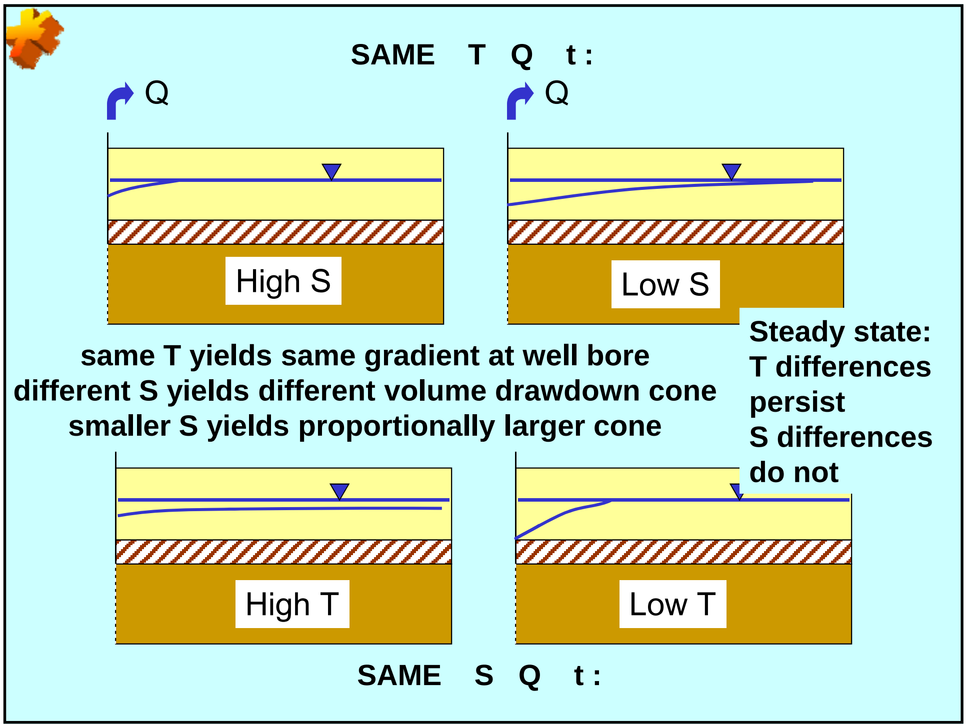
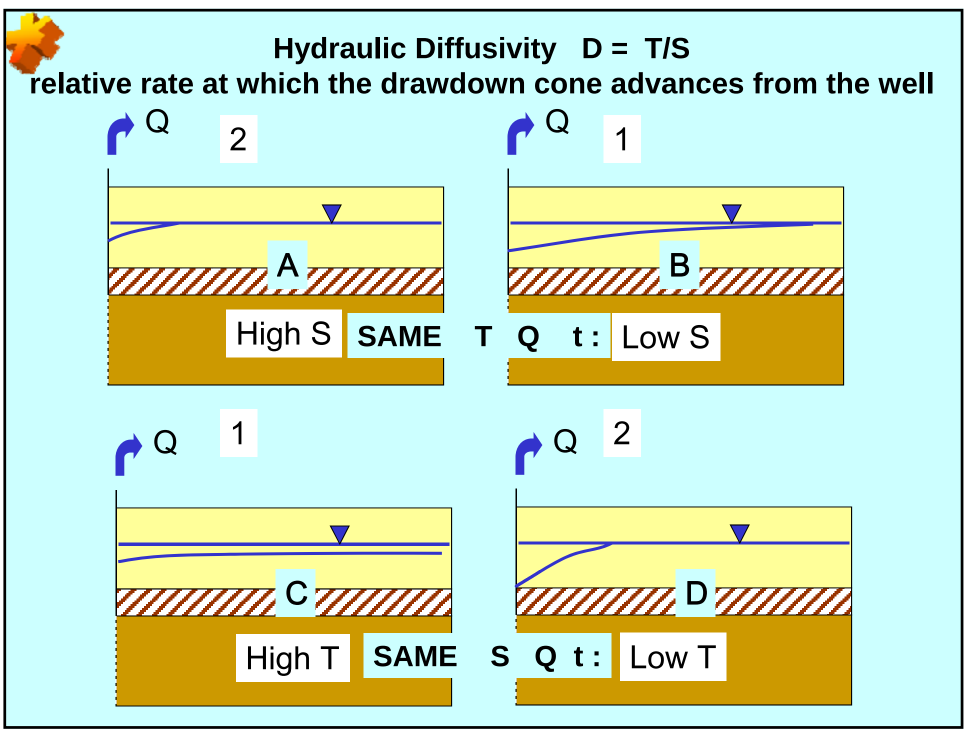
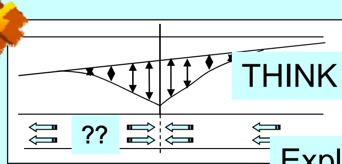

