GEL 4250 - Hydrogeology (Groundwater)

LAB 3 - MODELING GROUNDWATER FLOW WITH FLOWNETS PAPER LAB

Grade:
/25

Name:_____ Section: _____

COMPLETE & TURN IN ONLY PAGES THAT HAVE A FIELD FOR YOUR NAME. ALL OTHER PAGES ARE JUST WORKPAGES & WILL NOT BE GRADED.

For full credit, be precise in your answer, show ALL your work and TYPE or NEATLY DRAW the results!

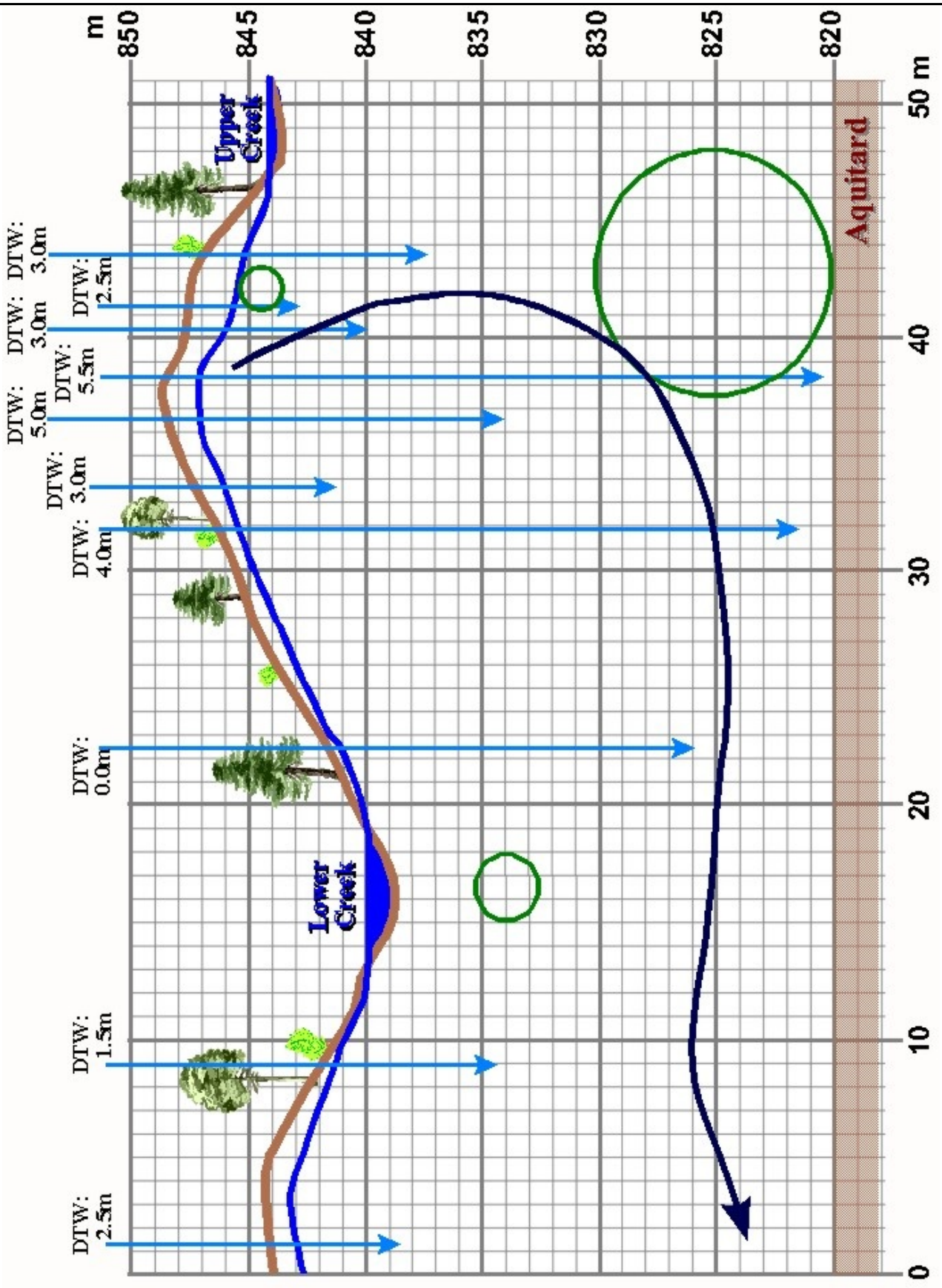
Construct a flow-net on the provided graph on the next page. Answer questions below:

Pick ANY one of the flowtubes on your flow-net and calculate flow (indicate chosen flowtube on your flow net):	How computed:

Draw flownet on next page. NEATNESS COUNTS!!!!

THIS PAGE IS GRADED. TURN IN THIS COMPLETED PAGE. DO NOT FORGET YOUR NAME.

Name:_____ Section: _____



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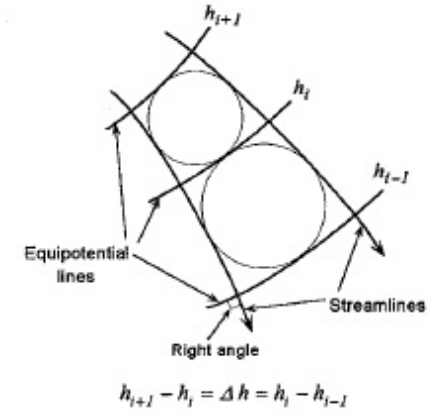
Instructions:
During this LAB you will use the tool of drawing flownets to scale in order to predict flow parameters in the subsurface and to calculate groundwater flow. NEATNESS COUNTS! You will need the following materials this LAB exercise:

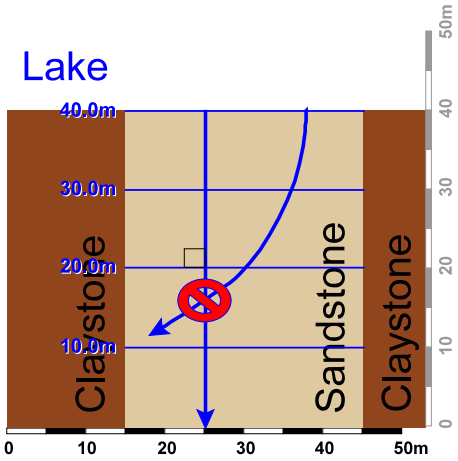
- ☐ Graph Paper
- ☐ Calculator
- ☐ Pencil(s)
- ☐ ERASER
- ☐ Ruler / Protractor (best use "Geodreieck")

Read Fetter (2001) section 4.11, 4.12, 7.1, 7.2, 7.3 (p.132 - 138, 236 - 248)

FLOWNETS Summary & Rules

Rule 1: Equipotential lines are always parallel to constant head boundaries.
Rule 2: Equipotential lines are always perpendicular to no-flow boundaries.
Rule 3: Flow lines and equipotential lines are always perpendicular and form curvilinear squares in a homogeneous, isotropic medium.
Rule 4: Flow lines can never intersect. In other words, flow lines constitute imaginary no-flow boundaries in that there is no flow across a flow line.
Rule 5: Flow tubes however may merge or split if equipotential lines are satisfied.





What if my Aquifer curves?
Start with boundaries! Draw known equipotential & flow lines! *Follow the Rules!*
Start (sketch) set of equally spaced flow lines... *Trial & Error Method*!
Start (sketch) equipotential lines. Try to make curvilinear squares with flowlines...

