NATURAL RESOURCES CONSERVATION SERVICE
MONTANA CONSERVATION PRACTICE SPECIFICATION

NUTRIENT MANAGEMENT (ACRE)

CODE 590

DEFINITION: Nutrient management is managing the amount, source, placement, form, and timing of plant nutrients and soil amendments.

PURPOSE: Nutrient management effectively and efficiently uses scarce nutrient resources to adequately supply soils and plants appropriate nutrients to produce food, forage, fiber, and cover while minimizing environmental degradation. Nutrient management is applicable to all lands where plant nutrients and soil amendments are applied.

CONSERVATION MANAGEMENT SYSTEMS. Nutrient management is a component of a conservation management system. It is used in conjunction with crop rotation, residue management, cover or green manure crops, pest management, conservation buffer practices, irrigation water management, waste recycling, and/or other practices needed on a site-specific basis to address natural resource concerns and producer objectives. The major role of nutrient management is to minimize nutrient losses and optimize inputs thus helping protect surface and ground water supplies while maximizing net production and profits.

NUTRIENT MANAGEMENT PLANNING. A nutrient management plan should follow the use of the four R's (Right Rate, Right Source of Nutrients, Right Method of Placement and Right Time of Application). The nutrient management plan is a dynamic tool and must be monitored and adjusted on an annual basis. As a minimum, a nutrient budget for nitrogen, phosphorus, and potassium will be designed that considers all sources of nutrients including but not limited to green manures, legumes, crop residues, compost, animal manures, organic by-products, bio-solids, waste water, organic matter, soil biological activity, commercial fertilizer, irrigation water and other nutrient sources.

Nutrient management components of the conservation plan will include the following information:

- Field maps and soil maps with location of designated sensitive areas,
- Soil inventory with soils information,
- Current and/or planned crop rotation or sequence,
- Phosphorus and Nitrogen Leaching Risk Assessments and wind (WEPS) and water (RUSLE2) erosion loss estimates.
- Phosphorus risk assessment showing low risk for offsite transport of phosphorus site when phosphorus is applied in excess of crop requirement.
- If soil phosphorus levels are increasing a discussion of the risk associated with phosphorus accumulation and a proposed phosphorus drawdown strategy.
- Results of soil, water, plant, and organic materials sample analysis.
- Realistic expected yields.
- Sources of all nutrients to be applied.
- Nutrient rates, form, timing, and application method to meet crop demands and soil quality concerns.

- All enhanced efficiency fertilizer products used.
- NRCS Job Sheets MT-590 must be used in the nutrient management design to meet producer objectives.
- For manure applications location of nearby residences and any identified meteorological (prevailing wind at different times of the year) or topographical influences that may affect the transport of odors to those locations.
- Guidance for implementation, operation, maintenance and recordkeeping.

Soil Survey – Digitized soil survey mapping and associated data is an essential layer that should *always* be utilized with nutrient management design. Soil survey information provides valuable information including such characteristics as soil texture, horizon depth, hydraulic conductivity, drainage class, depth to water table, restrictive features, other physical and chemical properties, soil loss tolerance, and numerous other factors that might affect site potential. SSURGO (Soil Survey Geographic database) is digitized soil mapping that is available for most counties in Montana at: http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Field Risk Assessment

A site-specific assessment of the potential for Phosphorus transport from the field and nitrogen leaching must be completed using the Montana Phosphorus Preliminary Risk Assessment Tool and Montana Preliminary Nitrogen Risk Assessment Tool. If the preliminary assessments for either Nitrogen or Phosphorus indicate a need for assessment then the Montana Phosphorus Risk Assessment and the Montana Nitrogen Risk Assessment Tools must be completed. Copies of each completed index will be attached to this specification.

When the Phosphorus Index (PI) assessment rating is **N/A** OR **LOW**, additional phosphorus or potassium can be applied at rates greater than the crop requirement not to exceed the nitrogen requirement of the succeeding crop. Nitrogen-based phosphorus application plans will be developed such that manure application rates of Nitrogen do not exceed crop and soil needs based on the nutrient budget (see Table 2).

