

**INCORPORATING PRIVATE
INDUSTRY DATA INTO CAST**
*WITH SUPPORTING INFORMATION ON NUTRIENT
DISTRIBUTION IN CAST*

October 2021 AgWG Meeting

Presented by: Vanessa Van Note

RECAP FROM AUGUST MEETING

THE PROBLEM

- **Hillandale Farms, Inc.**
 - CAFO layer facilities in Adams & York Counties are not accounted for in CAST.
 - Hillandale Farms is the largest CAFO in PA.
 - **Adams County in 2017:** 4,630,608 layers
 - **York County in 2017:** 1,229,125 layers
- **How do we know this?**
 - This population is not represented in the Ag Census.
 - **Adams Ag Census 2017:** 210,832 layers (192 Farms)
 - **York Ag Census 2017:** 274,531 layers (343 Farms)



Reviewed Ag Census and NASS Survey to **determine Hillandale Layer population was not present.**

Facility Layer Inventory Data used to **derive a Change Product** to combine with existing CAST layer population.

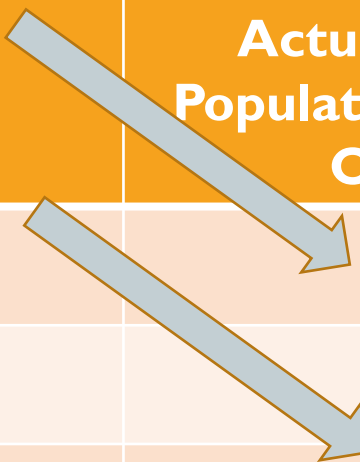
ON DATA
NMPs and CAFO permits used to **cross check facility numbers.**

1. 2017 NASS (National Agricultural Statistics Survey) **Census of Agriculture**
2. **NASS Annual Statistical Survey**
3. Hillandale Farms **Facility Layer Inventory Data**
4. Nutrient Management Plans (**NMPs**)
5. **CAFO** (Concentrated Animal Feeding Operation) Permits
6. Pennsylvania Manure Management Plans (**MMPs**)

THE CHANGE PRODUCT METHODOLOGY

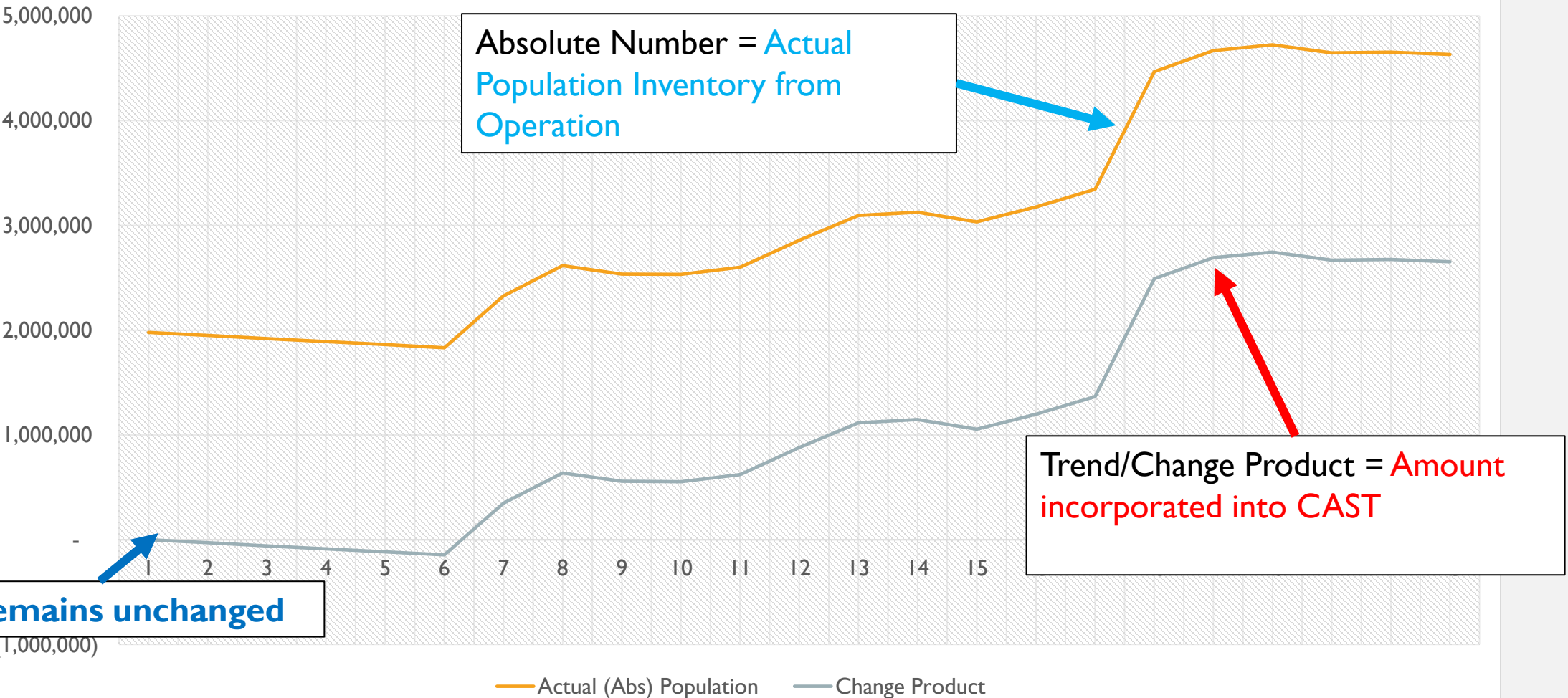
- As a **“Change Product”** or year-to-year change added to **existing population currently in CAST.**
- What is a “Change Product”?

Year	Actual (Absolute) Population Provided by Operation	Change Product (Amount incorporated into CAST)
1995	100	0
1996	200	100
1997	100	0
1999	400	300
2000	500	400



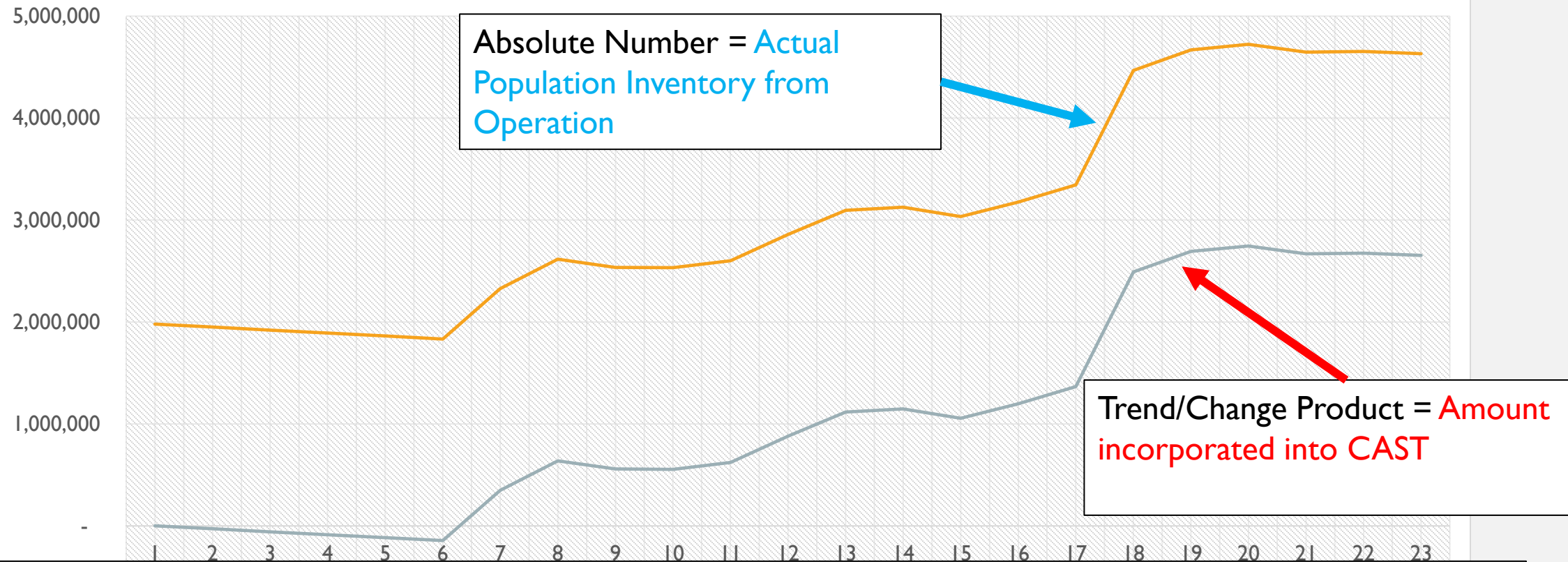
VISUAL EXPLANATION OF RELATIVE CHANGE

Difference between the Actual (Absolute) Population and the Change Product Amount



VISUAL EXPLANATION OF RELATIVE CHANGE

Difference between the Actual (Absolute) Population and the Change Product Amount



To summarize:

- Rather than incorporate 4.6 million layers into Adams existing layer populations, we incorporate 2.6 million.
- Rather than incorporate 1.2 million into York, we incorporated 891,000.

QUESTIONS POSED TO THE WG

- **To discuss and determine which data sources are acceptable alternatives or supplements to the Ag Census.**
 - For Hillandale, this data would supplement the Ag Census within CAST.
- **Is facility data an acceptable supplement or alternative to the Ag Census?**
- How do we identify gaps in our existing animal populations that are present due using only the Ag Census as a basis for animal populations in the model?
- Once gaps are identified, how do we fill them?

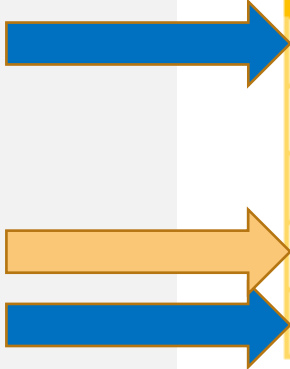
QUESTIONS POSED TO THE WG

**** Before getting to the methodology for incorporating facility population data, we must determine if private industry population data is appropriate to incorporate into our modeling tools.**

MECHANICS OF MANURE DISTRIBUTION

WHY ARE WE TALKING ABOUT THIS?

Table 3. The Estimated EOT Load % Increase between 2017 Progress without the Hillandale Population and 2017 Progress with the Hillandale Population



Geography	EOT N Change	EOT P Change	EOT S Change
Adams, PA	4%	15%	-
Franklin, PA	0.1%	-	-
Lancaster, PA	0.1%	-	-
Sussex, DE	0.2%	-	-
York, PA	0.8%	7%	-

(Positive percentages represent an increase in loads.

Load change = 2017 Progress with Hillandale Population – 2017 Progress without Hillandale Population)

How can the addition of manure nutrients in one county impact nutrients and loads in other counties?

WE WILL LOOK AT:

1. **How manure is distributed in CAST** – Basic Understanding
2. **What variables changed with the introduction of Hillandale Layers?**
 1. Why did the addition of manure in two PA counties impact loads in other counties throughout the watershed?
 2. The root cause(s) of the load changes due to the increase in Adams's and York's layer populations.

MANURE AS AN AGRICULTURAL LAND INPUT

(MODEL DOCUMENTATION SECTION 3: TERRESTRIAL INPUT)

