

HOW TO FILL OUT THE NUTRIENT MANAGEMENT SPECIFICATION SHEET**SEE ATTACHED EXAMPLE****Step 1. Tract and Field**

Enter the landuser's name, tract, field(s) and who assisted with the planning, and the date.

Step 2. Job sketch

On the back page of the job sheet sketch the field or fields covered by this plan. Include the field location(s), field identification, any sensitive areas within or adjacent to the field and required setback areas. Within the boundaries of each field record the total acreage of the field and the acreage to which nutrients can be applied (taking required setbacks into account). Other relevant information, such as complementary practices or adjacent field or tract conditions may be included.

The sketch should be prepared early in the planning process. It is helpful to have a visual image of the fields with respect to surrounding areas before developing the rest of the nutrient management plan. A completed nutrient management plan will contain aerial photographs or maps, including a soil map and soil interpretation that may be a part of the over-all conservation plan. These maps and/or photos may be used to help prepare the sketch in the specification sheet. **The sketch is optional if the conservation plan map contains the relevant information.**

Table 1 contains field conditions and nutrient application recommendations.

Step 3. Crop Sequence/Rotation

The crop sequence/rotation should describe the sequence of crops for 5 years. Start with last year's crop and project the crop rotation for the next 4 years. Crop rotation is important to calculate the total nutrient needs over the period of the rotation, nutrient build-up, and nutrient removal by way of harvest. The previous crop will indicate any nutrient credits, especially legume credits when present in the rotation. Circle the current crop.

[For our example, the crop rotation is continuous corn for grain.]

Step 4. Expected Yield

Enter the expected yield for the current crop. The expected yield is the basis for determining the nutrient requirement for the current crop. An unrealistic estimate of expected yield can result in either too many nutrients being applied creating potential for environmental contamination and inefficient use of the resource, or too few nutrients being applied, causing crop stress and limiting potential yield.

The expected yield should be based on realistic soil, climate and management parameters including crop variety, and may be determined from producer records or county yield averages, soil productivity tables, or local research. Because climate can have a dramatic effect on yields, expected yield should be based on at least 5 years' data. Extreme climate years should not be included in the analysis, as they may bias the results.

[Expected yields may be calculated in a variety of ways. In our example, the corn yields obtained on the field over the past five crop years were: 157, 146, 140, 80, and 142 bushels per acre. To estimate expected yield we eliminate the extreme low and high yields and take the average of the three remaining yields. Adding 5% to the over-all average will compensate for prospective favorable weather conditions. The estimate yields is thus, $(146 + 142 + 140)/3 = 143$ bushels, plus 5% = 150 bushels per acre.]

Step 5. Current Soil Test Levels.

The nutrient status of the soil is a key component of a nutrient management plan. This information is used to make recommendations for nutrient application. **As per NRCS Nutrient Management Policy, a soil test no more than 5 years old is required.** In this section, enter the soil test values for N, P, K, and other soil constituents as given in the report from the soil-testing laboratory. Indicate whether the values are in parts per million (ppm) or pounds per acre (lb/acre).

[For our example, the soil test levels are 10 ppm NO₃-N, 12 ppm P, and 149 ppm K, pH 7.2, SOM 1.2%, no test taken for EC. The soil tests were taken from the 0-1 foot soil depth in a coarse-textured soil.]

Step 6. Recommended Nutrients/Amendments to Meet Expected Yield.

Using the soil test results and considering the expected yield, record the estimated amounts of nutrients and other soil amendments needed to produce the expected yield. The land grant university or other approved soil test laboratories will base nutrient requirements for the crop on the soil test results, crop yields from field research, and local climatic conditions. Consult the extension agronomy guide or other publications from the Land Grant University. Nutrient recommendations come from extensive research results from similar soils and climatic conditions to develop recommended nutrient rates. Recommendations for micronutrients or other amendments may be entered in the blank columns.

