Water Quality

Focus Area
Nutrients and Bacterial Wastes

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— Nitrogen in the Environment —

How Nitrogen Enters Groundwater

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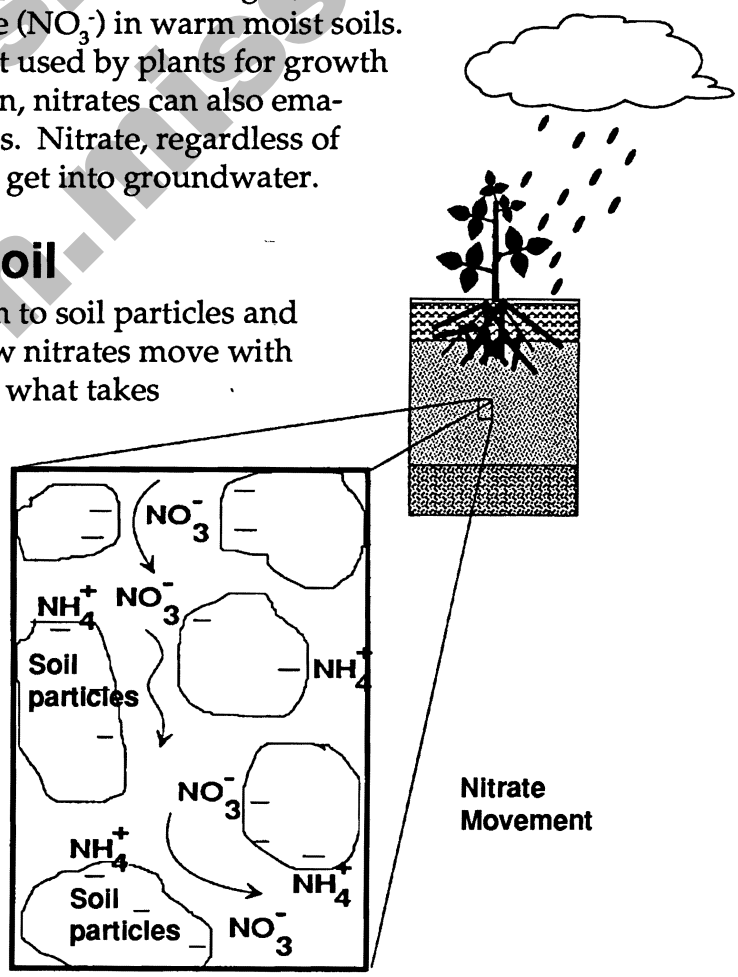
Nitrogen can be found in many different organic and inorganic forms in our environment. The air we breathe is composed of 78% nitrogen. Nitrogen can also be found in many varied forms in the soil. Plants need nitrogen from the soil for proper growth and development, but are only able to use very specific forms of nitrogen. Plants can not use the form of nitrogen found in the atmosphere.

Natural biological process carried out by microorganisms in the soil, convert organic nitrogen to inorganic forms, which plants are able to use. Organic nitrogen is a common component in plant residues and organic matter. Ultimately organic nitrogen is converted to inorganic ammonium (NH_4^+). Plants can use this form of nitrogen, but ammonium is quickly converted to nitrate (NO_3^-) in warm moist soils. Nitrate is the form of nitrogen that is most used by plants for growth and development. Where crops are grown, nitrates can also emanate from nitrogen fertilizers and manures. Nitrate, regardless of its source, is the form of nitrogen that can get into groundwater.

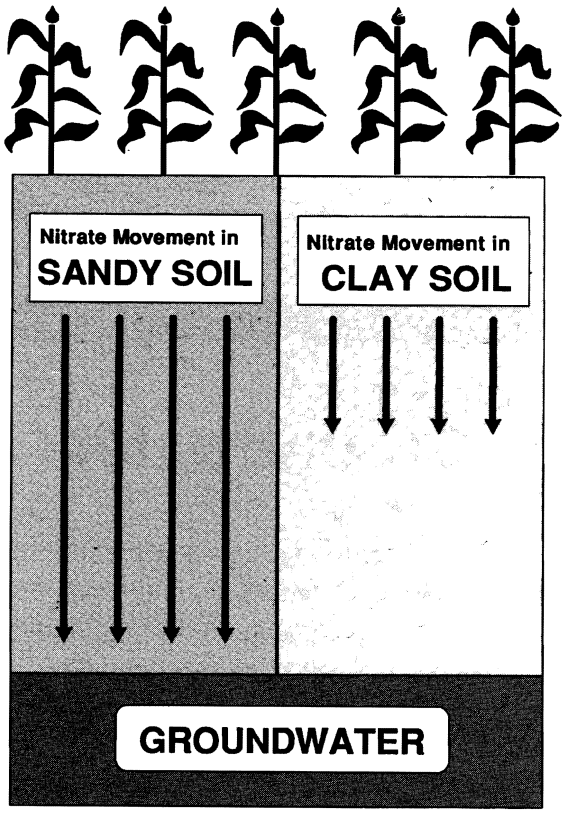
Nitrate Movement in the Soil

Unlike ammonium, nitrate does not attach to soil particles and as a result, is easily moved by water. How nitrates move with water in the soil can be best illustrated by what takes place when soils become wet from rainfall. When rainfall takes place, the soil becomes wet and the air spaces between soil particles begin to fill with water. If rainfall is heavy enough, the air spaces become filled to a point that forces of gravity will cause water to move downward in the soil.

As water moves downward, nitrates will also be carried, downward with water. The downward movement of nitrates in the soil is referred to as leaching.



Nitrate Movement



Nitrate is more likely to move downward in sandy soil than in clay soil. Graphic by Scott Killpack.

What Affects the Degree of Nitrate Leaching

How much leaching will take place is strongly influenced by how much water a soil can hold. For example, by their nature sandy type soils can not hold as much water as clay type soils. This means that leaching of nitrates will take place much more easily in a sandy soil compared to a clay soil. Often times, leaching is not a significant factor in heavy clay soils.

Other factors which can affect nitrate leaching include amount of rainfall, amount of water use by plants and how much nitrate (NO_3^-) is present in the soil system.

Conditions When Nitrates May Enter Groundwater

Whether nitrates continue to leach downward, and into groundwater, depends on underlying soil and/or bedrock conditions, as well as depth to groundwater. If depth to groundwater is shallow, and the underlying soil is sandy, the potential for nitrates to enter groundwater is relatively high. However, if depth to groundwater is deep and the underlying soil is heavy clay, nitrates will not likely enter groundwater. In some cases where dense hardpans are present, nitrate leaching will not progress beyond the depth of the hardpan.

Minimizing Groundwater Contamination from Nitrates

The potential of nitrates from animal manures and nitrogen fertilizers getting into groundwater can be reduced through good management practices. Applying manures and nitrogen fertilizers when crops are actively growing, and using nitrates for growth and development, will reduce the amount of nitrate in the soil system, and thus the amount that could potentially be leached. However, little can be done to minimize the leaching of nitrates into groundwater that result from the ongoing decay of organic matter in the soil. In this situation, nitrates are simply a natural biological result, of an ongoing cycle of nitrogen transformation processes in the soil. For information on health concerns of high nitrates in water, see WQ258.

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