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WELL HYDRAULICS

Methods for determining aquifer parameters

- In Unit 2 we discussed about various lab and field methods for determining the hydraulic conductivity values for the soil/rocks.
- Methods included the use of constant head Permeameter, falling head Permeameter and tracer tests for determining the K.
- How ever each method had its own demerit.
- The best method however for determining the aquifer parameters (K, T and S) are the aquifer tests/pumping tests.

Pumping/Aquifer Test Basics

- Groundwater is pumped from an aquifer in order to estimate important aquifer parameters such as **hydraulic conductivity (K)**, **transmissivity (T)** and **the storage coefficient (S)**. However, it's the aquifer that is being tested – not the pump doing the work.
- Therefore, “**aquifer test** or aquifer testing” or “**pumping test**” are more appropriate terms.
- An aquifer test is probably the most accurate method that can be used to estimate aquifer parameters.

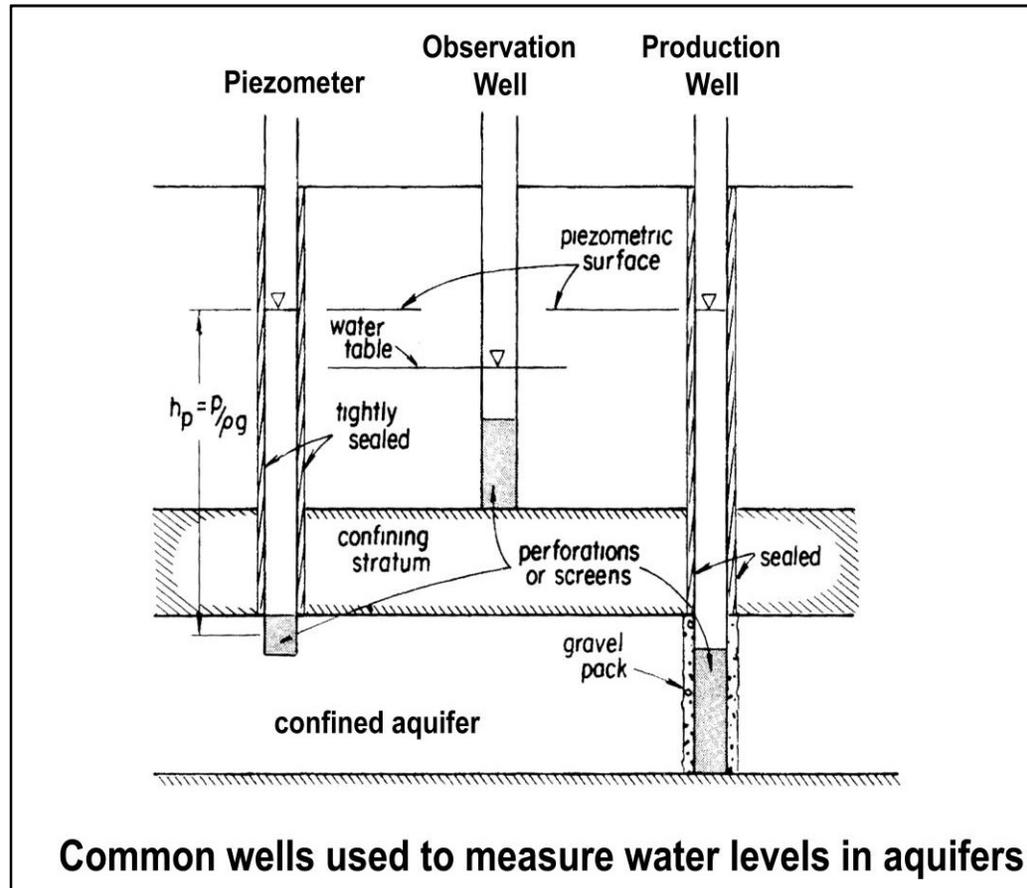
Pumping/Aquifer Test Basics

- An aquifer test consists of a production or pumping well, which discharges groundwater from the aquifer at a constant rate that stresses the aquifer, and observation wells from where the decline in the water level is measured.
- Three observation wells at various positions, up and down gradient are considered appropriate for thorough test results.
- The specific capacity (Q/s) of a production well can also be used to estimate aquifer parameters.

