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Ground Water and the Rural Homeowner

Water-Level Rises

The opposite problem, namely a rising water table, has developed in some parts of the country. Rising water tables occur in areas where pumpage has been curtailed after years of large ground-water withdrawals, such as for mine dewatering or municipal water supply, which kept the water table below its natural levels. The curtailment of pumping allows the water table to rise to the previous natural level, which may flood underground structures that were built when the water table was lowered.

In many parts of the country, water levels in shallow aquifers have been lowered artificially over large areas. If houses are constructed in dewatered areas and if the water table then recovers to its natural (higher) level, basement flooding or foundation failures may occur, especially where the natural water level is within 10 feet of the land surface. Many basements that were built in a dry unconsolidated material and that had remained dry for decades have now become permanently wet. The public's first reaction may be that unusually heavy precipitation in the past few months has raised the water table or created a temporary perched-water system, when in fact the situation is much more serious and will remain a problem unless pumping is resumed to maintain a lower water table.

Where water levels are closely monitored, water-level records can indicate whether such high water levels are related solely to climatic events or whether water levels are recovering after nearby pumping has ceased. An increasing number of local areas are being dewatered for mining or industrial uses, which could cause serious problems in the future when such pumpage is decreased or ended.

Similar situations have occurred where housing developments were built during a period of extended drought when the water table was low. Even if basements were the "daylight" or raised type because the natural water table was shallow, the eventual return of a wet period caused the water table to rise a few feet and flood basements.

Quality of Water

Some common ground-water quality concerns are excessive hardness (high dissolved magnesium and calcium content), a high concentration of salt or iron, or the presence of hydrogen sulfide (sulfur), methane gas, petroleum or organic compounds, or bacteria. Some are naturally occurring; others are introduced by human activities. In many areas, the homeowner has little recourse other than to use chemical treatment to remove or reduce the level of these constituents or to abandon the water supply. Hardness, iron, and sulfur are common constituents that can be treated.

Salt contamination

Salt contamination is difficult and expensive to remedy unless the well drawing saline water from a deep aquifer also penetrates one or more freshwater aquifers at lesser depth. In such cases, the deep saline aquifer can be sealed off and the well can be drilled in the freshwater aquifer instead. In many parts of the country, however, when a well is drilled deeper into bedrock to obtain larger supplies, saline water is more likely encountered than additional freshwater is.

Road-salt contamination of ground water has increased in the last 30 years and is of major concern in northern areas. Highway departments mix salt with sand to spread on roads for deicing. Salt is readily soluble in water and runs off highways into lakes and streams and percolates to the water table.

Probably more serious than the spreading is the stockpiling of uncovered salt and sand mixtures. This practice produces concentrated saltwater runoff that percolates to underlying aquifers and nearby wells. Many stockpiles are within small villages or near housing areas where nearby domestic wells can become contaminated.

Leachate from sand and salt stockpiles is a potential source of contamination to shallow ground water.

Oil spills

Another chronic problem in many rural homes is leaking or spilled fuel oil which eventually contaminates the owner's own well. Many homes have a fuel tank, either buried or above ground, adjacent to the house and within a few feet of the well. Spills or accumulated leakage eventually can migrate to the aquifer and can be drawn into the well, making it unusable for years. Usually the only solution is to obtain a new water source. In some instances, however, reducing the pumping rate to reduce drawdown allows the oil to float on the water surface safely above the well's intake area.

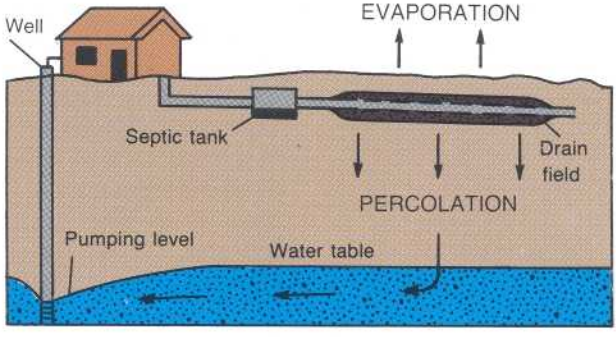
Methane gas

Perhaps the problem that poses the greatest hazard to a well owner is flammable gas in the well. Small volumes of natural gas, usually methane, can be carried along with the water into wells tapping carbonate or shale rock. In some areas, the gas dissipates soon after installation of the well, but, in other areas, a large continual source of natural gas remains. Because methane is flammable and cannot be detected by smell, precautions are needed to prevent explosions and fire. Venting of the well

head to the open air is the simplest precaution but, because gas can also accumulate in pump enclosures, pressure tanks, and basements, other venting may be needed. For this reason, a home should never be built over a well.

