



How To Build Your Own Water Well Sounder

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Introduction

Obtaining accurate measurements of changing depths to water in private water wells has been a challenge for private well owners. There are devices manufactured specifically for this purpose, but their costs are typically more than most well owners are willing to pay. A simple device that a private well owner could build themselves would enable them to better track the performance of their well. This publication is intended to help private well owners assemble their own water level measuring device, typically called a water well sounder.

How Water Levels in Wells Are Measured

A water well sounder is a standard tool of the trade for groundwater hydrogeologists, water well drillers and pump installers. To measure depth to groundwater, a two-wire cable with open ends is lowered into the well. When the wires touch the water, the electrical circuit closes triggering a milli-Ohm meter and a buzzer. One of the most common and durable versions of the commercially manufactured brands is the wire line sounder shown in Figure 1 just for reference. One this size that holds 500 feet of marked wire, with both visual and audio indication of touching water sells for close to \$500.

Why Measure Well Water Levels?

Periodic measurements of static (non-pumping) water levels in private wells lets the owner track any changes in the background depth to water in their aquifer. Real time measurements of pumping water levels in the well taken at similar intervals since pumping began can tell the owner if there are problems with the well's current performance.



Figure 1. A Powers Electric 500-foot sounder. No endorsement implied. Source: G. Hix



Figure 2. Arrow points to an opening a well seal where all sounder readings can be referenced. Source: G. Hix

Monthly measurement intervals are good to track seasonal elevation changes. Whereas, yearly intervals measure long-term trends in ground water elevations. Thus, good well management includes periodic water level measurements taken from the same measuring point, with the same measuring device, at similar times since pumping began. All measurements should be made from a reference point that anyone taking subsequent measurements can readily identify.

A good reference point may be the flush top of a well seal, or the top of the well casing if the well is a pitless adapter equipped well, or it may be the top of a dedicated sounding tube that extends above the well head, see Figure 2. Many people prefer to subtract the height of the measuring point above the land surface and record all measurements of depths to water as below land surface. A water level measurement can be followed by a bmp (below measuring point) or bls notation (below land surface). Whichever standard is adopted, all later readings should be measured and referenced from the same location.

How to Make a Water Level Measuring Device

A simple homemade device for measuring the depth to water in a well can be made from readily available hardware store components, see Figure 3. They include (with approximate costs):

- one plastic wire spool with a hand crank: \$10
- SPT-2 lamp wire 18-2 or extension cord wire. Length depends on well depth: \$0.50/ft.
- one Volt-Ohm meter: \$10-\$20 with closed circuit buzzer (continuity alarm).
- fifteen quarter inch threaded hex nuts: \$1.50.
- two non-shielded copper wire butt connectors: \$1.50.
- Two banana plugs: \$3. (optional)

Additional tools needed: power drill, wire stripper-crimping pliers, electrical black PVC tape, permanent felt tip pens, and a tape measurer.

Construction

- There is a small raised wire holding device that comes cast onto the center shaft of the spool on this model. It can be removed with a hack saw blade or a sharp knife to allow the lamp wire to lie flat on the shaft.



Figure 3. Plastic spool and 250 feet of white lamp cord wire 18-2 gauge. Source: G. Hix

- Next drill a 3/8-inch diameter hole through the center of the shaft on the side away from the hand crank.
- Next thread the lamp wire through the hole drilled in the shaft and tie a large knot in the wire to keep the entire wire from coming off the spool if most of the wire is down inside the well. Forgetting to do this could cause you to loose the sounder wire down the well when the far end of the wire is reached.
- Leave approximately two feet of wire extending out of the center shaft. To take measurements, connect these leads to the Volt-Ohm meter red/black probes (or directly to the meter with banana plugs). The length of lamp wire that must be hand cranked onto this spool will be determined by the maximum depth to water that needs to be measured in a given well.
- After cranking the desired amount of lamp wire onto the spool, cut it and split the working end of the lamp wire back approximately 18" (inches).
- Cut one side of the two halves of the lamp wires back at approximately 18" as shown in the Figure 4. Using a wire stripper or a knife, cut approximately one inch of insulation off each lead exposing the twisted fine copper wires.
- Thread approximately fifteen quarter inch hex nuts over the longer strand of wire one at a time



Figure 5. Sounding a pitless adapter well with cover cap removed. Source: G. Hix



Figure 6. Arrow points to access port in a well seal where a sounding tube could be installed. Source: G. Hix

wire line sounder caught between the submersible cable and the drop pipe. Unfortunately, getting a wire line sounder caught in the well is a possibility when attempting to obtain static and pumping water levels.

