Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

CODE 590

(ac)

DEFINITION

Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve plant health and productivity
- Reduce excess nutrients in surface and ground water
- Reduce emissions of objectionable odors
- Reduce emissions of particulate matter (PM) and PM precursors
- Reduce emissions of greenhouse gases (GHG)
- Reduce emissions of ozone precursors
- Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water
- Improve or maintain soil organic matter

CONDITIONS WHERE PRACTICE APPLIES

All fields where plant nutrients and soil amendments are applied. Does not apply to one-time nutrient applications at establishment of permanent vegetation.

CRITERIA

General Criteria Applicable to All Purposes

Develop a nutrient management plan for nitrogen (N), phosphorus (P), and potassium (K), which accounts for all known measurable sources and removal of these nutrients.

Sources of nutrients include, but are not limited to, commercial fertilizers (including starter and in-furrow starter/pop-up fertilizer), animal manures, legume fixation credits, green manures, plant or crop residues, compost, organic by-products, municipal and industrial biosolids, wastewater, organic materials, estimated plant available soil nutrients, and irrigation water.

When irrigating, apply irrigation water in a manner that reduces the risk of nutrient loss to surface and ground water.

Follow all applicable State requirements and regulations when applying nutrients near areas prone to contamination, such as designated water quality sensitive areas, (e.g., lakes, ponds, rivers and streams,

sinkholes, wellheads, classic gullies, ditches, or surface inlets) that run unmitigated to surface or groundwater.

Soil and tissue testing and analysis
Base the nutrient management plan on current soil test results in accordance with land grant university (LGU) guidance, or industry practice when recognized by the University of Illinois. Use soil tests no older than 2 years when developing new nutrient management plans. Use tissue testing, when applicable, for monitoring or adjusting the nutrient management plan in accordance with University of Illinois guidance, industry practice when recognized by the University of Illinois, and Illinois Agronomy Technical Note No. 23 “Soil Sampling Guidelines for Immobile Plant Nutrients” .

For nutrient management plan revisions and maintenance, take soil tests on an interval recommended by the University of Illinois or as required by local rules and regulations.

Collect, prepare, store, and ship all soil and tissue samples following University of Illinois guidance or industry practice. The test analyses must include pertinent information for monitoring or amending the annual nutrient plan. Follow University of Illinois guidelines regarding required analyses and test interpretations.

Soil test analyses must be performed by laboratories successfully meeting the requirements and performance standards of the Illinois Soil Testing Association Lab Accreditation Program (ISTA-LAP) http://www.soiltesting.org/ or the North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP) http://www.naptprogram.org/pap , or other NRCS-approved programs that consider laboratory performance and proficiency to assure accuracy of soil test results.

Maintain soil pH within ranges which enhance the adequate level for plant or crop nutrient availability and utilization. Refer to State University of Illinois documentation for guidance. The soil and tissue tests must include analyses pertinent to monitoring or amending the annual nutrient budget, e.g., pH(water), phosphorus (Bray P1 or Mehlich III colorimetrically analyzed), potassium (Ammonimim acetate or Mehlich III colorimetrically analyzed) . Testing for CEC, organic matter, and/or nitrogen is optional.

Manure, organic by-product, and biosolids testing and analysis
Collect, prepare, store, and ship all manure, organic by-products, and biosolids following University of Illinois guidance,industry practice when recognized by the University of Illinois, and/or the testing laboratory’s guidelines. In the absence of such guidance, test at least annually, or more frequently if needed to account for operational changes (e.g., feed management, animal type, manure handling strategy, etc.) impacting manure nutrient concentrations. When planning for new or modified livestock operations, acceptable “book values” may be obtained from: the NRCS Agricultural Waste Management Field Handbook, Livestock Facilities Handbook, MWPS-18.Section 1.

Manure tests results from the previous year may be used for initial plan preparation unless there has been a change in the operation that would be expected to cause significant changes to the manure chemistry such as changes in feed management, storage methods, livestock type or animal production phase. The running average manure nutrient content test values can be used to calculate the appropriate manure rates to meet the nutrient requirements specified for the current year. Prior to establishing stable nutrient content averages, sampling will occur at a frequency based on the designed storage period. For example, manure storage facilities designed for 6 months storage will sample twice yearly. Storage facilities designed for 9 months storage will be sampled every 9 months.

