EXERCISE 4

Shaping Earth's Surface
Running Water and Groundwater

The study of the processes that modify Earth's surface is of major significance to the Earth scientist. By understanding those processes and the features they produce, scientists gain insights into the geologic history of an area and make predictions concerning its future development.

Some of the agents that are responsible for modifying the surface of Earth are running water (Figure 4.1), groundwater, glacial ice, wind, and volcanic activity. Each produces a unique landscape with characteristic features that can be recognized on topographic maps. Exercises 4 and 5 examine several of these agents, the variety of landforms associated with them, and some of the consequences of human interaction with these natural systems.

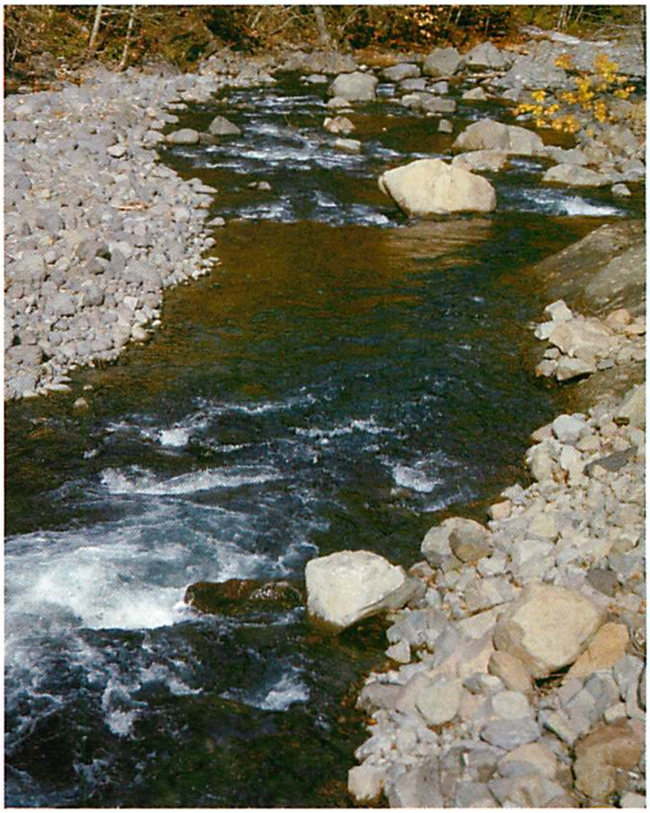

Figure 4.1 Mountain stream. (Photo by E.J. Tarbuck)

Objectives

After you have completed this exercise, you should be able to:

1. Sketch, label, and discuss the complete hydrologic cycle.
2. Explain the relation between infiltration and runoff that occurs during a rainfall.
3. Discuss the effect that urbanization has on the runoff and infiltration of an area.
4. Identify on a topographic map the following features that are associated with rivers and valleys: rapids, meanders, floodplain, oxbow lake, and backswamps.
5. Explain the occurrence, fluctuation, use, and misuse of groundwater supplies.
6. Identify on a topographic map the following features associated with karst landscapes: sinkholes, disappearing streams, and solution valleys.

Materials

calculator
ruler
hand lens

Materials Supplied by Your Instructor

graduated measuring cylinder (100 ml)
coarse sand, fine sand, soil
small funnel
cotton
beaker (100 ml)
stereoscope
string

Terms

hydrologic cycle	permeability	aquifer
infiltration	hydrograph	karst topography
groundwater	discharge	disappearing stream
runoff	base level	solution valley
erosion	meander belt	sinkhole
evaporation	zone of saturation	cave
transpiration	water table	cavern
porosity	zone of aeration	

Introduction

On Earth, the water is constantly being exchanged between the surface and atmosphere. The **hydrologic cycle**, illustrated in Figure 4.2, describes this continuous movement of water from the oceans to the atmosphere, from the atmosphere to the land, and from the land back to the sea.

A portion of the precipitation that falls on land will soak into the ground via **infiltration** and become **groundwater**. If the rate of rainfall is greater than the surface's ability to absorb it, the additional water flows over the surface and becomes **runoff**. Runoff initially flows in broad sheets; however, it soon becomes confined and is channeled to form streams and rivers. **Erosion** by both groundwater and runoff wears down the land and modifies the shape of Earth's surface. Eventually runoff and groundwater from the continents return to the sea or the atmosphere, continuing the endless cycle.

Examining the Hydrologic Cycle

Figure 4.2 illustrates Earth's water balance, a quantitative view of the hydrologic cycle. Although the figure correctly implies a uniform exchange of water between Earth's atmosphere and surface on a worldwide basis, factors such as climate, soil type, vegetation, and urbanization often produce local variations.

Use Figure 4.2 as a reference to answer questions 1–6.

1. On a worldwide basis, more water is evaporated into the atmosphere from the (oceans, land). Circle your answer.
2. Approximately what percent of the total water evaporated into the atmosphere comes from the oceans?

$$\text{Percent from oceans} = \frac{\text{ocean evaporation}}{\text{total evaporation}} \times 100$$

= ________ %

Notice in the figure that more water evaporates from the oceans than is returned directly to them by precipitation.

3. Since sea level is not dropping, what are the other sources of water for the oceans in addition to precipitation?

____

Over most of Earth, the quantity of precipitation that falls on the land must eventually be accounted for by the sum total of **evaporation**, **transpiration** (the release of water vapor by vegetation), **runoff**, and **infiltration**.

4. Define each of the following four variables.

Evaporation: ________________________________

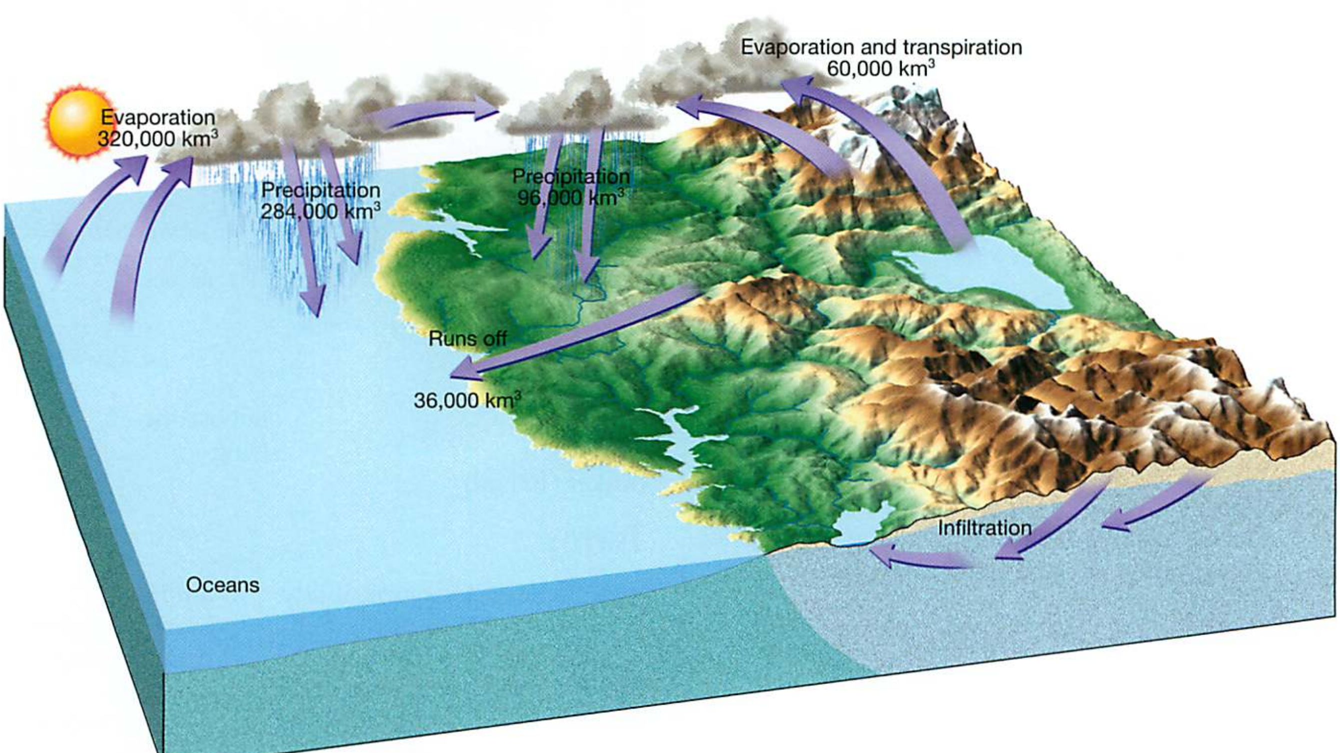

Figure 4.2 Earth's water balance, a quantitative view of the hydrologic cycle.

