THE AMERICAN WELL OWNER

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

A Quarterly Publication for Well Owners - 2003 Number 2

Perchlorate In Ground Water

MESSAGE FROM THE PUBLISHER

Think About Well Yield

Well yield is what the geologic formation can provide on a sustainable basis. The Endangered Species Act information in this issue shows the potential dangers of pumping too much water from high yield wells. The hydrofracturing article explains a technique used to improve well yield.

Yield, or flow, is typically measured in gallons per minute. Well yield can't be estimated by simply timing how long it takes to fill a pail from an installed water system. Yield tests need to be run for several hours with simultaneous measurements of changes in the well's water level.

For homeowners, the daily household need is for between 70 and 100 gallons a day per person. For a family of four, this works out at a required well yield of about a quart of water per minute over a 24-hour period. However to meet peak home demand for showers, laundry and dishwasher, the water system may have to deliver 5 gallons a minute or more. Many wells with a low (geologic) yield when drilled, say ½ gallon a minute, are able to produce 5 gallons a minute for peak demand because of the large volume of water already stored in the well. There are 1½ gallons for every foot in a six inch diameter well. A 200 foot well may store 300 gallons. If seasonal lawn watering via an irrigation system is added to the demands on a well system, then a quart a minute is not likely to be an adequate well yield.

For more well information about wells visit Ground Water Info on the Trust's web-site at www.agwt.org. All well owners have a vested interest in water conservation and resource protection.

Andrew W. Stone
American Ground Water Trust

The word perchlorate is heard frequently in the news. While unlikely to be a problem for the vast majority of well owners, the perchlorate story can serve as a reminder about the importance of understanding the origin and flow pathways of well water. Safe ground water from a well is a great asset for a home. Contamination of any kind is not good for the economy or the environment. If we knew back in the 40's and 50's what we know now about contamination and health risks, would we have put more control on our manufacturing industries?

What is it?

Perchlorate (ClO_4^-), is a manufactured chemical used as the main ingredient of rocket fuel, safety flares, matches and fireworks. It is also used in some batteries, and vehicle air bags. It is very mobile in ground water and surface water systems and can persist for many decades. Perchlorate travels with water and unlike some contaminants, doesn't stick to surfaces within the soil or aquifers. Perchlorate contamination of ground water only became widely known in the late 1990's when new laboratory techniques lowered the detection limit in water from 400 to 4 micrograms/liter.

What are the health effects?

The principal health concern is that if perchlorate gets into drinking water it could damage the thyroid gland, which controls growth, development and metabolism. Perchlorate interferes with iodide uptake into the thyroid gland, and because iodide is an essential component of thyroid hormones, it disrupts how the thyroid functions. Impairment of a woman's thyroid function during pregnancy may impact the baby and result in delayed development and decreased learning capability. Changes in thyroid

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Helping communities, residents, businesses and farms that use water wells maintain safe, reliable, cost-effective water supplies and ensure a sustainable local environment.

hormone levels may also result in thyroid gland tumors. Determining the threshold levels of ingested perchlorate needed to inhibit the uptake of iodide, is the subject of ongoing medical research.

Where is it?

Forty-two states have known manufacturers or users of perchlorate. (See map)

Perchlorate Manufacturers and Users in the US

Source: http//www.clu-in.org/download/contaminantfocus/perchlorate/usmfg_titleless.pdf

Perchlorate is known to have contaminated drinking water wells in 22 states. The principal problems exist around military bases, or former bases, where rocket fuel was stored or used. In 2000 the California Department of Health Services reported perchlorate in 44 public drinking water systems, 23 of them at levels greater than 18 micrograms/liter. The San Martin area of Santa Clara County, California has a 7-mile-long plume of perchlorate-contaminated water that has affected over 200 private wells. This particular contamination is believed to be related to the manufacture of road flares.

A study by the Environmental Working Group revealed high levels of perchlorate in some winter lettuce irrigated by Colorado River water, with some lettuces containing more than 30 micrograms/L of perchlorate. The source of perchlorate was found to be Lake Mead, which was being polluted by flows from an industrial complex near Las Vegas, Nevada, that manufactured perchlorate as a rocket fuel ingredient. (See http://www.ewg.org/reports/rocketlettuce for more information)

How is perchlorate removed from water?

