Review of Aquatic Life Uses Progress Update

Water Quality Advisory Committee

November 15, 2022

Thomas Amidon, BCES

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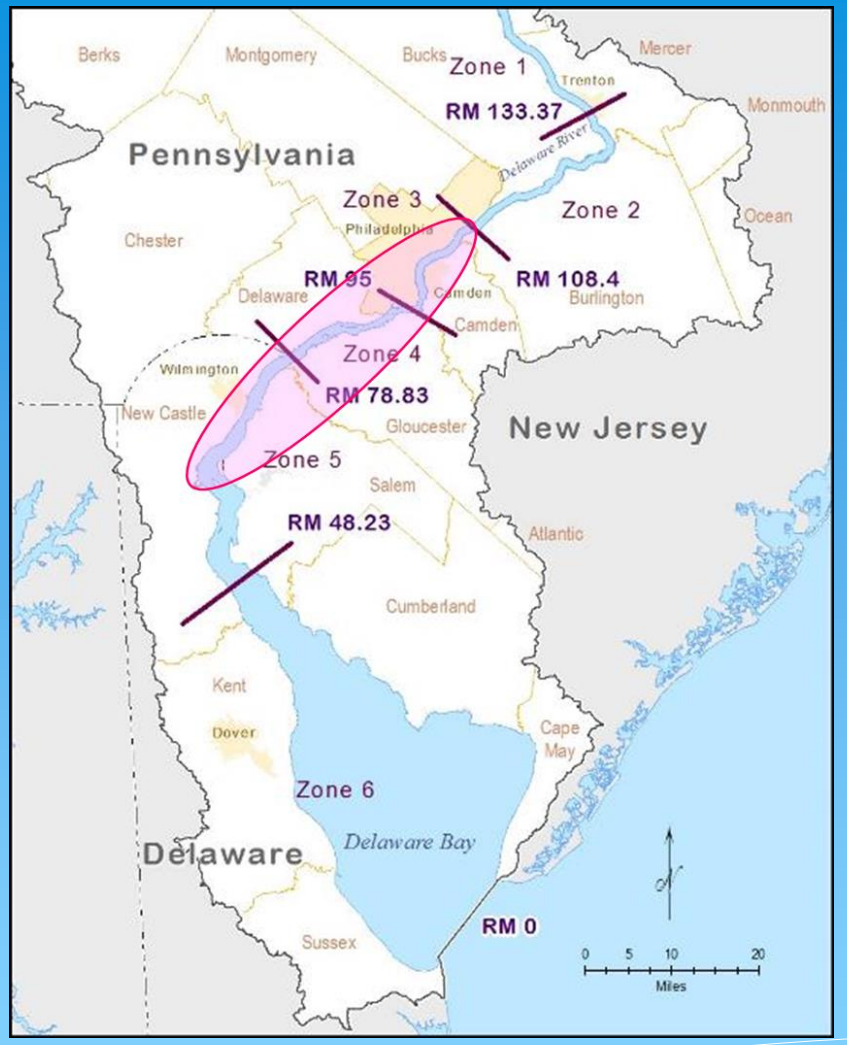

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Discussion Items

Analysis of Attainability	Recap Low DO Metric (2^{nd} to 1^{st} percentile) Questions/Clarifications
Linking Aquatic Life Uses with Dissolved Oxygen Conditions	Preview and status EPA follow-up
Water quality criteria development	Implementation of the Clean Water Act

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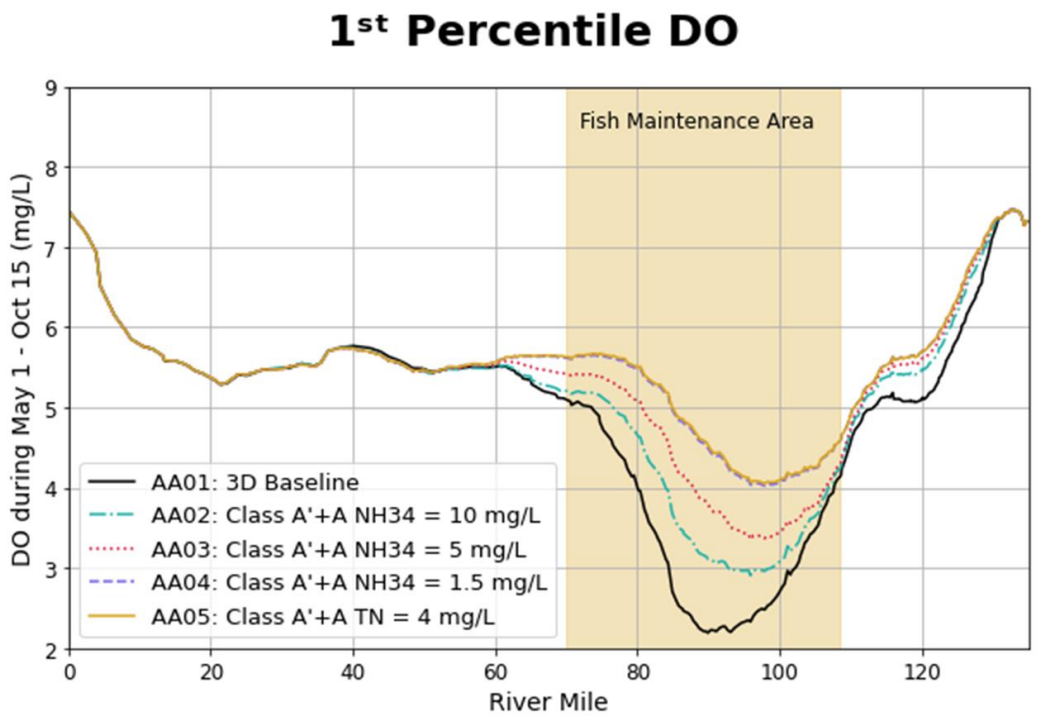
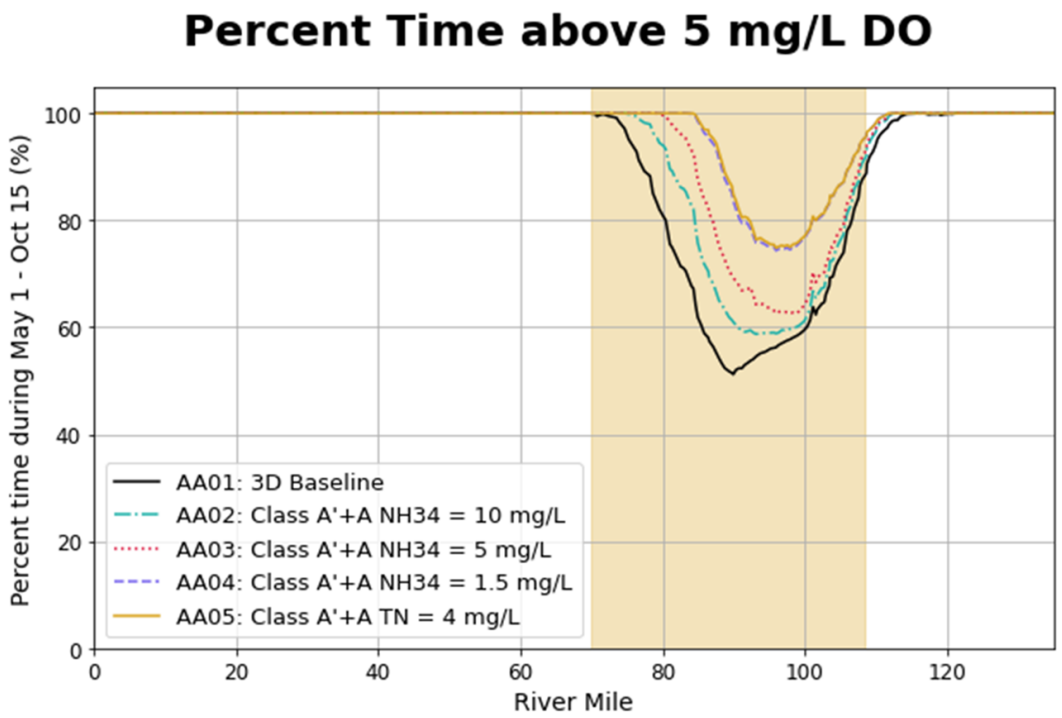
AA results for scenarios AA01–AA05*

