LOWEST LOADING LAND USE

Modeling Workgroup

February 14, 2017

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ISSUE: MODEL LOADS BELOW THAT OF FOREST

- Is it realistic for the loads from other land uses to be lower than from forest? Should reductions be limited?

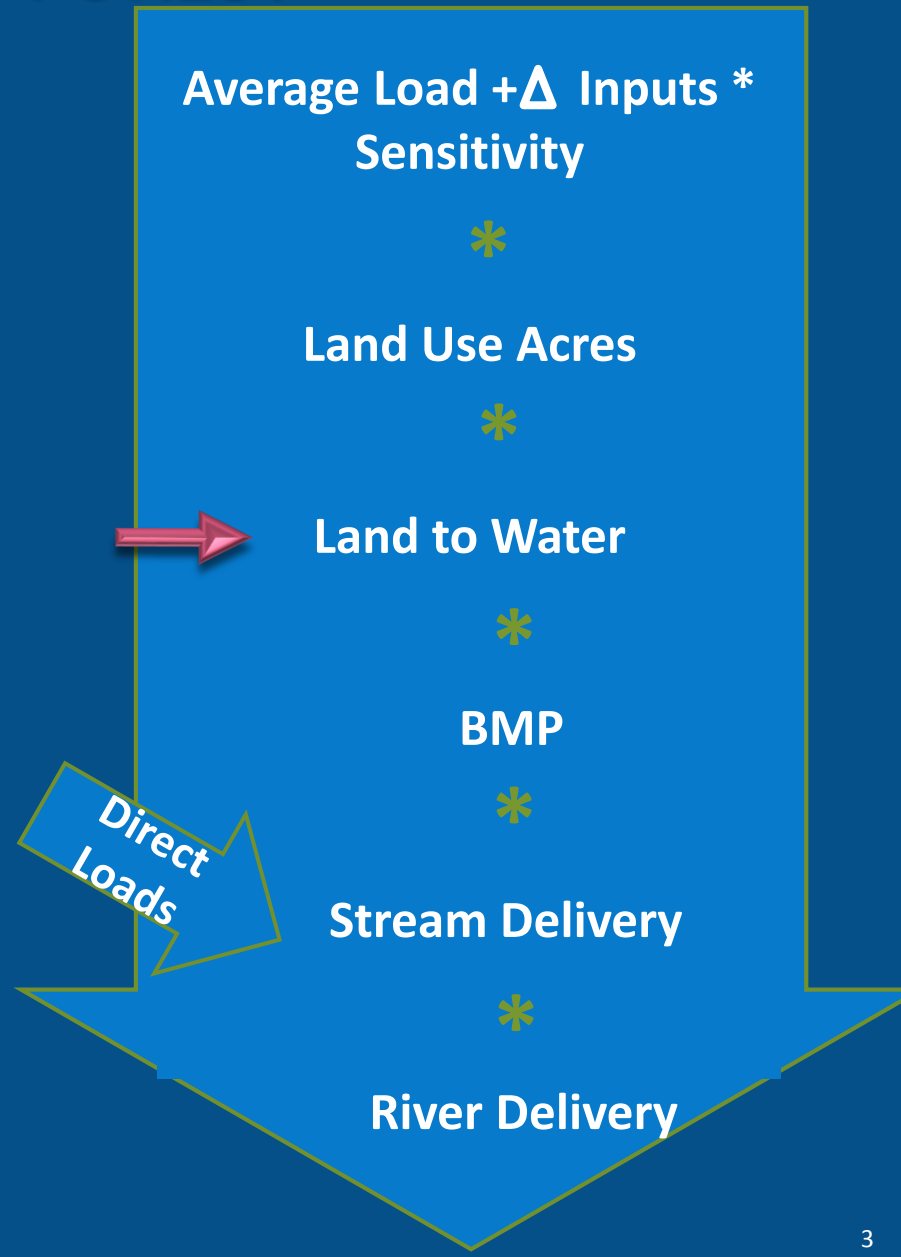
- At the August 2016 Modeling Workgroup, this issue was presented.

