MOUNTAIN FIR LAB PART A

KEY

L06

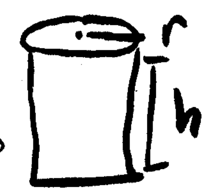
[redacted] Interpretation of Drilling Log (4 PAGES)

Examine the attached drilling log and answer the following questions.

1. Determine the following:

AREA CIRCLE = πr^2

VOLUME OF CYLINDER = $\pi r^2 h$



A. Surface elevation at the top of the well: 1161.37 ft

B. Total depth of the boring 55 ft

C. Borehole diameter 7 7/8"

D. Well assembly diameter 4"

E. Elevation at the base of the boring 1106.37 ft

F. Elevation at the base of the Pittsburgh Coal 1153.37 ft

G. Depth at which groundwater was first encountered during drilling 35.5 ft

H. Depth of the static water level in the well on 6/23/89 26 ft

I. Drilling method: Air Rotary

J. Elevation at which groundwater was first encountered during drilling 1125.87

K. Elevation of the static water level in the well on 6/23/89 1135.37 ft

L. Elevation of the bottom of the well screen 1121.97 ft

M. Elevation of the top of the well screen 1131.67 ft

N. Composition of material packed around well screen. ~~3.2 ft~~ COARSE SAND

O. How far above the top of the well screen does the screen pack rise? 3.2 ft

P. Composition of material surrounding the solid PVC riser pipe. CEMENT/BENTONITE GROUT

2. Based on the drilling log, what lithostratigraphic unit likely serves as the aquifer providing water to the monitoring well? GRAY LIMESTONE @ 35 ft depth

3. Examine the position of the static water level vs. the encounterd ground water level.

A. What hydrostatic conditions are implied by this relationship. CONFINED / ARTESIAN

B. What type of aquifer condition exists? Is it unconfined / confined? What are the likely aquitards / aquifers? CONFINED, GRAY SHALE = AQUITARD, COAL / LIMESTONE = AQUIFER

4. What is the relative porosity and permeability of the following lithostratigraphic units (describe as either "low" or "high" for each characteristic, refer to notes as needed).

	Porosity		Permeability
Pittsburgh Coal	HIGH	(FRACTURES)	HIGH
Upper Pgh Limestone	HIGH	(SOLUTIONS)	HIGH
Gray Shale below Pgh LS	LOW		LOW
L. Pgh Coal	HIGH	(FRACTURES)	HIGH
Lower Pgh LS	HIGH	(SOLUTIONS)	HIGH

5. Examine the location of the screened interval in relation to the lithostratigraphy. In terms of ground water chemistry, would you think the well water to be on the alkaline or acidic side?

Acidic — Coal + FeS_2 (Pyrite) + H_2O = H_2SO_4 / Acid mine H_2O

6. What type of groundwater chemistry would you expect in relation to the Pittsburgh Coal - alkaline or acidic?

Acidic

7. What would happen to the groundwater chemistry of the well (screened interval), if the cement-bentonite grout seal leaked around the solid PVC riser pipe?

Grout = Cement = High pH = Alkaline

8. What is cement made out of?? Would this material render water alkaline or acidic? What would be an extreme pH of the well water if some of the cement-bentonite grout leaked into the well screen during installation (by mistake)? What would be the easiest way to check for grout contamination in the field?

Limestone, Alkaline, pH = 12-14, use a pH meter

9. Common well construction calculations:

Some base expenses:

Drilling = \$11.30 / linear ft; 4" PVC slotted screen = \$5.00 / linear ft; 4" PVC riser = \$3.00 / linear ft; cement-bentonite grout mix = \$8.35 / 50# bag; bentonite pellets = \$15.00 / 50# bucket; coarse sand = \$7.50 / 50# bag; fine sand = \$5.45 / 50# bag; 10" steel casing = \$23.50 / linear ft.

Assume the following in your calculations:

- 1 50# bag of cement-bentonite grout mix fills 0.5 ft^3 of volume
- 1 50# bucket of bentonite pellets fills 0.8 ft^3 of volume
- 1 50# bag of coarse sand fills 0.3 ft^3 of volume
- 1 50# bag of find sand fills 0.2 ft^3 of volume

Some preliminary questions and hints:

i. Does a drill hole most resemble a cube, sphere, cone, trapezoid, or cylinder? Cylinder

ii. What is the equation to calculate the volume of the object in i. above? Vol cyl = $\pi r^2 h$
(hint look at beginning of notes)

iii. What is the diameter of the annular space between the walls of the bore hole and the outside of the PVC well assembly? Is it constant or variable throughout the assembly?

