NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Acre)
CODE 590

DEFINITION

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

PURPOSES

- To minimize the transport of applied nutrients into surface water or ground water.
- To budget and supply adequate plant nutrients for optimum crop yield and quality.
- To properly utilize manure or organic by-products as plant nutrient sources.
- To promote management practices that sustains the physical, biological, and chemical properties of the soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all lands where plant nutrients and soil amendments are applied.

CRITERIA

Criteria Applicable to All Purposes

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

Plans for nutrient management are to be developed 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 Field Office Technical Guide* (FOTG); procedures contained in the *National Planning Procedures Handbook* (NPPH); and the *NRCS National Agronomy Manual* (NAM) Section 503. The contents of the plan shall conform to the “Nutrient Management Plan – Plans and Specifications” section of this standard.

All nutrient management plans concerning sludge application are to meet the applicable criteria of this standard and other applicable local, state, and federal laws and regulations.

Persons who review and approve Nutrient Management Plans, for which NRCS has technical responsibility, must be approved by the Illinois NRCS State Conserva-tionist.

Nutrient management plans that are a component of a more comprehensive conservation plan shall be designed to be compatible with the other practices scheduled in the overall plan. Erosion, runoff, and water management control practices shall be implemented as needed on fields that receive applications of nutrients.

A nutrient budget for nitrogen, phosphorus, and potassium shall be developed considering all potential sources of nutrients including, but not limited to animal manure (and other organic by-products such as compost and sewage sludge), waste water, commercial fertilizer, crop residues, legume credits, and irrigation water.

Realistic yield levels will be based on soil productivity information, potential yield, or historical yield data based on a 5-year average. Realistic yields can be increased by 5% to account for improved genetics, pest control technology, or other technological advances that increase crop productivity. A procedure for calculating 5-year average yields is found in the *Illinois Agronomy Handbook*. When historical yield data is not available, determine estimated yield levels by comparing crop productivity data established for similar soils under similar cropping patterns. For new crops or varieties, industry documented yield data may be used until more farm information is available. University of Illinois Bulletins 810 and 811 may also be used.

Nutrient management plans will specify the form, source, amount, timing, and method of application of nutrients on each field in order to achieve realistic production levels while minimizing transport of nutrients to surface and/or groundwater.

Soil Sampling and Plant Tissue Testing

Crop nutrient recommendations contained in nutrient management plans will be based on current soil tests obtained through sampling and analytical procedures prescribed by the University of Illinois or through standard industry practice(s) recognized by the University of Illinois. Soil tests no older than 4 years are considered current.

Plant analysis is advisable when assessing plant secondary and/or micronutrient nutrition or evaluating for potential nutrient imbalances in forage crops. Plant analysis will be interpreted according to University of Illinois guidelines.

Soil tests taken soon after manure, bio-solid, or other organic by-product application may produce erroneous soil test results for phosphorus. Soil tests other than in-season soil nitrogen assessment tests should be delayed for 9 to 12 months after organic amendment applications. Laboratories that are accepted in one or more of the following programs shall analyze soil tests:

- state certified programs,
- the North American Proficiency Testing Program (Soil Science Society of America), or
- laboratories whose tests are accepted by the University of Illinois.

For nutrient management planning, the minimum data required for soil tests include guidelines for pH, phosphorus, and potassium. The cation exchange capacity (CEC) of the soil is useful in calculating lime and potassium application rates. The CEC can be estimated using guidelines in the *Illinois Agronomy Handbook*, laboratory tests, and information in published soil surveys. Recent soil surveys provide the CEC for each soil horizon. Most earlier soil surveys do not. In these cases, the CEC can be estimated using the following formula.

CEC= 0.6(% clay) + 2(% organic matter)

Example: A soil with 20% clay and 2% OM will have an approximate CEC of 16-meq/100 g soil.

.6(20) + 2(2) = 16

Percent organic matter is needed to determine nitrogen rates for small grain crops. Organic matter can be determined by laboratory analysis or estimated use of the publication *Color Chart for Estimating Organic Matter in Mineral Soils in Illinois (AG-1941),* University of Illinois at Urbana-Champaign, College of Agriculture, Cooperative Extension Service.

