



California Department of Fish and Wildlife Guide for entering coordinates into map interfaces

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When entering coordinates into a California Department of Fish and Wildlife (CDFW) map interface, the first step is to specify which system those coordinates are using. CDFW interfaces accept both UTM coordinates and latitude/longitude in either NAD83/WGS84 or NAD27. Latitude/longitude coordinates may be entered in the formats of decimal degrees, degrees minutes seconds, or degrees decimal minutes. All longitude values must be given as negative values (indicates west of the Prime Meridian) and only numerals should be entered. Degree symbols ($^{\circ}$), indications of direction (west or W) or distance (mE) should be left off of all coordinates. A single space is used to indicate separations between degrees and minutes, as well as between minutes and seconds. To simplify the entry of X and Y coordinates into the same fields, entry of longitude and latitude are reversed from what is typically read as lat/lon. Further explanations of these concepts are provided below, but here are some basic examples:

Typical GPS reading		Equivalent entry for CDFW map interface	
UTM Easting	UTM Northing	Easting	Northing
631234E	4270875N	631234	4270875
Latitude	Longitude	Longitude*	Latitude*
38.57665 N	121.49343 W	-121.49343	38.57665
38 $^{\circ}$ 34' 35.95" N	121 $^{\circ}$ 29' 36.36" W	-121 29 36.36	38 34 35.95
38 $^{\circ}$ 34.5991' N	121 $^{\circ}$ 29.6059' W	-121 29.6059	38 34.5991

*Note that these are reversed

There are many methods for describing one location

Some examples of common coordinate formats used in California **which all indicate the same position on Earth** are shown in the following table.

North coordinate	East or west coordinate	Zone	Datum	Coordinate system
38.57563	-121.49782	(none)	WGS84	Latitude/Longitude
38.57563 $^{\circ}$ N	121.49782 $^{\circ}$ W	(none)	NAD83	Latitude/Longitude
38 34 32	-121 29 52	(none)	NAD83	Latitude/Longitude
38 $^{\circ}$ 34' 33" N	121 $^{\circ}$ 29' 48" W	(none)	NAD27	Latitude/Longitude
38 34.538	-121 29.869	(none)	WGS84	Latitude/Longitude
38 $^{\circ}$ 34.543' N	121 $^{\circ}$ 29.805' W	(none)	NAD27	Latitude/Longitude
630853	4270755	10	NAD83	UTM
630949.1 mN	4270560.6 mE	10S	NAD27	UTM
601013 m	2043762 m	0402	NAD83	State Plane (these are not supported by CDFW interfaces)
331400 ft N	2143591 ft E	CA Zone 2	NAD27	State Plane (these are not supported by CDFW interfaces)

As you can see, there are many ways to describe a single location on Earth. Coordinates are much more than just two strings of numbers. Those sets of numbers can only be interpreted when placed into the correct context. In order to map something correctly, an understanding of how these coordinate systems work is helpful.

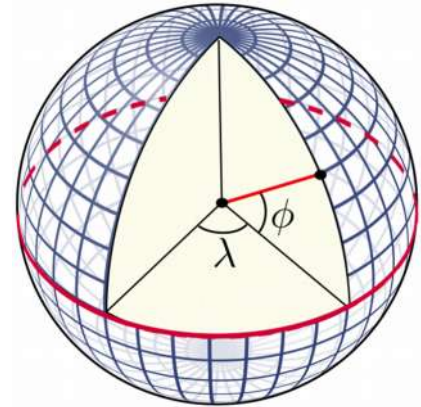
Latitude and Longitude Coordinates

Latitude and longitude are measured in degrees of angle.

Latitude is measured in degrees north or south of the equator. A latitude of zero degrees north falls along the equator, while 90° north is at a right angle to the equator, putting it at the north pole. Since all of California is above (north of) the equator, all California latitude values are degrees north, or positive values.

Longitude is measured in degrees east or west of the Prime Meridian. The Prime Meridian is defined as that line between the north and south poles which passes through Greenwich, England. All of California is east of England, so all longitude values in the state are degrees east, and are typically given as negative values.

Each degree can be divided up into minutes and seconds in the same way we divide up an hour of time. There are 60 seconds in one minute and 60 minutes in one degree. Minutes are sometimes denoted with a single quotation mark (') while seconds are shown with a double quotation mark ("). In this way, 38 degrees, 42 minutes, 12 seconds north can be written as 38° 42' 12" N. Coordinates expressed this way are in degree minute second format. Most map interfaces, including those used by CDFW, require users to type a space to separate degrees from minutes, and minutes from seconds, in the format 38 42 12.