Several types of point-of-use or point-of-entry treatment systems for homes, including exchange resins, reverse osmosis and distillation, can reduce perchlorate concentrations in well water. Some ion exchange resins remove all other anions before binding perchlorate, resulting in corrosive water that may need to have some hardness restored. Because perchlorate binds tightly to resins, high salt concentrations may be necessary for resin regeneration. Brine disposal could then be a problem because the perchlorate is concentrated and not destroyed.

For contaminated site clean up, many different technologies are under development, including biological treatment and large-scale ion (anion) exchange systems. Biological processes (bioremediation) may be the most cost efficient, and research continues with bioreactor treatment systems and with below ground in-situ treatment involving trenches filled with bio-barriers of organic material.

What Is Being Done about Perchlorate?

The United States EPA has set a preliminary safety level of 1 microgram/L for perchlorate and is continuing to assess health risks to assist with future rulemaking. Federal drinking water regulations for perchlorate could take several years to develop. The EPA is developing a national database by monitoring perchlorate in utility source water. California is currently working on a state standard of 2 to 6 micrograms/L for water utility supply. Other states are beginning to address the perchlorate issue and are setting their own standards. Assessing the problem, and finding site-by-site solutions, is likely to be an issue for many years to come.

For more information about perchlorate, visit the EPA website: http://www.clu-in.org/ (search for contaminant, then perchlorate).

HYDROFRACTURE OF WELLS

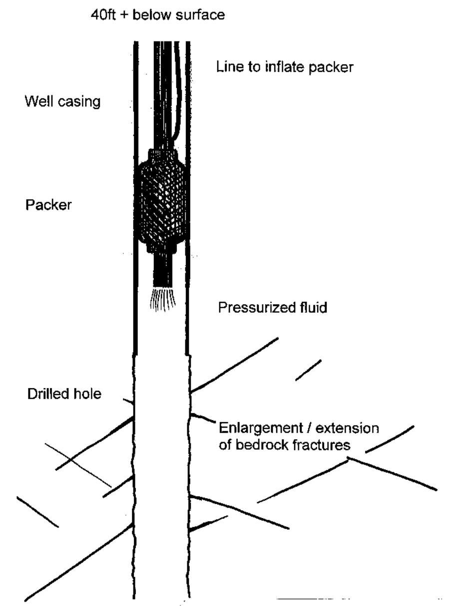
What is it?

Hydrofracturing (or hydrofracking) is a process that may be used to increase the flow of water into a well. It is usually applied to low yielding wells. There are many instances of hydrofracturing resulting in increased yield for homeowners. The process can take place at the time a new well is constructed or it can be used at any time on an existing well with low or declining yield. It is only suitable for wells receiving their water from water moving through fractures and fissures in bedrock. The technique involves injecting high-pressure water via the drilled well into the rock formations surrounding it. Hydrofracturing may widen fractures in the bedrockand extend them further into the formation and so increase the network of water bearing fractures/ fissures supplying water to the well. Hydrofracturing was originally developed to increase oil and gas well production and has now been adopted as a technique by the water well industry. In most states, hydrofracturing work can only be undertaken by a licensed or registered water well contractor

How does it work?

The procedure involves lowering down the well one or two inflatable hard rubber "sleeves" or "balloons" (packers as they are more correctly called). First, all pipes, wires and the pump need to be removed from the well. The packers are then inflated to seal off a section of the well. The packers are usually set a minimum of 20 feet below the end of the casing and 60 feet below ground surface. Water is pumped at high pressure into the section of the well between the packers, or below the packer if only one is used. Most hydrofracturing equipment for private wells can provide between 500 and 2000 psi pressure, sometimes up to 3,000 psi (pounds per square inch). Up to 50 gallons a minute is usually adequate as a pumping rate for adding water into the well. Some states have specific regulations relating to the hydrofracturing process.

Hydrofracturing – Inflatable Packer



The water pressure within the sealed-off section of the well will rise as the surrounding rocks resist the flow of water out of the well. A sign of successful hydrofracturing is a sudden drop in the pressure indicating that the surrounding rocks are accepting water. If more fissures have been opened there is often a strong backflow of turbid water when pumping into the well is stopped. If however, during the hydrofracturing process the pressure in the well increases to the maximum working pressure of the equipment, with no sudden drop in pressure, then the hydrofracturing procedure may not have been effective.

The cost for single packer hydrofracturing is usually less than when a double packer system is used. A double system allows for a selected zone in the well to pressured by inflating both packers. The packers are usually first set near the bottom of the well and then moved up to another section. Selection of the zones to pressurize may be made from information on the well drillers log or from a down-hole camera survey. Although not often used, some contractors may use proppants (small beads or sand grains) to keep open (prop) fractures & cracks in the rock.

