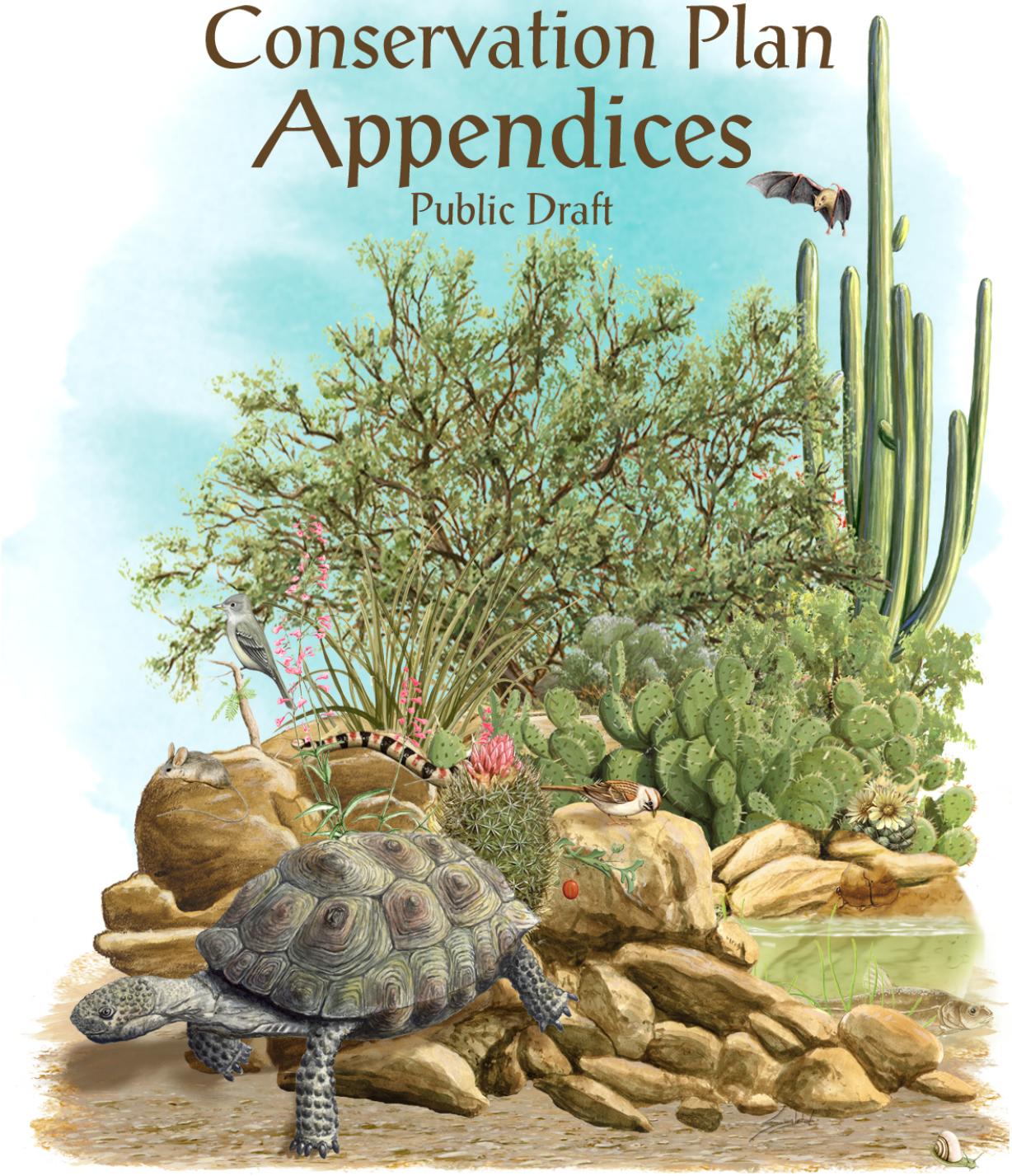
Pima County

# Multi-species Conservation Plan Appendices

Public Draft



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# Appendix A. Covered Species accounts

This appendix provides detailed species account information for the Covered Species. Information includes the conservation status of each species, its global and local distribution, and key natural-history information including threats that affect the species. The appendix also summarizes the projected take and anticipated mitigation for the MSCP. Finally, the appendix includes the conservation commitments that Pima County is agreeing to implement to avoid, minimize, and mitigate for Covered Activities. The proposed management activities in this appendix are in addition to the numerous avoidance, minimization, and mitigation tools that are covered in detail throughout the MSCP. For purposes of brevity, only those management activities that are specific to a particular species (or group of species) are highlighted in this appendix. Proposed monitoring commitments are discussed in detail in Appendix O.

For all species, Pima County will encourage the research community to gain a better understanding of species status and ecology, especially: abundance, distribution, habitat use and associations, and movement patterns; both within the County's preserve system as well as other areas of Pima County and southern Arizona. As part of our monitoring commitment, Pima County will develop a database to store observations of Covered Species and track other efforts that are monitoring or researching the species.

### Calculation of Habitat Take and Mitigation Acres

The following species accounts hightlight the amount of habitat lost and mitigation that is modeled to occur during the course of the 30-year permit. Acres of habitat lost are calculated using the growth model in Appendix D. The acres of mitigation that occurs in current (October 2012) portfolio of mitigation lands is calculated using the 25% credit for State Trust lands under lease by Pima County (see Table 4.4 for the MSCP for more information).

### Conservation rankings

In the following species accounts, conservation rankings are noted, which were taken from the Priority Ranking Definitions compiled by the Arizona Game and Fish Department Heritage Data Management System (Arizona Game and Fish Department 2009b).

Global Rank: priority ranking (1 to 5) based on the number of occurrences throughout the entire range of the element (species or subspecies)

G1 Very Rare: 1 to 5 occurrences or very few individuals or acres.
G2 Rare: 6 to 20 occurrences or few individuals or acres.
G3 Uncommon or Restricted: 21 to 100 occurrences, rather rare throughout a fairly wide range, or fairly common in a rather restricted range.
G4 Apparently Secure: more than 100 occurrences, though it could be quite rare in some parts of its range.
G5 Demonstrably secure: more than 100 occurrences.

State Rank: priority ranking (1 to 5) based on the number of occurrences of the species in Arizona.

S1 Very Rare: 1 to 5 occurrences in Arizona or very few individuals or acres within the state.
S2 Rare: 6 to 20 occurrences in Arizona or few individuals or acres within the state.
S3 Uncommon or Restricted: 21 to 50 occurrences in Arizona, either rather rare throughout a fairly wide range or fairly common in a rather restricted range within the state.
S3S4 Fairly Common: 51 to 100 occurrences and found over a rather wide range within Arizona.
S4 Apparently Secure: more than 100 occurrences within Arizona, though it could be quite rare in some parts of the state.
S5 Demonstrably secure: more than 100 occurrences within Arizona.

# Plants

## Pima Pineapple Cactus (*Coryphantha scheeri* var. *robustispina*)

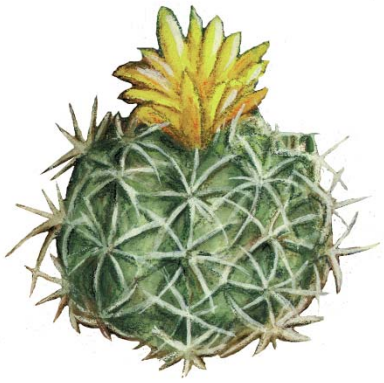
### Conservation Status

Endangered Species Act Status: Listed as endangered by USFWS in 1993.

State: Arizona Native Plant Law, Highly Safeguarded.

Other: U.S. Forest Service Sensitive; protected from international trade by CITES.

Rankings: G4, S2



### Description

*Coryphantha scheeri* var. *robustispina* is a succulent perennial that is hemispherical or cylindroid in shape and up to 4.0-18 inches (10.0-46.0 cm) tall and 3.0-7.0 inches (8.0-18.0 cm) in diameter. The spines are very stout and are straw-colored when young, but blacken with age (Ecosphere Environmental Services Inc. 1992). Each spine cluster has 1 strong central spine that is usually curved or hooked at the abruptly narrowed tip. There are 6 radial spines in young plants, and these increase to 10 to 15 in older plants. The spines vary from 0.76-0.92 inch (19.0-23.0 mm) long and the upper ones are more slender than the lower ones. The areoles are densely covered with deciduous woolly fibers that disappear at maturity. The tubercles are grooved along their upper surface. The stems can branch by developing basal offsets (clones) from the oldest tubercles

(Roller 1996). The plant may occur in clusters which are formed either by producing basal offsets, or when seeds germinate at the base of the mother plant. Flowers are bright silky yellow, or rarely white, with coral edges and have a narrow floral tube. The fruit is green, ellipsoid, succulent, and sweet. The seeds are brown or black and finely veined or netted.

**Distribution and Trend**

Because there is no evidence to the contrary, we assume that the historic range of the Pima pineapple cactus is the same as the present range. The species inhabits southeastern Arizona and north-central Sonora. In southeastern Arizona, the known range lies within Santa Cruz and Pima Counties and is generally bounded to the east by the Santa Rita Mountains, to the west by the Baboquivari Mountains and does not extend to the north past the south side of Tucson (Arizona Game and Fish Department 2001e, Schmalzel 2004, WestLand Resources Inc 2004, Baker 2005a, 2006, Baker 2007, Schmalzel 2008). It is found in low densities in the northern areas of Sonora, Mexico (U. S. Fish and Wildlife Service 2007c). There are populations in the Vail area and just south of Interstate 10 and west of Highway 83, north of Mt. Fagan. Pima County encompasses the majority of this variety's known range.

The USFWS determined that this species is Endangered, citing the amount of habitat loss that had occurred and was likely to continue to occur throughout the range of this species, the amount of habitat modification, the scarcity of individual plants, and the difficulty in protecting an area large enough to maintain a viable population as factors contributing to the need to list this species as endangered (U.S. Fish and Wildlife Service 1993). Populations of the Pima pineapple cactus are believed to be on a downward trend due to loss and degradation of habitat (Arizona Game and Fish Department 2001e). Westland Resources Inc. (2004) attempted to estimate population size for this species, though the USFWS (2007a) found deficiencies in their analysis.

**Habitat Requirements**

This species is found at elevations below 4,000 ft, in the desert scrubland or the ecotone between desert scrubland and desert grassland, on relatively flat areas (less than 10 percent slope) (U. S. Fish and Wildlife Service 2007c). It occurs from approximately 2,300 to 5,000 feet (702 to 1,525 m) in elevation, and is usually found on flat ridgetops with little slope and in soils that are mostly rocky loams (Arizona Game and Fish Department 2001e). Pima pineapple cactus were associated with alluvium of a wide variety of ages, more than other geological surfaces (U. S. Fish and Wildlife

Service 2007a). It is present in Arizona Desert (upper edge), Desert Grassland, and the lower edge of Southwestern Oak Woodland (Benson 1982).

Although little information is available regarding specific habitat requirements, the limited range and sparsely distributed populations of this cactus suggest specialized needs that may be revealed by further research. Some observers think that this cactus appears to be found most often on degraded, historically and/or currently overgrazed grassland in association with kangaroo rat mounds (R. Schmaltzel, *personal communication* to K. Kingsley, 22 Feb 2000; K. Kingsley, *personal observation*), although others disagree with the observation of association with kangaroo rats (B. Pavlick, *personal observation*). Probably the most consistent observation is that the cactus is found most often in "open" areas not associated with dense grass cover, though to the degree to which this is an artifact of the ease with which it can be found in "open" areas is not known.

**Current and Potential Threats**

General: The USFWS (1993, 2007c) identified the following factors as affecting the species:

- present or threatened destruction, modification, or curtailment of habitat or range including the increase in exotic, invasive species;
- overutilization (of the plant) for commercial recreational, scientific, or educational purposes;
- disease and predation; and
- inadequacy of existing regulatory mechanisms.

Existing and potential pest species: Pima pineapple cactus appear to have been damaged by the larval stage of a moth in the family Phycitidae, though the effect of this damage is unknown (U.S. Fish and Wildlife Service 1993). An unidentified beetle eats the plant and lays eggs in the plant. Larvae consume the plant from the inside out. This appears to be the proximate cause of death of many plants, but whether it is the ultimate cause is unknown. Competition with non-native grasses, such as bufflegrass, Lehmann's lovegrass, and red brome, may be a problem for this species. The introduction and spread of Lehmann's lovegrass has affected up to 75% of Pima pineapple cactus habitat (U.S. Fish and Wildlife Service 1993) and altered historical fire regimes (Roller 1996). Individual Pima pineapple cactus plants appear to exhibit less vigor in community types characterized by higher fire frequencies and continuous stands of Lehmann's lovegrass (Roller 1996).

Threat mechanism: Speculation includes direct loss of individuals, loss or degradation of habitat by trampling or grazing by livestock, recreation, and agricultural or land development; poaching; and competition with non-native plants. However, the only threat that has been clearly documented to impact this species is direct disturbance of land with individuals on it. Lack of one of the important pollinators for this species, a

ground-nesting bee (*Diadasia rinconis*) may limit the distribution of the cactus (McDonald 2005).

**Management Needs**

General: The Arizona Game and Fish Department (2001e) identified the following key management needs:

- livestock management needs to be improved;
- education needs to be provided to the public regarding Arizona Native Plant Law and cactus theft;
- additional surveys need to be conducted to better delineate the range, particularly in Mexico;
- further research is needed to determine if transplantation is successful as a mitigation measure;
- further demographic monitoring should be initiated to determine if existing populations are stable; and
- several preserves that are large enough to sustain viable populations should be set aside.

Current protective measures: The USFWS Final Rule listing this variety as Endangered implements Federal protection under the Endangered Species Act. At the time of the listing, USFWS determined that designation of critical habitat was not prudent for the species due to the threat of illegal collection (U.S. Fish and Wildlife Service 1993). Protection for plants under the ESA is somewhat limited when they occur on private land. The Arizona Native Plant Law protects the species as a “Highly Safeguarded Species” requiring a permit for collection and salvage. The species is included in Appendix II of CITES, which requires that a permit be obtained for export from the country of origin.

Corridor needs: No specific corridor needs are known. Dispersal corridors may be necessary for the successful establishment of new populations of the species; however, characteristics of appropriate corridors are unknown and long-distance dispersal mechanisms are unknown. McDonald (2005) indicated that the Pima pineapple cactus plants need to be within approximately 600 m of each other in order to facilitate effective pollination and plants that are located at distances greater than that from one another become isolated.

Dispersal requirements: Dispersal mechanisms are currently unknown, though dispersal may be aided by jackrabbits. Dispersal can take place by both sexual and asexual reproduction; however, suitable habitat must be available for new populations to become established. Because little is known regarding specific habitat requirements for this species, potential dispersal routes and establishment sites are impossible to assess without further research. Protection of habitats that are characteristic for this species

and within the known range to the extent possible will ensure future management options.

Key relationships: Pima pineapple cactus is found primarily in Lower Sonoran Desert Scrub and Semi-desert Grassland dominated by white-thorn acacia (*Acacia constricta*), velvet mesquite (*Prosopis velutina*), thread snakeweed (*Gutierrezia microcephala*), triangle-leaf bursage (*Ambrosia deltoidea*), and various other cacti and grasses (Ecosphere Environmental Services Inc. 1992). Roller (1996) documented the collection and ingestion of fruit by the greater roadrunner (*Geococcyx californianus*) and activity around individual plants by rodents and lagomorphs. These animals may be important for dispersal of seeds, but effective seed dispersal has not been demonstrated, and the seed dispersal mechanism remains unknown. The species appears to be reliant on the ground-nesting bee *Diadasia rinconis* for pollination (McDonald 2005). The potential effects of the recent loss of feral European honeybees and the arrival and establishment of Africanized honeybees on populations of both native plants and their native pollinators are unknown.

Existing monitoring and research programs: Six demographic plots were established by contractors funded by the National Fish and Wildlife Foundation in the Altar Valley in 2002 (Routson et. al. 2004) and were monitored annually through 2009 (Baker 2010). Pima County monitors populations at its two mitigation banks (Madera Highlands and Elephant Head. Powell (2011) resurveyed the population of the cactus at the County's Southeast Regional Park; that population was originally surveyed in 1998.

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-1): 15,044.

Acres of mitigation habitat within the current portfolio of conservation lands: 18,704.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Pima pineapple cactus:

- Work with experts to maintain and post a habitat suitability map and Priority Conservation Area map on a publicly accessible website, such as the SDCP Mapguide site, to be used as a reference for where the species may be encountered.
- Land acquisitions in the range of the species, as defined by the PCA, will be reviewed for evidence of occupancy of the species and its habitat as part of the due diligence (pre-closing), unless precluded by the property owner.
- Seek funds or partnerships to conduct surveys on County-controlled lands in areas south of the Sierrita Mountains and west of Interstate 19, in an attempt to verify whether additional locations exist, and to determine whether additional acres of acquisition may be counted as habitat mitigation under the MSCP.

- Encourage studies and other scientific investigations that are designed to increase knowledge about the species. This may include, but is not limited to, habitat/connectivity requirements, population viability analyses, effectiveness of transplant methodologies, persistence over time in developed areas, etc.
- Place restrictive covenants or conservation easements on the County's fee simple lands within the PCA at Marley Ranch, Rancho Seco, King 98, Canoa, Cienega Creek Natural Preserve, and Diamond Bell Ranch, as described in Chapter 4 of the MSCP. Additional future land acquisitions will also likely include areas of occupancy for the species.
- If necessary and where feasible, acquire additional high-value areas to offset impacts of Covered Activities. Planned future land acquisitions, such as the Marley Ranch Phase 2 acquisition agreement, include areas of likely occupancy for the species.
- Continue to utilize mitigation credits from County mitigation banks or other non-County operated mitigation banks to offset impacts to Covered Activities.
- Pima County will continue to administer mitigation banks at Madera Highlands (Altar Valley) and Elephant Head (Santa Cruz Valley) for the benefit of County departments. The mitigation banks are protected with conservation easements.
- Management plans and master plans for County-owned open space lands in the PCA will include attempts to to avoid or minimize impacts to the species on those lands that we own due to such activities as prescribed fire, and ground-disturbing activities such as new trails or ranch infrastructure.
- Pima County will continue to apply avoidance and minimization measures, as described in Chapter 4.
- Continue to work with the Altar Valley Conservation Alliance to promote conservation activities throughout the valley.
- Participate in the recovery planning with the USFWS and assist them in developing a new monitoring protocol.
- At County mitigation banks and long-term monitoring plots, Pima County will note the collection and/or destruction of tagged individuals during periodic surveys. These data, along with data collected by others in the region, can be used by the USFWS to investigate the effects of collecting on this species.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

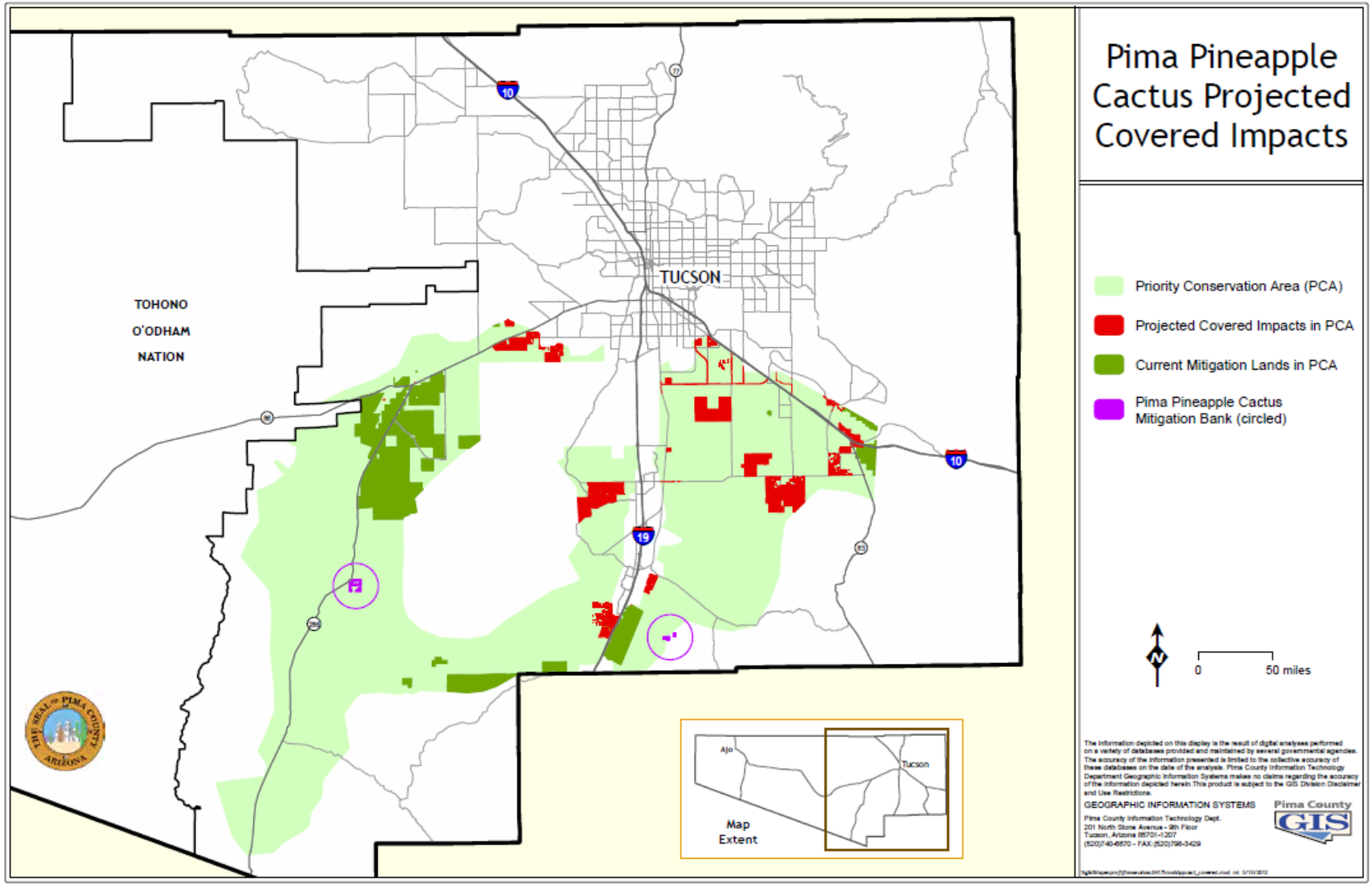



**Figure A-1. Map of projected impacts and mitigation for the Pima pineapple cactus.**

## Needle-spined pineapple cactus (*Echinomastus erectocentrus* var. *erectocentrus*)

### Conservation Status

Endangered Species Act Status: None, but former Federal Candidate 2 species.

State: Arizona Native Plant Law, Salvage Restricted.

Other: USFWS Species of Concern; U.S. Forest Service Sensitive.

Rankings: G3 S3.

### Description

The needle-spined pineapple cactus is a succulent perennial that is 4 to 6 inches (10-15 cm) tall (although occasionally to 12 to 15 inches [30-37 cm]) and 3 to 5 inches (7.5-13 cm) wide. The plant has tubercles that are about 0.25 inch (0.6 cm) long and are borne on longitudinal ridges. There are 1 or 2 central spines, distinguishing this variety from *E. e. acunensis*, which has 2 or 3 central spines. The central spines are 0.5 to 0.86 inch (1.2-2.2 cm) long, pointed upward, and have reddish brown tips. The radial spines number 11 to 15 per cluster, and are about 0.5 or 0.63 inch (1 to 1.5 cm) long and are white to red-tinged. The flowers are pink, 1.5 inches (3.8 cm) long and 1.5 to 1.8 inches (3.8-4.5 cm) wide, and have bright red stigma lobes. The fruit is green when young and tan when dry and is 0.4 inch (1.0 cm) long and 0.3 inch (0.8 cm) wide.

### Distribution and Trend

Benson (1969) described the range as "Southeastern Arizona from southeastern Pima County to western Cochise County." However, his map (p. 190) shows three localities in eastern Pinal County and 1 in eastern Cochise County. The species primarily occurs in Pima and Cochise counties, south and east of Tucson and in southeastern Pinal County near to the San Pedro River (Arizona Game and Fish Department 2009a). This species is scattered in a few locations, apparently disjunct from each other. Recent search efforts by Baker (Baker 2000, Baker 2005a, 2006, Baker 2007) have revealed >1,000 individuals southeast of Tucson. Large

areas of the potential range between known locations have never been searched adequately to find this species, so expansion of known range is likely. Population trends of the needle-spined pineapple cactus are unknown at present.

### Habitat Requirements

The needle-spined pineapple cactus has been found on alluvial fans and hills on southern and western exposures, generally from 3,000 to 4,600 feet elevation (915-1403 meters) (Arizona Game and Fish Department 2009a). Substrates consist of alluvial soils with rock and gravel over sandstone conglomerate, and limestone outcrops. It appears *E. e. erectocentrus* may grow over a wider range of substrates than the subspecies *E. e. acuñensis*. In late 2011, the USFWS announced it was reviewing *E. e. acuñensis* for possible listing under the ESA; as part of that listing, it is likely that any taxonomic and habitat differences between these two subspecies will be addressed.

### Current and Potential Threats

Illegal collection for the cactus trade and urbanization are management factors of concern for the needle-spined pineapple cactus (Arizona Game and Fish Department 2009a). Road development, overgrazing, and off-road vehicle use may also impact this species. There are no known records of potential damage to needle-spined pineapple cactus by insects, herbivores, or competition with non-native species. It is possible that invasive non-native grasses such as Lehmann lovegrass and red brome could create conditions that would foster fires that may be detrimental to this species, but no known studies demonstrate this.

Threat mechanism: Speculation includes loss or degradation of habitat by trampling by livestock and vehicles and poaching; however, these potential threats have not been clearly documented (Arizona Game and Fish Department 2009a).

### Management Needs

General: Probably the most pressing management need for protection of this species is acquisition of more information about the species through further research. In particular, additional surveys need to be conducted to better delimit the range (e.g., Baker 2005b, 2006), demographic studies should be initiated to determine if existing populations are stable, and studies of the reproductive biology are needed to allow effective management. Resolution of taxonomic uncertainty, with general agreement as to the appropriate name and taxonomic status of this entity would be helpful.

Current protective measures: The Arizona Native Plant Law protects the species as “Salvage Restricted” requiring a permit for collection. *Echinomastus erectocentrus* was originally listed in Appendix II of CITES in 1975, and later uplisted to Appendix I in 1983; thus requiring that a permit be obtained for export from the country of origin. Evidently the only recent legal exports were seeds grown for cultivation (U.S. Fish and Wildlife Service 2000b).

Corridor needs: No specific corridor needs are known. Dispersal corridors may be necessary for the successful establishment of new populations and maintenance of existing populations of the species; however, characteristics of appropriate corridors are not known. Known distribution suggests that populations are naturally isolated from each other.

Key relationships: The needle-spined pineapple cactus inhabits the Arizona Upland Subdivision of the Sonoran Desert Scrub and Semidesert Grassland. Dominant associated species are: *Larrea tridentata*, *Cercidium microphyllum*, *Fouquieria splendens*, *Yucca angustissima*, *Opuntia phaeacantha*, *Prosopis velutina*, *Coryphantha* ssp., *Zinnia pumila*, *Allionia incarnata*, *Dyssodia* spp., *Psilostrophe cooperi*, *Aristida purpurea*, and *Erioneuron pulchellum*. There is no known information concerning pollinators or disseminators of this subspecies, which might provide important information about the life cycle requirements and limited range of this cactus. Some herbivores and frugivores likely consume the flowers and fruits, and some animals may disperse seeds; however, documentation is lacking.

Existing monitoring and research programs: No known monitoring efforts or studies are currently under way.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-2): 439

Acres of mitigation habitat within the current portfolio of conservation lands: 8,655

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the needle-spined pineapple cactus:

- Include measures to avoid and minimize impacts to the species in management and master plans in Pima County-controlled mitigation lands within the PCA.
- Pima County will continue to apply avoidance, minimization and mitigation measures as described in Chapter 4.
- Explore partnerships with developers and ranchers to jointly achieve conservation of this species.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.
- Encourage and support studies and research to better understand the status and life history requirements of the needle-spined cactus.Database.

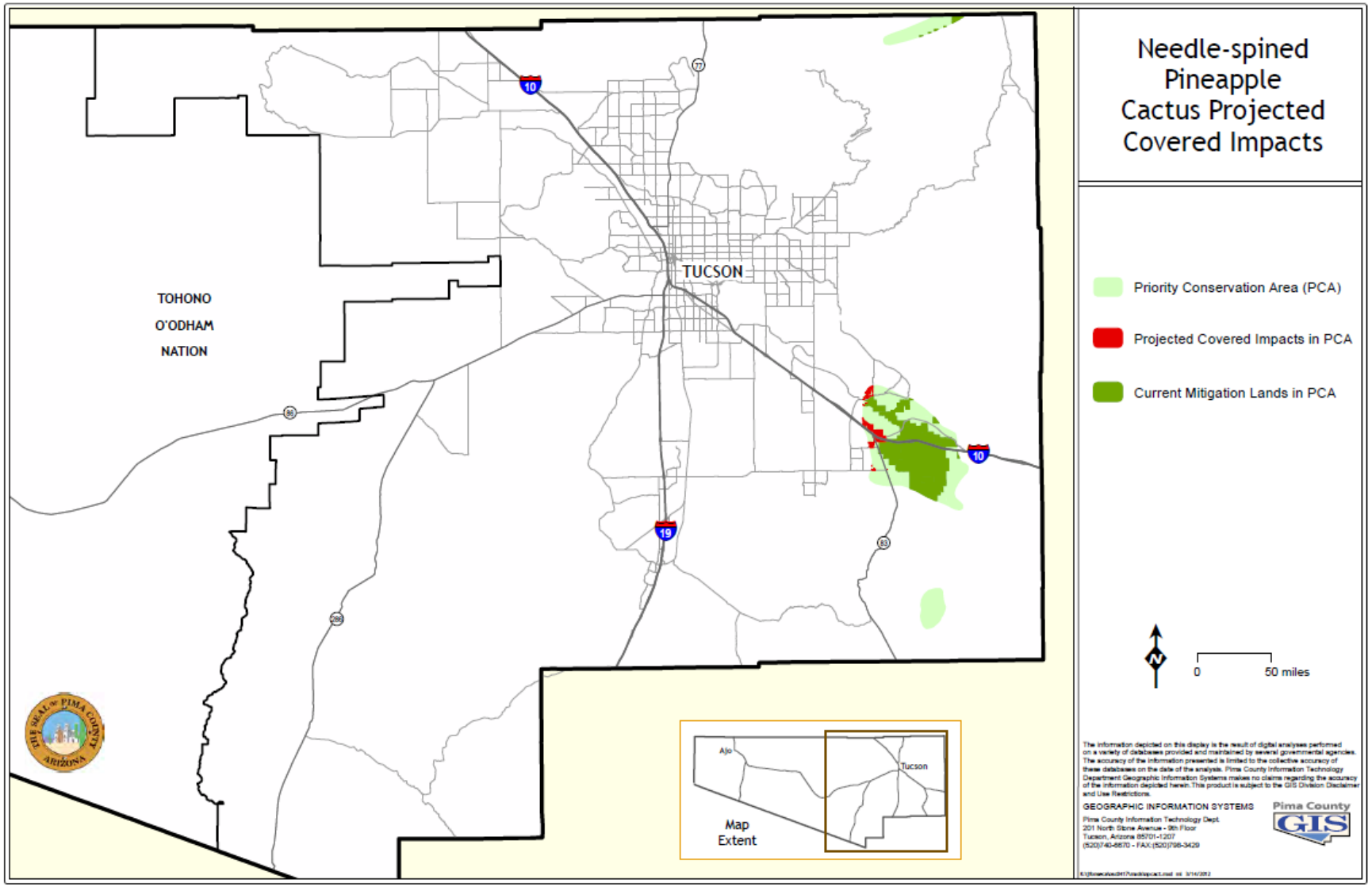



**Figure A-2. Map of projected impacts and mitigation for the needle-spined pineapple cactus.**

## Huachuca water umbel (*Lilaeopsis schaffneriana recurva*)

### Conservation Status

Endangered Species Act Status: Listed As Endangered by the USFWS in 1997. Critical habitat designated in 1999.

State: Highly Safeguarded.

Other: U.S. Forest Service Sensitive Species.

Rankings: G4, T2, S2

### Description

Herbaceous semi-aquatic perennial with tiny 3- to 10-flowered umbels that arise from nodes of creeping shallow (0.4-0.8 inch [1.0-2.0 cm]) underground rhizomes which run along the bottom of still ponds. Cylindrical hollow leaves that are pale green in color and typically borne 2 or 3 per node, having septa at irregular intervals. Generally 0.04-0.12 inch (1.0-3.0 mm) in diameter, however, length varies depending on microhabitat. When growing above water in wet soil near streams, stems are often 1.2-2.0 inches (3.0-5.0 cm) tall (too weak to support leaves) but may be up to 8.0 inches (20.0 cm). Inflorescence peduncles are typically 0.4-2.8 inch (1.0-7.0 cm) long and always shorter than leaves. Flowers are 0.04-0.08 inch (1.0-2.0 mm) wide with tiny maroon-tinted petals and are borne below leaves. Fruits are globose, 0.06-0.08 inch (1.5-2.0 mm) in diameter, and slightly longer than wide.

### Distribution and Trend

The Huachuca water umbel was historically found in Pima County: Tucson, along the Santa Cruz River; Cochise County: Huachuca Mountains, San Pedro area, Saint David (extirpated), San Bernardino Valley/Black Draw; Santa Cruz County: Sonoita Creek, Canelo Hills/Turkey Creek, San Rafael Valley. This species has been extirpated from a significant portion of its historical range. There are 20 locations historically for this species in Tucson, none of which are currently suitable. A population at House Pond on the San Bernardino National Wildlife Refuge was extirpated during pond reconstruction in the 1970s. A population at Saint David was presumed extirpated due to channel erosion.

The current distribution is in Pima, Santa Cruz, and Cochise counties, and in Sonora, Mexico. In the United States, 20 occupied sites occur in the following 4 watersheds: San Pedro River,

Santa Cruz River, Rio Yaqui, and Rio Sonora. All sites are between 3,500 and 6,500 feet (1,148-2,133 m) elevation (U.S. Fish and Wildlife Service 1999). Three populations are thought to exist in Pima County: (1) Cienega Creek in Las Cienegas National Conservation Area; (2) Cienega Creek Natural Preserve; and (3) Bingham Cienega Preserve. The species was found in Cienega Creek Natural Preserve in 2001 (Engineering and Environmental Consultants Inc. 2001), but subsequent visits failed to detect the species. Surveys at La Cebadilla Property, the species was not detected, but it was thought to be present there previously (Engineering and Environmental Consultants Inc. 2001). Wetland conditions required by the species have not been found at Bingham Cienega Preserve since 2007. It may also be possible to reestablish populations in the effluent-dominated portion of the Santa Cruz River and in the portion of the San Pedro River within Pima County.

Huachuca water umbel populations are highly dynamic and expand and contract depending on the presence of "refugia" where this species can escape the effects of scouring floods in a watershed that has an unaltered hydrograph and a healthy riparian community that stabilizes the channel. From these refugia, the species can rapidly expand if conditions are appropriate. However, entire patches can be lost due to flooding or may be greatly reduced due to competition with other species (U.S. Fish and Wildlife Service 1997a).

### Habitat Requirements

Huachuca water umbel requires perennial water, gentle stream gradients, small- to medium-sized drainage areas, and (apparently) mild winters, although it can recover from freezing. It is usually found in water depths from 2.0 to 6.0 inches (5.0 to 15.0 cm), but occasionally to 10.0 inches (25.0 cm) deep. It grows in submerged sand, mud and/or silt, but usually requires some organic component (Mima Falk, USFWS, personal communication to Ken Kingsley, 1 May 2000). This plant grows in cienegas (marshy wetlands). It formerly occurred also at lower elevations, as in the Santa Cruz River at Tucson. Plants may be found in both unshaded and shaded sites (U.S. Fish and Wildlife Service 1999).

The physical and biological habitat features essential to the conservation of Huachuca water umbel include (U.S. Fish and Wildlife Service 1999):

- a riparian plant community that is fairly stable over time and not dominated by nonnative plant species,
- a stream channel that is relatively stable, but subject to periodic flooding,
- refugia sites, and
- a substrate that is permanently wet or nearly so, for growth and reproduction of the plant.

### Current and Potential Threats

General: Wetland areas are rare and declining in the Sonoran desert region (Hendrickson and Minckley 1984, Pima County 2000). Historic watershed degradation

included impacts associated with livestock grazing, development, and diversion of water. Some of these may continue to deteriorate habitat for this species, or keep it unsuitable for re-establishment. Individual plants or entire populations can be destroyed when flooding is too frequent or intense, although an intermediate level of flooding frequency may reduce competition from other plant species (U.S. Fish and Wildlife Service 1999).

Existing and potential pest species: Huachuca water umbel populations have declined, perhaps in part due to competition when their habitat is aggressively colonized by other wetland species, both native (e.g., cattails [*Typha* spp.], and nonnative (e.g., water cress [*Rorippa nasturtium-aquaticum*]. *Arundo donax* is also a species of concern in some areas. Crayfish (*Orconectes* spp.) are likely detrimental to this species.

Threat mechanism: Populations are threatened by loss of wetland aquatic habitat that results from drawdown of groundwater, alteration of the watershed, development overgrazing; trampling and grazing by livestock; diversion of water and de-watering of habitats; and flash flooding. Also, overcrowding by other plants may result in reduction of local populations of this species.

**Management Needs**

General: Perennial water flow and excessive erosion are key management issues. Huachuca water umbel populations are restricted to wetland areas that are rare in the southwest United States and adjacent Mexico. Protective measures should include procurement of instream flow rights and management of watersheds to reduce flood intensity. Rural and urban development, road building, chaining, agriculture, mining, fire, and other land disturbances that degrade the watershed can adversely affect Huachuca water umbel.

Current protective measures: Endangered status for this species implements Federal protection under the Endangered Species Act (U.S. Fish and Wildlife Service 1999). Designation of Critical Habitat (all of which is located within Santa Cruz and Cochise County) prohibits destruction or adverse modification of Critical Habitat by any activity funded, authorized or carried out by any Federal agency. Designation of the San Pedro Conservation Area was accomplished by legislation that states that the BLM is charged with conservation, protection and enhancement of the riparian area, which includes populations of Huachuca water umbel. Management of Las Cienegas National Conservation Area may protect this species there, and surveys conducted in 2011 show robust populations there (Jeff Simms, personal communication to Brian Powell, November 2011). Coronado National Forest monitors all of their known populations and has protective measures such as livestock exclosures in place in critical habitat. Populations on Fort Huachuca are monitored and recreational use is excluded. The species shows excellent response to reintroductions, so there is a good likelihood of reestablishing the species if conditions are favorable (Titus and Titus 2008a).

Corridor needs: The species likely disperses vegetatively as well as by seed, so dispersal corridors along rivers are likely critical for this species to become re-established in areas from which it has been extirpated.

Dispersal requirements: Dispersal can take place by both sexual and asexual reproduction along stream corridors; however, suitable habitat, which at present is severely limited, must exist for new populations to become established.

Key relationships: A primary constituent of designated critical habitat for this species includes an aquatic plant community that is relatively stable over time and in which non-native species do not exist or are at a density that has little or no adverse effect on resources available to Huachuca water umbel (U.S. Fish and Wildlife Service 1999). The health of Huachuca water umbel populations may serve as an indicator of habitat conditions for other sensitive species that occupy the same community, including: Canelo Hills lady's tresses (*Spiranthes delitescens*), Huachuca spring snail (*Pyrgulopis thompsonii*), Gila chub (*Gila intermedia*), Sonora tiger salamander (*Ambystoma tigrinum stebbensii*), Chiricahua leopard frog (*Rana chiricahuensis*), and Mexican gartersnake (*Thamnophis eques*) (Warren et. al. 1991). The pollinator or pollination mechanism of this species is not known. If another species is necessary for pollination, then conservation of that species will be necessary in order to maintain viable populations of Huachuca water umbel.

Existing monitoring and research programs: Titus and Titus (2008b) monitored populations at Bingham Cienega Preserve for two years but that population has been extirpated, though a seeds may still be present on the site. Site-specific monitoring is ongoing at Fort Huachuca, the San Pedro River Conservation Area, and at Las Cienega National Conservation Area.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-3): 628.

Acres of mitigation habitat within the current portfolio of conservation lands: 4,056.

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Huachuca water umbel:

- Pima County will work with the USFWS to reestablish populations where conditions are shown to be appropriate; Pima County will monitor the outcome of that work;
- Though the umbel has been surveyed at other potential sites on County preserve lands, Pima County will investigate any credible observations of this species on other preserve lands and if presence is confirmed, Pima County will monitor at that site if conditions are appropriate (i.e., there is a chance for long-term establishment of the populations).

- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database. Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Protect existing habitat in the County-controlled mitigation lands from invasive species and controllable desiccation, where such efforts have a good chance for success.
- Continue to seek protection of water rights at Cienega Creek Natural Preserve and Bingham Cienega Natural Preserve to maintain and restore habitat.
- Continue to seek opportunities to acquire water rights to protect habitat for any newly detected, natural populations located on Pima County preserves.
- Survey for this species in suitable habitat during inventories of new properties.
- Consider establishing or re-introducing this species at aquatic sites on County-controlled mitigation lands; such activities would be conducted in a manner consistent with the Recovery Plan for this species, should one be completed.
- Aid in the development of a Recovery Plan for this species, should one be initiated.

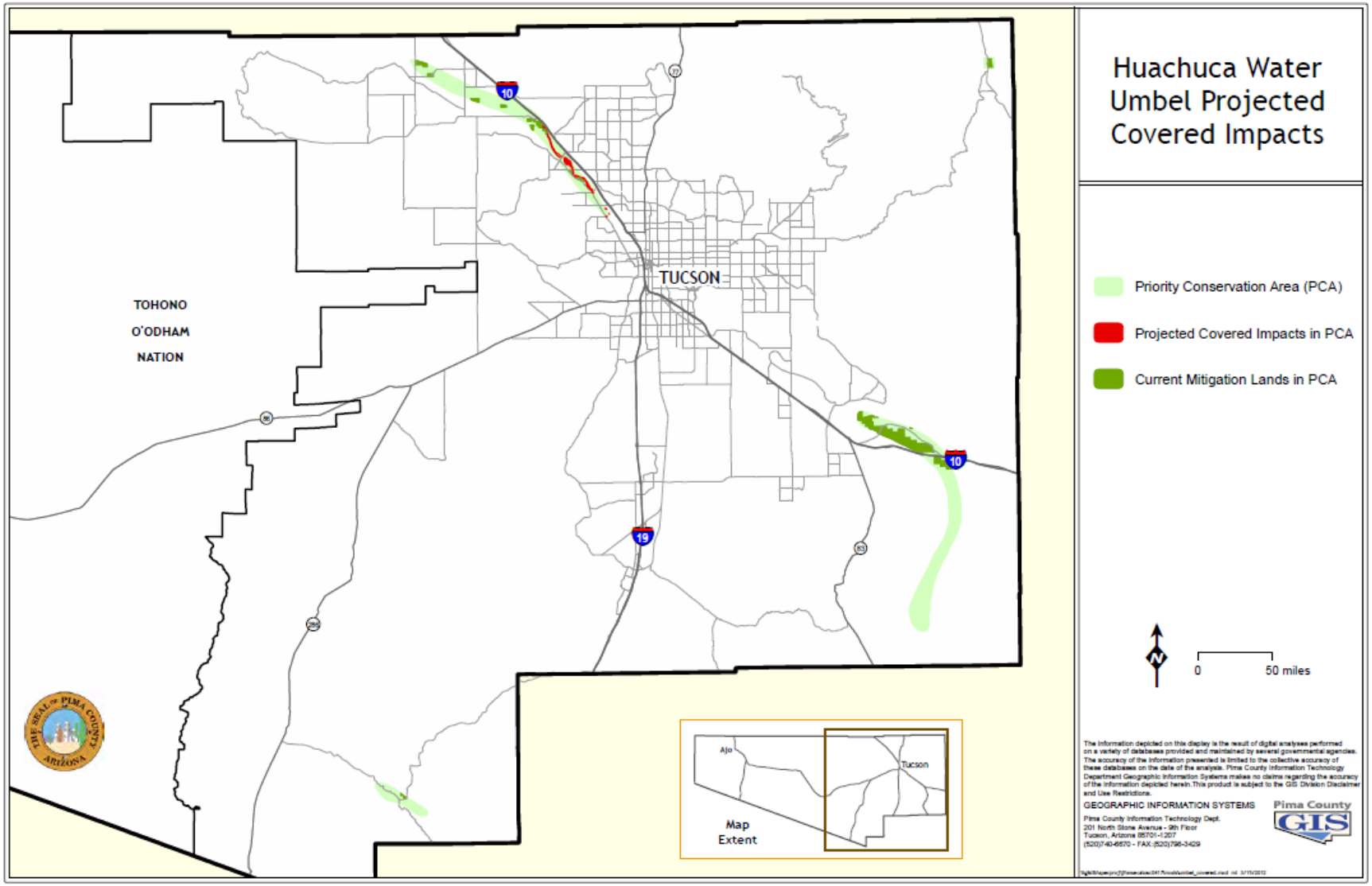



**Figure A-3. Map of projected impacts and mitigation for the Huachuca water umbel.**

## Tumamoc globeberry (*Tumamoca macdougalii*)

### Conservation Status

Endangered Species Act Status: None. Species had been listed as endangered, but was found to be more abundant and widespread than was thought at the time of listing.

State: Arizona Native Plant Law: Salvage Restricted.

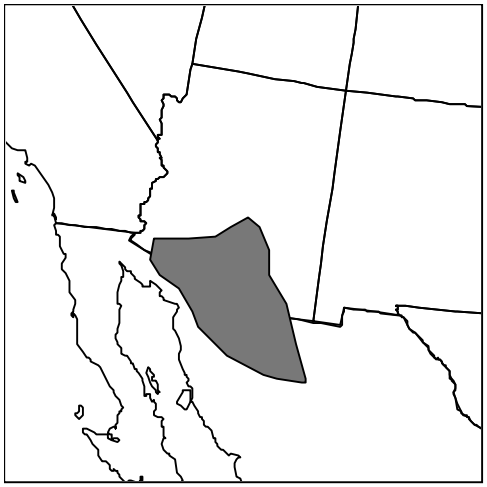
Other: U.S. Forest Service Sensitive Species; Bureau of Land Management Sensitive;

Rankings: G4.

### Description

The Tumamoc globeberry is a cryptic perennial dioecious or monoecious vine with grasping tendrils. It arises each summer rainy season from a cluster of tuberous roots that are united into a woody crown with a short stem. The slender annual stems have many nodes. Each node along the stem produces 1 tendril, 1 leaf, 1 male flower raceme, and 1 female flower bud. Leaves vary widely in size and shape. Most are rounded in outline, divided into 3 lobes; these lobes are about 0.8 to 1.6 inches (2.0 to 4.0 cm) long, with secondary lobes. The leaves have tiny pustule-like hairs. The flowers have pale yellow petals that are united below their middle, 0.4 to 0.6 inch (1.0 to1.5 cm) long. Round, green fruit (that give the common name to the plant), about size of a seedless grape, striped like watermelon when young, develop and turn red after 4 to 5 weeks. They contain 2 to several large seeds, 0.28 to 0.32 inch (7.0-8.0 mm) long that are 4-sided (Arizona Game and Fish Department 2004).

### Distribution and Trend



At the time of its discovery, and for many years thereafter, this vine was thought to be very rare and very limited in its distribution. Over time, with acquisition of effective search images and application of extensive and intensive efforts by field crews working primarily for consultants doing surveys for a plant that was initially considered a critically endangered species, the Tumamoc globeberry was found to be more abundant and widespread than had been initially thought.

The range of the Tumamoc globeberry covers approximately 31,000 square miles of Sonoran Desert from just southeast of Guaymas, Sonora, Mexico, to Tucson, Arizona, west to Organ Pipe Cactus National Monument and north to Pinal County, Arizona. The species' range in Pima County covers much of the County, with the highest concentrations of the species found west of I-10 and east

of the Tohono O'Odham Nation (Reichenbacher 1990, Rondeau et. al. 1996), but also some populations exist west to Organ Pipe Cactus National Monument (cited in Schmidt et. al. 2007). Frank Reichenbacher maintains long-term monitoring sites at Sabino Canyon, Tumamoc Hill, and the Tucson Mountains. Bureau of Reclamation maintains long-term monitoring sites in the Avra Valley. Surveys for this species will likely increase its known range in Pima County.

Reichenbacher (2009) reported on monitoring results of three populations in eastern Pima County, with the original surveys starting in the mid-1980s through the mid-1990s (Tumamoc Hill, CAP aqueduct, and Sabino Canyon). All three populations have declined by >85%.

### Habitat Requirements

The species is capable of occupying a wide range of habitats from halophytic coastal scrub communities on clayey saline hardpans only a few hundred feed from the Gulf of California shoreline to rocky loamy soils derived from weathered granite at nearly 3,000 ft. elevation in south central Arizona (Arizona Game and Fish Department 2004). Southeast of Guaymas, it occurs in a halophytic coastal scrub community on extremely salty hardpans; at Kino Bay it occurs in coastal scrub on salty sand of old barrier dunes; in Tucson it is found on hot, dry, south-facing slopes of basalt and along desert washes. The largest population known is found in creosotebush desert scrub on gravelly loams primarily derived from weathered granites. Biotic communities in which it has been found include Arizona Upland and Lower Colorado Valley, Plains of Sonora and Central Gulf Coast subdivisions of Sonoran Desert Scrub Biotic Community; and the Sinaloan Thornscrub Biotic Community (Arizona Game and Fish Department 2004).

Habitat trends in planning area: Large areas of potentially suitable habitat are found within the species' range, which has not been adequately surveyed. Much of the species' range in the United States is on protected land or land that is not likely to be developed. However, some development has occurred within the species range, and habitat has been lost.

### Current and Potential Threats

General: Threats include urbanization, farming, overgrazing, recreation, habitat conversion, javelina (eating tubers), off-road vehicle use, and pesticides (Arizona Game and Fish Department 2004). According to the Arizona Game and Fish Department (2004), the main factors affecting survival are thought to be:

1) intensity and seasonal distribution of summer precipitation;
2) intensity, duration, and seasonal distribution of droughts;
3) date and intensity of first hard frost;
4) local predation pressure, varying from minor stem clipping to partial or complete excavation; and
5) anthropogenic habitat alteration.

Existing and potential pest species: Javelina consume the roots and may destroy the plants in the process. A leaf-mining insect is known to consume some leaf tissue. Rabbits clip growing stems.

Threat mechanism: Physical destruction of plants and failure to reproduce are thought to be the dominant threat mechanisms.

**Management Needs**

General: Maintenance of at least some of the range of this species in relatively pristine condition is probably necessary for its survival.

Current protective measures: Large areas that are known to be within the species range and that are known to have the species present are under management control of a variety of government agencies. Some preserves (e.g., Bureau of Reclamation CAP preserve) have been created and surrounded with fences to keep out javelinas. Many plants were transplanted from the CAP right of way, placed in preserves, and monitored for a number of years (Reichenbacher and Perrill 1991). Monitoring is very difficult, confounded by the difficulties of relocating plants once discovered, of distinguishing them from neighbors only a few millimeters away, and of accounting for dormant plants.

Corridor needs: None are known.

Key relationships: The pollinator(s) have not been identified yet but are believed to be one or more moth species because the plant flowers at night. The highly contagious (i.e., clumped) distribution suggests very strongly that seeds are inefficiently dispersed. Some obscure environmental parameter may be responsible, but this seems unlikely. Several species of birds have been mentioned as seed consumers (Arizona Game and Fish Department 2004), but the effectiveness of them as seed dispersers has not been demonstrated. It is believed that nurse plants are necessary to provide support for the delicate vine and provide a means of displaying mature fruits to potential seed dispersers. Nurse plants may also moderate soil conditions, enabling the globeberry to grow in a wide variety of soil types.

Migratory requirements: None are known. Seed dispersal agents may be a limiting factor for at least some populations.

Existing monitoring and research programs: Frank Reichenbacher (Reichenbacher 1990, Reichenbacher and Perrill 1991, Reichenbacher 2008, 2009) has been a leading force in monitoring populations of the species and all of his plots are in eastern Pima County.

**MSCP Projected Modeled Habitat Loss and Mitigation**

Acres of habitat projected to be lost due to Covered Activities (Figure A-4): 15,706.

Acres of modeled habitat within the current portfolio of conservation lands: 21,266.

**Pima County's MSCP Management and Conservation Commitments**

Pima County will pursue the following management actions and conservation commitments for the Tumamoc globeberry:

- Evaluate newly discovered populations within the County preserve system for presence of threats and protective measures to be taken.
- Minimize impacts by participating in buffelgrass management efforts within the Sonoran desertscrub vegetation community.
- Work with the City of Tucson and Bureau of Reclamation to conserve suitable habitat in the Avra Valley.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

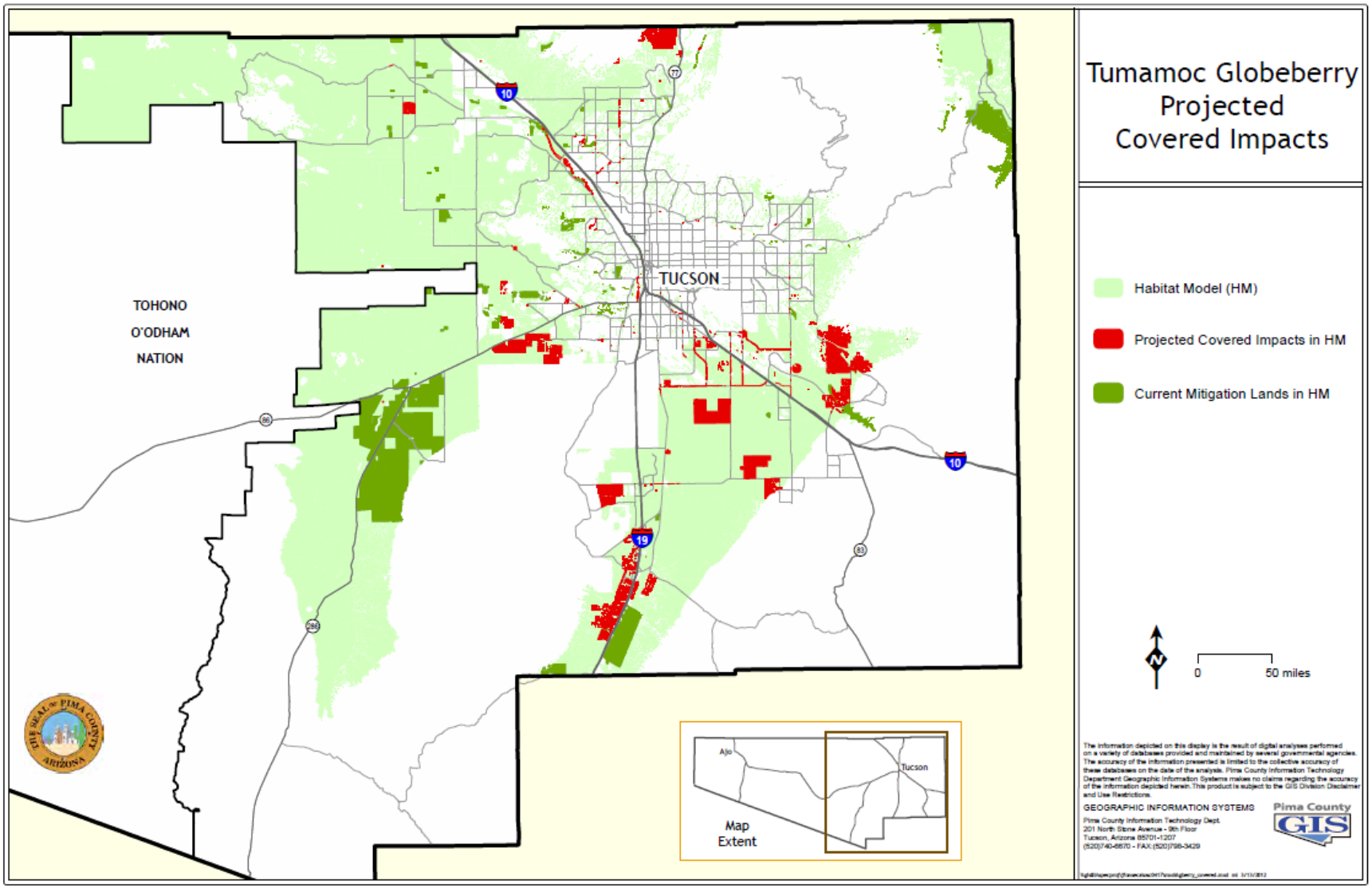



**Figure A-4. Map of projected impacts and mitigation for the Tumamoc globeberry.**

# Mammals

## Lesser long-nosed bat (*Leptonycteris curasoae yerbabuena*)

### Conservation Status

Endangered Species Act Status: Listed as Endangered in 1988.

State: Wildlife of Special Concern in Arizona.

Other: U.S. Forest Service Sensitive Species; Threatened in Mexico. "Red" Priority Species by Western Bat Working Group.

Rankings: G3, S2.

### Description

The lesser long-nosed bat is a medium-sized bat, is grayish to reddish brown and has an elongated snout. This bat has a nose-leaf, no tail, and an interfemoral membrane that is reduced to a narrow band along each hind leg; this species has large eyes and reduced ears compared to other bats in Arizona (Arizona Game and Fish Department 2003e). It is easily confused with the Mexican long-tongued bat, which has a visible tail enclosed in the interfemoral membrane. Structural adaptations of the mouth of lesser long-nosed bat correspond to procuring nectar, their primary food source. The tongue is long and tipped with brush-like papillae that facilitate nectar lapping and teeth are modified, having lost the cutting and crushing cusps essential to successfully foraging on insects.

### Distribution and Trend

The lesser long-nosed bat has been found in southern Arizona from the Picacho Mountains southwest to the Agua Dulce Mountains and southeast to the Chiricahua Mountains, in far southwestern New Mexico in the Animas and Peloncillo Mountains, and south from Arizona and New Mexico throughout the drier parts of Mexico, including Baja California. Occasionally, individuals have been reported outside of this range, for example there are records of individuals from the Phoenix area and the Bill Williams River during July and August. It is a seasonal resident in Arizona, usually arriving in early April and departing in mid-to-late September. However, it has been seen visiting hummingbird feeders in Tucson in January and February in recent years. It apparently resides in New Mexico only from mid-July to early September (USFWS 1995).

In Pima County, the lesser long-nosed bat is found in the spring and summer. Most of the currently known roost sites are inactive mine adits. In eastern Pima County, roosts are found in the Santa Catalina, Rincon, Whetstone, and Santa Rita mountains (Davis and Sidner 1992, Arizona Game and Fish Department 2003e, Swann and Powell 2006, WestLand Resources Inc 2009), though they are apparently not found in abundance on the east and north sides of the Santa Catalina Mountains due to the lack of *Agave*

*palmeri* there (Ronnie Sidner, *personal communication* to Brian Powell, October 2011). A maternity roost of this species once occurred in Colossal Cave and efforts have been made to restore the suitability of this roost for the lesser long-nosed bat (U. S. Fish and Wildlife Service 1995). It has been recorded in a number of locations in western Arizona including Cabeza Prieta National Wildlife Refuge and Organ Pipe Cactus National Monument (Cockrum 1981, Cockrum and Petryszyn 1986, Petryszyn and Cockrum 1990). Monitoring efforts associated with the Town of Marana's and the City of Tucson's Habitat Conservation Plans indicate that the lesser long-nosed bat forages in the exurban areas of Tucson and avoids the densely populated areas (Arizona Game and Fish Department, *unpublished data*). As of November 2012, there are no known roost sites on Pima County preserves.

In their 5-year review, The U. S. Fish and Wildlife Service (2005a) summarized the results of comments made to inform that review by noting: "Nearly all of the LLNB experts and researchers who provided input to this 5-year review indicated that they felt that the number of lesser long-nosed bats at most of the roost sites in both the United States and Mexico are stable or increasing. Specifically, Dr. Medellín indicated that the roosts they are monitoring in Mexico show stable or increasing numbers, but he provided no specific numbers for these roosts (Medellín 2005). Two of the 12 individuals providing input to this 5-year review expressed concern about roost numbers (McCasland 2005, Howell 2007). Their concerns were related to ongoing threats and to the fact that increases at certain roosts may not indicate overall population increases."

### Habitat Requirements

The lesser long-nosed bat is known from Semidesert Grasslands and Sonoran Desert Scrub, Arizona Upland Subdivision at elevations below 3,500 feet from April until July up to Madrean Evergreen Woodland (oak transition regions) at elevations up to 5,500 feet from July until late September/early October (U. S. Fish and Wildlife Service 2005a). In Arizona there appears to be both sexual and seasonal differences in the range of the lesser long-nosed bat. During the early part of their stay (late April to late July) pregnant females congregate at traditional roost sites, give birth, and raise their young at lower elevations (below about 3500 ft (1068 m)) within the range of columnar cacti. Males and perhaps nonreproductive females may be found at this time in roosts in the eastern part of the state. By late July, most females and young have dispersed from the maternity colonies and some have moved to higher elevations (up to about 5500 ft (1678 m)) where they are found feeding on agave flowers. By late September or October, all of these bats migrate south to Mexico, although exactly where is not known (Arizona Game and Fish Department 2003a).

### Current and Potential Threats

The primary threat to the species is from roost disturbance because the number of roosts is so small and because so many individuals gather at a single roost (U. S. Fish and Wildlife Service 2005a). Other threats include the increase in border activity and specifically the use of caves by illegal immigrants and drug traffickers, recreation, loss of habitat to development, loss of key foraging resources because of changes in species composition and loss of food plants (columnar cacti and agaves), and roost deterioration (U. S. Fish and Wildlife Service 2005a).

There is no known information on existing or potential harm to the lesser long-nosed bat by pest species. Major bat predators include snakes in roosts, carnivores at roost entrances, and owls while the bats are foraging. Unlike many other bats, however, the lesser long-nosed bat is not lunar-phobic (i.e., it does not reduce its foraging activity during the bright time of the lunar month), which suggests that it does not suffer strong selection pressure from nocturnal aerial predators (U. S. Fish and Wildlife Service 1995).

### Management Needs

Management "needs" and recovery actions are detailed in the Recovery Plan (U. S. Fish and Wildlife Service 1995). In summary, these are:

- Continue protecting roost sites and evaluate the need for and implement protection for food plants.
- Monitor all major roosts in Arizona, New Mexico, and Mexico once a year.
- Continue surveying for additional roosts in the U.S. and Mexico.
- Develop and conduct a public education and information campaign in Arizona, New Mexico, and Mexico on the beneficial aspects of bats in general and the lesser long-nosed bat specifically.
- Conduct critical research on population census techniques, physical requirements for roosts, foraging ranges of roosts, reproduction and mating systems and other life history and habitat questions.

<u>Current protective measures:</u> Two laws provide some measure of protection at cave roosts, subject to enforcement capability. The Federal Cave Protection Act of 1988 prohibits persons from activities that "destroy, disturb, deface, mar, alter, remove, or harm any significant cave or alters free movement of any animal or plant life into or out of any significant cave located on Federal lands, or enters a significant cave with the intent of committing any act described …". The Arizona Revised Statute (ARS) 13-3702 makes it a class 2 misdemeanor to "deface or damage petroglyphs, pictographs, caves, or caverns." Activities covered under ARS 13-3702 include "kill, harm, or disturb plant or animal life found in any cave or cavern, except for safety reasons." Of course, the effectiveness of these laws in protecting bat roosts is related to enforcement efforts, which are currently minimal. Protective measures such as gating may actually lead to abandonment (U. S. Fish and Wildlife Service 2005a), so guidelines need to be developed.

Corridor and migratory needs: Because lesser long-nosed bats migrate seasonally between the southwestern United States and Mexico, it is assumed that they utilize migration corridors, and that some quality of the corridor is necessary for this species. Specific corridors are not known, and may vary from year to year, or between fall and spring migrations, but the northward migration is thought to be in relation to the distribution and abundance of saguaros, agaves, and other food plants. Some roosts for day and night use must be present within the migration corridor, and populations of forage plants along migration routes are necessary.

Key relationships: This species is a known pollinator of several agave species and columnar cacti, upon which it depends for food. It is often used as an example of mutualism, although, the importance of this species in pollinating plant species with which it is associated in Arizona is not clear because they also exist outside of the known range of lesser long-nosed bat (Cockrum and Petryszyn 1991, U. S. Fish and Wildlife Service 1995, Ober and Steidl 2004).

Existing monitoring and research programs: Long-term monitoring projects for this species have increased in the last decades. Sidner (2005) has been monitoring the species at the Fort Huachuca military reservation since 1990 and efforts at the Organ Pipe Cactus National Monument have been ongoing since 1995 (Organ Pipe Cactus National Monument 2006b). Since 2001, the Arizona Game and Fish Department has been coordinating exit counts at a number of sites in Arizona (Arizona Game and Fish Department, *unpublished data*).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-5): 5,495.

Acres of PCA habitat within the current portfolio of conservation lands: 79,298.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the lesser long-nosed bat:

- Protect known roosts and foraging habitats of this species on County-controlled mitigation lands using appropriate means.
- Investigate the purchase of valid mining claims for mines with known roosts; look into opportunities for creating roost preserves and install bat-friendly exit gates, where appropriate and economically feasible.
- Restrict discretionary activities within 1 kilometer of known roosts during May to September if this can be accomplished without disclosure of roost locations.
- Evaluate known roosts of this species on County preserves for conditions and needs for structural stabilization. Where appropriate, such stabilization will be carried out using techniques that minimize disturbance and alteration of conditions.
- Pima County will apply avoidance, minimization and mitigation measures as described in Chapter 4.

- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

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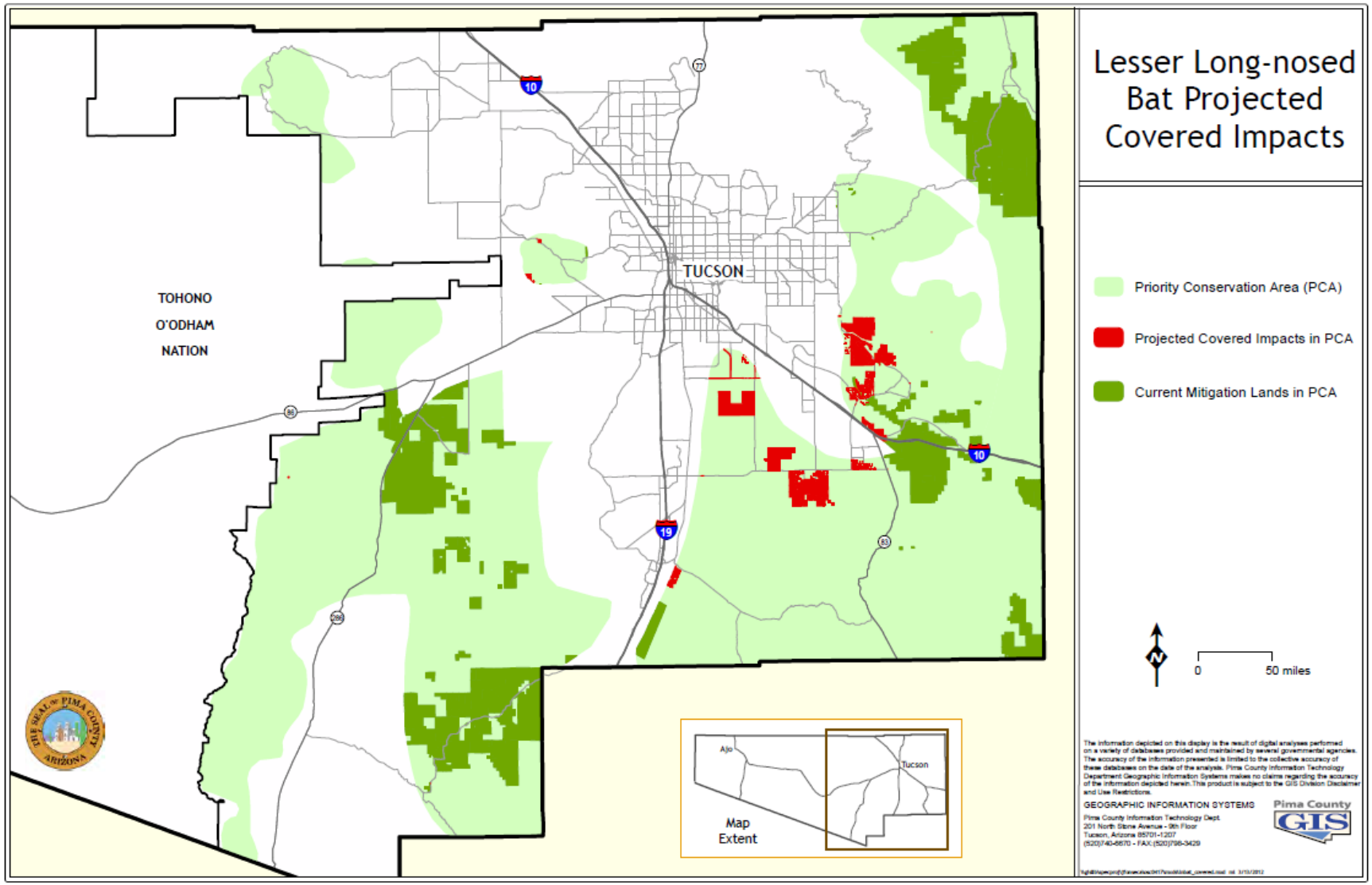



**Figure A-5. Map of projected impacts and mitigation for the lesser long-nosed bat.**

# Mexican Long-tongued Bat (*Choeronycteris mexicana*)

## Conservation Status

Endangered Species Act Status: None.

State: Wildlife of Species Concern in Arizona.

Other: USFWS Species of Concern; California Species of Special Concern, U.S. Forest Service Sensitive Species. "Red" Priority Species by Western Bat Working Group.

Rankings: G2, S1.

## Description

The Mexican long-tongued bat has a long and slender nose, with a leaf-like structure that is broad at the base, pointed at tip, and about 0.2 in. (5.0 mm) high. The forearm is 1.68-1.92 inches (42.0-48.0 mm) long, and the hind foot is 0.44-0.56 in. (11.0-14.0 mm) long. The tail is approximately 1/3 inch (10 mm) in length, about 1/3 the length of the interfemoral membrane. Dorsal pelage varies from buffy brown to dark grayish brown, palest on shoulders; the venter is paler, and the short ears are pale brownish gray. The tongue is long and extendable. The upper incisors are small, and do not fill the space between the canines. There are no permanent lower incisors, but 1 to 4 deciduous teeth may persist in adults (Arizona Game and Fish Department 2006b).

## Distribution and Trend

This species is known from Venezuela northward through Central America and Mexico to southeastern Arizona, southwestern New Mexico, and San Diego, California (Barbour and Davis 1969, Cryan and Bogan 2003a). Only adult females migrate into the United States, but juvenile bats of both sexes wander widely after they leave the maternity roost (Arizona Game and Fish Department 2006b).

The Mexican long-tongued bat is found throughout Pima County, particularly in the eastern portion (Hoffmeister 1986). Roost sites have been found in the Santa Catalina, Rincon, Baboquivari, and Santa Rita mountains and lower Cienega Creek (Don Carter, *unpublished data*; Cryan and Bogan 2003b, Arizona Game and Fish Department 2006b, WestLand Resources Inc 2009). Individuals have been netted at Rincon Creek

(Arizona Game and Fish Department 2006b, Swann and Powell 2006) and in Organ Pipe Cactus National Monument (Organ Pipe Cactus National Monument 1999, 2006a). Work by Wolf and Shaw (*unpublished data*) at hummingbird feeders in and around Tucson found Mexican long-tongued bats throughout the Tucson Basin, particularly along the Pantano, Rillito, and Agua Caliente washes and Tanque Verde Creek. Ronnie Sidner has studied the species extensively at the Fort Huachuca Military Reservation (Cochise County; *unpublished data*). Populations in Arizona appear to be highly variable (Arizona Game and Fish Department 2006b) and there is no evidence of a trend.

### Habitat Requirements

The Mexican long-tongued bat is known from the canyons of mixed oak-conifer forests in mountain ranges surrounded by desert (Arizona Game and Fish Department 2006b). It requires caves or inactive mines or unoccupied buildings to use as both day and night roosts. Most roost sites are located near a water source and near areas of riparian vegetation (Cryan and Bogan 2003a). Carter and Peachy (1996) studied roost sites in the Cienega Creek Natural Preserve and most sites were located immediately adjacent to the creek. The roost sites consisted of pocketed, eroded clay soil holes such as sink holes, or soil piping caves.

Long-tongued bats feed on nectar and pollen, also probably ingesting insects found in the flowers (Hevly 1979). Food plants include paniculate agaves and occasionally columnar cacti (Hevly 1979). These bats have also been observed feeding at hummingbird feeders on the edges of urban Tucson (Arizona Game and Fish Department 2006b). The value of this resource has not been determined.

### Current and Potential Threats

More potential roosts sites are available now than before mining occurred in the mountain ranges occupied by this species. However, both natural caves and mine roost sites are threatened by human disturbance, destruction, mining activities, mine closures, and border activities. There are no known records of existing or potential harm to the Mexican long-tongued bat by predators or introduced pest species. Current threats to this species include roost disturbance by humans, loss of forage plants (agave and saguaro flower nectar and pollen), recreational caving, mine reclamation, renewed mining, and loss of riparian vegetation (Arizona Game and Fish Department 2006b). This species is extremely sensitive to disturbance at roost sites, and may abandon roosts if disturbed; the females taking babies with them and subjecting them to additional mortality factors (Arroyo-Cabrales et. al. 1987).

### Management and Information Needs

Mexican long-tongued bats are very wary of humans and are easily disturbed. Human disturbance to roost sites should be restricted. Surveys for this species may be difficult because it roosts in small (5-15 individuals) colonies. The development of improved survey methods could greatly increase knowledge of population trends. Studies to

determine food habits, range, population densities, and migration and roosting patterns are also needed (Arizona Game and Fish Department 2003a).

Current protective measures: Two laws provide some measure of protection at cave roosts, subject to enforcement capability. The Federal Cave Protection Act of 1988 prohibits persons from activities that "destroy, disturb, deface, mar, alter, remove, or harm any significant cave or alters free movement of any animal or plant life into or out of any significant cave located on Federal lands, or enters a significant cave with the intent of committing any act described …". The Arizona Revised Statute (ARS)13-3702 makes it a class 2 misdemeanor to "deface or damage petroglyphs, pictographs, caves, or caverns." Activities covered under ARS 13-3702 include "kill, harm, or disturb plant or animal life found in any cave or cavern, except for safety reasons." The effectiveness of these laws in protecting bat roosts is related to enforcement efforts, which are currently minimal. Protective measures such as gating may actually lead to abandonment (U. S. Fish and Wildlife Service 2005a), so guidelines need to be developed. Pima County's Natural Resources, Parks, and Recreation department has stabilized soil pipe caves at the Cienega Creek Preserves with some success, so restoration of roosting habitat is possible.

Corridor and migratory needs: Because Mexican long-tongued bats migrate seasonally between the southwestern United States and central Mexico, it is assumed that they utilize migration corridors, and that some quality of the corridor is necessary for this species, but there is no specific information known that supports conclusions regarding corridor needs. Specific migratory requirements are not known. It is presumed that food and shelter along the migration route are necessary.

Key relationships: The Mexican long-tongued bat is found in the canyons of mixed oak-conifer forests, at elevations ranging from 4,000 to 6,000 feet, in mountain ranges surrounded by desert (Arizona Game and Fish Department 2006b). The presence of flowering agave during the summer months appears to be critical for this species.

Existing monitoring and research programs: No long-term monitoring of the species has been conducted, though according to Cryan and Bogan (2003b), there is no evidence to conclude that populations in Arizona and New Mexico have increased or decreased. Trend monitoring may be difficult given the dispersed roost characteristic of the species.

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-6): 15,495.

Acres of mitigation habitat within the current portfolio of conservation lands: 44,473.

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Mexican long-tongued bat:

- Evaluate known roosts of this species on County preserves for conditions and needs for structural stabilization. Where appropriate, such stabilization will be

carried out using techniques that will minimize disturbance and alteration of conditions. Install bat-friendly exit gates, where appropriate and feasible.

- Emphasize management for this species within Cienega Creek Natural Preserve and Colossal Cave Mountain Park.
- Pima County will apply avoidance, minimization, and mitigation measures as described in Chapter 4.
- Encourage the purchase and installation of new lighting within the cave tour portion of Colossal Cave Mountain Park to reduce stress on bats and to promote higher abundance and occupancy.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

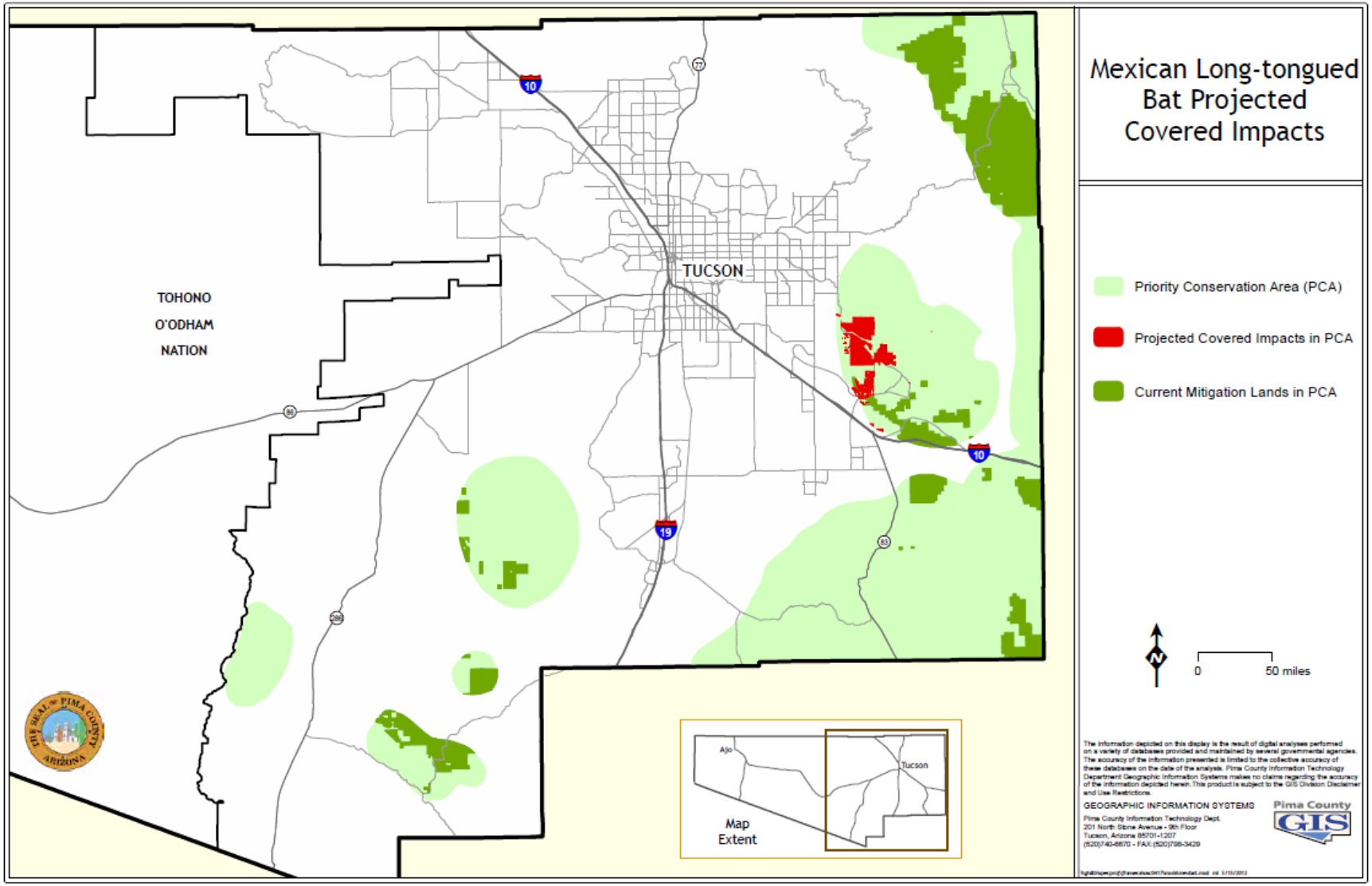



**Figure A-6. Map of projected impacts and mitigation for the Mexican long-tongued bat.**

## Western red bat (*Lasiurus blossevillii*)

### Conservation Status

Endangered Species Act Status: None.

State: Species of Special Concern in Arizona.

Other: U.S. Forest Service Sensitive Species; "Red" Priority Species by Western Bat Working Group.

Rankings: G5, S2.

### Description

The western red bat is a medium-sized bat, forearm 1.5 to 1.7 inches (38 to 43 mm) long, weight 0.25 to 0.5 ounce (7 to 15 g); wings long, narrow and pointed, wingspan 11 to 13 inches (290-332 mm), ears short and rounded, 0.3 to 0.5 inches (11-13 mm) in length; interfemoral membrane (uropatagium) completely furred on the dorsal surface. Color ranges from bright orange to yellow-brown with white-tipped hairs; whitish patches near the shoulder; wing membranes black. Males are usually more brightly colored than females (Arizona Game and Fish Department 2003d).

### Distribution and Trend

The total range of western red bat extends from extreme southern Canada through the United States east and west of the Great Plains south to Panama and South America. apparently only a summer resident in the southwestern United States (Barbour and Davis 1969, Shump and Shump 1982, Arizona Game and Fish Department 2003c) and it winters northward to Sonora and coastal California (Findley et. al. 1975). It is presumed to be found throughout Pima County, including the Santa Rita Experimental Range, Empire Gulch, SE of the Boboquivari Mountains, Santa Catalina Mountains including Sabino Canyon, Buenos Aires National Wildlife Refuge (Arizona Game and Fish Department 2003c), Rincon Creek (Swann and Powell 2006), and Colossal Cave Mountain Park. As of 2003 there have been <20 documented occurrences of the bat in Pima County (Arizona Game and Fish Department 2003a).

There is no trend data for this species, but anecdotal evidence suggests that it may be less common in recent decades (Arizona Game and Fish Department 2003c). Declines—if they have occurred—may be attributable to loss of riparian gallery forests.

### Habitat Requirements

The western red bat inhabits broadleaf riparian deciduous forests and woodlands. Cottonwood distribution throughout the range of this species is thought to determine this species' ability to complete its annual migration (Pierson et. al. 1999, Arizona Game and Fish Department 2003c). The species often roosts alone (Arizona Game and Fish Department 2003c). They have been found roosting in fruit orchards (Arizona Game and Fish Department 2003a).

### Current and Potential Threats

General: Current threats to this species are based on habitat loss and degradation of riparian areas and other broadleaf deciduous forests and woodlands (Arizona Game and Fish Department 2003c).

Existing and potential pest species: There are no known records of existing or potential harm to the western red bat by predators or introduced pest species.

Threat mechanism: Current threats include habitat loss and degradation of riparian and other broad-leaf deciduous forests and woodlands from the destruction of stream banks and accelerated erosion related to grazing, dam construction, water diversions, aquifer pumping, and pasture and cropland conversion (Arizona Game and Fish Department 2003c). Toxic chemicals may also negatively impact local populations of this and other bat species (Clark 1988).

