Nutrient Trading in Virginia: Lessons from a Mature (and Maturing) Program

May 1 | 2019
WE DON'T CARE
HOW
YA'LL DO IT
UP NORTH.
Why Look at the Virginia Trading Program?

- **Maturity**: The Chesapeake Bay forced early adoption of trading.
- **Success**: The program has been a keystone of TMDL progress.
- **Sophistication**: A lot of science and accountability behind the trades.
- **Flexibility**: Trades can go a lot of directions.
- **Lessons learned**: Why are some types of trades not happening?
Chesapeake Bay Watershed
Chesapeake Bay Fast Facts

• Nation’s largest estuary
• 200 miles long
• Drains parts of 6 states + DC
• Relatively shallow (average depth 21 feet)
• Depth of up to 174 feet in deep channel
Chesapeake Bay – Historical Issues

- Water quality
  - Oxygen
  - Water clarity
  - Algal blooms
- Loss of SAV
- Overfishing
- Disease
Dissolved Oxygen Impairment
Chesapeake Bay TMDL

- Adopted in 2010
- Actually 92 TMDLs (!)
- Driven primarily by DO criteria
- Reductions
  - Nitrogen (25%)
  - Phosphorus (24%)
  - Sediment (20%)
- Goal of complete implementation by 2025
Modeling Framework Used to Model Management Scenarios

INPUTS
- BMP Data
- LU Data
- Point Sources Data
- Septic Data
- U.S. Census Data
- Agricultural Census Data

MODEL-DERIVED
- Airshed Model
- Land Use Change Model
- Precipitation Data
- Meteorological Data
- Elevation Data
- Soil Data

SCENARIO BUILDER

WATERSHED MODEL

CHESAPEAKE BAY MODEL

MEET WQS?
- NO
- YES

ALLOCATION METHODOLOGY

Reduce/Readjust Loads to Meet Standards

Brown and Caldwell
Required reductions high in more “effective” parts of watershed
### Elements of Implementation

- Clean Air rules (CAIR)
- NPDES permits
- MS4 Permits
- State regs. on new development
- CAFO permits
- Agricultural cost share programs
- Etc.
## Point Source Nutrient Controls in Virginia

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tr>
<td>1997</td>
<td>Water Quality Improvement Fund Established to fund nutrient reduction strategies in the Chesapeake Bay watershed</td>
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<td>2005</td>
<td>Tributary Strategies establish loading goals</td>
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<td></td>
<td>Legislation requiring watershed general permit</td>
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<tr>
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<td>Authorized the Nutrient Credit Exchange</td>
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<tr>
<td>2007</td>
<td>VPDES Watershed General Permit becomes effective on January 1, 2007</td>
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<td>2010</td>
<td>Bay TMDL issued by EPA on December 29, 2010</td>
</tr>
<tr>
<td>2011</td>
<td>Effluent limits in 2007 VPDES Watershed General Permit become effective</td>
</tr>
</tbody>
</table>
Perceived Benefits of Trading in ~2005

- **Timing**
  - Let the big guys go first...or those already planning an upgrade
  - Don’t all compete for the same consultants and contractors at one time
- **Operational flexibility in living under a cap**
- **Cost savings** ($0.8 billion on a $2.2 billion program)
- **Accommodate economic & population growth**
- **Market-based incentives**
  - Go beyond compliance (regulated sources)
  - Achieve reductions from non-regulated sources
Virginia’s Trading Program at a Glance

Expanded Program

- Wastewater
- Forest Land – New
- Agriculture
- Storm Water
  - New & Existing Development

Chesapeake Bay Nutrient Credit Exchange Program

Source: Baxter, 2015
Watershed Nutrient General Permit Highlights

- Cap & trade program
- General permit overlays individual NPDES permits and addresses nutrient loads only
- >150 facilities covered
- Calendar year annual TN and TP load limits
- “Bubbling” or aggregate permits allowed
- Sets conditions for nutrient credit transactions
- Other permit components
  - Compliance schedules and plans
  - Monitoring and reporting
**WLAs based on stringent treatment at design capacity (3-8 mg/L TN, 0.3 – 0.5 mg/L TP)**

