Geography 415 Hydrology

LAB 1 (January 23, 2003)

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Hours: Friday 10:00am – 12:00pm, or by appointment
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1. Estimation of Mean Rainfall

Using the figures, tables and grids provided calculate the mean areal rainfall for the Limestone Creek Basin. Use the Thiessen Polygon and Isohyetal methods described in your textbook to get the mean areal rainfall.

A. Thiessen Polygon Method

1. The watershed area of the Limestone Basin is 32.7 km^2, this is your given area.

2. Trace the basin outline, stations and tributaries onto the 10x10 grid paper

3. Make the Thiessen polygons by first drawing lines to join all the stations. (see the dashed lines on p. 38 of Dunne and Leopold). Then draw perpendicular bisectors to those lines to form the Thiessen polygons (see black lines p. 38 of D & L).

4. Next trace the polygons onto the grid paper and fill in the values for the table below. See the last page of the lab for hints on finding areas.

Station Number	Station Precip. (mm)	Area of Polygon (km^2)	% of total area for polygon	Area-weighted precipitation
1	20	**0.671**	**2.06**	**0.41**
2	26	**1.595**	**4.89**	**1.27**
3	25	**2.970**	**9.10**	**2.28**
4	32	**1.947**	**5.97**	**1.91**
5	35	**1.815**	**5.56**	**1.95**
6	38	**3.388**	**10.38**	**3.94**
7	40	**5.698**	**17.46**	**6.98**
8	50	**6.171**	**18.91**	**9.46**
9	52	**3.377**	**10.35**	**5.38**
10	48	**4.994**	**15.30**	**7.34**
Totals	**366**	**32.63**	**99.98**	**40.92**

*Note: if the total percent in the fourth column does not equal 100% then adjust the percentages to equal 100 and enter them into column 6. Enter the corrected area into column 5. Do this by using the following equation:

corrected area = (measured area of polygon / total measured area) (given area)

corrected percent = corrected area / given area

5. What is the Thiessen weighted average precipitation = ____40.9 mm___ (include units)

B. Isohyetal Method

1. Use the second copy of the Limestone Basin and refer to Dunne and Leopold in order to determine the mean areal rainfall.

2. First construct your isohyets using the precipitation values from the stations provided in the last table and the isohyetal range provided below. Then trace the isohyet map onto grid paper and find the area enclosed in each isohyet and fill in the corresponding table.

Isohyetal Range	Average precip. between Isohyets	Area of Basin Between Isohyets	% of area between isohyets	Area-weighted precipitation
20-25	**22.5**	**2.112**	**6.6**	**1.49**
25-30	**27.5**	**2.970**	**9.3**	**2.56**
30-35	**32.5**	**2.695**	**8.5**	**2.76**
35-40	**37.5**	**5.357**	**16.8**	**6.30**
40-45	**42.5**	**4.730**	**14.9**	**6.33**
45-50	**47.5**	**7.227**	**22.7**	**10.78**
> 50	**52.5**	**6.754**	**21.2**	**11.13**
Totals	-N/A-	**31.80**	**100**	**41.35**

*Note: The average precipitation for the area between two isohyets is the mean of the isohyetal values in the range. You may have to make the same corrections as in the Thiessen exercise. Use the same technique that was described above.

3. What is the Isohyetal weighted average precipitation = ____41.4 mm___ (include units)

5. Comment on the differences between the two methods, why were there different results? Why would one method be more beneficial to hydrologists? Please answer in the space provided below.

2. Mean Annual Precipitation and Elevation

The following data is for mean annual precipitation and elevation for a certain mountain