Bacteria

The most common water-quality problem in rural water supplies is bacterial contamination from septic-tank effluent. A recent nationwide survey by the U.S. Environmental Protection Agency and Cornell University found that contamination of drinking water by septic effluent may be one of the foremost water-quality problems in the Nation.



How septic effluent percolates to the water table.

Barnyard runoff

Probably the second most serious water-contamination problem in rural farm homes is from barnyard waste. If the barnyard is upslope from the well, barnyard waste that infiltrates to the aquifer may reach the well. Pumping, too, can cause migration of contaminants to the well. On many farmsteads built more than 100 years ago, the builders were careful to place the supply well upslope from the barnyard. Unfortunately, many present-day owners have not remembered this basic principle and have constructed a new house and well downslope of the barnyard.

Barnyard upslope from farmhouse well may cause bacterial contamination of water supply. *(Photograph courtesy Cornell University.)*

Pesticides and fertilizers

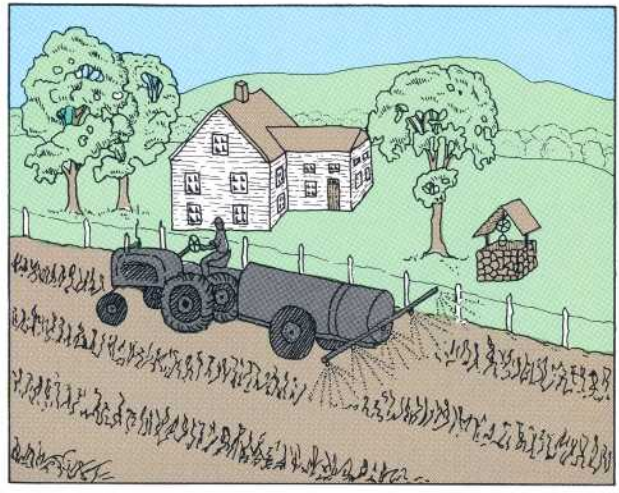
The last 3 decades have seen a significant increase in small part-time farms and rural dwellings as large farms have been sold and divided into smaller units. Many modern rural homes are constructed on former cropland on which heavy applications of herbicides and fertilizers may have been made. How these chemicals move

New home on land recently used for crops.

through the soil and ground water and how quickly they decompose or how their harmful effects are neutralized is not well understood.

Also common is the farming practice of applying fertilizers and pesticides to croplands immediately adjacent to the barnyard or farmyard. Residue from these applications can infiltrate to the aquifer and can be drawn into a supply well for the barn or the house. Decreasing the use of fertilizers and pesticides in the vicinity of wells can help minimize this problem.

Homeowners also should be careful to properly dispose of wastewater from used containers of toxic chemicals. Many farms have their own disposal sites, commonly pits or a wooded area, for garbage and the boxes, sacks, bottles, cans, and drums that contained chemicals. Unfortunately, these owner disposal sites can contaminate farm water supplies.



Pesticide spraying near well.

Septic Systems and Ground Water

The liquid effluent from a septic system follows the same path as the rain or snowmelt that percolates into the unsaturated zone. Like the rain, once the effluent reaches the water table, it flows down the hydraulic gradient, which may be roughly parallel to the slope of the land, to lower points. Thus, again, the location of one's house in relation to neighboring houses, both upslope and downslope, is important.