### Management Needs

General: Adequate management strategies include developing efficient survey methods that address population status, life history, and roost selection, and protecting broad-leaf deciduous riparian areas. Additionally, land acquisition and land owner education programs (most riparian habitat is privately owned) would also effectively bolster management efforts for this species (Arizona Game and Fish Department 2003c).

Current protective measures: No protective measures are known to currently exist specifically for this species except that all bats are protected by State wildlife regulations against direct taking. Pima County has a floodplain ordinance that prevents, minimizes or mitigates some destruction of habitat for this species. The Federal Clean Water Act, in its Section 404, may also protect some of the habitat of this species.

Corridor needs and migratory requirements: Because western red bats migrate seasonally between the southwestern United States and South America and, in Arizona, occur primarily in riparian regions, it is assumed that they travel along riparian corridors and that some level of quality of the riparian corridors is necessary for this species.

Key relationships: This species is found in broadleaf riparian deciduous forests and woodland habitats. The western red bat is associated with cottonwood and sycamore trees (Arizona Game and Fish Department 2003c).

Existing monitoring and research programs: No monitoring programs exist for this species, most likely because of the difficulty in locating individuals to enumerate.

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-7): 170.

Acres of mitigation habitat within the current portfolio of conservation lands: 20,850.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the western red bat:

- Pima County will implement the Pima County Floodplain Ordinance to minimize loss of habitat for this species, as described in Chapter 4.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

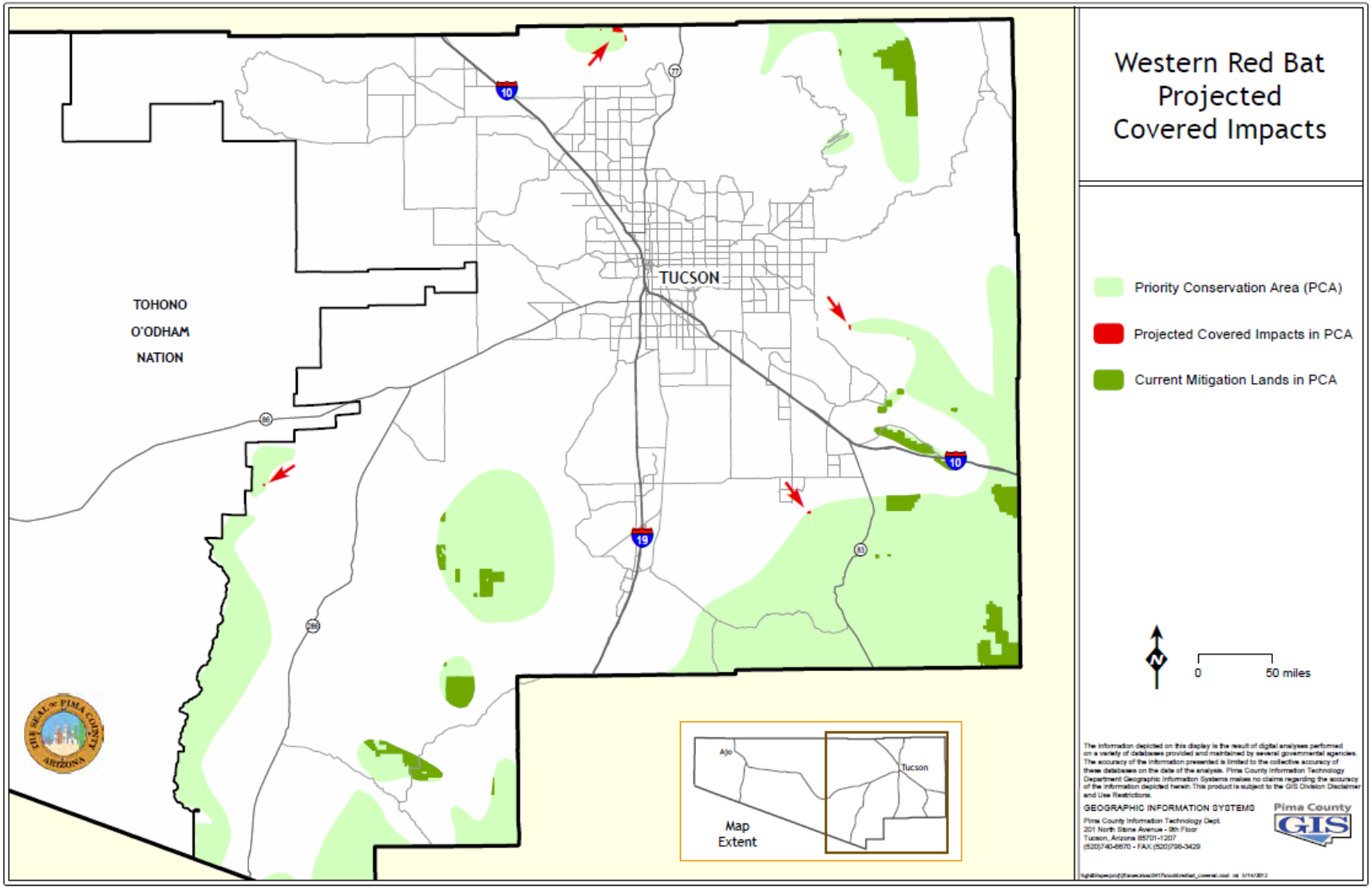



**Figure A-7. Map of projected impacts and mitigation for the western red bat.**

## Southern yellow bat (*Lasiurus ega*)

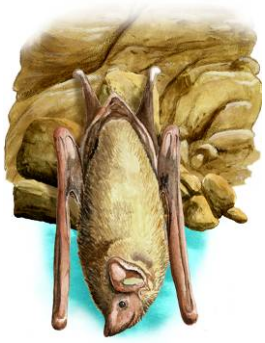
### Conservation Status

Endangered Species Act Status: None.

State: Wildlife of Special Concern in Arizona.

Other: U.S. Forest Service Sensitive Species. "Red" Priority Species by Western Bat Working Group.

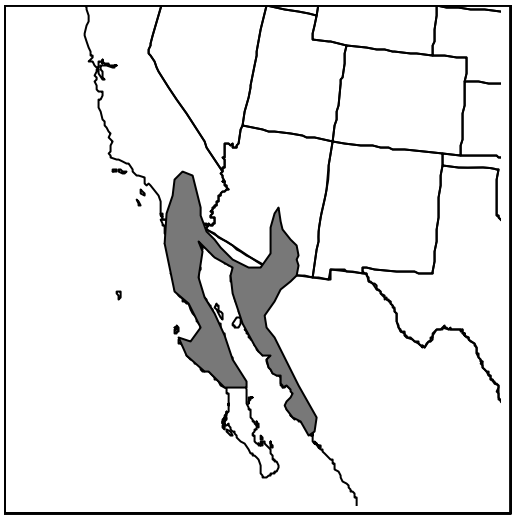
Rankings: G5, S1



### Description

The western yellow bat has an average wingspread of 13 to 14 inches (32-35 cm), and an average body length of 2.5 to 3 inches (6.25 to 7.5 cm) (Noel and Johnson 1993). Its fur is the yellowish color of the dead palm fronds in which it is often found.

### Distribution and Trend



The historic range of this species is not well known and, in Arizona it was not known until recently (Noel and Johnson 1993). This is a tropical species that barely enters the United States in southern Arizona, southern California, Texas, and New Mexico, and ranges south to Uruguay and Argentina (Noel and Johnson 1993). There are very few records of this species in the U.S. and primarily in urban areas (Noel and Johnson 1993, Arizona Game and Fish Department 2003d). Most records of southern yellow bats from Arizona are from urban Tucson and Phoenix, where they are associated with planted fan palms (Hoffmeister 1986, Arizona Game and Fish Department 2003d). Also, it has been found in recent years in Sasabe, Sabino Canyon, and the Galiuro Mountains (Graham County). The species is said to be encountered by tree trimmers in urban Tucson.

Population trends are not known, although records of this species appear to be increasing (Noel and Johnson 1993, Fahey 1997), this may be a result of better observation and reporting. It is also possible that this species has declined along the Santa Cruz River and Rillito Wash as a result of historic loss of riparian woodland, and that the population has shifted to palm trees in the absence of riparian deciduous trees.

### Habitat Requirements

This species is likely to be found primarily in association with planted fan palms (*Washingtonia filifera* and *W. robusta*) in residential and park areas up to 6,000 feet (Arizona Game and Fish Department 2003c). It is also found in riparian deciduous forests and woodlands (Jason et. al. 2006) and one individual in Texas was found roosting in yucca (Higginbotham et. al. 2000). Individuals have been found roosting about 15 feet above the ground in a hackberry (*Celtis reticulata*) and sycamores (*Platanus wrightii*) (Arizona Game and Fish Department 2003d). It is known to occur in association with Washington fan palms at Yuma, and in broad-leaved riparian areas along the Bill Williams River (Hoffmeister 1986, Arizona Game and Fish Department 2003d).

### Current and Potential Threats

General: Loss and degradation of riparian woodlands due to trampling of stream banks and increased erosion associated with grazing, construction of dams, water diversions, aquifer pumping, and pasture and cropland conversion, burning and removal of palm groves, and pruning of urban palm trees (Arizona Game and Fish Department 2003d).

Existing and potential pest species: None are known.

Threat mechanism: Loss of roost sites resulting from historic loss of riparian deciduous woodland and ongoing palm frond removal and trimming in more developed areas.

### Management Needs

General: Management guidelines for halting or reducing tree trimming would probably benefit this species.

Current protective measures: None are specifically known for this species. All bats are protected by Arizona State law against direct harm.

Corridor and migratory needs: None are known for this species.

Key relationships: This species appears to be dependent upon fan palms and riparian deciduous woodland tree species (cottonwoods and willows) for roost sites (Spencer et. al. 1988).

Existing monitoring and research programs: No information is currently known regarding existing monitoring and research programs for this species.

### MSCP Projected Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-8): 755.

Acres of PCA habitat within the current portfolio of conservation lands: 8,377.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the southern yellow bat:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4.
- Because this species is thought to be associated with untrimmed palm trees within the urban environment, Pima County will support public education about the importance of leaving palm trees untrimmed (or only conducting minimal trimming in the case of a safety issue), and may support a small project to map the location of palm tree resources.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.
- Conduct tree maintenance at Agua Caliente Park in such as way as to promote and protect potential roost sites, where these efforts do not interfere with other park goals.

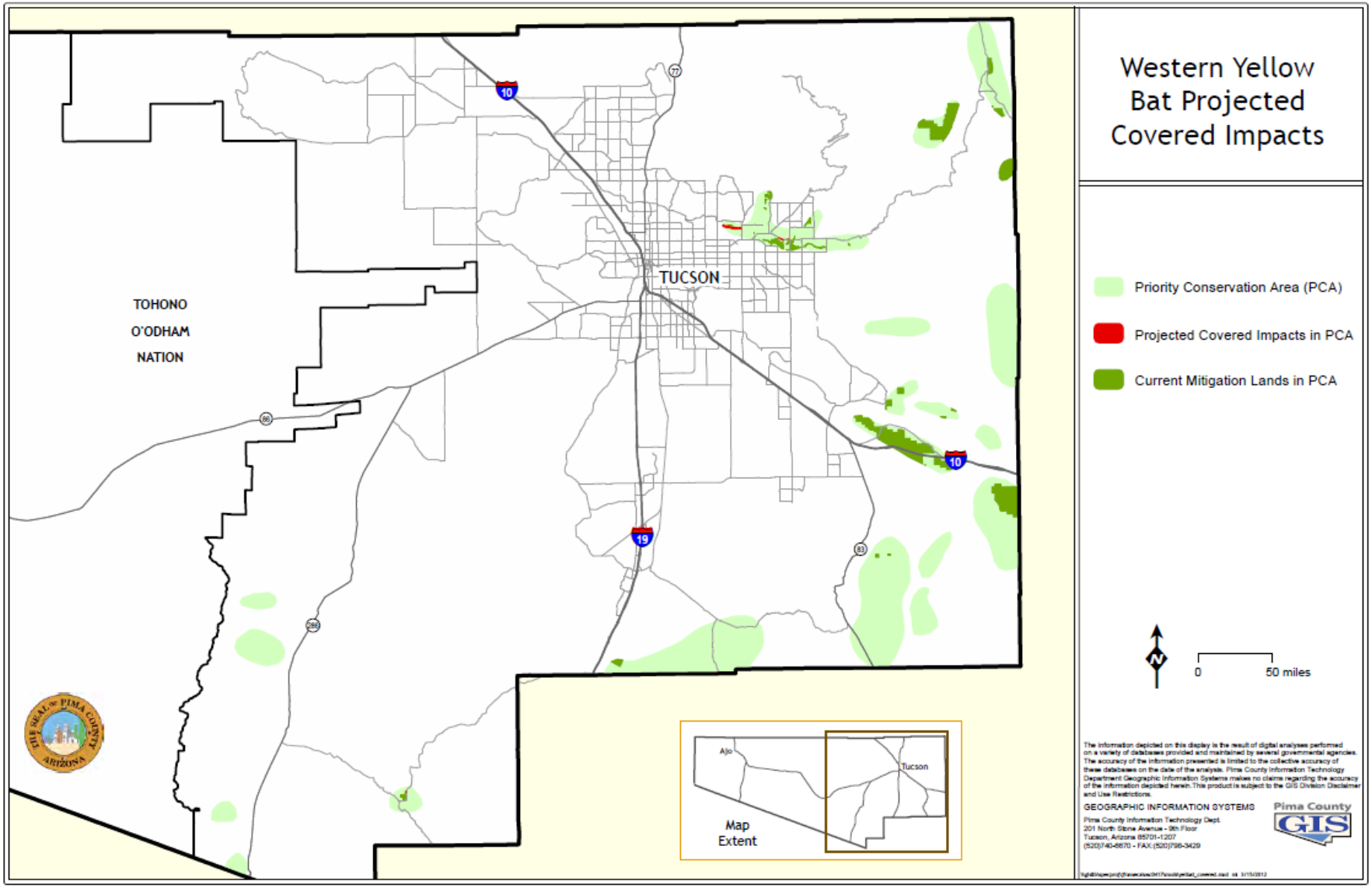



**Figure A-8. Map of projected impacts and mitigation for the western yellow bat.**

## California leaf-nosed bat (*Macrotus californicus)*

### Conservation Status

Endangered Species Act Status: None. Former FWS Category 2 Candidate.

State: Wildlife Species of Special Concern in Arizona.

Other: USFWS Species of Concern; U.S. Forest Service Sensitive Species; "Red" Priority Species by Western Bat Working Group.

Rankings: G4, S3S4.

### Description

The California leaf-nosed bat is a bat with an erect, lanceolate nose-leaf. The ears are large, 1.16 to 1.52 inches (29.0-38.0 mm) long, and joined together near the base. The tail extends free past the edge of the uropatagium for 0.2-0.4 inch (5.0 to 10.0 mm). The forearm measures 1.88 to 2.25 inches (47.0-55.0 mm), and the wingspan is about 13.5 inches (35 cm). The color is grey (Arizona Game and Fish Department 2001g).

### Distribution and Trend

This species is known from southern California, southern Nevada, across the southwestern half of Arizona (with one report from northwestern Mohave County) and southward to the southern tip of Baja California, northern Sinaloa, and southwestern Chihuahua, Mexico (Arizona Game and Fish Department 2001g). The historic range of *M. californicus* does not include New Mexico. In Arizona, the species is known to occur in the Sonoran desert scrub from south of the Mogollon Plateau. At some roosts, this species is a year-round resident; the winter range for *M. californicus* is nearly the same as the summer range (Arizona Game and Fish Department 2003a). Because this species does not hibernate, the identification and protection of winter roost sites with appropriate conditions is crucial to the conservation of this species. This species does not always use the same roost sites in the summer and winter due to different requirements as the seasons change.

In Pima County, this is one of the most common species of bats to find in caves, mines, and rock shelters throughout the County, especially low elevation ranges including in

Organ Pipe Cactus National Monument (Cockrum 1981, Cockrum and Petryszyn 1986, Petryszyn and Cockrum 1990) and mountain ranges near Tucson including the Tucson Mountains (Swann and Powell 2007), and Waterman, Silverbell, Santa Catalina, Rincon, Sierrita, and Baboquivari mountains (Arizona Game and Fish Department 2001g).

Population trends are poorly known, but concerns have been expressed regarding roost abandonment and reduced numbers as a result of disturbance by both recreationists and scientists at a number of well known and accessible roost sites (Arizona Game and Fish Department 2003a), as well as impacts associated with border activities.

### Habitat Requirements

The California leaf-nosed bat is known from caves, mines, and rock shelters, mostly in Sonoran Desert Scrub (Arizona Game and Fish Department 2001g). Day roosts in mines usually occur within approximately 80 feet of the entrance and the bats prefer areas with abundant ceiling and flying space. In the colder areas of the range, roosts are chosen with temperatures equal to or exceeding 80 degrees Fahrenheit; the roosts are usually approximately 80 to 100 feet or more from the back of the entrance (Noel and Johnson 1993, Arizona Game and Fish Department 2001g). Night roost sites can include open buildings, cellars, bridges, and porches. Winter and summer roost sites can differ, with an apparent requirement for winter roost sites that maintain warmer temperatures needed by this non-hibernating, non-migrating species. The species forages widely.

### Current and Potential Threats

General: The most important threat potentially affecting this species is usually considered to be human disturbance to roosts (Arizona Game and Fish Department 2001g), though habitat conversion and pesticide use are also a concern.

Existing and potential pest species: There are no known records of existing or potential harm to the California leaf-nosed bat by predators or introduced pest species. Though they roost colonially, they are unlikely to be impacted by white-nosed syndrome because they do not hibernate.

Threat mechanism: This species depends for its survival on the roosts it uses, especially when nursing young and in the winter. Disturbance may cause the bats to desert their roost and likely perish unless they can find another suitable roost (Arizona Game and Fish Department 2003a). Also, destruction or modification of the roost may make it unusable to the bats.

### Management Needs

General: Restricting human disturbances to roosts is a key management priority for this species. In addition, studies to determine home range, foraging areas and distances, and local and seasonal movement will augment current understanding of this species. Review of historical studies of roost sites and disturbance are also necessary to fully

comprehend the management needs of this species (Arizona Game and Fish Department 2001g). Within the species' range, surveys for—and protection of—roosts may be appropriate. California leaf-nosed bats have been shown to accept properly designed gates at roost sites (Arizona Game and Fish Department 2003a).

Current protective measures: Two laws provide some measure of protection at cave roosts, subject to enforcement capability. The Federal Cave Protection Act of 1988 prohibits persons from activities that "destroy, disturb, deface, mar, alter, remove, or harm any significant cave or alters free movement of any animal or plant life into or out of any significant cave located on Federal lands, or enters a significant cave with the intent of committing any act described …". The Arizona Revised Statute (ARS)13-3702 makes it a class 2 misdemeanor to "deface or damage petroglyphs, pictographs, caves, or caverns." Activities covered under ARS 13-3702 include "kill, harm, or disturb plant or animal life found in any cave or cavern, except for safety reasons." Of course, the effectiveness of these laws in protecting bat roosts is related to enforcement efforts, which are currently minimal. If done improperly, protective measures such as gating may actually lead to abandonment (U. S. Fish and Wildlife Service 2005a), so guidelines need to be developed.

Corridor and migratory needs: As this is not a migratory species, no known migration corridor needs exist for this species. However, some evidence indicates that this species forages primarily along desert washes, and so foraging corridors may be a need. It is not unusual for California leaf-nosed bats to move between roost sites, and some roosts are used more during some seasons than at others.

Key relationships: The California leaf-nosed bat is found primarily in Sonoran Desert Scrub, both major divisions, at elevations below 4,000 feet, most occurring at elevations below 2,500 feet (Arizona Game and Fish Department 2001g).

Existing monitoring and research programs: No known monitoring or on-going research efforts are taking place for this species.

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-9): 180.

Acres of mitigation habitat within the current portfolio of conservation lands: 12,632.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the California leaf-nosed bat.

- Protect existing known roosts and foraging habitat from all potentially detrimental activities on County preserve lands.
- Investigate the purchase of valid mining claims for mines with known roosts; look into opportunities for creating roost preserves. Each roost will be considered for gating, and where appropriate, proper gates will be installed.

- On County preserves, restrict discretionary activities near known roosts if this can be accomplished without disclosure of roost locations.
- Evaluate known roosts of this species on County-controlled mitigation lands for conditions and needs for structural stabilization. Where appropriate, such stabilization will be carried out using techniques that minimize disturbance and alteration of conditions.
- Encourage the purchase and installation of new lighting within the cave tour portion of Colossal Cave Mountain Park to reduce stress on bats and to promote higher abundance and occupancy.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

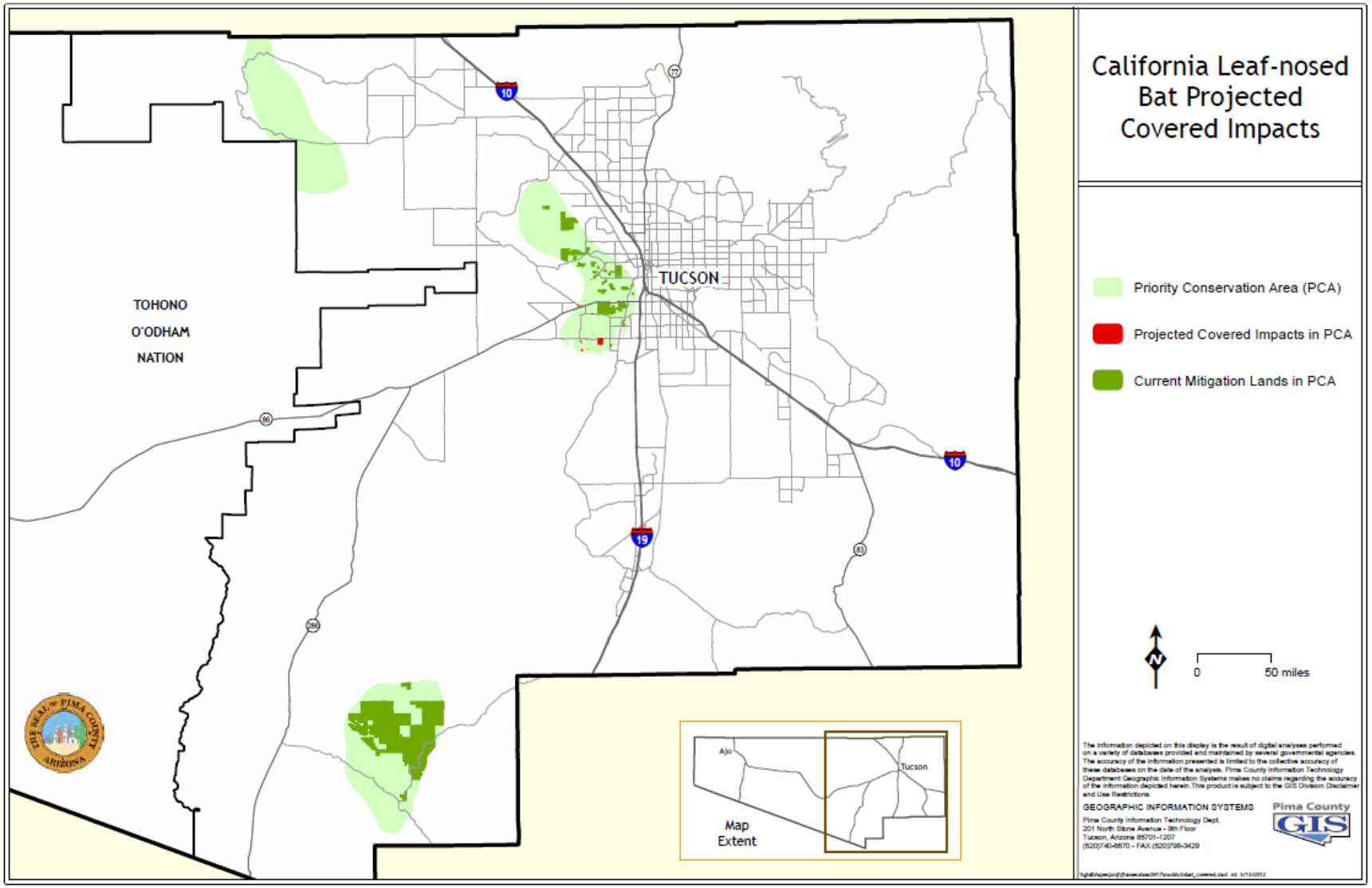



**Figure A-9. Map of projected impacts and mitigation for the California leaf-nosed bat.**

## Pale Townsend's big-eared bat (*Plecotus townsendii pallescens*)

### Conservation Status

Endangered Species Act Status: None. Former FWS Category 2 candidate.

State: Wildlife of Special Concern in Arizona.

Other: USFWS Species of Concern; "Red" Priority Species by Western Bat Working Group.

Rankings: G4T4, S3S4.

### Description

The pale Townsend's big-eared bat is a pale yellowish brown, medium-sized bat, forearm 1/56 to 1.88 inches (39.0-47.0 mm), wingspan averaging between 11.5 and 12.5 inches (29 31 cm), and body length of 2 to 2.5 inches (5 to 7 cm). It has large, hairless ears, 1.2 to 1.6 inches (30.0-39.0 mm) in length. It has a large glandular lump on each side of the nose (Noel and Johnson 1993, Arizona Game and Fish Department 2001i).

### Distribution and Trend

This species is known from western North America from southern British Columbia south through the Pacific Northwest and southern California on the west and the Black Hills of South Dakota and West Texas on the east through the Mexican uplands to the Isthmus of Tehuantepec in southern Mexico. Isolated (and presumable relict) populations also exist in the Ozark Mountains of Oklahoma, Missouri, Arkansas, Kentucky, Virginia, and West Virginia (Hoffmeister 1986, Noel and Johnson 1993, Arizona Game and Fish Department 2001i). Townsend's big-eared bat is widespread in Arizona, although it is not considered common anywhere, and is least common in northeastern grasslands and southwestern desert areas (Arizona Game and Fish Department 2003a).

In Pima County, this species is frequently found in small groups in inactive mines and caves, and occasionally in buildings. It has been found across a wide elevational range in Pima County (Arizona Game and Fish Department 2003e). This species has been observed at Colossal Cave Mountain Park, Rincon Mountains (Davis and Sidner 1992, Swann and Powell 2006), Tucson Mountains (Swann and Powell 2007), Sierrita Mountains (Snow et. al. 1996), Baboquivari Mountains (Hoffmeister 1986), Santa Rita

Mountains (Snow et al. 1996, WestLand Resources Inc 2009), and Organ Pipe Cactus National Monument (Cockrum 1981, Cockrum and Petryszyn 1986). There are likely roosts that are not currently identified in the Tortolita, Tucson, and Silverbell mountains.

Population trends for Townsend's big-eared bats are unclear, though there have been losses or reductions of maternity colonies reported (Arizona Game and Fish Department 2003a).

### Habitat Requirements

This species is known to use caves, mines and buildings (generally abandoned or inactive) through a range of elevations and vegetation communities. It has been found in Sonoran Desert Scrub (both Arizona Upland and Lower Colorado River Valley subdivisions), Madrean Evergreen Woodland (oak woodland, oak/pine, and pinyon/juniper), and coniferous forests in Arizona (Hoffmeister 1986, Noel and Johnson 1993, Arizona Game and Fish Department 2001i). This species is frequently found in inactive mines and caves, and occasionally in buildings. Night roosts may often be in abandoned buildings. In winter, they hibernate in cold caves, lava tubes and mines mostly in uplands and mountains from the vicinity of the Grand Canyon to the southeastern part of the state (Arizona Game and Fish Department 2001i). The bats prefer to hang from open ceilings at roost sites and do not use cracks or crevices. At maternity roosts these bats apparently prefer dim light near the edge of the lighted zone (Arizona Game and Fish Department 2001i). Winter roosts generally contain fewer individuals (usually singles or small groups and, in Arizona, occasionally as many as 50) than summer roosts (Arizona Game and Fish Department 2003a).

### Current and Potential Threats

Disturbance of roosts appears to be the most important threat. Renewed mining, closure and sealing of abandoned mines naturally or for hazard abatement, and, possibly, the use of non-target pesticides are all considered threats (Arizona Game and Fish Department 2001i). Historical alteration in the vegetation community along the Lower Colorado River is considered to have changed the available food supply for this species (U.S. Bureau of Reclamation 2008), and similar conditions have occurred along the Santa Cruz River. Because this species hibernates in cold caves, it is thought to be the only species of bat covered under the County's MSCP that may susceptible to white-nosed syndrome.

### Management Needs

General: Management needs for this species include:

- Development of consistent, effective monitoring methods;
- Surveys to identify important summer and winter roost sites and foraging areas;
- Surveys to locate, census, and monitor maternity colonies;
- Protection of maternity and hibernaculum roosts using bat-friendly gates and weathering zone stabilization;

- Establishing buffer zones to protect maternity roosts from human access during roost occupancy; and mitigation against or prevention of renewed mining activity near significant roosts and foraging areas (Arizona Game and Fish Department 2003a)
- Monitoring for the occurrence of white-nosed syndrome in Pima County and other areas of Arizona to determine if or when it may be present.

Current protective measures: Human access to some sites is limited by policy, procedure, and terrain. Some caves and mines known to have this species have been gated, but the extent to which this has occurred in Pima County is not known.

Corridor and migratory needs: None are known for this species. It does use different roosts in winter and summer, so suitable roosts may be considered migratory requirements.

Key relationships: This species is dependent on caves and mines for roosts, and on moths for food.

Existing monitoring and research programs: No species-specific studies are known to be currently underway in southern Arizona.

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-10): 1,591.

Acres of mitigation habitat within the current portfolio of conservation lands: 26,173.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the pale Townsend's big-eared bat:

- Where possible, protect existing known roosts and foraging habitats of this species in County preserves from all potentially detrimental activities.
- Investigate the purchase of valid mining claims for mines with known roosts; look into opportunities for creating roost preserves. Each roost will be considered for gating, and where appropriate and financially feasible, proper gates will be installed.
- On County-controlled mitigation lands, restrict discretionary activities within 1 kilometer of known summer roosts during May to September, and known hibernacula from October to April, if this can be accomplished without disclosure of roost locations.
- Evaluate known roosts of this species, including buildings, on County-controlled mitigation lands for conditions and needs for structural stabilization. Where appropriate, such stabilization will be carried out using techniques that minimize disturbance and alteration of conditions.
- Implement white-nosed syndrome prevention protocol during all roost visits.

- Encourage the purchase and installation of new lighting within the cave tour portion of Colossal Cave Mountain Park to reduce stress on bats and to promote higher abundance and occupancy.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

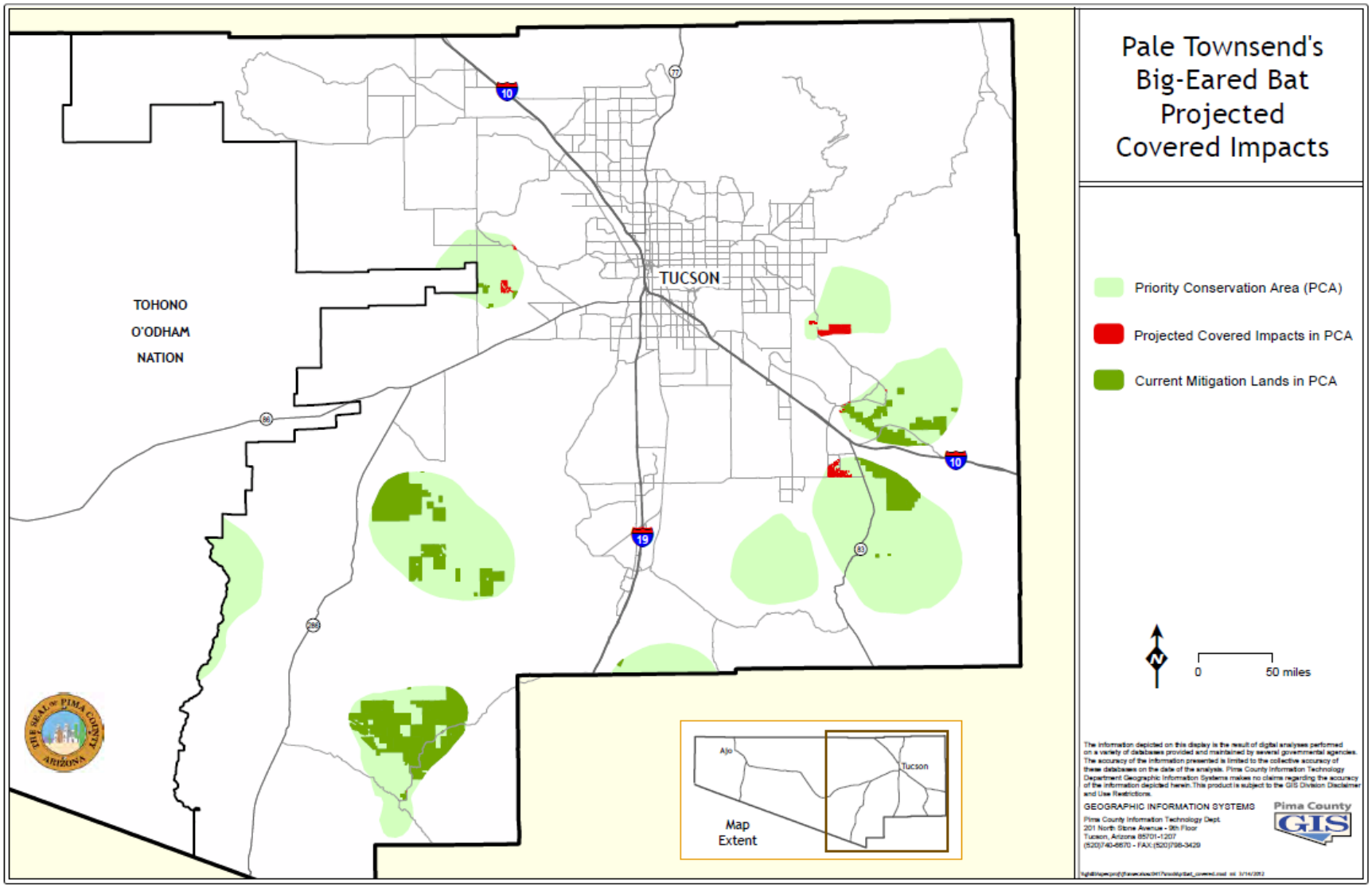
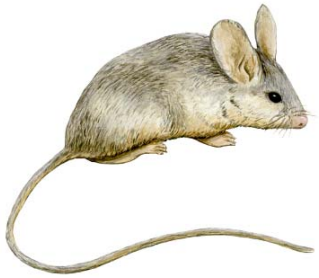



**Figure A-10. Map of projected impacts and mitigation for the pale Townsend's big-eared bat.**

## Merriam's mouse (*Peromyscus merriami*)

### Conservation Status



Endangered Species Act Status: None.

State: Wildlife of Special Concern in Arizona.

Other: None.

Rankings: G5, S3.

### Description

Merriam's mouse has a pale gray body, faintly washed with tawny; the belly is creamcolored, and the tail is long, thinly haired and bicolored. There are 4 mammae. The head and body are 3.8 to 4.0 inches (97 to 102 mm) long, and the tail is 4.0 to 4.8 inches (102 to 122 mm) long (Burt and Grossenheider 1976). Merriam's mouse is very similar to the Cactus mouse (*P. eremicus*), and differs in having a slightly larger size, a ventrally curving baculum (as opposed to the dorsally curving baculum of *P. eremicus*) and a longer hind foot (Hoffmeister 1986).

### Distribution and Trend

Merriam's mouse was found in the large mesquite forests along rivers throughout Pinal, Pima, and Santa Cruz counties in Arizona and into Sonora, Mexico (Arnold 1940). In Arizona it has been found in the south-central part of the state, from just north of Florence at the north, southeast of Tucson to the east, and Quitobaquito to the west (Hoffmeister 1986, Arizona Game and Fish Department 2001h).

Most areas where Merriam's mice were historically present have been altered and recent records are lacking as to whether the species persists in these areas. These areas include the Santa Cruz River area (San Xavier) before the bosques were removed in the early part of the twentieth century for firewood (Phillips et. al. 1964), and at Wilmot Station southeast of Tucson where they were formerly taken in large numbers (Biota Information System of New Mexico 2008e). It now occurs in isolated pockets throughout the County, including at Organ Pipe Cactus National Monument (Petryszyn and Russ 1996) and in a number of sites in eastern Pima County including the Tucson Mountains, Cienega Creek, the northwest foothills of the Santa Rita Mountains, and the Altar Valley (Kingsley 2006). Hoffmeister (1986) reports the species from historical Ft. Lowell, Sabino Canyon, Baboquivari Mountains, and near Arivaca.

### Habitat Requirements

Merriam's mice are known primarily from heavy, forest-like stands of mesquite (bosques). They have also been found in thick stands of mesquite, cholla, prickly pear, paloverde, and grasses (Hoffmeister 1986). There is no information on the specific home range needs of this species.

### Current and Potential Threats

General: The greatest threat to Merriam's mouse is loss and degradation of mesquite-forest habitat.

Existing and potential pest species: There are no identified pest species. However, near human habitation, feral cats may impact this species, and house mice may compete with it.

Threat mechanism: Loss of habitat through cutting of firewood or clearing for grazing or other development. Groundwater depletion in many places resulted in loss of formerly lush riparian areas with large mesquites or dense vegetation. Reestablishment and regeneration of suitable habitat for this species may be precluded by groundwater depletion.

### Management Needs

General: Preservation of existing mesquite bosques and reestablishment of mesquite bosque habitat may benefit the Merriam's mouse, if it persists or can be reintroduced.

Current protective measures: The Merriam's mouse has been designated as a Species of Special Concern by the State of Arizona (Arizona Game and Fish Department 2006c). This status affords no specific protection. Some of its potential habitat lies within protected areas, where mesquite collecting and habitat destruction may be regulated.

Corridor and migratory needs: There is no known information on corridor or dispersal needs. It is possible that this species requires large contiguous mesquite bosques along river corridors for its long-term survival, but this has not been demonstrated. The species does not migrate.

Key relationships: Merriam's mouse is apparently totally dependent on large mesquite trees. It may also require a mixture of other plants such as cacti, trees, and grasses.

Existing monitoring and research programs: There are no known monitoring and research programs for this species. A long-term program of trapping for small mammals is continuing at Organ Pipe Cactus National Monument (Organ Pipe Cactus National Monument 2006b).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-11): 390.

Acres of mitigation habitat within the current portfolio of conservation lands: 8,360.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Merriam's mouse.

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat, as described in Chapter 4.
- Restore mesquite bosque and associated communities, where feasible.
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations to benefit the species.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

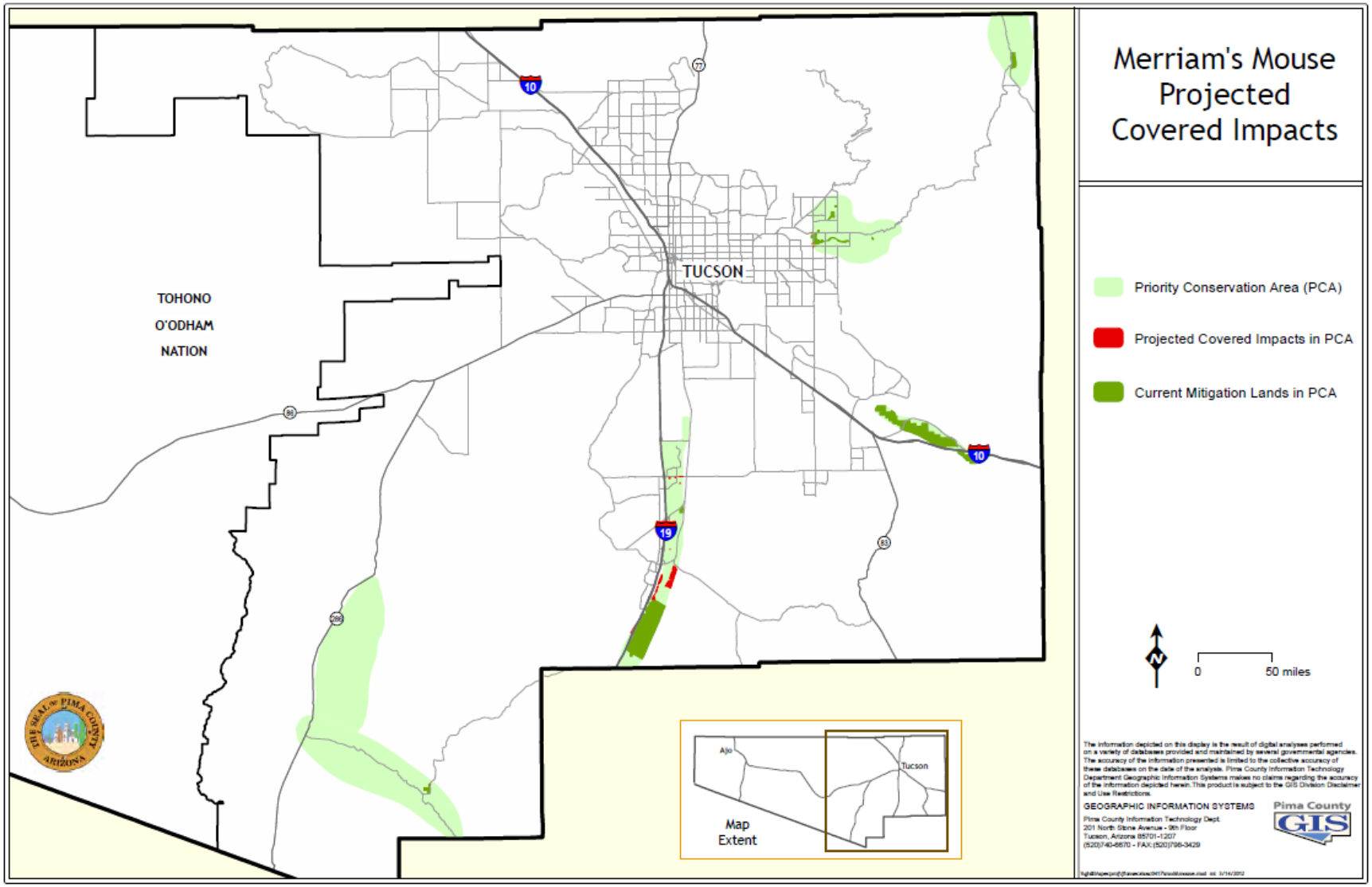



**Figure A-11. Map of projected impacts and mitigation for the Merriam's mouse.**

# Birds

## Burrowing owl (*Athene cunicularia hypugaea*)

### Conservation Status

Endangered Species Act Status: None.

State: None.

Other: Nine states have listed the species as endangered, threatened, or of special concern. Migratory bird under the Migratory Bird Treaty Act.

Rankings: G4, TU, S4.

### Description

The burrowing owl is a small owl that measures from 7.5 to 10 inches (19 to 25 cm) in length and weighs about 5 ounces (150 g). The legs are long and sparsely feathered below the tibiotarsal joint. It has a round head with no ear tufts and a distinct oval facial ruff, framed by a broad, buffy white eyebrow-to-malar stripe on the interior part. The iris is usually bright lemon yellow. The wings are relatively long and rounded, with 10 brown and buffy white barred rectrices. The dorsum is brown; back, scapulars and crown profusely spotted with buffy white. The throat and undertail coverts are white; and the remainder of underparts of adults are buffy white with broad barring on both sides. Females are generally darker than males overall, particularly in worn plumage (Haug et. al. 1993).

### Distribution and Trend

The historic range of the western burrowing owl (*Athene cunicularia hypugaea*) includes Arizona, California, Colorado, Idaho, Iowa, Kansas, Louisiana, Minnesota, Montana, North Dakota, Nebraska, New Mexico, Nevada, Oklahoma, Oregon, South Dakota, Texas, Washington, Wyoming, Canada, and Mexico. Migratory populations breed in North America and may winter as far south as Guatemala or El Salvador (Biota Information System of New Mexico 2008a).

In Arizona the burrowing owl has been recorded from Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott and Tonto National Forests (BISON-M 2000) (Arizona Game and Fish Department 2001c). In western Pima County

they breed on and near to the Barry M. Goldwater Range (Corman and Wise-Gervais 2005) and have been observed at Organ Pipe Cactus National Monument (Groschupf et. al. 1988). Burrowing owls have been well studied in eastern Pima County (Brown and Mannan 2002). They are found primarily in three areas of the County: (1) in the Altar Valley north to the Santa Cruz River in Marana; (2) along the Santa Cruz River, primarily south of downtown Tucson to the Santa Cruz County line, and (3) in and around the Davis-Monthan Air Force Base (Estabrook 1998, Arizona Game and Fish Department 2001c, Alanen 2003, Corman and Wise-Gervais 2005, Garcia and Conway 2007, Town of Marana 2009, Tucson Bird Count 2012).

Burrowing owls have declined in abundance throughout most of their range (Haug et al. 1993, Brown and Mannan 2002, Klute et. al. 2003, Tucson Bird Count 2012). In the western states, 54% of 24 jurisdictions reported burrowing owl populations decreasing, and there were no reported increases (U.S. Bureau of Reclamation 2008).

### Habitat Requirements

Within their geographic range, burrowing owls inhabit open areas such as grasslands, pastures, coastal dunes, desert scrub, and the edges of agricultural fields. They also inhabit golf courses, airports, cemeteries, vacant lots, and road embankments, wherever there is sufficient friable soil for a nesting burrow (Haug et al. 1993, Estabrook 1998). Agricultural areas such as fields and croplands often provide optimal habitat for burrowing owls, as do moderately grazed areas (Moulton et. al. 2006). Urban development in these areas may result in a loss of habitat (Klute et al. 2003).

### Current and Potential Threats

General: Predation is a major cause of mortality in burrowing owls. The dominant mammalian predators of burrowing owls are badgers (*Taxidea taxis*); other predators include opossums (*Didelphis virginiana*), weasels (*Mustela* spp.), skunks (*Mephitis* spp.), and domestic dogs and cats, and squirrels (Arrowood et. al. 2001). Avian predators include Swainson's hawks (*Buteo swainsonii*), ferruginous hawks (*B. regalis*), merlins (*Falco columbarius*), prairie falcons (*F. mexicanus*), peregrine falcons (*F. peregrinus*), great horned owls (*Bubo virginianus*), red-tailed hawks (*B. jamaicensis*) and Cooper's hawks (*Accipiter cooperii*) (Haug et al. 1993). Other observed causes of mortality include human disturbance or burrow destruction through agricultural and construction activities, collisions with vehicles (the owls habitually sit and hunt on roads at night), and toxic chemicals such as insecticides and strychnine-laced grains (often dispersed for rodent and insect pest control in agricultural areas where birds nest). Also, a decline in the population of burrowing mammals may adversely affect owls by way of a reduced number of burrows (Haug et al. 1993).

Existing and potential pest species: Burrowing owls have been reported suffering from body parasites such as lice (*Colpocephalum pectinatum*), sticktight fleas (*Echidnophaga gallinacea*), and human fleas (*Pulex irritans*). Several species of nest arthropods and fleas have been found in burrows (Haug et al. 1993). Many species of predators (listed above) are known to prey on burrowing owls.

Threat mechanism: Threats include loss of habitat through urban development in agricultural or rural areas; direct toxicity or loss of prey resulting from use of insecticides or rodenticides for pest management purposes in areas where burrowing owls breed; reduction in nest sites resulting from decreases in burrowing mammal population; and direct mortality from vehicular collisions and loss of artifical and natural burrows.

### Management Needs

General: Management measures that have been proposed for burrowing owls include protecting burrowing mammal populations to provide nesting habitat for burrowing owls; creating artificial burrows where natural burrows are destroyed or limited; providing artificial perches where limited for hunting and predator observation; and managing vegetation for foraging habitat through fire or grazing (City of Tucson Burrowing Owl Working Group 2007). Pima County populations are especially important since there has been a decrease in populations within Pima County as well as others throughout other Arizona lowlands (Brown and Mannan 2002, Klute et al. 2003).

Current protective measures: This species is protected under the Migratory Bird Treaty Act. The Migratory Bird Treaty Act makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment.

Corridor and migratory needs: No specific information is known for corridor needs for this species. Most populations of the species are migratory to some extent and this appears to be the case for Arizona populations (Haug et al. 1993), although some populations in Arizona also appear to be resident, non-migratory populations.

Key relationships: The burrowing owl nests in desert valleys and grasslands and is often found in association with prairie dog colonies. However, there are no known prairie dog colonies in Pima County. Although it has not been specifically documented, it is most likely that this species depends on round-tailed ground squirrels in Pima County.

Existing monitoring and research programs: Considerable attention has been paid to this species, especially in the last 10 years and numerous research and monitoring efforts throughout its range have been undertaken (Klute et al. 2003), including in Pima County (Estabrook and Mannan 1998, Garcia and Conway 2007).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-12): 1,486.

Acres of mitigation habitat within the current portfolio of conservation lands: 2,663.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the burrowing owl:

- Pima County will continue to apply avoidance and minimization measures as described in Chapter 4;
- Pima county will place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4.
- Offer to collaborate with the Town of Marana and City of Tucson HCPs to develop management strategies for the protection of this species.
- Collaborate with Federal partners and conservation groups (e.g., Tucson Audubon Society) to develop guidelines for successful implementation of artificial burrows.
- On County preserve lands, enact a 100-m buffer “restricted activity zone” around known nests during the nesting period. Allow only short duration “pass through” activities.
- Request clearance surveys prior to CIP projects constructed in Priority Conservation Areas.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

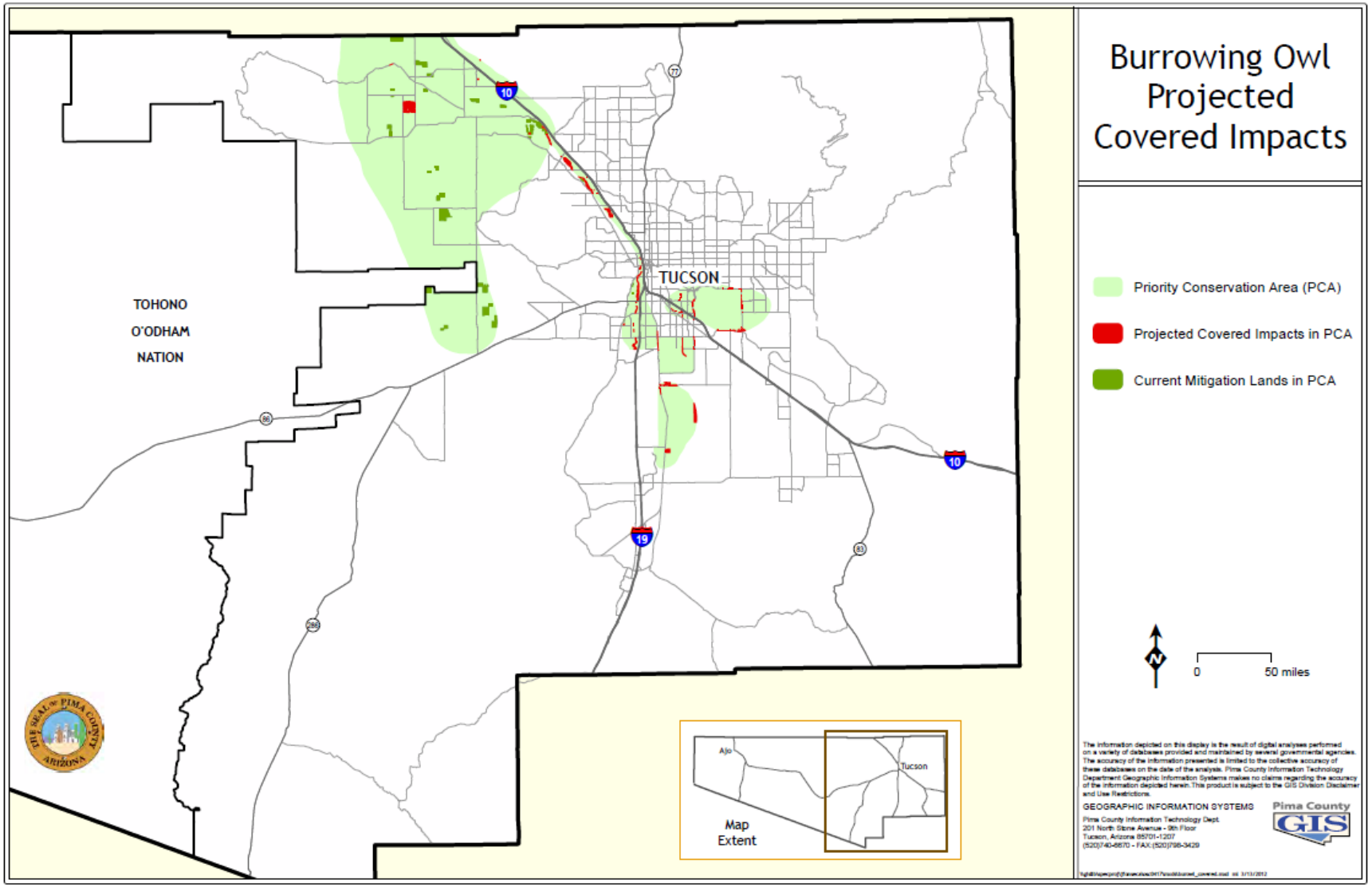



**Figure A-12. Map of projected impacts and mitigation for the burrowing owl.**

## Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)

### Conservation Status

Endangered Species Act Status: No current protected status, but it was listed as Endangered until 2006. FWS produced a negative 12-month Finding in 2011 related to a 2007 petition to relist. The 12-month Finding is currently under litigation.

State: Wildlife Species of Special Concern in Arizona.

Other: U.S. Forest Service Region 3 Sensitive Species

Rankings: G5, T3, S1.

### Description

The cactus ferruginous pygmy-owl is a small bird, averaging 6.5 inches (16.5 cm) in length and weighing 2.5 ounces (70 g). The owl is gray-brown or rufous (reddish) brown in color. The head is small, compared to some other owls, and it lacks ear tufts. The eyes are yellow. The crown is finely streaked with flecks of buff. The tail is relatively long compared to those of other owls. There are subtle differences in coloration and size between the sexes (females are larger than males), and juveniles have somewhat different plumage from adults (Cartron and Finch 2000).

### Distribution and Trend

The historical distribution and decline of the species was described by Johnson et. al. (2000). Evidence suggests that the species is is at the edge of its range in Arizona, and that most of its range is in Mexico, Central, and South America. The exact limits of distribution of each subspecies are not clearly resolved. Most evidence indicates that the species was historically found primarily, if not exclusively, in riparian areas, including xeroriparian washes. Most current locations occur in Sonoran desertscrub, semidesert grasslands, and the drainages within those communities. Baseline information is limited, and most of the early bird studies were fairly concentrated along rivers. It is possible, although not certain, that the species occurred primarily along rivers and may have also occupied desert scrub. Records of the species extend along the southern Arizona river valleys, as far north as New River, north of Phoenix, west to Agua Caliente on the Gila River, and east to (possibly) the

confluence of the San Francisco and Gila Rivers. At one time, it was common in the Phoenix area.

The current distribution and abundance in Pima County is unknown and the population in southern Arizona and northern Sonora, Mexico has been declining for approximately 10 years. In 1999, a total of 78 individual owls were detected in Arizona in the Organ Pipe Cactus National Monument, Tohono O'odham Nation, Altar Valley, northwest Tucson and the Tortolita Mountains, and the Roskruge Mountains (Richardson et. al. 2000). The owls are thought to currently persist in three areas of Pima County: the Tohono O'odham Nation, the Altar Valley, and in Organ Pipe Cactus National Monument. Monitoring has taken place in the Altar Valley of Sonora, Mexico since 2000 where a documented decline in occupancy and abundance has been noted in most years (Flesch and Steidl 2006, Flesch 2008a, Flesch 2008b).

### Habitat Requirements

Pygmy owls are found in a mix of dense thicket or woodland vegetation types in the Sonoran Desert, requiring saguaros or trees that are large enough for nesting cavities. A variety of multilayered vegetation cover and canopy cover are important to provide habitat for the owl's prey. Most of the known pygmy owls detected since 1993 were found in an area that is a mixture of private, State, and BLM lands. Residential development within occupied areas ranges from scatter ranches on hundreds of acres to six residences per acre. Livestock grazing and recreational use occur in the area (Richardson et al. 2000). Other areas that are relatively more pristine, with fewer human residences and less intensive human activities have fewer or even no records of cactus ferruginous pygmy-owls.

### Current and Potential Threats

General: Threats were defined as historic loss of riparian habitat, and current threats are usually summarized as "development" and "other potential impacts." The species was listed as endangered because of historical and current evidence suggesting a significant population decline had occurred in Arizona and that the owl was nearly extirpated. Loss and alteration of the owl's habitat was identified as the primary threat to the remaining population (U.S. Fish and Wildlife Service 1997b). Specific causes of human-related deaths of individual owls are not well known, but were speculated to include casualties caused by pest control, pollution, collision with cars, TV towers, and glass windows, electrocution by power lines, and cat predation (Abbate et. al. 2000).

Existing and potential pest species: There has been some speculation that the introduced house sparrow and European starling may compete for nest cavities with cactus ferruginous pygmy-owls, but this has not been substantiated (Cartron et al. 2000). Several species of native birds have also been mentioned as potential competitors for nest cavities and raiders of prey caches (Cartron et al. 2000).

Threat mechanism: Historical habitat losses, current habitat losses and alterations, reduction in prey density, and competition have all been mentioned as threats. Also,

the possibility of natural fluctuations of a species at the edge of its range has been raised (Johnson et al. 2000). Drought and predation play a role in reduced pygmy-owl productivity. There is an inherent risk of extinction in small populations due to stochastic variation in demographic parameters, sex ratio, genetic diversity, environmental conditions and disease (Cartron et al. 2000).

### Management Needs

General: Scientific understanding of management needs is lacking. Specific recommendations have been made to increase and intensify surveys and to centralize information. Specifically called for are conducting surveys within a range of housing development patterns and sites with other types of human activities to clarify the levels and design of human activities tolerated by cactus ferruginous pygmy-owls (Richardson et al. 2000; Cartron et al. 2000).

Current protective measures: Since the delisting of the species, there are no protective measures beyond what might be afforded by the Migratory Bird Treaty Act.

Corridor and migratory needs: None are positively known. It has been speculated that loss of more-or-less continuous riparian corridors may have been the cause of the species decline in Arizona. Although it has been stated that the species is not migratory (U.S. Fish and Wildlife Service 1997b), habitat connectivity is needed to facilitate dispersal and is important in maintaining populations of pygmy owls which generally function as metapopulations.Key relationships: This species often uses former woodpecker nest sites for nest holes in Arizona (Catron et. al. 2000).

Existing monitoring and research programs: Since the species was delisted, the number of surveys and monitoring efforts has declined significantly in Arizona. Glenn Proudfoot continues to conduct long term monitoring of pygmy owls in Texas. The longest-running effort in Mexico is by Aaron Flesch in northern Sonora, Mexico (Flesch 2008a, Flesch 2008b).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-13): 7,908.

Acres of mitigation habitat within the current portfolio of conservation lands: 41,795.

### MSCP Management and Conservation Commitments

Pima County has spent considerable resources on this species by funding surveys, research (genetic work), and telemetry and habitat analysis studies. Pima County will continue this commitment by working with the USFWS to develop a set of Permit coverage conditions for this species. Pima County will pursue additional management actions and conservation commitments for the cactus ferruginous pygmy owl:

- Pima County will apply avoidance and minimization measures as described in Chapter 4;

- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- Maintaining permeability will be the first priority for on-site CLS set asides for covered subdivisions and development plans under this Section 10 permit that occur within key Special Species Management Areas.
- Support and participate in research experiments and other scientific efforts to benefit and increase knowledge of this species in collaboration with the USFWS, AGFD, and other partners.
- Implement the Floodplain Ordinance to minimize loss of habitat, as described in Chapter 4.
- Facilitate the release of captive-bred birds on Pima County lands, if such a program is carried out.
- If possible, work with citizen's group to build and install nest boxes on County-owned or managed properties that the USFWS deems appropriate for such use.
- On County-owned lands, enact a 250 m buffer "restricted activity zone" around known nests during the nesting period. Allow only short duration "pass through" activities.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database..

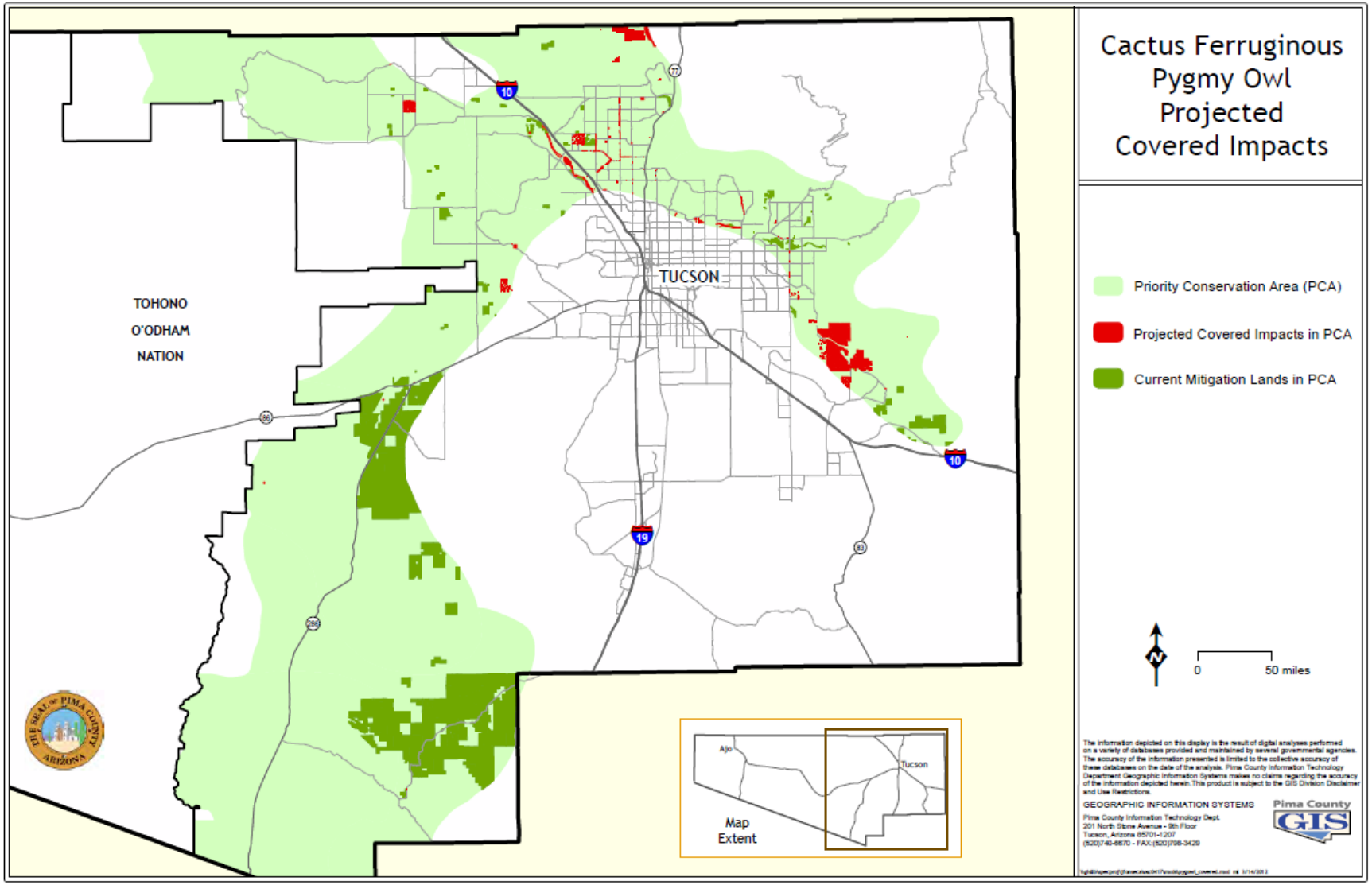



**Figure A-13. Map of projected impacts and mitigation for the cactus ferruginous pygmy owl.**

## Rufous-winged sparrow (*Aimophila carpalis*)

### Conservation Status

Endangered Species Act Status: None.

State: None.

Other: Species of Special Concern in Utah; Migratory bird under the Migratory Bird Treaty Act.

Rankings: G4,S3.

### Description

The rufous-winged sparrow is a small (5.1-5.5 inches [13-14 cm], 15 g), distinctly marked sparrow. The adult has a gray head with black moustachial and malar stripes, narrow rufous postocular stripe, and rufous crown streaked with gray, often with a vague gray median stripe; grayish brown back streaked with dark brown; unstreaked pale gray underparts; dark brown wing-feathers edged buffy brown or rufous (on tertials), with two indistinct buffy white wing-bars, and rufous lesser wing-coverts (often concealed). The tail is long and rounded, and the bill is distinctly bicolored, with the lower mandible orange-pink and the upper mandible dusky (except along cutting edges, which are the same color as the lower mandible). The sexes are similar, and the adult plumages remain similar throughout the year. The juvenile plumage is similar but buffier, with distinct spotting or streaking on underparts, head streaked brown, less distinct facial pattern, and all dark bill (Lowther et. al. 1999).

### Distribution and Trend

The rufous-winged sparrow is year-round resident from south-central Arizona (Pinal County) south along the Pacific slope of Mexico through central Sonora to central Sinaloa. In Arizona, it is a resident in central and southern portions of eastern Pinal County (Red Rock, Oracle Junction), and northern portion of the San Pedro River near Winkelman (Lowther et al. 1999). The rufous-winged sparrow is found in the eastern two-thirds of Pima County including the Santa Cruz and Avra valleys, and the foothills of the major mountain ranges of eastern Pima County (Phillips et al. 1964, Lowther et al. 1999, Corman and Wise-Gervais 2005, Powell 2006, 2007, Tucson Bird Count 2012). Arizona Breeding Bird Atlas records indicate that this species is fairly widespread in appropriate habitat in Pima County, and that there are no specific concentrations that should be deemed especially significant.

Comparing historical distribution to current distribution shows a species that is highly variable. Rufous-winged sparrows were found by Bendire near old Fort Lowell, Tucson, in “the early part of June,” 1872. By 1884, the species had disappeared from the area. It was considered by the American Ornithologist’s Union to be extirpated in Arizona due to overgrazing. The species reappeared, or was rediscovered, in the Tucson area in 1936 and has been recorded locally with some consistency (Phillips et al. 1964, Lowther et al. 1999), and is now fairly common and widespread (Corman and Wise-Gervais 2005).

### Habitat Requirements

According to results from the Arizona Breeding Bird Atlas (Corman and Wise-Gervais 2005), habitats in which this species was recorded and the proportion of the 64 records that were from each habitat are Arizona Upland Biome 73 percent, Lower Colorado River Biome 1.5 percent, Semidesert Grassland 6 percent, Sonora Savanna Grassland 3 precent, Urban/Agricultural (parks) 1.5 percent, Sonoran Riparian Deciduous Forest and Woodlands 3 percent, and Sonoran Riparian Scrubland 8 percent. Several records were from residential, rural, and park situations, indicating that this species may not be excluded by some level of human use and modification of the landscape.

Rufous-winged sparrows use flat or gently hilly Sonoran desert scrub and Sinaloan thorn scrub, characterized by scattered spiny trees and shrubs. This species apparently does not use the steeper hillsides. Grasses are essential components of the species' habitat. Hackberry (*Celtis* sp.), cholla species (*Opuntia* spp.), and paloverde (*Cercidium microphyllum*) almost invariably are present (Lowther et al. 1999). Territories typically include some wash (riparian) habitat. Areas near Tucson, where the species has been found, include swales of tobosa grass, desert (dry) washes, riparian (flowing water) areas, farmland (brush and cleared areas along irrigation ditches) and deep-soil sites (spaced mesquite trees with many clumps of sacaton grass). Small numbers occur in oak savannahs at higher elevations.

### Current and Potential Threats

General: Loss of grassland habitat as a result of overgrazing and urban development is believed to have had the greatest effect on populations (Latta et. al. 1999). Overgrazing in the desert habitats was alleged to have caused the local extirpation of the species in the 1880s from at least part of its range (Phillips et al. 1964). Apparent recovery of this species over the past 50 years may be related, at least in part, to improved grazing management.

Existing and potential pest species: Parasitism by brown-headed cowbirds was noted in as many as one-half of monitored nests at the time of the rufous-winged sparrow's discovery, but has been reported infrequently since then. A study conducted in 1969 found rates of brood parasitism to be 7 cowbird eggs reared out of 90 sparrow nests (Lowther et al. 1999).

Threat mechanism: Loss of habitat through urban development or overgrazing.

### Management Needs

General: Arizona Partners in Flight (a state, Federal, and private partnership for conservation of native land birds) developed a conservation plan for key breeding, winter and resident birds. In that plan, rufous-winged sparrow is recognized as a "priority species" and serves as one of the representative species for Lowland Grassland Priority Habitat (Latta et al. 1999). Specific management needs, beyond protection of habitat from direct impacts of development and overgrazing, are not currently known.

Current protective measures: None.

Corridor needs: No information is available to support conclusions or conjecture with regard to corridor needs.

Key relationships: Rufous-winged sparrows require flat or gently hilly desert grasslands with scattered trees or shrubs and grass of various species. They require seeds and arthropods for food. During hot hours in spring and summer, they forage in the deep shade portion of shrubs. When flushed by humans, rufous-winged sparrows generally fly to spiny shrubs or cacti (Lowther et al. 1999). More specific dependent relationships have not been demonstrated. This species is an occasional host of the brown-headed cowbird. There is no information on the kinds of predators that are likely to impact this species. Population fluctuations and survivorship appear to be closely tied to rainfall amounts and timing (Lowther et al. 1999).

Migratory requirements: Rufous-winged sparrows are nonmigratory, although individuals may move a short distance in winter months in search of food (Lowther et al. 1999).

Existing monitoring and research programs: No species-specific monitoring or research is currently known.

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-14): 19,747.

Acres of mitigation habitat within the current portfolio of conservation lands: 37,237.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the rufous-winged sparrow:

- Pima County will apply avoidance, minimization and mitigation measures as described in Chapter 4.
- Monitor grazing on Pima County lease lands for range health and avoid over-grazing on all County-controlled mitigation lands, as indicated in Chapter 5. Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database..

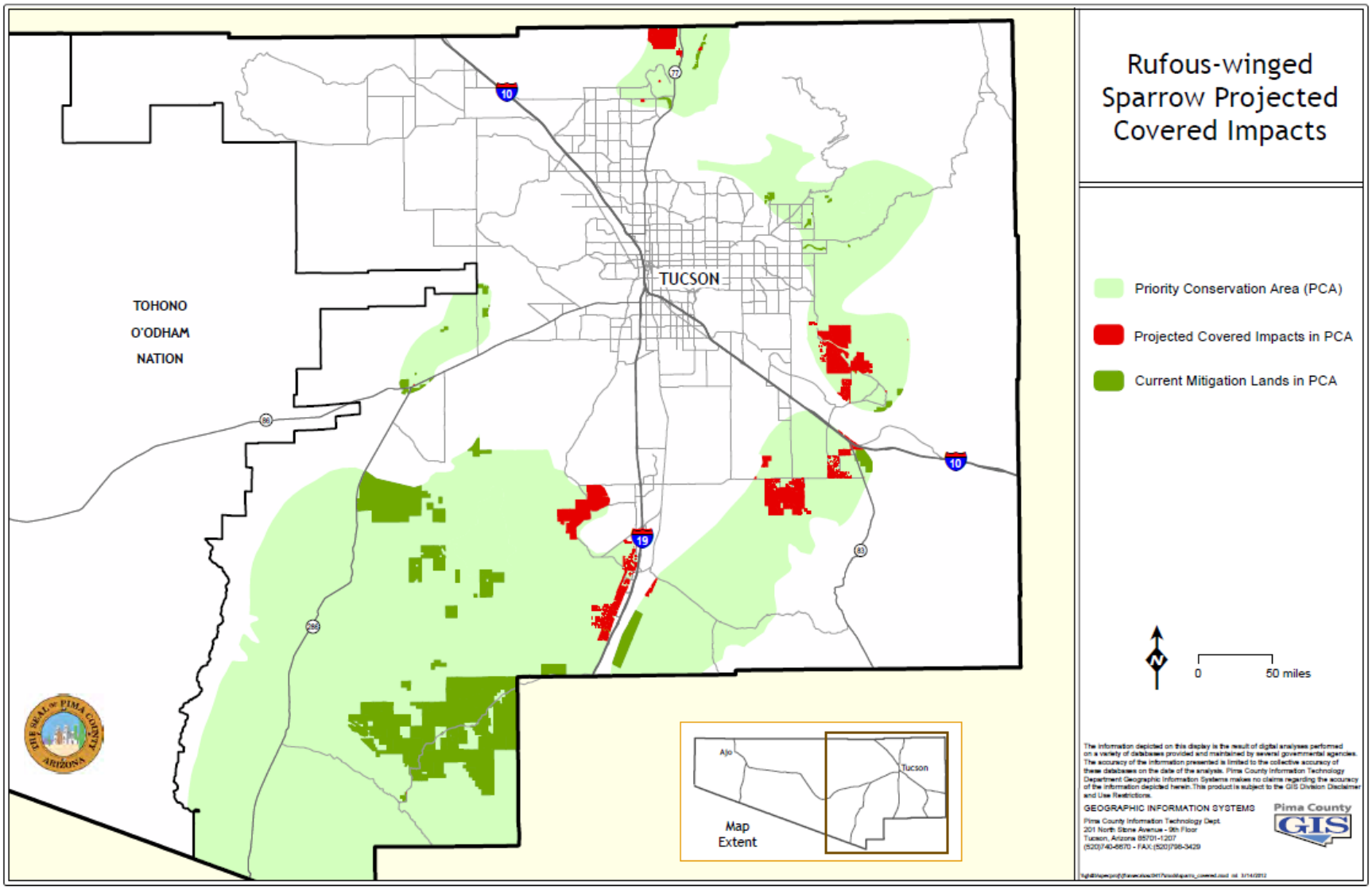



**Figure A-14. Map of projected impacts and mitigation for the rufous-winged sparrow.**

## Swainson's hawk (*Buteo swainsoni*)

### Conservation Status

Endangered Species Act Status: Former FWS Candidate.

State: Arizona Wildlife Species of Special Concern.

Other: USFWS Species of Concern; Migratory species; U.S. Forest Service Sensitive Species; restricted from international trade by CITES.

Rankings: G5, S3.

### Description

The Swainson's hawk is a large, slim-winged, long-tailed buteo. This buteo is the most variable in terms of coloration of any raptor in Arizona (Glinski and Hall 1998). The only color patterns that seem consistent are the two-toned underwing, with the leading edge appearing lighter than the trailing edge, and the white patch on the throat and forehead. The species is adapted for hunting in the open country and has more pointed wings and a longer tail than the more familiar red-tailed hawk. In a soar, the bird somewhat resembles a Peregrine Falcon with its long pointed wings, but when it is gliding, the wings are crooked like those of an Osprey. When soaring, the wings are held in a dihedral. Total length of males is 19 to 20 inches (48 to51 cm) and of females is 20 to 22 inches (51 to 56 cm), and the wingspan is 47 to 57 inches (119 to 144 cm).

### Distribution and Trends

Swainson's hawks breed throughout most of the western U.S., from northern Mexico to Alaska (The National Geographic Society 1987, England et. al. 1997). They are very rare fall visitors to the eastern U.S., and they winter primarily in South America (England et al. 1997). In Arizona, this species breeds throughout the state in suitable open grassland habitats and open desert scrub that sustains a grassland component (Glinski and Hall 1998, Corman and Wise-Gervais 2005).

The Swainson's hawk is a common breeder in semi-desert grasslands of southeastern Arizona, particularly east of Pima County (Corman and Wise-Gervais 2005). In Pima County it is an uncommon breeder in the Altar Valley and other isolated pockets of semi-desert grasslands such as in the foothills of the Santa Rita, Santa Catalina and Las Guijas Mountains and near the Pantano Wash (Nishida et. al. 2001, Hobbs 2004, Corman and Wise-Gervais 2005).

Although the nesting range has remained relatively stable, Swainson's hawks have suffered major declines in certain portions of their range, especially in California, Oregon, and Nevada (England et al. 1997, Arizona Game and Fish Department 2001d). In Arizona, data are inadequate to determine trends (Bednarz 1988).

### Habitat Requirements

Migrating Swainson's hawks are frequently seen in agricultural fields where they forage (Glinski and Hall 1998). They often can be seen resting on utility poles and fence posts. The importance of Arizona's watercourses to migrating hawks is uncertain, although migrating Swainson's hawks are regularly sighted in the valleys of the Gila and Santa Cruz rivers, from central Arizona south to Mexico (Glinski and Hall 1998). They are rarely seen in urban or suburban developed areas, woodlands, forests, or dense scrublands.

Swainson's hawks forage in open stands of grass dominated vegetation, sparse shrublands, and small open woodlands. In many parts of their range today, they have adapted well to foraging in agricultural areas (e.g.,wheat and alfalfa), but cannot forage in most perennial crops or in annual crops that grow much higher than native grasses, making prey more difficult to find (England et al. 1997).

Although Swainson's Hawk will nest in almost any tree of suitable size, in Arizona and adjacent Mexico, vegetation used for nesting include: catclaw acacia (*Acacia greggii*), cholla cactus (*Opuntia* sp.), mesquite (*Prosopis glandulosa*), desert willow (*Chilopsis linearis*), Joshua tree (*Yucca brevifolia*), creosotebush (*Larrea tridentata*), paloverde (*Cercidium* sp.), ironwood (*Olneya tesota*), and saguaro (*Carnegiea gigantea*) (Glinski and Hall 1998).

### Current and Potential Threats

General: Habitat loss, degradation, fragmentation, and use of pesticides are likely contributors to the decline of this species (Arizona Game and Fish Department 2001d). Throughout their Arizona range, Swainson's hawks must contend with habitat loss through a continually expanding human population and associated development and recreation activities (Arizona Game and Fish Department 2001d).

Existing and potential pest species: No information is available regarding predation of adults; however, predation of nestlings or fledglings by American crows, great horned owls, golden eagles, and predatory mammals has been documented (England et al. 1997).

Threat mechanism: Use of pesticides in areas of wintering hawk concentrations may significantly affect some North American breeding populations. Pesticides also reduce prey on wintering grounds and most likely impact the breeding grounds as well, depending on the setting. Direct mortality is caused by shooting, as the species is sometimes erroneously perceived as a pest, and it is often an easy target because it habitually perches on utility poles and fence posts along roads in open country.

### Management Needs

General: The health of this species on its wintering grounds in South America remains uncertain (Glinski and Hall 1998). On the breeding grounds, research is needed to

learn why populations and productivity have declined, especially in areas where apparently suitable habitat remains unoccupied (England et al. 1987).

Current protective measures: The Swainson's hawk does not receive any special Federal or state protection, although it is generally protected by provisions of the Migratory Bird Treaty Act of 1918 (Glinski and Hall 1998).

Corridor needs: During migration, Swainson's hawks rest and feed in grasslands and harvested fields, especially where grasshoppers are numerous, and often they perch on fence posts and telephone and power poles (England et al. 1997). The importance of Arizona's watercourses to migrating hawks is uncertain, although migrating Swainson's hawks are regularly sighted in the valleys of the Gila and Santa Cruz Rivers, from central Arizona south to Mexico (Glinski and Hall 1998).

Dispersal requirements: No specific dispersal requirements for this species are known.

Key relationships: Because the Swainson's hawk is an extremely versatile predator, no clear dependence on any particular prey species is noted. It is also versatile in selection of nest sites, so is not dependent on any particular tree species. However, it is closely tied to grasslands, if not dependent on them. Agricultural fields are also important resources for this species and impacts from pesticides can have a substantial impact on populations, especially on the wintering grounds.

Existing monitoring and research programs: No ongoing research and monitoring projects are known.

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-15): 11,400.

Acres of mitigation habitat within the current portfolio of conservation lands: 53,733.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Swainson's hawk:

- Pima County will apply avoidance, minimization and mitigation measures as described in Chapter 4;
- Continue to prioritize protection and acquisition of high-quality habitat;
- Where feasible, restore semi-desert grasslands by introducing wildlife fire and other methods to reduce shrub cover.
- Enact a 400 m buffer "restricted activity zone" around known nests during the nesting period. Allow only short duration "pass through" activities.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

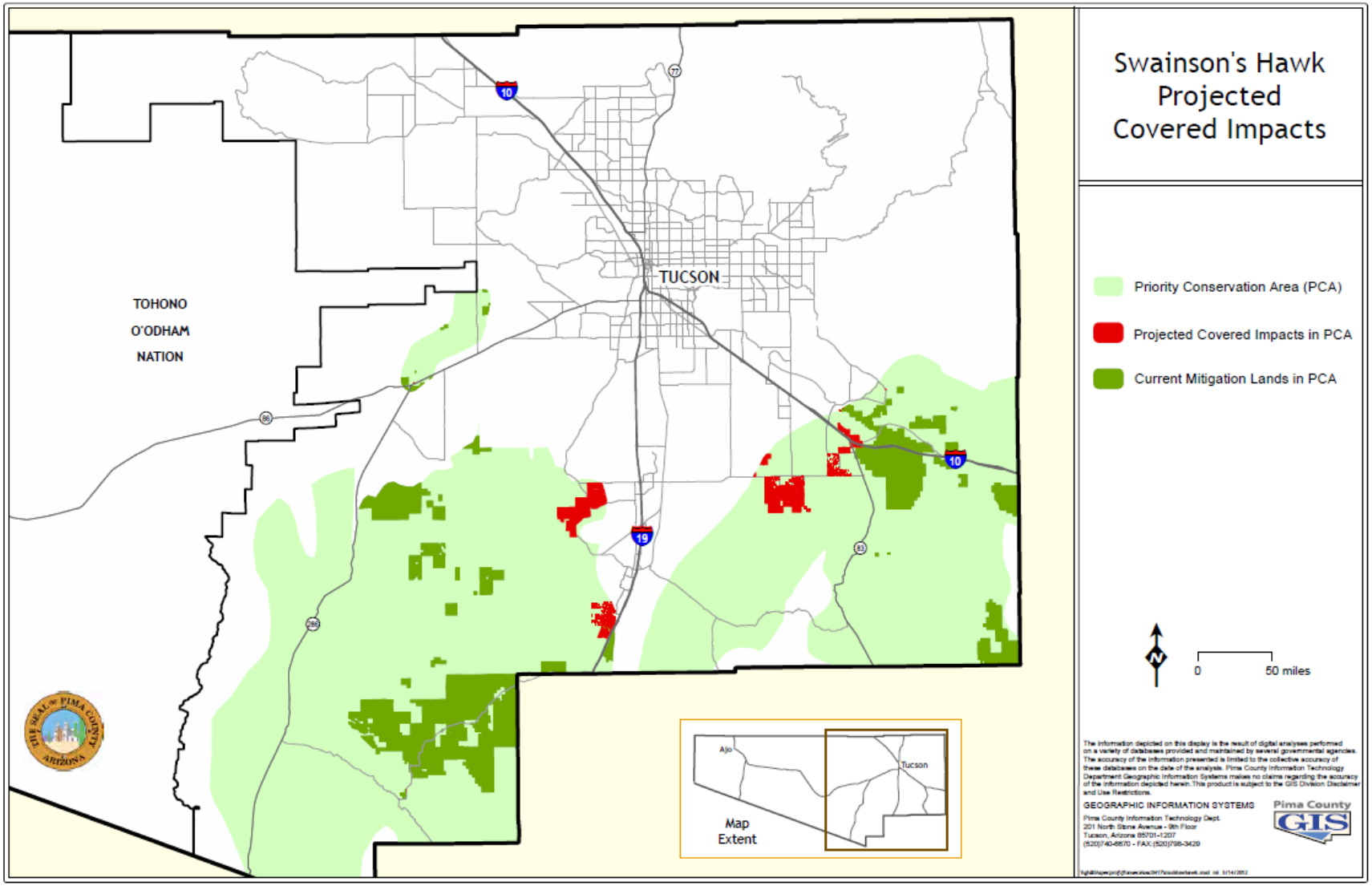



**Figure A-15. Map of projected impacts and mitigation for the Swainson's hawk.**

## Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)

### Conservation Status

Endangered Species Act Status: Candidate species; petitioned for listing as endangered in 1998. USFWS initiated a 1-year status review process in 2000, then listed the species as warranted for protection under the ESA but precluded due to higher priority listings (U.S. Fish and Wildlife Service 2000a). It is currently being evaluated for listing by FWS under the Multi-District Litigation settlement.

