Wisconsin Conservation Planning Technical Note 1

Nutrient Management

INTRODUCTION

~~Definition of Nutrient Management~~

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

~~PURPOSE~~

~~Nutrient management planning is an important and yet oftentimes cumbersome process.~~ This Technical Note has been developed in order to provide guidance for nutrient management planning in addition to NRCS Field Office Technical Guide (FOTG) Standard 590. A Comprehensive Nutrient Management Plan (CNMP) is different from a 590 plan and additional documentation is required. More information on CNMPs can be found in the NRCS National Planning Procedures Handbook, Subpart F, Part 600.75 and this fact sheet: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_019284.pdf.~~.~~

NRCS, Field Office Technical Guide (FOTG), Section IV, Conservation Practice Technical Standard 590, Nutrient Management, provides specific criteria for nutrient management planners (see section V). It identifies the necessary components of a nutrient management plan (see section VII), and lists ~~criteria for~~ operation and maintenance requirements of the practice (see section VIII). Federal, state, and local laws may provide additional requirements and guidance. ~~Please be aware that t~~The Wisconsin Conservation Planning Technical Note WI-1 is the companion document to NRCS FOTG Standard 590 and ~~includes~~ provides ~~more detail on criteria that are required~~additional guidance and references for plan development ~~where specified~~.

~~Periodic updates to material contained in t~~This technical note ~~may occur~~is updated periodically. To find the most current information for developing nutrient management plans, use Snap Plus nutrient management software from ~~http://www.snapplus.net/~~ developed by the UW Madison, Soil Science Department and available free of charge. (http://www.snapplus.wisc.edu/)~~.~~ This nutrient management planning tool will allow nutrient management planners to use the most current application rate guidelines found in UWEX ~~publication~~ Publication A2809 and the most current manure book values for estimating manure production and nutrient availablility. ~~Snap Plus will also stay current and highlight soil map units that are susceptible to leaching N. These soils are found~~ Soil restriction map units are listed in Appendix 1 of this technical note and will be changing to numerical map units as county soil surveys are updated. Soil restriction map units are continuously updated so this Tech Note may not be current. The most recent soil restriction units are available in SnapPlus.

This technical note provides detailed guidance on the following:

Part I: Minimum Requirements for a NRCS 590 Nutrient Management Plan

Part II: Minimum Requirements for a Winter Spreading Plan

Part III ~~Items of Benefit for Nutrient Management Planning~~ Enhanced Nutrient Management Planning

Part IV: Determining Manure Nutrient Credits

Part V: DNR Contacts

Part VI: Certified Laboratories

The appendices below are in a separate document.

Appendix 1: Soil Restriction Map Units

Appendix 2: Nutrient Management for Wisconsin Cranberry Production
Appendix 3: Guidelines for Adaptive Nutrient Management

PART I

MINIMUM REQUIREMENTS FOR A NUTRIENT MANAGEMENT PLAN

The landowner/producer (person required to have the plan developed, or receiving the cost share monies) is responsible for annually updating the plan and keeping records of all the components of the nutrient management plan for a minimum of four years~~, as well as having the plan updated annually~~. A nutrient management plan shall be developed according to the ~~following~~ criteria ~~and steps as~~ defined in the NRCS FOTG Standard 590, Nutrient Management and include the following:~~.~~ ~~If the goal of the client is to develop a Comprehensive Nutrient Management Plan (CNMP), the additional documentation requirements found in the NRCS National Planning Procedures Handbook, Subpart F, Part 600.75, must also be met. Records shall be assembled to meet the following requirements:~~

A. Plan Narrative ~~describing a summary of~~summarizing the implementation and operation of the nutrient management plan as it pertains to the entire farm unit. Details ~~should~~ shall include:

1. A~~a~~n overview of the operation including typical crops grown and ~~a summary of~~ the sources of nutrients other than fertilizer applied to the land.
2. A summary of Phosphorus reduction strategies ~~should be included~~ , as appropriate.
3. An explanation for any fields that are out of compliance with the standard and the schedule for bringing them into compliance.

B. Aerial photographs and/or maps of the farm containing:

1. Boundaries, identification numbers, and acreage for all crop fields, pastures, and nutrient management units. ~~An attempt should be made to p~~Provide consistent field identification in the nutrient management plan, soil test record, and conservation plan. ~~A cross reference summarizing field identification numbers shall be provided when field identification numbers are not consistent.~~
2. ~~A map or photograph identifying s~~Soil series and soil series boundaries.
3. Location and identification of ~~the following features that require protection. Delineate boundaries for nutrient application restriction areas based on the following criteria. Include a legend of map symbols used. One plan map should include soils,~~ spreading restrictions~~,~~ as identified in FOTG 590 Standard Criteria V.A.2. and V.A.3.a~~and field boundaries~~. Each map shall have a legend defining map symbols. The 590 spreading restriction maps can be downloaded from http://www.manureadvisorysystem.wi.gov/~~-~~.
   ~~a. Nutrient Application Prohibitions~~
      ~~(1) Identify the following features:~~

~~(a) Surface water, established concentrated flow channels, contouring, field edge or in-field filter strip, or non-harvested permanent vegetative buffers. Buffers do not necessarily have to be next to the stream. See Standard 393 Filter Strip standard for more information.~~

C. ~~Minimum f~~Field-specific (or nutrient management unit specific) documentation of:

1. ~~Current or P~~planned crop rotation ~~or sequence~~ including the previous crop and crop to be grown this year.

2. Projected yield goals for each crop based on previous yields.

3. Dominant critical ~~soils series~~soil map unit for soil erosion calculations (most erosive soil map unit comprising greater than 10% of field area) and the predominant soil ~~group (sandy, loamy, or organic)~~map unit to obtain nutrient application rates~~for the field or nutrient management unit~~.

4. Previous year's actual and current year's proposed nutrient and soil amendment application rates including the form, rate, and timing for:

   a. Commercial fertilizers
   b. Manure (If you are collecting and applying livestock manure, complete ~~part~~ Part IV~~3~~, ~~section~~ Step 1 below~~.~~).)
   c. Other organic byproducts
   d. Credits for Legume Nitrogen ~~and Phosphorus (see #5) credits~~
   e. Soil Amendments (e.g., lime)

5. Soil test information ~~(including pH, organic matter, soil P, and soil K), as developed following standard sampling guidelines and as analyzed by an approved Wisconsin laboratory (refer to Appendix 2 for contact information). per University of Wisconsin – Extension (UWEX) Publication A2100, "Sampling Soils for Testing" (2002), is your guide for soil sampling~~Criteria V.A.1.e.~~. A soil test is the only practical way of telling whether lime and fertilizer are needed. However, if a soil sample does not represent the general soil conditions of the field~~
   ~~, the recommendations based on this sample will be useless. An acre of soil to a 6-inch depth weighs about 1,000 tons, yet less than 1 ounce of soil is used for each test. Therefore, it is very important that the soil sample is characteristic of the entire field. The following directions will help you collect good soil samples.~~

   ~~**Do not sample any area of a field that varies widely from the rest of the field in color, fertility, slope, soil texture, drainage, or productivity unless the area is large enough to be treated separately.**~~

   ~~**Push aside organic materials and avoid areas near dead furrows, roads, and fences; areas where fertilizer has been banded; and eroded knolls and low spots.**~~

   ~~**Sample contour strips separately if it is approximately 5 acres or more. Cores from 2-3 strips that have identical cropping and management histories may be combined.**~~

