

## Pre-Course Study Material

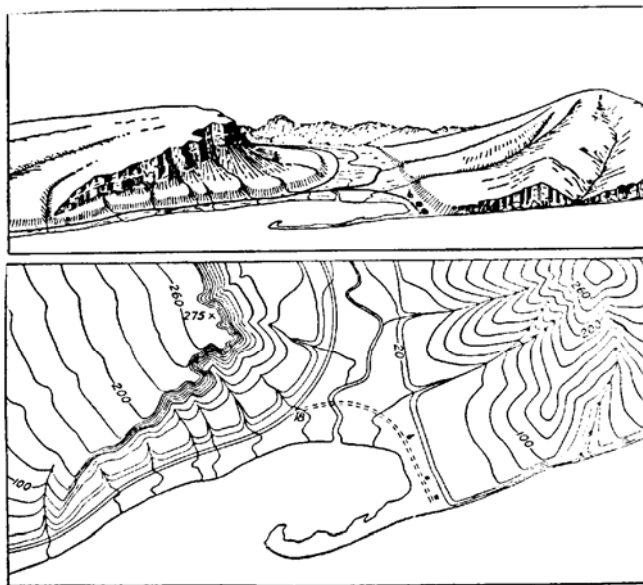
### Topography

#### Topographic Relief

A topographic map is printed on a flat piece of paper. Therefore, it is necessary to use symbols to represent the variation in elevation (relief) of geographic features, such as ridges and valleys, hills, and streams. These ground forms are measured vertically as well as horizontally. Contour lines, colors, and raised areas are symbols that show changes in elevation. Maps with relief show the general shape of the land.

#### Contour Lines

A contour line is a line on a map or chart connecting all points of the same elevation. Any point on a contour line is the same elevation as all the other points on the same line. In other words, contour lines connect points of equal elevation.



*A. A landscape in perspective and the same landscape in contour lines. Note especially that lines are far apart for level land, almost touch for cliffs.*

Contour interval is the difference in elevation between two adjacent contour lines. On U.S.G.S. maps they could be drawn at any elevation, but in practice they are drawn at intervals of 1, 5, 10, 20, 40, and 80 feet. Occasionally you will find a map with a 25 foot contour interval or metric units.

To make the contours easier to read, every fifth one is printed darker and has the elevation marked every so often in the line (every fifth contour on 40' interval maps). This is called the index contour. The thinner or lighter colored contour lines are called intermediate contours.

To find the contour interval on a map, check the legend or find two index contours adjacent to each other. Read their elevations and find the difference. If the number of spaces between them is 5, divide the difference by 5 to find the contour interval. If the number of spaces between them is 4, divide the difference by 4 to find the contour interval. For example:

- Two adjacent index contour lines indicate 250 feet and 300 feet.
- Find the difference by subtracting 250 feet from 300 feet = 50 feet.
- Count the spaces between the dark index contour lines; there are 5.
- Divide 50 feet by 5.
- $50 \text{ divided by } 5 = 10 \text{ foot contour interval.}$

Contours have certain general characteristics. Below are characteristics which are not rules but guidelines that are helpful in many cases. Contours:

- Usually have smooth curves. Exceptions are large outcrops of rocks, cliffs, and fractured areas of the earth's surface.
- Are "V" shaped in stream beds and narrow valleys. The point of the "V" always points uphill or upstream.
- Are usually "U" shaped on ridges with the "U" bottom pointing down the ridge.
- Are usually "M" or "W" shaped just upstream from stream junctions.

- Tend to run perpendicular to streams.
- Tend to parallel each other, each approximately the shape of the one above it and the one below it.
- Do not cross or touch. Exception is overhanging cliffs.
- Do not fork.
- Never end on the map, only at the map edges and sometimes at overhanging cliffs.
- Indicate steep terrain by being closely spaced.
- Indicate a uniform slope by being equally spaced.
- Indicate depressions or pit by a contour line joined forming a circle having hachures (short lines extending from the contour line at right angles).
- Indicate elevation in feet above mean sea level in index contours.