State: Wildlife of Special Concern in Arizona.

Other: Listed as a migratory bird under the Migratory Bird Treaty Act; U.S. Forest Service Sensitive Species.

Rankings: G5T3, S3.

### Description

The western yellow-billed cuckoo is a 10- to 12-inch (26 to 30 cm) long slender bird with relatively short, dark legs. The plumage is grayish brown on top and white below. The primary feathers on the wings are rufous (orange-brown) in color and there is a bold black-and-white pattern under the tail. The mandible of the bill is yellow. The plumage of both sexes is similar. Juveniles, which hold juvenile plumage well into the fall, have a much paler pattern on the tail and the bill may show little to no yellow (Arizona Game and Fish Department 2003b).

### Distribution and Trend

In the western U.S., the species now occurs in small and isolated pockets in California, Arizona, Utah, Idaho, Montana, and Wyoming. The species was extirpated in British Columbia in the 1920s, Washington in the 1930s, and Oregon in the 1940s, and in the Sacramento Valley, California, where it was originally a common breeding bird, now less than 1% of the original breeding habitat remains (Laymon and Halterman 1987). In Arizona, the species was a common resident in the (chiefly lower) Sonoran zones of southern, central, and western Arizona; scarce in the north-central part of the state, and very rare in the northeast (Phillips et al. 1964).

In Arizona, the western yellow-billed cuckoo now nests primarily in the central and southern parts of the state. It has been extirpated from most lower elevation localities, especially the Colorado River valley (Biota Information System of New Mexico 2008c) and most of the Santa Cruz River in Pima County (Corman and Magill 2000). The yellow-billed cuckoo breeds in eastern Pima County in cottonwood/willow forests. It has been found nesting at Cienega Creek (Empire Ranch, and Cienega Creek Natural Preserve), Arivaca Creek, Buehman Canyon, and several sites in the Altar Valley (Corman and Magill 2000, Arizona Game and Fish Department 2003b) including confirmed nesting in Brown Canyon in the Baboquivari Mountains (B. Powell, *unpublished data*). There was a high density of nesting pairs along the Santa Cruz River in Santa Cruz County in 2000 (Powell 2000) and again in 2009 (Krebbs and Moss 2009). Yellow-billed cuckoos have been recorded in the pecan groves in Green Valley and Sahuarita (Kingsley 1989). They have been recorded as rare transients in the Rincon Mountain District of Saguaro National Park, but no breeding has been reported in Rincon Creek, the most likely habitat for the species in the park (Powell 2004, 2006). Recent unconfirmed breeding in eastern Pima County includes along the Santa Cruz River north of Tucson in 2005 (Crawford 2005) and along Tanque Verde Creek in 2002 (Sage Landscape Architecture and Environmental Inc 2003).

The distribution of the species is greatly reduced from the range that is occupied at the beginning of the 20$^{th}$ Century, but in recent decades it does not appear to be declining.

### Habitat Requirements

The western yellow-billed cuckoo uses cottonwood and willow groves almost exclusively for migrating and breeding, though they occasionally use mesquite bosque and even oak, though they often avoid saltcedar (Rosenberg et. al. 1991, Hughes 1999). They prefer large trees for nesting, seeming to prefer to nest near the tops of tall cottonwood and willow trees. Hamilton and Hamilton (1965) suggest nest placement within river bottoms may be due to humidity requirements for successful hatching and rearing of chicks. The cuckoo often forages in open areas, woodlands, orchards and adjacent streams (Hughes 1999), which include stands of smaller mesquite trees and even tamarisk (Rosenberg et al. 1991). This species may be rarely observed as a transient in desert and urban settings (Arizona Game and Fish Department 2002c).

### Current and Potential Threats

General: The primary threat to this species' survival is the continued loss, degradation, and fragmentation of mature cottonwood-willow riparian habitat. Major threats to this habitat type include reclamation, flood control, and irrigation projects; habitat loss due to urbanization and agricultural activities; and the continued invasion of nonnative saltcedar into riparian areas. Exposure to pesticides and other contaminants on wintering and breeding grounds, as well as livestock grazing and off-road vehicle use within riparian habitats, also continue to threaten this species' survival (Laymon and Halterman 1987). As the quality of the habitat decreases through competition with exotic plant species, or inappropriate grazing, the number of western yellow-billed cuckoos that can be supported may decrease. There is evidence that pesticide use

(DDT) adjacent to the breeding grounds and in the wintering grounds may cause eggshell thinning (Laymon and Halterman 1987).

Existing and potential pest species: Invasive exotic plant species such as saltcedar (*Tamarix* spp.) have altered native riparian habitat and may render it less suitable for the western yellow-billed cuckoo.

Threat mechanism: The primary threat to yellow-billed cuckoo habitat is the degradation and fragmentation of riparian woodlands, specifically mature cottonwood-willow riparian habitat, and failure of these to regenerate because of flood management practices. Threats to remaining populations in central and southern Arizona are stated as: degradation and loss of riparian habitat from vegetation clearing, stream diversion, water management, agriculture, urbanization, overgrazing, and recreation (Arizona Game and Fish Department 2002c). Depletion of groundwater has dried many riparian areas and resulted in the loss of riparian vegetation.

**Management Needs**

General: Management of riparian habitat known to support cuckoo populations is considered necessary. Corman and Magill (2000) summarize the needs of the species as follows: expand survey effort to encompass all major riparian habitat types and include areas within potentially suitable habitat that were not thoroughly surveyed; conduct nest searching and monitoring studies; land management agencies need to promote regeneration of riparian habitat; management activities require cooperation, coordination, and funding.

Current protective measures: This species is protected under the Migratory Bird Treaty Act. The Migratory Bird Treaty Act makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment. Pima County has a floodplain ordinance that prevents some destruction of habitat for this species. The Federal Clean Water Act, in its Section 404, may also protect some of the habitat of this species.

Corridor and migratory needs: Contiguous well-developed riparian corridors may be beneficial, but have not been demonstrated to be necessary. Corridors to connect isolated breeding areas are probably unnecessary for a highly mobile migratory species such as this. The migratory habits and routes of this species are poorly known and need further study; however, it is likely that riparian corridors play a role since food sources, such as caterpillars, are found there (Hughes 1999)

Key relationships: Mature cottonwood-willow riparian habitat is utilized by this species for breeding and source of primary prey items, particularly caterpillars and cicadas.

Existing monitoring and research programs: Monitoring is ongoing along the Colorado River for the Bureau of Reclamation's Habitat Conservation Plan, and along the San Pedro River at the San Pedro River Conservation Area. The National Park Service

hopes to conduct periodic monitoring at the Tumacacori National Historical Park to follow up on the work of Powell (2000) and Krebbs and Moss (2009).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-16): 74.

Acres of mitigation habitat within the current portfolio of conservation lands: 8,962.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the yellow-billed cuckoo:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat for this species as described in Chapter 4;
- Seek to protect additional water rights at Cienega Creek Natural Preserve and Buehman Canyon to maintain and restore habitat.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.
- Enact a 400 m buffer “restricted activity zone” around known nests during the nesting period. Allow only short duration “pass through” activities.

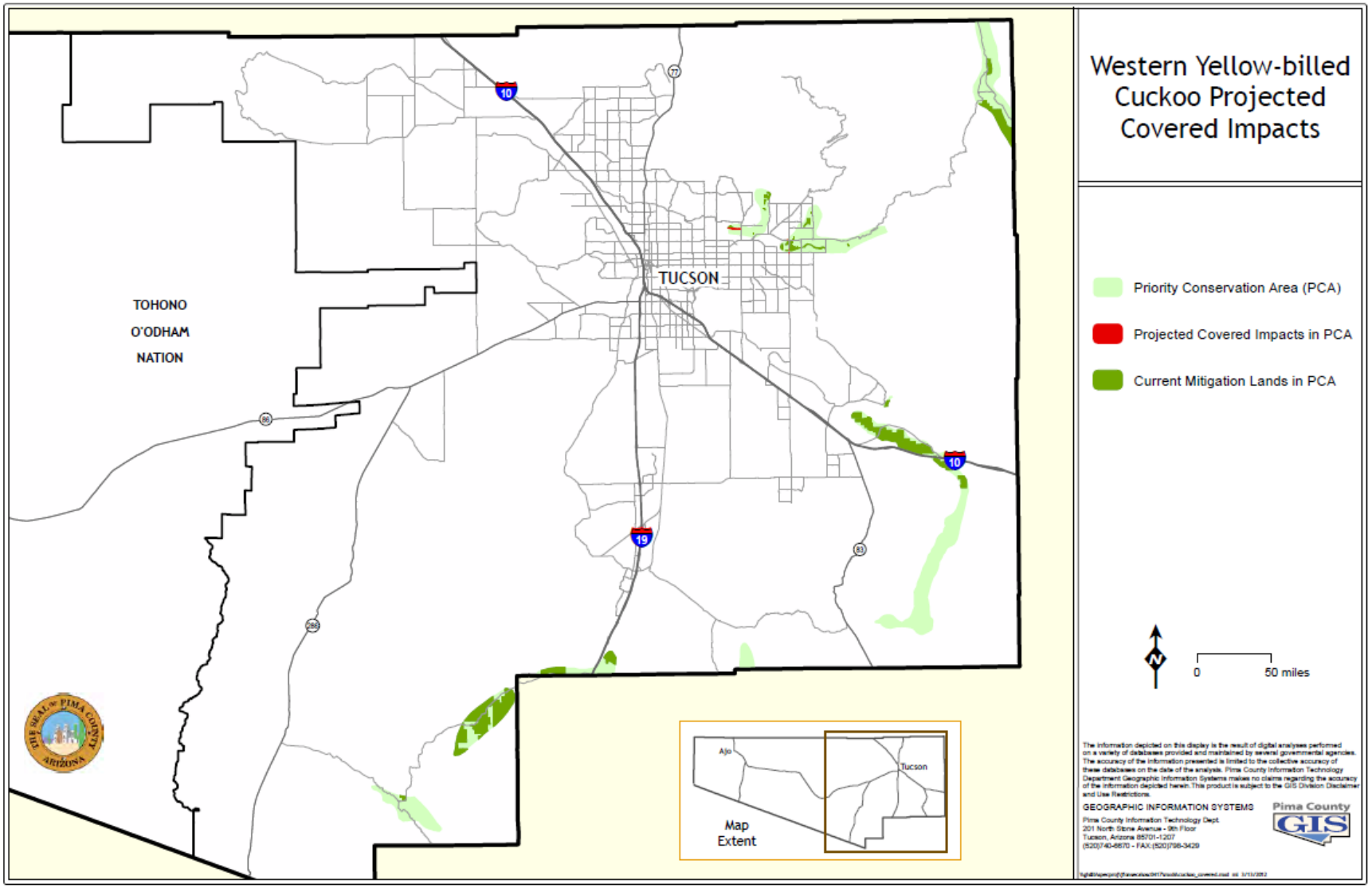



**Figure A-16. Map of projected impacts and mitigation for the yellow-billed cuckoo.**

## Abert's towhee (*Pipilo aberti*)

### Conservation Status

Endangered Species Act Status: None.

State: None.

Other: Listed as a "migratory bird" under the Migratory Bird Treaty Act.

Rankings: G3G4, S3.

### Description

Abert's towhee is a large sparrow with gray-brown upperparts. There is little or no contrast between crown and back. The breast, flanks, and belly are pinkish brown. There is black on the lores, malar region, chin, and extreme anterior forehead surrounding a pale bill, giving the appearance of a black mask around the bill. The male and female plumages are identical (Tweit and Finch 1994).

### Distribution and Trend

This species is resident from southeastern California, southern Nevada, southwestern Utah, central Arizona, and southwestern New Mexico south to northeastern Baja California and northern Sonora (Tweit and Finch 1994). In Pima County, Abert's towhees are common along brushy washes and the effluent-dominated portion of the Santa Cruz River, and they may be present in urban backyards, especially those that are along washes. It is common along many of the major washes and rivers of eastern Pima County including the Santa Cruz River, Brawley Wash, Rillito River, Pantano Wash; and Rincon, Cienega, and Arivaca creeks (Tweit and Tweit 1986, Powell 2004, Corman and Wise-Gervais 2005, Powell 2006, Tucson Bird Count 2012).

Since the mid-1970s the range of Abert's towhee has expanded from the upper Santa Cruz to Nogales, up Sonoita Creek, up Oak Creek nearly to Sedona, and from the upper San Pedro into Mexico (Corman and Wise-Gervais 2005). The species has also been found utilizing exotic shrubs along irrigation ditches and suburban backyards in Phoenix and Tucson. The range of the species has contracted in other areas, and Abert's towhees have completely disappeared from some areas of Utah. In Arizona, loss of native riparian habitat has fragmented the species range, and invasive species such as

saltcedar (*Tamarisk* sp.) has reduced the suitability of much existing habitat (Tweit and Finch 1994), although the species may be abundant in saltcedar-dominated habitats.

### Habitat Requirements

Abert's towhee prefers Sonoran Riparian Deciduous Woodland and Riparian Scrubland, with a dense understory of shrubs. The plant species used for nesting varies considerably, but the species consistently uses very dense vegetation in which to place its nest (Corman and Wise-Gervais 2005). Much of their preferred habitat for nesting has been altered and fragmented, and Abert's towhee is now found in remnants of riparian woodland and scrubland, marshes, and areas with exotic vegetation, including saltcedar in the lower Colorado River valley (Rosenberg et al. 1991) and in mixed exotic-native habitat in the Phoenix, and Tucson areas (Tweit and Finch 1994). They are also found in Sonoran and Chihuahuan Desert Scrub habitats, usually near washes. This species appears to be well adapted to urban development in some areas, such as Tucson. However, density in urban areas may be less than in natural areas.

### Current and Potential Threats

General: Much riparian habitat has been lost through the clearing of land for agriculture, development or grazing, or through groundwater depletion that has lowered the water table. Exotic species such as saltcedar have become established in many remaining riparian areas and may have reduced habitat quality for Abert's towhee. After removal of cattle from the San Pedro Riparian National Conservation Area, spring densities of Abert's towhees in cottonwood-willow habitat almost doubled (Tweit and Finch 1994).

Existing and potential pest species: Cowbirds are sometimes parasites of Abert's towhee nests (Ehrlich et. al. 1988). Because Abert's towhee eggs are larger than those of cowbirds, Abert's towhee is probably not a good host for the cowbird (Tweit and Finch 1994). Because cowbirds usually select host nests that contain eggs smaller than their own. Cowbird nestlings do not appear to thrive in Abert's towhee nests, possibly starving to death due to competition from the much larger towhee nest mates (Tweit and Finch 1994).

Threat mechanism: Destruction of riparian habitat through development, agriculture, grazing or groundwater depletion. There have been no known studies performed on the effects of pesticides or other contaminants in areas where Abert's towhees are present (Tweit and Finch 1994).

### Management Needs

General: Protection of native riparian habitat is needed for the conservation of Abert's towhee. Management programs that benefit the endangered southwestern willow flycatcher may also benefit Abert's towhee in portions of their sympatric range.

Current protective measures: This species is protected under the Migratory Bird Treaty Act, despite the fact that it is essentially non-migratory. The Migratory Bird Treaty Act makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship,

import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment. The Pima County Floodplain Protection ordinance provides guidance to avoid, minimize, or mitigate for damage to riparian habitat that is used by this species. The Federal Clean Water Act, in its Section 404, may also protect some of the habitat of Abert's towhee.

Corridor and migratory needs: There is no known information available on corridor needs of this species. The species is essentially sedentary, although it is classified as a "Migratory Bird" under the Federal Migratory Bird Treaty Act.

Key relationships: Abert's towhee is considered a riparian obligate species (Tweit and Finch 1994), but the specific type of riparian association upon which it is obligate can vary from xeroriparian to hydroriparian. The dependency appears to be more on vegetation density and structure than on species of vegetation or presence of water.

Existing monitoring and research programs: No specific monitoring and research programs for this species are currently known. However this species is one that is frequently observed in studies of riparian birds within its range and is a common bird along washes in the Tucson Basin (Tucson Bird Count 2012).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-17): 600.

Acres of mitigation habitat within the current portfolio of conservation lands: 10,216.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Abert's towhee:

- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat.
- Identify and pursue opportunities for restoration of mesquite bosques on appropriate portions of the County-controlled mitigation lands.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

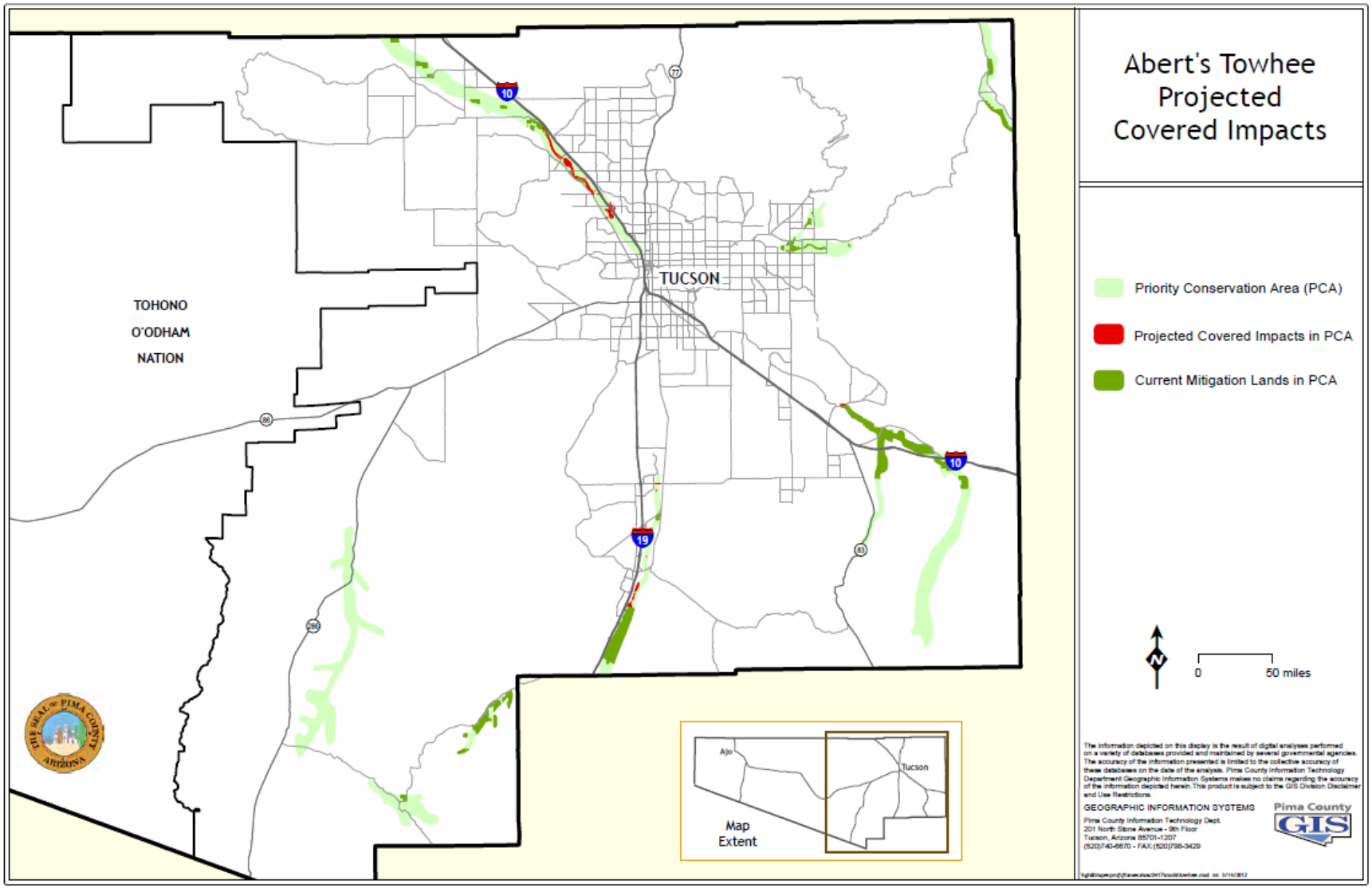



**Figure A-17. Map of projected impacts and mitigation for the Abert's towhee.**

## Bell's vireo (*Vireo bellii arizonae*)

### Conservation Status

Endangered Species Act Status: None. Subspecies in California is listed as Endangered.

State: None.

Other: U.S. Forest Service Sensitive Species; Migratory bird under the Migratory Bird Treaty Act.

Rankings: G5T4, S4.

### Description

The Bell's vireo is a small bird, with a length of 4.5 to 5.0 inches (115 to 125 mm) and weight from 7 to 10 g. Its short, rounded wings make it's tail look long. It has a short, straight bill, somewhat compressed at the base. Males and females have similar plumage throughout the year. The plumage color varies; it is generally drab gray to green above, and white to yellow below; the breast is unstreaked. There is a faint white eye ring. There are 2 pale wing bars, and the lower bar is more prominent. Juvenile plumage resembles that of adults in worn summer plumage—essentially white and gray, but whiter below with more distinct wingbars (Brown 1993).

### Distribution and Trend

The Bell's vireo is widespread in central and southwest United States and northern Mexico (Brown 1993). It breeds from southern California to southern Nevada, Utah, northwest and southern Arizona and New Mexico; and from Texas north to North Dakota, east to Ohio, and south to Tennessee, and in the northern half of Mexico. The winter range is not well known. Records have been reported from southern Baja California and southern Sonora south along west coast of Mexico and Central America to Honduras and casually to northern Nicaragua. It has also been reported from the east coast of Central America from Veracruz south to Honduras. There are scattered winter records from extreme southern California, southern Arizona, southern Texas, Louisiana, and southern Florida (Brown 1993).

The subspecies present in Pima County, the Arizona Bell's vireo, breeds from southern Nevada, southwest Utah, and northwest and central Arizona south to southeast California (the lower Colorado River Valley) and southern Sonora, Mexico (Brown

1993). In Pima County, locations include foothills of the Santa Catalina, Rincon, Santa Rita, and Baboquivari mountains (Lloyd et. al. 1998, Powell and Steidl 2000, Arizona Game and Fish Department 2002f, Powell and Steidl 2002, Corman and Wise-Gervais 2005, Powell 2006, Tucson Bird Count 2012); large rivers, creeks, and washes of eastern Pima County including the Santa Cruz River, Rillito River, Pantano and Brawley washes, and Rincon and Cienega creeks (Mills et. al. 1989, Powell 2004, Kirkpatrick et. al. 2007, Tucson Bird Count 2012). In western Pima County they nest in xeroriparian washes such as at the Organ Pipe Cactus National Monument and Barry M. Goldwater Range (Groschupf et al. 1988, Arizona Game and Fish Department 2002f, Hardy et. al. 2004, Organ Pipe Cactus National Monument 2006a, Schmidt et al. 2007).

The Arizona Bell's vireo has been declining along the lower reaches of the Colorado River and along the lower reaches of the Gila, Santa Cruz, and Salt rivers (Rosenberg et al. 1991, Arizona Game and Fish Department 2002f), but remains common throughout its range at higher elevations (Brown 1993) and this probably includes eastern Pima County. Since the late 1960s, the Arizona Bell's vireo has been expanding its range eastward along the Colorado River into Grand Canyon National Park (Brown et. al. 1983).

### Habitat Requirements

General: Bell's vireo prefers dense, low, shrubby vegetation in riparian areas. Characteristically it is found in dense shrubland or woodland along lowland stream courses, with willows (*Salix* spp.), mesquite (*Prosopis* spp.), and seepwillows (*Baccharis glutinosa*) being characteristic plant species (Brown 1993). It is known to be a habitat generalist in riparian scrubland dominated by the introduced shrub tamarisk (*Tamarix ramosissima*) along the Colorado River in Grand Canyon, Arizona (Brown et al. 1983); it is a specialist in native seepwillow and mesquite habitats of the lower Colorado River Valley, Arizona where tamarisk is rarely used by the species (Brown 1993). In southern Arizona it uses a wide range of plants for nesting, including willows, hackberry, and ash (Powell and Steidl 2000, 2002, Kirkpatrick et al. 2007). Where present during the breeding season, they can often be found nesting near the edge of dense thickets of vegetation (Arizona Game and Fish Department 2002f).

### Current and Potential Threats

General: Current threats to this subspecies include the continued loss and degradation of habitat due to urbanization (Mills et al. 1989), water projects, flood control projects, agriculture, livestock grazing, introduced competitors, exotic invasive plants (especially giant reed), off-road vehicles, and nest parasitism by brown-headed cowbirds (Brown 1993).

Existing and potential pest species: Bell's vireo is frequently used as a host by brown-headed cowbirds (*Molothrus ater*) (Averill-Murray et. al. 1999, Powell and Steidl 2000), though parasitism is lower in mesic vegetation as compared to more xeric sites (Brand et. al. 2010). Success of the brood parasite is usually low, since vireos typically respond to the presence of cowbird eggs by abandoning the nest (Brown 1993) or

occasionally by building a second floor of nest over the cowbird eggs (Ehrlich et al. 1988).

Threat mechanism: Loss of riparian habitat and parasitism by brown-headed cowbirds.

### Management Needs

General: The management priority for the Arizona Bell's vireo should be the return of healthy stands of cottonwood-willow habitat that provide this riparian-obligate subspecies with the breeding habitat it requires. Activities such as revegetation of disturbed riparian areas, control of invasive exotic plants, reduction of cattle grazing in riparian areas, and limiting off-road vehicle traffic are key management actions. Trapping and removal of cowbirds where rates of brood parasitism are high may increase productivity of Bell's vireo.

Current protective measures: This species is protected under the Migratory Bird Treaty Act. The Migratory Bird Treaty Act makes it unlawful to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment. Habitat protection is afforded by the various county and local wash protection and floodplain ordinances and by Section 404 of the Federal Clean Water Act.

Corridor needs: There is no known information on corridor requirements.

Key relationships: Bell's vireo is a riparian-obligate and requires dense riparian habitat to persist and breed. However, the species of plants that make up that habitat vary throughout the species range. It requires insects for its diet, but appears to be an opportunistic gleaner. It has an adverse relationship with the brown-headed cowbird.

Migratory requirements: Bell's vireo leaves the northernmost limits of its breeding range in August or September, although southern populations (such as in southern Arizona) may depart as late as November. The species overwinters primarily along the Pacific coast of southern Mexico. Spring migrants begin to return to the breeding range from early to mid-March (Brown 1993).

Existing monitoring and research programs: No specific monitoring and research programs for this species are currently known, but it is recorded by the Tucson Bird Count (2012) along select washes and river of the Tucson Basin. Annual surveys at Organ Pipe Cactus National Monument (2006a) occasionally record this species.

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-18): 143.

Acres of mitigation habitat within the current portfolio of conservation lands: 7,924.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Bell's vireo:

- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Identify and pursue opportunities for restoration of mesquite bosques and xeroriparian vegetation communities on appropriate County-controlled mitigation lands.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

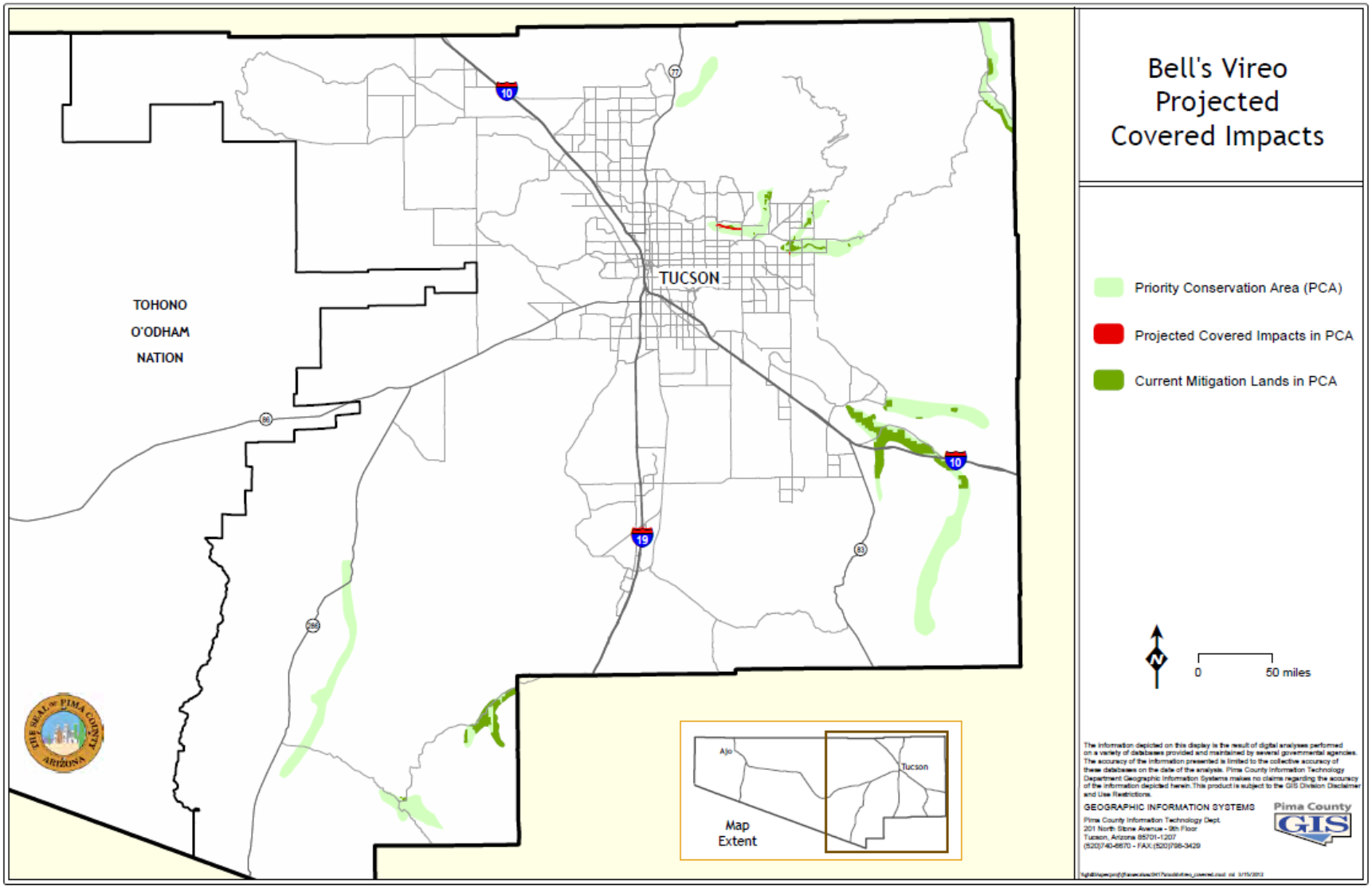



**Figure A-18. Map of projected impacts and mitigation for the Bell's vireo.**

## Southwestern willow flycatcher (*Empidonax trallii extimus*)

### Conservation Status

Endangered Species Act Status: Listed as Endangered in 1995, critical habitat originally designated in 1997 and currently proposed for revision.

State: Wildlife of Special Concern in Arizona.

Other: U.S. Forest Service Sensitive Species; Listed as a migratory bird under the Migratory Bird Treaty Act.

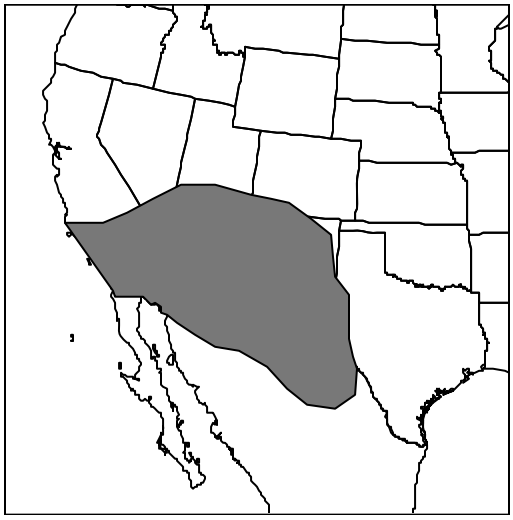
Rankings: G5T1T2, S1.

### Description

The southwestern willow flycatcher is a small bird, approximately 5.75 inches (15 cm) long. The body is brownish olive to grayish green on the upper parts with a pale olive breast, pale yellow belly, and whitish throat, and two white wing bars. An eye ring may be faint or absent. The bill is relatively large, the maxilla dark and the mandible usually entirely yellow or pale orange, and it often has a dusky tip. Both sexes are alike. The species is most easily identified by its vocalizations (Arizona Game and Fish Department 2002d).

### Distribution and Trend

Southwestern willow flycatchers are known from southern Nevada, southern Utah, southern California, most of Arizona and New Mexico, western Texas, and southwestern Colorado (Finch and Stoleson 2000). They winter in Mexico, Central America, and/or northern South America (Arizona Game and Fish Department 2002d).



In Arizona, willow flycatchers have been documented along 12 drainages. The major concentrations have occurred near the confluence of the Gila and San Pedro Rivers, Roosevelt Lake, Alamo Lake, Topock Marsh, the lower Grand Canyon, the Gila River, and Camp Verde. Three high elevation sites were also documented, 2 on the Little Colorado River near Greer and 1 on the San Francisco River near Alpine (Paradzick et al. 2000). The species has relatively high breeding densities in Arizona along the San Pedro River at the confluence with the Gila River (Pinal County) (Ellis et. al. 2008), and it has been documented breeding at Redington, along the San Pedro in Pima County in 1998 (Arizona Game and Fish

Department 2002d). It has also been documented as a breeder along Upper Cienega Creek in Pima County, though only sporadic records exist (Finch and Stoleson 2000). Surveys along the Santa Cruz River in recent years have not found any breeding individuals (Scott Wilbor, in personal communication to the Town of Marana, 2009).

The subspecies suffered a significant decline in numbers and distribution, which led to the USFWS decision to list the species in 1993 (U.S. Fish and Wildlife Service 1995). Since its listing, considerable attention went into surveying for the species. In Arizona, for example, the number of known territories increased from 111 at the time of listing to 1,214 in 2005 (Durst et. al. 2007), an increase that was probably due to increased survey effort. The subspecies has also expanded into new areas, such as the Grand Canyon.

### Habitat Requirements

Breeding Southwestern Willow Flycatchers are riparian obligates; they typically establish territories and nest in relatively dense riparian vegetation where surface water is present or soil moisture is high enough to maintain the appropriate vegetation characteristics. Beyond these generalities, the flycatcher shows adaptability in habitat selection, as the dominant plant species (both native and exotic), size and shape of breeding patch, and canopy height and structure can be variable. (Paradzick 2005, Paxton et. al. 2007). This use of diverse plant species suggests that vegetation structure, not species composition, is the most important feature of flycatcher habitat. Vegetation characteristics of Southwestern Willow Flycatcher breeding habitat generally include high canopy or midstory cover, dense twig structure, and high levels of live green foliage (Hatten and Paradzick 2003). Flycatchers appear to prefer young habitat, and bred in some riparian patches that were only 3 years of age. However, they will occupy older habitat, perhaps as refugia until younger habitat becomes available. The use of vegetation communities appears to differ by elevation. Low-elevation sites were characterized by two vegetation types: (1) mixed native/exotic associations and (2) monotypic exotic habitat dominated by dense stands of tamarisk forming a nearly closed canopy (Paradzick et. al. 2000). A large proportion of seemingly suitable habitat remains unoccupied.

### Current and Potential Threats

General: Historic habitat loss and degradation was the cause of population declines that led to the species' listing under the ESA (U.S. Fish and Wildlife Service 1995). These threats continue and other threats include fluvial geomorphic changes and corresponding modification of vegetation, overgrazing, cowbird parasitism, fire, predation, and human disturbance (Arizona Game and Fish Department 2002d). Changes in the operation of the Roosevelt Dam will likely impact the species in the short-term, but the perhaps the most significant change for the species may be the recent introduction of the saltcedar leaf beetle (*Diorhabda elongate)* into many areas along the Colorodo River. Because the flycatcher utilizes tamarisk, loss of Tamarisk may impact the flycatcher, though if former Tamarisk-dominated sites can be restored back to native vegetation, this may ultimately benefit the flycatcher.

Existing and potential pest species: Brown-headed cowbird parasitism rates can be high for this species (Stoleson and Finch 2000).

### Management Needs

General: The highest priority is for protection of occupied and potential willow flycatcher habitat. Riparian areas with little or no survey effort need to be identified and surveys conducted. Coordinated surveys and research studies for this species have been done since 1993 in Arizona and data have revealed a lot of information on the nesting requirements of the species (Finch and Stoleson 2000, Paradzick et al. 2000, Hatten and Paradzick 2003, Durst 2004, Paradzick 2005, Sogge et. al. 2005, Durst et al. 2007, Hatten and Sogge 2007, Ellis et al. 2008). The species and its habitat are protected under the Endangered Species Act, local wash or floodplain ordinances, and public land management agency policies.

Corridor needs: There is no specific information available on the corridor or migratory requirements of this species' biology, but it is assumed that riparian corridors are used for migration. Because of the mobile nature the species, occupying new habitat is not likely to be a problem.

Key relationships: Southwestern willow flycatchers are early-successional obligates in mesic riparian systems, but they also use mature Tamarisk forests for nesting.

Existing monitoring and research programs: Surveys and monitoring studies have been done under the coordination of the AGFD and USFWS since 1993. No long-term monitoring is taking place in Pima County, but considerable effort is focused on the confluence of the San Pedro and Gila rivers in adjacent Pinal County (Ellis et al. 2008).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-19): 0.

Acres of mitigation habitat within the current portfolio of conservation lands: 314.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the southwestern willow flycatcher:

- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- For County-controlled mitigation lands, enact a 100 m buffer "restricted activity zone" around known nests during the nesting period. Allow only short duration "pass through" activities will be allowed.
- Develop management guidelines for County-controlled mitigation lands that include efforts to reduce impacts from feral pets (e.g., cats and dogs), recreation, shooting, etc. in the vicinity of occupied habitat.
- Protect all known and potential habitat for this species on County-controlled mitigation lands as described in Chapters 4 and 5.

- Acquire and protect water rights to maintain and restore habitat, where appropriate.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

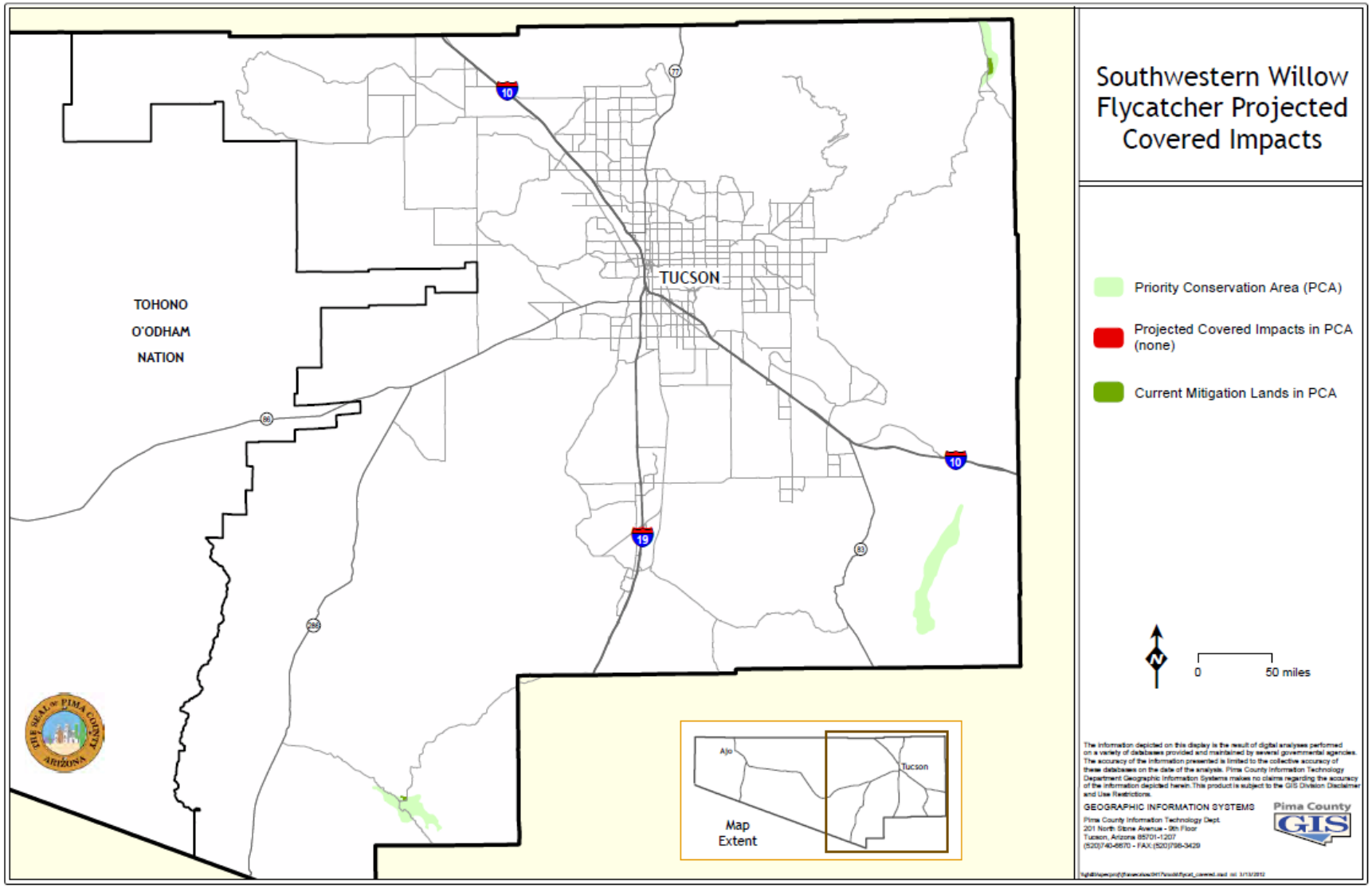



**Figure A-19. Map of projected impacts and mitigation for the southwestern willow flycatcher.**

# Fishes

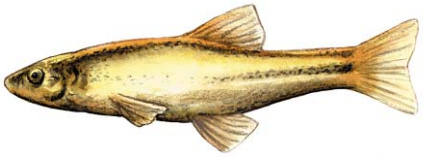
## Longfin Dace (*Agosia chrysogaster*)

### Conservation Status

Endangered Species Act Status: None. Former candidate for Category 2 listing.

State: None.

Other: USFWS Species of Concern; U.S. Forest Service Sensitive Species. Special protection in Mexico.

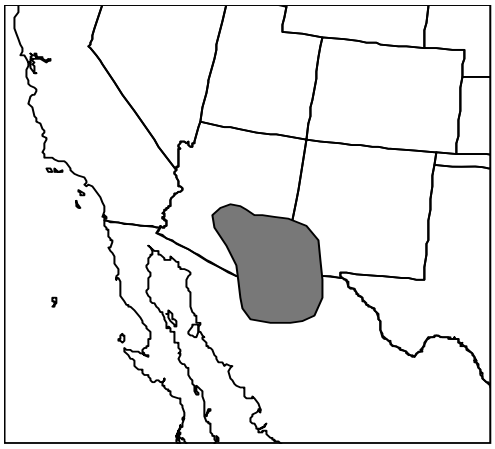


Rankings: G4 S3S4.

### Description

The longfin dace is a small silvery fish that is usually found in water with a sandy substrate. The body of the longfin dace is fusiform, with small scales. Adults rarely exceed 2.6 inches (6.5 cm) standard length. There are approximately 70 to 90 scales in the lateral line. The head is thick and blunt, and the mouth is small, subterminal, oblique; overhung by a bluntly rounded snout; the mouth terminates posteriorly at a point under the nares. The back and upper sides are silvery gray to olive, sides sometimes with golden flecks; the lower sides and abdomen are whitish, and the peritoneum black. A diffuse, dusky lateral stripe originates at the upper corner of the opercle, terminating in a black spot at the base of the caudal fin.

### Distribution and Trend



The longfin dace was historically found throughout Arizona, New Mexico, and northwestern Mexico (Arizona Game and Fish Department 2006a). The longfin dace is currently found in a broad area that consists of disjunct populations. It is known to be present in the Bill Williams and Gila River drainages in Arizona; south into Sonora, Mexico (coastal streams and Rio Yaqui basin), the Rio Sinaloa, Mexico, and perhaps farther south (Arizona Game and Fish Department 2006a). It is native to the Gila River basin (including the San Francisco River), the Bill Williams, Yaqui, Magdalena, and Sonoyta drainages and has been introduced into the Virgin River basin, Arizona, Zuni and Mimbres rivers, and Rio Grande basin, New Mexico (Biota Information System of New Mexico 2000, Arizona Game and Fish Department 2006a).

Known populations of the longfin dace in Pima County occur in: (1) Cienega Creek Natural Preserve and further upstream in Las Cienegas National Conservation Area (Rosen and Schwalbe 1988, Simms et. al. 2006, Bodner et. al. 2007); (2) Buehman Canyon south-southeast of Cocklebur Tank; (3) upper reaches of the Canada del Oro; and in Arivaca Creek. There are populations upstream of Pima County in the Santa Cruz River (Voeltz and Bettaso 2003, Powell et. al. 2005) and following significant floods, individuals may potentially become established in the Santa Cruz River in Pima County. They were reintrocuted to Bingham Cienega in 2006 but have since been lost.

### Habitat Requirements

The habitat of longfin dace is wide ranging, from intermittent hot low-desert streams to clear and cool higher elevations streams. They tend to occupy relatively small or medium size streams, with sandy or gravely bottoms; eddies, pools near overhanging banks or other cover (Arizona Game and Fish Department 2006a). Usually in water less than 0.6 ft (0.2 m) deep with moderate velocities of around 1.1f/s (0.3m/s). They are rarely abundant in large streams or above 5,000 ft (1524 m). Generally found in water less than 75° F (24° C), but are tolerant of high temperatures and low dissolved oxygen. During low water, they may take refuge in moist detritus and algal mats (Sublette et. al. 1990).

### Current and Potential Threats

Loss of small, sandy stream habitat will negatively impact this species. Flood control programs and groundwater pumping may contribute to the drying-out of suitable stream habitat and overgrazing may impact habitat quality.

Existing and potential pest species: Longfin dace are known to be vulnerable to 5 species of native parasites (Mpoame and Rinne 1983). The most dangerous parasite appears to be *Ichthyophthirius multifiliis*, of which epizootic outbreaks appear to be common in streams throughout Arizona. Other parasites found on longfin dace include: *Myxobolus macrocapsularis*, *Rhabdochona decaturensis*, *Rhabdochona* sp., and *Lernaea cyprinacea* (Mpoame and Rinne 1983).

Threat mechanism: Loss of stream habitat through water management practices or high water consumption; also, natural flood events can decimate local populations.

### Management Needs

General: Protection of existing occupied habitat should continue, and transplantation to recovered potentially suitable habitat may be appropriate. Invasion of non-native fishes should be prevented, and existing populations of non-natives (if any) in this species' habitat should be eliminated.

Current protective measures: All known habitat for this species in Pima County is under some form of protection.

Corridor and migratory needs: The species is reliant on intact stretches of streams for dispersal, though can seek refuge in small pools for long periods of time. Long-term metapopulation dynamics probably requires at least occasional connection between isolated local populations and flood events will disperse or displace the species to downstream to other locations.

Key relationships: None are specifically known.

Existing monitoring and research programs: Long-term monitoring of this species in Pima County and surrounding areas has occurred as a result of a number of efforts. Monitoring is undertaken throughout central and southern Arizona as part of the Central Arizona Project's non-native species detection effort (Marsh et. al. 2009, Clarkson et. al. 2011). This monitoring takes place in the Cienega Creek Preserve. The BLM monitors for this and other native species annually at Las Cienegas National Conservation Area (Simms et al. 2006). Monitoring for this and other native species has occurred annually in Aravaipa Canyon since 1970 (Eby et. al. 2003). Finally, the species is periodically monitored at the Muleshoe Ranch (Cochise County) (Brunson et. al. 2001).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-20): 1.

Acres of mitigation habitat within the current portfolio of conservation lands: 3,074.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the longfin dace:

- Continue current effort to obtain surface-water rights for wildlife in Buehman Canyon;
- Support Outstanding Waters protection by ADEQ for Cienega Creek, Davidson Canyon and Buehman Canyon;
- Place restrictive covenants or conservation easements on County-controlled mitigation lands as described in Chapter 4.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database..

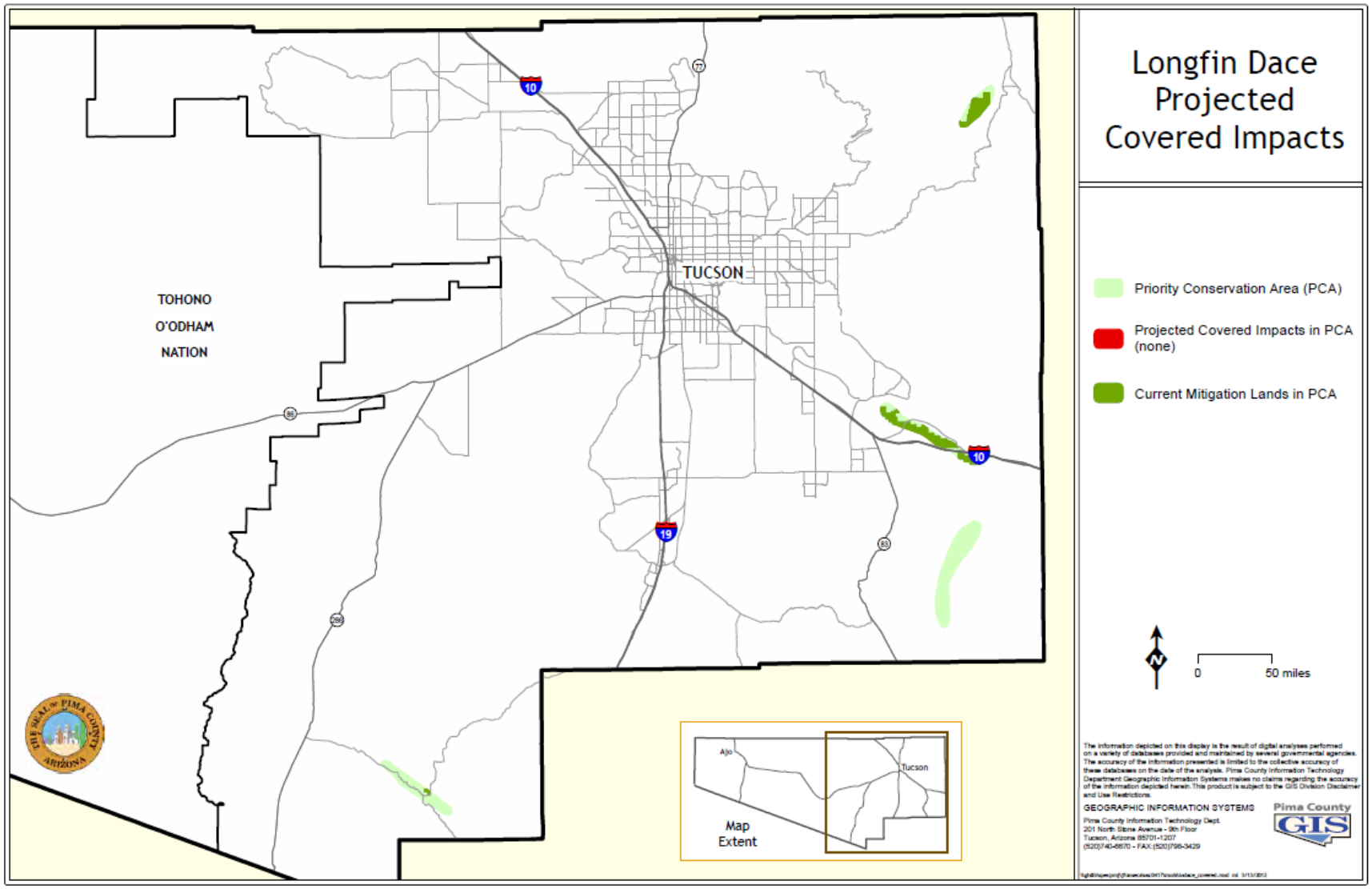
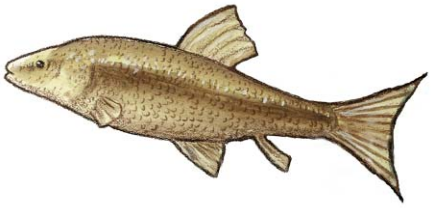



**Figure A-20. Map of projected impacts and mitigation for the longfin dace.**

## Gila chub (*Gila intermedia*)



### Conservation Status

Endangered Species Act Status: Listed as Endangered in 2002. Critical habitat designated in 2005 (U. S. Fish and Wildlife Service 2005b).

State: Wildlife of Special Concern in Arizona.

Other: State Endangered in New Mexico; U.S. Forest Service Sensitive Species; Listed Endangered in Mexico.

Rankings: G2, S2.

### Description

The Gila chub is a small-finned, deep-bodied, chunky and dark colored minnow (Weedman et. al. 1996). Females are typically larger than males and attain lengths up to approximately 9.8 inches (25 cm); males are rarely greater than 5.9 inches (15 cm) in length. The scales are large, thick, and broadly overlap, and usually have prominent growth rings. The lateral-line scales are almost always fewer than 80. Dorsal fin-rays are usually 8 or fewer (rarely 9); anal fin-rays are 8 or fewer; and pelvic fin-rays number 8 or 9. An abrupt, soft, and fatty nuchal hump sometimes develops in large females of some populations. The total vertebrae vary from 38-45, but are usually fewer than 42. Diffuse lateral bands are rarely present and there is no basicaudal spot. Breeding males are red or orange on the lower cheek and posterior parts of lips, paired fin bases, and on the ventro-lateral surfaces including the caudal peduncle.

The Gila chub is similar in appearance to the roundtail chub, *Gila robusta*, but can be distinguished by having a chunkier body type. In addition, the length of head measured from terminus to posterior edge of operculum divided by the minimum depth of caudal peduncle is usually less than 3.0 (Arizona Game and Fish Department 2002e).

### Distribution and Trend

The Gila chub is currently known from the following drainages: Santa Cruz River (Cienega Creek, Sabino Canyon, Sheehy Spring), Middle Gila River (Eagle, Bonita and Harden Cienega Creeks and San Carlos and Blue Rivers), San Pedro River (Bass, O'Donnell and Redfield Canyons, Babocomari River and Turkey Creek), Agua Fria River (Silver and Sycamore [rare] Creeks), Verde River (Spring and Walker Creeks). Gila chub populations were extirpated from Monkey Spring (Santa Cruz River), and Fish and Cave Creeks (Salt River) (Weedman et al. 1996). The distribution of the Gila chub in Pima County is very restricted and is found only in Sabino Creek (Dudley and Matter 2000), and Cienega Creek (Marsh et. al. 2010).

The Gila chub has experienced a decline in distribution and abundance. The species' historical range likely included suitable habitat throughout the entire Gila River basin except the Salt River drainage above Roosevelt Lake. Records include rivers, streams, and stream-fed tributaries in Arizona, New Mexico, and northern Sonora, Mexico. In Arizona, occupied habitats included suitable cienegas and small tributaries, as well as artificial habitats such as Buckeye Canal (Weedman et al. 1996). By 1973, populations of Gila chubs had declined throughout their range (Minckley 1973). The species is found in only one drainage in New Mexico (Carman 2006). In Arizona, populations of Gila chub (e.g., Turkey Creek) have been disappearing (Arizona Game and Fish Department 2002e), but at the Cienega Creek Preserve they were noted in 2003 for the first time since the County acquired the property in 1986.

### Habitat Requirements

Home range requirements: Gila chubs are normally found in small headwater streams, cienegas and springs, or marshes of the Gila River basin. They utilize diverse habitat types based on the season and age of the fish. Adults have been collected from deep pools with heavily vegetated margins and undercut banks. Juveniles have been collected from riffles, pools and undercut banks of runs (Arizona Game and Fish Department 2002e). Gila chubs have an affinity for deeper pools in slow velocity water and are almost always associated with cover such as undercut banks, root wads, and instream debris piles (Biota Information System of New Mexico 2008d). In larger stream systems they utilize heavily vegetated backwaters for cover and feeding. The limit of their elevational range is unknown (Arizona Game and Fish Department 2002e).

### Current and Potential Threats

General: Alteration of habitat and introduction of non-native predators has caused significant declines in Gila chub populations throughout their former range (U. S. Fish and Wildlife Service 2005b). Suitable aquatic areas in Pima County have been significantly reduced and widespread alteration of hydrologic regimes within watersheds has taken place in the last century. Many watercourses that likely supported Gila chub at one time no longer have perennial flows, rather they convey water only during storm events. Many watercourses have become channelized through increased flooding intensity and no longer offer microhabitats necessary for the Gila chub to meet its life cycle requirements.

Existing and potential pest species: The inability of Gila chub populations to reproduce successfully and thrive after the introduction of green sunfish was documented at

Sabino Canyon by Dudley and Matter (2000). Many water bodies in Pima County have been colonized by a wide array of other non-native species that may contribute to the decline of the chub. These may include the following: introduced plants such as saltcedar (*Tamarix ramosissima*), which alter hydrology and change habitat characteristics; invertebrates such as the Asian clam (*Corbicula fluminea*) and crayfish (*Orconectes* sp.); amphibians such as the eastern bullfrog (*Rana catesbiana*); and numerous other non-native fish such as smallmouth bass (*Micropterus dolomieu*) (Weedman 1998). Additionally, parasites introduced incidentally with nonnative species may jeopardize Gila chub populations (U.S. Fish and Wildlife Service 1983).

Threat mechanism: Loss or degradation of habitat due to water diversion and groundwater depletion, dam and reservoir construction, increased peak flood discharges, and increased sedimentation; and negative interactions with competitive and predatory non-native fishes (Weedman et al. 1996).

**Management Needs**

General: Detection and control of non-native species in streams and other aquatic habitats that support Gila chub is critical. Land management activities that affect watersheds, alter stream flow characteristics or affect the amount of perennial water in streams may be detrimental to populations of Gila chub, especially those activities that increase erosion and degrade stream banks (Arizona Game and Fish Department 2002e). In areas that have been modified, steps should be taken to restore aquatic habitat, where necessary.

Current protective measures: Habitat restoration projects are ongoing at Las Cienegas National Conservation Area and Empire-Cienega Ranch and Pima County protects Cienega Creek Natural Preserve. The state water-quality standards provide limited protection through the Outstanding Waters designations applying to Cienega Creek. The Federal government's Section 404 requirements and Endangered Species Act also provide protection for this species and its aquatic habitat.

Corridor and migratory needs: Dispersal corridors within rivers and streams must be available for this species to become reestablished within former portions of its range. Currently, Gila chub populations are effectively isolated by ephemeral reaches of stream or in-channel structures that impede movement and harbor predatory non-natives (Weedman et al. 1996). Removal of aggressive non-native fish and other species such as crayfish and bullfrogs within these corridors may be necessary for any level of success.

Key relationships: Historically, Gila chub were commonly found in association with Gila topminnow, desert sucker, Sonora sucker, longfin dace, and speckled dace. The plant community that characterizes habitat where this species is found is broadleaf riparian vegetation consisting of cottonwood, willow, ash, alder, sycamore, walnut, and *Baccharis* spp. in association with submerged aquatic vegetation typical of cienega/marsh habitats (Arizona Game and Fish Department 2002e). A major cause of

decline of Gila chub populations is the introduction of non-native species, discussed above.

Existing monitoring and research programs: Long-term monitoring of this species in Pima County and surrounding areas has occurred as a result of a number of efforts. Monitoring is undertaken throughout central and southern Arizona as part of the Central Arizona Project's non-native species detection effort (Marsh et al. 2009, Clarkson et al. 2011). This monitoring takes place in the Cienega Creek Preserve. The BLM monitors for this and other native species annually at Las Cienegas National Conservation Area (Simms et al. 2006). Also, monitoring for this and other native species has occurred annually in Aravaipa Canyon since 1970 (Eby et al. 2003). Finally, the species is periodically monitored at the Muleshoe Ranch (Cochise County) (Brunson et al. 2001).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-21): 1.

Acres of mitigation habitat within the current portfolio of conservation lands: 3,465.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Gila chub:

- Seek to prohibit Pima County Health Department from using Gambusia for mosquito control in watersheds tributary to reintroduction sites and in the Cienega Creek watershed upstream of Colossal Cave Road.
- Support protection of Cienega Creek water quality via ADEQ's Outstanding Waters program;
- Identify and address management of non-native aquatic organisms through management plans and ranch infrastructure projects on County-controlled mitigation lands in the Cienega watershed.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database..

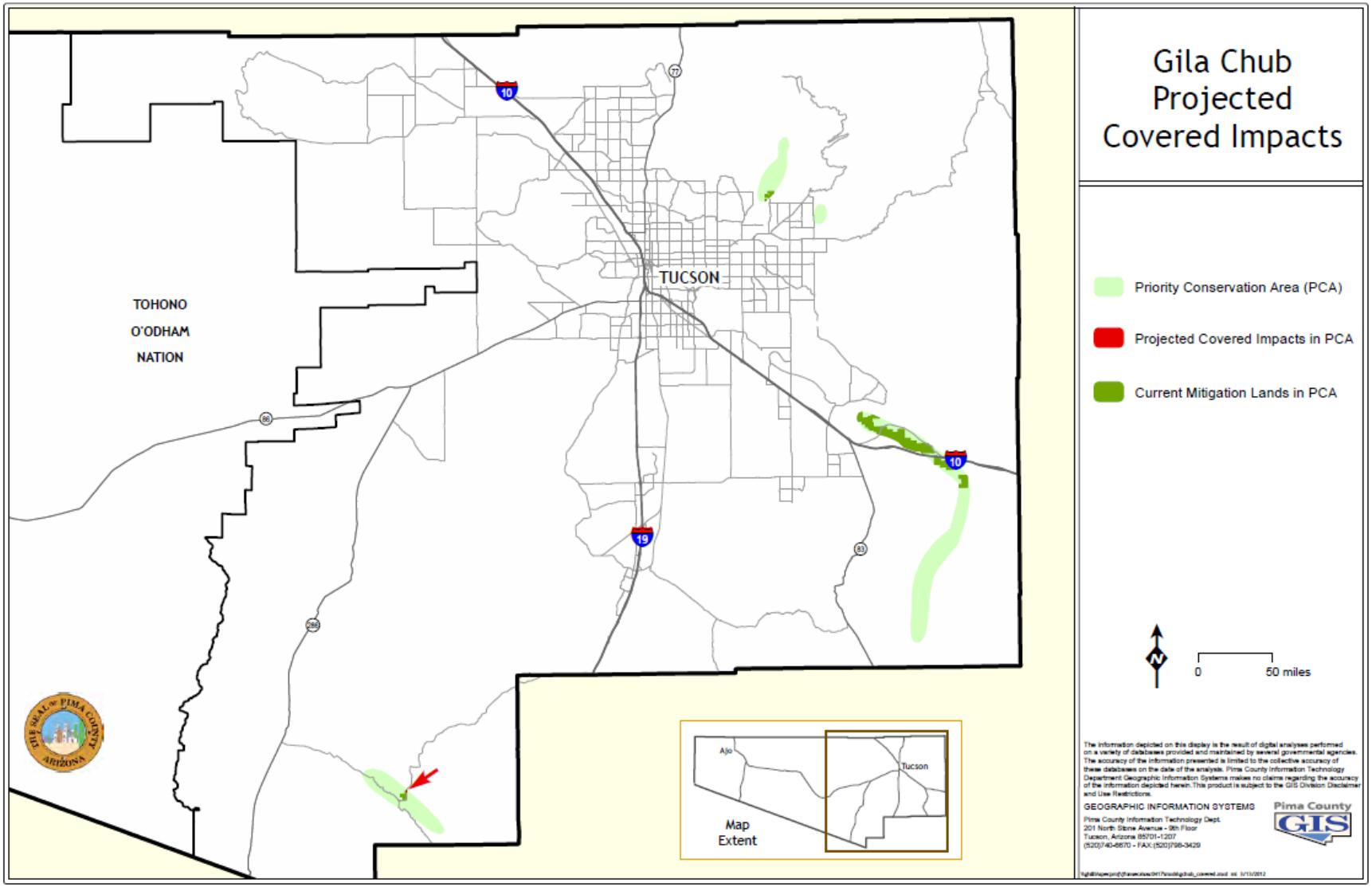



**Figure A-21. Map of projected impacts and mitigation for the Gila chub.**

## Gila topminnow (*Poeciliopsis occidentalis occidentalis*)

### Conservation Status

Endangered Species Act Status: Listed as Endangered in 1967.

State: Wildlife of Special Concern in Arizona.

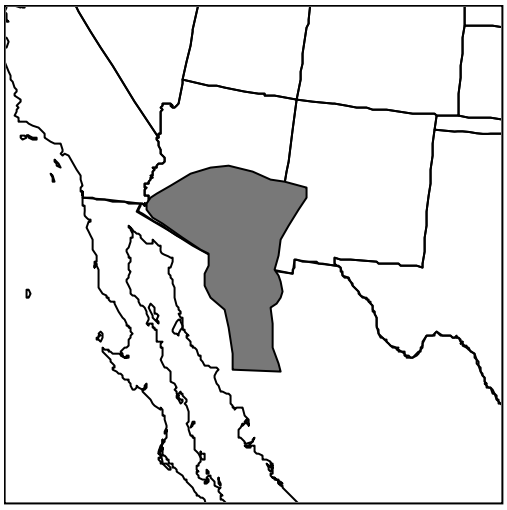
Other: U.S. Forest Service Sensitive Species;
Threatened in Mexico.

Rankings: G3T3, S2

### Description

The Gila topminnow is a small fish that is generally tan- to olive-colored, with darker dorsal coloration and a light to whitish ventral coloration. A dark band is present along both sides of the body. Scales on the dorsum are darkly outlined and extend as black speckles to the upper belly and pre-pectoral area. The dorsal profile is slightly curved and the body is somewhat elongated. The caudal fin is rounded to almost square. The fins are characterized by rays that are outlined with melanophores and lack dark spots. Breeding males are blackened with varying degrees of golden coloration in the pelvic, pectoral, and caudal fins and in the front of the body along the midline. Orange coloration is present at the base of the gonopodium. Males are smaller than the females and rarely measure more than 1 inch (2.5 cm) standard length; the females sometimes reach lengths of 2 inches (5 cm) or more, but are usually 1.2 to 1.8 inches (3.0 to 4.5 cm.) standard length (Minckley 1973).

### Distribution and Trend



Weedman (1998) cited reports that the Gila topminnow was once the most common fish in the Gila River Basin, but that there was a well-documented decline of the species once the basin was settled by historic settlements. Historically the subspecies was found in most perennial springs and streams, and along the vegetated margins of rivers within the Gila River drainage in Yavapai, Gila, Pinal, Maricopa, Graham, Greenlee, Cochise, Pima, Santa Cruz and Yuma Counties (AGFD 2009a). By 1994, the Gila topminnow was restricted to 10 known populations in widely separated, isolated locations (Weedman and Young 1997). Currently, nine naturally occurring localities are known to support Gila topminnows within Arizona (Arizona Game and Fish Department 2001j). The species is still widespread in some river drainages in Sonora, Mexico (Weedman et. al. 1998). The only stable populations of the Gila

topminnow in Pima County are along stretches of Cienega Creek including the Cienega Creek Natural Preserve (Weedman and Young 1997, Voeltz and Bettaso 2003, Simms et al. 2006, Bodner et al. 2007). Numerous reintroductions have occurred for this species in Pima County, but these efforts have had limited success (Constantz 1979, Weedman and Young 1997). There are populations upstream of Pima County in the Santa Cruz River (Voeltz and Bettaso 2003, Powell et al. 2005) and following floods, individuals may potentially establish in the Pima County reach of the river. Captive-bred populations can be found throughout the County.

The Gila topminnow was once a widespread and abundant fish in southern Arizona that has steadily declined to a small number of disjunct populations. According to Weedman (1998), more than 350 Gila topminnow stockings to wild and captive localities have been executed. These included 206 reintroductions at 178 wild locations and 141 captive sites. Successfully re-established populations represent approximately 8% of these efforts (Weedman and Young 1997).

### Habitat Requirements

The basic habitat requirement for the Gila topminnow is water that is permanent and free from non-native predators. Beyond that, habitat requirements of Gila topminnows are broad. The subspecies historically occupied headwater springs and vegetated margins and backwater areas of intermittent and perennial streams and rivers. Topminnows can withstand water temperatures from near freezing to 90-100 degrees Fahrenheit (32-38 degrees Celsius) (Arizona Game and Fish Department 2001j, Carveth et. al. 2006). Weedman (1998) cited reports that Gila topminnows can live in a fairly wide range of water chemistry conditions, with pH's ranging from 6.6 to 8.9, dissolved oxygen readings from 2.2 to 11 mg/l, salinities from tap water to sea water and that topminnows can temporarily tolerate almost total loss of water by burrowing into mud for 1 to 2 days. Preferred habitats contain dense mats of algae and debris, usually along stream margins or below riffles, with sandy substrates sometimes covered with organic muds and debris (Minckley 1973). Gila topminnows are restricted to springs, cienegas, permanent and interrupted streams, and margins of large rivers (Weedman 1998).

### Current and Potential Threats

General: The revised recovery plan (Weedman 1998) identifies the following factors as affecting the ability to delist the species in the foreseeable future:

- irrevocable loss of habitat or contamination by mosquitofish;
- habitat alteration;
- habitat destruction;
- non-native species introductions; and
- limited existing mechanisms and resources to alleviate the above threats.

Existing and potential pest species: The inability of Gila topminnow populations to survive and thrive after the introduction of mosquitofish has been well documented (Weedman et al. 1998). Pima County water bodies have been planted with a wide array of other non-native species that may reduce their suitability to support the Gila topminnow. These include introduced plants such as saltcedar (*Tamarix ramosissima*) and water primrose (*Ludwigia peploides*) which alter hydrology and change habitat characteristics; invertebrates such as the Asian clam (*Corbicula fluminea*) and crayfish (*Orconectes* sp.); amphibians such as the bullfrog (*Rana catesbiana*); and numerous additional non-native fish such as smallmouth bass (*Micropterus dolomieu*), green sunfish (*Lepomis cyanellus*), and western mosquitofish (Weedman 1998).

Threat mechanism: Habitat alteration and destruction, and introduction of predaceous non-native fish, principally mosquitofish, are the main reasons for decline of the Gila topminnow (Weedman 1998). Introduction of other non-native species, including crayfish and bullfrogs, have likely contributed to the decline of this species as well.

**Management Needs**

General: Protection of remaining extant populations is critical to the survival of the species. The revised recovery plan for the Gila topminnow (Weedman 1998) identifies the following actions:

- reintroduction and protection of populations throughout the historic range and monitoring of both natural and re-introduced populations should be continued;
- a protocol for managing populations including protection of genetic integrity should be developed and implemented;
- further studies of the life-history, genetics, ecology and habitat of Gila topminnow and interactions with non-native species should be conducted; and
- the public and resource managers should be informed and educated regarding the subspecies.

The Arizona Game and Fish Department (2001j) recommends that land management activities such as mining, grazing, fuel-wood cutting, logging, etc., should be evaluated in relation to site-specific characteristics, as these activities can have either a positive or negative effect on Gila topminnow populations due to timing, intensity or other activity-related factors. In addition, managers should reevaluate the use of mosquitofish for use in mosquito control and instead consider the use of Gila topminnow, which has been shown to be just as effective for mosquito control (Childs 2006).

Current protective measures: Endangered status for this species affords Federal protection under the Endangered Species Act. Restoration efforts along the Cienega Creek (BLM and Pima County) have contributed to significant populations of the species there. A Memorandum of Understanding was signed in 1981 between the USFWS, AGFD, and USFS allowing coordination for the reintroduction of Gila topminnow on Forest Service-administered lands. Gila topminnows are currently being held in several refugia, with isolation of genetic stocks from different sources or origin, for potential reintroduction to suitable habitats (Arizona Game and Fish Department 2001j). Federal

Clean Water Act protections under Section 404 and state Outstanding Water (surface water quality regulations) may also provide protections for the subspecies.

Corridor and migration needs: The current recovery plan recommends that, until further genetic studies are completed for the Gila topminnow, each existing population of Gila topminnow should remain separate (Weedman 1998). Corridor planning should also include prevention of non-native species movement into habitats occupied by Gila topminnow populations. To this end, the Bureau of Reclamation pays for monitoring of sites inhabited by Gila topminnow with the goal of early detection of invasive species (Clarkson et al. 2011). Because populations of Gila topminnow historically expanded into intermittent waters during wet years and then retreat to headwater springs and perennial reaches of streams during drier years, future planning should attempt to incorporate this facet of the species' life history.

Key relationships: No beneficial key relationships are known. Key adverse relationships exist with exotic predators and competitors, as discussed above.

Existing monitoring and research programs: Long-term monitoring of this species in Pima County and surrounding areas has occurred as a result of a number of efforts. Monitoring is undertaken throughout central and southern Arizona as part of the Central Arizona Project's non-native species detection effort (Marsh et al. 2009, Clarkson et al. 2011). This monitoring takes place annually in the Cienega Creek Preserve. The BLM monitors for this and other native species annually at Las Cienegas National Conservation Area (Simms et al. 2006).

### MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-22): 1.

Acres of mitigation habitat within the current portfolio of conservation lands: 4,480.

### MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Gila topminnow:

- Support protection of Cienega Creek water quality via Arizona Department of Environmental Quality's Outstanding Waters program;
- Identify and address management of non-native aquatic organisms through management plans and ranch infrastructure projects on County-controlled mitigation lands in the Cienega watershed
- Use as mosquito control if suitable agreements can be reached with AGFD and USFWS.
- Prohibit Pima County Health Department from using Gambusia for mosquito control in watersheds tributary to reintroduction sites and in the Cienega Creek watershed upstream of Collosal Cave Road.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.

- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

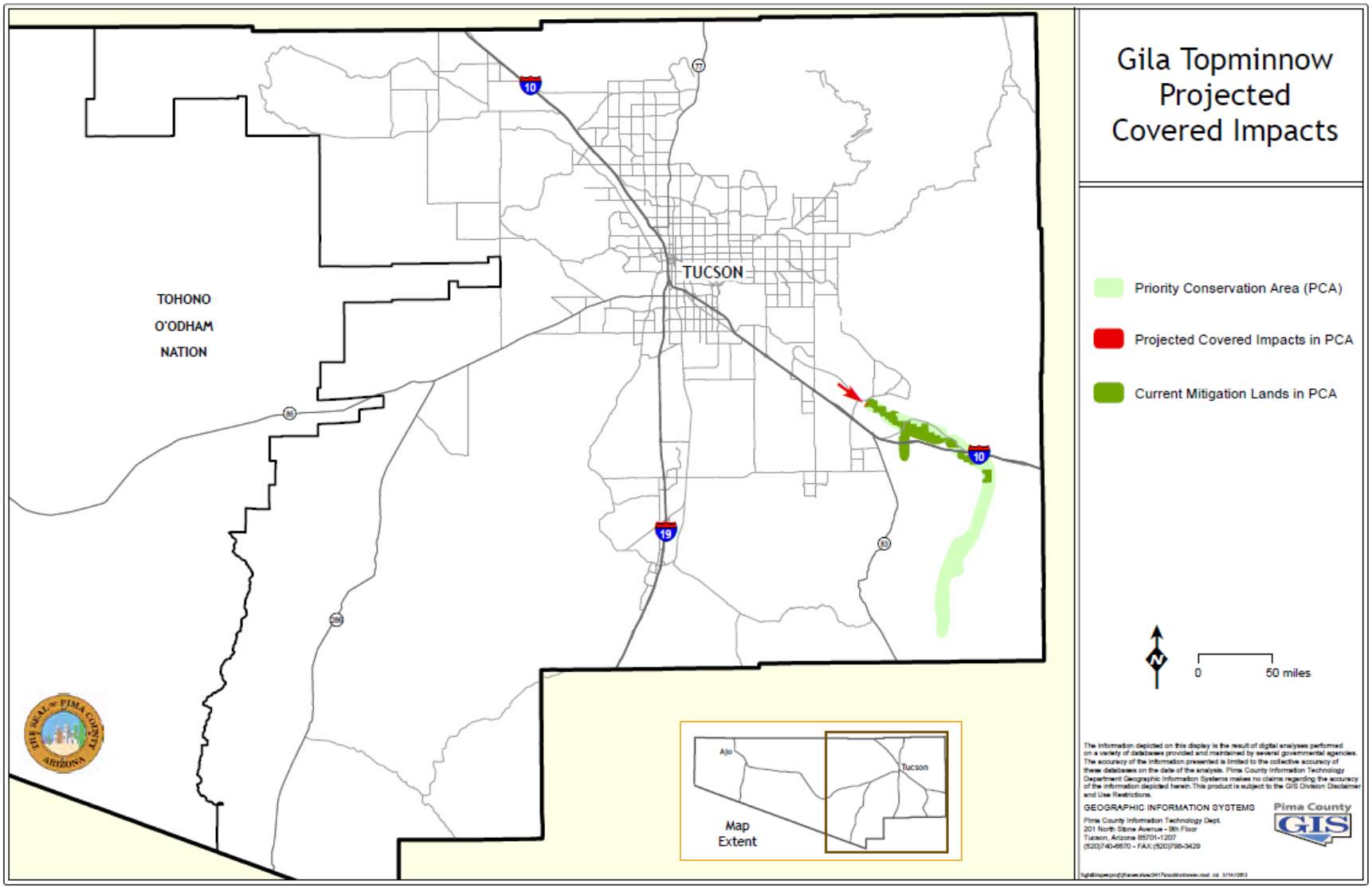



**Figure A-22. Map of projected impacts and mitigation for the Gila topminnow.**

# Desert Sucker (*Catostomus clarkii*)

## Conservation Status

Endangered Species Act Status: None. Former FWS candidate for Category 2 listing.

State: Wildlife of Special Concern in Arizona.

Other: USFWS Species of Special Concern; U.S. Forest Service Sensitive Species.

Rankings: G3G4, S3S4.

## Description

This is a medium sized catostomid fish, attaining adult size of 4 to 11 inches (10 to 28 cm) standard length. It has large lips with small papillae evenly dispersed over the lower lip; and jaws with cartilaginous scraping edges. The scales in the lateral line have been recorded ranging from 61 to 104. There are 8 to 12 dorsal rays (usually 10 or 11) and 8 to 12 pelvic rays that are 9 or 10 inches (22.8 to 25.4 cm) long. There is usually a small flap of skin present at the base of each pelvic fin. Coloration ranges from silvery tan to dark greenish above, and is silvery to yellowish below (Arizona Game and Fish Department 2002a).

## Distribution and Trend

The historic range of the desert sucker includes Arizona, New Mexico, Nevada, Utah, and Mexico. The desert sucker occurs in suitable habitats of the lower Colorado River downstream from the Grand Canyon, generally including tributary streams of the Gila River drainage upstream of Gila, Arizona, along with the Virgin River basin of Utah, Arizona, and Nevada including the pluvial White River and Meadow Valley Wash. Populations of desert sucker are declining, although its distribution is still widespread. The decline is due mainly to diminished habitat through the alteration of historic flow regimes and construction of reservoirs (Arizona Game and Fish Department 2002a).

No known natural populations of this species currently occur in Pima County. There are populations upstream of Pima County in the Santa Cruz (Powell et al. 2005) and San Pedro rivers and, following floods, individuals may potentially establish in Pima County.

### Habitat Requirements

The desert sucker is found in rapids and flowing pools of streams, primarily over bottoms of gravel-rubble with sandy silt in the interstices. It can tolerate a wide range of water temperatures, from 50 to 70 degrees Fahrenheit (10 to 21 degrees C). Water depth is generally less than 1 foot (0.3 m). Habitat usage information for the desert sucker is life-stage specific. Larval desert suckers utilize backwaters, embayments, and some pools. As juveniles, desert suckers move into faster flowing habitats like riffles and rapids. As desert suckers mature into adults they move from juvenile habitats (riffles, etc.) into deeper pools and pool-like areas.

### Current and Potential Threats

General: Loss, fragmentation or modification of habitat from water development projects, stream diversions, and aquifer pumping is a major threat to the species. Invasion of non-native fishes, either from stock or domestic watering tanks upstream of the Gila River, and extending downstream, is an equal or greater threat. The Red Shiner is present in the Gila River and has been suggested as a potential competitor for native species. At early life stages, the desert sucker may be preyed upon by nonnative fish in some areas. Hybridization with other sucker species is also a threat to desert suckers at some locations.

Existing and potential pest species: Desert suckers are known to be vulnerable to six species of native parasites. The most dangerous parasite appears to be *Ichthyophthirius multifiliis*, of which epizootic outbreaks appear to be common in streams throughout Arizona. Other parasites found on desert suckers include *Myxobulus oblongus*, *Ornithodiplostomum ptychocheilus, Clinostomum marginatum*, *Isoglaridacris bulbocirrus*, and *Rhabdochona decaturensis* (Mpoame and Rinne 1983).

Threat mechanism: Loss of stream habitat through water management practices and/or depletion of groundwater. Also, natural flood events can decimate local populations. Non-native predators and competitors are also a threat to native fish species.

### Management Needs

General: Aravaipa Creek canyon area must have its upstream aquifer protected. Over-appropriation or use of the headward Sulphur Springs Valley aquifer must be guarded against. Maintenance of flow in this stream is highly critical because of the habitation of shallow riffle areas by 5 of the 7 remaining native Cypriniform fishes (including desert suckers).

A winter snagging season for anglers currently exists for this sucker below Stewart Mountain Dam on the lower Salt River. This management action was taken as a measure to encourage harvest of the species, as many die during the extremely low winter water flows (Arizona Game and Fish Department 2002a).

Current protective measures: There are no current protective measures for this species. Desert suckers are known to be relatively sedentary and migrational or seasonal movements do not occur (Bestgen et al. 1987)

Corridor and migratory needs: Corridor needs of the desert sucker are not known.

Key relationships: None are specifically known.

Existing monitoring and research programs: There are no known research and monitoring programs at this time.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-23): 0.