Observation of groundwater

- The occurrence, distribution and movement of groundwater must be detected and analyzed by means of water levels data measured in observation wells and piezometers.
- **A piezometer:** is a well (or narrow tube) from which the pressure head(water level) can be measured at a point in the aquifer.
- **Observation well:** is used to measure water levels during an aquifer test.
- **Production/Pumping well:** is the well from which water is discharged during an aquifer test.
- **Drawdown:** a decline in water level measured from any well during an aquifer test is called drawdown.
- Drawdown increases over time and decreases with distance from the production well.

Observation of groundwater



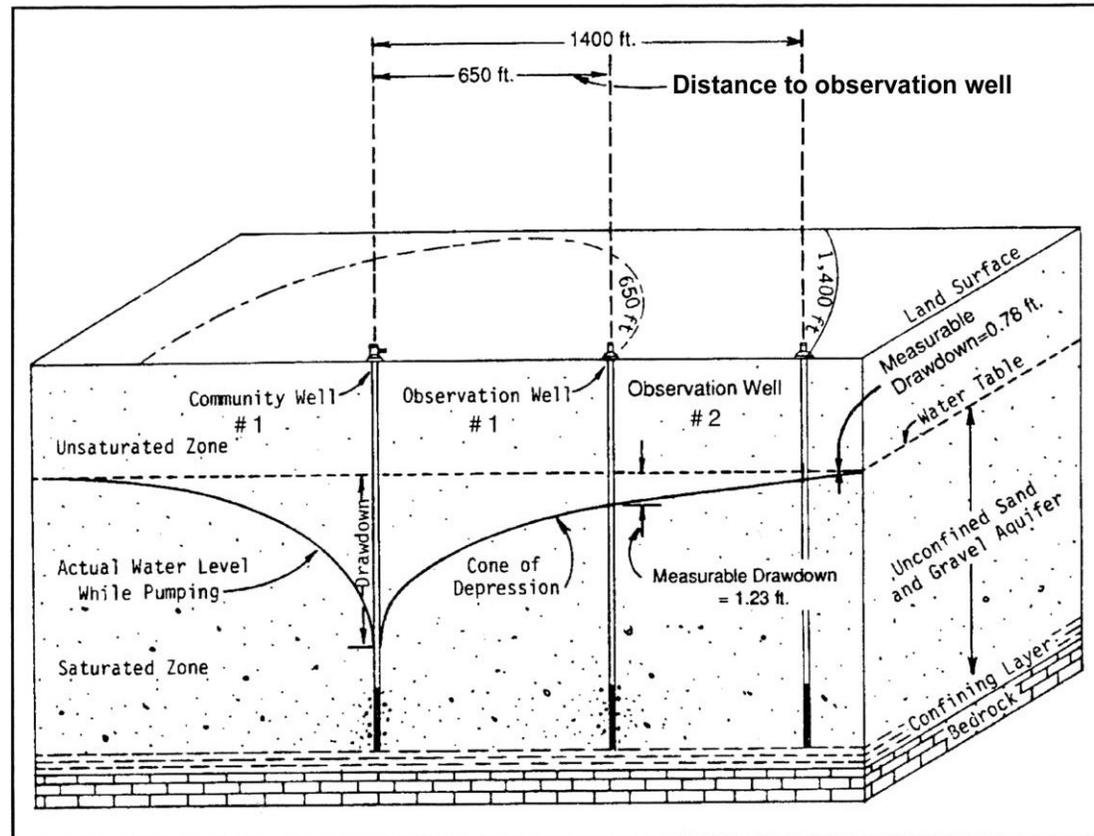
Observation of groundwater

- **Drawdown** and the **time of the drawdown** are the most important field data collected during an aquifer test.
- Change in groundwater level with respect to time in response to pumping is called as **drawdown (s)**
- The most accurate drawdown measurements occur when $s = S_a$; drawdown due to laminar flow (s_a)

