Using Manure to Produce Biofuel on PA Mined Lands

Field Testing Results

Business Case & Role of Nutrient Trading

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Potential problems with use of manure for mine soil amendment

- Low C/N ratio means
  - Unstable material
  - Potential for significant nutrient loss at application rates needed
  - Contains relatively small amounts of organic matter in relation to nutrient content
- Odor
- Attracts flies
- High moisture content and bulky

Is there a way to overcome these problems?

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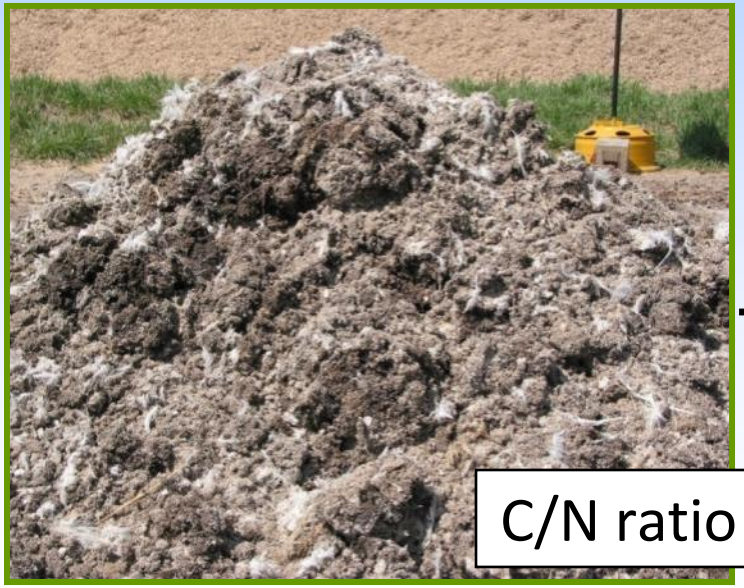
We have investigated two possible approaches:

1

2



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Field experiment on AML site in Schuylkill County

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Five soil amendment treatments applied Spring of 2006

	Treatment	Total Application		Fresh Manure Equiv.	C	N	P_2O_5
		Dry wgt	Fresh Wgt				
		---------- tons/acre ----------				------- lb/acre -------	
1	Control (lime + fert)	6	6		–	125	400
2	Compost	30	65	38.5	10	1620	1842
3	Compost	60	130	77.0	20	3240	3684
4	Man + PMS (20:1 C:N)	63	162	38.5	16	1620	1839
5	Man + PMS (30:1 C:N)	101	266	38.5	24	1620	1839

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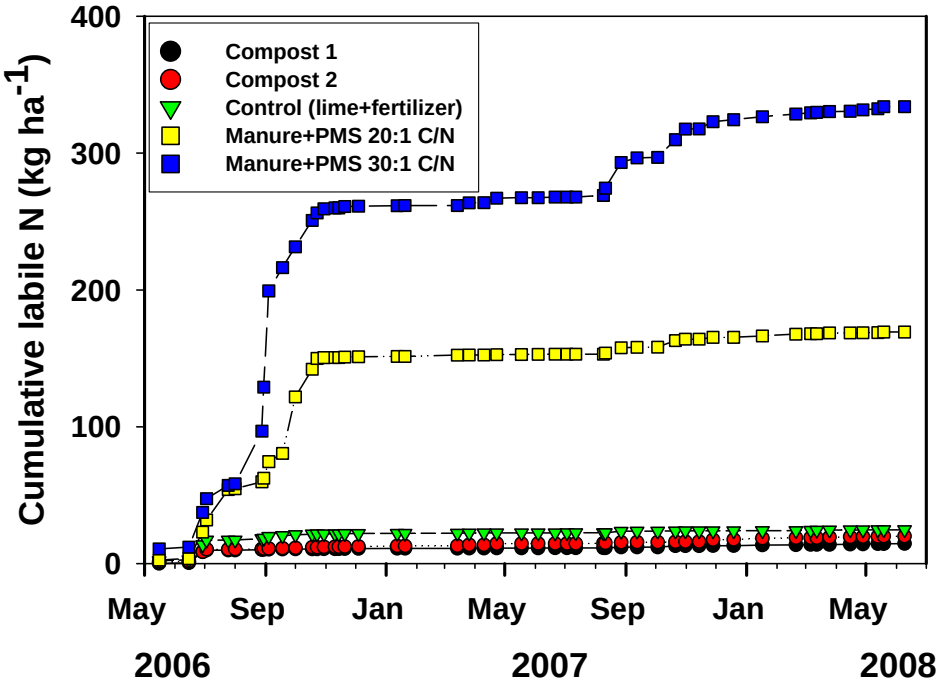
Spring 2006, Two weeks after planting


July 2006, nothing but annual ryegrass…

Nitrogen leaching losses from field experiment in Schuylkill County

Cumulative N leaching loss over 3 years.

