THE AMERICAN WELL OWNER

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

A Quarterly Publication of the American Ground Water Trust© - 2005 Number 2

Independent Authority on Ground Water

The Top Ten Ground Water States

MESSAGE FROM THE PUBLISHER

PRIVATE WELLS CAN SAVE TAX DOLLARS

Growing population and growing expectations will increase pressure on tax dollars for transport, education and medical services in addition to increasing demands for the fundamentals of housing, food and water. The World's population increasing by 150 people per minute, every minute, 24 hours a day. In the US there will be close to 400 million people by 2050.

There will have to be capital investment compromises as planners and policy makers strive to balance resources and demands. In the US there is already an investment backlog for replacing and upgrading water utility and wastewater treatment plants and pipelines. Most private wells for rural and suburban homes help relieve pressure for tax-based capital investment for water projects and also relieve stress on water resources required for urban areas.

A major challenge for rural planners and zoning boards is to decide on the ideal building lot size that can safely and reliably provide water for wells and safely dispose of wastewater via septic systems. There is not a one-size-fits-all formula for determining the optimal lot size. Current ground water use, rates of local recharge and geologic conditions governing storage need to be part of the decision-making process.

Asking the right questions is the key to finding the right answers. Does your community have a scientifically based planning and zoning water supply policy for building development? Will the policy result in sustainable water supply to homes, not compromise ground water quality and not stress tax resources?

Andrew W. Stone

American Ground Water Trust

Since 1950, the United States Geological Survey has tracked water use across America. Water use patterns have changed over this period to adjust to population growth, economic trends, legal decisions, and periodic droughts. Many areas that once appeared to have more water than could be used now live with constraints on supply. As a result, communities have invested in new water supplies and instituted conservation measures while farmers have changed to more water-efficient crops. Droughts have helped to define the reliability limits of local water supplies, although the specific quantitative impact of climate change is difficult to isolate from other supply and demand pressures.

We use ground water in many daily activities. Some uses are immediately tangible, such as drawing water from a private well through our home faucets for a drink. Other daily needs employ ground water in less obvious ways such as when we use a product that required water in the manufacturing process. Ground water use patterns vary from state to state based primarily on the availability of surface water and by the type of use.

Ground Water Use:
Top Three - Greatest Total
California, Texas, Nebraska

In 2000, the total water volume (ground and surface water) from fresh and saline sources used was 408,000 million gallons per day (Mgal/d), of which 85 percent was freshwater. Ground water withdrawals amounted to 84,500 Mgal/d, of which 99 percent was freshwater. California used the largest quantity of fresh ground water at 15,200 Mgal/d, nearly twice the amount used by Texas at 8,470 Mgal/d. Nebraska, Arkansas, Florida, Idaho, Kansas, Arizona, Colorado and Mississippi filled out the top 10 states ranked by total ground water use with a combined 35,650 Mgal/d.

Ground Water Use:
Top Three - Irrigation Use
California, Nebraska, Arkansas

Agricultural irrigation accounted for 68 percent of the total freshwater ground water withdrawals (56,885 Mgal/d).

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THE TOP TEN GROUND WATER STATES...*continued from front page*

California, Nebraska, Arkansas, Texas and Idaho accounted for 63 percent of total irrigation water obtained from ground water. Kansas, Arizona, Florida, Colorado and Missouri rounded out the top 10 states. Application rates range between 1 and 2 acre-feet per acre for states that utilize ground water from the High Plains (Ogallala) aquifer (Nebraska, Texas, Kansas, and Oklahoma) or the Mississippi River alluvium (Arkansas, Missouri, Mississippi, and Louisiana) for irrigation. Application rates are much higher and can exceed 5 acre-feet in regions where surface water is combined with flood-irrigation methods (Arizona, Montana, and Idaho).

Public supply refers to water distributed through pipes to at least 25 people or a minimum of 15 connections. Between 1995 and 2000 the growth in the water volume obtained through public water supply ground water sources matched the eight percent growth in the population served by public systems. The largest ground-water withdrawals were in California (257 Mgal/d) and Florida (239 Mgal/d), and combined with Texas and New York, represented 59 percent of the 16,000 Mgal/d of ground water withdrawals by public water systems in 2000. The remaining states in the top 10 are Ohio, Arizona, Washington, New Jersey, Utah and Illinois (131 Mgal/d).

Ground Water Use:
Top Three – Public Supply
California, Florida, Texas

Domestic water use is water used for indoor and outdoor household purpose. The source of domestic water is (98 percent) ground water obtained with a private well. Fifteen percent of the United States population relies on wells for their household activities. Water use from private wells between 1995 and 2000 is estimated to have risen by 6 percent and the population on private wells by only 2 percent. The USGS estimates that a total of 3,590 Mgal/d was used for domestic needs in 2000. The top ten states for domestic water use from ground water account for 1,689 Mgal/d and include in decreasing order California, Michigan, Florida, North Carolina, New York, Illinois, Virginia, Ohio, Pennsylvania and Texas.

