Nutrient Management (Acre) 590

DEFINITION

Managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments.

PURPOSES

- To budget and supply nutrients for plant production.
- To properly utilize manure or organic by-products as a plant nutrient source while maintaining or improving soil and plant resources.
- To minimize agricultural non-point source pollution of surface and groundwater resources.
- 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.

CRITERIA

I. General Criteria Applicable To All Purposes

A. Introduction

Plans for nutrient management shall comply with all applicable federal, state, and local laws and regulations.

Plans for nutrient management in Michigan will follow Michigan State University Extension (MSUE) nutrient recommendations found in Michigan Natural Resources Conservation Service (NRCS) electronic Field Office Technical Guide (eFOTG), Section IV: (http://www.nrcs.usda.gov/technical/efotg/). Plans developed under this standard will meet the requirements of the Michigan Commission of Agriculture (MCA) Right To Farm (RTF) Generally Accepted Agricultural and Management Practices (GAAMPs) for "Nutrient Utilization" or "Manure Management and Utilization."

Agricultural producers who voluntarily follow this practice, and conform to the applicable RTF GAAMPs, are provided protection from public or private nuisance litigation under Michigan Public Act 93 of 1981, as amended, and the Michigan Right To Farm Act, Michigan Department of Agriculture.

Plans for nutrient management shall be in accordance with policy requirements of the NRCS General Manual, Title 450, Part 401.03 (Technical Guides, Policy, and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management Policy); technical requirements of the NRCS eFOTG; and procedures contained in the National Planning Procedures Handbook (NPPH) and the NRCS National Agronomy Manual, Section 503.

Persons reviewing and approving plans for nutrient management shall be certified by the nutrient management plan certification requirements in the NRCS General Manual or any certification program acceptable to NRCS within the state. These plans will be reviewed and approved by an individual certified through the certification program.

Nutrient management plans that are part of a Comprehensive Nutrient Management Plan (CNMP) or Conservation Plan shall be compatible with the other requirements in these plans.

A nutrient budget for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to, animal manure and organic by-products, wastewater, commercial fertilizer, crop residues, legume credits, and irrigation water.

Realistic yield goals shall be established based on soil productivity potential and the crop management practices utilized. A realistic yield goal is one which is achievable in three out of five crop years. If the goal is not achieved, then the entire crop management system shall be re-evaluated to identify those factors, other than soil fertility, that are limiting yield. Use the MSU Soil Management Groups (SMG), Soil Survey Information, or local MSUE yield data to establish realistic yield goals. For new crop varieties, industry yield recommendations may be used until documented yield information is available. See MSUE bulletins E-

2904 and E-2934 for nutrient recommendations for field crops and vegetable crops grown in Michigan that are based on these yield goals. Fruit crops, turf, flowers, shrubs, and trees are not fertilized according to yield goal.

Plans for nutrient management shall specify the form, source, amount, timing, and method of application of nutrients on fields to achieve realistic production goals, while minimizing nitrogen and/or phosphorus movement to surface and/or groundwaters.

Erosion, runoff, and water management controls shall be installed, as needed, on fields that receive nutrients.

B. Soil Testing and Plant Tissue Nutrient Analysis

A nutrient management plan shall be based on current soil test information developed in accordance with MSUE and North Central Region recommended soil testing practices (Brown et al., 1998). Labs providing soil testing information shall be participants in the North America Proficiency Testing (NAPT) program (http://www.usual.usu.edu/napt/participants.php). Current soil tests are those no older than 3 years. Soil sampling and testing frequency depends on the crops being grown and the cropping system. The following are recommendations for soil testing frequency.

Soil samples are best collected at the same point in time (for instance April) and using the same method (for instance zone method) in a cropping system. For most field crop production systems, sampling and testing the soil every three years is adequate. More frequent sampling provides a better record for nutrient management. Refer to the reference document MSUE Bulletin E-498S (Warncke et al., 2006) for further guidance.

At a minimum, obtain soil test analyses for pH, phosphorus, potassium, calcium, and magnesium. Organic matter and in-season soil nitrogen tests may assist in managing nitrogen inputs.

In vegetable crop and other high value cropping systems, sample soil and test at least every two years, but annual testing is encouraged. Where high value crops are rotated with field crops, soil sample and test after the high value crop is harvested.

Sod production fields should be soil sampled and tested prior to crop establishment.

For fields where perennial woody ornamentals are grown, sample and test soils every two to three years. Leaf tissue analysis on a regular basis is also recommended (Smith, 1989).

