THE AMERICAN WELL OWNER

★ INFORMATION AND ADVICE ABOUT GROUND WATER, WELLS AND WATER SYSTEMS ★

A Quarterly Publication for Well Owners - 2004 Number 1

Who Owns Well Water?

MESSAGE FROM THE PUBLISHER

What Goes On Underground?

The Cone of Depression article in this issue of THE AMERICAN WELL OWNER (TAWO) describes the hydraulic response of the aquifer to pumping. In other words, what happens to water levels when the pump runs? A common metaphor for pumping from a well is "taking money out of the bank" with the aquifer being the "bank account." The effects on the "bank account" [aquifer] from "cash withdrawal" [pumping discharge] lead to concerns about how often there will be "cash deposits" [water recharge] into the "bank account" [aquifer].

Simple metaphors are good for basic explanations of cause and effect. The banking metaphor is however too simple, because in reality there can be other "customers" [wells] withdrawing from the same "bank account" [aquifer]! Not only can neighbors have an impact on the "money reserves" [ground water storage] in the "bank account" [aquifer], but also nearby land use activities, (particularly related to development) can impact the amount of "deposit" [recharge] into the shared bank account. In addition, the amount of water "in the bank" [ground water storage] can become depleted even if there is no "cash withdrawal" [pumping]. How can this be? All ground water is on the move, however slowly, from point of recharge gain to the point of discharge loss, usually at a stream or wetland. Rise and fall of water levels in aquifers has been taking place for millions of years. Ground water molecules have no respect for property boundaries, as is explained in the article, Who Owns Well Water?

The final article in this issue looks at causes and cures for Declining Well Yield. This is often a well issue and not an aquifer issue. The basic message from the three articles in this TAWO is that the more well owners understand about ground water and wells, the easier it will be to make decisions about resource protection and management. (Visit www.privatewell.com for ground water information.)

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The stocks of water companies are traded on the major exchanges around the world. Water is a commodity bought and sold in bottles everyday in our local grocery stores. Fifty-three percent of the United States population draws ground water from a household faucet for cooking and washing. Some households pay a utility to supply water while others have access to a private well and no monthly bills. Who owns the water in your well?

The answer is not clear-cut and depends somewhat on where you live and what you want to do with the water. In the eastern United States, the water supply has historically been greater than the demand and water has been freely available to all for reasonable uses as long as the use did not interfere with a neighbor's use of the water supply.

In the western United States where the climate is more arid and water supply may not be sufficient to accommodate all demands, the allocation of water has been determined by "first appropriation." The right to use a water supply was based on who used the water first and how much the consumptive use was (how much water was used and not returned locally to a stream or the ground). An established water right is considered "real property" in most states west of the Mississippi River and may be bought and sold. In some states, the water right may be separated from the property with which it was originally associated and sold as a distinct item. A parcel of land may lose access to water if its rights are sold.

The situation in the eastern United States is

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beginning to change. Development is increasingly creating local situations where demand exceeds supply. Private well owners and water utilities may find that long-time good-producing wells now go dry in the summer, or at times of peak use, because of the increased withdrawal from the aquifer source. "Water ownership" and "water rights" are becoming an issue. In some areas, building moratoriums are in place to slow or restrict new development unless a new proven water supply is shown to be available.

You would think that long-established well users would have a "right to water" over new wells drilled for recent development. However, it is frequently difficult and/ or expensive to prove cause and effect, as an existing well's yield and reliability may decline gradually as new wells are brought on-line in the surrounding area. It may be that the decline in a well's yield results from less recharge from rainfall because of changes in the land use (removing forest, creating paved roads etc.) and not directly because of additional nearby wells. Many private well owners do not know accurately the quality or the actual or potential yield of water from their wells. This may make it difficult to establish "ownership" of the water if conditions change.

Water rights vary from state to state. The laws regulating water rights in many states are being debated strongly as stakeholders attempt to balance new development with existing finite resources. Water use decisions must address support for a varied range of uses such as original and treaty-based Native American allocations, sustainable healthy aquatic habitats and established domestic and business water users.

