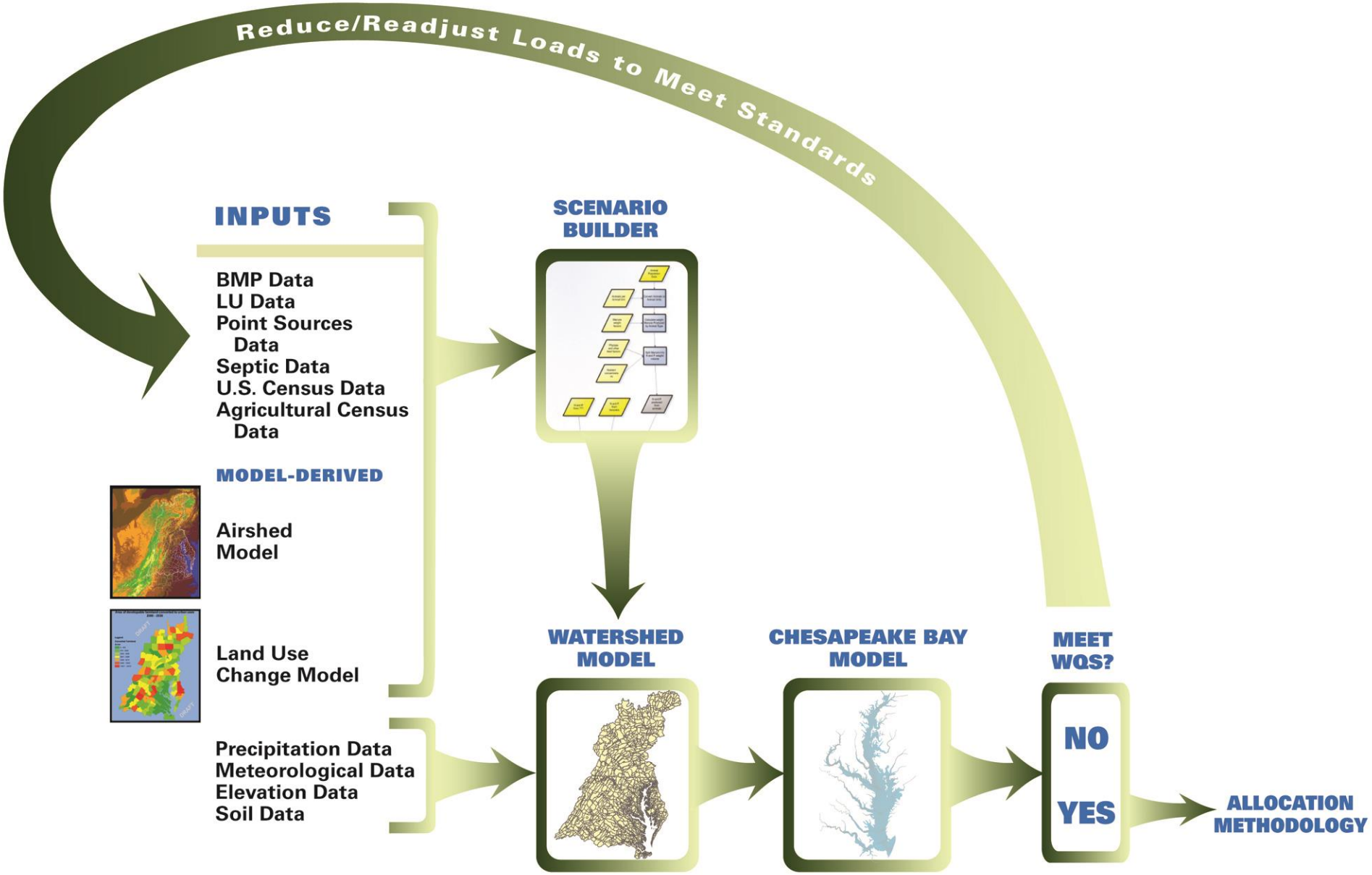
