



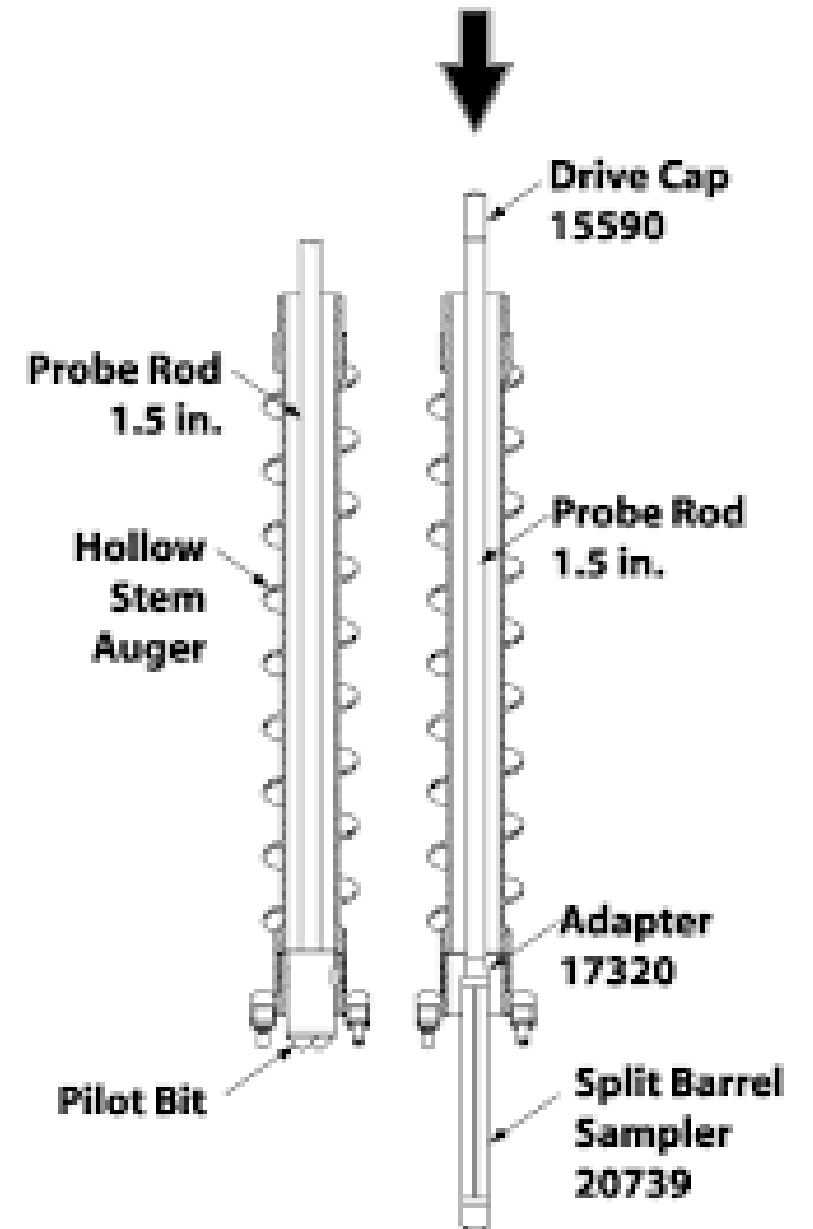


Hollow stem auger



Split spoon sampler





Driller's logs

A **W** **COPY** **WESTERN GEOPHYSICAL**

Western Geophysical Company
20107 Avenue 66
Calgary, Alberta T2C 1A8
403 241-2100, Telex 534010

SEISMIC SHIPPING DOCUMENT

CONTRACTOR: 367 PROJECT No: 90-094 DATE: Feb 23/91

PARTY No: 1001 CREW LOCATION: 1001

CONTRACT: Frank Jones - 15 Hrs A. B. Jones - 14 " "

CHILLER: Frank Jones - 15 Hrs A. B. Jones - 14 " "

PURPOSE: EXPLORATION CLASS 110 UNDES DRILLING TIME: 11 Hrs TRAVEL TIME: 3 Hrs

EXPLOSIVE: WATER GEL EXPLOSIVE CLASS 110 UNDES MAINTENANCE TIME: 1 Hrs DOWNTIME: 1 Hrs

DETONATING CORD: DETONATING CORD CLASS 110 UNDES

DETONATING ELECTRIC: DETONATING ELECTRIC CLASS 110 UNDES

TRADE NAME: EXPLOSIVES CAPS BITS MUD, etc. USED

QUANTITY REC'D FROM MAG: 4000 20

SIGNATURE: Frank Jones - 15 Hrs A. B. Jones - 14 " "

