

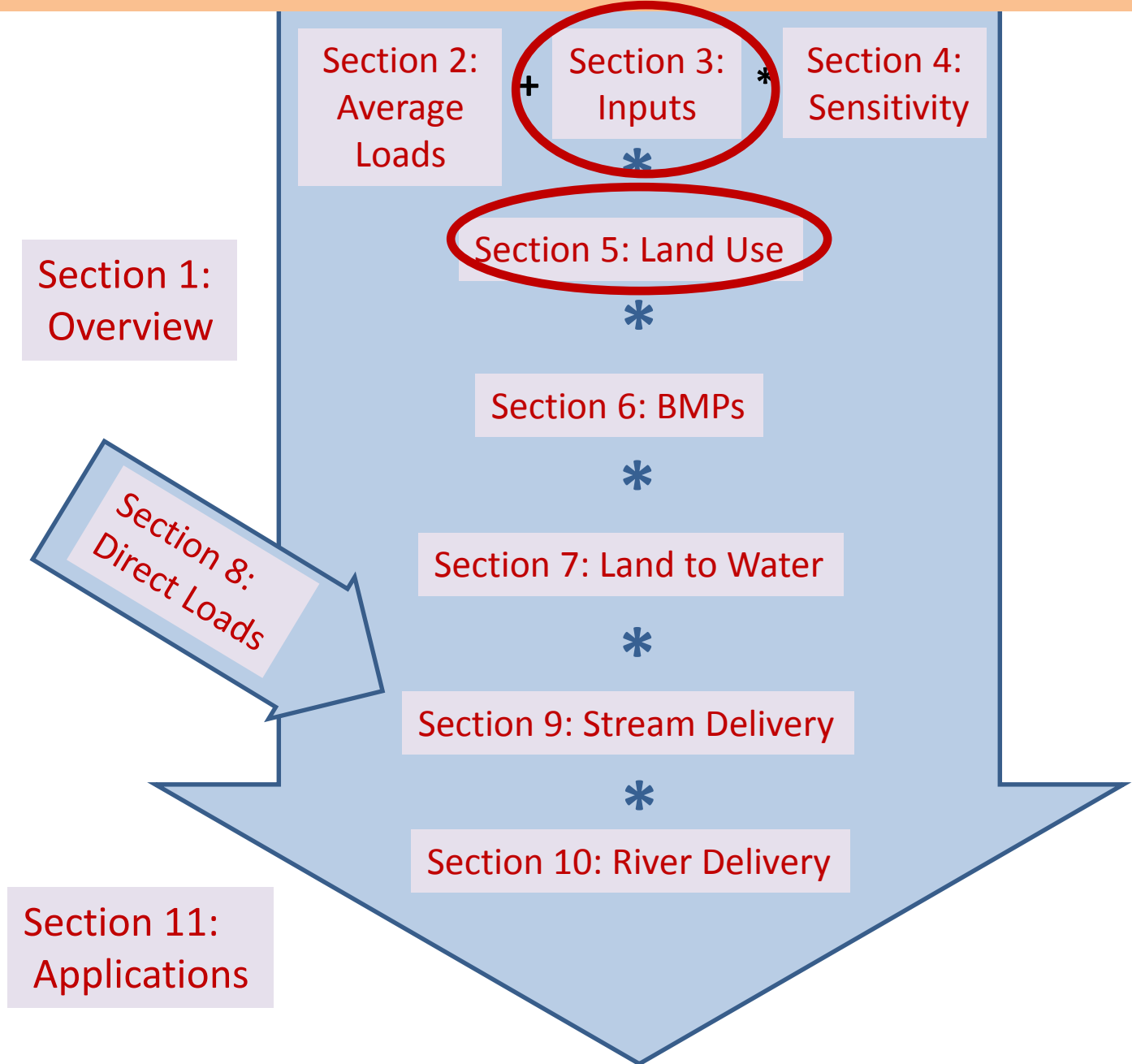
Review of Nutrient Inputs to the Watershed Model

Presentation to Scientific and Technical Advisory Committee

September 14, 2016

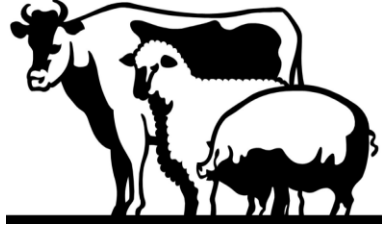
Matt Johnston
University of Maryland
CBPO Non-Point Source Data Analyst

Phase 6 Model Documentation



Phase 6 Inputs Conceptual Model

Livestock Manure (and Biosolids)



Barnyard



Fertilizer



Pasture



Access Area



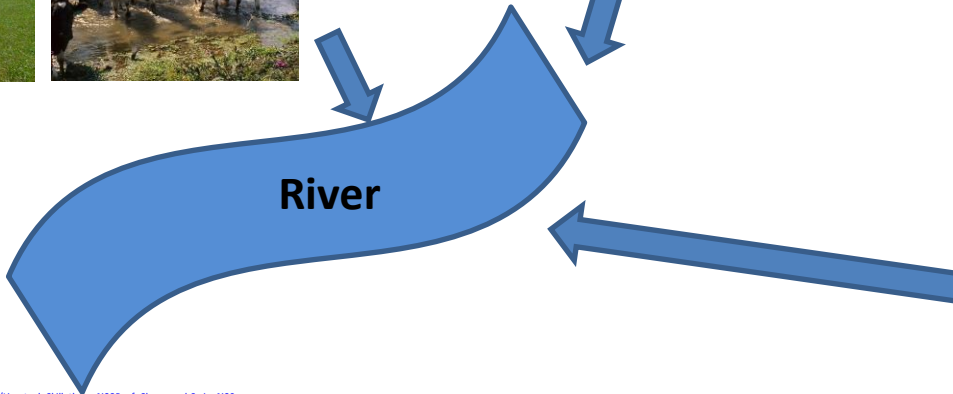
Nutrient Application Prescription



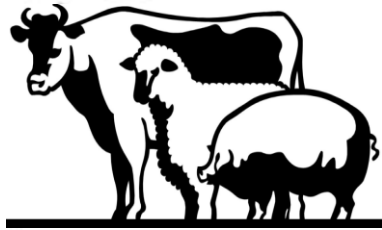
Crops



River



Livestock Manure (and Biosolids)



