WATER Quality

K-STATE Kansas State University

# Measuring the Depth to Water in Wells

Knowing the depth to water in a well both during pumping and non-pumping (static) conditions is important information for landowners and operators who depend on a well for water. The depth to water measurement tells you about the resource, and knowing about your resource helps you make good planning and management decisions. Uses for this depth to water information include:

- general knowledge about groundwater resource availability and fluctuation
- tracking of temporary depletion of the resource during extended drought conditions
- knowing about declining resource because of aquifer overdraft conditions
- learning that you have increased well draw down during pumping, which indicates reduced well performance likely due to clogging or partial plugging of the well screen
- planning for future water use activities and actions

There are three methods commonly used to measure depth to water in a well. They are: tape measure or weight on a cord, electric sounder and airline tube. Of these only the air tube is installed and left in the well to be used each time a measurement is made.

**Tape or Cord Measure.** A simple, reliable, accurate, and low cost method to measure depth to water in a well, is by using an ordinary tape measure. One marked with feet, tenths, and hundredths of feet is ideal. The depth is limited to slightly less than 100 feet unless you have a very long tape. It is very helpful to know the approximate depth to water. This method is most convenient and accurate when the lower portion is covered with an indicator coating (paste) that changes color upon contact with water. In most cases, however, powdered chalk, dust or a mud solution is often used to coat the lower part of the tape as an indicator. The depth to water is measured by lowering the tape, usually with a weight attached, to a predetermined even foot mark at the surface reference point, such as top of casing. The depth to water is the difference between the reading at the reference point and the level of water contact where the indicator changes color, or total depth less the depth to change in color.

Usually the least costly method to measure depth to water in a well is a cord with a weight, which is similar to using a tape measure. However, it still requires a separate measurement of the length of cord but the depth is not limited to the length of the tape. A weight that has been hollowed out at the bottom so it makes a sound as it hits the water is a convenient feature.

Because fluctuating water levels, cascading water, or pump-column leaks make obtaining good readings difficult, the tape method is seldom used to measure a pumping well. These problems can be avoided by using a small-diameter pipe (stilling well) placed inside the well beside the pump column. A water level measurement access tube can also be placed outside the well casing in the gravel pack zone at the time that a new well is constructed.

**Electric Sounder.** This refinement of the tape measurement method uses a two-conductor electrical wire, with an integral supporting cable to prevent stretching. Alternatively, some sounders utilize one conductor wire, with the second lead grounded to the conducting well casing. When the contacts touch the water surface it completes an electrical circuit. A bell, light, or meter is wired in series with a battery to provide a visual or audible signal when the circuit is completed. Commercial units are generally marked at regular intervals along the wire (usually every five feet) so that actual depth to water is found by measuring or estimating and adding the distance from the surface reference point to the first calibration marker below the reference point. The sounder may also be used with a geophysical type reel containing direct reading depth counters. Electric sounders are also affected by cascading water or pump column leaks, thus for use in a pumping well the stilling well is essential.

**Air Tube.** Another technique used for measuring depth to water relies on the relationship between pressure and depth of the water. A pressure head of 1 pound per square inch (psi) is exerted by a column of fresh water 2.31 feet in height. An open ended airtight tube is set to a know depth that is greater than any anticipated well drawdown. Depth to water at any time is calculated from the difference between the length of air line and

the pressure required to force water out of the line. This method is commonly used in pumping wells. Accuracy is assured by calibrating the pressure gauge with an electric sounder or steel tape. However, relative measurements do not require calibration.

The ease of measuring the depth to water in a well is greatly simplified by placement of a permanent access or air tube in the well (see figure 1). The end of the air tube should extend 6 inches above or below the pump intake (5 feet above for high capacity wells) and a known distance down from the top of the casing. The air tube may be 1/4 to 3/8 inch inside diameter. Attaching the tube to the pump column as the pump is lowered into place allows a lighter more flexible tube to be used and improves accuracy because the bottom of the tube is accurately known. A rigid metal or plastic tube can also be used and does not have to be attached to the pump column. A hose is securely attached to the tube and to the pipe or fitting that penetrates and is permanently sealed to the sanitary well cap. The air valve and pressure gauge can be permanently and securely mounted to the well cap. Removing the pressure gauge and installing a plug when not making readings prevents damage to the gauge.