S.P. & LN. No. USED USED

| | | | |
|-----------|-------|---|----------------------------|
| 64X 3372X | 2" 10 | 1 | 0 - 14 m Clay & Rock |
| 3369X | 2" 10 | 1 | 0 - 7 m Clay & Rock 7-14 m |
| 3366X | 2" 10 | 1 | " " " " " " |
| 3363X | 2" 10 | 1 | 0 - 14 m Clay & Rock |
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7-10-62-7W6



3-4-63-6W6



9-10-63-6W6



6-13-63-6W6



10-18-63-5W6



12-17-63-5W6

2-16-63-5W6



6-24-63-5W6



11-19-64



Gross lithology



Vertical exaggeration 168x

Depth in metres

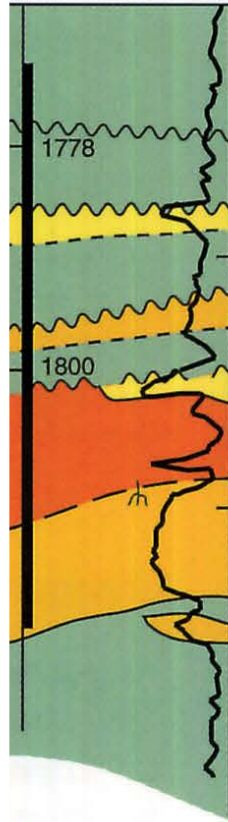
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3-4-63-6W6



9-10-63-6W6



6-13-63-6W6

10-18-63-5W6



12-17-63-5W6

2-16-63-5W6



6-24-63-5W6



11-19-64



Gross lithology



Vertical exaggeration 168x
Depth in metres

7-10-62-7W6



3-4-63-6W6

9-10-63-6W6

6-13-63-6W6

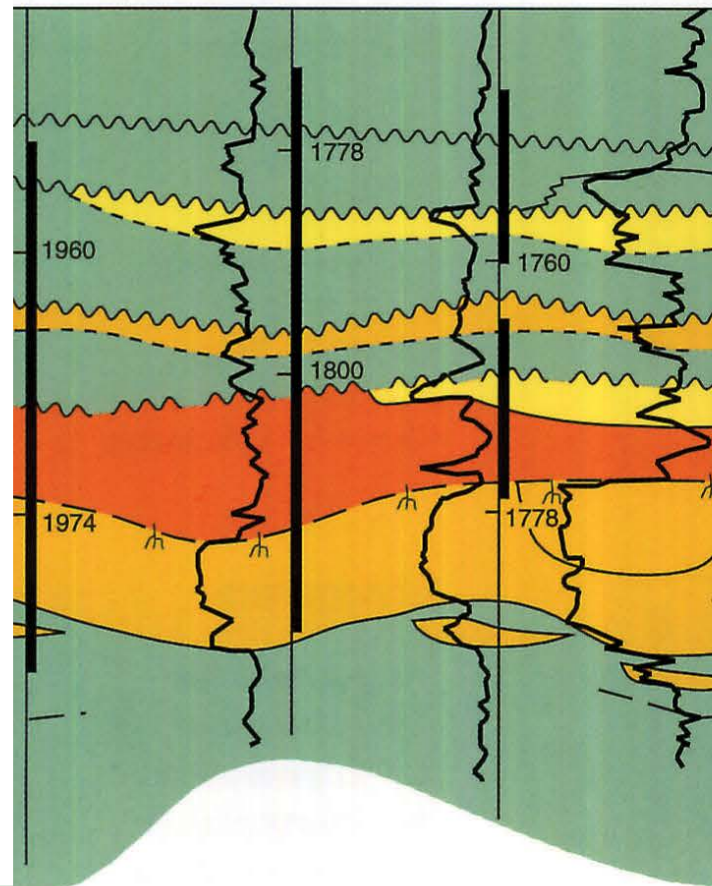
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12-17-63-5W6

