Vegetation Classification and Map Accuracy Assessment of the Proposed Tehachapi Pass High-Speed Rail Corridor Vegetation Map

Kern County, California

*Prepared for the **Strategic Growth Council** by the*

California Department of Fish and Wildlife

Vegetation Classification and Mapping Program

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ABSTRACT

The Geographical Information Center (GIC) at California State University, Chico, completed a vegetation map of the Proposed Tehachapi Pass High-Speed Rail Corridor (HSRC), covering 199,493 acres. The project was funded by the Strategic Growth Council to support routing and mitigation planning for the high-speed rail system. The map was produced using heads-up digitizing based on 2012 National Agricultural Imagery Program (NAIP) imagery. The minimum mapping unit (MMU) is one acre for most vegetation types, with a smaller MMU for wetlands. Although the primary purpose of the map is to document vegetation communities, it provides additional structural data such as herbaceous, shrub, and tree cover, and information about the level of disturbance within the vegetation stand. This report describes the tasks performed by the California Department of Fish and Wildlife Vegetation Classification and Mapping Program (VegCAMP), specifically, the creation of a vegetation classification for the project area and the accuracy assessment of the map. The overall accuracy of the map exceeded the state standard of 80%.

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INTRODUCTION

In 2015, the Geographical Information Center (GIC) at California State University, Chico, completed a vegetation map of the Proposed Tehachapi Pass High-Speed Rail Corridor (HSRC), covering 199,493 acres (see Figure 1). The project was funded by the Strategic Growth Council to support routing and mitigation planning for the high-speed rail system. Mapping standards, map attributes, and the map classification are reported in GIC (2014). This report describes the portions of the project specific to VegCAMP's role: the creation of the vegetation classification for the project area and the accuracy assessment of the map.

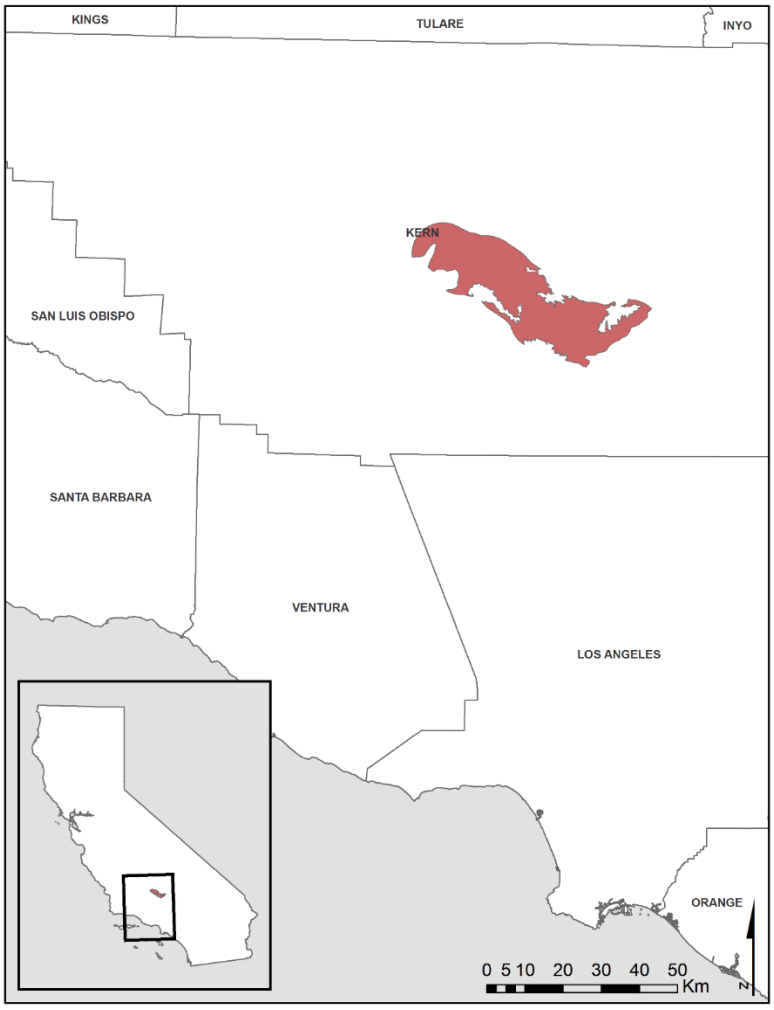

Figure 1. HSRC mapping area.

The HSRC sits at the unparalleled convergence of four ecosystems – the Sierra Nevada, Sierra Nevada Foothills, Mojave Desert, and Great Valley ecosystems, as described by Miles and Goudey (1997) (Figure

2). Many vegetation types mix in a relatively small area as a result of this convergence. Because the timing of the project did not permit a full data collection and classification effort, we based the vegetation classification for the HSRC on the existing classifications from these four ecosystems. Field data was collected to determine which of the existing vegetation types are present in the mapping area. The vegetation classification follows the National Vegetation Classification Standard (NVCS) (FGDC 2008, Faber-Langendoen et al. 2009), and in some cases includes types at the Association level. However, the map types are generally defined at the Alliance level. For some vegetation, such as herbaceous or sparsely-vegetated types, it was not possible to refine the resolution to the Alliance level and so a more general category such as Group, or in some cases Macrogroup, was the finest reliably depicted level in the map.

Once GIC completed a draft map of the HSRC, an accuracy assessment effort with field verification was conducted by VegCAMP staff to validate the vegetation map. An accuracy assessment analysis helps map users determine how much confidence can be assigned to each of the map classes and provides an understanding of the map's appropriateness for various applications. The Survey of California Vegetation (SCV), the vegetation mapping and classification standard implemented by VegCAMP for the state of California, requires 80% accuracy for vegetation maps.

METHODS

MAPPING AREA

The HSRC mapping area was created as a link, via the Tehachapi Pass, between two areas that were previously mapped to state standards (Figure 2). The 2013 California Desert Vegetation Map in Support of the Desert Renewable Energy Conservation Plan (DRECP) covers the desert area to the south of the pass, while the San Joaquin Valley map completed by GIC covers the area to the north of the pass. These two maps form the northwest and southeast boundaries of the map.

To set the mapping boundary through the Tehachapi Pass, a buffer of five miles was applied to the Highway 58 corridor between General Beale Road on the north side and the DRECP map boundary on the south side. The upper elevation limit was set at 5000 feet and delimited using a digital elevation model. Finally, the boundary of the Hardpan Terraces subsection of the Great Valley ecoregion (Miles and Goudey 1997) was used to determine the extent of the map into the Central Valley.

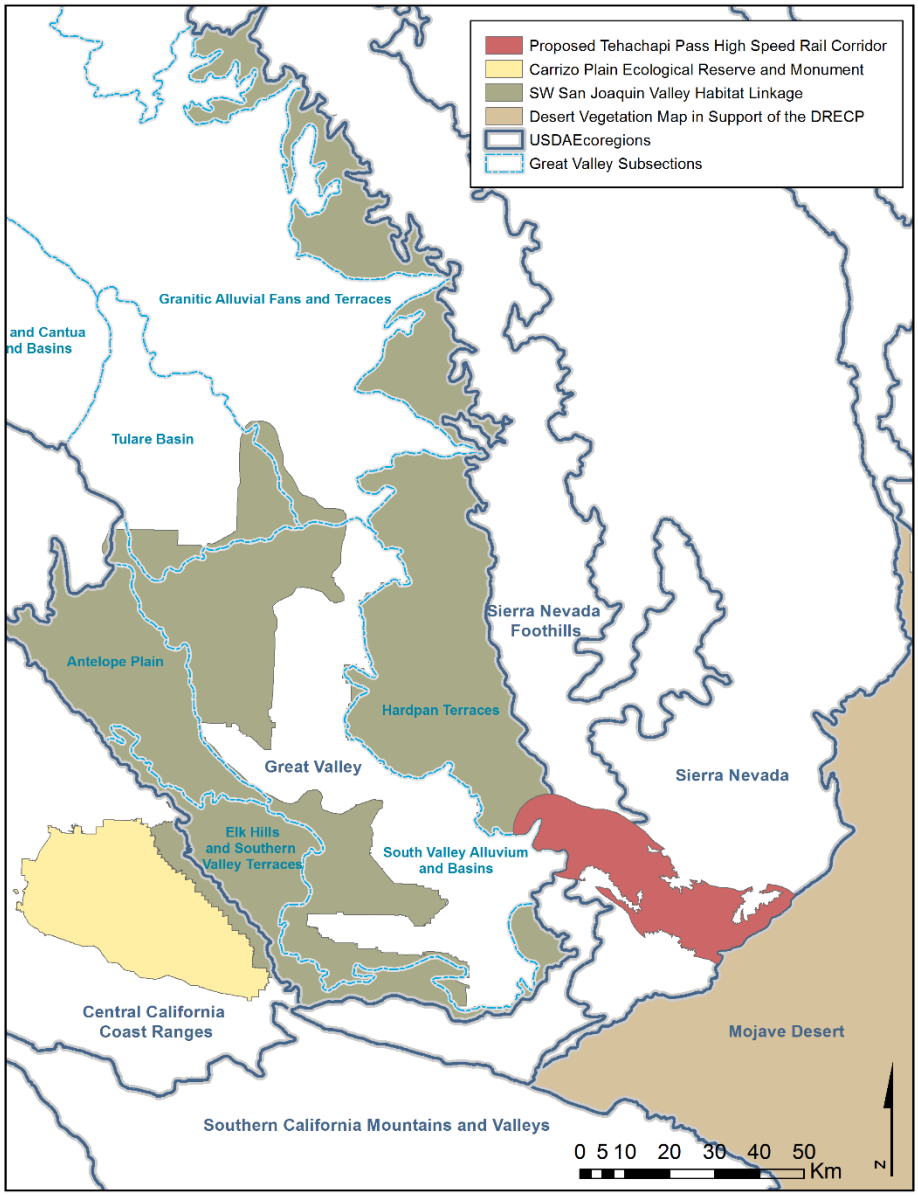

Figure 2. HSRC mapping area in relation to other mapping projects.

FIELD DATA COLLECTION FOR THE CLASSIFICATION

From May 19 to June 4, 2014, VegCAMP staff collected 52 Rapid Assessment, 9 Relevés, and 226 Reconnaissance surveys within the HSRC (Figure 3). We used the survey forms and data collection protocols in Appendices A and B. Vegetation sampling by VegCAMP staff was limited to public lands and private lands for which we could obtain landowner permission to survey.

GIC staff also collected reconnaissance data at 574 points prior to and during mapping. These were not used for the classification. Data collected by GIC staff were gathered on both public and private land; private land was accessed with landowner/manager permission, or by use of a spotting scope from public lands.

