Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Lower Colorado River Vegetation Monitoring 2012 Annual Report

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

December 2013

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Lower Colorado River
Multi-Species Conservation Program

Lower Colorado River Vegetation Monitoring 2012 Annual Report

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KEY TERMS

BLCA	Beal Lake Conservation Area
BWRE	Bill Williams River East
cm	centimeters
CMP	Cibola Mass Planting
CNT	Cibola Nature Trail
CNU1	Cibola NWR Unit 1 Conservation Area
COR	Contracting Officer's Representative
CRANE1	Crane Roost 1
CRANE2	Crane Roost 2
CVCA	Cibola Valley Conservation Area
CWN	Cottonwood North
DBH	diameter at breast height
DC	Diameter Class
GPS	Global Positioning System
HC	Height Class
HCP	Habitat Conservation Plan
LCR	Lower Colorado River
m	meters
MSCP	Multi-Species Conservation Program
NWR	National Wildlife Refuge
PVC	polyvinyl chloride
PVER	Palo Verde Ecological Reserve
Reclamation	Bureau of Reclamation
SC	size class
TVV	total vegetation volume
VV	Vegetation volume

EXECUTIVE SUMMARY

Parametrix, Inc. and GeoSystems Analysis, Inc. conducted vegetation surveys between October and December 2012 in support of habitat creation site evaluations for the Lower Colorado River Multi-Species Conservation Program. Reclamation's vegetation monitoring protocols (Bangle 2012) were reviewed and edited in conjunction with Bureau of Reclamation staff. Protocol changes were then reflected in revised field datasheets and field instructions (Appendix I). Surveys were conducted at four habitat creation areas (Beal Lake Conservation Area, Palo Verde Ecological Reserve, Cibola Valley Conservation Area, and Cibola National Wildlife Refuge Unit 1 Conservation Area) and one reference site at Bill Williams River National Wildlife Refuge (Bill Williams River East). Over a total of 26 field days, 405 plots were surveyed. The project team assisted with reviewing and testing various iterations of the Reclamation vegetation database, and following completion of field data collection, data were entered into the Reclamation database template.

Current survey methodologies appear sufficient to document data of interest to support Multi-Species Conservation Program habitat evaluation goals. Data were summarized by conservation area and site to determine vegetation characteristics to include:

- Tree and shrub density.
- Tree and shrub height.
- Canopy closure.
- Cover.
- Foliar density.
- Species composition.

Habitat creation areas were generally comprised of a dense overstory of native trees and shrubs, resulting in an average canopy closure of 79 percent, with a variably-dense mix of native and non-native understory vegetation. Tree density averaged 608 trees per acre, ranging from 68 trees per acre at a honey mesquite restoration site (Cibola Valley Conservation Area 4 West) to 1,564 trees per acre at the Cibola National Wildlife Refuge Unit 1 Conservation Area Mass Transplanting demonstration site. Arrowweed was abundant at Beal Lake Conservation Area (94 percent frequency), common at Cibola National Wildlife Refuge Unit 1 Conservation Area Crane 1 (33 percent frequency), Cibola Valley Conservation Area 4 East (17 percent frequency), and Cibola Valley Conservation Area 6 (13 percent frequency), and rare elsewhere. Surface water was rare and present only during irrigation events. Bill Williams River East plots were variably dominated by native trees and saltcedar, with a mix of native and non-native understory vegetation. Canopy closure was 87 percent. Tree density (including saltcedar) was 458 trees per acre. Arrowweed was common (25 percent frequency), but coyote willow was not observed at this site. Age and SC distribution was more widely spread compared to Multi-Species Conservation Program restoration sites. Surface water was more frequent at Bill Williams River East compared to habitat creation areas.

Spanish false fleabane (*Pulicaria paludosa*), a non-native plant of interest, was observed at Palo Verde Ecological Reserve within Site 6, along corridors (e.g., roads and canals), and at Bill Williams River East. Buffelgrass (*Pennisetum ciliare*), observed at Beal Lake Conservation Area in 2011, was not observed during 2012 at any sites. Morning glory (*Ipomea purpurea*), a noxious weed, continues to be prevalent at Cibola Valley Conservation Area.

Extensive feral pig activity continues at Beal Lake Conservation Area, with rooting activities affecting the different sites within the conservation area. Wild burro and cattle signs were observed throughout and adjacent to the Bill Williams River East survey area.

As an additional task, the project team worked with Reclamation staff to develop draft electronic forms to record data directly into mobile devices during the field survey. Field protocols were initially demonstrated to database developers at Reclamation to familiarize development staff with the field protocol and data collection challenges and constraints. A subsequent meeting was held in Boulder City to design draft electronic forms. Subsequent meetings focused on development and revision of electronic field forms. Two rounds of field testing and multiple office reviews were conducted, which focused on usability of electronic forms while retaining accuracy, completeness, and efficiency of data collection. Reclamation database developers have addressed recommendations of the project team regarding form revisions. Following these revisions and potential simplifications in data collection methods, it is anticipated that electronic field forms will be ready for a pilot-scale data collection assessment during 2013 surveys.

1. INTRODUCTION

The Lower Colorado River (LCR) Multi-Species Conservation Program (MSCP) is a 50-year effort aimed at balancing the use of LCR water resources with the conservation of native species and habitats. To achieve these goals, the Bureau of Reclamation (Reclamation) is tasked with creating and maintaining habitat to conserve 26 federal or state-protected MSCP species, while potentially benefitting five additional "evaluation" species that might be listed in the future. To achieve these objectives, the Habitat Conservation Plan (HCP) specifies the creation of 8,132 acres of various habitat types, including 5,940 acres of cottonwood-willow cover and 1,320 acres of honey mesquite cover (LCR MSCP 2004, LCR MSCP 2011). Key vegetation species, which are either directly planted or establish passively at these habitat creation areas include:

- Cottonwood *(Populus fremontii)*
- Goodding's willow *(Salix gooddingii)*
- Coyote willow *(Salix exigua)*
- Willow Baccharis *(Baccharis salicina)*
- Desert Broom *(Baccharis sarothroides)*
- Honey mesquite *(Prosopis glandulosa)*
- Screwbean mesquite *(Prosopis pubescens)*
- Heliotrope *(Heliotropium curassavicum)*
- Quail Bush *(Atriplex lentiformis)*
- Saltcedar *(Tamarix* spp.*)*
- Arrowweed *(Pluchea sericea)*

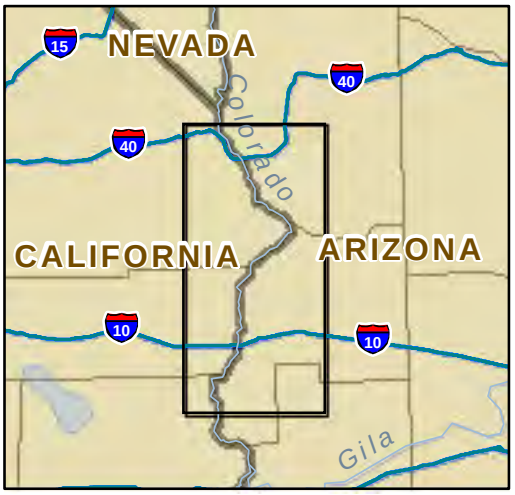
To assist in vegetation establishment and trend monitoring at MSCP cottonwood-willow and honey mesquite habitat creation areas and reference locations, Reclamation implements annual vegetation surveys at established locations.

Parametrix, Inc. and GeoSystems Analysis, Inc. (the Project Team) conducted vegetation surveys for Reclamation during 2012 through Contract GS10F0013N/R11PD30179. The Project Team worked with Reclamation to review survey methods and develop revised field instructions and datasheets. Field surveys were conducted between October 4 and December 2, 2012, at four habitat creation areas on the LCR: Beal Lake Conservation Area (BLCA), Palo Verde Ecological Reserve (PVER), Cibola Valley Conservation Area (CVCA), and Cibola National Wildlife Refuge (NWR) Unit 1 (CNU1). In addition, surveys were conducted on Bill Williams River NWR near the confluence with Mineral Wash (area Bill Williams River East [BWRE]), which supports a high density and diversity of avifauna and serves as a reference site. An overview of survey locations is provided in Figure 1-1.

The Project Team provided multiple rounds of review, comment, and recommendation on the 2012 Reclamation database. Data were entered into a revised version that was compatible with the 2012 field methods, to be subsequently merged with the comprehensive MSCP database. Following data entry, vegetation data were summarized for each of the project sites.

During this project year, the team assisted Reclamation with the development of electronic forms to potentially be used for field data collection during subsequent years. This task (Task 7) was summarized as a separate report (Parametrix 2013) and is not detailed in this annual report.

This report documents methods, recaps survey efforts, summarizes vegetation conditions at the monitored sites, and provides near-term recommendations for surveys conducted in subsequent years. Section 2 reviews methods, Section 3 provides results and discussion, and Section 4 presents conclusions and recommendations.



Source(s): ESRI County, U.S. State, and components of the ESRI USA Base Map

2012 Vegetation Monitoring Locations: Regional Map

Source(s): Bing Maps served online via ESRI Base Map Server.
Geographic Projection of both data frames = UTM, NAD 1983, Zone 11N.
Map created by Chad McKenna, GeoSystems Analysis, Inc.
July 3, 2013.

GSA GeoSystems Analysis, Inc.
Innovations in Hydrology

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Source(s): National Geographic served online via ESRI Base Map Server.

2. METHODS

2.1 SURVEY OVERVIEW

Crews surveyed a total of 405 vegetation monitoring plots in 2012. The survey protocol for each plot depended on the site management and the number of years since planting. Two types of surveys were conducted during 2012: intensive surveys and reduced effort plots. Intensive surveys, also referred to as "enhanced" surveys, were implemented at BWRE and habitat creation areas with at least 3 years of post-planting growth that are not mowed by farm machinery for weedy plant reduction. Reduced effort plots were implemented in areas planted during the spring of 2012 (i.e., PVER Site 7), in areas planted during spring of 2011 (i.e., PVER Site 6), and where mowing occurs between planted rows of honey mesquite and quail bush (CVCA sites 4E, 5, and 6).

2.2 2012 SURVEY METHODOLOGY ADJUSTMENTS

Per recommendations following 2011 surveys and discussions with Reclamation, several survey changes were implemented for the 2012 field season. These were reflected in the 2012 MSCP protocols (Bangle 2012), and the 2012 Field Instructions (Appendix I). Changes are also reflected in the 2012 field datasheets (Appendix II). Specifications or deviations from surveys conducted during 2011 consisted of:

- Datasheet Revisions:
  - The "general information" datasheet, which included notes, canopy gaps, distance to water, and snags (mature dead trees), was moved to be the last datasheet.
  - Separate datasheet sections were provided for each standard tree size class (SC) recorded in the B plot (i.e., SC1, SC2, and SC3).
  - Changes to reflect protocol revisions, as listed below.
- Methods and Protocol Changes:
  - Addition of the term "Diameter Class (DC)," which refers to stem diameter class at 10 cm above ground surface, and follows the same diameter ranges as "Size Class."
  - Addition of the term "Height Class (HC)," which provided categorical estimates for trees that were not measured.
  - For saltcedar and mesquite, the height and diameter of each stem of five representative individuals were measured. For all additional trees, the tree HC and number of stems in each DC were recorded.
  - For standard trees, the tree height and diameter at breast height (DBH) were recorded for five representative individuals. DBH and HC were recorded for all additional trees.
  - For shrubs, the height of five representative individuals of each species was recorded. For all additional individuals, height estimates to the nearest 0.5 m were provided. Additionally, the location of each shrub within the B plot was noted by recording the B plot quadrant (1-4).
  - DC1 stems were recorded for standard trees and shrubs within Quadrants 1 and 3 of the B plot.
  - DC1 coyote willow and arrowweed stems were still counted in only the E plots. Stems were dot-counted, and only five stem height measurements were taken. Dead coyote willow and arrowweed DC1 stems were also dot-counted in the E plots.

2.3 SURVEY METHODOLOGY

Because long-term vegetation monitoring for the MSCP is detailed and complex, vegetation attributes must be monitored at several different scales. To do this, the MSCP vegetation monitoring plot design utilizes nested plots for capturing data on different plant life-forms, growth habits, and SC. The nested and sometimes overlaying (sub-) plots include 1 A plot (10 x 40 m); 1 B plot (5 x 15 m divided into four 2.5 x 7.5 m quadrants); 4 C plots (0.5 x 2 m); five measurement points (D); and 4 E quadrats. Each of the sub-plots and the measurement points are nested within the primary plot (see plot graphic in Appendix I) and assigned a distinguishing letter (A–E) unique to the particular measurement sub-plot or point. The specific vegetation attributes captured within each sub-plot are summarized more generally below for intensive versus reduced effort plots. Detailed field instructions are included in Appendix I.

Following final protocol revisions (as discussed above in Section 2.2), intensive-level plot surveys included monitoring of:

- Total canopy closure, species-specific vegetation volume, and vertical foliar density at D points.
- Distance to surface water and canopy gaps within 30 meters (m) of plot center (D1).
- SC4 and larger snags within the A plot, and cavities within them.
- Tree height and DBH for SC4 trees and larger (greater than 12 centimeters (cm) DBH), not including mesquite and saltcedar, in the A plot.
- Tree height and stem DC for mesquite and saltcedar SC2 (greater than 3 m tall) in the A plot.
- Tree height and DBH for SC1 through 3 trees (less than or equal to 12 cm DBH) in the B plot, not including coyote willow.
- Tree height and stem DC for saltcedar and mesquite SC1 (less than or equal to 3 m tall) in the B plot.
- Shrub height and quadrant within the B plot, not including arrowweed.
- Cover for trees and shrubs in the B plot.
- Stems of DC2 and greater (greater than 2.5 cm in diameter at 10 cm above ground surface) for the first and third quadrants of the B plot (B1 and B3, respectively), to include all species.
- DC1 stems for the first and third quadrants of the B plot (B1 and B3, respectively), for trees and shrubs excluding coyote willow and arrowweed.
- Coyote willow and arrowweed stem count and height in the E plots for DC1 stems.
- Foliar and ground cover in the C plots.

Reduced effort plots included monitoring of:

- Tree height and DBH for standard trees and coyote willow in the A plot (all SCs).
- Tree height and stem DCs for all saltcedar and mesquite in the A plot.
- Shrub height for only quail bush, desert broom, willow baccharis, and arrowweed in the A plot.
- Cover estimates of heliotrope in the entire A plot.
- A list of all species observed in the A plot.

To facilitate plot relocation during future surveys, previously unmarked plot centers were marked by survey crews with a t-post, rebar, and engraved plot marker. One piece of rebar was also inserted at each corner of the primary plot to increase the probability that the same plot area is established and measured for future surveys when conditions are not favorable for Global Positioning System (GPS) reception. Exceptions to permanent marking are discussed in Section 3. Each section of rebar and t-post was flagged with blue and white striped flagging to increase visibility during future surveys. All previous flagging was removed from plot corners and plot center.

2.4 KUS METHOD FOR VEGETATION VOLUME

In addition to standard field instructions, the Kus method (Kus 1998) was utilized to survey vegetation volume at a subset of monitoring sites. The Kus method, as specified for MSCP vegetation surveys, is summarized below:

- The sampling volume consists of virtual 2-m long by 2-m wide by 1-m tall rectangular prisms, stacked vertically.
- Within each 1-meter level, the plane-view of coverage is estimated for each species and split into classes.
- Cover Classes: Less than 1 percent, 1–10 percent, 11–25 percent, 26–50 percent, 51–76 percent, 76–90 percent, and greater than 90 percent.
- Overhanging branches from trees rooted outside the prism are included in cover class estimation.
- If a dead stem from a live tree is within the prism, it counts for cover.
- Cover classes should be estimated to 7 m above ground surface.
- Required materials include a 2-m by 2-m polyvinyl chloride (PVC) frame, two stadia rods, or marked 7-m-tall PVC, and reference cutouts to provide a frame of reference for cover classes.

A total of 48 plots were surveyed using the Kus method (half at CVCA and half at CNU1) (Table 2-1).

Table 2-1. Plots Surveyed Using the Kus Method During the 2012 Field Season

Site/Phase	Number of Plots
Cibola Valley Conservation Area	
CVCA Phase 03	13
CVCA Phase 04W	11
Cibola National Wildlife Refuge Unit 1	
Nature Trail	24
Total:	**48**

The Kus apparatus was centered at Point D1 (plot center), and data were recorded using Vegetation Structure Datasheet 1. For CVCA, the Field Supervisor led surveys, and crew members assisted in estimating foliar cover classes. For CNU1, the Field Supervisor and one crew member conducted all Kus surveys.

2.5 SURVEY SUMMARY

During the 2012 season, surveys were completed at BLCA, BWRE, PVER, CVCA, and CNU1 (Table 2-2). A list of all the plots sampled is included in Appendix III.

Table 2-2. Total Number of Plots Each Day Within Sites and Areas Surveyed Using the Intensive Versus Reduced Effort Method During the 2012 Field Season

Phase, Site, and Date Completed	Intensive Plots	Reduced-Effort Plots	Total Plots Measured
Beal Lake Conservation Area	**35**	**0**	**35**
Phase 01 Cell A	**3**	**0**	**3**
10/7/2012	3	0	3
Phase 01 Cell B	**2**	**0**	**2**
10/3/2012	1	0	1
10/8/2012	1	0	1
Phase 01 Cell C	**1**	**0**	**1**
10/3/2012	1	0	1
Phase 01 Cell D	**3**	**0**	**3**
10/8/2012	3	0	3
Phase 01 Cell F	**2**	**0**	**2**
10/7/2012	2	0	2
Phase 01 Cell FF	**2**	**0**	**2**
10/6/2012	1	0	1
10/7/2012	1	0	1
Phase 01 Cell G	**2**	**0**	**2**
10/4/2012	1	0	1
10/8/2012	1	0	1
Phase 01 Cell H	**2**	**0**	**2**
10/8/2012	2	0	2
Phase 01 Cell I	**3**	**0**	**3**
10/8/2012	3	0	3
Phase 01 Cell JJ	**2**	**0**	**2**
10/6/2012	1	0	1
10/7/2012	1	0	1
Phase 01 Cell K	**2**	**0**	**2**
10/6/2012	2	0	2
Phase 01 Cell L	**2**	**0**	**2**
10/5/2012	2	0	2
Phase 01 Cell M	**1**	**0**	**1**
10/6/2012	1	0	1
Phase 01 Cell N	**3**	**0**	**3**
10/6/2012	3	0	3
Phase 01 Cell O	**1**	**0**	**1**
10/6/2012	1	0	1

(Table Continues)

Table 2-2. Total Number of Plots Each Day Within Sites and Areas Surveyed Using the Intensive Versus Reduced Effort Method During the 2012 Field Season (Continued)

Phase, Site, and Date Completed	Intensive Plots	Reduced-Effort Plots	Total Plots Measured
Beal Lake Conservation Area (Continued)	**35**	**0**	**35**
Phase 01 Cell P	**2**	**0**	**2**
10/5/2012	1	0	1
10/7/2012	1	0	1
Phase 01 Cell Q	**2**	**0**	**2**
10/7/2012	1	0	1
10/8/2012	1	0	1
Bill Williams River East	**36**	**0**	**36**
Cougar Point	**5**	**0**	**5**
10/17/2012	2	0	2
10/18/2012	3	0	3
Esquerra Ranch	**20**	**0**	**20**
10/16/2012	8	0	8
10/17/2012	8	0	8
10/18/2012	4	0	4
Mineral Wash	**11**	**0**	**11**
10/15/2012	9	0	9
10/16/2012	2	0	2
Cibola National Wildlife Refuge Unit 1	**63**	**0**	**63**
Crane Roost	**27**	**0**	**27**
11/28/2012	17	0	17
11/29/2012	10	0	10
CW North	**6**	**0**	**6**
12/2/2012	6	0	6
Mass Transplanting	**6**	**0**	**6**
11/29/2012	6	0	6
Nature Trail	**24**	**0**	**24**
11/29/2012	2	0	2
11/30/2012	9	0	9
12/1/2012	11	0	11
12/2/2012	2	0	2
Cibola Valley Conservation Area	**62**	**34**	**96**
Phase 01	**19**	**0**	**19**
10/25/2012	13	0	13
10/26/2012	6	0	6
Phase 02	**19**	**0**	**19**
10/26/2012	7	0	7
10/27/2012	12	0	12

(Table Continues)

Table 2-2. Total Number of Plots Each Day Within Sites and Areas Surveyed Using the Intensive Versus Reduced Effort Method During the 2012 Field Season (Continued)

Phase, Site, and Date Completed	Intensive Plots	Reduced-Effort Plots	Total Plots Measured
Cibola Valley Conservation Area (Continued)	**62**	**34**	**96**
Phase 03	**13**	**0**	**13**
10/28/2012	13	0	13
Phase 04E	**0**	**6**	**6**
10/1/2012	0	3	3
10/24/2012	**0**	1	1
10/25/2012	0	2	2
Phase 04W	**11**	**0**	**11**
10/27/2012	11	0	11
Phase 05	**0**	**13**	**13**
10/24/2012	0	13	13
Phase 06	**0**	**15**	**15**
10/24/2012	0	15	15
Palo Verde Ecological Reserve	**95**	**80**	**175**
Phase 01	**8**	**0**	**8**
11/8/2012	4	0	4
11/9/2012	4	0	4
Phase 02	**17**	**0**	**17**
11/7/2012	2	0	2
11/8/2012	13	0	13
11/9/2012	2	0	2
Phase 03	**22**	**0**	**22**
11/7/2012	22	0	22
Phase 04	**20**	**0**	**20**
11/9/2012	14	0	14
11/10/2012	6	0	6
Phase 05	**28**	**0**	**28**
11/10/2012	14	0	14
11/11/2012	14	0	14
Phase 06	**0**	**40**	**40**
11/11/2012	0	4	4
11/12/2012	0	27	27
11/13/2012	0	9	9
Phase 07	**0**	**40**	**40**
11/13/2012	0	14	14
11/14/2012	0	26	26
Grand Total:	**291**	**114**	**405**

Site-specific observations are provided in the site reports (Appendix IV); survey summaries and key observations are provided below. Plot location maps for each site are provided in Appendix V.

2.5.1 Beal Lake Conservation Area (BLCA)

BLCA was the first site surveyed by the Project Team. Between October 2 and October 4, 2012, the Project Supervisor, Field Supervisor, and Data Manager met with the Contracting Officer's Representative (COR) and reviewed modifications to field data collection. An additional crew leader was trained on October 4, 2012. MSCP personnel working on the development of electronic field forms for data collection were also present to observe data collection methods and the flow of surveys. After this initial session, four teams of two field personnel each completed data collection at BLCA, averaging approximately 2 plots per 9.5-hour day. All plot corners and plot centers were marked with blue and white striped flagging. All previously-installed flagging was removed.

2.5.2 Bill Williams River East (BWRE)

BWRE was the second area surveyed. Four two-person survey crews completed surveys between October 15 and October 18, 2012. Each two-person team completed an average of 2.25 intensive plots per day, as anticipated following 2011 surveys. Plot centers were marked with a wooden stake and flagged with blue and white flagging. No additional markings were placed (i.e. plot corners were not marked).

2.5.3 Palo Verde Ecological Reserve (PVER)

PVER was surveyed during one field trip (November 7–14, 2012) totaling eight days. Four two-person teams completed surveys of the seven sites. Two-person teams completed an average of approximately 4 intensive plots per day or 6.5 reduced effort plots per day.

Newly-established plots in Site 7 were marked with center t-posts and a piece of rebar topped with a survey cap stamped with the site phase and plot number. Previously unmarked plot corners in Site 1 and Site 2 were marked with rebar during the 2012 survey.

2.5.4 Cibola Valley Conservation Area (CVCA)

CVCA was surveyed during one field trip between October 24 and October 28, 2012. Four two-person teams completed surveys. Teams completed an average of approximately 4.5 intensive plots per day or 5.5 reduced-effort plots per day.

Plot centers and corners in Sites 05, 04W, 04E were not previously marked due to access between rows by farming equipment in previous years. Because 04W will no longer be mowed, rebar was added to plot corners to facilitate future surveys. Sites 05 and 04E remain unmarked.

2.5.5 Cibola National Wildlife Refuge Unit 1 (CNU1)

CNU1 was surveyed from November 28 through December 2, 2012. Four two-person teams completed surveys. Teams averaged three intensive plots per day. No reduced effort plots were located at this site.

The majority of plots were previously marked with center posts with engraved caps and rebar in the corners. During 2012, several plots within the Nature Trail were marked with center posts, engraved caps, and rebar in plot corners. However, plots within view of the hiking trail were not marked. Five plots in the Nature Trail require center markers to be placed during 2013 surveys. Seven plots within the Crane Roost require center t-posts.

2.6 DATA ENTRY

Raw vegetation data were entered into the Reclamation vegetation database for the first time last year (after the 2011 field season). Between the 2011 and 2012 field seasons, Reclamation completed several major changes and improvements to the vegetation database. The project team provided database review and comments for the 2012 database to improve performance and efficiency and ensure database compatibility with the 2012 field protocol. After a compatible database version was developed, four field staff began the process of entering hard copy datasheets into the MSCP Access database. Data entry began on February 6, 2013, and was finished on March 16, 2013. Data entry at each plot was quality checked independently by a different staff member before the data were delivered to MSCP. The databases along with supporting GIS data were delivered to MSCP during April 2013.

2.7 VEGETATION DATA SUMMARIES

The project team analyzed key attributes captured during 2012 vegetation data collection to summarize pre-identified parameters that are important for assessing habitat value for MSCP management species. Data were analyzed in Microsoft Excel (Microsoft Corporation, Redmond, WA) by Site for the following parameters:

- Tree and shrub plant density and frequency.
- Tree and shrub stem density.
- Tree and shrub height.
- Tree DBH.
- Canopy closure.
- Ground cover by type.
- Foliar cover by species.
- Community composition (species frequency richness, diversity, evenness).
- Vertical foliar density.

Terms specific to the data analysis are described below:

- *Area*: MSCP management area, which is further subdivided into Sites. Areas measured during the 2012 field season were BLCA, BWRE, PVER, CVCA, and CNU1.
- *Site*: A sub-area MSCP designation, which typically is comprised of a field or fields planted in the same year. For example, PVER is subdivided into sites named PVER1, PVER2, PVER3, and so on. The CNU1 Crane Roost is further separated into two sub-sites due to differing planting years and vegetation composition. Crane Roost 1 (CRANE1) is comprised of the northernmost of the four fields in the Crane Roost, planted previously by Cibola NWR. Crane Roost 2 (CRANE2) is comprised of the three southern fields planted by MSCP in 2009.
- *Standard Tree*: Growth form that includes predetermined species that typically grow with a single trunk or at least a dominant trunk. Standard tree diameter is measured at breast height and SCs are represented by six individual classes. Species in this growth form are cottonwood and Goodding's willow. Palms and palo verde species have also been measured as standard trees at MSCP sites.

- *Saltcedar and Mesquite*: Saltcedar and various mesquite species and hybrids are grouped into their own growth form class primarily due to their multi-stemmed growth habit. MSCP protocols specify that saltcedar is defined as a shrub for all MSCP habitat creation areas, whereas it is considered a tree for BWRE. Saltcedar and mesquite are represented by two SCs determined by height of the tallest live branch—SC1 trees are less than or equal to 3 m tall, and SC2 trees are taller than 3 m.
- *Shrub*: Growth form composed of woody perennial species that typically emerge with multiple stems. Shrubs are generally shorter-statured at maturity than multi-stemmed trees. As mentioned previously, saltcedar is considered a shrub at all MSCP habitat creation areas.
- *Coyote willow and Arrowweed*: Coyote willow and arrowweed are similarly surveyed primarily because they spread vegetatively from roots. This clonal growth precludes the determination of plant densities following two growing seasons. Therefore, for intensive level surveys, the plants are represented by stem count, density, and height measurements. For MSCP, coyote willow is considered a tree whereas arrowweed is considered a shrub. A list of all species encountered during field surveys is presented in Table 2-3.

Table 2-3. Species Encountered During 2012 Vegetation Surveys[a]

Scientific Name	Common Name	Native Status	Species Code
Atriplex lentiformis	quail bush	Native	ATRLEN
Azolla filiculoides	Pacific mosquitofern	Native	AZOFIL
Baccharis salicina/B. salicifolia	willow baccharis/Mule fat	Native	BACSAL
Baccharis sarothroides	desert broom	Native	BACSAR
Bassia hyssopifolia	five hook bassia	Introduced	BASHYP
Bothriochloa laguroides	silver beardgrass	Native/Introduced	BOTLAG
Bouteloua gracilis	blue grama	Native	BOUGRA
Carex	Sedge	Unknown	CAREX
Chenopodium sp.	Goosefoot	Native	CHESPP
Conyza canadensis	Canadian horseweed	Native	CONCAN
Cynodon dactylon	Bermudagrass	Introduced	CYNDAC
Cyperus esculentus	yellow nutsedge	Native/Introduced	CYPESC
Cyperus sp.	Nutsedge	Native	CYPSPP
Datura discolor	desert thorn-apple	Native	DATDIS
Echinochloa colona	junglerice	Introduced	ECHCOL
Heliotropium curassavicum	heliotrope	Native	HELCUR
Hymenoclea monogyra	singlewhorl burrobrush	Native	HYMMON
Ipomoea purpurea	morning glory	Introduced	IPOPUR
Lactuca serriola	prickly lettuce	Introduced	LACSER
Leptochloa fusca	Mexican sprangletop	Native	LEPFUS
Medicago sativa	alfalfa	Introduced	MEDSAT
Melilotus indicus	sourclover	Introduced	MELIND
Nicotiana spp.	tobacco	Native/ Introduced	NICSPP
Panicum capillare	witchgrass	Native	PANCAP
Phoradendron macrophyllum	Colorado Desert mistletoe	Native	PHOCAL

(Table Continues)

Table 2 3. Species Encountered During 2012 Vegetation Surveys (Continued)[a]

Scientific Name	Common Name	Native Status	Species Code
Pluchea sericea	arrowweed	Native	PLUSER
Polygonum argyrocoleon	silversheath knotweed	Introduced	POLARG
Populus fremontii	cottonwood	Native	POPFRE
Prosopis glandulosa	honey mesquite	Native	PROGLA
Prosopis pubescens	screwbean mesquite	Native	PROPUB
Pulicaria paludosa	Spanish false fleabane	Introduced	PULPAL
Salix exigua	coyote willow	Native	SALEXI
Salix gooddingii	Goodding's willow	Native	SALGOO
Schoenoplectus americanus	chairmaker's bulrush	Native	SCHAME
Schismus barbatus	Mediterranean grass	Introduced	SCHBAR
Schoenoplectus californicus	California bulrush	Native	SCHCAL
Setaria pumila	yellow bristlegrass	Introduced	SETPUM
Sonchus asper	spiny sowthistle	Introduced	SONASP
Sorghum halepense	Johnsongrass	Introduced	SORHAL
Sporobolus airoides	alkali sacaton	Native	SPOAIR
Tamarix sp.	saltcedar	Introduced	TAMSPP
Tiquilia plicata	fanleaf crinklemat	Native	TIQPLI
Trianthema portulacastrum	desert horsepurslane	Native	TRIPOR
Trifolium repens	white clover	Introduced	TRIREP
Typha angustifolia	narrowleaf cattail	Introduced	TYPANG
Typha latifolia	broadleaf cattail	Native	TYPLAT

[a] Native Status listed as described in USDA PLANTS Database <www.plants.usda.gov>. MSCP Common Names were used; when not available the USDA PLANTS Database Common Name was used.

2.7.1 Tree and Shrub Density

Densities for trees and shrubs, exclusive of arrowweed and coyote willow, were obtained for a site by dividing the total count of individuals by the total area surveyed. All intensive and reduced effort plots were included in this calculation. Tree density was first determined by SC in units of trees per acre to normalize density calculations and account for variably sized survey areas. For intensive-level surveys, SCs 1–3 were tallied within the 5-m by 15-m B Plot, whereas SC4 was tallied through the 10-m by 40-m A Plot. For reduced effort plots, all SCs were tallied throughout the A plot. The density for each SC was then added together to obtain total tree densities. Shrub density was determined by dividing the shrub counts per species by the survey area.

The count of total individuals for each species was calculated for a site by multiplying tree/shrub density times the total site area. The overall density and total number of individuals for each species within an area were then predicted by weighting the density of trees calculated for a site according to the percent of the area that each site contributes to the total area. Total shrub and tree counts and densities were obtained by summing values for each species within each growth form. Relative density was obtained by dividing the species density by the overall tree or shrub density and multiplying by 100.

Because coyote willow and arrowweed individuals were not counted within intensive plots, plant density was not calculated for these species at sites monitored using intensive survey methods. Stem density was calculated and compared with stem densities for other species.

For all sites surveyed using intensive protocols, stem density was calculated for all tree and shrub species (including arrowweed and coyote willow) by dividing the number of stems by the area surveyed. Site and area-wide density and relative density were extrapolated as above for standard tree and shrubs. The relative density of each stem DC was determined by species.

2.7.2 Tree and Shrub Height

Tree height was captured using two different methodologies during fieldwork. Up to five individuals per species per SC were measured in the field protocol. For the sixth and subsequent individuals, heights are represented by HCs. To account for the differences in the ways that tree heights are reported, we analyzed tree height data using two different approaches. First, measured heights were used to determine the average tree height for each SC by species within a site and area. The average height of each SC was then multiplied by the proportion of trees that fell in that SC in the site to obtain site averages. Secondly, the proportion of trees in each HC was determined for each species. For measured trees, HC was not assigned in the field. Measured trees were assigned to HCs as follows:

- Recorded Height of Less Than 3.4 m: HC1
- Recorded Height of 3.5 m to 10.4 m: HC2
- Recorded Height of 10.5 m to 15.4 m: HC3
- Recorded Height of 15.5 m to 20.4 m: HC4
- Recorded Height of 20.5 m to 25.4 m: HC5
- Recorded Height of Greater Than 25.4 m: HC6

Average shrub height was obtained by calculating the mean height from measured individuals (up to five per species, measured to nearest 0.1 m) of a given species within each site.

2.7.3 Tree Diameter at Breast Height (DBH)

Standard tree DBH analysis was also conducted in two different ways. First, the distribution of SCs was determined for each area and site by assessing density of trees per acre by SC. Normalizing to a per unit basis accounted for differences in area that was surveyed for SC1–SC3 (Plot B) versus SC4 and greater (Plot A). The relative density of trees in each SC was calculated by dividing the density in each SC by the total tree density, and dividing by 100. Additionally, the DBH was summarized by species for all SCs using tree diameter measurements for the representative "measured" trees of each species measured for each SC. In many cases, more than five trees were measured within a given SC (crews often felt that additional measurements were required to provide representative data. In these cases, all measured individuals were included in the analysis. The average DBH for each SC and each species was multiplied by the relative density of the SC to obtain an overall average DBH by species.

2.7.4 Canopy Closure

Canopy closure for each D point was determined by multiplying the number of canopy "hits" by 2.702703 (100 divided by the number of line intersections on the densiometer) following methods used previously to analyze these data for MSCP (BioWest 2010). The canopy closure within a site was calculated by taking the average closure from all D points.

2.7.5 Vegetation Structure

Vegetation structure and vertical foliar density were characterized using hits-to-pole data. Vegetation volume (VV) was calculated by dividing the total number of "hits" by the number

of decimeter intervals monitored (i.e., from ground surface to 7 meters for each D point). Hits-to-pole data were recorded by species, and a "total vegetation" category was not recorded. As a result, total vegetation volume (TVV) could not be assessed. Instead, VV was determined by species for trees and shrubs. Species composition was calculated using hits data by dividing the total number of hits of a given species by the total hits of all species. Composition was also described by vegetation type/life form (tree, shrub, and herbaceous).

Vertical foliar density was characterized by growth form and species via the number of hits per meter layer. The mean vertical foliar density of each species was obtained for each plot for each meter layer by taking the mean of the five D Points. The plot means were then averaged to represent site means.

2.7.6 Foliar and Ground Cover

Foliar and ground cover were summarized for each site as follows:

- Shrub and tree foliar cover were summarized by species for each site. The midpoint percentage for each cover class was used to approximate cover for each B Plot. Foliar cover within a site was obtained by taking the average of all B Plots.
- Ground cover was summarized by cover type, which is recorded as dead vegetation, herbaceous, rock, water, woody, litter, or bare ground in the field. The midpoint percentage for each cover class (e.g., 0.5 percent for less than 1 percent, 5 percent for 1 to 10 percent, 95 percent for 90 to 100 percent, etc.) was used to estimate cover for different ground cover types from each C Plot. Mean ground cover of each cover type was obtained for each plot by calculating the average of the four C points. Foliar density for each site is the average of the plot means.
- Herbaceous foliar cover was summarized for all herbaceous vegetation and by species for each site and was calculated in the same manner as groundcover. All herbaceous vegetation is shown for sites where more than one herbaceous species is present.

2.7.7 Vegetation Community Parameters

The frequency of all tree and shrub species (i.e., including coyote willow and arrowweed) by species, was determined by counting the number of plots for the given area that the species was located in, dividing by the number of total plots, and multiplying by 100. The tree or shrub species was considered in frequency calculations if it was listed as an incidental species (i.e., the plant was present in the survey area). The relative frequency was calculated by dividing the frequency of a given species by the overall tree frequency and multiplying by 100. Vegetation community composition was characterized according to total species richness (number of tree, shrub, and herbaceous species represented) and also according to Simpson's index of evenness and diversity.

3. RESULTS AND DISCUSSION

3.1 KUS METHOD FOR VEGETATION VOLUME

Kus surveys required approximately 15 minutes per plot (one survey point per plot), similar to carrying out the hits-to-pole method for five points as currently done for intensive surveys. Due to the amount of materials required, one pair of surveyors conducted Kus surveys only (i.e., they did not carry out intensive surveys during the same plot visit). Thus, additional hiking time would be required to implement this method for MSCP surveys, and the overall labor and cost required to conduct annual surveys would increase.

3.2 SITE CONDITIONS AND VEGETATION CHARACTERISTICS

Tree and shrub densities and relative densities are summarized by MSCP Conservation Area in Table 3-1 and Table 3-2, respectively. Ground cover is summarized in Table 3-3. Standard tree DBH is summarized in Table 3-4. Average tree heights are provided in Table 3-5. Canopy closure is summarized in Table 3-6.

Stem density for arrowweed and coyote willow is summarized in Table 3-7 for all intensive level survey sites.

Vegetation composition determined from hits-to-pole data, separated into vegetation classes (tree, shrub, and forb) is summarized in Table 3-8. Total vegetation volume is summarized in Table 3-9. Species richness, evenness, and diversity, by Site, are provided in Table 3-10.

In general, MSCP restoration sites were comprised of a dense native riparian tree and shrub overstory with a mix of native and non-native understory vegetation. Tree density (excluding coyote willow) ranged from 68 (at CVCA4W, a mesquite site) to 1,564 (at CNU1 Mass Transplanting) trees per acre. Sites with more than 2 years of growth were dominated by a closed canopy (average of 79 percent across revegetation sites) with few snags, and surface water was generally present only due to irrigation (i.e., there was no natural overbanking). Riparian trees were generally comprised of one age-class of cottonwood and Goodding's willow, corresponding to the year that the given site was planted. Cottonwood and Goodding's willow DBH typically increased with the number of years since planting.