### Contour Characteristic Terminology

Depression: A low place in the ground having no outlet for surface drainage.

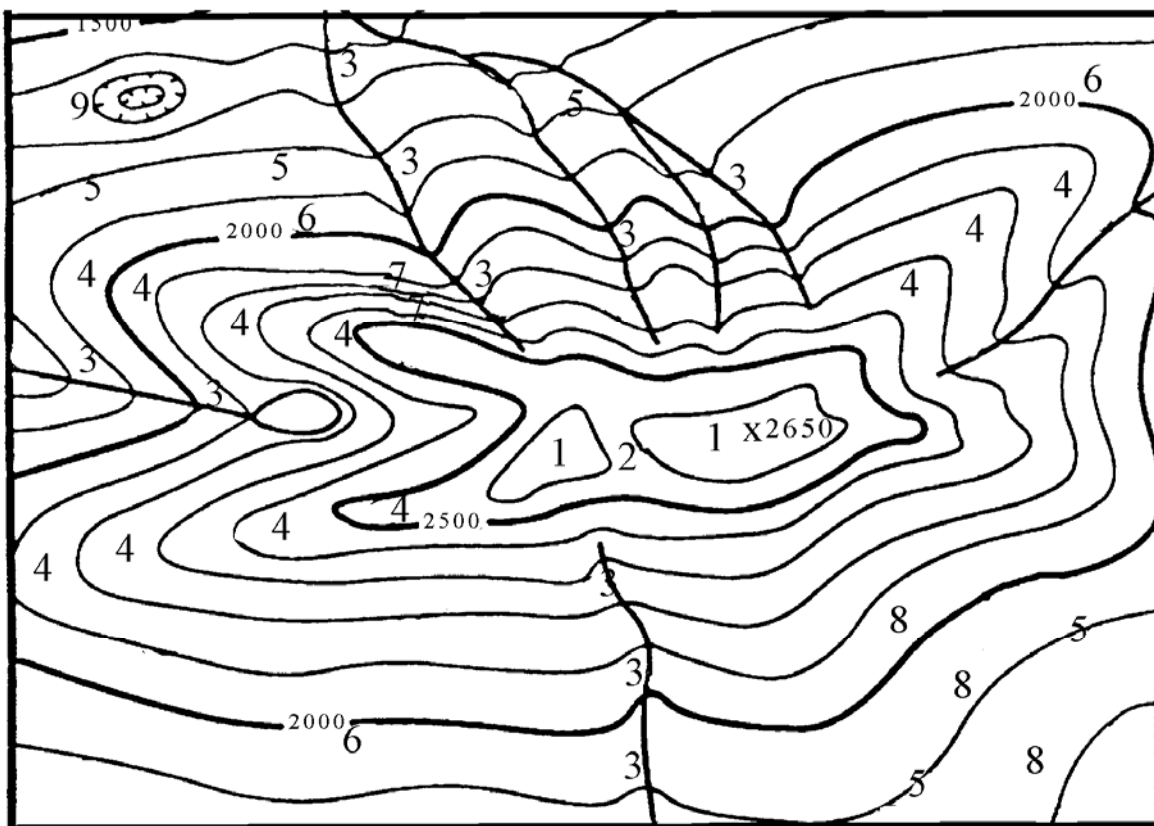
Hill: A naturally occurring mass of earth whose crest or summit is at a lower elevation than a mountain.

Mesa: A flat-topped mountain bounded on all sides by steep terrain.

Ridge: Long narrow elevation of land, often located on a mountainside.

Saddle: Ridge between two hills or summits.

