

## Intermediate Wildland Fire Behavior, S-290

### Pre-Course Work

The pre-course work is designed to ensure that students come to class with a basic understanding of the fire environment in order to learn Intermediate Fire Behavior concepts.

The pre-course work and reference documents should be reviewed and the pre test questions answered. Complete the pre-qualifying test using the information on the Student CD and in suggested reference materials.

When you have completed the pre-qualifying test, bring it with you for review on the first day of class.

### Maps

This section contains excerpts from the Map and Compass publication located on the Student CD.

### Objectives:

- Identify important elements found on a map legend.
- Identify features commonly found on topographic maps.
- Determine aspect from a topographic map.

A map is designed for the purpose of permitting you to visualize a portion of the earth's surface, drawn to a specified scale, with pertinent features properly positioned to facilitate planning and organizing operations. Maps, although drawn to a scale, are not absolutely accurate because they represent a curved and uneven surface on a flat piece of paper. Furthermore, photocopying, scanning, or other graphic reproductions can further skew a map. Care must be taken to ensure that the map you are using reflects true map distance to ground distance measurements.

**There are three basic types of maps: 1.**

#### Planimetric Maps

Planimetric maps show the positions of features without showing their relationship to the hills and valleys of the land. They can include rivers, lakes, roads, boundaries, or other human-made, symbolic features.

For example:

- a. Common road maps  
Road atlas, street maps, and Thomas Guides.
- b. Specific area maps  
Preplan maps, floor plan maps, storm drain, sewer and water system maps.
- c. Schematic maps  
Agency maps (unit, aviation, resource, district response maps).

## 2. Topographic Maps

Topographic maps show both the horizontal and vertical (relief) positions of features. Topographic maps are often referred to as quadrangles or quads, for example:

- a. Contour maps  
These are the most common method of representing the shape and elevation of the land. A contour is a line of equal elevation on the ground that delineates the same elevation above or below a specific reference elevation, usually sea level.
- b. Shaded-relief maps  
These are pictorial. They are shaded to simulate sunlight on the terrain. This shadow effect accentuates the shape of the physical features.

For fire behavior purposes, we generally work with topographic maps.

## 3. Orthophoto Maps

Orthophoto maps depict terrain and other features by color-enhanced photographic images. It is an aerial photograph of the land.

Some orthophoto maps are overlain with contour lines and other features commonly associated with topographic maps. These maps are corrected for scale and are the same size as U.S.G.S. quads.

### Key map parts:

Map Legend: A legend shows information needed to interpret a map. Each type of map has information represented in a different way relating to its subject matter. The legend can

explain map scales, symbols, and color.

Map Scale: The map scale indicates the ratio or proportion of the horizontal distance on the map to the corresponding horizontal distance on the ground.

Representative Fraction (R.F.) Scale: Expresses the ratio of the map distance to the ground distance in like units of measurements. It is usually written as a fraction or ratio. A representative fraction is always written with the map distance as one. A representative fraction of 1/24,000 (1:24,000) means that one UNIT of measurement (inches, millimeters, feet, etc.) on the map is equal to 24,000 of the SAME UNITS on the ground. You CANNOT mix units in a representative fraction. If it is one INCH on the map, it is 24,000 INCHES on the ground.

Graphic scale (G.S.) or Comparison Scale: This is entirely different. It usually COMPARES map distances to the ground distance in DIFFERENT units of measurements. Usually a graphic scale is a line marked off on a map indicating so many inches or millimeters equal so many feet, kilometers, chains, or miles on the ground. A comparison scale of 1" to 2000 feet means that 1 inch on the map is proportioned to 2000 feet on the ground. We are comparing inches and feet which are DIFFERENT UNITS of measurement.

Table 9, found in the *Fire Behavior Appendix B* is a useful tool to easily see map scale conversion factors of various representative fractions.

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.

Contour Interval: This 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, but not often.

Index Contour: To make the contours easier to read, every fifth one is printed darker and has the elevation marked every so often in the line. The thinner or lighter colored contour lines are called intermediate contours.

