Appendix F

Consolidated Response to Comments on:

Definitions and Recommended Nutrient Reduction Efficiencies of Nutrient Application Management for Use in Phase 5.3.2 of the Chesapeake Bay Program Watershed Model (June 25, 2015)

This appendix responds to the comments received on the above cited expert panel report which was first released June 25, 2015. As of July 30, 2015, written comments were received from:

- Beth McGee, Chesapeake Bay Foundation (CBF)
- Bill Angstadt, Angstadt Consulting Inc. (ACI)
- Tom Simpson and Ron Korcak, Aqua Terra Science (ATS)
- Tarah Heinzen and Abel Russ, Environmental Integrity Project on behalf of Environmental Integrity Project, Waterkeepers Chesapeake, Assateague Coastal Trust, Potomac Riverkeeper Network, Potomac Riverkeeper, Upper Potomac Riverkeeper, Shenandoah Riverkeeper, Midshore Riverkeeper Conservancy, Maryland League of Conservation Voters, Sierra Club Maryland Chapter, and the Center for Progressive Reform (EIP)
- Jill Witkowski, Choose Clean Water Coalition (CCWC)
- Royden Powell, Maryland Department of Agriculture (MDA)
- Jeff Sweeney, Chesapeake Bay Program Modeling Team
- Kelly Shenk, EPA Chesapeake Bay Program Office (EPA)
- Marel King, Chesapeake Bay Commission (CBC)

The responses below indicate how the Panel addressed the comments in the revised version of the report. Comments are organized by theme.

Tier 1

General Comments

The Panel should accept comment on Tier 1 efficiencies and adjust its Tier 1 recommendations as necessary. Although the Panel has characterized its Tier 1 recommendations as "approved," it should take comment on those recommendations here because load reduction efficiencies for Tiers 2 and 3 quantitatively incorporate Tier 1 efficiency values. In other words, the three tiers are not distinct, either conceptually or quantitatively. To the extent that the Panel does accept comments on Tier 1, we will comment here that the Panel should adjust Tier 1 efficiencies for known rates of non-compliance (see comment III. above). In addition, there does not appear to be any basis for assuming a reduction in phosphorus load under Tier 1 nutrient application management, which is based on crop nitrogen needs, and so we urge the Panel to eliminate Tier1 P efficiencies. [EIP]

Tier 1 Should Be Revised to Remove Phosphorus Reduction Credit Where Practices Actually Increase Phosphorus Runoff. The Choose Clean Water Coalition understands that the Tier 1 efficiencies have been previously approved. However, because the Tier 1 efficiencies form the foundation for Tier 2 and Tier 3, it is important that the Tier 1 efficiencies are robust and supported by the science. Tier 1 gives a

10% phosphorus reduction credit for application of manure at crop need nitrogen rates. It is our understanding that applying manure to crops based on nitrogen need will result in over- application of phosphorus. This over-application will lead to phosphorus runoff into adjacent waterways. For this reason, Tier 1 should give a 0% phosphorus reduction credit for applying manure at crop need nitrogen rates. [CCWC]

Tier 1 must be re-assessed and revised before approval of current EP report as it has fatal flaws and is the basis for Tiers 2 and 3 efficiencies, adversely impacting their efficiencies.

Specific Tier 1 Fatal Flaws

- As defined, will result in increases in P losses rather than the claimed 10% P reduction
- EP report acknowledges Tier 1 as 1970-80s Nutrient Management (Chart p 13), which is Pre-CBP and several generations behind current "basic NM" definition and state requirements

Rationale for expected increases in P loss under Tier 1

- Tier 1 allows N based applications of manure/litter and LGU recommended fertilizer P where "fertilizer only" is applied
  - Given high cost of fertilizer P, farmers are unlikely to apply P substantially above recommended rates, as claimed in past, and some may apply less, so efficiency for Tier 1 type of fertilizer only P application should be zero (0)
- Application of manure at crop need N rates will result in over application of P
  - Rate of increase in P loss may slow if excess manure previously applied but P application at N-based manure rates will continue to increase P losses, so how can this result in a 10% P reduction efficiency?

Implications of <u>NOT</u> addressing fatal flaws in Tier 1

- Substantial over estimation of progress in P reductions
- Directionally incorrect estimate: Will credit reduction for a practice that increases P loss

Implication for Tier 2

- Tier 2 P efficiencies will be too high since use Tier 1 as base so will result in over estimation of P reduction progress where credited

Implication for Phase 6.0

- If proposed Ph. 5.3.2 NAM Tier 1 recommendations are approved as written and corrected for Ph. 6.0, will create confusion and controversy, particularly while both models are in use.

2013 approval of Tier 1 appears to only have been for 2013 Progress and Milestone assessment (see P 12 of report) of report. Is there documentation of approval for use through 2018 (P 13 of report)? Regardless of answer, since Tier 1 gives a 10% P reduction while actually increasing P losses, it cannot be credibly used for progress assessments or as basis for Tiers 2 and 3.

Nitrogen in Tier 1: Current NM (and that reported prior to 2010) assumes N applied at recommended rates. Unclear why or how to apply proposed Tier 1 N efficiency to existing NM acres. [ATS]

As noted later on, I don't see justification for reduction in P loss on non-manured acres. Though the focus of our comments is on Tier 2 and 3, since these efficiencies build on Tier 1, Tier 1 is a consideration. [CBF]

Overriding issue is that Tier 1 is ***<u>directionally incorrect</u>*** and will result in continued increases in P losses due to N-based manure application and little to no change in fertilizer only P use, rather than the

"approved" 10% reduction. Was this issue discussed with the panel? Tier 2 and three are reductions were developed relative to Tier 1 which makes them derived from an incorrect base.
The reported approval was for use in 2013 Progress and milestone runs according to the table on P 12. It was not approved in 11-14 and was re-opened so unclear why Tier 1 was "approved" as it was well past the 2013 uses. Tier 1 is also discussed throughout the report with a more detailed technical discussion on pp24-28 so it was considered during panel deliberations. Again, was the issue that the definition does not support the reduction discussed by panel members? [ATS]

Tier 2 and 3 appear to be based on additionally from Tier 1. As stated above, literature citations are provided for the enhancements from "basic NAM", the relative reductions added to Tier 1 reductions discredits the reductions for these tiers. [ATS]

The Panel should clarify how Tier 1 practices are credited in baseline model runs. The NM Efficiencies document's discussion of Practice Baseline is not completely clear, and warrants further explanation. Section 5.2 indicates that practices satisfying 1995 Land Grant University recommendations are comparable to those meeting Tier 1 conditions. But it is not clear how those practices implemented before 2009 were identified prior to assigning credit for post-Total Maximum Daily Load ("TMDL") nutrient reductions for Tier 1 practices achieved pursuant to the TMDL. Given that the practices receiving credit conform to recommendations pre-dating the TMDL by 14 years, it does not seem appropriate to award credit for all Tier 1 practices without first verifying when the practices (and related nutrient loss reductions) went into effect. Similarly, there is no discussion of the verification or quality assurance requirements for the determinations of which practices are post-TMDL and therefore appropriate recipients of nutrient efficiency credits in the Bay Model. If the model baseline assumes that no farms were using Tier 1 practices in 2009, then the authors should clearly say so. Otherwise, the authors should clearly state that Tier 1 practices implemented before 2009, and therefore assumed to be part of the baseline, are not eligible for Tier 1 credit. [EIP]

Response: This is clarified in the Tier 1 approved Panel Report.

Tier 1 Process

Based on comments on earlier report, were there never any suggestions that the Tier 1 definition and reductions either be better explained/documented and/or revisited??? [ATS]

Since Tier 1 was "approved, was there no justification to discuss it? If that was the reason, why is it discussed in detail on pp 24-28? [ATS]

Appears to document that THIS panel considered and decided on Tier 1 [ATS]

Response: No suggestions related to Tier 1 were considered in the Panel's response to comment on the Fall 2014 Tier 2 Report recommendations because comments related to Tier 1 were deemed irrelevant based on the Tier 1 report being previously approved and incorporated into the model. Tier 1 details were included in the July 2015 report at the request of the AgWG to frame the era of nutrient management the Panel already captured and approved, but did not discuss in detail during the late 2014 and 2015 meetings. To clarify, this Panel was responsible for the Tier 1 recommendations and approved report.

Tier 1 Timeline

Figure 1 appears to indicate that Tier 1 represents NM from the 1970s-80s. NM was started in the mid-

1980s although LGU fertilizer recommendations started before then. Is this level of NM intended to get Tier 1 credit through 2017 despite the current knowledge base strongly indicating that N-based manure applications result in continued build-up and loss of P? Was this discussed with EP? [ATS]

Response: Figure 1 indicates that research from the 70s and early 80s was the backbone for Tier 1 type NM and this BMP is available for credit throughout the modeling timeframe. From 2005 to present, the Panel agrees that the majority of plans were and continue to be written to a standard consistent with the Tier 2 definition and have improved upon the Tier 1 plans written for millions of acres before 2005. See also response to Tier 1 Justification comments.

Tier 1 Definition

Follows LGU recs for N and P would include some P risk factor assessment in most/all (?) states, would it not? [ATS]

Response: Plans written beginning in 2005 had the first acres planned with P risk assesments in the Chesapeake Bay watershed.

Don't current LGU recommendations require some type of P risk assessment evaluation for soils above a certain soil test P level, in most, if not all Bay states? [ATS]

Response: Yes. P risk assessment is not part of the Tier 1 definition, it is part of the Tier 2 definition.

As stated on numerous occasions before, it is very hard to find scientific rational for a 10% P reduction under these conditions. The rate of increase in P loss may be slowed by only applying crop N needs but P loss should continue to increase. This may have been done to work within limits of PH5.3.2 WSM capabilities to handle P but that would not appear to justify the 10% P reduction [ATS]

Response: The scientific rationale for the 10% P reduction is based on manure P decreasing in application by a significant amount in the model. The decrease is calculated from a difference of P loss from corn acres receiving 100% v 120% non-nutrient management N rates in fertilizer and manure. The Panel agreed that non-nutrient management application rates in the model were consistent with nutrient management rates in the real world and the 20% N increase was a proxy for real world non-nutrient management. Using non-NM rates in the simulation as a baseline also minimizes the benefit of any resulting efficiency calculation because non-nutrient management acres are receiving idealized rates of N as a baseline condition.

Tier 1 Justification

On manured acres? Or all acres? If all acres, how can you justify assuming 20% lower P on non-manured acres? *[Scenario 3 in developing Tier 1 efficiency]* [CBF]

Response: Non-manure acres are not affected by the 20% N adjustment (the % P adjustment was dependent on county specific manure N:P ratios resulting in 8% efficiency). High-till without manure acres get standard efficiency of 5% TN and 8% TP from a prior NM sensitivity run. Only fertilizer and manure on corn was adjusted because the LGU rates for all forms of nitrogen was 20% or more greater than late 1980s and 1990s rates.

I had a very hard time understanding this paragraph…I understand that Tier 1 efficiencies have already been approved, but as they influence Tier 2 and 3 credits, it is important to understand the logic. This paragraph is not clear, especially the second sentence. *[Tier 1 credit]* [CBF]

Response: This section of text (pgs XXX) was revised to improve its clarity and comprehension.

