CAST Result Summaries on Septic, Biosolids, Spray Irrigation on Ag Land and non-Ag Land, Large Onsite System and RIB Loads

A Presentation to the CBP Wastewater Workgroup
Aug 15, 2017

Ning Zhou, CBPO

New Wastewater Sources in CAST

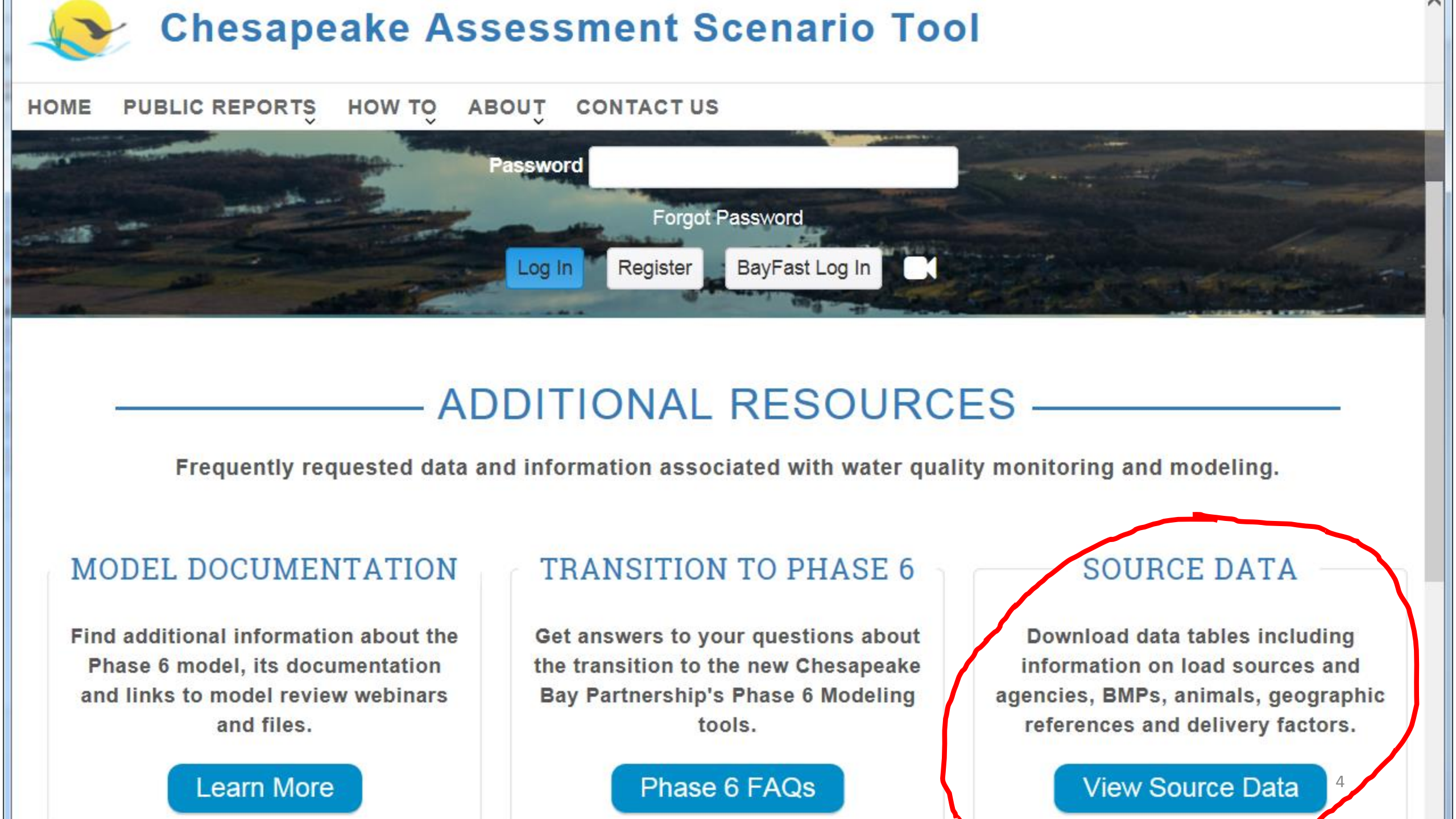
For phase 6 model, we have included the following new wastewater loading sources:

- Biosolids
- Spray irrigation on Ag land
- Spray irrigation on non-Ag land
- Large monitored onsite system
- Rapid infiltration basin (RIB)

CAST was built with the pass through factors generated from the phase 6 model. Different scenarios could be run through CAST with the constant pass through factors of the land river segments for most loading sources, except some like Biosolids and Spray Irrigation on Ag Land.

Results and summaries are available for review at https://archive.chesapeakebay.net/VT/Phase_6_Calibration_Data_Review/9b-Annual%20Loading%20Summary%20for%20Septic,Biosolid%20and%20etc/

New Wastewater Nutrient Loading Sources						
Source Type	Biosolids	Spray Irrigation on Ag land	Spray Irrigation on non-Ag land	Rapid Infiltration	Large Monitored onsite system	Boat Discharge
Definition	Wastewater treatment sludge applied to Ag land	Wastewater effluent applied to Ag land	Wastewater effluent applied to non- Ag land	Wastewater treatment plant effluent discharge to ground through rapid infiltration basin	Community or commercial wastewater treatment system discharge through drainfield to ground	Boat sewage wastewater discharged to surface water
Discharged to	ground	ground	ground	ground	ground	surface water
Land type	Ag land	Ag land	Golf course and grass field	infiltration basin/ large septic drianfield	large septic drainfield	
Load In Phase V	Only VA	No	No	No	As part of septic	No
New in phase 6	Existing	New	New	New	Refined/separated from septic load	New
Allocation Category	Load Allocation	Load Allocation	Load Allocation	Load Allocation	Load Allocation	Load Allocation
Data collection	in process	in process	in process	not yet	not yet	not yet
BMP Crediting	No	No	No	No	No	Yes
Nutrient Loads applied/ discharged	estimated from reported poundage	estimated from monitored effluent data or permit data	estimated from monitored effluent data or permit data	calculated from monitored effluent data	calculated from monitored effluent data	estimated from monitored pumpout data and estimated number of boats
Plant uptake	Calculated by model	Calculated by model	State Default rates or calculated by model			
Additional Attenuation through land surface and subsurface	Simulated as fertilizer as Ag		simulated through septic soil attenuation, same as septic system attenuation rates of Zone 1-4	Reduced attenuation rate of Zone 1; attenuation rate of Zone 2-4	Monitoring data for monitored zones; attenuation rates for unmonitored zones	


Chesapeake Assessment Scenario Tool
HOME
PUBLIC REPORTS
HOW TO
ABOUT
CONTACT US
Password
Forgot Password
Log In
Register
BayFast Log In
ADDITIONAL RESOURCES
Frequently requested data and information associated with water quality monitoring and modeling.
MODEL DOCUMENTATION
Find additional information about the Phase 6 model, its documentation and links to model review webinars and files.
Learn More
TRANSITION TO PHASE 6
Get answers to your questions about the transition to the new Chesapeake Bay Partnership's Phase 6 Modeling tools.
Phase 6 FAQs
SOURCE DATA
Download data tables including information on load sources and agencies, BMPs, animals, geographic references and delivery factors.
View Source Data

