PRACTICE SPECIFICATIONS
Nutrient Management

1) SCOPE

a) The work shall consist of designing an annual nutrient management plan for the timing, form, method, rate, and location (including application setbacks) of nutrient application used to supply nutrients to plants while minimizing environmental losses due to runoff, erosion, leaching, de-nitrification, volatilization or other losses.

b) Develop and maintain a nutrient management recordkeeping system as defined in section 10 of this document.

c) Each nutrient budget area must include maps (aerial site photograph, soils maps, or USGS maps) of each area designed or identified in the budget. Sensitive areas (i.e. surface water, sandy soils) and setbacks shall be indicted on the maps.

d) Nitrogen (N) leaching risk assessment (for sandy soils) and Phosphorus (P) index risk assessment (when manure is applied) must be included with the budget.

2) DEFINING SOIL SAMPLING AND NUTRIENT BUDGET AREAS

a) Soil samples for nutrient analysis should always be taken from areas with similar soils and managements and should never represent an area greater than 40 acres. Areas of the field for which any of the following are different should be sampled separately.
   i) Soil texture, slope or landscape position that affect yield potential or nutrient availability (i.e. soil organic matter, soil texture, bottomland versus upland),
   ii) Previous crop (i.e. soybeans or other legume that provide an N credit),
   iii) Manure history (i.e. manure applied to only a portion of a field),
   iv) Fertilizer history (i.e. higher rate of nitrogen applied in one area versus another in previous year),
   v) Dryland vs. irrigated,
   vi) Irrigation water management practices that may have leached nitrate differently (i.e. upper, middle and lower end of a gravity irrigated field),
   vii) Other significant differences in site conditions, or management history.
   viii) Additional sampling guidelines can be found in NebGuide G1740 “Guidelines for Soil Sampling”.

b) Multiple soil sampling areas can be combined into one nutrient budget area if soil test values are similar, and the following are the same:
   i) Crop planted (i.e. corn, wheat, sorghum, etc.),
   ii) Irrigation,
   iii) Realistic yield goals, and
   iv) N-credits (i.e. previous legume crop, manure history, etc.).

c) Additional requirements if <u>site specific nutrient management</u> is utilized are as follows:
   i) Soil samples will be taken using either grid sampling and/or management zones (directed) sampling.
      (1) Grid Sampling
         (a) When using grid sampling a sampling density of at least one sample per 2.5 acres is required. A sampling density of one sample per acre is recommended for fields with more apparent variability;
         (b) Grid sampling is typically used for surface samples and all nutrients other than nitrogen.

      (2) Management Zones (directed) Sampling

(a) When using directed sampling, each management zone shall be no larger than 20 acres in size;
(b) Spatial factors and tools such as soil maps, aerial photos, yield maps, and other maps of soil variability such as maps from previous grid sampling efforts can be used to direct where samples are taken to determine if they have different fertilizer needs;
(c) In addition, if parts of the field had different preceding crops, different fertilizer/manure history, eroded areas, or old farmsteads should be sampled separately;
(d) Ideally each management zone should have similar site and soil conditions (i.e. soil texture, soil color, organic matter, slope, drainage, etc.);
(e) Soil samples for nitrogen management generally use directed sampling rather than grid sampling because it is more practical.

(3) A combination of grid and directed sampling may be utilized. For example, surface grid samples may be utilized for amendments/nutrients other than nitrogen, and directed management zone sampling used for nitrogen management.

ii) In order to utilize site specific nutrient management a variable rate fertilizer applicator equipped with GPS guidance technology must be available to apply recommended nutrients and the grids/management zones must be identified with GPS coordinates.

iii) Additional information on soil sampling for site specific nutrient management can be found in EC-154 “Soil Sampling for Precision Agriculture”.

3) DETERMINING REALISTIC YIELD GOALS

a) Use a five-year average yield plus 5% based on actual records such as scale tickets, yield monitors, or Farm Service Agency certified yields when available. Do not include yields from when a significant crop loss occurred from hail, drought, wind or other natural disasters, or

b) If actual yields are not available five year county average yields from FSA or National Agricultural Statistics Service, or yields from similarly managed fields with similar site conditions plus 5% can be used.

