Laboratory Exercise #2 – Introduction to Quadrangle Maps

A. Introduction to Quadrangle Maps

The United States Geological Survey has developed a nationwide series of quadrangle maps that cover small areas in great detail on the earth's surface. These maps can be purchased anywhere in the country and are also available on-line (http://store.usgs.gov/). The standard quadrangle map covers 7.5 minutes of latitude and longitude (Figure 1). Note that since a minute is approximately 1 mile, a quadrangle map covers roughly 7.5 miles of latitude.

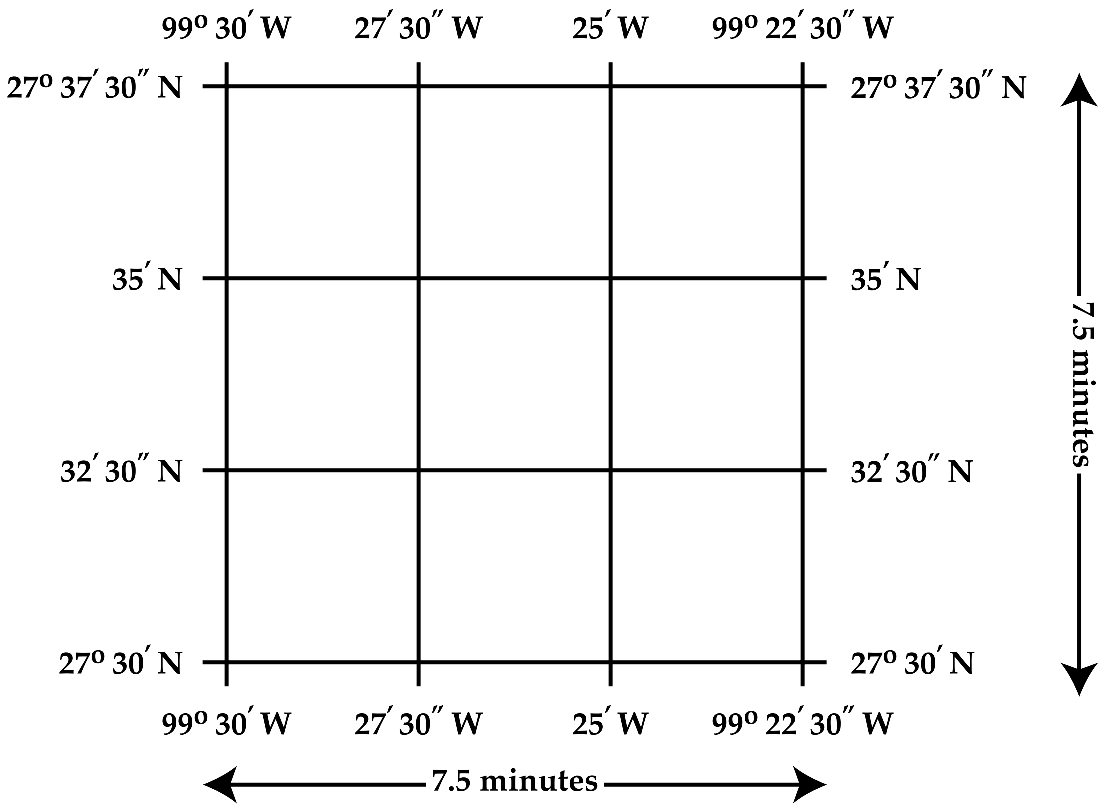

Figure 1. Simplified quadrangle map showing latitude and longitude.

Realize that 1/2 minute on a 7.5 minute quadrangle map equals 30 seconds so that 1 minute = 60 seconds.

Q: If 1′ of latitude is approximately 1 mile, then what is the distance for 1 second of latitude? (Hint there are 5280 ft in a mile.)

A: Approximately 88 feet

Now you should realize that maps that cover very small areas use degrees, minutes, and seconds. Again latitude is always written first and longitude is second as with degrees, minutes, and

seconds (“) written as indicated below:
##° ##’ ##” N,   ###° ##’ ##” W

Q: Which two hemispheres does Texas reside within (northern or southern?; eastern or western?). These answers will help you to determine whether latitude is N or S and longitude is E or W in Texas.

Again you not only need to write latitude and longitude correctly but also need to be able to determine the latitude and longitude of a point on a map. Refer to map on Figure 2 for a simple example.