Acres of mitigation habitat within the current portfolio of conservation lands: 99.

### Management and Conservation Commitment

Pima County will pursue the following management actions and conservation commitments for the desert sucker:

- Place restrictive covenants or conservation easements on County-controlled mitigation lands in the San Pedro watershed, as described in Chapter 4;
- Pima County will protect its existing water rights associated with County-owned mitigation lands in the San Pedro watershed.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

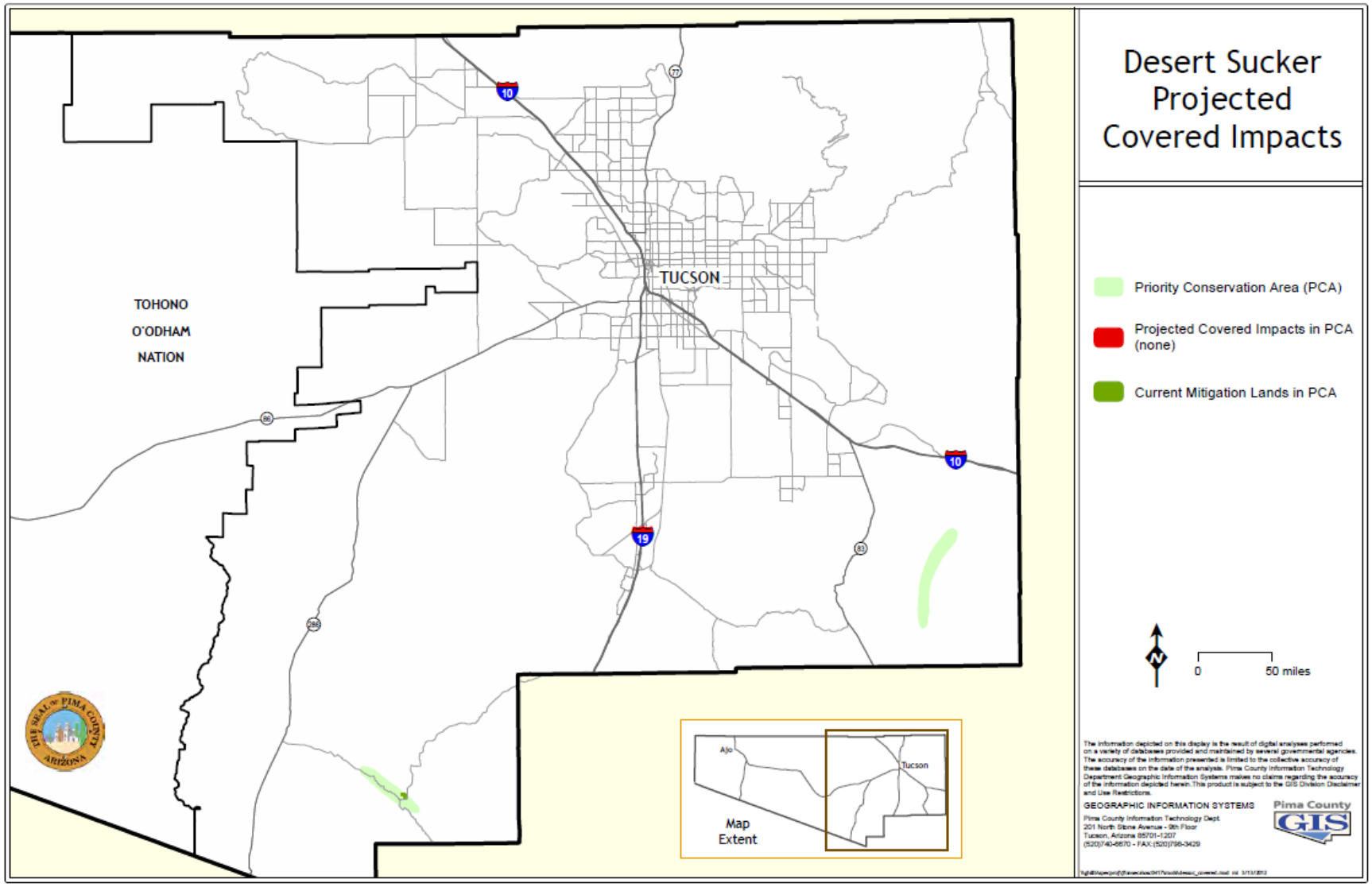



**Figure A-23. Map of projected impacts and mitigation for the desert sucker.**

## Sonora Sucker (*Catostomus insignis*)

### Conservation Status

Endangered Species Act Status: Former FWS candidate for Category 2 listing (1994).

State: Wildlife of Special Concern in Arizona.

Other: USFWS Species of Special Concern; U.S. Forest Service Sensitive Species, Region 3; Endangered in Mexico.

Rankings: G3, S3.

### Description

This is a large catostomid fish, attaining adult size of 8 to 31 inches (20 to 79 cm) standard length. Its lower lip is about 3 times as thick as its upper lip. There are 10 to 11 rays in the dorsal fin. The body is sharply bicolored, olive brown above and deep yellow below. The scales on the upper half of the body have dark spots forming faint dashed lines. Weights of Sonora suckers range from 4 ounces to 4 pounds (Arizona Game and Fish Department 2002b).

### Distribution and Trend

The historic range of the Sonora sucker includes Arizona, New Mexico, and Mexico. The Sonora sucker is native to the Gila and San Francisco drainages (except in extreme headwaters). The status of the species is stable in the San Francisco and Gila River. In Arizona, the Sonora sucker has been recorded in the Apache-Sitgreaves and Coconino National Forests in Arizona, and is widespread in the Gila and Bill Williams river basins of Arizona (Arizona Game and Fish Department 2002b). Populations are stable in the San Francisco and Gila River drainages (Arizona Game and Fish Department 2002b).

No known natural populations of this species occur in Pima County. There are populations upstream of Pima County in the Santa Cruz (Powell et al. 2005) and San Pedro rivers and following floods, individuals may potentially establish in Pima County.

### Habitat

The Sonora sucker requires lentic and pool habitats, with gravel-rubble bottoms. It is found in a variety of habitats from warm water rivers to trout streams (Arizona Game and Fish Department 2002b).

### Current and Potential Threats

General: Loss, fragmentation or modification of habitat from water development projects, stream diversions, and aquifer pumping is a threat to the species. Invasion of non-native fishes either from stock or domestic watering tanks upstream of the Gila River, and extending downstream, is an equal or greater threat. The red shiner is present in the Gila River and has been suggested as a potential competitor for native species. It has been reported in the lower reaches of Aravaipa Creek.

Existing and potential pest species: Sonora suckers are known to be vulnerable to 10 species of parasites. The most dangerous parasite appears to be *Ichthyophthirius multifiliis,* of which epizootic outbreaks appear to be common in streams throughout Arizona. Other parasites found on desert suckers include *Myxobulus catostomi, M. discrepans, M. nodularis, Ornithodiplostomum ptychocheilus, Clinostomum marginatum, Ligula intestinalis, Isoglaridacris bulbocirrus, Neoechinorhynchus* sp., *and Rhabdochona decaturensis* (Mpoame and Rinne 1983).

Threat mechanism: Loss of stream habitat through water management practices or high water consumption; also, natural flood events can decimate local populations. Non-native predators and competitors also threaten native fish populations.

### Management Needs

General: Aravaipa Creek canyon area must have its upstream aquifer protected. Over-appropriation or use of the headward Sulphur Springs Valley aquifer must be guarded against. Maintenance of flow in this stream is highly critical because of the habitation of shallow riffle areas by 5 of the 7 remaining native Cypriniform fishes (including Sonora suckers). In the event of reduction in flow, intermittent surface flow could result (Biota Information System of New Mexico 2008b).

Current protective measures: There are no current protective measures for this species.

Corridor and migratory needs: Corridor needs of the Sonora sucker are not known. This species tends to be relatively sedentary (Bestgen et. al. 1987).

Key relationships: The Sonora sucker requires rivers or streams that have deep and quiet, rocky or gravelly pools. They are intolerant of lake conditions created by dams.

Migratory requirements: Unknown

Existing monitoring and research programs: There are no known research and monitoring programs at this time.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-24): 0.

Acres of mitigation habitat within the current portfolio of conservation lands: 50.

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Sonora sucker:

- Pima County will place restrictive covenants or conservation easements on County-controlled mitigation lands in the San Pedro watershed, as described in Chapter 4.
- Pima County will protect its existing water rights associated with County-owned mitigation lands in the San Pedro watershed.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

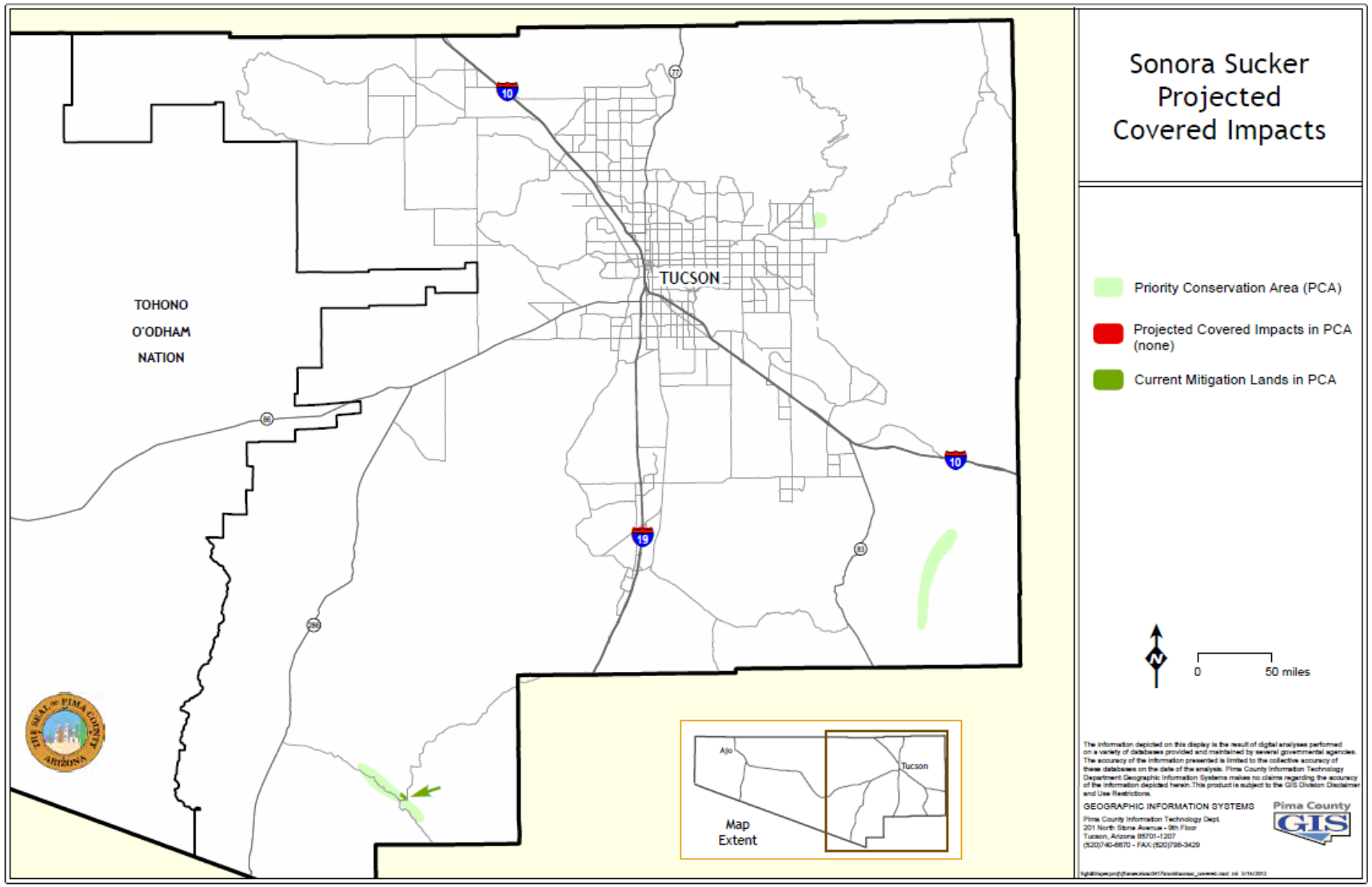



**Figure A-24. Map of projected impacts and mitigation for the Sonoran sucker.**

# Amphibians

## Chiricahua leopard frog (*Lithobates chiricahuensis*)

### Conservation Status

Endangered Species Act Status: Listed Threatened in 2002. A Recovery plan was finalized in 2007 (U. S. Fish and Wildlife Service 2007b) with Critical Habitat proposed in 2011 (U. S. Fish and Wildlife Service 2011) and finalized in 2012.

State: Wildlife of Special Concern in Arizona, Endangered in New Mexico.

Other: U.S. Forest Service Sensitive Species, Threatened in Mexico.

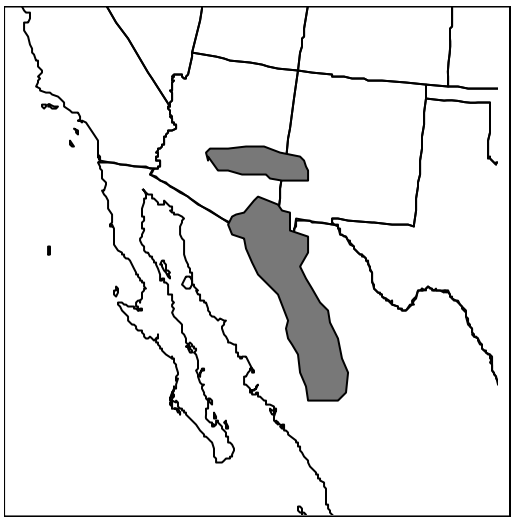
Rankings: G3, S3.

### Description

Description: Eggs are black and white and strongly demarcated between the animal and vegetal poles. Tadpoles are darkly pigmented with darkly blotched tails. Adults are distinguished from other leopard frogs by their unique thigh pattern that includes prominent, white-tipped tubercles on a dark field. Generally, adults are stout-bodied, medium-sized frogs with many dorsal spots, no spots on the head, and poorly defined or discontinuous dorsolateral folds.

### Distribution and Trend

Historical distribution of this species is difficult to ascertain because it was formerly considered *Rana pipiens*, and so classified by observers before it was described as a separate species in 1979. Positive historical records are known from over 114 sites in southeastern Arizona, where it occupied most large rivers and lakes, as well as many small tributaries and ponds. From 1990 to 1994, 265 potential sites, including 87 of the 114 known historical sites were surveyed, and Chiricahua leopard frogs were found in 12 historical and 51 previously unknown sites (Sredl and Howland 1994).



The total range includes montane regions in central and southern Arizona, southwestern New Mexico south into the Sierra Madre Occidental to western Jalisco, Mexico, at

elevations from 3,500 to 8,400 feet (1,066 to 2,450 m). Two disjunct distributions exist within central and southeastern Arizona, from montane central Arizona east and south along the Mogollon Rim to montane areas of west-southwestern New Mexico, and southeastern montane areas of Arizona into Sonora and Chihuahua, Mexico (U. S. Fish and Wildlife Service 2007b). Elevational range of the central and eastern Arizona distribution is 3,500 to 8,040 feet (1,068 to 2,452 m), and 1,219 to 4,023 feet (372 to 1,227 m) near the Arizona-Mexico border.

Populations in Pima County occur in stock tanks in the Buenos Aires National Wildlife Refuge, canyons in the Santa Rita and Baboquivari mountains, and in Cienega Creek adjacent to the Empire Ranch and Cinco ponds areas. In 1994, this species was found ranging from Empire Gulch to Springwater Canyon, but failed to appear there in 1996 (Rosen and Caldwell 2004). Three individuals were found in Cienega Creek at Empire Ranch in 1986 (Rosen and Schwalbe 1988). Recent surveys of the north end of the Santa Rita Mountains at the site of the proposed Rosemont Mine revealed individuals in 9 locations in around the proposed project site (WestLand Resources Inc 2009). The species is not known to occur on either the Sands or Clyne ranches, which are located in the southeast corner of the County and are owned by Pima County, but historical records appear to exist for the area (David Hall, *personal communication* to Brian Powell).

### Habitat Requirements

The Chiricahua leopard frog is an aquatic and riparian species. Habitat includes a variety of water sources including rocky streams with deep, rocky pools, overflow pools and oxbows of rivers, permanent springs, ponds, and wetlands at elevations from 3,500 to 8,040 feet in central and eastern Arizona, and from 1,219 to 4,023 feet in southeastern Arizona (U. S. Fish and Wildlife Service 2007b). It also occurs in thermal springs and seeps, stock tanks, wells, and river reaches. Adjacent upland communities include oak and pine-oak woodland, chaparral, grassland, and desert. Ideal habitat includes permanent water (during breeding season, and at least muddy conditions otherwise for survival), aquatic heterogeneity (deep pools with nearby shallow areas), undercut banks (retain moisture during drought), overhanging terrestrial vegetation, and abundant aquatic vegetation (U. S. Fish and Wildlife Service 2007b).

<u>Home range requirements:</u> Known habitat requisites are detailed above. Home range requirements beyond these are not known, though recent work suggest that they can disperse overland for 4-5 miles from breeding sites (David Hall and Phil Rosen, *unpublished data*).

<u>Ability to use major land use categories:</u> The Chiricahua leopard frog uses agricultural land, water, streams and canals, lakes, and unforested wetlands.

### Current and Potential Threats

The cause of the species' historical decline is not known for certain, but is thought to be a combination of habitat loss, exotic, invasive species, and disease (chytrid fungus).

Today, invasive species such as introduced fishes, crayfish, and bullfrogs are one of the most important threats to the Chiricahua leopard frog on the local scale (U. S. Fish and Wildlife Service 2007b). This, coupled with habitat fragmentation and loss resulting from water diversion, groundwater pumping, and pollution have meant that recovery criteria have not been met for this species. Climate change and increases in UV radiation will likely impact this species in the future. Finally, the cold-loving chytrid fungus is thought to be a major problem for this and other amphibian species in Arizona and elsewhere in the U.S. (Bradley et. al. 2002, Lips et. al. 2006).

Existing and potential pest species: The introduced crayfish (*Oronectes virilis*) is having major negative affects on native populations of frogs in North America (Kats and Ferrer 2003), probably contributing to the statewide decline of *L. chiricahuensis* in Arizona (U. S. Fish and Wildlife Service 2007b). Bullfrogs are also important predators of native frogs and recent eradication efforts in southern Arizona (Atascosa Mountains and Cienega Valley) appear to have established conditions that are favorable to the reestablishment of the Chiricahua leopard frog.

Threat mechanism: Historical habitat loss and isolation of local populations has disrupted the metapopulation structure of this species. Multiple threats impact local populations, and without a healthy metapopulation structure, recovery of local populations in not possible (Sredl and Howland 1994).

**Management Needs**

General: Management actions for this species should focus on protecting existing populations, establishing new habitat, and reducing threats. Factors to assure available quality habitat include (1) maintenance or development of permanent water sources within a metapopulation area, while preventing further groundwater pumping, (2) development and maintenance of heterogeneous habitats that include cover, shelter, breeding microhabitats, (3) increase depth, duration, and surface area of water, (4) prevent introduction of non-native predators and eradicate such species whenever possible, and (5) prevent pollution, especially from agricultural and industrial sources.

Current protective measures: The most important protections have been the establishment of critical habitat and the resulting protections that that action affords on Federal lands. Arizona implemented an open season on bullfrogs, and set an unlimited bag and possession limit for dead bullfrogs. The regulations will simplify efforts to pressure bullfrog populations in specific areas to favor native species.

Key relationships: This species requires perennial water for survival and reproduction.

Existing monitoring and research programs: The Cienega Watershed Partnership is working on a watershed-wide conservation project within the Cienega Valley. A key focus of that conservation effort is eradication of non-native species (bullfrogs and crayfish), restoration of potential breeding sites, and reintroduction of individuals. The Arizona Game and Fish Department and the U.S. Fish and Wildlife Service developed a safe harbor agreement for the species and that has led to a host of local restoration

efforts for the species. Key populations of the species are periodically monitored by the Arizona Game and Fish Department and the USFWS.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-25): 2.

Acres of mitigation habitat within the current portfolio of conservation lands: 13,471.

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Chiricahua leopard frog:

- Actively manage this species on Pima County owned and leased lands; maintain and/or re-establish several viable populations in springs, tinajas, stock ponds and other suitable sites, where appropriate and in consultation with AGFD and USFWS.
- Acquire and protect water rights to maintain and restore habitat for this species where appropriate.
- County-controlled mitigation lands >3,400 feet will be managed for control/removal of invasive aquatic exotic species to create suitable habitat for this species and protect sites from other stresses such as spread of chytrid fungus and controllable desiccation, where prudent and feasible.
- Support simultaneous removal of bullfrogs and crayfish across whole landscapes, where feasible, such as is being accomplished in the Cienega watershed.
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

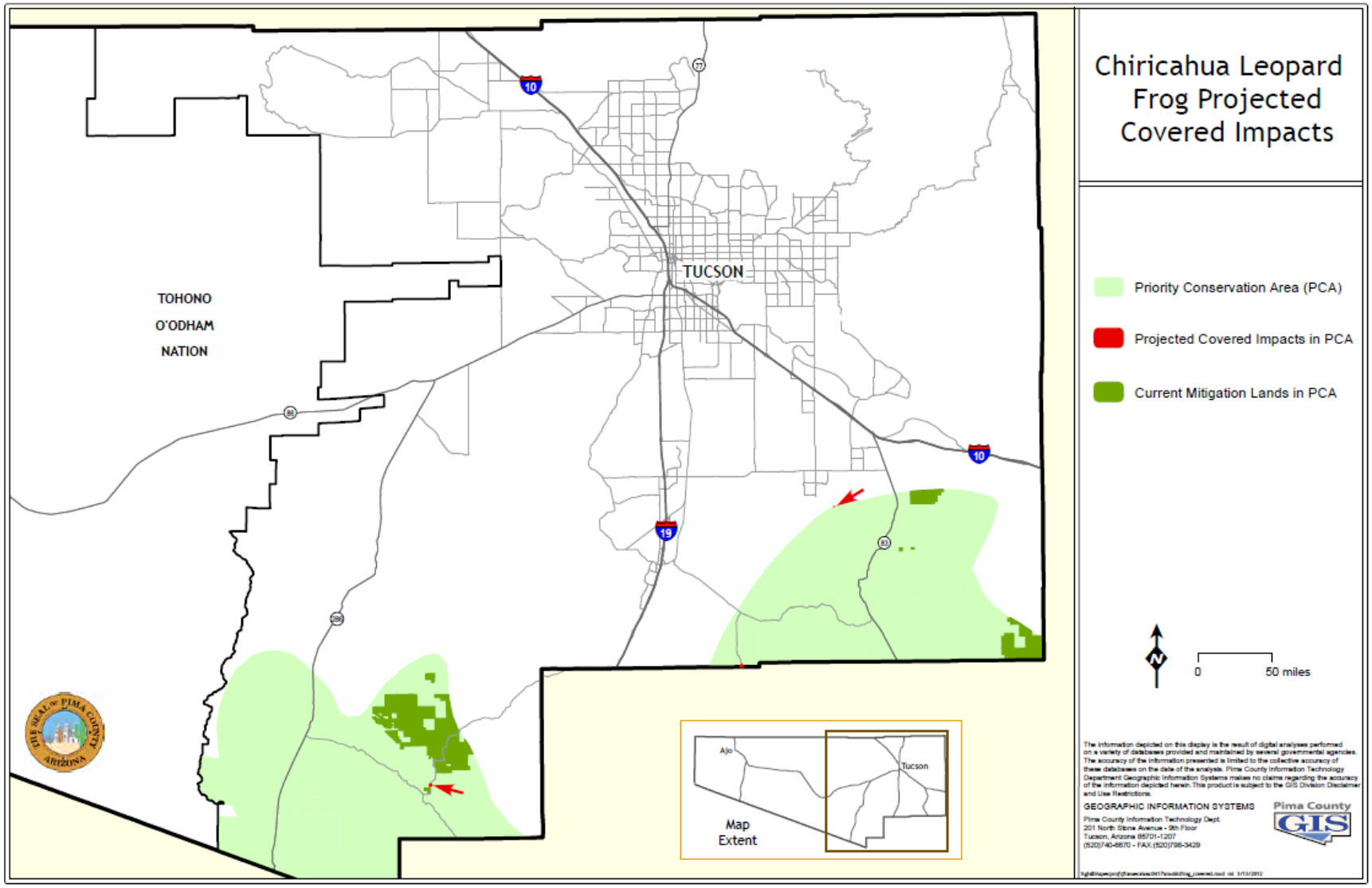



**Figure A-25. Map of projected impacts and mitigation for the Chiricahua leopard frog.**

# Lowland leopard frog (*Lithobates yavapaiensis*)

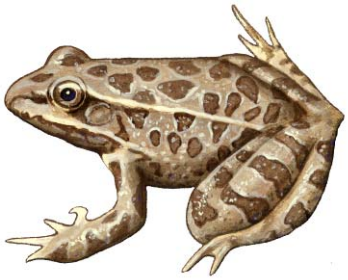
## Conservation Status

Endangered Species Act Status: None. Former FWS Category 2 candidate for listing.

State: Wildlife of Special Concern in Arizona;
Endangered in New Mexico.

Other: USFWS Species of Concern; Sensitive by U.S. Forest Service.

Rankings: G4 S4.

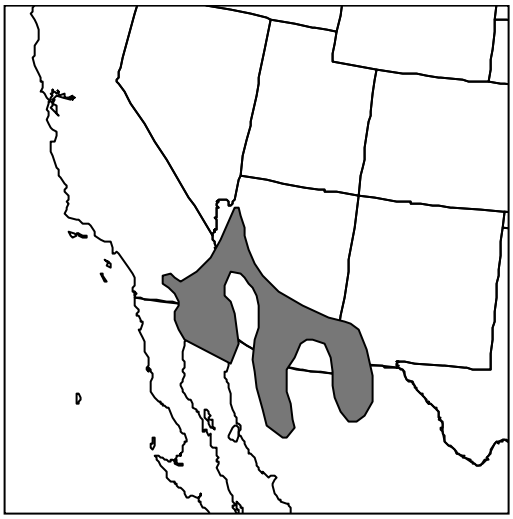


## Description

The lowland leopard frog is a medium-sized frog. The dorsal field color of adults is a light gray-green, green, tan, or brown, with dark brown spots and no halos. Adults can be distinguished from other leopard frogs by their prominent dorsolateral folds that are discontinuous posteriorly and deflected medially in the sacral area. The supralabial stripe diffuses anterior to the eye, the venter is cream-colored, and yellow pigment on the groin often extends posterior to the venter and to the ventral portions of the legs (Arizona Game and Fish Department 2006d).

## Distribution and Trend

The range of the lowland leopard frog once included lower elevations of the lower Colorado River and its tributaries in Nevada, California, Arizona, New Mexico, northern Sonora and extreme northeast Baja California, Mexico. This frog occurred in the Colorado River near Yuma in extreme southwestern Arizona, in west, central, and southeastern Arizona south of the Mogollon Rim, and the Virgin River drainage in extreme northwestern Arizona (Arizona Game and Fish Department 2006d). The lowland leopard frog currently occurs in central and southeastern part of Arizona. They are absent from the lower Colorado River and have declined significantly in southeastern Arizona.



Populations in Pima County are found at Cienega Creek (Caldwell 2002, Rosen and Caldwell 2004) and nearby Davidson Canyon (WestLand Resources Inc 2008), several canyons in the Rincon Mountain District of Saguaro National Park (Flesch et. al. 2006, Swann and Wallace 2008), and several sites in the Santa Catalina Mountains including Buehman, Youtcy, Alder, and Romero canyons. In the last 10 or so years they likely been extirpated from Sabino and Molino canyons, and Agua Caliente Wash (Sartorius

and Rosen 2000). A comprehensive survey of the Santa Catalina and Rincon Mountains will be completed in early 2013 by Pima County and the University of Arizona.

### Habitat Requirements

This species is generally restricted to permanent waters south and west of the Mogollon Rim, below 5,500 feet elevation and chiefly below 3,000 feet. This frog apparently prefers small to medium streams over ponds, stock tanks, and other aquatic habitats (Arizona Game and Fish Department 2006d). Populations typically occur in aquatic systems with surrounding Sonoran Desert Scrub, Semidesert Grassland, or Madrean Evergreen Woodland upland vegetation communities at elevations from 800 to 5,500 feet in Arizona. In New Mexico, lowland leopard frogs were associated with vegetation that includes Arizona sycamore (*Platanus wrightii*), seepwillow (*Baccharis glutinosa*), other trees and shrubs, and various forbs and graminoid plants. Lowland leopard frogs often concentrate near deep pools associated with root masses of large riparian trees (Biota Information System of New Mexico 2000). Large pools are essential for adult survival and reproduction, and small pools and marsh habitats probably enhance survival of juveniles (Arizona Game and Fish Department 2006d).

### Current and Potential Threats

General: Some die-offs have occurred, but specific causes have not been positively identified. The species is threatened by a multitude of human impacts in aquatic habitats. Other threats include diseases such as Chytrid fungus, flooding, and alteration of riparian and aquatic habitat, introduction of non-native predatory fishes (bass, sunfish, and catfish) and bullfrogs (Arizona Game and Fish Department 2006d), human use of aquatic habitats, and the invasion of the introduced Rio Grande leopard frog (*R. berlandieri*) in the lower Gila and Salt rivers.

Existing and potential pest species: Non-native predators and competitors include bullfrogs, Rio Grande leopard frogs, crayfish, predatory fish, and diseases.

### Management Needs

General: Management actions for this species should focus on protecting existing populations, establishing new habitat, and reducing threats. Factors to assure available quality habitat include (1) maintenance or development of permanent water sources within a metapopulation, while preventing further groundwater pumping, (2) development and maintenance of heterogeneous habitats that include cover, shelter, breeding microhabitats, (3) increase depth, duration, and surface area of water, (4) prevent introduction of non-native predators and eradicate such species whenever possible, and (5) prevent pollution, especially from agricultural and industrial sources.

Current protective measures: Arizona implemented a closed season for the lowland leopard frog and implemented a year round, open season on bullfrogs, and set an unlimited bag and possession limit for dead bullfrogs across the entire state, except for 3 western counties. The regulations will simplify efforts to pressure bullfrog populations

in specific areas to favor native species. Most of the areas known to be currently occupied by this species are protected by a variety of land management agencies and regulations.

Corridor needs: Like the Chiricahua leopard frog, the lowland leopard frog appears to be a classic metapopulation species whose avenues of connection between local populations have been significantly impacted by human activities and their consequences. This species probably requires dispersal corridors consisting of streams and adjacent riparian habitat in reasonably good condition, without insurmountable interruptions or barriers.

Key relationships: No specific key relationships are known for this species.

Migratory requirements: See above under corridor needs.

Existing monitoring and research programs: Don Swann with the National Park Service has been monitoring lowland leopard frogs at sites throughout the Rincon Mountain Unit of Saguaro National Park for approximately 10 years. An inventory of the Santa Catalina and Rincon Mountains will be completed in early 2013.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-26): 7,753.

Acres of mitigation habitat within the current portfolio of conservation lands: 38,710.

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the lowland leopard frog:

- Actively manage this species on County-controlled mitigation lands; maintain and/or re-establish several viable populations in springs, tinajas, stock ponds and other sites, where appropriate and in coordination with the USFWS and AGFD.
- Acquire and protect select water rights to maintain and restore habitat for this species.
- County-controlled mitigation lands will be managed and monitored for the detection and subsequent removal of aquatic invasive species to create suitable habitat for this species and protect sites from other stresses.
- Support simultaneous removal of bullfrogs, crayfish, and non-native fish across whole landscapes, such as is being conducted in the Cienega watershed.
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

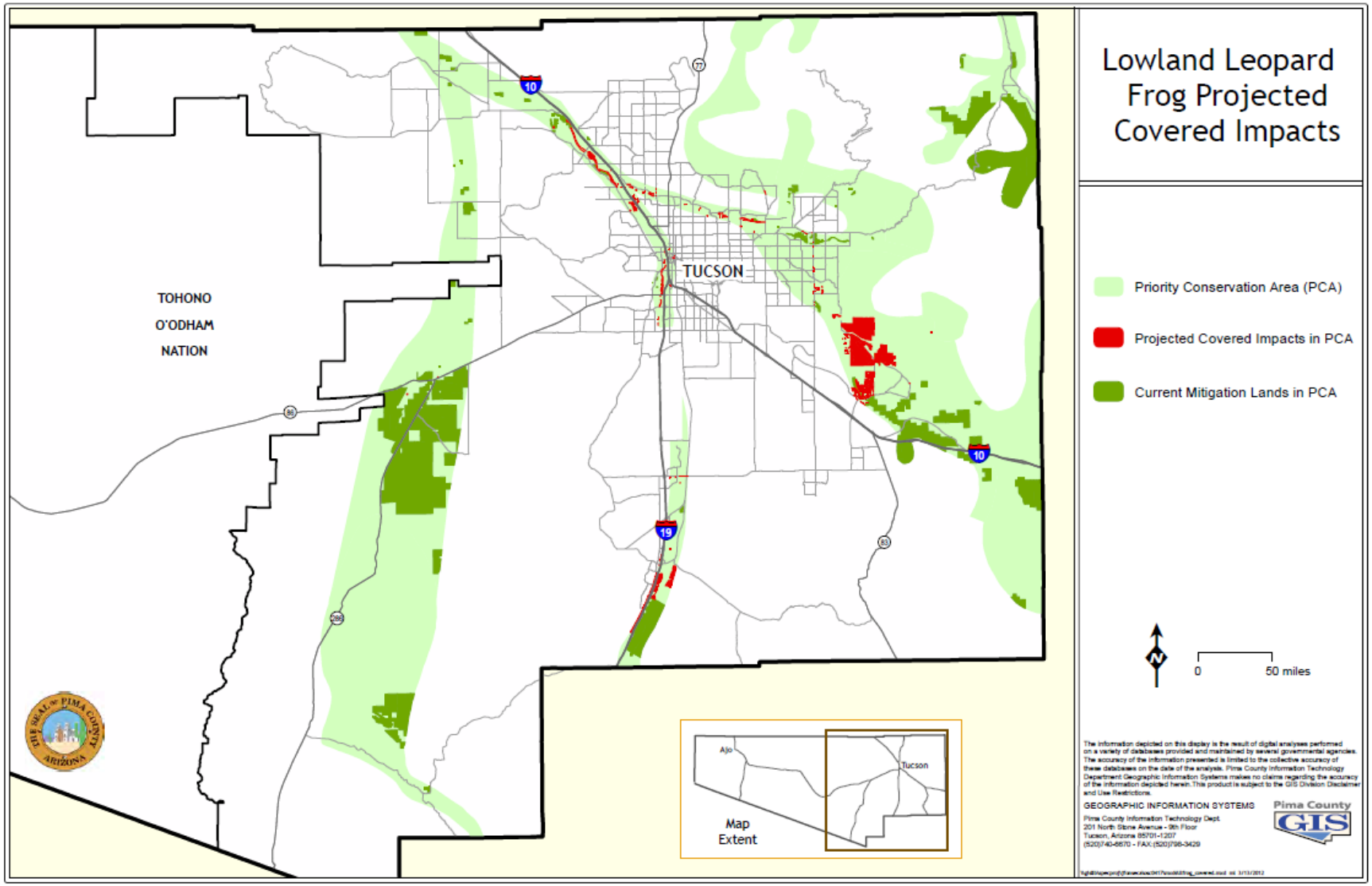
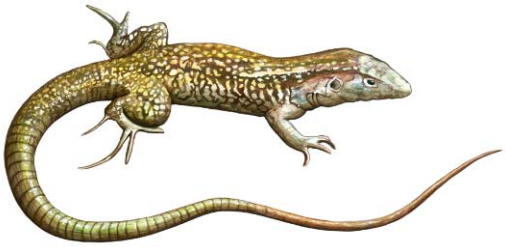



**Figure A-26. Map of projected impacts and mitigation for the lowland leopard frog.**

# Reptiles

## Giant spotted whiptail lizard (*Cnemidophorus burti stictogrammus*)

### Conservation Status



Endangered Species Act Status: None.

State: None.

Other: U.S. Forest Service Sensitive Species; Bureau of Land Management Sensitive Species; Threatened in New Mexico.

Rankings: G4, T4, S3.

### Description

This is a slender, fast-moving lizard. The adult size for the species is 3.5 to 5.5 inches (8.7 to 13.7 cm) snout-vent length, with a tail generally longer than the snout-vent length. The medial and upper surfaces of the neck, legs, and feet are dark grayish green to bluish, with green or pale spots, and a reddish brown to reddish orange color on the head and neck. The tail is brown in adults and reddish or orange in young. Large males may have no stripes (Stebbins 1985).

### Distribution and Trend

The historic range of the giant spotted whiptail includes Arizona, the extreme southwestern edge of New Mexico, and Sonora, Mexico (Arizona Game and Fish Department 2001b). Its range in Arizona extends from the Baboquivari and Pajarito Mountains on the west, to Guadalupe Canyon in extreme southwestern New Mexico. It includes the Santa Cruz and San Pedro river basins in the south-central part of the state, from the Santa Catalina Mountains near Oracle southward to the Yaqui River basin and the Rio de la Concepcion in Sonora (Lowe 1964).

In Pima County, the giant spotted whiptail currently occurs in the foothills of the Santa Catalina, Rincon, San Luis, Baboquivari and Santa Rita mountains; and along the West Branch of the Santa Cruz River, Arivaca Creek, and Empire Gulch (Arizona Game and Fish Department 2001a, Edwards and Swann 2003, Flesch et al. 2006, Rosen 2008c).

### Habitat

Giant spotted whiptails are found in lower Sonoran (chiefly riparian areas) and upper Sonoran life zones, in mountain canyons, arroyos, and mesas in arid and semi-arid regions, entering lowland deserts along stream courses (Stebbins 1985). It is found in dense shrubby vegetation, often among rocks near permanent and intermittent streams, and in grassy areas within riparian areas (Degenhardt et. al. 1996, Arizona Game and Fish Department 2001a), through an elevation range of near sea level to around 4,500 feet (1,370 m).

### Current and Potential Threats

General: Giant spotted whiptails could be impacted by uncontrolled wildfire or by loss of riparian vegetation in its limited habitat. In New Mexico, habitat alteration and overcollecting represent the major perceived threats to the species (Biota Information System of New Mexico 2008).

Existing and potential pest species: None have been cited, although it is probable that invasive non-native grasses, such as red brome and buffelgrass, may increase incidence and severity of fires in the limited habitat of this subspecies.

Threat mechanism: Direct loss of individuals by collecting, and loss of habitat resulting from all factors that cause degradation of riparian habitat.

### Management Needs

General: Distribution, population, habitat and life history studies are needed (Arizona Game and Fish Department 2001a).

Current protective measures: Arizona prohibits commercial collection of reptiles, but enforcement is limited. Some protection and mitigation of habitat is afforded by Pima County's floodplain ordinance and the Federal Clean Water Act, Section 404 program.

Corridor and migratory needs: No known information is available on corridor needs of this subspecies. It is apparently found in several disjunct populations and may be a relict of another climatic era that has survived in isolated refugia.

Key relationships: No known information is available on key relationships of this subspecies.

Existing monitoring and research programs: There are no known monitoring and research programs for this subspecies.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-27): 4,586.

Acres of mitigation habitat within the current portfolio of conservation lands: 7,407.

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the giant spotted whiptail:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4;
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

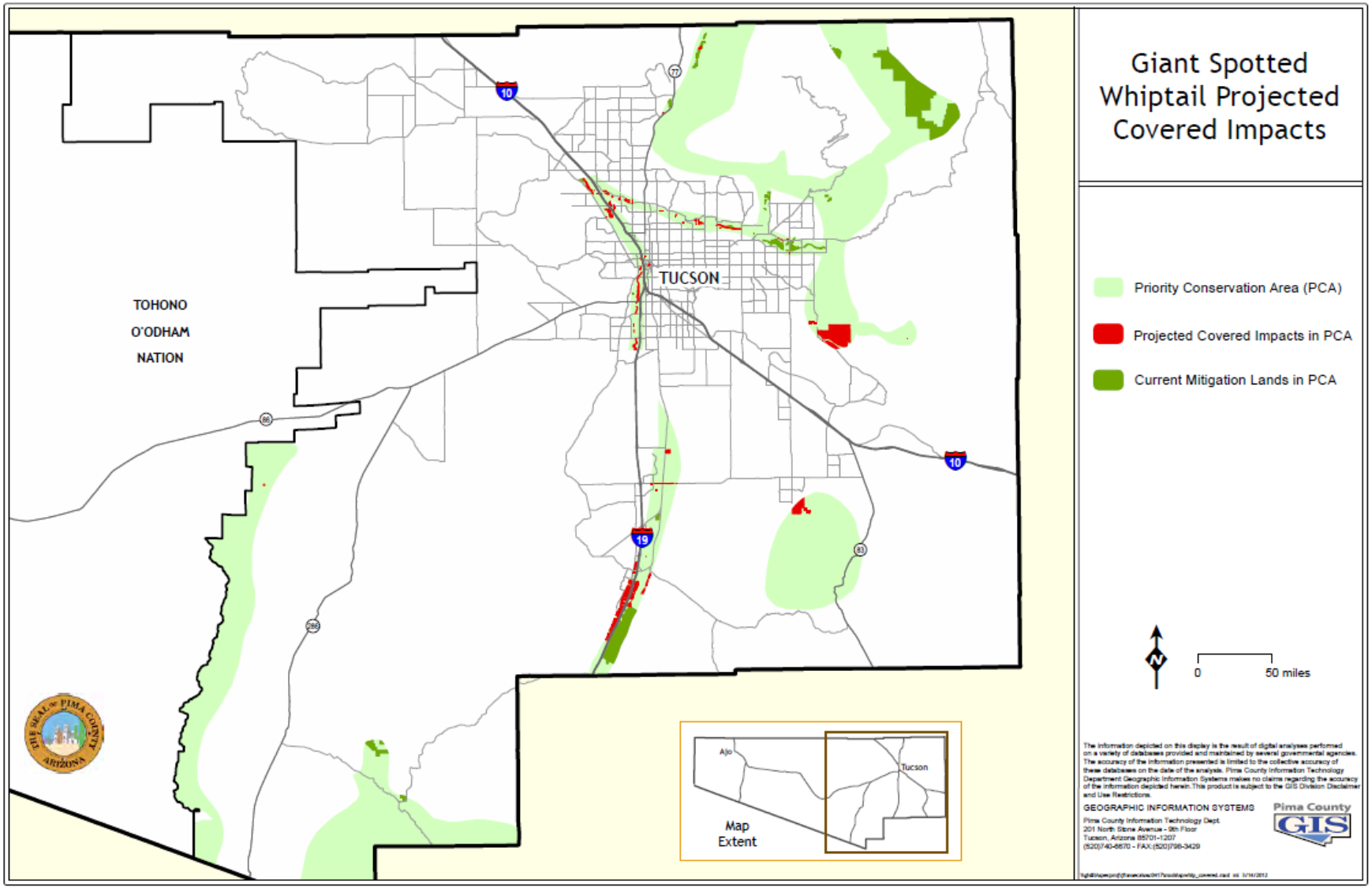



**Figure A-27. Map of projected impacts and mitigation for the giant spotted whiptail lizard.**

## Desert box turtle (*Terrapene ornate luteola*)

### Conservation Status

Endangered Species Act Status: None.

State: None.

Other: Special protection in Mexico; protected from international trade by CITES.

Rankings: G5T4 S3S4.

### Description

This chiefly terrestrial turtle is from 4 to 5.75 inches (10 to 15 cm) in carapace length. The plastron has a single hinge in front and can be drawn tightly against the carapace. The carapace is high and round, and is typically marked with pale radiating lines or a series of black or dark brown dots on a yellow field. The plastron may have similar markings. The markings become less distinct as age advances and are eventually lost. This subspecies can be distinguished from the other subspecies (the ornate box turtle, *T. o. ornata,* which does not occur in Arizona) by its having no dorsal markings as an old adult, and younger individuals having 11 or more light radiating lines on the second costal scute, whereas *T. o. ornata* has a maximum of 9 or 10 (Degenhardt and Christiansen 1974). The shells of older individuals are uniform straw color or pale greenish brown. The first nail on each hind foot turns inward on males. The iris and spots on forelimbs are reddish (yellowish in females), and the head is sometimes greenish. Females grow larger than males (Stebbins 1985, Degenhardt et al. 1996).

### Distribution and Trend

The desert box turtle ranges from south-central New Mexico south to central Chihuahua and Sonora, Mexico, and from western Texas across New Mexico to the eastern base of the Baboquivari Mountains at elevations from sea level to about 6,000 feet (Stebbins 1985). There is no trend data for this species.

The distribution of this species in Pima County is not well known, but it has been observed in the Las Cienega Conservation Area, in the Santa Cruz River valley near Sahuarita, and in the Altar Valley. A few specimens have been found along the San Pedro River in Pima County (Hall and Steidl 2007). A dead carcass was located on Esperanza Ranch south of Tucson (Llewellyn and Zetlan 2007). Two individuals were found in the Rincon Mountain District of Saguaro National Park in 2005 (Flesch et al. 2006), but it is unclear if these

are natural populations or released pets. Two box turtles were observed in 2012 at the Cienega Creek Natural Preserve (Trevor Hare, p*ersonal communication* to J. E. Fonseca; and Don Carter, photos)

### Habitat

The western box turtle is primarily a prairie turtle that inhabits arid and semi-arid grasslands and shrub land across much of its range where soils are sandy. It also occurs in open woodland with herbaceous understory (Stebbins 1985). Desert box turtles are found in land use and land-cover associations that include rangeland, water, streams and canals, wetland, barren land, and sandy areas other than beaches (Biota Information System of New Mexico 2008f). It has also been found in pecan orchards in Sahuarita (K. Kingsley, *unpublished data*).

### Current and Potential Threats

General: The desert box turtle is sensitive to highway traffic and collecting (Hall and Steidl 2007). It may also have been affected be Compound DRC-1339 used by Animal Damage Control and has apparently been caught in leghold traps as well (Biota Information System of New Mexico 2008f).

Existing and potential pest species: Ectoparasites of *T. ornata* include both fly larvae in some parts of the range and chigger mites in other areas (Biota Information System of New Mexico 2008f). It is not known whether this is a problem in Pima County. It is possible that invasive non-native grasses, such as red brome, Lehmann lovegrass, and buffelgrass may increase the incidence of fires which could cause significant mortality in local populations of this species. Further, the box turtle seems to prefer more open areas, so the increase in non-native grasses may impact habitat quality.

Threat mechanism: Road mortality and possibly collecting, residential development (subdivisions) in this species' limited habitat. Grass fires may also cause mortality.

### Management Needs

General: Encourage or support further study. The range, population ecology, and threats to this species in Pima County are not well known.

Current protective measures: Commercial collection is prohibited by state law.

Corridor and migratory needs: No known information is available on this species need for corridors or migration, though the latter is unlikely.

Key relationships: No key relationships are known for this species in this area. In some parts of its range, the western box turtle may be associated with prairie dog towns (Biota Information System of New Mexico 2008f).

Existing monitoring and research programs: The Arizona Game and Fish Department is soliciting confirmed sightings of the species.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-28): 909.

Acres of mitigation habitat within the current portfolio of conservation lands: 5,574.

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the desert box turtle:

- Keep track of credible sightings of individuals within Pima County.
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- Protect and enhance habitat conditions for existing natural populations (mainly Cienega Creek and San Pedro River) as indicated by emerging research and where feasible;
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

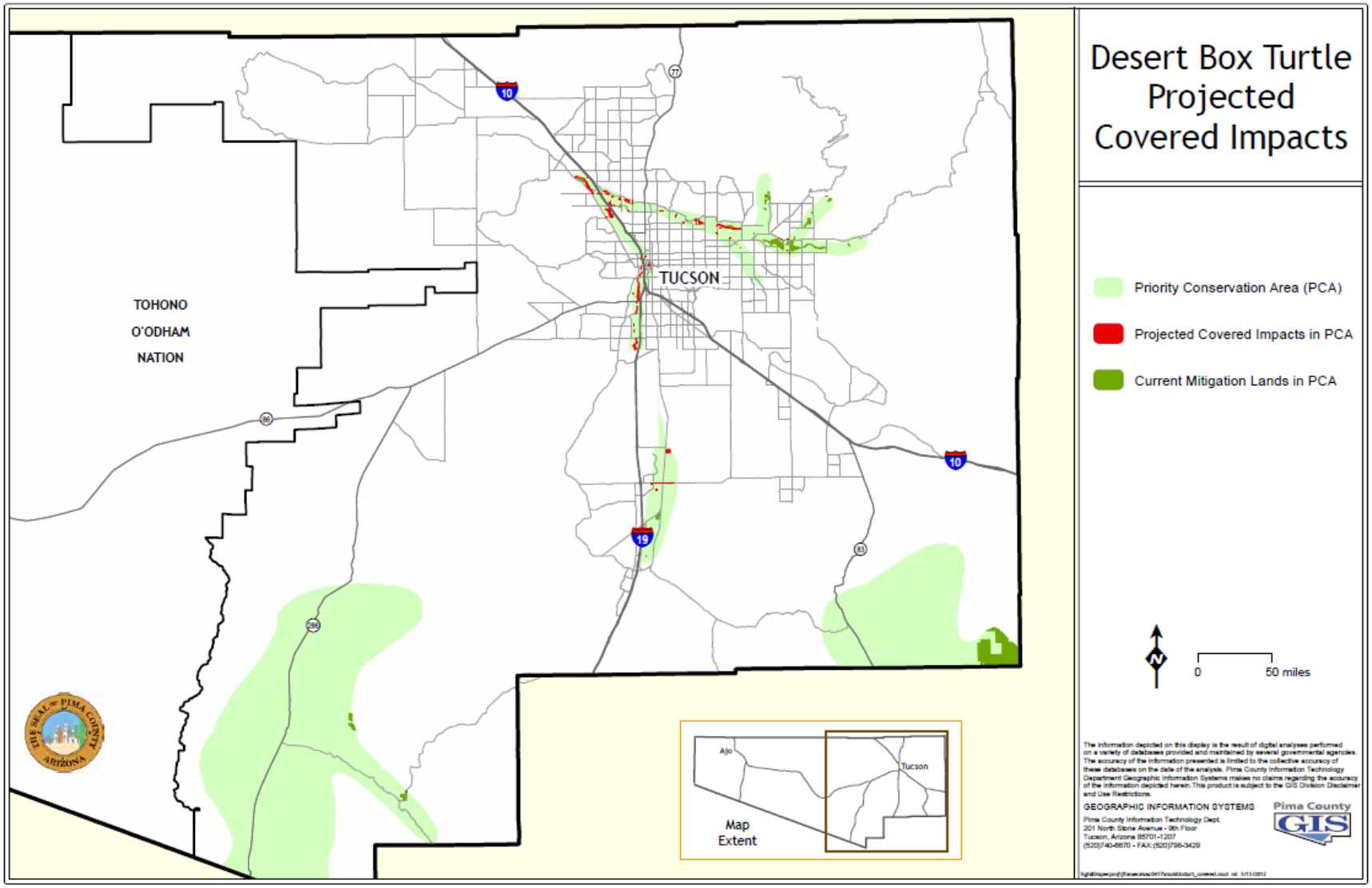
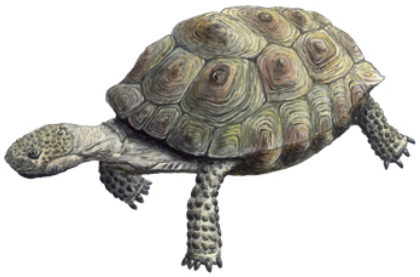



**Figure A-28. Map of projected impacts and mitigation for the box turtle.**

## Desert tortoise, Sonoran population (*Gopherus agassizii*)

### Conservation Status



Endangered Species Act Status: Petitioned (in 2008) for protection under the Endangered Species Act. A positive 12-month finding was made in December 2010 indicating that listing was warranted, but precluded by other higher priority actions. As such, it was listed as a candidate species under the ESA. Currrently, evaluation for listing is scheduled for 2015 under the Multidistrict Litigation settlement.

State: Wildlife of Special Concern in Arizona.

Other: Has special protection in Mexico; protected from international trade by CITES.

Rankings: S4 G4T4.

### Description

The desert tortoise is a terrestrial species that reaches adult sizes of about 20 to 38 centimeters (Stebbins 1985). The Sonoran desert tortoise has a high domed shell, usually a brown or grey carapace, with a definite pattern and growth lines on the carapace. The plastron is unhinged and often pale yellow in coloration. The limbs are very stocky, including elephant-like rear conical limbs; the forelimbs are flattened and covered with large conical scales. The tail is short. Males have long gular (throat) shield and larger chin glands on each side of the lower jaw. Individuals of the Sonoran population tend to be more pear-shaped, with narrower front ends, wider flared rear ends and flatter carapaces. Mojave population individuals tend to be more oval and have a higher domed carapace.

### Distribution and Trend

The Sonoran population includes tortoises south and east of the Colorado River, from locations near Pearce Ferry in Mohave County, to the south beyond the International Boundary, and many scattered locations in between. The northeastern-most tortoise records in Arizona occur along the Salt River near Roosevelt Lake in Gila County. The middle San Pedro River drainage in Cochise County harbors the eastern-most substantial populations. Tortoises have been found as far west as the Barry M. Goldwater Range, Yuma Proving Ground, and the Cabeza Prieta National Wildlife Refuge (Arizona Game and Fish Department 2001f). Populations throughout its range are becoming increasingly fragmented due to threats to habitat in valley bottoms used for dispersal and exchange of genetic material (U. S. Fish and Wildlife Service 2008).

In Pima County, the Sonoran population of the desert tortoise is widespread across many low-elevation areas of the county where rocky outcrops, caliche-incised washes, and bajadas occur. They are found west of Tucson in the Avra Valley and nearby

mountains, such as the Tortolita and Silverbell mountains (Rosen 2003, Flesch et al. 2006, Zylstra 2008, Town of Marana 2009), north and east of Tucson in the Santa Catalina and Rincon mountains (Murray 1996, Flesch et. al. 2007, Zylstra 2008), Pantano Wash, and Cienga Creek Preserve and the far western portion of the County (Rosen and Lowe 1996, Wirt et. al. 1999, Schmidt et al. 2007).

**Habitat Requirements**

The Sonoran population of the desert tortoise occurs primarily on rocky slopes and bajadas of Mojave and Sonoran desertscrub, but may encroach into desert grassland, juniper woodland, and interior chaparral communities, with rare observations in Ponderosa pine woodlands. Washes and valley bottoms may be used in dispersal. Tortoises of the Sonoran population in Arizona are found from approximately 1,000 feet to 7,800 feet in elevation, with most observations below 4,000 feet (Arizona Game and Fish Department 2001f). Adequate shelter sites are one of the most important habitat features for this species and winter hibernacula are burrows that are often excavated in loose soil or under vegetation, and include rock crevices.

Home range requirements: According to several short-term telemetry studies, male Sonoran desert tortoises are reported to have variable home range sizes, from 2.6 hectares to 25.8 hectares (Averill-Murray and Klug 2000). Individual home ranges overlap both within and between the sexes. Tortoises require loose soil in which to excavate burrows. Burrows are one of the most important tortoise habitat features in the Sonoran Desert.

**Current and Potential Threats**

General: Threats include loss and degradation of habitat, illegal collection and vandalism, predation by feral dogs and, to a lesser degree, Upper Respiratory Tract Disease (URTD) (Jones et. al. 2005), and predation by ravens. Causes of habitat loss include roads, housing, and energy development; conversion of habitat to agriculture; overgrazing; and off-road vehicle use, and invasion of exotic species (Arizona Game and Fish Department 2001f).

Existing and potential pest species: Mountain lions are one of the few, if not only, natural predators capable of breaking through an adult tortoise's shell, but other carnivores, including coyote, kit fox, bobcat, gray fox, and badger, may prey on hatchlings, juveniles, and eggs or kill adults by chewing on exposed limbs. Feral dogs are also a threat. Other potential predators of small tortoises include golden eagle, other raptors, common raven, and greater roadrunner.

Threat mechanism: Desert tortoise populations have been impacted by fragmentation, degradation, and loss of habitat and by elevated mortality rates caused by drought, shooting, road mortality, predation by dogs and ravens (especially near human settlements and roads), disease, livestock trampling, and collecting, among other causes. Release of captive tortoise may result in disruption of wild populations or introduction of diseases; although a recent study indicates that captive tortoises in the Tucson area are not important repositories for URTD (Jones et al. 2005). Jones et al.

(2005) found that tortoises in suburban areas were significantly more likely than those from remote areas to possess antibodies for the URTD, suggesting that urbanization may have a negative impact on tortoise health. Fires affect tortoises directly, killing them with heat or low oxygen levels, and indirectly by altering their habitats (Esque et. al. 2003).

**Management Needs**

General: The Arizona Game and Fish Department has monitored 26 permanent plots sporadically since the 1970s, with 13 sites being surveyed at least 4 times each. That monitoring program has received attention in the last few years, with a more concerted effort being put forth in the western part of Arizona (Christina Jones, *personal communication* to Brian Powell). Additional research is also necessary to develop a more complete understanding of tortoise populations and how they respond to different land management practices. Research should include studies on population dynamics (reproductive ecology, life tables, population viability, population genetics), habitat (effects of exotic vegetation, fire, and grazing), disease, and effectiveness of mitigation measures.

Current protective measures: FWS lists the species as a candidate under the ESA. AGFD lists the desert tortoise as a species of special concern and it is fully protected in the state of Arizona. It is illegal to kill or capture a desert tortoise except under special permits issued by AGFD. Tortoises salvaged from urban or developing areas must be relinquished to the AGFD or to the Arizona-Sonora Desert Museum for adoption. Release of captive wildlife, including desert tortoises, into the wild is prohibited. Pima County's Floodplain ordinance provides some avoidance and minimization measures for areas along certain watercourses, including Pantano Wash. Pima County's Hillside ordinance restricts grading of steep hillsides and protects certain peaks and ridges.

Corridor and migratory needs: No known information is available on this species' need for corridors, but recent genetic data indicate that gene flow has regularly occurred between mountain ranges in southern Arizona, and such genetic exchange is likely to decrease or stop completely because of anthropogenic barriers to tortoise movement such as roads (Edwards et. al. 2004). Examples of such barriers include interstate highways (I-10 and I-19), CAP canals, railroads, and busy streets.

Key relationships: No key relationships are known for this species in the study area.

Existing monitoring and research programs: Saguaro National Park, Organ Pipe Cactus National Monument, Arizona Game and Fish Department, and Bureau of Land Management all have ongoing monitoring programs. Revisions to the statewide monitoring program for the species was suggested by Zylstra and Steidl (2009).

Management goals: Reduction in habitat fragmentation, habitat loss and degradation from urban and agricultural development and roads, and control of non-native grass and forbs would assist in maintaining stable populations of desert tortoise in the planning area. The establishment of reserves within Pima County allow for permanent protection from conversion of natural land cover of large areas of desert tortoise habitat.

### Projected Modeled Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-29): 9,490.

Acres of modeled habitat within the current portfolio of conservation lands: 46,707.

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the desert tortoise:

- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- Implement the Floodplain and Hillside ordinances as described in Chapter 4:
- Investigate opportunities for minimizing lethal take.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

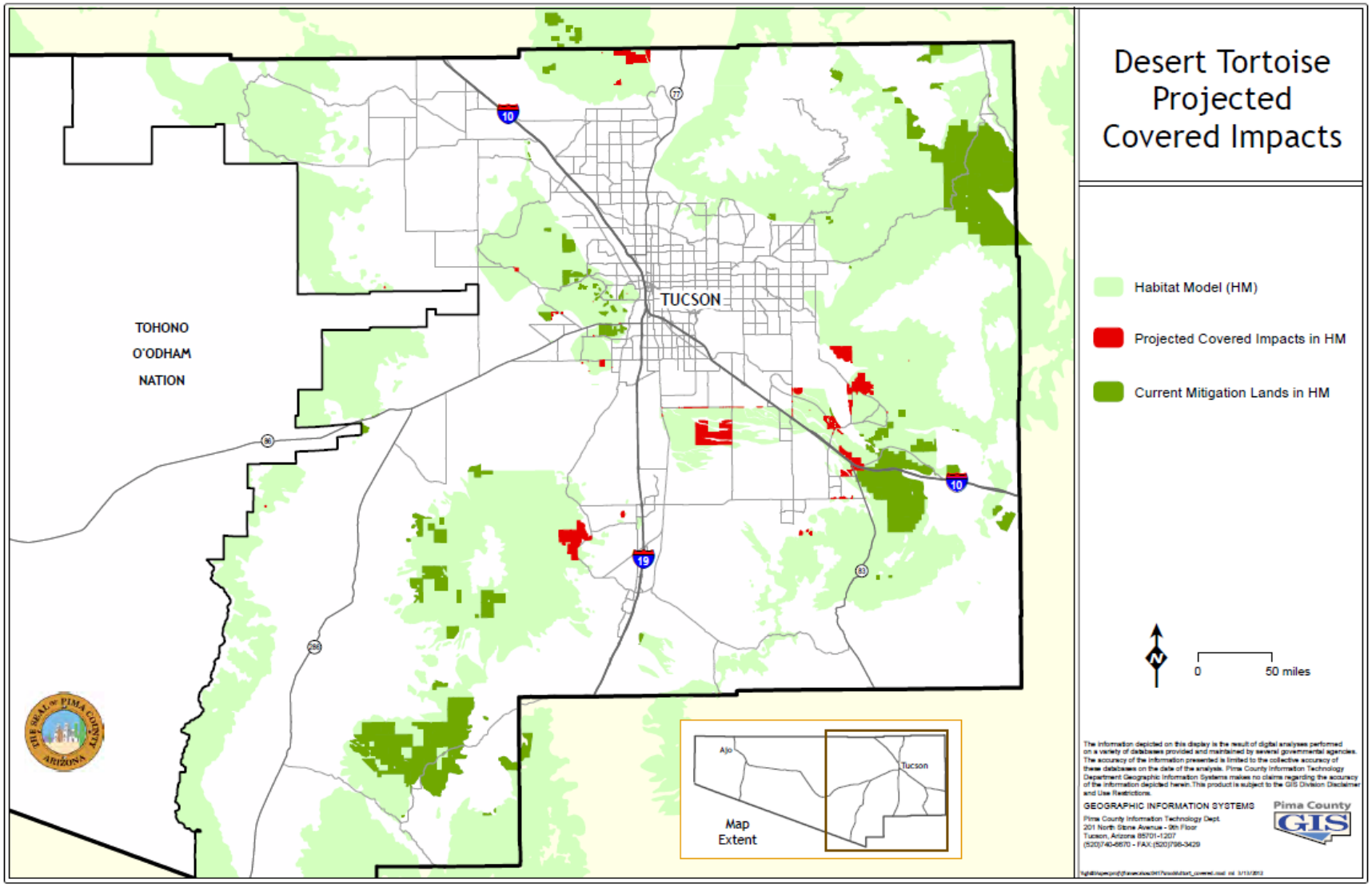



**Figure A-29. Map of projected impacts and mitigation for the desert tortoise.**

# Northern Mexican Gartersnake (*Thamnophis eques megalops*)

## Conservation Status

Endangered Species Act Status: Petitioned (in 2003) for protection under the Endangered Species Act (Center for Biological Diversity 2003). In 2008 the species was determined to "warranted" for listing under the ESA, but was precluded from listing due to higher priorities and became a candidate species. This species is scheduled for evaluation for listing in 2013 under the Multi-District Litigation settlement.

State: Wildlife of Special Concern in Arizona, Endangered in New Mexico.

Other: Determined subject to special protection in Mexico; protected from international trade by CITES.

Rankings: G3, S2S3.

## Description

The northern Mexican gartersnake has a relatively stout body with a total length of 18.0 to 40.0 inches (45.7 to 101.6 cm). Individuals are brown to greenish brown with a yellow-white dorsal stripe flanked by stripes on the third and fourth scale rows in the anterior region. Large brown blotches are on the back of the head that are separated from the corner of the mouth by light-colored crescents (Stebbins 1985).

## Distribution and Trend

The historical range of the northern Mexican gartersnake includes Arizona, New Mexico, and northwest Mexico, from southern Arizona to Oaxaca, Mexico, but it. It is now extirpated from the Colorado River near Yuma, the apparent western limit of this snake's historical range (Arizona Game and Fish Department 2001k). In Arizona, this subspecies ranges from the southeast corner of the state from the Santa Cruz Valley east and north (Arizona Game and Fish Department 2001k) as far as the Verde River (Schmidt et. al. 2005). Records after 1980 include the San Rafael Valley and Sonoita grasslands areas, Arivaca, the Agua Fria, Verde, Salt, and Black rivers, and Oak Creek. *T. e. megalops* is extirpated from the Santa Cruz and Rillito rivers, and Tanque Verde and Pantano washes in the Tucson area (Rosen and Schwalbe 1988). In a rangewide survey in 1988, this species was

found in Lower and Upper Sonoran Life Zones, at elevations from 1,739 to 6,152 feet, within 50 ft of permanent water where lush vegetation grew (Rosen and Schwalbe 1988).

Within Pima County, the northern Mexican gartersnake is now only found at Cienega Creek, including the Cienega Creek Natural Preserve (Rosen and Schwalbe 1988, Rosen and Caldwell 2004). It may occur in the Altar Valley and Arivaca Cienega (Rosen and Schwalbe 1988). A 2007 survey of the lower Santa Cruz River found no Mexican gartersnakes (D. Abbate *personal communication*, in Town of Marana 2009). The species is found in greater abundance to the southeast of Pima County in the San Raphael Valley, Canelo Hills, and Sonoita grasslands (Rosen et. al. 2001).

### Habitat

In Arizona, habitat for this species is chiefly cienegas within desert grassland to elevations of 8,500 feet (Arizona Game and Fish Department 2001k). However, habitat occasionally includes desert and lower oak woodland habitats. This subspecies also occurs in and adjacent to streams in valley floors and generally open areas, but not in steep mountain canyon stream habitats. Within streams and cienegas, the species uses areas that are characterized by shallow, slow moving, and at least partially vegetated water bodies, such as springs. In general, this species requires intact riparian vegetation communities along permanent water that is free from bullfrogs.

### Current and Potential Threats

General: “Mexican gartersnake historical localities in the Phoenix and Tucson areas have all been devastated by urbanization, introduction of bullfrogs and predatory fishes and removal of dense vegetation” (Rosen and Schwalbe 1988). Lowering of water table, destruction, degradation, and fragmentation of habitat, predation by introduced bullfrogs and predatory fishes, and direct mortality are all considered threats to this species (Arizona Game and Fish Department 2001k). In New Mexico, the range of *T. e. megalops* corresponded to an area that has been highly modified by humans chiefly for agriculture.

Existing and potential pest species: Non-native predators are known to include bullfrogs, fishes, and may include crayfish (Rosen and Schwalbe 1988, Arizona Game and Fish Department 2001k).

Threat mechanism: Habitat loss through water depletion and diversion combined with invasive, aquatic predators. The species does not appear to be severely impacted by cattle grazing in Mexico as long as non-native predators and competitors are absent or at low levels (Jeff Servoss, *personal communication* to Brian Powell).

### Management Needs

General: Management of introduced species, water, and riparian cover are needed for this species. Studies of distribution, habitat, populations, and life history are suggested (Arizona Game and Fish Department 2001k).

Current protective measures: FWS lists this species as a candidate species under the ESA. The New Mexico Department of Game and Fish manages for this snake by regulating the method and season of take and the amount, age, and sex of individuals, and by regulating disturbance of the species. Take is restricted in Arizona.

Corridor and migratory needs: This is probably a metapopulation species that has multiple local populations, formerly connected by contiguous rivers and streams. The conditions that would foster maintenance of local populations and connections between them have been eliminated as a result of human activities. Artificial maintenance of local populations and gene flow may be necessary.

Key relationships: The best-known key relationships are adverse for this species and involve non-native species. Healthy populations of this species are found in association with leopard frogs (*Lithobates* sp.) and the fish genera *Gila* and *Poeciliopsis* (Rosen and Schwalbe 1988).

Existing monitoring and research programs: An extensive survey for this species was conducted in 2012 at Las Cienegas National Conservation Area.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-30): 3,613.

Acres of mitigation habitat within the current portfolio of conservation lands: 10,564.

### Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the northern Mexican gartersnake:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4.
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- Acquire and protect existing water rights to maintain and restore habitat, where feasible.
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

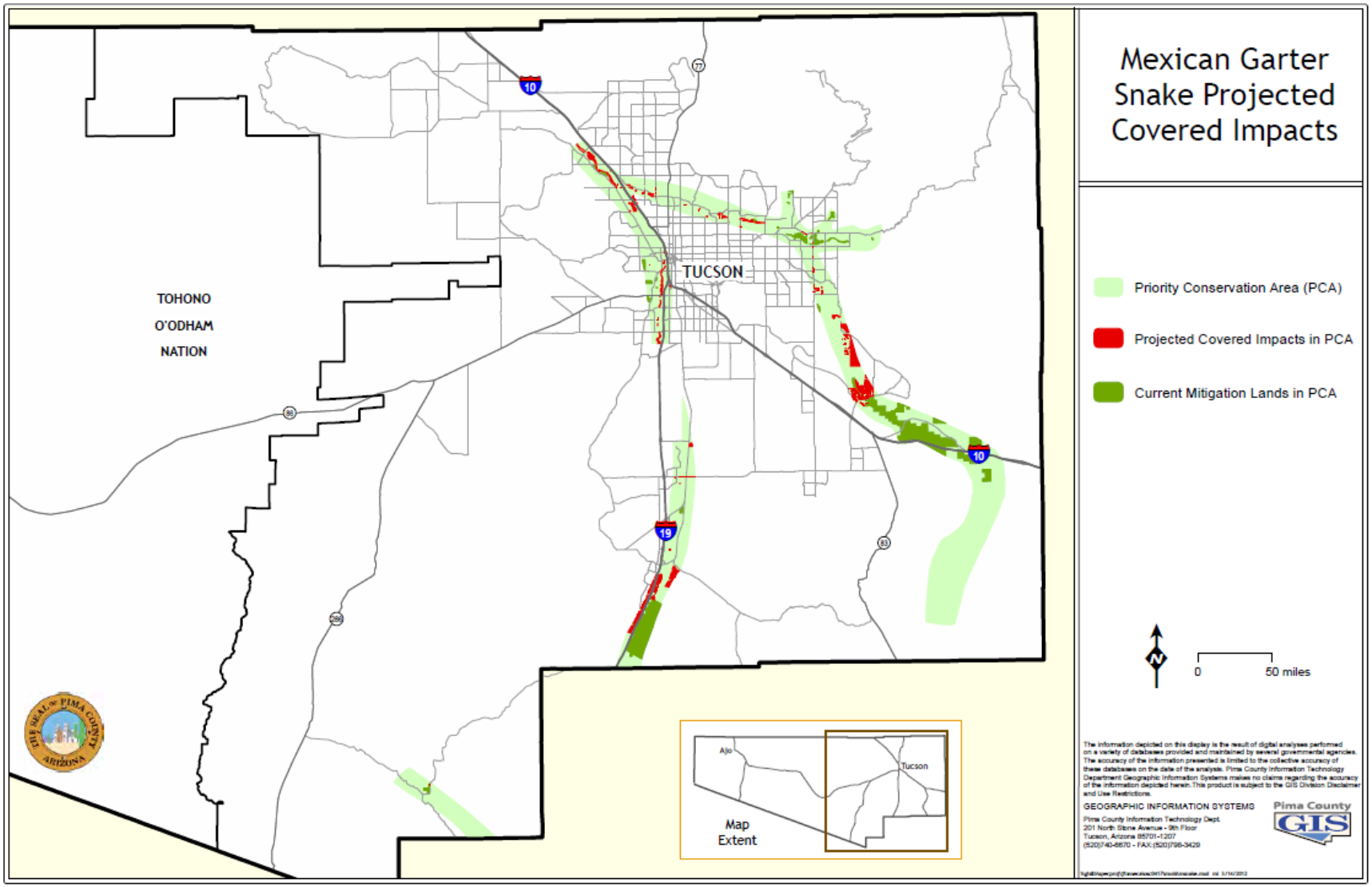



**Figure A-30. Map of projected impacts and mitigation for the northern Mexican gartersnake.**

## Ground snake (valley form) (*Sonora semiannulata*)

### Conservation Status

Endangered Species Act Status: None.

State: None.

Other: None.

Rankings: G5, S5.

### Description

The ground snake is a small species that may reach about 18 inches (45 cm) total length. The species is highly polymorphic. Dorsal color is brownish, orange, reddish, or gray. Patterns include plain, cross-banded, longitudinally banded (red or orange if present), or a combination (Stebbins 1985). Plain, striped, and cross-banded individuals sometimes occur at the same locality (Stebbins 1985).

### Distribution and Trend

The ground snake is known to occur in New Mexico, Arizona, Colorado, Utah, Texas, and Chihuahua and Sonora, Mexico at elevations from 2,000 to 5,500 feet (Stebbins 1985). The valley form is known only from an undetermined limited area in Pima County. The range of *S. semiannulata* includes grassland areas of the central United States from southeastern Colorado to southwest Missouri, south and west into northern Mexico. It ranges across the deserts of west Texas, New Mexico, Mexico, Arizona, Nevada, and California. Apparent isolated populations exist in eastern Oregon and western Idaho, Baja California, northern Utah, and northern Kansas (Stebbins 1985; Degenhardt et al. 1996). Scattered localities occur from the southern half and northwestern quarter of Arizona (Lowe 1964). The valley form is only known from Pima County.

In Pima County, the species is found in desert grassland areas around the base of the Tortolita, Santa Catalina, and Rincon mountains. Two individuals were found at the Rincon Mountain District of Saguaro National Park in 2001-2002 (Flesch et al. 2007), but no individuals were found in the Tucson Mountain District of Saguaro National Park (Flesch et al. 2006). Rosen (2004) reports other credible historical sightings near Oracle and Redington Pass and throughout the Avra Valley. Four historical records of

the ground snake show that it once occurred along the Blanco Wash, from the confluence with the Santa Cruz River south to Avra Valley Road (City of Tucson 2008). In June 2003, one ground snake was found at Blanco Wash and Silverbell Road (Rosen 2004). In 2004, ground snakes were confirmed to persist at Red Rock (Pinal County). Surveys in 2004 found no reconfirmation of the species along I-10, near the Marana exit (Rosen 2004), but surveys in 2008 revealed two individuals (Rosen 2008a). A photographic voucher was collected at the base of the Tortolita Mountains in the Town of Marana, near Stone Canyon (Rosen 2004).

### Habitat

Generally, terrestrial habitats including grassland islands within mountain seas. This species occupies plains, valley, and foothill habitats (Lowe 1964; Degenhardt et al. 1996). It has been found mostly near mountains with higher slopes and areas with poorly drained soils, and speculation is that this is because subsurface moisture is required for the species and its prey (Stebbins 1985; Degenhardt et al. 1996). Vegetation may be scant (Great Basin sagebrush plains and creosote desert), or dense (lower Colorado River thickets of mesquite, arrowweed, and willow communities). The species ranges from prairies through desert communities, thornscrub, and pinyon-juniper woodland to the pine-oak zone (Stebbins 1985). Specifically, this species has been found in Tobosa desert grassland over silty, loamy clay soils on the Tohono O'odham Nation (P. Rosen, *personal communication* to D. Scalero, 4 Mar 1999).

### Current and Potential Threats

The valley form of *S. semiannulata* is thought to be impacted by habitat destruction, primarily conversion to agriculture and development. It is likely also impacted by road mortality as a result of seeking out roads for warmth.

### Management Needs

General: The most pressing need is for identification and delineation of the habitat of this form and determination of actual threats to it. This may be followed by development of specific management policies and methods.

Current protective measures: None are specifically known.

Corridor and migratory needs: No information is known for this species.

Key relationships: No information is known for this species.

Existing monitoring and research programs: No known programs are specifically directed at this species. Numerous amateur and professional herpetologists maintain their own records of the species they encounter, generally in an informal way, and they may have information of use in understanding the distribution, biology, and conservation needs of this form.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-31): 11.

Acres of mitigation habitat within the current portfolio of conservation lands: 809.

### Management and Conservation Commitments

Pima County will pursue the following management action and conservation commitment for the ground snake:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4;
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4; especially for lands in northern Avra Valley north of the Avra Valley Road.
- Management plans for mitigation lands in northern Avra Valley will address means to detect and limit off-road vehicular impacts to habitat.
- Work with City of Tucson and Marana to encourage conservation of lands in northern Avra Valley;
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

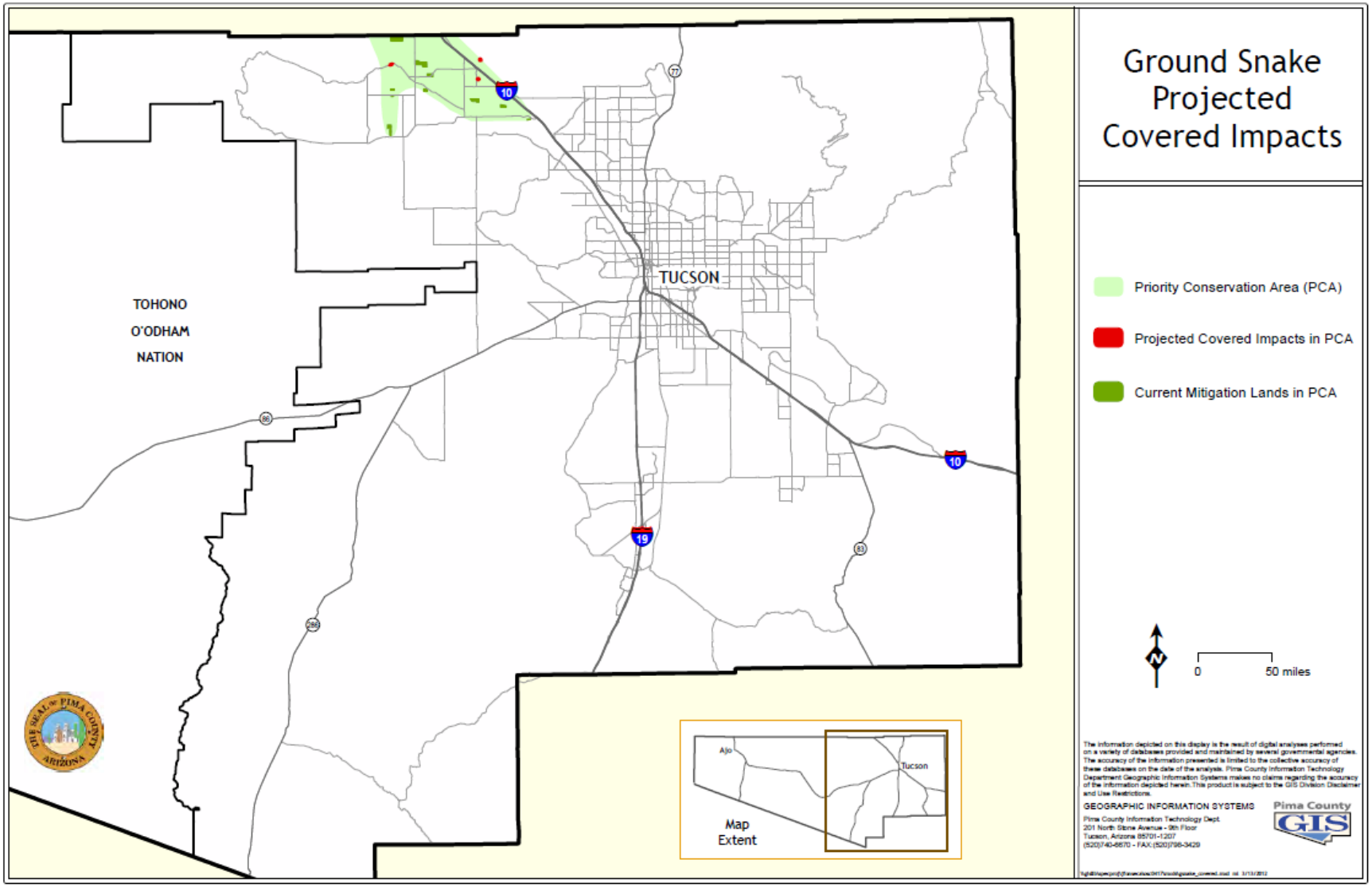



**Figure A-31. Map of projected impacts and mitigation for the ground snake.**

# Tucson shovel-nosed snake (Chionactis occipitalis klauberi)

## Conservation Status

Endangered Species Act Status: Petitioned for listing in 2004. In 2010, the species as determined to warrant protection under the ESA, but it was precluded by higher priority actions and became a candidate species. This species is currently scheduled for evaluation for listing in 2014 under the Multi-District Litigation settlement.

State: None.

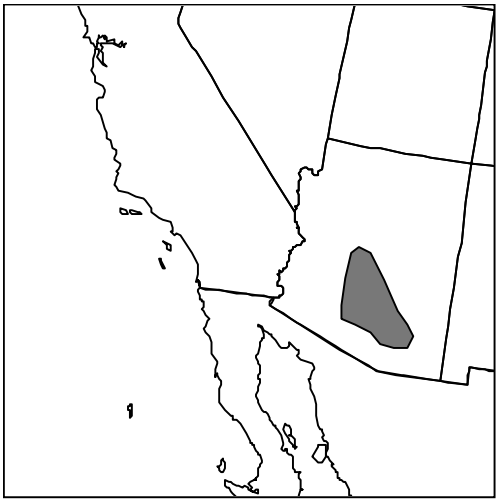
Other: None.

Rankings: G5, S5 for the western shovel-nosed snake.

## Description

The adult Tucson shovel-nosed snake is 10 to 17 inches (25 to 42 cm) long. Markings vary considerably between individuals and between subspecies. Tucson shovel-nosed snakes have a cream-colored, whitish or yellowish body with approximately 21 or more black or brown bands across the back, reaching almost to the belly or encircling the body. Between these bands are black or brown smaller bands. The snout is flattened and shaped somewhat like a shovel (Stebbins 1985). The taxonomy of this species is a subject of debate (Wood et. al. 2008).

## Distribution and Trend



The range of the western shovel-nosed snake in Arizona includes the Sonoran and Mohave deserts in the southwestern portion of the state, within which its distribution is limited chiefly to dunes and similar areas having fine sand without rocks (Lowe 1964). This species has been found in an area from northern Pima County across southwestern Pinal County into southern Maricopa County (Stebbins 1985).

In Pima County, the last known records of the Tucson shovel-nosed snake in or near the County were: (1) Sanders Road and Avra Valley Road in 1979 (Rosen 2003) and (2) near Picacho Reservoir (Pinal County) in 2006 and 2007 (Rosen 2008b), and (3) north of the West Silverbell Mountains (Pinal County) (Rosen 2008b). One individual

was found in the Sonoran Desert National Monument on State Route 238. Despite extensive survey efforts to locate the species in the Avra Valley, particularly in 2007-2008, no individuals were found (Rosen 2003, 2007, Rosen 2008b). It is unknown if the species currently persists in the Permit Area.

