NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Ac.)

CODE 590

DEFINITION

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

PURPOSE

- To budget, supply, and conserve nutrients for plant production.
- To minimize* agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates.
- To maintain or improve the physical, chemical, and biological condition of soil.

*Note, the term, “minimize”, used throughout the standard is intended to characterize efforts that reduce to the practical extent possible.

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable to all lands where plant nutrients and soil amendments are applied. A requirement to follow this practice standard may be defined by specific regulations and/or certain state or federal conservation programs. This practice standard does not apply to establishment applications for long-term, non-rotated perennial crops that do not receive supplemental nutrient applications.

Within this context, the General Criteria, Plans and Specifications, and Operation and Maintenance sections apply to all lands where plant nutrients and soil amendments are applied. The Additional Criteria included in this standard are only applicable when air quality and/or soil condition are identified as a primary resource concern.

CRITERIA

General Criteria Applicable to All Purposes

A nutrient budget for nitrogen, phosphorus, and potassium must be developed that considers all potential sources of nutrients including, but not limited to, green manures, legumes, crop residues, compost, animal manure, organic by-products, biosolids, process waste water, organic matter, soil biological activity, commercial fertilizer, and irrigation water.

Enhanced efficiency fertilizers, used in the State must be defined by the Association of American Plant Food Control Officials (AAPFCO) and be accepted for use by the State fertilizer control official, or similar authority, with responsibility for verification of product guarantees, ingredients (by AAPFCO definition) and label claims.

For nutrient risk assessment policy and procedures see NRCS Title 190, General Manual (GM), Part 402, Nutrient Management, and Title 190, National Instruction (NI), Part 302, Nutrient Management Policy Implementation.

The New York Nitrate Leaching Index (NY NLI) must be completed on all fields.

The New York Phosphorus Runoff Index (NY P Index) must be completed on all fields.

On organic operations, the nutrient sources and management must be consistent with the USDA's National Organic Program.

Fertilizer applications within minimum manure application setback areas (e.g., sinkholes, wellheads, gullies, ditches, or surface inlets) must be made according to Cornell University's crop fertilization guidelines for timing, rate, source, and placement.

Applications of irrigation water must minimize the risk of nutrient loss to surface and groundwater.

To optimize nutrient availability and utilization, soil pH must be maintained in a range appropriate for the crops in the rotation. Refer to Cornell University guidance for recommended crop pH levels.

Safety

Workers should be protected from and avoid unnecessary contact with plant nutrient sources. Extra caution must be taken when handling anhydrous ammonia or when dealing with organic wastes stored in unventilated enclosures.

Soil, Manure, and Tissue Sampling and Laboratory Analyses (Testing)

Nutrient planning must be based on current soil, manure, and (where used as supplemental information) tissue test results developed in accordance with Cornell University guidance, or industry practice, if recognized by the University.

Soil tests must be taken at least every 3 years, not to extend beyond the spring of the fourth crop year. Any nutrient recommendations made in the spring of the fourth crop year must be based on new soil tests.

The soil and tissue tests must include analyses pertinent to monitoring or amending the annual nutrient budget, e.g., pH, soil organic matter, phosphorus, potassium, or other nutrients and tests for nitrogen where applicable. Follow Cornell University guidelines regarding required analytical methods and analyses. Soil samples will be analyzed with the Cornell Morgan test or other tests that can be converted to Cornell Morgan equivalents.

Soil tests must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program (NAPT) or Agricultural Laboratory Proficiency Program (ALP).

Nutrient values of manure, organic by-products, and biosolids must be determined prior to land application. Such analyses must include, at minimum, total nitrogen (N), ammonium N, total phosphorus (P) or P2O5, total potassium (K) or K2O, and percent solids, or follow Cornell University guidance regarding required analyses.

Manure, organic by-products, and biosolid samples must be collected and analyzed at least once per calendar year, or more frequently if needed to account for operational changes (feed management, animal type, manure handling strategy, imported organic by-products, etc.) impacting manure nutrient concentrations. Less frequent manure testing is allowable where operations can document a predictable level of nutrient concentrations from past tests, unless operational changes occur or Federal, State, or local laws require more frequent testing.

