

CHESAPEAKE BAY JOURNAL

WHITE PAPER / JULY 2015

Nutrient Management & the Chesapeake Bay

Introduction

Each year, plans are written to guide how fertilizer and manure should be applied on more than 2.25 million acres of farmland in the Chesapeake Bay watershed to optimize crop production and minimize nutrient losses to the environment. Exactly what happens to those plans, how well they are implemented and the level of nutrient reduction they provide has become an area of increased debate within the Chesapeake Bay cleanup effort.

Over the years, improvements in science, technology and equipment have, without a doubt, improved the potential to more precisely apply nutrients and reduce nitrogen and phosphorus losses. Yet it is often unclear exactly how much pollution is kept out of the water by those actions, especially in different landscapes. Even more difficult to determine is the extent to which those nutrient recommendations are followed. Nutrient management originated as a common sense approach to help farmers optimize yields by reducing the purchase and application of unneeded fertilizers. Today, though, nutrient management can be a financial burden for many farmers.

Trying to estimate the amount of pollution reductions that can be attributed to nutrient management plans in the Chesapeake Bay watershed has been both difficult and controversial. During the last few years, a panel of experts worked to review existing science and recommend new estimates about the nitrogen and phosphorus pollution reductions that could be credited to various levels of nutrient management implementation.

Though difficult, it is part of a larger, ongoing effort to continually improve overall accountability and better track cleanup progress within the Chesapeake Bay Program partnership. That process, which is still evolving, is aimed at improving estimates of the amount of nutrient reductions attributable to various management actions, tracking their implementation, verifying that they are maintained over time, then assessing their ultimate impact on Chesapeake Bay water quality. Those efforts, drawn on the latest research findings and scientific data, are subject to updates and revisions based on new information.

The nutrient management recommendations apply only to computer models that will be in use through 2017. A new, more sophisticated Chesapeake Bay watershed model will go into use by the Bay Program partnership the next year, and will rely on recommendations from another

Bay Water Quality & the TMDL

Nutrient and sediment pollution cause widespread water quality problems in the Chesapeake Bay. Sediment clouds the water, preventing the growth of underwater grasses that provide important habitat for juvenile fish, crabs and waterfowl. It also smothers bottom-dwelling organisms, buries oyster reefs and can degrade other benthic habitats.

Nutrients spur the growth of algae blooms, which also cloud the water. In addition, when the algae die, they sink to the bottom and decompose in a process that draws oxygen out of the water that is needed by other aquatic life, thus causing oxygen-starved dead zones.

In 2010, the Chesapeake Bay Total Maximum Daily Load, or pollution diet, was established. The TMDL established limits on the amount of nitrogen, phosphorus and sediment that could reach the Bay from each major tributary and each state. Achieving TMDL goals would help the water clear up, allowing for the recovery of underwater grass beds, an increase in dissolved oxygen levels in the water and elimination of the “dead zone” in most years.

team of experts. The overall goal is to continually improve the ability to align what is happening on the land with actual changes measured in local streams and downstream Bay water quality.

Nutrient Management

In the post-World War II years, the widespread availability of new fertilizers, along with new crop varieties, dramatically increased crop production. But crops typically cannot use all of the nutrients applied to the soil, and excess applications lead to nutrient losses that impact local waterways and downstream lakes, bays and coastal waters.

Nutrient management is a science — and a bit of an art — that evolved over time to better match manure and commercial fertilizer applications with the soil nutrient supply and expected crop yields. Initially, nutrient management was primarily an economic tool to help farmers achieve optimal economic returns by avoiding the purchase of excess fertilizer. Over time, nutrient management

has become more sophisticated, often with more precise application recommendations, as greater emphasis has been placed on reducing nitrogen and phosphorus losses to waterways.

