FWG Responses to USWG Comments -- Compiled

Comments Received from the District of Columbia (DOEE)

I wasn't able to join the call on Monday, but I did think it important to let you know that the District supports the proposal to use tree canopy as a land use in the model. The issue that I discussed in my email (below) is one that is important, but can be dealt with over time. I apologize if my email gave the impression that the District did not support this proposal. That is not the case.

I have reviewed the tree canopy literature review and presentation. I found it to be a useful overview of the science and it will help DOEE in estimating the benefits of the District's tree planting efforts. My one concern in developing a load reduction associated with tree canopy is the continued tenuous connection between tree planting and tree canopy. The District, along with all other jurisdictions, has very poor data on the number of trees removed annually because much of the tree loss occurs on private lands and there is currently no way to track it. However, we have excellent data on the number of trees planted. This leads to what must be over reporting to the Bay Program in terms of tree canopy increases. It is of course more accurate to utilize satellite or lidar data to determine canopy however this is problematic as well in that:

1) This data is not collected annually (which is a political issue for reporting); and
2) The methodology for analyzing the data changes frequently (which makes it difficult to have consistent canopy data).

The bottom line is that although the analysis is well done, I believe there is a large hole in how to translate the analysis into a useful tool for jurisdictions to report load reductions.

This comment mainly deals with how the Tree Canopy land use would relate to annual reporting of new Tree Canopy as a BMP. This is an important issue that was intentionally not addressed in the Expert Panel's Technical Memo because they were asked to give a timely recommendation on loading rates before finishing their Final Report this fall. The Final Report will include recommendations for the Forestry Workgroup and other CBPO stakeholders to consider regarding annual BMP credit for new acres of Tree Canopy. The Forestry Workgroup's recommendation at this time (pending consideration of the Expert Panel report) is that new (planted) acres of Tree Canopy should continue to be tracked and reported as an annual BMP between land use updates. The Forestry Workgroup commits to working with CBPO partners on this issue between now and the final calibration in 2016 to come to a decision on how Tree Canopy will be treated as a land use and annual BMP.

The question about methodology for Tree Canopy change analysis will be an issue for multiple land uses given the future use of Bay-wide high resolution imagery updated periodically going forward. The Land Use Workgroup and Forestry Workgroup will work with CBPO stakeholders to develop a sound methodology that incorporates sufficient consistency to enable effective land use change analysis for Tree Canopy and other land uses.

Comments Received from Maryland (MDE)

Our position on this BMP/land-use is that UTC should be included in this calibration of the model. We believe that including tree canopy in the model will be a valuable addition, and that including it in this iteration of the calibration will enable us to see whether this is a workable enhancement. Based on what comes out of this calibration we will be able to make a better informed decision about whether this should be included in the future. However, the tree canopy Expert Panel will need to be formally approved before the Phase 6 model is finalized.

The FWG agrees that it is important to include Tree Canopy in this Oct. 1 calibration, because it is the only way the modeling questions raised by the partners can be explored and addressed. We propose that the Tree Canopy land uses and loading rates be revisited by the WQGIT prior to final inclusion in Phase 6 after there has been time for full review/approval of the Expert Panel Final Report and time to work with the jurisdictions on the other modeling questions raised based on the Oct 1 calibration with Tree Canopy included.

Here are some thoughts and questions regarding the proposed loading rates:

Land-Use vs. BMP – What is UTC considered in the modeling world? Is it a land use or a BMP? Right now it seems to be a hybrid that is assessed spatially like a land use, but has the reduction efficiency of a BMP, in order to set the target loading rate. This is OK. We liked the term overlay that was used in the past, but it would nice to see this definition formalized.

According to the modelers, there is not an either/or distinction between some land uses and BMPs There are preferable land uses such as forests, wetlands, even hay over corn – for environmental benefits. Impervious is the opposite - a condition to avoid across all sectors, not a BMP. These preferable land uses are "credited" in the model based on their lower loading rates (e.g. Forest, Open Space), and there are BMPs that are credited based on converting acres from a higher loading land use to a lower loading one (e.g. Land Retirement BMP converts higher loading Crop or Pasture acre to the lower loading "Hay without Nutrients" land use). The Forestry Workgroup envisions the Tree Canopy land use working in this way – existing mapped acres are incorporated into the model as a land use and newly planted acres could be reported annually as a BMP (land use conversion from turf or impervious to Tree Canopy) between land use updates. That said we will consider recommendations from the Expert Panel Final Report on the question of BMP credit, as well as additional input from the CBP partnership.

