Export Rate Targets for the July Version of the Phase 6 Watershed Model

Modeling Quarterly Review
July 21, 2015
Olivia Devereux

Role of Targets in Calibration

- Used to calibrate the land use export rates in the Watershed Model

Initial calibration load = target * BMPs * land to stream to river delivery

Target = literature target + ∑(Sensitivity(input - average))

- Data needed for targets
  - Measured load
  - Relative rates for major land use groups
  - Relative rates for land uses within a major land use group
  - Acres for Phase 6 land uses
  - Inputs to the model by land use and land segment
  - Sensitivity of nutrient export to inputs

Improvements over Phase 5.3.2

- Transparency
- Broad involvement of workgroups and others
- Multiple models that better represent the Chesapeake Bay region than solely using literature from a broader geographic area

Role of Workgroups

Chesapeake Bay Program committees, goal implementation team, and workgroups	Meeting Date
Modeling Review	9/30/2014, 1/29/2015, 3/26/2015, 4/23/2015, 6/11/2015, 7/21/2015
Modeling Team Meeting	9/15/2014, 1/20/2015, ongoing weekly
Water Quality Goal Implementation Team	4/13/2015
Land Use Workgroup	9/25/2014; 2/26/2015
Watershed Technical Workgroup	10/2/2014, 3/5/2015
Forestry Workgroup	10/1/2014, 3/4/2015, 3/20/2015
Wetlands Expert Panel	11/12/2014
Urban Stormwater Workgroup	10/21/2014, 12/16/2014, 3/3/2015
Agricultural Workgroup	10/9/2014, 10/22/2014, 2/19/2015, 3/25/2015, and multiple other meetings with updates from the Subgroup
Agricultural Modeling Subcommittee	9/16/2014,12/16/2014, 2/12/2015, 2/18/2015
Agricultural Loading Rate Review Subgroup	3/25/2015

Multiple Models

would be used in decision-making. The outputs of the individual models can be compared, and differences among the models can be related to the different assumptions and approaches. Together the models provide an average prediction, and differences among the predictions can be summarized (perhaps as a range or probability distribution) to provide an estimate of the uncertainty in the model average prediction. For example, a multi-model ensemble approach could be used to define a target nutrient reduction needed to achieve a water quality standard. Multiple solutions (target nutrient reductions) would be obtained from several models and averaged to obtain the mean target nutrient reduction. The main advantage of this approach is the mean model result tends to more correct than any single model result (Reichler and Kim 2008, Bever et al. 2013, Boomer et al. 2013), and the ensemble provides a measure of uncertainty (the variability in the model solutions). The multiple solutions also provide options to select more or less conservative management targets. Weighted averaging and Bayesian methods can improve multi-model ensemble integration (Kadane and Lazar 2004, Tobias and Li 2004, Morales et al. 2006).

