Field Exercises and Review Questions

GS407/507-River Environments
Field Trip Reading Questions

Read through the course readings and answer the following questions on separate pages. Neat, word-processed answers are most preferable, but field sheets / hand-written notes are also acceptable. Many of the field stops on the trip will also help answer these questions.

Section 1. Orr and Orr, 1999 - Overview of Deschutes-Columbia Plateau

1-1. Briefly describe the physiographic setting (elevation, physical boundaries, general characteristics) of the High Lava Plains province of Oregon.

1-2. What fault zone dominates the High Lava Plains? What is its orientation?

1-3. What three major fault/fracture zones converge in the proximity of Newberry Volcano? What is the likelihood of a Newberry Eruption during our field trip?

1-4. What is meant by "bimodal" lava composition of the High Lava Plains? List and discuss the two types of lavas that have been erupted in the High Lava Plains.

1-5. How does the age of volcanic deposits in southeastern Oregon (e.g. Owyhee uplands) compare the age near Newberry?

1-6. What is the geologic explanation for the formation of Fort Rock, southeast of Newberry?

1-7. When were the basalts of Lava Butte (south of Bend) erupted? What impact did the eruption have on the Deschutes river in that area?

1-8. What type of volcano is Newberry? How did the central Newberry crater (and associated lakes) form? What other famous Oregon volcano experienced similar processes?

Section 2. Jenson and Chitwood, 2000 - Overview of Newberry Volcano

2-1. How long has Newberry Volcano been active? What type of volcano is it? What is the chemical composition of lavas associated with Newberry?

2-2. How has Newberry volcanic activity impacted river systems in the region (e.g. Deschutes and Crooked River)?

2-3. What is the Newberry "caldera"? How did it form? What topographic features are located in the caldera at present?

2-4. How far south and north of Bend does the Newberry Volcano extend? Is Bend part of Newberry Volcano?

2-5. In chronological order, briefly list the dates and names of known eruptions at Newberry.

Section 3. Orr and Orr, 1999 - Overview of Deschutes-Columbia Plateau

3-1. What are the major rivers that drain the Deschutes-Columbia Plateau region? What is the dominant type of bedrock material that characterizes the region?

3-2. Where does the Deschutes river drain from and to? How long is it? How does it relate to the Columbia River?

3-3. What is the significance of the Columbia River Basalt (CRB) group in this region? When were the CRB's erupted? Over how long of a period were they erupted?

3-4. Describe the geographic extent of the Columbia River Basalts in terms of Washington and Oregon? How far north do they extend? How far south? How far east? How fare west?

3-5. Approximately how many individual lava flows have been identified in the Columbia River Basalt Group? Approximately how often did the eruptions take place?

3-6. Where is the source region for the Columbia River Basalts? Were these erupted by volcanic mountains? Explain your answer.

3-7. How do the Clarno and John Day formations compare to the CRB's? Are they older or younger? Are they also composed of basalts? What are they composed of? What type of rock material?

3-8. How do the "Dalles Formation" and "Wasco windblown silts" compare to the CRB's? Are they older or younger? Are they also composed of basalts? What are they composed of? Are the lithified rocks are unconsolidated sediment?

3-9. How did the Pleistocene ice ages and Missoula floods impact the Columbia Plateau? What types of deposits and landforms record the history of the Missoula floods?

Section 4. Bebee et al., 2002 - Middle Deschutes Field Geology

4-1. What is the drainage area of the Deschutes River? What are the physiographic boundaries of the Deschutes? (to the east, west, north, south)

4-2. How old are the Clarno and John Day Formations? What types of rocks are these formations composed of ? How did they form?

4-3. What part of the Deschutes River valley are these rock exposed (see Fig. 2).

4-3. How old are the Columbia River Basalts? What part of the Deschutes River valley are these rocks exposed (see Fig. 2)?