2-16-63-5W6

6-24-63-5W6

11-19-64

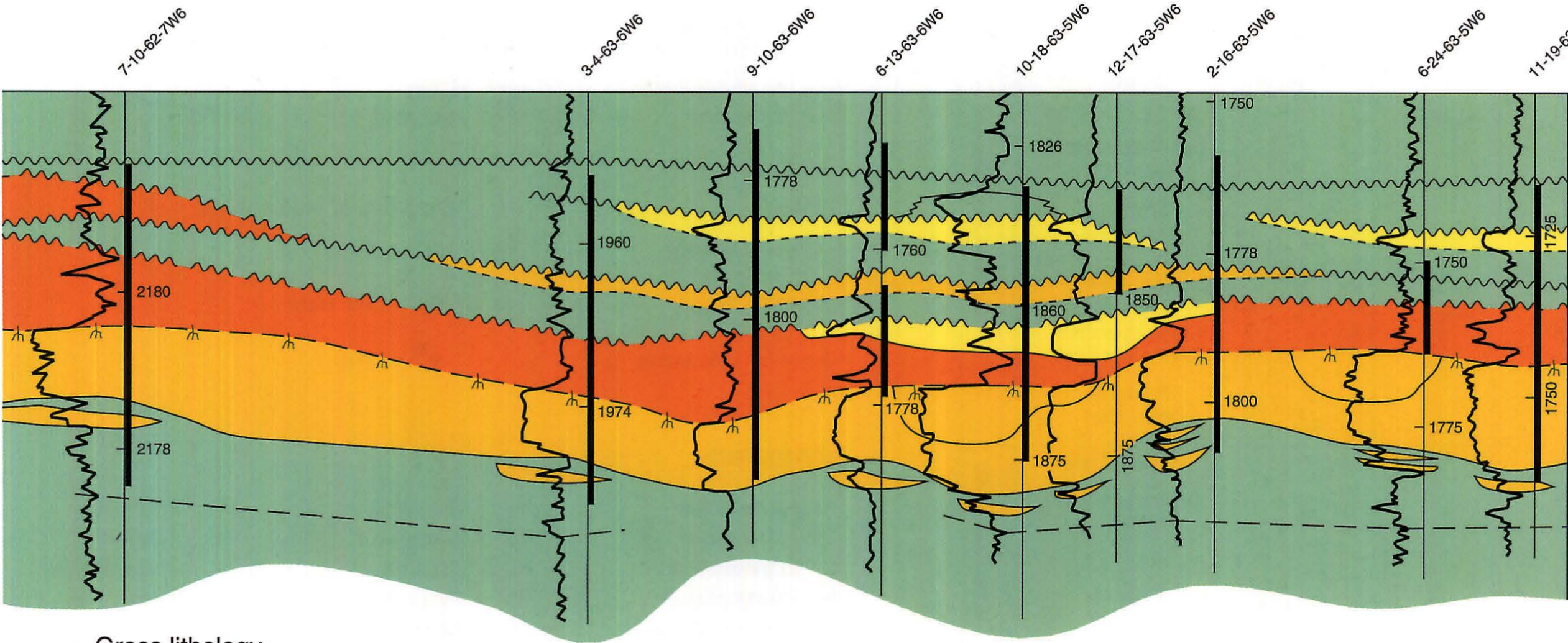


Gross lithology

-  Sandstone lithosome
-  Mudstone lithosome
-  Terrestrial lithosome



Vertical exaggeration 168x
Depth in metres



Gross lithology

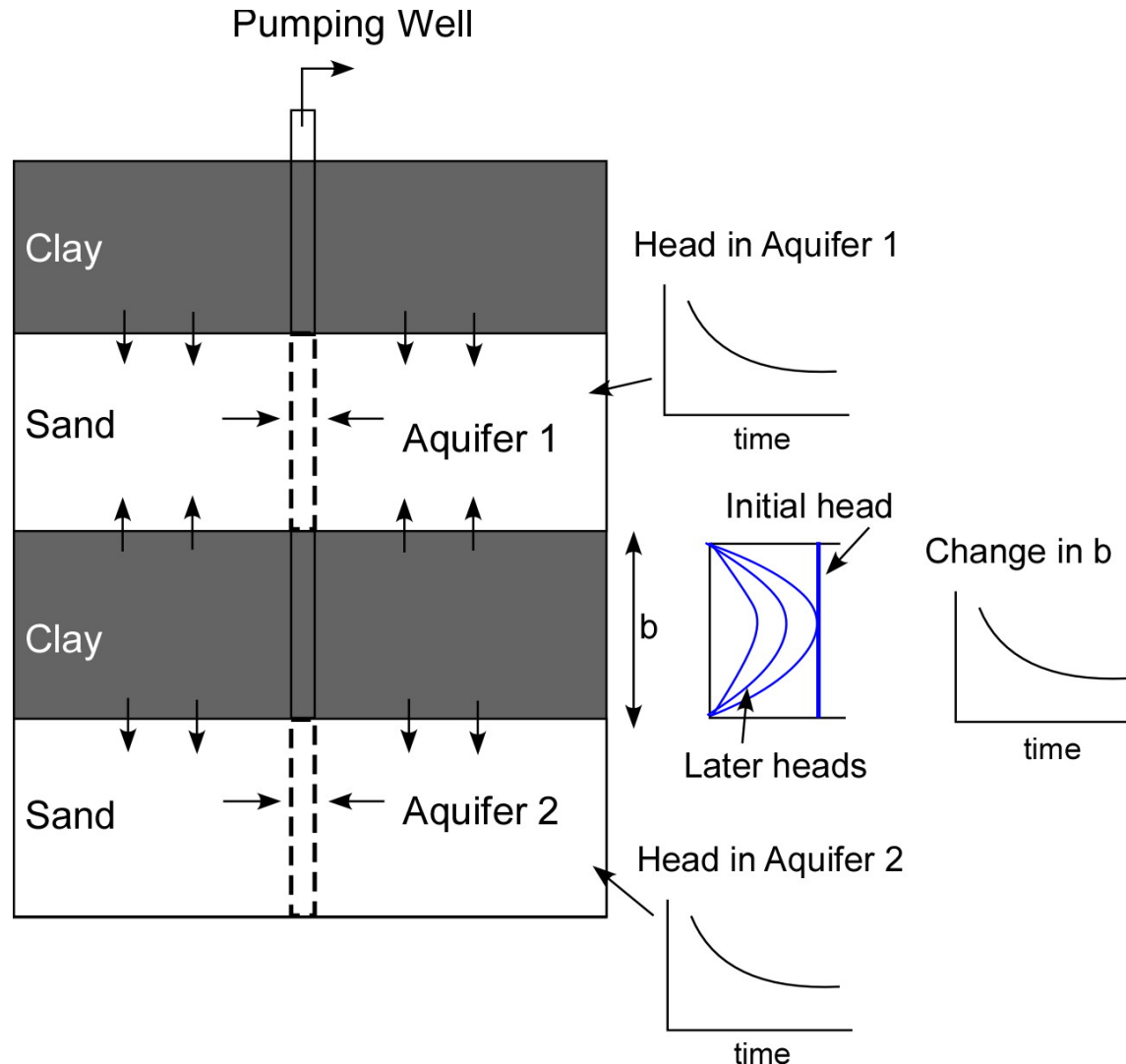
- Sandstone lithosome
- Mudstone lithosome
- Terrestrial lithosome



Vertical exaggeration 168x

Depth in metres

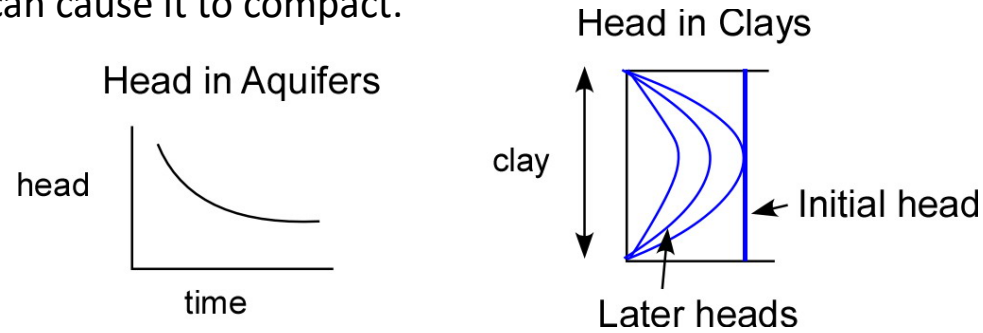
Basics of Land Subsidence:



- Wells are screened in sand aquifers, extracting water lowers the heads in the sand
- Compressibility of clay is 1-2 orders of magnitude greater than that of sand. For a clay, $\alpha \gg \eta\beta$
- K is much lower for clay than for sand, so drainage and compaction are much slower for confining units than for aquifers.
- Aquifer drainage leads to compaction of aquitards.

