

Vegetation preserve-level mapping protocol

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Purpose

Vegetation maps are a fundamental tool for conservation science and management. They are integral to planning restoration projects, monitoring species and habitats, modeling species range or movement, and identifying management issues. A review of the need for standardized vegetation maps can be found in:

- California State University Northridge Center for Geographical Studies. *A Shared Vision for the Survey for California Vegetation*.
<https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=114778&inline>.

Vegetation mapping can be completed at different levels or scales depending on the purpose of the map. Large-scale mapping tends to use broad categories to understand large changes over time and map the distribution of resources. In coordination with this mapping effort, remote sensing models will be used to map Group level communities. This document will focus on preserve-level mapping protocols.

Overview

This protocol is designed to create small-scale mapping, on a preserve level, in order to target management of habitats, identify important vegetation communities that may get missed in large-scale mapping, and inventory plant communities to Alliance and Association levels.

This map will use the Vegetation Classification Manual (VCM) for Western San Diego County (link in materials list). This classification system is standardized with the State of California's Survey of California Vegetation (SCV) and the National Vegetation Classification Standard (NVCS). This classification system was completed in 2011 and describes plant communities in the western portions of San Diego County. An update with additional classes in the foothills and mountains is in progress with the Vegetation Classification and Mapping Program (VegCAMP), part of California Department of Fish and Wildlife (CDFW).

Preserve-level maps should focus on updating existing mapping. The most recent large-scale mapping effort, using this classification, was completed in 2014 (based on 2012 imagery). If the target preserve is not included in the mapping extent in 2014, a map of the most recent vegetation for all of San Diego County can be used. This map uses the Holland code classification system and methods varied.

Download links for existing vegetation maps:

- AECOM 2012:
https://sdmmp.com/view_article.php?cid=SDMMP_CID_71_630f856fa84cc
- County of San Diego (Holland)
https://sdmmp.com/view_article.php?cid=SDMMP_CID_71_60904b2f1a54e.

This protocol was developed using the following list of sources. It is intended to use methods that are efficient but identify important information and align with other regional and State efforts.

- Vegetation Classification and Mapping Program (VegCAMP). Oct 29, 2025. Survey of California Vegetation Classification and Mapping Standards.
[https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fnm.dfg.ca.gov%2FFileHandler.ashx%3FDocumentID%3D102342%26inline&wdOrigin=BROWS
ELINK](https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fnm.dfg.ca.gov%2FFileHandler.ashx%3FDocumentID%3D102342%26inline&wdOrigin=BROWS%20ELINK)
- National Park Service. 2013. Vegetation Classification Guidelines: National Park Service Vegetation Inventory, Version 2.0. Natural Resource Report NPS/NPC/NRR-2011/374
- Aerial Information Systems, Inc. (AIS). 2019. 2015-2018 Vegetation Photo Interpretation and Mapping of Marine Corps Base Camp Pendleton, San Diego County, California.
- AECOM. 2019. Vegetation Classification Report for Marine Corps Base Camp Pendleton with Vegetation Key, Crosswalk, and Descriptions. Prepared for MCI West-Marine Corps Base Camp Pendleton Environmental Security Department Land Management Section.
- Menke, J., E. Reyes, A. Hepburn, D. Johnson, and J. Reyes. 2016. California Vegetation Map in Support of the Desert Renewable Energy Conservation Plan (2014-2016 Additions). Final Report. Prepared for the California Department of Fish and Wildlife Renewable Energy Program and the California Energy Commission. Aerial Information Systems, Inc., Redlands, CA.

Methods overview:

Older vegetation maps are available for all open space areas in San Diego County so this method focuses on updating maps, including updating boundaries of polygons and updating the classification due to either a change in vegetation on the ground or an update from Holland to the VCM system. Updates to the map may also be required because of differences in the minimum mapping unit used previously or a change in methods. Additional information can be added to the map, as needed. VegCAMP recommends a number of attributes be included, although many are optional.

