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Executive Director

February 20, 2024

Michael S. Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue N.W.
Washington, DC 20460

**SUBJECT: DOCKET ID NO. EPA-HQ-OW-2023-0222**
**"WATER QUALITY STANDARDS TO PROTECT AQUATIC LIFE IN THE DELAWARE RIVER"**

Dear Administrator Regan:

The Delaware River Basin Commission (DRBC) supports the U.S. Environmental Protection Agency's (EPA) proposed designated use and the application of science-based water quality criteria to protect all stages of aquatic life in the Delaware River Estuary. This written submission contains detailed technical comments for EPA's consideration. These comments supplement the oral comments provided by DRBC's Executive Director Steve Tambini during EPA's public hearing on February 6, 2024.

Please note that our comments are presented in the order in which each issue arises in EPA's Notice of Proposed Rulemaking (NPRM) and not in the order of their priority to the DRBC. Unless otherwise noted, the referenced sections are sections of the NPRM preamble.

## III. BACKGROUND

### III.B.1. Causes of Low Dissolved Oxygen in the Specified Zones of the Delaware River (88 FR 88317-18)

The text of the preamble accompanying footnotes 8 through 11 states:

> Along the Delaware River, untreated wastewater discharges typically occur during and after rainfall due to combined sewer overflows (CSOs), which are a source of nutrients (*i.e.,* nitrogen and phosphorus), sediments, and toxic contaminants, and can lead to increased chemical and biological oxygen demand in the river. Although the cumulative impact of historical CSOs on sediment oxygen demand in the Delaware River has not been estimated, CSOs can over time increase or maintain sediment oxygen demand as untreated organic material settles on the riverbed and is broken down by oxygen consuming bacteria (thus, removing oxygen from the water column), a process that continues long after the end of an overflow event. CSOs have been a persistent source of pollutants in the specified zones of the Delaware River for over a century. For example, sewer overflows from Philadelphia in the early 1900s deposited over 200,000 tons of solids per year, which, in combination with other solid wastes, created deposits 12 feet deep in the river. From July 1, 2021, to June

> 30, 2022, Philadelphia's wastewater system alone discharged over 1.7 billion cubic feet of CSOs into the Delaware River.

EPA's discussion of the causes of low dissolved oxygen (DO) in the specified zones of the Delaware River focuses on both: 1) impacts from combined sewer overflows (CSOs) during and after rainfall; and 2) impacts from treated wastewater that contains high levels of ammonia nitrogen. The DRBC's draft Analysis of Attainability report (DRBC, 2022) and the modeling on which it relies demonstrate that the primary cause of low DO is ammonia nitrogen in treated wastewater discharged from active point sources.

The DRBC agrees that sediment oxygen demand (SOD), to which CSOs may contribute, is a significant factor affecting Estuary DO levels. However, the emphasis on CSOs in the quoted paragraph seems to suggest that *CSOs* are the primary or at least a significant driver of SOD *and* low DO in the Estuary. Reducing CSOs through the implementation of LTCPs certainly has the potential to improve SOD, and thus DO, in the river. But how much the anticipated reduction in CSO discharges will reduce SOD is not yet known and remains an important subject for further investigation. In contrast, the science to date demonstrates clearly that reducing ammonia nitrogen loads from specific wastewater treatment plants will significantly elevate seasonal DO in the Estuary, resulting in levels far more supportive of fish propagation than those experienced currently.

To underscore the impact of CSOs, EPA points out that over a 12-month period, Philadelphia's wastewater system alone discharged 1.7 billion cubic feet of CSOs into the Delaware River (see preamble text accompanying footnote 11). Notably, over the same period, Philadelphia's three wastewater treatment plants collectively discharged more than ten times that volume—approximately 21.1 billion cubic feet of treated wastewater—containing elevated concentrations of ammonia nitrogen. PADEP, Electronic Discharge Monitoring Report (eDMR) System (retrieved Feb. 18, 2024). We recommend that EPA acknowledge the primary influence of treatment plant discharges on Estuary DO conditions.

### III.B.2. Endangered Species in the Specified Zones of the Delaware River (88 FR 88318-19)

EPA's text accompanying footnote 32 further states:

> Low oxygen levels can lead to habitat displacement effects whereby juvenile Atlantic Sturgeon seeking relief are constrained to waters that remain suboptimal for growth due to other limiting factors (*e.g.,* higher salinity waters).

Habitat displacement effects on juvenile sturgeon are possible; however, salinity is unlikely to be the limiting factor in this system. The Technical Support Document (TSD) states that growth is maximized at 9 ppt salinity and that salinity levels in the study area never exceed 2 ppt. For juvenile sturgeon to be displaced to a point where salinity is harmful, they would have to be pushed dozens of miles downstream, far past the extent of the seasonal DO sag. Examples of more appropriate limiting factors associated with habitat displacement could be prey availability, benthic habitat, or other factors that draw juvenile sturgeon to their current concentration area near Marcus Hook.

### III.B.3. Dissolved Oxygen Trends in the Specified Zones of the Delaware River (88 FR 88319)

The preamble text accompanying footnote 35 reads:

> Starting in 1970, dissolved oxygen levels began to increase steadily in association with declining ammonia nitrogen concentrations in the river.

This sentence, which is repeated in the EPA's TSD (see p.11) is misleading. The primary reason for improvement in dissolved oxygen levels starting in the 1970s was the control of carbonaceous biochemical oxygen demand (CBOD) in wastewater treatment plant discharges. The USGS report Water Quality Trends in the Delaware River Basin Calculated Using Multisource Data and Two Methods for Trend Periods Ending in 2018 (USGS Scientific Investigations Report 2022-5097) cited at footnote 36 of the NPRM, relied on screened data from eight organizations for 16 constituents, including ammonia, at 124 sites across the Delaware River Basin, beginning as early as 1968. The report shows that ammonia levels have remained largely unchanged (Figure 5). EPA at footnote 35 of the NPRM cites Sharp's observation (Sharp, 2010) that Delaware Estuary DO concentrations increased and ammonia concentrations decreased starting in the 1970s and appears to assume a causal link between the two. While there is some uncertainty regarding ammonia trends over that time period, it is well understood and well documented that wastewater treatment plant upgrades were specifically engineered, funded and implemented to reduce *carbonaceous* biochemical oxygen demand (CBOD) in order to improve ambient dissolved oxygen. CBOD—not *nitrogenous* biochemical oxygen demand (NBOD)—reductions were modeled and mandated by DRBC and implemented throughout the 1970s and 1980s. The journal article The Historical Context of Water Quality Management for the Delaware Estuary (Albert, 1988) recounts that EPA funded over one billion dollars of regional wastewater treatment plant upgrades in response to wasteload allocations developed and issued by DRBC, resulting in the addition of secondary wastewater treatment at treatment plants that included PWD-NE (1985), PWD-SE (1986), PWD-SW (1980), Trenton (1983), Camden (1987), and DELCORA (1980).