The heart of nutrient management is a plan, which is usually written by a consultant or extension agent in collaboration with the farmer. Ideally, the plan uses information from soil and manure tests, the type of crop being grown, climate and expected yields to determine the amount of nutrients to apply. Nutrient management plans are built around the “4Rs”:

- ≈ the Right Source
- ≈ at the Right Rate
- ≈ at the Right Time
- ≈ in the Right Place

The plan factors in the type of fertilizer or manure being applied and its nutrient content, then recommends application rates for particular fields, as well as the timing and placement of those applications.

Plans can get much more detailed, though, especially when involving the use of animal manure which typically is both more difficult to precisely apply and is more likely to run off the field. For example, some plans may provide very specific recommendations about the timing of applications and whether they should be split into multiple applications over time, whether manure should be incorporated into the soil, and if applications near streams or other environmentally sensitive areas should be restricted. The type of tillage used on the land may also affect plan recommendations. In some cases, the plan may recommend the transport of manure away from the farm if the volume generated exceeds crop needs.

Nutrient management & the Chesapeake Bay

Nutrient management may be the oldest best management practice (BMP) used to reduce nutrient runoff to the Chesapeake Bay, and it is one of the most widely implemented, affecting millions of acres of farmland in the Bay watershed. Over time, nutrient management became the cornerstone of agricultural nutrient reduction efforts in the Chesapeake watershed and was touted as a win-win solution for farmers and the environment — farmers could save money and reduce runoff.

But the reality is more complex. Farms that rely on purchased commercial fertilizers can save money. Those with stockpiles of animal manure face a different situation. The economics of modern agriculture make achieving nutrient balances difficult for animal operations. Many of those farms import at least a portion of their feed, and end up with more nutrients — in the form of manure — than they need for their own crop lands. Because moving feed is cheaper than moving manure, it's typically not economical to ship manure back to the lands growing corn, soybeans or other feed. That's especially true for manure from dairy operations or swine operations, which is heavier, wetter and harder to transport. Some farmers who aren't raising animals can be reluctant to import manure because it's harder to work with and apply.

Manure presents other problems as well. Unlike commercial fertilizers, which can provide the exact mix of nitrogen and phosphorus needed for a crop, manure typically does not. Animal waste, especially poultry litter, tends to have a higher ratio of phosphorus to nitrogen than is needed to grow a crop. Adequate nitrogen is critical for maximizing crop yields, but a farmer who tries to meet a crop's needs using only manure is usually overapplying phosphorus which, over time, can build up in soils and lead to long-term pollution problems. But if the farmer only applies enough manure to meet the phosphorus needs of a crop, additional nitrogen must be purchased in the form of commercial fertilizer — while leaving the farmer with an excess of manure.

That creates a paradox. Nutrient management originated to help farmers optimize economic returns by avoiding unneeded fertilizer applications. But for farmers with large amounts of manure, nutrient management can limit their ability to use that manure, forcing them to pay both to export surplus manure, and — in many cases — to buy additional nitrogen fertilizer.

Questions about Plan Implementation

While nutrient management plans have been written for millions of acres of farmland in the watershed, concerns have grown over the years about the extent to which they are actually implemented and improving water quality. A recent panel of experts trying to determine the amount of nutrient reductions resulting from the implementation of nutrient management plans on cropland in the Chesapeake Bay watershed pointedly commented on the “paucity of data” linking specific management actions with actual changes in water quality.

Further, it is unclear the extent to which nutrient management plans are resulting in reduced nutrient use relative to increased plant efficiency and yields. For example, agricultural fertilizer sales have increased since 2007, but yields have also increased since 2007 because of improved varieties and improved timing and placement.

A random survey of farmers in the Bay watershed conducted by the U.S. Department of Agriculture's Conservation Effects Assessment Project in 2011 found that 56 percent of farmers using only commercial fertilizer applied nitrogen on all crops within 21 days of planting. But for those applying manure, that fell to 12 percent. Likewise, 35 percent of farmers using commercial fertilizer said they applied nitrogen at the recommended rate on all cropland, but that fell to 9 percent for those using manure.