Samples must be collected, prepared, stored, and shipped following Cornell University guidance or industry practice.

When planning for new or modified livestock operations, acceptable “book values” recognized by NRCS (e.g., NRCS Agricultural Waste Management Field Handbook; ASABE D384.2 Manure Production and Characteristics; etc.) and Cornell University, or analyses from similar operations in the geographical area, may be temporarily used if they accurately estimate nutrient output from the proposed operation. In such cases, manure testing for the operation must be performed as soon as a quality sample can be taken, not to exceed 12 months.

Manure 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, or other Cornell University-approved program that considers laboratory performance and proficiency to assure accurate manure test results.

Nutrient Application Rates

Nutrient application rates for nitrogen, phosphorus, and potassium must not exceed Cornell University guidelines for the priority nutrient considering applicable risk assessments or industry practice when recognized by the University.

At a minimum, determination of the nutrient application rate must be based on crop/cropping sequence; current soil test results; soil type; N contributions from any manure applications in the past two years, soil organic matter, and prior crops; crop yield potential; other current year nutrient applications; the NY P Index; the NY NLI; and any other applicable field-specific risk factors.

If Cornell University does not provide specific guidance that meets these criteria, application rates must be based on plans that consider yield potential and associated plant nutrient uptake rates.

Crop yield potential is established based on historical yield data, soil productivity information, and climate conditions, and assumes optimum soil fertility and good management. A database of field corn yield potentials is provided by the Cornell University guidelines. Field corn yield potentials may be changed by following guidance developed by Cornell University.

For new crops or varieties, industry-demonstrated yield and nutrient utilization information may be used until Cornell University information is available.

Nutrient applications and other field operations conducted in appropriate areas of fields for the purpose of planned and documented research trials may vary from the requirements of this standard.

Lower-than-recommended nutrient application rates are permissible if they meet the grower’s objectives.

Nutrient Sources

Nutrient sources utilized must be compatible with the application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic matter content, and local climate to minimize risk to the environment.

Nutrient Application Timing and Placement – Core Risk Assessments

Timing and placement of all nutrients must correspond as closely as practical with plant nutrient uptake (utilization by crops), and consider nutrient source, cropping system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment results outlined in this practice standard and the supporting Cornell University guidelines.

Use the current NY Nitrate Leaching Index, NY Phosphorus Runoff Index, and RUSLE2 to assess the risk of nutrient and soil loss. Identified resource concerns must be addressed to meet current planning criteria (quality criteria).

The planned rates of nitrogen application must be consistent with the NY NLI risk assessment and associated management recommendations per field. A NY NLI below 2 indicates that the potential for nitrate leaching (and other soluble nutrients) below the root zone is low and nitrogen should be applied in accordance with Cornell University guidelines. A NY NLI from 2 through 10 indicates that the potential for nitrate leaching below the root zone is intermediate and practices specified for NLI ratings greater than 10 should be considered. A NY NLI greater than 10 indicates that the potential for nitrate leaching below the root zone is high and at least one management practice outlined in the New York Nitrate Leaching Index documentation will be implemented to further reduce the potential for nitrate leaching to groundwater (e.g., winter hardy cover crops to take up excess nitrogen, especially when fall manure is applied; limiting fall manure N applications to the greater of 50 lbs/acre of first year available N or 50% of the expected N requirement of next year's crop; foregoing fall incorporation of sods until spring to conserve nitrogen; etc.).

The planned rates of phosphorus application must be consistent with NY P Index risk assessments and associated management recommendations per field. Manure may be applied to the Cornell University crop nitrogen guideline for Low (0-49 rating) or Medium (50-74 rating) risk NY P Index rated fields. Manure applications are limited to the estimated crop phosphorus removal rates on High (75-99 rating) risk NY P Index fields. No manure or phosphorus containing fertilizers will be applied on Very High (100+ rating) risk NY P Index rated fields. The NY P Index does not apply to heavy use areas that are planned for conversion to pasture, managed according to the Prescribed Grazing conservation practice standard (528), and that do not receive mechanically applied manure.