~~A composite sample consists of at least 10 cores using a probe or auger to plow depth or at least 6 inches. Mix these cores well and place 2 cups of this soil in a sample bag. When at least three composite samples per field are submitted to the lab, the significantly higher testing sample is removed from the recommendation to ensure that no part of the field is under-fertilized. Identify the sample bag with your name, field identification, and sample number. Record the field and sample location on a map. And finally, fill out the soil information sheet carefully. Include the soil series, field number, field acres, and sample number(s) for each field so test summaries and soil test recommendations reflect this information.~~

~~a. *Sampling fields for a single recommendation:* If the field was tested more than four years ago or has P and K levels in the responsive range (H or lower), then every 5 acres needs 1 sample. Soil sampling size for fields testing in the non-responsive range (VH or EH) for P and K levels can be increased as follows:~~

~~Acres~~	~~Samples~~
~~5-10~~	~~2~~
~~11-25~~	~~3~~
~~26-40~~	~~4~~
~~41-60~~	~~5~~
~~61-80~~	~~6~~
~~81-100~~	~~7~~

~~b. *Grid sampling fields and variable rate applications:* If fertilizer and lime applications vary across a field, soil sampling for fields in the responsive range (H or lower) for P and K levels may need samples every 200 feet. While fields in the non-responsive range (VH or EH) for P and K levels can have samples every 300 feet.~~

6. Where P (all sources) is applied in ~~one year to meet current and future crop needs in a rotation~~excess of crop need, the credits for surplus P must be tracked and subsequent nutrient applications shall be adjusted using FOTG 590 ~~criteria~~ Criteria V.A.1.g. and V.C. ~~of NRCS FOTG Standard 590.~~

7. The current NRCS soil loss ~~equations~~ estimates for sheet and rill or wind ~~form, WI-CPA-15~~, or equivalent should be included.

8. Document current year's actual crop yield and nutrient application rates including form, timing, and application method. Changes to nutrient applications that are not consistent with the plan should be documented in the plan. Include the reasons why the changes were made and revise the P budget in #6 above as necessary. The plan for the production year is not considered complete until all actual nutrient application rates ~~the previous year is~~ are documented.

9. For Nitrogen Restricted Soils see Appendix 1. For certified soil testing laboratories see Part VI of this document. For Nutrient Management for Wisconsin Cranberry Production see Appendix 2.

~~10. Planner will demonstrate the farm operation has adequate acres to field apply all the manure generated by the farm operation while maintaining compliance with the standard. Consider the following guides for assessing a generalized manure land base estimate:~~

~~1.2 acres of cropland/Animal Units (AU) or more on a farm growing forage crops in rotation are likely to balance nutrients in/nutrients out when UW fertilizer recommendations are followed.~~

~~2.0 acres of cropland/AU or more on a farm growing only cash grains are likely to balance nutrients in/nutrients out when UW fertilizer recommendations are followed.~~

1~~1~~0. Pastures must be included in the nutrient management plan. Further information regarding state rules and exceptions associated with nutrient management planning for pastures can be found at:

- http://datcp.wi.gov/uploads/Environment/pdf/ATCP50GuidanceNutrientManagementOnPastures.pdf
- UWEX Soil Fertility Guidelines for Pastures in Wisconsin - http://learningstore.uwex.edu/Assets/pdfs/A4034.pdf

~~For cranberry crops, see Appendix 2 for certified soil testing laboratories and Appendix 3 for Nutrient Management for Wisconsin Cranberry Production.~~

PART II

~~MINIMUM~~ REQUIREMENTS FOR A WINTER SPREADING PLAN

The Winter Spreading Plan shall be consistent with the WI NRCS 590 Nutrient Management practice standard.

A. Winter Spreading Plan Implementation Maps:

These maps should be simplified for use in the field by farmer or manure hauler and contain the following:

1. Field boundaries, identification numbers, and acreage.
2. Field access locations.
3. Location of stacking areas (See NRCS FOTG Standard 313 or Table 1 in "Additional Considerations").
4. Planned mitigation practices by field as defined by Criteria V.A.2.d.~~.~~
5. Identification of fields~~,~~ or portions of fields not spreadable due to access limitations or nutrient management prohibitions.

B. Documentation records:

The landowner/producer (person responsible for the land application of manure) shall review the winter spreading plan annually prior to winter application of manure, and keep records of all the components of the winter spreading plan for a minimum of four years. Utilize data forms, spreading logs, GPS data, or photos to document implementation activities.

ADDITIONAL CONSIDERATIONS AND RESOURCES FOR WINTER SPREADING

A.

Assessment of Seasonal or Annual Field Conditions at Time of Manure Application:~~.~~

The following factors are used to select fields or portions of those fields with the lowest risk for runoff at the time of winter manure application:

1. Previous crop and condition/amount of residue cover
2. Cover crops (type/condition)
3. Surface roughness (primary/secondary tillage practices completed prior to manure spreading)
4. Field rutting or surface compaction (presence)
5. Previous manure application (timing/rate)
6. Other in-field considerations identified by the planner

B. Assessment of Forcasted Weather Charicteristics and Snow Conditions~~-~~ at Time of Manure Application:~~.~~

Consider the following conditions before winter manure application.

1. Snow depth (< 6 inches, <12 inches, >12 inches or more)
2. Snow charicteristics (powder, compacted) and uniformity of cover
3. Presence of ice (soil surface, crust on snow etc.)
4. Frost depth and uniformity
5. Predicted air temperature (5~~-~~day forecast)
6. ~~-~~Predicted preciptiation (5~~-~~day forecast)
7. ~~-~~Month of application (sun intensity– angle and duration i.e. mid-winter vs. early/late winter)

C. Winter Manure Spreading Research Findings – UW Discovery Farms Publications:

~~a.~~ Runoff Lessons: Frozen and Snow Covered Ground

~~a.~~ Considerations for Early Winter Applications of Manure (Nov 2013)

——Considerations for Mid-Late Winter Manure Applications (Jan 2014)

D. Table 1. NRCS FOTG Conservation Practice Standard 313, Waste Storage Facility Table 10.– Temporary, Unconfined Stacks of Manure and Derivatives Outside the Animal Production Area

1. Waste Consistencies Note 1		
	> 32% Solids	16% to 32% Solids Note 2
2. Size & Stacking Period		
Stacking Period	8 months	8 months
Maximum Volume/Stack	≤ 40,000 cu ft.	≤ 15,000 cu ft.
Maximum Number of Stacks/40 acres Note 3	–	2
Frequency of Stacking Site Use	1 year out of 2	1 year out of 3
3. *Hydrologic Soil Groups*		
	B or C	B or C
4. Subsurface Separation Distance		
Subsurface Saturation	≥ 3 ft.	≥ 3 ft.
Bedrock	≥ 3 ft.	≥ 5 ft.
5. Surface Separation Distance		
Wells Note 4	≥ 250 ft.	≥ 250 ft.
Lakes	≥ 1,000 ft.	≥ 1,000 ft.
Sinkholes, or other Karst Features	≥ 1,000 ft.	≥ 1,000 ft.
Quarries	≥ 1,000 ft.	≥ 1,000 ft.
Streams	≥ 300 ft.	≥ 500 ft.
Wetlands and Surface Inlets	≥ 300 ft.	≥ 500 ft.
Areas of Concentrated Flow	≥ 100 ft.	≥ 300 ft.
Land Slope Down Gradient of Stack	≤ 6%	≤ 3%
Floodplain	≥ 100 ft.	≥ 300 ft.
Tile lines	≥ 40 ft.	≥ 40 ft.