4-4. How old is the Deschutes Formation? What types of rocks is this formation composed of? How did these rocks form?

4-5. How have lava flows impacted the Deschutes River drainage in the past 1.5 million years?

4-6. How have lahar deposits from Mt. Jefferson impacted the Deschutes River? What is a "lahar"? How long ago were these lahars deposited? How far away from Mt. Jefferson can lahars travel?

4-7. How have landslides impacted the Deschutes River drainage over the past 40,000 years? How do the landslides influence river rafting on the Deschutes?

4-8. Does the flow and discharge of the Deschutes change drastically throughout the year? Why or why not? What geologic processes control the discharge of the Deschutes river?

Section 5. O'Connor et al., 1995 - Overview of Missoula Floods

5-1. What are the "Missoula Floods" and how do they relate to the Columbia River Gorge of Oregon?

5-2. How long ago did the Missoula Floods occur? How did they originate? Where was "Lake Missoula"?

5-3. What was the maximum discharge of water that flowed through the Columbia Gorge during the Missoula flood events? How does this discharge compare to modern rivers of the world?

5-4. What types of deposits and erosional landforms associated with the Missoula Floods remain on the landscape today, in Washington and Oregon? (How do we know that the Missoula Floods happened?).

5-5. Will the Missoula Floods happen again in the future? What types of geologic conditions would be required for the Missoula Floods to happen again?

Section 6. Orr and Orr, 1999 - Overview of Willamette Valley

6-1. What is the drainage area of the Willamette Basin? What are the physiographic boundaries of the basin? What two mountain ranges form the primary boundaries of the basin?

6-2. What percent of Oregon's population live in the Willamette Valley? What is the primary land-use type in the basin?

6-3. How did the Willamette Valley form in relation to the Coast Range and Cascades? Is the Willamette Valley the result of erosion (like the Grand Canyon), uplift, or a combination of the two?

6-4. What type of plate tectonic setting is the Willamette Valley associated with?

6-5. Which side of the valley is associated with large alluvial fans? What mountains are these fans associated with?

6-6. How did the Missoula Floods impact the Willamette Valley? What is the name of the Missoula Flood deposits left behind in the valley?

6-7. What is an "erratic"? How are "erratics" related to the Missoula Floods? Did Missoula Flood waters extend south to Eugene? How do you know?

6-8. How many "Missoula Floods" were there, as recorded in the Willamette Valley? How often did they occur?

6-9. Was Monmouth impacted by Missoula Floods? Was Monmouth covered by Missoula Flood waters? How do you know?

GS407/407 River Environments – Surficial Mapping Field Exercise

Referring to the surficial mapping summary table on p. 116 of your field guide, use the described mapping techniques to keep a systematic log of landforms, materials, processes, and age for select localities at each of your field stops. At each field stop, complete the following tasks:

(1) Plot the field-stop position on the topographic base maps provided on pages 150-183 of your field guide. Give each plotted point a unique identifier and stop number.
(2) Systematically record your surficial geology observations on the table below.

Use the following decision criteria in combination with the table on p. 116 of the field guide to make your observations:

Landform Criteria = (a) decide whether you are observing a hillslope, valley bottom, or "other" landform; (b) is the landform a "deposit" or an "erosional surface"; (c) then choose the appropriate descriptor from the table on p. 116.

Material Criteria = (a) decide whether the landform is comprised of bedrock, regolith, or bedrock with a thin veneer of regolith; (b) then choose the appropriate descriptor from the table on p. 116. (c) If you decide the landform is supported by pure rock (and no regolith cover), provide the rock type as the "material".

Process Criteria = (a) decide whether you are observing a depositional or erosional landform; (b) then decide whether the deposition/erosion is the product of a fluvial, mass wasting, glacial, volcanic, or combination environment; (c) then choose an appropriate descriptor from the table.

Age Criteria = (a) the goal here is to determine how old the deposits or landform surfaces are, i.e. how long ago was the regolith deposited, or how long has the erosion surface been exposed at the Earth's surface? (b) Can you use the law of superposition, law of cross-cutting relations, and/or a relative weathering criteria (e.g. soil development, rind thickness) to bracket or hypothesize how old the feature is?

Stop I.D.	**Map I.D./ Page No.**	**Landform**	**Material**	**Process**	**Age**	**Comments**
______	______	__________	___________	__________	__________	__________________
______	______	__________	___________	__________	__________	__________________
______	______	__________	___________	__________	__________	__________________
______	______	__________	___________	__________	__________	__________________
______	______	__________	___________	__________	__________	__________________
______	______	__________	___________	__________	__________	__________________
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Continued on Back

Stop I.D.	Map I.D./ Page No.	Landform	Material	Process	Age	Comments

GS407/507 River Environments – Stream Ordering Exercise

Introduction

Watersheds represent a collection of stream tributary networks with interconnected branches that flow from drainage divides (interfluves) to the exit point, downstream. Smaller-area watersheds are in turn connected to larger-area watersheds until they reach a scale that empties into the ocean. The primary physical function of the stream network is to deliver water and sediments over time, under the influence of gravity. The sediment or water discharge of a river system is calculated by:

$Q = vol. / t$ where Q = discharge, volume = vol. of sediment or water, and t = time.

Gravitational force is the driving mechanism moving sediment and water downstream, climate-derived rainfall/precipitation is necessary for water flux, the sediment and water transported by the river represents its "load", and the discharge represents the "output" of the watershed over time. The number and types of tributary connections in watersheds are important factors that control the output. The critical controlling morphometric parameters include:

Drainage basin area (i.e. precipitation "catchment" area)
stream gradient (slope of channel = gravitational force)
Number of stream segments in the network
Lengths of stream segments in the nework

An example of these controlling factors is:

The greater the drainage basin area and the steeper the stream gradient, the greater the volume of water and faster the stream velocity, the greater the energy to transport sediment = higher discharges of water and sediment over time.

The following exercise illustrates the analytical techniques used to characterize the physical drainage morphometry of a watershed.

Exercises

Examine the map of the watershed and drainage network shown on the following page.

1. Label the drainage boundary on this map. Label the tributary outlet for the watershed.
2. Compare the map to the drainage patterns shown on "Figure 5.2A" on p. 32 of your field guide. What drainage type is associated with this map?
3. Using the drainage pattern as a guide, draw drainage divides around the stream network systems labeled "sub-basin 1", "sub-basin 2", "sub-basin 3", "sub-basin 4", "sub-basin 5", and "sub-basin 6".
4. Using the "Strahler stream ordering method" illustrated on "Figure 5.17", p. 34 of your field guide, determine and label the stream order numbers for each tributary in the watershed. Label the stream order numbers next to the stream segments on your map.
5. Answer the following questions:

What is the highest stream order of the basin?
How many total first order stream segments are there? = ______
How many total second order stream segments are there? = ______
How many total third order stream segments are there? = ______
How many total fourth order stream segments are there? = ______