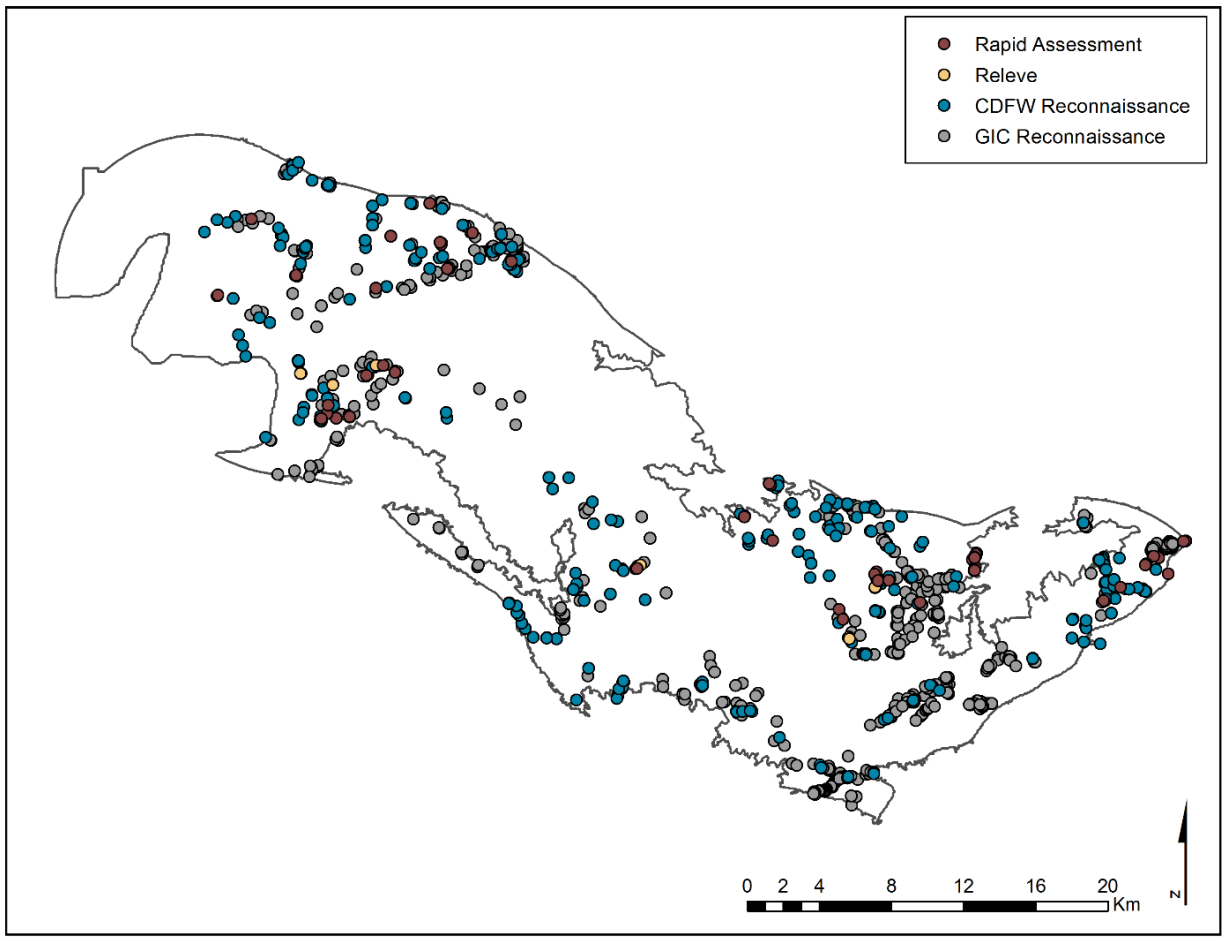

Figure 3. Location of field surveys within the HSRC.

CLASSIFICATION

All Rapid Assessment and Relevé surveys, and the 220 Reconnaissance surveys with species and cover estimates (a total of 281 samples) were used to create a vegetation classification for the project area. These surveys were analyzed together using multivariate cluster analysis performed by PC-ORD version 5 software. The cluster analysis was based on abundance (cover) values converted to seven different classes using the following modified Braun-Blanquet (1932) cover categories: 1=<1%, 2=1-5%, 3=>5-15%,

4=>15-25%, 5=>25-50%, 6=>50-75%, 7=>75%. For the analysis, VegCAMP used the Sorensen distance measure and flexible beta linkage method at -0.25 (McCune and Grace 2002).

The resulting classes were augmented by vegetation types defined in adjacent and nearby projects: the Mojave Desert (Thomas et al. 2004), the Great Valley Ecoregion (Buck-Diaz et al. 2012), and the Carrizo Plain National Monument (Stout et al. 2013), in addition to the Manual of California Vegetation (Sawyer et al. 2009). The vegetation classification includes Associations, which are the finest (lowest) level of the NVCS hierarchy. A field key to vegetation types in the HSRC was then created (Klein and Keeler-Wolf 2014).

The vegetation classification served as the basis for the vegetation types in the map classification used by GIC. However, the map classification differs in two respects: 1) it is primarily to the Alliance level; 2) it includes non-vegetation classes such as quarries and open water. Vegetation types that are poorly represented in the study area, or that are not distinguishable on the imagery, such as herbaceous types, are included in the map classification, but are mapped to a higher level of the hierarchy, such as Group. Appendix C presents the classification in hierarchical form and includes the three-letter codes for Groups as used by GIC.

ACCURACY ASSESSMENT

Accuracy Assessment (AA) sample allocation employed an analysis that balanced three goals: achieving target levels of samples based on budgeted staff time for conducting the Accuracy Assessment, distributing the samples amongst the vegetated mapping classes, and facilitating access to vegetation polygons based on land ownership and access efficiency.

The first step in the allocation process was to remove from consideration all polygons that had been previously visited by crews conducting field surveys. Within the resulting subset, locations for potential roadside surveys were identified by selecting polygons that intersected roads. Polygons in publicly accessible areas were then added by selecting those that intersected the California Protected Areas Database (http://www.calands.org/) and were within 500 meters of a road. Polygons in private properties that VegCAMP had approval to survey were also added.

The next step was to summarize the number of polygons that had been mapped for each vegetation type and set target numbers of surveys for each type. All polygons of rare types that were not selected in the above allocation process were reexamined to see: 1) when located on private land, whether they could possibly be assessed from a distance, or 2) when located on publicly accessible land but more than 500 meters from a road, whether it was reasonable for field staff to make the extra effort to visit them. After the rare polygons were chosen, polygons of more common vegetation types were selected from the subset defined above and aerial imagery was examined to determine their accessibility. To increase the efficiency of field crews, polygons of different types that were clustered within reasonable walking distance of each other were given preference over polygons that were more widely spaced. Polygons were selected in excess of the targeted count in order to provide flexibility to the field crews.

After the allocation process was complete, a priority level was assigned to each polygon. Polygons coded with rare vegetation types were given the highest priority. Vegetation types where fewer than ten polygons had been allocated were assigned intermediate priority, and all others were considered low priority. Priority levels were incorporated into field maps to help staff prioritize the time they would spend accessing particular polygons. To prevent bias, paper and digital maps prepared for AA field crews did not include the vegetation type or other map attributes assigned by GIC. Additionally, only the polygons to be assessed were shown on the maps so that the shape of surrounding polygons would not influence the field crews.

From March 30 to April 16, 2015, VegCAMP collected accuracy assessment samples in the mapping area (Figure 4) using the data collection form and protocol in Appendix D. Crews identified the vegetation type(s) within the allocated polygons using the Hierarchical Field and Mapping Key (Klein and Keeler-Wolf 2014). A set of digital photographs was taken from the GPS waypoint within or adjacent to the polygon and archived in folders named with the waypoint identification number. As AAs were collected, they were entered into a Microsoft Access database; quality control was performed on this database prior to analysis.

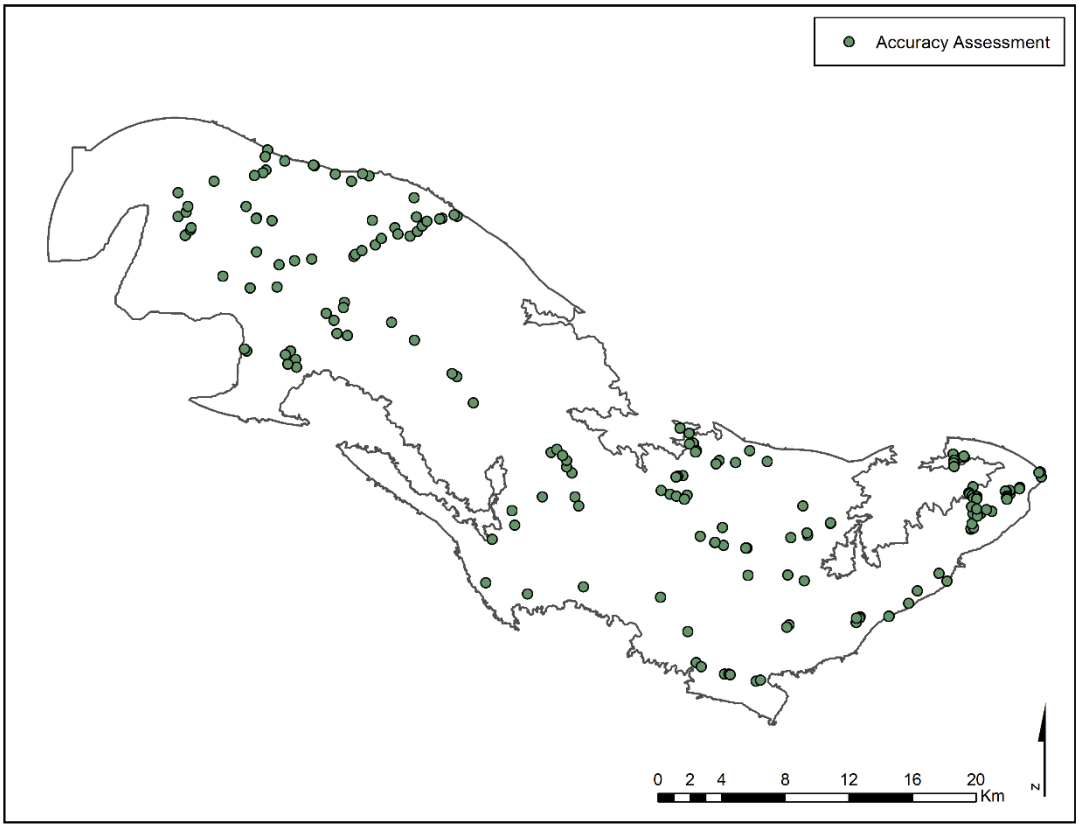

Figure 4. Location of AA surveys within the HSRC.

VegCAMP staff reviewed each AA and removed from consideration those samples that had problems associated with access, vegetation identification, visibility, or significant changes in land use or vegetation since the date of the imagery on which the map was based. If the field crews could not identify the vegetation type based on the field key or incorrectly identified the type, senior VegCAMP staff assigned the correct type based on the species covers recorded for the AA, any additional notes taken by the field crews, and sometimes the field photos. All field calls were reviewed and a "final call" was recorded in the database when possible.

The scoring process compared the vegetation label assigned to each polygon in the map (i.e., the photo-interpreted map unit attribute) with the ”final call” for the polygon. Other attributes (cover, disturbance, height) were not scored, but results were provided to GIC so the photointerpreters could correct any systematic errors.

A closeness-of-fit, or fuzzy logic, method was used to score each AA, rather than simply denoting if a sample was correct or incorrect (Gopal and Woodcock 1994; Congalton and Green 1999; Foody 2002;

Hagen 2003; Metzler and Sader 2005). Each field-verified polygon was scored according to a set of decision rules (Table 1), with a total of five possible points for each polygon. Scores were summed for each vegetation type, then divided by the total possible score and multiplied by 100 for a percent accuracy. The scores and reviewers' notes were provided to GIC so systematic errors could be corrected.

