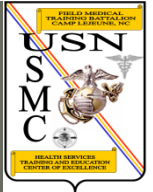


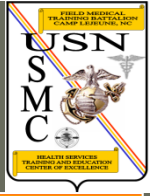


LAND NAVIGATION





OVERVIEW



- Information Contained on a Map
- Map Colors
- Contour Lines
- Measuring Distance
- Locate Position
- Lensatic Compass
- Orientation of the Map



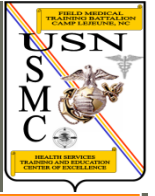
LEARNING OBJECTIVES

Please Read Your

Terminal Learning Objectives

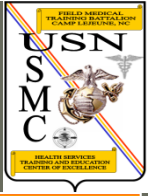
And

Enabling Learning Objectives



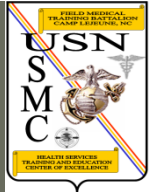


INFORMATION ON THE MAP





PURPOSE OF A MAP

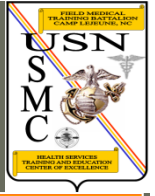


- Provides information on the existence, the location, and the distance between ground features





DEFINITION OF A MAP



- A geographic representation of the earth's surface drawn to scale as seen from above





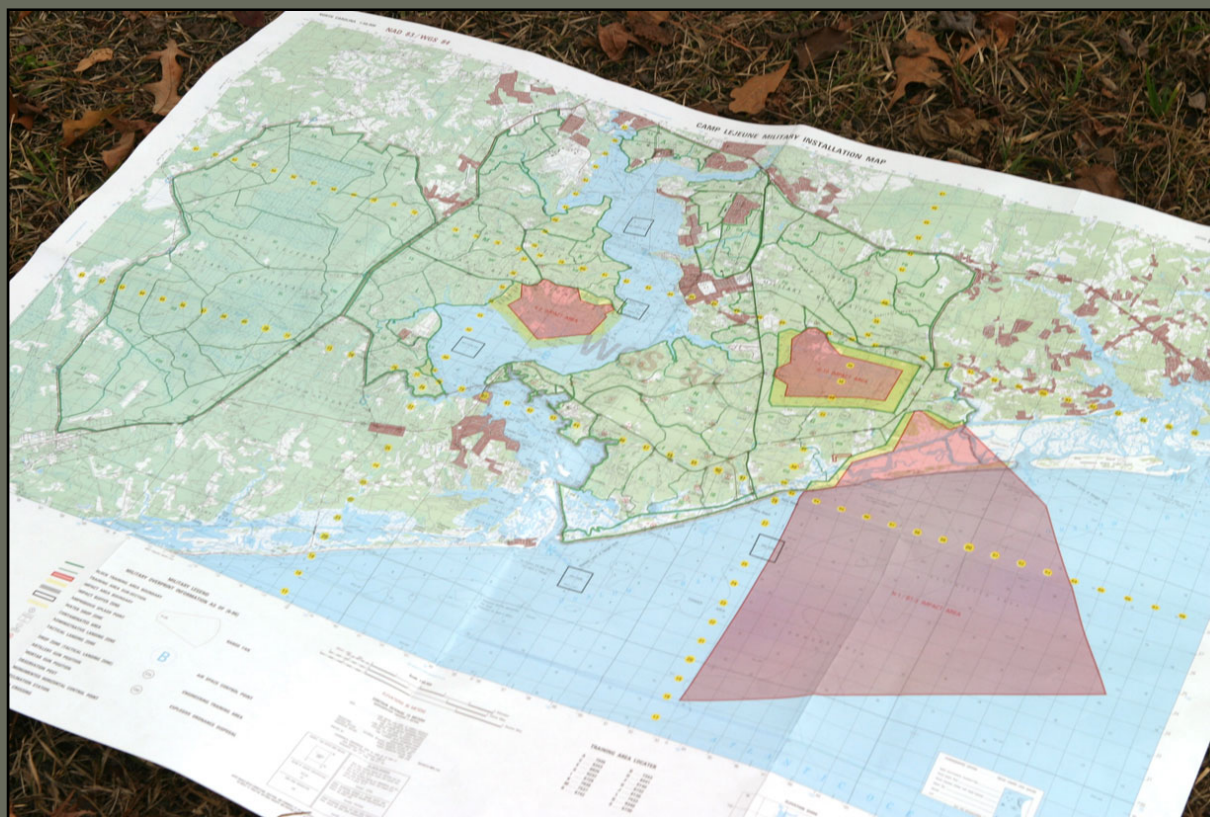
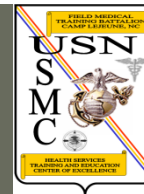
CHARACTERISTICS OF A MAP

- Designed to show common info
- Location of ground objects
- Populated areas
- Routes of travel
- Communications Lines
- Extent of vegetation cover
- Elevation and relief of the earth's surface



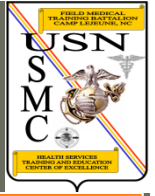


CARE AND IMPORTANCE





CARE AND IMPORTANCE

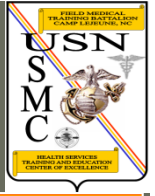


- Maps are printed on paper and require protection from:
 - Water
 - Mud
 - Tearing





CARE AND IMPORTANCE

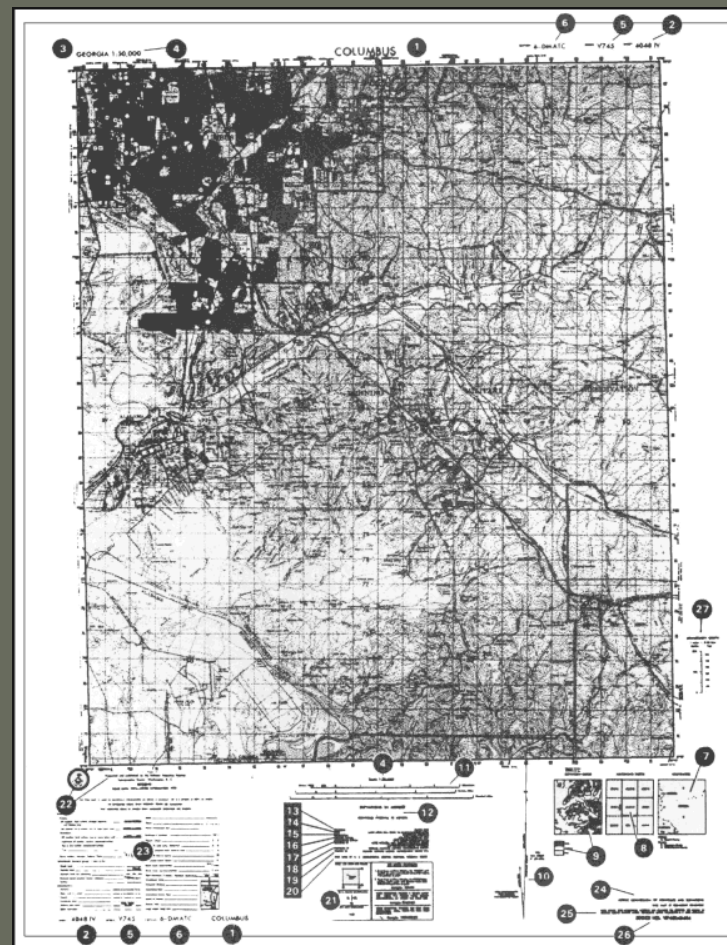


- When marking:
 - Use lighter lines which are easily erased without smearing
- If trimming the map:
 - Be careful not to cut any of the marginal information



CARE AND IMPORTANCE

- Maps must be protected because they can hold tactical information:
 - Friendly Positions
 - Supply Points



MAP ILLUSTRATIONS

- Mapmakers use standard symbols
- They represent natural and manmade features
- Resemble as close as possible, the actual features but as viewed from above



New River

- 1 HMM-263: Building AS 1408
(New River flightline)

Cherry Point

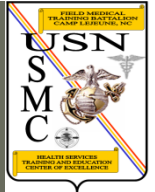
- VMA-542: VMA-542 hanger
MALS-14: VMA-542 hanger
MACG Det: Building 4398

7/29/00

MARGINAL INFORMATION

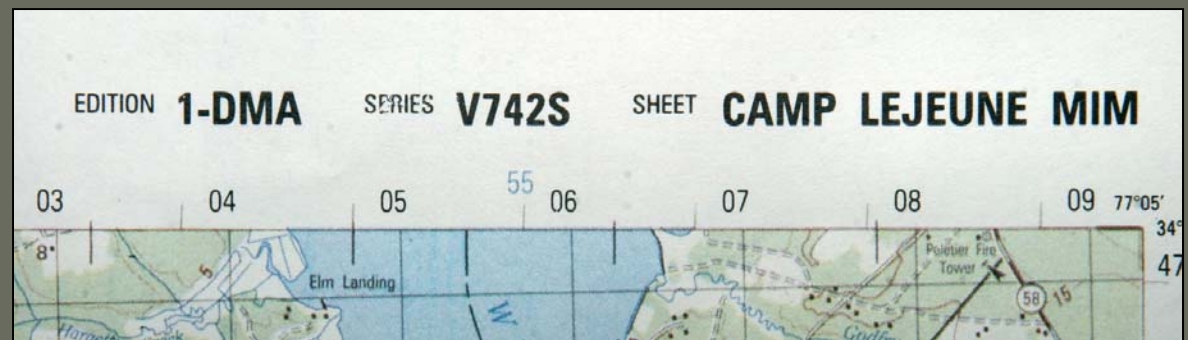
- All maps are not the same, so it becomes necessary every time a different map is used to examine the marginal information carefully





MARGINAL INFORMATION

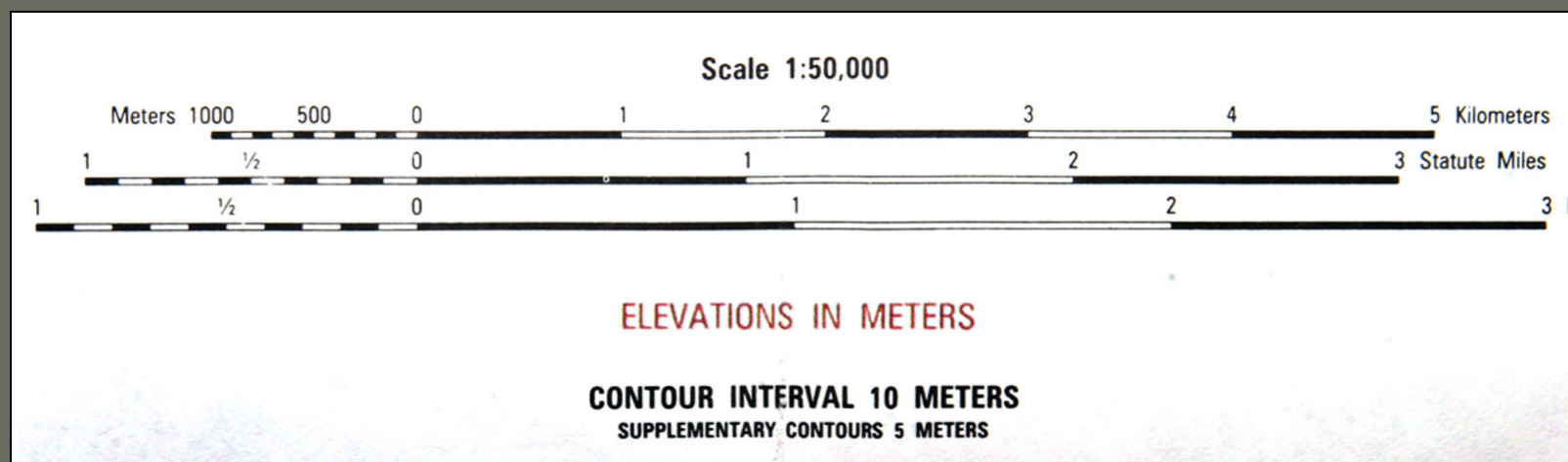
- Includes:
 - Margin of Information
 - Sheet Name
 - Series Name
 - Series Number
 - Scale Notation
 - Edition Number
 - Index to Boundaries





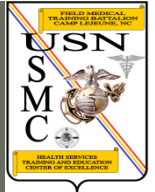
MARGINAL INFORMATION

- Contour Interval:
 - Appears in the center lower margin
 - States the vertical distance between adjacent contour lines on the map