Nutrient Application Rates

The current *Illinois Agronomy Handbook* suggestions should be used as a guide to establish nutrient and lime application rates. Nutrient and lime application rates should consider current soil test results, realistic yield goal and management capabilities.

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

- **Limestone-** It is recommended that soil pH be maintained within the optimum ranges established for the crops to be grown.

- **Nitrogen Application** –

1. Nitrogen application rates will be calculated using the procedure described in the current *Illinois Agronomy Handbook*.

2. Nitrogen credits from manure, legumes, sludge etc. will be included in the nutrient budget and used for calculating nitrogen rates required by the planned crops.

3. Applied nitrogen will not exceed the lesser of:

   a. 10% of the planned amount

   b. or the accuracy limits of the calibrated application equipment used.

4. When manure or other organic by-products are a source of nutrients, see "Additional Criteria" below.

- **Phosphorus Application –** Phosphorus application rates will be determined according to guidelines prescribed in the current *Illinois Agronomy Handbook.* Phosphorus application rates shall match the recommended rates as closely as possible. For **grain** and **forage** crops commonly grown in Illinois, except for starter fertilizer, no phosphorus is recommended when soil P tests reach the levels indicated in the *Illinois Agronomy Handbook,* Chapter 11, "Soil Testing and Fertility." Optimum soil test levels and application rates for specialty crops may differ from those established for grain and forage crops.

- **Potassium Application** – There are no known water quality problems associated with potassium. Potassium application rates should be determined according to suggestions contained in the current *Illinois Agronomy Handbook.*

- **Other Plant Nutrients -** The planned rates of application of other nutrients shall be consistent with the *Illinois Agronomy Handbook* guidance.

- **Starter Fertilizers –** Starter fertilizers containing nitrogen, phosphorus, and potassium may be applied in accordance with University of Illinois recommendations. Nutrients applied in the starter fertilizer will be included in the nutrient budget.

Nutrient Application Timing

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.

Fall applications of nitrogen for spring planted crops shall be delayed until the soil temperature is 60 degrees F (4 inch depth) or less when using a nitrification inhibitor or until 50 degrees F (4 inch depth) or less without an inhibitor. Regardless of soil temperatures, fall nitrogen applications should not be made prior to the second week of October in northern Illinois and the third week of October in central Illinois. Fall nitrogen applications are not recommended south of Illinois Route 16. In Appendix B, page 17 use **Table 1. Nitrogen Risk Assessment** to obtain additional guidance for nitrogen application in order to optimize agronomic and environmental concerns.

Nutrient Application Methods

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 (449).

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

Manure or other organic by-products plus a supplemental fertilizer shall not be applied at rates where plant-available nitrogen will exceed the nitrogen requirements for the crop(s) to be grown. For phosphorus requirements, refer to the WASTE UTILIZATION (633) standard and specifications.

Field Risk Assessment

A field-specific assessment of the potential for phosphorus transport from the field shall be completed where phosphorus containing materials are being land applied. This assessment will be done using the Illinois NRCS Phosphorus Assessment Procedure (Appendix A). In such cases, plans shall include:

- a record of the assessment ratings 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 done, the results of the assessment and the subsequent recommendations shall be discussed with the producer during plan development.

Heavy Metals Monitoring

When sewage sludge is 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, and/or any applicable state and local laws or regulations.

Additional Criteria to Minimize Agricultural Non-Point Source Pollution of Surface and Ground Water Resources

Evaluate water quality standards and designated use limitations that exist locally or statewide. Complete an assessment of the potential for nitrogen and/or phosphorus transport from the field. **Table 1 in Appendix B** and/or the Illinois Phosphorus Assessment Procedure in Appendix A are to be used. The results of these assessments and recommen-dations shall be discussed with the producer and included in the plan.