When manure or organic by-products are applied, the soil erosion input of the NY P Index must be based on the annual soil loss rate as provided by RUSLE2 for the crop year in which the manure is to be applied. On certain fields, due to other NY P Index risk factors, the use of the annual soil loss rate will have minimal affect on management. To reduce unnecessary analysis, the rotational average annual soil loss rate may be used in the NY P Index evaluation in lieu of the annual soil loss rate on fields with one or more of the following attributes:

- fields that will not receive manure or organic by-products in that crop year;
- fields in a long-term, perennial hay crop;
- fields with a flow path distance of less than 75 feet to a perennial or intermittent stream;
- fields with no concentrated flows and a flow path distance of greater than 300 feet to perennial or intermittent streams;
- fields with the predominate soil rated as poorly or very poorly drained;
- fields with the predominate soil rated as frequently flooded; or
- other factors based on field knowledge where the annual soil loss rate will not increase the NY P Index risk rating from Low or Medium to High or Very High.

Each field must be planned and managed to maintain the estimated rotational average annual sheet/rill soil erosion at or below the tolerable soil loss limit (T) for the predominate soil type in the field, as calculated by RUSLE2. Areas of gully erosion will also be addressed with appropriate conservation practices.

Nutrient Application Timing and Placement – Manure Application Setbacks

Setbacks from wells and down-gradient surface waters, surface inlets, sinkholes, swallets, and springs must be maintained for mechanical applications of manure, litter, and process wastewater.

One of the following minimum flow path distances must be maintained between manure applications and surface waters and surface inlets:

- a 100-foot setback; or
- a 35-foot setback, where the entire setback width is a vegetated buffer; or
- a 15-foot setback with incorporation within 24 hours of application.

The minimum spreading setback requirement for wells and down-gradient springs is:

- a 100-foot setback, unless specific evidence shows that it can be done without contamination.

The minimum spreading setback requirement for down-gradient sinkholes and swallets is:

- a 100-foot setback.

If operating near a public water supply (surface water or wellhead), employ additional setbacks as required by state and local rules.

Nutrient Application Timing and Placement – Frozen, Snow Covered, and/or Saturated Conditions

Nutrients must not be mechanically surface-applied if a high probability of offsite nutrient loss is identified. Except as specifically defined in this section, this precludes spreading when the following field conditions are present:

- frozen and/or snow-covered soils or
- when soils are saturated from rainfall or snow melt, as indicated by visible water on the soil surface with the potential to runoff (isolated areas of saturation not prone to runoff must be avoided, but do not prohibit spreading on a given field).

If nutrient applications are made according to the criteria and conservation measures in one or more of the scenarios in this section to safeguard against offsite delivery, then such applications may be made to frozen and/or snow covered soil.

Scenario 1: Commercial fertilizers may be applied during frozen, but not snow covered, soil conditions to fields in close grown crops, such as hay or small grains, and in accordance with the Cornell University Nutrient Guidelines, NY P Index, NY NLI, and RUSLE2.

Scenario 2: When conditions allow, manure may be frost-injected or immediately incorporated upon application when soils are frozen and/or snow covered and in accordance with the general setback requirements, Cornell University Nutrient Guidelines, NY P Index, NY NLI, and RUSLE2.

Scenario 3: In instances where mechanical surface applications of manure, litter, or process wastewater to frozen and/or snow covered soils are necessary, the applications will:

- be in accordance with the Cornell University Nutrient Guidelines, NY P Index, NY NLI, and RUSLE2;
- be based on a check of the 48 hour weather forecast to assess if rainfall and/or temperatures are predicted to cause snowmelt and/or runoff conditions;
- not be applied to soils designated by the soil survey as frequently flooded;
- be in accordance with Section 1 (“Limestone areas”) in “Manure and Groundwater: the Case for Protective Measures and Supporting Guidelines” for fields with soils less than 40 inches deep over carbonate bedrock;
- not be within a 100-foot flow path distance from surface waters, surface inlets, springs, sinkholes, and swallets;
- not be within 100 feet of wells; and
- not be applied in concentrated flow areas (i.e., well-defined channels within fields).

