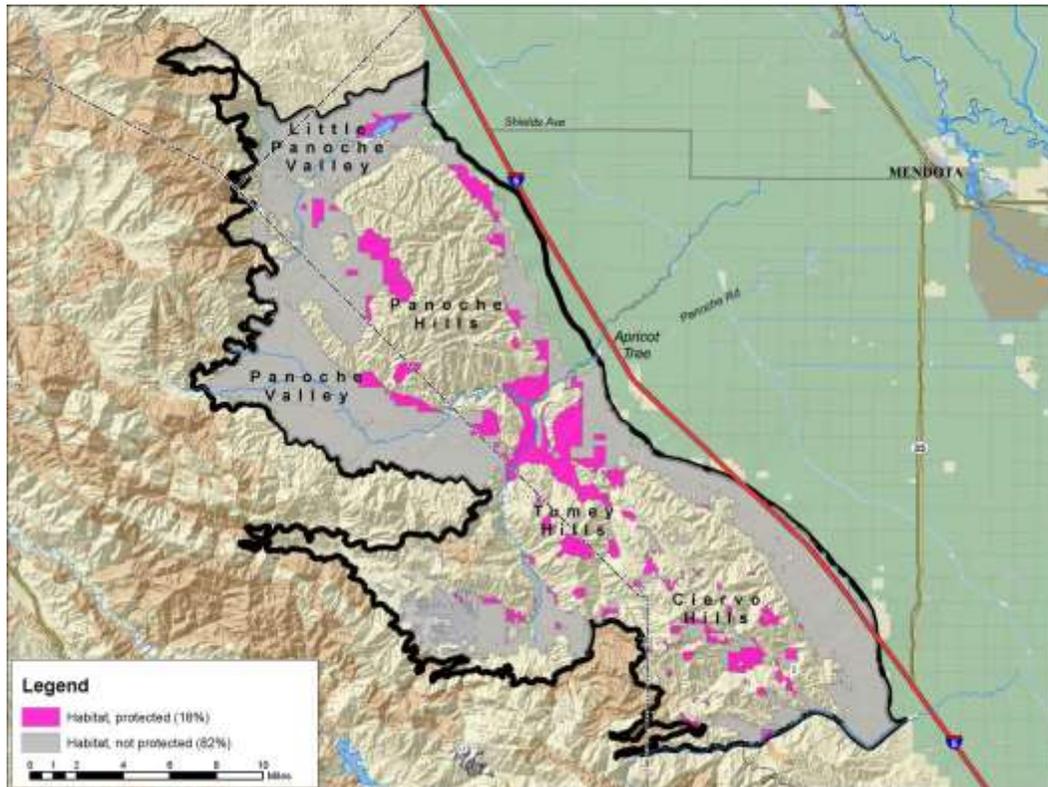


# MEASURING SITE-SPECIFIC PROTECTION REQUIRED TO MEET DELISTING CRITERIA FOR ENDANGERED UPLAND SPECIES OF THE SAN JOAQUIN VALLEY OF CALIFORNIA



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OF ENDANGERED UPLAND SPECIES OF THE SAN JOAQUIN VALLEY OF CALIFORNIA**

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## INTRODUCTION

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The *Recovery Plan for Upland Species of the San Joaquin Valley* (U.S. Fish and Wildlife Service 1998) identifies a number of site-specific protection requirements to meet delisting criteria for listed plant and animal species (Appendix A) and for the long-term conservation of California-listed and federal candidate species and species of concern. The understanding of which delisting criteria or long-term conservation goals have been met (or progress towards meeting those goals) requires the identification of three spatial elements:

- The specific *sites*, or regions associated with the places identified in the recovery plan that are required to meet the criteria
- The area within those regions that are appropriate habitat for each species
- And the areas within those regions that are protected

The sites identified in the recovery plan are described by place name, county, and land ownership but specific boundaries of these regions were not identified in the plan. Specific boundaries are necessary for spatial analysis in cases where a certain percentage of habitat or amount of area within a region is identified as necessary for recovery. Using spatial analysis, one can directly measure percentages or area of habitat protected within a region, but only if a specific, geometric boundary is defined.

While there are other past and ongoing efforts to identify protected lands (Orman and Phillips 2011, Appendix B) and habitat quality (ESRP unpublished data, Appendix B), there has not yet been an effort to identify and define bounded regions in which habitat quality and land protection status can be analyzed to measure progress towards delisting criteria.

In 2012, a multi-agency technical group assisting with implementation of the recovery plan (San Joaquin Valley Recovery Team, SJVRT) identified a need for defined regions as well as improved information on habitat quality and land protection status to measure progress towards recovery. This effort would guide recommendations for land protection and identify areas where land use change (*e.g.*, from open rangeland to renewable energy facility) could impede recovery. Along with the need, the group identified a need for technical assistance with GIS analysis and funding to support time needed for data collection and analysis. The Bureau of Land Management identified funding to support initial work by the California State University, Stanislaus – Endangered Species Recovery Program (ESRP) to provide GIS technical assistance to the group to identify and define regions associated with site-specific requirements and begin creating geographical information systems (GIS) data suitable for spatial analysis.

We report here on this initial effort with the objectives of:

- Identifying named recovery regions that need a defined spatial boundary
- Identifying currently-available data or other information sources suitable for defining the region boundary
- Begin the process of using the data and information sources to define preliminary recovery region boundaries for selected species
- Working with the SJVRT to review and refine preliminary region boundaries

## METHODS

### *IDENTIFYING RECOVERY REGIONS, CURRENTLY AVAILABLE DATA AND INFORMATION SOURCES*

Using the Ciervo-Panoche Natural Area as an initial example, we reviewed available data that defined sub-regions of the San Joaquin Valley based on soil, vegetation, and other physiographic characteristics including Ecological Subregions of the U.S.<sup>1</sup> NRCS National Coordinated Common Resource Area (CRA) Geographic Database (NRCS 2010), and ecological subregions of California described by Jepson (UCSB 1998). We found that using a combination of CRA (NRCS 2010) and Jepson ecoregions (UCSB) with some edits to subdivide or combine CRA regions could produce reasonable geographic regions in the foothills along the San Joaquin Valley edge that were not completely arbitrary.

When applied to sites on the San Joaquin Valley floor, use of CRAs were found to be inadequate because sub-regions were often separated by land use rather than physical barriers. In 2012, Larry Saslaw (BLM Bakersfield [retired]) provided maps that were developed in the 1990's by a group called the San Joaquin Valley Bio-Technical Committee (SJVBTC). During group meetings in the 1990s, the SJVBTC identified and mapped (Figure 1) some areas that coincide with areas specified in the recovery plan.



**Figure 1. Example map (1:100,000 scale) of conservation areas identified by the San Joaquin Valley Biological Technical Committee (SJVBTC 1992).**

One advantage of the SJVBTC-defined boundaries is they were contemporary to the development of the recovery plan in the mid-1990's and they were developed by researchers and agency staff who also identified recovery areas described in the plan.

<sup>1</sup> <http://www.fs.fed.us/land/pubs/ecoregions/intro.html>

## RESULTS AND DISCUSSION

### *RECOVERY REGIONS FOR SELECTED SPECIES*

We examined site-specific recovery requirements for three species with different types of site-specific requirements. Tipton kangaroo rat (TKR) requirements consist of an amount (area) of “contiguous occupied habitat” in three regions on the San Joaquin Valley floor. Bakersfield cactus (BACA) requirements consist of the protection of specific clumps, or groupings of plants at a number of sites that were identified at the time of the recovery plan. San Joaquin kit fox (SJKF) requirements consist of a percentage of habitat to be protected within three core areas and additional, less defined satellite areas.

#### **Tipton kangaroo rat**

Tipton kangaroo rats are limited to the San Joaquin Valley floor where recovery regions are more difficult to define based on physical landscape features. For TKR, site-specific protection requirements (USFWS 1998) for Tipton kangaroo rats (TKR) are identified as:

- Pixley National Wildlife Refuge-Allensworth Natural Area (2,000 ha of contiguous, occupied habitat)
- Semitropic Ridge Natural Area (2,000 ha of contiguous, occupied habitat)
- Kern Fan (2,000 ha of contiguous, occupied habitat)

To identify recovery areas we used digital (scanned) copies of a series of maps created by the SJVBTC (1992). Maps were imported to a GIS and conservation areas highlighted on maps were digitized to polygon features. We digitized, edited, and added attribute information for regions that best matched the described Pixley National Wildlife Refuge (Figure 2), Allensworth Natural Area (Figure 3), Semitropic Ridge Natural Area (Figure 4), and the Kern Fan area (Figure 5).

As an example of measuring areas within each one, we overlaid these regions with habitat information for San Joaquin kit fox (Table 1). SJKF suitability was used as an example because we don’t currently have TKR suitability information and we assume that the total for well-defined TKR habitat would represent less area than what is described in Table 1. Additionally, surveys and additional landscape metrics would be required to identify the areas that are both *contiguous* and *occupied*.

