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.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied. This standard does not apply to one-time nutrient applications to establish perennial crops.

CRITERIA

General Criteria Applicable to All Purposes

Nutrient Management Plan content shall be consistent with applicable requirements and guidance found in *PA Code Title 25, Chapter 83, subchapter D, Sections 83.201 to 83.491* (Act 38 Regulations), the *Pennsylvania Nutrient Management Program Technical Manual* (Act 38 Technical Manual), the *Penn State Agronomy Guide* and other technical references cited.

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

At a minimum, the nutrient budget will include information for one complete crop year. October is considered the beginning of a crop year. Nutrient budgets for up to three consecutive crop years may be included in a plan.

All applied nutrients including manure, biosolids, starter fertilizers, or pop-up fertilizers must be accounted for in the nutrient budget.

Enhanced efficiency fertilizers used in the plan must be defined by the Association of American Plant Food Control Officials (AAPFCO) and be accepted for use by the PA Department of Agriculture fertilizer control official with responsibility for verification of product guarantees, ingredients (by AAPFCO definition) and label claims as applicable.

Erosion, nitrogen, and phosphorus must be managed to protect water quality.

Soil erosion shall be managed to protect soil quantity and water quality. Sheet and rill erosion shall not exceed "T" over the planned crop rotation, classic and ephemeral gullies shall be treated to eliminate concentrated flow erosion, and stormwater runoff shall be treated to control and trap sediment and nutrients as needed to protect water quality.

On all fields, nitrogen leaching risk shall be lessened utilizing management techniques described in the plan. Adequate treatment to address nitrogen leaching risk shall be consistent with criteria and guidance in this standard, *Act 38 Regulations*, the *Act 38 Technical Manual*, current Pennsylvania Nutrient Management Program guidance, the *Penn*

State Agronomy Guide, and other relevant Penn State Extension publications.

Phosphorus application shall be managed to minimize phosphorus losses from fields and water quality impacts. Phosphorus risk assessment by means of the current version of the *Pennsylvania Phosphorus Index* (P-Index) shall be used on all fields in accordance with Penn State Extension guidance.

Areas contained within minimum application setbacks (e.g., sinkholes, wellheads, gullies, ditches, or surface inlets) must receive nutrients consistent with the setback restrictions detailed in *Act 38 Regulations* and the *Act 38 Technical Manual.*

To avoid salt damage, the rate and placement of applied nitrogen and potassium in starter fertilizer must be consistent with Penn State Extension guidelines or industry practice recognized by Penn State Extension.

Soil pH must be maintained in a range that enhances an adequate level for crop nutrient availability and utilization. Refer to Penn State Extension publications for guidance.

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

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

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 Penn State Extension guidance or industry practice recognized by Penn State Extension.

All soil tests used in the nutrient management plan must be current within three years.

It is recommended that a single soil test sample not represent more than 20 acres. One soil test sample can represent multiple fields grouped in a crop management unit (must have similar soil capabilities and management histories) as long as the sample does not represent more than 20 acres. If a single field is larger than 20 acres, a single soil test sample may be used to represent this field.

Soil tests shall be conducted for each crop management unit on the operation to determine the level of phosphorus (as P), potassium (as K), and soil pH, utilizing procedures recommended by Penn State and published in *Recommended Soil Testing Procedures for the Northeastern United States, Bulletin #493* published by the University of Delaware. Other procedures shall be approved by NRCS

The plan must include a summary of the results of the soil test analyses for each crop management unit showing the following: (a) soil test levels for phosphorus and potassium as reported by the laboratory, (b) soil test levels for phosphorus (as P) in parts-per-million (PPM) and potassium (as K) in PPM, after conversion from the test results from the laboratory, as needed, (c) soil test levels for pH, (d) the date of the soil tests and the name of the lab performing the tests.

After the approval of the initial plan, soil tests are required for each crop management unit at least every 3 years from the date of the last test.

Soil test analyses must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP) under the auspices of the Soil Science Society of America (SSSA) and NRCS, or other NRCS-approved program that considers laboratory performance and proficiency to assure accuracy of soil test results. Alternate proficiency testing programs must have solid stakeholder support and be regional in scope.

Manure, organic by-products, and biosolids samples must be collected and analyzed at least annually. More frequent testing is required as needed to account for operational changes (feed management, animal type, manure handling strategy, etc.) impacting manure nutrient concentrations.