- More information was requested about the frequency and cause.
  1. Land to water factors reflect the location of land uses within a catchment. Natural land uses can be closer to streams than other land uses.
  2. BMPs reduce loads below forest.
  3. Wide range of loads across watershed, resulting in some land segment loads much below the watershed-wide average.

WATERSHED MODEL LOADS < FOREST

- Load with land to water factors and no BMPs

Scenario	Version	Nutrient	Land Use	% Land Segments	Avg lb/a < forest
Calibration	Beta 4	TN	Mixed Open	20.16%	0.566
E3	Beta 3	TN	Ag Open Space	0.16%	0.838
WIP2	Beta 3	TN	Ag Open Space	0.16%	0.773
Calibration	Beta 4	TP	Harvested Forest	0.10%	0.006
Calibration	Beta 4	TP	Mixed Open	2.55%	0.007
WIP2	Beta 3	TP	Ag Open Space	1.71%	0.003
WIP2	Beta 3	TP	Grains with Manure	0.21%	0.009
WIP2	Beta 3	TP	Legume Hay	1.92%	0.004
WIP2	Beta 3	TP	Other Hay	0.68%	0.006
E3	Beta 3	TP	Ag Open Space	1.66%	0.003
E3	Beta 3	TP	Grains with Manure	0.21%	0.009
E3	Beta 3	TP	Legume Hay	1.82%	0.004
E3	Beta 3	TP	Other Hay	0.62%	0.006