Barnyard



Fertilizer



Nutrient Application Prescription



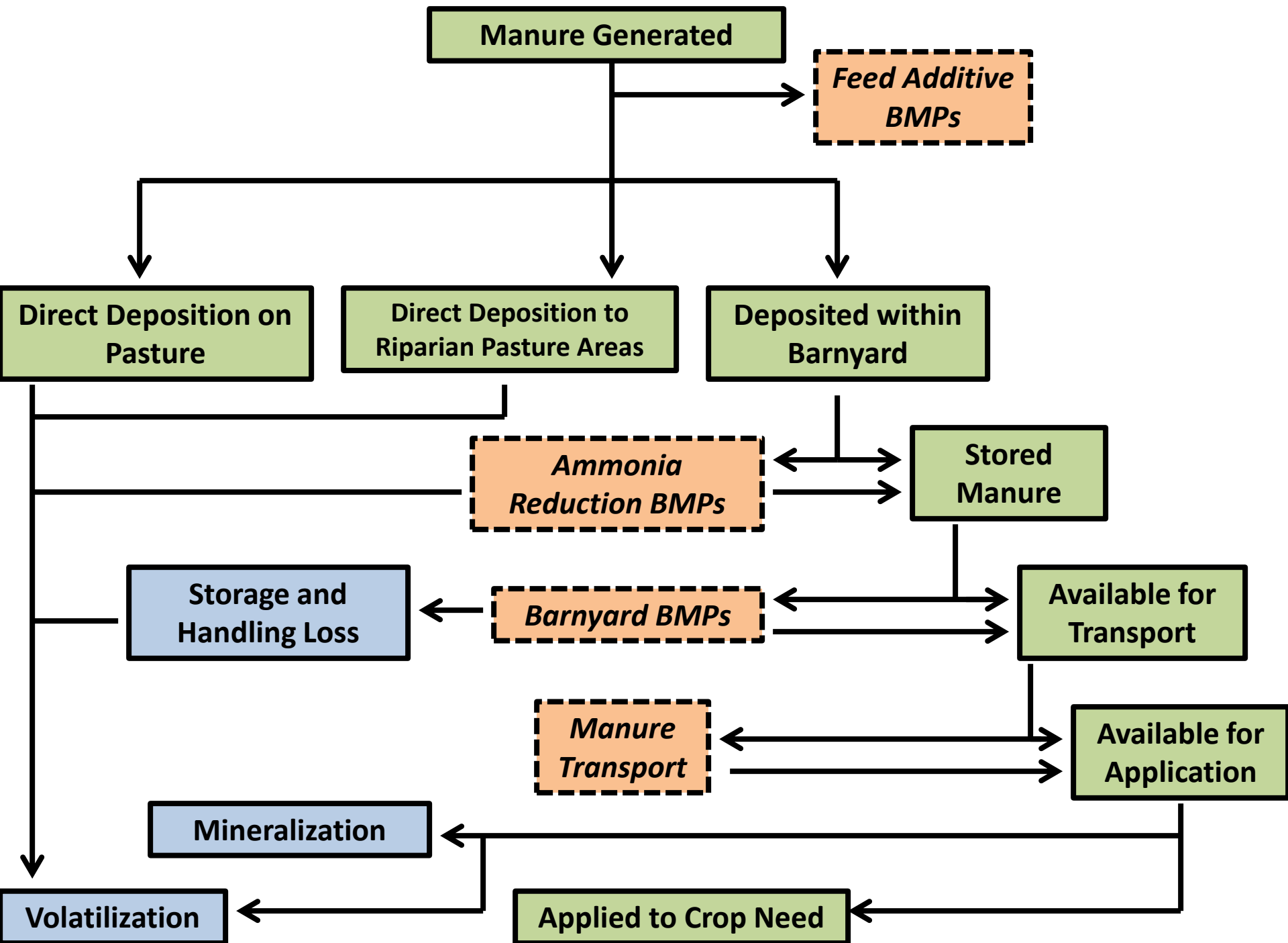
Pasture

Access Area



River

1) Given the state of **available manure** and fertilizer data, please comment on the overall appropriateness of the methods used to estimate **total manure** and fertilizer available for application to agricultural lands.



Estimating Manure Generation

Animal Type	Manure Source	Lbs Dry Manure/Animal/Yr	Lbs TN/Lb Dry Manure	LbsTP/Lb Dry Manure
Beef	Use Beef - Cow (confinement) from ASAE 2005 for manure values	5,475.00	0.028788	0.006467
Dairy	Use Lactating Cow, Dry Cow and Heifer from ASAE 2005 for manure values	4,404.33	0.042221	0.006764
Other Cattle	Use average of Beef and Dairy from above to estimate manure values	4,939.67	0.035504	0.006616
Horses	Use average of Horse- Sedentary and Horse - Intense Exercise from ASAE 2005 for manure values	3,102.50	0.031672	0.005941
Hogs for Breeding	Use Gestating Sow and Lactating Sow ASAE 2005 for manure values	657	0.070273	0.019417
Hogs for Slaughter	Use Grow-Finish from ASAE 2005 for manure values	120	0.083333	0.014167
Sheep and Lambs	Use ASAE 2003 for manure values	240.9	0.038182	0.007909
Goats	Use ASAE 2003 for manure values	680.91	0.034615	0.008462

•Poultry litter estimates vary by year and are explained in detail in the PLS report.

Livestock Manure (and Biosolids)



Barnyard

Fertilizer



1) Given the state of available manure and **fertilizer** data, please comment on the overall appropriateness of the methods used to estimate total manure and **fertilizer** available for application to agricultural lands.

