

## NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

### NUTRIENT MANAGEMENT (acre) Code 590

#### DEFINITION

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

#### PURPOSES

- Budget and supply nutrients for plant production.
- Properly utilize manure or organic by-products as a plant nutrient source.
- Minimize agricultural nonpoint source pollution of surface and ground water resources
- Protect air quality by reducing nitrogen emissions (ammonia and NO<sub>x</sub> compounds) and the formation of atmospheric particulates
- 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

##### General Criteria Applicable to All Purposes

##### **A. SOIL AND TISSUE SAMPLING AND LABORATORY ANALYSIS (TESTING)**

Nutrient application recommendations will be based on field specific soil samples no older than 4 years. The samples shall be taken and analyzed for phosphorus, potassium, pH, and organic matter and for other nutrients or soil information needed to develop the nutrient management plan. Annual soil nitrate analysis is encouraged on appropriate soils and for appropriate crops. Tissue testing is used when appropriate to help evaluate current crop year nutrient management decisions.

Soil sampling procedures will be consistent with the most current version of *USDA NRCS Fact Sheet MN-NUTR3 (Soil Sampling and Fertilizer Recommendations)*. Nitrate testing and tissue testing and analysis should be consistent with the most recent University of Minnesota Extension Service (UMES) guidance.

Soil samples will be analyzed at a soil-testing laboratory certified by the Minnesota Dept. of Agriculture (MDA) on line at: <http://www.mda.state.mn.us/licensing/pestfert/soilabs.htm>

##### **B. NUTRIENT APPLICATION RATES**

Nutrient application rate recommendations will be based on crop nutrient budgeting, recent proven yields, soil productivity information, climatic conditions, level of management, nutrient costs, expected return and University of Minnesota Extension Service guidelines.

##### **Crop Nutrient Budgeting**

Nitrogen, phosphorus and potassium rate recommendations will be based on field and crop specific nutrient budgets. The budgets will: a.) identify nutrients needed to achieve proven yields b.) deduct nutrients to be supplied from sources including but not limited to soil organic matter or residual soil nitrates, previous manure or organic by-product applications, irrigation water and legume crops grown either one or two years prior to the planned crops; and c.) identify additional commercial fertilizer including starter fertilizer and/or manure needed to achieve the target yields.

- Credit for nutrients provided by legumes will be consistent with the most current UMES guidance.

##### **Proven Yields**

- When Land Grant University guidelines are based on yield goals:

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Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact the MN Natural Resources Conservation Service in your area, or download it from the electronic Field Office Technical Guide for Minnesota

- Average the four highest of the previous five years' yields for a specific crop to determine proven yields. Do this annually to capture improved management and hybrids.
  - i) Yield monitor data, field specific weigh wagon data or scale slips can be used to obtain historic yield information. Yield monitor data may be more field and within field specific than other data sources.
- If long term data for an individual field is not available, use yield data from similar soil, cropping and management conditions elsewhere on the farm or in the local area.
- Industry yield recommendations may be used for new crops or varieties until documented yield information is available.
- When Land Grant University guidelines are based on soil productivity, nutrient costs and expected returns:
  - Historic yield data can also be used to capture site specific soil variability, climatic conditions and management skills.

### **University of Minnesota Extension (UMES) Guidelines**

Recommended nutrient application rates shall match UMES fertilizer and nutrient guidelines as closely as possible (See "Additional Criteria" below for exceptions when applying manure or organic by-products). NRCS specialists will consider contiguous land grant university recommendations on a case by case basis. If UMES or contiguous land grant universities do not provide specific recommendations application shall be based on proven yields and associated plant nutrient removal information.

- 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.
- Band or row apply  $P_2O_5$  applications when possible to reduce needed per acre rate.
- Deviation from UMES guidelines is allowed on a case by case basis. Consult the most current version of *USDA-NRCS Minn. Amendment (Nutrient Management Planning) to 180-VI National Planning Procedures Handbook* for detail.

### **B. NUTRIENT APPLICATION TIMING**

Application timing shall correspond as closely as possible with plant nutrient uptake, while

considering cropping system limitations, climatic conditions and field accessibility.

- Avoid fall application of urea ammonium nitrate (UAN solution), ammonium nitrate (AN), and other nitrate-nitrogen forms of commercial N fertilizer.
- Delay fall applications of other N forms until soil temperatures are below 50 degrees F at a six inch depth.
- Use Table 1 and Figure 1 to determine other soil/location combinations where fall commercial N applications should be avoided
- Manure and commercial nitrogen and phosphorus fertilizer shall not be applied to frozen, snow-covered or actively thawing areas having one or more of the following conditions:
  - Within 300 feet of sensitive features including surface waters, surface tile intakes, sinkholes, water supply wells, mines and quarries
  - Uncontrolled ephemeral erosion
  - Frequently flooded soils
  - Beyond 300 feet of sensitive features no solid manure applications when sheet and rill soil losses are greater than 4 tons per acre per year and no fertilizer or liquid manure applications when sheet and rill soil losses are greater than 2 tons per acre per year
  - Any actively thawing field draining to surface waters

### **C. NUTRIENT APPLICATION METHODS**

Application methods shall be employed that reduce the risk of nutrient transport to surface and ground water, or into the atmosphere.