Amendment	N loss (lb N/acre)
Compost 1	14
Compost 2	19
M+PMS (20)	153
M+PMS (30)	303
No-till corn	160



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Carbon and Nitrogen content of AML soil before and 3 years after treatment.

Date and Treatment	C	N
	%	%
Spring 2006 (before reclamation)	3.18	0.09
Spring 2009 (3 years after reclamation)		
Lime and fertilizer	4.20	0.18
Compost 1 (30 T/A)	6.79	0.42
Compost 2 (60 T/A)	6.86	0.47
Manure + PMS (20:1)	5.86	0.31
Manure + PMS (30:1)	6.20	0.27

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June 2008, Switchgrass mixed with ryegrass


August 2008, mostly switchgrass!!


July 27,2009 only switchgrass

July 27,2009

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Oct. 4,2009

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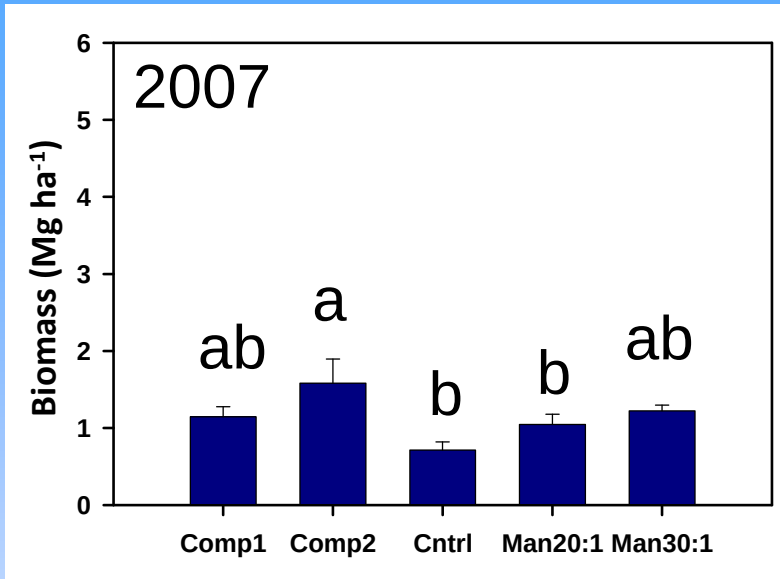

