In the Upper Midwest, hundreds of thousands of additional acres have been placed into tile drainage over the past couple of years as the Corn Belt continues to expand. Unmanaged tile systems, though, have virtually no control over when and how much water and nutrients are removed. A smarter system using drainage water management puts farmers in the driver seat with better management over their water and nutrients.
Subsurface tile drainage is getting smarter as farmers continuously seek out better ways to get more out of their most valuable inputs like nitrogen. But the investment isn’t just paying off with higher yields. Improved drainage systems are also reducing the amount of nitrogen leaking into rivers, streams, and groundwater.

For years, the purpose of burying drainage tiles below the soil surface was to shed water from the field as quickly as possible to expedite planting during a wet spring. Unmanaged tile systems, though, have virtually no control over when and how much water and nutrient is removed. A smarter system using drainage water management puts farmers in the driver seat with better management over their water and nutrients.

In a managed drainage system, a farmer can raise or lower the outlet level with adjustable riser boards in a water control structure located at the edge of the field.

“The farmer isn’t plugging the tile. He’s just forcing that water table closer to the surface with a control structure before the drainage exits from the system,” explains Matt Helmers, associate professor of agricultural engineering at Iowa State University.

The outlet in the structure typically is raised after harvest to reduce the amount of water delivered to a drainage ditch, then lowered a few weeks prior to planting to allow the field to drain, and then raised again after planting to store water through the growing season.

With this controlled system that limits the amount of water drained from the field, nutrient loads can also be reduced by as much as 45% or more, according to USDA’s Natural Resources Conservation Service (NRCS), which is promoting managed drainage as a way to improve water quality in the U.S.

This new approach to managing drainage is a significant break from the old way of draining excess water from fields, specifically in the Upper Midwest where tile drainage systems are most common, says Leonard Binstock, drainage consultant and executive director of the Agriculture Drainage Management Coalition.

“It’s not necessary to drain 24/7,” Binstock says in reference to the old tile drainage systems that lack a control structure. “That’s one thing that’s been going on for the last 100 years. You put the system in, and it basically drains 24/7.”

With a managed system that controls the water level in the field, drainage happens largely at the farmer’s discretion, he explains. That gives the farmer another tool to control water and nutrient use efficiency with bigger payoffs in higher crop yields.

“If you’re using a tile system and doing

Left: Control drainage well installation. Photo courtesy of USDA-ARS.
In a managed drainage system, a farmer can raise or lower the outlet level with adjustable riser boards in a water control structure located at the edge of the field. Illustration courtesy of Illinois NRCS.

An opportunity for change

Tile drainage is increasing in popularity as farmers seek to get more value out of their water and fertilizer and invest in their farm’s productivity as an alternative to buying high-priced farm ground.

Alex Echols, consultant at the Sand County Foundation in Alexandria, VA, says the recent surge in interest among farmers for smarter drainage systems is an opportunity that can’t be missed if the U.S. wants to improve water quality. In the Upper Midwest region alone, between 60 and 80% of the roughly 100 million acres planted to row crops have had their hydrology substantially modified through drainage systems, he says.

However, less than 1,000 farms currently have controlled drainage in place in the U.S., Nichols notes. That number is expected to double in the next year and possibly double again the following year.

“In the Upper Midwest, we have put hundreds of thousands of additional acres into tile drainage over the past couple of years that hadn’t been drained previously,” Echols says.

Most of the new tiling development, Binstock says, has come about as the Corn Belt continues to expand north and west.

“Twenty years ago, there wasn’t that much corn growing in the two Dakotas, and those have become major corn-growing states. And the farmers there are finding out the
same things the eastern Corn Belt realized 50 to 60 years ago. You need good drainage to grow good row crops. So, they’re doing a lot of tiling in the two Dakotas just to get to the same level as the other farm states as far as productivity. The one thing they’ve had going for them is the fact that they can put in the right system the first time, if they have access to it.”

The eastern Corn Belt states like Ohio, Indiana, Illinois, and parts of Michigan, where existing tile drainage systems are 60 to 90 years old, are also opportunities to upgrade to smart systems, he says. As farmers replace lines that have maxed out their usefulness and need to be replaced, farmers can install a smart system that meets best management practices if the farmer is aware of the technology and its benefits.

This renewed interest in tile drainage across the Corn Belt creates an opportunity to get drainage done right and to make some significant steps forward in reducing the amount of fertilizer making its way into water supplies in the future, Binstock says.

Farmers today are also more educated about nutrient outflow via tile drainage and the effects on the environment, Helmers notes. The improved public knowledge at the farm level, he says, is an opportunity to promote managed drainage as farmers continue to see improved tiling systems as an investment that can pay off for years in the future.

“I think there’s becoming more recognition about what can we do to reduce or minimize the amount of nitrate that is leaving the field,” Helmers says. “And so, that’s where people are looking at a shallower drain placement in areas, or drainage water management where we put an outlet at the exit of the drainage system and try to manage the water table back in the field.”

Install a new system or upgrade the old?

Farmers are also more quickly realizing the benefits of upgrading their current tile systems through field mapping. With the aid of GPS technology, farmers can easily see on a screen where potential improvements can be made with their existing tile.

“Yield monitors really help highlight areas of the field that may be too wet. And as a result, you see depressed yields,” Helmers says. “So, that’s helped promote more interest with some farmers in upgrading their drainage.”

The problem farmers often face with the old tile systems, Binstock says, is that tile lines might be spaced
too far apart, creating a field that doesn’t drain as efficiently as possible.

