Lab #12: Groundwater (GetWET Field Trip)

GEOL121 Introductory Geology Lab

Name: _____

TA and Section: _____

Assignment

Part 1: Well installation and core descriptions

1. Watch the movie clip of the GetWET well installation on GetWET website, under the 'Students and Faculty' tab at: http://getwet.colostate.edu/index.html

2. List and describe two aspects of the well installation that you found interesting and about which you learned something.

3. Look over the core descriptions in Figure 12.2. Give a general description of the subsurface material that comprises the well field (i.e. layers, thicknesses, grain size).

4. Where was bedrock encountered in three of the wells during drilling? Why do you think the depth to bedrock varies somewhat?

5. Which layers in the subsurface do you think have the greatest permeability? Why?

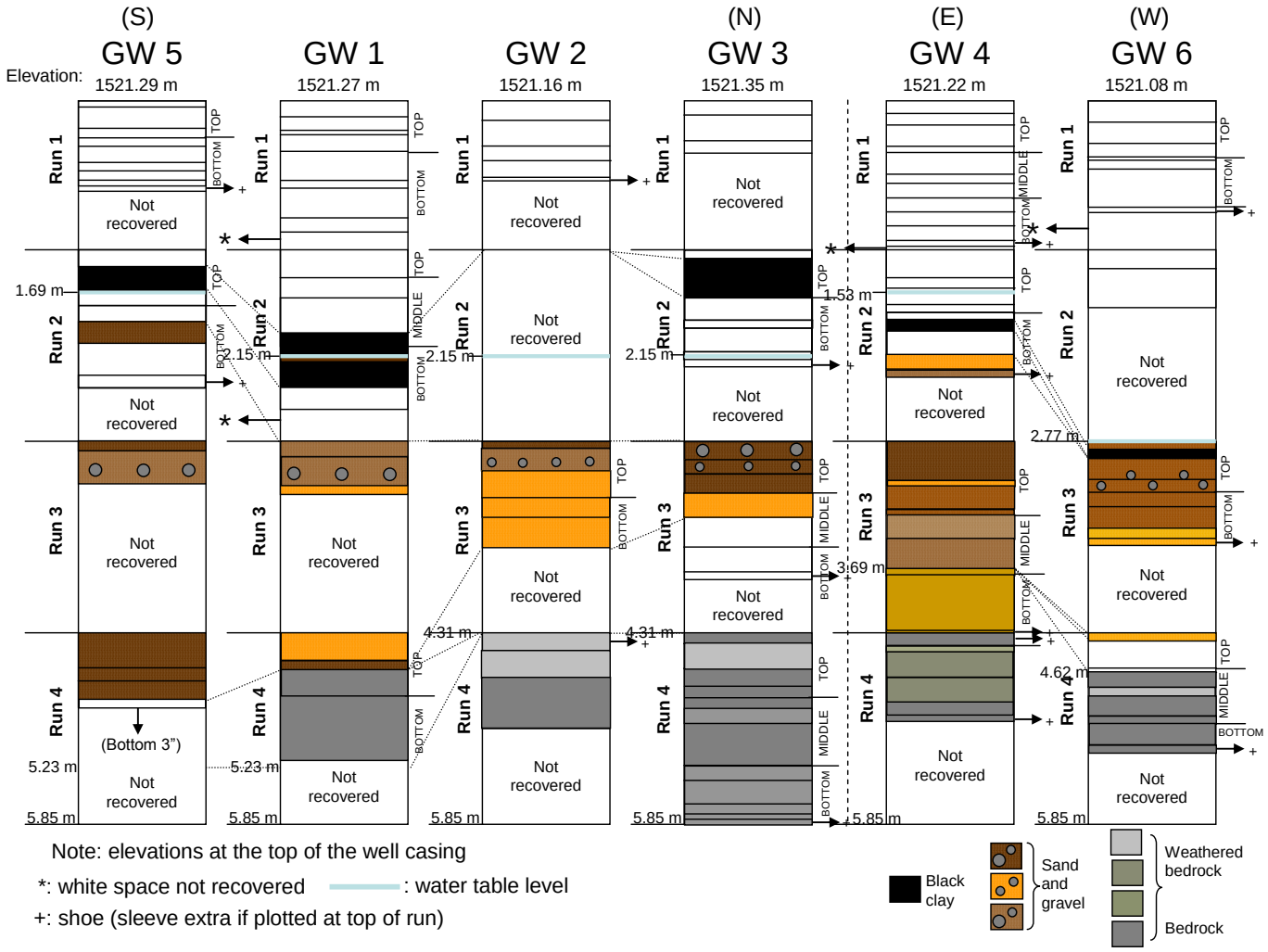


Figure 12.2. Cross sections of core collected from each well at the GetWET Observatory. Water levels during drilling are shown by light gray line and accompanying measurement. Dashed lines indicate correlation of units between wells. (modified from C. Spence, REU 2006)