Four shrub species were variably prevalent: quail bush, willow baccharis, desert broom, and saltcedar. Willow Baccharis was the most common shrub species at most sites. Quail Bush was the most common species at CNU1 Crane 1 and PVER5, and saltcedar was the most common shrub at Crane 1 and CVCA3. Ground cover was over 70 percent litter at all sites except CVCA4W, where bare ground was nearly 70 percent.

Arrowweed stems were observed at BLCA, CNU1 Crane 1, and CVCA 1. BLCA arrowweed stem density was over 46,000 per acre, comprising 88 percent of total stems at the site. In contrast, arrowweed stem density at Crane 1 and CVCA1 was less than 700 stems per acre. Coyote willow stem density was as high as 20,915 stems per acre (PVER2) and often dominated stem counts.

In contrast, arrowweed stem density at Crane 1 and CVCA1 was less than 700 stems per acre. Coyote willow stem density was as high as 20,915 stems per acre (PVER2) and often dominated stem counts.

In contrast, BWRE was comprised of a mix of native and non-native overstory of variable age classes, with surface water commonly present within and/or adjacent to plots. Cottonwood and Goodding's willow DBH was much more variable. The standard deviation of cottonwood DBH (21.4) was an order of magnitude greater than for any MSCP restoration site, and the standard deviation of Goodding's willow DBH (28.1) was twice that of any restoration site. Similar to MSCP creation sites, the canopy was very dense, with overall canopy closure of 87 percent. Tree density at BWRE was 459 trees per acre, with saltcedar included. Excluding saltcedar, tree density was 155 trees per acre, lower than all MSCP cottonwood-willow restoration sites except PVER1. With saltcedar considered a tree at BWRE, willow baccharis was the only shrub observed in B plots. Coyote willow was not observed, but arrowweed was common and comprised 88 percent of total stems at the site.

Additional detail by site is provided for each Conservation Area in the following sections.

Table 3-1. Tree Density by Site for 2012 Vegetation Surveys

Area	Site	Area (acres)	Tree Density (Trees per Acre)						Relative Tree Density				
			All Trees	Cottonwood	Goodding's Willow	Honey Mesquite	Screwbean Mesquite	Saltcedar[a]	Cottonwood	Goodding's Willow	Honey Mesquite	Screwbean Mesquite	Saltcedar[a]
BLCA	**N/A**	**47**	**1,268**	**350**	**122**	**11**	**785**	**N/A**	**28%**	**10%**	**1%**	**62%**	**N/A**
BWRE	**N/A**	**100**	**459**	**26**	**92**	**37**	**0**	**304[a]**	**6%**	**20%**	**8%**	**0%**	**66%[a]**
CNU1	CNT	36	364	68	211	48	38	N/A	19%	58%	13%	10%	N/A
	CWN	19	404	306	0	98	0	N/A	76%	0%	24%	0%	N/A
	CMP	20	1,564	1,481	63	20	0	N/A	95%	4%	1%	0%	N/A
	CRANE1	45	242	10	0	232	0	N/A	4%	0%	96%	0%	N/A
	CRANE2	102	661	116	535	10	0	N/A	17%	81%	2%	0%	N/A
PVER	PVER1	31	83	38	18	27	0	N/A	46%	22%	32%	0%	N/A
	PVER2	72	663	288	375	0	0	N/A	43%	57%	0%	0%	N/A
	PVER3	80	377	329	44	5	0	N/A	87%	12%	1%	0%	N/A
	PVER4	97	825	285	532	7	0	N/A	35%	65%	1%	0%	N/A
	PVER5	210	632	245	386	1	0	N/A	39%	61%	0%	0%	N/A
	PVER6	213	838	339	486	13	0	N/A	40%	58%	2%	0%	N/A
	PVER7	226	1,178	545	625	8	0	N/A	46%	53%	1%	0%	N/A
CVCA	CVCA1	91	391	296	95	0	0	N/A	76%	24%	0%	0%	N/A
	CVCA2	71	969	327	642	0	0	N/A	34%	66%	0%	0%	N/A
	CVCA3	103	1,088	660	412	17	0	N/A	61%	38%	2%	0%	N/A
	CVCA4W	58	68	0	1	67	0	N/A	0%	1%	99%	0%	N/A
	CVCA4E	45	94	0	0	94	0	N/A	0%	0%	100%	0%	N/A
	CVCA5	71	111	1	0	110	0	N/A	1%	0%	99%	0%	N/A
	CVCA6	89	141	1	0	140	0	N/A	1%	0%	99%	0%	N/A

[a] Saltcedar is included only for BWRE, where its growth form is considered a tree.

Table 3-2. Shrub Density by Site for 2012 Vegetation Surveys

Area	Site	Area (acres)	Shrub Density (Shrubs per Acre)					Relative Shrub Density			
			All Shrubs	Quail Bush	Willow Baccharis	Desert Broom	Saltcedar[a]	Quail Bush	Willow Baccharis	Desert Broom	Saltcedar[a]
BLCA	N/A	**47**	**816**	**0**	**717**	**0**	**99**	**0%**	**88%**	**0%**	**12%**
BWRE	N/A	**100**	**42**	**0**	**42**	**0**	**N/A**	**0%**	**100%**	**0%**	**N/A**
CNU1	CNT	36	1,540	0	1,540	0	0	0%	100%	0%	0%
	CWN	19	0	0	0	0	0	N/A	N/A	N/A	N/A
	CMP	20	234	0	189	0	45	0%	81%	0%	19%
	CRANE1	45	600	315	144	0	141	52%	24%	0%	24%
	CRANE2	102	198	5	23	0	170	3%	12%	0%	86%
PVER	PVER1	31	0	0	0	0	0	N/A	N/A	N/A	N/A
	PVER2	72	0	0	0	0	0	N/A	N/A	N/A	N/A
	PVER3	80	2	0	2	0	0	0%	100%	0%	0%
	PVER4	97	40	19	22	0	0	47%	53%	0%	0%
	PVER5	210	121	73	19	29	0	60%	16%	24%	0%
	PVER6	213	19	8	11	1	0	40%	57%	3%	0%
	PVER7	226	34	2	31	1	0	7%	90%	3%	0%
CVCA	CVCA1	91	523	0	517	6	0	0%	99%	1%	0%
	CVCA2	71	2,053	11	1,815	26	202	1%	88%	1%	10%
	CVCA3	103	21,948	145	0	0	21,803	1%	0%	0%	99%
	CVCA4W	58	6,343	5,474	854	15	0	86%	13%	0%	0%
	CVCA4E	45	543	543	0	0	0	100%	0%	0%	0%
	CVCA5	71	222	222	0	0	0	100%	0%	0%	0%
	CVCA6	89	0	0	0	0	0	N/A	N/A	N/A	N/A

[a] Saltcedar is included for all sites except BWRE, where its growth form is considered a tree.

Table 3-3. Ground Cover by Site for 2012 Vegetation Surveys

Area	Site	Area (Acres)	Dead (%)	Herbaceous (%)	Rock (%)	Water (%)	Woody (%)	Litter (%)	Bare (%)
BLCA	N/A	47	1	1	0	0	3	73	21
BWRE	N/A	100	2	1	0.03	7	1	70	16
CNU1	CNT	36	0.4	0.5	0	0	2	87	8
	CWN	19	0	1	0	0	2	94	1
	CMP	20	0.1	1	0	0	1	95	0
	CRANE1	45	0.3	0	0	0	2	86	11
	CRANE2	102	1	5	0	0	1	80	13
PVER	PVER1	31	10	1	0	0	2	83	4
	PVER2	72	0.3	0.3	0	0	3	94	1
	PVER3	80	1	3	0	0	1	89	3
	PVER4	97	0.2	1	0	0	1	93	1
	PVER5	210	1	1	0	0	0.4	89	5
CVCA	CVCA1	91	0.5	1	0	0	2	93	1
	CVCA2	71	1	0.3	0	0	1	77	19
	CVCA3	103	0.3	1	0	0	1	77	17
	CVCA4W	58	2	1	0	0	0.3	27	69

Table 3-4. Standard Tree DBH by Site for 2012 Vegetation Surveys

		Cottonwood			Goodding's Willow		
Area	Site	Mean DBH (cm) (Standard Error)	n (number of measured trees)	Range	Mean DBH (cm) (Standard Error)	n (number of measured trees)	Range
BLCA	N/A	7 (0.3)	292	0–30	2.7 (0.3)	81	0–14
BWRE	N/A	13.6 (3.8)	37	0–91.5	12.4 (1.5)	121	0–74.5
CNU1	CNT	17.9 (1.2)	76	6.5–62	4.7 (0.4)	100	0–14
	CWN	13.8 (0.8)	42	0.5–32	N/A	N/A	N/A
	CMP	5.7 (0.4)	180	0–21.5	0.9 (0.3)	7	0–2
	CRANE1	N/A	N/A	N/A	N/A	N/A	N/A
	CRANE2	4.4 (0.4)	44	1–11.5	2.7 (0.2)	208	0–9.5
PVER	PVER1	27 (1.8)	18	15.5–43	16.9 (2.5)	9	9–34
	PVER2	10.8 (0.7)	114	0.5–38.5	8.2 (0.4)	149	0.5–21.5
	PVER3	14.4 (0.4)	173	1–29.5	3.7 (1.2)	21	1–20.5
	PVER4	11.8 (0.5)	147	0.5–27	6.6 (0.3)	219	0–19.5
	PVER5	7.4 (0.3)	149	1–16.5	4.6 (0.2)	204	0–16
	PVER6	3 (0.2)	267	0–11.5	3.7 (0.1)	330	0–9
	PVER7	1.8 (0.1)	285	0–4	1.4 (0.1)	284	0–4
CVCA	CVCA1	11 (0.7)	135	0.5–48.5	9.3 (0.8)	50	0.5–25
	CVCA2	9.2 (0.3)	154	0–22	5.2 (0.2)	227	0–13.5
	CVCA3	6.3 (0.3)	181	2–31.5	3.2 (0.2)	100	0–12.5
	CVCA4W	N/A	N/A	N/A	12.5 (0)	1	12.5–12.5
	CVCA4E	N/A	N/A	N/A	N/A	N/A	N/A
	CVCA5	4.5 (0)	1	4.5–4.5	N/A	N/A	N/A
	CVCA6	2.5 (2.5)	2	0–5	N/A	N/A	N/A

Table 3-5. Tree Height by Site for 2012 Vegetation Surveys

Area	Site	Acres	Average Tree Height (Standard Error) (meters)					
			All Trees	Cottonwood	Goodding's Willow	Honey Mesquite	Screwbean Mesquite	Saltcedar[a]
BLCA	**N/A**	**47**	4.9 (0.2)	7.5 (0.4)	3.8 (0.2)	5.1 (0.1)	3.9 (0.1)	N/A
BWRE	**N/A**	**100**	4.9 (0.1)	7.7 (1.0)	6.5 (0.3)	4.7 (0.2)	N/A	4.5 (0.1)
CNU1	CNT	36	7.5 (0.2)	12.7 (0.5)	4.7 (0.3)	6.3 (0.2)	6.8 (0.2)	N/A
	CWN	19	7.3 (0.5)	11.1 (0.5)	0.0 (0.0)	2.3 (0.3)	N/A	N/A
	CMP	20	6.6 (0.5)	7.1 (0.5)	2.2 (0.4)	0.9 (1.3)	N/A	N/A
	CRANE1	45	6.2 (0.5)	18.2 (1.1)	0.0 (0.0)	5.0 (0.2)	N/A	N/A
	CRANE2	102	3.9 (0.2)	6.0 (0.5)	3.7 (0.3)	2.9 (0.2)	N/A	N/A
PVER	PVER1	31	6.3 (0.9)	17.0 (0.4)	12.6 (0.6)	3.6 (0.1)	N/A	N/A
	PVER2	72	6.2 (0.3)	11.5 (0.5)	9.0 (0.3)	0.0 (0.0)	N/A	N/A
	PVER3	80	11.3 (0.4)	14.6 (0.3)	5.3 (0.9)	2.0 (0.5)	N/A	N/A
	PVER4	97	9.0 (0.3)	11.7 (0.3)	8.7 (0.7)	4.0 (0.2)	N/A	N/A
	PVER5	210	6.5 (0.2)	7.4 (0.2)	6.1 (0.9)	3.4 (0.0)	N/A	N/A
	PVER6	213	4.0 (0.1)	3.8 (0.1)	5.0 (0.1)	2.2 (0.1)	N/A	N/A
	PVER7	226	2.7 (0.0)	3.2 (0.1)	2.9 (0.1)	1.3 (0.1)	N/A	N/A
CVCA	CVCA1	91	7.5 (0.3)	11.3 (0.4)	8.7 (0.7)	0.0 (0.0)	N/A	N/A
	CVCA2	71	8.2 (0.2)	10.3 (0.2)	7.5 (0.3)	0.0 (0.0)	N/A	N/A
	CVCA3	103	5.3 (0.4)	7.4 (0.4)	3.9 (0.4)	3.5 (0.3)	N/A	N/A
	CVCA4W	58	3.7 (0.1)	0.0 (0.0)	7.2 (0.0)	3.7 (0.1)	N/A	N/A
	CVCA4E	45	3.1 (0.1)	0.0 (0.0)	0.0 (0.0)	3.1 (0.1)	N/A	N/A
	CVCA5	71	3.3 (0.1)	4.6 (0.0)	0.0 (0.0)	3.3 (0.1)	N/A	N/A
	CVCA6	89	2.8 (0.0)	2.8 (1.7)	0.0 (0.0)	2.8 (0.0)	N/A	N/A

[a] Saltcedar is excluded for all sites except BWRE, where its growth form is considered a tree.

Table 3-6. Canopy Closure by Site for 2012 Vegetation Surveys (Intensive-Level Survey Sites Only)

Area	Site	Acres	Percent Canopy Closure
BLCA	**N/A**	**47**	**82**
BWRE	**N/A**	**100**	**87**
CNU1	CNT	36	92
	CWN	19	87
	CMP	20	89
	CRANE1	45	97
	CRANE2	102	42
PVER	PVER1	31	82
	PVER2	72	95
	PVER3	80	74
	PVER4	97	88
	PVER5	210	70
CVCA	CVCA1	91	91
	CVCA2	71	79
	CVCA3	103	82
	CVCA4W	58	39

Table 3-7. Coyote Willow and Arrowweed Stem Density by Site for 2012 Vegetation Surveys (Intensive-Level Survey Sites Only)

Area	Site	Acres	Density (Stems per Acre)	
			Coyote Willow	Arrowweed
BLCA	**N/A**	**47**	**1,840**	**46,163**
BWRE	**N/A**	**100**	**0**	**9,021**
CNU1	CNT	36	162	0
	CWN	19	0	0
	CMP	20	0	0
	CRANE1	45	0	674
	CRANE2	102	3,464	0
PVER	PVER1	31	18,528	0
	PVER2	72	20,915	0
	PVER3	80	2,507	0
	PVER4	97	2,492	0
	PVER5	210	834	0
CVCA	CVCA1	91	12,166	389
	CVCA2	71	3,619	0
	CVCA3	103	2,798	0
	CVCA4W	58	0	0

Table 3-8. Vegetation Community Composition by Site for 2012 Vegetation Surveys as Estimated by Hits-to-Pole Data (Intensive-Level Survey Sites Only)

Area	Site	Composition (Percent of Total Vegetation Hits)		
		Tree	Shrub	Herbaceous
BLCA	N/A	64	35	1
BWRE	N/A	89	7	4
CNU1	CNT	51	37	12
	CWN	89	0	11
	CMP	78	9	12
	CRANE1	62	38	0
	CRANE2	62	3	35
PVER	PVER1	97	1	2
	PVER2	99	0	1
	PVER3	95	0	5
	PVER4	93	2	5
	PVER5	86	3	11
CVCA	CVCA1	94	1	6
	CVCA2	88	3	9
	CVCA3	76	10	14
	CVCA4W	38	48	14

Table 3-9. Vegetation Volume by Site for 2012 Vegetation Surveys as Estimated by Hits-to-Pole Data (Intensive-Level Survey Sites Only)

Area	Site	Total Vegetation Volume (m^3/m^2)								
		Cottonwood	Goodding's Willow	Coyote Willow	Honey Mesquite	Screwbean Mesquite	Saltcedar	Baccharis spp.	Quail Bush	Arrowweed
BLCA	N/A	0.07	0.01	0.00	0.01	0.04	0.01	0.02	0.00	0.08
BWRE	N/A	0.01	0.04	0.00	0.03	0.00	0.10	0.01	0.00	0.01
CNU1	CNT	0.01	0.01	0.00	0.07	0.01	0.00	0.12	0.00	0.00
	CWN	0.03	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	CMP	0.09	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
	CRANE1	0.01	0.00	0.00	0.17	0.00	0.08	0.04	0.01	0.01
	CRANE2	0.03	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00
PVER	PVER1	0.02	0.01	0.07	0.03	0.00	0.00	0.00	0.00	0.00
	PVER2	0.02	0.08	0.09	0.00	0.00	0.00	0.00	0.00	0.00
	PVER3	0.07	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	PVER4	0.06	0.07	0.02	0.00	0.00	0.00	0.00	0.01	0.00
	PVER5	0.13	0.09	0.01	0.00	0.00	0.00	0.01	0.00	0.00
CVCA	CVCA1	0.05	0.01	0.10	0.00	0.00	0.00	0.00	0.00	0.00
	CVCA2	0.05	0.04	0.05	0.00	0.00	0.01	0.00	0.00	0.00
	CVCA3	0.08	0.04	0.01	0.01	0.00	0.00	0.02	0.00	0.00
	CVCA4W	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.05	0.00

Table 3-10. Vegetation Community Composition Observed During 2012 Vegetation Surveys

	Species Richness				Trees and Shrubs Only		
Site	Trees	Shrubs	Herbaceous	All Species	Trees + Shrubs (S)	Evenness (e^H)/S	Simpsons Index of Diversity (1-D)
BLCA	5	3	5	13	8	0.471	0.649
BWRE	6	4	30	40	10	0.519	0.658
CNT	6	2	4	12	8	0.337	0.333
CWN	3	1	2	6	4	0.955	0.404
CMP	2	2	4	8	4	0.963	0.310
CRANE1	2	5	0	7	7	0.736	0.758
CRANE2	4	3	6	13	7	0.594	0.583
PVER1	4	2	7	13	6	0.575	0.727
PVER2	3	1	6	10	4	0.661	0.499
PVER3	4	3	7	14	7	0.529	0.243
PVER4	2	3	9	14	5	0.602	0.518
PVER5	5	3	16	24	8	0.456	0.629
PVER6	4	3	21	7	7	0.336	0.528
PVER7	5	3	15	8	8	0.333	0.536
CVCA1	4	1	9	14	5	0.625	0.489
CVCA2	4	3	13	20	7	0.537	0.653
CVCA3	4	4	12	20	8	0.607	0.723
CVCA4W	1	4	9	14	5	0.302	0.071
CVCA4E	1	3	16	4	4	0.510	0.367
CVCA5	3	2	15	5	5	0.461	0.514
CVCA6	2	2	20	4	4	0.410	0.251

3.2.1 Beal Lake Conservation Area

Fields at BLCA were primarily either dominated by cottonwood with a mixed understory of mesquite and willow, or honey and screwbean mesquite overstory with dominant understory of arrowweed and scattered Goodding's willow, coyote willow, and willow baccharis. Several plots were also dominated by arrowweed with scattered mesquite, Goodding's willow, coyote willow, and willow baccharis. Surface water was not present at BLCA during surveys. Buffelgrass (*Pennisetum ciliare*), observed at BLCA in 2011, was not observed during 2012 at any sites. Feral pig activity continues to be prevalent at BLCA, with rooting activities variably affecting the fields within BLCA.

Tree and shrub densities and relative tree and shrub densities at BLCA are provided in Table 3-1 and Table 3-2; stem densities and relative stem densities are summarized in Table 3-11. Tree and shrub frequency and relative frequency are summarized in Table 3-12. All standard tree species, mesquite species, and saltcedar were encountered at BLCA, but screwbean mesquite comprised the majority of individuals. The shrub class was dominated by willow baccharis, with a minor component of saltcedar. Stem density was dominated by arrowweed. The relative number of stems by DC for each species is shown in Table 3-13.

Overall tree height by species is summarized in Table 3-14. Distribution of trees between HCs is shown in Table 3-15. Shrub height data are summarized in Table 3-16.

The density of standard trees by SC is shown in Figure 3-1. Canopy closure for BLCA is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-2. Arrowweed was the densest species until the 2 to 3 meter layer, where screwbean mesquite comprised the higher portion of vegetation density. The upper canopy was comprised primarily of cottonwood.

Tree and shrub foliar cover are summarized in Table 3-17, and herbaceous foliar cover is summarized in Table 3-18.

Table 3-11. Stem Density at Beal Lake Conservation Area for 2012 Vegetation Surveys

Species	Density, Stems (per acre)	Relative Density (percent)
Cottonwood	413	1
Goodding's Willow	188	<1
Coyote Willow	1,840	4
Honey Mesquite	6	<1
Screwbean Mesquite	1,347	3
Saltcedar	814	2
Willow Baccharis	1,628	3
Arrowweed	46,163	88

Table 3-12. Tree and Shrub Frequency at Beal Lake Conservation Area for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	49	21
	Goodding's Willow	46	20
	Coyote Willow	11	5
	Honey Mesquite	26	11
	Screwbean Mesquite	100	43
Shrubs	Willow Baccharis	49	27
	Arrowweed	94	52
	Saltcedar	37	21

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-13. Stem Diameter Class (DC) Distributions by Species for Beal Lake Conservation Area for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	17	41	24	15	1	1
Goodding's Willow	26	61	11	2	0	0
Coyote Willow	91	9	0	0	0	0
Honey Mesquite	0	100	0	0	0	0
Screwbean Mesquite	55	41	3	1	0	0
Saltcedar	98	2	0	0	0	0
Willow Baccharis	59	39	2	0	0	0
Arrowweed	100	0	0	0	0	0

Table 3-14. Tree Height Summary for 2012 Beal Lake Conservation Area Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	7.5	176	0.38	1–25
Goodding's Willow	3.8	58	0.22	0.8–8.6
Honey Mesquite	5.1	34	0.14	3.1–6.4
Screwbean Mesquite	3.9	353	0.07	0.1–8.2

Table 3-15. Height Class (HC) Summary for Standard Trees and Mesquite at Beal Lake Conservation Area

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	14	60	15	10	1
Goodding's Willow	50	50	0	0	0
Honey Mesquite	0	100	0	0	0
Screwbean Mesquite	32	68	0	0	0

Table 3-16. Shrub Height Summary for 2012 Beal Lake Conservation Area Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Willow Baccharis	2.9	465	0.11	0.6–4.4
Saltcedar	1.8	74	0.14	0.3–5

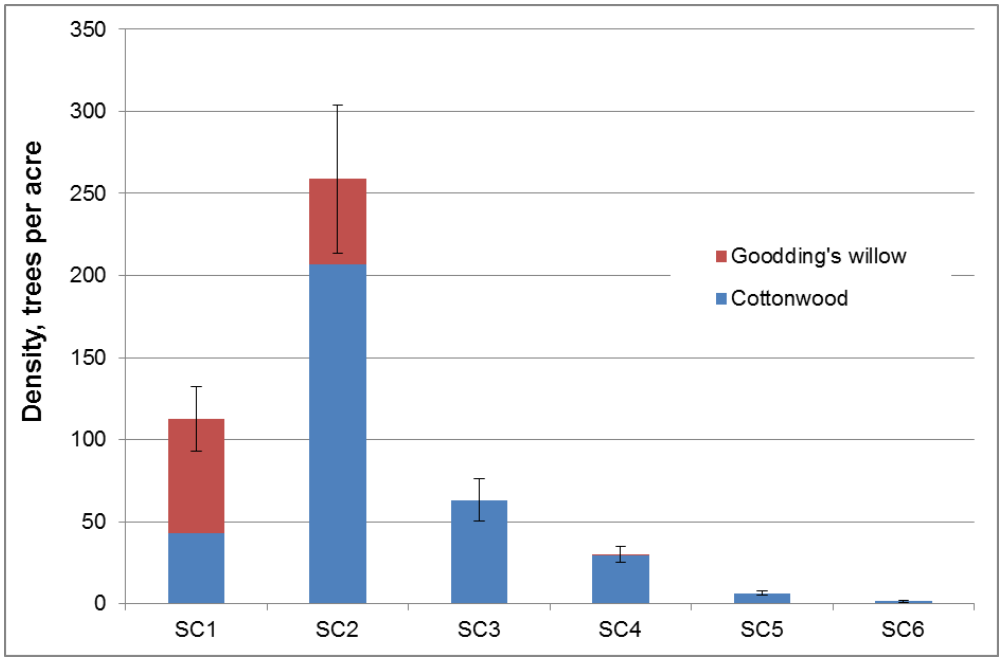

Figure 3-1. Cottonwood and Goodding's willow density for 2012 Beal Lake Conservation Area vegetation surveys.
(Error bars indicate one standard error of total tree density.)

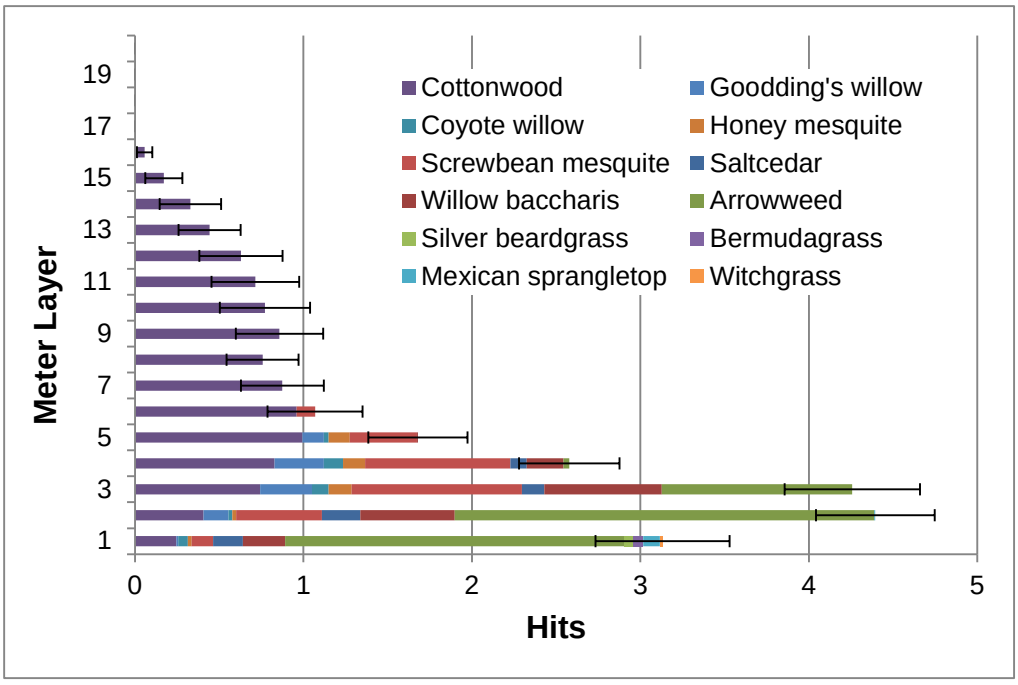

Figure 3-2. Vertical foliar density for 2012 Beal Lake Conservation Area vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-17. Tree and Shrub Foliar Cover for 2012 Beal Lake Conservation Area Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	26	21
Goodding's Willow	5	4
Coyote Willow	2	2
Honey Mesquite	2	2
Screwbean Mesquite	20	16
Saltcedar	4	4
Willow Baccharis	13	11
Arrowweed	51	41

Table 3-18. Herbaceous Foliar Cover Summary for 2012 Beal Lake Conservation Area Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	**3**	**Not applicable**
Silversheath	<1	<1
Bermudagrass	2	93
Mexican Sprangletop	<1	<1
Witchgrass	<1	<1
Unknown	<1	6

3.2.2 Bill Williams River East (BWRE)

The BWRE survey area was comprised of a mixed native and non-native (saltcedar) overstory, with variably-dense understory growth of various native and non-native species. Vegetation composition varied primarily based on distance from the active river and backwater channels. Different cohorts of riparian trees were apparent, with younger trees present nearer the active channel. BWRE plots were often within or immediately adjacent to surface water, depending on plot locations relative to the active channel and meanders/backwaters. These water features included the Bill Williams River, backwater channels, and areas flooded due to beaver dams. Compared to 2011, the river elevation was higher, and more surface water was present. Wild burro and cattle signs were observed throughout and adjacent to the Bill Williams River NWR survey area.

Tree and shrub densities and relative tree and shrub densities at BWRE are provided in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-19. Tree and shrub frequency and relative frequency are summarized in Table 3-20. All standard trees and saltcedar were encountered at BWRE, but screwbean mesquite was absent. One blue palo verde was encountered. Saltcedar was the most common tree species. Shrub counts were dominated by willow baccharis, and stem density was dominated by arrowweed. The relative number of stem DCs for each species is shown in Table 3-21. All arrowweed stems fell within DC1, while cottonwood, Goodding's willow, and honey mesquite stems were distributed between DC1 and DC6.

Overall tree height by species is summarized in Table 3-22. Distribution of trees between HCs is shown in Table 3-23. HC2 (4–10 m) was most common. Height data for willow baccharis, the only shrub observed at the site aside from arrowweed, are summarized in Table 3-24.

The density of standard trees by SC is shown in Figure 3-3. Canopy closure for BWRE is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-4. Saltcedar had the most hits between 1 and 5 m, Goodding's willow was most common between 5 and 10 m, and the upper canopy was comprised primarily of cottonwood.

Tree and shrub foliar cover are summarized in Table 3-25, and herbaceous foliar cover is summarized in Table 3-26.

Table 3-19. Stem Density at Bill Williams River East for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Cottonwood	27	<1
Goodding's Willow	147	1
Honey Mesquite	90	1
Saltcedar	872	8
Willow Baccharis	123	1
Arrowweed	9,021	88

Table 3-20. Tree and Shrub Frequency at Bill Williams River East for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	31	12
	Goodding's Willow	72	28
	Honey Mesquite	53	20
	Saltcedar	100	39
Shrubs	Willow Baccharis	31	55
	Arrowweed	25	45

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-21. Stem Diameter Class (DC) Distributions by Species for Bill Williams River East for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	11	22	11	11	33	11
Goodding's Willow	29	14	6	18	22	10
Honey Mesquite	20	40	13	13	10	3
Saltcedar	32	37	17	10	3	0
Willow Baccharis	83	10	7	0	0	0
Arrowweed	100	0	0	0	0	0

Table 3-22. Tree Height Summary for 2012 Bill Williams River East Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	7.7	37	0.99	1.3–28
Goodding's Willow	6.5	109	0.34	0.8–19
Honey Mesquite	4.7	132	0.20	0.2–15.9
Saltcedar	4.5	689	0.06	0.5–9.1

Table 3-23. Height Class (HC) Summary for Standard Trees, Mesquite, and Saltcedar at Bill Williams River East

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	17	53	21	8	1
Goodding's Willow	18	67	13	1	0
Honey Mesquite	36	61	2	0	0
Saltcedar	25	75	0	0	0

Table 3-24. Shrub Height Summary for 2012 Bill Williams River East Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Willow Baccharis	1.9	28	0.27	0.2–5

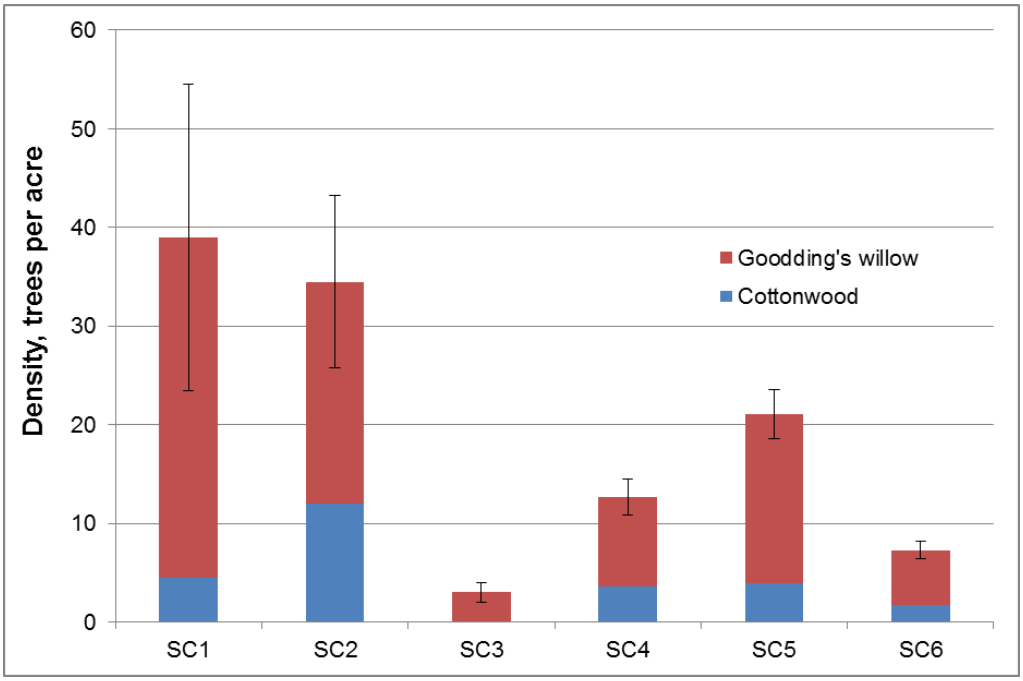

Figure 3-3. Cottonwood and Goodding's willow density for 2012 Bill Williams River East vegetation surveys.
(Error bars indicate one standard error of total tree density.)

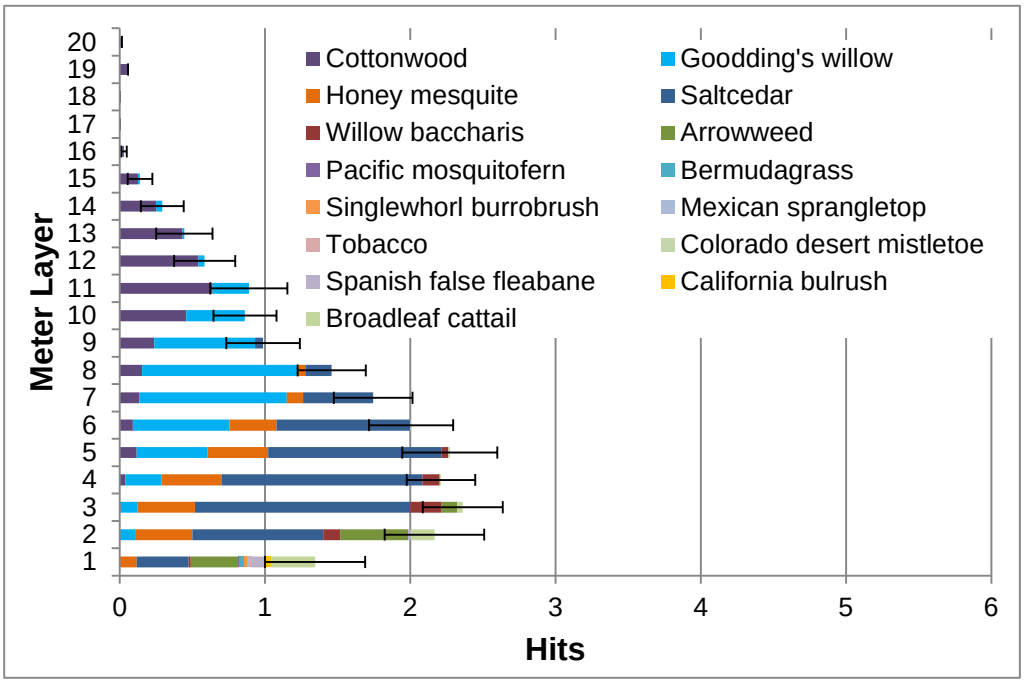

Figure 3-4. Vertical foliar density for 2012 Bill Williams River East vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-25. Tree and Shrub Foliar Cover for 2012 Bill Williams River East Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	8	8
Goodding's Willow	25	24
Honey Mesquite	12	11
Saltcedar	49	48
Willow Baccharis	3	3
Arrowweed	6	5

Table 3-26. Herbaceous Foliar Cover Summary for 2012 Bill Williams River East Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	**3**	**Not applicable**
Bermudagrass	<1	14
Desert Thorn-Apple	<1	1
Mexican Sprangletop	<1	1
Spanish False Fleabane	<1	10
Mediterranean Grass	<1	10
California Bulrush	<1	18
Fanleaf Crinklemat	<1	<1
White Clover	<1	<1
Narrowleaf Cattail	1	11
Broadleaf Cattail	2	33

3.2.3 Palo Verde Ecological Reserve

Vegetation across PVER varied in accordance with the planting plans implemented by Reclamation. These vegetation types included: dominant cottonwood with scattered coyote and Goodding's willow; mixture of cottonwood and willows; dominant cottonwood with little understory; dominant Goodding's and coyote willow; dense quail bush (Site 1); dense understory of alfalfa in newly planted fields (Sites 5 through 7); variable cover of Bermudagrass; and minor amounts of honey mesquite and arrowweed. Surface water was not observed at PVER. Spanish false fleabane (Pulicaria paludosa), a non-native plant of interest, was observed at PVER within Site 6 and along corridors (e.g., roads and canals) and at Bill Williams River.

3.2.3.1 Palo Verde Ecological Reserve Site 1

Tree densities and relative tree densities at PVER Site 1 are summarized in Table 3-1, and stem densities and relative stem densities are shown in Table 3-27. Tree frequency and relative frequency are summarized in Table 3-28. Screwbean mesquite was absent, and no shrubs were encountered. The relative number of stem DCs for each species is shown in Table 3-29.

Overall tree height by species is summarized in Table 3-30. Distribution of trees between HCs is shown in Table 3-31. The density of standard trees by SC is shown in Figure 3-5. Canopy closure

for PVER1 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-6. Coyote willow had the most hits between 1 and 4 m, and cottonwood was prevalent above.

Tree and shrub foliar cover are summarized in Table 3-32, and herbaceous foliar cover is summarized in Table 3-33.

