Review of Air-Water Nitrogen Exchange Prototype

WQGIT Conference Call

April 14, 2014

Lewis Linker, Robin Dennis,
and Gary Shenk

Air-Water Nitrogen Exchange Decision Rules Overview

- Decision rules are sought that are straightforward, consistent, equitable, and flexible and can give credit for air program reductions beyond the current best assessment of air controls in 2025 when the TMDL is completed (the Allocation Air Scenario).
- Currently, N-to-P exchanges and basin-to-basin exchanges are implemented in the CB TMDL for the Phase 2 WIPs. The concept of air-water exchanges were approved in 2010, but a consistent method to implement them was previously unavailable.
- A practical way to implement the air-water N exchange is now available and approved by the CBP Modeling and Air Directors workgroups.

The nitrogen deposition loads to the Chesapeake watershed are relatively large and decreasing faster than other nitrogen loads….

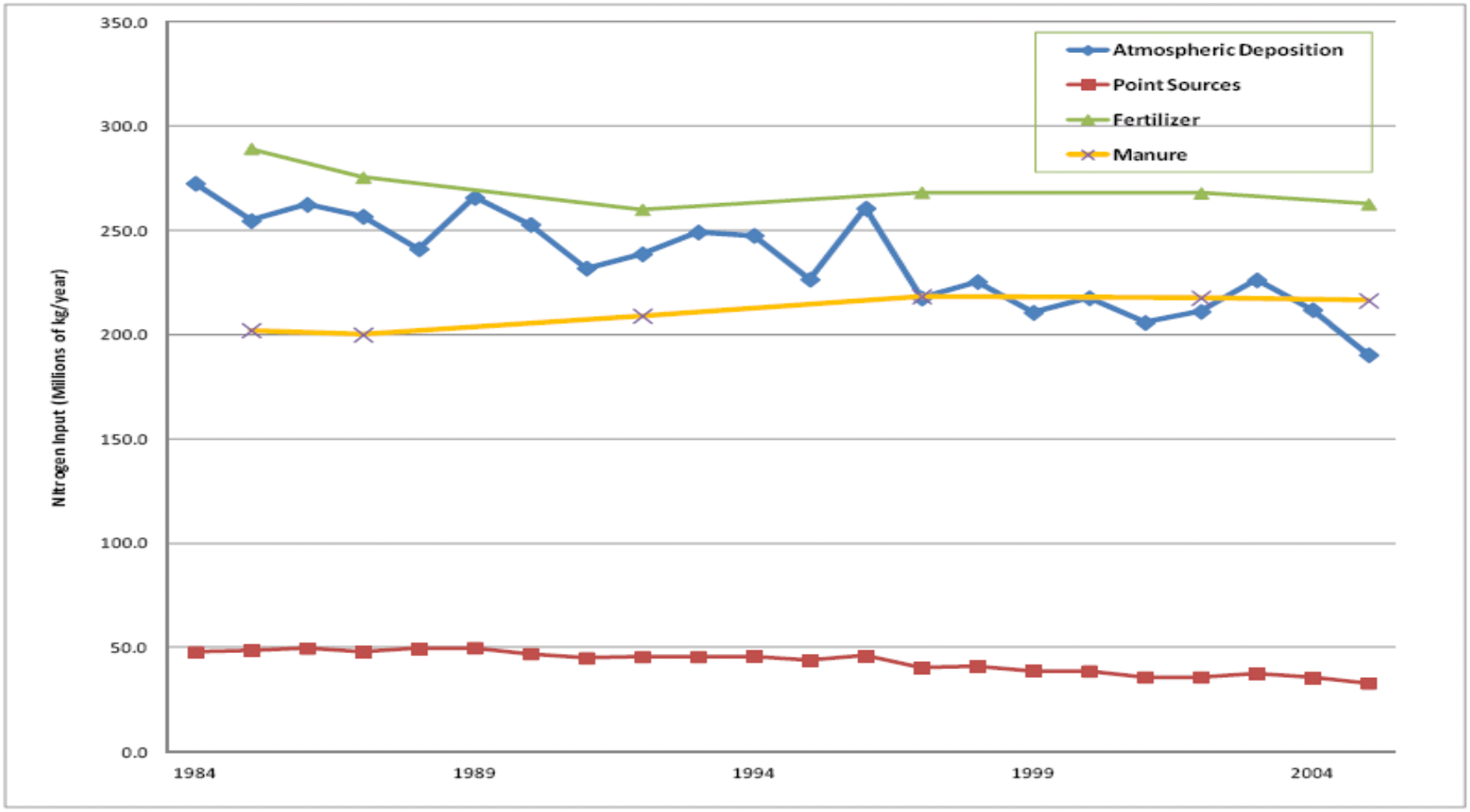
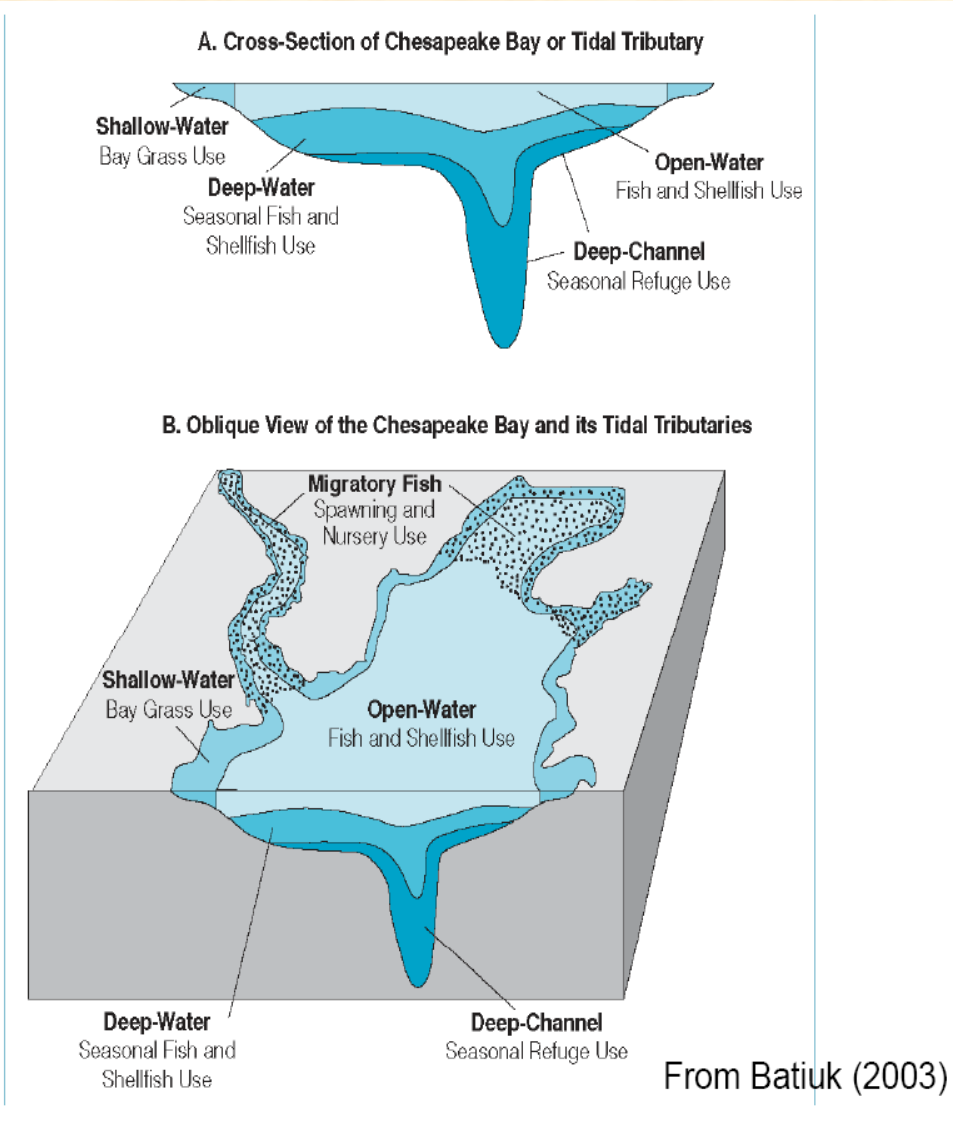