<table>
<thead>
<tr>
<th>Virginia Waterbody ID</th>
<th>Discharger Name</th>
<th>VPDES Permit No.</th>
<th>Total Nitrogen (TN) Wasteload Allocation (lbs/yr)</th>
<th>Total Phosphorus (TP) Wasteload Allocation (lbs/yr)</th>
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<tbody>
<tr>
<td>B37R</td>
<td>Coors Brewing Company</td>
<td>VA0073245</td>
<td>54,820</td>
<td>4,112</td>
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<td>B14R</td>
<td>Fishersville Regional STP</td>
<td>VA0025291</td>
<td>48,729</td>
<td>3,655</td>
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<td>B32R</td>
<td>INVISTA - Waynesboro (Outfall 101)</td>
<td>VA0002160</td>
<td>78,941</td>
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<td>B39R</td>
<td>Luray STP</td>
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<td>B35R</td>
<td>Massanutten PSA STP</td>
<td>VA0024732</td>
<td>18,273</td>
<td>1,371</td>
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<td>B37R</td>
<td>Merck - Stonewall WWTP (Outfall 101)</td>
<td>VA0002178</td>
<td>43,835</td>
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<td>B12R</td>
<td>Middle River Regional STP</td>
<td>VA0064793</td>
<td>82,839</td>
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<td>B23R</td>
<td>North River WWTF</td>
<td>VA0060640</td>
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<td>B22R</td>
<td>VA Poultry Growers - Hinton</td>
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<td>Stuarts Draft WWTP</td>
<td>VA0066877</td>
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<td>3,655</td>
</tr>
</tbody>
</table>
Trading Only Allowed within Major Basins

- Potomac
- Rappahannock
- James
- York
- Eastern Shore
Trades based on loads delivered to tidal waters

Delivery Factor
Nitrogen
- 0.0 - 0.2
- 0.3
- 0.4 - 0.5
- 0.6 - 0.7
- 0.8 - 0.9
- 1.0

Delivery Factor
Phosphorus
- 0.0 - 0.3
- 0.4 - 0.5
- 0.6
- 0.7 - 0.8
- 0.9
- 1.0 - 2.5
Three Pathways of Point Source Compliance

1. Meet your individual WLA
2. Acquire point source credits through the Exchange or independently
3. Acquire credits through the Nutrient Offset Fund if no other option is available
Virginia Nutrient Credit Exchange

• Voluntary association
• 73 owners of 105 treatment facilities, municipal and industrial
• Consultant members (to pay for the beer)
• What they do:
  • Facilitate trades
  • Sets credit prices among its members
  • Acts as clearinghouse – buys all generated credits and offers cost-sharing from sales
  • Annual accounting and compliance planning
• Virginia DEQ certifies annual compliance plans
<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Credit Forecasts</th>
<th>Preliminary Use of Credits</th>
<th>Credit Exchange (Pounds)</th>
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<tbody>
<tr>
<td></td>
<td>2018</td>
<td></td>
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<tr>
<td>Delivered WLA</td>
<td>Expected Load</td>
<td>Expected Credits</td>
<td>In-Bubble Exchange</td>
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<tr>
<td></td>
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<td>Private Exchange</td>
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<td>WQIF-Held Credits</td>
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<tr>
<td></td>
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<td>Expected Net Credits</td>
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<tr>
<td>The Exchange (group)</td>
<td>2,612,604</td>
<td>1,966,103</td>
<td>706,501</td>
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<td>ACSA-Fishersville</td>
<td>4,873</td>
<td>1,845</td>
<td>3,028</td>
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<td>ACSA-Greenville</td>
<td>1,424</td>
<td>497</td>
<td>927</td>
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<td>ACSA-Harriston</td>
<td>1,025</td>
<td>203</td>
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<td>ACSA-Middle River</td>
<td>8,284</td>
<td>3,764</td>
<td>4,520</td>
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<td>ACSA-Mt. Sidney</td>
<td>854</td>
<td>1,307</td>
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<td>ACSA-Stuarts Draft</td>
<td>2,436</td>
<td>588</td>
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<td>ACSA-Vesper View</td>
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<td>546</td>
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<td>ACSA-Weyers Cave</td>
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<td>5,534</td>
<td>(4,072)</td>
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<td>Alexandria Renew Ent.</td>
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<td>Broadway Regional</td>
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<td>Fairfax Co-Norman Cole</td>
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<td>Leesburg</td>
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<td>31,261</td>
<td>66,197</td>
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<td>Loudoun Water- Broad Run</td>
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<td>Luray</td>
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<td>Massanutten PSC</td>
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<td>Merck</td>
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<td>MillerCoors LLC</td>
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<td>Mt. Jackson</td>
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<td>Purcellville</td>
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<td>Stafford Co-Aquia</td>
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<td>Stony Creek</td>
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<td>2,914</td>
<td>77</td>
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<tr>
<td>Strasburg</td>
<td>5,134</td>
<td>7,072</td>
<td>(1,938)</td>
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<td>USOA</td>
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<td>292,754</td>
<td>9,853</td>
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<td>VA Am. Water PW Sec. 1</td>
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<td>22,842</td>
<td>19,187</td>
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<td>19,187</td>
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<td>Waynesboro</td>
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<td>2,985</td>
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<tr>
<td>Purchase by Eastern Shore</td>
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</tbody>
</table>