When the Phosphorus Index (PI) assessment rating is MODERATE (**MEDIUM)** additional phosphorus and potassium may be applied at a phosphorus crop requirement for the planned crops in the rotation.

When the Phosphorus Index (PI) assessment rating is **HIGH**, phosphorus-based plans will have manure application rates of phosphorus and potassium that do not exceed phosphorus crop removal rates (see Table 2). Also, a soil phosphorus drawdown strategy must be implemented and a site assessment for nutrients and soil loss must be completed to determine if mitigation practices are required to protect water quality. Any deviation from these high risk requirements requires approval from the Chief of the NRCS.

When the Phosphorus Index (PI) assessment rating is **VERY HIGH**, no application of manure will be recommended until a site assessment for nutrients and soil loss is completed to determine if mitigation practices are required to protect water quality. A soil phosphorus drawdown strategy must also be implemented. Phosphorus-based plans will have manure application rates of phosphorus that do not exceed crop removal rates (see Table 2). Any deviation from these high risk requirements requires approval from the Chief of the NRCS.

Expected Yield

Use the producers crop yield records (i.e., weight slips from the elevator, documented FSA records, etc.) to average the yields obtained over a period of years. Yield estimates will be more accurate with a greater number of years of data. Years of exceptionally poor or exceptionally good yields should be eliminated from the calculation. Add up all the yields and divide by the number of years crops were produced. The expected yield can then be calculated by adding five percent onto the average yield. Five percent is added to figure in a little higher yield to cover those years when conditions are favorable and

to take into account improved varieties and management techniques. County crop yield estimates can be obtained from "Montana Agricultural Statistics", Montana Department of Agriculture and USDA - National Agricultural Statistics Service at www.nass.usda.gov/mt.

Soil Tests

Current soil tests must be used to effectively plan for nutrient application. Current soil tests are those no older than three years. When a first-time nutrient management plan is designed, especially if animal wastes are to be utilized as a source of nutrients, soil tests should be taken the year the plan is developed for the most accurate planning. Due to potential annual variability, Nitrogen should be tested each year a crop is grown. Phosphorus and potassium may be completed once every three years until a baseline or consistent database is established. Application of micro-nutrients should be based on soil tests or plant analysis.

As a minimum, sample analysis must include NO_3 (Nitrate), Phosphorus (Olsen Method), Potassium, Organic Matter (OM), pH, and Electro-Conductivity (EC) for the 0" - 6" sample for annual crops and 0" - 12" for pasture and hayland. A sample to test for NO_3 (Nitrate) should be taken at the 6" - 24" depth for annual crops. Deeper samples (36" - 48", or as deep as possible) should be taken when there is a potential for nitrogen leaching.

Soil test analyses must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP) under the auspices of the Soil Science Society of America (SSSA) and NRCS, or other NRCS-approved program that considers laboratory performance and proficiency to assure accuracy of soil test results. The list of current accredited soil labs can be found at: http://www.naptprogram.org/pap.

Regular testing of soil nutrient availability is essential for proper nutrient management decision making. Soil tests should be completed as close as possible to the time of seeding.

$$\frac{\text{Soil sample depth (in.)}}{\text{6 (inches)}} \times 2 \times _____ \text{ ppm} = \text{pounds/acre } NO_3$$

Where two soil samples are taken and analyzed at different depths, i.e., at 0"- 6" and at 6"- 24", calculate pounds of nitrogen using the above formula for each sample depth and add the results.

For example: Soil was sampled at two different depths to get a better representation of nutrient concentrations. Results were:

Sample 1: 0" - 6" 32 ppm NO_3

Calculations – Sample 1. $\frac{6"}{6"} \times 2 \times 32 \text{ ppm} = 64 \text{ pounds/acre } NO_3$

Sample 2: 6" - 24" 8 ppm NO_3

Nitrate Rate – Sample 2. $\frac{18"}{6"} \times 2 \times 8 \text{ ppm} = 48 \text{ pounds/acre } NO_3$

64 + 48 = 112 pounds/acre NO_3

Nutrient Application Timing

Apply nutrients as close to time of utilization as possible. This will ensure that potential for leaching, runoff, or volatilization will be minimized. Nitrogen application in the fall is not recommended except for fall seeded crops, with the exception of "starter fertilizer" or pasture or seed production fields.