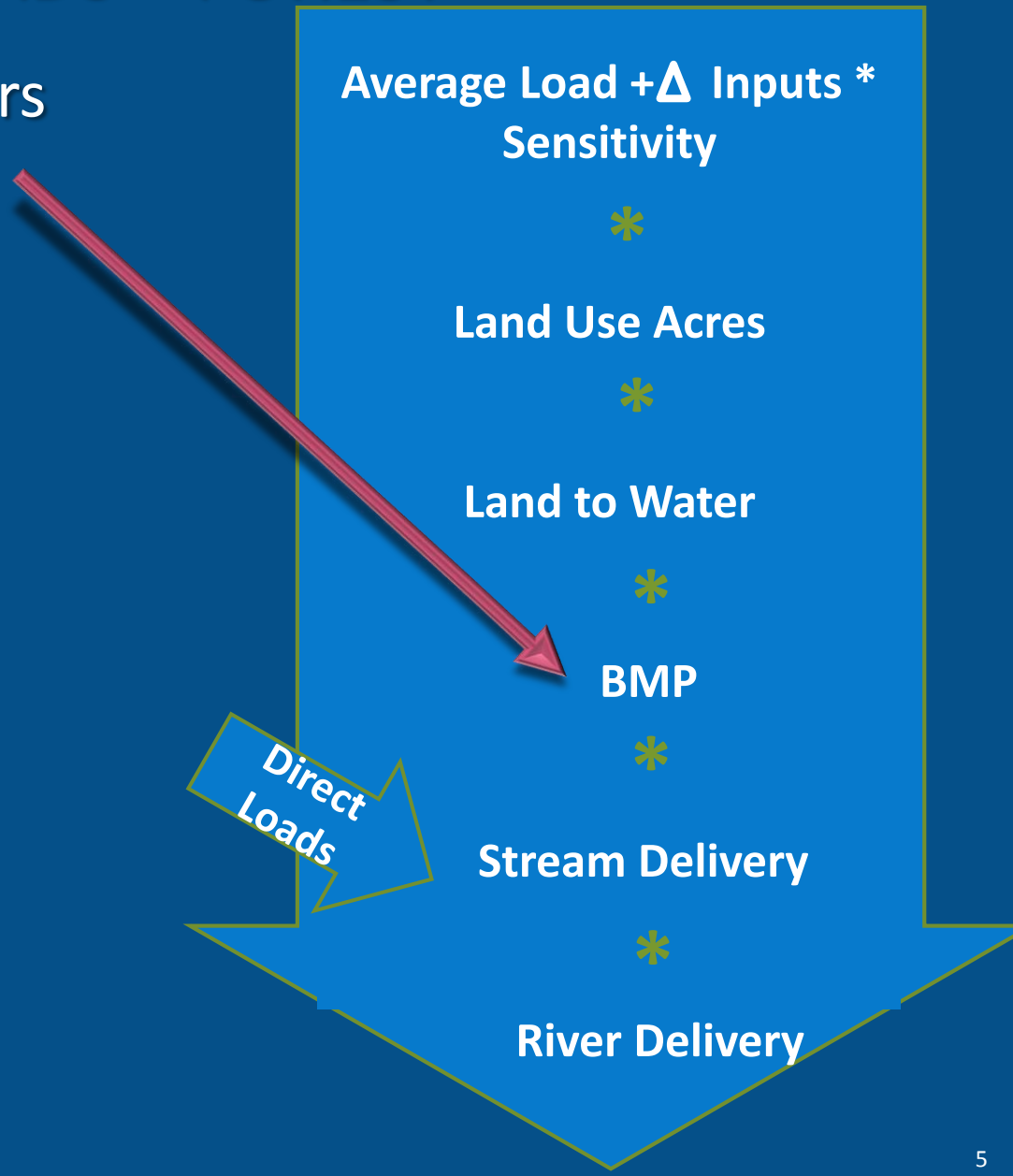
WHY THIS IS OCCURRING

- Land to Water Factors
  - Delivered non-forest loads are less than delivered forest loads based on distance to the water for acres in each sector and catchment.
  - Example: a catchment with croplands on the higher elevations and forest in the bottom lands.

WATERSHED MODEL LOADS < FOREST

- Edge of Stream – Includes land to water factors and BMPs

Scenario	Version	Nutrient	Sector	% Land Segments	Avg lb/a < forest
E3	Beta 3	TN	Agriculture	0.022%	0.64
E3	Beta 3	TN	Developed	0.034%	0.813
WIP2	Beta 3	TN	Agriculture	0.015%	0.697
WIP3	Beta 3	TN	Developed	0.003%	0.774
E3	Beta 3	TP	Agriculture	1.659%	0.016
WIP2	Beta 3	TP	Agriculture	1.113%	0.008