Equations

Write down useful equations for flownet calculations: *Answer in graded section above. This answer box is for your own records and is NOT graded.*

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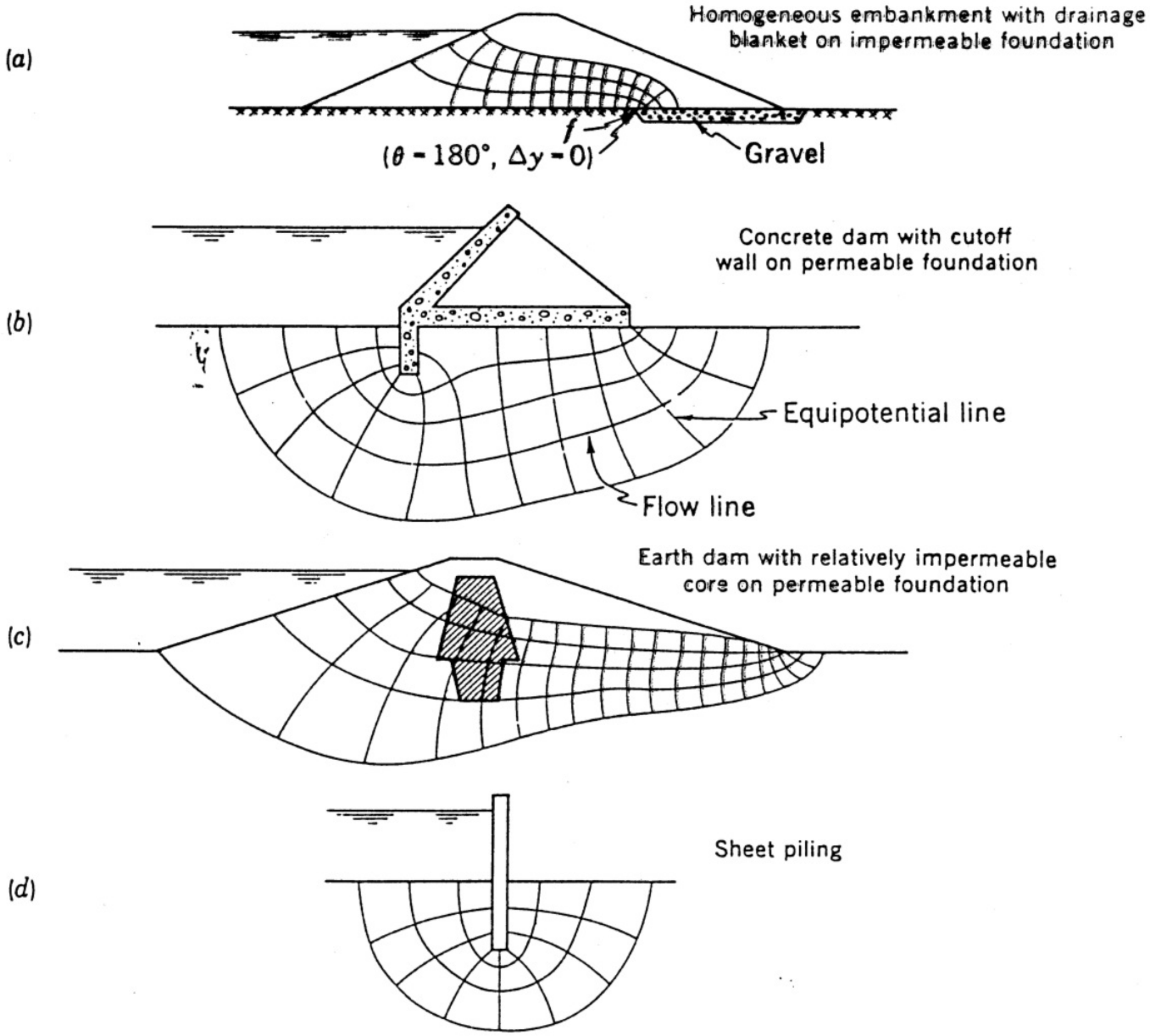
Flownet Examples