[Recommended nutrients from the Wyoming Guide to Fertilizer Recommendations based on soil test are 205 lb. N, 45 lb P₂O₅, 0 lb. K₂O.]

Table 2 is the completion of the nutrient budget. A nutrient budget is the comparison between the quantity of all the sources of nutrients available to the producer and the requirement of nutrients to meet the crop and soil needs. The source can either be from on the farm, such as livestock manure or credits from legumes, or from off the farm, such as purchased fertilizer or irrigation water. The requirement is the amount of nutrients needed by the crop to obtain the expected yields.

Although a nutrient budget is not an exact formula for supplying nutrients, it is one method to compare the nutrient needs of the crop with the nutrients available on the farm. Nutrient budgets can easily determine if there is a gross imbalance between the nutrients that are available vs. the amount required. Nutrient budgets are one of the best methods to see the over-all supply of crop nutrients available compared to the estimated crop needs as given by historic records and field research. Continued use of soil testing, plant and water analyses, and yield monitoring are essential to maintain a good nutrient balance with desired results.

Step 7. Nutrient Sources - Credits

A number of nutrient sources for crop production are available before the crop is planted. One source is the inherent nutrients in the soil determined by soil test levels of nitrogen, phosphorus, and potassium. Others become available to the crop through a process of recycling through animals, plants, air, water, and organic matter. Nitrogen from legumes and organic waste mineralization are examples.

Nitrogen Credits

Line 1. Credits from previous legume crops. Atmospheric nitrogen is fixed by legume plants and brought into the soil. Amounts of nitrogen added by legume production vary by plant species and growing conditions. Refer to local university extension information for the most appropriate legume nitrogen credits.

If no information is available, use 40 pounds per acre for elevations below 6,000 feet and 30 pounds per acre for elevations above 6,000 feet. **Only apply this credit, if a legume has been part of the crop rotation since the last soil test. Do not take this credit if smooth brome or other non-leguminous species dominates the “alfalfa” stand.**

[For our example, there is no legume in the rotation, so 0 pounds of nitrogen credit from a previous legume crop.]

Line 2. Residuals from long-term manure applications. Not all the nitrogen applied in previous manure applications is available to the crop during the year of application. Some of the nutrients are tied up in organic complexes that require organic material decomposition before the nutrients are made available for plants. A percentage of last year's manure application and an even smaller percentage of previous applications will become plant available during this crop season. Use local manure mineralization rates to determine the amount of nitrogen released from previous manure application. Phosphorus and potassium are considered to be almost 100% plant available the year of application, therefore usually little or no residual amounts are calculated for these nutrients.

If local mineralization rates are not available, use the following values:

<u>Year</u>	<u>% Mineralization</u>
1	45%
2	20%
3	10%
4	5%

[For our example, 15 tons of beef manure which contained 10 pounds of organic nitrogen per ton was applied 2 years prior to the current corn crop. The nitrogen available to this corn crop is approximately 20% of the total organic N in the manure applied two years ago. Therefore, $15 \times 10 \times .2 = 30$ pounds/acre of N that can be credited to this year's corn crop.]

Line 3. Irrigation water. Irrigation water, especially from shallow aquifers, contains some nitrogen in the form of nitrate nitrogen. This nitrogen is available for crop use. To calculate the amount of nitrogen applied with irrigation water, determine the concentration of nitrate nitrogen in the water (in ppm or mg/L). This will require a water analysis. The amount of nitrogen added in irrigation

water will equal the nitrate nitrogen concentration (in ppm or mg/L), multiplied by the net irrigation water volume (in acre-feet), times 2.7. The factor 2.7 converts ppm or mg/L and acre-feet into pounds per acre.

[In our example, 18 acre-inches (net) of irrigation water is applied having a nitrate nitrogen concentration of 4.5 ppm. N (lb/acre) = Concentration of NO_3-N (ppm or mg/L) X volume of irrigation (acre-feet) X 2.7 $\rightarrow 18/12 \times 4.5 \times 2.7 = 18$ pounds per acre.]