Basics of Land Subsidence:

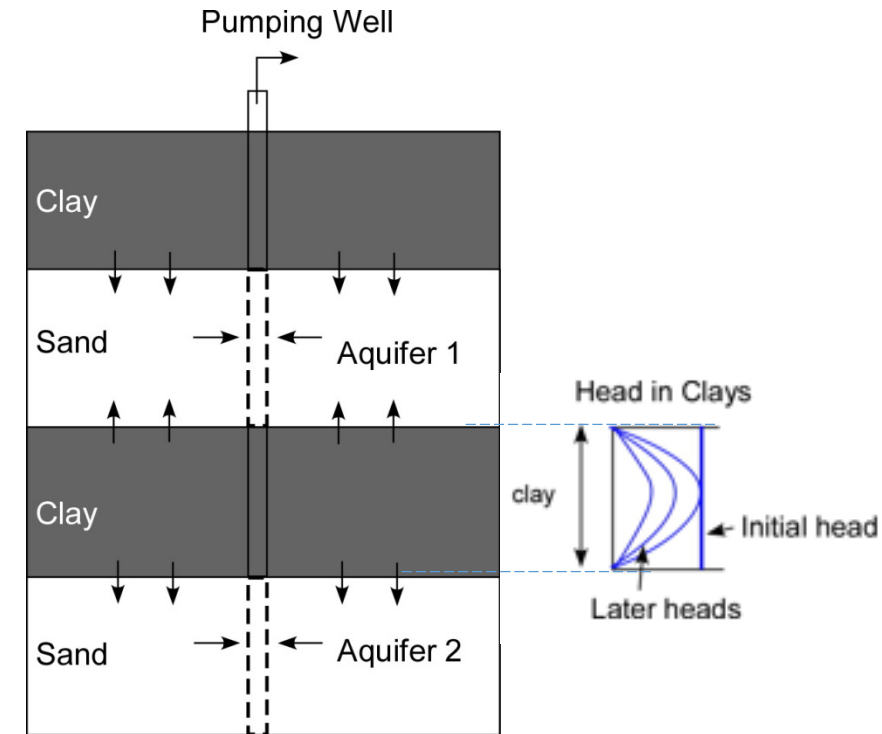
When pumping occurs, there is a decrease in pressure in both the aquifer and the clay beds. The increase in effective stress acting on the clay can cause it to compact.



In our example, the water produced IS the volume released from aquifer and clay compaction (ignoring water expansion). If all water comes completely from compression of the clay, the change in thickness of the system is related to our change in storage term (storativity):

$$S_s = \underbrace{\rho g \alpha}_{\text{Aquifer Compaction}} + \underbrace{\rho g \beta \eta}_{\text{Expansion of Water}}$$

$$\Delta b = b \rho g \alpha \Delta h \quad \text{Actually a function of time}$$



Basics of Land Subsidence:

Clay thickness = 30m

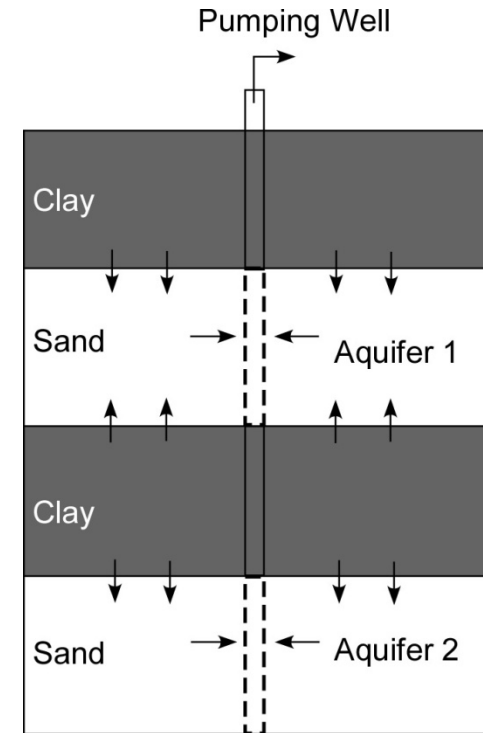
Clay compressibility = $10^{-7} \text{ m}^2 \text{ s}^2/\text{kg m}$

Water density = 1000 kg/m^3

Gravitational constant = 9.81 m/s^2

Drawdown (reduction in head) in aquifer = 2m

$$\Delta b = b \rho g \alpha \Delta h$$



Basics of Land Subsidence:

Clay thickness = 30m

Clay compressibility = $10^{-7} \text{ m}^2 \text{ s}^2/\text{kg m}$

Water density = 1000 kg/m^3

Gravitational constant = 9.81 m/s^2

Drawdown (reduction in head) in aquifer = 2m

$$\Delta b = b \rho g \alpha \Delta h$$

$$\text{Subsidence} = (30)(1000)(9.81)(10^{-7})(2) = 0.059 \text{ m}$$