Part 2: Create a map of the water table

1. Divide into groups of no more than three students.
2. Measure the depth (in meters) to the water table in each of the six wells at the GetWET. Be sure to measure from the south side of the well at the black mark on the PVC casing and record on Table 12.2.
3. Using the elevations of the top of the casing provided in Table 12.2, calculate the elevation of the water table, and record in the column provided.
4. Draw Spring Creek onto the map in Figure 12.3 by using a tape measure or a known pace, and measure the depth of water at the Spring Creek gauge. Add the data to Table 12.2.
5. Plot the elevations of the water level of the wells and of Spring Creek on the map in Figure 12.3 and contour the water table in the same way you contoured elevation data in the topographic maps lab. Select an appropriate contour interval.

Table 12.2. Elevation data for groundwater wells and the gauge at Spring Creek.

Groundwater Well	**Elevation at top of casing (m)**	**Depth to water from top casing (m)**	**Elevation of the water table (m)**
1	1521.27		
2	1521.16		
3	1521.35		
4	1521.22		
5	1521.29		
6	1521.08		
Spring Creek Gauge	**Elevation of creek bed at staff gauge (m)**	**Depth of water at staff gauge (m)**	**Elevation of surface water (m)**
	1518.85		

6. In order to show on the map in Figure 12.3 where exactly groundwater will flow, you must construct **groundwater flow paths** (lines) based on the contours of the water table. The flow of shallow groundwater on your map of the water table is perpendicular to the contour lines. (See Figure 12.1 for an example of water table contours and groundwater flow paths). Draw at least **three** flow paths **perpendicular** to your water table contours. Because your contours might not be straight lines, the flow paths won't be straight. Think hard about how to join the contours to the level of water in Spring Creek.

7. What is the hydraulic gradient of the water table? Remember, hydraulic gradient is hydraulic head loss divided by length of flow ($\Delta h/\Delta x$). Show your calculations.