Table 3-27. Stem Density at Palo Verde Ecological Reserve Site 1 for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Cottonwood	54	<1
Goodding's Willow	18,528	99
Coyote Willow	54	<1

Table 3-28. Tree Frequency at Palo Verde Ecological Reserve Site 1 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	38	33
	Goodding's Willow	13	11
	Coyote Willow	38	33
	Honey Mesquite	25	22

Table 3-29. Site 1 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	50	0	0	0	0	50
Goodding's Willow	0	25	0	50	25	0
Coyote Willow	49	48	3	0	0	0
Honey Mesquite	25	75	0	0	0	0

Table 3-30. Tree Height Summary for 2012 Palo Verde Ecological Reserve Site 1 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	17.0	18	0.37	13.9–19
Goodding's Willow	12.6	9	0.65	10.4–16.3
Honey Mesquite	3.6	22	0.14	2.3–5.5

Table 3-31. Height Class (HC) Summary for Standard Trees and Mesquite at Palo Verde Ecological Reserve Site 1

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	0	0	7	80	13
Goodding's Willow	0	37	49	14	0
Honey Mesquite	25	75	0	0	0
Screwbean Mesquite	0	0	7	80	13

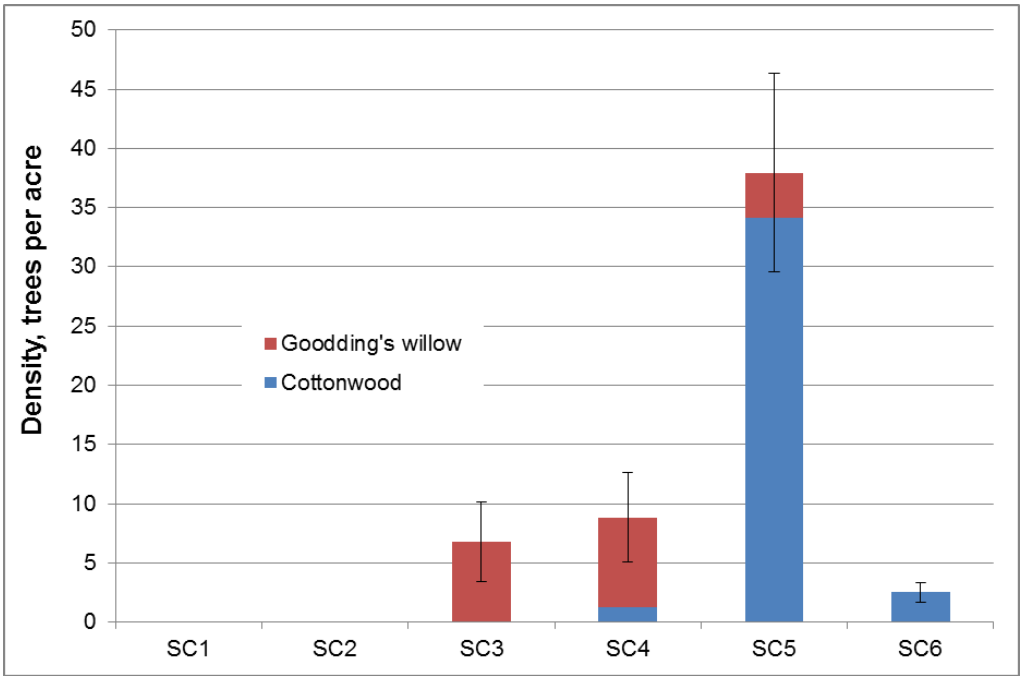

Figure 3-5. Cottonwood and Goodding's willow density for 2012 Palo Verde Ecological Reserve Site 1 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

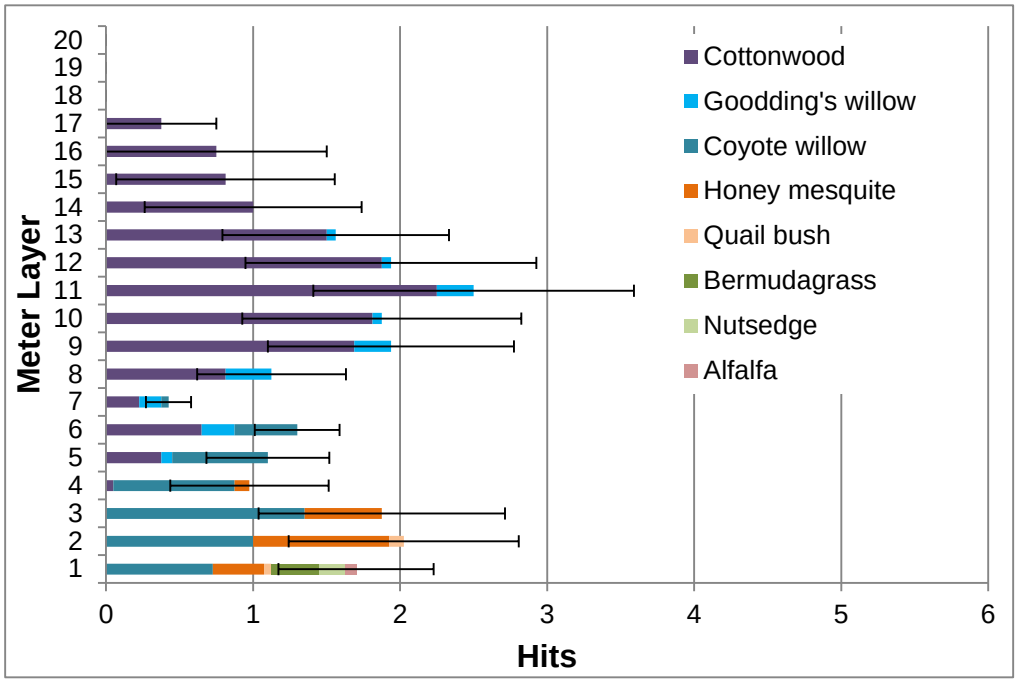

Figure 3-6. Vertical foliar density for 2012 Palo Verde Ecological Reserve Site 1 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-32. Tree and Shrub Foliar Cover for 2012 Palo Verde Ecological Reserve Site 1 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	36	47
Goodding's Willow	10	14
Coyote Willow	22	30
Honey Mesquite	7	9

Table 3-33. Herbaceous Foliar Cover Summary for 2012 Palo Verde Ecological Reserve Site 1 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	**6**	**Not applicable**
Canadian Horseweed	<1	<1
Bermudagrass	3	68
Nutsedge	1	28
Heliotrope	<1	3

3.2.3.2 Palo Verde Ecological Reserve Site 2

Tree densities and relative tree densities at PVER Site 2 are shown in Table 3-1; stem densities and relative stem densities are summarized in Table 3-34. Tree frequency and relative frequency are summarized in Table 3-35 (no shrubs were observed). The relative number of stem DCs for each species is shown in Table 3-36.

Overall tree height by species is summarized in Table 3-37. Distribution of trees between HCs is shown in Table 3-38. The density of standard trees by SC is shown in Figure 3-7. Canopy closure for PVER2 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-8. Coyote willow was prevalent near ground surface, Goodding's willow comprised the majority of the mid-canopy, and cottonwood was most common in the upper canopy.

Tree foliar cover is summarized in Table 3-39, and herbaceous foliar cover is summarized in Table 3-40.

Table 3-34. Stem Density at Palo Verde Ecological Reserve Site 2 for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Cottonwood	273	1
Goodding's Willow	400	2
Coyote Willow	20,915	97

Table 3-35. Tree Frequency at Palo Verde Ecological Reserve Site 2 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	53	24
	Goodding's Willow	82	38
	Coyote Willow	82	38

Table 3-36. Stem Diameter Class (DC) Distributions by Species for Palo Verde Ecological Reserve Site 2 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	2	21	37	33	7	0
Goodding's Willow	0	37	35	22	6	0
Coyote Willow	62	37	1	0	0	0

Table 3-37. Tree Height Summary for 2012 Palo Verde Ecological Reserve Site 2 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	11.5	87	0.50	1.6–22.2
Goodding's Willow	9.0	129	0.29	0.6–19

Table 3-38. Height Class (HC) Summary for Standard Trees and Mesquite at Palo Verde Ecological Reserve Site 2

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	4	31	46	16	3
Goodding's Willow	3	62	34	1	0

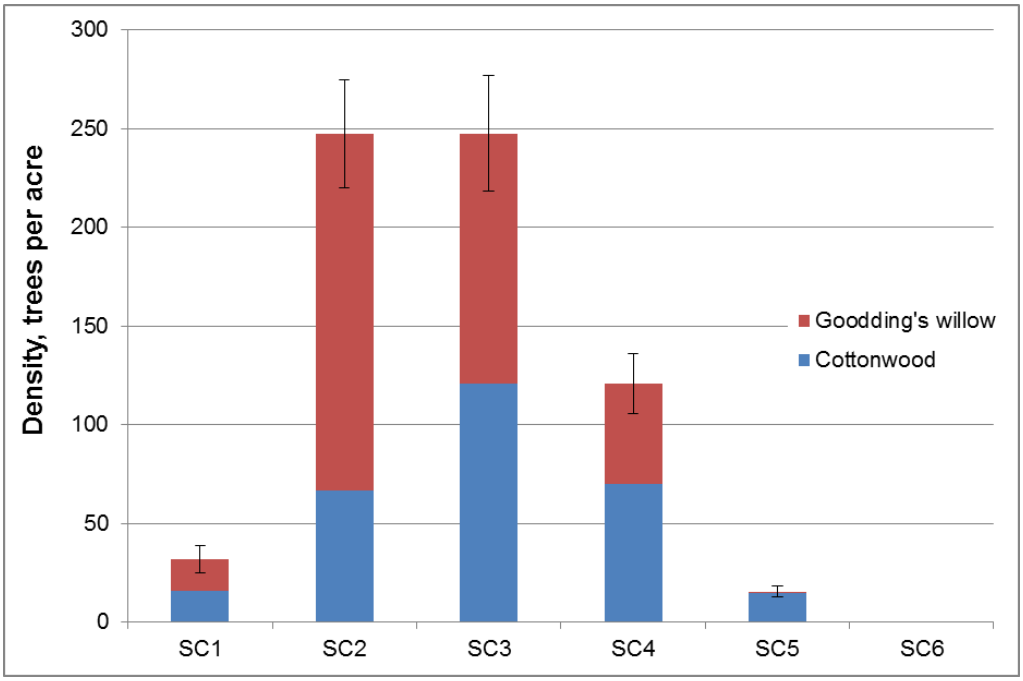

Figure 3-7. Cottonwood and Goodding's willow density for 2012 Palo Verde Ecological Reserve Site 2 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

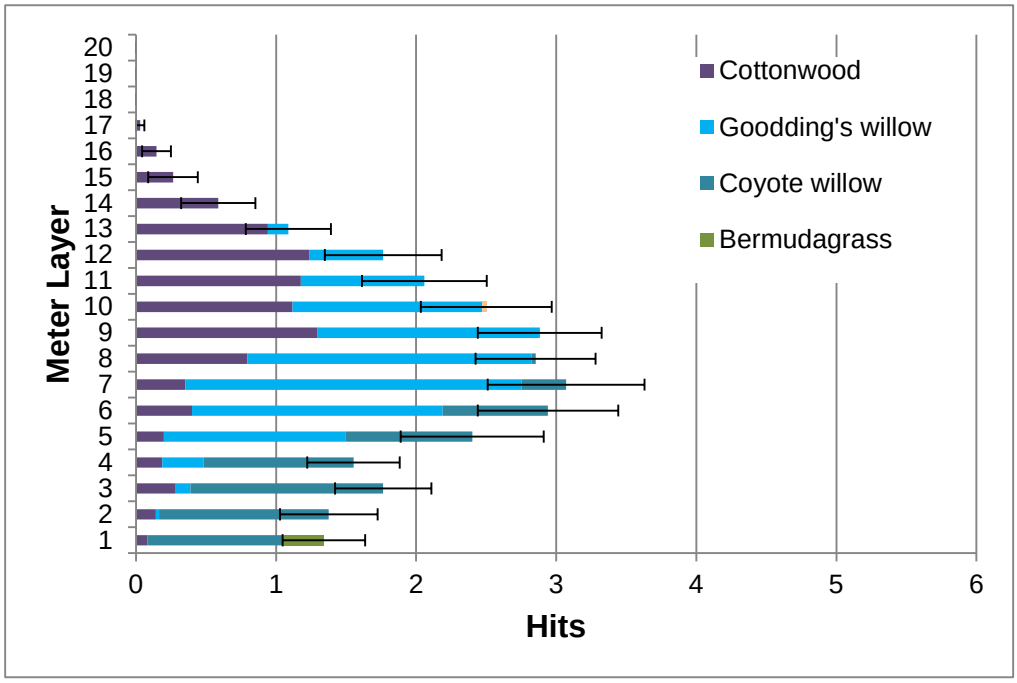

Figure 3-8. Vertical foliar density for 2012 Palo Verde Ecological Reserve Site 2 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-39. Tree and Foliar Cover for 2012 Palo Verde Ecological Reserve Site 2 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	25	28
Goodding's Willow	36	40
Coyote Willow	30	33

Table 3-40. Herbaceous Foliar Cover Summary for 2012 Palo Verde Ecological Reserve Site 2 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	**1**	**Not applicable**
Bermudagrass	1	97
Nutsedge	<1	2
Alfalfa	<1	1

3.2.3.3 Palo Verde Ecological Reserve Site 3

Tree and shrub densities and relative tree and shrub densities at PVER Site 3 are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-41. Tree and shrub frequency and relative frequency are summarized in Table 3-42. The relative number of stem DCs for each species is shown in Table 3-43.

Overall tree height by species is summarized in Table 3-44. Distribution of trees between HCs is shown in Table 3-45. Height for willow baccharis, the only shrub observed at this site, is summarized in Table 3-46. The density of standard trees by SC is shown in Figure 3-9. Canopy closure for PVER3 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-10. Cottonwood dominated vertical foliar density.

Tree and shrub foliar cover is summarized in Table 3-47, and herbaceous foliar cover is summarized in Table 3-48.

Table 3-41. Stem Density at Palo Verde Ecological Reserve Site 3 for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Cottonwood	416	13
Goodding's Willow	72	2
Coyote Willow	2,626	84
Honey Mesquite	10	<1

Table 3-42. Tree and Shrub Frequency at Palo Verde Ecological Reserve Site 3 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	76	47
	Goodding's Willow	24	15
	Coyote Willow	52	32
	Honey Mesquite	10	6
Shrubs	Willow Baccharis	5	100

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-43. Stem Diameter Class (DC) Distributions by Species for Palo Verde Ecological Reserve Site 3 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	1	11	12	57	16	2
Goodding's Willow	0	86	7	7	0	0
Coyote Willow	44	56	0	0	0	0
Honey Mesquite	0	100	0	0	0	0

Table 3-44. Tree Height Summary for 2012 Palo Verde Ecological Reserve Site 3 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	14.6	173	0.31	2.5–25.5
Goodding's Willow	5.3	20	0.89	2.6–14
Honey Mesquite	2.0	2	N/A	1.5–2.4

Table 3-45. Height Class (HC) Summary for Standard Trees and Mesquite at Palo Verde Ecological Reserve Site 3

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	2	13	39	39	6
Goodding's Willow	34	62	4	0	0
Honey Mesquite	100	0	0	0	0

Table 3-46. Shrub Height Summary for 2012 Palo Verde Ecological Reserve Site 3 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Willow Baccharis	2.3	1	N/A	2.3–2.3

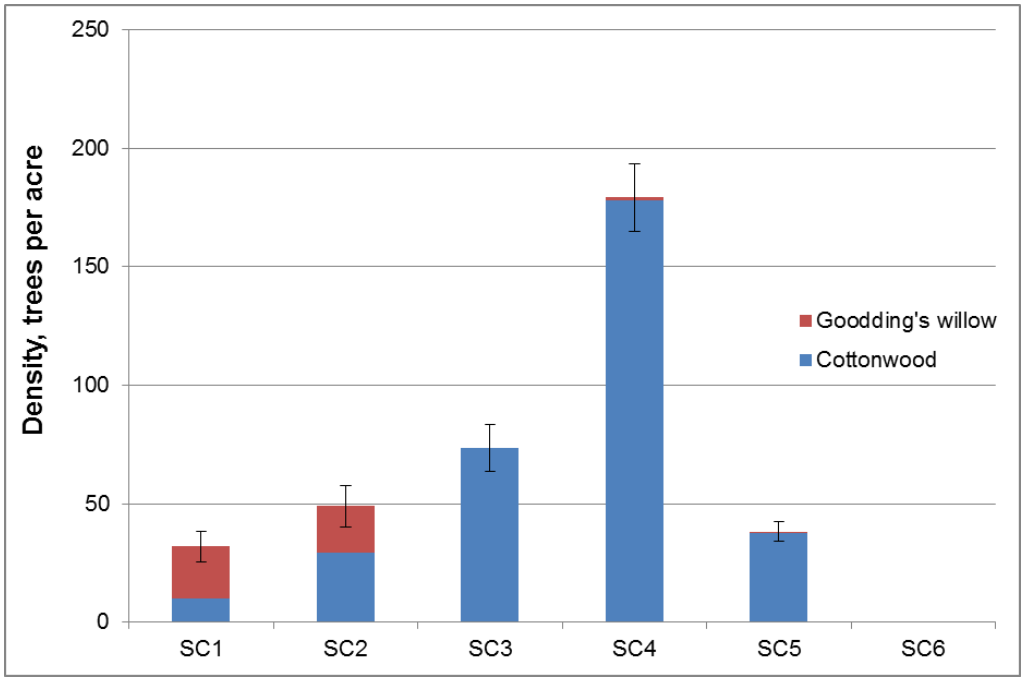

Figure 3-9. Cottonwood and Goodding's willow density for 2012 Palo Verde Ecological Reserve Site 3 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

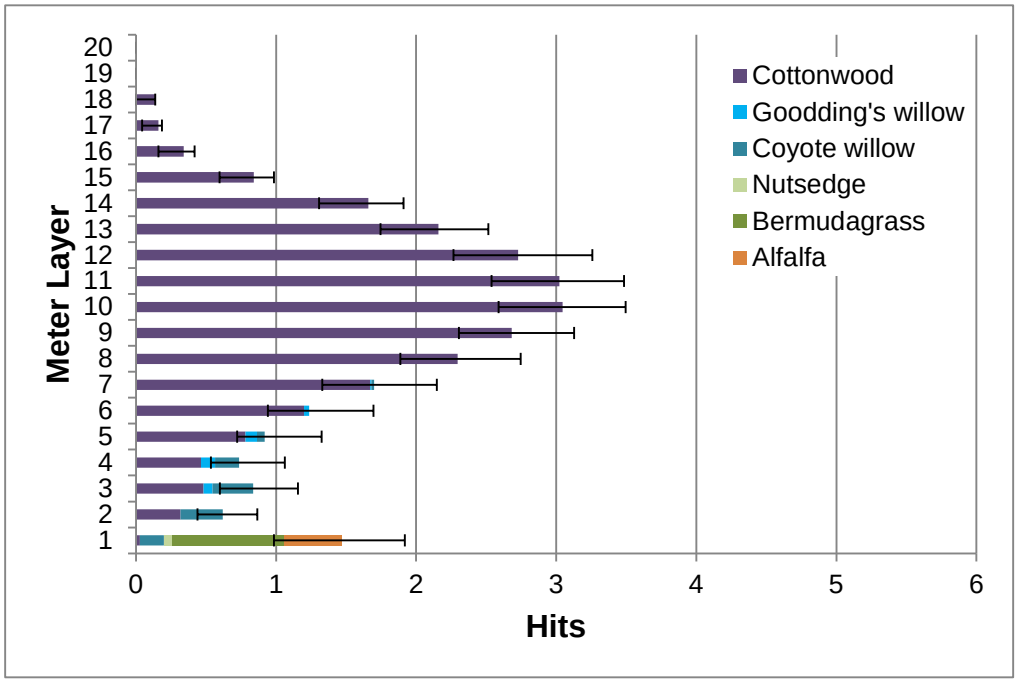

Figure 3-10. Vertical foliar density for 2012 Palo Verde Ecological Reserve Site 3 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-47. Tree and Shrub Foliar Cover for 2012 Palo Verde Ecological Reserve Site 3 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	56	82
Goodding's Willow	2	3
Coyote Willow	11	15
Honey Mesquite	<1	<1
Saltcedar	<1	<1
Desert Broom	<1	<1

Table 3-48. Herbaceous Foliar Cover Summary for Palo Verde Ecological Reserve Site 3 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	**16**	**Not applicable**
Bermudagrass	9	55
Nutsedge	<1	1
Prickly lettuce	<1	<1
Alfalfa	8	43

3.2.3.4 Palo Verde Ecological Reserve Site 4

Tree and shrub densities and relative tree and shrub densities at PVER4 are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are shown in Table 3-49. Tree and shrub frequency and relative frequency are summarized in Table 3-50. The relative number of stem DCs for each species is shown in Table 3-51.

Overall tree height by species is summarized in Table 3-52. Distribution of trees between HCs is shown in Table 3-53. Height for shrubs is summarized in Table 3-54. The density of standard trees by SC is shown in Figure 3-11. Canopy closure for PVER4 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-12. Cottonwood and Goodding's willow were co-dominant.

Tree and shrub foliar cover is summarized in Table 3-55, and herbaceous foliar cover is summarized in Table 3-56.

Table 3-49. Stem Density at Palo Verde Ecological Reserve Site 4 for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Cottonwood	318	9
Goodding's Willow	545	16
Coyote Willow	2,492	73
Willow Baccharis	16	<1
Quail Bush	54	2

Table 3-50. Tree and Shrub Frequency at Palo Verde Ecological Reserve Site 4 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	70	28
	Goodding's Willow	90	36
	Coyote Willow	80	32
	Honey Mesquite	10	4
Shrubs	Willow Baccharis	25	71
	Quail Bush	10	29

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-51. Stem Diameter Class (DC) Distributions by Species for Palo Verde Ecological Reserve Site 4 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	3	8	32	37	19	0
Goodding's Willow	12	42	27	18	2	0
Coyote Willow	53	47	0	0	0	0
Willow Baccharis	67	33	0	0	0	0
Quail Bush	10	90	0	0	0	0

Table 3-52. Tree Height Summary for 2012 Palo Verde Ecological Reserve Site 4 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	11.7	135	0.33	2.3–23.2
Goodding's Willow	8.7	38	0.66	0.8–17.2
Honey Mesquite	4.0	10	0.18	3.2–4.6

Table 3-53. Height Class (HC) Summary for Standard Trees and Mesquite at Palo Verde Ecological Reserve Site 4

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	4	29	54	12	1
Goodding's Willow	12	44	39	5	0
Honey Mesquite	0	100	0	0	0

Table 3-54. Shrub Height Summary for 2012 Palo Verde Ecological Reserve Site 4 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	2.6	7	0.12	2.2–3
Willow Baccharis	3.0	8	0.24	2–4.2

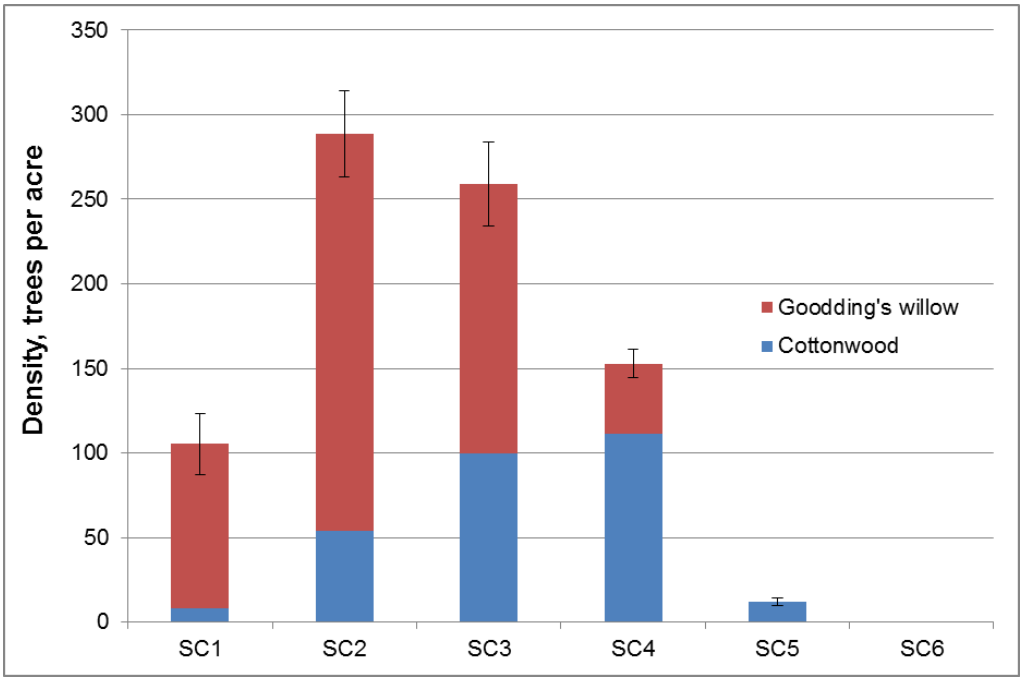

Figure 3-11. Cottonwood and Goodding's willow density for 2012 Palo Verde Ecological Reserve Site 4 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

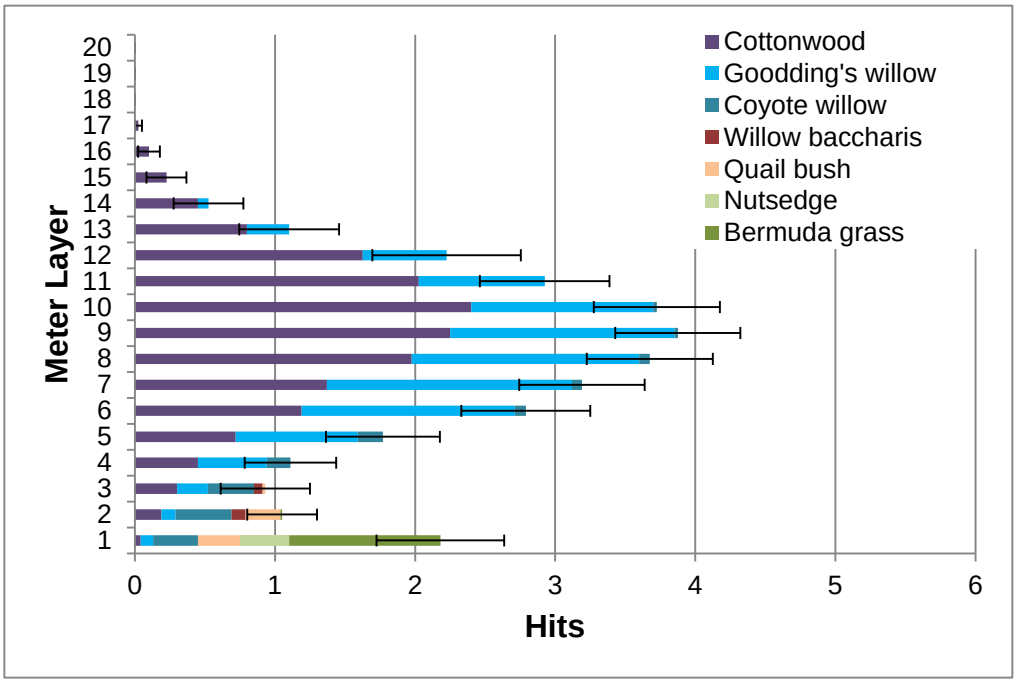

Figure 3-12. Vertical foliar density for 2012 Palo Verde Ecological Reserve Site 4 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-55. Tree and Shrub Foliar Cover for 2012 Palo Verde Ecological Reserve Site 4 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	45	49
Goodding's Willow	31	33
Coyote Willow	9	10
Honey Mesquite	<1	<1
Willow Baccharis	2	2
Desert Broom	<1	<1
Quail Bush	5	6

Table 3-56. Herbaceous Foliar Cover Summary for 2012 Palo Verde Ecological Reserve Site 4 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous	**13**	**Not applicable**
Goosefoot	1	4
Bermudagrass	13	91
Nutsedge	1	5
Mexican Sprangletop	<1	<1
Alfalfa	<1	<1

3.2.3.5 Palo Verde Ecological Reserve Site 5

Tree and shrub densities and relative tree and shrub densities at PVER5 are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-57. Tree and shrub frequency and relative frequency are summarized in Table 3-58. The relative number of stems diameters classes for each species is shown in Table 3-59.

Overall tree height by species is summarized in Table 3-60. Distribution of trees between HCs is shown in Table 3-61. Height for shrubs is summarized in Table 3-62. The density of standard trees by SC is shown in Figure 3-13. Canopy closure for PVER5 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-14. Cottonwood and Goodding's willow were co-dominant.

Tree and shrub foliar cover is summarized in Table 3-63, and herbaceous foliar cover is summarized in Table 3-64.

Table 3-57. Stem Density at Palo Verde Ecological Reserve Site 5 for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Cottonwood	301	16
Goodding's Willow	505	26
Coyote Willow	834	43
Willow Baccharis	158	8
Desert Broom	62	3
Quail Bush	73	4

Table 3-58. Tree and Shrub Frequency at Palo Verde Ecological Reserve Site 5 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	75	40
	Goodding's Willow	93	49
	Coyote Willow	18	9
	Honey Mesquite	4	2
Shrubs	Willow Baccharis	21	46
	Desert Broom	21	46
	Quail Bush	4	8

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-59. Stem Diameter Class (DC) Distributions by Species for Palo Verde Ecological Reserve Site 5 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	5	26	41	26	3	0
Goodding's Willow	12	60	24	4	0	1
Coyote Willow	41	59	0	0	0	0
Willow Baccharis	63	37	0	0	0	0
Desert Broom	81	19	0	0	0	0
Quail Bush	100	0	0	0	0	0

Table 3-60. Tree Height Summary for 2012 Palo Verde Ecological Reserve Site 5 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	7.4	122	0.24	1.6–15.4
Goodding's Willow	6.1	6	0.88	1.1–12.4
Honey Mesquite	3.4	3	0.03	3.3–3.4

Table 3-61. Height Class (HC) Summary for Standard Trees and Mesquite at Palo Verde Ecological Reserve Site 5

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	5	88	7	0	0
Goodding's Willow	10	89	2	0	0
Honey Mesquite	0	100	0	0	0

Table 3-62. Shrub Height Summary for 2012 Palo Verde Ecological Reserve Site 5 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	1.9	38	0.12	1.2–2.9
Willow Baccharis	2.8	10	0.15	2–3.5
Desert Broom	1.4	15	0.09	0.8–2.1

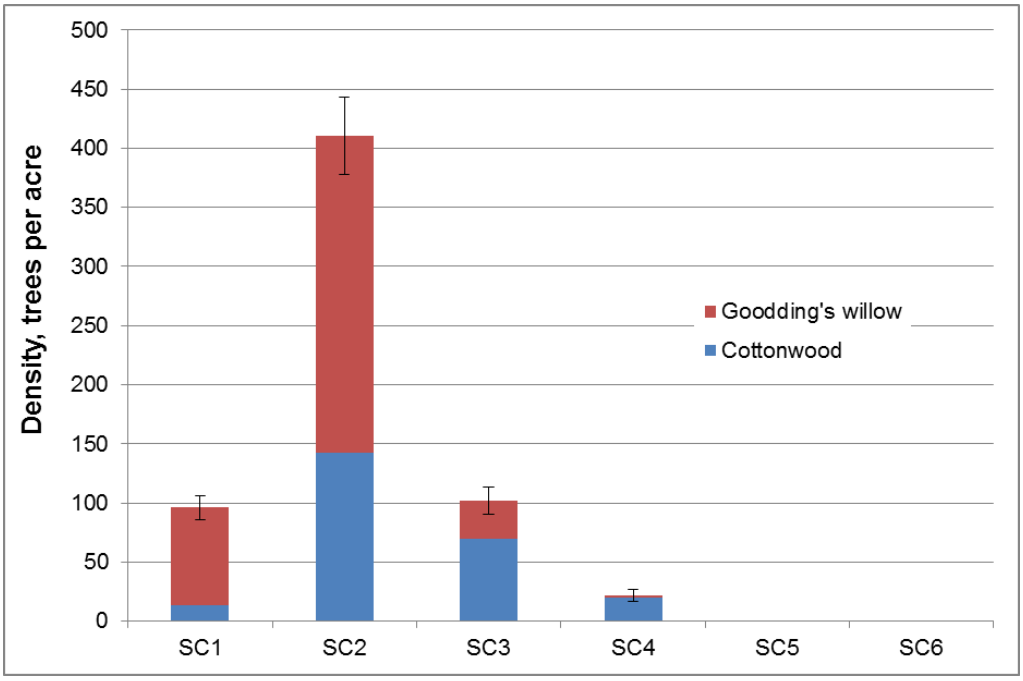

Figure 3-13. Cottonwood and Goodding's willow density for 2012 Palo Verde Ecological Reserve Site 5 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

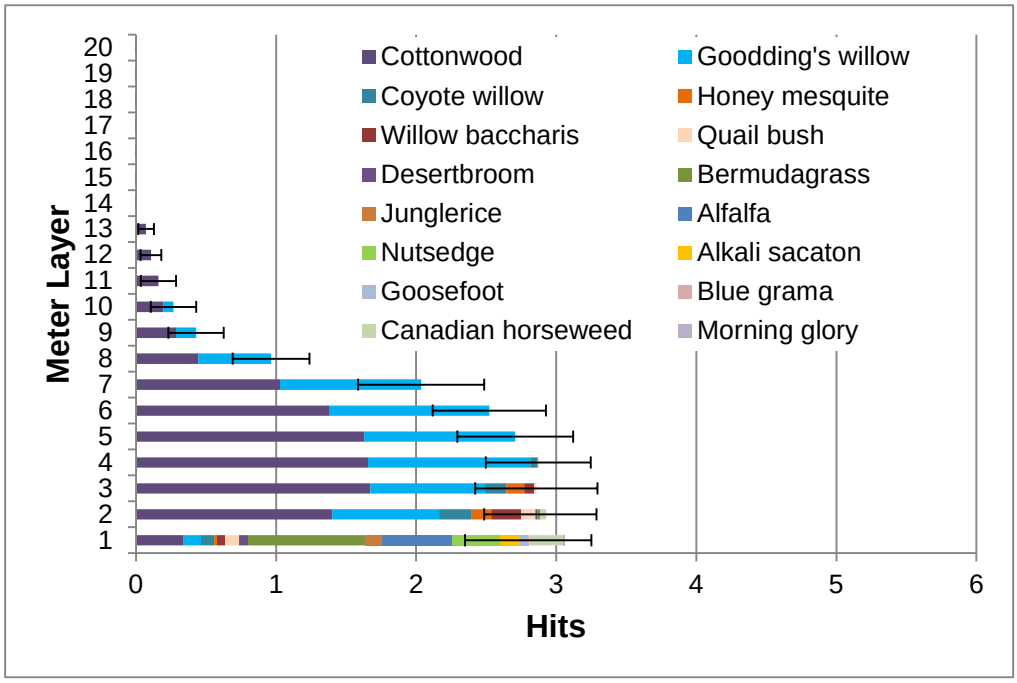

Figure 3-14. Vertical foliar density for 2012 Palo Verde Ecological Reserve Site 5 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-63. Tree and Shrub Foliar Cover for 2012 Palo Verde Ecological Reserve Site 5 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	33	52
Goodding's Willow	21	33
Coyote Willow	2	3
Honey Mesquite	<1	<1
Willow Baccharis	3	4
Desert Broom	1	2
Quail Bush	3	5

Table 3-64. Herbaceous Foliar Cover Summary for 2012 Palo Verde Ecological Reserve Site 5 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	**22**	**Not applicable**
Blue Grama	<1	<1
Goosefoot	<1	2
Canadian Horseweed	1	5
Bermudagrass	11	50
Nutsedge	1	4
Junglerice	1	6
Morning Glory	<1	<1
Mexican Sprangletop	<1	2
Prickly Lettuce	<1	<1
Alfalfa	5	22
Silversheath Knotweed	<1	2
Yellow Bristlegrass	<1	2
Alkali Sacaton	1	6

3.2.3.6 Palo Verde Ecological Reserve 6

Tree densities and relative tree densities at PVER6 are summarized in Table 3-1. Coyote willow density is summarized in Table 3-65. Tree and shrub frequency and relative frequency are summarized in Table 3-66.

Overall tree height by species is summarized in Table 3-67. Distribution of trees between HCs is shown in Table 3-68. Height for shrubs is summarized in Table 3-69. The density of standard trees by SC is shown in Figure 3-15.

Table 3-65. Density and Estimated Tree Counts for Coyote Willow at Palo Verde Ecological Reserve Site 6 for 2012 Vegetation Surveys

Observed Trees	Density (trees per plot)	Density (trees per acre)	Estimated Trees for Site
1,947	48.7	492	104,892

Table 3-66. Tree and Shrub Frequency at Palo Verde Ecological Reserve Site 6 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	95	34
	Goodding's Willow	93	33
	Coyote Willow	80	28
	Honey Mesquite	15	5
Shrubs	Willow Baccharis	25	67
	Desert Broom	3	7
	Quail Bush	10	27

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-67. Tree Height Summary for 2012 Palo Verde Ecological Reserve Site 6 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	3.8	267	0.12	0.6–8.9
Goodding's Willow	5.0	330	0.10	0.1–8.1
Honey Mesquite	2.2	57	0.11	0.8–3.6

Table 3-68. Height Class (HC) Summary for Standard Trees and Mesquite at Palo Verde Ecological Reserve Site 6

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	35	65	0	0	0
Goodding's Willow	19	81	0	0	0
Honey Mesquite	95	5	0	0	0

Table 3-69. Shrub Height Summary for 2012 Palo Verde Ecological Reserve Site 6 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	1.0	30	0.07	0.3–1.4
Willow Baccharis	2.3	43	0.12	1.1–5.3
Desert Broom	1.0	2	0.65	0.3–1.6

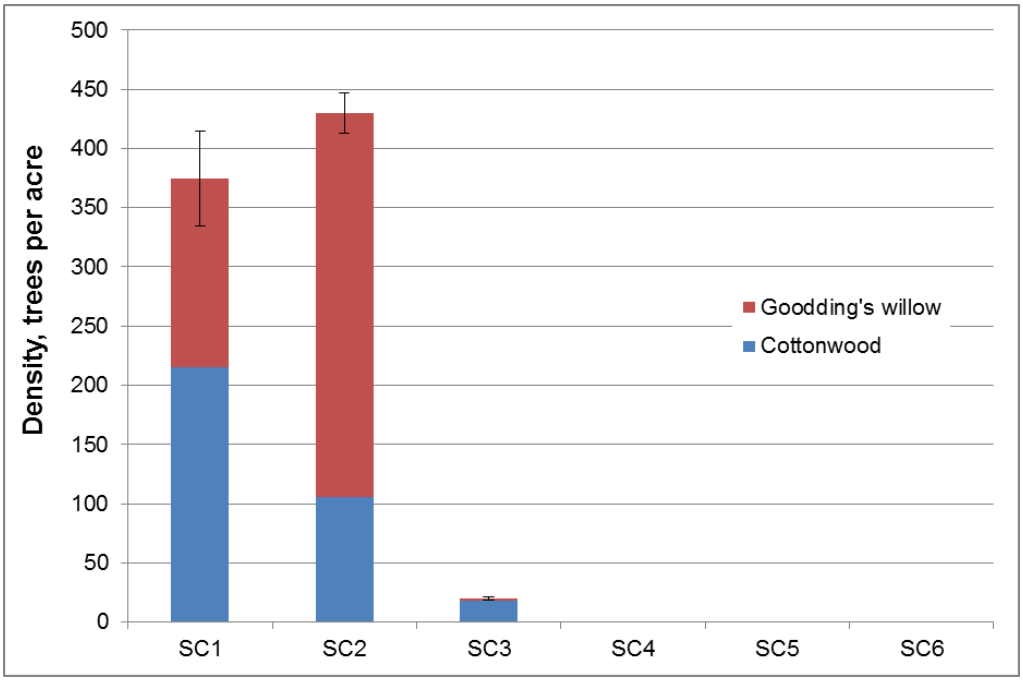

Figure 3-15. Cottonwood and Goodding's willow density for 2012 Palo Verde Ecological Reserve Site 6 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

3.2.3.7 Palo Verde Ecological Reserve Site 7

Tree densities and relative tree densities at PVER7 are summarized in Table 3-1. Coyote willow density is summarized in Table 3-70. Tree and shrub frequency and relative frequency are summarized in Table 3-71.