Sector Targets – How does UTC interact with the sector and land use targets? I'm guessing that the sector targets will remain constant, but that the loads in the urban and natural sectors will be shuffled around to accommodate UTC.

YES - The sector loading target for Developed lands as a composite will remain the same, but the loading ratios of the Developed land use classes will be adjusted to account for tree canopy benefits. As a result, the land uses without tree canopy (turf, impervious, etc.) would be slightly higher and the land uses with Tree Canopy would be lower based on the Expert Panel's recommendations (18.5% reduction N, 17% reduction in P and TSS). The table below shows the proposed developed land loading ratios

before and after Tree Canopy is incorporated. Column 2 simply applies the reductions to the pre-existing loading ratios that were approved by the Urban Stormwater Workgroup based on the Tetra Tech analysis of developed land loading rates. Column 3 (recommended) revises the Tetra Tech-based loading ratios to ensure that the effects of Tree Canopy are not double counted. Thus, the land uses without Tree Canopy have a slightly higher loading ratio than they did before (increased by ~.02).
(Revised loading ratios provided by Olivia Devereux)

TN Relative Loading Rate

Shown on MS4 land uses, the same relative differences will be on CSS and non-regulated. Shown here with the draft acres for regulated.

Land Use	original	no adjustment	adjusted
MS4 Tree Canopy over Turfgrass	-	0.39	0.41
MS4 Turf Grass	0.48	0.48	0.50
MS4 Tree Canopy over Impervious	-	0.82	0.83
MS4 Roads	1.00	1.00	1.02
MS4 Buildings and Other	0.79	0.79	0.80
MS4 Construction	1.19	1.19	1.21

TP Relative Loading Rates

Shown on MS4, the same relative differences will be on CSS and non-regulated. Shown here with the draft acres for regulated.

Land Use	original	no adjustment	adjusted
MS4 Tree Canopy over Turfgrass	-	0.83	0.85
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MS4 Buildings and Other	0.79	0.79	0.82
MS4 Construction	3.89	3.89	3.92

Data – More empirical data would improve our understanding of the land-use loading rates. We looked into the studies that are being used to determine the loading rates, primarily the Wang 2008 study. It appears that the modeled surface runoff reductions in the study (which is the primary basis for the 17% reduction in TN, TP, and TSS - with a bump up for TN to 18.5% due to nutrient uptake and interflow loads) are based off of a 1969 study that looked at the rainfall interception rates for conifers in England, but the results of which did not apply to deciduous trees (modeled interception rates did not match observed data for deciduous trees). However, a lack of data doesn't necessarily mean that we should not attempt to model UTC—the ESC Expert panel set a solid precedent for defining loading rates based on one or two old studies—but more research should be conducted and/or empirical data collected to define the rates.

We're not sure what literature this comment is based in but are happy to discuss it further when the Final Expert Panel report goes through the CBP review/approval process. The Wang study uses the widely utilized and peer-reviewed UFORE-Hydro model (now part of iTree tools) for modeling canopy interception, which takes into account differences in deciduous and evergreen trees and incorporates a seasonally varying leaf area index.

That said, we welcome the opportunity to get additional input that may refine the loading rates as the Final Expert Panel report goes through official CBP review process prior to the final Phase 6 Calibration.

Relative Loading Rates - It would make sense that the loading rate for UTC should fall in between undisturbed forest and the land use that is being covered by canopy. Of particular concern is turf, as it would not make much sense for turf with ESD and UTC to have a lower loading rate than undisturbed forest. Unless there is substantial empirical evidence supporting it, it would seem illogical that tree canopy covering a managed understory would be ecologically better than tree canopy over an unmanaged understory. This is not to say that a loading rate shouldn't be lower than forest, but there would need to be a lot more evidence than we currently have.

