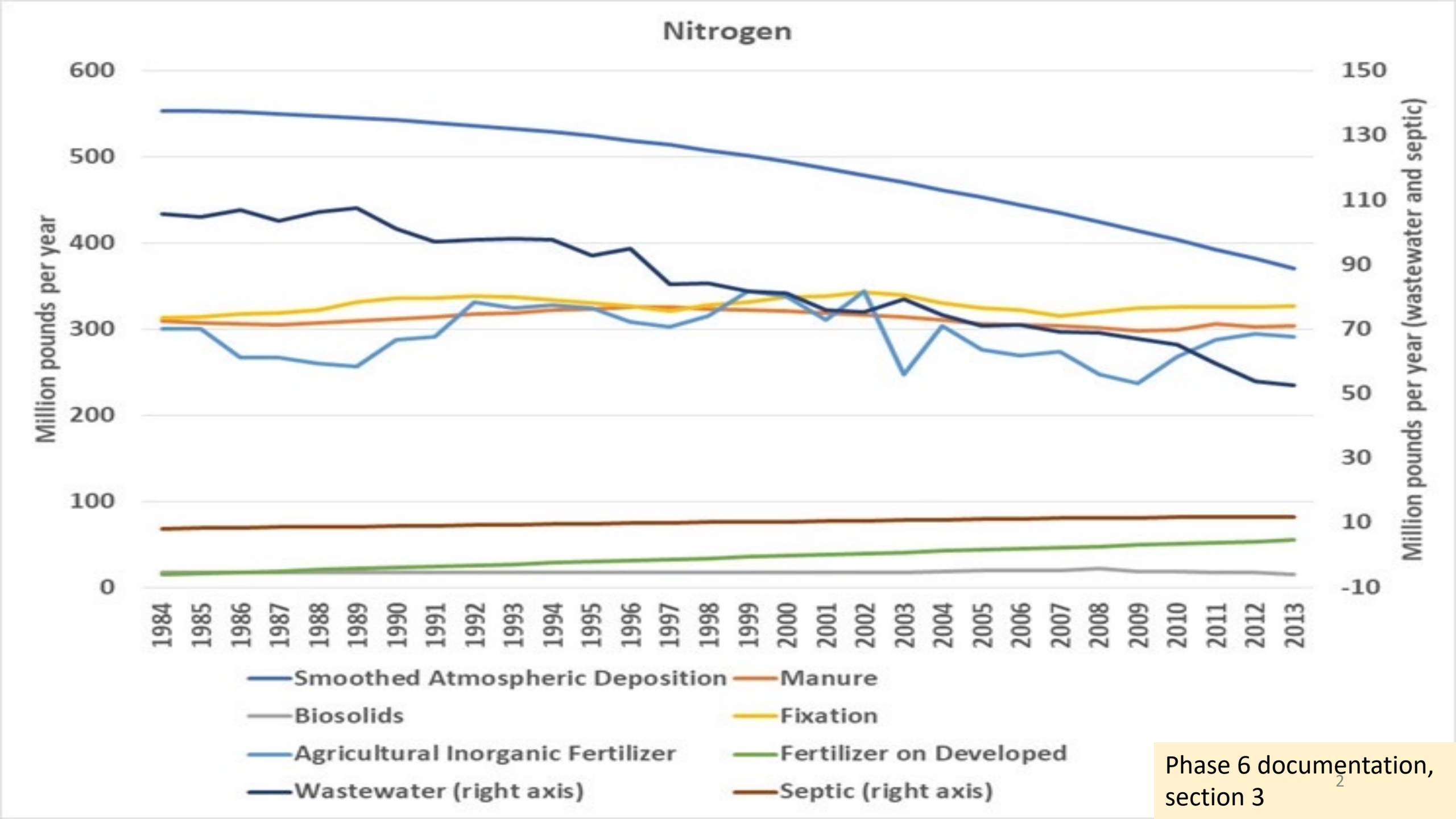
Poultry Sources in Chesapeake Bay Program Nitrogen Modeling