Nutrient Application Timing and Placement – Management, Storage, and Temporary Manure Piles

When nutrients from manure or organic by-products exceed the ability of the land base to properly recycle them through crops grown, or if constraints of the land base prevent allocation of manure and/or organic by-products according to the requirements of this standard, a strategy must be developed to properly allocate surplus manure and/or organic by-products. The strategy must address identified annual nutrient surpluses through storage, treatment, source reduction, and/or through additional land base availability in order to safely utilize surplus manure and/or organic by-products.

Storage:

If storage is a component of the preferred alternative for addressing insufficient land base or seasonal limitations for manure application, the storage period will be planned to store manure for the specified time to overcome land base limitations (and any extra period that is needed for farm management purposes) according to the NRCS Waste Storage Facility Conservation Practice Standard (313).

Temporary Manure Piles:

When no storage is required by the nutrient management plan (and no waste storage facility exists on the farm), areas for temporary manure piles will be identified to safely pile manure during adverse field conditions and temporary seasonal crop constraints. Temporary manure pile areas are appropriate only for manure having a moisture content that allows it to be stacked.

Temporary manure piles must be removed and land applied according to the requirements of this standard as soon as practicable after favorable field conditions for manure spreading return. Temporary manure pile areas are not intended for accumulating large volumes of manure over long durations, but rather smaller volumes during conditions not conducive for field application.

Temporary manure pile area(s) must be located:

- with at least a 300-foot setback from all wells;
- with at least a 300-foot flow distance to the nearest down-gradient watercourse;
- where the flow path provides diffuse overland flow;
- where clean water runoff will be excluded from the temporary manure pile area;
- where there are no groundwater springs, seeps, subsurface drainages, or longstanding groundwater concerns;
- where access is practicable during poor weather conditions such as excessive ice, snow, or muddy ground; and
- not on soils designated as occasionally flooded or frequently flooded by the soil survey unless justified otherwise based on field observation and documented by the planner.

Soils will be evaluated for their potential to leach contaminants into groundwater. Soils must be stable enough to support equipment. Grading of the area will be provided only where the ground surface slope prevents proper equipment operation and efficiency. All side slopes for any excavation and earth fill must not be steeper than three (3) horizontal to one (1) vertical.

The temporary manure pile areas must have sufficient area to store accumulated manure. Unless there is evidence on the farm that the manure is more stackable, assume that the manure will not stack higher than 4 feet with a 4:1 angle of repose. Manure consistency and moisture characteristics need to be considered when locating and sizing the temporary manure pile areas.

Temporary manure piles are intended for use by farms with minor seasonal constraints for manure application until some degree of manure storage (NRCS Waste Storage Facility Conservation Practice Standard – 313) is reasonable and feasible for farm management. Temporary manure piles are not

appropriate for addressing annual nutrient surpluses caused by such constraints as insufficient land base and/or repeated seasonal nutrient surpluses.

Nutrient Application Timing and Placement – Additional Risk Reduction Measures

When there is a high risk of transport of nutrients, conservation practices must be coordinated and applied as a system to avoid, control, or trap field applied manure and nutrients before they can leave the field by surface or subsurface drainage (e.g., tile). The number of applications and the application rates must also be considered to limit the transport of nutrients to tile.

The total single application of liquid manure:

- must not exceed the soil's infiltration or water holding capacity, and
- must be adjusted to avoid runoff or loss to subsurface tile drains.

Manure or organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in harvested plant biomass, not to exceed Cornell University guidelines.

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 rate must not exceed the acceptable phosphorus risk assessment criteria, 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.

Nutrients must be applied with the right placement, in the right amount, at the right time, and from the right source to minimize nutrient losses to surface and groundwater. One or more of following nutrient use efficiency strategies or technologies must be used:

- slow and controlled release fertilizers;
- nitrification and urease inhibitors;
- enhanced efficiency fertilizers;
- incorporation or injection;
- timing and rate of applications;
- soil nitrate and organic N testing;
- coordinating nutrient applications with optimum crop nutrient uptake;
- Corn Stalk Nitrate Test (CSNT), Pre-Sidedress Nitrate Test (PSNT), and Illinois Soil Nitrogen Test (ISNT);
- tissue testing, chlorophyll meters, and spectral analysis technologies;
- other Cornell University recommended technologies that improve nutrient use efficiency and minimize surface or groundwater resource concerns;
- application of fertilizer N no more than 30 days before planting spring planted crops; and/or
- in-season N fertilizer applications completed in accordance with Cornell Guidelines for Field Crops or adaptive N management techniques.