Storage facilities designed with 12 or months of storage will be sampled at least annually. Over the course of the plan implementation, if no operational changes occur, less frequent manure testing is allowable where operations can document a stable level of nutrient concentrations for the preceding three consecutive years, unless federal or state regulations require more frequent testing.

Manure analyses must include, at minimum, total Kjeldahl Nitrogen (N), ammonium Nitrogen, total phosphorus (P) or P2O5, total potassium (K) or K2O, and percent solids. Plant available Nitrogen from the

organic fraction of the manure will be estimated based on animal species, animal production phase, storage and application method. Nitrogen will be credited to the nutrient budget at 50, 25, and 12.5 percent of the estimated year of application plant available organic nitrogen respectively for subsequent years 1, 2, and 3.

When planning for new or modified livestock operations, acceptable “book values” may be obtained from: the NRCS Agricultural Waste Management Field Handbook, Livestock Facilities Handbook, MWPS-18.Section 1.

Manure testing analyses must be performed by laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification program (MTLCP) under the auspices of the Minnesota Department of Agriculture.
http://www2.mda.state.mn.us/webapp/lis/manurelabs.jsp

For nutrient management plans developed as a component of a comprehensive nutrient management plan for an animal feeding operation (AFO) follow policy in NRCS directive General Manual (GM) 190, Part 405, “Comprehensive Nutrient Management Plans.” These plans must include documentation of all nutrient imports, exports, and on-farm transfers.

Nutrient loss risk assessments
Use current NRCS-approved nitrogen, phosphorus, and soil erosion risk assessment tools to assess the site-specific risk of nutrient and soil loss.

Complete an NRCS-approved nutrient risk assessment for N on all fields where nutrient management is planned unless the State NRCS, in cooperation with State water quality control authorities, has determined specific conditions where N leaching is not a risk to water quality, including drinking water.

For purposes of implementing the 590 Nutrient Management Practice Standard and Assessments, a field will be considered tile drained when at least 50 percent of the field acreage is drained via subsurface drains. The Illinois Drainage Guide will be used to determine the extent of drainage.

Fields that are tile drained and/or contain soils that have high risk characteristics for nitrogen leaching will achieve a Medium risk for nitrogen as outlined in the Illinois NRCS Nitrogen Management Guidelines.

Complete an NRCS-approved nutrient risk assessment for P when any of the following conditions are met—

- P application rate exceeds University of Illinois fertility rate guidelines for the planned crop(s).
- The planned area is within or contributes to a HUC 12 watershed impaired for phosphorus or algae as designated by Illinois Environmental Protection Agency (i.e. water bodies with total phosphorus or aquatic algae listed as a cause of impairment according to the most recent 305(b) assessment report.)
- Fields not meeting these conditions will not be required to use the Illinois Phosphorus Index unless otherwise required under other criteria of the standard.

Any fields excluded from a P risk assessment must have a documented agronomic need for P, based on soil test P and University of Illinois nutrient recommendations.

For fields receiving manure, where P risk assessment results equate to—

- LOW risk.—Manure can be applied at rates to supply P at greater than crop requirement not to exceed the N requirement for the succeeding crop.
- MODERATE risk.—Manure can be applied at rates not to exceed crop P removal rate or the soil test P recommended rate for the planned crops in rotation.
- HIGH risk.—Manure can be applied at rates not to exceed crop P removal rate if the following requirements are met:

- A soil P drawdown strategy has been developed, documented, and implemented for the crop rotation.
- Implementation of all mitigation practices determined to be needed by site-specific assessments for nutrients and soil loss to protect water quality.
- Any deviation from these high-risk requirements that would increase the risk of P runoff requires the approval of the Chief of the NRCS.

The 4Rs of nutrient stewardship
Manage nutrients based on the 4Rs of nutrient stewardship—apply the right nutrient source at the right rate at the right time in the right place—to improve nutrient use efficiency by the crop and to reduce nutrient losses to surface and groundwater and to the atmosphere.