**Table 1. Amount of potential and not necessarily contiguous habitat by TKR region.**

<b>Pixley NWR-Allensworth NA &gt;2,000 ha of contiguous, occupied habitat</b>
Pixley NWR = 570 ha
Allensworth = 1,830 ha
Total = 2,400
<b>Semitropic Ridge NA &gt;2,000 ha of contiguous, occupied habitat</b>
Total = 3,688 ha
<b>Kern Fan &gt;2,000 ha of contiguous, occupied habitat</b>
Total = 3,048 ha

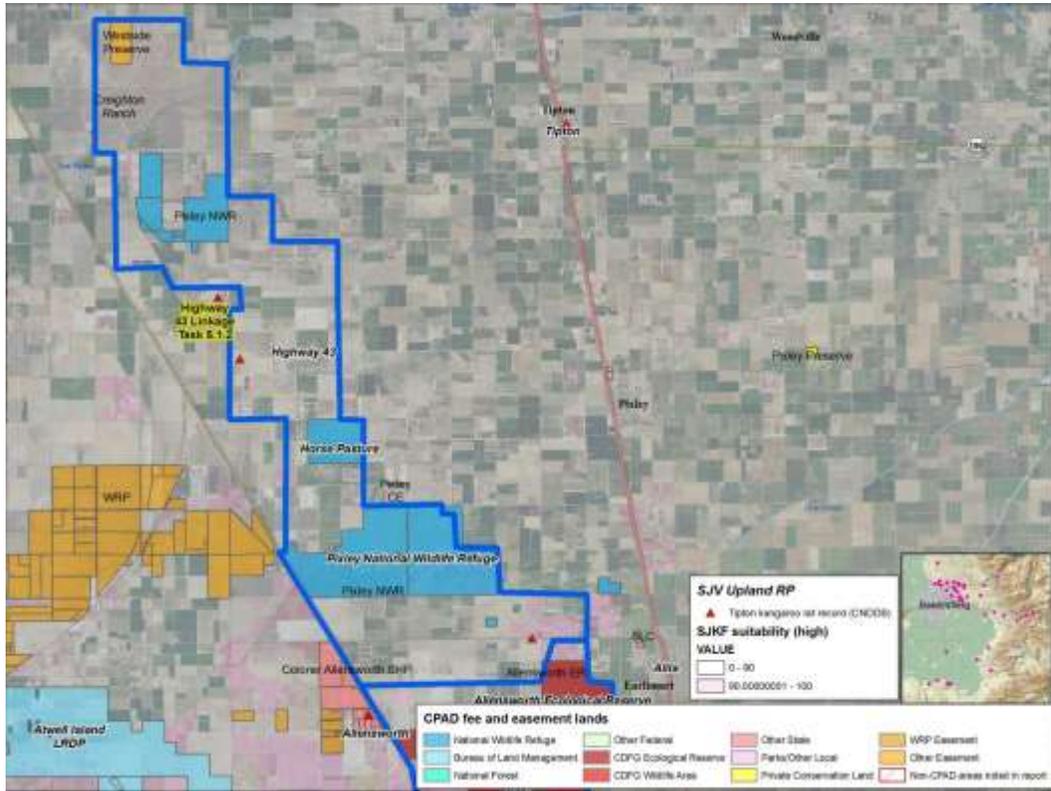


Figure 2. Pixley National Wildlife Refuge region with preliminary region boundary (in blue).

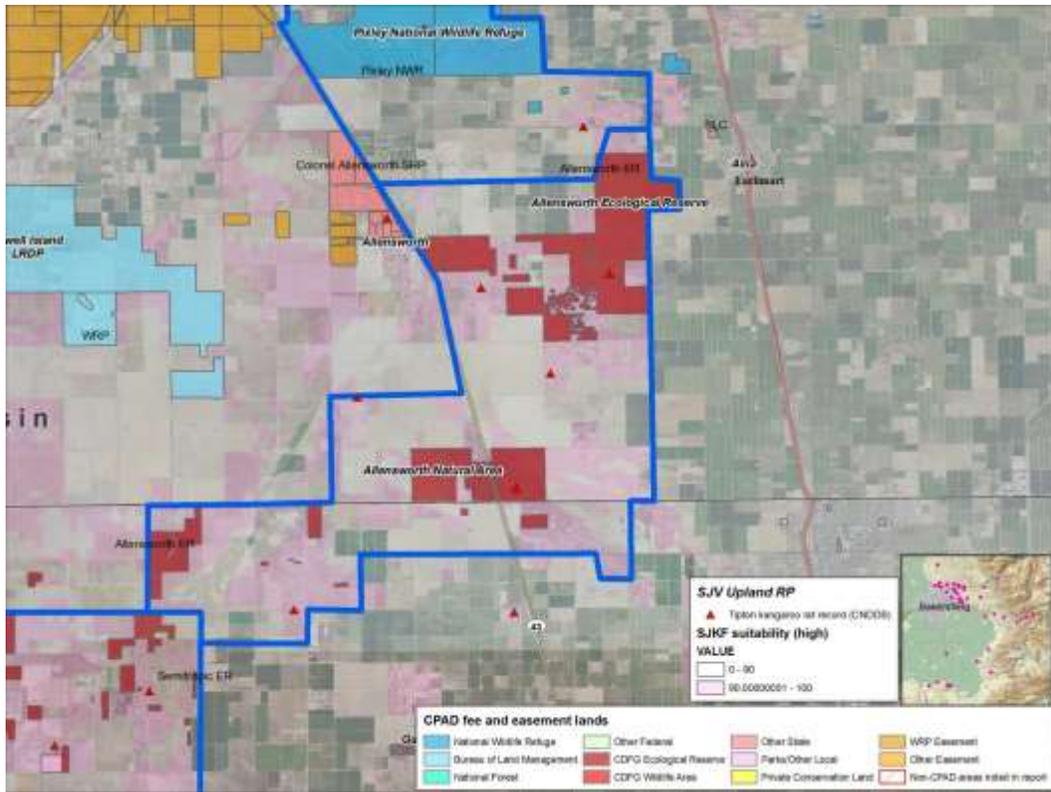


Figure 3. Allensworth Natural Area region with preliminary region boundary (in blue).

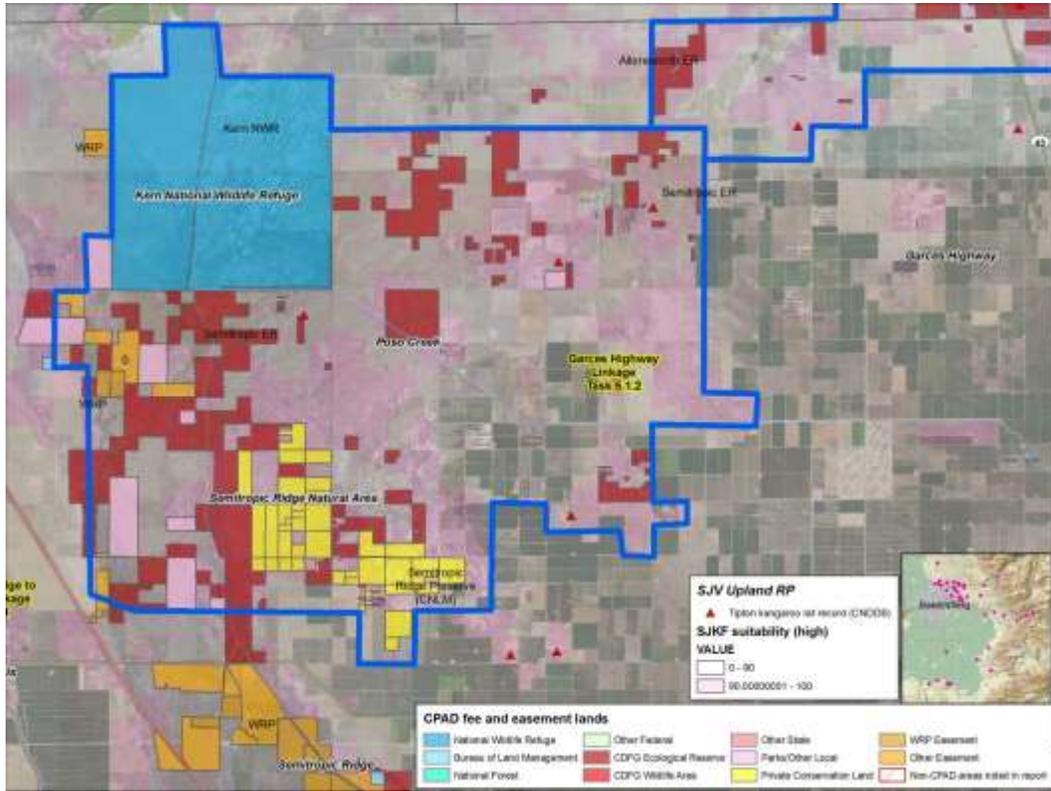


Figure 4. Semitropic Ridge Natural Area region with preliminary region boundary (in blue)