B1. Soil sampling depth and procedures

Where primary tillage is used for seedbed preparation, soil sample to 7 or 8 inches (acre furrow slice depth). If no-till or conservation tillage are used, collect an additional soil sample 3 inches deep for an assessment of soil pH (acidification of the surface soil). For the in-season corn pre-sidedress soil nitrate test (PSNT), take soil cores to a 12 inch depth and, in some cases, a 12 to 24 inch depth.

Composite soil samples that represent no more than 20 acres of a uniform soil area are more representative of that soil than samples from a larger area. Given that large fields may have uniform soil areas that amount to more than 20 acres, one composite sample may represent a larger acreage. Soils in most Michigan fields are not uniform; use 20 acres per composite sample as a general guide unless field variability or uniformity suggest more or less intensive sampling is appropriate.

However, if a larger field size, 20 to 40 acres, has similar soil taxonomic or textural characteristics, the field may be sampled as one field. Two methods of assessing similar taxonomic characteristics are the Michigan SMG system and USDA Textural Class triangle. Directions for use of these methods are found in the MAEAP Guidance Document (http://www.maeap.org/).

Within each sampling area collect 15 to 20 vertical cores (about 0.75 inches thick) to 7 or 8 inches. Collect cores in a pattern that will give a good representation of the delineated area and mix these cores thoroughly to form the composite sample. Additional information on soil sampling is contained in MSUE Bulletins E-498 (Warncke, 1998), MSUE Bulletin E-498S (Warncke et al. 2006), MSUE-2904 (Warncke et al., 2004), and E-1616 (Meints and Robertson, 1983).

B2. Plant tissue testing

Nutrient management for small fruits and tree fruits is best based on leaf tissue analyses. Tissue samples and analyses should be taken every 3 to 5 years (MSUE 2482 (Hanson and Hull, 1994). More frequent sampling provides a better record for nutrient management.

Use soil test information prior to crop establishment as the basis for adjusting the soil pH and nutrient levels. Once fruit crops are established, soil test information is not as useful as leaf tissue analysis in managing nutrient inputs.

Leaf tissue analysis of field and vegetable crops can be useful in monitoring the effectiveness of nutrient programs or in diagnosing nutrient related growth problems.

C. Nutrient Application Rates

Soil amendments shall be applied, as needed, to adjust soil pH to the specific range of the crop for optimum availability and utilization of nutrients. Optimum pH by plant species can be found in the NRCS National Agronomy Manual and target pHs for field and vegetable crops can be found in MSUE Bulletins E-2904 and E-2934.

Recommended nutrient application rates shall be based on MSUE E-2904 Nutrient Recommendations for Field Crops in Michigan (Warncke et al., 2004) and on MSUE E-2934 Recommendations for Vegetable Crops in Michigan (Warncke and Dahl, 2004). Recommendations for fruit crops are given in MSUE Bulletins E-852 (Hanson, 1996) and E-2011 (Hanson and Hancock, 1996).

The planned rates of nutrient application, as documented in the nutrient budget, shall be determined based on the following guidance:

C1. Nitrogen application rate

Planned nitrogen application rates shall match the recommended rates within plus or minus ten percent, except when manure or other organic by-products are a source of nutrients. When manure or other organic by-products are a source of nutrients, see "Additional Criteria" below.

C1a. The amount of nitrogen fertilizer used for field and vegetable crops shall be based on a realistic yield goal and the amount of nitrogen available from the soil, previous crop, manure, and/or biological materials. See MSUE Bulletins E-2904 and E-2934 for guidance.

C1b. Recommended nitrogen rates for fruit crops are given in MSUE Bulletins E-852 and E-2011. Recommended nitrogen rates for turf, flowers, shrubs, and trees are provided by the MSU Soil and Plant Nutrient Laboratory.

C1c. For additional criteria of coarse textured soils or other high leaching landscapes, see Section II of the NRCS eFOTG for identification of groundwater-sensitive soils *(also reference document MI NRCS Agronomy Tech Note 37)*. Fall nitrogen applications should not be made on loamy sand or sandy soils; i.e., MSU Soil Management Groups (SMG) 4 and 5. Alternative nitrogen management practices on sandy soils and other groundwater-sensitive areas include: crop rotations, forage crops, cover crops, plant analysis, soil sampling for nitrate, split applications of nitrogen, and use of nitrification inhibitors.