Note 1 Refer to AWMFH, Figure 9-1 for consistency values and Chapter 4 for % solids, for specific livestock types.

Note 2 16% to 32% solids represents waste at near saturation conditions where additions of free water from runoff, rain, or ——snowmelt can result in liquid flow conditions.

Note 3 The separation distance between stacks shall be at least 100 feet.

Note 4 Community water system wells may require larger separation distances (see NR 812).

PART III
~~ITEMS OF BENEFIT FOR~~ ENHANCED NUTRIENT MANAGEMENT PLANNING

The ~~items~~ practices listed in ~~Part II of the technical note~~this section are recommendations that ~~should be considered in~~will enhance nutrient management planning~~. These items may~~ and provide additional water quality benefit~~. over and above the criteria in NRCS FOTG Standard 590, Nutrient Management.~~

The rate, timing, and placement of nutrients are important considerations that may affect water quality.

A. General

1. Nutrients should be applied as near to the time of crop use as possible.

2. Minimize ~~nutrient~~ manure applications on frozen or snow-covered ~~ground~~soils. ~~. The P Index can provide crop management assessments for reducing potential P loads.~~

3. ~~Use the Wisconsin P Index or soil test P management strategies in criteria C. of NRCS FOTG Standard 590 to prioritize nutrient application sites.~~ Apply nutrients to the least environmentally sensitive areas first at rates needed to supply the crop N requirements or the anticipated crop removal of P and/or K. Criteria to consider include: hydraulic loading rate of the soil profile, soil permeability, infiltration capacity, slope, distance to surface water features, erodibility, accessibility, present crop, potential fate of runoff, infiltration, and presence of conservation practices.

4. Apply manure to crops which can use all of its nutrients, including nitrogen, whenever possible. Grasses such as corn are best. Applying manure to a forage legume crop adds substantial cropland available for spreading throughout summer months and provides a good utilization of all nutrients. Manure applied to forages may stimulate~~s~~ grass production and weed growth~~,~~ result~~s~~ ing lower forage protein~~,~~ and tend~~s~~ to reduce the alfalfa stand. ~~If it is unavoidable to spread manure on alfalfa, t~~The following recommendations are suggested in "Applying Manure to Alfalfa," North Central Regional Research Report 346.

   a. Preplant manure applications generally can have a positive effect on seedling-year alfalfa dry matter production where weeds are adequately controlled. This response may also be carried over into the full production years. Although manure may increase certain seedling-year weed problems, these usually do not persist past first cutting. Repeated manure applications at high rates may increase forage potassium to unacceptably high levels.

   b. Topdressing manure to established alfalfa is somewhat more risky. While benefits can be obtained, especially on low-testing soils or on legume-grass mixtures, problems from compaction, salt burn and stand suffocation can occur. Alfalfa can be a major sink for recycling nitrogen and other nutrients; however, topdress applications, especially to frozen soils, may result in large nutrient runoff losses. Various management practices, including using low rates on the poorest stands immediately after cutting, will help reduce the agronomic and environmental risks associated with following this strategy.

   c. Applying at the end of the alfalfa rotation may leave more nitrogen than the following crop can use. This can lead to large, unacceptable environmental risks from nitrate leaching. A producer who takes this approach must consider the nitrogen contributed from both the legume and the manure. Removing all of the alfalfa top growth before application and limiting manure rates by taking into account the alfalfa nitrogen credit is essential.

~~5. When implementing rotational grazing, estimate pasture productivity and length of grazing period, and determine stocking rates and acreage needed by following the recommendations in UWEX Publication A3529, "Pastures for Profit: A Guide to Rotational Grazing," revised 2002.~~

B. Nitrogen

1. Nitrogen management practices to improve nitrogen use efficiency are summarized in UWEX ~~publication~~ Publication A3340, "Corn Fertilization" (1998).

   a. Use the appropriate nitrogen rate for the production conditions.

   b. Make proper adjustments for high corn residue cover.

   c. Fully credit nitrogen that may be available from organic sources such as manure legumes and soil organic matter.

   d. Use soil nitrate tests when appropriate to help identify the optimum N rate.

   e. Avoid fall applications of N fertilizers.

   f. Use sidedress N applications or delay N applications to coincide with the crop N demand, especially on coarse-textured soils where nitrate leaching is likely.

   g. Use a nitrification inhibitor with ammonium forms of nitrogen where the risk of N loss through leaching or denitrification is high.

   h. Control ammonia losses from urea containing fertilizers by incorporating or injecting these materials within 72 hours, by using urease inhibitor, or by selecting a non-urea material for surface applications.

   i. Control ammonia losses from dairy farms by removing excess protein from the cow's diet. Incorporate manure in the field being aware of the potential for increased erosion and P losses. Cover manure storage structures or use organic matter in bedding to form a crust cover. ~~When possible,~~ Consider diverting urine away from feces.

2~~.~~. Reference list of articles related to nitrification inhibitors, urease inhibitors, and slow release fertilizers.

Extension Publications and Conference Proceedings

Franzen, D.W. 2013. Nitrification Inhibitor Claims – Are They Real? Proc. Wisconsin Crop Management Conference. 52:124-137. http://www.soils.wisc.edu/extension/wcmc/2013/pap/Franzen_inhibitor.pdf

Franzen, D.W. 2013. Volatilization Losses from Urea. Proc. Wisconsin Crop Management Conference. 52:139-155. http://www.soils.wisc.edu/extension/wcmc/2013/pap/Franzen_urea.pdf

Franzen. D.W. 2011. Nitrogen Extenders and Additives for Field Crops. North Dakota State University Extension Publication SF-1581. http://www.ag.ndsu.edu/pubs/plantsci/soilfert/sf1581.pdf

Goos, R.J. 2011. Nitrogen Fertilizer Additives Which Ones Work? Proc. North Central Extension-Industry Soil Fertility Conference. 27:5-15. http://extension.agron.iastate.edu/nce/ncepdfs/2011/ncsfc%202011%20goos%20p5.pdf

Goos, R.J. 1987. Ammonium Thiosulfate as a Urease Inhibitor: A Suggested Mechanism. Proc. North Central Extension-Industry Soil Fertility Conference. 3:103-105. http://extension.agron.iastate.edu/nce/ncepdfs/1987/ammoniumthiosulfate.pdf

Laboski, C. 2006. Does it pay to use nitrification and urease inhibitor? Proc. Wisconsin Crop Management Conference. 45:44-50.

~~. The first 20 pounds per acre of N in starter fertilizers is not credited towards the total nutrient need of the crop to be grown ([update]UWEX Publication A3340, "Corn Fertilization," 1998). Phosphorus and potassium from starter fertilizers are fully credited.~~

3. When concerned with the rate and placement of nitrogen, consider these points in addition to those found in Section VI of NRCS FOTG, Standard 590, Nutrient Management:

   a. Unused or residual nitrate may be leached from the soil and ~~pollute~~ impact groundwater and surface waters. In years of normal fertilizer application and unexpected low yields, excess nutrients, including nitrate, may accumulate in the soil. Pre-plant soil nitrate tests can be used to measure carryover nitrogen and adjust nitrogen applications (see UWEX Pub~~lication~~ A-A362~~4~~2809, "Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin~~Soil Nitrate Tests for Wisconsin Cropping Systems~~," ~~1994~~2012). Additional options for reducing the amount of nitrogen subject to leaching include:

      (1) Growing a winter cover crop to use carryover nitrogen.