Plans developed to minimize agricultural nonpoint source pollution of surface or ground water resources shall include practices and/or management activities that can reduce the risk of nitrogen or phosphorus movement from the field. (See Appendix B for Recommended Management Practices).

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's structure, chemical properties, or biological condition. Use of nutrient sources with high salt content will be minimized unless provisions are used to leach salts below the crop root zone.

Nutrients shall not be applied when soils are flooded or saturated or when soil moisture content is such that compaction and/or ruts would be caused by ground-driven machinery.

CONSIDERATIONS

Consider additional practices to control erosion and to protect or improve water quality, soil nutrient and water storage, infiltration, aeration, tilth, and diversity of soil organisms:

- Conservation Cover (327),
- Grassed Waterway (412),
- Contour Buffer Strips (332),
- Filter Strips (393),
- Irrigation Water Management (449),
- Riparian Forest Buffer (391A),
- Conservation Crop Rotation (328),

- Cover and Green Manure (340),
- Residue Management (329A, 329B, or 329C, and 344), and
- Field Borders (386).
- Drainage Water Management (554)

(See **Appendix B** for Recommended Management Practices to Reduce Nitrogen and Phosphorus Losses.)

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

Cover crops could be planted whenever possible to utilize and recycle residual nitrogen.

Utilize application methods and timing that reduce the risk of nutrient transportation to ground and surface waters or into the atmosphere. Suggestions include:

- split nitrogen applications to best coincide with periods of maximum crop utilization,
- use a nitrification inhibitor to reduce nitrogen losses on soils rated moderate or high in probability for nitrogen loss,
- avoid winter nutrient application for spring seeded crops where leaching and/or runoff potential exists,
- band applications of phosphorus near the seed row,
- apply nutrients uniformly to application areas or as prescribed by precision agricultural techniques,
- incorporation immediately land-applied manure or organic by-products,
- delay field application of animal manures or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the planned application.

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

Consider impacts of restricting soil layers and of surface and subsurface drainage systems on both runoff and leaching.

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

Consider nitrogen volatilization losses associated with land application of animal manures or fertilizers containing urea. Volatilization losses can become significant if manure or urea is not incorporated into the soil after application. If timely incorporation is not an option, consider the use of urease inhibitors.

Consider the impact of the chosen tillage system on nutrient form, placement, and timing, e.g. liming practices for no-tilled crops.

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

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

On sites receiving manure or organic waste applications, consider using the Pre-Side-dress Nitrate Test (PSNT) soil sampling procedure or other approved techniques to refine nitrogen recom-mendations.

Consider the potential to affect National Register listed or other eligible cultural resources.

PLANS AND SPECIFICATIONS

Plans and specifications shall describe the requirements for applying the practice to achieve its intended purpose(s).

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

- aerial photograph or map and a soil map of the site,
- current and/or planned plant production sequence or crop rotation,
- results of soil, plant, water, manure or organic by-product sample analyses,
- realistic yield goals for crops in the rotation,
- quantification of all nutrient sources,
- recommended nutrient rates, timing, form, and method of application and incorporation,
- location of designated sensitive areas or resources and the associated nutrient management restriction,
- guidance for implementation, operation, maintenance, and record keeping,
- complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

Organic plant nutrients seldom have nutrient content that matches the needs of the crops to be grown. For example, when animal manure is used to supply all or most of the nitrogen for grass grain crops other nutrients can be supplied in amounts greater than is removed in the harvested grain. This can lead to an increase in soil test phosphorus and other nutrients.

If increases in soil phosphorus levels are expected, plans shall document:

- the relationship between soil phosphorus levels and potential for phosphorus transport from the field,
- the potential for soil phosphorus drawdown from the production and harvesting of crops.