MARGINAL INFORMATION

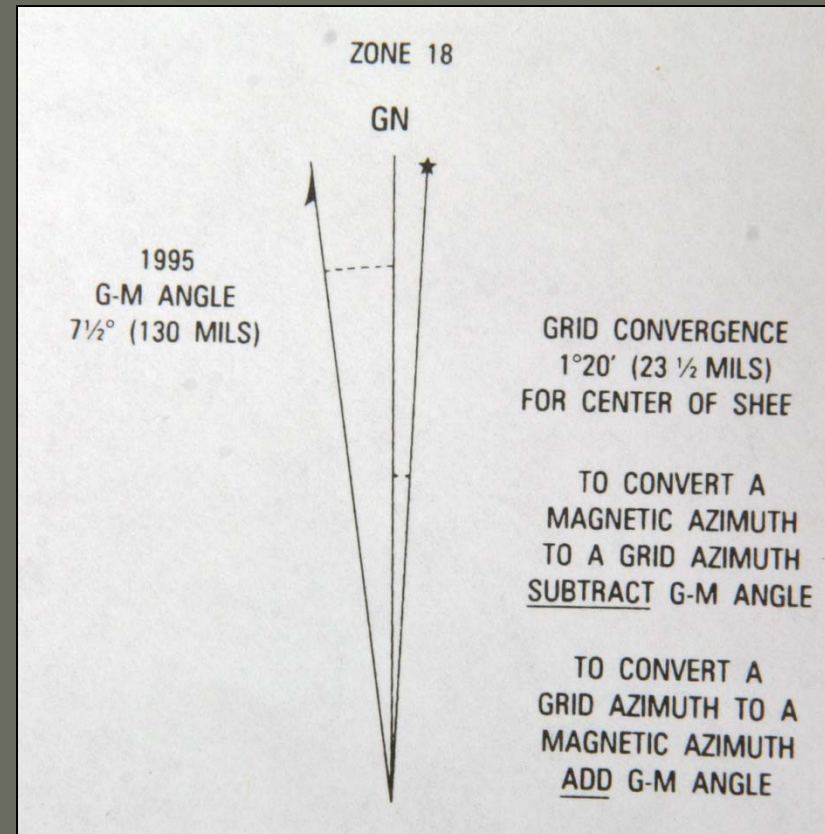


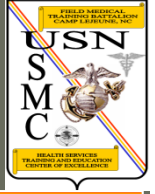
- Grid Box:
 - Gives basic instruction on reading grids in determination of specific points on the map



MARGINAL INFORMATION

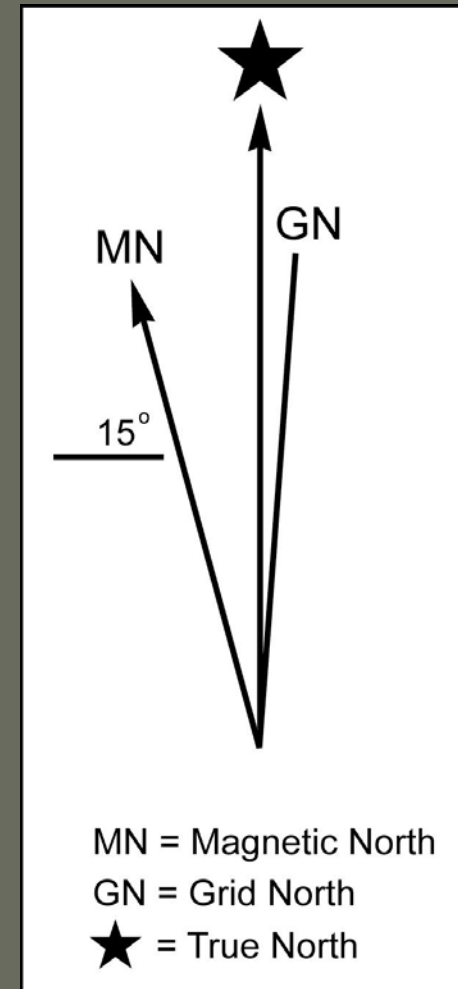
- Declination Diagram:
 - It is located in the lower left margin of the large scale on the map and indicates the angular relationship of:
 - True North
 - Grid North
 - Magnetic North





MARGINAL INFORMATION

- True North:
 - A line from any position on the earth's surface connects at the North Pole
 - Unlike grid lines, all lines of longitude are true north lines



MARGINAL INFORMATION

- Magnetic North:
 - The direction to the North Magnetic Pole, as indicated by the north seeking needle of a magnetic compass
 - The North Magnetic Pole is located in Canada at Hudson Bay.

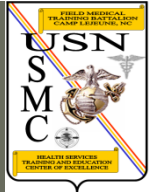




MARGINAL INFORMATION

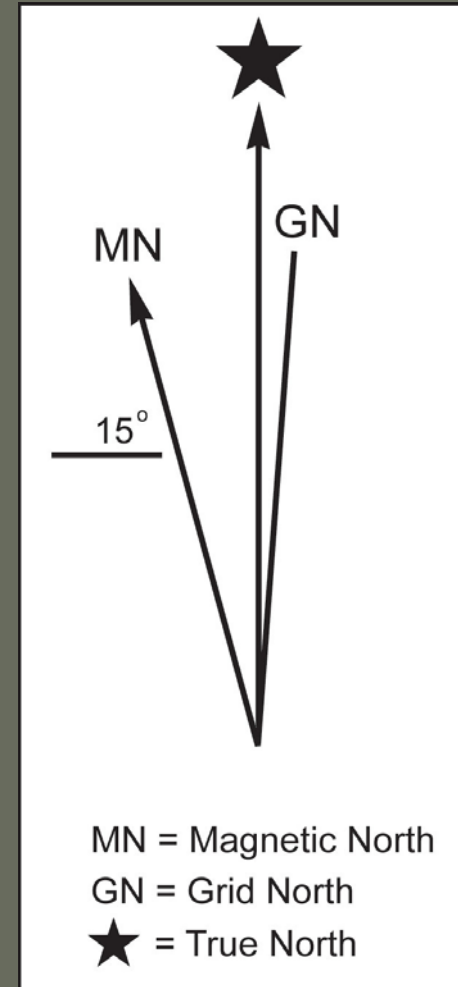


- Grid North:
 - The north that is established by the vertical grid lines on the map
 - The variation between grid north and true north is due to the curvature of the earth



MARGINAL INFORMATION

- Grid Magnetic (GM) Angle:
 - The GM angle is used to convert magnetic azimuth to grid azimuth and vice versa





MARGINAL INFORMATION

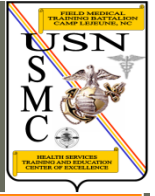


- Grid Magnetic (GM)
Angle:
 - Determine the Grid azimuth with a protractor, measuring from Grid North
 - Magnetic Azimuth is taken from a compass and measured from Magnetic North





NOTE

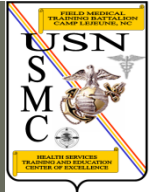


To convert one azimuth to the other, simply read the directions in the declination diagram

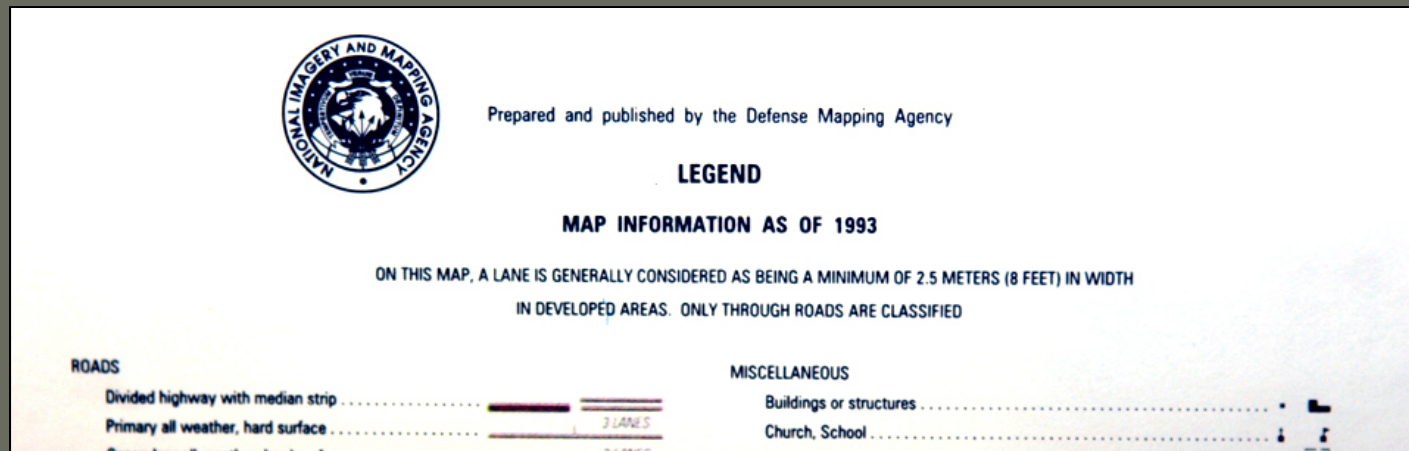




MARGINAL INFORMATION

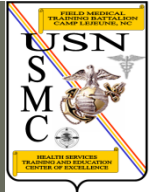


- Legend:
 - Located in the lower left margin
 - Illustrates and identifies some of the symbols on the map





MARGINAL INFORMATION



- Legend note:
 - Every time a map is used, refer to the Legend to prevent errors in symbol identification

LEGEND

ROADS

Divided highway with median strip	
Primary, all weather, hard surface	
Secondary, all weather, hard surface	
Light duty, hard or improved surface	
Fair or dry weather, unimproved surface	
Trail	
Route markers: Interstate; Federal; State	
Bridge	

RAILROADS (Standard gauge 144 m. - 4'8 1/2")

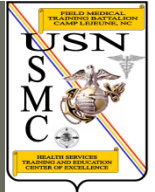
Single track	
Multiple track	
Nonoperating	
Railroad station: Location known	
Car line	
Railroad bridge	
Tunnel: Highway; Railroad	

BOUNDARIES

National, with monument	
State, territory	
County, parish	
Civil township, town	
Incorporated city, village, town	
Reservation: National; State; Military	

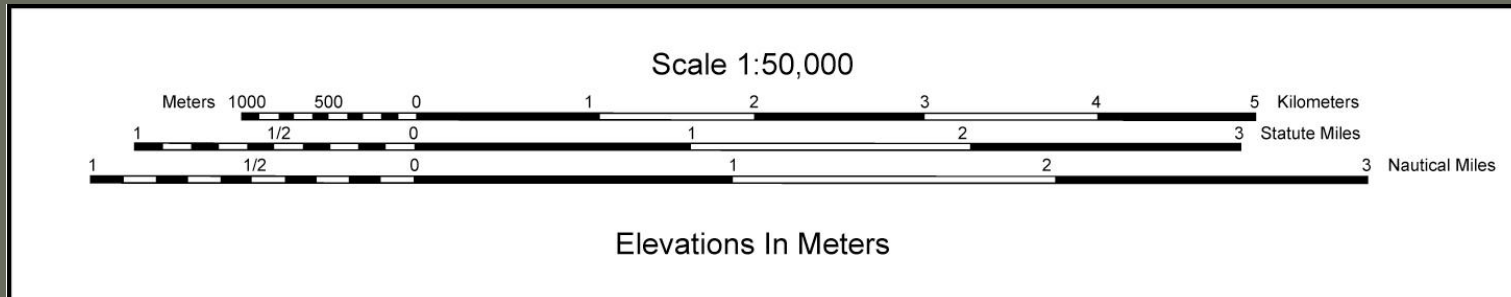
Power transmission line	
Buildings	
Structures	
Church; School	
Power substation	
Windmill; Watermill	
Well; Tank	
Mine shaft	
Open pit mine or quarry	
Horizontal control station	
Bench mark, monumented	
Bench mark, non-monumented	
Spot elevations in meters	
Levees, rims, dikes	
Bluffs, cliffs	

Woodland	
Scattered trees; Scrub	
Vineyard; Orchard; plantation	
Intermittent lake; Dam; Earthen; Masonr	
Stream: Perennial; Intermittent	
Marsh, swamp	
Small falls; Large falls	
Small rapids; Large rapids	



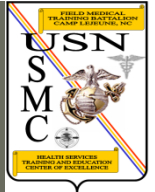
MARGINAL INFORMATION

- Bar Scales:
 - Located at the center bottom of the margin
 - Special "rulers", ground distance may be measured directly without having to convert the map scale ratio
 - Normally, the scale for meters, yards, statute miles (land) and nautical miles (sea)





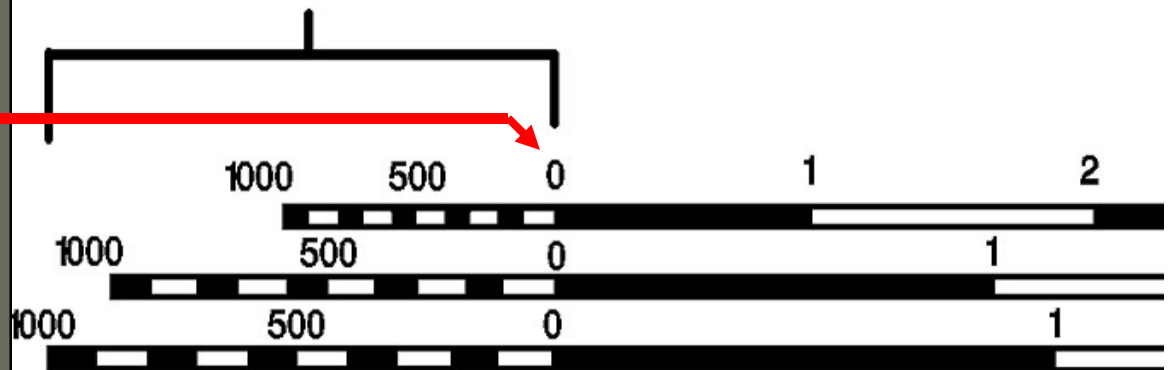
MARGINAL INFORMATION



- Extension scale:

Easy to use, but notice that “zero” is not at the end of the scale.

