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.

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

Relationship with State of Virginia's Program

Virginia's nutrient management program is overseen by the Virginia Department of Conservation & Recreation (DCR). Virginia's state rules governing the writing of nutrient management plans (NMPs) are codified in state regulation at 4 VAC 50-85. Some provisions in these regulations are mandatory requirements (containing the verb "shall"). The general criteria in this Standard include requirements identical to or more stringent than all of the mandatory requirements found in state regulation starting at 4 VAC 50-85-130. Therefore, any NMP satisfying the general criteria of this Standard will also satisfy the minimum requirements of Virginia's state rules governing the writing of NMPs.

The following technical documents referenced in the state NMP regulations are also referenced in this Standard:

- Virginia Nutrient Management Standards & Criteria, revised July 2014 ("DCR Standards & Criteria").
- Virginia Phosphorus Index Version 2.0 Technical Guide, revised October 2005 ("VA P Index").
- Virginia Commercial Vegetable Production Recommendations, updated annually.

Requirement to Prepare NMP

A nutrient management plan (NMP) must be prepared that contains recommendations for the management of nutrients. The NMP's recommendations shall seek to maintain or enhance crop production while minimizing the potential for degradation of natural resources.

NMP Writer Certification
NMPs shall be prepared only by individuals with current certificates of competence issued by Virginia DCR (see 4 VAC 50-85-40 for details about certification requirements).

NMP Preparation Procedures Derived from State of Virginia's Program
Application Rates for Nutrients & Amendments
NMPs shall contain application rate recommendations for nitrogen (N), phosphate (P_2O_5), and potash (K_2O).

Crop nutrient needs in NMPs shall be based on DCR Standards & Criteria, Virginia Commercial Vegetable Production Recommendations, and on soil test results for P_2O_5 and K_2O.

Recommended application rates for N shall not exceed crop nutrient needs.

Recommended application rates for P shall be determined as follows:

- P application rates for inorganic P sources shall not exceed crop nutrient needs over the crop rotation based on a soil test.
- P application rates for any P source must be zero on soils exceeding the 65% P saturation levels listed in DCR Standards & Criteria. This establishes the following maximum soil test levels above which no P application can be recommended under any circumstances:

Region of Virginia	**Mehlich I Soil Test P Level**
Eastern Shore & Lower Coastal Plain	458 ppm
Middle and Upper Coastal Plain & Piedmont	375 ppm
Ridge & Valley	525 ppm

Whenever possible, P application rates for organic P sources should not exceed crop nutrient needs for the rotation based on a soil test. If this is not possible, maximum P application rates and control practices shall be determined using the VA P Index Method used in conjunction with the Revised Universal Soil Loss Equation, Version 2 (RUSLE2) or appropriate current NRCS-approved soil erosion assessment technology. This method is explained in DCR Standards & Criteria. Final P application rates recommended in the NMP may be no less stringent than the maximum rates determined using this method (i.e., more stringent P rate recommendations in the NMP are recommended, but are not required).

The following options for determining P application rates in NMPs are not accepted:

- The Environmental Threshold Method found in DCR Standards & Criteria.
- P Index Method with DCR's Erosion Risk Assessment Procedure (ERA) found in DCR Standards & Criteria.

A single P application may be recommended to address multiple crops in the rotation if the single application does not exceed the sum of appropriate application rates for individual crops.

Recommended application rates for K shall be sufficient to meet crop needs.

NMPs shall contain application recommendations for lime as needed to adjust or maintain soil pH in the appropriate range for the crop to be grown.

NMPs shall not recommend application rates of liquid manures or sludges using irrigation equipment that exceed hydraulic rates listed in DCR Standards & Criteria.

NMPs shall not recommend application rates of liquid manures or sludges using non-irrigation spreading equipment that exceed 14,000 gallons per acre. Liquid manure or sludge application rates must not exceed hydraulic loading capacity of the soil at the time of application.