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

- 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 ground water and potential health impacts. In large portions of Central and Northern Illinois the discussion about nitrogen should include information on the role of tile drainage on the transport of nitrates to surface water. 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,
- discussion about how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment,
- a statement that the plan was developed based on the requirements of the current standard and any applicable federal, state, or local regulations or policies. Note that changes in any of these requirements may necessitate a revision of the plan,

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

OPERATION AND MAINTENANCE

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

- periodic plan review to determine if adjustments or modifications to the plan are needed. As a minimum, plans will be reviewed and revised with each soil test cycle,
- protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage,

- calibration of application equipment to ensure uniform distribution of material at planned rates,

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

- maintaining records to document plan implementation. As applicable, records include:

  - soil test results and recommendations for nutrient application,

  - quantities, analyses and sources of nutrients applied,

  - dates and method of nutrient applications,

  - documentation of crops planted, planting and harvest dates, yields, and crop residues removed,

  - results of water, plant, and organic by-product analyses,

  - dates of review, person performing the review, and recommendations that resulted from the review.

Records should be maintained for five years or for a period longer than five years if required by other federal, state, or local ordinance, or program or contract requirements.

Workers should be protected from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients or when dealing with organic wastes stored in unventilated enclosures.

The disposal of material generated when cleaning 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

Agricultural Experimental Station. Nitrogen-Loss Potential Ratings for Illinois Soils, Illinois Bulletin 784, 1989.

College of Agricultural, Consumer and Environmental Sciences, Office of Research, Average Crop, Pasture, and Forestry Productivity Ratings for Illinois, Soils, Bulletin No. 810; University of Illinois, 2000.

University of Illinois, College of Agricultural, Consumer and Environmental Sciences, Office of Research, Optimum Crop Productivity Ratings for Illinois Soils, Bulletin No. 811, 2000;

Cooperative Extension Service, Illinois Agronomy Handbook, University of Illinois, 2001-2002.

Illinois Department of Agriculture, 8 Illinois Administrative Code, Part 900: Livestock Waste Regulations, Springfield, Illinois, November 12, 1998.

Illinois Environmental Protection Agency, Illinois Administrative Code, Title 35; Environmental Protection; Subtitle C: Water Pollution; Chapter II: Environmental Protection Agency: Part 391: Design Criteria for Sludge Application on Land, Springfield, Illinois, January 1984.

Illinois Environmental Protection Agency, Illinois Administrative Code, Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; Part 302: Water Quality Standards and Part 304: Effluent Standards, Springfield, Illinois, June 1989.

Illinois Environmental Protection Agency, Illinois Administrative Code, Title 35: Environmental Protection; Subtitle G: Waste Disposal; Chapter II: Environmental Protection Agency; Part 362: Illinois Design Standards for Land Application of Wastewater, Peer Review Draft, Springfield, Illinois, October 1989.

Potash & Phosphorous Institute, N, P, & K: Partners in Corn Production Efficiency Pamphlet, 11 pp., Atlanta, Georgia.

Sharpley, A. N., T. Daniel, T. Sims, J. Lemunyon, R. Stevens, and R. Parry, Agricultural Phosphorus and Eutrophication, U. S. Department of Agriculture, Agriculture Research Service, ARS-149, 42 pp., 1999.

USDA-Soil Conservation Service, National Animal Waste Management Field Manual, 1975.

APPENDIX A

ILLINOIS PHOSPHORUS ASSESSMENT PROCEDURE

Use and Interpretation of the Illinois Phosphorus Assessment Procedure

Background:

Phosphorus (P) loading to surface water can accelerate eutrophicaction. The availability of other nutrients and light penetration into the water column will also influence the response of waterbodies to phosphorus. Land managers who desire to minimize transport of phosphorus need a practical assessment procedure to assist them in making decisions concerning the applications of phosphorus-containing materials.

Factors such as: the amount of erosion and runoff; the form, amount, and distribution of phosphorus in the soil: and fertilizer and manure application rate, timing and placement determine P loss from agricultural fields and the resulting P loading to water resources. Most phosphorus compounds found in soils have low water solubility. Consequently, P loss from agricultural land was once thought to be primarily associated with soil erosion. In many cases, sediment-bound P is still the dominant form in which P losses from agricultural fields occur. Over the past decade, research has shown that phosphorus can be lost in runoff in dissolved forms. High dissolved P concentration in runoff is more frequently observed where soil P levels are high particularly near the soil surface. High soil P levels, however, do not automatically equate to high dissolved P in runoff. As stated earlier, numerous factors interact to create the potential for P losses from agricultural fields. Many of the basic processes that govern P transport are known. It is difficult, however, to know at any given site which factor(s) influence P loss rates proportionally more than others. Insufficient data exist in Illinois to definitively guide landowners as to which factors in a specific field contribute the most to P losses. There are indications, however, that where solution P losses from crop fields are dominant, high soil P concentration at the surface are likely the most dominant factor.