The text of the preamble accompanying footnote 38 reads:

> Recent modeling studies have shown that further reductions in pollutant loading, including a reduction in the volume and frequency of CSOs as well as enhanced treatment of ammonia nitrogen discharges, could significantly improve the dissolved oxygen conditions in the relevant zones of the Delaware River.

The cited studies, which were performed by DRBC, point almost exclusively to reductions in ammonia from treated wastewater discharges as the factor that can significantly improve DO conditions in the impacted zones of the Estuary. It would be more accurate to state: "Recent modeling studies have shown that further reductions in pollutant loading through enhanced removal of ammonia nitrogen by wastewater dischargers and, to a much lesser extent, reduction in the volume and frequency of CSOs, could significantly improve dissolved oxygen conditions in the relevant water quality zones of the Delaware River."

Footnote 39 of the preamble states in part:

> Although portions of the Delaware River Estuary are within New York's jurisdiction, the EPA's proposed rulemaking is not applicable to waters under New York's jurisdiction (see IV.A. of this preamble: Scope of EPA's Proposed Rule).

No portions of the Delaware River Estuary are within New York's jurisdiction. The statement would be correct if "Estuary" were deleted or replaced with "Basin."

## III.D. Currently Applicable Aquatic Life Designated Uses and Dissolved Oxygen Criteria (88 FR 88319-20)

The first paragraph of section D of the preamble states:

> Based on the conditions of the Delaware River at the time, DRBC concluded that 'propagation of fish' was not attainable . . . due to the presence of industrial and municipal discharges and associated low dissolved oxygen levels. DRBC, therefore, adopted WQS to include 'maintenance of resident fish and other aquatic life,' 'passage of anadromous fish,' and a dissolved oxygen criterion of 3.5 mg/L, as a daily average, for these zones of the Delaware River. Because these WQS provide for the 'maintenance' and 'passage' of aquatic life (i.e., 'protection') but not the 'propagation of fish, shellfish and wildlife,' these WQS are not consistent with the goals specified in CWA section 101(a)(2). However, these WQS adopted in 1967 remain applicable for Zone 3, Zone 4, and the upper portion of Zone 5 of the Delaware River as directly referred to or implicitly incorporated in Delaware's, New Jersey's, and Pennsylvania's WQS.

Additional points of background relevant to this topic include:

1. The aquatic life uses adopted by DRBC and incorporated into the states' WQSs were approved by EPA under the Federal Water Pollution Control Act, 33 U.S.C. Sec. 1251 *et seq*. (the "Clean Water Act").

2. Section 101(a)(2) of the CWA establishes as a national goal water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water, wherever attainable.

3. Citing work completed by DRBC in September 2022, EPA on December 1, 2022, formally recognized that propagation was attainable and determined that the WQS needed to be revised.

## III.D.2. Delaware's, New Jersey's, and Pennsylvania's Current Dissolved Oxygen Criteria (88 FR 88320)

The text introducing Table 3 states:

> As explained above with respect to the aquatic life designated use, DRBC's dissolved oxygen criteria for the specified zones of the Delaware River do not protect for aquatic life propagation and are therefore not consistent with CWA section 101(a)(2) goals.

The national goals of the CWA include the statutory language "wherever attainable." A fully accurate version of this statement might read: "Because EPA determined on December 1, 2022 that propagation is attainable, these WQS are no longer consistent with the goals specified in CWA section 101(a)(2), which include, in relevant part, the protection and propagation of fish, shellfish, and wildlife "wherever attainable."

## III.D.3. Intersection of Delaware's, New Jersey's, and Pennsylvania's Current Aquatic Life Designated Uses and Dissolved Oxygen Criteria with CWA 101(a)(2) Goals (88 FR 88321)

The preamble text preceding Table 4 states:

> However, none of the three states' dissolved oxygen water quality criteria for the specified zones are protective of fish and shellfish propagation. Therefore, none of the states, and by extension none of the specified zones of the Delaware River, currently has a set of WQS for aquatic life that are fully consistent with the CWA section 101(a)(2) goals (i.e., 'water quality which provides for the protection and propagation of fish, shellfish, and wildlife [. . .]').

The following statement better characterizes the regulatory status of the existing WQS. "However, due to the determination in 1967 that propagation was not then attainable, none of the three states promulgated dissolved oxygen water quality criteria for the specified zones that are protective of fish and shellfish propagation. Because EPA has determined that propagation in the Estuary is now attainable, none of the states, and by extension none of the specified zones of the Delaware River, currently has applicable WQS for aquatic life that are fully consistent with the CWA section 101(a)(2) goals (i.e., 'wherever attainable, . . . water quality which provides for the protection and propagation of fish, shellfish, and wildlife [. . .]')."

## IV. PROPOSED WATER QUALITY STANDARDS

### IV.A. Scope of EPA's Proposed Rule (88 FR 88321)

EPA states:

> EPA's proposed rule, if finalized, would apply to Zone 3, Zone 4, and the upper portion of Zone 5 of the Delaware River.

The preamble here and elsewhere refers to DRBC water quality management zones 3, 4, and upper zone 5. Importantly, the DRBC water quality zones for the tidal Delaware River include the tidal portions of tributaries (see DRBC Water Code, § 3.30.1.), while the proposed rules do not (see EPA's proposed rule language at § 131.XX(a)(1) and (2), providing that the designated use in (a)(1) and the aquatic life criteria in (a)(2) apply to "river miles 108.4 to 70.0 of the Delaware River," and § 131.XX(d)(1) and (2), providing that the designated use in paragraph (b) applies "in New Jersey and Pennsylvania for river miles 108.4 to 70.0 of the Delaware River" and the aquatic life criteria in paragraph (c) applies "in Delaware, New Jersey, and Pennsylvania for river miles 108.4 to 70.0"). While the proposed rule language is clear, EPA could eliminate any misunderstanding as to the scope of the proposed standards by adding the word "mainstem" before "Delaware River" in future communications about the new standards. Notably, DRBC's modeling analyses and cost studies, on which EPA relied for its proposed rulemaking, all focused on outcomes in the mainstem tidal Delaware River and Bay and were not designed to evaluate outcomes within the tidal tributaries.

### IV.C.1. Derivation of Dissolved Oxygen Criteria (88 FR 88322)

The second sentence of this section of EPA's preamble states:

> Although the methods and data are from peer-reviewed scientific literature, the EPA is nonetheless in the process of completing an external peer review on the application of these methods and data in this context where the EPA is proposing

> criteria to protect proposed and applicable aquatic life designated uses that include propagation.

As part of this rulemaking, EPA should disclose the external peer review process, including but not limited to the reviewers' comments, EPA's responses, and any revisions to the methods recommended or made as a result of the review.

We note that the first sub-heading in this section of the preamble reads, "Existing the EPA Methodology and Guidance Documents." In case EPA prepares errata, it appears the first two words of this heading should have been deleted.

The last sentence in this sub-section states:

> Given the availability of laboratory data specific to the oxygen requirements of Atlantic Sturgeon and Shortnose Sturgeon, the EPA chose to derive site-specific criteria to protect the oxygen-sensitive endangered species in the specified zones of the Delaware River and not rely on the national recommendations in the Gold Book or Virginian Province Document in this instance.