Gary Shenk – CBPO

11/18/2021

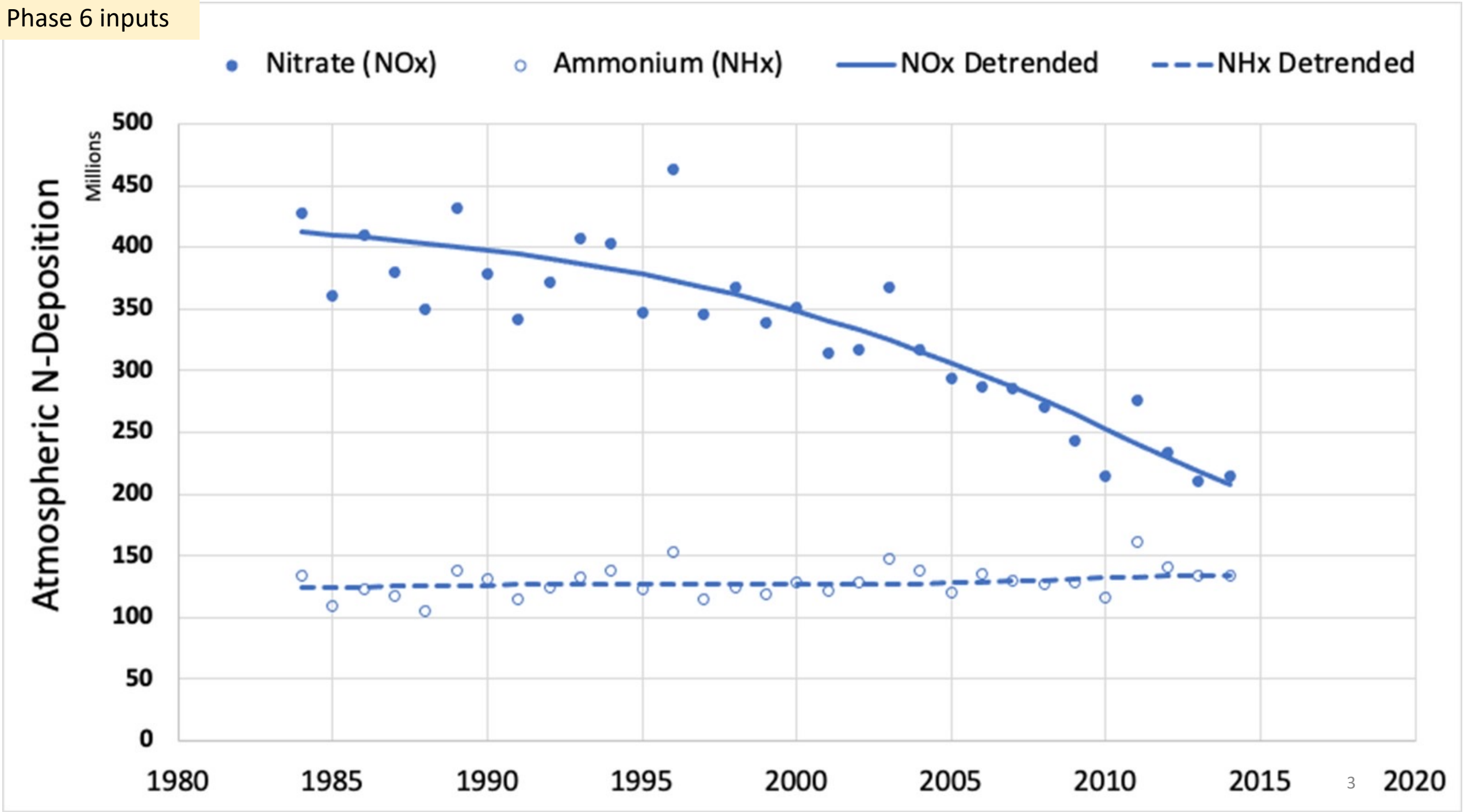
STAC workshop

Improving Modeling and Mitigation Strategies for Poultry Ammonia Emissions Across the Chesapeake Bay Watershed



Phase 6 documentation, section 3

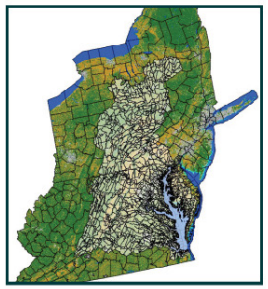
Phase 6 inputs



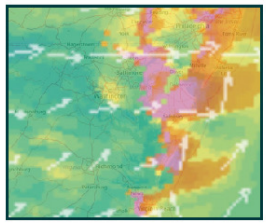
CBP TMDL Water Quality Models

Data and Model Inputs

Pollution Control Data
Land Use Data
Point Sources Data
Septic Data
U.S. Census Data
Agricultural Data



Land Use Change Model



Airshed Model

Precipitation Data
Meteorological Data
Elevation Data
Soil Data

What are the load changes due to land use, BMPS, Wastewater

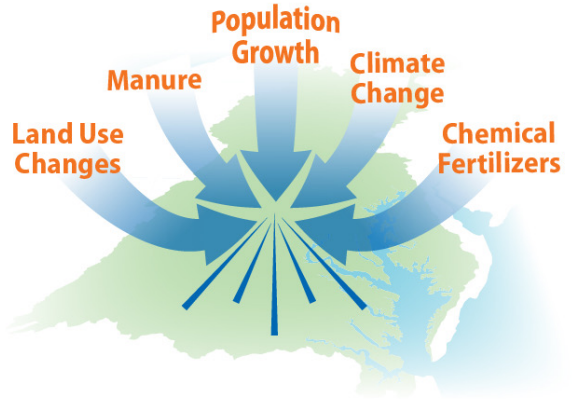
CAST and Dynamic Watershed Model

How do load changes affect dissolved oxygen

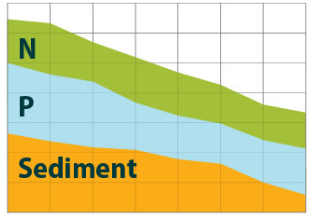
Estuary Model

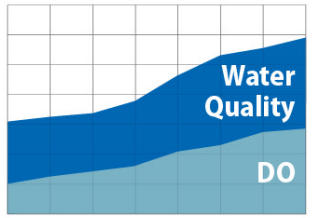
Model Outputs

Prediction of Impacts



BMP Implementation Results





Background:
https://www.chesapeakebay.net/documents/Understanding_Chesapeake_Bay_Modeling_Tools.pdf

Use of CBP Watershed Model (CAST)