Inspections by the Maryland Department of Agriculture show better performance, though it still reports that only about two thirds of farmers are following recommendations in nutrient management plans. State officials say that survey may undercount actual performance because their inspections target farms believed to be the most problematic.

Still, the figures highlight concerns about whether recommendations are being fully implemented, especially for operations using manure, which is more difficult to manage and is more prone to runoff. The USDA report showed



As crop prices have increased over the past decade, farmers have increasingly become reluctant to reduce crop acreage. Photo / Dave Harp

that about half of the cropland in the watershed received only chemical fertilizer, while half received at least some manure, though it showed the cropland receiving only chemical fertilizer was decreasing, while the acreage receiving at least some manure was increasing.

Balancing conflicting information

Trying to determine the impact of nutrient management on Chesapeake Bay water quality has proven elusive over the years. For a quarter century, the state-federal Chesapeake Bay Program has used increasingly sophisticated computer models to estimate the amount of nutrients and sediment that wash off the Bay's 64,000-square-mile watershed and into the Chesapeake, where it contributes to water quality problems.

For years, records showed more manure was produced, and more fertilizer was bought, than could be applied to the available farmland if all written nutrient management plans were being followed. Before 2010, that problem was resolved simply by removing excess manure from the balance sheets. Officials even developed a term for it: "poofing."

That changed, when the Bay Program began using a new Watershed Model with the new Chesapeake Bay Total Maximum Daily Load. The new "Phase 5.3.2" Watershed Model used new procedures for representing nutrient application in the watershed by assuming that all manure was applied to agricultural land within the county of origin unless there were records of it being transported elsewhere. Manure could no longer be "poofed" away. This resulted in higher application rates in many areas, which also reduced benefits being attributed to nutrient management.

That change resulted in objections from states, which

are under increased pressure to meet nutrient reduction goals under the TMDL. State officials noted that uneven data quality in some areas resulted in greatly distorted application rates for some counties in the new watershed model. Many state officials also contended that some acreages receiving nutrient management are not credited simply because they lack correct documentation. Likewise, some farms are implementing more advanced, and effective, nutrient management techniques that do not receive full credit.

The issue of distorted application rates along with the potential under-crediting of nutrient management acreage is important to states because nutrient management can be applied to large swaths of active farmland. It is not the most effective agricultural best management practice in terms of nutrient reductions — Bay Program figures indicate it's responsible for a bit less than 10 percent of the nutrient reductions attributed to agriculture.

But, other "big hitter" agricultural BMPs in terms of nutrient reductions require taking land out of production, such as agricultural land retirement programs, or even riparian forest buffers. As crop prices have increased over the last decade, farmers have become more reluctant to take land out of production. USDA figures actually suggest cropland acreage in the watershed is increasing slightly.

In response to state concerns, the Bay Program's Agriculture Workgroup in late 2011 created an "expert panel" to review the nutrient management issue. It was one of many expert panels convened by the Bay Program partnership in recent years to determine the nutrient reduction "efficiencies" — the amount of nutrient reduction credit — that should be credited in the Phase 5.3.2 Water-

Nutrient management originated to help farmers optimize economic returns by avoiding unneeded fertilizer applications. But nutrient management can limit farmer's ability to use excess manure, forcing them to pay both to export surplus manure, and — in many cases — to buy additional nitrogen fertilizer.

Photo / Dave Harp



shed Model for implementation of various best management practices.

Expert Panel Looks for a Solution

The Nutrient Management Expert Panel, consisting of representatives from land grant universities, state and federal agricultural agencies, conservation districts and some stakeholder groups, sought to establish nutrient reduction efficiencies for three “tiers” of nutrient management. Each tier represents increasing levels of precision in planning and nutrient application management. They included:

≈ **Tier I: Crop Group Nutrient Management.** This essentially assumes a basic nutrient management plan with applications that are consistent with recommendations of state land grant universities during the early years of the Bay Program regarding nutrient sources and application rates.