Data Used to Develop Application Rates for Nutrients & Amendments

Determine expected crop yields for purposes of developing application rate recommendations using any of the following methods:

- Soil productivity ratings found in DCR Standards & Criteria.
- In the absence of verifiable past crop yield records, reasonable adjustments to the soil productivity ratings found in DCR Standards & Criteria based on the farmer's past experience. Upward yield expectation adjustments may not impact more than 20% of the acreage of any crop on a particular farm.
- Verifiable past crop yield records. Calculate the average of the three highest yielding years taken from last five years the particular crop was grown in the particular field.

Obtain soil analyses for developing application rate recommendations as follows:

- Analyze representative samples using standard sampling and analysis methods and the Mehlich I extraction procedure. Other methods may be used and correlated to Mehlich I only as approved and explained in DCR Standards & Criteria.
- Soil analysis results shall be dated no more than two years prior to the start date of entirely new NMPs. If an existing NMP is being maintained, updated, or revised, soil analysis results may be dated no more than three years prior to start date of the revised NMP (Note: This two-year timeframe for new NMPs is based on 2019 national NRCS 590 and is stricter than VA DCR state requirements).
- Representative soil sample cores shall be obtained from 0 to 4" depth for fields that were not tilled within the previous three years and from 0 to 6" depth for fields that have been or will be tilled.

Obtain analysis of organic nutrient sources for developing application rate recommendations as follows:

- For existing operations, use the most recent organic nutrient source analysis or an average of past analyses taken within the last three years for the operation.
- For new operations or sources, use average analyses from DCR Standards & Criteria or appropriate NRCS documents.
- Manure analyses shall include % moisture, total N, ammonium N, total P, and total K.
- Plant-available nutrient content of organic sources shall be determined using mineralization and availability coefficients from DCR Standards & Criteria.
- Mineralization of organic nutrients from previous applications shall be accounted for in development of application rates.

When developing N application rate recommendations, follow procedures in DCR Standards & Criteria for estimating N contributions from preceding legumes.

Timing of Nutrient Applications

NMPs shall contain recommendations on the timing of nutrient applications. Timing recommendations for nutrient sources containing N shall be as close to plant uptake periods as reasonably possible. Applications of N-containing materials shall only be recommended to sites where an actively growing crop is in place at time of application or where a timely planted crop will be established within 30 days of the nutrient application.

For organic nutrient sources only, NMPs may recommend the following less restrictive application timing if needed to help manage manure storage constraints:

- Application of organic nutrient sources may occur within 60 days of planting a spring-seeded crop to sites that are not designated as environmentally sensitive sites.
- Broader application windows can be recommended for spreading organic nutrient sources in very limited situations (see 4 VAC 50-85-140.A.4.b. (2) and (3) for details).

- Certain composted organic nutrient sources with a final carbon to nitrogen ratio of 20:1 or greater are exempt from the restrictions on timing of application listed above (see 4 VAC 50-85-140.A.4.d. for details).

NMPs shall include the following recommendations for split applications of N. "Split application" is defined as using a sequence of two or more applications, separated by approximately three weeks or more, to a single crop in order to improve nutrient uptake efficiency.

- On fields designated as environmentally sensitive sites, NMPs shall recommend split application of inorganic N for all row crops and small grains in accordance with procedures in DCR Standards & Criteria.
- For crops to receive irrigation, NMPs shall recommend irrigation scheduling and split application of inorganic N.
- In lieu of split applications in the above situations, NMPs may recommend the application of the total N needed for spring-planted row crops within one week prior to planting if at least 50% of the plant available N is supplied with "slowly available" sources. "Slowly available" in this context refers to slow- or controlled-release inorganic N fertilizers (see detailed definition at 4 VAC 50-85-10; not all enhanced efficiency fertilizers will qualify).
- NMPs shall include a statement that applications of inorganic nutrient sources, liquid manure, liquid sewage sludge, or liquid industrial waste are not to occur on frozen or snow-covered ground. When the ground is frozen, applications of dry or semi-solid manures and dewatered wastes is acceptable only under limited circumstances (see 4 VAC 50-85-140.A.4.f. for details).

Placement of Nutrient Applications

NMPs shall recommend no application of manure, biosolids, or industrial wastes to designated setback areas around wells, springs, surface waters, sinkholes, and rock outcrops. Setback distances shall be consistent with those listed in DCR Standards & Criteria, unless alternative setback or buffer distances are specified in regulations or permits for that site. The land area within such setbacks shall be deducted from calculations of usable acreage for spreading organic nutrients.