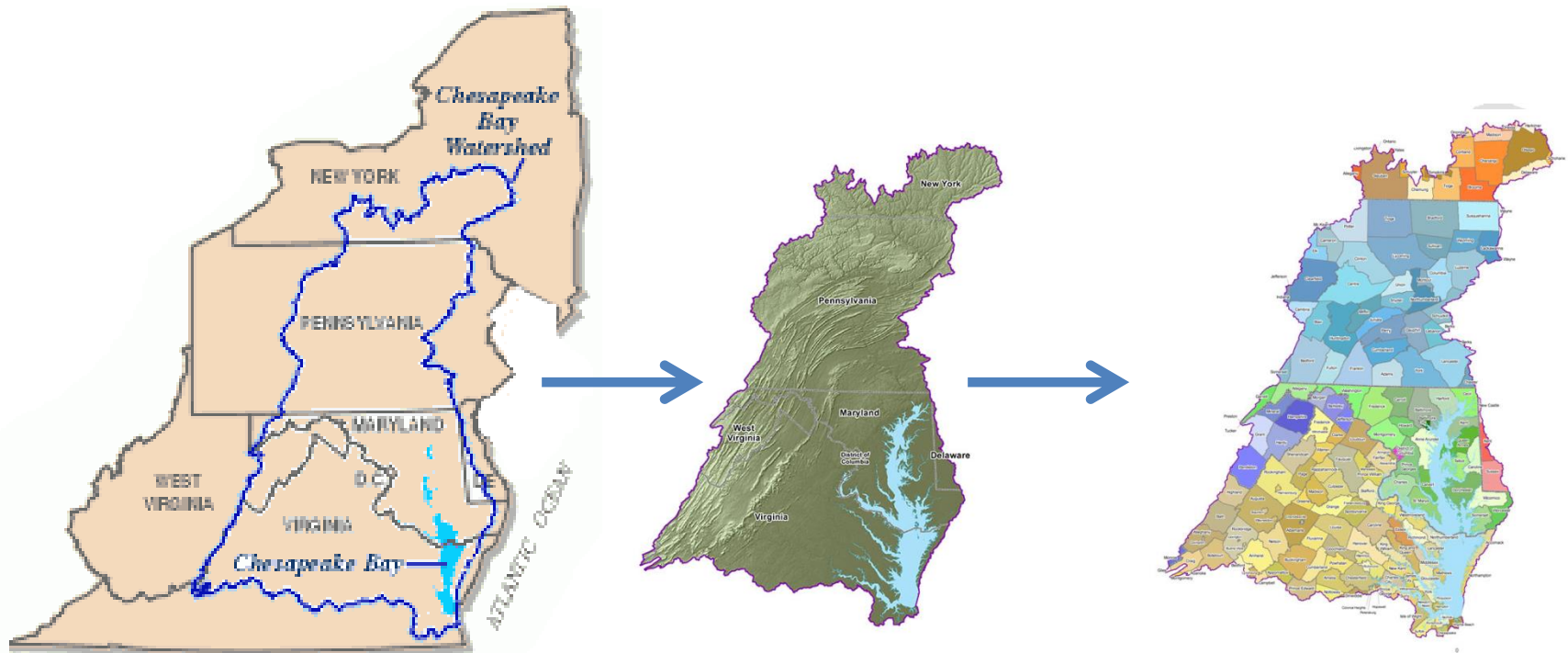
Plant Application Prescription



Crops



Inorganic: Going from Sales to Use



- Begin with regional-level sales, break those down to watershed-level sales, and break those down to county-level use.
- Watershed-level based upon dollars spent on fertilizer within CB watershed counties.
- County-level based upon relative crop need or application goal.

Multiple Lines of Evidence for Fertilizer Use

- Partnership compared Phase 6 fertilizer estimates to CEAP estimates and fertilizer use reported by Maryland farmers in annual implementation reports.

Comparing Total Inorganic Applications to Agriculture in Watershed

Data Source	Lbs Inorganic PAN	Lbs Inorganic P	% Delta from CEAP N	% Delta from CEAP P
CEAP	406,020,000	80,870,000	NA	NA
Phase 6 Beta 3 (Avg. 2001-2006)	405,182,999	80,360,063	-0.20%	-0.60%

Comparing Total Inorganic Applications to Agriculture in Maryland

Scenario	Lbs Inorganic PAN	Lbs Inorganic P	% Delta from AIR for N	% Delta from AIR for P
MD AIR	76,946,211	8,087,974	NA	NA
Phase 6 Beta 3	76,133,253	12,184,432	-1%	51%

Livestock Manure (and Biosolids)



Barnyard

2) Understanding that farmer-reported **nutrient application rates** are not available for the majority of agricultural acres throughout the calibration period (1984-2013), please comment on the overall appropriateness of the methods used to distribute **applications** to crops, hay and pasture.