≈ **Tier II: Field Level Nutrient Application Management.** This represents an elevated level of nutrient management, which can be supported with records, that more precisely aligns nutrient application with field level crop needs to reduce environmental impacts.

≈ **Tier III: Adaptive Nutrient Management.** This assumes a higher level of rigor for nutrient management that goes beyond Tier II by adapting nutrient applications over time based on more precise, and ongoing, field level tests that can evaluate nutrient management practices.

Initial Panel Recommendations

The initial activities of the Expert Panel were slowed by the unwieldy number of members (nearly 30), a leadership change on the panel, and the complexity of the task. State officials, frustrated from having time go by with no resolution to their concerns over nutrient management, pressed the panel for results.

In fall 2013, the expert panel produced a recommended

Tier I nutrient reduction efficiency. It called for:

≈ 9.25 percent total nitrogen reduction and 10 percent phosphorus reduction from high-till and low-till fields that are eligible for manure.

≈ 5 percent total nitrogen reduction and an 8 percent total phosphorus reduction from high-till lands that do not use manure, as well as for pasture lands, hay, alfalfa and nursery lands.

Tier I recommendations emphasize the most basic management and represents only two of the “four Rs” — right nutrient source and right application rates. It is largely based on reductions in nitrogen application rates made by land grant universities in each state; estimates using the Chesapeake Bay Watershed Model runs analyzing the impact of those application reductions; information about crop yields; and best professional judgment.

Those recommendations were adopted during meetings in fall 2013 and replaced previous nutrient management efficiencies in the watershed model beginning with data reported by states for 2013. The practical impact of the Tier I changes on estimated nutrient loads reaching the Bay was slight. Nonetheless, the basis for the phosphorus reductions that resulted from the recommendations have generated some questions and may be reviewed in the future.

Tier II Recommendations & Controversy

At that time, the panel did not make recommendations for the more advanced tiers of nutrient management, citing limitations in time and data. State representatives expressed concern about the lack of Tier II and Tier III efficiency recommendations as many believed they had farm acreages that qualified for greater nutrient reductions than provided by Tier I. The expert panel was directed by the Agriculture Workgroup in summer 2014 to further work on the issue and was given a two-month time frame in which to make recommendations.

The expert panel made new Tier II efficiency recommendations in fall 2014. They included:

≈ 15.75 percent total nitrogen reduction and 20 percent total phosphorus reduction for high-till and low-till land with manure applications.

≈ 11.5 percent total nitrogen and 18 percent total phosphorus reduction from high-till land without manure, pasture, hay alfalfa and nursery lands.

At that time, no Tier III recommendations were made because of time constraints.

Many stakeholders and some Bay Program partners, including the U.S. Environmental Protection Agency, the Chesapeake Bay Commission and the Bay Program’s Citizens Advisory Committee expressed concerns about the new Tier II recommendations. Some worried the changes would result in millions of pounds of nutrient reductions that existed only on paper — not in reality.

Generally, concerns cited vagueness about the recommended pollution reduction efficiencies; what agricultural land uses these efficiencies would apply to; lack of documentation showing how the recommended efficiencies were derived; and a lack of clarity about what actions

Nutrient Management Reduction Percentage by Land Use (maximum efficiencies by land use are in bold)

		High-Till with Manure	Low-Till with Manure	High-Till without Manure	Pasture	Hay with Nutrients	Alfalfa	Nursery
Tier 1 Reduction from no NMP	TN	9.25	9.25	5	5	5	5	5
	TP	10	10	8	8	8	8	8
Tier 2 Reduction from no BMP	TN	12.79	12.79	N/A	N/A	7.6	N/A	N/A
	TP	15.94	15.94	N/A	N/A	14.07	14.07	N/A
Tier 3 Reduction from no BMP	TN	15.23	15.23	N/A	N/A	N/A	N/A	N/A

Source: Nutrient Management Expert Panel

constituted Tier II implementation as opposed to Tier I implementation.

The Agriculture Workgroup reconvened the Nutrient Management Expert Panel in 2015 and recharged the panel with addressing those concerns about the draft recommendations.