Latitude (ϕ) versus longitude (λ)

Alternatively, degrees can be divided up with decimal places. This is something we do not normally do with time, but 42 minutes and 12 seconds might also be expressed as 0.70333 hours. Similarly, 38° 42' 12" N can be expressed as 38.70333 degrees. Coordinates expressed this way are in decimal degree format and are much easier to work with if compiling tabular spreadsheets of locations.

A third option is degrees decimal minutes format, where the full degrees and minutes are given, but then decimal fractions of minutes are given in place of seconds, in the format 121° 29.869' W or simply as -121 29.869.

When entering latitude and longitude coordinates into CDFW map interfaces, remember:

- Select the same map datum the coordinates were captured with (NAD83/WGS84 or NAD27)
- Longitude and latitude are reversed of typical lat/lon reading
- Enter longitude as a negative value
- Separate degrees from minutes and seconds using a space
- Leave off other annotations (such as W, north, °, degrees, ", etc.)

For more information on latitude and longitude coordinate systems, refer to the following Wikipedia links:

Latitude: <http://en.wikipedia.org/wiki/Latitude>

Longitude: <http://en.wikipedia.org/wiki/Longitude>

UTM Coordinates

UTM coordinates are expressed as meters measured north and east within a map grid. If you take a GPS point of a position in UTM, walk 100 meters to the north, and then take another point you will see that your northing will have increased by very nearly 100 meters. Similarly, walking 100 meters to the west will decrease your easting by 100 meters.

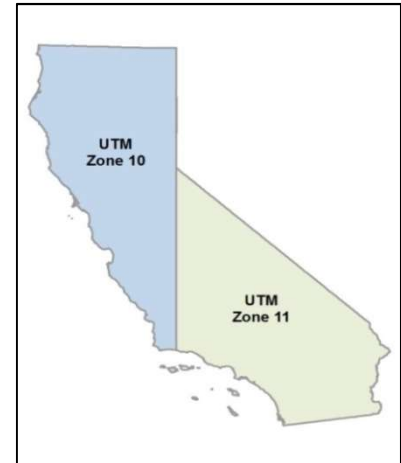
The UTM coordinate system breaks the world up into various blocks called UTM zones. A set of northing and easting values describe a position with respect to where it falls within a particular zone. Most of Northern California is in Zone 10, while most of Southern California is in Zone 11. When collecting GPS coordinates near a zone boundary it is especially important to note which zone those coordinates reference.

Occasionally, a letter will be added to the end of a UTM zone to indicate what portion of that zone is being referenced. All of Zone 11 in California is part of Zone 11S, while the part of the state in Zone 10 is split between Zone 10S and Zone 10T. CDFW map interfaces do not need to know the letter portion of the zone in order to properly map a set of UTM coordinates.

The UTM system is designed so that all values are positive numbers. Sometimes decimal places are used at the end of UTM coordinates. Typically decimals are not needed for UTM coordinates, since these would indicate a position on Earth with the precision of some fraction of a meter.

When entering UTM coordinates into CDFW map interfaces, remember to:

- Select the same map datum the coordinates were captured with (NAD83/WGS84 or NAD27)
- Choose the correct UTM zone



UTM Zones within California

For more information on the UTM coordinate system, refer to its Wikipedia page at: http://en.wikipedia.org/wiki/Universal_Transverse_Mercator_coordinate_system

Map Datums

In addition to knowing either the latitude/longitude or UTM zone/easting/northing, you must know which map datum a set of coordinates are in to be able to map them properly. Earth is not a perfect sphere. The various map datums make slightly different assumptions about how non-spherical the planet is. These varying assumptions mean that a single set of coordinate values will be plotted at different locations when referencing different datums.

The datums WGS84, NAD83, and NAD27 are used in California. The differences between WGS84 and NAD83 are trivial, so CDFW map interfaces treat them as equivalent. However, when a particular set of coordinates are incorrectly plotted in NAD27 when they were originally taken with a GPS set to NAD83 (or vice-versa), significant errors may result.

For example, UTM Zone 10 621343 4293168 mapped in NAD83 is 217 meters away from the same coordinates when mapped in NAD27. That is quite a substantial error when you consider that a typical smart phone can provide coordinates accurate to within 10 meters.

If you have a set of coordinates but have no idea which map datum was used in determining them, your first assumption should be that they are in WGS84/NAD83. Most map interfaces and most GPS units are set to use WGS84 by default.

For more information regarding datums, refer to: http://en.wikipedia.org/wiki/Geodetic_datum

State Plane Coordinates

Certain jurisdictions manage their spatial data in one of several different state plane formats. CDFW map interfaces will not accept state plane coordinates. Such coordinates must first be converted to either

latitude/longitude or UTM. A state plane to latitude/longitude converter and related information are available at: <http://www.ngs.noaa.gov/TOOLS/spc.html>