The purpose of this guide is to (1) help land managers identify factors in agricultural fields known to contribute to “P” runoff loss and, (2) identify practices that can reduce phosphorus loss from agricultural fields. The factors most commonly associated with both dissolved and sediment-bound P loss are presented. For each factor, guidance is provided to help land managers estimate the relative potential for P transport to surface water. It is important to realize that the procedure is not a predictive tool for P loading. It is merely a tool for assessing the relative potential for phosphorus transport.

Use of Assessment:

When possible, land managers should adopt management practices that minimize phosphorus loss risk factors. If phosphorus containing materials need to be applied to fields that have medium or high risk potentials, recommended management practices should be used to reduce the risk of phosphorus transport.

Examples of Practices to Reduce Phosphorus Risk Potential

Soil Erosion Control:

- Use residue management and/or structural practices to reduce sheet and rill erosion.
- Install filter strips, riparian forest buffers, contour buffer strips, field borders, or wetlands

Minimize Connectivity to Water Bodies:

- Install water and sediment control basins to reduce quantity of sediment transported offsite.
- Install conservation buffers adjacent to water resources to create nutrient application setbacks.

Reduce Runoff Potential:

- Terrace fields to reduce slope length.
- Contour strip cropping, contour buffer strips, cover crops, crop rotations that include meadow and/or small grains, and crop residue management.

Lower Soil Test Phosphorus:

- Sample soils on high testing fields to determine vertical distribution of the phosphorus.
- If phosphorus is concentrated in the top two inches of soil, invert the soil (e.g. moldboard plow) where soil erosion will not be a problem.
- Avoid stratification by placing phosphorus materials beneath the top two inches of the soil surface.

Practice Nutrient Management:

- Apply no more than maintenance levels of phosphorus when soil test P reaches the levels described in the Illinois Agronomy Handbook, Chapter 11.

PHOSPHORUS RISK ASSESSMENT PROCEDURE

Risk Factor	Phosphorus Risk Potential		
	Low	**Medium**	**High**
1. Soil Erosion	**<= “T”**	**> “T” - <= 2”T”**	**> 2”T”**
2. Connectivity to Water. Does runoff from the application area enter a waterway, tile inlet, or surface drain outlet into a perennial surface water body e.g. stream, pond, lake, or wetland? If so what is the distance from the application area to the water body.	**> 1000’**	**<= 1000’ – 200’**	**< 200’**
3. Runoff Potential	**See “Runoff Matrix” Below**		
4. Soil Test Phosphorus Levels 0 - 6 2/3” sample depth	**<35 lbs. P/ac**	**35-70 lbs. P / ac**	**> 70 lbs. P/ac**
5. P Inputs	**See “P Inputs Matrix” Below**		

Phosphorous Risk Assessment - Site Characteristic Definitions:

1. SOIL EROSION – Sheet and rill erosion as measured by the most current version of the Revised Universal Soil Loss Equation (RUSLE).

2. CONNECTIVITY TO WATER – Defines the potential for P to be transferred from the site to a perennial stream or water body. The more closely connected the runoff is from the field via concentrated flow (from a defined grassed waterway or surface drain) to a perennial stream or water body the higher the potential for of P transport.

3. RUNOFF CLASS – Represents the effect of the Hydrologic Soil Group (A, B, C, D) on runoff. This factor represents the site's runoff vulnerability. See the Solution Runoff Class Matrix below.