LandRiverSegment	LoadSource	LandToWater_TN_Factor	LandToWater_TP_Factor	LandToWater_SED_Factor	StreamToRiver_TN_Factor	StreamToRiver_TP_Factor	StreamToRiver_SED_Factor	RiverToBay_TN_Factor
H24021PM1_3510_4000	Ag Open Space	0.691618323	1.063235164	0.473533988	0.949401855	0.999789834	0.999628663	0.902504683
H24021PM1_3510_4000	Combined Sewer Overflow				1	1	1	0.902504683
H24021PM1_3510_4000	CSS Buildings and Other	0	0	0	0.953919768	0.999659717	0.999447823	0.902504683
H24021PM1_3510_4000	CSS Construction	0	0	0	0.953919768	0.999659717	0.999447823	0.902504683
H24021PM1_3510_4000	CSS Forest	0	0	0	0	0	0	0.902504683
H24021PM1_3510_4000	CSS Mixed Open	0	0	0	0	0	0	0.902504683
H24021PM1_3510_4000	CSS Roads	0	0	0	0.953919768	0.999659717	0.999447823	0.902504683
H24021PM1_3510_4000	CSS Tree Canopy over Impervious	0	0	0	0.953919768	0.999659717	0.999447823	0.902504683
H24021PM1_3510_4000	CSS Tree Canopy over Turfgrass	0	0	0	0.953919768	0.999659717	0.999447823	0.902504683
H24021PM1_3510_4000	CSS Turf Grass	0	0	0	0.953919768	0.999659717	0.999447823	0.902504683
H24021PM1_3510_4000	Double Cropped Land	0.69534409	1.023873568	0.462352306	0.950838327	0.999702156	0.999462128	0.902504683
H24021PM1_3510_4000	Full Season Soybeans	0.69534409	1.023873568	0.462926298	0.950838327	0.999702156	0.999462128	0.902504683
H24021PM1_3510_4000	Grain with Manure	0.69534409	1.023873568	0.464183718	0.950838327	0.999702156	0.999462128	0.902504683
H24021PM1_3510_4000	Grain without Manure	0.69534409	1.023873568	0.464183748	0.950838327	0.999702156	0.999462128	0.902504683
H24021PM1_3510_4000	Harvested Forest	0.690124869	1.057088375	0.508082211	0.950656414	0.999376059	0.999028563	0.902504683
H24021PM1_3510_4000	Headwater or Isolated Wetland	0.690124869	1.057088375	0.508082211	0.950656414	0.999376059	0.999028563	0.902504683
H24021PM1_3510_4000	Legume Hay	0.691618323	1.063235164	0.459100097	0.949401855	0.999789834	0.999628663	0.902504683
H24021PM1_3510_4000	Mixed Open	0.690124869	1.057088375	0.451474071	0.950656414	0.999376059	0.999028563	0.902504683
H24021PM1_3510_4000	MS4 Buildings and Other	0.686380982	1.072008133	0.500300586	0.953919768	0.999659717	0.999447823	0.902504683
H24021PM1_3510_4000	MS4 Roads	0.686380982	1.072008133	0.500300586	0.953919768	0.999659717	0.999447823	0.902504683
H24021PM1_3510_4000	MS4 Tree Canopy over Impervious	0.686380982	1.072008133	0.500300586	0.953919768	0.999659717	0.999447823	0.902504683
H24021PM1_3510_	MS4 Tree Canopy							

New Septic Soil Attenuation/Pass Through Factors

By the recommendations of the Septic Attenuation Expert Panel, new septic soil attenuation rates/pass through factors were developed for individual land river segment based on soil type (Zone 1) and groundwater transportation (Zone 3).

For surface water attenuation, in addition to the delivery rates of phase 5 model, the phase 6 model added small stream to river delivery/pass through factors.

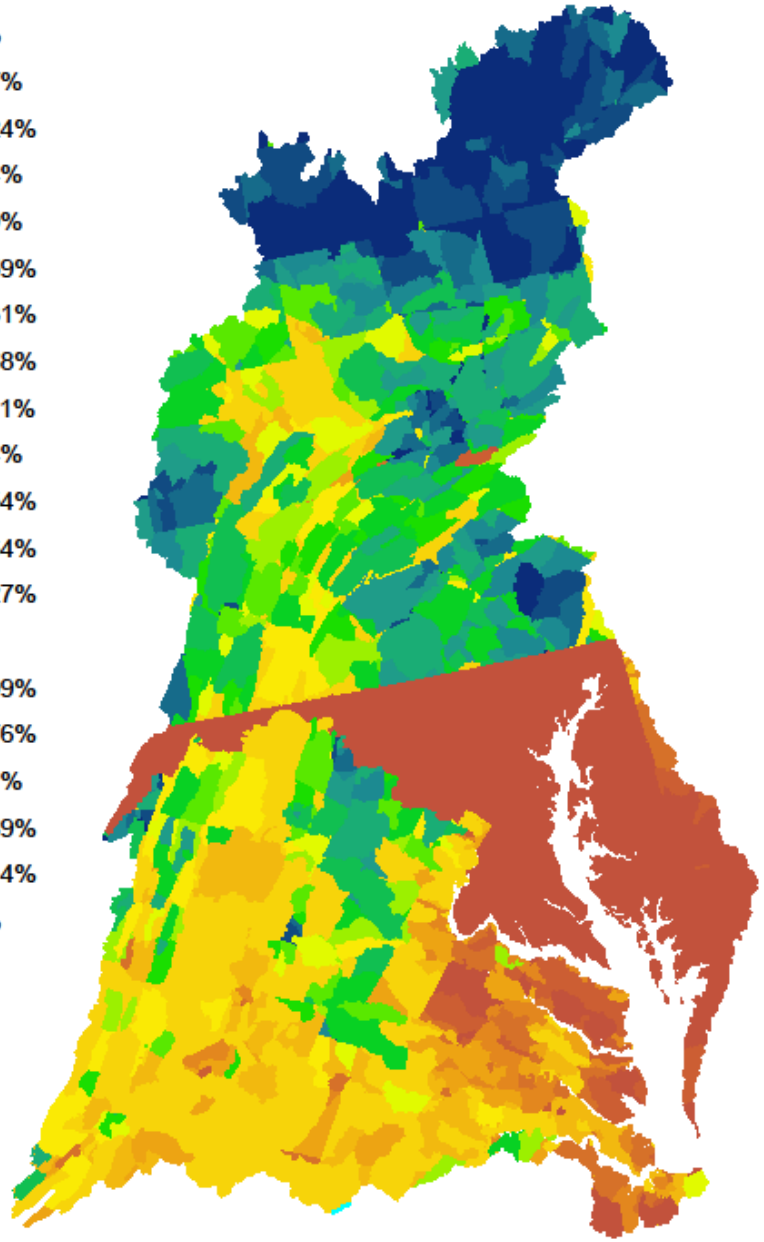
After Zone 1 and Zone 3, septic load goes from small stream to river and from river to the Bay.