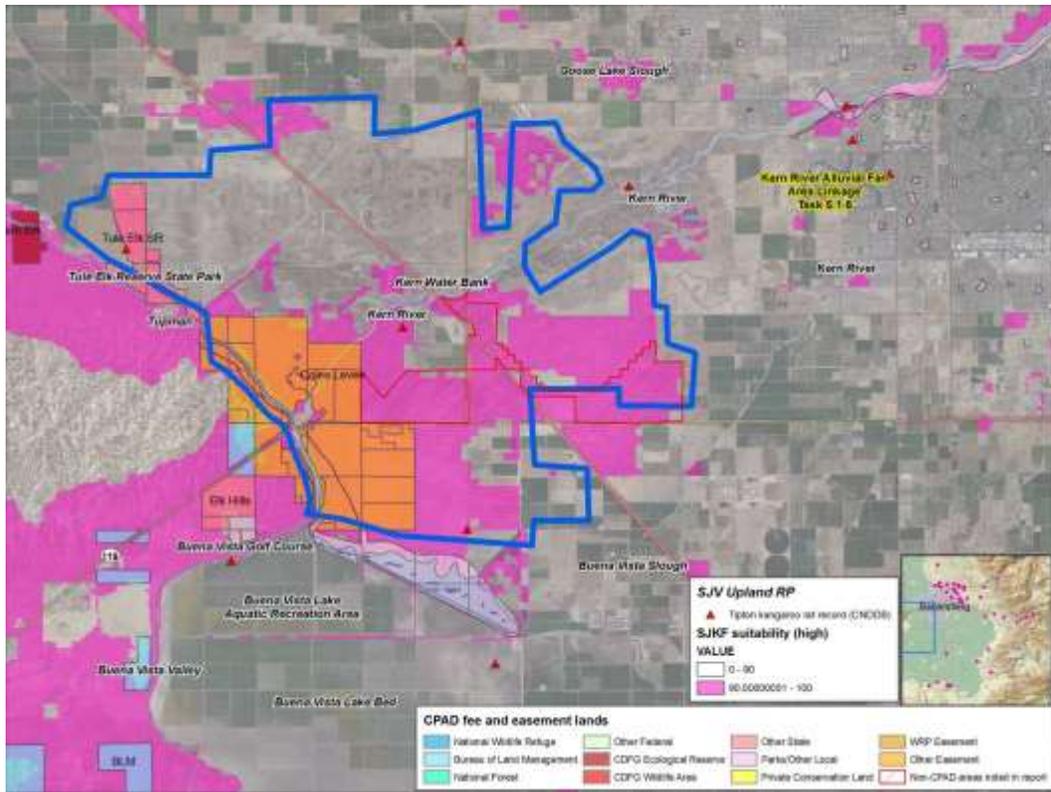


Figure 5. Kern Fan region with preliminary region boundary (in blue)

## Bakersfield Cactus.

As a plant, site protection requirements for BACA differ from animal species in that the protection is targeted towards existing clumps of plants at known locations. We chose BACA as a case study because we recently surveyed all known populations to determine their status (Cypher et al. 2011). As part of the status survey, we identified element occurrence regions currently occupied by BACA clumps and updated their boundaries where necessary.

Site-specific protection requirements (USFWS 1998) for Bakersfield cactus (BACA) are identified as:

- 90% of clumps and occupied habitat in the 9 regions (Figure 6) with historical BACA occurrence records (Caliente-Bena Hills, Comanche Point, Cottonwood Creek, Fuller Acres, Granite Station, Kern Bluffs, Kern Canyon, Metropolitan Bakersfield south of Kern River, north of Kern River).
- 100 clumps each from 2 regions (Figure 6, Sand Ridge, Wheeler Ridge)

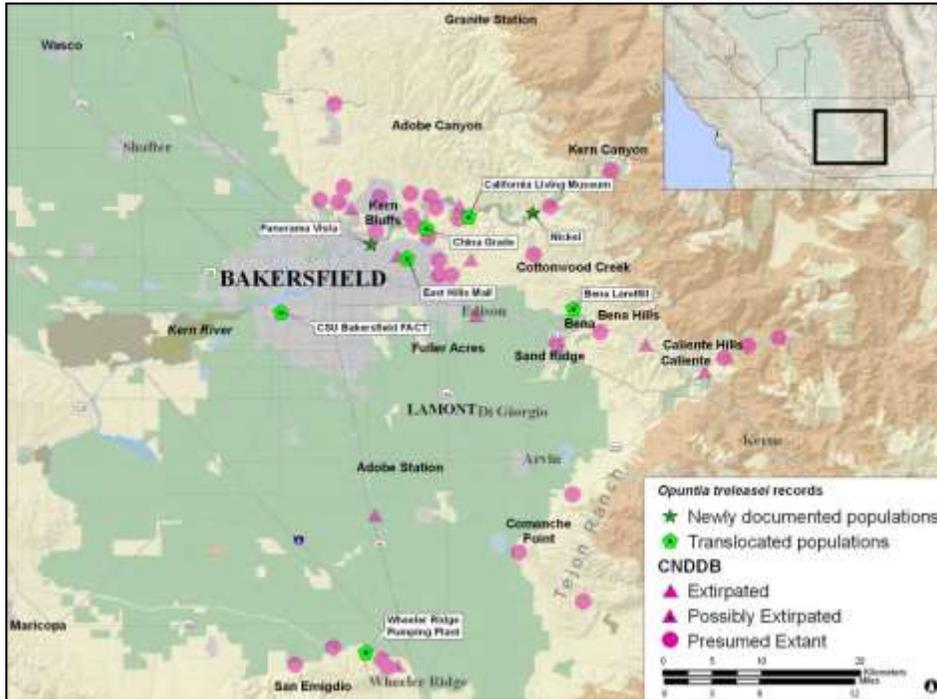


Figure 6. Status of Bakersfield cactus populations (from Cypher et al. 2011).

Figure 7 and Figure 8 display current BACA element occurrence records in relation to protected lands. In the case of BACA, we considered each element occurrence as a defined region and compared those to the protection status of lands.

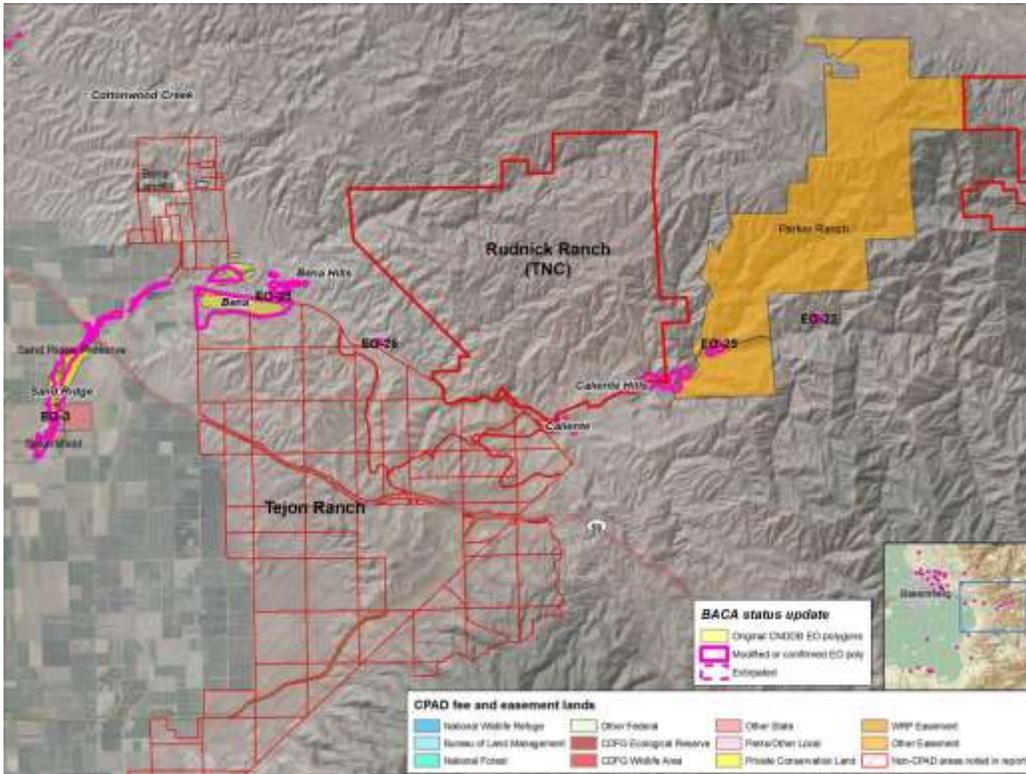


Figure 7. Protected lands and Bakersfield cactus element occurrences in the Caliente-Bena Hills area.