Nutrient source
Choose nutrient sources compatible with application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic content, and local climate to minimize risk to the environment.

Determine nutrient values of all nutrient sources (e.g. commercial fertilizers, manure, organic by-products, biosolids) prior to land application.

Determine nutrient contribution of cover crops, previous crop residues, and soil organic matter.

For operations following USDA's National Organic Program, apply and manage nutrient sources according to program regulations.

Enhanced efficiency fertilizers, used in Illinois must be defined by the Association of American Plant Food Control Officials (AAPFCO) (Illinois Department of Agriculture) and be registered for use by the Illinois Department of Agriculture.

In areas where salinity is a concern, select nutrient sources that limit the buildup of soil salts. When manures are applied, and soil salinity is a concern, monitor salt concentrations to prevent potential plant or crop damage and reduced soil quality.

Apply manure or organic by-products on legumes at rates no greater than the University of Illinois or other applicable region-releveant publications estimated N removal rates in harvested plant biomass, not to exceed P risk assessment limitations.

For any single application of nutrients applied as liquid (e.g., liquid manure, nutrients in irrigation water, fertigation)—

- Do not exceed the soil's infiltration rate or water holding capacity.
- Apply so that nutrients move no deeper than the current crop rooting depth.
- Avoid runoff or loss to subsurface tile drains.

Nutrient rate
Plan nutrient application rates for N, P, and K using University of Illinois recommendations or industry practices when recognized by theUniversity of Illinois . Nutrient application rates may deviate from standard University of Illinois recommendations if appropriate adaptive management techniques and procedures are implemented. Refer to Illinois NRCS Adaptive Nitrogen Management Guidelines. Lower-than-recommended nutrient application rates are permissible if the client's objectives are met.

At a minimum, determine the rate based on crop/cropping sequence, current soil test results, and NRCS-approved nutrient risk assessments. Where applicable, use realistic yield goals.

For new crops or varieties where University of Illinois guidance is unavailable, relevant information from adjacent LGU's, or industry-demonstrated yield and nutrient uptake information may be used.

Estimate realistic yield potentials or realistic yield goals using University of Illinois procedures or based on historical yield or growth data, soil productivity information, climatic conditions, nutrient test results, level of management, and/or local research results considering comparable management and production conditions.

Average crop yields for each crop may be determined using one of the following methods:

- Average of five years for each crop based on producer records, excluding individual years where the yield varied plus or minus 25% of the five year average. Multiply the average by 1.05.
- Crop insurance yields, Farm Services Agency yields, or county average yields.
- Weighted average of the yields based on soil type and yields from the University of Illinois “Average Crop, Pasture, and Forestry Productivity Ratings for Illinois Soils: Bulletin No. 810 or Optimum Crop Productivity Ratings for Illinois Soils: Bulletin No. 811”.

Crop nutrients provided by the application of biosolids, starter fertilizers, or pop-up fertilizers must be accounted for in the nutrient budget.

Estimate legume-nitrogen credits from guidelines provided in the Illinois Agronomy Handbook.

On fields where the median soil test Bray P1 or Mehlich 3 exceeds 70 /acre, dual carrier fertilizers such as, but not limited to, 10-34-0, 18-46-0, or 11-52-0 may be applied pre-plant to late summer/fall seeded small grains or forages. The rate of the dual carrier product will not be applied to exceed 30 lbs. N/acre.

Nutrient application timing and placement

Consider the nutrient source, management and production system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment to develop optimal timing of nutrients. For N, time the application as closely as practical with plant and crop uptake. For P, time planned surface application when runoff potential is low. Time the application of all nutrients to minimize potential for soil compaction.

For crop rotations or multiple crops grown in one year, do not apply additional P if it was already added in an amount sufficient to supply all crop nutrient needs.

To avoid salt damage, follow University of Illinois recommendations for the timing, placement, and rate of applied N and K in starter fertilizer or follow industry practice recognized by the University of Illinois .

Starter fertilizer applications containing phosphorus may be applied on phosphorus restricted fields where the:

- fertilizer is placed below the soil surface
- Soil loss is managed

Unincorporated, surface-applied nutrients must not be applied if nutrient losses offsite are likely. This includes spreading of manure, urea, UAN solutions, ammonium sulfate, and/or ammoniated phosphates:

- Soils are frozen.
- Soils are snow-covered.
- The top 2 inches of soil are saturated.

