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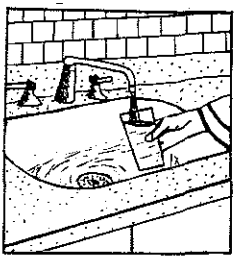
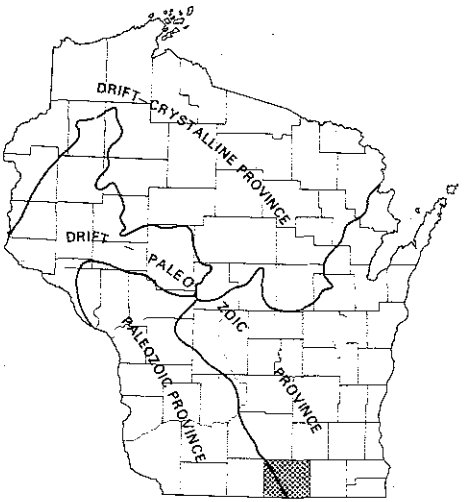


GROUND-WATER QUALITY OF ROCK COUNTY

May 1982

Prepared by Alex Zaporozec



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WHAT YOU SHOULD KNOW ABOUT GROUND WATER AND ITS QUALITY

GROUND WATER AS A RESOURCE IN ROCK COUNTY

There is ground water--more or less of it, more or less accessible, and generally of good quality--everywhere under the county. In 1979, about 99 percent of all water used in Rock County came from ground-water sources, and every day some 28 million gallons of fresh water were withdrawn from underground water-bearing rocks called aquifers. This is about 200 gallons of water for every man, woman, and child in the county, or 0.8 ton of water for each person each day. About one third of this amount was used in households, supplied either by public water systems or by private wells. Another 20 percent each was used for various public uses and industrial purposes. The remaining ground water was withdrawn for commercial purposes, irrigation and stock watering.

HOW GROUND WATER OCCURS AND MOVES

The source of ground water is that part of the precipitation which infiltrates the soil. Ground water is normally hidden from view and, as a consequence, many people have difficulty visualizing its occurrence and movement. Ground water does not occur in underground rivers and lakes and does not migrate thousands of miles through the earth. Generally, ground water withdrawn by pumping in the county also originated within the county boundaries.

Most of the rocks near the earth's surface are comprised of both solids and holes. The solid part is, of course, much more obvious than the holes, but without the holes there would be no ground water to supply wells and springs. Ground water fills these numerous, interconnected small openings (pores or cracks) in rocks and forms aquifers that function both as reservoirs, in which water is in storage, and as pipelines, which transmit water from one point to another. Ground water is constantly moving toward lower-lying places and ultimately discharges into streams and springs, or wells.

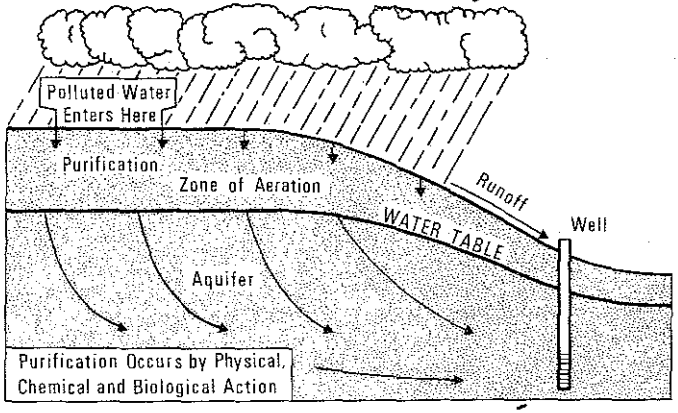
The intricate maze of interconnected openings offers natural frictional resistance to the flow, and therefore, ground water moves through the aquifers only very slowly. Flow is measured in feet per day or feet per year as compared to feet per second in streams. The slow movement of ground water is a significant factor in making ground-water pollution a difficult problem.

GROUND WATER IS CLEAN IN NATURE

The value of ground water as a resource not only depends on its widespread occurrence but also on its generally excellent and consistent quality. The quality of ground water is determined mainly by the character of the earth materials it contacts and by the duration of the contact. When water comes into contact with these materials, it dissolves some minerals.

