

Normering Rising head test (behorende bij vraag 13 Nota van Inlichtingen)

Onderstaande methode of gelijkwaardig is van toepassing.

(gebaseerd op

https://personal.utdallas.edu/~brikowi/Teaching/Field_Methods/Measuring_Groundwater_Discharge.html, geraadpleegd, 27 januari 2022)

Measuring Groundwater Discharge: Rising Head Slug Test

We will estimate the specific discharge of the aquifer (water flux per unit area per unit time). We will use a modified version of Darcy's Law, which states:

$$q = Q/A = -K \cdot dh/dl \quad (5.1)$$

Wherein:

q = specific discharge (m/day)

Q = total discharge (m³/day)

A = frontal flow surface (m²)

K = hydraulic conductivity (m/day), hereunder described as " I "

h = hydraulic head (m)

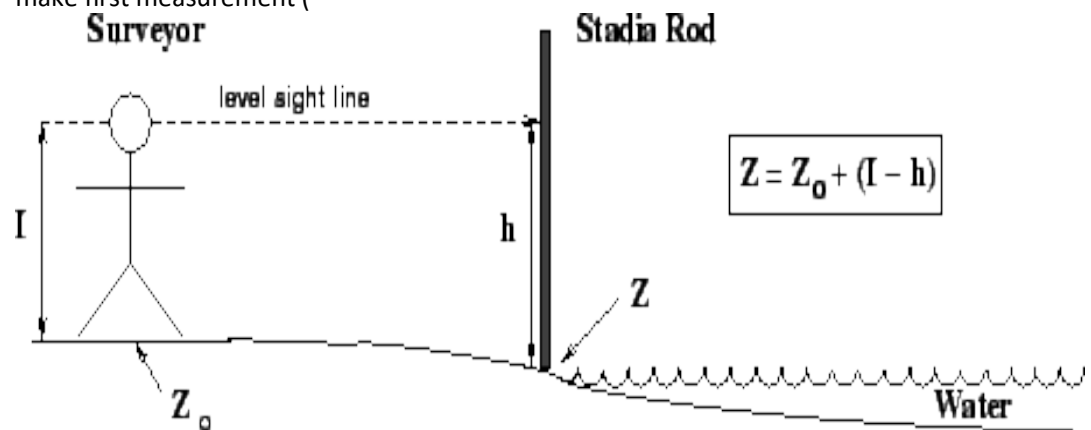
l = length (horizontal) (m)

The slope will be estimated (requires more than one borehole to measure this), so all we lack is a value for hydraulic conductivity. This can be measured by adding or removing water from the aquifer, and watching the response. In our case we will remove 3-4 liters of water, creating a drawdown in the well, which will gradually decrease with time as water flows from the aquifer into the well. The rate of flow gives us a measure of the hydraulic conductivity of the well.

Specifically, we will perform a rising-head slug test (p. 141-5, [Sanders, 1998](#)). In this approach, an amount of water (or an iron bar called a "slug") is "instantaneously" removed from the aquifer, and the water level recovery is monitored. Use the following procedure:

1. Measure the "static" depth to water from your benchmark, before any water is removed from the well (Fig. 5.6)
2. Remove the beeper tape from the well
3. Remove the desired volume of water from the well using the bailer (one liter for each group)
4. Record water level recovery [slug test data form](#)

1. make first measurement (



) as soon as possible after removing water from the borehole

2. initially make frequent measurements, e.g. every 15 seconds
3. when measurements at consecutive time steps differ by less than a few % double the time interval between measurements
4. continue reading levels until about 2/3 (at least 63%) of the initial drawdown has been recovered, i.e. until $Z_0 > Z$, see [slug test data form](#)