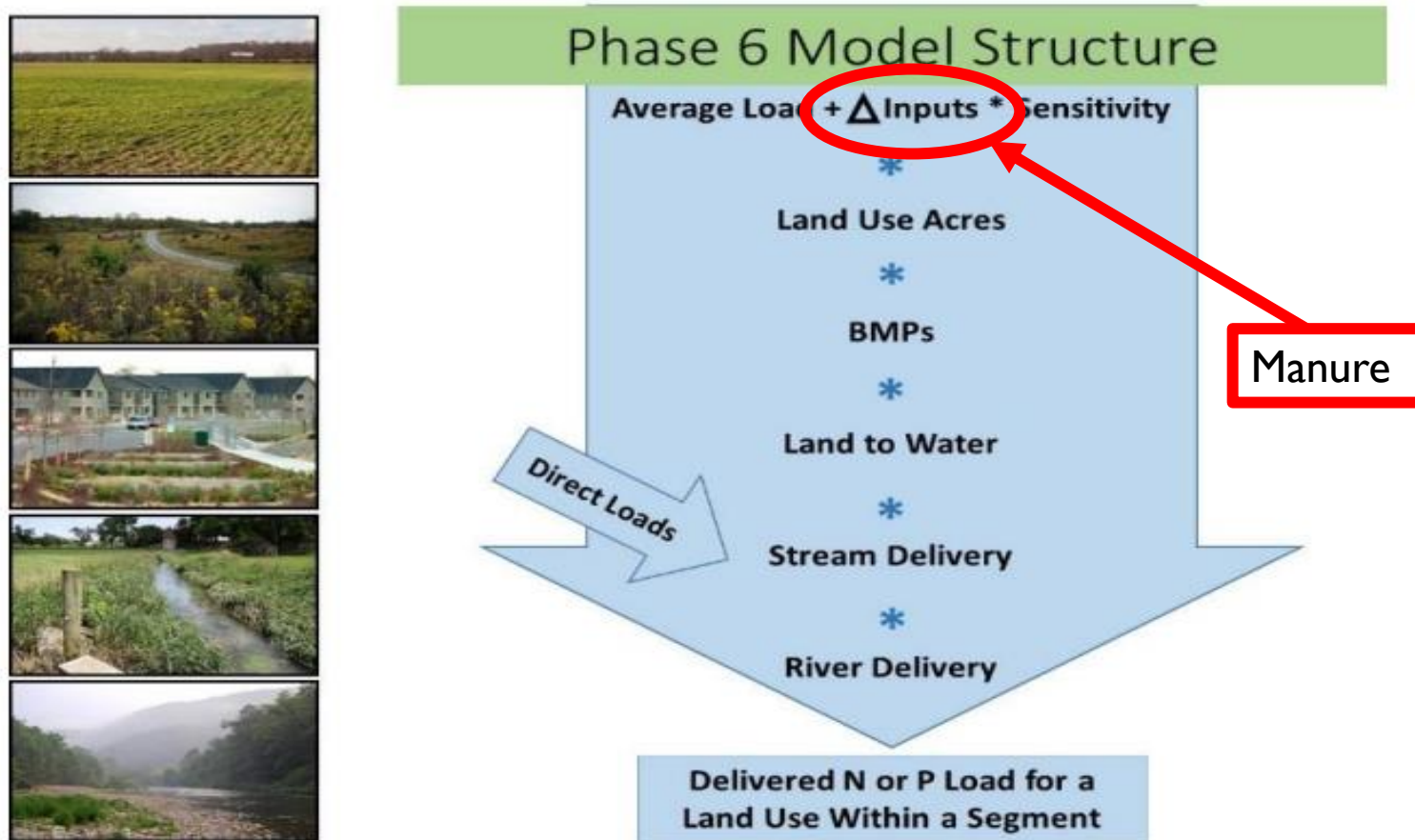
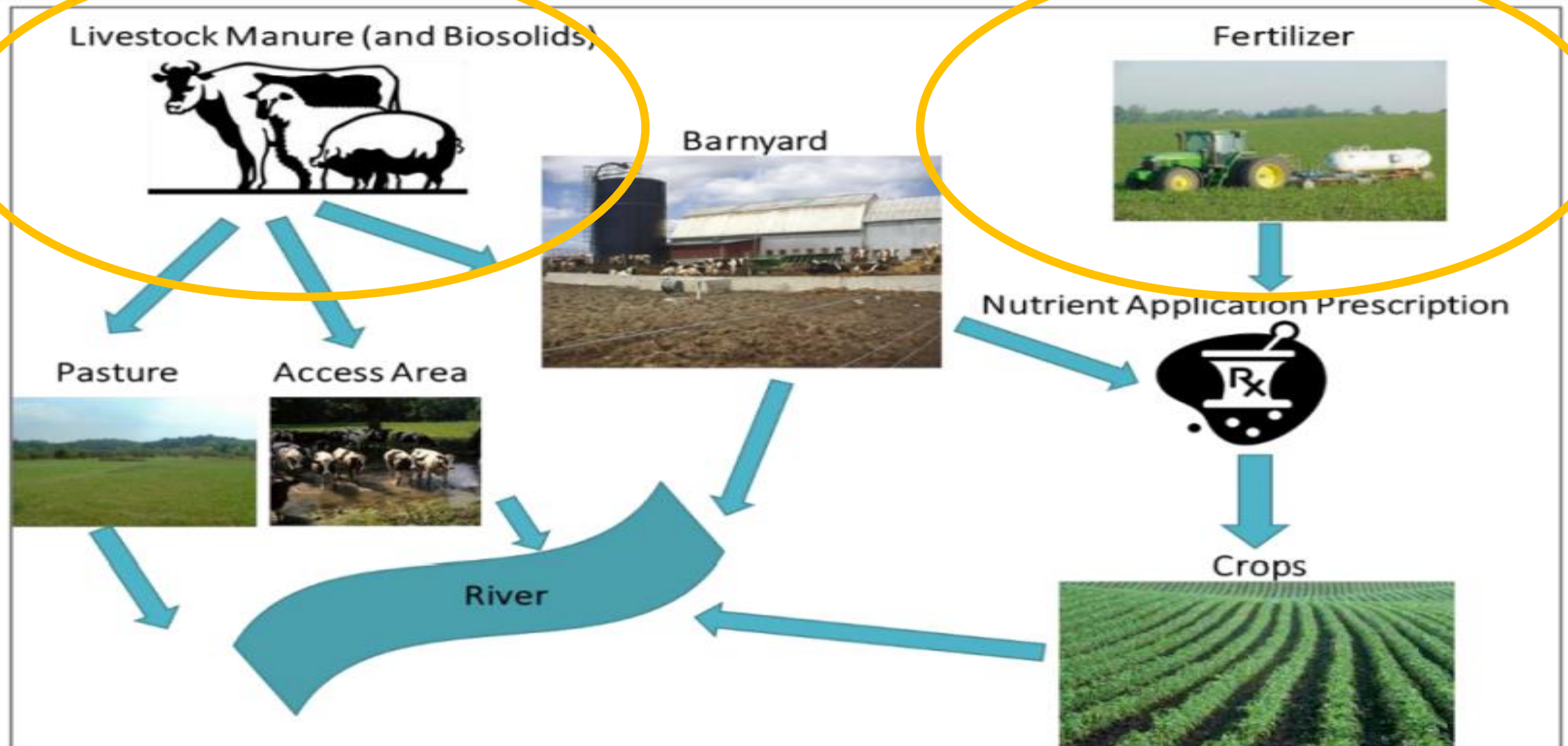
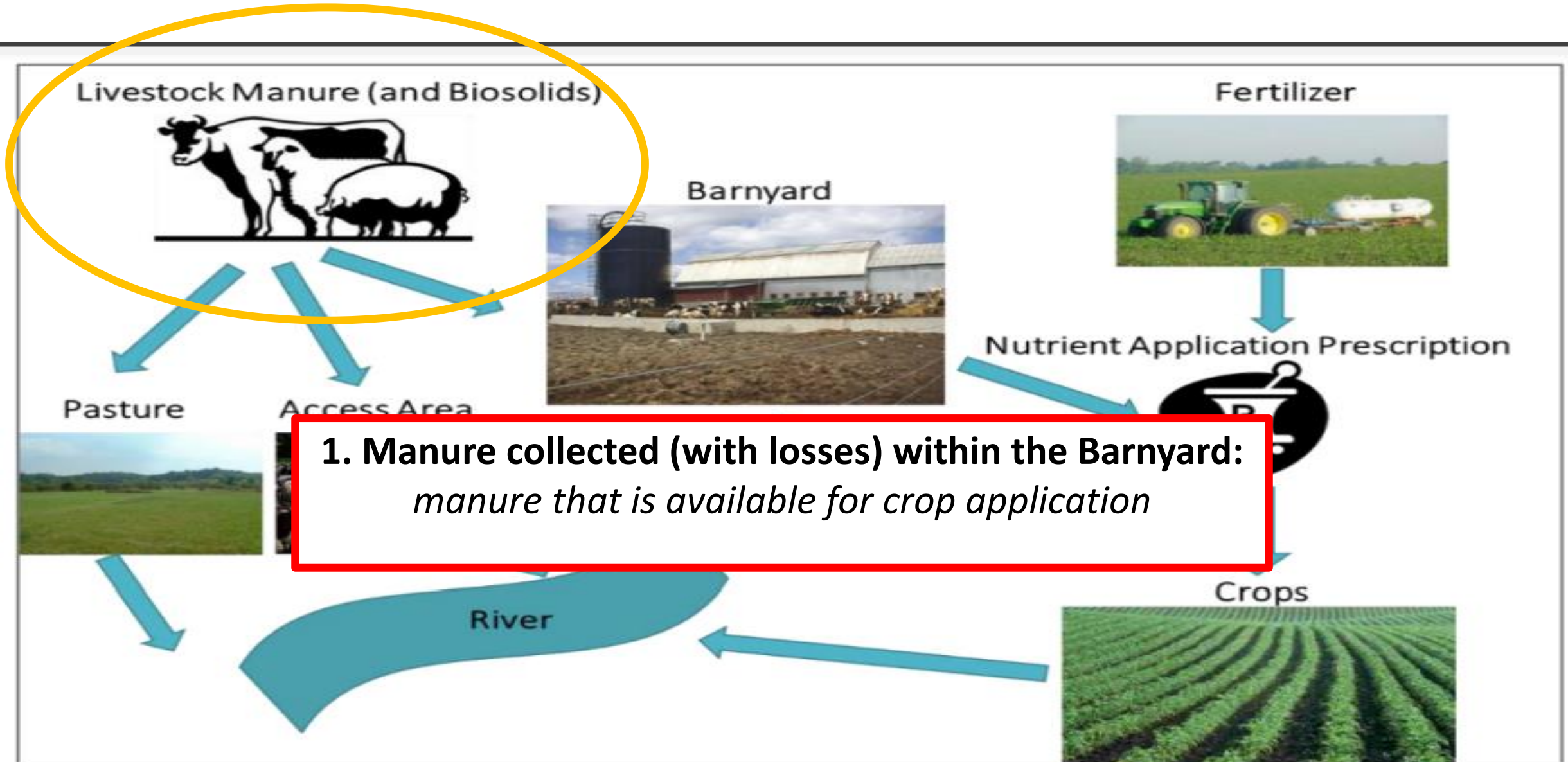


Figure 3-1: Phase 6 Model structure

CAST (PHASE 6) SEPARATES NUTRIENT INPUTS TO AG LANDS INTO THE FOLLOWING CATEGORIES:

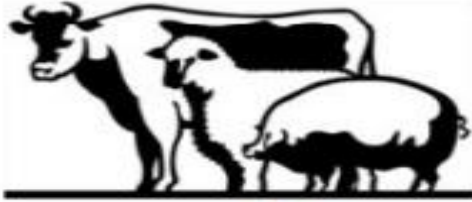


MANURE CATEGORIES:



MANURE CATEGORIES:

Livestock Manure (and Biosolids)



