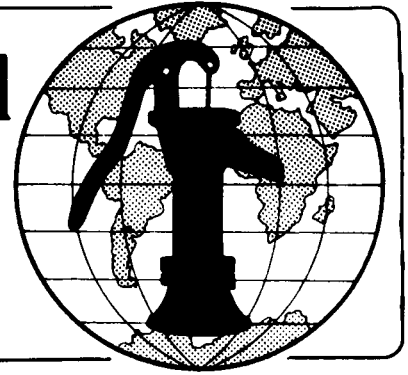


Water for the World



Testing the Yield of Wells Technical Note No. RWS. 2.C.7

Testing the yield of a well is important to determine its capacity and to obtain information to help aid in selecting a permanent pump. See "Selecting Pumps," RWS.4.P.5. In addition, the yields of several test wells are sometimes compared to determine the best site for a supply well. Testing the yield of a well involves pumping the well at specific rates for specified periods of time, measuring drawdown in the well, and performing calculations. Some of the data obtained when testing the yield will be recorded in the drilling log. See "Maintaining Well Logs," RWS.2.C.6.

This technical note describes how to test the yield of a well. Read the entire technical note before beginning the testing process.

Useful Definitions

DRAWDOWN - The distance between the water table and the water level in a well during continued pumping.

SPECIFIC CAPACITY - The yield of a well divided by the drawdown at a specific pumped level expressed as liters per minute per meter.

STATIC LEVEL - The measured distance to the water level in a well before any pumping has taken place.

YIELD - The volume of water that can be pumped during a specific period of time expressed as liters per minute.

Materials Needed

For a fairly comprehensive test, you will need a pump that can operate continuously for one to four hours at varying pumping rates. You will also need a steel measuring tape, chalk, a large container of known capacity, and some way to record data.

Testing Yield

1. Measure the static level in the well before any pumping has taken place. If the pump is equipped with an air hose and gauge, the water level is measured by pumping air into the hose until all water in the hose has been expelled, then reading the gauge and converting air pressure to meters of water. If the pump does not have an air hose and gauge, the measurements must be made with a steel measuring tape. This technical note describes only the latter method.

Chalk the lower end of a steel measuring tape, fasten a weight to it so that it will hang straight, and lower it into the well about 1m below water level. This may take a few practice tries. Use the top of the well casing, or the base of the pump, or some other convenient mark as a reference point. Make all measurements from this point. Note the reading on the tape and pull the tape out of the well. The water line will be clearly visible on the wet end of the tape. Subtract the wet portion from the total reading to obtain the actual depth from the reference point to the static water level. See Figure 1.

For example, if the total reading, when the tape is in the well, is 17m and the "wet end" reading is 1.25m, then the actual depth equals:
 $17.00\text{m} - 1.25\text{m} = 15.75\text{m}$

The static level is 15.75m. See Worksheet A, Lines 1-3.

2. Operate the pump for about one-third of its capacity for one to four hours. This will produce about one-third of the full drawdown. During the pumping, measure the yield of the pump by filling a container of known volume and recording the length of time it takes to fill it.

