Vegetation Mapping and Accuracy Assessment Report for Carrizo Plain National Monument

By

Deborah Stout, Jennifer Buck-Diaz, Sara Taylor, and Julie M. Evens
California Native Plant Society, Vegetation Program
2707 K Street, Suite 1
Sacramento, CA 95816

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Abstract

The California Native Plant Society (CNPS) Vegetation Program has produced a fine-scale vegetation map and monitoring data for the Carrizo Plain National Monument in conjunction with the US Bureau of Land Management and California Department of Fish and Wildlife. The vegetation map encompassed over 247,000 acres and was based upon 2007 true color one-foot resolution aerial imagery from San Luis Obispo County and 2010 natural color one-meter resolution digital imagery from Kern County. The minimum mapping unit (MMU) was 1 acre, with exceptions for wetland and other special types (0.5 acre MMU). The classification and map followed the National Vegetation Classification Standard and state of California Vegetation and Mapping Standards. The map includes 56 map unit codes, of which 48 are natural vegetation codes and eight are non-vegetated or exotic vegetation codes (e.g., cliffs and rock outcrops, developed, agriculture, exotic trees and shrubs). While the primary map attribute is vegetation type, additional map attributes include structural information (e.g., herbaceous, shrub and tree cover), and disturbance and site quality information. This report provides a summary of the mapping and field sampling methods, vegetation classification, results, and accuracy assessment that meets an overall accuracy of over 80%. The fine-scale vegetation map and supporting field survey data provide baseline information for long-term land management, conservation, and wildlife protection within the Carrizo Plain National Monument.

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Introduction and Background

The vegetation mapping project for the Carrizo Plain National Monument was completed under contract by California Native Plant Society (CNPS) to the US Bureau of Land Management (BLM). The project was implemented in four primary stages: 1) collection of field data to inform vegetation classification required for mapping, including installation of long-term monitoring plots to measure vegetation change over time; 2) preparation of a key to the vegetation types based on survey data; 3) creation of a Monument-wide, fine-scale vegetation map based on the vegetation key; and 4) post-mapping collection and analysis of additional data used to verify map accuracy. The data presented in this report and the accompanying vegetation will allow for informed management of vegetation, the identification and maintenance of habitat suitable for federally listed plant and animal species, and the increased understanding of ecosystem functions and processes within the Monument specifically, and within the Central Coast and San Joaquin Valley regions more broadly.

The Carrizo Plain National Monument is the largest of three core recovery areas identified in the US Fish and Wildlife Service Recovery Plan for Upland Species of the San Joaquin Valley (Williams et al. 1998). The listed species are greatly influenced by vegetation composition and structure, which have been altered significantly by land conversion, invasive non-native plant species, and shifts in shrub and herb covers due to inter-annual climatic fluctuations. The vegetation mapping was conducted at a mapping scale and a vegetation classification fine enough to provide a detailed baseline and to conduct modeling of habitat for both plant and wildlife species identified in the Recovery Plan.

In addition, the protocol used in the long-term monitoring plots was designed specifically to detect change over time in herbaceous, shrub, and woodland vegetation strata. Future data collected from long-term monitoring plots along with the vegetation rapid assessments and relevé plots can be analyzed with data from other sources such as climate stations, and with prescribed management activities such as prescribed fires and livestock grazing, to guide adaptive management strategies outlined in the Resource Management Plan for the Monument in 2010.

Methods

Project Location

The Carrizo Plain National Monument is located in eastern San Luis Obispo and western Kern counties. It includes a large interior valley bounded to the west by the Caliente Range and to the east by the Temblor Range. Soda Lake and its surrounding playa form a natural sink in the northern portion of the valley. The project area encompasses 247,000 acres of the Carrizo Plain National Monument, excluding a small area of BLM lands that lie west of the California Department of Fish and Wildlife (CDFW) Chimineas management unit. The Monument boundary used in this project was provided by CDFW staff, Rosie Yacoub.

Data Collection

Vegetation mapping efforts relied upon both existing data and data collected specifically for this project. Vegetation classification surveys were conducted in 2008 and 2010 by CNPS and CDFW, using the CNPS-CDFW Combined Vegetation Rapid Assessment and Relevé protocol

(Buck-Diaz and Evens 2011). In addition, CNPS compiled data from other projects in the region, including surveys of herbaceous plant communities conducted in 2010 by CNPS in concert with The Nature Conservancy and the Natural Resources Conservation Service. All data were quality controlled, merged, and standardized prior to vegetation classification analysis. In total, 1,019 surveys were conducted (114 in 2005–2007, 267 in 2008, and 638 in 2010) to evaluate vegetation resources and establish a comprehensive floristic classification. Additionally, 45 long-term monitoring plots were established to detect vegetation change over time across different plant community types, which included a 400 m^2 relevé plot with one 100 m^2 and eight 1 m^2 plots nested within the larger plot (Buck-Diaz and Evens 2011). See Appendix A for these protocols.

More than 1,000 reconnaissance points also were recorded during the 2010 survey effort to inform the mapping stage of this project. For the reconnaissance, GPS point locations were taken along with observations on vegetation type and cover. Sometimes these points were recorded for vegetation seen at a distance, with the point location offset determined using a compass and laser rangefinder. Reconnaissance points were taken to increase the number of observations on the variety of vegetation types occurring in the area, to determine the edge of stands, and to mark transitions between one vegetation type and another.

Classification and Key of Vegetation Types

Compiled data were analyzed using PC-Ord cluster analysis software, allowing for the classification of vegetation sampled in the over 1,000 surveys. The attributes that distinguish each vegetation type sampled, including species composition, structure, and cover, were used to develop a key to vegetation Alliances. The vegetation map was in turn based on the classification and key to Alliances and higher level units (see Appendix B and Appendix C). More detailed information on the sampling and classification of survey plots is contained in the Carrizo Plain National Monument Vegetation Classification and Mapping Project report (Buck-Diaz and Evens 2011). In general, the vegetation classification is hierarchical and follows the National Vegetation Classification Standard (Faber-Langendoen et al. 2012, FGDC 2008, Jennings et al. 2009, USNVC 2012) and *A Manual of California Vegetation* (Sawyer et al. 2009), including the floristic levels of Alliance and Association and higher levels of Group and Macrogroup.

Vegetation Mapping

Vegetation polygons were digitized using ESRI's ArcMap (version 9.3.x) at a scale of 1":2000'. Aerial imagery used included 2007 true color one-foot aerial imagery (1:4000 spatial accuracy) flown for San Luis Obispo County as the base, and 2009 and 2010 natural color one-meter aerial imagery (1:12000 spatial accuracy) from Kern County (NAIP 2010). Ancillay imagery data included 2005 color infrared one-meter imagery (NAIP 2010), which was particularly useful in distinguishing trees in shrub canopy. Digital Globe's Image Connect service was also used for other color aerial imagery, particularly in areas where the San Luis Obispo County imagery was blurry, washed out, darkened, or in shadow.

Other ancillary data aided in digitizing polygons and designating map attributes, including CNPS and CDFG survey data and photos from 2008 and 2010, CNPS pre- and post-map reconnaissance data and photos from Spring 2010 and Spring 2012, local roads layer,

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administrative and study area boundary layers, 2009 vegetation life form and oak alliance map by Aerial Information Systems for San Luis Obispo County, and CA-GAP land cover maps.

For the mapping, the vegetation classification was translated to a mapping classification with the vegetation map unit legend per Appendix A. The woodlands, shrublands, and some herbaceous vegetation types were mapped at the Alliance-level. However, many upland herbaceous types were mapped at a higher level (Group or Macrogroup) to ensure repeatable, accurate mapping of difficult to discern types. An existing vegetation map of the few thousand acres of CDFW lands within the Monument (VegCAMP 2010) was included and revised, so that stands mapped were edgematched and consistent with the classification and other standards defined in this report.

A number of mapping rules were implemented to ensure consistency among photo interpreters; to prevent 'over-delineating', or splitting vegetation stands into polygons that lack ecological significance; and to ensure that rare types, which often occur in relatively small stands, were not overlooked. The following mapping rules were used during this project:

> Minimum mapping unit (MMU) – the minimum polygon size allowed:
> - 1 acre (1/2 hectare) for typical vegetation types
> - 0.5 acre (1/4 hectare) for localized vegetation types (e.g., wetlands, alkali scalds)
> - 10-meter width for linear polygons meeting one of the above MMUs
>
> Polygon breaks – the minimum polygon size allowed in splitting a vegetation type into multiple polygons:
> - 3 acres when splitting by cover class in the overstory
> - 5 acres for splitting by cover class in the understory
> - 5 acres for non-floristic differences of at least two classes (e.g., development, roads/trails, etc.)

Using the survey data available, mappers familiarized themselves with the aerial photo signatures (color-texture-tone combinations) of each vegetation type. Correlations between the vegetation units and photo signatures were evaluated and refined early on to ensure that the map would consistently represent the different vegetation types at a fine-scale resolution. Mappers were assigned individual areas in which to map, divided loosely by the environment such as the plain, the Temblor Range, or the Caliente Range. This reduced the number of alliances encountered by each mapper, thereby increasing the recognition of fewer, more ecologically cohesive vegetation signatures. Assigned mapping areas were seamed together when completed.

A number of techniques were used both before and after seaming to conduct quality control, many of which involved comparing the attributes assigned to a given polygon. For example, if a polygon was classified as *Juniperus californica*, mappers checked that a reasonable conifer cover class was assigned or, conversely, if significant conifer cover was assigned that the polygon was not classified as a shrubland type. The ArcGIS Dissolve Tool was also used frequently to identify adjacent polygons, attributed similarly, that should be merged into a single polygon.

Accuracy Assessment

Upon completing the map, it was tested for accuracy using a combination of field data collection and analysis of the results. A subset of polygons was selected in a random, stratified approach to ensure verification of most, if not all, of the vegetation types mapped across the study area. Time and budget constraints limited polygons selection to those within 1 km of a road. From April to June 2012, nearly 700 accuracy assessment surveys (AAs) were collected in approximately 600 polygons throughout the mapping area (Figure 1). The AAs were stand-based with both the vegetation type and the extent of the polygons evaluated, when possible.

Additionally, cover values and disturbance attributes were assessed when possible. For polygons containing more than one vegetation type meeting MMUs, an AA was done for each type to provide sufficient information for the mapper to divide the polygon. Trimble Juno SB devices with ESRI's ArcPad software were used to collect GPS point locations, and ArcPad's offset function assisted with distance surveys. See Appendix D for an example of the AA field form.

During the AAs, field crews also collected data at 139 polygons attributed as 'Field Check'. Field Check is a notation made in a polygon attribute table by mappers when they had difficulty determining vegetation type, cover, or other parameters when interpreting the aerial imagery and other data. If an AA polygon had a nearby Field Check polygon, the polygon was assessed to answer the mapper's question and improve overall map accuracy. Field Check points were assessed separately from AA polygons and were not included in the analysis used to determine map accuracy.

Data from AA field forms were entered into an MS Access database, and the vegetation types attributed by the mappers were analyzed and scored using AA survey data and accompanying ground photos. Cover and disturbance attributes were not scored, but were provided as feedback to mappers. A fuzzy logic method was used to compare the vegetation type assigned to each polygon in the map (i.e., the photo-interpreted map unit attribute) with the type assigned during field verification, instead of straight score of correct or incorrect (Congalton and Green 1999, Foody 2002, Gopal and Woodcock 1994, Hagen 2003).

For each polygon assessed, a database code having a corresponding numeric score was assigned (see Table 1), based on the accuracy of the vegetation type identified by the mapper. For example, a polygon assigned a correct vegetation type received a score of 5 (code A), while a polygon that was incorrect at the Alliance level but correct at the Macrogroup level (or next level up in hierarchy) received a score of 3 (code D). Scores were then summed for each vegetation type, divided by the total possible score for each type, and multiplied by 100 to determine the percent accuracy. The minimum accuracy standard for this project was an overall mapping score of 80%. In some cases, the Final Field Call was at the Alliance level, when the mapper was expected to map at the Group or Macrogroup level, such as for herbaceous wetland types. If the mapper chose the correct Group in such a case, a full score would be given. An attempt was made to sample an adequate number of all mapped types, however, almost half of the map units had an AA sample size of n<5, often because they were uncommon in the study area or difficult to access.

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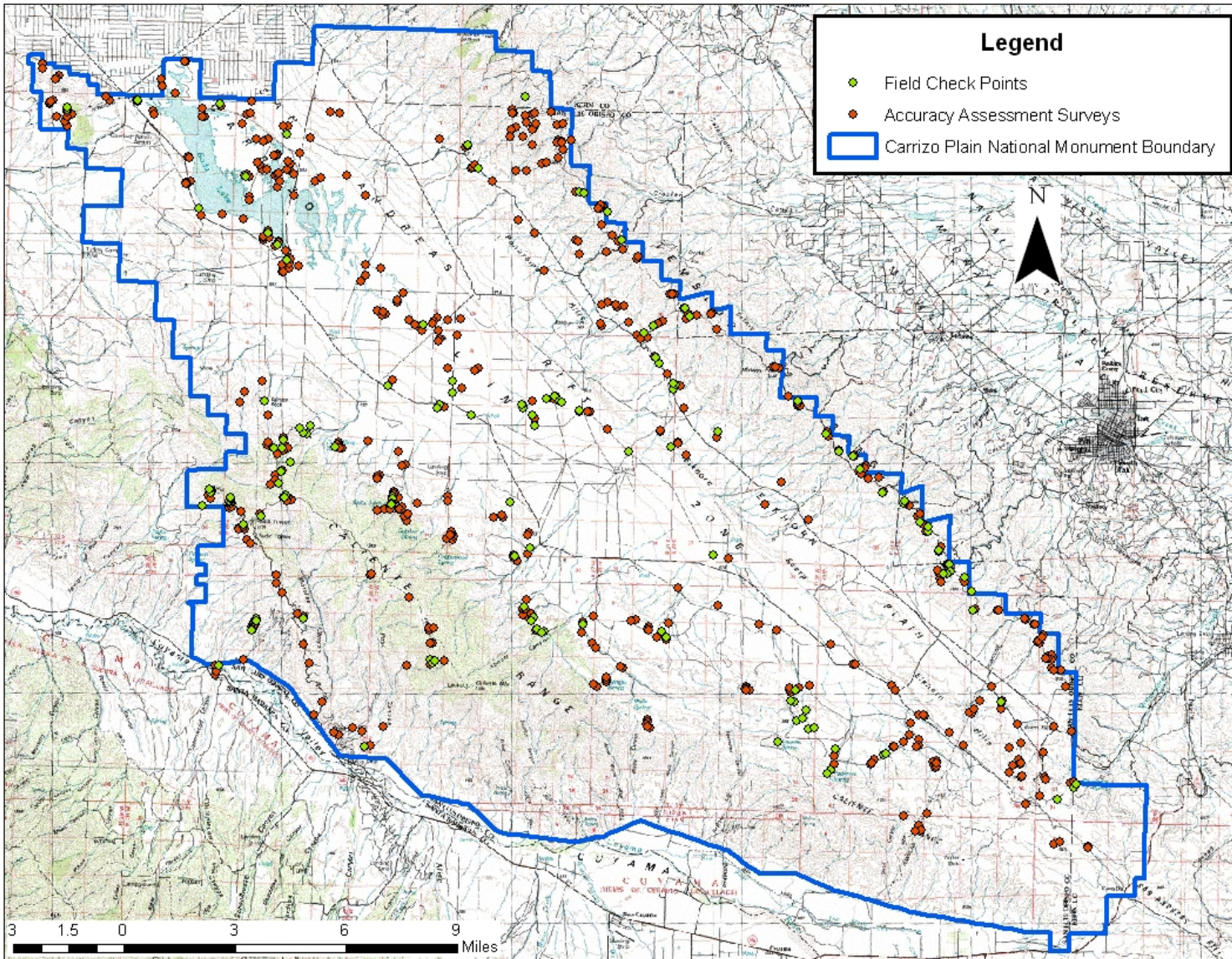
Figure 1. Carrizo Plain National Monument study area boundary with points where polygons were verified for accuracy (Accuracy Assessment Surveys) or checked to confirm mapping attributes (Field Check Points).

AA analysis helps map users determine how much confidence can be assigned to each of the map units, and provides an understanding of the map's appropriateness for various applications. Two forms of accuracy, users' and producers', can be estimated from the data (Story and Congalton 1986). Users' accuracy (field verification) is conditional on the mapped classes and is defined as the probability that a location mapped as class 'i' is in fact class 'i'. This provides an estimate of how well spatial mapping data actually represents what is found on the ground (i.e., if the user goes to a location mapped as class 'i', what is the probability it is in fact vegetation class 'i'). Producers' accuracy (map user), on the other hand, is conditional on the true vegetation class in the field. The producers' accuracy for class 'j' is the probability that a location of vegetation class 'j' in the field is mapped as class 'j'. Producers' accuracy may inform the producers of remotely sensed and mapped data and how readily a mapping class may be detected by mapping whenever it occurs on the ground (Story and Congalton 1986, Lea and Curtis 2010).

Table 1. Score codes assigned for each polygon during Accuracy Assessment analysis.

Code	Reason For Score	Score
A	PI completely correct.	5
B	Correct at the Group level OR the next level up in the hierarchy.	4
C	Threshold/transition between PI call and Final call. This was used when cover values of the dominant or indicator species were close to the values that would key to the PI's type (e.g., an AA call of *Eriogonum fasciculatum* Alliance would get this score if the PI call was *Ephedra californica* Alliance and the stand had 2% *Ephedra californica* and 2% *Eriogonum fasciculatum*).	4
D	Correct at the Macrogroup level OR next level up in hierarchy.	3
E	Based on close ecological similarity. Ecological similarity addresses assessed and mapped calls that contained vegetation with overlapping diagnostic species but were not technically closely related in the NVCS hierarchy. This was common in stands that contain a mix of species of late and early seral vegetation types and also common in zones of overlap between ecoregions.	3
F	Correct Division.	2
G	Some floristic/hydrologic similarity. This addresses cases in which the mapped and the assessed vegetation type had different diagnostic species, but bore some similarity in ecological traits based on predicted and actual setting such as hydrologic regime, overall climate, or successional state.	2
H	Correct only at Lifeform.	1
I	No similarity above Formation and incorrect life form.	0
J	Survey removed because significant change in polygon (e.g., the stand was burned, developed, or cleared since the date of the base imagery).	N/A; no score
K	Survey removed because inadequate portion (<10%) of the polygon was viewed by the AA field crew.	N/A; no score
L	Survey removed because field/PI data is incomplete, inadequate or confusing (e.g., cover values were not provided for key species in the stand).	N/A; no score
M	Supplementary record, not scored (multiple point assessments where the AA call was the same at multiple points).	N/A; no score

Map Attributes

This section provides an alphabetical listing and definitions of the attributes assigned to each polygon mapped.

