Applying knowledge to improve water quality
Pacific Northwest
Regional Water Program
A Partnership of USDA NIFA
& Land Grant Colleges and Universities

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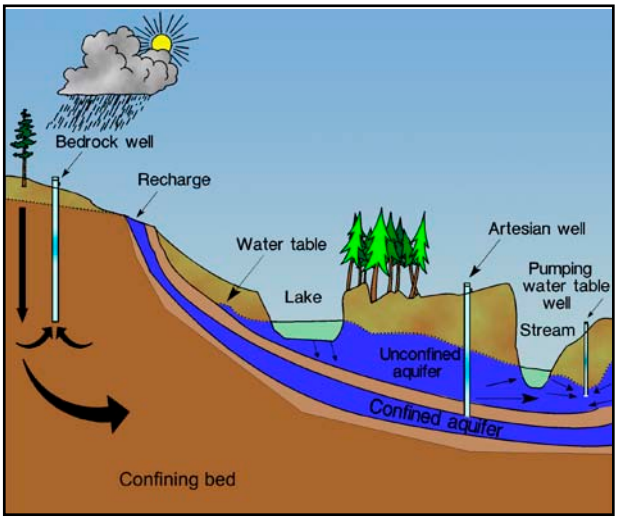
Nitrogen Management:

Nitrates in Groundwater

Nearly 60 percent of Pacific Northwest residents rely on groundwater as their primary source of drinking water. Nationally, groundwater provides about 50 percent of drinking water. Thus, protection of groundwater from contamination by any substance that might cause health problems is a serious concern. One potential groundwater contaminant is the inorganic chemical nitrate (NO_3).



Without careful management nitrates can leach from the surface into aquifer (groundwater) resources.

Nitrates in groundwater

Even though naturally occurring and introduced nitrate is a common groundwater contaminant at low concentrations in the United States, the severity of nitrate contamination is hard to assess. Researchers agree that nitrate concentrations in unpolluted groundwater seldom exceed the U.S. Public Health Service 10 ppm NO_3-N standard.

Recent United States Geological Survey data show that almost every state has areas where nitrate levels exceed the 10 ppm standard. However, an Environmental Protection Agency study found that only 2.7 percent of rural wells exceeded this standard. In recent studies of rural wells in Idaho, Oregon, and Washington, fewer than 5 percent of the tested wells exceeded the federal 10 ppm nitrate-nitrogen standard. Several recent studies in the Great Plains and Midwest have found localized areas where nitrate concentrations in groundwater have been increasing. A significant portion of these locations are in agricultural areas where feedlots are common or high rates of nitrogen are used to fertilize crops.

Sources of nitrate in groundwater

Cultivated soil usually contains between 1,500 and 4,000 pounds per acre of nitrogen bound up in living and dead plants and animals. Plants are unable to use this organic nitrogen directly. But as organic matter decomposes, it releases nitrogen in forms plants can use, primarily ammonium (NH_4) and nitrate (NO_3). This conversion of organic nitrogen into inorganic, plant-available forms occurs in natural ecosystems (forest or grassland, for example) as well as in agricultural and urban environments.

Organic nitrogen fertilizers used in agriculture include animal manures, human wastes, composts, sewage sludge, legume crops, and green manure crops. The most common inorganic nitrogen fertilizers contain nitrate and/or ammonium.

Plants do not necessarily use all the nitrate in chemical fertilizers or all the nitrate produced when organic matter decomposes. When the nitrate supply is greater than the amount plants use, nitrate can accumulate in the soil, be lost from the system, or both. With greater nitrogen inputs for higher crop yields, efficiencies of nitrogen use may be lower and the potential for losses may increase.

Nitrate can be lost from the system in a variety of ways. From the standpoint of groundwater quality, leaching into groundwater is the only concern. Leaching is the downward movement of water and nitrate through the soil. The potential for nitrate leaching varies with soil type and with the amount of water in precipitation or irrigation. For example, sandy soils under high precipitation or irrigation have a high leaching potential.

Downward movement of nitrate through soils was taking place even before the presence of humans; it is unrealistic to expect to stop it entirely. However, careless use of fertilizer and improper management of other nitrogen materials

Pacific Northwest Regional Water Quality Coordination Project Partners

Land Grant Universities

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Water Resource Research Institutes

Water and Environmental Research Center (Alaska)
http://www.uaf.edu/water/

Idaho Water Resources Research Institute
http://www.boise.uidaho.edu/

Institute for Water and Watersheds (Oregon)
http://water.oregonstate.edu/

State of Washington Water Research Center
http://www.swwrc.wsu.edu/

Environmental Protection Agency

EPA, Region 10
The Pacific Northwest
http://www.epa.gov/r10earth/

Office of Research and Development, Corvallis Laboratory
http://www.epa.gov/wed/

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The Project

Land Grant Universities, Water Research Institutes, and EPA Region 10 have formed a partnership to provide research and education to communities about protecting or restoring the quality of water resources. This partnership is being supported in part by the USDA's National Institute of Food and Agriculture (NIFA).

Our Goal and Approach

The goal of this Project is to provide leadership for water resources research, education, and outreach to help people, industry, and governments to prevent and solve current and emerging water quality and quantity problems. The approach to achieving this goal is for the Partners to develop a coordinated water quality effort based on, and strengthening, individual state programs.

Our Strengths

The Project promotes regional collaboration by acknowledging existing programs and successful efforts; assisting program gaps; identifying potential issues for cross-agency and private sector collaboration; and developing a clearinghouse of expertise and programs. In addition, the Project establishes or enhances partnerships with federal, state, and local environmental and water resource management agencies, such as by placing a University Liaison within the offices of EPA Region 10.

can increase the rate of movement and the magnitude of groundwater contamination.

In urban areas nitrogen materials are abundant, and the potential for groundwater contamination is high. Nitrogen fertilizers used on lawns, gardens, and golf courses are leachable. The nitrogen in compost and pet droppings, when converted to nitrate through natural processes, can easily leach into groundwater if not carefully managed. Finally, improperly maintained septic systems can also result in nitrate contamination of groundwater supplies.

Best Management Practices – Agriculture

Best management practices (BMPs) to protect aquifers (groundwater) from nitrates that should be used by agricultural producers include:

- Apply nitrogen at recommended rates for crop production.
- Use preplant soil profile nitrate testing and soil and plant nitrate testing when appropriate.
- Base nitrogen application rates on realistic yield goals.
- Credit nitrogen contributions from legumes, manures, and other organic wastes.
- Plan nitrogen applications to correspond with crop demand (in season).
- Do not apply nitrogen fertilizer in the fall on coarse textured soils or shallow soil over fractured bedrock.
- Use nitrification inhibitors when soil conditions and nitrogen application timing may promote leaching.
- Apply manure uniformly in accordance with crop nutrient requirements.
- Schedule irrigation to minimize leaching.
- Manage fertigation systems carefully.
- Diversify crop rotations to include crops that utilize deep residual nitrogen.

National Water Quality Program Areas

The four land grant universities in the Pacific Northwest have aligned our water resource Extension and research efforts with eight themes of the USDA's National Institute of Food and Agriculture.

1. Animal Waste Management
2. Drinking Water and Human Health
3. Environmental Restoration
4. Nutrient and Pesticide Management
5. Pollution Assessment and Prevention
6. Watershed Management
7. Water Conservation and Management
8. Water Policy and Economics

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