      (2) Growing legume crops (when managed without supplemental N inputs) to "scavenge" N remaining in the profile.

      (3) Growing high N demanding crops such as corn and forage grasses.

   b. Nitrification inhibitors used with ammonium or ammonium-forming N fertilizers can improve N efficiency and limit loss of fertilizer N on soils where the potential for nitrate loss through leaching or denitrification is high.

   c. Consider using the Wisconsin Nitrogen Leaching Index—An Index approach to Assess Nitrogen Losses to the Environment. Include NRCS reference when available.

   The Nitrogen Leaching Index (N-Index) is a Tier-1 Tool that provides ~~a qualitative and quantitative~~an assessment of the effects of N management on agricultural landscapes and N losses to the environment. The tool can be used by conservation planners to conduct prompt assessments of management practices and how specific management practices affect N losses to the environment. The tool allows nutrient management planners to compare current benchmark N management activities with other N best management practices, providing a positive or negative response to the change in the environment.

   The N-Index can separate and rank the effects of nitrogen management on atmospheric and surface N losses when calibrated using local/regional data of N uptake, yields, N cycling, N content in manures, and other local parameters to facilitate the decision making process in identifying the potential, local best management practices and alternatives that reduce N losses. The tool keeps track of inorganic N sources, such as the N fertilizer, initial soil NO3-N, initial soil NH4-N, NH4-N from manures, irrigation NO3-N, and atmospheric N deposition inputs. The tool assesses N transformations, such as mineralization of N from crop residues, organic soil matter, and other organic sources that contribute and sum all of the N inputs for the system.

   $SNI = N_f + N_{in} + N_{min} + N_{atm} + N_{ma1} + N_{ma2} + N_{cr} + N_{irb} + N_{iro}$ where:

   - SNI = total system nitrogen inputs (lbs./ac/yr.);
   - N_f = N applied as fertilizer (lbs./ac/yr.);
   - N_{in} = root zone initial inorganic N before planting (0–3.3 ft. depth or 0 – depth of the deepest rooted crop – lbs. NH_4- N + NO_3-N acre);
   - N_{min} = mineralization of N from soil organic matter (0–1.0 ft. depth; (lbs. N/ ac/ year);
   - N_{atm} = atmospheric N deposition (lbs. N /ac/ year);
   - N_{ma1} = initial NH_4-N + N mineralization from manure (lbs. N/ac/ year);
   - N_{ma2} = N mineralization from manure applied last year (lbs. N ac/year) ;
   - N_{cr} = crop residue N mineralization (lbs N/ac/year);
   - N_{iro} = available organic N applied in irrigation water (lbs. N /ac.).

   Instrumental to the assessment are the components of the cropping system N pathways for removal:

*S*NR = cropping system N pathways for removal (lbs N/ac/year);

- *N*c =N uptake by crops (lbs. N/ac.);
- *N*d =N denitrification (lbs. N/ac);
- *N*v =N ammonia volatilization (lbs. NH3-N/ac);
- *N*erav =N erosion (lbs. N/ac.).

4. ~~4.~~ First year annual N removal by legumes and companion crops

Legume crop maximum N applications:

Most legume crops can fix sufficient N from the air to ensure adequate growth without applying additional N to the soil; therefore recommended N fertilization rates for most legume crops are zero. However, legumes will use available N in the soil in preference to fixing their own. Thus, manure N applied to legume crops is considered to have a low risk of loss through leaching if it does not exceed the crop N removal rate or is no more than 205 lb of available N per acre.

Table ~~3~~2. First-year available manure N application rates allowed for legume and legume plus companion crops*

Crop	**Yield range**	**Manure available N allowed** (lb/acre)
Alfalfa; alfalfa/brome; red clover; or trefoil, birdsfoot, seeding or established †	< 1.5 ton/a	50
	1.5 – 2.5 ton/a	100
	2.6 – 3.5 ton/a	155
	> 3.5 ton/a	205
Barley for grain underseeded with alfalfa, alfalfa/brome, or red clover seeding ‡	All yield levels, bu/a	150
Dry beans	10-20 cwt/a	75
	21-30 cwt/a	125
	31-40 cwt/a	175
Oats for grain underseeded with alfalfa, alfalfa/brome, or red clover seeding ‡	All yield levels, bu/a	140
All pastures §	0.5-1.9 ton/a	55
	2 -3 ton/a	115
	3.1 - 4.0 ton/a	160
	4.1 - 5.0 ton/a	205
Small grain silage underseeded with alfalfa	2 - 3.5 ton/a	170
Small grain & legume silage	2 - 3.5 ton/a	70
Small grain & legume silage underseeded with alfalfa	2 - 3.5 ton/a	170
Soybean	15-25 bu/a	75
	26-35 bu/a	115
	36-45 bu/a	155
	> 45 bu/a	195

*Some legume crops such as peas and snap beans are not included in this table because N removal in the harvested portions of the crop is similar to their N fertilizer recommendation.

†* To minimize the potential for stand injury, single applications should not exceed 5,000 gal/acre for liquid or 10 ton/acre for solid maures.

‡ Nitrogen allowed is the recommended rate for the grain crop plus removal in the forage crop. This rate may be too high for successful management of the grain crop.

§ Nitrogen allowed is the total available N deposited by grazing animals plus manure applied mechanically.

Note: As per the FOTG 590 Standard, commercial N should not be applied to legume crops that do not have an N requirement unless it is an unavoidable ingredient of a fertilizer needed to provide other required nutrients.

Non-leguminous crops maximum N application rates:

If commercial N fertilizer is applied in any amount: Total N applications, including N in starter, should not exceed the UW recommended rate for the crop. For non-legume crops other than corn or wheat, there is only one N rate recommended for a given crop or, in the case of potatoes, crop and yield range combination.

If only organic sources are applied: The 590 Standard recognizes that there will always be some uncertainty in estimating manure N availability because of variability in manure nutrient contents, uneven application rates, and weather. When organic sources of nutrients are used to meet 100% of the N requirement: 1) an additional 20 lb N/a of may be applied as commercial starter fertilizer for corn; 2) no additional commercial N should be applied to wheat beyond the top end of the MRTN range at a wheat: N price ratio of 0.050; and 3) up to 20% more N than recommended may be applied to crops other than corn or wheat.

Crops	Yields (per acre)[1]	N removal (lb/a)[2]
Legume forages with inter-seeded companion forages[3]		
Spring-seeded forages (Yields are for total annual dry matter harvests of both legumes and the inter-seeded forages)[4]	0.5-1.5 T	110
	1.6-2.5 T	170
	2.6-3.5 T*	220
	3.6-4.5 T	280
Small grains inter-seeded with legume forages		
Barley (Yields shown are for grain. Add N removal from above for appropriate first year forage yield to this N removal for grain to get totalannual N removal)	25-50 bu	40
	51-75 bu*	70
	76-100 bu	100
Oats (Yields shown are for grain. Add N removal from above for appropriate first year forage yield to this N removal for grain to get totalannual N removal)	30-60 bu	40
	61-90 bu*	60
	91-120 bu	80
Soybean for beans	15-25 bu	80
	26-35 bu	120
	36-45 bu	160
	46-55 bu	200
	56-65 bu*	240
	66-75 bu	280
	76-85 bu	320
Soybean for forage	0.5-2 T	70
	2.1-4 T*	170
	4.1-6 T	280
Dry beans	6 - 12 cwt	40
	13-18 cwt	60
	19-24 cwt*	80
	24-30 cwt	110

* These yield ranges represent good yields with excellent management for most Wisconsin cropping conditions. Higher yields are rare and should be verifiable if used for planning purposes.