Exceptions for the above criteria related to surface-applied nutrients when there is a risk of runoff can be made when specified conditions are met and adequate conservation measures are installed to prevent the offsite delivery of nutrients. NRCS, in cooperation with the State water quality control authority, will define

adequate treatment levels and specified conditions for applications of manure if soils are frozen and/or snow covered or the top 2 inches of soil are saturated. At a minimum, must consider the following site and management factors:

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- Exceptions for the above criteria can be made for surface-applied nutrients:
- when adequate conservation measures are in place such as and not limited to, Conservation Crop Rotation (328), Residue and Tillage Management (329, and 345,), Contour Farming (330),
- Stripcropping (585), Cover Crop (340), Field Border (386), and Filter Strip (393).
- when adequate ephemeral erosion control practices are installed to prevent the offsite delivery of nutrients such as and not limited to Terraces (600), Water and Sediment Control Basins (638), and Grassed Waterways, (412).
- when top dressing fertilizers for small grains or pastures on frozen soils prior to green up, or when frost seeding legumes mixed with fertilizer and,
- adequate treatment must achieve a **Medium** Phosphorus Index rating.

Additional Criteria to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater

Apply conservation practices to avoid nutrient loss and control and trap nutrients before they can leave the field(s) by surface, leaching, or subsurface drainage (e.g., tile, karst) when there is a significant risk of transport of nutrients.

Manure application(s) must meet all applicable state and federal regulations such as the Livestock Management Facilities Act (LMFA), Illinois Environmental Protection Act, and Federal Clean Water Act.

The total single application of liquid manure applied through an irrigation system:

- must not exceed the soil infiltration rate and water holding capacity
- be based on crop rooting depth

The total single application of injected liquid manure must be applied in such a manner as to avoid runoff or loss to subsurface tile drains.

Crop production activities and nutrient use efficiency technologies must be coordinated to take advantage of mineralized plant-available nitrogen to minimize the potential for nitrogen losses due to denitrification or ammonia volatilization.

Manure will not be applied to the following areas:

- On slopes >15% unless incorporated or injected.
- Within ¼ mile of a residence other than the operator’s unless injected or incorporated within 24 hours.
- Within 200 feet of surface water unless upgrade or there is adequate diking.
- Within 150 feet of potable water supply wells.

- Within 10-year flood plains unless injected or incorporation methods are used. Surface applied manure will be injected or surface applied and incorporated within 24 hours of application.
- Organic soils with a seasonal water table within 1 foot of the soil surface.
- Grassed waterways unless incidental to liquid manure applied through irrigation systems and:
    - there is no runoff from the irrigation and,
    - the distance to surface water is greater than 200 feet and,
    - the distance to potable water is greater than 150 feet and,
    - the distance to a non-potable well, abandoned or plugged well, drainage well, or injection well is greater than 100 feet and,
    - precipitation is not expected within 24 hours.

Manure may be surface applied to fields with permanent vegetation without injection or incorporation on slopes up to 15%. Manure may not be applied:

- Within 150 feet of potable water supplies.
- Organic soils with a seasonal water table within 1 foot of the soil surface.
- Within 15 feet of either side of the centerline of intermittent drainage way within the pasture unless incidental to liquid manure applied through irrigation systems.
- Within 35 feet of either side of a drainage ditch or open surface inlet to a tile drain or open sinkhole (karst).

Liquid manure may not be applied to fields or areas within fields where soil depth to fractured bedrock, sand or gravel is less than 24 inches.

Fields targeted for manure application after small grain or corn silage harvest that meet the high risk conditions outlined in the Nitrogen Management Guidelines will be planted to a double crop grain, annual forage, or cover crop.

For fields receiving manure, where phosphorus risk assessment results equate to **LOW** risk, additional phosphorus can be applied at rates greater than crop removal rate not to exceed the nitrogen requirement for the succeeding crop.