EXTENSION SCALE





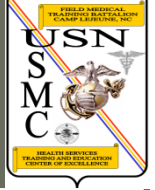


MAP COLORS



- To ease the identification of features on the map, the topographic symbols are usually printed in different colors, with each color identifying a class of features



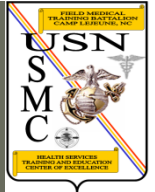


MAP COLORS

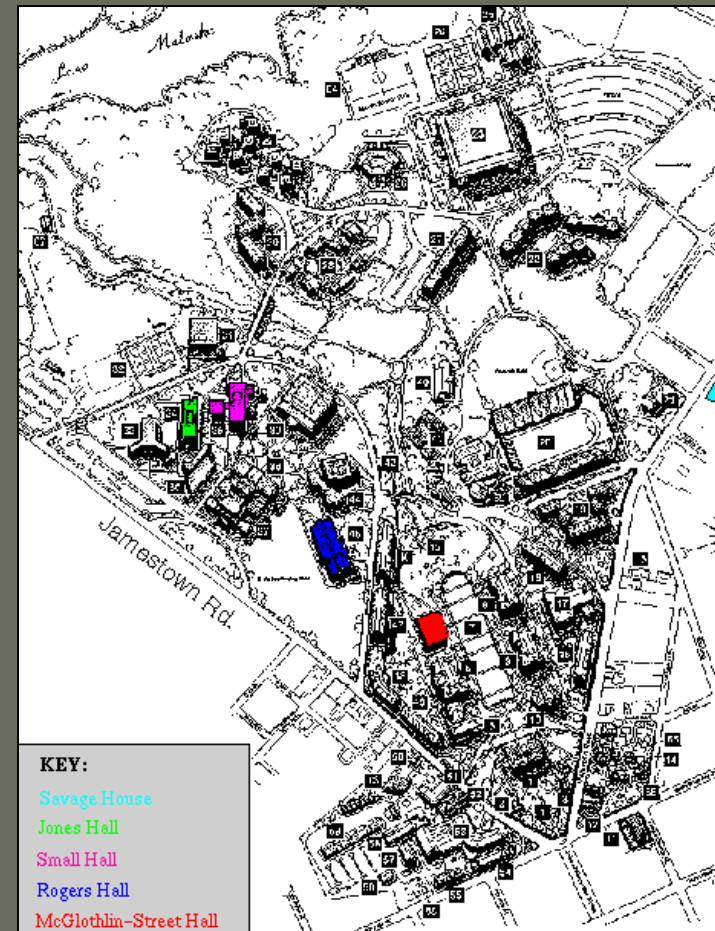
- The colors vary with different types of maps, but on a standard, large scale, topographic map, there are five basic colors:
 - **Black**
 - **Red**
 - **Blue**
 - **Green**
 - **Red / Brown**



MAP COLORS

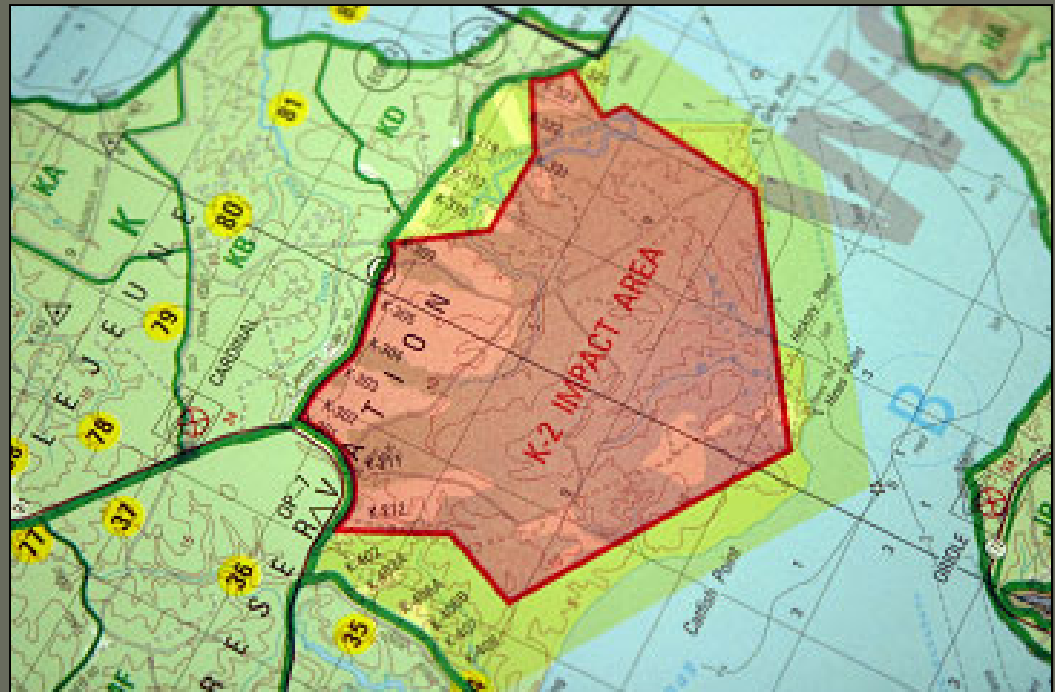


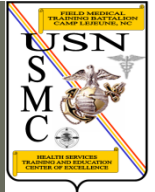
- Black
 - Used to identify the majority of cultural or man made features:
 - Buildings
 - Bridges
 - Roads not shown in red



MAP COLORS

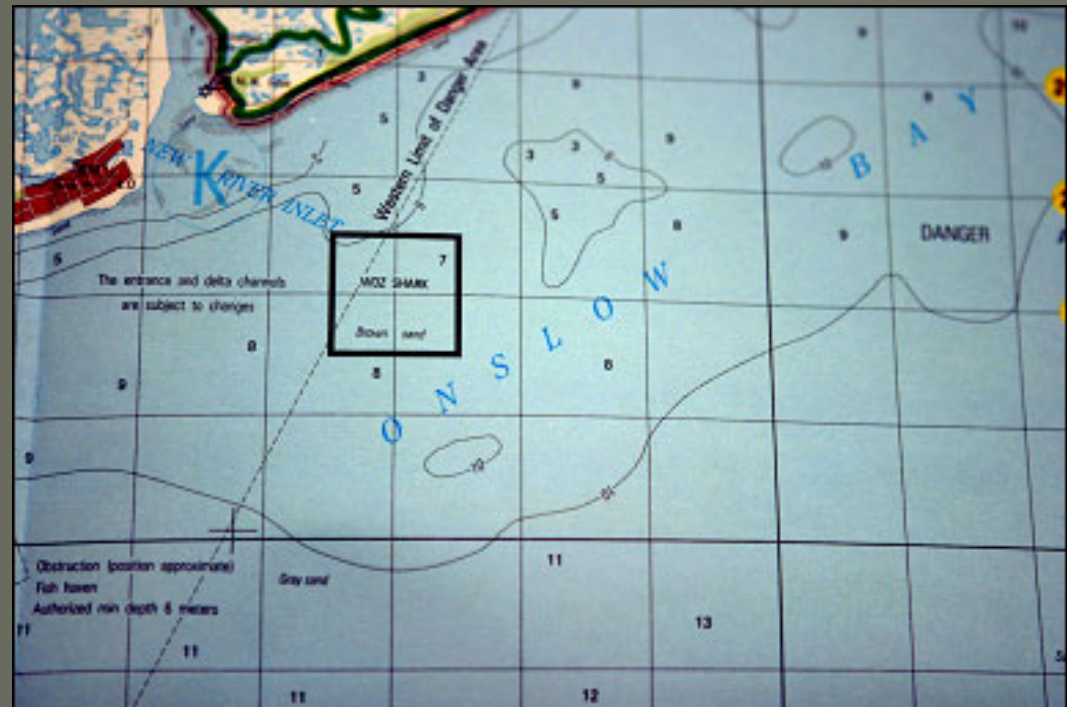
- Red
 - Main roads, built up areas, and special features such as dangerous or restricted areas





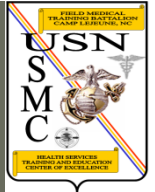
MAP COLORS

- Blue
 - Water features
 - Lakes
 - Rivers
 - Swamps
 - Streams





MAP COLORS



- Green
 - Identifies vegetation
 - Woods
 - Orchards



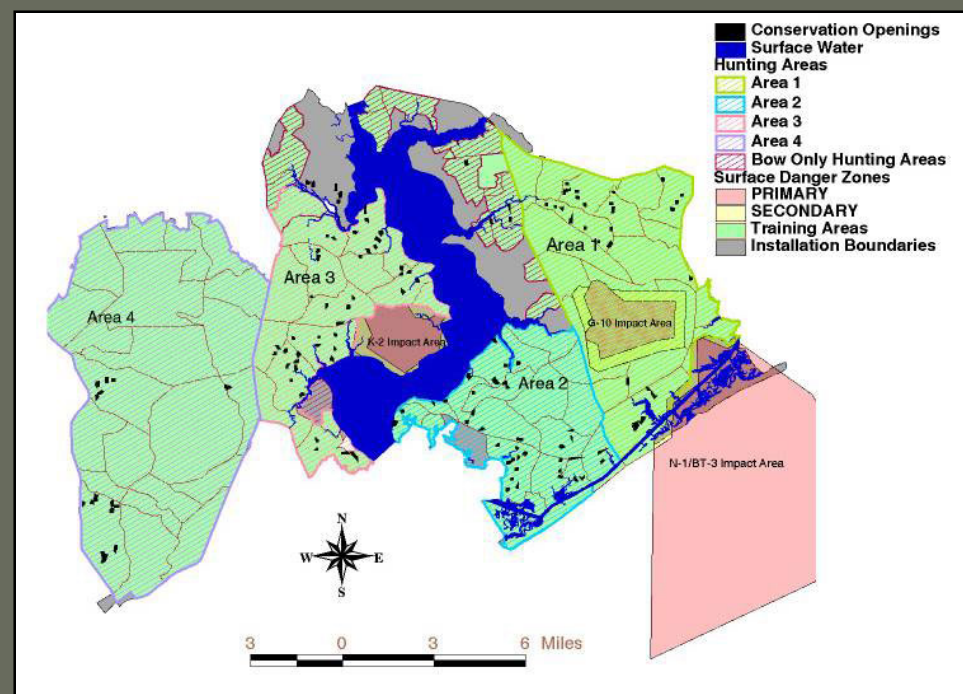
MAP COLORS

- Red / Brown
 - All landforms:
 - Contours
 - Fills
 - Cuts



NOTE

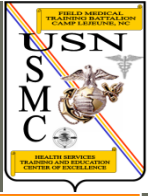
Occasionally other colors may be used to show special information. These will be indicated in the margin for information.