To improve nitrogen use efficiency, the PSNT can be used to determine the residual nitrogen in the soil prior to nitrogen sidedress applications. *See MI NRCS Agronomy Tech Note 31 for information on products that enhance N efficiency.*

C2. Phosphorus application rate

Planned phosphorus application rates shall match the recommended rates as closely as possible. Apply phosphorus fertilizer based on soil tests or plant tissue analysis using MSUE recommended rates and methods of application that will enhance phosphorus recovery, uptake, and utilization. When manure or other organic by-products are a source of nutrients, see "Additional Criteria" below.

C3. Potassium application rate

Excess potassium shall not be applied in situations that cause unacceptable cation imbalances in crops or forages. When forage quality is an issue associated with excess potassium application, MSUE standards shall be used to set forage quality guidelines.

On organic soils (SMG M) that have been fertilized, the time of sampling is important, since considerable amounts of potassium may leach over winter. For fall sampled organic soils, assume the potassium test level will decline 25 percent because of leaching. This anticipated loss is reflected in the potassium recommendation. For samples collected between March and June, decrease potassium recommendations by 25 percent.

C4. Other plant nutrients

The planned rates of application of other nutrients shall be consistent with MSUE guidance or industry practice if recognized by MSUE.

C5. Starter fertilizers

Starter fertilizers containing nitrogen, phosphorus, and potassium may be applied according to MSUE recommendations or industry practices if recognized by MSUE. Refer to MSUE Bulletins E-2904 and E-2934.

D. Nutrient Application Timing and Methods

How nutrient applications are made is important for considering efficient utilization of nutrients and potential impacts of nutrients on the environment, particularly on water resources. Nitrogen and phosphorus are the nutrients of most concern.

Timing and method of nutrient application shall correspond as closely as possible with plant nutrient uptake characteristics, while considering cropping system limitations, weather and climatic conditions, and field accessibility.

Nutrients shall not be applied to frozen, snow-covered, or saturated soil if the potential risk for runoff exists.

Nutrient applications associated with irrigation systems shall be applied in accordance with the requirements of Irrigation Water Management (Code 449).

MSUE Bulletins E-2904, E-2934, E-852, and E-2011 can provide guidance on recommended timing and methods of nutrient application for use in Michigan.

II. Additional Criteria Applicable To Manure Or Organic By-Products Applied As A Plant Nutrient Source

A. Introduction

Nutrient values of manure shall be determined prior to land application based on laboratory analysis, acceptable "book values" recognized by NRCS and/or MSUE, or historic records for the operation if they accurately estimate the nutrient content of the material. Book values recognized by NRCS may be found in Midwest Plan Service Publication 18 (1993, 2000) and the NEH Part 651 Agricultural Waste Management Field Handbook, Chapter 4, Agricultural Waste Characteristics. The AWMFH amendment for Michigan uses the MWPS Publication 18 "as excreted" book values.

Manure analyses shall be performed by laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification Program (MTLCP) (http://www2.mda.state.mn.us/webapp/lis/manurelabs.jsp).

Nutrient values for organic by-products and municipal sewage sludge or biosolids should be determined prior to land application based on laboratory analysis, as recommended in the RTF Nutrient Utilization GAAMPs (MCA) for by-products. Laboratory analysis to determine N, P_2O_5, and K_2O content in municipal biosolids (sewage sludge) is required by the State of Michigan Part 24 rules, as discussed in MSUE bulletin E-2781 (Jacobs and McCreary, 2001).

Fields receiving organic by-products to supply nutrients are to be planned in accordance with the latest recommendations found in the Michigan RTF GAAMPs for Nutrient Utilization. Application of municipal biosolids to land in Michigan must be approved by a permit from the Michigan Department of Environmental Quality (MDEQ).

B. Nutrient Application Rates

The water application rate (in/hr) for liquid manure applied through irrigation shall not exceed the soil intake/infiltration rate. See eFOTG, Section II, Irrigation Groups and Irrigation Intake Family Descriptions for a list of soils, their irrigation group number, and irrigation intake family. Use modern irrigation scheduling techniques to avoid applying excess water. The total application should not exceed the field capacity of the soil.

B1. Nitrogen application

When the plan is being implemented on a phosphorus standard, manure or other organic by-products shall be applied at rates consistent with the phosphorus standard. In such situations, an additional nitrogen application, from non-organic sources, may be required to supply the recommended amounts of nitrogen.

The fertilizer rate of N recommended for crops should not be exceeded by the amount of plant available N (PAN) added, either by manure or manure plus N fertilizer applied. The PAN per ton or per 1,000 gallons of manure should be determined by using a manure analysis and the correct mineralization and ammonium volatilization factors.