Addressing Concerns

The reconvened Nutrient Management Panel began by reviewing the concerns and comments of the fall 2014 report. During its five-month deliberation time, it reviewed and summarized both published studies as well as “gray literature” sources, such as reports and other non peer-reviewed data. This extended review provided a better scientific basis for either directly estimating the nutrient reductions for certain actions, or for informing a best professional judgment estimate of the nutrient reductions. In June, the panel produced a new report, which more thoroughly documented the literature used in reaching decisions and outlined the line-of-reasoning used in reaching its revised recommendations.

The new Tier II recommendations cover a suite of practices that put more emphasis on the timing and placement of nutrients on the fields. Better matching application timing with actual field conditions can improve nutrient use by the crop and reduce runoff. Among the practices included in the Tier II definition of nutrient management were:

- ≈ Improving the timing of manure and fertilizer applications, so they are placed closer to a crop’s growth period, thereby reducing the potential for nutrient losses.
- ≈ Using the Phosphorus Site Index, a tool that helps evaluate individual fields based in their risk for phosphorus loss, and using that information to adjust recommended phosphorus applications.
- ≈ Manure incorporation into the soil, which reduces

Tier III Practices

Five practices qualify for Tier III nitrogen reduction efficiencies because they provide information that help farmers more precisely apply nutrients. They include:

≈ *Pre-Sidedress Soil Nitrate Test (PSNT)*, which monitors spring soil nitrogen levels just before plant’s rapid period of growth and nutrient use. It is used to identify sites that do, and do not, need additional nitrogen applications.

≈ *Corn Stalk Nitrate Test (CSNT)*, which reflects actual nitrogen use by the plant during the growing season which, over a period of years, can help fine-tune nitrogen applications based on different levels of plant uptake in individual fields.

≈ *Illinois Soil Nitrate Test (ISNT)*, a soil test used to make field-specific assessments of nitrogen supply over a period of years to fine-tune recommended application levels.

≈ *Fall Soil Nitrate Test (FSNT)*, which is done after a corn crop is harvested but before a winter small grain crop is planted to determine whether additional nitrogen is needed for the winter crop based on the amount left in the soil.

≈ *Variable Rate Nitrogen Application*, which uses a crop sensing system to adjust application rates based on actual field conditions.

the potential for ammonia losses to the atmosphere that can ultimately be deposited back on the ground. Incorporation also reduces the potential for phosphorus runoff in certain settings.

The revised Tier II recommended efficiencies, which incorporate Tier I efficiencies, were:

- ≈ 12.79 percent reduction for nitrogen for both high-till

and low-till lands receiving manure.

≈ 15.94 percent reduction for phosphorus for both high and low till fields receiving manure.

The panel made no recommendations for lands not receiving manure.

Besides reducing the efficiencies compared with the panel's draft recommendations from fall 2014, the Expert panel also reduced the amount of agricultural land they could be applied to by 40 percent, primarily by eliminating lands for which there was no scientific documentation to show that implementation of advanced nutrient management techniques would reduce nutrient runoff.

In addition, the panel made Tier III recommendations for adaptive nitrogen management that use more detailed information that would lead to an even more precise application of manure and fertilizers. The Tier III recommendation would apply for the use of any one of advanced four nitrate tests, or an application change (See box on page 5).

The recommended Tier III efficiency was a 15.23 percent reduction for nitrogen for high till and low till crop land receiving manure. That figure also incorporates the Tier I and Tier II reduction efficiencies.

The panel did not calculate a Tier III efficiency for phosphorus because of time constraints.

No one has yet used the Bay Program's Chesapeake Bay Watershed Model to estimate the impact of the proposed revisions for nutrient management efficiencies, but some believe they could increase the amount of reductions credited to nutrient management by about a fifth. That is considerably less than the changes proposed by the panel last fall, which some believe would have increased the

modeled nutrient management reductions by about half.