Septic-tank effluent that enters the aquifer supplying the homeowner's well introduces not only bacteria but also other contaminants. Many rural homeowners also discharge other waste products, including toxic material, into their septic systems, and these products gradually accumulate in the aquifer. What happens to these contaminants in the ground is not well known. Some adhere to rock material, others travel with the water. In some types of rock material, the leach field or dry-well part of the septic system can gradually become clogged by contaminants.

Rural homes in small, older communities and in more recent roadside housing developments are commonly situated on small or narrow lots along an access highway. Most do not have a

Rural roadside housing development.

community water supply, and almost all have their own individual septic systems. In clusters such as this, effluent recycling can occur if the wells are shallow or the septic systems are improperly placed. Deep wells are less likely to draw in septic waste.

This type of effluent problem becomes acute in an area underlain by a shallow water-table aquifer where the septic effluent discharges into water that is used by many homeowners. This dilemma has been posed in many rural housing developments throughout the Nation. One either "fouls his own nest" with effluent or connects to a central sewer system. Although a sewer system protects the aquifer from further contamination, it reduces recharge of water to the aquifer. This engineering, economic, and social dilemma must be resolved soon in many areas. An increasing number of counties and townships are planning and zoning rural areas to limit the density of houses according to soil conditions. Other approaches being considered are a community water supply with individual septic systems or individual water supplies with a community sewer system.

Some banks and lenders require that the prospective buyer or the seller furnish proof of a bacteria-free water supply before they will issue a mortgage. When a seller faces such a requirement, a common procedure is to chlorinate the water to destroy the bacteria in the well. This treatment affects only the well and perhaps a volume of the aquifer immediately adjacent to the well, but for only a brief time. If the contamination is in the aquifer, the source will not be attacked nor the problem solved; thus a water analysis showing bacteria-free water immediately after the well has been disinfected is not necessarily an assurance of a safe water supply. The homeowner should periodically have the water analyzed for bacteria. If a high bacteria count occurs repeatedly, the problem is probably in the water source, and chemical treatment of the well alone cannot solve it.

In a bacteria-contaminated water system, chlorination of the water pumped from the well is commonly recommended as a solution. Other-

wise, one must obtain a water supply from a new well that either is upgradient from the contaminating source or that taps a deeper aquifer. Moving the septic system to a more distant spot is a long-term solution, but the underlying contaminated zone may take years to stop releasing contaminants to the aquifer.

Cluster-housing contamination

In a row-housing setting, the house at the highest location will generally have the safer water supply. Because the effluent migrates down beneath the development, it could be pumped, used, and again discharged by each house along its course. The house furthest downslope would receive the combined effluent from the other houses.

Another contamination problem from closely spaced septic systems can occur where a row of houses on the uphill side of a road faces a row of houses on the downhill side of the road. Here, the safer water supply would be on the uphill side. The downhill side would receive effluent from the uphill side plus any contamination generated along the road, such as road salt or metal compounds. In flat areas underlain by a shallow water table, especially where cluster developments are two or more decades old, almost perpetual recycling of septic waste may occur.

Another source of contamination that is common in villages or hamlets lacking a central water or sewage system is small waste-generating businesses such as laundries, auto-repair shops, and industries that discharge wastes to their own septic systems. Many of the bacterial problems, cited in a recent U.S. Environmental Protection Agency rural water study, were in hamlets, villages, or crossroads communities. Once indoor plumbing became common and outdoor privies were removed, all waste went into septic systems from which increased amounts of liquid effluent eventually entered the aquifer and became subject to pumping by wells.

Unknown Hazards Beneath the Land

Previous land uses, some of which may be unknown to the present landowner, can have long-lasting effects on the land and on underlying aquifers.

Hidden dump site may contain chemical-waste containers.

Former chemical dump sites

Many sites where commercial and industrial wastes are buried have been abandoned and have been covered with soil or have become revegetated. In many such areas, individual homes or entire housing developments have been built without proper consideration of the buried waste. (The tragedy of Love Canal, near Niagara Falls, N.Y., is an unfortunate example of construction over concealed waste.) A prospective land buyer, home builder, or buyer of a recently built rural home should inquire of local agencies about the former use of the land.

