nest boxes will need to be present prior to elf owl occupation. The habitat will be observed during neotropical bird surveys for the presence of cavities and primary cavity nesters (woodpeckers). If nest boxes are installed, they will be monitored during the breeding season. If elf owls are detected during the breeding season, nest searches and mistnetting/banding may be conducted.
  - Gilded flickers and Gila woodpeckers will be surveyed as part of the system-wide neotropical bird monitoring effort. Once suitable nesting habitat (snags and cavities) develops on the site, more directed presence/absence surveys may be conducted for gilded flicker or Gila woodpeckers. If these species are detected during breeding season, nest searches and mistnetting/banding may be conducted.
- Southwestern Willow Flycatcher
  - Standardized presence-absence surveys (Sogge et al. 1997, USFWS 2000) will be conducted in the riparian habitat after three growing seasons (2011). A minimum of five surveys each year will be conducted beginning in May and ending in July. If a SWFL is detected after June 15, or positive breeding evidence is identified, nest searches will be conducted to determine breeding status and use of habitat. Targeted banding and mistnetting may be conducted to document long-term use of the site and to define habitat requirements.
- Yellow-billed Cuckoo
  - Standardized presence-absence surveys (Halterman and Johnson 2005) will be conducted after three growing seasons (2011). A minimum of five surveys will be conducted beginning June and

ending in September. If a YBCU is detected during the breeding season, nest searches will be conducted and targeted banding and mistnetting may be conducted to document long-term use of the site and to define habitat requirements.

- Small Mammals
  - There will be no additional pre-development monitoring at PVER for the Colorado River cotton rat, as habitat for this species does not include agricultural crops or unplanted fields.
  - Post-development monitoring will include presence/absence surveys utilizing a standardized protocol. Trapping will occur at night and will be concentrated in areas where native grasses are being planted. The number of traps will be determined by how much of the native grass successfully develops in dense enough patches that a cotton rat population can be sustained.
- Bats
  - Bats are being monitored acoustically two nights quarterly per year using Anabat bat detectors. One detector is placed in the nursery area and two detectors are placed at opposite ends of Phase 2. These three locations will serve as post-development monitoring for CW cover types for all phases.
  - Three Anabat bat detectors are also being deployed concurrently within monotypic saltcedar habitat adjacent to PVER to compare differences in bat activity between saltcedar, agricultural fields, and CW cover types. Additional detectors may be placed within mesquite cover types once those areas have become established.
  - Once sufficient data has been collected for various vegetation and structural types, long-term monitoring may be implemented. This will include the placement of at least one permanent bat detector station at PVER.
- Reptiles and Amphibians
  - No monitoring will be conducted because no habitat for reptiles and amphibians will be created or altered.

## **Vegetation Classification**

The LCR MSCP Habitat Conservation Plan (LCR MSCP 2004) outlines the specific habitat acreage to be created and utilizes the Anderson and Ohmart (1976, 1984) classification system as the performance standard. Reclamation will evaluate compliance with performance standards by determining vegetation classification annually until the target goals have been met. To map the vegetation at PVER, Reclamation will annually obtain aerial imagery of the site. Each phase will be mapped out utilizing the Anderson and Ohmart system (1976, 1984) as shown in Tables 7 and 8.

**Table 7. Vegetation Communities, Criteria, and Types**

Community Type	Criteria	Vegetation Structural Type
Cottonwood-willow (CW)	<i>P. fremontii</i> and/or <i>S. gooddingii</i> constituting at least 10% of total trees	I, II, III, IV, V, VI
Saltcedar (SC)	<i>Tamarix</i> spp. constituting 80-100% of total trees	I, II, III, IV, V, VI
Saltcedar-Honey mesquite (SH)	<i>P. glandulosa</i> constituting at least 10% of total trees	I, II, III, IV, V, VI
Saltcedar-Screwbean mesquite (SM)	<i>P. pubescens</i> constituting at least 20% of total trees	I, II, III, IV, V, VI
Honey mesquite (HM)	<i>P. glandulosa</i> constituting at least 90% of total trees	I, II, III, IV, V, VI
Arrowweed (AW)	<i>Tessaria sericea</i> constituting at least 90-100% of total vegetation area	I, II, III, IV, V, VI
<i>Atriplex</i> spp. (ATX)	<i>A. lentiformis</i> , <i>A. canescens</i> , and/or <i>A. polycarpa</i> constituting 90-100% of total vegetation in area	I, II, III, IV, V, VI