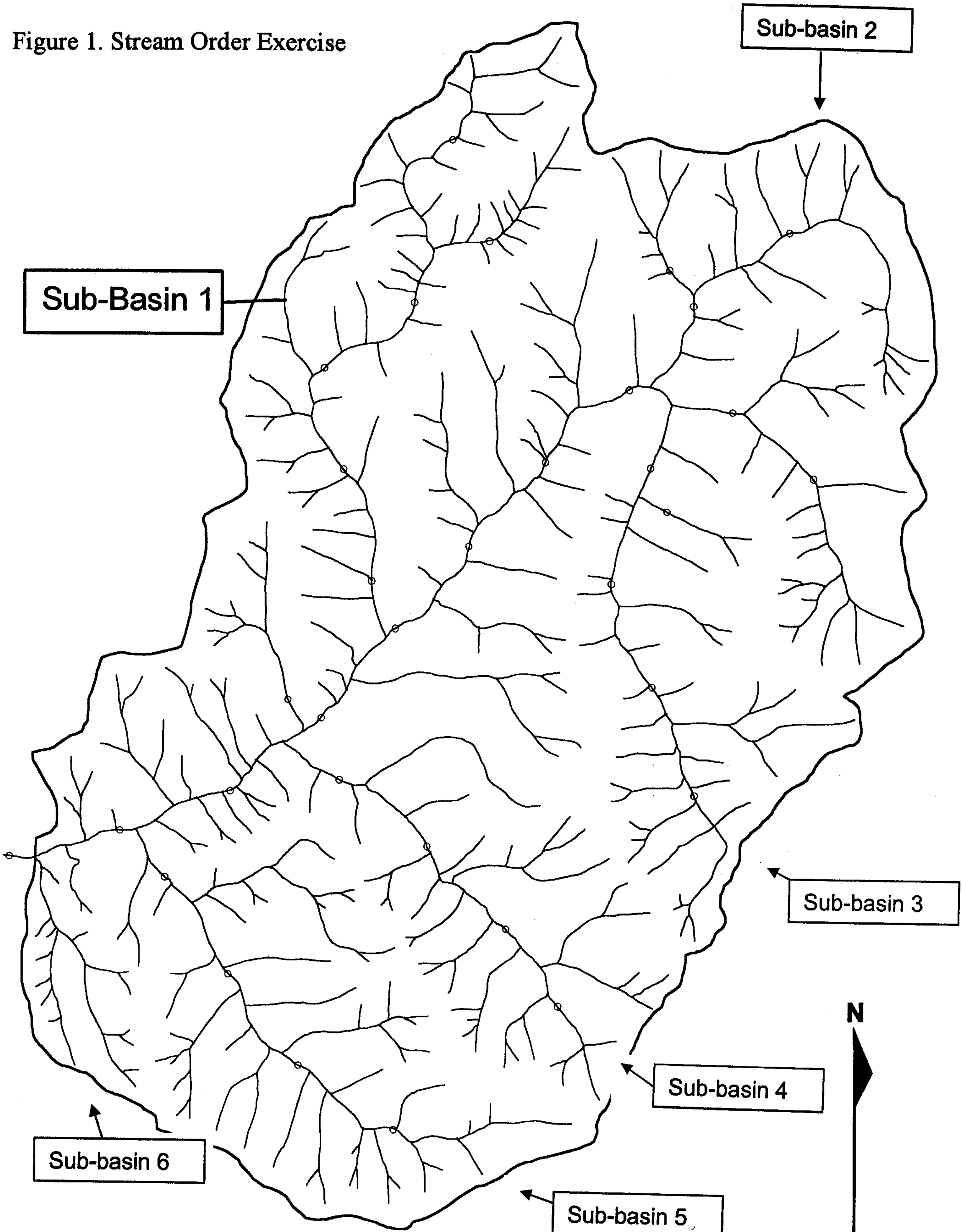
What is the general relationship between stream order and the no. of stream segments in the order? Plot the general relationship on an x-y graph, with stream order on the x-axis, and number of segments on the y-axis.

Hypothesize the relationship you would expect between stream order and stream channel width. Plot the general relationship on an x-y graph, with stream order on the x-axis, and channel width on the y-axis.

Hypothesize the relationship you would expect between stream order and channel gradient. Plot the general relationship on an x-y graph, with stream order on the x-axis, and channel gradient on the y-axis.

If the bedrock underlying a given watershed was very porous and permeable (i.e. sponge-like), would you expect the number of stream channel segments to increase, decrease, or stay the same? Why, explain your answer.

Figure 1. Stream Order Exercise



GS407/507 River Environments – Fluvial Hydrology Problem Set
Using the equation lists on p. 35-47 of your field guide, and the unit conversion charts on p. 123-130, solve the following problems. Show all of your math work and calculations!