EPA makes clear that it specifically chose not to use its DO national guidance or guidance developed in other regions inhabited by the same DO-sensitive species. Does EPA plan to now use the methodology developed for the Delaware River Estuary in other water bodies used by DO-sensitive species such as the Atlantic Sturgeon?

The subsection, "Delineating Seasons for Criteria Derivation," begins:

> In consideration of available information, including information developed by DRBC, the EPA is proposing to delineate three distinct seasons for dissolved oxygen criteria development that are intended to protect Atlantic Sturgeon early life stages, while also protecting a range of other aquatic species' sensitive life stages in the specified zones.

DRBC worked closely with EPA to develop the definition and basis for the three seasons, and supports the delineation. DRBC's draft report *Linking Aquatic Life Uses with DO Conditions in the Delaware Estuary* provides additional analysis, including the basis for the demarcation between spawning and growth seasons in particular.

In the sub-section, "Ecological Modeling to Derive Criteria for the Juvenile Development Season" (88 FR 88323), EPA describes its cohort model that "uses growth and mortality rates to calculate […] the instantaneous amount of biomass produced per unit of cohort biomass per day[…] to estimate the fraction of the cohort that survives from July 1 through October 31 (i.e., the Juvenile Development season) and the relative change in biomass for the same period."

Within the scripts that EPA developed to implement its cohort model, EPA constrains the average fish weight to prevent the weight from falling below the starting weight of 27 grams. (Code 6.01. "if weight falls below initial weight, then reset to initial weight"). This raises two concerns:

1. What is the biological justification for not allowing a fish to become smaller than its starting size (i.e., to lose weight)? Once a fish grows larger, the model allows for loss of mass, so why wouldn't that be appropriate across all weights?

2. Forcing growth back to the initial value affects the calculation of HSI. HSI is the difference between the mean seasonal growth rate and the mean seasonal mortality rate. When growth is forced back to the initial value on a given day, that day's predicted growth rate is not being fully reflected in the cohort. However, that growth rate is reflected in the seasonal mean growth rate calculation that is ultimately used in calculating the HSI.

In the sub-section, "Ecological Modeling to Derive Criteria for the Juvenile Development Season" (88 FR 88323), EPA states:

> As part of the cohort model, the EPA developed a new mortality model and implemented a peer-reviewed bioenergetics-based growth model described by Niklitschek and Secor (2009b) to predict the daily instantaneous mortality rate and growth rate, respectively, for members of the cohort. To develop a mortality model, the EPA fit a regression to experimental data to predict mortality resulting from low dissolved oxygen at any given temperature and percent oxygen saturation.

Table 2 on page 24 of the Technical Support Document includes mortality rates from the upper panel of Figure 7 in Niklitschek and Secor 2009a only. The lower panel of the figure shows instantaneous mortality rates associated with a water temperature of 20°C, salinity = 1 ppt, and dissolved oxygen saturations of 40, 70, and 100%. These values appear to be more relevant to the study area than the tests done at salinity of 8 ppt (upper panel). Why are these values not included in the analysis? Do Niklitschek and Secor have additional data that is not shown in the paper at 1 ppt salinity and 28°C that could also be included?

In the sub-section, "Ecological Modeling to Derive Criteria for the Juvenile Development Season" (88 FR 88323-24), EPA discusses its estimates of existing and restored conditions in the context of criteria derivation.

As described in the TSD, the EPA relied on characterizations of actual observed conditions (dissolved oxygen, temperature, and salinity), as well as estimated restored conditions over the 20-year period from 2002 to 2022 (2010 being excluded due to data limitations). EPA's estimate of the restored condition was based on DRBC's highest attainable dissolved oxygen (HADO) scenario, set forth in the draft report *Analysis of Attainability: Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary* (DRBC, 2022). The HADO scenario represents expected water quality after all impactful wastewater discharges have been fully upgraded and all CSO Long Term Control Plans have been fully implemented. The EPA's characterized existing and restored conditions are in various ways relevant to: the EPA's model validation comparisons (88 FR 88323), criteria calculations (88 FR 88324), and characterization of baseline and policy scenarios for the economic analysis (88 FR 88330).

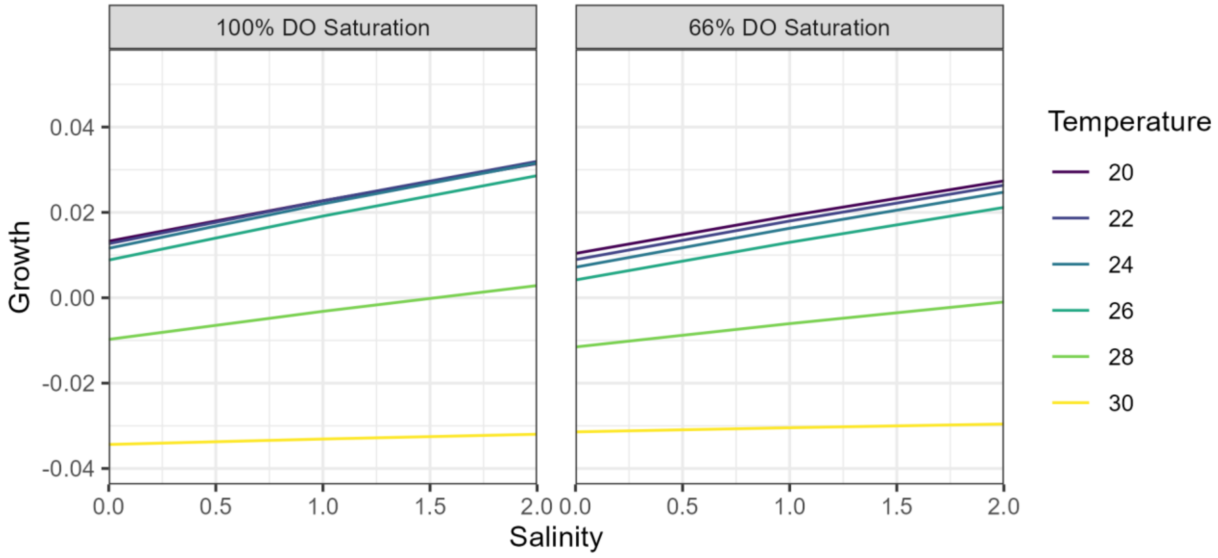
The manner in which EPA characterized existing and restored water quality conditions could be improved to better reflect the rich analyses that can be derived from DRBC's modeling output, as described in the Appendix to these comments. Regarding the characterization of existing water quality for both model validation and criteria calculations, EPA relied exclusively on observed data at the Chester and Penns Landing gages. Daily, depth-averaged estimates of dissolved oxygen at any of the 661 water column cells in Zones 3, 4, and upper 5 of DRBC's model domain can be computed as a function of observed data at individual gages for any year based on empirical spatial relationships from the three simulation years (2012, 2018, and 2019). DRBC provided these computations for 2008 to 2023 and would be pleased to provide them back to 2002 upon request. When evaluating existing water quality in a management zone, it is important to consider the range of water quality rather than just the water quality at the location of a single gage in each zone. Specific recommendations to improve empirical formulations, fill data gaps, and address code issues are consolidated in the Appendix to these comments.