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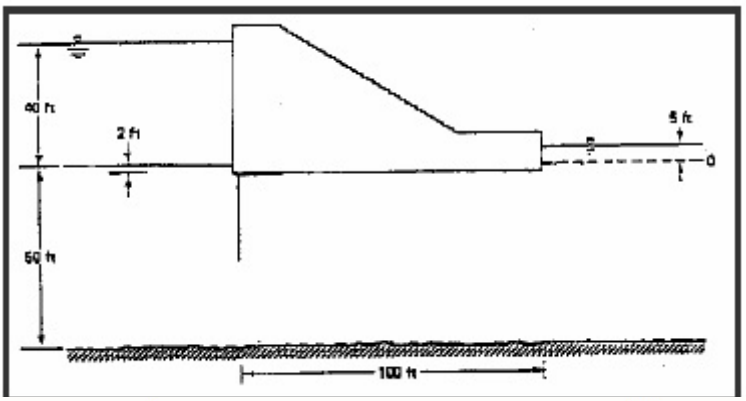
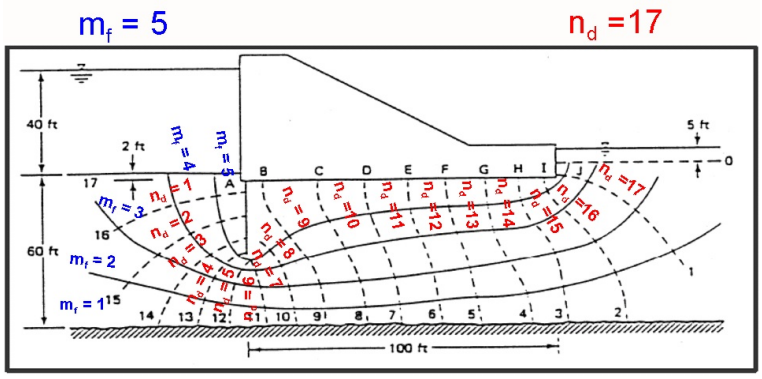
Flownet Construction Example

A concrete dam is constructed on a permeable stratum underlain by an impermeable rock. A row of sheet pile is installed at the upstream face. If the permeable soil has a hydraulic conductivity of 150 ft/day, determine the rate of flow or seepage under the dam.



Solution: The flow net is drawn with: $m_f = 5$ and $n_d = 17$



Solve for the flow per unit width: $$Q = \frac{m_f}{n_d} k_f H = \left(\frac{5}{17}\right)\left(150\,\frac{ft}{day}\right)(35\,ft) = 1544\,\frac{ft^3}{day}/\,ft$$

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YOUR FLOWNET ASSIGNMENT (The one you will turn in)

Turn in your solution to the flownet problem below (see drawing) including...

- ☐ your neatly "hand-drawn" flownet
- ☐ calculation of one of the flow tubes

Answer the following questions as a study guide:

- ☐ Identify if Upper Creek and Lower Creek are gaining or losing streams.
- ☐ Calculate either input or output Q for each of the Creeks per unit width of aquifer
- ☐ Hills are recharge areas. Calculate total recharge of the aquifer per unit width. Subtract amount for gaining streams, add amount for losing streams.
- ☐ If Upper Creek gets contaminated, is contamination able to enter the Lower Creek.