GENERAL NUTRIENT MANAGEMENT CONSIDERATIONS

- When organic matter mineralizes nitrogen is released into the soil for potential plant uptake. The Montana fertilizer guidelines assume an average organic matter level of two percent. This is directly incorporated into the available nitrogen requirements. For soils with organic matter levels that exceed two percent, additional nitrogen will be released to the soil through mineralization at a rate of 15-20 pounds of nitrogen per acre for each one percent of organic matter. Therefore, for nutrient budgeting purposes, Nitrogen fertilizer rates can be decreased by 15-20 pounds of nitrogen per acre, if the soil has three percent organic matter or more, assuming moisture and heat conditions are adequate (limits: dry land crops maximum 30 pounds; irrigated crops maximum of 60 pounds).

- Where annual precipitation is less than 14 inches, zero pounds of nitrate nitrogen credit for mineralization should be assigned.

- Leaving crop residue on the soil requires additional nitrogen due to microbial activity “tying up” some nitrogen especially when adding high-carbon organic residues. As a rule, approximately 10 pounds of nitrogen for every 1,000 pounds of residue over 3,000 pounds (up to a total of 40 lbs/N/a) should be added to offset this tie-up if nitrogen is broadcast.

- Soil organic matter, soil health and the amount of available nutrients to growing crops can be improved by increasing crop residue, adding crop diversity in the rotation and managing the carbon to nitrogen ratio.

- Estimates of N benefits (nitrogen credits) following legumes grown the previous year can be estimated based on research in Montana. For annual legume crops such as chickpea, lentil and peas, the N benefits averages about 10 pounds per acre and varies from 0-20 pounds per acre. For perennial legumes such as alfalfa or sweet clover nitrogen needs can be reduced by 35-50 pounds per acre. Actual nitrogen fixation rates and nitrogen credits can vary widely due to climate, soil, management, temperature, biomass and other factors. Taking soil tests as close as possible to the time of planting provides the most accurate analysis of soil nitrogen.

- If an irrigation water test has been completed, use Table 1. “Nitrogen Contribution from Irrigation Water”, to determine the total pounds of nitrogen supplied from water.

- Test soil, plants, water and organic material for nutrient content.

- Set realistic yield goals.

- Apply nutrients according to soil test analysis and Montana State University “Fertilizer Guidelines for Montana Crops” EB161 March 2005 guidelines.

- Account for nutrient credits from all sources.

- Consider effects of drought or excess moisture on quantities of available nutrients.

- Use cover and green manure crops where possible to recover or retain residual nitrogen and other nutrients between cropping periods.

- Apply nutrients as close to time of optimum nutrient uptake as possible.

- Use split applications of nitrogen fertilizer for greater nutrient efficiency.

- Inject or incorporate nutrients for greater nutrient efficiency.

- Use slow and controlled release fertilizers to minimize leaching of nitrogen fertilizer.

- Use nitrification and urease inhibitor fertilizers to minimize loss from volatilization.

- Use enhanced efficiency release fertilizers to reduce nutrient losses and increase nutrient availability.

NUTRIENT MANAGEMENT ASSESSMENT

Within an area designated as having impaired or protected natural resources (soil, water, air, plants, and animals), the nutrient management plan should include an assessment of the potential risk for nitrogen and phosphorus to contribute to water quality impairment. The Montana impaired water body list is located at http://cwaic.mt.gov/faq.aspx and lists streams impaired by specific causes. If a stream is impaired for phosphorus and/or nitrogen then the appropriate assessment must be run. The 303d impaired watershed list is generally updated on a two-year basis so the most current list should be used.