Overall tree height by species is summarized in Table 3-72. Distribution of trees between HCs is shown in Table 3-73. Height for shrubs is summarized in Table 3-74. The density of standard trees by SC is shown in Figure 3-16.

Table 3-70. Density and Estimated Tree Counts for Coyote Willow at Palo Verde Ecological Reserve Site 7 for 2012 Vegetation Surveys

Observed Trees	Density (trees per plot)	Density (trees per acre)	Estimated Trees for Site
1,321	33.0	334	75,511

Table 3-71. Tree Frequency at Palo Verde Ecological Reserve Site 7 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	85	29
	Goodding's Willow	98	33
	Coyote Willow	95	32
	Honey Mesquite	15	5
Shrubs	Willow Baccharis	58	82
	Desert Broom	8	11
	Quail Bush	5	7

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-72. Tree Height Summary for 2012 Palo Verde Ecological Reserve Site 7 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	3.2	285	0.05	0.6–5.8
Goodding's Willow	2.9	284	0.06	0.4–5.4
Honey Mesquite	1.3	42	0.08	0.7–2.7

Table 3-73. Height Class (HC) Summary for Standard Trees and Mesquite at Palo Verde Ecological Reserve Site 7

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	30	70	0	0	0
Goodding's Willow	63	37	0	0	0
Honey Mesquite	100	0	0	0	0

Table 3-74. Shrub Height Summary for 2012 Palo Verde Ecological Reserve Site 7 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	1.1	9	0.08	0.6–1.3
Willow Baccharis	1.7	122	0.05	0.5–2.5
Desert Broom	0.8	4	0.06	0.6–0.9

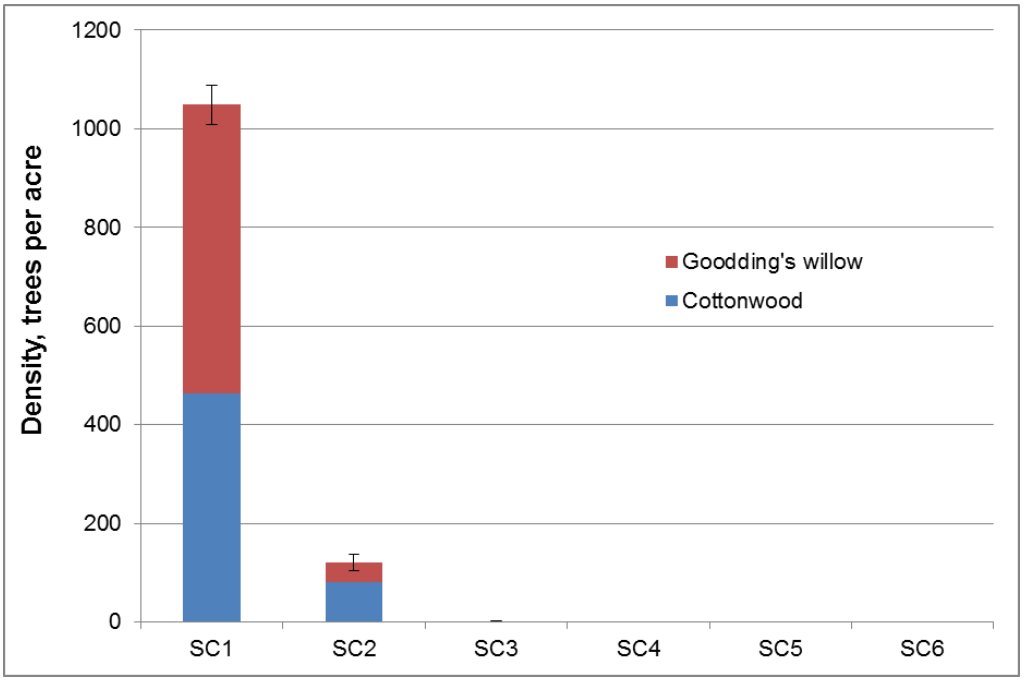

Figure 3-16. Cottonwood and Goodding's willow density for 2012 Palo Verde Ecological Reserve Site 7 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

3.2.4 Cibola Valley Conservation Area

Vegetation across the site varied in accordance with the various planting plans implemented by Reclamation. Sites 1 and 2 were dominated by cottonwood, Goodding's willow, and/or coyote willow. Site 3 was dominated by cottonwood with one plot (CVCA_03_101) dominated by honey mesquite. Sites 4W, 4E, 5, and 6 are dominated by honey mesquite and quail bush. Saltcedar, arrowweed, and heliotrope, while present in some plots, were not prevalent. Surface water was not observed at PVER. Morning glory (*Ipomea purpurea*), a noxious weed, continues to be prevalent at CVCA.

3.2.4.1 Cibola Valley Conservation Area Site 1

Tree and shrub densities and relative tree and shrub densities at CVCA1 are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-75. Tree and shrub frequency and relative frequency are summarized in Table 3-76. The relative number of stem DCs for each species is shown in Table 3-77.

Overall tree height by species is summarized in Table 3-78. Distribution of trees between HCs is shown in Table 3-79. Height for shrubs is summarized in Table 3-80. The density of standard trees by SC is shown in Figure 3-17. Canopy closure for CVCA1 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-18. Coyote willow comprised the largest portion of vegetation volume until 6 m, and cottonwood was dominant above.

Tree and shrub foliar cover is summarized in Table 3-81, and herbaceous foliar cover is summarized in Table 3-82.

Table 3-75. Stem Density at Cibola Valley Conservation Area Site 1 for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Cottonwood	465	2
Goodding's Willow	116	1
Coyote Willow	17,781	95
Saltcedar	33	<1
Willow Baccharis	17	<1
Arrowweed	389	2

Table 3-76. Tree and Shrub Frequency at Cibola Valley Conservation Area Site 1 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	100	41
	Goodding's Willow	62	25
	Coyote Willow	85	34
Shrubs	Willow Baccharis	15	40
	Arrowweed	8	20
	Saltcedar	15	40

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-77. Stem Diameter Class (DC) Distributions by Species for Cibola Valley Conservation Area Site 1 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	4	20	25	27	21	4
Goodding's Willow	0	21	36	36	7	0
Coyote Willow	31	68	1	0	0	0
Saltcedar	50	50	0	0	0	0
Willow Baccharis	50	50	0	0	0	0
Arrowweed	100	0	0	0	0	0

Table 3-78. Tree Height Summary for 2012 Cibola Valley Conservation Area Site 1 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	11.3	110.0	0.37	1.1–19.7
Goodding's Willow	8.7	36.0	0.66	1.5–19.7

Table 3-79. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola Valley Conservation Area Site 1

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	3	36	50	10	0
Goodding's Willow	12	33	53	1	0

Table 3-80. Shrub Height Summary for 2012 Cibola Valley Conservation Area Site 1 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Willow Baccharis	1.9	2	N/A	1–2.8
Saltcedar	4.6	8	0.38	3.1–6.1

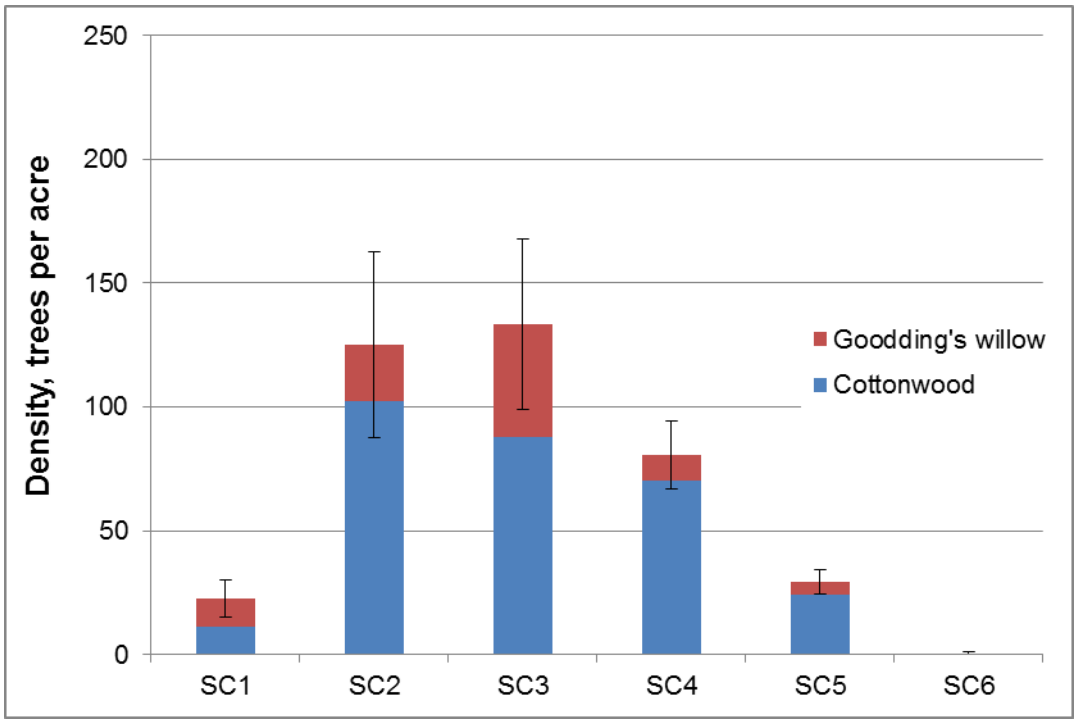

Figure 3-17. Cottonwood and Goodding's willow density for 2012 Cibola Valley Conservation Area Site 1 vegetation surveys.
(Error bars indicate one standard error of total tree density)

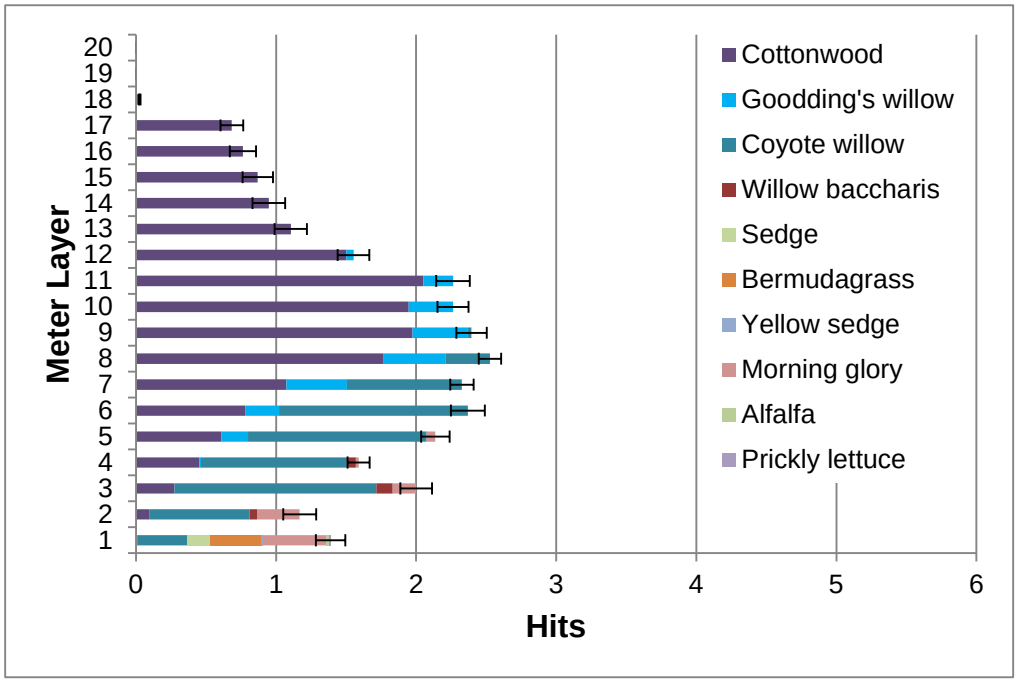

Figure 3-18. Vertical foliar density for 2012 Cibola Valley Conservation Area Site 1 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-81. Tree and Shrub Foliar Cover for 2012 Cibola Valley Conservation Area Site 1 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	42	52
Goodding's Willow	9	11
Coyote Willow	29	36
Saltcedar	<1	<1
Willow Baccharis	<1	<1

Table 3-82. Herbaceous Foliar Cover Summary for 2012 Cibola Valley Conservation Area Site 1 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	**7**	**Not applicable**
Sedge	<1	2
Canadian Horseweed	2	20
Bermudagrass	3	42
Morning Glory	2	32
Alfalfa	<1	<1

3.2.4.2 Cibola Valley Conservation Area Site 2

Tree and shrub densities and relative tree and shrub densities at CVCA2 are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-83. Tree and shrub frequency and relative frequency are summarized in Table 3-84. The relative number of stem DCs for each species is shown in Table 3-85.

Overall tree height by species is summarized in Table 3-86. Distribution of trees between HCs is shown in Table 3-87. Height for shrubs is summarized in Table 3-88. The density of standard trees by SC is shown in Figure 3-19. Canopy closure for CVCA2 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-20. Coyote willow, Goodding's willow, and cottonwood were co-dominant until 6 m, and cottonwood was most common above.

Tree and shrub foliar cover is summarized in Table 3-89 and herbaceous foliar cover is summarized in Table 3-90.

Table 3-83. Stem Density at Cibola Valley Conservation Area Site 2 for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Cottonwood	364	7
Goodding's Willow	608	12
Coyote Willow	3,619	71
Saltcedar	466	9
Willow Baccharis	11	<1

Table 3-84. Tree and Shrub Frequency at Cibola Valley Conservation Area Site 2 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	84	39
	Goodding's Willow	63	29
	Coyote Willow	68	32
Shrubs	Willow Baccharis	32	23
	Desert Broom	5	4
	Quail Bush	11	8
	Saltcedar	89	65

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-85. Stem Diameter Class (DC) Distributions by Species for Cibola Valley Conservation Area Site 2 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	5	16	31	42	6	0
Goodding's Willow	4	63	30	4	0	0
Coyote Willow	18	71	11	0	0	0
Saltcedar	70	29	1	0	0	0
Willow Baccharis	50	50	0	0	0	0
Quail Bush	100	0	0	0	0	0

Table 3-86. Tree Height Summary for 2012 Cibola Valley Conservation Area Site 2 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	10.3	141	0.25	1.1–16.8
Goodding's Willow	7.5	98	0.27	0.2–13.7

Table 3-87. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola Valley Conservation Area Site 2

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	2	50	46	2	0
Goodding's Willow	5	89	6	0	0

Table 3-88. Shrub Height Summary for 2012 Cibola Valley Conservation Area Site 2 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	1.4	4	0.31	0.8–2.3
Willow Baccharis	2.0	9	0.15	1.2–2.7
Desert Broom	0.9	1	0.00	0.9–0.9
Saltcedar	3.1	114	0.14	0.3–6.4

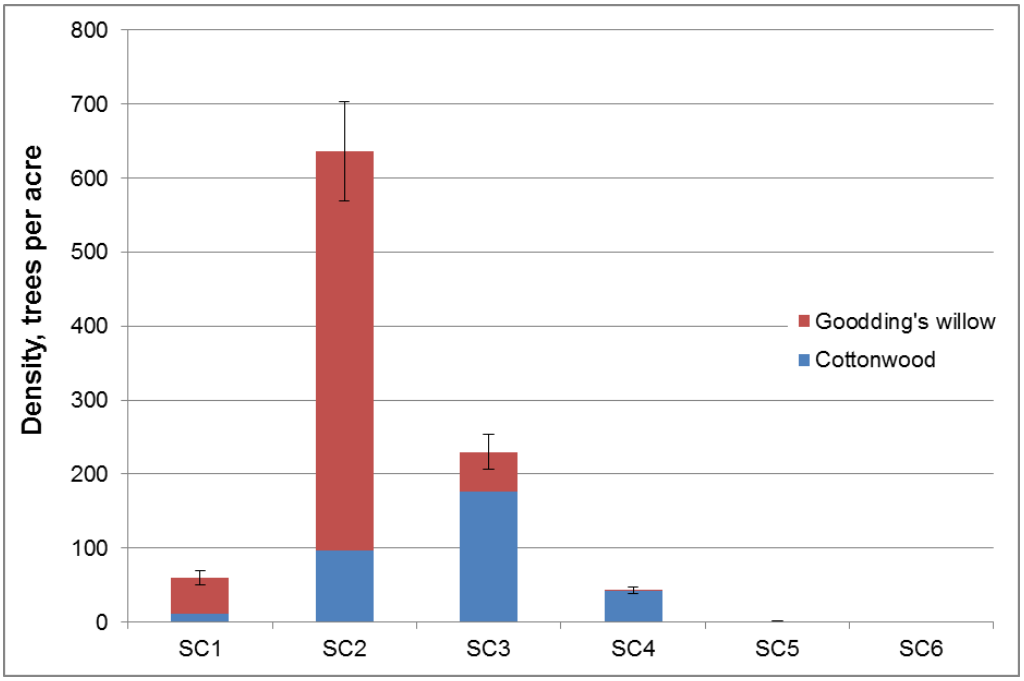

Figure 3-19. Cottonwood and Goodding's willow density for 2012 Cibola Valley Conservation Area Site 2 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

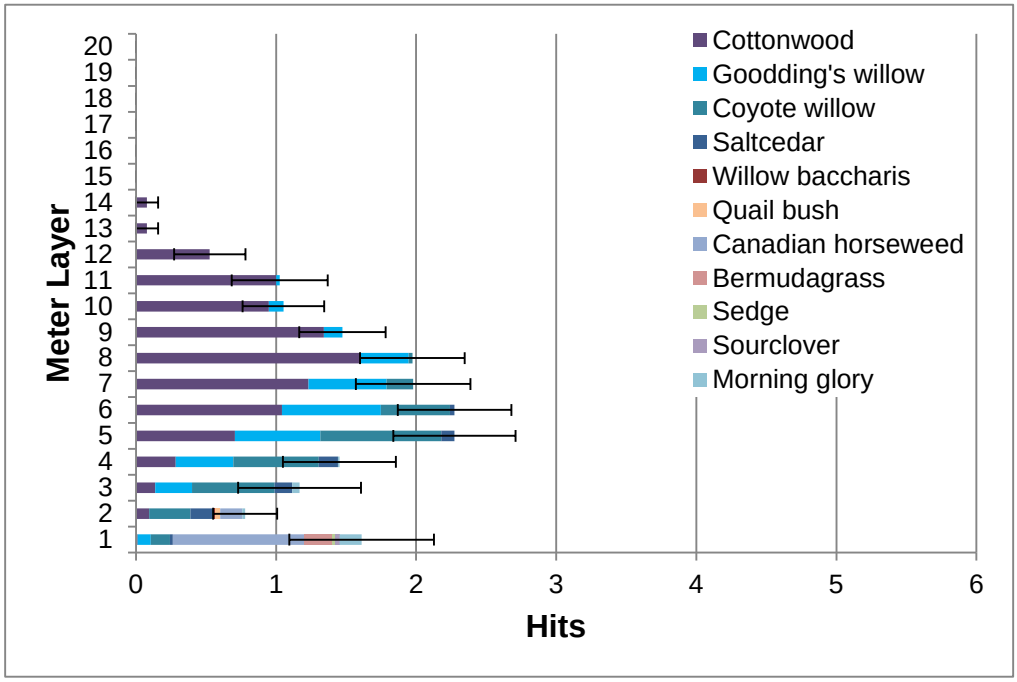

Figure 3-20. Vertical foliar density for 2012 Cibola Valley Conservation Area Site 2 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-89. Tree and Shrub Foliar Cover for 2012 Cibola Valley Conservation Area Site 2 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	42	43
Goodding's Willow	28	29
Coyote Willow	21	22
Saltcedar	4	4
Willow Baccharis	<1	<1
Desert Broom	<1	<1
Quail Bush	1	1

Table 3-90. Herbaceous Foliar Cover Summary for 2012 Cibola Valley Conservation Area Site 2 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous	**6**	**Not applicable**
Sedge	3	50
Canadian Horseweed	1	17
Bermudagrass	2	27
Junglerice	<1	<1
Heliotrope	<1	<1
Morning Glory	<1	4
Alfalfa	<1	<1
Spiny Sowthistle	<1	<1

3.2.4.3 Cibola Valley Conservation Area Site 3

Tree and shrub densities and relative tree and shrub densities at CVCA3 are summarized in Table 3-1 and 3-2; stem densities and relative stem densities are shown in Table 3-91. Tree and shrub frequency and relative frequency are summarized in Table 3-92. The relative number of stem DCs for each species is shown in Table 3-93.

Overall tree height by species is summarized in Table 3-94. Distribution of trees between HCs is shown in Table 3-95. Height for shrubs is summarized in Table 3-96. The density of standard trees by SC is shown in Figure 3-21. Canopy closure for CVCA3 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-22. A diverse understory is present until 4 m, and cottonwood is dominant above.

Tree and shrub foliar cover is summarized in Table 3-97, and herbaceous foliar cover is summarized in Table 3-98.

Table 3-91. Stem Density at Cibola Valley Conservation Area Site 3 for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Cottonwood	722	14
Goodding's Willow	490	10
Coyote Willow	2,798	55
Honey Mesquite	25	<1
Saltcedar	382	8
Desert Broom	647	13
Quail Bush	25	<1

Table 3-92. Tree and Shrub Frequency at Cibola Valley Conservation Area Site 3 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	77	48
	Goodding's Willow	38	24
	Coyote Willow	23	14
	Honey Mesquite	23	14
Shrubs	Desert Broom	15	25
	Quail Bush	8	13
	Saltcedar	38	63

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-93. Stem Diameter Class (DC) Distributions by Species for Cibola Valley Conservation Area Site 3 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	3	60	33	3	0	0
Goodding's Willow	34	61	5	0	0	0
Coyote Willow	46	54	0	0	0	0
Honey Mesquite	0	33	67	0	0	0
Saltcedar	98	2	0	0	0	0
Desert Broom	100	0	0	0	0	0
Quail Bush	67	33	0	0	0	0

Table 3-94. Tree Height Summary for 2012 Cibola Valley Conservation Area Site 3 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	7.4	65	0.37	3–18
Goodding's Willow	3.9	37	0.36	0.4–10.4
Honey Mesquite	3.5	18	0.25	0.3–5

Table 3-95. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola Valley Conservation Area Site 3

	Proportion in HC (percent)				
Species	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	1	93	7	0	0
Goodding's Willow	35	65	0	0	0
Honey Mesquite	25	75	0	0	0

Table 3-96. Shrub Height Summary for 2012 Cibola Valley Conservation Area Site 3 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	1.3	35	0.10	0.4–3.2
Desert Broom	1.8	51	0.13	0.4–3.9
Saltcedar	1.9	27	0.30	0.3–5.2

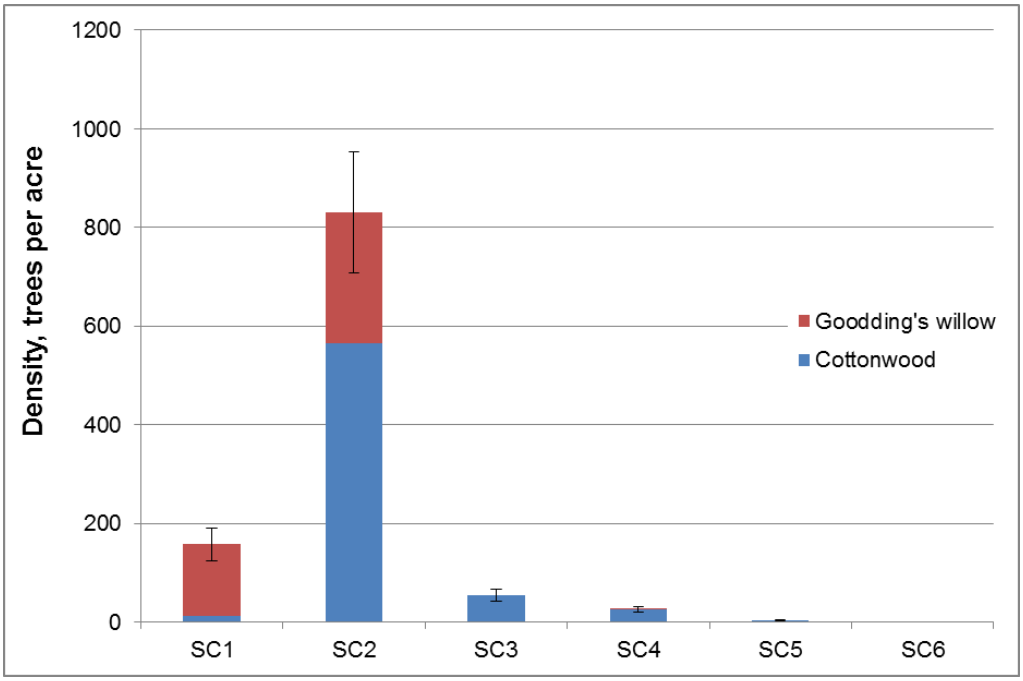

Figure 3-21. Cottonwood and Goodding's willow density for 2012 Cibola Valley Conservation Area Site 3 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

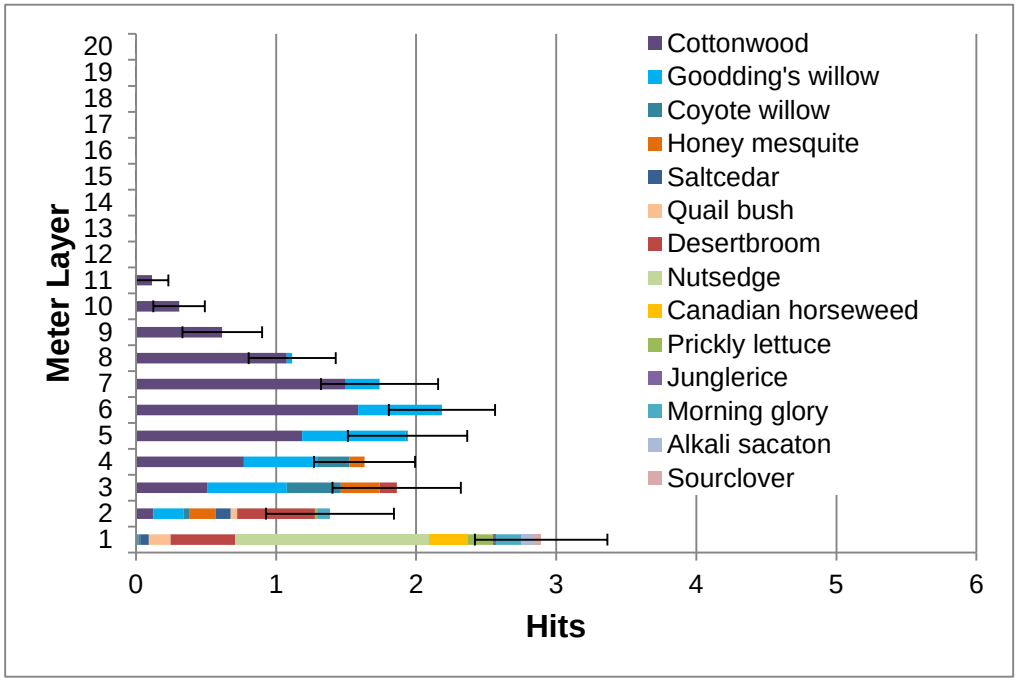

Figure 3-22. Vertical foliar density for 2012 Cibola Valley Conservation Area Site 3 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-97. Tree and Shrub Foliar Cover for 2012 Cibola Valley Conservation Area Site 3 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	31	43
Goodding's Willow	12	17
Coyote Willow	5	6
Honey Mesquite	3	4
Saltcedar	3	5
Desert Broom	14	19
Quail Bush	5	7

Table 3-98. Herbaceous Foliar Cover Summary for 2012 Cibola Valley Conservation Area Site 3 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	**5**	**Not applicable**
Canadian Horseweed	1	13
Bermudagrass	<1	2
Nutsedge	3	71
Junglerice	<1	<1
Heliotrope	<1	2
Morning Glory	<1	9
Sourclover	<1	<1
Desert Horsepurslane	<1	2

3.2.4.4 Cibola Valley Conservation Area Site 4W

Tree and shrub densities and relative tree and shrub densities at CVCA4W are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-99. Tree and shrub frequency and relative frequency are summarized in Table 3-100. The relative number of stem DCs for each species is shown in Table 3-101.

Overall tree height for honey mesquite, the only tree observed at CVCA4W, is summarized in Table 3-102. The distribution of trees between HCs is shown in Table 3-103. Height for shrubs is summarized in Table 3-104. Canopy closure for CVCA4W is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-23. Quail Bush comprises the highest portion of vertical foliar density until 2 m, above which honey mesquite provides the majority of vertical foliar density.

Tree and shrub foliar cover is summarized in Table 3-105, and herbaceous foliar cover is summarized in Table 3-106.

Table 3-99. Stem Density at Cibola Valley Conservation Area Site 4W for 2012 Vegetation Surveys

Species	Density (per acre)	Relative Density (percent)
Honey Mesquite	167	5
Saltcedar	304	9
Willow Baccharis	20	1
Quail Bush	3,071	86

Table 3-100. Tree and Shrub Frequency at Cibola Valley Conservation Area Site 4W for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Goodding's Willow	9	8
	Honey Mesquite	100	92
Shrubs	Willow Baccharis	27	14
	Quail Bush	100	52
	Saltcedar	64	33

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-101. Stem Diameter Class (DC) Distributions by Species for Cibola Valley Conservation Area Site 4W for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Honey Mesquite	6	71	24	0	0	0
Saltcedar	100	0	0	0	0	0
Willow Baccharis	100	0	0	0	0	0
Quail Bush	96	4	0	0	0	0

Table 3-102. Tree Height Summary for 2012 Cibola Valley Conservation Area Site 4W Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Honey Mesquite	3.7	96	0.06	2.1–5.9

Table 3-103. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola Valley Conservation Area Site 4W

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Honey Mesquite	40	60	0	0	0

Table 3-104. Shrub Height Summary for 2012 Cibola Valley Conservation Area Site 4W Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	1.5	1,116	0.03	0.4–3.1
Willow Baccharis	2.0	3	0.19	1.8–2.4
Saltcedar	2.6	25	0.17	0.5–3.9

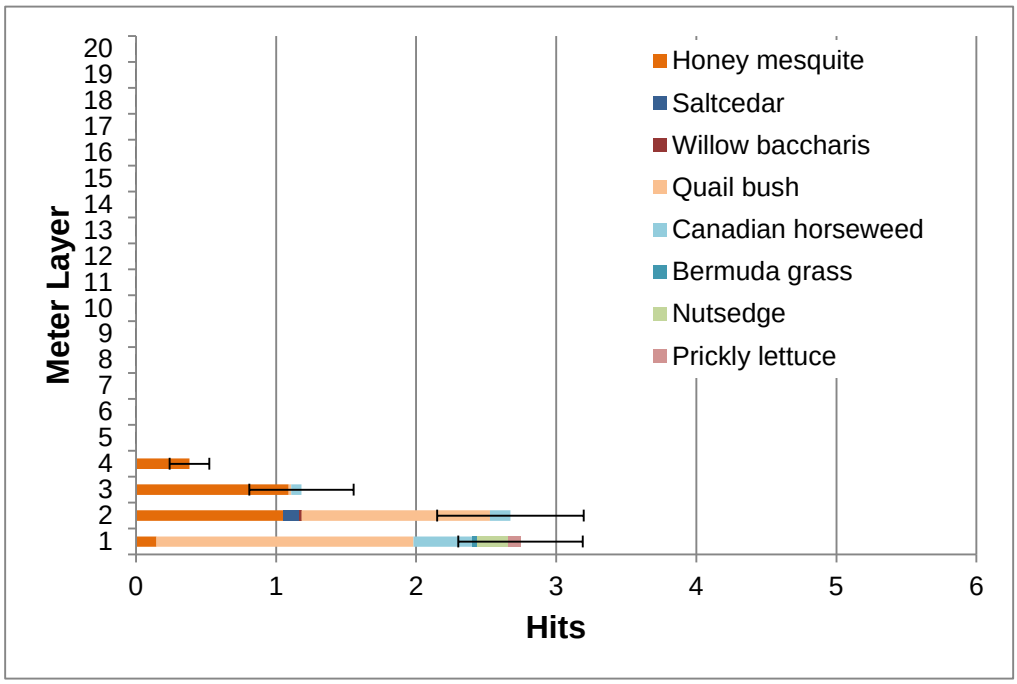

Figure 3-23. Vertical foliar density for 2012 Cibola Valley Conservation Area Site 4W vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-105. Tree and Shrub Foliar Cover for 2012 Cibola Valley Conservation Area Site 4W Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Goodding's Willow	<1	<1
Honey Mesquite	9	19
Saltcedar	2	3
Willow Baccharis	<1	2
Arrowweed	<1	<1
Quail Bush	35	75

Table 3-106. Herbaceous Foliar Cover Summary for 2012 Cibola Valley Conservation Area Site 4W Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous	**6**	**Not applicable**
Sedge	<1	2
Canadian Horseweed	3	50
Nutsedge	3	48
Spiny Sowthistle	<1	<1

3.2.4.5 Cibola Valley Conservation Area Site 4E

Tree and shrub densities and relative tree and shrub densities at CVCA4E are summarized in Table 3-1 and Table 3-2. No coyote willow was observed within CVCA4E. Tree and shrub frequency and relative frequency are summarized in Table 3-107.

Height for honey mesquite, the only tree observed in CVCA4E, is summarized in Table 3-108. Distribution of honey mesquite between HCs is shown in Table 3-109. Height for shrubs is summarized in Table 3-110.

Table 3-107. Tree and Shrub Frequency at Cibola Valley Conservation Area Site 4E for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Honey Mesquite	100	100
Shrubs	Arrowweed	17	8
	Quail Bush	100	46
	Saltcedar	100	46

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-108. Tree Height Summary for 2012 Cibola Valley Conservation Area Site 4E Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Honey Mesquite	3.1	103	0.09	0.9–5.5

Table 3-109. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola Valley Conservation Area Site 4E

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Honey Mesquite	76	24	0	0	0

Table 3-110. Shrub Height Summary for 2012 Cibola Valley Conservation Area Site 4E Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	1.8	322	0.28	0.3-6.9
Saltcedar	1.2	13	0.10	0.4-1.5

3.2.4.6 Cibola Valley Conservation Area Site 5

Tree and shrub densities and relative tree and shrub densities at CVCA5 are summarized in Table 3-1 and Table 3-2. No coyote willow was observed. Tree and shrub frequency and relative frequency are summarized in Table 3-111.

Height for cottonwood and honey mesquite, the only tree species observed at CVCA5, is summarized in Table 3-112. Distribution for these species between HCs is shown in Table 3-113. Height for shrubs is summarized in Table 3-114.

Table 3-111. Tree and Shrub Frequency at Cibola Valley Conservation Area Site 5 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Absolute	Relative
Trees	Cottonwood	8	7
	Honey Mesquite	100	93
Shrubs	Quail Bush	92	48
	Saltcedar	100	52

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-112. Tree Height Summary for 2012 Cibola Valley Conservation Area Site 5 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	4.6	1	N/A	N/A
Honey Mesquite	3.3	222	0.07	1.6–6.1

Table 3-113. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola Valley Conservation Area Site 5

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	0	100	0	0	0
Honey Mesquite	78	22	0	0	0

Table 3-114. Shrub Height Summary for 2012 Cibola Valley Conservation Area Site 5 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	2.0	285	0.12	0.5–3.7
Saltcedar	2.4	21	0.24	0.5–3.9

3.2.4.7 Cibola Valley Conservation Area Site 6

Tree and shrub densities and relative tree and shrub densities at CVCA5 are summarized in Table 3-1 and Table 3-2. No coyote willow was observed within CVCA6. Tree and shrub frequency and relative frequency are summarized in Table 3-115.

Height for cottonwood and honey mesquite, the only tree species observed in CVCA6, is summarized in Table 3-116. Distribution for these species between HCs is shown in Table 3-117. Height for saltcedar, the only shrub observed in CVCA 6, is summarized in Table 3-118.

Table 3-115. Tree and Shrub Frequency at Cibola Valley Conservation Area Site 6 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	13	12
	Honey Mesquite	100	88
Shrubs	Arrowweed	13	12
	Saltcedar	100	88

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-116. Tree Height Summary for 2012 Cibola Valley Conservation Area Site 6 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	2.8	2	N/A	1.1–4.5
Honey Mesquite	2.8	349	0.05	0.9-8

Table 3-117. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola Valley Conservation Area Site 6

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	50	50	0	0	0
Honey Mesquite	86	14	0	0	0

Table 3-118. Shrub Height Summary for 2012 Cibola Valley Conservation Area Site 6 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Saltcedar	0.8	20	0.12	0.1–1.6

3.2.5 Cibola National Wildlife Refuge Unit 1

Vegetation across CNU1 varied due to differences in planting techniques and layouts. CW North was dominated by widely-spaced cottonwood with little understory vegetation. The Nature Trail was variably-dominated by cottonwood, Goodding's willow, or willow baccharis. Scattered honey and screwbean mesquite were also present, with Johnsongrass common in the understory. The Crane Roost was dominated by cottonwood, Goodding's willow, or mesquite, depending on the location of plots within the planting plan. Stressed riparian vegetation was prevalent at the Crane Roost, likely due to excessive soil salinity. The Mass Transplanting Demonstration was dominated by cottonwood with little understory vegetation. Saltcedar was sometimes present in plots, but was not prevalent. No surface water was observed at CNU1. No noxious weeds or Spanish false fleabane were observed.

3.2.5.1 Nature Trail

Tree and shrub densities and relative tree and shrub densities at Cibola Nature Trail (CNT) are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-119. Tree and shrub frequency and relative frequency are summarized in Table 3-120. The relative number of stem DCs for each species is shown in Table 3-121.

Overall tree height by species is summarized in Table 3-122. Distribution of trees between HCs is shown in Table 3-123. Height for willow baccharis, the only shrub observed at CNT, is summarized in Table 3-124. The density of standard trees by SC is shown in Figure 3-24.

Canopy closure for CNT is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-25. Willow Baccharis was prevalent until 5 m, honey mesquite was co-dominant between 2 and 9 m, and cottonwood dominated vertical foliar density above 8 m.

Tree and shrub foliar cover is summarized in Table 3-125, and herbaceous foliar cover is summarized in Table 3-126. Johnsongrass dominates the herbaceous vegetation at CNT.