West Side of Mountain

Mean Annual Precipitation (in.)	Elevation (feet)
26	300
30	1100
41	1930
44	2340

East Side of Mountain

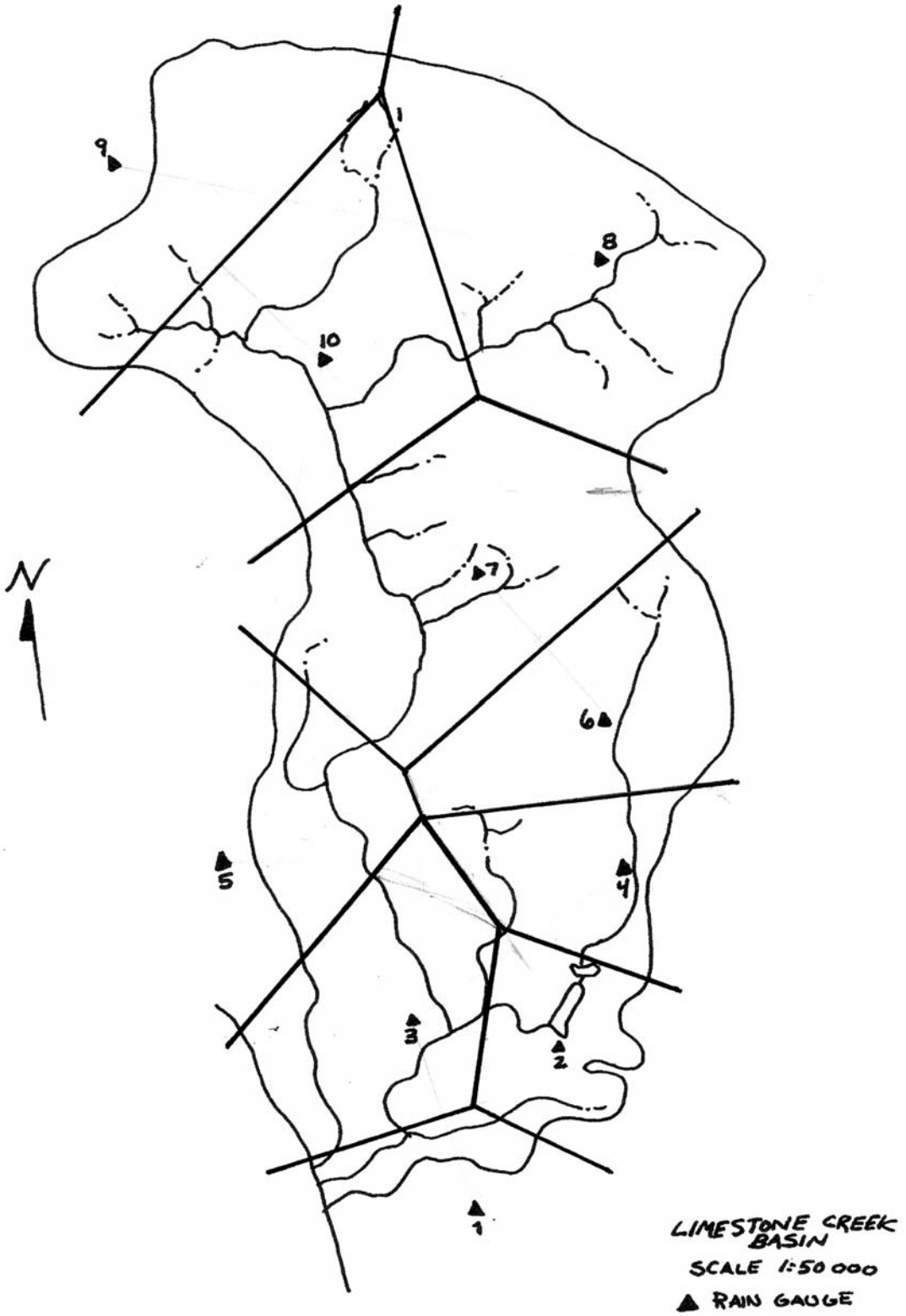
Mean Annual Precipitation (in.)	Elevation (feet)
24	7920
20	5630
3.7	4356

1. Plot the mean annual precipitation against elevation for each side of the mountain. Briefly discuss the relationship between the two variables for each side of the mountain.

************HINTS WHEN FINDING AREA***************

The scale of the basin map is 1:50 000, thus make the scale of the grid paper 1:50 000. This means that every cm on the grid paper represents 50 000 cm on the ground, or 0.5 km (but you knew that!). Every side of a large block is 2.10 cm, you need to figure out how many km^2 each large block represents.