A site-specific environmental assessment must be done using the Montana Preliminary Screening Tool for nitrogen and for phosphorus and if indicated by the preliminary tools, the Phosphorus and/or Nitrogen Risk Assessment Tool(s) must be completed. Refer to “Montana Phosphorus Risk Assessment”, Montana Agronomy Technical Note 77 (Rev. 4), May 2013 and “Montana Nitrogen Risk Assessment”, Montana Agronomy Technical Note 91, May 2013. The Conservation Management Unit (CMU) is the basis for the risk assessment; all acreage in the CMU must have similar soil type, cropping history and management practice treatment. Erosion prediction models for water (RUSLE2) and wind (WEPS) should be used to assess potential of offsite transport of nutrients.

Evaluate all other areas having the potential for high levels of nutrients, produced or applied, that may contribute to environmental degradation. For example, areas with high livestock concentrations or large areas of high intensity cropping, such as continuous potatoes, corn, or specialty crops, may be contributing heavy nutrient loads to surface or groundwater.

Conservation practices and management techniques should be implemented with nutrient management to mitigate any unacceptable risks.

MANURE MANAGEMENT PLANNING

Application Rates

Nutrient application rates must be planned based on Montana NRCS phosphorus and nitrogen risk assessment results (see Table 2).

Solid and liquid manure applications will be based on *at least* one analysis of the material during the time it is to be used. In the case of daily spreading, the waste shall be sampled and analyzed at least once each year. Organic nutrients tested at different times of the year may vary in nutrient content due to changes in bedding, feed, amounts of water entering a storage facility, or degradation. Manure sampling techniques must be completed so representative analyses are determined. To minimize variation, samples should be collected and analyzed as near to the application period as possible.

Manure analysis at a minimum must include total nitrogen (as N), ammonium nitrogen (as NH_4-N), total phosphorus (as P_2O_5), total potassium (as K_2O), and percent dry matter (solids). Except for percent dry matter, the results of the analysis must be expressed as pounds per 1,000 gallons for liquid wastes and pounds per ton for solid manure.

The determination of application rates based on plant nutrient needs is the primary consideration when planning organic nutrient utilization. Base organic nutrient application rates on nitrogen or phosphorus (excessive or deficient) for non-legume crops, grass hayland and grass pasture. Base organic nutrient application rates on phosphorus or potassium for planned legumes. In nutrient sensitive areas, base nutrients on sensitive N, P, or K.

NRCS Job Sheet MT-590 must be used in the nutrient management design to meet producer objectives.

Where agricultural wastes are to be spread on land not owned or controlled by the producer, the waste management plan, as a minimum, shall document the amount of waste to be transferred and who will be responsible for the environmentally acceptable use of the waste.

Records of the use of wastes shall be kept a minimum of five years.

Soil Conditions

Soil salts (specifically salinity) may rise in areas receiving long-term applications of manure due to the inherent salt content naturally present in wastes. Reduce application rates or rotate field applications prior to salinity levels reaching four millimhos per centimeter (mmhos/cm).

Vegetation

Ensure timing, quantity and distribution of waste applications do not cause ammonia burn, salt damage, crown damage, or stand suffocation to establish crops and forages.

Water Quality

The Montana Water Quality Act, Section 75-5-605 of the Act states "It is unlawful to cause pollution of any state waters or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any state waters...." See the Montana Supplement in the Agricultural Waste Management Field Handbook (AWMFH), Chapter 1 "Rules and Regulations".

Wastes should be spread in a manner that prevents runoff of the wastes during application. Base the application rate of liquid wastes on soil infiltration rates so as not to exceed the amount of water needed to bring soil moisture content to field capacity within the rooting zone at the time of application. The actual rate shall be adjusted during application to avoid ponding or runoff. Stop applications if runoff or ponding is observed. Procedures for determining inches per hour rates for irrigated liquid manure are found in the AWMFH, Chapter 11.

Application Equipment

Evaluate equipment to determine the capacity to regulate varying application rates. For example, utilizing an applicator that can only be adjusted in units of 1,000 is not appropriate for a design that calls for 3,400 gallons/acre. Do not design a system calling for numerous rates unless and until variable rate manure application equipment is available to the producer. Do not design a system for a low application rate that the applicator is not capable of delivering. For example, designing a system calling for a different rate on each of 15 fields would require numerous calibrations, calculations, and documentation.