Per the Phase 5.3.2 watershed model, using the current reduction rates for tree canopy, canopy over urban pervious with ESD would result in a lower loading rate than forest (see the following calculation example, which uses MD statewide average unit loads and reduction efficiencies). These rates will obviously change per the Phase 6 model, so it is unclear what the effects of canopy will be at the current reduction rates in Phase 6. However, the target rates should be adjusted to ensure that scenario below does not occur.

MD No Action Forest EOS TN Unit Load = 3.08 lbs/ac/yr

MD No Action Urban Pervious EOS TN Unit Load = 10.78 lbs/ac/yr

ESD to the MEP TN Removal Rate = 72%

Canopy Cover TN Removal Rate = 18.5%

Canopy Over Urban Pervious with ESD TN Load = 10.78 lbs/ac/yr * 0.28 * 0.815 = 2.5 lbs/ac/yr

We agree and appreciate MDE taking the time to do a preliminary assessment of this possible scenario. This is why it is very important for us to have a "testing" period with the proposed Tree Canopy loading rates incorporated into the Oct. 1 calibration, so that these potential issues can be teased out and modifications can be made to address them. At the end of the day, it's important to look at the big picture and compare loading rates among the sector LU categories to see if it all makes sense. If not, there needs to be adjustments.

One last point, and one that was raised during the USWG call, it warrants some further explanation as to why canopy over impervious surface receives the "bump-up", if the rationale is based on a reduction in loading from interflow---especially in areas with a high degree of impervious.

This question will be taken back to the Expert Panel for consideration in their Final Report. The Forestry Workgroup preliminary stance on the issue is that it makes sense to remove the additional 1.5% N

** COMMENTS WERE ALSO RECEIVED FROM MD STATE HIGHWAY ADMINISTRATION

The MD SHA comments are directed at the scientific rationale in the Expert Panel Technical Memo and Literature Synthesis, and we propose that these should be provided to the Expert Panel for consideration as they're completing their Final Report. If questions remain after the Expert Panel Final Report is released, they will be addressed through the formal CBP review/approval process.

Comments Received from Pennsylvania (PA DEP)

Following the conference call on Tuesday, September 15, DEP staff from the Urban Stormwater Workgroup reached out to DEP and DCNR staff on the Forestry Workgroup in order to gain a better understanding of the Tree Canopy Expert Panel's recommendations. We also wanted to ensure that we would be communicating the same thoughts on the proposed land use recommendations. These staff met on Monday, September 21 to discuss; the mutual comments and concerns identified below are the result of that discussion.

1. Conceptually, Pennsylvania supports the recommendations. Through canopy interception, transpiration, and improved infiltration, trees help to reduce storm water runoff in urban and developed areas. Accounting for these benefits acknowledges the load reductions that trees provide and also helps to promote additional benefits of trees in urban areas such as increased property values, energy efficiency, climate mitigation, aesthetics, and human health benefits.

The Forestry Workgroup appreciates Pennsylvania's provisional support for including the Tree Canopy land uses in Phase 6 and is committed to working with the CBP partners on addressing the below questions prior to its inclusion in the final Phase 6 calibration.

2. As with any change to the Bay Model, we need to be sure that we understand how the load reductions will be calculated and applied. As such, we have the following comments:
a. Could the Bay Program produce an example of how the land use designations would be calculated and applied in the model, based on the high-resolution photography pilot currently occurring in Virginia?

We will work with the Land Use Workgroup and modeling team to provide a "pilot" example of how the new land use classes and loading rates will affect model outputs for a given area. Maryland has the most complete high resolution Tree Canopy dataset at this time, so that may be the best pilot area to use, but this can be discussed further among partners. The only way we can do this assessment is to include the Tree Canopy land uses and loading rates in the Oct. 1 calibration and use it as a "testing period" to assess impacts and address issues and concerns before final calibration.

b. During the Forestry and Urban Stormwater Workgroup conference calls, it was explained that acres would be calculated on the area directly beneath tree canopies and the appropriate load reductions applied to those areas. Is there any relationship among these two new designations and the existing land use classes? Will loading rates be affected in any of the other land uses by incorporation of the new tree canopy classes? For example, if load reductions are shifted to other land use classes, what does this mean; will jurisdictions be responsible for the increased loading?