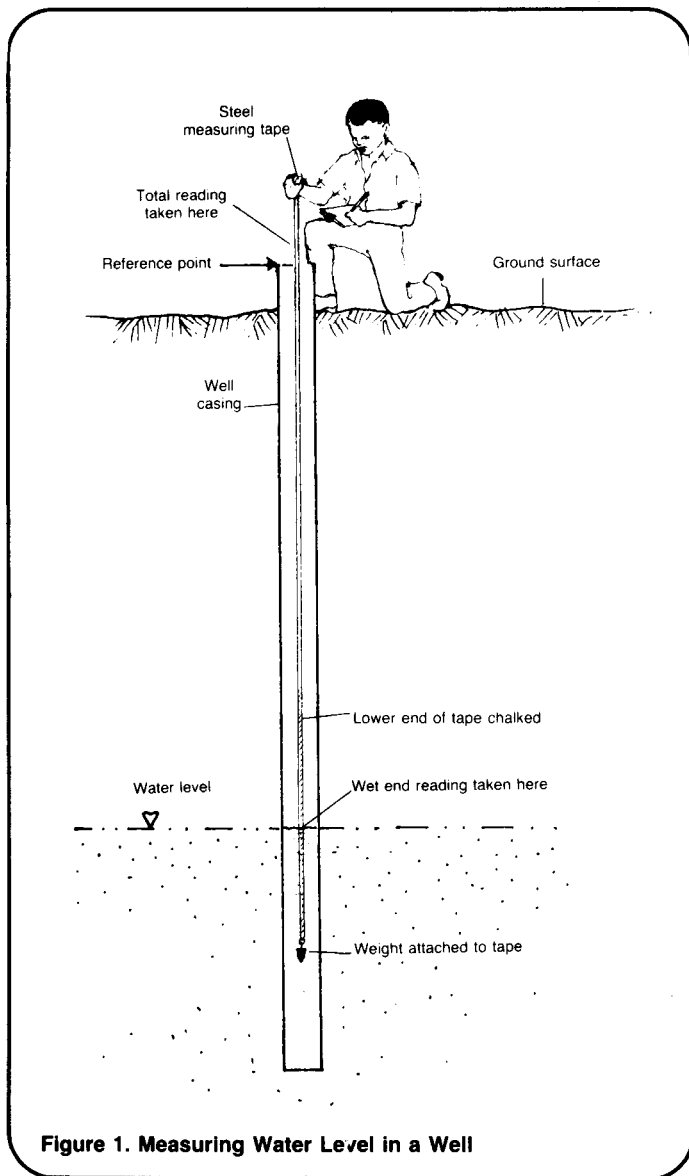


Figure 1. Measuring Water Level in a Well

For example, if the container holds 200 liters, and the pump requires 199 seconds to fill it, then the yield equals:

$$\frac{200 \text{ liters}}{199 \text{ seconds}} = 1.0 \text{ liters/sec.} \times$$

$$60 \text{ sec./min.} = 60 \text{ liters/min.}$$

The yield is 60 liters per minute at one-third the pump's capacity.

3. Measure the water level in the same manner as before, and calculate the drawdown by subtracting the original depth of the static level from the new depth. Do not forget to first subtract the reading on the wet end of the chalked tape.

For example, if the new readings are 19.15m at the reference point and 0.90m at the wet end of the tape, then the new depth equals:

$$19.15\text{m} - 0.90\text{m} = 18.25\text{m}$$

The drawdown at this point equals:
 $18.25\text{m} - 15.75\text{m} = 2.50\text{m}$

4. Calculate the specific capacity at this one-third drawdown point by dividing the yield by the drawdown.

$$\frac{60 \text{ liters/min.}}{2.50\text{m}} = 24.0 \text{ liters per}$$

minute per meter. See Worksheet A, Lines 4-9.

5. Operate the pump for about two-thirds of its capacity for one to four hours. This will produce about two-thirds of the full drawdown. Measure the yield of the pump by filling a container and timing it as before.

For example, if the pump requires 100 seconds to fill a 200-liter container, the yield equals:

$$\frac{200 \text{ liters}}{100 \text{ seconds}} = 2.0 \text{ liters/sec.} \times$$

$$60 \text{ sec./min.} = 120 \text{ liters/min.}$$

The yield is 120 liters per minute at two-thirds the pump's capacity.

6. Measure the water level in the same manner as before, and calculate the drawdown by subtracting the original depth of the static level from the new depth. Do not forget to first subtract the reading on the wet end of the chalked tape.

For example, if the new readings are 22.30m at the reference point and 1.05m at the wet end of the tape, then the new depth equals:

$$22.30\text{m} - 1.05\text{m} = 21.25\text{m}$$

The drawdown at this point equals:
 $21.25\text{m} - 15.75\text{m} = 5.50\text{m}$

7. Calculate the specific capacity at this two-thirds drawdown point by dividing the yield by the drawdown.

$$\frac{120 \text{ liters/min.}}{5.50\text{m}} = 21.8 \text{ liters per}$$

minute per meter. See Worksheet A, Lines 10-15.

8. Operate the pump at its full capacity for one to four hours. This will produce the maximum drawdown for the pump. Measure the yield of the pump by filling a container and timing it as before.