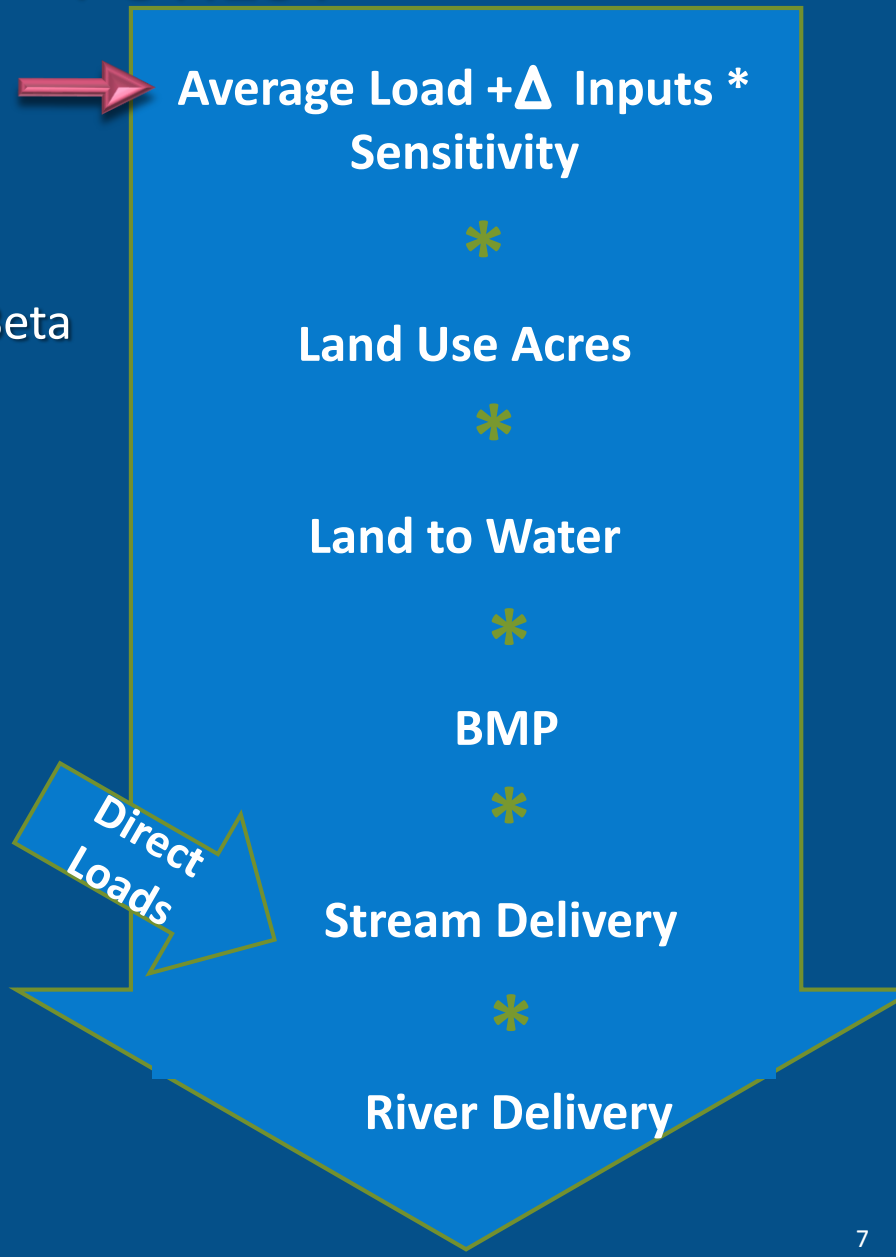


WHY THIS IS OCCURRING

- BMPs
  - Example: Infiltration BMP reduces 85% of TN
    - 7.81 Lbs. TN (from turfgrass land use acre in FIPS 54063) * (1-0.85) = 1.171 Lbs. TN
    - Forest loads at 1.48 Lbs. TN
- Multiple BMPs compound the problem
  - Example: Bioretention reduces 80 % N and Urban Nutrient Management reduces 9% N
    - 7.81 Lbs. TN (from turfgrass land use acre in FIPS 54063) * (1-0.8) * (1-0.09) = 1.42 Lbs. TN
    - Forest loads at 1.48 Lbs. TN

CALIBRATION AVERAGE LOADS < FOREST

- Calibration Average Loads
  - TP for 11 land segments, 9 are mixed open
    - Mixed open has 3 slightly negative, which is persistent among Beta versions.
    - Others are slightly < forest
  - 0.02 lbs per acre < forest, on average