Drawdown and Groundwater Boundaries

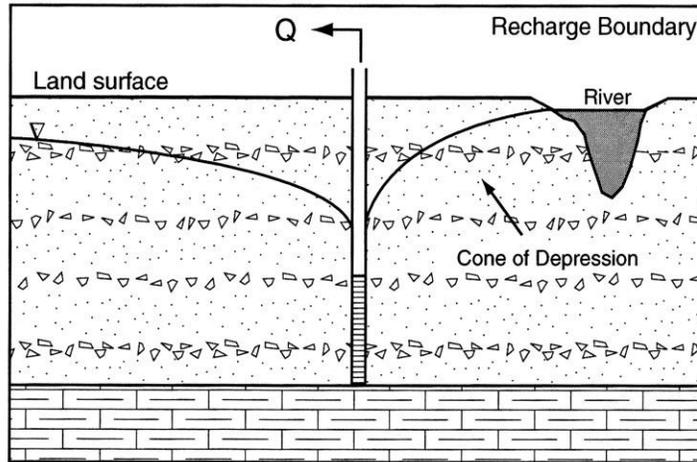
- Drawdown (s_r) will decrease under the influence of recharge boundary.
- Drawdown (s_b) will increase under the influence of barrier boundary.
- Drawdown (s_p) will increase under the influence of perched aquifer.
- Drawdown is additive in case of well interference.

Observation of groundwater

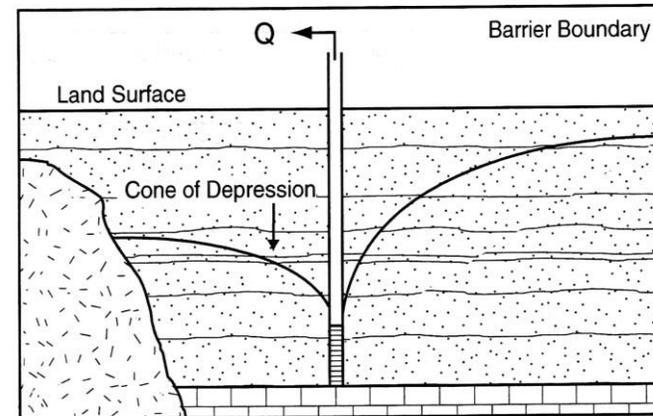


Block diagram showing production well, observation wells, cone of depression, and drawdown .