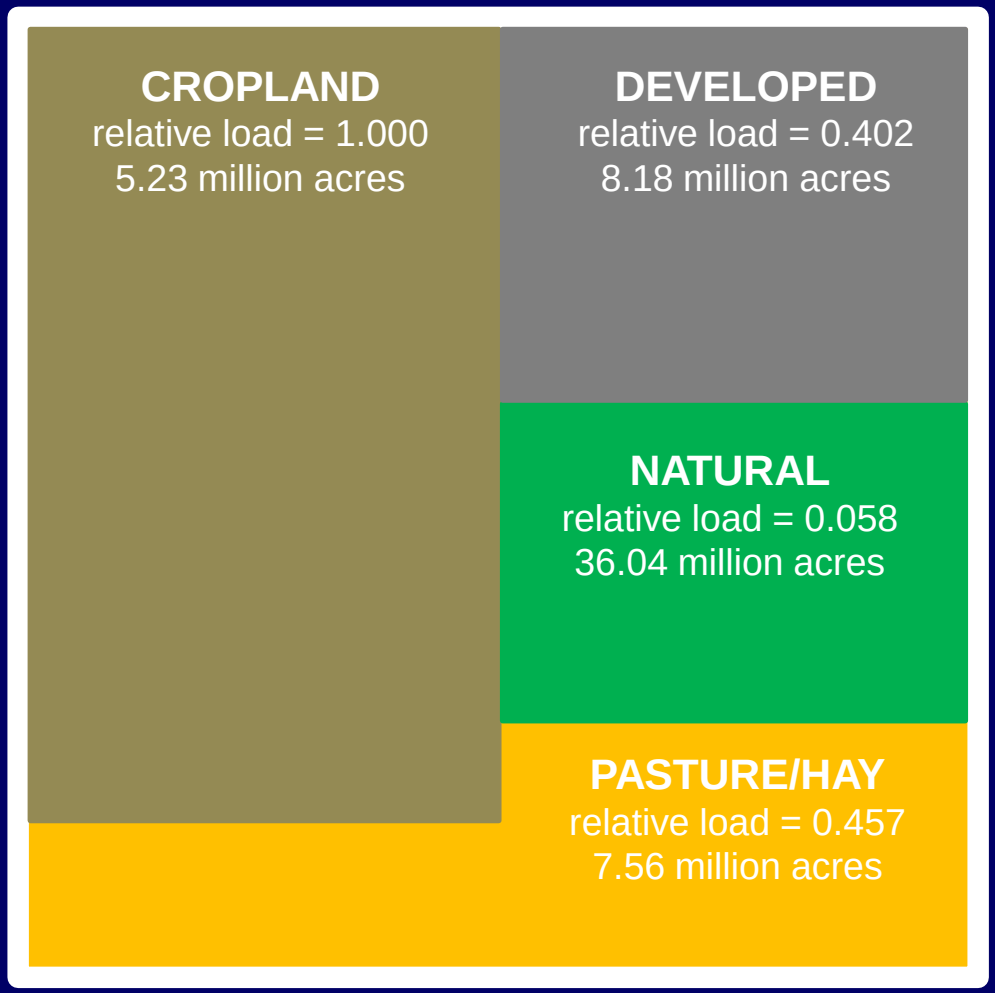
Three Aspects Anchor the Nutrient Targets to Data

The first anchor to the data is the use of the observed long-term ’91 – 2000 NPS loads as represented by this box.

Total average 1991-2000 TN or TP loads minus point source, septic, atm dep to water, and animal feeding operations.

Second Anchor to the Data: Multiple Models Set the Relative Loads

The relative loads of the 4 major land uses are set by multiple models:
CEAP, SPARROW, WSM Phase 5.3.2



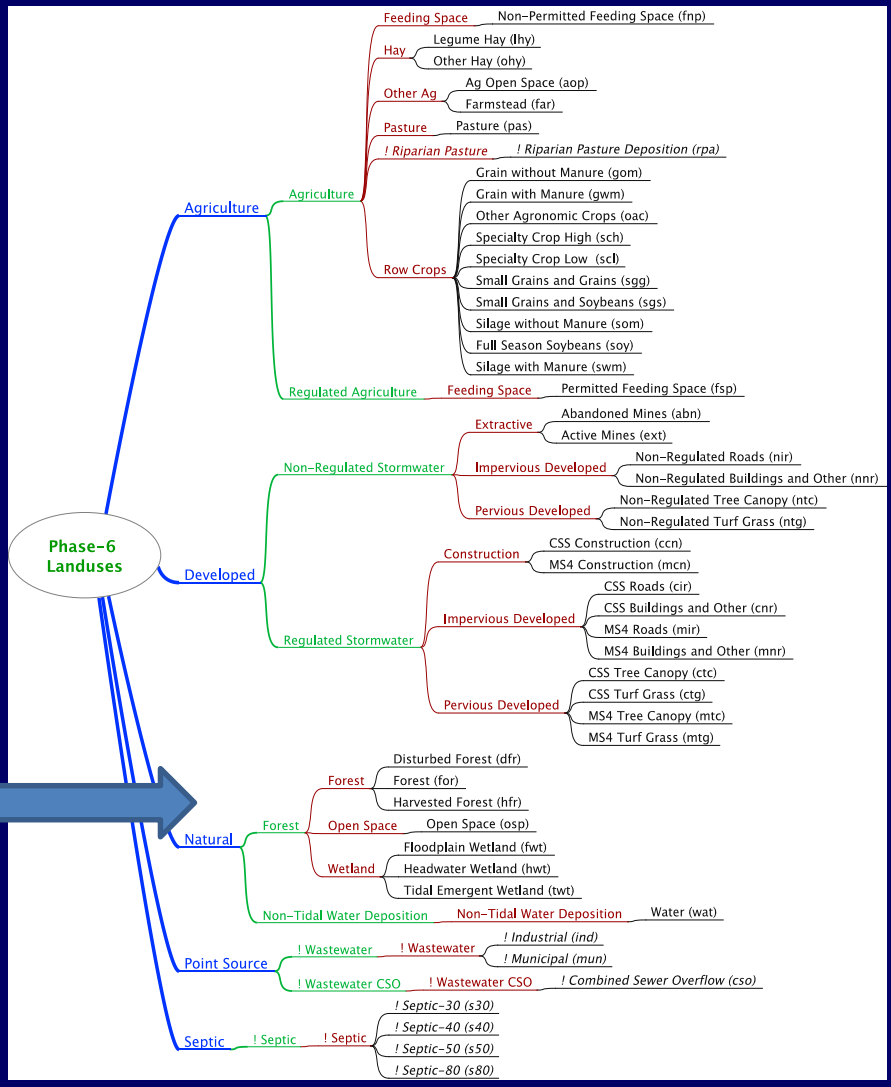
Third Anchor to the Data: Expert Groups Set the Relative Loads of the Land Uses within Each Major Land Use Group