Transpiration: ______________________

Runoff: ______________________

Infiltration: ______________________

5. On a worldwide basis, about (35, 55, 75) percent of the precipitation that falls on the land becomes runoff. Circle your answer.
6. At high elevations or high latitudes, some of the water that falls on the land does not immediately soak in, run off, evaporate, or transpire. Where is this water being temporarily stored?

____

____

Infiltration and Runoff

During a rainfall most of the water that reaches the land surface will infiltrate or run off. The balance between infiltration and runoff is influenced by factors such as the **porosity** and **permeability** of the surface material, slope of the land, intensity of the rainfall, and type and amount of vegetation. After infiltration saturates the land and the ground contains all the water it can hold, runoff will begin to occur on the surface.

7. Describe the difference between the terms *porosity* and *permeability*. Is it possible for a substance to have a high porosity and a low permeability? Why?

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Permeability Experiment

To gain a better understanding of how the permeability of various Earth materials affects the flow of groundwater, examine the equipment setup in Figure 4.3 and conduct the following experiment by completing each of the indicated steps.

Step 1. Obtain the following equipment and materials from your instructor:
- graduated measuring cylinder
- beaker
- small funnel
- piece of cotton
- samples of coarse sand, fine sand, and soil (enough of each to fill the funnel approximately two-thirds full)

Step 2. Place a small wad of cotton in the neck of the funnel.

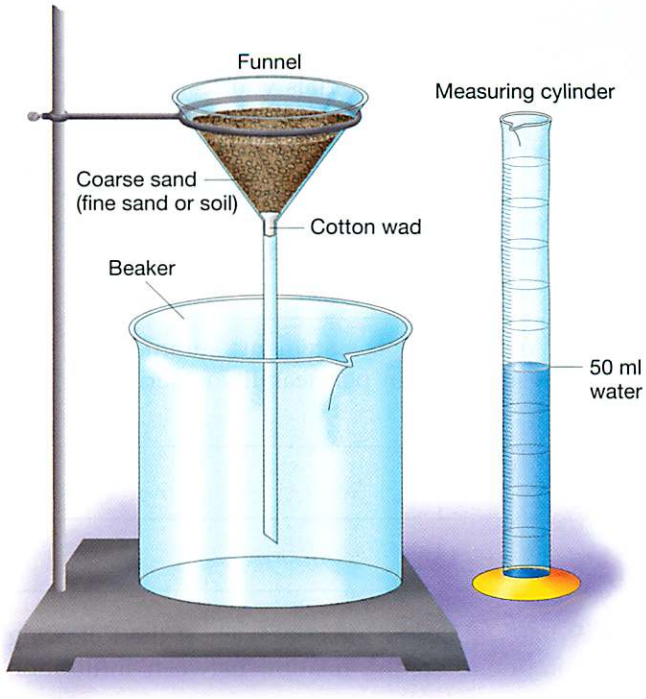


Figure 4.3 Equipment setup for permeability experiment.

Step 3. Fill the funnel above the cotton about two-thirds full with coarse sand.

Step 4. With the bottom of the funnel placed in the beaker, measure the length of time that it takes for 50 ml of water to drain through the funnel filled with coarse sand. Record the time in the data table, Table 4.1.

Step 5. Using the measuring cylinder, measure the amount (in milliliters) of water that has drained into the beaker and record the measurement in the data table.

Step 6. Empty and clean the measuring cylinder, funnel, and beaker.

Step 7. Repeat the experiment two additional times, using fine sand and then soil. Record the results of each experiment at the appropriate place in the data table, Table 4.1. (*Note:* In each case, fill the funnel with the material to the same level that was used for the coarse sand and use the same size wad of cotton.)

Step 8. Clean the glassware and return it to your instructor, along with any unused sand and soil.

Table 4.1 Data Table for Permeability Experiment

	Length of time to drain 50 ml of water through funnel	Milliliters of water drained into beaker
Coarse sand	seconds	ml
Fine sand	seconds	ml
Soil	seconds	ml

8. Questions 8a–8c refer to the permeability experiment.

   a. Of the three materials you tested, the (coarse sand, fine sand, soil) has the greatest permeability. Circle your answer.

   b. Suggest a reason why different amounts of water were recovered in the beaker for each material that was tested.

   ___

   c. Write a brief statement summarizing the results of your permeability experiment.

   ___

   ___

   ___

9. What will be the effect of each of the following conditions on the relation between infiltration and runoff?

   Highly permeable surface material: ___

   ___

   Steep slope: ___

   ___

   Gentle rainfall: ___

   ___

   Dense ground vegetation: ___

   ___

10. What will be the relation between infiltration and runoff in a region with a moderate slope that has a permeable surface material covered with sparse vegetation?

   ___

   ___

Infiltration and Runoff in Urban Areas

In urban areas much of the land surface has been covered with buildings, concrete, and asphalt. The consequence of covering large areas with impervious materials is to alter the relation between runoff and infiltration of the region.

Figure 4.4 shows two hypothetical **hydrographs** (plots of stream flow, or runoff, over time) for an area before and after urbanization. The amount of precipitation the area receives is the same after urbanization as before. Runoff is evaluated by measuring the stream **discharge**, which is the volume of water flowing past a given point per unit of time, usually measured in cubic feet per second. Use Figure 4.4 to answer questions 11–14.

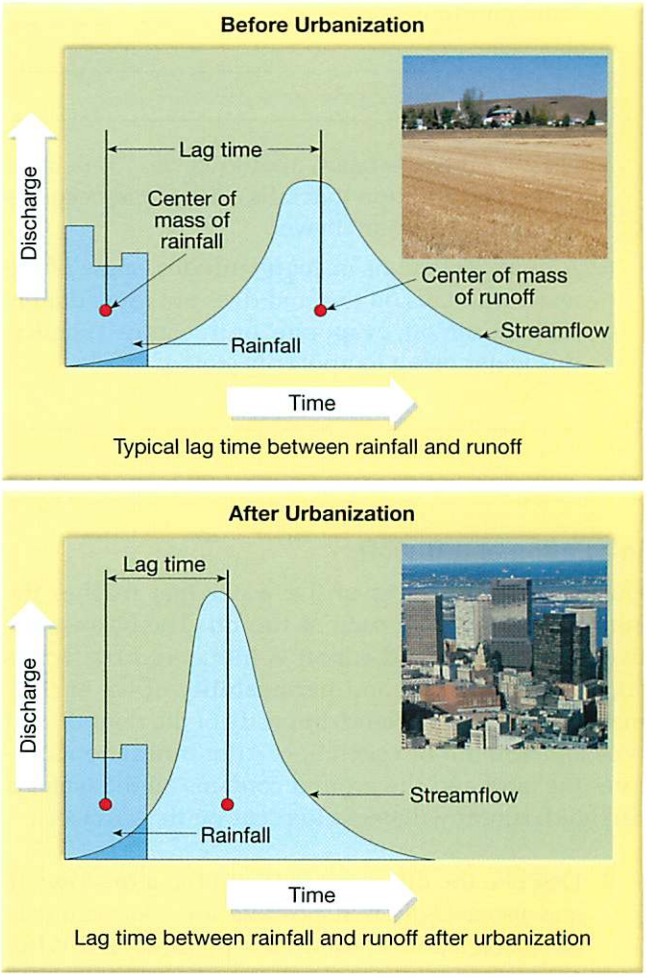


Figure 4.4 The effect of urbanization on stream flow before urbanization (top) and after urbanization (bottom). (After L. B. Leopold, U.S. Geological Survey Circular 559, 1968)

11. As illustrated in Figure 4.4, urbanization (increases, decreases) the peak, or maximum, stream flow. Circle your answer.

12. What is the effect that urbanization has on the lag time between the time of the rainfall and the time of peak stream discharge?

   ___

13. Total runoff occurs over a (longer, shorter) period of time in an area that has been urbanized. Circle your answer.

14. Based on what you have learned from the hydrographs, explain why urban areas often experience flash-flooding during intense rainfalls.