- The application rate (in/hr) for *liquid material* including irrigation water shall not result in runoff or ponding (application rate shall not exceed the soil infiltration rate). Infiltration rates can be determined by examining soil permeability data for the most restrictive topsoil layer. Total application shall not exceed the amount of water needed to bring soil moisture content to field capacity within the rooting zone at the time of application. The actual rate shall be adjusted during application to avoid ponding or runoff. Stop applications if runoff or ponding is observed.
- Incorporate fertilizers containing phosphorus within a few days of application or within 24 hours if precipitation is imminent.
- Incorporate surface or broadcast applications of Urea and UAN solution within three days.

Table 2 summarizes the following guidance.

- *Fields delivering runoff to surface waters*
  - Maintain a 25 foot separation between surface waters and applied manure.
  - Inject or incorporate manure within 24 hours and prior to rainfall if within 300 feet of surface waters (if no filter strip separates the site from the receiving water).
- *Active or inactive water supply wells, mines, quarries, sinkholes receiving surface runoff, or other direct conduits to ground water.*
  - Immediately incorporate commercial nitrogen fertilizer and inject or incorporate manure within 24 hours and prior to rainfall on fields draining to these features
  - Do not apply manure within 50 feet
- *Established grassed waterways, ditches and other water conveyances.* Do not apply manure. Irrigated applications are allowable on a case by case basis on within-field grassed waterways.
- *Surface Tile Intakes.* Within 300 feet inject or incorporate manure within 24 hours.
- *Coarse-Textured Soils*
  - Sidedress or split apply commercial nitrogen fertilizer on coarse textured soils (no fall applications).
  - Use a nitrification inhibitor with early sidedressed nitrogen on labeled crops
  - Avoid fall liquid manure applications or delay applications until daily average soil temperatures at a six-inch depth are below 50 degrees F.
- *Fields with excessive soil loss* Do not apply manure or commercial fertilizers on fields with sheet and rill soil losses greater than 6 tons/acre/year or uncontrolled ephemeral erosion.
- *Fractured bedrock and High water table soils*
  - Do not fall apply commercial nitrogen fertilizer on fields with less than 36 inches of soil above fractured bedrock.
  - Maintain a separation distance of at least 15 inches between manure and fractured bedrock or high water table.
- *Soils Classified by NRCS as frequently flooded*
  - Incorporate commercial fertilizer applications within 24 hours during peak flood periods.
  - Do not apply manure during the period when flooding is expected and incorporate within 48 hours on cropland fields during other times of the year.

- *Drinking Water Supply Management Areas (DWSMAs) and Source Water Protection Areas (SWPAs)*

Utilize regional nitrogen and phosphorus Best management practices in DWSMAs and SWPAs having medium to high vulnerability to contamination.

#### **E. CONSERVATION MANAGEMENT UNIT (CMU) RISK ASSESSMENT.**

CMU (field or portion of field) risk assessments of the potential for nutrient transport from the area will be determined as follows:

#### **Potential off-field nitrogen transport will be determined** using Figure 1 and Table 1 in:

- Areas with an identified nitrogen-related water quality impairment.
- DWSMAs and SWPAs with medium to high vulnerability to contamination.
- Areas having High or Very High pollution sensitivity of the water table or surficial aquifer as portrayed in a County Geologic Atlas or Regional Hydrogeologic Assessment.

#### **Potential off-field phosphorus transport will be determined:**

- Within phosphorus impaired watersheds by using the University of Minnesota's Phosphorus Site Index for fields receiving only commercial fertilizer applications.
- On any CMU receiving or proposed to receive manure or other organic by-product by using the NRCS Phosphorus Loss Potential and Manure Application Rates Table (Table 3).

#### **Additional Criteria Applicable to Manure and Organic By-Products Applied as a Plant Nutrient Source**

The preceding "General Criteria Applicable to All Purposes" applies to manure and organic by-products including use of proven yields; nutrient budgets, and application method and timing restrictions in sensitive areas.

#### **A. MANURE AND ORGANIC BY-PRODUCTS SAMPLING AND LABORATORY ANALYSIS (TESTING)**

Nutrient values of manure and other organic by-products will be sampled and analyzed from all "significant" manure sources on the farm to help make accurate nutrient rate recommendations. For purposes of this standard, "significant" means manure and bedding from 15 or more

animal units. Significant sources with similar animal types, housing, feed management and handling can be considered the same source if cumulative samples over time indicate minimal variation between the different confinement areas.

