

**WIP II Nitrogen to Phosphorus Exchange Options**  
**Prepared for WQGIT Conference Call November 14, 2011**  
**Updated with Addendum (p5) January 5, 2012**

**BACKGROUND**

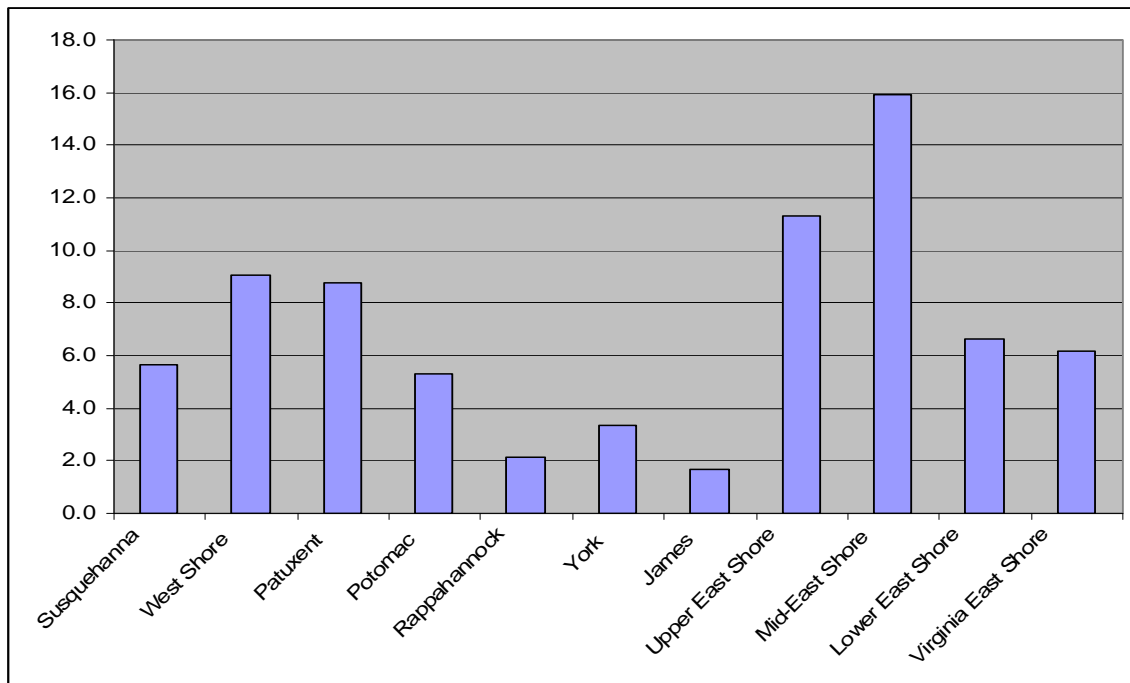
The nitrogen to phosphorus (N:P) exchanges used in the Phase I WIP process were set asymmetrically at 5:1 phosphorus to nitrogen exchange and 15:1 nitrogen to phosphorus exchange because of conservative assumptions based on the range of response documented in the peer-reviewed literature. For the Phase II WIPs an extensive analysis of 37 model runs were used to develop three WIP II N:P exchange options. EPA requests the recommendations and guidance of the WQGIT on these three options before resolving which approach to take for Phase II WIP development. The WIP II N:P exchanges are only applicable to the Phase II WIP development, and are generally applied as one of the final steps in WIP development to *trim* allocation overshoots of nitrogen or phosphorus reductions. The WIP II N:P exchanges are not intended for, or recommended for, watershed nutrient trading programs.

In evaluating the Phase II WIP N:P exchange options the following four principles had particular weight:

- 1) The N:P exchange approach should be relatively simple and easy to communicate.
- 2) The N:P exchange should include sufficient safety factors to ensure water quality standard achievement.
- 3) The N:P exchange should be equitable and applied consistently throughout the watershed.
- 4) The N:P exchange should respect exchanges that have already occurred in Phase I WIP development and any new approach, such as Options 2 or 3, should minimize disruption to previous exchanges.

**CURRENT STATUS – RECENT CHANGES**

The revised N:P ratios by major river basin are shown below. To simplify the approach the above and below fall line regions of the western tributaries from the Patuxent to the James have been combined using a load weighted average, resulting in a total of 11 separate regions with unique N:P exchange rates. In addition, in Option 2 the buffers have been reduced to 10% based on additional analysis of the N:P exchange uncertainty.



Documentation of the N:P exchange analysis, particularly the estimated transport and nutrient limitation in the estuary that is the primary driver in the N:P exchange estimates, is being developed.

## FINDINGS

1. Generally, the 5:1 phosphorus to nitrogen exchange and 15:1 nitrogen to phosphorus exchange ratios used by the CBP partners during development of the Phase I WIPs were reasonable bounds and were environmentally protective. Notably though, Virginia's major western river basins of the Rappahannock, York, and James were outside the 5:1 to 15:1 bounds and consistently have a lower ratio than 5:1 in the current calculated estimates.
2. There are significant spatial distinctions.
  - a. P is relatively more important, i.e., generates more nitrogen exchange, in northern river basins.
  - b. N is relatively more important in southern river basins, resulting in relatively less nitrogen mass in exchange for phosphorus.

## OPTIONS

**Option 1:** There is a wide range of exchange ratios in the watershed and 15:1 and 5:1 are reasonable, conservative bounds. Option 1 keeps the same WIP I N:P exchange ratios moving forward.

Pros: - Existing Phase I WIP exchange ratios are most conservative.  
 - No change is needed from the 2010 Bay TMDL and Phase I WIPs.