4) SOIL TESTING REQUIREMENTS

a) Utilize appropriate test method based on soil properties (refer to appropriate NebGuides(s)/Extension Circulars to determine the appropriate test method).

b) All soil sampling must be prior to N fertilizer/manure application.

c) Surface Soil Testing:
   i) Surface tests will be taken for pH, organic matter, nitrate, phosphorus and potassium at a minimum. When soil organic matter is less than 1% soil tests for sulfur, zinc and iron shall also be done. Tests for other nutrients may be done if recommended by the University of Nebraska;
   ii) Requirements for number of samples, methods of sampling, depth of samples (0-8” unless otherwise specified), and other guidelines for surface soil sampling can be found in NebGuide G1740;
   iii) Soil test values for all nutrients (other than nitrates), organic matter and pH <u>must be no older than five years old</u> and should be taken during the same time of the year in subsequent years to determine trends.

d) Deep Nitrate Testing:
   i) Nitrate-N soil test results must be from a current year test or they are not valid.
   ii) Nitrate-N values (in ppm) shall be listed for each depth sampled and a weighted average nitrate-N value (in ppm) recorded for the entire profile.

iii) Requirements for timing, number of samples, methods of sampling, depth of samples and other guidelines for deep nitrate sampling can be found in NebGuide G1740. Additional guidelines are as follows:
   (1) Deep nitrate sampling depths will never be less than 2 feet.
   (2) University of Nebraska nitrogen recommendations for corn and sorghum are based on a 48-inch sampling depth and on a 36-inch depth for most other crops. When depth of sampling is less than this, an appropriate estimated value can be used below the sampling depth. In most situations a value of 3 ppm (low value) or greater will be used for an assumed nitrate value.
   (3) Timing of soil nitrate sampling:
      (a) For spring planted crops on medium and fine textured soils, samples can be taken in the fall after the harvest of the previous crop;
      (b) For fall planted crops on medium and fine textured soils, samples can be taken during the early fall prior to planting, or after emergence of the crop;
      (c) Sampling on coarse textured (sandy) soils must be taken in the same season that the crop is planted (i.e. spring for corn, fall for winter wheat), or after emergence of the crop.
   (4) When Federal, NRD and/or state requirements on timing and sampling depths are more restrictive they must be adhered to.
   (5) Deep nitrate soil tests <u>are required annually whenever N fertilizer or manure will be applied</u> with the following exceptions and guidelines (When NRD and/or state regulations require deep nitrate tests the following exceptions do not apply):
      (a) Non-legume crops following annual or biennial legumes (i.e. corn following soybeans/edible beans/sweetclover) – Deep nitrate tests are not necessary unless there is a reason to believe nitrate levels are elevated due to previous applications of manure or nitrogen fertilizer, drought, crop failure, or any other reason there might be residual nitrogen in the soil profile;
      (b) Non-legume crops following alfalfa or other perennial legume (i.e. corn following alfalfa) – Deep nitrate tests are not necessary unless there is a reason to believe they are elevated;
      (c) Pastures/CRP – Deep nitrate tests are not necessary unless there is a reason to believe they are elevated due to previous applications of manure or nitrogen fertilizer. Refer to NebGuide G78-406-A “Fertilizing Grass Pastures and Haylands”;
      (d) Deep nitrate tests are not required when the only source of N is a starter fertilizer and less than 25 pounds of total N will be applied;
      (e) When deep nitrate tests are not taken, an assumed value of at least 3-ppm for residual nitrate values will be used in the nutrient budget in addition to appropriate N-credits when following legumes.

5) SUPPLEMENTAL TESTS FOR NITROGEN MANAGEMENT (optional tests)

a) Cornstalk Nitrate Test
   i) The concentration of nitrate in the stalk at the end of the growing season reflects all factors that influenced N availability and N needs during the growing season. This test is used to determine if the crop had adequate nitrogen at the end of the growing season and enables the producer to evaluate their current fertility program and adjust accordingly;
   ii) Stalks should be sampled between one and three weeks after black layers have formed on 80% of the kernels;
   iii) Each sample will consist of fifth-teen 8-inch stalk segments taken from 6 inches above the soil surface according to criteria outlined in Section 2 “Defining Soil Sampling and Nutrient Budget Areas”;

iv) Additional information can be found Iowa State University Extension PM 1584 “Cornstalk testing to evaluate nitrogen management”.

b) Pre-Sidedress Soil Nitrate Test (PSNT)
   i) The PSNT is a growing season soil nitrate test used to determine the amount of available N in the soil profile prior to side-dress applications;
   ii) The PSNT is recommended for fields to which manure has been regularly applied because it will more accurately account for mineralized N from the manure as well as some of the variability associated with manure application;
   iii) Soil samples for the PSNT should be taken to a depth of 12 inches when the corn is 6 to 12 inches tall;
   iv) Collect a minimum of 15 cores for each sample using the criteria outlined in Section 2 “Defining Soil Sampling and Nutrient Budget Areas”. If the field has had manure applied 20-25 cores should be collected.