   ___

   ___

   ___

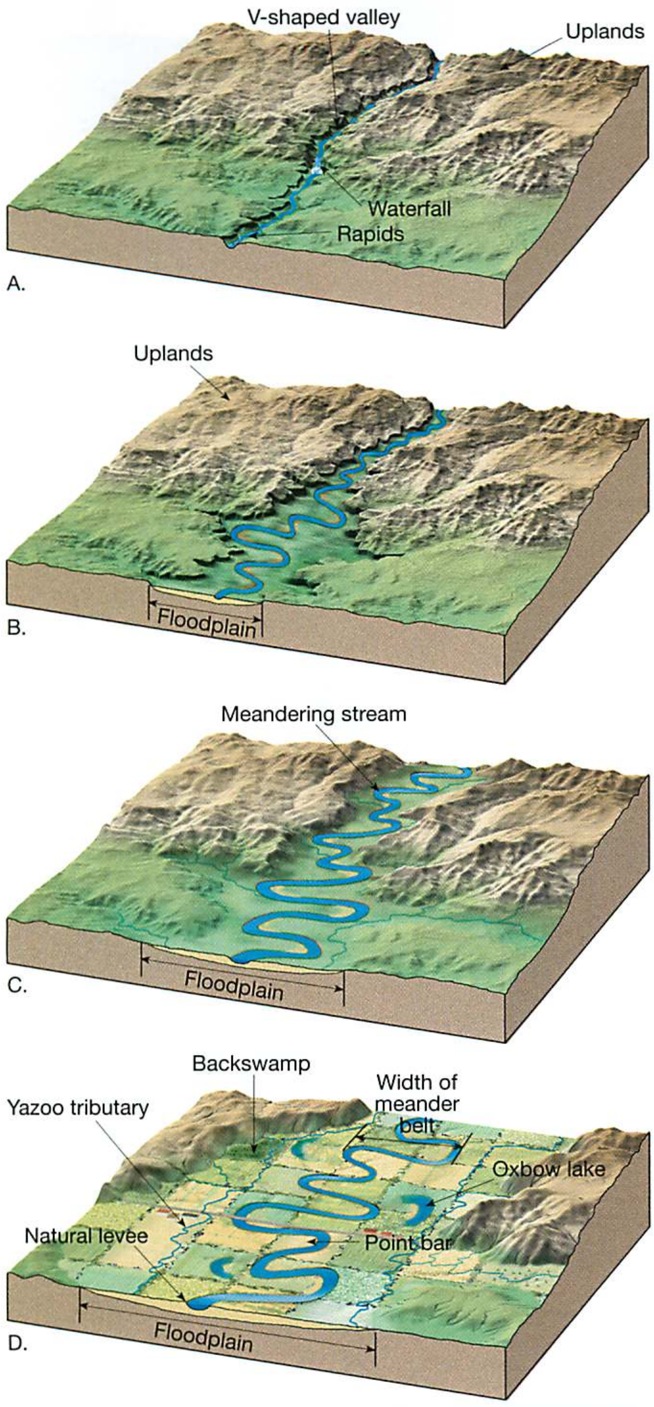


Figure 4.5 Common features of valleys. **A.** Near the headwaters. **B.** and **C.** In the middle. **D.** At the mouth. (After Ward's Natural Science Establishment, Inc., Rochester, New York)

Running Water

Of all the agents that shape Earth's surface, running water is the most important. Rivers and streams are responsible for producing a vast array of erosional and depositional landforms in both humid and arid regions. As illustrated in Figure 4.5, many of these features are associated with the *headwaters* of a river, while others typically are found near the *mouth*.

An important factor that governs the flow of a river is its **base level**. Base level is the lowest point to which a river or stream may erode. The ultimate base level is sea level. However, lakes, resistant rocks, and main rivers often act as temporary, or local, base levels that control the erosional and depositional activities of a river for a period of time.

Often the *head*, or source area, of a river is well above base level. At the headwaters, rivers typically have steep slopes and downcutting prevails. As the river deepens its valley it may encounter rocks that are resistant to erosion and form *rapids* and *waterfalls*. In arid areas rivers often erode narrow valleys with nearly vertical walls. In humid regions the effect of mass wasting and slope erosion caused by heavy rainfall produce typical V-shaped valleys (Figure 4.5A).

In humid regions downstream from the headwaters, the gradient or slope of a river decreases while its discharge increases because of the additional water being added by tributaries. As the level of the channel begins to approach base level, the river's energy is directed from side to side and the channel begins to follow a sinuous path, or *meanders* (Figure 4.6). Lateral erosion by the meandering river widens the valley floor and a *floodplain* begins to form (Figures 4.5B and 4.5C).

Near the mouth of a river where the channel is nearly at base level, maximum discharge occurs and meandering often becomes very pronounced. Widespread lateral erosion by the meandering river produces a floodplain that is often several times wider than the river's *meander belt*. Features such as *oxbow lakes, natural levees, backswamps* or *marshes*, and *yazoo tributaries* commonly develop on broad floodplains (Figure 4.5D).

Figure 4.6 This high-attitude image shows incised meanders of the Delores River in western Colorado. (Courtesy of USDA–ASCS)

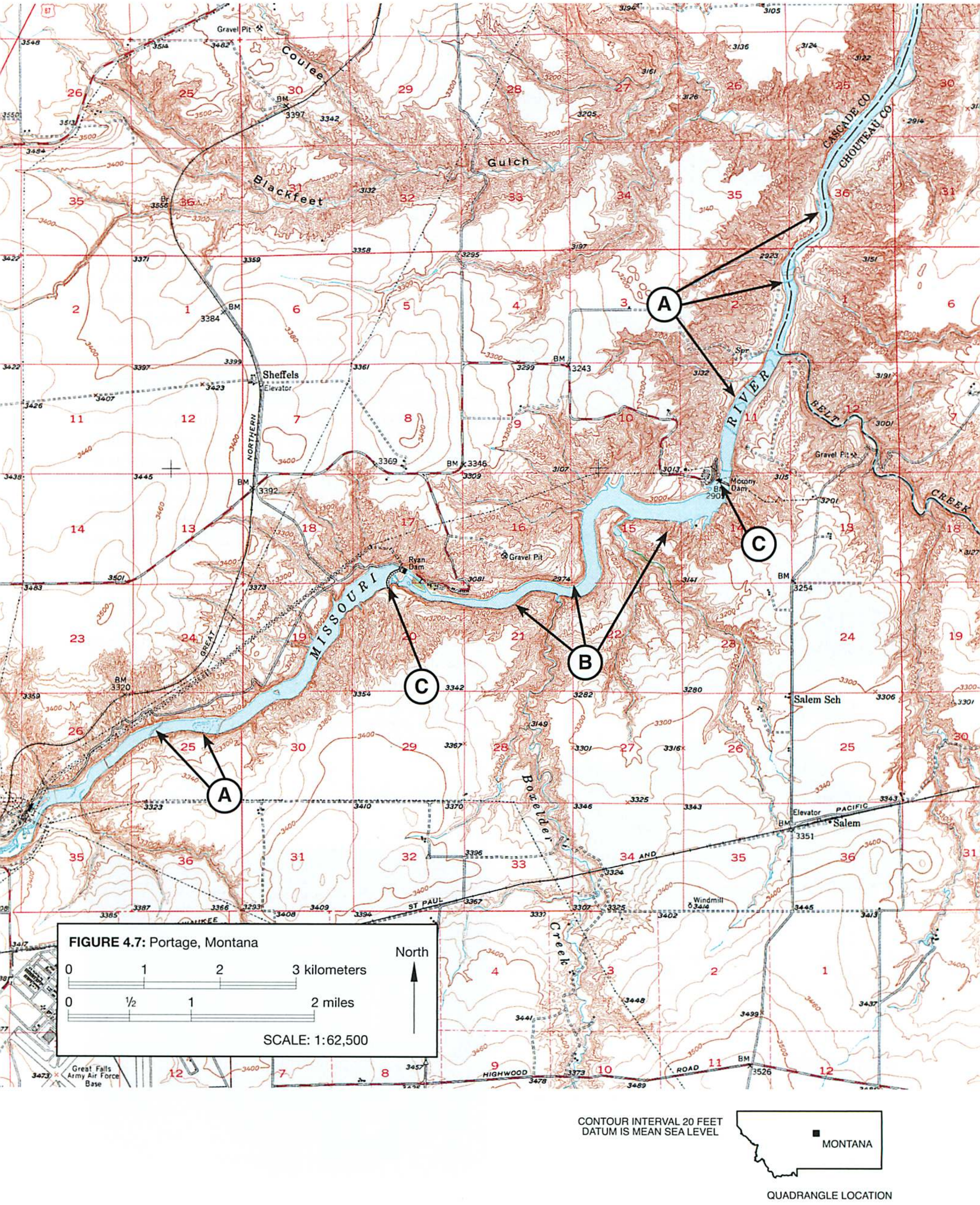


Figure 4.7 Portion of the Portage, Montana, topographic map. (Map source: United States Department of the Interior, Geological Survey)