Table 3-119. Stem Density at Cibola NWR Unit 1 Conservation Area Nature Trail for 2012 Vegetation Surveys

Species	Density, Stems (per acre)	Relative Density (percent)
Cottonwood	45	1
Goodding's Willow	202	6
Coyote Willow	162	5
Honey Mesquite	94	3
Screwbean Mesquite	67	2
Willow Baccharis	2,770	83

Table 3-120. Tree Frequency Cibola NWR Unit 1 Conservation Area Nature Trail for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	50	23
	Goodding's Willow	29	13
	Coyote Willow	17	8
	Honey Mesquite	67	30
	Screwbean Mesquite	58	26
Shrubs	Willow Baccharis	88	100

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-121. Stem Diameter Class (DC) Distributions by Species for Cibola NWR Unit 1 Conservation Area Nature Trail for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	0	0	20	40	40	0
Goodding's Willow	4	62	29	2	2	0
Coyote Willow	27	73	0	0	0	0
Honey Mesquite	0	38	29	19	14	0
Screwbean Mesquite	7	27	33	33	0	0
Willow Baccharis	52	43	3	2	0	0

Table 3-122. Tree Height Summary for 2012 Cibola NWR Unit 1 Conservation Area Nature Trail Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	12.7	76	0.52	7.5–28.6
Goodding's Willow	4.7	64	0.33	0.9–11.3
Honey Mesquite	6.3	104	0.18	1.6–10
Screwbean Mesquite	6.8	79	0.18	1.4–10.2

Table 3-123. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola NWR Unit 1 Conservation Area Nature Trail

	Proportion in HC (percent)				
Species	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	0	26	54	16	4
Goodding's Willow	30	69	1	0	0
Honey Mesquite	5	95	0	0	0
Screwbean Mesquite	0	100	0	0	0

Table 3-124. Shrub Height Summary for 2012 Cibola NWR Unit 1 Conservation Area Nature Trail Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Willow Baccharis	3.3	685	0.11	0.6–5.3

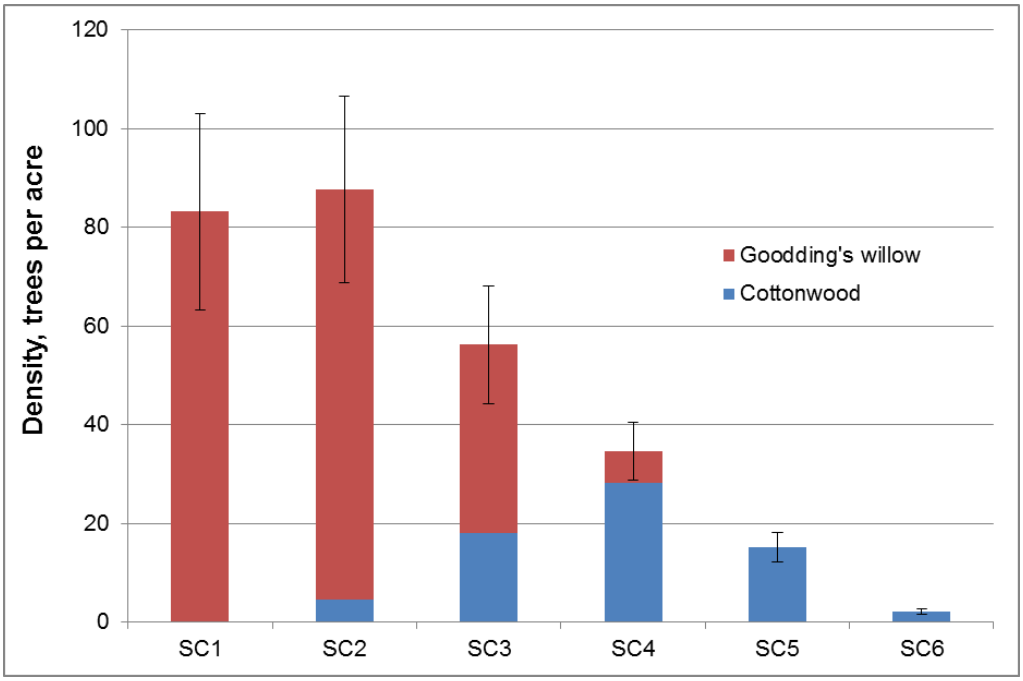

Figure 3-24. Cottonwood and Goodding's willow density for 2012 Cibola NWR Unit 1 Conservation Area Nature Trail vegetation surveys.
(Error bars indicate one standard error of total tree density.)

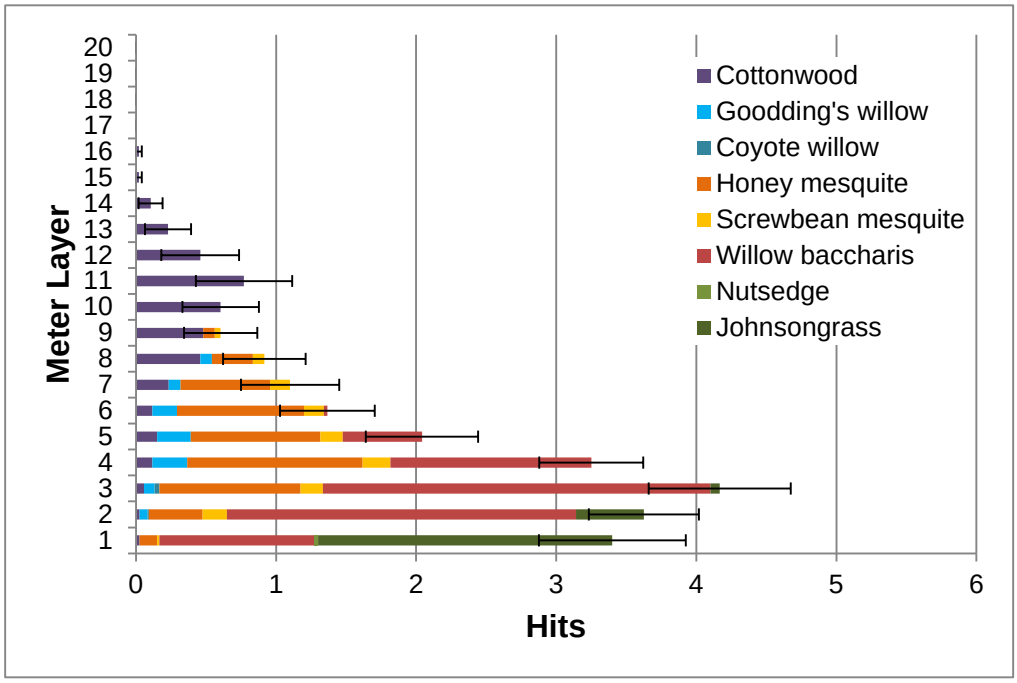

Figure 3-25. Vertical foliar density for 2012 Cibola NWR Unit 1 Conservation Area Nature Trail vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-125. Tree and Shrub Foliar Cover for 2012 Cibola NWR Unit 1 Conservation Area Nature Trail Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	12	11
Goodding's Willow	9	9
Coyote Willow	2	2
Honey Mesquite	22	20
Screwbean Mesquite	10	9
Willow Baccharis	52	49

Table 3-126. Herbaceous Foliar Cover Summary for 2012 Cibola NWR Unit 1 Conservation Area Nature Trail Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	16	**Not applicable**
Bermudagrass	<1	1
Nutsedge	<1	<1
Johnson Grass	15	99

3.2.5.2 Cottonwood North (CWN)

Tree and shrub densities and relative tree and shrub densities at Cottonwood North (CWN) are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-127. Tree and shrub frequency and relative frequency are summarized in Table 3-128. The relative number of stems DCs for each species is shown in Table 3-129.

Overall tree height for cottonwood and honey mesquite, the only tree species observed at CWN, is summarized in Table 3-130. Distribution of these trees between HCs is shown in Table 3-131. Height for saltcedar, the only shrub observed at CWN, is summarized in Table 3-132. The density of cottonwood, the only standard tree species detected at CWN, by SC is shown in Figure 3-26. Canopy closure for CWN is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-27. Bermudagrass was prevalent in the first meter, honey mesquite was common up to 4 m, and cottonwood was the only species with hits above 4 m.

Tree and shrub foliar cover is summarized in Table 3-133, and herbaceous foliar cover for Bermudagrass, the only herbaceous species observed at CWN, is summarized in Table 3-134.

Table 3-127. Stem Density at Cibola NWR Unit 1 Conservation Area CW North for 2012 Vegetation Surveys

Species	Density, Stems (per acre)	Relative Density (percent)
Cottonwood	324	95
Honey Mesquite	18	5

Table 3-128. Tree Frequency at Cibola NWR Unit 1 Conservation Area CW North for 2012 Vegetation Surveys

Species	Frequency (percent)	
	Frequency	Relative Frequency
Cottonwood	100	55
Honey Mesquite	83	45
Saltcedar	17	100

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-129. Stem Diameter Class (DC) Distributions by Species for Cibola NWR Unit 1 Conservation Area CW North for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	0	6	11	50	33	0
Honey Mesquite	100	0	0	0	0	0

Table 3-130. Tree Height Summary for 2012 Cibola NWR Unit 1 Conservation Area CW North Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	11.1	42	0.46	2.1–17.1
Honey Mesquite	2.3	32	0.31	0.3–6.2

Table 3-131. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola NWR Unit 1 Conservation Area CW North

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	3	27	67	3	0
Honey Mesquite	83	17	0	0	0

Table 3-132. Shrub Height Summary for 2012 Cibola NWR Unit 1 Conservation Area CW North Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Saltcedar	0.6	1	N/A	0.6–0.6

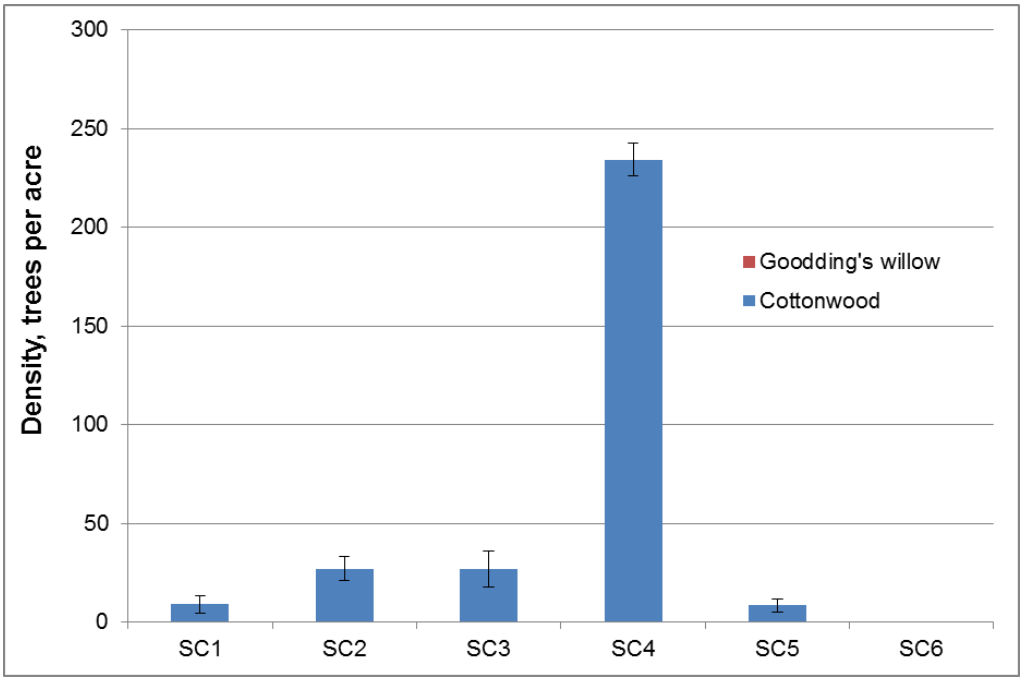

Figure 3-26. Cottonwood density for 2012 Cibola NWR Unit 1 Conservation Area CW North vegetation surveys.
(Error bars indicate one standard error of total tree density.)

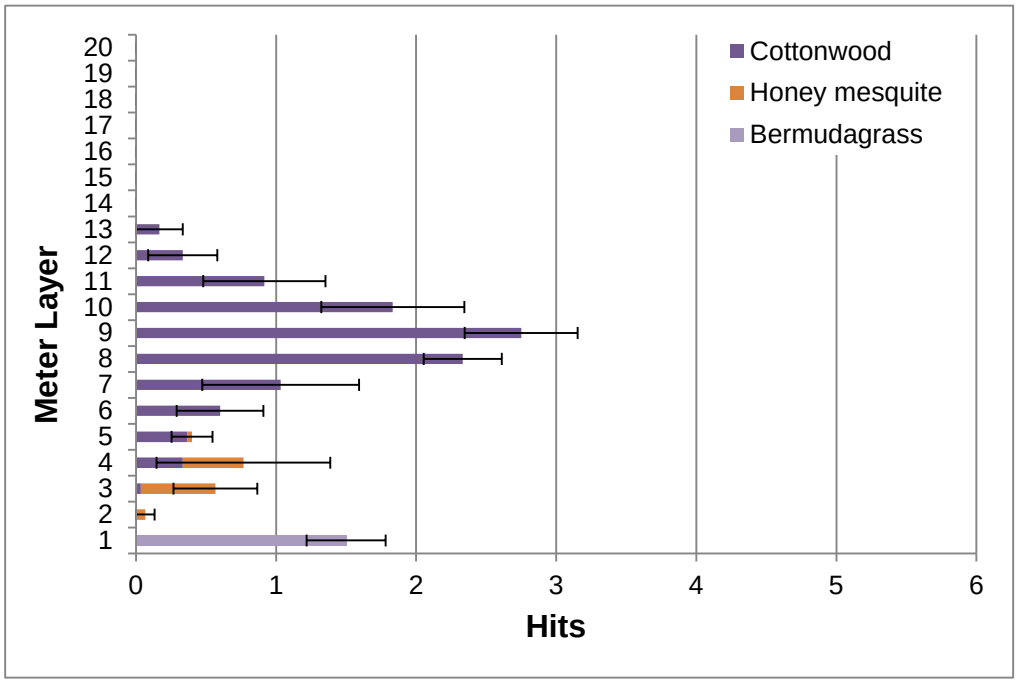

Figure 3-27. Vertical foliar density for 2012 Cibola NWR Unit 1 Conservation Area CW North vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-133. Tree and Shrub Foliar Cover for 2012 Cibola NWR Unit 1 Conservation Area CW North Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	73	95
Honey Mesquite	3	4
Saltcedar	<1	<1

Table 3-134. Herbaceous Foliar Cover Summary for 2012 Cibola NWR Unit 1 Conservation Area CW North Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Bermudagrass	20	100

3.2.5.3 Mass Transplanting

Tree and shrub densities and relative tree and shrub densities at Cibola Mass Planting (CMP) are summarized in Table 3-1 and Table 3-2; and absolute and relative stem densities are provided in Table 3-135. Tree and shrub frequency and relative frequency are summarized in Table 3-136. The relative number of stems DCs for each species is shown in Table 3-137.

Tree height is summarized in Table 3-138. Distribution of trees between HCs is shown in Table 3-139. Height for willow baccharis and saltcedar, the only shrub species observed at CMP, is summarized in Table 3-140. The density of standard trees by SC is shown in Figure 3-28. Canopy closure for CMP is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-29. Bermudagrass and Johnsongrass were common in the first meter, and cottonwood was dominant above.

Tree and shrub foliar cover is summarized in Table 3-141, and herbaceous foliar cover for Bermudagrass and Johnsongrass, the only herbaceous species observed at CWN, is summarized in Table 3-142.

Table 3-135. Stem Density at Cibola NWR Unit 1 Conservation Area Mass Transplanting for 2012 Vegetation Surveys

Species	Density, Stems (per acre)	Relative Density (percent)
Cottonwood	1,547	75
Goodding's Willow	54	3
Honey Mesquite	18	1
Saltcedar	198	10
Willow Baccharis	234	11

Table 3-136. Tree Frequency at Cibola NWR Unit 1 Conservation Area Mass Transplanting for 2012 Vegetation Surveys

Species	Frequency (percent)	
	Frequency	Relative Frequency
Cottonwood	100	50
Goodding's Willow	50	25
Honey Mesquite	50	25
Willow Baccharis	83	83
Saltcedar	17	17

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-137. Stem Diameter Class (DC) Distributions by Species for Cibola NWR Unit 1 Conservation Area Mass Transplanting for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	10	45	24	19	1	0
Goodding's Willow	33	67	0	0	0	0
Honey Mesquite	100	0	0	0	0	0
Saltcedar	100	0	0	0	0	0
Willow Baccharis	23	77	0	0	0	0

Table 3-138. Tree Height Summary for 2012 Cibola NWR Unit 1 Conservation Area Mass Transplanting Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	7.1	99	0.46	0.8–19
Goodding's Willow	2.2	7	0.39	1–3.8
Honey Mesquite	0.9	3	1.31	0.4–4.5

Table 3-139. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola NWR Unit 1 Conservation Area Mass Transplanting

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	24	60	15	1	0
Goodding's Willow	86	14	0	0	0
Honey Mesquite	91	9	0	0	0

Table 3-140. Shrub Height Summary for 2012 Cibola NWR Unit 1 Conservation Area Mass Transplanting Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Willow Baccharis	3.0	21	0.22	1.3–4.9
Saltcedar	0.8	5	0.46	0.2–2.6

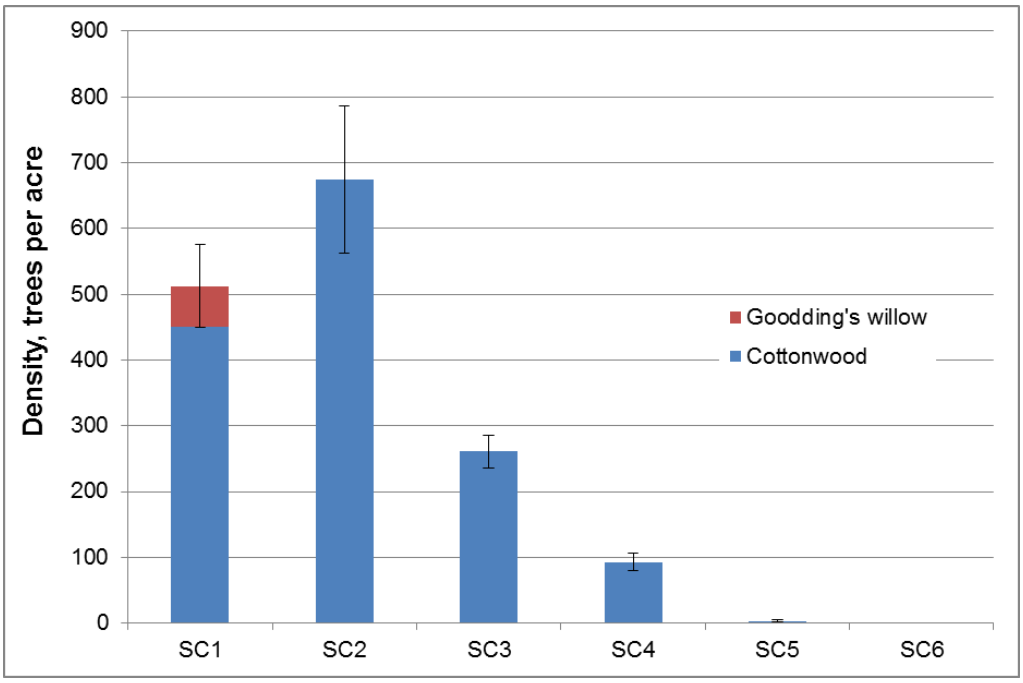

Figure 3-28. Cottonwood and Goodding's willow density for 2012 Cibola NWR Unit 1 Conservation Area Mass Transplanting vegetation surveys.
(Error bars indicate one standard error of total tree density.)

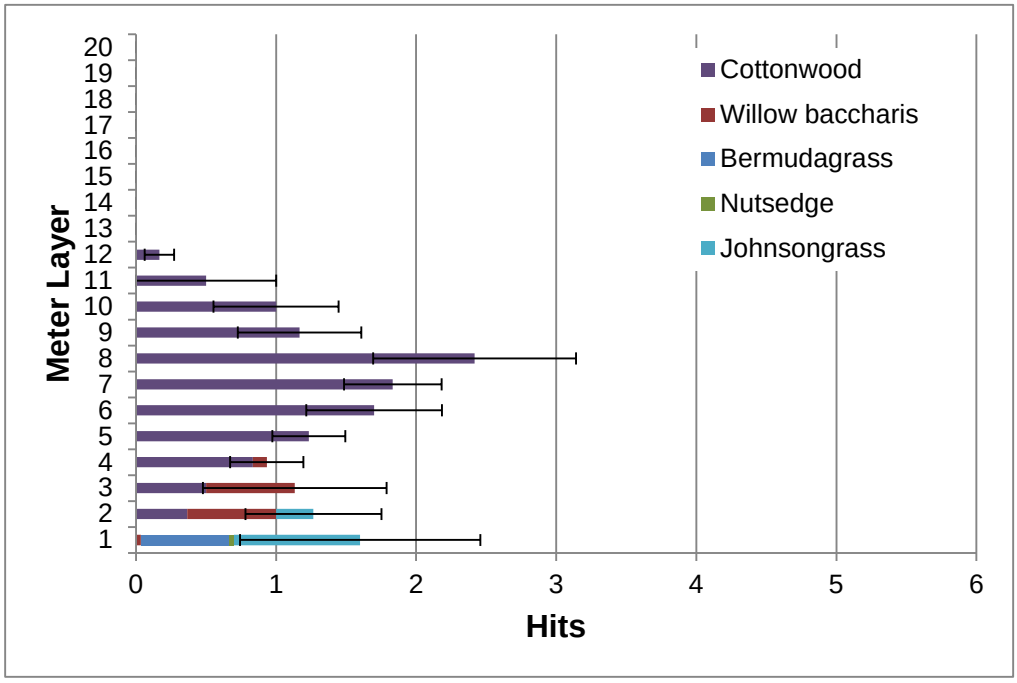

Figure 3-29. Vertical foliar density for 2012 Cibola NWR Unit 1 Conservation Area Mass Transplanting vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-141. Tree and Shrub Foliar Cover for 2012 Cibola NWR Unit 1 Conservation Area Mass Transplanting Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	61	85
Goodding's Willow	1	1
Honey Mesquite	<1	<1
Saltcedar	<1	<1
Willow Baccharis	10	13

Table 3-142. Herbaceous Foliar Cover Summary for 2012 Cibola NWR Unit 1 Conservation Area Mass Transplanting Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	7	**Not applicable**
Bermudagrass	6	94
Johnson Grass	<1	6

3.2.5.4 Crane Roost 1

Tree and shrub densities and relative tree and shrub densities at Crane Roost 1 are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-143. Tree and shrub frequency and relative frequency are summarized in Table 3-144. The relative number of stems DCs for each species is shown in Table 3-145.

Tree height for cottonwood and honey mesquite, the only tree species sampled at Crane Roost 1, is summarized in Table 3-146. Distribution of these tree species between HCs is shown in Table 3-147. Height for shrub species is summarized in Table 3-148. The density of cottonwood, the only standard tree sampled at Crane Roost 1, by SC is shown in Figure 3-30. Canopy closure for Crane Roost 1 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-31. Honey mesquite and saltcedar were co-dominant up to 7 m, and cottonwood was most common above.

Tree and shrub foliar cover is summarized in Table 3-149. No herbaceous foliar cover was observed.

Table 3-143. Stem Density at Cibola NWR Unit 1 Conservation Area Crane Roost 1 for 2012 Vegetation Surveys

Species	Density, Stems (per acre)	Relative Density (percent)
Cottonwood	18	<1
Honey Mesquite	342	8
Saltcedar	1,960	45
Willow Baccharis	1,025	24
Arrowweed	674	15
Quail Bush	342	8

Table 3-144. Tree Frequency at Cibola NWR Unit 1 Conservation Area Crane Roost 1 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	33	25
	Honey Mesquite	100	75
Shrubs	Willow Baccharis	50	27
	Arrowweed	33	18
	Quail Bush	17	9
	Saltcedar	83	45

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-145. Stem Diameter Class (DC) Distributions by Species for Cibola NWR Unit 1 Conservation Area Crane Roost 1 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	0	0	0	0	0	100
Honey Mesquite	5	16	32	37	11	0
Saltcedar	30	64	6	0	0	0
Willow Baccharis	2	91	7	0	0	0
Arrowweed	100	0	0	0	0	0
Quail Bush	47	53	0	0	0	0

Table 3-146. Tree Height Summary for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 1 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	18.2	6	1.11	13.2–21.3
Honey Mesquite	5.0	61	0.23	0.4–8.1

Table 3-147. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola NWR Unit 1 Conservation Area Crane Roost 1

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	0	0	17	67	17
Honey Mesquite	27	73	0	0	0

Table 3-148. Shrub Height Summary for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 1 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	2.7	35	0.14	2.4–3.2
Willow Baccharis	3.4	16	0.27	1.3–5.3
Saltcedar	4.0	36	0.26	1–7.2

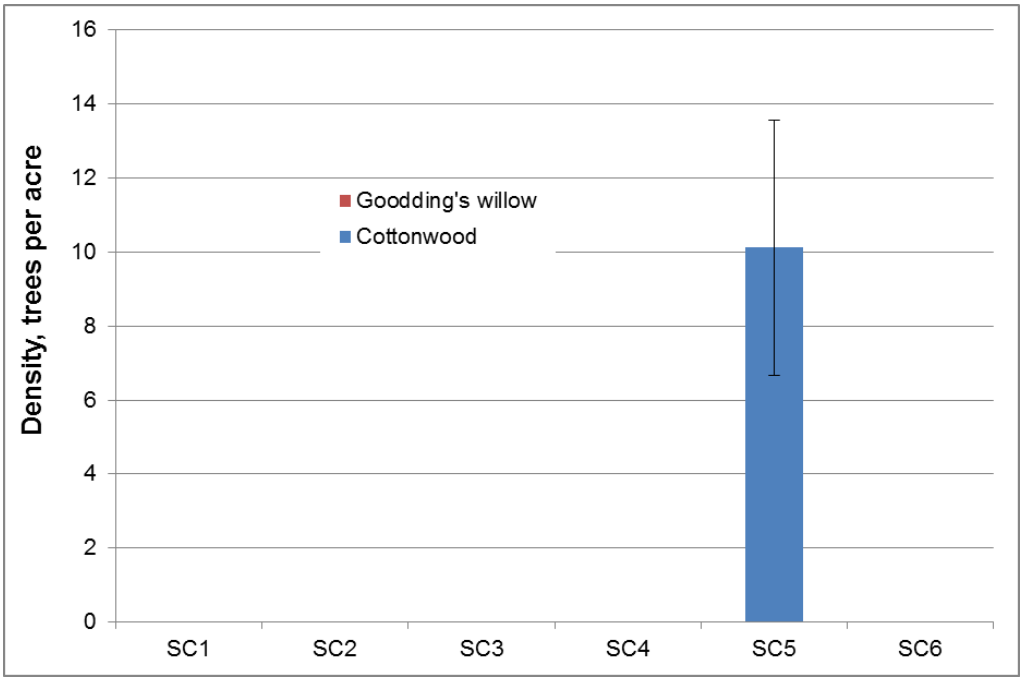

Figure 3-30. Cottonwood density for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 1 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

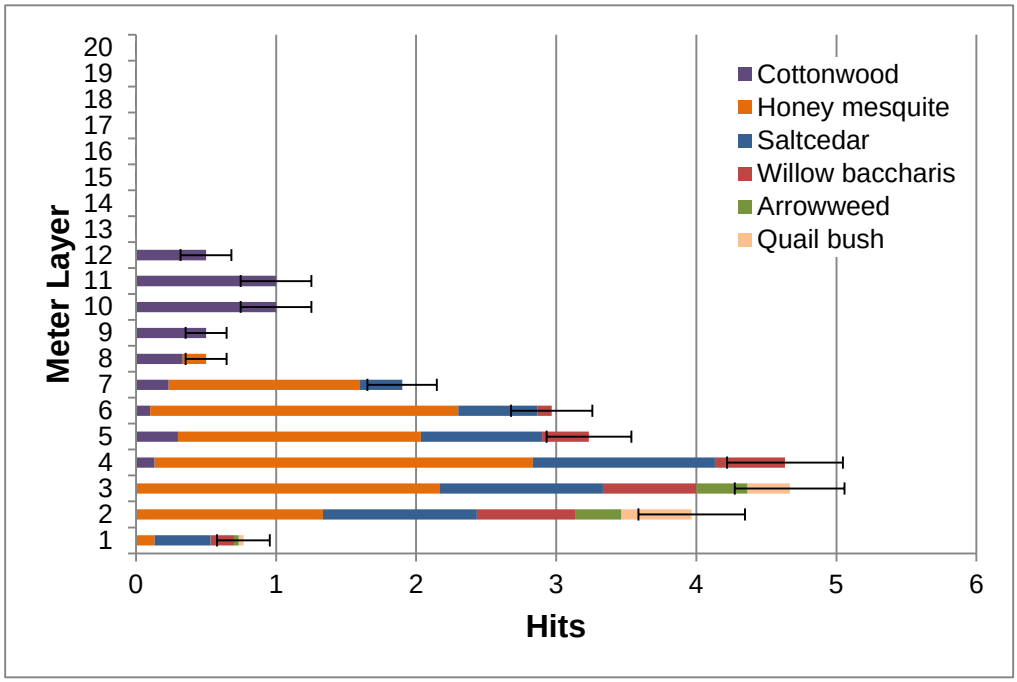

Figure 3-31. Vertical foliar density for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 1 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-149. Tree and Shrub Foliar Cover for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 1 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	11	11
Honey Mesquite	32	32
Saltcedar	28	28
Willow Baccharis	12	12
Arrowweed	<1	<1
Quail Bush	17	17

3.2.5.5 Crane Roost 2

Tree and shrub densities and relative tree and shrub densities at Crane Roost 2 are summarized in Table 3-1 and Table 3-2; stem densities and relative stem densities are provided in Table 3-150. Tree and shrub frequency and relative frequency are summarized in Table 3-151. The relative number of stems DCs for each species is shown in Table 3-152.

Tree height is summarized in Table 3-153. Distribution of trees between HCs is shown in Table 3-154. Height for shrubs is summarized in Table 3-155. The density of standard trees by SC is shown in Figure 3-32. Canopy closure for Crane Roost 2 is shown in Table 3-6. Vertical foliar density by species is shown in Figure 3-33. Bermudagrass and alfalfa were common in the first meter, and cottonwood and Goodding's willow were co-dominant above.

Tree and shrub foliar cover is summarized in Table 3-156, and herbaceous foliar cover is summarized in Table 3-157.

Table 3-150. Stem Density at Cibola NWR Unit 1 Conservation Area Crane Roost 2 for 2012 Vegetation Surveys

Species	Density, Stems (per acre)	Relative Density (percent)
Cottonwood	113	2
Goodding's Willow	606	12
Coyote Willow	3,464	67
Honey Mesquite	5	<1
Saltcedar	889	17
Willow Baccharis	72	1
Quail Bush	10	<1

Table 3-151. Tree Frequency at Cibola NWR Unit 1 Conservation Area Crane Roost 2 for 2012 Vegetation Surveys

Vegetation Class	Species	Frequency (percent)	
		Frequency	Relative Frequency
Trees	Cottonwood	52	32
	Goodding's Willow	71	44
	Coyote Willow	19	12
	Honey Mesquite	19	12
Shrubs	Willow Baccharis	10	10
	Quail Bush	5	5
	Saltcedar	81	85

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 3-152. Stem Diameter Class (DC) Distributions by Species for Cibola NWR Unit 1 Conservation Area Crane Roost 2 for 2012 Vegetation Surveys

Species	Relative Density (percent)					
	DC1	DC2	DC3	DC4	DC5	DC6
Cottonwood	14	41	27	18	0	0
Goodding's Willow	20	71	8	1	0	0
Coyote Willow	46	54	0	0	0	0
Honey Mesquite	0	100	0	0	0	0
Saltcedar	99	1	0	0	0	0
Willow Baccharis	86	14	0	0	0	0
Quail Bush	0	100	0	0	0	0

Table 3-153. Tree Height Summary for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 2 Vegetation Surveys

Species	Mean (meters)	n (number of trees)	Standard Error (meters)	Range (meters)
Cottonwood	6.0	50	0.47	2.4–15.5
Goodding's Willow	3.7	96	0.26	0.9–13
Honey Mesquite	2.9	15	0.16	1.8–4.1

Table 3-154. Height Class (HC) Summary for Standard Trees and Mesquite at Cibola NWR Unit 1 Conservation Area Crane Roost 2

Species	Proportion in HC (percent)				
	HC1 (0–3 m)	HC2 (4–10 m)	HC3 (11–15 m)	HC4 (16–20 m)	HC5 (21–25 m)
Cottonwood	11	82	7	0	0
Goodding's Willow	41	59	1	0	0
Honey Mesquite	52	48	0	0	0

Table 3-155. Shrub Height Summary for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 2 Vegetation Surveys

Species	Mean (meters)	n (number of shrubs)	Standard Error (meters)	Range (meters)
Quail Bush	2.3	2	N/A	2.1–2.6
Willow Baccharis	1.8	9	0.83	0.5–6.4
Saltcedar	1.8	84	0.13	0.2–4.8

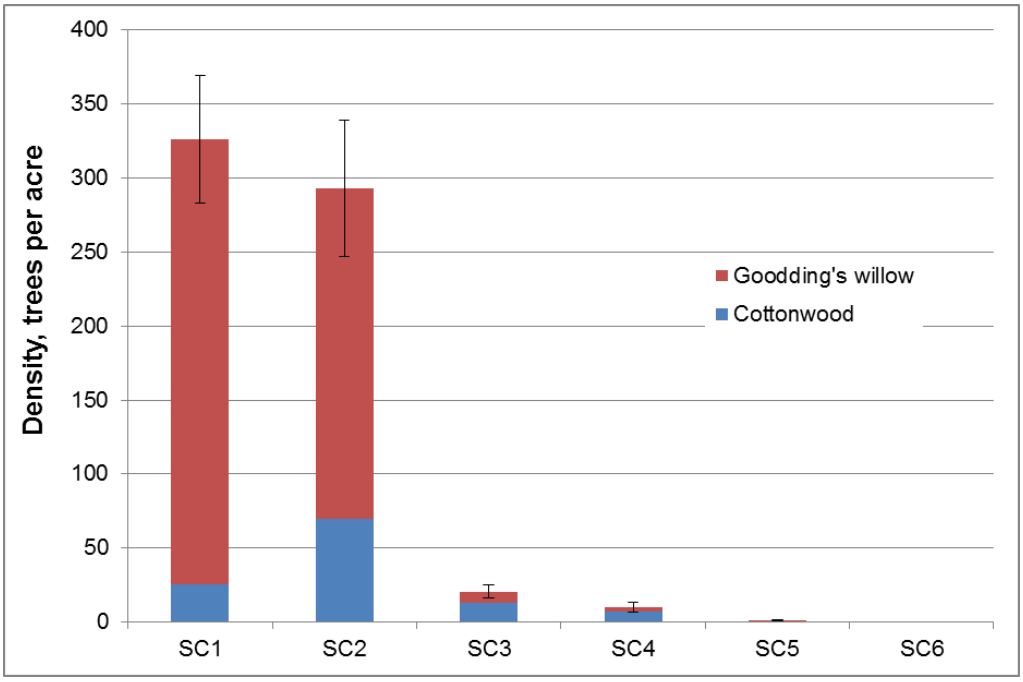

Figure 3-32. Cottonwood and Goodding's willow density for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 2 vegetation surveys.
(Error bars indicate one standard error of total tree density.)

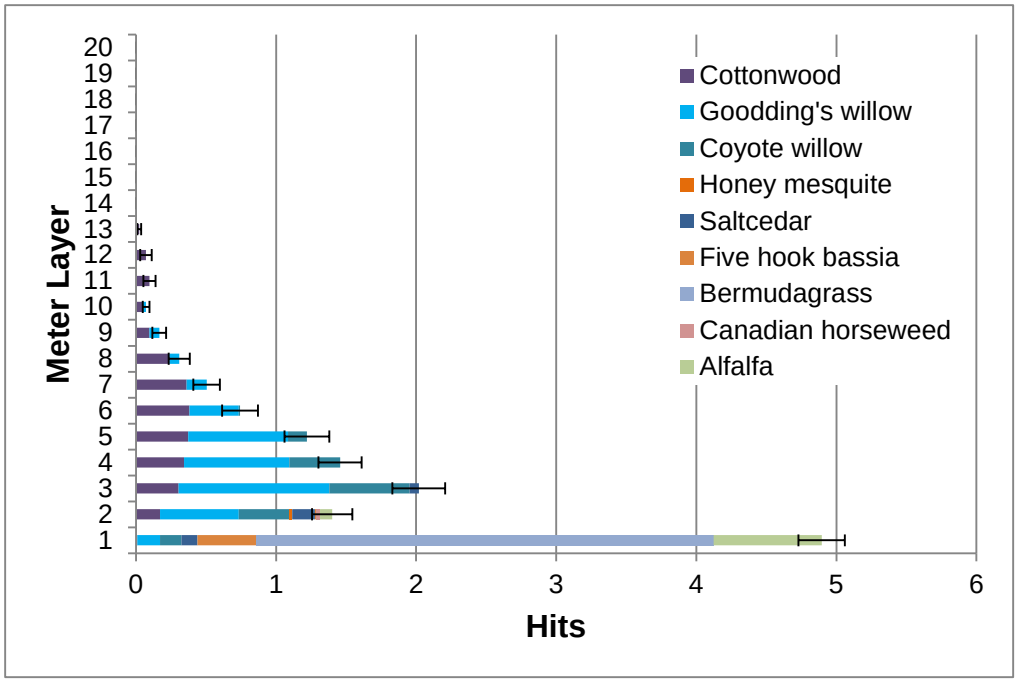

Figure 3-33. Vertical foliar density for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 2 vegetation surveys, estimated using hits-to-pole dataset.
(Error bars indicate one standard error of total vegetation hits per meter layer.)

Table 3-156. Tree and Shrub Foliar Cover for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 2 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
Cottonwood	12	31
Goodding's Willow	13	32
Coyote Willow	8	19
Honey Mesquite	1	3
Saltcedar	6	14
Willow Baccharis	<1	<1
Quail Bush	<1	<1

Table 3-157. Herbaceous Foliar Cover Summary for 2012 Cibola NWR Unit 1 Conservation Area Crane Roost 2 Vegetation Surveys

Species	Cover (percent)	
	Cover	Relative Cover
All Herbaceous Vegetation	**60**	**Not applicable**
Five Hook Bassia	9	15
Bermudagrass	50	82
Alfalfa	2	4
Desert horsepurslane	<1	<1

4. CONCLUSIONS AND RECOMMENDATIONS

Intensive and reduced-effort surveys, as conducted during 2012, appear sufficient to collect data of interest to Reclamation. During 2011, review and modifications to MSCP protocols were required. In addition, data gaps were identified following review of 2011 field data. Due to modifications to protocols and datasheets prior to the 2012 field season, 2012 survey efficiency, data completeness, and data quality were increased. In addition, survey efficiency increased due to familiarity of project personnel with the field protocols; many 2011 crew members returned for 2012 and the majority of plot centers and plot corners were marked in 2011.

