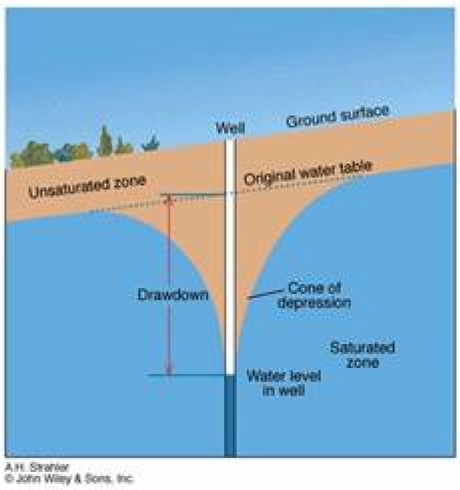
# *Operating Considerations for Wells and Implications to Well Yield*

**Whether you operate or own a relatively small private potable water well, a large public water supply well, or a private well for industrial use… any ground water well, how you operate it can affect the quality and sustainability of the water received. How you operate your system or well(s) can potentially cause damage to occur to the aquifer or wells without you even realizing it.**




Over pumping drains the geology around the well

The rate at which water flows into your well is determined by the geology of the ground in which the well is constructed, the specifics regarding the construction of your well and the way that you operate it. How you operate a well can determine the quality and constituents of the water as well as the capacity and length of service the well will provide.

For instance, when a well goes dry, in some cases, the cause can be a mystery while another well is commonly successfully drilled only a short distance away and at the same depth as the old one. If the original well was a low yield well, it is possible that the way the well was operated caused it to run dry. In a low yield well, the water could be constantly drawn down and demand for water exceeds the rate at which it flows into the well. Pumping water out of a well faster than it comes in is called over pumping. Periods of extended over pumping increase the rate at which water travels through the ground immediately around the well, drawing in sediment adding cloudiness to the water, degrading water quality, and may eventually clog the cracks that are the arteries in the geology of the aquifer. Elevated pumping, although different than over pumping, can also cause the level of minerals in the water to change.

Every well that is being pumped has some influence on the surrounding area. When a well is pumped, nearby water starts flowing in, draining the ground around the well while more distant water flows in to replace the water that was pumped. The difference in rate of travel results in a cone shaped depression in the aquifer around the well that gets shallower further from the well. The cone, to some degree, grows in size the longer you keep the well level drawn down. Once pumping ceases the cone of depression fills in as water from a distance moves toward the area of lower pressure or level. Because this cone influences the movement of water through the aquifer, it creates a zone of influence, which affects the way water flows through the geology in the vicinity of the well.

When a well withdraws water more slowly or intermittently from an aquifer, the water is more representative of the geology within a relatively close vicinity of the well but over pumping or excessive pumping increases the radius of influence that a well creates and can even reverse the direction of natural flow in the aquifer. The influence created by excessive pumping can potentially bring contaminants such as nitrates and fertilizers from adjacent farm land and surface or sub-surface water from nearby streams or other bodies of water.

Excessive pumping (for long durations) also has implications. By definition, it may not create a cone of depression to the degree that over pumping does, but certainly can create a zone of influence that may increase the rate of travel of the water through the ground geology and cause the level of minerals or other constituents in the water to change.

When a well is pumped more slowly or intermittently shut down, this allows the aquifer, cone of depression, or zone of influence to recharge, benefitting from the aquifer's surrounding geologies natural tendency to dilute and filter contaminants.

The negative effects of over pumping are cumulative and potentially long lasting. When you over pump an aquifer the result can be contamination from surrounding sources or even land subsidence. Subsidence is not real common, but it does occur.
Subsidence is the settling of ground and may be caused by a number of natural occurrences but it has been estimated that more than 80 percent of the land subsidence is related to the withdrawal of ground water. When land subsides, it is compacting. The spaces in the ground close and therefore the ground lowers or subsides. An aquifer consists of spaces in the ground that contain the water. Once those spaces disappear, the aquifer's ability to store water is reduced forever. A long rainy season or good snowmelt is not going to recreate voids that have closed. When a well is over pumped, water is withdrawn faster than it is coming in and the water level in the well drops dramatically as the geology around the well begins to drain. The longer this goes on the more widespread the dewatered area is. When the nearby cracks and voids are emptied of water they may collapse if they were not self supporting, causing subsidence.

Even short term over pumping can result in decreased well yield. Dewatering is what causes the cone of depression around a well. The longer this goes on the larger the cone (dewatered area) becomes. The deeper and wider the cone, the smaller the interface between the well and aquifer and the lower the yield of the well can be. This is the purpose of a dewatering operation; to lower the groundwater level and decrease the inflow rate so that an area can, for example, be excavated. Whether on purpose or unintended, the result of over pumping is dewatering and this is not an efficient way to operate a well intended as a continuing source of water.

Over pumping threatens the well's longevity not only through subsidence and dewatering but also through mineral or biological buildup. Wells fed by fractures, those that dribble in through tight shale or those with well screens are all susceptible to loss of production resulting from buildup of mineral crust or biofouling. This buildup can be escalated by continually over pumping and exposing the well screens to air. The same minerals that cause buildup on faucet aerators for example, can build up where water comes into the well, reducing the well yield.

Additionally, every well has a designed flow rate. This depends on slot size of the screen, the area of the well screen, among other things. One parameter considered by well drillers and manufacturers with regard to a design flow rate is the velocity of the water through the well screen. This depends on slot size as well as other considerations specific to the well. If the prescribed velocity is exceeded, gasses in the water can come out of solution just behind the screen and can eventually form scale on the inside screen surface. If the well is operated in this manner and mineral or slime buildup occurs on the screen as described above, such as minerals seen on a faucet aerator, portions of the screen can become restricted. This could then result in excessive velocity past the remaining open areas of the screen, increasing the potential for excessive velocities and scale formation across the entire screen area, further compounding the problem. This describes just another implication to improper well operation and another consideration for well operation strategies.

Attention to how a well is operated is very important. Work to understand and appreciate the design and operating characteristics of your well to include, its drawdown, specific capacity, and yield.

By Robert Jewell

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