[1] Yields for forages are on a dry matter basis. Yields for grains and beans are at the moisture content used for measuring yields.

[2] First year available N credits for manure applications prior to legume crop establishment cannot exceed this N rate. This represents N removed in harvested crops. For perennial legumes it also includes N held in the roots over winter (60 lb N/a). If a legume forage is grown for only one year, subtract 60 lb N from the removal value. If the crop is not harvested, N removal is 0 lb/a.

[3] Companion forages include oats, barley, and oats-pea forage.

[4] For late-summer seeded legume forages, use the total N removal for the first year of harvest. However, both the first and second year available N credits for the manure applications prior to establishment cannot exceed this N rate.

C. Phosphorus

1. Phosphorus losses are usually greatest on sites with high erosion.

Definitions of types of ephemeral:

- **Sheet erosion**, sometimes referred to as inter-rill erosion, is the detachment of soil particles by raindrop impact and the removal of thin layers of soil from the land surface by the action of rainfall and runoff.

- **Rill erosion** is the formation of small, generally parallel channels formed by runoff water and usually do not re-occur in the same place on the landscape from one storm event to the next, season to season or from one year to the next.

- **Ephemeral erosion ~~or ephemeral gullies~~** are ~~concentrated flow channels~~means erosion which form~~eds when~~ rills that may converge to form shallow channels. These shallow channels can easily be filled with soil by typical tillage operations and usually re-formed in the same general location by subsequent runoff events.

- **Classical gullies or classic gullies** are concentrated flow channels formed when rills converge to form well defined permanent incised drainage ways that cannot be crossed by ordinary farming operations.

2. When applying ~~manure~~ nutrients on non-frozen ground, consider the following:

   a. Use runoff and erosion control practices such as spring tillage, maintaining high levels of crop residue on the soil surface, contour farming, and utilization of vegetated riparian buffers.

   ~~b. Rotate to P-demanding crops.~~

   ~~c~~b. Limit corn starter P applications on row crops to 20 pound P_2O_5 per acre, to the extent possible, eliminate all non-starter P applications.

   ~~d~~c. Whenever possible, apply manure on fields with lower P soil tests.

   ~~e~~d. Where possible, develop a means to move nutrients off the farm to areas with less environmental hazard.

3. Consider following National Research Council dietary P recommendations to lower P levels in rations and avoid high levels of P in manure.

4. To limit high-risk manure applications to frozen or snow-covered soil, complete a Winter Spreading Plan (Part II) and implement the following additional management practices ~~should be implemented~~:

    a. Temporary stacking of manure, manure storage, manure trading, and additional rental land for manure spreading.

    b. Where supplemental feeding of P in current rations is above National Research Council recommended levels, a feed management strategy will be discussed with the producer and their animal health and feed supply professionals with the goal of reducing supplemental feeding of P and reducing manure P losses.

D. Subsurface Drainage resources

- Michigan State University: http://animalagteam.msu.edu/animalagteam/tile_drains
- University of Wisconsin Discovery Farms: http://www.uwdiscoveryfarms.org/OurResearch/AgriculturalTileDrainage.aspx
- University of Minnesota Extenstion: http://www.extension.umn.edu/agriculture/water/publications/

E. Other Considerations

1. Use appropriate pH management to keep the soil pH in the proper range for optimum crop production. Soil pH affects the availability of almost all of the essential elements ~~(s. S~~ee UWEX Pub~~lication~~ A2809~~, "Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin" 2012Soil Test Recommendations for Field, Vegetable, and Fruit Crops," 1998)~~.

2. Good soil tilth should be maintained because it encourages infiltration, reduces runoff, and enhances crop vigor. This is especially important when the objective is to protect surface water.

    a. Organic matter additions promote good soil tilth.

    b. Equipment travel on saturated soils should be avoided to reduce soil compaction and rutting.

3. The hydraulic loading rate of the upper horizons should be considered. If the loading rate is low, or if there is a horizon that prohibits downward movement of liquid (i.e., hard pan or a clay horizon), it is important not to apply more liquid manure than the soil can absorb.

PART ~~III~~IV

DETERMINING MANURE NUTRIENT CREDITS

Proper crediting of manure nutrients can lower commercial fertilizer needs and reduce the potential for surface and groundwater pollution. Manures contain significant amounts of the major plant nutrients (N, P and K) and many other essential nutrients. Only a portion of the nutrients from field-spread manure is available in the first year. The rest becomes available over time as the nutrients are released from the organic fraction. Calculating the fertilizer value of manure involves three steps~~.~~

~~STEP 1:~~ :

1) E~~E~~stimate ~~Quantity~~ quantity of ~~On~~on-~~Farm~~ farm ~~Manure~~ manure p~~P~~roduction;
2)
~~STEP 2:~~ E~~E~~stimate a~~A~~vailable - n~~N~~utrients;
3)
~~STEP 3:~~ E~~E~~stimate the m~~M~~anure n~~N~~utrient c~~C~~redit and a~~A~~pplication r~~R~~ates

An example of how to estimate the quantity of on-farm manure production is provided below. Chapter 9 Nutrient credits in UWEX Pub A2809 describes manure nutrient availability and the process for estimating manure nutrient credits including example calculations. Manure nutrient content can vary significantly from the average values provided in UWEX Pub A2809. Therefore, sampling manure and analyzing for nutrient composition is encouraged as a means to more accurately assess manure nutrients. UWEX Publication A3769 Recommended Methods of Manure Analysis provides guidance on how to collect and handle manure samples.~~For more information, reference the UWEX "Nutrient Management Fast Facts," Nutrient and Pest Management Program. Call (608) 265-2660 for a copy or email npm@hort.wisc.edu.~~

~~STEP 1:~~ Estimate Quantity of On-Farm Manure Production

Manure production can be estimated by utilizing the information provided in Table ~~1~~3. Manure production can vary considerably between production systems. Other manure production estimates are acceptable. Estimates of the percent of the total manure production that is actually collected may also aid in the planning process. The planner may ~~wish to~~ explain the manure production/collection system in the narrative section as described in Part 1.

Manure storage size may provide a better quantity estimate:

- What is the manure storage facility size?
- Multiply ~~pit~~ storage facility size by the number of times emptied/year. This equals the total annual manure collection.

SnapPlus2 offers a Manure Production Estimator or a Grazing Application Estimator and is available for free at http://snapplus.wisc.edu/.