Figure 4. Time series of estimated atmospheric, fertilizer, manure, and point source total nitrogen input loads to the Chesapeake watershed.

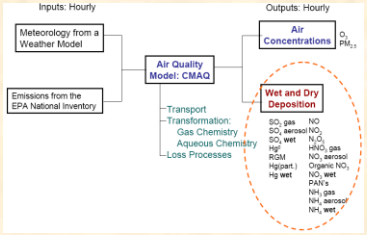
The air-water nitrogen exchange needs to go all the way from NOx emissions from smoke stacks and tailpipes to delivered nitrogen loads to the Chesapeake. Attenuation of the NOx emission load happens at all steps, from the losses due to the fraction of NOx emission that deposited on the watershed to losses of nitrogen on CB land and in rivers.



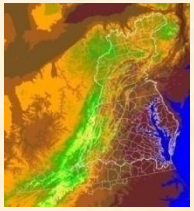
Water quality standards of Deep Water, Deep Channel, and Open Water dissolved oxygen are key for living resource protection.

The CBP is always on two modeling tracks…

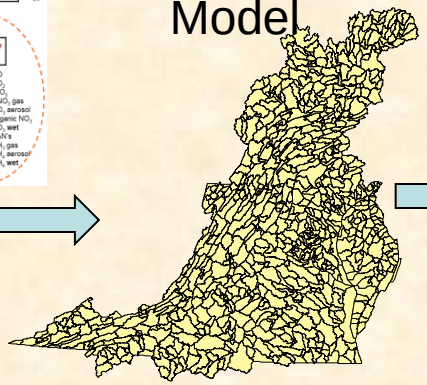
Airshed Model



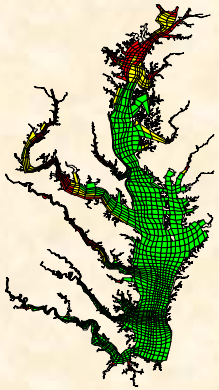
Land Use Model



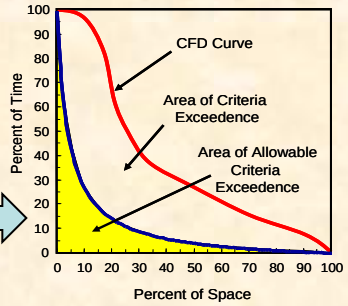
Watershed Model



Bay Model



Criteria Assessment Procedures



Effects

Allocations

…one track uses the 2010 Models to assess milestone progress toward the 2017 Midpoint, and the other track is to use new refined models in 2017 to layout implementation plans between 2018 and 2025. The air-water N exchange is for the first track. The second track is the new 2017 airshed model. The new 2017 airshed model with updated emission inventories will replace the accumulated air-water N exchanges up to 2017 (this will avoid double counting).

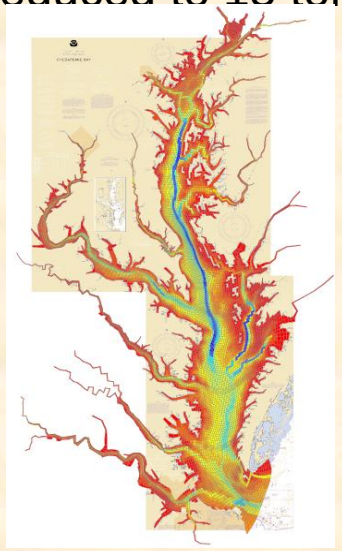
….but the estimated load reductions that could be realized by the air-water nitrogen exchange are relatively small: The discounting that takes place in the delivered load to the Bay – <u>The 1% Credit</u>

Atmo Dep About 70% of the emission NOx load is removed in conversion of NO_2 to units of N. Example 100 tons of emissions reduced to 30 tons.