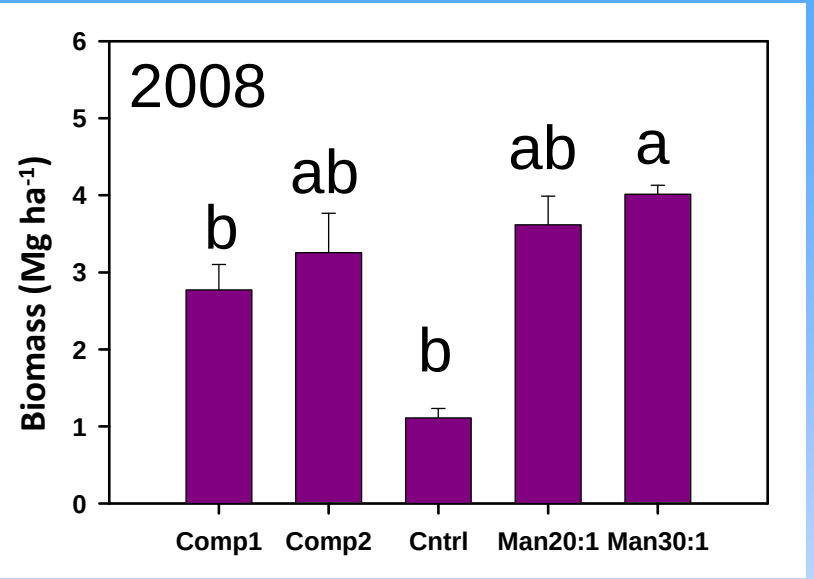

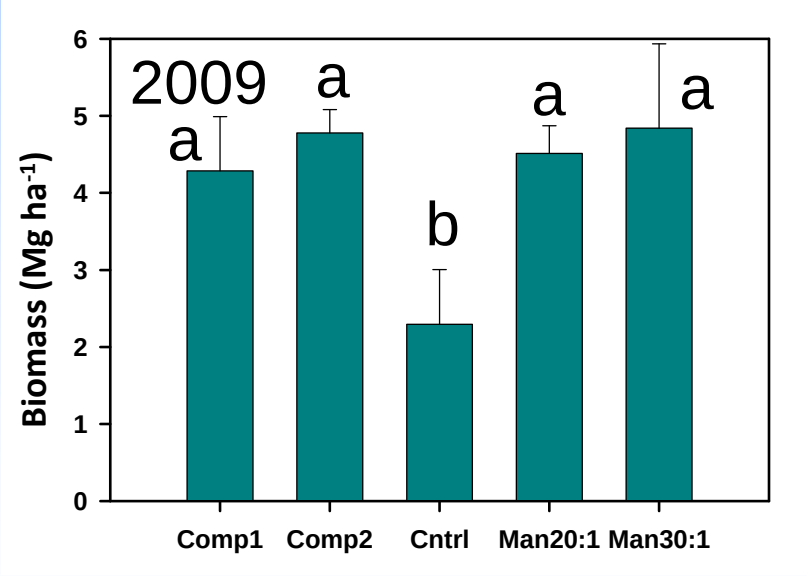

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Full-scale demonstration at active mining sites in Clearfield County

- 30 acres total at 3 sites
- Approximately half amended with compost, half amended with PMS+manure.
- Planted with
  - Switchgrass
  - Atlantic Coastal Panic Grass
  - Big Bluestem
  - 3 grasses mixed
  - 3 grasses+2 legumes mixed

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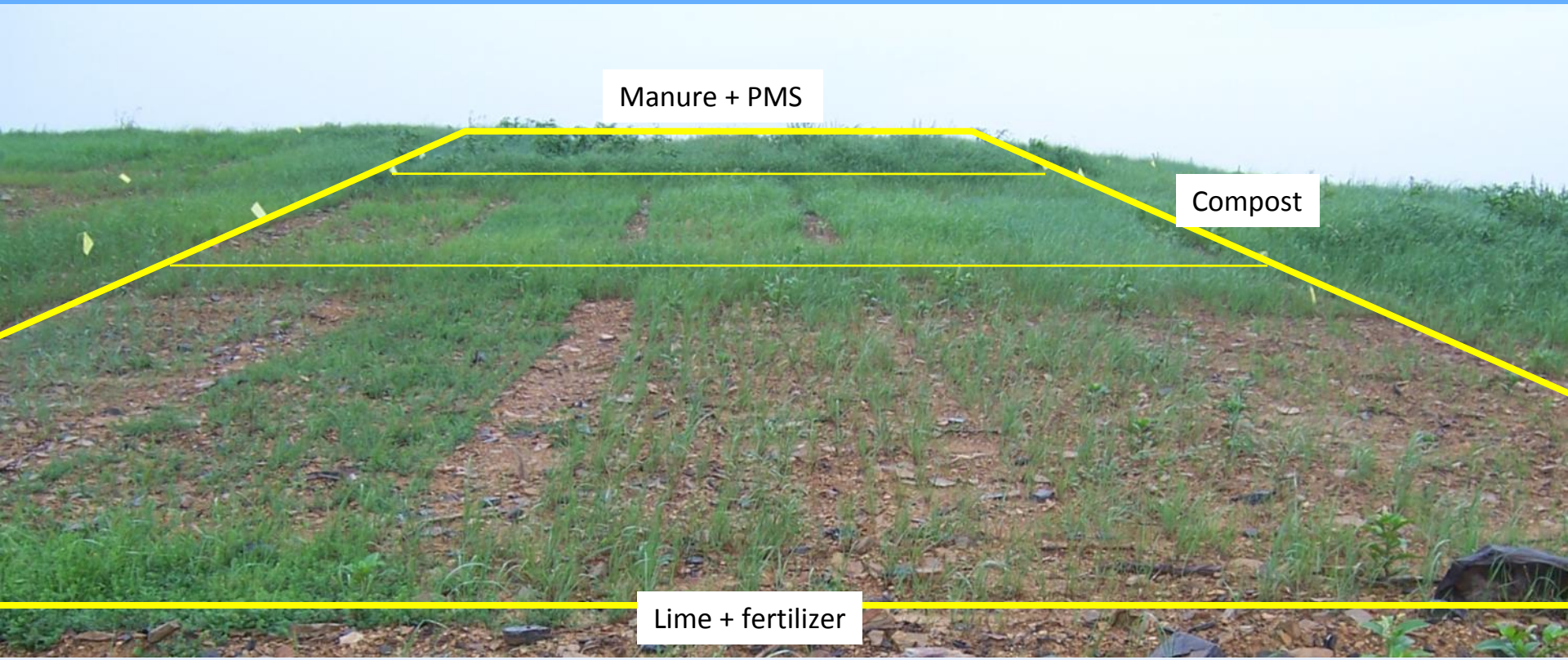
Lower Emigh Mine Site Demonstration areas

Lower Emigh Mine Site, treatments applied Spring 2009, planted Spring 2009
Photographed on August 21, 2009



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Lower Emigh Mine Site, growth on Manure + PMS treatment
Photographed on August 21, 2009

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Lower Emigh Mine Site, growth on Manure + PMS treatment
Photographed on August 21, 2009

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Economics of Manure on Mined Lands

- What are the volumes and where are the sources of poultry manure and paper mill sludge in PA?