1. The rational runoff method predicts peak runoff rates (discharge = vol / time) from data on rainfall intensity (i.e. rainall into drainage basin) and watershed characteristics (e.g. underlying bedrock type and infiltration capacity). The governing equation is:

$$Q_{pk} = 0.278CIA$$

Where Q_{pk} = peak discharge of drainage basin in m^3/sec, I = rainfall intensity in mm/hr, C = infiltration factor of watershed (asphalt/concrete = 0.80, thin soil over bedrock = 0.40), and A = drainage basin area in km^2.

A. Determine the peak discharge (in cubic meters per second) for a drainage basin experiencing a rainfall event with the following characteristics: drainage area = 10,000 acres, rainfall intensity = 1.25 cm/hr, and substrate = loamy soil over sandstone. Show all of your work.

B. If a drainage basin has an area of 175 km^2 and experiences a 30 mm/hr rainfall event with a 500 m^3/sec peak discharge, calculate the infiltration factor for the watershed. Show all of your work. Based on your answer, is this watershed likely rural/forest or highly urbanized? Explain your reasoning.

C. If 30% of a forested, 1000 km^2 watershed is urbanized, calculate the anticipated peak runoff associated with a 0.5 in/hr rainfall event.

2. If a river channel has a discharge of 5 ft^3/sec and a cross-sectional area of 5 m^2, calculate the average velocity of the river in m/sec. Show all of your math work.

3. Empirical data show that hypothetical watersheds in the western Cascades have peak flood discharges every 2-3 years as described by the following equation:

$$Q_{2.33} = 34.5A^{0.93}$$

Where Q = peak discharge in ft^3/sec and A = drainage area of a given basin in acres. Calculate the expected peak discharge for a drainage basin with an area of 125 km^2. Show all of your work.

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GS407 / 507 River Environments
Review of Day 1 Concepts / Preview of Day 2 Concepts

1. Using your class notes, write and explain the following equations that pertain to fluvial dynamics (show all of your unit algebra in metric units (kg-m-sec)).

   A. Force (according to Newton's 2^{nd} law)

   B. Work (force as applied to a mass)

   C. Weight (according to newton's 2^{nd} law)

   D. Density

   E. Potential Energy

   F. Kinetic Energy

2. Using your class notes, write and explain the following equations that pertain to river hydrology (show your unit algebra in metric units)

   A. Flow Velocity

   B. Discharge (according to continuity equation)

   C. Wetted Perimeter

   D. Manning's Equation

   E. Stream Power

   F. Roughness (manning's n)

3. Review Questions from Day 1

A. List and briefly define the 5 agents of transport at the Earth's surface (agents of sediment transport)

B. What are the 4 criteria necessary to systematically analyze the geomorphic character of the landscape (forms basis of surficial mapping criteria)

C. What are the two primary controlling factors that allow rivers to perform geomorphic work? Briefly explain.

D. Define the following terms as related to surficial materials

i. Regolith

ii. Bedrock

iii. Alluvium

iv. Colluvium

v. Till

vi. Diamicton

vii. Cross-stratification

viii. Clast Imbrication

3. Find a boulder in the vicinity of the campground. Assuming an average rock density of 3 gm/cm^3, calculate the volume and weight of the boulder using Newton's second law (assume that $g = 9.8\ m/sec^2$. Calculate the weight in newtons (N). Show all of your unit algebra.

A. Based on readings in your field guide, what types of processes are used by the river to transport large boulders?

B. What is the density of pure water in kg / cubic meters? Will the boulder float? Why or why not?

C. What would be necessary, given the density of the boulder, to cause it to float? What types of fluvial processes or conditions may result in flotation of the boulder?