Refer to the PAN spreadsheet tool in Michigan NRCS eFOTG, Section IV, CNMP Technical Tools for guidance in determining PAN from manure applications. PAN estimates should consider mineralizable N for the first cropping year following application, residual mineralizable N for any manure applied for the previous 3 cropping years, and any losses of NH_4-N (ammonium-N) due to ammonia volatilization.

Manure or other organic by-products may be applied on legumes at rates not to exceed the estimated nitrogen removal in harvested plant biomass.

B2. Phosphorus application rate

When manure or other organic by-products are used, the planned rates of phosphorus application shall be consistent with any one of the following options:

1. Phosphorus Index (PI) Rating - For a selected crop field, a baseline PI score will be assessed; if the score is 17 or less, the landowner can follow the strategy in the baseline assessment. If the baseline score is 18 or greater, the landowner can mitigate selected transport and/or source categories so the planned score is at or below 17. The planned mitigation strategy can be implemented by the landowner and for this field the phosphate application rate will be identified as part of the Index.
   Technical guidance is found in eFOTG, Section IV, Technical Tools.

2. Soil Test Threshold Values: Bray P1 Soil Phosphorus Tests - follow guidance as summarized below:

   2a. Bray P1 Soil Test, 0-74 ppm P (0-149 lb P/ac): nitrogen based manure application.

   2b. Bray P1 Soil Test, 75-149 ppm P (150-299 lb P/ac): phosphorus based manure application, where manure P added does not exceed the P removed by the harvested crop(s); apply in one year an amount of manure P equal to the amount of P removed by up to two crop years when no additional fertilizer or manure P is applied for the second crop year, and the addition of PAN does not exceed the N fertilizer recommendation for, or the N removed by, the first year's crop.

   2c. Bray P1 Soil Test, ≥ 150 ppm P (≥ 300 lb P/ac): no manure application allowed.

3. Soil Test Method: nitrogen based manure application on sites where a Bray P1 soil test results in a nutrient recommendation to apply phosphorus; phosphorus based or no manure application on sites where the Bray P1 soil test is too high to recommend any application of phosphorus.

A single application of phosphorus applied as manure may be made 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, as described above under 2. When such applications are made, the application rate shall:

1. Not exceed the recommended nitrogen application rate during the year of application, or

2. Not exceed the estimated nitrogen removal in harvested plant biomass during the year of application when there is no recommended nitrogen application, and

3. Not be made on sites considered vulnerable to off-site phosphorus transport unless appropriate conservation practices or best management practices are used to reduce the vulnerability.

C. Field Risk Assessment

When animal manure or other organic by-products are applied to frozen or snow covered fields, a field-specific assessment of the potential for phosphorus transport from the field shall be completed. This assessment may be done using the Manure Application Risk Index (MARI) or other recognized assessment tool. In such cases, plans shall include:

- A record of the assessment rating for each field or sub-field, and

- Information about conservation practices and management activities that can reduce the potential for phosphorus movement from the site.

When such assessments are completed, the results of the assessment and recommendations shall be discussed with the producer during the development of the plan.

Winter manure application is allowed on frozen or snow-covered ground if a field specific assessment,

such as the Michigan NRCS MARI, ranks the field "Low" or "Very Low." A "Medium" MARI rating can be used if all GAAMPs for Manure Management and Utilization are met, but fields with a "High" rating will not be used. See Michigan NRCS eFOTG, Section IV for the MARI Spreadsheet tool and instructions for use. For livestock operations defined as CAFO's, refer to the MDEQ web site for additional General Permit guidance: (http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3713-96774--,00.html.

See Michigan NRCS eFOTG, Section I, directory Michigan Technical Notes for the MARI Technical Note #35. The MARI Excel Spreadsheet is found in Michigan NRCS eFOTG Section IV, directory Technical Tools, subdirectory Field Assessment Tools.

D. Heavy Metals Monitoring

When biosolids (sewage sludge) are applied, the accumulation of potential pollutants (including arsenic, cadmium, copper, lead, mercury, nickel, selenium, and zinc) in the soil shall be monitored in accordance with the Federal Clean Water Act, U.S. Code, Reference 40, CFR, Parts 403 and 503; and Part 24 Rules of Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Additional information about land application of biosolids in Michigan can be found in MSUE bulletin E-2781 (Jacobs and McCreary, 2001).

III. Additional Criteria For Pasture

The stocking rate of animals must ensure a plant stand is maintained. Plant stands must be capable of slowing runoff water, controlling erosion, and reducing nutrient loss from the pasture.