Organization that can pay for, encourage, and/or compel management

Phase 6 Watershed Model/CAST

Nitrogen, Phosphorus, Sediment

Compare to goals

Proposed ***Strategy***

CAST Structure

Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)

*

Land management

*

Watershed Delivery

Nitrogen for a land use in a geographic area

Nitrogen Sources to the Chesapeake

CAST Structure

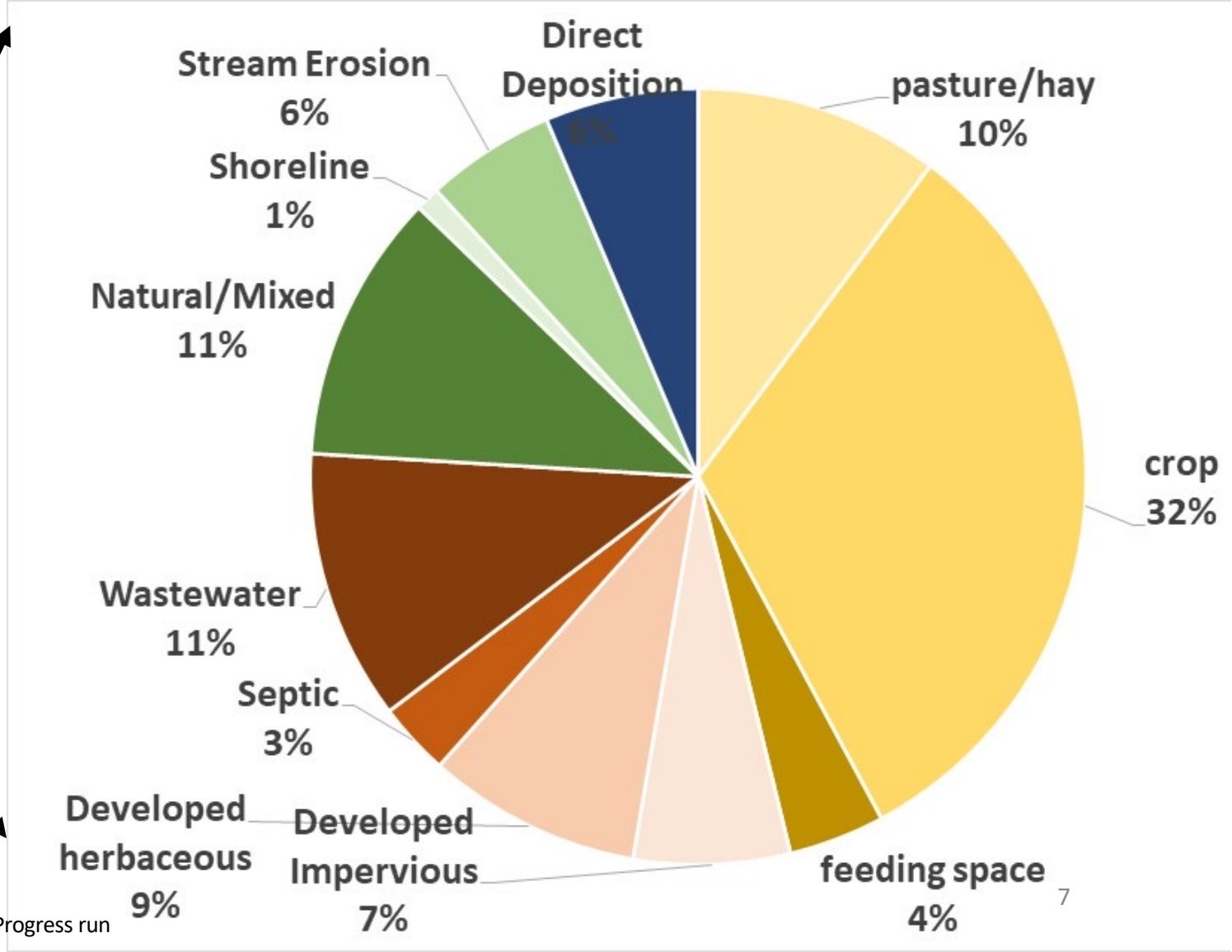
Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)

*

Land management

*

Watershed Delivery



https://www.chesapeakeprogress.com/clean-water/water-quality CAST-2019 2020 Progress run

Nitrogen Sources to the Chesapeake

CAST Structure

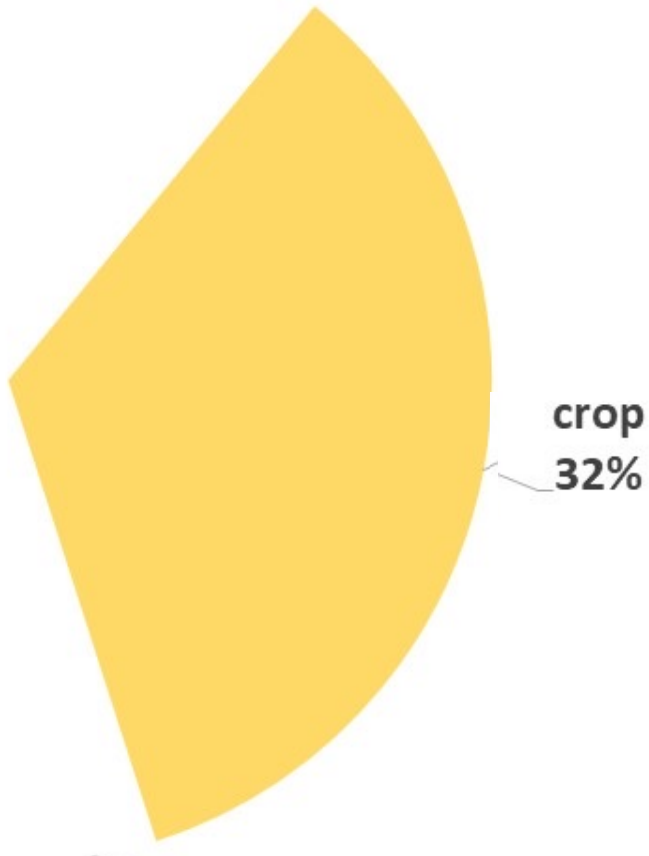
Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)