Table ~~1~~3. Manure Quantity Estimation ~~For~~ for Crop Production *Version January 16, 2003*

Animal	Size Lbs.	Daily Manure Production To Apply						Annual Manure Production To Apply									
		Solid		Liquid				Number of Head	x	Daily Total Tons or Gal.	x	365 Day Total	x	% Collected	=	Total Collected Tons or Gal.	
		Lbs/day	ft^3/day	MWPS ft^3/day x WI dairy & beef dilution factor	ft^3/day & WI dilution	MWPS gal./day x WI dairy & beef dilution factor	gal./day & WI dilution										
Dairy																	
Calf	150	13	0.200	.21*1.8=	.37	1.53*1.8=	2.80										
Calf	250	21	0.320	.33*1.8=	.60	2.47*1.8=	4.50										
Heifer	750	65	1.000	1.03*1.8=	1.85	7.70*1.8=	13.8										
Lact. Cows	1000	106	1.700	1.71*1.8=	3.07	12.7*1.8=	23.0										
	1400	148	2.400	2.38*1.8=	4.28	17.7*1.8=	32.0										
Dry Cows	1000	82	1.300	1.30*1.8=	2.35	9.7*1.8=	18.0										
	1400	115	1.820	1.82*1.8=	3.33	13.6*1.8=	25.0										
Beef																	
Calf	450	26	0.420	.415*3.2=	1.3	3.1*3.2=	9.9										
High Forage	750	62	1.000	1.00*3.2=	3.2	7.5*3.2=	24.0										
High Forage	1100	92	1.400	1.48*3.2=	4.8	11*3.2=	35.0										
High Energy	750	54	0.870	.87*3.2=	2.7	6.5*3.2=	20.8										
High Energy	1100	80	1.260	1.27*3.2=	4.1	9.5*3.2=	30.5										
Beef Cow	1000	63	1.000	1.00*3.2=	3.2	7.5*3.2=	24.0										
Swine																	
Nursery Pig	25	2.7	0.040	.04		.30											
Grow-Finish Pig	150	9.5	0.150	.17		1.20											
Gestating Sow	275	7.5	0.120	.14		1.00											
Sow & Litter	375	22.5	0.360	.42		3.00											
Boar	350	7.2	0.120	.14		1.00											
Poultry / Other																	
Layers	4	0.26	0.004	.004		.03											
Broilers	2	0.18	0.003	.003		.02											
Turkeys	20	0.9	0.014	.015		.11											
Duck	6	0.33	0.005	.006		.04											
Sheep	100	4	0.060	.055		.40											
Horse	1000	50	0.800	.827		5.98											

Source: Midwest Plan Service publication number MWPS-18 “Manure Characteristics” Section 1, copyright 2000. Solid volumes are as excreted. The liquid dairy and beef values are computed from the MWPS daily production and have approximately equal nutrient values annually as solid manure. MWPS liquid dairy and beef factors are multiplied by 1.8 and 3.2 respectively. Dilution on your operation may be substantially different. **Use manure analysis and manure storage volumes** to determine manure production whenever possible.

Manure quantities are likely to be more accurate estimated from storage size:

What is the manure storage pit size? _____ gallons or tons?

Multiply pit size x Number of times emptied/year _____ = Total annual manure collection

STEP 2: Estimate Available Nutrients

When manure is analyzed:

Because the nutrient content of manure can vary significantly from the values provided in UWEX Pub A2809 Table 29.2 (below), it is strongly recommended that a process of manure sampling and analysis be developed to quantify the nutrient content of the major manure source(s) of the

livestock operations. The process should establish a representative manure nutrient content range that improves the planning and application process. Consider additions of bedding, mixing and agitation of manure, dilution or concentration in storage, and other factors pertinent to the operation during the sampling and analysis process. An approved laboratory (Appendix 2Part VI) should be used for manure analysis.

Total pounds of Nutrient Concentration per ton or 1,000 gallons	X	% Manure Nutrient Availability expressed as a decimal	=	Available pounds of Nutrient per ton or 1,000 gallons
Use Table 29.2		*Use Table 39.1*		*Use manure analysis or Table 4 9.3 when manure is not tested.*
Dairy solid 10-5-9 pounds of N- P_2O_5-K_2O per ton	X	Dairy, surface applied 1st year .3-.6-.8% available of N- P_2O_5-K_2O	=	Dairy, surface applied 1st year 3-3-7 pounds of N- P_2O_5-K_2O per ton

Manure Sampling Instructions

Proper sampling is critical for obtaining results that accurately reflect the true nutrient content of manure. Regardless of the type of manure storage system, following proper sampling procedures is necessary to obtain the right information so that fertilizer recommendations can be adjusted appropriately. **Keep all manure samples frozen until shipped or delivered to the laboratory. Mail samples early in the week (Monday, Tuesday, or Wednesday). Avoid mailing over holidays or weekends.** Remember to always use screw-top plastic containers for safety. Plastic sample bottles can be obtained at the certified laboratories listed in Appendix 2Part VI.

Liquid Manure Systems

Agitate the contents of the storage facility thoroughly. If the material is to be hauled immediately, a composite sample taken from several loads (5-10) is recommended. These samples can then be mixed together and one composite sample submitted. A container on the end of a long pole works well to sub-sample as the manure is being pumped into the top of the spreader tank. A representative sample can also be taken directly from the storage facility soon after thorough agitation if hauling is to be delayed. Again, several sub-samples should be taken and mixed together to ensure a representative sample. Place the sample in a quart-sized screw top plastic container filled to no more than three-fourths capacity, and freeze immediately.

Solid Manure Systems

Use a push probe, auger, or spade to obtain a representative sample from several places in the manure pile or pack. If the material is being loaded for spreading, a sample can be obtained by sub-sampling several spreader loads. Place the 1-2 pound sample in a 0.5 to 1 quart screw-top plastic bottle and freeze immediately.

STEP 3: Estimate the Manure Nutrient Credit and Application Rates

Identify the fields that have received or will receive manure.

Then, determine how much manure per acre has been applied or will be applied to each field. UWEX Publication A3381, "Determining Manure Application Rates," contains more information.

Available pounds of Nutrient per ton or 1,000 gallons	x	Manure Application Rate per acre	=	Manure Nutrient Credit per acre
Use manure analysis or Table 4 when manure is not tested.				
Dairy, surface applied 1st year 3-3-7 pounds of N- P_2O_5-K_2O per ton	x	20 tons per acre surface application rate	=	60-60-140 pounds of N- P_2O_5-K_2O per acre

MANURE CREDITING EXAMPLES

Example 1:

Producer Smith incorporates 40 tons per acre of fresh solid dairy manure to corn ground last fall without testing the manure. Estimate the amount of N, P_2O_5, and K_2O available to the next corn crop from manure.

1. Use Table 4 9.3 to estimate first year available nutrients from incorporated solid dairy manure as 4-3-7 per ton.

2. Use the equation in Step 3 to calculate the manure nutrient credit from a 40-ton per acre application rate.

Available pounds of Nutrient per ton or 1,000 gallons	x	Manure Application Rate per acre	=	Manure Nutrient Credit per acre
Use manure analysis or Table 4 9.3 when manure is not tested.				
Dairy, incorporated 1st year 4-3-7 pounds of N- P_2O_5-K_2O per ton	x	40 tons per acre surface application rate	=	160-120-280 pounds of N- P_2O_5-K_2O per acre

Example 2:

Producer Jones surface spread 7,000 gallons per acre of fall-applied stored liquid dairy manure on a 20-acre cornfield for two consecutive years. A manure analysis from a private lab showed a total nutrient value of 32-15-36 per 1,000 gallons. Next spring he will plant corn and apply 100 pounds per acre of 9-23-30 starter fertilizer. A UWEX soil test recommended 160 pounds N per acre, 60 pounds P_2O_5 per acre, and 120 pounds K_2O per acre. Calculate the amount of nutrients in the manure and starter fertilizer, and how much additional nutrients must be supplied from other sources.

1. Table 9.3 shows the percent available nutrients in dairy manure as 30% N, 60% P_2O_5, and 80% K_2O for first-year nutrient availability. However, since similar manure rates have been applied for two consecutive years, increase these values an additional ten percentage points for each nutrient to 40% for N, 70% for P_2O_5, and 90% for K_2O. See the first footnote in Table 9.3.

