Chapter 1

Agricultural Nutrient Management Law & Regulations

Skill Sheets

Agricultural Nutrient Management Laws & Regulations

True or False.

__F__ Farm operators who have 80 or more animal units do not need a nutrient management plan.

__T__ Farmers who gross $2,500 or more per year need a nutrient management plan.

__F__ Anyone can write a nutrient management plan as long as they read the training materials.

__F__ Continuing nutrient management education requirements are waived for certified farm operators who have a college degree.

__T__ A nutrient application voucher allows an operator to fertilize the acreage he/she manages.

__F__ Certified farm operators can write plans for others with similar farms.

Agricultural Nutrient Management and the Environment

True or False.

F Nutrient management's purpose is to simultaneously maximize farm profits and environmental harm.

F Fecal organisms only come from farm sources.

T Excessive nutrients in the State's waters can cause algal blooms.

F Karst topography is less likely to have adverse effects to water quality due to nutrient application.

T Water in streams and rivers can originate from both surface and underground sources.

T Rain that falls on the ground can cause soil erosion and nutrient runoff.

Agricultural Nutrient Management Plans, Records and Enforcement

True or False.

F The best time to write a plan is after you have planted and fertilized a field.

F A plan can ignore all pastures and any field smaller than 10 acres.

T A plan can be good for 1-3 years, depending upon the crop.

F Once a plan is written for a cropping year, it cannot be changed.

T Soil tests can be used for up to 3 years.

T A current yield goal is based on past crop performance for that field.

F Records for nutrient management purposes must include the field name and rate of lime application.

T The Annual Implementation Report is required to be filed every year by March 1.

T Only the first plan written for an operation is filed with MDA.

F An NM Specialist will fine you the first time he finds a violation during the implementation review.

Chapter 2

Data Collection Skill Sheets

Data Collection

Of the following features, check those that are required to be included in a nutrient management plan for each property that the operator farms.

- ☑ map
- ☐ photograph
- ☑ watershed location code number
- ☑ tax account ID number
- ☐ directions to farm
- ☐ number of years the operator has farmed the property

Tax Account ID Numbers

Which of the following statements are true concerning the characteristics, sources, and uses of tax account ID numbers in Maryland nutrient management plans?

T___A tax account ID number may have up to 16 digits and starts with a two-digit county code.

T___Tax account ID numbers can be found in a variety of places including:

- on the landowner's county tax bill;
- at the local (county) office of the Maryland Department of Assessment & Taxation (DAT) or on the DAT website; or
- a regional MDA office.

T___Tax account ID numbers are used by MDA officials to check for compliance with the Water Quality Improvement Act of 1998's Nutrient Management Regulations.

Farm Map

Check the features that must be shown or labeled on the farm map.

- [x] Field boundaries
- [x] property boundary
- [x] streams and ponds
- [x] road name that shows the approximate location of the farm
- [x] unique field identifiers (numbers or names)
- [x] acreage of each field
- [x] unimproved pastures
- [ ] outbuilding(s)
- [ ] residence(s)

Field Information

Check the features of each management unit that must be included in a nutrient management plan.

- [x] Farm identifier
- [x] unique field identifier
- [ ] distance to nearest road
- [x] crop
- [x] yield goal
- [x] dominant soil map unit (P risk assessment, soil texture)
- [x] nitrogen credits from previous legume crop, or past manure or biosolid applications
- [ ] location of outbuildings
- [x] tillage method
- [x] acres in field

Chapter 3

Soil Sampling and Testing Skill Sheets

Management Units

Which of the following criteria are necessary to define an area as a management unit?

- ☑ The area in question should have a similar complex of soils.
- ☑ The area in question should have been managed similarly in the past (same crops planted and same fertility regimes).
- ☑ A producer intends to manage the given area similarly during the planning period.
- ☐ The area in question should not be divided by surface water (stream, drainage ditch, etc.)
- ☐ The areas under consideration should have the same account ID number.
- ☐ The area in question should be on the same side of any state or county road.