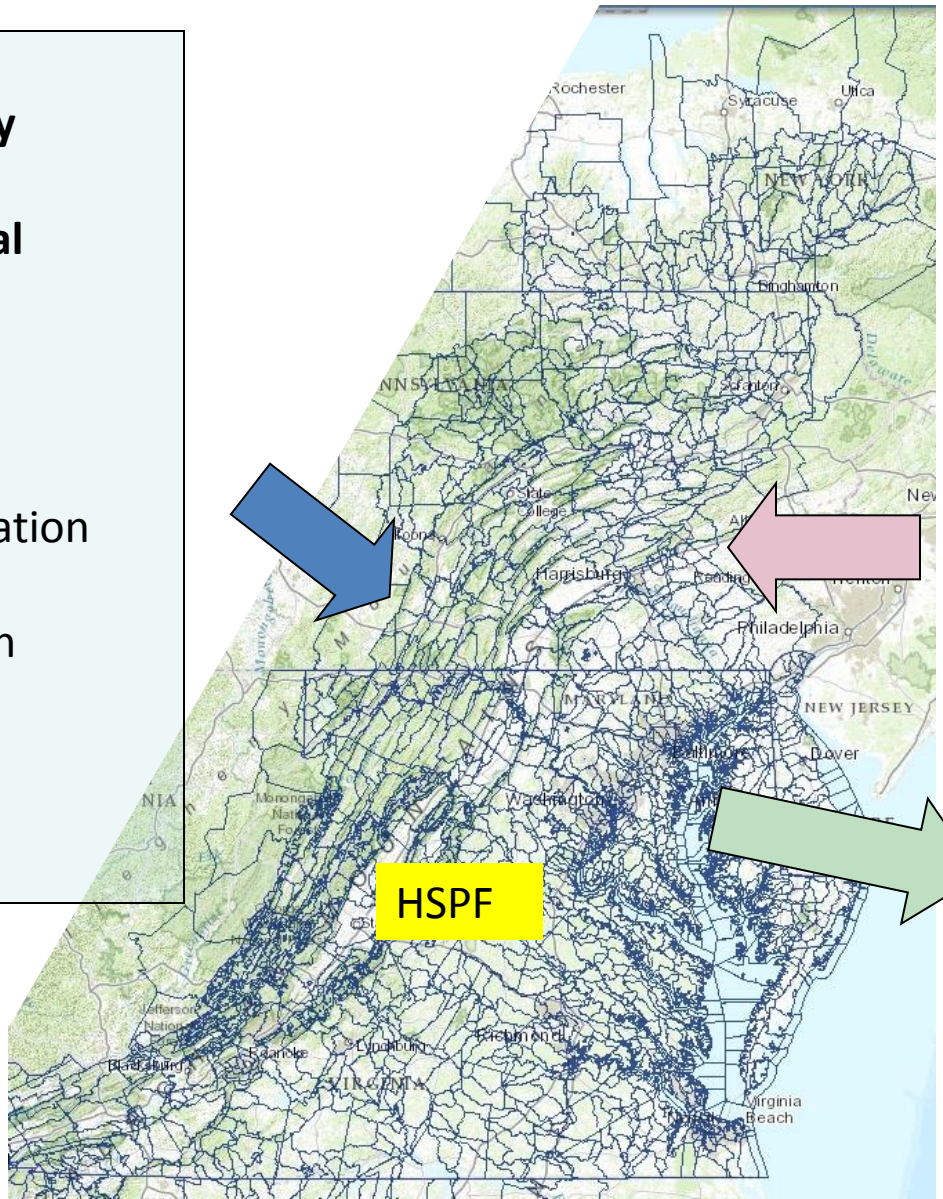
Chesapeake Bay Partnership Models



