

# ***BIOSOLIDS MANAGEMENT***

***OLD LINE***



***Environmental, Inc.***



***Lisa L. Williams***

***Synagro - Old Line Environmental, Inc.***

***[LWilliams@synagro.com](mailto:LWilliams@synagro.com)***

**SYNAGRO**  
YOUR PARTNER FOR A CLEANER, GREENER WORLD

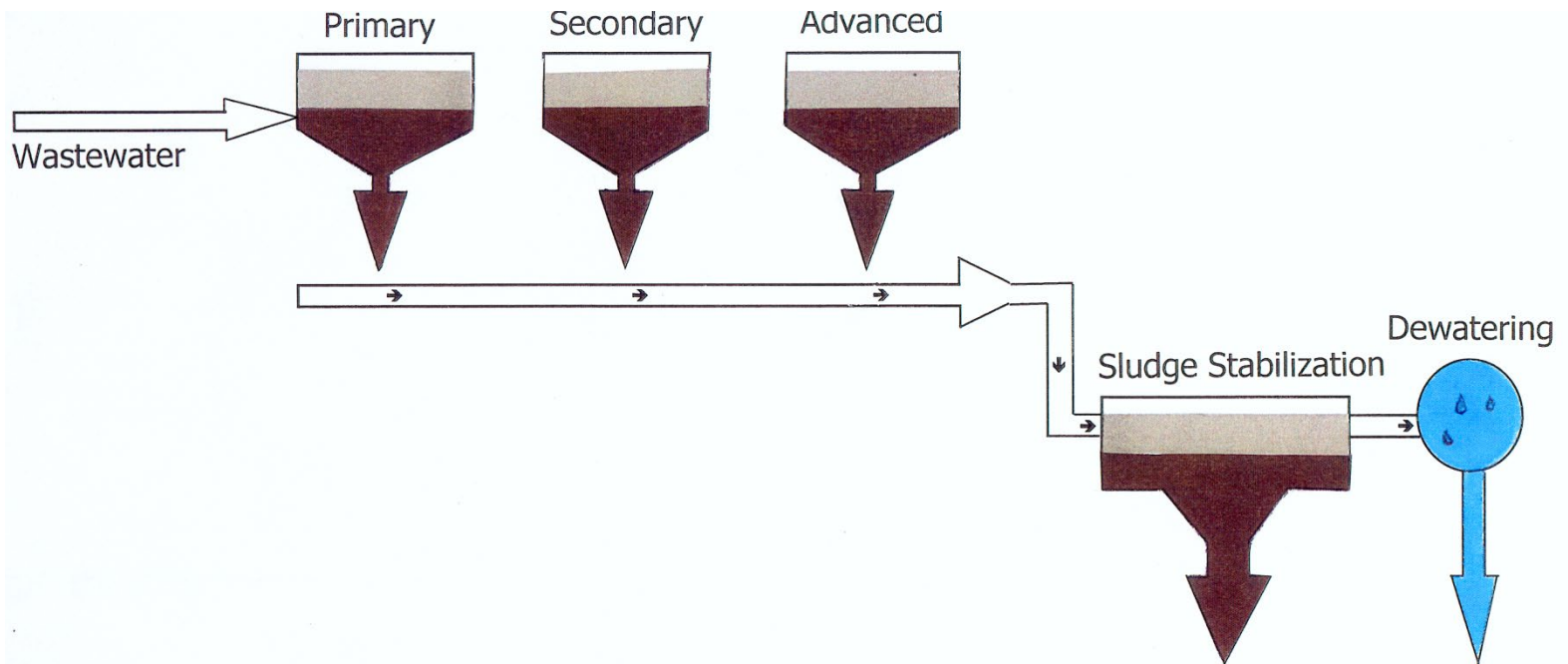
# WHAT ARE BIOSOLIDS?

Primarily organic solids produced by wastewater treatment processes that can be beneficially recycled.