Barnyard



Fertilizer



2. Manure deposited on pasture

Pasture



Access Area



Nutrient Application Prescription



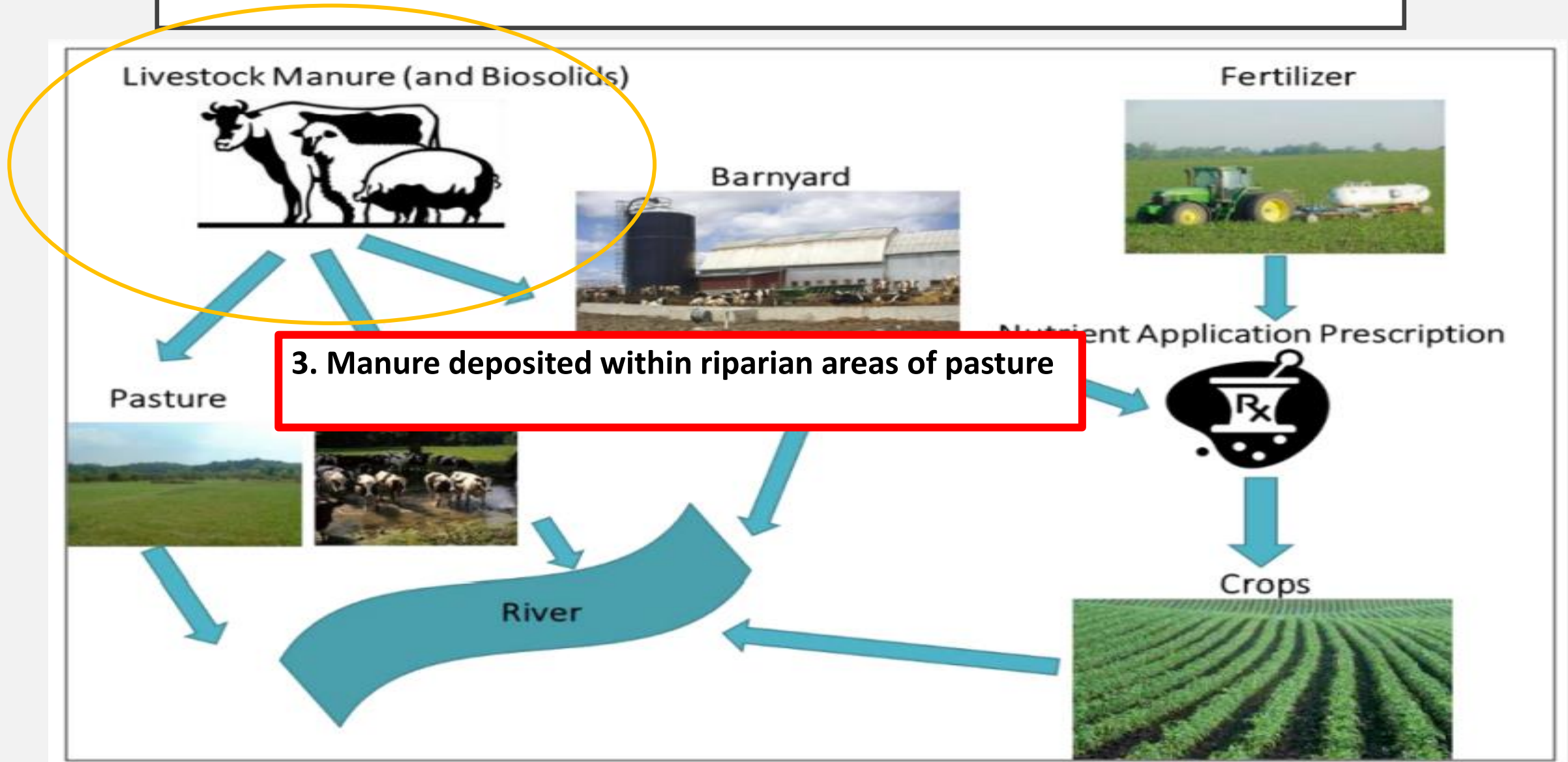
Crops



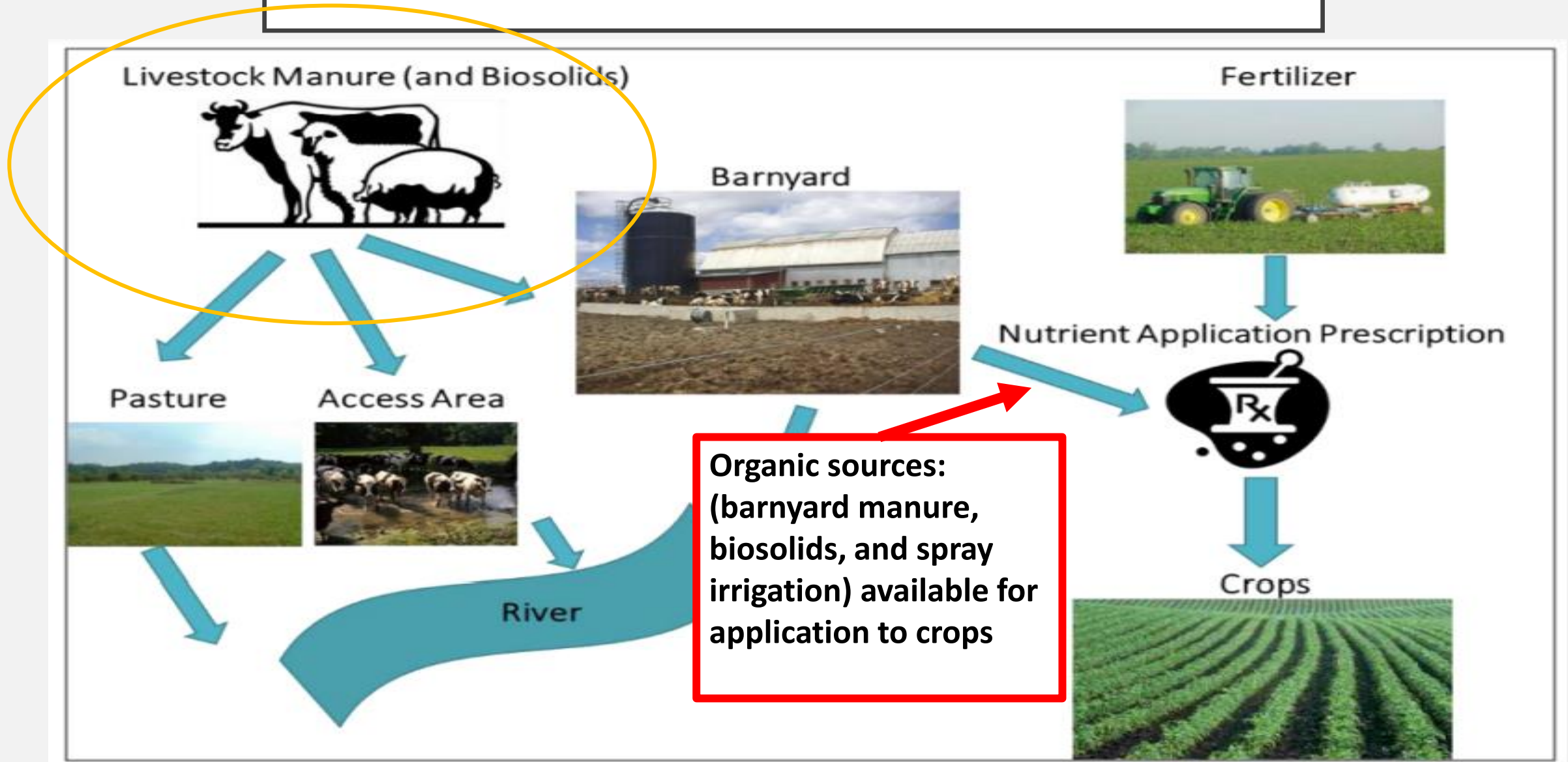
River



MANURE CATEGORIES:

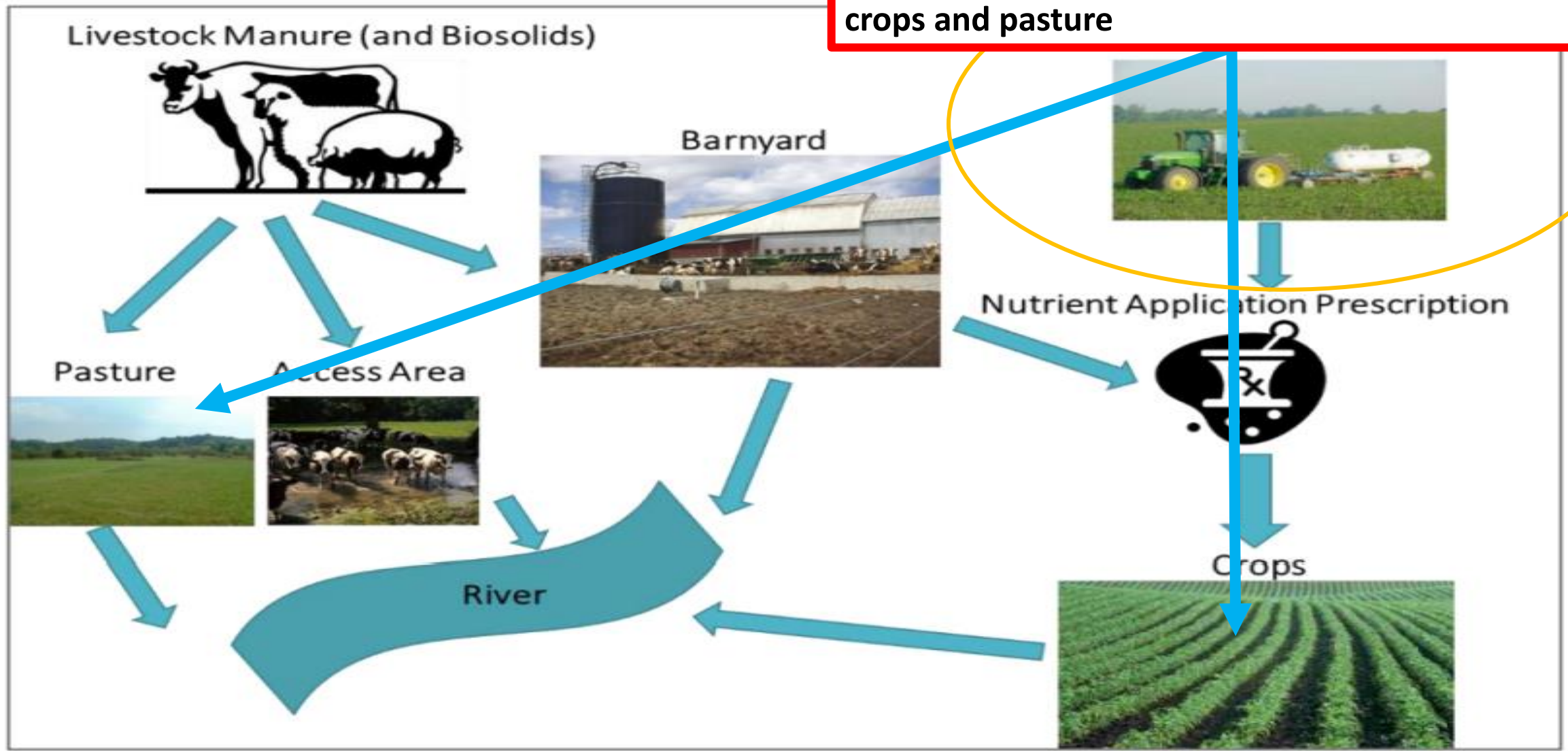


APPLICATION OF MANURE TO CROPS



THE FINAL CATEGORY: INORGANIC FERTILIZER

4. Inorganic fertilizer available for application to crops and pasture



THE “FATE” OF MANURE AFTER EXCRETION

- CAST will prioritize manure or organic fertilizer applications to inorganic fertilizer applications for organic eligible application goals.
- *What do we mean by “organic fertilizer”?*
 - Biosolids and Manure. Biosolid applications are handled prior to manure.
- Each crop has a specific crop need, or *crop application goal to meet crop yield*, Organic fertilizer cannot be used to meet inorganic only crop applications.

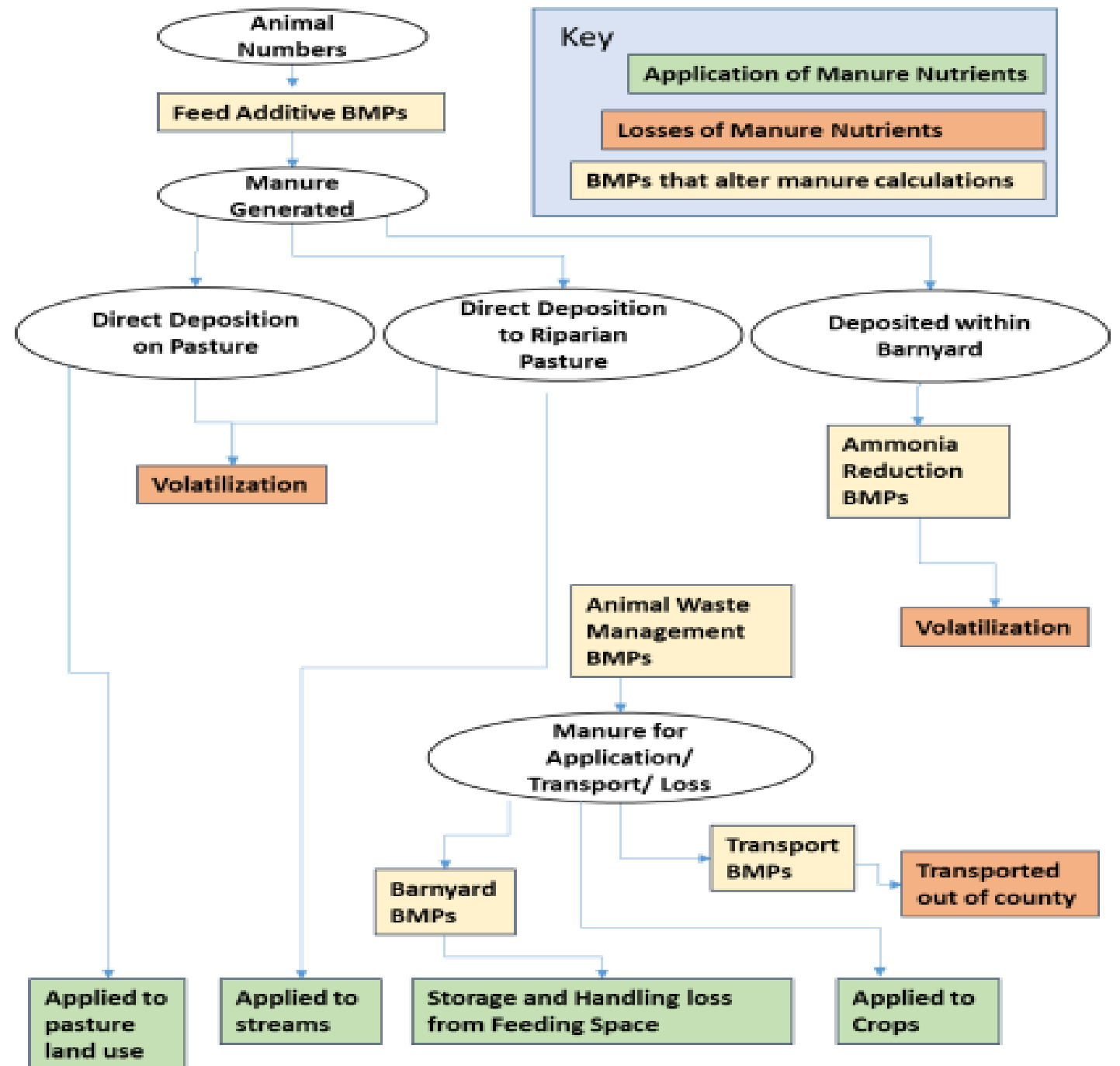
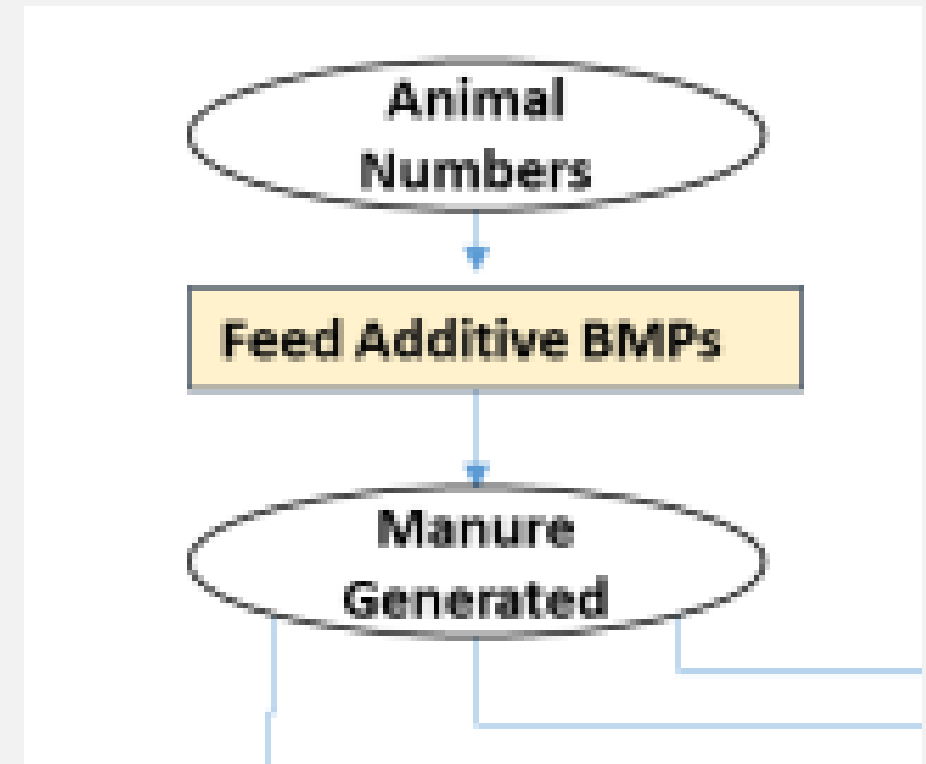