For fields receiving manure, where phosphorus risk assessment results equate to **MEDIUM** risk, additional phosphorus may be applied at a phosphorus crop removal rate for the planned crops in the rotation.

When phosphorus risk assessment results equate to **HIGH** risk, additional phosphorus may be applied at phosphorus crop removal rates if the following requirements are met:

- a soil phosphorus drawdown strategy has been implemented, and
- a site assessment for nutrients and soil loss has been conducted to determine if mitigation practices are required to protect water quality.
- any deviation from these high risk requirements must have the approval of the Chief of the NRCS.

Manure may be applied on legumes at rates equal to the estimated removal of nitrogen in harvested plant biomass.

Manure may be applied at a rate equal to the recommended phosphorus application, or estimated phosphorus removal in harvested plant biomass for the crop rotation, or multiple years in the crop sequence at one time. When such applications are made, the application must not exceed the recommended nitrogen application rate during the year of application or harvest cycle, and no additional phosphorus must be applied in the current year and any additional years for which the single application of phosphorus is supplying nutrients.

Multiple year applications will not be applied on fields that exceed Bray P1 or Mehlich 3 median test values of 300 lbs. P/ac. No phosphorus will be applied to fields that exceed median test values 400 lbs. P/ac.

Application of organic by-products and biosolids must meet all state and federal regulations and strictly follow the conditions outlined in the appropriate NPDES permit and/or State Operating Permit as issued by the IEPA.

Fields receiving organic by products and/or biosolids must be monitored for the accumulation of heavy metals and phosphorus in accordance with applicable Federal and State law.

Additional Criteria to Reduce the Risk of Potential Pathogens From Manure, Biosolids, or Compost Application From Reaching Surface and Groundwater

When applicable, follow proper biosecurity measures as provided in NRCS directives GM-130, Part 403, Subpart H, “Biosecurity Preparedness and Response.”

Follow all applicable Federal, Tribal, State, and local laws and policies concerning the application of manure, biosolids, or compost in the production of fresh, edible crops.

Apply manure, biosolids, or compost with minimal soil disturbance or by injection into the soil unless it is being applied to an actively growing crop, a minimum of 30 percent residue exists, or there is a living cover that has a fibrous root system with 75 percent or more cover. Do not surface apply manure if a storm event is forecast within 24 hours.

Additional Criteria to Reduce Emissions of Objectionable Odors, PM and PM Precursors, and GHG and Ozone Precursors

To address air quality concerns caused by odor, N, sulfur, and particulate emissions; adjust the source, timing, amount, and placement of nutrients to reduce the negative impact of these emissions on the environment and human health.

One or more of the following may be used:

- slow or controlled release fertilizers
- nitrification inhibitors
- urease inhibitors
- nutrient enhancement technologies
- incorporation
- injection
- stabilized nitrogen fertilizers
- residue and tillage management
- no-till or strip-till
- other technologies that minimize the impact of these emissions

Do not surface apply solid nutrient sources, including commercial fertilizers, manure, or organic by-products of similar dryness/density when there is a high probability that wind will blow the material and emissions offsite. Do not surface apply liquid nutrient sources when there is a high probability that wind will blow the liquid droplets applied from sprinklers or other applicable methods offsite.

Reduce the potential for volatilization by applying sources subject to volatilization during cooler, higher humidity conditions or by placement that minimizes vulnerability to volatilization.

Additional Criteria to Improve or Maintain Organic Matter

Design the plant or crop management systems so the soil conditioning index (SCI) organic matter subfactor is positive.

Apply manure, compost, or other organic nutrient sources at a rate and with minimal disturbance that will improve soil organic matter without exceeding acceptable risk of N or P loss.

For low residue plant or cropping systems, apply adequate nutrients to optimize plant or crop residue production to maintain or increase soil organic matter.

CONSIDERATIONS

General Considerations

Consider development of nutrient management plans by conservation management unit (CMU). A CMU is a field, group of fields, or other land units of the same land use and having similar treatment needs and planned management. A CMU is a grouping by the planner to simplify planning activities and facilitate development of conservation management systems. A CMU has definitive boundaries such as fencing, drainage, vegetation, topography, or soil lines.