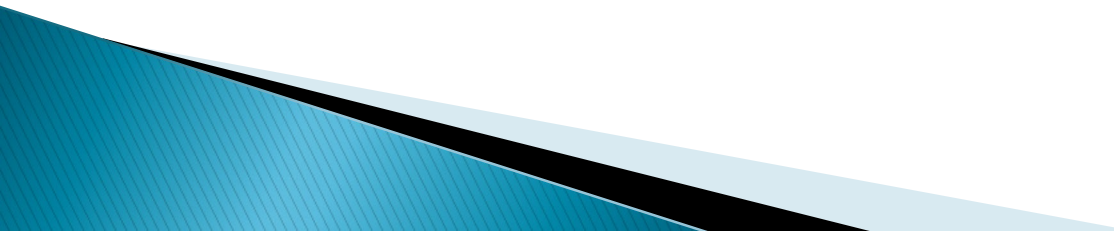


# *WASTEWATER TREATMENT – SLUDGE GENERATION*



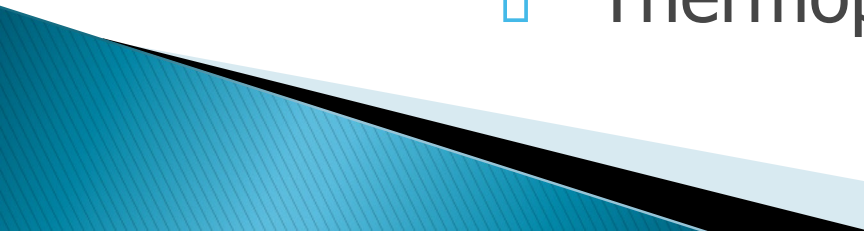
# ***COMMON WASTEWATER TREATMENT PLANT SOLIDS STABILIZATION PROCESSES***

## ***Class B – PSRP (Process to Significantly Reduce Pathogens)***

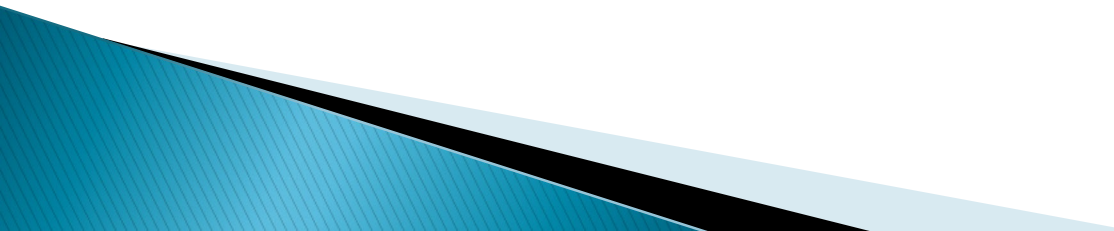
- Aerobic digestion
  - Anaerobic digestion
  - Lime-stabilized
- 

# ***TECHNOLOGIES OFFERING FURTHER STABILIZATION***

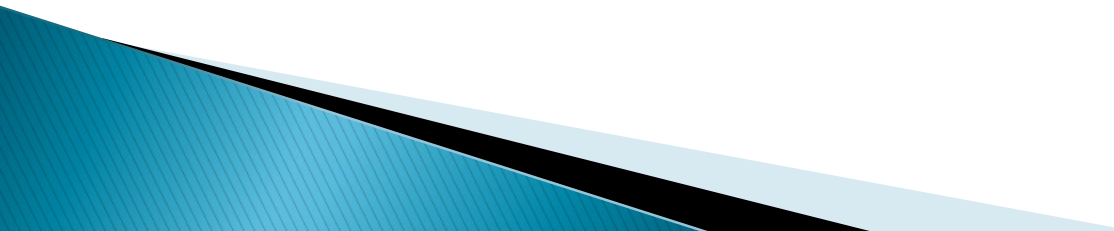
## ***Class A – PFRP (Process to Further Reduce Pathogens)***

- Composting
  - Pelletization (thermal drying)
  - Pasteurization (heat/lime)
  - Thermophilic digestion
- 

# ***OBJECTIVES OF LAND APPLICATION MANAGEMENT***

- Utilization and recycling
  - Protection of public health
  - Protection of surface and groundwater
  - Reliability
- 