Location

*Do **not** apply organic nutrients:*

1. Within 100 feet to any down-gradient surface waters, open tile line intake structures, sinkholes, agricultural well heads, or other conduits to surface waters.

2. To established grassed waterways, ditches, or other water conveyance system.

3. To fields with predicted water erosion rates greater than 5 T/A/Y (RUSLE).

4. Where a minimum separation distance of 15 inches cannot be maintained between injected, incorporated, or unincorporated manure and fractured bedrock.

NOTE: With a 35-foot wide vegetated buffer where applications of manure, litter, or process wastewater are prohibited, nutrients can be applied up to 36 feet of state waters.

Timing

Fall applications of manure on coarse textured soils are not allowed. Delay fall applications on coarse-textured soils until daily average soil temperatures at a 6-inch depth are below 50 degrees F.

Inject or incorporate during periods of the year when the water table is greater than 20 inches from the soil surface.

Apply in the morning to minimize odor if applications on warm days are necessary.

Avoid compaction on medium and fine textured soils by applying when soil moisture content is significantly less than field capacity (field is in a good tillable condition).

PRECISION AGRICULTURE

The following components are required of a precision / variable rate Nutrient Management Plan:

Method of zone development (aerial imagery, NDVI, EC monitoring, grid soil sampling, etc.)

Geo-referenced field boundary and analyzed GIS layer(s) data used to generate nutrient or soil amendment recommendations.

The nutrient recommendation guidance and recommendation equations used to convert the GIS base data layer(s) to a nutrient source material recommendation GIS layer or layers.

Nutrient Budget (Job Sheet MT-590 or similar form) for each nutrient variably applied is required in the design of the precision agricultural nutrient management plan. When real time variable nutrient application is practiced, pre-application map, target rate, and as-applied rate maps are required to document budget process (the NRCS budget form is not required).

Application records for each management zone or “as applied map” within individual field boundaries (or electronic records) will document the source, timing, method, and rate of all applications.

A digitized yield map (when required). A yield monitoring system must include: GPS location during harvest, grain flow sensor, moisture sensor, speed sensor, header position and data output memory card. Digitized yield monitoring is critical in effectively designing precision agriculture nutrient management prescriptions, and should be collected annually and incorporated as a data layer for following year prescriptions. All yield monitors must be calibrated annually according to the manufacturer’s specification.

Electronic records of the GIS data layers and nutrient applications must be maintained for at least five years.

Nutrient Management Zones

Initial delineations of nutrient management zones can be determined using any one, or a combination of the following methods:

Digital soil survey data should always be used as a layer, and if possible, digital yield data from previous years should be utilized for delineation of zones. Soil sampling may be completed prior to establishment of the zones or after zone establishment to develop nutrient budgets. Note that if sampling is completed post zone establishment, it may be necessary to adjust zones dependent on sample analysis.

Multi-spectral **satellite imagery or aerial ortho-photography** with a spatial resolution no greater than 30 meters, and at a minimum spectral data from the red and near-infrared bands. Aerial ortho-photography should have a spatial resolution no greater than five meters and must be displayed as natural color or color infrared. In all cases, the vintage (date) and source of the photography utilized must be provided.

Grid Soil Sampling – involves dividing a field into equal square or rectangular sections (grids) of several acres in size. Collect one soil test (one from 0” - 6” and one from 6” - 24”) per four acres on fields of less than 50 acres in size or one soil test per five acres on fields greater than 50 acres. Management zones should then be determined based on an interpretation of measurable differences in nutrient status within the management unit, in addition to other layers utilized, i.e., previous years yield data, digitized scouting reports, soil survey layers, etc. Additional soil testing is not required after zones are established.

Electro-Conductivity (EC) – monitoring management zones should then be determined based on an interpretation of measurable differences in soil properties (soil texture, structure, organic matter, drainage, topsoil depth, soil water contents, and other soil characteristics) within the management unit along with layers of other applicable digital data, i.e., digitized yield data, scouting reports, soil survey layers, etc.
Soil sampling is required to correlate EC readings prior to setting the zones and application rates.