Develop site-specific yield maps using a yield monitoring system, multispectral imagery or other methods. Use the data to further delineate low- and high-yield areas, or zones, and make the necessary management changes. Use variable rate nutrient application based on site-specific factor variability. See NRCS directive Agronomy Technical Note (TN) 190, AGR.3, “Precision Nutrient Management Planning.”

Use the adaptive nutrient management learning process to improve nutrient use efficiency on farms as outlined in NRCS’ national nutrient policy in GM-190, Part 402, “Nutrient Management.” Consider using an adaptive approach to adjust nutrient rate, timing, form, and placement as soil biologic functions and soil organic matter changes over time. See NRCS directive Agronomy Technical Note (TN) 190, AGR.7, “Adaptive Nutrient Management Process.”

When developing new nutrient management plans, consider using soil test information no older than 1 year rather than 2 years.

Develop a whole farm nutrient budget (nutrient mass balance), including all imported and exported nutrients. Imports may include feed, fertilizer, animals and bedding, while exports may include crop removal, animal products, animal sales, manure, and compost.

Modify animal feed diets to reduce the nutrient content of manure following guidance contained in Conservation Practice Standard (CPS) Feed Management (Code 592).

Provide a nutrient analysis of all nutrient source exports (manure or other materials).

Excessive levels of some nutrients can cause induced deficiencies of other nutrients, (e.g., high soil test P levels can result in zinc deficiency in corn).

Use soil tests, plant tissue analyses, and field observations to check for secondary plant nutrient deficiencies or toxicity that may impact plant growth or availability of the primary nutrients.

Do not apply K in situations where an excess (greater than soil test K recommendation) causes nutrient imbalances in crops or forages.

Use bioreactors and multistage drainage strategies to mitigate nutrient loss pathways, as applicable.

Use legume crops and cover crops to provide N through biological fixation. Cover crops with a carbon to nitrogen ratio below 20:1 can release a large amount of soluble N after being plowed or tilled into the soil when an actively growing crop is not present to take up nutrients, leading to increased risks of nitrate movement and nitrous oxide emissions. The nitrous oxide emissions often occur in high soil moisture

conditions, such as when a legume cover crop is plowed down in fall or early spring. To avoid these losses, use grass-legume or grass-legume-forbs mixtures with a more balanced carbon to nitrogen ratio.

Use winter hardy grass cover crops to take up excess N after the cash crop growing season and promote contribution of the nitrogen to next plant or crop.

Use conservation practices that slow runoff, reduce erosion, and increase infiltration (e.g., filter strip, contour farming, or contour buffer strips).

Use application methods, timing, technologies or strategies to reduce the risk of nutrient movement or loss, such as—

- Split nutrient applications.
- Banded applications.
- Injection of nutrients below the soil surface.
- Incorporate surface-applied nutrient sources when precipitation capable of producing runoff or erosion is forecast within the time of a planned application.
- High-efficiency irrigation systems and technology.
- Enhanced efficiency fertilizers
    - Slow or controlled release fertilizers
    - Nitrification inhibitors
    - Urease inhibitors.
- Drainage water management.
- Tissue testing, chlorophyll meters, or real-time sensors.
- Pathogen management considerations.

When a recycled product (e.g., compost) is to be used as a nutrient source on food crops or as food for humans or animals, make sure that pathogen levels have been reduced to acceptable levels (reference the Food and Drug Administration's Food Safety Modernization Act). www.fda.gov/FSMA When the recycled product has come from another farming operation, implement biosecurity measures and evaluate the risk of pathogen transfer that could cause plant or animal diseases.

Use manure treatment systems that reduce pathogen content from manure.

Implementing a soil health management system that reduces tillage or other soil disturbance, includes a diverse rotation of crops and cover crops, keeps roots growing throughout the year, and keeps the soils covered to reduce nutrient losses, and improves—

- Nutrient use efficiency, rooting depth, and availability of nutrients.
- Soil organic matter levels.
- Availability of nutrients from organic sources.
- Aggregate stability and soil structure.
- Infiltration, drainage, and aeration of the soil profile.
- Soil biological activity.
- Water use efficiency and available moisture.

Use targeted or prescribed livestock grazing to enhance nutrient cycling and improve soil nutrient cycling functions.