Comments: Open text field for any comments that the mapper might have. "Field Check" was included in this field to indicate that it would be beneficial to make a field check of the polygon.

Confidence: A rating of the mapper's confidence of attribution, primarily for Alliance type (sometimes on cover by vegetation layer or heterogeneity), during delineation. This also helped assign areas to field check during the accuracy assessment surveys.

Mapping Confidence Levels	
Code	**Meaning**
1	Low
2	Medium
3	High

Cover: Five separate attribute entries for cover, which is defined as the percent "bird's-eye" cover within a vegetation stand. "Bird's-eye" cover is what can be seen on air photo; therefore, it does not include the cover of understory layers that may be obscured by an overstory layer. They include Conifer Cover (**ConifCover**), Hardwood Cover (**HdwdCover**), Total Tree Cover (**TreeCover**), which is the combined total cover of conifer and hardwoods, and Shrub Cover (**ShrubCover**). The fifth cover type of Herbaceous Cover (**HerbCover**) has fewer and coarser cover classes than the woody types, with cover ranges based on the CWHR ground cover classes for desert habitats (Mayer and Laudenslayer 1988).

Tree and Shrub Cover Classes	
Code	Range
0	<1% or not present
5	1-9.9%
15	10-19.9%
25	20-29.9%
35	30-39.9%
45	40-49.9%
55	50-59.9%
65	60-69.9%
75	70-79.9%
85	80-89.99%

Herbaceous Cover Classes	
Code	Range
0	0%
1	<2%
2	2-9%
3	10-39%
4	40-59%
5	60-100%
99	cannot determine

Database ID (DB_ID): If a data point was used to help identify the vegetation in a polygon, its database id is included in this field.

Delineator, Attributer, and QCer: CNPS staff responsible for delineating, attributing, or performing quality control of the map.

Heterogeneity: Describes how heterogeneous the polygon is (low, medium, or high), as measured by the number of vegetation types it contains and the relative area they cover. A low heterogeneity polygon is dominated by a single vegetation type. A polygon with medium to high

heterogeneity may include more than one vegetation type if they are below MMU and, therefore, cannot be delineated separately.

Heterogeneity Classes	
Code	Range
1	Low, less than <5% heterogeneous
2	Moderate, 5-40% heterogeneous
3	High, >40% heterogeneous

Macrogroup: Macrogroup assigned to the map unit according to the current classification.

Macrogroup Codes	
Code	**Description**
M009	California Forest & Woodland Macrogroup
M036	Warm Mediterranean & Desert Riparian, Flooded & Swamp Forest Macrogroup
M043	California Chaparral Macrogroup
M044	California Coastal Scrub Macrogroup
M045	California Annual & Perennial Grassland Macrogroup
M046	California Ruderal Grassland & Meadow Macrogroup
M048	Northern Rocky Mountain-Vancouverian Montane & Foothill Grassland & Shrubland Macrogroup
M073	Western North American Temperate Lowland Wet Shrubland, Wet Meadow & Marsh Macrogroup
M074	Western North American Vernal Pool Macrogroup
M076	Warm Desert Freshwater Shrubland, Meadow & Marsh Macrogroup
M082	Cool (and Warm) Semi-Desert Alkaline-Saline Wetland Macrogroup
M088	Mojave-Sonoran Desert Scrub Macrogroup
M091	Warm Interior Chaparral Macrogroup
M092	North American Warm-Desert Xero-Riparian Macrogroup
M093	Great Basin Saltbrush Scrub Macrogroup
M171	Great Basin & Intermountain Dry Shrubland & Grassland Macrogroup
M999	Unvegetated or Non-native Map Units

Methods Used (Method_ID): Attribute identifies what type of field data (if any were available) supported the vegetation type decision for that polygon. Some of the stands were assessed from a distance using a compass, laser rangefinder or binoculars. For reconnaissance, multiple stands were often assessed from a single location.

Methods Used to Identify Polygon	
Code	**Description**
1	Rapid assessment field data
2	Relevé field data
3	Field reconnaissance
4	Photo-interpretation
5	other information
6	Pre-map reconnaissance
7	Adjacent Alliance to RA-Relevé

National Vegetation Classification Level (NVC_level): The standardized level of the vegetation description used in the National Vegetation Classification Standard (see http://biology.usgs.gov/npsveg/nvcs.html). Most polygons were assessed to the Alliance level. Since the categories for human land use or other unvegetated lands are not in the NVC, those descriptions were drawn from the California Wildlife Habitat Relationships (CWHR 2011).

Non-Native Plants (NonNative_Plants): Level of impact by exotic or invasive species, broken into the following shown in the table below.

Non-Native Plant Impact Levels	
Code	**Range**
0	None or not visible
1	Low (1-33.3% relative exotic cover)
2	Medium (>33.3-66.7% relative exotic cover)
3	High (>66.7-100% relative exotic cover)

Object ID: Number automatically assigned to each polygon by the GIS software. Note that GIS processing may change the number assignment.

Old ID (old_ID): previously used Unique identifier from UID field, used during the process of mapping but no longer unique.

Other Impact (OtherImpact): Lists type of impact on vegetation. Available choices are OHV activity, Development, Disking/Grading, Riparian modification, Erosion/runoff, or Ungulate trails. This is the place where impacts, other than those from roads/trails and non-native plants, are given.

Other Impact Levels (Level_OtherImpact): Lists the level of impact for the Other Impact Type displayed in the previous column.

Other Impact Levels		
Code	**Range**	**Other Impact Types**
0	None or not visible	OHV activity, Development, Disking/Grading, Riparian modification, Erosion/runoff, or Ungulate trails
1	Low (less than 33% of polygon is affected and/or impact is seen but does not affect vegetation density)	
2	Medium (between 33%-66% of the polygon is affected)	
3	High (>66% of polygon is affected)	

Roads/Trails: Level of impact by paved and unpaved roads or hiking (human) trails. Impact is defined by proportion of any polygon of vegetation that is roadless. This has the advantage of helping to identify roadless areas—but the disadvantage of being scale independent. A polygon with a road more or less bisecting it will have a rating of 2, regardless of size; a very large

polygon with this rating might still contain a big roadless area. This is broken into the classes shown in the table below.

Roads/Trails Impact Levels	
Code	**Range**
0	None or not visible
1	Low (at least 2/3 (67% to 100%) of the vegetation polygon area is un-roaded by any type of road or trail)
2	Medium (between 1/3 and 2/3 (33% to 66%) of the vegetation polygon is intersected by any type of road or trail)
3	High (<33% of the vegetation polygon lacks roads of any kind)

Shape: Point or polygon, depending on the feature class; automatically generated by the GIS software.

Shrub_Dieback: Since imagery used for mapping was from 2007 and field reconnaissance started in 2010, noted shrub dieback during field visits helped mappers understand which areas had changed in shrub cover, so that shrub cover could be estimated correctly during mapping.

Unique Identifier (UID): The number assigned to each polygon delineated within the mapping area, which does not change with GIS processing. They range from CNM00900 through CNM19999.

Vegetation Type (VegCode): Numeric code for the cover type (i.e., vegetation alliance, group, or unvegetated type like playa) assigned by the mapper in the attribute table.

Vegetation Type and Codes	
Vegetation Type	**Code**
Native and Naturalized Vegetation Types	
Allenrolfea occidentalis	4311
Ambrosia salsola	2416
Amsinckia (menziesii, tessellata)	5111
Arctostaphylos glauca	2231
Artemisia californica	2312
Artemisia californica - Eriogonum fasciculatum	2314
Atriplex canescens	2413
Atriplex polycarpa	2411
Atriplex spinifera	4312
Atriplex vallicola - Lasthenia ferrisiae - Lepidium jaredii Association	6313
Baccharis salicifolia	4111
California Annual and Perennial Grassland Macrogroup	5100
California Ruderal Grassland & Meadow Macrogroup	5200
Corethrogyne filaginifolia Provisional	5131
Distichlis spicata	6411

Vegetation Type and Codes	
Vegetation Type	**Code**
Ephedra californica	4211
Ephedra viridis	2525
Ericameria linearifolia - Isomeris arborea	2335
Ericameria nauseosa	2511
Eriogonum (elongatum, nudum)	5132
Eriogonum fasciculatum	2317
Forestiera pubescens	4114
Frankenia salina	4317
Gutierrezia californica	2321
Isocoma acradenia	2323
Juncus arcticus (var. balticus, mexicanus)	6211
Juniperus californica	1121
Krascheninnikovia lanata	2521
Lasthenia californica - Plantago erecta - Vulpia microstachys	5114
Lepidospartum squamatum	4213
Leymus triticoides	6213
Lupinus albifrons	2324
Lycium andersonii	2522
Monolopia (lanceolata)-Coreopsis (calliopsidea)	5115
Nassella cernua Provisional	5121
Pluchea sericea	4221
Poa secunda	5122
Populus fremontii	1211
Prunus fasciculata	4215
Quercus douglasii	1131
Quercus john-tuckeri	2111
Ribes quercetorum Provisional	2611
Salix laevigata	4113
Salvia carduacea Provisional	5116
Salvia leucophylla	2325
Salvia mellifera	2328
Schoenoplectus americanus	6111
Suaeda moquinii	4314
Unvegetated and Exotic Types	
Agriculture	9120
Cliffs & Rock Outcrops	9113
Developed	9111
Exotic trees & shrubs	9140
Playa	9115
River & Lacustrine Flats & Streambeds	9114
Tamarix	9141
Unvegetated	9110

Results

Approximately 19,000 individual stands of vegetation were delineated during the mapping process. The most commonly mapped types were the *Ericameria linearifolia - Isomeris arborea* Alliance, *Atriplex polycarpa* Alliance, and California Annual and Perennial Grassland Macrogroup. See Figure 2 for a snapshot of the map showing the fine-scale delineation of vegetation types. The highlighted polygon shows an example of the attributes included within each vegetation stand (polygon) mapped including the following: vegetation type; cover classes for the shrub, herb and tree layers, and site impacts. If a polygon is mapped as a woody vegetation type, the overstory cover is at least 3% cover for semi-desert shrub types (such as *Ephedra californica* Shrubland Alliance) and 5% cover for tree types (such as *Juniperus californica* Woodland Alliance).

While a large portion of this region is herbaceous, there are no accurate and effective methods to differentiate among herbaceous vegetation types using aerial imagery. This is due in part to annual variation in rainfall and temperature; lower-than-average rainfall years result in decreased abundance and diversity of native annual and perennial forbs and grasses. Therefore, with the exception of highly sampled areas, a majority of herbaceous stands were assigned to the California Annual and Perennial Grassland Macrogroup.

Map Accuracy

Based on the information collected during the AA surveys, the average producers' map accuracy across all types was 83.4% and the average users' map accuracy was 88.6%. Table 2 provides a summary of all native and naturalized vegetated map units; including their average score and associated sample size for both users' and producers' accuracy. Of the 45 vegetation map units that were sampled to verify the map, 22 had a sample size of n<5, resulting in 49% of all map types with reportable results. Also, preferred accuracy for fine-scale vegetation mapping is 80% overall; in this project, the map generally met or exceeded these expectations.

A contingency table (Appendix E) for the area displays the resulting vegetation calls for both the field surveyors (users) and photo interpreters (producers). The contingency table has rows showing the types attributed by the photo interpreters (producers' map classes) as compared to the columns showing the types assessed on the ground by the field surveyors (users' final field calls). The table displays the numbers of assessed polygons by type, not the fuzzy scores, and numbers on the diagonal are correct calls by the photo interpreters. In some cases, the Final Field Call was at the Alliance level (e.g., *Juncus arcticus* (var. *balticus, mexicanus*) Alliance), when the mapper was originally expected to map at the Group or Macrogroup level (*e.g.,* Western North American maritime lowland wet meadow & herbaceous seep Group). Alternatively, the Final Field Call was sometimes at the Macrogroup level (e.g., California Annual & Perennial Grassland Macrogroup), when the mapper attributed the polygon at a more detailed Alliance level (e.g., *Amsinckia (menziesii, tessellata)* Alliance). If the mapper's call was correct at the Group or Macrogroup in such cases, a full score of 5 (100%) was recorded, though the assessment would not show up on the diagonal indicating a correct call.

Artemisia californica
Juniperus californica
Salvia leucophylla
Artemisia californica
Quercus john-tuckeri
Quercus john-tuckeri
Populus fremontii
Arctostaphylos glauca

California Annual and Perennial Grassland Macrogroup
Juniperus californica
Salvia leucophylla
Salvia leucophylla
Artemisia californica
Salvia leucophylla
Salvia leucophylla
Quercus john-tuckeri
Quercus j
Salvia leucophylla

Attribute table:

OBJECTID	5264
VegCode	Quercus john-tuckeri
NVCS_level	Alliance
Heterogeneity	Low, less than <5% heterogeneous
ShrubCover	20-29.9%
HerbCover	10-39%
NonNative_Plants	Low
Roads_Trails	Not Visible
OtherImpact	none
Level_OtherImpact	<Null>
Method_ID	Photo-interpretation
DB_ID	<Null>
Comments	FC: Vegcode
Confidence	Medium
Delineator	Rebecca Crowe
Attributer	Rebecca Crowe
QCer	Deborah Stout
UID	CNM14736
Shrub_Dieback	<Null>
ConifCover	<1% or not present
HdwdCover	<1% or not present
TreeCover	<1% or not present
Macrogroup	Warm Interior Chaparral Macrogroup
Shape_Length	1090.292065
Shape_Area	29738.760569
old_ID	<Null>

Figure 2. Depiction of the fine-scale delineation of different vegetation types in the map and the attributes included in each polygon of the map.

Table 2. Percent accuracy assessment of vegetation map units with sample size. Types that scored less than 80% accuracy are shown in bold font.

Code	Vegetation Type	N-Producers	% Producers	N-Users	% Users
1121	*Juniperus californica*	36	93	42	89
1131	*Quercus douglasii*	2	80	1	100
1211	*Populus fremontii*	1	100	1	100
2111	*Quercus john-tuckeri*	20	68	8	85
2231	*Arctostaphylos glauca*	1	100	1	100
2310	**Central & southern California coastal sage scrub Group**	10	78		
2312	*Artemisia californica*	3	73	2	90
2314	*Artemisia californica - Eriogonum fasciculatum*	4	80	6	77
2317	*Eriogonum fasciculatum*	28	81	35	79
2321	*Gutierrezia californica*	14	84	21	82
2323	*Isocoma acradenia*	3	80	1	80
2324	*Lupinus albifrons*	2	70	2	90
2325	*Salvia leucophylla*	2	100	6	87
2328	*Salvia mellifera*	2	80		
2330	**Central & southern California coastal seral scrub Group**	6	70		
2335	*Ericameria linearifolia - Isomeris arborea*	48	86	66	78
2411	*Atriplex polycarpa*	43	80	49	82
2413	*Atriplex canescens*	1	80		
2416	*Ambrosia salsola*	7	74	2	100
2511	*Ericameria nauseosa*	2	100	5	80
2521	*Krascheninnikovia lanata*	2	80	2	90
2522	*Lycium andersonii*				
2525	*Ephedra viridis*	8	75	4	100
4113	***Salix laevigata***	1	60		
4211	*Ephedra californica*	47	91	47	89
4213	*Lepidospartum squamatum*			1	80
4221	*Pluchea sericea*	2	70	1	100
4310	W. N.A. Temperate Lowland Wet Shrubland, Wet Meadow & Marsh Macrogroup	5	80		
4311	*Allenrolfea occidentalis*	14	96	17	93
4312	*Atriplex spinifera*	34	90	45	88
4314	*Suaeda moquinii*	4	85	2	70
5100	California Annual & Perennial Grassland Macrogroup	48	92	85	92
5111	*Amsinckia (menziesii, tessellata)*	4	100	1	100

Code	Vegetation Type	N-Producers	% Producers	N-Users	% Users
5114	*Lasthenia californica - Plantago erecta - Vulpia microstachys*	22	92		
5115	*Monolopia (lanceolata)-Coreopsis (calliopsidea)*	21	95		
5122	*Poa secunda*	2	90		
5132	*Eriogonum (elongatum, nudum)*	2	40	2	80
5200	California Ruderal Grassland & Meadow Macrogroup	16	94	13	100
6111	*Schoenoplectus americanus*			1	80
6210	Western North American Maritime Lowland Wet Meadow & Herbaceous Seep Group	7	83		
6211	*Juncus arcticus (var. balticus, mexicanus)*			3	100
6213	***Leymus triticoides***			**4**	**70**
6310	California Vernal Pool Group	1	100	1	100
6313	*Atriplex vallicola - Lasthenia ferrisiae - Lepidium jaredii Association*	15	95	16	95
6411	*Distichlis spicata*	8	90	5	96
9140	Exotic trees & shrubs			1	80
	Total Number of Samples and Average Score Across All Types	**498**	**83.4%**	**498**	**88.6%**

Discussion

After map accuracy scoring was completed, CNPS staff reviewed the polygons for which the field verifiers and mappers did not agree to assess issues in photo interpretation and attribution. Comments and updates were made to the map, and each polygon that differed in the vegetation type by the users and the producers was checked in ArcGIS and edited as needed. After the review and updates, the mappers evaluated the results of the AA to conduct a quality control of the entire map, so that the final map accuracy was improved overall (i.e., greater than the AA analysis results presented in Table 2).

During this map update process, a number of trends were noted. For example, polygons identified as *Quercus john-tuckeri* by the mappers (producers) were often observed during AA to be *Juniperus californica*, particularly in specific geographic regions. Based on this observed trend, polygons identified as *Quercus john-tuckeri* in these geographic regions were rechecked in ArcGIS and attributes edited as appropriate. A similar trend was observed with *Eriogonum fasciculatum*, which in some geographic regions was confused with *Ericameria linearifolia*. Polygons in these areas were also rechecked and edited as necessary. Other shrub types commonly attributed incorrectly include *Gutierrezia californica* and *Isocoma acradenia*. Both species are subshrubs and are often difficult to detect in aerial imagery, and stands were frequently classified as other shrubs types or often as herbaceous types.

This final quality control process also included checking and re-attributing polygons of vegetation types classified at the Group or Macrogroup level, which the exception of the California Annual & Perennial Grassland Macrogroup and the California Ruderal Grassland & Meadow Macrogroup, which were retained. For instance, the Caliente Mountains had several polygons attributed as Central and South Coastal Californian Coastal Sage Scrub Group. Many of these were ultimately re-attributed as *Artemisia californica, Arctostaphylos glauca, Salvia leucophylla*, or *Salvia mellifera* Alliances. A second instance was the Western North American Maritime Lowland Wet Meadow & Herbaceous Seep Group. During the AA, these polygons were identified as *Juncus arcticus* (var. *balticus, mexicanus*), *Leymus triticoides*, or *Schoenoplectus americanus* Alliances. After AA analysis was completed, polygons mapped to this Group level were reattributed to one of these alliance types by interpreting the imagery, field survey data, and AA data points.