CONTOUR LINES



FMST 305

CONTOUR LINES

- Contour Lines:
 - Most common way of indicating elevation and relief on maps
 - A line representing an imaginary line on the ground, along which all points are at the same elevation





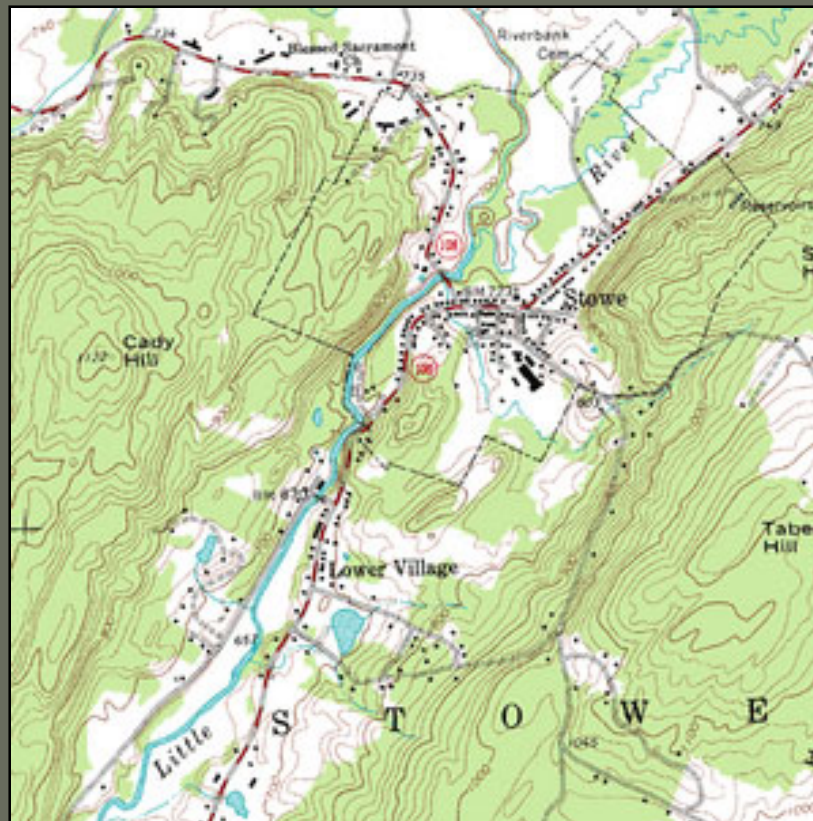
CONTOUR LINES

- Contour Lines:
 - Printed **red-brown**, starting at zero elevation
 - Every fifth contour line is a heavier brown line
 - These heavy lines are known as index contour lines. Also, some place along this heavy brown line, the elevation is given



CONTOUR LINES

- Spacing of Contour Lines:
 - Indicate the nature of the slope
 - The closer the contour lines, the steeper the slope



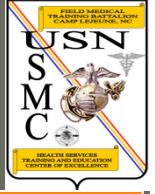
LAND FORMATIONS

- Hill:
 - A point or small area of high ground





LAND FORMATIONS

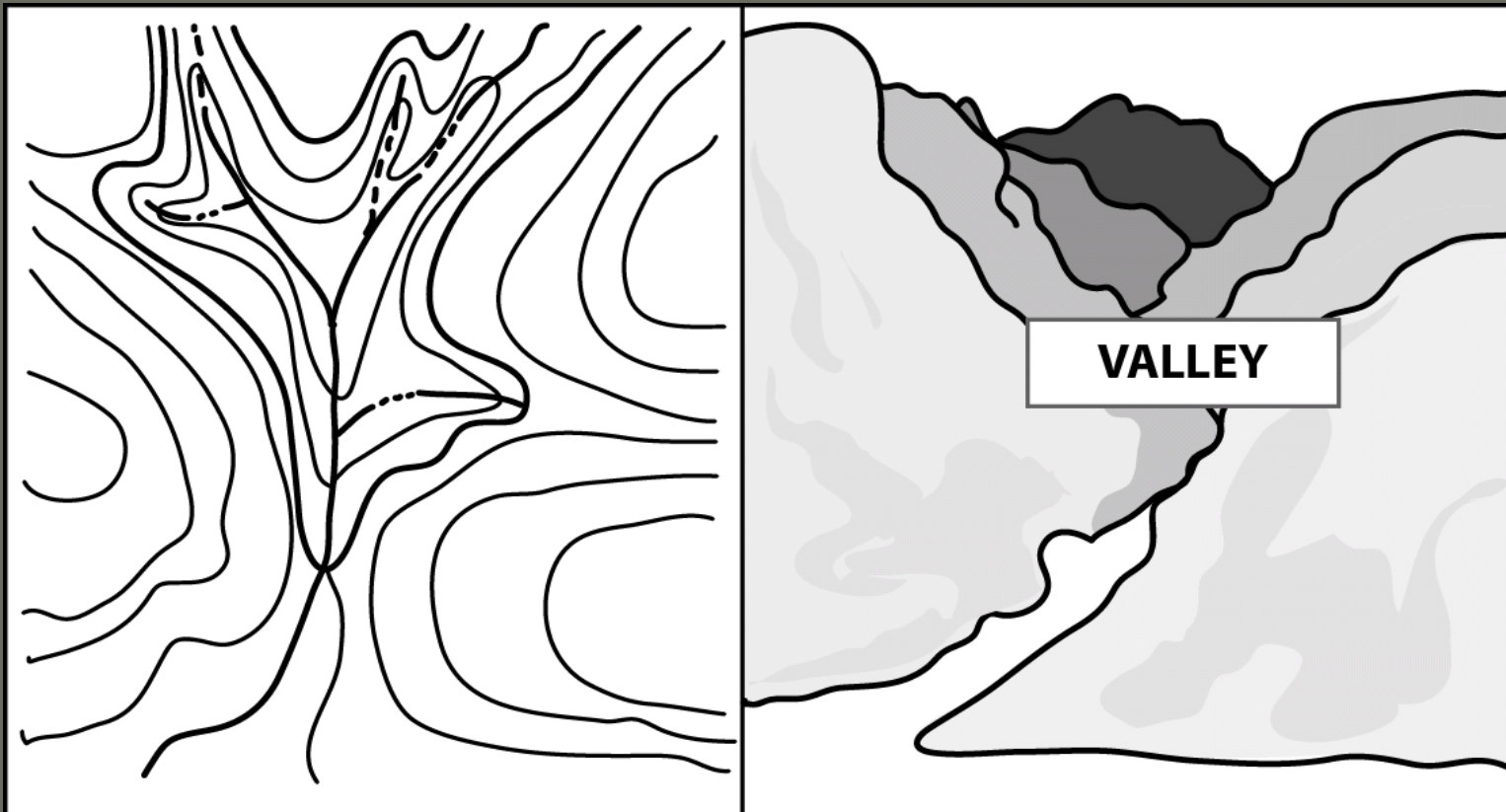


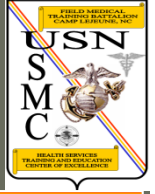
- Valley:
 - A stream course bordered on the sides by higher ground
 - Contours indication a valley are "U" shaped, and the curve of the contour crossing always points up





LAND FORMATIONS



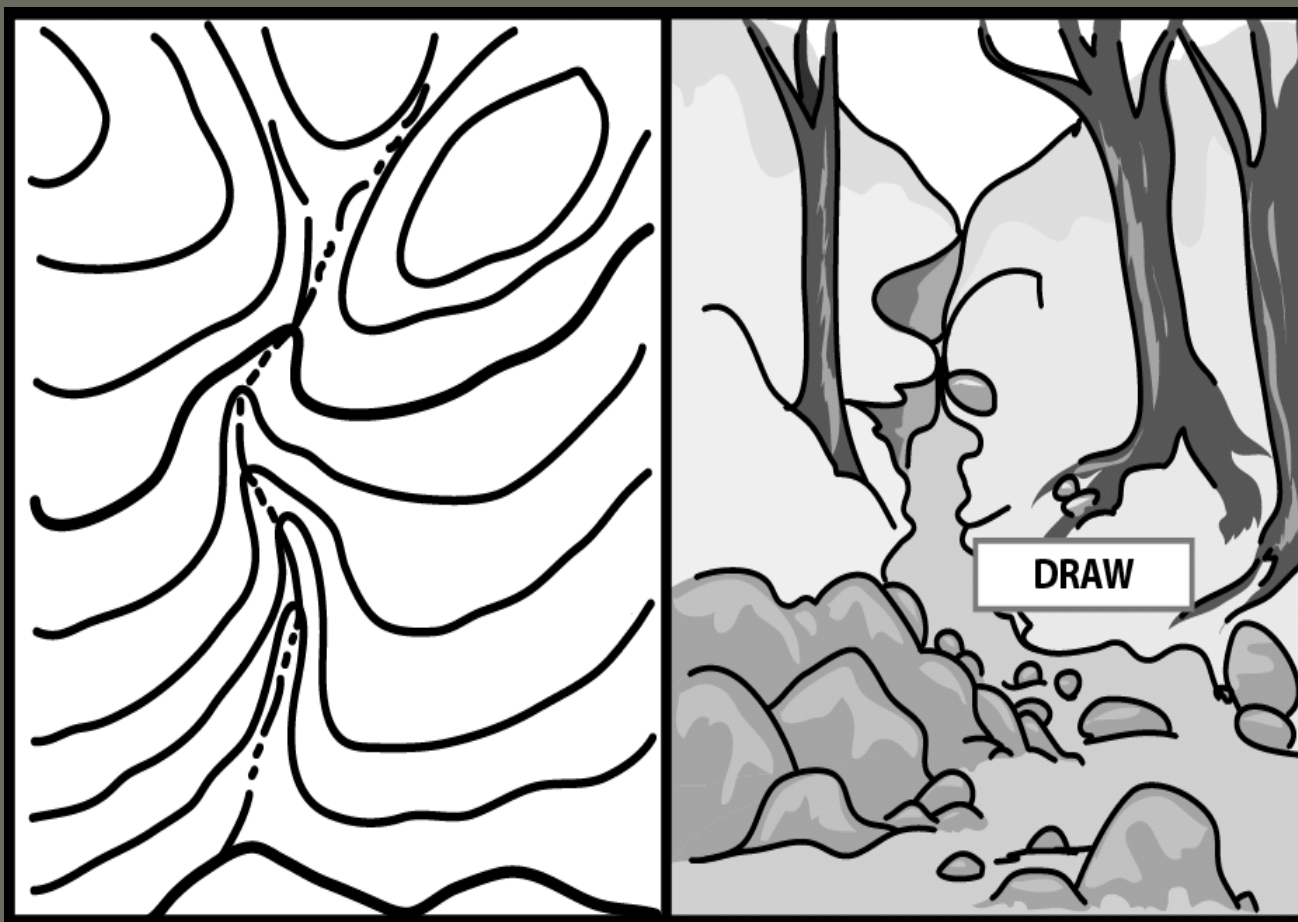


LAND FORMATIONS

- Draw:
 - A less developed stream course in which there is essentially no level ground, therefore, has little or no maneuver room within its confines
 - The ground slopes upward on each side and towards the head of the draw, contours indicating a draw are "V" shaped, with the point of the "V" toward the head of the draw

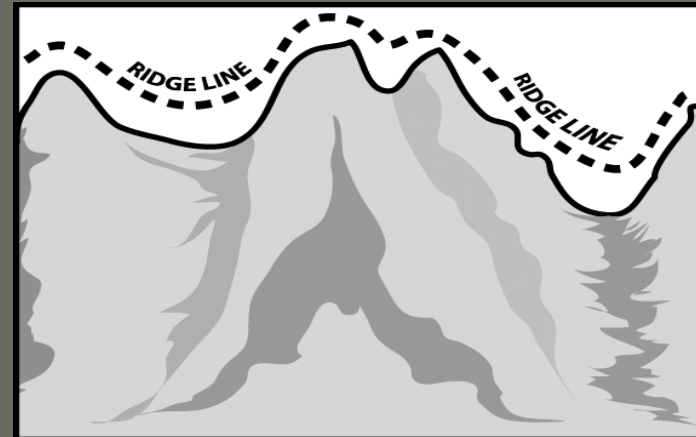


LAND FORMATIONS



LAND FORMATIONS

- Ridge:
 - A line of high ground, with normally minor variations along its crest
 - The ridge is not simply a line of hills, all points of the ridge crest are higher than the ground on both sides of the ridge