How the Watershed Model Works
Calibration Mode

Hourly or daily values of Meteorological factors:

Precipitation
Temperature
Evapotranspiration
Wind
Solar Radiation
Dew point
Cloud Cover



Annual, monthly, or daily values of anthropogenic factors:

Land Use Acreage
BMPs
Fertilizer
Manure
Tillage
Crop types
Atmospheric deposition
Waste water treatment
Septic loads

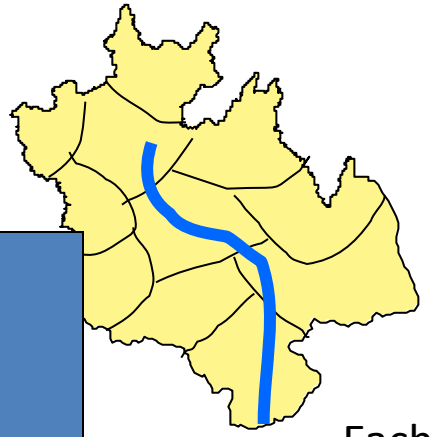
Daily flow, nitrogen, phosphorus, and sediment compared to observations over 21 years

How the Watershed Model Works

Each segment consists of a number of separately-modeled land uses:

- Regulated Pervious Urban
- Regulated Impervious Urban
- Unregulated Pervious Urban
- Unregulated Impervious Urban
- Construction
- Extractive
- Combined Sewer System
- Wooded / Open
- Disturbed Forest

- Corn/Soy/Wheat rotation (high till)
- Corn/Soy/Wheat rotation (low till)
- Other Row Crops
- Alfalfa
- Nursery
- Pasture
- Degraded Riparian Pasture
- Afo / Cafo
- Fertilized Hay
- Unfertilized Hay
  - Nutrient management versions of the above



Plus: Point Source and Septic Loads, and Atmospheric Deposition Loads

Each calibrated to nutrient and Sediment targets

How the Watershed Model Works

Precipitation

Fertilizer (42 lbs N / year)
(1.3 lbs P / year)
Atmospheric deposition

Management filter

Runoff

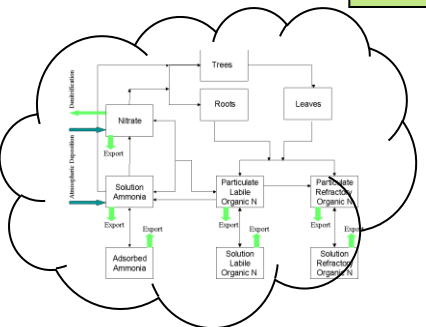
River

Hydrology submodel

Sediment submodel

Phosphorus submodel

Nitrogen submodel



hourly

Buffers
wetlands

Developed Land Uses

	Regulated	Unregulated	Combined Sewer
Pervious	✓	✓	✓
Impervious	✓	✓	✓
Construction	✓		✓

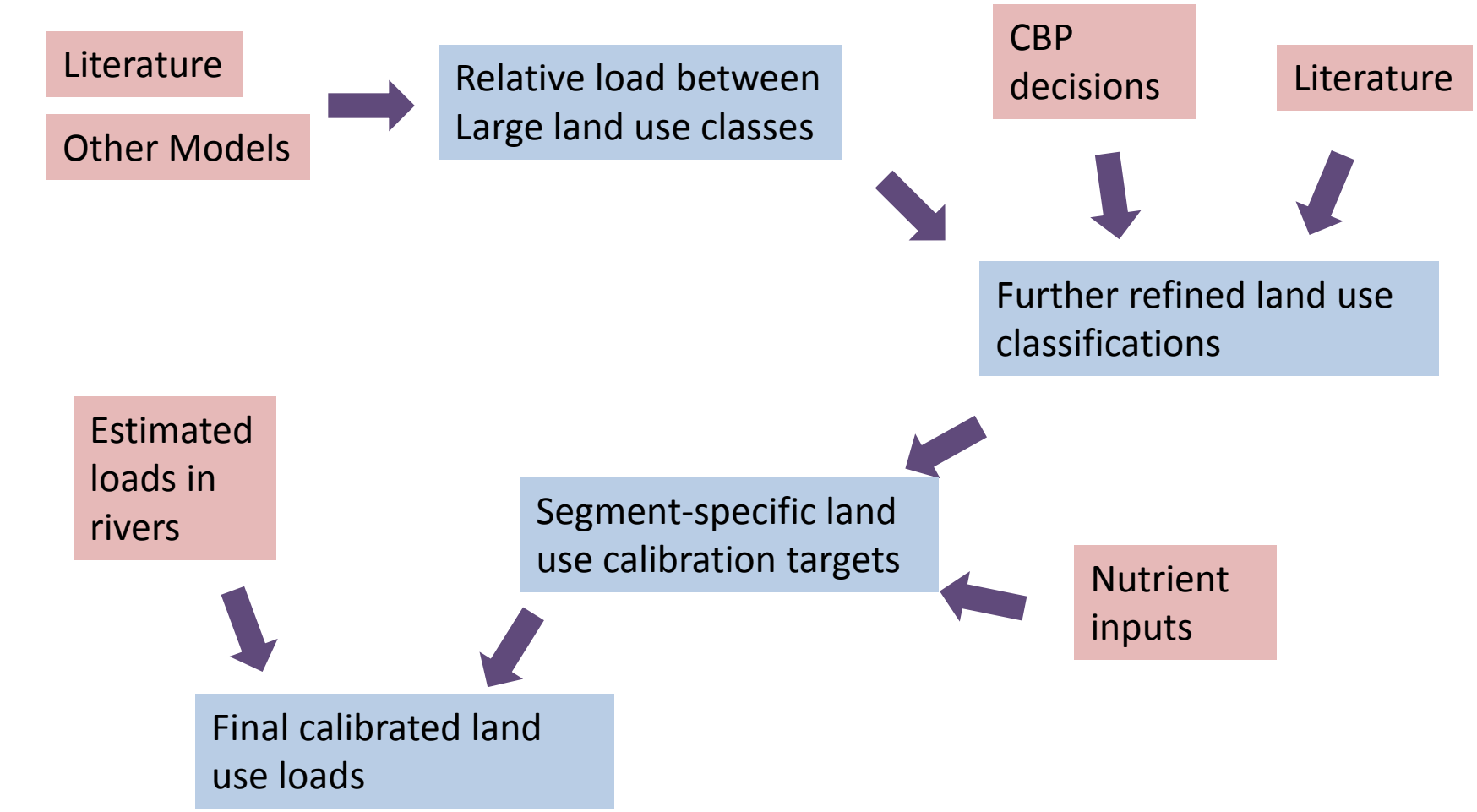
- **Regulated vs Unregulated normally corresponds to MS4 and non-MS4. Loading rates are identical so these categories are a convenience for the state partners.**
- **Combined Sewer land uses have zero loads. The loads from WWTPs and CSOs in combined sewer areas are in the model, so including these would be double counting**