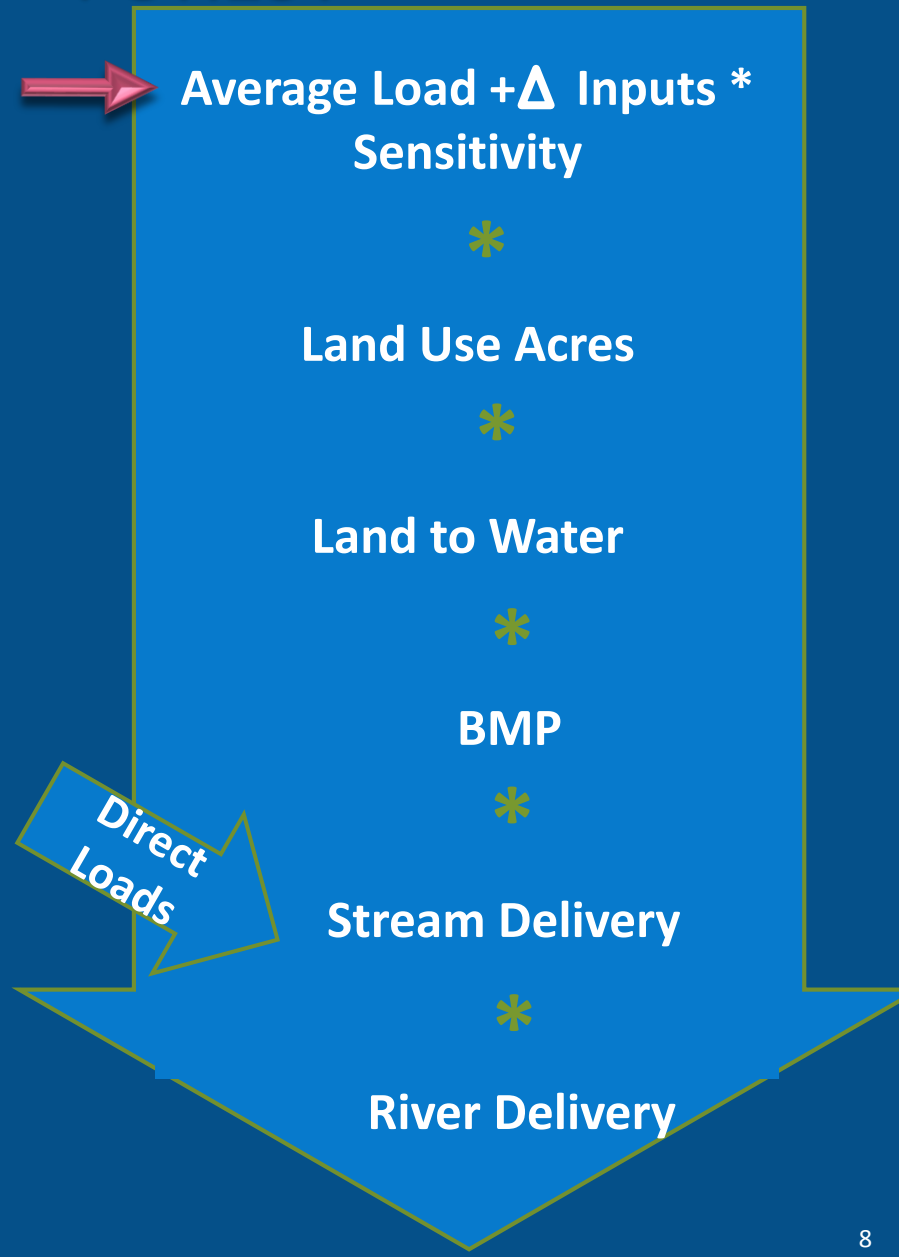
CALIBRATION AVERAGE LOADS < FOREST

- Example for Mixed Open TP in N10001:
  - Forest Runoff input = 1.331
  - Forest Sediment loss input = 0.004
  - Mixed Open Runoff Input = 1.577
  - Mixed Open Sediment input= 0.247

  - Forest Runoff Input Average = 6.717
  - Forest Sediment Input Average = 0.071
  - Mixed Open Runoff Input Average = 6.734
  - Mixed Open Sediment Input Average = 2.725

  - Forest Runoff Sensitivity = 0.007
  - Forest Sediment Sensitivity = 0.011
  - Mixed Open Runoff Sensitivity = 0.040
  - Mixed Open Sediment Sensitivity = 0.063

  - Forest Watershed Average Load = 0.060
  - Mixed Open Watershed Average Load = 0.339