Land-Based Optical Sensing – is a form of utilizing vegetative indices to optically scan the growing crop in real time and respond to variability. Where this type of precision agriculture is practiced, soil sampling may not be necessary to establish zones; however, it is still recommended that at least a bulk sample be analyzed. Where required, establish calibration according to manufacturer's or land grant university recommendations. Soil sampling within the primary management zones should be completed after harvest to validate nutrient applications and prepare for the following year’s crop(s).

Apply Nutrients – After the zone map is developed, and soil samples are collected and soil analysis obtained, apply nutrients using variable rate application. This requires the use of GPS-guided application equipment capable of interpreting digital management zone information. A minimum of three application rates is typically implemented; high, medium, and low nutrient quantities based on realistic yield goals and cost.

ADVANCED NUTRIENT MANAGEMENT

Enhanced Nutrient Management is the development and implementation of a Nutrient Management Plan (NMP) that stresses the use of the four R’s. This requires use of multiple nutrient concentration tests, spectral analysis or other techniques to reduce potential of leaching, runoff or volatilization of nutrients and requires more than just routine soil tests. Phosphorus and Nitrogen Risk Assessment Tools must be completed for all fields, This information is used to apply any or all of the following: slow or controlled release fertilizers, nitrification or urease inhibitors, nutrient enhancement technologies, incorporation, injection, split application of fertilizers and other technologies that increase nutrient efficiency, minimize potential of surface and groundwater contamination, protect air quality and maintains or improves physical, chemical and biological condition of soil.

Resource concerns must be identified and NMP must address potential for offsite nutrient transport and provide mitigation as necessary.

ORGANIC MANAGEMENT SYSTEMS

Nutrient management is a component of an organic conservation management system. Healthy soil is essential to successful organic crop production systems. Organic soil management techniques build organic matter and humus, protect the soil from erosion, reduce nutrient loss, and maintain soil in a condition that supports diverse life forms. Crop rotations that include a wide range of diverse crops and manage the crop and soil carbon to nitrogen ratio are an essential component in fertility management and long-term sustainability. Organic management systems must comply with all applicable standards in the National Organic Program (NOP) Rule and all rules of certification body.

Nutrients to meet both the needs of the crop and organic certification standards may be supplied by several management tools or techniques:

MANURE OR ORGANIC BY-PRODUCTS

- Composting may be necessary for a specific period of time before application on organic fields (check with certification body for specific requirements). Raw animal manure must not be applied to

land that is used to grow food for human consumption unless it is incorporated not less than 90 days for above-ground crops and 120 days for below-ground crops.

- Composted plant and animal materials must be produced following a process that meets certification requirements.

COVER CROPS / GREEN MANURE

- Grown primarily for purposes to add nutrients and organic matter, increase organic matter, improve soil microbial activity and help manage weeds.

- A harvested grain legume can add about 0 to 20 lbs of Nitrogen/acre, an annual legume green manure can provide about 5 to 40 lbs of N/acre, and a perennial or biennial legume can provide up to 40 lbs N/acre for the next crop.

- Terminating cover or green manure crops early preserves moisture for the following crops but reduces accumulation of soil organic matter and N. The effect on the succeeding crop yield should be balanced with the long term soil health benefits.

- Effective in controlling erosion, adding organic matter, improving soil structure, stimulating biological activity in the soil and reducing compaction.

- Breaks insect and disease cycles and provides a habitat for pollinators, parasitic wasps, and other beneficial organisms.

- Many field crops and forages can be used as cover crops or green manure (see Field Office Technical Guide (FOTG), Section IV, Cover Crop (Code 340) for species and seeding rates.

GUIDELINES FOR OPERATION AND MAINTENANCE FOR NUTRIENT MANAGEMENT

- Conduct periodic plan reviews to determine if adjustments or modifications to the plan are needed. At a minimum, plans must be reviewed and revised, as needed with each soil test cycle, changes in manure volume or analysis, crops, or crop management.

- Fields receiving animal manures and/or bio-solids must be monitored for the accumulation of heavy metals and phosphorus in accordance with land- grant university guidance and State law.

- Significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

- Calibrate application equipment to ensure accurate distribution of material at planned rates.