### Sampling

- *Samples will be collected and analyzed at each emptying (except daily scrape and haul) for at least 3 consecutive years.*
  - Samples from daily spreading operations should be collected and analyzed at least 4 times (seasonally) per year
  - Sampling frequencies can be reduced to every other emptying when cumulative test results indicate minimal variation in N and P nutrient concentrations (less than 20% difference between high and low values).
  - Always retest manure following changes in conditions affecting manure nutrient content including unusual climatic conditions or changes in manure storage and handling, livestock types or livestock feed.
- *Sampling techniques shall be consistent with the most current versions of UMES' publication *Livestock Manure Sampling*; and USDA-NRCS-MN's *Fact Sheet MN-NUTR6. - Manure Sampling and Analysis*.*
  - Sampling from the manure application equipment is preferred. Sampling from stored manure may be allowed on a case by case basis.

### Analysis

- *Analyze at a minimum, for total nitrogen, phosphorus and potassium concentrations and percent moisture content. Organic nitrogen concentration is also useful. The analyses should be expressed as or converted to pounds per ton or per 1000 gallons of Total N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O.*
- *Use MDA certified labs to perform the analysis:*  
<http://www.mda.state.mn.us/licensing/pestfert/manurelabs.htm>
  - Use of on-site analytical kits is permitted if endorsed by the MDA, UMES or MPCA.
- *Retain records of manure analysis for 6 years and use to determine if nutrient concentrations vary within and between years.*

## B. MANURE AND ORGANIC BY-PRODUCTS RATES

- Manure or organic by-product application rates will be based on analyses of the material. *Published book nutrient content table values can only be used for:* a) initial generalized planning and proposed new facilities, or b) estimating quantity of manure or nutrients in manure from a limited number of animals (e.g. less than 15 animal units). Published nutrient values can be found in Chapter 4 of the NRCS *Agricultural Waste Management Field Handbook (AWMFH)* or the most recent versions of Midwest Plan Service's *Livestock Waste Facilities Handbook*. Values used must be acceptable to the MPCA for feedlot permitting purposes.
  - Nutrient concentration data from the current system's cumulative manure analyses or data from the most recent samples taken will be used as the starting point when calculating manure nutrient available to crops.
  - Calculating 1<sup>st</sup>, 2<sup>nd</sup> or 3<sup>rd</sup> year nutrients available to crops from manure will be consistent with procedures and availability percentages found in the most current version of form *USDA-NRCS MN-CPA-35 (Manure Nutrient Crediting)*. Some deviation from suggested nutrient manure credits is allowed (Consult the most current version of *USDA-NRCS Minn. Amendment (Nutrient Management Planning) to 180-VI National Planning Procedures Handbook* for detail.)

### General

- Limit rates to approximately 3,000 gallons liquid or 10 tons solid per acre when applying onto existing legumes (unless higher rates have been shown to not damage the forage and runoff potential to nearby waters is low).
- Do not recommend rates that the application equipment cannot deliver.
- Do not recommend multiple rates within a management area unless variable rate manure application equipment is available.
- Do not recommend a different rate on each of numerous fields unless the producer has the capability and time to apply at those rates.
- Soil salt content may rise in low rainfall areas receiving long-term applications of manure. Reduce application rates or rotate field applications when salinity levels measured as electrical conductivity of a saturated paste extract exceed from 2-12 mmhos/cm. dependent on crop salt tolerances. Consult Chapters 5, 6, and 11 of the *AWMFH* for additional detail.

### *Nitrogen*

- Application rates can be based on UMES nitrogen recommendations and nitrogen budgeting regardless of crop phosphorus and potassium needs except as noted below under phosphorus
  - Use estimated nitrogen removal in harvested plant biomass when UMES nitrogen recommendations do not apply (e.g. legumes).

### *Phosphorus*

Manure application rates can also be calculated based on crop or forage P<sub>2</sub>O<sub>5</sub> removal rates and phosphorus budgeting. Table 3 defines when manure applications must be based on phosphorus removal.

Crop or forage harvested plant biomass P<sub>2</sub>O<sub>5</sub> removal rates can be based on one year, multiple years, or all years of the crop rotation provided the rate does not exceed the recommended nitrogen application rate during the year of application and the total amount of P<sub>2</sub>O<sub>5</sub> applied over the entire crop sequence does not exceed the sequence's calculated phosphorus removal needs.

Inorganic nitrogen applications may be required to supply, but not exceed, the recommended amounts of nitrogen in any given year when manure or organic by-products are applied on a phosphorus budgeting basis.

### **C. MANURE AND ORGANIC BY-PRODUCTS TIMING, PLACEMENT AND INCORPORATION**

- *Broadcast applications.* Incorporate within a few days of any application (as soon as possible when wintertime applications are allowed).
- *Existing legume stands.* Apply immediately after cutting
- *Vulnerable sites.* Manure applications should not be made on sites considered vulnerable to off-site phosphorus transport unless appropriate conservation practices, best management practices or management activities are used to reduce transport potential.