Ground Water Use:
Top Three – Domestic Total
California, Michigan, Florida

For the first time in 30 years, the US Census Bureau did not collect information on domestic water sources during the 2000 census. Based on 1990 data, the top ten states for well ownership are Maine (42 %), New Hampshire, Vermont, Texas, New York, Nebraska, Michigan, Idaho, Minnesota and Indiana (25 %). The states with the largest total number of wells also have some of the largest populations and large regions of rural character with minimal development that cannot be served economically by centralized public water utilities. Michigan has the largest number of wells (1,121,000) followed by Pennsylvania, North Carolina, New York, Florida, Ohio, Wisconsin, Texas, Indiana and Virginia (539,000).

Ground Water Use:
Top Three – Well Ownership
Maine, New Hampshire, Vermont

Ground water obtained through private wells will always bean important component of water supply delivery in America and the world. The cost to develop and maintain infrastructure for public supplies is frequently prohibitive in all but densely populated areas. Individual private wells can access ground water economically and sustainably by using sanitary well construction methods, efficient pumps and withdrawal patterns that do not exceed the safe yield of the recharge to the aquifers.

Ground Water Use:
Top Three – Total Private Wells
Michigan, Pennsylvania, North Carolina

VIRUS AND BACTERIA—WHAT ARE THE DIFFERENCES?...*continued from back page*

and are known as bacteriophages (“eater of bacteria”).

There are no convenient standard water tests to identify viruses in water samples, such as exist for coli form bacteria. The isolation and identification of viruses is difficult and usually requires a large water sample on the order of 50 or more gallons that is analyzed with special techniques. These identification methods are not able to detect all viruses. The combined sampling and analytical methods are effective for most viruses less than 75 percent of the time compared to over 90 percent for standard coli form bacteria testing procedures.

Viruses and bacteria may enter a well through similar pathways found in poorly constructed wells that lack adequate casing, grouting and /or a sealed well cap. This common pathway may allow a private well owner to infer that a well is likely free of viruses if the coli form and fecal coli form bacterial tests are negative. It is important for a well owner to test the well water annually for bacteria to monitor for biological contamination. If there are fecal coli form bacteria, then there may also be viruses from a human/ animal waste stream source.

Ups And Downs Of The Water Table

At some depth below ground level any "empty" spaces in the underlying geologic formations are filled with water. Different rocks will have different amounts of "space," with sands and gravels having up to 25% space, and solid rocks such as unweathered granite, having lees than 1% or zero. When wells are drilled, the first strike of water is when the well reaches the water table. After "striking" water, drillers will typically continue a well for a considerable distance further down in the saturated rocks because they know that water table levels can rise and fall. When the well is finished, the water level in the well will usually be at the same level as the surrounding water table.

When rain or snowmelt soaks down to the water table, the table level will rise. If there is no recharge, then the water table will slowly fall because ground water is constantly moving towards rivers and springs. When wells are drilled into saturated rocks then pumping will also result in a lowering of the water table as water is pumped out. At any time, the level of the water table in a particular location is a balance among recharge, natural discharge and pumping.

