**ES302 Quantitative Methods Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**WOU Geologic Site Analysis Exercise Worksheet**

**Objectives:** To review natural resource records for the WOU Campus, make observations, conduct a geologic site analysis using available map resources.

**Introduction:**

The WOU campus geologic map resources are located at the following URL:

[https://people.wou.edu/~taylors/g302/ES302\_geologic\_map\_analysis\_data\_packet.pdf](https://people.wou.edu/~taylors/g302/WOU_Site_Maps.pdf)

Relevant site data include: site maps and topographic map (p. 5-6), geologic map (p. 7), annual precipitation (p. 8) groundwater overview with maps (p. 9-14), and soil survey map with unit descriptions (p. 15-20). All of this information is required background data to understand local site geologic conditions.

**Instructions:**

Step 1: read through the WOU Campus Geologic Map Resources Packet to familiarize yourself with the basic geologic overview. [https://people.wou.edu/~taylors/g302/ES302\_geologic\_map\_analysis\_data\_packet.pdf](https://people.wou.edu/~taylors/g302/WOU_Site_Maps.pdf)

Step 2: Complete the WOU Geologic Site Analysis Exercise Worksheet questions below, as directed, and referred to in the data packet from Step 1 above.

In addition to the data packet, use your favorite internet search tools (e.g. google, Wikipedia, etc.) to assist with answering the questions below.

1. Examine the WOU campus location and topographic maps on page 4-5. Locate WOU campus and Monmouth on the west-central side of the map. Locate the position of the WOU campus garden, approximately 50 feet southwest of the letter “M” in the word Monmouth on the topographic quadrangle.
2. Reading the brown contour lines, what is the approximate elevation of the campus garden site?
3. What is the name of the closest hill top to the campus garden site?
4. In looking at the contour line spacing on campus, and at this part of Monmouth, are they closely spaced or widely spaced apart, compared to other regions of the map?
5. Thinking about the contour lines and the slope of the landscape on campus, is the garden site generally flat lying / gentle slope, or is the garden site very steep and hilly?
6. What is the name of the closest surface water creek just to the north of the campus garden? In which direction is this creek flowing?
7. What major river nearby does this creek flow into?
8. Are there any lakes shown on the map of our area? If so, describe where they are located and how they are formed by looking at the contour patterns and reading the map.
9. Examine the WOU campus geologic map on page 7. This is the topographic map base with a color-coded overlay of geologic map units showing the Earth materials that underlie the landscape beneath the surface. Locate WOU campus and Monmouth on the west-central side of the map. Locate the position of the WOU campus garden, approximately 50 feet southwest of the letter “M” in the word Monmouth (same location as in question 2 above). Note the map scale and the explanation block with the color code that describes the geologic rock layers. Each of the colored polygons also has a letter label the corresponds to a geologic unit, for example green is labeled with a “Ts” which is the code for Tertiary Spencer Formation, as shown in the explanation block.

A. What is the general geologic map color and letter symbol abbreviation associated with the campus garden site?

B. Find the color / letter symbol on the explanation block, and read the geologic material description. What is the name of the deposit, as symbolized by the letter designation?

C. Using two sentences, describe the geologic materials that underlie the campus garden site, and WOU campus in general, as symbolized with the color code and letter designation?

D. What major nearby river is the likely source of these sedimentary deposits that cover campus?

E. Locate the hilltop just southwest of campus, named “Cupids Knoll” and shown in a green color with Ts symbol. Using two sentences, describe the geologic materials that underlie this hilltop location.

F. Are the slopes at Cupids Knoll steep or gentle, based on contour line spacing?

1. Are the slopes near the campus garden steep or gentle, based on contour line spacing?
2. Note the feature labeled “WT” on Cupids Knoll, this is an abbreviation for “water tank” that is used to supply water to Monmouth and Campus. Provide an idea as to why a “WT” feature would be located on Cupids Knoll, rather than at the campus garden site on campus.
3. Read the groundwater report (with maps) for the Dallas-Monmouth area, where campus is located in western Oregon (pages 8-14).
4. Based on reading the precipitation maps on p. 8, what is the average annual rainfall (inches) west of campus at the town of Falls City?
	1. What is the average annual rainfall (inches) at the WOU campus in Monmouth?
	2. What is the straight line distance between Falls City and WOU campus in miles?
	3. Compare the precipitation data for each location, are they the same or different
	4. Based on the two locations, calculate a differential rainfall gradient between the two points in inches or rainfall change per mile of distance east-to-west across the study area.
	5. Hypothesize an explanation for the rainfall patterns displayed in the region? What are the causal mechanisms for the changing rainfall gradient?
5. Based on reading the groundwater summary on pages 9-11, list and briefly describe the top three problems associated with well drilling and groundwater use in the Dallas-Monmouth area.
6. At the time of this report, was there a major problem with water quality and chemical contamination of groundwater in this area? If so, what were the likely sources of poor chemical quality to the water?