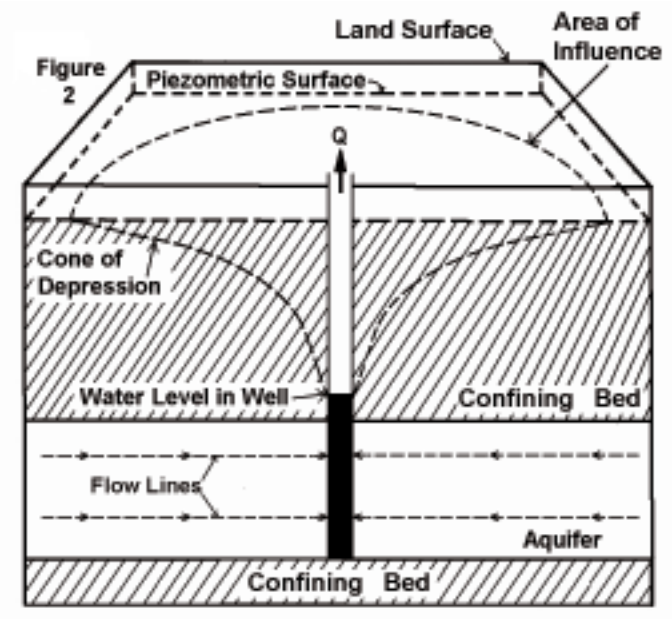
Some jurisdictions allow on-property use from a well but prohibit or exert control over water transfers or sales. Some wells are regulated if they exceed a certain capacity. In some cases, well drilling may be restricted or only allowed for certain purposes, such as garden irrigation. If there are water quality concerns, wells may only be permitted to access specific depths of an aquifer. You may have water beneath your property, but if you can't access it – then for all practical purposes you can't own it.

Because water is always on the move above and below ground, a landowner can't always "keep" large quantities for extended periods. For example, ground water that is "saved" by careful use and conservation one year may not be there for use in drought conditions the next year. Owning the right to water is not the same as owning water. Those little molecules are free spirits and don't pay any attention to property boundaries. What is in your well this morning, may be in your tea this afternoon and a cloud 300 miles downwind tomorrow or in your neighbor's well next week.

WHAT CAN WE LEARN FROM A CONE OF DEPRESSION? . . . *continued from page 4*

water level within the well stabilizes when the water volume entering the surface area of the cone and moving to the well equals the pumping rate (Q). At that time, the shape of the cone stops changing.

Hydrologists can learn much about the amount of water stored in an aquifer from knowing the shape of the cone in a pumping well, how long it takes to stabilize and how long after pumping stops it takes to return to a flat water table. If several wells are pumping from the same aquifer their "cones" may intersect, and if there is no recharge, they will cause a gradual lowering of the water table. In order to know the cone's shape and how fast it develops or recovers, hydrologists will often drill observation wells to measure water level changes around a pumping well.



Although the physics of aquifer flow can be complicated, professionals trained in hydrology and geology (hydrogeologists) can interpret the shapes of the cones of depression, (known as drawdown curves) to work out how much water is available in an aquifer, the direction in which it is naturally flowing, and the likely effects of pumping different volumes of water. In most cases, the hydrogeologists try to calculate "safe yield. This is the amount of water that can be safely taken from an aquifer on a long-term sustainable basis. Interpretation of water level changes in response to pumping is an example of the practical application of calculus!

How to Fix a Declining Well Yield

A reduced rate of water flow (that is, less pressure) at the tap may appear to be a symptom of a declining yield from well. However, before you blame the aquifer or the well, check that conditioning equipment such as softeners and iron removal have been properly serviced. Declining water pressure is not necessarily a symptom of a well problem.

Lowered water tables and slow inflow to a well may result in "no-water" at the tap from time to time and/or diminished flow. There are two potential causes:

(1) Less water in the aquifer due to a natural drought or local over pumping. [Even if there is still water in the well, pumping from a greater depth, because of a lowered water table, may reduce the flow or the water pressure.]
(2) Reduced efficiency of water inflow to the well resulting from various types of blockage around the drilled hole.

This article considers declining yield related to blockage in the well (Number 2).

Properly drilled, constructed and developed private wells can provide an adequate source of drinking water for many decades. However, if a blockage develops in the flow pathway(s) leading to a well, yield may be reduced. The loss of yield is usually related to one, or a combination of, three problems:

(1) Physical plugging with fine sediment (silt and clay),
(2) A build up of encrusted scale as the result of chemical precipitation, or
(3) Fouling with colonies of bacteria.

The blocking of inflow pathways may occur gradually over a period of years. If a well is not monitored periodically, the problem may go undetected and be more difficult to correct when finally discovered.

Knowing the cause of the declining yield is necessary in order to apply the proper cure. All new wells should be tested for basic water chemistry when first completed to establish a record of the baseline conditions for pH (acidity), hardness, alkalinity, iron, manganese and turbidity. The chemistry of well water is usually related to the rock types encountered in the drilled hole. When a well is pumped and water levels drop, air moves down into the drilled hole to replace the water. The oxygen in the air can cause chemical changes in the rocks and increase the chance of chemical encrustation.

A tool for diagnosing a well that has experienced a loss of yield is to survey the well hole with a camera. A camera survey creates a permanent record of the physical appearance of open-hole zones and the well construction materials such as casing and screens. Encrusted scale and the build-up of bacteria colonies (biofouling) are likely to be visible as well as the condition of the well casing or screen. The video record can be compared with the original well construction log to assess changes. The encrustation information also shows the contractor where to focus "well cleaning" or rehabilitation.

