Critical Period for the Chesapeake Bay TMDL

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Presentation C

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Choosing a Critical Period

- No specific EPA guidance
- Data available influences decision
- Regionally tend to use wet, dry, normal years, which a 10 yr hydrologic period covers
- Nationally varies. Several use 7Q10 for low flow
- All attempt to incorporate low flow
- Some use worst case scenarios
- If no single critical year then averages used

Current Regulations

- U.S. EPA regulations at 40 CFR 130.7(c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters.
  - These regulations ***do not*** include either a ***definition*** of critical conditions nor ***guidance*** for determining critical conditions
- Understanding that by achieving the water quality standards at critical conditions, it is expected that ***water quality standards should be achieved during all other times.***

Critical Condition Definitions

- A definition is provided in EPA TMDL protocols for sediment (1999), nutrients (1999) and pathogens (2001):
  - "…the ***worst case scenario*** of environmental conditions in the water body in which the loading expressed in the TMDL for the pollutant of concern ***will continue to meet water quality standards***.
  - Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc) that results in ***attaining and maintaining the water quality criterion and has <u>acceptably low</u> frequency of occurrence."***
- In practice, EPA expects the "worst case scenario" to consider the normally expected range of conditions and not extreme conditions

Navigating the TMDL Process:

- *Recommendations:*
  - First, look to ***existing regulatory requirements***
  - Tailor selection to ***specific pollutant(s)***
  - Tailor selection to the ***pollutant sources***
  - Tailor selection to the ***water quality standard***
    - Frequency, duration and magnitude of standard violation that is acceptable
  - Select a ***low but realistic recurrence interval*** – not unrealistic extreme conditions
  - Where appropriate, ***consider antecedent history***
    - Consider past conditions and sequence of events
    - A long period of continuous data should be analyzed (e.g., a continuous simulation)

Regional Practices - Critical Period

- How do States determine the critical period?
  - All States: Dependent upon pollutant, WQS, TMDL endpoint as well as amount of flow data available
  - All States: Typically use representative data with a range of flows including high, low, and average
  - MD, DC & VA: Critical period selected based on dry, average and wet years
  - MD: In some TMDLs, time-variable models use worst condition in calibration period; steady state models for nutrients use 7Q10
  - DE: 7Q10 used for free flowing streams; tidal streams use calibration period with critical condition of monthly average or seasonal average
  - PA: Starting to use growing season average for nutrients
  - WV: Watershed TMDLs uses representative precipitation induced flow data over a 6-year period with high, low, and average conditions

Original Decisions

- WQ Team previously decided on the representative hydrologic period of 1991-2000
- Recommend decision criteria for selecting the critical period:
  - Select the critical period within the hydrologic period 1991-2000 (representative of long-term hydrology, within model calibration period, ease of model operations)
  - Three-year period (match criteria assessment period)
  - Representation of around a 10-year return period

Critical Period Methodology Summarization

- 93-95 most consistent with existing state practices; closest to 10-year return period
- 96-98 is the second most consistent but tends toward extreme condition years
- Remaining years have return periods less than 6 years
- General inclination from States is to use 93-95 timeframe

Summary of Analysis

	All Tributaries - Time Period (1978-2009)		Potomac + Susquehanna (1930-2009)		
	Without Multiplier	With Multiplier	With Multiplier	With Multiplier	With Multiplier
	No De-trending	No De-trending	No De-trending	De-trended (Linear Regression)	De-trended (LOWESS)
Year	**1993-1995**				
Median (High r^2)	7.53	7.48	7.27	6.34	8.92
Mean (High r^2)	6.84	6.99	7.39	5.97	8.35
Median (All monthly spans)			9.31	6.62	9.07
Mean (All monthly spans)			11.28	8.05	11.26
Overall Range 1993-1995	**5.97 - 11.28**				
Year	**1996-1998**				
Median (High r^2)	18.95	16.02	17.56	11.30	16.66
Mean (High r^2)	18.82	14.87	15.24	11.78	16.26
Median (All monthly spans)			19.26	14.35	18.26
Mean (All monthly spans)			21.63	15.57	21.05
Overall Range 1996-1998	**11.30 - 21.63**				

- The Log Pearson III frequency analysis method was used.
- High r^2 refers to monthly spans with highest correlation between flow and DO exceedances.9
- With and without multiplier refers to use of river basin multipliers for flow weighting.

Decision Requested:

1. Water Quality Goal Implementation Team approval of a critical period for use in the Chesapeake Bay TMDL