### **Additional Criteria for Nutrient Applications onto Idled Land with a Perennial Cover, CRP or Similar Land**

- Apply organic nutrients only in emergency situations such as inability to spread on cropland

because of flooding situations. If applications are necessary.

- Apply only once in a three-year period to the same location in CRP fields.
  - Apply on areas furthest from receiving waters or having gentlest slopes or having lowest Soil Test Phosphorus levels.
  - Do not apply when the ground is frozen, snow covered or actively thawing.
  - Do not apply on soils classified by USDA-NRCS as frequently flooded.
  - Do not apply organic nutrients to the entire field. Leave large enough portions of the field undisturbed to provide nesting and cover habitat for wildlife.
  - Maintain vegetation on CRP fields at no less than an 80% cover condition after application.
  - Repair and reseed areas damaged by application of organic nutrients
- Base application rates on the amount needed to supply 30 lbs./ac. total nitrogen (N) on coarse textured soils and 60 lbs./ac. N on other soil types (increase to 80 lbs./ ac. N on other than coarse textured soils for drag hose applications if the 60 lb./ac. rate cannot be applied).
  - Periodically test for soil P content and cease applications when test results indicate 75 ppm or higher Bray 1 phosphorus (60 ppm Olsen).

### **Additional Criteria to Protect Air Quality by Reducing Nitrogen and/or Particulate Emissions to the Atmosphere**

- In areas with an identified or designated nutrient management related air quality concern, any component of nutrient management identified by risk assessment tools as potentially contributing to atmospheric pollution shall be adjusted, as necessary, to minimize the loss(es).
- When tillage can be performed, surface applications of manure, other on-farm organic nitrogen sources and fertilizer nitrogen formulations subject to volatilization (e.g., urea) shall be incorporated into the soil within 24 hours after application.
- When manure or organic by-products are applied to grassland, hayland, pasture or minimum-till areas the rate, form and timing of application(s) shall be managed to minimize volatilization losses.
- Irrigated liquid forms of manure shall be applied when humidity is high, and little or no

wind is blowing and/or other conditions that minimize volatilization losses

- Operators will handle and apply poultry litter or other dry types of animal manures when the potential for wind-driven loss is low and there is less potential for transport of particulates into the atmosphere.
- When sub-surface applied using an injection system, manure and other organic materials shall be placed at a depth and applied at a rate that minimizes leaks onto the soil surface, while minimizing disturbance to the soil surface and plant community.
- Weather and climatic conditions during manure or organic by-product application(s) shall be recorded and maintained in accordance with the operation and maintenance section of this standard.

**Additional Criteria to Improve the Physical, Chemical and Biological Condition of the Soil**

- Nutrients shall be applied and managed in a manner that maintains or improves the physical, chemical and biological condition of the soil.
- Minimize the use of nutrient sources with high salt content unless provisions are made to leach salts below the crop root zone.
- To the extent practicable nutrients shall not be applied on medium and fine textured soils when the potential for soil compaction and rutting is high (soil moisture content is at field capacity).

**Criteria Applicable to Municipal Wastewater and Biosolids (Sewage Sludge) Applied as a Plant Nutrient Source**

Biosolids shall be sampled, analyzed and applied in accordance with USEPA regulations. (40 CFR Parts 403 (Pretreatment) and 503 (Biosolids); Minnesota Rule R. chapter 7041 and other local regulations regarding the use of biosolids as a nutrient source. Consult Minnesota Rule Chapter 7041 for detail including application timing restrictions.

When biosolids are applied, the accumulation of potential pollutants (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) in the soil shall be monitored in accordance with the US Code, Reference 40 CFR, Parts 403 and 503, Minnesota Rule R. chapter 7041 and/or any applicable state and local laws or regulations.

The single application or lifetime limits of heavy metals shall not be exceeded. The concentration of salts shall not exceed the level that will impair seed germination or plant growth. Consult Minnesota Rule R. Chapter 7041 and Chapters 5, 6, and 11 of the NRCS Agricultural Waste Management Field Handbook (AWMFH) for additional details.

**CONSIDERATIONS**

The use of management activities and technologies listed in this section, although not required, may improve both the production and environmental performance of nutrient management systems.

The addition of these management activities, when applicable, increases the management intensity of the system and should be considered in a nutrient management system.

- Use winter cover crops to capture unused soil nitrogen for recycling to later crops. This practice is effective when adequate soil moisture is available to the cover crop; and when length of the remaining growing season will permit sufficient cover crop growth.
- Plan additional conservation practices such as filter strips or riparian buffers to reduce transport of attached and dissolved nutrients to surface waters and sinkholes.
- Inject or incorporate manure and other organic by-products within 24 hours on all fields within a watershed listed as having surface water quality impairment due to nutrients
- Delay manure or organic by-product applications if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.
- Prioritize and scheduling fields for manure applications based on gentleness of slope, lowest Soil Test Phosphorus levels and greatest distance from sensitive features.
- Consider travel time and route to fields when scheduling fields for manure applications. Minimize travel time on roads and highways.
- Select the lesser of the following winter-time manure application rates: a) 5000 gallons or 12 tons per acre (swine, dairy or beef); 4 tons per acre poultry, or b) rates necessary to satisfy crop P removal in the harvested portions of the desired crop.