I don't see any support for why we would expect reductions in P loss on non-manured acres… *[Tier 1 credit]* [CBF]

Response: The P reduction is commensurate with the model derived efficiency change from the landuse conversion previously credited in the Phase 5.3.2 CBWM. This reduction was based on the assumption that application rates on unimproved (non-NM) acres was high for various reasons including insurance fertilizations attempting to improve yield prior to yield response studies that proved no yield response from N or P additions beyond crop need would result in improved yield. Additionally, some amendments of P were made in accordance with P build-up of soil stores to improve the availability of P to crop uptake. These concepts predated scientific understanding that beyond a certain, soil-specific, threshold soil test phosphorus levels cannot reduce crop stress and perceived crop stress is likely due to early-season temperature effects.

This claim about yields being wrong should be supported by data. [CBF]

Response: The panel believes this claim to be supported by data they are familiar with and is expanded upon further in the next response.

So, is this suggesting that the reason we haven't documented an actual decrease in N application historically is because yields have increased? If so, then as noted above, providing data to support this assertion is important. [CBF]

Response: Yield data included in the model is based upon 5 year intervals of Ag Census interpolated for annual yield data in the CBWM. Specifically illustrated in Maryland as illustrated, Ag Census yield data was collected on disproportionately low yield years compared to average annual yields collected by the National Ag Statistics Service. The chart appended below shows a clear trend in corn yields increasing through time and point data from Ag Census occurring at noticeably low levels, presumably due to weather. This skewing of the data incorporated into the Phase 5.3.2 CBWM results in low estimations of N and P application rates by the Phase 5.3.2 CBWM and obfuscates the improvements in expected yield of roughly 30% during the simulation period. Also included in the analysis, performed by a panel member, are the major row crops, wheat, soybeans and barley which make up the vast majority of high till with manure acres simulated in the CBWM.

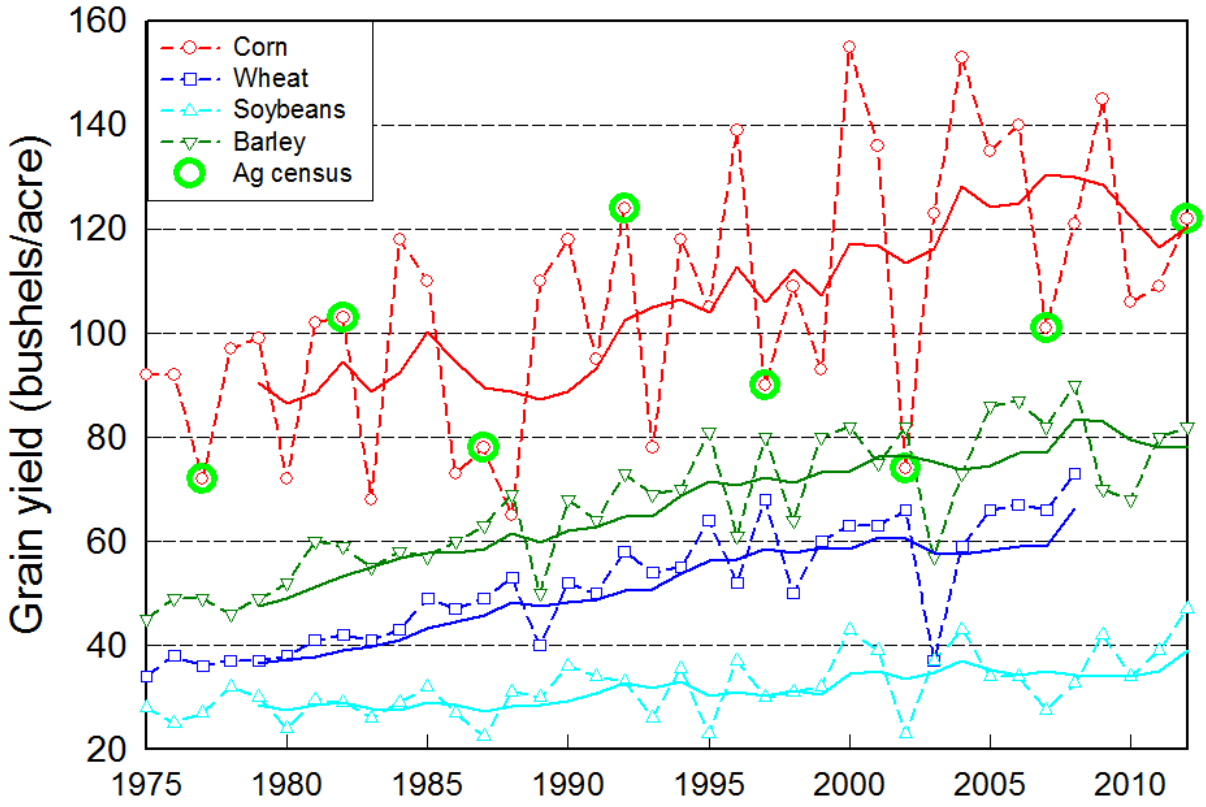

Figure 1 Grain yield in bushels per acre for Maryland from the NASS exhibiting double digit percent increases over the simulation period for major commodity crops and illustrating a disproportionate number of low yield years captured by Ag Census, which is currently the only input data for yield in the Phase 5.3.2 CBWM.

Hmm, results of CEAP data indicate an increase in fertilizer/manure application in recent years. The Panels' response to this observation is that yields have also increased…again, data to support this assumption should be provided. [CBF]

Response: Yield data has been provided above to support the report's claim of yield increases driving the more modest increases in N and P application rates Bay-wide.

In 2014 Report regarding Tier 1, states "The Panel based the effectiveness solely on LGU recommendation changes over time because of a lack of scientific literature documenting efficiencies of the proposed practice." It appears Ph 5.3.2 model runs were made based on the changes in LGU recommendations from the 1970s or 80s? Is that correct

Response: The LGU recommendations from the 1970s and early 1980s were used as a proxy for the baseline condition where no NM was planned or implemented. The change in LGU recommended rates from this time to the simulation period: late 1980s and early 1990s, was the basis for the 20% increase in application rates of nitrogen on corn in the CBWM simulations used to estimate an EOS efficiency for High and low till crops eligible for manure application (landuses: HWM & LWM). The model runs were not basing Tier 1 on a change from a true baseline condition for which no data exists to a LGU

recommendation from the 1970s or early 1980s because this period predates an NM credit afforded in the model as a result of the approved Tier 1 CGNAM BMP. This recommendation is further explained in the Tier 1 report available here.

Concerns about use of WSM to generate reductions but NOW also concerned about crediting changes in LGU recommendations over last 30-40 years as a creditable BMP. Were not these changes an optimistic suggestion for what a farmer was supposed to be applying at base level NM at any point in time??? [ATS]

Response: The CBWM was used to inform the approved recommendation for credit because the CBWM was already calibrated for the NMPs given credit in the suite of model runs used to inform the TMDL. Any other recommendation could have violated the CBWM calibration and invalidate the TMDL. NM plan writers generally immediately used contemporary recommendations from LGUs. This fact was especially resonant for N, but in the case of P, the adoption of P risk assessment tools was slightly delayed due to the time involved in adapting a research tool to the more binary regulatory environment. See also Tier 1 Justification response.

Appears to relate to LGU recommendations since the 1970s as discussed above, or perhaps to some other data? This appears to be giving credit for changes in LGU recommendations and/or practice for the last 30+ years to annual progress runs from 2010 thru 2017? Please explain this. *[Tier 1 justification]* [ATS]

Response: See Tier 1 Justification response, below.

Does this not support the comment above? Also supports concerns about P reductions being directionally correct and whether N reduction level can be justified based on 1970s recommendations. *[Absence of historic surveys on nutrient applications to crops]* [ATS]

Response: See Tier 1 Justification response, below.

Perhaps for N but allowing N=based manure rates negates any credit for P (losses increase). How is it verified that farms are following changes in LGU recommendations since 1985, or is this assumed? *[LGU guides informing Tier 1]* [ATS]

Response: See Tier 1 Justification response, below. There has been a separate, but concurrent effort to clean BMP historical records in the CBWM.

Only applies to N and not P and not certain about the rationale for N. *[Applicability of Tier 1 to land use]* [ATS]

Response: See Tier 1 Justification response, below.

All LGUs in w/s were only recommending 1lb/bu of yield for corn by 1985/? Unless 1lb/bu was credited as NMP throughout calibration period, would not application below that rate have to occur to get post calibration (and post 2009 credit)? [ATS]

Response: see below.

What is basis for manure PAN application only being 20% above LGU fertilizer recommendation? Not

sure we understand what is being said here. [ATS]

Response: By 1985 and through to 1990, LGUs decreased the recommended application rates by 20% or more. Some LGUs had a piecemeal reduction from 1.4 to 1.0, but prior to 1985 and after 1985, all supporting LGU literature collected reflected a 20% or more drop in N rates for manure and fertilizer. LGU recommendations from the 1970s and early 1980s as a proxy for real world baseline conditions for which no useable data exists. See also, Tier 1 Justification response, below.

Figures 5 & 6

Made 20% manure application reduction and then calculated P reductions from WSM scenarios – no data? [ATS]

Response: Figures 5 and 6 were mislabeled, the typo has been fixed. See also Tier 1 Justification response.

WSM issue with P. Agree if you apply less P, the rate of accumulation will decrease but WSM cannot handle concept of losses related to accumulation of P above crop needs over time? [ATS]

Response: CBWM can handle the concept of losses related to accumulation of P, but the CBWM only simulates accumulation over a 10 years simulation period and the losses are annualized with an average of these simulated years.

Tier 1 Justification Response: Tier 1 CGNAM is an approved model-derived estimate and recommendation based on two simulations in the CBWM, results are illustrated in Fig 5 & 6.

1. *A run was completed using the original Phase 5.3.2 landuse change designation where all available agricultural land in the watershed was converted to the nutrient management version of the landuse, where high-till with manure was converted to nutrient management high-till with manure, high-till without manure was converted to nutrient management high-till without manure, pasture was converted to nutrient management pasture, alfalfa was converted to nutrient management alfalfa, and hay was converted to nutrient management hay. The NM and no NM run were compared at the watershed level. A watershed scale percent difference at the edge of stream level load was used as an estimate of an efficiency for landuses, alfalfa, hay, nursery and high-till without manure.*
2. *A run was completed using the CBWM where non-NM corn in the high-till with manure landuse was subject to a 20% increase in nitrogen application commensurate with the proxy-higher application rates recommendation by LGUs in the late 1970s and early 1980s. Only corn among the other landuse's crops was adjusted to be consistent with the historical LGU documents. This run was compared at the EOS level to a no-NM run with regular corn application rates for an increase in load from the increased ammonium nitrate and manure rates consistent with pre-model LGU rates. The change in EOS loads was recommended and approved at the Tier 1 efficiency for high and low till with manure landuses.*

These runs were in an effort to replicate and model the best professional judgment of the panel relating historical recommended rates on corn with a calibration for the CBWM, that should not be violated with the panel's interim NM recommendation. The landuses beyond that which simulate

corn used a calibrated CBWM estimation procedure designed by the CBPO modeling team and panel anaylsis. This efficiency takes a variable county specified rate of reduction from a Tier 1 acre and averages it for the whole watershed to ensure uniformity among the states for practices performed throughout the history of the model's simulations. The improvement of the EOS efficiency for high-till with manure landuse is a result of a simulation increasing corn application rates to contemporary rates predating the watershed model. This is the best professionally judged proxy for pre-BMP application rates and was deemed conservative by the panel and the CBP Partnership when it was approved in Oct 2013 because it only affected corn acres and any increase in phosphorus was related to the excreted ratio of N to P in the manure which was applied at 1.2 times the modern N rate.

