Loading rates

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What's a loading rate: Section 2.2

Spatially-averaged and temporally averaged nutrient loading export rate to a stream or other waterbody for a given land use.

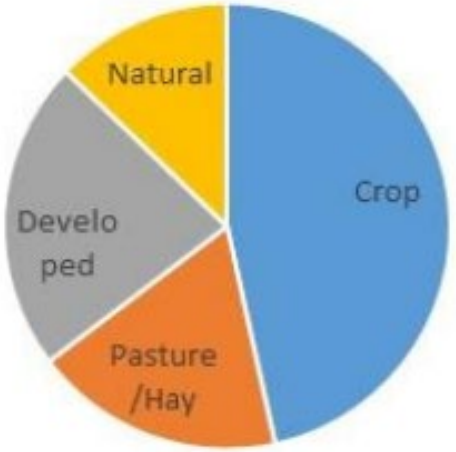
Why does it matter?

Each model segment must have an initial load which can be compared against a management action.

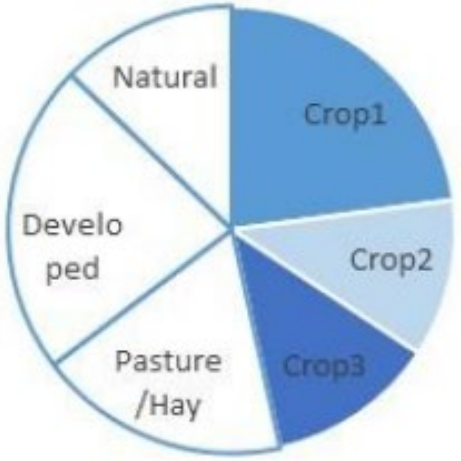
How do we get loads?

- Monitoring data estimates total landscape loads
- Overall load is divided into broad categories
- Broad categories are seperated into smaller land uses

Step 1:
Estimate Total Non-point Source Load
Monitoring Data



Step 2:
Divide into Broad Classes
Multiple models



Step 3:
Split Classes into individual land uses
Multiple lines of evidence

Isolating the load from managment

1) Remove the effect of BMPs

2) Loads that are not land use based, such as wastewater treatment plants, must be removed

3) The effects of small streams and large rivers must be accounted for

Table 2-4: Calculation of total landscape loads for above the RIM stations.

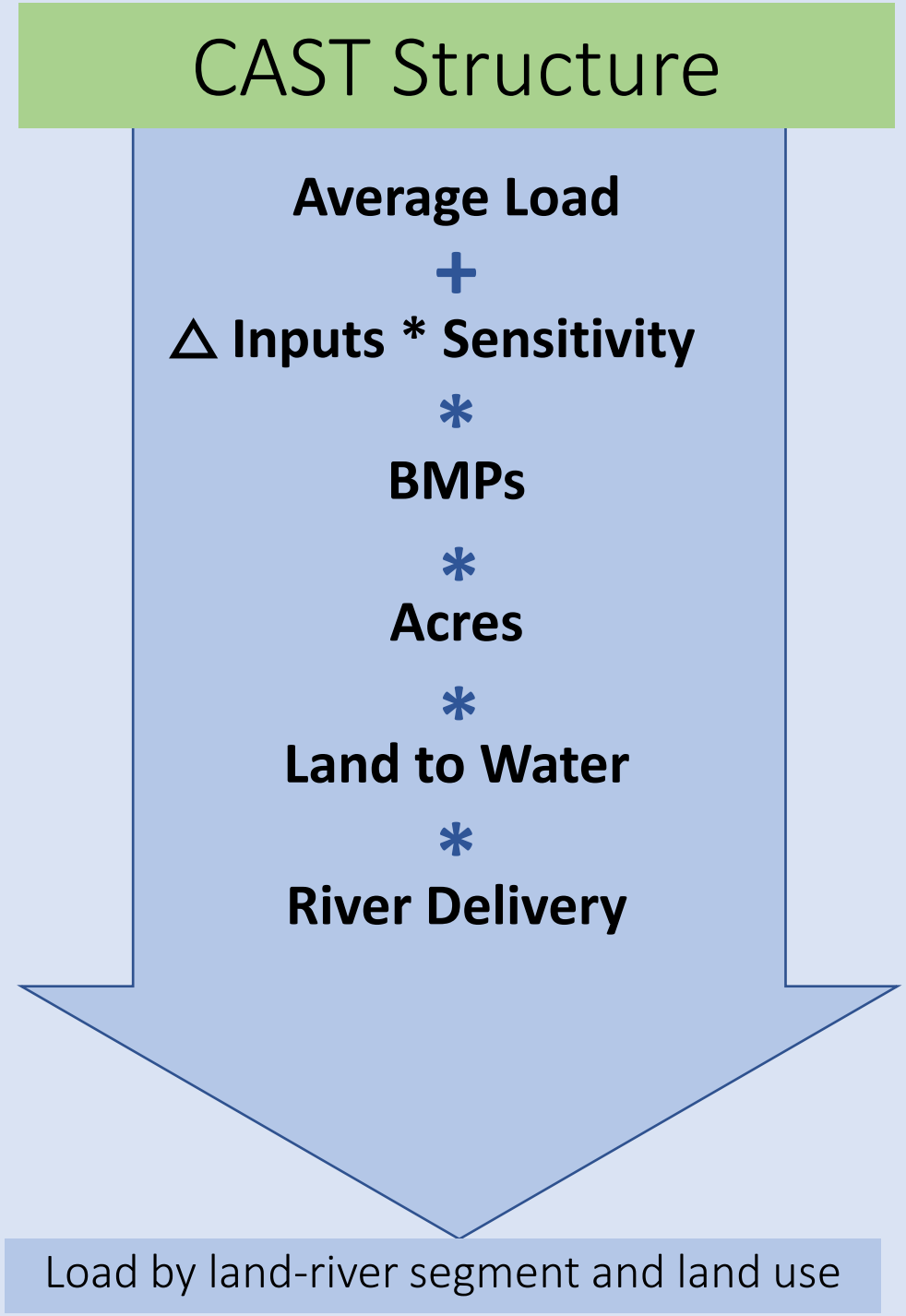
Component	Total Nitrogen		Total Phosphorus	
	Factor (%) or Amount (million pounds per year)	Load (million pounds per year)	Factor (%) or Amount (million pounds per year)	Load (million pounds per year)
Monitored Load at RIM Stations	NA	210.3	NA	13.8
BMP Effects Removed	16.2	226.5	1.5	15.3
River Attenuation Removed	83.70%	270.6	98.50%	15.5
Lower Susquehanna reservoir plus simulated reservoirs	NA	270.6	3.75	19.2
Wastewater Removed	30.8	239.8	5.2	14.1
Animal Feeding Space Removed	18.2	221.7	0.7	13.4
Riparian Pasture Deposition Removed	5.8	215.9	1.8	11.6
Atm. Deposition on Water Removed	6.5	209.4	0.2	11.4
Septic Systems Removed	5.9	203.5	NA	11.4
Rapid Infiltration Basin	0.1	203.5	0.002	11.4
Small Stream Attenuation Removed	89.30%	227.9	88.20%	12.9
Total Edge of Stream Load	NA	227.9	NA	12.9