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

- 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 hachured (short lines extending from the contour line at right angles) contour line joined forming a circle.
- 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: 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.
- Slope: An inclined ground surface that forms an angle with the horizontal plane (flat ground). The degree of inclination, steepness, is also called slope.
- Aspect: The compass direction that a slope faces. By visualizing the contours on a topographic map, aspect can be determined even though the map is a flat surface. Widely spaced contours indicate a gentle slope, probably not a well defined aspect. But contours closely spaced indicate steep terrain and aspect can easily be determined.

**Intermediate Wildland Fire Behavior, S-290  
Pre-Qualifying Test**

Name: \_\_\_\_\_

Score: \_\_\_\_\_

Home Unit: \_\_\_\_\_

**Maps**

1. If there is a 1200 feet change in elevation, over a horizontal distance of one mile, what is the % slope?

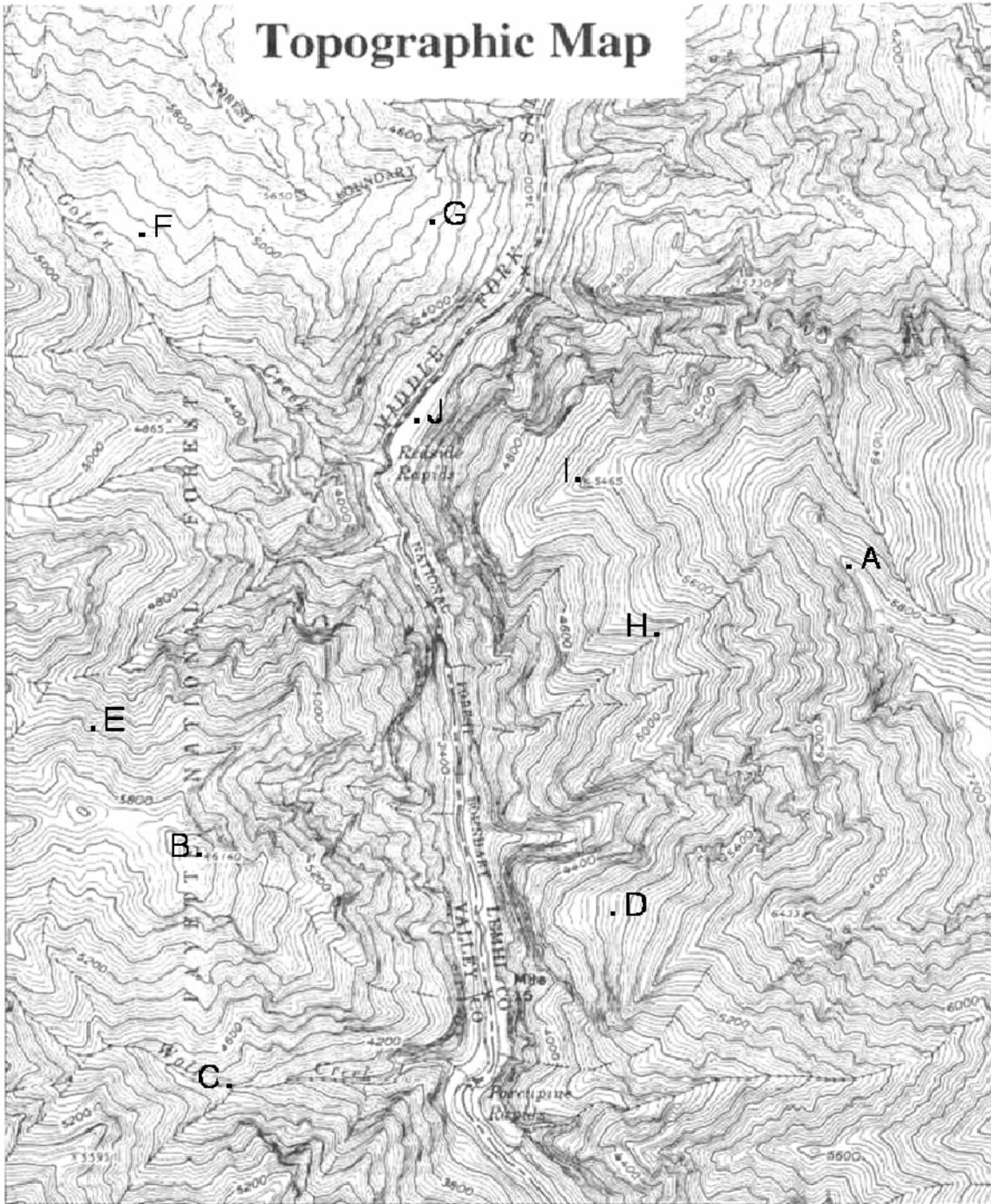
**Using the map provided on page 3.**

2. How many inches per mile does the map represent?
3. What is the map scale of this map? With inches as a unit of measure, what does this ratio mean?
4. One inch on this map equals how many feet on the ground?
5. What is the contour interval of your map?
6. What is an index contour?

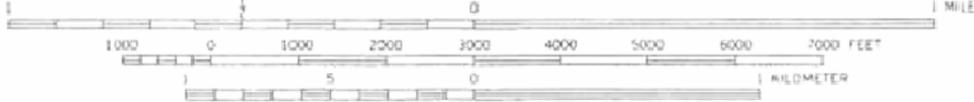
7. Choosing from the Map Feature List in the table below, write in the map feature displayed for each point.

Point Corresponding Map Feature	Map Feature List
A	North Aspect
B	East Aspect
C	Bench Mark
D	Canyon Bottom or Valley
E	West Aspect
F	Intersecting Drainage
G	Ridgeline
H	South Aspect
I	Intermittent Stream
J	Hill Top

# Topographic Map



SCALE 1:24 000



CONTOUR INTERVAL 40 FEET  
DOTTED LINES REPRESENT 20-FOOT CONTOURS  
NATIONAL GEODETIC VERTICAL DATUM OF 1929

## Basic Principles of Fire Behavior

**Objective:** Understand basic fire behavior principles presented in S-190, Introduction to Fire Behavior.

Review your student workbook from S-190 and you may also reference material pertaining to weather.

Recommended reference;

- *Mountain Meteorology; Fundamentals and Applications*, C. David Whiteman, 2000.

1. Three environmental factors that affect wildland fire behavior are:
  - a. fuels, solar radiation, weather
  - b. fuels, RH, temperature