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Day 2 Lab Exercise 2 at Lower Paulina Creek, Newberry Volcano

Read over the field hydrology procedures outlined on p. 53-65 of the field trip guide. Use these directions to help you complete questions 1-6 below.

1. Divide the width of Paulina Creek into about 6-8 subsections. Establish 6-8 measuring points from stream bank left. At each station measure and record the depth (meters) and flow velocity at about 2/3'rds the total depth from the top of the stream surface. Record data for each section in meters and seconds. A diagrammatic sketch is illustrated on p. 42 of the field guide.

2. Using the graph paper provide on p. 73 of the field guide, draw a scaled profile of the stream surface and bottom using the depth information recorded above. Use a vertical exaggeration of x1 on your profile. Choose and appropriate scale that allows you to use the full width of the graph paper.a

3. Based on your vertical and horizontal scale, determine the area covered by 1 "grid square" on your graph / profile. Answer in sq. meters.

4. For each subsection of Paulina Creek, calculate and record flow depth, flow velocity, subsection area, and subsection discharge (use units of meters and seconds).

5. Sum the discharge for each subsection, determine the total stream discharge in cubic meters per second.

6. Perform a traverse from one side of Paulina Creek to the other, note the presence or absence of Mazama ash in the valley bottom. Determine the highest elevations on each side of Paulina Creek, where Mazama ash is present / absent. Assuming this is a high-water scour mark, determine the discharge in Paulina Creek at the time the Mazama Ash was scoured away.

   A. Plot the high water marks at the appropriate elevation on the topo sheet provided on p. 165 of the field guide. You may use a combination of GPS, altimetery, and topographic position to plot your points.

   B. Using graph paper on p. 73, draw a scaled topographic profile perpendicular to Paulina Creek, through the two high-water points. Use a vertical exaggeration of x1. Mark the position of the points on your profile.

   C. How much area is covered by 1 "grid square" on your graph, according to your vertical and horizontal scales (answer in sq. meters).

   D. Using your scaled profile, calculate the cross-sectional area of the channel flow necessary to scour the Mazama ash from the valley bottom (i.e. count the no. of squares in the channel cross-section and multiply by the area covered by each square). Answer in square meters.

   E. Using your scaled profile, determine the wetted perimeter of Paulina Creek that was necessary to scour Mazama Ash from the valley bottom (see figure 6.1 on the bottom right of p. 44 for definitions of wetted perimeter and hydraulic radius).

F. Calculate the hydraulic radius of Paulina Creek that was necessary to scour Mazama Ash form the valley bottom.

G. Using the topo map on p. 165, calculate the approximate gradient of Paulina Creek at the field station. Answer in m/m (i.e. diminsionless ratio).

H. Using the table on p. 37 of your field notes, determine the approximate roughness of the Paulina Creek valley bottom at the field station.

I. Using Manning's Equation from p. 35 of your field guide, estimate the velocity of Paulina Creek that was present at the time that Mazama Ash was scoured from the valley bottom.

J. Finally, using the continuity equation, and your answers from 6D, 6F, and 6H above, estimate the discharge in Paulina Creek at the time that Mazama Ash was scoured at the two high-water points.

7. Based on our field observations of terraces along Paulina Creek, answer the following questions:

   A. What is a river terrace, how is it defined?

   B. What diagnostic materials are river terraces comprised of that provide definitive confirmation that it is a terrace as opposed to some other geomorphic surface?

   C. Will these terrace materials likely be well sorted or poorly sorted? Will they likely be rounded or angular?

   D. Given that the terrace examined along Paulina Creek was covered in Mazama Ash, what is the maximum age of the terrace (i.e. when was the last time that Paulina Creek was depositing sediment at that level?)?

   E. What do the presence of terraces imply about the river system, is it eroding or depositing? Aggrading or degrading? Incising or back-filling?