Ecological Modeling To Derive Criteria for the Juvenile Development Season (88 FR 88324)

The preamble states:

> The EPA requests comment on the conclusion that HSI greater than zero defines suitable habitat for juvenile Atlantic Sturgeon growth and survival, or alternatively, if evidence could support that a value of HSI less than zero could also be protective or if a higher HSI threshold may be needed to protect propagation in the specified zones.

The bioenergetics model provides: 1) a compelling causal link between dissolved oxygen levels and propagation; and 2) a meaningful way to compare the seasonal dissolved oxygen conditions from one year to another and one loading scenario to another in terms of the degree of support for propagation. However, observations or additional bases to support the conclusion that a positive HSI over the growth and development season of every year are required to support a sustainable, propagating fish population would strengthen EPA's proposal. The growth and development season (July through October) in the applicable zones of the Delaware River Estuary experiences a salinity gradient between 0 and 2 psu and a temperature gradient between 20 and 30 degrees C. The graphs below show, based on EPA's bioenergetics model, the growth rates that would be calculated at dissolved oxygen saturation levels of 100% and 66%, respectively. Mortality will always negatively impact HSI, especially at higher temperatures. As a result, regardless of DO saturation, losses due to mortality must be overcome by growth in order to achieve a total HSI of zero. Given that the temperature-induced mortality in a mid-Atlantic estuary is non-trivial, it is not clear that the natural conditions could reasonably be expected to achieve a minimum HSI of 0 during all years.



Ecological Modeling To Derive Criteria for the Juvenile Development Season (88 FR 8832)

The preamble states:

> The predicted HSI value relies on an expected distribution of percent oxygen saturation values during the season; therefore, the EPA selected two percent oxygen saturation percentiles as thresholds at or above which median HSI is expected to be greater than zero to maintain the expected distribution of percent oxygen saturation values.

A more accurate statement would be, "The predicted HSI value accounts for the ~~relies on an~~ expected distribution of percent oxygen saturation and temperature values during the season." The use of more than one seasonal percentile criterion will not "maintain the expected distribution of percent oxygen saturation values," it will merely make the criteria more stringent and no longer connected to a particular median HSI outcome. See comments below on Alternative 2.

Criteria Expressed as Percent Oxygen Saturation (88 FR 88324)

The text linked to footnote 66 of the preamble states, ". . . EPA derived the proposed criteria in terms of percent oxygen saturation, rather than in units of concentration . . . ."

DRBC agrees with the expression of dissolved oxygen criteria in units of percent oxygen saturation. See comments below on Alternative 1.

## IV.C.2. Proposed Dissolved Oxygen Criteria (88 FR 88325)

The second paragraph of Section IV.C.2 of the preamble includes the statement:

> For this proposed rulemaking, the exceedance frequency is determined based on the dissolved oxygen percentile from which the magnitude is derived (*i.e.*, the 10th percentile can be exceeded 10% of the time, which for a season consisting of 123 days is 12 cumulative days of exceedance).

The proposed criteria do not contain a minimum dissolved oxygen criterion. Minimum suitability criteria for dissolved oxygen are important to protect fish health/survival and are routinely included in state and regional water quality regulations. In fact, the EPA Gold Book recommends a minimum dissolved oxygen criterion, "to make certain that no acute mortality of sensitive species occurs as a result of lack of oxygen." It is important that EPA identify the critical level of acute dissolved oxygen exposure and demonstrate how the proposed 10th percentile criterion will provide protection against short-term low dissolved oxygen occurrences. Page 37 of the TSD briefly addresses a minimum by stating, "Empirically, if the criterion for the 10th percentile is attained, then minimum values that would impact the cohort are unlikely." DRBC agrees with this assertion, and with the proposition that regulating dissolved oxygen at the 10th percentile level rather than a minimum provides the same level of protection without being impacted by the data issues encountered at the extreme low end of the frequency distribution. Clearer support by EPA for the assertion that the 10th percentile criterion is protective of critical minimum dissolved oxygen levels would strengthen the proposal.

## IV.C.3. Comments Regarding Alternatives (88 FR 88325)

EPA specifically requested comments on the alternatives in Part IV.C.3, in particular regarding how they would be protective and why they might be beneficial compared to the proposed criteria.

### Alternative 1: Dissolved Oxygen Criteria Expressed as Concentration (mg/L)

For the reasons clearly articulated by USEPA in the section of the preamble entitled “Criteria Expressed as Percent Oxygen Saturation” (88 FR 88324), DRBC agrees that it is preferrable to express the criteria in units of percent oxygen saturation (as proposed) rather than as dissolved oxygen concentration (as contemplated by Alternative 1). Percent oxygen saturation is the most direct measure of impact on aquatic life and incorporates the impacts of temperature on dissolved oxygen solubility throughout the year.

### Alternative 2: Single Dissolved Oxygen Criterion During the Juvenile Development Season with a 10% Exceedance Frequency

EPA's proposed DO criteria for the critical Juvenile Development season consist of two seasonal percentile thresholds that must both be met. Alternative 2, the specification of a single 10th percentile seasonal criterion during the Juvenile Development season, in our view has a stronger technical basis than the proposed approach. While the basis for the proposed criteria is transparent, the application of both undermines EPA’s target goal (achieving a median HSI of 0.0).

Each of the two juvenile development season criteria corresponds to the intersection of the 0.0 HSI predictions for existing and restored conditions with DO percentile, which represents the point at which, in half of all years, the juvenile cohort is expected not to lose biomass. There is noise around each prediction, and the median DO (calculated using a QGAM function) associated with an HSI of 0.0 was selected for each proposed seasonal percentile criterion. (IPP = 0.0). The finding is based on actual data and predictions for the Delaware River, so the expected DO distribution is already accounted for in each criterion. For example, for the 10th percentile criterion example: if the 10th percentile is 66% POSAT (or 5.4 mg/L) or higher, then the water quality associated with the entire range of the DO distribution can be expected to meet the IPP target. The 10th percentile criterion not only protects at the 10th percentile level, it also assures that the DO condition associated with a particular 10th percentile level will be protective.

As stated in the proposed rulemaking (p. 88324): “These models can be understood to find the minimum dissolved oxygen level that if achieved would result in an expectation that HSI would be equal to or greater than zero as often or more often than if it is less than zero.” This sentence applies to each of the percentile criteria independently; either of the proposed percentile criteria is equivalent to a median HSI of zero, accounting for the range around each median. Applying both criteria makes it impossible to determine what HSI level is being captured by the criteria.

Two reasons point to a lower percentile being more meaningful than the median (50th percentile). First, lower DO occurrences are what directly drive growth and mortality impacts on fish. Second, changes in pollutant loads exert a greater impact under lower DO conditions than higher DO conditions, based on mass balance. Thus, in our view, the dual-criteria approach does not afford a stronger technical basis, more clarity, or greater environmental protection.