# ***BENEFITS FROM BIOSOLIDS***

- Added N, P and micronutrients
  - Increases soil organic matter
    - Cation exchange capacity
    - Tilth
    - Water-holding capacity
  - Lime to adjust pH
- 

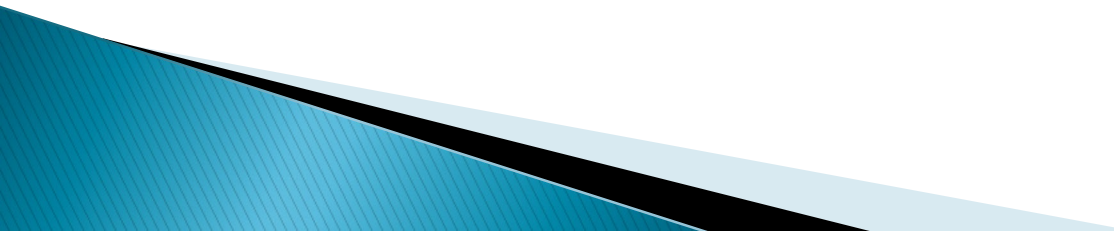


# ***TYPICAL BIOSOLIDS VALUE***

<u><b>Nutrient</b></u>	<u><b>Value Per Acre*</b></u>
N .....	\$84.00
P .....	38.50
K .....	13.50
S .....	4.00
Mg .....	5.00
Zn .....	4.00
Lime .....	40.00
Spreading/Tillage .....	<u>\$18.00</u>
<b>Cost Savings</b> .....	<b>\$207.00</b>

- 
- Based on a 2023 application of Cox Creek lime-stabilized biosolids applied at an agronomic rate for a 140 Bu corn crop. (May 2023 Fertilizer Prices (N-P-K / lb @ \$0.60-\$0.77-\$0.45)*

# ***SOIL pH REQUIREMENTS***

- Soil pH must be raised to at least 6.0, prior to or at the time of biosolids application.
  - Soil pH must be maintained at 6.0 or above.
  - Lime-stabilized and lime-amended biosolids may not be applied to fields with soil pH's at or above 7.5.
- 

























# ***BIOSOLIDS ANALYSES***

	<u>% Solids</u>	<u>% TKN</u>	<u>% Ammonia</u>	<u>% Org. N</u>	<u>% Nitrate</u>
Blue Plains (digested Class A)*	<b>30.1</b>	<b>5.08</b>	0.66	4.42	.0025
Sod Run (anaerobic digest)**	<b>17.5</b>	<b>4.39</b>	0.66	3.73	.0057
Cox Creek (lime-stabilized)*	24.3	3.91	0.22	3.69	.0035
Parkway (lime-stabilized)*	32.1	3.96	0.15	3.8	0.0025
Little Patuxent (digested Class A)*	94.6	6.37	0.31	6.06	0.0013
Mattawoman (lime-stabilized)*	36.4	4.42	0.165	4.26	0.002
QA Kent Island (aerobic digest)*	23.2	4.3	0.22	4.08	0.0068

\* *Data from 2021 Waypoint Analytical analyses*

\*\* *Data from 2021 Suburban Testing Labs analysis*

# ***SAMPLE NITROGEN CONCENTRATIONS***

**Lbs./Dry Ton** = (% conc. as a decimal x 2,000 lbs.)

	<u>TKN</u>	<u>Ammonia</u>	<u>Org. N</u>	<u>NO<sub>3</sub></u>
Blue Plains (Digested Class A)	101.6 (0.0508*2000)	13.2	88.4	0.05
Sod Run (D) (digest)	87.8 (0.0439*2000)	13.2	74.6	0.114

*Blue Plains: 2021 Waypoint Analytical analysis*

*Sod Run: 2021 Suburban Testing Labs analysis*

# ***SAMPLE NITROGEN CONCENTRATIONS***

**Lbs./Wet Ton** = (lbs./DT x % solids as a decimal)

	<u>TKN</u>	<u>Ammonia</u>	<u>Org. N</u>	<u>NO<sub>3</sub></u>
Blue Plains (Digested Class A)	30.6 (101.6*0.301)	3.97	26.6	0.015
Sod Run (D) (digest)	15.4 (87.8*0.175)	2.3	13.1	0.02