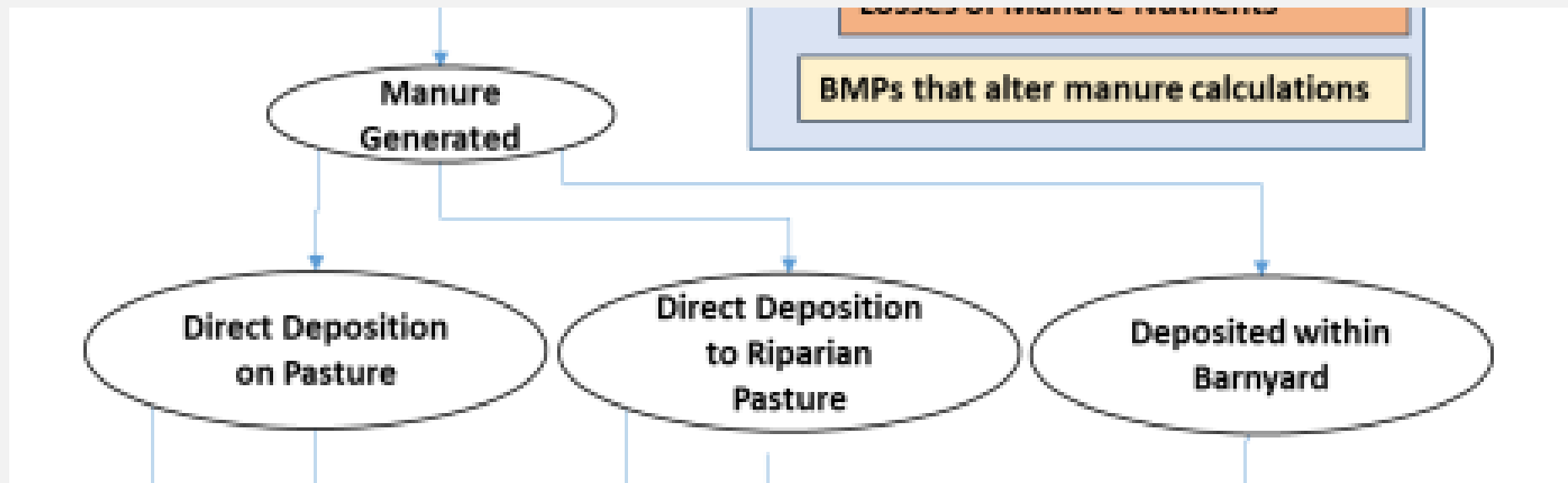
Figure 3-6: Manure application processes

HOW MANURE IS GENERATED IN CAST

- The amount of manure generated **is estimated** from:
 - 1) animal numbers,
 - 2) the average daily rate of manure production for an animal,
 - 3) and the estimated nutrient content of the manure.
- The amount of manure generated in CAST can be modified by feed additive BMPs.



HOW MANURE GENERATED IS DISTRIBUTED



After manure is distributed, it is **further subject to losses through a combination of volatilization, storage and handling loss, and manure transport**, depending upon the area of deposition.

DIRECT DEPOSITION ON PASTURE

1. This is manure that will be unavailable for manure transport or application to meet crop application goals.
2. This manure is not applied toward the pasture's crop application goal, meaning the pasture will still be eligible to receive supplemental manure and/or inorganic fertilizer applications later in the scenario simulation to meet its crop need.

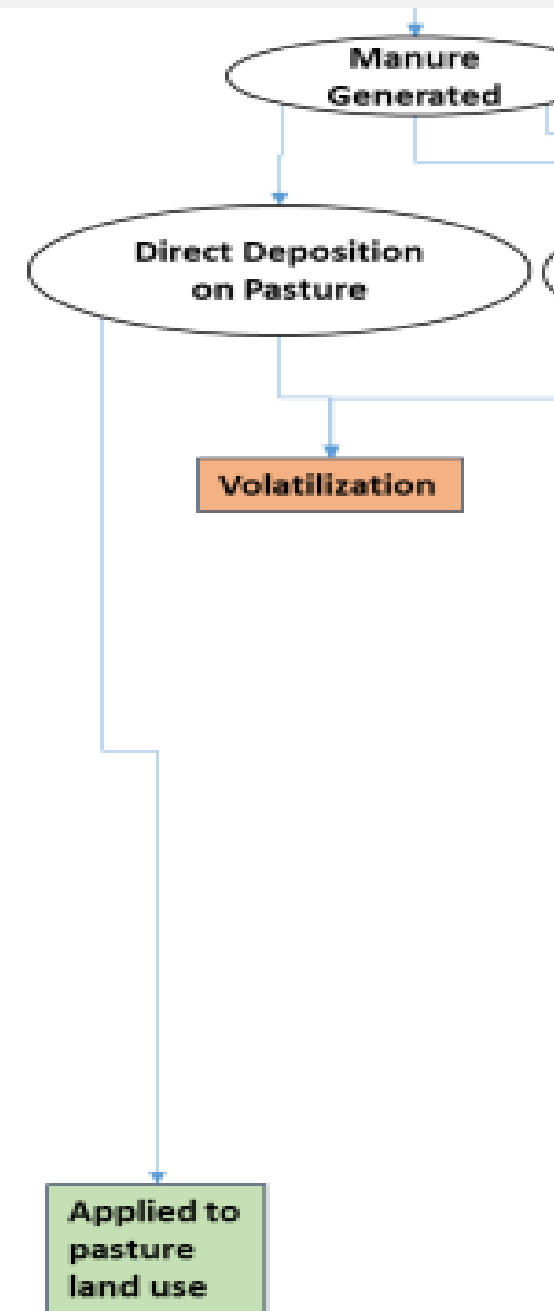
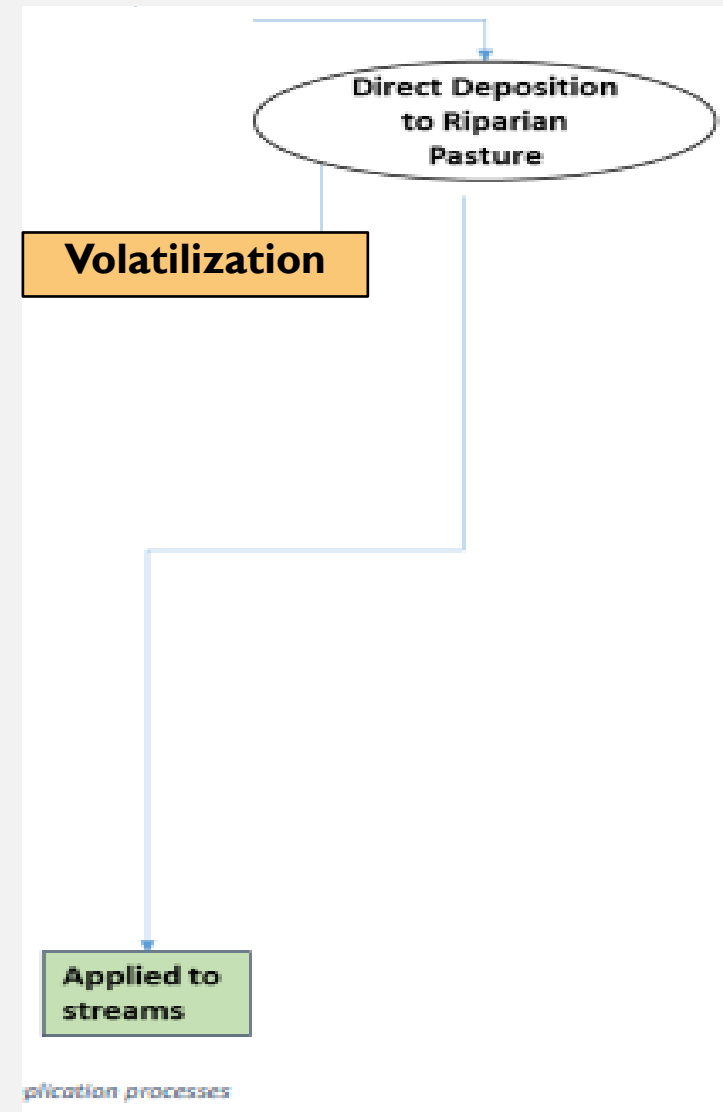


Figure 3-6: Manure a

DIRECT DEPOSITION TO RIPARIAN PASTURE



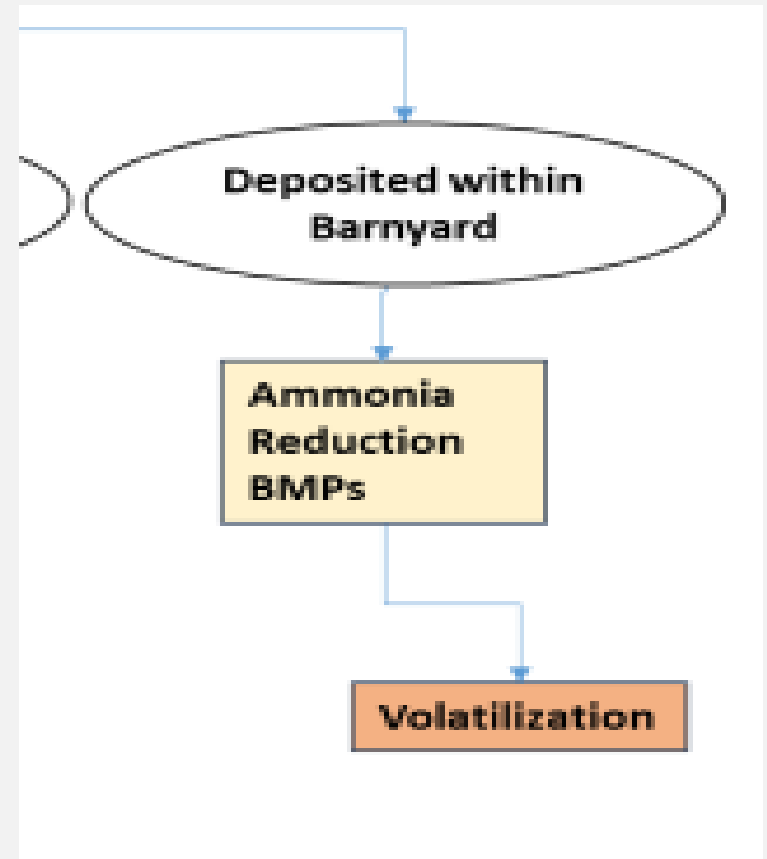
DEPOSITED WITHIN BARNYARD

All manure deposited within the barnyard can be:

- 1) lost as part of incidental barnyard losses to the environment;**
- 2) collected and transported to another county through manure transport;**
- or 3) applied to crops within the county.**

Barnyard BMPs:

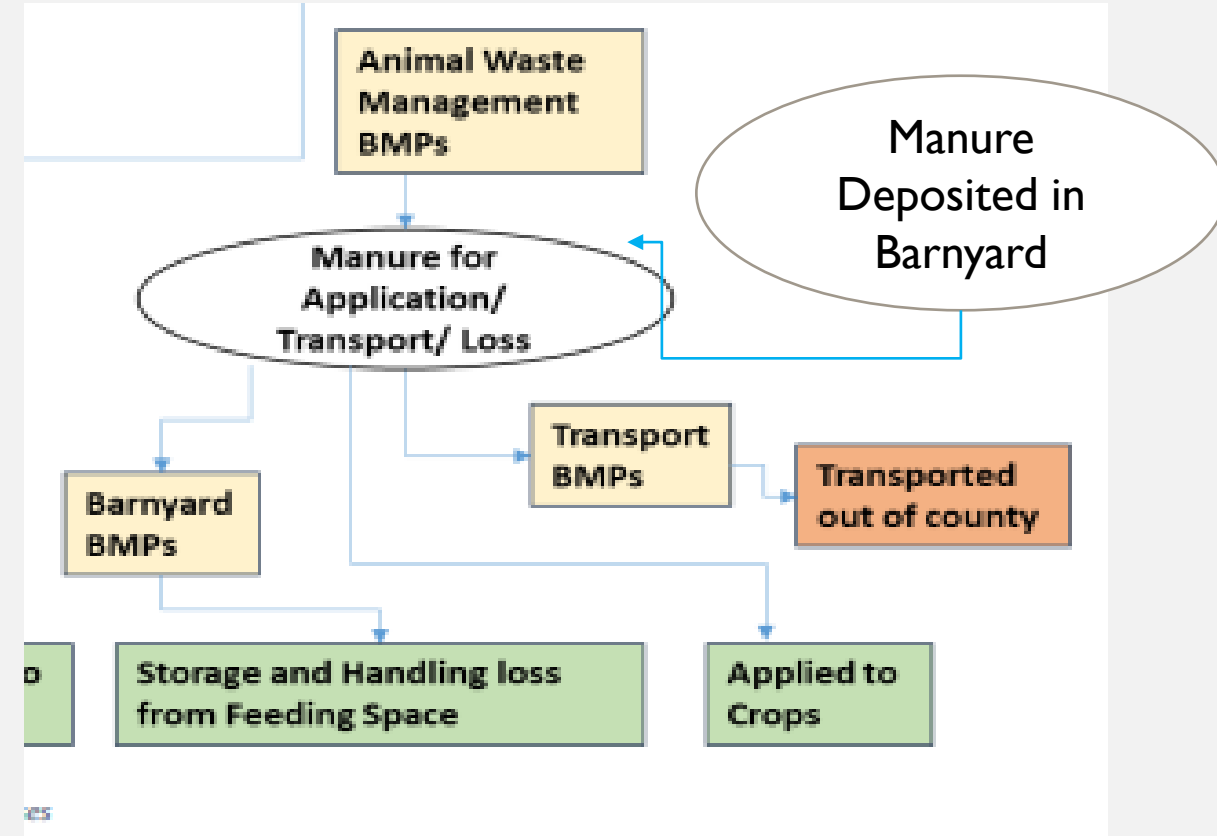
- **Ammonia Emission Reduction BMPs**, like biofilters for poultry houses, lagoon covers for cattle operations, and poultry litter amendments can all reduce ammonia emissions in the barnyard by making ammonia plant available or reducing the atmospheric deposition load delivered to tidal waters.
- **Manure Treatment Technologies** transport manure nutrients out of a county. Following transport, manure nutrients may be reduced using a reduction efficiency (Ex. MTT18) or a reported reduction (Ex. MTT19)



LOSS OF MANURE

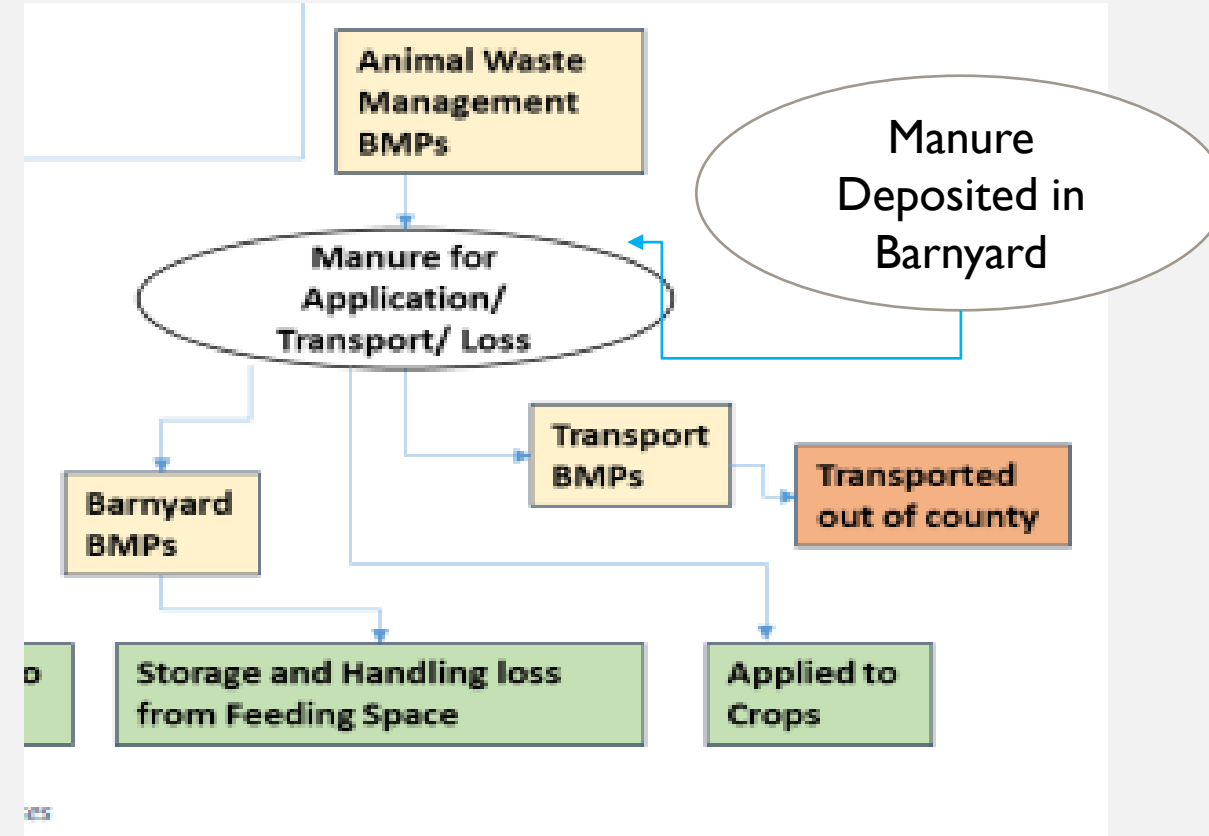
Storage Handling and Loss: the portion of manure deposited within the barnyard that **is considered unrecoverable** due to incidental losses to the environment immediately adjacent to the barnyard.

- These incidental losses **become the nutrient load for the permitted feeding space and non-permitted feeding space** land uses after watershed processing losses are considered.
- All remaining manure is considered recoverable and available for manure transport and application to crops.



MANURE FOR TRANSPORT

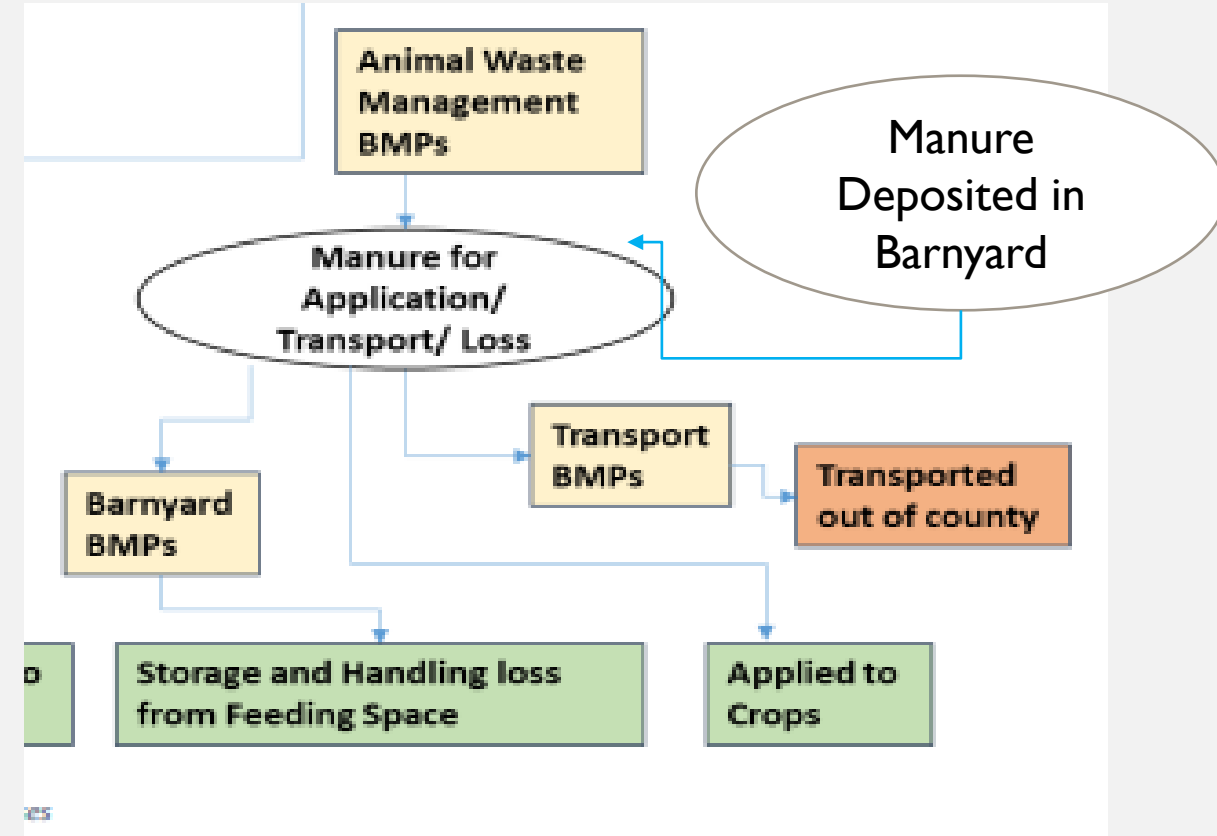
Manure for Transport: All manure which is **recoverable** after **AWMS BMPs** are accounted for is made available for manure transport.



MANURE FOR APPLICATION

Applied to Crops: CAST applies manure nutrients on a slope prioritizing applications to **higher-commodity crops first, like vegetables and corn, before applications occur on crops such as pasture, hay and legumes.**

- Per the **nutrient spread slope**, the order of priority for manure N is:
 - 1) Grains/Specialty Crops,
 - 2) Non-Legume Hay/Pasture,
 - 3) Row Crops/Legume-hay



THE FLOW PATH HILLANDALE MANURE NUTRIENTS FOLLOWED IN CAST (WITH MT BMP)

EXAMPLE 2017 PROGRESS SCENARIO WAS RUN WITH A DRAFT VERSION OF CAST-21

Layer Population introduced to Adams and York Counties

Permitted Feed Space Acres
Increased – Increase in
Nutrient Loading EOT

Manure from Hillandale Layers Generated

Volatilization

Manure distributed to
Barnyard (permitted
feeding space)