The dissolved minerals are rarely harmful to health and may give the water a pleasant taste. Moreover, since the subsurface materials act as natural filters to screen out some contaminants, the sanitary quality of ground water exceeds that of surface water.

Water entering the soil at the ground surface may be polluted to some degree, but is naturally purified as it percolates through soil and other fine-grained materials in the zone of aeration (see diagram below).

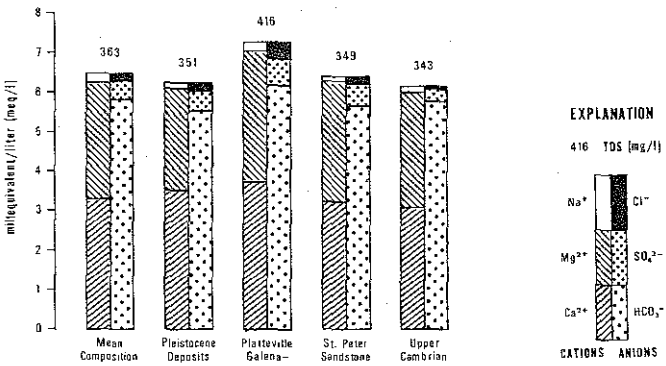


The natural quality of ground water in the county is very good and it is suitable for most uses. In some parts of the county the natural quality of ground water is unfortunately changing as a result of man's activities. However, in contrast to some areas of the nation where ground-water abuses and mismanagement have rendered ground water unfit to drink, the quality of most ground water in the county is much better than the quality required by minimum drinking water standards.

CHEMICAL COMPOSITION OF GROUND WATER

Chemical constituents of ground water originate from solution of earth materials. In the county, ground water primarily moves through glacial deposits and sedimentary rocks containing calcium-magnesium carbonate and consequently, it is slightly alkaline and always very hard. Slow movement of ground water enables it to dissolve more minerals and attain higher concentration than surface water can. The total content of dissolved minerals in the county's ground water is within the recommended limit.

Major dissolved mineral substances in the county's ground water are calcium, magnesium, sodium, iron, manganese, bicarbonate, sulfate, chloride, and nitrate. Of those, calcium, magnesium and bicarbonate form about 93 percent of all dissolved solids in the water, and are responsible for the excessive hardness. The variations in ground-water composition between individual aquifers are only slight (see graph below).



Besides these common constituents, ground water in Rock County may contain a number of additional elements, concentrations of which are at the present time below permissible limits.

COMMON GROUND-WATER QUALITY PROBLEMS

Water in nature is never pure water, and it always contains at least small quantities of dissolved mineral substances. Only a few of these natural "impurities" may cause ground-water quality problems in the county. Among those are calcium and magnesium bicarbonates, which cause excessive hardness, and iron and manganese.

Objectionably high hardness is a common characteristic of ground water everywhere in the county. It results in a scale formation in kettles, boilers, and pipes, and in release of corrosive carbon dioxide. The most commonly noticed effect of hardness is its tendency to prevent soap from lathering and form soap scum. Softening of water is necessary to remove the calcium and magnesium ions from the water.

Because iron compounds are common in rocks, high iron content is a common nuisance in Rock County. Manganese is less abundant in earth materials than iron, and its occurrence in ground water is less common and the concentration is generally much less than that of iron. High concentrations of iron or manganese do not pose any health hazard, but are of considerable concern for aesthetic reasons. Even small amounts can seriously affect the usefulness of water for some domestic and industrial purposes by staining laundry, plumbing fixtures, and cookware.

From the constituents added by the activities of man, bacteria and nitrates are the ones that may commonly cause problems in the county.

Coliform bacteria, which themselves are harmless, are useful indicators of satisfactory quality of ground water. Their presence may indicate the presence of other more harmful microorganisms. If coliform bacteria are found in your well water in numbers, which indicate the supply is unsafe, the water should be chlorinated or boiled before ingestion until further sampling indicates that the water is safe. If the problems persist, your well should be examined by a registered well driller or plumber.

Nitrate is the most common identifiable pollutant in ground water. Its sources are both natural and man-made. Nitrate concentrations in excess of the recommended limit (10 mg/l as NO_3-N) can be found in many places in the county, and almost 27 percent of the 406 wells sampled exceeded this limit. Higher concentrations occur more frequently in rural areas where the pollution potential is higher because of barnyard drainage, animal wastes, use of fertilizers, runoff from agricultural land, and a greater number of septic tanks.