Calculation of Manure Production & Utilization

NMP writers shall estimate annual manure production on each farm utilizing procedures in DCR Standards & Criteria, appropriate NRCS documents, or actual farm records of manure handled during a representative 12-month period.

NMPs shall state the total amount of manure produced and the amount that can be used on the farm, based on the above-referenced estimate and procedures and information in DCR Standards & Criteria. The NMP shall address any excess manure and provide recommendations concerning options for proper use of such excess manure.

Environmentally Sensitive Sites

The NMP writer shall evaluate every field in the NMP to determine whether or not it is an environmentally sensitive site. NMPs shall identify and address the protection from nutrient pollution of environmentally sensitive sites.

"Environmentally sensitive site" is any field which is particularly susceptible to nutrient loss to groundwater or surface water since it contains, or drains to areas which contain sinkholes, or where at least 33% of the area in a specific field contains one or any combination of the following features:

1. Soils with high potential for leaching based on soil texture or excessive drainage;
2. Shallow soils less than 41 inches deep likely to be located over fractured or limestone bedrock;
3. Subsurface tile drains;
4. Soils with high potential for subsurface lateral flow based on soil texture and poor drainage;
5. Floodplains as identified by soils prone to frequent flooding in county soil surveys; or

6. Lands with slopes greater than 15%.

To determine if a particular site meets criteria 1, 2, or 4, refer to the tables found in DCR Standards & Criteria.

To determine if a particular site meets criteria 3, 5, or 6, refer to the county soil survey and your knowledge of the site.

NMP Duration
NMPs shall provide recommendations for one to five years of crop production. NMPs developed for a period of time greater than three years and up to five years shall be limited to sites in permanent pasture or continuous hay.

NMP Maintenance and Revisions
NMPs shall state that immediate modification is required if any of the following occur:

- Animal numbers will increase above the level specified in the original NMP.
- Animal types including intended market weights will change.
- Additional imported manure, biosolids, or industrial waste beyond that identified in the original NMP will be land-applied.
- The land area available for manure application drops below the level needed for manure utilization according to the original NMP.

The NMP shall also state that modification is required if cropping systems, rotations, or fields are changed and P will be applied at levels greater than crop nutrient needs based on a soil test.

NMPs shall recommend new soil analysis for each field at least once every three years in order to update the existing NMP.

NMPs shall recommend new manure analyses as follows:

- When the baseline nutrient content for the particular manure type on the particular farm operation has not yet been established, manure analyses shall be recommended until such a baseline is established.
- When the baseline nutrient content is established, new manure analyses shall be recommended at least once every three years for dry or semi-solid manure and at least once every year for liquid manures.

Other NMP Preparation Procedures
Consistency with NRCS Conservation Plan
All information and recommendations in the NMP related to crop rotations, nutrient incorporation methods (tillage), and other conservation practices must be consistent with the client's NRCS conservation plan.

All information and recommendations in the NMP related to manure production and utilization, including animal numbers and manure storage capacities, must be consistent with the client's NRCS conservation plan and animal waste management system plan.

Soil Erosion Requirements
Soil erosion and associated runoff is a key pathway for nutrient loss that must be controlled in order to satisfy the minimum requirements of this 590 Standard.

The NMP and associated NRCS conservation plan must recommend crop rotations, tillage methods, and other conservation practices that minimize the site-specific risk of soil erosion, runoff, and associated nutrient loss. Use applicable current NRCS-approved technology to assess soil erosion risk.

Nutrient & Soil Loss Risk Assessments
NMP writers must use current NRCS-approved procedures for assessing the risk of N, P, and soil loss.

The screening for environmentally sensitive sites described above constitutes the approved site-specific N loss risk assessment procedure under the Virginia 590 Standard. All fields must be screened using this procedure during the NMP development process.