2. Use Step 2 to calculate the available nutrient content.

Total pounds of Nutrient Concentration per ton or 1,000 gallons	x	% Manure Nutrient Availability expressed as a decimal	=	Available pounds of Nutrient per ton or 1,000 gallons
Use Table 9.2		*Use Table 39.1*		*Use manure analysis or Table 4 9.3 when manure is not tested.*
Dairy liquid 32-15-36 pounds of N- P_2O_5-K_2O per 1,000 gallons	x	Dairy, surface applied 2nd year .4-.7-.9% available of N- P_2O_5-K_2O	=	Dairy, liquid surface applied 2nd year 13-11-32 pounds of N- P_2O_5-K_2O per ton

3. Use Step 3 to calculate the manure nutrient credit from a 7,000-gallon rate per acre.

Available pounds of Nutrient per ton or 1,000 gallons	x	Manure Application Rate per acre	=	Manure Nutrient Credit per acre
Use manure analysis from 2: above.				
Dairy, liquid surface applied 2nd year 13-11-32 pounds of N- P_2O_5-K_2O per ton	x	7,000 gallons per acre surface application rate	=	91-77-224 pounds of N-P_2O_5-K_2O per acre

4. Subtract the manure and starter P_2O_5 and K_2O credits from the soil test recommendations to determine if additional nutrients are required. Round the resulting positive numbers to the nearest 10 pounds per acre.

Soil test recommended pounds of Nutrient per acre	–	Manure Nutrient Credit per acre plus starter fertilizer	=	Additional Fertilizer Need per acre

Use soil test recommendation for the field		*Use 3: above*		
Soil test recommended crop need of 160-60-120 of N-P_2O_5-K_2O per acre	–	91-77-224 pounds of manure N-P_2O_5-K_2O per acre plus 9 pounds of starter N (*where the first 20 pounds is not counted)* -23 P_2O_5-30 K_2O starter fertilizer	=	69-(40 extra)-(134 extra) pounds of N-P_2O_5-K_2O per acre Rounded to 70-0-0 additional fertilizer need.

UWEX Pub A2809 Table 9.2.Typical nutrient content of manures tested in Wisconsin (1998-2012)

	DM	N	P_2O_5	K_2O	S
Solid manure			lb/ton		
Dairy – semi-solid (11.1-20.0% DM)	15	8	3	6	0.8
Dairy – solid (>20.0% DM)	33	9	4	8	1.2
Beef	29	13	8	12	1.9
Chicken	57	49	44	33	3.0
Duck	36	12	10	9	1.8
Goat	43	13	7	10	2.0
Horse	33	10	6	8	1.3
Sheep	34	19	9	24	2.2
Swine	19	18	13	10	2.0
Turkey	59	51	44	31	3.8
Liquid manure			lb/1000 gal		
Dairy – liquid (<4.0% DM)	2	14	4	14	1.1
Dairy – slurry (4.1-11.0% DM)	6	23	8	21	2.3
Beef	3	16	7	15	1.6
Goat	4	17	8	19	1.7
Poultry	2	12	7	9	1.3
Swine-finish (indoor pit)	5	43	18	28	3.2
Swine-finish (outdoor pit)	2	18	7	10	1.0
Swine (farrow-nursery)	2	21	8	13	1.0
Veal calf	1	9	3	16	0.6

Table 2. Average Nutrient and Dry Matter Content from Various Solid and Liquid Manure

Species/Management	% Dry Matter	N	P_20_5	K_20
	Pounds per ton			
Dairy, solid	24	10	5	9
Beef, solid	35	14	9	11
Swine, solid	20	14	10	9
Duck, solid	35	17	21	30
Chicken, solid	60	40	50	30
Turkey, solid	60	40	40	30
Sheep, solid	45	26	18	40
Horse, solid	45	10	6	10
	Pounds per 1000 gallons			
Dairy, liquid	6	24	9	20
Veal calf, liquid	2	15	10	25
Beef, liquid	5	20	9	20
Swine, liquid indoor pit	7	50	42	30
Swine, liquid outdoor pit	4	34	16	20
Swine, liquid, farrow-nursery indoor pit	3	25	23	22
Poultry, liquid	3	16	10	12

These data are taken from a combination of Midwest Plan Service (2000), manure analysis from Wisconsin certified soil testing laboratories (2002), and University of Wisconsin - Extension publications.

Table 3. Estimated First-Year Nutrient Availability (%) from Various Manures

UWEX Pub A2809 Table 9.1. Estimated nutrient availability for various manures.

	N					
	Time to Incorporation					
Species	Not Incorp. or > 72 hrs	1-72 hours	Injected or Incorp. within 1 hr	P_2O_5	K_2O	S
First-year availability	% of total					

Beef: liquid (≤ 11.0% DM)[a]	30	40	50	80	80	55
Beef: solid (> 11.0% DM)	25	30	35	80	80	55
Dairy: liquid (≤ 11.0% DM)[a]	30	40	50	80	80	55
Dairy: solid (> 11.0% DM)	25	30	35	80	80	55
Goat	25	30	35	80	80	55
Horse	25	30	35	80	80	55
Poultry[b]	50	55	60	80	80	55
Sheep	25	30	35	80	80	55
Swine	40	50	65	80	80	55
Veal calf	30	40	50	80	80	55
Second-year availability						
All species	10	10	10	0	0	10
Third-year availability						
All species	5	5	5	0	0	5

[a] If dry matter (DM) is < 2.0% and NH_4-N is > 75% of total N, the following equation for first-year N availability may be used in an effort to better account for the high concentration of NH_4-N found in these manures: first-year available N = NH_4-N + [0.25 x (Total N – NH_4-N)], assuming manure is injected or incorporated in < 12 hours.

[b] Poultry includes chicken, duck, and turkey.

Species	N	P_2O_5	K_2O
Dairy, surface applied	30%	60%	80%
Dairy, incorporated	40%	60%	80%
Veal calf, surface applied	40%	60%	80%
Veal calf, incorporated	50%	60%	80%
Beef, surface applied	25%	60%	80%
Beef, incorporated	35%	60%	80%
Swine, solid surface applied	50%	60%	80%
Swine, solid incorporated	65%	60%	80%
Swine, liquid indoor pit, surface	50%	60%	80%
Swine, liquid indoor pit, incorporated	65%	60%	80%
Swine, liquid outdoor pit, surface	50%	60%	80%
Swine, liquid outdoor pit, incorporated	65%	60%	80%
Swine, liquid, farrow-nursery indoor pit, surface	50%	60%	80%
Swine, liquid, farrow-nursery indoor pit, incorporated*	65%	60%	80%
Duck, surface applied	50%	60%	80%
Duck, incorporated	60%	60%	80%
Chicken, surface applied	50%	60%	80%
Chicken, incorporated	60%	60%	80%
Turkey, surface applied	50%	60%	80%
Turkey, incorporated	60%	60%	80%
Poultry, liquid, surface	50%	60%	80%
Poultry, liquid, incorporated	60%	60%	80%
Sheep, solid surface applied	25%	60%	80%
Sheep, solid incorporated	35%	60%	80%
Horse, solid surface applied	25%	60%	80%
Horse, solid incorporated	35%	60%	80%

If manure has been applied to the same field at similar rates for 2 consecutive years, increase the nutrient values in the table an additional 10 percentage points. If manure has been applied to the same field at similar rates for three or more consecutive years, increase the nutrient values in the table an additional 15 percentage points. In other words 10% of the total is available to plant in the 2nd year and an additional 5% is available in the 3rd year. (See example 2)