SAME T Q t :
Q
Q
High S
Low S
same T yields same gradient at well bore
different S yields different volume drawdown cone
smaller S yields proportionally larger cone
Steady state:
T differences persist
S differences do not
High T
Low T
SAME S Q t :

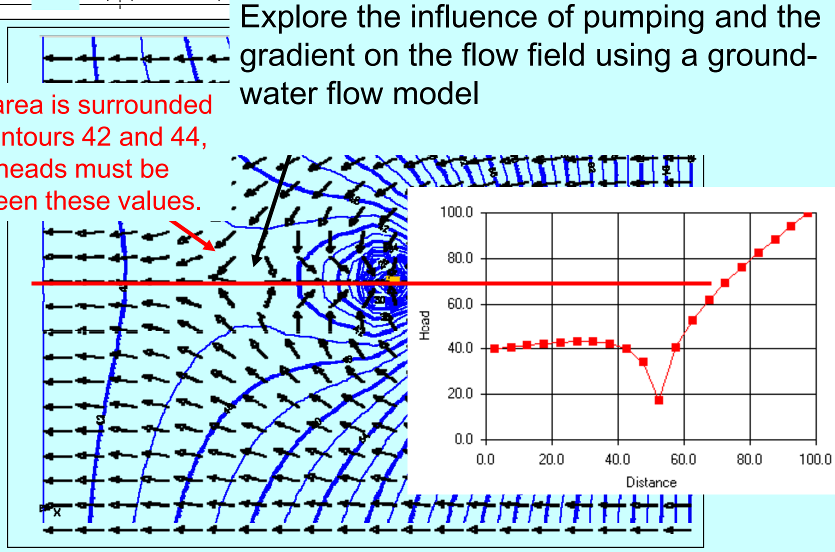

Hydraulic Diffusivity D = T/S
relative rate at which the drawdown cone advances from the well
Q
2
Q
1
A
B
High S
SAME T Q t :
Low S
Q
1
Q
2
C
D
High T
SAME S Q t :
Low T



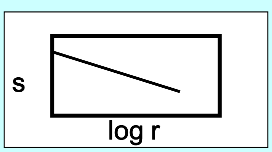
THINK in 3 Dimensions! … plan view:

Explore the influence of pumping and the gradient on the flow field using a ground-water flow model

The area is surrounded by contours 42 and 44, thus heads must be between these values.



s vs. log r - is a straight line, if assumptions are met, drawdown decreases logarithmically with distance from the well because gradient decreases linearly with increasing area (2π rh)



$$Q = \frac{2\pi T(h_2 - h_1)}{\ln(r_2/r_1)}$$

Theim Eqtn

T = transmissivity [L^2/T]
Q = discharge from pumped well [L^3/T]
r = radial distance from the well [L]
h = head at r [L]

and rearranging to get T from field data:

$$T = \frac{Q}{2\pi(h_2 - h_1)} \ln\left(\frac{r_2}{r_1}\right)$$

Plot before applying equations

- to verify conditions are appropriate for application of equations
- to identify data problems

In an unconfined aquifer, T is not constant

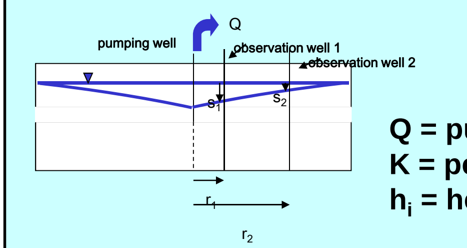
If drawdown is small relative to saturated thickness, confined equilibrium formulas can be applied with only minor errors

Otherwise call on Dupuit assumptions and use:

$$Q = \pi K \frac{(h_2^2 - h_1^2)}{\ln(r_2/r_1)}$$

or, to determine K from field measurements of head:

$$K = \frac{Q \ln(\frac{r_2}{r_1})}{\pi (h_2^2 - h_1^2)}$$



Q = pumping rate [L^3/T]
K = permeability [L/T]
h_i = head @ a distance r_i from well [L]
using the aquifer base as datum

The aquifer base must be the datum because the head not only represents the gradient but also reflects the aquifer thickness, hence the flow area.

Predict Drawdown Using Theis Equation

Class picks:	T	S	r	t	Q
	$1\times10^{-3} m^2/s$	1×10^{-5}	2m	year	0.01m/s

Take 3 minutes to calculate: s

$$s = h_o - h = \frac{Q}{4\pi T} W(u)$$

$$u = \frac{r^2 S}{4Tt}$$

USE table of W(u) from 3 slides back

$$W(u) = \int_u^{\infty} \frac{e^{-u}}{u} du = [-0.5772 - \ln u + u - \frac{u^2}{2 \cdot 2!} + \frac{u^3}{3 \cdot 3!} - \frac{u^4}{4 \cdot 4!} + ...]$$

What value did you get for s? ~15m