- **Determined directly from the CBP Land Data Team analysis at roughly 10 year increments**

Necessary information for simulating a land use

- Where it is
  - Need to have consistent estimate through time
- What it does
  - Loads it receives
    - fertilizer, manure, etc
  - Loads it exports
    - Relative to inputs
    - Relative to other land uses
    - Relative to other measurable factors

Land Use Load Decisions – Phase 6



Average Targets

Land Use	TN	TP
Forest	2	0.15
Harvested Forest	20	0.80
Crop	23	2-2.5
Hay	6	0.4-0.8
Pasture	4.5	0.7
Urban	10	1.5
Extractive	12.5	3.5
Nursery	240	85

Literature

Other Models

Relative load between Large land use classes

Figure 1 Median TN concentration in NPDES Phase 1 storm water data using data from Pitt, undated. Error bars are one standard deviation

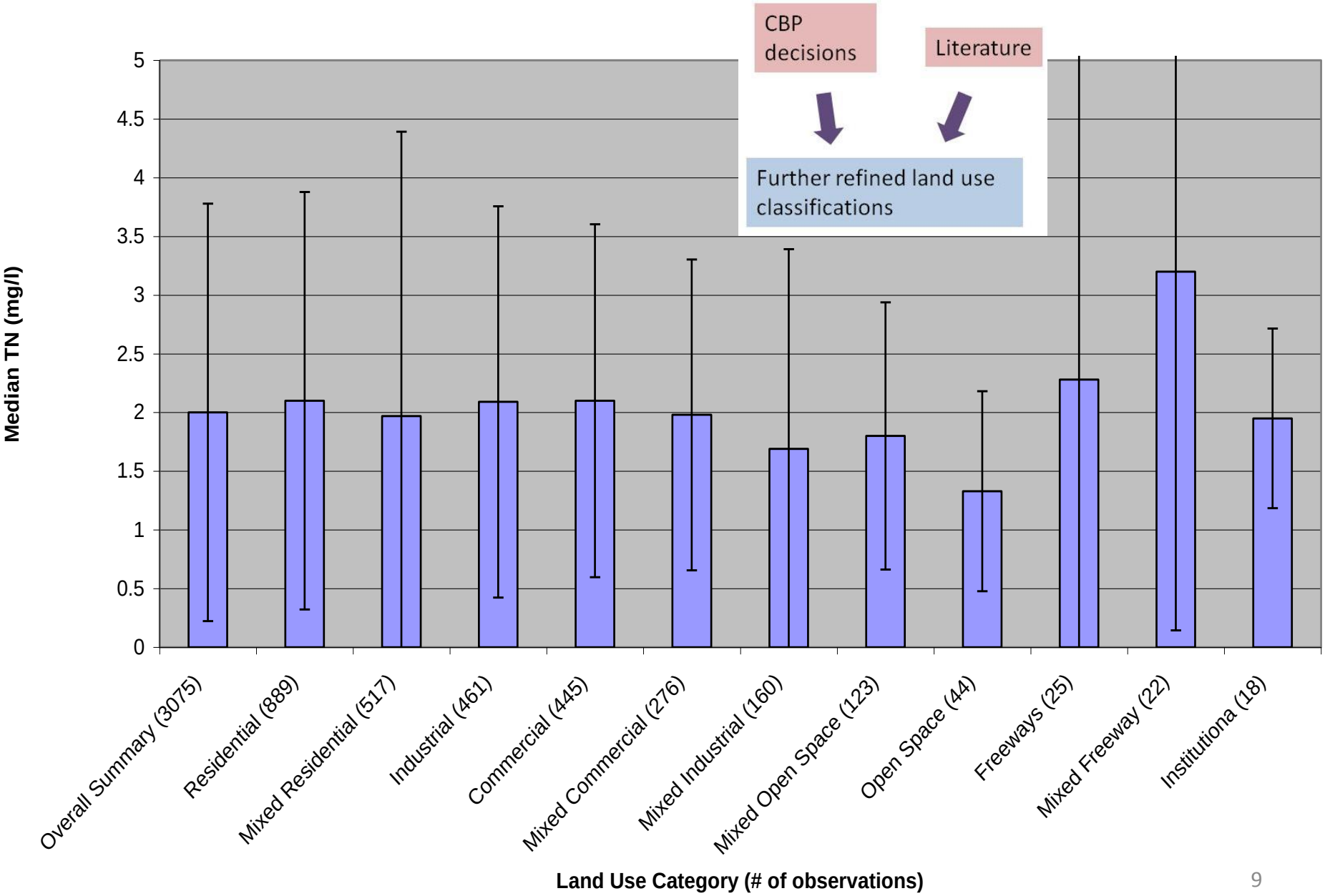
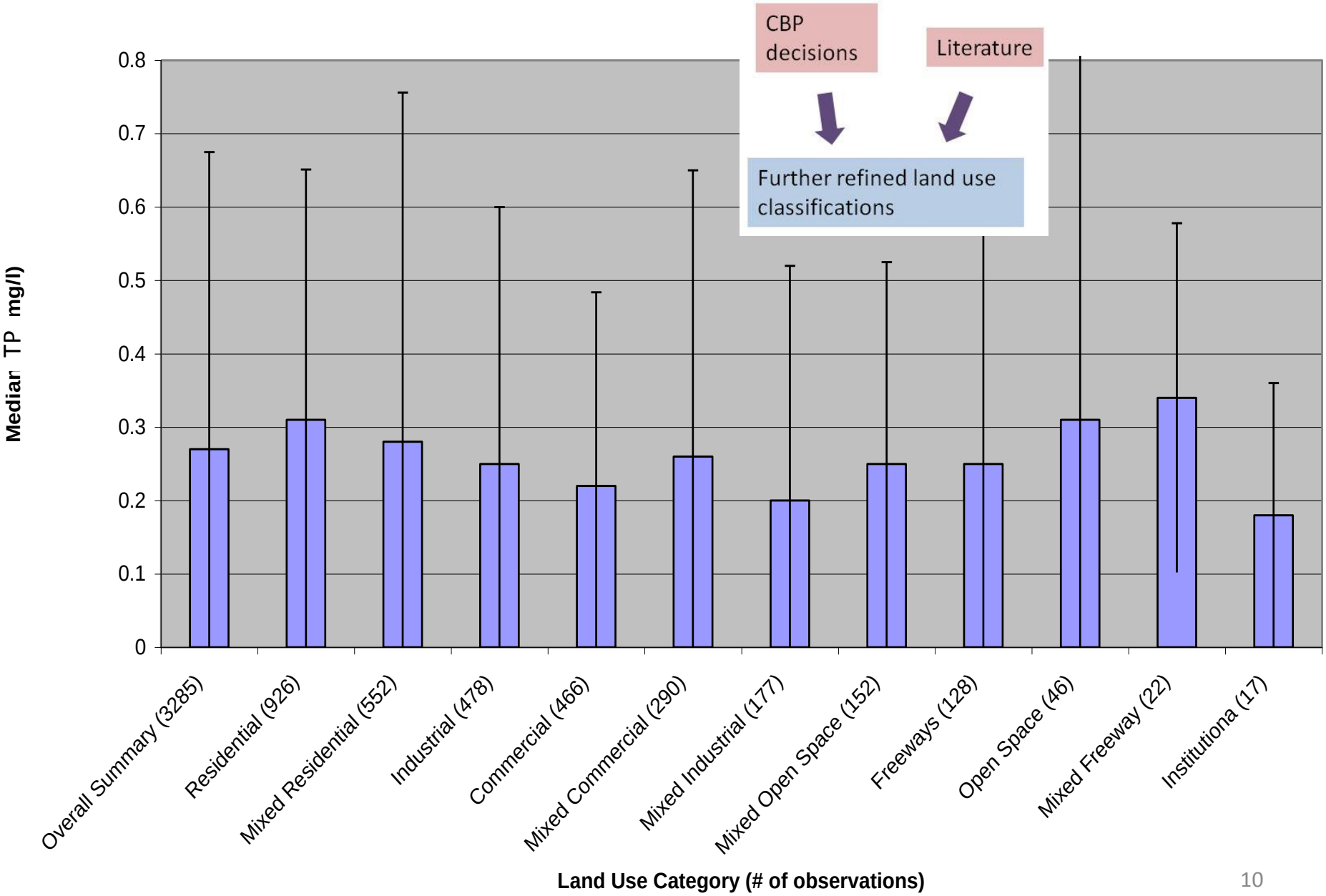