Points for a well owner to note about the hydrofracturing process

There may be permit and reporting requirements for hydrofracturing. Well contractors who specialize in hydrofracturing services will know whether "paperwork" is required. In order to assess the effectiveness of the hydrofracturing process the contractor will usually perform a "before & after" test of the well yield. There is the potential for the hydrofracturing process to temporarily influence water levels or turbidity in a close-by neighboring well if the two wells share some of the same fractures. There have been instances where packers set too close to the surface have caused a breakout of water above ground.

The contractor should use high quality water (and/ or water pumped in advance from the well to be pressurized) for the hydrofracturing process to avoid introducing any contaminants into the aquifer. After hydrofracturing, the contractor will normally purge the well of fine material but there could be some cloudiness in the water for a few days. The use of high-pressure equipment is potentially dangerous and homeowners should stay away from the wellhead when the hydrofracturing equipment is pressurized. It is normal practice to sanitize a well after any maintenance or well development work. You may have to wait 24 hours before the well can be put back into use.

The beneficial effects of hydrofracturing should be permanent, and usually achieve a satisfactory water yield for less cost than drilling a new well. With more and more well contractors possessing the equipment necessary for hydrofracture, the process is becoming routine for areas where there are typically low yielding wells in bedrock.

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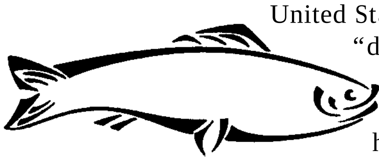
AMERICAN GROUND WATER TRUST
16 Centre Street, Concord, New Hampshire 03301

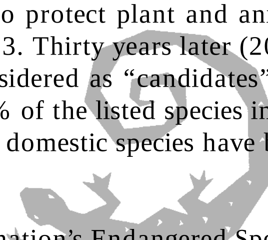
TOPICS IN UPCOMING ISSUES

- **River-flow & Ground Water**
- **"Acid Rain" and Ground Water pH**
- **Water Conservation – Who Benefits?**

ENDANGERED SPECIES ACT

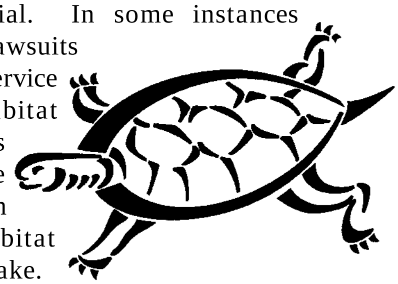
Did you know that the Endangered Species Act (EDA) was adopted in 1973 as a law to protect plant and animal species believed to be on the brink of extinction? There were 109 species listed in 1973. Thirty years later (2003) there are more than 1,200 Endangered Species on the list, with 250 additional species considered as "candidates" for listing and nearly 4,000 species designated as "species of concern." Some 306 species (25% of the listed species in the United States) have designated critical habitat. Since 1973 only 25 domestic species have been "de-listed" or removed from the Endangered Species list.





What has this got to do will water wells? Many of the nation's Endangered Species have an aquatic habitat. The hydrologic system is integrated so that rivers, lakes, wetlands and ground water are often closely interconnected. Just as humans are sensitive to deterioration of water quality and overuse of resources, so too are aquatic animals and plants sensitive to contamination and to changes in the hydrology of their habitats. Over-pumping of ground water, and any type of environmental degradation not only can have detrimental effects for human water users but can, (and does) impact plant and animal species.

Actions that threaten habitat of endangered species may carry strong penalties. The EDA has had a major impact on construction and economic development and its implementation continues to be controversial. In some instances environmental groups bring lawsuits to force the Fish & Wildlife Service to designate critical habitat designation. The Service is also faced (principally by the private sector) with litigation challenging the critical habitat determinations that it does make.



Cause and effect related to land use changes can have impacts throughout the hydrologic system. If you are proposing new development related to water wells or waste water disposal – it might be a good idea to check that you won't be impacting some little critter or flower that is listed as Endangered.

For more information about the EDA visit
http://endangered.fws.gov/

Published by: **AMERICAN GROUND WATER TRUST**
P.O. Box 1796, 16 Centre Street
Concord, New Hampshire 03301

Telephone: **(603) 228-5444**
Fax: **(603) 228-6557**
Consumer Line: **(800) 423-7748**
E-Mail: **TrustInfo@agwt.org**
Web Site: **http://www.agwt.org**

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