Technique

Proper soil sampling technique involves which of the following?

- ☐ collecting 2-3 shovels full of soil per management unit
- ☑ collecting 15-20 samples per management unit
- ☐ making sure to sample unusual areas such as wet spots and areas around limestone outcrops
- ☑ collecting samples at a depth of 8 inches
- ☑ mixing the soil well before sending a sub-sample off to the soil lab of your choice
- ☐ drying the soil sample in a metal pan for 1 week (or a microwave to speed the process) before shipping it to the soil lab of your choice
- ☑ allowing the sample to air dry prior to shipping it off to the soil lab of your choice

Converting to FIV Scale

A soil test report from A&L Laboratory (using Melich-3 extraction) contains the following data:

Phosphorus, P	60 ppm
Potassium, K	98 ppm
Calcium, Ca	1600 ppm
Magnesium, Mg	120 ppm

Convert these values to the Maryland FIV scale.

Worksheet 3-1*
Converting to Maryland Fertility Index Values (FIVs)

Farm _____ Field Skill sheet

Laboratory A & L (Mehlich-3)

Phosphorus (P)		**Potassium (K)**	
Reported analysis for P	60	Reported analysis for K	98
	X		X
Value in P column A - See SFM-4, Table 2	1.09	Value in K column A - See SFM-4, Table 2	0.65
	+		+
Value in P column B - See SFM-4, Table 2	2	Value in K column B - See SFM-4, Table 2	-2
	=		=
Maryland FIV-P	67	Maryland FIV-K	62

Calcium (Ca)		**Magnesium (Mg)**	
Reported analysis for Ca	1600	Reported analysis for Mg	120
	X		X
Value in Ca column A - See SFM-4, Table 2	0.13	Value in Mg column A - See SFM-4, Table 2	0.76
	+		+
Value in Ca column B - See SFM-4, Table 2	-27	Value in Mg column B - See SFM-4, Table 2	3
	=		=
Maryland FIV-Ca	181	Maryland FIV-Mg	94

Or another way

- Lab value x Column A value + column B value = FIV

- (60 ppm P x 1.09) + 2 = 67 FIV-P
- (98 ppm K x 0.65) + (-2) = 62 FIV-K
- (1600 ppm Ca x 0.13) + (-27) = 181 FIV-Ca
- (120 ppm Mg x 0.76) + 3 = 94 FIV-Mg

Chapter 4

Manure Sampling and Testing Skill Sheets

Sampling Principles and Available Nitrogen

Indicate whether each of the following is True or False.

__F__ Manure samples should be taken from piles in pastured areas.

__F__ A hand-full of manure from one spot in a storage pile is an adequate sample to send for manure analysis

__F__ It is always appropriate to use average manure analyses to complete a Nutrient Management Plan.

__F__ The process by which ammonium (NH_4^+) can be lost to the atmosphere when manure is left on the soil surface is known as mineralization.

Estimating Plant Available Nitrogen

What is the Plant Available Nitrogen (PAN) in pounds per ton of a chicken (broiler) litter whose analysis is shown below if the manure is incorporated within 48 hours by light disking?

ABC AG LAB

(301) 555-5555

17 Farm Drive
Smithville, MD 20000

MANURE ANALYSIS REPORT
Poultry Litter

Analyte	%
N (Total)	3.05
NH_4-N*	0.59
P_2O_5	2.36
K_2O	2.71

* NH_4-N and NH_4^+ are two commonly used ways of expressing ammonium nitrogen.

Worksheet 4-1*
Estimating PAN in Litter

1. Total nitrogen (N) (%) — 3.05

- Obtain value from manure analysis.

2. Ammonium nitrogen (NH_4^+) (%) — 0.59

- Obtain value from manure analysis

3. Organic nitrogen (%) — 2.46

- Subtract **#2** from **#1**.

4. Manure mineralization factor — 0.5

- Expressed as a decimal.
- Refer to the *Infocard*.

5. Available organic nitrogen (%) — 1.23

- Multiply **#3** by **#4**.