- Protect nutrient storage areas from weather to minimize runoff and leakage.

- Avoid unnecessary exposure to fertilizer and organic waste, and wear protective clothing when necessary, clean up residual material and dispose of properly.

- Observe setbacks required for nutrient applications adjacent to water bodies, sinkholes, wells, gullies, ditches, drainages, and other sensitive areas.

- Updated wind or water (WEPS or RUSLE2) erosion prediction losses, Phosphorus and Nitrogen Risk Assessment (as needed).

- Documentation and review of mitigation practices implemented.

- Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation for the change.

- Records must be maintained for at least five years to document plan implementation and maintenance. As applicable, records include:

  - soil, plant tissue, water, manure, and organic by-product analyses resulting in recommendations for nutrient application

  - quantities, analyses and sources of nutrients applied,

  - dates, and method(s) of nutrient applications, source of nutrients, and rates of application,

  - weather conditions and soil moisture at the time of application; lapsed time to manure incorporation; rainfall or irrigation event,

  - crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and crop residues removed,

  - dates of plan review, name of reviewer, and recommended changes resulting from the review, and

  - all enhanced efficiency fertilizer products used.

Additional records for precision/variable rate sites must include:

- methods of development of nutrient management zones for variable rate application of nutrient and with maps and dates of aerial imagery.

- maps identifying the variable application source, timing, amount, and placement of all plant nutrients applied, and

- GPS-based yield maps for crops where yields can be digitally collected (when required).

TABLE 1. NITROGEN CONTRIBUTION FROM IRRIGATION WATER

Water Application Rate (Acre-Feet)

NITROGEN IN WATER (PPM)	0.5	1.0	1.5
	(POUNDS/NITROGEN/ACRE)		
2	3	5	8
4	5	11	16
6	8	16	24
8	11	22	32
10	13	27	40

TABLE 2. PHOSPHORUS APPLICATION BASED ON PI

PHOSPHORUS RISK RATING	PHOSPHORUS APPLICATION
Low Risk	Nitrogen Based
Moderate or Medium Risk	Phosphorus requirement for planned crops in the rotation
High Risk *	Phosphorus Based (up to crop removal amounts)*
Very High Risk *	No application*

*****Site assessments for N, P and soil loss must be completed to determine if mitigation practices are required and a soil phosphorus drawdown strategy must be implemented.

REFERENCES

Department of Land Resources and Environmental Sciences, Montana State University Extension Service Soil Nutrient Management on Organic Grain Farms in Montana. Kathrin Olson-Rutz, Clain Jones, Perry Miller. EB0200 October 2010.

Montana Department of Agriculture, Organic Certification Program, Policy Manual, Oct. 2011(or most current) http://agr.mt.gov/agr/Programs/Organic/index.html.

Montana State University Extension Service, MontGuide MT2011AG, “Crop and Fertilizer Practices to Minimize Nitrate Leaching”, January 2011.

Montana State University Extension Service, MontGuide EB0182, “Nutrient Management in No-Till and Minimum till Systems, May 2008.

Montana State University Extension Service, MontGuide MT2008AG “Soil Sampling Strategies” April 2008.

Montana State University Extension Service, Bulletin EB 161 “Fertilizer Guidelines For Montana Crops”, March 2005.Moyer, Jeff and Rodale Institute, Organic No-Till Farming Advancing No-Till agriculture, Crops, Soil, Equipment. 2011.National Organic Program, Organic regulations and program handbook, http://www.ams.usda.gov/AMSv1.0/nop

U.S. Department of Agriculture, Natural Resources Conservation Service. 2010. Agronomy Technical Note, (TN) 190-AGR-3, Precision Nutrient Management Planning. Washington, DC.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2011. Title 190, General Manual, (GM), Part 402, Nutrient Management. Washington, DC.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2011, Title 190, National Instruction (NI), Part 302, Nutrient Management Policy Implementation. Washington, DC.

U.S. Department of Agriculture, Natural Resources Conservation Service, National Engineering Handbook, Agricultural Waste Management Field Handbook, Part 651, Chapters 1, 4, 6, 11, and 16.