*

Land management

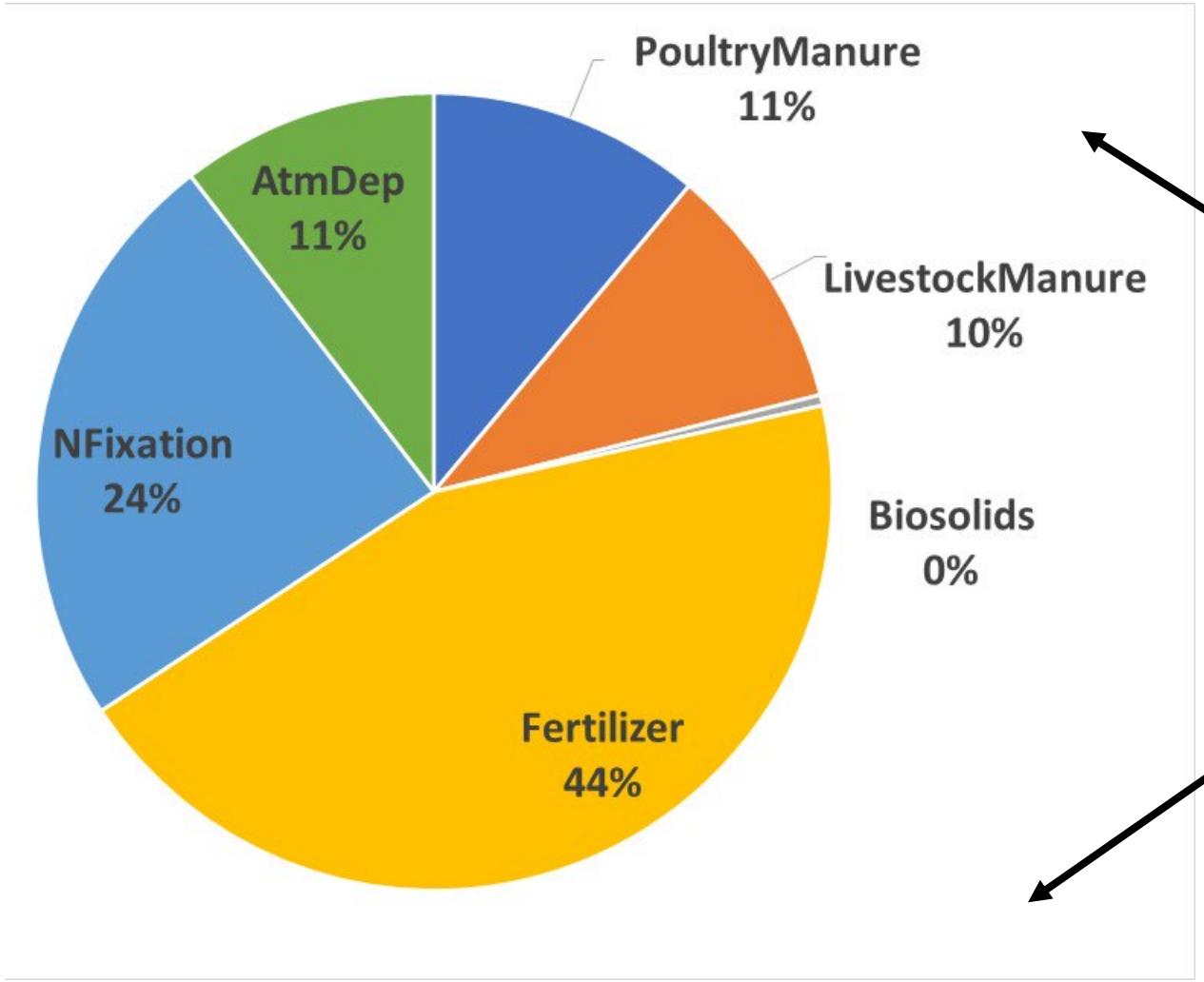
*

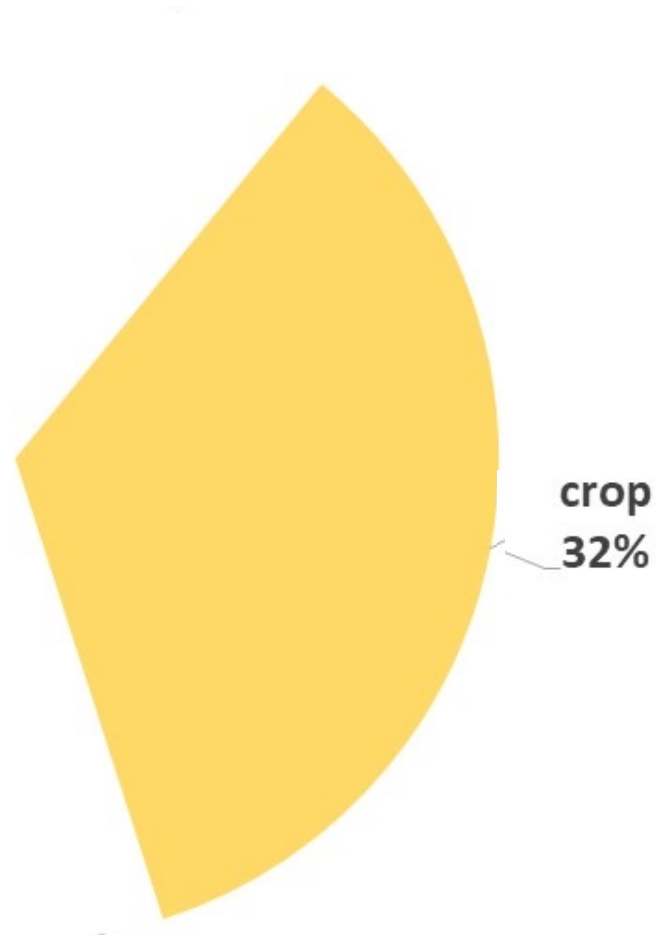
Watershed Delivery



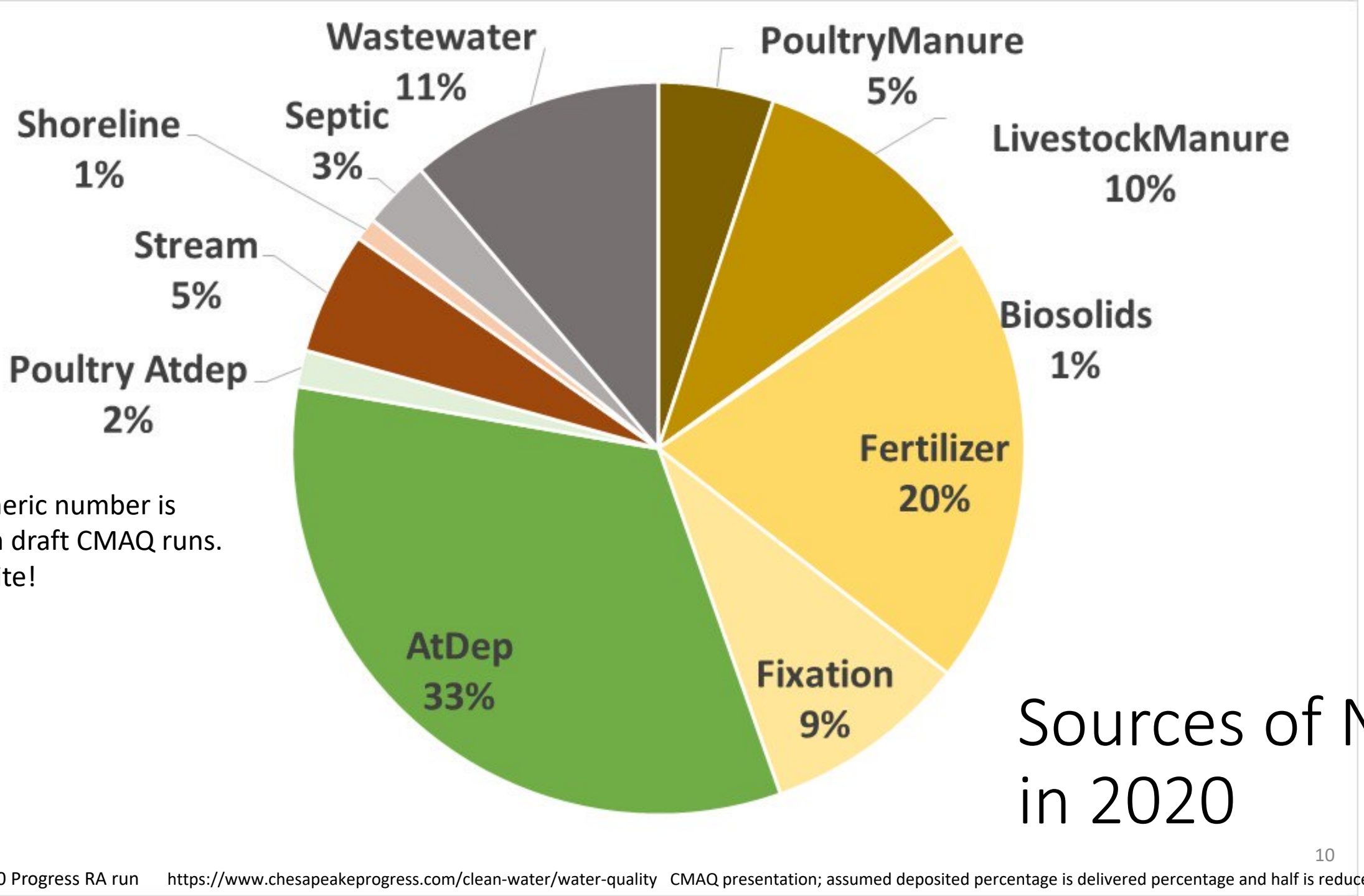
CAST-2019 2020 Progress run