As described in the 2011 annual report (Parametrix and GeoSystems Analysis, Inc.), the Kus method presents an alternate way to survey vegetation volume at MSCP sites. The usefulness of Kus data to Reclamation remains uncertain. We recommend review of the 2012 Kus survey data, comparison with hits-to-pole data, and analysis of data usefulness prior to further Kus surveys on the LCR.

To maintain 2013 data collection quality, we recommend another training session at the onset of the 2013 survey season to review the current detailed methods and field protocols. This session should be attended by, at a minimum, the Reclamation COR, the Project Supervisor, and all field crew leaders. We anticipate that any questions on the protocols or inconsistencies between detailed methods, datasheets, and field instructions can be addressed during this training session.

We recommend continued review and refinement of the vegetation field protocol to improve survey efficiency, support electronic field data collection, and validate that survey methods conform to MSCP habitat evaluation objectives.

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Appendix I

2012 Field Instructions

Appendix I-1

Part A – Intensive Plots

1.0 Plot Setup

1.1 General Notes:

1. Existing Plot Center markers are assumed the center of the plot. All measurements will be based off this center marker.
2. Existing A Plot center markers and corner stakes WILL NOT be moved.
3. New plots to be marked:
    a. Plots at Bill Williams River NWR will be staked at the center with a wooden stake.
    b. Plots at CVCA Phase 4 will be staked during 2012. CVCA 5 and 6 will NOT be staked during 2012, as mowing between rows is ongoing.
    c. PVER Phase 7 plots will be marked with a center marker and rebar stakes in the four A Plot corners.
4. For new plots (Plot Centers to be established this year), use ArcPad to navigate to plot centers. Place re-bar in the A Plot corners and the plot center to allow repeated surveys. Place an engraved plot marker on the rebar at the plot center.
    a. If the plot area based on this center location will result in an A Plot within 5 m of the habitat edge, move the plot toward the interior, which allows all survey area to be more than 5 m from the edge of the habitat. Move the center point in the direction that minimizes deviation from the mapped plot center. Note the new center point UTM on Datasheet 1.
5. Re-place rebar stakes in the corners of A Plots if the stakes have been disturbed. **Place rebar stakes in A Plot corners that were not marked last year at PVER Phases 1 and 2.**
6. Note any plots for which engraved center markers are not located.

1.2 Setup Instructions—PLOTS NOT PREVIOUSLY MARKED (Bill Williams River NWR, PVER 7, and some Cibola NWR Nature Trail plots):

1. Use GPS to navigate to plot center marker.
2. Use the plot attributes in ArcPad to determine the azimuth bearing ("Bearing 1") for the long plot edge (Borders 2 and 4). Note that the same bearing is used for all of the plots in a phase.
3. Subtract 90^{o} to determine the azimuth bearing ("Bearing 2") for the short plot edge (Borders 1 and 3).
4. From the plot center, use a compass to line up the measuring tape with Bearing 2 between the plot center and A Plot Border 4.
5. With one person holding the coiled tape at the plot center, pull the 0 mark on the tape out 5 meters to the midpoint of A Plot Border 4. Check the bearing of this line with a compass. Place a pin flag at this location—the midpoint of A Plot Border 4.
6. With one person staying at the midpoint of A Plot Border 4, extend the tape to 10 m total (5 m from plot center) along the bearing line. Place a pin flag at the 10 m mark (the midpoint of A Plot Border 2).

7. Add pin flags at the: 1 m (point D5), 2.5 m (double flag, midpoint of B Plot Border 4), 5 m (plot center/D1), 7.5 m (double flag, midpoint of B Plot Border 2), 9 m (D3)and 10 m (midpoint of A Plot Border 2). Place two pin flags each at 0 m, 2.5 m, 7.5 m, and 10 m.
8. Reel in the tape and move to the midpoint of A Plot Border 2. Determine the direction of Bearing 1 from this location. Have one person stand at this location with the reeled tape and compass, and the second person extend the tape 20 m down A Plot Border 2 to Corner 1-2[1].
9. Once the tape has been extended to 20 m, backsight the tape at several locations to ensure that the azimuth remains at Bearing 1.
10. Place a piece of re-bar at Corner 1-2[1].
11. Attach the clip of the tape at 0 m to the rebar stake. Place double pin flags at the 12.5 m mark of Border 2. The double flag in this location marks the center of plot C2.
12. Continue extending tape along Bearing 1 to the 40 m mark of Border 2 (Corner 2-3[1]). Place double pin flags at the 27.5 m mark of Border 2. The double flag here marks the center of plot C1. Continue to 40m mark. Place a re-bar stake at Corner 2-3[1].
13. From Corner 2-3[1], extend the tape on Bearing 2 for 10 m along Border 3 to reach Corner 3-4[1]. Place a re-bar stake at this corner.
14. From the 27.5 m mark of Border 2, extend the tape 10 m along Bearing 2. Place pin flags at 2.5 m, 5 m (double flag), 7.5 m, and 10 m (double flag). Reel in the tape.
15. Repeat 14 for the 12.5 mark of Border 2.
16. Fill in pin flags along A Plot and B Plot borders.
17. From Plot Center, extend the tape 4 m in each direction along Bearing 1 (this should direct you to double flags on Border 1 and Border 3 of the B Plot) and place a pin flag at these two points (D2 and D4).
18. After conducting surveys, remove corner rebar stakes for Bill Williams River NWR plots. At other locations, leave rebar and flag with blue/white striped flagging.

1.3 Setup Instructions—PLOTS PREVIOUSLY MARKED:

1. Use GPS to navigate to plot center marker and to locate existing A Plot corner rebar stakes.
    a. If corner stakes cannot be located, use a compass and tape to determine plot corner stakes as detailed above.
2. Use the plot attributes in ArcPad to determine the azimuth bearing ("Bearing 1") for the long plot edge (Borders 2 and 4). Note that the same bearing is used for all of the plots in a phase.
3. Subtract 90^{o} to determine the azimuth bearing ("Bearing 2") for the short plot edge (Borders 1 and 3).
4. From plot center, place flags each direction along Bearing 2 at the following locations—double flags at 2.5 m (edge of B plot); single flag at 4 m (D3 and D5); and a single flag at 5 m (midpoints of A plot edges 2 and 4).
5. Attach the clip of the tape at the midpoint of A Plot edge 2. Use Bearing 1 to determine the direction for Border 2. Extend the tape along Bearing 1, and place double pin flags in each direction along Bearing 1 at 7.5 m (midpoint of C1 and C2).

6. Fill in pin flags along Border 2 to guide A Plot surveys. Confirm that the pin flags are in line with previously-marked plot corners 1-2^1 and 2-3^1.
7. From the 12.5 m mark of Border 2 (center of Plot C2), extend the tape 10 m along Bearing 2. Place pin flags at 2.5 m (Corner 1-2^2), 5 m (double flag at midpoint of E3), and 7.5 m (Corner 4-2^2).
8. Repeat 7 for the 27.5 m mark of A Plot Border 2.
9. Fill in pin flags along A and B Plot borders. Adjust A Plot Border 4 as needed to align with previously marked plot corners 3-4^1 and 4-1^1.
10. After conducting surveys, remove corner rebar stakes for Bill Williams River NWR plots. At other locations, leave rebar and flag with blue/white striped flagging.

2.0 Vegetation Surveys

2.1 General Notes:

1. **Field and datasheet instructions are to be used to guide survey efforts. If inconsistencies or ambiguities are found, immediately notify the Field Supervisor, who will then notify the Project Supervisor. If crews are at a remote location where cell service is unavailable (i.e. Bill Williams River), crews shall refer to the MSCP Vegetation Monitoring Methods. At the end of the field day, the Field Supervisor will contact the Project Supervisor.**
2. On Datasheet 10, note major problems with the site, which might include prevalence of invasive species or patches of vegetation mortality. If serious conditions such as these are encountered, notify the Field Supervisor, who will then notify the Project Supervisor.
3. Trees, shrubs, etc. will be considered IN a given plot if any portion of the basal cover falls on Border 1 or Border 2 of the given survey area. They will be considered OUT of a given plot if any portion of the basal cover falls on Border 3 or Border 4 of the given survey area. The exception to this rule is for the C Plots—if herbaceous foliage is above the quadrat (regardless of the location of the herbaceous base), it will be included for herbaceous canopy cover; if the basal area of a plant is on the border, the portion of the vegetation inside the quadrat will be considered for basal cover.
4. Height of vegetation is measured as the distance of the maximum live foliage above ground surface in a vertical direction. We are NOT measuring stem length, so do not straighten or extend branches for height measurements.
5. Diameter is measured at a different height above ground surface depending on whether DBH or stem counts are being recorded. Diameter is always measured at 10 cm above ground surface for stem counts versus 1.4 m above ground surface for DBH. Diameter measurements are recorded without straightening the stem.
6. Size classes for mesquite and *Tamarix* are as follows: Size Class (SC) 1 is <3.01 m tall; SC2 is ≥3.01 m tall.
7. Size classes for non-mesquite or *Tamarix* trees are designated by DBH as follows: SC 1 is ≤2.5 cm DBH; SC2 is 2.51 – 8 cm DBH; SC3 is 8.01 – 12 cm DBH; SC 4 is 12.01 to 20 cm DBH; SC5 is 20.1 – 40 cm DBH; and SC6 is >40 cm DBH. All DBH measurements will be ROUNDED UP to the next 0.5 cm interval. For example, a trunk measured as 2.01 cm would be recorded as 2.5, and would fall in SC 1; a trunk measured 11.6 cm would be recorded as 12, and would fall in SC3; and a trunk measuring exactly 12.0 cm would be recorded as 12.
8. For measuring DBH, measure the diameter of the largest LIVE stem for a given individual. The stem is considered live if there is any green foliage further along the stem.
9. Stem size is determined by "diameter classes" (DC). Class separations are identical to tree size classes; however, **diameter class is determined at 10 cm above ground surface**.

2.2 Datasheets 1-3 (Vegetation Structure)

1. On each sheet, enter the date, site location, section, and observers.

2. Measure the canopy closure using a convex densiometer. Proceed to points D1 through D5. Place the densiometer level on top of a post, 1.2 m directly above the D points. Count the number of hits for either vegetation (including both live and dead branches/trees) or open sky at each line intersection AND corners. Write the number of hits in the Canopy Closure Section. The total number of hits recorded sums to 37. The orientation of the densiometer measurements is as follows: D1) face "up" the plot; D2-D5) face out from plot center.
3. Conduct hits to pole surveys at D1 through D5. At each location, extend the stadia rod vertically to a height slightly above the canopy, or to its full extent if required.
4. From 0 to 7 m, count the number of hits per meter by species. A "hit" occurs when LIVE plant material (leaves or stem foliated at or beyond the given point) is within 10 cm of the center of the rod for a given 10 cm interval.
5. For 7 m and above, estimate if the number of hits per meter is 0, less than or equal to 5, or greater than 5.
6. When no more hits are encountered, place a "0" in the final blank.
7. A level should be rested against the side of the stadia rod to ensure it is vertical.

2.3 Datasheet 4 (Large Trees)

1. Survey the entire A Plot area for mesquite trees that are >3 m tall (SC2), *Tamarix* spp. greater than 3 m tall (SC2), or trees of another species with a dbh greater than 12 cm (SC4).
    a. For Tamarix and mesquite:
        i. For the first five trees of each mesquite and Tamarix, record the diameter of all live stems (diameter at 10 cm above ground surface). The diameter of each stem will be ROUNDED UP to the next 0.5 cm as for DBH measurements.
        ii. Measure and record heights of five trees per species that represent the size range observed in the plot. Height is recorded to the nearest tenth of a meter.
        iii. For additional trees, record the number of stems in each Diameter Class and the tree Height Class. Use additional datasheets as needed.
        iv. Record a check mark in the appropriate column if the individual is rooted within the B plot. Note that IN (sides 1 and 2) and OUT (sides 3 and 4) rules apply when determining if the tree is within the B plot. If the tree is not within the B plot, record a zero in the cell.
    b. For other tree species (standard trees):
        i. Measure and record height (to the nearest tenth of a meter) for five trees of each species that represent the size range observed in the plot for the given species.
        ii. After five trees are recorded, continue to record the DBH for each tree but visually estimate and record height in "height classes," as follows. Attach additional datasheets as needed.

            1. Height Class 1 – 0-3 meters
            2. Height Class 2 – 4-10 meters
            3. Height Class 3 – 11-15 meters

4. Height Class 4 – 16-20 meters
5. Height Class 5 – 21-25 meters
6. Height Class 6 – >25 meters

c. **For DBH, always round UP to the nearest half centimeter as discussed in the Vegetation Survey General Notes.**

2. After a tree is recorded, chalk and/or flag it to prevent re-measuring during A Plot OR B Plot surveys.
3. For each tree recorded in the A Plot, put a check mark in the adjacent column IF that tree is also within the B Plot area. If it is not within the B Plot area, record a zero in the cell.

2.5 Datasheet 5 and 6 (Small Trees)

1. Survey the entire B Plot area for additional mesquite trees or saltcedar plants that are less than 3.01 m tall.
2. Collect mesquite and saltcedar data as for the A Plot—height and stem diameters for five representative individuals, number of stems in each Diameter Class and Height Class for additional individuals. Note that all mesquite and saltcedar plants in SC2 (greater than or equal to 3.01 m tall) have already been measured.
3. Collect data on other tree species in the B Plot with a DBH of <12 cm (SC1 through SC3). Collect data as for the A Plot—DBH and height for five representative individuals, DBH and Height Class for additional individuals. Note that all trees in SC 4 (dbh >12 cm) have already been measured and a check mark was recorded if the tree occurred within the B Plot area.
4. As for the A Plot, Border 1 and 2 are "in" for the B Plot and each quadrant within.
5. Trees shorter than 1.4 m (breast height) in the B Plot will be recorded with a DBH of "0". Trees >1.4 m with branching or non-woody stems at breast height will be recorded with a DBH of 0.5.
6. **Record the required information for ALL TREES. Attach additional sheets as necessary.**
7. DO NOT COUNT SALEXI INDIVIDUALS IN PLANT COUNTS!

2.6 Datasheet 7 (B Plot Shrubs, Shrub and Tree Foliar Cover)

1. Survey the entire B Plot area for shrub species, NOT including PLUSER or SALEXI (remember SALEXI is always considered a tree under this monitoring protocol not a shrub).
    a. Measure and record height (to the nearest tenth of a meter) for five individuals of each species that represent the size range observed in the plot for the given species. After five shrubs of each species are measured and recorded, visually estimate height for all additional individuals of each species to the nearest half meter. As for the A Plot, Border 1 and 2 are "in" for the B Plot and each quadrant within.
    b. Estimate the foliar cover classes within the B Plot for each woody species according to the provided cover classes. ****This should include cover estimates for SALEXI and PLUSER, even though we are not recording other measurements for these species in this B Plot.**
        i. **Record for all tree and shrub size classes, including those recorded on A Plot datasheets.**

ii. Remember that these are species specific, so cover classes CAN add up to greater than 100%.

2.7 Datasheet 8 (Stem Counts)

1. Survey the Stem Count Area:
    a. Dot count, by species and B Plot quadrant, stems by diameter class for **trees** and **shrubs**. Dot count (not species-specific) **dead stems** GREATER THAN OR EQUAL TO 1.5 m tall, including those in diameter class 1. DIAMETER CLASSES ARE FOR THE DIAMETER AT 10 cm ABOVE GROUND SURFACE, NOT DBH.
        i. **DEAD STEMS OF SALEXI OR PLUSER ARE NOT TO BE COUNTED IN THE STEM COUNT AREA.**
    b. RECORD SALEXI WITH A DIAMETER OF >2.5 cm AT 10 cm ABOVE GROUND SURFACE in the table on the bottom right. **DO NOT INCLUDE STEMS ON PLANTS LESS THAN 1.5 m TALL**.
    c. For species other than SALEXI, stems are only dot-counted. For SALEXI, record the height of the first representative stems in each DC and quadrant. **Dots will be recorded for stems that are measured**—for example, a B1 quadrant with 12 DC2 SALEXI stems would have five measurements and 12 dots, NOT 5 measurements and 7 dots.
    d. For multiple stems to be counted for one plant/tree, branching must be complete at 10 above ground surface—at 10 cm above ground, daylight must be observed between branches. If branches do not separate until 10.1 cm above ground surface, it counts as one stem.
2. Dot count live and dead DC1 SALEXI and PLUSER stems in the E quads. **DO** Include stems less than 1.5 m tall. Record the heights for the first five **live** stems in each quad (do not measure height of dead stems), and dot count all stems as noted in 1c above. DO NOT COUNT STEMS IN DC2 OR GREATER.

2.8 Datasheet 9 (C Plots)

1. Estimate total foliar cover OF HERBACEOUS PLANT SPECIES less than 0.5 m tall within each C Plot collectively, and then by species (i.e. one cover class for total herbaceous cover, followed by one row for each species). If no herbaceous species occur in quads, write "no herbs" and enter a "0" in the cover class column.
    a. For C Plots, there are no "out" and "in" borders—if herbaceous foliage is above the open space within the quadrat, it counts for foliar cover.
2. Estimate foliar cover of young (non-woody) tree and shrub species (e.g. seedling cottonwood and Goodding's willow, young coyote willow and arrowweed propagules. DO NOT INCLUDE THESE SPECIES IN HERBACEOUS FOLIAR COVER ESTIMATES.
    a. Do NOT include non-woody branches of plants with woody vegetation.
3. Estimate ground cover (coverage of ground surface) for:
    a. Herbaceous species (annual or perennial species that still have living tissue);
    b. Woody species;

c. Dead (dead plants still attached to the ground, e.g. annual species that have died but are still attached to roots).
d. Litter (dead plants unattached to ground, but laying on the ground surface);
e. Bare ground;
f. Rock/Gravel; and
g. Water
h. If no cover exists for one or several categories, enter a "0" in the cover class column.
i. As for foliar cover, there are no "in" or "out" borders. If a portion of a given cover is within the quadrat, it is included for ground cover.

4. Estimate the depth of litter and herbaceous vegetation to the nearest cm at three points in each quad.
    a. The measuring point will be the center point of each third of the 0.5 by 2 m quad. If this point is occupied by woody basal cover, the measuring point shall be the nearest point not occupied by woody basal cover.
    b. Litter depth is the depth of **continuous plant litter** above the ground surface. If no litter is present, record a depth of "0." If litter is present, but less than 0.5 cm deep (e.g. a leaf flat on the ground) record a litter depth of 0.5 cm. If litter depth is greater than 0.5 cm, round to the nearest cm.
    c. Herbaceous vegetation height is the height AT THE MEASURING POINT. If herbaceous vegetation is present but less than 0.5 cm deep, record a height of 0.5 cm. If height is greater than 0.5 cm, round to the nearest cm. **DO NOT INCLUDE NON-WOODY SHRUBS AND TREES IN HERBACEOUS DEPTH MEASUREMENTS.**

2.9 Datasheet 10 (General Information)

1. Enter the date, area, site, section, and observers.
2. Determine the presence of or open canopy space (gaps) with an area of greater than or equal to 9 square meters (e.g. 3 m by 3 m) within 30 m of **Plot Center**. "Gap" is defined as without foliated vegetation greater than 2 m off the ground surface. Number each gap, place in distance category (using the distance to the edge of the canopy gap from plot center), denote whether it is a Canopy Gap (space within the planted area) or Edge Gap (open space outside of planted area, e.g. road, edge of field, stream edge), and record UTM coordinates of the center (Canopy Gap) or edge (Edge Gap). If no gaps exist within 30 m of Plot Center, write "None" and put a "0" in the distance category box.
3. Determine the presence of water within 30 m of **Plot Center**. If none exists, write "None" and enter a "0" in the Distance Category box. If water does exist within 30 m, determine the Distance Category and note the source or type of water.
4. Determine the presence of snags (ENTIRELY dead trees devoid of foliage, regardless of species) with a dbh> 12.0 cm (SC4 or greater) within the A Plot. Tally by SC. If snags have cavities, count and record the number of cavities and UTMs of those trees.

5. Record all “incidental” species on the bottom of Datasheet 10. This list will include ALL species observed in the primary plot which are not recorded otherwise.

Appendix I-2

Part B – Reduced Effort Plots

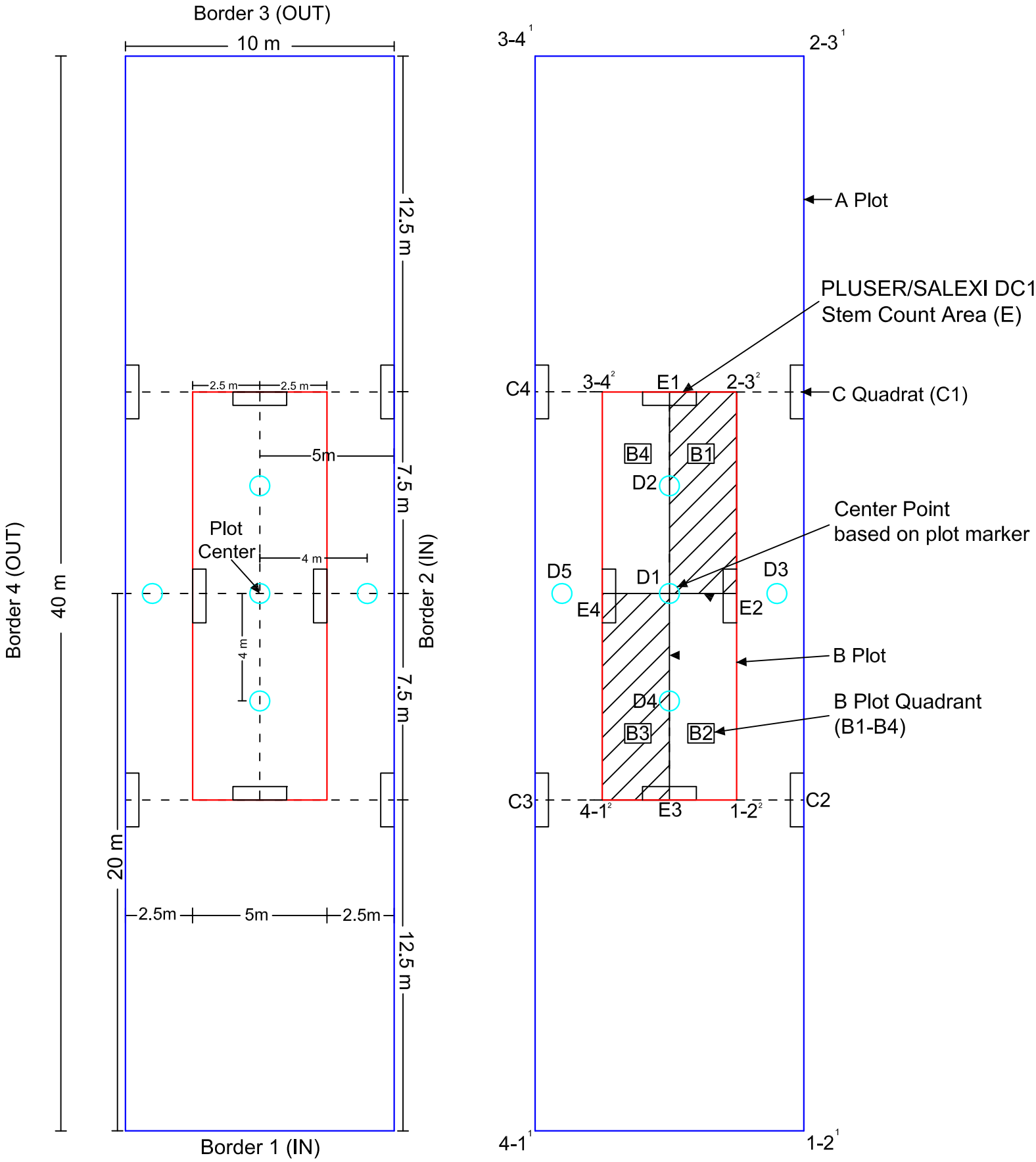
3.0 Reduced Effort Plot Instructions

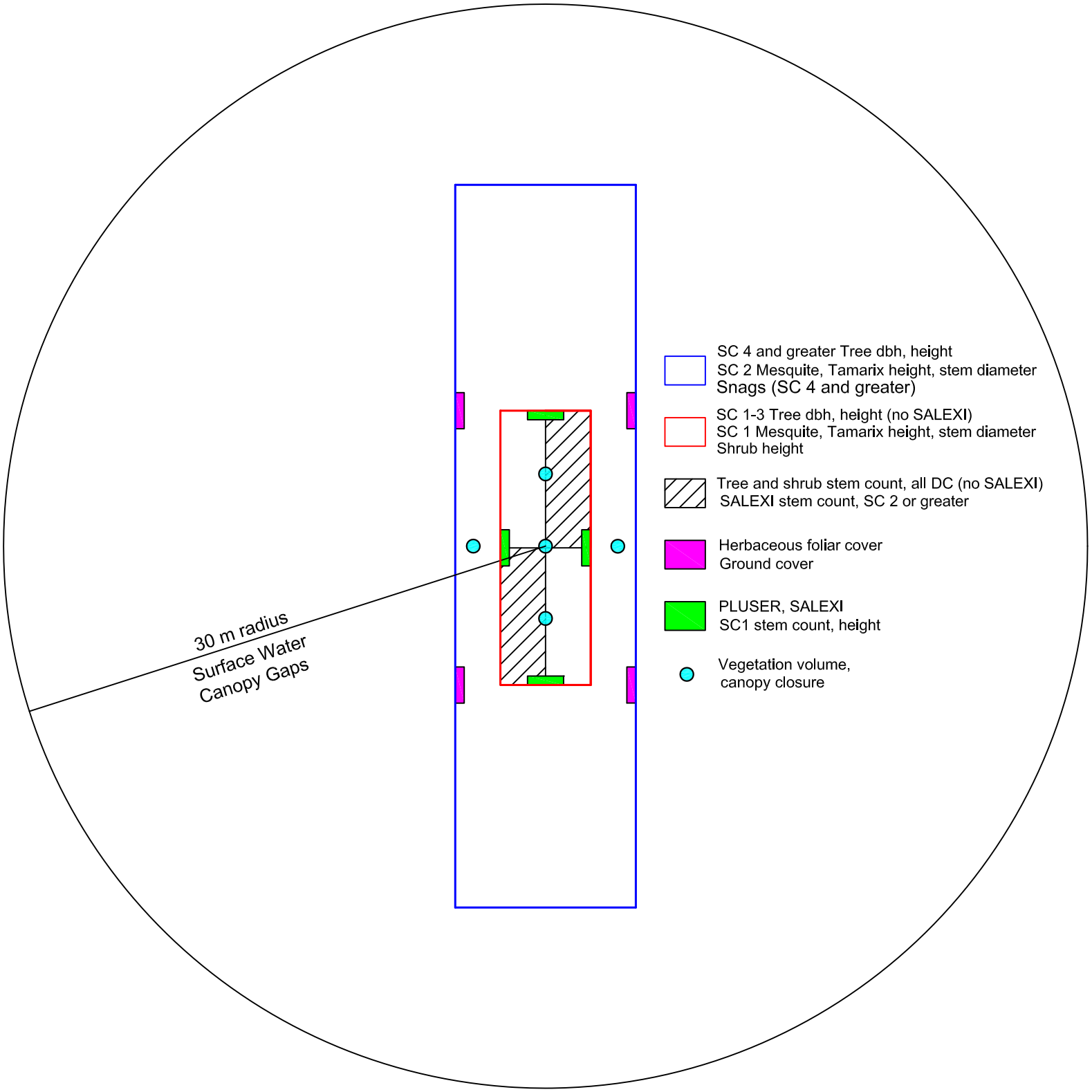
3.1 General Notes:

1. Reduced effort protocols will be implemented at:
    a. Mesquite plots at CVCA 5 and CVCA 6—fewer observations because of clearing between mesquite rows.
    b. First- and second-year plantings for all vegetation types—less vegetation growth which makes some observations irrelevant, minimal cloning of SALEXI.
2. All species within the A Plot will be noted.
3. Cover estimates will be included for salt heliotrope (HELCUR) for the A PLOT.
4. The following section describes DEVIATIONS from the full intensity (enhanced) vegetation monitoring protocols.

3.2 Vegetation Surveys

1. Skip datasheets 1 through 3 entirely.
2. For datasheet 4, record all tree size classes, not just SC4 trees and SC2 mesquite. Do not record PLUSER. **DO RECORD SALEXI (individuals, not stems).**
    a. For non-mesquite and Tamarix: Record height of the five individuals per species, which will represent the range of heights observed in the plot. Record the DBH and height class of all additional individuals. Attach additional datasheets as necessary.
    b. For mesquite and Tamarix: Record height of the five individuals per species, which will represent the range of heights observed in the plot. Record the diameter of each stem for these five individuals. Record height class and the number of stems in each diameter class for all additional individuals.
3. Skip datasheets 5 and 6.
4. For datasheet 7, survey the entire **A Plot area**.
    a. Record only Atriplex spp., Baccharis spp., **and PLUSER** for plant counts.
    b. Measure height of five individuals per species. Record height to the nearest 0.5 m for additional individuals.
    c. Estimate cover for **HELCUR within the entire A Plot.**
    d. **Note additional species observed within the entire A Plot in the notes section. Cover estimates NOT required for any species except HELCUR.**
5. **Skip datasheets 8 -10.**


Border 3 (OUT)
10 m
12.5 m
7.5 m
Border 2 (IN)
7.5 m
12.5 m
Border 4 (OUT)
40 m
2.5 m
2.5 m
5m
Plot
Center
4 m
4 m
20 m
2.5m
5m
2.5m
Border 1 (IN)
3-4 1
2-3 1
A Plot
PLUSER/SALEXI DC1
Stem Count Area (E)
C4
3-4 2
E1
2-3 2
C Quadrat (C1)
B4
B1
D2
Center Point
based on plot marker
D5
D1
D3
E4
E2
B Plot
D4
B Plot Quadrant
(B1-B4)
B3
B2
C3
4-1 2
E3
1-2 2
C2
4-1 1
1-2 1


30 m radius
Surface Water
Canopy Gaps
SC 4 and greater Tree dbh, height
SC 2 Mesquite, Tamarix height, stem diameter
Snags (SC 4 and greater)
SC 1-3 Tree dbh, height (no SALEXI)
SC 1 Mesquite, Tamarix height, stem diameter
Shrub height
Tree and shrub stem count, all DC (no SALEXI)
SALEXI stem count, SC 2 or greater
Herbaceous foliar cover
Ground cover
PLUSER, SALEXI
SC1 stem count, height
Vegetation volume,
canopy closure

Appendix II

2012 Field Datasheets

LCR-MSCP Vegetation Monitoring **Datasheet 1: Vegetation Structure**

Date _____ Area _____ Site _____ Section _____

Observers _____

Hits to Pole (D1-D5)

Record number of decimeter 'hits to pole' (within 10cm radius) for each meter layer, at collection points D1-D5 as in plot diagram, up to 7m . Meter layers above 7 meters will be estimated using 0, ≤5, or >5 hits per meter layer (not decimeter layer).

D1							D2						
Species →	Hits by Species						Species →	Hits by Species					
0_1							0_1						
1_2							1_2						
2_3							2_3						
3_4							3_4						
4_5							4_5						
5_6							5_6						
6_7							6_7						
Estimates							**Estimates**						
7_8							7_8						
8_9							8_9						
9_10							9_10						
10_11							10_11						
11_12							11_12						
12_13							12_13						
13_14							13_14						
14_15							14_15						
15_16							15_16						
16_17							16_17						
18_19							18_19						
19_20							19_20						
20_21							20_21						
21_22							21_22						
22_23							22_23						
23_24							23_24						

Canopy Closure (D1-D5)

Record number of cross hairs/corners covered with vegetation and/or sky (37 total). Record as live/total.

	D1	D2	D3	D4	D5
Canopy					
Sky					

LCR-MSCP Vegetation Monitoring **Datasheet 2: Vegetation Structure**

Date _____ Area _____ Site _____ Section _____

Observers _____

Hits to Pole (D1-D5)

Record number of decimeter 'hits to pole' (within 10cm radius) for each meter layer, at collection points D1-D5 as in plot diagram, up to 7m . Meter layers above 7 meters will be estimated using 0, ≤5, or >5 hits per meter layer (not decimeter

D3								D4							
Species →	Hits by Species							Species →	Hits by Species						
0_1								0_1							
1_2								1_2							
2_3								2_3							
3_4								3_4							
4_5								4_5							
5_6								5_6							
6_7								6_7							
Estimates								**Estimates**							
7_8								7_8							
8_9								8_9							
9_10								9_10							
10_11								10_11							
11_12								11_12							
12_13								12_13							
13_14								13_14							
14_15								14_15							
15_16								15_16							
16_17								16_17							
18_19								18_19							
19_20								19_20							
20_21								20_21							
21_22								21_22							
22_23								22_23							
23_24								23_24							

LCR-MSCP Vegetation Monitoring **Datasheet 3: Vegetation Structure**

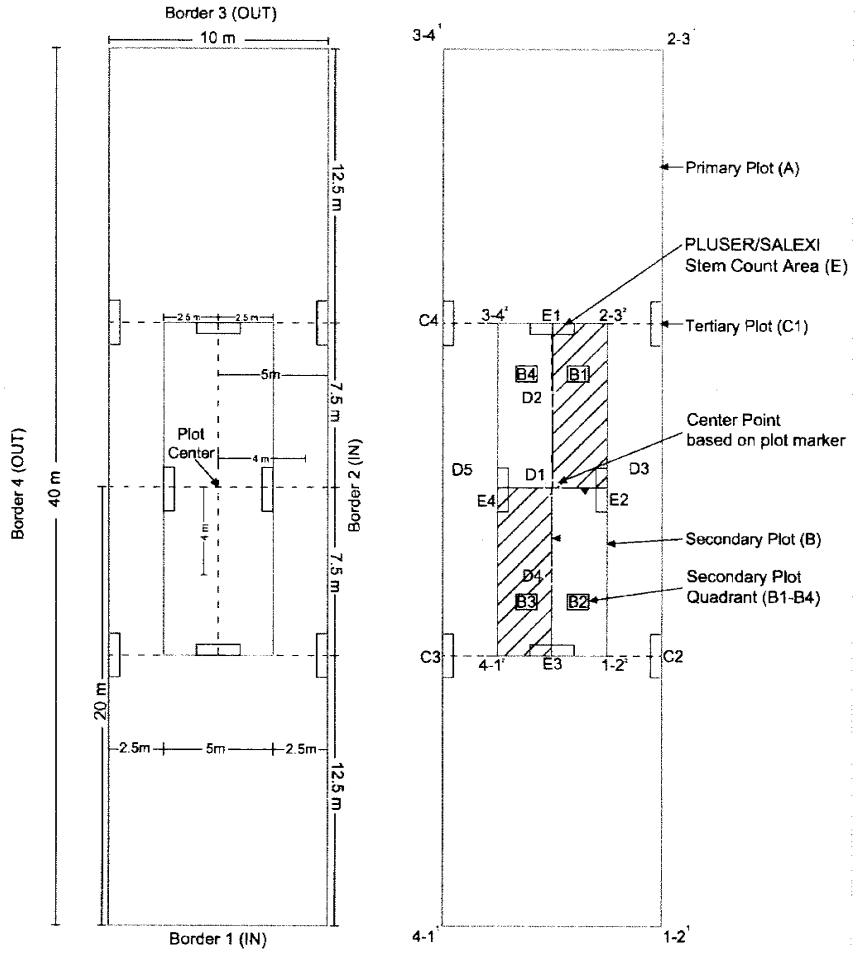
Date _____ Area _____ Site _____ Section _____

Observers _____

Hits to Pole (D1-D5)

Record number of decimeter 'hits to pole' (within 10cm radius) for each meter layer, at collection points D1-D5 as in plot diagram, up to 7m . Meter layers above 7 meters will be estimated using 0, ≤5, or >5 hits per meter layer (not decimeter layer).

D5							
Species →	Hits by Species						
0_1							
1_2							
2_3							
3_4							
4_5							
5_6							
6_7							
Estimates							
7_8							
8_9							
9_10							
10_11							
11_12							
12_13							
13_14							
14_15							
15_16							
16_17							
18_19							
19_20							
20_21							
21_22							
22_23							
23_24							



Created by Parametrix/GSA

LCR-MSCP Vegetation Monitoring **PLOT A** **Datasheet 4: Large trees**

Date _____ Area _____ Site _____ Section _____

Observers _____ Page___of___

DO NOT RECORD SALEXI HERE

SC4, SC5, SC6 Standard Trees **Mesquite SC2; Tamarix SC2**

Species →																																		
Tree #	DBH	HT(m)	IN B PLOT	DBH	HT(m)	IN B PLOT	DBH	HT(m)	IN B PLOT	Diameter	Diameter	Diameter	Diameter	Diameter	Diameter	HT(m)	IN B PLOT	Diameter	Diameter	Diameter	Diameter	Diameter	Diameter	HT(m)	IN B PLOT	Diameter	Diameter	Diameter	Diameter	Diameter	Diameter	HT(m)	IN B PLOT
1-M																																		
2-M																																		
3-M																																		
4-M																																		
5-M																																		
Tree #	DBH	HT Class	IN B PLOT	DBH	HT Class	IN B PLOT	DBH	HT Class	IN B PLOT	DC1	DC2	DC3	DC4	DC5	DC6	HT Class	IN B PLOT	DC1	DC2	DC3	DC4	DC5	DC6	HT Class	IN B PLOT	DC1	DC2	DC3	DC4	DC5	DC6	HT Class	IN B PLOT

Standard tree height: First 5 heights are measured (per species/SC); remaining trees are assigned height class. Record height for measured trees in M section (measured trees should be representative of variation in habitat); all additional trees below.

Standard tree DBH:
DBH: Record DBH for all trees; measure DBH at 1.4m height. If more than one trunk, measure largest trunk. If tree is <1.4m, record 0. **Size classes:**
SC6) ≥40.01cm;
SC5) 20.01-40.0cm;
SC4) 12.01-20cm.

Mesquite and Tamarix:
Size Class: ≥3.01m height.
Diameter: For the 5 measured trees, record basal diameter for all live stems at 10cm above ground. After first 5 trees, record diameter class (all live stems at 10cm) and height class for all additional trees.

Height Classes:
HC1= 0-3m;
HC2=4-10m;
HC3=11-15m;
HC4=16-20;
HC5=21-25m;
HC6=>25m.

Diameter Classes:
DC1=≤2.5cm;
DC2=>2.5-8.0cm;
DC3=8.1-12.0cm;
DC4=12.1-20.0cm;
DC5=20.1-40.0cm;
DC6=>40.0.

LCR-MSCP Vegetation Monitoring **PLOT B** **Datasheet 5: Small trees (SC1-2)**

Date ____________ Area ____________ Site ______ Section ______________________________

Observers ______________________________ Page___of___

DO NOT RECORD SALEXI HERE												
	Standard Trees SC1						Standard Trees SC2					
Species→												
Tree #	DBH	HT (m)	DBH	HT (m)	DBH	HT (m)	DBH	HT (m)	DBH	HT (m)	DBH	HT (m)
1-M												
2-M												
3-M												
4-M												
5-M												
Tree #	DBH	HT Class	DBH	HT Class	DBH	HT Class	DBH	HT Class	DBH	HT Class	DBH	HT Class

Standard tree height: First 5 heights are measured (per species/SC); remaining trees are assigned height class. Record height for measured trees in M section (measured trees should be representative of variation in habitat); all additional trees below.