The Bay Program partnership will review the panel's recommendations through the summer and make final decisions in the fall.

Uncertain Data

There is little doubt that advances in science and technology allows farmers to more precisely apply nutrients than ever before. Instead of placing all of the fertilizer on fields at once, applications on many farms are made several times in smaller amounts, reducing runoff potential. New equipment and technologies allow nutrient applications to be tailored to small portions of fields. Instead of just testing soil and manure, many farmers are testing corn stalks to see how much nitrogen is actually being absorbed.

But trying to find the "right" nutrient reduction percentage — or efficiency — for nutrient management is tough.

Nutrient management can result in significant reductions for some crops, such as corn. But others, such as soybeans, often don't need fertilizer, so there's no benefit from a nutrient management plan. Effectiveness will vary by soils, by region and a host of other factors. And, while nutrient management plans might result in significant changes for some farms, they may result in little change in others because farmers have already adjusted their management.

The "efficiency" tries to represent, on average, what nutrient management (or any other BMP) accomplishes over a broad area, under the assumption that farms that achieve great reduction are balanced out by those with less reductions.

Complicating that is a general lack of solid research data on which to make recommendations. In its report, the expert panel included a plea for more research about the actual effectiveness of best management practices. It is difficult — in some cases "virtually impossible" — to extrapolate from local, often short-term field-scale studies, the nutrient reduction efficiencies that should be applied over broader areas.

The panel contended that better data would provide a number of benefits:

≈ Help convince the agricultural community that their actions do in fact affect water quality

≈ Help convince the environmental community that BMPs can achieve nutrient reductions if implemented correctly.

≈ Help policy makers better identify the most important BMPs for a particular state based on its effectiveness.

New Model, New Panel & Verification

There will be opportunities to put that new science to use in the future. The new recommendations, if approved, will only be in place through 2017. After that, the Bay Program plans to switch to a new, more detailed, computer model of the Bay's watershed, factoring in a wealth of new science and updated information.

The "Phase 6" Watershed Model represents a major overhaul compared with prior models. It will handle nutrients

Measuring the Midpoint Assessment

The Phase 5.3.2 Watershed Model will be used to evaluate nutrient reduction efforts through 2017, and will be used by the EPA to assess state progress through the midpoint assessment toward attaining the TMDL. By 2017, states are supposed to have implemented practices to achieve 60 percent of their pollution load reductions assigned under the TMDL. The watershed implementation plans written by the states were developed using the Phase 5.3.2 model, and the Bay Program has consistently used that tool to measure progress.

Meanwhile, the new Phase 6 Watershed Model is under development, and will go into use in 2018, when states will have to use information from that model to develop Phase III WIPs, which will guide nutrient reduction efforts from 2018 through 2025.

Therefore, it is likely — if not probable — that models will paint conflicting pictures of progress by late 2017. The new model, for instance, is being designed to better handle phosphorus, including the impact its long-term buildup in the soil. Recent monitoring shows that rather than decreasing, phosphorus loads from most rivers around the Bay are actually increasing.

Data Validation versus Verification

State progress toward meeting their nutrient reduction goals established in the Chesapeake Bay Total Maximum Daily Load are measured using the Bay Program's watershed model. Each year, states submit information to the Bay Program about the nutrient and sediment control actions they took in the past year, and that information is used in the model to estimate the amount of nutrient and sediment reductions those actions should accomplish.

But to get credit, states have to be able to certify that their data meet certain quality control standards.

To get credit for Tier I nutrient management, for instance, states can't just report "X" number of acres of farms having nutrient manage-

ment plans. They have to be able to validate that those plans conform with the Bay Program partnership's approved definition for that practice. For instance, the Nutrient Management Expert Panel recommended the state plans should contain a number of elements to be counted toward nutrient goals, such as:

- ≈ Exist in electronic or paper format;
- ≈ Be developed by a certified professional with the farmer;
- ≈ Be no more than 3 years old;
- ≈ Use soil tests; and
- ≈ Follow application recommendations of their respective land grant universities.