## VIII. ALTERNATIVE REGULATORY APPROACHES AND IMPLEMENTATION MECHANISMS

### VIII.C. Clean Water Act Section 303(d)/305(b) Water Quality Assessments (88 FR 88329)

The text accompanying footnote 79 of the preamble states:

> DRBC therefore concluded that further controls on point sources are needed to achieve dissolved oxygen water quality conditions that support aquatic life designated uses that include propagation in the specified zones. The EPA's economic analysis evaluates point source controls that are expected to result in dissolved oxygen levels that meet EPA's proposed criteria.

This statement suggests that DRBC's modeling supports the expectation that point source controls will result in attainment of the EPA's proposed criteria. However, DRBC's evaluation, as set forth in our 2022 Analysis of Attainability report, was performed based on the highest attainable dissolved oxygen conditions at different matrices (magnitude, duration, and frequency), not on the EPA's proposed DO criteria.

Later in the same paragraph, EPA states:

> If, after finalization of this rulemaking, DRBC, Delaware, New Jersey, or Pennsylvania require effluent limitations and/or other pollution control requirements that the EPA agrees are stringent enough to implement the final dissolved oxygen criteria, the specified zones may be a candidate for Category 4b in future IRs. The EPA will work with Delaware, New Jersey, and Pennsylvania, in consultation with DRBC, on future IRs to determine the appropriate assessment status for the waters that are subject to this rulemaking.

EPA should make explicit that if a CSO discharger is adhering to a schedule of compliance for a CSO Long Term Control Plan (LTCP), water quality impairments for DO may fall within assessment Category list 4b as described in EPA's Integrated Reporting Guidance for CWA sections 303(d), 305(b), and 314, and a TMDL may not be required. Given that the implementation and the assessment of the impacts of implementation will likely span many years, it is imperative that current decision makers provide clear guidance for future EPA staff on this point.

## IX. ECONOMIC ANALYSIS

### IX.A. Baseline for the Analysis (88 FR 88330)

Between footnotes 80 and 81, the preamble states:

> Along the specified zones of the Delaware River, there are three combined sewer systems with CSO LTCPs that are relevant for consideration by the EPA as part of the baseline.

EPA identifies these as the Philadelphia, Camden and Delaware County (PA) systems. EPA should acknowledge that combined sewer systems with CSOs are also present in the Wilmington and Trenton systems.

## IX.B. Development of the Policy Scenario (88 FR 88330)

This section opens with the statement:

> There is a wide range of potential paths that Delaware, New Jersey, and Pennsylvania may choose to take when implementing the EPA's proposed WQS.

This statement could be misunderstood. A variety of regulatory tools exist under the Clean Water Act, and potential implementation schedules may well "range widely." (On the latter point, see, https://www.epa.gov/waterfinancecenter/clean-water-act-financial-capability-assessment-guidance.) However, with respect to the infrastructure improvements required, the range of options is limited. DRBC modeling demonstrates that: 1) scenarios aligned with attaining EPA's proposed criteria necessarily involve effluent concentrations capped at approximately 1.5 mg/L of ammonia for the facilities exhibiting the greatest water quality impact; and 2) other manipulations of loads from other point and nonpoint sources will have relatively little impact and would therefore not be aligned with attaining EPA's proposed criteria.

### Economic Analysis Document, section 4.2.1: Characterizing Water Quality under the Baseline and Proposed Rule.

In subsection 4.2.1.2 (p. 48) of EPA's separate Economic Analysis document (cited in footnote 87 of the NPRM) EPA states:

> However, the 10th percentile of depth-averaged daily modeled DO concentrations is 5.27 mg/L and is therefore below the value needed to meet EPA's proposed standard based on 10 percent exceedance. To represent conditions after implementation of the proposed standards, EPA selectively adjusted the daily modeled DO concentrations when necessary to meet the proposed WQS (i.e., adjusting depth-average daily modeled DO concentrations that are below but closest to the level corresponding to the 10 percent exceedance to be equal to the 10 percent exceedance value, as needed for the 10th percentile of the distribution of depth-average daily DO concentrations to equal 5.4 mg/L). The needed adjustments to modeled 2019 outputs were small.

EPA acknowledges that "the 10th percentile of depth-averaged daily modeled DO concentrations is 5.27 mg/L and is therefore below the value (5.4 mg/L) needed to meet EPA's proposed standard based on 10 percent exceedance." To proceed with the economic analysis for the restored condition, EPA adjusted 4% of the depth-averaged daily DO modeled concentrations upward to equal 5.4 mg/L. The rationale EPA offers is that the adjustment was needed to ensure the estimate of restored condition would satisfy the proposed WQS and that the adjustment was within the magnitude of the level of uncertainty. DRBC agrees with this; however, as we explain elsewhere in our comments, more accurate estimations of dissolved oxygen for both the baseline and policy conditions, which would not propagate calibration uncertainty, would be achieved by developing empirical relationships between modeled scenarios and calibration scenarios and applying the relationships to observed gage data. DRBC performed a similar analysis using permitted loads and found that the expected 10th percentile dissolved oxygen under a restored condition for 2019 would be approximately 5.6 mg/L. DRBC's preliminary results for an evaluation conducted for the 15-year period from 2008 to 2023 indicated that in most of these years, the 10th percentile DO and POSAT would exceed 5.4 mg/L and 66%, respectively, everywhere in the Estuary.

## IX.C. Potential Costs (88 FR 88330-31)

The preamble text accompanying footnote 84 states, "The EPA relied on cost information from several DRBC studies to estimate the costs of achieving the proposed WQS."

Notably, the DRBC staff coordinated extensively with dischargers in development of the Nitrogen Reduction Cost Estimation Study prepared for DRBC by Kleinfelder (January 2021). The coordination included: sharing of draft interim technical memos with the Water Quality Advisory Committee (WQAC); a presentation on the results of cost estimation by the report's author at a special meeting of the WQAC on July 16, 2020; and a 45-day review and public comment period in the summer of 2020. Accordingly, all Tier 1 dischargers and the WQAC were afforded an opportunity to comment. In addition, special outreach to Philadelphia Water Department's DO Partnership was provided to ensure this group was aware of the opportunity to review and comment on the Kleinfelder report. DRBC did receive comments on the draft Kleinfelder report, which it passed through to Kleinfelder. Kleinfelder in turn made changes to its draft report where appropriate, and these were included in the final report issued in January 2021.

The text accompanying footnote 85 states, "The EPA's 2019 restored scenario follows DRBC's approach by including the seven Class A' and two Class A facilities and excluded the three Class B facilities."

EPA's summary of DRBC's classification scheme is focused only on the "Tier 1" facilities for which additional monitoring was performed. DRBC evaluated a total of 67 wastewater treatment plants for their effluent impact on DO in the Delaware River Estuary. Through a series of screenings of monitored data and sensitivity simulations, DRBC narrowed down the dischargers of concern to 19, as set forth in DRBC's 2022 Analysis of Attainability report ("AA report"). It is correct that three of the 12 "Tier 1" facilities were identified as Class B facilities in the AA report; however, 58 of the 67 facilities evaluated were classified as Class B facilities because they do not have a measurable impact on dissolved oxygen in Zones 3, 4, and upper 5 of the Estuary.