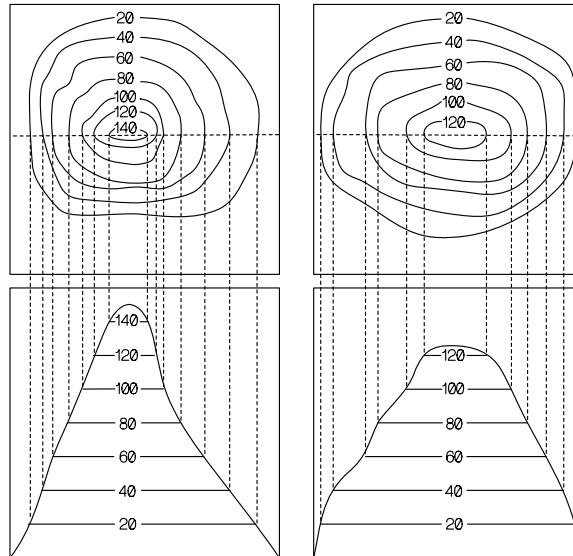
Valley: Stretch of low land lying between hills or mountains and sometimes occupied by a stream.



1-Top of hill; 2-Saddle; 3-Streams and bottom of canyon; 4-Ridges;  
 5-Contour line; 6-2000 on contour line indicates elevation in feet  
 above sea level; 7-Steep slope; 8-Gentle slope; 9-Depression

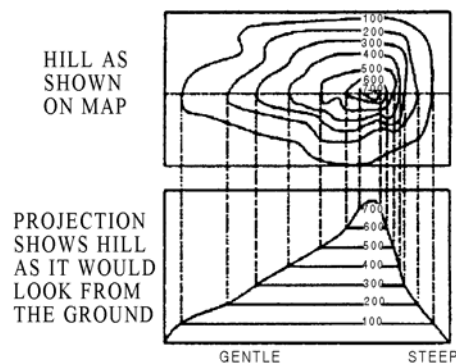
## Cross-sectioning Landscape Profiles

When the contour lines are close together at the top of a hill, the hilltop is pointed. The hilltop is flat when the contour lines are widely spaced at the top.



Contour lines widely spaced show a gentle slope; when they are close together, the slope is steep.

Remember: A contour line is a brown line on your map that connects points of the same elevation. You can find the contour interval in the margin at the bottom of the map. The heavy brown lines (every fifth one) have the elevation printed on them. You can tell from looking at your map what the slopes, hills, and valleys will look like on the ground.



## **Topography Questions**

1. What is the definition of a contour line?
2. What is the definition of a contour interval?
3. Two adjacent index contour lines on a map are 500 feet and 700 feet, and there are 5 spaces between them. What is the contour interval?
4. Do contour lines ever cross or touch?
5. What do contour lines that are closely spaced indicate?
6. What do hachures on contour lines indicate?

## Topography Exercise

The map on page 8 has five numbered squares with arrows. Locate and write the elevation closest to where the arrow is pointing.

Arrows:

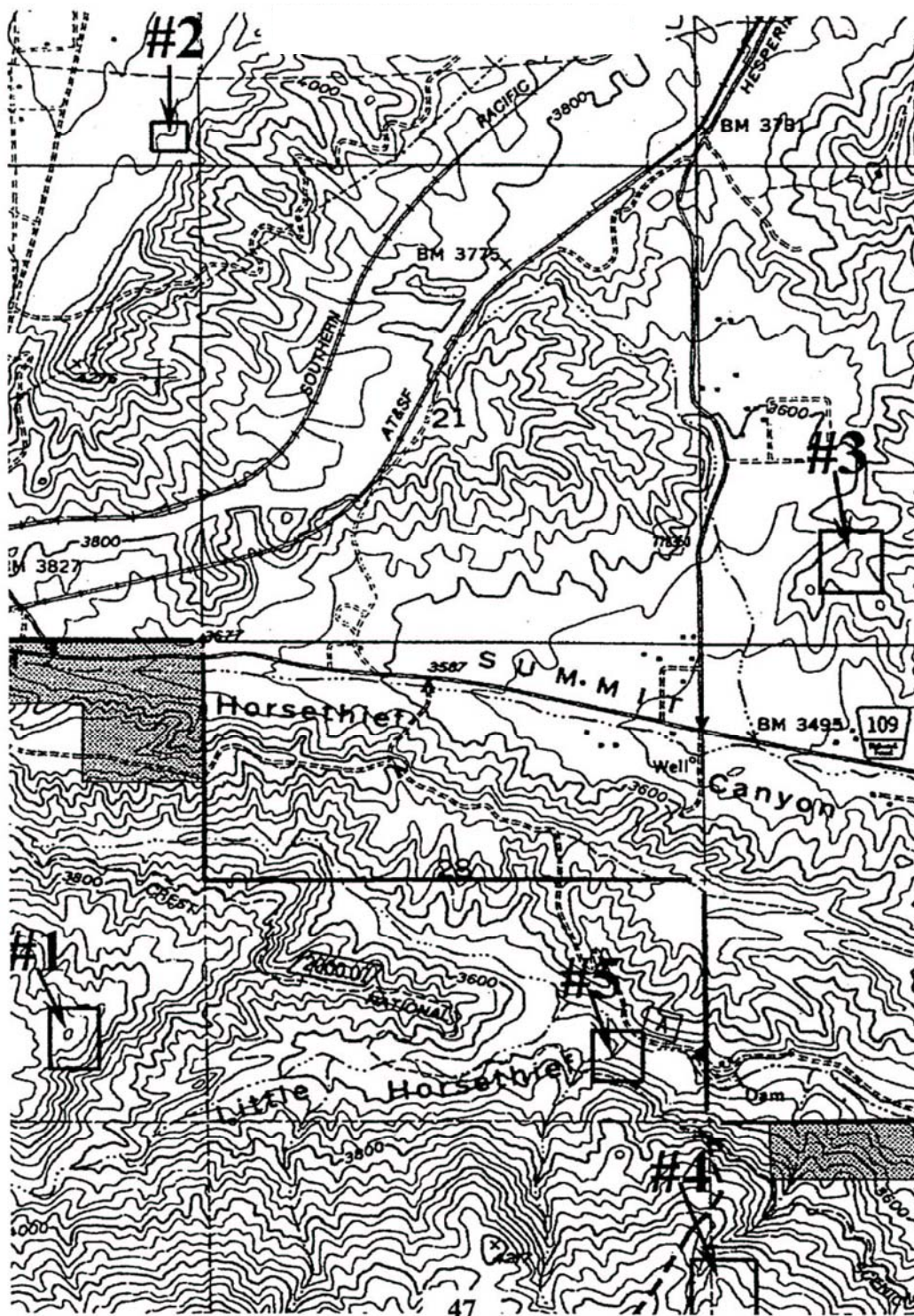
- 1.
- 2.
- 3.
- 4.
- 5.

Using the map on page 9, identify the topographic feature inside the rectangles numbered 6 - 11.