In pasture systems where the grazed forage is the sole feed source for livestock, nutrients from manure deposited by the grazing livestock will not exceed the nutrient requirements of the pasture forage.

Pasture systems utilizing supplemental feed often result in manure nutrient deposition in excess of pasture forage requirements. Therefore, nutrient management with rotation to harvested forage or row crops is necessary. Quantify available nutrient deposition based on livestock density and nutrient mineralization factors. Base manure nutrient loading of the crop rotational nutrient requirement consistent with MSUE recommendations.

Exclude livestock from contact with streams or watercourses except for controlled crossings and accesses for watering or following Prescribed Grazing (528).

Runoff from pasture feeding and watering areas will travel through a vegetated buffer before it travels into a surface watercourse. This criterion is met when buffers are designed for the resource concern according to Filter Strip (393A) or Riparian Forest Buffer (391).

IV. Additional Criteria To Minimize Agricultural Non-Point Source Pollution Of Surface And Groundwater Resources

In areas with identified or designated nutrient-related water quality impairment, an assessment shall be completed of the potential for nitrogen and/or phosphorus transport from the field. (See the latest version of the MDEQ Water Quality and Pollution Control in Michigan (305b) Report for a list of impaired watersheds: http://www.michigan.gov/deq/0,1607,7-135-3307_7255---,00.html

The Leaching Index (LI), (MARI), or other recognized assessment tools (Phosphorus Index) may be used to make these assessments. The results of these assessments and recommendations shall be discussed with the producer and included in the nutrient management plan.

Plans developed to minimize agricultural non-point source pollution of surface or groundwater resources shall include practices and/or management activities that can reduce the risk of nitrogen or phosphorus movement from the field.

V. Additional Criteria to Improve the Physical, Chemical, and Biological Condition Of the Soil

Nutrients shall be applied in such a manner as not to degrade the soil structure, soil tilth, chemical properties, or biological condition.
Nutrients shall not be applied to flooded or saturated soils when the potential for soil compaction and creation of ruts is high.

CONSIDERATIONS

Consider induced deficiencies of nutrients due to excessive levels of other nutrients.

Consider additional conservation practices such as Conservation Cover (327); Grassed Waterway (412);

Contour Buffer Strips (332); Field Borders (386); Filter Strips (393); Irrigation Water Management (449); Riparian Forest Buffer (391); Conservation Crop Rotation (328); Cover Crops (340); Residue Management, Mulch Till (329B); Residue Management, No Till and Filter Strip (329A); Residue Management, Ridge Till (329C); Residue Management, Seasonal (344); and Prescribed Grazing (528) to improve soil nutrient and water storage, infiltration, aeration, tilth, diversity of soil organisms, and to protect or improve water quality.

Consider cover crops whenever possible to utilize and recycle residual nitrogen especially where late fall or early spring manure applications are planned.

Consider application methods and timing that reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere. Suggestions include:

1. Splitting applications of nitrogen to provide nutrients at the times of maximum crop utilization.

2. Avoiding winter application of nutrients for spring seeded crops.

3. Banding phosphorus near the seed row.

4. Applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques.

5. Incorporating manure or organic by-products immediately into the land.

6. Delaying field application of animal manure or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application (generally greater than ½ inch rainfall).

Consider minimum application setback distances from environmentally sensitive areas such as sinkholes, wells, gullies, ditches, surface inlets, or rapidly permeable soil areas.

Consider the potential problems from odors associated with the land application of animal manure, especially when applied near or upwind of residences.

Consider nitrogen volatilization losses associated with the land application of animal manure. Volatilization losses can become significant if manure is not immediately incorporated into the soil after application.

Consider the potential effects of installation and operation of nutrient management on the cultural, archaeological, historic, and economic resources.

Consider using soil test information no older than one year when developing new plans, particularly if animal manure will be a nutrient source.

Consider annual reviews to determine if changes in the nutrient budget are desirable (or needed) for the next planned crop.

On sites on which there are special environmental concerns, consider other sampling techniques, e.g. the PSNT or soil surface sampling for phosphorus accumulation or pH changes.

Consider ways to modify the chemistry of animal manure, including modification of the animal's diet, to reduce the manure nutrient content and enhance the producer's ability to manage manure effectively.

PLANS AND SPECIFICATIONS

Nutrient plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.

Nutrient plans will be developed using one of two methods.

1. Crop nutrient budgets will be developed within plus or minus ten percent of the nutrient recommendation. Planners will use MSUE Bulletins for guidance.