Nitrogen Sources to the Chesapeake





CAST-2019 2020 Progress run

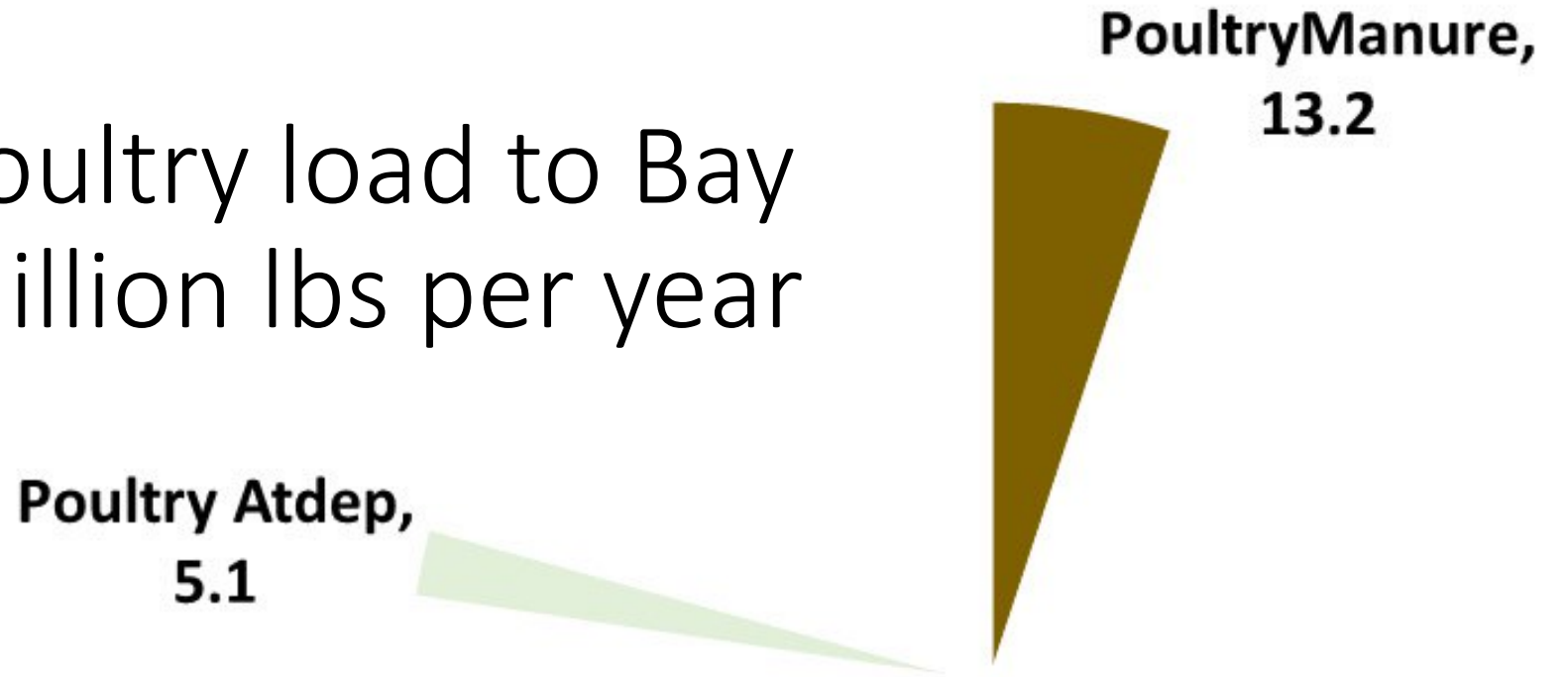


Atmospheric number is based on draft CMAQ runs. Do not cite!

Sources of N in 2020

CAST-2019 2020 Progress RA run https://www.chesapeakeprogress.com/clean-water/water-quality CMAQ presentation; assumed deposited percentage is delivered percentage and half is reduced