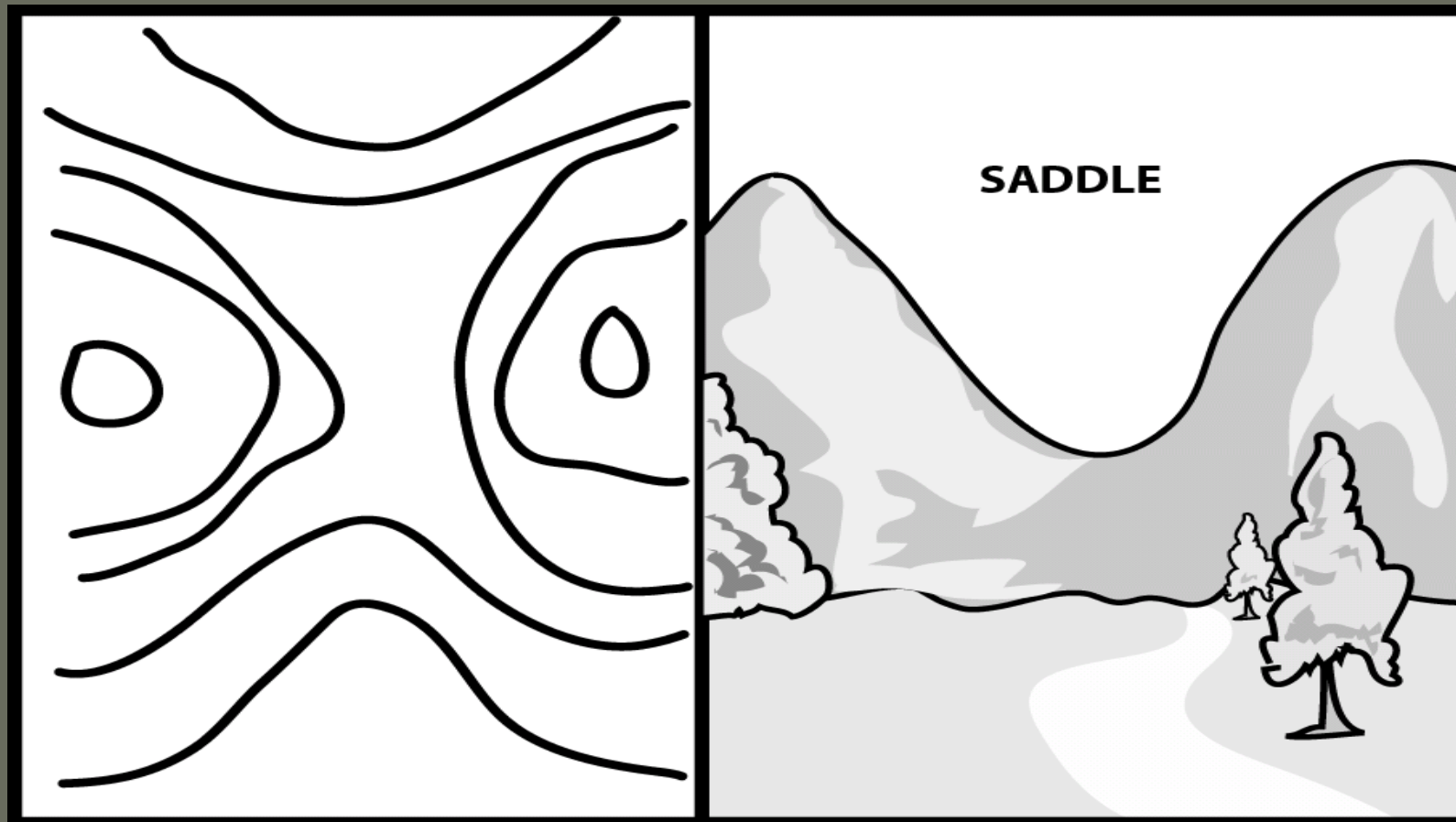
LAND FORMATIONS

- Saddle:
 - A dip, or low point along the crest of a ridge
 - A saddle is not necessarily the lower ground between two hilltops, it may simply be a dip or break along an otherwise level ridge rest



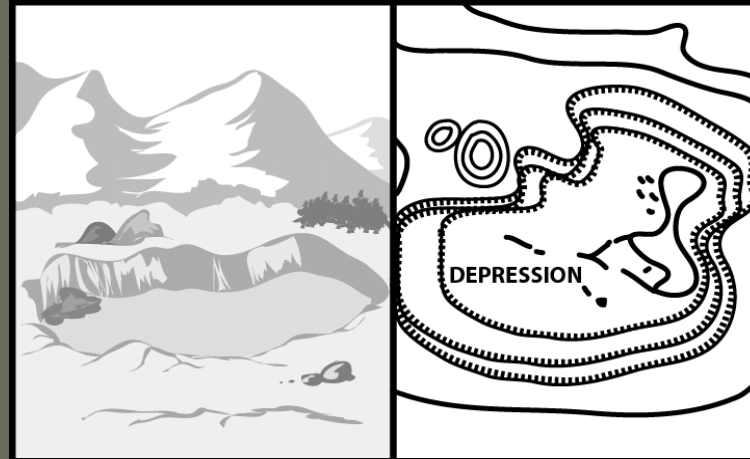


LAND FORMATIONS



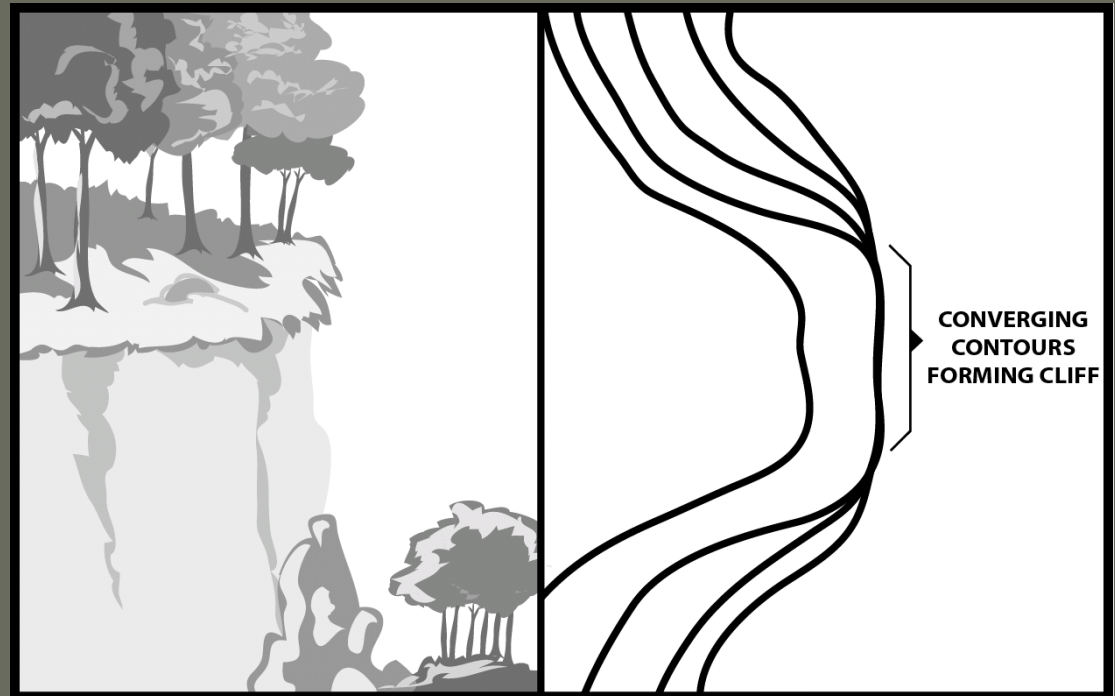
LAND FORMATIONS

- Depression:
 - A low point or sinkhole, surrounded on all sides by higher ground



LAND FORMATIONS

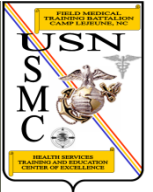
- Cliff:
 - A vertical, or near vertical, slope





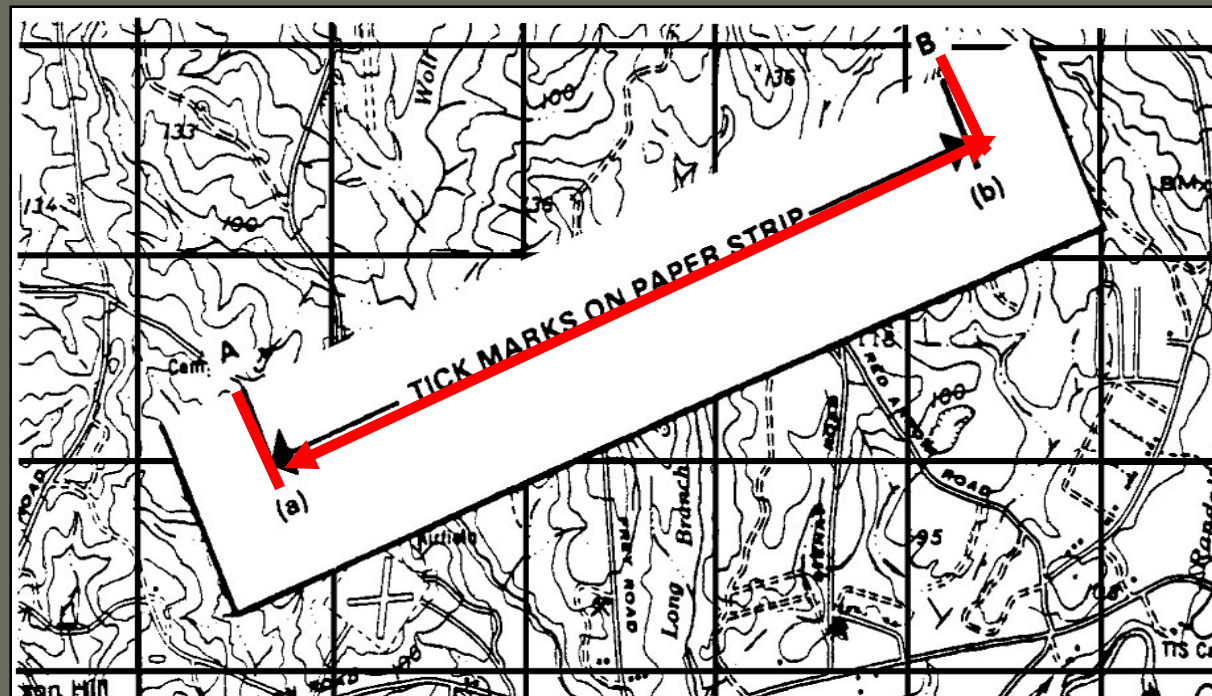


MEASURING DISTANCE



MEASURING DISTANCE

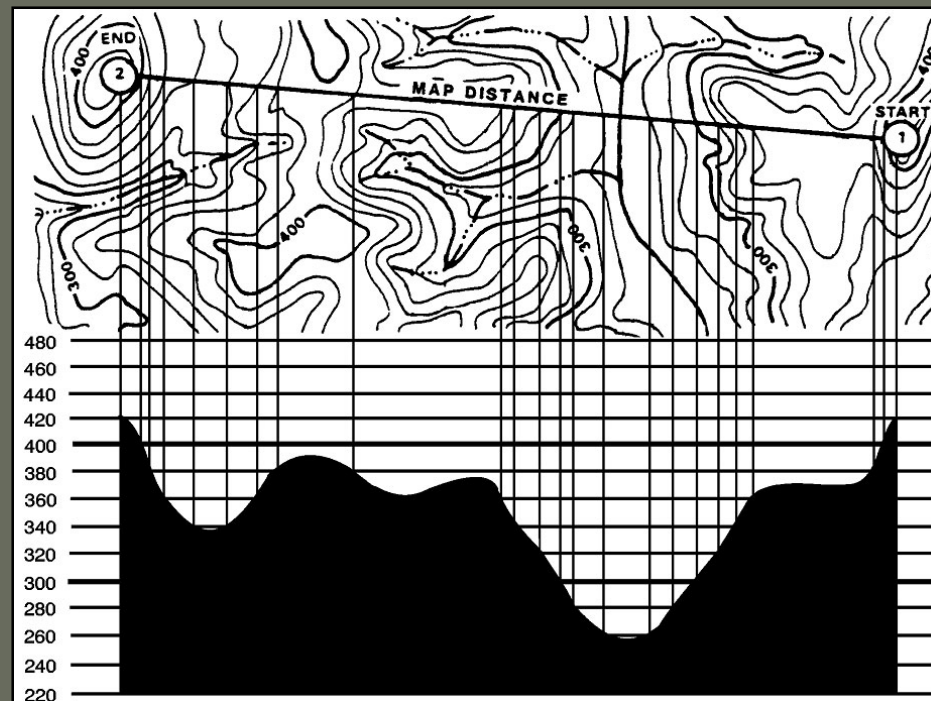
- Straight Line Distance:
 - Distance between 2 points