The delivered loads to the Bay from Spray Irrigation on non-Ag land, Large Onsite System and RIB are calculated in the same way septic loads are calculated through the attenuation /pass through factors discussed above.

Original load ➪ Drainfield/Zone1 ➪ Groundwater/Zone3 ➪ small stream ➪ river ➪ Bay

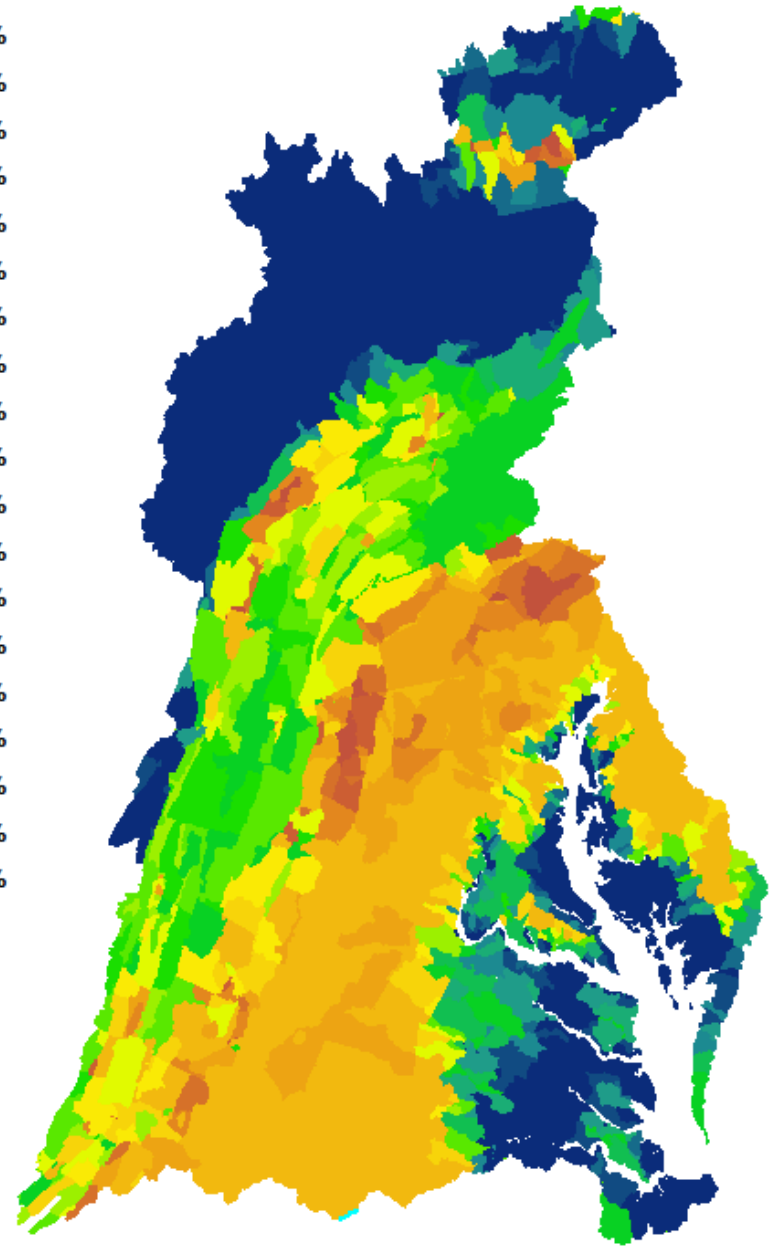
Septic Nitrogen
Zone1 PassTrough Rate

- 81.71% - 84%
- 77.25% - 81.7%
- 72.65% - 77.24%
- 69.8% - 72.64%
- 67.6% - 69.79%
- 66.32% - 67.59%
- 65.69% - 66.31%
- 65.12% - 65.68%
- 64.41% - 65.11%
- 63.55% - 64.4%
- 62.65% - 63.54%
- 61.28% - 62.64%
- 59.41% - 61.27%
- 57% - 59.4%
- 54.77% - 56.99%
- 52.32% - 54.76%
- 49.9% - 52.31%
- 48.15% - 49.89%
- 46.82% - 48.14%
- 46% - 46.81%