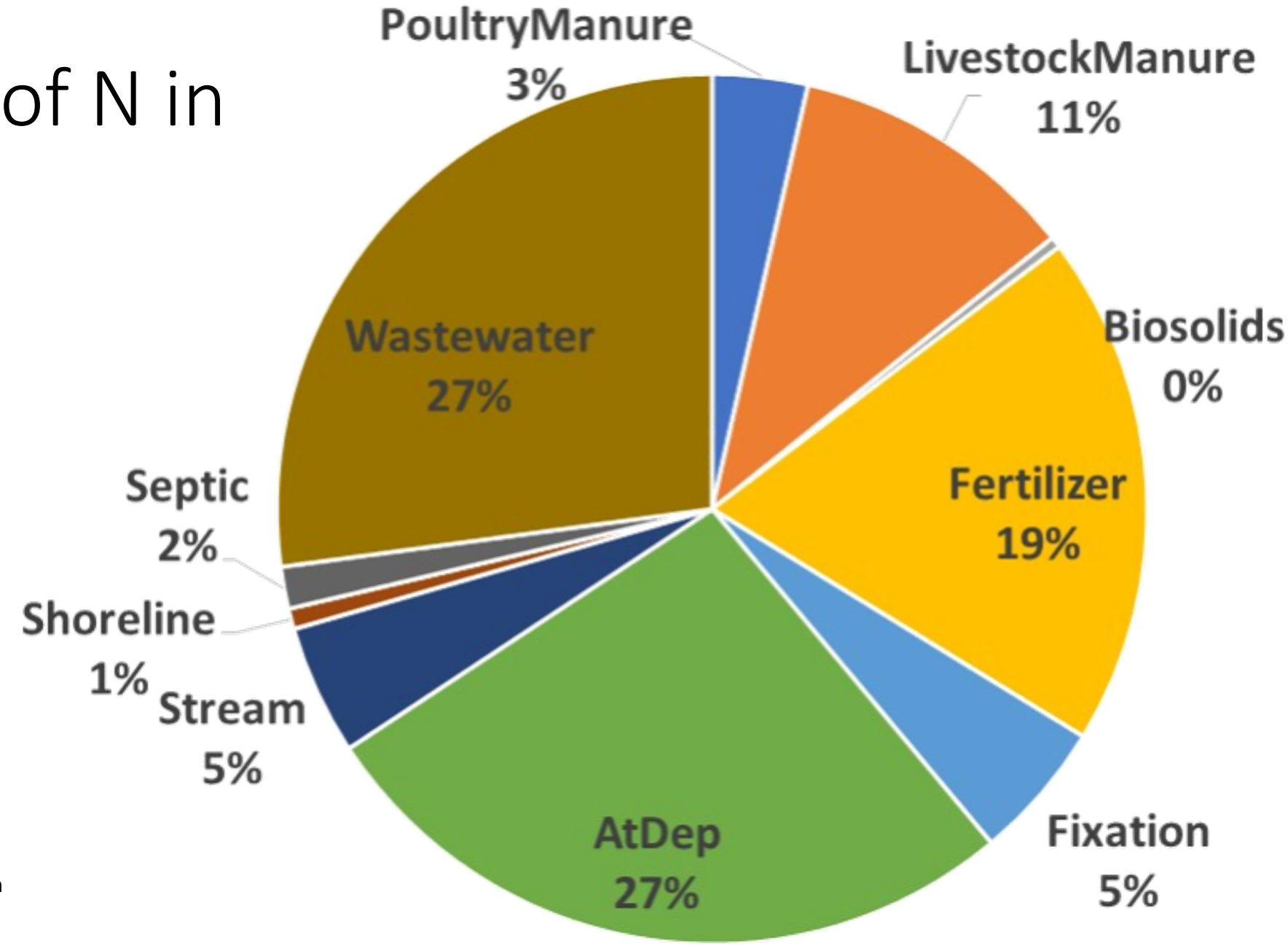
Poultry load to Bay million lbs per year



- Total = 18.3 million lbs nitrogen per year of 259 total
  - Atmospheric number is based on draft CMAQ runs. Do not cite!
- Other estimates of poultry atmospheric deposition are higher
  - Joe Wood calculated 5.9 million based on the effectiveness of biofilters

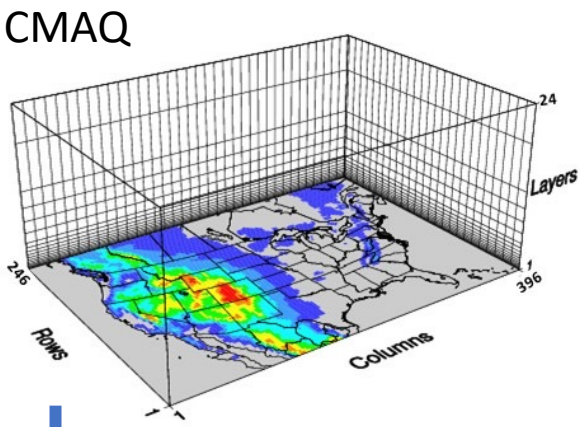
CAST-2019 2020 Progress RA run https://www.chesapeakeprogress.com/clean-water/water-quality CMAQ presentation; assumed deposited percentage is delivered percentage and half is reduced

Sources of N in 1985



Fraction of atmospheric deposition from poultry is not available for 1985

N fate in CAST



volatilization

birds

Harvest

Land

CAST Structure
Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)
*
Land management
*
Watershed Delivery

Litter house/storage

Bay

Denitrification

Storage loss

CAST Structure
Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)
*
Land management
*
Watershed Delivery

Source

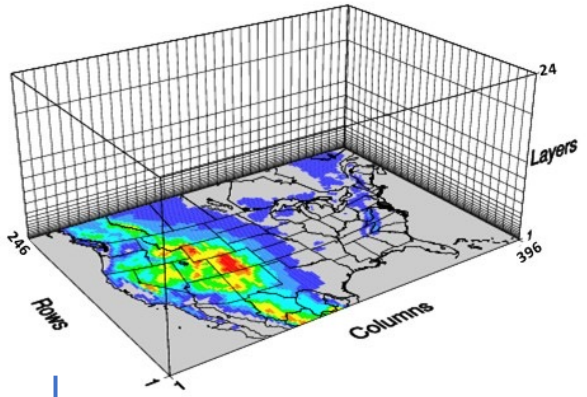
Storage

Sink

N to Bay

Filtered emissions

CMAQ



volatilization

birds

Harvest

Land

CAST Structure
Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)
*
Land management
*
Watershed Delivery