Table 1. Scoring rules

Reason for Score	Score
Photointerpreter (PI) completely correct	5
Correct Group OR next level up in hierarchy	4
Threshold/transition between PI call and Final call	4
Correct Macro Group OR next level up in hierarchy	3
Based on close ecological similarity	3
Correct Division	2
Some floristic/hydrologic similarity	2
Correct only at Life Form	1
No similarity above Formation and incorrect Life Form	0
Survey removed because of a significant change in polygon	no score
Survey removed because an inadequate portion of the polygon was viewed	no score
Survey removed because field/PI data is incomplete, inadequate or confusing	no score
Survey removed; supplementary point (e.g., second point in polygon)	no score

RESULTS

The classification analysis based on field survey data resulted in 73 Alliances (15 tree, 38 shrub, and 20 herbaceous) and 65 Associations (24 tree, 29 shrub, and 12 herbaceous). One new Alliance and eight new Associations were defined for this project and will be reviewed by senior staff from VegCAMP and the Vegetation Program of the California Native Plant Society before they are incorporated into the SCV-compliant hierarchy. The new types include the *Hesperoyucca whipplei* Provisional Alliance and the following Associations:

Acroptilon repens

Juniperus californica / Eriogonum fasciculatum

Juniperus californica / Purshia tridentata

Phacelia spp.

Pinus monophylla / Quercus john-tuckeri

Quercus chrysolepis – Aesculus californica

Quercus douglasii – Pinus sabiniana / Artemisia tridentata

Quercus douglasii – Pinus sabiniana / Ericameria nauseosa.

The classification hierarchy (Appendix C) includes all vegetation types defined in this classification project, as well as types from existing projects that were encountered in the project area.

A total of 179 AAs were collected within the mapped area (Figure 4). Of these, 14 were removed during analysis for one of the reasons given in Table 1. The final 165 AAs addressed 59 of the 92 [1]mapped vegetation types in the area (Table 2). Non-vegetation types (agriculture, urban, bare gravel/sand, and open water) were not assessed, with the exception of five polygons mapped as Cliffs and Rock Outcrops.

Table 2. The number of polygons originally assigned to each map class, with the number of AAs. Note that map classes are in order of the classification hierarchy (see Appendix C).

Group or Macrogroup with Code	Map Class	# polygons mapped	# AAs
WVO: Californian Broadleaf Forest and Woodland Group	WVO	3	1
	Aesculus californica Alliance	58	6
	Quercus agrifolia Alliance	2	1
	Quercus chrysolepis Alliance	294	3
	Quercus douglasii Alliance	1323	
	Quercus kelloggii Alliance	47	1
	Quercus lobata Alliance	95	
	Quercus wislizeni Alliance	853	
ECW: Californian Evergreen Coniferous Forest and Woodland Group	*Juniperus californica* Alliance	574	6
	Pinus sabiniana Alliance	203	6
CMF: Californian Montane Conifer Forest Group	*Abies concolor* Alliance	2	
	Pinus ponderosa Alliance	2	
MCW: Western Great Basin Montane Conifer Woodland Group	*Pinus monophylla* Alliance	205	2
IMF: Introduced North American Mediterranean Woodland And Forest Group	IMF	8	
	Ailanthus altissima Semi-natural Alliance	7	4
	Eucalyptus (globulus, camaldulensis) Semi-natural Alliance	2	

[1] The draft (pre-accuracy assessment) map had a total of 92 types. After corrections were made to the map based upon the results of the Accuracy Assessment, 84 types remained.

Group or Macrogroup with Code	Map Class	# polygons mapped	# AAs
RWF: Southwestern North American Riparian Evergreen And Deciduous Woodland Group	*Platanus racemosa* Alliance	18	
	Populus fremontii Alliance	104	
	Salix gooddingii Alliance	5	
	Salix laevigata Alliance	74	6
RWS: Southwestern North American Riparian/Wash Scrub Group	*Baccharis salicifolia* Alliance	10	
	Celtis reticulata Provisional Alliance	3	
	Forestiera pubescens Alliance	9	
	Salix exigua Alliance	1	
	Salix lasiolepis Alliance	3	
	Sambucus nigra Alliance	2	
RIS: Southwestern North American Introduced Riparian Scrub Group	RIS	1	1
	Tamarix spp. Semi-natural Alliance	25	
CXC: Californian Xeric Chaparral Group	CXC	2	
	Arctostaphylos viscida Alliance	3	
	Ceanothus cuneatus Alliance	212	7
CMC: Californian Mesic Chaparral Group	*Cercocarpus montanus (betuloides)* Alliance	249	5
PMC: Californian Pre-montane Chaparral Group	*Ceanothus leucodermis* Alliance	1	
CCS: Central and South Coastal Californian Coastal Sage Scrub Group	CCS	1	
	Eriogonum fasciculatum Alliance	558	5
	Eriogonum wrightii Alliance	68	4
	Hesperoyucca whipplei Provisional Alliance	158	4
CSS: Central and South Coastal California Seral Scrub Group	CSS	5	
	Ericameria linearifolia – Peritoma arborea Alliance	242	10
	Gutierrezia californica Alliance	3	1
	Lotus scoparius Alliance	14	2
	Lupinus albifrons Alliance	22	1
CFG: California Annual Forb/Grass Vegetation Group	CFG	1049	
	Artemisia dracunculus Alliance	9	1
CAI: Mediterranean California Naturalized Annual And Perennial Grassland Group	CAI	319	
	Centaurea (virgata) Provisional Semi-Natural Alliance	5	
MDS: Western Cordilleran Montane Deciduous Scrub Group	*Prunus virginiana* Provisional Alliance	3	
	Rhus trilobata Provisional Alliance	1	
	Ribes quercetorum Provisional Alliance	43	6
VCS: Vancouverian Coastal Deciduous Scrub Group	*Toxicodendron diversilobum* Alliance	8	

Group or Macrogroup with Code	Map Class	# polygons mapped	# AAs
MSC: Western Mojave and Western Sonoran Desert Borderland Chaparral Group	*Quercus john-tuckeri* Alliance	105	6
MRC: Mogollan Rim Chaparral Group	*Ceanothus greggii* Alliance	2	
FEM: Arid West Freshwater Emergent Marsh Group	*Schoenoplectus acutus* Alliance	1	
	Typha (angustifolia, domingensis, latifolia) Alliance	1	
VPG: California Vernal Pool and Grassland Matrix	VPG	7	
WTM: Californian Warm Temperate Marsh/Seep Group	WTM	4	1
	Juncus arcticus (var. balticus, mexicanus) Alliance	5	
NRW: Naturalized Warm-Temperate Riparian and Wetland Group	NRW	3	1
DAM: Western North American Disturbed Alkaline Marsh and Meadow Group	DAM	1	1
SSB: Southwestern North American Salt Basin and High Marsh Group	*Frankenia salina* Alliance	4	
LDS: Lower Bajada and Fan Mojavean–Sonoran Desert Scrub Group	*Ambrosia dumosa* Alliance	29	3
	Ambrosia salsola Alliance	10	1
	Atriplex polycarpa Alliance	63	4
	Larrea tridentata Alliance	20	2
	Larrea tridentata – Ambrosia dumosa Alliance	17	3
UDS: Mojavean Upper Desert Scrub Group	*Eriogonum fasciculatum – (Viguiera parishii)* Provisional Alliance	317	3
	Salazaria (Scutellaria) mexicana Alliance	56	4
	Yucca brevifolia Alliance	78	2
MWS: Mojavean Semi-Desert Wash Scrub Group	*Ephedra californica* Alliance	18	3
	Lepidospartum squamatum Alliance	91	6
	Prunus fasciculata Alliance	102	3
SSS: Shadscale-Saltbush Cool Semi-Desert Scrub Group	*Atriplex canescens* Alliance	69	4

Group or Macrogroup with Code	Map Class	# polygons mapped	# AAs
ISS: Intermontane Seral Shrubland Group	*Encelia (actoni, virginensis)* Alliance	25	2
	Ericameria nauseosa Alliance	635	3
	Ericameria teretifolia Alliance	62	4
	Gutierrezia sarothrae Alliance	11	3
TSS: Inter-Mountain West Mesic Tall Sagebrush Shrubland and Steppe Group	*Artemisia tridentata* Alliance	188	5
IDS: Intermontane Deep Or Well-drained Soil Scrub Group	IDS	1	
	Ephedra nevadensis Alliance	148	4
	Ephedra viridis Alliance	130	1
	Grayia spinosa Alliance	8	
	Lycium andersonii Alliance	7	
SCS: Intermountain Shallow/Calcareous Soil Scrub Group	*Purshia tridentata* Alliance	44	4
SDG: Southern Great Basin Semi-Desert Grassland Group	*Achnatherum (Stipa) speciosum* Alliance	45	3
CCC: Central California Coast Ranges Cliff and Canyon Group	*Selaginella bigelovii* Alliance	7	1
Temperate Tree Developed Vegetation Group	Ornamental Trees	21	
Agriculture	AGR	30	
Bare Gravel and Sand	BGS	22	
Cliffs and Rock Outcrops	CRO	73	5
Quarry, Mining, Gravel	QMG	27	
Urban	URB	67	
Open Water	WAT	10	

Note that the number of polygons mapped in Table 2 refers to the “pre-AA” numbers of polygons that were mapped of each type. After the Accuracy Assessment, GIC made corrections to the map, resulting in the removal of some map classes and changes in the number of polygons in other classes.

Two forms of accuracy (users' and producers') can be estimated from the data (Story and Congalton 1986). Users' accuracy provides an estimate of commission error, or how well spatial mapping data actually represents what is found on the ground, i.e., if the user goes to a location mapped as a certain class, what is the probability it is in fact that class? Producers' accuracy, on the other hand, measures omission error, or the probability that vegetation of a given class in the field is mapped as that class. Producers' accuracy may inform the producers of mapped data how easily a mapping class may be recognized on the imagery (Story and Congalton 1986, Lea and Curtis 2010).

A contingency table displaying the users' and producers' accuracy for the map is found in Table 3. Note that the table does not include fuzzy scores, only the numbers of assessed polygons. In some cases, the final call was to Alliance level, when in fact the mapper was only expected to map to Group level, such as for herbaceous types. If the mapper chose the correct Group in such a case, a full score would be given, though the assessment would not show up in Table 3 on the diagonal indicating a correct call.

Overall users' map accuracy was 81.7% and overall producers' accuracy was 83.5% (Table 4). In general, we consider accuracy results reportable for individual mapping classes with at least five samples. However, due to land access restrictions, it was not possible to get adequate numbers of AAs for all mapped types. A total of 43 map classes had fewer than five AAs, resulting in approximately 26% of all individual map types with reportable results for either users' or producers' accuracy (or both). For the reportable assessed map classes, the overall users' accuracy averaged 89% and producers' accuracy averaged 87%. **Since the preferred accuracy for fine-scale vegetation mapping products is 80%, the map exceeded the standard.** However, users should keep in mind that the accuracy of particular map classes with fewer than five samples may not meet this standard.