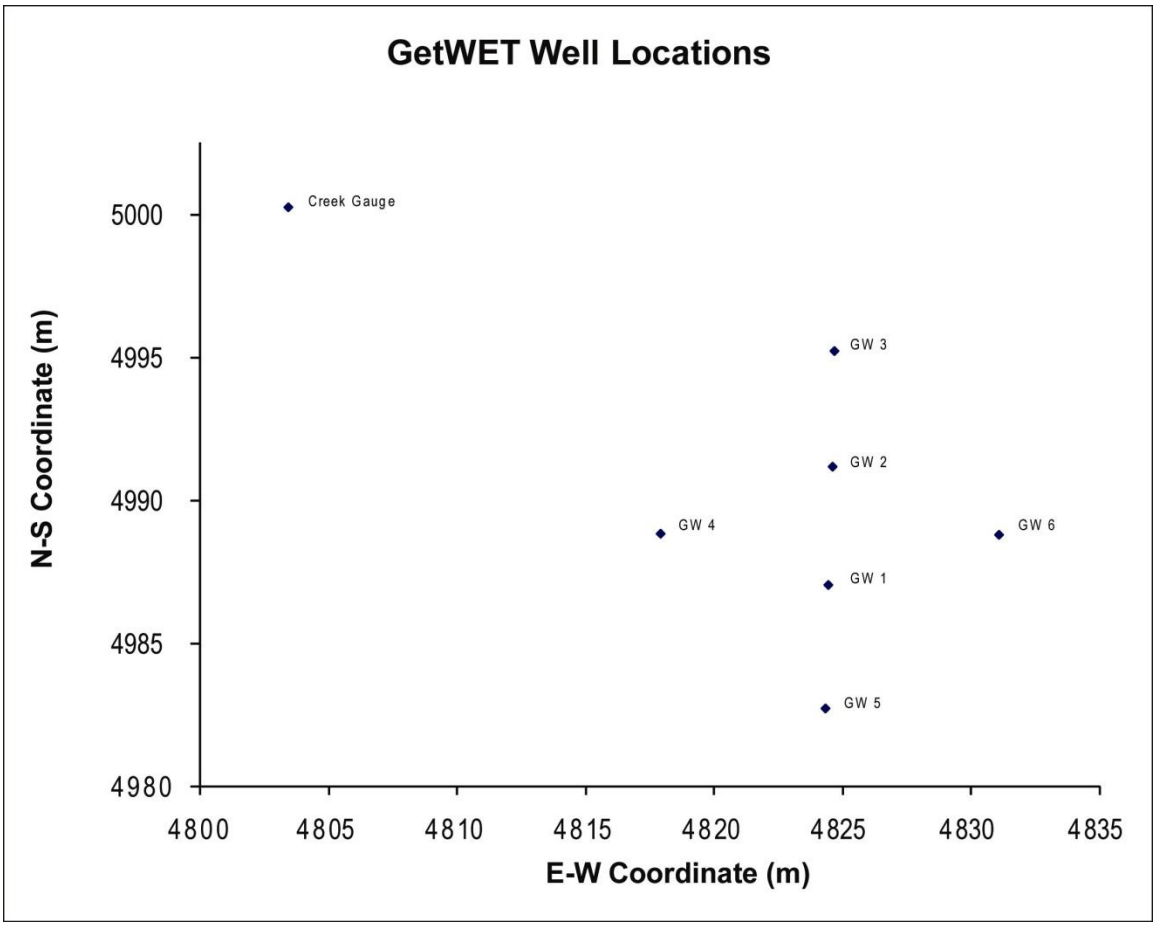


Figure 12.3. Locations of groundwater wells at the GetWET Observatory. North is to the top of the map.

8. Using your water table contour map, which direction is groundwater flowing?

9. Does the direction of groundwater flow in the vicinity of the GetWET Observatory fit with regional groundwater flow of the High Plains Aquifer, as shown in Figure 12.14? Why or why not?

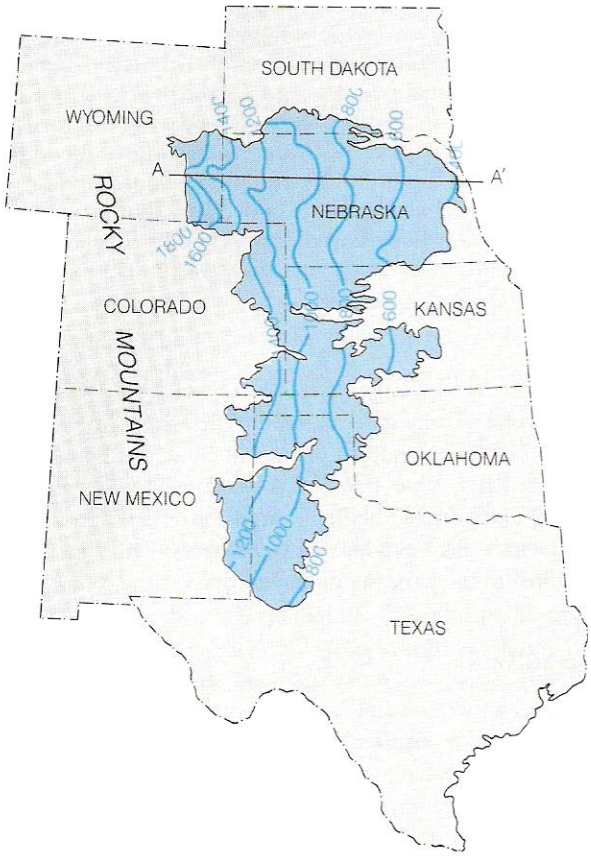


Figure 12.4. Regional extent of the High Plains Aquifer, with contours (in meters) on the water table. (from Murck, et al., 1996).