The sector loading target for Developed lands as a composite will remain the same, but the loading ratios of the Developed land use classes will be adjusted to account for tree canopy benefits. As a result, the land uses without tree canopy (turf, impervious, etc.) would be slightly higher and the land uses with Tree Canopy would be lower based on the Expert Panel's recommendations (18.5% reduction N, 17% reduction in P and TSS). The table below shows the proposed developed land loading ratios before and after Tree Canopy is incorporated. Column 2 simply applies the reductions to the pre-existing loading ratios that were approved by the Urban Stormwater Workgroup based on the Tetra Tech analysis of developed land loading rates. Column 3 (recommended) revises the Tetra Tech-based loading ratios to ensure that the effects of Tree Canopy are not double counted. Thus, the land uses without Tree Canopy have a slightly higher loading ratio than they did before (increased by ~.02). (Revised loading ratios provided by Olivia Devereux)

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c. It is our understanding that the intent is to re-fly in 5 years. How will changes in the tree canopy affect the model in the future? Does the Chesapeake Bay Program plan to provide a timely update of this data within the model?

As with all other mapped land uses in the model, Tree Canopy land use data will be updated when the next round of high resolution data is available. Our understanding is that the CBP partnership has committed to periodically updating this high resolution imagery for future updates to the model and many other purposes, though the mechanism for that is still being worked out.

d. What are the implications if tree canopy decreases after the baseline calculation? Even though we have a strong tree planting program, development pressure continues to increase.

Just as has been the case with the Forest land use and others, when the land use is updated, acres of Tree Canopy that have been converted to turf or impervious will have that higher loading rate. This is an important reason for explicitly including canopy categories in the simulation – to be able to quantify the benefits and consequences of gains and losses – in terms of loads and water quality. As such, it also provides an incentive for communities to protect the tree canopy they have and make up for losses as much as possible.

e. If trees are planted and "counted" as a BMP, how does this activity relate to the new classes and associated load reductions?

The Expert Panel will be making recommendations in their Final Report regarding BMP credit for newly planted acres of tree canopy, for the Forestry Workgroup and CBP's consideration. The Forestry Workgroup's recommendation at this time (pending consideration of the Expert Panel report) is that new (planted) acres of Tree Canopy should continue to be tracked and reported as an annual BMP between land use updates.

Again, if tree canopy is helping to reduce storm water and associated loads, we support the inclusion of the new land use designations. However, we need to fully understand the accounting and application in the model in order to agree with the proposed recommendations.

Comments Received from Virginia (VA DEQ)

Thank you for the opportunity to comment on the proposal to establish a Tree Canopy Land Use, which was discussed at the September 14 Urban Stormwater Work Group meeting. The Commonwealth does not support the establishment of this land use and proposes that it should not be passed on the Water Quality GIT. The key reasons for this position are enumerated below.

I have attached staff's detailed comments on the proposal. The following are the Commonwealth's three main concerns with the establishment of a tree canopy land use:

1) There are an inadequate number of relevant studies that support the establishment of a separate land use with unique loading rates. Many of the studies cited by the expert panel were conducted outside of the country. There were very few studies actually conducted within the Chesapeake Bay watershed.

We respectfully disagree and affirm that the Expert Panel should have an opportunity to consider and respond to the questions raised as they prepare their Final Report and as the Final Report goes through the official CBP review process prior to the final model calibration. We assert that there is sufficient scientific support to justify unique loading rates for Tree Canopy and are open to further refinement of the Panel's proposed loading rates with the benefit of additional time for partnership review and input.

2) The establishment of this land use will cause confusion at the local level in that localities across the Commonwealth currently have large inventories of urban BMPs that are treating areas that contain urban tree canopies. Will these localities or the state now need to separate out the tree canopies from those treated acres? If the loading rate for tree canopies is reduced, will loading rates for remaining urban lands need to be recalculated for the model simulation? Will the efficiencies of urban BMPs need to be reevaluated?

