Appendix "G" - Universal Transverse Mercator (UTM)

The Universal Transverse Mercator (UTM) projection and grid system was adopted by the U.S. Army in 1947 for designating rectangular coordinates on large-scale military maps. To this date, the United States and NATO armed forces continue to use UTM as their map coordinate system. UTM is by no means limited to military applications. Anyone who desires the ability to navigate or survey on land-based applications in great detail will benefit from the use of UTM. In addition to its accuracy and relevance for close distance measurements, the advent of inexpensive Global Positioning System (GPS) receivers and its inherent ability to provide "on-the-fly" area and linear information to the end-user has encouraged other map users to adopt UTM as their standard mapping coordinate system. Calculations and readings are straightforward since UTM is metric based and uses constant distance relationships between gridlines.

To simplify the use of maps and to avoid the inconvenience of pinpointing locations on curved reference lines, cartographers superimposed a rectangular grid consisting of two sets of straight parallel lines, uniformly spaced and perpendicular to each other. Starting from the international date line at longitude 180°, UTM zones are numbered 1 through 60 going east, with each zone 6° longitude wide and between latitudes 80°S and 84°N. Zone 1 extends from 180°W to 174°W. The Mojave Desert Air Quality Management District (MDAQMD) is located at UTM Zone 11 between 120°W and 114°W. In the middle of each 6° wide UTM Zone is a central meridian assigned with an easting value of 500,000 meters. Coordinates west of a central meridian are given values less than 500,000 meters while coordinates to the east are given values greater than 500,000 meters. Northing values are measured positively from the Equator, which is designated zero. The UTM coordinates of the MDAQMD office is UTM Zone 11 easting 470,140 meters and northing 3,818,820 meters under North American Datum 1983 (NAD83). NAD83 uses satellite technology to improve the accuracy of previous NAD27 in defining the size and shape of the earth. An alternate coordinate system used in California is Teale Albers and works similar to UTM.

The AVAQMD favors the use of UTM geodic data because of the ease in extrapolating coordinates from detailed UTM topographical maps and aerial photographs that are easily obtained from the Internet. The precision UTM provides in mapping and locating of facilities in remote areas is advantageous in conducting emissions inventory and health risk assessments.

Maps on the Web

Topographic maps with geodic data can be found on the following websites:

        http://terraserver-usa.com
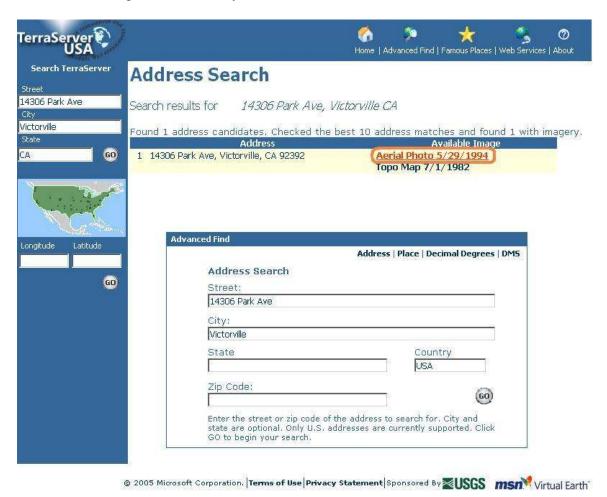   http://earth.google.com/ (Free Version)
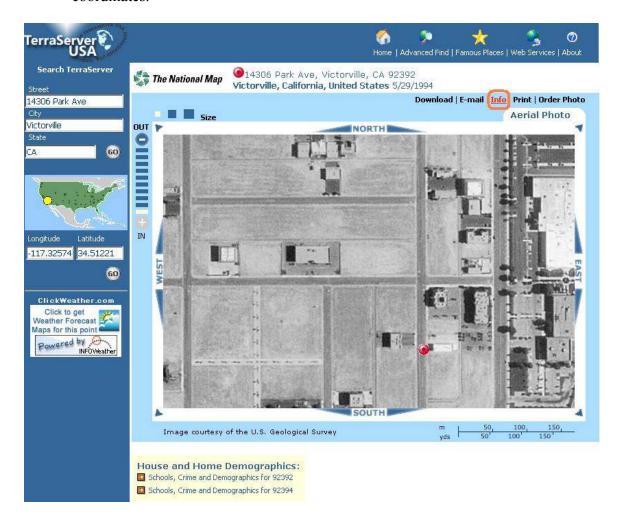   http://www.topozone.com