### Habitat

The western shovel-nosed snake is known from the Lower Sonoran life zone, in areas with sand and loose soil. It consistently occurred on open, sandy sites and was present in mixed riparian scrub (xeroriparian), creosotebush (lower Colorado desert), and Sonoran desert scrub (Arizona Upland) and it was also present in mesquite bosque (floodplain woodland) (Jones 1988). It is absent or infrequent in rocky desert terrain. It is most abundant in flat and sparsely vegetated areas with fine, wind-blown sand, such as dunes, washes, sandy flats, loose soil, and rocky hillsides having sandy gullies or pockets of sand among rocks (Lowe 1964; Stebbins 1985). Associated vegetation includes creosote, desert grasses, desert forbs, cactus, and mesquite (Stebbins 1985).

### Current and Potential Threats

General: Loss of habitat to agricultural and urban development is likely to impact this species in portions of its range. Off-road vehicle activities are likely to adversely affect this species. Road building is likely to have destroyed and possibly fragmented some habitat and increased traffic probably increases road kill of individuals.

Specific: This subspecies has probably suffered significant losses of habitat due to agricultural and urban development in the Avra Valley. It also is impacted by highway traffic within its habitat, and it may be affected by scientific and commercial collecting.

Existing and potential pest species: There is no known evidence of any pest species that affects this species. It is possible that invasion of its habitat by non-native plants, such as red brome, bufflegrass, or black mustard may be detrimental to this species by reducing or eliminating open ground.

Threat mechanism: Habitat loss due to agricultural and urban development; off-road vehicle activity, including military activity, may compact soil or crush buried snakes; increased highway traffic may cause direct mortality. Collection by herpetologists and illegal commercial collectors may cause local population losses and disrupt habitat.

### Management Needs

General: Protection of habitat from development and disturbance by off-road vehicle activities, and enforcement of laws against commercial collection are necessary to protect this species. Speed limits or other road use limitations (such as seasonal restriction of use after dark) may help protect snakes (Rosen and Lowe 1994).

Current protective measures: Some of this species' habitat is protected within Organ Pipe Cactus National Monument and Saguaro National Park. Arizona prohibits commercial collection of reptiles, but enforcement is limited. Pima County's Floodplain

ordinance may afford suitable habitat some avoidance, minimization or mitigation measures.

Corridor and migratory needs: None are specifically identifiable. This species is capable of crossing roads, including paved highways, although road kill may be a significant cause of mortality in some locations.

Key relationships: In much of its range, the western shovel-nosed snake is associated with creosotebush, which it may use as escape cover and as a foraging substrate. Glass (1972) made observations that strongly suggested that this subspecies may have a physiological resistance to scorpion (*Vejovis spinigeris*) venom, and contrasted scorpion capture behavior of this subspecies with that of *C.o. occipitalis* described by other authors. This suggests that scorpions may be a significant part of this subspecies' diet, and that subspecies may differ in behavior and physiology. Banded sand snakes (*Chilomeniscus cinctus*) appear to be replacing or out competing Tucson shovel-nosed snakes out of existing areas of the Tucson shovel-nosed snake's range.

Existing monitoring and research programs: No specific studies are currently known.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-32): 81.

Acres of PCA habitat within the current portfolio of conservation lands: 1,175.

### Management and Conservation Commitments

Pima County will pursue the following management action and conservation commitment for the Tucson shovel nosed snake:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4;
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4, especially for lands in northern Avra Valley north of the Avra Valley Road.;
- As funds permit, acquire and restore floodprone lands along the Brawley Wash corridor;
- Work with City of Tucson and Marana to encourage conservation of lands in northern Avra Valley;
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

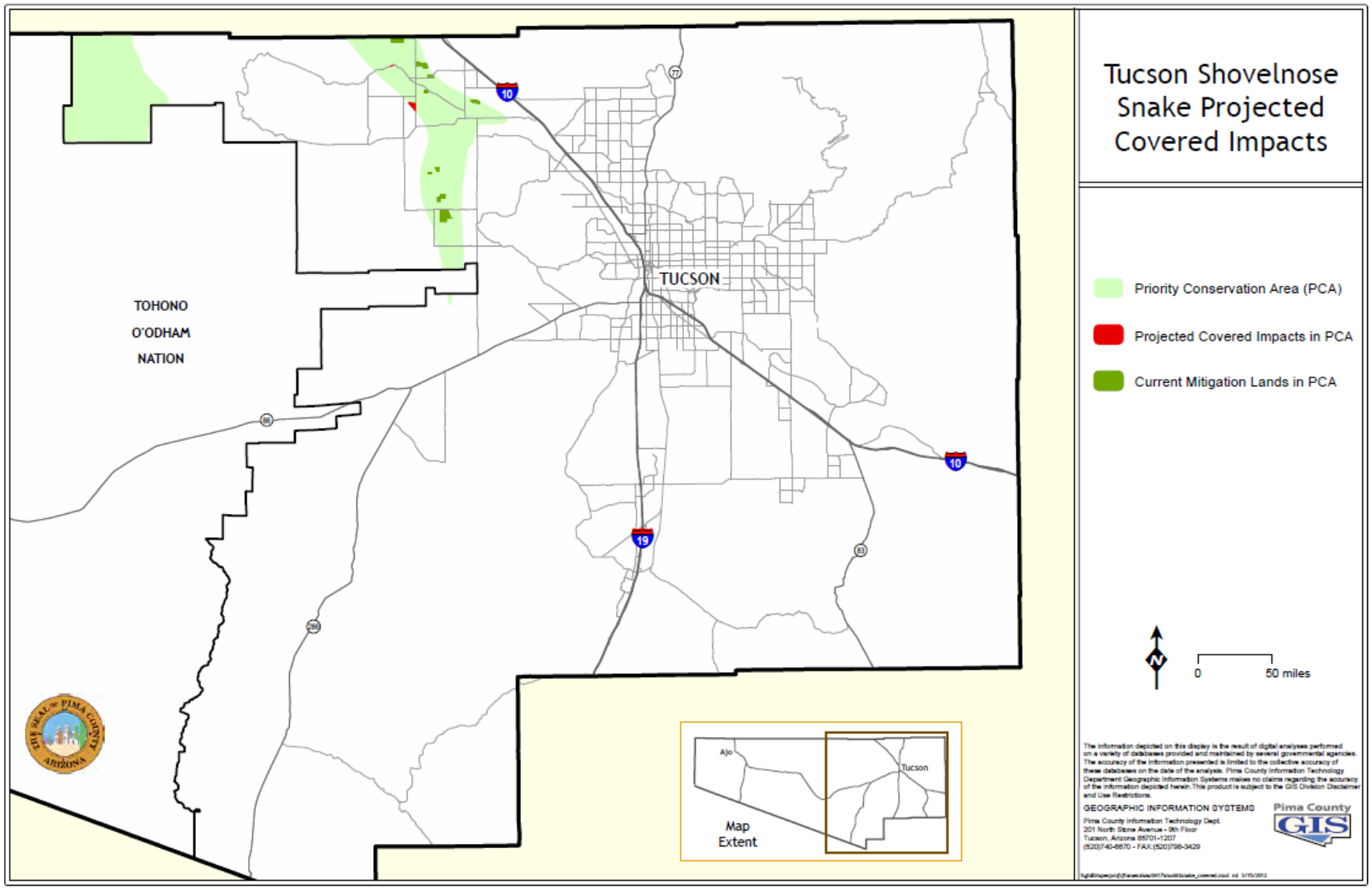



**Figure A-32. Map of projected impacts and mitigation for the Tucson shovel-nosed snake.**

# Invertebrates

## Talus snails (*Sonorella* species)

### Conservation Status

Endangered Species Act Status: One species (*S. eremite*), was proposed for listing as an Endangered species, but the proposal was withdrawn because a Conservation Agreement was developed. The Sonoran talus snail (*S. magdalenesis*) was the subject of a substantial 90-day finding in 2012 as a result of a petition to list under the ESA. The Rosemont talus snail (*S. rosemontensis*) has also been petitioned for listing.

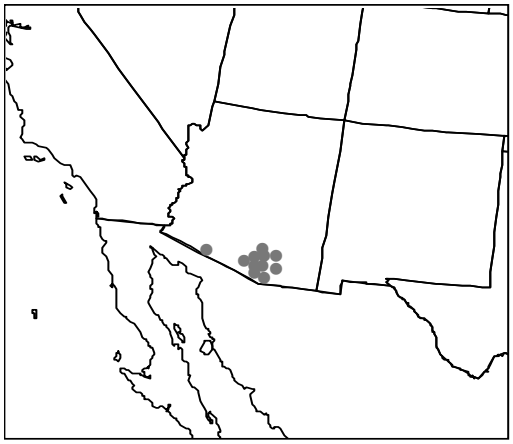
State: None.

Other: None.

Rankings: Most of these species should be G1 or G2 S1 or S2.

### Distribution and Trend

All available evidence supports the hypothesis that all of the localized taxa are relicts of previously widespread taxa isolated by repeated episodes of isolation and dispersal during repeated climate changes in the distant past (McCord 1994, Terkanian 1999). Current distribution is probably not different from historic distribution, but there has been no known systematic search effort in approximately 30 years, and some species may be extinct. Some that were described by Pilsbry and Ferris in 1915 and 1918 were not relocated by Miller in the 1960s and 70s (Bequaert and Miller 1973). The total range of most of the known species is less than the land occupied by one moderate-sized house.



In Pima County, as in the rest of the genera's distribution, this diverse genus of rock snail is usually found in loose masses or "slides" of coarse broken volcanic or limestone rock known as talus. Many different species are known to occur in Pima County, at a variety of elevations:

| Species Name | Known Location(s) in Pima County |
|---|---|
| *Sonorella. ambigua* syn w/ *S. papagorum (*may by synonymous with *S. eremita)* | Black Mtn, San Xavier District |
| *S. eremita* | Mineral Hill; San Xavier District |
| *S. imperatrix* | Total Wreck Mine vicinity |
| *S. imperialis* | Empire Mtns |
| *S. magdalenensis* syn. *S. tumamocensis* | Cerro Colorado; Roskruge; S. Tucson Mtns; N. Santa Ritas, Tumamoc Hills |
| *S. odorata odorata; S.o. marmoris* | Head of Alder Canyon; Old Dan's Gulch below Marble Peak; Soldier Camp; Bear Wallow |
| *S. rinconensis* | Rincon Mountains |
| *S. sitiens* | Las Guijas Mtn |
| *S. sabinoensis tucsonica* | Tucson Mtns Wild Pig Amphitheater |
| *S. sabinoenis buehmanensis* | Buehman Canyon |
| *S. tortillita* | Tortilita Mtns. |

### Habitat

All *Sonorella* species live in isolated, undisturbed areas of rocks, generally, or exclusively, limestone, mostly, if not exclusively, on north-facing or trending slopes, usually near hilltops or in rocky canyons (Pilsbry and Harris 1915, Pilsbry 1918, Terkanian 1999).

### Current and Potential Threats

General: The total known and likely range of many of these species is very small and is isolated from any other potential habitat. Relatively minor perturbations of the habitat may result in changes that impact the snails. These species are thought to be particularly sensitive to potential global climate change (Terkanian 1999).

Existing and potential pest species: None are currently known for these animals, and none are likely to be problematic.

Threat mechanism: Minor to major disruption of habitat by road building, development, or other land uses.

### Management Needs

General: Locating, examining, and documenting the currently existing populations and determining the most appropriate methods of management are the most pressing needs.

Current protective measures: Some populations are within protected lands, and most are difficult of access. Pima County's Hillside Ordinance may minimize loss of habitat. Some habitat in the Tucson Mountain Park is protected by a reversionary clause under the Recreation and Public Purposes Act. The San Xavier talus snail is protected through a Conservation Agreement.

Corridor and migratory needs: None are known, and the concept is probably irrelevant for these species.

Key relationships: There may be key interdependencies with some species of fungi.

Existing monitoring and research programs: No known monitoring and research programs exist for these species.

### Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities: 0.1 ac (per species). Take is anticipated to result from inadvertent trail construction and use.

Acres of mitigation habitat within the current portfolio of conservation lands: NA

### Management and Conservation Commitments

Pima County will pursue the following management action and conservation commitment for talus snails:

- Talus deposits should be identified in rapid assessments for preserve management purposes, and prioritized for survey efforts.
- Management plans for County reserves that include talus deposits should recommend specific measures to avoid and minimize disturbances from County activities. Discretionary projects under Pima County control may not be routed across potentially occupied habitat.
- If buffelgrass management is needed on occupied talus deposits in County-controlled mitigation lands, best management practices should be developed first, in consultation with mollusc experts.
- Requests from outside agencies for right-of-way and grading permits should be reviewed for potential habitat impacts. Further investigations of potentially suitable habitat should be required, inclusive of focused surveys and support for confirmation of species taxonomy.
- Continued adherence with protected peaks and ridges standards in the County code (Hillside Ordinance) as described in Chapter 4.
- If state or Federal agencies permit an activity on County-controlled mitigation lands over which Pima County has no jurisdiction, Pima County will request avoidance, inclusive of donation of property rights on remaining habitat and taxonomic studies.
- Map talus deposits on the urban periphery.
- Develop avoidance and minimization measures that apply to utility construction across such deposits.
- Pima County and BLM will evaluate the potential for talus snail occurrences located on BLM Recreation and Public Purposes Act lands.
- Implement monitoring as described in Appendix O, including recording and entering incidental observations in the Covered Species Information Database.

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# Appendix B. Capital improvement projects that will be covered under Pima County's Section 10 Permit. Many impacts projected are in the existing built environment; impacts to areas of natural cover are approximately 1,800 acres.

| Project | Location | Department | Acres |
|---|---|---|---|
| Fairground Infrastructure Improvements | PC Fairgrounds | Facilities Management | 4.9 |
| Shooting Sports Program Site Improvements | Southeast Regional Park, Tucson Mountain Park, Northwest Site (To Be Determined) | Natural Resources, Parks, and Recreation | 1.5 |
| Flowing Wells Branch Library | Flowing Wells - Ruthrauff, Romero and Wetmore | Facilities Management | 7.9 |
| Arizona Sonora Desert Museum - Education Facility Phase III | 2021 N. Kinney Rd., Tucson | Facilities Management | 0.5 |
| Pima Air and Space Museum - Cold War Hangar | 6000 E. Valencia Rd. , Tucson | Facilities Management | 7.9 |
| Eckstrom-Columbus Library Expansion and Remodeling | 4350 E. 22nd. St. | Facilities Management | 1.0 |
| Archaeological Site Acquisitions, Marana Mound | N. of Cochise Canyon Trail, E. of Interstate 10, W. of CAP Canal in Marana | Office of Sustainability | 7.9 |
| Steam Pump Ranch Rehabilitation | 10901 N. Oracle Rd., Oro Valley, AZ | Office of Sustainability | 7.9 |
| Archaeological Site Acquisitions, Cocoraque Butte | P#208-48-0060 T14S, R10E, Section 8 | Office of Sustainability | 7.9 |
| Site Interpretation/Preservation, Los Morteros | Along Silverbell Rd. North of Linda Vista Blvd in Marana P#226-03-033A & 226-03-0340 T12S,R12E Section 7 | Office of Sustainability | 7.9 |
| Vail Area Historic Sites | 13105 E. Colossal Cave Rd., Vail, AZ | Office of Sustainability | 7.9 |
| Sahuarita Branch Library | 725 W. Via Rancho (303-06-045B) | Facilities Management | 8.0 |
| Green Valley Government Center Master Plan Implementation | 301 W. Camino Casa Verde, Green Valley | Facilities Management | 8.0 |
| Benson Highway Park Development & Land Acquisition | directly west of S. Country Club Road and adjacent to and south of Benson Hwy., east of Tucson Blvd | Natural Resources | 8.0 |
| Coronado Middle School Athletic Fields Upgrades | 3410 East Wilds Road | Natural Resources | 8.0 |
| George Mehl Family Foothills Park | 4001 E. River | Natural Resources | 8.0 |
| New Tucson Girl's and Boy's Chorus Building | 3605 N. Edith Blvd. | Natural Resources | 8.0 |
| Rillito Racetrack Conversion | 4502 N. 1st. Ave., Tucson | Natural Resources | 8.0 |
| Yaqui Park Community Center | I-10 and I-19 Junction | Natural Resources | 8.0 |
| Flowing Wells Junior High | 4545 N. La Cholla Blvd. | Natural Resources | 8.0 |
| Canoa Ranch Historic Interpretive Center (Parks and CR Project) | Approximately 45 miles south of Tucson off I-19 at Canoa Ranch exit and on east side of highway | Natural Resources | 8.0 |
| Flowing Wells High School | 3725 N. Flowing Wells Road | Natural Resources | 8.0 |
| James D. Kreigh Park Updates | 23 W Calle Concordia, 1/10 mile west of North Oracle, north side of Calle Concordia | Natural Resources | 8.0 |
| Lawrence Park Improvements | 6777 S. Mark Road | Natural Resources | 8.0 |
| Robles Community Park | Ajo Road, 1/2 mile south on Sasabe Road | Natural Resources, Parks, and Recreation | 5.0 |
| Southeast Regional Park (Esmond Station Regional Park) | 141-17-011A | Natural Resources, Parks, and Recreation | 8.0 |
| Ted Walker Park Sporting Dog Training Site | 6775 N Casa Grande Hwy. | Natural Resources | 8.0 |
| Avra Valley Watchable Wildlife Site | W. of San Joaquin Rd. & S of Bopp Rd. | Natural Resources | 0.2 |
| BAJA Seniors Sports Complex | East on Whitehouse Canyon Road and | Natural Resources | 12.0 |

| Project | Location | Department | Acres |
|---|---|---|---|
| | south on Camino de la Canoa | | |
| Flowing Wells, Kino and Other Swimming Pool Renovations | Kino Pool, 2805 E Ajo Wy | Natural Resources | 8.0 |
| Green Valley Performing Arts/Learning Center III | 120 W. Continental Rd. Green Valley | Natural Resources | 8.0 |
| JVYC/Ochoa Gym (South Tucson Request) | Southwest corner of 25th Street and S. 6th Avenue | Natural Resources | 8.0 |
| Lawrence Community Center and Swimming Pool | 6777 S. Mark Road | Natural Resources | 4.0 |
| Lawrence Hiaki Pathway (Pascua Yaqui) | Bounded by Jeffery Road on N, Mark Road on W, Los Reales on S, Camino de Oeste on E | Natural Resources | 8.0 |
| West Valencia Branch Library | 138-25-6210 (Cardinal south of Valencia) | Facilities Management | 8.0 |
| Ajo Community Golf Course | North Ajo Well Road, Ajo | Natural Resources | 2.0 |
| Freedom Park Adult Learning Center | 4800 block of East 29th Street between Swan and Craycroft | Natural Resources | 8.0 |
| Corona Foothills Middle School and Sycamore Elementary School Sports Fields Improvements | 16701 South Houghton Road, Vail | Natural Resources | 8.0 |
| Old Vail Middle School Sports Fields Improvements | 13299 E. Colossal Cave Road, Vail | Natural Resources | 8.0 |
| Flowing Wells District Park Expansion | T13S, R13E, Section 16 South Bank of Rillito, East of Shannon | Natural Resources | 8.0 |
| Pima County Animal Care Center (PACC) Improvements | 4000 N. Silverbell Rd. | Facilities Management | 5.0 |
| Hohokam Community Sports Fields and Hohokam Park | NE Corner of Camino de Oeste and Los Reales | Natural Resources | 8.0 |
| Altar Valley Watershed Restoration Project | South of AZ286 along Brawley and Altar Wash complex | Natural Resources | 5.0 |
| Site Interpretation/Preservation, Pantano | Pantano Railroad Stop | Office of Sustainability | 8.0 |
| Site Interpretation/Preservation, Dakota Wash | Dakota Wash | Office of Sustainability | 8.0 |
| Site Interpretation/Preservation, Honey Bee | Honey Bee | Office of Sustainability | 8.0 |
| Site Interpretation/Preservation, Coyote Mountains | Coyote Mountains | Office of Sustainability | 8.0 |
| Indoor Sports Complex Curtis Park - formally Kino Regional Park | 5542 N Shannon Rd (Shannon north of Curtis Rd) | Natural Resources | 8.0 |
| Kory Laos Freestyle Memorial BMX Park | 5542 N Shannon Rd (Shannon north of Curtis Rd) | Natural Resources | 8.0 |
| PC Southeast Regional Park (Fairgrounds) - Horse Racing Facility | Houghton Road and Dawn Road, South of I-10 | Natural Resources | 8.0 |
| Reclaimed Water to Protect Cienega Creek | Cienega Creek/Rincon Creek Reclaimed Line Extension | Regional Flood Control | 2.0 |
| Art of the American West - Tucson Art Museum | North Wing of the Pima County Old Courthouse | Facilities Management | 0.1 |
| Pima Community College Health Education Campus | 2800 E. Ajo Way | Facilities Management | 8.0 |
| Pima County Softball Tournament and Recreation Park | SW Corner of Ina Road and I-10 (Former Sports Park) | Natural Resources | 0.5 |
| Tucson Children's Museum - New Museum | West of I-10 in the Rio Nuevo museum complex | Facilities Management | 5.0 |
| LSB - Asbestos Abatement and Fire Sprinklers | Legal Services Building | Facilities Management | 8.0 |
| Colossal Cave Mountain Park | 16721 E. Old Spanish Trail, Tucson | Facilities Management | 2.0 |
| Santa Cruz River: Rillito and Community Development Confluence | 214-01-024B | Regional Flood Control | 0.5 |
| Catholic Comm Services - Sahuarita-Green | Dot at Inter section of I-19 & Duval Mine | Facilities Management | 2.0 |

| Project | Location | Department | Acres |
|---|---|---|---|
| Valley Clinic | Road | | |
| Catholic Comm Services - Vail Area Clinic | 141-17-011A | Facilities Management | 8.0 |
| Eastside Government/Community Ctr: Library, Park, Sheriff | 141-17-011A | Facilities Management | 274.1 |
| Catholic Comm Services - Quincy Douglas Center | 1575 East 36th Street 85713 | Facilities Management | 8.0 |
| Joyner-Green Valley Library Renovation and HVAC | 601 North La Canada Drive | Facilities Management | 8.0 |
| Davis Monthan Approach Corridor Open Space Acquisitions | 141-11-003J | County Administratoin | 8.0 |
| Ajo Curley School Gym & Town Plaza | Ajo Curley School | Office of Sustainability | 8.0 |
| Joint Municipal and Justice Courts Facility | Stone Avenue across from Public Works | Facilities Management | 8.0 |
| Habitat Protection Priorities & Associated Lands | Not Defined, Many Locations | County Administratoin | 8.0 |
| Floodprone and Riparian Land Acquisition (Combined w/ FC52 and PR219) | Not Defined, Many Locations | Regional Flood Control | 0.5 |
| Historic Fort Lowell Park - Master Plan Implementation | 2900 N. Craycroft Road | Office of Sustainability | 8.0 |
| Dunbar School Rehabilitation | 325 W 2nd St | Office of Sustainability | 8.0 |
| Performing Arts Rehabilitation | 408 S 6th Av | Office of Sustainability | 8.0 |
| One Stop Career Center | Not Defined | Facilities Management | 8.0 |
| Theresa Lee and Tuberculosis Clinic Relocation | Not Defined | Facilities Management | 2.0 |
| Elections Equipment | Not Defined | Facilities Management | 8.0 |
| Affordable Housing Program | Not Defined, Many Locations | Community Development | 8.0 |
| Neighborhood Reinvestment Program | Not Defined, Many Locations | Community Development | 8.0 |
| Pima County Comprehensive Housing Center | Not Defined | Community Development | 8.0 |
| Model Airplane Parks | Not Defined, Many Locations | Natural Resources | 8.0 |
| Arizona Velodrome Center - Kino Campus | Udall Park | Natural Resources | 8.0 |
| River Park Acquisitions and Development Countywide | Not Defined, Many Locations | Natural Resources | 0.5 |
| Public Natural Park Trail Access | King Canyon Trailhead | Natural Resources | 0.2 |
| Public Natural Park Trail Access | AZ Trail at Sahuarita Trailhead | Natural Resources | 0.3 |
| Public Natural Park Trail Access | Pistol Hill Trailhead | Natural Resources | 0.3 |
| Public Natural Park Trail Access | Chalk Mine Rd Trailhead | Natural Resources | 0.5 |
| Public Natural Park Trail Access | Robles Pass Trails Park Staging Area | Natural Resources | 0.3 |
| Public Natural Park Trail Access | Lawrence Hiaki Pathway | Natural Resources | 0.5 |
| Flowing Wells, Kino and Other Swimming Pool Renovations | Flowing Wells Pool, 4545 N La Cholla Bl | Natural Resources | 8.0 |
| Various Trailhead Parking/Staging | Kennedy Park West: End of W Starr Pass Bl East End Of E Broadway | Natural Resources | 0.2 |
| Various Trailhead Parking/Staging | Kennedy Park West End Of W Starr Pass BlEast End Of E Broadway Bl | Natural Resources | 0.2 |
| Santa Cruz River Community Park-Menlo Park (COT) | East Bank North Of W Ajo Wy | Natural Resources | 32.6 |
| Rillito Park at Columbus Boulevard District Park | 3600 N Columbus Bl | Natural Resources | 31.6 |
| Yaqui Park Improvements A | 39th St To 40th St 10th Av To 12th Av | Natural Resources | 3.9 |
| Southeast Regional Park/Shooting Range | 305010070 (current) 30501009A0 (future) | Natural Resources | 5.1 |
| Dan Felix Memorial Park - Pegler Wash | River Road and Camino de la Tierra | Natural Resources | 13.9 |

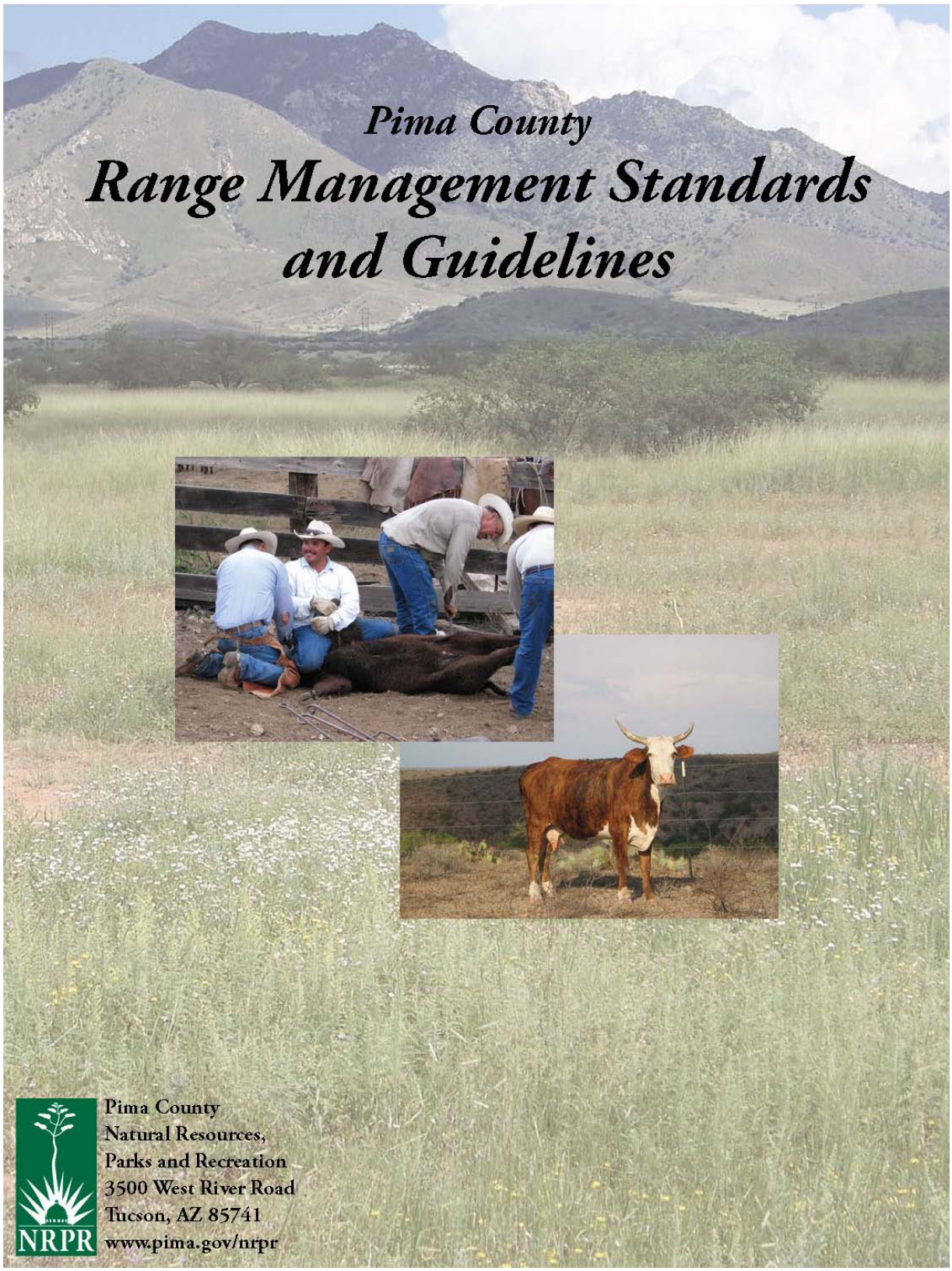
| Project | Location | Department | Acres |
|---|---|---|---|
| Bicycle Lane on Sahuarita Road | Along both sides of the three-mile stretch of Sahuarita Road from the west Town boundary to the east Town boundary. | Natural Resources | 18.0 |
| Arroyo Chico (COT) | Along Arroyo Chico Wash from Country Club to Campbell. | Natural Resources | 6.7 |
| Catalina Community Park | 15300 N. Lago Del Oro Parkway | Natural Resources | 30.1 |
| Northside Community Park (COT) | 1090 E. River Road | Natural Resources | 3.1 |
| Divided Urban Pathway Mountain Ave-First Ave | Rillito South bank between First and Mountain | Natural Resources | 0.6 |
| Udall Park Expansion | | Natural Resources | 10.1 |
| Southeast Regional Park/Shooting Range | 305010070 (current) 30501009A0 (future) | Natural Resources | 6.5 |
| Various Trailhead Parking/Staging (Kennedy Park trailhead) | W Ajo HY, west of La Cholla | Natural Resources | 2.5 |
| George Mehl Foothills Park | | Natural Resources | 1.9 |
| Mission View Wash | Park Avenue at I-10 to 36th Street | Regional Wastewater | 11.9 |
| SS6.03 Santa Cruz Interceptor, Phase III | | Regional Wastewater | 7.0 |
| Old Nogales Hwy Capacity improvements | | Regional Wastewater | 30.6 |
| North Rillito Relief Project 2 | | Regional Wastewater | 4.3 |
| North Rillito Relief Project 3 | | Regional Wastewater | 3.4 |
| Roger Treatment Plant Demo | | Regional Wastewater | 54.4 |
| Water Reclamation Facility Site | | Regional Wastewater | 29.1 |
| Water Reclamtion Campus | | Regional Wastewater | 21.0 |
| North Rillito Relief Project | | Regional Wastewater | 7.7 |
| Prince Rd. & I-10 ADOT Sewer Modifications | Prince Rd at I-10 | Regional Wastewater | 1.3 |
| Sabino Creek Pump Station | | Regional Wastewater | 8.3 |
| Haystack Mountain | | Sherriff | 0.0 |
| Tumamoc (FM 2) | | Sherriff | 0.0 |
| Valencia Standpipe | | Sherriff | 0.0 |
| Rincon Valley FS 1 (Fire | | Sherriff | 0.1 |
| Arivaca\Ruby Road | | Sherriff | 0.1 |
| Golder Ranch Fire Station | | Sherriff | 0.1 |
| FM2.13 Arizona Sonora Desert Museum - Gray Water | 2021 North Kinney Road | Facilities Management | 29.6 |
| FM2.13 Arizona Sonora Desert Museum - Gray Water | 2021 North Kinney Road | Facilities Management | 10.2 |
| Green Valley Government Center Master Plan Implementation | 601 La Canada Dr., Green Valley, AZ | Facilities Management | 11.0 |
| New Pima County Nursing Home and add Adult Day Care | Kino Campus Ajo Way/County Club - 10-20 acre | Facilities Management | 14.9 |
| Pima County Community College Healthcare Campus | Kino Campus, 2800 E Ajo Way | Facilities Management | 5.1 |
| Fairgrounds Infrastructure Improvements | 11500 S Houghton Rd | Facilities Management | 209.2 |
| Southern Arizona Cart Club | 11700 S Harrison Rd | Facilities Management | 8.4 |
| Primary and Specialty Physician Care Site Expansion (Brain Inst) | 2800 E Ajo Way | Facilities Management | 14.8 |
| Kino Sports Complex Northside Maintenance Facility | No Site - Ajo Way/Country Club - 1acre+/- | Facilities Management | 1.0 |
| One Stop Career Center | No Site W/SW Tucson - 2.5 acre+/- | Facilities Management | 2.5 |
| Catholic Comm. Serv - Sahuarita-Green | No Site - Sahuarita / GV AZ - 2 acre+ | Facilities Management | 2.0 |

| Project | Location | Department | Acres |
|---|---|---|---|
| Valley Clinic | | | |
| Northwest Regional Justice Center | No Site - NW of La Cholla / Orange Grove - 15-20 acre | Facilities Management | 20.0 |
| Catholic Comm. Services - Quincy Douglas Center | No Site Kino Blvd at 36th - 2 acre+ | Facilities Management | 2.0 |
| Tucson Children's Museum | Rio Nuevo W of I-10 | Facilities Management | 2.5 |
| Green Valley Performing Arts/ Learning Center III | W of Continental Rd, Green Valley, AZ | Facilities Management | 20.0 |
| Freedom Park Adult Learning Center | No Site - Freedom Park 4800 block of E 29th 2-5 acre | Facilities Management | 2.5 |
| ATLANO Anza trail | | Office of Sustainability | 2.0 |
| DOT-06 Magee Road: La Canada Drive to Oracle Road (PC-RTA-12) | Magee Road: La Canada Drive to Oracle Road | Transportation | 22.1 |
| DOT-23 Thornydale: Cortaro Farms to Linda Vista | Thornydale: Cortaro Farms to Linda Vista | Transportation | 27.2 |
| DOT-32 Kolb Road: Sabino Canyon Rd to Sunrise Dr | Kolb Road: Sabino Canyon Rd to Sunrise Dr | Transportation | 36.8 |
| DOT-44 Orange Grove Road: Corona Dr to Oracle Rd (Phase 1) | Orange Grove Road: Corona Dr to Oracle Rd (Phase 1) | Transportation | 35.3 |
| DOT-53 Old Tucson-Nogales Hwy - Summit | South Old Nogales Highway, North of Old Vail Connection Road to East Suncrest Drive | Transportation | 17.8 |
| Silverbell RD at Blanco/Brawley Washes | Silverbell RD at Blanco/Brawley Washes | Transportation | 3.0 |
| Railroad Overpass: Ruthrauff Road (PC-RTA-09) | Railroad Overpass: Ruthrauff Road | Transportation | 330.2 |
| Magee Road/Cortaro Farms Road: Mona Lisa to La Canada (Stage I) (PC- RTA-07) | Magee/Cortaro Farms Road: Magee/La Cholla Intersection | Transportation | 25.6 |
| Madera Canyon Rd at Medium Wash | Madera Canyon Rd at Medium Wash | Transportation | 0.8 |
| Colossal Cave Rd: Acacia School to Old Vail Road | Colossal Cave Rd: Acacia School to Old Vail Road | Transportation | 10.1 |
| DOT-18 Cortaro Farms Rd: Camino de Oeste to Thornydale (PC Portion) | Cortaro Farms Rd: Camino de Oeste to Thornydale | Transportation | 26.3 |
| DOT-29 Houghton Road: Interstate 10 to Tanque Verde Rd (COT-RTA-32) | Houghton Road: I-10 to Tanque Verde Road | Transportation | 231.0 |
| DOT-31 Tanque Verde Road: Catalina Highway to Houghton Road (PC-RTA-27) | Tanque Verde Road: Catalina Highway to Houghton Road | Transportation | 30.7 |
| DOT-50 Kinney Road: Ajo Way to Bopp Road | Kinney Road: Ajo Way to Bopp Road | Transportation | 11.8 |
| La Canada Drive: Ina Road to River Road (PC-RTA-11) | La Canada Drive: Ina Road to River Road | Transportation | 49.8 |
| Magee Road/Cortaro Farms Road: Corridor Study & Thornydale Road to Mona Lisa (Stage III)(PC-RTA-07) | Magee Road/Cortaro Farms Road: La Canada Drive to Thornydale Road | Transportation | 65.5 |
| DOT-58 Kino Parkway Overpass at 22nd Street | Kino Parkway Overpass at 22nd Street | Transportation | 12.8 |
| La Cholla Boulevard: Tangerine Road to Magee Road (PC-RTA-04) | La Cholla Blvd. from Tangerine Road to Magee Road | Transportation | 90.4 |
| La Canada Drive: Ina Road to Calle Concordia (PC-RTA-11) | La Canada Drive: Ina Road to Calle Concordia | Transportation | 44.4 |
| Valencia Road: Mt. Eagle Road to Ajo Highway (PC-RTA-23) | Valencia Road: Mt. Eagle Road to Ajo Highway | Transportation | 32.0 |
| Valencia Road: Wade Road to Mt. Eagle Road (PC-RTA-21) | Valencia Road: Wade Road to Mt. Eagle Road | Transportation | 27.3 |
| DOT-20 La Cholla Boulevard: River Road to Ruthrauff Road (PC-RTA-10) | La Cholla Boulevard: River Road to Ruthrauff Road | Transportation | 13.6 |
| Valencia Road, Alvernon to Kolb-RTA #24 | Valencia Road, Alvernon to Kolb | Transportation | 78.3 |
| Kolb and Valencia Intersection Improvement | T15A, R15E, Sec 07,08 | Transportation | 288.4 |
| Ina Road at Oracle Road Intersection | T13S R13E | Transportation | 72.1 |

| Project | Location | Department | Acres |
|---|---|---|---|
| Tres Rios del Norte (USACOE Study) | SCR W Cortaro Farms Rd To W Sunset Rd | Regional Flood Control | 403.6 |
| Santa Cruz River: Paseo de Las Iglesias Restoration (USACOE Study) | SCR: San Xavier Rd To Downtown Tucson | Regional Flood Control | 503.1 |
| Arroyo Chico Detention Basin (USACOE) | Broadway Bl & Park Av To East Of Plummer Ave | Regional Flood Control | 51.3 |
| FC5.06 Santa Cruz River Flood Control, Erosion Control and Linear Park, Ajo to 29th St | Santa Cruz River: W Silverlake Dr to W Ajo Wy | Regional Flood Control | 106.3 |
| FC5.10 Canada del Oro River Park, Thornydale to Magee | Canada Del Oro: N Thornydale Rd To W Magee Rd | Regional Flood Control | 31.0 |
| Diablo Village Regional Detention Basins | T15S, R12E, west 1/2 Sec 16 | Regional Flood Control | 100.3 |
| Santa Cruz River Continental Ranch Remediation | Section 22, T 12S, R 12E - Santa Cruz River | Regional Flood Control | 59.1 |
| Pantano Wash: Kolb Executive Park Bank Protection | Latitude-32.241923, Longitude-110.842510 | Regional Flood Control | 0.0 |
| Pantano Wash:Speedway to Tanque Verde | Lat 32.242118, Lon-110842357 | Regional Flood Control | 0.0 |
| Pantano Wash Kenyon to 22nd St | | Regional Flood Control | 0.7 |
| Pantano Wash Golf Links Extension | | Regional Flood Control | 0.7 |
| Pantano Wash - Rillito to Tanque Verde | | Regional Flood Control | 0.7 |
| TRDN/Community Development Ecosystem Restoration | | Regional Flood Control | 0.7 |
| Sahuarita/Green Valley Grade Controls | | Regional Flood Control | 0.7 |
| Santa Cruz/Rillito/Community Development Confluence | | Regional Flood Control | 0.7 |
| Santa Cruz River - Los Reales to Drexel | | Regional Flood Control | 0.7 |
| Green Valley Drainageways 3,6,9,13,17 | | Regional Flood Control | 0.7 |
| Carmack Wash at Magee Rd | | Regional Flood Control | 0.7 |
| Rollercoaster wash at Rudasill | | Regional Flood Control | 0.7 |
| SS6.05 Tanque Verde Interceptor: Craycroft to Tucson Country Club | | Regional Wastewater | 2.1 |
| TV Creek: Sabino Canyon to Craycroft (USACOE) | | Regional Flood Control | 113.4 |
| Madera Canyon at Florida Canyon Wash | | Transportation | 0.8 |
| First Avenue: Orange Grove Road to Ina Road (PC-RTA-13) | | Transportation | 17.3 |
| Sunset Road: Silverbell Road to I-10 to River Road (PC-RTA-08) | | Transportation | 8.0 |
| Valencia Road: Mark Road to Wade Road (PC-RTA-21) | | Transportation | 115.7 |
| ATOITP-Anza Trail | | Office of Sustainability | 96.6 |
| Julian Wash Linear Park (COT) | | Regional Flood Control | 65.3 |
| Curtis Park Skateboard Park and Improvements | | Regional Flood Control | 8.2 |
| Brandi Fenton Memorial Park Phase II Environmental Ed Center | | Regional Flood Control | 8.5 |
| Ajo Detention Basin | | Regional Flood Control | 52.4 |
| Old Vail Corridor | | Transportation | 330.2 |
| Alvernon-Swan Bypass Corridor | | Transportation | 221.2 |
| Valencia Corridor | | Transportation | 438.0 |
| Wilmot Corridor | | Transportation | 312.1 |

| Project | Location | Department | Acres |
|---|---|---|---|
| Kolb Corridor | | Transportation | 293.3 |
| Country Club Corridor | | Transportation | 138.5 |
| Golf Links Corridor | | Transportation | 312.0 |

## Appendix C. Ranch management standards and guidelines.



# Introduction

The Sonoran Desert Conservation Plan (SDCP) is a locally developed, long-term vision for protecting the natural and cultural heritage of Pima County. The Plan seeks to combine short-term actions to protect and enhance the natural environment with long-range planning to ensure that the natural and urban environments not only coexist but develop an interdependent relationship, where one enhances the other. The biological goal of the Plan is to protect the full range of plants and animals native to the region by maintaining ecosystem functions.

Ranch conservation is one of the six primary elements of the SDCP. Ranching conserves large areas of open space and wildlife habitat that might otherwise be developed. By virtue of the extensiveness of ranching as a land use and the ongoing stewardship provided by ranchers, ranching in many areas of Pima County is uniquely suited to preserve natural, unfragmented open space, wildlife habitats, and the land's basic natural and cultural resource values.

Eastern Pima County has over 1.4 million acres of land classified as grazing lands, of which over one million of these acres could potentially be developed into urban use in the future. Current ranch operations put annual livestock numbers at about 20,000 animals in 2009. Most ranches in Pima County are still family-owned enterprises. Current fragmentation of ranch lands is greatest within a twenty-five mile radius of Tucson where increasing land values and development pressure have resulted in ranches being converted into urban uses.

Through the ranch conservation element of the SDCP and the associated Multi-species Conservation Plan (MSCP) expected outcomes include:

- The metropolitan urban boundary is better defined;
- The heritage and culture of the west and early Pima County are preserved;
- An important traditional industry is maintained to support a diversified local economy;
- Watersheds and water resources are conserved and protected;
- The natural landscape can be conserved as a working landscape to provide open space, wildlife corridors, and habitat needed to maintain sustainable and diverse ecosystems;
- The landscape will balance traditional uses such as grazing with other uses such as recreation, preservation of cultural resources, habitat enhancement and restoration, control of invasive species, and the conservation and/or preservation of specific species and habitats identified as sensitive.

As a part of the SDCP land conservation strategy, the County has purchased numerous ranch properties over the past decade. With the passage of the 2004 Habitat Protection Priority Bond program, the acquisition of large working ranches has increased significantly. As of early 2010, the County owns or has committed to acquire fifteen working ranches exceeding 51,000 acres of private fee land as well as the grazing leases on over 191,000 additional acres. The Natural Resources, Parks and Recreation (NRPR) Department is responsible for

managing these open space properties. All ranches purchased (with the exception of the A7 Ranch, which as of 2010 is operated by Pima County staff) are independently operated, generally by the previous owners, who own the cattle, manage the ranches day to day and are responsible for operational costs under terms of a Management Agreement. Ranch operators have entered into third-party agreements with the County to conduct operations on County property and on grazing leases held by the County under the conditions outlined in the Management Agreement. This strategy relieves the County of operational and maintenance expenses on the ranches while directing the ranching operation in an ecologically sustainable manner. The County maintains all authority for ultimate decision making regarding property uses, timing and intensity.

The NRPR Department manages the properties with the intent of achieving sustainable uses of natural resources and maintaining functionally healthy habitat for both wildlife and livestock. The County uses methods developed by the United States Department of Agriculture (USDA), Agricultural Research Service, Natural Resources Conservation Service (NRCS), the United States Department of Interior, Bureau of Land Management (BLM), and the University of Arizona (UA) to inventory rangeland resources, assess rangeland and riparian health, and monitor rangeland and riparian conditions and trends. These techniques will be utilized to guide ranch and grazing management decisions.

## Pima County Ranch Land Vision

The County's vision is to manage ranch properties to achieve sustainable use of natural resources and consistency with habitat needs for implementation of a MSCP by maintaining functionally healthy habitats for both wildlife and livestock.

## Standards

The County will use three standards to maintain healthy rangelands on its ranch properties. These standards become the goals for the desired conditions of rangelands (plant communities, soils/sites and ecological processes). The standards are measurable and attainable, and comply with Federal, State and County statutes, policies and directives applicable to land ownerships found on County-owned ranches.

1. Rangeland plant communities will be managed to provide adequate cover to protect soils from accelerated erosion and promote proper hydrological function.
2. Rangelands will be managed for diverse native plant communities which exhibit the appropriate plant functional groups (life-forms) and annual productivity for the ecological sites present.
3. Rangelands and riparian areas will be managed to optimize ecosystem health and condition, and for habitats that support diverse native wildlife, fish, and plant populations.

## Guidelines

The County will use seven guidelines to manage grazing on its ranches. Guidelines are management approaches, actions and practices necessary to achieve desired rangeland condition goals. Guidelines identify and apply methods to control grazing land use; they are developed and applied to achieve desired conditions within site capability and they can be adjusted over time.

1. Stocking rates will be established to balance livestock numbers with forage plant production. Permitted numbers may remain the same but stocking rates can change yearly to match changing forage and water supplies.
2. Appropriate grazing systems (methods of grazing and resting pastures) will be employed to allow plant forage species to recover from grazing, reproduce and accumulate soil cover (foliar, basal and litter).
3. Utilization levels of key forage species will be used as guidelines for achieving sustainable use of renewable forage resources. Forage utilization will be managed to achieve target levels of 35-40% or less use of the current year's growth of selected key forage species consistent with a conservative grazing regime[1] [2]. If necessary these levels may be adjusted depending on pasture conditions or to meet specific management objectives.
4. Practices such as fencing (using Arizona Game and Fish Department (AGFD) wildlife-friendly standards), improving available water supplies, range seeding, shrub management and prescribed burning may be used as indicated by monitoring plant community response to applied management.
5. Adaptive management will be used to make grazing management decisions each year. This process employs a strategy of:
   a. Applying management throughout the year (with record keeping);
   b. Monitoring plant communities (in the fall of each year), grazing use, and precipitation;
   c. Assessment of results using an interdisciplinary approach;
   d. Using the assessment to plan and/or modify grazing management decisions for the coming year and determine the need to modify and implement appropriate practices;
   e. Recognizing that results of monitoring that cannot be explained by assessment of the data (vegetation, climate and grazing use) may indicate research needs that can be addressed through a committee of rangeland experts.
6. Habitat will be managed to provide for ecosystem health and the maintenance of diverse populations of native plant, fish and wildlife species. Grazing plans will balance stocking rates and pasture rotations with maintaining or actively improving rangeland habitats for native species. Management tools such as wildlife-friendly fencing and year-round water drinkers may be utilized to enhance these habitats. Water tanks and troughs should contain wildlife escape ramps, if needed. Depending on management activities, strategies for rehabilitation or restoration projects will be evaluated and integrated into ranch plans on a case-by-case basis.
7. Special wildlife habitat features (caves, mines, rock outcrops, springs, seeps, etc.) will be identified and considered during implementation of management actions, and conserved and/or enhanced through appropriate actions to maintain their unique habitat values.

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[1] Smith, L., G. Ruyle, J. Maynard, S. Barker, W. Meyer, D. Stewart, B. Coulloudon, S. Williams, and J. Dyess, 2005, Principles of obtaining and interpreting utilization data on Southwest rangelands, University of Arizona Cooperative Extension AZ1375, 14pp.

[2] Holechek, J. L., M. Thomas, F. Molinar, and D. Galt. 1999. Stocking desert rangelands: what we've learned. Rangelands 21:8–12.

## Rangeland Inventory

The County will conduct an inventory of all the County-owned ranches. This inventory will consist of mapping all cultural improvements (houses, corrals, roads, fences, water developments, etc.) with information such as names, pasture size, scale and legends on the land on a comprehensive map base. Information

will also be obtained where possible on historic/prehistoric resources that could be significantly impacted by grazing or other resource management activities. Inventory data will be collected in and/or converted into digital format for inclusion into the Pima County Geographic Information Services Division library, and cultural data will be recorded with the Arizona State Museum. Rangeland resources will be delineated using established data management techniques.

Pima County-owned and leased rangelands lie within one or more of three environmental/geographic regions: the Upper Sonoran Desert, the Semi-desert Grasslands, and the Mexican Oak Savannah. In Arizona, these regions correspond to Major Land Resource Areas (MLRAs)[3] in which soils that are alike in their ability to produce vegetation are grouped together into units called "Ecological Sites". An ecological site is defined as a distinctive kind of land with specific physical characteristics (soil, slope, landform, etc.) and processes (erosion, fire, hydrology, etc.) that differs from other kinds of land in its ability to produce a distinctive variety and amount of vegetation. Ecological sites are described with written narratives of the site's physical characteristics, soils and historic climax plant community. They are the recommended basic unit of rangeland classification and are suitable for mapping at a land management scale. Ecological site descriptions are published by NRCS and are available at the USDA Ecological Site Information System website[4]. The County will use established procedures for mapping and delineating ecological sites as described in the NRCS National Range and Pasture Handbook[5].

The "Soil Survey of Pima County, Eastern Part" is completed and available online for all private, State Trust and Tribal lands east of the Tohono O'odham Nation[6]. Because soil mapping units are generally correlated to ecological sites, soil polygons in conjunction with on-site field truthing can be used to create ecological site delineations, and to identify soil-moisture and temperature regimes within MLRAs.

- MLRA 40-1 is the Upper Sonoran Desert region in Arizona and is characterized by a precipitation regime of 10-13 inches annually, elevations ranging from 2,000 feet above mean sea level (FAMSL) to 3,200 FAMSL, soils in the typic-aridic soil-moisture regime and thermic soil-temperature regime. Twenty ecological sites have been described in this zone.

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[3] USDA, Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, U.S. Department of Agriculture Handbook 296 (2006)

[4] http://esis.sc.egov.usda.gov

[5] USDA NRCS, 2003, National Range and Pasture Handbook. Grazinglands Technology Institute, Revision 1 December 2003 (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html).

[6] USDA, NRCS, 2003, Soil Survey of Pima County, Arizona, Eastern Part (http://soildatamart.nrcs.usda.gov).

- MLRA 41-3 is the Semi-desert Grassland region in southern Arizona, characterized by a precipitation zone of 12-16 inches annually, elevations from 3,200 to about 4,500 FAMSL and soils in the ustic-aridic soil-moisture and thermic soil-temperature regimes. Twenty ecological sites have been described in this zone.
- MLRA 41-1 is the Mexican Oak Savannah region in southern Arizona and is characterized by a 16-20 inch precipitation zone, elevations above 4,500 FAMSL and an aridic-ustic soil-moisture regime and-thermic soil-temperature regime. Fourteen ecological sites have been described in this zone.

NRCS ecological site descriptions also include information related to commonly encountered plant communities, which will enable determination of the current ecological status or condition of a specific site by comparing the present-day characteristics of the plant community to the potential that is described in the ecological site description[7]. "State and Transition" models describe succession of plant communities in arid regions like Arizona and may provide future guidance in further determining realistic vegetation management objectives[8].

## Assessments

The County will use two assessment techniques to evaluate the health and functionality of rangelands and riparian areas. These techniques are qualitative (i.e., depend upon professional judgment). They require considerable training and will be done in an interdisciplinary fashion. The assessments are not monitoring techniques and will not be used to measure progress towards meeting goals. They are tools to be used for educational and communication purposes and to help identify problems and set priorities for both monitoring and management.

1. Rangeland Health is a qualitative assessment that will be used to rate 17 indicators that affect the three primary attributes of the rangeland ecosystem being evaluated: site and soil stability, hydrologic function, and biotic integrity of the plant community[9]. Rangeland health assessments will be performed on ecological sites during the initial inventory process and at monitoring locations to determine the status or function of these ecosystem attributes. Subsequent assessments will be performed prior to lease renewals. A preponderance of evidence will be used to determine if the evaluated rangeland ecosystem attributes are healthy, at risk, or unhealthy[10].

[7] Task Group on Unity in Concepts and Terminology, 1996, New concepts for assessment of rangeland condition, Journal of Range Management, 48: 271-282.

[8] Bestelmeyer, B.T., J.R. Brown, et al., 2003, Development and use of state-and transition models for rangelands, Journal of Range Management, 56(2): 114-126

[9] Pellant, Pyke et al., 2005, Interpreting Indicators of Rangeland Health – Version 4 (http://www.blm.gov/nstc/library/techref.htm).

[10] Reference area information to assist in the use of this technique have been developed by NRCS for major ecological sites in places such as un-grazed or lightly grazed exclosures on the Santa Rita Experimental Range.

2. Riparian Proper Functioning Condition is a qualitative assessment that addresses questions which examine the hydrology, vegetation, and erosion/deposition processes of a riparian area[11] [12], although this assessment does not identify the cause of a resource problem. Proper functioning condition assessments will be performed on riparian reaches with similar channel characteristics on all riparian areas encountered during the initial inventory process, and at any riparian monitoring location. Subsequent assessments will be performed prior to lease renewals. A summary determination will be made for each area being evaluated: either proper functioning condition, functional "but at risk", or non-functioning.

## Monitoring

Rangeland monitoring will implement fixed (permanent) plots placed in strategic areas (key areas) in pastures. These key areas usually represent a dominant ecological site and are in areas receiving average grazing use[13]. Where possible, both a grazed area and an un-grazed (exclosure) control area on the same ecological site will be monitored. The use of an un-grazed control site will help separate grazing effects from climatic effects on plant communities. At all plot locations photo points will be established and seasonal rainfall recorded twice each year for winter (October through May) and summer precipitation (June through September) thus obtaining records for cool and warm seasons. Existing plots that are found to be unproductive in providing useful data or prove excessively difficult to access may be moved to more favorable locations to maximize monitoring efforts. All monitoring plots, new or existing, will be evaluated for whether their data accurately reflects local field conditions prior to any long-term time commitment.

Vegetation monitoring will utilize several techniques to determine trends and to assess progress towards meeting County rangeland management objectives. These techniques include:

1. Plant Frequency Sampling[14] – Frequency is the number of times a plant species is present in a given number of sample quadrats of uniform size placed repeatedly across a stand of vegetation. It is expressed as a percentage of total placements and reflects the probability of encountering a particular species at any location within the stand. The sensitivity of frequency data to density and dispersion make frequency a useful parameter for monitoring and documenting changes in plant communities. It is useful for monitoring vegetation changes over time at the same locations or for comparisons of different locations. The presence of annual plants is directly correlated to habitat suitability for some wildlife; therefore, annual species are recorded as well as perennials. Species-specific data are more useful when using the ecological site guides to compare the current vegetation community to the potential natural community. Plant frequencies are com-

[11] BLM, 1998, A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas, TR 1737-15.

[12] BLM, 1999, A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas, TR 1737-16.

[13] USDA NRCS (National Resources Conservation Service), 2003, National Range and Pasture Handbook, Grazinglands Technology Institute, Revision 1 December 2003 (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html).

[14] Ruyle, G. B., Ed., 1997, Some methods for monitoring rangelands and other natural area vegetation, Report 9043, University of Arizona, Cooperative Extension Service, Tucson, Arizona

pared to frequencies from previous years to identify changes and help determine trend. Binomial confidence intervals will be used to identify changes in frequencies that signify meaningful departures from normal sampling variation. A 40 centimeter square quadrat size, and 200 quadrats located along paced transects as recommended by range scientists at the UA is considered the ideal standard and will yield important data related to plant species diversity, plant functional groups and trend in individual plant species.

2. Point cover[15] – Points of cover will be sampled on each transect to measure soil ground cover, with 600 to 800 points being considered an ideal number by range scientists. These measurements include bare soil, plant basal cover, gravel/rock cover, litter cover and cover of cryptogamic plants (algae, mosses and lichens). Soil cover is one of the principle factors affecting soil erosion. Point cover is gathered concomitant with frequency data.
3. Fetch[16] – Fetch is a measurement of the fragmentation or patchiness of cover, which is directly related to acceleration of soil erosion. Fetch is measured as the distance from a point on a transect to the nearest perennial grass or shrub base. Asymmetry is calculated using the formula: (maximum-median)/(median-minimum), where the median, minimum, and maximum values come from the collective dataset of individual fetch measurements from a transect. As asymmetry (longer fetch distances increase relative to the shortest fetch distances) increases, fragmentation of cover increases and erosion can accelerate. Asymmetry values exceeding 10 are indicative of soil erosion beyond natural levels. This measurement is most applicable to grassland sites and communities with over 2% basal or ground cover, and will not be used on desert sites with less cover.
4. Dry Weight Rank[17] – Composition by weight is probably the best measure of the relative abundance of a plant species in a community. In each quadrat (the same quadrat used in frequency measurements) the 3 species having the highest yield on a dry matter basis are visually estimated. These species are ranked 1-3 with the highest yielding species getting a rank of 1. This measure of the plant community yields plant species composition (by annual production) and allows the comparison of the present-day plant community on a site to the potential or the desired plant community described in the ecological site description. This comparison is expressed numerically as the similarity index.
5. Comparative Yield[18] – This method will be used for estimating above ground biomass production. Reference quadrats are chosen, representing the range in dry weight of vegetative standing crop or yield expected to be commonly encountered during sampling. The current production in these (usually five, 40-centimeter square) quadrats is clipped and weighed (grams air-dry). Results from sample quadrats are then compared to the reference quadrats and rated. The summary yields a standing crop of biomass in pounds per acre on an air dry basis. This measure can be used to compare production of the present day plant community to that shown on the ecological site description for a normal, above average or below average rainfall year.
6. Utilization measurements – Utilization is a measure of the percent of the current year's growth, by weight, that has been removed from a forage plant by grazing, browsing or trampling. Utilization levels (expressed as a percentage) are used as guidelines to assist in achieving plant community objectives[19]. Utilization is determined[20] at the end of the planned grazing period, or at the end of the

[15] Ibid

[16] D. Robinett (personal email communication to I. Rodden, January 11, 2009).

[17] Ruyle, G. B., Ed., 1997, Some methods for monitoring rangelands and other natural area vegetation, Report 9043, University of Arizona, Cooperative Extension Service, Tucson, Arizona

[18] Ibid

[19] Smith, L., G. Ruyle, J. Maynard, S. Barker, W. Meyer, D. Stewart, B. Coulloudon, S. Williams, and J. Dyess, 2005, Principles of obtaining and interpreting utilization data on Southwest rangelands, University of Arizona Cooperative Extension AZ1375, 14pp.

[20] BLM, Interagency Technical Reference 1734-3, 1996, Utilization studies and residual measurements.

grazing season (February for summer forage crop, June for spring forage crop) if grazed year-round. In years where a spring forage crop is lacking, year-round utilization may be gauged prior to the summer rains. Utilization is measured on one or more key forage species selected at each key area. During the grazing period or season, estimates of utilization and use patterns can be used to adjust stocking rates, if needed. Utilization estimates based on forage produced to time of estimate during a growing season should be identified as "seasonal utilization" and usually will have a different guideline percentage than utilization based on current annual growth. If grazing in one year or season results in utilization in excess of the guidelines, then the current plan may be adjusted or revised to allow recovery of that particular pasture in the subsequent year. Actual utilization data can be used with vegetation monitoring and rainfall amounts to assess trends in various attributes of the plant community and soil cover[21].

## Ranch Planning

Pima County rangelands fall within the geographic area of the Tucson Field Group for Coordinated Resource Management (CRM). The group is the local arm of the Arizona CRM group consisting of representatives from NRCS, BLM, AGFD, United States Forest Service, Arizona State Land Department, local Natural Resource Conservation Districts, and Arizona Cooperative Extension. The local group meets each summer to develop plans for interagency ranch planning and monitoring efforts in the coming year.

Within this framework Pima County will develop a Coordinated Resource Management Plan (CRMP) for each of its ranch properties as time and resources permit. The CRMP will include a grazing component with an assessment of rangeland resources (ecological sites, cultural features, etc.), current rangeland conditions, and goals. Adaptive management will utilize monitoring results in a feedback loop each year to develop and modify grazing plans. The CRMP will establish a collaboration model for the managers, ranch operators, natural resource agencies and the public to work together to achieve common conservation goals for the land. Pima County does not, however, relinquish its authority for overall management decisions made on County-owned and/or leased properties.

The CRMP process brings together a team of local area experts to share programmatic needs and conservation strategies that support the SDCP program goals on ranch properties. Draft CRMP plans will be available for public review and comment and will be posted on the Natural Resource Division portion of the Pima County Natural Resources, Parks and Recreation website at www.pima.gov/nrpr.

## CRMP Goals

1. Establish stocking rates, timing, frequency, and duration of grazing that are consistent with utilization guidelines.

[21] Holechek, JL., Pieper, RD., and Herbel, CH., 2004, Range Management: Principles and Practice, 5th edition, Pearson Prentice Hall, New Jersey, 607 pages.

2. Attain a stable or positive trend over time in rangeland conditions (vegetative, soils, productivity).
3. Utilize grazing systems that shall allow for sufficient plant growth, reproduction and residual cover to protect soils from accelerated erosion.
4. Adjust stocking rates to account for variation in precipitation and forage production.
5. Practice cooperative management and collaboration with ranch operators, other agencies and the public.
6. Maintain public access to and across the ranch properties where public health/safety and negative impacts to wildlife or wildlife habitat are not an issue.

## Ranch Management Action Strategies

1. Identify property boundaries and legal access.
2. Map ranch roads, boundaries, pastures, improvements (and document condition of improvements), and water sources. Install signs to clearly communicate ranch roads and boundaries.
3. Identify ecologically sensitive areas and the management needs of these areas.
4. Determine percentage of ranch lands that livestock can utilize (noting sensitive areas, slope and distance from water, or important wildlife habitats).
5. Compile and review historical stocking and utilization rates, precipitation records, fire regimes, and other factors that contributed to the current resource conditions.
6. Consult with AGFD Wildlife Managers to identify wildlife resources and requirements on ranch lands.
7. Identify riparian areas and assess the function and ecological condition of each.
8. Inventory ecological sites and identify current ecological status (health) or condition.
9. Analyze all of the above information and develop a coordinated resource management plan.
10. Select key areas and establish rain gauges, photo points and monitoring transects with a paired ungrazed control plot where possible. (Monitoring efforts will be repeated every year for an initial three year baseline assessment and biennially at a minimum thereafter.)
11. Evaluate alternative methods to manage grazing. (Select and apply one.)
12. Utilize an adaptive management model to incorporate the yearly assessment of monitoring results into a process of developing annual grazing plans, adjustment of stocking rates, and determining the need for practices or research (to help explain unknowns). (Research findings should be incorporated back into the system as available.)
13. Develop fire management plans with the agency responsible for fire management decisions. (Develop maps showing areas that would benefit from fire and provide them to the agency to guide managers if a natural fire starts.)
14. Evaluate other legal or illegal uses and/or impacts on ranch properties (e.g. camping, hunting, off-road vehicle use, or border issues) and develop strategies to enhance, address or mitigate negative impacts where possible. Mitigation actions should be compatible with existing ranch management plans.

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Terms used in this report can be found and described in the "Glossary of terms used in range management", 4th edition. Glossary Update Task Group (1998). T. Bedell. Denver, Society for Range Management.

# Optimal Timeline for Annual Evaluation of Grazing Practices for Each Ranch

| ACTION | TIMELINE |
|---|---|
| Evaluate pasture utilization levels | February or June |
| Annual monitoring and photos at key areas | September to November |
| Twice annual recording of precipitation at key areas | May and September |
| Operator submits suggested revisions based upon the assessment of monitoring results | September |
| Review and assess current year's data, monitoring analyses, goals and objectives, and completed or new projects or concerns | November |
| NRPR Review Panel reviews the operator's changes and makes decisions for the next year | December |
| Operator meets with the NRPR Review Panel to discuss proposed use for the coming two years | December |
| Review a summary of monitoring and pasture utilization data to date with ranch operator, so stocking rate adjustments, if apparent, can be initiated with fall livestock work schedule | November to January |
| Decisions made on the approved stocking rate | March |
| Additional on-the-ground stocking rate adjustments, if necessary | January to June |

# Appendix D. Land absorption, habitat impact, and mitigation analysis. Model developed by Julia Fonseca, Cory Jones, Mike List, Mark Probstfeld, and Sherry Ruther.

Overview: Urban growth projections utilize land absorption modeling to estimate how landscapes might change as a result of an increasing human population. The growth projection scenario used for estimating habitat impacts was developed by a public-private team of planners and engineers during the City-County Water Study (Stantec 2009), then modified for this study to assess a shorter and varied time horizon. Then the impacts within the Permit Area from the growth model were combined with the impacts from future Capital Improvement Program projects for the 30-year term of the MSCP. This combined result was then intersected with species habitats to measure habitat impacts. Figure A-33 summarizes the methods used and CLS mitigation was calculated as shown in Figure A-34.

The resulting impacts are a projection of where Covered Activities might occur. Projections are for US Fish and Wildlife's analytical purposes. The projections are not for use in parcel-specific determination of permit coverage, nor will they represent areas of actual habitat take. Actual locations of take by Covered Activities will be tracked and reported to USFWS annually, based on what land is actually developed in the permit area under the County's incidental take permit.

Urban Growth Projection: The projection of urban growth we used for habitat impacts was consistent with what was called the "status quo" growth scenario in the City-County Water Study (Stantec 2009). The defining characteristic of the "status quo" growth scenario is that new growth in the suburbs occurs at 2,500 people per square mile, a relatively low metropolitan population density that is consistent with current patterns of growth in the Tucson area. More information is available about the development of the "status quo" growth scenario in Stantec (2009).

Since 2009, additional growth scenarios have been developed as part of Imagine Greater Tucson. These scenarios are based on a higher population and a longer time frame than the 30-year term we used. Also, IGT planning scenarios assume a much higher population density. If the region is able to achieve higher urban densities (i.e., requiring higher densities in planned communities and/or implementing transit oriented development), then the predicted habitat impacts for the 30-year term of the permit would be fewer than represented here.

Our analysis also excluded consideration of future annexation patterns. Annexations could reduce the total long-term impacts of urban development within Pima County's permit area.

We excluded western Pima County from the growth model *a priori* because there is no basis (i.e., specific population projections and refined GIS data) to project future development there. Development opportunities in western Pima County are largely

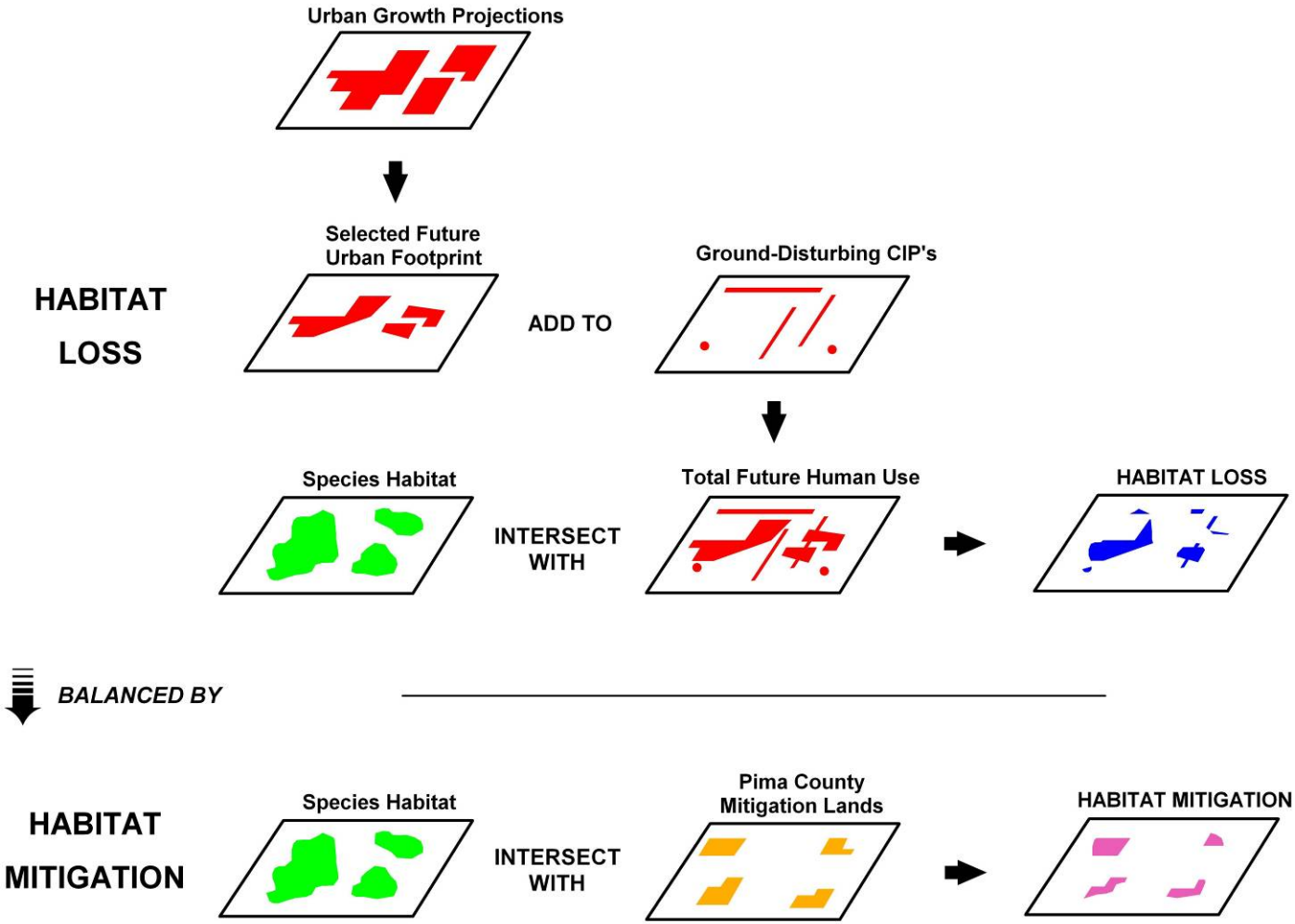


**Figure A-33. Schematic representation of the methods used to calculate habitat loss and habitat mitigation (illustration by Mike List).**

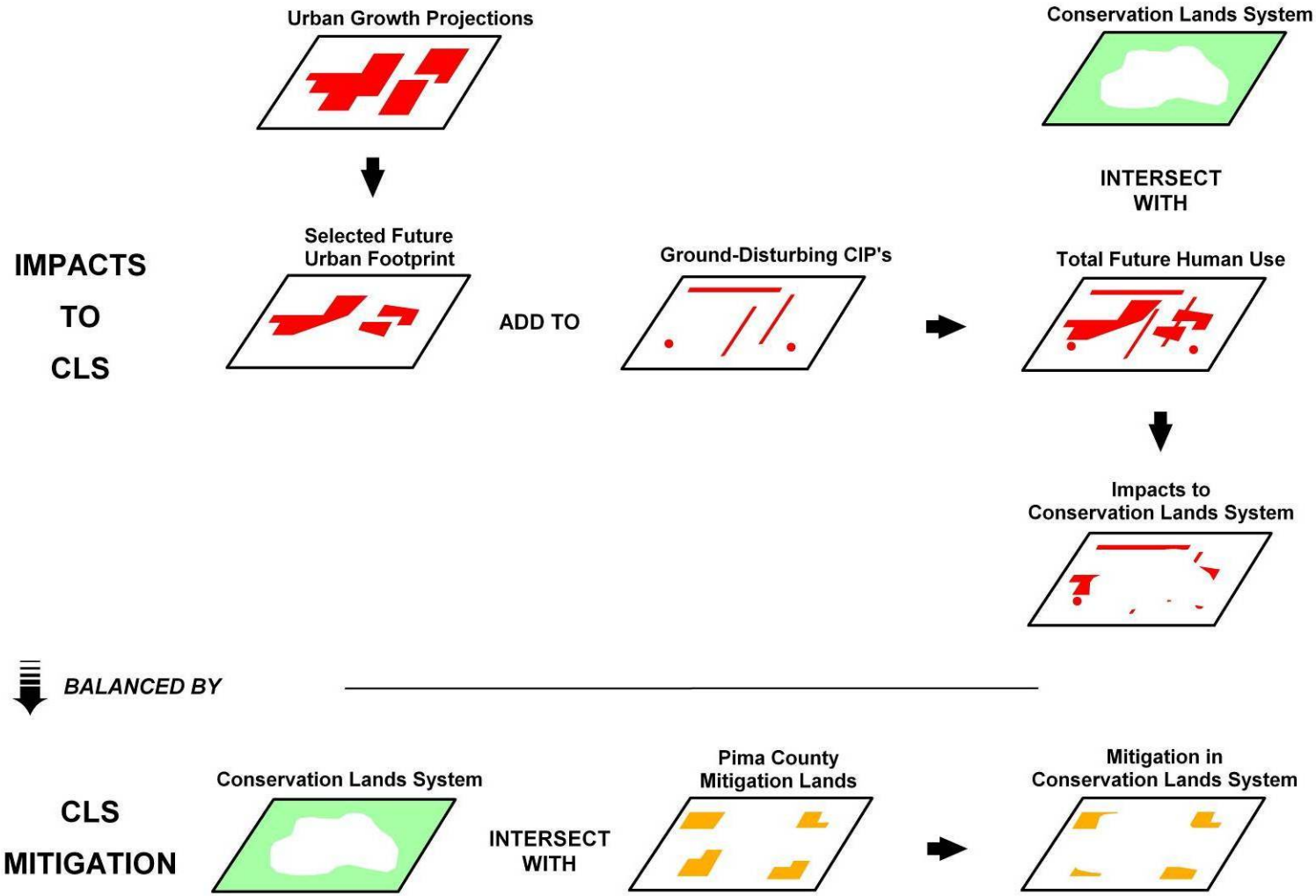


**Figure A-34. Schematic representation of the methods used to calculate CLS impacts and mitigation (illustration by Mike List).**

limited to infilling the built environment on private lands in the isolated, low density communities of Ajo, Why, and Lukeville.

For our purposes, assumptions were needed to predict population growth at 10-year increments, and to differentiate Covered Activities from other impacts in the Permit Area. Because of the changes in Covered Activities, we departed from methods described in Fonseca et al. (2009), which were the basis for habitat impacts in the Draft 5 MSCP.

We obtained population projections from the Arizona Department of Economic Security (2008) for the years 2020, 2030, and 2040. These projections were used in conjunction with an urban form classification developed for the City-County Water Study. New population allocated by the land absorption model was 559,477. This GIS layer divides eastern Pima County into four urban form units (urban core, core suburbs, expanding suburbs, and exurbs) and many sub-units (e.g., exurbs - lot split low density). Each urban form unit dictates a unique population density, ranging from 4,500 people per square mile in the urban core to 300 people per square mile in portions of the exurbs. The urban form boundaries were drawn using elements of the Pima County Comprehensive Plan and the City of Tucson General Plan in conjunction with data on current population density as well as subdivision and annexation history. The urban form layer was overlain with the past ten years of residential building permits, and the resulting ratios of permits by urban form were applied to the population projections. In this fashion, land absorption was “spread around” at varying population densities based on dynamics particular to eastern Pima County.

A definition of the current built environment per the Pima Association of Government’s latest land use model (2008) was used as the starting point for adding new urban growth. This is different than the Draft 5 MSCP calculation for the 2008 built environment, which was based solely on Pima County data. Road rights-of-way (ROW) were not included in the built environment.

Constraints to future land absorption were as chosen by the City-County Water Study Committee. For this model we stipulated that urban growth would not occur:

- in the existing built environment, except non-mapped infill in the urban core/core suburbs,
- in areas of greater than 25% slope,
- in areas of existing mines/quarries,
- in areas of floodways,
- on Federal or tribal lands except BLM disposable land outside CLS,
- in existing or proposed preserves of any kind,
- on Tucson Water municipal lands and wellfields,
- on active landfills,
- on golf courses,
- within road rights-of-way,
- in public parks
- in cemeteries

- in DM/TIA approach and departure corridors.

Most land absorption occurred in the suburbs, which were divided into four urban form sub-units. The City-County study recognized both planned and unplanned residential suburban development (Stantec 2009). Planned development was defined using information from Comprehensive Plan Amendments, State Trust discussions, and other GIS data. Planned development included unbuilt *and* partially built communities. At 2020, we assumed that the only State Trust Land available to absorb growth was located within planned communities. In the subsequent timeframes, State Trust Land was released to development throughout the rest of the suburbs, but not in any of the exurbs.

Suitability for future development was developed in consultation with the City-County Water Study, and in consideration of recent trends in development. Suitability was assumed to improve with proximity to:

- Existing, committed, and planned road and transit infrastructure,
- Existing potable water infrastructure,
- Top single-site employers,
- Existing sewage conveyance and treatment infrastructure,
- Recent (2003-2008) building permits and house sales,
- Current built environment,
- Municipal parks and selected trailheads,
- High-performing school districts
- Areas not deemed “high stress”.

Note, these variables were weighted in terms of influence through a match pairs comparison exercise (i.e., Analytical Hierarchy Process) completed by the team of engineers and planners.

Population is “absorbed” by the most suitable 30-meter cell (equivalent to approximately 1/5 acre). The cell size was determined by the slope grid used for urban growth constraints. The cells with the highest development suitability scores were iteratively chosen until each population projection per urban form unit per timeframe was satisfied. The 2020 land absorption projections were added to the existing built environment to

yield a new development constraint, and so on through the next two ten-year increments.

Covered Activities

Covered activities modeled included private development and County capital Improvements. As defined in the MSCP, Covered private development consists of Type 1 grading permits, subdivisions and development plats. For the purpose of analysis, we assumed that ~33,000 acres would be available for private impacts, with ~1,800 acres for the County's known capital improvements.

Staff reviewed all capital improvements projects identified by contributing departments of Pima County. Projects which would likely be completed before the MSCP permit is issued were not analyzed. All road projects are considered covered, but only repaving and other projects confined to existing built rights-of-way were not modeled. Only capital improvement projects in the Permit Area and causing ground-disturbance outside the built environment were modeled as potential habitat impacts.

The cells of projected urban growth within planned communities within the City-County model in the Permit Area were selected to represent the potential location of Covered Activities. Selections occurred up to the ceiling of approximately 33,000 acres for covered private activity. Growth that occurred in planned communities represented the bulk of Covered Activities in this model. About 7,200 acres of the cells of growth were distributed in areas that were rezoned between 2002 and 2009.

Habitat Losses

Habitat losses were modeled using the sum of covered private development activities and capital projects, intersected with each of the species' habitat. We assumed that nearly all of the capital improvement projects would be completed in the first 20 years. For covered private development, the assumptions about the slow release of State Trust land to the private sector results in most of the pre-permit rezonings and extant planned communities being developed in the first 20 years.

Habitats were defined using all Priority Conservation Areas 1 through 4 defined by experts (EPG 2001). Two species, the desert tortoise and Tumamoc globeberry, do not have PCAs and therefore we used habitat suitability models for these species. The desert tortoise model used was the "bedrock plus" model developed by Julia Fonseca with review by the Marana Technical Biological Team and others. The Tumamoc globeberry model used was the potentially suitable habitat model developed by RECON and others during the Sonoran Desert Conservation Plan.

Occurrences of talus snails are too localized to model.

Habitat Mitigation

To analyze how mitigation compensates for species' habitat loss, we used a projection of mitigation lands that Pima County expects to acquire with existing funding plus

existing County-controlled mitigation lands, previously described in the *Pima County Mitigation Lands* report (Connolly and Fonseca 2009). Lands located outside Pima County were analyzed, but in nearly all cases, PCAs or habitat models do not extend into these areas at the present time. Thus these lands were not analyzed for habitat mitigation. Outside of the County boundary, Pima County owns approximately 1,700 acres of Mitigation Land, and leases approximately 9,600 acres outside Pima County boundaries.

Uncertainties related to actual future habitat losses and thus habitat mitigation obligations under the Section 10 (a) permit are discussed in *Habitat Mitigation in the Pima County Multiple Species Conservation Plan (*Fonseca 2009).

**Literature Cited**

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Fonseca, Julia, 2009. Habitat Mitigation in the Pima County Multiple Species Conservation Plan. County Administrator's Office. http://www.pima.gov/cmo/sdcp/reports/d52/Habitat_Report.pdf

Fonseca, J. M. List, C. Jones, J. Regan, and M. Probstfeld. 2009. Projected Impacts of Urban Growth for Pima County's Multiple-Species Conservation plan, Draft dated January 2009. Report to the Pima County Board of Supervisors. http://www.pima.gov/cmo/sdcp/reports/d51/Urban%20Growth%20Projection.pdf

Stantec, Pima County, City of Tucson, Curtis Lueck and Associates 2009. Location of Growth, Urban Form, and Cost of Infrastructure. White Paper supporting Phase 2 of the Water and Wastewater Infrastructure, Supply and Planning Study. Accessed July 7 at http://www.tucsonpimawaterstudy.com/Reports/Phase2/GrowthReport.pdf.