Additional Criteria to Protect Air Quality by Reducing Odors, Nitrogen Emissions, and the Formation of Atmospheric Particulates

To address air quality concerns caused by odor, nitrogen, sulfur, and/or particulate emissions, the source, timing, amount, and placement of nutrients must be adjusted to limit the negative impact of these emissions on the environment and human health. One or more of the following must 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;
- timing;
- treatment processes that reduce emissions; and/or
- other technologies that minimize the impact of these emissions.

Do not apply poultry litter, manure, or organic by-products of similar dryness/density when there is a high probability that wind will blow the material offsite.

Additional Criteria to Improve or Maintain the Physical, Chemical, and Biological Condition of the Soil to Enhance Soil Quality for Crop Production and Environmental Protection

Time the application of nutrients to avoid periods when field activities will result in excessive soil compaction.

In areas where salinity is a concern, select nutrient sources that minimize the buildup of soil salts.

CONSIDERATIONS

Soil, Manure, and Tissue Sampling and Laboratory Analyses (Testing)

- Soil test information should be no older than 1 year when developing new plans.
- Farmers may choose to soil sample more frequently to further improve nutrient management.
- The area represented by a soil test should be no larger than the acreage recommended by Cornell University soil testing guidelines.
- Evaluate whether excessive levels of some nutrients can cause induced deficiencies of other nutrients, (e.g., high soil test phosphorus 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.
- Evaluate whether potassium should not be applied in situations where an excess (greater than soil test potassium recommendation) causes nutrient imbalances in crops or forages.

Nutrient Application Rates – Adaptive Nutrient Management Techniques

- Use variable-rate nitrogen application based on expected crop yields, soil variability, soil nitrate or organic N supply levels, or chlorophyll concentration.
- Use variable-rate nitrogen, phosphorus, and potassium application rates based on site-specific variability in crop yield, soil characteristics, soil test values, and other soil productivity factors.
- Develop site-specific yield maps using a yield monitoring system. Use the data to further diagnose low- and high-yield areas, or zones, and make the necessary management changes. See Title 190, 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 the NRCS National Nutrient Policy in GM 190, Part 402, Nutrient Management and NRCS Agronomy Tech Note 6.

Nutrient Application Rates, Timing, Form, and Placement – Frozen and/or Snow Covered Conditions

- Limit applications during frozen and/or snow covered conditions to daily production amounts.
- Reduce application rates.
- Apply only solid manure.
- Prioritize applications to fields with significant surface residue (e.g., residues associated with perennial hay, corn grain, cover crop, small grain, etc.).
- Prioritize applications to fields with longer flow distances to water, mild slopes, and/or few or no concentrated flows.

Nutrient Application Timing and Placement – Additional Risk Reduction Measures

- Use split applications of nitrogen to deliver nutrients during periods of maximum crop utilization.
- Apply nitrogen and/or phosphorus fertilizer in a band to improve nutrient availability.
- Incorporate surface-applied manures or organic by-products if precipitation capable of producing runoff or erosion is likely within the time of planned application.