No site-specific P loss risk assessment is required when P application rate recommendations do not exceed crop nutrient needs based on a soil test. When clients wish to apply P (organic sources only) at rates exceeding crop nutrient needs, rate recommendations must be developed using the P Index Method in conjunction with the current NRCS-approved soil loss assessment technology. This process constitutes the approved site-specific P loss risk assessment procedure under the Virginia 590 Standard.

As stated above, erosion for all fields in the NMP must be assessed using applicable NRCS-approved tools or technology.

Minimum NMP Implementation & Recordkeeping
NRCS considers the recommendations in the final NMP corresponding to the minimum NMP preparation procedures above to be “Basic 590” elements.

In order to fulfill the minimum requirements of this Virginia 590 Standard, the NRCS client must fully implement these Basic 590 elements of the NMP, as well as keep records documenting that implementation has occurred.

Basic 590 implementation can be summarized as follows:

1. Follow application rate recommendations in the NMP for N, P, K, and lime.
2. Follow recommendations in the NMP related to timing of inorganic N fertilizer applications. Specifically, apply no inorganic N in the absence of an actively growing crop or more than 30 days ahead of planting.
3. Follow the spreading schedule in the NMP for any applied manures/biosolids. In limited cases, spreading of manure/biosolids may be allowed up to 60 (or more) days ahead of planting.
4. Follow all restrictions in the NMP regarding nutrient applications to frozen or snow-covered ground. In particular, never spread inorganic fertilizer or liquid manure/biosolids on frozen or snow-covered ground.
5. On any fields listed in the NMP as environmentally sensitive sites, follow more intensive guidelines listed in the NMP for timing of nutrient applications. In particular, split all inorganic N applications to row crops and small grains between at least two applications and follow more restrictive guidelines on timing of any manure/biosolids spreading (i.e., never more than 30 days before planting or in absence of a growing crop).
6. Follow all NMP recommendations for not spreading manure/biosolids in designated setback areas (near wells, springs, surface water, etc.).
7. Ensure the NMP is based on up-to-date soil and manure tests (liquid manure tests not more than one year old; soil tests for entirely new NMPs not more than two years old; soil tests for NMP revisions and all solid/semi-solid manures not more than three years old).
8. Ensure the NMP is updated to reflect any increases in animal numbers or other significant livestock or cropping system changes that occur after the NMP was first written.
9. Implement the crop rotations, tillage methods and other conservation practices specified in the NMP and NRCS conservation plan.
10. Keep records documenting implementation of the nine elements listed above.

In-season Changes to the NMP
If in-season crop rotation changes, nutrient testing, or other factors trigger the need for modification to one or more recommendations in the NMP, then those changes to the NMP must be approved by a DCR-certified NMP writer and must be documented in writing.

Such changes should be documented before the farmer makes the associated nutrient applications.

If the NMP is modified in this manner, then the farmer's records of actual nutrient applications should match the revised NMP recommendations.

Adaptive Nutrient Management
NRCS supports the use of adaptive nutrient management ("ANM"). ANM is on-farm testing to compare two or more nutrient management techniques or strategies.

In order to qualify as ANM for NRCS purposes, all test plots must meet minimum criteria in adaptive nutrient management protocols published by NRCS.

In many cases, one or more treatments in an ANM test plot will involve nutrient application rates or management techniques that differ from those recommended in the NMP. Deviations from "Basic 590" elements of the NMP are acceptable under this Standard if they are associated with technically sound and properly documented ANM test plots.

CONSIDERATIONS

General Considerations
NRCS in Virginia recommends that NMP writers and farmers implement the following techniques and activities that go beyond the minimum required by this Standard.

NRCS in Virginia uses the term "Enhanced 590" to describe these supplemental techniques and activities.

Planning and listing Enhanced 590 techniques and activities in the NMP document is recommended, but not required.

Enhanced Data Collection & Analysis
Consider using extra or enhanced data to develop NMP recommendations and guide in-field management of nutrients. Examples include, but are not limited to:

- Measure and track crop yields on a field-by-field basis over multiple years.
- Following Land Grant University guidelines, conduct more frequent or extensive soil, tissue, or manure testing than the minimum required.
- Collect and analyze GPS-linked precision data upon which to base variable rate (VR) fertilizer applications.
- Conduct and analyze on-farm nutrient management test plots in accordance with NRCS Adaptive Nutrient Management (ANM) policy.

