# Critical Period and Hydrologic Averaging Period

*What's the difference between the hydrologic averaging period and the critical period?*

Despite the similar sounding names, these two periods serve distinct purposes in establishing nutrient and sediment reduction planning targets. Both are explained in Section 6 of the Chesapeake Bay TMDL document. The hydrologic period is used for expressing average annual loads from various sources. It is not to be confused with the critical period, which defines a period of high stress. The critical period addresses the foundational question: "What would loads need to be for the Bay to meet water quality standards (WQS) during the *critical period*?"

## *Critical Period*

- Defined critical *conditions* (see Section 6.2.1. below) are a required feature of all TMDLs. They are the "reasonable worst-case scenarios" used to set pollutant reduction targets. The Chesapeake Bay TMDL has a three-year critical *period* because water quality standards are evaluated over a three-year period.
- After much deliberation, the Partnership chose 1993-1995 because its 10% chance of recurrence is similar to the precedent set in other TMDLs.
- The critical period documentation is in Section 6 and Appendix G of the TMDL document.

Changing the critical period to a more recent date would:

- Increase the confidence in the overall planning target calculation. Instead of asking "How much do loads have to change since 1995 to meet WQS?" (when the data were not as robust), we would be asking "How much do loads have to change since 20XX to meet WQS?"
- Potentially allow for simplifying Conowingo considerations since the effects of dynamic equilibrium would already be part of the critical period.
- Have an effect on the overall level of nutrient and sediment reductions needed to meet water quality standards.

## *Hydrologic Averaging Period*

- Many loads, especially nonpoint source loads, depend heavily on hydrology. When planning targets or CAST scenarios are expressed as a certain number of pounds, they are conditional on the flows and loads of the hydrologic averaging period.
- The hydrologic averaging period sets the balance among point and nonpoint loads and among basins.
- The long-term hydrologic averaging period used since 2010 is 10 years because most 10-year periods are representative of long-term hydrology.
- 1991-2000 was chosen when developing the Bay TMDL because, at the time, it was the most recent and representative of average conditions.
- The hydrologic averaging period documentation is in Section 6 and Appendix F of the TMDL.

Changing the hydrologic averaging period to a more recent date would:

- Allow for including changed environmental conditions directly in the calculations as a change in the nonpoint and point source balance.
- Retain the modeling convenience of overlap with the critical period, if the critical period were also moved.

**FAQ:**

*Can the hydrologic and critical periods be changed without reopening the Bay TMDL?*

Yes, they can be changed for purposes of calculating future planning targets without reopening the Bay TMDL. Updating the hydrologic period and the critical period for use in calculating planning targets going forward does not change the Bay TMDL.

*Do the critical period and the hydrologic period have to overlap?*

No, but there are important reasons for them to do so. The estuarine model must always produce scenarios that contain the critical period, and so the dynamic watershed model must always produce loads for the estuarine model that include the critical period. Those same scenarios can be run on any hydrologic averaging period for output from CAST, but it may require keeping two versions of CAST to have the periods separate.

*What are the resources associated with updating the model with new critical and hydrologic periods?*

The technical modeling effort in making the change is within partnership capacity, but resources in reviewing and vetting the changes in loads for the partnership will require close consideration during the review period in 2027. The CBPO has better data and tools to do the work more quickly than in 2010, but the resources would need to be balanced with other priorities.

**Excerpts from the TMDL Document**

Section 6.1.1: The hydrologic period for modeling purposes is the period that represents the long-term hydrologic conditions for the waterbody. This is important so that the Bay models can simulate local long-term conditions for each area of the Bay watershed and the Bay's tidal waters so that no one area is modeled with a particularly high or low loading, an unrepresentative mix of point and nonpoint sources or extremely high or low river flow. The selection of a representative hydrologic averaging period ensures that the balance between high and low river flows and the resultant point and nonpoint source loadings across the Bay watershed and Bay tidal waters are appropriate. The hydrologic period also provides the temporal boundaries on the model scenario runs from which the critical period is determined.

Section 6.2.1: The allowable loading is often dependent on key environmental factors, most notably wind, rainfall, streamflow, temperature, and sunlight. Because those environmental factors can be highly variable, EPA regulations require that in establishing the TMDL, the critical conditions (mostly environmental conditions as listed above) be identified and employed as the design conditions of the TMDL [40 CFR 130.7(c)(1)]. When TMDLs are developed using supporting watershed models,

such as the Chesapeake Bay TMDL, selecting a critical period for model simulation is essential for capturing important ranges of loading/waterbody conditions and providing the necessary information for calculating appropriate TMDL allocations that will meet applicable WQS. Because the WQS applicable to this TMDL are assessed over 3-year periods, the critical period is defined as the 3-year period within the previously selected 1991–2000 hydrologic period (see Section 6.1.1) that meets the above description (USEPA 2003a).