Examples

A.   The instructions for using "TerraServer" to determine UTM coordinates of a facility:

      1.   On the left hand side enter your address below the words "Search TerraServer" and click "Go". For this example, we will determine the coordinates of the MDAQMD office in Victorville.

2.	Pick an appropriate map under "Available Image". It may be easier to locate your facility by first using "Topo Map" and then switching to "Aerial Photo" or "Urban Areas". In this example, we'll directly choose "Aerial Photo".

3.   On the top right of the map, click on "Info" to display the grid and corresponding coordinates.

4. Use the red "push-pin" to help locate your facility. If needed, pan the map by clicking on an arrow on the sides or corners. In this example, we'll click on the south arrow to get a better view of the surrounding streets.
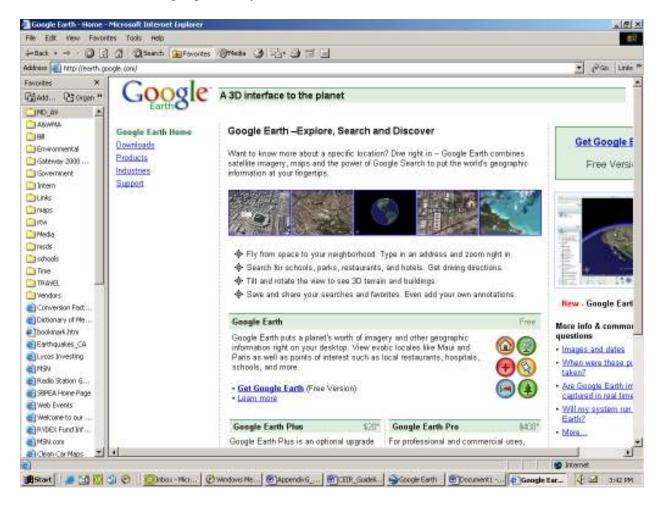
5. Longitude/Latitude coordinates of the "push-pin" are displayed on the left side of the webpage. Note the year the aerial photograph was taken when determining your facility. In this example, the aerial photograph was taken in 1994 and the current MDAQMD office building is not in the picture. By looking at the streets and buildings, we can determine approximately where the building would be in this aerial photograph. Because the "push-pin" is not placed at our facility, the longitude/latitude coordinates given at the left do not represent the coordinates of the MDAQMD office building. We will need to determine the coordinates by using other information.