Line 4. Other. Other nitrogen credits come from atmospheric deposition from dust and ammonia in rainwater. This value is recorded by a number of weather stations throughout the U.S., and can be obtained from National Atmospheric Deposition Program, Fort Collins, CO or from the attached tables. Atmospheric deposition may range from a few pounds nitrogen per acre per year to over 30 pounds. **If the nearest data collection site is more than 100 miles from the area being planned, use no nitrogen contribution from atmospheric deposition.**

The nutrient content of any other material that is brought onto the site, like mulch or compost, can be determined by estimating the mass weight and per cent concentration of nitrogen of the material.

[For our example the atmospheric nitrogen contribution is 8 pounds per acre.]

Step 8. Plant Available Nutrients Applied to the Field

The producer has the ability to bring various sources of nutrients onto the field to supply the requirements of the crop. The nutrient budget is designed to allocate the sources of nutrients available and adjust the amounts based on the calculations to match the crop's needs. Use the column "Current" for calculating the producer's current nutrient budget.

Line 6. Credits. Total nutrient credits are summed in Line 5 and entered here.

[0 from legume + 30 residual manure + 18 irrigation water + 8 atmosphere = 56 lb. N]

Line 7. Fertilizer. If starter fertilizers are applied, such as in the cases of cool, wet soils or reduced tillage systems, the amount of starter nutrients is entered here. Make a note in the "Recommended Methods and Application" box that a starter fertilizer will be used. Similarly, enter amounts for other fertilizer applications such as Plow Down, Fertigation or Side Dress.

[In our example, the producer applies 5 lb. N – 10 lb. P_2O_5 - 5 lb. K_2O as starter fertilizer]

Line 8. Manure and Biosolids. Manures and biosolids can be produced either on the farm or transported to the farm with the express purpose of utilizing the nutrients. Manure application rates should be based on crop nutrient requirements, but can also be applied in lesser rates in order to distribute organic material and micronutrients over a broader number of fields.

Manure application rates in Line 8 are based on plant available nutrients delivered to crop. Manure nutrient content is calculated from information gathered from the moisture content and nutrient analysis of the manure. In lieu of nutrient analysis, a published estimate of plant available nutrients from specific sources of manure can be used. These book values are based on state university research and inventory data, and offer guidance for land application. **Actual manure analysis is highly recommended.** A historic average of the farm or storage manure consistency can be used, if the history is based on laboratory analyses over a period of years,

[In our example, 25 tons of beef cattle manure will be applied with a plant available content of 8 lb. N; 4 lb. P₂O₅; 10 lb. K₂O per ton, based on manure analysis. Total nutrients applied are 200 lb. N; 100 lb. P₂O₅; 250 lb. K₂O]

Step 9. Nutrient Status

The nutrient sources available for field application are subtotaled on Line 9.

[N = 56 + 5 + 200 = 261; P₂O₅ = 10 + 100 = 110; K₂O = 5 + 250 = 255]

Next, the nutrient recommendations to meet expected yield are taken from Table 1 and put on Line 10. Subtracting the nutrient requirements (line 10) from the nutrients available (line 9) give a nutrient status (Line 11).

[N -- 261 – 205 = +56 lb/ac; P₂O₅ -- 110 - 45 = +65 lb/ac; K₂O -- 255-0 = +255 lb/ac]

If line 11 is a negative number, the amount shown on this line represents a deficiency of nutrients for the crop based on obtaining the expected yield. This amount of nutrients must be supplied to field to supplement the nutrient credits, starter fertilizer, and manure already applied. This supplement is usually provided by commercial fertilizer, but can be added by additional rates of manure or even irrigation water. Enter the method and timing of the application in the appropriate “plan” column on the specification sheet.

[If line 11 is negative (e.g. additional nutrients are required to meet crop needs) then add nutrients by adjusting inputs, including fertilizer.]