Fertilizer



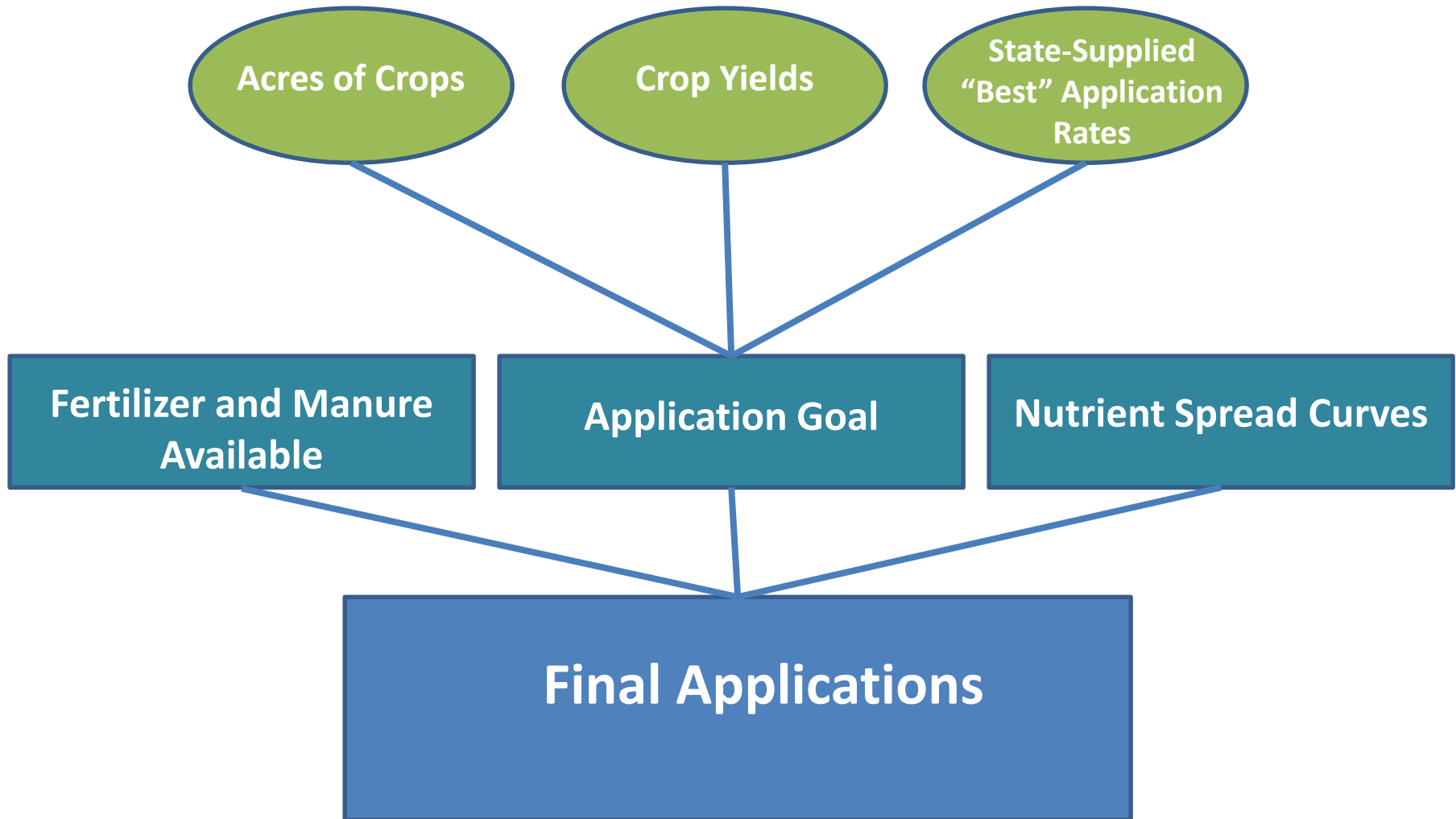
Nutrient Application Prescription



Crops



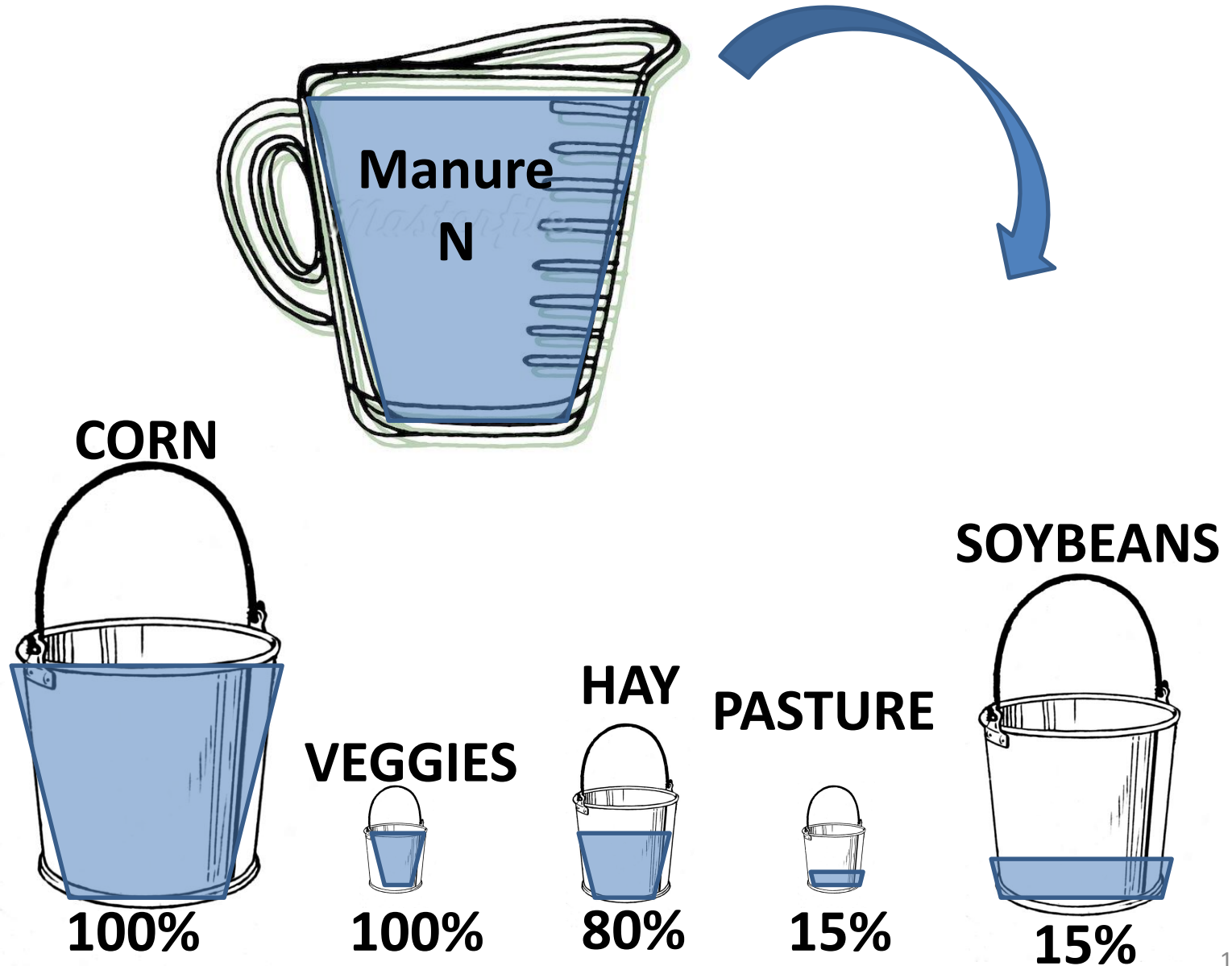
“Prescribing” Applications to Crops



Crop Application Goal

- States provided the following for each crop:
 - Total N and P application goals per acre or yield unit (varied by decade as nutrient management guidelines changed)
 - Example: 1 lb of N/bushel of corn for grain yield
 - Fraction of total application goal which should be met by applications in each month
 - Example: 0.4 of yearly total N on corn for grain should be applied in April
 - Indication of which applications are eligible to be met by only inorganic fertilizer, or by any kind of nutrient in each month
 - Example: April applications are eligible to be met by inorganic and organic fertilizer. June applications are eligible to be met by only inorganic fertilizer.