Elevated soil test P levels may lead to reduced mycorrhizal fungal associations and immobilize some micronutrients, such as iron, zinc, and copper.

Apply manure, compost, or other nutrient sources with minimal soil disturbance and at a rate that will improve soil organic matter without exceeding acceptable risk of N or P loss.

PLANS AND SPECIFICATIONS

In the nutrient management plan, document—

- Aerial site photograph(s), imagery, topography, or site map(s).
- Soil survey map of the site.
- Soil information including: soil type, surface texture, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and ponding frequency.
- Location of designated sensitive areas and the associated nutrient application restrictions and setbacks.
- Location of nearby residences, or other locations where humans may be present on a regular basis, that may be impacted if odors or PM are transported to those locations.
- Results of approved risk assessment tools for N, P, and erosion losses.
- Documentation establishing the application site presents a low risk for P transport to local water if P is applied in excess of crop requirement.
- Current and planned plant production sequence or crop rotation.
- All available test results (e.g. soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient budget and management plan are based.
- When soil P levels are increasing above an agronomic level, include a discussion of the risk associated with P accumulation and a proposed P draw-down strategy.
- Realistic yield goals for the crops (where applicable for developing the nutrient management plan).
- Nutrient recommendations for N, P, and K for the entire plant production sequence or crop rotation.
- Listing, quantification, application method and timing for all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports, and onsite transfers.
- Guidance for implementation, operation and maintenance, and recordkeeping.

For variable rate nutrient management plans, also include—

- Geo-referenced field boundary and data collected that was processed and analyzed as a GIS layer or layers to generate nutrient or soil amendment recommendations per management zone. Must include site-specific yield maps using soils data, current soil test results, and a yield monitoring system with GPS receiver to correlate field location with yield.
- Nutrient recommendation guidance and recommendation equations used to convert the GIS base data layer or layers to a nutrient source material recommendation GIS layer or layers.
- After implementation, provide application records per management zone or as applied map within individual field boundaries (or electronic records) documenting source, timing, method, and rate of all nutrient or soil amendment applications.

If increases in soil P levels are expected above an agronomic level (i.e., when N-based rates are used), document—

- Soil P levels at which it is desirable to convert to P-based planning.
- A long-term strategy and proposed implementation timeline for soil test P drawdown from the production and harvesting of crops.
- Management activities or techniques used to reduce the potential for P transport and loss.
- For AFOs, a quantification of manure produced in excess of crop nutrient requirements.

OPERATION AND MAINTENANCE

Review or revise plans periodically to determine if adjustments or modifications are needed. At a minimum, review and revise plans as needed with each soil test cycle, changes in manure management, volume or analysis, plants and crops, or plant and crop management.

Monitor fields receiving animal manures and biosolids for the accumulation of heavy metals and P in accordance with LGU guidance and State law.

For animal feeding operation, significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment to ensure accurate distribution of material at planned rates. For products too dangerous to calibrate, follow LGU or equipment manufacturer guidance on proper equipment design, plumbing, and maintenance.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation to explain the difference.

Protect workers from and avoid unnecessary contact with nutrient sources. Take extra caution when handling anhydrous ammonia or when managing organic wastes stored in unventilated tanks, impoundments, or other enclosures.

Use material generated from cleaning nutrient application equipment in an environmentally safe manner. Collect, store, or field apply excess material in an appropriate manner.

Recycle or dispose of nutrient containers in compliance with State and local guidelines or regulations.

Maintain records for at least 5 years to document plan implementation and maintenance. Records must include—

- All test results (soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient management plan is based.
- Listing and quantification of all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports and onsite transfers.
- Date(s), method(s), and location(s) of all nutrient applications.
- Weather conditions and soil moisture at the time of application, elapsed time from manure application to rainfall or irrigation event(s).
- Plants and crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and plant or crop residues removed.
- Dates of plan review, name of reviewer, and recommended adjustments resulting from the review.

For variable rate nutrient management plans, also include—

- Maps identifying the variable application location, source, timing, amount, and placement of all plant and crop nutrients applied.
- GPS-based yield maps for crops where yields can be digitally collected.

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