Required attribute data:

- Vegetation group, alliance, and association
- Survey Date
- Surveyor's names and affiliation
- Data source (if taken from an outside source)
- Mapping method (see list below)
- Date of imagery used (record only if imagery was the only source for mapping)

Optional data (recommended to align with VegCAMP State-wide mapping efforts):

Some of this information may be obtained from aerial images after field collection

- Total tree cover*
- Total shrub cover
- Total forb cover
- Total grass cover
- Non-native species cover
- Roadedness category (categories listed below)
- Clearing (or anthropogenic alteration) category (categories listed below)
 - Notes about clearing type (i.e. restoration, grading, etc)
- Land use category (categories listed below)
- Development score (categories listed below)
- Hydrologic modification category (categories listed below)
- Recent fire evidence (yes or no if there is evidence)
 - Record the year of the most recent fire. This information should come from regional fire boundaries.

*"All vegetation cover is reported as absolute percent cover in a bird's-eye view. This equates to the cover of each layer that can be seen (i.e., that is not covered by a higher layer). Cover also takes porosity into account. This means that if conifer canopies cover 10% of the stand, but are themselves only 50% opaque to the ground, then the cover estimate should be 5%." (Quoted from VegCAMP)

Polygon delineation

Polygons of homogeneous vegetation communities should be updated from the existing maps. The minimum mapping unit is an important consideration when deciding to combine or divide polygons. VegCAMP allows for different minimum mapping units based on the project's needs. For recent mapping in Camp Pendelton, AECOM and AIS used "**1 acre for upland vegetation, and ¼ acre for riparian, wetlands, and water**". If a different minimum mapping unit from this recommendation was used, it should be noted in the metadata.

When polygons are below the minimum mapping unit, some rules for aggregating polygons are listed below (quoted from VegCAMP). For the full VegCAMP document, see: <https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fnrms.dfg.ca.gov%2FFileHandler.ashx%3FDocumentID%3D102342%26inline&wdOrigin=BROWSELINK>.

“(1) A below-MMU vegetation unit that is completely surrounded by another vegetation type is aggregated with the surrounding type.

(2) Similar growth forms are combined when possible: tree-dominated types are aggregated with other tree-dominated types, shrub types with other shrub types, and herbaceous types with other herbaceous types.

(3) If a below-MMU vegetation unit is the same growth form as two adjacent larger stands, and the adjacent stand types are very dissimilar in environment, the unit may be aggregated with the more environmentally similar type.

(4) Whenever possible, wetland vegetation types are not aggregated with upland types, even if they are in the same growth form.”

Some rules for dividing polygons are listed below (quoted from VegCAMP):

(1) “A polygon of a single vegetation map unit should be divided into smaller polygons based upon a change in cover class. Even though cover is attributed in 1% increments, the recommended cover classes to be used for dividing polygons of woody vegetation are the Braun-Blanquet categories (1=<1%, 2=1-5%, 3=>5-15%, 4=>15-25%, 5=>25-50%, 6=>50-75%, 7=>75%). The cover classes used to determine divisions of herbaceous vegetation are: <2%, 2-9%, 10-40%, >40%.”

(2) Overstory cover break

- a. Break a polygon on overstory cover if there is a change in cover class of the dominant/nominal layer. For example, if the vegetation is shrub-dominated, a change in cover class of the shrub layer is reason for a polygon division.
- b. For projects with a 1-acre MMU, there is typically a 3-acre MMU for a break in the overstory cover, i.e., the resulting polygons must be at least 3 acres in size.

(3) Understory and emergent cover break

- a. Break a polygon on understory cover or the emergent overstory cover if there is a change in cover class of the understory or emergent overstory layers. For example, if the vegetation is tree-dominated, a change in cover class of the shrub layer or a cover class break in the herbaceous layer as in (hi.) above is reason for a polygon division. Or, if the vegetation is shrub-dominated, a change in the cover class of the emergent tree layer (i.e. <1% to 1-5%) as in above is reason for a polygon division.

- b. For projects with a 1-acre MMU, there is typically a 5-acre MMU for a cover class break in the understory or emergent overstory layers. Again, MMUs have varied between the desert and other parts of the state.
 - c. Height and size class break for tree types, unless these have been modeled after mapping.
- (4) Break a polygon on tree height if there is a change in the height class or CWHR size class of the tree layer.
- a. For projects with a 1-acre MMU, there is typically a 3-acre MMU for a break in tree height or size class.”

Biosecurity considerations

Clean boots and equipment between sites to prevent the spread of invasive plants or pathogens. More information on Best Management Practices can be found here:

<https://www.cal-ipc.org/resources/library/publications/landmanagers/>.