Table 3. Accuracy Assessment Contingency Table. Row headings are vegetation classes as mapped by the photointerpreters.
Column headings are classes as observed in the field. Entries in the table are the number of AA polygons. The diagonal indicates completely correct AAs. Users' (or commission) errors can be seen by reading across the table, showing how many polygons in each map class were incorrectly labeled. For example,one poly mapped as *Ceanothus cuneatus* Alliance is actually *Aesculus californica* Alliance
Producers' (omission) errors are read down the table, and show how many stands of a vegetation class were not mapped (missed).
For example, the sampled stand of *Ephedra nevadensis* Alliance was missed because it was incorrectly mapped as *Ambrosia dumosa* Alliance.
Note that the map was scored using closeness-of-fit or fuzzy logic rules, rather than simply right/wrong (see text).

	Observed Type in Field																																																										
Type Mapped	WVO	Aesculus californica	Quercus agrifolia	Quercus chrysolepis	Quercus douglasii	Quercus kelloggii	Quercus wislizeni tree	Juniperus californica	Pinus sabiniana	Pinus monophylla	Ailanthus altissima	Platanus racemosa	Salix laevigata	Forestiera pubescens	Sambucus nigra	RIS	Tamarix spp.	Ceanothus cuneatus	Cercocarpus betuloides	Eriogonum fasciculatum	Eriogonum wrightii	Hesperoyucca whipplei	Ericameria linearifolia-Peritoma arborea	Gutierrezia californica	Lotus scoparius	Lupinus albifrons	CFG	Artemisia dracunculus	CAI	Ribes quercetorum Prov.	Quercus john-tuckeri	WTM	Juncus arcticus (var. balticus, mexicanus)	NRW	DAM	Ambrosia dumosa	Ambrosia salsola	Atriplex polycarpa	Larrea tridentata	Larrea tridentata-Ambrosia dumosa	Eriogonum fasciculatum - Viguiera	Salazaria mexicana	Yucca brevifolia	Ephedra californica	Lepidospartum squamatum	Prunus fasciculata	Atriplex canescens	Encelia (actoni, virginensis)	Ericameria nauseosa	Ericameria teretifolia	Gutierrezia sarothrae	Artemisia tridentata	Ephedra nevadensis	Ephedra viridis	Grayia spinosa	Purshia tridentata	Achnatherum speciosum	Selaginella bigelovii	CRO	Grand Total
WVO					1																																																							1
Aesculus californica		5						1																																																				6
Quercus agrifolia					1																																																							1
Quercus chrysolepis				2			1																																																					3
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Encelia (actoni, virginensis)																																																1	1											2
Ericameria nauseosa																																																	3											3
Ericameria teretifolia																																																					3			1				4
Gutierrezia sarothrae																																										1						1											1	3
Artemisia tridentata																																																	1			4								5
Ephedra nevadensis																																									2												1		1					4
Ephedra viridis																																																						1						1
Grayia spinosa																																																												0
Purshia tridentata								1																																						1										2				4
Achnatherum speciosum																													1												1																1			3
Selaginella bigelovii																																																										1		1
CRO																													1																									1					3	5
Grand Total	0	6	0	2	4	1	2	6	4	3	3	1	5	0	1	0	1	5	4	7	2	6	12	0	1	1	1	1	3	6	7	0	1	0	1	0	0	3	3	2	4	2	2	2	5	4	2	3	6	0	0	4	6	4	7	3	1	1	4	165

Table 4. Users' and producers' polygon count and average closeness-of-fit (fuzzy) scores per map class, in order of the classification hierarchy (Appendix C).

Map Class	Users' Count	Users' Accuracy	Producers' Count	Producers' Accuracy
WVO: Californian Broadleaf Forest and Woodland Group	1	80.0	0	n/a
Aesculus californica Alliance	6	93.3	6	96.7
Quercus agrifolia Alliance	1	80.0	0	n/a
Quercus chrysolepis Alliance	3	93.3	2	100.0
Quercus douglasii Alliance	0	n/a	4	65.0
Quercus kelloggii Alliance	1	100.0	1	100.0
Quercus wislizeni tree Alliance	0	n/a	2	70.0
Juniperus californica Alliance	6	93.3	6	90.0
Pinus sabiniana Alliance	6	86.7	4	100.0
Pinus monophylla Alliance	2	100.0	3	86.7
Ailanthus altissima Semi-Natural Alliance	4	90.0	3	100.0
Platanus racemosa Alliance	0	n/a	1	80.0
Salix laevigata Alliance	6	96.7	5	100.0
Sambucus nigra Alliance		n/a	1	60.0
RIS: Southwestern North American Introduced Riparian Scrub Group	1	80.0	0	n/a
Tamarix spp. Semi-Natural Alliance	0	n/a	1	80.0
Ceanothus cuneatus Alliance	7	82.9	5	92.0
Cercocarpus montanus (betuloides) Alliance	5	84.0	4	90.0
Eriogonum fasciculatum Alliance	5	92.0	7	88.6
Eriogonum wrightii Alliance	4	85.0	2	100.0
Hesperoyucca whipplei Provisional Alliance	4	100.0	6	86.7
Ericameria linearifolia – Peritoma arborea Alliance	10	98.0	12	91.7
Gutierrezia californica Provisional Alliance	1	60.0	0	n/a
Lotus scoparius Alliance	2	10.0	1	60.0
Lupinus albifrons Alliance	1	100.0	1	100.0
CFG: California Annual Forb/Grass Vegetation Group	0	n/a	1	0.0
Artemisia dracunculus Alliance	1	60.0	1	60.0
CAI: Mediterranean California Naturalized Annual And Perennial Grassland Group	0	n/a	1	n/a

Map Class	Users' Count	Users' Accuracy	Producers' Count	Producers' Accuracy
Ribes quercetorum Provisional Alliance	6	96.7	6	96.7
Quercus john-tuckeri Alliance	6	90.0	7	94.3
WTM: Californian Warm Temperate Marsh/Seep Group	1	60.0	0	n/a
Juncus arcticus (var. *balticus, mexicanus*) Alliance	0	n/a	1	60.0
NRW: Naturalized Warm-Temperate Riparian and Wetland Group	1	60.0	0	n/a
DAM: Western North American Disturbed Alkaline Marsh and Meadow Group	1	100.0	1	100.0
Ambrosia dumosa Alliance	3	53.3	0	n/a
Ambrosia salsola Alliance	1	40.0	0	n/a
Atriplex polycarpa Alliance	4	95.0	3	100.0
Larrea tridentata Alliance	2	90.0	3	86.7
Larrea tridentata – Ambrosia dumosa Alliance	3	86.7	2	90.0
Eriogonum fasciculatum – (Viguiera parishii) Alliance	3	60.0	4	55.0
Salazaria (Scutellaria) mexicana Alliance	4	55.0	2	60.0
Yucca brevifolia Alliance	2	100.0	2	100.0
Ephedra californica Alliance	3	80.0	2	100.0
Lepidospartum squamatum Alliance	6	86.7	5	96.0
Prunus fasciculata Alliance	3	93.3	4	75.0
Atriplex canescens Alliance	4	75.0	2	100.0
Encelia (actoni, virginensis) Alliance	2	90.0	3	66.7
Ericameria nauseosa Alliance	3	100.0	6	80.0
Gutierrezia sarothrae Provisional Alliance	3	60.0	0	n/a
Ericameria teretifolia Alliance	4	60.0	0	n/a
Artemisia tridentata Alliance	5	96.0	4	100.0
Ephedra nevadensis Alliance	4	85.0	6	63.3
Ephedra viridis Alliance	1	100.0	4	70.0
Grayia spinosa Alliance	0	n/a	7	57.1
Purshia tridentata Alliance	4	85.0	3	80.0
Achnatherum (Stipa) speciosum Alliance	3	46.7	1	100.0
Selaginella bigelovii Alliance	1	100.0	1	100.0
CRO: Cliffs and Rock Outcrops	5	92.0	4	95.0
Mean Overall Accuracy		**81.7**		**83.5**

All map classes with ≥ 5 samples for users' accuracy met the 80% minimum standard. However, two types with ≥ 5 samples did not meet the standard for producers' accuracy: the *Ephedra nevadensis* Alliance and the *Grayia spinosa* Alliance. The *Ephedra nevadensis* Alliance was missed in 5 of 6 samples (with a closeness-of-fit score of 63.3%), in three cases it was mistaken for the *Ericameria teretifolia* Alliance, once as the *Eriogonum fasciculatum – (Viguiera parishii)* Alliance, and once as the *Ambrosia dumosa* Alliance. Photointerpreters missed the *Grayia spinosa* Alliance in all seven samples (with a closeness-of-fit score of 57.1%), mistaking it for the *Ambrosia dumosa*, *Ambrosia salsola*, *Eriogonum fasciculatum – (Viguiera parishii)*, *Salazaria (Scutellaria) mexicana*, and *Ephedra nevadensis* Alliances once each, and twice for the *Atriplex canescens* Alliance. Interestingly, the photointerpreters for the DRECP map, Aerial Information Systems, Inc., likewise had difficulties seeing these two desert shrub types in the imagery (VegCAMP and AIS 2013).

MAPPING RESULTS

Table 5 presents a summary of the polygons mapped and acres of each type after GIC made specific and systematic corrections based on the AA scores and reviewer's notes.

Table 5. Map classes, number of polygons mapped, and acres of each type mapped.

Map Class	Polygons mapped	Acres
WVO: Californian Broadleaf Forest and Woodland Group	2	10.9
Aesculus californica Alliance	60	441.5
Quercus chrysolepis Alliance	295	5833.6
Quercus douglasii Alliance	1329	30817.8
Quercus kelloggii Alliance	49	1313.6
Quercus lobata Alliance	94	999.6
Quercus wislizeni tree Alliance	847	16556.2
Juniperus californica Alliance	575	9173.2
Pinus sabiniana Alliance	202	1128.3
Abies concolor Alliance	2	13.3
Pinus monophylla Alliance	202	4044.3
IMF: Introduced North American Mediterranean Woodland And Forest Macrogroup	8	21.3
Ailanthus altissima Semi-Natural Alliance	6	24.4
Eucalyptus (globulus, camaldulensis) Semi-Natural Alliance	2	2.5