The Panel does not see the multiplicative nature of the Tier 2 and 3 NM BMPs as reason for revisiting our approved recommendation on Tier 1. The concept of stacking Tier 2 and 3 credits beyond the Tier 1 credit were included in the Panel's approved Tier 1 recommendation and the framework of the elements differentiating Tier 1 plans with Tier 2 plans was approved in the 3 definitions recommended and approved in Oct 2013. The July 2015 report clarifies elements of Tier 2 and Tier 3 NM acres based on feedback from the 2014 report stating that Tier 2 components were not worthy of the efficiencies we recommended with the science we presented as evidence. The recommendation for Tier 2N, Tier 2P and Tier 3N credit are each singular values derived from literature that approximates the difference between Tier 2 in addition to Tier 1 levels of effort for a constituent nutrient or Tier 3 components in addition to Tier 2 levels of effort for nitrogen. The recommendation of this report is designed for Phase 5.3.2 of the CBWM. This is inclusive of the 2013 Progress run, milestones and subsequent progress runs until the Phase 6.0 model is approved for use in 2018. The notion that the recommendation was only for 2013 Progress was a misinterpretation of the impetus for a recommendation for only part of the Phase 5.3.2 Panel's charge at that time. Implications on Phase 6.0 of the CBWM are null and, at this stage model development, speculative. Comments and suggestions for that Panel should be referred to that Panel at their public meeting.

The Panel disagrees that the Tier 1 recommendation is fatally flawed. The panel judged the CBWM's estimation of N and P reductions from calibrated landuse changes and an increased rate of fertilizer and manure nitrogen on corn as both conservative relative to the actual real-world benefit of NMPs from 1985 to present and protective of the Phase 5.3.2 CBWM calibration. The Tier 1 credit is based on late 1980s and 1990s era nutrient management; non-nutrient management or pre-nutrient management rates were simulated with 1970s or early 1980s nutrient management recommendations as a proxy. This recommendation does allow for P application rates of manure greater than crop need or removal, but no P risk assessment. This is consistent with contemporary plans from the late 80s, 90s and early 2000s. The consistency with this management approach is part of the reason the Panel uses Tier 1 to define this era. The Panel disagrees with the comment that farmers would not waste manure P based on monetary value. During the era where Tier 1 was the penultimate in nutrient management technology, manure P had a nominal value. The Panel agrees that fertilizer P would be applied at economic rates and simulated no increase in fertilizer P with the model runs simulating a pre-BMP condition on corn acres.

The Panel asserts that the Tier 1 NAM is applicable to historical reporting of NM acres. Modern NM acres are generally more consistent with the definition and efficacy of the Tiers 2 and 3 recommendations herein. Further inquiries about the Tier 1 report should reference appropriate sections of the approved Tier 1 report and general comments about that report can be referred to the CBPO who in turn can forward questions to the Panel according to the BMP Protocol.

Tier 2

Tier 2N

On the Tier 2 N efficiency, we think the supporting science is not strong – details in the attached. [CBF]

Response: The Panel made a conscientious decision to use unpublished local data as we would have used local published data, if it exists. Analysis of this data was performed in a way to maximize the applicability to the model as discussed in the component sections in the report. This analysis on panel-reviewed data makes it as good or better than peer reviewed literature in the opinion of the Panel.

As noted later on, we don't think manure incorporation should be included in the estimate of this efficiency and the benefits of timing appear to be based on expected increases in yield/crop uptake, not on any measured concentration reductions of soil N or N in runoff or leaching. [Efficiency T2N] [CBF]

Response: Increases in uptake were approved by the panel as an appropriate proxy for N runoff and leaching because the nature of split timing or incorporation reduces availability for loss. Additionally, any increase in yield is a direct benefit of a reduction in loss because the lost N cannot contribute to the yield of the crop, so it is also a good indicator of quantity of pollution prevented at the EOF/plot scale. Appropriate adjustments were made to convert plot or EOF reductions into EOS efficiencies.

Table 1 Summary comparing BMP N reduction estimates derived from measured environmental variables (fall residual nitrate-N or mass of nitrate-N leached) and reduction estimates derived from decreases in recommended N soil amendments with BMP implementation

Best Management Practice	Variable Measured	Without BMP	With BMP	Reduction, as % with-out BMP	Notes	Reference
		----- kg N/ha -----				
Reduce corn N requirement, 1.2 to 1.0 lbs N/bu.	Fall soil NO_3-N, 0-90 cm	56	39	30%	Avg. over 3-yr study	Coale et al., (2000)
	Total PAN applied	230	191	17%		
Pre-sidedress soil nitrate test	Fall soil NO_3-N, 0-120 cm	151	66	56%	Avg. over 3-yr study	Durieux et al., (1995)
	Total PAN applied	168	120	29%		
Pre-sidedress Soil Nitrate Test	Mass NO_3-N leached, Pan lysimeters	50	19	62%	Avg. over 2-yr study	Guillard et al., (1999)
	Total PAN applied	196	113	42%		
Pre-sidedress Soil Nitrate Test	Mass NO_3-N leached, Tile-drain lysimeters	28	16	43%	Avg. over 2-yr study	Sogbedji, et al., (2000)
	Total PAN applied	19	15	21%		
Reduction Estimated from Environmental Variable :				**48%**	**Avg. of % reductions, from all studies**	
Reduction Estimated from Decrease in Total PAN applied :				**27%**		

The process of estimating N reduction efficiencies for any BMP should ideally be based on measurement of a suitable environmental variable (e.g. surface runoff, subsurface leaching, fall soil residual nitrate-N, etc.). As noted in section 4.3 however, there were very few reports that directly related a measured change in an environmental variable to implementation of a BMP. The most common BMP evaluation was to relate BMP implementation to a reduced need for N application, which results from an increase in a crop efficiently removing soil-N or more leaving less N available for loss through leaching, denitrification, or ammonia volatilization, etc.

Never-the-less, there were several studies that documented BMP performance by direct measurement of ***both*** *an environmental variable and crop yield as measured by influence on PAN need. Table 1 summarizes the BMP evaluation studies and compares N loss reductions with N input reductions. These examples show reducing the corn N application coefficient from 1.2 to 1.0 lbs of N per bu of yield decreased fall nitrate-N from 56 to 39 kg N/ha, which is a 30% reduction in post-season soil nitrate-N (very susceptible to leaching). The corresponding percent reduction in total PAN was 17% (from 230 to 191 kg N/ha). Similar results were also found in a VA study by Ditsch (1991) and in all three PSNT evaluation studies in Table 1.*

The reason the environmental variables show a larger percentage reduction, compared to the percent reduction based on applied total PAN, is because these BMPs successfully identified situations where excess-N that is added beyond crop need was being recommended or applied. The applied PAN reduction directly reduces the total PAN applied to the crop. Because the majority of the total PAN goes to crop N needs, reducing the excess results in a smaller percentage reduction in PAN. Thus, practices that directly reduce excess-N will have a larger percentage impact on environmental losses compared to the percentage impact on total PAN applications. Furthermore, a closer examination of Table 1 studies having both environmental variables and total PAN-parameters measured, shows that in every case there was a larger percentage N reduction for estimates derived from environmental-based parameters than from estimates based on applied total PAN reductions, with the over-all average percent reduction based on environmental or fertilizer parameters being 48% and 27%, respectively.

The "bottom line" consequence in using applied total-PAN based reductions for N efficiencies is that they are an underestimate of the environmental N reduction; a situation that the Panel unanimously views as being conservative, particularly in view of the paucity of directly-measured environmental data.

Manure Incorporation

If less N is lost to volatilization, then more N will be kept in the soil, yes? What is missing from this discussion, I think, is support for the idea that reducing these losses via volatilization would result in a net benefit to the environment compared to the n losses from soil. That is, studies that would compare N runoff and N leaching from cropland with and without incorporation... instead the efficiency is based on reduced volatilization without taking into account additional soil losses. Also, the efficiency was based on manure incorporation within one day, according to Table 11, most states do not have this time limit or require incorporation at all…I would suggest this be a stand alone BMP as opposed to be used to justify Tier 2 credit because of the variation among states. [CBF]

Response: The Panel recognized that manure incorporation is a multi-faceted management practice that requires the difficult task of balancing issues such as soil erosion, surface runoff of soluble nutrients and organic matter, denitrification losses, etc. However, the Panel responded to the need for a short-term place-holder estimate of the benefits of manure incorporation that could incorporate the existing, albeit limited, data.

It is well known the manure incorporation increases plant available N, not just soil N, by reducing ammonia loss, and NMPs that account for this reduce environmental loss by reducing manure application rates or lowering the recommendation for supplemental N (where manure is not expected to meet crop needs). Both of these N reductions would lead to reduced environmental losses, particularly leaching losses, which is the major loss process for N. This benefit, however, depends on the degree of soil cover produced by the incorporation and time between application and incorporation. The Panel chose to limit the use of this credit to situations where manure was incorporated by implements that would leave at least 30% residue cover and to cases where the incorporation occurred within one day of application. These conditions have therefore been listed as prerequisites for the manure incorporation credit. If a state did not have these conditions in their NMP then they would not be eligible for the manure incorporation credit in P5.3.2. It is the panel recommendation that this situation be given more comprehensive consideration in the Phase 6 CBWM Manure Incorporation Panel.

I think this is the final efficiency estimate, but it isn't clear in the text. My suggested edits are to clarify; if I'm wrong about that point, please ignore my edits but try to explain where the 10% in Table 7 came from. [EIP]

Response: The edits somewhat change the meaning of the text. 10% is a result of the PAN savings in applied PAN due to reduced volatilization and conservation of PAN. 10% is equivalent to 10% conserved applied N and the Panel asserts this will results in more than 10% reductions in edge of plot N loss. EOS loss prevention is calculated in Table 7.

I don't see 20% as an adjustment factor in Table 7, and I don't see the adjustment factors in Table 7 discussed here. Could you explain how a 20% adjustment factor was applied (or explain what the 20% number represents if not an adjustment factor), and could you explain where the factors in Table 7 came from? [EIP]

Response: 20% is the adjusted literature value based on the post-hoc analysis performed by the panel and documented in the paragraph.

It isn't clear what 'conservative' means in this context – please explain whether you think the final adjusted efficiency is biased high or low. [EIP]

Response: Conservative estimates are considered to be unbiased estimates, but the final value is lower than an expected result from a study that explicitly measures for the component or practice effect on representative soils and crops Bay-wide.

Could you cite the study that this came from? [EIP]

Response: The analysis for which a cite is desired was performed by the panel as a result of combining literature values in the above paragraph.

This paragraph is very unclear to me. Would fields with no practices other than conservation tillage get Tier 2 credit? Or does conservation tillage get extra credit on top of Tier 2 credit? If one of these is true, please state… [EIP]

Please clarify – does 'this component BMP' mean manure incorporation or conservation tillage (or something else)? [EIP]

This suggests to me that conservation tillage land use will be given manure incorporation credit or the full Tier 2N credit. Which is it, if either? [EIP]

This sentence has a backstory that is probably obvious to folks who have been in the weeds for a long time, but could you please explain a little more what you mean here? [EIP]

Response: The above comments concerning Manure Incorporation for N revolve around the conflict of crediting the NM component, Manure incorporation, on land that could be credited under Conservation Tillage (a separate BMP). What the paragraph explains is that reduced tillage is an effective means of accomplishing both BMPs together and therefore an additional N credit from the NM component (manure incorporation) is a substantiated claim.

Figure 1 doesn't appear to be helpful on this point – are you referring to another figure? [EIP]

Response: Figure 1 points out the timeframe in which the benefits of this BMP component would be credited. It occurs at such a point in time where Tier 1 NM has evolved into Tier 2 in some states and after a point in model simulation history where the calibration would not account for the component.