### Table 10 (88 FR 88331)

In the second column of Table 10 DELCORA is incorrectly listed as a DE facility. DELCORA is a PA facility.

### Table 10 and other locations throughout Economic Analysis

EPA may have underestimated, and should therefore revisit, the annualized costs in 2022 dollars shown in Table 10. Using Scenario AA08 from DRBC's Analysis of Attainability and the annualized costs in 2019 dollars from Tables 6-4 through 6-16 presented in the Nitrogen Reduction Cost Estimation Study prepared by Kleinfelder under contract to DRBC, DRBC estimates an annualized cost for ammonia reduction alone at approximately $149 million in 2019 dollars, which is higher than EPA's estimate of $137.1 million in 2022 dollars. When annualized costs for additional treatment to bring effluent DO to 6 mg/L are added (where appropriate) in 2019 dollars, the estimated annualized cost increases to approximately $157 million. When costs are further modified to convert from 2019 dollars to 2022 dollars using the annual average factors from the Engineering News Record Construction Cost Index (ENR-CCI), DRBC's estimate increases to approximately $181 million in 2022 dollars, which is substantially higher than EPA's estimate of $137.1 million.

## IX.D. Potential Benefits (88 FR 88332)

In the first full paragraph on p. 88332, EPA states:

> The effluent treatment measures implemented in response to the proposed WQS would directly affect the amount of ammonia nitrogen discharged to the specified zones of the Delaware River and therefore also reduce BOD. However, DRBC's model does not account for the changes in BOD. The EPA approximated BOD concentrations following effluent treatment by assuming that baseline BOD concentrations are reduced by the same percentage change that dissolved oxygen improves within each zone (*i.e.*, Zone 3, 4, and Upper 5) of the model.

These three sentences raise concerns. (1) First, the statements could be clarified by explicitly referencing ambient BOD where that is intended. A clearer version might read, "The effluent treatment measures implemented in response to the proposed WQS would directly affect the amount of ammonia nitrogen discharged to the specified zones of the Delaware River and therefore also reduce BOD in ambient water. DRBC's model does not account for changes in BOD in ambient water. [See our second comment.] The EPA approximated BOD concentrations in ambient water after implementation of advanced treatment by assuming that baseline BOD concentrations in ambient water will be reduced by the same percentage as dissolved oxygen improves within each zone (i.e., Zone 3, 4, and Upper 5) of the model." (2) The second sentence in the paragraph is true but misleading. In fact, the DRBC model accounts for multiple constituents of BOD individually. As recent state-of-the-art models do, DRBC's model explicitly simulates three types of ultimate CBOD based on sources, as well as multiple nitrogen species—ammonia nitrogen, nitrate nitrogen, and organic nitrogen—in both loadings and ambient water, rather than lumping them together as BOD.

### Water Quality Index referenced throughout Economic Analysis

As part of its Economic Analysis, EPA developed a Water Quality Index (WQI) for anticipated changes in water quality that included the parameters DO, BOD, FC, TN, TP, and TSS, but not ammonia. In the Economic Analysis EPA acknowledges that no changes to water quality are anticipated for FC, TN, TP, and TSS. Changes to Estuary water quality are anticipated, however, for ammonia. EPA should consider reworking its WQI and resultant Economic Analysis to include ammonia, and to exclude the parameters expected to remain unchanged, for a more accurate assessment of economic benefit.

### Missing from Economic Analysis

In their 2019 paper, Waldman and co-authors document that some proportion of Delaware Estuary juvenile Atlantic Sturgeon return to estuaries *outside their natal estuary* to spawn. Specifically, the authors estimate that 51.8 and 26.6 effective migrants per generation historically migrated from the Delaware Estuary to the Hudson and James estuaries respectively. Thus, an expanded and more robust population of Atlantic Sturgeon in the Delaware Estuary, resulting from the attainment of EPA's proposed criteria, would reasonably be expected to exert population benefits to the New York Bight DPS as a whole and specifically to adjacent estuaries, including the Hudson and the James. EPA should modify its economic analysis to capture these benefits. Reference: Waldman, J., Alter, E., Peterson, D., Maceda, L, Roy, N., and Wirgin, I. 2019. "Contemporary and historical effective population sizes of Atlantic sturgeon Acipenser oxyrinchus oxyrinchus." Conservation Genetics 20:167-184.

## IX.E. Conclusion (88 FR 88332)

In the final paragraph of this section, EPA states:

> The EPA's monetary estimation of benefits does not account for benefits related to protections for a critically endangered species (Atlantic Sturgeon), increased housing values, or increased commercial fishing, among other benefits.

EPA indicates that its monetary estimation of the benefits of the proposed rule does not account for some benefits, including increased housing values and increased commercial fishing. Because the costs and benefits of this proposal are of particular concern to the public, we urge EPA to re-visit its economic analysis to ensure that a comparable level of effort is applied to estimating benefits as was applied to estimating costs. If and when EPA does so, we note that DRBC's draft socio-economic evaluation demonstrated a wide distribution in the socio-economic status of anticipated ratepayers, an aspect that merits closer analysis.

## X.J. Executive Order 12898 (88 FR 88335)

Throughout Environmental Justice and Economic Analyses

EPA cites DRBC's estimate that during dry conditions, a relatively small proportion of PWD wastewater flow is attributable to sewage originating from residential rate-payers within the City of Philadelphia. But much of the wastewater treated and discharged by PWD comes from adjacent suburban communities outside the City of Philadelphia and is accepted into the PWD system by contract. EPA should expand its evaluation to explore the impact of suburban and other contract wastewater in the overall distribution of wastewater flow and resulting constraints on capacity that may limit better treatment. EPA should further explore the ability-to-pay of its suburban wastewater customers to assess their impact on the overall affordability of this proposal.

Thank you for this opportunity to comment on the EPA's proposed rulemaking.

Sincerely,

Steven J. Tambini

Attachment

# Appendix

This Appendix contains recommendations for improving empirical formulations, filling data gaps, and addressing specific issues in EPA's Technical Support Document and code.