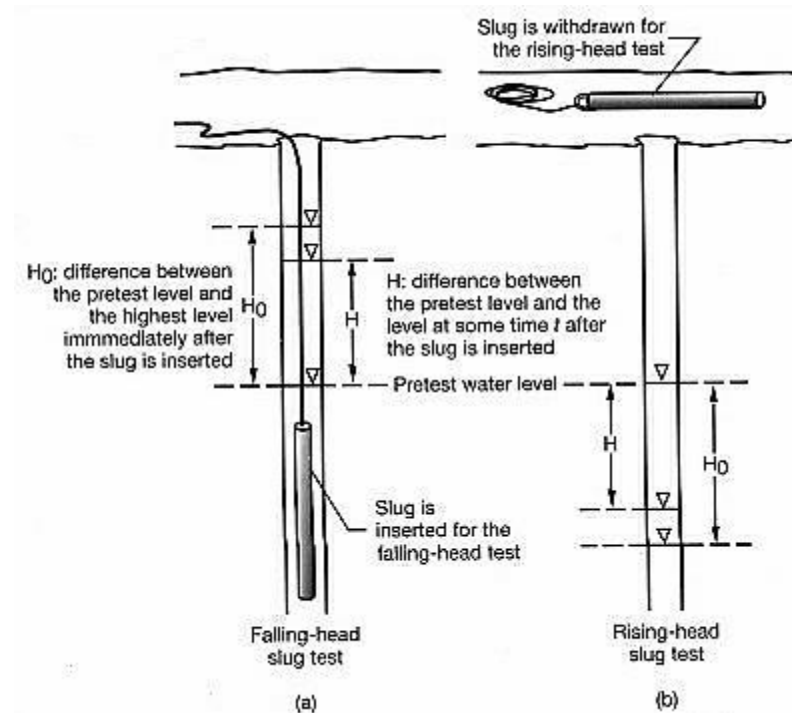


Figure 5.6: Cartoon of slug test geometry. We will use the rising head method (b), after Fig. 5.1, [Sanders \(1998\)](#).

1 Withdrawal Slug Test Analysis

1. record slug test data on suggested form (Fig. [5.7](#))
2. make a semi-log plot of the results as in Fig. [5.8](#) using either of the following approaches:
 - a) plot using spreadsheet program like Excel, set y axis to logarithmic
 - b) add a 5th column giving the logarithm of head ratio (column 4 of form); plot on regular graph paper, using column 1 (time) for X, column 5 (log of head ratio) for Y
3. fit a straight line to your set of points, result should look something like Fig. (Fig. [5.8](#))
4. determine $Z = Z_0 + (I-h)$ from the plot, and calculate hydraulic conductivity I using the textbook formula (with Z_0, Z). Note that “h” is the *natural logarithm*

$$Z = Z_0 + (I-h)_1 + (I-h)_2 + \dots \quad (5.2)$$

5. calculate the specific discharge using equation ([5.1](#)), assuming a gradient of H .

Slug Test Data Table for Use With Depth to Water Readings

(1) Time after test began (units: _____)	(2) Depth to water (units: _____)	(3) Depth to water minus Depth to water before the test began	(4) Head Ratio (H/H_0)*
Before test began		0	
0		= H_0	
1			
2			
3			
etc.			

* H/H_0 is the value in Column 3 divided by H_0 . H_0 may be chosen as the highest value in Column 3 and usually occurs at or near time = 0. (See text for explanation of how to choose H_0)

Note that in a falling head test, the values in Column 3 will be negative. Disregard the negative signs, and treat the numbers as if they are positive.

(a)

Figure 5.7: Suggested form for slug test data, after Fig. 5.4, [Sanders \(1998\)](#).

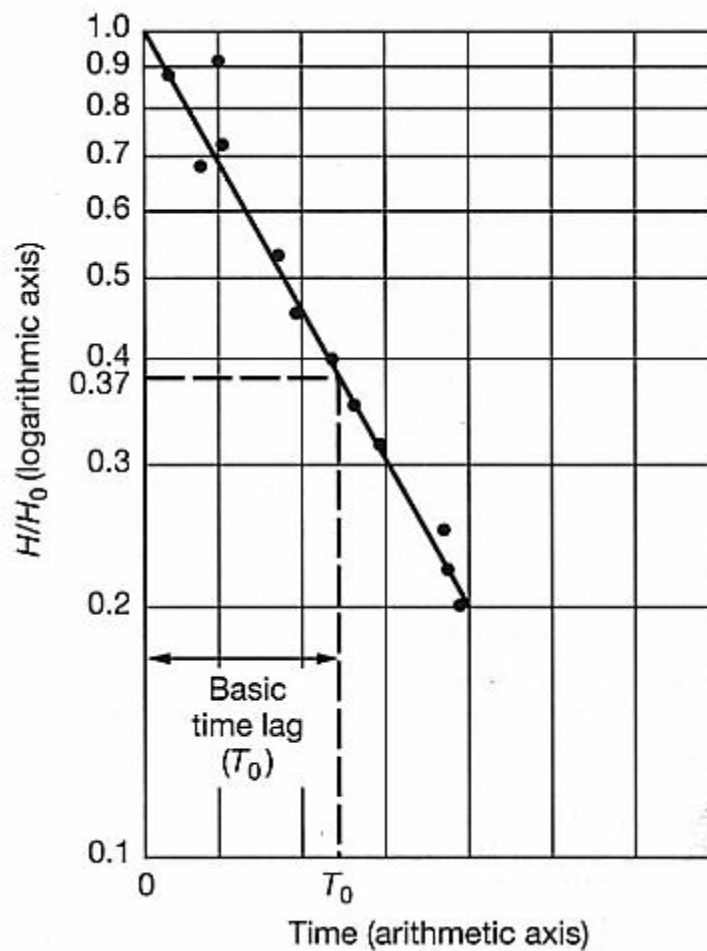


Figure 5.8: Example plot to determine T from slug test data, after Fig. 5.5, [Sanders \(1998\)](#).