An aside on removing the estimated effect of BMPs

- Ran two scenarios in CAST version 5.3.2
  - WITH BMPs
  - WITHOUT BMPs
- Calculated the difference in load between these two

Year	TN Percent Change	TP Percent Change	P5.3.2 BMP scenario	P5.3.2 NoBMP Scenario

Looking at how CAST works:



CAST Structure

Illustrative example

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

Average nitrogen load to stream for double cropped ag land watershed wide is 40 pounds per acre

Load by land-river segment and land use

CAST Structure

Illustrative example

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

Load by land-river segment and land use

Your area applies 115 pounds of fertilizer while the watershed-wide average is 140.

Each additional pound of fertilizer results in 0.2 lbs of runoff

40 + (115-140) * 0.2 = 35 lbs/acre

CAST Structure

Illustrative example

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

BMPs are applied which give, in aggregate, a 20% reduction

35 * (1-.20) = 28 lbs/acre

Load by land-river segment and land use

CAST Structure

Illustrative example

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

There are 100 acres of double cropped land in this segment

28 lbs/acre * 100 acres = 2800 lbs

Load by land-river segment and land use

CAST Structure

Illustrative example

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

The land here is 50% leaker than average due to high groundwater recharge in the piedmont carbonate

The river system reduces loads by 30%

2800 lbs * 1.5 * (1-.30) = 2940 lbs
Delivered to the Bay from this land use and segment

Load by land-river segment and land use

The big question:

Does the loading rate/ratio on land uses capture BMP effects?

Do Ag Loading Rates account for BMPs implicitly?

Worked to exclude BMPs

- Were able to remove impacts of BMPs via difference between studies.

Fox et al. 2001

- Corn for grain with manure
- Full season soybeans
- Legume Hay
- Ag Open Space
- *Good local paper with multiple trials, no BMPs present.*

Owens et al.

- Hay – *2012-good data with fields geared towards multiple treatments, no BMPs*
- Full season soybeans -*1995- Cover crop was used annually.*

Spargo et al. 2011

- Small grains
- Silage
- Corn
- *Does encompass some BMPs, such as no till, the time of these ranges from zero to >25 years and so likely removed impacts of management.*

The short answer:

Not really

- The loading rates/ratios worked to removed the impact of BMPs
- Multiple other source sector groups investigated specific loading rates for each sector specific land use

Next Steps

- Experimentation with loading rates:
  - What is we changed loading rates?
    - Connected to the land uses we specify
- Ex. One loading rate for Crops, One for pasture

Questions?