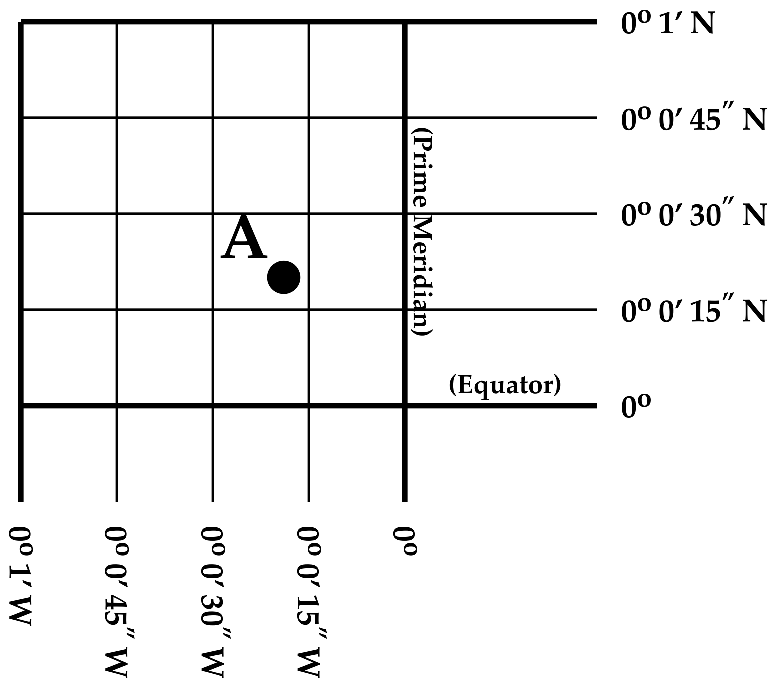

Figure 2. A simple 1 X 1 ‘ grid.

The location of point A in Figure 2 can be determined by using the same principles applied in last week’s lab. Note that the degrees for both latitude and longitude are zero. Additionally, point A is located between 0 and 1 minutes so minutes will be zero and we only need to determine seconds. So based on interpolation we can determine the location of point A as 0° 0’ 20” N, 0° 0’ 20” W.

Note that the actual quadrangle map used in this weeks lab will be more complex as indicated in Figure 1. However, a quadrangle map covers only 7.5 minutes of latitude and longitude. Therefore, the degree numbers for latitude/longitude are the same for all answers in this lab. Additionally, since Laredo is in the northern and western hemispheres all latitude is N and all longitude is W.

Questions:

1. Precisely determine the locations of the following features (using degrees, minutes, and seconds) present on the Laredo East 7.5 minute quadrangle. Determine location to within 5 seconds.

Points	**Location**
1	______________________________
2	______________________________
3	______________________________
4	______________________________
5	______________________________
6	______________________________

2. Of the locations listed above in question 1, indicate the point or points that are the most north, south, east, and west?

	Location
North	_________________________
West	_________________________
South	_________________________
East	_________________________

B. Map Scale - Again

Graphic scale bars are also included with 7.5 minute quadrangle maps. Use the statue mile scale to answer the questions in this section.

Note that scale can also be expressed numerical in the form of a fractional scale. For the USGS 7.5 minute quadrangle map the fractional scale is 1:24,000, which literally means that one map unit equals 24,000 units on the earth's surface. Consequently, for the 7.5 minute quadrangle maps we can determine that 1 inch on the map is equivalent to 2,000 feet (0.379 miles) on the earth's surface. Therefore, one can directly measure map distance with a ruler and using the above conversion factors one can determine how many feet or miles is represented between different locations on the map.

Questions:

3. Determine the distance (in miles) along a straight line from between Iron Pasture Tank (ie. TAMIU) to the corner of Interstate 35 (I 35) and Bob Bullock Loop on the Laredo East 7.5 minute quadrangle using the graphic scale.

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4. Determine the same distance using a fractional scale as indicated below:

    ____________ ~~in~~ X 0.379 miles / ~~in~~ = _____________ miles

5. Which scale (fractional or graphic) is inherently more accurate? Explain in detail.

C. Introduction to Elevation and Contour Lines

A map is a two dimensional representation of a region of the earth. However, the landscape obviously varies in the third dimension (elevation). Technically**, elevation** is the number of feet a geographic feature is above an established datum. The **datum** is designed as 0 ft, which is commonly defined as mean (average) sea level in the region.

Contour lines provide a method for depicting the variation in elevation in between bench marks. A **contour line** is a line of equal elevation that is drawn on a topographic map. The significance of a contour line is that along this line the elevation is always the same. For example, for a 100 ft contour line every point along this contour line is always 100 ft. Again, look at your topographic map.

The vertical distance in elevation between two adjacent contour lines is referred to as the **contour interval**. The contour interval (often abbreviated 'CI') is always indicated on the bottom of a USGS quadrangle map, below the graphic scale bars. The specific contour interval of a map depends on the nature of the landscape that the map depicts. For relatively flat areas such as the Texas coastal plain the contour interval may be as low as 10 feet. For steep, highly mountainous regions the contour interval may be as high as 100 feet.

Finally, notice on your map that every fifth contour line is printed as a bold line and is labeled. These labeled contour lines are referred to as **index contours**. To keep today's lab simple we will foucs on only index contour lines ,which have an elevation clearly labeled on them.

The importance of contour lines is that they indicate the nature of the land surface in terms of whether it is gentle or steep. Gentle slopes (flatter areas) have widely spaced contour lines and steep slopes have closely spaced contour lines (Figure 3).