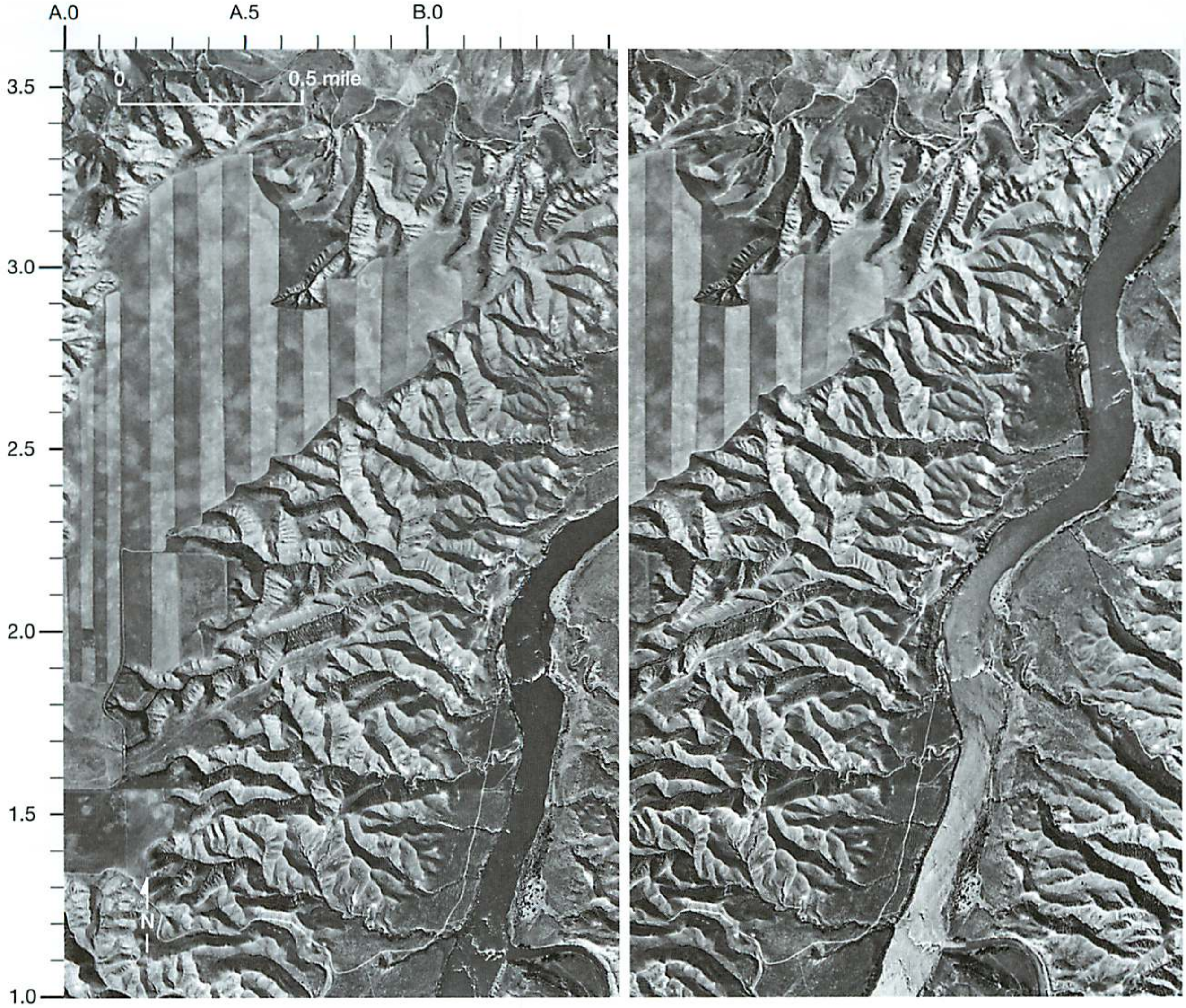


Figure 4.8 Stereogram of the Missouri River, vicinity of Portage, Montana. (Courtesy of U.S. Geological Survey)

Questions 15–25 refer to the Portage, Montana, topographic map, Figure 4.7, and stereogram of a portion of the same region, Figure 4.8. On the map, notice the rapids indicated by A and the steep-sided valley walls of the Missouri River indicated by B.

15. Compare the aerial photograph to the map. Then, on the topographic map, outline the area that is shown in the photo.

16. Use the map to determine the approximate total *relief* (vertical distance between the lowest and highest points of the area represented).

Highest elevation (______ ft) – lowest elevation (______ ft) = total relief (______ ft).

17. On Figure 4.9, draw a north–south topographic profile through the center of the map along a line from north of Blackfeet Gulch to south of the Missouri River. Indicate the appropriate elevations on the vertical axis of the profile. Label Blackfeet Gulch and the Missouri River on the profile. (*Note:* Exercise 3 contains a detailed explanation for constructing topographic profiles.)

18. Label the upland areas between stream valleys on the topographic profile in Figure 4.9 with the word "upland."

19. The upland areas are (broad and flat, narrow ridges). Circle your answer.

20. Approximately what percentage of the area shown on the map is stream valley and what percentage upland?

Stream valley: ______ %

Upland: ______ %

21. Approximately how deep would the Missouri River have to erode to reach ultimate base level?

______ ft

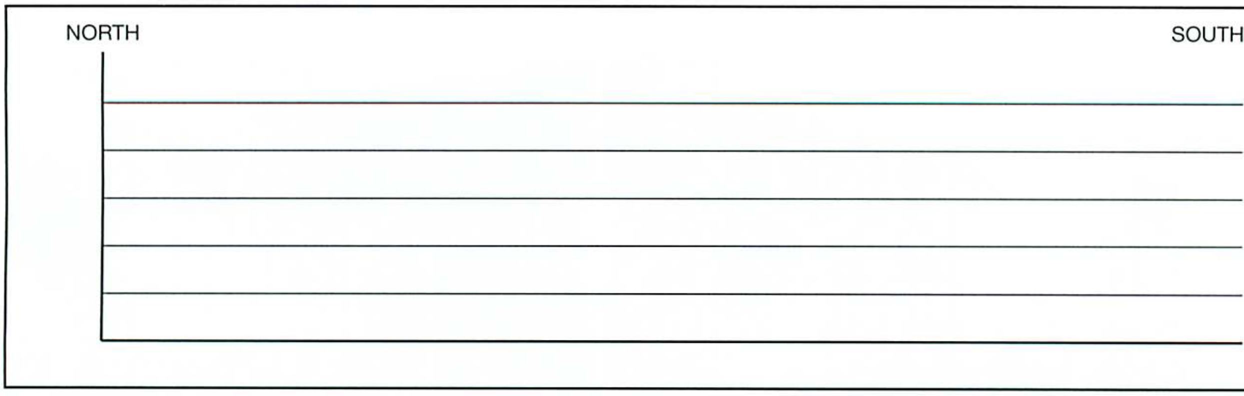


Figure 4.9 North–south topographic profile through the center of the Portage, Montana, map.

22. It appears that the Missouri River and its tributaries are, for the most part, actively (eroding, depositing) in the area. Circle your answer.

23. With increasing time, as the tributaries erode and lengthen their courses near the headwaters, what will happen to the upland areas?

Notice the dams located along the Missouri River at C.

24. What effect have the dams had on the width of the river, upriver from their locations?

25. Assuming that climate, base level, and other factors remain unchanged, how might the area look millions of years from now?

Questions 26–31 refer to the Angelica, New York, topographic map, Figure 4.10.

26. What is the approximate total relief shown on the map?

_______ feet of total relief

27. Draw an arrow on the map indicating the direction that the main river, the Genesee, is flowing. (*Hint:* Use the elevations of the contour lines on the floodplain to determine your answer.)

