Phosphorus Best Management Practices
Protecting Water Quality

Drainage Ditch Management

Authors: Rory O. Maguire, North Carolina State University, Raleigh, North Carolina; Brian A. Needelman, University of Maryland, College Park, Maryland; Peter A. Vadas, USDA-ARS, State College, Pennsylvania

Author's email
rory_maguire@ncsu.edu

Editing and Design:
Forbes Walker
Wanda Russell
Gary Dagnan
Anne Dalton
University of Tennessee Extension

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Definition:

Drainage ditches are open trenches used to improve drainage in relatively flat areas with wet soils. They are extensive in the Coastal Plain of the Eastern U.S., the Midwest and California. Typically, shallow (0-5 ft) ditches draining individual fields flow into deeper (5-10 ft) collection ditches that ultimately discharge into streams and other surface waters. Water enters both shallow and deeper ditches via surface and subsurface pathways or as tile drain effluent.

Purpose:

In areas with high water tables, drainage ditches effectively lower the water table to allow farm machinery to operate at critical times, such as planting. Drainage ditches act as direct conduits between agricultural fields and surface waters, so mitigating nutrient movement into and through ditches is essential to protect surface water quality.

How Does This Practice Work?

Three important management strategies can reduce nutrient losses and transport through drainage ditches:

Controlled drainage: Water control structures at the final point of drainage outlet can be used to regulate water depth in the ditch, field-water table depth and water outflow. Water level can be lowered to allow access for farm machinery at critical times. The water level can be raised when desirable, resulting in several beneficial effects, such as (1) providing water storage in the field for use by crops during dry periods, (2) reducing the amount of drainage water by 20-30 percent, which decreases nutrient export load, (3) increasing denitrification, reducing nitrate-nitrogen losses by about 10-20 percent and (4) increasing sediment and particulate phosphorus retention.

Negative effects of water-control structures include possibly increasing dissolved phosphorus (P) losses from sediments under anaerobic conditions and maintenance costs for outlet pipes.

Sediment removal: Surface runoff preferentially erodes small soil particles that are rich in P. These P-rich particles are deposited in the drainage ditches where they can continue to release P, as well as physically reducing water flow through the ditches. Therefore, ditches require periodic clean-outs to maintain flow capacity for adequate drainage, typically at a minimum of 15- to 20-year intervals. Generally, ditches are dredged using a backhoe, and sediments are deposited on ditch banks and adjacent field edges.

Vegetated buffers: Buffers can retain nutrients and sediment, decreasing inputs into drainage ditches. Buffers are covered in more detail in another fact sheet.

Where This Practice Applies and Its Limitations:

Controlled drainage can be installed only on relatively flat sites at drainage outlets. Sediment removal is part of essential drainage ditch management, to keep them conducting water effectively. Installing buffers can remove land from production, but loss in income may be covered by cost-share.

Effectiveness:

On average, controlled drainage can reduce the loss of total nitrogen by 9 lb. acre^{-1} yr^{-1} or 45 percent and total P by 0.1 lb acre^{-1} yr^{-1} or 35 percent.

Cost of Establishing and Putting the Practice in Place:

The benefits of increased crop production and water quality will exceed costs associated with controlled drainage up to a land slope of ~0.5 percent.

Operation and Maintenance:

Sediment removal and periodic mowing of vegetation are necessary costs of maintaining effective drain function.

References:

Gilliam, J.W., J.L. Baker and K.R. Reddy. 1999. *Water quality effects of drainage in humid regions*. In R.W. Skaggs and J. van Schilfgaarde (eds.) Agricultural drainage. Agronomy Monograph no. 38. ASA-CSSA-SSSA, Madison, WI.

Gilliam, J.W., D.L. Osmond, and R.O. Evans. 1997. *Selected agricultural best management practices to control nitrogen in the Neuse River Basin*. NC Agricultural Research Service Technical Bulletin 311, NC State University, Raleigh, NC.

For Further Information:

The Drainage Outlet: http://d-outlet.coafes.umn.edu/

Osmond, D.L., J.W. Gilliam and R.O. Evans. 2002. *Riparian Buffers and Controlled Drainage to Reduce Agricultural Nonpoint Source Pollution, North Carolina*. Agricultural Research Service Technical Bulletin 318, North Carolina State University, Raleigh, N.C. Available at: www.soil.ncsu.edu/about/publications/index.php