“With some of the older systems that were put in during the ’50s, ’60s, and ’70s, the laterals were placed farther apart. So a lot of the farmers today are splitting the old lines,” he says. “They’ve got old lines that are spaced 100 to 120 ft apart, and they’re splitting those down to 50 and 60 ft, which gives you more uniformity across the field. Your water table is more constant, your soil works better, you have better seed-to-soil contact and better production.”

If a farmer is interested in making that kind of investment in his tile system, he says, that would be an opportunity for the farmer to go the next step and convert it to a managed system with a control structure installed at the edge of the field.

However, not every field with existing tile lines can easily be retrofitted for managed drainage, Helmers notes. If a field is laid out in a pattern where the drain lines follow along the contour, he says, it might be possible to retrofit that field. Otherwise, upgrading a current system might not work as well and a new system would have to be installed.

“To do drainage water management and to reduce outflows, you have to have the systems designed to where they’re fairly even level topography,” Binstock explains. “Unfortunately, a lot of the older systems were put together with the main at the bottom of the hill and the laterals running up the hill, so everything’s running downhill on gravity. The new recommendation on designing systems is to run the main up the hill and run the laterals across the grade. That way you can use control structures stepping up your main to give you the zones that you can manage and, because your lines are running across the slope, they do a better job of catching the water as it runs down the slope underground.”

Cost and profit of drainage water management

A yield benefit from managing drainage averages a 5% increase, with the biggest increases in productivity occurring during drier periods when water stored in the soil has the biggest payoff, Echols says.

Binstock agrees that potentially an average 5% yield increase can be expected by installing an improved tile drainage system.

“That may seem like a small amount, but at today’s commodity prices, it’s an investment that creates a return for the farmer in the long term,” he says.

Cost of the control structures are anywhere from $1,000 to $2,000, Helmers adds. However, with NRCS sharing the cost of a Drainage Water Management Plan under the Environmental Quality Incentives Program (EQIP), the overall cost to the farmer is greatly reduced.

The economics of installing an updated system are even more enticing when the cost is spread out over time and acres, Binstock points out.

“Most of the controls have cost-share under EQIP funding of up to 75%,” he says. “That’s a 25% cost to the farmer. So if a control structure is going to run about $1,600, the farmer’s going to have $400 of out-of-pocket cost. But that one structure may control 20 to 30 acres. So when you think about that over the long term, it’s not a very high cost on a yearly basis. Once you put the structure in the ground, it’s there the same life as your drainage system. That’d be $400 for every 20 to 30 acres. If you’ve got a $20/acre cost out of pocket and you amortize it over 20 years, you’re talking about less than a dollar per acre per year. So really, the costs aren’t that great to the farmer.”

The time it takes the farmer to manage a controlled drainage system also has to be factored, Binstock says.

“The cost to manage a system is time for most producers. You’re going to have to go out there to move the boards up or down in the control structures. If the farmer doesn’t want to do that, there are automatic controls where the producer can sit at his computer and move the boards in their control structures.”

For $2,500, Echols says, the farmer can add a sensor, solar panel, and motor to manage the structure remotely. A remote-controlled system, he adds, would make managing the system simpler, particularly if the control structure is located in an inaccessible location of the field.
CCAs—the connecting point for farmers

CCAs play an integral role for farmers as they are often the connecting point for information about drainage water management and the benefits it provides in terms of improved crop yields and cleaner water, Helmers says. The more CCAs can help farmers with fine-tuning their water and nitrogen management, the more they can help with their client’s bottom line while helping the environment in the process.

“I think there’s an opportunity here,” Helmers stresses. “I don’t think the demand for cleaner water is going to go away, and I think our CCAs can be heavily involved to provide a service to the farmer to make sure that they are implementing practices that have the potential to reduce the nutrient export from their land.”

Because CCAs are often times the farmer’s point of information and the influencer on their farming practices, that puts the CCA in the unique role of educating farmers on the costs and benefits of a smarter tiling system.

Binstock also recommends CCAs to increase their own knowledge and training in regards to managed drainage as demand for improved yields and cleaner water grows in the future.

“CCAs can become TSPs (Technical Service Providers) for drainage water management,” Binstock advises. “As a matter of fact, that’s one of my recommendations as something they could add to their portfolio. So when they talk to the farmer, that just gives them another opportunity to be of service to their clients.”

The greatest obstacle CCAs have with educating their clients is changing the farmer’s understanding of best management practices with tile drainage, he says. Just because tile drainage has always been done one way doesn’t mean it’s the right method that can meet the challenges of the future.

“It’s really hard for people to change something they’ve done a certain way for so long,” Binstock warns. “It’d be like for all of us Americans who drive on the right side of the road to change over to the European type of driving a car on left side. It takes time to make that happen.”

Echols stresses that drainage water management is just one tool among many that are needed to help farmers achieve greater usage of their nitrogen and to reduce the amount that ends up in the public water supply. Agronomic practices such as cover crops and employing the 4Rs of nutrient management—applying the right source at the right rate, at the right time, and in the right place—are also integral in the goal of reducing nitrogen loss.

Routing drainage water through wetlands, buffers, and bioreactors in order to capture nutrients that have escaped the agricultural production zone, he adds, are additional practices farmers can adopt to help reduce nitrogen loss.

But those improved systems and farming practices begin with sharing knowledge with farmers, Binstock says. If the right information isn’t passed on from the CCA to his or her client, the costs can reach far into the future, particularly when it comes to installing a tile drainage system that could be in place for generations into the future.

“If they put in the wrong system,” he says, “you’re going to be living with it for 60 years.” &

USDA-NRCS’ Paul Sweeney shows a drainage water management system in Iowa. Photo courtesy of Iowa NRCS.