6. Ammonium conservation factor — 0.82

- Depends upon incorporation practices.
- Refer to *Infocard*.

7. Available ammonium nitrogen (%) — 0.484

- Multiply **#2** by **#6**.

8. PAN in manure (lbs/T or lbs/gal) — 34.28

- Add #7 to #5. Multiply by 20 if manure is solid or semi-solid. Multiply by 0.0837 if manure is liquid.

~34

Manure Quantity Estimation

How much manure is generated by four 1200 lb. horses kept on pasture for 24 hours a day for a three-month period?

Worksheet 4-2 *
Manure Quantity Estimation

Farm name Skill Sheet

Starting Date: 1-1-19 Ending Date: 4/1/19

A. Total days in manure production period: 90

Livestock Information

B. Livestock group	horses
C. Average weight (lbs)	1,200
D. # of animals	4
E. Animal units [(**C** x **D**)/1000]	4.8
F. Full days confined	0
G. Days partially confined	0
H. Hours per day confined	0
I. Day equivalents partially confined (**G** x **H**)/24	0
J. Total day equivalents confined (**F** + **I**)	0
K. Total day equivalents unconfined (**A** – **J**)	90
L. Weight of manure/AU/day (lbs) (**Table 4-1**)	50

Bedding Estimation

M. Bedding type	None
N. Volume of bedding (cu ft.)	
O. Density of bedding (lbs/cu ft.) (**Table 4-2**)	
P. Weight of bedding (tons)	0

Uncollected Manure

Q. Weight of manure on pasture (tons) - [(**E** x **L** x **K**)/2000]	10.8

Collected Solid Waste

R. Weight of collected manure (tons) - [(**E** x **L** x **J**)/2000]	0
S. Weight of collected manure & bedding (tons) - (**P** + **R**)	0

Chapter 5

Recommendations Skill Sheets

Nitrogen

Select the following statements that true.

T Nitrogen (N) recommendations for agronomic crops are based on crop and yield goal.

T To calculate the net nitrogen (N) recommendation for the crop being planned, residual N (N-credits) from recent legume crops, or past manure or biosolids applications must be subtracted from the gross N recommendation.

F Nitrogen (N) recommendations for all crops are based on soil test results as well as type of crop and yield goal.

F N-credits resulting from release of nitrogen by recently grown legume crops are not considered in the determination of how much N fertilizer to apply.

Phosphorus, Potassium, Calcium, and Magnesium

Select the following statements that are true.

T For most crops, the higher the soil test value for available phosphorus or potassium, the lower the recommendation.

T Recommendations for phosphorus and potassium are based on soil test results and crop yield goal.

F Residual phosphorus (P-credits) from past manure or sewage sludge applications must be accounted for when determining the appropriate P_2O_5 application rate.

Phosphorus Restrictions

Select the statements that True.

F If a management unit/block has a FIV-P equal to or greater than 150, phosphorus fertilizer may never again be applied to that field.

T In general, phosphorus restrictions result from a determination that fields or management units with excessive amounts of available phosphorus also have characteristics that allow transport of available phosphorus to nearby waterways.

T The aim of the Phosphorus Management Tool is to identify critical areas where there is a high P loss potential from the site because there is both a large potential for transport of P off the field/management unit and a large source of P present in the soil.

F Management practices are not considered when calculating the P loss rating.

Including Nitrogen Credits in Fertilizer Calculations

Joe Smith raises continuous conventional-till corn on Field 3. His long-term yield is 160 bu/A. Last growing season, he arranged to use some of his neighbor's chicken (broiler) litter on this field. He applied 3 tons of litter per acre. Soil tests indicate that pH is 6.2, FIV-P is 110 and FIV-K is 130.

1) How many pounds of nitrogen credit would be reasonable in this situation for corn grown in the upcoming growing season?
2) 2)What is the net N recommendation for corn grain in the upcoming growing season?

Horse Manure Analysis Information:

3.42% nitrogen (N)

0.63% ammonium nitrogen (NH_4^+)

Note: Two worksheets are required here as 2 questions were asked.