Timing N Applications

Yes, aren't these practices typically linked? *[PSNT & split applications]* If so, then how can PSNT be used to justify Tier 3 credits? [CBF]

Response: PSNT is related to the splitting of applications, but the intent to run the PSNT can be credited separately. The splitting of applications is worth a decrease in leaching potential. The decrease in application rates is creditable by the Tier 3 method which requires an adjustment in rate.

So these numbers are based on difference in crop yield? If so, then there are several steps between that and actual reductions in runoff or leaching. [CBF]

Response: From above: Increases in uptake were approved by the panel as an appropriate proxy for N runoff and leaching because the nature of split timing or incorporation reduces availability for loss. Additionally, any increase in yield is a direct benefit of a reduction in loss because the lost N cannot contribute to the yield of the crop, so it is also a good indicator of quantity of pollution prevented at the EOF/plot scale. Appropriate adjustments were made to convert plot or EOF reductions into EOS efficiencies.

In general, it would be helpful to see the original literature values and how the panel quantitatively translated them into the 'literature values' shown in Table 7. [EIP]

Response: the original literature values are from those cited in the report. Values that were calculated from the research and the result analysis the Panel performed and used are documented in the report. Some literature values are from unpublished data and cannot be shared without the scientists' consent.

Did the panel make these calculations using the three sources cited at the beginning of the paragraph? [EIP]

Response: Yes.

These appear to be the final 'literature values' shown in Table 7. Is that right? [EIP]

Response: The final values of literature analysis are presented in the literature values in Table 7. These were then adjusted for scale, crop type and management variability adjustments (compliance, BPJ).

This is clearer – but what were the literature values that you averaged? [EIP]

Response: Literature values were averaged in the final efficiency values located at the right right column of Table 7. An average value from literature for corn was halved as a proxy for the benefit of splitting N applications to Hay receiving nutrients was presented as the literature value for Hay.

Tier 2P

As noted later on, we do not think manure incorporation and use of PSI justify this efficiency. The relatively high Tier 1 efficiency for P makes these additional proposed reductions even more problematic. [CBF]

Response: Manure incorporation and the P risk assessments from various states were new practices involved in a NMP beyond the simple rate changes quantified in Tier 1. While manure incorporation was not used as a contributing factor in the Tier 2 P efficiency estimate explicitly, it is a contributing factor to states' P risk assessment tools, so the benefits are implicitly included. The resulting efficiency of manure incorporation as calculated by the Panel with appropriate scale, crop and management variability adjustments yielded a reduction potential close to those of the P risk assessment tool, so this was supporting evidence the Panel chose to present in it's support of the controversial P risk tools.

Tier 2 P efficiencies were based on the benefits of manure incorporation and use of P indices. The studies used to derive the benefits of manure incorporation did not consider subsurface P losses (an important P loss pathway). Without knowing what those losses are and how much they may counteract benefits from reduced surface runoff loss, we don't see how a pollution removal efficiency can be estimated. Benefits of using P indices were based on modeled benefits from a study that looked at the relationship of P index value and P losses. There is no empirical evidence showing that application of the P index has reduced P losses. In fact, the only study we are aware of looking at soils saturated with P is the infamous Green Run study that showed no reduction in P loss and no change in soil P even after poultry litter application was ceased for 10 years. While intuitively one might think that reductions in land application of manure driven by use of a P index should lead to reductions in P loss – it seems in many cases, the use of the P index is not making things better, perse, it just stops things from getting worse. An analogy is this: If I overeat, I will gain weight. If I stop overeating (e.g., apply P at agronomic rates), I don't lose weight, I just stop gaining weight. [CBF]

Response: Manure incorporation was explicitly not used for the calculation of the Tier 2 P efficiency. Instead the Tier 2 P efficiency is derived by the P risk assessment tools (aka PSI). The study analyzing the change in load from soils with different PSI ratings did include subsurface loss potential in its estimation via the SWAT model. The Green Run study, performed in part by a panelist only eliminated manure application in the first 5 years of the 10 year duration. While the results did not show a reduction in P

loss, the P index rating of this site also did not change. The Panel based the estimation of the PSI benefits on sites that change their status and we adjusted the efficiency by 25% to approximate only 1 in 4 sites having the measured benefit to P loss where the PSI is issued. This adjustment was a consensus approved approach and BPJ estimation after deliberations that included the very points raised in this comment.

Tier 2 Phosphorus Reductions do not appear to be supported by literature: It's a long standing issue nationally that P indices were developed as risk management tools but are not necessarily protective of water quality. In fact studies documenting water pollution reductions and water quality benefits of P indices are sorely lacking. Just having a P index or just running a P index does not necessarily result in an immediate reduction of phosphorus losses from a field. For example on P-saturated soils, eliminating P application is not going to reduce the losses from the field immediately, it is just going to ensure that the problem does not get worse while the crop continues to draw down the reserve of P in the soil.

In order for these efficiencies to be justified I recommend that the panel define the situations where real reductions of P losses are likely and define the verification/reporting measures necessary for states to receive credit. Another option would be to wait until the CBP partnership refines the model to address P in the soils and until we have a CBP-approved manure incorporation efficiency in order to be able to back up any P reductions. [EPA]

Response: See above. Additionally, the Panel considered situations where real P reductions occur as being well simulated by SWAT and the literature cited for this estimate uses SWAT and bases the reduction in P loss from a change in PSI category. The Panel agreed that these are scientifically reliable conditions to estimate P loss reductions.

Tier 2 Should Be Revised to Remove Phosphorus Reduction Credit because there is no Evidence that Using a Phosphorus Index will Actually Reduce the Amount of Phosphorus Reaching Local Waterways. Tier 2 provides a phosphorus reduction credit for using a phosphorus index. However, there is no empirical evidence demonstrating that applying a phosphorus index will actually reduce phosphorus runoff. Where soil is already saturated with phosphorus, as in Green Run, a study shows no reduction in phosphorus loss and no change in soil phosphorus even after poultry litter application was ceased for 10 years. While the use of the phosphorus index may be stopping phosphorus runoff from getting worse, there is no proof that it is actually making things better. Without evidence demonstrating that use of a phosphorus index on phosphorus-saturated soils actually *decreases* phosphorus runoff, Tier 2 should give no phosphorus reduction credit for a phosphorus index on phosphorus-saturated soils. [CCWC]

Response: See above responses regarding P risk assessment estimate techniques, justification and conditions for which the estimate was made accounting for the final efficiency. These responses also address the popular science article presented by multiple commenters regarding Green Run.

Manure Incorporation

This sentence is confusing and should be clarified. Is the point that the benefits of incorporation on certain soil types reduces surface runoff and these benefits outweigh the potential losses via subsurfaces pathways? If so, please clarify. Also, not sure what is meant by "less than well-drained soils did benefit from tillage."? [CBF]

Response: The report has revised the highlighted section of the report which was flagged for poor clarity.

The studies above and Table 6 highlight the importance of subsurface p losses, yet this study did not look at that and the efficiency is based on reductions from surface runoff only, without considering effects on subsurface losses. This is not appropriate. [Tier 2P incorporation] [CBF]

Response: This study did not consider subsurface P loss. Subsurface P loss is a significant concern on very limited acreage in the CBW. Despite the small acreage, incorporation was eliminated from the final Tier 2 P estimate and was instead used by the Panel as supporting evidence for the suite of conditions used to calculate a PSI. Management of high soil test P to reduce P loss is included in P risk assessment tools like the PSI and management options like incorporation are useful for both reducing risk and improving a PSI rating.

What was the control? Not understanding how you can have 88% less P loss, but the mass of P loss was not different than the control? [Tier 2P incorporation] [CBF]

Response: The control was an untilled site without manure application or a true control. In other words, untilled, dairy amended soils had the greatest runoff P\and the least runoff (88% lower) was generated by tilled dairy amended soils as well as untilled soils with no ammendment.

I thought it said on the previous page that Feyereisen and Folmar did not measure subsurface P, just subsurface flow…if so, how can that be used to discount the efficiency? As noted for the coastal plain, without some quantification of subsurface losses of P in these studies, the derivation of efficiencies based on surfaces losses alone, is not justified, even if they are discounted. [Tier 2P incorporation] [CBF]

Response: No efficiency was calculated from this section or specifically this paper. Adjustments to the resulting P loss reductions were made to compare the results of these studies to the estimate of the implementation of a complete P risk assessment. The paper mentioned sought to identify the surface and subsurface flow through soils that were used to generate P surface losses. If concentrations of P in surface and subsurface were proportional to flow in these pathways, as the analysis assumes, the 88% surface P loss reduction from tillage should be discounted to a number in the mid 40%s.

As noted earlier, without quantifying these losses and comparing to surface losses, it is not appropriate to establish an efficiency. Also, as noted earlier, the states have different timeframes and requirements around incorporation so it may not make sense to include it as justification for Tier 2 since it is not uniformly implemented. [Tier 2P incorporation] [CBF]

Response: No papers connecting subsurface P loss to tillage were discovered in published literature by the panel. BPJ was used to reduction the efficacy of the paper results to a holistic efficiency. This contribution is manifest in management variability adjustments in Table 7. Ultimately this component of Tier 2 P was not included in the final estimation of the efficiency, it was supportive of the efficiency the panel derived from the P risk assessment tools, which includes incorporation as an option.

Interesting data. Suggest CBP use the 1992-1198 P drawdown information from this in subsequent discussions on drawdown. Data was before this was being discussed and indicates a linear drawdown with greater negative slope for higher initial STP (high P soils reduced STP at faster rate). *[Figure 7]* [ATS]

Response: The P drawdown information from this figure is illustrative only. Because the CBWM does not account for accumulated STP, the load generated from STP is captured in the calibration and is simulated, to some degree in all landuses. For this reason, it is difficult to assign a reduction on one

landuse from drawing down P. Additionally, P drawdown is not a speedy BMP and is inappropriate for credit in the Phase 5.3.2 CBWM considering the planned longevity of this modeling tool.

Don't these two sentences contradict each other? [EIP]

Response: This comment refers to the control in the Tarkalson & Mikkelsen paper and is answered above.

Please rewrite or expand – I can't figure out what you are trying to say here. [EIP]

Response: This section was edited to improve clarity and understanding.

Unclear. What are you trying to say here? That manure incorporation produces lower P loads than surface broadcast application? [EIP]

Response: This section was edited to improve clarity and understanding, but yes, that is the correct understanding.

This is just a string of words – please put a complete sentence here to explain! *[Table 6]* [EIP]

Response: It is appropriate to interpret "Poorly drained soil surface runoff and disrupted macropore flow to groundwater" to mean soil surface runoff from poorly drained soils is reduced by tillage and subsurface flow of P in these soils is diminished by disrupting macropore flow of P also due to the tillage.

P-Risk Assessment Tools

The cited studies do a good job of demonstrating that PSIs can do a fairly good job of predicting P losses, but that is different than saying the application of these indices will reduce P losses. One well known study, paired watershed assessment/ Green run would suggest that even eliminating land application of manure for 10 years did not result in a decrease in P soil concentrations http://www.bayjournal.com/article/10_years_of_management_fails_to_reduce_phosphorus_in_study_area

I recognize that the watershed model does not have lag times, but in this case, until we see actually changes in soil PSI values it is premature to give credit for their implementation alone as there is no monitoring data to support a reduction in P losses. This in contrast to other BMPs like cover crops and buffers that do have lag times, but also have lots of studies supporting the notion they actually do reduce nutrient losses. As noted in the article: "The results show that 10 years of management actions failed to reduce the amount of phosphorus that had built up in the soil during the previous four decades. They only slowed the rate at which phosphorus was accumulating."