UWEX Pub A2809 Table 9.3. Estimated first-year available nutrient contents of manures.[a]

	N					
	Time to incorporation					
Species/management	Not Incorp. or > 72hrs	1-72 hours	Injected or Incorp. within 1 hr	P_2O_5	K_2O	S
Solid manure	lb/ton					
Beef	3	4	5	6	10	1
Dairy: semi-solid (11.1-20.0% DM[b])	2	2	3	2	5	1
Dairy: solid (> 20.0% DM)	2	3	3	3	6	1
Goat	3	4	5	6	8	1
Horse	2	3	4	5	6	1
Poultry: chicken	24	27	29	35	26	2
Poultry: duck	6	7	7	8	7	1
Poultry: turkey	26	28	31	35	25	2
Sheep	5	6	7	7	19	1
Swine	7	9	12	10	8	1
Liquid manure	lb/1000 gal					
Beef	5	6	8	6	12	1
Dairy: liquid (< 4.0% DM)	4	6	7	3	11	1
Dairy: slurry (4.1-11.0% DM)	7	9	12	6	17	1
Goat	4	5	6	6	15	1
Poultry	6	7	7	6	7	1
Swine: finish (indoor pit)	17	22	28	14	22	2
Swine: finish (outdoor pit)	7	9	12	6	8	1
Swine: (farrow-nursery)	8	10	14	6	10	1
Veal calf	3	4	4	2	13	1

[a] These estimates are based on the typical total nutrient contents of manures tested in Wisconsin (Table 9.2) multiplied by the estimated first-year nutrient availability (Table 9.1).

[b] DM = dry matter

Table 4. Manure Book Values - Estimates of Available Nutrients from Manure by Species and Management Systems for up to Three or More Consecutive Years of Application

Note: Table 4 replaces Tables 23 and 24 in UWEX Publication A-2809 (1998). Figures are rounded to the nearest whole pound.

These figures are calculated using STEP 2 and the values given in Tables 2 and 3.

PART ~~I~~V

DNR ~~REGIONAL OFFICES AND CONTACTS~~CONTACT INFORMATION AND RESOURCES FOR NUTRIENT MANAGEMENT

DNR Service Center Locations by Region - The State of Wisconsin is divided into five regional areas. They include Northern Region, Northeast Region, West Central Region, South Central Region, and Southeast Region. The DNR Central Office is located in Madison.

Contacts

CAFO - AG Runoff Management Staff (by DNR office and county)
http://dnr.wi.gov/topic/AgBusiness/CAFO/Contacts.html

Agricultural Nonpoint Source Specialists (by DNR office and county)
http://dnr.wi.gov/topic/Nonpoint/NPScontacts.html

Drinking and Groundwater Staff (link in lower left corner) by county
http://dnr.wi.gov/topic/drinkingwater/

Resources

Reporting Concerns regarding Agricultural Operations
http://dnr.wi.gov/topic/Nonpoint/dischargesComplaints.html

Manure Spills Response Planning and Prevention
http://dnr.wi.gov/topic/agbusiness/manurespills.html

Nonpoint Source Pollution
http://dnr.wi.gov/topic/nonpoint/

CAFO's and Nutrient Management
http://dnr.wi.gov/topic/AgBusiness/CAFO/NutrientManagementPlan.html

Agricultural TMDL's
http://dnr.wi.gov/topic/tmdls/npstmdls.html

Impaired Waters
http://dnr.wi.gov/topic/impairedwaters/

~~**NORTHERN REGION (NO)**~~

~~Spooner, Department of Natural Resources, 810 W. Maple Street, Spooner, WI 54801~~

~~715-635-2101 phone 715-635-4105 fax 715-635-4001 TDD~~

~~Counties served: Ashland, Barron, Bayfield, Burnett, Douglas, Iron, Polk, Price, Rusk, Sawyer, Taylor, Washburn.~~

~~**NORTHERN REGION (NO)**~~

~~Rhinelander, 107 Sutliff Ave, RHINDLANDER WI 54501,~~

715-365-8900-phone, 715-365-8932-fax

Counties served: Florence, Forest, Langlade, Lincoln, Oneida, Vilas.

NORTHEAST REGION (NE)

Department of Natural Resources, 1125 N Military Ave, PO Box 10448, Green Bay WI 54307-0449 920-492-5800-phone, 920-492-5913fax, 920-492-5812-tdd

Counties served: Brown Door, Kewaunee, Marinette, Menominee, Oconto, Outagamie, Shawano

NORTHEAST REGION (NE)

Department of Natural Resources, 427 E Tower Dr, Suite 100, WAUTOMA WI 54982 920-787-4686-phone

Counties served: Calumet, Fond du Lac, Green Lake, Manitowoc, Marwuette, Waupaca, Waushara, Winnebago

~~WEST CENTRAL REGION (WC)~~

~~Department of Natural Resources, 1300 W Clairmont, PO Box 4001, EAU CLAIRE, WI 54702-4001 715-839-3700 phone, 715-839-6076 fax~~

~~Counties served: Chippewa, Dunn, Eau Claire, La Crosse, Monroe, Pepin, Pierce, St. Croix, Vernon~~

~~WEST CENTRAL REGION (WC)~~

~~Department of Natural Resources, 910 Hwy 54E, BLACK RIVER FALLS, WI 54615 715-284-1429 phone, 715-284-1737 fax~~

~~Counties served: Adams, Buffalo, Clark, Crawford, Jackson, Juneau, Marathon, Portage, Trempealeau, Wood~~

~~SOUTH CENTRAL REGION (SC)~~

~~Department of Natural Resources, 3911 Fish Hatchery Rd, FITCHBURG, WI 52711 608-275-3266 phone, 608-275-3338 fax, 608-275-3231 tdd~~

~~Counties served: *Columbia, *Dane, Dodge, Jefferson, Rock~~

~~SOUTH CENTRAL REGION (SC)~~

~~Department Of Natural Resources, 1500 N Johns St, DODGEVILLE, WI 53533~~

~~608-935-1940 phone, 608-935-9652 fax~~

~~Counties served: Richland, Sauk, Grant, Iowa, Lafayette, Green, *Dane, *Columbia~~

~~SOUTHEAST REGION (SE)~~

~~Department of Natural Resources, 2300 N Dr Martin Luther King Jr Dr, PO Box 12436, MILWAUKEE WI 53212, 414-263-8500~~

~~Counties served: Kenosha, Milwaukee, Ozaukee, Racine, Sheboygan, Walworth, Washington, Waukesha~~

~~[Andrew changes this]~~

~~*Indicates counties served by two offices along basin lines~~

PART VI

CERTIFIED SOIL TEST LABORATORIES

The following laboratories have been approved as of the publication date of this document.

UW Soil & Forage Laboratory
8396 Yellowstone Drive
Marshfield, WI 54449
Ph: (715) 387-2523

Rock River Laboratory
710 Commerce Drive
P. O. Box 169
Watertown, WI 53094
Ph: (920) 261-0446

Dairyland Laboratories
217 E. Main Street
Arcadia, WI 54612
Ph: (608) 323-2123

Agsource Soil & Forage Laboratory
106 N. Cecil Street
Bonduel, WI 54107
Ph: (715) 758-2178

A&L Great Lakes Laboratories
3505 Conestoga Drive
Fort Wayne, IN 46808
Ph: (260) 483-4759