- Use products or materials (e.g. nitrification inhibitors, urease inhibitors and slow or controlled release fertilizers) that may improve the nitrogen use efficiency (NUE) of the nutrient management system by reducing losses of nitrogen into water and/or air.
- When fertigating consider applying irrigation water in accordance with NRCS standard Irrigation Water Management (Code 449)
- Consider morning manure applications to minimize odor if applications on warm days are necessary.
- Use "good neighbor practices." These practices include not spreading manure: a.) before holidays and weekends when people are engaged in outdoor activities; b.) near heavily traveled highways; c.) when wind would blow odors toward populated areas, and d.) on calm, humid days on fields in close proximity to residences and roadways. Also consider injection or incorporation within 24 hours if applied on sites within 300 feet of residences and 1000 feet of roads

## PLANS AND SPECIFICATIONS

Nutrient management plans shall be developed in accordance with this standard and with the NRCS General Manual Title 450, Part 401.03 and title 190, Part 402; and the NRCS National Planning Procedures Handbook (NPPH). The plans shall specify the source, amount, form, timing and method of application of nutrients on each field to achieve realistic production goals, while minimizing nitrogen and/or phosphorous movement to surface and/or ground waters.

Nutrient management plans shall include a statement that the plan was developed based on requirements of the current standard and any applicable Federal, state, or local regulations, policies, or programs, which may include the implementation of other practices and/or management activities. Changes in any of these requirements may necessitate a revision of the plan.

### Nutrient management plan components will include:

- *A soil map and an aerial photo or map* clearly identifying fields and acreage receiving recommendations. Sensitive features should be shown on the maps if possible. Fields

scheduled for wintertime manure applications should also be shown.

- *An identification of sensitive features* requiring special attention and the practices to use in those sensitive areas.
- *Current or planned plant production sequence* or crop rotation and type(s) of surface residue management.
- *A field specific schedule of nutrient applications to include*
  - Per acre annual rates (Express rates for commercial fertilizer as pounds/acre N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O. Expressing as pounds or gallons/acre of a specific product or form is also encouraged). Rates for manure will be expressed as tons/acre or gallons/acre.
  - Form of the nutrient
  - Timing of applications including anticipated month(s) of application(s)
  - Frequency of application (if applied more than once in the cropping year to the same field)
  - Application method including time to incorporation
  - Amount of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O available to plants at prescribed commercial fertilizer and manure application rates
- *Information, calculations and data used to develop the schedule of nutrient applications*
  - Results of soil, water, manure and/or organic by-product sample analyses
  - Plant tissue test results, if appropriate
  - Soil types and slopes used for planning purposes
  - realistic yield goals for the crops to be grown
  - Listing and quantification of available nutrient sources
  - Complete nutrient budgets for the crop. This information includes calculations used to determine N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O available to the crop from manure applications.
- *A record of the phosphorous and nitrogen risk assessment ratings for each field if required) and practices to reduce risk of phosphorus and nitrogen movement. Operation, maintenance and recordkeeping guidance*
- *Additionally, the following plan component will be added if STP levels are at or greater than 21 ppm Bray P1 (16 ppm Olsen) and increases in soil phosphorus levels are expected:*
  - The soil phosphorous level at which it may be desirable to convert to phosphorus based implementation.

- o The potential for soil phosphorus drawdown from the production and harvesting of crops.
- *Additionally, the following plan components, will be added when manure is utilized as a source of nutrients:*
  - o A description of the size and kind of livestock present including quantity of organic materials produced during the planning period.
  - o Description of the manure storage and handling system including application equipment and labor needed to apply the organic nutrient source.
  - o Annual amount of nitrogen and phosphorus from manure that will need to be land applied.
  - o Description of the manure nutrient testing practices (methods, frequency)
  - o Description of equipment calibration practices
  - o Cover crop to be planted when applying manure in summer to harvested fields that would otherwise not have actively growing crops for the remainder of the season.

## 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:

### A. PLAN UPDATES

All plan components will be annually reviewed and updated on a regular basis but at least with each soil test cycle. However plan component 4 will be annually updated when manure or other organic by-products are utilized as a nutrient source or when soil nitrate tests are used to develop recommendations. Older versions of plans should be saved for a period of 5 years or longer.

### B. OPERATION

- Calibrate application equipment to ensure that commercial fertilizer or manure applications do not deviate by more than approximately 15% from planned rates.
- Maintain application equipment in good operating condition.
- Clean equipment after nutrient application. Insure that the application or spreading pattern

is uniform so that the amount specified for a particular area is applied across the entirety of that area.