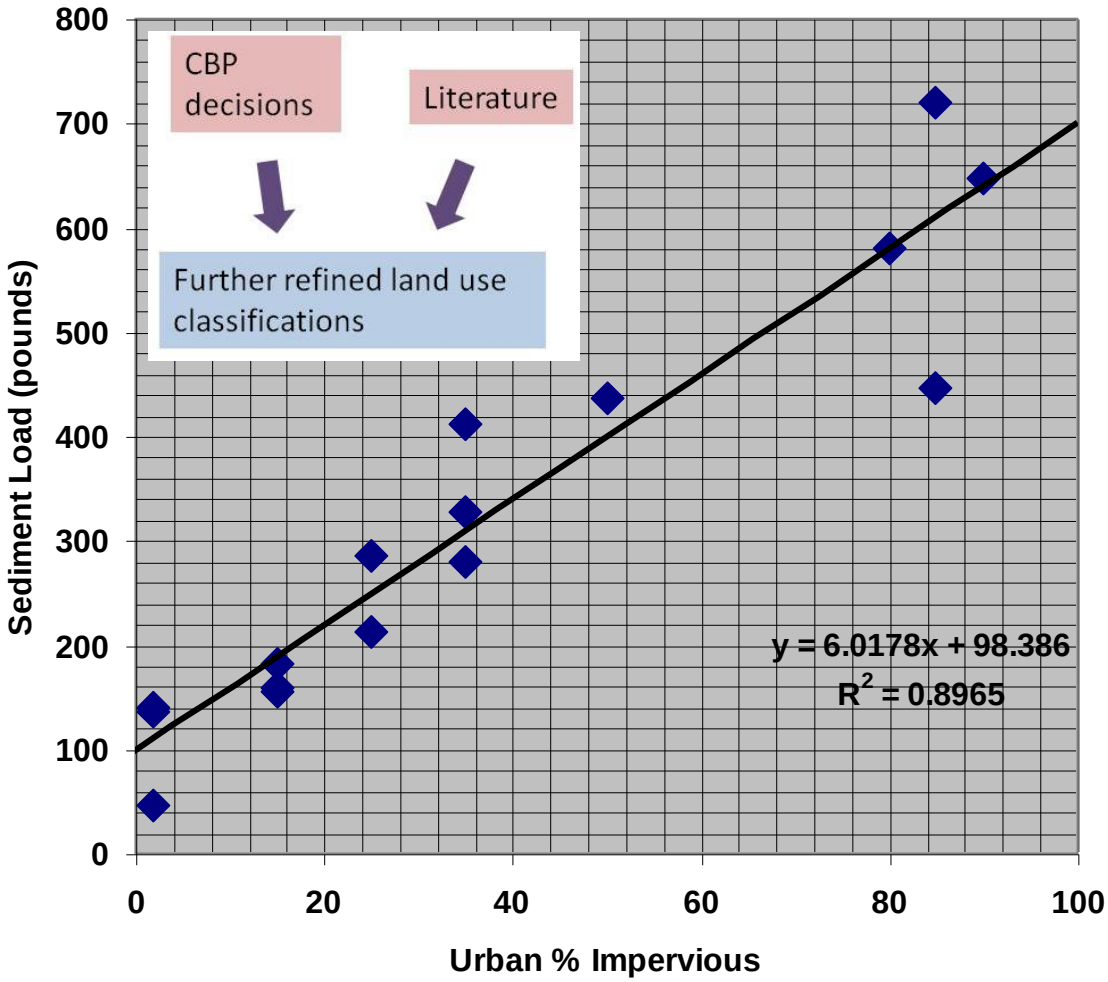
Figure 2 Median TP concentration in NPDES Phase 1 storm water data
Using data from Pitt, undated. Error bars are one standard deviation