A large portion of the Carrizo Plain National Monument is dominated by herbaceous vegetation, and a majority of these stands were assigned to the California Annual & Perennial Grassland Macrogroup. This Macrogroup encompasses a diverse mixture of native and non-native dominated stands, which fluctuate temporally and spatially depending on seasonal rainfall, temperature, and disturbance. Polygons attributed as California Ruderal Grassland & Meadow Macrogroup are mapped in more heavily disturbed or developed areas with herbaceous vegetation, which were dominated almost exclusively by non-native grasses including species of *Bromus* and *Hordeum*. However, certain areas of herbaceous vegetation are mapped to a specific native Alliance (or Association) when the vegetation afforded an obvious signature in the imagery and when the environmental setting is suitable (e.g., stands with *Monolopia lanceolata* within the Temblor Range); these Alliances are also denoted with their appropriate Macrogroup (e.g., California Annual & Perennial Grassland Macrogroup) in the map geodatabase.

While each polygon is mapped at the finest level possible using the supporting imagery and ground-based data, all of the vegetation types are hierarchically associated with the coarser Macrogroup level of the classification. Certain users of the map may be more interested in interpreting the map at this Macrogroup level to depict certain habitats, such as Coastal Sage Scrub for wildlife or plant species that do not distinguish between the finer floristic or structural levels of the vegetation (e.g., the finer Alliance level). This flexibility in the coarser and finer levels of the classification will be advantageous for different applications of the map.

In the short- and long-term, the detailed vegetation and site quality information in the map and associated field survey data will be useful for habitat monitoring, land management, conservation, wildlife habitat modeling, and wildlife protection in the Carrizo Plain National Monument. For example, specific vegetation types (e.g., *Atriplex polycarpa* Alliance) and overstory cover values (e.g., between 2 and 10% shrub cover) that are preferred by certain bird species can be evaluated and tracked over time. Additionally, users can aggregate adjacent polygons of the same vegetation type that may have different structural or site quality attributes (e.g., polygons of *Atriplex polycarpa* from 2–10% cover to 20–30% cover), depending on their needs for evaluating different thresholds of percent vegetation cover and/or different types of disturbance. Since the shrub and herb species appear to fluctuate regularly in cover across this landscape in space and time, re-mapping at a set interval (e.g., 7 or 10 years) will likely be useful for assessing and tracking changes in the habitats over time.

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Appendix A

CNPS Field Sampling Protocols and Field Forms

CALIFORNIA NATIVE PLANT SOCIETY / DEPARTMENT OF FISH AND GAME PROTOCOL
FOR COMBINED VEGETATION RAPID ASSESSMENT
AND RELEVÉ SAMPLING FIELD FORM
(March 22, 2010)

Introduction

This protocol describes the methodology for both the relevé and rapid assessment vegetation sampling techniques as recorded in the combined relevé and rapid assessment field survey form dated March 22, 2010. The same environmental data are collected for both techniques. However, the relevé sample is plot-based, with each species in the plot and its cover being recorded. The rapid assessment sample is based not on a plot but on the entire stand, with 12-20 of the dominant or characteristic species and their cover values recorded. For more background on the relevé and rapid assessment sampling methods, see the relevé and rapid assessment protocols at *www.cnps.org.*

Selecting stands to sample:

To start either the relevé or rapid assessment method, a stand of vegetation needs to be defined. A stand is the basic physical unit of vegetation in a landscape. It has no set size. Some vegetation stands are very small, such as alpine meadow or tundra types, and some may be several square kilometers in size, such as desert or forest types. A stand is defined by two main unifying characteristics:

1) It has compositional integrity. Throughout the site, the combination of species is similar. The stand is differentiated from adjacent stands by a discernable boundary that may be abrupt or indistinct.
2) It has structural integrity. It has a similar history or environmental setting that affords relatively similar horizontal and vertical spacing of plant species. For example, a hillside forest originally dominated by the same species that burned on the upper part of the slopes, but not the lower, would be divided into two stands. Likewise, sparse woodland occupying a slope with very shallow rocky soils would be considered a different stand from an adjacent slope with deeper, moister soil and a denser woodland or forest of the same species.

The structural and compositional features of a stand are often combined into a term called homogeneity. For an area of vegetated ground to meet the requirements of a stand, it must be homogeneous (uniform in structure and composition throughout).

Stands to be sampled may be selected by evaluation prior to a site visit (*e.g.,* delineated from aerial photos or satellite images), or they may be selected on site during reconnaissance (to determine extent and boundaries, location of other similar stands, etc.).

Depending on the project goals, you may want to select just one or a few representative stands of each homogeneous vegetation type for sampling (*e.g.,* for developing a classification for a vegetation mapping project), or you may want to sample all of them (*e.g.,* to define a rare vegetation type and/or compare site quality between the few remaining stands).

For the rapid assessment method, you will collect data based on the entire stand.

Selecting a plot to sample within in a stand (for relevés only):

Because many stands are large, it may be difficult to summarize the species composition, cover, and structure of an entire stand.   We are also usually trying to capture the most information as efficiently as possible. Thus, we are typically forced to select a representative portion to sample.

When sampling a vegetation stand, the main point to remember is to select a sample that, in as many ways possible, is representative of that stand. This means that you are not randomly selecting a plot; on the contrary, you are actively using your own best judgment to find a representative example of the stand.

Selecting a plot requires that you see enough of the stand you are sampling to feel comfortable in choosing a representative plot location. Take a brief walk through the stand and look for variations in species composition and in stand structure. In many cases in hilly or mountainous terrain look for a vantage point from which you can get a representative view of the whole stand. Variations in vegetation that are repeated throughout the stand should be included in your plot. Once you assess the variation within the stand, attempt to find an area that captures the stand's common species composition and structural condition to sample.

Plot Size

All relevés of the same type of vegetation to be analyzed in a study need to be the same <u>size</u>. Plot shape and size are somewhat dependent on the type of vegetation under study. Therefore, general guidelines for plot sizes of tree-, shrub-, and herbaceous communities have been established. Sufficient work has been done in temperate vegetation to be confident the following conventions will capture species richness:

> Herbaceous communities: 100 sq. m plot
> Special herbaceous communities, such as vernal pools, fens: 10 sq m plot
> Shrublands and Riparian forest/woodlands: 400 sq. m plot
> Open desert and other shrublands with widely dispersed but regularly occurring woody species: 1000 sq. m plot
> Upland Forest and woodland communities: 1000 sq. m plot

Plot Shape

A relevé has no fixed shape, though plot shape should reflect the character of the stand. If the stand is about the same size as a relevé, the plot boundaries may be similar to that of the entire stand. If we are sampling streamside riparian or other linear communities, our plot dimensions should not go beyond the community's natural ecological boundaries. Thus, a relatively long, narrow plot capturing the vegetation within the stand, but not outside it would be appropriate. Species present along the edges of the plot that are clearly part of the adjacent stand should be excluded.

If we are sampling broad homogeneous stands, we would most likely choose a shape such as a circle (which has the advantage of the edges being equidistant to the center point) or a square (which can be quickly laid out using perpendicular tapes).

<u>**Definitions of fields in the protocol**</u>

Relevé or Rapid Assessment Circle the method that you are using.

LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #: Number assigned either in the field or in the office prior to sampling. It is usually denoted with a four-letter abbreviation of the sampling location and then a four-number sequential number of that locale (*e.g.* CARR0001 for Carrizo sample #1). The maximum number of letters/numbers is eight.

Air photo #: The number given to the aerial photo in a vegetation-mapping project, for which photo interpreters have already done photo interpretation and delineations of polygons. If the sample site has not been photo-interpreted, leave blank.

Date: Date of the sampling.

Name(s) of surveyors: The full names of each person assisting should be provided for the first field form for the day. On successive forms, initials of each person assisting can be recorded. Please note: The person recording the data on the form should circle their name/initials.

GPS waypoint #: The waypoint number assigned by a Global Positioning System (GPS) unit when marking and storing a waypoint for the sample location. Stored points should be downloaded in the office to serve as a check on the written points and to enter into a GIS.

For relevé plots, take the waypoint in the southwest corner of the plot or in the center of a circular plot.

GPS name: The name/number assigned to each GPS unit. This can be the serial number if another number is not assigned.

Datum: (NAD 83) The standard GPS datum used is NAD 83. If you are using a different datum, note it here.

Bearing, left axis at SW pt (note in degrees) of <u>Long or Short</u> side: For square or rectangular plots: from the SW corner (= the GPS point location), looking towards the plot, record the bearing of the axis to your left. If the plot is a rectangle, indicate whether the left side of the plot is the long or short side of the rectangle by circling "long" or "short" side (no need to circle anything for circular or square plots). If there are no stand constraints, you would choose a circular or square plot and straight-sided plots should be set up with boundaries running in the cardinal directions. If you choose a rectangular plot that is not constrained by the stand dimensions, the short side should run from east to west, while the long side should run from north to south.

UTM coordinates: Easting (UTME) and northing (UTMN) location coordinates using the Universal Transverse Mercator (UTM) grid. Record in writing the information from a GPS unit or a USGS topographic map.

UTM zone: Universal Transverse Mercator zone. Zone 10 is for California west of the 120th longitude, zone 11 is for California east of 120th longitude, which is the same as the straight portion of California's eastern boundary.

Error: ± The accuracy of the GPS location, when taking the UTM field reading. Please record the error units by circling feet (ft), meters (m), or positional dilution of precision (pdop).   If your GPS does not determine error, insert N/A in this field.

Is GPS within stand? <u>Yes / No</u>   Circle"Yes" to denote that the GPS waypoint was taken directly within or at the edge of the stand being assessed for a rapid assessment, or circle "No" if the waypoint was taken at a distance from the stand (such as with a binocular view of the stand).

If No, cite from waypoint to stand, distance (note in meters) & bearing (note in degrees): An estimate of the number of meters and the compass bearing from the GPS waypoint to the stand.

Elevation: Recorded from the GPS unit or USGS topographic map. Please circle feet (ft) or meters (m).

Photograph #s: Write the name or initials of the camera owner, JPG/frame number, and direction of photos (note the roll number if using film). *Take four photos in the main cardinal directions (N, E, S, W) clockwise from the north, from the GPS location.* If additional photos are taken in other directions, please note this information on the form.

Stand Size: Estimate the size of the entire stand in which the sample is taken. As a measure, one acre is about 4000 square meters (approximately 64 x 64 m), or 208 feet by 208 feet. One acre is similar in size to a football field.

Plot Size: If this is a relevé, circle the size of the plot.

Plot Shape: Record the length and width of the plot and circle measurement units (i.e., ft or m). If it is a circular plot, enter radius (or just put a check mark in the space).

Exposure: (Enter actual ° and circle general category): With your back to the general uphill direction of the slope (i.e., by facing downhill of the slope), read degrees of the compass for the aspect or the direction you are standing, using degrees from north, adjusted for declination. Average the reading over the entire stand, even if you are sampling a relevé plot, since your plot is representative of the stand. If estimating the exposure, write "N/A" for the actual degrees, and circle the general category chosen. "Variable" may be selected if the same, homogenous stand of vegetation occurs across a varied range of slope exposures. Select "all" if stand is on top of a knoll that slopes in all directions or if the same, homogenous stand of vegetation occurs across all ranges of slope.

Steepness: (Enter actual ° and circle general category): Read degree slope from a compass or clinometer. If estimating, write "N/A" for the actual degrees, and circle the general category chosen.. Make sure to average the reading across the entire stand even if you are sampling in a relevé plot.

Topography: First assess the broad (macro) topographic feature or general position of the stand in the surrounding watershed, that is, the stand is at the bottom, lower (1/3 of slope), middle (1/3 of slope), upper (1/3 of slope), or at the top. **Circle all of the positions that apply.** Then, assess the local (micro) topographic features or the lay of the area (*e.g.,* surface is flat or concave). **Circle only one of the microtopographic descriptors**.

Geology: Geological parent material of site. If exact type is unknown, use a more general category (*e.g.,* igneous, metamorphic, sedimentary). *See code list for types.*

Soil Texture: Record soil texture that is characteristic of the site (*e.g.,* coarse loamy sand, sandy clay loam). *See soil texture key and code list for types.*

Upland or Wetland/Riparian (circle one): Indicate if the stand is in an upland or a wetland. There are only two options. Wetland and riparian are one category. Note that a site need not be officially delineated as a wetland to qualify as such in this context (*e.g.,* seasonally wet meadow).

% Surface cover (abiotic substrates). It is helpful to imagine "mowing off" all of the live vegetation at the base of the plants and removing it – you will be estimating what is left covering the surface. **The total should sum to 100%.** Note that non-vascular cover (lichens, mosses, cryptobiotic crusts) is not estimated in this section.

    % Water: Estimate the percent surface cover of running or standing water, ignoring the
           substrate below the water.
    % BA Stems: Percent surface cover of the plant basal area, *i.e.*, the basal area of stems at
           the ground surface. Note that for most vegetation types BA is 1-3% cover.
    % Litter: Percent surface cover of litter, duff, or wood on the ground.
    % Bedrock: Percent surface cover of bedrock.
    % Boulders: Percent surface cover of rocks > 60 cm in diameter.

% Stone:	Percent surface cover of rocks 25-60 cm in diameter.
% Cobble:	Percent surface cover of rocks 7.5 to 25 cm in diameter.
% Gravel:	Percent surface cover of rocks 2 mm to 7.5 cm in diameter.
% Fines:	Percent surface cover of bare ground and fine sediment (e.g. dirt) < 2 mm in diameter.

% Current year bioturbation: Estimate the percent of the sample or stand exhibiting soil disturbance by fossorial organisms (any organism that lives underground). Do not include disturbance by ungulates. Note that this is a separate estimation from surface cover.

Past bioturbation present? Circle Yes if there is evidence of bioturbation from previous years.

% Hoof punch: Note the percent of the sample or stand surface that has been punched down by hooves (cattle or native grazers) in wet soil.

Fire Evidence: Circle Yes if there is visible evidence of fire, and note the type of evidence in the "Site history, stand age and comments section," for example, "charred dead stems of *Quercus berberidifolia* extending 2 feet above resprouting shrubs." If you are certain of the year of the fire, put this in the Site history section.

Site history, stand age, and comments: Briefly describe the stand age/seral stage, disturbance history, nature and extent of land use, and other site environmental and vegetation factors. Examples of disturbance history: fire, landslides, avalanching, drought, flood, animal burrowing, or pest outbreak. Also, try to estimate year or frequency of disturbance. Examples of land use: grazing, timber harvest, or mining. Examples of other site factors: exposed rocks, soil with fine-textured sediments, high litter/duff build-up, multi-storied vegetation structure, or other stand dynamics.

Disturbance code / Intensity (L,M,H): List codes for potential or existing impacts on the stability of the plant community. Characterize each impact each as **L** (=Light), **M** (=Moderate), or **H** (=Heavy). For invasive exotics, divide the total exotic cover (e.g. 25% Bromus diandrus + 8% Bromus madritensis + 5% Centaurea melitensis = 38% total exotics) by the total % cover of all the layers when added up (e.g. 15% tree + 5% low tree + 25% shrub + 40% herbs = 85% total) and multiply by 100 to get the % relative cover of exotics (e.g. 38% total exotics/85% total cover = 45% relative exotic cover).   L = 0-33% *relative* cover of exotics; M =34-66% relative cover, and H = > 66% relative cover. *See code list for impacts.*

II. HABITAT AND VEGETATION DESCRIPTION per California Wildlife-Habitat Relationships (CWHR)

For CWHR, identify the size/height class of the stand using the following tree, shrub, and/or herbaceous categories. These categories are based on functional life forms.

Tree DBH: Record tree size classes when the tree canopy closure exceeds 10 percent of the total cover (except in desert types), or if young tree density indicates imminent tree dominance. Size class is based on the average diameter at breast height (dbh) of each trunk (standard breast height is 4.5ft/137cm). When marking the main size class, make sure to estimate the mean diameter of all trees over the entire stand, and weight the mean if there are some larger tree dbh's. The "**T6 multi-layered**" dbh size class contains a multi-layered tree canopy (with a size class T3 and/or T4 layer growing under a T5 layer and a distinct height separation between the classes) exceeding 60% total cover. Stands in the T6 class need also to contain at least 10% cover of size class 5 (>24" dbh) trees growing over a distinct layer with at least 10% combined cover of trees in size classes 3 or 4 (>11-24" dbh).

Shrub (mark one)**:** Record shrub size classes when shrub canopy closure exceeds 10 percent (except in desert types). You can record shrub size class by circling the class that is predominant

in the survey. Shrub size class is based on the average amount of crown decadence (dead standing vegetation on live shrubs when looking across the crowns of the shrubs).

Herb (mark one)**:** Record herb height when herbaceous cover exceeds 2 percent. You can record herb class by the size class that is predominant in the survey (H1 or H2). *This height class is based on the average plant height at maturity, not necessarily at the time of observation.*

Overall cover of vegetation

Provide an estimate of cover for the following categories below (based on functional life forms). Record a specific number for the total aerial cover or "bird's-eye view" looking from above for each category, estimating cover for the living plants only. Litter/duff should not be included in these estimates. The porosity of the vegetation should be taken into consideration when estimating percent cover (how much of the sky can you see when you are standing under the canopy of a tree, or how much light passes through the canopy of the shrub layer?).

To come up with a specific number estimate for percent cover, first use to the following CWHR cover intervals as a reference aid to get a generalized cover estimate: <2%, 2-9%, 10-24%, 25-39%, 40-59%, 60-100%. While keeping these intervals in mind, you can then refine your estimate to a specific percentage for each category below.

% Total Non-Vasc cover: The total cover of all lichens, bryophytes (mosses, liverworts, hornworts), and cryptogrammic crust on substrate surfaces including downed logs, rocks and soil, but not on standing or inclined trees or vertical rock surfaces.

% Total Vasc Veg cover: The total cover of all vascular vegetation taking into consideration the porosity, or the holes, in the vegetation. This is an estimate of the absolute vegetation cover, disregarding overlap of the various tree, shrub, and/or herbaceous layers and species.

% Cover

% Conifer Tree /Hardwood Tree: The total foliar cover (considering porosity) of all live tree species, disregarding overlap of individual trees. Estimate conifer and hardwood covers separately.
Please note: These cover values should not include the coverage of regenerating tree species (i.e., tree seedlings and saplings).

% Regenerating Tree: The total foliar cover of seedlings and saplings, disregarding overlap of individual recruits. See seedling and sapling definitions below.

%Shrub: The total foliar cover (considering porosity) of all live shrub species disregarding overlap of individual shrubs.

%Herbaceous: The total cover (considering porosity) of all graminoid species (grasses, sedges, etc.), disregarding overlap of individual herbs. The total cover (considering porosity) of all forb species, disregarding overlap of individual herbs.

