# SRBC Reports On Groundwater Nutrients

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involved in the study.

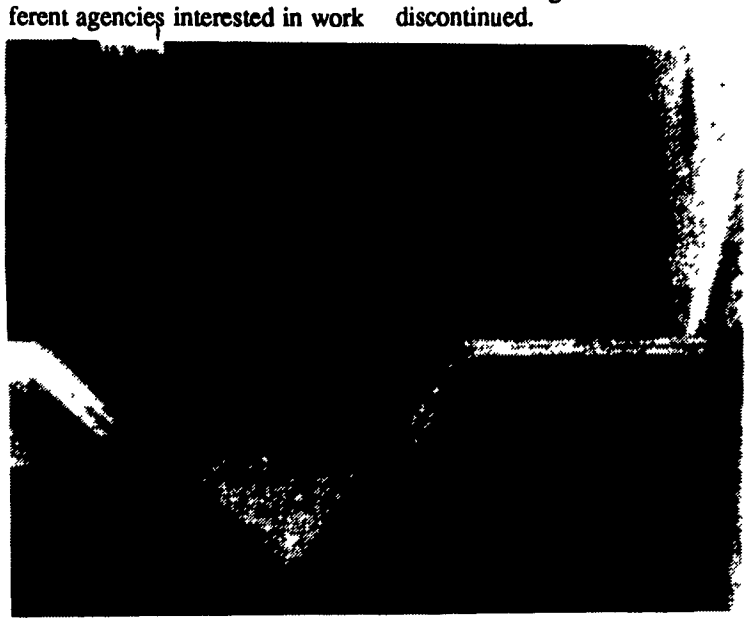
The study was jointly financed by the SRBC and the federal Environmental Protection Agency.

The farm toured Tuesday was the 219-tillable-acre dairy and poultry farm of Paul Clugston, located near Halifax. He milks 103 Holsteins in a commercial herd and raises approximately 92 replacement heifers and calves. He also has 65,000 broilers under contract to Pennfield Corp.

Clugston has been cooperating with nutrient studies for years, and has been involved with several different agencies interested in work done there. From 1986 to 1990, researchers from Penn State University looked into nutrient cycles at the site. Their work involved measuring amounts of nutrients put on the soil and amounts removed.

The SRBC studies were different in that they focused on measuring water flows, the nutrient levels in water flows, and also the effectiveness of artificial wetlands in removing nitrates from the water.

Because of problems with the design of the second study area at a farm near Enterline, much of the monitoring there was discontinued.



**The pipe at the top of the photograph is a drainage pipe that was installed as part of an USDA SCS erosion control plan. The pipe was sectioned and this measurement box installed by researchers in order to measure the rate of flow and also to take water samples. The small pipe on the right leads to a stilling well. The "V"-notched weir helps with measuring flow.**

**Larry Taylor stands by a surface water collection flume. Water flow is automatically recorded and samples of surface water are automatically taken by the equipment housed in boxes.**

**From the left, standing on an artificial wetland designed to breakdown groundwater nitrates into environmentally safe nitrogen gas are Paul Craig, extension agent, John Graham, civil engineer, Paul Clugston, owner-operator of the farm, Larry Taylor, hydrogeologist, and Donald Bollinger, chairman of the state Nutrient Management Advisory Board. The wetland is made of a series of haybale baffles to serve as a carbon source overlain with a sandstone gravel medium to allow water flow and provide a surface for bacterial growth.**

What researchers have been working with is a 10.9-acre self-contained watershed valley on Clugston's farm that has a natural small spring.

The center of the valley had originally been a wet, soggy, tree-line area until Clugston installed field drains according to his conservation plan created by the USDA's Soil Conservation District. The area had been considered highly erodible land.

Those field drains, according to researchers, were dug deep enough that researchers said they think the drains have been collecting all the shallow ground water from the field.

To treat the collected water, two 20-foot, by 50-foot, by 3-foot-deep rectangular artificial wetlands were constructed.

The first wetland was made five years ago, but it was put in during a dry period. Last year, a second biological filter was installed, after researchers experienced two years of more normal rainfall and discovered that the first wetland couldn't handle the flow.

The research data shows that high nitrate levels in the shallow groundwater, attributable to the use of manure fertilizer on the watershed, seemed to be contained in that layer of groundwater; and that the wetlands plants and microbes consumed the energy from the nitrates, converting it to N2.

The N2 is the gas which constitutes 78 percent of the earth's atmosphere and is considered a reservior of nitrogen that is not immediately available for use by plants and animals as a nutrient.

The report lists four conclusions reached by its authors:

• "Nitrification is an important process influencing the quality of recharge to the ground water system at both farm sites.

• "The nitrate concentration in ground water decreases with increasing depth below the water table. Thus, the depth to the shallowest water-bearing zone is an important factor in determining the degree that the quality of groundwater produced by a well will be influenced by agricultural activities.

• "In the rolling topography, as characterized by areas underlain by the Catskill Formation, field drains can be designed to capture a significant portion of the recharge to the ground water system; perhaps limiting the spread of nutrient contaminated ground water. The nutrient rich water can be treated using small, artificial wetlands.

• "Application timing and rates, and types of fertilizer may be important factors in the quality of recharge water, however, soil conditions, depth of water table, depth of water bearing zones, and natural chemical character of the ground water (either oxic or anoxic) are important considerations with respect to the degree the ground water will be contaminated."

What is means is that researchers are saying that it is possible to protect the movement of nutrients into deep groundwater by using a drainage system to collect rainwater filtering down through the earth and then treating or using that water.

While the researchers used "artificial wetlands" to use up nitrates in the collected groundwater, they said it is theoretically possible to use those nutrients in that water to operate a hydroponics facility.

They said they did have a problem getting enough phosphorus as a nutrient from the groundwater, despite the fact that Clugston uses almost all cow and poultry manure to fertilize.

In the report's comments on the effectiveness of the constructed artificial wetlands, which were designed using the same principles that would be used to construct a biological filter for waste water treatment, the researchers said that the lack of adequate phosphorus in the groundwater limited the ability of the wetlands to use up nitrates.

"Although there had been a small reduction in the nitrate in the

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**The old farmhouse sits on the right while all the measuring devices are in the foreground and researchers and others stand on the far side of an artificial wetland created to treat groundwater collected from a 10-acre watershed. It is all part of a research program designed to monitor the flow of water and nutrients in a real farming situation.**