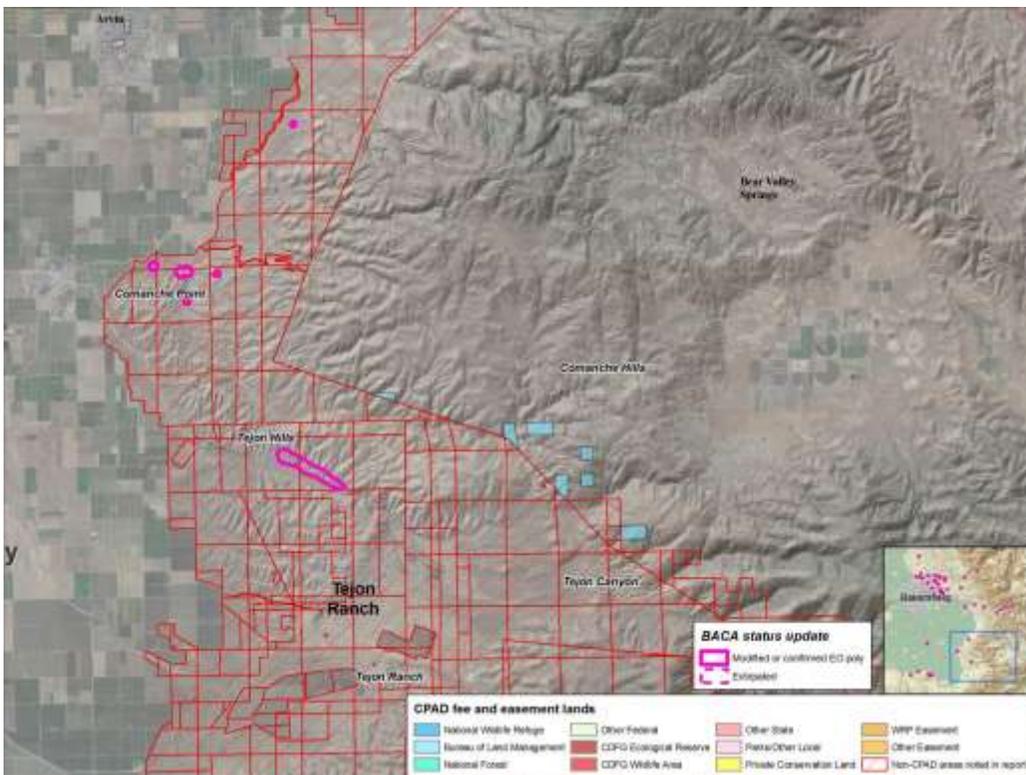


Figure 8. Protected lands and Bakersfield cactus element occurrences in the Camanche Point area.

We found that for the nine sites with 90% protection requirements of clumps and occupied habitat, only the Camanche Point site meets the protection criteria with the recent conservation agreement for Tejon Ranch. Three additional sites had greater than 50% of occupied habitat under some protection (Table 2). Two sites had between 10% and 50% of protection and Table 2) or 3 of the 9 sites

**Table 2. Estimated protection levels for occupied Bakersfield cactus habitat.**

Protection requirement	Site	Protection level	Protected ownership
90% of clumps and occupied habitat	Caliente-Bena Hills	65%	The Nature Conservancy, California Dept. of Fish and Wildlife, Center for Natural Lands Management
	Comanche Point	100%	Tejon Ranch Conservancy
	Cottonwood Creek	71%	California Dept. of Fish and Wildlife
	Fuller Acres – Unknown status	-	-
	Granite Station – Unknown status	-	-
	Kern Bluffs	33%	Kern Co. Parks, California Dept. of Fish and WildlifeG
	Kern Canyon	11%	Sequoia National Forest
	Metropolitan Bakersfield south of Kern River	< 1%	
	north of Kern River	51%	California Dept. of Fish and Wildlife
Greater than 100 clumps	Sand Ridge	> 100 clumps	California Dept. of Fish and Wildlife, Center for Natural Lands Management
	Wheeler Ridge	> 100 clumps	The Wildlands Conservancy

### San Joaquin kit fox

For San Joaquin kit fox, recovery criteria includes 90% protection of two core population areas (Ciervo-Panoche Natural Area and Western Kern County) and 100% protection of a third core area (Carrizo Plain Natural Area). All three core areas are relatively large regions that, to a greater degree than valley floor areas, bounded by landscape features such as mountain ranges and ridges. For these core areas, we identified a set of CRAs (NRCS 2010) within the Great Central Valley and Carrizo Plain (UCSB 1998) that appeared to best represent the described recovery sites. Of the three core areas, we found the Ciervo-Panoche Natural Area (Figure 9) as one best able to be bounded by CRA features due to its physical isolation from neighboring described regions on the San Joaquin Valley floor. Likewise, the Carrizo Plain Natural Area was a distinct region bounded by the mountain ranges (Figure 10). However, as described in the plan (land ownership) we also limited the northern boundary based on SJVBTC maps which coincides with the northern boundary of the current Carrizo Plain National Monument. We found that Western Kern County was the most difficult to adequately define because it represents a continuum of open habitat areas from northwestern Kern County to Southwestern Kern County (Figure 11, Figure 12).

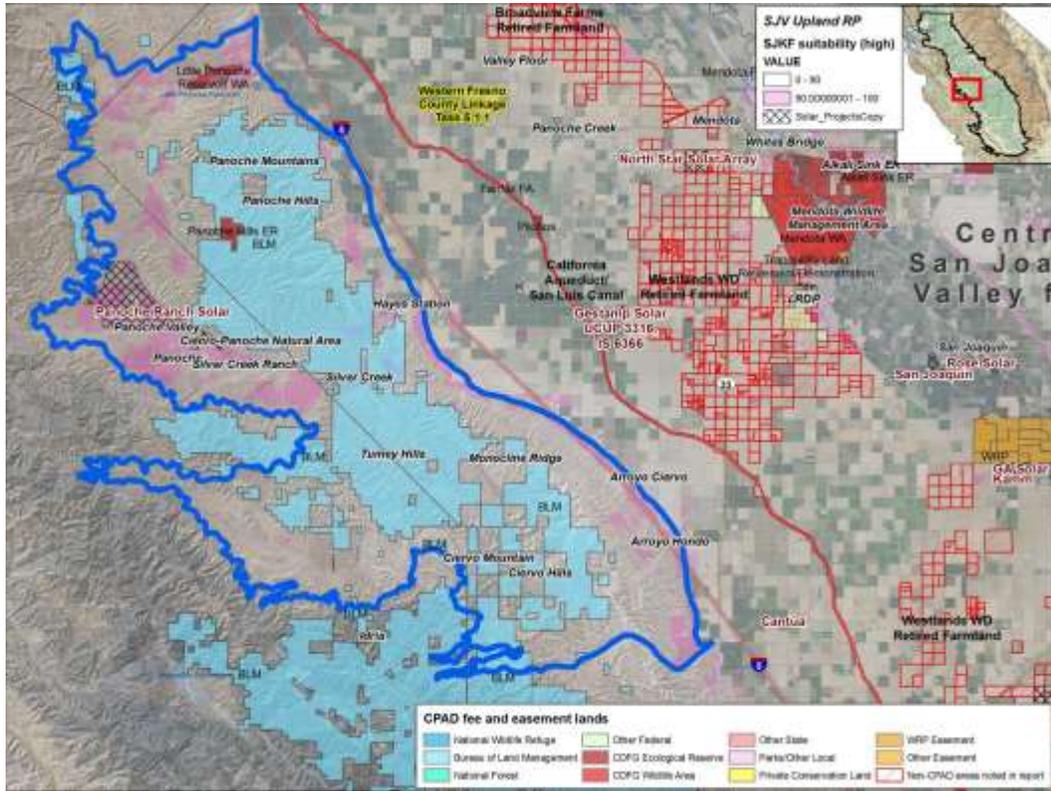


Figure 9. Ciervo-Panoche Natural Area (shown in blue outline).

