



No. 8: Factors Affecting Groundwater Contamination

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Orig. 1989; Last rev. 2012

BACKGROUND

Groundwater is the source of water for wells and springs. It fills spaces between particles of soil or between cracks in bedrock. Aquifers are geologic formations of permeable saturated zones of rock, sand, or gravel which carry enough water to yield usable amounts to wells. Aquifers are recharged by rainfall slowly seeping through the ground, or by surface waters with which they are interconnected. Factors influencing the likelihood of groundwater contamination are discussed in this leaflet.

CHEMICAL PROPERTIES

Solubility: A chemical or substance that readily dissolves in water is said to be highly water-soluble. As water seeps through the soil, it carries with it water soluble chemicals. This process is called leaching. The more water soluble a chemical is, the more likely it is to leach.

Adsorption: Many chemicals do not leach because they are *adsorbed*, or tightly held, by soil particles. Adsorption depends not only on the pesticide's chemical properties, but also on the soil type and the amount of organic matter present.

Degradation: Pesticides are degraded, or broken down, by heat, sunlight, microorganisms, and a variety of physical and chemical properties. Most pesticide degradation takes place within the top few inches of soil. Pesticides that take a relatively long time to degrade are said to be *persistent*. The longer the compound persists in the soil, the longer it is available to leach into groundwater.

Volatility: Compounds that vaporize easily are said to be volatile. Compounds that are both highly volatile and highly soluble in water may become groundwater contaminants. Chemicals that are highly volatile but not very water soluble are more likely to be lost to the atmosphere, and less likely to leach into groundwater.

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SOIL PROPERTIES

Soil texture: The relative proportions of sand, silt, and clay determine the texture of a soil. Texture affects movement of water through soil, and thus movement of dissolved chemicals such as pesticides. The coarser the soil, the faster the movement of percolating water, and the less opportunity for adsorption or evaporation. Soils with higher clay or organic matter content tend to hold water and dissolved chemicals longer. These soils also have more surface area onto which pesticides can be adsorbed.

Organic matter content: The amount of organic matter in a soil affects the adsorption capacity of a soil and the amount of water the soil can hold. Soils with a high organic matter content tend to hold water and dissolved chemicals in the root zone where they will be available to plants and eventual degradation.

Soil permeability: Soils that allow water to move downward very quickly are highly permeable. Dissolved chemicals are carried along with the water and thus are more likely to reach groundwater in soils that are highly permeable.

SITE CONDITIONS

Depth to groundwater: The shallower the depth to groundwater, or the water table, the less soil there is to act as a filter, and the fewer opportunities there are for degradation and adsorption of chemicals. Areas with high water tables are thus more susceptible to contamination.

Rainfall: If rainfall is high and soils are permeable, water carrying dissolved chemicals may take only a few days to percolate downward to the groundwater.

Geologic conditions: The permeability of the geologic layers between the soil and groundwater also affects the probability of contamination. Highly permeable materials such as gravel deposits or the sandy soils of Maryland's eastern shore allow water and dissolved compounds to freely percolate down to groundwater. In western Maryland, karst, or limestone formations with sinks or separations in the rock, underlies the soil; these sinks can act as direct entryways for contaminants. Layers of clay are much less permeable and thus inhibit the movement of water and chemicals.

SUMMARY

The combination of factors which would indicate the greatest vulnerability of groundwater is:

a pesticide of
high solubility
low adsorption
persistence
and
a soil that is
sandy
low in organic matter
and
a site with
shallow depth to groundwater
karst or permeable layers
heavy rainfall

This leaflet has focused on the conditions that contribute to groundwater vulnerability. For a discussion of how to protect groundwater from contamination by pesticides, refer to [Pesticide Information Leaflet Number 9](#).

SOURCES

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