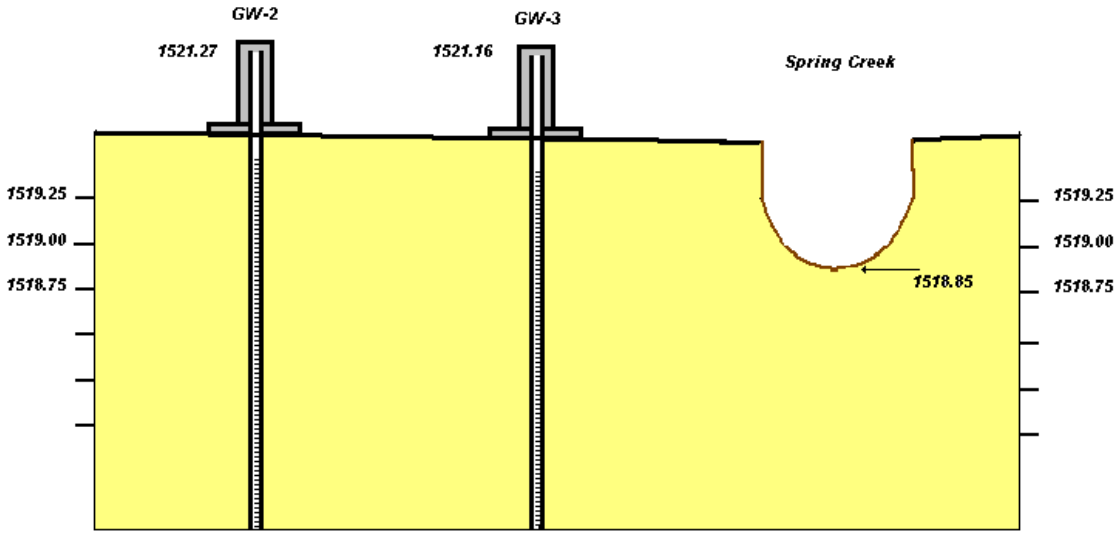
10. Approximately how much deeper is the water table in the High Plains Aquifer than in the wells you measured at the GetWET?

11. The High Plains Aquifer averages about 65 m thick and extends from the surface into the bedrock layers below. The Aquifer is tapped by about 17,000 wells, a majority of which pump water for agricultural purposes. How do you think the groundwater in the High Plains Aquifer is recharged (or replenished)?

12. Groundwater flows beneath the GetWET well field at an average rate of about $1x10^{-7}$ m/s (0.0000001 m/s). How does this compare to water velocity in Spring Creek that you measured last week? Why would groundwater move slower or faster than surface water?

13. The velocity of groundwater in the High Plains Aquifer is approximately 30 cm/day, which means water travels about 110 m/year. Groundwater under the GetWET moves at only about 4 cm/day, or 15 m/year. Why might groundwater flow faster in the High Plains Aquifer than in the shallow aquifer below the GetWET?

14. Using the diagram below construct a hydrogeologic cross-section of the subsurface between Spring Creek and wells GW 2 and GW 3. Draw in: 1) the water level in Spring Creek, 2) water table, and 3) groundwater flow direction. Label everything clearly, including compass directions.



15. Is Spring Creek a gaining or losing stream? Describe how this can happen.

16. How do you think the level of Spring Creek might change seasonally? How does this relate to the water table?

Part 3: Evaluate water quality of groundwater and surface water

1. Collect one bailer full of water and deliver some water into the container.
2. Measure temperature, pH, electrical conductivity (EC measures total dissolved solids (TDS) in the water) and DO. Record your data in the table below. Pour the water on the ground when you are finished.

Groundwater Well	**Temperature (^{o}C)**	**pH**	**EC (in microSiemens/cm)***	**TDS (mg/L)**	**DO (mg/L)**
1					
2					
3					
4					
5					
6					
Spring Creek					

* Conductivity is measured as microSiemens per centimeter (mS/cm). To convert to TDS in mg/L, multiply by 0.67, an average conversion factor.

3. How does the overall water quality of the wells compare to that of water in Spring Creek?

4. Do the measurements you made give you enough information about whether the water is suitable for drinking? If not, what other types of data on water quality would you like to see?

5. Of the water quality parameters you measured, two are on the List of National Secondary (non-enforceable) Drinking Water Regulations developed by the Environmental Protection Agency. The acceptable values set for these parameters are as follows: 1) pH - 6.5-8.5, and 2) TDS $\leq$ 500 mg. Do the measurements you made fall below the National Secondary Standards for pH and TDS?

6. Identify one human activity that would affect each of the four water quality parameters that you measured. Tell how the activity would change temperature, pH, EC, and DO.

7. Based on what you know about groundwater flow under the well field ($v=1x10^{-7}$ m/s), assuming there is a drinking water-supply well located 100 meters down gradient of GW 6, if someone spills toxic chemicals near GW 6, how long will it take to reach the drinking water well? Show all work and include correct units.