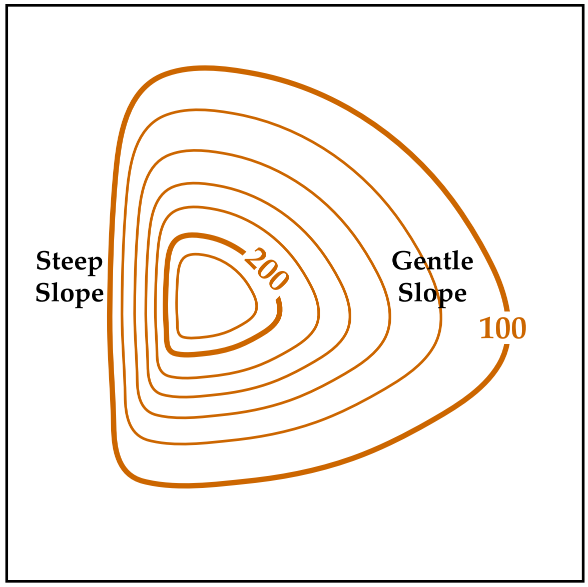

Figure 3. Gentle and steep areas depicted on a topographic map.

Another important concept is slope ,which is the vertical change in elevation per horizontal distance. More commonly referred to as rise over run, which is usually expressed as feet (vertical) per mile (horizontal). The rise is also referred to as the relief.

The rise is determined by subtracting the highest elevation from the lowest elevation and is usually expressed in units of feet.

Rise = (Highest Elevation) - (Lowest Elevation)

The run is determined using the map scale and is expressed in units of miles. Therefore, slope can be calculated as

Slope = Rise (ft) / Run (miles) = ##.# ft / mile

Finally, it is important for you to be able to determine the geographic direction (N, S, E, or W) in which the slope is decreasing in elevation, which will correspond to the direction in which water flows down a slope. Note that water always flow downhill and therefore water will move towards locations with a lower elevation as indicated in Figure 4. Note that in figure 4 the water in the stream (blue line) is flowing to the southeast.

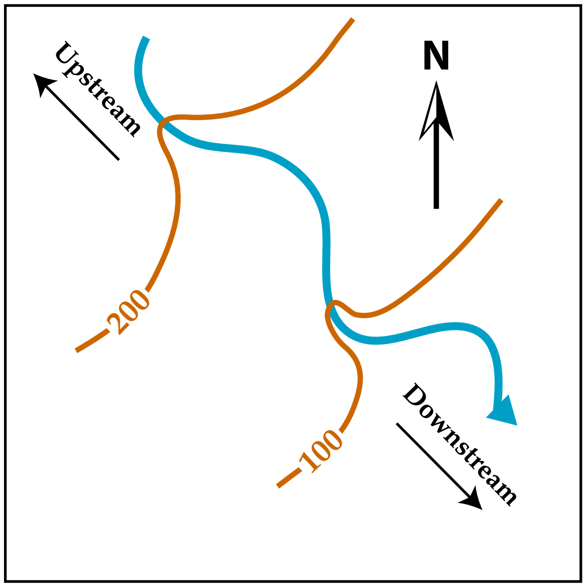

Figure 4. Illustration of relationships between elevation and direction of water flow in a stream.

<u>Questions:</u>

6. What is the contour interval of your quadrangle map?

7. As precisely as possible determine the elevations of the following features present on the Laredo East 7.5 minute quadrangle.

Points	Elevation
1	____________________
2	____________________
3	____________________
4	____________________
5	____________________
6	____________________

8. What geographic direction is Chacon Creek south of Lake Casa Blanca flowing in?

9. Determine the rise or relief in elevations between points 1 and 2 in feet, which are along a straight road.

10. Determine the horizontal distance in miles between points 1 and 2 on your map using the graphic scale on the map with a ruler.

11. Calculate the slope between points 1 and 2 (in feet / mile)

12. Determine the rise or relief in elevations between points 3 and 4 in feet.

13. Determine the horizontal distance in miles between points 3 and 4 on your map using the graphic scale on the map and by using a piece of string to accurately measure horizontal distances along this curved feature and using the graphic scale on the map.

14. Calculate the slope between points 3 and 4 (in feet / mile).

15. What geographic direction is the stream between points 3 and 4 flowing towards?

16. Determine the rise or relief in elevations between points 5 and 6 in feet.

17. Determine the horizontal distance in miles between points 5 and 6 on yourr map using the graphic scale on the map and by using a piece of string to accurately measure horizontal distances along this curved feature and using the graphic scale on the map.

18. Calculate the slope between points 5 and 6 (in feet / mile)

19. What geographic direction is the stream between points 5 and 6 flowing towards?

20. Which stream (from question 13 or 17) is steeper? Does this make sense based on the spacing of contour lines. Explain in detail.