Enhanced Nutrient Application Rate
Consider going beyond the minimum required with respect to nutrient application rates. Examples include, but are not limited to:

- Fine-tune N rates with in-season tools endorsed by the Land Grant University, such as the Pre-sidedress Nitrate Test (PSNT).
- On soils testing Very High in P, cut manure rates more aggressively than required by the NMP.
- Ensure secondary and micronutrients are available at sufficient levels to support optimum crop production and uptake of macronutrients.

Variable Rate Nutrient Application
Consider using precision technologies to vary nutrient or lime rates across different zones within the same field to better match crop or soil needs. The basis for variation can be soil type, yield maps or zones, grid- or zone-based soil testing, sensor readings (e.g., Greenseeker), or other factors.

Enhanced Nutrient Timing
Consider going beyond the minimum required when matching timing of nutrient applications with the period of expected crop nutrient uptake. Examples include, but are not limited to:

- Split N applications on all fields (not just environmentally sensitive sites) in order to best match the crop's uptake pattern.
- Apply manures as late as possible ahead of crop planting to minimize nutrient loss potential.

Enhanced Nutrient Placement
Consider taking extra steps to optimize placement of nutrients in order to maximize crop uptake and minimize loss to the environment. Examples include, but are not limited to:

- Band starter or sidedress fertilizer along the crop row.
- Inject fertilizer or manure into the mineral soil in order to reduce volatilization losses and immobilization of N by surface residues.
- Increase setback distances from environmentally sensitive features.

Enhanced Nutrient Form
Consider applying nutrients in a form that increases the potential for crop uptake and minimizes the opportunity for loss to the environment. The term "Enhanced Efficiency Fertilizers" (EFFs) refers to a broad class of materials that can potentially help fulfill this need.

Certain EFFs (such as many urease and nitrification inhibitor products) are *not* covered by the State of Virginia's current fertilizer law and associated performance guarantees. For such materials not covered by Virginia fertilizer law, NRCS in Virginia will rely on the Land Grant University to determine if any particular product is recommended for use as an EFF under this VA 590 Standard.

Cropping for Enhanced Nutrient Utilization, Capture, and Cycling
Consider modifying crop rotations to minimize the need for applied nutrients, maximize cycling and reuse of nutrients already on the farm, and minimize risk of nutrient loss to the environment. Examples include, but are not limited to:

- Growing legumes ahead of N-fertilized crops to reduce the need for added N.
- Prompt fall planting of small grain or other crops with strong N uptake potential to reduce winter nitrate leaching risk.
- Increasing above- and below-ground biomass returned to the soil by modifying the cropping system (i.e., more cover crops, more high-residue crops), by providing adequate fertility to grow that extra biomass, and/or by increasing the amount manure or other organic amendments applied – in all cases while minimizing nutrient loss risk.

Other Nutrient Management Enhancements
Consider implementing other nutrient management enhancements recommended by NRCS, DCR, or the Virginia Land Grant University system in order to further improve the efficiency of nutrient use.

PLANS AND SPECIFICATIONS

All NMPs must contain the following elements (identical to those required under State of Virginia regulations at 4 VAC 50-85-130):

NMP Identification

Each NMP shall be identified by a single cover sheet indicating:

- Farmer/operation name and address;
- Name, certificate number, and signature of the DCR-certified nutrient management planner who prepared the NMP;
- County and watershed code of land under the NMP;
- Total acreage under the NMP with double cropped acreage accounted for only once;
- Acreage of cropland, hay, pasture, and specialty crops included in the NMP for the first year of the NMP;
- Date the NMP was prepared or revised; and
- Type and approximate number of livestock, if applicable.

Map or Aerial Photograph

Each NMP shall contain a map or aerial photograph to identify:

- The farm location and boundaries;
- Individual field boundaries where nutrients will be applied;
- Field numbers and acreages where nutrients will be applied;
- Environmentally sensitive sites;
- Setback areas for nonapplication of manure and biosolids.
- Location of manure, biosolids, or waste storage, if any;
- Intermittent or perennial streams and associated buffers (if the P Index is used to determine P application rates for specific fields).