Conservation Practices to Reduce Nutrient Runoff and Improve Nutrient Recycling

- Use manure management conservation practices to manage manure nutrients to limit losses prior to nutrient utilization.
- Use legume crops and cover crops to provide nitrogen through biological fixation and nutrient recycling to reduce nitrogen inputs for subsequent crops.
- Use practices such as cover crops, crop rotations, crop rotations with perennials, strip cropping and contour farming to reduce runoff, increase infiltration, reduce erosion, improve nutrient cycling, and reduce energy inputs and improve soil health.
- Use conservation practices that will act as buffers to trap sediment and nutrients before entering surface waters, such as filter strips, contour buffer strips, and riparian forest buffers. These practices can also reduce the loss of nitrates and soluble phosphorus.
- Use high-efficiency irrigation technologies (e.g., reduced-pressure drop nozzles for center pivots) to reduce the potential for nutrient losses.
- Use no-till/strip-till in combination with cover crops to sequester nutrients, increase soil organic matter, increase aggregate stability, reduce compaction, improve infiltration, and enhance soil biological activity to improve nutrient use efficiency.
- Use bioreactors and multistage drainage strategies when supported by Cornell University guidelines and/or NRCS-NY practice standards.
- Modify animal diets to reduce nutrient imports and the nutrient content of manure following the NRCS Feed Management Conservation Practice Standard (592).
- Use the NRCS Agrichemical Handling Facility Conservation Practice Standard (309) to protect air, soil, and water quality.
- Use the NRCS Drainage Water Management Conservation Practice Standard (554) to reduce nutrient discharge through drainage systems.

Additional Measures to Protect Soil, Water, and Air Resources

- Material generated from cleaning nutrient application equipment should be utilized in an environmentally safe manner. Excess material should be collected and stored or field applied in an appropriate manner.
- Consider property boundaries when locating temporary manure piles.
- Nutrient containers should be recycled in compliance with State and local guidelines or regulations.
- Avoid applying manure and other by-products upwind of inhabited areas.
- The annual chloride loading associated with the application of organic by-products should not exceed 170 lbs per acre.
- Apply manure at a rate that will result in an “improving” Soil Conditioning Index (SCI) without exceeding acceptable risk of nitrogen or phosphorus loss.
- Use Cornell Soil Health Program principles and analyses to improve soil health and nutrient recycling.

PLANS AND SPECIFICATIONS

The following components must be included in the nutrient management plan:

- aerial site photograph(s)/imagery or site map(s), and a soil survey map of the land base treated with this standard;
- soil information including, soil type, surface texture, pH, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and/or ponding frequency;
- location of designated sensitive areas and the associated nutrient application restrictions and setbacks;
- description of existing or planned waste storages (NRCS Conservation Practice Waste Storage Facility – 313) and/or temporary manure pile areas on farms with manure, including the location of temporary pile areas identified on plan maps;
- the anticipated manure storage durations and volumes are identified based on the runoff and leaching risk assessments set by this standard, seasonal constraints, plans for the efficient use of manure nutrients, and any farm management needs;
- management to mitigate odor concerns for nearby residences or other locations;
- results of approved risk assessment tools for nitrogen, phosphorus, and erosion losses;
- documentation establishing that the application sites present low risk for phosphorus transport to local water when phosphorus is applied in excess of crop requirements;
- current and/or planned plant production sequence or crop rotation;
- soil, water, compost, manure, organic by-product, and plant tissue sample analyses applicable to the plan;
- when interim manure analyses are used based on book values or other data for new or modified operations, such information will be documented in the plan and quality manure analyses from the farm will be taken and used for planning nutrient applications as soon as practicable, not to exceed 12 months;
- when soil phosphorus levels are increasing, include a discussion of the risk associated with phosphorus accumulation and a proposed phosphorus draw-down strategy;
- realistic crop yield potentials based on site specific factors.

- complete nutrient budget for nitrogen, phosphorus, and potassium for the plant production sequence or crop rotation;
- listing and quantification of all nutrient sources and forms;
- all enhanced efficiency fertilizer products that are planned for use;
- in accordance with the nitrogen and phosphorus risk assessment tool(s), specify the recommended nutrient application source, timing, amount (except for precision/variable rate applications specify method used to determine rate), and placement of plant nutrients for each field or management unit;
- practice(s) planned to address nitrate leaching on all fields where the NLI rating exceeds 10;
- guidance for implementation, operation and maintenance, and recordkeeping.

In addition, the following components must be included in a plan labeled as a precision/variable rate nutrient management plan:

- document the 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;
- document the 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;
- document if a variable rate nutrient or soil amendment application was made;
- 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 applications that resulted from use of the precision agriculture process for nutrient or soil amendment applications; and
- maintain the electronic records of the GIS data layers and nutrient applications for at least 5 years.