Urban Sediment Targets

Sediment load for several urban land use types were compiled for sites in the mid-Atlantic and Illinois. Langland and Cronin (2003)

When plotted against 'typical' impervious percents for those urban land use types, the relationship is striking.

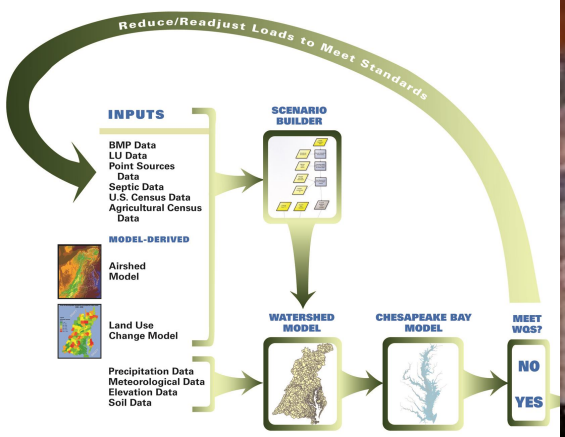


By setting pervious urban at the intercept and impervious urban at the maximum, the land use division within each particular segment determines the overall load according to the above relationship.

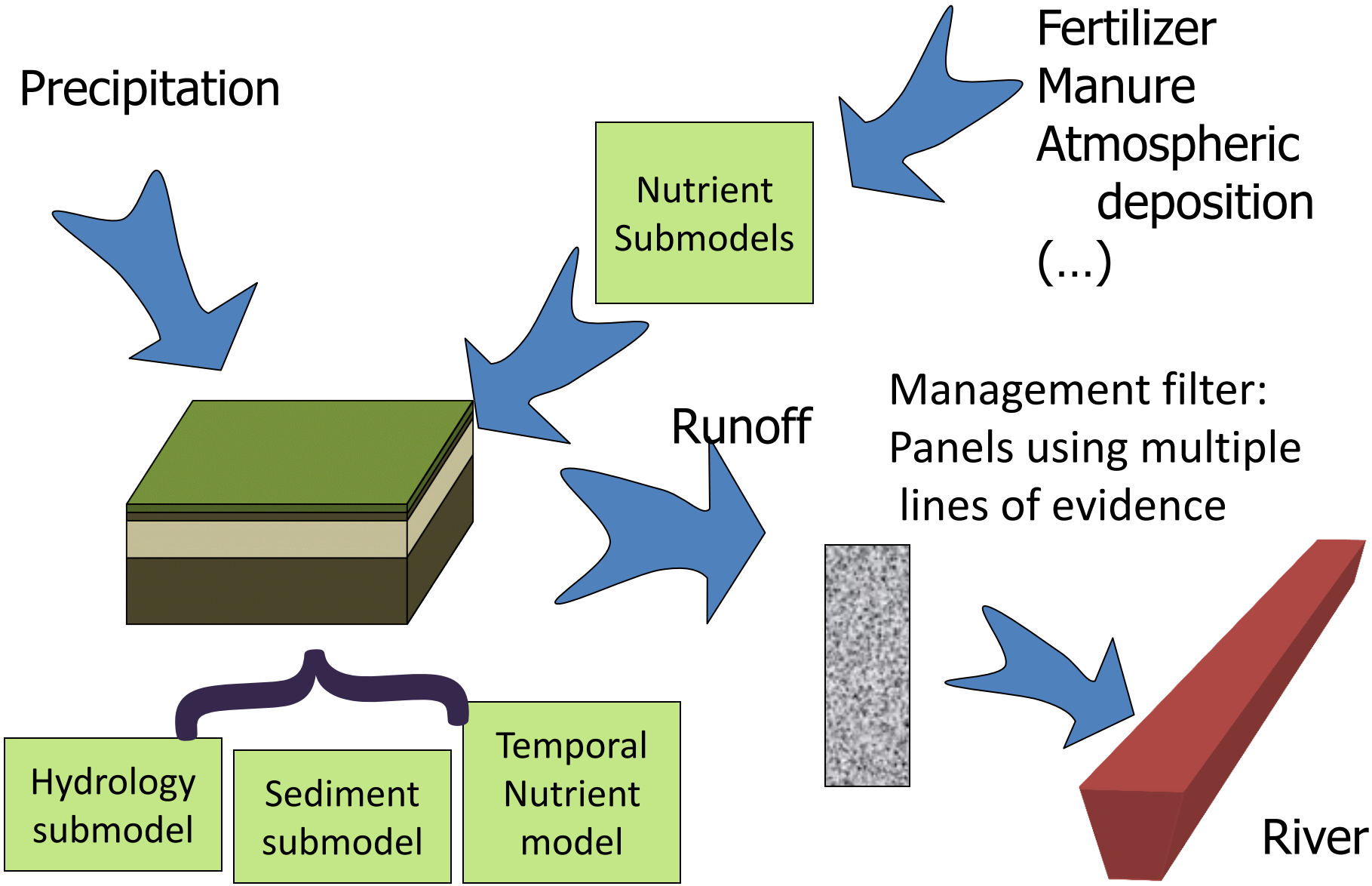
Nitrogen Targets

- Basinwide average of 2 mg/l
- Pitt also found
  - Very low nitrate from impervious areas
  - Relatively constant TKN concentration
- Impervious concentration = average TKN adjusted regionally for atmospheric deposition
- Pervious concentration is average TKN + 0.8 mg/l NO3, adjusted regionally for atmospheric deposition