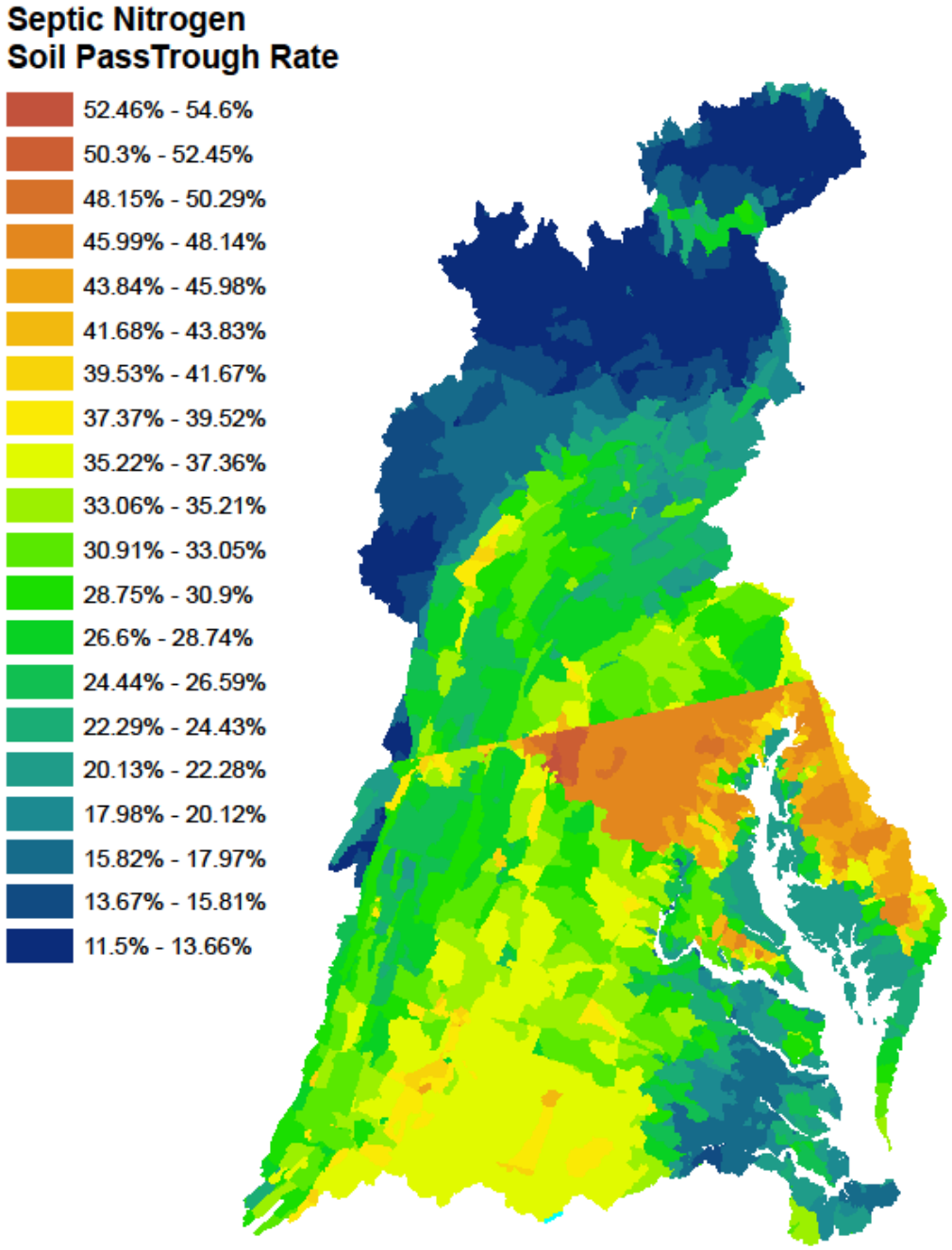
Septic Nitrogen
Zone 3 PassTrough Rate

- 63.01% - 65%
- 61.01% - 63%
- 59.01% - 61%
- 57.01% - 59%
- 55.01% - 57%
- 53.01% - 55%
- 51.01% - 53%
- 49.01% - 51%
- 47.01% - 49%
- 45.01% - 47%
- 43.01% - 45%
- 41.01% - 43%
- 39.01% - 41%
- 37.01% - 39%
- 35.01% - 37%
- 33.01% - 35%
- 31.01% - 33%
- 29.01% - 31%
- 27.01% - 29%
- 25% - 27%



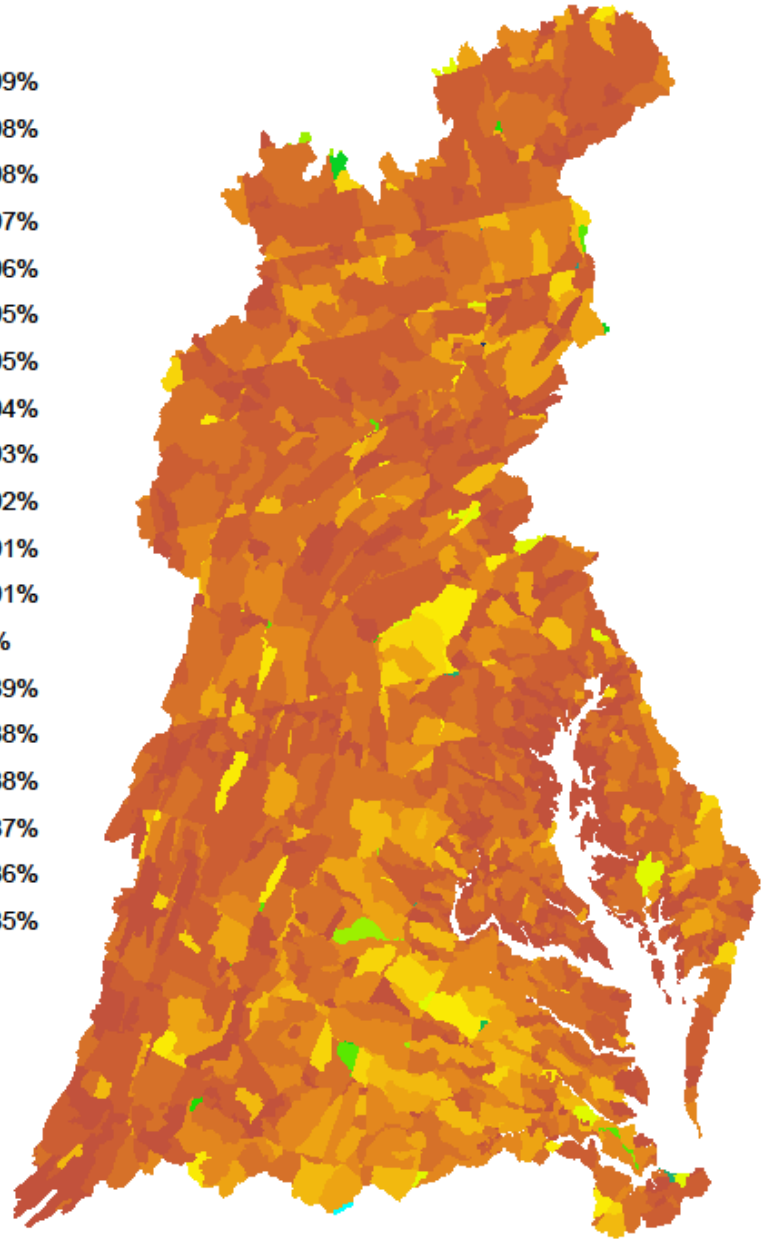
Combining Zone 1 and Zone 3, we obtained the septic nitrogen soil pass through rates for phase 6 model.

In phase 5, we had 60% attenuation or 40% pass through cross the watershed, except MD