*Based on reading the “Summary and Conclusions” section on p. 10-11:*

1. What are the primary water-bearing, aquifer, geologic units in the Dallas-Monmouth area?
2. What geologic units for the best water-bearing, aquifer units in the area. What is the maximum range of well yield expected from these units, as listed in gallons per minute of pump flow? (gal/min)
3. Using 2-3 sentences, summarize the primary limitations and potential problems associated with using groundwater as a primary water resource in the Dallas-Monmouth area.

*Examine Table 1 on page 12, showing a list of aquifer materials and groundwater bearing geologic materials in our area. In Question 3 above, related to the geologic map, we discovered that the WOU Campus Garden is underlain by geologic unit “Qtm” which is the Quaternary middle terrace deposit of river sand, gravel, silt and clay. On Table 1, p. 12, this is equivalent to the unit referred to as “Older Alluvium” in the Geologic Unit column. Alluvium is a fancy latin-based word for “river deposit”. Read the lithology description for the “Older Alluvium” unit; Answer the following questions.*

1. What is the deposit composed of? And how thick is the sediment layer?
2. For wells drilled into this layer of alluvium, what is the average (mean) depth (in feet) to which the well is drilled to produce groundwater?
3. The “static water level depth” column lists the average (mean) depth at which groundwater is encountered, in feet, for any given geologic unit listed on Table 1. What is the mean static groundwater level depth for wells drilled in the “Older Alluvium” deposit that underlies the campus garden?
4. Does this depth seem relatively shallow and easy to access when drilling a well, or does it seem very deep and difficult to get to, in general, based on your intuition?
5. What is the average (mean) well yield for this aquifer type in gallons / minute (gal/min)?
6. Compared to the other aquifer materials and geologic units listed on Table 1 (p. 12), is the “Older alluvium” associated with a relatively high, medium, or low well yield compared to the other units on the list?

*Examine the two hydrogeologic maps shown on p. 13 of the data packet. Read the map explanation and related text to understand the map information presented. Answer the following questions.*

1. List the four geologic map units identified on the maps, what are the symbol abbreviations and types of Earth materials?
2. How does the detail of the geologic materials presented on these hydrogeologic maps compare to the detail presented on the geologic map show on p. 7? More detail or less detail with respect to geologic map units? Which units are mapped similarly with respect to age and description, which are mapped differently?
3. For the map on the left on p. 13, what do the red contour lines represent? Where are the deepest (lowest altitude) sand and gravel deposits located in the map area?
4. For the map on the right on p. 13, what do the red contour lines represent? Using internet search tools. What are the differences between a “structure contour” and a “saturated thickness isopach” line?
5. Compare the map on the left with the map on the right on p. 13. Where are the deepest sand and gravel deposits located with the maximum saturated thickness available for groundwater extraction in the map area?
6. Locate WOU campus on the hydrogeologic maps on p. 13 and compare them to the location of the Natural Science Building shown on p. 5-6 base / topographic maps.
	1. What is the approximate altitude of the base of the sand and gravel aquifer at the Natural Science Building?
	2. What is the approximate saturated thickness of groundwater in the sand and gravel aquifer beneath the Natural Science Building?
	3. What is the surface elevation of the Natural Science Building?
	4. By comparing the surface elevation to the altitude of the base of the sand-and-gravel aquifer, how deep would you have to drill beneath the NS Building to reach the base of the sand and gravel aquifer?

*Examine the Groundwater Flow Contour Map on p. 14 of the data packet. This map shows contour lines drawn on the elevation of groundwater in wells from the Monmouth-Independence area. Groundwater, like all water, flows under pressure from the influence of gravity pulling it downward from higher elevations to lower elevations. The red arrows show the direction of groundwater flow in aquifer materials across the study area.*

1. In which direction is groundwater flowing beneath the campus garden site? From north to south?

From east to west? From west to east? from south to north?

1. What is the approximate elevation of the top of the water table beneath the Natural Science Building? What is the surface elevation of the Natural Science Building? Given the difference between the two, how deep would you have to drill to hit groundwater beneath the NS Building?
2. Examine the soil survey map on page 15, and the related soil unit descriptions on pages 16-20. Locate the WOU campus garden shown by the blue star on p. 15 soil survey map.
3. What is the number / letter code of the soil unit that underlies much of campus and the campus garden site?

*Locate the soil unit number / letter code in the soil survey descriptions on p. 20. Answer the following*

 *questions:*

1. What is the name of this soil unit?
2. Describe the landform locations that this soil type is associated with.
3. What is the elevation range for this type of soil in the Willamette Valley?
4. What is the average annual precipitation associated with this type of soil?
5. What is the average air temperature associated with this type of soil?
6. Describe what this soil is composed of and what it looks like.
7. What types of crops are grown on this type of soil in the Willamette Valley?
8. What type of irrigation is commonly used on this type of soil?
9. What types of native vegetation are commonly associated with this soil type?
10. Provide a 2 to 3 paragraph summary of lessons learned by analyzing topographic, geologic, precipitation, groundwater, and soils maps of the WOU Campus area. In your answer, describe the key information contained on each map type, and provide some ideas / examples as to how these resource maps could be used for land management planning activities for future site development in the WOU-Monmouth-Independence area.