# Appendix E. Summary of Pima County's environmental ordinances and protocols.

| Regulation or County Code Ordinance/ Guideline Name | Summary |
|---|---|
| Chapter 6.04: Animal Control Regulations (Ordinance) | Prohibits dogs or canine-wild animal hybrids from roaming at-large |
| Chapter 7.33: Removal of Rubbish, Trash, Weeds, Filth and Debris (Ordinance) | Provides that all property owners, lessees, or occupants shall be responsible to remove all rubbish, trash, filth, and debris that constitute a hazard to public health or safety from the property and contiguous areas. Provides the County with an option to enforce the removal of trash and debris from private property |
| IChapter 16.28 and 16.26 Floodplain and Erosion Hazard Management Ordinance | Minimizes alteration of flow velocity in the floodplain. Massive changes in velocity can adversely alter habitat (bank stability, vegetation density and types, availability of water); Establishes building setbacks along major watercourses, minimizing alteration of areas adjacent to channel banks and encourages leaving banks natural |
| Chapter 16.30: Watercourse and Floodplain and Erosion Hazard Management Ordinance (riparian habitat protection and mitigation requirements) | Emphasizes avoidance and/or minimization of impacts to regulated riparian habitat. Mitigation is required when impacts cannot be avoided. Applies to all properties within unincorporated Pima County that contain riparian habitat as delineated on the riparian habitat maps |
| Chapter 17.08: Ambient Air Quality Standards | Establishes ambient air quality standards and air quality monitoring and procedures |
| Section 18.07.080: Modification of Development Standards in Riparian Areas | Allows for development standards to be modified to promote the protection of riparian habitat. Applies whenever development requires a floodplain-use permit |
| Section 18.09.04: Cluster Development Option | This development option is to provide site planning and unity of design on sites possessing unique or severe topographic or hydrologic features. The cluster development option applies to residential zones only, at the request of the property owner |
| Section 18.09.100: Conservation Subdivision Ordinance | This ordinance encourages and provides incentives for designing residential subdivisions that respect natural features and constraints of the property, while allowing landowners to achieve full density permissible under the existing zoning designation. Development under this scenario is discretionary |
| Chapter 18.59: Golf Course Zone | Permits the development of golf courses in Pima County while preserving and enhancing water resources, scenic vistas, neighborhoods, property uses and values. Golf courses zoned on or after January 1, 2007 are required to use effluent, reclaimed water, or CAP water, and are required to utilize water conservation irrigation systems |
| Chapter 18.61: Hillside Development Overlay Zone | This ordinance establishes standards for development on hillsides with slopes of 15% or greater. Hillsides are protected by regulating the type and densities of development allowed, limiting the amount of allowable grading, preserving undisturbed natural open space, and establishing design standards that minimize the potential for erosion. It also establishes no-build zones around specified prominent peaks and ridges |
| Chapter 18.67: Buffer Overlay Zone Ordinance | Preserves and promotes the visual aesthetics and open-space amenities of lands in the vicinity of public preserves; protects the ecological viability of public preserve; creates a transition area between undeveloped public preserves and more urbanized areas; retains economic benefits associated with public preserves; and establishes a consistent set of performance standards for development |
| Chapter 18.72: Native Plant Preservation Ordinance | This ordinance preserves individual native plants and native plant communities. It identifies specific plants that are to be protected and mitigated when impacted by development |
| Chapter 18.91: Rezoning Procedures | This ordinance establishes a public process for changing and amending zoning districts subsequent to a recommendation from the Planning and Zoning Commission and adoption by the Board of Supervisors. It also establishes the requirement that applications to change or amend a zoning district must include an assessment of potential impacts to federally-listed threatened or endangered species |
| Chapter 18.92: Transfer of Development Rights Ordinance | This ordinance establishes a process by which potential development associated with lot or parcel of land may be transferred to another lot or parcel of land in Pima County. Its purpose is to facilitate the severance of development rights from identified sensitive lands and transfer them to lands more appropriate for intense land uses |
| Chapter 10.56: Community Participation and Mitigation Ordinance | Creates processes that (1) allow individual citizens, neighborhoods, and businesses to provide input into the design and construction phases of transportation projects; and (2) ensure that potential environmental effects of transportation projects are considered |

| Regulation or County Code Ordinance/ Guideline Name | Summary |
|---|---|
| Tucson/Pima County Outdoor Lighting Code | This code limits trespass lighting from one property to another and reduces the allowable amount of lighting depending on an area's need to maintain dark sky conditions |
| Pima County Comprehensive Plan Regional Plan Policy 6B1 – Environmental Element | This policy formally adopts the CLS map and establishes conservation objectives for land uses and activities within the CLS that are under the jurisdiction of Pima County and Pima County Flood Control District. The Board of Supervisors applies this policy to a variety of requests for discretionary land-use modifications which most notably include new rezoning requests, applications to amend the comprehensive plan, and requests for Type II and III conditional use permits. Implementation of this policy is intended to achieve the level of conservation necessary to protect a site's conservation values, preserve landscape integrity, and provide for the movement of native fauna and pollination of native flora across and through the landscape. Setting aside undisturbed natural open space that reserves the most environmentally sensitive areas from development is a preference when mitigating for development-related impacts on projects within the CLS and that are subject to this policy |
| Site Analysis Requirements | This is intended to be a tool that enables the public, elected officials, the Planning and Zoning Commission, Pima County staff, and the rezoning applicant to comprehensively evaluate the proposed development in relation to policies of the comprehensive plan, and County ordinances and other County policies especially those that relate to smart growth and sustainability. It defines by size and proposed land use those proposed rezonings that, by policy, must submit a site analysis and establishes the minimum submittal requirements for such applications. Inventory of existing characteristics of the site is required including biological resources (which include information on federally-listed threatened or endangered species as required by Chapter 18.91), topography, hydrology, and water resources. It also requires the applicant to discuss the proposed development's potential impacts on the site's characteristics including discussion of sensitive design and mitigation techniques to be incorporated into the project |
| Environmentally Sensitive Roadway Design Guidelines | These guidelines were developed to address concerns about the potential conflict between conservation of environmentally sensitive areas, transportation design and construction practices, and the ongoing need for infrastructure improvements. Projects for such roadways are to inventory biological, cultural and historic, as well as visual resources and identify potential mitigation options appropriate for incorporation into project design |
| Design and Construction Guidelines for Public Gravity or Pressure Sewers | This policy prohibits new sewers from being placed within or along wash bottoms |
| Capital Improvement Program – Project Management Process | This County process (also referred to as the "Exit Gate" process) includes review for opportunities to avoid and minimize potential project impacts through planning and consultation with County compliance staff regarding riparian habitat, floodplain, and cultural resource impacts. Avoidance and minimization practices are then incorporated into project design, as appropriate |
| Park Policies for Natural Resource Parks | On-site evaluation of Natural Resources, Parks, and Recreation projects to document species and/or environmental features to be avoided during construction. It also seeks to reduce impacts from public access, trails, and recreation (e.g., All-terrain vehicles) and associated infrastructure |
| Sustainable Action Plan for County Operations, Board Resolution 2007-84 | Establishes water rights goal for Pima County's natural environment and requires minimization of impacts due to CIP and sale of County land |
| Resolution 2005-265: Resolution to Manage Invasive Species in Pima County | Establishes actions to be undertaken by Pima County agencies—under the leadership of Pima County Public Works Department—to address the undesirable spread of non-native, invasive species in Pima County. Most notably includes the creation of the Pima County Invasive Species Work Group which is responsible for the coordination and prioritization of invasive species identification, mapping, control, and eradication efforts on Pima County lands and invasive source lands that will directly impact County lands where possible |

# Appendix F. Maeveen Marie Behan Conservation Lands System conservation guidelines and mitigation ratios under the SDCP. Mitigation ratios follow the same format: acres conserved:acres developed. Note that mitigation ratios in this table differ from the mitigation ratios for MSCP mitigation (see Section 4.3.1 in the MSCP).

| CLS Category | Mitigation ratio | Conservation guideline |
|---|---|---|
| Important Riparian Area (IRA) | 4:1 | At least 95 percent of the total acreage of lands shall be conserved in a natural or undisturbed condition. Every effort should be made to protect, restore, and enhance the structure and functions of IRAs, including their hydrological, geomorphological, and biological functions. Areas within an IRA that have been previously degraded or otherwise compromised may be restored and/or enhanced. Such restored and/or enhanced areas may contribute to achieving the 95 percent conservation guideline for IRAs. |
| Biological Core Management Areas | 4:1 | Land-use changes may occur through a combination of on- and/or off-site conservation inside the Biological Core Management Area or Habitat Protection Priority Areas. For purposes of this policy, Habitat Protection Priority Areas are areas referenced and mapped as part of the 2004 Conservation Bond Program. Development shall be configured in the least sensitive portion(s) of the property. Area(s) of undisturbed natural open space will be configured to include on-site conservation values and preserve the movement of native fauna and pollination of native flora across and through the landscape. Natural open space on individual lots is driven by minimum lot size requirements for the pertinent zoning district. Land use and management within these areas shall focus on the preservation, restoration, and enhancement of native biological communities. Land uses appropriate for these areas must retain and improve conditions for on-site conservation values, preserve the movement of native fauna and pollination of native flora across and through the landscape, and preserve landscape integrity. A transfer of development rights may be used in order to secure County-controlled mitigation lands. |
| Multi-use Management Areas | 2:1 | Land-use changes may occur through a combination of on- and off-site conservation inside the Multiple Use Management Area or any more protective category of the CLS, including Habitat Protection Priority Areas. Development shall be configured in the least sensitive portion(s) of the property. Area(s) of undisturbed natural open space will include on-site conservation values and facilitate the movement of native fauna and pollination of native flora across and through the landscape. Land use and management goals within these areas shall focus on balancing land uses with conservation, restoration, and enhancement of native biological communities. Land uses appropriate for these areas must facilitate the movement of native fauna and pollination of native flora across and through the landscape, maximize retention of on-site conservation values, and promote landscape integrity. Additional conservation exceeding 66⅔ percent will be encouraged through the use of development-related incentives and may utilize undisturbed natural open space on individual lots (driven by minimum lot size requirements for the pertinent zoning district). A transfer of development rights may be used in order to secure lands utilized for mitigation, restoration, and/or enhancement purposes. |
| Special Species Management Areas | 4:1 | Acreage of lands within this designation shall be conserved as undisturbed natural open space and will provide for the conservation, restoration, or enhancement of habitat for the affected Special Species (cactus ferruginous pygmy owl, southwestern willow flycatcher, and Mexican spotted owl). As such, land use changes may occur through a combination of on- and off-site conservation inside the Special Species Management Area. Development shall be configured in the least sensitive portion(s) of the property. Area(s) of undisturbed natural open space will be configured to facilitate the movement of the relevant Special Species through the landscape and will include those on-site conservation values essential to survival of the relevant Special Species. A transfer of development rights may be used in order to secure County-controlled mitigation lands. |
| Scientific Research Areas | NA | Scientific Research Areas should continue to be managed for the purpose of scientific research on the environment and natural resources. Scientific research activities should minimize any long-lasting impacts that may affect adjacent or nearby CLS lands. Any land-use changes subject to Pima County jurisdiction should achieve the conservation goals of the underlying CLS category. |
| Agriculture Inholdings within CLS | 0 | Intensifying land uses of these areas will emphasize the use of native flora, facilitate the movement of native fauna and pollination of native flora across and through the landscape, and conserve on-site conservation values when they are present. Development within these areas will be configured in a manner that does not compromise the conservation values of adjacent and nearby CLS lands. |
| Critical Landscape Connections | NA | Land-use changes in these broadly defined areas should protect existing biological linkages. Where they occur, barriers to movement of native fauna and flora should be removed and fragmented corridors of native biological communities should be restored. Opportunities to remove barriers and restore corridor connectivity may arise as part of other, non-land use related activities (e.g., new construction for or upgrade of infrastructure services). Such opportunities should be pursued. High priority shall be given to identifying, preserving, and re-establishing the connection between native biological communities. |

## Appendix G. Lands that have been acquired or leased and which will be used for MSCP mitigation. For a complete description of each property including its resources and reason for purchase, see Pima County (2011) and Fonseca and Jones (2009).

| Preserve | Owner | Land Tenure | Acres |
|---|---|---|---|
| A-7 Ranch | Pima County | Fee simple | 6,747.9 |
| A-7 Ranch | State of Arizona | Grazing lease | 34,218.3 |
| Ajo | Pima County | Fee simple | 1,397.4 |
| Amadon | Pima County | Fee simple | 38.2 |
| Arivaca open space | Pima County | Fee simple | 122.1 |
| Arthur Pack Regional Park | Pima County | Fee simple | 281.2 |
| Avra - I-10 | Pima County | Fee simple | 46.7 |
| Bar V Ranch | Pima County | Fee simple | 1,765.5 |
| Bar V Ranch | State of Arizona | Grazing lease | 12,134.6 |
| Baxter | Pima County | Fee simple | 26.0 |
| Bear Creek Ranch | Pima County | Fee simple | 17.8 |
| Bee | Pima County | Fee simple | 160.2 |
| Big Wash Rehabilitation | Pima County | Fee simple | 146.7 |
| Bingham Cienega Natural Preserve | Pima County | Fee simple | 267.9 |
| Brawley Wash/ Manville-Garcia | Pima County | Fee simple | 395.8 |
| Buckelew Properties | Pima County | Fee simple | 1,015.5 |
| Buckelew Properties | State of Arizona | Grazing lease | 2,514.0 |
| Buehman Canyon | Pima County | Fee simple | 2,286.0 |
| Canoa Ranch | Pima County | Conservation easement | 84.3 |
| Canoa Ranch | Pima County | Fee simple | 4,697.3 |
| Chilton Ranch | Pima County | Fee simple | 163.2 |
| Cienega Corridor | Pima County | Fee simple | 1,686.9 |
| Cienega Creek National Preserve | Pima County | Fee simple | 4,267.0 |
| Clyne Ranch | Pima County | Fee simple | 956.7 |
| Cochie Canyon | Pima County | Fee simple | 286.0 |
| Colossal Cave Mountain Park | Pima County | Fee simple | 780.7 |
| Dakota Wash | Pima County | Fee simple | 23.0 |
| Diamond Bell Ranch | State of Arizona | Grazing lease | 29,856.0 |
| Dos Picos | Pima County | Fee simple | 55.8 |
| Doucette | Pima County | Fee simple | 22.0 |
| Drainageway | Pima County | Fee simple | 292.5 |
| Drewes | Pima County | Fee simple | 9.8 |
| Elephant Head sec.15 mit. lands (Easely) | Pima County | Fee simple | 162.9 |
| Empirita Ranch | Pima County | Fee simple | 2,787.9 |
| Estates at Old Dpanish Trail | Property owner | Conservation easement | 98.3 |
| FLAP Properties (various locations) | Pima County | Fee simple | 1,805.6 |
| Hartman & Cortaro | Pima County | Fee simple | 49.0 |
| Heater | Pima County | Fee simple | 0.4 |
| Joshua Tree II | Pima County | Fee simple | 39.6 |
| King 98 Ranch | Pima County | Fee simple | 1,039.1 |
| King 98 Ranch | State of Arizona | Grazing lease | 3,291.1 |
| Linda Vista/Patrick Property | Pima County | Fee simple | 9.3 |
| Los Morteros | Pima County | Fee simple | 106.8 |
| Lower Santa Cruz Replenishment | Pima County | Fee simple | 104.6 |
| Madera Highlands | Pima County | Fee simple | 373.3 |
| Malcolmson Donation | Pima County | Fee simple | 73.8 |
| Marana Cottonwoods | Pima County | Fee simple | 72.5 |
| Marley | Pima County | Fee simple | 6,389.5 |
| Nunez | Pima County | Fee simple | 19.3 |
| Oracle Ridge | Pima County | Fee simple | 1,173.3 |

| Preserve | Owner | Land Tenure | Acres |
|---|---|---|---|
| Park | Pima County | Fee simple | 40.2 |
| Poteet | Pima County | Fee simple | 74.7 |
| Rancho Seco | Hooker Associates | Conservation easement | 477.1 |
| Rancho Seco | Pima County | Fee simple | 9,576.8 |
| Rancho Seco | State of Arizona | Grazing lease | 21,659.1 |
| Reid Property | Pima County | Conservation easement | 4.0 |
| Reid Property | Pima County | Fee simple | 3.3 |
| Ruddick | Pima County | Fee simple | 14.6 |
| San Domingo flood-prone area | Pima County | Fee simple | 14.0 |
| Sands Ranch | Pima County | Fee simple | 5,219.8 |
| Section 404 or Pima County riverine | Pima County | Fee simple | 728.7 |
| Segurson donation | The Nature Conservancy | Fee simple | 150.8 |
| Six Bar Ranch | Goff | Conservation easement | 40.0 |
| Six Bar Ranch | Pima County | Fee simple | 3,309.3 |
| Six Bar Ranch | State of Arizona | Grazing lease | 10,267.8 |
| Sopori Ranch | Pima County | Fee simple | 4,471.6 |
| Sopori Ranch | State of Arizona | Grazing lease | 10,935.4 |
| South Wilmot LLC | Pima County | Fee simple | 35.5 |
| Southeast Regional Park | Pima County | Fee simple | 52.8 |
| Starr Pass Resorts easements | Pima County | Conservation easement | 103.1 |
| Sweetwater Preserve | Pima County | Fee simple | 188.4 |
| Tang | Pima County | Fee simple | 40.1 |
| Tanque Verde & Houghton Partners LLC | Pima County | Fee simple | 77.7 |
| Tanque Verde Creek | Pima County | Fee simple | 216.6 |
| Terra Rancho Grande | Pima County | Fee simple | 72.1 |
| Tortolita Mountain Park | Pima County | Fee simple | 796.1 |
| Treehouse | Pima County | Fee simple | 6.3 |
| Trico | Pima County | Fee simple | 96.6 |
| Trico Marana | Pima County | Fee simple | 72.4 |
| Tucson Mountain Park biological corridor | Pima County | Fee simple | 9.9 |
| Tucson Mountain Park | Pima County | Fee simple | 2,437.6 |
| Tucson Mountain Park mitigation area | Pima County | Fee simple | 42.5 |
| Tucson Mountain Park, 36th Street corridor | Pima County | Fee simple | 228.7 |
| Tumamoc | Pima County | Fee simple | 277.0 |
| Wal-mart conservation easement | Pima County | Conservation easement | 0.9 |
| Walden | Pima County | Fee simple | 447.3 |
| Wexler property | Pima County | Fee simple | 15.2 |
| Total | | | 196,563 |

## Literature Cited

Fonseca, J. and C. Jones 2009. Progress report: Measuring effectiveness of open space land acquisitions in Pima County, Arizona in relation to the Sonoran Desert Conservation Plan. Available online: http://www.pima.gov/cmo/sdcp/reports/d52/Acquisition_Analysis.pdf is the link.

Pima County. 2011. Protecting our land, water, and heritage: Pima County's voter-supported conservation efforts. Available online: http://www.pima.gov/cmo/admin/Reports/ConservationReport/

## Appendix H. Generic ranch management agreement.

PIMA COUNTY
NATURAL RESOURCES, PARKS AND RECREATION DEPARTMENT
Ranch Management Agreement

This Ranch Management Agreement ("Agreement") is made by and between Pima County, by and through its Natural Resources, Parks and Recreation Department, a political subdivision of the State of Arizona ("County ") and XX Cattle Company, L.L.C. (a ficticious company to illustrate a generic ranch management agreement), an Arizona limited liability company ("Manager").

RECITALS

WHEREAS, County owns certain real property in Pima County, Arizona, more particularly described in Exhibit A (not attached to this appendix); and

WHEREAS, County acquired its interest in the Property in a transaction prior to or contemporaneous with the establishment of this Agreement; and

WHEREAS, County and Manager acknowledge that the Property currently remains in a relatively undisturbed, natural state, has ecological, open space, cultural and historic values, and provides natural habitat for native plants and wildlife (collectively the "Resource Values"); and

WHEREAS, the Property has historically been operated primarily as a livestock ranching operation and County is committed to property management as a sustainable ranching operation which fosters abundant and diverse native flora and fauna, clean air, clean water and stable soils, providing for potential economic return; and

WHEREAS, County and Manager share the goal of preserving the biological resources on the Property and permitting land uses that are compatible with the conservation of significant ecological values; and

WHEREAS, County and Manager are further interested in preserving the working ranching landscape in the County; and

WHEREAS, County has acknowledged its commitment to protecting and preserving natural areas, open space and working landscapes through the adoption of the Sonoran Desert Conservation Plan; and

WHEREAS, the voters of Pima County have endorsed implementation of the Sonoran Desert Conservation Plan by passage, at a special election held on May 18, 2004, of certain bond measures permitting the issuance of general obligation bonds to fund the acquisition of working landscape open space (see Questions 1, 2, and 4 of Pima County Ordinance 2004-18); and

WHEREAS, Manager is familiar with the Property and has experience with existing conditions of the Property; and

WHEREAS, this Management Agreement benefits the County by relieving it of the financial costs and burdens of physically managing and operating the Property using County employees;

NOW, THEREFORE, for valuable consideration, the receipt and sufficiency of which are hereby acknowledged by the parties, and in exchange of the mutual covenants, terms, conditions and restrictions contained herein, and pursuant to the law of the State of Arizona, the parties hereto agree as follows:

AGREEMENT

**1.** Description of the Property. Manager shall provide management services for the Property as identified in Exhibit A, and shall not be required to pay any fees to the County with respect to Manager's use, occupancy and management of the Property.

**2.** Term and Renewal. This Agreement shall be for a term of Fifteen (15) years and shall commence on the date the Agreement is certified by the Pima County Clerk of the Board. County and Manager shall have the option to extend the term of this Agreement for two additional five (5) year periods, upon mutual written agreement.

**3.** Management Objectives.

3.1. Manager shall use the Property subject to the terms and conditions of this Agreement and shall exercise commercially reasonable efforts to use the Property in accordance with County's resource management objectives (the "Management Objectives") listed below in the order of priority:

3.1.1. Protect, preserve, and enhance natural plant and wildlife communities of the Property
3.1.2. Rehabilitate degraded vegetation and wildlife habitats where possible and economically feasible
3.1.3. Manage wildfire hazards to the Property and adjoining private and public lands by managing vegetative fuels
3.1.4. Make judicial use of water resources associated with the Property
3.1.5. Provide for the safety of Manager's invited and noticed visitors to the Property
3.1.6. Report the occurrence of identified adverse resource impacts resulting from undocumented immigrant travel and associated law enforcement activities

3.2. County and Manager mutually agree that the provisions of this Agreement shall be interpreted conservatively so as to ensure that natural resource management and protection of Resource Values take precedence over grazing and revenue generation. Notwithstanding any other provision of this Agreement, the County shall have the right, in its reasonable discretion, to

limit or exclude grazing on portions of the Property from time to time, and for any period of time, so long as the reduction is justified using commonly acceptable range management principles.

**4.** Resource Management Plan

4.1. Drafting Plan. Manager agrees to comply with the terms and conditions of a Coordinated Resource Management Plan (the "Management Plan") to be developed cooperatively between County and Manager with the assistance of state and Federal natural resource management agencies. Such Management Plan shall include, but not be limited to, a livestock grazing plan, access plan, natural resource and biological resource protection plan, and any other elements necessary to protect the Resource Values and achieve the County's Management Objectives for the Property. Upon the execution of this Management Agreement, County and Manager shall meet and review any existing grazing and management plans. County may, in its reasonable discretion, request changes or alterations in those plans for resource protection purposes. County shall have discretionary authority to approve and adopt the final Management Plan. The Management Plan shall, by this reference, be incorporated and adopted herein.

4.2. Annual Resource Condition Assessment. County and Manager shall meet at least annually to evaluate the Property's resource conditions to determine whether the Management Plan is appropriate for existing conditions or needs to be modified. Should the County require a modification to the Management Plan, including but not limited to the exclusion of grazing from all or certain areas of the Property the County and Manager may consult with other natural resource agency representatives if the Manager does not concur with such a requirement. The parties may agree to a compromise based on that consultation, although County shall retain, in its sole discretion, the right to limit or exclude grazing from certain areas of the Property. If the Management Plan is changed, the County shall give Manager written notice of the change and the time required for the removal of the livestock.

**5.** Use of Property.

5.1. Cattle Grazing. Manager may use the Property for open pasture cattle grazing and associated ranching and related operations, including the use and grazing of horses used in such ranching operations, in accordance with the Management Plan. Cattle grazing shall be limited to cattle, and shall not include other livestock such as sheep, horses, llamas or exotic breeds on the property without the express written permission of the County. Manager shall be permitted to pasture horses in specific areas agreed to by the County and for durations and during times of the year that do not result in adverse impacts on the Resource Values.

5.2. Associated Activities. Manager may also use the Property for all activities normally associated with ranching operations, in accordance with the Management Plan.

5.3. No warranties or representations. County makes no warranties or representations to Manager as to the suitability of the Property for grazing.

5.4. Use consistent with County's rights. Manager understands and agrees that the Property shall be managed and operated in such a manner as to protect the biological resources of the Property and the possibility exists that such management objectives and natural conditions may limit, restrict, or otherwise impact the location and number of cattle permitted to graze on the Property. Manager further understands and agrees that Manager's use of the Property shall be consistent with the mission of the Sonoran Desert Conservation Plan, the conditions of the 2004 Bond measure and any amendments and the Management Objectives set out herein. Manager further understands and agrees that Manager's use is subject to County's primary rights to operate the Property for the benefit of the public and the public interest.

5.5. No other Uses. Any other uses of the Property are subject to the prior written approval of the County, not to be unreasonably withheld, conditioned or delayed.

5.6. Damage and Repairs. Manager shall be responsible for damage to the Property or its Resource Values caused by its intentional, reckless, or negligent conduct, or the intentional, reckless, or negligent conduct of its agents, employees or contractors. Manager shall not be responsible for repairing any damages caused by the negligence of the County or its agents, employees or contractors, unless Manager shares responsibility for that damage, in which event Manager shall be responsible for the proportion of damages that were caused by Manager. In the event of damage caused by third parties, Manager shall be responsible only for repairing damage to the ranching infrastructure on the portion of the Property that Manager is using to conduct its ranching operations.

**6.** Grant Projects.

6.1. County agrees to cooperate as a participating agency for any grant applications Manager might seek for the Property that enhance the Property's Resource Values or advances the County's Management Objectives, provided:

6.1.1. Manager obtains prior approval of the County Administrator and Board of Supervisors for the grant application.

6.1.2. Manager agrees to be bound by the terms and conditions of the grant agreement if awarded.

6.1.3. Manager shall not be permitted to assert as in-kind matches labor, resources, or other assets of the County without the County's prior written approval for such assertion.

6.1.4. Manager retains all obligations and assumes any liability that may be incurred as a result of an early termination of this Agreement by Manager.

6.2. Manager agrees to reasonably cooperate with County, at no cost to Manager, for any grant applications County might make with respect to the Property.

**7.** Repair and Maintenance of Improvements

7.1. Repairs and Improvements. Manager shall keep all improvements on the Property used by Manager (other than roads) in functional condition, suitable for the purpose(s) for which they have been installed, including corrals, fencing, water storage tanks, water lines, wells, pumps, and pressure systems. Manager shall keep all roads on the Property in the condition in which they exist as of the date hereof, unless Manager elects to maintain and improve the roads under Section 7.2. below. Manager alone shall bear the cost for any and all repair and maintenance work related to improvements and facilities needed for Manager's ranching operation on the Property. County shall not be obligated to make any improvements or repairs to the Property whatsoever and County shall not be entitled to require Manager to make any improvements upon the Property whatsoever or repairs to any currently inoperative or obsolete facilities or equipment upon the Property whatsoever. All improvements and major repairs shall be approved by the County at the initial planning stage, which approval shall not be unreasonably withheld, conditioned or delayed.

7.2. New structures or roads. Manager shall not construct any new structures or roads on the Property without the prior written approval of the County (not to be unreasonably withheld, conditioned or delayed) as to site location and design. Manager may be required to seek cultural resource clearance of the location before engaging in any earth moving activity. Manager shall comply with all applicable Federal, state and local building codes and ordinances for any structure or road constructed on the Property by Manager. All costs for any such construction shall be borne solely by the Manager. Manager shall be permitted but is not required to maintain existing roads, at Manager's sole expense, including grading, filling, and otherwise maintaining the roads in passable condition. Such permission does not include paving any roads on the Property without the prior written approval of the County.

7.3. Garbage and Waste. Manager shall arrange for the storage and disposal of all garbage and waste materials according to applicable law at its sole cost and expense. Manager shall remove garbage, trash and non-toxic or

hazardous waste to a legal dumpsite no less than twice a year. Manager shall be responsible for handling and disposing of garbage and waste in such a manner as to prevent the production of offensive odors and the attraction of rodents and other vermin. Manager shall not use existing dumpsites on the property for permanent waste disposal.

7.4. Hazardous Wastes. All toxic and hazardous materials resulting from Manager's operations under this Agreement shall be removed to a legal dumpsite off the Property at Manager's sole cost and expense. Manager, at Manager's sole cost and expense, shall remedy any hazardous or potentially hazardous condition occurring on or after the effective date of this Agreement by or under the direction of Manager within 30 calendar days of written or oral notice by County's officers, agents or employees or by any Federal, state, or local regulatory agency having jurisdiction (or if more than 30 days are required to complete such remedy, such additional amount of time as may be reasonably necessary, so long as Manager commences the remedy within the initial 30-day period and maintains a reasonable completion schedule). At the discretion of County's officers, agents or employees, Manager shall stop work or any activities related to the hazardous materials that create a hazardous or potentially hazardous condition until Manager cures such hazardous or potentially hazardous condition. As used in this Agreement, the term "Hazardous Material" shall mean any substance or material which has been determined by any state, Federal or local governmental authority to be capable of posing a risk of injury to health, safety and property including all of those materials and substances designated as hazardous or toxic by any other governmental agency now or hereafter authorized to regulate materials and substances in the environment.

**8.** Utilities. Manager shall contract directly with the appropriate public utility for all water, gas, electricity, portable phones or telephone service, garbage, and sewage, or other utility or service furnished to or used by Manager in its discretion during the term of this Agreement at Manager's sole cost and expense. Manager shall indemnify and hold harmless County from and against any charge for the installation, connection, maintenance, and furnishing of all utilities, meters and services required by Manager. Manager shall provide for the extension of any utility service or distribution lines (water, gas, electricity, portable or telephone, garbage, sewage, or other) that are required to serve the Property at Manager's sole cost and expense. Manager shall comply with all applicable government mandated water and energy conservation programs in fulfilling its obligations of this Agreement. In the event the installation of utilities shall involve any earth disturbing or view shed impacts, Manager shall first obtain County's approval for such activities, which approval shall not be unreasonably withheld, conditioned or delayed. County shall not be liable for any damages resulting from any failure to furnish or delay in furnishing any utility service, whether water, gas, electricity, portable or-telephone, garbage, sewage or other.

**9.** Vehicle Travel. Manager's trucks, or other approved vehicles, shall be used in a manner which is consistent with the Management Plan. Only such off-road travel shall be allowed as reasonably necessary to conduct ranch operations. Travel through washes with wheeled, motorized vehicles shall be restricted to essential needs for ranch operations.

**10.** Managers Acceptance Of Property. Manager and County each hereby accepts the buildings, improvements, and any equipment on the Property in their existing condition. No representation, statement, or warranty (express or implied) has been made by or on behalf of County or Manager as to such condition or as to the use that may be made of such property. In no event shall County be liable for any defect in such property or for any limitation on its use.

**11.** Cattle, Ranch Equipment and Personal Property. Manager shall provide any and all equipment and personal property, including tools, machinery, and supplies necessary for the ranching activities authorized under this Agreement. Manager shall be responsible for the cost of repairing or replacing all such items as needed. County shall not assume responsibility for any damage or cost or expenses to Manager's ranch equipment or personal property incurred during activities on the Property.

**12.** Prohibited Uses.

12.1. Natural Resources. Except as specifically permitted hereunder, Manager is strictly prohibited from removing any trees, cacti, shrubs, gravel, rock, sand, minerals or cultural artifacts from the Property. Manager shall disturb no wildlife habitat, biologic, cultural, geologic, scenic, historical or archaeological site or resource, commit no waste of any kind, nor in any manner substantially change the contour or condition of the Property. Subject to the intent and limitations of this Section 12, Manager shall be permitted to use sand and gravel from the Property at locations on the Property approved by the County, in quantities reasonably necessary to enable Manager to maintain roads and corrals on the Property; provided Manager complies with all applicable laws and regulations.

12.2. Noise. Manager shall not install, use, or permit the installation or use upon the Property of any public address equipment, television equipment, radio, loudspeaker, or other equipment or device producing noises that can be heard outside the immediate area of the Ranch headquarters/residence area except as reasonably necessary to conduct ranch operations and maintenance. This shall not be deemed to prohibit the use of equipment that is necessary to fix ranch equipment or improvements on the property, provided that the noise is minimized to the extent reasonably possible.

12.3. Water Pollution. Manager shall comply promptly with any regulations, conditions, or instructions affecting the activity authorized if and when issued by Federal, state, interstate or local government water pollution control

agency having jurisdiction to abate or prevent water pollution. Manager shall not discharge any substances which will contaminate streams or other bodies of water or otherwise become a public nuisance. Such regulations, conditions or instructions in effect or prescribed by the Federal, state or local government or contained herein are made a condition of this Agreement. Such prohibition does not pertain to controlling cattle waste in streams, streambeds or watercourses, or bodies of water, unless water quality measures have been taken or installed to prevent cattle from entry into such streams, streambeds, water courses, ponds or water bodies.

12.4. No Explosives. Manager's use of explosives on the Property is strictly prohibited.

12.5. Hunting. Manager shall not post any of the Property against public entry for hunting without prior written approval of County. Predator control activities on the Property shall be approved by the County prior to any actions being taken by Manager.

**13.** Water Rights.

13.1. Permitted Uses of Water. Manager may, at its own cost and expense, utilize water from the Property to the extent permitted by law and by County's water rights associated with the Property, including, without limitation, water from [select] resources. County assumes no responsibility to Manager for any water shortage from the source or sources of water or from any source whatsoever; nor does County warrant the quality or quantity of water obtained from any source.

13.2. Water Limited to Cattle Ranching. Use of water by Manager shall be limited to the amount required to operate its cattle ranching operation consistent with ranch management purposes hereunder utilizing conservation standards and methodologies.

13.3. Water Testing. County reserves the right to enter the Property at regular intervals to test the quality of the water and, farther, to curtail use of potable water by Manager from wells or springs on the Property in the event the water exceeds contaminant level standards established by the Arizona Department of Environmental Quality.

**14.** Right Of Entry.

14.1. General. County reserves the right during the term of this Agreement to enter the Property at any reasonable time or times, for the purpose of inspection, consultation with Manager, making repairs or improvements, water quality testing, posting notices and for all other lawful purposes.

14.2. Resource Management. County and its designees shall have the right to enter the Property for the purpose of monitoring or conducting research on

the Resource Values on the Property. Such entry by County shall not interfere with Manager in carrying out regular grazing operations that Manager has the right to perform under the terms of this Agreement.

14.3. Prior Notice. County shall, whenever feasible, provide Manager with two (2) business day's notice of its intent to enter any residences upon the Property. Such notice shall be given to Manager at the numbers and/or address identified below in Section 26.7.

14.4. Public Access. Manager may not post No Trespassing signage on County lands or block access to property or adjacent public lands without prior written permission of the County.

**15.** Native Plants and Cultural Resources. Manager shall comply with the provisions of the Arizona Native Plant Law (A.R.S. § 3-901 et seq. or any successor statutes) and with Arizona laws relating to archaeological discoveries (A.R.S. § 41-841 et seq. or any successor statutes). Manager shall not disturb any cacti or other protected native plants nor disturb any ruins, burial grounds or other archaeological sites.

**16.** Undocumented Immigrants and Squatters. Within a reasonable period of time Manager is encouraged to provide the County with information on undocumented immigrant and associated law enforcement activity on the Property, as well as off-road vehicle travel, trash accumulation, abandoned vehicles, wildcat dumping and the existence of squatters, particularly where Resource Values are being adversely impacted. In no event is Manager responsible for remedying any such impacts, although Manager and the County may consult and agree to mutually acceptable remediation or mitigation methods.

**17.** Mining Activity. Manager shall report to the County any change in activity level, location or other notable conduct by mining claimants on the Property. Manager is not obligated to take any action or contact mining claimants for any reason pursuant to this provision.

**18.** Taxes.

18.1. Obligation for Taxes. Manager shall pay before delinquent all personal property taxes, assessments and fees levied on Manager by reason of its operations on the Property pursuant to this Agreement.

18.2. Contest of Tax. If Manager wishes to contest or review by appropriate legal or administrative proceedings any tax or other charge specified under the provisions of this Section in good faith, Manager shall give County written notice of its intent to do so at least ten (10) calendar days before the delinquency of such tax or charge, or within the applicable time period allowed by law. Manager may withhold payment of the tax being contested only if nonpayment is allowed during the pendency of such proceedings without the foreclosure of any tax lien or the imposition of any fine or penalty. The failure to pay any tax or charge within forty-five (45) calendar

days of Manager's receipt of written notification of the amount due shall constitute default, and the obligation to pay the same shall survive the end of this Agreement.

18.3. Tax Indemnification. Manager agrees to indemnify and hold harmless County, and County's officers, agents and employees from and against any liability, loss, or damage resulting from such contest or proceeding or from any tax or charge required to be paid by Manager, from any other sums imposed thereon, and from any proceedings to enforce the collection of any tax or charge for which Manager may be liable. Manager shall not permit any lien to attach to its interest in the Property or in this Agreement.

**19.** Indemnity and Hold Harmless.

19.1. County not Liable. County shall not be liable at any time for loss, damages, or injury to the person or property of any person at any time, arising directly or indirectly out of (i) any act of Manager or of anyone holding under Manager; (ii) the occupancy or use of the Property by the Manager; or (iii) any adverse and unsatisfactory state or condition of the Property caused by Manager's livestock grazing and ranching operations during the term of this Agreement. County shall not be liable for any loss of profits or business opportunity losses that Manager may incur for any reason, including interruption of business or termination of this Agreement.

19.2. Indemnification of County. The Manager shall indemnify, defend, and hold harmless the County, its officers, agents and employees from any claim, liability, loss, or damage arising out of, or in connection with, performance of ranching operations upon the Property under this Agreement by Manager, its agents, employees, or subcontractors, except to the extent that such claim, liability, loss, or damage was caused by the negligent or intentionally wrongful acts or omissions of personnel employed or contracted by the County, or by any activities on the Property of the general public. The foregoing indemnification obligation shall survive the termination of this Agreement.

19.3. Indemnification of Manager. County shall indemnify, defend and hold harmless the Manager, its officers, agents and employees from any claim, liability, loss, or damage, to the extent suffered or incurred by Manager as a direct result of a negligent or wrongful act of the County or personnel employed or contracted by the County. The foregoing indemnification obligation shall survive the termination of this Agreement.

**20.** Insurance.

20.1. Insurance Coverage. Manager shall maintain the following insurance during the term of this Agreement:

20.1.1. Commercial General Liability. Coverage shall be at least as broad as ISO form CG 00 01 in an amount not less than $2,000,000.00, covering the Property, endorsed to include County as an additional insured with coverage at least as broad as ISO form CG 20 10.

20.1.2. Commercial General Automobile Liability. Coverage shall be at least as broad as ISO form CA 00 01 in an amount not less than $1,000,000.00 for vehicles actually used in the operations at the Property (as compared to used for simple commuting).

20.1.3. Workers' Compensation. Statutory limits, with Employers' Liability coverage in an amount not less than $1,000,000.00 per injury, illness, or disease.

20.2. Changes to Insurance Requirements. County retains the right to reasonably increase the limits or types of coverage from time to time as determined in the best interests of County by Pima County Risk Management.

20.3. Injury Reports. Manager shall provide to County a report listing any incident involving injury to persons or damage to property occurring at the Property within two (2) business days of any such incident. If any such injury to persons requires emergency medical treatment, Party shall contact County within one (1) business day of such incident. County shall have the right to investigate any incident involving injury to persons or property occurring at the Property and Party shall provide County with all information available to Party about such incident.

20.4. Insurance Certificates. Manager shall provide County with current certificates of insurance which shall show County as an additional insured where required. All certificates of insurance must provide for guaranteed thirty (30) days written notice of cancellation, non-renewal or material change.

20.5. Waiver of Subrogation. Each party waives its claims and subrogation rights against the other for losses typically covered by property insurance coverage.

**21.** Manager not an Employee or Agent. It is understood and agreed that Manager, in the performance of this Agreement, is not an agent or employee of County, and that this Agreement is not intended to and shall not be construed to create the relationship of agent, servant, employee, partnership, joint venture, or association. No participant or applicant for participation in Manager's grazing operation, no officer or employee of Manager, no person engaged by Manager to administer or operate its grazing operation shall be construed to be an employee of County for any purpose, including tort claims. Nor shall any person obtain any right to employment, retirement, or other benefits that accrue to employees or officers of the County.

**22.** Assignment or Sublicense. Manager shall not assign this Agreement or any interest in it, nor allow any person other than Manager and its agents, contractors and employees to occupy or use any part of the Property, without first obtaining County's written consent, not to be unreasonably withheld, conditioned or delayed. Manager shall fully disclose to County the qualifications, experience, and financial ability of any proposed assignee/submanager for such an assignment or sublicense ("the Consent Disclosure"). Manager acknowledges that it has been selected to manage the Property due to its unique qualifications, and that County may reasonably withhold its consent to a proposed assignment or sublicense. County's consent to one assignment, sublicense, or use shall not be consent to any subsequent assignment, sublicense, occupancy, or use by another person. Any unauthorized assignment or sublicense shall be void. Manager's interest is not assignable by operation of law without County's written consent. If Manager requests the County's consent to an assignment or subcontract, the County shall deliver any objections in writing to Manager within thirty (30) days after receipt of Manager's written request for consent (the "Consent Request"). The Consent Request shall include the Consent Disclosure. If the County does not disapprove of the proposed assignment or subcontract within that thirty (30) day period, then the matter shall be placed on the next available Board of Supervisor's agenda (based on the normal deadline for submittal of agenda items) for consideration.

**23.** Default.

23.1. Default. If Manager violates any of the terms and conditions of this Agreement, County may give Manager written notice of the specific violation.

23.2. Termination for Default. If, within sixty (60) days after written notice of the violation, Manager has failed to commence corrective action or shown acceptable reason therefor, County has the right immediately, or at any time thereafter prior to any cure by Manager, to terminate this Agreement, take back possession of the Property (including all buildings and improvements thereon), and pursue all remedies legally available.

23.3. Liability for Breach. Termination for default shall not excuse Manager from any liability for damages for breach of contract, but in no event shall Manager be liable for special, consequential or punitive damages.

23.4. Entry for Mitigation. In the event County reasonably determines that activities or actions by Manager have adversely impacted the Property, its improvements, or its Resource Values, County shall, in addition to its right to declare Manager in default and terminate this Agreement, as provided above, be entitled to enter the Property for the purpose of mitigating damages and recover from Manager the cost of such Manager-caused damage and corrective action.

**24.** Restoration and Surrender of Premises.

24.1. Vacating Property. Upon expiration or earlier termination of this Agreement for any reason, Manager shall vacate the Property and surrender peaceable possession of it to the County. Manager shall promptly remove its personal property, and repair any damage or injury to the Property or to any of its buildings, structures, or improvements and restore the Property to the condition as existed when Manager first took possession of the Property under this Agreement, reasonable wear and tear and casualty damage excepted. Continued possession and use of the Property by the Manager is prohibited and shall be deemed a trespass for which County may seek all appropriate civil and criminal remedies.

24.2. Personal Property. If an early termination occurs, for any of the reasons set forth in Section 25 below, Manager shall remove all personal property and livestock from the Property as soon as practicable but in no event later than sixty (60) calendar days after notice of the termination (unless County extends this time period, in writing). If Manager fails to remove all personal property and livestock within the time specified, County may, at its sole discretion, take possession of the personal property and livestock and offer the property and livestock for sale at public auction, or otherwise dispose of the property and livestock according to applicable law.

**25.** Termination. This Agreement may be terminated early as follows: (1) by either party upon a default of any covenant or term hereof by the other party pursuant to Section 23 above; (2) for conflict of interest as provided in Section 26.15; (3) for non-appropriation of funds pursuant to Section 26.17; (4) by Manager for any reason or for no reason and Manager shall thereafter be fully relieved and released of and from all future duties and responsibilities under this Agreement, for no payment of consideration of any kind to or from County or Manager (this shall not be deemed to relieve Manager of any liability for past acts); and (5) by County if it determines in its reasonable discretion that the Management Objectives of the Property will be adversely impacted by continuation of the Agreement and upon the approval of the County Board of Supervisors. If the County determines to terminate this Agreement under option (5) above, the County shall first contact the Manager in writing describing the reason for the contemplated termination and shall then meet with Manager to determine if the parties can find a mutually acceptable means to eliminate the adverse impact to the Management Objectives without terminating the Management Agreement.

**26.** Miscellaneous.

26.1. Attorney's Fees. If either party brings any action or proceeding in court to enforce any provision of this Agreement or for damages because of an alleged breach of any provision of this Agreement (except as may otherwise be specified in this Agreement), the prevailing party shall be entitled to receive from the losing party the amount the court determines to be reasonable attorney's fees for the prevailing party.

26.2. Binding Effect. The covenants and agreements contained in this Agreement shall bind the respective successors, assigns, heirs, and legal representatives of the parties.

26.3. Non-discrimination. Both parties shall comply with State Executive Order 99-4, if applicable, and all other applicable Federal and state laws, rules and regulations, including the Americans with Disability Act.

26.4. Entire Agreement. This Agreement and any attached exhibits or addendum set forth all covenants, agreements, conditions, and understandings between County and Manager concerning the Property. There are no covenants, agreements, conditions, or understandings, either oral or written, between the parties other than those set forth in the Agreement.

26.5. Compliance With Law. At Manager's sole cost and expense and before the start of permitted activities, Manager shall comply with all applicable Federal, state, county or municipal statutes, ordinances, regulations, orders, or directives of a governmental agency, as such statutes, ordinances, regulations, orders, or directives now exist or may later provide, concerning the use and safety of the Property. Manager shall obtain all permits which may be required by public agencies, including, but not limited to, the United States Army Corps of Engineers, Arizona State Land Department, and Arizona Game and Fish Department, having jurisdiction over the activities of Manager and comply with all conditions and requirements set forth in the permits issued by such agencies. Manager's failure to procure any such permit or comply with any such regulation or law shall be a default under this Agreement (one which cannot be "cured" pursuant to Section 23).

26.6. Modification. Provisions of this Agreement may be modified, waived, or added to only by an instrument in writing signed by both parties.

26.7. Notices. Notices relating to this Agreement or under the unlawful detainer statutes of Arizona shall be in writing and shall be delivered personally, sent by United States mail, first class postage prepaid, facsimile, electronic mail, or by private messenger or courier service to the addresses below:

Any change in address shall be communicated by written notice to the other party and delivered according to this section. A communication by any method permitted under this section shall be effective when actually received.

26.8. Personal Liability. No personal liability shall attach to any County officer or employee for any financial obligation to be performed under this Agreement.

26.9. Remedies Cumulative. All remedies conferred on County and Manager by this Agreement and by law shall be deemed cumulative, and no one remedy shall be deemed to be exclusive of the other or of any other remedy conferred by this Agreement or by law.

26.10. Severability. If any provision of this Agreement or any specific application shall be deemed to be invalid or unenforceable, the remainder of this Agreement or the application of the provision in other circumstances shall not be affected, and each provision of this Agreement shall be valid and enforceable to the fullest extent permitted by law.

26.11. Surrender of Property. No act by County, its elected officials, officers, agents, or employees during the term of this Agreement shall be deemed an acceptance of a surrender of the Property.

26.12. Text to Prevail Over Headings. The captions and section headings appearing in this Agreement are included for convenience only and do not in any way limit or amplify the terms or provisions of this Agreement.

26.13. Waiver. Waiver by County or Manager of any breach of any term, covenant or condition shall not be deemed to waive the same term, covenant or condition on a future occasion. Neither County nor Manager shall waive any covenant, term, or condition of this Agreement unless the waiver is in writing and signed by the party making the waiver.

26.14. Conflict of Interest. This Agreement is subject to cancellation pursuant to A.R.S. Section 38-511.

26.15. Limitations. Nothing in this Agreement shall be construed as limiting or expanding the statutory responsibilities of County in performing functions beyond those granted to it by law or as requiring County to expend any sums in excess of its appropriations.

26.16. Non-Availability of Funds. This Agreement shall be subject to available funding, and nothing in this Agreement shall bind County to expenditures in excess of funds authorized by the Pima County Board of Supervisors for purposes outlined in this Agreement. This Agreement may be terminated if for any reason, there are not sufficient appropriated and available monies for the purpose of maintaining the County's obligations under this Agreement. In the event of such termination the County shall have no further obligation whatsoever to Manager and Manager shall have no further obligation whatsoever to the County, except for the indemnities which are specifically stated herein to survive termination hereof.

26.17. Landlord Tenant Act not Applicable. This Agreement is for the provision of management and operation services by Manager to County and is not subject to the provisions of the Arizona Landlord Tenant Act, A.R.S. Section 33-301 et seq.

26.18. Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed an original. This Agreement may be executed and delivered by a facsimile transmission of a counterpart signature page hereof

26.19. Legal Arizona Workers Act Compliance.

26.19.1. Manager hereby warrants that it will at all times during the term of this Contract comply with all Federal immigration laws applicable to Manager's employment of its employees, and with the requirements of A.R.S. § 23-214 (A) (together the "State and Federal Immigration Laws"). Manager shall further ensure that each subcontractor who performs any work for Manager under this contract likewise complies with the State and Federal Immigration Laws.

26.19.2. County shall have the right at any time to inspect the books and records of Manager and any subcontractor in order to verify such party's compliance with the State and Federal Immigration Laws.

26.19.3. Any breach of Manager's or any subcontractor's warranty of compliance with the State and Federal Immigration Laws, or of any other provision of this section, shall be deemed to be a material breach of this Contract subjecting Manager to penalties up to and including suspension or termination of this Contract. If the breach is by a subcontractor, and the subcontract is suspended or terminated as a result, Manager shall be required to take such steps as may be necessary to either self-perform the services that would have been provided under the subcontract or retain a replacement subcontractor, (subject to County approval if MWBE preferences apply) as soon as possible so as not to delay project completion.

26.19.4. Manager shall advise each subcontractor of County's rights, and the subcontractor's obligations, under this Article by including a provision in each subcontract substantially in the following form:

"Manager hereby warrants that it will at all times during the term of this contract comply with all Federal immigration laws applicable to Manager's employees, and with the requirements of A.R.S. § 23-214 (A). Manager further agrees that County may inspect the Manager's books and records to insure that Manager is in compliance with these requirements. Any breach of this section by Manager will be deemed to be a material breach of this contract subjecting Manager to penalties up to and including suspension or termination of this contract."

26.19.5. Any additional costs attributable directly or indirectly to remedial action under this Article 27.19 shall be the responsibility of Manager.

26.20. Scrutinized Business Operations. Pursuant to A.R.S. § 35-397, Manager hereby certifies that it does not have scrutinized business operations in Iran or Sudan. The submission of a false certification

by contractor may result in action up to and including termination of this Agreement.

# Appendix I. Draft Conservation Easement for Mitigation Land Owned in Fee Simple by Pima County or Pima County Regional Flood Control District. This particular version is drafted for County-owned land, and would need to be adapted for use on District-owned land.

MITIGATION LAND CONSERVATION EASEMENT

THIS CONSERVATION EASEMENT is made this ____ day of _____, 2011, by Pima County, ("Grantor"), in favor of Pima District Regional Flood Control District, a political subdivision of the State of Arizona, ("District" or "Grantee") (collectively, the "Parties"), pursuant to A.R.S. § 33-271, et. seq.

In consideration of the mutual covenants contained herein, Grantor hereby voluntarily grants and transfers to District a conservation easement (the "Easement"), in perpetuity, over and across the property described in **Exhibit A** (the "Property"), which Easement shall run with the land and shall bind the Grantor and District in perpetuity, subject to the terms and conditions contained herein. Further, as a part of this Easement, Grantor hereby transfers to District all rights (except as specifically reserved herein) that are now or hereafter allocated to, implied, reserved or inherent in the Property, and the Parties agree that such rights are terminated and extinguished, and may not be used on or transferred to any portion of the Property as it is now or hereafter may be bounded or described, or to any other property adjacent or otherwise, nor used for the purpose of calculating permissible residential density or development intensity of the Property or any other property.

1. PURPOSE. The Parties agree that it is the purpose of this Easement to: (i) assure that the Property will be preserved forever in its predominantly open, scenic, undeveloped and natural condition; (ii) prevent any uses of the Property that will significantly impair or interfere with the areas of biological, ecological, hydrological or geological importance (the "Conservation Values") of the Property; (iii) conserve habitat for wildlife; (iv) protect rare and unique native plants and animals currently known or later identified; and (v) promote the conservation purposes stated in A.R. S. § 33-271(2).

2. RIGHTS OF DISTRICT. Grantor hereby grants the following rights to District:

2.1 To identify, preserve, protect and monitor, in perpetuity, the Conservation Values of the Property;

2.2 To prevent Grantor or third persons from conducting any activity on or use of the Property that is prohibited or inconsistent with this Easement;

2.3 To enter upon the Property for administrative purposes, provided that such entry shall be upon seven (7) days written notice to Grantor, and District shall not in any case unreasonably interfere with Grantor's use and quiet enjoyment of the Property;

2.4 Upon thirty (30) days written notice to Grantor, and subject to Grantor's approval, which shall be in Grantor's sole discretion, District or other educational or research agencies and institutions may enter upon the Property to engage in ecological, geological and/or archeological studies, research and special projects, provided that District shall not unreasonably interfere with Grantor's use and quiet enjoyment of the Property;

To enter upon the Property at any time during the term of this Conservation Easement under emergency circumstances to prevent an imminent breach of the terms of this Easement or, in District's sole discretion, to prevent damage to or destruction of the Conservation Values.

3. [reserved for right to exchange for value upon agreement of the parties and 3rd party beneficiary]

4. PROHIBITED ACTIVITIES. The following activities and uses are expressly prohibited:

4.1 Development of the Property, including subdivision or lot splitting of the Property.

4.2 Constructing or placing of any additional buildings or structures, except construction of additional agricultural outbuildings or recreational development, as might be provided elsewhere in this Easement.

4.3 Surface alteration or natural vegetation alteration other than that necessary to retain, restore or enhance the Property’s Conservation Values as defined herein.

4.4 Severing of surface or subsurface water rights associated with the Property, including the transfer, encumbrance, lease and sale of water rights, except where severance of such water rights does not diminish the Conservation Values as defined herein.

4.5 Manipulating, impounding or altering any natural watercourse, except as may be necessary to retain, restore or enhance the Conservation Values as defined herein.

4.6 Development of, or the granting of rights-of -way, access or easements for new roads, except as might be provided elsewhere in this Easement.

4.7 Development of, or the granting of rights-of-way, access or easements for new utilities, including telecommunications facilities, except where environmental analysis adequately demonstrates that allowing such activities is not harmful to the Conservation Values of the Property. Review of such environmental analyses and final determination as to the harmful nature of such impacts is granted solely to Grantee.

4.8 Filling, excavating, dredging, mining, drilling, exploration, or extraction of minerals, hydrocarbons, soils, sand, gravel, rock or other materials on or below the surface of the Property, except as except as may be necessary to retain, restore or enhance the Conservation Values as defined herein.

4.9 The storage, dumping, accumulation or disposal of toxic and/or hazardous materials, trash, garbage, solid waste or other unsightly material on the Property.

4.10 The introduction of non-native fish or amphibians or other non-native organisms to or from catchments, tanks, springs or creeks.

4.11 The introduction of non-native species of noxious or aggressive character that might adversely affect the Conservation Values of the Property.

4.12 Storage and use of biocides and chemical fertilizers except for residential and agricultural purposes that may be provided for herein. Aerial application of biocide or other chemicals is prohibited except where Grantor and Grantee concur that it is an appropriate and necessary management technique to promote the recovery or reestablishment of native species or to reduce threats to ecosystem structure and function.

4.13 Pumping of surface or subsurface water from existing diversions for other than on-site residential, wildlife, recreational, habitat enhancement and agricultural uses associated with livestock grazing on the Property as provided for herein. Increases in the amount of surface or subsurface water per pump shall not be permitted without joint approval from Grantor and Grantee.

4.14 Construction of new water diversions that divert surface or subsurface water from any spring or watercourse, except as may be necessary to retain, restore or enhance the Conservation Values as defined herein.

4.15 Planting non-native, invasive plant species. Planting of such vegetative species is permissible only for the purposes of supporting existing ranching operations, if any, and will be limited to those areas identified herein that have historically been devoted to the growing of such species.

4.16 Installation of underground storage tanks for petroleum or other polluting substances, except those already existing or permitted septic tanks.

4.17 Confinement of livestock where animals are permanently located in enclosures and the majority of their feed supplied from outside sources. This includes but is not limited to feeder cattle, dairy, pig, poultry and exotic animal farm operations.

4.18 Commercial enterprises inconsistent with protection of the Property's Conservation Values, excluding farming and ranching as provided herein. Commercial enterprises, other than farming or ranching, that provide for ecotourism or wildlife-related recreation may be approved subject to the joint consent of Grantor and Grantee.

4.19 Use of the Property to provide temporary residential space for mobile homes, travel trailers, tent trailers, self-propelled recreational vehicles and like structures or vehicles, except as needed to protect the Conservation Values.

4.20 Any paving of roads using asphalt or concrete except where required by County ordinance.

4.21 Any modification of the topography of the Property through the placement thereon of soil, dredging spoils, or other material, except for those uses permitted under this Easement.

4.22 Off-road vehicular travel except as reasonably necessary to facilitate permitted activities on the Property.

5. DEFAULT AND REMEDIES.

5.1 If District determines that Grantor is in breach of the terms of this Easement, District shall give written notice to Grantor of such breach and demand corrective action sufficient to cure the breach and, where the breach involves injury to the Property resulting from any activity inconsistent with the purpose of this Easement, to restore the portion of the Property so injured. If Grantor fails to cure the breach within thirty (30) days after receipt of such notice, or under circumstances where the breach cannot reasonably be cured within a thirty (30) day period, fails to begin curing such breach within the thirty (30) day period, or fails to continue diligently to cure such breach until finally cured, then the District may bring an action at law or in equity in a court of competent jurisdiction to enforce the terms of this Easement, to enjoin the breach by temporary or permanent injunction, to recover any damages to which it may be entitled for breach of the terms of this Easement or injury to any protected uses or Conservation Values, including damages for any loss thereof, and to require the restoration of the Property to the condition that existed prior to any such injury. If upon receipt of notice from the District the Grantor fails to cease the activity which caused the breach, the District may bring immediate action at law or equity to enjoin the breach by temporary or permanent injunction.

5.2 Nothing contained in this Easement shall be construed to entitle District to bring any action against Grantor for any injury to or change in the Property resulting from causes beyond Grantor's control, including unforeseeable acts of trespassers, fire, flood, storm, drought, pests, earth movement, and major vegetative disease, or from any prudent action taken by Grantor under emergency conditions to prevent, abate or mitigate significant injury to the Property resulting from such causes.

6. COSTS, TAXES. Grantor retains all responsibilities and shall bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance of the Property. Grantor remains solely responsible for obtaining any applicable governmental permits and approvals for any activity or use which shall be undertaken in accordance with all applicable Federal, state, and local laws, regulations, and requirements. Grantor shall pay before delinquent all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Property by competent authority (collectively "taxes"), and shall furnish Grantee with satisfactory evidence of payment upon request.

7. THIRD PARTY BENEFICIARY. Grantor grants to _____ the right as third party beneficiary to enforce the terms and conditions of this Easement ensuring perpetual preservation of the Conservation Values of the Property.

8. GENERAL PROVISIONS.

8.1 **Severability**. If any provision of this Easement is found to be invalid, the remainder of the provisions of this Easement shall not be affected thereby.

8.2 **Entire Agreement**. This instrument sets forth the entire Agreement of the Parties with respect to this Easement.

8.3 **Public Access.** Nothing contained herein shall be construed as affording the public at large access to any portion of the Property, except that the public shall have ingress and egress over the Property along any and all designated trails constructed pursuant to paragraph 3.12 above, for the purpose of engaging in any properly permitted activity on the Property.

8.4 **Successors**. The covenants, terms, conditions, and restrictions of this Easement shall be binding upon, and inure to the benefit of the Parties hereto and their respective personal representatives, heirs, successors, and assigns, and shall continue as a servitude running in perpetuity with the Property.

8.5. **Cancellation**. This Easement is subject to cancellation per A.R.S. §38-511.

8.6 **No Subordination**. Upon recordation in the Pima District, Arizona, Recorder's Office, this Easement shall be deemed superior to all after acquired property interests in the Property. District shall have no obligation to subordinate its rights and interests in this Easement to any party.

## Appendix J. Conservation Easement template for private ranch lands. This has—and will continue to be—used for easements held by Pima County on private ranch lands.

GRANT OF CONSERVATION EASEMENT AND TRANSFER OF DEVELOPMENT RIGHTS

THIS CONSERVATION EASEMENT is made this ____ day of _____, 20__, by _____, ("Grantor"), in favor of Pima County, a political subdivision of the State of Arizona, ("County" or "Grantee") (collectively, the "Parties"), pursuant to A.R.S. § 33-271, et. seq.

In consideration of the mutual covenants contained herein, Grantor hereby voluntarily grants and transfers to County a conservation easement (the "Easement"), in perpetuity, over and across the property described in Exhibit X (the "Property"; not included in this appendix), which Easement shall run with the land and shall bind the Grantor and County in perpetuity, subject to the terms and conditions contained herein. Further, as a part of this Easement, Grantor hereby transfers to County all development rights (except as specifically reserved herein) that are now or hereafter allocated to, implied, reserved or inherent in the Property, and the Parties agree that such rights are terminated and extinguished, and may not be used on or transferred to any portion of the Property as it is now or hereafter may be bounded or described, or to any other property adjacent or otherwise, nor used for the purpose of calculating permissible residential density or development intensity of the Property or any other property.

1. PURPOSE. The Parties agree that it is the purpose of this Easement to: (i) assure that the Property will be preserved forever in its predominantly open, scenic, undeveloped and natural condition; (ii) prevent any uses of the Property that will significantly impair or interfere with the areas of biological, ecological, or geologic importance (the "Conservation Values") of the Property; (iii) conserve habitat for wildlife; (iv) protect rare and unique native plants and animals currently known or later identified; and (v) promote the conservation purposes stated in A.R. S. § 33-271(2).

2. RIGHTS OF COUNTY. Grantor hereby grants the following rights to County:

2.1 To identify, preserve, protect and monitor, in perpetuity, the Conservation Values of the Property;

2.2 To prevent Grantor or third persons from conducting any activity on or use of the Property that is prohibited or inconsistent with this Easement;

2.3 To enter upon the Property for administrative purposes, provided that such entry shall be upon seven (7) days written notice to Grantor, and County shall not in any case unreasonably interfere with Grantor's use and quiet enjoyment of the Property;

2.4 Upon thirty (30) days written notice to Grantor, and subject to Grantor's approval, which shall be in Grantor's sole discretion, County or other educational or research agencies and institutions may enter upon the Property to engage in ecological,

geological and/or archeological studies, research and special projects, provided that County shall not unreasonably interfere with Grantor's use and quiet enjoyment of the Property;

2.5 To enter upon the Property at any time during the term of this Conservation Easement under emergency circumstances to prevent an imminent breach of the terms of this Easement or, in County's sole discretion, to prevent damage to or destruction of the Conservation Values.

3. PERMITTED ACTIVITIES. The following activities shall be permitted on the Property as on all lands that County designates as Level II or Level III for purposes of complying with the MSCP:

3.1 Livestock grazing under a current ranch management or grazing plan that is referenced in the Easement and reviewed by Grantee annually. Such grazing may be confined to specific areas of the Property and may be prohibited in certain critical areas, such as springs or riparian areas.

3.2 Farming in existing areas of use, as described herein.

3.3 Vegetation removal as reasonable and necessary for habitat improvements to promote recovery or reestablishment of native species, fencing, maintaining utility easements, livestock developments and residential needs, except where priority vulnerable species may be negatively impacted.

3.4 The use of existing corrals, barns, outbuildings or ranch dumpsites, as identified herein, that is reasonable and necessary to sustain ranching and farming operations, provided they do not compromise the Conservation Values for which the Property was acquired.

3.5 The construction of replacement corrals, barns, outbuildings, residences or other structures on the existing disturbed sites. New structures may be permitted consistent with the purposes of this Easement.

3.6 Use of surface or subsurface water from water developments or natural sources for on-site domestic use, habitat improvements, livestock watering, wildlife waters, farming, fire-fighting, or dust control that is not inconsistent with the purposes of the Easement.

3.7 Prescribed fire for areas of 10 acres or less. Prescribed fire on areas exceeding 10 acres requires written approval from Grantee.

3.8 Installation of new or replacement of existing wire-strand fencing, built to wildlife-friendly standards as established by the Arizona Game and Fish Department.

3.9 The use of herbicides or pesticides on cultivated lands, as part of habitat improvement projects, in residential areas, barns, corrals, or other livestock confinements.

3.10 Replacement of existing wells, pumps, pipelines, windmills, septic systems and storage tanks as necessary for permitted operations on the Property along with maintenance and repair of existing water developments.

3.11 Construction of new roads, permanent or temporary, where necessary to enhance or protect Conservation Values on the Property or to facilitate farming or livestock-related activities.

3.12 Construction of trails for nonmotorized recreation including hiking, wildlife-watching, mountain biking, hunting access to adjoining public lands, and horseback riding, provided the trails don't compromise the Conservation Values for which the Property was acquired.

3.13 Hunting by licensed and/or permitted hunters consistent with the rules, regulations and seasons established by the Arizona Game and Fish Department.

3.14 Wildlife management activities carried out in cooperation with the Arizona Game and Fish Department.

4. PROHIBITED ACTIVITIES. Any activity or use of the Property inconsistent with the purpose of this Easement or the Conservation Values of the Property is prohibited. Without limiting the generality of the foregoing, the following activities and uses are expressly prohibited:

4.1 Development of the Property, including subdivision or lot splitting of the Property.

4.2 Constructing or placing of any additional buildings or structures, except construction of additional residences, associated outbuildings and agricultural outbuildings or recreational development, as might be provided elsewhere in this Easement.

4.3 Surface alteration or natural vegetation alteration other than that necessary to retain, restore or enhance the Property's Conservation Values as defined herein.

4.4 Severing of surface or subsurface water rights associated with the Property, including the transfer, encumbrance, lease and sale of water rights, except where severance of such water rights benefits the Conservation Values as defined herein.

4.5 Manipulating, impounding or altering any natural watercourse, except as may be necessary to retain, restore or enhance the Conservation Values as defined herein.

4.6 Development of, or the granting of rights-of -way, access or easements for new roads, except as might be provided elsewhere in this Easement.

4.7 Development of, or the granting of rights-of-way, access or easements for new utilities, including telecommunications facilities, except where environmental analysis adequately demonstrates that allowing such activities is not harmful to the Conservation

Values of the Property. Review of such environmental analyses and final determination as to the harmful nature of such impacts is granted solely to Grantee.

4.8 Filling, excavating, dredging, mining, drilling, exploration, or extraction of minerals, hydrocarbons, soils, sand, gravel, rock or other materials on or below the surface of the Property, except as minimally necessary in connection with such activities as may be required in performing any activities permitted herein or as allowed under Federal law.

4.9 The storage, dumping, accumulation or disposal of toxic and/or hazardous materials, trash, garbage, solid waste or other unsightly material on the Property.

4.10 The introduction of non-native fish or amphibians or other non-native organisms to or from catchments, tanks, springs or creeks.

4.11 The introduction of non-native species of noxious or aggressive character that might adversely affect the Conservation Values of the Property.

4.12 Storage and use of biocides and chemical fertilizers except for residential and agricultural purposes that may be provided for herein. Aerial application of biocide or other chemicals is prohibited except where Grantor and Grantee concur that it is an appropriate and necessary management technique to promote the recovery or reestablishment of native species or to reduce threats to ecosystem structure and function.

4.13 Pumping of surface or subsurface water from existing diversions for other than on-site residential, wildlife, recreational, habitat enhancement and agricultural uses associated with livestock grazing on the Property as provided for herein. Increases in the amount of surface or subsurface water per pump shall not be permitted without joint approval from Grantor and Grantee.

4.14 Construction of new water diversions that divert surface or subsurface water from any spring or watercourse, except for activities otherwise permitted herein.

4.15 Planting non-native, invasive plant species. Planting of such vegetative species is permissible only for the purposes of supporting existing ranching operations, if any, and will be limited to those areas identified herein that have historically been devoted to the growing of such species.

4.16 Installation of underground storage tanks for petroleum or other polluting substances, except those already existing or permitted septic tanks.

4.17 Confinement of livestock where animals are permanently located in enclosures and the majority of their feed supplied from outside sources. This includes but is not limited to feeder cattle, dairy, pig, poultry and exotic animal farm operations.

4.18 Commercial enterprises inconsistent with protection of the Property's Conservation Values, excluding farming and ranching as provided herein. Commercial

enterprises, other than farming or ranching, that provide for ecotourism or wildlife-related recreation may be approved subject to the joint consent of Grantor and Grantee.

4.19 Use of the Property to provide temporary residential space for mobile homes, travel trailers, tent trailers, self-propelled recreational vehicles and like structures or vehicles, except that such vehicular campers owned by the Grantor, guests or other individuals engaging in activities otherwise permitted by this Easement who may be parked on the Property to accommodate reasonable visitation.

4.20 Any paving of roads using asphalt or concrete except where required by County ordinance.

4.21 Any modification of the topography of the Property through the placement thereon of soil, dredging spoils, or other material, except for those uses permitted under this Easement.

4.22 Off-road vehicular travel except as reasonably necessary to facilitate permitted activities on the Property.

5. DEFAULT AND REMEDIES.

5.1 If County determines that Grantor is in breach of the terms of this Easement, County shall give written notice to Grantor of such breach and demand corrective action sufficient to cure the breach and, where the breach involves injury to the Property resulting from any activity inconsistent with the purpose of this Easement, to restore the portion of the Property so injured. If Grantor fails to cure the breach within thirty (30) days after receipt of such notice, or under circumstances where the breach cannot reasonably be cured within a thirty (30) day period, fails to begin curing such breach within the thirty (30) day period, or fails to continue diligently to cure such breach until finally cured, then the County may bring an action at law or in equity in a court of competent jurisdiction to enforce the terms of this Easement, to enjoin the breach by temporary or permanent injunction, to recover any damages to which it may be entitled for breach of the terms of this Easement or injury to any protected uses or Conservation Values, including damages for any loss thereof, and to require the restoration of the Property to the condition that existed prior to any such injury. If upon receipt of notice from the County the Grantor fails to cease the activity which caused the breach, the County may bring immediate action at law or equity to enjoin the breach by temporary or permanent injunction.

5.2 Nothing contained in this Easement shall be construed to entitle County to bring any action against Grantor for any injury to or change in the Property resulting from causes beyond Grantor's control, including unforeseeable acts of trespassers, fire, flood, storm, drought, pests, earth movement, and major vegetative disease, or from any prudent action taken by Grantor under emergency conditions to prevent, abate or mitigate significant injury to the Property resulting from such causes.

6. <u>COSTS, TAXES</u>. Grantor retains all responsibilities and shall bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance of

the Property. Grantor remains solely responsible for obtaining any applicable governmental permits and approvals for any activity or use which shall be undertaken in accordance with all applicable Federal, state, and local laws, regulations, and requirements. Grantor shall pay before delinquent all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Property by competent authority (collectively "taxes"), and shall furnish Grantee with satisfactory evidence of payment upon request.

7. THIRD PARTY BENEFICIARY. Grantor grants to _____ the right as third party beneficiary to enforce the terms and conditions of this Easement ensuring perpetual preservation of the Conservation Values of the Property.

8. GENERAL PROVISIONS.

8.1 **Severability**. If any provision of this Easement is found to be invalid, the remainder of the provisions of this Easement shall not be affected thereby.

8.2 **Entire Agreement**. This instrument sets forth the entire Agreement of the Parties with respect to this Easement.

8.3 **Public Access.** Nothing contained herein shall be construed as affording the public at large access to any portion of the Property, except that the public shall have ingress and egress over the Property along any and all designated trails constructed pursuant to paragraph 3.12 above, for the purpose of engaging in any properly permitted activity on the Property.

8.4 **Successors**. The covenants, terms, conditions, and restrictions of this Easement shall be binding upon, and inure to the benefit of the Parties hereto and their respective personal representatives, heirs, successors, and assigns, and shall continue as a servitude running in perpetuity with the Property.

8.5. **Cancellation**. This Easement is subject to cancellation per A.R.S. §38-511.

8.6 **No Subordination**. Upon recordation in the Pima County, Arizona, Recorder's Office, this Easement shall be deemed superior to all after acquired property interests in the Property. County shall have no obligation to subordinate its rights and interests in this Easement to any party.

## Appendix K. Habitat Protection Priorities in eastern Pima County.

The Habitat Protection Priorities (Fig. A-35) were developed for the 2004 Bond election by the Arizona Land and Water Trust and The Nature Conservancy, using data developed by Pima County, STAT, and others. The data were integrated into a computer data set that enabled basic modeling of goals and criteria to identify priorities.

Conservation goals included: 1) to maximize the benefit of existing protected areas by increasing their size; 2) to emphasize protection of the rarest habitat types or “special elements” as per STAT; 3) to maintain a network of connected protected lands where native habitat and natural corridors remain; and 4) to systematically evaluate lands throughout all of eastern Pima County so that priorities are identified in all of the County’s biologically important areas.

Selection criteria included: 1) lands from the most biologically important CLS categories including the Biological Core, Important Riparian and Recovery Management Areas; 2) private lands equal to or greater than 10 acres in size in vacant or agricultural status; 3) State Trust lands within the priority CLS categories, emphasizing lands eligible for conservation under the Arizona Preserve Initiative. Thousands of parcels met the selection criteria, and were evaluated as to how each parcel met the conservation goals. The evaluation resulted in the Figure A-35.

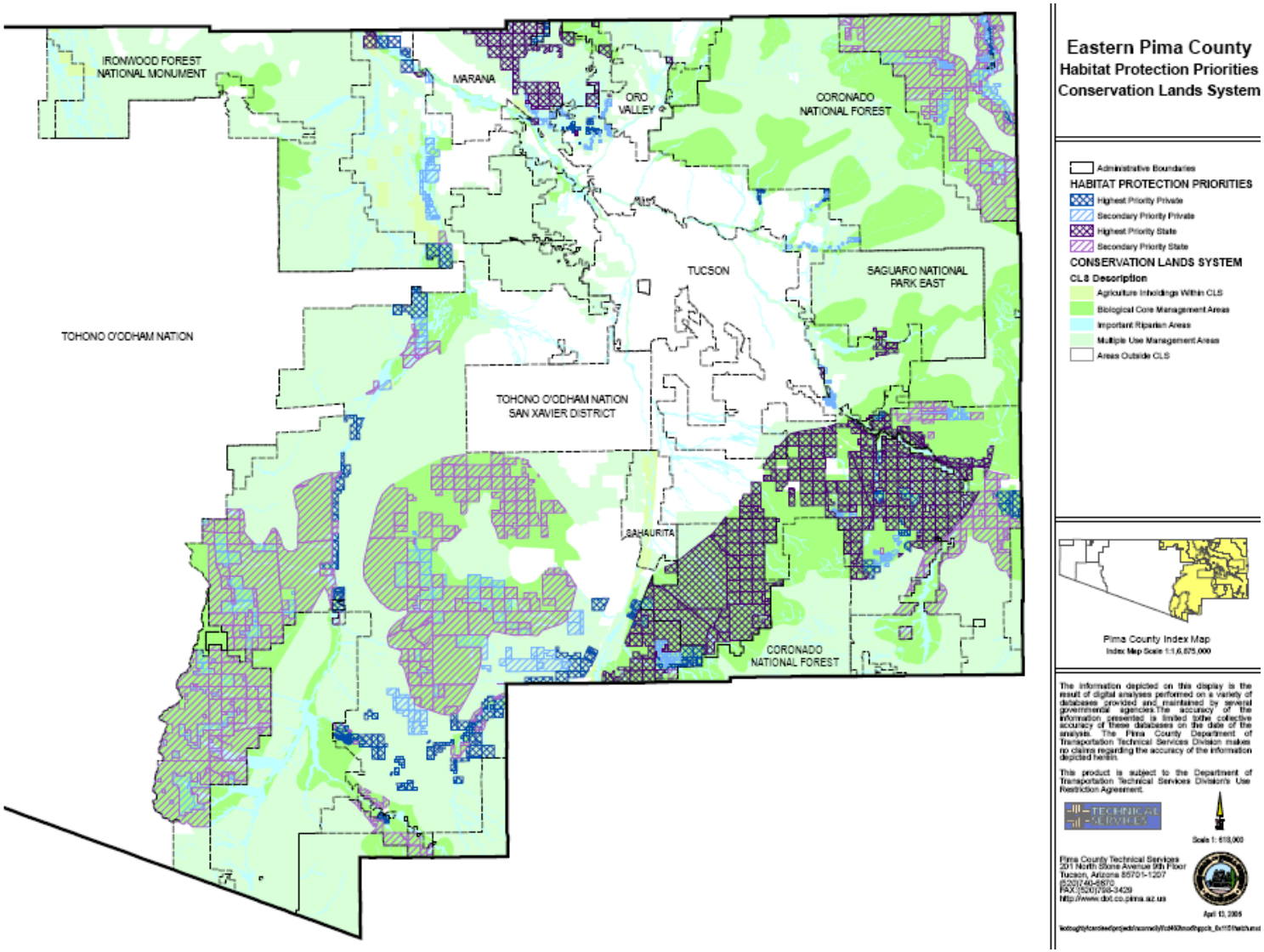


**Figure A-35. Map of Habitat Protection Priorities in eastern Pima County.**

# Appendix L. List of prohibited and permitted activities on County-controlled Mitigation Lands.

## Section 1: High value Biological resources: Prohibited activities

Purpose. County-controlled mitigation lands shall promote the biological goal and objectives of the Sonoran Desert Conservation Plan and associated MSCP and seek to appropriately manage natural land cover and water resources, promote recovery or reintroduction of native species, and to reduce threats to ecosystem structure and functions, including threats to habitat for identified species.

Prohibited Activities:

Any activity or use of the Property inconsistent with the purpose of this easement is prohibited. Without limiting the generality of the foregoing, the following activities and uses are expressly prohibited:

1) Development of the Property, including subdivision or lot splitting of the Property.
2) Constructing or placing of any additional buildings, permanent camping developments, mobile homes or billboards except construction of additional residences, associated outbuildings and agricultural outbuildings as might be provided elsewhere in this easement.
3) Surface alteration or natural vegetation alteration other than that necessary to accommodate the uses of the Property authorized herein.
4) Severing of surface or subsurface water rights associated with the Property, including the transfer, encumbrance, lease and sale of water rights.
5) Development of, or the granting of rights-of-way, access or easements for, new roads or utilities including telecommunications facilities.
6) Filling, excavating, dredging, mining, drilling, exploration or extraction of minerals, hydrocarbons, soils, sand, gravel, rock, or other materials on or below the surface of the Property, except as minimally necessary in connection with such activities as may be required in performing any activities permitted herein.
7) The dumping, extended storage, accumulation or disposal of toxic and/or hazardous materials, trash, ashes, garbage, waste or other unsightly or offensive material on the Property.
8) The introduction of non-native fish or amphibians or other non-native organisms to or from catchments, tanks, springs or creeks.
9) The introduction of non-native species of noxious or aggressive character that might adversely affect the natural values of the Property.
10) Storage and use of biocides and chemical fertilizers, except for residential and agricultural purposes that may be provided for herein. Aerial application of biocide or other chemicals is prohibited, except where utilized for rehabilitation of native habitats and approved by Grantee.

11) Pumping of groundwater for other than on-site residential, habitat restoration, ecotourism and agricultural uses associated with livestock grazing on the Property as provided for herein, except that any increases in groundwater pumping shall not be permitted that might adversely affect the natural values of the property.
12) Any actual or planned diversion or pumping of water from any perennial spring or watercourse, unless otherwise permitted herein.
13) Any actual or planned planting of non-native vegetation or plant species, except for such uses that have historically been part of the ranching operation, if any, on the Property, and such plantings remain confined to the areas where they exist at the time of the grant of this easement.
14) Any actual or planned underground storage tanks for petroleum or other polluting substances, except already existing or permitted septic tanks.
15) Confinement livestock feeding in which animals are permanently located in enclosures and the majority of their feed supplied from outside sources. This includes but is not limited to cattle feeder, dairy, pig, poultry, ostrich and emu farm operations.
16) Commercial enterprises inconsistent with protection of the Property's conservation values, excluding farming, ranching, and ecotourism operations provided for herein.
17) Any actual or planned use or location on the Property of mobile homes, travel trailers, tent trailers, self-propelled recreational vehicles and like structures or vehicles, except for vehicular campers authorized by Grantor, may only be parked on the Property to accommodate reasonable visitation and management operations.
18) Any actual or planned paving of roads using asphalt or concrete.
19) Any actual or planned commercial logging.
20) Any actual or planned modification of the topography of the Property through the placement thereon of soil, landfill, dredging spoils, or other material, except for those uses permitted under this easement.
21) Any actual or planned surface collection or excavation of archaeological artifacts, fossils, and/or materials other than those approved by Grantor and Arizona State Museum.
22) Off road vehicular travel except as reasonably necessary to facilitate permitted activities on the Property, such as ranching operations, habitat restoration projects, and site monitoring.

<u>Permitted Activities</u>

These may be modified as appropriate for an individual property.

23) Livestock grazing under a ranch management or grazing plan identified and referenced in the easement. Such grazing may be confined to specific areas of the Property and may prohibit grazing in certain critical areas, such as springs or riparian zones.

24) Farming in existing areas of use.
25) Shrub removal as reasonable and necessary for fencing or maintaining utility easements, livestock developments, and residential needs, except of sensitive or T&E species.
26) The use of existing corrals, barns, outbuildings, or ranch dumpsites reasonable and necessary for ranching and farming operations, provided they do not compromise the biological values for which the Property is acquired.
27) The construction of replacement corrals, barns, outbuildings, residences or other structures on the existing disturbed sites. The easement may provide for building envelopes or identify locations where new structures may be permitted.
28) Use of water from designated water developments or natural sources for on-site domestic, livestock watering, farming, fire-fighting, or dust control that is not excessive or inconsistent with the purposes of the easement.
29) Prescribed fire, with written approval of Grantee, for areas exceeding 10 or more acres.
30) New or replacement fencing, provided the fencing allows safe passage of wildlife.
31) Use of herbicides or pesticides on cultivated lands, in the residential area, or in barns, corrals, or other livestock confinements.
32) Replacement of existing wells, pumps, pipelines, windmills and storage tanks as necessary for permitted operations on the Property along with maintenance and repair of existing water developments.
33) Construction of new roads where necessary to enhance or protect biological values on the Property or to facilitate farming or livestock-related activities.
34) Construction of trails for non-motorized, passive recreation including hiking, horseback riding, picnicking, and bird watching.
35) Grantee shall have the right to enter the Property, upon reasonable notice to Grantor, for monitoring and enforcement of the terms of this easement.

**Section 2: High-value community resources**
Purpose: These lands shall protect lands that contribute to the preservation of resources valued by urban and suburban residents including but not limited to open space, signature viewsheds, archaeological and cultural resources, significant natural vegetative features, wildlife habitat, riparian areas, and groundwater recharge areas. (Based on purpose statement for Bond Question #1 and 11/16/03 memo from Bond Advisory Committee to BOS re: Recommendations on Other Jurisdiction's Open Space Bond Proposals.)