Map Class	Polygons mapped	Acres
Platanus racemosa Alliance	19	69.0
Populus fremontii Alliance	104	494.8
Salix gooddingii Alliance	5	22.6
Salix laevigata Alliance	73	292.8
Baccharis salicifolia Alliance	10	16.7
Celtis reticulata Provisional Alliance	3	3.8
Forestiera pubescens Alliance	9	17.0
Salix exigua Alliance	1	1.1
Salix lasiolepis Alliance	3	13.1
Sambucus nigra Alliance	3	4.2
Tamarix spp. Semi-Natural Alliance	26	80.0
CXC: Californian Xeric Chaparral Group	2	110.2
Arctostaphylos viscida Alliance	3	5.6
Ceanothus cuneatus Alliance	209	1230.9
Cercocarpus montanus (betuloides) Alliance	248	1810.8
Eriogonum fasciculatum Alliance	564	4063.7
Eriogonum wrightii Alliance	66	674.9
Hesperoyucca whipplei Provisional Alliance	160	849.8
CSS: Central and South Coastal California Seral Scrub Group	5	83.3
Ericameria linearifolia – Peritoma arborea Alliance	243	5175.2
Gutierrezia californica Provisional Alliance	3	11.9
Lotus scoparius Alliance	12	89.5
Lupinus albifrons Alliance	22	95.2
CFG: California Annual Forb/Grass Vegetation Group	1048	48805.5
Artemisia dracunculus Alliance	9	46.5
CAI: Mediterranean California Naturalized Annual And Perennial Grassland Group	324	5636.4
Centaurea (virgata) Provisional Semi-Natural Alliance	5	159.4
Prunus virginiana Provisional Alliance	3	12.3
Rhus trilobata Provisional Alliance	1	1.1
Ribes quercetorum Provisional Alliance	43	76.2
Toxicodendron diversilobum Alliance	8	27.3
Quercus john-tuckeri Alliance	104	2539.1
Ceanothus greggii Alliance	2	5.5
Schoenoplectus acutus Alliance	1	1.4
VPG: California Vernal Pool and Grassland Matrix	7	357.5
WTM: Californian Warm Temperate Marsh/Seep Group	3	11.7
Juncus arcticus (var. *balticus, mexicanus)* Alliance	6	74.0
NRW: Naturalized Warm-Temperate Riparian and Wetland Group	2	8.6

Map Class	Polygons mapped	Acres
Frankenia salina Alliance	4	132.6
Ambrosia dumosa Alliance	24	301.5
Ambrosia salsola Alliance	8	17.1
Atriplex polycarpa Alliance	62	1363.4
Larrea tridentata Alliance	22	118.2
Larrea tridentata – Ambrosia dumosa Alliance	14	1864.1
Eriogonum fasciculatum – (Viguiera parishii) Provisional Alliance	319	4445.8
Salazaria (Scutellaria) mexicana Alliance	49	202.9
Yucca brevifolia Alliance	77	636.0
Ephedra californica Alliance	17	284.9
Lepidospartum squamatum Alliance	91	974.2
Prunus fasciculata Alliance	103	538.0
Atriplex canescens Alliance	64	692.3
Encelia (actoni, virginensis) Alliance	27	149.5
Ericameria nauseosa Alliance	637	13797.5
Ericameria teretifolia Alliance	58	405.2
Gutierrezia sarothrae Provisional Alliance	7	16.4
Artemisia tridentata Alliance	198	801.5
Ephedra nevadensis Alliance	148	1011.8
Ephedra viridis Alliance	133	1336.8
Grayia spinosa Alliance	20	174.8
Lycium andersonii Alliance	7	13.8
Purshia tridentata Alliance	43	384.5
Achnatherum (Stipa) speciosum Alliance	43	752.0
Selaginella bigelovii Alliance	7	54.7
Ornamental Trees	21	73.7
AGR: Agriculture	29	14032.3
BGS: Bare Gravel and Sand	22	213.8
CRO: Cliffs and Rock Outcrops	72	234.5
QMG: Quarry, Mining, Gravel	24	1941.7
URB: Urban	63	9086.2
WAT: Water	10	82.5
Total	**9455**	**199493.0**

LOCATION OF DATA

Databases of Rapid Assessment, Relevé, Reconnaissance and Accuracy Assessment field surveys, original field survey forms, digital photos in cardinal directions for each sample for this project, and copies of landowner access permits are located in the offices of the Vegetation Classification and Mapping Program, California Department of Fish and Wildlife, Sacramento, California.

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Appendix A

Combined Rapid Assessment and Relevé Field Form

and Protocol

Combined Vegetation Rapid Assessment and Relevé Field Form

(Revised February 27, 2014 for Sonoma County, used for Tehachapi High Speed Rail Corridor Project)

For Office Use **Final database #:**	**Final vegetation type:**	**Alliance**_____ **Association**

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Database #:	**Date:**	**Name of recorder:**
TEHA		**Other surveyors:**

Allocation UID: _____ GPS name: _____ For Relevé: **Bearing°,** left axis at ID point_____ of **Long / Short** side

UTME ___ ___ ___ ___ ___ ___ **UTMN** ___ ___ ___ ___ ___ ___ ___ **Zone: 10 NAD83 PDOP_____**

GPS within stand? Yes / No If No, cite from GPS to stand: distance (m) _____ bearing ° _____ inclination ° _____
and record projected UTMs: UTME ____ ____ ____ ____ ____ ____ UTMN ____ ____ ____ ____ ____ ____

Camera Name: Cardinal photos at ID point:

Other photos:

Stand Size (acres)**: <1, 1-5, >5 | Plot Size (m²): 10 / 100 / 500 / 1000 | Plot Shape ___ x___** m **| RA Radius____** m

Exposure, Actual °: _____ NE NW SE SW Flat Variable All | Steepness, Actual °: _____ 0° 1-5° 5-25° > 25

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

Geology code: _____ Soil Texture code: _____ | 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: Litter: Bedrock: Boulder: Stone: Cobble: Gravel: Fines: =100%

% Current year bioturbation _____ Past bioturbation present? Yes / No | % Hoof punch _____

Fire evidence: Yes / No (circle one) If yes, describe in Site history section, including date of fire, if known.

Site history, stand age, comments:

Disturbance code / Intensity (L,M,H): _____/____ _____/____ _____/____ _____/____ _____/____ **"Other"** _____ / ____

II. HABITAT 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.)

III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: _____

Field-assessed association name (optional): _____

Adjacent alliances/direction: _____/_____, _____/_____

Confidence in alliance identification: L M H Explain: _____

Phenology (E,P,L**): Herb Shrub Tree Other identification or mapping information:**

Combined Vegetation Rapid Assessment and Relevé Field Form

(Revised February 27, 2014 for Sonoma County, used for Tehachapi High Speed Rail Corridor Project)

Database #: _____ SPECIES SHEET

IV. VEGETATION DESCRIPTION

% NonVasc cover:____ Total % Vasc Veg cover:_____

% Cover - **Conifer tree / Hardwood tree: _____/_____ Regenerating Tree: _____ Shrub: _____ Herbaceous: _____**

Height Class - Conifer tree / Hardwood tree: _____/_____ Regenerating Tree: _____ Shrub: _____ Herbaceous: _____

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

Stratum categories: T=Tree, S = Shrub, H= Herb, E = SEedling, A = SApling, N= Non-vascular/ **For relevés**: r=trace, + = <1%

Strata	Species	% cover	C	Final species determination

Unusual species: _____

PROTOCOL FOR COMBINED VEGETATION RAPID ASSESSMENT
AND RELEVÉ SAMPLING FIELD FORM
(February 27, 2014)

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. 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 not based on a plot, but for this project is based on a visually estimated circular area within a representative portion of the entire stand, with up to 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.

Defining a Stand:

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 a portion of a vernal pool, and some may be several square kilometers in size, such as forest types. All samples must be in stands that meet the minimum mapping unit of 1 acre for upland and 0.5 acre for special stands such as small wetlands, riparian and serpentine barrens.

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).

Selecting a bounded plot (relevé) or unbounded area (Rapid Assessment) to sample within a stand:

In all cases, determine if what you are going to sample is needed based on target sample size by referring to the alliance tracking sheet.

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 stand of vegetation, the main point 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.

In rapid assessments, you will collect data based on a visually estimated circular area with a minimum radius of 20 meters. If the shape of a stand is constrained as in a narrow riparian stringer or meadow, the dimensions of the focused assessment area may only approximate the maximum width of the stand (*e.g.,* only 5 or 10 m radius circle).

Selecting plots to avoid spatial autocorrelation:

When possible, do not sample adjacent stands. Do not sample vegetation types of the same type within the same sub-watershed. Exceptions can be made due to limited access to private lands.

Plot Size:

For this project, relevé plot sizes are as follows:

Herbaceous communities: 100 m^2

Special herbaceous communities, such as vernal pools, fens: 10 m^2

Shrublands, riparian forest/woodland, upland forest/woodland communities: 500 m^2

Plot Shape:

A relevé has no fixed shape, though plot shape should reflect the character of the stand and are either squares or rectangles. Adjust the orientation and dimensions of the plot to incorporate the best approximation of stand homogeneity. 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 from the plot.

Location of GPS Points:

For relevés, one corner will be considered the plot Identifier Point and should be in the SW corner, if possible. This point will be associated with the TEHAXXXX number from a series of provided numbered stickers. For Rapid Assessment, the point should be taken at the center of the assessed circular area.

Definitions of fields in the protocol

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Database #: Place a TEHAXXXX sticker in this field for all relevé (including allocated and opportunistic plots) and rapid assessments. Use the sticker number in the GPS Waypoint ID field.

Date: Date of the sampling.

Name of recorder: The full name of the recorder should be provided for the first field form for the day. On successive forms, initials can be recorded.

Other 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.

Allocation UID: Indicate the allocation point UID found on the GPS Unit or paper map.

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

Bearing°, left axis at ID point of Long / Short side: Fill this in for relevés only. For square or rectangular plots: from the Identifier Point corner, 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 square plots). If there are no stand constraints, set up the plot with boundaries running in the cardinal directions and place the Identifier Point in the SW corner.

UTM coordinates: Easting (UTME) and northing (UTMN) location coordinates using the Universal Transverse Mercator (UTM) grid. Record the information from your GPS unit. These coordinates are always the base point of the survey. Soil samples and photos are taken from this point, and exposure, steepness, topography, etc. are measured here. If the GPS is not within the stand (i.e., the point is projected), these are the UTMs of the base point.

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

PDOP: Record the PDOP from the GPS unit.

Is GPS within stand? Yes / No 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 the point is taken at the edge of the stand, note the direction to the stand.

If No, cite from GPS to stand: distance (m), bearing°, inclination°: From the base GPS point, measure the distance to the projected point using a range finder. Record the compass bearing from the base point to the projected point; record the inclination if the base and projected points are not at the same elevation.
and record projected UTMs: These are the coordinates of the projected point, or the point being surveyed. They are generated in the field if the GPS units have the ability to calculate projected points. If the GPS unit does not have this capability, make a note to that effect and leave these fields blank.

Camera Name: Write the camera name.

Cardinal photos at ID point: Take four photos in the main cardinal directions (N, E, S, W) clockwise from the north, from the Identifier Point and record the jpeg numbers here. Try to include the horizon in at least some of these photos. If this is a distance survey to a projected point, take the four cardinal photos at the base point and at least one photo of the stand.

Other photos: This may include cardinal photos at additional corners or other relevant photos. Notes regarding photo locations or subjects can go here.

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 in meters.

RA Radius: Enter radius of visually estimated sample area for rapid assessments (should be a 20 meter radius minimum)

Exposure: (Enter actual º and circle general category): While facing in the general downhill direction, 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 º and circle general category): Read degree slope from your compass. 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 top, upper (1/3 of slope), middle (1/3 of slope), lower (1/3 of slope), or bottom. **Circle *all* of the positions that apply for macrotopography.**

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 code: 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 code: 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 : Indicate if the stand is in upland or a wetland/riparian. (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). The total should sum to 100%. 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. Note that non-vascular cover (lichens, mosses, cryptobiotic crusts) is not estimated in this section.