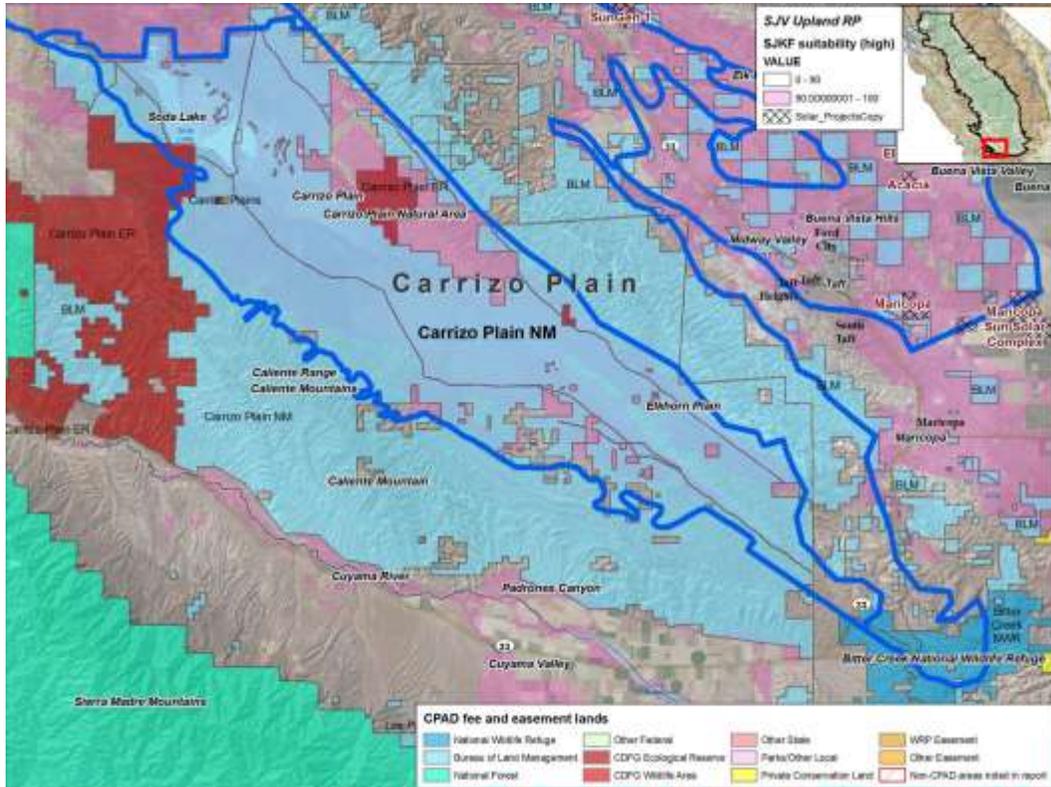


Figure 10. Carrizo Plain Natural area (shown in blue outline).



## ***DATA REVIEW***

A presentation describing preliminary boundaries and methodology was presented at a quarterly meeting of the SJVRT on March 11<sup>th</sup>, 2013. Members of the team provided feedback on the utility of data sources including those derived from the SJVBTC maps. A consensus of the group is that SJVBTC-derived boundaries have an advantage over other sources in that they were created during the period when the recovery criteria were formulated and some staff involved with creating the criteria were also involved with defining the boundaries on the SJVBTC maps.

## **REFERENCES**

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- Constable, J. L., B. L. Cypher, S. E. Phillips, and P. A. Kelly. 2009. Conservation of San Joaquin kit foxes in western Merced County, California. California State University-Stanislaus, Endangered Species Recovery Program, Fresno, California. 55pp.
- Cypher, B.L., E.N. Tennant, C.L. Van Horn Job, and S. E. Phillips. 2011. Status Survey for Bakersfield Cactus (*Opuntia basilaris* Var. *treleasei*). Unpublished report to the Central Valley Project Conservation Program and Habitat Restoration Program. CSU Stansislaus, Endangered Species Recovery Program, Turlock, CA.
- Kelly, P.A., S.E. Phillips, and D.F. Williams. 2005. Documenting Ecological Change in Time and Space: The San Joaquin Valley of California. Pp. 57-78 in Lacey, E. A. and P. Myers, eds. Mammalian Diversification: From Chromosomes to Phylogeography. Publications in Zoology Series. University of California Press, Berkeley, CA. 383 pp.
- (NRCS) U.S. Dept. of Agriculture, Natural Resources Conservation Service. 2010. National Coordinated Common Resource Area (CRA) Geographic Database. URL: <http://soils.usda.gov/survey/geography/cra.html>
- Orman, L. and S. Phillips. 2011. Cataloging Protected Lands in the San Joaquin Valley Using Geographic Information Systems. Unpublished report to the Central Valley Project Conservation Program and Habitat Restoration Program. CSU Stansislaus, Endangered Species Recovery Program, Turlock, CA.
- (SJVBTC) San Joaquin Valley Bio-Technical Committee. c.1992-1994. Unpublished maps created during technical committee meetings. Unpublished material provided as digital scans by Larry Saslaw, Bureau of Land Management Bakersfield (retired).
- (UCSB) U.C. Santa Barbara Biogeography Lab. 1996. California Gap Analysis Vegetation Layer (Statewide). 1:100,000-1:250,000. University of California, Santa Barbara, CA. URL: [http://www.biogeog.ucsb.edu/projects/gap/gap\\_home.html](http://www.biogeog.ucsb.edu/projects/gap/gap_home.html)
- (UCSB) U.C. Santa Barbara Biogeography Lab. 1998. Jepson Geographic Subdivisions of California Layer (Statewide). 1:100,000-1:250,000. University of California, Santa Barbara, CA. URL: [http://www.biogeog.ucsb.edu/projects/gap/gap\\_home.html](http://www.biogeog.ucsb.edu/projects/gap/gap_home.html)
- U.S. Fish and Wildlife Service. 1998. Recovery plan for vernal pool ecosystems of California and Oregon. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon.

APPENDIX A. SITE-SPECIFIC PROTECTION REQUIREMENTS TO MEET DELISTING CRITERIAL FOR THE SIX FEDERALLY-LISTED PLANTS AND FIVE FEDERALLY-LISTED ANIMAL SPECIES

(Adapted from U.S. Fish and Wildlife Service 1998)

Species	Site Name	County	Ownership <sup>1</sup>	Protection Level
California jewelflower	Carrizo Plain	San Luis Obispo	USBLM/CDFG/The Nature Conservancy	95 percent of occupied habitat
	Kreyenhagen Hills	Fresno	USBLM	95 percent of occupied habitat
	San Joaquin Valley			
	1. valley floor	any	any	260 hectares (640 acres)
	2. eastern foothills	any	any	260 hectares (640 acres)
	Santa Barbara Canyon	Santa Barbara	USBLM/private	90 percent of plants and occupied habitat
palmate-bracted bird's-beak	Colusa National Wildlife Refuge	Colusa	USFWS	95 percent of occupied habitat
	Delevan National Wildlife Refuge	Colusa	USFWS	95 percent of occupied habitat
	Sacramento National Wildlife Refuge	Colusa/Glenn	USFWS	95 percent of occupied habitat
	San Joaquin Valley			
	1. Alkali Sink Ecological Reserve-Mendota Wildlife Area	Fresno	CDFG	95 percent of occupied habitat
	2. other (including western Madera County)	any	any	260 hectares (640 acres)
	Springtown Alkali Sink	Alameda	CDFG/City of Livermore/Federal Communications Commission/private	90 percent of plants and occupied habitat
	Central Valley	any	any	2 population, each about 260 hectares (640 acres)
Kern mallow	Lokern	Kern	USBLM/Center for Natural Lands Management/CDFG/private	90 percent of plants and occupied habitat
	other (if Kern mallow positively identified elsewhere)	Kern	any	2 populations, each about 260 hectares (640 acres)
Hoover's woolly-star	Antelope Plain-Lost Hills-Semitropic	Kern	USBLM/The Nature Conservancy	75 percent of occupied habitat
	Carrizo Plain-Elkhorn Plain-Temblor Range-Caliente Mountains-Cuyama Valley-Sierra Madre Mountains	San Luis Obispo/Santa Barbara	USBLM/CDFG/The Nature Conservancy/U.S. Forest Service	75 percent of occupied habitat
	Kettleman Hills	Fresno/Kings	USBLM	75 percent of occupied habitat
	Lokern-Elk Hills-Buena Vista Hills-Coles Levee-Taft-Maricopa	Kern	USBLM/CDFG/Coles Levee Ecosystem Preserve/U.S. Department of Energy/The Nature Conservancy/Occidental	75 percent of occupied habitat

Species	Site Name	County	Ownership <sup>1</sup>	Protection Level
	San Joaquin Valley floor (may be within above areas including Alkali Sink Ecological Reserve)	any	any	260 hectares (640 acres)
San Joaquin woolly-threads	Carrizo Plain-Elkhorn Plain	San Luis Obispo	USBLM/CDFG/The Nature Conservancy	95 percent of occupied habitat
	Jacalitos Hills	Fresno	USBLM	95 percent of occupied habitat
	Kettleman Hills	Fresno/ Kings	USBLM	95 percent of occupied habitat
	Lost Hills	Kern	private	260 hectares (640 acres)
	Panoche Hills	Fresno/ San Benito	USBLM	95 percent of occupied habitat
	San Joaquin Valley floor (may be within Lost Hills)	any	any	260 hectares (640 acres)
Bakersfield cactus	Caliente-Bena Hills	Kern	private	90 percent of clumps and occupied habitat
	Comanche Point	Kern	private	90 percent of clumps and occupied habitat
	Cottonwood Creek	Kern	private	90 percent of clumps and occupied habitat
	Fuller Acres	Kern	private	90 percent of clumps and occupied habitat
	Granite Station	Kern	private	90 percent of clumps and occupied habitat
	Kern Bluffs	Kern	private/Kern Co.	90 percent of clumps and occupied habitat
	Kern Canyon	Kern	private	90 percent of clumps and occupied habitat
	Metropolitan Bakersfield south of Kern River	Kern	private	100 clumps
	north of Kern River	Kern	private	100 clumps
	Sand Ridge	Kern	The Nature Conservancy/private	90 percent of clumps and occupied habitat
	Wheeler Ridge	Kern	private/California Department of Water Resources	90 percent of clumps and occupied habitat
giant kangaroo rat	Ciervo-Panoche Natural Area	Fresno, San Benito	USBLM/CDFG/Private	entire metapopulation
	Western Kern County	Kern		
	1. Lokern Area	Kern	USBLM/CDFG/California Department of Water Resources/U.S. Department of Energy/The Nature Conservancy/private	90 percent of extant historical habitat
	2. Occidental of Elk Hills	Kern	USBLM/CDFG/California Department of Water Resources/U.S. Department of Energy/The Nature Conservancy/private	90 percent of extant historical habitat (all in Buena Vista/McKittrick Valleys)