Filling the Buckets of Application Goal



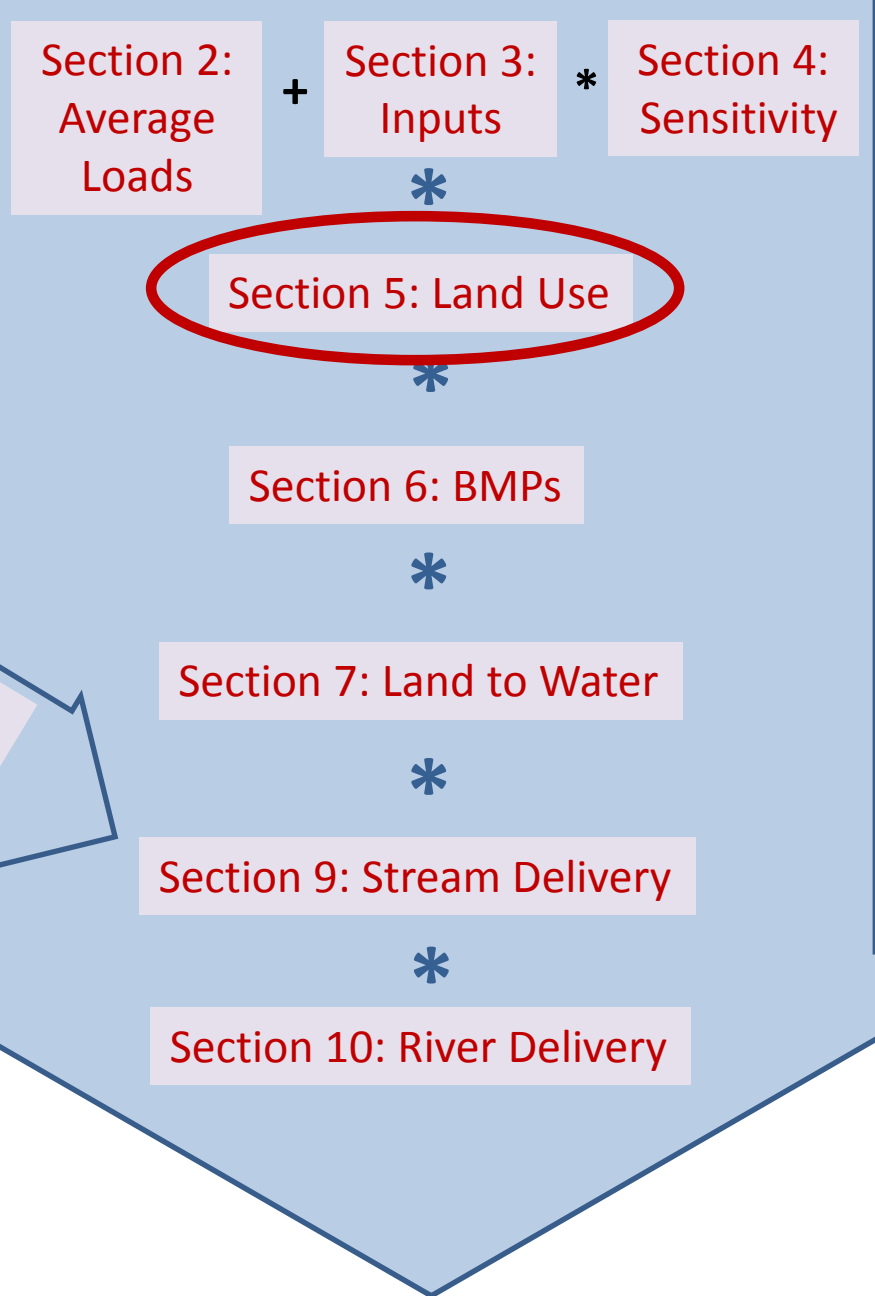
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