Nutrient values of manure, organic by-products and biosolids must be determined prior to land application as recommended by Penn State Extension.

Analytical manure testing results shall be used in the development of the plan. Manure test results must include: the percent solids, total nitrogen (as N), ammonium nitrogen (as NH_4-N), total phosphate (as P_2O_5) and total potash (as K_2O) for each manure group. Analytical results shall be recorded in the plan. Analytical results of phosphorus source coefficient (PSC) when analyzed and used in the plan shall be included.

Manure testing is not required for manure groups associated with less than five animal-equivalent units of livestock or poultry at an operation. For these small quantity manure groups, the nutrient content of the manure may be determined using standard book values.

Manure analyses shall be performed using manure sampling and chemical analysis methods which accurately represent the contents of the manure. Methods described by the *Penn State Agronomy Guide*, Penn State Agricultural Analytical Services Lab Manure Testing Program, and Penn State Extension publications may be used to meet this requirement. Other methods shall be approved by NRCS.

For newly proposed or modified operations and for manure groups on existing operations where sampling and analysis are not possible prior to initial plan development, the following applies: the plan must use either standard book values, or analytical results from a similar facility as approved by the NRCS. Standard book values contained in the *Penn State Agronomy Guide* and the *NRCS Agricultural Waste Management Field Handbook* may be used to meet this requirement. Other values shall be approved by NRCS. When prior analysis is not possible, samples and analysis of the manure generated on the operation shall be obtained within 1 year of implementation of the approved plan.

Standard book values shall be used in the plan for the nutrient content of manure deposited on pastures by grazing animals

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 or other NRCS-approved program that considers laboratory performance and proficiency to assure accurate manure test results.

When annual manure testing results indicate consistent nutrient values over three or more consecutive years, the rolling average of consistent manure analyses may be used in nutrient management plans provided livestock management remains constant during the planned period.

Nutrient Application Rates.

Application rates shall be developed to protect surface and groundwater using management techniques and practices described in the plan.

The planned nitrogen rate shall not exceed the amount of nitrogen necessary to achieve realistic expected crop yields or the amount of nitrogen the crop will utilize for an individual crop year. The nitrogen rate must take into account residual nitrogen from previous legumes in the crop rotation and previous manure applications. Nitrogen application rates shall not exceed Penn State Extension guidelines.

The planned phosphorus rate shall be consistent with the site-specific assessment of risk and impacts to water quality as determined by the P-Index and consistent with Penn State Extension, *Act 38 Regulations*, and the *Act 38 Technical Manual*. Rate, timing, application method, and source of planned phosphorus management shall meet current P-Index management guidance to minimize the effects of phosphorus losses from fields.

The planned potassium application rates must not exceed Penn State Extension guidelines.

Realistic expected crop yield goals must be established based on historical yield data, soil productivity, local climate, nutrient test results, management level, and local research results considering comparable production conditions. When actual yield records are available during the development of the initial plan, it is recommended that the expected crop yields be based on these records. At the time of the plan review, revise yield goals for the updated plan are to be based on yield records. For new crops or varieties, industry-demonstrated yield and nutrient utilization information may be used until Penn State information is available.

For the development of the initial plan where actual yield records are not available, realistic expected crop yield goals are determined by the operator and the planner and approved by NRCS. These yields should be consistent with soil capability, climate, operator management capability, as well as soil productivity guidance contained in the *Penn State Agronomy Guide.*

Lower-than-recommended nutrient application rates are permissible if the grower's objectives are met.

Nutrient Sources.

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

Nutrient Application Timing and Placement.

Timing and placement of all nutrients must correspond as closely as practical with plant nutrient uptake and consider nutrient source, cropping system limitations, soil properties, weather conditions, drainage system, and soil biology to minimize risk to the environment.

Nutrients must not be surface-applied if nutrient offsite losses are likely. This precludes spreading on frozen and/or snow-covered soils and when the top 2 inches of soil are saturated from rainfall or snow melt.

Winter application of manure is not a preferred management action for addressing water quality, and therefore shall only be considered for use where it is a necessary for operation of the farm, and where fields identified for winter application are situated in such a way as to minimize the potential for manure or nutrient run off during the winter season. Exceptions for the no-winter-application criteria above can be made for surface-applied manure when conditions specified by *Act 38 Regulations* and the *Act 38 Technical Manual* are met and adequate conservation measures are installed to prevent the offsite delivery of nutrients. The following site and management factors must be considered: slope, organic residue and living covers, amount and form of nutrients to be applied, and adequate setback distances to protect local water quality. The Pennsylvania Winter Application Matrix must be completed and documented in the plan for any operation with the possibility of winter application.