Count up all the large blocks first, then the small blocks (find out how many small blocks in each big block!!). When you find out the number of big blocks you can multiply that by the number of km^2 that each large block represents. Since you were given an area of 32.7 km^2 the totals for each polygon or isohyet should not be too far off that value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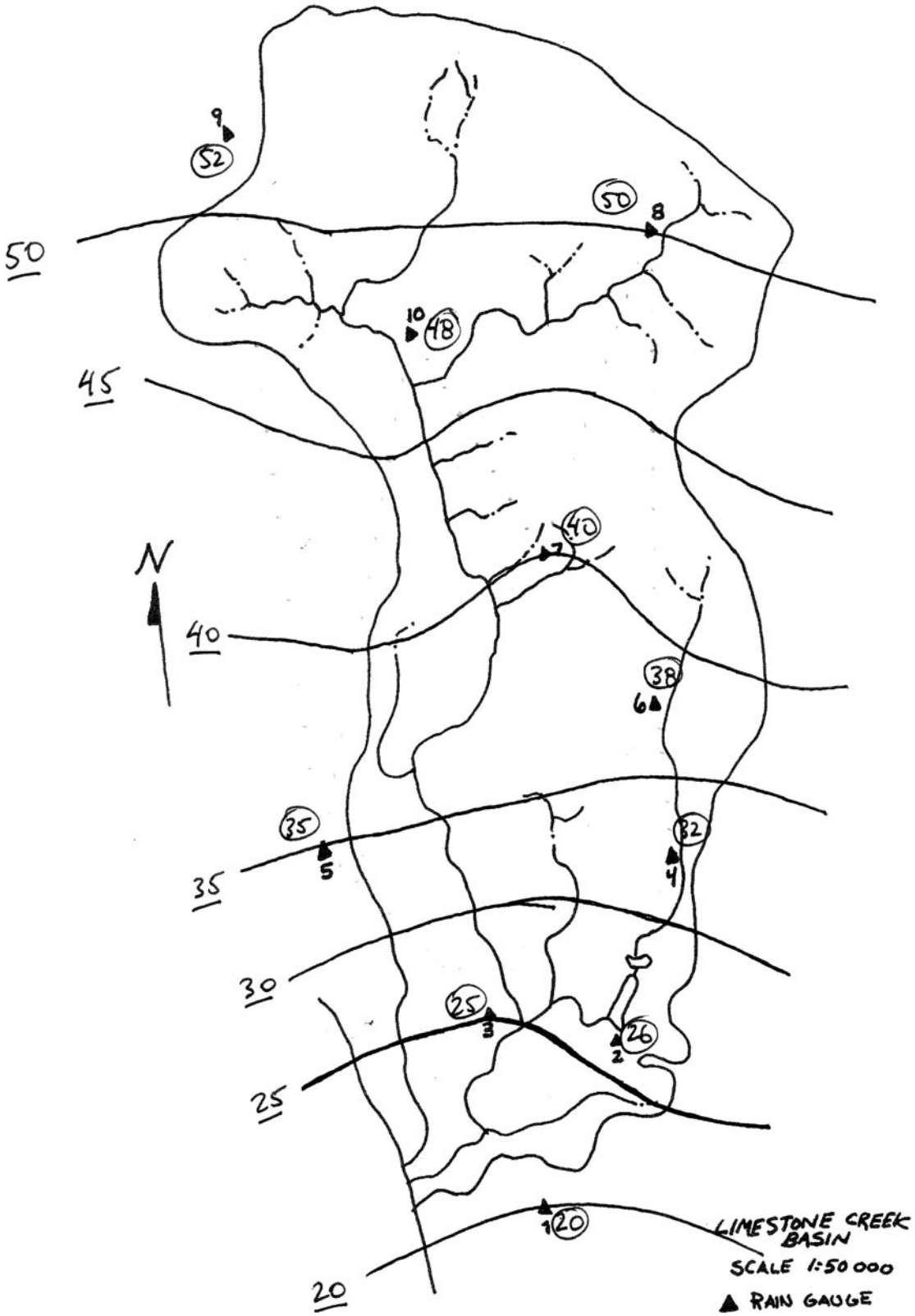
LIMESTONE CREEK BASIN
SCALE 1:50 000
▲ RAIN GAUGE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LIMESTONE CREEK BASIN
SCALE 1:50 000
▲ RAIN GAUGE

Suggestions to Questions

5.

