# Topographic Maps

## Introduction

You are already familiar with many types of maps, such as road maps and weather maps. **Topographic maps** are useful because they represent the three-dimensional configuration of the land by using lines and symbols.
Topographic maps show the location and shape of mountains, valleys, plains, streams, wooded areas, roads, buildings, and many other features.
Topographic maps are useful tools for planning highways, recreation areas, airports, housing developments, industrial sites, selecting pipeline and powerline routes, for agricultural research, property surveys, and natural resources management. For you, topographic maps may be useful for recreational activities such as hiking, boating, camping, fishing or hunting. Many of you have probably already used topographic maps.
Most topographic maps of the U.S. are printed and distributed by the U.S. Geological Survey.

## What is Topography?

Topography is the configuration of the land surface, and it is shown on topographic maps with **contour lines**.

### What are contour lines?

A contour line is an imaginary line on the surface of the Earth connecting points of equal elevation.

1. Each contour line represents one elevation.
2. Contour lines never cross.

   Contour lines would merge to form a single line only at a vertical cliff (very rare). In the extremely rare case of an overhang, contour lines would cross, but the hidden contours are dashed.
3. The vertical spacing (difference in elevation) between contour lines is known as the **contour interval**. Typical contour intervals are 10, 20, 50, and 100 feet. (Metric contour maps are also available.) The more rugged the topography in an area, the larger the contour interval that is required for the map. The contour interval is generally given in the **legend** of the map.
4. Every fifth contour is printed darker. These lines are called **index contours**. If the contour interval on a map is 20 feet, then the 100', 200', 300' (etc.) contours will be **index contours**.
5. Points on the map marked "BM" are **bench marks** - survey points of known elevation. The exact elevation of a point is given as "BM 60" (for an elevation 60 feet above sea level).
6. **Closely spaced** contour lines represent **steep** slopes.
   **Widely spaced** contour lines represent **gentle** slopes.
7. Remember that **streams and rivers flow downhill** (from higher elevations to lower elevations). Note that **where a contour line crosses a stream or river** (or even a dry gully or valley), the contour lines are bent sharply, forming a "V". The **point of the "V" points uphill or upstream**. (Look at map and think about this for a minute.)
8. **Closed depressions** are indicated by contour lines that form roughly a circle, with short "tick marks" or "hachure marks" perpendicular to them **on the downhill side**. Examples of closed depressions are sinkholes and craters, or other bowl-shaped depressions.
9. A series of concentric contour lines in a rough circle represents a hill.

**What else is present on a topographic map?**

**Colors**

The colors on a topographic map are symbolic of different map features.

- Blue = water
- Green = forest
- Brown = contour lines
- Black = cultural features (buildings, place names, boundary lines, roads, etc.)
- Red = principal roads
- Pink = urban areas
- Purple = revisions to an older map, compiled from aerial photos. If an area has become urbanized, this may be shown as purple shading on the new, revised map.

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**Symbols**

Check the topographic map symbol sheet for more information (in your binder, in your notes, etc). You will find a list of many common map symbols for things such as boundaries, roads, buildings, railroads, types of vegetation, marshes, quarries and mines, water and coastal features, etc.

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**Latitude and Longitude**

The edges of many topographic maps are bounded by lines of **latitude** and **longitude**. The large maps available from the U. S Geological Survey are called **topographic quadrangle maps**.
The size of the quadrangle is given in degrees, minutes, and seconds.
Look for the latitude and longitude, given in degrees, minutes, and seconds, at the corners of the map.
The **lines that run east and west**, bounding the top and bottom of the map are **latitude lines**. Look at the left and right top corners of the map to see the latitude of the line that forms the top (northern) edge of the map.
The **lines that run north and south**, bounding the left and right sides of the map are **longitude lines**. Look at the top and bottom corners on the left to see the longitude of the line that forms the left (western) edge of the map.
Intermediate latitude and longitude lines (for various seconds or minutes) are found along the edges of the map. Please note that the degrees may have been left off (as an abbreviation), and you may see only minute and second designations. The degrees are listed only at the corners on most maps.
Also note that there are other numbered lines on the map and tick marks along the map edges. Some of these are other systems of measurement, such as **Universal Transverse Mercator** (UTM) lines. If you look carefully, these are NOT parallel to the edges of the map or the latitude and longitude lines. *If you are looking for latitude and longitude markings, you will need to ignore these other lines and tick marks. Look for the tick marks labeled with minutes (') and seconds (").*
Maps covering 7.5 minutes (7.5' or 7'30") of latitude and longitude, and maps covering 15 minutes (15') of latitude and longitude are common. Maps covering a large region are typically $1^o$ x $2^o$ quadrangles, or 30' x 60' quadrangles.
Topographic maps at the equator that cover 7.5' x 7.5' are basically square. The 7.5' x 7.5' maps become narrower as you approach the poles because the lines of longitude converge poleward.

For latitude or longitude:
$1^o$ = 60 minutes (60')
1 minute (1') = 60 seconds (60") .

**Scale**

Scale is the relation between the size of the map and the size of the real area, on the ground.
There are three ways to represent the scale of a map:

1. **Verbal scale** - such as saying "1 inch = 5 miles".
2. **Bar scale** (or graphical scale) - indicated by a line or bar with distances marked in miles, feet, or kilometers.
3. **Ratio scale** (or **fractional scale**) - a fraction representing the relationship between one unit on the map and one unit on the ground.
   *Example:* 1:24,000 or 1/24,000.
   This ratio (or representative fraction) indicates that "one unit on the map is equal to 24,000 units of the same size on the ground."
   This holds true for any units. You may consider the units to be inches, centimeters, feet, or any other unit of measure. The units are always the same on both sides of the fraction. It is the proportion between the map and the real world that is being expressed.

Simple mathematics can **convert** a ratio (or fractional scale) to any desired comparison of units.
We often want to know:
"How many feet (or miles) are equal to one inch on the map?"
*Example:* Ratio scale 1:24,000
This says 1 unit on the map = 24,000 units on the ground.
If we want to know how many miles on the ground would be equal to one inch on the map, we set the problem up like this:

1. 1 inch = 24,000 inches
2. We know that there are 12 inches in 1 foot, so multiply:
   1 inch = 24,000 inches x (1 foot/12 inches)
   In essence, we are multiplying one side of the equation by 1, because 1 foot = 12 inches.
3. Now, if you do the multiplication and division above, you get:
   1 inch = 2000 feet
4. Because there are 5280 feet in one mile, you can find out how many miles (or fractional part of a mile) would be present in 2000 feet.
   1 inch = 2000 feet x (1 mile/5280 feet)
   You divide 2000 feet by 5280 feet, then cancel out "feet".
5. If you do this, then you get
   1 inch = 0.379 miles
   This is the answer you were looking for. On a map with scale 1:24,000, one inch = 2000 feet, and one inch = 0.379 miles.

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**North Arrow**

**Magnetic north** (where the compass needle points) is different from **true north** (the north pole where all of the longitude lines converge - the Earth's axis of rotation).
The compass angle between true north and magnetic north is called **declination**, and varied depending on where you are on the globe. Magnetic declination changes each year!

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**Quadrangle name**

On the large U.S. Geological Survey topographic maps, the quadrangle name and location is generally found in the upper and lower right corners of the map. The quadrangle is named for a town or other feature in the quadrangle.