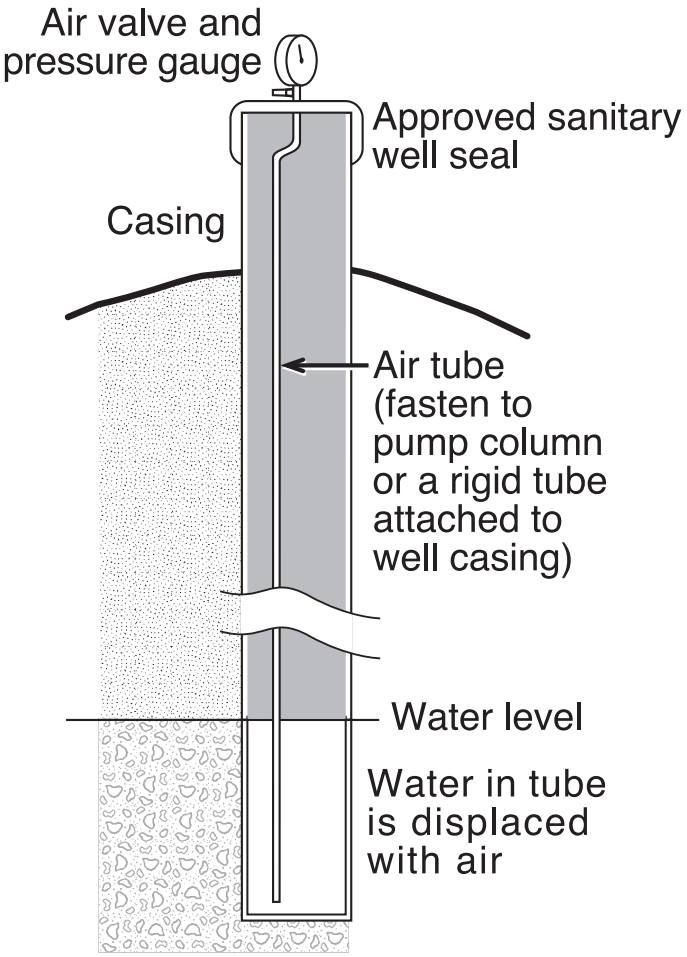
The depth to water in the well is the depth of the bottom end of the air tube minus the depth of water above the end of the tube. Air is pumped into the system until the gauge pressure reaches the maximum and goes no higher. This means that all water has been forced out of the bottom of the tube and any additional air is released as bubbles from the tube. As long as there are no leaks in the system, the pressure will be held at the gauge reading, at least temporarily. The gauge reading is the pressure required to force water out of the air tube which is also the pressure of the water column in the well above the bottom of the air tube. The gauge reading in psi is converted to feet of water above the end of the tube by multiplying by the conversion factor, 2.31 feet of water per psi of gauge pressure or: Depth to water = depth of bottom of air tube minus gauge pressure (in psi) times 2.31 ft/psi.

**Example:** An air tube with the bottom at 85 feet is permanently installed in a well. The gauge pressure reads 5 psi. This means that the water level is 11.55 ft above the end of the air tube.

Depth to water is 85 ft (depth to bottom of air tube) minus the feet of water column above the end of the air tube. For this example the depth to water is

depth to water = 85 ft - gauge pressure x 2.31 ft
= 85 - 5 psi x 2.31 ft/psi = 11.55 ft
= 85 - 11.55
= 73.45 ft.

**Figure 1:** Air tube for measuring depth to water. (Pump and pump column not shown.)

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MF 2669 July 2005