Wells that have been constructed with an above ground completion and a sanitary well seal may or may not have a vented opening fitted with a sounding tube that extends to the top of the pump.

Sounding Tubes

Arizona does not require that sounding tubes be installed in private water wells. Sounding tubes are most common in municipal, industrial, monitoring and only some irrigation wells. The Arizona Department of Water Resources (ADWR) Rule R12-15-811(C) however states: "Access port. Every well with casing four inches in diameter or larger shall be equipped with a functional watertight access port with a minimum diameter of one-half inch so that the water level or pressure head in the well can be monitored". See Figure 6 and attached page size drawing of a well and its components at the end.

This rule, and the lack of anything more specific, does not prevent a well owner from having a dedicated sounding tube installed in their well specifically for measuring water levels in it. The attached drawing illustrates how a sounding tube can be installed to the top of the submersible pump to more safely allow water level readings without the risk of getting the sounder wire caught. A sounding tube can be installed in a well anytime a water well contractor is engaged in removing or installing a pump in

the well. It is not recommended that well owners attempt to install one themselves.

Taking Measurements

Set a Volt-Ohm meter to read the lowest amount of Ohms. Ohms are represented on some meters using the Greek omega (Ω) symbol.

When connected to the wire line sounder, the Ohm meter will show a zero indication when both ends of the wire are out of water because the circuit is open. Once the second wire is submerged in water it closes the circuit and a Volt-Ohm meter will indicate the closure (also indicated by a buzzer sound in some meters). See two photos in Figure 7. This occurs when the shorter of the two wire ends becomes submerged.

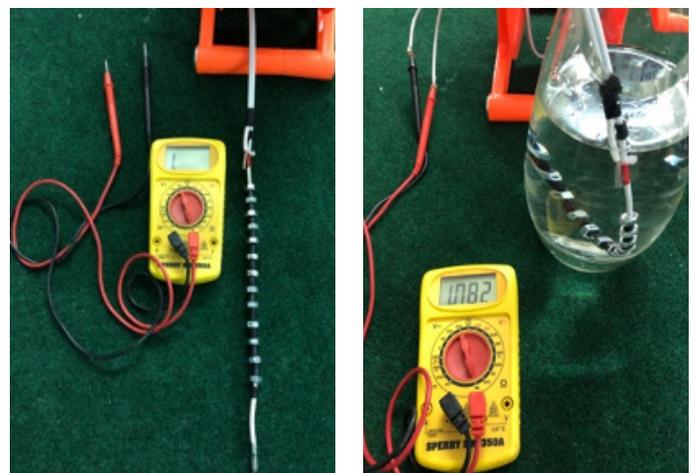


Figure 7. Photo on left shows an open circuit with both wires out of water. Photo on the right shows a reading on the Ohm meter when they are submerged in water. Source: G. Hix

A homemade water level measuring device as described above will allow a private well owner to keep track of the performance of their well and their aquifer. Measurements made after long periods of not pumping will tell a well owner how the aquifer is performing. It may come up in periods of recharge from rainstorms or snow melt runoff or it may decline in periods of extended drought. And periodic measurements of the pumping water level at nearly the same point in time that the well has been pumping can tell well owner how efficiently the well is performing.

their groundwater and their well. Proper monitoring includes measuring and tracking the performance of the static and pumping water levels over time. It takes a well sounder to obtain these measurements

Well Performance

Well pumping rates may decline over time for two major reasons:

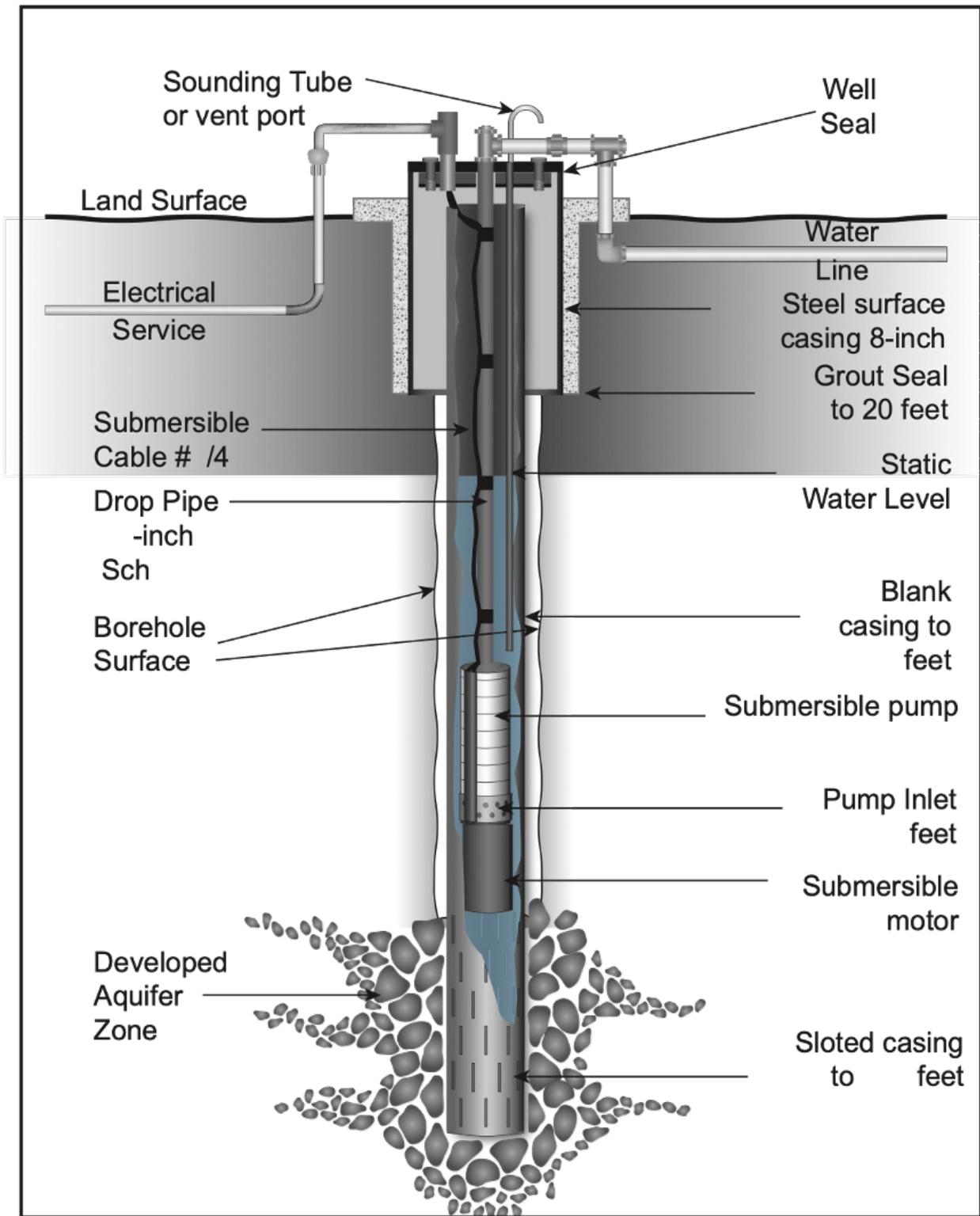
- 1) If the static water table is dropping three to four feet a year, it typically means that the aquifer is being depleted and if the pump cannot be lowered in the well, the pumping rate of the well will be greatly reduced.
- 2) If the pumping water level keeps dropping deeper each time the pump runs for the same amount of time, that means that the water is being taken out faster than the well casing can let it in. In other words, deeper pumping water levels after the same amount of run time on the pump with recovery water levels staying the same imply blocked perforations in the well casing (screen). This may become evident if the pump begins to break suction and pump air and water and the recovery static water level remains nearly the same, then water is not getting back into the well as fast as it is pumped out.

Therefore, a secondary benefit of making regular well level measurements is knowing that the well is slowing down because the groundwater table is dropping or that the screen is plugged up you never get the same performance back.

If well rehabilitation is needed, it should be performed by a licensed water well contractor as it will require removing the pump and motor.

Conclusion

Because no one else is monitoring the performance of private water wells, it is the well owner's responsibility to measure and monitor to manage their most valuable asset,



Drawing of a typical domestic well equipped with a sounding tube.

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