2. For crop fields that may require additional nutrients in the buildup phase, nutrient applications will be at the maintenance level, which is based on crop removal rates. This approach supplies nutrients in the amount that will be removed by the crop. These values are found in Table 3 in MSUE 2904 and MSUE 2934. The maintenance application can be used when the cost of nutrients is relatively high; the crop removal application rate avoids reducing existing soil nutrient levels to an even lower level that might significantly reduce crop growth.

Plans in areas with specially protected water bodies shall be developed incorporating any special requirement for that area. See the MDEQ 305b list. In hydrologic unit areas that are identified as being impaired with nitrogen or phosphorus, plans will include an assessment of the potential for nitrogen or phosphorus transport from the field. Use the Leaching Index (LI) and the Manure Risk Index (MARI) to determine the potential risk of polluted runoff at the field edge or below the root zone. See Michigan NRCS eFOTG, Section 1 Michigan Technical Note #37 for guidance using MARI for assessing nitrate leaching inventory and evaluation.

A. The following components shall be included in the nutrient management plan:

1. Aerial photograph or map and a soil map of the site.
2. Current and/or planned plant production sequence or crop rotation.
3. Results of soil, plant, water, manure, or organic by-product sample analyses.
4. Realistic yield goals for the crops in the rotation.
5. Quantification of all nutrient sources.
6. Recommended nutrient rates, timing, form, and method of application and incorporation.
7. Location of designated sensitive areas or resources and the associated nutrient management restriction.
8. Guidance for implementation, operation, maintenance, and recordkeeping.
9. Complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

B. If changes in soil phosphorus are expected, plans shall document:

1. The soil phosphorus concentration at the beginning of the buildup period.
2. The relationship between soil phosphorus concentration during buildup and potential for phosphorus transport from the field.
3. The potential for soil phosphorus drawdown from the production and harvesting of crops.

When applicable, plans shall include other practices or management activities as determined by specific regulation, program requirements, or producer goals.

C. In addition to the requirements described above, plans for nutrient management shall also include:

1. A discussion about the relationship between nitrogen and phosphorus transport and water quality impairment. The discussion about nitrogen should include information about nitrogen leaching into shallow groundwater and potential health impacts. The discussion about phosphorus should include information about phosphorus accumulation in the soil, the increased potential for phosphorus transport in soluble form, and the types of water quality impairment that could result from phosphorus movement into surface water bodies.
2. Discussion about how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment.
3. A statement that the plan was developed based on the requirements of the current NRCS standard and any applicable federal, state, or local regulations or policies; and changes in any of the requirements may necessitate a revision of the plan.

OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

1. Periodic plan review to determine if adjustments or modifications to the plan are needed. As a minimum, plans will be reviewed and revised every 3 years or less per crop requirement.
2. Protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage shall be according to MSUE Bulletin E-2335 (Wilkinson, 1996).
3. Calibration of application equipment to ensure uniform distribution of material at planned rates within plus or minus 30 percent of the planned

application rate for manures and plus or minus 10 percent of the application rate for inorganic fertilizer. The importance of developing an accurate plan is obvious; the landowner will apply nutrients from both sources at a rate that is planned, thereby ensuring environmental quality criteria and protecting contract incentive payments.

4. Documentation of the actual rate at which nutrients are applied. When the actual rates used differ from or exceed the recommended and planned rates, records will indicate the reasons for the differences.

5. Maintaining records to document plan implementation. As applicable, records include:

   - Most recent soil test and/or plant tissue analysis used to make recommendations for nutrient application.
   - Quantities, analysis, and sources of nutrients applied.
   - Dates and methods of nutrient applications.
   - Crops planted, planting and harvest dates, yields, and crop residues removed.
   - Results of water, plant, and organic by-product analyses.
   - Dates of review and person performing the review, and recommendations that resulted from the review.

Records will be maintained for 5 years, or longer if a contract requirement. Recordkeeping systems, such as those suggested in the RTF GAAMPs, will be used.

Protect workers from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection will include the use of protective clothing when working with plant nutrients. Take extra caution when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

The disposal of material generated by the cleaning of nutrient application equipment should be accomplished properly. Excess material should be collected and stored, or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for runoff and leaching.

The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.

REFERENCES

(Please refer to Michigan NRCS eFOTG, Section IV**:** http://www.nrcs.usda.gov/technical/efotg/ for some of the MSUE Bulletins, Technical Tools, and Technical Notes listed in this standard.)

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