- Can the nutrient trading credit sales and the paper industry help fund the delivery and application of material to mined sites?

- Can reclaimed sites produce an annual cash crop and environmental credits?

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Duquesne University Sustainability MBA Research Effort – Jan. 2009 to May 2010

Phased Approach:

- Comparison of conventional versus manure & paper mill sludge reclamation techniques
- How nutrient trading can fund delivery of manure to mined sites
- Paper mill sludge and poultry manure supply and disposal
- Revenue sources: biomass sales and environmental credit (e.g. carbon offsets) sales
- Biomass market research in coal region

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Phase I – Revegetation Cost Comparison January – May 2009

- Review of PA DEP Bureau of Mining recent bond charts for post-mining reclamation of surface mines.
- Clearfield County demonstration project costs
- Cost data for raw manure, composted manure from industry sources
- Isolate comparative revegetation costs; application of lime, commercial fertilizer and grass seed versus application of composted manure, raw poultry manure, paper mill sludge and switchgrass seed.
- Draft report under review

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Comparative Revegetation Cost Details

- Revegetation Estimated Costs – Clearfield County Demonstration Project:

  Conventional - $600/acre

  Manure & Paper Mill Sludge - $1,000/acre – pilot project

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Reclamation Cost Assumptions

Conventional: lime, commercial fertilizer (appr. 4 tons/acre) one application of combined mixture followed by seeding

Poultry Manure & Paper Mill Sludge:

- Manure delivered at no cost (35 tons/acre)
- Paper mill sludge delivered and applied at no cost. Costs paid by local paper mill (110 tons/acre)
- 4–Step Process: Mobilization, paper mill sludge and manure applied separately using calibrated spreaders then chisel plowed prior to seeding (costs can be reduced by limiting steps and applications of materials and allowing mixing of materials prior to application - $600/acre or less achievable)

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Phase II – Nutrient Trading & Manure on Mined Lands
June – August 2009

- Deliverables:

  Evaluation of transaction costs (manure transportation costs, payment to farmer, broker and aggregator) versus market credit price to incentivize trading activity

  Market research about expected demand and pricing for nutrient reduction credits in 2010 and beyond

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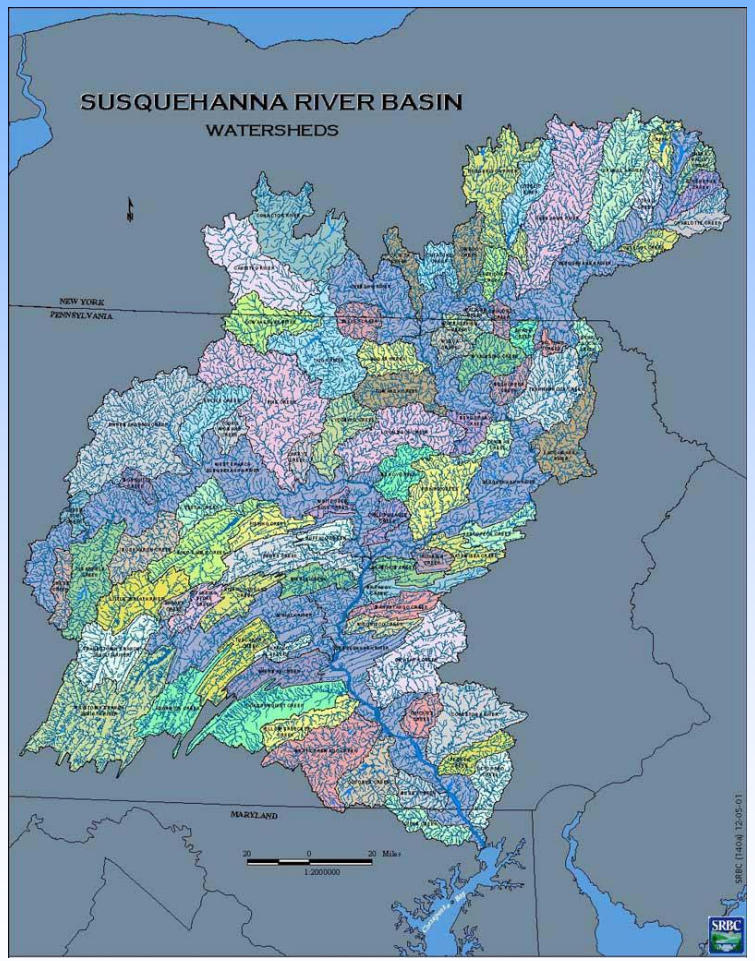
Susquehanna River Basin