CROPLAND
relative load = 1.000
5.23 million acres

DEVELOPED
relative load = 0.402
8.18 million acres

NATURAL
relative load = 0.058
36.04 million acres

PASTURE/HAY
relative load = 0.457
7.56 million acres

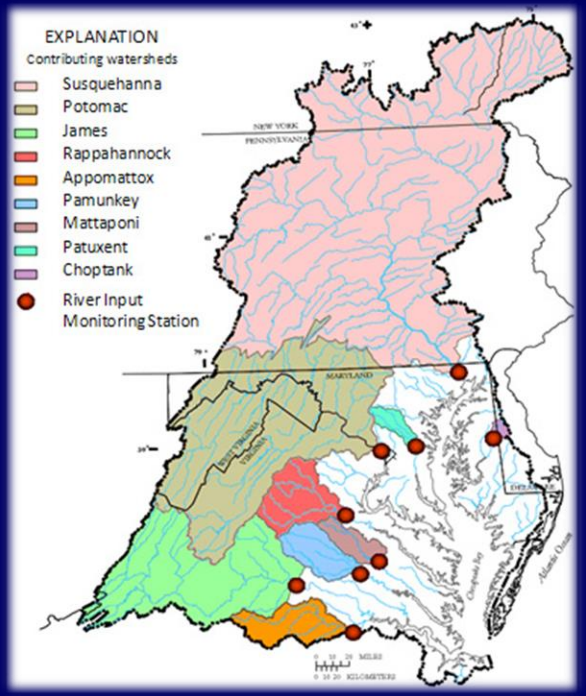


Decisions

- Monitored loads used to set the total target load
- Used relative loads from multiple models
  - CEAP
  - SPARROW
  - WSM Phase 5.3.2
- Used land use specific information from literature and workgroups

All Land Use Targets Are Relative and Set to Monitored Load

- Use Indicator's river input average annual load
- Include nonpoint downstream of RIM sites
- Subtract out:
  - Point sources
  - Atmospheric deposition to water
  - Septic
  - Apply factor to back up to EOS load
- TN EOS = 376,449,593 Lb/Yr
- TP EOS = 24,697,087 Lb/Yr



Target Calculation

- The basis for each target is the watershed-wide value and relative differences among land uses.
- Targets are calculated for each nutrient species by land use within each land segment.
- All geographic variation in the targets comes from the sensitivities and nutrient inputs. Additional variation is accounted for in the land to water factors (work by Claggett, Mandel, Christianson).

  ➔ This adjustment can be + or – based on the characteristics of each land segment.

- Loads are subject to modification through calibration: actual rate adjusted while relative differences maintained.

Additional Data Expected

- SPARROW data using Phase 6 land uses and acres—Fall 2015
- Revised Phase 6 land uses and acreages
- Changes to the agricultural relative land use export rates
- RUSLE2 data that will inform the sediment loads


Questions?