This efficiency is based on modeled losses – that is not sufficient, particularly in light of the Green Run results. [CBF]

Response: The credit available for P index use is a result of the ability of management decisions to influence P loss short and long term. The credit is driven by P risk assessment tools performed in the field and then re-run as a result of management changes dropping the rating to a less deleterious level. See also, Tier 2 P responses regarding Green Run, above.

Paragraph is hard to follow and redundant but the conclusion appears to be that 5 of the 12 southern states evaluated had moderate to strong relationships between PSI and published load data while 7 of the twelve had weak, no or negative relationships with published loading data. Is that interpretation correct and how should the PSI assessment be viewed as rationale for increased reductions, if it is?

Given lack of clarity on derivation of the Tier 1 P reduction, do these data support a higher reduction for PSI use in Tier 2? [ATS]

Response:

Insufficient data for panelist to make recommendation but use graph of PSI vs SWAT model estimates above as basis for reduction. Isn't this a weak basis for a reduction? By visual observation, appears big reduction is from medium to low rather than from high to medium. Should this be considered if graph is used to estimate reductions (need to move from medium to low PSI to get credit)? Which PSI was used (location) and how does it correlate to CB W/S PSIs or newer tools? [ATS]

Response: The Panel deemed this data sufficient for an estimate in the absence of any other peer reviewed literature being available to draw a conclusion from. Categories Medium and Low would not result in a P risk assessment tool triggering a management change. The Panel understands that some NM planners would advise improvements to get a producer's field in a low category from a medium, but to base the estimate on this change would bias the result toward a greater estimation.

In addition to Tier 1 P reductions? Do not most CB W/s states now require some P risk assessment tool as part of a basic NMP. If so, why additional reduction. [ATS]

Response: Tier 2 is recommended to be its own efficiency combining the Tier 1 credit with Table 7 Tier 2 P efficiencies to form a Tier 2 P credit. Tier 1 credit is earned by a reduction in manure applications to LGU recommended N rates and additional credit is earned by a reduction from the benefits of P risk assessment tools reducing the P loss risk.

Tier 3

It appears you get full credit for using any one of the five practices. Is that correct, and, if so, why? [ATS]

Response: Credit is recommended to be granted for the change in rate of application from results of any of these tools. There is no current method to collect Tier 3 components individually by the states, so to deliver an estimate that can be used for the period this recommendation is advised, combining the estimates was the prudent strategy.

PSNT

Suggest some language be included to indicate the rationale for why this should be given additional credit beyond benefits of split application/timing in Tier 2. [CBF]

Response: PSNT is related to the splitting of applications, but the intent to run the PSNT can be credited separately. The splitting of applications is worth a decrease in leaching potential. The decrease in application rates is creditable by the Tier 3 method, which requires an adjustment in rate.

I can't figure out how these numbers are averages of any of the numbers above – please clarify, preferably with a table showing which studies/results contributed to which averages. *[PSNT narrative]* [EIP]

Response: Each adjusted literature value from Table 7 is taken from the component sections' conclusions from the literature. Then, each adjusted value is summed and divided by the total number of values for

an arithmetic mean. This is, in the Panel's opinion, the most responsible way to give credit for practices that are not tracked individually or could be reported individually.

CSNT

Where does the value in Table 7 come from? And what is the rationale for applying to all geographies? Seems like the benefits would be more like the PSNT? If not, can you provide a sentence for why you don't expect it to vary by geography? [CBF]

Please add a sentence or two explaining how you ended up selecting 20% as the 'literature value' in Table 7. [EIP]

Response: Results are consistent across Bay and non-Bay geographies indicating a consistent reduction. 20% is representative of combining silage with grain application rates.

ISNT

Given this, seems like assigning a value to this is pretty weak. Suggest deleting from consideration. Also, do any other states besides NY employ this approach? *[ISNT data limitations]* [CBF]

Response: Results from trials indicate similar reductions. Pathways of prevented loss are similar to other methods. This tool is useful to NY farmers now, but perhaps others later. Sampling with this approach requires two years of testing before rate change is implemented. Credit cannot be applied until rate is changed, therefore the implicit conservatism in this tool is supportive of the reduction and inclusion in the average Tier 3 BMP.

Are you saying that you used reductions in N applications as a proxy for reductions in EOS N loads? If so, please state that clearly up front. And, in addition, please explain how the 33% was derived. Is it the difference between 150 lbs/acre and the 100 lbs/acre? Why not the difference between 20 ppm soil residual and 9 ppm (55%)? What are the standard assumptions and how do they play into the calculations? [EIP]

Response: The context of the explanation leads the reader through the change in soil residual between the two trials being 9ppm, which is roughly a 33% reduction from non-BMP soil residuals using standard assumptions for soil density and depth of soil NO3 testing. The ISNT captures the root zone residuals and not N lost due to leaching, so a deeper profile of soil must be considered for the percent reduction estimate.

Variable Rate N

Again, are you using reduced applications as a proxy for reduced loads? If so, please state clearly up front. [EIP]

Response: Yes. This conclusion should not cloud the scientific analysis noted in the section and is not appropriate for prioritization at the beginning of the section. See also, response regarding N rate coefficient changes compared to N loss risk prevention with appropriate data slide.

Tier 3P Discussion

As there is no Tier 3 P recommendation, think this should either be removed or put in an appendix for

the PH. 6 EP. Data and experience indicate there is likely more than feed management and even whole farm P balances (both of which are important) to getting substantial reductions in P losses. Since no conclusion is reached on Tier 3 P, suggest the discussion not be included as part of the main report. [ATS]

Response: While the comment is valid, this section will remain in the body of the report for consistency with the other components.

Effectiveness estimates for Tiers 2 and 3 (Table 7)

The "literature values" in this table are apples and oranges e.g., some like the manure incorporation are based on ammonia conserved (N) or reduced surface runoff (P) while others are based on reduced N application or I think, differences in nutrient uptake as reflected in crop yield…yet, they appear to be treated the same? Or maybe that is what the "mgt. Variability adjustment takes into account? Would suggest clarifying what the literature values represent and then explicitly adding discounts if they do not represent actual monitored losses to surface or groundwater. [CBF]

Response: All N values can be interpreted as reduced N application. As noted in Tier 2 N responses, reduced N application is the common metric for which literature was analyzed, because N efficiency relevant to crop production is the most common metric supported by funding agencies, and it is the basis for economic survival in agriculture. Hence, increased PAN from ammonia reduction is manifest in a NMP as lower application of manure and greater plant recovery of N, which reduces N losses to the environment. See also, response regarding N rate coefficient changes compared to N loss risk prevention with appropriate data slide. Likewise, nitrogen testing after a season of corn can reduce N application in the next season, which is a basic principle in adaptive management. Split timing of N results in less applied N due to decreased N losses to denitrification and decreased leaching, both of which impact the environment. The Panel recognizes the monitored losses in surface and groundwater would be excellent metrics to evaluate NM, but they are a critical "missing links" in the NM databases at this point in time due to an extreme shortage of funds to monitor surface and groundwater quality. Therefore, the Panel used reductions in N application rates as the best available metric to evaluate the environmental impacts of NM.

As noted in the text, it is not clear how this value based on conserved ammonia would relate to net reductions in N loss, given the total amount of N is the same. *[Table 7: Tier 2N manure incorporation literature value]* [CBF]

Response: See above and the Tier 2 related response.

As noted in text, these values do not consider subsurface losses of P, so would suggest they are not appropriate for inclusion. *[Table 7: Tier 2P manure incorporation literature value]* [CBF]

Response: Tier 2 P does not include manure incorporation in the estimate; it is merely an informative exercise to adjust the literature values because incorporation is a major management component to the PSI. The PSI is, in fact, the sole factor in estimating credit for Tier 2 P reductions.

As noted in text, this is based solely on a model – there are no studies documenting P loss reductions from implementing the PSI and in fact the Green Run study suggests a VERY long time lag. Also, states vary in their use and form of this tool. Would suggest no credit be given. *[Table 7: Tier 2P, PSI literature*

value] [CBF]

Response: See Tier 2 P response, above.

As noted in text, this value seems high given there is relatively little information on the benefits. Also, how widely used in the region is this? Suggest deleting. *[Table 7: Tier 3P, ISNT literature value]* [CBF]

Response: The studies cited and the summary written on pages 39-40 of the report for the Tier 3N – ISNT values demonstrate consistent and significant reductions in N application rates (over multiple sites and years) when the ISNT is used to adaptively manage N based on field-specifically characterized soil N supply versus standard book values used in Tier 2 N management. Like other adaptive N management tools, the ISNT is used more and more each year, especially in cropping systems involving significant organic N contributions from hay in rotation, cover crops, manure, and/or compost. For conservatism, the rate reductions and associated leaching losses were further and significantly discounted to arrive at the final value.

This is some kind of combination of the average of the three N timing estimates and the manure incorporation estimate, right? I can't reproduce the math – could you explain in a footnote? *[Table 7: Tier 2N on row crop]* [EIP]

Response: Adjusted data points for N timing (X_f) were utilized as a mean that contributed in an additive way to the Manure Incorporation adjusted value for the row crop efficiency of 3.9 percent(i.e., (X_{f1}+ X_{f2}+ X_{f3})/3+Y_{f1}). Where X is an N timing value of row crops (excluding hay) and Y is Manure Incorporation effects. This mathematical approach attempts to average similar timing components, while allowing the non-timing component to be independent of timing. The Panel recognizes that this approach may exceed the accuracy of the data, however, the Panel chose to use this approach to put more emphasis on incorporation which was considered to be significantly undervalued - indeed manure incorporation will be the subject of a completely new BMP in the Phase 6 model.

For the nutrient reduction efficiencies to be more defensible, it was very important to accommodate the "discount" factors. Section 4 and Section 5 are valuable write-ups and point to the need for the discount factors. However, it also highlights what literature and studies to consider for determining the benefits of BMPs. Small-scale, short-term studies in controlled environments are the opposite of what's needed to inform the model, particularly when a panel's recommendation are single efficiency units applied across the 64K sq. mile watershed. The panel's extrapolations could be difficult to defend – even with the accounting for discounts – particularly because of the large extent of reported acres in this BMP and the sensitivity among many stakeholder groups. National and large regional studies of nutrient balances/imbalances should have been accommodated to some degree in the panel's assessment – and these exist. Even large scale-model results using monitored, survey and/or published data are preferable to small-scale, short-term studies – as important lines of evidence to inform the CB WSM. The premise of Tier 1 benefits is changing land-grant recommendations over time. Why not use data of changes in large-scale nutrient balances of what occurred on the ground – rather than what was supposed to occur on the ground. Maybe the benefits would be greater than the panel's recommendations. Maybe the benefits would be less. [Team]

Response: The Panel agrees that smaller scale nutrient budgets could improve the estimated adjustment factors, but it is the Panel's opinion that the current large scale of the P5.3.2 model and the uncertainties in its nutrient budgets (particularly the fertilizer inputs and manure generation data) magnify the complexities of recommending a nutrient budget approach. The suggestions of using small-scale nutrient budgets should be revisited in the new Phase 6 model where fertilizer and manure inputs plan to be improved. Footnotes will be added to address confusion about the nature of the adjustments. See also Section 4.3 of the Report entitled: The Need for Applied Research on BMP Effectiveness.