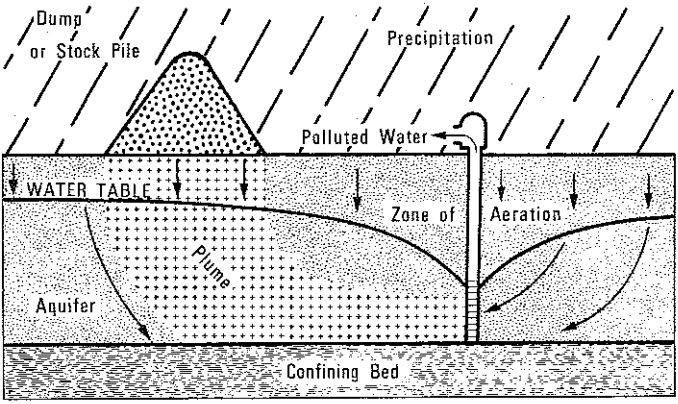
When water with nitrate exceeding 10 mg/l has been discovered, it should not be given to infants under 6 months of age; sometimes these higher concentrations are potentially dangerous to them. Don't boil the water, boiling does not reduce the nitrate level. If you are concerned about the high concentration of nitrate in your well, seek professional advice.

HOW POLLUTANTS TRAVEL UNDERGROUND

Before strategies for dealing with ground-water pollution can be developed, the movement of ground

water and pollutants must be understood. In the subsurface, pollutants travel first downward (within the unsaturated zone), and after reaching the top of a ground-water reservoir (the water table) in the same direction as ground water.

Pollutants in ground water tend to travel in relatively compact and well-defined slugs or "plumes" (see diagram below). The shape and size of a plume depends upon local geology, the ground-water flow, the type and concentration of pollutant, and continuity of its supply. The concentration of pollutants in ground water can be reduced with time and distance traveled.



Several factors influence the transport of pollutants and the rate of reduction of their concentration. The most important is the texture and composition of the earth material, especially the character of the openings through which the polluted water passes. Fine-grained materials filter out bacteria and reduce concentration of some pollutants by ion exchange. Clay and silt in particular are very effective in reducing the concentration of pollutants. Aquifers with large openings, such as coarse sand or gravel and fractured rock, afford little or no reduction in concentration.

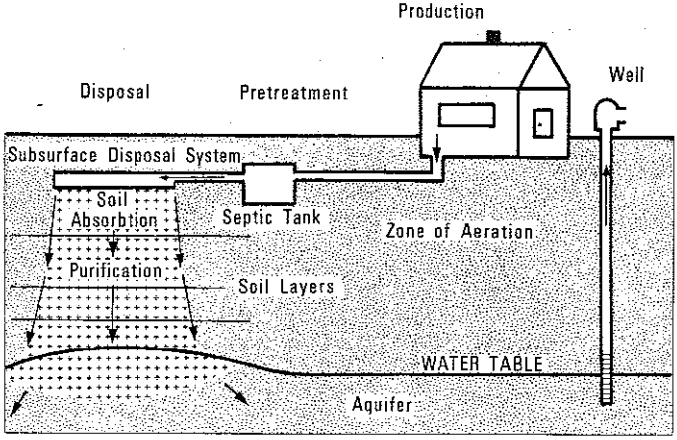
POTENTIAL POLLUTION SOURCES

Potential sources of ground-water pollution are numerous. The quality of ground water in Rock County most commonly can be affected by inadequate disposal practices of all kinds of wastes, by excessive applications of fertilizers and pesticides, by storage of wastes and chemicals on the ground, by spills and leaks of toxic and hazardous liquids, and by improperly constructed and abandoned wells.

Disposal of solid and liquid wastes on the land, in sanitary landfills, and in holding ponds and lagoons, can, if not located, designed and operated properly, result in significant ground-water pollution. However, waste-disposal sites are regulated in the county, and there is no evidence that they have caused ground-water problems.