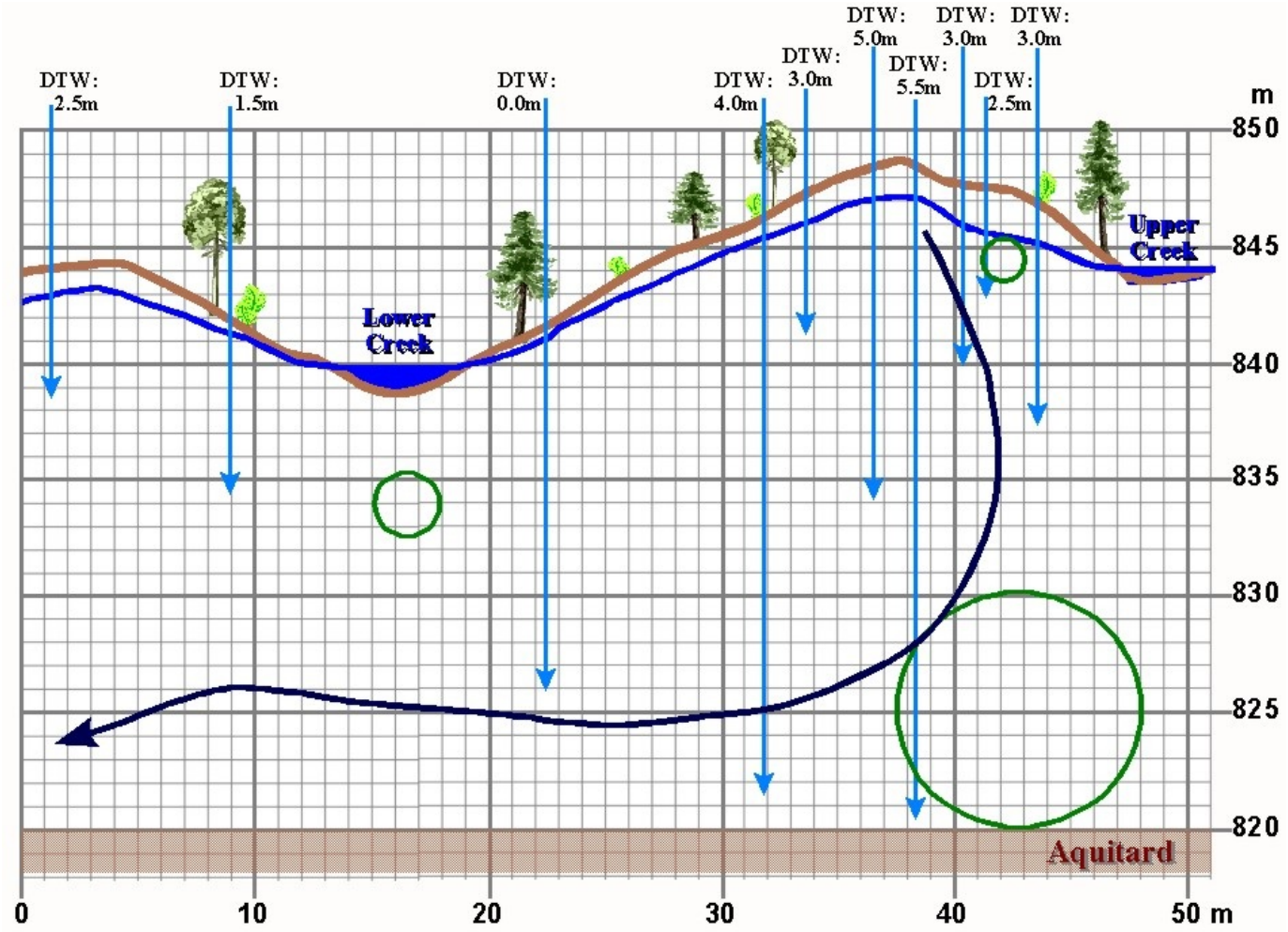
Flownet - Data: $\mathbf{k_f = 2.8\times10^{-6}\ m/s}$

Flownet Construction hints:

3 of the curvilinear squares already given (green circles) ☺
One flow tube boundary is also given (deep blue arrow) ☺
the equipontential interval should be 0.5m
the central part of the flownet should have 9 flow tubes
Assume vertical flow at recharge areas as dictated by your equipotential lines

The arrows indicate observation wells with the arrow point at the well depth / potentiometer opening. DTW = Depth to Water at each of the well locations. Well-heads to be assumed flush with ground level.

Use the picture below as scratch paper. Make additional copies as needed.



Hint: Flow tubes may merge or split if pressure conditions are satisfied!

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