This is of limited importance as Tier 1 reductions are by far the largest yet least justified. However, some estimates are cited as having no published (or gray?) literature so unsure how you apply the chart below. Also, applicability to the CB w/s may have been considered but was not shown in decision support diagram. *[Tier 2 and 3 synthesis of efficiencies]* [ATS]

The Panel should not average efficiencies for practices and geographies unless it is necessary for implementation of the Bay Model. The rationale behind the Panel's decision to average its adjusted efficiencies for certain practices and geographies into one Tier credit value is also unclear. For example, though the Panel derived significantly different adjusted efficiencies for Tier 2 N timing in different geographic regions, these values are averaged into one Tier credit. And although the Panel started with distinct pollution reduction values from the literature for five Tier 3 N practices, the Panel ultimately recommends a single adjusted efficiency for any and all of these practices. If this is necessary due to limitations in the Model, the Panel should make that clear. This approach is also at odds with other calculation methods, because rather than weighting the values based on relevant criteria such has the prevalence of the Tier in different geographic areas, the final credit is an unweighted mean. Without further explanation, the decision to average these values seems arbitrary. [EIP]

The Panel should clarify how it derived adjusted efficiencies from literature values for pollution reduction. The NM Efficiencies document lacks critical detail on the Panel's methodology for translating the relevant literature values into the final literature value adopted for each adjusted efficiency. For example, the draft indicates that the Panel has "weighted" the available literature values in deriving its numbers, but provides no explanation of how the different values were weighted and why. The final document should provide a clear explanation of the calculations leading to the literature values adopted and the Panel's rationale for its approach. We have provided specific comments on this issue in the attached track changes copy of the draft report. [EIP]

Please add an appendix listing these values and the weights that were applied in averaging. Without that level of detail, the reader doesn't know how you got from point A to point B. *[Literature values for Tier 2 and 3 component efficiencies, and adjustments]* [EIP]

Efficiencies and averages Response: Averages in Table 7 were applied to percent nutrient reductions therefore units are not appropriate. Measures can be found in the preceding NM component subsection. The averages performed by the panel were a result of tracking limitations in the framework of the Phase 5.3.2 CBWM. When Phase 6.0 CBWM is developed and tracking and verification programs are enhanced by 2018, these elements of the recommendation should be revised by the appropriate panel. The Panel weighed unpublished or gray literature as heavily as peer reviewed papers collected by the Panel based on personal communication with the researchers to ensure its applicability to this report. In all cases of component BMPs, watershed scale, peer reviewed, local data were not available despite the Panel's best

efforts in several years of active discussion and deliberation.

Please explain how these are applied e.g., is 80% meaning it is multiplied by 0.8? or 0.2? *[Management variability factor]* [CBF]

Response: An 80% adjustment to the Management Variability factor is applied by multiplying by 0.8 (see N timing section).

With the discounts, the panel seems to have somewhat accommodated what's measured with what's needed for the model – an accounting of the net change in fluxes after considering all pathways (runoff, subsurface, and groundwater loads), all species (e.g. NO3-N, NH4+-N, and organic N), etc. However, the 25% reduction for "scale" and those for management variability (from literature values) are generous in light of the usefulness of information that informed the recommendations. An Expert Panel shouldn't use a particular "discount" value because another Expert Panel used it. The point of each panel is to revise the data and methods with an approach and information that are more defensible than the ones currently being used. For example, the panel used a discount value from the Cover Crop Panel which used the particular discount because an earlier group used it – and this same number goes back through a few version of the Watershed Model. [CBPO Modeling Team]

Response: The Panel used previously approved discounts in part because they are decent estimates and improvement on those estimates would require time and effort, which this panel could not spare. Secondly, the Panel was relying on approved adjustments and even terms for adjustments to be consistent and avoid dissent from the recommended approach by the CBP Partnership. See also Section 4.3 The Need for Applied Research on BMP Effectiveness.

Practice monitoring, reporting and verification

For CBP review and approval, states should provide basis for claimed number of acres implementing NM (how reported numbers were determined, not verification protocol).

- EPA CBPO has been reluctant to question state submissions except where there were insufficient acres in a county on which to apply a BMP. EPA should review both the reported numbers and the basis for them and discuss questions and concerns with each state as part of its regulatory responsibility under the TMDL.
- Both the state report on the basis of submissions and EPA's response and actions should be public information. [ATS]

Response: This concern should be addressed within state QAPPs. See also verification and CEAP responses below.

How would a state know this, especially regarding the intent? Shouldn't you be discounting efficiency estimates by the expected rate of noncompliance? *[That a plan is implemented and followed]* [EIP]

Response: This type of raw data does not exist for the Panel to comment on, analyze or recommend.

States should not get credit unless they can document what percentage of their crops receive split or better timing of applied fertilizer, as these studies are the driver of this benefit. *[Tier 2 N]* [CBF]

Response: The splitting of fertilizer applications is based on a crop's portion of the CBWM landuse as an adjustment. Only corn is credited wholesale within the row crop landuse, so this is already a conservative estimate for percentage of acres.

I understand the CBP, Nutrient Management Panel is reviewing nutrient reduction efficiency policies and the discount rate for application to farm operation acreage implementing nutrient management. I am clarifying Maryland's current reporting and how this may be adjusted in the future in accordance with any CBP policy adjustments.
We believe that a default discount rate should not apply when other means are available to determine performance. This is particularly valid in regulatory programs where compliance evaluation is an integral component of the program.
Currently Maryland mandates nutrient management of all agricultural land, however we do not claim a reduction on 100% of acreage subject to the law. Instead, we have voluntarily discounted the acreage by a percent consistent with the outcome of compliance inspections. While attempting to present realistic data related to practice implementation, this discount or reduction is still not the most accurate statistical representation of compliance in Maryland for the following reasons:

- Maryland targets compliance inspections to those individuals with the most risk of problems through complaints, discrepancies in reporting and other operations thought to be high risk. For this reason we are more likely to find compliance issues on a greater percent of these operations.
- Operations are considered out of compliance if their nutrient management plan is not up to date, regardless of whether otherwise following nutrient management requirements. Out-of – date NMPs account for the largest percent of noncompliance issues.
- Actual operations that are out of compliance by virtue of over-applying or misapplying nutrients represent less than 10% of those sited for noncompliance since we have been keeping these records (9 years).

We have concerns that a discount rate will be set using faulty criteria. For the above reasons, we are concerned that Maryland's compliance rate which includes an inherent bias, would be used for the region. Alternatively, we do not believe it is reasonable to consider use of CEAP report outcomes of 30% adhering to NMP, because the CEAP report does reflect performance or outcomes at the State scale. Practice or program performance should be reportable in a construct that allows for or considers respective jurisdictional variations. Respective states have widely ranging set of protocols for tracking program and practice performance. To the extent a jurisdiction has capacity to track and report more refined information, such accuracy should be provided for in modeled calculations.
Finally, if the Chesapeake Bay Model begins applying a percent reduction to reported nutrient management acres by default, Maryland will report 100% of its acres. Otherwise. we would be subject to the model reduction on top of the discount we already voluntarily apply prior to reporting acreage. [MDA]

Response: This comment addresses some concerns of other commenters, but largely the context and not the content of this report. These estimates of compliance are more supportive of the BPJ included in our Management Variability adjustments and are in contrast to the CEAP interpretations offered herein. The Panel does not recommend a default reduction on reported acres after tracking, reporting or verification by a jurisdiction with an approved QAPP. Management Variability adjustments where not otherwise states are generally used to capture BPJ of non-compliance, non-applicability for a field based on physical characteristics, omission from an NMP for BPJ by a Planner or poor environmental response from the BMP.

State Programs Table

590 Nutrient Management should not be automatically considered equivalent with Tier 2 or Tier 3 nutrient management without verification documentation. I was surprised to see the panel recommend that 590 Nutrient Management be considered as Tier 2 or Tier 3. The expert panel acknowledges that "The NRCS 590 Standard establishes the minimum expectation for development and implementation of NMPs nationwide." In its national Farm Bill database, USDA tracks acres under the 590 nutrient management as a whole and does not distinguish between standard/baseline level of nutrient management versus precision agriculture-based nutrient management. Likewise most state NRCS offices do not track different levels of nutrient management separately. I recommend that if states want to receive Tier 2 or Tier 3 credit for 590 nutrient management acres, then they must provide information to verify that the level of nutrient management implemented is on par with the requirements for Tier 2 or Tier 3. [EPA]

I would offer that 590 is more applicable to Tier 1. [CBF]

As noted earlier in the matrix, PA regulations also provide for "Tier 1" plans for those farms that use manure but are not CAOs or CAFOs. This should be clarified here. Are there situations in other states where "Tier 1" is likely to be reported? If so, they should be noted. [CBC]

Nutrient reduction credit should reflect variability in state nutrient management programs. It's important that pollution reduction credit is on par with the rigor of the state nutrient management program. The Panel did an excellent job of illustrating the wide variability in state nutrient management programs. I recommend that the panel clearly articulate how the variability in rigor of state nutrient management programs translates into P reduction credit.

- How can each state receive the same P reduction credit under Tier 2 from having a P index when P indices vary among states? Can we address this question through verification/reporting requirements?
- How can each state receive the same P reduction credit under Tier 2 when some states have manure incorporation requirements while others do not? Can we address this question through verification/reporting requirements? [EPA]

State Program Table Response: The Panel borrows language from the 590 standard considering it "minimum expectation…" The Panel agrees that this national standard of NM be analogous to an expectation for a jurisdiction to report credit for Tier 2 acreage. The Panel also disagrees that USDA's 590 standard be considered indicative of a Tier 1 plan because timing and placement and erosion prevention are integral parts to 590 and Tier 2 (omits explicit erosion standards, but maintains conservation tillage baselines), but only proper N rate is considered for crediting Tier 1. All plans meeting the 590 standard are consistent with the Tier 2 definition. While many plans approved in states have elements that address goals for P loss reduction, they do so with distinctly separate tools. These particular plans like those in VA which use an Environmental Threshold Method, developed by Virginia Tech for estimating soil loss and soluble P loss, are still eligible for Tier 2 credit despite not receiving Federal cost share. Additionally, 590 requires certain pH adjustment protocols that are not particularly resonant in the Chesapeake Bay Watershed and do not significantly impact soil water quality. Finally, 590 includes prescriptions for field shape and size that land managers may not adhere to, like field

lengths because these physical attributes do not have a significant impact where there is no slope. The table of state programs comes directly from a Tetra Tech survey report. The classifications of the plans in this table are intended to be recommendations based on cursory reviews of this information cross-walked with the section 6.1 guidance. See also verification, compliance and CEAP responses below.

Verification

Is this "guidance" or is this a checklist that describes the elements needed to meet the definitions for each tier? For instance, item #2 here for Tier 1 says that the plan is developed cooperatively between the farmer and trained professional, but that is not the case for PA Manure Management Plans (identified as a "Tier 1" plan in the matrix), which can be developed by the farmer alone. Therefore, will only the plans developed with a trained professional count? Another example is whether "Tier 1" plans that may be N-based only will still get the P credit, or only N credit. The Panel should clarify its expectations regarding these elements for each tier. Additionally, because the regulatory requirements vary across the states, each jurisdiction should provide a description of how their NMP meets the elements of the Tier they intend to report it as. [Tracking, verification] [CBC]

Response: The Manure Management Plans being tracked are those developed either by trained professionals, assessed and approved by trained professionals, or developed by farmers assisted and overseen by trained professions to write these plans. Winter manure applications are allowed but only in limited conditions and in limited locations (reduced winter application rates, added application setbacks, winter cover or established crop required on application fields, limited field slope for application fields). This is consistent with the Tier 1 definition. The plans do NOT allow manure and fertilizer applications to be in excess of LGU N rates. These plans also address barnyard manure losses, losses from pastures and manure stacking losses.

Checklist for determining Implementation was in the EP charge and is included on p 61.