Bay

Litter house/storage

Denitrification

Storage loss

CAST Structure
Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)
*
Land management
*
Watershed Delivery

Source

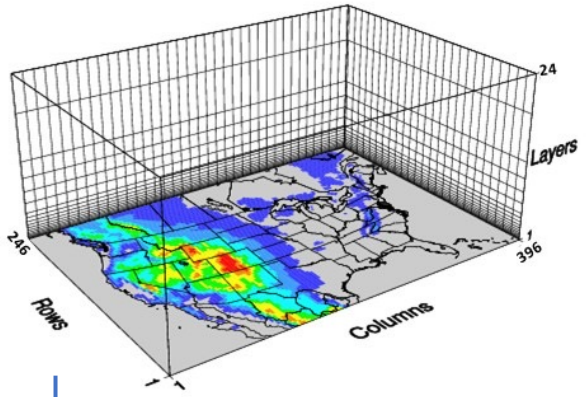
Storage

Sink

N to Bay

Restrict volatilization

CMAQ



volatilization

birds

Harvest

Land

CAST Structure
Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)
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Watershed Delivery

Bay

Litter house/storage

Denitrification

Storage loss

CAST Structure
Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)
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Land management
*
Watershed Delivery

Source

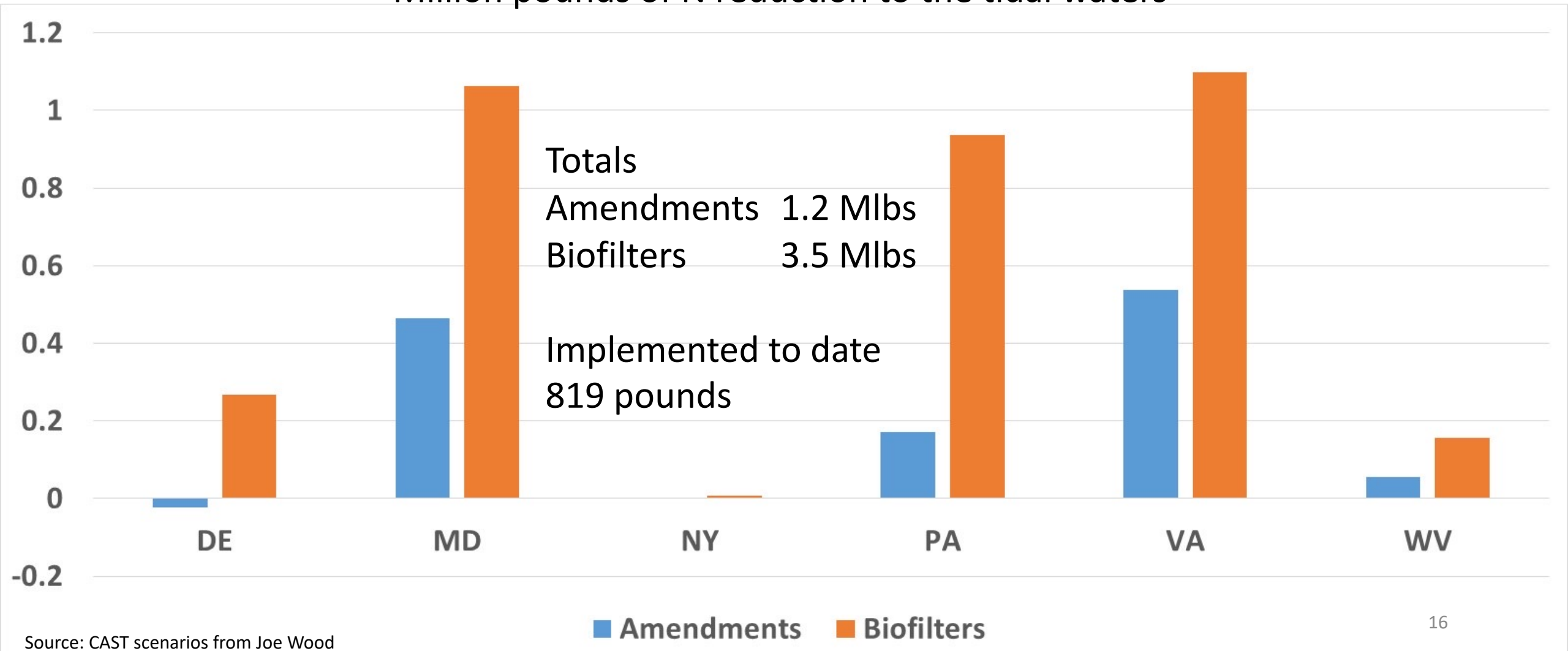
Storage

Sink

N to Bay

Potential Reductions currently available in CAST

Million pounds of N reduction to the tidal waters



Source: CAST scenarios from Joe Wood

Summary

- The CBP tracks nitrogen loads to the Chesapeake from poultry litter
  - Land application
  - Atmospheric deposition
  - Storage losses
- Poultry litter accounts for 7% or so of nitrogen loads to the Chesapeake
  - The percentage has grown with increases in poultry and decreases in other sources
- Restricting or capturing ammonia emissions could reduce nitrogen to the Bay