Before you go in the field:

- Download map of existing 2012 vegetation mapping (or most recent for target preserve)
- Identify the preserve and areas within the preserve for the current field day
 - It may be useful to break the preserve into a grid and target certain grids in a day
- Create maps in a digital form or to be printed for the field (examples at the end)
- Identify access points and trails in target areas
- Obtain access and gate keys, if needed

Required equipment:

- Digital or printed maps with existing vegetation polygons
- GPS or device with embedded GPS
- Pen/marker
- Vegetation manual (PDF or printed)
 - AECOM. 2011. Vegetation Classification Manual for Western San Diego County. https://sdmmp.com/view_article.php?cid=CID_201604011922_50.
- Binoculars
- Plant identification tools (if needed)
- Biosecurity equipment (if needed)

Field methods:

- Print out large paper maps with aerial, latest vegetation map outlines and labels, large grid to organize planning

- Set up Fieldmaps or device with online map and GPS
- Walk all trails, find vantage points
- Correct alliance/association from existing map
 - Focus on top 5 most dominant plants in a homogeneous region in order to key vegetation
- Adjust lines of boundaries on paper maps
- Once you are back in the office, digitize notes from the field and finalize polygon layer
- Add in additional VegCAMP fields from aerial imagery
- QAQC topology and attributes

Description of optional VegCAMP fields

Quoted from: AECOM. 2019. Vegetation Classification Report for Marine Corps Base Camp Pendleton With Vegetation Key, Crosswalk and Descriptions. Prepared for MCI West-Marine Corps Base Camp Pendleton Environmental Security Department Land Management Section.

Roadedness

Roadedness Disturbance is defined as the level of impact in a polygon by paved and unpaved roads, railroads, well defined trails, and berms. Impact is defined by the proportion of any polygon that is contiguously without these features, as shown in Table 1. The table is adapted from *2013 Vegetation Map in Support of the Desert Renewable Energy Conservation Plan*, (Menke *et al.* 2013). Roads following polygon boundaries were not included in the assessment. Polygons were not created or split because of differences in roadedness, but existing vegetation polygons were assigned a Roadedness Disturbance class.

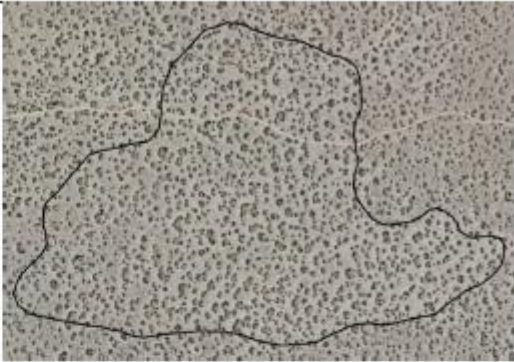


The Roadedness Disturbance code reflects the combination of the number of roads in the polygon and the roads' effect on the contiguous space that has no roads – that is, where the roads fall within the polygon. This definition of roadedness has the advantage of helping to identify roadless areas, but the disadvantage of being scale independent. For example, any polygon with a road more or less bisecting it will be assigned a code of Moderate, regardless of size. However, a very large polygon with a “Moderate” Roadedness Disturbance code might still contain an extensive roadless area.

Development

Development Disturbance accounts for the level of impact by structures and compounds that are smaller than the MMU criteria for land use. Structures may include buildings, tanks,

trailers, metal electrical towers, communication towers, and utility and mining structures. This attribute also includes paved parking lots, collapsed structures, and debris such as junked vehicles and major trash dumping, etc. Polygons were not created or split because of differences in development disturbance, but existing vegetation polygons were assigned a Development Disturbance class. The classification is adapted from *2013 California Desert Vegetation Map and Accuracy Assessment in Support of the Desert Renewable Energy Conservation Plan* (Menke *et al.* 2013).