8. Define a knickpoint. What process is occurring at knickpoints, erosion or deposition?

   A. What is headward erosion and how does it apply to river knickpoints?

   B. In which direction do knickpoints migrate over time? Upstream or downstream?

9. Read over the stream classification notes in your field guide on p. 80-89.

   A. Using the parameters outlined for the Rosgen classification shown on p. 83-85, classify Paulina Creek according to Rosgen stream type. Provide your data and answer below.

   B. Using the parameters outlined for the Montgomery and Buffington classification shown on p. 85-89, classify Paulina Creek according to this criteria. Provide your observations and answer below.

GS407 / 507 River Environments
Day 3 - Lab Exercise 3 at Whiskey Dick Campground – Middle Deschutes

1. Examine the Whitehorse section of the topographic map shown on p. 171 of the field guide.

2. Identify the bench mark elevations along the railroad tracks. Using the bench marks on the railroad grade, approximate the gradient of the Deschutes River in this region.

   A. Calculate the gradient in ft/mi (change in elevation / change in distance).

   B. Calculate the gradient in m/km

   C. Calculate the gradient in percent

3. Using the graph paper provided on p. 71 of your field guide, draw a topographic profile along line X-Y-Z as shown on the map on p. 171. This profile is across the Deschutes canyon at Whitehorse Rapids.
   A. Use a horizontal scale on the profile equal to the horizontal scale on the map.

   B. Determine the contour interval of the map on p. 171.

   C. Use a vertical scale with an exaggeration of x3 that of the horizontal (for example if 1 in on the map = 30 ft on the ground in the horizontal, then a x3 exaggeration on the vertical would be 1 in = 10 ft. Draw the profile

   D. On your topographic profile identify and label the following: cliff faces, colluvial hillslopes, landslide deposits, river channel.

4. Examine the gravel deposits behind and under the tents in camp. Measure the intermediate clast diameter (the "b" axis), in millimeters, of 20 clasts, and average them. Plug the average diameter into the Costa (1983) equation on p. 51 of the field guide. In that equation, d = grain diameter, Vc = critical velocity to move the clasts.
   A. calculate the critical velocity necessary to transport the gravel clasts near camp (answer in m /sec)

   B. Using the "float method" approximate the average surface water velocity of the Deschutes River today. (answer in m/sec)

   C. How do the velocities from 4 A and 4 B above compare? Are we transporting gravel bedload today?

   D. Using the continuity equation on p. 35, demonstrate how discharge is related to velocity. Now relate discharge to stream power, also shown on p. 35. What are two ways in which the river system could increase it's stream power to transport gravel of the caliber measured in camp? Explain your reasoning.

GS407 / 507 River Environments
Day 5 - Lab Exercise 4 at Buckskin Mary Campground – Middle Deschutes

Read over the notes on flood periodicity (i.e. "recurrence interval") as presented on p. 14, p. 39-40, p. 45, and p. 66 of the field guide.

1. A total of 60 years of river discharge data were collected for a hypothetical river. The peak discharges for each year were identified and tabulated (herein referred to as "Qp"). The data were ranked from 1 = highest Qp to 60 = lowest Qp for the 60 year period. As subset of the data below were selected from the 60-year record.

Qp (cu. m /sec)	Rank	RI	Prob.
1300	16	_____	_____
500	53	_____	_____
1100	23	_____	_____
1700	6	_____	_____
2200	2	_____	_____
2000	3	_____	_____
100	60	_____	_____
300	57	_____	_____
800	39	_____	_____
1500	10	_____	_____

A. Calculate the Recurrence Interval (RI) for each of the above discharges, answer in the space provided above.

B. Calculate the probability of occurrence for each of the above datum (p = 1/RI), answer in the space provided above.

C. Plot the recurrence interval –Qp data on the "Gumbel" probability graph on p. 69 of the field guide. RI is on the "x-axis", put Qp on the "y-axis". Use a y-axis scale of 10 tics = 500 cu. meters /sec.