Height Class

Modal height for conifer tree /hardwood tree, shrub, and herbaceous categories: Provide an estimate of height for each category listed. Record an average height value per each category by estimating the mean height for each group. Please use the following height intervals to record a height class:
01 =< 1/2m, 02=1/2-1m, 03 = 1-2 m, 04 = 2-5 m, 05 = 5-10 m, 06 = 10-15 m, 07 = 15-20 m, 08 = 20-35 m, 09 = 35-50 m, 10 => 50m.

Species list and coverage

For rapid assessments, list the 10-20 species that are dominant or that are characteristically consistent throughout the stand. These species may or may not be abundant, but they should be constant representatives in the survey. When different layers of vegetation occur in the stand, make sure to list species from each stratum. As a general guide, make sure to list at least 1-2 of the most abundant species per stratum.

For relevés, list all species present in the plot, using the second species list page if necessary.

For both sample types, provide the stratum where:
T = Tree. A woody perennial plant that has a single trunk.
S = Shrub. A perennial, woody plant that is multi-branched and doesn't die back to the ground every year.
H = Herb. An annual or perennial that dies down to ground level every year.
E = Seedling. A tree species clearly of a very young age that is less than 1" dbh.
A = Sapling. 1" - <6" dbh and young in age, OR small trees that are less than 1"diameter at breast height and are clearly of appreciable age and kept short by repeated browsing or burning.
N = Non-vascular. Includes mosses, liverworts, hornworts, cryptogammic crust, lichens, and algae.

Be consistent and don't break up a single species into two separate strata. The only time it would be appropriate to do so is when one or more tree species are regenerating, in which case the Seedling and/or Sapling strata should be recorded for that species. These may be noted on the same line, e.g.:

Strata	Species	%Cover	C
T/E/A	Quercus douglasii	40/<1/<1	

If a species collection is made, it should be indicated in the collection column with a "C" (for collected). If the species is later keyed out, cross out the species name or description and write the keyed species name in pen on the data sheet. Do not erase what was written in the field, because this information can be used if specimens get mixed up later. If the specimen is then thrown out, the "C" in the collection column should crossed out. If the specimen is kept but is still not confidently identified, add a "U" to the "C" in the collection column (CU = collected and unconfirmed). In this case the unconfirmed species epithet should be put in parentheses [e.g *Hordeum (murinum)*]. If the specimen is kept and is confidently identified, add a "C" to the existing "C" in the collection column (CC = Collected and confirmed).

Use Jepson Manual nomenclature. Write out the genus and species of the plant. Do not abbreviate. When uncertain of an identification (which you intend to confirm later) use parentheses to indicate what part of the determination needs to be confirmed. For example, you could write out *Brassica* (*nigra*) if you are sure it is a *Brassica* but you need further clarification on the specific epithet.

Provide the % absolute aerial cover for each species listed. When estimating, it is often helpful to think of coverage in terms of the following cover intervals at first:

<center><1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%.</center>

Keeping these classes in mind, then refine your estimate to a specific percentage. All species percent covers may total over 100% because of overlap.

Include the percent cover of snags (standing dead) of trees and shrubs. Note their species, if known, in the "Stand history, stand age and comments" section.

For rapid assessments, make sure that the major non-native species occurring in the stand also are listed in the space provided in the species list with their strata and % cover. For relevés, all non-native species should be included in the species list.

Unusual species: List species that are locally or regionally rare, endangered, or atypical (*e.g., range extension or range limit*) within the stand. This field will be useful to the Program for obtaining data on regionally or locally significant populations of plants.

INTERPRETATION OF STAND

Field-assessed vegetation alliance name: Name of alliance or habitat following the most recent CNPS classification system or the Manual of California Vegetation (Sawyer J.O., Keeler-Wolf T., and Evens, J. 2009). Please use scientific nomenclature, *e.g., Quercus agrifolia* forest. An alliance is based on the dominant or diagnostic species of the stand, and is usually of the uppermost and/or dominant height stratum. A dominant species covers the greatest area. A diagnostic species is consistently found in some vegetation types but not others.

Please note: The field-assessed alliance name may not exist in the present classification, in which case you can provide a new alliance name in this field. If this is the case, also make sure to state that it is not in the MCV under the explanation for "Confidence in alliance identification."

Field-assessed association name (optional): Name of the species in the alliance and additional dominant/diagnostic species from any strata, as according to CNPS classification. In following naming conventions, species in differing strata are separated with a slash, and species in the uppermost stratum are listed first (*e.g., Quercus douglasii/Toxicodendron diversilobum*). Species in the same stratum are separated with a dash (*e.g., Quercus lobata-Quercus douglasii*).

Please note: The field-assessed association name may not exist in the present classification, in which you can provide a new association name in this field.

Adjacent Alliances/direction: Identify other vegetation types that are directly adjacent to the stand being assessed by noting the dominant species (or known type). Also note the distance away in meters from the GPS waypoint and the direction in degrees aspect that the adjacent alliance is found
(e.g., *Amsinckia tessellata* / 50m, 360° N   *Eriogonum fasciculatum* /100m, 110°).

Confidence in Identification: (L, M, H)   With respect to the "field-assessed alliance name", note whether you have L (=Low), M (=Moderate), or H (=High) confidence in the interpretation of this alliance name.

Explain: Please elaborate if your "Confidence in Identification" is low or moderate. Low confidence can occur from such things as a poor view of the stand, an unusual mix of species that does not meet the criteria of any described alliance, or a low confidence in your ability to identify species that are significant members of the stand.

Phenology: Indicate early (E), peak (P) or late (L) phenology for each of the strata.

Other identification problems or mapping issues: Discuss any further problems with the identification of the assessment or issues that may be of interest to mappers. Note if this sample represents a type that is likely too small to map. If it does, how much of the likely mapping unit would be comprised of this type. For example: "this sample represents the top of kangaroo rat

precincts in this general area, which are surrounded by vegetation represented by CARR000x; this type makes up 10% of the mapping unit."

Is polygon >1 type: Yes / No (circle one): In areas that have been delineated as polygons on aerial photographs/imagery for a vegetation-mapping project, assess if the polygon is mapped as a single stand. "Yes" is noted when the polygon delineated contains the field-assessed alliance and other vegetation type(s), as based on species composition and structure. "No" is noted when the polygon is primarily representative of the field-assessed alliance.

If yes, explain: If "Yes" above, explain the other vegetation alliances that are included within the polygon, and explain the amount and location that they cover in the polygon.

CNPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form

Relevé or Rapid Assessment (circle one)   (Revised Dec 10, 2009)

(margin note: entered BCH 7/1/10)

For Office Use:	Final database #:	Final vegetation type name:	Alliance_____ Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	Air photo:	Date:	Name(s) of surveyors (circle recorder):
DUTC 0001	—	4/14/10	(JJB)

GPS wypt #: —— GPS name: 1 Datum: —— or (NAD83). Bearing, left axis at SW pt ○ (degrees) of ~~Long~~ / ~~Short~~ side

ÚTME 7 3 1 0 9 3 UTMN 4 1 1 8 0 9 8 Zone:(10)/ 11 (circle one) Error: ± 2.1 ft / m / pdop

GPS within stand? (Yes)/ No   If No, cite from waypoint to stand, distance ——(meters) & bearing ——(degrees)

Elevation: 22 ft /(m) Camera Name/Photograph #'s: A12 (N) 1347 – 1350 ; (35), NE

Stand Size (acres): <1, 1-5,(>5) | Plot Size (m²): 10 /(100)/ 400 / 1000 | Plot Shape 10 x 10 ft /(m) or Circle Radius ——ft / m

Exposure, Actual °: n/a NE NW SE SW (Flat) Variable All | Steepness, Actual °: 0 (0°) 1-5° 5-25° > 25

Topography: Macro: top upper mid (lower) bottom | Micro: convex flat concave (undulating)

Geology code: SAAL   Soil Texture code: MCSC | (Upland) or Wetland/Riparian (circle one)

% Surface cover: (Incl. outcrops) (>60cm diam) (25-60cm) (7.5-25cm) (2mm-7.5cm) (Incl sand, mud)

H20: ○ BA Stems: 2 Litter: (60) Bedrock: ○ Boulder: ○ Stone: ○ Cobble: ○ Gravel: ○ Fines: 38 =100%

% Current year bioturbation + Past bioturbation present? (Yes)/ No | % Hoof punch +

Fire evidence: Yes /(No) Time since fire (years): <1 / 1-5 / 6-20 / 21-70 / >70 yr. / (Unknown) (circle one)

Site history, stand age, comments: Upland of mounded matrix of vernal pool/upland habitat, dominated by Bromus hordeaceus. Mixed forbs + other grasses co-occur. Mounds w/ lots of ground squirrel activity. A cowtrail runs through plot. Fresno Soil Series (FpA). Grazing level is light

Disturbance code / Intensity (L,M,H): 05/M 04/L ____/ ____/ ____/ "Other" _____/ __

II. HABITAT AND VEGETATION DESCRIPTION

~~Tree DBH~~ : T1 (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

~~Shrub:~~ S1 seedling (<3 yr. old), S2 young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), (H2) (>12" ht.)   % Non-Vasc cover: 0   Total % Vasc Veg cover: 90

% Cover -Overstory Tree Conifer/Hardwood: —/— Low-Medium Tree: — Shrub: — Herbaceous: 55/35 gr

Height Class - Overstory Conifer/Hardwood: —/— Low-Medium Tree: — Shrub: — Herbaceous: 02

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species, Stratum, and % cover. Stratum categories: T= Overstory tree, U= Understory Tree, S = Shrub, H= Herb, N= Non-vascular.
% cover intervals for reference: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

Strata	Species	% cover	C	Strata	Species	% cover	C
H	Bromus hordeaceus	25		H	Hordeum murinum	15	
	Erodium cicutarium	10			Trifolium microcephalum	2	
	Trifolium dep.x.depaup	2			Poa annua	+	
	Vulpia bromoides	15			Trifolium variegatum	+	
	Bromus rubens	3			Liliaceae n#	+	
	Plagiobothrys canescens	10	C		Hordeum marinum	+	
	Erodium botrys	10			Hypochaeris glabra	+	
	Erodium moschatum	+			Gromocarpus setigerus	+	
	E. cicutarium	2			Deschampsia caespitata	+	
	Trifolium gracilentum v.gra	5			Trifolium sp (microcephalum big)	+	C

Unusual species: _____

III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: Bromus hordeaceus

Field-assessed association name (optional): Bromus hordeaceus – Plagiobothrys canescens

Adjacent alliances/direction: Eryngium - Plagiobothrys SE _____/ __

Confidence in alliance identification: L (M) H Explain! Could be a Plagiobothrys canescens std

Phenology (E,P,L): Herb P Shrub — Tree — Other identification or mapping information: Consider naming Plagiobothrys canescens

CNPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form
RELEVE SPECIES SHEET (Revised 9/10/09)

Page _2_ of Polygon/Stand #: _DUTC0001_

Stratum categories: T = Overstory tree, U = Understory tree, S = Shrub, H = Herb, and N=Non-vascular
% Cover Intervals for reference: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

Strata	Vascular plant name or lichen/bryophyte	% Cover	Collection	Final species determination (or DBH)
H	Vulpia myuros	+		
	Sinapis arvensis *Lepidocarpum gracile*	*	C	
	Castilleja attenuata	+		
	Lolium multiflorum	+		
	Trifolium depaup. v. truncat.	+		

This protocol describes the methodology for vegetation sampling techniques in long-term monitoring plots. This document is a supplement to the most current relevé protocol which can be found at *www.cnps.org*.

A permanently marked plot will be established at each long-term monitoring location. The plot will consist of one 400 m^2 main plot with 1 nested 100 m^2 subplot and 8 nested 1 m^2 subplots arranged in an overall 20 by 20 m^2 nested plot design (see figure below). Transect tapes will delineate the larger plots and a 1 m^2 PVC frame will be used to sample each smaller subplot. Plots will be marked by pounding in 20 or 30 cm (8 or 10 inch) nails with washers at each plot corner, in addition to GPS coordinates. The tops of each nail and washer will be spray-painted orange for future relocation. An accurate GPS device and a metal detector should be used for future monitoring to help relocate plots.

At each plot and sub-plot level, the following categories of ocular percent cover will be estimated: relative cover of graminoids (grasses as well as rushes and sedges) and forbs, and absolute cover of non-vascular plants. Plant species composition and absolute percent cover will be collected in both the 100 and 400 m^2 plots. The 400 m^2 plot will include a count of the number of visibly active giant kangaroo rat precincts as well as photos from each corner facing diagonally into the plot. A full CNPS relevé will be sampled at the 100m^2 sub-plot. Plant species composition (richness) will be determined in the 8-1 m^2 subplots at each sample location, as well as a notation if the plot falls within a clipped or disturbed portion of a giant kangaroo rat precinct.

For the initial sampling, a soil sample (2 cups) will be taken from the SW corner of the 400m^2 plot (from the first 10 cm of soil) and stored in a bag labeled with the plot ID and date. All data collected at each sample location will be considered as baseline, future sampling will allow the detection of changes in species composition and structure over time.
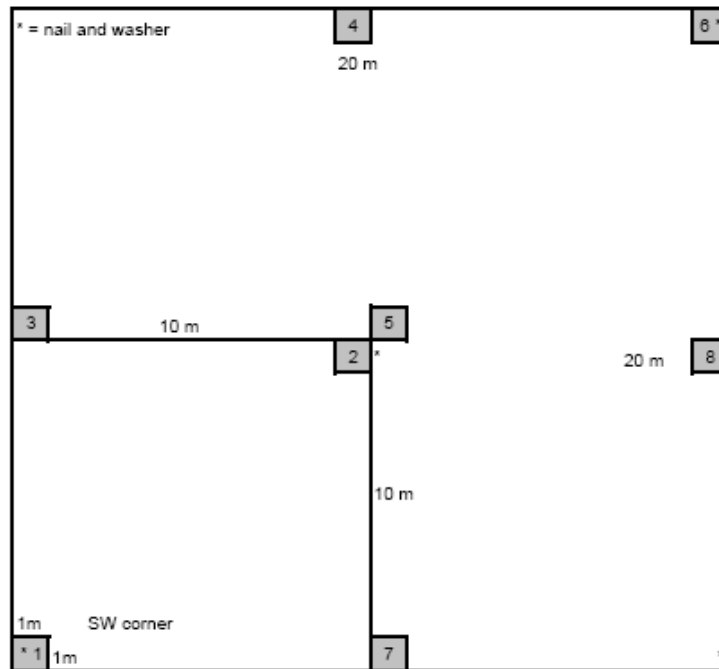
Plot ID: DUTC0006 Date: 4/14/10	~~Date:~~	Quad #	1	2	3	4	5	6	7	8
Species	400m2(%)	100m2(%)	1m2(x)	1m2(x)	1m2(x)	1m2(x)	1m2(x)	1m2(x)	1m2(x)	1m2(x)
~~Achillea millefolium~~ % NV			0	0	0	1	1	2	0	0
~~Achyrachaena mollis.~~ % Forb			10	10	12	7	12	10	20	6
Agoseris % Grass			2	12	4	17	3	15	5	11
Allenrolfea occidentalis										
Allium _____										
Amaranthus albus.										
Amsinckia menziesii										
Asclepias _____										
Astragalus _____										
Atriplex _____										
Avena _____										
Bassia hyssopifolia										
Blennosperma nanum										
Blepharizonia plumosa										
Bloomeria crocea.										
Bromus diandrus										
Bromus hordeaceus			X			X		X	X	X
Bromus madritensis ssp. rubens								X		X
Calandrinia ciliata.										
Calochortus venustus.										
Calyptridium monandrum.										
Camissonia _____										
Capsella bursa-pastoris										
Castilleja attenuata			X			X		X	X	
Caulanthus _____										
Centaurea melitensis										
Chaenactis _____										
Chamomilla suaveolens										
Chenopodium _____										
Chorizanthe uniaristata.										
Clarkia _____										
Claytonia perfoliata										
~~Collinsia bartsiifolia~~ Cerastium glomeratum									X	
Convolvulus arvensis.										
Conyza coulteri.										
Coreopsis _____										
Crassula connata			X	X	X	X	X	X	X	X
~~Cryptantha~~ Crassula tillea										X
Cucurbita _____										
Datura wrightii										
Daucus pusillus.										
~~Delphinium parryi~~ Deschampsia danthonoides				X	X		X		X	
Descurainia pinnata										
Dichelostemma capitatum										
Distichlis spicata				X	X		X			
Dodecatheon clevelandii.										
Eremalche exilis										
Eremocarpus setigerus								X		
Erigeron foliosus										
Eriogonum _____										
Eriophyllum pringlei.										
Erodium botrys.						X		X		X
Erodium brachycarpum.										
Erodium cicutarium						X				X
~~Erysimum capitatum~~ Erodium moschatum									X	X
Eschscholzia _____										
Filago _____										
Gilia _____										
Guillenia _____										
Gutierrezia californica										
Helianthus annuus.										
Hemizonia pungens			X	X	X		X		X	X
Herniaria hirsuta										
Heterotheca sessiliflora										
Hirschfeldia incana										
~~Holocarpha heermanii~~ Hordeum depressum			X	X	X	X	X	X	X	
~~Hordeum murinum ssp. glaucum~~ murinum			X			X	X	X	X	X

A-14

Appendix B

Hierarchical Vegetation Classification

FORMAT OF HIERARCHY: (Sorted by Tree, Shrub, Herb, & Other Types)
<u>**MACROGROUP**</u>
        GROUP
                ALLIANCE
                   ASSOCIATION

*Starred Alliances and Associations are classified types not found currently in the National Monument, but found in the general region

<u>**M009 California Forest & Woodland Macrogroup**</u>
    California broadleaf forest & woodland Group
        1111 *Quercus agrifolia* Alliance*
        1131 *Quercus douglasii* Alliance
           Quercus douglasii / Ericameria linearifolia*
           Quercus douglasii-Juniperus californica/Ericameria linearifolia
           Quercus douglasii / herbaceous*
           Quercus douglasii-Juniperus californica/Ceanothus montanus*
           Quercus xalvordiana
    California conifer forest & woodland Group
        1121 *Juniperus californica* Alliance
           Juniperus californica - Ericameria linearifolia / Herbaceous
           Juniperus californica - Salvia leucophylla
           Juniperus californica / Herbaceous

<u>**M036 Warm Mediterranean & Desert Riparian, Flooded & Swamp Forest Macrogroup**</u>
    Mediterranean California lowland flooded & swamp forest and Sonoran-Chihuahuan warm desert riparian scrub Groups
        1211 *Populus fremontii* Alliance
           Populus fremontii/Salix exigua
           Populus fremontii
         4112 *Salix exigua* Alliance*
        4113 *Salix laevigata* Alliance
        4114 *Salix lasiolepis* Alliance*