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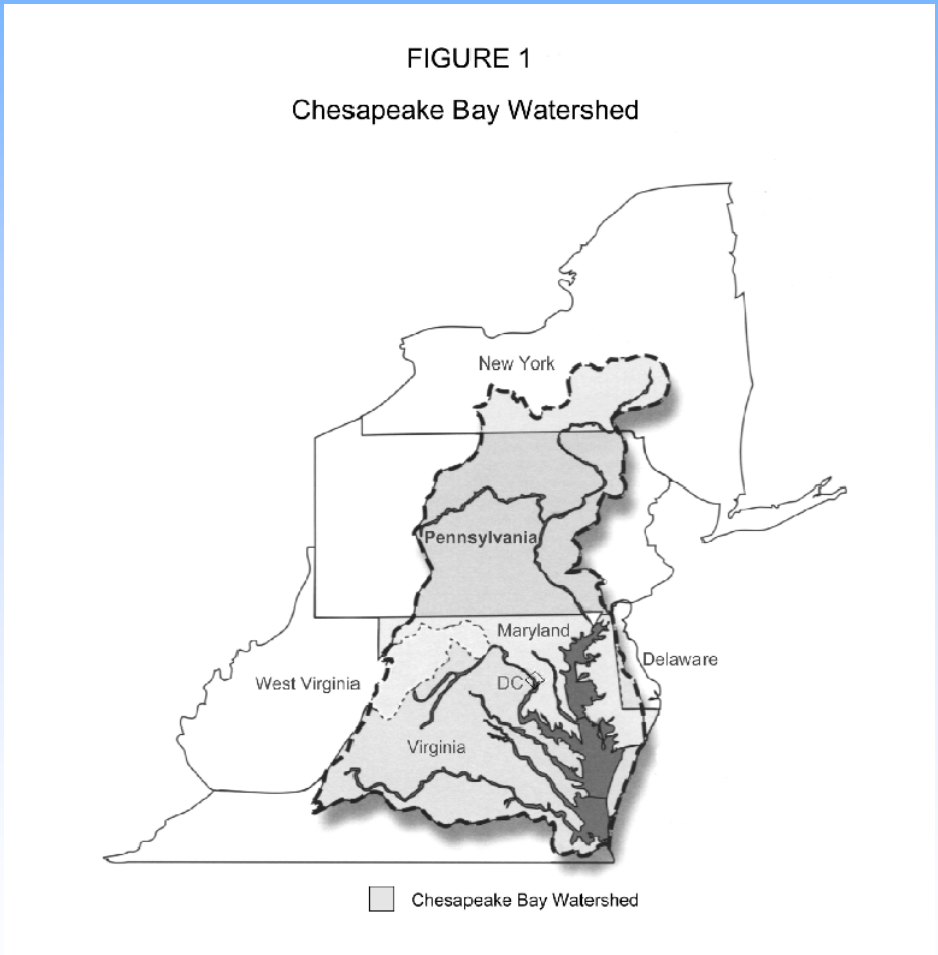
Cheseapeake Bay Watershed