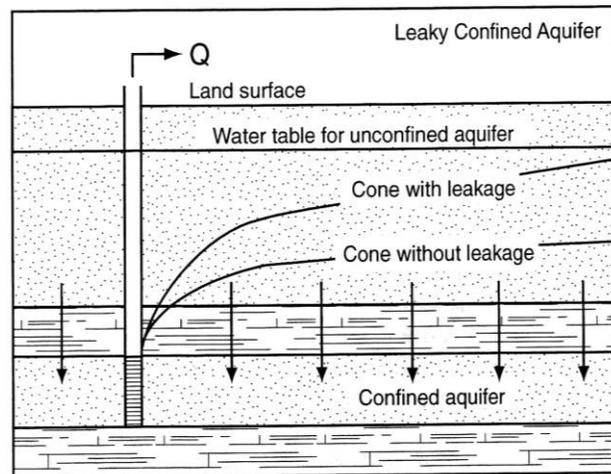
Observation of groundwater



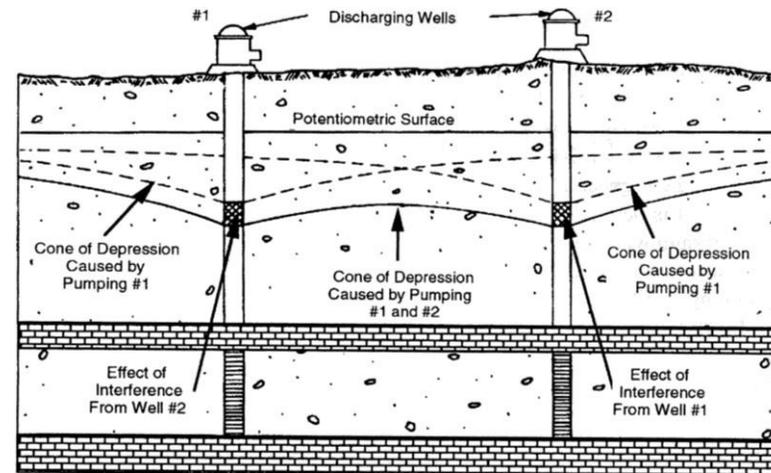
Drawdown due to a recharge boundary



Drawdown due to a barrier boundary



Drawdown decreasing due to a "leaky" unit

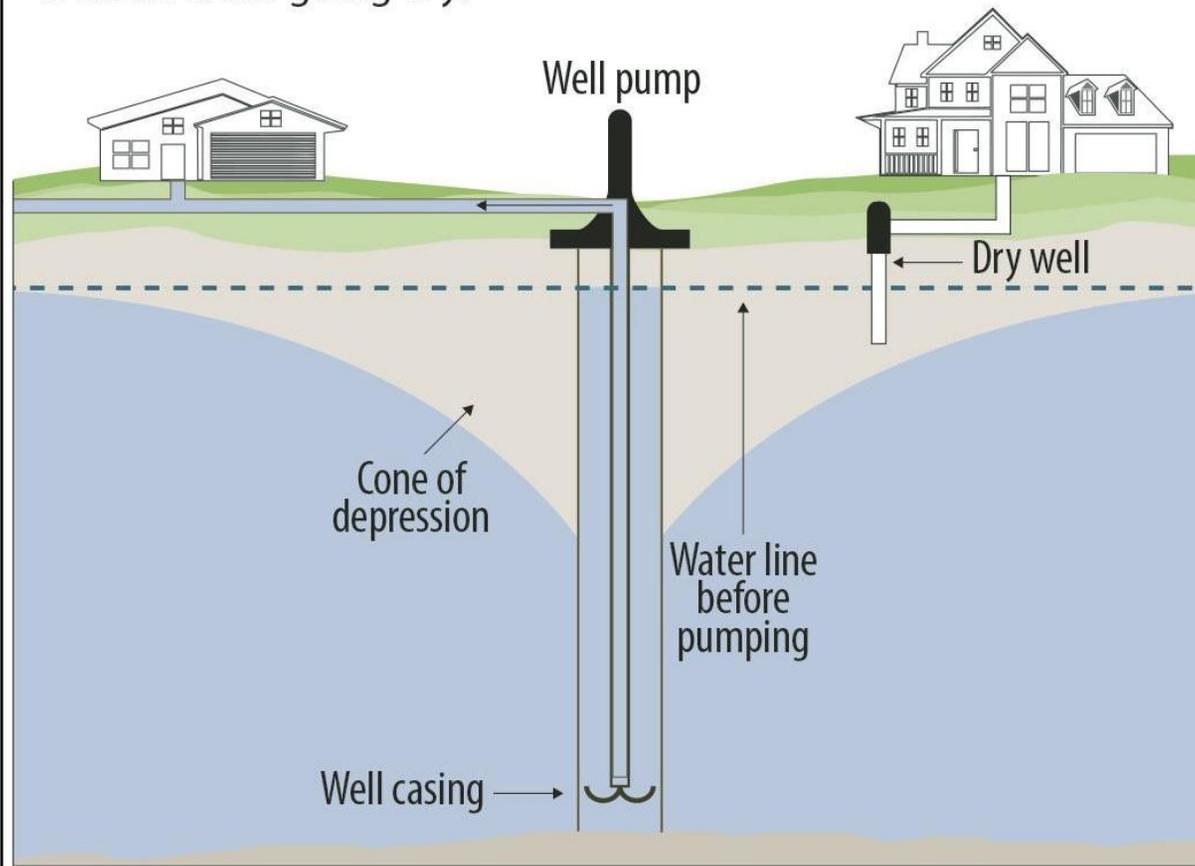


Drawdown increasing in a confined aquifer due to well interference
Drawdown is additive.

Observation of groundwater

A cone of depression

Large water withdrawals from an aquifer can lower the water table and create a "cone of depression" that can result in shallow wells going dry.



Terms used in Aquifer testing

- **Static Water Level (S.W.L.):** This is a level at which water stands in a well, when no water is being taken from the aquifer, either by pumping or by free flow.
- **Pumping Level (P.L.):** This is the level at which water stands in the well when pumping is in progress.
- **Drawdown (s):** Drawdown in a well means the extent of lowering of the water level when pumping is in progress, or when water is discharged from flow well.
- **Well Yield/Flow Rate (Q):** Yield is the volume of water per unit time, discharged from a well. e.g. m³/day.
- **Specific Capacity (Q/s):** Specific capacity of a well is its yield per unit of drawdown i.e. yield/drawdown.

Terms related to well performance

- When a well is pumped water is removed from the aquifer surrounding the well and the water table or the piezometric surface depending on the type of aquifer is lowered.
- The drawdown at a given point is the distance the water level is lowered.
- A drawdown curve (cone) shows the variation of drawdown with distance from the well.
- In three dimensions, the drawdown curve describes a conic shape known as the **cone of depression**.
- The outer limit of the cone of depression defines the area of influence of the well.