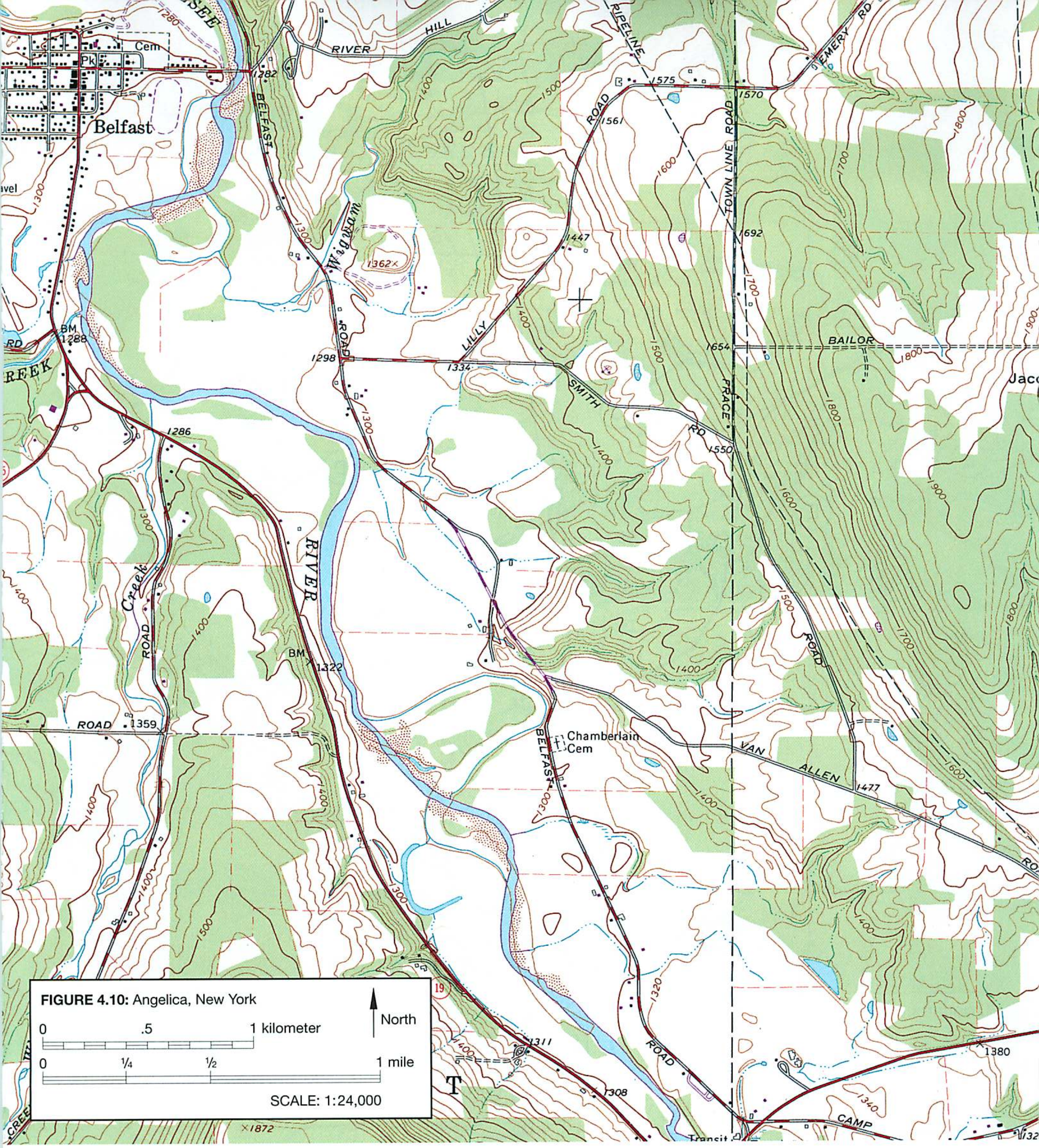
28. What is the approximate *gradient* (the slope of a river; generally measured in feet per mile) of the Genesee River?

Average gradient = _______ ft/mile

29. The Genesee River (follows a straight course, meanders from valley wall to valley wall). Circle your answer.

30. Most of the areas separating the valleys on the Angelica map are (very broad and flat, relatively narrow ridges). Circle your answer.

31. Assume that erosion continues in the region without interruption. How might the appearance of the area change over a span of millions of years?



CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICLE DATUM
OF 1929

QUADRANGLE LOCATION

Figure 4.10 Portion of the Angelica, New York, topographic map. (Map source: United States Department of the Interior, Geological Survey)

Figure 4.11 Portion of the Campti, Louisiana, topographic map. (Map source: United States Department of the Interior, Geological Survey)

Figure 4.12 Stereogram of the Campti, Louisiana, area. (Courtesy of U.S. Geological Survey)

Questions 32–39 refer to the Campti, Louisiana, topographic map, Figure 4.11, and stereogram of the same area, Figure 4.12. On the map, A indicates the width of the floodplain of the Red River and the dashed lines, B, mark the two sides of the meander belt of the river.

32. Approximately what percentage of the map area is floodplain?

    Floodplain = _______ % of the map area

33. In Figure 4.13, draw a north–south topographic profile along a line from the south edge of the City of Campti to south of Bayou Pierre. Indicate the appropriate elevations on the vertical axis of the profile. Label the floodplain area and Bayou Pierre on the sketch.

34. Approximately how many feet is the floodplain above ultimate base level?

    _______ feet above ultimate base level

35. Using Figure 4.5 as a reference, identify the type of feature found at each of the following lettered positions on the map. Also, write a brief statement describing how each feature forms.

    Letter C (in particular, *Old River*): ____________

    ____

    Letter D: ______________________________

    ____

    Letter E: ______________________________

    ____

    Letter F: ______________________________

    ____

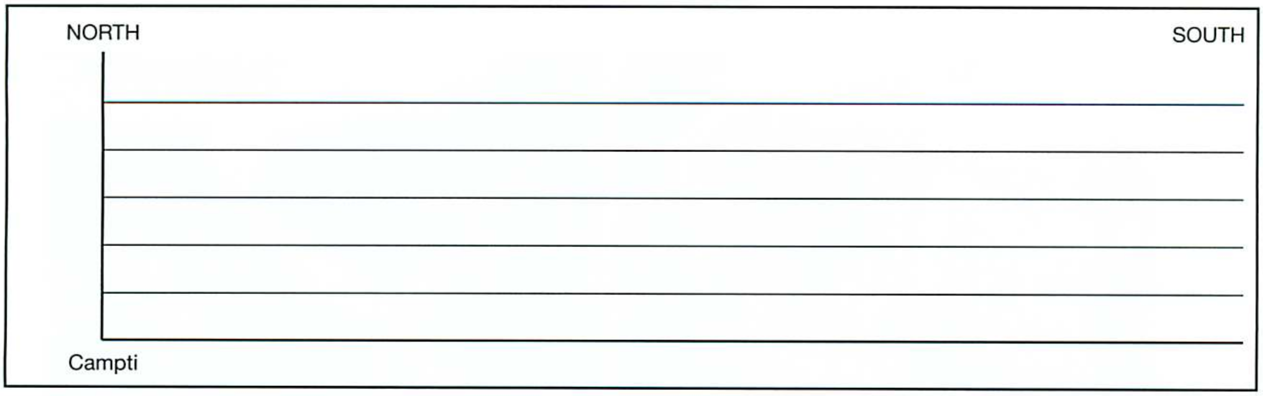


Figure 4.13 North–south topographic profile of the Campti map.

36. Identify and label examples of a point bar, cutbank, and an oxbow lake on the stereogram.

37. Write a statement that compares the width of the meander belt of the Red River to the width of its floodplain.

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38. (Downcutting, Lateral erosion) is the dominant activity of the Red River. Circle your answer.

39. Assuming that erosion by the Red River continues without interruption, what will eventually happen to the width of its floodplain?

____

____

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Answer questions 40–42 by comparing the Portage, Angelica, and Campti topographic maps.

40. On which of the three maps is the gradient of the main river the steepest?

____

41. Which of the three areas has the greatest total relief (vertical distance between the lowest and highest elevations)?

____

42. Choosing from the three topographic maps, write the name of the map that is best described by each of the following statements.

Primarily floodplain: ______________________________

River valleys separated by broad, relatively flat upland areas: ______________________________

Most of the area consists of steep slopes: ______________________________

Greatest number of streams and tributaries: ______________________________

Poorly drained lowland area with marshes and swamps: ______________________________

Active downcutting by rivers and streams: ______________________________

Surface nearest to base level: ______________________________

Groundwater

As a resource, groundwater supplies much of our water needs for consumption, irrigation, and industry. On the other hand, as a hazard, groundwater can damage building foundations and aid the movement of materials during landslides and mudflows. In many areas, overuse and contamination of this valuable resource threaten the supply. One of the most serious problems faced by many localities is land subsidence caused by groundwater withdrawal.