- Does not provide any recommendations on how to verify.
- Comment: Experience indicates verifying NM is extremely difficult to impossible unless fertilizer and manure sale, distribution and use reporting is made much more stringent, comparable to or greater than that currently required for pesticide use.
- Comment: Much effort is directed to definitions, efficiencies and verification protocols and use for NM yet there are serious concerns about adequacy of information to verify NM implementation at a minimum and to explain CBP-CEAP implementation discrepancy. [ATS]

The Panel should incorporate the Chesapeake Bay Program's Verification Framework requirements. Rather than directly address the need for verification of nutrient management practices receiving pollution reduction credit, the Panel has elected to postpone the incorporation of verification practices in this version of the NM Efficiencies. Instead, the Panel has recommended "non-visual assessments" of basic plan elements. NM Efficiencies Section 6.1. However, these recommendations fall short of ensuring that credited practices are in place and implemented correctly, and some of the recommendations simply cannot be implemented without a visual assessment. For example, the Panel recommends non-visually "identifying the presence" of the nutrient management plan's *implementation*, including the rate and timing of nutrient applications. The Jurisdictions can track the existence of plan elements, such as whether a plan is current, in electronic format, and developed by a

professional, without a visual assessment, but cannot evaluate implementation of any of the eligible practices simply by reviewing plan documents. By postponing the incorporation of verification requirements until the Phase 6 Panel, the Panel risks crediting NM Efficiencies that are not realized in practice. In addition to overestimating pollution reductions, this is likely to create inconsistencies in reporting across Jurisdictions. The Panel has stated, for example, that Maryland chooses not to report all NM practices due to imperfect implementation and compliance. The other Jurisdictions report all NM Efficiencies from farms with documentation for Tier 1 or Tier 2 practices, but certainly also lack perfect implementation and compliance. Requiring some basic verification would improve consistency and accuracy in the Model. A failure to address the lack of verification in the Efficiencies will also affect the Phase III WIP development process. If the Phase III WIPs are based on a Model that credits NM Efficiencies for practices that have not been verified and may not be properly implemented, they will underestimate the remaining reductions needed. Even though the Jurisdictions are still in the process of creating their BMP verification plans, the Bay Program's Verification Framework document provides the Panel with more than enough information about the criteria for an adequate program to begin to factor verification into the NM Efficiencies at this stage. [EIP]

Verification Response: See compliance and CEAP responses below. The guidance for non-visual indicators in Section 6.1 is a list the Panel has recommended for states to use in the reporting process to determine if plans reported should be credited as Tier 1, 2N, 2P, 2N&P or 3N. Verification is performed in accordance with a jurisdiction's approved QAPP.

Compliance Rates

Application of efficiencies to acres needs to consider compliance rates in each state (e.g., anecdotal evidence for PA suggests compliance/knowledge of state regs is low, and this should accounted for when assigning efficiencies to acres). Along the same lines, Tier 2 N efficiency is largely based on improved timing/split application. Before getting credit for Tier 2, states need to clearly demonstrate improvement over Tier 1 (ie., that a certain % of farmers/acres are doing split application), particularly in light of the CEAP findings about low rates of appropriate timing, especially with manure. And for example, assuming that implementation of 590 standard nutrient management plan is equivalent to Tier 2 is not sufficient. [CBF]

Nitrogen and Phosphorus Reduction Credit Must Be Adjusted to Account For Compliance Rates. The draft Nutrient Reduction Efficiencies overestimate nitrogen and phosphorus reduction by assuming that all farms required to have a Nutrient Management Plan will actually have them, or those that do have them will implement the plan as written. Such an optimistic approach fails to recognize the current reality of spotty implementation. In 2013, the USDA Conservation Effects Assessment Project (CEAP) examined the extent of basic nutrient management on fertilized land in the Bay Watershed.[1] For nitrogen, only 7% of acres met all nutrient management criteria in 2011.[2] This was a decline from 13% in 2003-2006. For phosphorus, only 21% of acres met all nutrient management criteria.[3] Studies also show that many Nutrient Management Plans are not fully implemented, that rates of non-compliance are high, and that practices are not always implemented optimally. In 2010, a University of Maryland survey found that, of farms that chose to respond, 36.9% of those required to have Nutrient Management Plans did not even have them.[4] This number is likely low, as it only represents farms that chose to respond to the survey. While many of these farms may have adopted some sort of Nutrient Management Plans in

the past five years, a 2015 Journal of Environmental Quality article recently found that non-compliance with existing plans is even higher across Delmarva. Sixty-one percent of farmers interviewed in Maryland, Delaware, and Virginia expressly or impliedly stated that they are not adhering to their Nutrient Management Plans.[5] We applaud Maryland for not reporting all Nutrient Management Plans acres to the Bay Program for Tier 1 credit as a result of demonstrated non-compliance. However, all of the states should adopt a consistent and conservative approach based on actual Nutrient Management Plan compliance rates. Without specific information on Nutrient Management Plan compliance rates in each state, the proposed Nutrient Reduction Efficiencies should assume at least as much non-compliance in other states as has been demonstrated in Maryland. This can be done by including a "non-compliance adjustment" in the efficiency calculations. It is critical that the proposed Nutrient Reduction Efficiencies adjust for the lack of Nutrient Management Plan implementation. Without this adjustment, the proposed Nutrient Reduction Efficiencies will over- estimate phosphorus and nitrogen reduction. Over-estimating the nitrogen and phosphorus reduction will cause a gap between estimated and modeled nutrient reduction and actual water quality improvements. To avoid this, these Nutrient Reduction Efficiencies must be adjusted to reflect the realities of current levels of compliance and implementation. [CCWC]

The Panel should adjust nutrient reduction credits to account for known rates of non-compliance with nutrient management plans. The NM Efficiencies also fail to account for significant, well-known rates of Nutrient Management Plan ("NMP") non-compliance. Even if the Panel does not specifically address verification to improve the accuracy of the credited practices and, in turn, the Watershed Model, the Efficiencies should adopt a conservative approach with regard to NMP implementation. In general, full implementation of nutrient application management is rare. A recent survey by the USDA Conservation Effects Assessment Project (CEAP) examined the extent of basic nutrient management (appropriate rate, timing, and method) on fertilized land in the Bay Watershed.[1] For nitrogen, only 7% of acres met all nutrient management criteria in 2011.[2] This was a decline from 13% in 2003-2006. For phosphorus, only 21% of acres met all nutrient management criteria.[3] The extent of nutrient application management may be higher in the subset of farms with NMPs, but studies have shown that many NMPs are not fully implemented, that rates of non- compliance are high, and that practices are not always implemented optimally. For example, a 2010 University of Maryland survey found that, of farms that chose to respond, 36.9% of those required to have NMPs did not even have them.[4] This number is likely low, as it only represents farms that chose to respond to the survey. While many of these farms have likely adopted some sort of NMP in the past five years, a 2015 Journal of Environmental Quality article recently found that non-compliance with existing plans is even higher across Delmarva. Sixty-one percent of farmers interviewed in Maryland, Delaware, and Virginia expressly or impliedly stated that they are not adhering to their NMPs.[5] The Panel has indicated that Maryland alone has chosen not to report all NMP acres to the Bay Program for Tier 1 credit as a result of demonstrated non-compliance. While this is commendable, the Panel should require all of the Jurisdictions to adopt a consistent and conservative approach. If the other Jurisdictions lack basic research on NMP compliance rates due to a lack of verification practices, the Panel should presume that they have at least as much non-compliance as Maryland, rather than permitting them to report NM Efficiencies based on an assumption of perfect compliance. The Panel should incorporate this revised presumption into the Efficiencies directly by including a "non-compliance adjustment" in the efficiency calculations, and should represent it in Table

7. The estimated non-compliance rate should be based on existing research, such as the Maryland and Delmarva studies cited herein. Although the Panel has already adopted a conservative methodology to address other NM Efficiency uncertainties, such as the 75% adjustment to apply a plot-scale measure to the watershed scale, these existing adjustments do not adequately address the uncertainties that arise from unknown—but likely high—rates of NMP non-compliance. [EIP]

Compliance Response: See CEAP response below. In addition the Panel was not charged with determining the extent of compliance of NM BMPs. The recommendations in the report should apply to compliant NMPs as they are categorized into tiers based on the non-visual indicators presented in section 6.1. Management Variability adjustments also capture a BPJ estimate of real world non-compliance within the Bay watershed and are specific for different tier components due to the nature of interaction with the component to physical challenges in different locations.

Membership

Not all of these members participated in the 2015 efforts, would suggest those that did, be distinguished somehow. [CBF]

Response: This is not consistent with the BMP Protocol, but participating members from each meeting are summarized in the meeting minutes appendix with the members' affiliation.

Table 3: 2014 Report

Were not concerns about this proposal and associated concerns about its basis in Tier 1 the reason the panel was reconvened in 201? Note it was not" approved" in 2014. [ATS]

Response: The unapproved 2014 report was not approved for a variety of concerns and comments addressed and redressed by the Panel in meetings and webinars.. The comments related to the multiplicative nature of tiered BMPs were addressed wholesale with the complete revision and subsequent July 2015 recommendation.

Tables 4 and 8

Commenters noted that Table 4 is incorrect and should be updated to match Table 8.

Response: Table 4 (revised and pasted below) reviews the multiplicative calculation of the recommendations as they are to be interpreted by the Phase 5.3.2 CBWM. Table 8 is a review of the final recommended efficiencies derived in Table 4. Table 4 was missing a Tier 1 line for HYW including pass-through load resulting in a different initial load for Tier 2 (HYW). This table was revised to reflect this difference. Tier 3N in Table 4 also had a typographical error citing the wrong initial load and both the pass-through load and combined efficiency have been updated to be consistent with Table 8.

Practice Tier	Stand-Alone Efficiencies	Initial Load	Pass-Through Load	Combined Efficiencies
1N	0.0925	100	90.75	9.25%
1P	0.1	100	90	10.00%

1N(HYW)	0.05	100	95	5.00%
2N	0.039	90.75	87.2108	12.79%
2N(HYW)	0.028	95	92.34	7.66%
2P	0.066	90	84.06	15.94%
3N	0.028	87.2108	84.7689	15.23%

Alternate Tier Proposal

- **Recommend merging Tier 1 and Tier 2 into Basic Nutrient Management (BNM) that represents state requirements, NRCS standards and technical expectations**
    - BNM should require application of the "4Rs" and use of a P risk assessment tool
    - Since Tier 1 P reduction should be negative (see above), propose assuming it equals 0 and subtracting 10% from current Tier 2 P BNM efficiency.
    - BNM N recommended at 9% (round efficiency to whole number - "significant digits"?)
        - Actual difference between proposed Tier 1 and Tier 2 N reductions is unclear
        - 4Rs for N use has been the NM expectation since before 4R term was coined
    - Define BNM as N application based on LGU recommendations and use of 4R approach with 9% N efficiency; use P risk assessment tool with 7% P efficiency
        - Tier 2 had 6.6% P reduction. Whole number rounding makes it 7%. [ATS]

Response: The Panel recognizes this alternative approach as supportive of the method for estimating credit for P risk assessment. The Panel disagrees with the comment suggesting Tier 1 P as a negative reduction due to the reduction in P applied as manure from the 2013 CBWM simulation as explained in the general Tier 1 response above. Significant figures was discussed as a panel, but rounding was abandoned to prevent miscommunication of adjustment results and comments about applicability in the stacking summary provided in Table 4, for which no rounding was advised by the CBPO Modeling Team.