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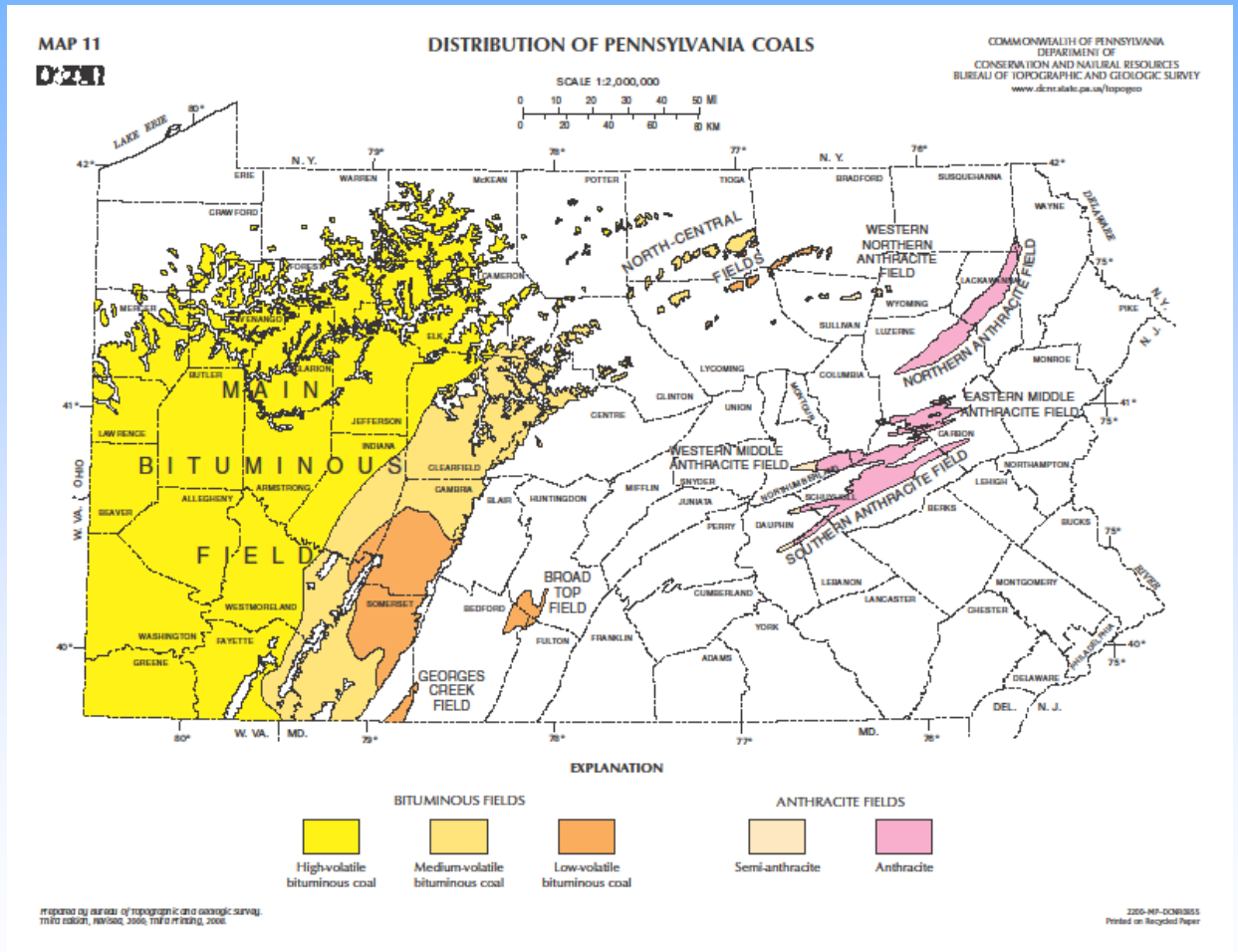
PA Mining Regions