Abandoned wells

Although still relatively rare, waste sites can be abandoned wells that are now used for disposal of wastes, commonly oil or laundry wastes. Many garages and repair shops have used abandoned drilled wells for disposal of waste oil, and laundries have used abandoned dug wells for disposal of laundry wastes to prevent clogging of their septic systems. These practices point to an area where concern for ground-water protection should be considered more carefully. Abandoned wells should be filled and sealed properly to eliminate the danger of someone falling into the well or having the shaft collapse, as well as to remove the temptation to use them for disposal of hazardous wastes.

Former orchards or vegetable lands

Individual homes and developments alike have been built on former orchards or vegetable farms. Although these lands can be picturesque where fruit trees remain, one must remember that pesticides and chemical fertilizers probably were applied heavily in the past. The fate of many of these chemicals in the soil is unknown, and long-term contamination may remain, especially in the shallow ground water. The soil through which recharge from precipitation moves is the repository for much of the chemicals that are deposited on the land. Decades may pass before these chemicals are dissipated or flushed away. Therefore, anyone planning to buy or build a house on a former orchard or truck farm should consult farm or zoning agencies to obtain information on the potential for pesticide and fertilizer residue.

Crop dusting and orchard spraying. *(Photographs courtesy Cornell University.)*

Oil and gas fields

Oil and gas development has occurred and is occurring in many parts of the country. Oil and gas development almost always includes the production of brine or saline water, which then must be disposed of. Most states regulate the disposal of brine to prevent contamination of surface and ground water, but, in old oil and gas fields that were abandoned before extensive regulation, saline water is still escaping from improperly sealed or cased wells into freshwater aquifers.

One method of producing more oil or gas from old fields is to inject water or brine into the producing formation to increase the pressure and move the oil or gas to wells. Some oil or gas fields are "leaking," however, and once the pressure is increased, the injected fluid or oil finds avenues of escape to other formations, such as through abandoned boreholes or corroded well casings. Some shallow producing areas that contain many abandoned wells spaced a few hundred feet apart have created an unmanageable leakage problem. Every old abandoned oil or gas well that is not cemented-in may provide an avenue for saline water, oil, or gas to escape into the nearest aquifer and contaminate the system. It would be wise to verify that the home being purchased is not near an old oil or gas field.

Subsidence and sinkholes

Land subsidence occurs where large amounts of ground water have been withdrawn from a thick layer of saturated fine-grained sediment that is susceptible to compaction. General subsidence is not noticeable in some large areas, but in others, concentric cracks develop over smaller areas where compaction is occurring.

Sinkholes are common where the land is underlain by limestone or other carbonate rocks that are naturally dissolved through ground-water circulation. A sinkhole can also develop where salt beds occur beneath the land surface. As the limestone or salt is dissolved naturally by ground water or by industrial solution-mining of the salt, the overlying material can collapse into the resulting cavern. In worst cases, such collapses create a large sinkhole that will topple or swallow any structure above it. Housing development should be avoided in sinkhole-prone areas. Although it is difficult for an individual to discern the exact locations of potential sinkholes, areas prone to sinkhole development are generally well known by State geological surveys.

Sinking land ruins croplands.

Sinkholes develop suddenly.

Consider Past and Future Land Use

The preceding section highlighted some of the contamination hazards that may be attributed to previous land uses. One way to obtain information on previous land use is to contact local county or town planning or zoning boards. Their records may show that land was formerly used for agriculture, landfill, or industrial/mining purposes. Land owners can then better evalute what past land-use practices should be considered in planning future land use.

Similarly, land-use or zoning maps can show where planners have designated uses that may be considered detrimental to home ownership. Many planning agencies have evaluated and classified the land for preferred and alternate uses. Consult these local agencies before building or buying in specific areas.

Country Living Calls for Knowledge

Before purchasing a home in a rural area, the buyer should determine the amount and quality of water and should locate the waste-disposal system.

A well log and a water analysis may be as important as a deed

As ground water receives increasing attention nationwide, particularly because of toxic-chemical contamination, a written legal document verifying an adequate water supply from new or old wells is becoming important. Some mortgage lenders require a negative bacterial analysis of the water and a yield test of the well to verify an adequate supply. As mentioned earlier, a single analysis for bacteria may not reflect true conditions, but it is worthwhile to have it done nevertheless.