<u>**M091 Warm Interior Chaparral Macrogroup**</u>
    Arizonan desert margin chaparral Group
        2111 *Quercus john-tuckeri* Alliance
          Quercus john-tuckeri - Juniperus californica - Ericameria linearifolia
          Quercus john-tuckeri
        2112 *Adenostoma sparsifolium* Alliance*

<u>**M043 California Chaparral Macrogroup**</u>
    Californian mesic sclerophyll chaparral Group
        2211 *Quercus berberidifolia* Alliance*
          Quercus berberidifolia - Ceanothus cuneatus
        2212 *Cercocarpus montanus* Alliance*

Californian xeric chaparral Group
        2223 *Adenostoma fasciculatum* Alliance*
          Adenostoma fasciculatum
          Adenostoma fasciculatum - Eriogonum fasciculatum
        2226 *Adenostoma fasciculatum - Salvia mellifera* Alliance*
          Adenostoma fasciculatum - Salvia mellifera
        2231 *Arctostaphylos glauca* Alliance
          Adenostoma fasciculatum - Arctostaphylos glauca
          Arctostaphylos glauca
          Arctostaphylos glauca - Quercus john-tuckeri Provisional
        2227 *Ceanothus cuneatus* Alliance*
          Adenostoma fasciculatum - Ceanothus cuneatus
        2228 *Eriodictyon crassifolium* Provisional Alliance*

<u>**M044 California Coastal Scrub Macrogroup**</u>
    Central & southern California coastal sage scrub Group
        2312 *Artemisia californica* Alliance
          Artemisia californica
        2314 *Artemisia californica - Eriogonum fasciculatum* Alliance
          Artemisia californica - Eriogonum fasciculatum
        2317 *Eriogonum fasciculatum* Alliance
          Eriogonum fasciculatum
          Eriogonum fasciculatum - Hesperoyucca whipplei
          Eriogonum fasciculatum - Ephedra californica
        2325 *Salvia leucophylla* Alliance
          Salvia leucophylla
          Salvia leucophylla - Artemisia californica
          Salvia leucophylla - Eriogonum fasciculatum
        2328 *Salvia mellifera* Alliance
          Salvia mellifera-Eriogonum fasciculatum/ Bromus rubens
    Central & southern California coastal seral scrub Group
        2335 *Ericameria linearifolia - Isomeris arborea* Alliance
          Ericameria linearifolia
          Eastwoodia elegans
          Isomeris arborea
          Eastwoodia elegans - Krascheninnikovia lanata
        2321 *Gutierrezia californica* Alliance
          Gutierrezia californica / Poa secunda
        2323 *Isocoma acradenia* Alliance
          Isocoma acradenia Provisional
        2324 *Lupinus albifrons* Alliance
          Lupinus albifrons

<u>**M093 Great Basin Saltbrush Scrub Macrogroup**</u>
    Intermountain shadscale – saltbush Group
        2411 *Atriplex polycarpa* Alliance
          Atriplex polycarpa / annual herbaceous
        2413 *Atriplex canescens* Alliance

Atriplex canescens / herbaceous

M171 Great Basin & Intermountain Dry Shrubland & Grassland Macrogroup
Intermountain Semi-Desert Shrubland & Steppe Group
2511 *Ericameria nauseosa* Alliance
Ericameria nauseosa

M088 Mojave-Sonoran Semi-Desert Scrub Macrogroup
Mojave Mid-Elevation Mixed Desert Scrub Group
2521 *Krascheninnikovia lanata* Alliance
Krascheninnikovia lanata
2522 *Lycium andersonii* Alliance
Lycium andersonii
2525 *Ephedra viridis* Alliance
Ephedra viridis-Ericameria linearifolia/Monolopia lanceolata Provisional

M048 Northern Rocky Mountain-Vancouverian Montane & Foothill Grassland & Shrubland Macrogroup
Northern Rocky Mountain montane-foothill mesic deciduous shrubland Group
2611 *Ribes quercetorum* Provisional Alliance

M076 Warm Desert Freshwater Shrubland, Meadow & Marsh Macrogroup
North American warm desert riparian low bosque & shrubland Group
4111 *Baccharis salicifolia* Alliance
Baccharis salicifolia
Baccharis salicifolia - Pluchea sericea
4114 *Forestiera pubescens* Alliance
Forestiera pubescens
4221 *Pluchea sericea* Alliance

M092 North American Warm-Desert Xero-Riparian Macrogroup
Warm semi-desert shrub & herb wash-arroyo Group
4211 *Ephedra californica* Alliance
Ephedra californica / annual-perennial herb
Ephedra californica / Ambrosia salsola
4213 *Lepidospartum squamatum* Alliance
*Lepidospartum squamatum - Artemisia californica**
Lepidospartum squamatum / ephemeral annuals
4215 *Prunus fasciculata* Alliance
2416 *Ambrosia salsola* Alliance
Ambrosia salsola

M082 Cool (and Warm) Semi-Desert Alkali–Saline Wetland Macrogroup
Intermountain basins alkaline–saline shrub wetland Group
4311 *Allenrolfea occidentalis* Alliance
Allenrolfea occidentalis / Lasthenia (*gracilis*)

4312 *Atriplex spinifera* Alliance
Atriplex spinifera / herbaceous
4317 *Frankenia salina* Alliance
Frankenia salina-Psilocarphus brevissimus Provisional
4314 *Suaeda moquinii* Alliance
Suaeda moquinii/Lepidium dictyotum Provisional

M073 Western North American Temperate Lowland Wet Shrubland, Wet Meadow & Marsh Macrogroup (6100 and 6200)
Western North American maritime lowland wet meadow & herbaceous Seep Group
6211 *Juncus arcticus* (var. *balticus, mexicanus*) Alliance
Juncus arcticus var. *balticus*

Western North American temperate interior freshwater marsh Group
6111 *Schoenoplectus americanus* Alliance
Schoenoplectus americanus

M074 Western North American Vernal Pool Macrogroup
California Vernal Pool Group
6311 *Eleocharis acicularis* Alliance*
6312 *Eleocharis macrostachya* Alliance*
6313 *Lasthenia fremontii - Distichlis spicata* Alliance
Atriplex vallicola - Lasthenia ferrisiae - Lepidium jaredii
6317 *Layia fremontii – Achyrachaena mollis* Alliance
Achyrachaena mollis
Layia platyglossa

M082 Cool (and Warm) Semi-Desert Alkaline–Saline Wetland Macrogroup
Intermountain basins alkaline–saline herb wet flat Group
6213 *Leymus triticoides* Alliance
Leymus triticoides
6411 *Distichlis spicata* Alliance
Distichlis spicata

M045 California Annual & Perennial Grassland Macrogroup (5100)
California annual herb/grass Group
5111 *Amsinckia* (*menziesii, tessellata*) Alliance
Amsinckia tessellata - Erodium cicutarium
Phacelia ciliata Provisional
Phacelia tanacetifolia Provisional
5113 *Eschscholzia* (*californica*) Alliance
Eschscholzia californica
Lupinus bicolor Provisional
5114 *Lasthenia californica - Plantago erecta - Vulpia microstachys* Alliance
Erodium cicutarium - Vulpia microstachys
Lepidium nitidum-Trifolium gracilentum-Vulpia microstachys

       Lasthenia gracilis-Plantago erecta-Plagiobothrys
                canescens
       Lasthenia gracilis
       Lasthenia minor Provisional
       Pectocarya (*linearis, penicillata*)
    5115 *Monolopia* (*lanceolata*)-*Coreopsis* (*calliopsidea*) Alliance
       Coreopsis calliopsidea-Mentzelia pectinata
       Monolopia lanceolata
       Monolopia stricta Provisional
    5116 *Salvia carduacea* Provisional Alliance
       Salvia carduacea Provisional
California native bunchgrass grassland (perennial grassland) Group
    5131 *Corethrogyne filaginifolia* Provisional Alliance
       Corethrogyne filaginifolia Provisional
    5132 *Eriogonum* (*elongatum, nudum*) Alliance
       Eriogonum elongatum Provisional
       Eriogonum nudum Provisional
    5121 *Nassella cernua* Provisional Alliance
       Nassella cernua Provisional

M045 California Ruderal Grassland & Meadow Macrogroup (5200)
    California ruderal grassland & forb meadow Group
       5211 *Bromus rubens-Schismus* (*arabicus, barbatus*)

**M048 Northern Rocky Mountain-Vancouverian Montane & Foothill Grassland &
Shrubland Macrogroup**
    **Northern Rocky Mountain lower montane, foothill & valley grassland
Group**
       5122 *Poa secunda* Alliance
          Monolopia stricta - Poa secunda
          Poa secunda - Bromus rubens

Other Types
    Unvegetated (9110)
       9111 Developed
       9112 Road
       9113 Cliffs & Rock Outcrops
       9114 River & Lacustrine Flats & Streambeds
       9115 Playa
    Agriculture (9120)
    Water (9130)
       9131 Perennial Stream Channel
       9132 Reservoirs & Ponds
    Exotic trees & shrubs (9140)
       9141 *Tamarix*
    Unknown (9999)

Appendix C

Hierarchical Vegetation Field and Mapping Key

The following key was created to distinguish the mapped and classified vegetation types in the Carrizo Plain National Monument. This key was used to attribute each photo-interpreted polygon within the map. It was written specifically for the Carrizo Plain National Monument based on data collected or observed here; it may not apply to other areas without revision from local area data. For example, cover of California juniper, considered a tree in the National Vegetation Classification Hierarchy, may be as low as 5% and the stand will still be considered a tree type.

Due to the diversity of vegetation in the mapping area, and to avoid an excessively long document, a series of paired statements (or couplets) was not developed for each option. Instead, sets of characteristics with choices beneath them are provided. Also, to make this key shorter and more easily applied in the field, it is somewhat artificial in not following the exact hierarchy (i.e., one does not have to key down through all levels of the hierarchy to get to the Association).The key will first lead the user to general options, and the individual selections for the finest-level vegetation types will be listed beneath these options. The user will need to work through the numbered list of types from the more general to the most specific options until the best fit is reached. Some broader level types (i.e., Macro Group, Group) that were used to attribute difficult polygons are also included.

All choices are identified by a combination of alpha-numeric codes, using capital letters, numerals, upper- and lowercase letters, and decimal points to distinguish the different key levels. The most basic, general levels in the key are on the left side of the alpha-numeric code, and the most specific are on the right side. This coding system in the key relates to a series of left indentations. Thus, the major groupings are down the left-hand side of the pages; nested within them are the sub-groupings. The preliminary key will direct you to the major groupings, such as forest/woodland, shrubland, and herbaceous, with the more specific choices beneath them. The more specific lists within these are generally based on presence/absence or dominance/sub-dominance of species. *Please note: since there may be more than two alternatives in a group, be sure to work through all of the options in a list before you decide on the best choice.*

Also, alliances that occur in the Chimineas Ranch or other adjacent CDFW and BLM lands but were not sampled in the Carrizo Plain National Monument are included in the key and are marked with an asterisk(*).

Terms and Concepts Used Throughout the Key

Dominance by layer: Tree, shrub, and herbaceous layers are considered physiognomically distinct. A vegetation type is considered to belong to a certain physiognomic group if it is dominated by one layer. Layers are prioritized in order of height when naming the type.

Dominant: Dominance refers to the preponderance of vegetation cover in a stand of uniform composition and site history. It may refer to cover of an individual species (as in "dominated by Blue Oak"), or it may refer to dominance by a physiognomic group, as in "dominated by shrubs." Dominance refers to the relative cover of one species or physiognomic group as compared to another species or physiognomic group.

Co-dominant: Co-dominance refers to two or more species in a stand that share dominance and have between 30 and 60 percent relative cover each.

Key to the vegetation types in the Carrizo Plain National Monument

Class A. Vegetation characterized by an even distribution of overstory trees. Shrub or herbaceous species may total higher cover than trees. The tree overstory may have as low as 5% cover (e.g., in the *Juniperus californica* and *Quercus douglasii* Alliances) while shrubs may not be significant
= **Tree-Overstory (Woodland / Forest Vegetation), on page C-3**

Class B. Vegetation characterized by an even distribution of woody shrubs in the canopy. Herbaceous species may total higher cover than shrubs. The shrub canopy may have less than 10% total cover (i.e., 3% or greater), especially in areas of saline or alkaline soils, along washes, or in desert-transition areas (e.g., *Allenrolfea occidentalis, Atriplex spp., Eastwoodia elegans, Ephedra californica, Ericameria nauseosa, Gutierrezia californica, Lepidospartum squamatum, Lycium andersonii, Suaeda moquinii*) = **Shrubland Vegetation, on page C-6**

Class C. Vegetation characterized by non-woody, herbaceous species in the canopy including grasses, graminoids, and broad-leaved herbaceous species. Shrubs, if present, usually comprise <3% of the vegetation. Trees, if present, generally have <6% cover
= **Herbaceous Vegetation, on page C-13**

Class D. Non-vegetated or urbanized types with <2% total vegetation cover
= **Unvegetated or Urbanized, on page C-15**

Class A. Tree-Overstory (Woodland / Forest Vegetation)

Woodlands and forests characterized by needle or scale-leaved conifer trees and/or broad-leaved evergreen and deciduous tree species. The trees may only occur intermittently in the overstory and may be associated with shrubs.

I.A. Stands are dominated or characterized by riparian winter deciduous trees or tall shrubs, including *Populus fremontii* and/or a species of *Salix…*

> **I.A.1.** *Populus fremontii* is dominant or co-dominant with >5% absolute cover in the tree canopy. Stands occur along streams, springs, and valleys with a subsurface water supply …
> > *Populus fremontii* **Forest Alliance (1211)**

> > **I.A.1.a.** *P. fremontii* is dominant in the overstory with *Salix exigua* in the shrub layer and a variable mix of grasses and forbs …
> > > *Populus fremontii/Salix exigua* **Association (1211)**

> > **I.A.1.b.** *P. fremontii* is dominant in the overstory, and the understory has a variable mix of grasses and forbs …
> > > *Populus fremontii* **Association (1211)**

> **I.A.2.** *Salix laevigata* dominates with >50% relative cover in the tree canopy, or >30% relative cover when *S. lasiolepis* is present in the sub-canopy…
> > *Salix laevigata* **Woodland Alliance (4113)**
> > **(No Association defined)**

I.B. The tree overstory is characterized by a species of *Quercus* that is evenly distributed with >5% cover. The oak may be the sole dominant tree or share dominance with *Juniperus californica…*

I.B.1. *Quercus agrifolia* dominates the tree canopy and is an uncommon type that tends to grow on soils with high organic matter. A variety of shrubs such as *Adenostoma fasciculatum, Arctostaphylos glauca, Ericameria linearifolia, Eriogonum fasciculatum* and *Rhamnus ilicifolia* may be present in the understory…

Quercus agrifolia Woodland Alliance* (1111)

I.B.2. *Quercus douglasii* or *Quercus* x*alvordiana* is the dominant oak species in an open to intermittent tree canopy. *Juniperus californica* may be present as a sub- to co-dominant tree…

Quercus douglasii Woodland Alliance (1131)

I.B.2.a. *Juniperus californica* is a sub- to co-dominant tree with *Quercus douglasii*, while *Cercocarpus montanus* is present and dominant or co-dominant in the shrub understory…

Quercus douglasii–Juniperus californica/Cercocarpus montanus Woodland Association* (1131)

I.B.2.b. *Juniperus californica* is a sub- to co-dominant tree with *Quercus douglasii*, while *Ericameria linearifolia* is generally present and dominant or co-dominant in the shrub understory…

Quercus douglasii–Juniperus californica/Ericameria linearifolia Woodland Association (1131)

I.B.2.c. *Quercus* x*alvordiana* is dominant in the tree canopy, typically with an herbaceous understory. *Juniperus californica* may be scattered.

Quercus x*alvordiana* Woodland Association (1131)

I.B.2.d. *Quercus douglasii* is dominant with *Ericameria linearifolia* present in the shrub understory, which may mix with other shrubs such as *Arctostaphylos glauca, Adenostoma fasciculatum, Artemisia californica, Eriogonum fasciculatum, Rhamnus ilicifolia, and Salvia leucophylla*. *Poa secunda* is generally present in this association within the study area, and *Juniperus californica* is absent or low in cover (<1% absolute cover) …

Quercus douglasii/Ericameria linearifolia Woodland Association* (1131)

I.B.2.e. *Quercus douglasii* is dominant with annual grasses and forbs dominant the understory, and shrubs have no or low (<3%) absolute cover. The most common herb species are non-natives *Bromus diandrus, B. hordeaceus, B. rubens,* and *Erodium cicutarium*. Native grasses *Nassella cernua* and *Poa secunda* are often present…

Quercus douglasii/Herbaceous Woodland Association* (1131)

I.C. *Quercus john-tuckeri* is the dominant oak or it intermixes as a low tree with similar or higher cover than *Juniperus californica*. A variety of shrubs such as *Ceanothus cuneatus, Ericameria linearifolia, Eriogonum fasciculatum* and *Salvia leucophylla* may be present in the shrub understory …

Quercus john-tuckeri Shrubland Alliance (2111)

I.C.1. *Juniperus californica* occurs in the tree canopy and is similar or lower in cover to *Quercus john-tuckeri*. *Ericameria linearifolia* often intermixes in the shrub layer, and a variety of other sub-dominant shrubs such as *Eriogonum fasciculatum* and *Salvia leucophylla* can also occur…

Quercus john-tuckeri–Ericameria linearifolia/Juniperus californica Shrubland Association (2111)

I.C.2. *Quercus john-tuckeri* is the sole dominant in the low tree or tall shrub canopy. Other plants may be present at relatively low cover including *Adenostoma fasciculatum, Ceanothus cuneatus* and *Salvia leucophylla*…

<div align="right">***Quercus john-tuckeri* Shrubland Association (2111)**</div>

I.D. The tree canopy is characterized by an even distribution of *Juniperus californica* with >4% absolute cover. *Quercus douglasii* is typically absent in the overstory and soils tend to be shallow and sandy or silty…

<div align="right">***Juniperus californica* Woodland Alliance (1121)**</div>

I.D.1. *Salvia leucophylla* is present in the shrub understory and other shrubs such as *Eriogonum fasciculatum* may be sub- to co-dominant. If *Ericameria linearifolia* present, it is much lower cover in cover than the *S. leucophylla*…

<div align="right">***Juniperus californica/Salvia leucophylla* Woodland Association (1121)**</div>

I.D.2. *Ericameria linearifolia* is present in the shrub understory and other shrubs such as *Eriogonum fasciculatum* or *Ephedra viridis* may be present and co-dominant with *E. linearifolia*. If *Salvia leucophylla* is present, it is much lower in cover than *E. linearifolia.* Various herbs are present in the understory…

<div align="right">***Juniperus californica/Ericameria linearifolia/*Herbaceous Woodland Association (1121)**</div>

I.D.3. Annual grasses and forbs dominate the understory and shrubs have low cover (<2% absolute cover)…

<div align="right">***Juniperus californica/*Herbaceous Woodland Association (1121)**</div>

Class B. Shrubland Vegetation

Class B. Group I. Shrublands dominated by sclerophyllous temperate broad-leaved shrubs (with leaves hardened by a waxy cuticle). They are dominated by typical chaparral shrub genera; including chamise (*Adenostoma fasciculatum*), manzanita (*Arctostaphylos*), scrub oaks (*Quercus*), etc.