- Impervious load averages 11.2 lb/ac/year
- Pervious load averages 9.4 lb/ac/year

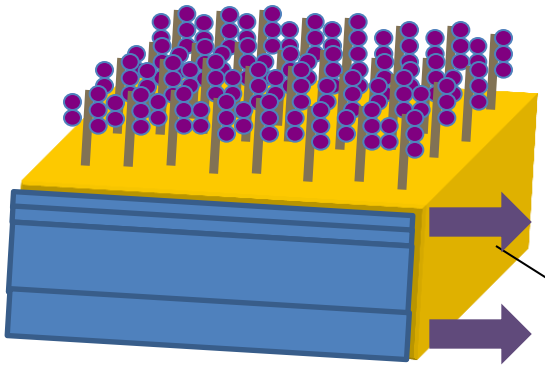
What's on the table for Phase 6?



Phase 6


Precipitation
Fertilizer
Manure
Atmospheric deposition
(…)
Nutrient Submodels
Runoff
Management filter:
Panels using multiple lines of evidence
Hydrology submodel
Sediment submodel
Temporal Nutrient model
River

Scale issue

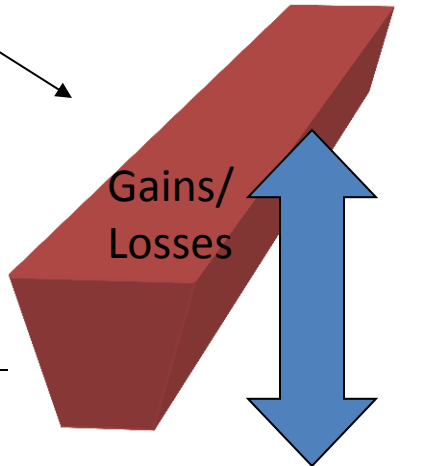


Edge of **Field**
Expected loads Leaving a representative acre

Measured Surface or total load?

One of the ‘peculiarities’ is that GW exists!!!

Edge of Stream
60-100 sq miles



In Stream Concentrations

Adding a new land use

- Where it is
  - Need to have consistent estimate through time
- What it does
  - Loads it receives
    - fertilizer, manure, etc
  - Loads it exports
    - Relative to inputs
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What's on the table for Phase 6?