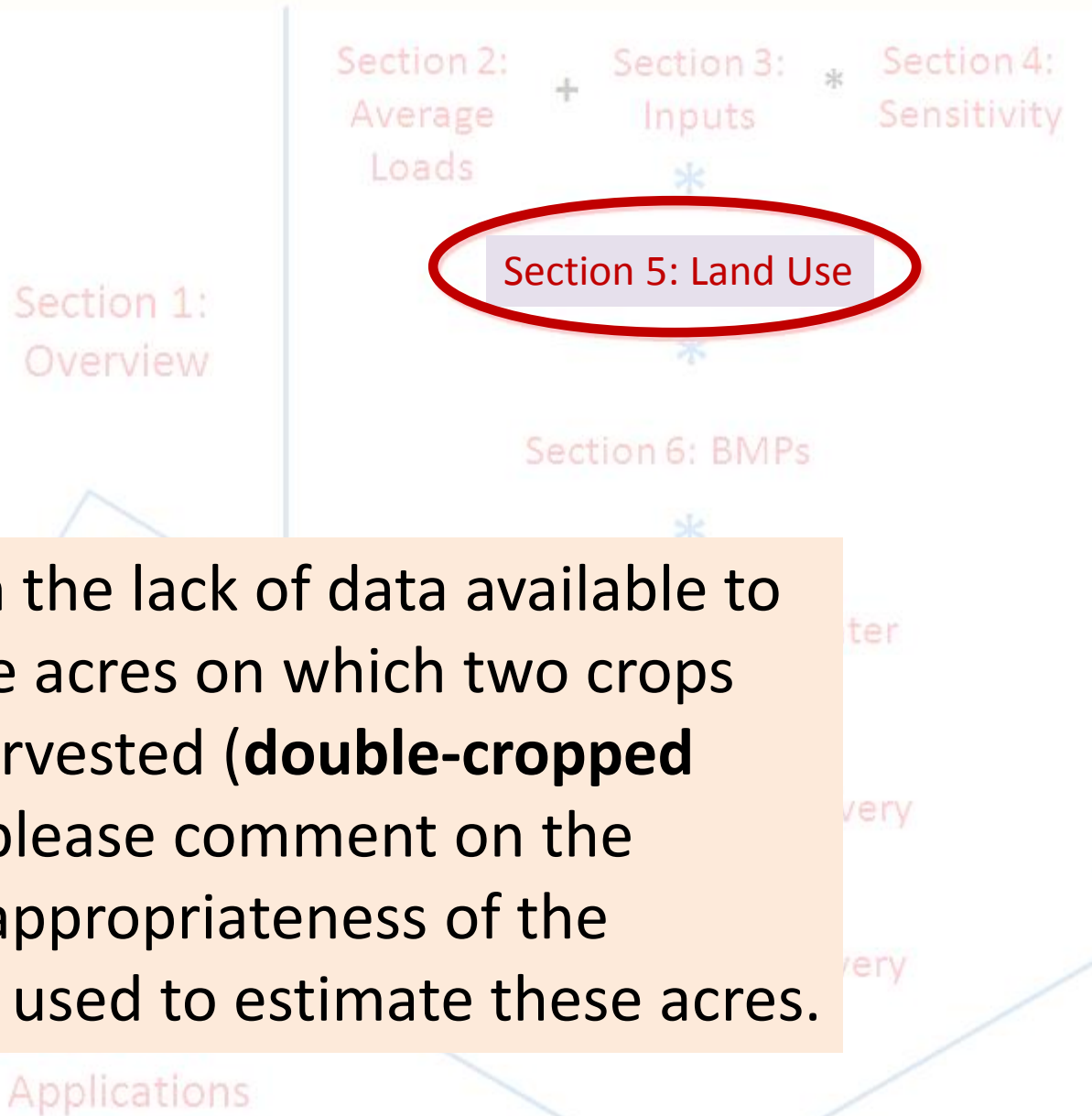
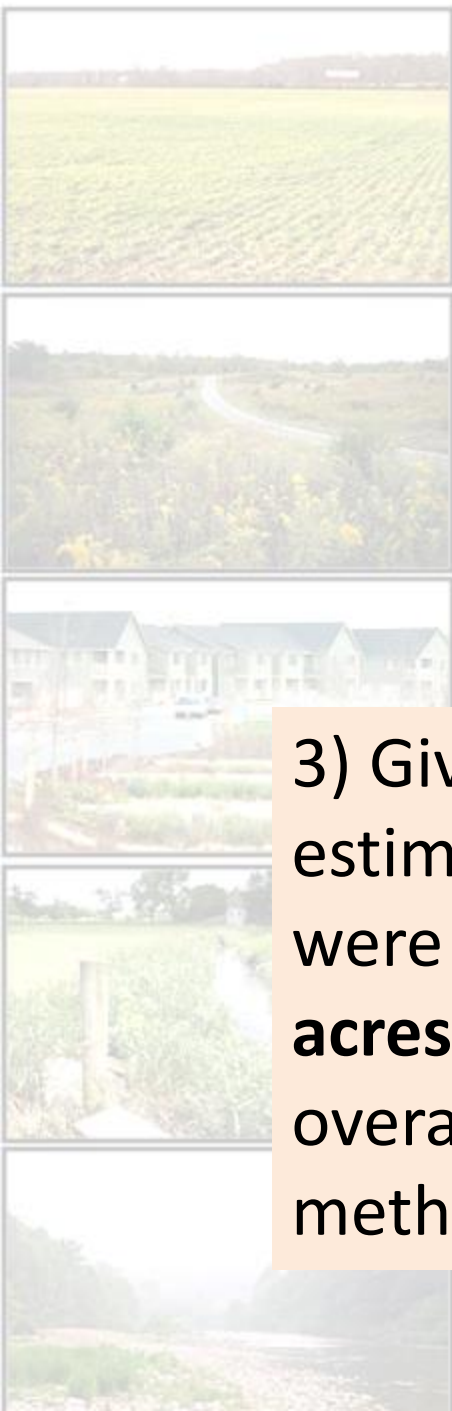
Section 1:
Overview