I.A. *Prunus fasciculata* is the dominant shrub in the canopy, often occurring in riparian areas and steep moist slopes. *Ribes quercetorum* and *Juniperus californicus* may be present and low in cover …

Prunus fasciculata **Shrubland Association**
Prunus fasciculata **Shrubland Alliance (4215)**

I.B. *Ribes quercetorum* is the dominant shrub in the canopy, often growing clonally in stands on steep north-facing slopes, which have resprouted recently after fire…

Ribes quercetorum **Shrubland Association**
In the *Ribes quercetorum* **Shrubland Alliance (2611)**

I.C. *Quercus berberidifolia* is dominant to co-dominant in the shrub canopy. Stands are small, rare and likely found on north-facing slopes with well- to extensively-drained soils…

Quercus berberidifolia–Ceanothus cuneatus
in the *Quercus berberidifolia* **Shrubland Alliance* (2211)**

I.D. *Quercus john-tuckeri* is dominant or it intermixes with similar or higher cover than *Juniperus californica*. A variety of other shrubs such as *Ceanothus cuneatus, Ericameria linearifolia, Eriogonum fasciculatum* and *Salvia leucophylla* may be present. Stands are found primarily on north-facing slopes with well- to extensively-drained soils…

Quercus john-tuckeri **Shrubland Alliance (2111)**

> **I.D.1.** *Juniperus californica* occurs in the tree canopy and is similar or lower in cover to *Quercus john-tuckeri. Ericameria linearifolia* often intermixes in the shrub layer, and a variety of other sub-dominant shrubs such as *Eriogonum fasciculatum* and *Salvia leucophylla* can also occur*…*
>
> *Quercus john-tuckeri–Ericameria linearifolia/Juniperus californica* **Shrubland Association (2111)**

> **I.D.2.** *Quercus john-tuckeri* is the sole dominant shrub in the shrub canopy. Other shrubs may be present at relatively low cover including *Adenostoma fasciculatum, Ceanothus cuneatus* and *Salvia leucophylla*…
>
> *Quercus john-tuckeri* **Shrubland Association (2111)**

I.E. *Ceanothus cuneatus* is dominant or shares dominance with *Adenostoma fasciculatum* or other shrubs (e.g. *Artemisia californica, Malacothamnus* sp.) in the canopy. Soils are often sandy and well-drained…

Ceanothus cuneatus **Shrubland Alliance* (2227)**

> **I.E.1.** *Adenostoma fasciculatum* co-dominates in the shrub canopy, sometimes having twice as much cover as *Ceanothus cuneatus*…
>
> *Adenostoma fasciculatum–Ceanothus cuneatus* **Shrubland Association* (2227)**

I.F. *Arctostaphylos glauca* is dominant or shares dominance with *Adenostoma fasciculatum* in the shrub canopy…

Arctostaphylos glauca **Shrubland Alliance (2231)**

> **I.F.1.** *A. glauca* is the sole dominant in the shrub canopy, and other shrubs if present are low in cover…
>
> *Arctostaphylos glauca* **Shrubland Association (2231)**

I.F.2. *Quercus john-tuckeri* is sub- to co-dominant in the shrub canopy…
Arctostaphylos glauca–Quercus john-tuckeri **Provisional Shrubland Association (2231)**

I.F.3. *Adenostoma fasciculatum* co-dominates in the shrub canopy, sometimes having twice as much cover as *Arctostaphylos glauca…*
Adenostoma fasciculatum–Arctostaphylos glauca **Shrubland Association* (2231)**

I.G. *Cercocarpus betuloides* (=*C. montanus*) intermixes as a co-dominant to dominant shrub with other chaparral species. Stands occur in mesic scrub settings on north-facing, protected slopes and are rare in the region…
Cercocarpus montanus **Shrubland Alliance* (2212)**

I.H. *Salvia mellifera* shares dominance with *Adenostoma fasciculatum* in the shrub canopy, with *A. fasciculatum* sometimes having twice as much cover as *S. mellifera.* Found on slopes of all aspects, but especially those with south-facing exposure…
Adenostoma fasciculatum–Salvia mellifera **Shrubland Association* in the**
Adenostoma fasciculatum–Salvia mellifera **Shrubland Alliance* (2226)**

I.I. *Adenostoma fasciculatum* dominates the shrub canopy with >50% relative cover…
Adenostoma fasciculatum **Shrubland Alliance* (2223)**

I.I.1. *Adenostoma fasciculatum* is the sole dominant shrub, and generally has greater than 20% absolute cover in the region. A variety of shrubs can occur as sub-dominants with sparse or low cover, including *Arctostaphylos glauca, Ceanothus cuneatus, Eriogonum fasciculatum, Salvia leucophylla, Hesperoyucca whipplei,* and others…
Adenostoma fasciculatum **Shrubland Association* (2223)**

I.J. *Adenostoma sparsifolium* is dominant or co-dominant in the shrub layer with other chaparral or coastal scrub species. Scattered, uncommon stands occur in the CDFW Gifford unit and possibly other areas in the southwest portion of the Chimineas Ranch...
Adenostoma sparsifolium **Shrubland Alliance[†] (2112)**
[†]From observations in surrounding area, no survey data from the project

I.K. *Eriodictyon crassifolium* is dominant in an open shrub canopy. This uncommon type often occurs in chaparral stands that that have had recent fire or similar disturbance.
Eriodictyon crassifolium **Provisional Shrubland Alliance[†] (2228)**
[†]From observations in surrounding area, no survey data from the project

Class B. Group II. **Shrublands dominated by scale-like, microphyllous, or broad-leaved species, including drought-deciduous and cold-deciduous species. These are generally considered to be part of desert transition, riparian, coastal sage scrub or other more soft-leaved shrub habitats. Includes species of *Allenrolfea, Artemisia, Atriplex, Baccharis, Ephedra, Ericameria, Pluchea, Salix, Salvia,* and others.**

II.A. Shrublands characterized by species that can tolerate saline or alkaline soils, but are not necessarily restricted to these conditions. Includes *Allenrolfea, Atriplex, Frankenia,* and *Suaeda…*

II.A.1. *Allenrolfea occidentalis* dominates with >2% absolute cover on seasonally saturated soils, and other alkaline-tolerant shrubs such as *Atriplex spinifera* may be present at low cover. *Lasthenia* (*gracilis*) is sub-dominant to dominant with *Bromus rubens, Delphinium recurvatum, L. ferrisiae,* and others in the herb layer …
Allenrolfea occidentalis/Lasthenia (*gracilis*) **Shrubland Association**
In the *Allenrolfea occidentalis* Shrubland Alliance (4311)

II.A.2. *Suaeda moquinii* dominates the shrub canopy with >2% absolute cover. *Lepidium dictyotum, Atriplex* spp*., Frankenia salina, Hordeum murinum, Descurainia sophia,* and other alkaline-tolerant species may be present…

Suaeda moquinii/Lepidium dictyotum Provisional Shrubland Association in the Suaeda moquinii Shrubland Alliance (4314)

II.A.3. *Frankenia salina* dominates as a sub-shrub or herb with >4% absolute cover, though non-native herbs may be high in cover during some years…

(No Association defined)
Frankenia salina Herbaceous Alliance (4317)

II.A.4. A species of *Atriplex* is dominant or co-dominant in the shrub canopy with >50% relative cover and >2% absolute cover. Other shrubs such as *Eastwoodiae elegans, Ericameria linearifolia,* or *Eriogonum fasciculatum* may be present at lower cover…

II.A.4.a. *Atriplex spinifera* dominates the shrub canopy. The herb layer has open to intermittent cover including *Bromus rubens, Erodium cicutarium* and *Lasthenia* (*gracilis*)…

Atriplex spinifera/Herbaceous Shrubland Association in the Atriplex spinifera Shrubland Alliance (4312)

II.A.4.b. *Atriplex canescens* dominates the shrub canopy. Herbs such as *Erodium cicutarium, Malacothrix coulteri, Monolopia lanceolata, Phacelia* and *Schismus* are present and may be higher in cover than the shrub layer*…*

Atriplex canescens/Herbaceous Provisional Shrubland Association in the Atriplex canescens Shrubland Alliance (2413)

II.A.4.c. *Atriplex polycarpa* dominates the shrub canopy. Herbs such as *Amsinckia tessellata, Bromus rubens, Eremalche parryi, Erodium cicutarium, Lotus wrangelianus,* and *Monolopia lanceolata* are present and can be higher in cover than the shrub layer…

Atriplex polycarpa/Annual Herbaceous Shrubland Association in the Atriplex polycarpa Shrubland Alliance (2411)

II.A.5. Shrublands in alkaline basins and high marshes with dominant plants or mixture of plants not like above…

Intermountain basins alkaline–saline shrub wetland Group (4300) in the Cool (and Warm) Semi-Desert Alkaline–Saline Wetland Macrogroup (4300, 6200 and 6400)

II.B. Shrublands characterized by species that grow in seasonally or intermittently flooded habitats on alluvial soils. Stands often occur along riparian and stream corridors, lake margins, permanent springs, marshes, or washes. Includes *Baccharis salicifolia, Lepidospartum, Pluchea, Salix* and others*...*

II.B.1. *Lepidospartum squamatum* characterizes an open shrub canopy along alluvial streams, washes, or fans, and may have as little as 2% absolute cover. Other shrubs such as *Artemisia californica* or *Ericameria nauseosa* may intermix as co-dominants …

Lepidospartum squamatum Shrubland Alliance (4213)

II.B.1.a. *Artemisia californica* is sub-dominant to co-dominant in the shrub canopy…
Lepidospartum squamatum–Artemisia californica Shrubland Association* (4213)

II.B.1.b. Other shrubs if present occur at low cover, and a variety of herbs are present in the understory …
Lepidospartum squamatum/Mixed ephemeral annuals Shrubland Association (4213)

II.B.2. *Salix exigua* is dominant or co-dominant in the shrub canopy with >50% relative cover or >30% relative cover when *S. lasiolepis* is present...

<div align="center">

***Salix exigua* Shrubland Alliance[†] (4112)**

[†]From observations in surrounding area, no survey data from the project

</div>

II.B.3. *Salix lasiolepis* is dominant in the shrub or tree canopy, typically with >50% relative cover…

<div align="center">

***Salix lasiolepis* Shrubland Alliance[†] (4114)**

[†]From observations in surrounding area, no survey data from this project

</div>

II.B.4. *Pluchea sericea* is present in the canopy with >2% absolute cover and no other shrub species have equal or greater cover. Stands occur around springs, seeps, irrigation ditches, canyon bottoms, streamsides, and seasonally flooded washes. May include *Baccharis salicifolia, Atriplex, Ericameria nauseosa,* and others…

<div align="center">

***Pluchea sericea* Shrubland Alliance (4221)**

</div>

II.B.5. *Baccharis salicifolia* is dominant or co-dominant in the shrub canopy usually with >3% cover. Stands occur along canyon bottoms, floodplains, irrigation ditches, lake margins, or stream channels and they may include a variety of other shrub species…

<div align="center">

***Baccharis salicifolia* Shrubland Alliance (4111)**

</div>

II.B.5.a. Other shrubs if present are low cover, and annual herbs including *Bromus rubens, Melilotus indicus,* and *Erodium* spp. are usually present and may be abundant in the understory…

<div align="center">

***Baccharis salicifolia* Shrubland Association (4111)**

</div>

II.B.5.b. *Pluchea sericea* is sub- to co-dominant in the shrub canopy (usually with lower cover than *Baccharis salicifolia*)…

<div align="center">

***Baccharis salicifolia*–*Pluchea sericea* Shrubland Association (4111)**

</div>

II.B.6. Stands not as above and characterized by any combination of *Salix exigua*, *Salix lasiolepis,* and *Baccharis salicifolia. Populus fremontii* and other *Salix* species may intermix No clear dominance or co-dominance by any of these species. …

<div align="center">

Warm Mediterranean & Desert Riparian, Flooded & Swamp Forest Macrogroup (4110)

</div>

II.B.7. *Ambrosia salsola* (=*Hymenoclea salsola*) characterizes an open to intermittent shrub canopy on sandy alluvial soils with >4% absolute cover. Other shrubs, such as *Eriogonum fasciculatum* and *Ericameria linearifolia,* may be present at lower cover in the canopy…

<div align="center">

***Ambrosia salsola* Shrubland Association**
***Ambrosia salsola* Shrubland Alliance (2416)**

</div>

II.B.8. *Ericameria nauseosa* has >50% relative cover in the shrub canopy and grows on well-drained soils in washes, stream terraces or slopes. The shrub layer may include *Atriplex canescens, Ephedra californica, Ericameria linearifolia, Gutierrezia californica, Hymenoclea salsola* and others, which are typically low in cover…

<div align="center">

***Ericameria nauseosa* Shrubland Association**
***Ericameria nauseosa* Shrubland Alliance (2511)**

</div>

II.B.9. *Forestiera pubescens* has >50% relative cover in the shrub canopy and grows in steep ravines and washes…

<div align="center">

***Forestiera pubescens* Provisional Shrubland Association**
***Forestiera pubescens* Shrubland Alliance (4114)**

</div>

II.B.10. *Tamarix* sp. has >75% relative cover in the shrub canopy in riparian areas…

<div align="center">

***Tamarix* Shrubland Semi-natural Stands (9141)**

</div>

II.C. Shrublands not as above and characterized by desert or desert-transition shrubs. Includes *Ambrosia, Eastwoodia, Ephedra, Ericameria, Isomeris, Krascheninnikovia* and *Lycium…*

II.C.1. *Ephedra californica* has >2% absolute cover in an open shrub canopy on low elevation uplands and washes, with sandy soils. Other shrubs may be sub- to co-dominant, such as *Ambrosia salsola* and *Gutierrezia californica…*

Ephedra californica Shrubland Alliance (4211)

II.C.1.a. Stands occur in uplands where other shrubs are not present or low in cover. The herb layer is open to dense and may include *Amsinckia tessellata, Bromus rubens, Poa secunda, Uropappus lindleyi,* and others …

Ephedra californica/Annual-perennial herb Shrubland Association (4211)

II.C.1.b. Stands occur in washes where *Ambrosia salsola* is typically present as a sub- to co-dominant. The herb layer is variable…

Ephedra californica–Ambrosia salsola Shrubland Association (4211)

II.C.2. *Ephedra californica* occurs at >2% cover and usually co-dominates with *Eriogonum fasciculatum* in the shrub canopy. Often found on southern exposures with herbs such as *Amsinckia tessellata, Erodium cicutarium, Schismus* and others…

Eriogonum fasciculatum–Ephedra californica Provisional Shrubland Association of the Eriogonum fasciculatum Shrubland Alliance (2317)

II.C.3. *Ambrosia salsola* (=*Hymenoclea salsola*) characterizes an open to intermittent shrub canopy on sandy alluvial soils with >4% absolute cover. Other shrubs, such as *Eriogonum fasciculatum* and *Ericameria linearifolia,* may be present at lower cover in the canopy…

Ambrosia salsola Shrubland Association Ambrosia salsola Shrubland Alliance (2416)

II.C.4. *Lycium andersonii* has >50% relative cover in the shrub canopy and grows on low elevation uplands or near washes. The shrub layer may include *Ephedra californica, Eriogonum fasciculatum, Gutierrezia californica, Krascheninnikovia lanata,* and others…

Lycium andersonii Shrubland Association of the Lycium andersonii Shrubland Alliance (2522)

II.C.6. *Artemisia tridentata* is dominant or co-dominant on sandy alluvial soils in the lower Cuyama River drainage. Stands tend to be small and scattered in the mapping area...

Artemisia tridentata Shrubland Alliance[†] (2711)
[†]From observations in surrounding area, no survey data from this project

II.C.7. *Ericameria linearifolia, Isomeris arborea,* and/or *Eastwoodiae elegans* is dominant to co-dominant with each other or other shrubs in the shrub canopy. The shrub layer may also include *Gutierrezia californica, Ephedra californica, Eriophyllum confertiflorum, Eriogonum fasciculatum* and others. The herb layer can be well-developed, and *Poa secunda* is characteristically present…

Ericameria linearifolia–Isomeris arborea Shrubland Alliance (2335)

II.C.7.a. *Eastwoodia elegans* is dominant or shares dominance with *Ericameria linearifolia…*

Eastwoodia elegans Association (2335)

II.C.7.b. *Isomeris arborea* is primarily dominant or shares dominance with *Ericameria linearifolia* in the shrub canopy…

Isomeris arborea Shrubland Association (2335)

II.C.7.b. *Ericameria linearifolia* is primarily dominant or co-dominant with other shrubs in the shrub overstory…

Ericameria linearifolia Shrubland Association (2335)

II.C.7.d. *Krascheninnikovia lanata* and/or *Eriogonum fasciculatum* are sub- to co-dominant in the shrub canopy with *Eastwoodia elegans…*

> **Eastwoodia elegans–Krascheninnikovia lanata Shrubland Association (2335)**

II.C.8. *Krascheninnikovia lanata* is dominant in the shrub canopy. Other shrub species may include *Eastwoodia elegans, Ephedra californica, Gutierrezia californica,* and *Eriogonum fasciculatum…*

> **Krascheninnikovia lanata Shrubland Association of the**
> **Krascheninnikovia lanata Shrubland Alliance (2521)**

II.C.9. *Ericameria nauseosa* has >50% relative cover in the shrub canopy and grows on well-drained soils in washes, stream terraces or slopes. The shrub layer may include *Atriplex canescens, Ephedra californica, Ericameria linearifolia, Gutierrezia californica, Hymenoclea salsola* and others, which are typically low in cover…

> **Ericameria nauseosa Shrubland Association**
> **Ericameria nauseosa Shrubland Alliance (2511)**

II.C.10. *Ephedra viridis* is dominant or sometimes can be co-dominant with *Ericameria linearifolia* or *Eriogonum fasciculatum*. The shrub layer may also include *Isomeris arborea* and others, and the herb understory is well-developed with *Poa secunda* characteristically present…

> **Ephedra viridis–Ericameria linearifolia/Monolopia lanceolata Provisional Shrubland**
> **Association of the Ephedra viridis Shrubland Alliance (2525)**

II.D. Shrublands characterized by coastal sage shrub species. Includes *Artemisia californica, Eriogonum fasciculatum, Salvia* spp*.,* and *Lupinus albifrons…*

II.D.1. *Gutierrezia californica* dominates an open shrub canopy, and other shrubs may occur at low cover. The herb layer is usually well-developed, including natives such as *Poa secunda* and non-natives such as *Bromus* and *Erodium* species…