Will these localities or the state now need to separate out the tree canopies from those treated acres? No. Per Jeff Sweeney - As with all 150+ BMPs reported for credit in the model, there's no requirement for BMPs to be reported with the most-detailed LU category the BMP applies to. As is the norm for reporting BMPs on other land uses, jurisdictions can choose to report their urban BMPs with a land use specified (if known) or if not specified, the BMPs will be proportionally distributed over the urban land uses. Thus, it does not need to add to their reporting requirements. The benefit is that local jurisdictions will now have a more accurate accounting of their tree canopy and its water quality benefits to encourage good management.

The aggregate loads for the Developed sector as a composite will not change, but the allocation of the loading among the land uses will shift to incorporate Tree Canopy. The table below shows the proposed developed land loading ratios before and after Tree Canopy is incorporated. Column 2 simply applies the reductions to the pre-existing loading ratios that were approved by the Urban Stormwater Workgroup based on the Tetra Tech analysis of developed land loading rates. Column 3 (recommended) revises the Tetra Tech-based loading ratios to ensure that the effects of Tree Canopy are not double counted. Thus, the land uses without Tree Canopy have a slightly higher loading ratio than they did before (increased by ~.02). (Revised loading ratios provided by Olivia Devereux)

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3) While the new high resolution land use data may provide a reasonable snapshot of tree canopy area at the time of the imagery, the forecasting and hindcasting to establish tree canopy acres for each year through the calibration period would require significant assumptions, introducing additional uncertainty in the model.

Forecasting and hindcasting land use data is a common issue for almost all LU's in the urban sector and is not unique to the Tree Canopy land uses. The Land Use Workgroup has developed methodologies that yield reasonable estimates for the purposes of the model calibration. The Land Use Workgroup is providing a separate memo responding to these and other tree canopy mapping concerns. We assert that using the best available data to account for Tree Canopy is a more accurate depiction of reality in the model than not mapping and accounting for it at all.

In addition, we would like it noted that the USWG has had only two weeks to review the materials in support of the proposed tree canopy land use. It is our view that an action that has important implications for the Bay model and may also result in policy implications at the state and local level should involve more time and consideration.

We agree that additional time for review by the partnership is needed, and that the best way to assess the various questions raised is to include Tree Canopy land uses in the October 1 calibration to allow for additional "testing" of its impact and modeling questions, and to allow for the final Expert Panel Report and loading rates to go through full partnership review.

NOTE: Virginia also submitted a set of comments (see below) focused on the Expert Panel Reports, but we leave it to the Panel to consider and address those questions in their Final Report and in the partnership review process.

Comments Received from West Virginia (WV DEP):

Want to let you know that from the WV perspective, we support the tree canopy land use proposal. While there are certainly issues that need resolved it is important to give trees, one of our most effective natural stormwater management tools, proper credit. Accurate reflection of actual land

uses in the model is difficult, but it should not be a reason to limit evolving/identifiable land uses. With the timing of Model 6, incorporation/adoption of land uses and land use modifiers is urgent.

We agree and appreciate the supportive comments.

No comments were received from New York or Delaware.

Virginia Detailed Comments

FWG notes that the Expert Panel will be able to clarify and address many of these questions as they develop their Final Report and as it goes through the partnership review process. The mapping questions at the end should be addressed by LUWG/Peter Claggett as it will be working with the contractors over the next year.

DEQ staff has reviewed the technical memo, literature synthesis, and presentation to the CBP USWG produced by the CBP Tree Canopy Expert Panel and Forestry WG and has the following questions and concerns:

- The panel investigated and reported on several documents related to natural forest and runoff associated with and without disturbance. Natural forests disturbed or not do not seem a good surrogate for urban situations with and without tree canopy.
- Several studies were in conjunction with other stormwater BMPs. This confuses the issue or at least creates confounding in trying to estimate the effect tree canopy alone has on runoff and pollutant loadings.
- Overall there were very few if any studies where actual long term measurements were taken and none of which were within the Chesapeake Bay watershed.
- The panel did not discuss or provide any detail on how stormwater or other BMPs would interact with tree canopy land uses. Actual installations are treating areas that include tree canopy impacted land uses. It is not likely localities are placing BMPs to treat tree canopy areas exclusively. It was indicated at the USWG that when specific land uses are not known BMPs would be proportioned to the tree canopy land uses. This will create a confusing situation where BMPs reported as urban that are treating some canopy areas being put exclusively on those land uses. Or should application of BMPs be excluded from the tree canopy land uses?
- Assuming a one to one relationship between runoff reduction and pollutant loading reductions and the use of the simple method to estimate loadings seems optimistic and overly simplistic.
- There is a reliance on assumptions because there is insufficient literature or data to support a hard or definitive set of numbers.
- Loadings from the trees such as leaf litter were not accounted for directly by the panel.
- If infiltration is increased then the opportunity for increased leaching losses from Nitrate Nitrogen were also not considered.
- Tree canopy over open space and pervious areas is troubling based on our understanding of how the land uses will be developed from remote sensed imagery. It is not clear to VA that an accurate extent can be determined and mapped throughout the calibration period.

- The global loadings targets being used were based on literature searches that could not support tree canopy land uses. The event mean concentrations that did result from that literature effort would include the impacts from tree canopy on the land uses with sufficient literature to support a unique loading rate. It seems like double counting to take additional reductions from numbers that already include the impact of tree canopy.
- Policy impacts have not been fully discussed. Such as the need to offset canopy losses and who would be responsible for producing such offsets. How will tracking and reporting be impacted? How do we communicate model world applications of BMPs to a land use no one is specifically targeting for BMP implementation activities?

More specific comments and questions are included below.

From memo and synthesis in bold:

"The expert panel at its July meeting agreed that he water quality benefits of tree canopy should be quantified for tree canopy over pervious and impervious land uses because the runoff characteristics of each land cover type differ and therefore affect the ultimate runoff and pollutant load from these areas when tree canopy is present"

However, the resulting recommendations are essentially identical for both pervious and impervious land uses under canopy. Considering the lack of infiltration on impervious surfaces is it appropriate to provide an additional TN reduction for impervious land uses under tree canopy. Additionally, it was indicated that this impact was related to reduced interflow or shallow storm driven ground water. It is our understanding there is no interflow simulated in CBP watershed modeling for impervious surfaces.

"Further, the panel finds that tree canopy would be most effectively tracked as a land use, using periodically updated imagery, rather than an annually reported BMP. Annual reporting of tree planting does not account for losses of trees due to mortality, land use conversion, and other factors. Net changes in tree canopy are best tracked using high-resolution imagery."

Yet in the presentation given to the USWG 9/15/2015 on the slide titled "Related Issues" the second bullet the FWG recommends that new acres of tree canopy continue to be reported annually to CBP for WIP credit. So are we being asked to track and report annually or not? It is our understanding there is no WIP goal for tree canopy nor has there been any annual reporting in support of a nonexistent WIP goal.

"It is assumed that the nutrient and sediment loads from tree canopy land uses are greater than that for forests, but lower than those for open space, turf grass, or impervious surfaces. However, limited research studies are available to quantify the nutrient and sediment benefits of tree canopy directly."

If there is such limited research to quantify tree canopy benefits directly then how do we know the assumptions are justified on relative loadings from the acres covered by tree canopy?

"Therefore, the assumption is that pollutant loads will be reduced proportional to reductions in annual runoff volume. This same assumption provides the basis for recommendations made by other expert panels (see Schueler and Lane, 2012) and by state stormwater regulations such as Virginia's

Runoff Reduction method (Hirschman et al. 2008). While individual storm events will differ in the amount of runoff produced, the time step of interest for modeling purposes is annual."