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

Nutrient management plans must identify and address resource concerns to meet quality criteria for water quality (sediment, nitrogen, phosphorus) and soil quantity (tolerable erosion). Practices and management techniques to address these concerns must be compatible and consistent with the operation's planned conservation system.

Planners shall assess and document soil erosion and sedimentation risk using approved tools, technologies, and procedures. Estimates of soil loss from sheet-and-rill erosion shall be evaluated utilizing soil loss prediction technology and supported field inspection as needed; evaluation to determine presence of gullies and sedimentation impacts on water quality will be determined by on-site inspection.

Nutrient placement, timing, source, and rate shall be managed to avoid nutrient and sediment loading to stormwater runoff.

Implementation of additional conservation practices or suites of practices (including but not limited to residue and tillage management, conservation crop rotation, cover crop, and buffer practices) are required where needed to meet these criteria. Runoff pathways between field and water resources shall be treated, as needed, to control and trap sediment and nutrients. Existing Critical Runoff Problem Areas, as defined by *Act 38 Regulations*, shall be identified during the field visit, documented in the plan and eliminated when the plan is implemented.

Nutrients shall be managed to minimize soil nitrate leaching losses to groundwater. The following leaching reduction strategies and technologies shall be considered in the planning process:

Corn fertilization considerations

- Treat pre-plant and early post plant broadcast applied nitrogen fertilizer with a nitrification inhibitor (does not apply to in-row starter fertilizer)
- Split apply nitrogen fertilizer application applying majority as sidedress
- Sidedress applications to corn after corn has reached the four true-leaf stage
- Under normal conditions, apply no more than 50 lbs/acre actual N as starter fertilizer (in-row plus broadcast)
- When manure is applied between previous crop harvest and corn planting time, apply no more than 20 lbs/acre N as in-row starter and zero N broadcasted. Assess need for sidedress N based on Chlorophyll Meter (at 6 true-leaf stage) or PSNT (at 12-inch tall)

- Evaluate nitrogen management program performance using CSNT and adjust management according that data

Fall/winter considerations

- Do not fall incorporate sod/forage crops with tillage. Sod/forage crops may be terminated with herbicides when soil temperature at 4-inch depth is approaching 45^{o}F
- Add winter crops and winter hardy cover crops to crop rotation whenever possible and especially when fall/winter manure application is planned
- Always plant a winter hardy cover crop as soon as possible after corn silage harvest to allow establishment and vigorous growth when fall manure application is planned
- Manure may be applied in fall where there is a growing crop (perennial crops, winter grain, hardy cover crops). Applications should generally not exceed the greater of 50 lbs/acre of first year available N or 50% of the expected N requirement of next year's crop
- For legume crops, limit annual manure application to no more than 150 lbs of available N/acre.

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

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. The following nutrient use efficiency strategies or technologies must be considered:

- "Enhanced Efficiency (EE)" fertilizer products decrease losses to the environment as compared to a "reference soluble" product. EE products include:
  - "Slow Release" fertilizers with coatings or occlusions that slow nutrient release,
  - "Stabilized" fertilizers amended with an additive that reduces the rate of transformation of fertilizer compounds
- Cover crops
- Injection and low disturbance incorporation techniques
- Reduced rate and split application
- In-season soil and leaf analyses based decision
- In-season Pre-Sidedress Nitrate Test or Chlorophyll Meter Test, and late season Corn Stalk Nitrate Test to guide management
- Other technologies recommended by Penn State Extension that improve nutrient use efficiency and minimize surface or groundwater resource concerns.

Additional Criteria Applicable to Properly Utilize Manure or Organic By-Products as a Plant Nutrient Source

When manures are applied and soil salinity is a concern, salt concentrations must be monitored to prevent potential crop damage and/or reduced soil quality.

The total single application of liquid manure must not exceed the soil infiltration or water holding capacity. Single applications shall never exceed 9,000 gallons per acre unless approved by NRCS. This application rate must be adjusted to avoid runoff or loss to subsurface tile drains.

Coordinate crop production activities and nutrient use efficiency technologies that minimize excess mineralized plant-available nitrogen to minimize the potential for nitrogen losses due to denitrification, leaching, and volatilization.