D. Draw a best-fit line through the data, project the line to estimate Qp-100 (i.e. the anticipated discharge necessary for a 100-year flood.

E. Examine the graph you have created. Comment on the relationship between the frequency of small-scale floods vs. large scale floods. Which ones happen more often? How does the frequency of occurrence relate to the probability that a flood of a given magnitude will occur in a given year?

2. Examine the hillslope adjacent to Buckskin Mary Campground on river right. Compare the hillslope deposits and shape to the mass wasting diagram on p. 113 of the field guide. Identify the dominant processes responsible for the colluvial deposits that you observe.

3. Hike to the Dant overlook along the gravel road. Identify the landform and material that comprise the surfical deposit at the mouth of the steep canyon across the river. Draw a line around the boundary of this landform on the topo sheet on p. 173 of your field guide. What is the dominant process that resulted in this deposit? What observational evidence support you interpretation as to the process?

4. Using the data presented on p. 235, plot an X-Y graph of alluvial surface area (y-axis) vs. valley-bottom width (x-axis). To derive the data, read the graphs on p. 235 and fill in the table below for the river-mile positions listed. After you fill out the table, plot the graph in the space below. Answer the summary questions.

River Mile	Valley-Bottom Width (meters)	Alluvial Surface Area (hectares)
100	________	____________
90	________	____________
84	________	____________
81	________	____________
79	________	____________
73	________	____________
67	________	____________
50	________	____________

A. From your graph, describe the relationship on the Deschutes between volume of alluvial deposits in storage and valley-bottom width. What valley bottom localities would you most likely find a flood record that would preserve paleoflood stage indicators? Frame your answers in the context of valley width, transport energy, stream power and sediment-transport efficiency.

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GS407 / 507 River Environments
Day 6 - Lab Exercise 5 Geomorphic Analysis of the Columbia Plateau near Petersburg, OR

Soil maps are created by the U.S. Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service) on a county-by-county basis in each state. The soil maps are used for agricultural and development purposes. Soils as defined on the field trip represent post-depositional alteration of surficial deposits and landscape stability between depositional events.

A portion of a soils map in the Petersburg vicinity of Wasco County, Oregon is shown on p. 175 of the field guide. The base for the map is an aerial photograph, soils units are coded with a number and a letter. Pages 176-181 of the field guide provide soil unit descriptions for those shown on the map of p. 175. County soil surveys provide the best approximation of geomorphic and surficial material maps available to the general public. Your goal in this exercise is to simply examine the map, read the soil-unit descriptions, and provide a geomorphic interpretation of the soil survey.

Fill in the table below and answer the questions that follow. I've completed the first entry (map unit "34F") for you to give an example as to how to interpret the soil survey data.

Soil Map Unit ID	Soil Series Name	Landform Association	Surficial Material/ Texture	Slope Gradient	Depositional Process	Bedrock Assoc.
34F	Nansene	uplands/hills	silt loam	35-70%	Loess/ aeolian	Overlies Basalt (CRB)
35						
36						
37						
38						
45B						
45C						
45D						
45E						

Geomorphic/Soil Interpretation (Cont).

Soil Map Unit ID	Soil Series Name	Landform Association	Surficial Material/ Texture	Slope Gradient	Depositional Process	Bedrock Assoc.
46B						
46C						
46C						
48E						
48F						
54D						
54E						
55B						
55C						
55D						
55E						
56B						
56D						

Questions:

1. Based on the field stops from the trip and the soils map, what are the two dominant types of surficial deposits located in this vicinity of Wasco County?

2. What is the dominant bedrock that underlies surficial deposits in this region?

3. What is the siginificance of the letter designations on the map units? Do they signify a difference in material? Process? Or landform? Specificially what is the difference between the letter designations given the same number on the map unit ID?

4. What other types of landuse information is available in the soil descriptions?

5. What is the dominant native vegetation type in this region?

6. What is the average annual rainfall associated with soils in this region?

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