Our understanding is that the simple method has not been used to estimate CBP BMP's potential reduction by other BMP expert panels. This is a site screening tool that most states and CBP have been moving away from since it should not be used for anything else that site specific screening uses. Again an assumption is being inserted over something measured or otherwise definitive. From the literature synthesis: **"The results also showed that interception losses relative to rainfall decreased with increasing rainfall depth. The analysis of temporal patterns in interception indicates that it was greatest at the beginning of each rainfall event. Rainfall frequency is more significant than rainfall rate and duration in determining interception losses."** Considering the phase 6 WSM will operate on an hourly time step and antecedent rainfall events will be accounted for as well as rainfall frequency is it really appropriate to think in terms of an annual time step? Considering the model can account for sub annual time step and frequency and duration of rainfall events should we not recommend a diminishment in tree canopy interception when rainfall is more frequent or of significant duration and quantity to render canopy interception lowered? Other BMPs have their effectiveness diminished based on rainfall intensity. Since the model will simulate each hour of each day of each month of each year for decades does it make since to apply a single effectiveness number across all time frames and rain events?

"In order to quantify tree canopy's effect on annual runoff volume reduction, an approach outlined in Herrera (2008) was applied, with some modifications based on the panel's best professional judgment and literature specific to the Chesapeake Bay region."

"Herrera Environmental Consultants (2008) propose the 5% value for deciduous trees based on unpublished data provided by Professor Qingfu Xiao (Xiao, unpublished). "

"The values used in Herrera (2008) were specific to evergreens in the Pacific Northwest and are substituted with those from studies of urban (and primarily deciduous) trees in the Chesapeake Bay region."

It seems from the literature synthesis that Herrera et al. was a document on natural forests in the Pacific Northwest on rainfall interception and the study type was not know (modeled or measured). Is it appropriate to use an unknown study type referencing unpublished information on natural forests in an area of the country as unique as the Pacific Northwest as a basis for a potential reduction of tree canopy over human modified landscapes in CB watershed? It is not clear how the panel accounted for such significant differences.

The panel indicates **"The method does not account for any additional infiltration provided by the tree roots or pollutant uptake by the trees because there is insufficient data to assign a value based on the literature review."** But then indicates **"The transpiration loss from the tree canopy land use is applied to the subsurface flow, or interflow."** So if there is not sufficient information to infer anything on infiltration then how can transpiration loss be applied to subsurface flow or interflow? This seems a contradiction.

"Further, the panel concluded based on its literature review (see Attachment B), that recent studies document the available supply of leaf litter in urban areas and the potential to contribute to runoff loads. However, there remain significant gaps in understanding the fate of nutrients from leaf litter as part of the stormwater pollutant load. "

"In a recent STAC workshop report (Sample et al 2014), Nowak (2014) provided data for Baltimore, MD estimating an urban tree canopy biomass nutrient load of 28.8 lbs/ac/yr and 2.95 lbs/ac/yr of N and P, respectively. If a fraction of this load washes off into the stream, leaf drop alone would be a considerable component of Chesapeake Bay watershed model nutrient loadings rates."

The effect or impact on loadings of leaf litter and other plant parts (pollen, branches, sticks and twigs, roots breaking sidewalks) has not been accounted for by the panel and could be significant loading sources as mentioned above. Possibly even overcoming the perceived benefit of the canopy's interception of rainfall and coupled with the lack of interception for several months per year a diminishment in the proposed loadings impacts of canopy seems justified and conservative. It could also be said that until this is quantified and accounted for the real benefit of tree canopy over a given land use cannot be determined. Or that until such a determination can be made it does not seem justified to assume a reduction is occurring.

"Only a handful of studies directly address the water quality benefits of urban trees, and an even smaller subset provide results that can be used to develop effectiveness values for urban tree planting."

One conclusion is that there is not sufficient information to justify any loadings reduction at this time. We did not see any long term measured studies. Some of the measured studies were for less than a year in duration. Some pointed to seasonal variation. Band et al. n.d. was not summarized in the synthesis. It seems to have accounted for ¾ of the values used to estimate percent interception of 17%. Unclear if the 2 modeling studies used for this estimate were of similar simulation periods, similar or identical models. The quality and quantity of data used in the models is not stated. Where these calibrated and validated models?

Interception seems to be the main reduction pathway determined by the panel. Based on the synthesis 14 studies were listed in Table 1. Of which 12 were based on modeling estimates and 2 on measured data. Two of the 14 were in the watershed and seem the entire basis for the estimated 17% annual interception. Both were based on modeling. Wang et al. 2008 indicated roughly a 1 percent decrease in runoff for each 10% increase in canopy. This would seem to indicate a maximum possible reduction in runoff of 10% when going from zero tree canopy to 100% canopy. Not the 17 percent determined evidently from a simple arithmetic average of 4 modeled estimates for 4 catchments in the DC Baltimore area.