Select best management techniques to plan nutrient rates, timing and method of nitrogen and phosphorus application to reduce nitrogen leaching risks and P-Index ratings.

For fields where P-Index evaluation results in a **LOW or MEDIUM rating** indicating low to medium potential for phosphorus loss, additional phosphorus can be applied at rates greater than crop requirement not to exceed the amount of nitrogen necessary to achieve realistic expected crop yields recommended by Penn State Extension. The chance for adverse impacts on surface waters exists. Assess current farm nutrient management and conservation practices that minimize the risk of future P loss to assure functionality. Maintenance of these practices is required to minimize the risk of future P loss impacts on surface waters.

Manure or organic by-products may be applied to legumes crops at rates equal to or less than the estimated nitrogen removal in harvested plant biomass where the P-Index rating is Low or Medium. Application rates may not exceed criteria in *Act 38 Regulations,* the *Act 38 Technical Manual* and Penn State Extension guidelines.

For fields where P-Index evaluation results in a **HIGH rating** indicating high potential for P loss and adverse impacts on surface waters additional phosphorus may be applied at a rate no greater than the phosphorus removal rate for the next crop in the rotation. Soil and water conservation measures and P-based manure application rates are required to minimize the risk of P loss. Operation and maintenance of conservation practices and activities protecting water resources are critical where P-Index rating is high.

P-Banking: In some cases a phosphorus removal rate of manure may be very low and not allow for planning a rate that is practical for the operation's application equipment. A phosphorus banking rate for up to three years may be allowed based on obtaining approval from the NRCS. If permission is granted, the rate must not exceed the net nitrogen requirement in the year of application and may not elevate the P Index rating into the Very High management guidance category. No additional phosphorus can be applied during the P-Bank period of the crop sequence.

For fields where P-Index evaluation results in a **VERY HIGH rating** indicating very high potential for phosphorus loss and greater adverse impacts on surface waters, no phosphorus may be applied. Conservation measures to minimize soil erosion, phosphorus loss and adverse impacts to water quality must be planned and implemented. Proper operation and maintenance of conservation practices and continuous best management practices to protect water resources are critical.

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

When air quality is an identified concern, the source, timing, amount, and placement of nutrients must be adjusted to minimize the negative impact of these emissions on the environment and human health. One or more of the following may be used:

- "Enhanced Efficiency (EE)" fertilizer products decrease losses to the environment as compared to a "reference soluble" product. EE products include:
  - "Slow Release" fertilizers with coatings or occlusions that slow nutrient release,
  - "Stabilized" fertilizers amended with an additive that reduces the rate of transformation of fertilizer compounds
- Injection and low disturbance nutrient incorporation techniques
- Reduced rate and split application
- Physical and biological barriers, such as tree screens and forested buffers, to minimize offsite movement of odors, emissions and particulates
- 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 soil compaction.

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

CONSIDERATIONS

Install adequately sized waste storage facilities with sufficient storage so late fall and winter manure applications are never necessary.

Improve whole-farm nutrient balance by maximizing home-grown feed and forage production. Imported feedstuffs increase production expenses and can affect long-term sustainability of the farm operation.

Always plant cover crops

- On fields near/within sensitive areas
- After corn silage harvest

Select shorter maturity summer annual grain cultivars (corn and soybeans) with demonstrated agronomic and yield traits for your area. This will increase time to plant cover crops before frost.

Elevated soil test phosphorus levels can inhibit mycorrhiza growth and development increasing risk

of crop stress. Attempt to maintain soil test levels of phosphorus in the range optimum for crop production.

Higher than optimum soil test levels of some nutrients can induce crop deficiencies of other nutrients, e.g., high soil test phosphorus levels can result in zinc deficiency in corn.

Use no-till/strip-till in combination with cover crops to scavenge and sequester nutrients, increase soil organic matter, increase aggregate stability, reduce compaction, improve infiltration, and enhance soil biological activity to improve nutrient use efficiency.

Improve crops rotations by adding cover crops and perennials to improve nutrient use-efficiency, reduce energy inputs and increase soil health benefits

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 *NRCS Agronomy Technical Note - Precision Nutrient Management Planning*.

Develop manure management strategies that maximize nutrient use efficiency and minimize manure nutrient losses prior to crop utilization.

Apply manure at a rate that will result in a positive Soil Conditioning Index without exceeding acceptable risk of nutrient loss.

Use legume crops to provide nitrogen through biological fixation and cover crops to scavenge available nutrients after harvest.