<u>Prohibited Activities</u>

Any activity or use of the Property inconsistent with the purpose of this easement is prohibited. Without limiting the generality of the foregoing, the following activities and uses are expressly prohibited:

1) Development of the Property, including subdivision or lot splitting of the Property.
2) Constructing or placing of any additional buildings, permanent camping accommodations, mobile homes or billboards except construction of additional residences, associated outbuildings and agricultural outbuildings as might be provided elsewhere in this easement.
3) Surface alteration or natural vegetation alteration other than that necessary to accommodate the uses of the Property authorized herein.
4) Severing of surface or subsurface water rights associated with the Property, including the encumbrance, lease and sale of water rights.
5) Development of, or the granting of rights-of-way, access or easements for, roads or utilities including telecommunications facilities.
6) Filling, excavating, dredging, mining, drilling, exploration or extraction of minerals, hydrocarbons, soils, sand, gravel, rock, or other materials on or below the surface of the Property, except as minimally necessary in connection with such activities as may be required in performing any activities permitted herein.
7) The storage, dumping, accumulation or disposal of toxic and/or hazardous materials, trash, ashes, garbage, waste or other unsightly or offensive material on the Property.
8) Any actual or planned surface collection or excavation of archaeological artifacts, fossils, and/or materials unless authorized by Grantor and Arizona State Museum.
9) The introduction of invasive, non-native plant species or exotic animals other than domestic animals.
10) Pumping of groundwater for other than currently existing uses on the Property as provided for herein, except that any increases in groundwater pumping shall not be permitted that might adversely affect the natural values of the property.

<u>Permitted Activities</u>

Activities consistent with the purpose of the open space acquisition shall be permitted. This may include, but is not limited to, the following:

1) Livestock grazing, preferably under a ranch management or grazing plan, identified and referenced in the easement.
2) Farming in existing areas of use.
3) Shrub removal as reasonable and necessary for fencing or maintaining utility easements, livestock developments, and residential needs.
4) The use of existing corrals, barns, outbuildings, or ranch dumpsites reasonable and necessary for ranching and farming operations, provided they do not compromise the biological values for which the Property is acquired.
5) The construction of replacement corrals, barns, outbuildings, residences or other structures on the existing disturbed sites. The easement may provide for building envelopes or identify locations where new structures may be permitted.

6) Use of water from designated water developments or natural sources for on-site domestic, livestock watering, farming, fire-fighting, or dust control that is not excessive or inconsistent with historic and traditional uses on the Property.
7) Fire protection and prescribed fire activities, with written approval of Grantee, for areas exceeding 10 or more acres.
8) New or replacement fencing, provided the fencing allows safe passage of wildlife.
9) Use of herbicides or pesticides on cultivated lands, in the residential area, or in barns, corrals, or other livestock confinements.
10) Replacement of existing wells, pumps, pipelines, windmills and storage tanks as necessary for permitted operations on the Property along with repair of existing water developments.
11) Construction of new roads where necessary to enhance or protect biological values on the Property or to facilitate farming, livestock-related activities, or habitat monitoring efforts.
12) Construction of trails for non-motorized, passive recreation including hiking, horseback riding, swimming, picnicking, and birdwatching.
13) Grantees shall have the right to enter the Property, upon reasonable notice to Grantor, for monitoring and enforcement of the terms of this easement.

# Appendix M. Draft Pima County MSCP Implementing Agreement.

**PUBLIC DRAFT**
**IMPLEMENTING AGREEMENT**

BETWEEN
U. S. FISH AND WILDLIFE SERVICE AND
PIMA COUNTY AND PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

FOR THE
PIMA COUNTY MULTIPLE-SPECIES CONSERVATION PLAN

LOCATED IN
PIMA COUNTY, ARIZONA

NOVEMBER 2012

TO ESTABLISH A PROGRAM OF AVOIDANCE, MINIMIZATION, AND MITIGATION FOR SPECIES IN PIMA COUNTY, ARIZONA AND SELECT LANDS IN ADJACENT COUNTIES

## 1.0 PARTIES

The parties to this implementing Agreement ("Agreement") are Pima County, Arizona, a political subdivision of the State of Arizona and the Pima County Regional Flood Control District, a political taxing subdivision of the State of Arizona (collectively the "County") and the United States Fish and Wildlife Service (the "Service").

## 2.0 RECITALS AND PURPOSES

**2.1 Recitals.** The parties entered into this agreement in consideration of the following facts:

**2.1.1** Pima County's Multiple-Species Conservation Plan (MSCP) Permit Area has been determined to provide, or potentially provide, habitat for the following listed species: Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*), Huachuca water umbel (*Lilaeopsis schaffneriana recurva*), Lesser long-nosed bat (*Leptonycteris curasoae yerbabuena*), Gila topminnow (*Poeciliopsis occidentalis occidentalis*), Gila chub (*Gila intermedia*), Chiricahua leopard frog (*Lithobates chiricahuensis*), and Southwestern willow flycatcher (*Empidonax traillii extimus*).

**2.1.2** Pima County's MSCP Permit Area has been determined to provide, or potentially provide, habitat for the following unlisted species: Birds: Abert's Towhee (*Pipilo aberti*), Western yellow-billed cuckoo (*Coccyzus americanus*), Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*), Rufous-winged sparrow (*Aimophila carpalis*), Bell's

vireo (*Vireo bellii arizonea*), Swainson's hawk (*Buteo swainsoni*), and Burrowing owl (*Athene cunicularia hypugaea*); Plants: Needle-spined pineapple cactus (*Echinomastus erectocentrus* var. *erectocentrus*), and Tumamoc globeberry (*Tumamoca macdougalii*); Mammals: Mexican long-tongued bat (*Choeronycteris mexicana*), Allen's big-eared bat (*Idionycteris phyllotis*), Western red bat (*Lasiurus blossevillii*), Southern yellow bat (*Lasiurus ega*), California leaf-nosed bat (*Macrotus californicus*); Pale Townsend's big-eared bat (*Plecotus townsendii pallescens*), and Merriam's mouse (*Peromyscus merriami*); Amphibians: lowland leopard frog (*Lithobates yavapaiensis*); Reptiles: Tucson shovel-nosed snake (*Chionactis occipitalis klauberi*), Northern Mexican gartersnake (*Thamnophis eques megalops*), Groundsnake (valley form) (*Sonora semiannulata*), Giant spotted whiptail lizard (*Aspidoscelis burti stictogramma*), Desert box turtle (*Terrapene ornata luteola*) and Sonoran Desert tortoise (*Gopherus agassizii*); Fishes: Desert sucker (*Catostomus clarki*), Sonoran sucker (*Catostomus insignis*), and Longfin dace (*Agosia chrysogaster*); Invertebrates: talus snails (*Sonorella eremita, S. ambigua ambigua syn papagorum; S. imperatrix, S. imperialis, S. magdalensis syn. tumamocensis; S. odorata odorata syn marmoris; S. rinconensis; S. sabinoensis buehmanensis; S. sabinoensis tucsonica, S. sitiens sitiens, and S. tortillita*)

**2.1.3** The County has developed a Habitat Conservation Plan for the proposed incidental take permit under Section 10 of the Endangered Species Act. That Habitat Conservation Plan is titled the "Pima County Multi-Species Conservation Plan" ("MSCP").

**2.1.4** The Service has developed an environmental impact statement to address the effects of issuing an incidental take permit to the County, and has completed its National Environmental Policy Act obligations in compliance with agency guidelines.

**2.1.5** The County has worked cooperatively with the Service to develop a series of measures described in the MSCP, to avoid, minimize, and mitigate to the maximum extent practicable the effects of take on covered species incidental to the County's covered activities.

**2.2 Purpose**. The purpose of this agreement is to guide implementation of the terms of the MSCP.

## 3.0 DEFINITIONS

Terms defined and used in the MSCP and the Endangered Species Act (ESA) have the same meaning when used in this Agreement, except the following terms used in this Agreement have the following meanings:

**3.1** "Conservation Plan" means the habitat conservation plan prepared by the County and submitted under the title of Multi-Species Conservation Plan.

**3.2** "Covered activities" means those activities described in Chapter 3 of the MSCP, including activities undertaken by the County on Mitigation Land Interests, pre-

construction, construction and maintenance activities undertaken by County, and certain discretionary private development approved by the County as described in Chapter 3.

**3.3** "Covered Species" means species adequately covered in the MSCP and identified in Sections 2.1.1 and 2.1.2 of this Agreement.

**3.4** “Listed species” means a species (including a subspecies, or a distinct population segment of a vertebrate species) that is listed as endangered or threatened under the ESA.

**3.5** “Maeveen Marie Behan Conservation Lands System (MMB-CLS)” or “CLS” means the biological reserve system design adopted as the Regional Environmental Element of the County’s 2001 Comprehensive Plan Update and any subsequent revisions. The MMB-CLS guides the County’s discretionary land-use decisions as they relate to Covered Activities and establishes a higher standard for avoidance, minimization and mitigation for projects located therein. The MMB-CLS also provides the underpinnings to the County’s selection of lands secured for mitigation under the permit.

**3.6** “Mitigation Land” means those lands, leases, or rights held by the County and committed to the Service as compensation for impacts of covered activities under the Section 10 permit. They consist of either (a) the acres of County land and any appurtenant rights described in a recorded, perpetual conservation easement, and for which The County manages and monitors for the purposes of compensating for the covered activities under the terms of the MSCP, or (b) the State Trust land for which County holds a grazing lease and manages and monitors for the purposes of compensating for the covered activities under the terms of the MSCP, or (c) the acres of private land that are retained as natural open space through development approvals and which have been set aside for the conservation of Covered Species and are managed and monitored pursuant to Chapters 5 and 6 of the MSCP, respectively, or (d) acres of former Federal land conveyed to the County in fee through the Recreation and Public Purposes Act or through exchange which the County manages and monitors for the purposes of compensating for covered activities under the permit, or (e) other rights owned by the County which are used for the purposes of compensating for covered activities, and recorded for that purpose in the County Recorder’s Office.

**3.7** “Opt-in Participant” means those property owners who voluntarily solicit protections afforded by the Pima County MSCP and who fulfill certain requirements.

**3.8** "Permit" means the incidental take permit issued by the Service to the County pursuant to Section 10(a)(1)(B) of the ESA.

**3.9** ."Permit Area" means the Pima County Section 10 Permit Area consisting of approximately 1,400,000 acres in Pima County, Cochise County, and Pinal County, Arizona as described in Chapter 3 of the MSCP.

**3.10** "Unlisted species" means a species (including a subspecies, or a distinct population segment of a vertebrate species) that is not listed as endangered or threatened under the ESA. The term "unlisted species" includes both candidate species and other species of concern.

## 4.0 OBLIGATIONS OF THE PARTIES

**4.1 Obligations of the County.** The County will fully and faithfully perform all obligations assigned to it under this agreement, the permit, and the MSCP.

**4.1.2. Interim obligations upon a finding of unforeseen circumstances.** If the Service makes a finding of unforeseen circumstances, during the period necessary to determine the nature and location of additional or modified mitigation, the County will avoid contributing to appreciably reducing the likelihood of the survival and recovery of the affected species.

**4.2 Obligations of the Service.** Upon approval of a final MSCP and final EIS, the Service will issue the County a permit under Section 10(a)(1)(B) of the ESA, authorizing incidental take by the County of each listed covered species resulting from covered activities on covered lands.

**4.2.1 Permit coverage.** The permit will identify all covered species. The permit will take effect for listed covered species at the time the permit is issued. The permit will take effect for an unlisted covered species upon the listing of the species.

**4.2.2. Section 7 Considerations.** When performing Section 7 consultations under the Clean Water Act or other Federal laws, the Service will consider the permit and actions related to the implementation of the MSCP.

**4.2.3 Revisions of ordinances and guidelines relating to the MSCP.** USFWS will review any modifications of environmental ordinances or guidelines identified as avoidance and minimization measures in Chapter 4 of the MSCP within 45 days and confer with County to determine if Pima County remains in compliance with the terms of the permit identified under Chapter 7, Changed Circumstances.

## 5.0 HABITAT CONSERVATION PLAN INCORPORATION

Pursuant to the provisions of Section 10(a)(1)(B) of the ESA, the County has prepared a Habitat Conservation Plan entitled the "Pima County Multi-Species Conservation Plan" ("MSCP") and submitted it to the Service with a request that the Service issue a Permit to allow Covered Species to be incidentally taken within the Permit Area as depicted and described in Chapter 3 of the MSCP. The MSCP proposes a mitigation program for the subject Covered Species and their habitats.

In the event of any direct contradiction between the terms of this Agreement and the MSCP, the terms of the Permit control.

## 6.0 TERM

**6.1 Initial Term**. This Agreement and the MSCP will become effective on the date that the Service issues the Permit. This agreement, the MSCP and the Permit will remain in effect for a period of 30 years from issuance of the Permit.

**6.2** Notwithstanding paragraph 6.1, the Parties agree and recognize that once the Covered Species have been incidentally taken and their habitat modified pursuant to the MSCP, the take and habitat modification will be permanent. It is therefore the intention of the Parties that the provisions of the MSCP and of this Agreement regarding the establishment and maintenance of mitigation lands as habitat for the Covered Species will be permanent and extend beyond the term of this Agreement, to the extent permitted by law and recorded in conservation easements or other legally enforceable instruments.

**7.0 FUNDING**

**7.1** The County will expend funds as may be necessary to carry out its obligations under the MSCP. The County must notify the Service if the County's funding resources have materially changed, including a discussion of the nature of the change, from the information provided in Chapter 8 of the MSCP.

**8.0 MONITORING AND REPORTING**

**8.1 Planned periodic reports.** The County will submit an annual report describing its activities and an analysis of whether the terms of the MSCP were met for the reporting period, as specified in Section 9.1.1 of the MSCP. The County will also submit a comprehensive report every 10 years, as specified in Section 9.1.2 of the MSCP.

**8.2 Other reports.** The County will provide, within 30 days of being requested by the Service, any additional information in its possession or control related to implementation of the MSCP that is requested by the Service for the purpose of assessing whether the terms and conditions of the permit and the MSCP, including the MSCP's adaptive management plan, are being fully implemented.

**8.3 Certification of reports.** All reports will include the following certification from a responsible official who supervised or directed preparation of the report:

> I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate, and complete.

**8.4 Monitoring by Service**. The Service may conduct inspections and monitoring in connection with the permit in accordance with their regulations. (See 50 C.F.R. §§ 13.47, 220.47.)

**9.0 ADAPTIVE MANAGEMENT**

**9.1 County-initiated adaptive management.** The County will implement the adaptive management provisions in Chapter 6 of the MSCP when changes in management

practices are necessary to achieve the MSCP's biological objectives, or to respond to monitoring results or new scientific information. The County will make the changes without awaiting notice from the Service, and will report to the Service on any actions taken pursuant to this section.

**9.2 Service-initiated adaptive management.** If the Service determines that one or more of the adaptive management provisions in the MSCP have been triggered and that the County has not changed its management practices in accordance with Chapter 6 of the MSCP, the Service will so notify the Parties and will direct the County to make the required changes. Within 30 days after receiving the notice, the responsible Party will make the required changes and report to the Service on its actions. The changes are provided for in the MSCP, and hence do not constitute unforeseen circumstances or require amendment of the permit or MSCP, except as provided in this section.

**9.3 Reductions in mitigation.** The County will not implement adaptive management changes that may result in less mitigation than provided for covered species under the original terms of the MSCP, unless the Service first provides written approval. The County may propose adaptive management changes by notice to the Service, specifying the adaptive management modifications proposed, the basis for them, including supporting data, and the anticipated effects on covered species, and other environmental impacts. Within 120 days of receiving the notice, the Service will approve the proposed adaptive management changes, approve them as modified by the Service, or notify the County that the proposed changes constitute permit amendments that must be reviewed under Section 11.2 of this agreement.

**9.4 No increase in take.** This section does not authorize any modifications that would result in an increase in the amount and nature of take, or increase the impacts of take, of covered species beyond that analyzed under the original MSCP and any amendments. Any modification must be reviewed as a permit amendment under Section 11.2 of this agreement.

## 10.0 LAND TRANSACTIONS

**10.1 Acquisition of land by the County.** Nothing in this agreement, the MSCP, or the permit limits the County's right to acquire additional lands, including additional mitigation land interests. Any activities on acquired land will be covered by the permit if it meets the requirements of covered activities in the MSCP and is located in the Permit Area.

**10.2 Disposal of mitigation land by the County**. The County's transfer of ownership or control of mitigation land will require prior approval by the Service except that transfers of mitigation land may be processed as minor modifications in accordance with Chapter 4 of the MSCP if the Service concurs that:

(a) The land will be transferred to an agency of the Federal government and, prior to transfer, the Service has determined that transfer will not compromise the effectiveness

of the MSCP based on adequate commitments by that agency regarding management of such land; or

(b) The land will be transferred to a non-Federal entity that has entered into an agreement acceptable to the Service (e.g., an easement held by the state fish and wildlife agency with the Service as third-party beneficiary) to ensure that the lands will be managed in such a manner and for such duration so as not to compromise the effectiveness of the MSCP; or

(c) The land will be transferred to a non-Federal entity that, prior to completion of the land transaction, has agreed to be bound by the MSCP as it applies to the transferred land and has obtained an incidental take permit following normal permit procedures covering all species then covered by the County's permit

## 11.0 MODIFICATIONS AND AMENDMENTS

**11.1 No Amendment Needed.** The Parties acknowledge that the Permit Area within the jurisdiction of Pima County will change over the term of the permit. None of the following changes shall require amendment of the permit as long as the changes are reported in the annual report to the Service with the County's description of how the changes will be addressed with regard to compliance with the MSCP:

(a) Removal of Permit Area by annexation, or

(b) Addition to Permit Area by acquisition by the County if described in Chapter 3 of the MSCP, or

(c) Reduction of Permit Area by disposal by the County of land, water, or land or water interests not associated with mitigation lands as described in Section 10.2 of this agreement.

### 11.2 Minor modifications.

(a) Any party may propose minor modifications to the MSCP or this agreement by providing notice to all other parties. That notice will include a statement of the reason for the proposed modification and an analysis of its environmental effects, including its effects on operations under the MSCP and on covered species. The parties will use best efforts to respond to proposed modifications within 60 calendar days of receipt of such notice. Proposed modifications will become effective upon all other parties' written approval. If, for any reason, a receiving party objects to a proposed modification, it must be processed as an amendment of the permit in accordance with subsection 11.2 of this section. The Service will not propose or approve minor modifications to the MSCP or this agreement if the Service determines that such modifications would result in operations under the MSCP that are significantly different from those analyzed in connection with the original MSCP, adverse effects on the environment that are new or significantly different from those analyzed in connection with the original MSCP, or additional take not analyzed in connection with the original MSCP.

(b) Minor modifications to the MSCP and this Agreement processed pursuant to this subsection may include but are not limited to the following:

(1) corrections of typographic, grammatical, and similar editing errors that do not change the intended meaning;

(2) correction of any maps or exhibits to correct errors in mapping or to reflect previously approved changes in the permit or MSCP;

(3) minor changes to survey, monitoring, or reporting of parameters or protocols if not already covered in Changed Circumstances; and

(4) Other types of modifications that are minor in relation to the MSCP, that the Service has analyzed and agreed to, and on which the public has had an opportunity to comment.

(c) Any other modifications to the MSCP or this Agreement will be processed as amendments of the permit in accordance with subsection 11.2 of this section.

**11.2 Amendment of the Permit.** The permit may be amended in accordance with all applicable legal requirements, including but not limited to the ESA, the National Environmental Policy Act, and the Service's permit regulations. The party proposing the amendment will provide a statement of the reasons for the amendment and an analysis of its environmental effects, including its effects on operations under the MSCP and on Covered Species.

**12.0 REMEDIES, ENFORCEMENT, AND DISPUTE RESOLUTION**

**12.1 In general.** Except as set forth below, each party has all remedies otherwise available to enforce the terms of this agreement, the permit, and the MSCP.

**12.2 No monetary damages.** No party is liable for damages to any other party or other person for any breach of this agreement, any performance or failure to perform a mandatory or discretionary obligation imposed by this agreement or any other cause of action arising from this agreement.

**12.3 Injunctive and temporary relief.** The parties acknowledge that the Covered Species are unique and that their loss as species would result in irreparable damage to the environment, and that therefore injunctive and temporary relief may be appropriate to ensure compliance with the terms of this agreement.

**12.4 Enforcement authority of the United States.** Nothing contained in this Agreement is intended to limit the authority of the United States government to seek civil or criminal penalties or otherwise fulfill its enforcement responsibilities under the ESA or other applicable law.

**12.5 Dispute resolution.** The parties recognize that disputes concerning implementation of, compliance with, or termination of this agreement, the MSCP, and

the permit may arise from time to time. The parties agree to work together in good faith to resolve such disputes, using the informal dispute resolution procedures set forth in this section, or such other procedures upon which the parties may later agree. However, if at any time any party determines that circumstances so warrant, it may seek any available remedy without waiting to complete informal dispute resolution.

**12.5.1 Informal dispute resolution process.** Unless the parties agree upon another dispute resolution process, or unless an aggrieved party has initiated administrative proceedings or suit in Federal court as provided in this section, the parties may use the following process to attempt to resolve disputes:

(a) The aggrieved party will notify the other parties of the provision that may have been violated, the basis for contending that a violation has occurred, and the remedies it proposes to correct the alleged violation.

(b) The party alleged to be in violation will have 30 calendar days, or such other time as may be agreed, to respond. During this time it may seek clarification of the information provided in the initial notice. The aggrieved party will use its best efforts to provide any information then available to it that may be responsive to the inquiries.

(c) Within 30 calendar days after the response was provided or was due, representatives of the parties having authority to resolve the dispute will meet and negotiate in good faith toward a solution satisfactory to all parties, or will establish a specific process and timetable to seek a solution.

(d) If any issues cannot be resolved through negotiations, the parties will consider non-binding mediation and other alternative dispute resolution processes and, if a dispute resolution process is agreed upon, will make good faith efforts to resolve all remaining issues through that process.

## 13 MISCELLANEOUS PROVISIONS

**13.1** No partnership. Neither this agreement nor the MSCP makes or may be deemed to make any party to this agreement the agent for or the partner of any other party.

**13.2** No Federal or State Contract. Notwithstanding any language to the contrary in this Agreement, this Agreement is not intended to create, and shall not be construed to create an enforceable contract between the Service and the County under Federal or state law with regard to the Permit. The sole purposes of this agreement as between the Service and Pima County are to clarify the Parties' mutual obligations and responsibilities under the MSCP and describe the processes the parties intend to follow to ensure the successful implementation of the MSCP in accordance with the Permit. This Agreement is not, nor shall it be construed as, a Federal rule, regulation, or final Federal action.

**14.4 Notices.** Any notice permitted or required by this agreement must be in writing, delivered personally to the persons listed below, or will be deemed given five (5) days after deposit in the United States mail, certified and postage prepaid, return receipt

requested and addressed as follows, or at such other address as any party may from time to time specify to the other parties in writing. Notices may be delivered by facsimile or other electronic means, provided that they are also delivered personally or by certified mail. Notices must be transmitted so that they are received within the specified deadlines.

Assistant Regional Director
United States Fish and Wildlife Service
[Street Address]
[City, State, Zip Code]
County Administrator, Pima County
130 West Congress
Tucson, AZ 85701

Chief Engineer, Pima County Regional Flood Control District
97 E. Congress St.
Tucson, AZ 85701

**14.5 Availability of funds.** Implementation of this Agreement and the MSCP by the Service is subject to the requirements of the Anti-Deficiency Act and the availability of appropriated funds. Nothing in this Agreement will be construed by the Parties to require the obligation, appropriation, or expenditure of any money from the U.S. treasury. The parties acknowledge that the Service will not be required under this Agreement to expend any Federal agency's appropriated funds unless and until an authorized official of that agency affirmatively acts to commit to such expenditures as evidenced in writing. The parties acknowledge that County's obligations under this agreement are limited by A.R.S. §42-17106.

**14.6 Duplicate of Originals**. This Agreement may be executed in any number of duplicate originals. A complete original of this Agreement will be maintained in the official records of each of the Parties.

**14.7 Third Party Beneficiaries.** Without limiting the applicability of the rights granted to the public pursuant to the provisions of 16 U.S.C. § 1540(g), this Agreement does not create any right or interest in the public, or any member thereof, as a third party beneficiary, nor does it authorize anyone not a Party to this Agreement to maintain a suit for personal injuries or property damages pursuant to the provisions of this Agreement. The duties, obligations, and responsibilities of the Parties to this Agreement with respect to third parties remain as imposed under existing Federal or State law.

**14.8 Relationship to the ESA and Other Authorities**. The terms of this Agreement are governed by and construed in accordance with the ESA and other applicable laws. In particular, nothing in this Agreement is intended to limit the authority of the Service to seek penalties or otherwise fulfill its responsibilities under the ESA. Moreover, nothing in this Agreement is intended to limit or diminish the legal obligations and responsibilities of the Service as an agency of the Federal government.

**14.9 References to Regulations.** Any reference in this Agreement, the MSCP, or the Permit to any regulation or rule of the Service is deemed to be a reference to the regulation or rule in existence at the time an action is taken. Any reference in this Agreement, the MSCP, or the Permit to any regulation or rule of the County is deemed to be a reference to the regulation or rule in existence at the time an action is taken.

**14.10 Applicable Laws.** All activities undertaken pursuant to this Agreement, the MSCP, or the Permit must be in compliance with all applicable State and Federal laws and regulations.

IN WITNESS WHEREOF, THE PARTIES HERETO have executed this Implementing Agreement to be in effect as of the date last signed below.

BY Regional Director Date_____
United States Fish and Wildlife Service
[City, State]

_____

BY Chairperson Date_____
Pima County Board of Directors
Pima County Regional Flood Control District
Tucson, AZ

_____

BY Chairperson Date_____
Pima County Board of Supervisors
Tucson, AZ

_____

Note: This document is a proposal that will be modified by the USFWS to produce a draft agreement for public review.

## Appendix N. Current Pima County Parks Rules, P.C.P.R. § 4-040.

The Pima County Parks Rules are adopted by the Pima County Board of Supervisors as the code of rules and regulations for Pima County parks and recreation areas pursuant to A.R.S. 11-935(B)(2) and 11-936.The Pima County Park Rules are organized by subject matter under an expandable two-factor decimal numbering system which is designed to facilitate supplementation without disturbing the numbering of existing provisions. Each section number designates, in sequence, the numbers of the chapter and section. Thus, Section 2.020 is Section 020 located in Chapter 2.

In parentheses following each section, is a legislative history identifying the specific sources for the provisions of that section by stating the adopting or amending resolution number, resolution section, and year the resolution was adopted.

The Pima County Parks Rules are subject to change. The most recent and accurate resolutions of the Pima County Parks and Recreation Commission amending the Pima County Parks Rules may be found in the Pima County Parks and Recreation Department office.

### 1.010 Fees

It shall be unlawful to enter upon or use for any purpose the land, water or facilities within the boundaries of County parks and recreation areas when a fee, rental, admission or other consideration has been established for such use, unless the person entering or using such land, water or facility has paid said fee, rental, admission or other consideration. (Res. 2000-3, § 2, 2000)

### 1.020 Commercial activity

It shall be unlawful to use County park or recreation areas for commercial purposes, public meetings or assemblies, erection of signs, fences, barriers or structures, to distribute advertising materials, or to sell any goods or services without first obtaining a written permit from the Pima County Parks and Recreation Department. (Res. 2000-3, § 2, 2000).

### 1.030 Motor vehicles

It shall be unlawful:

A. To operate a motorbike, motorcycle or other motor vehicle on trails, or cross country, or on primitive unsurfaced roadways that have been posted, signed, or barriered to prohibit vehicle use.

B. To operate a motor vehicle except on roads and parking areas designated for such purposes.

C. To operate a motor vehicle at a speed greater than that posted or to fail to obey traffic signs.

D. In all cases, a motor vehicle shall be operated in compliance with the Arizona Motor Vehicle Code as provided under Title 28, Arizona Revised Statutes, while within the boundaries of any Pima County Park or Recreation area. (Res. 2000-3, § 2, 2000).

**1.040 Bicycles**

Within Tucson Mountain Park, Tortolita Mountain Park, Roy P. Drachman Agua Caliente Regional Park, Cienega Creek Natural Preserve and Colossal Cave Mountain Park, it shall be unlawful to ride a bicycle except on a road or established trail, or in an arroyo, wash or riverbed. It shall further be unlawful to ride a bicycle on a road or established trail posted to prohibit bicycle use. (Res. 2000-3, § 2, 2000).

**1.050 Destruction, damage or removal of County property**

A. It shall be unlawful to destroy, damage, deface or remove any County regulatory sign, property or facility owned or administered by the Pima County Parks and Recreation Department.

B. It shall be unlawful to collect, remove, destroy, mutilate, damage or deface any natural resource, including, but not limited to, all live and dead vegetation and all parts thereof, wildlife, soil, rocks, and water, except as otherwise provided for by law or without obtaining prior written approval from the Pima County Parks and Recreation Department.

C. Except as otherwise planned for and provided for by the Pima County Parks and Recreation Department, all environmental settings shall be kept in their natural state. (Res. 2000-3, § 2, 2000)

**1.060 Litter**

It shall be unlawful to litter, deposit, or abandon in or on any County park, parkway or recreational facility any garbage, sewage, refuse, trash, waste, or other obnoxious materials except in receptacles or containers provided for such purposes. These receptacles are not to be used for residential trash disposal. (Res. 2000-3, § 2, 2000).

**1.070 Areas posted against entrance, use or occupancy**

It shall be unlawful to enter, use or occupy public parks or recreation under the supervision and control or Pima County Parks and Recreation Department for any purpose when said parks or areas are posted against such entrance, use or occupancy. (Res. 2000-3, § 2, 2000).

**1.080 Hunting**

Hunting is not permitted within the fenced boundaries of Rifle Ranges or Archery Ranges. (Res. 2000-3, § 2, 2000)

**1.090 Firearms**

It shall be unlawful to discharge firearms or other weapons in Pima County public parks except in designated Rifle Ranges or Pistol Ranges. (Res. 2000-3, § 2, 2000)

**1.100 Archery**

A. It shall be unlawful to shoot with bow-and-arrow except in designated "Archery Ranges" and subject to the following specific regulations:

1. Tucson Mountain Park. Bow hunting areas are all areas in the Tucson Mountain Park, except that no discharge of archery weapons is permitted within the corridor described by 660 feet on either side of the centerline of Gates Pass Road between Gates Pass Overlook and the intersection of Gates Pass Road and Kinney Road.

2. David Yetman Trail. Discharge of archery weapons is not permitted within 660 feet on either side of the David Yetman Trail from G-3 entry to the 22nd Street entry.

3. Tucson Estates. Discharge of archery weapons is not permitted within 2,640 feet of the park boundary around Tucson Estates including all the Little Cat Mountain range between Starr Pass Trail and the David Yetman Link Trail.

4. Old Tucson; Arizona-Sonora Desert Museum; Sonoran Arthropod Studies area; Gilbert Ray Campground. Discharge of archery weapons is not permitted within 2,640 feet of the boundaries of the Old Tucson premises, the Arizona-Sonora Desert Museum premises, the Sonoran Arthropod Studies premises and the Gilbert Ray Campground.

B. In addition to the foregoing limitations, all bow hunting must comply with all rules, regulations and other requirements of the Arizona Game and Fish Department. (Res. 2000-3, § 2, 2000)

**1.110 Fires**

It shall be unlawful to build fires, except in designated places, or in fireplaces, stoves or grills either provided or approved by the Pima County Parks and Recreation Department. (Res. 2000-3, § 2, 2000)

**1.120 Aircraft, parachutes and hang gliders**

It shall be unlawful to operate any aircraft of any nature or parachute or hang glide on County Park property except in areas designated for such use by the Commission, or in an emergency. (Res. 2000-3, § 2, 2000)

**2.010 Registration and User fees**

A. Registration is required.

B. Registration shall include the license number of the vehicle and the state where registered.

C. The registration fee shall be paid in advance. (Res. 2000-3, § 2, 2000)

**2.020 Camping regulations**

A. All registrants must park in the space assigned by the registrar.

B. One camping unit per site only.

C. Checkout time is Noon.

D. A seven day camping limit will be enforced, without exception. After seven days, the campers must leave the park for a minimum of seven days to gain eligibility to re-register.

E. Open camp fires are not permitted. Fireplaces have been provided for this purpose. Registrar may permit approved portable grills upon inspection.

F. Under no circumstances may clotheslines, lanterns, wiring, flags, or any other articles whatsoever, be strung across or secured to any vegetation or other County properties.

G. The County assumes no responsibility for personal belongings or property of any kind. (Res. 2000-3, § 2, 2000)

**2.030 Water**

A. The washing of vehicles and any other unnecessary use of water is prohibited.

B. Hose connections to or from any camper or trailer for any purpose other than filling holding tanks is strictly prohibited by order of the State Health Department.

C. The State Health Department requires that all water-soluble waste be disposed of at the Dumping Station, although dishwater waste and contents of commode bags may be emptied in the restroom toilets. Registrar will direct all non-specified disposals to avoid illegal dumping. (Res. 2000-3, § 2, 2000)

**4.010 Domestic animals and other pets at large**

No domestic animals or other pets are permitted to be at large in Pima County Parks and Recreation areas. (Res. 2000-3, § 2, 2000)

**4.020 Restraint**

A. Domestic animals and pets shall be restrained by a cage, or a leash of not more than six (6) feet in length and of sufficient strength to control the animal.

B. Exemptions from restraint requirements:

1) Animals participating in pet shows or classes approved by the Parks and Recreation Department, provided that the animal is accompanied by and under the control of its owner or handler.

2) Dogs confined within a county maintained temporary or perma- nent dog run located within a county park. (Res. 2000-3, § 2, 2000)

**4.030 Saddle, pack and draft animals**

It shall be unlawful to bring saddle, pack or draft animals into a County Park and Recreation site unless it has been developed to accommodate them and is posted accordingly. (Res. 2000-3, § 2, 2000)

**4.040 Grazing and foraging**

It shall be unlawful to allow grazing or allow any forage-consuming domestic livestock to graze or to roam at-large within the fenced or posted boundaries of Pima County Parks. (Res. 2000-3, § 2, 2000)

**4.050 Tucson Mountain Park**

A. Dogs are not permitted within Tucson Mountain Park, except in the Gilbert Ray Campground. Seeing eye dogs shall be exempt.
(Res. 2000-3, § 2, 2000)

**4.060 License**

Dogs over four (4) months of age shall wear a valid license on a collar. (Res. 2000-3, § 2, 2000)

**4.070 Litter**

A. Dog owners or handlers shall clean up all litter created by the animal and place it in trash cans.

B. Exemption. Owners of seeing eye dogs shall be exempt.
(Res. 2000-3, § 2, 2000)

**5.010 Intoxicants in Park and Recreation Areas**

A. No person shall posses or consume spirituous liquor in Pima County Parks and Recreation areas.

B. Exemption. On premises under lease from Pima County and upon compliance with the terms of the lease and with applicable State liquor licensing laws.

C. "Spirituous liquor" includes alcohol, brandy, whiskey, rum, tequila, mescal, gin, wine, porter, ale, beer, any malt liquor or malt beverage, absinthe, a compound or mixture of any of them or of any of them with any vegetable or other substance, alcohol bitters,

bitters containing alcohol, any liquid mixture or preparation, whether patented or otherwise, which produces intoxication, fruits preserved in ardent spirits, and beverages containing more than one-half of one percent of alcohol by volume. (Res. 2000-3, § 2, 2000)

**5.020 Disturbing the Peace in Park and Recreation Areas**

No person shall maliciously and willfully disturb the peace or quiet of a neighborhood, family or person by: loud or unusual noise; tumultuous or offensive conduct; threatening, traducing, quarreling, challenging to fight or fighting; or applying any violent, abusive or obscene epithets to another. (Res. 2000-3, § 2, 2000)

**7.010 Violations and penalties**

A person who violates any of the Parks Rules, adopted pursuant to A.R.S. § 11-931, et seq., is guilty of a class 2 misdemeanor pursuant to A.R.S. § 11-940. (Res. 2000-3, § 2, 2000)

**7.020 Expulsion of violators**

Pima County park police officers and other law enforcement officers shall have authority to order violators of the Park Rules to leave parks and recreation areas. (Res. 2000-3, § 2, 2000).

# Appendix O: Monitoring Plan for the Pima County MSCP

## Introduction and Monitoring Setting

This appendix provides additional details about the ecological effectiveness monitoring activities and commitments that Pima County will undertake as part of the County's Section 10 permit obligations. As noted in Chapter 6 of the MSCP, the Pima County Ecological Monitoring Program (PCEMP) will be the primary monitoring program for the MSCP and will endeavor to monitor a mix of parameters, from species-level monitoring to monitoring habitat, threats, landscape pattern, and climate. This approach, which provides species-level monitoring commitments for many of the Covered Species, but which includes other monitoring activities, has its genesis in the SDCP, which had the biological goal of ensuring "*the long-term survival of the full spectrum of plants and animals that are indigenous to Pima County through maintaining or improving the habitat conditions and ecosystem functions necessary for their survival"* (Pima County 2000). That goal is broad in scope and required thinking that incorporated—but ultimately transcended—species-level needs to create a landscape conservation plan that has received widespread acclaim and success.

Further justification for expanding the monitoring program from a traditional HCP focus on individual species to a broader, more integrated approach can be found in the nature of the larger HCPs, such as Pima County's. Monitoring programs with many species have found that monitoring for each Covered Species have often not been fully implemented, and if developed, are very expensive to maintain. Further, many monitoring efforts for HCPs have been criticized for not provided sufficient information to detect meaningful changes in populations of target species and for not adequately informing management (see critiques in Harding et. al. 2001, Wilhere 2002, Rahn et. al. 2006). Populations of many vertebrates, for example, change markedly through time and in response to environmental changes, so assessing trends can take years, even if the trend is biologically meaningful (Elzinga et. al. 2001, Fleishman and Mac Nally 2003). For these reasons, Pima County has chosen a monitoring approach that integrates a range of parameters over an approach that focuses solely on species-level monitoring.

After developing the scientific foundation of the biological element of the SDCP, the Science and Technical Advisory Team (STAT), which guided the biological element of the SDCP, developed the foundation of multi-element monitoring approach that is outlined here. In 2006, STAT developed the program's guidance document (Shaw 2006) and subsequent financial support from the USFWS—by way of a Section 6 (ESA) planning grant—lent support to this effort (Powell 2007). This appendix summarizes and builds on earlier reports by RECON Environmental Inc. (2007), Powell (2010c), and Steidl et al. (2010), all of which summarize a design process for choosing specific program elements and parameters, where they will be monitored, and by what methods.

## Location of Monitoring Activities

Most on-the-ground monitoring activities will take place on mitigation lands as well as at other properties owned and/or managed by Pima County for open-space conservation such as Tucson Mountain Park. Collectively, these are known as County preserve lands and they encompass approximately 230,000 acres (see Fig A-36). Pima County owns and/or manages >120 properties, many of which are small in area. To establish efficiencies for the PCEMP, Pima County will establish most on-the-ground monitoring activities on properties ≥100 acres in size. Together, these properties represent over 99% of the County's preserve lands. On-the-ground monitoring will take place on a property <100 acres in size if a specific resource of interest exists on that property such as springs, mines, and caves.

Ground-based monitoring will not take place on privately-owned natural open-space set asides (those undeveloped lands within subdivisions for which Pima County is seeking mitigation for the MSCP) unless Pima County acquires fee title to those lands for conservation (see Section 6.4 of the MSCP for greater detail). On Natural Open-space Set Asides for which partial credit is being sought by Pima County, the County will use remote-sensing methods to ensure that the set asides remain in their natural (i.e., undeveloped) state.

The specific location of monitoring activities on preserve lands will vary by the parameter being monitored and this appendix provides a description of monitoring site locations. In some cases, specific sites that have already been determined for monitoring are presented (such as for many of the Covered Species and water resources), but for other parameters, specific locations need to be determined after the onset of protocol development. For these parameters, the sampling frame (i.e., spatial extent to possible monitoring sites) is specified.

## Protocol Development

Throughout this appendix are references to protocols. Protocols will vary somewhat in scope and detail, but for the purposes of Pima County's effort, protocols will be of sufficient detail so that it is clear what is being monitored, where (exactly) it is monitored, by what methods, and what will be done with the resulting data. Each step of the project will include standard operating procedures for data collection, storage, and analysis so that future field and office workers will be able to collect data in exactly the same manner over time (Oakley et. al. 2003). Long-term monitoring efforts that have been established in the last decade or so (e.g., National Park Service Inventory and Monitoring Program) have recognized the importance of developing clear and detailed protocols and Pima County will adhere to this standard. In some cases (and especially for some single-species efforts), Pima County will

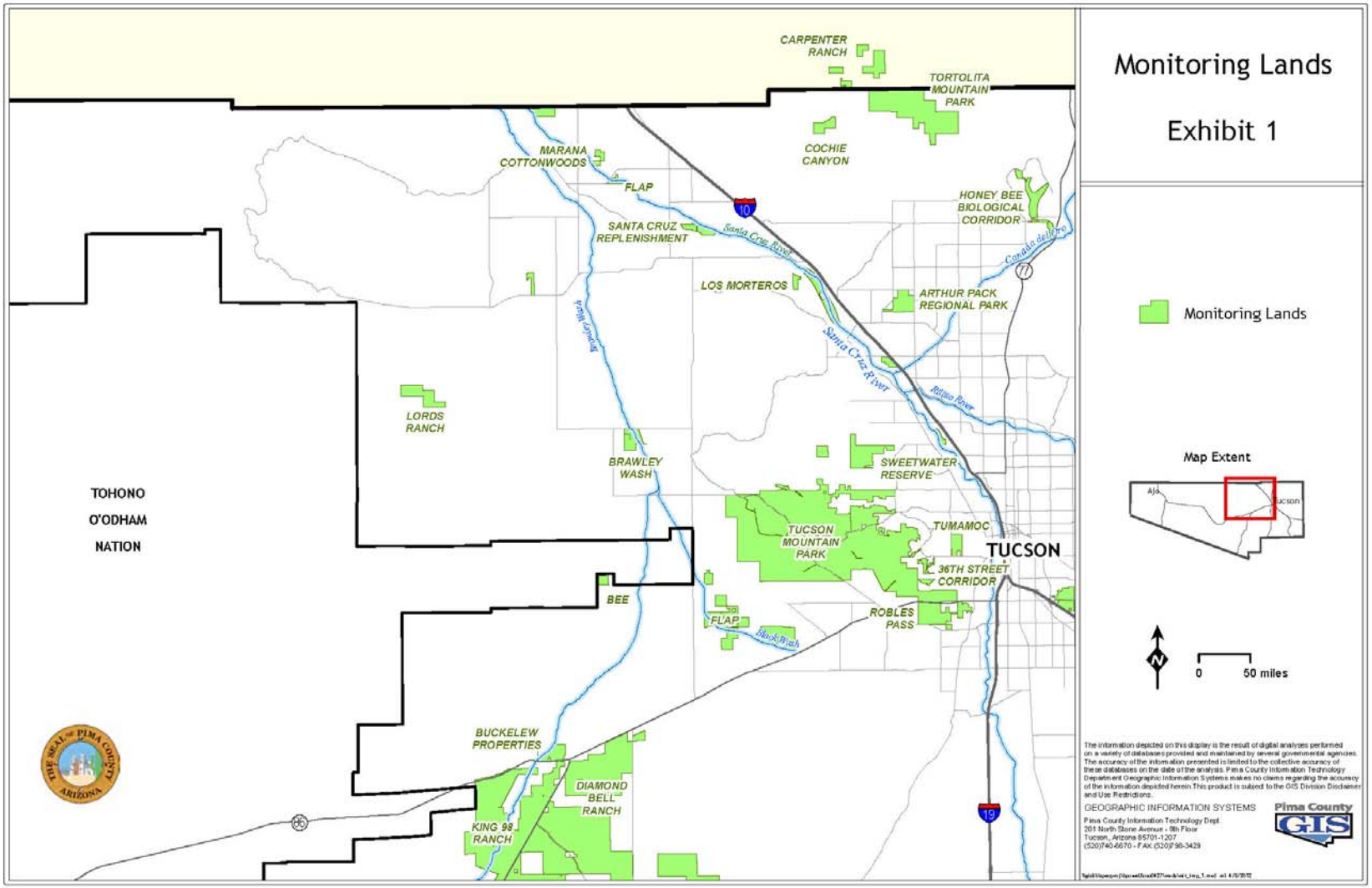


**Figure A-36. County preserves >100 acres that will be included in the sampling frame for the establishment of long-term monitoring plots and on which other parameters may be monitored.**

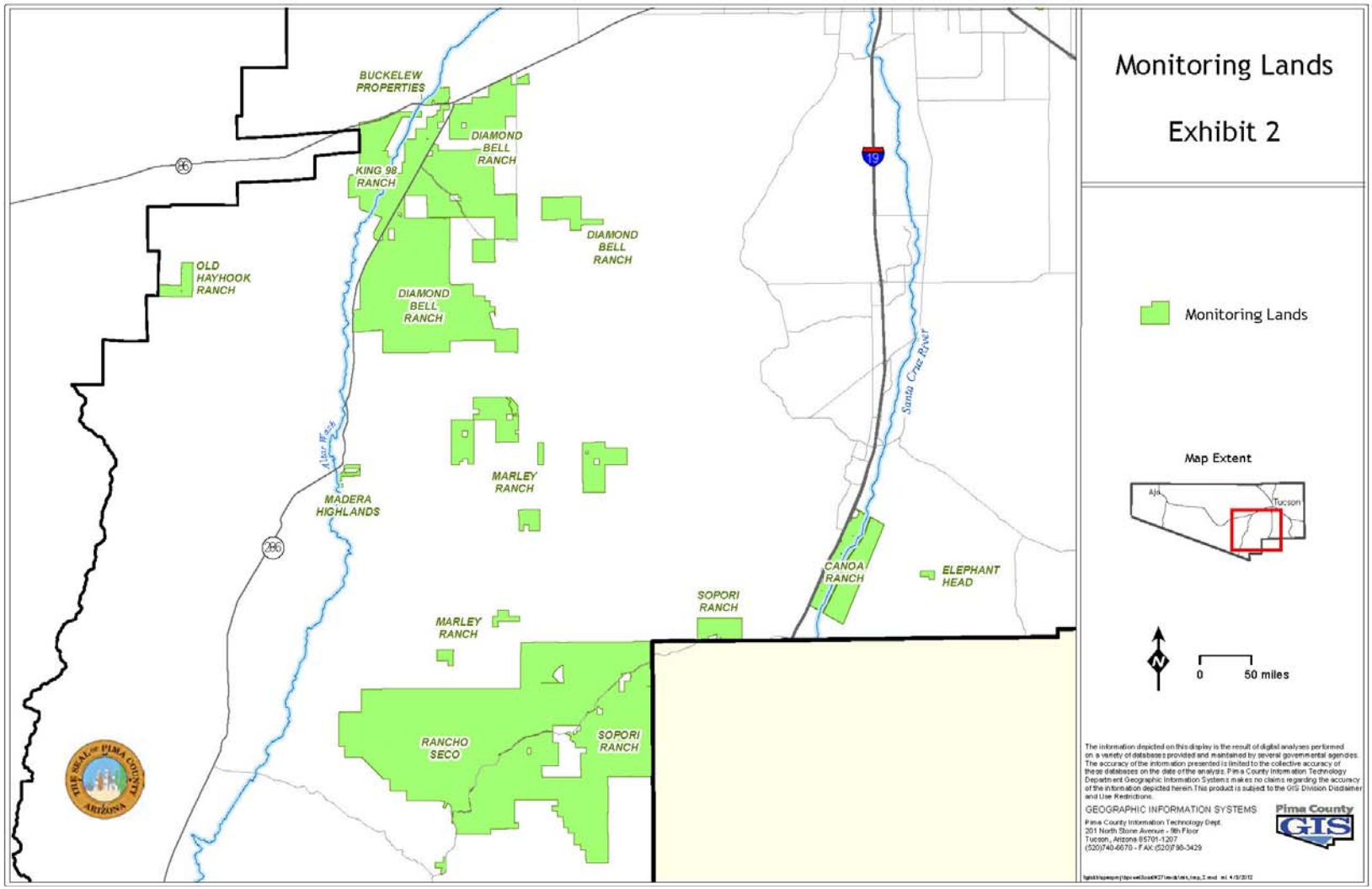


**Figure A-36 cont.**

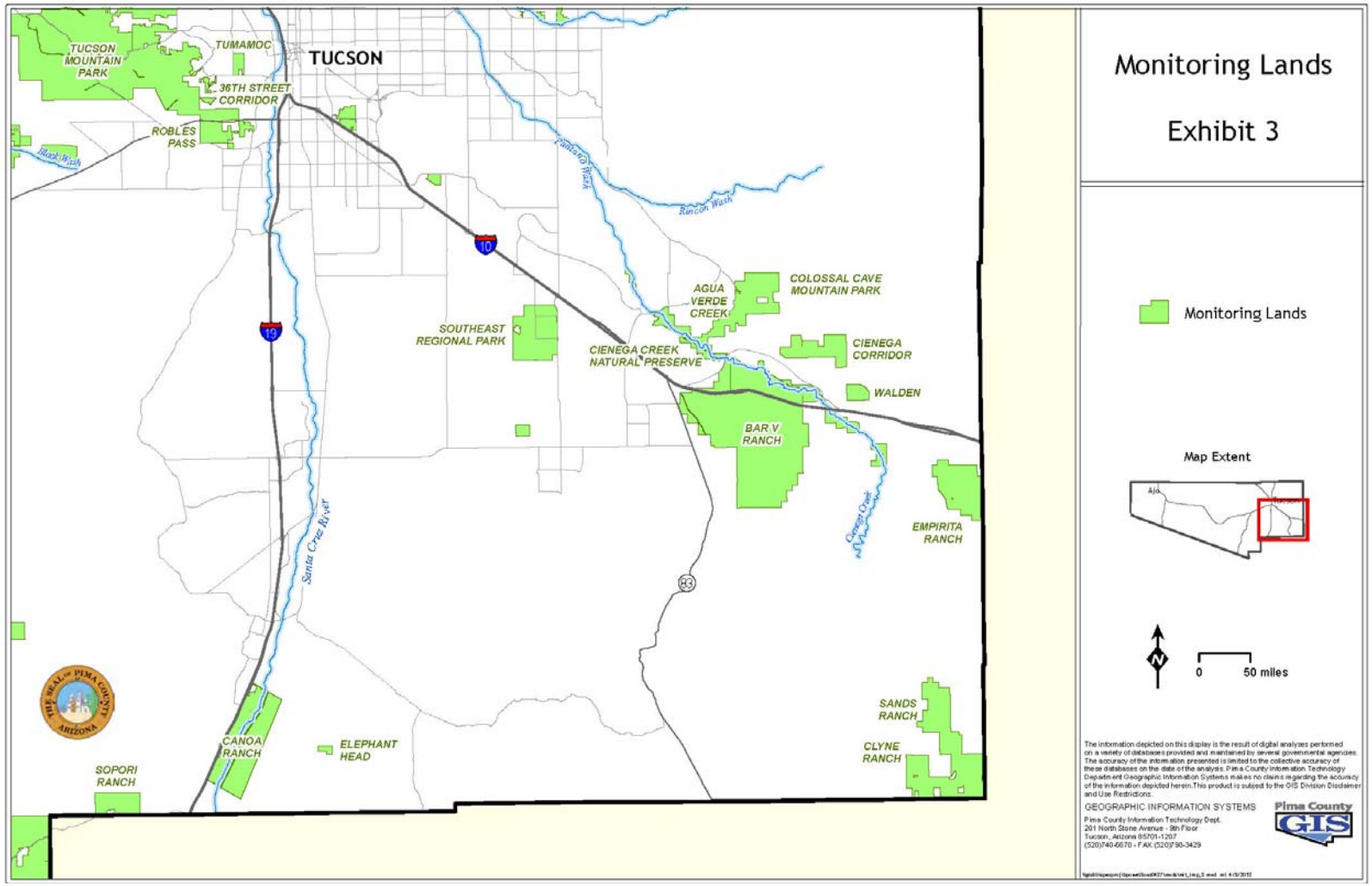


**Figure A-36 cont.**

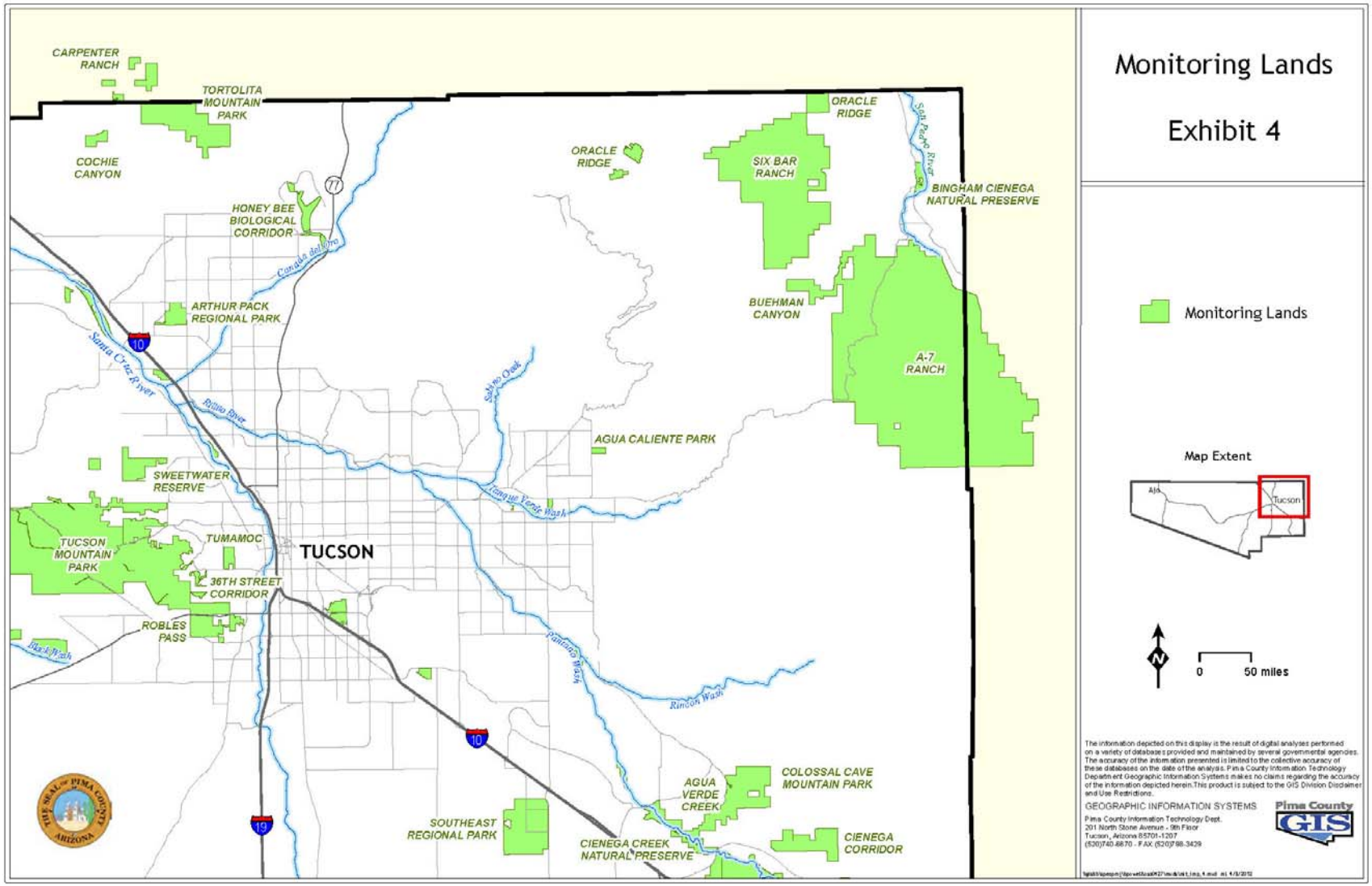


**Figure A-36 cont.**

utilize an existing field-data collection protocol as a starting point for developing a protocol that is both specific to Pima County and that takes into account other aspects of the data cycle—not just how to collect data in the field. Development of protocols often involves initial field testing and subsequent revisions before a final protocol is accepted.

The time frames proposed here for the development and implementation of monitoring protocols will allow us to adequately consider and evaluate existing protocols, gather additional information, and field test protocol options. Pima County will be conducting these types of activities throughout the time periods indicated; this will allow us to develop protocols specific to the MSCP approach that will most effectively and efficiently provide us the necessary information and date to evaluate the objectives of the MSCP and to meet permit requirements.

## Species Monitoring

Species-level monitoring is a key feature of the PCEMP and Pima County will commit to monitor population parameters for 15 species, which represent a mix of spatially-restricted and widespread species; and includes species that occur in a variety of locations (Table A.3; first column). This section provides information about the parameter to be monitored, the monitoring protocol to be used, and where and how often monitoring will take place. If a Covered Species is not listed here, it will be monitored through habitat, threats, and/or landscape monitoring. (A summary of how Pima County is addressing monitoring for each Covered Species is summarized in Table A.3 of this appendix). If a species-specific monitoring effort is not being proposed for that species, it does not mean that Pima County will not be tracking information about it. Instead, the County will track incidental sightings (i.e., observations of a species made by staff and others while performing other work duties). In addition, the County will promote the use of mitigation lands for non-invasive research and monitoring studies by other entities and observations by the general public. If an established field survey protocol will be used by Pima County, a web-based link to that protocol is provided in the literature cited section of this appendix.

Species-specific monitoring may take place at additional sites than those noted below or more frequently if Pima County and the USFWS agree that such an undertaking is warranted. For example, though Pima County has completed biological inventories of some preserve lands, more work is needed and therefore additional populations of a Covered Species may be discovered. The species-specific accounts, below, provide details on situations where new information can lead to additional monitoring commitments. The data-collection protocol to be used is noted, but Pima County may change protocols based on information collected during the initial years of monitoring and any changes to a protocol will be discussed and agreed upon with the USFWS prior to implementation. Species monitoring does not preclude habitat monitoring, threats monitoring, landscape-pattern monitoring, and climate monitoring; and for most Covered Species, the combination of these monitoring approaches will help ensure that biologically important changes are detected and addressed.

### Pima Pineapple cactus

Pima County currently monitors populations of the Pima pineapple cactus on two mitigation banks (Elephant Head and Madera Highlands) using a protocol that tracks the fate of individuals that were identified in a previous survey. This approach does not provide a measure of true population size (i.e., it does not account for new individuals to be included in the sample) and therefore it will not be used in the PCEMP. Instead, Pima County will commit to monitoring at least 10 sites on County preserves (including mitigation banks) where the species is known to occur. The goal will be to monitor abundance at select sites. Monitoring will take place every three years. Surveys will involve line or plot-based surveys based on the work by Roller (1996; see Literature Cited for website link to protocol), but it may be appropriate to refine the sampling design and protocol to increase efficiency of surveys and survey a larger area. Refinement of the protocol may include population estimation (rather than enumeration) using occupancy models that account for imperfect detectability (Royle et. al. 2005, MacKenzie et. al. 2006). A recovery plan for the species is being drafted by Marc Baker, who has indicated that he is developing a long-term monitoring plan for the species (Marc Baker, *personal communication* to Brian Powell). Pima County will work with the USFWS to determine if that protocol is appropriate for our needs. A preliminary protocol for the County effort (including a detailed sampling design, survey method, and mapped locations of monitoring sites) will be developed in consultation with the USFWS and submitted within 18 months of permit issuance. Until that time, the County's Pima pineapple cactus surveys will follow Roller (1996).

### Lesser long-nosed bat

The lesser long-nosed bat can forage >40 km from their day roost each night (Ober et. al. 2005), thereby making it more effective to focus monitoring efforts at roost and maternity sites (caves, mines, and adits) where population estimation may be possible. Pima County will commit to monitoring lesser long-long nosed bat abundance (or an index of abundance) at all known roost and/or maternity sites within County preserves, though to date there are no known roosts on County preserves. (Pima County is currently undertaking an inventory of caves, mines, and adits). If one or more sites are found, Pima County will commit to monitor the site(s) annually in coordination with the multi-agency lesser long-nosed bat monitoring effort headed by the Arizona Game and Fish Department. Until or unless a site is found on County preserves, Pima County will offer to participate in an annual count at one of the known roost and/or maternity sites outside of the County's preserve system and within eastern Pima County or adjacent Cochise County. Regardless of the location of the site to be monitored, Pima County will employ whatever counting method the Arizona Game and Fish Department and USFWS deem appropriate. Monitoring will begin within 12 months of permit issuance. Finally, the Arizona Game and Fish Department has indicated that they will develop a multi-species bat monitoring plan and if that is ever developed, Pima County will work with the USFWS to determine if the plan's goals and methods are appropriate for application to Pima County's Section 10 monitoring and management needs and responsibilities. The continued spread of white-nosed syndrome should not directly

impact this species, but may impact guidelines and protocols for accessing caves, mines, and adits to conduct bat assessments and monitoring. See note in the section below on contingency plans.

**Mexican long-tongued bat, California leaf-nosed bat, and Pale Townsend's big-eared bat**

As with the lesser long-nosed bat, monitoring for these species is best performed at roost and maternity sites. Therefore, Pima County will monitor species' occupancy and the availability and management of roost sites at a subset of known cave and adit roost sites within County preserves, as well as monitoring habitat improvement projects, which includes stabilization and gating. Following the conclusion of an ongoing cave, mine, and adit inventory, Pima County will have a more complete understanding of the distribution and use of these resources by bats and will supply this information to the USFWS when the inventory process is complete. Regardless of the outcome of that effort, Pima County will commit to monitoring at least 10 sites every three years for occupancy and site condition, with the possibility of adding additional sites if a roost is deemed by Pima County and the USFWS to be of significant size to warrant such an effort. Restoration sites will be monitored each year for 3 years following the restoration effort, with monitoring changing to every three years thereafter. Pima County will enter sites to conduct visual counts using low or infrared lights, unless it is determined that monitoring with accustic sampling devices is more effective (i.e., when bats are in crevasses that hide them). Because visits to the sites will be infrequent, it is not anticipated to result in long-term stress to the animals. Pima County will develop a cave, mine, and adit visitation protocol (including what kinds of equipment to be used) to minimize disturbance to bats at all caves, mines, and adits. This is particularly important because many of these species are sensitive to disturbance and this will need to be considered in developing and implementing the monitoring protocol. For example, in some situations it may be deemed inappropriate to disturb roosting bats. Pima County will work with the USFWS to determine what level of disturbance is appropriate and determine the tradeoffs between protecting the species and monitoring their populations. Also, the monitoring program may be altered because of the potential spread of white-nosed syndrome into the area. If this occurs, Pima County will coordinate with state and Federal wildlife officials to potentially restrict visitation of caves, mines, and adits to protect species that are susceptible to white-nosed syndrome (most likely the Pale Townsend's big eared bat) and other species, such as *Myotis velifer*, that may not be covered under this MSCP, but which might co-locate with Covered Species. If closure of the caves, mines, and adits occurs, it will likely impact monitoring activities and Pima County will work with the USFWS to develop an alternative protocol. A preliminary monitoring protocol will be provided to the USFWS within 24 months of permit issuance and monitoring will begin within 24 months of permit issuance.

### Cactus Ferruginous Pygmy Owl

The cactus ferruginous pygmy owl has been a cornerstone of the County's conservation planning since the late 1990s, but since that time, the owl population has declined so significantly in the Permit Area that it may no longer occur there. Because of the low probability of encountering the species, Pima County will monitor sites with the very highest likelihood of presence. A map of the species' most suitable habitat will be obtained from a recent effort by the Arizona Game and Fish Department and USFWS (unpublished data). Once the map is complete and sampling frame established, Pima County will survey for occupancy at a minimum of 10 transects (with multiple sampling points in each transect) within the preserve system. Each transect will be surveyed using the large-area survey protocol (Arizona Game and Fish Department and U.S. Fish and Wildlife Service 2000). Pima County may modify this protocol based on data from Flesch and Steidl (2007), which indicates that the number of within-season surveys can be reduced if surveys take place at specific periods in the species' nesting cycle when detectability is greatest. Regardless of the number and/or timing of intra-annual surveys, Pima County will survey all transects every three years. Mapping habitat and identifying the sampling frame for monitoring within County preserves will take place within 18 months of permit issuance and revisions to the sampling protocol and full implementation of the monitoring protocol will begin within 24 months of permit issuance. Any revisions to the protocol will be approved by the USFWS prior to implementation. If, after three sampling seasons (i.e., nine years), no individuals have been observed, Pima County will meet with the USFWS and species experts to determine if additional monitoring is appropriate for this species or if monitoring resources would best be directed elsewhere. Finally, Pima County will also offer to the AZGFD for County lands to be used for future release and monitoring of captive-bred individuals.

### Southwestern Willow Flycatcher

Pima County will monitor for the presence of the southwestern willow flycatcher at 3 sites (totaling 4 transects; each transect includes multiple survey points) within the following County preserves: Cienega Creek Preserve (2 transects), Bingham Cienega Preserve (1 transect), and at the A7 Ranch along the San Pedro River (1 transect). These sites encompass the entirety of the known or potential habitat for this species within the County's preserve system. Pima County will use the call-playback survey protocol of Sogge et al. (2010; see Literature Cited for website link to protocol), which prescribes 3 surveys per year per site during the breeding season. Surveys will take place every 3 years at all sites beginning in the second spring after permit issuance. Survey results will be reported to the USFWS and AZGFD within 3 months of completing surveys. The first monitoring season will take place within 12 months of permit issuance and the protocol and maps will be provided to the USFWS within 24 months of permit issuance. Pima County will investigate credible sightings of this species on other preserve lands and if presence is confirmed, Pima County may decide to pursue monitoring at that site.

### Western Yellow-billed Cuckoo

Pima County will monitor for abundance and/or occupancy at 2 sites (a total of 3 transects; each transect includes multiple survey points): Cienega Creek Preserve (2 transects) and Bingham Cienega Preserve (1 transect). Agua Verde Creek in Colossal Cave Mountain Park may also be monitored, as will County-owned sites along the effluent-dominated section of Santa Cruz River north of Roger Road if sufficient evidence exists of yellow-billed cuckoo occupying those locations during the breeding season. Periodic surveys of the Santa Cruz River by entities such as the Tucson Audubon Society will inform us if cuckoos have occupied areas along the river. All monitoring will employ the standardized protocol by Laymon (1998) and Wiggins (2005; see Literature Cited section for link to on-line protocol), which uses the tape-playback method. Pima County will conduct at least 3 surveys per year during the breeding season and surveys will be conducted every 3 years at all sites beginning in the second spring after permit issuance. Monitoring will begin within 18 months of permit issuance and the protocol and maps will be provided to the USFWS within 30 months of permit issuance.

### Fishes: Gila chub, Gila topminnow, longfin dace, desert sucker, and Sonora sucker

Fish species that are covered under the County's Section 10 permit only occur at 2 sites within the preserve system: Cienega Creek Preserve and Buehman Canyon. Buehman Canyon currently contains only the longfin dace, but the Cienega Creek Preserve contains all 3 fish species that are covered under the Section 10 permit and that are confirmed to occur within the Permit Area: Gila chub, Gila topminnow, and longfin dace. Pima County will monitor for the presence of the longfin dace at Buehman Canyon at least every 2 years using a passive survey method (using binoculars)(need literature citation). The primary focus of fish monitoring will be at the Cienega Creek Preserve, and there the County will rely on the annual monitoring effort that is part of the Bureau of Reclamation's biological opinion related to the Central Arizona Project (Bureau of Reclamation 1998). The revised biological opinion and long-term monitoring program includes a 100-year, annual monitoring effort in areas throughout Arizona, including 2 sites within the Cienega Creek Preserve (Clarkson et. al. 2011), where monitoring began in 2008 (Marsh et. al. 2009). The long-term monitoring protocol used can be found in Clarkson et al. (2011; see Literature Cited section for a link to the document). Though the primary purpose of the CAP monitoring effort is to detect the presence of non-native fish, surveyors also record the number of native fish caught per species, catch-per-unit-effort, and presence of crayfish. They employ electrofishing and seining. Because this is a long-term effort and ties into a monitoring program that includes site throughout central and southern Arizona, Pima County will rely on this effort for monitoring fish species at the Cienega Creek Preserve. If, for any reason, the program ceases monitoring activity at the Cienega Creek Preserve, Pima County will assume responsibility for the effort by monitoring annually through the end of the 30-year permit.

Following significant upgrades to the County's two wastewater facilities, the Santa Cruz River downstream of the facilities may show more favorable conditions for the reestablishment of Gila topminnow, longfin dace, desert sucker, and Sonora sucker. Pima County will work with the USFWS following upgrades in 2016 and subsequent water-quality testing to determine if fish monitoring is a reasonable and prudent activity at that location. If so, Pima County will commit to monitoring every 5 years using electrofishing and seining using the same methods as employed by Clarkson *et al.* (2011).

### Lowland leopard frog

Recent surveys for lowland leopard frogs on County preserves found that the species occurs in 6 sites: Cienega Creek Natural Preserve, Youtcy Canyon Spring (A7 Ranch), Espiritu Canyon (tinajas; A7 Ranch), Buehman Canyon, and Edgar Canyon (Six Bar Ranch) (Brian Powell, *unpublished data*). Pima County will monitor occupancy of lowland leopard frogs at these sites every 3 years. Surveys will take place in the late spring and early summer (pre-monsoon). Occupancy will be for any stage of the species' life cycle (eggs, tadpoles, adults) and employ a visual encounter survey method (Heyer 1994), which is the same as for the Chiricahua leopard frog (see below). Surveys will include a rapid assessment of habitat conditions (mostly water availability) during each visit. Survey protocols will include a detailed procedure for cleaning equipment to prevent the spread of Chytrid fungus among frog populations. While conducting surveys for the lowland leopard frog, Pima County will also note the presence of other aquatic species such as the Sonoran mud turtle, canyon treefrog, as well as American bullfrog and crayfish. Pima County will investigate any sightings of the lowland leopard frogs on other preserve lands and, if presence is confirmed, Pima County may decide to pursue monitoring at that site. Pima County may also periodically test frogs for the presence of Chytrid fungus. Monitoring will begin within 24 months of permit issuance and protocols and maps will be provided to the USFWS within 30 months of permit issuance.

### Chiricahua leopard frog

No known populations of this species currently exist on County preserves. However, Pima County will inventory any new County preserve for this species. In addition, Pima County has been planning to create habitat for this species on the Sands Ranch (Goat Well) and recently completed work at Hospital Tank on the Clyne Ranch specifically for the benefit of this species. According to David Hall (*personal communication* to Brian Powell), Chiricahua leopard frogs are known to have historically occurred in Hospital Tank. Whether these reintroductions take place under the State of Arizona's safe harbor agreement (Arizona Game and Fish Department and U.S. Fish and Wildlife Service 2006) or under this Section 10 permit is unknown at this time and will depend on the timing of implementation of the Section 10 permit. Regardless, Pima County will commit to monitoring all reintroduced populations for each of the first 3 years following the reintroduction effort, then every 3 years thereafter. Surveys will take place in the late spring and early summer (pre-monsoon). Occupancy will be established if there is

an observation for any stage of the species' life cycle (eggs, tadpoles, adults). Surveys will employ a visual encounter survey method (Heyer 1994) (U. S. Fish and Wildlife Service 2007; see Literature Cited section for link to the document and included monitoring protocol), but would also likely involve capturing individuals to ensure proper species identification. Surveys will also include a rapid assessment of habitat conditions (mostly water availability) during each visit. Survey crews will strictly follow a detailed procedure for cleaning equipment to prevent the spread of Chytrid fungus among populations of frogs. While conducting surveys for the lowland or Chiricahua leopard frog, Pima County will also note the presence of other aquatic species such as the Sonoran mud turtle, canyon treefrog, as well as American bullfrog and crayfish. Pima County may periodically test frogs for the presence of Chytrid fungus. Monitoring will begin within 24 months of permit issuance and protocols and maps will be provided to the USFWS within 30 months of permit issuance.

### Desert tortoise (Sonoran population)

The desert tortoise is the most widespread of all the Covered Species for which Pima County is proposing single-species monitoring. Pima County will monitor tortoise occupancy on plots within the preserve system that contain the species' modeled habitat and monitoring will be largely restricted to sites within the urban/exurban interface. Pima County will commit to monitoring at approximately 10 sites, which will be surveyed every 2 years according to the field protocol suggested by Zylstra (2008). This protocol suggests at least 4 visits to each site each survey year. Ideally, Pima County's monitoring for this species would contribute to a larger monitoring effort throughout the species' range. A long-term monitoring protocol may be developed by the Arizona Game and Fish Department (Christina Jones, *personal communication* to Brian Powell). Once the AGZGD protocol is complete, Pima County will decide if it is appropriate for Pima County to be involved. The County's commitment to monitoring the desert tortoise is not contingent on the state's development of a long-term monitoring plan for the tortoise. Monitoring by Pima County will begin within 24 months of permit issuance and protocols and maps will be provided to the USFWS within 30 months of permit issuance.

## Habitat Monitoring

### Introduction

Habitat is the sum of resources that a particular species needs to perform life-history functions such as foraging, nesting, mating, and seeking refuge (Morrison et. al. 1998). Because of its important to species, habitat monitoring will be a critical component of the PCEMP. As noted in the introductory section of this appendix, monitoring certain parameters in addition to—or instead of—the species themselves is often warranted for landscape-scale conservation programs. In the case of the County's considerable conservation commitment for the MSCP (including over 200,000 acres under ownership or management), habitat monitoring at landscape or ecosystem level is particularly warranted. A second—and related—justification for this approach is that changes to a

species' habitat are most likely to affect populations of the species themselves and in some cases may predict these changes in advance, thereby providing an opportunity to address impacts to species or habitats or enact management actions to improve habitat quality (e.g., Krueper et. al. 2003). This is the reason why many successful species conservation projects focus on improving a species' habitat and in reducing threats. The USFWS has acknowledged the habitat-based approach to monitoring for HCPs as appropriate in their five-point policy provided that there is a tie to the Covered Species (U.S. Fish and Wildlife Service 2000), which is accomplished in Table A.3 of this appendix.

The design process for the habitat element of the PCEMP is given in detail by Steidl et al. (2010) and we refer to the reader to that document for details (a link to the document is provided in the Literature Cited section of this appendix). The following sections provide an overview of what, how, and where Pima County will be undertaking habitat monitoring.

### Long-term Monitoring Plots: The "Heart" of Vegetation and Groundcover Monitoring for the PCEMP

Pima County will establish a network of long-term monitoring plots within County preserves. Within each plot, multiple parameters (i.e., measures or indicators) will be monitored over time, with most of the focus being on vegetation and groundcover. During the early planning stages of the PCEMP, it was determined that monitoring a host of parameters at the same location has inherent advantages over designs that monitor only one or a few resources at a site. Co-location of monitoring plots is common (e.g., National Biological Service 1995, Manley et. al. 2006), particularly when the resources of interest have an important effect on—or are influenced by—each other. Sampling for multiple parameters at the same location has two primary advantages over strategies that establish sampling locations for parameters independently. First, co-locating measurements will allow for assessments of interactions among parameters and provide data that can be used as covariates (i.e., explanatory variables) in analyses of trends. For example, changes in vegetation structure and composition can be explored to assess whether these changes are associated with changes in precipitation. Second, costs are reduced when sampling plots are co-located because several parameters can be measured at a site during a single visit.

Because of the overwhelming influence of vegetation on vertebrate species (and in consideration of the methods used to monitor it) the best approach to establishing long-term monitoring plots is to establish a *primary sampling unit*, and for the PCEMP that will be a circular plot with a radius of approximately 150 m (17.5 acres) to support measurement of all vegetation, groundcover, and precipitation. Within each plot will be 12 subplots where measurements of vegetation and groundcover will occur (see Appendix O for a more detailed description of the spatial layout and data collection protocol). This plot size and arrangement of subplots will facilitate precise estimates of vegetation and other parameters within the plot, but is not so large as to make sampling inefficient. Though long-term monitoring plots are optimized for vegetation monitoring,

additional parameters will be monitored at long-term monitoring plots including precipitation, and threats such as off-road vehicle use and presence of select invasive species.

### a. Establishing Long-term Monitoring Plot Locations

The primary goal of the PCEMP is to determine the status and trends in resources over time. However, in the case of parameters measured at long-term monitoring plots, it is not possible to survey all of these resources across the preserve lands due to financial and logistical limitations. To increase the efficiency of monitoring, Pima County will employ *sampling,* which is the process of selecting units from a larger population so as to draw inferences to it. In particular, Pima County will establish monitoring plots using a *probability-based sampling* approach, which employs a component of randomization in selecting sampling units to ensure that inferences can be made to the entire preserve system (Thompson 2002). The method of selecting where and how often to sample is referred to as *sampling design*; these choices ultimately determine the power and precision of the monitoring program, its spatial and temporal inference, and overall cost (see Thompson and Seber 1996, Lohr 1999, Morrison et. al. 2001, Thompson 2002). Probability-based sampling contrasts with a variety of non-probability based approaches that are often used in ecological monitoring (Olsen et. al. 1999). Subjective approaches include judgment sampling (investigator knows best where plots should be placed) and haphazard sampling (any site will be sufficient; Morrison et al. 2001). These approaches may be sufficient for some monitoring applications, but they will be avoided in the development of the PCEMP.

Monitoring at long-term monitoring plots will take up a significant amount of the on-the-ground monitoring effort for the PCEMP. As such, it is crucial to develop a program that maximizes the amount of information gained with the minimum amount of field work necessary. To accomplish this objective, Pima County will stratify all potential monitoring plots and then employ a random (GRTS) design to determine the location of plots within each stratum (Theobald et. al. 2007). Stratification will be necessary because of the wide range of ecological communities within the preserve system and because stratification adds greater efficiencies in situations where there are considerable differences among sites (Scott 1998). The method of stratification has not been finalized and may use ecological sites (Natural Resources Conservation Service 2011) or a more simple stratification scheme based on dominant vegetation communities. At a minimum, four strata will be used: Sonoran Desert upland, semi-desert grassland, meso-riparian, and hydro-riparian. Site visits, on-the-ground protocol testing, and input from experts will be required to determine the most efficient approach to stratification.

### b. Parameters Monitored at Long-term Monitoring Plots

On-the-ground monitoring activities will be focused primarily on vegetation, groundcover, and climate. Vegetation is a key habitat feature for many Covered

Species (see habitat narratives in Table A.3) and vegetation is an indicator of site characteristics, past disturbance events, and climatic patterns. Two aspects of vegetation are important: (1) *structure* is the physical formation, arrangement, and physiognomy of vegetation and will be measured as density or volume of vegetation; and (2) *composition* is the plant species present on a site and will be measured as stem density, abundance, or frequency. Pima County will only monitor perennial plants at long-term monitoring plots because annual plants are extremely variable from year-to-year and season-to-season, making establishing trends in annual plants very difficult. However, Pima County will note the presence of select annual plants, particularly invasive species, while surveying at long-term monitoring plots.

In the spring of 2010, Pima County developed and pilot tested a field protocol to monitor vegetation and other resources at long-term monitoring plots. That protocol can be found in Appendix O and includes information on ground-cover monitoring, which is also an important habitat feature for some covered species and is a key leading indicator of change in some plant communities, particularly in the uplands. Finally, precipitation will be monitored at a select set of long-term monitoring plots where there is not a precipitation gauge nearby. Precipitation is key to plant growth and long-term data on precipitation will be used to help explain observed changes in the vegetation community at long-term monitoring plots.

#### c. Number and Revisit Pattern for Long-term Monitoring Plots

After permit issuance, Pima County will establish at least 100 long-term monitoring plots in County preserves. This is the minimum effort that Pima County will commit to, but the final number of plots will be determined after permit issuance and after additional pilot data is collected. To assist in this planning effort, Pima County will use statistical power analyses to assist in determining the number of plots needed to detect a biologically meaningful change (Peterman 1990, Steidl et. al. 1997) and power analysis will be performed using data from the pilot test of the protocol. Once the number of plots has been established, Pima County will determine the best revisit pattern to plots. The most common temporal strategies involve surveying sites at fixed intervals, which for vegetation monitoring typically occurs at 3-5 year intervals. Other options for temporal sampling involve the use of panel designs (McDonald 2003). At this stage of planning, Pima County commits to monitoring each site on the same revisit schedule (i.e., every 3-5 years), but the County will periodically assess if there is a more efficient approach. These decisions will be made in consultation with experts and the USFWS.

### Using Remote Sensing Tools to Monitor Habitat Change

Habitat monitoring, particularly for vegetation, does not need to be restricted to on-the-ground measurements at long-term monitoring plots. The PCEMP will determine if remote sensing technologies can be used to monitor changes in habitat parameters, most notably vegetation structure and composition. In particular, the use of light detection and ranging technology (LiDAR), combined with multi-spectral imagery, is a powerful new tool set for monitoring vegetation structure change as well as changes in

stream channel morphology. (Stream channel morphology was not chosen for inclusion into the program, in part because of the expense of collecting on-the-ground monitoring data, but it can be monitored easily and inexpensively using LiDAR). Swetnam and Powell (2010) conducted a pilot study of the effectiveness of LiDAR for characterizing vegetation along the Cienega Creek Natural Preserve and for its application to the MSCP. The pilot study found that vegetation monitoring using LiDAR is feasible, particularly in areas with significant amounts of vegetation, such as in riparian systems.

LiDAR is an optical remote sensing technology that uses a rapid pulse laser beam to measure the distances between the sensor and an object. The resulting data is a 3-D image of vegetation and 2-D image of the bare ground layer. LiDAR data are spatially extensive and intensive, mapping nearly every plant that has direct overhead exposure to the sensor. LiDAR data have many applications for ecological monitoring, but the most important application for the PCEMP is the ability to obtain detailed vegetation maps of individuals plant to estimate their vertical and horizontal measurements (Andersen et. al. 2006). Never before has 3-D vegetation data been available over such an extensive area as it is now available because of LiDAR. LiDAR data can also be combined with 2-D orthophotographic imagery to generate accurate vegetation maps at landscape scales (Hudak et. al. 2008). The result is a map that has characteristics of vegetation structure from the LiDAR data and vegetation greenness from the aerial imagery. In addition to vegetation maps, some human induced impacts that might be tracked in a bare earth surface layer include roads, ATV trails, hiking trails, grazing and agricultural impacts, and structures.

LiDAR is not without its problems, not the least of which is the high cost of data acquisition and specialized expertise to analysis it. Data requirements for vegetation applications, such as for Pima County, are far greater than for more standard applications of LiDAR (e.g., bare earth layer), meaning that for vegetation, it can be more than twice as expensive to acquire data for vegetation as compared to bare earth. Other challenges include questions about its utility for monitoring change in the desert uplands and semi-desert grassland communities (e.g., Streutker and Glenn 2006). Despite these challenges, Pima County will continue to explore options for employing this promising new tool. Towards this end, Pima County worked with the Pima Association of Governments to collect high density LiDAR at the Cienega Creek Preserve in 2011.

Though LiDAR presents an exciting and potentially powerful tool for monitoring vegetation and stream-channel morphology change, Pima County will not commit to including LiDAR as part of the MSCP at this time, because of the County's commitment to monitoring at long-term monitoring plots. Over time, Pima County may use LiDAR data to replace long-term monitoring plots if (and only if) Pima County and the USFWS agree to such a change as part of the County's adaptive monitoring strategy.

## Water Resources

Water is a driver of ecological patterns and processes, especially in arid environments. In riparian areas, in particular, water availability has a profound effects on biodiversity in general (Stromberg et. al. 1996, Eby et. al. 2003). In the southwestern U.S., more than 70 percent of vertebrate species use riparian areas during some stage of their life cycles (Knopf et. al. 1988), and in Pima County many Covered Species occur in riparian areas, especially hydo-riparian and meso-riparian communities (Rosen 2000). In addition to supporting high biodiversity, naturally functioning riparian areas improve water quality and provide important floodplain functions (Leopold et. al. 1964, Stromberg et al. 1996, Naiman and Decamps 1997). Water monitoring is therefore an essential component of the PCEMP, especially given the increasing demand for water by humans and the likelihood of reduced natural water resources as a result of climate change (Powell 2010a). Three primary water resources will be monitored as part of the PCEMP: (1) seeps and springs, (2) shallow groundwater in select systems, and (3) perennial streams. The following sections provide details of the County's justification for—and commitment to— monitoring these resources. A narrative on the connection between Covered Species and the water resources can be found in Table A.3.

