Summary
Chesapeake Bay WQS AD HOC Committee
April 28, 2004

Welcome/Introductions

Attendees:
DEQ: *Alan Pollock, Elleanore Daub, Rick Hoffman, John Kennedy, Jean Gregory*
CB COMMISSION: *Melanie Davenport*
CBF: *Jeff Corbin*
DCR: *Charlie Lunsford*
EPA/CBPO - *Rich Batuik, Mark Smith*
Greeley & Hanson*: Ed Cronin*
JRA: *Patti Jackson*
ODU: *Harold Marshall, Mike Lane*
USFWS: *Cindy Kane*
VACo: *Frank Harkson*
VAMWA: *Will Hunley, Norm LeBlanc, Jim Pletl, Chris Pomeroy, Clifton Bell*
VIMS: *Lyle Varnell*
VMA: *Bernard Kiernan, Tom Bodkin*
VML: *Bob Steidel*
VMRC*: Tony Watkinson*

Chlorophyll *a* Update

Review of EPA's designated use statement and current VA WQS designated uses DEQ recognized that the existing VA aquatic life designated use is broader in its protection of "aquatic life" than the proposed Open Water designated use contained in the Chesapeake Bay Program TSD, which supports only "fish and shellfish". Thus, aquatic life, such as macroinvertebrates, zooplankton and phytoplankton, are protected under Virginia's existing aquatic life use designation. Therefore, the definitions of designated uses for this rulemaking will include the broader "aquatic life" uses.

Update on chlorophyll *a* information (DEQ and VAMWA with input from Harold Marshall - ODU) To further exemplify the 'unbalanced' nature of the James River, DEQ presented a slide of phytoplankton community abundance (% total abundance) in the James, Rappahannock and York. The York appears to be the 'best' with more equal percentages of blue-green algae, diatoms and other phytoplankton. Cyanobacteria dominated the James River.

Comments on this information shown were that if the slide had been expressed as biomass, the percentage for cyanophytes would be very small and the chart would show the James as having the 'best' from a biomass perspective. Since cyanophytes are considered 'bad' fish food, are there problems in the James River with the fish populations? Dr. Marshall responded that there are warning signs that the system is out of balance. Since 1986 abundance and biomass of cyanobacteria have increased. Although the James fish population may appear to be good, cyanobacteria are not preferred food for fish. A system is best when diatoms reign in abundance and biomass. These gradual increases in undesirable species are usually associated with a change in trophic status of system. There are several variables that affect the proliferation of cyanobacteria. The N:P ratio is one factor and as the ratio decreases, conditions become more favorable for cyanobacteria. As you reduce nitrogen, cyanobacteria become more

competitive but it is unknown exactly how the James cyanobacteria population will change as nitrogen is reduced since there are other factors that affect these cells (TSS and light).

It was observed that N and P must be controlled proportionally and that controls implemented will likely result in changes in the phytoplankton communities in all tidal rivers.

Another slide was shown of cells / Liter of *Microcystis aeruginosa* (a cyanobacteria) over time (1986 - 2003) and compared to a 'threshold' value of 10,000,000 cells / L. EPA recommends this threshold value as the level at which zooplankton communities can be altered due to poor food quality. There were high peaks in the early 1980's with a long period of low numbers during the 1990's. Lower but more chronic peaks reappeared during 1996-2003). Several expressed an interest in seeing the water quality conditions during the period of low numbers in the 1990's (median chlorophyll *a* concentrations in the James during the summer show chlorophyll *a* concentrations were still high during 1990's i.e. 20 - 40 ug / L)

Dr. Marshall noted there are other warning signs that the system is out of balance. These include the increasing presence of phytoplankton species that are less favorable as a food and oxygen source in the Chesapeake Bay ecosystem (e.g. cyanobacteria, dinoflagellates). There has been a significant trend over the past decade of increased abundance and biomass of cyanobacteria within the Virginia river estuaries. In addition, species representation among the cyanobacteria have increased during this period. For instance, in 1994 our survey indicated 38 cyanobacteria taxa, with an increase to 110 taxa in our survey during 2004. Included among these taxa is the more common presence of Microcystis and several filamentous species. Microcystis has been associated with toxin production in other freshwater and esturarine systems (but no reports of toxicity in the Bay estuary system to date). This species and other cyanobacteria are more common during summer months, producing high cell concentrations (or blooms). This development is aided by the reduced residency time commonly present in our regional rivers during summer allowing their development to continue.