*For this Compliance Year, 0% of all Class A Credit Purchases are expected to be satisfied using Class B Credits.
**Expected Class B Credits are estimates only. Actual Class B Credits—and the resulting Class B sales price—will vary from estimates based on actual Delivered Loads in the Compliance Year.

EXCHANGE COMPLIANCE PLAN ANNUAL UPDATE, FEBRUARY 1, 2017

2-4
### Nitrogen Facility Summary

#### Facility-level Nitrogen Trading
Projected Sales and Purchases of Class A Nitrogen Credits

#### Loading & Credit Summary

<table>
<thead>
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<td><strong>Planning Period</strong></td>
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<tr>
<td><strong>Future Estimates (non-binding)</strong></td>
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<td><strong>Design Flow (mgd)</strong></td>
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<td>67.00</td>
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<td>67.00</td>
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<td><strong>Projected Flow (mgd)</strong></td>
<td>47.40</td>
<td>49.88</td>
<td>51.54</td>
<td>50.00</td>
<td>53.48</td>
<td>53.76</td>
<td>54.04</td>
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<td><strong>Projected Avg. Annual Concentration (mg/L)</strong></td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
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<td>3.00</td>
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<td><strong>Discharged Load (end of pipe)</strong></td>
<td>433,079</td>
<td>455,738</td>
<td>470,904</td>
<td>456,834</td>
<td>468,830</td>
<td>491,188</td>
<td>493,746</td>
<td>496,304</td>
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<tr>
<td><strong>Delivery Factor</strong></td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<tr>
<td><strong>Expected Load</strong></td>
<td>433,079</td>
<td>455,738</td>
<td>470,904</td>
<td>456,834</td>
<td>468,830</td>
<td>491,188</td>
<td>493,746</td>
<td>496,304</td>
</tr>
<tr>
<td><strong>Delivered WLA</strong></td>
<td>612,158</td>
<td>612,158</td>
<td>612,158</td>
<td>612,158</td>
<td>612,158</td>
<td>612,158</td>
<td>612,158</td>
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<tr>
<td><strong>Expected Credits (delivered)</strong></td>
<td>179,079</td>
<td>156,420</td>
<td>141,254</td>
<td>155,324</td>
<td>123,528</td>
<td>120,970</td>
<td>118,412</td>
<td>115,854</td>
</tr>
<tr>
<td><strong>Transfers In (Out) within Owner Bubble</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td><strong>Transfers In (Out) from Private Exchange</strong></td>
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<td>0</td>
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<td>0</td>
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<tr>
<td><strong>WQIF-Held Credits</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td><strong>Expected Net Credits</strong></td>
<td>179,079</td>
<td>156,420</td>
<td>141,254</td>
<td>155,324</td>
<td>123,528</td>
<td>120,970</td>
<td>118,412</td>
<td>115,854</td>
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<tr>
<td><strong>Class A Credit Sales (Purchases)</strong></td>
<td>71,632</td>
<td>156,420</td>
<td>127,128</td>
<td>155,324</td>
<td>123,528</td>
<td>120,970</td>
<td>118,412</td>
<td>115,854</td>
</tr>
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<td><strong>Expected Class B Credits</strong></td>
<td>107,447</td>
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<td>14,126</td>
<td>0</td>
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<td>0</td>
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</table>
Different Prices for Class A and Class B Credits Provide Incentive for Up-Front Commitments