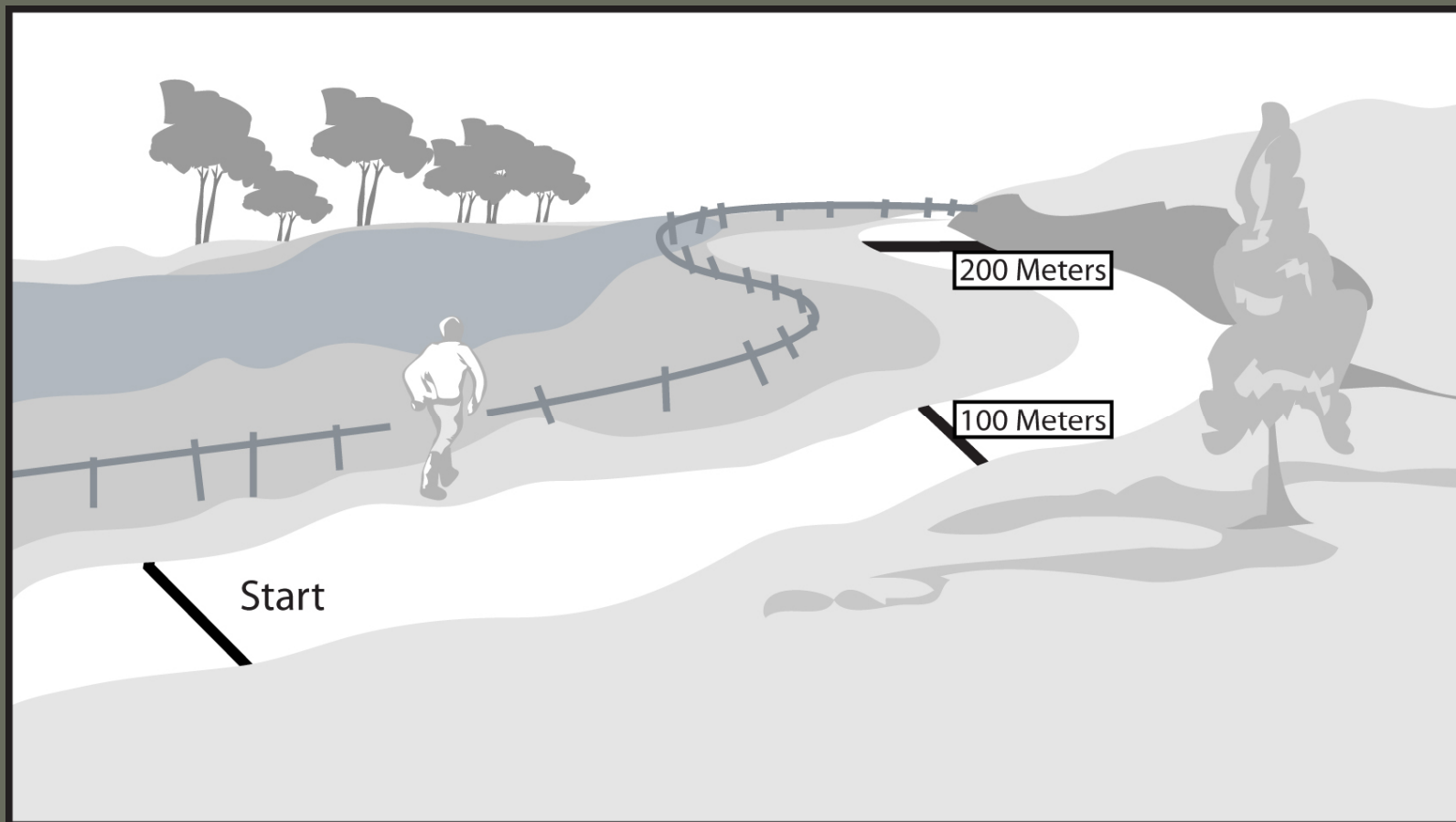
MEASURING DISTANCE

- Curved or Irregular Distance:
 - Measure distance along:
 - A winding road
 - Stream
 - Any other curved line





PACE COUNT





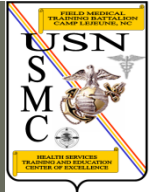
PACE COUNT



- Used to keep a record of ground distance
- Record your count in 100-meter increments
- Step off with your left foot and count every time the left foot hits the deck



PACE COUNT

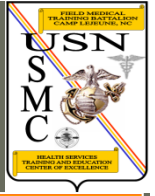


- Record your 100-meter increments by putting a knot in a rope or piece of string





PACE COUNT EXAMPLE

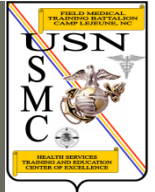


- A student is walking an azimuth of 25°
- That person must travel in this direction for 500 meters to reach object
- The student's pace count equals 65 paces for 100 meters





PACE COUNT EXAMPLE



- To figure out how many paces the student must take:
 - Multiply your pace count by the distance:
 - $(500m \div 100m) \times 65 = 325$ paces for 500m





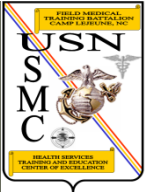


LOCATE POSITION





PROTRACTOR



The protractor is a tool used to locate the position on a map.

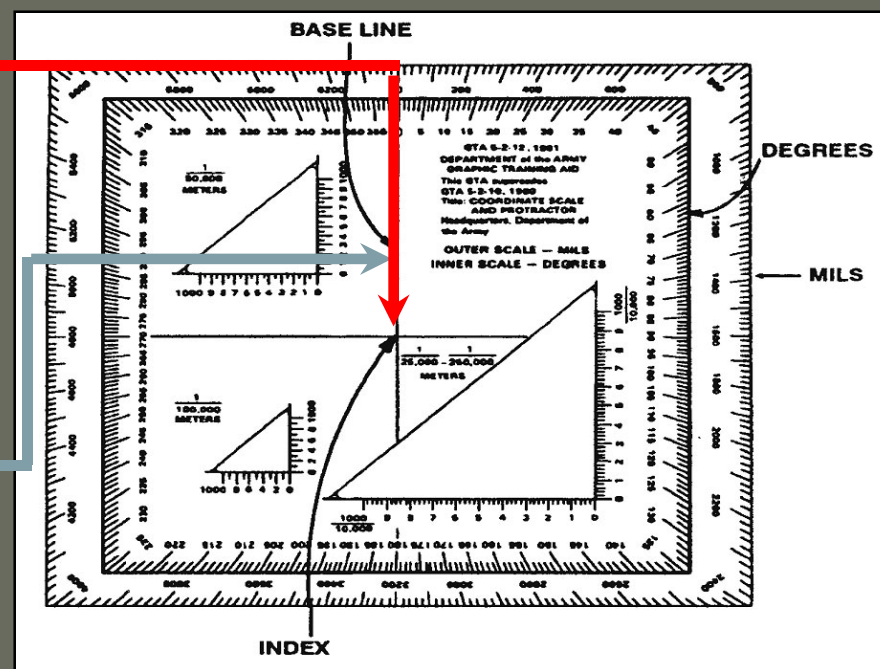


PROTRACTOR

- Index Mark:
 - Center of protractor from which all directions are measured
- Degrees:
 - Graduated in 1° tick marks (0° - 360°)
 - 0° - 180° is called Base Line

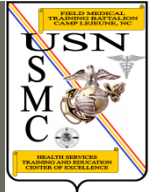
Index Mark

Base Line



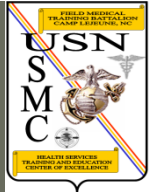


THE GRID SYSTEM



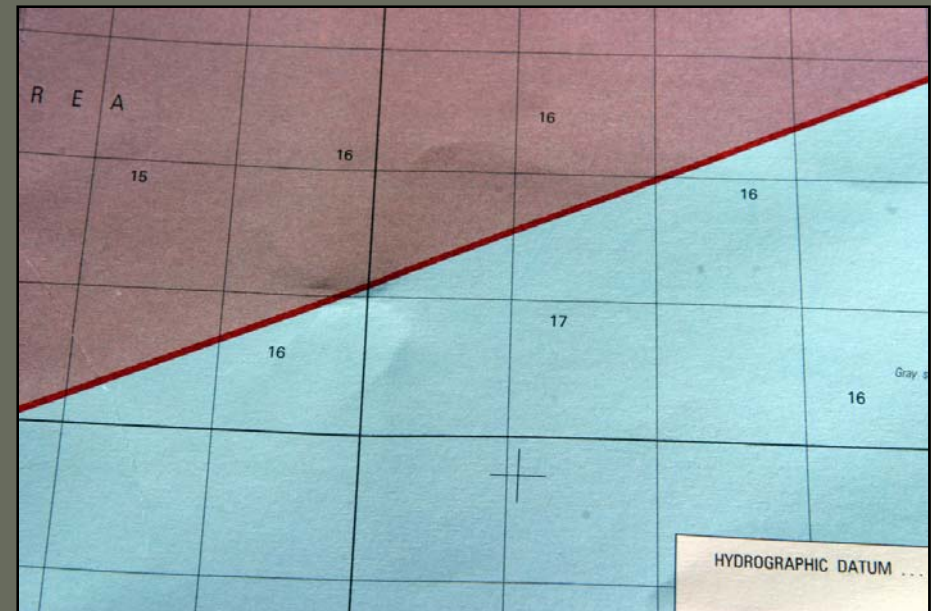
The protractor is used in conjunction with the maps grid system to locate position (s).

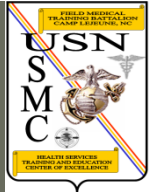




THE GRID SYSTEM

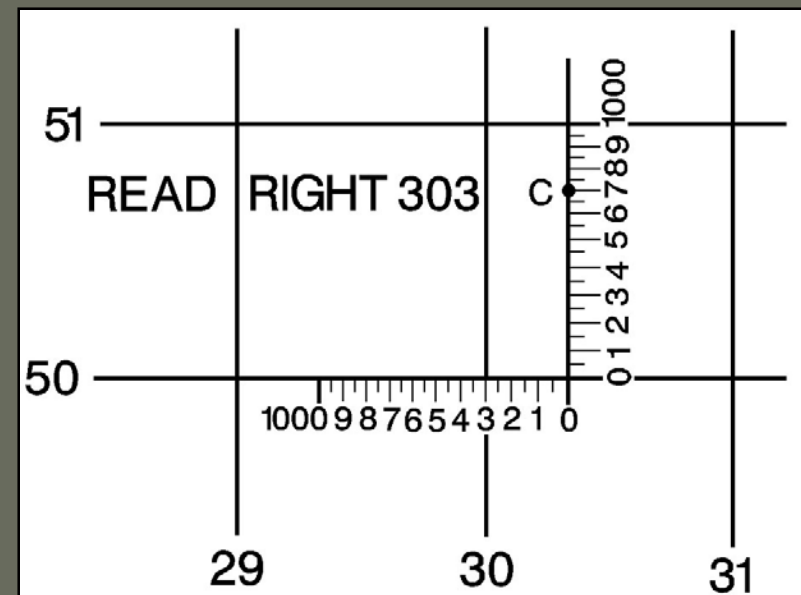
- Tells someone where specific locations or points are
 - A network of lines, in the form of squares placed on the face of the map





