WATER CARRIES CHEMICALS IN THE SOIL TO THE AQUIFER

Recharge is water moving into the ground-water system.

Recharge from precipitation and irrigation may carry nitrogen compounds from the soil into the aquifer, often resulting in elevated nitrate concentrations in shallow wells.

Agricultural fertilizers are the main source of nitrate in ground water.

Man-made fertilizers became widely available after World War II and quickly came into use across the nation. Today, nitrogen fertilizers (commonly nitrate or ammonium compounds) are used in large quantity in most agricultural settings.

NITRATE CONCENTRATIONS VARY WITH SPACE AND TIME

Nitrates concentrations are generally lower at greater depths.

In the Central Columbia Plateau, 26% of wells less than 300 feet deep have nitrate concentrations exceeding the EPA MCL of 10 mg/L.

Only 8% of wells deeper than 300 feet have nitrate concentrations exceeding the MCL.

Some nitrate may be transformed into other compounds as it is carried through the groundwater system. Mixing also decreases nitrate concentrations, as water with higher nitrate concentrations enters deep groundwater systems farther from agricultural influences.

Nitrates concentrations at the water table may vary greatly.

Ground water moves along flow paths that vary from a few to hundreds of miles (shown with blue arrows, below).

Shallow flow paths tend to be influenced by land use practices at the surface, while water in deeper flow paths is farther from human influences.

Deeper flow paths also have much longer travel times, in most cases predating modern land use practices.

Water from different sources increases the variability of nitrate concentrations in shallow groundwater. In the Quincy-Pasco subunit, recharge water carrying nitrate along shallow flow paths mixes with canal water from the CBIP. Recharge water carrying nitrate into deeper flow systems mixes with deeper, older water.

Nitrate concentrations in the regional groundwater system have generally increased since the 1950’s.

Nitrate concentrations in the regional groundwater system vary greatly but have generally increased due to increased irrigation and use of nitrogen fertilizers.

Single wells may show highly variable trends in nitrate concentration. A good illustration of regional trends is Ringold Springs (right), a ground water discharge point integrating an area of several square miles.

HUMAN HEALTH EFFECTS OF NITRATE

A June 1995 Washington State Department of Health Fact Sheet states:

Health impacts: High levels of nitrate in drinking water can cause a potentially fatal blood disorder called methemoglobinemia. Although methemoglobinemia can affect any age, nitrate contaminated water principally causes this illness in children under six months. Some studies have suggested a possible link between nitrate and cancer and birth defects. These suggestions, however, have not been confirmed.

Methemoglobinemia: In order for nitrate to cause methemoglobinemia or “blue baby disease,” it must first be changed in the body into nitrite. Babies less than six months old have a lower stomach acidity, which allows certain bacteria to grow in the stomach and intestines that are capable of converting nitrate to nitrite. Nitrite then changes the oxygen-carrying hemoglobin to methemoglobin, which does not carry oxygen. . . . Poisonings usually occur when contaminated water is used to prepare infant formula and foods. Boiling water for infant formula is a good practice for killing bacteria, but it will not destroy nitrates.

Treatment: If the child is in limb-threatening, immediate treatment is necessary, other treatment is optional. Treatment is begun with standard interventions.

Prevention: Infants under one year of age should not drink water containing nitrate at a concentration greater than the drinking water standard of 10 parts per million (ppm) (or 0.01 milligrams per liter (mg/L)) as nitrites. Although no health based standards exist for adult exposure, the following subpopulations may be at risk:

- Individuals with reduced gastric acidity
- Individuals with a hereditary lack of methemoglobin reductase, and
- Women who are pregnant.

For more health information, contact your water utility or county health agency, or the Washington State Department of Health:

1-800-521-0323.

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
National Water-Quality Assessment Program

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References: