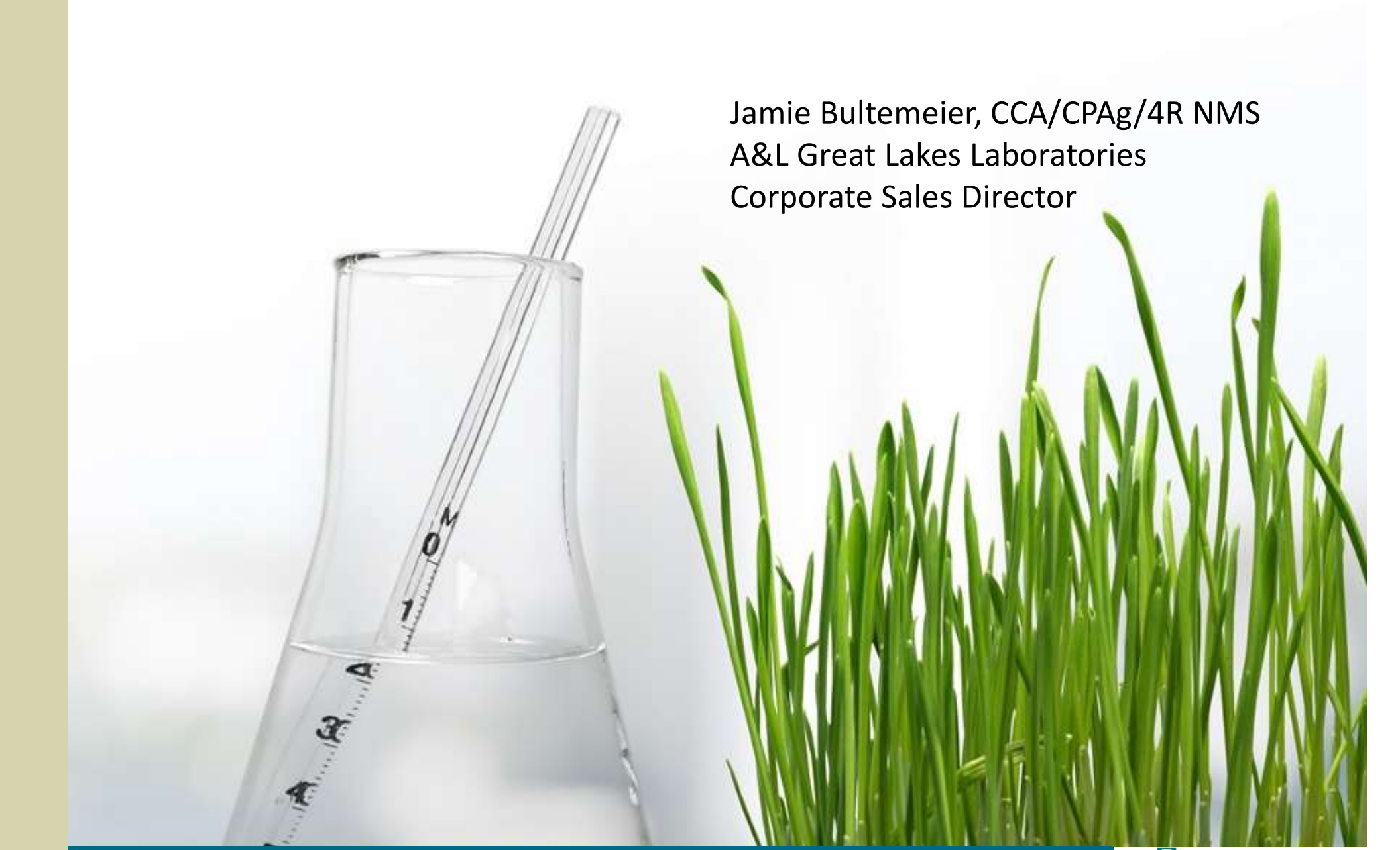
Manure Testing and Characteristics

Jamie Bultemeier, CCA/CPAg/4R NMS
A&L Great Lakes Laboratories
Corporate Sales Director



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William Galloway and his manure spreader around 1905.

Manure Report Basics

Report Number
F19010-6501
Account Number
99990

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To:

For: HOG MANURE

Attn:

Purchase Order:

Lab Number: 14088
Sample ID: TD
Manure Type: SWINE, LIQUID PIT (16)

MANURE ANALYSIS

Date Received: 1/10/2019
Date Reported: 1/11/2019
Page: 1 of 1

Analysis	Unit	Analysis Result (As Received)	Pounds Per 1,000 Gal **	First Year Availability @ Pounds Per 1,000 Gal
Moisture	%	98.62	8215	
Solids	%	1.38	115	
Nitrogen, Total (TKN)	%	0.303	25.2	23.4 *
Nitrogen, Ammonium (NH_4-N)	%	0.270	22.5	22.5 *
Nitrogen, Organic (N)	%	0.033	2.7	0.9 *
Phosphorus (P)	%	0.025	4.8 (as P_2O_5)	4.8 * (as P_2O_5)
Potassium (K)	%	0.253	25.3 (as K_2O)	25.3 * (as K_2O)

@ Estimate of first-year availability does not account for incorporation losses. Consult MWPS-18, "Livestock Waste Facilities Handbook" for additional information.
* Source: MWPS-18, Livestock Waste Facilities Handbook, 1993 # Source: A3411, "Manure Nutrient Credit Worksheet", University of Wisconsin
** Manure density assumed to be 8.33 lb/gallon

Manure Report Basics

Report Number
F19315-6503
Account Number
[redacted]

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To:

Lab Number: 21167
Sample ID: RTL 2019
Manure Type: POULTRY, SOLID WITH LITTER (11)

MANURE ANALYSIS

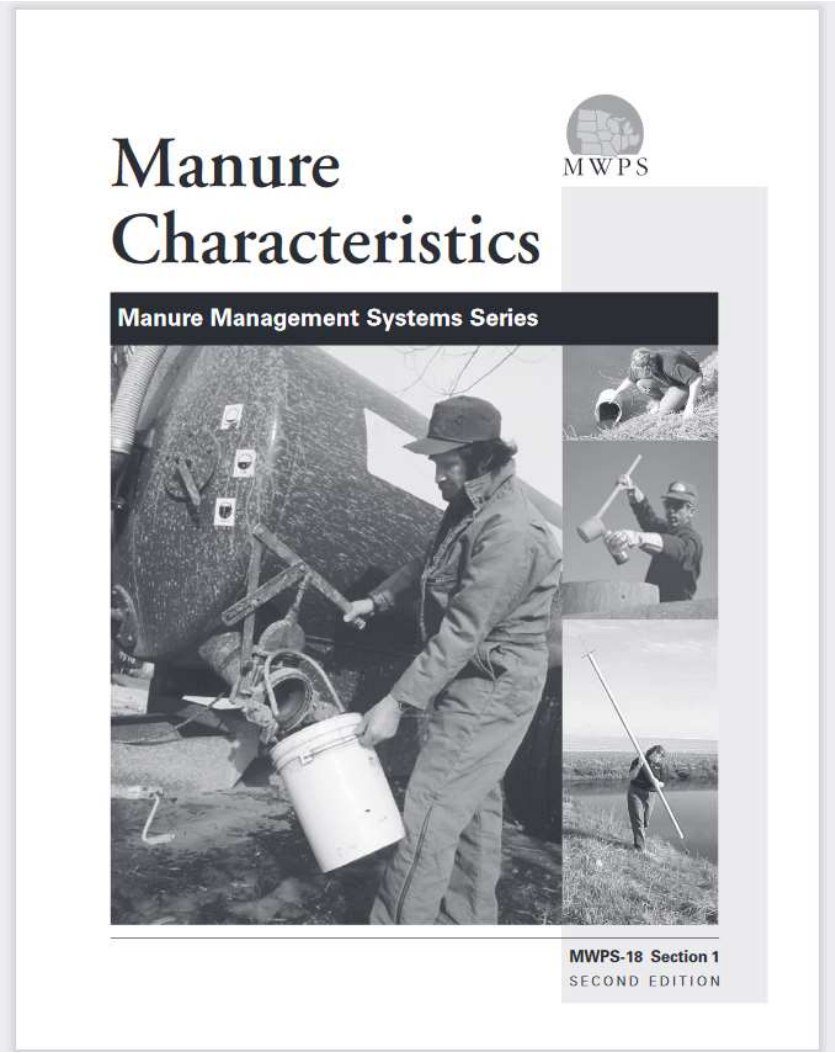
Date Sampled: 11/10/2019
Date Received: 11/11/2019
Date Reported: 11/12/2019 Page: 1 of 2

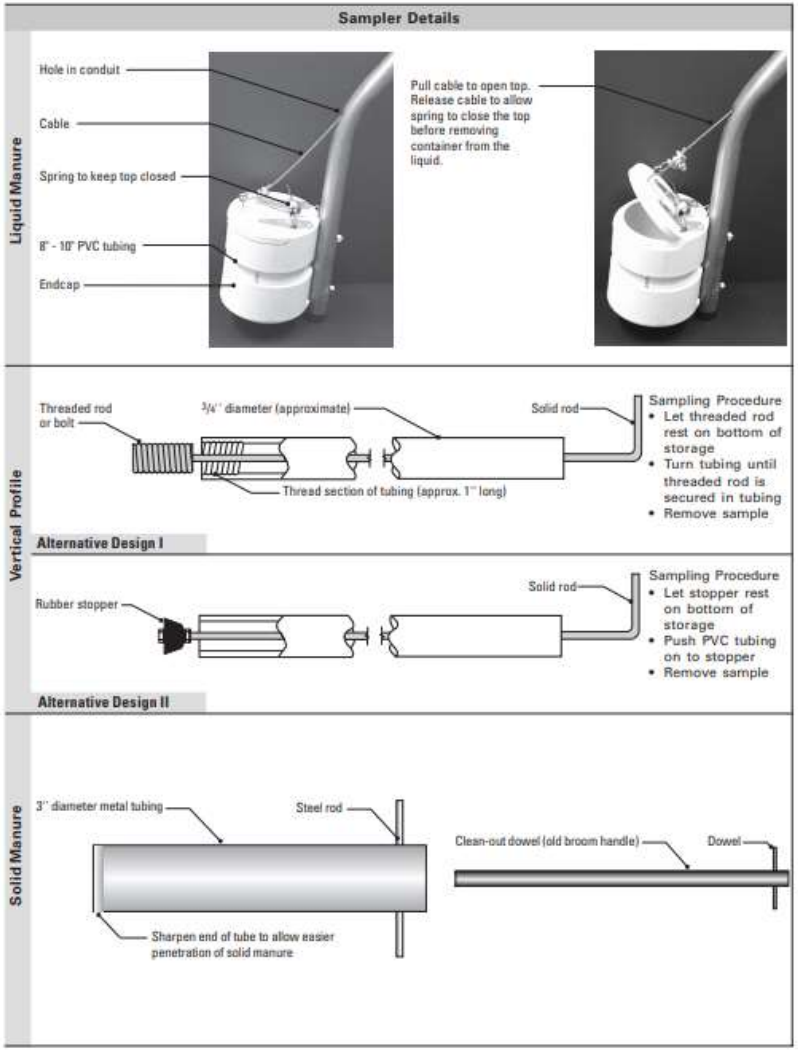
Analysis	Unit	Analysis Result (As Received)	Pounds Per Ton	First Year Availability @ Pounds Per Ton
Moisture	%	33.79	676	
Solids	%	66.21	1324	
Ash @ 550 C	%	31.30	626.1	
Organic Matter (LOI @ 550 C)	%	34.91	698.1	
Organic Carbon (LOI @ 550 C)	%	20.25	404.9	
Carbon:Nitrogen Ratio (C:N)	-	13.7:1		
Nitrogen, Total (TKN)	%	1.478	29.6	18.9 *
Nitrogen, Ammonium (NH_4-N)	%	0.140	2.8	2.8 *
Nitrogen, Organic (N)	%	1.338	26.8	16.1 *
Phosphorus (P)	%	0.671	30.7 (as P_2O_5)	30.7 * (as P_2O_5)
Potassium (K)	%	1.085	26.0 (as K_2O)	26.0 * (as K_2O)
Sulfur (S)	%	0.27	5.5	3.0 #

@ Estimate of first-year availability does not account for incorporation losses. Consult MWPS-18, "Livestock Waste Facilities Handbook" for additional information.
* Source: MWPS-18, Livestock Waste Facilities Handbook, 1993 # Source: A3411, "Manure Nutrient Credit Worksheet", University of Wisconsin

Great Manure Reference

www.canr.msu.edu/uploads/files/ManureCharacteristicsMWPS-18_1.pdf





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Bulk Density of Manure

- Liquid assume to be 8.33 pounds/gal

- Dry manures – Bucket test
  - Fill a 5-gallon bucket and weigh
  - Divide weight by 0.67 to determine pounds/cubic foot

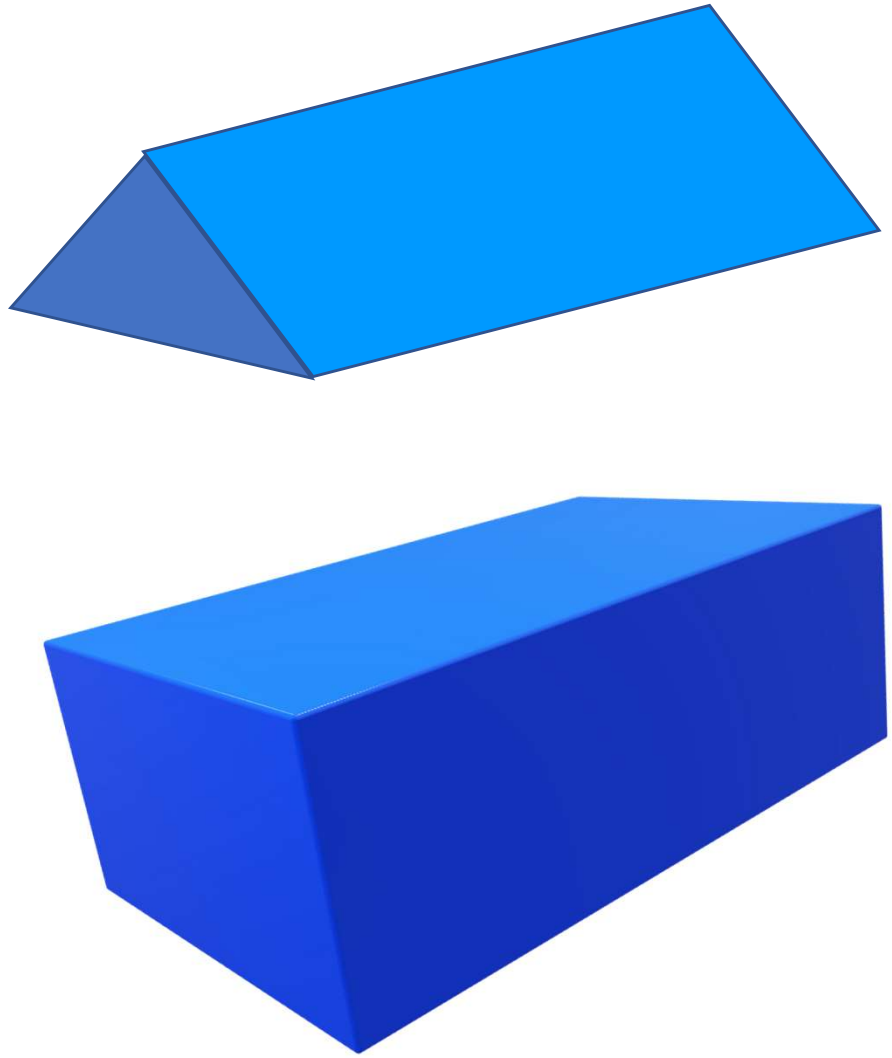
- *V=3.14 x Height x Radius x Radius*
  - 1 cubic ft = 1,728 cubic inches

Volume of spreader

$$\frac{\text{Height x Width x Length}}{2}$$

+

Height x Width x Length



Sources of Nutrients in Manure

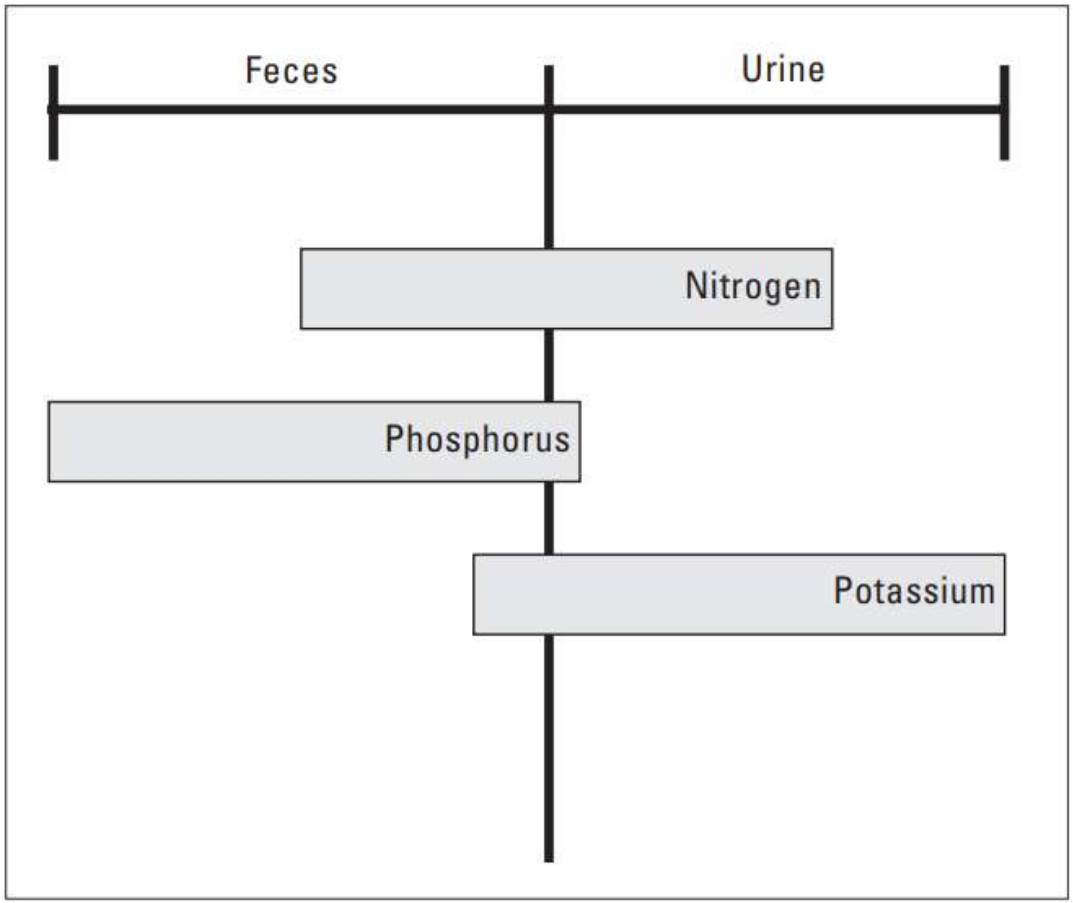
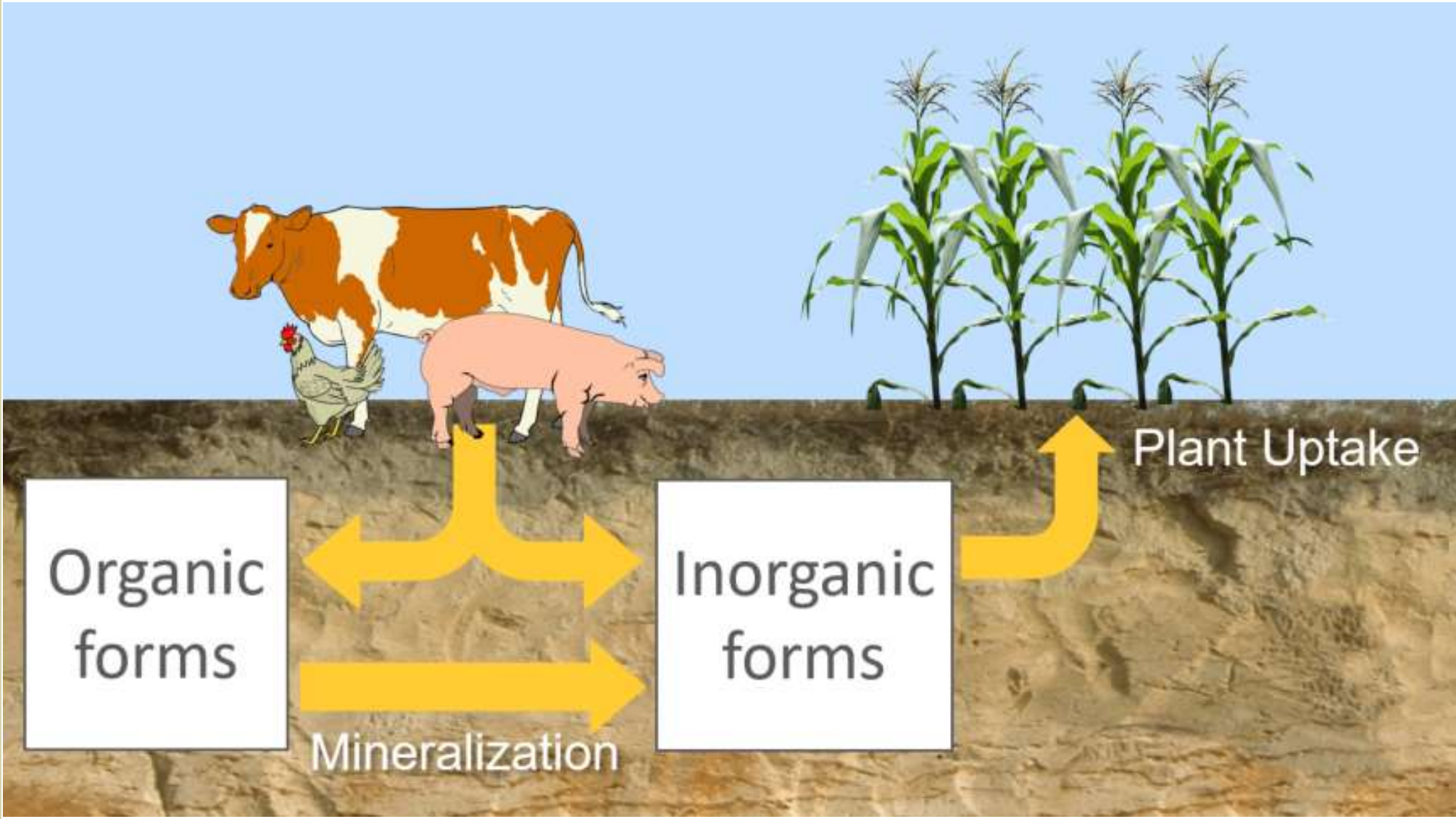


Figure 4. Distribution of nutrients between feces and urine.
Based on NRCS *Agricultural Waste Management Field Handbook,* Part 651.

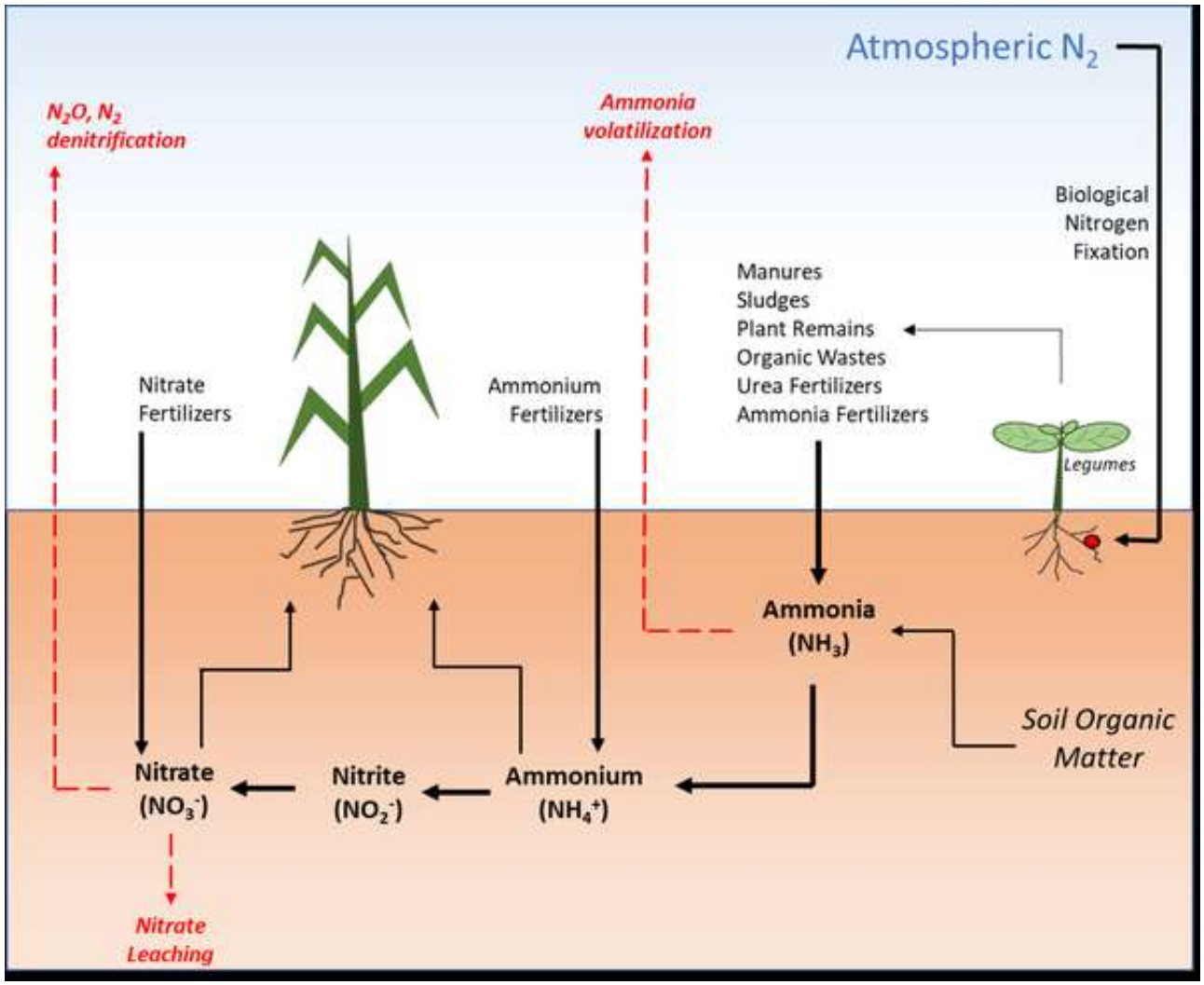
Nutrient forms in Manures

- Nitrogen
  - Organic – solid fraction
  - Ammonia – Odor/unstable/water soluble
  - Ammonium – water soluble
  - Nitrate – water soluble – very small fraction in manure
- Phosphorus
  - Water soluble P – Dissolved in liquid fraction
  - Particulate P – in manure solids (~30% plant available)
- Potassium
  - Water soluble - In the liquid fraction – can leach out of stockpiled/stored manures

Organic Vs. Inorganic Nutrients

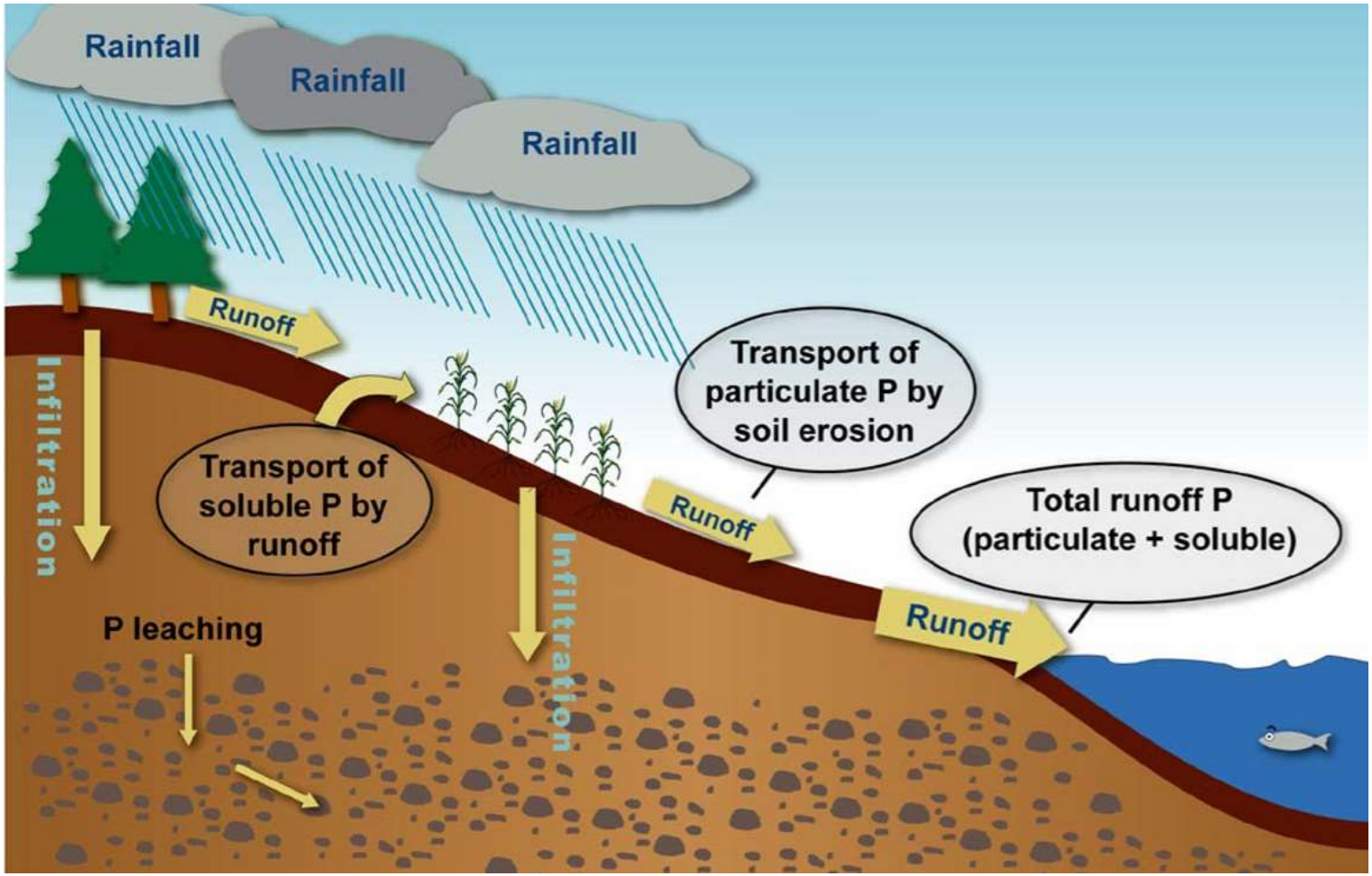


Nitrogen Forms



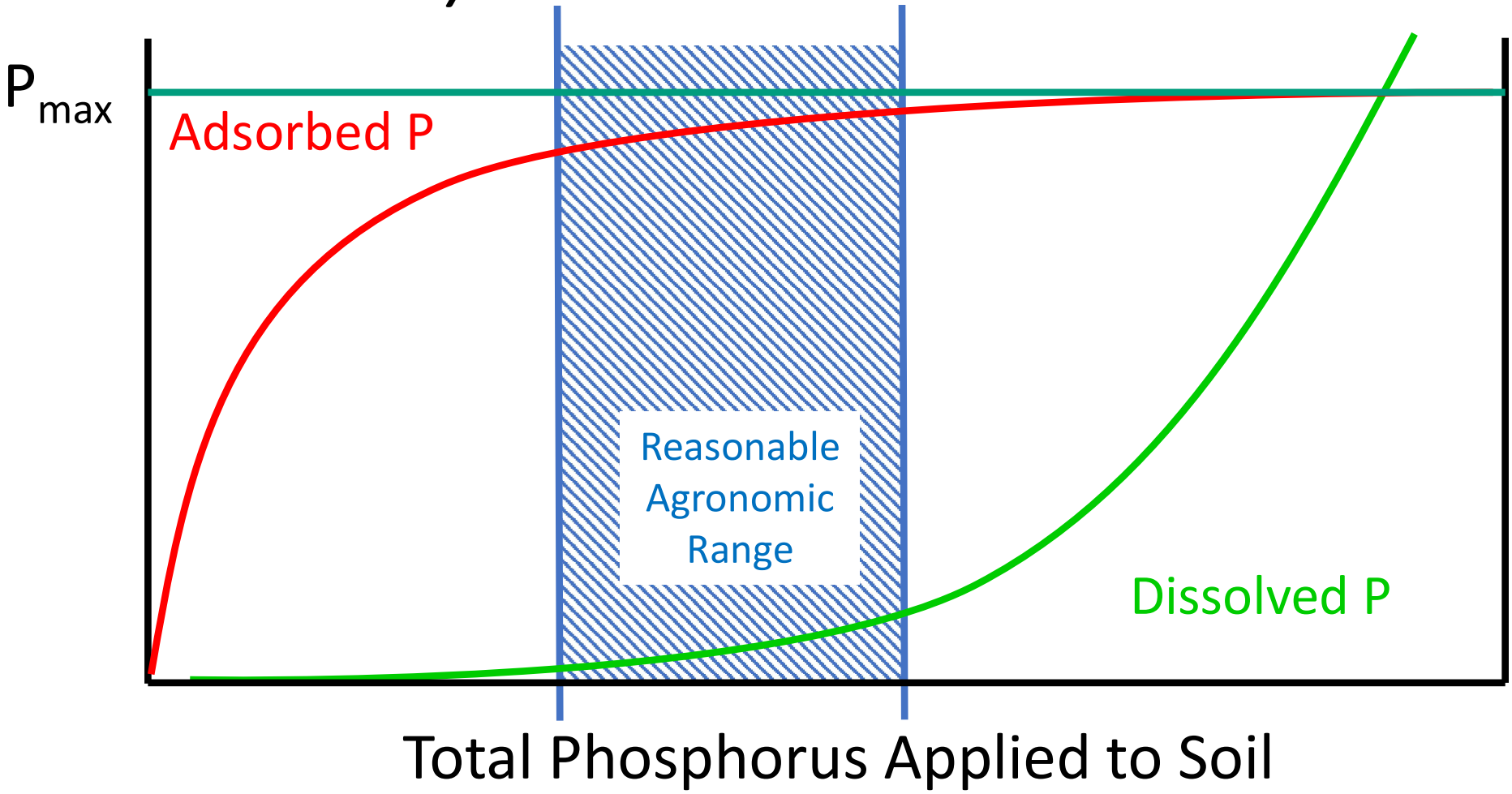
Source: NC State, 2019

Phosphorus Movement



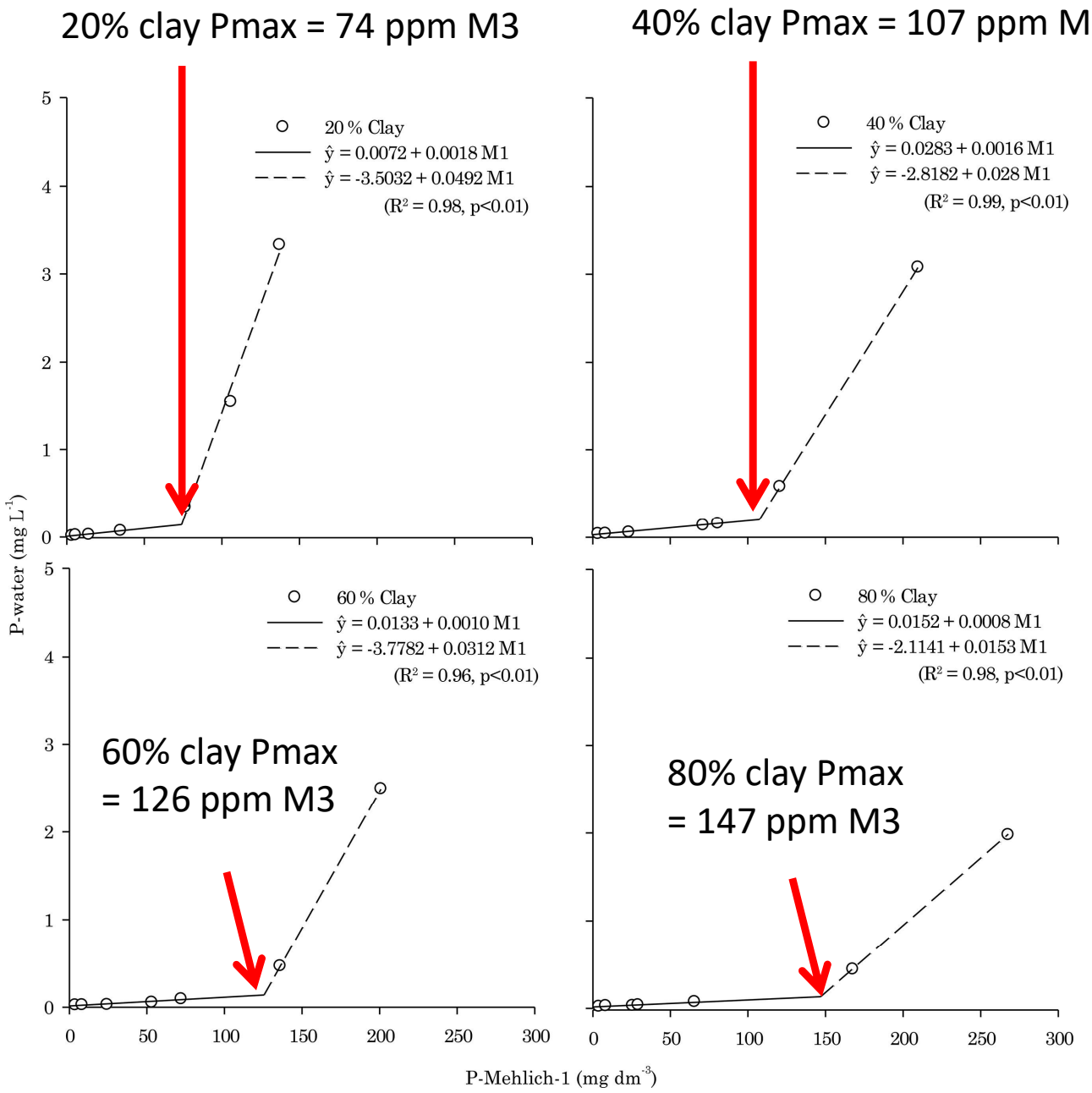
Source: Bundy, Univ. Wisconsin

Dissolved /Adsorbed P



Adopted from Basta (2007)

Impact of Clay Content and STP on Phosphorus Movement



Source: Gatiboni, 2015 - Brazil

Indiana NRCS 590

Table 2. Organic Nutrient Application Guidelines Based on Soil Test Phosphorus

Soil Test Phosphorus Level (Bray P_1/Mehlich 3 ppm)	Basis for Nutrient Application
≤50 ppm	Nitrogen Based
51 – 100 ppm	1.5 x Crop P_2O_5 Removal[1)]
101 – 200 ppm	Crop P_2O_5 Removal[1)]
> 200 ppm	No P Application

[1)] Found in Table 3

Table 2 Explanation. The nutrient application guidelines in Table 2 are meant to address longer-term P loading to the soil. For example, if STP levels are £ 50 ppm (Bray P_1/Mehlich 3), then the P applications are based on this year's planned or current crop nitrogen needs. If the STP is 51 – 100 ppm and a corn (160 bu./acre) – soybean (40 bu./acre) rotation removes an average of 50 lbs P_2O_5/acre/yr (60 lbs P_2O_5/acre/yr for corn and 40 lbs P_2O_5/acre/yr for soybean), then the long-term P_2O_5 application rate will not exceed 75 lbs/acre/yr (50 x 1.5 = 75). If the STP is 101-200 ppm, and the previous example crop rotation is used, then the long- term P2O5 application rate will not exceed 50 lbs/acre/yr. Using Table 2, there will be no application of P if the Bray P_1/Mehlich 3 soil test is > 200 ppm.

P_2O_5 to Build Soil Test Phosphorus 1 ppm – M3

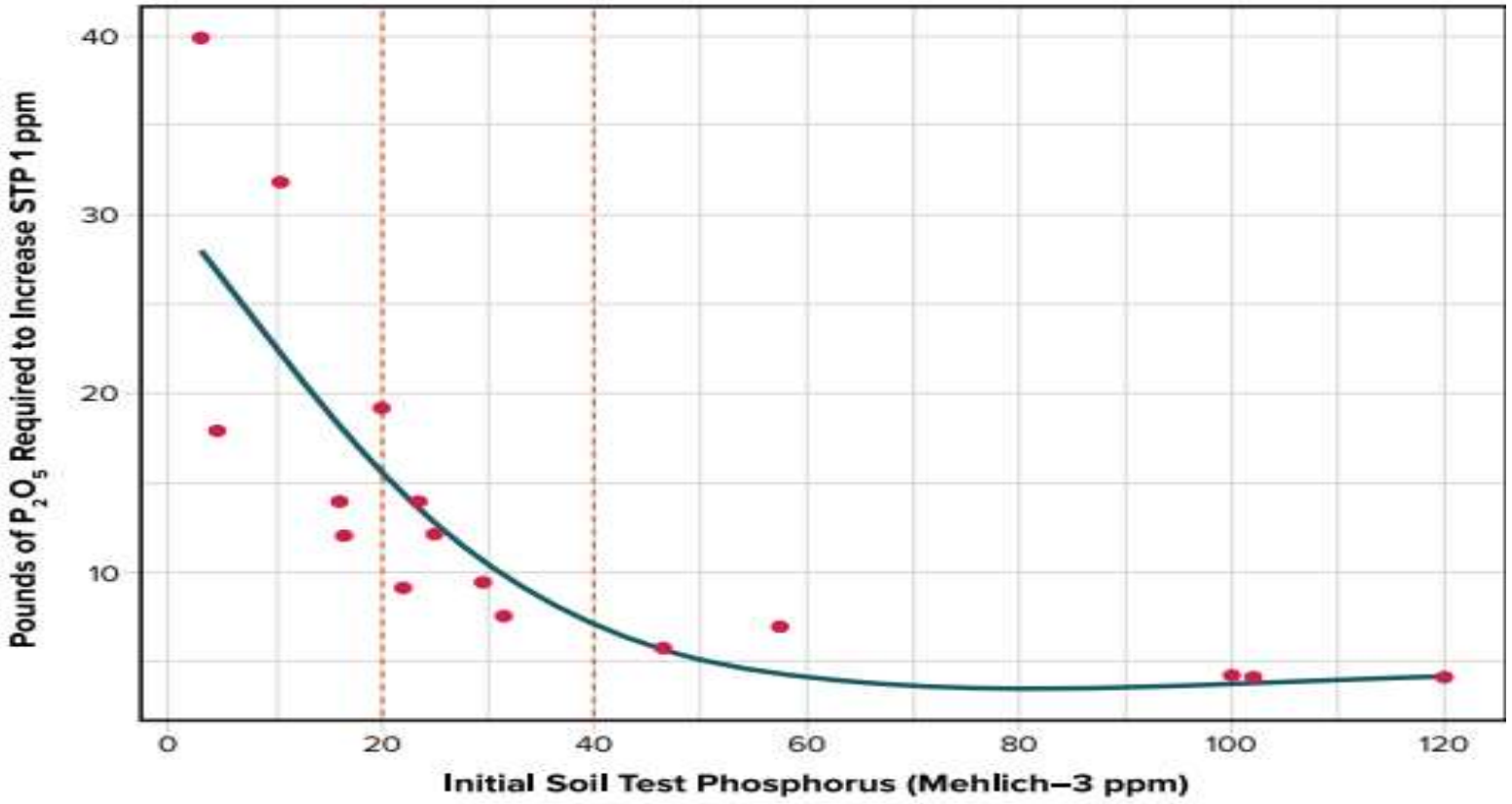


Figure 3. Pounds of P_2O_5 fertilizer required to increase soil test phosphorus levels by 1 part per million in 16 Kentucky soils (Adapted from Thom and Dollarhide, 2002). Red vertical, dashed lines indicate the tri-state maintenance range for corn and soybean.

Source: 2020 Tri-State Fertilizer Recommendations

Manure by Species

- Bovine
  - Most N in organic form 50-60% – Slow to breakdown
  - Beef solid manure is the slowest to release N
- Poultry
  - 20-40% organic N – slow to break down
  - Phosphorus mostly in organic forms
  - Dry Urine
  - Higher salt content
  - High in general organic matter
- Swine lagoon
  - Most of the total N in plant available ammonium
  - Total Phosphorus content related to % solids
  - Significant level of soluble phosphorus

Manure by Species

First-Year Availability Estimates

Table 1. First-year nutrient availability for different animal manure sources.

Manure Source	Nitrogen[1]	Phosphorus[2]	Potassium[2]
	Percent of Total Nutrient Applied		
Beef cattle (solid or liquid)	30–50	80–100	90–100
Dairy (solid or liquid)	30–50	80–100	90–100
Liquid swine (anaerobic pit)	90–100	90–100	90–100
Liquid swine (anaerobic lagoon)	90–100[3]	90–100[3]	90–100
Poultry (all species)	50–60	90–100	90–100

[1]The estimates for N availability do not account for potential volatile N losses during and after land application. Correction factors for volatile loss are given in Table 2. The ranges are provided to account for variation in the proportion of ammonium N (and for poultry manure also uric acid), bedding type and amount, and both sampling and analysis.

[2]The ranges in P and K availability are provided to account for variation in sampling and analysis, and for needed P and K supply with different soil test levels. A small portion of manure P may not be available immediately after application, but all P is potentially available over time. Use lower P and K availability values for soils testing in the Very Low and Low soil test interpretation categories, where large yield loss could occur if insufficient P or K is applied and a reasonable buildup is desirable. Use 100% when manure is applied to maintain soil-test P and K in the Optimum soil test category, when the probability of a yield response is small.

[3]Values apply for the liquid portion of swine manure in lagoons; the N and P availability will be less and difficult to estimate with settled solids.

C:N Ratio

Material	C/N Ratio	Material	C/N Ratio
Cattle Manure	19:1	Poultry Carcass	4:1
Cattle Carcass	10:1	Sawdust	442:1
Corn Silage	40:1	Sheep Manure	16:1
Corn Stalk	68:1	Swine Carcass	14:1
Dairy Manure	20:1	Swine Manure	12:1
Grass Clippings	17:1	Turkey Litter	16:1
Horse Manure	30:1	Wheat Straw	127:1
Leaves	54:1	Wood Chips	600:1

(Rynk et al., 1992)

C:N Ratio

- >30:1 Soil N Immobilization ~ ties up nitrogen
- <20:1 Soil N Mineralization ~ releases nitrogen
- During the growing season it takes 8 – 15 weeks to go from 70:1 C:N to 30:1 C:N.

Common External Impacts

- Copper sulfate foot baths
- Calcium carbonate dairy bedding sand
- Rusting livestock equipment – Fe and Zn
- Elevated Zn – Swine Nursery

Nutrient Movement

Manure Report Basics - Again

Report Number
F19010-6501
Account Number
99990

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To:

For: HOG MANURE

Attn:

Purchase Order:

Lab Number: 14088
Sample ID: TD
Manure Type: SWINE, LIQUID PIT (16)

MANURE ANALYSIS

Date Received: 1/10/2019
Date Reported: 1/11/2019
Page: 1 of 1

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Potassium (K)	%	0.253	25.3 (as K_2O)	25.3 * (as K_2O)

@ Estimate of first-year availability does not account for incorporation losses. Consult MWPS-18, "Livestock Waste Facilities Handbook" for additional information.
* Source: MWPS-18, Livestock Waste Facilities Handbook, 1993 # Source: A3411, "Manure Nutrient Credit Worksheet", University of Wisconsin
** Manure density assumed to be 8.33 lb/gallon

Manure Report Basics - Again

Report Number
F19315-6503
Account Number
[redacted]

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Fort Wayne, IN 46808
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algreatlakes.com

To:

Lab Number: 21167
Sample ID: RTL 2019
Manure Type: POULTRY, SOLID WITH LITTER (11)

MANURE ANALYSIS

Date Sampled: 11/10/2019
Date Received: 11/11/2019
Date Reported: 11/12/2019 Page: 1 of 2

Analysis	Unit	Analysis Result (As Received)	Pounds Per Ton	First Year Availability @ Pounds Per Ton
Moisture	%	33.79	676	
Solids	%	66.21	1324	
Ash @ 550 C	%	31.30	626.1	
Organic Matter (LOI @ 550 C)	%	34.91	698.1	
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Sulfur (S)	%	0.27	5.5	3.0 #

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Manure Report Basics - Again

Report Number
F19035-6500
Account Number

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To: For:

Attn:

Lab Number: 14371
Sample ID: SOLID
Manure Type: DAIRY, SOLID W/O BEDDING (6)

MANURE ANALYSIS

Date Sampled: 1/24/2019
Date Received: 2/4/2019
Date Reported: 2/6/2019 Page: 1 of 2

Analysis	Unit	Analysis Result (As Received)	Pounds Per Ton	First Year Availability @ Pounds Per Ton
Moisture	%	83.21	1664	
Solids	%	16.79	336	
Ash @ 550 C	%	1.57	31.4	
Organic Matter (LOI @ 550 C)	%	15.22	304.4	
Organic Carbon (LOI @ 550 C)	%	8.83	176.6	
Carbon:Nitrogen Ratio (C:N)	-	21.8:1		
Nitrogen, Total (TKN)	%	0.404	8.1	3.4 *
Nitrogen, Ammonium (NH_4-N)	%	0.040	0.8	0.8 *
Nitrogen, Organic (N)	%	0.364	7.3	2.6 *
Phosphorus (P)	%	0.045	2.1 (as P_2O_5)	2.1 * (as P_2O_5)
Potassium (K)	%	0.143	3.4 (as K_2O)	3.4 * (as K_2O)
Sulfur (S)	%	0.06	1.2	0.7 #

@ Estimate of first-year availability does not account for incorporation losses. Consult MWPS-18, "Livestock Waste Facilities Handbook" for additional information.
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