THE GRID SYSTEM

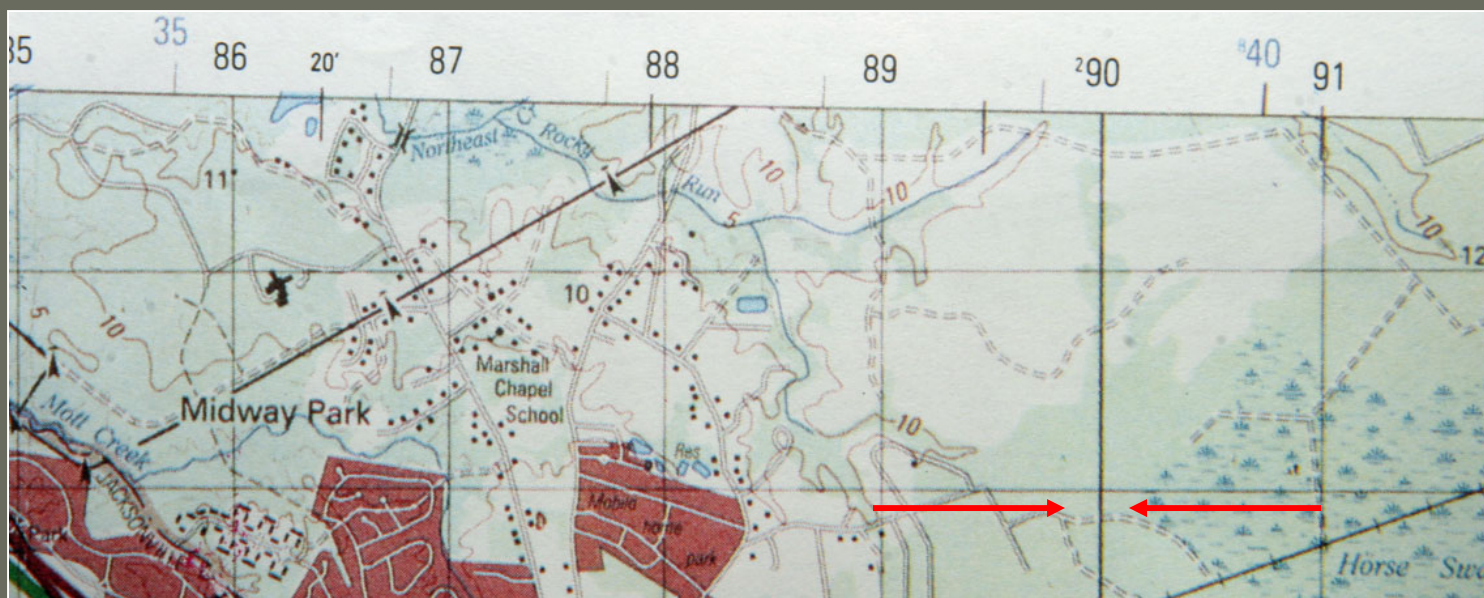
- Squares are somewhat like the blocks formed by the street system of a city
- The "streets" in a grid all have very simple names
- The names are all numbers





THE GRID SYSTEM

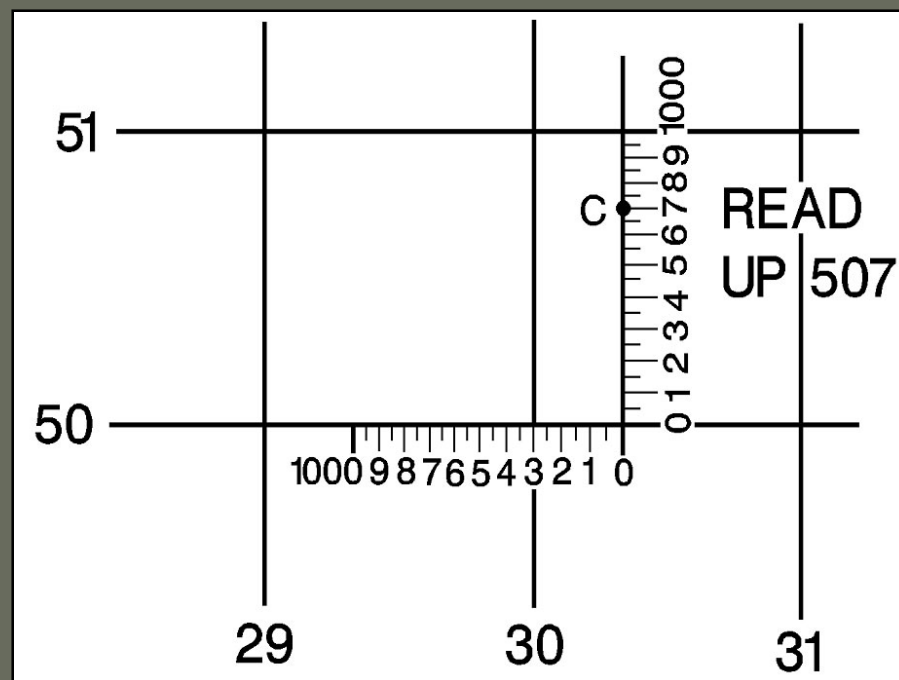
- Every tenth line is made heavier in weight
- This will help you find the line you are looking for
- Each grid line on the map has its own number

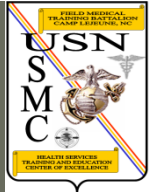




THE GRID SYSTEM

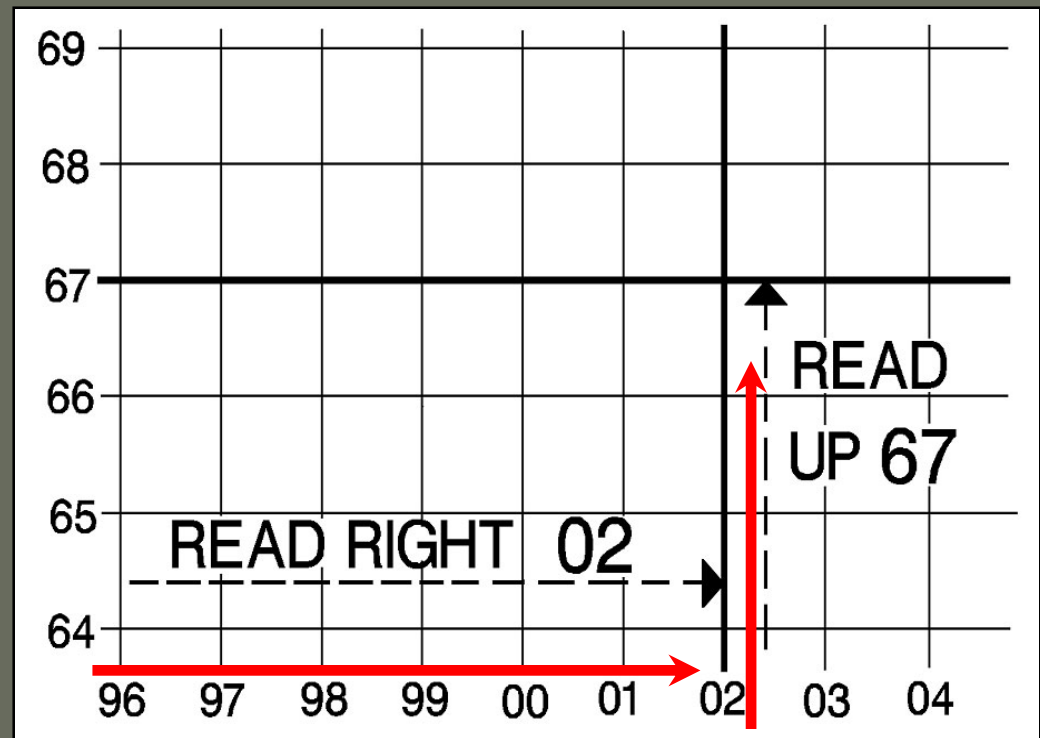
- Four digit numbers identify a 1,000 square meter grid square
- Six digits identify:
 - 100-meter grid square
- Eight digits identify:
 - 10-meter grid square





THE GRID SYSTEM

- Map Reading Rule:
 - Read Right and Up





SKILLS CHECK



SKILLS CHECK



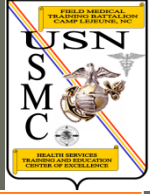
What is located at grid coordinates?

A: 68558380

B: 64807880



SKILLS CHECK



What is located at grid coordinates?

A:68558380 Potable tank water storage

B:64807880 School, Hospital, Fence



SKILLS CHECK



What is the distance
between points A and B?

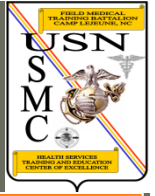


SKILLS CHECK



6,150 Meters





LENSATIC COMPASS

- The primary instrument used to determine and maintain direction during land navigation



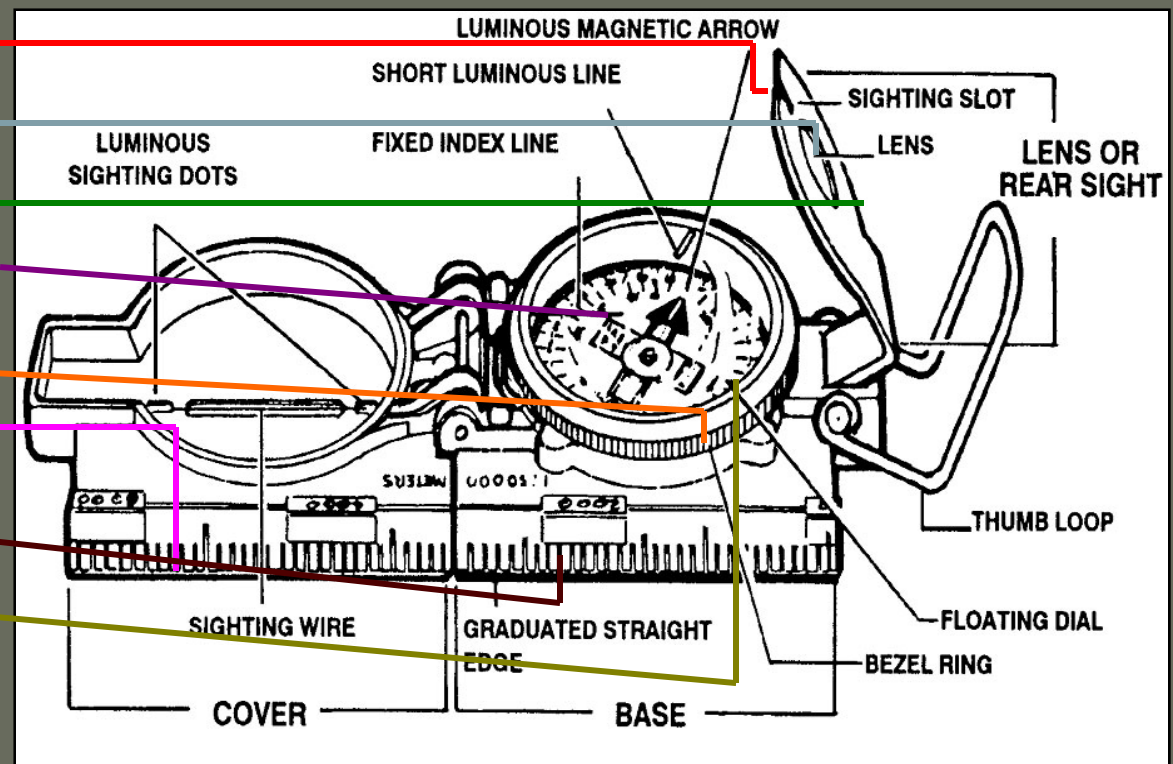
PARTS OF THE COMPASS

- Thumb loop
- Short Luminous line
- Luminous sighting dots
- Luminous arrow, "Magnetic North"
- Lanyard
- Sighting wire
- Graduated straight edge



PARTS OF THE COMPASS

- Sighting slot
- Lens
- Rear sight
- Fixed index line
- Bezel ring
- Cover
- Base
- Floating dial



COMPASS PRECAUTIONS

- Handle with care
- Reading should never be taken near visible masses of metal or electrical circuits



COMPASS PRECAUTIONS

- In cold weather, always carry the compass in its pouch, outside of your outer layer of clothing