Standard tree DBH:
DBH: Record DBH for all standard trees; measure DBH at 1.4m height; if more than one trunk, record DBH of largest trunk. If tree is < 1.4m, record 0.
SC2) 2.5-8cm DBH;
SC1) <2.5cm DBH.

Height Classes:
HC1= 0-3m;
HC2=4-10m;
HC3=11-15m;
HC4=16-20m;
HC5=21-25m;
HC6= >25m.

Diameter Classes:
DC1=≤2.5cm;
DC2=>2.5-8.0cm;
DC3=8.1-12.0cm;
DC4=12.1-20.0cm;
DC5=20.1-40.0cm;
DC6=>40.0.

Notes

LCR-MSCP Vegetation Monitoring

PLOT B Datasheet 6: Small trees SC3; Mesq/Tam SC1

Date _____ Area _____ Site _____ Section _____

Observers _____

DO NOT RECORD SALEXI HERE

Page___of___

Standard trees SC3

Mesquite SC1; Tamarix SC1

Species →																														
Tree #	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	Diameter	Diameter	Diameter	Diameter	Diameter	Diameter	HT(m)	Diameter	Diameter	Diameter	Diameter	Diameter	Diameter	HT(m)	Diameter	Diameter	Diameter	Diameter	Diameter	Diameter	HT(m)
1-M																											
2-M																											
3-M																											
4-M																											
5-M																											
Tree #	DBH	HT Class	DBH	HT Class	DBH	HT Class	DC1	DC2	DC3	DC4	DC5	DC6	HT Class	DC1	DC2	DC3	DC4	DC5	DC6	HT Class	DC1	DC2	DC3	DC4	DC5	DC6	HT Class

Standard tree height: First 5 heights are measured (per species/SC); remaining trees are assigned height class. Record height for measured trees in M section (measured trees should be representative of variation in habitat); all additional trees below.

Standard tree DBH:
DBH: Record DBH for all standard trees; measure DBH at 1.4m height; if more than one trunk, record DBH of largest trunk. If tree is <1.4m, record 0.
Tree SC3: 8.1-12cm DBH.

Mesquite and Tamarix:
Size Class 1: ≤3.0m height.
Diameter: For the 5 measured trees, record basal diameter for all live stems at 10cm above ground. After first 5 trees, record diameter class (all live stems at 10cm) and height class for all additional trees.

Height Classes:
HC1= 0-3m;
HC2=4-10m;
HC3=11-15m;
HC4=16-20;
HC5=21-25m;
HC6= >25

Diameter Classes:
DC1=≤2.5cm;
DC2=>2.5-8.0cm;
DC3=8.1-12.0cm;
DC4=12.1-20.0cm;
DC5=20.1-40.0cm;
DC6=>40.0.

LCR-MSCP Vegetation Monitoring **PLOT B** **Datasheet 7 - Secondary Shrubs**

Date _____ Area _____ Site _____ Section _____

Observers _____

Record the **measured** height for 5 individuals of each species to the nearest **0.1 m** (M section). **Estimate** height for all additional individuals to the nearest **0.5 m.** Record the quadrant number of each shrub **ONLY** if you are PMX/GSA contractors.

DO NOT RECORD PLUSER HERE

Shrub Species

Species→																		
Plant #	HT(m)	Quad	HT(m)	Quad	HT(m)	Quad	HT(m)	Quad	HT(m)	Quad	HT(m)	Quad	HT(m)	Quad	HT(m)	Quad	HT(m)	Quad
1-M																		
2-M																		
3-M																		
4-M																		
5-M																		

Notes

Tree and Shrub Foliar Cover

Estimate foliar cover of each tree and shrub species in Plot B. Include all size classes together. Cover estimates are by individual species, so MAY be greater than 100%. Guide: Visualize if sun was above you, how much area would be covered by shadows from vegetation? Put zero if there are no trees or shrubs.

Include SALEXI and PLUSER.

Tree & Shrub Cover	Species→									
Cover classes: 1) <1%; **2)** 1-10%; **3)** 11-25%; **4)** 26-50%; **5)** 51-75%; **6)** 76-90%; **7)** >90% **NOTE:** 1% of Plot B is approximately 0.75 X 0.75 meters.										

LCR-MSCP Vegetation Monitoring **Datasheet 8 - Stem Counts**

Date_____ Area _____ Site_____ Section_____ Observers_____

Dot count stems by **species** and **diameter class (1-4)**. Stem counts only, no other measurements. Dot count includes stems of trees/shrubs that meet the minimum stem count criteria (tree or shrub with height > 1.5 m). Stem diameters are measured at 10cm above the ground. Separate dot counts for quadrants 1 and 3. Include DEAD stems in separate column (all species combined).

DO NOT include **SALEXI** and **PLUSER** in this section.

Stem counts include trees and shrubs - Plot B (Quad 1 and 3)

Diam	Quad						Diam	Quad		
DC1	1						DC4	1		
	3							3		
DC2	1						DC5	1		
	3							3		
DC3	1						DC6	1		
	3							3		

Clonal Species Stem Counts (E Quads)

Dot count **diameter class 1** stems for clonal spp. (**SALEXI, PLUSER**) in four quadrats (including those less than 1.5 m tall). Measure height of first 5 stems to nearest 0.1 m, including those less than 1.5 m tall to obtain average plant height.

E-Quad	Salexi DC1		Pluser DC1	
	Dot Cnt	HT (5 ea)	Dot Cnt	HT (5 ea)
E1				
Dead				
E2				
Dead				
E3				
Dead				
E4				
Dead				

SALEXI Diameter Class 2-4 - Plot B (Quad 1 and 3)

Dot count stems of **SALEXI** in **diameter class 2-4**. Dot count includes stems of trees/shrubs that meet the minimum criteria (height > 1.5 m). Stem diameters are measured at 10cm above the ground. Separate dot counts for secondary quads 1 and 3. Height is measured for 5 trees each quad. No DEAD category here.

DC	Quad	Dot Cnt	HT(5 ea)
DC2	1		
	3		
DC3	1		
	3		
DC4	1		
	3		

LCR-MSCP Vegetation Monitoring **Datasheet 9 - Ground Layer**

Date_____ Area_____ Site_____ Section_____

Observer_____

Herbaceous Foliar Cover (C Plots)

Record foliar cover (vertical projection of vegetation on the ground) of live herbaceous plants (include seedling trees/shrubs-not woody) by species. Put zero if there are no plants. **Cover classes: 1=** <1%; **2=** 1-10%; **3=** 11-25%; **4=** 26-50%; **5=** 51-75%; **6=** 76-90%; and **7=** >90%.

Plot C1-C4	Species Code	Cover Class

Ground Cover (C Plots)

Record ground cover (covering the ground surface); herbaceous means all herbaceous plant material combined. **Cover classes: 1=** <1%; **2=** 1-10%; **3=** 11-25%; **4=** 26-50%; **5=** 51-75%; **6=** 76-90%; and **7=** >90%.

Veg Heights/Litter Depths

Vegetation Ht and Litter depth at 3 points (visually estimate 3-thirds of each plot and measure center of each third). Record veg or litter that is touching meter stick; not tallest or deepest points.

Plot	Type	Cvr Cls	Height/Depth (cm) 1	2	3
C1	Herbaceous				
	Woody				
	Litter				
	Dead				
	Bare Ground				
	Rock/Gravel				
	Water				
C2	Herbaceous				
	Woody				
	Litter				
	Dead				
	Bare Ground				
	Rock/Gravel				
	Water				
C3	Herbaceous				
	Woody				
	Litter				
	Dead				
	Bare Ground				
	Rock/Gravel				
	Water				
C4	Herbaceous				
	Woody				
	Litter				
	Dead				
	Bare Ground				
	Rock/Gravel				
	Water				

LCR-MSCP Vegetation Monitoring **Datasheet 10: General Information**

Date _____ Area _____ Site _____ Section _____

Observers _____

Distance to Gap

Estimate distance to all gaps ≥9 square meters that are within 30 meters of plot center; then estimate gap size, and take GPS point at gap center.

Distance from center categories: **1**= <3m, **2**= 3-6m, **3**= 6.1-9m, **4**= 9.1-12m, **5**= 12.1-30m.

Gap Size estimate: write in an estimated size, for example, 2x5m or 3X3m; if edge put road, field, river, or other.

C or E: Record if gap is canopy or edge; UTM pt at gap center or if edge, then at edge of habitat.

Gap Num	Dist Catg	Size Est	C or E	Easting	Northing

Distance to Surface Water

Estimate distance to any surface water that is within 30 meters of plot center, then record source or type of water.

Distance from center categories: **1**= <3m, **2**= 3-6m, **3**= 6.1-9m, **4**= 9.1-12m, **5**= 12.1-30m.

Source or type of water: irrigation, lake, river, stream, marsh, pond, canal, or unknown.

Water Num	Dist Catg	Type

Snags

Tally all snags by size class; snags are defined as mature dead trees that would possibly be used by woodpeckers. **SC6)** ≥40.01cm; **SC5)** 20.01-40cm; **SC4)** 12.01-20cm DBH.

If snag has a cavity, record # of cavities in each snag and GPS the snag.

Tallies				#	DBH	#Cavities	Easting	Northing
SC4	SC5	SC6						

Incidental species

Record all species that are within Plot A that were NOT recorded anywhere else within the plot. No additional data need to be collected on the species listed in this box.

Notes

Appendix III

Plot Locations Sampled During 2012

Area	Site	Section	Bearing	Effort	KusMethod	Date Entered	Date Sampled
Beal Lake Conservation Area	A	0092	315	ENH	No	2/11/2013	10/7/2012
Beal Lake Conservation Area	A	0093	315	ENH	No	2/11/2013	10/7/2012
Beal Lake Conservation Area	A	0100	315	ENH	No	2/11/2013	10/7/2012
Beal Lake Conservation Area	B	0005	315	ENH	No	2/11/2013	10/8/2012
Beal Lake Conservation Area	B	0082	315	ENH	No	2/18/2013	10/3/2012
Beal Lake Conservation Area	C	0010	315	ENH	No	2/18/2013	10/3/2012
Beal Lake Conservation Area	D	0094	315	ENH	No	2/21/2013	10/8/2012
Beal Lake Conservation Area	D	0098	315	ENH	No	2/21/2013	10/8/2012
Beal Lake Conservation Area	D	0099	315	ENH	No	3/1/2013	10/8/2012
Beal Lake Conservation Area	F	0034	315	ENH	No	2/27/2013	10/7/2012
Beal Lake Conservation Area	F	0088	315	ENH	No	2/26/2013	10/7/2012
Beal Lake Conservation Area	FF	0075	315	ENH	No	2/26/2013	10/7/2012
Beal Lake Conservation Area	FF	0080	315	ENH	No	2/26/2013	10/6/2012
Beal Lake Conservation Area	G	0020	315	ENH	No	2/26/2013	10/4/2012
Beal Lake Conservation Area	G	0081	315	ENH	No	2/25/2013	10/8/2012
Beal Lake Conservation Area	H	0014	315	ENH	No	2/26/2013	10/8/2012
Beal Lake Conservation Area	H	0083	315	ENH	No	2/28/2013	10/8/2012
Beal Lake Conservation Area	I	0095	315	ENH	No	2/28/2013	10/8/2012
Beal Lake Conservation Area	I	0096	315	ENH	No	2/28/2013	10/8/2012
Beal Lake Conservation Area	I	0097	315	ENH	No	2/28/2013	10/8/2012
Beal Lake Conservation Area	JJ	0071	315	ENH	No	3/1/2013	10/7/2012
Beal Lake Conservation Area	JJ	0079	315	ENH	No	3/1/2013	10/6/2012
Beal Lake Conservation Area	K	0056	315	ENH	No	3/1/2013	10/6/2012
Beal Lake Conservation Area	K	0085	315	ENH	No	2/25/2013	10/6/2012
Beal Lake Conservation Area	L	0037	315	ENH	No	2/25/2013	10/5/2012
Beal Lake Conservation Area	L	0086	315	ENH	No	2/25/2013	10/5/2012
Beal Lake Conservation Area	M	0048	315	ENH	No	2/26/2013	10/6/2012
Beal Lake Conservation Area	N	0089	315	ENH	No	2/26/2013	10/6/2012
Beal Lake Conservation Area	N	0090	315	ENH	No	2/26/2013	10/6/2012
Beal Lake Conservation Area	N	0091	315	ENH	No	2/27/2013	10/6/2012
Beal Lake Conservation Area	O	0053	315	ENH	No	2/27/2013	10/6/2012
Beal Lake Conservation Area	P	0063	315	ENH	No	2/27/2013	10/5/2012
Beal Lake Conservation Area	P	0087	315	ENH	No	2/27/2013	10/7/2012
Beal Lake Conservation Area	Q	0026	315	ENH	No	3/1/2013	10/7/2012
Beal Lake Conservation Area	Q	0084	315	ENH	No	2/18/2013	10/8/2012
Bill Williams River East	Cougar Point	0001	40	ENH	No	BLANK	10/17/2012
Bill Williams River East	Cougar Point	0002	40	ENH	No	BLANK	10/18/2012
Bill Williams River East	Cougar Point	0003	40	ENH	No	2/6/2013	10/18/2012
Bill Williams River East	Cougar Point	0004	40	ENH	No	2/7/2013	10/17/2012
Bill Williams River East	Cougar Point	0005	40	ENH	No	2/8/2013	10/18/2012
Bill Williams River East	Esquerra Ranch	0006	40	ENH	No	2/7/2013	10/18/2012
Bill Williams River East	Esquerra Ranch	0007	40	ENH	No	2/7/2013	10/18/2012
Bill Williams River East	Esquerra Ranch	0008	40	ENH	No	2/7/2013	10/18/2012
Bill Williams River East	Esquerra Ranch	0009	40	ENH	No	2/8/2013	10/18/2012
Bill Williams River East	Esquerra Ranch	0010	40	ENH	No	2/8/2013	10/17/2012
Bill Williams River East	Esquerra Ranch	0011	40	ENH	No	2/8/2013	10/17/2012
Bill Williams River East	Esquerra Ranch	0012	40	ENH	No	2/8/2013	10/17/2012
Bill Williams River East	Esquerra Ranch	0013	40	ENH	No	2/8/2013	10/17/2012
Bill Williams River East	Esquerra Ranch	0014	40	ENH	No	2/11/2013	10/17/2012
Bill Williams River East	Esquerra Ranch	0015	40	ENH	No	2/11/2013	10/17/2012
Bill Williams River East	Esquerra Ranch	0016	40	ENH	No	2/11/2013	10/16/2012
Bill Williams River East	Esquerra Ranch	0017	40	ENH	No	2/11/2013	10/17/2012
Bill Williams River East	Esquerra Ranch	0018	40	ENH	No	2/12/2013	10/17/2012
Bill Williams River East	Esquerra Ranch	0019	42	ENH	No	2/12/2013	10/16/2012
Bill Williams River East	Esquerra Ranch	0020	42	ENH	No	2/12/2013	10/16/2012
Bill Williams River East	Esquerra Ranch	0021	42	ENH	No	2/12/2013	10/16/2012

Area	Site	Section	Bearing	Effort	KusMethod	Date Entered	Date Sampled
Bill Williams River East	Esquerra Ranch	0022	42	ENH	No	2/12/2013	10/16/2012
Bill Williams River East	Esquerra Ranch	0023	42	ENH	No	2/12/2013	10/16/2012
Bill Williams River East	Esquerra Ranch	0024	42	ENH	No	2/13/2013	10/16/2012
Bill Williams River East	Esquerra Ranch	0026	42	ENH	No	2/13/2013	10/16/2012
Bill Williams River East	Mineral Wash	0025	42	ENH	No	2/13/2013	10/15/2012
Bill Williams River East	Mineral Wash	0027	42	ENH	No	2/14/2013	10/16/2012
Bill Williams River East	Mineral Wash	0028	42	ENH	No	2/15/2013	10/16/2012
Bill Williams River East	Mineral Wash	0029	42	ENH	No	2/15/2013	10/15/2012
Bill Williams River East	Mineral Wash	0030	42	ENH	No	2/15/2013	10/15/2012
Bill Williams River East	Mineral Wash	0031	42	ENH	No	2/15/2013	10/15/2012
Bill Williams River East	Mineral Wash	0032	42	ENH	No	2/15/2013	10/15/2012
Bill Williams River East	Mineral Wash	0033	42	ENH	No	2/18/2013	10/15/2012
Bill Williams River East	Mineral Wash	0034	42	ENH	No	2/18/2013	10/15/2012
Bill Williams River East	Mineral Wash	0035	42	ENH	No	2/18/2013	10/15/2012
Bill Williams River East	Mineral Wash	0036	42	ENH	No	2/18/2013	10/15/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0006	179	ENH	No	2/19/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0010	179	ENH	No	2/19/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0018	179	ENH	No	2/20/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0031	179	ENH	No	2/20/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0036	179	ENH	No	2/20/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0043	179	ENH	No	2/20/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0045	179	ENH	No	2/21/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0057	179	ENH	No	2/21/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0078	179	ENH	No	2/21/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0095	179	ENH	No	2/21/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0103	179	ENH	No	2/21/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0124	179	ENH	No	2/21/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0130	179	ENH	No	2/22/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0131	179	ENH	No	2/25/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0134	179	ENH	No	2/25/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0140	179	ENH	No	2/25/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0142	179	ENH	No	2/25/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0145	179	ENH	No	2/25/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0153	179	ENH	No	2/25/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0157	179	ENH	No	2/25/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0159	179	ENH	No	2/26/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0165	179	ENH	No	2/26/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0168	179	ENH	No	2/26/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0170	179	ENH	No	2/26/2013	11/28/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0190	179	ENH	No	2/26/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0195	179	ENH	No	2/26/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Crane Roost	0198	179	ENH	No	2/26/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	CW North	0003	359	ENH	No	2/27/2013	12/2/2012
Cibola National Wildlife Refuge Unit 1	CW North	0005	359	ENH	No	2/27/2013	12/2/2012
Cibola National Wildlife Refuge Unit 1	CW North	0007	359	ENH	No	2/27/2013	12/2/2012
Cibola National Wildlife Refuge Unit 1	CW North	0011	359	ENH	No	2/27/2013	12/2/2012
Cibola National Wildlife Refuge Unit 1	CW North	0018	359	ENH	No	2/27/2013	12/2/2012
Cibola National Wildlife Refuge Unit 1	CW North	0020	359	ENH	No	2/27/2013	12/2/2012
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	0012	359	ENH	No	2/27/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	0014	359	ENH	No	2/27/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	0019	359	ENH	No	2/27/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	0023	359	ENH	No	2/27/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	0027	359	ENH	No	2/27/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	0034	359	ENH	No	2/27/2013	11/29/2012

Area	Site	Section	Bearing	Effort	KusMethod	Date Entered	Date Sampled
Cibola National Wildlife Refuge Unit 1	Nature Trail	0001	359	ENH	No	2/28/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0006	359	ENH	No	2/28/2013	11/30/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0009	359	ENH	No	2/28/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0011	359	ENH	No	2/28/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0013	359	ENH	No	3/1/2013	11/30/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0014	359	ENH	No	3/1/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0017	359	ENH	No	3/1/2013	11/29/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0020	359	ENH	No	3/1/2013	11/30/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0022	359	ENH	No	3/1/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0025	359	ENH	No	3/1/2013	11/30/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0026	359	ENH	No	3/1/2013	12/2/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0028	359	ENH	No	3/1/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0031	359	ENH	No	3/4/2013	11/30/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0033	359	ENH	No	3/4/2013	11/30/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0035	359	ENH	No	3/4/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0036	359	ENH	No	3/4/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0042	359	ENH	No	3/5/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0044	359	ENH	No	3/5/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0046	359	ENH	No	3/5/2013	11/30/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0048	359	ENH	No	3/5/2013	11/30/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0050	359	ENH	No	3/5/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0052	359	ENH	No	3/5/2013	12/1/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0053	359	ENH	No	3/5/2013	12/2/2012
Cibola National Wildlife Refuge Unit 1	Nature Trail	0055	359	ENH	No	3/5/2013	11/30/2012
Cibola Valley Conservation Area	Phase 01	0002	87	ENH	No	2/19/2013	10/26/2012
Cibola Valley Conservation Area	Phase 01	0016	87	ENH	No	2/19/2013	10/26/2012
Cibola Valley Conservation Area	Phase 01	0021	87	ENH	No	2/19/2013	10/26/2012
Cibola Valley Conservation Area	Phase 01	0040	87	ENH	No	2/19/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0052	87	ENH	No	2/19/2013	10/26/2012
Cibola Valley Conservation Area	Phase 01	0056	87	ENH	No	2/20/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0061	87	ENH	No	2/20/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0063	87	ENH	No	2/20/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0091	87	ENH	No	2/20/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0094	87	ENH	No	2/20/2013	10/26/2012
Cibola Valley Conservation Area	Phase 01	0098	87	ENH	No	2/20/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0104	87	ENH	No	2/20/2013	10/26/2012
Cibola Valley Conservation Area	Phase 01	0114	87	ENH	No	2/20/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0117	87	ENH	No	2/20/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0119	87	ENH	No	2/20/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0126	87	ENH	No	2/21/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0138	87	ENH	No	2/21/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0147	87	ENH	No	2/21/2013	10/25/2012
Cibola Valley Conservation Area	Phase 01	0151	87	ENH	No	2/20/2013	10/25/2012
Cibola Valley Conservation Area	Phase 02	0001	269	ENH	No	2/19/2013	10/26/2012
Cibola Valley Conservation Area	Phase 02	0004	269	ENH	No	2/19/2013	10/26/2012
Cibola Valley Conservation Area	Phase 02	0014	269	ENH	Yes	2/12/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0016	269	ENH	Yes	2/12/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0019	269	ENH	Yes	2/15/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0026	269	ENH	Yes	2/12/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0028	269	ENH	Yes	2/13/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0030	269	ENH	Yes	2/13/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0039	269	ENH	Yes	2/15/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0044	269	ENH	Yes	2/13/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0052	269	ENH	Yes	2/13/2013	10/27/2012

Area	Site	Section	Bearing	Effort	KusMethod	Date Entered	Date Sampled
Cibola Valley Conservation Area	Phase 02	0054	269	ENH	Yes	2/12/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0059	269	ENH	Yes	2/15/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0068	269	ENH	No	2/21/2013	10/26/2012
Cibola Valley Conservation Area	Phase 02	0073	269	ENH	No	2/21/2013	10/26/2012
Cibola Valley Conservation Area	Phase 02	0076	269	ENH	No	2/22/2013	10/26/2012
Cibola Valley Conservation Area	Phase 02	0083	269	ENH	No	2/25/2013	10/27/2012
Cibola Valley Conservation Area	Phase 02	0091	269	ENH	No	2/25/2013	10/26/2012
Cibola Valley Conservation Area	Phase 02	0093	269	ENH	No	2/25/2013	10/26/2012
Cibola Valley Conservation Area	Phase 03	0006	179	ENH	Yes	2/15/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0024	179	ENH	Yes	2/15/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0027	179	ENH	Yes	2/15/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0054	179	ENH	Yes	2/18/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0060	179	ENH	Yes	2/18/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0101	179	ENH	Yes	2/18/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0106	179	ENH	Yes	2/18/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0112	179	ENH	Yes	2/18/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0116	179	ENH	Yes	2/18/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0121	179	ENH	Yes	2/19/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0133	179	ENH	Yes	2/19/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0151	179	ENH	Yes	2/19/2013	10/28/2012
Cibola Valley Conservation Area	Phase 03	0162	179	ENH	Yes	2/19/2013	10/28/2012
Cibola Valley Conservation Area	Phase 04E	0045	88	RED	No	2/22/2013	10/1/2012
Cibola Valley Conservation Area	Phase 04E	0117	88	RED	No	2/22/2013	10/1/2012
Cibola Valley Conservation Area	Phase 04E	0125	88	RED	No	2/22/2013	10/1/2012
Cibola Valley Conservation Area	Phase 04E	0177	88	RED	No	2/25/2013	10/25/2012
Cibola Valley Conservation Area	Phase 04E	0232	88	RED	No	2/25/2013	10/25/2012
Cibola Valley Conservation Area	Phase 04E	0274	88	RED	No	2/25/2013	10/24/2012
Cibola Valley Conservation Area	Phase 04W	0002	358	ENH	Yes	2/12/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0021	358	ENH	Yes	2/12/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0024	358	ENH	Yes	2/12/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0040	358	ENH	Yes	2/12/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0045	358	ENH	Yes	2/13/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0053	358	ENH	Yes	2/13/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0058	358	ENH	Yes	2/13/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0060	358	ENH	Yes	2/13/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0065	358	ENH	Yes	2/15/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0084	358	ENH	Yes	2/15/2013	10/27/2012
Cibola Valley Conservation Area	Phase 04W	0088	358	ENH	Yes	2/15/2013	10/27/2012
Cibola Valley Conservation Area	Phase 05	0009	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0022	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0034	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0036	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0041	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0043	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0061	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0066	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0069	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0074	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0083	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0087	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 05	0097	359	RED	No	2/21/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0002	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0008	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0013	359	RED	No	2/22/2013	10/24/2012

Area	Site	Section	Bearing	Effort	KusMethod	Date Entered	Date Sampled
Cibola Valley Conservation Area	Phase 06	0023	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0028	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0034	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0054	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0057	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0079	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0081	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0091	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0093	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0102	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0105	359	RED	No	2/22/2013	10/24/2012
Cibola Valley Conservation Area	Phase 06	0108	359	RED	No	2/22/2013	10/24/2012
Palo Verde Ecological Reserve	Phase 01	0001	268	ENH	No	3/1/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 01	0004	268	ENH	No	3/2/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 01	0009	268	ENH	No	3/4/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 01	0015	268	ENH	No	3/4/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 01	0020	268	ENH	No	3/4/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 01	0024	268	ENH	No	3/4/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 01	0034	268	ENH	No	3/4/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 01	0039	268	ENH	No	3/4/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0004	88	ENH	No	3/4/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0012	88	ENH	No	3/4/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0015	88	ENH	No	3/4/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 02	0021	88	ENH	No	3/4/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0026	88	ENH	No	3/4/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 02	0040	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0043	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0045	88	ENH	No	3/5/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 02	0053	88	ENH	No	3/5/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 02	0060	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0062	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0067	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0091	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0093	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0099	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0101	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 02	0109	88	ENH	No	3/5/2013	11/8/2012
Palo Verde Ecological Reserve	Phase 03	0010	88	ENH	No	3/7/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0012	88	ENH	BLANK	BLANK	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0021	88	ENH	No	3/11/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0021	88	ENH	No	3/7/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0026	88	ENH	No	3/7/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0032	88	ENH	No	3/7/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0046	88	ENH	No	3/7/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0052	88	ENH	No	3/7/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0054	88	ENH	No	3/7/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0064	88	ENH	No	3/7/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0066	88	ENH	No	3/7/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0069	88	ENH	No	3/11/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0078	88	ENH	No	3/10/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0085	88	ENH	BLANK	BLANK	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0090	88	ENH	No	3/10/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0100	88	ENH	No	3/10/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0113	88	ENH	No	3/10/2013	11/7/2012

Area	Site	Section	Bearing	Effort	KusMethod	Date Entered	Date Sampled
Palo Verde Ecological Reserve	Phase 03	0115	88	ENH	No	3/11/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0118	88	ENH	No	3/11/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0123	88	ENH	No	3/11/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0127	88	ENH	No	3/11/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 03	0129	88	ENH	No	3/11/2013	11/7/2012
Palo Verde Ecological Reserve	Phase 04	0004	87	ENH	No	3/1/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0022	87	ENH	No	3/1/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0029	87	ENH	No	3/1/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 04	0036	87	ENH	No	3/1/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 04	0043	87	ENH	No	3/1/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0046	87	ENH	No	3/1/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0058	87	ENH	No	3/2/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 04	0079	87	ENH	No	3/2/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0083	87	ENH	No	3/2/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0087	87	ENH	No	3/5/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0093	87	ENH	No	3/5/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 04	0105	87	ENH	No	3/5/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 04	0108	87	ENH	No	3/5/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 04	0113	87	ENH	No	3/5/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0121	87	ENH	No	3/5/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0128	87	ENH	No	3/5/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0134	87	ENH	No	3/5/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0136	87	ENH	No	3/5/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0141	87	ENH	No	3/5/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 04	0146	87	ENH	No	3/5/2013	11/9/2012
Palo Verde Ecological Reserve	Phase 05	0003	87	ENH	No	3/5/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0028	87	ENH	No	3/5/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0032	87	ENH	No	3/6/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0041	87	ENH	No	3/6/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0064	87	ENH	No	3/6/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0074	87	ENH	No	3/6/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0078	87	ENH	No	3/6/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0081	87	ENH	No	3/6/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0107	87	ENH	No	3/6/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0113	87	ENH	No	3/6/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0144	87	ENH	No	3/6/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0146	87	ENH	No	3/6/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0157	87	ENH	No	3/6/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0173	87	ENH	No	3/6/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0176	87	ENH	No	3/6/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0190	87	ENH	No	3/6/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0195	87	ENH	No	3/6/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0206	87	ENH	No	3/8/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0236	87	ENH	No	3/8/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0252	87	ENH	No	3/8/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0264	87	ENH	No	3/8/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0268	87	ENH	No	3/8/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0279	87	ENH	No	3/8/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0287	87	ENH	No	3/8/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0297	87	ENH	No	3/8/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0304	87	ENH	No	3/8/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 05	0312	87	ENH	No	3/8/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 05	0329	87	ENH	No	3/8/2013	11/10/2012
Palo Verde Ecological Reserve	Phase 06	0001	88	RED	No	3/12/2013	11/13/2012

Area	Site	Section	Bearing	Effort	KusMethod	Date Entered	Date Sampled
Palo Verde Ecological Reserve	Phase 06	0004	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 06	0020	88	RED	No	3/12/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0022	88	RED	No	3/12/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0025	88	RED	No	3/12/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0032	88	RED	No	3/12/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0039	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 06	0054	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 06	0058	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 06	0065	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 06	0069	88	RED	No	3/13/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0079	88	RED	No	3/13/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0087	88	RED	No	3/13/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 06	0091	88	RED	No	3/13/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 06	0109	88	RED	No	3/13/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0121	88	RED	No	3/13/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 06	0127	88	RED	No	3/13/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0130	88	RED	No	3/13/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0134	88	RED	No	3/13/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0138	88	RED	No	3/13/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0153	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0163	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0165	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0173	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0184	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0186	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0193	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0197	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0203	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0210	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0228	88	RED	No	3/14/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0257	88	RED	No	3/15/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0267	88	RED	No	3/15/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0275	88	RED	No	3/15/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 06	0282	88	RED	No	3/15/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 06	0286	88	RED	No	3/15/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 06	0289	88	RED	No	3/15/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0297	88	RED	No	3/15/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 06	0305	88	RED	No	3/15/2013	11/11/2012
Palo Verde Ecological Reserve	Phase 06	0318	88	RED	No	3/16/2013	11/12/2012
Palo Verde Ecological Reserve	Phase 07	0002	88	RED	No	3/9/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0005	88	RED	No	3/12/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0013	88	RED	No	3/11/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0020	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0022	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0030	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0035	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0055	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0069	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0076	88	RED	No	3/14/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0082	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0094	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0098	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0106	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0113	88	RED	No	3/13/2013	11/14/2012

Area	Site	Section	Bearing	Effort	KusMethod	Date Entered	Date Sampled
Palo Verde Ecological Reserve	Phase 07	0115	88	RED	No	3/14/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0121	88	RED	No	3/11/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0128	88	RED	No	3/11/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0134	88	RED	No	3/12/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0142	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0154	88	RED	No	3/13/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0162	88	RED	No	3/11/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0164	88	RED	No	3/13/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0170	88	RED	No	3/11/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0182	88	RED	No	3/12/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0189	88	RED	No	3/9/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0193	88	RED	No	3/11/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0198	88	RED	No	3/11/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0201	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0212	88	RED	No	3/11/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0214	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0221	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0226	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0232	88	RED	No	3/12/2013	11/14/2012
Palo Verde Ecological Reserve	Phase 07	0250	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0252	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0258	88	RED	No	3/12/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0265	88	RED	No	3/9/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0268	88	RED	No	3/11/2013	11/13/2012
Palo Verde Ecological Reserve	Phase 07	0285	88	RED	No	3/12/2013	11/13/2012

Appendix IV

2012 Site Reports

Appendix IV-1

Beal Lake Habitat Restoration Demonstration Site

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Report
10/18/12

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Beal Lake Conservation Area
Dates of Survey: October 2, 2012 – October 9, 2012
Surveyors: Matt Grabau (Project Supervisor), Chad McKenna (Data Manager), Will Widener (Field Supervisor), Daniel Bunting, Talise Dow, Cyrus Bullock, Andrew Alderete, Jake Hamm, Jason Harris, Robert Cleveland
Reclamation Observers: Dianne Bangle (COR), Steven Farinella (MSCP IT Specialist), Michelle Reilly (MSCP Application Developer), Sonja Kokos (MSCP Adaptive Management Program Manager)

I Summary of Field Activities

During an initial protocol review session (October 2 - 4, 2012), the project Supervisor, Field Supervisor, and Data Manager met with the COR and reviewed and refined field data collection methods at Beal Lake Conservation Area. An additional crew leader was trained on October 4. The MSCP IT Specialist, MSCP Application Developer, and MSCP Adaptive Management Program Manager were present during portions of this session. Protocols were discussed and demonstrated to facilitate development of database field forms.

During a 4-day field session (October 5-8, 2012) four teams of two field personnel collected vegetation data. Data collection was completed on the morning of October 9 by two teams of two field personnel. An average of approximately 2 plots by each team was completed per day; all the plots within the site were surveyed. Average time of arrival to the site was 0730 hours and average time of departure was 1700 hours. Plot survey efficiency was lower than the anticipated 2.25 plots per 2-person crew per day in 9.5 hours. However, all crew members are now familiar with field protocols, and it is anticipated that survey efficiency will increase for remaining 2012 surveys. Weather conditions consisted of abundant sunshine and temperatures in the 90's (degrees Fahrenheit) throughout the survey, much lower than temperatures during 2011 surveys. No major obstacles or unusual observations occurred during the survey. Existing center posts and corners (1/2" re-bar) of each primary plot were marked with blue and white striped flagging to facilitate future plot setup. Flagging of various colors from 2011 was removed.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- Initially, minor clarifications and revisions were required for the field methods and field forms.
- Two large rattlesnakes (*Crotalus* sp.) were spotted, one within plot BLCA_A_0100 and one within plot BLCA_D_0098, during the field surveys.
- Plots dominated by thick mesquite (*Prosopis pubescens* and *Prosopis glandulosa*) and arrowweed (*Pluchea sericea*) slowed down plot set-up and data collection.

III Habitat

Habitat types encountered and surveyed at the site include:

- Plots with a dominant cottonwood (*Populus fremontii*) overstory with mixed mesquite understory and scattered willows (*Salix* sp.).
- Plots with dominant mesquite overstory with dominant arrowweed understory with scattered willows and baccharis (*Baccharis* sp.).
- Plots dominated by arrowweed with scattered mesquite, willow, and baccharis.
- Very few plots within the site contain herbaceous species or tamarix (*Tamarix* sp.).
- No water features within the plots.

IV Other Considerations

Other considerations for the field site which may require swift management action include:

- Buffelgrass (*Pennisetum ciliare*), observed in plot BLCA_N_0091 during 2011, was not observed during 2012 surveys.
- Abundant sign (prints, scat, and odor) of feral pigs was observed throughout the project area, with extensive soil and vegetation disturbance apparent in some areas (one feral pig was spotted within the project area).
- Plots BLCA_M_0048 and BLCA_K_0056 overlap with areas cleared of vegetation for mist net placement.
- Plots that were partially flooded during the 2011 survey as a result of leaks in irrigation outlets were not flooded during the 2012 survey.

Appendix IV-2

Bill Williams River National Wildlife Refuge; Reference Site

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Reports
10/23/12

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Bill Williams River National Wildlife Refuge
Dates of Survey: October 15, 2012 – October 18, 2012
Observers: Will Widener (Field Supervisor), Daniel Bunting, Talise Dow, Cyrus Bullock, Robert Cleveland, Andrew Alderete, Jake Hamm, Jason Harris

I Summary of Field Activities

During a four day field session (October 15-18, 2012), four teams of two field personnel completed vegetation data collection at the Bill Williams River National Wildlife Refuge (BWRNWR). An average of approximately 2 ¼ plots by each team was completed per day as anticipated. All 36 plots within the site (eighteen within BWRE1 and 18 within BWRE2) were surveyed. The team camped just outside the boundary of the refuge within Bureau of Land Management (BLM) property and hiked to the monitoring plots within the refuge. Time of arrival to the plots varied depending on hiking distance and ability to locate the center of the plots within dense vegetation. An average work day, including hiking to and from the plots and data collection, lasted approximately 10 hours. Weather conditions consisted of sunshine and temperatures in the 90's (degrees Fahrenheit) for the duration of the survey (similar to the 2011 survey).

The center of each plot was marked with a wooden stake (1"x2"x36") with blue and white striped flagging. The center of plots BWRE_ER_0010 and 0022 occur within the river; thus, the center stakes are likely to wash away during high water events. Plots BWRE_ER_0019 and 0023 were marked with a large fallen tree branch pounded into the ground and flagged, instead of a stake. Plot center for BWRE_ER_0019 is within a trail/intermittent wash and plot center for BWRE_ER_0023 is within a large pile of woody debris.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- Numerous water crossings – water levels within the site during the 2012 survey were higher than during the 2011 survey due to rain events which occurred prior to the survey.
- Plots dominated by thick mesquite (*Prosopis pubescens* and *Prosopis glandulosa*).
- Difficult hiking conditions at times.
- Limited access to plots.
- Areas dominated by salt cedar (*Tamarix* sp.), usually containing extensive dead and downed woody debris, made passage within the refuge somewhat difficult.

III Habitat

Habitat types encountered and surveyed at the site include:

- Plots with a dominant cottonwood (*Populus fremontii*) overstory with mixed mesquite understory and scattered Goodding's willows (*Salix gooddingii*).
- Plots dominated by mesquite.
- Few plots within the site contain herbaceous species and salt cedar.
- Numerous plots included water features such as the Bill Williams River, backwater channels, beaver ponds, and/or wetlands.

IV Other Considerations

Other considerations for the field site which may require swift management action include:

- Accumulation of much dead and down woody debris may pose a fire risk within the refuge.
- Spanish false fleabane (*Pulicaria paludosa*), a non-native species with the potential to spread rapidly if not managed, was identified within plots BWRE_CP_0005, BWRE_ER_0010, BWRE_ER_0026, BWRE_MW_0031, and BWRE_MW_0034. Spanish false fleabane is currently not considered a prohibited, regulated and/or restricted noxious weed in Arizona.
- Wild burros and cattle sign were observed within and adjacent to the site, and are likely to cause soil and vegetation disturbance.