In addition to the cyanobacteria, other less favorable plankton components are the dinoflagellates. Their representation in the Bay estuaries has also increased over the past decade. In 1994 we recorded 125 taxa, in 2004, 191 taxa were identified. Among these taxa are numerous bloom producers (and even toxic species) that are most common in the lower reaches of Virginia rivers. During bloom periods the cells are introduced into other estuaries by way of tidal flow, etc. Many of these dinoflagellates form resting stages that come to the sediment, allowing their development to continue the following year if favorable conditions are present. Over the past several years many of these blooms have increased in their range and bloom duration. The result has been a broader establishment of these taxa throughout the Bay.

Within the Bay system there are also potential toxin producers among the diatoms. However, diatoms are considered the more favorable community to be present in an estuarine system, in contrast to cyanobacteria and dinoflagellates. Decreased water quality conditions associated with increased nutrients and temperatures, plus reduced

light availability will generally favor cyanobacteria and dinoflagellate development, over diatom growth. Noticed more recently is that many of the summer/fall blooms of dinoflagellates are becoming longer in duration and areal coverage. What previously took 1-2 tidal cycles to dissipate a bloom my now involve 2-4 tidal cycles

VAMWA presented data correlating harmful algal blooms with chlorophyll *a* concentrations. Also presented was their reasoning for why the values for chlorophyll *a* in the criteria document are not valid criteria (EPA used freshwater data, historical levels and/or the reference community (IBI) approach) to protect designated uses - particularly the IBI reference community 'binning' approach which was driven by secchi depth (turbidity). Chlorophyll *a* and impairments to designated uses are better connected by considering harmful algal blooms. Looking at *Microcystis* blooms and cyanophytes in general, it appears that 35-40 ug/L chlorophyll *a* is 'threshold'. *Prorocentrum* and *Cochlodinium* dataset only showed one sample exceeding the 'threshold' in Virginia.

VAMWA summarized that *Microcystis aeruginosa* in TF James becomes common at 35-40 mg/L, they see no evidence of impairment of higher trophic levels at this concentration and that it becomes a "nuisance" somewhere between 50 – 200 mg/L. Also, in the higher salinity regions in Virginia, blooms are not common and the bloom thresholds in the criteria document were derived from Maryland data or other literature sources. Also, this criterion should be site-specific to the tidal fresh James and incorporate an adaptive management plan.

Comments heard in response to VAMWA's presentation were that *Cochlodinium* is a large species of phytoplankton that used to be confined to the York and Rappahannock before 1992. Now we see blooms of this species out to the Bay mouth. Also, the dataset might not be catching the species or bloom conditions, so we don't really know if they are 'uncommon'. When flyovers are conducted, blooms are commonly seen. Even though our data base is large - we are still not catching the full effect of blooms. [NOTE TO GROUP: Further clarification on the occurrence of blooms from Dr. Marshall in an email received March 10: *In reference to blooms in the James, most of these are not captured in our routine monitoring program of once per month sampling. The chance of coinciding a scheduled sampling date with one of these blooms is not very good. Many of these blooms are short lived, generally lasting over 1-2 tidal cycles, and often restricted in areal development. In addition, the location of the two river stations (TF, RET) in the James may do not represent the most likely sites for bloom development, which often occurs downstream of the RET station. However, I do receive reports from Shellfish Sanitation Division regarding blooms that are not observed in our monitoring program. They often occur between the scheduled sampling dates or are in regions where we have no standard stations. In addition, due to our increased coverage of HABs since 1995 in Virginia estuaries, I do have additional information regarding bloom events in these rivers. However, associated data is generally limited to temperature and salinity.*] Also, the mention of 'no impairment' to zooplankton caused concerns because we know from lab studies that *Microcystis* does effect zooplankton feeding. Also, concerns were raised about using bloom levels as thresholds. It was agreed that if the threshold was based on impairments due to blooms, the criteria would not be set at the bloom level but at some level below that.

EPA update on longitudinal attainability plots (observed and confirmation scenarios) and comparison with threshold values

EPA presented their updated recommendations for statewide chlorophyll *a* criteria for different salinities. They were as follows:

Spring tidal fresh and oligohaline <10
Spring and summer mesohaline and polyhaline <5
Summer tidal fresh and oligohaline <15

EPA also presented attainment data for the rivers based on cap load allocations. There were several instances where the cap load allocations would not attain the recommended thresholds.

One comment received on the attainable model values presented by EPA could be misinterpreted to be the thresholds. This is not correct in that thresholds should be based on biological impairments.