Worksheet 5-1
Manure Nitrogen Credits for Prior Years
Shill Sheet

Farm name _____ Field Corn

		Last Year	2 Years Ago
1.	**Organic Nitrogen**		
3.42	%N - 0.63 %NH_4-N = %Organic N (Last yr.)	2.79	
_____	%N - _____ %NH_4-N = %Organic N (2 yrs. ago)		
	- Values are from manure analysis		
	- If no analyses were performed, use average analyses (See "Manure Summary Report.")		
2.	**Mineralization Rate**	0.15	
	- Refer to *Infocard* for the mineralization rate for the appropriate animal species.		
3.	**Conversion Factor**	20	
	- Factor is 20 if units are lbs/ton.		
	- Factor is 0.0837 if units are lbs/1000 gal.		
4.	**Application Rate**	3	
	- This is amount of manure applied each year.		
	- Enter rate as tons/acre or gallons/acre.		
5.	**Nitrogen Credit (lbs/acre)**	25.1	
	- Multiply **#1** x **#2** x **#3** x **#4**.	~25	

Worksheet 5-2
Nitrogen Recommendation Worksheet for Crop Production Using Manure & Commercial Fertilizer

Field Skill sheet

1. Crop — Corn

2. Gross Crop N Recommendation — 160

- See Appendix for crop nutrient recommendations.

3. N Credits

a) Manure credit (last year) — 25

- See **Worksheet 5-1**.

b) Manure credit (2 years ago) — 0

- See **Worksheet 5-1**.

c) Legume credit — 0

- See ***Infocard***.

4. Total N Credit — 25

- Add **3a** + **3b** + **3c**.

5. Net Crop N Recommendation (lbs/acre) — 135

- Subtract **#4** from **#2**.

Including Nitrogen Credits in Fertilizer Calculations

Joe Smith grows continuous conventional-till corn on Field 3. His long-term yield is 160 bu/ac. Last growing season, he applied chicken litter on this field at a rate of 3 tons per acre. Soil tests indicate that pH is 6.2, FIV-P is 110, and FIV-K is 130. How many pounds of nitrogen credit would be reasonable in this situation for corn grown in the upcoming growing season? What is the net N recommendation for corn grain in the upcoming growing season?

Litter Analysis Information:

3.42% total nitrogen (N)

0.63% ammonium nitrogen (NH_4-N)

Including Nitrogen Credits in Fertilizer Calculations

Worksheet 5-1

Manure Nitrogen Credits for Prior Years

(Credits must be calculated for the 2 previous years)

Farm/Tract_____ **Field** 3 _____

	Last Year	2 Years Ago
1. Organic Nitrogen		
3.42 %N - 0.63 %NH_4-N = %Organic N (Last year)	2.79	
____ %N - ____ %NH_4-N = %Organic N (2 years ago)		

- Values are from the manure analysis.
- If no analyses were performed, use average analyses.
- See "Manure Summary Report" in Chapter 4 for average manure analyses.

2. Mineralization Rate		
- Refer to the *Infocard* for the mineralization rate for the appropriate animal species year (last year or 2 years ago).	0.15	
3. Conversion Factor		
- Conversion factor is 20 if the units are lbs/ton. - Conversion factor is 0.0837 if the units are lbs/1000 gallons.	20	
4. Application Rate		
- This is the amount of manure applied in each year. - Enter the rate as tons/acre or gallons/acre.	3	
5. Nitrogen Credit		
- Expressed as lbs/acre. - Multiply **#1** x **#2** x **#3** x **#4**.	25	

% Organic N X Mineralization Rate X Conversion Factor X Application Rate = N Credit

Including Nitrogen Credits in Fertilizer Calculations

Worksheet 5-2

Nitrogen Recommendation Worksheet for Crop Production Using Manure and Commercial Fertilizer