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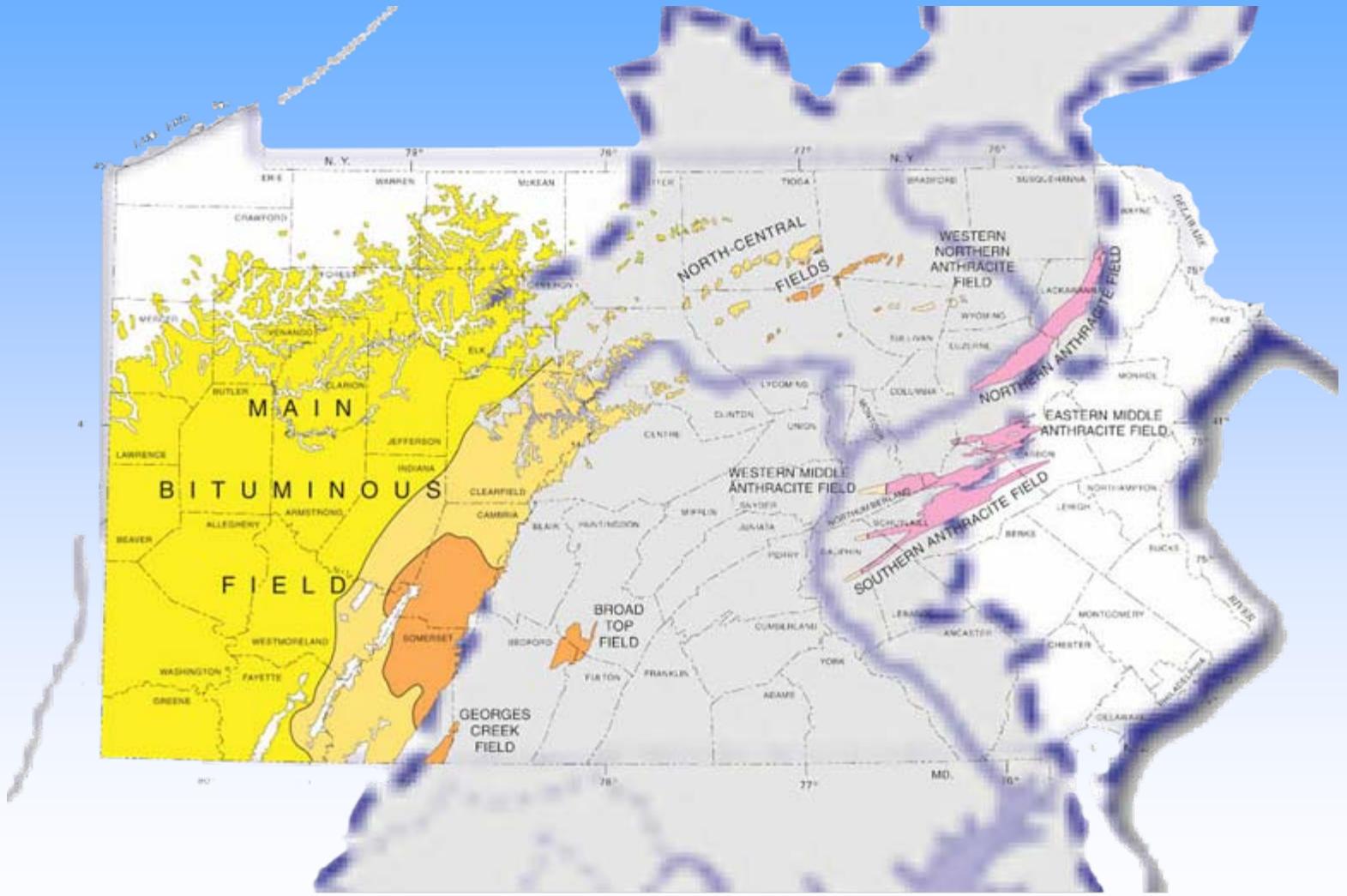
Bay Watershed Boundary Overlay

- 

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Nutrient Trading Background

- Bay State Stakeholders have agreed to reduce to 175 million lbs. annually by 2010
- Pennsylvania's obligation is to reduce nitrogen loading to Chesapeake Bay from 109 million lbs. to 72 million lbs.
- Phosphorous from PA to be reduced from 3.6 million lbs. to 2.5 million lbs.
- 183 WWTPs in Bay Watershed subject to 6.0 mg N/l and 0.8 mg P/l discharge limits
- New developments and WWTP expansions require offsets

Source: PA Chesapeake Bay Tributary Strategy, PA DEP, 2004

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Manure Production vs. Mine Reclamation

- 321,154 tons of poultry manure produced in PA in 2006* (19 million lbs. N)
- 654,766 tons of of poultry manure produced in PA in 2006**
- One ton of poultry manure contains approximately 60-80 lbs. of N and 50-70 lbs. of P
- 900 acres of AML reclaimed in 2008
- 2008 Stage 2 - 5,480 acres (backfilled, graded and planted)

* Dr. Paul Patterson, Professor of Poultry Science, Penn State University – PDA 2008 poultry data