<u>Recommendations for improving empirical formulations developed by EPA to estimate DO under different loading conditions as a function of observed gage data over many years</u>

Regarding the estimation of restored DO, DRBC recommends the following improvements:

1. **It is important to develop the empirical relationship that represents the benefits of restoration by comparing *modeled* restored DO to *modeled* existing DO rather than to *observed* existing DO.** The eutrophication model is best at characterizing relative changes from one loading scenario to another and from one location to another. Defining a relationship linking modeled restored to modeled existing represents only the modeled improvement to DO, without propagating uncertainty as to how well the model represents DO at the observed point. This relationship can then be applied to observed data to approximate restored conditions. DRBC recommends the following approach to estimate restored DO at the two gage locations:
    - Develop a regression (or GAM) between modeled existing DO and modeled HADO DO at the two gage locations.
    - Apply these regressions (or GAMs) to observed DO at each respective gage to estimate restored DO at the two gages.
2. **Extend restored DO estimations beyond two gage locations to fully represent Zones 3 and 4.** Changes in DO at the two gage locations do not fully represent changing conditions throughout the Estuary. DRBC's modeling has demonstrated that with restoration, the location of the DO sag will move upstream (DRBC, 2022). Thus, the improvement at one or two discrete locations will not necessarily fully capture DO improvements throughout the Estuary and can lead to significantly misleading characterizations. Expanding the spatial extent of these calculations allows for evaluation of minimum (or median, for example) DO within the Estuary in different scenarios, regardless of where that minimum (or median) location is. Specifically, DRBC generated restored DO estimates for 500 locations throughout Zones 3 and 4 for 2008–2023 with this recommended approach:
    - Develop a regression (or GAM) between observed DO at each gage and modeled existing DO at each location throughout Zones 3 and 4.
    - Apply these regressions (or GAMs) to the estimated restored DO from each gage (discussed above in point 1). For each location throughout Zones 3 and 4, this will result in two estimations of restored DO: one using the Chester regression and one using the Penn's Landing regression.
    - For each location, calculate a weighted average of the two estimations for that location. The weights for each gage scale linearly with the distance to each gage. This will result in restored DO estimates at all 500 modeled locations in Zones 3 and 4.
3. **Use data from May-October rather than June-November to develop restored DO relationships.** The May-October period aligns with the time frame during which to expect reduced ammonia loading. In DRBC's model, ammonia loading was reduced during May-October, so including November in the regression is questionable and there is no justification to exclude May.

4. **Including flow in the GAM is unnecessary.** While it was worthwhile to consider, in practice removing flow as an independent variable does not meaningfully affect the predictive ability of the model (Chester w/ flow $R^2$ = 0.774 vs. w/o flow $R^2$ = 0.760 and Penn's Landing w/ flow $R^2$ = 0.889 vs. w/o flow $R^2$ = 0.888). It is preferable to select a simpler model (without flow) that performs just as well.

The methodology details identified above matter, as evidenced by at times significant differences between DRBC and EPA restored DO estimations. All differences below were computed as:

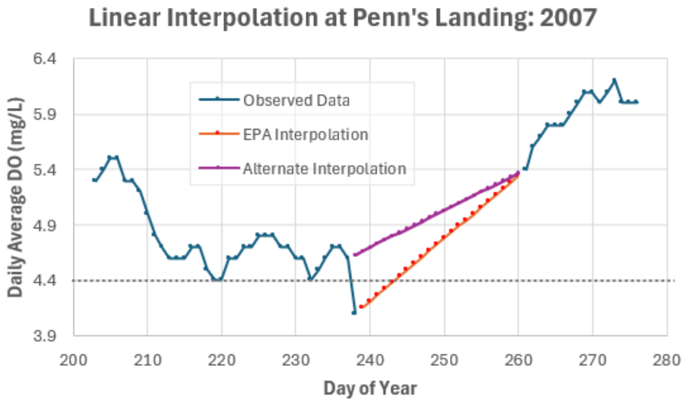
[EPA Restored Value] – [DRBC Restored Value]

- At Penn's Landing, differences in restored DO range from -0.4 to 1 mg/L
- At Penn's Landing, differences in restored DOSAT range from -1.2 to 10.4%
- At Chester, differences in restored DO range from -0.77 to 1.2 mg/L
- At Chester, differences in restored DOSAT range from -8.5 to 14.7%

<u>Comments to improve the methodology EPA utilized to fill observed data gaps</u>

- Page 13 of the Technical Support Document states: "For the summer months, EPA filled small gaps in the data by interpolating from available observations; EPA did not interpolate data to fill large gaps in the winter months."
    - **Define "small" and "large" gaps more precisely.** Gaps up to 22 days long (18% of Juvenile Development Season) were filled in with linear interpolation.

    - **Conduct quality control for individual linear interpolations applied and consider an alternative method (see detailed suggestions below).** In the example below, the linear interpolation (in red) for a 22-day period in 2017 is heavily influenced by the last data value, which was the lowest value observed between July and November by 0.3 mg/L. An alternate interpolation that starts 1 day before the data gap yields significantly different interpolated values.

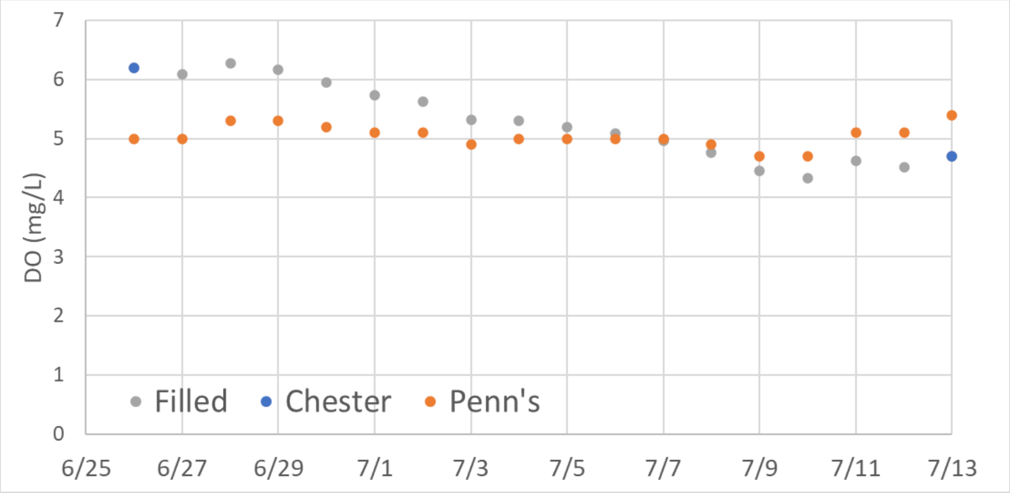


Linear Interpolation at Penn's Landing: 2007

- **Specific suggestions to improve interpolation methodology**
    - <u>Use all available observed data and avoid unnecessary interpolation by treating DO, conductivity, and temperature datasets independently.</u> In the scripts EPA wrote, when processing observed DO, conductivity, and temperature data from Chester and Penn's Landing

gages, days that do not have values for all 3 parameters are removed from the dataset (using complete cases in R). Then, all 3 variables are linearly interpolated across those gaps. However, some days that are removed from the dataset may have had some data for other variables. For example, in 2020 at Penn's Landing, 21 days with missing conductivity data are removed from all 3 observed data sets, though these 21 days do have DO and temperature data. In EPA's methodology as reflected in its scripts, DO and temperature are interpolated across these 21 days instead of using the observations on those days.