4. SOIL "P" TEST (BRAY P1 or Mehlich 3) – The soil test procedure using the Bray P1 extraction, or other extraction test calibrated to Bray P1, that provides an index of plant available P expressed in lbs. P/ac (PPM X 2 = lbs./ac where soil samples are obtained to the 6 2/3” depth).

5. P INPUTS - Represents the combined effect of application method and application rate on the potential for phosphorus to be transported in runoff in both dissolved and sediment-bound phases. Phosphorus application rate is expressed in terms of the University of Illinois maintenance phosphorus recommendations applicable to crops/yields grown on the site being evaluated. See the “P Inputs Matrix” below. Phosphorus may be in the form of commercial fertilizer or organic materials such as manure, animal waste lagoon supernatant, wastewater from municipal or agricultural sources or nonagricultural biosolids such as sewage sludge or landscape waste. When using the “P Input Matrix, it is assumed that soil incorporation is performed prior to runoff events. Instances where incorporation is typically not performed prior to runoff events will be considered as non-incorporated surface applications.

Solution Runoff Class Matrix

Hydrologic Soil Group			
A	**B**	**C**	**D**
Low	Medium	High	High

P INPUT MATRIX

	Application Rate		
Application Method	**<= UI Recommendations**	**>UI – 150% UI**	**>150% UI**
Incorporation or Injection > 3" below surface	Low	Low	Low
Shallowly incorporated surface applications <3 inches	Low	Medium	High
Non-incorporated surface applications	Medium	High	High

The table below identifies specific risk factors that may present in a given field. No attempt should be made to "average" the factors and assign a composite rating for the field. It is recognized that the risk factors do not act independently to influence phosphorus loss from agricultural fields and P loading into water resources. Simple averaging however, assumes that all risk factors have the same amount of influence. Attempts to objectively weight some factors more or less than others would be desirable but difficult without supporting data. The phosphorus assessment procedure is not a process based or empirical model. The procedure was developed as a conservation planning tool. The tool is designed to provide guidance to select and plan conservation measures that will lower the potential for phosphorus loss from agricultural fields and P loading into water resources.

Phosphorus Risk Potential	
Risk Factor	**Site value**
Soil Erosion	
Proximity to water	
Solution Runoff Potential	
Soil Test Phosphorus	
Phosphorus Inputs	

References:

- Sharpely, A.N., Determining An Environmentally Sound Soil Phosphorus Value, Journal Of Soil and Water Conservation, 1996.

- Sharpley, A.N., T. Daniel, T. Sims, J. Lemunyon, R. Stevens, and R. Parry. 1999. Agricultural Phosphorus and Eutrophication. U.S. Department of Agriculture, Agricultural Research Service, ARS-149, 42 pp.

APPENDIX B

Recommended Management Practices to Reduce Nitrogen and Phosphorus Losses

Nitrogen:

1. Set realistic yield goals and follow University of Illinois' nitrogen recommendations.
2. Take credit for nitrogen from **all** sources: previous legume crop, incidental nitrogen contained in diammonium phosphate (DAP) and other fertilizers, manure applications, etc.
3. Determine nitrate loss potential using **Table 1** (following this Appendix). Use this as a guideline to determine application timing for fields with various soil textures. (More detailed information on total nitrogen loss potential is available in the University of Illinois Agricultural Experiment Station Bulletin 784, Nitrogen-Loss Potential Ratings for Illinois Soils.)
4. In fields where spring applications are not usually troublesome, apply the majority of the nitrogen shortly before or after planting.
5. For fall applications, use a nitrification inhibitor or wait until the soil has cooled down to 50^{o} F. Even when applying a nitrification inhibitor, do not apply nitrogen until soil has cooled to 60^{o} F. Probable dates when these soil temperatures are expected are contained in the *Illinois Agronomy Handbook*. In most cases, fall nitrogen applications should not begin prior to the third week in October.
6. Use adequate levels of phosphorus, potassium, and other nutrients to ensure optimum yields and nitrogen use efficiency.
7. Conduct a post-harvest evaluation of the nitrogen program:
   - Compare actual yields vs. yield goal;
   - Evaluate factors affecting yields and nitrogen use efficiency;
   - Consider using plant tissue analyses and an end-of-season corn stalk nitrate test to evaluate plant nitrogen sufficiency;
   - Refine nitrogen rates for future years.
8. Review each nutrient management plan annually to determine if changes in the nutrient budget are needed.
9. Calibrate application equipment annually, at minimum, to ensure uniform distribution of material at planned rates.
10. Use filter strips and riparian forest buffers to intercept nutrients transported surface runoff to the stream. (Note: these practices will have minimal effect in areas with extensive subsurface drainage.)
11. Avoid applying nitrogen around environmentally sensitive areas such as sinkholes, wells, gullies, ditches, surface inlets, or rapidly permeable areas.
12. Use cover crops, such as rye, to capture residual nitrogen after harvest and prevent nitrogen from being lost between harvest and planting of the next crop.
13. Utilize water table management to reduce artificial drainage when it is not needed for crop growth or field operations.
14. Utilize water table management to reduce artificial drainage when it is not needed for crop growth or field operations.