*Blue Plains: 2021 Waypoint Analytical analysis*

*Sod Run: 2021 Suburban Testing Labs analysis*



# ***COMPARISON BIOSOLIDS: MANURE (lbs./wet ton)***

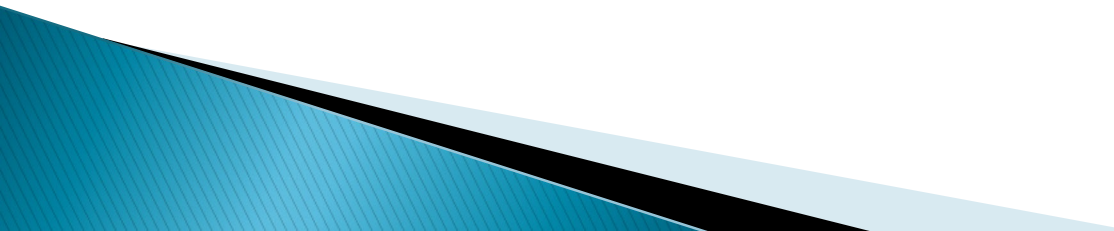
	<b><u>N</u></b>	<b><u>NH<sub>4</sub></u></b>	<b>1<sup>st</sup> Season <u>Mineralization</u></b>	<b><u>P<sub>2</sub>O<sub>5</sub></u></b>	<b><u>K<sub>2</sub>O</u></b>
Cattle, solid	43.4	6.8	0.35	23.7	50.7
Poultry, solid (broilers)	78.2	10.4	0.50	69.0	83.6
Blue Plains (digested Class A)	30.6	3.97	0.20	44.0	0.6
Sod Run (anaerobic digest)	15.4	2.3	0.20	27.7	0.6

*Manure: University of Maryland Ext – Manure Summary Report (2019 update)*

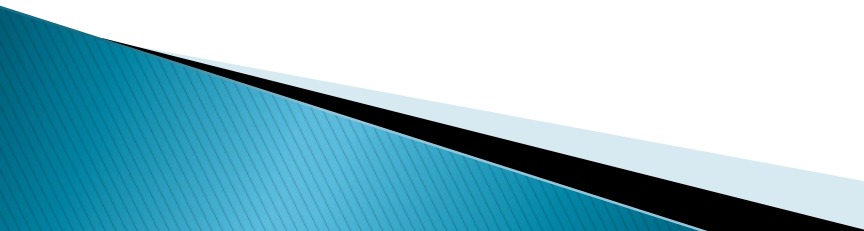
*Biosolids: (a) Blue Plains: 2021 Waypoint Analytical, % total solids = 30.1*

*(b) Sod Run: 2021 Suburban Testing, % total solids = 17.5*

# ***NUTRIENT MANAGEMENT PLANNING FOR BIOSOLIDS APPLICATION SITES***

- NMP submitted with permit application package. NMP good for one biosolids application or one year, whichever comes first.
  - NMP update required prior to biosolids application after first year.
  - Biosolids permits valid for five years.
- 

# ***NUTRIENT MANAGEMENT PLANNING REQUIREMENTS FOR BIOSOLIDS APPLICATION SITES***

- Yield goal for each crop that potentially could be grown on a field permitted for biosolids application.
  - N requirements for each crop.
  - Fertility recommendation for each crop.
- 

# ***BIOSOLIDS APPLICATION RATE***

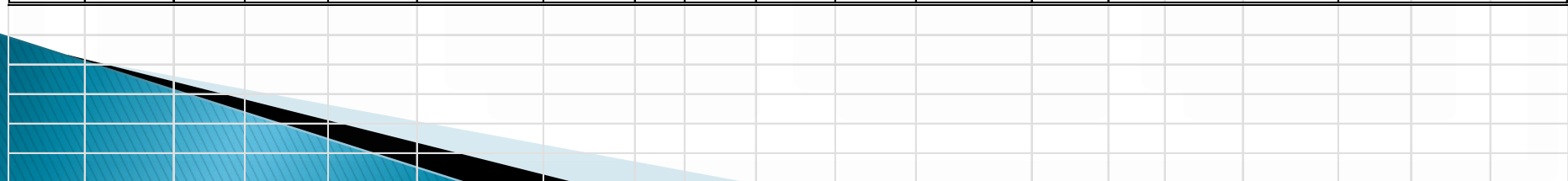
N required = Crop Need (lbs./acre) – Residual N