Species	Site Name	County	Ownership <sup>1</sup>	Protection Level
	3. Naval Petroleum Reserve-2	Kern	USBLM/CDFG/California Department of Water Resources/U.S. Department of Energy/The Nature Conservancy/private	80 percent of extant historical habitat (all in Buena Vista Valley)
	4. Other areas with natural land			80 percent of extant historical habitat
	Carrizo Plain Natural Area	San Luis Obispo	USBLM/CDFG/The Nature Conservancy	entire metapopulation
	San Juan Creek Valley	San Luis Obispo	USBLM/CDFG/The Nature Conservancy	entire metapopulation
	Upper Cuyama Valley	San Luis Obispo, Santa Barbara	USBLM/CDFG/The Nature Conservancy	entire metapopulation
	Kettleman Hills	Kings, Fresno	USBLM	entire metapopulation
Fresno kangaroo rat	Western Madera County	Madera	private	greater than or equal to 1,012 hectares (2,500 acres) of occupied habitat
	Kerman & Alkali Sink Ecological Reserves	Fresno	CDFG	greater than or equal to 384 hectares (950 acres) each of occupied habitat
	Lemoore Naval Air Station	Kings, Fresno	Department of Defense (U.S. Navy)	greater than or equal to 384 hectares (950 acres) of occupied habitat
Tipton kangaroo rat	Pixley National Wildlife Refuge-Allensworth Natural Area	Tulare, Kern	USFWS/CDFG/private	greater than or equal to 2,000 hectares (4,942 acres) of contiguous, occupied habitat
	Semitropic Ridge Natural Area	Kern	USFWS/CDFG/The Nature Conservancy/private	greater than or equal to 2,000 hectares (4,942 acres) of contiguous, occupied habitat
	Kern Fan	Kern	Kern County Water Agency	greater than or equal to 2,000 hectares (4,942 acres) of contiguous, occupied habitat
blunt-nosed leopard lizard	northern Valley floor	Merced or Madera	private	greater than or equal to 2,428 hectares (6,000 acres) contiguous, occupied habitat
	western edge of Valley	Fresno, San Benito	USBLM/private	greater than or equal to 2,428 hectares (6,000 acres) contiguous, occupied habitat
	southern Valley floor	Tulare	USFWS/CDFG/private	greater than or equal to 2,428 hectares (6,000 acres) contiguous, occupied habitat
	west-central edge of Valley	Kings, Fresno	USBLM/private	greater than or equal to 2,428 hectares (6,000 acres) contiguous, occupied habitat
	southern Valley floor	Kern	USFWS/CDFG/The Nature Conservancy/California Department of Water Resources/private	greater than or equal to 2,428 hectares (6,000 acres) contiguous, occupied habitat

Species	Site Name	County	Ownership <sup>1</sup>	Protection Level
	western Kern County	Kern	USBLM/CDFG/Kern County Water Agency/California Department of Water Resources/ Department of Energy/Center for Natural Lands Management/private	greater than or equal to 2,428 hectares (6,000acres) contiguous, occupied habitat
	Carrizo Plain Natural Area	San Luis Obispo	USBLM/CDFG/The Nature Conservancy	entire metapopulation
	Upper Cuyama Valley	San Luis Obispo/ Santa Barbara	USFS/USBLM/private	entire metapopulation
San Joaquin kit fox	Ciervo-Panoche Natural Area	Fresno, San Benito	USBLM/CDFG/private	90 percent of existing potential habitat
	western Kern County	Kern	USBLM/CDFG/Kern County Water Agency/California Department of Water Resources/U.S. Department of Energy/Center for Natural Lands Management/private	90 percent of existing potential habitat
	Carrizo Plain Natural Area	San Luis Obispo	USBLM/CDFG/The Nature Conservancy/private	100 percent of existing potential habitat
	greater than or equal to 9 satellite populations:			80 percent of existing potential habitat
	northern range and Valley edges	Alameda, Contra Costa, San Joaquin, Stanislaus	various public and private	80 percent of existing potential habitat
	northern Valley floor	Merced, Madera	various public and private	80 percent of existing potential habitat
	central Valley floor	Fresno	various public and private	80 percent of existing potential habitat
	west-central Valley edge	Fresno, Kings	various public and private	80 percent of existing potential habitat
	southeast Valley floor	Tulare, Kern	various public and private	80 percent of existing potential habitat
	Kettleman Hills	Fresno, Kings, Kern	various public and private	80 percent of existing potential habitat
	southwestern Valley floor	Kern	various public and private	80 percent of existing potential habitat
	Salinas-Pajaro Rivers watershed	Monterey, Santa Benito, San Luis Obispo	various public and private	80 percent of existing potential habitat
	upper Cuyama Valley	Santa Barbara, San Luis Obispo	various public and private	80 percent of existing potential habitat

1. Protection levels apply only to any lands specified in the ownership column

## APPENDIX B. SUMMARY OF PROTECTED LANDS IN THE SAN JOAQUIN VALLEY MULTISPECIES RECOVERY PLAN STUDY AREA

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(adapted from Orman and Phillips 2011)

A goal of this effort is to examine the current status of protected lands in relation to tasks established by the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (SJVRP, U.S. Fish and Wildlife Service 1998).

We reviewed fee and easement lands by general region in the San Joaquin Valley (Figure 13) and by proximity to higher quality upland habitat. Upland habitat was measured using a generalized version of a San Joaquin kit fox habitat suitability model developed by Brian Cypher and Scott Phillips (manuscript in preparation). The model was modified to include habitat only in natural lands – or those not currently developed. This is consistent with mapping efforts in the upland species recovery plan based on the California GAP Analysis Program (UC Santa Barbara 1996).

Below we discuss habitat quality and land status in geographic regions of the San Joaquin Valley in relation to geographically explicit tasks in the recovery plan. Examples of tasks include the protection of natural lands (Task 2.1), the establishment of specialty preserves (Task 2.2), and the establishment or maintenance of linkages between natural lands (Tasks 5.1 and 5.3).

### ***PROTECTED LANDS AND ARID-UPLAND HABITAT QUALITY***

Most listed upland species of the San Joaquin Valley are arid-adapted species and not well-adapted to dense vegetation of more-mesic regions. This limits the best arid habitats of the San Joaquin Valley to the drier south (Figure 14). The physiographic isolation of the Southern San Joaquin Valley from inland deserts limits the area of available habitat contributing to the endangerment of these species.

We examined the locations of protected lands in relation to general habitat attributes – land use, slope, and vegetation density. We developed a map of rangeland land use based on the U.S. Dept. of Agriculture, National Agricultural Statistics Service CropScape Data Layer<sup>2</sup>. Slope was classified using a 30-m digital elevation model. Vegetation density was estimated using a 16-day vegetation index (Normalized Difference Vegetation Index, NDVI) product derived from remotely sensed Moderate Resolution Imaging Spectroradiometer (MODIS) imagery and produced by the Global Land Cover Facility<sup>3</sup>. The resulting layer depicts areas of the San Joaquin Valley that are rangelands, in less rugged areas, and have relatively low levels of vegetation (Figure 15, Figure 16, Figure 17).

Using the source GIS data for rangeland, slope and vegetation density, we conducted an overlay analysis with CPAD and additional easement data to examine elements of habitat quality by the type of protected land. Using elements from other modeling efforts, we defined the best upland habitat as being rangelands, with less than 10% slopes (less rugged areas), and with sparse vegetation. We then summarized the amount of protected lands for

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<sup>2</sup> <http://nassgeodata.gmu.edu/CropScape/>

<sup>3</sup> <http://glcf.umiacs.umd.edu/data/ndvi/>

each habitat element – rangelands, rangelands with less than 10% slopes, rangelands with less than 10% slopes with sparse vegetation (Table 3).