About 52% of NOx atmo dep emitted in the CB watershed
Is deposited in the CB watershed. Example: 30 tons reduced to 15 tons.

Forest, Cropland, Pasture, and Pervious Developed Land Use

The ~1% Credit



About 7% of NOx atmo dep deposited is exported to rivers and streams and delivered to the Bay. Example: 15 tons reduced to 1 ton.

Rivers and Streams

On average about 1% of NOx emissions are delivered to the Chesapeake (but additional reductions can be attributed to tidal Bay deposition).

History of Air-Water N Exchange Development

- December 2010: Approved in concept (with the publication of the CB TMDL) but without clear guidance on how to implement the air-water exchange.
- January, April, and July 2013: Technical aspects of the air-water N exchange were reviewed by the Modeling Workgroup with continual refinements to the method.
- March 15, 2013: Methodology approved by the R3 Air Managers including Air Directors or representatives from MD, DE, VA, PA, and APD.
- September 6, 2013: Technical aspects of the air-water N exchange were approved by the Modeling Workgroup for forwarding to the WQGIT for managers review and approval.

Flow of how it could work:

1. Identify reductions above and beyond compliance with the CAA and above and beyond what's represented in the Allocation Air Scenario. An acceptable air-water exchange would be credible state programs that meet the above conditions and are verifiable/enforceable.
2. EPA will consider air-water exchanges on a case-by-case basis and the aggregate air-water exchange decision rules will be applied to acceptable exchanges.
3. Find source and loads in the current accounting of the Allocation Air Scenario CBP estimated atmospheric emissions.
4. Air Protection and Water Protection programs determine if the proposed air-water exchange meets necessary conditions for an acceptable exchange .

Flow of how it could work:

6. Use CMAQ state level transfer coefficient tables to estimate reduced atmospheric deposition load to the watershed and tidal Bay.
7. Use Watershed Model Phase 5.3.2 state tables to quantify loads delivered to the Bay from each State-basin as well as direct deposition to the tidal Bay.

The CMAQ 2020 CAIR or Allocation Air Scenario: The Scenario of Record for the Air Allocation to the Tidal Bay and the Reference Allocation of Deposition to the Watershed.

The 2020 Scenario includes the Clear Air Interstate Rule (CAIR) the Clean Air Mercury Rule (CAMR), the Best Available Retrofit Technology (BART) used for reducing regional haze, and the off-road diesel and heavy duty diesel regulations as well as emission reductions due to regulations implemented through the Clean Air Act authority to meet National Ambient Air Quality standards for criteria pollutants in 2020. These include:

On-Road mobile sources: For On-Road Light Duty Mobile Sources this includes Tier 2 vehicle emissions standards and the Gasoline Sulfur Program which affects SUV's pickups, and vans which are now subject to same national emission standards as cars.

On-Road Heavy Duty Diesel Rule – Tier 4: New emission standards on diesel engines starting with the 2010 model year for NOx, plus some diesel engine retrofits.

Clean Air Non-Road Diesel Rule: Off-road diesel engine vehicle rule, commercial marine diesels, and locomotive diesels (phased in by 2014) require controls on new engines.

Off-road large spark ignition engine rules affect recreational vehicles (marine and land based).

EGUs: CAIR second phase in place (in coordination with earlier NOx SIP call); Regional Haze Rule and guidelines for Best Available retrofit Technology (BART) for reducing regional haze; Clean Air Mercury Rule (CAMR) all in place.