Section 11:
Applications

Section 8:
Direct Loads

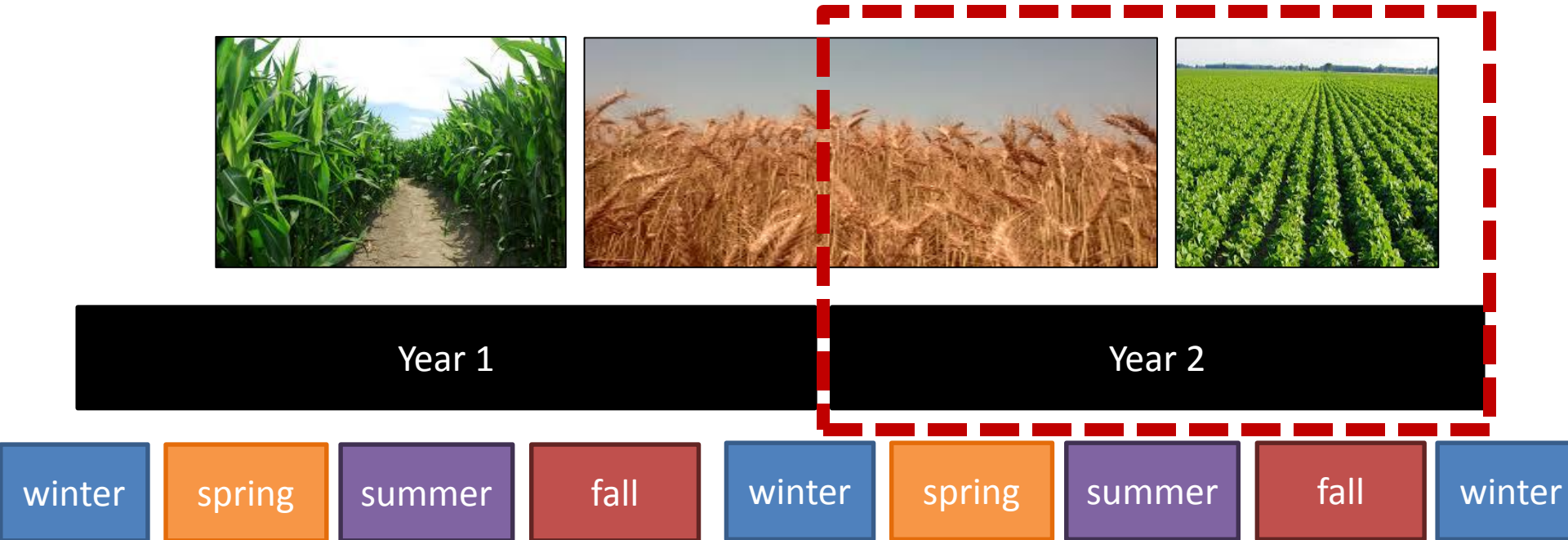


Phase 6 Model Documentation



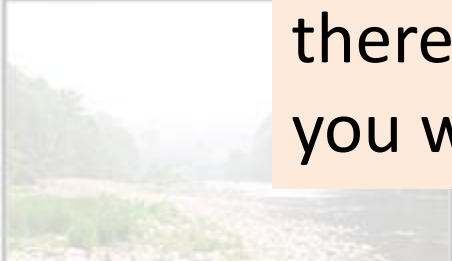
3) Given the lack of data available to estimate acres on which two crops were harvested (**double-cropped acres**), please comment on the overall appropriateness of the method used to estimate these acres.

Double-Cropped Acres



- Acres established by difference of individually harvested crop acres and total harvested cropland from Ag Census.

Phase 6 Model Documentation



Section 1:
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Section 2:
Average
Loads

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Section 3:
Inputs

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Section 4:
Sensitivity

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Section 5: Land Use

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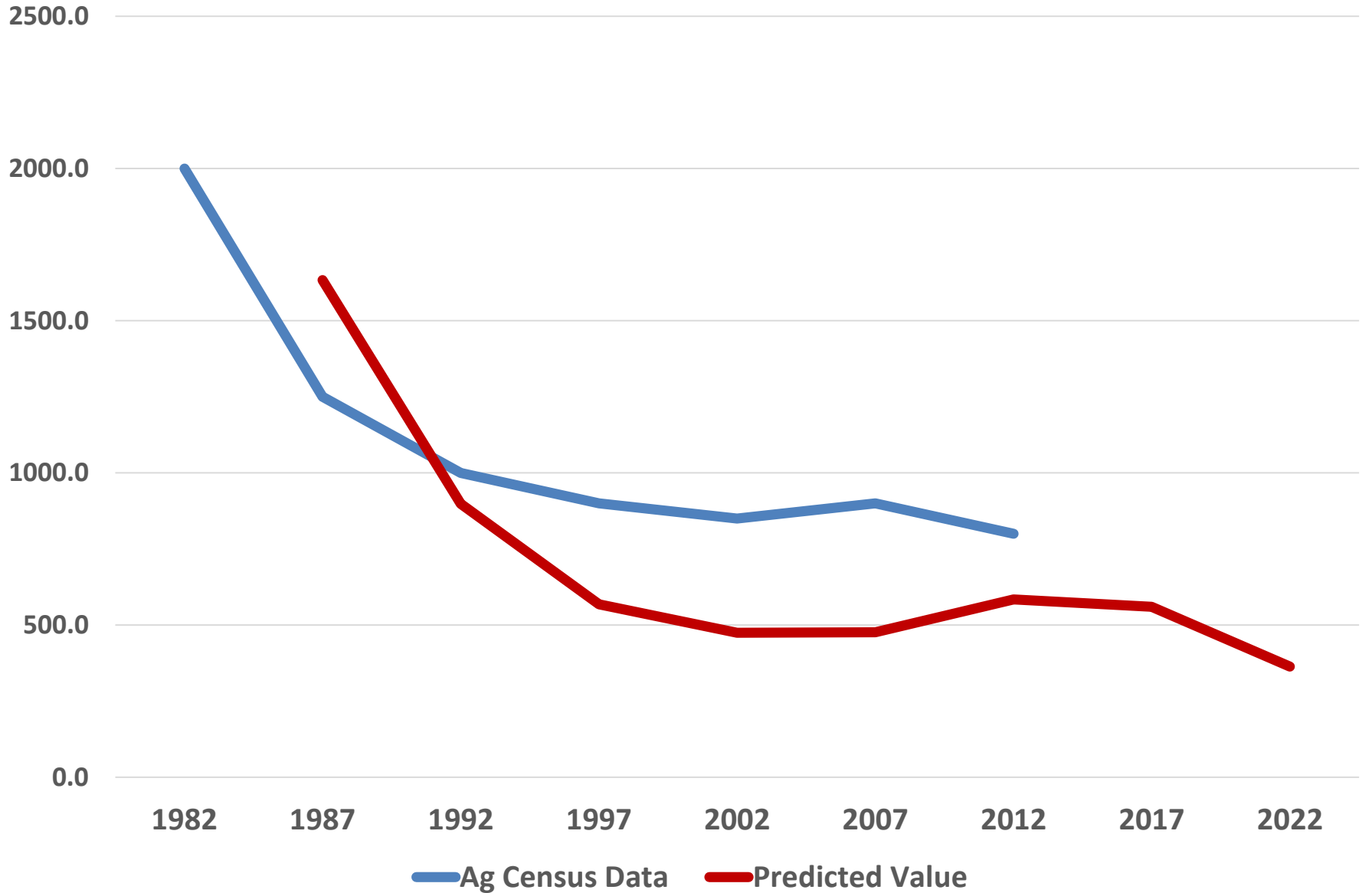
4) Considering the current state of the science related to agricultural forecasting and agricultural economics, please comment on the overall appropriateness of the agricultural forecasting method. Are there alternative forecasting methods you would recommend?