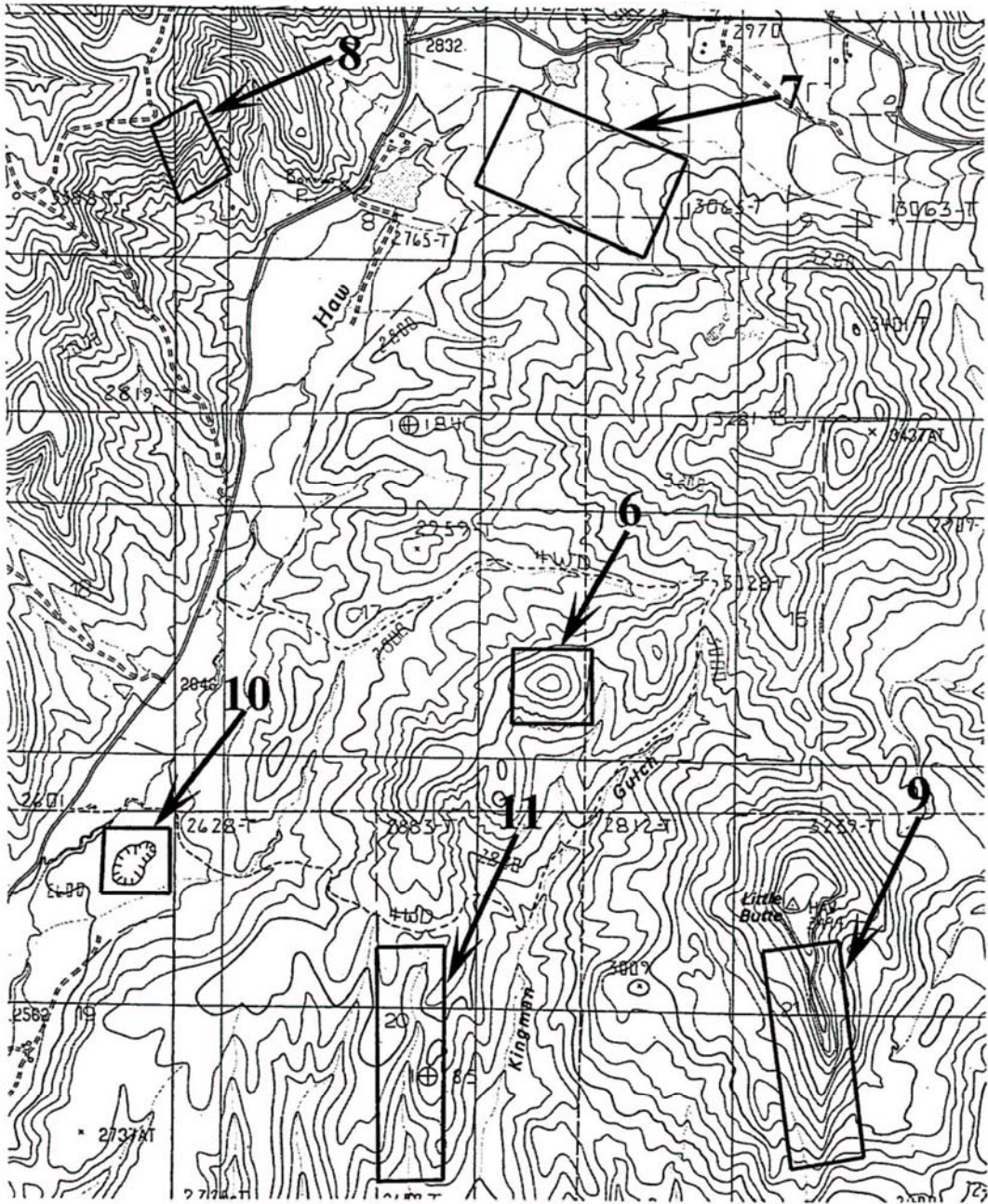
Topographic features: stream, hilltop, steep terrain, ridge, depression, flat terrain

Rectangles:

- 6.
- 7.
- 8.
- 9.
- 10.
- 11.

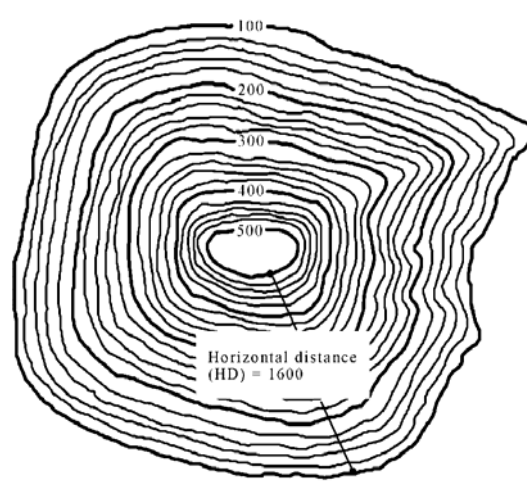






## Slope and Aspect

A slope is an inclined ground surface that forms an angle with the horizontal plane (flat ground). The degree of inclination, steepness, is also called *slope*. *Aspect* is the compass direction that the slope is facing.