More advanced Tiers of nutrient management, if approved, would

require that states be able to certify those plans have additional elements including a Phosphorus Site Index if soil tests showed one was necessary; as well as more detailed estimates of crop yields based on soil conditions of each field; and that nutrient applications were timed and placed to reduce the risk of nutrient losses.

This data validation process is different than the still-being-developed verification process. Validation only ensures that the data submitted is consistent and meets certain standards. Verification, in contrast, is aimed at providing a new level of assurance that nutrient management (and all other best management practices) are being implemented as intended.

differently, operate at a finer scale and incorporate many new land uses. Instead of a single cropland category that mixes together row crops such as corn, wheat and soybeans, each crop type will be represented separately in the model. That will have significant ramifications for things like nutrient management, as nutrient use and applications vary greatly by crop.

A new Phase 6 Nutrient Management Expert Panel has already been created to update nutrient reduction efficiencies for that model. It will take recommendations from the existing panel and make adjustments or modifications to work in the new watershed model. Some people are already pressing it to re-examine the earlier, already approved, Tier I recommendations, which produced a significant phosphorus reduction on plans that applied primarily to nitrogen.

The Phase 6 Expert Panel will also review whether to continue the tiered approach used by the current panel, which groups similar practices together, or to recommend efficiencies based on specific practices. It will also examine baseline conditions for land uses — that is, the estimated nutrient levels being applied to land without nutrient management. The panel will also look at new issues, such as how to account for residual nutrients left after harvest that may be available for future crops — something not accounted for in the existing model that will be accounted for in the Phase 6 Model.

Addressing Verification

The Phase 6 Expert Panel will also offer the Bay Program recommendations about how nutrient management can be verified.

The Bay Program partnership adopted a new basinwide BMP verification framework in September 2014 that will be implemented over the next few years. The framework

requires that comparable procedures be established among states, and among pollutant source sectors, to verify that all best management practices counted toward Bay cleanup goals are implemented, functioning properly and not double-counted.

Verifying nutrient management plan implementation will be especially difficult, most agree. Nutrient management is what the verification framework calls a "non-visual" BMP; that is, its existence cannot be verified just through a visual inspection, such as a stream forest buffer.

Bay Program guidance says that verifying non-visual BMPs can include things like on-site review of farm records, but records alone are not considered adequate for verification. Verification would likely require that states sample a statistically valid number of farms employing nutrient management each year, though it's less clear exactly what will qualify as proof of nutrient management implementation — that's something the Phase 6 Expert Panel will have to help sort out.

Ideas are emerging. Most believe verification must include some testable, or measurable elements, such as measuring soil phosphorus levels. Some believe that verification could be done by establishing a nutrient balance for a farm — weighing all of the fertilizer bought and applied, along with manure being generated, against the amount of crops grown, products (such as milk or meat) produced, and manure exported to other farms.

Verification, ultimately, is an essential element for nutrient management. Most agree that nutrient management, especially new, more advanced and precise application techniques, can play a major role in meeting Bay cleanup objectives. But it is essential that the public, and policymakers, have confidence that it is working.

— Karl Blankenship

Roger Rohrer and his sons manage moisture as carefully as they do nutrients. The amount of residue left after harvest, and from cover crops, varies by field, with more being left on drier soils on the ridges to help them retain moisture.
Photo / Dave Harp



PA farm's future depends on nutrient management

≈ Proximity to town's water supply leaves no room for error when applying nutrients to crops.

BY KARL BLANKENSHIP

Roger Rohrer hasn't committed any crimes, but he runs his farm as though he's a man on probation. Standing outside one of his chicken houses in Pennsylvania's Lancaster County, he points to a small fenced area down a grassy slope.

"That is a Strasburg Borough municipal well," he said. "This whole farm drains right by that watershed."

Several years ago, he asked his insurance company whether he could get a policy that would protect him in the event of contamination of a municipal well. The answer was no. If there was contamination, Rohrer surmised, he'd be out of business.