6) NITROGEN RECOMMENDATIONS

a) Follow University of Nebraska recommendations per UNL Extension Circular EC155 “Nutrient Management for Agronomic Crops in Nebraska”, current NebGuides or software.

b) Appropriate Nitrogen Credits must be accounted for as follows:
   i) Soil test residual:
      (1) The amount of residual soil N is based on the average nitrate-N in the root zone in parts per million (ppm) to a depth of 2-4 feet depending on the crop to be grown according to University of Nebraska Guidelines.
   ii) Soil Organic Matter:
      (1) N credit for organic matter is based on the percent organic matter from a surface soil test and can be calculated using the algorithm in Nebraska Conservation Planning Sheet 11 or in NebGuide G174 for corn. For corn grown for grain the soil organic matter N credit = (0.14 x Expected Yield x % Organic Matter);
      (2) N credit from organic matter for other crops will be based on current University of Nebraska software, NebGuides or Extension Circulars for a given crop as appropriate.
   iii) Irrigation Water Nitrate:
      (1) If the field is irrigated and is located in an area where ground water nitrate concentrations of 10 ppm or greater have been documented, analyze irrigation water for nitrate content during the irrigation season;
      (2) In subsequent growing seasons when nitrogen will be applied, credit N in irrigation water when the nitrate concentration is 10 ppm or greater based on a nitrate test from the previous irrigation season;
      (3) N is credited based on normal seasonal application rates during the growing season (prior to milk stage for grain crops), or as follows: 6″ (east), 9″ (central), 12″ (west), or 15″ (panhandle);
      (4) Pounds of N/acre credited = (inches pumped X ppm nitrate X 2.7) ÷ 12;
      (5) Nebraska Conservation Planning Sheet 11 “Nutrient Management” contains an example chart listing pounds of N/acre credited based upon water application rate and ppm N content of water.

   iv) Legume N:
      (1) Pounds of N credited are based on Nebraska Conservation Planning Sheet 11, or current University of Nebraska software, NebGuides or Extension Circulars.
   v) Manure or other organic amendments:

(1) Manure application over the past three years will be credited per University of Nebraska recommendations (refer to NebGuide G1335 “Determining Crop Available Nutrients from Manure”).

c) Nitrogen application rates may exceed initial UNL recommendations in the following situations:
   i) Up to 40 pounds of additional nitrogen may be applied due to losses from volatilization of surface applied nitrogen, de-nitrification from flooded/saturated soils, or excessive nitrate leaching due to excessive rainfall;
   ii) The application rates are within the calibration limits and uniformity of application equipment. For example, if a manure spreader can only be calibrated to +/- 2.5 tons per acre and the recommended rate is 15 tons of manure per acre then an actual application rate of up to 17.5 tons per acre would be allowed. Likewise, if an anhydrous applicator can only be calibrated to +/- 20 pounds per acre then the actual application rate could exceed the recommended rate by 20 pounds per acre. When application rates are exceeded but still within the calibration limits of the equipment this must be documented;
   iii) When nitrogen deficiency to the crop is documented during the growing season additional N applications based on agronomist’s recommendations are allowed;
   iv) On fields where manure will be applied on rotational basis (e.g. once every four years) and manure application equipment can not be adjusted below the recommended rate (e.g. lowest rate that manure can be applied is 10 tons/acre with application equipment and recommended rate is less than this amount).

7) MANAGEMENT ADJUSTMENTS FOR NITROGEN APPLICATION

a) Management adjustments (i.e. timing of application, method, use of a nitrification inhibitor, and formulation of manure/fertilizer applied) in order to avoid excessive N leaching losses are as follows:
   i) Sites with High nitrate leaching potential (refer to Table 1):
      (1) Commercial nitrogen fertilizer or manure that is high in inorganic nitrogen, such as chicken litter or swine slurry, shall not be fall applied when growing spring planted crops;
      (2) Commercial nitrogen fertilizer or manure that is high in inorganic nitrogen, such as chicken litter or swine slurry, shall be split applied when growing fall planted crops such as wheat or rye with no more than 50% of the N applied in the fall;
      (3) Organic sources of nitrogen such as feedlot manure may be applied in the fall when soil temperatures are 50 degrees or less.
   ii) Sites with Medium and Low nitrate leaching potential (refer to Table 1):
      (1) Fall applications of commercial nitrogen fertilizer or manure that is high in inorganic nitrogen, such as chicken litter or swine slurry, shall only occur when soil temperatures are 50 degrees or less when spring planted crops are grown unless a nitrification inhibitor is utilized.
   iii) For site specific nutrient management a variable rate fertilizer applicator equipped with GPS guidance technology will be used to apply nitrogen at the recommended rates.