	Field(s) 3	Field(s)
1. Crop	Corn	
2. Gross Crop N Recommendation - See *Appendix* for crop nutrient recommendations.	160	
3. N Credits		
a) Manure credit from last year - See Worksheet 5-1.	25	
b) Manure credit from 2 years ago - See Worksheet 5-1.	0	
c) Legume credit - See *Infocard*.	0	
4. Total N Credit - Add 3a, 3b, and 3c.	25	
5. Net Crop N Recommendation - Subtract #4 from #2. - Expressed as lbs/acre.	135	

Gross Crop N Recommendation – Total N Credit = Net Crop N Recommendation

Fertilizer and Lime Recommendations

Joe Smith grows pumpkins for his vegetable stand in one of the fields on his farm, which is located in the Piedmont region. Soil tests indicate that the soil texture is silt loam, pH is 6.2, FIV-P is 90 and FIV-K is 75. What are the P, K, and lime recommendations for this crop?

Refer to Appendix B , Section 6 for P & K Recs and Appendix C for Lime Requirement

- If FIV-P is 90, phosphate rec for pumpkins is 30 pounds/acre

- If FIV-K is 75, potash rec for pumpkins is 65 pounds/acre

- If pH is 6.2 for a silt loam soil in the Piedmont region, lime requirement is 1 ton per acre

Lime

From the following list, check the information required for you to correctly determine lime requirement.

- ☑ soil pH
- ☑ target soil pH for crop
- ☐ soil mapping unit
- ☐ county
- ☑ soil texture
- ☑ soil region
- ☐ available soil calcium
- ☐ available soil magnesium

Chapter 6

Compile and Review Skill Sheets

Plan Requirements

In the following list of items, check those that are required components of a completed nutrient management plan.

- ☐ copy of county tax bill
- ☑ operator's name and address
- ☑ County (or counties) in which operation is located
- ☑ date the plan is prepared
- ☑ time period the plan covers
- ☑ source of yield goals
- ☑ limiting nutrient for each field/management unit
- ☑ Best Management Practices information
- ☑ certification number of certified farmer or certified consultant
- ☑ field information sheet(s)
- ☑ manure generation worksheets or manure quantity estimates
- ☑ farm map(s)
- ☐ watershed map
- ☑ manure test results (if applicable)
- ☑ soil test results
- ☑ fertilizer and/or manure recommendation sheet(s)
- ☑ Phosphorus Management Tool (PMT) worksheets (if applicable)

MDA Plan Submission Requirements

In the following list of items, check the required components of a completed nutrient management plan that are submitted to MDA the first time an operator submits his/her plan.

- ☑ MDA Reporting Form
- ☐ copy of field information sheet(s)
- ☐ copies of any lease agreements for rented land
- ☑ copy of all fertilizer and/or manure recommendation sheets
- ☐ copy of Phosphorus Management Tool (PMT) worksheet(s)
- ☐ copy of manure analyses
- ☐ name and address of custom applicator
- ☑ copy of soil test results
- ☑ copy of farm map(s)

Chapter 7

Fertilizer Management and Equipment Calibration

Skill Sheets

Determining the Fertilizer Application Rate

Scenario: The recommendation in his nutrient management plan indicates that Joe Schumacher needs 60 lbs. of nitrogen per acre at greenup for optimum growth of his orchardgrass pasture. Neither phosphorus nor potassium amendments are recommended. Joe wishes to purchase urea to meet the crop's nitrogen needs. What rate of urea (46-0-0) should be applied?

Worksheet 7-1*
Calculating the Quantity of Commercial Fertilizer Required to Meet a Nutrient Recommendation

Crop Orchardgrass

1. Recommended quantity of nutrient (lbs/acre) — 60

- See "Fertilizer Recommendations" page of nutrient management plan.

2. % of nutrient in preferred product — 46%

- Refer to label on product.

3. Nutrient content in preferred product — 0.46

- Expressed as a decimal fraction.
- Multiply **#2** by 0.01.

4. Quantity of preferred product required (lbs/acre) — 130

- Divide **#1** by **#3**.