% Water: Percent surface cover of running or standing water, ignoring the substrate below the water.
% BA Stems: Percent surface cover of the basal area of stems at the ground surface. 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 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, such as distribution of species. 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. See code list for impacts and definitions of levels of disturbance. Characterize each impact each as **L** (=Light), **M** (=Moderate), or **H** (=Heavy). Disturbance is evaluated on a stand basis.

II. HABITAT AND VEGETATION DESCRIPTION

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: Circle one of the tree size classes provided when the tree canopy closure exceeds 10 percent of the total cover, 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 or 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 toward the 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: Circle one of the shrub size classes provided when shrub canopy closure exceeds 10 percent (except in desert types) by recording which class 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: Circle one of the herb height classes when herbaceous cover exceeds 2 percent by recording the predominant class in the survey. Note*: This height class is based on the average plant height at maturity, not necessarily at the time of observation.*

INTERPRETATION OF STAND

Field-assessed vegetation alliance name: Enter the name of alliance following the Manual of California Vegetation, 2nd Edition (Sawyer, Keeler-Wolf and Evens 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.

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): Enter the name of the species in the alliance and additional dominant/diagnostic species from any strata. 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)*.

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. For herbs, this generally indicates if species are in flower and/or fruit and are therefore identifiable. For shrubs and trees, this attribute generally refers to cover, e.g., a tree that is fully leafed out will be considered peak (P) even if it is not in flower. Phenology is useful for cover estimation and species identification issues, and should be elaborated upon in the next field.

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.

Overall Cover of Vegetation

Provide an estimate of cover for the life-form categories below. 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 foliar cover for all categories below: consider how much of the sky you can see when you

are standing under the canopy of a tree, or how much light passes through the canopy of the shrub layer to help you estimate foliar cover.

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

% Vasc Veg cover: The total cover of all vascular vegetation taking into consideration the porosity, or the holes, in the vegetation, and disregarding overlap[1] of the various tree, shrub, and/or herbaceous layers and species.

% Cover by Layer

% Conifer Tree /Hardwood Tree: The total foliar cover (considering porosity) of all live tree species, disregarding overlap[1] 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[1] of individual recruits. See seedling and sapling definitions below.

%Shrub: The total foliar cover (considering porosity) of all live shrub species disregarding overlap[1] of individual shrubs.

%Herbaceous: The total cover (considering porosity) of all herbaceous species, disregarding overlap[1] of individual herbs.

Height Class by Layer

Modal height for conifer tree /hardwood tree, shrub, and herbaceous categories: 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 = <1/2 m, 02 = 1/2-1 m, 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 => 50 m. Note: *For the herbaceous layer height, this height class is based on the average plant height at the time of observation, as opposed to how this is recorded in the CWHR section (at maturity).*

Species List and Coverage

For rapid assessments, list up to 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.

[1] Porosity reduces the total cover of the canopy. Overlapping strata should not be included in the total cover percent; for instance, if a shrub is growing under a tree, only the cover of the tree will be added into the total; the cover of the shrub will be disregarded, except for the amount by which it fills in the porosity of the tree canopy.

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

For both sample types, provide the stratum:
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 < 1" dbh or has not reached breast height. Applies only to trees propagating from seed; resprouts are not recorded here even if they meet the size requirements.
A = SApling. 1" - <6" dbh and young in age, OR small trees that are <1" dbh, are clearly of appreciable age, and are kept short by repeated browsing, burning, or other disturbance. Includes trees that are re-sprouting from roots or stumps following fire, logging or other disturbance. These re-sprouts may exhibit a shrubby form, with multiple small trunks, but are species that are generally considered trees. If a majority of the trunks are >6" dbh, then the re-sprouts would be recorded under the "Tree" stratum.
N = Non-vascular. Includes moss, lichen, liverworts, hornworts, cryptogammic crust, 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 you're unsure of the strata for a species, call it what it is called in the MCV or, as a second choice, the Jepson Manual.

C: 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 except for dominant species that do not have ambiguous codes. If you aren't sure there aren't duplicate codes, don't use a code. 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 foliar cover for each species listed considering porosity. When estimating, it is often helpful to think of coverage in terms of the following cover intervals at first:

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

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. Use the code "SNAG." Note their species, if known, in the "Species" column (ie. SNAG – Quercus wislizeni).

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.

Also for relevés, record the <1% cover in one of two categories: r = trace (i.e., rare in plot, or solitary individuals) and + = <1% (few individuals at < 1% cover, but common in the plot).

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.

GEOLOGY CODE

IGTU	**Igneous (type unknown)**
MIIG	Mixed igneous
ULTU	Ultramafic (type unknown)
VOLC	General volcanic extrusives
ANDE	Andesite
ASHT	Ash (of any origin)
BASA	Basalt
DIAB	Diabase
OBSI	Obsidian
PUMI	Pumice
PYFL	Pyroclastic flow
RHYO	Rhyolite
VOFL	Volcanic flow
VOMU	Volcanic mud
INTR	General igneous intrusives
DIOR	Diorite
GABB	Gabbro
GRAN	Granitic (generic)
MONZ	Monzonite
PERI	Peridotite
QUDI	Quartz diorite
METU	**Metamorphic (type unknown)**
MIME	Mixed metamorphic
GREE	Greenstone
BLUE	Blue schist
FRME	Franciscan melange
GNBG	Gneiss/biotite gneiss
HORN	Hornfels
MARB	Marble
PHYL	Phyllite
SCHI	Schist
SESC	Semi-schist
SLAT	Slate
ULTU	Ultramafic (type unknown)
SERP	Serpentine
SETU	**Sedimentary (type unknown)**
BREC	Breccia (non-volcanic)
CACO	Calcareous conglomerate
CALU	Calcareous (origin unknown)
CASA	Calcareous sandstone
CASH	Calcareous shale
CASI	Calcareous siltstone
CHER	Chert
CONG	Conglomerate
DOLO	Dolomite
FANG	Fanglomerate
LIME	Limestone
MISE	Mixed sedimentary
SAND	Sandstone
SHAL	Shale
SILT	Siltstone
CLAL	Clayey alluvium
DUNE	Sand dunes
GLTI	Glacial till, mixed origin, moraine
GRAL	Gravelly alluvium
LALA	Large landslide (unconsolidated)
LOSS	Loess
MIAL	Mixed alluvium
SAAL	Sandy alluvium
SIAL	Silty alluvium
MIRT	Mix of two or more rock types
OTHE	Other than on list

ROCK SIZE

Boulder	> 60 cm diameter
Stone	25 cm to 60 cm
Cobble	7.5 cm to 25 cm
Gravel	2 mm to 7.5 cm
Fines	< 2 mm

DISTURBANCE CODES

01 Development
02 ORV activity
03 Agriculture
04 Grazing
05 Competition from exotics
06 Logging
07 Insufficient population/stand size
08 Altered flood/tidal regime
09 Mining
10 Hybridization
11 Groundwater pumping
12 Dam/inundation
13 Other
14 Surface water diversion
15 Road/trail construction/maint.
16 Biocides
17 Pollution
18 Unknown
19 Vandalism/dumping/litter
20 Foot traffic/trampling
21 Improper burning regime
22 Over collecting/poaching
23 Erosion/runoff
24 Altered thermal regime
25 Landfill
26 Degrading water quality
27 Wood cutting
28 Military operations
29 Recreational use (non ORV)
30 Nest parasitism
31 Non-native predators
32 Rip-rap, bank protection
33 Channelization (human caused)
34 Feral pigs
35 Burros
36 Rills
37 Phytogenic mounding
38 Sudden Oak Death

Simplified Key to Soil Texture
(Adapted from Brewer and McCann 1982)

Place about three teaspoons of soil in the palm of your hand. Take out any particles ≥ 3 mm in size.

A. Does soil remain in ball when squeezed in your hand palm?

Yes, soil does remain in a ball when squeezed..... **B**

No, soil does not remain in a ball when squeezed..... **sand**

SAND Sand (class unknown)
Very coarse texture……COSA Coarse sand
Moderately coarse texture…… MESN Medium sand
Moderately fine texture…….. FISN Fine sand

B. Add a small amount of water until the soil feels like putty. Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Does soil make a ribbon?

Yes, soil makes a ribbon; though it may be very short.....**C**

No, soil does not make a ribbon.....**loamy sand**
Very gritty with coarse particles….....COLS Coarse, loamy sand
Moderately to slightly gritty with medium to fine particles.....MELS Medium to very fine, loamy sand

C. Does ribbon extend more than one inch?

Yes, soil extends > 1 inch.....**D**

No, soil does not extend > 1 inch.....Add excess water

Soil feels gritty or not smooth…….. **sandy loam or loam**
LOAM Loam (class unknown)
Very gritty with coarse particles….....MCSL Moderately coarse, sandy loam
Moderately gritty with medium to fine particles.....MESA Medium to very fine, sandy loam
Slightly gritty .....MELO Medium loam

Soil feels very smooth.....**silt loam**
MESIL medium silt loam

D. Does ribbon extend more than 2 inches?

Yes, ribbon extends more than 2 inches, and does not crack if bent into a ring.....**E**

No, soil breaks when 1–2 inches long; cracks if bent into a ring……...Add excess water

Soil feels gritty or not smooth.....**sandy clay loam or clay loam**
Moderately to very gritty…….... MFSA Moderately fine sandy clay loam
Slightly gritty or not smooth……. MFCL Moderately fine clay loam

Soil feels very smooth.....**silty clay loam or silt**
Moderately fine texture……...MFSL Moderately fine silty clay loam
Very fine texture…….. MESI Medium silt

E. Soil makes a ribbon 2+ inches long; does not crack when bent into a ring.....Add excess water

Soil feels gritty or not smooth.....**sandy clay or clay**
Moderately to very gritty…… FISA Fine sandy clay
Slightly gritty or not smooth…….. FICL Fine clay
CLAY Clay (class unknown)

Soil feels very smooth.....**silty clay**
FISC Fine silty clay

UNKN = UNKNOWN PEAT = PEAT MUCK = MUCK

Appendix B

Reconnaissance Form

RECON FIELD FORM – TEHACHAPI CORRIDOR (May 8, 2014)

Date:	**Surveyors (circle recorder):** **Return?** □
Waypoint ID:	**Projected? Yes / No / Base / Digitized** If yes, enter **Base Waypoint ID**: **Bearing: _____(degrees) Distance: _____(meters) Inclination: _____(degrees)** Base UTMs / projected UTMs (circle one) UTME __ __ __ __ __ __ __ __ UTMN __ __ __ __ __ __ __ __ PDOP: +/-
Camera/Photos:	
Field alliance name:	Radius of obs.(m) _____
Joshua Tree cover:	(circle one) None <1% uneven dist. 1-5% with even dist. >5%
Notes: include information about the extent and homogeneity of the vegetation reconned and if possible corresponding signature on imagery	

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

Date:	**Surveyors (circle recorder):** **Return?** □
Waypoint ID:	**Projected? Yes / No / Base / Digitized** If yes, enter **Base Waypoint ID**: **Bearing: _____(degrees) Distance: _____(meters) Inclination: _____(degrees)** Base UTMs / projected UTMs (circle one) UTME __ __ __ __ __ __ __ __ UTMN __ __ __ __ __ __ __ __ PDOP: +/-
Camera/Photos:	
Field alliance name:	Radius of obs.(m) _____
Joshua Tree cover:	(circle one) None <1% uneven dist. 1-5% with even dist. >5%
Notes: include information about the extent and homogeneity of the vegetation reconned and if possible corresponding signature on imagery	