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

Use soil test information no older than 1 year when developing new plans.

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

Use the adaptive nutrient management learning process to improve nutrient use efficiency on farms.

Potassium should not be applied where excesses cause nutrient imbalances in crops or forages.

Workers and family members should be protected from and avoid unnecessary contact with plant nutrient sources. Extra caution must be taken when handling anhydrous ammonia and in areas where organic wastes are stored particularly in unventilated enclosures. Both indoors and outdoors, manure can generate toxic levels of dangerous gases during agitation and unloading handling periods.

Material generated from cleaning nutrient application equipment should be utilized in an environmentally safe manner. Surplus material should be collected and stored or field applied in an appropriate manner.

Nutrient containers should be recycled in compliance with state and local guidelines or regulations.

Considerations to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater.

Use conservation practices that slow runoff, reduce erosion, and increase infiltration, e.g., filter strip, contour farming, or contour buffer strips. These practices can also reduce the loss of nitrates or soluble phosphorus.

Use application methods and timing strategies that reduce the risk of nutrient transport by ground and surface waters, such as:

- split applications of nitrogen to deliver nutrients during periods of maximum crop utilization,
- banded applications of nitrogen and/or phosphorus to improve nutrient availability,
- drainage water management to reduce nutrient discharge through drainage systems,
- incorporate surface-applied manures or organic by-products if precipitation capable of producing runoff or erosion is forecast within the time of planned application.

Use the agricultural chemical storage facility conservation practice to protect air, soil, and water quality.

Use bioreactors and multistage drainage strategies when approved by the land-grant university.

Considerations to Protect Air Quality by Reducing Nitrogen and/or Particulate Emissions to the Atmosphere.

Avoid applying manure and other by-products upwind of inhabited areas.

Use high-efficiency irrigation technologies (e.g., reduced-pressure drop nozzles for center pivots) to reduce the potential for nutrient losses.

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 site
- location of designated sensitive areas and the associated nutrient application restrictions and setbacks,
- results of approved risk assessment tools for phosphorus and erosion losses,
- documentation establishing that the application site presents low/medium risk for phosphorus transport to local water when phosphorus is applied in excess of crop requirement,
- general description of complete crop rotation usually followed,
- soil, water, compost, manure, organic by-product, and plant tissue sample analyses when used to develop the plan,
- realistic crop yield goals,
- complete nutrient budget for nitrogen, phosphorus, and potassium for each crop year in the production sequence planned,
- identify and quantify of all nutrient sources and form,
- identify all enhanced efficiency fertilizer products planned for use,
- in accordance with P-Index, leaching management guidance, erosion plan, and Penn State Extension guidance, specify the recommended source, timing, placement, and amount (except for precision/variable rate applications, then specify method used to determine rate) of plant nutrients for each field or management unit,
- when air quality protection is a selected practice purpose - location of nearby locations where humans may be present on a regular basis, prevailing winds, and topographical influences that may affect the transport of manure odors to those locations, and
- guidance for practice implementation, operation and maintenance, and recordkeeping.

When increases in soil test phosphorus levels are expected (i.e., when N-based rates are used), include a discussion of the risk associated with phosphorus accumulation including:

- Current P-Index rating, the P-Index rating when phosphorus-balanced application is required, and the P-Index rating when no phosphorus may be applied
- Explanation of the potential to drawdown soil test phosphorus by the production and harvest of crops, and
- Practical strategy to draw-down P in high risk areas
- Explanation of management activities or techniques used to reduce the risk of potential phosphorus transport and loss,
- Document the quantity of manure produced in excess of crop nutrient requirements and account for its export or alternate use in the Comprehensive Nutrient Management Plan , and
- A practical long-term strategy to protect water quality including a proposed implementation timeline for reducing soil P levels

In addition, the following components must be included in 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.

Maintain the electronic records of the GIS data layers and nutrient applications for at least 5 years.

OPERATIONS 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 with each soil test cycle, changes in manure volume or analysis, crops, or crop management.

Fields receiving animal manures and/or biosolids must be monitored for the accumulation of heavy metals and phosphorus in accordance with Penn State Extension guidance and Pennsylvania 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.

Maintain records 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,
- weather conditions at the time of application; lapsed time to rainfall or tillage incorporation
- crops planted, planting and harvest dates, yields, and crop residue amounts 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.