6. Projection information is given under "Image Information". Distance and scale information is displayed on the scale at the bottom-right of the photograph and by gridlines that run North-South and East-West with units listed from top to bottom in: degree-minute-second, degree-decimal, and UTM (meters). We can determine UTM coordinate for a location by directly using the map scale or by approximation. In this example, the gridlines are 200 meters apart and the location of the MDAQMD office is represented by the orange "X" between easting 470,000 and 470,200 and also between northing 3,819,000 and 3,818,800. To approximate, visualize half a grid or 100 meters and then visualizing the remaining distance by dividing into tenths or 10 meters segments. This way, we can approximate UTM coordinates to the district requirement of the nearest ten meters. Realizing that the easting value is approximately four-tenths from our visualized midpoint at 470,100 to the gridline at 470,200, we can approximate UTM E at 470,140 meters. By doing the same for the northing value, we can approximate UTM N at 3,818,820 meters.
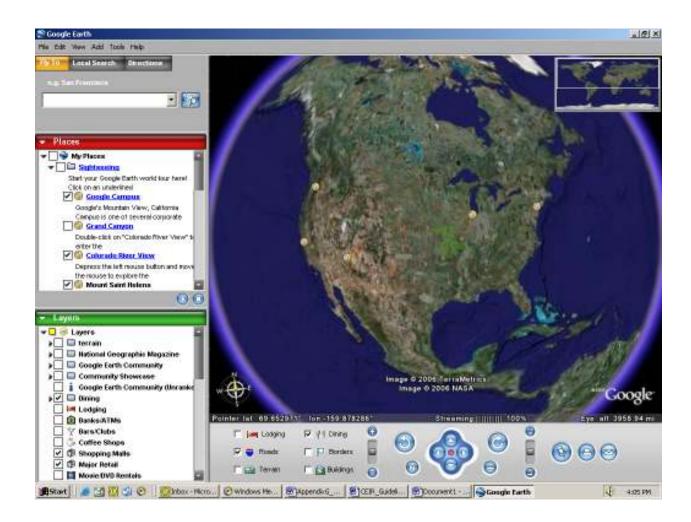
B.   The instructions for using "Google Earth" to determine latitude & longitude coordinates of a facility:

1.   The 'Free Version' of Google Earth can be downloaded from http://earth.google.com/. Then install the program on your PC.
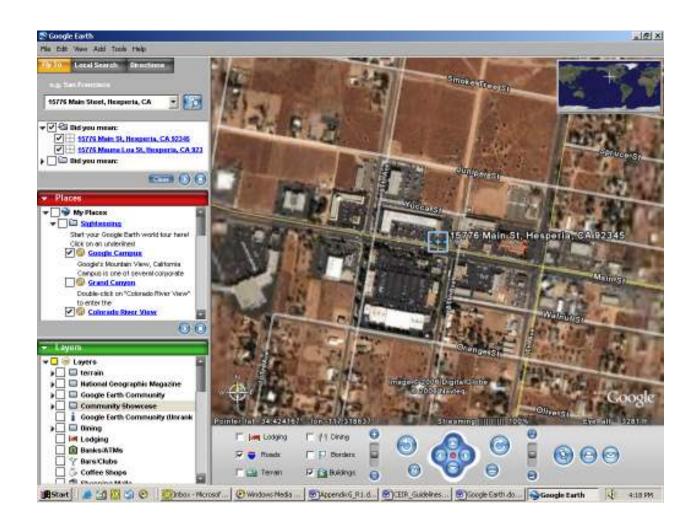

During the installation of Google Earth the following icon will appear on your desktop.

Google Earth (2).lnk

2. The following screen appears when Google earth is opened. Enter the address for which you want latitude (lat) and longitude (lon).

3.   For the following example 15776 Main Street, Hesperia, CA (City Hall) was entered. The latitude (lat) and longitude (lon) that appears in the lower left of the aerial photo is where the cursor is pointed too. To zoom in use the "+" sign and to zoom out use the "-" sign. The four arrows can be used to move the picture if the point of interest did not appear. To print click on 'file' and then click on 'print'.

More Information on UTM

These websites are references on UTM:
> http://earth-info.nga.mil/GandG/publications/precpos.html
> http://erg.usgs.gov/isb/pubs/factsheets/fs07701.html
> http://www.maptools.com/UsingUTM/UTMdetails.html
> http://www.uwgb.edu/dutchs/FieldMethods/UTMSystem.htm

These websites are references on GPS and coordinate systems in general:
> http://www.maptools.com/faq.html
> http://www.colorado.edu/geography/gcraft/notes/coordsys/coordsys_f.html
> http://www.colorado.edu/geography/gcraft/notes/gps/gps.html
> http://www.edu-observatory.org/gps/gps.html

This website can convert UTM to and from Longitude/Latitude:
> http://jeeep.com/details/coord/