15. Outlet tiles into constructed wetlands to remove a portion of the nitrogen before tile effluent discharges into lakes or streams.

Phosphorus:

1. Perform soil test regularly (minimum of every four years) and follow University of Illinois' recommendations for application rates.
2. Do not maintain excessively high phosphorus soil test levels, especially in areas prone to phosphorus transport.
3. Use variable rate applications to increase the precision of phosphorus applications and to maintain rates needed for optimal crop production.
4. In areas where phosphorus losses occur primarily from surface runoff, incorporate or inject phosphorus beneath the soil surface.
5. Control soil erosion to 'T' or less.
6. Utilize agronomic practices that optimize crop production to maximize phosphorus utilization.
7. Use filter strips or riparian forest buffers to reduce offsite transport of particulate phosphorus.
8. Avoid applying nutrients when soils are frozen or covered with ice or snow.
9. Fall applications of phosphorus that are not incorporated into the soil should not be applied on slopes greater than 5% unless runoff control measures such as heavy residue cover, contour mulch tillage, contour strip cropping, or terraces have been applied.
10. Minimize surface runoff of water by reducing compaction, maintaining high crop residue levels, installing runoff control structures such as terraces, etc.
11. Avoid stratification on soils that are susceptible to runoff and erosion.

Table 1. Nitrogen Risk Assessment

Nitrate loss potentials based on soil texture, timing, and nitrification inhibitors			
Application Timing[1]	**Soil Texture[2]**		
	Coarse	**Medium**	**Fine**
Fall with an inhibitor > 60° F	High	High	High
Fall with an inhibitor < 60° F	High	Medium	Medium
Fall without an inhibitor > 50° F	High	High	High
Fall without an inhibitor < 50° F	High	Medium	Medium
Spring without an inhibitor	Medium	Medium	Medium-Low
Spring with an inhibitor	Medium-Low	Low	Low
Spring split applied or sidedress	Medium-Low	Low	Low

Foot notes:

1. Temperatures refer to soil temperature measured at a depth of 4 inches. For this assessment, inhibitors refer to nitrification inhibitors.
2. Soil Texture: Coarse - sand, loamy sand, sandy loam
   Medium - silt, silt loam, loam
   Fine - silty clay loam, silty clay, clay, clay loam, sandy clay, loam, sandy clay

When developing recommendations to be included in a nutrient management plan, the planner needs to use the results of the assessment above with knowledge of locally significant transport processes.

For example, in large areas of northern and central Illinois, nitrates are detected in surface water resources at concentrations above 10 part per million. Soils in much of the region only have a moderate nitrogen loss potential. The presence of extensive tile drainage, however, increases the risk of nitrate transport to surface water resources.

By contrast, in southern Illinois, there are large areas of level, poorly drained soils. The climate is warmer and there is more rainfall than in northern and central Illinois. The conditions favor the formation of nitrate. The loss of nitrate, however, is primary to the atmosphere due to denitrification.