CVEN 5370: GIS Applications in Engineering
In-Class Assignment 2

Vectors

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You will work with the TWDB Groundwater Database in this assignment. Select a County and its adjoining areas for analysis. The purpose here is to delineate capture zones for a well of your choice.

You will obtain Capture Zone in two ways:

1. A radial capture zone using the Theis Solution
2. A capture zone delineation accounting for regional groundwater flow
3. Assume your well is intended to supply water to a small municipality serving 20,000 customers.

The Theis solution for drawdown $s(r,t)$ is:

$$s(r,t) = \frac{Q}{4\pi T} W(u)$$

where the **well function** $W(u)$ is given by the following integral:

$$W(u) = \int_u^\infty \frac{e^{-x}}{x}\, dx$$

And $u$ is defined as:

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

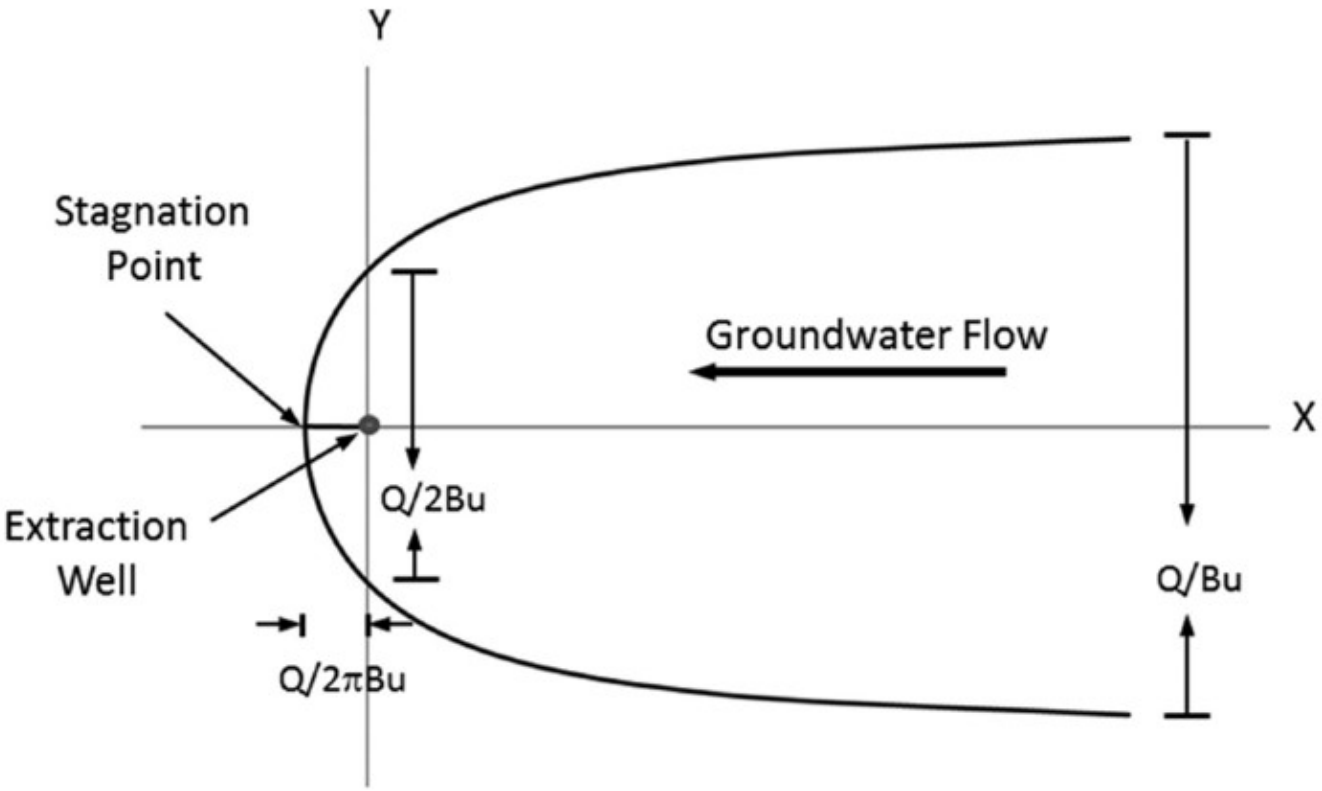
where:

- $s(r,t)$ = drawdown at distance $r$ and time $t$ (in meters)
- $Q$ = pumping rate (in cubic meters per second)
- $T$ = transmissivity of the aquifer (in square meters per second)
- $S$ = storage coefficient (dimensionless)
- $r$ = radial distance from the well (in meters)
- $t$ = time since pumping started (in seconds)

You can use the approximation presented by Vatankahah (2014) to compute the well function. You can find the paper at:
https://ascelibrary.org/doi/pdf/10.1061/(ASCE)HE.1943-5584.0000833?casa_token=Sy50GE3NSyMAAAAA:aR2gqU1zrS08-x8uEh1XSfYT0CW80RCqzanlMQnmp09PS0HFXFi6_yD62RTaBiCD6cA0L8IrHA

The hydraulic properties Transmissivity = Hydraulic Conductivity x Aquifer Depth and Storage coefficient needs to be obtained from the literature as well.

In the second case you will draw a capture zone accounting for regional hydraulic flow. You will assume hydraulic conductivity but will compute gradient by fitting a 2D plane equation to the hydraulic heads.




In the above Figure Q is the pumping rate, B is the aquifer thickness and U is the groundwater velocity (Flux).

You can use Gen AI for appropriate Equations.