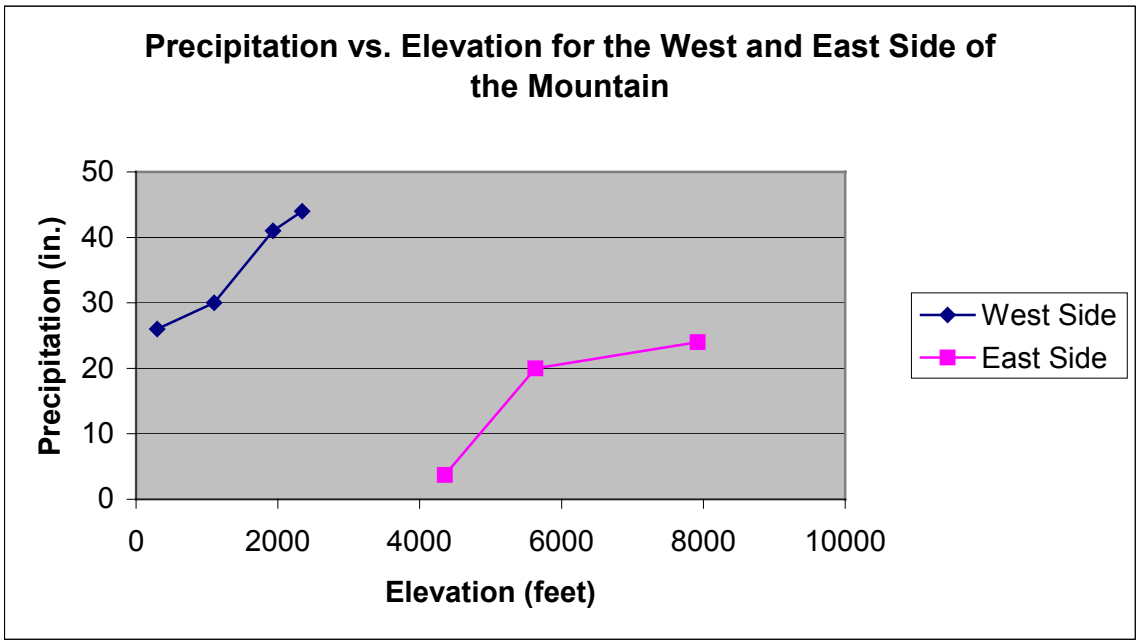
Theissen Polygons

- Theissen method defines areas represented by each gauge in order to weigh the effects of non-uniform rainfall distribution.
- Adjoining lines are created between each of the rain gauges. Perpendicular bisectors are then created to form polygons around each gauge.
- The area within the polygon is assumed to be the area represented by each gauge.
- More accurate than the arithmetic method. Once the polygons have been created, it is a simple process to compute mean rainfall from other events.
- Advantage – polygons only need to be created once.
- Disadvantage – doesn't account for topographic influences.

Isohyets

- Considered the most accurate method for computing mean rainfall. Rainfall gauges and locations are plotted.
- Contours of equal rainfall amounts (isohyets) are then drawn.
- The area between the isohyets are treated the same as Theissen polygons areas.
- Isohyetal method takes into account topographic influence, therefore, more accurate over mountainous terrain.
- Disadvantage – new isohyets have to be made for each rainfall event.

2. Mean Annual Precipitation and Elevation



Assuming an air mass is traveling west to east, the west side of the mountain has increasing precipitation deposits as the elevation increases due to orographic lifting of air masses. As the elevation increases, the temperature decreases, therefore, leading to increased rainfall at higher elevations. Once the remaining air mass reaches the east side of the mountain the remaining moisture content is low, which leads to smaller precipitation values.

This is referred to as the rain-shadow effect. The windward side (West) receives the largest amounts of precipitation, while the leeward side (East) experiences a rain shadow (an area of decreased precipitation).