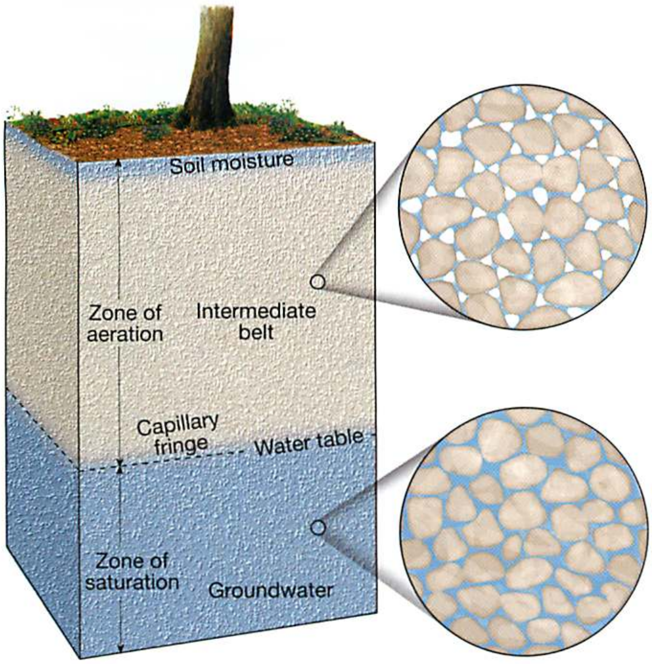

Figure 4.14 Idealized distribution of groundwater.

Water Beneath the Surface

Groundwater is water that has soaked into Earth's surface and occupies all the pore spaces in the soil and bedrock in a zone called the **zone of saturation.** The upper surface of this saturated zone is called the **water table.** Above the water table in the **zone of aeration,** the pore spaces of the materials are unsaturated and mainly filled with air. (Figure 4.14)

Figure 4.15 illustrates a profile through the subsurface of a hypothetical area. Use Figures 4.14 and 4.15 to answer questions 43–50.

43. Label the zone of saturation, zone of aeration, and water table on Figure 4.15.

44. Describe the shape of the water table in relation to the shape of the land surface.

____

45. What is the relation of the surface of the water in the stream to the water table?

____

46. What is the lowered surface in the water table around the well called? What has caused the lowering of the surface of the water table around the well? What will make it larger or smaller?

____

____

____

47. At point *A* on Figure 4.15, sketch a small, impermeable pocket of clay that intersects the valley wall.

48. Describe what will happen to water that infiltrates to the depth of the clay pocket at point *A*.

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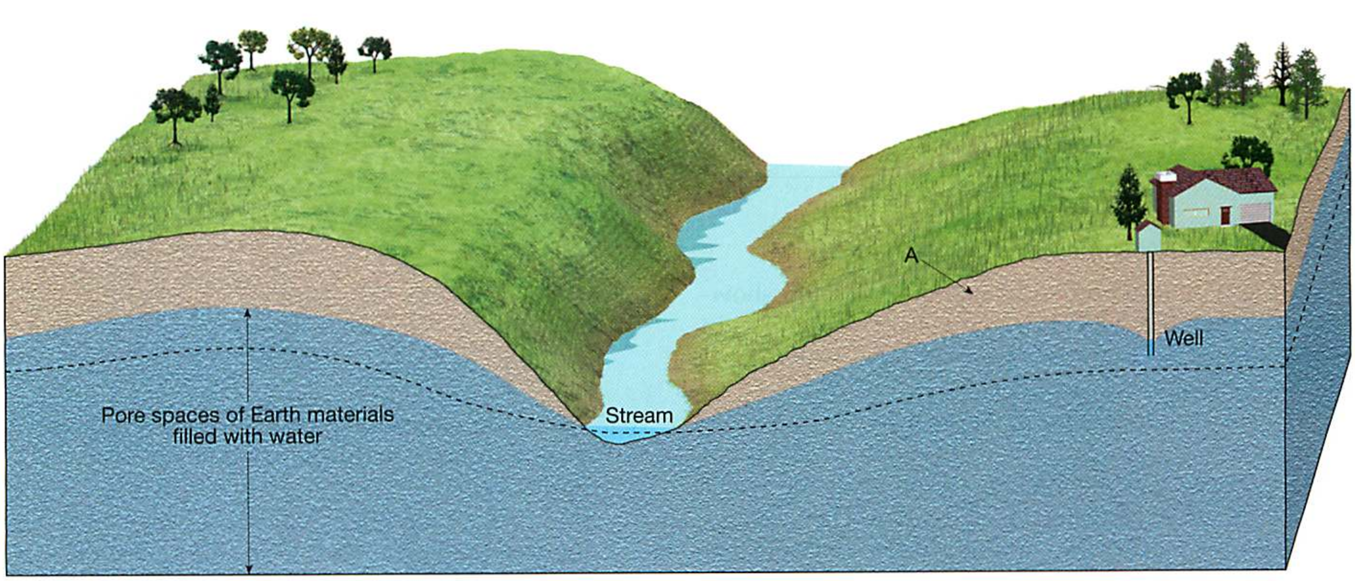

Figure 4.15 Earth's subsurface showing saturated and unsaturated materials.

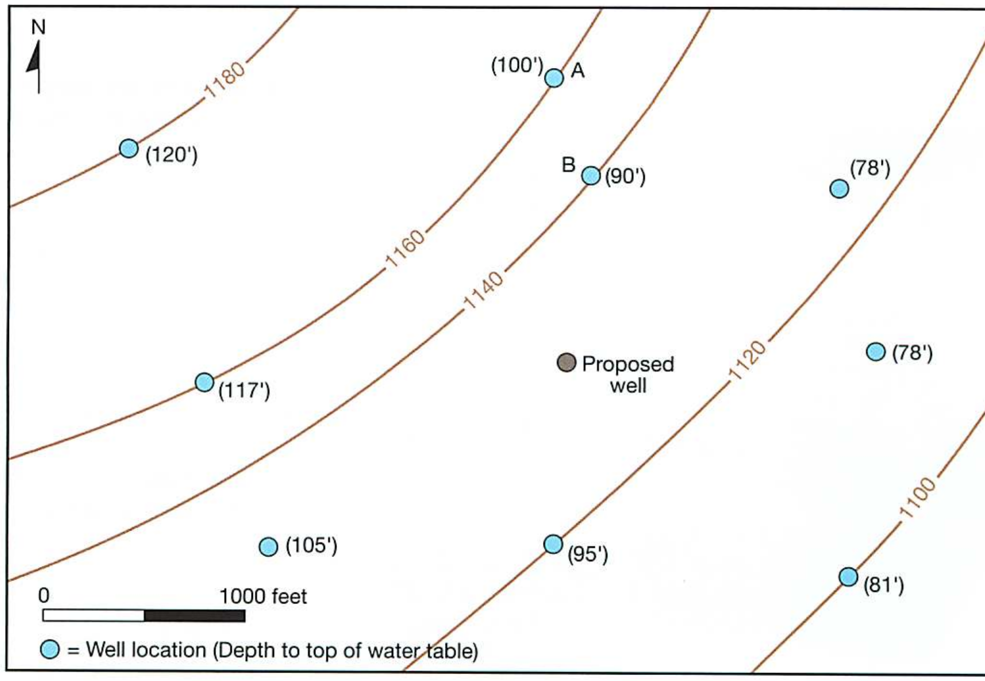

Figure 4.16 Hypothetical topographic map showing the location of several water walls.

The dashed line in Figure 4.15 represents the level of the water table during the dry season when infiltration is no longer replenishing the groundwater.

49. What is the consequence of the lower elevation of the water table during the dry season on the operation of the well? How might the problem have been avoided?

____

____

50. What are two main sources of pollutants that can contaminate groundwater supplies?

____

____

Groundwater Movement

Figure 4.16 is a hypothetical topographic map showing the location of several water wells. The numbers in parentheses indicate the depth of the water table below the surface in each well.

Questions 51–53 refer to Figure 4.16.

51. Begin by calculating the elevation of the water table at each indicated well location. Then, using a colored pencil, draw smooth 10-foot contours that illustrate the slope of the water table in the area. Using a different colored pencil, draw arrow(s) on the map that indicate the direction of the slope of the water table.

a. What is the average amount of slope of the water table in the area? Toward which direction does the water table slope?

____

____

b. Referring to the site of the proposed water well, at approximately what depth below the surface should the well drill the water table?

____

52. Assume that a dye was put into well A at 1 PM on May 10, 1990, and detected in well B at 8 AM on October 1, 1998. What was the velocity of the groundwater movement between the two wells in centimeters per day?