Non-EGUs: Solid Waste Rules (Hospital/Medical Waste Incinerator Regulations).

Prototype: Pennsylvania's Diesel Idling Program

- To reduce NOx emissions from truck diesel idling during long-haul rest periods, Pennsylvania provided electric hookups at long-haul truck rest areas.
- The estimated reduction in NOx emissions was736 tons NO_X which is equal to emissions of 224.1 tons-N of N (0.3045 stoichiometric conversion).

Prototype: Pennsylvania's Diesel Idling Program

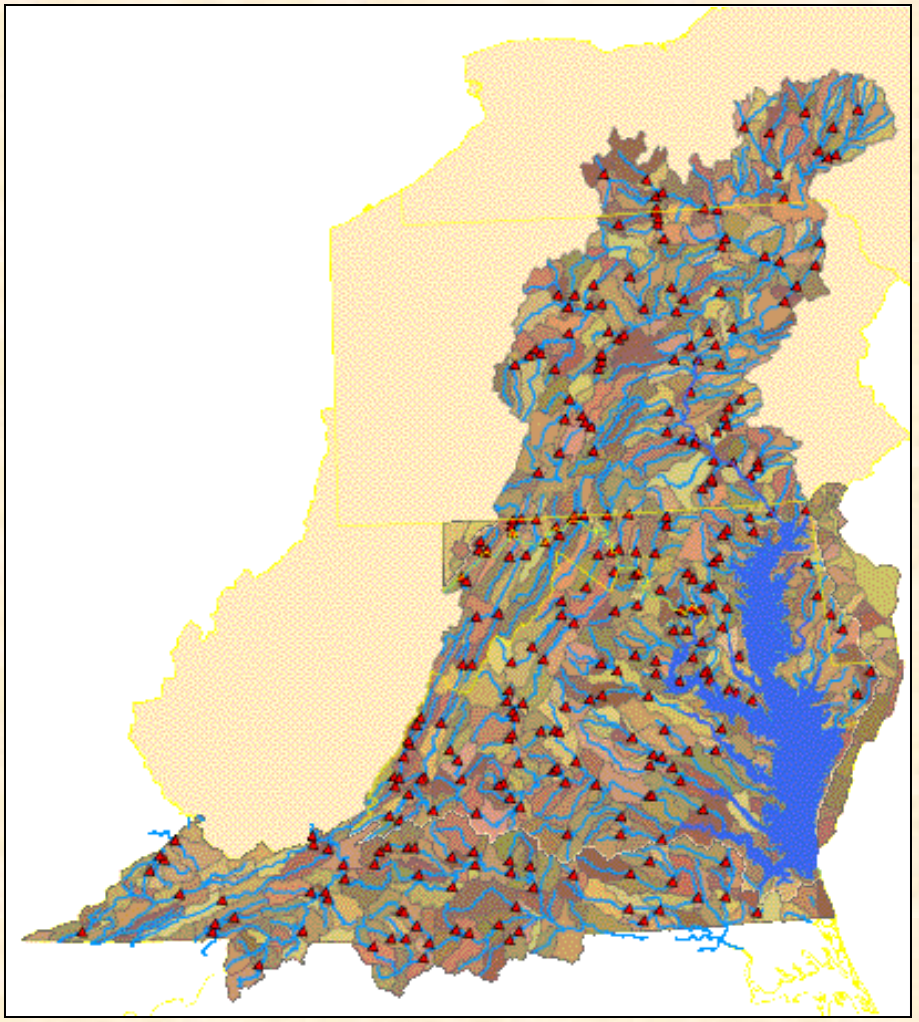
The 224.1 tons net N emission decrease after application of the Airshed Model derived State Level Transfer Coefficient Table is estimated to be a **55,468 lb/yr net N decrease in deposition in the Chesapeake watershed***.