- <u>Consider a more sophisticated interpolation approach.</u> While linear interpolation works well for very short gaps (1–2 days), another method would make sense for longer gaps, and some gaps are too long to reasonably fill via interpolation. EPA's current methodology, linear interpolation was used for a 22-day data gap at Penn's Landing in 2007. With 18% of the values for the 2007 Juvenile Development season being linearly interpolated, it would be prudent to remove this year from analysis. Thus, instead of simply filling all data gaps with linear interpolation, we suggest the following approach:
  - For data gaps of 1–2 days, fill using linear interpolation.
  - For data gaps of 3–18 days, if data are available at the other gage, fill using a function of data at the other gage.
    - Calculate the "offset" on the day before and after the data gap (days on which both gages have data) as the difference in values between the two gages.
    - Perform a linear interpolation of the offset, so that there is one value for each day of the data gap.
    - For each day of the data gap, add the offset to the existing gage data. These are the values to fill in for the missing data at the other gage.
    - Below is an example filling a 16-day DO data gap at the Chester gage in 2023 using available data from Penn's Landing.



  - For simultaneous data gaps at both gages of up to 6 days, fill using linear interpolation.
  - Remove the year from consideration if:
    - There is a simultaneous data gap at both gages longer than 6 days (5% of season).
    - There are more than 12 days (10% of season) total with simultaneous data gaps longer than 2 days at both gages.
    - There is a data gap at either gage longer than 18 days (15% of season).

Comments to address specific issues in the Technical Support Document

DRBC offers the following specific technical comments regarding the TSD, in which EPA documents its detailed methodology. Page numbers refer to the TSD.

- p 17. EPA states: "EPA estimated a time series of restored dissolved oxygen concentrations for July through October from 2002 to 2022…."

  This paragraph should include the date range of observed data used to develop the GAM, which as applied in the function imputeWQbyYear is May31/June 1 to November29/November 30.

*[DRBC Note: After page 17, two versions of the published TSD are inconsistent with one another with respect to pagination and in some details referenced in our comments. Notably, in the version linked from the Federal Register page ("Regs.gov version"), the title on the cover page appears in white, while in the version downloaded from EPA's website ("EPA version"), the title on the cover page appears in black. Figure 5 of the TSD is incorrectly labeled "Figure 1" in the Regs.gov version; it is properly labeled in the EPA version. Page numbers for both versions are provided below, with those for the EPA version in brackets. The pagination discrepancy does not occur on the TSD appendix pages on which DRBC offers comment.]*

- p 21 [22]. $G_{max}$ and $Z_{min}$ are defined twice, in different terms. It would be clearer to define each of these variables once.

- p 22–23 [24]. EPA States:

  > EPA calculated the **instantaneous daily mortality rate** for a 24-hour LC50 by recognizing that at the LC50 threshold, the fraction of individuals surviving 24-hours (*S*) is 0.5, and the **instantaneous mortality rate** is therefore –ln(*S*) = 0.6931. … EPA (2003) estimated that the 24-hour LC5…for Shortnose Sturgeon was…associated with a **daily mortality rate** of –ln(0.95) = 0.0513.

  Check language for consistency between instantaneous daily mortality rate vs. daily mortality rate vs. instantaneous mortality rate.

- p 24 [25]. There is a discrepancy between the acronym used for activity cost in the text (AC) versus equation 10 (ACT). This term should be defined in text as ACT to avoid confusion with T (temperature).

- p 27 [28]. EPA states:

  > The mortality rates calculated from estimates of LC50, which were derived from experiments using Shortnose Sturgeon,77 all have the same instantaneous mortality rate (i.e., –ln(0.5)), but the dissolved oxygen level causing 50% mortality in 24 hours increased with increasing water temperature (Figure 3).

  EPA should clarify that dissolved oxygen "level" refers to POSAT, not concentration because "level" might otherwise be assumed to imply concentration.

- p 28 [29]. EPA states:

  > Young-of-the-year catch per unit effort … between 2009 and 2022 was positively correlated with modeled survivorship near Penn's Landing (r2=0.56, p<0.01), but was not correlated with survivorship near Chester (Figure 4). Although we cannot be certain of the reason for the difference in the correlation, one possible explanation is that Chester is located at the extreme seaward limit of the oxygen-sag and therefore experiences interannual variability that may not as well reflect broader conditions in the specified zones of the river.

  If that explanation is true, how does EPA explain its reliance on Chester data in the development of criteria applicable to the entire FMA?

- p 30 [31]. The figure labeled "Figure 1," should be labeled, "Figure 5." [No error in EPA version.]

- p 30 [31]. The caption to Figure 6 reads, "Colors differentiate data by year," but the figure is in black and white. [Figure is in color in EPA version.]

- p 35 [36]. The legend to Figure 9 shows circles for observed and triangles for restored, but the data appear to be all circles. [Same issue in both versions.]

- p 39 [40]. Subsection 5.2, "Climate Change," of Section 5, "Limitations and Uncertainties" discusses potential water temperature increases due to climate change. Should salinity or sea level rise (SLR) be mentioned here as well?
- p 58-60. In Appendix 3, Table A3-4 contains 2022 data, but Tables A3-1 through A3-3 do not. EPA should include the 2022 data in the three tables where it is missing.
- p 61. TL4RM is not in the R bioenergetics model. The R model has a parameter tk4rm that is not in the TSD. The values are close but not identical.

Comments to address technical issues in EPA's codes

- When defining seasons, R scripts should be adjusted to account for leap years and to ensure that date ranges are consistent across all scripts. Although the TSD refers to seasons with start and end dates, throughout R coding, the seasons are defined by start and end day of year. As a result, the data selected by the R code for each season is off by one day during leap years. Furthermore, some day-of-year ranges are off by a day or two between different R scripts.
  - The R scripts 6.03 and 6.04 define the Juvenile Development season as day of year 182–304. During non-leap years, this is July 1–October 31. During leap years, this is June 30–October 30.
  - R script 6.01 defines the Juvenile Development season as day of year range 182–305, which is inconsistent with scripts 6.03 and 6.04, adding an extra day to the end of the season.
  - Similarly, R function imputeWQbyYear selects day of year 152–334 as the basis of the period used to estimate restored DO, and a constant date range is not ensured. So, data from June 1–November 30 is used for non-leap years and May 31–November 29 during leap years.

- Minor comments on R code (these do not appear to impact code functionality)

- **It would be cleaner to use the same code (a single function?) to process both Chester and Penn's Landing data—after the data are downloaded and cleaned up, it should be the exact same procedure.** There are some small differences between the two codes. Citing the biggest example here:
    - Code 5. removes 2010 from Penn's Landing data but Code 5.1 does not for Chester. This discrepancy is carried through until codes 6.03 and 6.04. In 6.03, descriptive characteristics for the HSI are calculated with 2010 data included for Chester and without 2010 data for Penn's Landing. However, 2010 is removed from all datasets right before the GAMs are developed.
        - Code 5.01 Penn's Landing: Year <- c(seq(2002,2009,by=1),seq(2011,2022,by=1))
        - Code 5. Chester: Year <- seq(2002,2022,by=1)
- line 54 typo in comment: precessed -> processed
- Code 5. line 86 can be deleted, it's reduplicative as the same calculation is performed again in line 95
    - tmp <- tmp %>% mutate(salinity.mean = ec2pss(ec=spCond.mean/1000,t=wt.mean,p = 0))