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very
very

Forecasting Agricultural Acres and Animals

- What:
 - Acres of crops forecasted past 2012 (last Ag Census)
 - Livestock, pullets and layers forecasted past 2012 (last Ag Census)
 - Broilers and turkeys forecasted past most recent NASS yearly poultry survey report
- How:
 - Double-exponential smoothing: short-term data forecasting method most often used when future values are believed to be related to both long-term and short-term trends.
 - Different weight is placed on short-term and long-term trends.
 - Ag Workgroup weighted most recent data at 0.8, and long-term data at 0.2.

Example of Double Exponential Smoothing



Phase 6 Model Documentation

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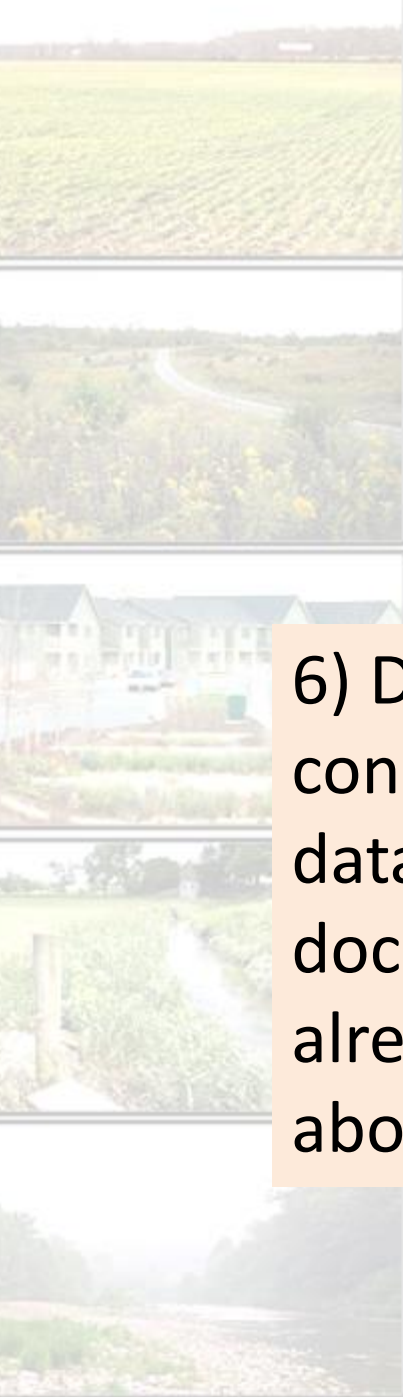
Section 5: Land Use

Section 6: BMPs

5) Does the documentation sufficiently describe the data and methods used to estimate nutrient inputs for the Watershed Model? Please expand if there are particular sections that should be expanded upon or improved.

Applications

Phase 6 Model Documentation



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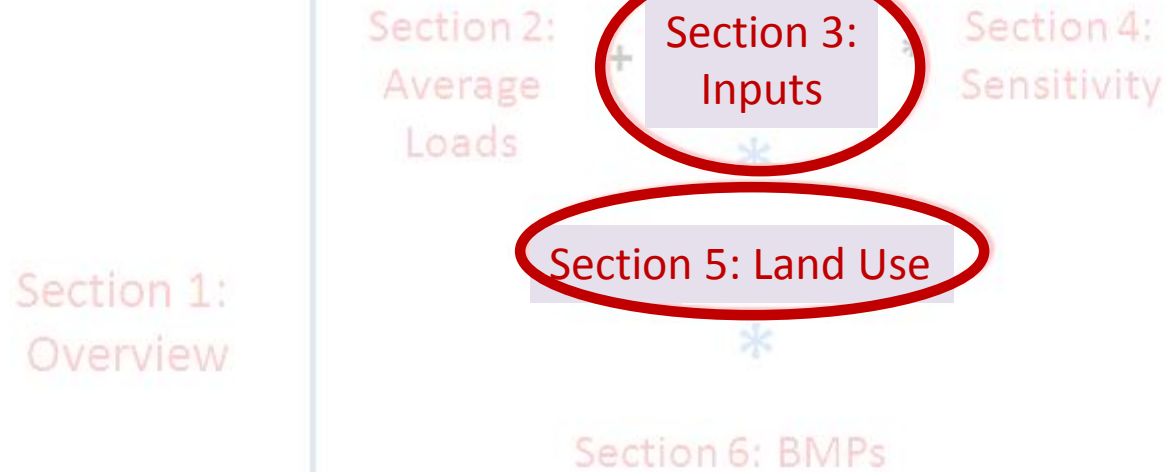
Section 5: Land Use

Section 6: BMPs

Section 11:
Applications

6) Do the reviewers have any concerns or comments about the data or methods described within the documentation aside from those already listed [in the questions] above?

Phase 6 Model Documentation



7) Are there additional technical data or scientific findings that could be employed by the Chesapeake Bay Program now, or developed in the future, to better inform nutrient input estimates across the watershed?

Applications