____

____

53. Use a different colored pencil to draw dashed 10-ft contour lines on the map that illustrate the configuration of the water table after well B was pumped for a sufficient period of time to lower the water table 22 feet at its location. Assume that an area within a 500-foot radius of well B was affected by the pumping.

The Problem of Ground Subsidence

As the demand for freshwater increases, surface subsidence caused by the withdrawal of groundwater from **aquifers** presents a serious problem for many areas. Several major urban areas such as Las Vegas, Houston-Galveston, Mexico City, and the Central Valley of California are experiencing subsidence caused by over-pumping wells (Figure 4.17). In Mexico City alone, compaction of the subsurface material resulting from the reduction of fluid pressure as the water table is lowered has caused as much as seven meters of subsidence. Fortunately, in many areas an increased reliance on surface water and replenishing the groundwater supply has slowed the trend.

A classic example of land subsidence caused from groundwater withdrawal is in the Santa Clara Valley, which borders the southern part of San Francisco Bay in California. The graph presented in Figure 4.18 illustrates the relation between ground subsidence in the valley and the level of water in a well in the same area.

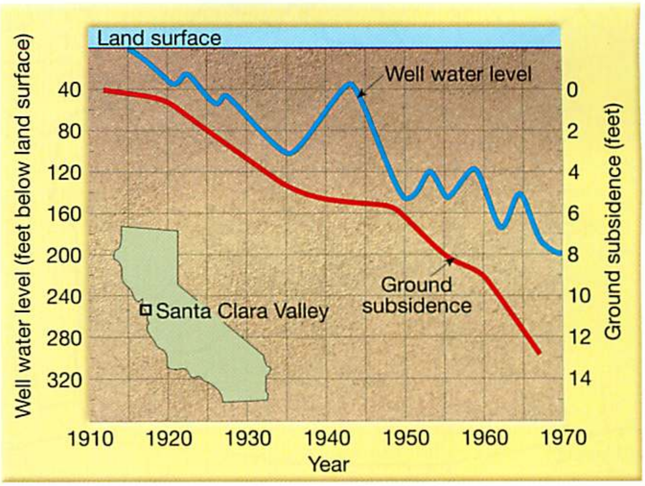

Figure 4.18 Ground subsidence and water level in a well in the Santa Clara Valley, California. (Data courtesy of U.S. Geological Survey)

Figure 4.17 The marks on this utility pole indicate the level of the surrounding land in preceding years. Between 1925 and 1977 this part of the San Joaquin Valley, CA subsided almost 9 meters because of the withdrawal of groundwater and the resulting compaction of sediments. (Photo courtesy of U.S. Geological Survey)

Questions 54–58 refer to Figure 4.18.

54. What is the general relation between the ground subsidence and level of water in the well illustrated on the graph?

____

____

55. What was the total ground subsidence and total drop in the level of water in the well during the period shown on the graph?

Total ground subsidence = _______ ft

Total drop in well level = _______ ft

56. During the period shown on the graph, on an average, about (1 ft, 5 ft, 10 ft) of land subsidence occurred with each 20-ft decrease in the level of water in the well. Circle your answer.

57. The ground subsidence that took place during the twenty years before 1950 was (less, greater) than the subsidence that took place between 1950 and 1970. Circle your answer.

58. Notice that minimal subsidence took place between 1935 and 1950. After referring to the well water level during the same period of time, suggest a possible reason for the reduced rate of subsidence between 1935 and 1950.

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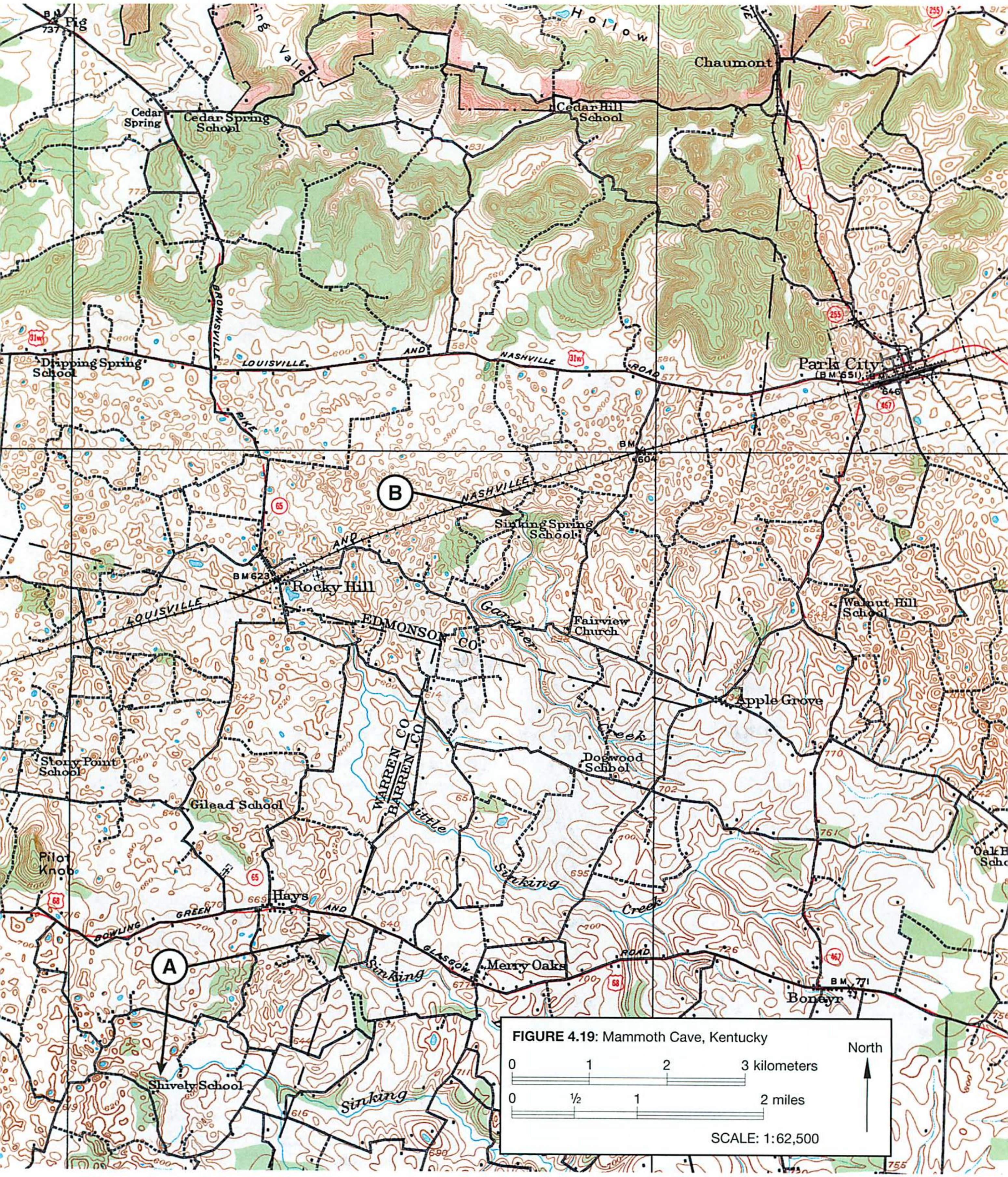

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

Figure 4.20 Portion of the Mammoth Cave, Kentucky, topographic map. (Map source: United States Department of the Interior, Geological Survey)

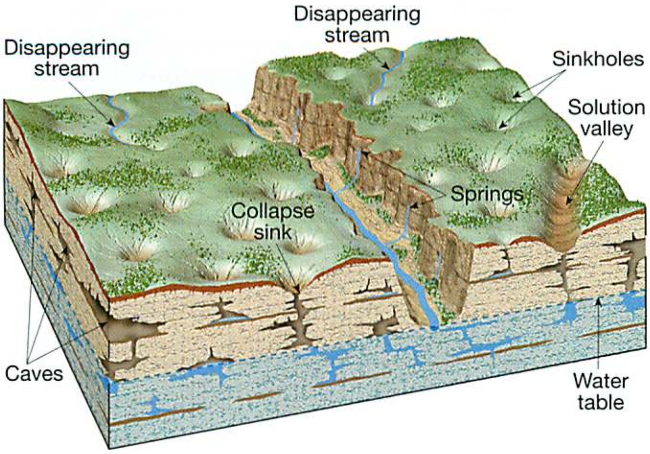

Figure 4.19 Generalized features of an advanced stage of karst topography.