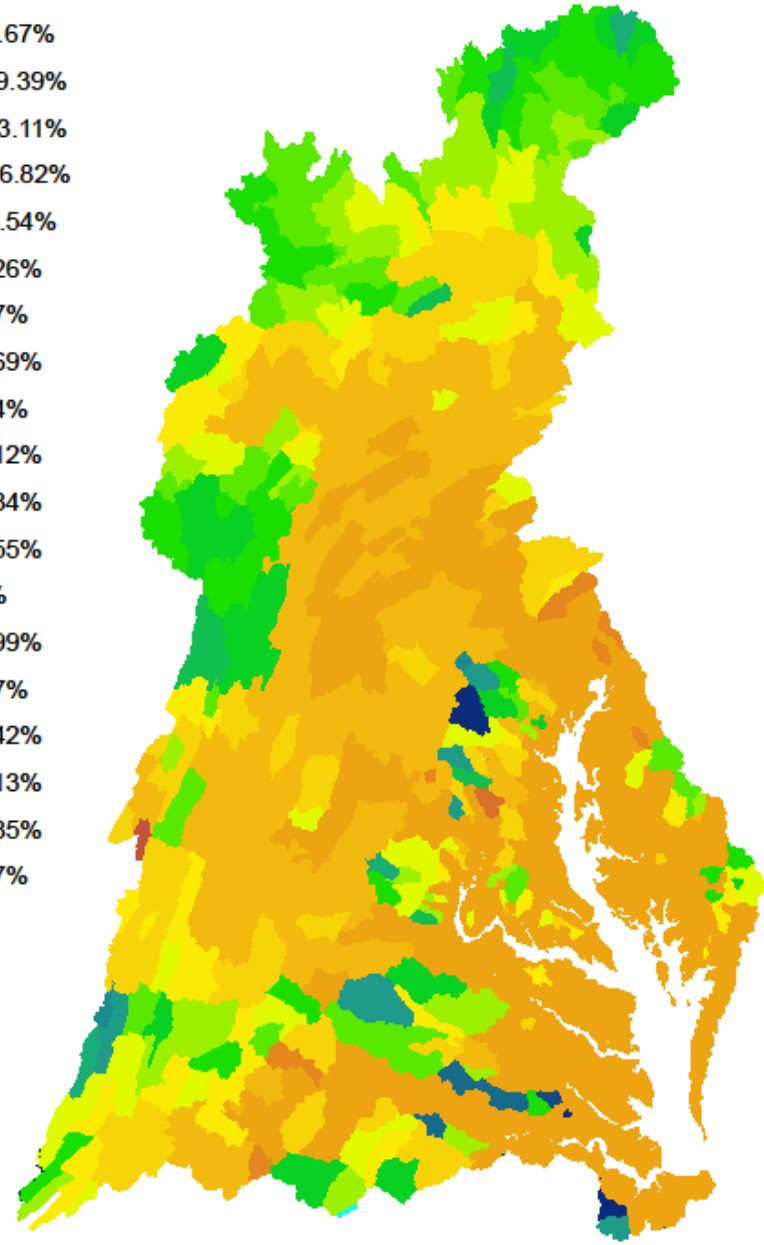
Nitrogen
StreamToRiver PassThrough

- 96% - 100%
- 91.99% - 95.99%
- 87.99% - 91.98%
- 83.98% - 87.98%
- 79.97% - 83.97%
- 75.96% - 79.96%
- 71.96% - 75.95%
- 67.95% - 71.95%
- 63.94% - 67.94%
- 59.93% - 63.93%
- 55.92% - 59.92%
- 51.92% - 55.91%
- 47.91% - 51.91%
- 43.9% - 47.9%
- 39.89% - 43.89%
- 35.89% - 39.88%
- 31.88% - 35.88%
- 27.87% - 31.87%
- 23.86% - 27.86%
- 19.84% - 23.85%



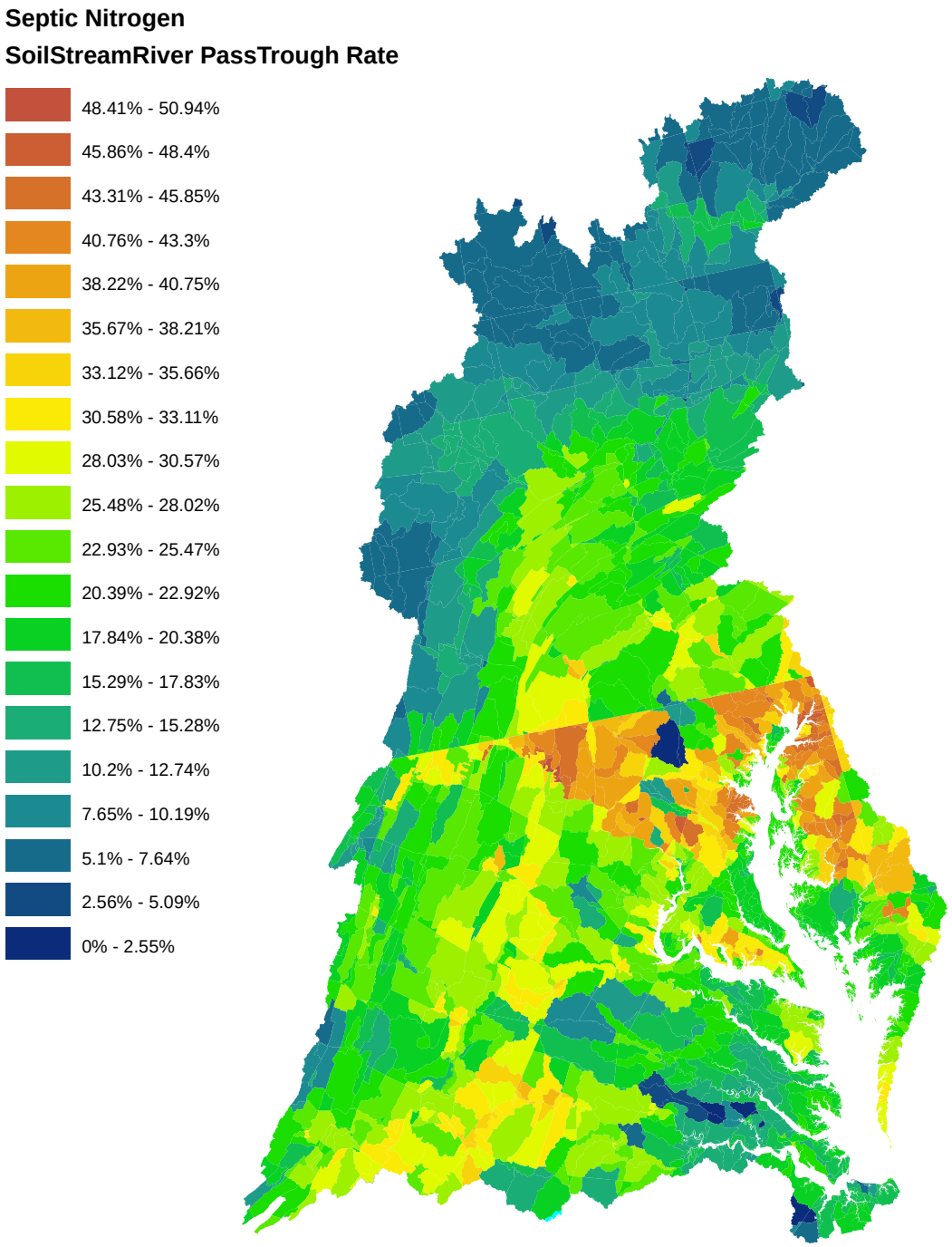
Nitrogen
RiverToBay PassThrough

- 119.4% - 125.67%
- 113.12% - 119.39%
- 106.83% - 113.11%
- 100.55% - 106.82%
- 94.27% - 100.54%
- 87.98% - 94.26%
- 81.7% - 87.97%
- 75.41% - 81.69%
- 69.13% - 75.4%
- 62.85% - 69.12%
- 56.56% - 62.84%
- 50.28% - 56.55%
- 44% - 50.27%
- 37.71% - 43.99%
- 31.43% - 37.7%
- 25.14% - 31.42%
- 18.86% - 25.13%
- 12.58% - 18.85%
- 6.29% - 12.57%
- 0% - 6.28%



Combined Pass Through Factors:

Through Zone 1, Zone 3, small stream and river to the Bay.



Septic Load Summary

Phase 6 model used the soil based and spatial variable soil attenuation rates/pass-through rates recommended by the expert panel.

Special case: MD soil data used in determining the pass-through rates was defined by MDE based on their surveys and studies.

The Bay wide septic nitrogen pass through rate in phase 6 is about 30%, a change from 40% in phase 5.

		Loads Applied to Land		Loads at EOS		EOS Pass Through		Loads Delivered To Bay		Delivered PassThrough	
Sources	State	TNL (lbs/yr)	TPL (lbs/yr)	TNL (lbs/yr)	TPL (lbs/yr)	%TN	%TP	TNL (lbs/yr)	TPL (lbs/yr)	%TN	%TP
Setic	DC	735		236		32.11%		205		86.88%	
	DE	1,556,678		538,983		34.62%		157,032		29.13%	
	MD	11,483,685		4,542,993		39.56%		3,436,720		75.65%	
	NY	7,216,010		1,718,095		23.81%		227,126		13.22%	
	PA	17,067,882		4,548,928		26.65%		2,186,688		48.07%	
	VA	13,183,347		4,123,976		31.28%		2,416,262		58.59%	
	WV	1,973,612		585,047		29.64%		353,549		60.43%	
Setic Toal		**52,481,948**		**16,058,258**		**30.60%**		**8,777,581**		**54.66%**	

New Wastewater Sources in CAST

As we defined the summary table previously, Biosolids and Spray irrigation on Ag land are simulated as fertilizer as Ag.