Class A Buyer
$4 P / $2 N

Exchange Buyer
$6 P / $3 N

Outside Buyer
$8 P / $4 N

Disbursement of Funds

Class A Supply Pool
A Pool / Total A Credits

90%

Class B Supply Pool
B Pool / Total B Credits

10%
Point Source Compliance Trades

2017

21 buyers
306,174 lbs of TN 1.9 % of WLA
28,073 lbs of TP 2.4 % of WLA
Primary Factors in Success of the Point Source Trading Program

- Watershed general permit
  - Expedient – one negotiation
  - Common schedule of compliance
  - Consistent requirements

- Formation of the Virginia Nutrient Credit Exchange Association with voluntary membership

- Permittees given ownership of the market and have embraced the program
Nonpoint Source Trading in VA

Reserved for accommodating new and expanding point sources only

Guidance adopted in January 2008

First bank approved in July 2008
To generate NPS credits, farms must first meet baseline requirements.

- Soil conservation plan
- Nutrient management plan
- Cover crops
- Livestock exclusion w/ 35’ buffer
- 35’ riparian buffer
Credits are generated from enhanced versions of the baseline practice

- Continuous no-till
- 15% N reduction on corn
- Early planting date
- Increase size
- Increase size
- Land conversion

Soil conservation plan
Nutrient management plan
Cover crops
Livestock exclusion w/ 35’ buffer
35’ riparian buffer
Credits can also be generated by stormwater retrofits (enhancements)
Other aspects of nonpoint source credits

- 2:1 trading ratio for NPS:PS trades
- 5% of credits are permanently retired
- Requires public or private broker; e.g.
  - Nutrient bank
  - Land conservation trust
  - Agricultural cooperative
- Credits certified/authenticated on an annual basis
~125 banks in operation across state
2:1 nonpoint : point trading ratio has been controversial

- Intended to address greater uncertainty in NPS practices.
- Reduces incentive for trading
- Nationally, trading ratios range from 1.1 to >3
- “The use of appropriate models and verification practices may reduce or eliminate the need for trading ratios...” EPA Memo on Trading Policy (2019)
How has NPS:PS trading actually worked?

<table>
<thead>
<tr>
<th>Type of Trade</th>
<th>Trades Occurring or Planned?</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWTP ➔ WWTP</td>
<td>Yes</td>
</tr>
<tr>
<td>WWTP ➔ MS4</td>
<td>Yes</td>
</tr>
<tr>
<td>Agriculture ➔ new development</td>
<td>Yes</td>
</tr>
<tr>
<td>Agriculture ➔ WWTP</td>
<td>No</td>
</tr>
</tbody>
</table>
Why no NPS-to-PS trades?

• Lack of demand
  • Not a lot of new WWTPs
  • Adequate capacity in existing WWTPs
  • Credits available from other point sources

• Lack of (cheap) supply
  • It takes a lot of land – a problem of scale
  • 2:1 trading ratio
  • NPS credit pricing driven by new development market (e.g., $20,000/lb P)
2017 Nutrient Trades

Point Source to Point Source under Watershed General Permit
- 25 facilities acquired approximately 28,000 lbs of TP and 306,000 lbs of TN credits
- Several minor WLA trades
- Approximately $1,800,000 market value

Non-Point Source Credits Sold (Permanent Offsets)
- Approximately 900 lbs of TP with 5,400 lbs of TN retired
- Approximately $18,000,000 market value