- Protect commercial fertilizer and agricultural waste storage facilities from weather and accidental leakage or spills.
- Obtain a chemigation permit from the MDA if planning to apply chemicals through an irrigation system. All chemigation systems must be fitted with effective anti-backsiphon devices or check valves to prevent backflow into water supplies.
- Store excess material in an appropriate manner for future use.
- Wastewater resulting from flushing application equipment shall be kept away from wells, streams, ponds, lakes or other water bodies and out of sinkholes and high runoff areas.
- Minimize exposure to manure gases and organic wastes and chemical fertilizers—particularly ammonia forms of fertilizers. Wear protective clothing, a respirator, gloves and footwear when appropriate. See Minnesota Rule Chapter 1513 for rules addressing Anhydrous Ammonia.  
<http://www.revisor.leg.state.mn.us/arule/1513/>  
Also see MDA's Anhydrous Ammonia Program at  
<http://www.mda.state.mn.us/chemicals/fertilizers/nh3.htm>
- Follow all local, state and federal regulations regarding the transport, storage and disposal of fertilizers and fertilizer containers. See Minnesota Statute 18C at:  
<http://www.revisor.leg.state.mn.us/stats/18C/>
- Report all agricultural chemical incidents to the state duty officer at 1-800-422-0798 (Greater Minnesota) or 1-651-649-5451 (Twin Cities Metropolitan Area).

### C. RECORD-KEEPING

Maintain records to document plan implementation and help develop succeeding nutrient management plans. As applicable records include:

- Field specific crop, yields, planting and harvest dates and residues removed,
- Type and analysis of nutrient applied to each field (commercial fertilizer, manure etc.) Application rate, method, date, timing and location (Indicate reasons for differences when actual application differs from planned applications)



- Weather conditions and soil moisture at the time of application; lapsed time to manure incorporation, rainfall or irrigation event.
- Manure and soil test results.  
*Additionally the following records should be kept when manure and organic by-products are used as a nutrient source:*
- Quantity of manure and other organic by-products produced annually.
- Dates and amount of manure removed from the system due to feeding, energy production, or export from the operation including:
  - Manure transported off-site to land not owned or controlled (include location of site and per acre application rate).
  - Manure transported off-site to be used for other than a crop nutrient.
  - Name and address of commercial hauler or applicator receiving manure.

Records should be maintained for six years or for a longer period if required by local ordinances.

## DEFINITIONS

- **Commercial Fertilizers**  
Products with a guaranteed analysis displayed in accordance with Minnesota's Fertilizer Soil Amendment and Plant Amendment Law (Minnesota Statute 18C).
- **Crop Nutrient Removal Rates**  
Removal rates for purposes of this standard are the quantity of N, P<sub>2</sub>O<sub>5</sub> or K<sub>2</sub>O taken up by a specific crop or crop rotation and removed in the harvested portion of that crop. Some databases express removal as elemental P and K and must be converted to P<sub>2</sub>O<sub>5</sub> or K<sub>2</sub>O.
- **Filter Strips**  
For purposes of this standard are strips of ungrazed permanent perennial plant species with growth patterns conducive to retarding runoff flow velocities. Strip establishment shall be consistent with the most current version of USDA-NRCS-MN Conservation Practice Standard 393 Filter Strip and with state rules.
- **Intermittent Streams**  
Include off-field drainage channels with definable banks that provide for seasonal water flow to a perennial stream, lake or wetland or water flow during snowmelt or rainfall events. These can be located on topographic maps, soil survey maps or by conducting on-site evaluations.

- **MDNR Regulated Wetlands**  
Includes all wetlands or other surface water features identified on MDNR protected waters and wetlands inventory maps. Protected Water Inventory Maps are available in local SWCD and NRCS offices or can be obtained on-line at: [http://www.dnr.state.mn.us/waters/watermgmt\\_section/pwi/maps.html](http://www.dnr.state.mn.us/waters/watermgmt_section/pwi/maps.html)
- **Coarse Textured Soils**  
For purpose of this standard applies to the surface soil texture and/or the subsoil texture within three feet of the surface. These textures include sand, loamy sand, loamy coarse sand, fine sand, loamy fine sand, loamy very fine sand, coarse sand, very fine sand, and any of the above listed textures with gravelly or very gravelly modifiers.

The percent of coarse textured soils contained within a planning unit necessary to make the whole unit susceptible to leaching will vary by site, contiguous nature of the map unit and planner and producer objectives. However the entire planning unit will be considered susceptible to leaching if at least 33% coarse textured soils are present either in the surface soil or subsoil as defined above.

- **Surface Waters**  
For purposes of this standard include lakes, perennial streams, MDNR regulated wetlands, off-field intermittent streams, off-field drainage ditches, and other water bodies considered locally important.