** www.pabiomass.org – 2002 USDA Census of Agriculture

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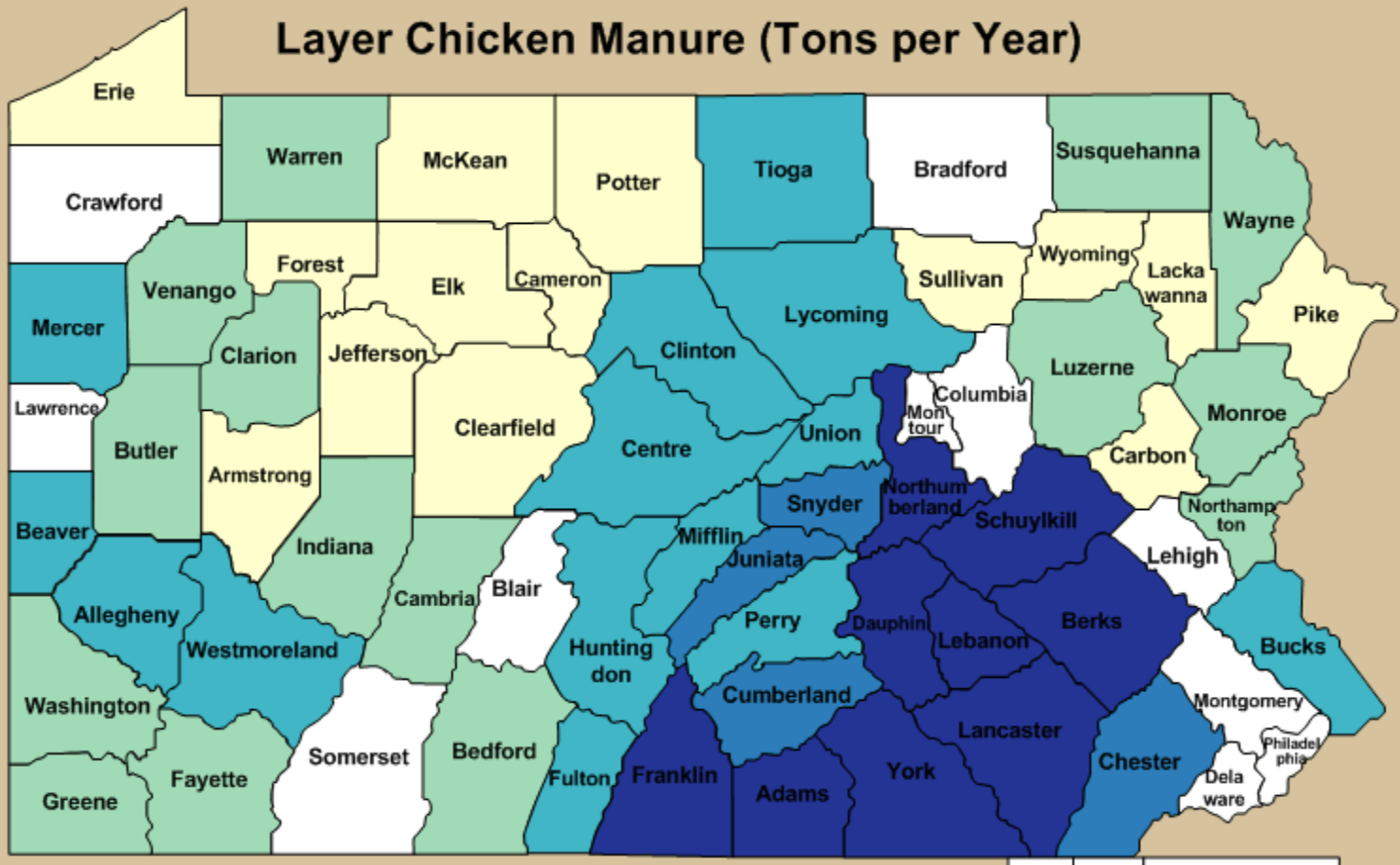
Layer Chicken Manure (Tons per Year)



Color	Count	Tons per Year
	11	Undisclosed
	14	1 to 20
	15	21 to 73
	14	74 to 3,901
	4	3,902 to 8,591
	9	10,536 to 116,554

Data Source:
2002 USDA Census of Agriculture: Pennsylvania County Level Data (Table 13)
as of April 2006
http://www.nass.usda.gov/census/census02/volume1/pa/index2.htm
***Manure production calculation: The Agronomy Guide 2004, Table 1.2-13;
Agromony Facts 54, Penn State College of Ag.;
http://www.agcom.purdue.edu/AgCom/Pubs/AE/AE-105.html

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Nutrient Trading Program Potential

- Credit Generation from Manure Export
  - Nitrogen – 9 Million lbs. annually *
  - Phosphorus – 1 Million lbs. per year*
- Trading Limit Restriction - Nitrogen (DEP)
  - 5.76 Million lbs. per year * (172,800 tons of poultry manure at 60lbs of N/ton – reclaim 5,000 acres at 35 tons/acre)

*Chesapeake Bay Tributary Strategy Compliance Study. Issue brief. Legislative Budget and Finance Committee. Metcalf and Eddy. November 2008.

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Phase III – Business Operating Model
October 2009 – January 2010

- Deliverables:
- Economics of waste paper mill sludge disposal
- Locations & volumes of poultry manure
- Market analysis of existing and potential demand for locally grown biomass in mining regions
- Draft business operating model for mine-land reclamation and biomass production and sale in local markets

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Biomass Market Research

- Switchgrass processing costs
- Biomass boiler manufacturers and warm season grass seed vendors
- Transportation costs
- Cost of biomass (low use wood) delivered to facilities, e.g. Fuels-for-Schools Program, e.g. $30/ton
- USDA Biomass Crop Assistance Program – collection, harvest, storage and transportation cost to qualified Biomass Conversion Facility (1 to 1 matching payment up to $45 per dry ton)

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Questions?

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