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

Appendix C

Classification Hierarchy with Additional Mapping Classes

Temperate Forest Subclass

California Forest and Woodland Macrogroup MG009

Californian Broadleaf Forest and Woodland Group (WVO)

Aesculus californica Alliance

Aesculus californica Association

Quercus chrysolepis tree Alliance

Quercus chrysolepis Association

Quercus chrysolepis – Aesculus californica Provisional Association

Quercus chrysolepis – Quercus kelloggii / (Toxicodendron diversilobum) Association

Quercus chrysolepis – Quercus wislizeni Association

Quercus douglasii Alliance

Quercus douglasii / Ceanothus cuneatus Association

Quercus douglasii / Eriogonum fasciculatum / herbaceous Association

Quercus douglasii / grass Association

Quercus douglasii – Aesculus californicus / grass Association

Quercus douglasii – Pinus sabiniana / Artemisia tridentata Provisional Association

Quercus douglasii – Pinus sabiniana / Ericameria nauseosa Provisional Association

Quercus kelloggii Alliance

Quercus lobata Alliance

Quercus lobata / grass Association

Quercus lobata – Quercus wislizeni Association

Quercus wislizeni tree Alliance

Quercus wislizeni – Aesculus californica Association

Quercus wislizeni – Cercocarpus betuloides Association

Quercus wislizeni – Quercus douglasii – Pinus sabiniana / (grass) Association

Californian Evergreen Coniferous Forest and Woodland Group (ECW)

Juniperus californica Alliance

Juniperus californica / Eriogonum fasciculatum Provisional Association

Juniperus californica / Purshia tridentata Provisional Association

Pinus sabiniana Alliance

Pinus sabiniana / grass Association

Californian–Vancouverian Montane and Foothill Forest MG023

Californian Montane Conifer Forest Group (CMF)

Abies concolor Alliance

Intermountain Basins Pinyon–Juniper Macrogroup Woodland MG026

Western Great Basin Montane Conifer Woodland Group (MCW)

Pinus monophylla Alliance

Pinus monophylla – Juniperus californica / Artemisia tridentata – Coleogyne ramosissima Association

Pinus monophylla / Quercus john-tuckeri Provisional Association

Introduced North American Mediterranean woodland and forest Macrogroup MG027

Introduced North American Mediterranean Woodland and Forest Group (IMF)

Ailanthus altissima Semi-Natural Alliance

Eucalyptus (globulus, camaldulensis) Semi-Natural Alliance

Southwestern North American Riparian, Flooded and Swamp Forest/Scrubland Macrogroup MG036

Southwestern North American Riparian Evergreen and Deciduous Woodland Group (RWF)

Platanus racemosa Alliance

Platanus racemosa – Populus fremontii Association

Populus fremontii Alliance

Populus fremontii – Salix laevigata Association

Salix gooddingii Alliance

Quercus lobata Riparian Alliance
Quercus lobata / Salix lasiolepis Association
Salix laevigata Alliance
Salix laevigata Association
Salix laevigata / Salix lasiolepis Association
Southwestern North American Riparian/Wash Scrub Group (RWS)
Baccharis salicifolia Alliance
Baccharis salicifolia Association
Celtis reticulata Provisional Alliance
Forestiera pubescens Alliance
Salix exigua Alliance
Salix lasiolepis Alliance
Salix lasiolepis Association
Sambucus nigra Alliance
Southwestern North American Introduced Riparian Scrub Group (RIS)
Tamarix spp. Semi-Natural Alliance

Mediterranean Scrub and Grassland Subclass

California Chaparral Macrogroup MG043
Californian Xeric Chaparral Group (CXC)
Arctostaphylos viscida Alliance
Ceanothus cuneatus Alliance
Ceanothus cuneatus Association
Californian Mesic Chaparral Group (CMC)
Cercocarpus montanus (betuloides) Alliance
Cercocarpus montanus (betuloides) / Juniperus californica Association
Cercocarpus montanus (betuloides) – Eriogonum fasciculatum Association
Californian Pre-montane Chaparral Group (PMC)
Ceanothus leucodermis Alliance
Ceanothus leucodermis Association

California Coastal Scrub Macrogroup MG044
Central and South Coastal Californian Coastal Sage Scrub Group (CCS)
Eriogonum fasciculatum Alliance
Eriogonum fasciculatum Association
Eriogonum fasciculatum var. foliolosum – Hesperoyucca whipplei Association
Eriogonum wrightii Alliance
Hesperoyucca whipplei Provisional Alliance
Central and South Coastal California Seral Scrub Group (CSS)
Corethrogyne filaginifolia Provisional Alliance
Ericameria linearifolia – Peritoma arborea Alliance
Peritoma arborea Provisional Association
Gutierrezia californica Provisional Alliance
Gutierrezia californica / Annual – perennial grass – herb Provisional Association
Isocoma acradenia Provisional Alliance
Isocoma acradenia Provisional Association
Lotus scoparius Alliance
Lupinus albifrons Alliance

California Annual and Perennial Grassland Macrogroup MG045
California Annual Forb/Grass Vegetation Group (CFG)
Amsinckia (menziesii, tessellata) Alliance

Phacelia spp. Provisional Association
Holocarpha (heermannii, virgata) Provisional Alliance
Holocarpha heermannii Provisional Association
Artemisia dracunculus Alliance
Eschscholzia (californica) Alliance
Lasthenia californica – Plantago erecta – Vulpia microstachys Alliance
Mediterranean California Naturalized Annual and Perennial Grassland Group (CAI)
Centaurea (virgata) Provisional Semi-Natural Alliance
Acroptilon repens Provisional Semi-Natural Association

Temperate and Boreal Shrubland and Grassland Subclass

Western North American Temperate Grassland and Meadow Macrogroup MG048
Western Dry Upland Perennial Grassland Group (DUP)
Poa secunda Alliance
Poa secunda ssp. *secunda* Association

Western Cordilleran Montane Shrubland and Grassland Macrogroup MG049
Western Cordilleran Montane Deciduous Scrub Group (MDS)
Prunus virginiana Provisional Alliance
Rhus trilobata Provisional Alliance
Ribes quercetorum Provisional Alliance
Ribes quercetorum Provisional Association

Vancouverian Lowland Grassland and Shrubland Macrogroup MG050
Vancouverian Coastal Deciduous Scrub Group (VCS)
Toxicodendron diversilobum Alliance
Toxicodendron diversilobum / herbaceous Association

Warm Interior Chaparral Macrogroup MG051
Western Mojave and Western Sonoran Desert Borderland Chaparral Group (MSC)
Quercus john-tuckeri Alliance
Quercus john-tuckeri / Pinus monophylla – Pinus sabiniana Provisional Association
Quercus john-tuckeri / Juniperus californica / Ericameria linearifolia Association
Mogollan Rim Chaparral Group (MRC)
Ceanothus greggii Alliance

Western North American Freshwater Marsh Macrogroup MG073
Arid West Freshwater Emergent Marsh Group (FEM)
Schoenoplectus acutus Alliance
Schoenoplectus acutus Association
Typha (angustifolia, domingensis, latifolia) Alliance

Western North American Vernal Pool Macrogroup MG074
California Vernal Pool and Grassland Matrix Mapping Unit (VPG)

Western North America Wet Meadow and Low Shrub Carr Macrogroup MG075
Californian Warm Temperate Marsh/Seep Group (WTM)
Carex densa Provisional Alliance
*Juncus arcticus (*var. *balticus, mexicanus)* Alliance
Juncus arcticus var. *balticus – Carex praegracilis* Association
Leymus triticoides Alliance
Leymus triticoides Association
Mimulus guttatus Alliance
Mimulus guttatus Association
Naturalized Warm-Temperate Riparian and Wetland Group (NRW)
Persicaria lapathifolia – Xanthium strumarium Provisional Alliance

North American Pacific Coastal Salt Marsh Macrogroup MG081
Temperate Pacific Tidal Salt and Brackish Meadow Group (TBM)
Distichlis spicata Alliance
Distichlis spicata – annual grasses Association
Western North American Disturbed Alkaline Marsh and Meadow Group (DAM)
Warm Semi-Desert/Mediterranean Alkali–Saline Wetland Macrogroup MG083
Southwestern North American Alkali Marsh/Seep Vegetation Group (SAM)
Eleocharis rostellata Provisional Alliance
Eleocharis rostellata Provisional Association
Southwestern North American Salt Basin and High Marsh Group (SSB)
Frankenia salina Alliance
Frankenia salina Association

Warm Semi-Desert Scrub and Grassland Subclass
Mojavean–Sonoran Desert Scrub Macrogroup MG088
Lower Bajada and Fan Mojavean–Sonoran Desert Scrub Group (LDS)
Ambrosia dumosa Alliance
Ambrosia dumosa Association
Ambrosia salsola Alliance
Ambrosia salsola Association
Atriplex polycarpa Alliance
Atriplex polycarpa Association
Larrea tridentata Alliance
Larrea tridentata – Ambrosia dumosa Alliance
Larrea tridentata – Ambrosia dumosa – Eriogonum fasciculatum Association
Mojavean Upper Desert Scrub Group (UDS)
Eriogonum fasciculatum – (Viguiera parishii) Provisional Alliance
Eriogonum fasciculatum – Ephedra nevadensis Provisional Association
Salazaria (Scutellaria) mexicana Alliance
Salazaria (Scutellaria) mexicana Association
Yucca brevifolia Alliance
Yucca brevifolia / Ephedra nevadensis Association
Madrean Warm Semi-Desert Wash Woodland/Scrub Macrogroup MG092
Mojavean Semi-Desert Wash Scrub Group (MWS)
Ephedra californica Alliance
Lepidospartum squamatum Alliance
Lepidospartum squamatum / Amsinckia menziesii Association
Lepidospartum squamatum / ephemeral annuals Association
Prunus fasciculata Alliance
Prunus fasciculata Association
Sonoran-Coloradan Semi-Desert Wash Woodland/Scrub Group (DWS)
Prosopis glandulosa Alliance

Cool Semi-Desert Scrub and Grassland Subclass
Cool Semi-Desert Alkali-Saline Flats Macrogroup MG093
Shadscale-Saltbush Cool Semi-Desert Scrub Group (SSS)
Atriplex canescens Alliance
Cool Semi-desert wash and disturbance scrub Macrogroup MG095
Intermontane Seral Shrubland Group (ISS)
Encelia (actoni, virginensis) Alliance

