



College of Agriculture and Life Sciences

Students

Research

Extension

Alumni and Friends

About

Study Shows Humble Road Ditches Can Play Powerful Nutrient Reduction Role

May 1st, 2019

Iowa City, Iowa — New research suggests that water quality challenges in Iowa and nationally would be even greater if it weren't for a little appreciated feature of the landscape: road ditches.

"Road ditches are human-made, hydrologic pathways we take for granted," said Keith Schilling, state geologist and director of the [Iowa Geological Survey at the University of Iowa](#), who led the study funded by the [Iowa Nutrient Research Center](#) at ISU.

"They are everywhere, criss-crossing our state," Schilling said. "Our research shows they are already working to help filter our water and raises the question: How can we better realize their potential?"

The scientists studied six ditches along paved and gravel roads in eastern Iowa's Lime Creek watershed in Buchanan County, where nearly 80 percent of the land is in row crops. Using detailed geographic information system data, Schilling's team estimated that about 30 percent of the watershed drains to road ditches. They analyzed soils, vegetation and surface and groundwater levels in the ditches. They monitored water quality upstream, midstream and downstream, looking at levels of nitrate-nitrogen, phosphorus, dissolved oxygen, salts and heavy metals.

Based on similar studies in other parts of the country, Schilling said the team was not surprised to find soil and groundwater conditions within the ditches favorable for denitrification. They were surprised to see the extent of ditch's processing capacity. Nitrate concentrations decreased an average of 60 percent in subsurface water from upstream to downstream locations in four of the six ditches. In the other two, nitrogen levels in water coming into the ditches were low enough that the ditches' additional nutrient processing capacity did not have a significant impact.

At nearly all sites, the ditches had rich, loamy, organic soils and shallow water tables that provided adequate anaerobic, or oxygen-poor, subsurface conditions for denitrification. "We found this occurring at levels comparable to wetlands constructed to filter nitrate from agricultural drainage," Schilling said.

While the ditches were effective at removing nitrate, the research found they did little to alter phosphorus levels in water flowing into them. Nor did they reduce concentrations of heavy metals, which were generally the same as in surrounding soils.

Schilling said the ditches in the research were typical of Iowa, but he cautioned that this was a limited study. Further research could explore increasing ditches' nitrate reduction capacity through modifications like increasing retention time and infiltration of flow. This could be done, he said, by adding features like check dams or swales or by using two-stage ditch designs that have shelves planted with vegetation to increase interaction of water with biologically active plants and microbes. Also, where ditches have potential to handle more water, additional drainage could be directed into them.

"Many of these changes could be relatively inexpensive and easy to incorporate into road ditch design and maintenance projects," said Schilling.

Another way to increase a ditches' nutrient processing ability may be to populate the ditches with different plant communities. Though the research did not find vegetation in the ditches – primarily introduced species like brome and reed canary grass -- to significantly influence water quality at the study sites, they suggest this deserves further study.

Two research papers from the study were recently published in the [Science of the Total Environment](#).

Co-authors with Schilling were Matthew Streeter, soil scientist with the IIHR-Hydroscience and Engineering, University of Iowa; Martin St. Clair, professor of chemistry at Coe College; and Justin Meissen, research and restoration program manager at the University of Northern Iowa's Tallgrass Prairie Center.

Schilling said the team is communicating its findings to transportation agencies and other groups, including county road engineers who have led the way on roadside vegetation management. He hopes to develop pilot projects to test design modifications that enhance nitrate processing in ditches.

"This research shows road ditches are already inadvertently functioning as an edge-of-field conservation practice in many of our watersheds," said Schilling. "I am hopeful that, with just a little more research and planning, we can manipulate them to do even more for us – and for a very reasonable cost."

[The Iowa Nutrient Research Center](#) was established by the Iowa Board of Regents in response to legislation passed by the Iowa Legislature in 2013. The center pursues science-based approaches to areas that include evaluating the performance of current and emerging nutrient management practices and providing recommendations on implementing the practices and developing new practices. Iowa State University leads the partnership that includes the University of Iowa and the University of Northern Iowa.

Contacts:

Keith Schilling, Iowa Geological Survey Bureau, University of Iowa, 319-335-1422,
keith-schilling@uiowa.edu

Matt Helmers, Iowa Nutrient Research Center, 515-294-6717, mhelmers@iastate.edu

Ann Y. Robinson, Agriculture and Life Sciences Communications Service, 515-294-3066,
ayr@iastate.edu



State Geologist Keith Schilling sorting road ditch soil samples for an Iowa Nutrient Research Center-funded project.

Communication Resources

[News Releases](#)

[CALs Online Faculty & Staff News](#)

[Calendar](#)

[Featured Stories](#)

[Communications Service](#)

[Displays and Exhibits](#)

[Nameplates](#)

Iowa State University



**College of
Agriculture and Life
Sciences**

138 Curtiss Hall
513 Farm House Lane
Ames IA 50011-1050

cals@iastate.edu

(515) 294-2518

Facebook

Twitter

Instagram

Vimeo

STORIES

[Site Index](#)

Copyright © 2019
Iowa State University
of Science and
Technology. All rights
reserved.

[Non-discrimination
Policy](#)

[Privacy Policy](#)

[Digital Access &
Accessibility](#)