~$6+/lb P

~$10,000 – 24,000/lb P
Relative Per-Pound Costs of Reducing Nitrogen Pollution

- Stormwater: $500+
- Wastewater TP: $92.40
- Agriculture: $47.40
- Native oyster aquaculture: $21.90
- Algal turf scrubbing: $15.80
- Land retirement: $7.00
- Grassed buffers: $6.60
- Forest buffers: $4.70
- Restored/constructed wetlands: $3.30
- Forest buffers: $3.20
- Cover Crops: $3.20
- Conservation tillage: $3.10
- Restored/constructed wetlands: $1.50
- Forest buffers: $1.20

Source: World Resources Institute

January 2010
Cost per pound escalates as treatment level increases

If you want agriculture ➔ WWTP trades...

- Look for highly economical ag practices
- Lots of land opportunity
- Avoid high trading ratios
- Streamlined trading mechanism
- Consider other market forces
- Buyers might have to make it happen
Underwater Grass Comeback Helps Chesapeake Bay

Stories of Progress in Achieving Healthy Waters

U.S. EPA Region 3 Water Protection Division
Susquehanna Flats, January 21, 2016

The fortified Susquehanna Flats, the largest bed of underwater grasses in the Chesapeake Bay and a popular fishing spot, seems able to withstand a major weather punch. Its resilience is contributing to an overall increase in the Bay’s submerged aquatic vegetation (SAV), a key indicator of ecosystem health.

Chesapeake Bay water quality at near-record high

Bay Barometer shows Chesapeake resilient, improving

Steep Cuts in Wastewater Pollution Leading Way in Chesapeake Bay Restoration; Sector Meeting 2025 Pollution Limits 10 Years Early (June 14, 2016) - Upgrades and operational efficiencies at wastewater treatment plants throughout the Chesapeake Bay watershed have achieved steep reductions in nitrogen and phosphorus pollution, putting this sector at the forefront of Bay restoration. The wastewater sector has reduced nitrogen going to the Bay by 57 percent and phosphorus by 75 percent since 1985 and, for the first time, is effectively meeting its 2025 nutrient pollution limits in the landmark Chesapeake Bay TMDL, according to Chesapeake Bay Program analysis.

Chesapeake regaining "resilience," EPA reports
Extra Slides
Grateful Dead-Zone: Thank You for Not Growing

What does this mean?

The overall message is best stated by Beth McGee: "There is scientific consensus that the dead zone is getting smaller over time, and ending earlier in the summer. This is an indication that the Clean Water Blueprint is working. But we also know that much more needs to be done to achieve a Bay that is healthy for all living creatures."

We will always have year to year variations in the dead zone due to the weather, but the long-term trend is very encouraging. The Chesapeake Clean Water Blueprint's ongoing programs to reduce nutrient pollution are working and we hope to keep on truckin' for smaller dead zones in years ahead."
Commonwealth of Virginia’s Chesapeake Bay
Watershed General Permit

Puget Sound Nutrient Source Reduction Project
March 6, 2019 Forum Meeting
Lacey, WA
Allan Brockenbrough, VA DEQ
Lessons Learned in Virginia

• Nutrient and sediment reductions necessary in all sectors
  • Wastewater, Agriculture, Regulated and Unregulated Urban, Septic, Forest
• State and local funding is critical
  • VA’s Water Quality Improvement Fund (WQIF)
  • Local stormwater fee programs
• Wastewater reductions have been the most dependable reductions and have “carried the load” under the Chesapeake Bay TMDL
• Watershed General Permit/Technology Regulation combined with WQIF funding was instrumental in achieving timely and lasting nutrient reductions
• Point Source – to – Nonpoint Source trading is very difficult
• Large scale environmental restoration is possible!
Background on Chesapeake Bay Watershed

- Portions of 5 states and the District of Columbia in 2 EPA regions lie within the Basin:
  - 64,000 square miles watershed
  - 11,684 miles of shoreline
  - 200 miles long and 21 ft. deep on average

- Significant portions of Chesapeake Bay and its tidal tributaries are listed as impaired because of nitrogen, phosphorus, and sediment