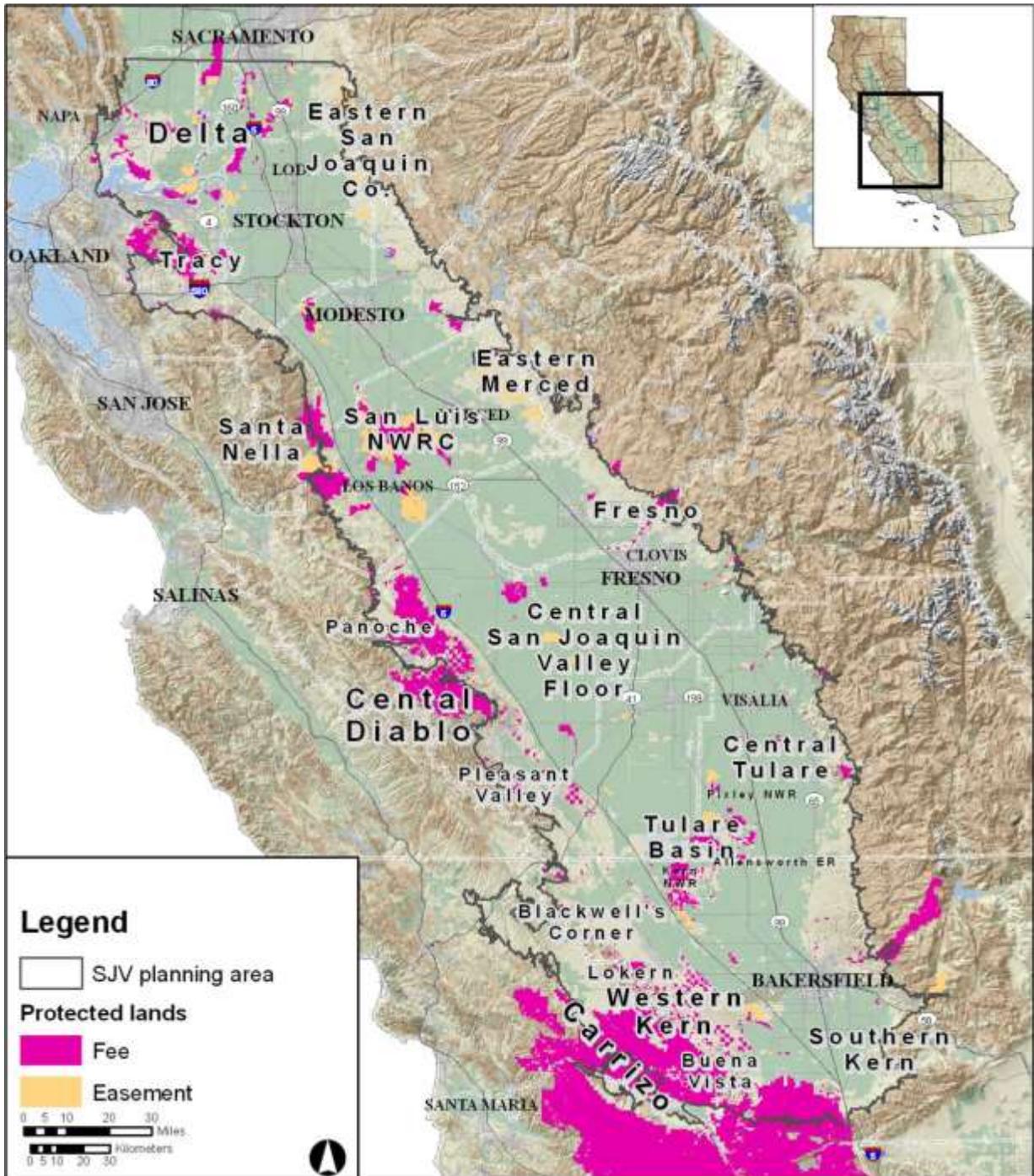
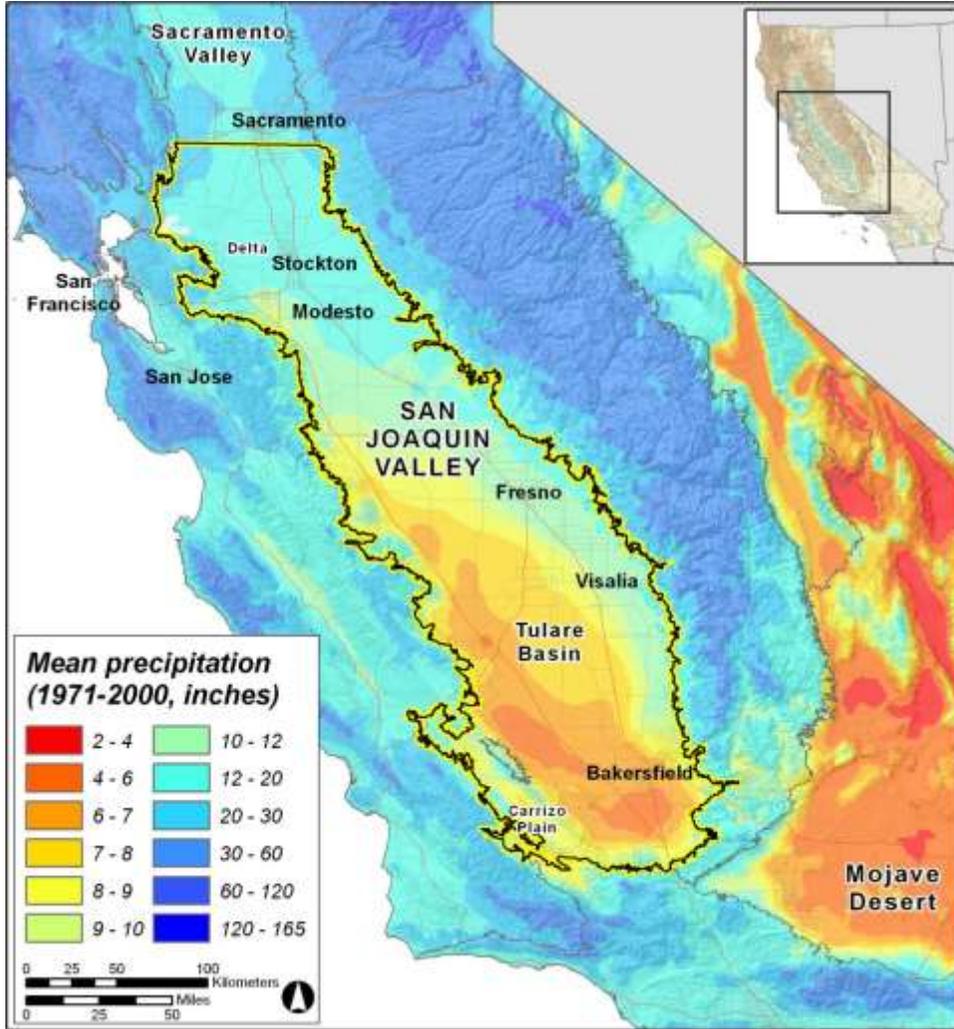


Figure 13. General regions of the San Joaquin Valley. Greater detail is shown in Map A though Map M below.



**Figure 14. Relative aridity of the Southern San Joaquin Valley.**

Within the 48,000 km<sup>2</sup> San Joaquin Valley Study Area (Figure 13, ), approximately 9% (4,400 km<sup>2</sup>) were either public lands, private conservation lands, or had a conservation easement. Of these, approximately 66% were publicly-owned lands, 13% were private conservation lands, and approximately 21% were under some form of easement (Table 3).

Approximately 70% of protected areas (3,128 km<sup>2</sup>) in the San Joaquin Valley Study Area are in rangelands – or lands with some habitat potential for upland species (Figure 15, Table 3). Of those, approximately 56% are in areas with less than 10% slopes, or on flatter ground (Figure 16, Table 3).

Of the protected areas on rangelands with less than 10% slope, approximately 55% (752 km<sup>2</sup>) were in areas categorized as having sparse vegetation (Figure 17, Table 3). These generally coincide with some of the best quality habitat (e.g., the Carrizo Plain). This represents approximately 20% of all San Joaquin Valley rangelands with low slope and sparse vegetation.