> **Gutierrezia californica/Poa secunda Association of the**
> **Gutierrezia californica Shrubland Alliance (2321)**

II.D.2. *Lupinus albifrons* dominates in the shrub canopy and grows on slopes that may be disturbed, steep, and unstable. A variety of coastal sage shrubs may be present, including *Ericameria linearifolia, Eriogonum fasciculatum,* and others…

> **Lupinus albifrons Shrubland Association of the**
> **Lupinus albifrons Shrubland Alliance (2324)**

II.D.3. *Salvia leucophylla* is dominant or shares dominance with *Artemisia californica, Eriogonum fasciculatum,* and/or *Ericameria linearifolia…*

> **Salvia leucophylla Shrubland Alliance (2325)**

II.D.3.a. *Salvia leucophylla* is the sole dominant (>60% relative cover) in the shrub canopy…

> **Salvia leucophylla Shrubland Association (2325)**

II.D.3.b. *Artemisia californica* is co-dominant with *Salvia leucophylla*, and *Eriogonum fasciculatum* and *Hesperoyucca whipplei* are often present…

> **Salvia leucophylla–Artemisia californica Shrubland Association (2325)**

II.D.3.c. *Eriogonum fasciculatum* is sub- to co-dominant with *Salvia leucophylla* and the two species characterize the shrub canopy. Sometimes other shrubs such as short-lived *Malacothamnus* can be present and co-dominant…

> **Salvia leucophylla–Eriogonum fasciculatum Shrubland Association (2325)**

II.D.4. *Salvia mellifera* is dominant or shares dominance with *Eriogonum fasciculatum* in the shrub overstory. Typically occurs on steep slopes*…*
                                    ***Salvia mellifera* Shrubland Alliance (2328)**

    II.D.4.a. *Eriogonum fasciculatum* is sub- to co-dominant with *Salvia mellifera* and *Bromus rubens* is typically present in the understory…
                    Salvia mellifera–Eriogonum fasciculatum/Bromus rubens
                                                    Shrubland Association (2328)

II.D.5. *Artemisia californica* and *Eriogonum fasciculatum* are co-dominant in the shrub canopy, with both having >30% relative cover. Stands tend to occur on relatively hot and steep slopes. The shrub layer may include *Hesperoyucca whipplei, Salvia leucophylla, Malacothamnus* spp or other shrubs.*…*
            ***Artemisia californica–Eriogonum fasciculatum* Shrubland Association**
        in the *Artemisia californica–Eriogonum fasciculatum* Shrubland Alliance (2314)

II.D.6. *Artemisia californica* dominates (with >60% relative cover) in the shrub canopy while other shrubs have sparse or low cover. Often found on relatively steep slopes…
                            ***Artemisia californica* Shrubland Association**
                    in the *Artemisia californica* Shrubland Alliance (2312)

II.D.7. *Eriogonum fasciculatum* is dominant or shares dominance with *Hesperoyucca whipplei* in the shrub canopy. Soils are usually sandy and well-drained…
                            ***Eriogonum fasciculatum* Shrubland Alliance (2317)**

    II.D.7.a. *Eriogonum fasciculatum* is the dominant in the shrub layer, and other shrub species have sparse or low cover…
                            ***Eriogonum fasciculatum* Shrubland Association (2317)**

    II.D7.b. *Hesperoyucca whipplei* occurs at >2% cover and usually co-dominates with *Eriogonum fasciculatum* in the shrub canopy. Sometimes *E. fasciculatum* is low in cover and *H. whipplei* has a much higher relative cover. Often found on southern exposures with native herbs such as *Amsinckia tessellata, Dichelostemma capitatum, Salvia columbariae, Uropappus lindleyi, Plantago erecta,* and others…
        ***Eriogonum fasciculatum–Hesperoyucca whipplei* Shrubland Association (2317)**

    II.D7.c. *Ephedra californica* occurs at >2% cover and usually co-dominates with *Eriogonum fasciculatum* in the shrub canopy. Often found on southern exposures with herbs such as *Amsinckia tessellata, Erodium cicutarium, Schismus* and others…
            ***Eriogonum fasciculatum–Ephedra californica* Shrubland Association (2317)**

II.D.8. *Ericameria linearifolia, Isomeris arborea,* and/or *Eastwoodiae elegans* is dominant to co-dominant with each other or with other shrubs in the shrub canopy. The shrub layer may also include *Gutierrezia californica, Ephedra californica, Eriophyllum confertiflorum, Eriogonum fasciculatum* and others. The herb layer can be well-developed, and *Poa secunda* is characteristically present…
            ***Ericameria linearifolia–Isomeris arborea* Shrubland Alliance (2335)**
                    ***(*See above for key step II.C.7. for associations in this alliance)**

<u>**Class C.**</u> **Herbaceous Vegetation**

Vegetation characterized by non-woody, herbaceous species in the canopy including grass, graminoid, and broad-leaved herbaceous species. Woody species may be emergent, typically with <5% cover.

I.A. Vegetation is characterized mainly by wetland graminoid, playa or vernal pool species, including graminoids such as *Distichlis, Juncus, Eleocharis, Schoenoplectus,* and forbs such as *Atriplex, Lasthenia,* and *Lepidium.*

> **I.A.1.** *Eleocharis* sp. is dominant or co-dominant along lakeshores, streambeds, swales, pastures, ditches, and ponds.

>> **I.A.1.a.** *Eleocharis macrostachya* is dominant or co-dominant along lakeshores, streambeds, swales, pastures, ditches, and ponds. *Juncus arcticus* (var. *mexicanus* or *balticus*)*, Polypogon monspeliensis, Rumex crispus, Distichlis spicata,* and a variety of other wetland herbs may be present…
>> *Eleocharis macrostachya* **Herbaceous Alliance* (6312)**

>>> **I.A.1.a.i.** *E. macrostachya* is strongly dominant (>66% average cover) in freshwater ponds, reservoir margins, and streamsides…
>>> *Eleocharis macrostachya* **Association* (6312)**

>> **I.A.1.b.** *Eleocharis acicularis* dominant in streambeds, swales, and spring areas. A variety of other wetland herbs may be present.
>> *Eleocharis acicularis* **Alliance* (6311)**
>> **(No Association defined)**

> **I.A.2.** *Juncus arcticus* var. *balticus* is dominant or co-dominant along edges of streams, lakes, and ponds. A variety of wetland graminoids or forbs intermix in the herbaceous layer, and *Rorippa nasturtium-aquaticum* and *Polypogon monspeliensis* may have similar or higher cover than *Juncus arcticus.* …
> *Juncus arcticus* **(var.** *balticus***,** *mexicanus***) Herbaceous Alliance (6211)**

>> **I.A.2.a.** *Juncus arcticus* var. *balticus* is typically dominant in the herb layer…
>> *Juncus arcticus var. balticus* **Association (6211)**

> **I.A.3.** *Schoenoplectus americanus* dominates or co-dominates along streams, around ponds and lakes, marshes, and roadside ditches. Soils are poorly drained. *Typha* spp.*, Distichlis spicata, Eleocharis parishii, Leymus triticoides, Polypogon monspeliensis, Schoenoplectus maritimus, Scirpus pungens,* and a variety of other wetland herbs may be present…
> *Schoenoplectus americanus* **Herbaceous Alliance (6111)**

>> **I.A.3.a.** *Scirpus pungens* co-dominanates with *Schoenoplectus americanus*…
>> *Scirpus pungens–Schoenoplectus americanus* **Provisional Association* (6111)**

>> **I.A.3.b.** *Schoenoplectus americanus* dominates, and other herbs are lower in cover…
>> *Schoenoplectus americanus* **Association (6111)**

> **I.A.4.** Vegetation not as above and characterized by other tall perennial graminoids such as *Schoenoplectus, Scirpus, Typha,* and *Juncus effusus…*
> **Western North American Temperate Lowland Wet Shrubland, Wet Meadow & Marsh Macrogroup (6100, 6200, and 6400)**

>> **I.A.4.1.** Vegetation including *Juncus* spp.
>> **Western North American Maritime Lowland Wet Meadow & Herbaceous Seep Group (6200)**

I.A.4.2. Vegetation including *Schoenoplectus, Scirpus,* and *Typha* spp.
Western North American Temperate Interior Freshwater Marsh Group (6100)

I.A.5. Vegetation not as above and characterized by vernal pool, playa, and swale species such as *Eleocharis* spp., *Eryngium* spp*., Lasthenia fremontii, Layia* spp*., Downingia* spp*., Psilocarphus* spp*.,* and others. Restricted to winter-flooded or at least winter-saturated substrates; not of convex or upland slopes - watered only by ambient precipitation. This vegetation occurs in alkaline vernal pools and playas in the study area …
Western North American Vernal Pool Macrogroup (6300)
California Vernal Pool Group (6310)

I.A.5.a. Native annual species *Atriplex vallicola, Lasthenia ferrisiae,* and/or *Lepidium jaredii* dominate, co-dominate, or are characteristically present in stands. Sometimes, *Lepidium nitidum* or *L. dictyotum* may be higher cover than the indicator species of the association, and other native herbs such as *Spergularia marina* are often present and variable in cover. ...
***Atriplex vallicola–Lasthenia ferrisiae–Lepidium jaredii* Herbaceous Association in the *Lasthenia fremontii–Distichlis spicata* Alliance (6313)**

I.A.5.b. Native annual and perennial species such as *Frankenia salina, Myosurus minimus, Psilocarphus brevissimus,* and *Plagiobothrys leptocladus* dominate, co-dominate, or are characteristically present in stands…
***Frankenia salina–Psilocarphus brevissimus* Provisional Herbaceous Association in the *Frankenia salina* Alliance (4317)**

I.A.6. Native perennial grasses and forbs are characteristic and evenly distributed across the herbaceous layer, though non-native herbs sometimes are dominant. Diagnostic species include *Distichlis spicata, Leymus triticoides,* and *Frankenia salina* in alkaline wetlands, playas, intermittently flooded terraces, and other similar locations*…*

I.A.6.a. *Distichlis spicata* is dominant or co-dominant with >30% relative cover in the herb layer. Soils are often deep, alkaline or saline, and poorly drained. *Descurainia sophia, Erodium cicutarium, Bromus, Hordeum, Amsinckia, Lasthenia,* and a variety of other native and non-native forbs and grasses may be present…
***Distichlis spicata* Herbaceous Alliance (6411)**

I.A.6.a.i. *Distichlis spicata* dominant (>50% relative cover) in the herb layer, though various annual forbs may be present…
***Distichlis spicata* Herbaceous Association (6411)**

I.A.6.b. *Leymus triticoides* is dominant or co-dominant (>30% relative cover) and with >15% absolute cover on poorly drained floodplains, pond/lake margins, drainage and valley bottoms. *Hordeum murinum, Erodium cicutarium, Amsinckia, Bromus, Distichlis spicata,* and a variety of other native and non-native forbs and grasses may be present…
***Leymus triticoides* Herbaceous Association in the *Leymus triticoides* Herbaceous Alliance (6213)**

I.A.6.c. *Frankenia salina* is dominant or co-dominant (>30% relative cover) in playas, alkaline depressions and alkali sinks that have poorly drained soils. *Atriplex* spp., *Cressa truxillensis* and other species may be present…
(No Association defined)
***Frankenia salina* Herbaceous Alliance (4317)**

I.A.7. Stands with low cover of alkaline/saline adapted herbaceous plants (like *Distichlis spicata, Frankenia salina,* and *Leymus triticoides)* and not like above…
Intermountain basins alkaline–saline herb wet flat Group in the

Cool (and Warm) Semi-Desert Alkaline–Saline Wetland Macrogroup (4300, 6200 and 6400)

I.B. Vegetation is characterized mainly by upland and mesic herbaceous species, including native and non-native grasses and forbs…

> **I.B.1.** A perennial *Eriogonum* species, *Corethrogyne filaginifolia,* or *Isocoma acradenia* characterizes the herb layer on shallow soils derived from sedimentary substrate. Stands typically have grazing or other disturbance history…

>> **I.B.1.a.** *Eriogonum nudum* or *E. elongatum* is dominant on low hills, mound, and toeslopes that usually have exposed bare ground and rocky soils, which may be disturbed by small mammals or grazing animals …
>> ###### *Eriogonum* (*elongatum, nudum*) Herbaceous Alliance (5132)

>>> **I.B.1.a.1.** *Eriogonum elongatum* is dominant or co-dominant with *Bromus rubens* on low hills and mounds…
>>> ###### *Eriogonum elongatum* Provisional Herbaceous Association (5132)

>>> **I.B.1.a.2.** *Eriogonum nudum* is dominant or is co-dominant with other herb species…
>>> ###### *Eriogonum nudum* Provisional Herbaceous Association (5132)

>> **I.B.1.b.** *Corethrogyne filaginifolia* is dominant on gentle to moderately slopes with sandy soils with *Castilleja exserta, Erodium cicutarium* and other herbs…
>> ###### *Corethrogyne filaginifolia* Provisional Herbaceous Association
>> ###### *Corethrogyne filaginifolia* Provisional Herbaceous Alliance (5131)

>> **I.B.1.c.** *Isocoma acradenia* is dominant on flat to gentle slopes near Soda Lake or base of the Temblor Range with a variety of herbs…
>> ###### *Isocoma acradenia* Provisional Association of the
>> ###### *Isocoma acradenia* Alliance (2323)

> **I.B.2.** Annual native herbs are characteristic and evenly distributed across the herbaceous layer, though non-native forbs and grasses may be dominant. Diagnostic species include *Amsinckia* spp., *Coreopsis calliopsidea, Eschscholzia* spp*., Lasthenia* spp*., Monolopia* spp., *Phacelia* spp., *Plantago erecta,* and *Vulpia microstachys…*
> ###### California Annual Herb/Grass Group (5110)

>> **I.B.2.a.** Native annual species *Vulpia microstachys*, *Plantago erecta* and/or *Lasthenia californica* (or *L. gracilis)* characteristically present in stands and usually at least 10% relative in cover to other herbs. Other native species such as *Castilleja exserta, Crassula connata, Lepidium nitidum, Lupinus,* and *Trifolium* species are often well-represented (and sometimes co-dominant to dominant) as well as a variety of herbs. Soils may be clayey, wet to moist in spring and dry by summer …
>> ###### *Lasthenia californica*–*Plantago erecta*–*Vulpia microstachys*
>> ###### Herbaceous Alliance (5114)

>>> **I.B.2.a.1.** *Erodium* and *Schismus* appear co-dominant to dominant in stands with *Vulpia microstachys,* and other native herbs such as *Amsinckia tessellata, Astragalus didymocarpus, Eriogonum gracillimum, Lepidium nitidum, Malacothrix coulteri, Microseris elegans,* and *Trifolium gracilentum,* with a variety of other native and non-native herbs*…*
>>> ###### *Erodium cicutarium*–*Vulpia microstachys* Association (5114)

>>> **I.B.2.a.2.** *Erodium cicutarium* and *Bromus rubens* are present and sub-dominant while *Vulpia microstachys, Lepidium nitidum,* and/or *Trifolium gracilentum* are co-dominant to dominant with other herbs…
>>> ###### *Lepidium nitidum*–*Trifolium gracilentum*–*Vulpia microstachys* Association (5114)

I.B.2.a.3. *Erodium* and *Bromus* appear sub-dominant to dominant in stands with *Lasthenia* (*gracilis*), *Plantago erecta, Plagiobothrys canescens, Crassula connata,* and a variety of other native herbs…
Lasthenia gracilis–Plantago erecta–Plagiobothrys canescens **Herbaceous Association (5114)**

I.B.2.a.4. *Lasthenia* (*gracilis*) appears dominant or co-dominant with other herbs on vernal alkaline flats…
Lasthenia gracilis **Herbaceous Association (5114)**

I.B.2.a.5. *Lasthenia minor* appears dominant or co-dominant with other herbs on vernal alkaline flats of the valley floor. Stands are rare in the region …
Lasthenia minor **Provisional Herbaceous Association (5114)**

I.B.2.b. *Pectocarya linearis* or *P. penicillata* is seasonally co-dominant to dominant on sandy flats with *Calandrinia ciliata, Camissonia campestris, Erodium cicutarium, Lasthenia gracilis, Linanthus liniflorus, Schismus* sp., *Vulpia microstachys,* and other herbs. Stands interdigitate with *Amsinckia* herb stands and *Ephedra* shrub stands …
Pectocarya (*linearis, penicillata*) **Herbaceous Association in the** *Lasthenia californica–Plantago erecta–Vulpia microstachys* **Herbaceous Alliance (5114)**

I.B.2.c. *Eschscholzia californica* and/or *Lupinus bicolor* is/are seasonally dominant on upland slopes or flats with sandy to loamy soils that are well drained. *Amsinckia, Avena, Bromus, Castilleja exserta, Erodium cicutarium, Uropappus lindleyi* and a variety of other native and non-native forbs and grasses may be present…
Eschscholzia (californica) **Herbaceous Alliance (5113)**

I.B.2.c.1 *Eschscholzia californica* is seasonally dominant on upland slopes or flats…
Eschscholzia californica **Herbaceous Association (5113)**

I.B.2.c.2 *Lupinus bicolor* is seasonally dominant on grazed flats…
Lupinus bicolor **Provisional Herbaceous Association (5113)**

I.B.2.d. *Amsinckia menziesii, A. tessellata, A. vernicosa, Phacelia ciliata* and/or *P. tanacetifolia* is/are seasonally characteristic in the herbaceous layer with greater than or equal to 10% relative cover. Soils are often well-drained and loamy and may have high levels of bioturbation (e.g., kangaroo rat precincts), high levels of (past/current) grazing and/or other disturbance...
Amsinckia (*menziesii, tessellata*) **Herbaceous Alliance (5111)**

I.B.2.d.1. *Erodium cicutarium* is present and sub-dominant to dominant with *Amsinckia tessellata. Astragalus didymocarpus, Bromus rubens, Guillenia lasiophylla, Lotus wrangelianus,* and *Vulpia microstachys* may be present with a variety of other native and non-native herbs…
Amsinckia tessellata–Erodium cicutarium **Herbaceous Association (5111)**

I.B.2.d.2. *Phacelia ciliata* is present and sub-dominant to dominant with *Amsinckia, Bromus rubens, Descurainia sophia, Erodium cicutarium, Guillenia lasiophylla, Lasthenia* and other species. Stands occur on terraces, flats and toeslopes usually adjacent to *Amsinckia* stands on well-drained soils and on grazed lands…
Phacelia ciliata **Provisional Herbaceous Association (5111)**

I.B.2.d.3. *Phacelia tanacetifolia* is seasonally dominant or co-dominant on steep, dry slopes on siltstone derived soils. A variety of other herbs such as *Amsinckia tessellata, A. vernicosa, Astragalus didymocarpus, Caulanthus inflatus, Eremalche*

parryi, Erodium cicutarium, Salvia columbariae, Lupinus succulentus, Eriogonum elongatum are present. Stands typically on moderate to steep slopes facing southeast and southwest...