- Home to over 18 million people

- Agricultural land use grew by >100,000 acres between 2004 and 2014

- Largest land area per unit volume of water of any estuary in the world
Submerged Aquatic Vegetation (SAV)

Light green bars denote years with partial data. Dark green = years with complete data. No bar

Source: Virginia Institute of Marine Science
Virginia's Efforts To Restore Seaside Grasses May Be A Worldwide Model

By PAMELA D'ANGELO • JUL 13, 2018

Harvested eel grass with seed pods

CREDIT PAMELA D'ANGELO
Water Quality Impairments

- Dissolved Oxygen
- Water Clarity
- Submerged Aquatic Vegetation
Bernie Fowler Sneaker Index
Bernie Fowler Sneaker Index
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
</table>
| 1983 | Original Chesapeake Bay Agreement (1 page)  
|      | MD, PA, VA, DC, EPA and chair of CB Commission  
|      | Signatories became Chesapeake Bay Executive Council |
| 1987 | First numeric goals to reduce N and P by 40% by 2000 |
| 1999 | EPA is sued for failing to require VA to develop a TMDL for Chesapeake Bay  
|      | Consent decree mandated EPA develop TMDL by 2011 if VA did not do so by 2010 |
| 2000 | Comprehensive agreement set a clear vision and strategy for restoration efforts thru 2010  
|      | 102 goals addressing pollution reduction, habitat restoration, living resources protection, land use policies, public engagement, ecosystem-based fisheries management, etc.  
|      | NY and WV subsequently joined CB Partnership |
Chesapeake Bay Program History cont.

2007

• Recognizing that the 2010 deadline established in the Chesapeake 2000 Agreement would not be met, the Bay partnership begins work on a Bay-wide TMDL

2009

• EPA again sued with plaintiffs asserting that EPA was legally required to establish a TMDL
• President Obama issues Executive Order requiring development of a federal strategy to restore Chesapeake Bay.
• Chesapeake Executive Council requires 2-year milestones

2010

• 2009 lawsuit settled requiring TDML and accountability framework
• TMDL issued
Elements of Trading Success

• Equitable WLAs
• Water quality improvement fund
• Watershed general permit
  • Expedient – one negotiation
  • Common schedule of compliance
  • Consistent requirements
• Permittees given ownership of the market through the Exchange
• WWTP ➔ MS4 trades may be a huge cost savings
# Point Source Nutrient Controls in Virginia

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>1997</td>
<td>- Water Quality Improvement Fund Established to fund nutrient reduction strategies in the Chesapeake Bay watershed</td>
</tr>
<tr>
<td>2005</td>
<td>- Tributary Strategies establish loading goals</td>
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<td></td>
<td>- Legislation requiring watershed general permit</td>
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<tr>
<td>2007</td>
<td>- VPDES Watershed General Permit becomes effective on January 1, 2007</td>
</tr>
<tr>
<td>2010</td>
<td>- Bay TMDL issued by EPA on December 29, 2010</td>
</tr>
<tr>
<td>2011</td>
<td>- Effluent limits in 2007 VPDES Watershed General Permit become effective</td>
</tr>
<tr>
<td>2012 &amp; 2017</td>
<td>- Virginia reissues the VPDES Watershed General Permit on January 1, 2012</td>
</tr>
</tbody>
</table>
Dual Approach to PS Nutrient Control

- Watershed General Permit for the control of annual TN and TP loads under the Chesapeake Bay TMDL (9VAC25-820)
  - Annual load limits
  - Trading allowed

- Technology based regulation for nutrient enriched waters and dischargers within the Chesapeake Bay watershed (9VAC25-40-70)
  - Minimum technology requirements for new or expanding facilities
  - Annual concentration limits based on nutrient removal technology installed at any plant in CB watershed
  - No trading
Chesapeake Bay Hydraulic Model

Chesapeake Bay Model, as it looked in August 1977. U.S. Army Corps of Engineers Waterways Experiment Station photo
(Left) Templates installed every two and a half feet for the construction of the model, between which the concrete was poured and contoured. (Right) Model aide installing some of the 700,000 resistance strips.