VA has recently contracted to have a high resolution land use developed. The vendor was asked to evaluate the development of tree canopy land uses. Even thought this evaluation was conducted using leaf off imagery a significant if not majority of the time shadow cast not actual canopy area was resolved. Included in this response are a few examples of where the canopy area can be seen as over another land use or shadow cast onto a land use. How will EPA and their vendor specifically dealing with

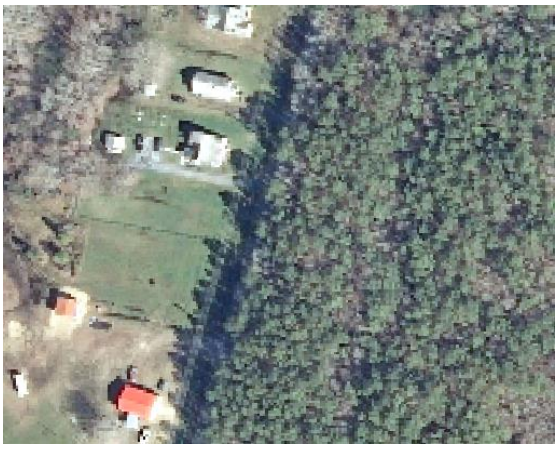
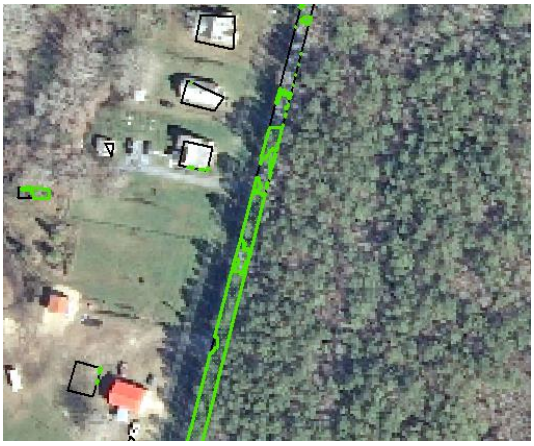
shadow cast on their high resolution imagery? And exactly how is the history of the proposed land uses to be determined? Is shadow cast an issue with older lower resolution imagery? All to be used to develop a tabular land use in a regional scale lumped parameter hydrologic and sediment model.

In the technical memo should equation 4 be applied to impervious? It is our understanding interflow is not going to be simulated in p6.x WSM. If interflow is not going to be simulated for impervious land uses is it proper to provide a reduction to a process that is not simulated? Also canopy over impervious indicates the majority of the understory is impervious and not providing a transpiration pathway since the impervious surface prevents infiltration. Or at least severely retards water movement via infiltration and transpiration. Is the base runoff coefficient 0.95 or 1.00?

Include discussion on math presented by panel. Did not see a reduction applied as per indicated. Equation 4 seems incorrect. A 30% reduction due to soluble forms of TN would be a coefficient of 0.7 not 0.3. Percent interflow reduction = (Transpiration*annual precipitation) *TN factor *100. In the example it appears a 70% reduction in TN dissolved was applied and it was not applied to the annual precipitation but net runoff.

Following provided by VA land use contractor:

Where Tree Canopy over Impervious extraction works:

However, a great deal of the output is truly tree shadow:

Additionally, other errors occur because the software misclassifies in the initial full land cover extraction, but gets cleaned up in various stages along the way as individual classes are developed independently (Ag, Harvested) and external datasets supplemented (NWI wetlands)

Preliminary issues in dark ditch areas around Ag:

Where wetland data is later clipped out:

Mistaken building shadows from earlier output:

The capabilities of the software make for an excellent overall land use product, and the additions of external data sources and various combinations of geoprocessing tools and post processing tasks result in the cleanup of most anomalies. However, to develop an accurate layer of what represents tree canopy over impervious, this classification would require its own workflow and additional post processing to fully develop.