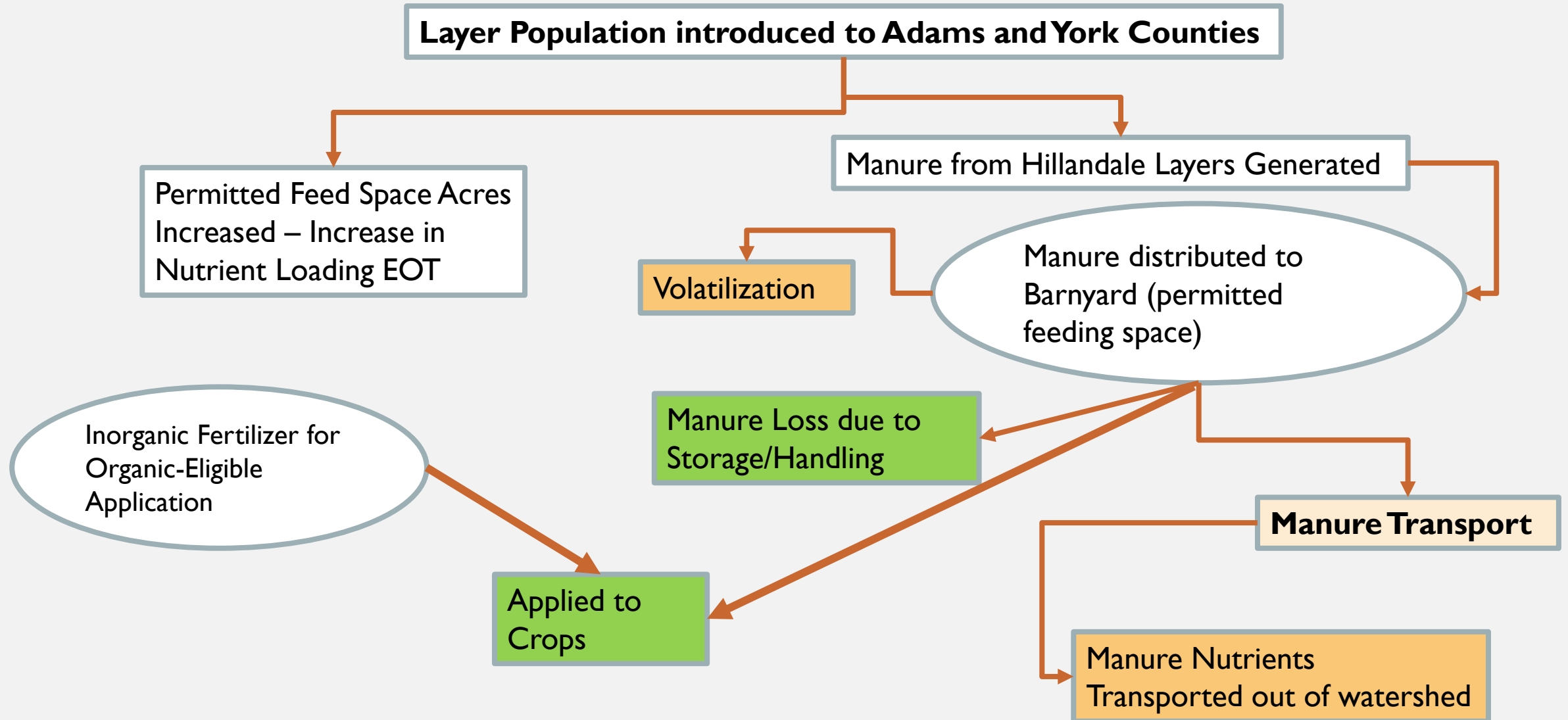
Inorganic Fertilizer for
Organic-Eligible
Application

Manure Loss due to
Storage/Handling

Applied to
Crops

Manure Transport

Manure Nutrients
Transported out of watershed



SO, WHEN THE HILLANDALE FACILITY (LAYER
POPULATION AND TREATMENT TECHNOLOGY) WERE
ADDED, WHAT CHANGED?

1. The **amount of manure generated** due to the animal population increasing.
 - This impacts the manure available for application.
 - Manure available for manure transport.
 - Ammonia volatilized as excreted in the barnyard.
2. **Permitted feeding space** land use acreage within Adams and York counties.
 - This change impacts all ag land uses.
3. The **application of inorganic fertilizer** to meet crop need.

WHAT DIDN'T CHANGE?

1. **Nutrient management Core** Implementation Rate in Adams and York Counties
2. **Ammonia Emission BMPs**
3. **Barnyard BMPs**, like animal waste management systems

WHAT CHANGED: INCREASE IN FEEDING SPACE

- **Feeding space is calculated** using the **reported animal population and estimated average areas per animal of roofed structure/barnyard.**
- There is a **set amount of acreage** available in a land river segment across all land uses in the model, **an increase or decrease in feeding space due to an increase or decrease in population will impact the distribution of acres across agricultural land uses.**



THE FLOW PATH OF HILLANDALE MANURE NITROGEN IN ADAMS COUNTY: *THE DIFFERENCE BETWEEN 2017 PROGRESS WITH HILLANDALE LAYERS AND 2017 PROGRESS WITHOUT HILLANDALE LAYERS*

EXAMPLE 2017 PROGRESS SCENARIO WAS RUN WITH A DRAFT VERSION OF CAST-21

2.6M Layers added to Existing Layer Population in Adams via a Change Product

Permitted Feed Space Acres Increase by 106 acres with a loading rate increase of 72,000 lbs N due to manure losses

1.5M additional lbs of manure nutrients generated

Feed Space Manure increases by 169,000 lbs manure nutrients

AVMS and BRC BMP Implementation decreases by 4% and 12% respectively

An additional 1.3M lbs manure nutrients available for storage

Nutrient Management Core N increases by 0% (12% Implementation)

Manure N Application to Crops

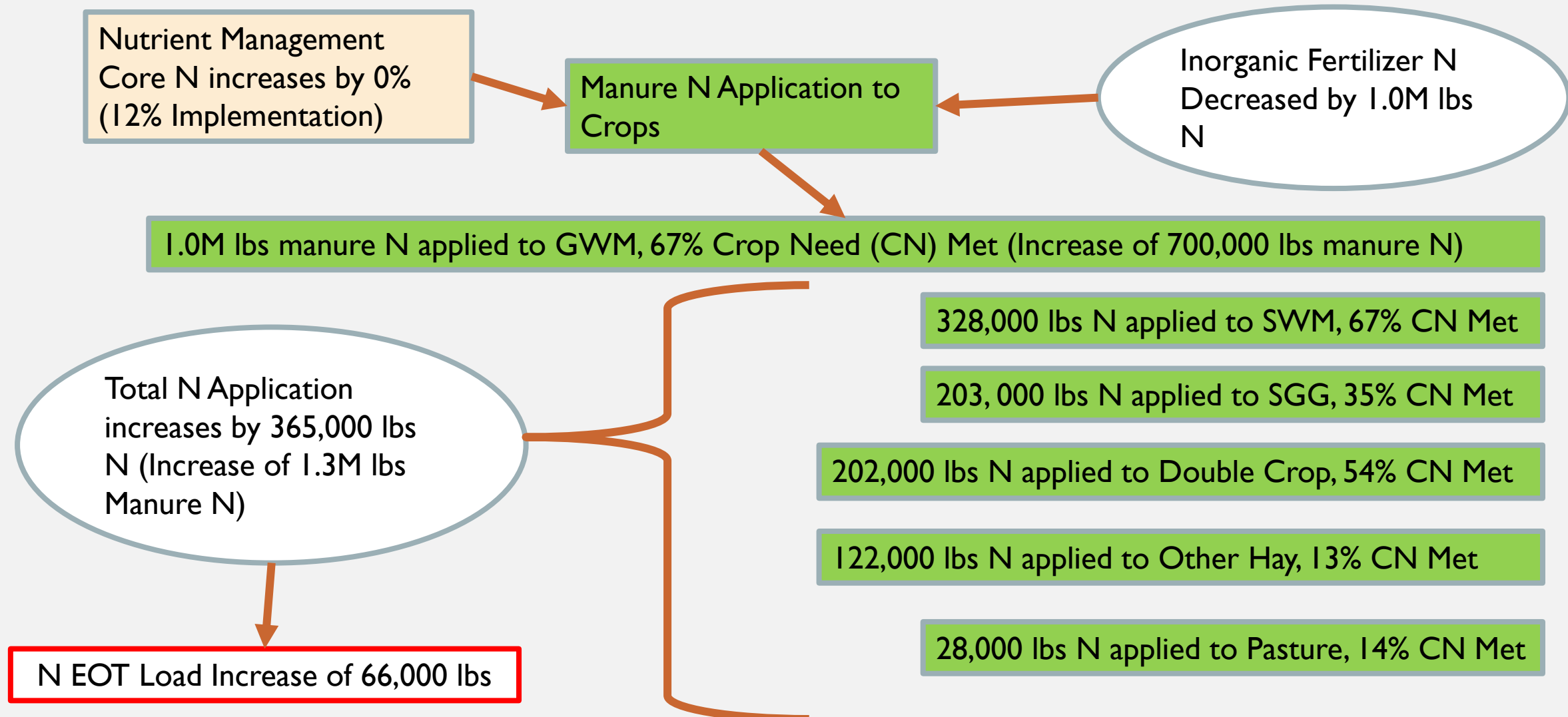
4.5M lbs manure nutrients transported out of Adams Co

Litter Amendments and Biofilter BMPs at 0% implementation

Volatilization

THE FLOW PATH OF HILLANDALE MANURE NITROGEN IN ADAMS COUNTY: *THE DIFFERENCE BETWEEN 2017 PROGRESS WITH HILLANDALE LAYERS AND 2017 PROGRESS WITHOUT HILLANDALE LAYERS*

EXAMPLE 2017 PROGRESS SCENARIO WAS RUN WITH A DRAFT VERSION OF CAST-21



THE IMPACT OF HILLANDALE MANURE NUTRIENTS IN SUSSEX COUNTY, DE: *THE DIFFERENCE BETWEEN 2017 PROGRESS WITH HILLANDALE LAYERS AND 2017 PROGRESS WITHOUT HILLANDALE LAYERS*

EXAMPLE 2017 PROGRESS SCENARIO WAS RUN WITH A DRAFT VERSION OF CAST-21

4.0M Layers added to Existing Layer Populations in Adams and York Co via a Change Product

Permitted Feed Space Acres remains unchanged in **Sussex**

2.8M additional lbs of manure nutrients available in the watershed

AWMS and BRC BMP Implementation remains unchanged

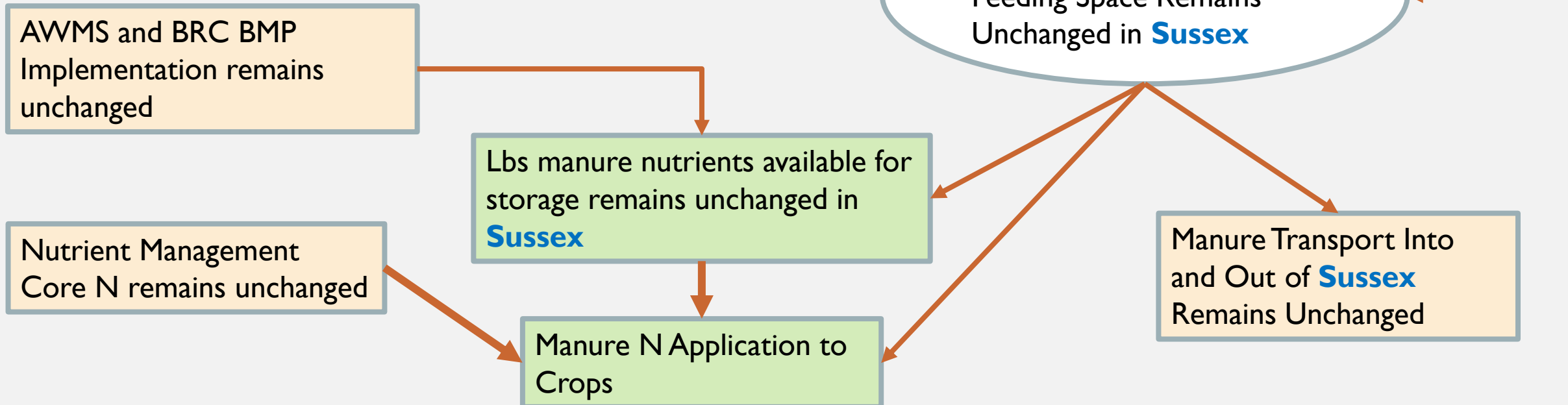
Nutrient Management Core N remains unchanged

Lbs manure nutrients available for storage remains unchanged in **Sussex**

Manure N Application to Crops

Available Manure in Feeding Space Remains Unchanged in **Sussex**

Manure Transport Into and Out of **Sussex** Remains Unchanged



THE IMPACT OF HILLANDALE MANURE NUTRIENTS IN SUSSEX COUNTY, DE: THE
DIFFERENCE BETWEEN 2017 PROGRESS WITH HILLANDALE LAYERS AND 2017 PROGRESS WITHOUT
HILLANDALE LAYERS

EXAMPLE 2017 PROGRESS SCENARIO WAS RUN WITH A DRAFT VERSION OF

Manure N application
to crops remains
unchanged in **Sussex**

Nutrient (N) Application
to Crops

Inorganic Fertilizer N
Application Increases due to
% crop need met with
organic fertilizer in Adams
and York Counties (which
led to a decrease in need for
inorganic fertilizer)

Total Inorganic Fertilizer
N Application increases
by 58,000 lbs N

N EOT Load Increase of 3,700 lbs

Load Source	Increase	Net
Double Cropped Land		77
Grain with Manure	34,045	81
Grain without Manure	14,182	108
Other Agronomic Crops	2,364	91
Pasture	297	77
Silage with Manure	121	53
Silage without Manure	40	108
Small Grains and Grains	1,319	79
Specialty Crop High	1,888	108

WHY DID INORGANIC FERTILIZER INCREASE IN SUSSEX COUNTY?

1. The addition of the Hillandale Layer Population in Adams and York counties from 1995 to present **changed the historic crop need of Adams and York counties.**
2. **This change occurred due to more manure being available for application in Adams and York counties.** Therefore, less inorganic fertilizer was needed to meet crop need historically in Adams and York counties.
 - *Manure is available in the county it is generated in, unless it is transported out. Inorganic fertilizer is available watershed wide.*
3. With this change in historic crop need being met with manure, **the inorganic fertilizer was redistributed watershed wide when the new version of the model was set up** (*which included the historic Hillandale population, as opposed to the version that did not include the Hillandale layer population*).