  - c. fuels, weather, topography
  - d. large fuels, fine fuels, topography
2. List **three** factors of topography which can influence fire ignition and spread.
3. List five weather factors which may produce rapid fire spread.
4. What is the general wind?
5. What are local winds? Give two examples.

6. When a cold front or thunderstorm is expected, what is the most significant weather change you can expect?
  
7. Winds associated with a cold front are strongest when?
  
8. Describe the intensity and direction of the winds produced by a thunderstorm.
  
9. Describe the effect relative humidity has on wildland fire behavior.
  
10. List **four** visible indicators of a stable air mass, and **four** visible indicators of an unstable air mass.

Stable

Unstable

## Fuel Groups/Models

**Objective:** Introduce student to fire behavior fuel groups and general fuel model characteristics within each fuel group.

Review the article, "*Aids for Determining Fuel Models for Estimating Fire Behavior.*"

1. What are the four fuel groups in the Fire Behavior Prediction System (FBPS)?
2. For each fuel group, how many fuel models are in each?
3. Give the four fuel timelag categories used to classify dead fuel. Then give the range of fuel sizes for each category.
4. What fuel size is most responsible for the spread of fire?



1. What is the range in moisture of extinction within each of the four fuel groups? On which page of the appendix did you find your information?
  
2. Using the Fire Behavior Characteristics Chart for light fuels found on page B-57, list the major flame length divisions marked, and associated fireline intensities. For each of the major divisions, list interpretations that affect tactics and firefighter safety.
  
3. The spread rate of a going fire is 10 chains per hour, with three foot flame lengths.
  - a. What is the Heat per Unit Area?
  
  - b. What is the Fireline Intensity?
  
  - c. There is a 10-fold increase in rate of spread for this afternoon. What is the expected flame length and fire intensity?
  
4. At the moment, light winds are blowing across the fire, but in the distance, a large flag is fully extended. Looking at the tree tops, saplings are swaying violently, even some larger trees sway noticeably.

Use the Beaufort scale for estimating 20-foot windspeed in Appendix B and give a range of estimated windspeed based on these observations.

What might this indicate later in the day?