If a significant portion of fields have Very High NY P Index ratings, the nutrient management plan must document:

- the soil phosphorus levels at which it is desirable to convert to phosphorus based planning;
- the potential plan for soil test phosphorus drawdown from the production and harvesting of crops;
- management activities or techniques used to reduce the potential for phosphorus transport and loss;
- for livestock farms with manure, a quantification of manure produced in excess of crop nutrient requirements; and
- a long-term strategy and proposed implementation timeline for reducing soil P to levels that protect water quality.

OPERATION AND MAINTENANCE

Conduct periodic plan reviews to determine if adjustments or modifications to the plan are needed. At a minimum, plans must be reviewed and revised as needed based on new soil analyses, with changes in manure volumes or analyses, and/or with changes in crop management.

If concerns are suspected, fields receiving animal manures and/or biosolids must be monitored for the accumulation of heavy metals and phosphorus in accordance with Cornell University guidance and State law.

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.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation for the change.

All manure in temporary piles will be applied to fields according to the nutrient management plan when favorable field conditions for manure spreading return. Pile areas will be re-graded and re-vegetated as soon as practicable after removal of manure.

Records must be maintained for at least 5 years to document plan implementation and maintenance. As applicable, records include:

- soil, plant tissue, water, manure, and organic by-product analyses resulting in recommendations for nutrient application;
- quantities, analyses, and sources of nutrients applied;
- dates and method(s) of nutrient applications, source of nutrients, and rates of application;
- dates that temporary manure pile areas are utilized when manure application cannot be achieved;
- weather conditions and soil moisture at the time of application;
- lapsed time to manure incorporation;
- irrigation events;
- crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and crop residues removed;
- dates of plan review, name of reviewer, and recommended changes resulting from the review; and
- all enhanced efficiency fertilizer products used.

Additional records for precision/variable rate sites must include:

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

REFERENCES

Agricultural Laboratory Proficiency (ALP) Program, http://www.collaborativetesting.com/store/main.aspx?DepartmentId=40

American Society of Agricultural and Biological Engineers (ASABE). 2005. Manure Production and Characteristics (ASAE D384.2), St. Joseph, MI. http://elibrary.asabe.org/standards.asp

Association of American Plant Food Control Officials (AAPFCO). 2011. AAPFCO Official Publication no. 64. AAPFCO Inc., Little Rock, AR.

Cornell Soil Health Program, http://soilhealth.cals.cornell.edu

NRCS, NY

January 2013

Czymmek, K, L. Geohring, Q.M. Ketterings, P. Wright, and A. Eaton. 2005. Supplemental manure spreading guidelines to reduce water contamination risk during adverse weather conditions. What's Cropping Up? 15(3): 1-3. http://nmsp.cals.cornell.edu/publications/files/WinterSpreadingGuidelines.pdf

Czymmek, K.J., L. Geohring, J. Lendrum, P. Wright, G. Albrecht, B. Brower, and Q.M. Ketterings. 2011. Manure management guidelines for limestone bedrock/karst areas of Genesee County, New York: Practices for risk reduction. Animal Science Publication Series No. 240. http://nmsp.cals.cornell.edu/publications/files/Karst_2_15_2011.pdf

Czymmek, K.J., Q.M. Ketterings, L.D. Geohring, and G.L. Albrecht. 2003. The New York Phosphorus Index. User's guide and documentation. CSS Extension Bulletin E03-13. 64 pp. http://nmsp.cals.cornell.edu/publications/extension/PI_User_Manual.pdf

Czymmek, K., Q.M. Ketterings, H. van Es and S. DeGloria. 2003. The New York Nitrate Leaching Index. CSS Extension Publication E03-2. 34 pp. http://nmsp.cals.cornell.edu/publications/extension/nleachingindex.pdf

Czymmek, K., H. van Es and L. Geohring. 2004. Manure and Groundwater: the Case for Protective Measures and Supporting Guidelines. http://nmsp.cals.cornell.edu/publications/files/Groundwater.pdf

DeGolyer, D. and H. van Es. Frost Injection of Manure at Table Rock Farm: A Case Study. What's Cropping Up?, Vol 11, No 2, 2001. http://css.cals.cornell.edu/cals/css/extension/cropping-up-archive/wcu_vol11no2_2001a3manureinjection.pdf

Follett, R.F. 2001. Nitrogen transformation and transport processes. In Nitrogen in the environment; sources, problems, and solutions, (eds.) R.F. Follett and J. Hatfield, pp. 17-44. Elsevier Science Publishers. The Netherlands. 520 pp.