NUTRIENT “BUCKETS” SIMPLIFIED

1. There is a set amount of inorganic fertilizer that must be fully distributed.



Fertilizer: Watershed Bucket

2. Inorganic fertilizer and Organic fertilizer may be applied to meet organic-eligible crop application goals.

Fertilizer: Watershed Bucket



Manure: County Bucket

3. But when the availability of organic fertilizer increases and is distributed within a county to meet organic eligible crop application goals...

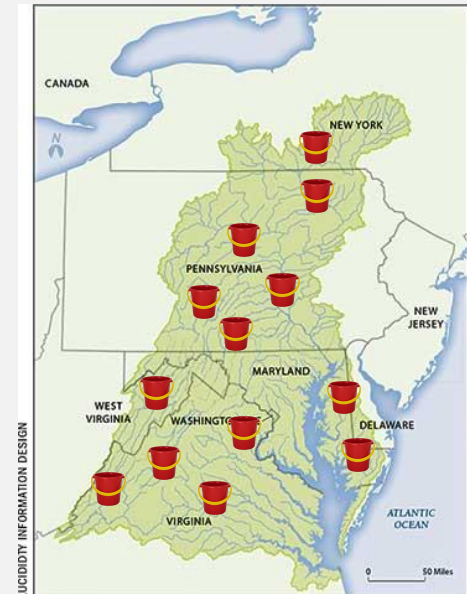
Fertilizer: Watershed Bucket



**Manure:
County
Bucket**

4. Inorganic fertilizer must be redistributed across the watershed.

These “buckets” are established only when a new version of the model is set up



IN SUMMARY

We observed load increases due primarily to:

- **Increase in available manure nutrients** due to an increase in the layer population.
- **Increase in feed space acres** due to an increase in the layer population.
- **Redistribution of inorganic fertilizer across the watershed** due to crop need in Adams and York Counties being met by available manure.
- For more information on nutrient allocations in CAST, please refer to slide 44 of this presentation and Section 3, *Terrestrial Inputs*, of the Model Documentation [here](#).



TO INCORPORATE OR TO NOT
INCORPORATE, THAT IS THE
QUESTION.



POTENTIAL OPTIONS BASED ON COMMENTS PROVIDED

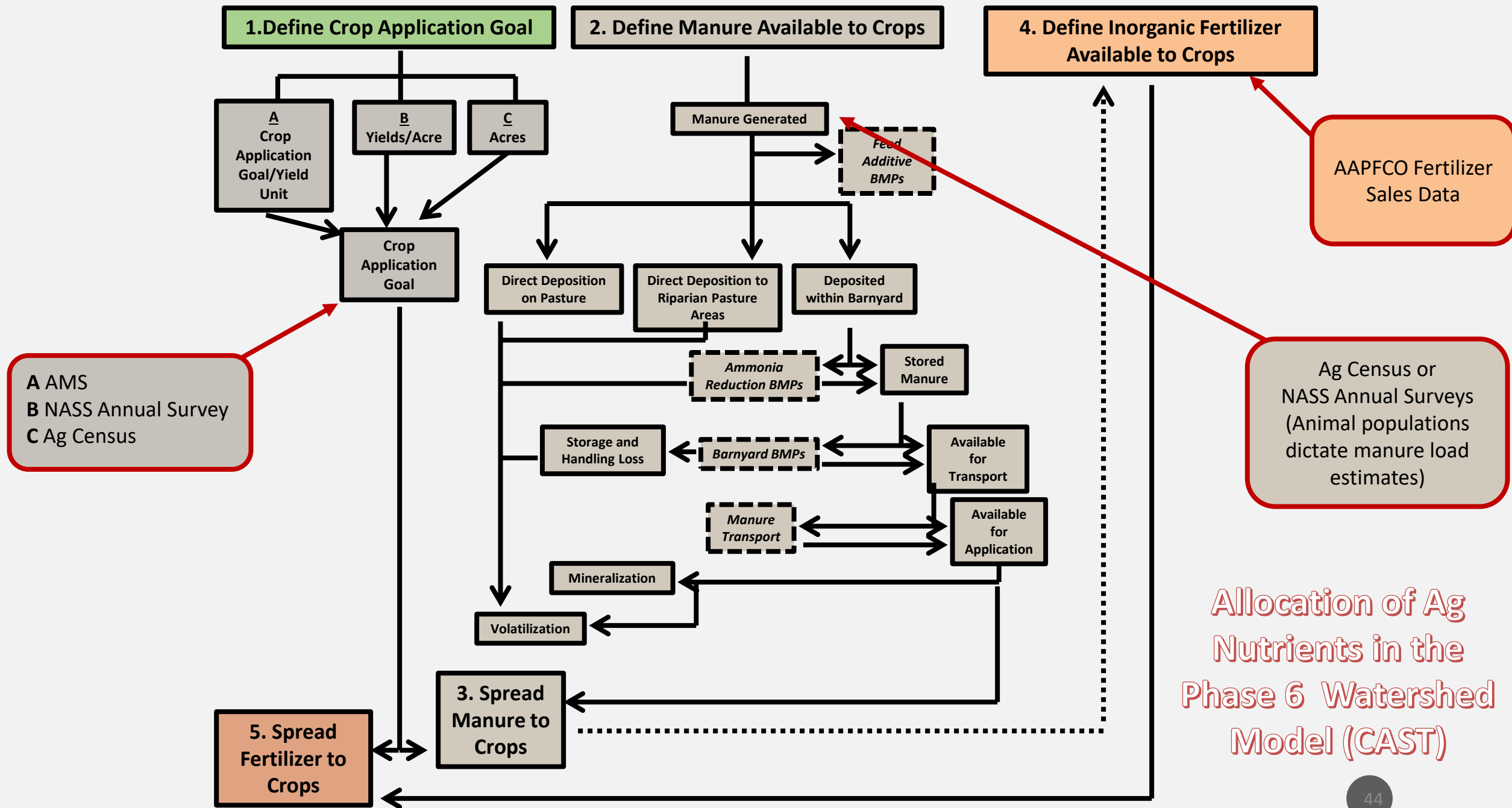
- **Guiding Question:** Should we work towards a solution for CAST-23? Or should this solely be a Phase 7 discussion?
- **Option 1:** Utilize the CAFO permits and NMPs to verify the data provided by the facility to ensure that the most accurate data available is being utilized in the modeling tools.
 - *What QA/QC standards is private industry held to? Is it comparable to standards states are held to?*
 - *Would the change in loads due to the incorporation one facility's data require current WIPs to be altered? Is the increase in loads in states outside of PA equitable?*
- **Option 2:** Utilize NASS Annual Survey to increase the total layer population in CAST.
 - The NASS Annual Survey Layer Population is larger than the Ag Census Total Population but does not close the gap between the current layer population and the Hillandale Layer Population in Adams and York Counties.

POTENTIAL OPTIONS BASED ON COMMENTS PROVIDED

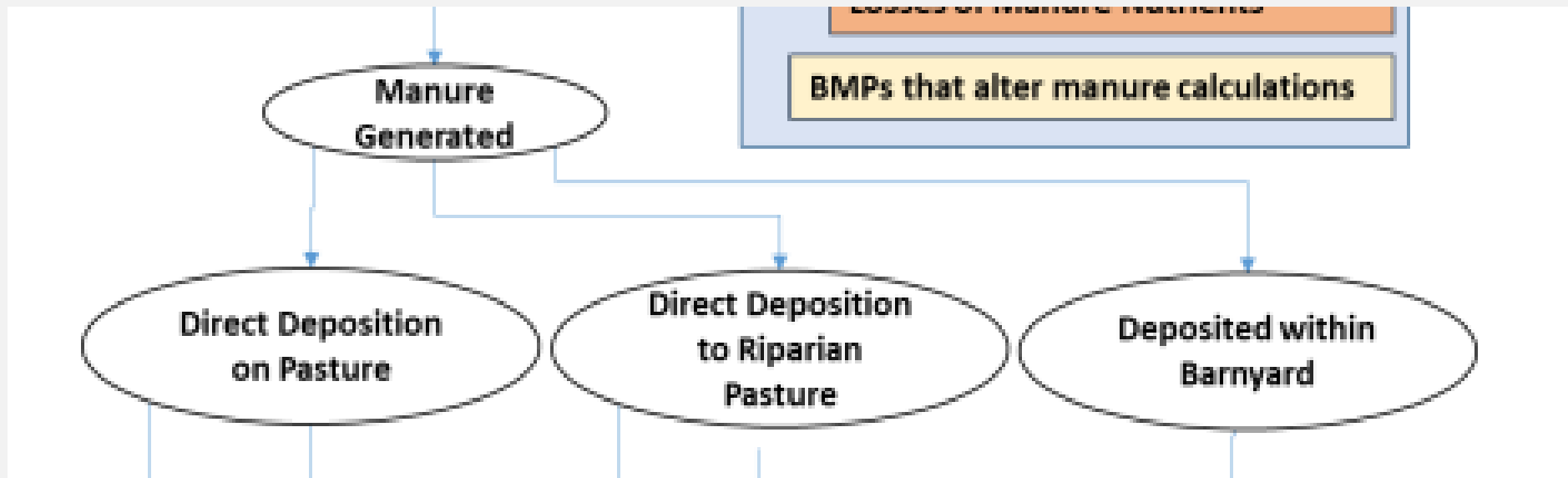
- **Guiding Question:** Should we work towards a solution for CAST-23? Or should this solely be a Phase 7 discussion?
- **Option 3:** Pool population data resources together across states to determine what data sources exist for supplementing the Ag Census.
- **Option 4:** Refrain from utilizing industry data as not every state or every industry has access to the same quality of data. Including industry data from one facility could lead to a data equity issue. In addition, operations should not be singled out. Data should be incorporated through existing avenues, like the Ag Census.
 - *How do we reconcile the fact that our current data does not account for this large operation?*

REFERENCE SLIDES

Slides that didn't quite make the cut.



HOW MANURE GENERATED IS DISTRIBUTED

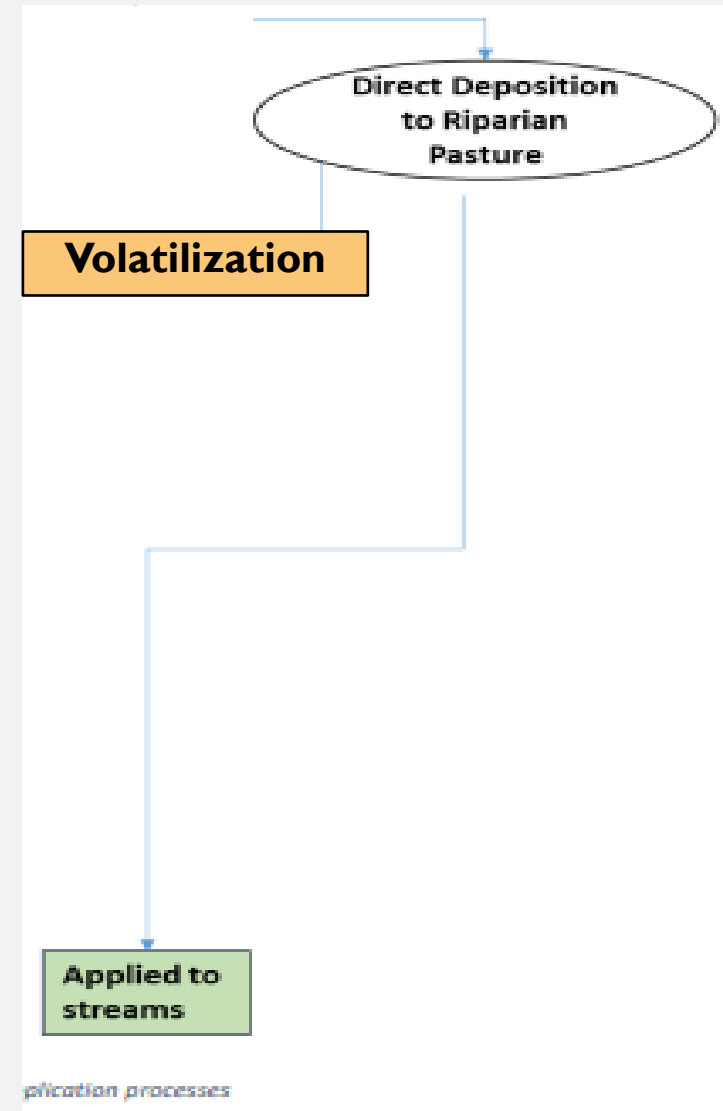


The total manure generated is split equally into twelve portions to represent monthly manure generation.

This split enables the model to **distinguish the amount of time an animal spends in each of the following areas each month**: pasture; riparian pasture access area; and barnyard using percentages provided by jurisdictions.

DIRECT DEPOSITION TO RIPARIAN PASTURE

- 80% of the total nitrogen and phosphorus deposited in the riparian access area is estimated to reach streams.