Examining a Karst Landscape

Landscapes that are dominated by features that form from groundwater dissolving the underlying rock are said to exhibit **karst topography** (Figure 4.19). On the surface, karst topography is characterized by irregular terrain, springs, **disappearing streams**, **solution valleys**, and depressions called **sinkholes** (Figure 4.19). Beneath the surface, dissolution of soluble rock may result in **caves** and **caverns**.

One of the classic karst regions in the United States is the Mammoth Cave, Kentucky, area. Locate and examine the Mammoth Cave, Kentucky, topographic map, Figure 4.20. An insoluble sandstone layer is the surface rock that forms the upland area in the northern quarter of the map. Underneath the sandstone layer is a soluble limestone. Erosion has removed all the sandstone in the southern three fourths of the map and exposed the limestone. On the limestone surface, numerous sinkholes, indicated by closed contour lines with hachures, are present, as well as several disappearing streams (letter A).

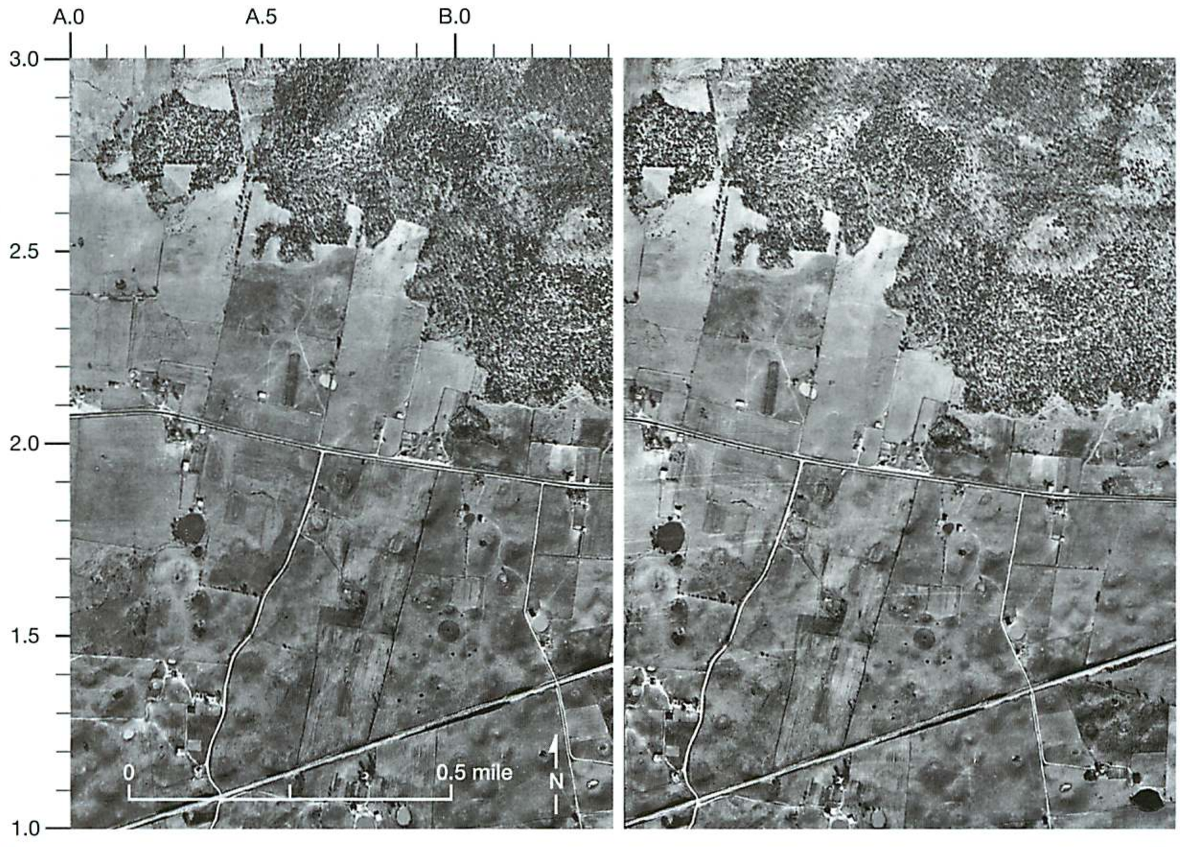

Figure 4.21 Stereogram of the Mammoth Cave, Kentucky, area. (Courtesy of the U.S. Geological Survey)

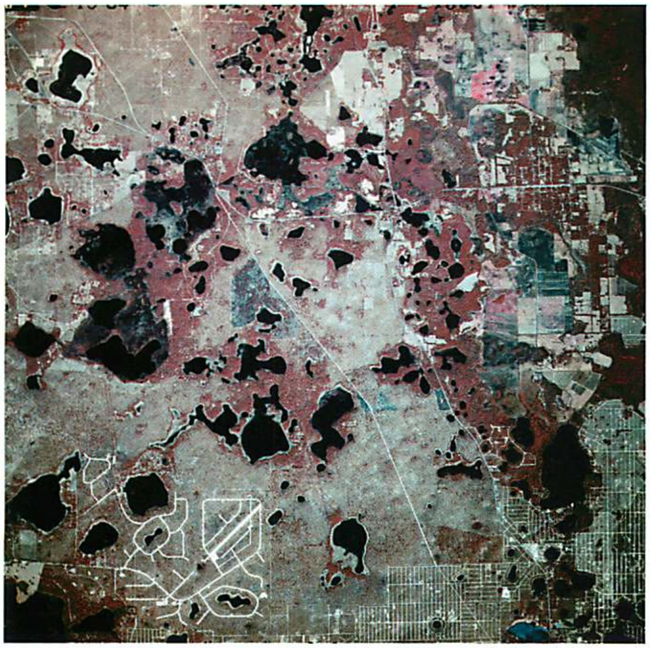

Figure 4.22 This high-altitude infrared image shows an area of karst topography in central Florida. The numerous lakes occupy sinkholes. (Courtesy of USDA–ASCS)

Use the Mammoth Cave topographic map, Figure 4.20, the stereogram of the same area, Figure 4.21, and Figure 4.22 to answer questions 59–63.

59. On the topographic map, outline the area that is shown on the stereogram.

60. What does the absence of water in the majority of sinkholes indicate about the depth of the water table in the area?

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61. Examine both the stereogram and map. Then describe the difference in appearance between the northern quarter and southern three-fourths of the mapped area.

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62. Describe what is happening to Gardner Creek in the area indicated with the letter B on the map.

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63. List two ways that sinkholes commonly form.

a. _______________________________________

b. _______________________________________

Running Water and Groundwater on the Internet

Apply the concepts from this exercise to investigate the hydrology of a river and the groundwater resources in your home state by completing the corresponding online activity on the *Applications & Investigations in Earth Science* website at http://prenhall.com/earthsciencelab

Shaping Earth's Surface
Running Water and Groundwater

Date Due: ____________________

Name: ____________________

Date: ____________________

Class: ____________________

After you have finished Exercise 4, complete the following questions. You may have to refer to the exercise for assistance or to locate specific answers. Be prepared to submit this summary/report to your instructor at the designated time.

1. Write a statement that describes the movement of water through the hydrologic cycle, citing several of the processes that are involved.

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2. Assume you are assigned a project to determine the quantity of infiltration that takes place in an area. What are the variables you must measure or know before you can arrive at your answer?

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3. Write a brief paragraph summarizing the results of your permeability experiment in question 8 of the exercise.

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4. Describe the effects that urbanization has on the stream flow of a region.

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Figure 4.23 River and valley features. (Photo by Michael Collier)

5. On Figure 4.23, identify and label as many features of the river and valley as possible. Write a brief paragraph describing the area and its relation to base level.

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6. Refer to the proportion of water that either infiltrates or runs off. Why does a soil-covered hillside with sparse vegetation often experience severe soil erosion? What are some soil conservation methods that could be used to reduce the erosion?

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7. Name and describe two features you would expect to find on the floodplain of a widely meandering river near its mouth.

Feature	Description
______	______________________
______	______________________

8. Assume you have decided to drill a water well. What are at least two factors concerning the water table and zone of saturation that should be considered prior to drilling?

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9. What is the average slope of the water table illustrated on Figure 4.16?

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10. What was the velocity of the groundwater movement between wells A and B in Figure 4.16?

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11. How might a rapidly growing urban area that relies on groundwater as a freshwater source avoid the problem of land subsidence from groundwater withdrawal?

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12. Name and describe two features you would expect to find in a region with karst topography.

Feature	Description
______	______________________
______	______________________