The map or aerial photograph shall be legible, with all features described above recognizable. A farm sketch or soil survey map may be used when a map or aerial photograph is not available, if the features described above are recognizable.

Summary of NMP Recommendations

Each NMP shall contain one or more summary sheets that list the following information for each field:

- Name of the farmer/operator:
- Field identification numbers to include USDA Farm Service Agency tract and field numbers;
- Field acreages;
- Expected crops or crop rotations;
- Crop nutrient needs per acre based on soil analysis results and soil productivity;
- Legume N credits per acre;
- Available nutrients in soil from previous crop and mineralization of organic residuals;
- Recommended organic nutrient source application rates in tons per acre or 1,000 gallons per acre; plant available nitrogen as N, phosphorous as P_2O_5, and potassium as K_2O per acre; and spreading schedule to include approximate months of application;
- Expected time of incorporation of organic nutrient sources into the soil if the organic nutrient sources will be used;
- Commercial fertilizer rates and timing of applications, including split applications of N and the possible use of soil N test results on a field before sidedressing with N; and
- Numerical phosphorus and potassium soil analysis results expressed as ppm P and K, pounds per acre P and K or pounds per acre P_2O_5 and K_2O for all fields in the NMP.

Individual fields may be grouped together if similar soil productivity levels, soil fertility levels, and environmentally sensitive site features exist.

Narrative Information

Each NMP shall also contain the following information in summary or narrative form:

- Identification and management of environmentally sensitive sites:
- Quantities of manure used as crop nutrients, if any, including manure from both on-farm and off-farm sources based on NMP recommendations and total land requirements for manure utilization;
- Quantity of unused manure, if applicable, and recommendations on appropriate use options;
- Liming recommendations if soil pH is below the optimal range or to raise soil pH to no more than the upper limit for lime stabilized sewage sludge;
- Recommendations or fact sheets to ensure efficient application of fertilizers and organic nutrient sources and other best management practices to reduce the potential for degradation of surface and groundwater quality, which may include but are not limited to: (1) Equipment calibration; (2) Application timing and method; (3) Crop rotation and agronomic practices; (4) Soil nitrate testing; and (5) Cover crop management.
- Information on maintaining and updating the NMP. General comments about NMP maintenance shall include: (1) The length of time the NMP is effective; (2) Identification of circumstances or changes in the farm operation such as an increase in animal numbers that would require the NMP to be updated prior to the time specified above; and (3) Expected crop yields for each field for the planned crop rotation.
- The following information for all fields where P application rates are based on the VA P Index: (1) Functioning riparian buffer widths and distances to surface waters in feet; (2) Presence of any contour planting at a maximum of 1.0% row grade, strip cropping, conservation tillage with greater than 30% residue, or terraces; (3) Percentage of required ground cover on pastures stated as <50% cover, 50-75% cover, or >75% cover; (4) Crop tillage type for each crop stated as either no-till or tilled for all cropland; and (5) If expected soil erosion for the VA P Index was developed using current NRCS-approved erosion assessment technology, (i) a copy of the applicable print-out indicating: crop(s) for each year in the crop rotation to match those indentified in the NMP, (ii) all mechanical field operations, (iii) edge of field soil loss for each field.
- Other notes as needed pertaining to nutrient applications, tillage, and other special conditions.

OPERATION AND MAINTENANCE

Required Operation & Maintenance

- Revise the NMP in a timely manner prior to its expiration date.
- Contact a certified NMP writer to revise the NMP if significant livestock or cropping systems occur during the NMP lifespan.
- Keep adequate records of nutrient application rates, timing, placement, etc. as well as soil and other testing in order to document compliance with minimum requirements of this Standard. Records should be kept for at least five (5) years.

Recommended Operation & Maintenance

- Confer at least annually with the NMP writer to optimize the NMP and its implementation.
- Collect and analyze yield records on a field-by-field basis.
- Conduct Adaptive Nutrient Management on farm testing and incorporate lessons learned into NMPs and NMP implementation.

REFERENCES

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