Differences between Tier 1 and Tier 2 N are summarized in Section 6.1, where differences are highlighted in bold as the Panel itemized elements of Tiers 1, 2 and 3 non-visual assessment. The LGU recommendations related to the 4Rs have adapted over time including during the CBWM simulation period, so the Panel has recommended these distinct eras be separate in their definition and efficiency as outlined in the report.

- **Recommend Tier 3 be renamed "Advanced Nutrient Management" (ANM) and the Ph. 6.0 EP be charged with defining/developing efficiencies for different ANM practices**
    - Explanation needed why five different N rate practices have the same efficiency in Tier 3.
    - PSNT has been in use since before 2000 and should be part of BNM when manure is applied (perhaps CSNT should as well) rather than a Tier 3 practice
    - Variable rate application is a different practice/technology and should have a different efficiency or be omitted until adequate data available for efficiency estimate

    - The reason for the apparent decision not to include an efficiency for reducing N application rate is unclear. The nitrogen response curve in the report (p 25) illustrates the level of knowledge of response and N losses of row crops, particularly corn, to N applications. Knowledge of response to decreased N application is sufficient for an efficiency estimate, compared to basis for other estimates in report
- Checklist for determining Implementation was in the EP charge and is included on p 61.
    - This needs to be revised to address changes to BNM and ANM levels [ATS]

Response: Tier 3 utilizes tests or in-field variability to determine adaptive N application rates. While these components are advanced, the panel feels Adaptive is more representative a title for these practices. Five components with individual reduction rates from literature were averaged to consolidate reporting framework difficulties within the states for the lifespan of P 5.3.2 CBWM. See also Tier 2 Justification comments. Tracking and reporting each of these components is too burdensome and specific to warrant such a recommendation. The Panel does not intend to change any non-visual indicators of the Tiers as a result of declining the proposed Basic NM and Advanced NM BMPs submitted via comment.

Geographic considerations

Overall, understand comment but provides opportunity to ask why "edge of stream" loads are so much lower below the fall line (in the coastal plain) than above the coastal plain. Probably related to lack monitoring and calibration approach but IS CAUSE OF LOW MODELED LOADS, PARTICULARLY FOR P IN DELMARVA POULTRY REGION COMPARED TO SHENANDOAH AND LANCASTER. [ATS]

Response: The Panel's recommendation is limited to the literature surveyed and best professional judgment considerations to adjust literature values to those more applicable to the CBWM framework and the cause of modeled loads (specifically located in the Coastal Plain and/or DELMARVA) was not in the purview of the original AgWG's charge nor the revised charge from January 2015.

Tier Definitions

Better explanation of farm level vs. field level is needed if important in differentiating between Tier 1 vs 2 and 3. Depending on perspective are not all three field level (or farm level)? [ATS]

Presence of a plan does not indicate/document implementation; see both CEAP reports. How do you verify it? *[Tier 2 definition]* [ATS]

Why would this not also be required for Tier 1 if it is allowed to remain (which should not occur)? *[Formal NM planning recs for Tier 2]* [ATS]

Response: Not all the Tiers are related to field level application of estimated or reasonably expected yield. A tier 1 plan would provide one estimate for each crop and the resulting rates of N and P depending on the nutrient source (P different for manure v fertilizer). A tier 2 plan would have independent yield estimates for each field based on soil tests of each field or productivity class estimations for each field in the absence of a soil test, so on a farm with 4 fields of corn a Tier 1 plan has one corn rate and a Tier 2 plan has 4. A Tier 3 plan could have variable rate applications in all 4 fields or

4 rates that have been adaptively managed based on the results of in-season or previous season testing, this is a significantly different level of effort from Tiers 1 and 2.

A plan is expected to be verified by state procedures in accordance with their QAPPs, approved by EPA. The Panel recognizes that current efforts to verify the actions in the plan are occurring in the field are not resulting in reducing the number of acres reported in a measured way to the CBPO, but the panel has provided estimates of management variability and adjusted the recommendations based on the likelihood that some producers cannot or do not follow the intent of the plan during some years. These estimates are manifested as an adjustment in Table 7, but are based on best professional judgment, so they include tacit knowledge and estimation that the AgWG entrusted the Panel to perform upon formation, consistent with the BMP Protocol. The Panel's response to comments regarding the CEAP report is discussed in the next subsection.

CEAP

When considering how many acres that Tier 1 or Tier 2 should be applied to, we think some consideration needs to be given to the CEAP data regarding rate and timing: For example, CEAP reports that:

- 54 % of cropped acres met the criteria for timing of N applications; 58% for P applications on all crops. However, for manured acres only, these percentages drop to 16% and 17%, respectively.
- Only 35% of cropped acres met criteria for application rate for N; 37% for P on all crops. However, for manured acres only, these percentages drop to 30% and 19%, respectively. [CBF]

Report refers to millions of acres of land implementing NMPs but two recent CEAP reports conclude that NMP implementation is about 12%. Recommend report include NM findings from the two CEAP reports and explain differences between report and CEAP findings, or remove report statements. Although not directly part of panel charge, differences between CBP and CEAP estimates of NM implementation need to be explained and this panel has the expertise to do so. [ATS]

Response: The Panel has concluded that the applicability of the CEAP results suggesting that only 12% of NMPs are followed without exception is not related to this recommendation. The Panel instead sought to credit actions in a plan that are related to nutrient reduction outcomes in the application of nutrients to land and not portions of written NMPs related to tillage, waste management, storage, handling or any management of grazed land or other conservation practices. These elements could all be considered as part of a plan that was not followed in the perception of CEAP surveys and reports. The Panel also considered that the CEAP report is based on a voluntary survey tool, which was originally developed outside the watershed and has different results between the original and most recent reports, which the Panel deemed worthy of excluding it from our final recommendations. The opinion of the Panel is that CEAP, while scientifically performed and published is not applicable to our recommendation because it has a different purpose than the interpretation of its results as being indicative of compliance with conservation practices reported by the States to the CBPO. See also, the response to comments related to verification above.

Pathways of Nutrient Loss

Are the implications different for N and for P? Also, didn't you partially correct for this in your application of adjustment factors? If so, it would be worth explaining that again here (briefly). [EIP]

Response: Phosphorus recommendations were based on a model simulation of surface and subsurface losses. Nitrogen reductions were calculated from literature values as reduced application of PAN from prevented volatilization or decreased leaching potential from split applications of nitrogen. The Panel understands that preventing volatilization conserves N in the field, but conserving it as PAN reduces the total application rate and the reduction of PAN prevents more pollution than the quantity conserved. Additionally, the inhibition of N loss is enhanced by more efficient plant uptake or denitrification due to split applications. The diminished leaching potential due to Tier 2 N manure incorporation is more than offset by the exclusion of setbacks as a quantified contributor to the efficiency and the benefits of split applications

General Comments

Comments/responses to questions often include "will be addressed by Ph. 6 panel". It is appears both Ph. 5.3.2 and Ph. 6.0 will be running similar scenarios during 2017 (2018?).

- Will that panel not use the Ph. 5.3.2 EP report as basis/starting point for their work?
- If efficiencies in current report are revised similar to recommendations above, based on science, major reversals in progress estimates from Ph. 5.3.2 should occur.
- Other possible changes, such as land use load increases "below fall line" would also increase total load to Bay (as not previously included in load) or reduce estimated progress and magnify progress reversals.
- Past history and policy responses in general indicate that reporting reversals or "negative progress" on any effort, even if due to improvements in science, data or experience are unlikely to occur.
- It is imperative that as many changes as possible that may result in progress reversals, including changes to the NAM report, be included in Ph. 5.3.2 model, BMP definition, efficiencies and scenario protocols. Concern over impacts on calibration or other "model world" issues should not preclude this from occurring. Failure to do this in Ph. 5.3.2 will create immense confusion and controversy if done in Ph. 6.0, but more likely will assure that no changes in net progress will result from Ph. 6.0. [ATS]

Response: The Phase 6.0 Panel will be an independent process and the recommendations of that Panel will be based on a different set of landuses, acres of crops, nutrient mass balance and verification protocols.

The efficiencies in the report will not be revised consistent with any comments provided. The current recommendation is scientifically sound, consensus approved and has been provided to the AgWG and CBP Partnership consistent with the BMP Protocol elements the AgWG has advised we adopt from the various generations of the Protocol produced during the tenure of this Panel.

The Panel considered and decided not to adopt any comments related to changes in efficiencies, landuses or adjustment factors in Table 7. This is due to the robust review performed on available literature, consistency in recommendation adjustments with other approved panel reports, lack of evidence provided in popular literature cited by commenters to rebuff the science presented in the report

and disbelief that any recommendation in this report would be reduced or discounted in future versions of the CBWM, given the same framework of parameters and assumptions.

The Panel does not expect any progress reversal as a result of the recommendations for the longevity of the Phase 5.3.2 CBWM. The Tier 1 recommendation is consistent with the BPJ of the model outcomes and is also consistent with the Phase 5.3.2 CBWM calibration. Violating the calibration was not recommended or needed to produce Tier 2 and 3 recommendations.

In review of the "Definitions and Recommended Nutrient Reduction Efficiencies of **Nutrient Application Management** for Use in Phase 5.3.2 of the Chesapeake Bay Program Watershed Model", I see no items that I would dispute.

I follow the rationale of the several discussions that end with this science issue should be consider for WSM6.0 (Adapt-N, Tier 3 P) or be a separate BMP under WSM 6.0 (manure application, application timing).

I would agree with the challenge and recommendation of the "scale issue".

1. Agronomic research primarily focuses on available nutrients in the root zone versus environmental nutrient loss.
2. This agronomic research does not relate well to the WSM 5.3.2 calibration at EOS.
3. If WSM 6.0 does calibrate based on EOF loads, the agronomic research maybe more viable.
4. Unfortunately, there is limited EOF monitoring data in the CB for nutrient loads or individual BMP efficiencies.

Another concern is the scale issue, or the point-of-measurement problem. This arises because the data available for estimating nutrient efficiencies are at the edge-of-field scale, or the bottom-of-root-zone scale, but the CBPWMs assume an edge-of-stream estimate. The inclusion of ecosystem effects (natural riparian zones, wetlands, etc.) and geologic processes (ground water lag times, storm water transport, etc.) between the edge-of-field or bottom-of-root-zone and the edge-of-stream is very complex, but ecosystem effects and geologic processes are also areas that have little or no existing data.

Therefore, there is a critical need for science-based, water quality BMP efficiency data based on research that is conducted at the appropriate scale with modern cultural practices. Such data would benefit virtually all of the Chesapeake Bay partners and stakeholder communities. The Panel suggests that this critical need be discussed and evaluated by appropriate Federal and State agencies to determine if a major Bay Watershed research program could be developed to fill this important data gap, and thereby provide more science-based estimates of BMP nutrient efficiencies that would benefit the entire Bay Partnership.

Finally, the insight on science-based efficiencies are very real. Both farmers & watershed researchers desire to implement nutrient bmps. But ask: show me the data on effectiveness and we will adopt?

i) The agriculture community, who have repeatedly asked the question "If I adopt a particular BMP, how do I know it will improve water quality?" (i.e., show me some water quality data and I'll consider the BMP);

ii) The environmental community, who have similar concerns about BMP efficacy, but also have an additional concern regarding "How do I know the BMP has been implemented and is operating properly?" (i.e., show me some verification data); and

iii) The policy-making community, who will have other concerns about "How do I track the BMPs and how do I compare or weight the BMPs so the ones applicable to my State receive priority support?" (i.e., where do I invest my limited resources to get the best return?). [ACI]

Response: The Panel agrees with this thoughtful and supportive comment. The questions above have been interpreted as being addressed to a community beyond the Panel and suggest they be considered by the larger CBP Partnership as a result of this report.