State Level Transfer Coefficients to State Watershed Area						
Emitter →	Delaware	Maryland	New York	Pennsylvania	Virginia	W. Virginia
Receptor ↓	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N
Delaware	5.40	2.31	0.44	0.87	1.10	0.44
Maryland	19.46	57.16	5.30	14.33	20.95	10.60
New York	5.31	7.25	11.50	10.47	4.76	4.73
Pennsylvania	23.86	49.09	16.37	62.28	24.79	28.11
Virginia	19.55	43.34	7.84	20.59	85.05	27.70
W. Virginia	1.88	6.04	1.03	3.73	5.50	9.88
WaterSHED Aggregate	75.46	165.19	42.49	112.27	142.15	81.47

* Used Pennsylvania watershed aggregate State Level Transfer Coefficient.

Prototype: Pennsylvania's Diesel Idling Program

After nitrogen attenuation on watershed lands and rivers the **55,468 lb/yr** net nitrogen deposition decrease in the Chesapeake watershed is estimated to be a **3,952 pound decrease in nitrogen load delivered to the Bay*.**



* A watershed wide average land and river attenuation rate of 0.07124 was used.

Prototype: Pennsylvania's Diesel Idling Program

The reduction of NOx emissions from the Pennsylvania Diesel Idling Program also result in a decrease in **2,228 lb/yr net deposition to the tidal Bay** as well. No further attenuation factors are applied to direct deposition loads to the tidal Bay.

State Level Transfer Coefficients to Tidal Bay Area						
Emitter →	Delaware	Maryland	New York	Pennsylvania	Virginia	W. Virginia
Receptor ↓	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N
Tidal Bay Aggregate	9.34	12.34	2.21	4.51	10.83	3.48

Prototype: Pennsylvania's Diesel Idling Program

Combining the reduction in nitrogen load delivered to the Bay from the watershed of **3,952** lbs/yr with the **2,228** lb/yr net deposition to the tidal Bay yields a total estimated reduction of **6,180** lb/yr due to the NOx reductions of the Pennsylvania's Diesel Idling Program.

Key Points:

- EPA will consider air-water exchanges on a case-by-case basis and use the aggregate air-water exchange decision rules on acceptable exchanges.
- EPA has responsibility for air deposition nitrogen, but states can go above and beyond compliance with the CAA requirements and above and beyond what was in the Allocation Air Scenario and then get the air-water exchange credit. An acceptable air-water exchange would be based on credible state programs that meet the above conditions and are verifiable/enforceable.
- An example that would be acceptable would be the Pennsylvania Diesel Idling Program (new verifiable/enforcable program, not required by CAA ,& not in Allocation Air Scenario Emissions).
- The Honeywell Hopewell consent decree NOx reductions would not be eligible because the consent decree just brings Honeywell back into compliance with CAA regulations.
- Shuttered EGU plants would also not be eligible because the emissions go into a pool that can be drawn from for new emissions.
- All air-water exchanges are short-term and are retired at the close of 2017 because the new Airshed Model emission data base already contain the air-water exchange reductions.

Conclusions:

- The air-water N exchange method is straightforward, consistent, equitable, and flexible and can give credit for air program reductions beyond the what's estimated by the Allocation Air Scenario.
- In the air-water N exchange the CBP partner initialing the implemented emission reduction garners the estimated reductions in deposition in the entire CB watershed and the tidal Bay as a nitrogen credit until the conclusion of the 2017 assessment of the WIP2s.
- Once new airshed models are in place for WIP3 development the new emission inventories will already account for the reductions from the air-water N exchange, so to avoid double counting the exchange will again be set to zero until new air-water exchanges are proposed for the WIP3s.
- Giving credit for air emission reductions in the Chesapeake TMDL is consistent with the Science Advisory Board's advocacy for the multiple benefits that accrue to watershed and coastal ecosystems as well as to human health by addressing initial sources in the "nitrogen cascade".
- The air-water exchange is consistent with the N-to-P and basin-to-basin exchanges already implemented and toward providing credit for good State developed air program emission reductions.