U.S. Army Corps of Engineers Baltimore District photos, c. 1976

Chesapeake Bay Model technician at a tide gauge located on the Elizabeth River, at Portsmouth, Virginia, August 1977. U.S. Army Corps of Engineers Waterways Experiment Station photo

The Chesapeake Bay Model is contained in this warehouse, on Kent Island, Maryland. The Chesapeake Bay Bridge is in the background. U.S. Army Corps of Engineers Waterways Experiment Station photo
Chesapeake Bay Modeling Today

• Watershed Model
• Estuary Model
• Airshed Model
• Land Change Model
• Chesapeake Assessment Scenario Tool (CAST)
DO Criteria Tailored to Aquatic Life Use

Minimum Amount of Oxygen (mg/L) Needed to Survive by Species

- **Striped Bass**: 5-6
- **American Shad**: 5
- **White Perch**: 5
- **Yellow Perch**: 5
- **Hard Clams**: 5
- **Alewife**: 3.6
- **Crabs**: 3
- **Bay Anchovy**: 3
- **Spot**: 2
- **Worms**: 1

**Migratory Fish Spawning & Nursery Areas**

- **6**

**Shallow and Open Water Areas**

- **5**

**Deep Water**

- **4**

**Deep Channel**

- **3**

- **2**

- **1**

- **0**
Water clarity criteria set to protect submerged aquatic vegetation

- 13% of surface light (freshwater-olighaline)
- 22% of surface light (mesohaline-polyhaline)
- ...or attain grass coverage (biocriteria)
Bay Designated Uses Refined in early 2000s
Virginia Watershed-based Permit Benefits

- **Environmental Benefits**
  - Quicker nutrient reductions from point sources
  - Manages additional loadings from growth through offsets of loads from new or expanding facilities
  - Creates incentives for NPSs to meet load allocations
  - BMP secondary benefits (e.g., habitat restoration, carbon sink)

- **Benefits to Permittees**
  - Provides several different tools for achieving compliance
  - More cost-effective approach than treatment upgrades only
  - Allows for future growth as it eases costs and resource demands

- **Benefits to Virginia DEQ**
  - More streamlined and efficient permitting process
  - Increased stakeholder support
2018 Municipal TN

Frequency

TN concentration (mg/l)
2018 Municipal TP

Frequency

TP Concentration (mg/l)
Point Source Nutrient Reductions

Statewide Total Nitrogen

Statewide Total Phosphorus
Wastewater sector leads progress in Chesapeake Bay Restoration

2017 Interim Target: 237.81

2025 Planning Target: 207.57

Legend:
- Agriculture
- Urban Runoff
- Wastewater/Combined Sewer Overflow
- Septic
- Forest/Non-Tidal Water Atmospheric Deposition
- Atmospheric Deposition to Watershed
- Atmospheric Deposition to Tidal Water
All Major Source Sectors Included

Sources of Nitrogen
- Forest: 21%
- Septic: 4%
- Point: 31%
- Urban Stormwater: 10%
- Agriculture: 33%

Sources of Phosphorus
- Forest: 15%
- Point: 24%
- Urban Stormwater: 17%
- Agriculture: 43%
- Atmospheric Deposition: 1%
Most NPS trades are permanent stormwater offsets

- Many small P trades to provide permanent stormwater offsets to meet Virginia’s post construction P loading requirements under the Virginia Stormwater Management Program (VSMP)
- ~125 NPS banks with 7,100 lbs of permanent TP offsets and 47,800 lbs of permanent TN offsets on state registry
- Many small P trades – approximately 4,000 lbs of P sold with retirement of an associated 27,600 lbs of N reductions retired (P serves as a proxy for N reductions under VSMP)
Options for New or Expanded Sources

- Compliance credits from one or more permitted facilities
- Purchase of WLAs from other sources (either short term or permanent)
- Credits from nonpoint source best management practices
- Credits through payments to Nutrient Offset Fund if no other option available
- Allocations through other means approved by Virginia DEQ on a case-by-case basis
- Acquire 5 years of offsets prior to permitting