EPA also presented chlorophyll *a* longitudinal plots (river mouth to fall line) for spring and summer for each river basin for observed data and under the confirmation model run scenario. As expected, the plots show that the 10-year confirmation runs result in lower levels of chlorophyll *a* than the observed levels. There are increased concentrations in the lower river kilometers (20 -80) in the spring, except for James, which showed peaks of chlorophyll *a* in spring and summer at the same location both seasons (80-100 near the Chickahominy). The Rappahannock and James in the summer show the largest difference between the observed and confirmation run in the tidal fresh areas. The York showed spring peaks toward the mouth of the river and the summer peaks farther upstream (peaks level out a Mattaponi and Pamunkey).

Concentration plots at various locations in these rivers show what could be attained. It was noted that several aspects of the watershed model are being recalibrated now.

Lunch

Each organization represented on the ad hoc committee was asked to give their opinion on a chlorophyll *a* numerical criterion and the chlorophyll *a* concentrations presented by EPA and others.

CBF – Supports numerical criteria that were initially proposed by EPA early in the development of the criteria document. Recommends numerical criteria in at least the James but encourages numerical criteria for all tidal Virginia waters. A criterion is needed because it would result in a better balanced aquatic phytoplankton community, fewer undesirable species and fewer blooms. In addition, it appears that the recommended criteria can be met once the cap load allocations are fully implemented. A narrative criterion along with the numerical may be an option.
DCR – Concern that in the mesohaline and polyhaline areas, the recommended criteria from EPA are not attainable.
EPA/CBPO – Support their recommendations for numerical criteria.
ODU - Pursuing a numerical chlorophyll a criterion would be beneficial and EPA's suggested numbers represent appropriate guidelines.
USFWS – Support numerical criteria as the scientific evidence supports the need for numeric criteria and the improvements that will result from implementation of these

criteria. The number chosen should protect for a balanced aquatic phytoplankton community which will likely be a more conservative number.
VaCo – Sees water clarity and dissolved oxygen as the primary drivers for Bay criteria rather than chlorphyll *a*. Sees more of a biological connection to the values presented by VAMWA and harmful algal blooms than from the threshold values presented by EPA. Favors a narrative criterion, but if a numerical criterion is chosen it should be site-specific in areas when chlorophyll *a* is high – the other rivers should only have a narrative criterion.
VAMWA – the EPA threshold criteria are not linked to designated uses. Numeric criteria should be based on areas where algal problems are demonstrated such in the tidal fresh James. The numeric criteria chosen should represent a number directly associate with chlorophyll *a* and harmful algal blooms such as *Microcystis*. Supports the values suggested in their presentation today (35 – 40 ug/L). Don't agree there are algal related impairments in the James but acknowledges we may be headed that way. Recommends that in these demonstrated algal problematic areas that we use an adaptive management approach and adopt criteria based on existing conditions as a numerical criterion and implement the load reductions to see how the chlorophyll *a* levels respond.
VIMS – Chlorophyll *a* is a good indicator of ecological health. Need a more comprehensive database (need more bloom information and more comprehensive models) to help decide upon the proper numeric criterion. VIMS will be submitting information to DEQ along these lines.
VMA – As a guideline, chlorophyll *a* is a good environmental health indicator. EPA's thresholds are problematic in that even with full implementation of best management practices, we still violate the thresholds.
VML – Supports only a narrative criterion and thinks the tributary strategies should move forward before we adopt any numerical criteria.
VMRC – Supports water quality standards for chlorophyll *a* that support marine fisheries resources. No recommendations on which value to use but appears that a value is needed.

DEQ commented that the group will likely see a numerical chlorphyll *a* criterion proposed.

Cumulative Frequency Distribution Method of Assessment

DEQ overview of criteria document. EPA has embraced a new method of assessment which recognizes that some spatial and temporal exceedences of the criteria occur in nature and are not captured in the criteria themselves. The interpolator model determines what percentage volume of Bay waters exceed the criteria at a calculated cumulative probability. These two variables are plotted against one another to develop the cumulative frequency distribution (CFD). This CFD is compared to a reference CFD. EPA has published reference CFDs for several designated uses and criteria and recommends that at a minimum the 10% space/time CFD be utilized if a reference CFD does not exist. Other issues addressed in the criteria document are concerns with reference vs. observed CFDs that are statistically the same and how to make that determination and also how the magnitude of criteria exceedence is not addressed by the CFD method.