If Strasburg's water supply becomes polluted and unusable, Rohrer doesn't want anyone pointing a finger at his farm. "We believe we are farming under probation," he said.

In the last decade and a half, "R Farm," as it is named, has transformed from an operation where urea fertilizer was heavily applied once — two weeks before planting — into a model of nutrient management where fertilizers are carefully metered out in three smaller doses to reduce runoff and improve crop performance.

His farm — actually two farms, one of 130 acres and one of 80 acres — are subdivided into a number of fields with different soil types. Yearly, a consultant prepares a nutrient management plan for each field. Based on soil tests, the crop being grown and other data, the plan tells Rohrer how much manure from the 1 million chickens he grows each year and how much chemical fertilizer should go on each field, and when.

He has gained a higher level of precision from several years of corn stalk nitrate tests, which provided greater insight about the amount of nitrogen the corn absorbed — and allowed fertilizer applications to be adjusted accordingly.

The plans tell him he doesn't need as much phosphorus as is produced by his chickens. So only 200 of the 1,200 tons of chicken litter produced each year are applied to the ground. The rest is sold to a mushroom producer in Kennett Square.

After a couple of mushroom crops have drawn down the nutrients, Rohrer brings back the poultry waste and sells it to Amish farmers who use it as mulch for their gardens. "I don't have to apply that litter on the fields," he said. "I currently have a place to get rid of it."

But he's worried that back-and-forth exchange won't last. As Maryland implements its new phosphorus management tool, which will reduce the amount of poultry litter that can be applied to Eastern Shore farms, he is

concerned the mushroom growers will be overwhelmed with poultry litter from Maryland, and not need his anymore.

"If you aren't aware of that, and aren't concerned about it in Lancaster County, you should be," he said.

The first nutrient application for most of the land is poultry litter, which provides the phosphorus the crops need to start growing, along with about a third of the nitrogen and a lot of organic material that will enrich the soil.

Each spring, he watches the weather for the right temperatures and, especially, the rainfall. He wants the soil to be "receptive" to the nutrients — dry — but he also wants about half an inch of rain within a few days so the nutrients and organic materials soak into the soil, preparing it for planting.

An application of commercial nitrogen is disced a couple of inches into the soil when the crop is planted, and a third "sidedress" application mixed with a stabilizer to help hold the nutrient into the soil, is dribbled between the rows when the plants are starting to grow — and will rapidly take up the nitrogen.

"It is common sense, really, but it takes more work," Rohrer said. "It takes more equipment."

He and his sons manage moisture as carefully as they do nutrients. The amount of residue left after harvest, and from cover crops, varies by field, with more being left on drier soils on the ridges to help them retain moisture.

"Good yields pull nutrients out of the ground. That's why the moisture is important. If we can keep moisture in the ground and get good yields, that allows us to be profitable."

While nutrient management is a core element, it is part of a larger conservation system employed by Rohrer on the farm.



Roger Rohrer shows off his riparian buffer. Because his farm is so close to the Strasburg Borough municipal water supply, he is particularly diligent with how he applies nutrients to his crops. Photo / Dave Harp

That system includes other measures, such as planting nutrient-absorbing cover crops in the fall, using continuous no-till on his fields and planting forest buffers along his streams. Several acres of land are set aside around each chicken house to give the ground a chance to absorb the runoff from the buildings before it reaches the stream.

Not everyone is sold on his techniques. "Some of my friends think I'm nuts," Rohrer said. But he is a fourth-generation farmer, and thinks the changes are essential if the land is to be farmed by future generations of his family.

As the public becomes further removed from farm production and has growing concerns about a clean environment, the social and political pressures — along with changing science — are going to require farmers to do a better job, he said. The wells drawing water from under his land are a constant reminder of that challenge.

"If anyone needs to be concerned about doing it by the book, or better than the book, it's us," he said. "But I would like to think I'd be doing it that way anyway."