- Manure
- Biosolids
- Legumes

$$\text{Rate (dt/acre)} = \frac{\text{N required (lbs./acre)}}{\text{PAN (lbs./dt)}}$$

***Note: PAN = Plant Available Nitrogen***

FIELD	ACRES	pH	P2O5	K2O	CROP	YIELD	CROP REQUIREMENTS			RESIDUAL N CARRYOVER IN LBS.	CY MANURE APPL LBS./ACRE			FERTILIZER NEEDED				
							N	P2O5	K2O		N	P2O5	K2O	N	P2O5	K2O		
											Biosolids							
											Legumes							
											Manure							
											Biosolids							
											Legumes							
											Manure							
											Biosolids							
											Legumes							
											Manure							



# ***PLANT AVAILABLE NITROGEN (PAN)***

$$\text{PAN} = [(\% \text{NH}_4\text{-N}) (K_v) + (\% \text{NO}_3) + (\% \text{N-Org}) (F)](20)$$

PAN = (Plant Available N in lbs./dt)

$K_v$  = Volatilization factor:

-- 0.5 **liquid**-surface applied

-- 1.0 cake/incorporated liquid

F = Mineralization factor for year 0-1

***Source: COMAR 26.04.06.06F***

# ***PLANT AVAILABLE NITROGEN***

***(PAN – Blue Plains digested Class A)***

$$\text{PAN} = [(\% \text{NH}_4\text{-N}) (K_v) + (\% \text{NO}_3) + (\% \text{N-Org}) (F)](20)$$

$$\text{PAN} = [(0.66) (1.0) + (0.0025) + (4.42) (0.2)](20)$$

$$= [(0.66) + (0.0025) + (0.884)] \times 20$$

$$= (1.546) \times 20$$

$$= 30.9 \text{ lbs PAN/dry ton}$$

# ***BIOSOLIDS N MINERALIZATION FORMULA***

N mineralized (Nm) =

Mineralization factor (Km) x % Org. N x  
Application Rate (total dt)

Pounds N mineralized this year from biosolids  
applied in year X



# ***BIOSOLIDS N MINERALIZATION FACTORS (Km) FOR RESIDUAL CALCULATIONS***

<b><u>Years After Application</u></b>	<b>Biosolids Type (<i>Km</i>)</b>	
	<b><u>Aerobically Digested or Lime-stabilized</u></b>	<b><u>Anaerobically Digested</u></b>
0-1	0.30	0.20
1-2	2.10	1.60
2-3	0.90	0.72
3-4	0.42	0.42

*Km = lbs. N mineralized/ton applied per % Org. N*  
*Source: (MD Nut. Mgmt. Manual – Section 1.C.)*

***TOTAL N MINERALIZED:  
MULTIPLE BIOSOLIDS APPLICATIONS***

$$Nm = Nm \text{ year } 1 + Nm \text{ year } 2 \dots + Nm_x$$

Add lbs./acre N mineralized from each biosolids application

(Mineralization of organic nitrogen from the 2 previous years)

***Source: COMAR 15.20.08.05F(6)***



# *Phosphorus Management*

- Use MD Ext. Service PMT software
- Input Org-P value based on N application rate
- Determine High, Medium, Low
- Determine field suitability
- Data sent to MDE with NMPs
- Updated before next biosolids application

# ***WHERE TO GO FOR INFORMATION***

## **MDE – Biosolids Division**

- Current PAN & Nutrient values for all biosolids sources
- Information on regulations
- Existing permits/pending permits
- Permitted fields map
- Past application rates

Most of this information is also available from the biosolids contractor.