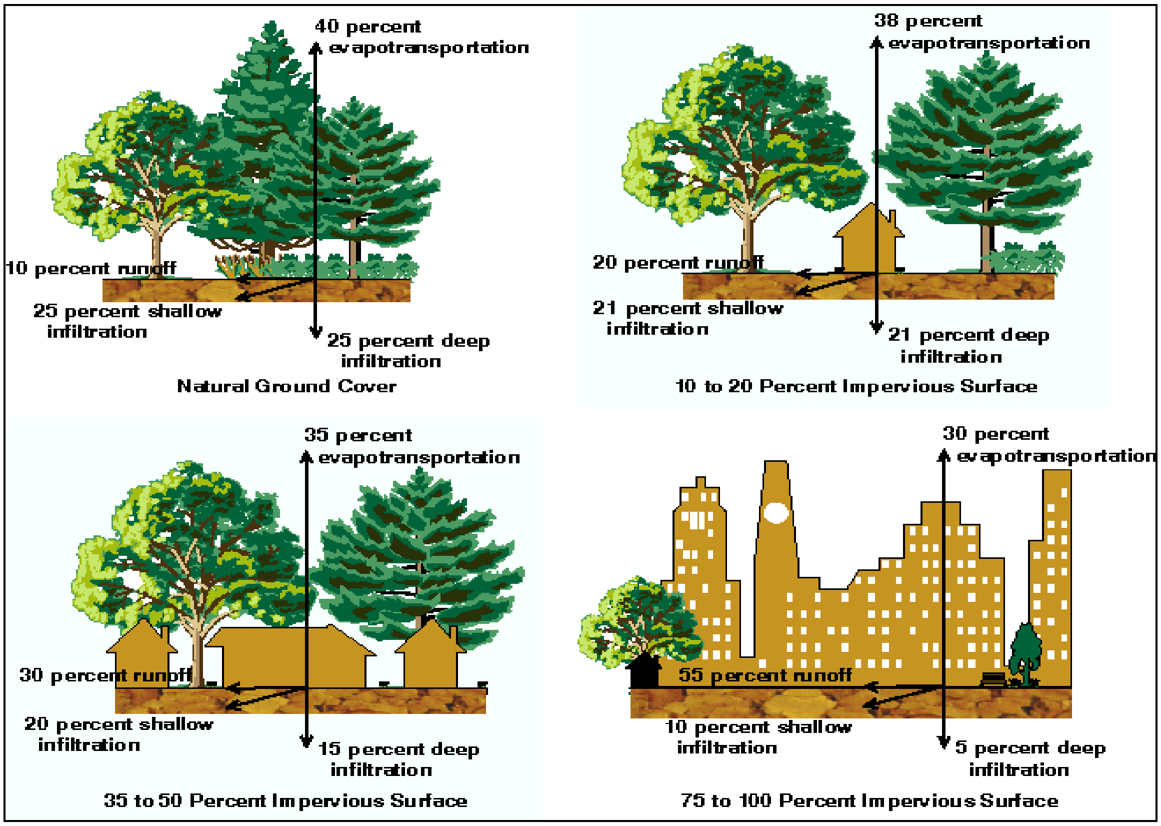


Figure Credit: USGS

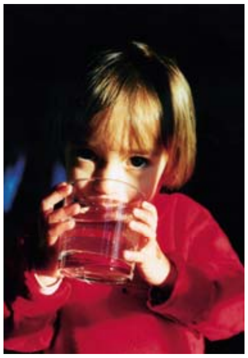
The rate of change in the level of a water table is very strongly influenced by the amount of space available in the rocks. For example, for the same amount of either recharge or pumping, the water table in rocks with 5% of space filled with water will rise and fall four times the vertical height of a water table in rocks with 20% of space.

Most places experience seasonal changes in water table levels because of peak months of rain or snow and because trees, bushes and grass use water in the growing season that would otherwise raise the water table level. In suburban areas, pavement and roofs can reduce ground water recharge, and additional wells can also help to lower water tables.

One of the challenges in calculating how much ground water is available for use is to work out if changes in water table levels are related to natural causes or to pumping and land use changes.

Plotting graphs of water table levels over a long period of time can be very useful for predicting future water levels. All well owners should keep records of information for their wells, and at any time a well is serviced, or the well cap needs to be removed, the contractor should be asked to measure the depth to the water table.

[In some areas, the water in a well may be under artesian pressure and the water level could be higher than the level where the driller first struck the water.] Whether a well's water level is at the water table or at an artesian level, keeping records of the date and the water level can really be helpful for estimating long-term reliability of supply.



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AMERICAN GROUND WATER TRUST
16 Centre Street, Concord, New Hampshire 03301

TOPICS IN UPCOMING ISSUES

- Sinkholes
- Salt Water Intrusion
- What Makes Water Corrosive?

VIRUSES AND BACTERIA – WHAT ARE THE DIFFERENCES ?

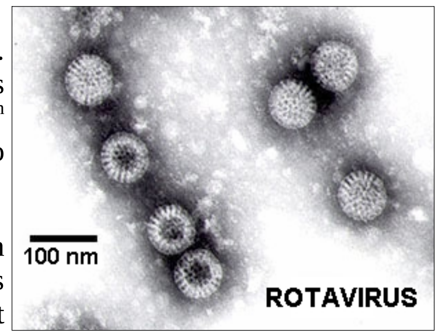

Photo credit: F.P. Williams of the US. EPA.

Viruses and bacteria are both words that bring to mind discomfort and disease. Both entities can be transported in water and can make us sick. Diseases related to bacteria and viruses were described in history as early as the 10th century and medical practitioners as far back as the 13th century began to postulate that an "invisible" organism was the cause of disease and decay.

We know today that bacteria are one-celled organisms that reproduce through cell division (binary fission), and produce and store energy using enzymes contained within their own structure. Viruses are not "cells" and are not classified as living organisms because they must rely on a host to reproduce or to create energy to live. Viruses have extremely simple structures that include a protective outer shell made of protein (the capsid) that surrounds the viruses' nucleic acid (either ribonucleic acid [RNA] or deoxyribonucleic acid [DNA], but not both). A tail may attach to the 20-sided polygon shaped capsid giving the virus the appearance of an angular light bulb. Some viruses are rod-shaped, wheel-shaped or spherical and do not contain a capsid.

Viruses are the smallest life forms known ranging between 20 to 400 nanometers (nm) in longest dimension (One nanometer is one-billionth of a meter). It would take 1.3 million of the smallest viruses laid end-to-end to make one inch. The smallest bacteria are 100 nanometers, but most are over 2,000 nanometers and may be as large as 13,000 nanometers (13 microns). Viruses are too small to be removed by filtration.

Bacteria may live on their own without a host, but viruses are parasites. Viruses must invade and live in host cells of plants, animals or bacteria and subjugate the cell's life-sustaining mechanisms to create food (synthesize proteins) and reproduce (manipulate RNA and DNA). Many viruses attack bacteria as a specialty

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