*Figure 4-1 from p. 42 of draft AA report (DRBC, Sept 2022)





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Cost versus DO improvement at upstream-most transect in the FMA for each AA scenario

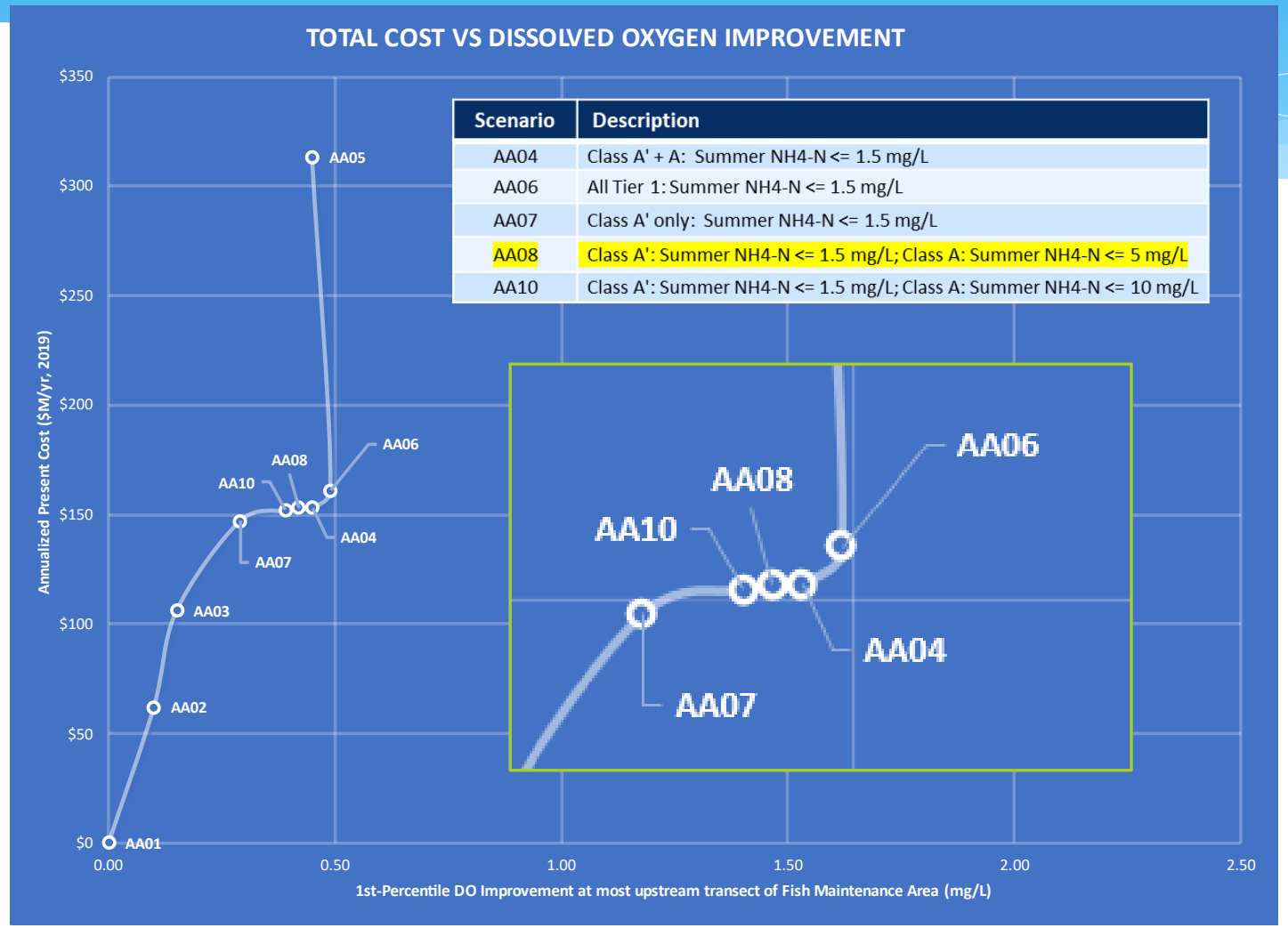

*Figure 4-5 from p. 47 of draft AA report (DRBC, Sept 2022)

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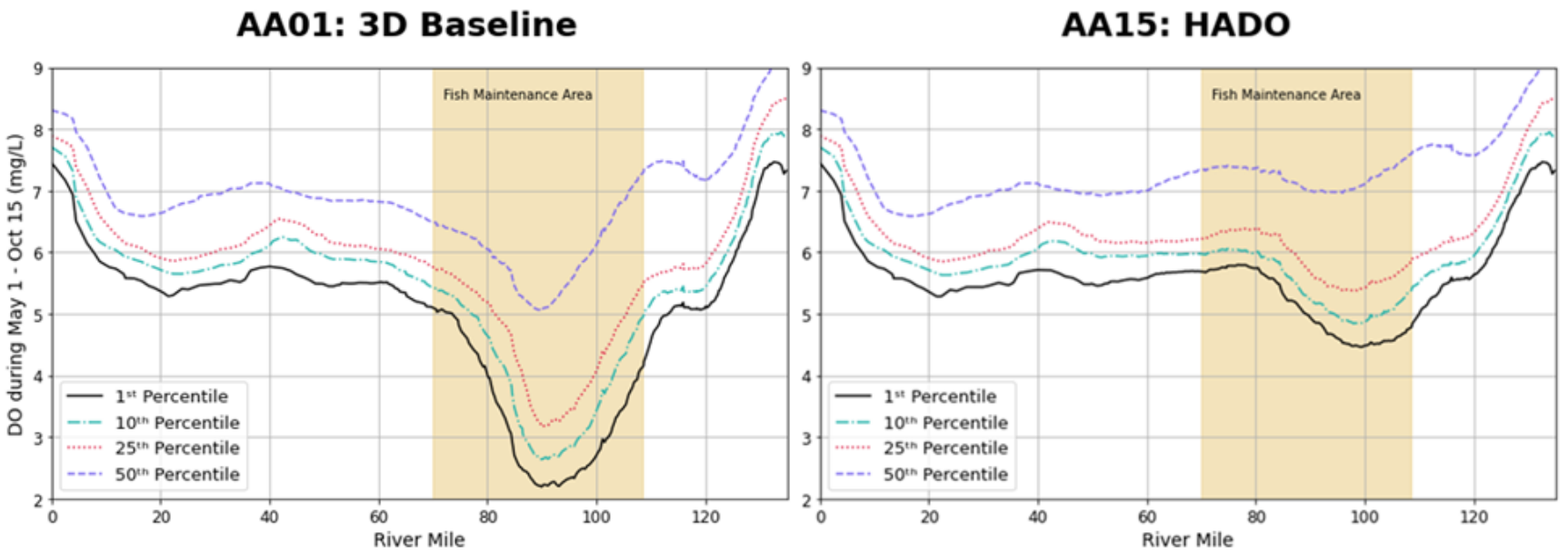
Preliminary HADO* Condition (AA15)

*Highest Attainable Dissolved Oxygen

Predicted DO percentiles for 3D Baseline and HADO conditions*

- Scenario AA08
  - 7 Class A' at ammonia = 1.5 mg/L
  - 2 Class A at ammonia = 5 mg/L
  - Effluent DO = 2 mg/L
  - Associated nitrate and CBOD adjustments
- Plus:
  - CSO reductions (based on LTCP)
  - Effluent DO = 4 mg/L for all 9 dischargers
  - Seasonally variable wastewater concentrations
  - 10% Reserve Capacity
- HADO condition expected to support both maintenance and propagation
  - Minimum DO will increase from 2.2 to 4.5 mg/L
  - Significant increase in time over 5, 6, and 7 mg/L

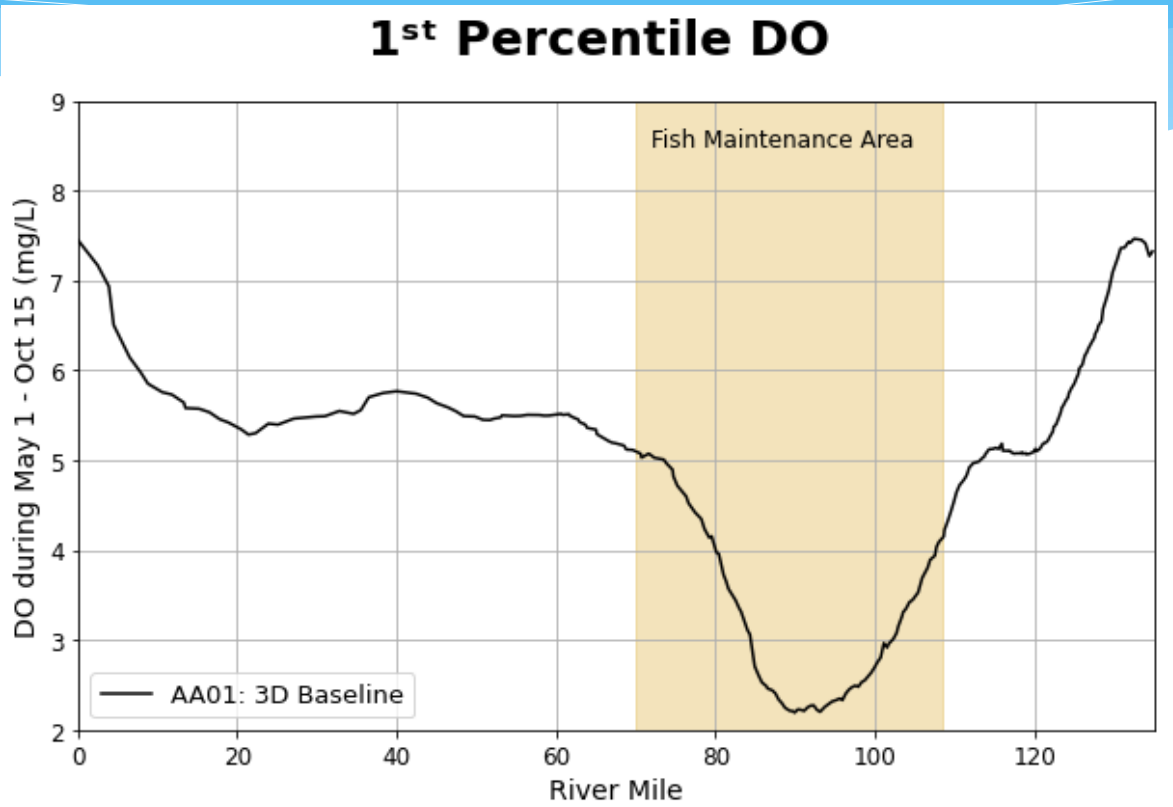


Percentile	Min value in FMA	
	AA01	AA15
1	2.2 mg/L	4.5 mg/L
10	2.6 mg/L	4.8 mg/L
25	3.2 mg/L	5.4 mg/L
50	5.0 mg/L	7.0 mg/L

*Figure 5-5 from p. 56 of draft AA report (DRBC, Sept 2022)

Challenge: Presenting 4D DO data on a 2D plot

- WASP generates **4-dimensional DO results** (3 spatial dimensions + time)
  - X-axis shows **one spatial dimension** (RM)
  - Y-axis **collapses 3 dimensions** (2 spatial dimensions + time) into 1 dimension
    - ***A 2D plot cannot display all DO results!***
    - Using multiple metrics/plots is critical
- DRBC re-evaluated methodology for representation of other three dimensions on spatial percentile graphs



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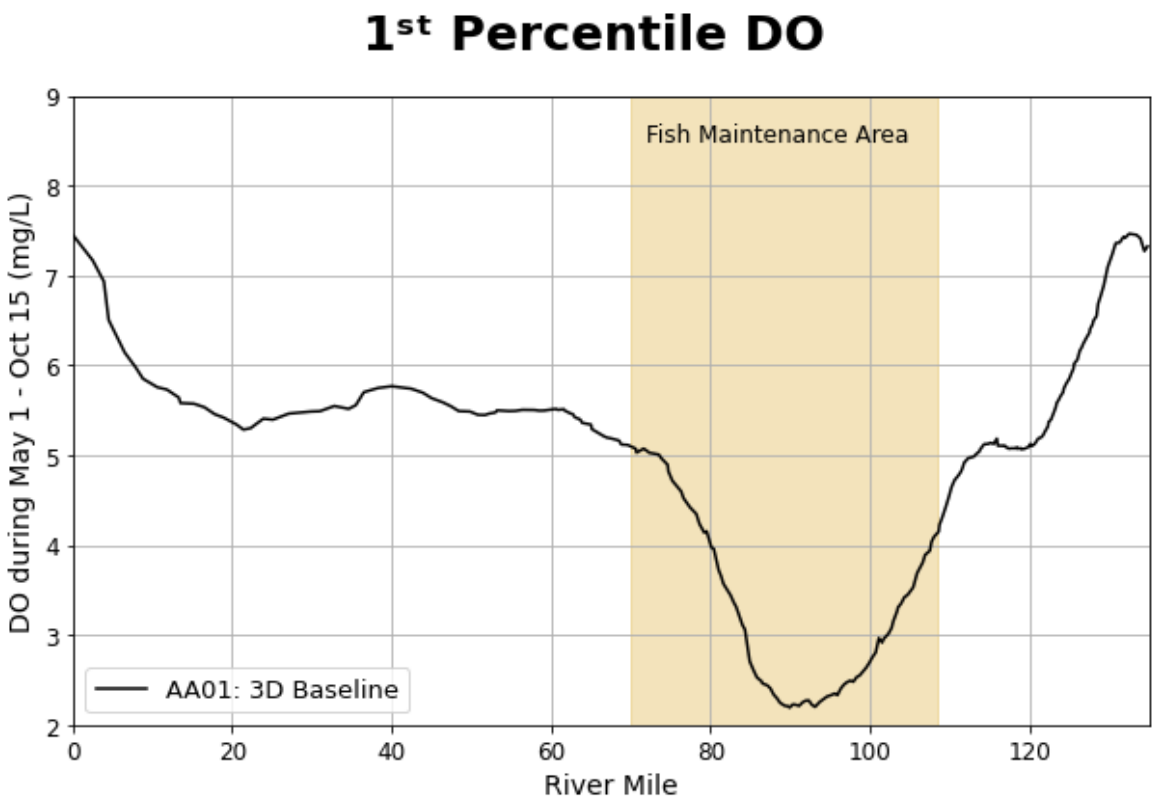
Characterizing minimum DO with a low percentile

Several possible approaches to display low-percentile DO for each cross-section (RM):

- Combine every DO value across space and time, take the percentile from that 3D (space–time) data set
  - *DRBC used this approach until mid-Sept*
  - ***2nd** percentile used to characterize min DO*
- Take percentile value from the time-series in every cell, evaluate the range of values over each 2D transect
  - *DRBC used this approach in the AA report (median was displayed)*
  - ***1st** percentile used to characterize min DO*



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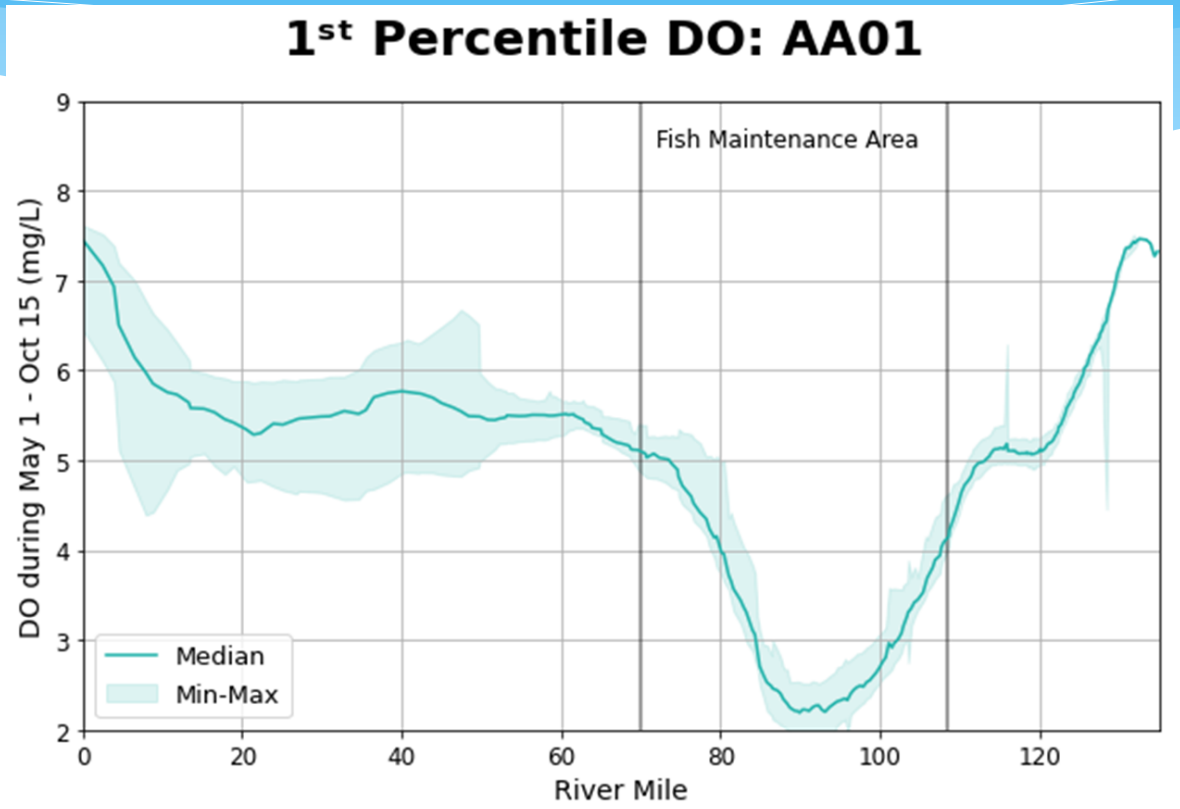
Why did DRBC change the method?

1. Conceptually more meaningful
   - Taking percentile over space and time is not necessarily representative of DO anywhere!
     - A percentile at a specific location is meaningful.
   - Median, minimum, and maximum result evaluated from each 2D transect.
     - **Within the FMA, median deemed representative for comparison purposes.**
   - Variability in Bay is due to vertical gradients as well as a larger number of cells per transect.



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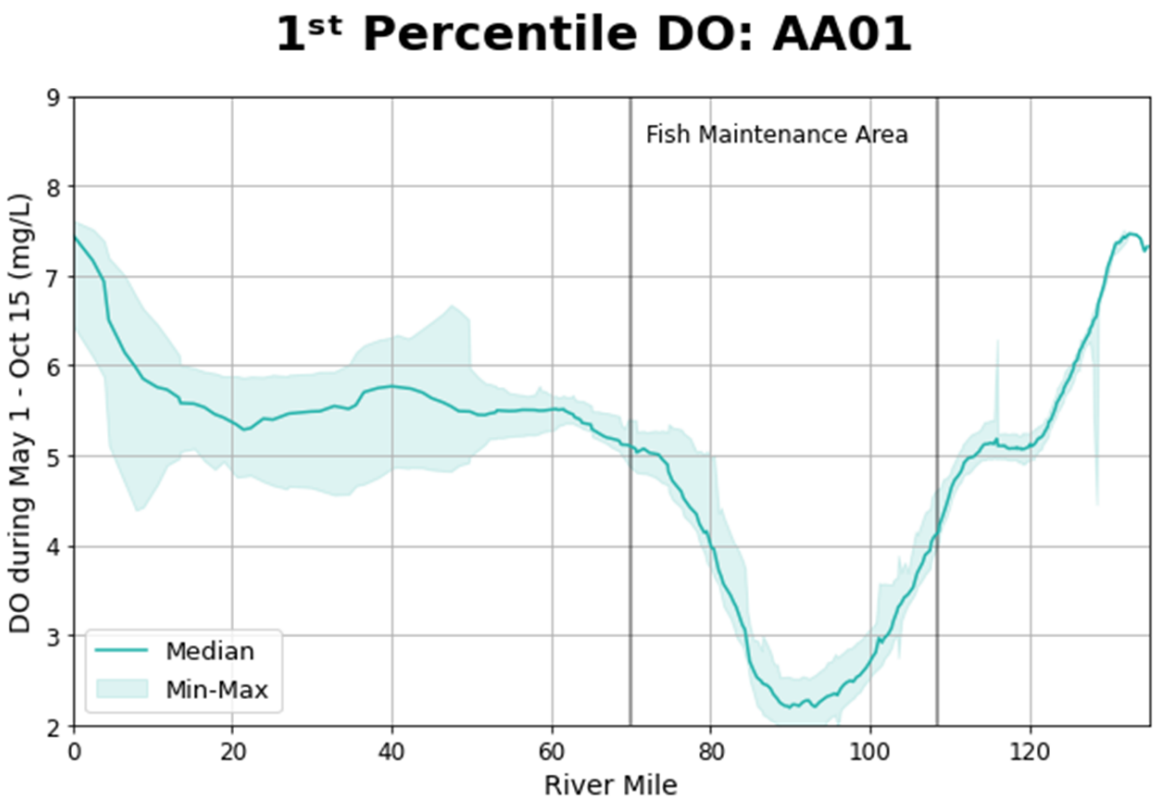
     - **Within the FMA, median deemed representative for comparison purposes.**
   - Variability in Bay is due to vertical gradients as well as a larger number of cells per transect.
2. Allows for use of lower percentile
   - Use lowest percentile that is not affected by "noise" to represent minimum DO



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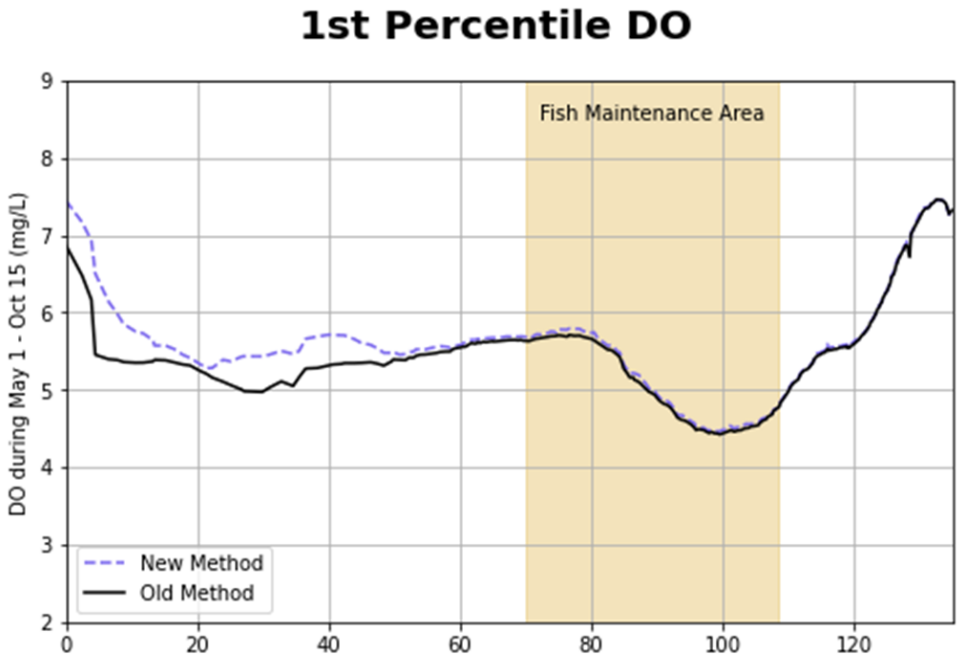

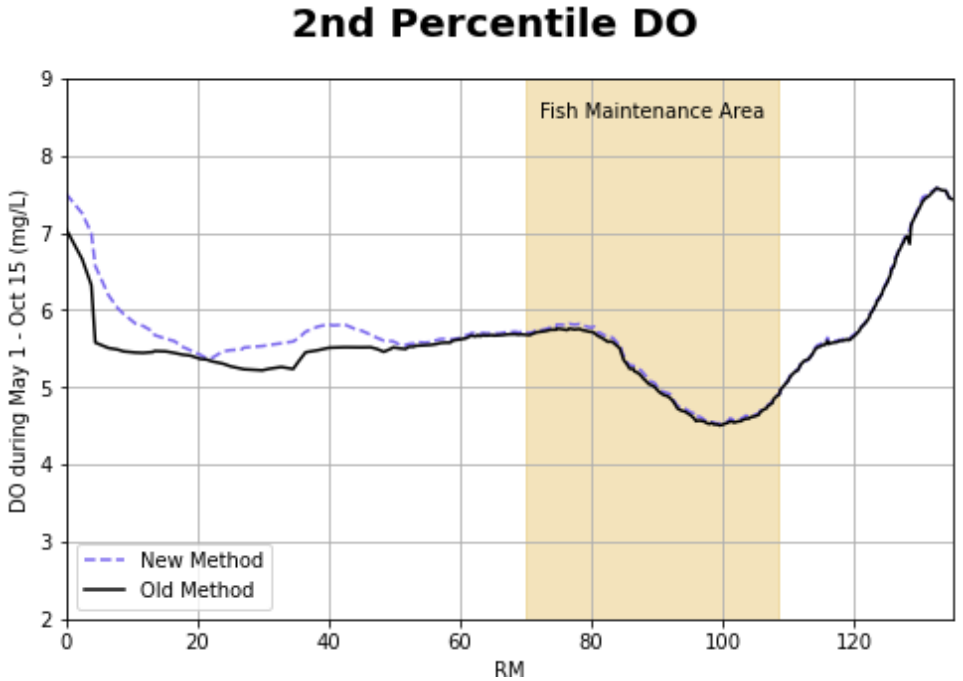

Key takeaways

- Minimal difference between two approaches in the FMA—**no results or interpretations were adjusted as a result of this change**.
  - *Recall: there is not a significant DO difference in the Bay for the HADO vs. 3D Baseline!*
- Both methods are conservative, but **the original method includes some values that might not be considered representative**.
  - "Extreme" cells can be over-represented in the results.
- No metric or plot is perfect; no metric or plot can represent all 4D DO data.
  - Additional appendices will be available in the next draft AA report.

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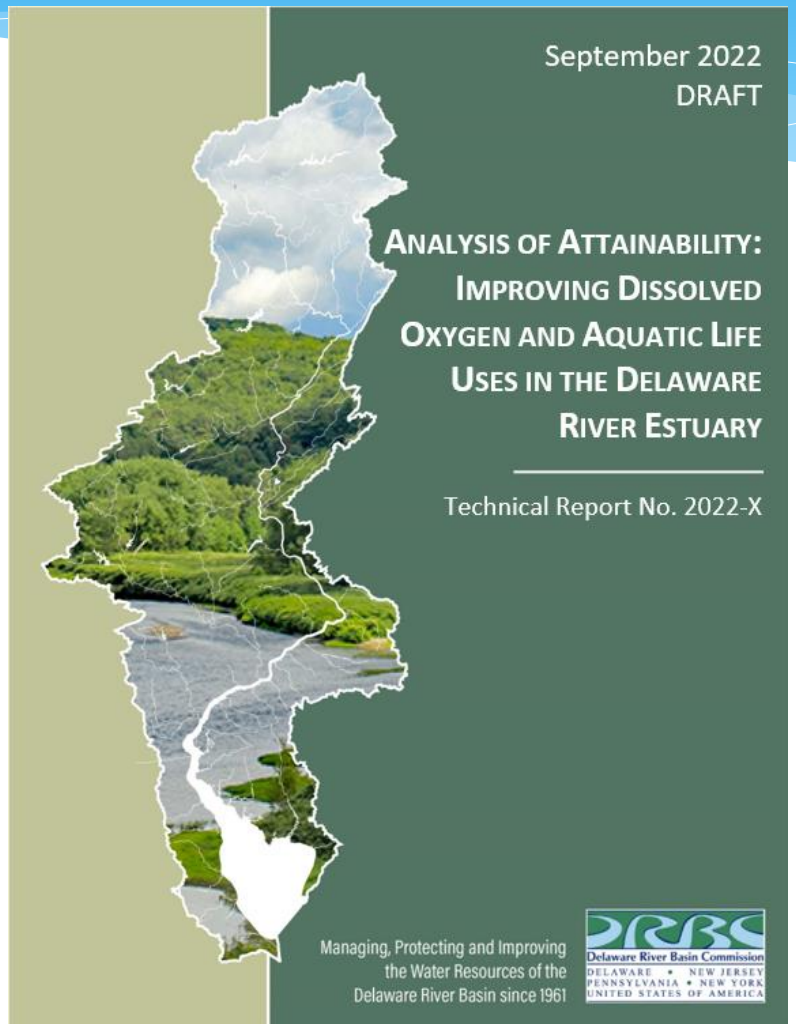
Questions / Clarifications



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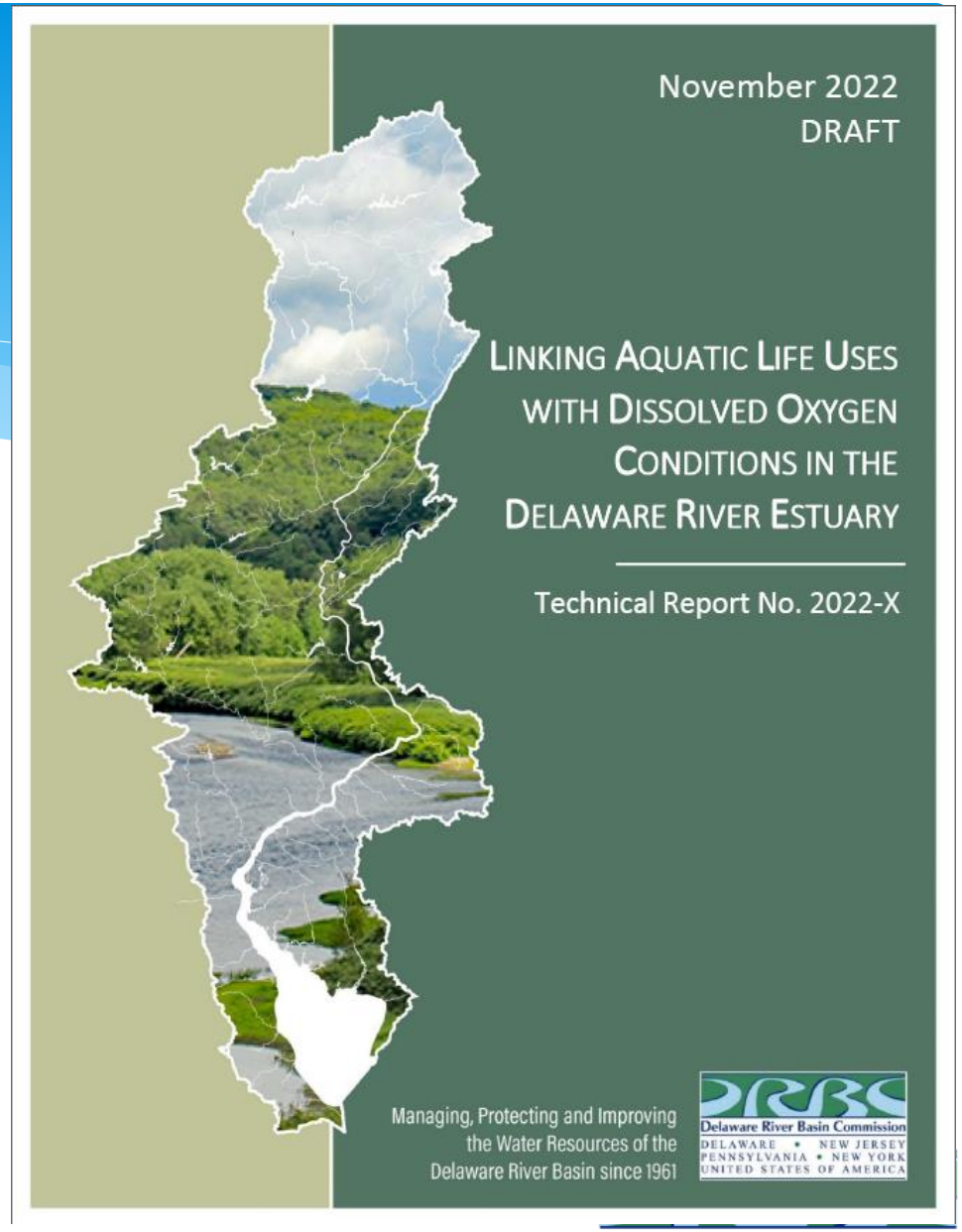
Linking aquatic life uses with DO conditions

- Status
  - 2nd draft released for WQAC review yesterday (11/14)
  - Completion follows informal consultation with USEPA and co-regulators
- Purpose
  - Synthesize the aquatic life use studies conducted pursuant to Resolution No. 2017-4
  - Determine the ranges of DO values that support propagation of DO-sensitive species
- This report does NOT propose specific water quality criteria



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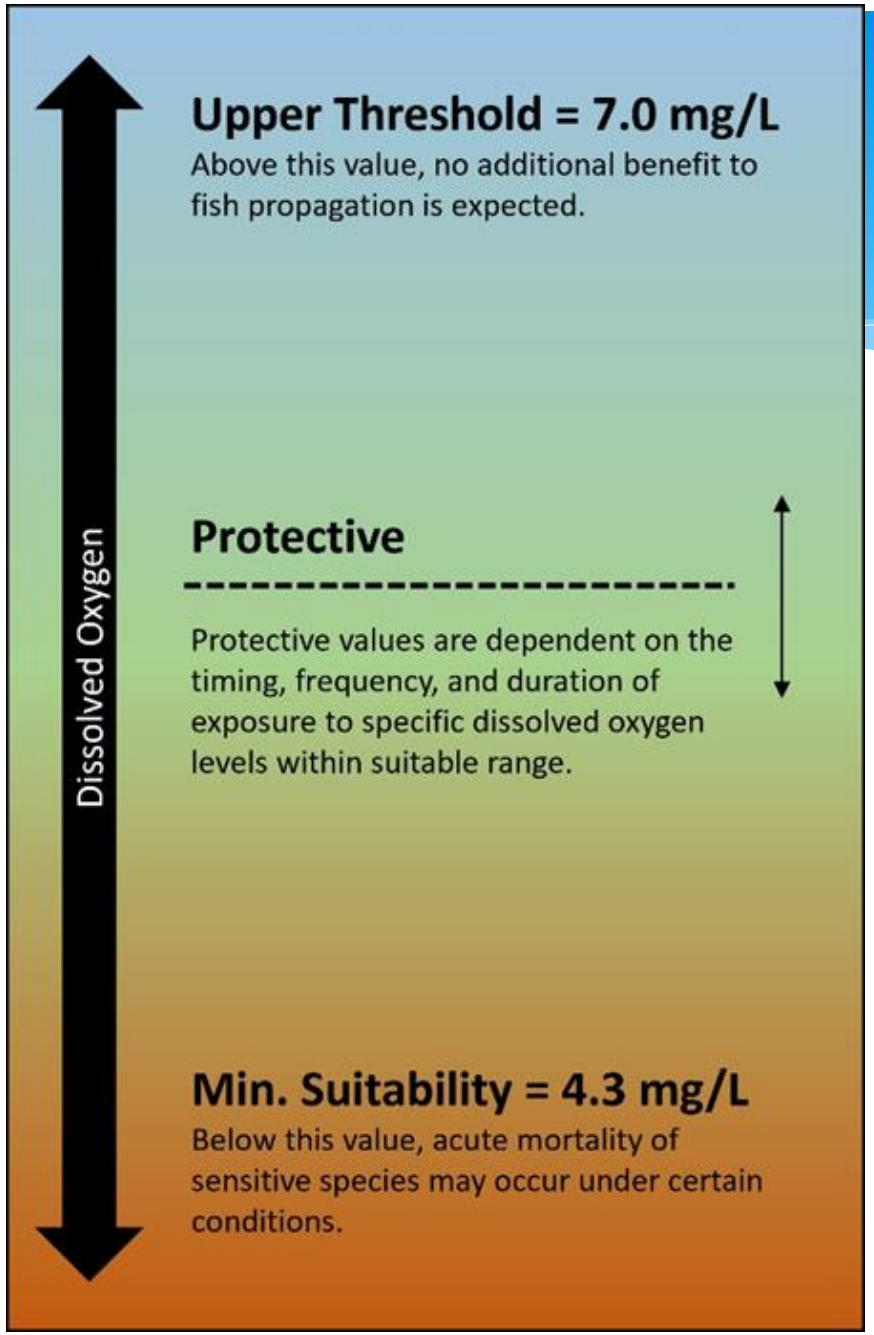

Suitability Gradient

- Minimum suitability threshold of 4.3 mg/L
  - EPA, 2003/2017
  - NOAA, 2017
  - Minimum DO to protect both endangered sturgeon species at stressful temperatures
    - ≥26°C for Atlantic Sturgeon
    - ≥29°C for Shortnose Sturgeon
- Minimum suitability threshold of 5.0 mg/L for spawning
  - American Shad (Stier and Crance, 1985)
  - Striped Bass (Turner and Farley, 1971)
- Upper DO threshold of 7.0 mg/L
  - Yellow Perch (Thorpe, 1977)
  - Channel Catfish (McMahon and Terrell, 1982)

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Seasonal Considerations

Summary of temporal and spatial occurrence patterns

Spring (April 1 - June 30)

Zone	Shortnose Sturgeon	Atlantic Sturgeon	American Shad	White Perch	Striped Bass	Channel Catfish	Largemouth Bass	Yellow Perch
2	All life stages present							
3								
4								
5								
6	Juveniles and adults present					Absent		

Summer (July 1 - September 30)

Zone	Shortnose Sturgeon	Atlantic Sturgeon	American Shad	White Perch	Striped Bass	Channel Catfish	Largemouth Bass	Yellow Perch
2	All life stages present							
3								
4								
5								
6	Juveniles and adults present					Absent		

Fall (October 1 - November 30)

Zone	Shortnose Sturgeon	Atlantic Sturgeon	White Perch	Striped Bass	Channel Catfish	Largemouth Bass	Yellow Perch	American Shad
2	Juveniles and adults present							Juveniles present
3								
4								
5								
6					Absent			

Winter (December 1 - March 31)

Zone	Shortnose Sturgeon	Atlantic Sturgeon	White Perch	Striped Bass	Channel Catfish	Largemouth Bass	Yellow Perch	American Shad
2	Juveniles and adults present							Juveniles present
3								
4								
5								
6					Absent			

- "critical propagation season" = May01–Oct15
  - "critical spawning/nursery period" = May01–Jun30
  - "critical growth/development period" = Jul01–Oct15
- Seasons
  - Spring = Apr–Jun
  - Summer = Jul–Sep
  - Fall = Oct–Nov

Spatial and temporal occurrence of egg and larvae stages of sensitive species captured during PSEG ichthyoplankton sampling

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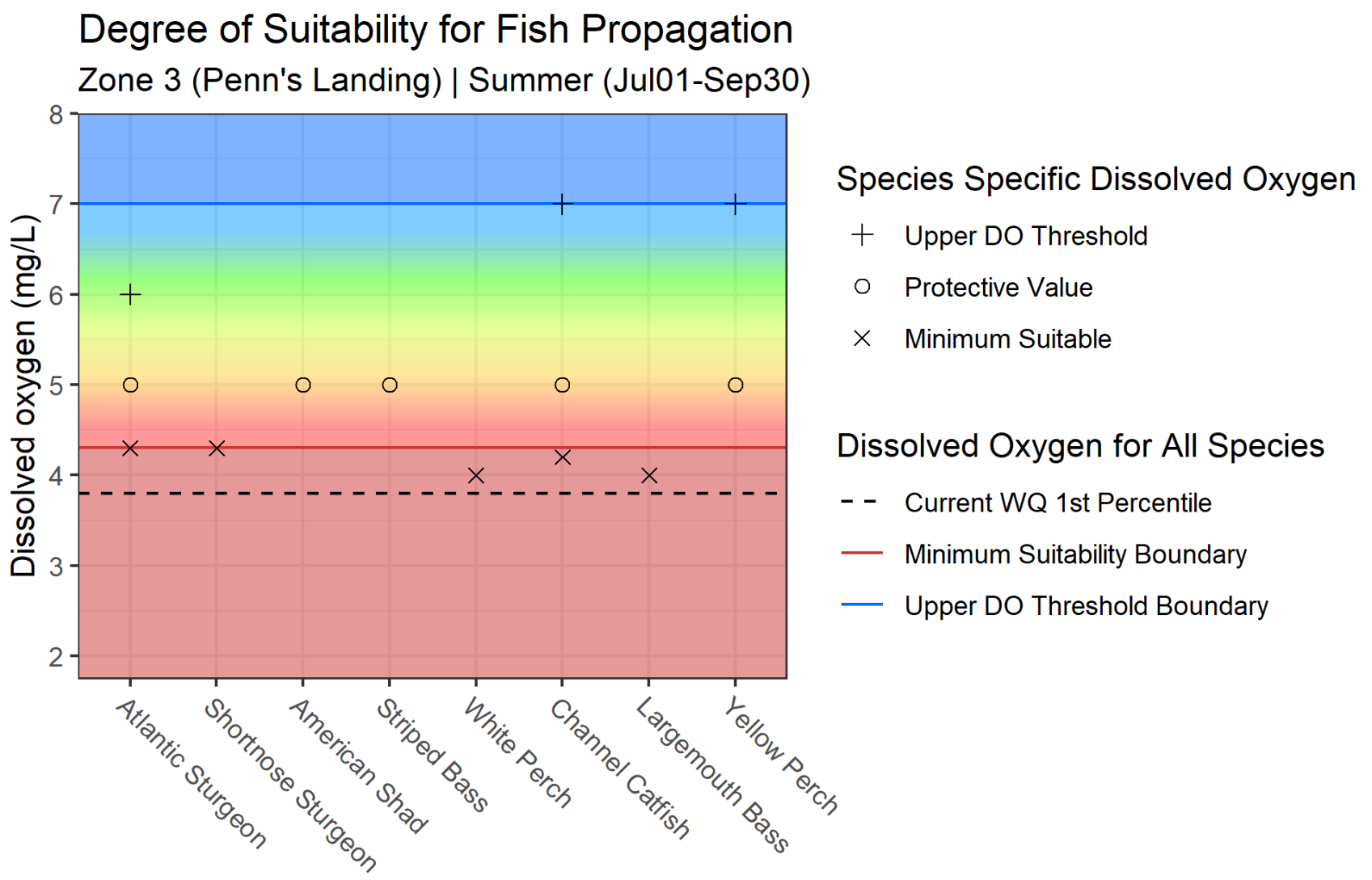
Visual evaluation of suitability at Penns Landing during Summer (Example)



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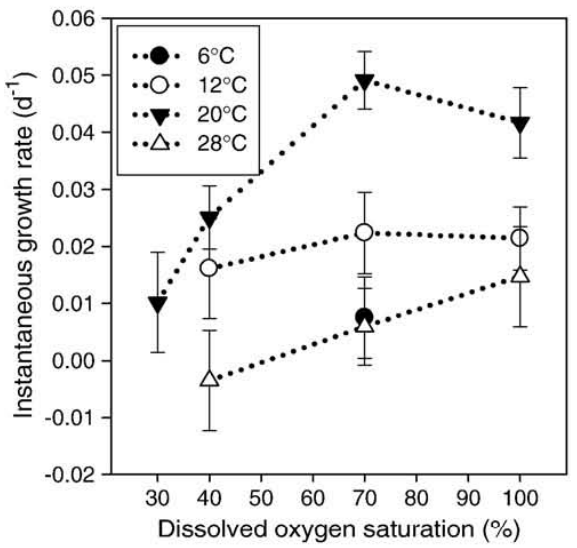
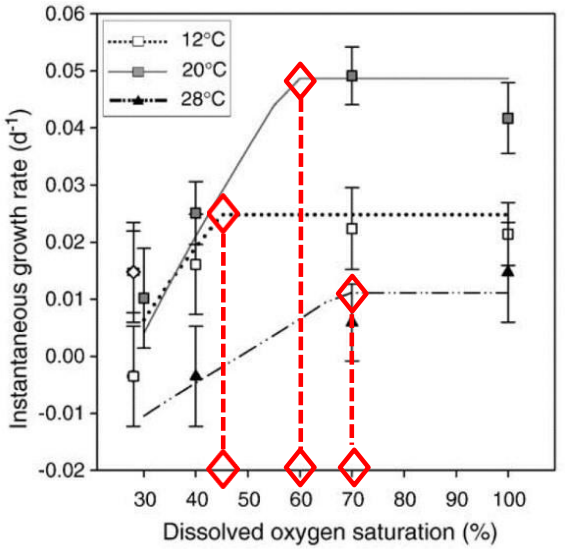
Thresholds for endangered sturgeon