Septic tanks and cesspools are common sources of ground-water pollution. Use of septic tanks is largely limited to unsewered areas of the county, which also often rely on private wells for their water supply. Problems may develop where many septic tanks are concentrated in one area. Close proximity of a disposal system to the well can create a serious pollution hazard. When a septic system fails to treat the wastewater before it reaches ground water, the contaminants

can be recycled through the nearby well (see diagram below). Proper location and installation of septic systems can prevent these unnecessary cases of ground-water pollution.



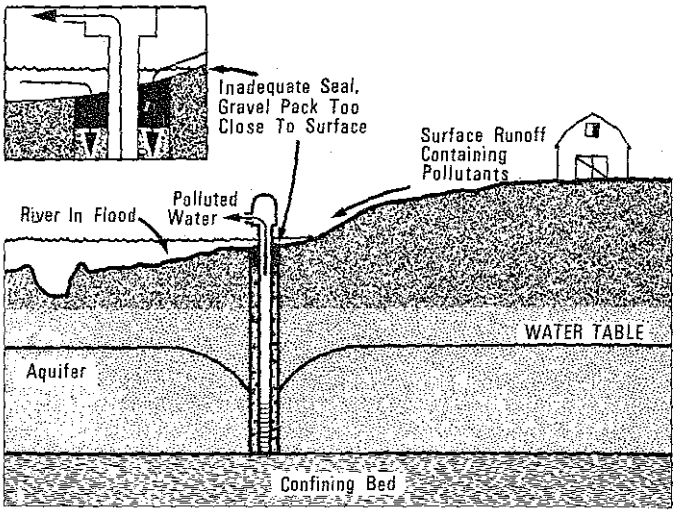
Fertilizers and pesticides have been suspected of being potential ground-water contaminants, but the evidence is not complete. When applied at recommended rates and timing, they usually pose little problem; part is consumed by plants and part is adsorbed on soil particles. It is when overapplied that the excessive chemicals are flushed down to ground water. Use fertilizers and pesticides only when needed, and according to the characteristics of your soil and to the manufacturer's directions.

Unprotected stockpiles may result in ground-water pollution where substantial leaching occurs. Rain can wash soluble pollutants through the soil and into the ground water. Covering stockpiles with plastic or storing soluble materials in shelters and bins can alleviate the problem.

Spills of liquid pollutants can occur anywhere in the county. Better housekeeping at industrial and agricultural facilities handling large volumes of chemicals can prevent careless accidents. Report chemical or oil spills if you happen upon them. Prompt handling of spills after they have taken place may provide protection against serious pollution.

Leakage from pipelines and storage tanks can create serious problems, because the leaks in the underground installations may go unnoticed until the pollutants reveal themselves. Design, construction, and inspection of pipelines and tanks need to be improved with an eye toward protecting ground water. The careful monitoring of fluid pressure and building of containment structures under and around the above-ground installations can further alleviate the problem.

Poorly constructed and improperly abandoned wells can become easy avenues for pollutants to enter ground water. The most common cause of well contamination is an inadequate seal in the annular space between the casing and the borehole, which allows surface contaminants to enter the well along the exterior of the casing (see diagram below). The open holes in abandoned wells often connect two or more aquifers, permitting water to migrate freely from one aquifer to another. Be sure to select a reputable well contractor, who will complete your well according to the state's standards; and make sure that any nearby, abandoned wells



are properly filled and sealed. If you have an old well, have its construction and location checked, and upgrade it to meet present standards.

PROTECTING GROUND WATER AGAINST POLLUTION

Rock County does not have serious, large-scale pollution problems at this time. However, potential for pollution is relatively high because the primary sources of ground water in the county are the shallow aquifers, which are also most susceptible to pollution. Once underground, the pollutants are hidden from view and slowly move with the ground water. It is extremely difficult, if not impossible, to reclaim the polluted aquifer. Even after the source of pollution has been removed, an aquifer might remain polluted for many years.

Ground-water pollution by human activities cannot be completely eliminated, but it can be minimized. The best answer to pollution is prevention, which includes finding out what the major sources of pollution are, and learning to control them. Everybody can help to curb the pollution--not only the professionals and government officials who are responsible for it, but all county citizens--whether it be a farmer, homeowner, well driller, developer, waste-disposal-facility operator, gas-station operator, fertilizer or pesticides dealer, manufacturer, or merchant, by realizing which of his activities may harm the ground water and by trying to eliminate or improve them, and by reporting any potential threats to the ground water.

For more information contact:

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