Biosolids and Spray irrigation on Ag land were combined and input into the nutrient spread with manure on the county scale before being loaded into the Watershed Model.

Therefore, the nutrient loss of these two sources is a function of manure application as well as all the pass through factor. Currently, scenarios for biosolid and spray irrigation on ag land can be run on the CAST only through developer mode with some modifications.

Loading Summaries - Biosolids and Spray Irrigation on Ag Land (2013)

- There are significant attenuation for biosolid nitrogen on Ag land, about 98%
- Applying Biosolids to Ag land results in negative phosphorus EOS loads.
- Spray Irrigating wastewater to Ag land results in negative EOS loads for both TN and TP.

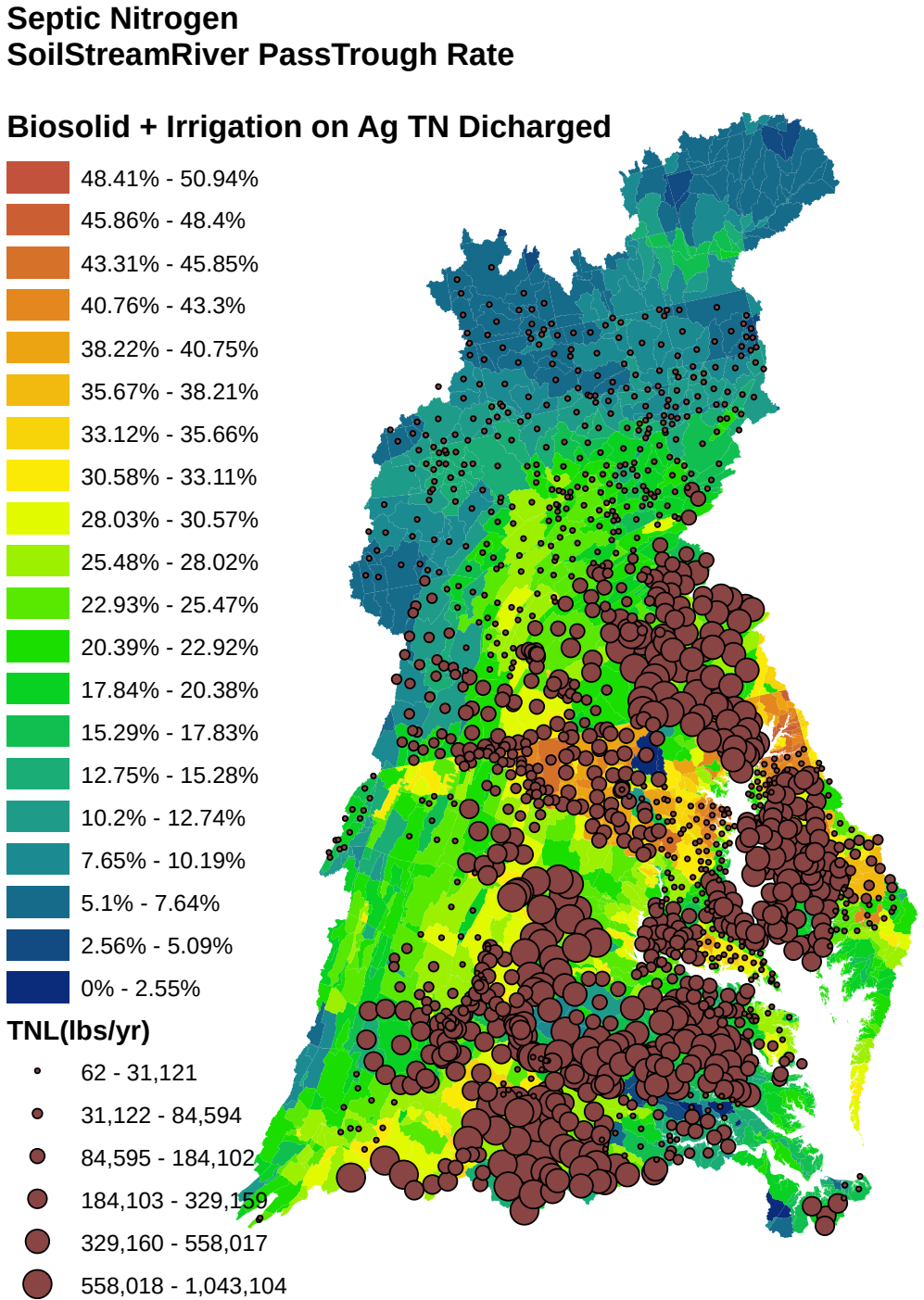
Enhanced plant uptake? If true, these could be potential Ag BMPs.

		Loads Applied to Land		Loads at EOS		EOS Pass Through		Loads Delivered To Bay		Delivered PassThrough	
Sources	State	TNL (lbs/yr)	TPL (lbs/yr)	TNL (lbs/yr)	TPL (lbs/yr)	%TN	%TP	TNL (lbs/yr)	TPL (lbs/yr)	%TN	%TP
Biosolids	DE	804	20	26	-1	3.30%	0.00%	6	0	22.26%	37.50%
	MD	1,595,496	703,301	38,497	-4,943	2.41%	-0.70%	33,371	-4,358	86.68%	88.16%
	NY	6,328	4,056	95	-58	1.50%	-1.43%	40	-29	42.32%	50.52%
	PA	3,191,357	2,045,288	108,048	-27,422	3.39%	-1.34%	70,726	-13,409	65.46%	48.90%
	VA	12,070,222	6,368,543	197,584	-86,829	1.64%	-1.36%	126,690	-81,557	64.12%	93.93%
	WV	73,269	22,243	949	-952	1.29%	-4.28%	776	-881	81.82%	92.55%
Biosolids Total		**16,937,476**	**9,143,452**	**345,199**	**-120,204**	**2.04%**	**-1.31%**	**231,609**	**-100,235**	67.09%	83.39%
Ag Irrigation	DE	41,665	6,210	-2,657	6.1	-6.38%	0.10%	-1,237	1.7	46.55%	27.87%
	MD	67,997	17,064	-1,793	-359.3	-2.64%	-2.11%	-1,620	-346.1	90.35%	96.33%
	VA	5,926	2,081	42	-11.7	0.70%	-0.56%	31	-12.3	74.76%	105.13%
Ag Irrigation Total		**115,588**	**25,355**	**-4,409**	**-364.9**	**-3.81%**	**-1.44%**	**-2,826**	**-356.7**	64.10%	97.75%

Biosolids and Spray Irrigation on Ag Land

STATE	Year	TN_Discharged (lbs/yr)	TN_Delivered (lbs/yr)
DE	2012	43,543	
MD	2012	2,660,276	
NY	2012	15,339	
PA	2012	3,188,786	
VA	2012	14,248,707	
WV	2012	81,006	
Total		20,237,657	