## Percent Slope

Slope is usually expressed in percent. It is useful in estimating the amount of time it takes to construct a piece of fireline. The estimation of percent slope can help determine whether or not a dozer, engine, or hand crew can work the topographic area. It is also used as an input for making fire behavior calculations. A one percent slope indicates a rise or drop of one unit over a distance of 100 horizontal units. Usually the mapper will be working with feet; therefore, a one percent slope rise would indicate a one foot rise over a 100 foot horizontal distance.

## Elevation/Vertical Difference

Slope can be determined in several different ways in the field, or it can be calculated from a topographic map. A number of slope calculation aids are available in the form of tables that show the relationship between map scale and contour interval; contour overlays; and slope indicator overlays or templates. Use of slope calculation aids is limited by map scale and contour intervals, and most are designed to be used with USGS 7-1/2 minute quadrangle maps.

In order to obtain a slope percent from a topographic map, determine the difference in elevation between two different points in the area of concern. First determine the elevation of each location. To find the elevation of a point, locate the index contour nearest the point, and then count contour lines up or down to the point. Some computer software, like BEHAVE, will do the arithmetic automatically.

Next, subtract one elevation from the other, and the difference is the vertical difference (rise).

Estimating slope is a simple mathematical process. The formula is:

$$\text{PERCENT SLOPE} = \frac{\text{VD} \times 100}{\text{HD}} \text{ or } \frac{\text{RISE} \times 100}{\text{RUN}}$$

VD or RISE = Vertical Distance (difference in elevation between two points; subtract one point in elevation from the other point).

HD or RUN = Horizontal Distance measured with ruler on a map, from one point to the other).

Given:  $\frac{\text{RISE is } (500' - 100') = 400'}{\text{RUN is } 1600'}$

$$400 \div 1600 = .25$$

$$.25 \times 100 = 25\%$$

## **Slope Questions**

1. What can the estimated percent slope help you determine?
2. How is slope expressed?
3. A one foot rise over 100 foot horizontal distance indicates what?
4. What is the percent slope formula?
5. What is the definition of slope?

## Slope Exercise

Solve the following slope problems using the map on the next page. The map scale is 1:24,000.

1. What is the contour interval on the map?
2. Calculate slopes between the following points:  
  
A to B:  
  
C to D:  
  
E to F:
3. Traveling from Point F to Point E, is the direction of travel upslope or downslope?





### **Topography Answers**

1. A contour line is a line on a map or chart connecting all points of the same elevation.
2. Contour interval is the difference in elevation between two adjacent contour lines.
3.  $700 \text{ feet} - 500 \text{ feet} = 200 \text{ feet}$   
 $200 \text{ feet divided by } 5 = 40 \text{ feet}$   
40 foot interval
4. Yes, but only when indicating sheer or overhanging cliffs.
5. Steep terrain.
6. Depressions or pits.

### **Topography Exercise Answers**

1. 4160'
2. 4120'
3. 3640'
4. 4160'
5. 3520'
6. Hilltop
7. Flat terrain
8. Steep terrain
9. Ridge
10. Depression
11. Stream or drainage

### **Slope Answers**

1. Whether or not a dozer, engine, or hand crew can work in the area.
2. Slope is usually expressed in percent.
3. One percent slope rise.
4.  $\text{PERCENT SLOPE} = (\text{RISE divided by RUN}) \times 100$
5. Slope is an inclined ground surface that forms an angle with the horizontal plane (flat ground).

### **Slope Exercise Answers**

1. 40'
2. Vertical distance = 400'  
Horizontal distance = 3000'  
 $400 \div 3000 = .13$ , or 13%  
  
Vertical distance = 640'  
Horizontal distance = 1200'  
 $640 \div 1200 = .53$ , or 53%  
  
Vertical distance = 330'  
Horizontal distance = 1400'  
 $330 \div 1400 = .24$ , or 24%
3. Downslope