Appendix IV-3

Cibola National Wildlife Refuge Unit #1

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Reports
1/10/13

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Cibola National Wildlife Refuge Unit 1 Conservation Area
Dates of Survey: November 28 – December 2, 2012
Observers: Will Widener (Supervisor), Talise Dow, Cyrus Bullock, Andrew Alderete, Daniel Bunting, Robert Cleveland, Jason Harris, Matthew Gautreaux

I Summary of Field Activities

During a five day field session (November 28 through December 2, 2012), four teams of two field personnel completed vegetation data collection at the Cibola National Wildlife Refuge (NWR) Unit #1. Vegetation surveys within the refuge consisted entirely of "intensive plots" (i.e. full vegetation monitoring protocol); the survey did not include any "reduced effort plots". The project site consists of 4 distinct units:

- CW North (CWN)
- Nature Trail (NT)
- Mass Transplanting (MT)
- Crane Roost (CR)

Two additional riparian areas exist within Cibola NWR Unit #1, but were not included in survey efforts—"Seed Feasibility Study" and "Cottonwood Genetics Study."

A total of 62 intensive plots were surveyed during the 2012 sampling period within the 4 units. An average of approximately 3 plots was completed by each team per day, as anticipated.

A majority of the plots were previously marked with a center T- post, an engraved identification cap, and ½ inch rebar in two corners. During this 2012 field session, field crews installed ½ inch rebar and flagging at all four plot corners. At the request of Cibola NWR personnel, flagging from previous surveys was removed and replaced with a single strip of blue/white striped flagging. **Exceptions to this plot marking include**:

- Several plots within the Nature Trail were not previously permanently marked; during the 2012 field session, the majority of plots within the Nature Trial were marked with T-posts/engraved caps in the center and ½ inch rebar and flagging in the four corners. The exceptions to this are:
    - Plots located within view of the trail were not marked.
    - Plots NWR1-NT-0005, 0025, and 0046 require center T-posts and engraved caps during 2013 surveys.
    - Plots NWR1-NT-0033 and 0055 require engraved caps during 2013 surveys.
- Within the Crane Roost, plots NWR1-CR-0006, 0010, 0031, 0057, 0140, 0157, and 0159 require center T-posts.

Crews performed Kus method surveys for vegetation volume within the Nature Trail (all 25 plots) in addition to the "Hits-to-Pole." Kus surveys were conducted at the D1 collection point of each plot (the Kus apparatus was centered at the plot centers). Foliar cover was estimated in 2m by 2m by 1m (length by width by height) stacked prisms in cover classes: <1%, 1-10%, 11-25%, 26-50%, 51-75%, 76-90% and >90% at each 1-meter height interval. The Kus surveys were led by the field supervisor, Will Widener, with one crew member assisting in determination of foliar cover classes for each interval.

Weather consisted of sunny conditions with temperatures in the upper 70's and lower 80's (degrees Fahrenheit), much warmer than during the 2011 survey.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- Plots dominated by thick seep willow (*Baccharis salicifolia*) and/or screwbean and honey mesquite (*Prosopis pubescens* and *Prosopis glandulosa*) within the Nature Trail.
- Difficulty in finding some plots. It is unclear if they were inconsistently marked or if incorrect coordinates were recorded. Although most center caps were found, others could not be located; additionally, t-posts were missing in several plots within the Nature Trail and Crane Roost. Note - This obstacle will be alleviated during future surveys due to additional marking of plot centers and corners during the 2012 field session as described in Section I.

III Habitat

Habitat types encountered and surveyed at the site include:

- CW North is dominated by cottonwood (*Populous fremontii*) overstory with little understory vegetation.
- Plots within the Nature Trail are dominated by cottonwood, Goodding's willow (*Salix gooddingii*), and/or seep willow with scattered mesquite (honey and screwbean) and Johnson grass (*Sorghum halepense*).
- Plots within the Crane Roost are dominated by cottonwood, Goodding's willow, and/or mesquite (honey and screwbean). Vegetation stress was apparent in some areas of the Crane Roost.
- Plots within Mass Transplanting are dominated by cottonwood.
- No noxious weeds or Spanish false fleabane (*Pulicaria paludosa*) were identified within any of the plots.
- Tamarix (*Tamarix* sp.) was identified within a few plots, but was not prevalent within the site.

IV Other Considerations

Other considerations for the field site which may require swift management action include:

- None

Appendix IV-4

Cibola Valley Conservation Area (CVCA)

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Reports
11/1/12

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Cibola Valley Conservation Area (CVCA)
Dates of Survey: October 24, 2012 – October 28, 2012
Observers: Will Widener (Field Supervisor), Talise Dow, Cyrus Bullock, Andrew Alderete, Daniel Bunting, Robert Cleveland, Jason Harris, Matthew Gautreaux

I Summary of Field Activities

During a five day field session (October 24-28, 2012), four teams of two field personnel completed vegetation data collection at the Cibola Valley Conservation Area (CVCA). Vegetation surveys included "intensive plots" (i.e. full vegetation monitoring protocol) for phases 01, 02, 03, and 04W, and "reduced effort plots" for phases 04E, 05, and 06, where site management results in disturbance of vegetation between planted rows. An average of approximately 4.5 intensive plots and approximately 5.5 reduced effort plots were completed by each team per day, which was higher than the anticipated 3.75 and 5.25 intensive and reduced effort plots per team per day, respectively. A total of 62 intensive plots and 34 reduced effort plots were surveyed during this 2012 monitoring effort.

A majority of the plots were previously staked with a center T- post and four corners with ½ inch rebar. During this 2012 field session, ½ inch rebar was installed at all four plot corners within phase 04W because this phase will no longer be mowed. **Exceptions to this plot staking include**:

- The center points of a majority of phase 04W, 05 and 06 plots were previously marked with T-posts and engraved caps. Plots with center points within mowed rows are not marked because of threat to plowing equipment. None of the plot corners in these phases were marked during the 2012 survey by request.

Crews performed Kus method surveys for vegetation volume in CVCA Phases 03 and 04W in addition to the "Hits-to-Pole." Kus surveys were conducted at the D1 collection point of each plot (the Kus apparatus was centered at the plot centers). Foliar cover was estimated in each 2m by 2m by 1m (length by width by height) stacked prisms in cover classes: <1%, 1-10%, 11-25%, 26-50%, 51-75%, 76-90% and >90% at each 1-meter height interval. The Kus surveys were led by the field supervisor Will Widener with three crew members assisting in determination of foliar cover classes for each interval while learning this new method.

Weather consisted of sunny conditions and temperatures in the upper 80's (degrees Fahrenheit) during the duration of the survey with gusty winds during two of the days. Weather conditions were similar to the 2011 survey.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- A rattlesnake (*Crotalus* sp.) was observed within phase 06.
- Plots that were flooded during the 2011 survey as a result of irrigation were not flooded during the 2012 survey.
- Hunters were observed at the site during 2012 surveys. When present, crews must take additional safety precautions.

III Habitat

Habitat types encountered and surveyed at the site include:

- Phase 01 and 02 plots are dominated by cottonwood (*Populus fremontii*), Gooding's willow (*Salix gooddingii*), and/or coyote willow *(Salix exigua*).

- Phase 03 plots are dominated by cottonwood with one plot (CVCA_03_0101) dominated by honey mesquite (*Prosopis glandulosa*).
- Phase 04W, 04E, 05, and 06 plots are dominated by honey mesquite and quail bush (*Atriplex lentiformis*), quail bush seedlings were prevalent within these areas.
- Tamarix (*Tamarix* sp.) and arrowweed (*Pluchea sericea)* was identified within a few plots, but was not prevalent within the site.
- Salt heliotrope (*Heliotropium curassavicum*) was present but not prevalent within the site.
- Unknown vegetation species observed within the site include:

AREA	Site	Section	Name Given in Field	Collector	Identified to…
CVCA	02	0052	Setaria (?)	TD/JH	Pending
CVCA	05	0034	Che 1	CB/AA	Chenopodium sp.
CVCA	05	0036	Che 1	TD/JH	Chenopodium sp.
CVCA	06	0008	UNKN 4	CB/AA	Pending
CVCA	06	0028	Che sp.	NC	Chenopodium sp.
CVCA	06	0028	UNKN 5	CB/AA	Leptochloa fusca
CVCA	06	0034	UNK PHY (nightshade)	DB/RC	Pending
CVCA	06	0081	UNKN 5	CB/AA	Leptochloa fusca
CVCA	06	0091	EUP sp.	DB/RC	Chamaesyce sp.
CVCA	06	0091	UNK Mallow	DB/RC	Pending
CVCA	06	0093	93 Unk 2 (Pectis?)	DB/RC	Pending
CVCA	06	0093	EUP sp.	DB/RC	Chamaesyce sp.
CVCA	06	0102	Chenopodium sp.	NC	Pending
CVCA	06	0102	UNKN 5	CB/AA	Leptochloa fusca
CVCA	06	0102	UNKN 5	CB/AA	Leptochloa fusca
CVCA	06	0105	UNKN 6	CB/AA	Pending
CVCA	04W	0045	Unknown 7	CB/AA	Pending

IV Other Considerations

Other considerations for the field site which may require management action include:

- Morning glory (*Ipomoea purpurea*), a noxious weed species with the potential to spread rapidly if not managed, was identified throughout the site and was especially abundant within CVCA_01_0151 and CVCA_02_0054. *Ipomoea purpurea* is a prohibited noxious weed in Arizona.
- Mowing of rows between the trenches at the mesquite plots (Phase 04W, 04E, 05 and 06) possibly disturbs habitat for some of the target species for the MSCP. Additionally, salt heliotrope appears to prefer these flat sandy rows in between the trenches and does not grow as well in the trenches. Thus, mowing likely reduces the abundance of salt heliotrope at the site.

Appendix IV-5

Palo Verde Ecological Reserve

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Reports
1/9/13

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Palo Verde Ecological Reserve
Dates of Survey: November 7-14, 2012
Observers: Will Widener (Field Supervisor), Talise Dow, Cyrus Bullock, Andrew Alderete, Daniel Bunting, Robert Cleveland, Jason Harris, Matthew Gautreaux

I Summary of Field Activities

During an eight day field session (November 7-14, 2012), four teams of two field personnel completed vegetation data collection at the Palo Verde Ecological Reserve (PVER). Vegetation surveys included "intensive plots" (i.e. full vegetation monitoring protocol) for phases 01, 02, 03, 04 and 05, and "reduced effort plots" for recently-planted phases 06, and 07 (planted in 2011 and 2012, respectively). An average of approximately 4 intensive plots and approximately 6.5 reduced effort plots were completed by each team per day, approximately equal to the anticipated 4.25 and 6.25 plots per day. A total of 95 intensive plots and 80 reduced effort plots were surveyed during this 2012 monitoring effort.

A majority of the plots were previously staked with a center T-post, engraved signature cap, and four corners with ½ inch rebar. During this CY 2012 field session, T-posts and engraved signature caps, as well as ½ inch rebar and flagging were installed at all four plot corners within phase 07. Additional rebar was placed at corners of plots that were not marked during the 2011 field season.

Weather consisted of mostly sunny conditions and temperatures in the 70's (degrees Fahrenheit) during the duration of the survey with gusty winds during two of the days and light rain showers during one day. Weather conditions were generally cooler than during the 2011 survey.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- Plots that were flooded during the 2011 survey as a result of irrigation were not flooded during the 2012 survey. Thus, irrigation-related flooding did not delay survey efforts.
- Hunters were observed at the site during 2012 surveys. When present, crews must take additional safety precautions.
- Previously–marked plot corners that were not on bearing were moved to the appropriate locations, as indicated on respective datasheets.
- Revised reduced effort datasheets provided by Reclamation were utilized for phases 06 and 07. However, due to high numbers of trees with identical data (e.g. DBH of 0.5 cm in Height Class 1), crew leaders determined that a dot count of individuals by species in each DBH and size class greatly increased survey efficiency. The Project Supervisor approved this procedure. Dot count tables were placed on the back of the appropriate datasheet. We recommend amending the current reduced effort datasheets (for recently-planted phases) to incorporate this data recording method.

III Habitat

Habitat types encountered and surveyed at the site include:

- Plots with a dominant cottonwood (*Populous fremontii*) overstory with scattered coyote and Gooding's willow (*Salix exigua* and *S. gooddingii*, respectively).
- Plots with a mix of cottonwood and willows (Gooding's and coyote willow).
- Plots dominated by cottonwood.

- Plots dominated by willows (both species).
- Plots dominated by quailbush (*Atriplex lentiformis*).
- Plots with an understory dominated by alfalfa (*Medicago sativa*).
- Plots with variable cover of Bermuda grass (*Cynodon dactylon*).
- A non-native plant of interest, Spanish false fleabane (*Pulicaria paludosa*), which may spread throughout the site if not managed, was identified within PVER_06_0001 as well as within corridors (i.e. roads, canal right-of-ways) throughout the site.
- Mesquite (*Prosopis glandulosa*) and arrowweed (*Pluchea sericea)* were identified within a few plots, but were not prevalent within the site.
- Unknown vegetation species observed within the site include:

AREA	Site	Section	Name Given in Field	Collecter	Identified to…
PVER	05	0206	Unknown 1	DB/MG	Pending
PVER	06	0001	Unk. 8	AA/CB	Pending
PVER	06	0001	Unk. 10	AA/CB	Pending
PVER	06	0058	Unk. 9	AA/CB	Pending
PVER	06	0087	Unk. 9	AA/CB	Pending
PVER	06	0076	Unk. 11	AA/CB	Pending

IV Other Considerations

Other considerations for the field site which may require swift management action include:

- Monitoring population trends of non-native Spanish false fleabane.

Appendix V

2012 Plot Location Maps

Appendix V-1

Beal Lake Conservation Area Map

Legend

- 2012 Vegetation Survey - Primary Plots
- Beal Fields (Site Name Labeled)

2012 Vegetation Monitoring Plots: Beal Lake Conservation Area (BLCA)

AREA = BLCA
SITE = Field Name

0 500 1,000 Feet

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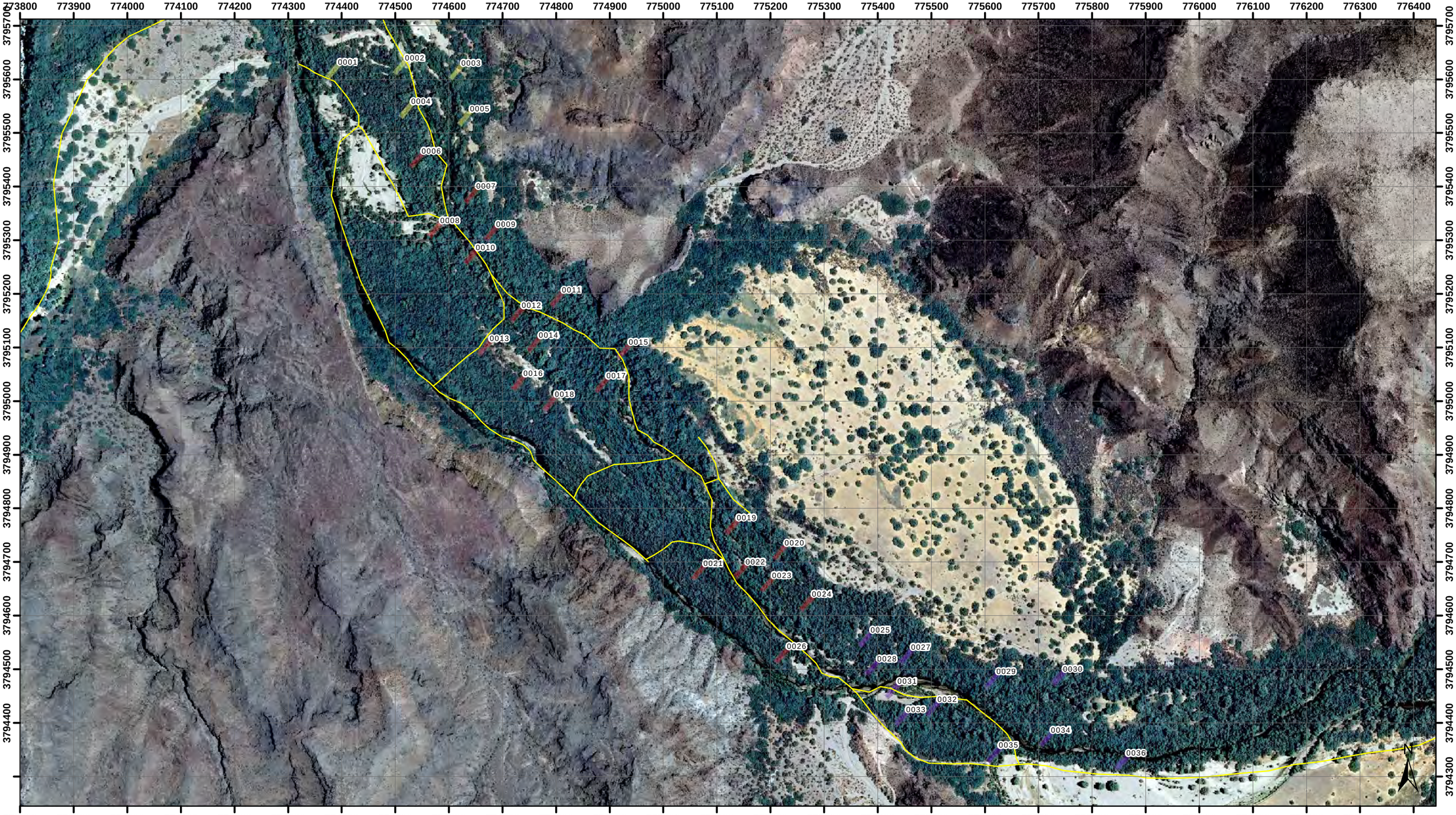
Map created by Chad McKenna of GeoSystems Analysis, Inc. on September 27, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Appendix V-2

Bill Williams River East Maps



Legend

Trails

Site

Cougar Point

Esquerra Ranch

Mineral Wash

2012 Vegetation Monitoring Plots: Bill WIlliams River East - All Sites

AREA = Bill Williams River East
SITE = ALL SITES (see detailed maps)
BEARING = 40

0 500 1,000 Feet

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Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 11, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Bill WIlliams River East - Cougar Point

AREA = Bill Williams River East
SITE = Cougar Point
BEARING = 40

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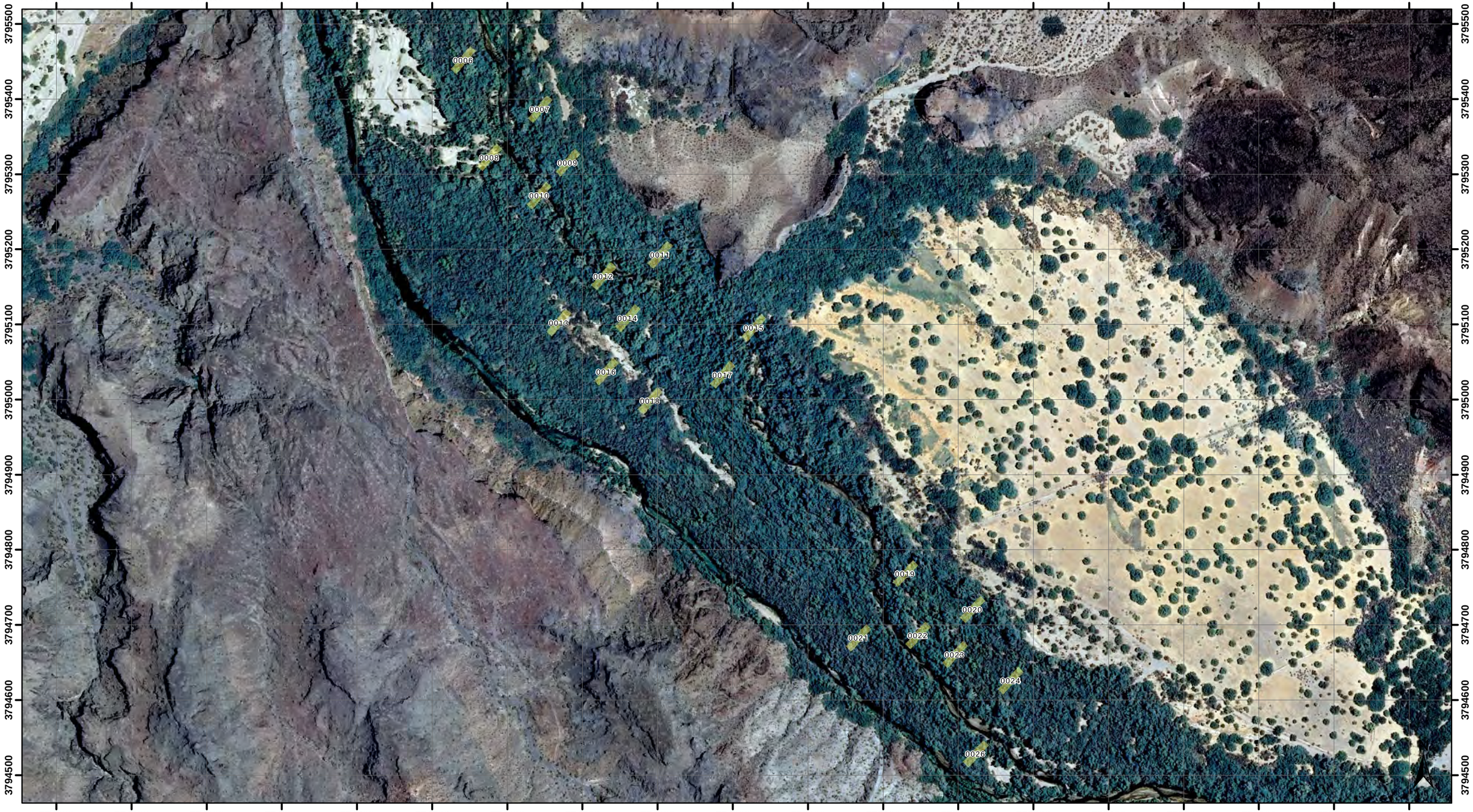
Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 11, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.



Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Bill WIlliams River East - Esquerra Ranch

AREA = Bill Williams River East
SITE = Esquerra Ranch
BEARING = 40

0 500 1,000 Feet

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Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Bill WIlliams River East - Mineral Wash

AREA = Bill Williams River East
SITE = Mineral Wash
BEARING = 40

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Appendix V-3

Palo Verde Ecological Reserve Maps

Legend

2012 Vegetation Survey - Primary Plots

PVER Phases

1 2 3 4 5 6 7

2012 Vegetation Monitoring Plots:
Palo Verde Ecological Reserve -
All Phases

AREA = PVER
SITE = All Sites
BEARING = Varies by Site

0 1,000 2,000 Feet

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Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

728800 728900 729000 729100 729200 729300 729400

3730700 3730600 3730500 3730400

0009 0004 0001 0020 0015 0024 0034 0039

N

728800 728900 729000 729100 729200 729300 729400

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 01

AREA = PVER
SITE = Phase 01
BEARING = 268

0 250 500 Feet

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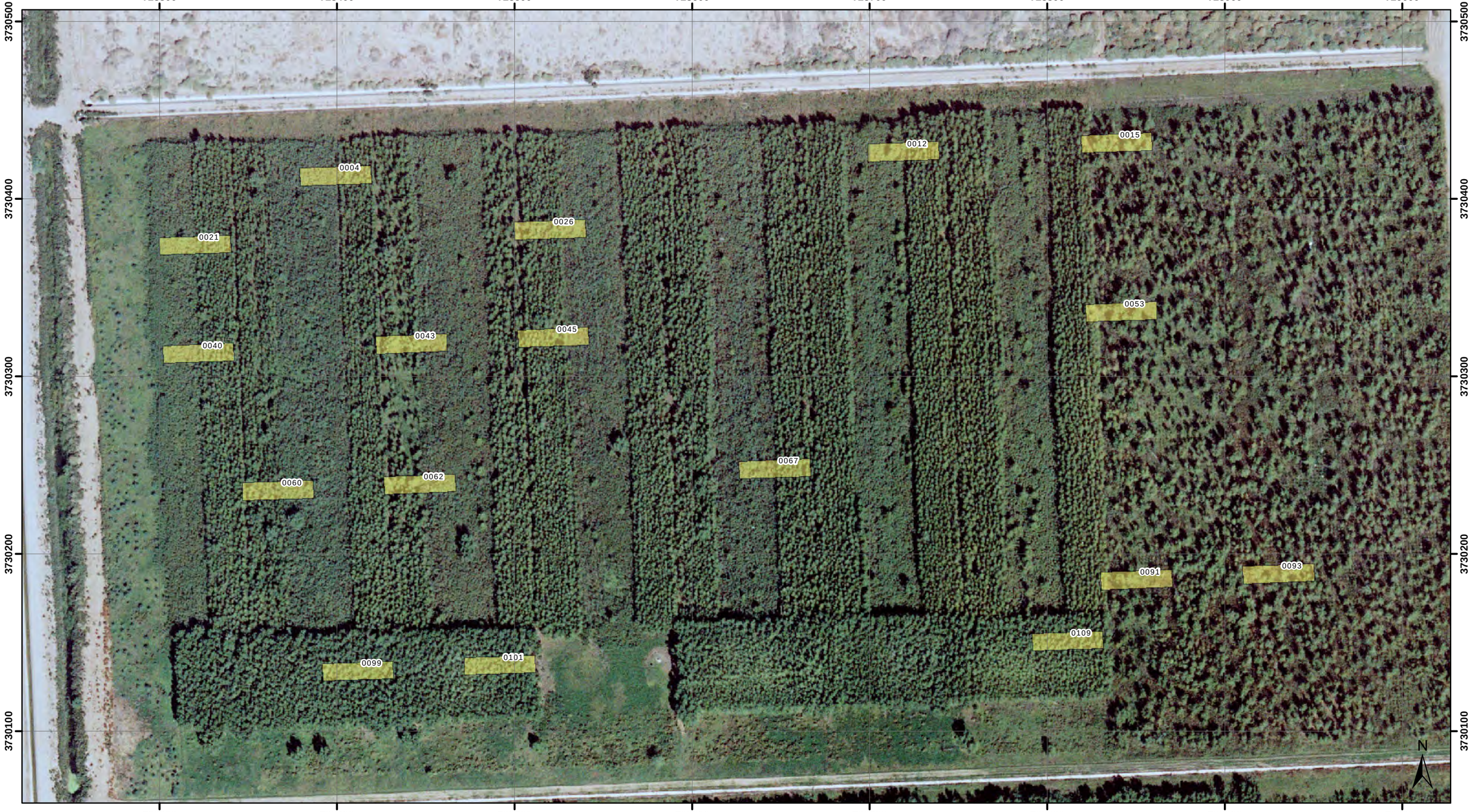
Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.



Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 02

AREA = PVER
SITE = Phase 02
BEARING = 88

0 250 500 Feet

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Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

728200 728300 728400 728500 728600 728700 728800 728900 729000 729100

3730100 3730000 3729900 3729800 3729700 3729600

0010 0012 0021 0026 0032 0046 0052 0054 0064 0066 0069 0078 0085 0090 0100 0113 0115 0118 0121 0123 0127 0129

N

728200 728300 728400 728500 728600 728700 728800 728900 729000 729100

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 03

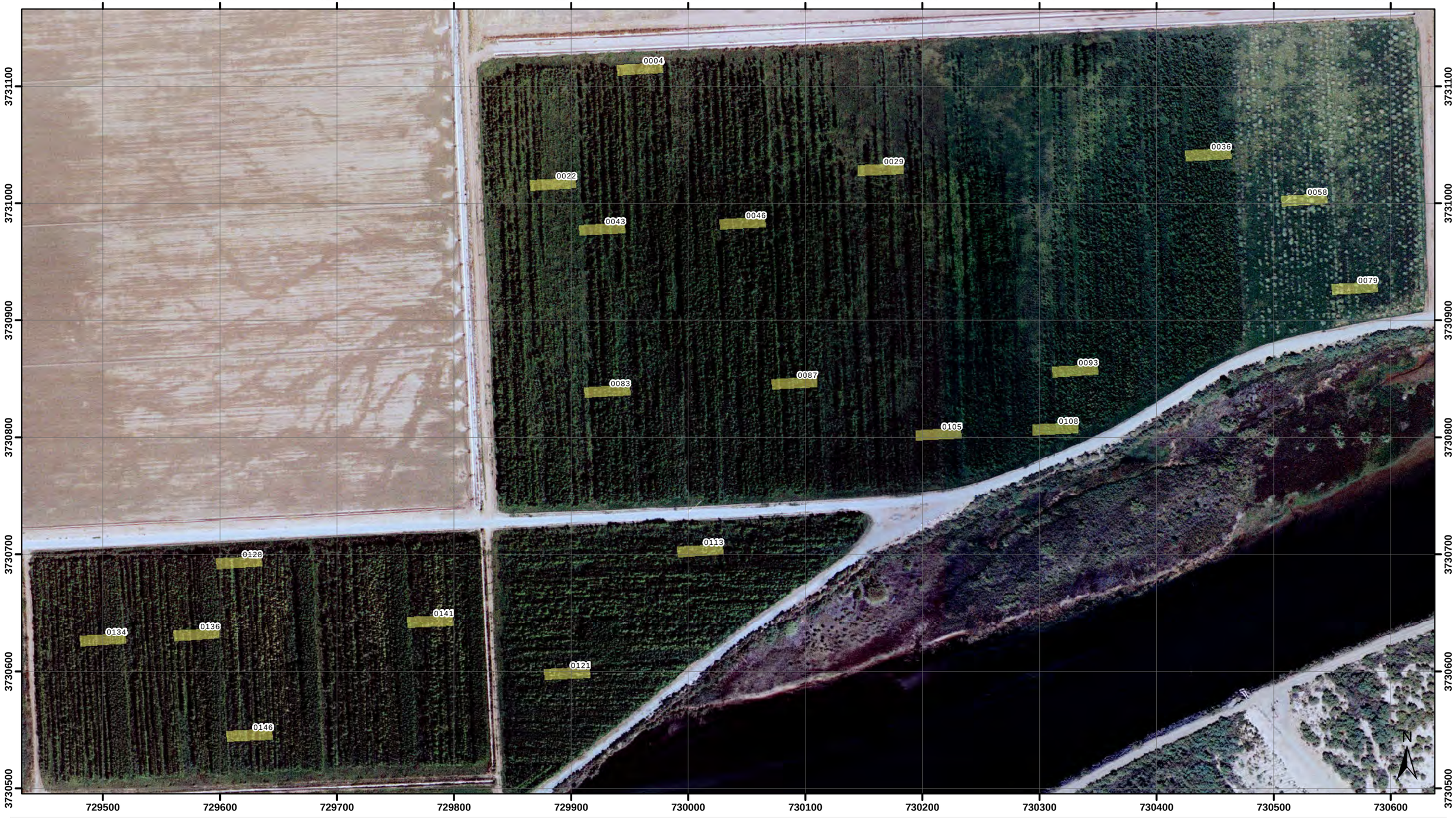
AREA = PVER
SITE = Phase 03
BEARING = 88

0 250 500 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.



Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 04

AREA = PVER
SITE = Phase 04
BEARING = 87

0 250 500 1,000 Feet

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Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

730300 730400 730500 730600 730700 730800 730900 731000 731100 731200 731300 731400 731500 731600 731700 731800 731900 732000 732100 732200

3732000 3731900 3731800 3731700 3731600 3731500 3731400 3731300 3731200 3731100 3731000 3730900

0003 0028 0032 0041 0064 0074 0078 0081 0107 0113 0144 0146 0157 0173 0176 0190 0195 0206 0236 0252 0264 0268 0279 0287 0297 0304 0312 0329

N

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 05

AREA = PVER
SITE = Phase 05
BEARING = 87

0 250 500 1,000 1,500 Feet

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Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 06

AREA = PVER
SITE = Phase 06
BEARING = 88

0 250 500 1,000 Feet

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Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 07

AREA = PVER
SITE = Phase 07
BEARING = 88

0 250 500 1,000 Feet

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Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Appendix V-4

Cibola Valley Conservation Area Maps

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Cibola Valley Conservation Area - All Sites

AREA = CVCA
SITE = ALL SITES (see detailed maps)
BEARING = VARIES BY PHASE

0 500 1,000 2,000 Feet

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Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 21, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Cibola Valley Conservation Area - Phase 01

AREA = CVCA
SITE = Phase 01
BEARING = 87 degrees

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Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 21, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Cibola Valley Conservation Area - Phase 02

AREA = CVCA
SITE = Phase 02
BEARING = 269 degrees

0 250 500 Feet

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Parametrix
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Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 21, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Cibola Valley Conservation Area - Phase 03

AREA = CVCA
SITE = Phase 03
BEARING = 179 degrees

0 250 500 Feet

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Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 21, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Cibola Valley Conservation Area - Phase 04E

AREA = CVCA
SITE = Phase 04E
BEARING = 88 degrees

0 250 500 Feet

GSA GeoSystems Analysis, Inc.

Parametrix
ENGINEERING, PLANNING, ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 21, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

714250

714500

3699000

3699000

3698750

3698750

3698500

3698500

0045

0024

0058

0084

0060

0040

0088

0002

0053

0065

0021

N

714250

714500

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Cibola Valley Conservation Area - Phase 04W

AREA = CVCA
SITE = Phase 04W
BEARING = 358 degrees

0 250 500 Feet

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Parametrix
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Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 21, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

714750

715000

3699250

3699000

3698750

0083

0066

0087

0034

0069

0036

0022

0074

0009

0041

0043

0097

0061

N

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Cibola Valley Conservation Area - Phase 05

AREA = CVCA
SITE = Phase 05
BEARING = 359 degrees

0 250 500 Feet

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Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 21, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Appendix V-5

Cibola National Wildlife Refuge Maps

713500 713750 714000 714250 714500 714750 715000 715250 715500 715750 716000 716250 716500 716750 717000 717250

3695250 3695000 3694750 3694500 3694250 3694000 3693750 3693500

9

CW North

Mass Transplanting

Nature Trail

Crane Roost

N

Legend

- 2012 Vegetation Survey - Primary Plots
- Site Boundaries

2012 Vegetation Monitoring Plots:
Cibola National Wildlife Refuge Unit 1 - All Sites

AREA = CNU1
SITE = ALL SITES (see detailed maps)
BEARING = VARIES BY PHASE

0 500 1,000 2,000 Feet

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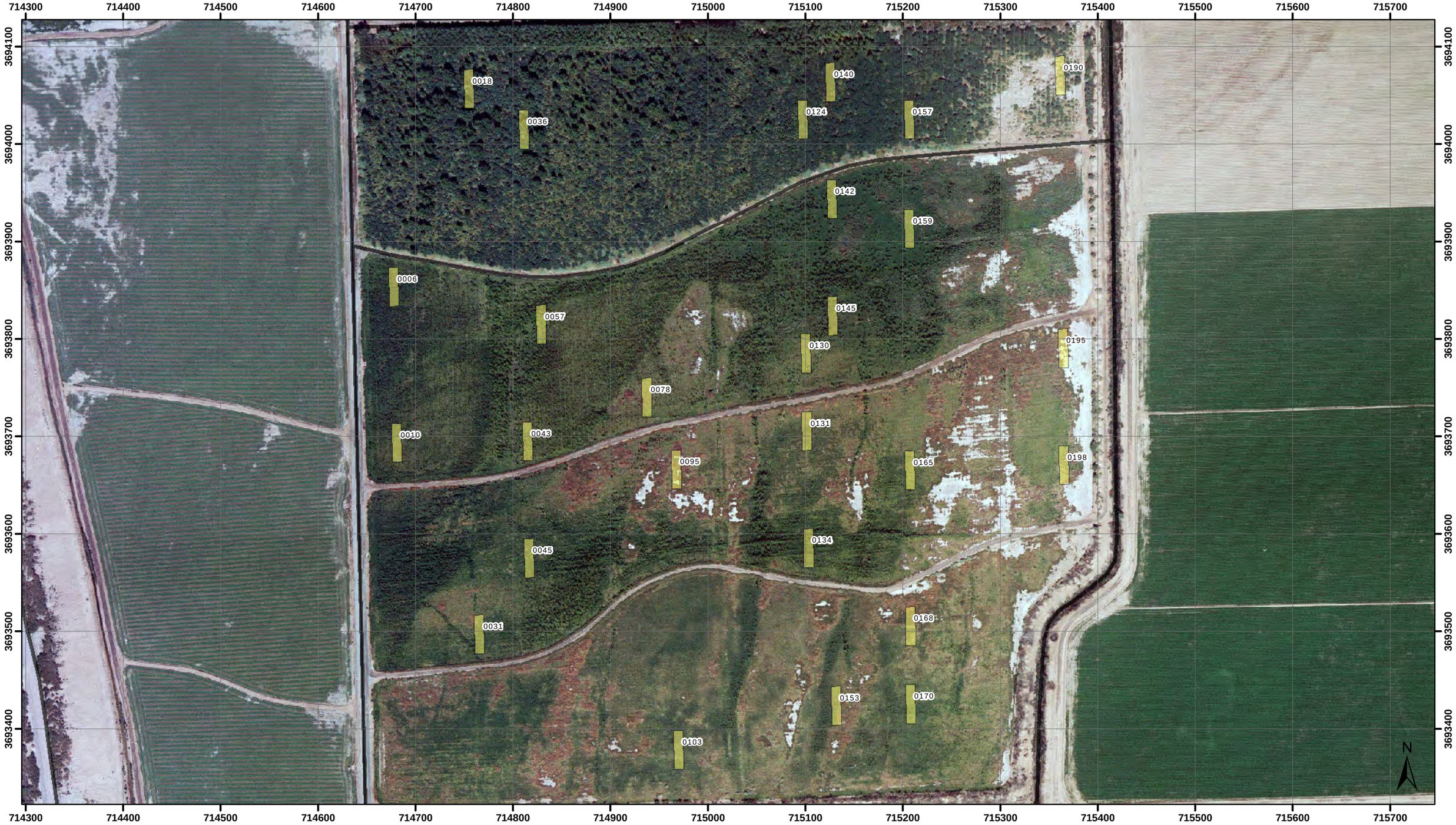
Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.



Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Cibola National Wildlife Refuge Unit 1 -Crane Roost

AREA = CNU1
SITE = Crane Roost
BEARING = 179

0 250 500 1,000 Feet

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Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

715800 715900 716000 716100 716200

3695300

3695200

0020
0007
0011
0003
0018
0005

N

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots:
Cibola National Wildlife Refuge Unit 1 - CW North

AREA = CNU1
SITE = CW North
BEARING = 359

0 125 250 Feet

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Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

715400 715500 715600 715700 715800 715900

3694400 3694300 3694200 3694100

0012 0014 0019 0023 0027 0034

N

715400 715500 715600 715700 715800 715900

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots: Cibola National Wildlife Refuge Unit 1 - Mass Transplanting

AREA = CNU1
SITE = Mass Transplanting
BEARING = 359

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Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

0 250 500 Feet

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2012 Vegetation Survey - Primary Plots

2012 Vegetation Monitoring Plots: Cibola National Wildlife Refuge Unit 1 - Nature Trail

AREA = CNU1
SITE = Nature Trail
BEARING = 359

0 250 500 Feet

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Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on October 26, 2012. Grid projection = UTM, NAD 1983, Zone 11N, meters.