Table 1. Nitrate Leaching Potential of Inorganic Nitrogen Sources*

Timing of Application	Soil Texture		
	Coarse	Medium	Fine
Fall Application	High	Medium-Low	Low
Spring Application, Pre-plant	High-Medium	Medium-Low	Low
Sidedress or Split Application	Medium-Low	Low	Low
Soil Textures	Sand, loamy sand & sandy loam	Silt, silt loam & loam	Clay, silty clay loam, silty clay, clay loam, sandy clay loam & sandy clay

*Leaching Potential for inorganic sources of nitrogen are based on soil texture and timing of application. Use Table 1 to determine the nitrate leaching potential for each field listed in the budget.

8) PHOSPHORUS RECOMMENDATIONS

a) P application rates will be based from one of the following:
   i) University of Nebraska or certified crop consultant recommendations when soil test levels are less than 30 ppm using the Bray P-1 or Mehlich III test or less than 20 ppm using the Olsen (Sodium bicarbonate) test.
   ii) Rates equal or less than the estimated crop removal of P in harvested plant biomass on sites when soil tests are greater than 30 ppm using the Bray P-1 or Mehlich III test, or 20 ppm using the Olsen test. Crop removal estimates can be found in Chapter 6 of the Agricultural Waste Management Field Handbook.
   iii) P applications in excess of crop P removal are allowed when manure or other organic sources of P are the primary source depending on the P loss risk of the site.
      (1) For determining P loss risk of the site refer to Nebraska Agronomy Technical Note 107 “Nebraska Phosphorus Index: Background and User Guide” or UNL Extension Circular EC195 “The Nebraska Phosphorus Index (2007): Background and Users Guide” for guidance.
      (2) Application rates will be based on the following for each risk category:
         (a) Sites with a Very High P-Index Rating
            (i) No manure applications allowed until risk rating is lowered.
         (b) Sites with High P-Index Ratings
            (i) P-Based Manure application as follows:
               1. At a rate equal to the estimated P removal in harvested plant biomass (grain and stover) for the planned crop rotation not to exceed five years (i.e. Corn-Soybeans would be a two-year rotation, Corn-Soybeans-Wheat-Sorghum would equal a four-year rotation). When such applications are made, the N application rate shall:
                  a. Not exceed the University of Nebraska recommended nitrogen application rate during the year of application for non-legume crops.
                  b. Not exceed 50% of the nitrogen removal in harvested plant biomass during the year of application for legume crops.
         (c) Sites with Low or Medium P-Index Ratings
            (i) N-Based Manure application as follows:
               1. Annual N applications shall not exceed the University of Nebraska recommended rates for non-legume crops.
               2. Annual N applications shall not exceed 50% of the nitrogen removal in harvested plant biomass for legume crops.

9) APPLICATION OF OTHER PLANT NUTRIENTS AND SOIL AMENDMENTS

a) All other plant nutrients and soil amendments (lime) other than N and P can be applied according to crop consultant or University of Nebraska recommendations.

b) Refer to Nutrient Management 590 Appendix A References for a complete list of references.

c) For site specific nutrient management a variable rate fertilizer applicator equipped with GPS guidance technology will be used to apply nutrients and soil amendments at the recommended rates.

10) RECORDKEEPING

a) Records will be kept for a minimum of five years for each nutrient budget area.

b) At a minimum the following records will be kept for each nutrient budget area:
   i) Copies of applicable test results such as: soil tests, manure tests, irrigation water tests, PSNT tests, cornstalk nitrate tests, or other applicable test results.
   ii) Maps showing the location of each area or management zone for which a nutrient budget was developed;
   iii) Actual application location, timing, method, and rate (lbs./acre, gals./acre, tons/acre, etc.) for each nutrient and nutrient source applied, the total amount of nutrients applied per acre from all sources, and whether or not a nitrification inhibitor was used;
   iv) Crop type and actual yield in bushels/ac, tons/acre or other appropriate measurement unit.

c) Optional job sheets for nutrient management records include:
   i) NE-CPA-38 “Annual Nutrient Budget/Management Plan Job Sheet”,
   ii) NE-CPA-78 “Nutrient & Irrigation Water Management Recordkeeping Job Sheet”,
   iii) NE-CPA-82 “Client Recordkeeping Worksheet”, or
   iv) Equivalent recordkeeping systems.
   v) A complete list of all job sheets is available on the following web address: http://efotg.nrcs.usda.gov/references/public/NE/NE_Job_Sheets_TOC_NPPH.pdf.

d) Additional record keeping requirements for site specific nutrient management based on grid or directed management zone soil sampling will document the following in addition to records listed above.
   i) Maps showing the locations of the grids/management zones and the associated soil test values;
   ii) Variable rate documentation of the amount of each nutrient applied in each grid or management zone, such as computer generated GIS maps from variable rate application equipment.