Cons: - Partners have specifically requested that the existing exchange ratios be updated to reflect the best scientific understanding.

- Existing fixed exchange ratios limit jurisdictional flexibility.

**Option 2:** There are significant geographic differences in the ratios and this information should be used to inform the Phase II WIP development process. Option 2 maintains some of the conservative nature of the asymmetric trading ratios by putting 10% bounds around the calculated N:P exchanges. For example, the Susquehanna with a calculated N:P exchange rate of 5.7 to 1 with a 10% buffer would be a 5.1 to 1 exchange rate for exchanging phosphorus for nitrogen and a 6.2 to 1 exchange rate for exchanging nitrogen for phosphorus. Under Option 2, if a significant nutrient exchange is proposed confirmation model runs will be needed to ensure water quality standards are still being met..

- Pros:
- Still provides for a conservative assumption.
  - Allows for more jurisdictional flexibility based on geography.

- Con:
- Less conservative than the Phase I WIP exchanges.

**Table of N:P exchanges under Option 2.**

<b>Basin</b>	<b>Exchange Exchange of P for N of N for P</b>	
	<b>w/ 10% Buffer</b>	<b>w/ 10% Buffer</b>
Susquehanna	<b>5.1</b>	<b>6.2</b>
West Shore	<b>8.2</b>	<b>10.0</b>
Patuxent	<b>7.9</b>	<b>9.6</b>
Potomac	<b>4.8</b>	<b>5.8</b>
Rappahannock	<b>1.9</b>	<b>2.4</b>
York	<b>3.0</b>	<b>3.7</b>
James	<b>1.5</b>	<b>1.8</b>
Upper East Shore	<b>10.2</b>	<b>12.5</b>
Mid-East Shore	<b>14.3</b>	<b>17.5</b>
Lower East Shore	<b>6.0</b>	<b>7.3</b>
Virginia East Shore	<b>5.6</b>	<b>6.8</b>

**Option 3:** Use the ratios exactly as calculated, and ensure water quality standards are being met with confirmation model runs if significant exchanges are proposed beyond the small scale “trim” adjustments made at the end of the WIP process used to balance implementation overshoot of a particular nutrient.

- Pro:
- Allows maximum jurisdictional flexibility.

- Con:
- Less conservative than options 1 or 2, but still sufficiently protective if confirmation model runs are made to ensure water quality standards are being met.

### Table of N:P exchanges under Option 3.

Basin	Ratio
Susquehanna	5.7
West Shore	9.1
Patuxent	8.8
Potomac	5.3
Rappahannock	2.2
York	3.3
James	1.6
Upper East Shore	11.3
Mid-East Shore	15.9
Lower East Shore	6.7
Virginia East Shore	6.2

### CURRENT STATUS – WQGIT August 8, 2011 Discussion

The previous discussion of the WIP II N:P exchanges was in depth with the WQGIT members generally inclined toward Option 3, which is to use the N:P ratios as calculated. An excerpt from the August 8, 2011 WQGIT minutes follows.

#### N:P Factors – Lewis Linker

##### Response to Questions:

- Almost all states had trimming exchanges at the end of WIP I development.
- With the asymmetric ratios the Bay always gets the benefit of any trade and N will always cost more for a P exchange and vice versa.
- The application scale is at the major basin level. What we are proposing is within a state basin, if NY comes in above N but below P it can work something out.
- This is a reflection of previous discussions, that if factors are applied in one, it should be applied through all. If it makes sense at one level than it should across, mostly in context of the TMDL.

##### Discussion:

- Russ Perkinson stated that we need to clarify in this document that these N:P exchanges are only appropriate for Phase II WIP development and not for trading. Pennsylvania supported this statement.
- Ron Entringer expressed that it is going to be important from our point of view for allocation for point sources. Trying to not go back and ask for more for local benefit. In some cases this could result in 20 to 1 P exchange. Not trivial and cannot start planning until we understand this. Would not support asymmetric approach we prefer straight ratios.
- The jurisdictions expressed the following leanings:
  - DE – Not strongly one way or another.
  - MD – Like opt 2 but it is complicated, some reservation; opt 3 is streamlined more appealing concern is water quality standards.
  - DC – Did not contemplate exchanges, not prepared to make decision.
  - PA – Option 3
  - VA – Option 3, but could probably live with option 2.
  - WV – Option 3
  - NY – Option 3

**Action:** Linker will work to pull together the suggested changes to this document and a report on the N:P exchanges to be brought back to the group at the October meeting.

### **UPDATED ADDENDUM – January 5, 2012**

On November 14, the WQGIT approved Option 3, N:P exchange ratios for each state basin. Option 3 included separate ratios for the upper, middle and lower Eastern Shore.

However, separate ratios for the upper, middle and lower Eastern Shore cannot be applied to Maryland and Delaware since the Phase II Planning Targets are at the state-basin scale. Delaware and Maryland's targets are not divided into the upper, middle and lower Eastern Shore.

The following table includes a load-weighted average of the upper, middle and lower Eastern Shore ratios for the Maryland Eastern Shore (9.6:1 ) and the Delaware Eastern Shore (7.4: 1). The Pennsylvania Eastern Shore ratio remains equal to the upper Eastern Shore ratio. The Virginia Eastern Shore ratio also remains unchanged and is based on Virginia's portion of the lower Eastern Shore.

#### **Revised Table of N:P exchanges under Option 3 (highlights denote changes)**

Basin	Ratio
Susquehanna	5.7
West Shore	9.1
Patuxent	8.8
Potomac	5.3
Rappahannock	2.2
York	3.3
James	1.6
Pennsylvania East Shore	11.3
Maryland East Shore	9.6
Delaware East Shore	7.4
Virginia East Shore	6.2