Table 1: Map Units for Roadedness Disturbance

Code	Range	Example
0	None visible	
1	<p>Low: at least 2/3 (67% to 100%) of the vegetation polygon area is roadless</p>	
2	<p>Moderate: between 1/3 and 2/3 (33% to 66%) of the vegetation polygon is intersected by roads of any kind</p>	
3	<p>High: less than 1/3 (<33%) of the vegetation polygon lacks roads of any kind</p>	
9	<p>Not applicable/Not assigned</p>	<p>Roadedness is not applicable when the Map Unit Code is 91100, 92000, 93300, 93310, 93330, 93331, 98000, 99100, 99200, 99300, 99900</p>

Code	Range	Description
0	None visible	<u>No development detected.</u> There are no noticeable development within the polygon.
1	Low	<u>Less than 2% of polygon affected:</u> Junk piles, structures, cement pads, etc. are widely spaced at very low density.
2	Moderate	<u>Between 2% to 5% of the polygon affected:</u> Multiple examples of dispersed junk, buildings, or other structures, etc. are visible throughout the polygon. There may be a dense concentration of development within a single or few parts of the vegetation polygon.
3	High	<u>More than 5% of polygon affected:</u> Multiple examples are evenly distributed in a vegetated polygon. A stand is typically mapped as an "Urban/Built Up" (99900) polygon if the contiguous disturbance exceeds 5% cover and meets the 2.5-acre threshold. However, mines or open pits may be assigned a Development Disturbance code of 0, 1, 2, or 3 depending on the amount of structures or debris present in the polygon.
9	Not applicable/ Not evaluated	Development Disturbance is not applicable when the Map Unit Code is 91100, 92000, 93300, 93310, 93330, 93331, and 98000.

Anthropogenic Alteration

This indicates the level of impact on vegetation through tillage, scraping, grazing, etc. Disturbance from structures, pavement, or debris is not included here but is addressed in Development Disturbance. Anthropogenic Alteration Disturbance captures past disturbances in the landscape that are still visible through their impact on vegetation, but do not have enough of an impact to change the vegetation type or percent cover range. For example, striations from former cultivation may be present on parcels of land that have not been under agriculture for decades. Anthropogenic alteration disturbance is typically bounded by a straight-line feature such as a fenceline or road, implying man-induced activity. Not included are small clearings caused by off-road vehicles at road intersections, fire effects, and powerline tower pedestal clearings.

Polygons were not created or split because of differences in Anthropogenic Alteration Disturbance, but existing vegetation polygons were assigned one of the classes presented below, which was adapted from Menke *et al.* (2013).

Code	Range	Description
0	None visible	<u>No Anthropogenic Alteration detected:</u> No ghost lines of tilling, differential effects of enclosure/exclosure fencing, effects of grazing/browsing, etc. are visible.
1	Low	<u>Less than 33% of polygon</u> is affected and/or impact is seen but does not affect vegetation cover or type. Less than 1/3 of a vegetation polygon has visible evidence of clearing, prior agricultural activity or other effects.

Code	Range	Description
2	Moderate	<u>Between 33% to 66% of polygon</u> is affected: A vegetation polygon has more than 1/3 but less than 2/3 visible effects of clearing, prior agricultural or other effects.
3	High	<u>More than 66% of polygon affected</u> : A vegetation polygon has more than 2/3 visible effects of clearing, prior agricultural or other effects.
9	Not applicable/ Not evaluated	Anthropogenic alteration is not applicable when the Map Unit Code is 91100 and 98000.

Exotics

Photointerpreters assigned each existing polygon a code reflecting the level of impact by exotic invasive species such as non-native grasses (*Avena* spp., *Bromus* spp.) or mustards (*Brassica* spp.). Polygons were not created or split because of differences in the presence of exotics. Existing vegetation polygons were assigned an Exotics class adapted from *2013 Vegetation Map in Support of the Desert Renewable Energy Conservation Plan*, (Menke et al., 2013).

Code	Range	Relative Cover	Description
0	None visible	0%	Sparse herbaceous vegetation with a minimal to low relative cover of exotic species; based on field data, no evidence of exotics in sampling, no evidence of exotics on imagery and based on modeling, assumed not present or not regular in the stand. This is expected on coarse rocky slopes, or very steep bouldery slopes, etc.
1	Low	<33%	Patches of exotics visible, but cover not significant (relative cover to total <33%): Sparse to moderate cover of herbaceous vegetation with a low to moderately high relative cover of exotic species. Patches of exotics are visible, but cover is not significant.
2	Moderate	<66%	Exotics (particularly herbaceous) significant and cover may exceed dominant vegetation strata (relative cover <66%): Exotics, particularly herbaceous ones, are significant and cover may exceed the dominant vegetation strata.
3	High	>66%	Stand characterized by exotics (vegetation type is "exotic") (relative cover >66%): This is reserved primarily for alliance-level calls which are defined by exotics; stands are characterized by exotic vegetation (as defined by the map unit).
9	Not applicable/ Not assigned		Exotics are not applicable when the Map Unit Code is 91100, 93300, 93310, 93330, 93331, 98000, 99100, 99200, 99300, 99900.