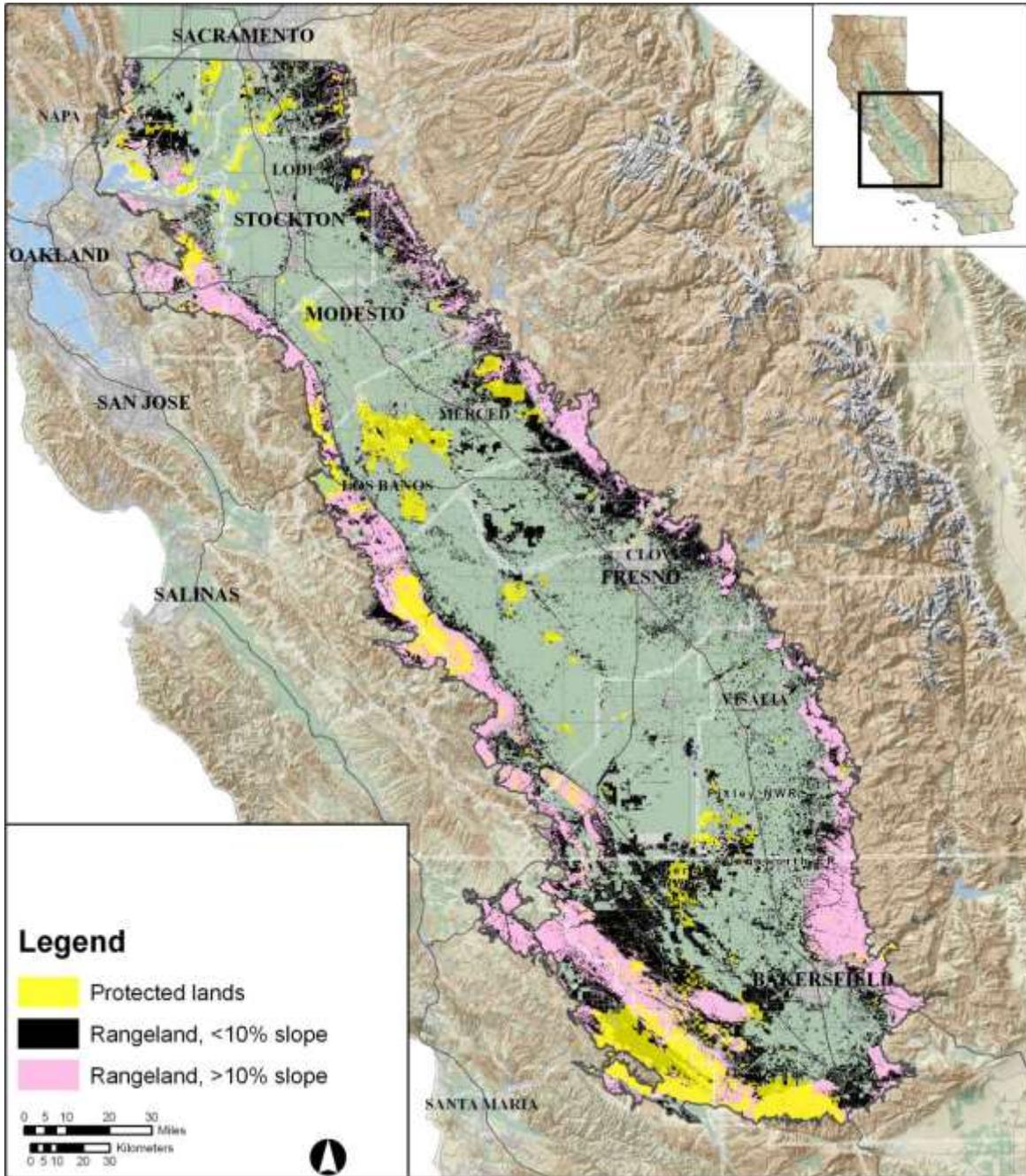


Figure 16. Rangeland land use/land cover, category of slope, and protected areas of the San Joaquin Valley, California.

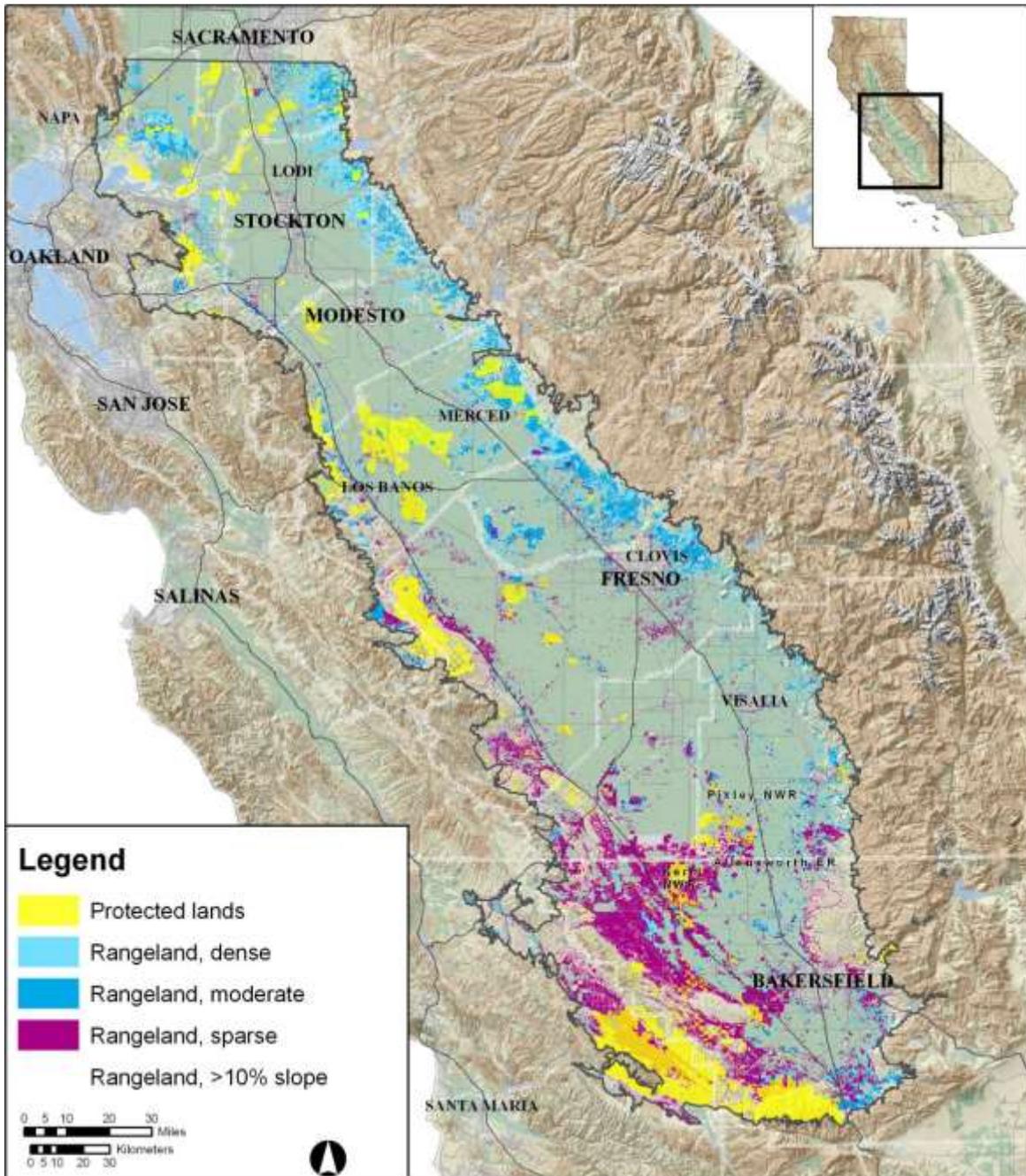


Figure 17. Rangeland land use/land cover, category of slope, and category of vegetation density<sup>4</sup>, and protected areas of the San Joaquin Valley, California.

<sup>4</sup> estimated by the normalized difference vegetation index

**Table 3. Summary of protected land area (km<sup>2</sup>) in the San Joaquin Valley by land use, slope, and vegetation density.**

Land Status	Non-rangeland	Rangeland					Rangeland Total	Grand Total
		> 10% slope	< 10% slope					
			Vegetation density (NDVI)					
			Dense	Moderate	Sparse	Total		
National Wildlife Refuge	131	34	32	48	46	126	160	<b>291</b>
BLM Land	111	1,074	2	4	383	389	1,463	<b>1,574</b>
USFS Land	8	27	0	0	0	0	27	<b>35</b>
Other Federal	38	6	1	7	6	14	21	<b>59</b>
CDFG Ecological Reserve	29	70	11	18	105	134	204	<b>233</b>
CDFG Wildlife Area	189	10	21	20	6	47	57	<b>246</b>
Other State	137	57	7	20	27	53	110	<b>247</b>
Private Conservation Land	102	332	20	51	89	159	491	<b>593</b>
City/Regional Park	98	28	7	9	5	22	50	<b>148</b>
Other Local	31	65	7	12	13	32	97	<b>128</b>
WRP Easement	117	0	5	6	34	45	45	<b>161</b>
Other Easement	355	72	94	198	39	332	404	<b>759</b>
<b>Protected land total</b>	<b>1,346</b>	<b>1,775</b>	<b>208</b>	<b>393</b>	<b>752</b>	<b>1,353</b>	<b>3,128</b>	<b>4,474</b>
Unprotected Land	27,794	6,742	2,193	2,829	3,862	8,884	15,626	<b>43,421</b>
<b>Grand Total</b>	<b>29,141</b>	<b>8,517</b>	<b>2,401</b>	<b>3,222</b>	<b>4,615</b>	<b>10,237</b>	<b>18,754</b>	<b>47,895</b>