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Appendix I – NRCS definition and policy language describing Adaptive Nutrient Management

402.1 Definition
Adaptive Nutrient Management — a process used to plan, implement, evaluate, and adjust nutrient application strategies over time (multiple seasons). The process is intended to allow for continued adjustment of the CPS Code 590 4Rs plan to achieve better nutrient-use efficiency (GM190.402.1 January 2012).

402.2 Adaptive Nutrient Management
The NRCS supports the adaptive nutrient management strategy. The process is to be carried out by producers themselves, in cooperation with the land-grant university, or with other agencies and industry partners following prescribed protocols developed by the State NRCS, Land-grant University, or other appropriate technical agencies and industry. The results of adaptive nutrient management testing that meet the established protocols and are concurred with by NRCS and the land-grant university may be used in nutrient planning where appropriate. For adaptive nutrient management projects supported by NRCS, a final report of results must be provided to the NRCS State Conservationist (GM190.402.2 January 2012).

Appendix II – Soil Conditioning Index

The Soil Conditioning Index (SCI) predicts the consequences of cropping systems and tillage practices on soil organic matter in a field. Soil organic matter is a primary indicator of soil quality and carbon sequestration. A positive SCI indicates a cropping system that, if continued, is likely to result in increasing levels of soil organic matter.

The SCI is embedded in RUSLE2. It has three main components including the amount of organic material returned to or removed from the soil, the effects of tillage and field operations on organic matter decomposition, and the effect of predicted soil erosion associated with the management system. See http://soils.usda.gov/sqi/concepts/soil_organic_matter/som_sci.html for more information.

Appendix III – P-Banking

The national 590 and national instructions for its implementation allow a technique called “P-Banking”. PA590 allows “P-Banking” under specific limited circumstances upon NRCS approval.

National Instructions Nutrient Management Policy Implementation
A “P-Banking/Multiple Year P-Application” strategy can be used if the practice is defined and endorsed by the Land-grant University for delivery of nutrients to crops with documented minimal negative environmental consequences. Manure P can be applied at a rate to meet the recommendation for multiple crop years (length to be determined by each State). For example, with a 3-year limit, a grower could apply manure (based on the total P concentration of manure) in 1 year to meet 3 years of crop P need, as long as crop N recommendations are not exceeded. In that example, no additional P is applied in the current or 2 additional years. States must provide additional guidance relating requirements for additional conservation practices that have been shown to minimize P runoff (e.g., incorporation, injection) (NI190.302.2.F.4 December 2012).

PA590
In some cases a phosphorus removal rate of manure may be very low and not allow for planning a rate that is practical for the operation’s application equipment. A phosphorus banking rate for up to three years may be allowed based on obtaining approval from the NRCS. If permission is granted, the rate must not exceed the net nitrogen requirement in the year of application and may not elevate the P Index Value into the Very High management guidance category.

Appendix IV – P-Index rating criteria - PA590 vs. national 590

The Pennsylvania P-Index (PA590) criteria are more restrictive (no P applied) than the national 590 phosphorus risk assessment criteria (apply P removal rate) at the highest water quality risk rating.

<table>
<tr><td colspan="4">Risk Rating and Criteria language from national 590 and Pennsylvania P-Index applicable (PA590)</td></tr>
<tr><td>National 590 assessment rating</td><td>National 590 PI Risk rating criteria</td><td>PI (PA590) rating</td><td>PI (PA590) criteria</td></tr>
<tr><td rowspan="2">Low</td><td rowspan="2">Additional phosphorus and potassium can be applied at rates greater than crop requirement not to exceed the nitrogen requirement for the succeeding crop.</td><td>Low</td><td rowspan="2">Nutrients can be applied to meet the nitrogen crop requirement.</td></tr>
<tr><td>Medium</td></tr>
<tr><td>Moderate</td><td>Additional phosphorus and potassium may be applied at a phosphorus crop requirement rate for the planned crops in the rotation.</td><td>High</td><td>Nutrients can be applied to meet the phosphorus crop removal.</td></tr>
<tr><td>High</td><td>Additional phosphorus and potassium 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.</td><td>Very High</td><td>No phosphorus can be applied.</td></tr>
<tr><td colspan="4">National 590 risk rating of LOW is equivalent to PA590 P-Index rating LOW + MEDIUM
National 590 risk rating of MODERATE is equivalent to PA590 P-Index rating HIGH
National 590 risk rating of HIGH is equivalent to PA590 P-Index rating VERY HIGH</td></tr>
</table>