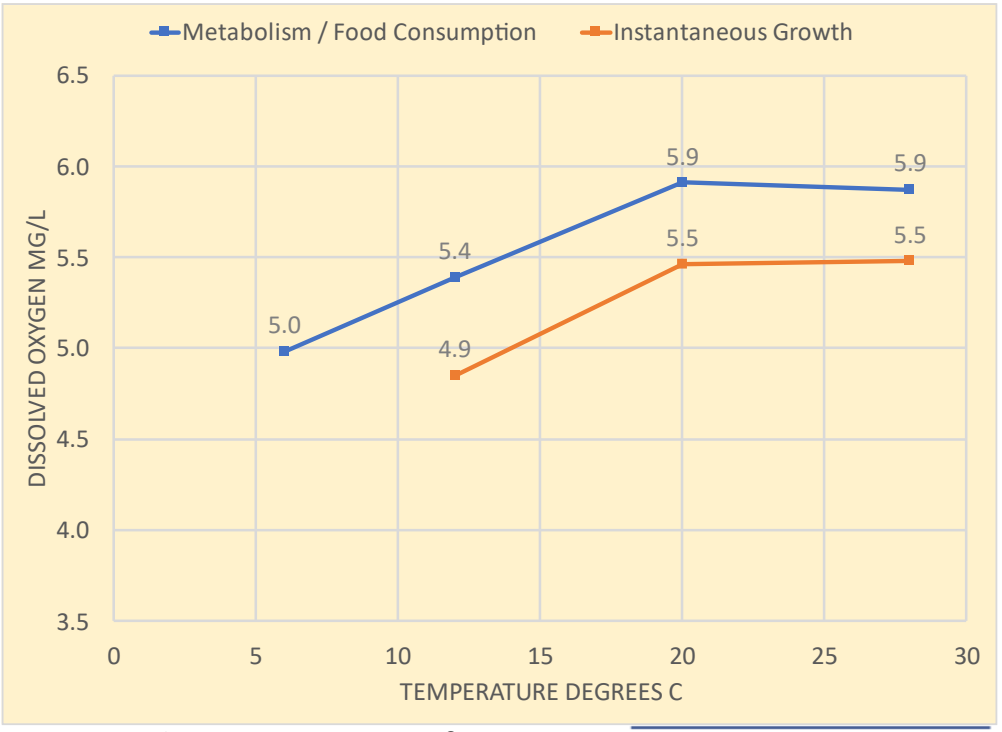
- Minimum suitability threshold = 4.3 mg/L
  - Based on acute mortality under stressful temps
- Upper DO threshold = 5.9 mg/L
  - Response threshold based on lab experiments and bioenergetics modeling of Atlantic Sturgeon
- What about 6.3 mg/L?
  - Growth rate at 70% DOsat higher than 30% or 40%
  - Threshold determined through bioenergetics modeling
    - 60% at 20 °C (~5.5 mg/L)
    - 70% at 28 °C (~5.5 mg/L)
  - Upper response threshold is not the same as a minimum required value

Laboratory Experiment



Modeling Interpretation





Greg Voigt, USEPA3

Follow-up on DO needs for juvenile Atlantic Sturgeon literature including author coordination

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Criteria Development

Administrative Process

- DRBC to initiate development of revised water quality standards
  - Designated uses
  - Water quality criteria
- DO Criteria (more than one likely)
  - Numeric values for DO
  - Averaging period(s) and seasons
  - Assessment methodology
- Criteria development will be performed:
  - In collaboration with co-regulators
  - Based upon guidance provided by the EPA for implementation of the Clean Water Act
  - With input from the Commission's WQAC
  - Based upon sound scientific rationale
- Final proposal will be subject of rulemaking

Technical Process

- Assemble protective values from literature
- Evaluate how others have implemented protective values as criteria
  - EPA guidance, and national criteria
  - Criteria developed or approved by EPA to protect similar uses
- Use water quality model to help determine the most useful means of expressing criteria over time and space in the Delaware Estuary
  - Design condition (permitted 2012)
  - Second design condition (permitted 2019)

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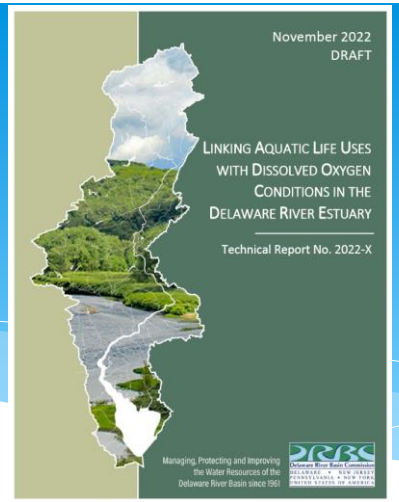
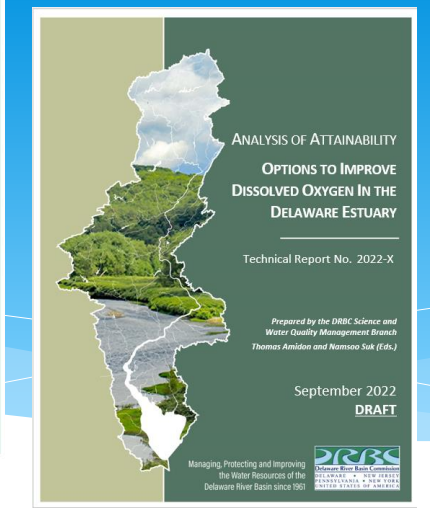
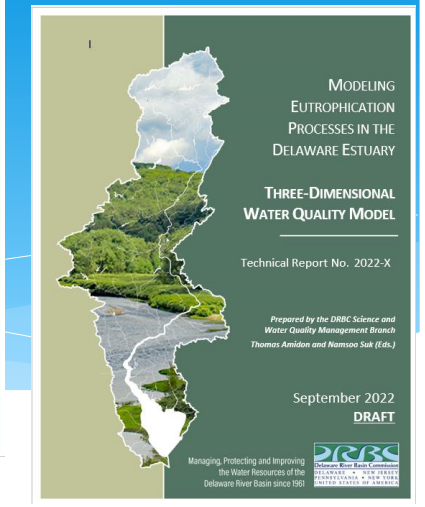
What's Next







Incorporate Comments and Finalize Reports

- Draft Hydrodynamics model calibration report
- Draft Water quality model calibration report
- Draft Socioeconomic evaluation study report
- Draft Linking aquatic life uses with DO conditions
- Draft Analysis of attainability report

Next Steps

- Solicit input from WQAC and co-regulators on draft reports
- Initiation of Rulemaking Process
  - WQS development
- Implementation Strategy
  - Consideration of prioritizing of dischargers
  - Consideration of alternative permitting

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