0-8 ft Diameter = 9.875 in $(1\,ft / 12\,in)$ = 0.822 ft   8-42 ft Diam = 7.875 in $\frac{1\,ft}{12\,in}$ = 0.66 ft

iv. How would you determine the volume of the annular space between the outside of the borehole and the outside of the PVC well assembly? Write a generalized equation.

O.D. − Well Diameter = Annular Space   Well Diameter 4 in $\frac{1\,ft}{12\,in}$ = 0.33 ft

Outside Diameter

4.22 - 0.73   6.32 - 1.68

Determine the following itemized construction costs for drilling and installing the monitoring well (refer to drilling / construction log). (Remember: when calculating volumes, make sure to use consistent length units)

A. Borehole drilling $ 621.50 — (55 ft)($11.30/ft) =
B. 10" steel casing $ 188.00 — (8 ft)($23.50/ft) =
C. Solid PVC riser $ 89.10 — (29.7 ft)($3.00/ft) =
D. Slotted PVC screen $ 50.00 — (10 ft)($5.00/ft)
E. Cement-Bentonite Grout in the 6" borehole at base of well. $ 144.29 — VOL = π(0.25 ft)²(11 ft) = 8.64 ft³ (r = 3 in)
F. Bentonite pellets at base of well $ 13.36
G. Coarse sand around screen $ 62.75
H. Fine sand around riser. $ 6.87
I. Cement-Bentonite Grout around PVC riser pipe $ 135.77

Total Cost for Well $ 1169.51

I. $[\pi(0.33 ft)^2\, 18.5 ft - \pi(0.17 ft)^2\, 18.5 ft]\left(\frac{1\ bag}{0.5 ft^3}\right)\left(\frac{\$8.35}{bag}\right) = \$77.49$

$[\pi(0.41 ft)^2(8 ft) - \pi(0.17 ft)^2\, 8 ft]\left(\frac{1\ bag}{0.5 ft^3}\right)\left(\frac{\$8.35}{bag}\right) = \$58.28$

$58.28 + $77.49 = $135.77

(H) $[\pi(0.33 ft)^2\, 1 ft - \pi(0.17 ft)^2\, 1 ft]\left(\frac{1\ bag}{0.2 ft^3}\right)(\$5.45)$

$= (0.342 ft^3 - 0.09 ft^3)\left(\frac{1\ bag}{0.2 ft^3}\right)(\$5.45) = \$6.87$

E. $(8.64 ft^3)\left(\frac{1\ bag}{0.5 ft^3}\right)\left(\frac{\$8.35}{bag}\right) = \$144.29$

F. Annular Vol = $V_{O.D.} - V_{W.D.}$ =

$H = 42 - 27.5 = 14.5 ft$

$r_{OD} = 3.94 in = 0.33 ft$

$r_{WD} = 2 in = 0.17 ft$

$[\pi(0.33 ft)^2\, 1.3 ft] - [\pi(0.17 ft)^2\, 1.3 ft] =$

$0.44 ft^3 - 0.12 ft^3 = 0.32 ft^3$

$(0.32 ft^3)\left(\frac{1\ bag}{0.8 ft^3}\right)\left(\frac{\$15}{bag}\right) = 6.00$

Base below Screen

$\pi(0.25 ft)^2(2 ft)\left(\frac{1\ bag}{0.8 ft^3}\right)\left(\frac{\$15}{bag}\right) = \$7.36$

6.00
+ 7.36
$ 13.36

G. $[\pi(0.33 ft)^2\, 10 ft - \pi(0.17 ft)^2\, 10 ft]\left(\frac{1\ bag}{0.3 ft^3}\right)\left(\frac{\$7.50}{bag}\right) =$

$(3.42 ft^3 - 0.91 ft^3)\left(\frac{1\ bag}{0.3 ft^3}\right)\left(\frac{\$7.50}{bag}\right) = \$62.75$