Once the likely cause of the yield loss is determined, a treatment method to remove blockage or reopen flow pathways may be chosen to regain some of the lost yield quantity. Effective treatments commonly involve the application of a chemical additive combined with agitation of the water column within the well to force the chemical out into the aquifer and to scrub the affected well materials to dislodge and remove scale and bacteria from the well. Hydrofracking bedrock wells, a process that increases water pressure in the well, can be effective in increasing yield from an encrusted blockage.

There are several types of chemical additives applied to dislodge/ dissolve/ remove blockage. They may include detergents, acids, neutralizers and biocides. The agitation method may involve reaming the well with surge blocks or completing a series of alternating water jet and pumping procedures. Most contractors who rehabilitate wells use a combination of methods. Water well rehabilitation is a job for a contractor with the right equipment and experience solving well problems. In most cases, the pump will have to be pulled from the well.

Rehabilitation is usually less expensive than a new well – particularly if local regulations require the professional abandonment and sealing of the old well. However, homeowners should discuss the well treatment options and likely costs prior to beginning well rehabilitation. The contractor will normally take responsibility for obtaining appropriate permits and for ensuring that the chosen procedure meets local, state and federal requirements for handling and storage of treatment chemicals during the rehabilitation process and disposal requirements for spent chemicals and/ or well discharge water.

Well rehabilitation works only if there is sufficient water in the aquifer. Consult your County Extension office or geological survey to determine whether a natural drought may have caused reduced well yields in your area. Check to see how many new wells have been drilled around your house lot in recent years to assess possible overdraft impacts. If these two conditions do not appear to be the source of the declining well yield, then find out from your contractor the pros and cons of rehabilitating a well versus deepening the existing well or drilling a new well.

Most states have a water well board or oversight-agency for well drillers and well construction. Not all well contractors undertake well rehabilitation work. State or county agencies or the State Well Contractor Association, may have lists of contractors who specialize in well rehabilitation. Most state association addresses are listed on the Trust's web site www.agwt.org (click on: Links to Organizations).

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TOPICS IN UPCOMING ISSUES

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- **Road Salt and Your Well**
- **Water from Space**

WHAT CAN WE LEARN FROM A CONE OF DEPRESSION?

A cone of depression is the name given to describe the shape of the water table surface around an actively pumped well. The cone shape (actually an inverted cone with the point down) is created as the aquifer around the well is dewatered and the surface of the original water table (static level) declines (Figure 1). The circular area of the cone, as projected up to the ground surface, defines the "area of influence" around the well where any surface water infiltration will flow to the well. The "cone" shape really does occur in simple geologic conditions (such as permeable sedimentary rocks) but when aquifers are in fractures, and water bearing zones occur beneath impermeable layers, the simple cone of depression concept becomes much more complicated. When the well is pumping water from a confined aquifer (beneath an impermeable layer) the actual water level in the aquifer [usually] does not change and does not form a cone shape. However, the pressure gradient as reflected in the piezometric (pressure) surface of the aquifer does change to form an inverted cone (Figure 2).

The formation of the cone of depression begins as pumping starts and the water column inside the well falls. The aquifer close to the well is dewatered first as the water table surface falls to follow the declining water in the well column. As pumping continues, the rate of water entering the well increases to compensate for the diminishing water volume available within the well column. The circular area of the cone expands outwards, intersecting more of the saturated aquifer. Drawdown of the

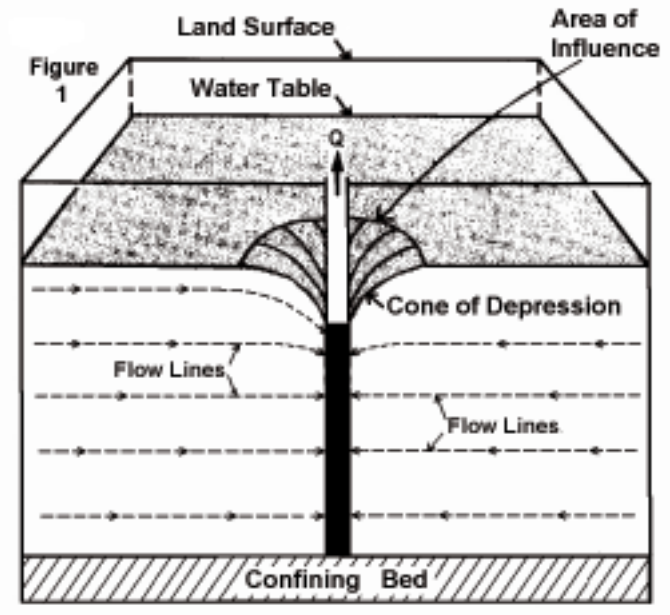

Figure 1

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Published by: AMERICAN GROUND WATER TRUST
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Individual Subscription Rates:
1 year (4 issues) $6
2 years (8 issues) $11
3 years (12 issues) $16
All rates subject to change.