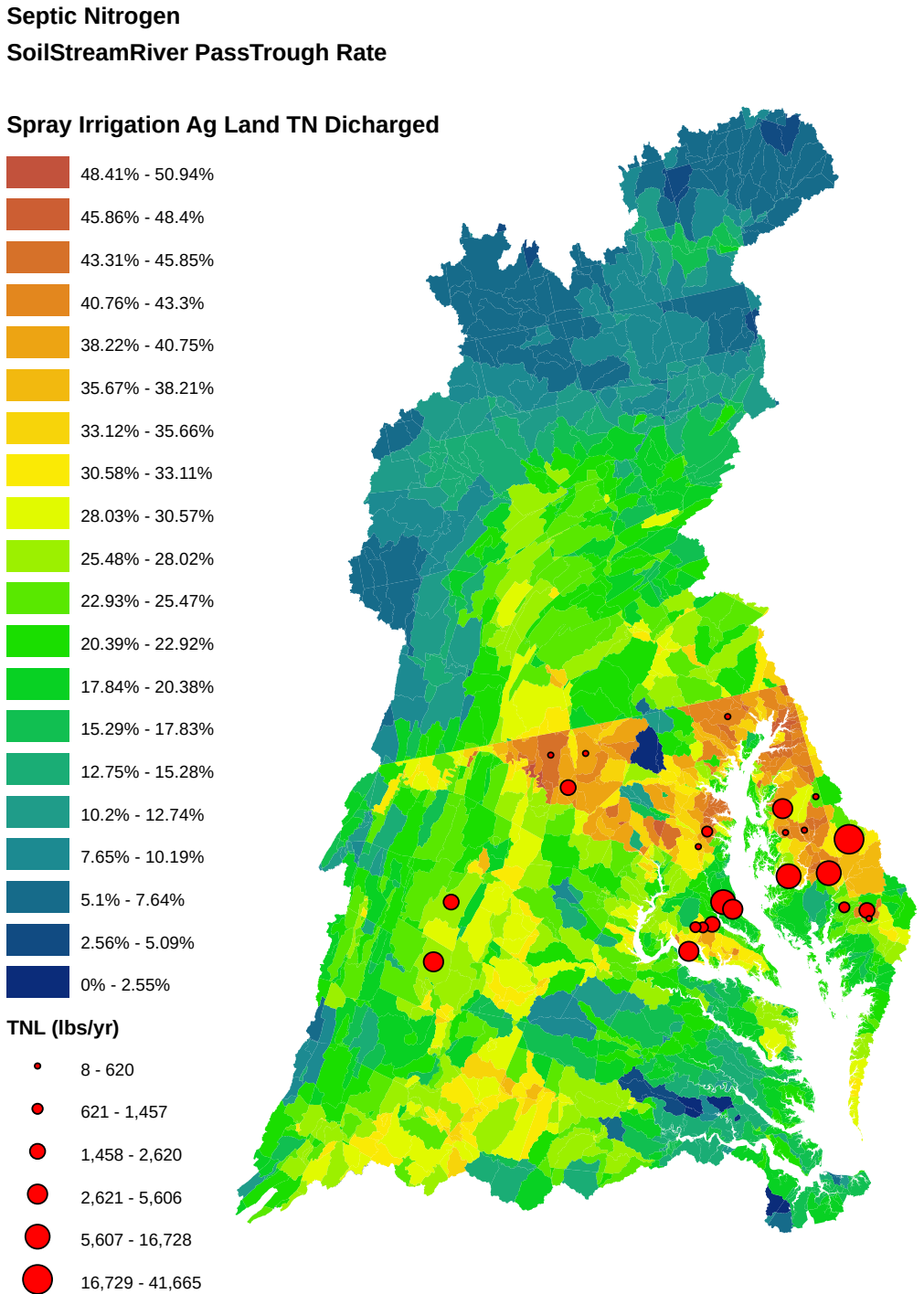
Biosolids and Spray Irrigation on Ag Land Delivered loads will be provided by the CAST developers after they make some modifications.



Spray Irrigation on Ag Land (draft)

STATE	Year	TN_Discharged (lbs/yr)	TN_Delivered (lbs/yr)
DE	2012	41,665	10,966
MD	2012	62,703	17,818
VA	2012	5,926	1,604
Total		110,294	30,388

Delivered loads were calculated as septic system loads (without considering plant uptake and manure &biosolids applications)



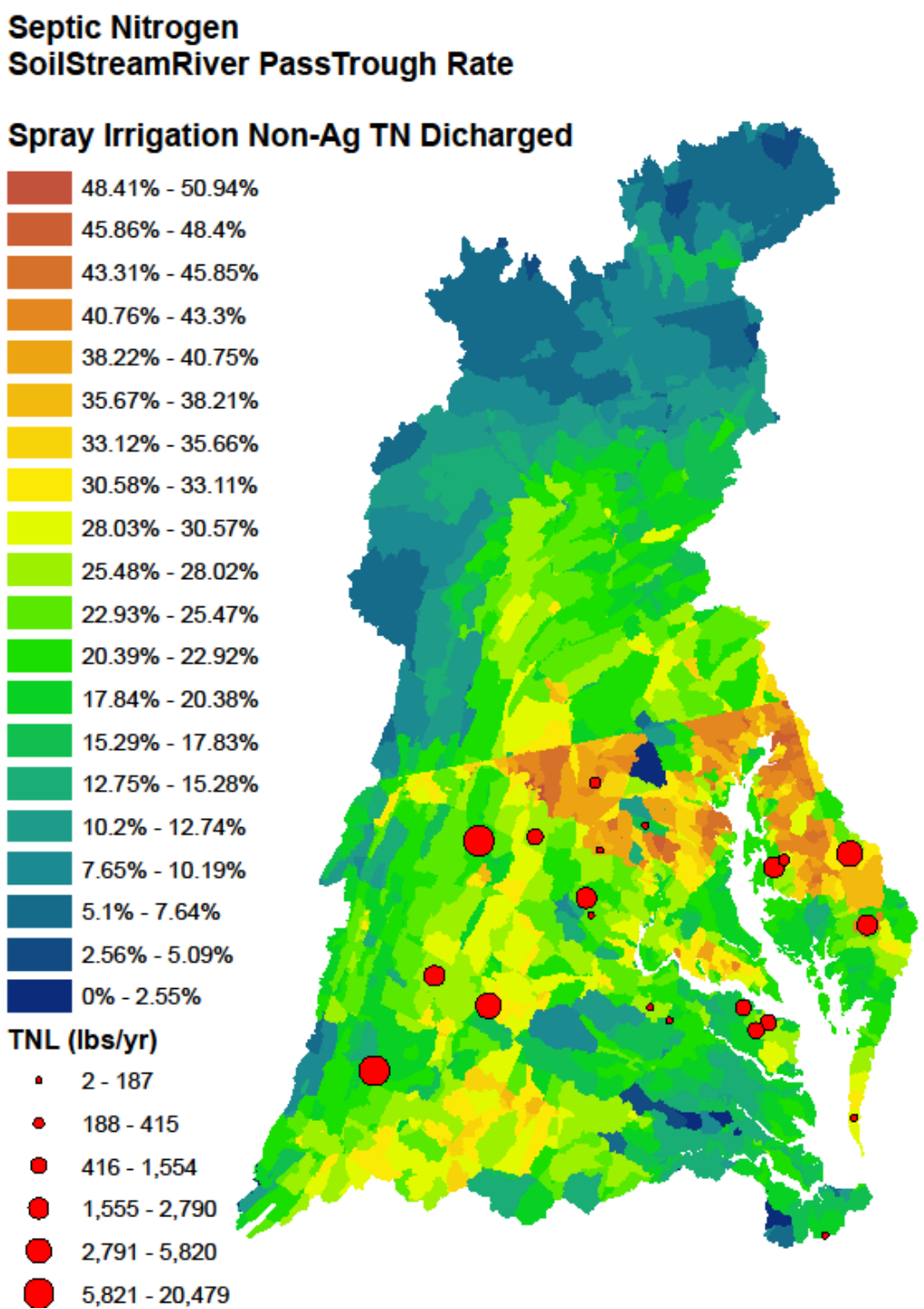
Loading Summaries – Non-Ag Irrigation, Large Onsite System and RIB (2012)