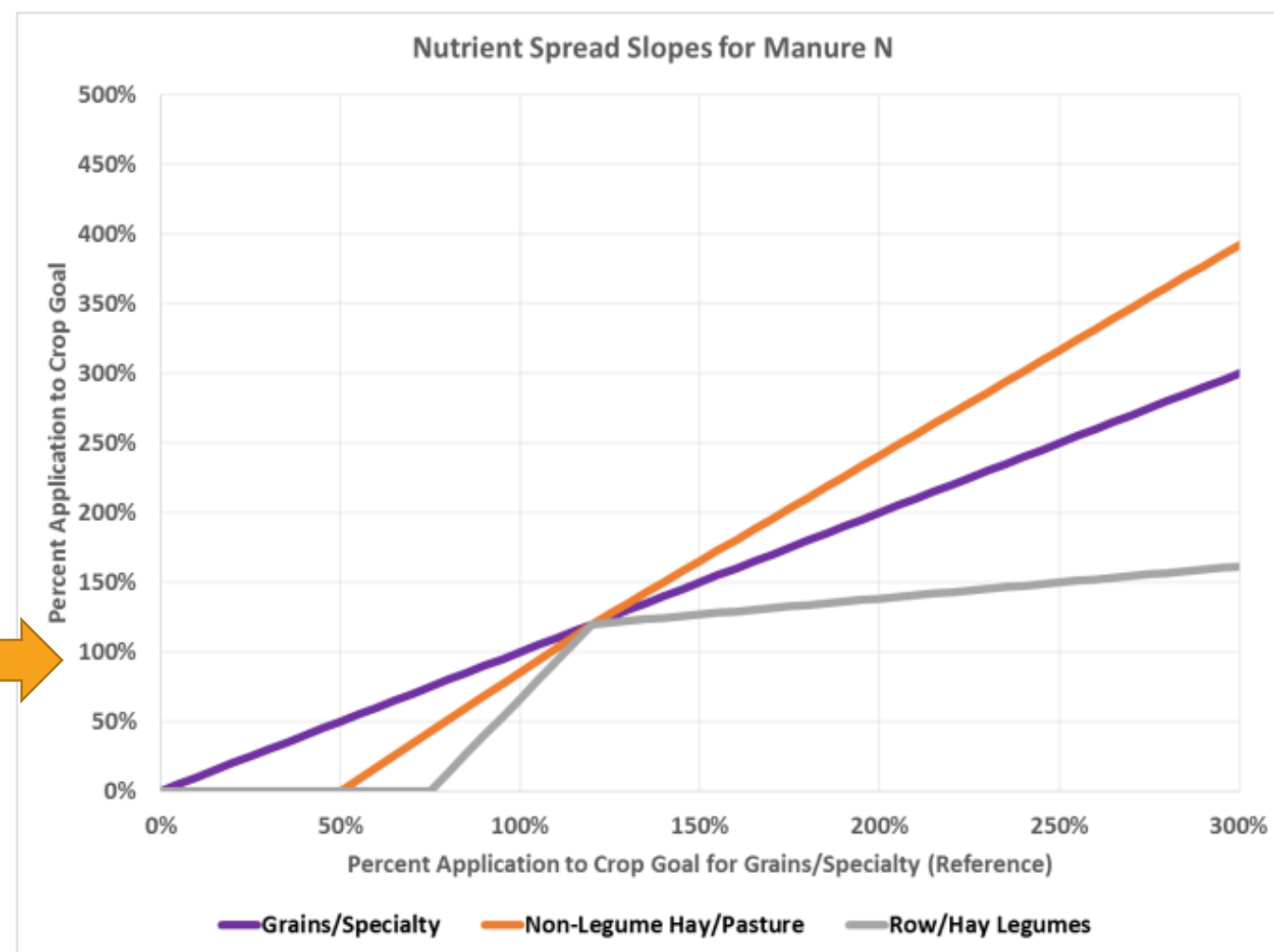
MANURE FOR APPLICATION

Applied to Crops: CAST applies manure nutrients on a slope prioritizing applications to higher-commodity crops first, like vegetables and corn, before applications occur on crops such as pasture, hay and legumes.

- Per the **nutrient spread slope** priority for manure N is:

- 1) Grains/Specialty Crops,
- 2) Non-Legume Hay/Pasture,
- 3) Row Crops/Legume-hay

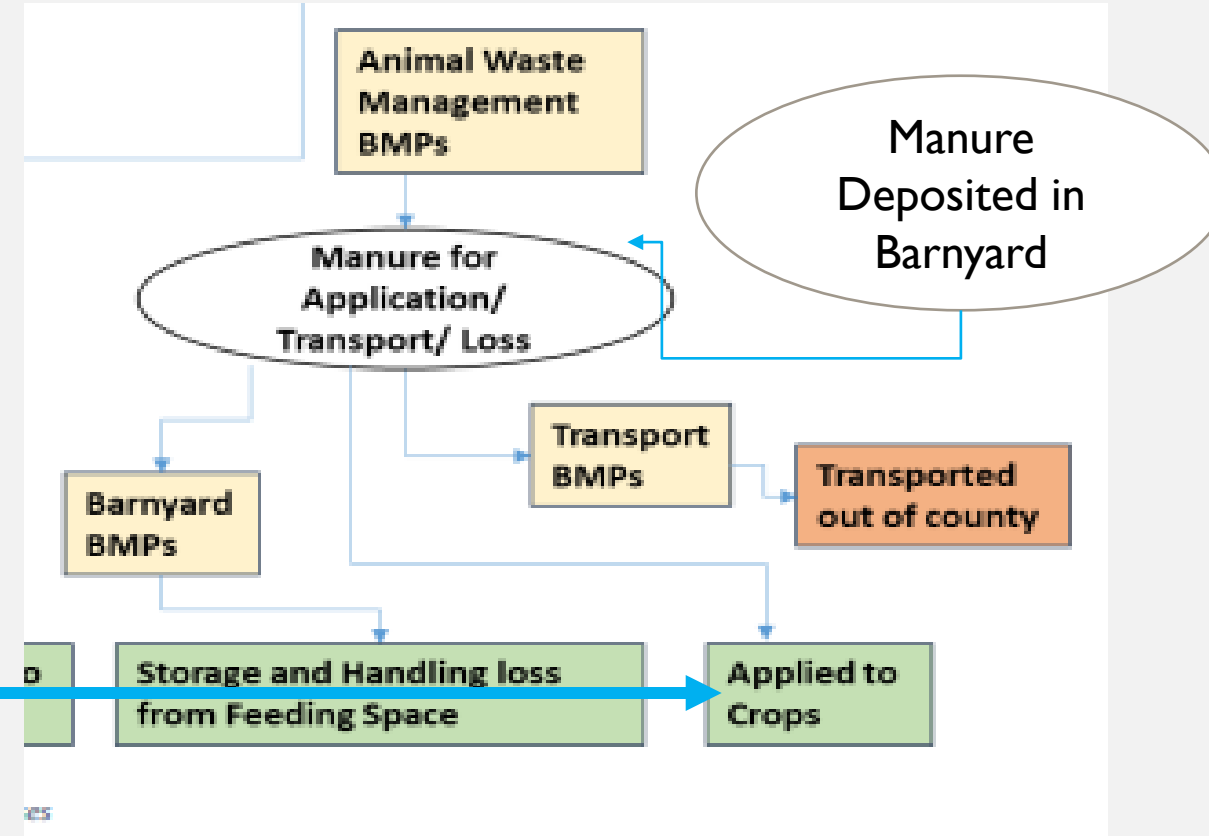
(To note: Biosolid applications occur first.)



MANURE FOR APPLICATION, MANURE FOR TRANSPORT, LOSS OF MANURE

Applied to Crops

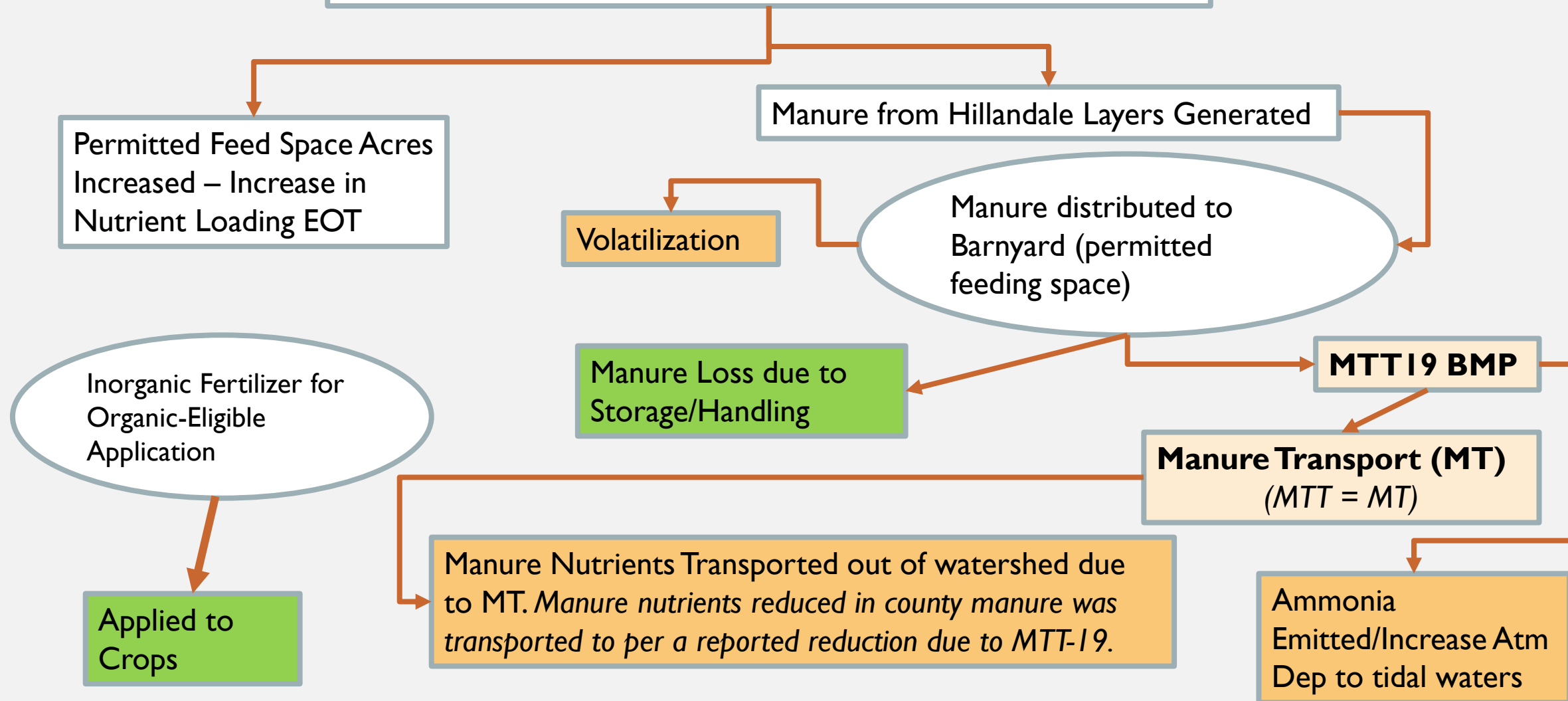
The **Nutrient Management Core BMP** will lower the nutrient application to the crops.



THE FLOW PATH HILLANDALE MANURE NUTRIENTS FOLLOWED IN CAST (WITH MTT19 BMP)

EXAMPLE 2017 PROGRESS SCENARIO WAS RUN WITH A DRAFT VERSION OF CAST-21

Layer Population introduced to Adams and York Counties



SO, WHEN THE HILLANDALE FACILITY (LAYER
POPULATION AND TREATMENT TECHNOLOGY) WERE
ADDED, WHAT CHANGED?

1. The **amount of manure generated** due to the animal population increasing.
 - This impacts the manure available for distribution.
 - Manure available for manure transport.
 - Manure Transport due to Manure Treatment Technology
 - Ammonia volatilized as excreted, in-field, and due to the MTT19 technology.
2. **Permitted feeding space** land use acreage within Adams and York counties.
 - This change impacts all ag land uses.
3. The **application of inorganic fertilizer** to meet crop need.

WHAT DIDN'T CHANGE?

1. **Nutrient management Core** Implementation Rate in Adams and York Counties
2. **Ammonia Emission BMPs**
3. **Barnyard BMPs**, like animal waste management systems

WHY DID INORGANIC FERTILIZER INCREASE IN SUSSEX COUNTY?

1. The P6 Ag Modelling Subcommittee recommended that **county-level chemical (inorganic) fertilizer sales (used to derive fertilizer use) be summed to a watershed-wide number**, which encompasses the inorganic fertilizer “bucket”.
2. The organic fertilizer “bucket” is distributed within the county it is generated in unless manure transport occurs (which enables the manure nutrients to be transported to another watershed county or out of the watershed).
3. The inorganic fertilizer “bucket” is distributed across all eligible watershed counties relative to crop need.
 - Crop need is met by manure nutrients, biosolids, spray irrigation, and inorganic fertilizer.
4. If the available manure nutrients increase or decrease in one county (Adams) in the watershed and are applied to meet the manure eligible crop need within that county, then the inorganic fertilizer will need to be redistributed across the watershed.
 - Because all inorganic fertilizer sold in the watershed is assumed to be applied in the watershed.

These “buckets” are only used in the calibration of the model.