## REFERENCES and ADDITIONAL INFORMATION

- Waterborne Pathogens in Agricultural Watersheds.** NRCS Watershed Science Institute Technical Note. June 2000.
- Reddy, K.R., R. Kahleel, and M.R. Overcash. 1981. **Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes.** J. Environ. Qual. 3:255-266
- Most information, guidance and aides needed to manage nutrients and develop nutrient management plans are located at: <http://www.mn.nrcs.usda.gov/technical/ecs/nutrient/nutrient.html>
- Sensitive Water Bodies GIS Project.** USDA-NRCS in Minnesota. February 2005

## NITROGEN LOSS POTENTIAL FOR MINNESOTA

**Potential off-field nitrogen transport** will be determined in:

- Areas with an identified nitrogen-related water quality impairment
- DWSMAs and SWPAs with medium to high vulnerability to contamination
- Areas having High or Very High pollution sensitivity of the water table or surficial aquifer as portrayed in a County Geologic Atlas or Regional Hydrogeologic Assessment

Table 1 and Figure 1 can be used to help determine regional potentials for nitrogen loss. The figure and table have been modified from similar tables and figures found in **Minnesota Agricultural Experiment Station Report 186. 1983. Nitrogen Loss Potential and Nitrogen Fertilizer Management of Minnesota Soils.**

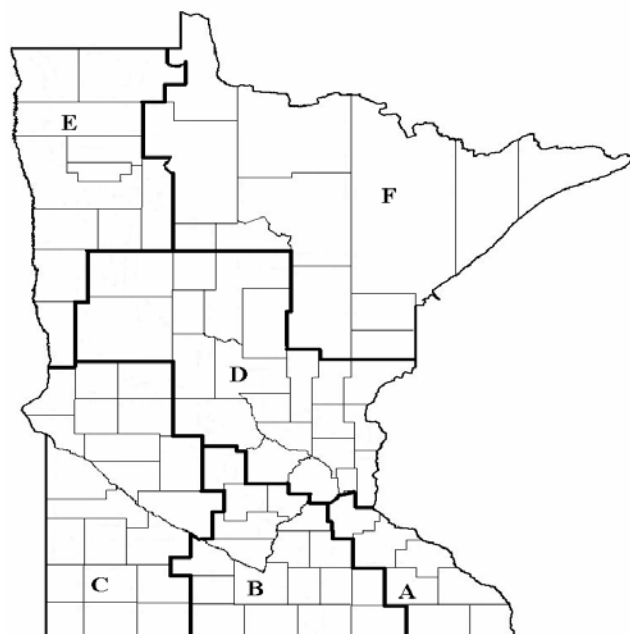
**N management options that reduce loss potential will be recommended if a client's existing nutrient management program rates moderate to very high.** Consult information contained in this standard and in UMES' Series of regional N-BMPs publications to help suggest management options. Options include: changing from fall application to spring pre-plant or sidedress or split applications, using an ammonia form of N fertilizer; or in certain instances using a nitrification inhibitor.

**Please note that the management option of most importance in Southeast Minnesota and on coarse textured soils statewide is eliminating fall application of commercial N fertilizers.**

**Table 1: Long Term Annual Relative Nitrogen Loss Potential<sup>1</sup>**

Zone	Application Method	Soil Texture <sup>2</sup>		
		Coarse	Medium	Fine
A	Fall	VH	H	M
	Spring preplant	H	M	M
	Sidedress or split	M	L	L
B	Fall	VH	M	M
	Spring preplant	H	L	L
	Sidedress or split <sup>3</sup>	M	L	L
C,D	Fall	VH	L	L
	Spring preplant	H	L	L
	Sidedress or split <sup>3</sup>	M	L	L
E	Fall	M	L	L
	Spring preplant	L	L	L
	Sidedress or split <sup>3</sup>	L	L	L
F	Fall	H	L	L
	Spring preplant	M	L	L
	Sidedress or split <sup>3</sup>	M	L	L

**Figure 1: Nitrogen Loss Zones**



<sup>1</sup>Potential Rating: VH-Very High, H-High, M-Moderate, L-Low

<sup>2</sup>Soil Texture: See definitions section

<sup>3</sup> If applied after June 15, the loss rating is reduced to Low on

Coarse textured soils. However, late nitrogen applications on most soils that are followed by conditions that reduce yield (i.e. below average precipitation) can cause nitrogen loss to occur due to the crop not utilizing the applied nitrogen. To reduce the potential for this to occur on corn ground, apply no later than the 8th leaf stage.