All these three sources are simulated as septic loads

		Loads Applied to Land		Loads at EOS		EOS Pass Through		Loads Delivered To Bay		Delivered PassThrough	
Sources	State	TNL (lbs/yr)	TPL (lbs/yr)	TNL (lbs/yr)	TPL (lbs/yr)	%TN	%TP	TNL (lbs/yr)	TPL (lbs/yr)	%TN	%TP
Non-Ag Irrigation	DE	5,820		2,689		46.20%		1,532		56.97%	
	MD	4,924		1,712		34.77%		1,595		93.14%	
	VA	46,441		14,725		31.71%		9,178		62.33%	
	WV	924		302		32.66%		255		84.49%	
Non-Ag Irrigation Toal		**58,109**		**19,428**		**33.43%**		**12,559**		**64.65%**	
Large Onsite	DE	134,226		61,656		45.93%		35,820		58.10%	
	VA	349,025		97,505		27.94%		58,855		60.36%	
Large Onsite Total		**483,251**		**159,161**		**32.94%**		**94,676**		**59.48%**	
RIB	DE	1,307		592		45.30%		439		74.08%	
	MD	12,447		3,146		25.28%		3,011		95.72%	
RIB Total		**13,754**		**3,738**		**27.18%**		**3,450**		**92.29%**	

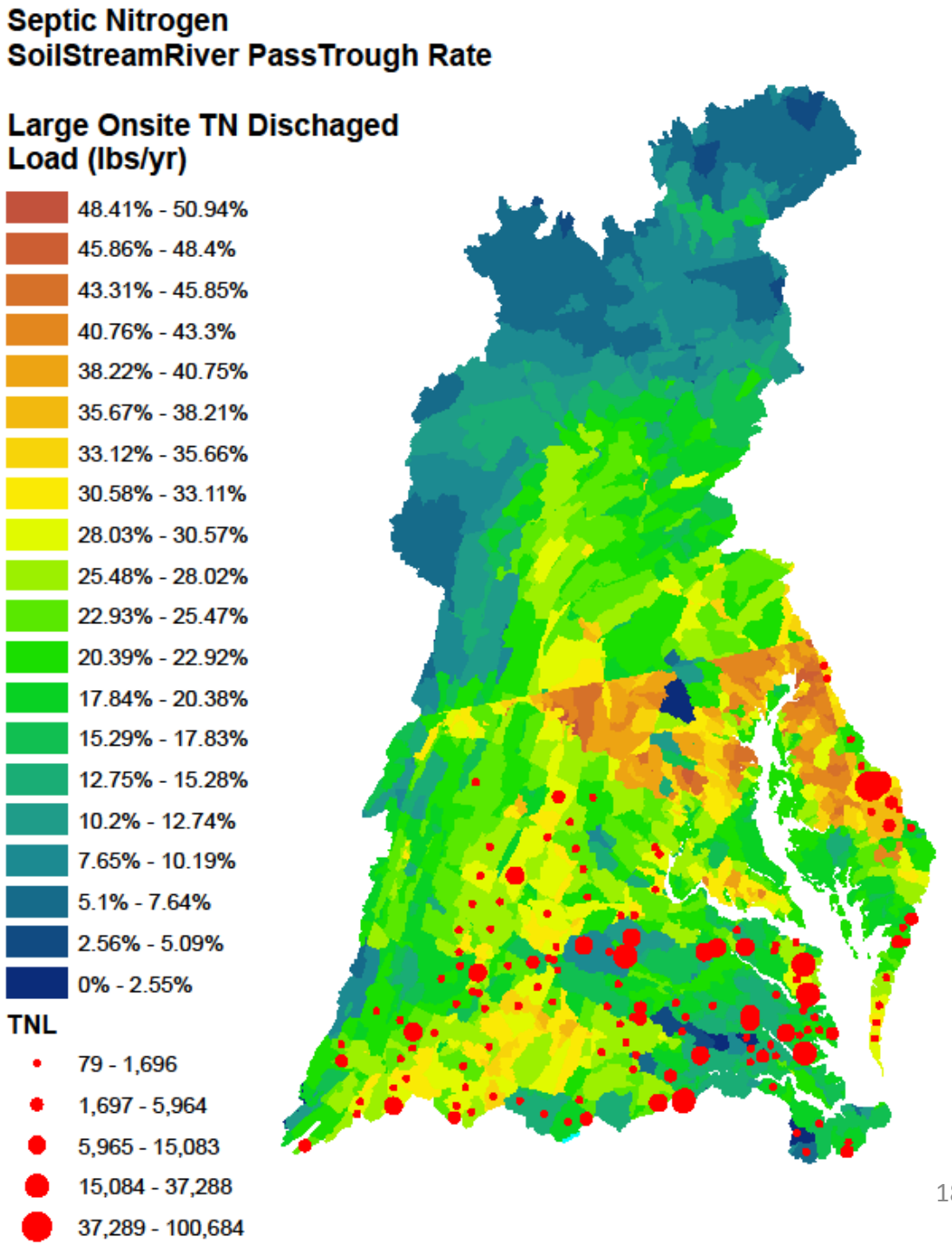
Spray Irrigation on Non-Ag Land:

STATE	Year	TN_Discharged (lbs/yr)	TN_Delivered (lbs/yr)
DE	2012	5,820	1,532
MD	2012	4,924	1,595
VA	2012	46,441	9,178
WV	2012	924	255
Total		**58,109**	**12,559**



Large Monitored Onsite Systems:

STATE	Year	TN_Discharged (lbs/yr)	TN_Delivered (lbs/yr)
DE	2012	134,226	35,820
VA	2012	349,025	58,855
Total	**2012**	**483,251**	**94,678**



Rapid Infiltration Basin:

STATE	Year	TN_Discharged (lbs/yr)	TN_Delivered (lbs/yr)
DE	2012	1,307	439
MD	2012	12,447	3,011
Total		**13,754**	**3,450**