Executive Summary

Benefits and Costs of a Subsurface Agricultural Drainage Water Management System

To Improve Water Quality and Increase Crop Production In a Public-Private Partnership

On Behalf of Agricultural Drainage Management Coalition

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Over the past decade, efforts to reduce agricultural nutrient pollution have focused on installing conservation practices, such as riparian buffers and filter strips, on or near cropland. Agricultural producers as well as state and federal governments, however, have largely overlooked installing conservation practices to reduce pollutants from subsurface drainage water.

Over 50 million acres of highly productive agricultural cropland are artificially drained by underground pipes, tubes, and tile. Many of these, mostly clay tile, drainage systems have been in place for over one hundred years. Much of the Midwest gets its drinking water from rivers and streams fed by runoff and subsurface drainage from agricultural lands. Municipal and rural water systems increasingly have to use denitrification processes to lower nitrate levels to meet water quality standards. Nutrient-laden surface waters have been identified as a major contributor to the formation of the hypoxia area in the northern part of the Gulf of Mexico.

Drainage Water Management (NRCS Practice Standard 554) is a practice that can be cost-shared under the Environmental Quality Incentives Program (EQIP) and possibly other conservation programs administered by the U.S. Department of Agriculture. This technical practice 554 is designed to keep more nutrients and water in the soil, where they can be productively utilized by crops. Subsurface water can be retained by installing control devices that limit tile drainage at various times of the year and to certain depths of the soil profile as needed to meet the needs of producers and their crops. The practice is most cost-effective on land that has very little slope (0 to 0.5 percent) because large areas can be managed by fewer control devices. Approximately 7.9 million acres in the Midwest would be classified as well-suited for this practice.

This report analyzes two scenarios to demonstrate the benefits and costs of agricultural drainage management systems. The first scenario assumes an existing drainage system which requires only a retro-fitting of water level control devices. The second scenario assumes an entirely new installation of water level control devices, drainage main, and lateral drains. The benefits and costs vary with significantly more investment, but greater benefit, involved in the latter. Exhibit 1E displays a summary of the benefits, costs, and benefit-cost ratios involved with both scenarios on an acre basis.

Exhibit 1. Estimated Benefit Cost Ratios and Return on Investment

	Public & Private Investment (per acre)	Managed Agricultural Drainage			
		Retro-fit Existing Systems		New Drainage System	
		Farm Benefits ($/Acre)	Public Benefits ($/Acre)	Farm Benefits ($/Acre)	Public Benefits ($/Acre)
Total Annual Benefits		$ 9.44	$ 152.89	$ 33.35	$ 160.86
Total Annual Costs		$ 1.00	$ 4.13	$ 11.15	$ 5.36
Farm & Public Benefits to Cost Ratio		9.44	37.06	2.99	30.02
Total Benefits to Cost Ratio		31.67		11.77	
Rate of Return on Investment					
-- Drainage Water Management Structures	$ 93.75 /ac	No Investment	158.68%	7.29%	113.09%
-- Drainage Main Line	$ 78.13 /ac				
-- Lateral Field Lines (no cost-share)	$ 270.00 /ac				

The analysis assumes a 100 percent public cost-share on retro-fitting the water level control devices and an 80 percent cost-share on the water control devices and drainage main lines for a new system (no cost-share on lateral drains). In both scenarios, the benefit-cost ratios for the farmer and public are significantly greater than one, and approach or exceed 3 to 1. Retro-fitting an existing drainage system has a particular high overall benefit-cost ratio, estimated at a combined 31.67 to 1. If a new drainage system is required, the

benefit-cost ratio is still a combined 11.77-to-1 or above. Measured as a rate of return on investment, the private benefits are above 7 percent and the public benefits are very high. The public benefits are high due to the avoided cost of denitrifying surface waters to meet EPA MCL requirements using conventional commercial denitrification techniques by municipal water systems.

The lands of greatest benefit are those poorly drained soils with zero to 0.5 percent slope, of which there are nearly 7.9 million acres in the five Corn Belt states. Public cost-sharing provides a needed incentive for farm operators to make these large investments, while maintaining a positive benefit-cost ratio on the public funds. If all of the targeted 7.9 million acres participated, this program is projected to have net annual benefits of $1.23 billion (all acres retro-fitted) to $1.394 billion (all new systems) while reducing nitrate loads by 128 million pounds (58 million metric tons).

Exhibit 2E. Estimated Maximum Annual Program Benefits and Costs

	Eligible Acres	Agricultural Water Drainage Management			
		Retro-fit Existing Systems		New Drainage System	
	7,887,106 ac.	Farm (000)	Public (000)	Farm (000)	Public (000)
Total New Investment in Drainage		Zero	$ 739,416	$ 3,485,115	$ 1,084,477
Total Annual Program Benefits		$ 74,479	$ 1,205,857	$ 263,031	$ 1,268,708
Total Annual Program Costs		$ 7,887	$ 32,534	$ 87,908	$ 42,262
Net Annual Program Benefits		$ 66,592	$ 1,173,323	$ 175,122	$ 1,226,446
	Nitrate Reduction	Total Net Benefits		Total Net Benefits	
Annual Totals	128,338,996 lb.	$ 1,239,915		$ 1,401,568	

Footnotes:

The two drainage systems are mutually exclusive, so the estimated farm and public benefits would be a weighted sum of the two systems.

Managed water drainage systems are a technically feasible, best management practice (BMP) that can reduce nitrate discharge into streams and shallow aquifers by 30 to 50 percent. Managed drained fields can yield 5 to 10 percent more in crop production per acre without additional inputs and fertilizers by keeping more nitrate and water in the soil profile. Yield variability can also be reduced by increasing soil moisture during dry periods within the growing season. Total (private and public) net annual program benefits of the installation of managed drainage practices could easily exceed $600 million dollars in the Corn Belt region, at 50% participation.

Drainage management requires a substantial investment in new drainage control devices to retro-fit existing systems or, in most cases, new tile mains and lateral drains. However, compared to alternative water quality conservation practices, such as taking valuable land out of production entirely, managed drainage is not only very affordable, it also has a high cost benefit ratio. In fact, managing subsurface drainage in conjunction with surface strategies, such as buffer strips and precise nutrient application, to reduce nutrient runoff is a more holistic approach to dealing with the water quality problems of the upper Midwest. Surface and subsurface strategies should complement each other to provide maximum water quality benefits to the public and management flexibility to producers.

As a program to enhance water quality while improving productivity, subsurface agricultural drainage management systems are efficient, profitable, and verifiable. They do the job in a way that virtually no other farming/land practice can solidly demonstrate. Benefits and costs will vary across the Corn Belt, but continuing research shows that by implementing drainage water management today, we have a unique opportunity to elevate drainage to a new level that simultaneously provides food and fiber for a hungry world at maximum efficiency while being environmental responsible for generations to come. Agricultural drainage water management should be given a higher priority for public funding purposes—it is simply a more cost-effective practice, particularly when used in conjunction with surface practices.

Note: Drafts of this analysis have been reviewed by the Agricultural Drainage Management Systems (ADMS) Task Force members and the author has incorporated and greatly appreciated their comments and suggestions. The final draft is however the responsibility of the authors and is not approved in whole or in part by the ADMS Task Force.