Table 2: Summary Nutrient Application Restrictions in Sensitive Areas

Environmentally Sensitive Features	Non-Winter Applications	Winter Applications (When soil is frozen, snow-covered or actively thawing)
Surface Waters - Intermittent Streams, DNR Protected Wetlands, Drainage Ditches without Berms, Lakes, Streams	<b>Without a Filter Strip –</b>  <b>Within 25 Feet of surface waters - Do Not Apply Manure</b>  <b>Within 300 Feet of surface waters - Inject or incorporate manure within 24 hours</b>  <b>If soil test phosphorous levels exceed 21 ppm Bray P1 or 16 ppm Olsen - Apply Manure at Phosphorous Removal Rates</b>	Within 300 Feet - Do Not Apply Manure
	<b>With a Filter Strip –</b>  <b>100 Feet Wide</b> around Lakes and Streams  <b>50 Feet Wide</b> around Intermittent Streams, DNR Protected Wetlands, Drainage Ditches without Berms  Manure may be applied outside of the filter strip area	
Open (Surface) Tile Intakes	Within 300 Feet – Inject or incorporate manure within 24 hours	Within 300 Feet - Do Not Apply Manure
Water Supply Wells (Active or Inactive), Mines, Quarries	Within 50 Feet - Do Not Apply Manure	
	Within 300 Feet – Inject or incorporate manure within 24 hours	Within 300 Feet - Do Not Apply Manure
Sinkholes - receiving surface runoff (MPCA), and other direct conduits to ground water (NRCS)	Within 50 Feet - Do Not Apply	
	Within 300 Feet - Inject or incorporate manure within 24 hours	Within 300 Feet - Do Not Apply Manure
Road Ditches	Do Not Apply Directly Into	
Fields with sheet and rill losses greater than 6 tons/acre/year	Do Not Apply Manure or commercial fertilizer	
Fields with uncontrolled ephemeral erosion	Do Not Apply Manure	
Established Waterways, Ditches and other water conveyance systems	Do Not Apply Manure	
Frequently Flooded Soils as classified by NRCS	During usual peak flooding periods, do not apply manure	Do not apply manure
	When the probability of flooding is low, incorporate manure within 2 days	Do not apply commercial nitrogen or phosphorous fertilizer
	During usual peak flooding periods, Incorporate commercial fertilizer applications within 24 hours	
Fractured Bedrock	Apply manure in a manner that maintains at least 15 inches of soil separation between applied manure and fractured bedrock	
High Water Table Soils	Apply manure in a manner that maintains at least 15 inches of soil separation between applied manure and the high water table	
Coarse Textured Soils	In Fall, Delay manure applications until daily average soil temperatures at a 6-inch depth are below 50 degrees F.	
	In Fall, Avoid liquid manure applications when possible	
	In Fall, Do not apply commercial nitrogen fertilizer	
	Use sidedress or split applications of commercial nitrogen fertilizer	

**TABLE 3. PHOSPHORUS LOSS POTENTIAL AND MANURE APPLICATION RATES**

**Potential off-field phosphorus transport will be evaluated:**

- Within watersheds impaired because of phosphorus will be determined for fields receiving only commercial fertilizer applications by using the University of Minnesota’s Phosphorus Site Index.
- On any CMU receiving or proposed to receive manure or other organic by-products will be determined using the following table

Distance to Surface Water (feet)	Soil Test Phosphorous (STP) Levels		Sheet and Rill Erosion Tons/Acre/Yr	Field Edge Filter Strip (100 Feet Wide)	
	Bray P1 (ppm)	Olsen (ppm)		No	Yes
<b>Base Manure Application on:</b>					
	NA		>6	<b>No Application</b>	
<b>&lt; 300</b>	≤ 21	≤ 16	<6	Nitrogen Needs	
	22 - 75	17 – 60	<6	P <sub>2</sub> O <sub>5</sub> Removal	Nitrogen Needs <sup>3</sup>
	76 - 150	61 – 120	<6		P <sub>2</sub> O <sub>5</sub> Removal/P-Index <sup>1</sup>
	> 150	>120	<2	No Application	P <sub>2</sub> O <sub>5</sub> Removal
			2-6	No Application/P-Index <sup>2</sup>	
<b>≥ 300</b>	< 76	< 61	<6	Nitrogen Needs/P-Index <sup>3</sup>	
	76 – 150	61 – 120	<6	P <sub>2</sub> O <sub>5</sub> Removal/P-Index <sup>1</sup>	Nitrogen Needs/P-Index <sup>3</sup>
	> 150	> 120	<4		Nitrogen Needs/P-Index <sup>3</sup>
			4-6	P <sub>2</sub> O <sub>5</sub> Removal/P-Index <sup>1</sup>	

1. Can apply manure at a nitrogen based rate if current or proposed management results in a Minn. Phosphorus Index value of ≤ 1.5
2. Can apply manure on a P<sub>2</sub>O<sub>5</sub> removal basis if current or proposed management results in a Minn. Phosphorus Index value of ≤ 1.5
3. Run Minn. Phosphorus Risk Index if site review indicates N based rates may be too high. Change to a P<sub>2</sub>O<sub>5</sub> Removal basis if current or proposed management results in an index value of > 1.5

Nitrogen Needs – For non-legumes, follow University of Minnesota nitrogen recommendations found in the most recent publication. For legumes, use annual crop nitrogen removal rates.

See the definition Section for a description of surface waters.