DEQ review of comments received during NOIRA on CFD approach
Comments received included the following:
- Put in guidance as with other agency 'tools'

- In favor of CFD but correct deficiencies (modeled data = questionable reliability); - Put all implementation procedures in regulation
- Too complicated - consider using 10%
- Need to consider magnitude of violation
- Only 30-day duration CFDs examined
- CFD allow more non-attainment and this will not lead to improvements in bay water quality
- With no margins of safety in the criteria, the CFDs must be strictly adhered to as a definitive line of attainment
- Reliance on a reference based CFD is inappropriate in an already impaired Bay
- Not appropriate to calculate a percentage of volume in a cell that exceeds criteria, and then extrapolate this data to a much larger areas; this could have the effect of saying an entire assessment unit is in compliance when, in fact, large parts of the assessed unit do not meet water quality standards

EPA example of use of CFDs with interpolator results
The CFD approach recommended by EPA has been through peer review several times. The current approach to assessment (10% time exceedance allowed) has no basis and does not capture the spatial variability. EPA believes that assessment and monitoring are all part of the water quality standard along with the criteria and use designations. The approach will not be complicated in that tools will be developed to assist the states in their assessments.

All standards should incorporate magnitude, duration, frequency, space and time components.

The fixed station water quality monitoring network design was shown in relation to the different designated uses. That data can be interpreted via an interpolator model to give a water quality view of the Bay. Other potential monitoring systems or designs may be needed. These may include buoy systems for continuous monitoring of dissolved oxygen at fixed locations, probability- based monitoring for shallow-water monitoring, continuing with the fixed-station monitoring for all objectives and useful for some designated uses, continuous underway monitoring systems (drunken sailor approach) for more detailed spatial assessment and remote sensing (aerial over-flights, satellite imagery for chlorophyll criteria attainment).

More intensive monitoring in shallow waters are needed since these areas have little information, can be extremely dynamic, have high spatial variability, encompass critical habitat and this is where most fish kills occur. The value of including several different monitoring systems was described and how a much different picture of water quality can be seen with more data. A concern was raised that these intensive survey designs only covered 16 out of about 100 segments and that the full assessment of the rest of the segments won't be completed until 2020. EPA explained that full assessment meant using the expanded monitoring data and that the existing fixed monitoring data could still be used to do the CFD assessment. More concerns were raised on how the more intensive monitoring would relate to the 303d list of impaired waters and the continuity of the fixed station network. Could a situation arise where a fixed station assessment shows impairment and the next assessment with an intensive monitoring network shows no

impairment, would this result in a de-listing? EPA responded that a de-listing would require assurance and confidence in the data.

The CFD is developed by interpolating the Bay water quality monitoring data for each sampling event (e.g., cruise), evaluating interpolated WQ monitoring data interpolator cell by cell using the appropriate criterion value, identifing the cells in a CBP segment / designated use area that exceed the criteria for each sampling event, and compiling the measures of % area (%volume) exceeding the criteria. This quantifies the SPATIAL EXTENT of the exceedences in a segment for each sampling event. Then sort and rank the measures of % area / volume of criteria exceedence, calculate the cumulative probability values based on the ranks and plot the % area exceedence vs. cumulative probability over time.

The CFD is compared to a reference curve. The deep water reference curve is based on areas where the benthic invertebrate populations were considered healthy and balanced (IBI was >3 as per recommendations from benthic experts).
Various tools for defining attainment were discussed including the magnitude of exceedence, the spatial and temporal extent of exceedence and the Kolmogorov-Smirnov significance test between observed and reference curves.

Questions:
Is the CFD approach valid and should we use it? Yes - since 10% is arbitrary but reference curves need to make sense.
Are the reference CFDs provided in the criteria document appropriate? Reference curves should be considered using an IBI of 3.5 or 4.0 - why was 3 chosen (was the recommendation from the benthic 'experts')? Reference curves need to make sense. Concerns that the reference curves can vary over time (see below comments on statistical test).
Should we use a significance test to determine if references vs. attainment curves are different? Concerns were raised that if any exceedence above the reference curve is considered a violation with no analysis and compensation for area below the reference curve line would result in an inappropriate 303d listing. Therefore, a statistical test to see if the curves are statistically equal is very important.
Should the magnitude of the criteria be examined? Not in regulation - EPA presents it as a diagnostic tool.
How much detail about the CFD should we put in the regulation? Need just enough to define how attainment will be done. Don't need details as other assessment procedures are in guidance. EPA recommended the entire CFD approach needs to be in the regulation (including if the state is going to use the statistical test between reference and observed CFD curves) as assessment guidance for listing is difference from determining whether or not you meet criteria. Some disagreed with EPA's idea that assessment guidance for listing is different from how you determine whether the criteria are met.

Review of Proposal Development

Maryland Update Maryland will route a draft regulation to the Bay states for comment this week. During May / June they will make the draft available for public informational meetings. They expect to have a proposal for public hearings in August.

Virginia Draft Language DEQ staff are drafting language now and it will be mailed out to the group about 2 weeks before the next meeting in May. DEQ will explain the rationale of the amendments at the next meeting.