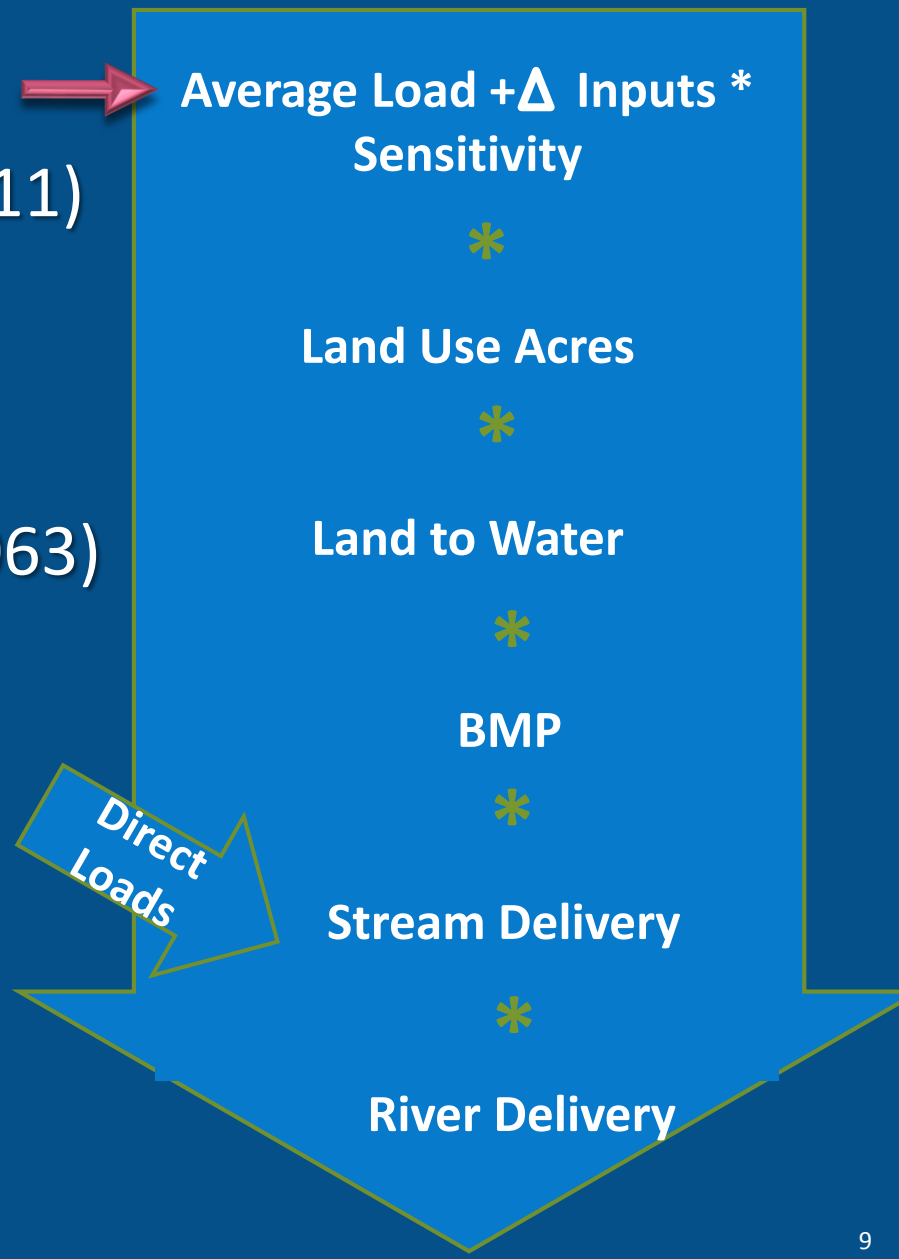


CALIBRATION AVERAGE LOADS < FOREST

- Forest Ave Load + ∑ (Δ Inputs * Sensitivity)
  = 0.060+((1.331-6.717)*0.007)+((0.004-0.071) *0.011)
  = 0.0212

- Mixed Open Ave Load + ∑ (Δ Inputs * Sensitivity)
  = 0.339+((1.577- 6.734)*0.040)+((0.247-2.725) *0.063)
  = - 0.0224

- Runoff and sediment inputs are substantially lower than the input average. This difference is not compensated for by a higher positive Watershed Average Load, as it would be in higher loading land uses.



OPTIONS FOR ADJUSTING THE CALIBRATION AVERAGE LOADS

- For each land segment and land use where load < forest,
  - Set to forest?
  - Set to 0.5 * forest?
  - For total nitrogen and total phosphorus, or by nutrient species?
- Adjustment is applied only for the calibration average loads, or calibration targets. It would not be applied to the time-variable model or CAST.

DETAILED INFORMATION

https://public.tableau.com/views/LowestLoadingLandUse/WatershedAverageLoadRate?:embed=y&:display_count=yes

CONSIDERATIONS AND OPTIONS IF THIS NEEDS TO BE ADDRESSED

- BMPs
  - Could set the forest loading rate as the lowest loading land use
  - At scale of lrseg and at edge-of-stream. Some BMPs are applied at EOR and EOT, so could still have some loads lower.
  - Calculated for TN or TP; maintain same proportion among nutrient species
  - No BMPs are applied to forest; some BMPs applied to wetlands. This would eliminate benefit of wetland BMPs.
    - Consider creating a wetland exception
    - Consider using the post-BMP wetland as the lowest loading land use by running a wetland scenario with all BMPs. This works where the same atmospheric deposition is used (most of the time). No other inputs on wetlands.
  - Cuts off BMP credit