## Springs

Springs are places where water, traveling through soil or rock, naturally rises to the surface. The discharge (flow) at springs is controlled by the rate of replenishment of the aquifer or water table and as a result, spring flow can decline as a result of drought, groundwater pumping, or natural disruption. Though small in area, springs are well-known hotspots of biodiversity (Sada et. al. 2005) and are important for a number of the Covered Species including fish, the lowland leopard frog, and bats (Fonseca et. al. 2000). Some springs have been converted into stock watering structures for ranch activities.

Pima County is in the process of compiling an inventory of springs on County preserves and after that inventory is complete, monitoring will begin within 24 months. In January 2012, the Sky Island Alliance began developing an interagency springs monitoring and stewardship program based on the highly successful program by the Springs Stewardship Institute (http://www.springstewardship.org/). Pima County will continue to be a partner in the Sky Island Alliance effort and will likely adopt the protocol and database that is established. Participating in a large landscape monitoring effort has many advantages, perhaps most importantly by being able to compare trends on County preserves to those of the larger landscape. At a minimum, Pima County will commit to monitor at least eight springs that are identified in County's ongoing springs inventory, which likely represents >60% of the known spring on County preserves (Brian Powell, *unpublished data*). Monitoring of those springs will take place at least once every 2 years. Pima County will present a springs monitoring protocol (including site maps and the types of data collected at each visit), to the USFWS within 3 years of permit issuance.

### Perennial Stream Flow and Extent

Like springs, perennial streams are restricted to relatively few areas within Pima County and contribute disproportionately to the species richness of an area (Naiman and Decamps 1997). Stream flow length has been identified in a number of local assessments as a top-ranking monitoring parameter (Mau-Crimmins et. al. 2005, RECON Environmental Inc. 2007) because flow length can be impacted by a host of threats such as drought (Christensen et. al. 2004) and adjacent land-use. Stream flow and associated vegetation can also respond positively to threats reduction (Krueper et al. 2003, Katz et. al. 2009).

Pima County will commit to monitoring perennial stream flow and/or extent at all of the sites that Pima County has determined this valuable resource exists within the preserve lands: Cienega Creek Preserve, Buehman Canyon, Davidson Canyon, Youtcy Canyon, and Espiritu Canyon. Monitoring streamflow extent will involve mapping the “wetted” areas along the entire stretch of these riparian systems. This “wet/dry” mapping has been taking place since 2001 at the Cienega Creek Preserve (Pima Association of Governments 2009). Flow monitoring will involve the use of a pygmy meter at the same sites over time, and flow monitoring has been conducted for years along Cienega Creek Preserve by the Pima Association of Governments and along Buehman Canyon by The Nature Conservancy. Pima County will commit to monitoring these parameters at least once per year and most likely during the hottest and driest part of the year (i.e., June). Pima County will present a monitoring protocol to the USFWS within three years of permit issuance and data will be collected at the above-mentioned sites within four years of permit issuance.

### Depth to Water in Select Groundwater-dependant Systems

Areas with shallow groundwater that support stream flow and/or riparian ecosystems are critical landscape features. Here, water is available for riparian and aquatic resources, including many of the Covered Species and their habitat. Depth to groundwater is a key monitoring parameter because relatively small differences in shallow groundwater elevations can be of great significance ecologically, particularly in the first several feet below the land surface (Lite and Stromberg 2005, Stromberg et. al. 2006). Depth to groundwater is a very sensitive and desirable indicator of ecosystem health and habitat for Covered Species because of its important connection to vegetation and surface water availability and because it is less variable than surface-water measurements. Fonseca (2008a) provides an in-depth analysis and discussion of this topic and we refer the reader there for more information, including recommendations for the PCEMP.

Because of its importance to habitat of Covered Species (see Table A.3), Pima County will commit to monitoring depth to shallow groundwater at sites along Cienega Creek and Bingham Cienega. Other sites may be included in the PCEMP and evaluation of these sites will be made within two years of permit issuance. Many other groundwater monitoring wells are monitored throughout eastern Pima County by other entities and the PCEMP will both contribute data to those effort and receive periodic updates.

Putting Pima County sites within a regional context will have the same advantages as noted for springs.

### Caves, Mines, and Adits

Some caves, mines, and adits (herein caves) are key habitat components for a number of Covered Species, most importantly bats, and therefore will be a top priority for monitoring. As noted in the species-specific monitoring effort for cave-dwelling bats, caves on County preserves that provide bat habitat will be visited at least once every 3 years. Initial site visits to lesser-known caves (i.e., all caves except at Colossal Cave Mountain Park) will entail a detailed survey of conditions including size and dimensions of the feature, evidence of vandalism, and any structural issues that may cause deterioration of the cave or preclude subsequent visits, as well as a determination about the potential for installing bat-friendly gating. Pima County is conducting an inventory of caves within the County Preserve System and recording key information about each site. Site monitoring will document changed conditions since the last visit, such as evidence of collapse and vandalism.

As mentioned in the section on Mexican long-tongued, California leaf-nosed, and Pale Townsend's big-eared bats, Pima County will develop a cave, mine and adit visitation protocol that will be sensitive to the potential for Pima County staff to spread white-nosed syndrome. Pima County will also work with State and Federal partners to develop a region-wide response if the disease is discovered in southern Arizona and/or. Pima County will abide by the directives from the State and Federal wildlife agencies regarding cave closure or visitation protocols, if such a directive is developed.

### Talus Deposits

Talus deposits are habitat for the talus snail species and subspecies that Pima County is proposing to cover under the MSCP. Therefore, protection of these sites on County preserves is a top priority for Pima County and the management objective is to avoid direct or indirect impacts to the deposits or the supporting natural processes affecting the deposits. There has been no systematic inventory of talus deposits on County preserves. Within five years of permit issuance, Pima County will complete an inventory of talus deposits on County preserves. Inventories will include incidental observations of shell casings that would indicate recent talus snail occupancy. Monitoring will be for evidence of vandalism and encroachment by non-native species, especially buffelgrass, which could impact habitat quality for the snails. Monitoring will take place at minimum every 5 years on at least 20 of the largest talus deposits in the preserve system.

## Landscape-pattern Monitoring

Landscape pattern is a broad category describing the spatial configuration and extent of land-cover and land-use parameters. *Land cover* is the observed biophysical state of the earth's surface and immediate subsurface and is typically delineated into major categories such as types of natural vegetation (e.g., forest and grassland) and human

uses such as urban development, agricultural fields, mine sites, and roads (McConnell and Moran 2000). *Land use* involves both the manner that land is manipulated and the intent of that manipulation (Turner et. al. 1995). The difference between land cover and land use can best be explained by example. Classification of an area by land cover may assign it as semi-desert grassland, but the land use there may vary from protected area to active ranchland with very different and important conservation implications such as the potential for future subdivision of the ranchland. This example illustrates why land use is considered an excellent leading indicator of environmental condition and a major determinant of land cover (Meyer and Turner 1994). Further, the type, distribution, and extent of major land uses can foreshadow changes to the distribution and abundance of plant and animal species (Blair 1999) or other parameters such as water quality (e.g., Soranno et. al. 1996) that have important implications for maintenance of biodiversity and ecological health in Pima County.

Throughout the development of the SDCP and PCEMP, the STAT has recommended monitoring landscape-level parameters. Fortunately, there are a host of tools that Pima County can use for this element, as suggested by Fonseca (2008b). To monitor landscape pattern, Pima County will use tools that are produced as part of the County's day-to-day operations to measure and forecast development-related activities and remote-sensing tools including, but not limited to, products such as the National Land Cover Dataset and Regional GAP (Table A.1).

### Retrospective Monitoring of Landscape Patterns

The objective of retrospective monitoring is to document changes in the type and location of conversion activities such as new roads and sewers, and land cover that took place in a previous time period (unusually every year, but sometimes longer depending on the data source). Retrospective monitoring will be completed using two primary methods: using the County's internal data and using freely available information from other sources. Information gained from this analysis will be useful in understanding regional trends affecting species and inform other regional conservation and monitoring efforts.

During the 30 years of the monitoring program, new tools will be available to obtain a more accurate footprint of roads and development activities and Pima County will work with the USFWS to determine the application of these new products to the PCEMP. Using freely available datasets, Pima County will monitor changes in land cover over longer time periods as the tools become available (usually every 3-5 years). For this, Pima County will likely use the National Land Cover Dataset (NLCD) and the Southwestern ReGAP. The NLCD was used to map Arizona in 1992, 2001, and 2006, with changes in land cover summarized over that time period. Pima County and its partners can use the NLCD to understand conversion of natural cover to urban, agricultural and mining land uses, and to understand regional changes in the distribution and extent of bare soil, rock, and riparian forests (primarily mesquite bosques, broadleaf deciduous forests, and wetlands combined). Data is acquired at a resolution of 30

meters and at a time interval of approximately every 10 years. Change can be resolved at a minimum of 1 acre. For more information on this approach, see Fonseca (2008).

### Prospective Monitoring

Prospective monitoring will *forecast* the location of development by showing the spatial footprint of processes such as rezonings, plat and subdivision approvals by the Pima County Board of Supervisors, and planned capital improvement projects. Pima County will summarize these data as they become available, most likely on 3-5 year intervals. See Table A.1 for more information.

## Threats Monitoring

Threats are any past, present, or future anthropogenic activity that may impact a Covered Species or which degrades or destroys its habitat. Many threats result from past human actions, but which no longer require such actions for the threat to be significant, such as the introduction of an invasive species. Threats are widely recognized as being an important component of broad-scale monitoring programs (Salafsky and Margoluis 1999).

There are many threats that can be monitored (for a complete list of those considered, see Steidl et al. [2010)]) but Pima County has narrowed the list to a select set that can have the greatest impact on the Covered Species and their habitat. The suite of chosen parameters is listed in Table A.2, which provides a summary of threats and how they will be monitored as part of the PCEMP. Threats were chosen for a variety of reasons, including their importance in the SDCP planning process, direction from technical advisors (the STAT and during the Phase I scoping sessions; RECON Environmental Inc. 2007), and because of ongoing efforts to collect the information. For some threats that are not included as part of the PCEMP (e.g., water quality, hunting pressure), other entities may be collecting this information. Similarly, some threats are not currently being considered for inclusion into the program, but may be monitored in the future by employing collaborations that are not currently in place.

**Table A.1. Retrospective and prospective approaches that will be employed to monitor changes in landscape pattern as part of the PCEMP. Changes in these monitoring parameters will be reported each year or as new information is received.**

| Approach | Parameter | Data sources used in analysis |
|---|---|---|
| Retrospective | Miles of new roads in Pima County | Annual additions to highways, roads, streets will be based on Pima County GIS information. |
| | Extent and location of the built environment | A number of measures will be used to monitor this parameter. 1) Grading and/or building permits issued would be considered to be developed, 2) for improvements to a parcel outside of the sewer service area, changes in the tax assessor's records from "unoccupied" to "occupied" would be noted as developed, and 3) approved applications to Development Services for "Notice of Intent to Discharge" and "Discharge Authorization through Pima County's Department of Environmental Quality. Reporting will be annually. |
| | Changes in land cover type and location | Pima County will use data from a variety of free sources as they become available. The National Land Cover Dataset and Southwestern ReGAP are two products that are likely to be used. Summaries will occur as data become available. |
| Prospective | Extent and location of potential future development | Pima County collects the following information and stores it in a GIS that can be summarized as data become available, most likely every 5 years. (1) Rezoning. Some development activity in eastern Pima County happens after the approval of rezoning applications. Pima County will track the location and type of rezoning within unincorporated Pima County and report separately changes in land use codes, such as from ranchlands to agriculture or mining. (2) Subdivision Plat Approvals. After rezoning approval by the Pima County Board of Supervisors, subdivision or plat plans are submitted to Development Services for approval. Approvals in the planning period will be mapped. (3) Planned CIP Projects. Any proposed and approved (but not started) county or incorporated jurisdiction CIP project such as roads, sewers, and bank stabilization. |

**Table A.2. Threats that will be monitored as part of the PCEMP.**

| Threat | Justification, Parameters and Approach |
|---|---|
| Development and fragmentation | Justification: Development-related activities is the leading cause of habitat destruction and fragmentation in Pima County and is the reason for the County's acquisition of a Section 10 permit. Parameters: Location and area of development (buildings, roads, sewer, bank stabilization, etc.) resulting from the private and public sectors. |
| Motorized off-road vehicle impacts | Justification: Off-road vehicles (from road recreation, drug smuggling, and law enforcement) are an increasing threat to a variety of resources including Covered Species, soils, and vegetation. Parameters: Location, extent, and condition of new roads. Monitoring Approach: Yet to be determined, but is likely to be anecdotal and qualitative within County preserves. |
| Invasive aquatic vertebrates and crayfish | Justification: Bullfrogs, invasive fish, and crayfish can significantly impact aquatic Covered Species. In areas where they are not currently present, early detection will be critical. Parameters: Presence and relative abundance. Monitoring Approach: Monitored concurrently with fish, leopard frogs, and presence of water along key perennial riparian areas within County preserves. Surveys will be conducted using visual encounter surveys and will be conducted during surveys for Covered Species. |
| Invasive plants | Justification: Invasive plants can out-compete native plants and alter ecosystem structure and function and therefore threaten habitat of Covered Species. Of particular concern are buffelgrass, fountaingrass, Lehmann's lovegrass, and African sumac. Parameters: Variable depending on the species, but the number of new individuals in an area (i.e., early detection) is critical. Monitoring Approach: Pima County will develop a database for recording observations 15-20 of the most important invasive species that all appropriate County staff and cooperators must be able to indentify. These invasive species will be surveyed for in and around all long-term monitoring plots at the same time as vegetation monitoring. Buffelgrass mapping and monitoring efforts are ongoing and are being coordinated by the Southern Arizona Buffelgrass Coordination Center; Pima County will assist with this effort. Lehmann's lovegrass will be monitored at most long-term monitoring plots that occur in semi-desert grassland communities. |

## Climate Monitoring

*Climate* is the average weather over a long time period and is fundamental to ecosystem patterns and processes and as such is the broadest-scale category for inclusion into the PCEMP. Especially in arid regions, the amount and timing of precipitation and temperature, in particular, has an overwhelming influence on distribution and abundance of plants and animals in both space and time, and is an important determinant of regional biodiversity (e.g., Brown et. al. 1997, Preston et. al. 2008).

Many parameters are used in monitoring climate, most importantly temperature, humidity, wind speed, and precipitation. The PCEMP will focus only on monitoring precipitation because this parameter is more spatially variable and has such an important control over the distribution of Covered Species. Fortunately, many of the other important climate parameters are being collected by other entities within the County (Flood Control District) and Pima County will periodically obtain data on temperature, humidity, and wind speed from these entities, including: Arizona Automated Local Evaluation in Real Time Network, Arizona Meteorological Network, National Weather Service Cooperative Observer Program, Colorado River Basin Forecast Center, Rainlog.org volunteer network, and Remote Automated Weather Station Network. In addition, Pima County will benefit from broader-scale syntheses of climate that are being conducted by researchers and Pima County will continue to keep abreast of the most current findings.

Pima County will collect precipitation data at a subset of long-term vegetation monitoring plots that will be established throughout the County preserves using a combination of manual rain gauges and multi-function weather stations with data loggers. Personnel will check manual rain gauges or download data from automatic data loggers twice per year (September and May). The protocol for this monitoring element will be finished within 2 years of permit issuance. All rain gauges will be installed prior to commitment of mitigation land.

## How Pima County is Addressing Monitoring Needs for Each Covered Species

This appendix has provided a summary of the variety of monitoring methods that Pima County will employ to satisfy the effectiveness monitoring requirements of the MSCP. A key requirement of the MSCP effectiveness monitoring element is to demonstrate that the monitoring being proposed addresses key needs of each Covered Species. Table O.3 summarizes the monitoring commitments that Pima County will undertake and how each relates to individual Covered Species.

**Table A.3 Summary of monitoring justification and approach for Covered Species. See the respective sections (in parentheses) in this appendix for additional information. Note that the number of acres of a species' modeled habitat or Priority Conservation Area that is lost due to Covered Activities will be reported elsewhere as part of the County's compliance monitoring effort**

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
|---|---|---|---|---|
| Pima pineapple cactus | Monitoring for occupancy and/or abundance at a minimum of 10 sites in the County preserve system | The Pima pineapple cactus is found on relatively flat areas in desert scrub and semi-desert grasslands. Pima County will monitor vegetation on County mitigation lands within the species' PCA for trends in shrub encroachment and shifts in species composition for perennial plant species | Number and location of building permits issued within the species' PCA in unincorporated Pima County will be reported annually. Land-use change within the PCA will be reported as data become available. | |
| Needle-spined pineapple cactus | | The needle-spined cactus is found on alluvial fans on southern and western exposures and requires undisturbed lands for reproduction and growth. Pima County will monitor vegetation within the PCA at long-term monitoring plots for trends in shrub encroachment and shifts in perennial species composition and structure in the County preserve system, especially at BarV Ranch and the Cienega Creek Preserve. | Number and location of building permits issued within the species' PCA in unincorporated Pima County will be reported annually. Land-use change within the PCA will be reported as data become available. | |
| Huachuca water umbel | Monitor occupancy in 2 sites every 3 years. | This species requires permanent water, which will be monitored along Cienega Creek and Bingham Cienega, the 2 sites where this species has been found in the past. In addition, shallow groundwater levels will also be monitored. | Land-use change within the Cienega watershed will be reported as data become available. | |
| Tumamoc globeberry | | Dominant host plants for this species (e.g., *Larrea* and *Ambrosia*) will be monitored at long-term monitoring plots with the County preserves, especially an Tucson Mountain Park, the northern Altar Valley, and San Pedro River valley. | Number and location of building permits issued within the species' modeled habitat in unincorporated Pima County will be reported annually. Land-use change within the PCA will be reported as data become available. Buffelgrass is likely a threat to this species and Pima County will continue to provide information on the spatial distribution and relative abundance of this species within the County's mitigation lands. | |
| Lesser long-nosed bat | Pima County will commit to monitoring at least one roost site on or off of Pima County preserves. (Currently, there are | This species relies on Palmer's agave and saguaro cacti resources and they will be monitored at long-term monitoring plots throughout the County's preserve system, including in the bat's known habitat, which is widespread throughout the species known range in Pima County. Though those particular plant | Cave, mine, and roost characteristics on County preserves will be monitored for evidence of vandalism and collapse. Number and location of building permits issued within the species' PCA in unincorporated Pima County will be reported annually. Land-use change within the | |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
|---|---|---|---|---|
| | no known roosts of the species on Pima County preserves). | species are not be targeted as separate monitoring components, Pima County anticipates that enough plots will be established to determine trends in these important plant species. Pima County will also monitor the condition of potential roost sites throughout the County's preserve system. Condition parameters will begin with initial characterization of cave conditions (e.g., size and dimensions, geological features, and evidence of recent human use), to be followed by assessments of condition, especially evidence of collapse and vandalism. | PCA will be reported as data become available. | |
| Mexican long-tongued bat | Pima County will commit to monitoring occupancy of the species at a subset of caves, mines, and adits that will be determined after an inventory of these resources is complete. | This pollen-loving bat cues into floristic, rather than structural features of vegetation, and is therefore closely tied to agave and cacti (particularly saguaro), resources. These resources will be monitored at a host of long-term monitoring plots throughout the County's preserve system, including within the bat's known habitat in the Altar valley, the Cienega watershed, and the San Pedro watershed. Though those particular plant species are not be targeted as separate monitoring components, we anticipate that enough plots will be established to determine trends in these important plant species. In addition to its key food resources, Pima County will monitor the condition of potential roost sites throughout the County's preserve system. Condition parameters will begin with initial characterization of cave conditions (e.g., size and dimensions, geological features, and evidence of recent human use), to be followed by assessments of condition, especially evidence of collapse and vandalism. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also periodically monitor vandalism or disturbance activities at roost sites. | |
| Western red bat | | Habitat features that are important for this species are 1) many types of water resources for foraging, and 2) structure and composition of vegetation (especially overstory and midstory) for daytime roosts in vegetation, particularly along stream courses. Pima County will monitor mesic riparian vegetation at long-term monitoring plots that will be located within the species PCA, with | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also monitor groundwater levels in select sites in | |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
|---|---|---|---|---|
| | | particular emphasis on monitoring condition and size classes of mesic trees. | eastern Pima County (e.g., Cienega Creek Preserve and Bingham Cienega) according to the protocol recommendations of Fonseca (2008a); groundwater levels too low will threaten the broadleaf riparian vegetation that is so important to this species. | |
| Southern yellow bat | | Habitat features that are important for this species are 1) many types of water resources for foraging, and 2) structure and composition of vegetation (especially overstory) for daytime roosts in vegetation, particularly palm trees and cottonwood trees along stream courses. Pima County will monitor mesic riparian vegetation using long-term monitoring plots that will be located within the County's preserve system, especially at the Cienega Creek Preserve. Particular emphasis will be placed on monitoring condition and size classes of mesic trees. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also monitor groundwater levels in select sites in eastern Pima County (e.g., Cienega Creek Preserve and Bingham Cienega) according to the protocol recommendations of Fonseca (2008a); groundwater levels too low will threaten the broadleaf riparian vegetation that is so important to this species. | |
| California leaf-nosed bat | Pima County will monitor occupancy at a subset of caves, mines, and adits, the location of which will be determined after an inventory is complete of these resources | This wide-ranging bat is not known to be tied to any specific terrestrial resource that might reasonably be monitored except caves, mines, and adits used for roosting, which will be monitored every 3 years for changes in condition. | Condition parameters will begin with initial characterization of cave conditions (e.g., size and dimensions, geological features, and evidence of recent human use), to be followed by periodic assessments of condition, especially evidence of collapse and vandalism. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. | |
| Pale Townsend's big-eared bat | Pima County will monitor the species' occupancy at a subset of caves, mines, and adits that will be determined after an inventory is complete of these resources. | Known habitat features that are important for this species are 1) caves, mines, and adits for roosting, 2) water resources for foraging, 3) trees and buildings for temporary night roosts. Habitat monitoring for this species will take place at caves, mines and adits within the preserve system, with visits taking place every 3 years. Water resources, such as presence of water in select locations (e.g., Cienega Creek Preserve), will be monitored at least once per year. Though | Caves, mines, and adits will be visited every 3 years to document changes to conditions, especially vandalism or modification. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. If white-nosed syndrome is found in Arizona, the Pale Townsend's big- | |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
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| | | there is no link to specific vegetation features, vegetation monitoring will take place at long-term monitoring plots throughout the species' PCA, such as in the Altar and Cienega valleys. As more information is known about the habitat requirements of this species, Pima County will link this information back to the data that will be collected at these plots. | eared bat may be particularly susceptible because the species hibernates. Pima County will work with state and Federal officials to initiate a more rigorous, state-wide monitoring program and adhere to cave-visiting protocols so as not to allow for transmittal of the disease. | |
| Merriam's mouse | | Habitat features that are important for this species are: 1) course woody debris, 2) vegetation structure and composition. This species is associated with bottomland mesquite forests, which will be included in the monitoring program via long-term monitoring plots, some of which will be located within the species' PCA. Course woody debris is a parameter that will be monitored at all long-term monitoring plots. Pima County will investigate trends in the density and cover of key plant species (mesquite) at Canoa Ranch and Cienega Creek Preserve. | Pima County will annually report the number and location of building permits issued within the species'<br>PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. | |
| Burrowing owl | | Habitat features that are important for this species are: 1) alluvial soils with existing burrows, usually located along river banks or in abandoned agricultural fields or other areas cleared of vegetation and 2) *lack* of vegetation so that predators can be easily seen. Pima County will monitor these resources at long-term monitoring plots within the species PCA that are located within the County's preserve system. | Buffelgrass is likely a threat to this species and Pima County will continue to collect information on the spatial distribution and relative abundance of this species within the County' preserve system and provide this information to the Buffelgrass Coordination Center, which is standardizing the protocol for buffelgrass mapping and abundance estimates. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. | |
| Cactus ferruginous pygmy-owl | Monitoring for occupancy at a minimum of 10 sites within the County preserve system. | Habitat features that are important for this species are: 1) cavities for nesting, 2) vegetation in all height categories including ash, mesquite, and ironwood. Pima County will monitor these vegetation resources at long-term monitoring plots within the species' PCA that are located within the County's preserve system, especially in the Altar Valley. Pima County is also | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. | |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
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| | | investigating the use of LiDAR to monitor vegetation structure, which is very important for this species. | | |
| Rufous-winged sparrow | | Habitat features that are important for this species are primarily vegetation in the overstory, midstory, and understory. Plant species associated with nesting and foraging habitat include mesquite and palo verde trees, hackberry, greythorn, and the species seems to be associated with the presence of some understory grasses. Pima County will monitor these vegetation resources at long-term monitoring plots within the species' PCA located within the County's preserve system, especially in the Altar Valley. Changes in understory composition, especially the increase in buffelgrass, may impact this species. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will continue to collect information on the spatial distribution of buffelgrass within the County' preserve system. | |
| Swainson's hawk | | Habitat features that are important for this species are primarily vegetation in understory (perennial grasses and general lack of shrubs) and lack of vegetation in the overstory and midstory, except for the importance of nesting trees along washes bordering semi-desert grasslands. Pima County will monitor these key vegetation resources at long-term monitoring plots, many of which will be the species' PCA and within the County's preserve system, such as in the Altar and Cienega valleys. Particular attention will be paid to the increase in shrubs in semi-desert grassland areas within the preserve system. Data from long-term monitoring plots will help inform management efforts to restore grasslands. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. | |
| Western yellow-billed cuckoo | Pima County will monitor abundance and occupancy at 3 transects within the County preserve system. Monitoring will take place every 3 years. | Habitat features that are important for this species are primarily mesic and hydro-riparian trees and large mesquite trees adjacent to these areas. Because of the importance of these resources for this and many other species, Pima County will place particular emphasis on monitoring these key vegetation resources at long-term monitoring plots, some of which will be the species' PCA and within the County's | Pima County will monitor groundwater levels at the Cienga Creek Preserve and Bingham Cienega; groundwater levels too low will threaten the broadleaf riparian vegetation that is so important to this species. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change | |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
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| | | preserve system, particularly along Cienega Creek, Bingham Cienega, and the A7 ranch. | within the species' PCA as data become available. | |
| Southwestern willow flycatcher | Pima County will monitor abundance and occupancy at 4 transects within the County preserve system. Monitoring will take place every 3 years. | Habitat features that are important for this species are primarily mesic and hydro-riparian shrubs and trees. Because of the importance of these resources for this and many other species, Pima County will place particular emphasis on monitoring these key vegetation resources at long-term monitoring plots, some of which will be the species' PCA and within the County's preserve system such as along the San Pedro River. Pima County is also investigating the use of LiDAR to monitor vegetation structure, which is very important for this species. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also monitor groundwater levels in select sites in eastern Pima County (e.g., Cienega Creek Preserve and Bingham Cienega) using the protocol recommendations of Fonseca (2008a); groundwater levels too low will threaten the riparian vegetation that is so important to this species. | |
| Abert's towhee | | Habitat features that are important for this species are primarily mesic-riparian and xeric-riparian small trees and shrubs and vegetation structure in the understory and midstory. These features will be monitored at long-term monitoring plots in riparian areas within the species' PCA in the County's preserve system such as at Canoa Ranch, Cienega Creek Preserve, and the A7 ranch. Changes in dense vegetation volume in the understory and midstory will be of concern for this species. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. | |
| Bell's vireo | | Pima County will monitor Bell's vireo nesting habitat, which is characterized by dense stands of xero-riparian and meso-riparian vegetation, particularly in the understory and midstory. Vegetation species of importance include hackberry, mesquite, and *Baccharis*. Pima County will monitor dominant perennial vegetation species (especially hackberry and mesquite) and vegetation density and volume as part of the habitat-based monitoring element of the PCEMP. Because of the importance of riparian systems to this and other Covered Species, Pima County will ensure that an adequate number of long-term monitoring plots are within the riparian stratum. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. | |
| Longfin dace | Pima County will | Presence of water will continue to be monitored | Pima County will continue to monitor | |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
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| | monitor the species' occupancy in Buehman Canyon every 2 years. Pima County will rely on a monitoring effort in Cienega Creek that is part of a non-native monitoring program, but which also monitors relative abundance of native fish species | at the Cienega Creek Preserve. Water quality (especially dissolved oxygen and water temperature) are regulated, in part, by vegetation, both hydro-riparian emergent vegetation and trees. Trees adjacent to the creek will be monitored at long-term monitoring plots, which will be located within the habitat of this species in Buehman Canyon and the Cienega Creek Preserve. | groundwater levels at the Cienega Creek Preserve; groundwater levels too low will threaten the presence of water and associated vegetation. In addition, fish surveys will target invasive species such as fish, crayfish, and bullfrogs. Finally, Pima County will monitor land cover change within the Cienega Creek watershed. | |
| Desert sucker | | | | Pima County will survey every 5 years along the Santa Cruz River downstream of the wastewater treatment plants for occupancy by this species |
| Sonora sucker | | | | Pima County will survey every 5 years along the Santa Cruz River downstream of the wastewater treatment plants for occupancy by this species |
| Gila chub | Pima County will rely on a monitoring effort in Cienega Creek that is part of a non-native monitoring program, but which also monitors relative abundance of native fish species | Presence of water will continue to be monitored at the Cienega Creek Preserve. Water quality (especially dissolved oxygen and water temperature) are regulated, in part, by vegetation, both hydro-riparian emergent vegetation and trees. Trees adjacent to the creek will be monitored at long-term monitoring plots, which will be located within the habitat of this species along Cienega Creek. | Pima County will continue to monitor groundwater levels at the Cienega Creek Preserve (Pima Association of Governments 1998) according to the recommendations by Fonseca (2008a); groundwater levels too low will threaten the presence of water and associated vegetation. In addition, annual fish surveys will also target invasive species such as fish and crayfish. Finally, Pima County will monitor land cover change within the Cienega | |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
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| | | | Creek watershed. | |
| Gila topminnow | Pima County will rely on a monitoring effort in Cienega Creek that is part of a non-native monitoring program, but which also monitors relative abundance of native fish species | Presence of water will continue to be monitored at Cienega Creek Preserve as part of the wet/dry mapping by Pima Association of Governments (Pima Association of Governments 1998). Water availability will also be monitored during sampling for fish. Water quality (especially dissolved oxygen and water temperature) are regulated, in part, by vegetation, both hydro-riparian emergent vegetation and trees. Trees adjacent to the creek will be monitored at long-term monitoring plots (or using LiDAR), which will be located along Cienega Creek. | Pima County will continue to monitor groundwater levels at the Cienega Creek Preserve (Pima Association of Governments 1998) according to the recommendations by Fonseca (2008a); groundwater levels too low will threaten the presence of water and associated vegetation. In addition, annual fish surveys will also target invasive species such as fish and crayfish. Finally, Pima County will monitor land-cover change within the Cienega Creek watershed. | |
| Chiricahua leopard frog | Pima County will monitor any reintroduction effort for this species. Established populations will receive occupancy monitoring every 3 years. | The presence of water is a key habitat feature for this species and therefore the availability of water at monitoring sites will be recorded during surveys for the species. | Pima County will periodically monitor for bullfrogs and crayfish on the Sands and Clyne ranches. | |
| Lowland leopard frog | Pima County will commit to monitoring for occupancy at 6 sites every 3 years. | The presence of water is a key habitat feature for this species and therefore the availability of water at monitoring sites will be recorded during each survey. During baseline surveys for this species, Pima County will map potential habitat for this species, with particular emphasis on mapping the location and dimensions of tinajas within the creek reaches that contain or could contain the species. In the Cienega Creek preserve Presence, Pima County and it partners (Pima Association of Governments) will continue to monitor stream flow (Pima Association of Governments 1998). Water quality (especially dissolved oxygen and water temperature) are regulated, in part, by vegetation, both hydro-riparian emergent vegetation and trees. Trees adjacent to the creek will be monitored at long-term monitoring plots (or using LiDAR), which will be located along Cienega Creek. Vegetation monitoring is likely at other sites that contain the | Pima County will continue to monitor groundwater levels at the Cienega Creek Preserve according to the recommendations by Fonseca (2008a); groundwater levels too low will threaten the presence of water and associated vegetation. In addition, surveys will look for target invasive species such as fish and crayfish that prey on the frog. | |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
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| | | lowland leopard frog. | | |
| Desert box turtle | | Habitat features that are important for this species are semi-desert grasslands, from shrubless areas to grasslands moderately invaded by shrubs and trees such as mesquite. The desert box turtle is also associated with sparse to moderate densities of perennial grasses. Pima County will monitor dominant perennial woody and grass species and vegetation density and volume at long-term monitoring plots within the County's preserve system, such as at the Sands and Clyne ranches. An increase in shrub cover in semi-desert grasslands will be of concern for this species. | Pima County will periodically quantify loss and fragmentation of habitat in the species' PCA. Pima County will also monitor the location and extent of wildland fire within the County's preserve system, which could adversely cause lethal take of individuals. Ultimately, however, fire is likely a net positive for this species as fire helps to reduce shrub cover. | |
| Desert tortoise (Sonoran population) | Pima County will commit to monitoring at least 10 sites every 3 years within the County preserve system | Habitat features that are important for this species include burrows and shrubby desert upland vegetation. Pima County will monitor dominant perennial woody and grass species and vegetation density and volume at long-term monitoring plots within the County's preserve system where the species occurs, especially parts of the Altar Valley, Tucson Mountain Park, the A7 ranch, and the lower Cienega Valley. Changes in understory species composition, especially the increase in buffelgrass (which causes a reduction in food sources), are likely to impact this species, and therefore is a concern. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will continue to collect information on the spatial distribution and relative abundance of buffelgrass within the County' preserve system and provide this information to the Buffelgrass Coordination Center, which is standardizing the protocol for buffelgrass mapping and abundance estimates (Rogstad 2008). | |
| Tucson shovel-nosed snake | | Habitat features that are important for this species are open, undeveloped areas with sandy to loamy soils. Soils type and consistency are part of initial assessments of long-term monitoring plots. | Fragmentation and degradation of habitat is key for this species and Pima County will periodically quantify loss and fragmentation of habitat in the species' PCA. As noted in the habitat element, off-road vehicle use in this species' habitat is very likely impacting this species. To monitor this, Pima County staff will note off-road vehicle ORV) use during site visits to properties with the species' PCA. Buffelgrass is likely a significant threat to this species and Pima County will continue to collect information on the spatial distribution and relative abundance of buffelgrass within the County' preserve system and provide this information to the Buffelgrass Coordination | Pima County will investigate any credible sighting of this species with the County's preserve system. |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
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| | | | Center, which is standardizing the protocol for buffelgrass mapping and abundance estimates (Rogstad 2008). | |
| Northern Mexican gartersnake | | Habitat features that are important for this species are close proximity to standing water, emergent vegetation, hydro-riparian streamside vegetation, and course woody debris. To monitor these some of these habitat needs, Pima County and its partner Pima Association of Governments will continue to monitor the distribution of standing water at Cienega Creek Preserve. Pima County will also monitor vegetation at the Preserve and other locations with the species' PCA in the County preserve system, with particular emphasis on mesic riparian areas. Pima County is also investigating the use of LiDAR to monitor, which are important for this species. | The distribution and abundance of this species is known to be heavily impacted by aquatic invasive invertebrates (bullfrogs and crayfish, in particular, though non-native fish are also important predators). Pima County and our cooperators will monitor for these species at Cienega Creek Preserve through a variety of methods, such as during annual fish surveys and wet/dry mapping of Cienega Creek Preserve by PAG. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also monitor groundwater levels in select sites in eastern Pima County (e.g., Cienega Creek Preserve) using the protocol recommendations of Fonseca (2008a); groundwater levels too low will threaten the open water and associated vegetation that is so important to this species. | Pima County will investigate any credible sighting of this species with the County's preserve system. |
| Giant spotted whiptail | | Habitat features that are important for this species are primarily mesic-riparian and xeric-riparian washes with often dense stand of vegetation, small rock outcrops, and course woody debris. Pima County will monitor dominant perennial vegetation species, vegetation density and volume, and course woody debris at long-term monitoring plots within the County's preserve system. Loss of dense vegetation in key areas along streams and washes and within the species' PCA will be of concern for this species. Because of the importance of riparian systems this and other species, Pima County will ensure that an adequate number of long-term monitoring plots and/or other monitoring (e.g., use of remote sensing tools) are within the riparian stratum. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. The encroachment of fountain grass is also of concern and this will be monitoring along select stream courses. | |

| Common Name | Single-Species Monitoring | Habitat Monitoring Summary | Threats Monitoring Summary | Other Notes |
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| Ground snake (valley form) | | Habitat features that are important for this species are open, undeveloped areas with sandy to loamy soils. Soils type and consistency are part of initial assessments of long-term monitoring plots. | Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Buffelgrass is likely a threat to this species and Pima County will continue to collect information on the spatial distribution and relative abundance of buffelgrass within the County' preserve system and provide this information to the Buffelgrass Coordination Center, which is standardizing the protocol for buffelgrass mapping and abundance estimates (Rogstad 2008). Off-road vehicle use in this species' habitat is very likely impacting this species. To monitor this, Pima County staff will note off-road vehicle (ORV) use during site visits to properties. ORV use can also be detected with visual inspection of aerial images, and possibly with the use of LiDAR. | |
| Talus snails (all) | | Talus snails are found only on talus deposits, where they live in the interstitial spaces between and under rocks. Inventory of talus slopes will be conducted within the County's preserve system. Site visits will include searching for evidence of talus snails (i.e., shells). Incidental observations of shell casings, (indicating occupancy) during periodic checks for threats to their habitat Monitoring of talus deposits will focus on threats. | Pima County will monitor percent and/or extent of encroachment of buffelgrass and other non-native plants on select talus slopes within the County preserve system. Other threats such as disruption of sites and vandalism will be monitored. | |

## Other Program Elements

### Adaptive Monitoring

Ecological monitoring is one of the most important aspects of the Pima County MSCP and will provide the bulk of the evidence to inform if the County's mitigation efforts are effective at conserving Covered Species and their habitats. Ecological monitoring is also a challenging endeavor that requires considerable up-front planning and flexibility in implementation to be successful (Noon 2003).

The PCEMP has been in the planning stage since 2007 (RECON Environmental Inc. 2007, Powell 2010c), but on-the-ground monitoring activities have not begun and it is expected that the monitoring plan will change somewhat during early development of the MSCP, particularly with regards to sampling and survey methods, which are often modified as new information becomes available. Therefore, it is essential that the program be broad in scope, flexible in design, and responsive to unanticipated management issues and stressors as they arise (Ringold et. al. 1996). Principles and examples of changes are noted in the Changed Circumstances section of the MSCP (Chapter 7). With regards to monitoring and modification of sampling design and data-collection protocols, there has been a greater awareness in recent years of the importance of modifying long-term monitoring protocols to effectively account for the variability of biological resources and the sampling error associated with monitoring those resources (Urquhart et. al. 1998). Changes in protocols to reflect on-the-ground realities will be made in coordination with the USFWS to ensure that any program changes will satisfy the Service's needs and concerns.

### Establishing Management and Monitoring Objectives

Throughout the development of the PCEMP, Pima County has recognized that monitoring should inform management by alerting managers to undesirable changes in the attribute of interest so that management action(s) can focus on reversing the trend. This is known as adaptive management and the principles and applications of adaptive management are discussed in Chapter 6 of the MSCP. An important first step in adaptive management (after the management context and measures are established) is to develop objectives, which are clearly articulated descriptions of a measurable standard, desired state, or trend and are articulated in understandable units that identify trigger points (a.k.a., thresholds) for management actions (Elzinga et al. 2001, Atkinson et. al. 2004, Tear et. al. 2005). In the monitoring context of the MSCP, Pima County will focus attention on both monitoring and management objectives. *Management objectives* provide a measure of management success by describing a desired future state of a resource; they should be realistic, specific, and measurable and are often related to the change or condition of a resource (e.g., maintain the current population of Pima pineapple cactus within the reserve system). *Monitoring objectives* are companions to management objectives whenever monitoring employs sampling procedures. Monitoring objectives specify information such as target levels of precision (a measurement of the repeatability of a sample),

and the magnitude of change. The difference between management objectives and sampling objectives is best summarized by Elzinga et al. (2001): “whereas a management objective sets a specific goal for attaining an ecological condition or change, monitoring objectives sets a goal for the measurement of that value”. For example, a management objective might be to maintain the total number of Pima pineapple cactus within the reserve system. The companion sampling objective might state a desire to be 90% confident that our sampling-based estimates of the population are within ±20% of the estimated true value.

Pima County will develop both management and monitoring objectives as part of the detailed protocol development process for each of the proposed parameters. As a general rule, management objectives will be centered on maintaining or improving conditions or resources at or above the baseline conditions at the start of the monitoring program. Because baseline conditions have not been established for all parameters, Pima County needs to undertake the appropriate inventories or first sampling event before committing to objectives. Both management and monitoring objectives will be realistic and any management action that may be employed to reverse an undesirable trend must have a reasonable chance for success and must be within Pima County’s ability to affect the outcome. For example, impacts resulting from climate change are expected to accelerate the conversion of semi-desert grasslands to desert scrub communities. Any management objective related to semi-desert grasslands will recognize that Pima County can not reverse or halt this trend. Furthermore, it should be recognized that that objectives—though intuitively appealing—can be difficult to establish for many species and communities with naturally variable populations and distributions (Walker and Meyers 2004). Neither large-scale changes beyond Pima County’s ability to control, nor the difficulty in monitoring to determine if an objective has been reached release Pima County from the need to establish objectives. Instead, Pima County will work closely with the USFWS during the protocol development phase for each parameter to help ensure that an appropriate balance is reached between promising too much and not promising enough so that management responses have the greatest chance for success.

### Data Management

Data management will play an important role in the PCEMP and considerable resources will be devoted to the effort. As a first step, Pima County completed a data management plan (Powell 2010b), which is a strategy for ensuring that data are documented, secure, accessible, and useful for decades by future managers and members of the public. The data management plan is based on a set of core principles:

- **Quality:** Ensure that appropriate quality assurance measures are taken during all phases of data development: acquisition, processing, summary and analysis, reporting, documenting, and archiving.

- **Interpretability**: Ensure that complete documentation accompanies each data set so that users will be aware of its context, applicability, and limitations.
- **Security**: Ensure that both digital and analog data are maintained and archived in a secure environment that provides appropriate levels of access to project leaders, technicians, network staff, and other users.
- **Longevity:** Ensure that data sets are maintained in an accessible and interpretable format, accompanied by sufficient documentation.
- **Availability**: Ensure that the data are made available and easily accessible to managers and other users.

Work on the PCEMP database has already begun as part of a larger, County-wide project to integrate land management and monitoring activities by building systems architecture (the applications, database systems, repositories, and software tools) that make up a contemporary data management enterprise.

Most data acquired by the program will be collected as field data or discovered through data mining initiatives such as legacy or existing data. Methods of field data collection, such as paper field data forms, field computers, automated data loggers, and GPS units, will be specified in individual monitoring protocols and study plans. Field crew members will closely follow the established standard operating procedures in the project protocol. These and other activities will be part of quality assurance and quality control procedures that will identify and reduce the frequency and significance of errors at all stages in the data life cycle. All elements of the County's data management plan will be reported to the USFWS within three years of permit issuance.

### Covered Species Information Database

The annual monitoring activities for the PCEMP will form the foundation of the program and will be used to determine permit compliance and effectiveness. Yet the program stands to benefit from the fact that Tucson is a regional center for ecological research and monitoring activities, much of which could contribute to an understanding of the distribution and abundance of Covered Species. To provide an effective means of collecting and summarizing this information, Pima County will develop the Covered Species Information Database (CSID). Each year Pima County will query researchers and other governmental entities and non-governmental organizations regarding any data collected on covered species in the preceding year. Information would include a diverse range of information such as reports, sightings, or emergence of new threats. Information from these sources would be part of the annual report to the USFWS. Participating researchers and government and non-governmental entities would be encouraged to participate through public outreach activities, but the program would be on a voluntary basis. Pima County would be careful to ensure that no sensitive information, such as locations of Threatened or Endangered species, be released without permission of the research entity and the

relevant landowner. Data from this project will be stored using appropriate protocols that include metadata.

### Citizen-science monitoring

Pima County is fortunate to have a citizenry that is active in conservation, research, and education. This interest has been demonstrated by citizen engagement in large-scale planning efforts such as the SDCP, as well as their participation in many volunteer opportunities such as the Tucson Bird Count and Sky Island Alliance's tracking and road monitoring programs. An important objective of the PCEMP will be to engage citizens in monitoring activities and products. Opportunities for citizen-science monitoring will be explored, such as for monitoring streamflow length. This has been done to great effect in Cienega Creek since 1999. These outings have been an extraordinary educational opportunity for participants and have contributed critical information for understanding the response of Cienega Creek to drought conditions. Other opportunities for citizens might include reporting sightings of invasive species, and the location and extent of off-road vehicles.

Though volunteers can be an effective model for achieving program goals, it does require more cost for oversight and management than most realize (Brudney 1990). It is often difficult to quantify, but some studies estimate that volunteers can cost organizations from $300-1,000 per year per volunteer (Public/Private Ventures 2002). For some PCEMP projects, most volunteer opportunities will have to be in and around where most volunteers live (i.e., mostly Tucson), but getting volunteers to more remote sites for projects such as wet/dry mapping may require that the County pay for travel expenses. Cost associated with recruiting, training, retaining, and recognizing volunteers will be factored into all protocols that will consider the use of volunteers.

### Project Communication

The primary function of the PCEMP will be to collect, analyze, and archive long-term monitoring data. Another key element of the program will be in communicating program results to natural resource managers, the general public, and the media. An important step in the development of the PCEMP will be for Pima County to develop a communications plan that identifies target audiences and appropriate products (e.g., reports and presentation) for each of the audiences. Other items for the communication plan include standardizing data reporting formats, and outlining data sharing protocols.

### Program Duration and Phasing

The PCEMP is being developed as part of the County's Section 10 permit, and as such monitoring will not get underway until after permit issuance. Because the Section 10 permit will be for 30 years, the PCEMP will also be for 30 years. (Monitoring after permit expiration is specified in the perpetual conservation

easements). All key elements of the PCEMP will be implemented within 5 years of permit issuance and the monitoring program will be implemented in three phases. The three program phases are articulated in the Chapter 6 of the MSCP. Within one year of permit issuance the County will enact an implementation plan to guide program development. The reason for the phasing, rather than starting all program elements and parameters at once, is to provide sufficient time to develop each piece with the appropriate care and attention. In this way, each program phase builds on the success and lessons learned from the previous phase(s).

## Glossary

**Abundance/Density**: Abundance or density (abundance scaled by area) facilitates estimates of total population change (i.e., number of individuals lost or gained) over time (Buckland et al. 2001, Rosenstock et al. 2002). Abundance is often more sensitive than occupancy to underlying changes in population size. It is the most common choice for some species groups that are highly detectable such as landbirds and for species that are abundant such as rodents, lizards, and fishes.

**Adaptive monitoring**: The monitoring program itself should be adaptable because new information on the function of the system, new threats, or new field methods may change program objectives or ways of collecting data (Ringold et al. 1996).

**Design**: The targets, attributes, and parameters to measure to achieve the objectives of the monitoring program, plus the timing and location of where those measurements will be made.

**Index**: An index (e.g., relative abundance) is a statistic assumed to be correlated to the true abundance of a population.

**Occupancy**: the proportion of area, patches, or sampling units that is occupied (i.e., species presence) (MacKenzie et al. 2003, Field et al. 2005, MacKenzie et al. 2006). Changes in occupancy can occur more slowly than abundance measures, because, for example, the number of individuals might be declining, but occupancy may be unchanged, a situation that is frequent for species that are common, widely distributed, and/or not at the edge of their geographic range. Occupancy is almost always the choice parameter for species that are rare and/or difficult to detect.

**Parameter**: Within the context of monitoring, parameter is often used to represent an attribute of the environment that can be measured or estimated to provides insight into the system of interest (Busch and Trexler 2003).

**Protocol**: The detailed methodology for measuring a parameter, including what to measure, how to measure it, and where and when to perform those measurement. For example,

**Sampling Design**. The method of selecting where and how often to sample is referred to as; these choices ultimately determine the power and precision, spatial and temporal inference, and overall cost of a monitoring program.

**Sampling Frame**: The complete collection of the possible sampling units from which samples can be drawn. Sampling frame determines the inference of results.

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# Appendix P. Vegetation and Groundcover (Habitat) Monitoring Protocol for the PCEMP

## Introduction

Appendix O outlines the rationale and approach that Pima County will undertake for monitoring at long-term monitoring plots. This protocol provides an in-depth, step-by-step guide for what will be monitored and how it will be monitored at long-term monitoring plots. This protocol was informed by an initial field test in 2010 and has subsequently been refined based on lessons learned from that effort.

In 2010, Pima County and our planning partners at the University of Arizona, researched an optimal plot shape and size and determined that the best design would be to establish a single, 150-m radius plot, at which sampling for vegetation and groundcover would take place at 12 subplots (Figure P.1; unpublished data). This design allows for a systematic sampling of the plot's larger area, but not so much sampling as to be inefficient (i.e., unnecessary and redundant). The location of plots will be established using a geographic information system and plots will be located within the County's preserve system with a few decision rules. First, areas above 35% slope will be excluded from having a plot to ensure the safety of field crew. We will also ensure that plots do not fall on or along property boundaries and therefore ensure that plot centers are not closer than 200m from the property boundaries.

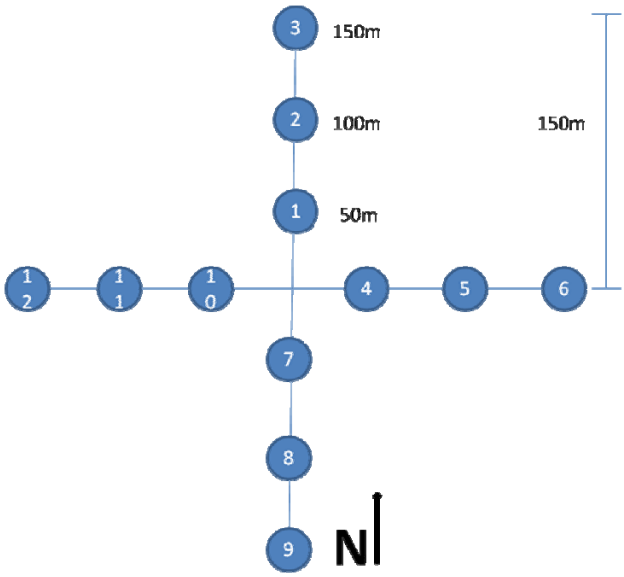


**Figure A-37. Arrangement of subplots in relation to the overall long-term monitoring plot. Sampling will take place at each of the 12 subplots.**

## Field Protocol

The following section is a step-by-step protocol for collecting vegetation and other environmental data at long-term monitoring plots.

### Setting up the 150-meter radius plot

Field personnel will navigate to the pre-determined, randomly selected location coordinates that have been downloaded to the handheld GPS unit. Using a post pounder, drive a T-post into the center of the 150-meter radius plot. The marker should be visible with approximately four feet of length showing above ground. Using a 100-meter tape, attach the loose end of the tape to the permanent marker. Using a compass, set a bearing for NORTH and choose a landmark approximately 100 meters away to walk toward. This will establish the northerly transect on which subplots #1 (at a distance of 50 meters from plot center) and subplot #2 (at a distance of 100 meters from plot center) will be located. The second 100-meter tape will be used to stretch the last 50 meters of the northerly transect where subplot #3 will be located (at a distance of 150 meters from the plot center). At the center of each subplot, drive an 18-inch length of #4 (one-half inch) rebar into the ground, leaving approximately eight inches above the ground for future relocation. On the parcels which have active cattle grazing, longer rebar (ie, 2-3 feet showing above the ground) should be used to make the marker more visible and so that cattle will not easily knock it over. Place a plastic cap with the “Pima County EMP” stamp on the top of the rebar to identify the subplot. Mark this permanent monument as a waypoint in the handheld GPS unit using the naming convention “PLOT NAME-CARDINAL DIRECTION-SUBPLOT DISTANCE” (e.g., “BAKERW100M”).

The boundaries of the subplot (i.e., 5 meters in any direction from the subplot center) must fall at least 10 meters from any road or trail. This eliminates including data for vegetation and surface features that are directly impacted by human activities. If any subplot at the 50m, 100m or 150m distance from plot center falls too close to a road or trail, move the location of the subplot center along the transect (either away from or toward the plot center) until the 10-meter rule for minimum distance is met.

After completing (1) the establishment of the subplot, (2) field observations and (3) data collection at the 150-meter subplot, reel in the tapes and return to the plot center to re-orient for the next transect. Replicate the procedures described above to locate the EAST, SOUTH, and WEST transects following a clockwise pattern (as read on a compass face) and establish subplots #4-5-6 (EAST transect), #7-8-9 (SOUTH transect) and #10-11-12 (WEST transect) (see Fig. 1.1).

For plots and subplots that have been previously established and marked with permanent monuments, navigate to the points using the handheld GPS unit. This eliminates the need to stretch the 100-meter tapes and will save time for the field crew, assuming the permanent rebar monuments have not been destroyed or tampered with. A lightweight, handheld metal detector could prove useful in the relocation of the subplot centers as the vegetation will surely change over time and the visible rebar above the ground may be hidden by vegetation or other environmental features. The rebar should

have a brightly colored cap to make it easier to relocate, but these caps deteriorate over time and it cannot be assumed they will always be visible. For this reason, the field crew should always have a few replacement caps on hand to replace worn or destroyed caps while in the field. If the rebar is missing or cannot be relocated after a search within a 10-meter radius of the subplot location coordinate, replace the missing rebar with a temporary marker (if the crew has no rebar in the field) to be replaced with a permanent monument at a later time. Record this marker with a waypoint in the handheld GPS unit and save using the naming convention described above.

### Data Collected at Each Subplot

The following section is a step-by-step guide to recording data at each of the 12 subplots per plot. All data is recorded the program's datasheet (Fig. P.1).

#### d. Surface Features

The first methods to be employed after the establishment/relocation of the subplot are the visual estimates of cover for "Surface Features" and "Ground Cover" within the 5-meter radius subplot. "Surface Features" shall be estimated for the area within a 2-meter radius from the center of the subplot, whereas "Ground Cover" shall be estimated within the entire 5-meter radial area from the subplot center. Cover estimates of surface features are to be completed as the first monitoring component on the subplot in order to minimize the disturbance to the soil surface by the field crew. Surface features include six (6) classes of particle sizes and exposed bedrock that make up the ground surface, including:

(1) **FINE** 0-2mm diameter
(2) **GRAVEL FINE** 2-16mm diameter (ant to beetle)
(3) **GRAVEL COARSE** 16-64mm diameter (beetle to baseball)
(4) **COBBLE** 64-256mm (baseball to basketball)
(5) **BOULDER** >256mm (larger than basketball)
(6) **BEDROCK** exposed bedrock

**Figure A-38. Datasheet for Long-term monitoring plots.**

Plot Name:_____ State Plane Coordinates: _____ _____
Cardinal Direction: N S E W Subplot: 50m 100m 150m
Observers: _____ Date: _____

***GROUND COVER***

| *SOIL COVER (5M)* | *% COVER* | *SURFACE FEATURE (2M)* | *% COVER* |
|---|---|---|---|
| | | | |
| BARE | | FINE 0-2mm | |
| PER. GRASS | | GRAVEL FINE 2-16mm (ant to beetle) | |
| ANN. GRASS | | GRAVEL COARSE 16-64mm (beetle to baseball) | |
| FORB | | COBBLE 64-256mm (baseball to basketball) | |
| SUBSHRUB | | BOULDER >256mm (larger than basketball) | |
| SHRUB | | BEDROCK (exposed bedrock) | |
| TREE | | BIO SOIL CRUST (cyanobacterial crust) | |
| LITTER | | WATER (pool or flowing) | |
| SNAG | | | |
| MOSS | | | |
| BIO SOIL CRUST | | | |

***POINT QUARTER***

| | **NE** | | | **SE** | | |
|---|---|---|---|---|---|---|
| | SPECIES | DISTANCE | RADIUS | SPECIES | DISTANCE | RADIUS |
| *PER. GRASS* | | | | | | |
| *SUBSHRUB* | | | | | | |
| *SHRUB* | | | | | | |
| *TREE* | | | | | | |

| | **SW** | | | **NW** | | |
|---|---|---|---|---|---|---|
| | SPECIES | DISTANCE | RADIUS | SPECIES | DISTANCE | RADIUS |
| *PER. GRASS* | | | | | | |
| *SUBSHRUB* | | | | | | |
| *SHRUB* | | | | | | |
| *TREE* | | | | | | |

***COUNTS***

| *SUBSHRUB - 2M 5M* | | *SHRUB - 2M 5M* | | *TREE 5M* | |
|---|---|---|---|---|---|
| SPECIES | COUNT | SPECIES | COUNT | SPECIES | COUNT |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

***BELT TRANSECT***
***NOTE: DO NOT DOUBLE-COUNT AT SUBPLOT CENTER!***

| CARDINAL DIRECTION | SPECIES | BASAL COVERAGE DISTANCE | | CARDINAL DIRECTION | SPECIES | BASAL COVERAGE DISTANCE | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
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***ROBEL POLE (CM)*** ***START:*** ***FINISH:*** ***TIME:***

| | | |
|---|---|---|
| NORTH | | |
| EAST | | |
| SOUTH | | |
| WEST | | |

***BIOLOGICAL SOIL CRUST***, or *cyanobacteria*, is a living, organic component of the "Surface Features" measurements because the presence (or absence) of these crusts is an indicator of soil stability and disturbance. These crusts, which vary in color and texture from sandy brown and flat for young crusts to black and lumpy for older crusts, take many years or decades to become established yet can be instantly destroyed from minor disturbances. It is important to note their presence within the subplot early on to avoid trampling while performing field observations.

***WATER***, whether flowing or standing, is also included in the "Surface Features" component of the sampling design as it can be indicative of microsite features (e.g., tinajas, ephemeral streams) and can help explain localized conditions of the primary 150-meter radius plot.

"Surface Features" cover estimates are to be made within a 2-meter radius from the center of each subplot. Because this measure is an estimate of a single "layer" of cover and does not account for vertical strata or height classes where cover may overlap (such as the case of overlapping tree and shrub canopy), *the total cover should equal to 100%.* In the case of estimates made for "Ground Cover" wherein canopy cover *could* overlap, it is possible for the total estimated coverage to equal to more than 100% because height classes and overlapping vertical strata are also considered.

When estimating cover for surface features, it can be helpful to begin the estimation with the feature that appears to be dominant, if indeed there is a dominant feature. For example, if at least two of the four subplot quadrants are entirely made up of exposed bedrock, you know that at least 50% of the total 100% coverage will be classified as "BEDROCK". This will make it easier to estimate the other particle classes because you can begin estimating from a smaller area, thereby reducing extent of the area to visualize and working your way down from most dominant size class to the least dominant size class. Of course, a dominant size class may not always be present or obvious which can make it more difficult to visually aggregate particle sizes and then estimate coverage for the individual size classes for the entire 2-meter radius area of estimation. Training tools such as a small quadrat representing, for example, 10% of the 2-meter area to be estimated can be helpful in reducing inter-observer variability and having a tangible basis to begin the field work and making visual estimates.

Estimating "Ground Cover" generally follows the same procedures as estimating "Surface Features" as mentioned in the above section. The exception is that it is estimated for the entire area of the 5m radius subplot (rather than the area of 2m radius for "Surface Features". The grand total of percent ground cover may well exceed 100% due to the fact that overlapping vertical strata (i.e., tree canopy hanging over shrubs or grasses) will be counted separately, thus the same area of ground may be covered by vegetation in more than one category and dually counted more than once.

The categories to be estimated for "Ground Cover" are as follows:

- **Bare ground**: includes exposed ground that has no vegetation growing on it, which may include soil, gravel, cobbles, boulders and/or bedrock.
- **Perennial grass**.

- **Annual grass**.
- **Forb**: includes annuals that are not grasses but lack the woody base of a shrub.
- **Subshrub**: includes perennial plants with a woody base that are < 0.5M in height.
- **Shrub**: includes perennial plants with a woody base that are >0.5M and <2M in height.
- **Tree**: includes perennial plants with a woody base that are >2M in height.

For Subshrub, Shrub, and Tree, a single plant species may well fall into any of these three categories because the categories are based on height measurements at the time of the survey, not the maximum height of that particular species or growth form. For example, the saguaro cactus—depending on its age and available resources—could fall into any of the three categories. A juvenile saguaro may fall into the Subshrub or Shrub category depending on its height, while a mature saguaro will fall into the Tree category because mature saguaro cacti grow to heights in excess of 2 meters.

Plants that are rooted outside of the subplot but have live canopy which is overhanging into the subplot should be included in the estimation of ground cover for that growth form category.

The height of a plant should be measured to the highest point of ***live*** vegetation on the plant. For example, a mesquite tree that has dead material in the canopy may measure over 2m in total height, but if the live growth on the plant measures under 2m and the dead material in the crown of the canopy puts it over the 2m cut-off, the tree should be counted as a Shrub, not a Tree.

- **Litter**: dead plant material such as grasses, leaves, twigs, bark and cactus carcasses.
- **Snag**: any dead plant that is still rooted in the ground.
- **Moss**: any type of moss that is attached to the ground surface, rocks or other environmental features.
- **Biological soil crust**: biological crust that is attached to the ground surface or to any environmental feature.

When estimating Ground Cover—as is the case with Surface Features—it can be worthwhile to identify which category is dominant and begin with that feature working down to the least dominant feature. In some cases, it may be desirable to start from the least dominant feature and work your way up to the most dominant feature, depending on the qualities of the site. With two observers, and especially if it is early in the field season or the observers have not worked closely together in estimating vegetation cover, it is useful to compare estimates and discuss the differences between the observations, why they are different and how to compromise on an agreed-upon estimate of cover. The goal of long-term monitoring is precision. The detection of trends over time is accomplished by systematic, repeatable observations that are as accurate as possible yet repeatable over time. A highly accurate survey that is not repeatable has little utility in detecting trend over time.

The overwhelming tendency when estimating cover is to *overestimate*. Lay persons and seasoned professionals alike in the field of vegetation surveying and cover estimation tend to not only overestimate, but also to vary in terms of their cover estimates of vegetation on the same site. There are training tools available to help with estimating cover, which are not different than the tools mentioned in the "Surface Features" section. The tools should be relative to the plot that is being surveyed (i.e., the training tool should represent an intuitive and logical sub-area of the total plot area, such as 10% or 25%). These tools can be anything from a square quadrat made of PVC or rope, a hula-hoop, or cloth cut to a certain size and shape to meet the training needs of the field crew. We would encourage future field crews to use these training tools.

**e. <u>Point Quarter</u>**

The "Point Quarter" method is used to determine the distance from the center of the subplot to the nearest: 1) Perennial grass; 2) Subshrub; 3) Shrub; and 4) Tree in each of the four quadrants of the subplot (ie, NE, NW, SE, SW). The measure of interest is an index to density. The datasheet should clearly identify the quadrant direction and the observer must be careful to enter the data in the appropriate field based on the subplot quadrant which is being observed. Although it is not absolutely necessary to perform the point quarter method in the same directional sequence each time, doing it in this fashion creates a methodical, systematic habit for the observer and thus makes him/her less prone to enter the data in the wrong field (i.e., entering data for the SE quadrant in the fields for the SW quadrant). The three (3) primary components of data collection for the point-quarter method include: 1) Species; 2) Distance (from subplot center); and 3) Radius (from basal center to median extent of canopy). These fields are clearly labeled on the datasheet (Fig. P.1). Plants observed should be identified to species-level if possible and recorded as a six-letter code drawn from the first three letters of the plant's genus followed by the first three letters of the plant species (i.e., *Krameria parviflora* = KRAPAR). In the rare instance that two plant species have the same six-letter code, create an identifier such as a "1" or "2" after the six-letter code that clearly distinguishes the two codes and plant species from each other to eliminate confusion during data processing.

The "Point Quarter" method measures the distance from the subplot center to the nearest perennial grass, subshrub, shrub and tree. The thresholds, or cutoffs, for maximum distance from subplot center to be measured to each type of growth form are:

- Perennial grass 10m
- Subshrub 10m
- Shrub 25m
- Tree 25m

If there is not a representative specimen for that quadrant, mark "NA" on the datasheet.

The objective of the point quarter method is to accurately measure the distance from the center of the subplot to the center of the base of the plant being observed, in a straight

line. If measuring with a tape, be sure that the tape is horizontally flat with no kinks, parallel to the ground, and makes a straight line from the rebar at the center of the subplot to the center of the base of the plant. The easiest way to do this is to work with another member of the crew, whereby one member stands with the tape reel or metal pocket tape at the center of the plot and the second member walks the end of the tape to the center of the base of the plant to be observed. Holding the tape low to the ground makes it easier to accurately measure the base of a tree, for example, as opposed to having it a few feet above the ground and eye-balling where the tape actually intersects with the center of the base of the tree.

Of course, certain sites do not allow for this ease of measurement as the vegetation may be too thick or the nearest plant to be observed is far enough from the subplot center that the tape cannot hold its form and introduces error into the measurement. In this case, “shooting” the plant with the rangefinder is the best method to employ as it is time-efficient, accurate to the nearest meter and can be used in a variety of landscapes as long as there is a clear line of sight from the observer to the plant. It is useful to become familiar with the rangefinder and understand its tolerances for distance. It is also helpful to check the accuracy of the rangefinder from time to time by laying out a length of tape such as 25M and having a crew member stand at each end of the tape and shoot the distance to find out if there is any error coming from the rangefinder when determining straight-line distances.

Another caveat of the rangefinder—particularly when used to measure the distance to trees with large or drooping canopies—is that the laser will not penetrate the canopy to the base of the tree, but will be reflected from the canopy and back to the observer, resulting in an incorrect measurement. Depending on the confidence of the observer or the needs of the particular survey or study, a measurement from the base of the tree to the edge of the canopy may be necessary to compensate for the inaccurate reading, since the center of the base of the tree is the desired point to be measured to.

The distance thresholds have adopted primarily in the interest of time efficiency in terms of searching far and wide from the subplot center only to find no plant in that growth form category to measure. If no individual plant is observed in any quadrant of the subplot, a line should be drawn in that field to indicate that no individual was found. Do not leave the field blank because during the data entry and analysis phase it raises a common but avoidable question – “Did the observer make an observation of “no plant present”, or did they simply forget to fill in the blank?” In all cases, some entry or notation should be made in every field on the data sheet to indicate that that component has been completed and that the observer did not simply forget to “fill in the blank”. If an entry on the data sheet is recorded in error and needs to be corrected in the field, erase the mark and enter the correct data. Do not mark through the incorrect notation and note the correct information in the same field or elsewhere on the data sheet – this introduces confusion during data entry.

### f. Plant Counts

Counting and recording individual plants based on the species and growth form provides data which can be used to infer species distribution across a plot, estimate the density of particular species or total vegetation across a plot and offers a picture of the plant diversity across the site. This method is very straightforward and on most subplot sites should require less than five minutes to complete. Plants observed should be identified to species-level if possible and recorded as a six-letter code drawn from the first three letters of the plant's genus followed by the first three letters of the plant species (i.e., *Krameria parviflora* = KRAPAR). In the rare instance that two plant species have the same six-letter code, create an identifier, such as a "1" or "2" after the six-letter code that clearly distinguishes the two codes and plant species from each other so eliminate confusion during data entry. The individual plants to be counted fall into three major categories: 1) Subshrub, 2) Shrub, and 3) Tree. As with other methods performed in this protocol, a plant species may fall into any of the three categories based on its height. As previously mentioned, the height categories are as such:

- Subshrub = <0.5m
- Shrub = >0.5m - <2.0m
- Tree = 2.0m or greater

The counts for Subshrub and Shrub are made inside the circular subplot at one of two distances from center: 2-meters or 5-meters. The count for Trees will ***always*** be made at the 5-meter distance. Accordingly, the rows on the data sheets in the Subshrub and Shrub categories each have an option to circle "2M" or "5M" depending which distance from subplot center is being observed for that plot (see "Counts" in Appendix XX). *It is crucial to data processing and analysis that the simple step of circling the distance that is being counted.* Also keep in mind that ***all*** twelve subplots in any given plot shall be counted at the same distance from center. For the 2m subplot counts, any Subshrub, Shrub or Tree should be identified to species level if possible. The field crew may want to lay out a rope or other tool to delineate the 2m subplot circle to get an actual visual on the edges and size of the 2m subplot; with repetition the crew will be able to imagine the borders of the 2m circle and be able to count all individuals within that area. If an individual plant is in question as to whether or not it falls within or outside the 2m subplot circle, the crew can lay out tape or rope to verify. Also, if plants fall on the line of the subplot circle, *every other one* should be counted as "in". For example, if along the 2m subplot circle the crew finds five mesquite plants that fall into the Shrub category, three (3) of the individuals are to counted as "in" and two (2) of the individuals should not be counted/included. This pertains only to plants that are of the same species and fall into the same height category.

These same rules apply to the 5m subplot circle as well, which encompasses the entire area within the 5m subplot. It may be necessary for a fresh field crew to lay out rope or tape as a training tool to more easily visualize the area's borders in order to be confident as to which plants are "in" and which plants fall "out" of the area and thus are

not to be included in the counts. Again, with repetition the delineation of the 5m subplot area will become easier to visualize. However, on certain sites such as grasslands with abundant, tall bunchgrasses for example, it can be difficult even for an experienced crew to visualize the area to include in the counts and therefore a tool such as rope or tape may be necessary.

The obvious question when performing this component of the protocol is when to use the 2m subplot circle or the 5m subplot circle for counting individual plants. Whichever size is agreed upon by the field crew and/or project manager, ***all*** subplots within the primary plot are to be observed using the same area. If the crew starts a plot using 2m, the crew should observe ***all*** subplots within that plot at 2m, no exceptions. Observing subplots in the same plot at different spatial scales does not facilitate data analysis and introduces uncertainty into the results of analysis. Which spatial scale to use will often be commensurate with the type of parcel that is being observed, specifically whether it is a rangeland with active cattle grazing, or not. Normally, the 5m subplot area will be used as it encompasses the entire subplot and can provide for more diversity and density data since a larger area is being counted. The 2m subplot circle will be used as the area to count on most (or all) of the rangeland sites. This is due to the fact that plant species which are browsed by cattle do not generally reach their growth potential and result in a very high number of small, tightly spaced individuals that have not had the opportunity to grow to full height. Thus, counting these individuals in a 2m subplot circle is adequate as that data can be extrapolated to the area of a 5m subplot very easily with statistical analysis. This is a practical solution in terms of saving time and energy for the field crew which would be spent tediously counting dozens or hundreds of tiny individuals.

The final decision of whether to perform the counts using a 2m or 5m subplot circle will generally follow the type of parcel that is being observed (i.e., active rangeland or not). However, this is a general rule and if the field crew and/or project manager determines that the site conditions, data needs, time constraints, or any number of opportunities or limitations facilitate using one scale or the other, the subplot area may be changed based on those specific needs. In the scheme of long-term vegetation monitoring, it is recommended to perform counts on the same plots in the same fashion so that the data are consistent.

### g. <u>Belt Transect</u>

The belt transect is a method not unlike the “Counts”, which provides data on species diversity, overall density and basal coverage, the latter being an extremely stable and reliable indicator to use in long-term vegetation monitoring. Like the “Counts”, the “Belt Transect” is to be performed using the same methods but may be performed at different spatial scales depending on the site characteristics and parcel type (i.e., parcels with active cattle grazing versus non-grazed preserves). The decision regarding which scale to implement will vary ONLY by the plot (NOT by the subplot) and will be decided by the field crew and/or project manager before the field work begins. This method is simple and straightforward, but can vary greatly in terms of the time it takes to complete due to the diversity of sites and the types and density of vegetation. In this method, there are

no height categories for the individual plants to fall into, only the identification and measurement of individual plants.

The objective of this method is to accurately count the total numbers of plants (identified to species-level, if possible) and accurately measure the basal coverage of those individuals. The resulting data will provide information on the diversity, density and coverage of plants along a 1m linear "belt" for each transect (i.e., one-half meter on each side of the tape). Plants observed should be identified to species-level if possible and recorded as a six-letter code drawn from the first three letters of the plant's genus followed by the first three letters of the plant species (i.e., *Krameria parviflora* = KRAPAR). In the rare instance that two plant species have the same six-letter code, create an identifier, such as a "1" or "2" after the six-letter code that clearly distinguishes the two codes and plant species from each other so minimize confusion during data entry.

The observer should use an implement of 1-meter length, such as PVC, and walk the transect (axis) looking for plants within one-half meter on each side of the tape, using the PVC as a guide. The decision to include or not include an individual plant is easy – if any part of the base of the plant falls within the one-half meter distance from the tape, it is to be included in the counts and measured entirely. To be clear, the entire width of the plant's base should be measured. DO NOT measure only the area of the plant's base that actually falls within the one-half meter; the objective of this method is to measure the change in basal coverage of the *entire* plant base in a temporally long-term monitoring scheme; measuring only part of the plant's base would be futile. The measurements are most easily done by aligning the PVC or other guide in a straight line from the plant's base to the tape, and recording an accurate measurement from one side of the plant base to the other, to the nearest centimeter. It is important to keep in mind that the measuring guide, such as PVC, has its own width and when measuring the plant base from end-to-end using a guide, do not include the width of the guide in the actual measurement of the plant base. If the vegetation or other obstacles do not allow for measuring along the tape with the measuring guide, a physical measurement with another tape may be necessary. Although this scenario is uncommon, it does occur, and coming away with accurate measurements of basal coverage (as opposed to eye-balling or estimating) is one of the objectives of this method.

The first option in terms of spatial scale or arrangement is to perform the belt transect along the length of each of the four 5m directional axes. One caveat of this method, even for experienced observers, is the tendency to double-count at the center of the subplot. With this in mind, it is important to exclude 1m at the center of the subplot for those two axes where counting plants would double the counts erroneously. The total area along the tape to be measured is 18m, which includes five (5) meters along two of the subplot axes, and four (4) meters along the other two subplot axes.

The alternative option (used primarily on grassland sites with tightly spaced individuals) is to count the last meter of each tape away from the subplot center. For example, if the tape reads "50m" at the center of the subplot, the observer will perform the belt transect from 54m to 55m (ie one meter total for each axis, four (4) meters total for the subplot).

Regardless of which option of the two mentioned above is chosen to perform the belt transect, the data shall be recorded in exactly the same way. The first component is "Cardinal Direction", which should be recorded as "N", "E", "S", and "W" depending on the cardinal direction of the subplot axis being observed. The second component is "Species" and should be recorded as a six-letter code following the naming convention mentioned above. The third and final component is "Basal Coverage Distance" and should be recorded in centimeters (see Appendix XX).

**h. <u>Robel Pole</u>**

The Robel pole is a tool that is 2m in length and graduated with a mark at every 10cm from the bottom of the pole to the top. The pole can be made of any material; PVC is lightweight, easy to write on and very packable. This tool is used to estimate vegetation structure and cover based on the "visual obstruction" method. This method works very well in grassland systems where coverage is typically continuous from the ground up. However, in uplands arid systems that do not have continuous grass coverage, using the Robel pole presents challenges in terms of observations and data analysis. This technique is quick and easy to estimate on a suitable site, and it can be used to estimate the distribution of biomass on the subplot site. On the other hand, this technique generally requires two people to efficiently measure cover (one person to hold the pole, one person to estimate cover). However, in the case of the circular subplot with rebar at the center of the plot, it is possible to drop the pole over the rebar and, as long as the bottom of the pole is flush with the ground surface, cover can be read and estimated by only one person.

Whether one or two persons are measuring cover using the Robel pole technique, the method remains the same. The pole should stand upright and straight and should be clearly graduated at every 10cm along the entire 2m length of the pole. It can be helpful to color in every other 10cm section for easier visibility. The observer should be a distance of 4m from the pole, which is positioned at the center of the subplot. The observer can use the tapes, or transects, of the subplot as a guide in order to be certain that he/she is 4m away. The observer should kneel or bend over so that their eyes are 1m above the ground surface. It is helpful to actually measure the distance from the ground to the observer's eyes, especially with a fresh field crew or at the beginning of the field season, so that they can be confident in the estimations of cover. One way to do this is for the observer to carry the 1m guide used for the belt transect as an "eye-height guide" so that when the observer squats or bends over, his/her eyes are at the same height as the 1m guide when it is standing upright. Having the observer's eyes 1m above the ground is integral to this technique.

From a distance of 4m from the Robel pole and with the observers eyes 1m above the ground surface, two (2) cover estimations per subplot quadrant are to be measured and recorded, for a total of eight (8) measurements per subplot. The observer should be looking toward the Robel pole, which is in place or being held by a crew member, and observing cover based on the last (highest on the pole) band or mark on the pole that is completely (or mostly) obscured by vegetation. With practice it is easy to see how the height of the observer's eyes above the ground directly affects the measurement, thus it

is important to maintain the 1m height of the observer's eyes in order to make accurate measurements and have precision over the long-term. As with other methods discussed here, it is helpful to begin and end this technique in the same directional fashion for each subplot as this lends itself to more consistent and precise data collection.

For example, if the first reading on the Robel pole is made at the 4m mark on the North transect of the subplot, the observer can make the subsequent observations following a clockwise pattern (as if looking at a compass face), starting at the North transect and continuing to the East, South and West transects. One observation should be made along each cardinal transect, along with one observation made in the center of each of the four quadrants. All eight (8) observations should be made from a distance of 4m from the Robel pole at the center of the subplot.

The shortcoming of the Robel pole technique in some arid systems is that the vegetation is not continuous from the ground up. For example, a shrub such as desert broom may have a much narrower basal area than canopy. Thus, if the Robel pole is near the base of the plant, the bottom of the pole may well be visible and unobstructed by vegetation, but higher up on the pole the canopy of the plant may obstruct some length of the pole. This is not continuous coverage along the length of the pole, which the technique is designed to measure, but coverage that contains gaps along the pole between areas that are obstructed and areas that are not obstructed. It is difficult to determine how to measure this type of "discontinuous" coverage as the observation/measurement loses its capacity to depict structure unless the individual areas of coverage are properly described and measured, which could introduce much more time spent in the field and in data processing. Simply aggregating the total amounts of coverage at different spacings along the pole and summing them into an aggregate measure of coverage would not accurately address the question of vegetation structure, which is the primary objective of the Robel pole method.

## Next Steps

These field instructions will form the foundation of the data collection at long-term monitoring plots. An example of a completed datasheet from 2010 is found in Figure A-39. Data management is also an important component of the PCEMP and Pima County will develop a detailed protocol for what to do with the datasheets once they are complete, how the data will be stored, and how the data will be reported out.

Plot Name: TUMAMOC Z State Plane Coordinates: 32.21406° 111.01705°

Cardinal Direction: N S E W Subplot: 50m 100m 150m

Observers: HASTINGS- WELBORN Date: 4/21/10

**POINT QUARTER** **START:** 11:20 **FINISH:** 11:26 **TIME:** 0:06

| | NE | | | SE | | |
|---|---|---|---|---|---|---|
| | SPECIES | DISTANCE | RADIUS | SPECIES | DISTANCE | RADIUS |
| PER. GRASS | ERAGROSTIS | 3.2 | 0.1 | ERAGROSTIS | 2.8 | 0.6 |
| SUBSHRUB | AMBDEL | 1.9 | 0.1 | KRAGRA | 0.1 | 0.1 |
| SHRUB | KRAGRA | 3.2 | 0.7 | EPHTRI | 1.8 | 0.2 |
| TREE | CYLVER | 4.1 | 0.7 | LARTRI | 5.0 | 1.4 |

| | SW | | | NW | | |
|---|---|---|---|---|---|---|
| | SPECIES | DISTANCE | RADIUS | SPECIES | DISTANCE | RADIUS |
| PER. GRASS | ERAGROSTIS | 5.5 | 0.5 | — | — | — |
| SUBSHRUB | KRAGRA | 0.4 | 0.1 | AMBDEL | 2.8 | 0.1 |
| SHRUB | KRAGRA | 3.6 | 0.5 | KRAGRA | 4.6 | 0.5 |
| TREE | LARTRI | 6.0 | 1.2 | LARTRI | 4.1 | 1.5 |

**COUNTS** **START:** 11:26 **FINISH:** 11:27 **TIME:** 0:01

| SUBSHRUB - 2M 5M | | SHRUB - 2M 5M | | TREE 5M | |
|---|---|---|---|---|---|
| SPECIES | COUNT | SPECIES | COUNT | SPECIES | COUNT |
| ZINACE | 1 | EPHTRI | 1 | CYLVER | 1 |
| KRAGRA | 1 | | | LARTRI | 11 |
| AMBDEL | 11 | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**GROUND COVER** **START:** 11:15 **FINISH:** 11:20 **TIME:** 0:05

| SOIL COVER (5M) | % COVER | SURFACE FEATURE (2M) | % COVER |
|---|---|---|---|
| | | | |
| BARE | 75 | FINE 0-2mm | 75 |
| PER. GRASS | 3 | GRAVEL FINE 2-16mm (ant to beetle) | 20 |
| ANN. GRASS | 15 | GRAVEL COARSE 16-64mm (beetle to baseball) | 5 |
| FORB | 2 | COBBLE 64-256mm (baseball to basketball) | T |
| SUBSHRUB | 2 | BOULDER >256mm (larger than basketball) | — |
| SHRUB | 15 | BEDROCK (exposed bedrock) | — |
| TREE | 15 | BIO SOIL CRUST (cyanobacterial crust) | — |
| LITTER | T | WATER (pool or flowing) | — |
| SNAG | 1 | | |
| MOSS | — | | |
| BIO SOIL CRUST | — | | |

**Figure A-39. Example data sheet from 2010 field season.**

**ROBEL POLE (CM)** **START:** 11:32 **FINISH:** 11:33 **TIME:** 0:01

| | | |
|---|---|---|
| NORTH | 10 | 0 |
| EAST | 200 | 50 |
| SOUTH | 0 | 0 |
| WEST | 0 | 10 |

**BELT TRANSECT** **START:** 11:28 **FINISH:** 11:32 **TIME:** 0:04

| CARDINAL DIRECTION | SPECIES | BASAL COVERAGE DISTANCE | | CARDINAL DIRECTION | SPECIES | BASAL COVERAGE DISTANCE | |
|---|---|---|---|---|---|---|---|
| S | KRAGRA | 969 | 973 | | | | |
| | AMBDEL | 980 | 990 | | | | |
| N | AMBDEL | 166 | 175 | | | | |
| | | 280 | 295 | | | | |
| | | 392 | 397 | | | | |
| | CYLVER | 403 | 420 | | | | |
| | KRAGRA | 406 | 420 | | | | |
| W | AMBDEL | 040 | 052 | | | | |
| E | ACACON | 763 | 775 | | | | |

***DO NOT DOUBLE-COUNT AT SUBPLOT CENTER!***

**Figure A-39. cont.**