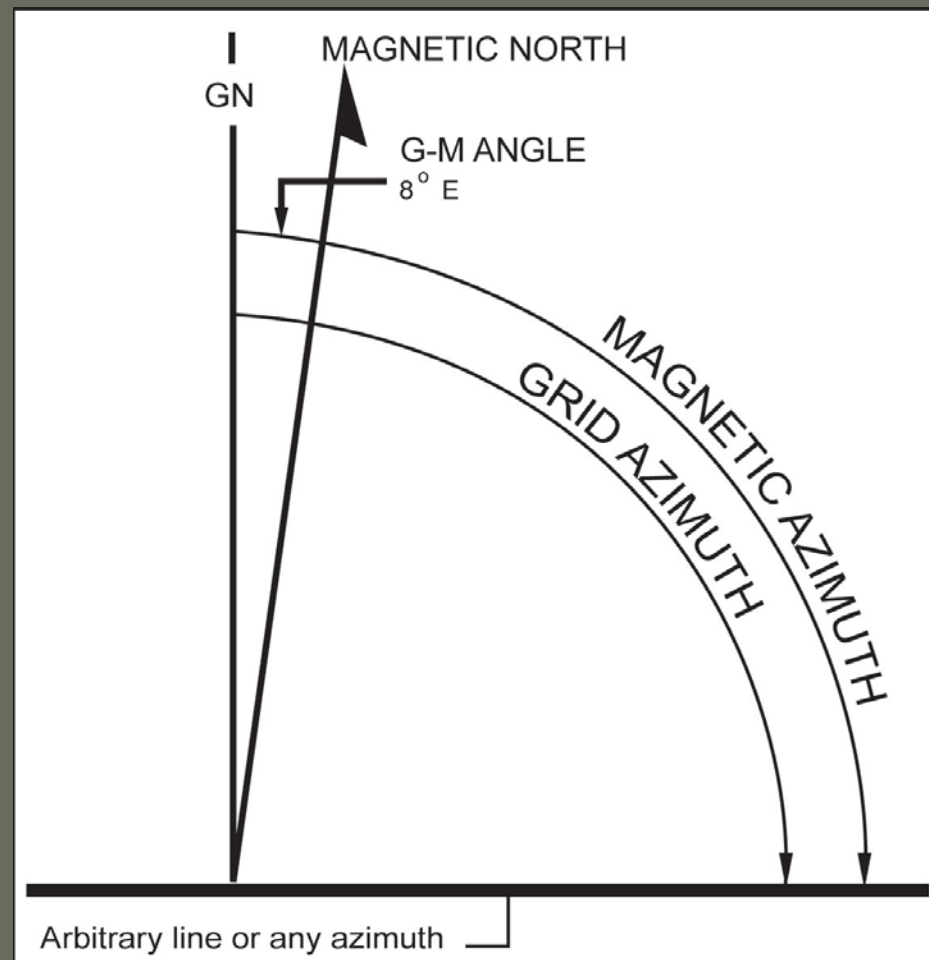


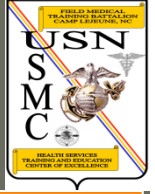


COMPASS TERMS AND CONCEPTS

- **Azimuth:**

An angle measured in a clockwise direction from a north base line



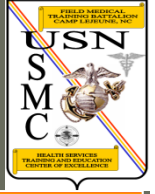


COMPASS TERMS AND CONCEPTS

- Grid Azimuth:
 - The heading due east is an azimuth of 90°
 - South = 180°
 - West = 270°
 - North = 360° or 0°
 - When using an azimuth, the point from which the azimuth originates is imagined to be the center of the azimuth circle

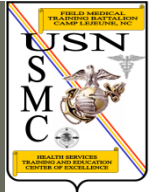


COMPASS TERMS AND CONCEPTS



- Obtaining A Grid Azimuth:
 - Draw a line to two points
 - Place the index of the protractor on point A
 - Ensure the base line is parallel to the north south grid lines

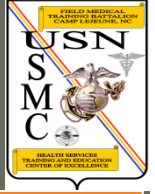




COMPASS TERMS AND CONCEPTS

- Obtaining A Grid Azimuth:
 - Read the inside scale
 - (Degree scale)
 - This is the grid azimuth from point A to point B

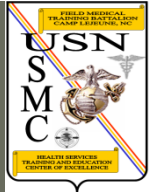




COMPASS TERMS AND CONCEPTS

- Back Azimuth:
 - The reverse direction of a forward azimuth
 - Is comparable to doing an about face
 - May be obtained by
 - Grid (protractor)
 - Magnetic (compass)

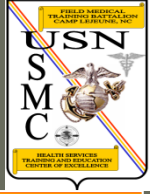




COMPASS TERMS AND CONCEPTS

- Back Azimuth:
 - To obtain a back azimuth from an azimuth less than 180° :
 - Add 180
 - If the azimuth is 180° or more:
 - Subtract 180





LAMS acronym for back azimuth

L- Less

A- Add

M- More

S- Subtract

If less then add, if more
then subtract



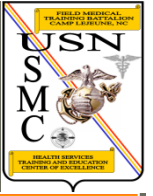
METHODS FOR HOLDING THE COMPASS



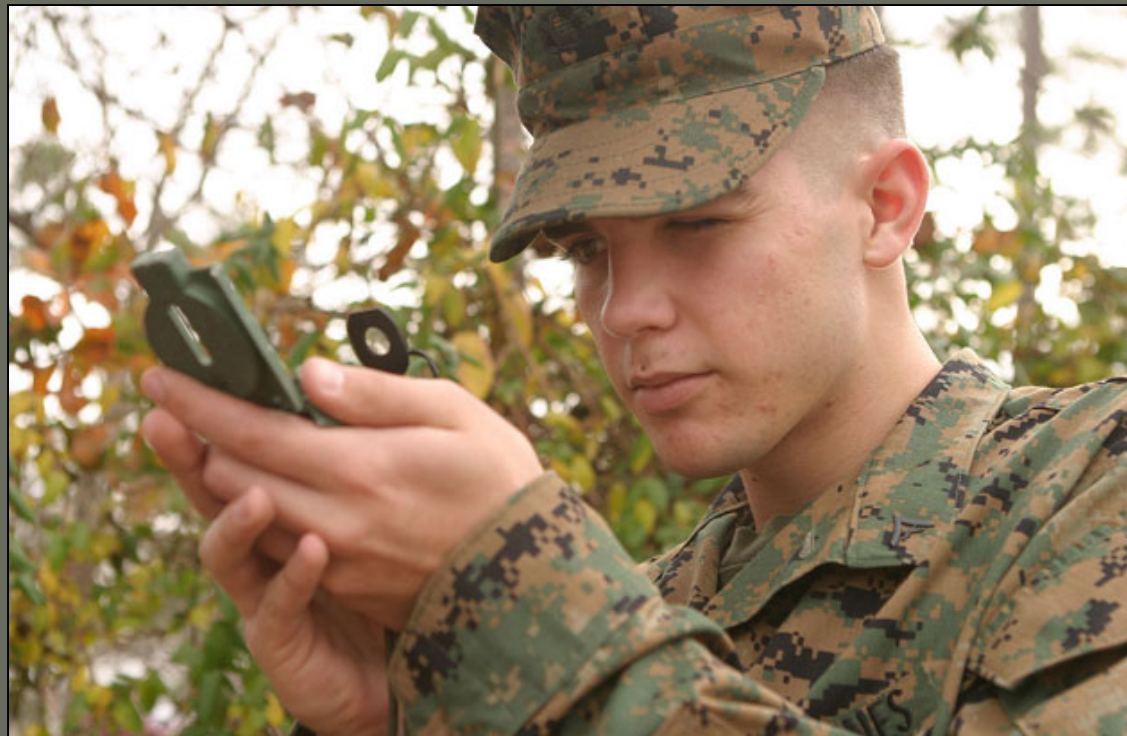
- The lensatic compass is used to determine or follow magnetic azimuth both day and night
- There are two recommended positions for holding the compass when navigating:
 - » Compass-to-Cheek
 - » Center Hold Position

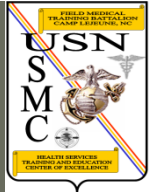


COMPASS-TO-CHEEK METHOD



- Recommended when determining the azimuth to a distant object





CENTER-HOLD POSITION

- Recommended for a predetermined azimuth (DAY and NIGHT)





COMPASS USE AT NIGHT

- All the luminous features on the compass will be used
- One click on the bezel ring equals;
 - Three (3) Degrees





SKILLS CHECK



SKILLS CHECK



What is the grid azimuth from point A to point B?

A: 68558380

B: 64807880



SKILLS CHECK



Point A to point B?

214 Degrees

What is the BACK azimuth?



SKILLS CHECK

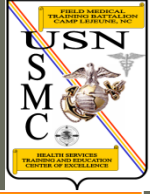


BACK azimuth?

$$214 - 180 = 34 \text{ Degrees}$$



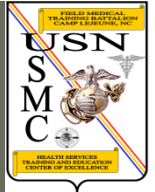
SKILLS CHECK



Convert the grid azimuth of 214 Degrees to Magnetic azimuth.



SKILLS CHECK



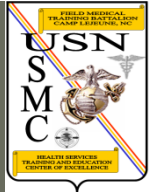
Convert the grid azimuth of 214 Degrees to Magnetic azimuth.

$$214 - 13.5 = 200.5 \text{ Degrees}$$



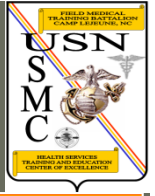


ORIENTATION OF A MAP





ORIENTATION OF A MAP

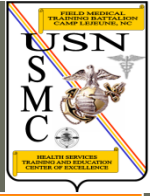


- A map is oriented when it is in position with its north and south corresponding to north and south on the ground





ORIENTATION OF A MAP



- Using A Compass:
 - Keep compass horizontal
 - Place Compass straight edge parallel to a North-South grid with the cover of the compass pointing to the top of the map





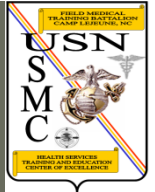
ORIENTATION OF A MAP



- Without A Compass: Terrain Association
 - Find linear features common to the ground and the map
 - Roads
 - Railways
 - Fence lines
 - Power lines etc.



DETERMINING LOCATION BY MAP AND COMPASS



- Inspection and Estimation:
 - Easiest and most simple
 - Survey roads and topographical features
 - Orient map to the ground
 - Identify prominent landmarks

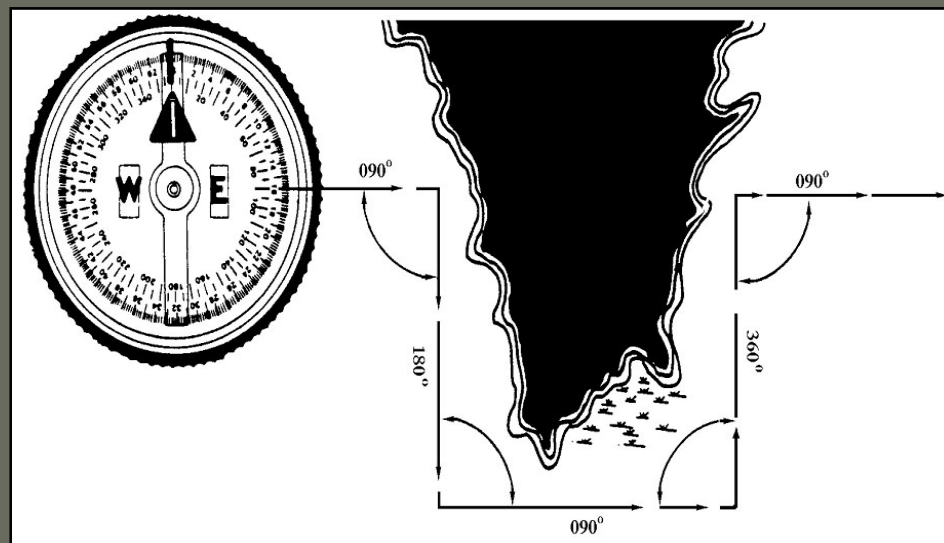




DETERMINING LOCATION BY MAP AND COMPASS



- 90° Offset Method:
 - To bypass enemy positions or obstacles and stay oriented
 - Detour around obstacle by moving in right angles, use this formula:
 - Right, add 90°
 - Left, subtract 90° (RALS)





DETERMINING LOCATION BY MAP AND COMPASS

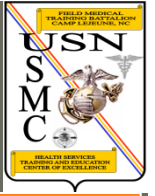


DEMONSTRATION

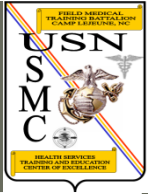




DETERMINING LOCATION BY MAP AND COMPASS



PRACTICAL APPLICATION





LAND NAVIGATION