A well record (driller's log) describes the well characteristics, including yield and the type of material that the driller encountered. The well log is not always available from the owner, and sometimes the driller who installed the well cannot be located. If the well log is available, however, it can be helpful. If water quantity becomes insufficient, a record of a yield test is helpful in determining what happened. Most dug wells, of course, have no description other than depth. In any case, it is wise to obtain information on well depth, water level, type of pump, pump-intake setting, and yield before buying a house.

Determine the location of the septic system and water source

The buyer of rural property must know the location of the water source and the waste-disposal system to evaluate the potential for certain problems. Even a cursory glance at their location, distance from each other, and the land slope often provides an initial estimate as to their adequacy. For example, evidence of two or more wells or septic systems warrants a detailed inquiry. An odor of sewage, a wet area, or lush grass over a leach field, especially during dry periods, indicates a potential problem.

Some Practical Considerations

As stated earlier, learn as much as you can about the land, the water supply, and the septic system of the house before you buy. Be sure to consider the environmental conditions, and try also to visit the site during bad weather. Don't be rushed—take time to be informed.

Most rural water problems are related to old dug wells, septic systems, and too-dense housing developments. Drilled or deep wells are generally less susceptible to sewage or surface-contamination sources than shallow wells are, but water from bedrock wells is more likely to contain gas or minerals than is water from shallow deposits. Most well drillers are aware of common local problems and generally locate wells properly.

Although potential water problems for the rural homeowner can sometimes be expensive, pose a health hazard, or possibly affect real estate values, these problems can be avoided by the observant, informed buyer or owner.

Table 1. Water factors to consider in buying or building a new home

Problem	Probable cause	Remedy or source of help
Inadequate water yield	Poor aquifer	Install larger, deeper well
	Well screen or pump intake encrusted	Have cleaned by well driller
	Lower water level	Deepen well Contact water resources agency
Wet basement	Seasonally high water table	Add sump pump or drains
	Recovered water level	Add sump pump or drains
	Drainage from roof or slope	Add roof gutter, reslope land Contact Soil Conservation Service
Gas in water	Methane from bedrock	Install vent on well head Aerate the water Install water treatment Drill new well away from house Contact State geological survey
Salty water	Road salting	Install new well farther upslope Provide better road drainage
	Road-salt stockpile	Install new well away from drainage Request correction by highway department Contact health department
Fuel-oil contamination	Leaky or spilled storage tank	Install new well upslope Adjust to low pumping rate
Oil or gasoline contamination	Nearby service station	Obtain new source of water Contact health department
Bacteria contamination	Septic effluent	Chlorinate as first step; contact health department Install new well upslope Install new leach field farther away Deepen well in some cases Seek control on neighboring system
	Barnyard waste	Redirect waste flow Install new well upslope Seek control on neighbor's activity Contact agricultural agency
Organic chemical contamination	Former land use	Install new well farther away Deepen well in some cases Contact health department
	Current land application	Create buffer zone around recharge area Dispose of wash water properly Seek control on neighbor's activity Contact health department
Land Subsidence	Excessive ground-water withdrawal	Contact State regulatory agency
	Rock solution	Relocate house Contact State geological survey
Sinkhole development	Rock solution	Relocate house Contact State geological survey
Source of ground water unknown	No knowledge	Contact water resource agency
	No well data available	Contact water resource agency

Table 2. Sources of information

Geologic conditions and mining areas
State geological surveys
State bureaus of mines
State natural resources agencies
U.S. Geological Survey
Soils, drainage, and agricultural uses
U.S. Department of Agriculture
State land-grant colleges
County extension agents
Topography
U.S. Geological Survey
Ground-water resources and water testing
State natural resources or environmental departments
State water resources departments
County health departments
U.S. Geological Survey
National Water Well Association
Water-supply and septic-system construction
State health departments
State environmental or conservation departments
County extension agents
U.S. Environmental Protection Agency
U.S. Department of Agriculture
Land-use and zoning
State planning agencies
County planning and zoning agencies

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