Hydro Modifier (Altered Hydrologic Regime)

The Altered Hydrologic Regime Modifier attribute denotes where a wash or sheet flow has been diverted from its natural path by restricted sheet flow or active channel flow crossing under a road, railroad, berm, etc., resulting in a vegetation difference downslope. The effect must create a boundary-forming break in vegetation type, shrub cover, tree cover, or herbaceous cover along the impediment. The modifier is only attributed to the polygon downslope of the impediment. The upslope portion on the polygon boundary must at least in part follow the hydrologic impediment. Drainage ditches conveying flow off the side of a road (though often visible on imagery) are not considered unless they make a boundary-forming break in the vegetation.

Examples of how impediments can result in an observable difference in vegetation type or cover include: 1) washes have contracted or have been diverted or eliminated on the downslope side of the impediment, 2) natural sheet flow has been diverted, modified or eliminated on the downslope side, or 3) the impediment caused water from wash or sheet flow to be impounded upslope.

Since the Altered Hydrologic Regime Modifier was applied only where mappable changes in vegetation type or cover were observed across an impediment, an existing polygon was not split solely because part of it was subject to a diversion of surface flow.

Code	Description	Explanation
0	Not affected	Neither the vegetation type nor percent cover is affected by hydrologic impediment that follows a portion of polygon boundary.
1	Affected	Vegetation type and/or percent cover is affected by hydrologic impediment that follows polygon boundary. Only the polygon downslope from the impediment is considered affected.
9	Not applicable/Not assigned	Altered Hydrologic Regime Modifier is not applicable when the Map Unit Code is 91100, 93300, 93310, 93330, 93331, 98000, 99200, 99300, and 99900.

Land Use

Land use is the human use of the land and is embodied through such features as urban centers, towns, mining, agriculture, and individual settlements. In this mapping effort land use was represented both as a possible vegetation class and as a separate attribute of a vegetated polygon. Every attempt was made to correlate the coding within both layers. A land use polygon was mapped if it was at least 2.5 acres in size. Note that where the Interstate 5 bridges crossed over natural vegetation, the polygon was coded for the vegetation type in the MapUnit attribute, and was also coded for Urban in the Land Use

attribute. In addition, the vacant ruderal areas associated with urban uses was coded as Disturbed Vegetation in Urban Use Mapping Unit in the MapUnit attribute, and as Urban in the Land Use attribute.

The hierarchical format of the classification is such that more detailed classes may be added at lower levels of the hierarchy for future more detailed land use mapping efforts. For example, the Urban (1000) class could be subdivided further into Residential (1100), Commercial (1200), Industrial (1300), Transportation/Communication (1400), and so on. The land use code assignment was mostly at an Anderson Level I (Anderson *et al.*, 1972) with lower levels for specific categories.

Code	Description	Explanation
0000	Not Assigned/Not Assessed	Polygon has not been assessed for land use.
1000	Urban	Built-up & urban disturbance represents isolated built-up areas as well as settlements and suburban areas.
2000	Agriculture	
2100		<u>Non-woody row & field crops:</u> Active or fallow cropland for vegetable, fruit, animal feed, or non-food production. Examples are lettuce, tomatoes, strawberries, hay, alfalfa, and cotton.
2200		<u>Orchards & Vineyards:</u> Woody agriculture is defined as orchards and vineyards. Examples are avocados, grapes, citrus, and tree nut crops.
9800	Undifferentiated Water	Bodies of open water either natural or artificially created
9810		<u>Water Impoundment Feature:</u> These are typically utility or other straight-edged water bodies such as drainage basins impounded by berms and may or may not contain water at time of imagery exposure.

MethodID

MethodID is used to indicate how the call for the vegetation type polygon was reached by identifying what type of field data (if any) is used to support the assignment. For polygons that do not have any corresponding point data, the value of “photo interpretation” is assigned.

Code	Description
3	Rapid Assessment (current project)
2	Relevé
3	Field Verification
4	Photo Interpretation
5	Adjacent Stand Information or Ground Photo
6	Reconnaissance (current project)
7	Other Information
8	Older Plot Data
9	Older Recon Data
10	Accuracy Assessment
60	Additional Recon Information