Keryk, K., Q. Ketterings, G. Albrecht, K. Stockin, and J. Beckman. 2008. Soil Sampling for Field Crops. Cornell University Agronomy Fact Sheet Series, Fact Sheet 1. http://nmsp.cals.cornell.edu/publications/factsheets/factsheet1.pdf

Ketterings, Q.M., K.J. Czymmek, and S.D. Klausner. 2003. Phosphorus guidelines for field crops in New York. CSS Extension Series E03-15. Cornell University, Department of Crop and Soil Sciences, Ithaca NY. 35 pp. http://nmsp.cals.cornell.edu/publications/extension/Pdoc2003.pdf

Ketterings, Q.M., S.D. Klausner, and K.J. Czymmek. 2003. Nitrogen guidelines for field crops in New York. CSS Extension Series E03-16. Cornell University, Department of Crop and Soil Sciences, Ithaca NY. 70 pp. http://nmsp.cals.cornell.edu/publications/extension/Ndoc2003.pdf

Ketterings, Q.M., S.D. Klausner, and K.J. Czymmek. 2003. Potassium guidelines for field crops in New York. CSS Extension Series E03-14. Cornell University, Department of Crop and Soil Sciences, Ithaca NY. 41 pp. http://nmsp.cals.cornell.edu/publications/extension/Kdoc2003.pdf

Ketterings, Q.M., W.S. Reid, and K.J. Czymmek. 2006. Lime guidelines for field crops in New York. First Release. Department of Crop and Soil Sciences Extension Series E06-2. 35 pp. http://nmsp.cals.cornell.edu/publications/extension/LimeDoc2006.pdf

Minnesota Department of Agriculture, Manure Testing Laboratory Certification Program, www.mda.state.mn.us/en/licensing/licensetypes/mapprogram.aspx

North American Proficiency Testing (NAPT) Program, www.naptprogram.org

Schepers, J.S., and W.R. Ruan, (eds.) 2008. Nitrogen in agricultural systems. Agron. Monogr. no. 49, American Society of Agronomy (ASA), Crop Science Society of America (CSSA), Soil Science Society of America (SSSA). Madison, WI.

Sims, J.T. (ed.) 2005. Phosphorus: Agriculture and the environment. Agron. Monogr. no. 46. ASA, CSSA, and SSSA, Madison, WI.

Stevenson, F.J. (ed.) 1982. Nitrogen in agricultural soils. Agron. Series 22. ASA, CSSA, and SSSA, Madison, WI.

U.S. Department of Agriculture, National Organic Program. www.ams.usda.gov/AMSv1.0/nop

U.S. Department of Agriculture, Natural Resources Conservation Service. 2010. Agronomy Technical Note, (TN) 190-AGR-3, Precision Nutrient Management Planning. Washington, DC.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2010. Agronomy Technical Note, (TN) 190-AGR-6, Adaptive Nutrient Management. Washington, DC

U.S. Department of Agriculture, Natural Resources Conservation Service. 2012. Revised Universal Soil Loss Equation, Version 2 (RUSLE2). http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm

U.S. Department of Agriculture, Natural Resources Conservation Service. 2011. Title 190, General Manual, (GM), Part 402, Nutrient Management. Washington, DC.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2011, Title 190, National Instruction (NI), Part 302, Nutrient Management Policy Implementation. Washington, DC.

This standard was developed in conjunction with the following conservation organizations: USDA-NRCS, NYS Department of Environmental Conservation, NYS Department of Agriculture and Markets, Cornell University, Cornell Cooperative Extension, and the NYS Conservation District Employees Association.

NRCS, NY

January 2013