(From Anderson and Ohmart 1984)

**Table 8. Vegetation Classification**

Structure Type	Characteristics
I	Mature stand with distinctive overstory greater than 15 feet high, intermediate class from 2-15 feet tall, and understory from 0-2 feet high
II	Stand with overstory (>15 feet) constituting greater than 50% of the trees with little or no intermediate class present
III	Stand with largest proportion of trees between 10 and 20 feet high with few trees above 20 feet or below 5 feet
IV	Few trees above 15 feet present; 50% of the vegetation is 5-15 feet tall with the other 50% between 0-2 feet high
V	60-70% of the vegetation present is between 0-2 feet tall with the remainder in the 5-15 foot class
VI	75-100% of the vegetation is from 0-2 feet high

(From Anderson and Ohmart 1984)

## Monitoring Analysis and Evaluation

Once the data is collected for each sampling period and vegetation classification is analyzed, the results will be evaluated based on thresholds, and trigger points will be identified by the reference conditions for each species.

### Reference Conditions

The PVER reference conditions will be based on data collected on the LCR for the SWFL (McLeod et al. 2005; Koronkiewicz et al. 2004, 2006). These variables may

change depending on future analysis of the long-term life history studies currently being conducted. Variables that may be referenced include canopy height, canopy closure, vertical foliage density, mean soil moisture (% volume), mean diurnal temperature, mean maximum diurnal temperature, and mean diurnal relative humidity (Table 9). These variables were chosen because there were statistically significant differences in occupied versus unoccupied habitat for the SWFL life history study sites (McLeod et al. 2005, Koronkiewicz et al. 2004, 2006).

Reference conditions for YBCU are in the process of being compiled by Reclamation from past and current studies. The species composition to be planted at PVER is suitable for cuckoos as well as other LCR MSCP-covered species. Variables that may be referenced include, but are not limited to, those listed above for SWFL. Other LCR MSCP covered species, such as vermilion flycatcher, Arizona Bell’s vireo, summer tanager, Gila woodpecker, gilded flicker, and yellow warbler are frequently observed during surveys for flycatchers and cuckoos. Reclamation will continue to expand the compilation of known reference conditions for these species for use in future development and management plans.

**Table 9. Southwestern Willow Flycatcher Reference Variables**

Canopy Height (M)	Average greater than 4.0 m
Canopy Closure (% total)	Greater than 70%
Vertical Foliage Density	Density greatest between 1 m and 4 m above ground. This may change as additional analysis is completed.
Mean Soil Moisture (% volume)	Minimum of 17% Average of 23%
Mean Diurnal Temperature (Celsius)	Between 26°C and 33°C
Mean Maximum Diurnal Temperature (Celsius)	Maximum of 45°C Average between 32°C and 45°C
Mean Diurnal Relative Humidity (%)	Greater than 33% Average between 33% and 63%

**Thresholds**

Thresholds signal that conditions are appropriate and current management practices should be continued. Thresholds include:

- Microclimate and vegetation reference conditions have been achieved.
- Planted land cover type is being utilized by one or more covered species during the non-breeding season.
- Planted land cover type is being utilized by one or more covered species during the breeding season.

If monitoring activities document occupancy of the land cover types planted in PVER by SWFL, YBCU, or other targeted covered species before reference conditions are achieved, management and maintenance activities would be adjusted, as appropriate.

### **Trigger Points**

Trigger points signal the need to alter current management activities to achieve goals for the site or to re-evaluate stated goals for the planted land cover types. The trigger points are:

- Microclimate and vegetation reference conditions have not been achieved.
- Previously suitable land cover type structures are no longer suitable for any of the targeted covered species.
- Targeted covered species habitat needs exceeded water availability.

## **4.0 Adaptive Management**

Results of vegetation data will be discussed annually to determine whether changes to planting designs are warranted. Covered species data will be evaluated annually to determine whether the thresholds or trigger points were reached. If results indicate that the restoration activities meet or exceed thresholds, recommendations will be made in the annual report for future management activities. If results indicate that restoration activities are deleterious to covered species or habitats, recommendations for modifications will be identified.

Performance criteria for woody riparian cover types are based on plant community and structural type classification (Anderson and Ohmart 1984). Annual reports will summarize each created habitat land cover type and its acreage. Monitoring results and data analysis will be followed by adaptive management recommendations, which will be implemented as appropriate.

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