> ***Phacelia tanacetifolia* Provisional Herbaceous Association (5115)**

I.B.2.e. *Coreopsis calliopsidea, Monolopia spp,* and/or *Mentzelia pectinata* is/are seasonally dominant or co-dominant on steep, dry slopes. A variety of other native herbs such as *Amsinckia tessellata, Astragalus didymocarpus, Caulanthus inflatus,* and *Malacothrix coulteri* are often present…

> ***Monolopia (lanceolata)–Coreopsis (calliopsidea)* Herbaceous Alliance (5115)**

I.B.2.e.1. *Coreopsis calliopsidea* and/or *Mentzelia pectinata* are seasonally dominant on steep, dry slopes with siltstone and gypsum-derived soils. A variety of other herbs such as *Amsinckia tessellata, Caulanthus inflatus, Camissonia boothii, Chaenactis stevioides, Guillenia lasiophylla, Erodium cicutarium,* and *Phacelia* species are present…

> ***Coreopsis calliopsidea–Mentzelia pectinata* Herbaceous Association (5115)**

I.B.2.e.2. *Monolopia lanceolata* is seasonally dominant or co-dominant on fine-textured, moderate to steep slopes in the Temblor and Caliente ranges and sometimes on flats/terraces above Soda Lake with *Amsinckia* spp…

> ***Monolopia lanceolata* Herbaceous Association (5115)**

I.B.2.e.3. *Monolopia stricta* is seasonally dominant on clay and silty hill slopes directly above Soda Lake with *Coreopsis calliopsidea, Erodium cicutarium, Layia munzii, Lepidium nitidum, Phacelia tanacetifolia,* and *Poa secunda*…

> ***Monolopia stricta* Provisional Herbaceous Association (5115)**

I.B.2.f. *Salvia carduacea* is dominant or co-dominant on moist alluvial toeslopes and terraces adjacent to washes with well-drained sandy soils and alluvium. *Camissonia campestris, Chaenactis glabriuscula, Erodium cicutarium, Malacothrix californica, Linanthus liniflorus, Pectocarya penicillata, Schismus* and others also occur in the herb layer, and *Gutierrezia californica* typically occurs at low cover in the shrub layer...

> ***Salvia carduacea* Herbaceous Association in the**
> ***Salvia carduacea* Provisional Herbaceous Alliance (5116)**

I.B.3. Perennial native grasses are characteristic and evenly distributed across the herbaceous layer, though non-native forbs and grasses may be dominant. Diagnostic species include *Poa secunda* and *Nassella cernua*…

> **California Native Bunchgrass Grassland (Perennial Grassland) Group (5120)**

I.B.3.a. *Poa secunda* characterizes the herbaceous layer…

> ***Poa secunda* Herbaceous Alliance (5122)**

I.B.3.a.1. *Coreopsis calliopsidea, Monolopia stricta,* and/or *Poa secunda* are seasonally co-dominant to dominant in the Soda Lake basin associated with *Erodium cicutarium, Heterodraba unilateralis, Layia munzii, Layia platyglossa,* and other herbs…

> ***Monolopia stricta–Poa secunda* Herbaceous Association (5122)**

I.B.3.a.2. *Poa secunda* is dominant or co-dominant with *Bromus rubens* on clayey soils on both flats and north-facing hillslopes along with *Allium* spp., *Claytonia parviflora, Erodium cicutarium, Dichelostemma capitata, Trifolium willdenovii,* and other herbs …

> ***Poa secunda–Bromus rubens* Herbaceous Association (5122)**

I.B.3.b. *Nassella cernua* characterizes the herbaceous layer with >2% absolute cover on well-drained soils. *Erodium cicutarium* is usually present and co-dominant, though it may be dominant to *N. cernua. Castilleja exserta, Bromus rubens, Lasthenia californica, Lotus wrangelianus, Trifolium albopurpureum,* and *Pectocarya penicillata* are often present…

Nassella cernua **Provisional Herbaceous Association**
Nassella cernua **Provisional Herbaceous Alliance (5121)**

I.B.4. Vegetation not as above and characterized or dominated by a pure to mixed assemblage of annual or perennial herbs and grasses. Adapted to winter precipitation and summer drought, typically not of bottomland or concave conditions, but of uplands. Stands may have significant non-native herbaceous cover, but they contain diagnostic presence native species of forbs and/or grasses…

California Annual & Perennial Grassland Macrogroup (5100)

I.B.5. Vegetation not as above and strongly dominated by non-native annual herbaceous and/or grass species including *Aegilops triuncialis, Avena spp., Brachypodium distachyon, Brassica nigra, Bromus spp., Centaurea melitensis, Conium maculatum, Cynosurus echinatus, Foeniculum vulgare, Lolium perenne, Schismus, Sisymbrium irio* and other mustards. Native plants, if present, are trace in presence and abundance. Often in heavily disturbed or developed areas, including past agricultural and livestock areas.

California Ruderal Grassland & Meadow Macrogroup (5200)

I.B.5.a. *Bromus rubens, Schismus* spp. and/or *Erodium* spp. strongly dominant in stands, and native plants, if present, are trace (<1%) in cover.

***Bromus rubens-Schismus* (*arabicus, barbatus*) Herbaceous Semi-natural Stands (5200)**

Class D. Unvegetated or Urbanized

I.A. Unvegetated (9110)

    I.A.1. Developed (9111)

    I.A.2. Road (9112)

    I.A.3. Cliff & Rock Outcrops (9113)

    I.A.4. River & Lacustrine Flats & Streambeds (9114)

    I.A.5. Playa (9115)

I.B. Agriculture (9120)

I.C. Water (9130)

    I.C.1. Perennial Stream Channel (9131)

    I.C.2. Reservoirs & Ponds (9132)

I.D. Exotic trees and shrubs (9140)

    I.D.1. *Tamarix* (9141)

I.E. Unknown (9999)

Appendix D

Field Verification Form for Mapping

Field Verification Form: BLM Vegetation Mapping

(04/2012)

Surveyors (circle recorder):		Date:	☐

Waypoint ID:	GPSname: Projected? Yes / No / Base If yes, enter base Waypoint ID: Bearing: _____(degrees) Distance: _____ (meters)	☐
	'Base' UTMs: UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ PDOP: +/-	
Polygon UID:	Projected UTMs: UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ (if necessary)	

Strata	Species	% cover	Strata	Species	% cover	Strata	Species	% cover	
									☐

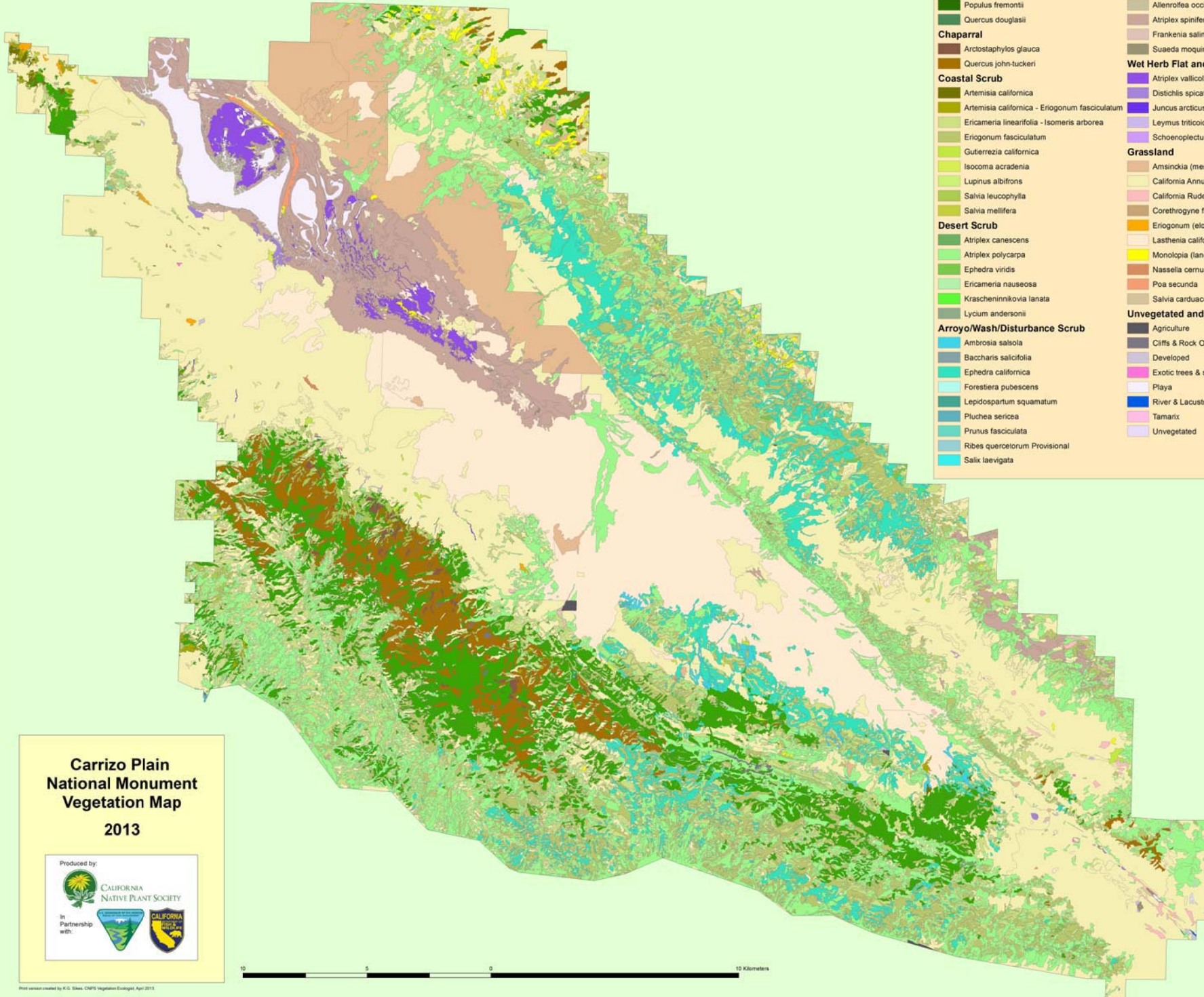| Notes: (including recommendations for line-work revision, state of veg. "discernability" based on season and topography, classification interpretation, homogeneity and unusual sightings of plants or animals)		☐
USGS Quad Name	N/A (GIS derived)	☐
Map Unit (name)		☐
Camera/Photos		☐
Conifer Cover	<1% 1-9% 10-19% 20-29% 30-39% 40-49% 50-59% 60-69% 70-79% 80-89%	☐
Hardwood Cover	<1% 1-9% 10-19% 20-29% 30-39% 40-49% 50-59% 60-69% 70-79% 80-89%	☐
Total Tree Cover	<1% 1-9% 10-19% 20-29% 30-39% 40-49% 50-59% 60-69% 70-79% 80-89%	☐
Shrub Cover	<1% 1-9% 10-19% 20-29% 30-39% 40-49% 50-59% 60-69% 70-79% 80-89%	☐
Herb Cover	<2% 2-9% 10-39% 40-59% 60-100%	☐
Exotic Plants	None or not visible 1 2 3 Not Applicable	☐
Development	None or not visible 1 2 3 Not Applicable	☐
Anthropogenic Disking/Grading	None or not visible 1 2 3 Not Applicable	☐
Roads/Trails	None or not visible 1 2 3 Not Applicable	☐
Other Impact	Type_____ 1 2 3 Not Applicable	☐
Estimated area of identifiable vegetation viewed	Rough % of polygon viewed from point _____	☐
Is this a "multiple" point assessment?	NO YES if yes: _____ of ____ points for this polygon	☐

D-2

Appendix E

Contingency Table

Final Field Call

Photo Interpreter Map Unit Name	Allenrolfea occidentalis	Ambrosia salsola	Amsinckia (menziesii, tessellata)	Arctostaphylos glauca	Artemisia californica	Artemisia californica - Eriogonum fasciculatum	Atriplex canescens	Atriplex polycarpa	Atriplex spinifera	Atriplex vallicola - Lasthenia ferrisiae - Lepidium jaredii Association	California Annual & Perennial Grassland Macrogroup	California Native Bunchgrass Grassland Group	California Ruderal Grassland & Meadow Macrogroup	California Vernal Pool Group	Central & Southern California Coastal Sage Scrub Group	Central & Southern California Coastal Seral Scrub Group	Distichlis spicata	Ephedra californica	Ephedra viridis	Ericameria linearifolia - Isomeris arborea	Ericameria nauseosa	Eriogonum (elongatum, nudum)	Eriogonum fasciculatum	Exotic trees & shrubs	Gutierrezia californica	Intermountain Basins Alkaline–Saline Shrub Wetland Group	Isocoma acradenia	Juncus arcticus (var. balticus, mexicanus)	Juniperus californica	Krascheninnikovia lanata	Lepidospartum squamatum	Leymus triticoides	Lupinus albifrons	Monolopia (lanceolata)-Coreopsis (calliopsidea)	Pluchea sericea	Poa secunda	Populus fremontii	Quercus douglasii	Quercus john-tuckeri	Salix laevigata	Salvia leucophylla	Salvia mellifera	Suaeda moquinii	Schoenoplectus americanus	W. N.A. Maritime Lowland Wet Meadow & Herbaceous Seep Group	Grand Total
Allenrolfea occidentalis	11								3																																					14
Ambrosia salsola		2																2		2													1													7
Amsinckia (menziesii, tessellata)			1								3																																			4
Arctostaphylos glauca				1																																										1
Artemisia californica		1			1	1												1																												4
Artemisia californica - Eriogonum fasciculatum						1												1					2																							4
Atriplex canescens								1																																						1
Atriplex polycarpa								26	3		4							3		4			2		1																					43
Atriplex spinifera	3							2	24		6							1																												36
Atriplex vallicola - Lasthenia ferrisiae - Lepidium jaredii Association									2	12	1																																			15
California Annual & Perennial Grassland Macrogroup									2	1	32						1	5		2			5																							48
California Native Bunchgrass Grassland Group																		1																												1
California Ruderal Grassland & Meadow Macrogroup									1		1		13														1																			16
California Vernal Pool Group														1																																1
Central & Southern California Coastal Sage Scrub Group						2												1	1	1									1														4			10
Central & Southern California Coastal Seral Scrub Group								3			1									2									1																	7
Distichlis spicata								3									4																		1											8
Ephedra californica						1		3			1							34		2			3		2							1														47
Ephedra viridis																		2	4	2																										8
Ericameria linearifolia - Isomeris arborea						1		6										1		33	1		6																							48
Ericameria nauseosa																					2																									2
Eriogonum (elongatum, nudum)																						2																								2
Eriogonum fasciculatum									3		3							2		5			14		1																					28
Exotic trees & shrubs																																														0
Gutierrezia californica								1			1							1			1	2			7								1													14
Intermountain Basins Alkaline–Saline Shrub Wetland Group	2							3																																						5
Isocoma acradenia									2														1																							3
Juncus arcticus (var. balticus, mexicanus)																												1																		1
Juniperus californica																				4							1	1	29												1					36
Krascheninnikovia lanata																													1	1																2
Lepidospartum squamatum																																														0
Lasthenia californica - Plantago erecta - Vulpia microstachys	1							1	3	2	15																																1			23
Lupinus albifrons											1																						1													2
Monolopia (lanceolata)-Coreopsis (calliopsidea)										3	16							1									1																			21
Pluchea sericea																							1												1											2
Poa secunda											1														1																					2
Populus fremontii																																					1									1
Quercus douglasii																																					1	1								2
Quercus john-tuckeri																		1		2									12										5							20
Salix laevigata																																									1					1
Salvia leucophylla																																									2					2
Salvia mellifera						1																	1																							2
Suaeda moquinii									3																																		1			4
Schoenoplectus americanus																																														0
W. N.A. Maritime Lowland Wet Meadow & Herbaceous Seep Group																												3				3												1		7
Grand Total	17	3	1	1	2	6	0	49	45	17	88	0	13	1	0	0	5	47	4	66	5	2	35	1	21	0	1	3	43	2	1	4	2	0	1	0	1	1	8	0	6	0	2	1	0	505

Map Pocket

Carrizo Plain National Monument
Vegetation Map

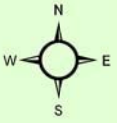# Carrizo Plain National Monument Vegetation Map

Vegetation Map Alliances and Other Units

Woodlands
- Juniperus californica
- Populus fremontii
- Quercus douglasii

Chaparral
- Arctostaphylos glauca
- Quercus john-tuckeri

Coastal Scrub
- Artemisia californica
- Artemisia californica - Eriogonum fasciculatum
- Ericameria linearifolia - Isomeris arborea
- Eriogonum fasciculatum
- Gutierrezia californica
- Isocoma acradenia
- Lupinus albifrons
- Salvia leucophylla
- Salvia mellifera

Desert Scrub
- Atriplex canescens
- Atriplex polycarpa
- Ephedra viridis
- Ericameria nauseosa
- Krascheninnikovia lanata
- Lycium andersonii

Arroyo/Wash/Disturbance Scrub
- Ambrosia salsola
- Baccharis salicifolia
- Ephedra californica
- Forestiera pubescens
- Lepidospartum squamatum
- Pluchea sericea
- Prunus fasciculata
- Ribes quercetorum Provisional
- Salix laevigata

Alkaline/Saline Scrub
- Allenrolfea occidentalis
- Atriplex spinifera
- Frankenia salina
- Suaeda moquinii

Wet Herb Flat and Marsh
- Atriplex vallicola - Lasthenia ferrisiae - Lepidium jaredii Association
- Distichlis spicata
- Juncus arcticus (var. balticus, mexicanus)
- Leymus triticoides
- Schoenoplectus americanus

Grassland
- Amsinckia (menziesii, tessellata)
- California Annual and Perennial Grassland Macrogroup
- California Ruderal Grassland & Meadow Macrogroup
- Corethrogyne filaginifolia Provisional
- Eriogonum (elongatum, nudum)
- Lasthenia californica - Plantago erecta - Vulpia microstachys
- Monolopia (lanceolata)-Coreopsis (calliopsidea)
- Nassella cernua Provisional
- Poa secunda
- Salvia carduacea Provisional

Unvegetated and Exotic Types
- Agriculture
- Cliffs & Rock Outcrops
- Developed
- Exotic trees & shrubs
- Playa
- River & Lacustrine Flats & Streambeds
- Tamarix
- Unvegetated

Carrizo Plain National Monument Vegetation Map
2013

Produced by:
CALIFORNIA NATIVE PLANT SOCIETY
In Partnership with:

Print version created by K.G. Sikes, CNPS Vegetation Ecologist, April 2013.

10   5   0   10 Kilometers

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W   E
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