Fertilizer Application Rate (Row Crop)

Scenario: The recommendation in his nutrient management plan indicates that Joe Schumacher needs 70 lbs. of sidedress nitrogen per acre for optimum growth of his sweet corn. Neither phosphorus nor potassium amendments are recommended. Joe wishes to purchase ammonium sulfate to meet the crop's nitrogen needs. What rate of ammonium sulfate (21-0-0-24S) should be applied?

Worksheet 7-1*
Calculating the Quantity of Commercial Fertilizer Required to Meet a Nutrient Recommendation

Crop sweet corn

1. Recommended quantity of nutrient (lbs/acre) — 70

- See "Fertilizer Recommendations" page of nutrient management plan.

2. % of nutrient in preferred product — 21%

- Refer to label on product.

3. Nutrient content in preferred product — 0.21

- Expressed as a decimal fraction.
- Multiply **#2** by 0.01.

4. Quantity of preferred product required (lbs/acre) — 333

- Divide **#1** by **#3**.

Calibration of Fertilizer Application Equipment (Pasture)

Ed Palmer plans on applying 285 lbs. of ammonium sulfate (21-0-0-24S) per acre for the spring greenup application on his orchardgrass pasture.

Application will be done with a spin-type spreader.

Given the following information, use the weight area method to determine if the spreader is properly calibrated.

Application width = 20 ft.

Length of calibration area = 100 ft.

The amount of fertilizer in the collection container after Ed has driven over the calibration area at his typical gate setting and ground speed is 13 lbs. 4 oz.

How many lbs. of fertilizer per acre is Ed actually spreading? _____

Worksheet 7-2*
Calibrating Fertilizer Application Equipment (Weight-Area Method)

1. Name and fertilizer guarantee of preferred product

ammonium sulfate
21-0-0-24S

2. Recommended application rate of preferred product (lbs/acre)

285 lbs

3. Calibration area

0.046

- Expressed on an acre basis.
- Calibration area (square feet) divided by 43,560.

length x width = area
20 ft. x 100 ft. = 2,000 sq. ft.
2,000 sq ft x $\frac{1\ ac}{43{,}560\ sq\ ft}$ = 0.046 ac

4. Amount of material applied in calibration area

13 lbs 4oz
or 13.25 lbs

- Expressed in gallons or pounds.
- 128 ounces per gallon.
- 16 ounces per pound.

5. Actual application rate

288

- Expressed as lbs/acre or gallons/acre.
- Divide **#4** by **#3**.

Manure Spreader Calibration

Mike Smith's nutrient management plan indicates that he should apply 3 T/ac of chicken litter to his corn in order to meet its nitrogen needs.

The empty weight of his spreader is 4000 lbs. He loads the spreader with chicken litter and weighs it again. The full weight is 16000 lbs. He spreads the load on the field. The area covered is 2200 feet long and 48 feet wide.

What is the current application rate? _____

Worksheet 7-3*
Calibrating a Manure Spreader Using the Weight-Area Method

1. Recommended application rate of manure — 3 T/A

2. Application area — 105,600 sq ft

- Expressed in square feet.
- Multiply length (in feet) x width (in feet).

2200 ft. x 48 ft. = 105,600 sq. ft.

3. Calibration area — 2.42 ac

- Expressed on an acre basis.
- Application area (square feet) divided by 43,560.

$$105{,}600 \text{ sq. ft.} \times \frac{1 \text{ ac}}{43{,}560 \text{ sq ft}} = 2.42 \text{ ac}$$

4. Amount of material applied in calibration area — 6 tons

Full weight – empty weight = amount applied
16000 lbs – 4000 lbs = 12000 lbs

- Expressed in tons or gallons

$$12000 \text{ lbs} \times \frac{1 \text{ ton}}{2000 \text{ lbs}} = 6 \text{ tons}$$

5. Actual application rate — ~2.5 ton/ac

- Expressed in tons or gallons.
- Divide **#4** by **#3**

6 tons ÷ 2.42 ac = 2.48 ton/ac