Encelia virginensis Association
Ericameria cooperi Provisional Alliance
Ericameria nauseosa Alliance
Ericameria teretifolia Alliance
Ericameria teretifolia Association
Gutierrezia sarothrae Provisional Alliance
Western North America Tall Sage Shrubland and Steppe Macrogroup MG096
Inter-Mountain West Mesic Tall Sagebrush Shrubland and Steppe Group (TSS)
Artemisia tridentata Alliance
Artemisia tridentata – Ericameria nauseosa Association
Inter-Mountain Dry Shrubland and Grassland Macrogroup MG098
Intermontane Deep or Well-drained Soil Scrub Group (IDS)
Ephedra nevadensis Alliance
Ephedra nevadensis – Salazaria (Scutellaria) mexicana Association
Ephedra viridis Alliance
Grayia spinosa Alliance
Grayia spinosa – Larrea tridentata Association
Lycium andersonii Alliance
Lycium andersonii Provisional Association
Intermountain Shallow/Calcareous Soil Scrub Group (SCS)
Purshia tridentata Alliance
Southern Great Basin Semi-Desert Grassland Group (SDG)
Achnatherum (Stipa) speciosum Alliance
Achnatherum (Stipa) speciosum Association

Mediterranean, Temperate, and Boreal Nonvascular and Sparse Vegetation Subclass
California Cliff, Scree, and Other Rock Vegetation Macrogroup MG110
Central California Coast Ranges Cliff and Canyon Group (CCC)
Selaginella bigelovii Alliance

Semi-Desert Nonvascular and Sparse Vascular Vegetation Subclass
North American Warm Semi-Desert Cliff, Scree, and Other Rock Vegetation Macrogroup MG117
North American Warm Desert Bedrock Cliff and Outcrop Group (DCO)
Eriogonum (clavatum, inflatum) Provisional Alliance

Herbaceous and Woody Developed Vegetation Subclass
Tree Developed Vegetation Macrogroup CGR040
Temperate Tree Developed Vegetation Group
Ornamental Trees

Appendix D

Accuracy Assessment Form

and Protocol

Accuracy Assessment, TEHA Fine Scale (03/18/2015)

Surveyors (circle recorder)**:**		**Date:**
Waypoint ID: **Polygon UID:**	**GPSname: Projected? Yes / No / Base / Digitized** If projected or digitized, enter base Waypoint ID: **Bearing: _____(degrees) Distance: _____ (meters)** Base UTMs / projected UTMs (circle one) UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ PDOP: +/-	

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)		
Alliance		
Map Unit (group code and name)		
Camera/Photos		
Tree Height	2-5m 5-10m 10-15m >15m NA	
Tree Size (dbh)	<1"dbh 1-6"dbh 6-11"dbh 11-24"dbh >24"dbh multi-layered NA	
Hardwood Cover: _____% Conifer Cover: _____% Total Tree Cover: _____% Shrub Cover: _____%		
Joshua Tree Cover	None or not observable 0-1% 1-5% >5% NA	
Herb Cover	<2% 2-9% 10-39% 40-59% >59% >40% Woody	
	Total Cover: _____%	
Isolated Tree	Yes (tree cover <5%) NA	
Clearing Disturbance	<5% 5-25% 25-50% >50%	
Invasive Plants (absolute cover)	<5% 5-25% 25-50% >50%	
Restoration	No Yes	
Estimated area of identifiable vegetation viewed	Radius (m) _____ or rough % of polygon viewed from point _____	
Linework ok	Only 1 vegetation type in this polygon	Vegetation change since imagery taken

Accuracy Assessment Protocol
Tehachapi Pass Corridor
03/19/2015

This protocol describes accuracy assessment (AA) data collection procedures. The primary purpose of the AA fieldwork is to supply data to test the accuracy of a specific vegetation map. The information collected can also contribute additional data for the classification of vegetation communities. The primary sampling units are the vegetation polygons delineated by photo-interpreters in the creation of the vegetation map.

If an entire AA polygon cannot be fully investigated due to terrain or other reasons, as much of the polygon as can be evaluated should be assessed.

Note that a delineated polygon may differ from the conventional definition of a stand of vegetation. It may lump more than one stand type into a single mapping unit or alliance. A stand is the basic physical unit of vegetation in a landscape. It has no set size. Some stands of vegetation are very small while some may be several square kilometers in size. 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.

Selecting a location to sample within a polygon (for subsamples only):

Because many polygons 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 may be forced to select a representative portion to sample.

When taking a subsample, the main point to remember is to select an area that, in as many ways possible, is representative of that polygon. 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 polygon.

Selecting an assessment site requires that you see enough of the polygon you are sampling to feel comfortable in choosing a representative plot location. If possible, take a brief walk through the polygon and figure out where the boundary lines are drawn. Look for variations in species composition and in stand structure. In the process, decide whether the polygon includes more than one mappable vegetation type or if the stand boundaries don't seem to match up with the polygon delineation. If more than one vegetation type is present, fill out an AA form for each mappable vegetation type. Small variations in vegetation that are repeated throughout the polygon should be included in your subsample. Once you assess the variation within the

polygon, attempt to find an area that captures the stand's species composition and structural condition to sample.

How to enter fields on the form:

Surveyors: Use initials for each person assisting on the assessment. If someone is present who is not a normal member of the field personnel, their full name should be used. The person recording the data on the form should circle their initials.

Date: Enter the date the AA point was sampled. Use the standard U.S. format of "month-day-year" or use letters to write out the month.

Waypoint ID: Record the waypoint number assigned by the Juno when marking and storing a waypoint for the sample location.

Note that the GPS point should be taken away from the edge of the polygon, and near the center of the subsample (if one is used).

Polygon UID: Record the unique identifier (UID) assigned to each polygon, included in the Juno data and on paper maps.

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

Projected? Yes / No/ Base/ Digitized Circle "Yes" to denote that the GPS waypoint was taken within the boundary of the polygon being assessed (it should be taken well within the boundary, to insure that the point will fall within the stand when mapped, accounting for GPS error). Circle "No" if the waypoint was taken at a distance from the stand (such as with a binocular view of the stand). Circle "Base" if the point is projected and enter the Base waypoint ID and UTMS. If entering the projected UTMs, circle "projected UTMs." If the point is digitized with the Juno, circle "Digitized" and also enter base ID to record where you are standing.

If No, record:

Distance (m): the distance in meters to the center of the polygon view from the GPS point using a rangefinder.

Bearing (degrees): the compass bearing from the GPS point to the center of the polygon view.

UTM coordinates: Record the Northing (UTMN) and easting (UTME) location coordinates using the Universal Transverse Mercator (UTM) grid as recorded by the Juno. Circle whether the UTMs are for a base or projected point.

PDOP: Record the PDOP from the Juno. It is typical for commercial GPS units to be accurate with a pdop value of 1 to 5. The lower the error number, the more accurate the GPS reading.

Species list and coverage

List up to 12 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.

Provide the stratum where:

T = Overstory 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.
N = Non-vascular Includes mosses, liverworts, hornworts, and algae.

Be consistent and don't break up a single species into two separate strata. Here is a list of a few species that can be ambiguous:

> ***Quercus wislizeni*** = If it is regenerating after a fire or disturbance call it an understory tree (U). Otherwise call it a Tree (T).
> ***Sambucus nigra*** = Shrub (S)
> ***Phoradendron* spp.** = Shrub (S)

If a species collection is made, it should be indicated in the fourth column with a "C" (for collected). If the species is later keyed out, the data sheet needs to be updated with the proper species name. If the specimen is then thrown out, the "C" in the collection column should be erased. 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.

All species percent covers may total over 100% because of overlap.

Notes: Describe the stand age or 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 or mining. Examples of other site factors: exposed rocks, soil with fine-textured sediments, high litter or duff build-up, multi-storied vegetation structure, or other stand dynamics. Include any recommendations for line-work revision. Record notes on the discernibility of the vegetation based on phenology or other factors, problems with interpretation of the classification, homogeneity of the vegetation, and or any unusual sightings of rare plants or animals.

Alliance Name: Assign the best-fitting name for the vegetation within the polygon, using the key.

Map Unit (group code and name): Enter the map unit and group code here*.*

Camera/Photos: Write in the identifier for the camera used. Write the 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.* Make sure to take additional photos of the general composition of the stand if the cardinal photos do not do an adequate job (also noting the general direction the photos were taken, e.g., NE).

Tree Height: Circle the height range of the modal tree height, or NA if there are no trees.

Tree Size: Circle the dbh range as appropriate. 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. Stands in the "multi-layered" class need also to contain at least 10%

cover of size class >24” dbh trees growing over a distinct layer with at least 10% combined cover of trees in size classes 6-11” and 11-24”.

Overall cover of vegetation
Provide an estimate of cover for the following categories below (based on functional life forms) to the nearest 1%. Your percent cover estimates should take into consideration the porosity of the canopy. Litter/duff should not be included in these estimates.

Hardwood Cover: The total aerial cover (canopy closure) of all live hardwood tree species that are present (overstory, emergent, or understory), disregarding overlap of individual trees.

Conifer Cover: The total aerial cover (canopy closure) of all live conifer tree species that are present (overstory, emergent, or understory), disregarding overlap of individual trees.

Joshua Tree Cover: Circle the appropriate cover class representing the total aerial cover (canopy closure) of all live Joshua trees that are present (overstory, emergent, or understory), disregarding overlap of individual trees.

Total Tree Cover: The total aerial cover (canopy closure) of all live conifer and hardwood tree species that are present (overstory, emergent, or understory), disregarding overlap of individual trees.

Shrub Cover: The total aerial cover (canopy closure) of all live shrub species disregarding overlap of individual shrubs and the canopy above the shrub layer.

Herb Cover: Circle the appropriate cover class representing the total aerial cover (canopy closure) of all herbaceous species, disregarding overlap of individual herbs and the herbs hidden from view by woody plants, in the cover classes.

Total Cover: Enter the total aerial cover of all vascular vegetation. This is an estimate of the absolute vegetation cover, disregarding overlap of the various tree, shrub, and/or herbaceous layers and species. It is possible that this will be a higher number than the sum of the three layers, since the total cover includes some of the herb and shrub layer that may be indistinct in an aerial view, but actually would be seen through the pores of the upper canopy.

Isolated Tree: Circle yes if the vegetation is not a tree type but contains isolated trees that make up less than 5% cover.

Clearing Disturbance: Circle the class representing how much of the polygon has been cleared for roads, trails, disking or scraping.

Invasive Plants: Circle the class representing the absolute cover of invasive plants within the polygon.

Restoration: Circle “No” if it the polygon shows no sign of being a restoration site; circle “yes” otherwise.

Estimated area of identifiable vegetation viewed: Enter the radius in meters of the area around your GPS point that you were able to assess within the polygon, or enter a rough estimate of the percent of the polygon that you were able to assess from your point AND additional area that you were able to view while driving or walking around or through the polygon.

Linework ok: Check the box if the photo-interpreters did a good job of drawing a boundary line that surrounds a distinct vegetation type. Examples for which you would *not* check the box

include situations where there is more than one type of mappable vegetation within the polygon, when a portion of the boundary includes part of an adjacent stand, or when the stand continues beyond the polygon boundary. If not checked, provide comments in the Notes section to explain.

Only 1 vegetation type in this polygon: Check if there is only one vegetation type within the polygon. If the polygon includes more than one mappable type, provide the additional types in the Notes section. If these other types are smaller than the MMU, and therefore would not be expected to be mapped, note that as well.

Vegetation change since imagery taken: Check the box if the vegetation in the polygon has changed since the aerial imagery used as the base of the vegetation map was taken. If yes, provide notes in the Notes section on how the vegetation has changed (for example: burned, developed, visible dominance change over time).