If line 11 is a positive number, the amount shown on this line represents an excess of nutrients needed for the crop, again based on obtaining the expected yield. There is no reason for nitrogen nutrition to be applied in quantities greater than crop requirements. Phosphorus and potassium are over-applied when animal manures or biosolids are applied to at rates to meet the nitrogen needs of the crop.

[If line 11 is positive i.e. nutrients are applied in excess of crop needs) return to Line 7 and 8 to adjust nutrient additions on the field. Use column “plan” to make adjustment in the nutrient budget.]

The nitrogen credits in lines 1 – 4 cannot be controlled by management. They are the result of previous management activities and the local environment. All adjustments to the nutrient budget must occur in the amounts of fertilizers and manures applied in the current year.

[In our example, we have excesses of all three major nutrients. We must decide which nutrient we will balance our budget, knowing that we may have excesses or deficiencies in the other two. For our example, we will balance on nitrogen.

The nitrogen credits are 56 lb/ac. The producer decides he still wants to use starter fertilizer, so our total nitrogen input to this point is 61 lb/ac. From line 10, 205 lb/ac of N is required, leaving a need of 144 lb/ac N. If we adjust the manure application rate to 20 tons per acre, that would apply 160 lb. of N, giving us a total of 221 lb/ac N. This results in only slight excess (16 lbs) of N being applied. This is well within the acceptable variability of estimating nitrogen requirements.

When we reduced the manure application to balance N, we reduced the amount of P and K applied. The amount of P₂O₅ applied in the manure was reduced to 80 lb/ac, and K₂O to 200 lb/ac. This produces a surplus of 45 lb/ac P₂O₅, and 205 lb/ac of K₂O. Record these adjustments in the “Plan” column. In this scenario, the use of the Phosphorus Index would be required to determine if continued over-application of phosphorus by manure application presents an acceptable risk.

Step 10. Recommended Method and Timing of Application

Record the planned method and timing of nutrient application in this block. The timing and method of nutrient application significantly affect the efficiency of nutrient use by plants. Nitrogen should be applied as near as possible to the time of maximum plant uptake to minimize potential losses from leaching or volatilization. Both nitrogen and phosphorus fertilizers should be injected or incorporated to reduce the risk of loss in runoff water or attached to sediment.

[Broadcast apply 20 ton/ac of beef cattle manure two weeks prior to planting and soil-incorporate within 24 hours. Do not apply the manure within 50 feet of Carp Creek, which forms the boundary between fields 144 and 142. Apply 100 lb/ac of 5-10-5 as a starter fertilizer at planting time].

Step 11. Operation and Maintenance

On the second page of the job sheet in the box titled, “***Perform the following operations and maintenance***” enter the information requested. Nutrient management plans should normally be reviewed annually by the producer, and a more thorough review performed at least every 5 years unless there is significant changes in the operation.

Field records should be maintained for at least 5 years. State regulations may require a longer period of record retention. Some producers may wish to maintain records indefinitely.

Application equipment should be calibrated so that it will apply nutrients to within 10% of the expected rate. Uniform application across the field is vital. Generally, no more than 10 – 15% variance in the required application rate from the actual amount applied is allowed. Commercial fertilizer applicators are easier to calibrate than manure spreaders. An added complication with manure spreaders is the uncertainty of available nutrient content in the manure.

All nutrient material should be handled with caution. Ammonium-containing materials, especially anhydrous ammonia, may be caustic. Protective clothing should be worn

when handling these materials. Goggles are appropriate when handling any fertilizer material, including biosolids.

Fertilizer materials remaining when fertilizer application is complete should be washed from application equipment and disposed of in a safe manner. Fertilizer materials left in application equipment may corrode or otherwise damage the equipment.

Step 13. Additional Specifications and Notes

Write any additional specifications and notes in the box provided. Additional notes may include any constraints not previously noted, special nutrient requirements of the crop, equipment constraints, constraints due to pest pressures, residue limitations, conservation buffer requirements, local regulations, and any other information of interest to the producer. Additional notes may also refer to sources of information used to calculate available nutrients and nutrient requirements.