For example, if the pump requires 66 seconds to fill a 200-liter container, the yield equals:

$$\frac{200 \text{ liters}}{66 \text{ seconds}} = 3.0 \text{ liters/sec.} \times$$

$$60 \text{ sec./min.} = 180 \text{ liters/min.}$$

The yield is 180 liters per minute at the pump's full capacity.

9. Measure the water level in the same manner as before, and calculate the drawdown by subtracting the original depth of the static level from the new depth. Do not forget to subtract the reading on the wet end of the chalked tape.

For example, if the new readings are 25.35m at the reference point and 0.85m at the wet end of the tape, then the new depth equals:

$$25.35\text{m} - 0.85\text{m} = 24.50\text{m}$$

The drawdown at this point equals:
 $24.50\text{m} - 15.75\text{m} = 8.75\text{m}$

Worksheet A. Calculating Yield, Drawdown, and Specific Capacity

Static Level

1. Total reading = 17.00 m

2. Wet end reading = 1.25 m

3. Static level = Line 1 - Line 2 = 17.00 m - 1.25 m = 15.75 m

Measurements at ONE-THIRD Pump Capacity

4. Yield = $\left(\frac{200 \text{ liters}}{100 \text{ seconds}}\right) \times 60 \text{ sec./min.} = \underline{1.0} \text{ liters/sec.} \times$
 $60 \text{ sec./min.} = \underline{60} \text{ liters/min.}$

5. Total reading = 19.15 m

6. Wet end reading = 0.90 m

7. Water level = Line 5 - Line 6 = 19.15 m - 0.90 m = 18.25 m

8. Drawdown = Line 7 - Line 3 = 18.25 m - 15.75 m = 2.50 m

9. Specific capacity = $\frac{\text{Line 4}}{\text{Line 8}} = \left(\frac{60 \text{ liters/min.}}{2.50 \text{ m}}\right) = \underline{24.0} \text{ liters/min./m}$

Measurements at TWO-THIRDS Pump Capacity

10. Yield = $\left(\frac{200 \text{ liters}}{100 \text{ seconds}}\right) = 60 \text{ sec./min.} = \underline{2.0} \text{ liters/sec.} \times 60 \text{ sec./min.} =$
120 liters/min.

11. Total reading = 22.30 m

12. Wet end reading = 1.05 m

13. Water level = Line 11 - Line 12 = 22.30 m - 1.05 m = 21.25 m

14. Drawdown = Line 13 - Line 3 = 21.25 m - 15.75 m = 5.50 m

15. Specific capacity = $\frac{\text{Line 10}}{\text{Line 14}} = \left(\frac{120 \text{ liters/min.}}{5.50 \text{ m}}\right) = \underline{21.8} \text{ liters/min./m}$

Measurements at FULL Pump Capacity

16. Yield = $\left(\frac{200 \text{ liters}}{66 \text{ seconds}}\right) \times 60 \text{ sec./min.} = \underline{3.0} \text{ liters/sec.} \times$
 $60 \text{ sec./min.} = \underline{180} \text{ liters/min.}$

17. Total reading = 25.35 m

18. Wet end reading = 0.85 m

19. Water level = Line 17 - Line 18 = 25.35 m - 0.85 m = 24.50 m

20. Drawdown = Line 19 - Line 3 = 24.50 m - 15.75 m = 8.75 m

21. Specific capacity = $\frac{\text{Line 16}}{\text{Line 20}} = \left(\frac{180 \text{ liters/min.}}{8.75 \text{ m}}\right) = \underline{20.6} \text{ liters/min./m}$

10. Calculate the specific capacity at the full drawdown point by dividing the yield by the drawdown.

$$\frac{180 \text{ liters/min.}}{8.75\text{m}} = 20.6 \text{ liters per}$$

minute per meter. See Worksheet A, Lines 16-21.

11. Measure the recovery time. That is, stop pumping and note the length of time required for the water in the well to rise to its static level. Generally, The shorter the time, the better the aquifer. If the well fails to recover completely to its original

static level within 24 hours, question the dependability of the aquifer.

You now have a good indication of the characteristics of the well. However, if your tests were made immediately after the well was constructed and before it was put into full use, the calculated yield will generally be 10-30 percent less than the actual yield of the well after 2-4 weeks of continuous use. In marginal cases, the tests can be repeated after three to four weeks before doing further work on the well or abandoning it.

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.