

## Study evaluates nitrogen at a manured grass field

The Washington State Department of Ecology and Washington State University teamed up to monitor nitrogen application and crop removal of nitrogen and relate them to groundwater quality at a manured grass field near Lynden, Washington for 4½ years.

A local dairy producer made this work possible by volunteering his field for the study in order to advance the understanding of nitrogen dynamics.

Another objective of the study was to evaluate whether land application guidelines for Dairy Nutrient Management Plans are effective in protecting groundwater.

Previous studies have shown elevated levels of nitrate in groundwater in northern Whatcom County. Over the last 30 years, 29% of wells tested had concentrations greater than 10 parts per million, the drinking water standard for nitrate.

## Study findings

- The major source of nitrate in groundwater at the study site was from manure applied for grass production. The amount and timing of manure applied each year to the field were the overriding factors that affected nitrate levels in the shallow (less than 11 feet) groundwater.
- When manure was applied at the recommended amounts and times of the year, nitrate concentrations in groundwater were low enough to meet safe drinking water levels.
- Most of the annual precipitation in the area occurs during the period of limited crop growth (October through March), when rain carries available nitrate in the soil to the water table. Late fall application in 2006 followed by heavy rain resulted in a significant increase in the groundwater nitrate concentration.

The study found that it is not possible to accurately predict actual nitrate concentrations in groundwater based on the amount of nitrogen applied. Neither the post-harvest soil nitrate test nor the nitrogen mass balance methods that we evaluated was a good predictor of resulting nitrate concentrations in shallow groundwater.

### Why do we care about nitrate contamination?

High nitrate concentrations can lead to methemoglobinemia (blue baby syndrome) in infants. Nitrate prevents hemoglobin from carrying oxygen in the blood, which leads to oxygen deprivation.

Health risks for adults who drink water with more than 10 mg/L nitrate-N are less clear. Some evidence suggests an increased risk of spontaneous abortions in pregnant women while other studies have found no link.

Residents outside the City of Lynden rely on the Sumas-Blaine Aquifer as their only available water supply. The aquifer is relatively thin, and there is not a good supply of groundwater beneath the aquifer. Therefore drilling wells deeper is not a long-term solution.

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## Recommendations

- Review nitrogen mass balance methods used in Dairy Nutrient Management Plans. Adapt existing methods or develop new methods so that they accurately account for nitrate effects on groundwater.
- Our results indicate that it is best to schedule the last manure application by late August to early September. Manure application during the high recharge period (September through mid-March) is likely to increase nitrate leaching to groundwater.
- Update post-harvest soil nitrate guidance used in Dairy Nutrient Management Plans to incorporate hydrologic influences on groundwater.
- Conduct groundwater monitoring using dedicated monitoring wells to evaluate the effectiveness of current and future management practices for minimizing impacts on groundwater nitrate.
- Continue collaboration between state and local organizations in partnership with universities, dairies, and other agricultural producers to improve nitrogen-use efficiency and protect groundwater quality.

## Resources

### Bibliography

Carey, B.M. and J.H. Harrison, 2014. Nitrogen dynamics at a manured grass field overlying the Sumas-Blaine Aquifer in Whatcom County. Washington State Department of Ecology, Olympia, WA. Publication No. 14-03-001. <https://fortress.wa.gov/ecy/publications/SummaryPages/1403001.html>

### Additional Resources

Information on health effects of nitrate is available from the Washington State Department of Health, Division of Environmental Health, Office of Drinking Water:  
[www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/Contaminants/Nitrate.aspx](http://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/Contaminants/Nitrate.aspx)

Information on having your well tested is available from the Whatcom County Health Department:  
[www.co.whatcom.wa.us/health/environmental/drinking\\_water/wellwater.jsp](http://www.co.whatcom.wa.us/health/environmental/drinking_water/wellwater.jsp) Phone: 360-676-6724.

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