6560-50-P

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 131

[EPA-HQ-OW-2023-0222; FRL 10760-01-OW]

RIN 2040-AG30

Water Quality Standards to Protect Aquatic Life in the Delaware River

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: On December 1, 2022, the U.S. Environmental Protection Agency (EPA) determined that revised water quality standards are necessary to protect aquatic life in certain water quality management zones of the Delaware River. Specifically, the EPA issued an Administrator’s Determination, pursuant to the Clean Water Act (CWA), finding that a revised designated use to protect aquatic life propagation and corresponding dissolved oxygen criteria to protect that use are necessary in Zone 3, Zone 4, and the upper portion of Zone 5 (in total, river miles 108.4 to 70.0) of the Delaware River. The CWA requires the EPA to publish proposed

water quality standards following an Administrator's Determination. Thus, the EPA is proposing to promulgate an aquatic life designated use that includes propagation and protective water quality criteria for dissolved oxygen for Zone 3, Zone 4, and upper Zone 5 of the Delaware River.

DATES: Comments must be received on or before **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. Public hearing: the EPA will hold two public hearings during the public comment period. Please refer to the **SUPPLEMENTARY INFORMATION** section for additional information on the public hearings.

ADDRESSES: You may send comments, identified by Docket ID No. EPA-HQ-OW-2023-0222, by any of the following methods:

- Federal eRulemaking Portal: https://www.regulations.gov/ (our preferred method). Follow the online instructions for submitting comments.
- Mail: U.S. Environmental Protection Agency, EPA Docket Center, Office of Water Docket, Mail Code 28221T, 1200 Pennsylvania Avenue NW, Washington, DC 20460.
- Hand Delivery or Courier: EPA Docket Center, WJC West Building, Room 3334, 1301 Constitution Avenue, NW, Washington, DC 20004. The Docket Center's hours of operations are 8:30 a.m. – 4:30 p.m., Monday through Friday (except Federal holidays).

Instructions: All submissions received must include the Docket ID No. for this rulemaking. Comments received may be posted without change to https://www.regulations.gov/, including any personal information provided. For detailed instructions on sending comments and additional information on the rulemaking process, see the "Public Participation" heading of the **SUPPLEMENTARY INFORMATION** section of this document.

FOR FURTHER INFORMATION CONTACT: Hannah Lesch, Office of Water, Standards and Health Protection Division (4305T), Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington, DC 20460; telephone number: (202) 566-1224; email address: Lesch.Hannah@epa.gov.

SUPPLEMENTARY INFORMATION:

This proposed rule preamble is organized as follows:

I. Public Participation

A. Written Comments

Submit your comments, identified by Docket ID No. EPA-HQ-OW-2023-0222, at https://www.regulations.gov (the EPA's preferred method), or the other methods identified in the **ADDRESSES** section. Once submitted, comments cannot be edited or removed from the docket. The EPA may publish any comment received to its public docket. Do not submit to the EPA's docket at https://www.regulations.gov any information you consider to be Confidential Business Information (CBI), Proprietary Business Information (PBI), or other information whose disclosure is restricted by statute. Multimedia submissions (audio, video, etc.) must be accompanied by a written comment. The written comment is considered the official comment and should include discussion of all points you wish to make. The EPA will generally not consider comments or comment contents located outside of the primary submission (i.e., on the web, cloud, or other file sharing system). Please visit https://www.epa.gov/dockets/commenting-epa-dockets for additional submission methods; the full EPA public comment policy; information about CBI, PBI, or multimedia submissions; and general guidance on making effective comments.

B. Participation in Public Hearings

The EPA is offering two public hearings so that interested parties may also provide oral comments on this proposed rulemaking. For more details on the public hearings and to register to attend the hearings, please visit https://www.epa.gov/wqs-tech/water-quality-standards-delaware-river.

II. General Information

A. Does this Action Apply to Me?

A range of individuals and entities could be affected by this rulemaking, if finalized. For example, entities that discharge pollutants to certain waters under the jurisdiction of the states of Delaware, New Jersey, and Pennsylvania – such as industrial facilities and municipalities that manage stormwater, separate sanitary, or combined sewer systems – could be indirectly affected by this rulemaking because Federal water quality standards (WQS) promulgated by the EPA would be the applicable WQS for these waters for CWA purposes (Table 1 of this preamble). Specifically, these WQS would be the applicable standards that must be used in CWA regulatory programs, such as permitting under the National Pollutant Discharge Elimination System (NPDES) under CWA section 402[1] and identifying impaired waters under CWA section 303(d). In addition, individuals and entities who rely on or benefit from aquatic life in those waters may be indirectly affected.

Table 1 - Entities Potentially Affected by this Proposed Rule.

Category	Examples of Potentially Affected Entities
Industry	Industrial point sources discharging to certain waters in Delaware, New Jersey, and Pennsylvania. Commercial fishing operations that harvest fish.
Municipalities, including those with stormwater or combined sewer system outfalls	Publicly owned treatment works or similar facilities responsible for managing stormwater, separate sanitary, or combined sewer systems that discharge to certain waters in Delaware, New Jersey, and Pennsylvania.
Recreation and Tourism	Anglers and tourists seeking recreational opportunities related to aquatic life in certain waters in Delaware, New Jersey, and Pennsylvania.

[1] Before any water quality-based effluent limit would be included in an NPDES permit, the permitting authority (here, the states of Delaware, New Jersey, and Pennsylvania), must first determine whether a discharge "will cause or has the reasonable potential to cause, or contribute to an excursion above any WQS." 40 CFR 122.44 (d)(1)(i) and (ii).

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities that could be indirectly affected by this action. If you have questions regarding the applicability of this action to a particular entity, consult the person listed in the **FOR FURTHER INFORMATION CONTACT** section above.

III. Background

A. Statutory and Regulatory Authority

CWA section 101(a)(2) establishes a national goal of "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water" (hereafter, collectively referred to as "101(a)(2) uses" or "101(a)(2) goals"), wherever attainable. The EPA's regulation at 40 CFR 131.10(g) implements this statutory provision by requiring that WQS protect 101(a)(2) uses unless those uses are shown to be unattainable.

Under the CWA, states have the primary responsibility for reviewing, establishing, and revising WQS applicable to their waters (CWA section 303(c)). WQS define the desired condition of a water body, in part, by designating the use or uses to be made of the water and by setting the numeric or narrative water quality criteria to protect those uses (40 CFR 131.2, 131.10, and 131.11). There are two primary categories of water quality criteria: human health criteria and aquatic life criteria. Human health criteria protect designated uses such as public water supply, recreation, and fish and shellfish consumption. Aquatic life criteria protect designated uses such as protection and propagation of fish, invertebrates, and other aquatic species. Regardless of their category, water quality criteria "must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use" (40 CFR 131.11(a)(1)).

States are required to hold a public hearing to review applicable WQS at least once every three years and, if appropriate, revise or adopt new standards (CWA section 303(c)(1); 40 CFR 131.20(a)). Every three years, states must also reexamine water body segments that do not include the 101(a)(2) uses to determine if new information has become available that indicates the 101(a)(2) uses are attainable, and if so, revise the WQS accordingly (40 CFR 131.20(a)). Any new or revised WQS must be submitted to the EPA for review and approval or disapproval (CWA section 303(c)(2)(A) and (c)(3)).

CWA section 303(c)(4)(B) independently authorizes the Administrator to determine that a new or revised standard is necessary to meet CWA requirements; this action is frequently referred to as an "Administrator's Determination." Pursuant to CWA section 303(c)(4)(B), after making an Administrator's Determination, the EPA must propose and promulgate WQS specified in the Administrator's Determination. If a state adopts and the EPA approves WQS that address the Administrator's Determination prior to the EPA's promulgation, then the EPA would no longer be required to promulgate WQS.

B. Relevant Ecological History of the Delaware River

The Delaware River has historically been home to numerous species of ecological, recreational, and economic importance; however, centuries of anthropogenic water quality impacts and habitat degradation, peaking in the mid-twentieth century, made portions of the river unsuitable for many aquatic species. In the 1700s and 1800s, many native fish species in the Delaware River faced declining populations due to overharvesting and the installation of physical barriers that prevented fish passage.[2] Further population declines of native oxygen-sensitive species – such as the Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*), American Shad (*Alosa sapidissima*), Shortnose Sturgeon (*Acipenser brevirostrum*), and Striped Bass (*Morone saxatilis*), among others[3] – were linked to accelerating degradation of water quality through the first half of the 1900s, including seasonal anoxia (i.e., absence of oxygen) by the mid-twentieth century in Zone 3, Zone 4, and the upper portion of Zone 5 of the Delaware River.[4]

Dissolved oxygen is an important water quality parameter that can significantly influence the distribution and abundance of aquatic organisms and ecological relationships in aquatic ecosystems. Aquatic organisms need to obtain adequate levels of dissolved oxygen to maintain and support normal functioning, including during sensitive life stages, such as spawning, larval development, and juvenile growth.[5] As dissolved oxygen levels decrease in a waterbody, the rate at which aquatic organisms can obtain oxygen from the water decreases, resulting in impaired

[2] Hardy, C. A. (1999). Fish or Foul: A History of the Delaware River Basin Through the Perspective of the American Shad, 1682 to the Present. Pennsylvania History, 66(4), 506-534. https://digitalcommons.wcupa.edu/hist_facpub/13 ; Secor, D.H. and Waldman, J. (1999). Historical abundance of Delaware Bay Atlantic sturgeon and potential rate of recovery. American Fisheries Society Symposium. 23. 203-216.https://www.researchgate.net/publication/291783957_Historical_abundance_of_Delaware_Bay_Atlantic_sturgeon_and_potential_rate_of_recovery ; Smith, T.I.J., & Clugston, J.P. (1997) Status and management of Atlantic sturgeon, Acipenser oxyrinchus, in North America. Environmental Biology of Fishes 48, 335–346. https://doi.org/10.1023/A:1007307507468 ; National Marine Fisheries Service. (1998). Recovery Plan for the Shortnose Sturgeon (Acipenser brevirostrum). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 104 pages. https://repository.library.noaa.gov/view/noaa/15971.

[3] Stoklosa, A.M., Keller, D.H., Marano, R., and Horwitz, R.J. (2018). "A Review of Dissolved Oxygen Requirements for Key Sensitive Species in the Delaware Estuary." Academy of Natural Sciences of Drexel University. November 2018. https://www.nj.gov/drbc/library/documents/Review_DOreq_KeySensSpecies_DelEstuary_ANStoDRBCnov2018.pdf.

[4] See citations in footnote 2 of this preamble; Atlantic States Marine Fisheries Commission. (1981). Interstate Fisheries Management Plan for the Striped Bass. http://www.asmfc.org/uploads/file/1981FMP.pdf.

[5] United States Environmental Protection Agency. (2021). Factsheet on Water Quality Parameters: Dissolved Oxygen. July 2021. Document ID: EPA 841F21007B. https://www.epa.gov/system/files/documents/2021-07/parameter-factsheet_do.pdf ; United States Environmental Protection Agency. (2023a). Indicators: Dissolved Oxygen. June 9, 2023. https://www.epa.gov/national-aquatic-resource-surveys/indicators-dissolved-oxygen.

growth and reduced survival. Maintaining a healthy ecosystem requires dissolved oxygen levels above thresholds that impair growth and survival of aquatic species.

1. Causes of Low Dissolved Oxygen in the Specified Zones of the Delaware River

Discharges of untreated or poorly treated municipal and industrial wastewater into the specified zones of the Delaware River have historically been a major cause of water quality degradation, including oxygen depletion.[6] While conditions have significantly improved, inputs of oxygen-consuming wastes from wastewater dischargers, especially ammonia (NH_3) and ammonium (NH_4^+) (which in combination are hereafter referred to as “ammonia nitrogen”), as well as sediment-water ammonium flux and sediment oxygen demand continue to be significant sources of oxygen demand in the specified zones of the Delaware River.[7]

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.[8] 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.[9] CSOs have

[6] Hardy (1999); Delaware River Basin Commission. (2022a). Analysis of Attainability: Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary. September 2022 Draft. See section 3 – “Factors that can Improve Dissolved Oxygen in the Fish Maintenance Area.” https://www.nj.gov/drbc/library/documents/AnalysisAttainability/AnalysisAttainability_DRAFTsept2022.pdf.
[7] Delaware River Basin Commission. (2022b). Modeling Eutrophication Processes in the Delaware River Estuary – Three-Dimensional Water Quality Model. https://www.nj.gov/drbc/library/documents/AnalysisAttainability/WQModelCalibrationRpt_DRAFTsept2022.pdf.
[8] Miskewitz, R. and Uchrin, C. (2013). In-Stream Dissolved Oxygen Impacts and Sediment Oxygen Demand Resulting from Combined Sewer Overflow Discharges. Journal of Environmental Engineering, 139(10). https://doi.org/10.1061/(ASCE)EE.1943-7870.0000739.
[9] Miskewitz and Uchrin (2013).

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.[10] 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.[11]

Although most point source discharges today are treated, treated effluent can still contain high levels of ammonia nitrogen, which depletes oxygen in the water as bacteria oxidize ammonia into nitrite, nitrate and dinitrogen gas.[12] During the reporting periods from July through October 2022, major wastewater treatment facilities along the Delaware River discharged ammonia nitrogen at monthly average concentrations ranging from a low of 0.07 milligrams nitrogen per liter (mg-N/L) at the Florence Township Sewage Treatment Plant in New Jersey (discharging into Zone 2 of the Delaware River) to a high of 35 mg-N/L at the Camden County Municipal Utilities Authority in New Jersey (discharging into Zone 3 of the Delaware River).[13]

2. Endangered Species in the Specified Zones of the Delaware River

The Delaware River is home to two oxygen-sensitive fish species – Shortnose Sturgeon and Atlantic Sturgeon – that are protected under the Federal Endangered Species Act (ESA). All populations of Shortnose Sturgeon were listed as endangered in 1967.[14] Across the U.S.,

[10] Hardy (1999).
[11] Philadelphia Water Department. (2022). Combined Sewer Management Program Annual Report. Stormwater Management Program Annual Report. See Appendix D – "NPDES Annual CSO Status Report FY 2022," Table 2 – "Overflow Summary for 7/1/2021 – 6/30/2022." https://water.phila.gov/pool/files/fy22-npdes-annual-report.pdf.
[12] United States Environmental Protection Agency. (2023b). Ammonia. https://www.epa.gov/caddis-vol2/ammonia.
[13] Each individual reporting period is one month long. For the reporting period ending on September 30, 2022, Florence Township Municipal Building discharged an average of .07 mg/L of ammonia. For the reporting period ending on July 31, 2022, Camden County Municipal Utilities Authority discharged an average of 35 mg/L of ammonia. Source: U.S. Environmental Protection Agency. Integrated Compliance Information System (ICIS). Database. Retrieved June 29, 2023.
[14] Federal Register, Vol. 32, No. 48 (32 FR 4000). March 11, 1967. https://www.fisheries.noaa.gov/s3//2022-12/4000-4002.pdf.

Shortnose Sturgeon face ongoing threats due to water pollution, habitat degradation, and fisheries bycatch, among other factors.[15] While the historic population size of Shortnose Sturgeon in the Delaware River remains unknown, in 2006 the population was estimated to be approximately 12,000 adults.[16] The New York Bight distinct population segment (DPS) of Atlantic Sturgeon – which includes the population found in the Delaware River – was listed as endangered under the ESA in 2012.[17] In 2017, the National Oceanic and Atmospheric Administration (NOAA Fisheries) designated the Delaware River, among others, as critical habitat for the New York Bight DPS of Atlantic Sturgeon,[18] and reaffirmed its endangered listing in 2022 following a five-year review of its status.[19] The remnant population of the New York Bight DPS of Atlantic Sturgeon faces ongoing threats due to water quality in natal rivers, such as the Delaware River, as well as climate change, ship strikes, fisheries bycatch, habitat loss, and entanglement in fishing gear.[20,21] Like the Shortnose Sturgeon, the historic population size of Atlantic Sturgeon is not well documented. However, in 1890, when the population was already

[15] NOAA Fisheries. (2023a). Shortnose Sturgeon – Overview. https://www.fisheries.noaa.gov/species/shortnose-sturgeon.
[16] *Id.*; NOAA Fisheries. (2023b). Shortnose Sturgeon – Populations. https://www.fisheries.noaa.gov/species/shortnose-sturgeon#populations.
[17] Federal Register, Vol. 77, No. 24. February 6, 2012. 77 FR 5879. https://www.federalregister.gov/documents/2012/02/06/2012-1946/endangered-and-threatened-wildlife-and-plants-threatened-and-endangered-status-for-distinct.
[18] Federal Register, Vol. 82, No. 158 (82 FR 39160). August 17, 2017. 50 CFR part 226. https://www.federalregister.gov/documents/2017/08/17/2017-17207/endangered-and-threatened-species-designation-of-critical-habitat-for-the-endangered-new-york-bight.
[19] National Marine Fisheries Service. (2022). New York Bight Distinct Population Segment of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*), 5-Year Review: Summary and Evaluation. February 17, 2022. https://www.fisheries.noaa.gov/resource/document/new-york-bight-distinct-population-segment-atlantic-sturgeon-5-year-review.
[20] *Ibid.* See Section 2.3.2, "Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)", A. through E., pp. 14-25.
[21] Dunton, K.J., Jordaan, A., Conover, D.O., McKown, K.A., Bonacci, L.A., and Frisk, M.G. (2015). Marine Distribution and Habitat Use of Atlantic Sturgeon in New York Lead to Fisheries Interactions and Bycatch. Marine and Coastal Fisheries 7:18-32. https://doi.org/10.1080/19425120.2014.986348 ; Atlantic Sturgeon Bycatch Working Group. (2022). Action Plan to Reduce Atlantic Sturgeon Bycatch in Federal Large Mesh Gillnet Fisheries. NOAA National Marine Fisheries Service. https://media.fisheries.noaa.gov/2022-09/Final-Action-Plan-to-Reduce-Atlantic-Sturgeon-Bycatch.pdf.

declining, there were approximately 180,000 female Atlantic Sturgeon in the Delaware River.[22] Despite improvements in dissolved oxygen levels since the 1970s, it is estimated that only 125 – 250 adult Atlantic Sturgeon currently return to spawn in the Delaware River.[23]

In addition to being listed as endangered under the ESA, available evidence suggests that Shortnose Sturgeon and Atlantic Sturgeon are the most oxygen-sensitive species in the specified zones of the Delaware River. In general, all sturgeon species share common life history traits,[24] among which they are recognized to be relatively more sensitive to low dissolved oxygen levels compared to other co-occurring fish.[25,26] Sturgeons are considered unusually sensitive to hypoxia given their documented metabolic and behavioral responses and limited ability to oxyregulate.[27] Juvenile Atlantic Sturgeon are particularly sensitive to low dissolved oxygen levels, especially at high water temperatures,[28] such as those typically present at the peak of summer in the Delaware River.[29] A literature review across oxygen-sensitive species in the Delaware River indicates that Atlantic Sturgeon, particularly the juvenile life stage, have the highest documented dissolved

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[22] Secor and Waldman (1999).

[23] White, S.L., Sard, N.M., Brundage, H.M., Johnson, R.L., Lubinski, B.A., Eackles, M.S., Park, I.A., Fox, D.A., and Kazyak, D.C. (2022). Evaluating Sources of Bias in Pedigree-Based Estimates of Breeding Population Size. Ecological Applications 32(5): e2602. https://doi.org/10.1002/eap.2602.

[24] Federal Register, Vol. 82, No. 158 (82 FR 39161). August 17, 2017. 50 CFR part 226. pp. 39161-39163. https://www.federalregister.gov/documents/2017/08/17/2017-17207/endangered-and-threatened-species-designation-of-critical-habitat-for-the-endangered-new-york-bight.

[25] *Ibid*. p. 39162, see Dees (1961), Sulak and Clugston (1999), Billard and Lecointre (2001), Secor and Niklitschek (2002), and Pikitch et al. (2005), cited therein.

[26] Stoklosa et al. (2018) ; Secor, D.H. and Niklitschek, E.J. (2001). Hypoxia and Sturgeons: Report to the Chesapeake Bay Program Dissolved Oxygen Criteria Team. March 29, 2001.Reference Number: [UMCES] CBL 01-0080.
https://www.researchgate.net/publication/277065759_Hypoxia_and_Sturgeons_report_to_the_Chesapeake_Bay_Program_Dissolved_Oxygen_Criteria_Team.

[27] Secor and Niklitschek (2001). Oxyregulation refers to an organism's ability to maintain metabolic rates as the oxygen level in the water declines.

[28] Secor, D., and T. Gunderson. (1998). Effects of hypoxia and temperature on survival, growth, and respiration of juvenile Atlantic sturgeon, Acipenser oxyrinchus. Fishery Bulletin 96:603-613.; Niklitschek, E. (2001). Bioenergetics modeling and assessment of suitable habitat for juvenile Atlantic and shortnose sturgeons (Acipenser oxyrinchus and A. brevirostrum) in the Chesapeake Bay. University of Maryland at College Park.

[29] More information is available in the associated document, *Technical Support Document for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River.*

oxygen requirements for growth and survival when compared to other oxygen-sensitive species in the specified zones of the Delaware River.[30] In its five-year review of the listing of the New York Bight DPS of Atlantic Sturgeon, NOAA Fisheries observed a continuation of low dissolved oxygen conditions in the Delaware River around the expected location of age 0-1 Atlantic Sturgeon.[31] 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).[32] NOAA Fisheries also noted studies linking age 0-1 Atlantic Sturgeon capture rates in the fall to the preceding summer dissolved oxygen conditions in the Delaware River, providing further evidence that low dissolved oxygen levels are a contributor to the mortality of juvenile Atlantic Sturgeon.[33]

3. Dissolved Oxygen Trends in the Specified Zones of the Delaware River

Dissolved oxygen levels in Zone 3, Zone 4, and the upper portion of Zone 5 of the Delaware River mirror trends in historic pollutant loading and recent pollution control efforts in the river. Average summer dissolved oxygen levels in the Delaware River near Chester, Pennsylvania (Zone 4) declined from near saturation in the late 1880s to near zero (i.e., anoxia) in the 1950s and 1960s.[34] Starting in 1970, dissolved oxygen levels began to increase steadily in association with declining ammonia nitrogen concentrations in the river.[35] Reductions in nutrient concentrations, including ammonia nitrogen, have been documented across the Delaware River

[30] Stoklosa et al. (2018).
[31] National Marine Fisheries Service (2022). See Section 2.3.2.1, "Present or threatened destruction, modification, or curtailment of its habitat or range."
[32] *Ibid*. See Allen et al. (2014), cited therein.
[33] *Ibid*. See Moberg and DeLucia (2016), Stetzar et al. (2015), and Park (2020), cited therein.
[34] Sharp, J. (2010). Estuarine oxygen dynamics: What can we learn about hypoxia from long-time records in the Delaware estuary? Limnology and Oceanography, 55(2), 535-548.
[35] Sharp (2010).

watershed through at least 2018.[36] However, dissolved oxygen levels in the summer remain low enough to limit the growth and survival of oxygen-sensitive species and life stages, such as juvenile Atlantic Sturgeon.[37] 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.[38]

C. Administration of Water Quality Standards in the Delaware River

In 1961, the Delaware River Basin Compact established the Delaware River Basin Commission (DRBC), comprised of the states of Delaware, New Jersey, New York,[39] and Pennsylvania and the Federal government, to jointly manage the Delaware River Basin's water resources.[40] Through DRBC, each state participates in the shared governance of this regional resource and maintains sovereign rights over the portion of the river within its jurisdiction.[41]

Pursuant to the Delaware River Basin Compact, DRBC adopts WQS for interstate waters, including the Delaware River Estuary.[42] However as noted above, under the CWA, states have

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[36] Shoda, M.E., and Murphy, J.C. (2022). Water-quality trends in the Delaware River Basin calculated using multisource data and two methods for trend periods ending in 2018. U.S. Geological Survey Scientific Investigations Report 2022–5097. https://doi.org/10.3133/sir20225097.

[37] More information is available in the associated document, *Technical Support Document for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River* ; Delaware River Basin Commission (2022a) ; Niklitschek, E., and D. Secor. (2009a). Dissolved oxygen, temperature and salinity effects on the ecophysiology and survival of juvenile Atlantic sturgeon in estuarine waters: I. Laboratory results. Journal of Experimental Marine Biology and Ecology 381:S150-S160. https://doi.org/10.1016/j.jembe.2009.07.018 ; Stoklosa et al. (2018).

[38] Delaware River Basin Commission (2022a, 2022b).

[39] 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 section IV.A. of this preamble: Scope of EPA's Proposed Rule). Therefore, the EPA does not discuss New York's WQS further in this proposed rulemaking.

[40] DRBC was established pursuant to Federal law (75 Stat. 688 (1961)).

[41] Delaware River Basin Compact, art. 1, "Short Title, Definitions, Purpose and Limitations," § 1.3(a), (b), & (c) "Purpose and Findings," pp. 3 & 4, and art. 5, "Pollution Control," § 5.5(b), "Further Jurisdiction," p. 11, (1961), available at https://www.nj.gov/drbc/library/documents/compact.pdf.

[42] Delaware River Basin Compact, art. 5, "Pollution Control," § 5.2, "Policy and Standards," p. 11 (1961), available at https://www.nj.gov/drbc/library/documents/compact.pdf (DRBC "may adopt and from time to time amend and repeal rules, regulations and standards to control…future pollution and abate existing pollution"). DRBC, the states, and the EPA refer to these rules, regulations, and standards as equivalent to WQS under the CWA. As such, the term WQS is used herein to refer to these rules, regulations, and standards.

the primary responsibility for reviewing, establishing, and revising WQS applicable to their waters, and must submit new or revised WQS to the EPA for review and approval or disapproval.

Given the unique interjurisdictional management of the Delaware River Estuary, WQS are submitted to the EPA for review through a process coordinated across the state, regional, and Federal levels. This process begins when DRBC adopts WQS for the Delaware River Estuary. To comply with CWA section 303(c), the Estuary states of Delaware, New Jersey, and Pennsylvania have provisions in their state WQS regulations that explicitly reference or implicitly incorporate DRBC's WQS as the applicable WQS for the portions of the river under their jurisdictions. When DRBC adopts new or revised WQS, each relevant member state submits a certification to the EPA from that state's attorney general or other appropriate legal authority, in accordance with 40 CFR 131.6(e). Those certifications provide that DRBC's new or revised WQS were duly adopted pursuant to state law. The EPA then reviews whether those WQS are consistent with the CWA and the EPA's implementing regulation and approves or disapproves them.

D. Currently Applicable Aquatic Life Designated Uses and Dissolved Oxygen Criteria

In 1967, DRBC adopted WQS for the zones of the Delaware River included in this proposed rule.[43] Based on the conditions of the Delaware River at the time, DRBC concluded that "propagation of fish" was not attainable for Zone 3, Zone 4, and the upper portion of Zone 5 (in total, river miles 108.4 to 70.0) of the Delaware River (hereafter, referred to as "specified zones" or "relevant zones"),[44] due to the presence of industrial and municipal discharges and

[43] Delaware River Basin Commission. (2013). Delaware River Basin Water Code. https://www.nj.gov/drbc/library/documents/watercode.pdf.
[44] A map showing the Delaware River watershed and the specified zones is available in the docket (Docket ID No. EPA-HQ-OW-2023-0222) as well as in each of the support documents associated with this rule: *Technical Support*

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.[45,46] 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.

1. Delaware's, New Jersey's, and Pennsylvania's Current Aquatic Life Designated Uses

As described in section III.C. of this preamble, Delaware, New Jersey, and Pennsylvania each has its own WQS for the specified zones of the Delaware River under its jurisdiction. Delaware's current aquatic life designated use for the specified zones of the Delaware River includes all life stages, thus including the propagation component of the CWA section 101(a)(2) use. New Jersey's aquatic life designated use for the specified zones of the Delaware River incorporate by reference the designated uses in DRBC's Water Quality Regulations. Pennsylvania's aquatic life designated uses for the specified zones of the Delaware River align with DRBC's "maintenance" and "passage" designated use (Table 2 of this preamble). Therefore, neither New Jersey's nor Pennsylvania's aquatic life designated use for the specified

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Document for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River; Economic Analysis for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River; and *Environmental Justice Analysis for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River.*

45 Delaware River Basin Commission. (2015). "Existing Use Evaluation for Zones 3, 4, & 5 of the Delaware Estuary Based on Spawning and Rearing of Resident and Anadromous Fishes." September 30, 2015. https://www.state.nj.us/drbc/library/documents/ExistingUseRpt_zones3-5_sept2015.pdf.

46 Anadromous fish are species that are born and reared as juveniles in freshwater, migrate to marine waters where they spend most of their adult lives, and return to their natal, freshwater rivers to spawn.

zones of the Delaware River include the propagation component of the CWA section 101(a)(2) use.

Table 2. Current Aquatic Life Designated Uses in Zone 3, Zone 4, and Upper-Zone 5 of the Delaware River

Entity	Designated Use
DRBC[47]	Maintenance of resident fish and other aquatic life, passage of anadromous fish, wildlife.
Delaware[48]	Fish, Aquatic Life & Wildlife.[49]
New Jersey[50]	The designated uses for the mainstem Delaware River and Delaware Bay are those contained in the DRBC Water Quality Regulations.
Pennsylvania[51]	Warm Water Fishes (Maintenance Only); Migratory fishes (Passage Only).[52]

2. Delaware's, New Jersey's, and Pennsylvania's Current Dissolved Oxygen Criteria

For dissolved oxygen in the relevant zones, all three states incorporate DRBC's water quality criteria by reference; therefore, DRBC's dissolved oxygen criteria are the applicable criteria for the relevant zones in each state (Table 3 of this preamble). As explained above with respect to the aquatic life designated use, DRBC's dissolved oxygen criteria for the specified

[47] Delaware River Basin Commission. "Administrative Manual – Part III Water Quality Regulations with Amendments Through December 7, 2022." Accessed May 3, 2023. https://www.nj.gov/drbc/library/documents/WQregs.pdf.

[48] Delaware Administrative Code. "7401 Surface Water Quality Standards." Title 7 Natural Resources & Environmental Control. Delaware Department of Natural Resource and Environmental Control. Accessed May 3, 2023. https://regulations.delaware.gov/AdminCode/title7/7000/7400/7401.pdf.

[49] Delaware defines *Fish, Aquatic Life & Wildlife* as, "all animal and plant life found in Delaware, either indigenous or migratory, regardless of life stage or economic importance." A footnote specifies that this use includes shellfish propagation.

[50] New Jersey Administrative Code. "N. J. A. C. 7:9B Surface Water Quality Standards." Accessed May 3, 2023. https://dep.nj.gov/wp-content/uploads/rules/rules/njac7_9b.pdf.

[51] Pennsylvania Code. "Chapter 93. Water Quality Standards." Commonwealth of Pennsylvania. Accessed May 3, 2023. https://www.pacodeandbulletin.gov/secure/pacode/data/025/chapter93/025_0093.pdf.

[52] Pennsylvania defines its "Warm Water Fishes" designated use as, "Maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat" and defines its "Migratory Fishes" designated use as, "Passage, maintenance and propagation of anadromous and catadromous fishes and other fishes which move to or from flowing waters to complete their life cycle in other waters." For the specified zones of the Delaware River, Pennsylvania excluded propagation from the designated uses by specifying "Maintenance Only" and "Passage Only" in parentheses.

zones of the Delaware River do not protect for aquatic life propagation and are therefore not consistent with CWA section 101(a)(2) goals.

Table 3. Current Dissolved Oxygen Criteria in Zone 3, Zone 4, and Upper-Zone 5 of the Delaware River

Entity	Dissolved Oxygen Aquatic Life Criteria
DRBC[53]	24-hour average concentration shall not be less than 3.5 mg/l. During the periods from April 1 to June 15, and September 16 to December 31, the dissolved oxygen shall not have a seasonal average less than 6.5 mg/l in the entire zone.
Delaware[54]	For waters of the Delaware River and Delaware Bay, duly adopted Delaware River Basin Commission (DRBC) Water Quality Regulations shall be the applicable criteria.
New Jersey[55]	For parameters with criteria in the DRBC Water Quality Regulations, the criteria contained therein are the applicable criteria.
Pennsylvania[56]	See DRBC Water Quality Regulations.

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

Table 4 of this preamble provides a summary outlining whether Delaware's, New Jersey's, and Pennsylvania's current aquatic life designated uses align with CWA section 101(a)(2) goals and whether each state's current dissolved oxygen criteria are protective of an aquatic life designated use that includes propagation. As explained above, Delaware is the only state that includes aquatic life propagation in its designated uses for the specified zones of the Delaware River. However, none of the three states' dissolved oxygen water quality criteria for

[53] Delaware River Basin Commission. "Administrative Manual – Part III Water Quality Regulations with Amendments Through December 7, 2022." Accessed May 3, 2023. https://www.nj.gov/drbc/library/documents/WQregs.pdf.
[54] Delaware Administrative Code. "7401 Surface Water Quality Standards." Title 7 Natural Resources & Environmental Control. Delaware Department of Natural Resource and Environmental Control. Accessed May 3, 2023. https://regulations.delaware.gov/AdminCode/title7/7000/7400/7401.pdf.
[55] New Jersey Administrative Code. "N. J. A. C. 7:9B Surface Water Quality Standards." Accessed May 3, 2023. https://dep.nj.gov/wp-content/uploads/rules/rules/njac7_9b.pdf.
[56] Pennsylvania Code. "Chapter 93. Water Quality Standards." Commonwealth of Pennsylvania. Accessed May 3, 2023. https://www.pacodeandbulletin.gov/secure/pacode/data/025/chapter93/025_0093.pdf.

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 […]").

Table 4. 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

State	Applicable Zone(s)	Designated Use Includes CWA section 101(a)(2) Propagation Component	Dissolved Oxygen Criteria Protective of Aquatic Life Propagation
Delaware	Upper-5	Yes	No
New Jersey	3, 4, Upper-5	No	No
Pennsylvania	3, 4	No	No

E. Summary of the EPA's Administrator's Determination

On December 1, 2022, the EPA determined that the CWA section 101(a)(2) use of propagation is now attainable and therefore revised WQS are necessary to protect aquatic life in certain water quality management zones of the Delaware River.[57] Specifically, the EPA issued an Administrator's Determination, pursuant to CWA section 303(c)(4)(B), finding that a revised designated use to protect aquatic life propagation and corresponding dissolved oxygen criteria to protect that use are necessary in Zone 3, Zone 4, and the upper portion of Zone 5 (in total, river miles 108.4 to 70.0) of the Delaware River. The Administrator's Determination can be accessed at https://www.epa.gov/wqs-tech/federally-promulgated-water-quality-standards-specific-states-territories-and-tribes.

[57] December 1, 2022. Letter from Radhika Fox, Assistant Administrator, EPA Office of Water, to Steven J. Tambini, Executive Director, Delaware River Basin Commission; Shawn M. Garvin, Secretary, Delaware Department of Natural Resources and Environmental Control; Shawn M. LaTourette, Commissioner, New Jersey Department of Environmental Protection; and Ramez Ziadeh, Acting Secretary, Pennsylvania Department of Environmental Protection.

IV. Proposed Water Quality Standards

A. Scope of EPA's Proposed Rule

In accordance with the Administrator's Determination, the EPA's proposed rule, if finalized, would apply to Zone 3, Zone 4, and the upper portion of Zone 5 of the Delaware River (in total, river miles 108.4 to 70.0), for the states of Delaware, New Jersey, and Pennsylvania (Table 5 of this preamble).

Table 5. Zones of the Delaware River Covered by the EPA's Proposed Rule

Segment of the Delaware River	River Miles	States Affected
Zone 3	108.4 to 95.0	New Jersey, Pennsylvania
Zone 4	95.0 to 78.8	New Jersey, Pennsylvania
Zone 5 – Upper Portion	78.8 to 70.0	Delaware, New Jersey

B. Proposed Aquatic Life Designated Use

The EPA is proposing to promulgate a revised aquatic life designated use for the specified zones of the Delaware River to meet the CWA section 101(a)(2) goals (i.e., "water quality which provides for the protection and propagation of fish, shellfish, and wildlife"), as specified in the EPA's Administrator's Determination.[58] Although the relevant zones of the Delaware River are each under the jurisdiction of two or more states (Table 5 of this preamble), CWA section 303(c) assigns the individual states the role of adopting WQS. Therefore, the EPA is evaluating the aquatic life uses on a state-by-state basis.

[58] The EPA's Administrator's Determination stated, "EPA is determining […that] revised aquatic life designated uses that provide for propagation of fish, consistent with CWA section 101(a)(2) and 40 CFR 131.20(a) […] are necessary for zone 3, zone 4, and the upper portion of zone 5 (in total, river miles 108.4 to 70.0) of the Delaware River Estuary, to meet the requirements of the CWA."

As explained in section III.D. of this preamble, Delaware's "Fish, Aquatic Life & Wildlife" designated use includes all life stages of indigenous and migratory organisms; therefore, Delaware's aquatic life designated use in the specified zones under its jurisdiction is already consistent with the CWA section 101(a)(2) goals and no revisions to Delaware's aquatic life designated use are necessary to meet CWA requirements. In contrast, New Jersey's and Pennsylvania's aquatic life designated uses for the relevant zones of the Delaware River under their jurisdiction do not include "propagation" and are therefore not consistent with CWA section 101(a)(2) goals. As explained in section III.E. of this preamble, the EPA determined that propagation is now an attainable use in the specified zones of the Delaware River.[59] Therefore, for the portions of the specified zones under New Jersey's and Pennsylvania's jurisdiction, a revised aquatic life designated use that includes propagation is necessary to meet CWA requirements and ensure that the specified zones of the Delaware River are consistent with CWA section 101(a)(2) goals.

Thus, the EPA is proposing to promulgate an aquatic life designated use for Zone 3, Zone 4, and the upper portion of Zone 5 of the Delaware River (in total, river miles 108.4 to 70.0) for the states of New Jersey and Pennsylvania, as follows: *Protection and propagation of resident and migratory aquatic life*.

C. Dissolved Oxygen Criteria to Protect Aquatic Life Propagation

The EPA is proposing to establish dissolved oxygen criteria – derived from the latest sound scientific information – for Delaware, New Jersey, and Pennsylvania, for the specified

[59] December 1, 2022. Letter from Radhika Fox, Assistant Administrator, EPA Office of Water, to Steven J. Tambini, Executive Director, Delaware River Basin Commission; Shawn M. Garvin, Secretary, Delaware Department of Natural Resources and Environmental Control; Shawn M. LaTourette, Commissioner, New Jersey Department of Environmental Protection; and Ramez Ziadeh, Acting Secretary, Pennsylvania Department of Environmental Protection.

zones of the Delaware River. The proposed dissolved oxygen criteria would protect the EPA's proposed designated use for New Jersey and Pennsylvania, as well as Delaware's current aquatic life designated use for the specified zones.

1. Derivation of Dissolved Oxygen Criteria

To derive protective dissolved oxygen criteria for the specified zones of the Delaware River, the EPA used methods adapted from peer-reviewed literature and data from laboratory studies relevant to oxygen-sensitive sturgeon species in the Delaware River. 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. This section presents a summary of the data and methods that the EPA used to derive protective dissolved oxygen criteria for this proposed rulemaking. First, the EPA describes the Agency's existing dissolved oxygen national recommendations and guidance documents. Then, the EPA explains how the Agency selected three seasons to derive criteria protective of oxygen-sensitive species in the relevant zones of the Delaware River. Next, the EPA details an Atlantic Sturgeon cohort model used to derive criteria protective of juvenile Atlantic Sturgeon during the season associated with their growth and development. After that, the EPA explains how criteria were developed to protect oxygen-sensitive species during the other two seasons. Lastly, the EPA concludes with an explanation for proposing criteria expressed as percent oxygen saturation, rather than as concentration. This section is intended to be a high-level summary of the EPA's criteria derivation methods and results for this proposed rulemaking. More details and information are available in the associated technical support document, *Technical Support Document for the Proposed Rule: Water Quality*

Standards to Protect Aquatic Life in the Delaware River. The EPA will consider information received during the public comment period (detailed above), in addition to the external peer review of the technical support document, and accordingly may make changes to the proposed criteria for a final rule.

Existing the EPA Methodology and Guidance Documents

Under CWA section 304(a), the EPA publishes, from time to time, national recommended aquatic life criteria for a variety of pollutants and parameters. The EPA's national recommended criteria for dissolved oxygen in freshwater and saltwater environments are from the 1986 *Quality Criteria for Water* ("Gold Book")[60] and the 2000 *Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras* ("Virginian Province Document"),[61] respectively. The EPA's recommendations in the Virginian Province Document state that, "in cases where a threatened or endangered species occurs at a site, and sufficient data exist to suggest that it is more sensitive at concentrations above the criteria, it is appropriate to consider development of site-specific criteria based on this species."[62] As explained previously in section III.B. of this preamble, Atlantic Sturgeon and Shortnose Sturgeon are federally listed as endangered under the ESA and are uniquely sensitive to hypoxia. 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-

[60] United States Environmental Protection Agency. (1986). Quality Criteria for Water 1986. Document ID: EPA 440/5-86-001. May 1, 1986. https://www.epa.gov/sites/default/files/2018-10/documents/quality-criteria-water-1986.pdf.
[61] United States Environmental Protection Agency. (2000). Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras. Document ID: EPA-822-R-00-012. November 2000. https://www.epa.gov/sites/default/files/2018-10/documents/ambient-al-wqc-dissolved-oxygen-cape-code.pdf.
[62] *Id.* Page 41.

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.

Delineating Seasons for Criteria Derivation

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. The EPA is proposing to define the *Spawning and Larval Development* season as occurring from March 1 to June 30, which generally covers spawning and egg and larval development periods for many oxygen-sensitive species, including Atlantic Sturgeon, Shortnose Sturgeon, American Shad, Atlantic Rock Crab, Channel Catfish, Striped Bass, Largemouth Bass, White Perch, and Yellow Perch.[63] The EPA is proposing to define the *Juvenile Development* season as occurring from July 1 to October 31 and the *Overwintering* season as occurring from November 1 to February 28/29, based on young-of-the-year juvenile Atlantic Sturgeon growth rates.[64] By November, growth rates are reduced by low water temperatures despite relatively high levels of dissolved oxygen.[65] While the EPA is proposing to define seasons largely based on the early life stages of Atlantic Sturgeon, the proposed seasons also generally correspond with early life stages of other oxygen-sensitive species in the specified zones of the Delaware River. By developing criteria that are protective of Atlantic Sturgeon, which, as described in section III.B. of this preamble, is the most oxygen-

[63]Stoklosa et al. (2018); Delaware River Basin Commission (2015); Moberg, T. and M. DeLucia. (2016). Potential Impacts of Dissolved Oxygen, Salinity and Flow on the Successful Recruitment of Atlantic Sturgeon in the Delaware River. The Nature Conservancy. Harrisburg, PA. https://www.conservationgateway.org/ConservationPractices/Freshwater/HabitatProtectionandRestoration/Documents/DelawareAtlanticSturgeonReport_TNC5172016.pdf.

[64] Moberg and DeLucia. (2016).

[65] This conclusion was based on results of the growth model, described in sections 3.3.3 and 4.1.2 of the associated document, *Technical Support Document for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River*.

sensitive species in the relevant zones of the Delaware River, the EPA concluded that the criteria would also be protective of other less oxygen-sensitive resident and migratory aquatic species in the specified zones of the Delaware River.

Ecological Modeling to Derive Criteria for the Juvenile Development Season

The EPA obtained recent and high-quality data from a variety of sources, described below and detailed in the associated technical support document, to evaluate oxygen requirements of Atlantic Sturgeon in each season. The EPA quantified water quality conditions in the specified zones of the Delaware River using recent and high-quality monitoring data from two locations in the Delaware River. Since the Atlantic Sturgeon was listed as an endangered species in 2012, there have been few recent studies documenting their oxygen requirements. However, available data on sturgeon growth and mortality from Campbell and Goodman (2004), Niklitschek and Secor (2009a), and EPA (2003), along with methods from Niklitschek and Secor (2005) and Niklitschek and Secor (2009b), water quality monitoring data, and juvenile Atlantic Sturgeon abundance data from the Delaware Department of Natural Resources and Environmental Control (DNREC) provided the EPA with sufficient data to establish quantitative relationships between age-0 juvenile sturgeon growth, mortality, and habitat suitability.[66]

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[66] Campbell, J., and L. Goodman. (2004). Acute sensitivity of juvenile shortnose sturgeon to low dissolved oxygen concentrations. Transactions of the American Fisheries Society 133:722-776 ; Niklitschek, E., and D. Secor. (2009a). Dissolved oxygen, temperature and salinity effects on the ecophysiology and survival of juvenile Atlantic sturgeon in estuarine waters: I. Laboratory results. Journal of Experimental Marine Biology and Ecology 381:S150-S160. https://doi.org/10.1016/j.jembe.2009.07.018 ; United States Environmental Protection Agency. (2003). Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and its Tidal Tributaries. Document ID: EPA 903-R-03-002. April 2003. https://nepis.epa.gov/Exe/ZyPDF.cgi/P100YKPQ.PDF?Dockey=P100YKPQ.PDF ; Niklitschek, E. J., and D. H. Secor. (2005). Modeling spatial and temporal variation of suitable nursery habitats for Atlantic sturgeon in the Chesapeake Bay. Estuarine, Coastal and Shelf Science 64:135-148. https://doi.org/10.1016/j.ecss.2005.02.012 ; Niklitschek, E. J., and D. H. Secor. (2009b). Dissolved oxygen, temperature and salinity effects on the ecophysiology and survival of juvenile Atlantic sturgeon in estuarine waters: II. Model development and testing. Journal of Experimental Marine Biology and Ecology 381:S161-S172. https://doi.org/10.1016/j.jembe.2009.07.019 ; USGS 01467200 Delaware River at Penn's Landing, Philadelphia, PA. Retrieved March 9, 2023. https://waterdata.usgs.gov/nwis/inventory/?site_no=01467200&agency_cd=USGS ; USGS 01477050 Delaware River at Chester PA. Retrieved January 31, 2023.

The EPA followed the peer-reviewed cohort modeling approach of Niklitschek and Secor (2005) to evaluate the effects of temperature, salinity, and dissolved oxygen on the potential growth and mortality of a hypothetical cohort or group of juvenile Atlantic Sturgeon spawned during a single year.[67] The cohort model uses growth and mortality rates to calculate the instantaneous daily production potential, or the instantaneous amount of biomass produced per unit of cohort biomass per day. The EPA used the cohort model 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.

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.[68] Mortality rates of juvenile sturgeons increased with declining dissolved oxygen levels and increased at higher rates with both declining dissolved oxygen and increasing water temperature. The EPA validated the results of the mortality model by using observed water quality data to predict relative abundance of the Atlantic Sturgeon young-of-year cohort on October 31 and comparing those results to catch data from DNREC’s juvenile abundance surveys.[69] The growth model takes a bioenergetic approach that accounts for temperature-

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https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=01477050 ; Park, I. (2023). State of Delaware Annual Compliance Report for Atlantic Sturgeon. Delaware Division of Fish and Wildlife, Department of Natural Resources and Environmental Control. September 2023.

[67] Water temperature and salinity can affect the oxygen requirements of aquatic species and are needed to compute percent oxygen saturation, a measure of dissolved oxygen availability to aquatic organisms, from dissolved oxygen concentrations.

[68] Experimental data are from Campbell and Goodman 2004, Niklitschek and Secor 2009a.

[69] USGS 01467200 Delaware River at Penn's Landing, Philadelphia, PA. Retrieved March 9, 2023. https://waterdata.usgs.gov/nwis/inventory/?site_no=01467200&agency_cd=USGS ; USGS 01477050 Delaware

controlled maximum metabolic rates that may be further limited by oxygen levels. Low oxygen levels limit overall metabolic rates and cause a shift in the allocation of available energy away from growth. Predicted growth rates reflect the balance between energy inputs and losses and are therefore reduced by low oxygen. Water quality monitoring data in the relevant zones of the Delaware River show that the lowest oxygen levels coincided with the highest water temperatures, resulting in lower growth rates than either condition would cause alone.

Habitat Suitability Indices have been used in the context of fish-habitat relationships, conservation management, and habitat evaluation to quantify the capacity of a given habitat to support essential life functions (e.g., growth, survival, reproduction) of a selected species.[70] For this proposed rulemaking, the EPA defined a Habitat Suitability Index (HSI) for Atlantic Sturgeon as the instantaneous daily production potential, which was calculated using the cohort model. HSI evaluates the combined effect of percent oxygen saturation, water temperature, and salinity on the potential growth and survival of juvenile Atlantic Sturgeon during the *Juvenile Development* season. The EPA used quantile generalized additive models (QGAMs) to quantify relationships between computed values of HSI in each year and corresponding seasonal percentiles of daily dissolved oxygen for that year.[71] QGAMs can model the non-linear

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River at Chester PA. Retrieved January 31, 2023. https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=01477050 ; Park (2023).

[70] E.g., Woodland, R.J., Secor, D.H., and Niklitschek, E.J. (2009). Past and Future Habitat Suitability for the Hudson River Population of Shortnose Sturgeon: A Bioenergetic Approach to Modeling Habitat Suitability for an Endangered Species. American Fisheries Society Symposium 69: 589-604; Collier, J.J., Chiotti, J.A., Boase, J., Mayer, C.M., Vandergoot, C.S., and Bossenbroek, J.M. (2022). Assessing habitat for lake sturgeon (Acipenser fulvescens) reintroduction to the Maumee River, Ohio using habitat suitability index models. Journal of Great Lakes Research. 48(1): 219-228. https://doi.org/10.1016/j.jglr.2021.11.006 ; Brown, S.K., Buja, K.R., Jury, S.H., Monaco, M.E., and Banner, A. (2000). Habitat Suitability Index Models for Eight Fish and Invertebrate Species in Casco and Sheepscot Bays, Maine. North American Journal of Fisheries Management, 20(2): 408-435, https://doi.org/10.1577/1548-8675(2000)020%3C0408:HSIMFE%3E2.3.CO;2.

[71] A percentile (e.g., 10th percentile) is the dissolved oxygen level below which the corresponding fraction (e.g., 10%) of the daily dissolved oxygen values during the season falls below. In this case, the season is the *Juvenile Development* season (July 1 – October 31).

relationship between dissolved oxygen and HSI as well as predict the expected median HSI, rather than the expected mean.

The EPA followed the approach of Niklitschek and Secor (2005) to define suitable habitat for juvenile Atlantic Sturgeon growth and survival as habitats with water quality resulting in HSI greater than zero. When HSI is less than or equal to zero, seasonal average mortality rates are greater than or equal to seasonal average growth rates and the overall biomass of the cohort is likely to decrease. Conversely, a cohort of juveniles utilizing habitat with HSI greater than zero has the potential to increase its biomass during the *Juvenile Development* season, thus contributing to successful propagation. Therefore, to derive protective dissolved oxygen criteria, the EPA evaluated seasonal percentiles of percent oxygen saturation to find the lowest value at which the QGAMs predict expected median HSI>0 as the minimum thresholds for percent oxygen saturation that, if attained, would provide suitable habitat during that seasonal period. 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. Similarly, the EPA requests comment on its use of QGAM to relate percentiles of dissolved oxygen levels to the conditional median HSI. 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. As an alternative, the QGAM could predict a lower conditional percentile, providing a high degree of certainty that HSI would be greater than zero if the dissolved oxygen level was attained. For example, at the dissolved oxygen level where the expected 25th percentile HSI=0, HSI would be expected to equal or exceed zero 75% of the time.

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. These two percentiles – the 10th percentile and the 50th percentile – describe the protective seasonal distribution of dissolved oxygen values. When both the 10th percentile and 50th percentile are attained, they function together to ensure that a detrimental shift in the oxygen distribution (i.e., a shift causing more low oxygen levels) at either the low end (10th percentile) or the center (50th percentile) of the dissolved oxygen distribution has not occurred. Median HSI is expected to be zero or higher, allowing the annual cohort of juvenile Atlantic Sturgeon to maintain or increase its biomass, when the 10th percentile of oxygen saturation is at least 66% and the 50th percentile, or median, of oxygen saturation is at least 74%. Therefore, the EPA expects oxygen levels will not impair juvenile Atlantic Sturgeon during the *Juvenile Development* season if the 10th percentile of oxygen saturation is at least 66% and the 50th percentile of oxygen saturation is at least 74%.

Criteria Development for Spawning and Larval Development and Overwintering Seasons

The Atlantic Sturgeon cohort model described above relies on experimental studies that were conducted using juvenile Atlantic Sturgeon and therefore provide information that is most relevant to juvenile growth and survival.[72] Additionally, the underlying studies allocated most experimental treatments to water temperatures between 12°C and 28°C, with only a single experimental treatment at 6°C and none at lower water temperatures.[73] The EPA's cohort modeling approach therefore does not apply to spawning and larval development lifestages and

[72] Experimental data are from Campbell and Goodman 2004 and Niklitschek and Secor 2009a.
[73] Niklitschek and Secor 2009a.

has minimal relevance to the overwintering period. Accordingly, the EPA did not use the cohort model to derive criteria for the *Spawning and Larval Development* or the *Overwintering* seasons.

Instead, the EPA concluded that Atlantic Sturgeon larvae were likely to be as sensitive to low dissolved oxygen as juvenile Atlantic Sturgeon[74] and that overwintering juveniles have temperature-limited metabolism and therefore have similar or slightly lower oxygen requirements than juveniles in warmer waters (e.g., summer water temperatures).[75] Thus, the EPA determined that the percent oxygen saturation threshold that would be protective of juveniles experiencing stressful (high) water temperatures during the *Juvenile Development* season would also be protective of larvae and overwintering juveniles not experiencing high water temperatures. Therefore, the EPA expects oxygen levels will not impair Atlantic Sturgeon when the 10th percentile of oxygen saturation is at least 66% during the *Spawning and Larval Development* and *Overwintering* seasons. The EPA notes that from 2002 – 2022, the median oxygen level during the *Spawning and Larval Development* and *Overwintering* seasons was well above levels expected to negatively impact either Atlantic Sturgeon or other oxygen-sensitive species. Therefore, the EPA concluded that a second criterion for a 50th percentile was not needed during these seasons.

Criteria Expressed as Percent Oxygen Saturation

Finally, the EPA derived the proposed criteria in terms of percent oxygen saturation, rather than in units of concentration (such as milligrams per liter or mg/L) for two main

[74] Stoklosa et al. (2018); United States Environmental Protection Agency. (2000). Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras. Document ID: EPA-822-R-00-012. November 2000. https://www.epa.gov/sites/default/files/2018-10/documents/ambient-al-wqc-dissolved-oxygen-cape-code.pdf.
[75] Niklitschek and Secor (2009a, 2009b).

reasons.[76] First, physiological effects of oxygen on aquatic organisms are *directly* related to percent oxygen saturation and *indirectly* related to dissolved oxygen concentration. As noted by Niklitschek and Secor (2009a), percent oxygen saturation or partial pressure are the most biologically relevant measures of oxygen because they determine the maximum rate at which aquatic organisms may obtain oxygen from the water. Second, percent oxygen saturation varies with water temperature less than dissolved oxygen concentration. Because oxygen solubility is higher in cold water than warm water, dissolved oxygen concentrations are often much higher in cold water. The strong negative relationship between dissolved oxygen concentration and temperature can complicate the interpretation of seasonal dissolved oxygen patterns. For example, in the Delaware River, dissolved oxygen concentrations increase quickly during fall as temperatures decrease, even though percent saturation increases more slowly. In this example, the increasing oxygen concentration gives the appearance that oxygen availability to aquatic organisms is increasing more rapidly than it is actually increasing. For Atlantic Sturgeon, this means that low levels of percent oxygen saturation may continue to impact growth and survival even though dissolved oxygen concentrations increase. Given this relationship between temperature and dissolved oxygen concentration, criteria expressed as concentration will be above or below the protective threshold at various times of the year as temperature changes, whereas criteria expressed as percent oxygen saturation can be protective throughout the year.

2. Proposed Dissolved Oxygen Criteria

[76] Percent oxygen saturation and dissolved oxygen concentration are two different ways to measure oxygen levels in water. Dissolved oxygen concentration is the amount of oxygen dissolved in the water, typically represented as milligrams of oxygen per liter of water. Percent oxygen saturation is the ratio, expressed as a percentage, of the dissolved oxygen concentration in the water to the dissolved oxygen concentration when at equilibrium with the atmosphere.

The EPA's proposed dissolved oxygen criteria cover three distinct seasons based largely on Atlantic Sturgeon early life stages and are intended to protect all oxygen-sensitive species in the Delaware River, as explained above. The *Spawning and Larval Development* season occurs between March 1st and June 30th and captures a comprehensive range of resident aquatic species' spawning periods.[77] The *Juvenile Development* season occurs between July 1st and October 31st and captures critical early life stage growth and development for young-of-the-year Atlantic Sturgeon. The *Overwintering* season occurs between November 1st and February 28th (or 29th, in a leap year), when juvenile Atlantic Sturgeon growth is limited by low water temperatures.

Each season has water quality criteria that each consist of three components: magnitude, duration, and exceedance frequency. The magnitude component indicates the required level of dissolved oxygen in the water, which in this proposal is presented in units of percent oxygen saturation. The duration component specifies the time period over which water quality is averaged before comparison with the criteria magnitude; in this proposal, the duration is a daily average.[78] The exceedance frequency component specifies how often (e.g., percentage of the time) each criterion can be exceeded in each season while still ensuring that the use is protected. 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). For dissolved oxygen, an exceedance occurs when the oxygen level in the water is below the criterion value.

[77] Stoklosa et al. (2018); Delaware River Basin Commission (2015).
[78] The EPA selected a daily average duration because it is a readily measurable indicator of the oxygen levels at a daily timescale. The daily average is protective because variability of dissolved oxygen levels on a single day is small in the Delaware River.

In this proposed rulemaking, the *Spawning and Larval Development* and *Overwintering* seasons each have a single, identical dissolved oxygen criterion with a magnitude of 66% oxygen saturation, a daily average duration, and a 10% exceedance frequency (which allows for up to 12 days of cumulative exceedance during each of these two seasons) (Table 6 of this preamble). The *Juvenile Development* season has two individually applicable dissolved oxygen criteria that together define a protective seasonal distribution of percent oxygen saturation. The criteria differ in both magnitude and exceedance frequency and both levels must be attained. The first *Juvenile Development* criterion defines the lower end of the distribution of oxygen levels and consists of a magnitude of 66% oxygen saturation, a daily average duration, and a 10% exceedance frequency (which allows for up to 12 days cumulative exceedance during the season). The second *Juvenile Development* criterion defines the center of the distribution and consists of a magnitude of 74% oxygen saturation, a daily average duration, and a 50% exceedance frequency (which allows for up to 61 days cumulative exceedance during the season) (Table 6 of this preamble).

Table 6. The EPA's Proposed Dissolved Oxygen Criteria

Season	Magnitude (Percent Oxygen Saturation)	Duration	Exceedance Frequency
Spawning and Larval Development *(March 1 – June 30)*	66%	Daily Average	10% *(12 Days Cumulative)*
Juvenile Development *(July 1 – October 31)*	66%	Daily Average	10% *(12 Days Cumulative)*
	74%	Daily Average	50% *(61 Days Cumulative)*
Overwintering *(November 1 – February 28/29)*	66%	Daily Average	10% *(12 Days Cumulative)*

3. Alternative Options Considered

During the criteria derivation process, the EPA made several decisions based on the best available sound scientific information to ensure the dissolved oxygen criteria would be protective of the applicable and proposed aquatic life designated uses. In this section, the EPA presents three alternative options the Agency considered. For each alternative, the EPA examined information currently available at the time of this proposal. The EPA has concerns about whether each alternative would be protective of the aquatic life designated uses that include propagation; therefore, the EPA did not include any of these alternatives as part of its lead proposed criteria. However, the EPA requests comment and additional information on whether and how one or more of these alternatives could protect the applicable and proposed aquatic life designated uses in the specified zones of the Delaware River and if so, what anticipated benefits would be associated with the alternative compared to the EPA's proposed criteria.[79]

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

The EPA's proposed dissolved oxygen criteria are expressed as percent oxygen saturation, as described in section IV.C.1 of this preamble. However, the EPA recognizes that some stakeholders might be more familiar with dissolved oxygen criteria expressed as concentration or might have other reasons for preferring criteria expressed as concentration. The EPA is seeking comment on whether dissolved oxygen criteria expressed as concentration (mg/L) would be protective of oxygen-sensitive species during each season.

To calculate *Juvenile Development* season criteria expressed as concentration (mg/L), the EPA followed an analogous approach to the method used for determining criteria as percent oxygen saturation, as explained in section IV.C.1 of this preamble. The EPA used quantile generalized additive models relating seasonal percentiles of dissolved oxygen concentration to

[79] More information is available in the associated document, *Technical Support Document for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River.*

the expected median habitat suitability index (HSI). The EPA selected as the alternative criteria values the dissolved oxygen concentration for which the expected median HSI is zero (Table 7 of this preamble).

To calculate dissolved oxygen criteria expressed as concentration for the *Spawning and Larval Development* and *Overwintering* seasons, the EPA started with the criteria computed as percent oxygen saturation (Table 6 of this preamble) and converted each of these to a concentration using each of the following two approaches, which differed based on water temperature assumptions.[80] The EPA's first approach uses the 90th percentile of water temperatures in each season, whereas the second approach uses the average water temperature in each season.[81] The 90th percentile approximates the highest water temperature in each season, which corresponds to when dissolved oxygen levels are generally at their lowest and therefore impacts to aquatic life are most likely to occur. In the Delaware River, the highest temperatures in the *Spawning and Larval Development* season occur in late June and the highest temperatures in the *Overwintering* season occur in early November. On the other hand, the EPA's second approach using an average water temperature results in the concentration that minimizes the magnitude of deviations in either direction from the protective level across the season. Because the average water temperature is lower than the 90th percentile water temperature, the EPA's second approach resulted in higher dissolved oxygen concentrations than the first approach (Table 7 of this preamble).

[80] The EPA assumed salinity = 0 for each conversion from percent oxygen saturation to concentration in the *Spawning and Larval Development* and *Overwintering* seasons.
[81] Seasonal 90th percentile and mean water temperature were calculated using the daily climatology computed for Chester for March 1, 2012 – June 30th, 2022, for the *Spawning and Larval Development* season and November 1, 2011 – February 28, 2022, for the *Overwintering* season.

In Table 7 below, the EPA leads with alternative criteria based on the 90th percentile water temperatures because existing dissolved oxygen criteria guidance and criteria derivation efforts in other states have commonly focused on the warmest conditions that occur, which are the most critical for mitigating impacts to aquatic life due to low oxygen.[82] For consideration, the EPA presents alternative criteria based on average water temperatures in parentheses.

Table 7. Alternative 1: Dissolved Oxygen Criteria Expressed as Concentration (mg/L).

Season	Water Temperature (°C)	Magnitude (mg/L)	Duration	Exceedance Frequency
Spawning and Larval Development *(March 1 – June 30)*	23.3 (14.7)*	5.6 (6.7)*	Daily Average	10% *(12 Days Cumulative)*
Juvenile Development *(July 1 – October 31)*	N/A+	5.4	Daily Average	10% *(12 Days Cumulative)*
	N/A+	6.1	Daily Average	50% *(61 Days Cumulative)*
Overwintering *(November 1 – February 28/29)*	12.4 (5.6)*	7.0 (8.3)*	Daily Average	10% *(12 Days Cumulative)*

* The 90th percentile of seasonal water temperature and corresponding criterion is used for the main estimate, while the average water temperature and corresponding criterion is shown in parentheses.
+ Water temperature is not applicable during the *Juvenile Development* season because the criteria magnitudes are derived from the EPA's Atlantic Sturgeon cohort model, described in section IV.C.1 of this preamble.

Concentration-based criteria derived using the EPA's first approach (based on the 90th percentile water temperatures) would be equivalent to the EPA's proposed 66% oxygen saturation when water temperature is near the 90th percentile temperature and oxygen is near the

[82] United States Environmental Protection Agency. (2000). Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras. Document ID: EPA-822-R-00-012. November 2000. https://www.epa.gov/sites/default/files/2018-10/documents/ambient-al-wqc-dissolved-oxygen-cape-code.pdf ; Batiuk, R.A., Breitburg, D.L., Diaz, R.J., Cronin, T.M., Secor, D.H., and Thursby, G. (2009). Derivation of habitat-specific dissolved oxygen criteria for Chesapeake Bay and its tidal tributaries. Journal of Experimental Marine Biology and Ecology 381: S204-S215. https://doi.org/10.1016/j.jembe.2009.07.023.

lowest point in each season. However, during periods in each season when water temperature is lower than the 90th percentile temperature, the concentration-based criteria would be below the level that is equivalent to the EPA's proposed 66% oxygen saturation level. For example, when water temperature is 2°C in mid-winter, oxygen saturation is 66% when the dissolved oxygen concentration is 9.1 mg/L. The EPA therefore has concerns about whether dissolved oxygen criteria expressed as concentration for this alternative would be protective for the *Spawning and Larval Development* and *Overwintering* seasons. Similar to the first approach, the concentration derived using the EPA's second approach (average water temperature) is also below the level that is equivalent to 66% oxygen saturation when water temperature is below the seasonal average. During periods in each season when the water temperature is warmer than the average, concentrations calculated using the EPA's second approach would result in an oxygen saturation higher than 66%.[83]

The EPA provided the concentrations in Table 7 of this preamble that result from the methods described above to help facilitate public comment. The EPA also requests public input and supporting information about other ways the Agency could develop dissolved oxygen criteria expressed as concentration – particularly for the *Spawning and Larval Development* and *Overwintering* seasons – to protect the relevant aquatic life uses in accordance with the CWA.

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

[83] More information on dissolved oxygen trends in the specified zones of the Delaware River is available in the associated rule documents, *Technical Support Document for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River* and *Economic Analysis for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River*.

The EPA's proposed dissolved oxygen criteria for the critical *Juvenile Development* season consist of two values – one that may be exceeded 10% of the time and one that may be exceeded 50% of the time – that must both be met during the season, as explained in section IV.C.1 of this preamble. However, the EPA recognizes that some stakeholders might prefer the simpler criteria framework a single criterion would afford or may have other reasons for preferring a single value.

The EPA is seeking comment and supporting information on applying a single dissolved oxygen criterion with a 10% exceedance frequency during the *Juvenile Development* season, including whether criteria expressed with a single criterion would protect the applicable and proposed aquatic life designated uses. This could mean applying a single criterion of 66% oxygen saturation (or 5.4 mg/L, if expressed as concentration) with a 10% exceedance frequency for the *Juvenile Development* season. The *Overwintering* and *Spawning and Larval Development* seasons are unaffected by this alternative.

The EPA also requests public input and supporting information about other potential options the Agency could consider for dissolved oxygen criteria in the form of a single criterion to protect the aquatic life uses in accordance with the CWA.

Alternative 3: Inclusion of a 1-in-3-Year Interannual Exceedance Frequency.

The EPA's proposed criteria do not include an interannual exceedance frequency and therefore would need to be met every year. However, the EPA recognizes that some stakeholders might prefer criteria with an interannual exceedance frequency to help accommodate the impact of environmental variability on dissolved oxygen conditions in the specified zones of the Delaware River. The EPA is seeking comment and supporting information on the addition of a 1-in-3-year interannual exceedance frequency as part of the dissolved oxygen criteria. The EPA is particularly interested in how and why this approach would protect the applicable and current aquatic life uses.

If a 1-in-3-year interannual exceedance frequency were included as part of the dissolved oxygen criteria, it would mean that in any three-year period, all criteria would need to be attained in at least two years. An exceedance would occur in any year where one or more of the criteria were not attained. The following two examples describe how a 1-in-3-year interannual exceedance frequency could function.

Example 1: If, in a given year, the dissolved oxygen during the *Juvenile Development* season fell below 66% saturation more than 10% of the time, then that year would not meet the *Juvenile Development* 10th percentile criterion. Therefore, that year would count as one year of exceedance towards the 1-in-3-year interannual exceedance frequency. If another criterion, for example the *Spawning and Larval Development* criterion, was not met in that same year, then it would still only count as one year of exceedance despite the fact that two criteria were not met that year (Table 8 of this preamble).

Table 8. Example 1 Scenario Where Dissolved Oxygen Criteria with the 1-in-3-year Interannual Exceedance Frequency are Met.

Season	**Was the Seasonal Criterion Met?**		
	Year 1	**Year 2**	**Year 3**
Spawning and Larval Development	**No**	Yes	Yes
Juvenile Development – 10th Percentile	**No**	Yes	Yes
Juvenile Development – 50th Percentile	Yes	Yes	Yes
Overwintering	Yes	Yes	Yes
Does the Full Year Meet Criteria?	**No**	Yes	Yes

Example 2: If, in a given year, the dissolved oxygen during the *Juvenile Development* season fell below 66% saturation more than 10% of the time, then that year would not meet the *Juvenile Development* 10th percentile criterion. If the following year, the

Juvenile Development season fell below 74% saturation more than 50% of the time, then that year would not meet the *Juvenile Development* 50th percentile criterion (Table 9 of this preamble). In this scenario, the first and second year in the three-year period both did not meet the criteria; therefore, the interannual exceedance frequency was not met.

Table 9. Example 2 Scenario Where Dissolved Oxygen Criteria with the 1-in-3-year Interannual Exceedance Frequency are Not Met.

Season	Was the Seasonal Criterion Met?		
	Year 1	**Year 2**	**Year 3**
Spawning and Larval Development	Yes	Yes	Yes
Juvenile Development – 10th Percentile	**No**	Yes	Yes
Juvenile Development – 50th Percentile	Yes	**No**	Yes
Overwintering	Yes	Yes	Yes
Does the Full Year Meet Criteria?	**No**	**No**	Yes

The EPA has historically considered it appropriate to apply a 1-in-3-year exceedance frequency in the context of aquatic life criteria for toxic pollutants, based on the ability of aquatic ecosystems to recover from criteria exceedances and natural variations in flow and the concentrations of the pollutant in a waterbody.[84] However, the EPA does not typically apply this construct to criteria for conventional water quality parameters like dissolved oxygen due to inherent differences between these parameters and toxic pollutants. For example, dissolved oxygen is typically not directly regulated in the same manner as toxic pollutants because low dissolved oxygen conditions (such as hypoxia) are a symptom of a related issue, such as nutrient or ammonia pollution.[85] The EPA also requests public input and supporting information

[84] Stephen, C.E., Mount, D.I., Hansen, D.J., Gentile, J.R., Chapman, G.A., and Brungs, W.A. (1985). Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. United States Environmental Protection Agency. Document ID: PB85-227049. https://www.epa.gov/sites/default/files/2016-02/documents/guidelines-water-quality-criteria.pdf ; United States Environmental Protection Agency. (2023). Proceedings from the EPA Frequency and Duration Experts Workshop: September 11-12, 2019. Document ID: EPA-820-R-23-002. February 2023. https://www.epa.gov/system/files/documents/2023-02/proceedings-frequency-duration-workshop.pdf.

[85] United States Environmental Protection Agency. (2000). Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras. Document ID: EPA-822-R-00-012. November 2000. https://www.epa.gov/sites/default/files/2018-10/documents/ambient-al-wqc-dissolved-oxygen-cape-code.pdf.

regarding any scientific approaches that can be used to predict the impact of periodic low oxygen levels on populations of aquatic organisms.

V. Endangered Species Act Consultation

Section 7(a)(2) of the Endangered Species Act (ESA) requires that each Federal Agency ensure that any action authorized, funded, or carried out by such Agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. Pursuant to section 7(a)(2) of the ESA, the EPA will consult with NOAA Fisheries concerning this rulemaking action proposing a designated aquatic life use including propagation and associated dissolved oxygen criteria in the specified zones of the Delaware River. The EPA will work closely with NOAA Fisheries to ensure that any WQS the Agency finalizes are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat in the specified zones of the Delaware River. As a result of this consultation, the EPA may modify some provisions of this proposed rule.

VI. Applicability

The EPA is proposing a Federal designated use that would apply in New Jersey and Pennsylvania, in addition to those states' designated uses that are already applicable. This means that for the specified zones of the Delaware River, the EPA is proposing to supplement, rather than replace, New Jersey's and Pennsylvania's currently applicable aquatic life designated uses. Therefore, New Jersey's and Pennsylvania's currently applicable aquatic life designated uses would remain applicable for CWA purposes. Those states' current water quality criteria associated with those uses would also remain applicable for CWA purposes, with the exception of any aquatic life criteria for dissolved oxygen, which would be replaced by the criteria that the

EPA promulgates through this rulemaking, if finalized.[86] The EPA concluded that this approach was the best way to make clear which of the states' WQS would and would not be revised by this rulemaking, if finalized. The EPA requests comment on this approach.

In addition, the EPA is proposing dissolved oxygen criteria that would replace Delaware's, New Jersey's, and Pennsylvania's existing dissolved oxygen criteria for the specified zones of the Delaware River. The EPA notes that there are aquatic life criteria for pollutants and parameters other than dissolved oxygen that are in effect for CWA purposes – not only in the zones covered by this proposed rulemaking, but also for other zones of the Delaware River that already include aquatic life propagation as a designated use; those criteria are not impacted by this rulemaking.

Since the EPA is only proposing to promulgate revised dissolved oxygen criteria for the specified zones of the Delaware River, Delaware, New Jersey, and Pennsylvania should evaluate whether other aquatic life criteria should similarly be added or revised for the specified zones or other zones of the Delaware River. One way these states can review their WQS is through the triennial review process. As explained in section III of this preamble, states must review their WQS at least once every three years and, if appropriate, revise standards or adopt new standards (40 CFR 131.20(a)). The EPA recommends that Delaware, New Jersey, and Pennsylvania review their existing aquatic life criteria during their next triennial review to determine if new or revised aquatic life criteria would be appropriate to protect all applicable aquatic life designated uses, including any Federal designated use that the EPA may promulgate as part of a final rule.

[86] In the December 1, 2022, Administrator's Determination, the EPA determined that revised dissolved oxygen criteria are necessary to protect a propagation designated use. This proposed rulemaking includes dissolved oxygen criteria that are protective of all life stages of resident and migratory aquatic life species in the Delaware River (section IV.C. of this preamble).

VII. Conditions Where Federal Water Quality Standards Would Not be Promulgated or Would be Withdrawn

As noted, under the CWA, states and authorized tribes have the primary responsibility for developing and adopting WQS for their navigable waters (CWA section 303(a) through (c)). Although the EPA is proposing a revised aquatic life designated use and protective dissolved oxygen criteria for the specified zones of the Delaware River, each state retains the option to adopt and submit to the EPA for review its own revised designated use and dissolved oxygen criteria that are consistent with CWA section 303(c) and the EPA's implementing regulation to address the EPA's Administrator's Determination.

A. Conditions Where Federal Standards Would Not be Promulgated

If Delaware, New Jersey, and Pennsylvania adopt and submit revised WQS that addresses the EPA's December 1, 2022, Administrator's Determination, and the EPA approves those WQS before finalizing this proposed rulemaking, then a Federal promulgation would no longer be required under the CWA. Similarly, if one state adopts and submits WQS consistent with this proposed rulemaking, and the EPA approves those WQS before finalizing this proposed rulemaking, then a Federal promulgation would no longer be required under the CWA for that state.

B. Conditions Where Federal Standards Would be Withdrawn

If the EPA finalizes this proposed rulemaking and Delaware, New Jersey, and Pennsylvania subsequently adopt and submit revised WQS to the EPA, and the EPA approves those WQS, then the EPA would undertake a rulemaking to withdraw the federally promulgated use and/or dissolved oxygen criteria (40 CFR 131.21(c)). Similarly, if one state adopts and submits revised WQS to the EPA, and the EPA approves those WQS, then the EPA would undertake a rulemaking to withdraw the federally promulgated WQS for that state.

If Delaware's, New Jersey's, and/or Pennsylvania's adopted dissolved oxygen criteria are as stringent or more stringent than the federally promulgated criteria, then that state's criteria would immediately become the CWA-applicable criteria upon the EPA's approval. If Delaware's, New Jersey's, and/or Pennsylvania's adopted dissolved oxygen criteria are less stringent than the federally promulgated criteria, and the EPA approves those less stringent criteria, then those EPA-approved criteria would become the applicable criteria for CWA purposes only after the EPA withdraws its federally promulgated criteria for the relevant state(s).

VIII. Alternative Regulatory Approaches and Implementation Mechanisms

The Federal WQS regulations at 40 CFR part 131 provide several approaches that Delaware, New Jersey, and Pennsylvania could use at each state's discretion when implementing or deciding how to implement the federally promulgated dissolved oxygen criteria, if finalized. The EPA has identified two approaches – WQS Variances and NPDES Permit Compliance Schedules – that might be of particular interest for the states covered by this proposed rulemaking. Additionally, the EPA included a discussion about CWA section 303(d)/305(b) water quality assessments to clarify potential options that may be available to states in the specific circumstances relevant to this rulemaking.

A. Water Quality Standards Variances

A WQS variance is a time-limited designated use and criterion, for a specific pollutant or water quality parameter, that reflects the highest attainable condition (HAC) during the term of the WQS variance (40 CFR 131.3(o)). WQS variances can be used to incrementally improve water quality where the designated use and criterion are unattainable for a period of time. The state would need to demonstrate that attaining the applicable designated use and dissolved oxygen criterion would not be feasible for a period of time (i.e., during the term of the WQS variance) because of one of the factors specified in 40 CFR 131.14(b)(2)(i)(A) and specify the actions that will be taken to make incremental water quality improvements during the term of the WQS variance.

If Delaware, New Jersey, and/or Pennsylvania choose/s to adopt a WQS variance, the state/s must specify in the WQS variance the term and the interim requirements of the WQS variance. The term must be justified by describing the pollutant control activities expected to occur over that term to achieve the HAC. The interim requirements must be a quantitative expression that reflects the HAC using one of the options provided at 40 CFR 131.14(b)(1)(ii).

WQS variances adopted in accordance with 40 CFR 131.14 and approved by the EPA for CWA purposes provide a legal avenue for states to write NPDES permit limits that are based on the HAC during the term of the WQS variance, while simultaneously implementing controls to make incremental water quality improvements toward ultimately attaining the applicable designated use and dissolved oxygen criterion.

B. NPDES Permit Compliance Schedules

The EPA's regulations at 40 CFR 122.47 and 131.15 address how permitting authorities can use schedules for compliance with a water-quality-based effluent limitation (WQBEL) in an NPDES permit, if the discharger needs time to undertake an enforceable sequence of actions – such as facility upgrades or operation changes – leading to compliance with the WQBEL. The EPA's regulation at 40 CFR 122.47 allows states authorized to administer the NPDES program to include compliance schedules in NPDES permits, when appropriate and where authorized by the state's WQS, provided the compliance schedule authorizing provision was approved by the

EPA. Such compliance schedules may be used to implement any CWA-effective WQS, including any WQS that the EPA promulgates as part of a final rule.

C. Clean Water Act Section 303(d)/305(b) Water Quality Assessments

If the EPA promulgates revised aquatic life WQS for the specified zones of the Delaware River and they become effective for CWA purposes, Delaware, New Jersey, and Pennsylvania will have an obligation under CWA sections 303(d) and 305(b) to assess whether the WQS are being attained. The EPA anticipates there may be a period of time immediately after promulgation of the revised WQS when the WQS will not be attained because the actions and procedures required to achieve compliance will take time to implement. In this scenario, any of the relevant zones not attaining the WQS should be classified as impaired on the relevant 303(d)/305(b) Integrated Report(s) (IR) that is submitted to the EPA for review.

Per the CWA and the EPA's implementing regulations, waters that are assessed as impaired by a pollutant typically require the development of a Total Maximum Daily Load (TMDL), which is a regulatory planning tool designed to restore water quality via allocations of pollutant reductions to relevant point and non-point sources. The EPA regulations also recognize that other pollution control requirements may obviate the need for a TMDL. Specifically, impaired waters do not require a TMDL if: (1) technology-based effluent limitations required by the CWA; (2) more stringent effluent limitations required by a state, local, or Federal authority; or (3) other pollution control requirements (e.g., best management practices) required by a state, local, or Federal authority are stringent enough to implement applicable WQS (40 CFR 130.7(b)(1)). Impaired waters that do not require a TMDL because they satisfy one of these alternatives are commonly referred to as Category 4b waters, as described in the EPA's Integrated Reporting Guidance for CWA sections 303(d), 305(b), and 314.[87]

DRBC developed a model to evaluate sources of pollution that affect dissolved oxygen levels in the specified zones of the Delaware River and concluded that point sources are the primary contributor to oxygen depletion within those zones.[88] 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.[89] 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.

IX. Economic Analysis

The EPA conducted an economic analysis to evaluate the potential costs and benefits associated with this proposed rulemaking. In the high-level summary of the EPA's economic analysis below, the EPA first describes a baseline scenario that is intended to characterize the world in the absence of the EPA's proposed rule. Next, the EPA describes development of a

[87] The EPA's Integrated Reporting Guidance is available at: https://www.epa.gov/tmdl/integrated-reporting-guidance-under-cwa-sections-303d-305b-and-314.
[88] Delaware River Basin Commission (2022a, 2022b).
[89] More details are available in the document, *Economic Analysis for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River*.

policy scenario based on potential pollution control actions that, if implemented, can be expected to meet the EPA's proposed dissolved oxygen criteria. Finally, the EPA evaluates the anticipated costs and benefits associated with the policy scenario and the EPA's proposed criteria. More details and information are available in the associated document, *Economic Analysis for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River*.

A. Baseline for the Analysis

The baseline is intended to characterize the world in the absence of the EPA's proposed rule. The EPA typically assumes full compliance with existing regulations and requirements – including CSO long-term control plans (LTCPs) – even if they are not yet fully implemented, as a basis for estimating the cost and benefits of proposed regulations. This baseline approach ensures that the cost and benefits of the existing regulations and requirements are not double counted.

In this economic analysis, the EPA assumes that without the proposed rule, the less stringent WQS (that do not support aquatic life propagation) currently in effect for CWA purposes would remain in effect (section III.D. of this preamble). Accordingly, the EPA assumes that water quality conditions in the specified zones of the Delaware River, particularly during the *Juvenile Development* season (July 1 – October 31), would continue to experience low oxygen levels that do not support aquatic life propagation, even with implementation of existing and planned CSO LTCPs.[90] 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. The Philadelphia Water Department, Camden County Municipal Utilities

[90] While the EPA normally assumes full compliance with *existing* LTCPs, for this proposed rulemaking, the EPA is also assuming full compliance with *planned* LTCPs. Because planned LTCPs are not final and therefore are subject to change, this adds uncertainty to the baseline conditions.

Authority, and Delaware County Regional Water Quality Control Authority all have LTCPs that are either approved or in progress.[91] The EPA expects implementation of these LTCPs, when finalized, to occur regardless of the EPA's proposed rule. Therefore, the EPA included estimated CSO volume reductions for these three dischargers as part of the baseline for this economic analysis.

DRBC modeled the effect of pollution reduction on dissolved oxygen levels in the Delaware River and provided the EPA with water quality simulation results under both baseline and "restored" conditions for the years 2012, 2018, and 2019.[92] Baseline simulations predict water quality conditions associated with the discharge of actual wastewater treatment plant (WWTP) flows at existing levels of treatment and after full implementation of LTCPs. The restored simulations predict water quality conditions associated with the discharge of actual WWTP flows at treatment levels that include additional effluent treatment and after full implementation of LTCPs.

Of the three available years (2012, 2018, and 2019), the EPA selected the 2019 year as representative of the most typical conditions in the relevant zones of the Delaware River. In comparison, 2012 had atypically poor conditions (low percent oxygen saturation, high water temperature), while 2018 had atypically good conditions (high percent oxygen saturation, low water temperature). Therefore, model runs used in this economic analysis are based on 2019 conditions.

B. Development of the Policy Scenario

[91] Delaware River Basin Commission (2022a) ; DELCORA. (2023). Combined Sewer System: DELCORA CSO LTCP. https://www.delcora.org/combined-sewer-systems/delcora-cso-ltcp/ ; Philadelphia Water Department. (2023). CSO Long Term Control Plan. https://water.phila.gov/reporting/ltcp/ ; State of New Jersey Division of Water Quality. (2023). Long Term Control Plan Submittals. https://www.nj.gov/dep/dwq/cso-ltcpsubmittals.htm.
[92] The EPA determined that the model runs from DRBC were sufficient for use in this economic analysis.

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. For this economic analysis, the EPA relied on available data to develop a policy scenario based on modeled pollution controls developed by DRBC that the EPA expects would meet the Agency's proposed dissolved oxygen criteria. Actual benefits, costs, and impacts will depend on the choices that states would make in implementing the proposed WQS, which may differ from the policy scenario in this economic analysis.

The EPA's proposed dissolved oxygen criteria apply to three seasons (section IV.C. of this preamble). Therefore, when developing a policy scenario for this proposed rulemaking, the EPA evaluated potential pollution control actions that would be expected to meet the EPA's criteria in each of the three seasons. The EPA began by evaluating water quality monitoring data for the past decade from two continuous monitoring stations in the relevant zones of the Delaware River – Penn's Landing in Zone 3 and Chester in Zone 4. Based on the monitoring data, the EPA expects that the Agency's proposed dissolved oxygen criteria for the *Spawning and Larval Development* and *Overwintering* seasons will likely be met without the need for additional WWTP upgrades or other controls beyond the baseline conditions (i.e., the LTCPs). Monitoring data for the *Juvenile Development* season indicated that additional pollution control actions are likely necessary to meet the EPA's proposed criteria in that season. To develop a policy scenario for the *Juvenile Development* season, the EPA relied on modeled data from DRBC predicting oxygen levels in 2019 in the specified zones of the Delaware River following a set of WWTP pollution control actions for certain dischargers. Modeled data for restored conditions are described in the baseline section above, while WWTP controls are described in the cost section below. The EPA expects that this policy scenario (hereafter, the "2019 restored scenario") will meet the proposed criteria during the *Juvenile Development* season.

C. Potential Costs

The EPA estimated compliance costs for the proposed WQS based on estimates for WWTPs to reduce effluent ammonia nitrogen concentrations and raise effluent dissolved oxygen concentrations. Although there are several causes that contribute to low dissolved oxygen conditions in the specified zones of the Delaware River, DRBC identified ammonia nitrogen loadings from WWTPs as the leading cause of oxygen-depletion in the river.[93] As a result, for the purpose of this economic analysis, the EPA assumed that additional pollution control technologies implemented at WWTPs is the most likely way that Delaware, New Jersey, and Pennsylvania will implement the proposed WQS. Therefore, the EPA evaluated WWTP controls rather than other non-point source controls for this cost analysis.

The EPA relied on cost information from several DRBC studies to estimate the costs of achieving the proposed WQS.[94] DRBC's 2022 *Analysis of Attainability* report categorized WWTPs as either class A', A, or B facilities. DRBC determined that discharges from Class A', A, and B facilities have a major impact, a marginal impact, or no measurable impact on oxygen levels in the specified zones, respectively. 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.[95]

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[93] Delaware River Basin Commission (2022a).
[94] *Id*.; Kleinfelder Inc. (2021). Nitrogen Reduction Cost Estimation Study Final Summary Report. https://www.nj.gov/drbc/library/documents/NitrogenReductionCostEstimates_KleinfelderJan2021.pdf; Kleinfelder Inc. (2023). Delaware River Basin Commission Nitrogen Reduction Cost Estimation Study – Supplemental Cost Addendum 2 Technical Memorandum – Final. https://www.nj.gov/drbc/library/documents/NitrogenReductionCostEstimates_Kleinfelder_aug2023addendum.pdf.
[95] Delaware River Basin Commission (2022a).

The EPA used WWTP-specific (capital, operations and maintenance (O&M)) compliance costs from Kleinfelder Inc. (2021, 2023) to estimate compliance costs, based on the discharger classification. Total compliance costs include the costs associated with both of the following:

1. Class A' Facilities: Costs associated with reductions in effluent ammonia nitrogen concentrations to 1.5 mg/L from May 1 through October 31 and increases in effluent oxygen concentrations to a monthly average of 6 mg/L year-round for the seven WWTPs categorized as Class A' facilities.

2. Class A Facilities: Costs associated with reductions in effluent ammonia nitrogen concentrations to 5 mg/L from May 1 through October 31 for the two WWTPs categorized as Class A facilities.

To estimate annualized compliance costs, the EPA assumed capital costs occur upfront in 2024 followed by a 5-year construction period. Consistent with Kleinfelder Inc. (2021, 2023), the EPA assumed O&M costs occur over a 25-year period from 2029 through 2053. The EPA thus annualized costs over a 30-year analysis period between 2024 and 2053 and discounted all cost values to 2024, using a 3 percent discount rate.

Table 10 of this preamble presents the annualized compliance costs associated with achieving the EPA's proposed WQS, using a 3 percent discount rate. The estimated total annualized compliance cost across nine WWTPs is $137.1 million (2022$). These costs vary considerably between the nine WWTPs, ranging from $1.9 million at the Lower Bucks County Joint Municipal Authority WWTP to $37.6 million at the Philadelphia Water Department (PWD) Southwest Water Pollution Control Plant (2022$). Among the dischargers, PWD bears the highest proportion of total costs, with its three facilities' combined costs accounting for over 50 percent of total costs. Overall, 66 percent of the costs are attributable to capital and 34 percent are attributable to O&M.

Table 10. Annualized Compliance Costs using a 3 Percent Discount Rate (Million 2022$)

Plant	State	Class	Annualized Costs (millions 2022$)
Camden County Municipal Utilities Authority	NJ	A’	$16.2
City of Wilmington	DE	A’	$23.9
Delaware County Regional Water Pollution Control Authority	DE	A’	$9.1
Gloucester County Utilities Authority	NJ	A’	$4.9
PWD Northeast Water Pollution Control Plant	PA	A’	$26.2
PWD Southeast Water Pollution Control Plant	PA	A’	$14.1
PWD Southwest Water Pollution Control Plant	PA	A’	$37.6
Hamilton Township	NJ	A	$3.3
Lower Bucks County Joint Municipal Authority	PA	A	$1.9
		Total	**$137.1**

D. Potential Benefits

Water quality improvements can have a wide range of effects on water resources and the environmental goods and services that they provide, including services valued by people (e.g., recreation, commercial fishing, public and private property ownership, existence services such as aquatic life, wildlife, and habitat designated uses). Some environmental goods and services (e.g., commercially caught fish) are traded in markets, and thus their value can be directly observed. Other environmental goods and services (e.g., recreation and support of aquatic life) cannot be bought or sold directly and thus do not have observable market values. This second type of environmental goods and services are classified as “non-market.” The estimated changes in the non-market values of the water resources affected by the EPA’s proposed WQS (hereafter, “non-market benefits”) are additive to market values (e.g., avoided costs of producing various market goods and services).

To value non-market benefits, the EPA used a benefit transfer approach based on a meta-analysis of surface water valuation studies to evaluate the use and nonuse benefits of improved surface water quality resulting from achievement of the EPA's proposed WQS in the 2019 restored scenario.[96] The benefit transfer approach involves three main steps:

1. Estimating water quality improvements associated with attainment of the EPA's proposed WQS relative to the baseline;

2. Translating these improvements into a water quality index (WQI) that can be linked to ecosystem services and uses that are valued by society. The WQI used for this analysis includes six parameters: dissolved oxygen, biological oxygen demand (BOD), fecal coliform (FC), total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS); and

3. Estimating the dollar value of the estimated water quality improvements based on estimates of the public's willingness-to-pay (WTP) derived from a meta-analysis of surface water valuation studies.

To estimate changes in ecosystem services provided in the specified zones of the Delaware River following attainment of the proposed WQS, the EPA obtained water quality modeling data from DRBC, including dissolved oxygen, TN, and TP levels for various effluent treatment scenarios. The EPA used DRBC's modeled output of dissolved oxygen levels in the specified zones following implementation of effluent controls (described in the cost section) and based on 2019 conditions (as described in the policy scenario section). The EPA used the 2019 restored scenario as the basis for representing conditions following the implementation of the

[96] The EPA has used this benefit transfer approach on numerous occasions, most recently in the *Benefit and Cost Analysis for Proposed Revisions to the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, which is available at https://www.epa.gov/system/files/documents/2023-03/steam-electric-benefit-cost-analysis_proposed_feb-2023.pdf.

proposed WQS, while making minor adjustments as needed[97] to ensure that predicted oxygen levels meet the EPA's proposed WQS. This analysis provides insight into the water quality improvements and benefits that are likely to result from implementation of the proposed WQS. For the remaining parameters included in the WQI (i.e., BOD, FC, and TSS), the EPA relied on measured data at various locations within the specified zones.

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. The EPA kept levels for the remaining parameters (TN, TP, TSS, and FC) unchanged from baseline conditions.

Table 11 of this preamble summarizes the percent change in dissolved oxygen and BOD by zone between the baseline and the 2019 restored scenario.

Table 11. Dissolved Oxygen and Biological Oxygen Demand Changes between the Baseline and 2019 Restored Scenarios

Zone	Percent Change from Baseline[a]
3	10.8%
4	23.8%
Upper-5	8.8%

a. The percent change for dissolved oxygen and biological oxygen demand are the same, but in opposite directions, i.e., the percent decrease in biological oxygen demand concentration is the same as the percent increase in dissolved oxygen concentration.

[97] Adjustments are detailed in section 4.2 of the associated document, *Economic Analysis for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River*.

To quantify benefits of water quality improvements, as is consistent with past practice, the EPA analyzed the values held by households residing within 100 miles of the specified zones of the Delaware River for water quality improvements associated with the EPA's proposed WQS.[98] Households may consider waters unaffected by the EPA's proposed WQS to be substitute waters for those affected, and this can influence what households would be willing to pay for improvements associated with the proposed WQS. The EPA deems waters unaffected by the proposed WQS within the 100-mile buffer around each Census block group as viable substitutes.

The EPA estimated the economic value of water quality changes using results of a meta-analysis of 189 estimates of total WTP (including both use and nonuse values) for water quality improvements, provided by 59 original studies conducted between 1981 and 2017. The estimated econometric model allows calculation of total WTP for changes in a variety of environmental services affected by water quality and valued by people, including changes in recreational fishing opportunities, other water-based recreation, and existence services such as aquatic life, wildlife, and habitat designated uses. The model also allows the EPA to adjust WTP values based on the core geospatial factors predicted by theory to influence WTP, including: scale (the size of affected resources or areas), market extent (the size of the market area over which WTP is estimated), and the availability of substitute waters. The model also takes into account important sociodemographic characteristics, such as population and income, which vary spatially.

[98] The EPA's 100-mile radius assumption follows Viscusi et al. (2008), which states: 'The survey defined relevant water quality as residing in a region that is "a 2-hour drive or so of your home, in other words, within 100 miles." About 80% of all recreational uses of bodies of water are within such a radius of users' homes. This 80% figure was based on data generated by EPA from the 1996 National Survey on Recreation and the Environment. Data indicates that 77.9% of boating visits, 78.1% of fishing visits, and 76.9% of swimming recreational visits are within a 100-mile radius of a given waterbody. (Citation: Viscusi, W. K., Huber, J., & Bell, J. (2008). The economic value of water quality. *Environmental and resource economics, 41*(2), 169-187.)

Table 12 in this preamble presents estimated household and total annualized WTP value for water quality improvements following attainment of the EPA's proposed WQS, based on a 3 percent discount rate. The total annualized value of water quality improvements from attainment of the proposed WQS is $112.8 million.

Table 12. Estimated Household and Total Annualized Willingness-to-Pay (WTP) for Water Quality Improvements under the EPA's Proposed Water Quality Standards, using a 3 Percent Discount Rate

Average Number of Affected Households (Millions)	Average Annual WTP Per Household (2022$)	Total Annualized WTP (Millions 2022$, 3% Discount Rate)
14.96	$8.18	$112.8

E. Conclusion

The United States Office of Management and Budget requires that for "significant regulatory actions" (as defined in Executive Order 12866 and as amended and reaffirmed by Executive Order 14094), that the EPA conduct an economic analysis. While this proposed rulemaking was not deemed significant, the EPA nonetheless conducted an economic analysis to evaluate the potential costs and benefits associated with the WQS in the EPA's proposed rule. For this proposed rulemaking, the EPA determined that the potential benefits justify the potential costs. The EPA estimates that the implementation of additional effluent treatment controls at certain WWTPs could lead to $137.1 million in annualized costs over 30 years (2022$, 3% discount rate). The EPA quantified estimated non-market benefits through average annual household WTP for water quality improvements. Annualized non-market benefits total $112.8 million per year over 30 years (2022$, 3% discount rate). 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. Therefore, the EPA's estimation of non-market benefits is likely an underestimate of total benefits and thus total benefits could potentially equal or exceed estimated total costs.

X. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review and Executive Order 14094: Modernizing Regulatory Review

This action is not a significant regulatory action as defined in Executive Order 12866, as amended by Executive Order 14094, and was therefore not subject to a requirement for Executive Order 12866 review.

B. Paperwork Reduction Act (PRA)

This action does not impose any new information collection burden under the PRA. OMB has previously approved the information collection activities contained in the existing regulations and has assigned OMB control number 2040-0049. While actions to implement these WQS, if finalized, could entail additional paperwork burden, this action does not directly contain any information collection, reporting, or record-keeping requirements.

C. Regulatory Flexibility Act (RFA)

I certify that this action will not have a significant economic impact on a substantial number of small entities under the RFA. This action will not impose any requirements on small entities. Small entities, such as small businesses or small governmental jurisdictions, are not directly regulated by this rule.

EPA-promulgated WQS are implemented through various water quality control programs including the NPDES program, which limits discharges to navigable waters, except in compliance with a NPDES permit. CWA section 301(b)(1)(C) and the EPA's implementing regulations at 40 CFR 122.44(d)(1) and 122.44(d)(1)(A) provide that all NPDES permits must include any limits on discharges that are necessary to meet applicable WQS. Thus, under the CWA, the EPA's promulgation of WQS establishes standards that states implement through the NPDES permit process. While states have discretion in developing discharge limits, those limits "must control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which the Director determines are or may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any [s]tate water quality standard, including [s]tate narrative criteria for water quality" (40 CFR 122.44(d)(1)(i)).

As a result of this action, if finalized, the states of Delaware, New Jersey, and Pennsylvania will need to ensure that permits they issue include any limitations on discharges necessary to comply with the WQS established in the final rule. In doing so, each state will have several choices associated with permit writing. While each state's implementation of the rule may ultimately result in new or revised permit conditions for some dischargers, including small entities, the EPA's action, by itself, does not impose any of these requirements on small entities; in other words, these requirements are not self-implementing.

D. Unfunded Mandates Reform Act (UMRA)

This action does not contain any unfunded mandate as described in UMRA, 2 U.S.C. 1531–1538, and does not significantly or uniquely affect small governments. The action imposes no enforceable duty on any state, local, or Tribal governments or the private sector.

E. Executive Order 13132: Federalism

The EPA has concluded that this action does not have federalism implications. It will not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. This rule would not alter Delaware's, New Jersey's, or Pennsylvania's considerable discretion in implementing these WQS, nor would it preclude any of those states from adopting revised WQS and submitting them to the EPA for review and approval either before or after promulgation of the final rule. If the states submit and the EPA approves revised WQS consistent with the CWA, then the EPA would no longer be required to promulgate Federal WQS.

Consistent with the EPA's policy to promote communications between the EPA and state and local governments, the EPA met with the states of Delaware, New Jersey, and Pennsylvania and DRBC in the process of developing this rulemaking to enable them to have meaningful input into its development. During these discussions, the EPA explained the scientific basis for the dissolved oxygen criteria to protect aquatic life propagation in the specified zones of the Delaware River and the overall timing of the Federal rulemaking effort. The EPA took these discussions with the states into account during the drafting of this rulemaking. The EPA specifically solicits comments on this proposed action from state and local officials.

F. Executive Order 13175: Consultation and Coordination with Indian Tribal Governments

This action does not have Tribal implications as specified in Executive Order 13175. This rulemaking will not affect federally recognized Indian tribes in Delaware, New Jersey, or Pennsylvania because the WQS would not apply to waters in Indian lands nor affect Tribal interests. Thus, Executive Order 13175 does not apply to this action.

G. Executive Order 13045: Protection of Children from Environmental Health and Safety Risks

The EPA interprets Executive Order 13045 as applying only to those regulatory actions considered significant under section 3(f)(1) of Executive Order 12866 and that concern environmental health or safety risks that the EPA has reason to believe may disproportionately affect children, per the definition of "covered regulatory action" in section 2-202 of the Executive Order. Therefore, this action is not subject to Executive Order 13045 because it does not concern an environmental health risk or safety risk. Since this action does not concern human health, the EPA's Policy on Children's Health also does not apply.

H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use

This action is not a "significant energy action" because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. This action proposes to establish Federal CWA aquatic life water quality criteria for specified zones of the Delaware River under the jurisdiction of the states of Delaware, New Jersey, and Pennsylvania.

I. National Technology Transfer and Advancement Act (NTTAA)

This rulemaking does not involve technical standards.

J. Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations and Executive Order 14096: Revitalizing our Nation's Commitment to Environmental Justice for All

The information supporting this Executive Order review is summarized below and detailed in the associated document, *Environmental Justice Analysis for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River*, which is available in the docket for this proposed rule.

The EPA believes that the human health or environmental conditions that exist prior to this proposed action result in or have the potential to result in disproportionate and adverse human health or environmental effects on communities with environmental justice (EJ) concerns.

For this EJ analysis, the EPA evaluated socioeconomic characteristics of communities living near the relevant zones of the Delaware River compared to communities living near other zones of the mainstem Delaware River. The relevant zones of the Delaware River border highly urbanized areas, including cities such as Philadelphia and Wilmington. Accordingly, the EPA's analysis accounts for the distinction between urban and rural communities.[99]

The EPA obtained data from the United States Census Bureau's American Community Survey (ACS) 5-year estimates for the years 2017-2021 at the Census block group level to construct a set of eight metrics for use in this analysis: (1) *Black or African American*, (2) *Asian*, (3) *Two or More Races*, (4) *Hispanic or Latino*, (5) *Limited English Speaking Household*, (6) *Median Household Income*, (7) *Below 200% of the Poverty Level*, (8) *Education Less than a High School Diploma or Equivalent*.[100] Analysis of these eight socioeconomic metrics provides insight into the spatial distribution and prevalence of certain indicators of social vulnerability for communities near the Delaware River.[101]

[99] For this analysis, the EPA defines "urban" and "rural" using the Census Urban Areas designation. More information about the Census classifications is available at https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html.

[100] The EPA also considered populations who identify as *American Indian and Alaskan Native*, *Native Hawaiian and Other Pacific Islander*, and *Some Other Race*; however, in the Delaware River watershed, these populations represent a very small fraction (often less than 1%) of the community composition. Therefore, these populations are not analyzed further in this EJ analysis.

[101] In the 2016 *Technical Guidance for Assessing Environmental Justice in Regulatory Analysis*, the EPA defined vulnerability as the "physical, chemical, biological, social, and cultural factors that result in certain communities and population groups being more susceptible or more exposed to environmental toxins, or having compromised ability to cope with and/or recover from such exposure." For this EJ analysis, the EPA focused on social vulnerability based on the metrics presented in Table 3 of the associated environmental justice analysis, which broadly cover categories of race, ethnicity, linguistic isolation, income, poverty, and education. These metrics provide insight into factors that may affect the ability of communities near the Delaware River to respond to environmental hazards or cope with reduced ecosystem services that may result from inadequate water quality. Although these socioeconomic metrics are relevant to communities living near the Delaware River, they are not intended to be an exhaustive list of all factors affecting community vulnerability. (Source: United States Environmental Protection Agency. (2016). Technical Guidance for Assessing Environmental Justice in Regulatory Analysis. https://www.epa.gov/sites/default/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf.)

The EPA extended a five-mile buffer from the specified zones to capture communities living in close proximity to waters affected by the EPA's proposed rule, if finalized.[102] Similarly, the EPA extended a five-mile buffer from other zones of the Delaware River to form a comparison group. Given the large number of block groups located near the mainstem Delaware River, communities are analyzed in groups, as follows:

- Delaware Urban Areas: Census block groups in urban areas within five miles of the specified zones in Delaware.
- New Jersey Urban Areas: Census block groups in urban areas within five miles of the specified zones in New Jersey.
- Pennsylvania Urban Areas: Census block groups in urban areas within five miles of the specified zones in Pennsylvania.
- Urban Comparison Group: Census block groups in urban areas within five miles of the remainder of the mainstem Delaware River (i.e., excluding block groups within five miles of the specified zones).
- Specified Zones Rural Areas: Census block groups in rural areas within five miles of the specified zones in New Jersey.[103]
- Rural Comparison Group: Census block groups in rural areas within five miles of the remainder of the mainstem Delaware River (i.e., excluding block groups within five miles of the specified zones).

[102] The EPA assumes that those living in Census block groups that are within the five-mile buffer, and therefore closest to the specified zones of the Delaware River, are most likely to be directly affected by the proposed rule. However, this assumption could underestimate directly affected communities and impact the results of the proximity analysis. Accordingly, the EPA conducted a sensitivity analysis using a ten-mile buffer and determined that community composition was not particularly sensitive to the buffer distance applied when comparing the results of the five-mile and ten-mile buffer.

[103] There are no rural areas within five miles of the specified zones in Delaware or Pennsylvania.

The EPA aggregated data across multiple block groups using aerial apportionment and a population-weighted mean approach to ensure that block groups with larger or smaller populations were accounted for proportionally to their size. This calculation relies on an assumption that households are evenly distributed within each block group. For *Median Household Income*, the EPA aggregated data across multiple block groups using a linear interpolation calculation.

The results of the urban and rural proximity analyses differed significantly. Urban communities in Pennsylvania near the specified zones surpassed the comparison group average (or were less than the comparison group for *Median Household Income*) for all eight socioeconomic metrics. Notably, urban communities in Pennsylvania near the specified zones are over 1.7 times more likely to identify as *Black or African American*, 1.7 times more likely to live below twice the poverty level, and have $23,000 lower median household income when compared to urban communities near the remainder of the mainstem river. Urban communities within five miles of the specified zones in all three states had lower income and higher poverty rates than the comparison group. Urban communities in Delaware near the specified zones also had a higher percentage of the population identify as *Black or African American* than the comparison group, while urban communities in New Jersey had a higher percentage of the population that identifies as *Hispanic or Latino* and a greater percentage with education less than a high school degree than the comparison group. Therefore, urban communities near the specified zones – especially in Pennsylvania – exhibited differences in socioeconomic community characteristics compared to other urban communities near the Delaware River.

On the other hand, rural communities near the specified zones did not greatly differ from rural communities near other parts of the mainstem river. While rural communities near the specified zones did exceed the comparison group average for four metrics (*Black or African American*, *Asian*, *Two or More Races*, and *Limited English Speaking Household*), the differences were always less than three percentage points. Therefore, the EPA could not conclude that rural communities near the specified zones were any more or less socially vulnerable compared to other rural communities near the mainstem Delaware River.

While neither the urban nor the rural proximity analyses directly indicate which communities may be experiencing potential EJ concerns, they provide insight into community composition surrounding an environmental resource. In general, the Delaware River has had two contrasting areas of water quality for decades. In the relevant zones, water quality for aquatic life has been significantly worse than in the other zones of the river.[104] Urban areas near these zones, especially in Pennsylvania, contain communities that are likely more socially vulnerable than urban communities that live near other zones of the Delaware River, which have better water quality. This trend in water quality and dissolved oxygen across the watershed, coupled with the corresponding differences in socioeconomic community composition, reveals a potential inequitable distribution of an environmental resource and access to clean surface waters within a single watershed.[105]

The EPA believes that this action would be likely to reduce existing disproportionate and adverse effects on communities with EJ concerns. Specifically, the EPA identified an inequitable distribution of an environmental resource where communities with environmental justice concerns have inequitable access to clean surface waters that support CWA section 101(a)(2) goals for aquatic life. The EPA's proposed rule, if finalized and implemented, could help to

[104] Delaware River Basin Commission (2022a).
[105] In this analysis, the EPA is not implying causality between poor water quality and socioeconomic factors.

lessen this inequitable distribution of an environmental resource by ensuring that WQS to protect aquatic life in the specified zones of the Delaware River meet the objectives of the CWA.

In addition to the proximity analysis, the EPA evaluated the potential distribution of costs associated with the proposed rule under the implementation (policy) scenario described in section IX of this preamble and further detailed in the EPA's associated document, *Economic Analysis for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River*. For this analysis, the EPA selected Philadelphia as a case study based on the results of the proximity analysis and the large share of total estimated costs potentially incurred by the Philadelphia Water Department (PWD) compared to other WWTPs.

The EPA used two methods to assess the potential financial impact to Philadelphia households resulting from costs associated with the proposed rule. First, the EPA calculated household burden by quantifying the potential increase to consumer water and wastewater bills and calculating the percentage of median household income spent on water bills with and without costs from additional wastewater treatment plant controls. Second, the EPA examined existing water rate structures in Philadelphia and customer assistance programs to identify possible ways in which the affected municipalities could adjust rates to lessen the financial burden on low-income households.

To determine household burden, the EPA analyzed how annual water and wastewater bills might change if costs associated with additional wastewater treatment plant controls at PWD facilities are passed on to households through increased water bills.[106] The EPA analyzed the financial impact to households if costs were passed on to residential households in proportion

[106] Residents in PWD's service area pay a single bill that covers both water and wastewater charges; for this analysis, the EPA uses the term "water bill" to refer to the single bill covering water and wastewater charges.

to the estimated wastewater flow attributed to residential households.[107] DRBC estimates that approximately 15% of the flow to PWD is attributable to residential sources while 85% is attributable to non-residential sources.[108] Therefore, the EPA calculated household burden assuming 15% of the costs associated with additional wastewater treatment plant controls would be spread evenly among Philadelphia households. Under this assumption the additional annual cost per household is $18.07, which would equate to $1.50 per household per month.[109] For this analysis, the EPA analyzed household burden using the Residential Indicator in the EPA's 2023 *Clean Water Act Financial Capability Assessment Guidance*[110] and determined that while the costs associated with the proposed rule are not expected to substantially impact household burden under this scenario, water bills still have the potential to be placing a high burden on a third of Philadelphia's households. However, the actual financial burden faced by households depends on many factors, including customer assistance programs.

In July 2017, Philadelphia became the first to implement an income-based alternative water rate structure through creation of the Tiered Assistance Program (TAP). This program is structured based on household income relative to the Federal poverty level such that monthly bills are capped at 2%, 2.5%, 3%, and 4% of monthly income for consumers whose income is 0-

[107] The EPA also analyzed a conservative scenario in which 100% of costs are passed on to residential households. Results of this scenario are available in the associated document, *Environmental Justice Analysis for the Proposed Rule: Water Quality Standards to Protect Aquatic Life in the Delaware River*.

[108] Delaware River Basin Commission. (2022c). Social and Economic Factors Affecting the Attainment of Aquatic Life Uses in the Delaware River Estuary. September 2022 Draft. https://www.nj.gov/drbc/library/documents/AnalysisAttainability/SocialandEconomicFactors_DRAFTsept2022.pdf.

[109] As of September 1, 2023, the monthly water bill for a typical residential consumer in Philadelphia is $74.81, which equates to $897.72 annually. Source: Philadelphia Water Department. Rate Changes Effective September 2023. Webpage, accessed September 26, 2023. https://water.phila.gov/drops/new-rate-information-effective-september-2023/.

[110] United States Environmental Protection Agency. (2023). Clean Water Act Financial Capability Assessment Guidance. Document ID: 800b21001. February 2023. https://www.epa.gov/system/files/documents/2023-01/cwa-financial-capability-assessment-guidance.pdf.

50%, >50-100%, >100-150%, and >150% of the Federal poverty level, respectively.[111] TAP discounts are offset by a surcharge added to the water bill of non-TAP customers.

For illustrative purposes, the EPA analyzed how the TAP rate structure might apply to eligible low-income consumers with water bills that include 15% of the costs associated with additional PWD wastewater treatment plant controls.[112] Under the TAP rate structure, a three-person household with income at or below the poverty level would have annual savings of at least $294. These savings are particularly significant for households whose income is half the poverty level or below. For example, a household at 50% of the poverty level would see savings of $667.

However, the effectiveness of the TAP rate structure depends in large part on participation by eligible households. When Philadelphia launched TAP in 2017, it was estimated that around 60,000 consumers would be eligible for the program.[113] However, as of December 2022, only 14,712 households were actively participating in TAP.[114] Equally problematic as low participation rates are the high attrition rates of TAP participants. In 2022, 9,496 participants defaulted from TAP due to a failure to recertify for the program. Of those who defaulted, 75% percent did not respond to the city's request for recertification.[115] Thus, even though Philadelphia enrolled 10,405 participants in 2022, the high attrition rate in the program prevents

[111] City of Philadelphia. (2023). Annual Report to the Mayor on the Tiered Assistance Program (TAP). Department of Revenue. March 31, 2023. https://www.phila.gov/media/20230526113411/Tiered-Assistance-Program-TAP-2022-annual-report.pdf.
[112] The EPA does not have the necessary data to calculate a per household surcharge that could increase water bills for higher-income customers, nor did the EPA include other assistance programs in this calculation.
[113] City of Philadelphia. (2017). Philadelphia Launches New, Income-Based, Tiered Assistance Program. Press Release. Office of the Mayor. June 20, 2017. https://www.phila.gov/press-releases/mayor/philadelphia-launches-new-income-based-tiered-assistance-program/.
[114] City of Philadelphia. (2023). Annual Report to the Mayor on the Tiered Assistance Program (TAP). Department of Revenue. March 31, 2023. https://www.phila.gov/media/20230526113411/Tiered-Assistance-Program-TAP-2022-annual-report.pdf.
[115] *Id.*

meaningful increases in participation. Philadelphia continues outreach efforts to raise awareness about TAP;[116] however, this large gap in participation indicates that the full potential of the program is likely not being realized.

Based on the structure of TAP and the current low participation rates, low-income communities are not necessarily protected from high water bills and increasing water rates. The way the program is designed, non-TAP customers subsidize the discounts applied to TAP customers. When there is high participation, the majority of program costs are borne by higher income households and participating low-income households are protected from high water bills and increasing water rates (including potential rate increases to offset costs associated with additional wastewater treatment plant technologies). With low-participation rates, a higher proportion of low-income households are paying the TAP surcharge and face higher water rates, thus placing an undue burden on low-income households not participating in the program.

In theory, costs associated with the EPA's proposed rule – if partially or fully passed on to residential consumers – should not impact the lowest income households in Philadelphia, assuming high participation in TAP. However, the current low participation rates in TAP indicate that some low-income communities are likely burdened by high water bills and could potentially indirectly bear costs associated with the EPA's proposed rule. Although Philadelphia's TAP is innovative, additional work to increase participation (through increased enrollment and decreased attrition rates) can further advance water affordability and protect low-income households.

The example of Philadelphia's TAP illustrates how an income-based rate structure can potentially have a measurable impact on low-income communities. Municipalities potentially

[116] *Id.*

affected by the EPA's proposed rule might consider holistic ways to advance water affordability, which can include adoption of alternative water rate structures and assistance programs that lower water bills for low-income households. There are several considerations for municipalities if choosing to implement a program similar to TAP in Philadelphia.[117] An income-based rate structure, such as Philadelphia's TAP, might be most effective for utilities with larger service areas and higher income disparities for households within the service area. When a utility has a large customer base, it allows the utility to distribute any surcharges (to offset lost revenue) among many households.[118] In theory, this redistribution of costs means that the per household surcharge can be small and affect higher income households who might be less socially vulnerable. In addition, the effectiveness of an income-based rate structure hinges on the participation rate of low-income communities. Municipalities seeking to implement a similar program should consider practices to encourage high enrollment and high retention rates among qualified households. Such practices could include automatically enrolling households who are concurrently on other assistance programs (such as SNAP) or ensuring a user-friendly process for recertification of eligibility, if applicable. By thoughtfully and strategically advancing water affordability programs, municipalities can work towards ensuring that socially vulnerable communities are not overburdened by expensive water bills.

List of Subjects in 40 CFR Part 131

Environmental protection, Indians-lands, Intergovernmental relations, Reporting and recordkeeping requirements, Water pollution control.

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[117] Mack, E.A., Wrase, S., Dahme, J., Crosby, S.M., Davis, M., Wright, M., & Muhammad, R. (2020). An Experiment in Making Water Affordable: Philadelphia's Tiered Assistance Program (TAP). Journal of the American Water Resources Association, 56(3), 431– 449. https://doi.org/10.1111/1752-1688.12830.
[118] *Id.*

Michael S. Regan,

Administrator.

For the reasons set forth in the preamble, the EPA proposes to amend 40 CFR part 131 as follows:

PART 131—WATER QUALITY STANDARDS

1. The authority citation for part 131 continues to read as follows:

Authority: 33 U.S.C. 1251 *et seq*.

2. Add §131.XX to read as follows:

§ 131.XX Water quality standards to protect aquatic life in the Delaware River.

(a) *Scope*. (1) The designated use in paragraph (b) of this section applies to river miles 108.4 to 70.0 of the Delaware River for the states of New Jersey and Pennsylvania.

(2) The aquatic life criteria in paragraph (c) of this section apply to river miles 108.4 to 70.0 of the Delaware River for the states of Delaware, New Jersey, and Pennsylvania.

(b) *Aquatic life designated use*. The aquatic life designated use is protection and propagation of resident and migratory aquatic life.

(c) *Dissolved oxygen criteria.* The applicable dissolved oxygen criteria are shown in Table 1 to this paragraph (c).

TABLE 1 TO PARAGRAPH (c)—DISSOLVED OXYGEN CRITERIA

Season	Magnitude (Percent Oxygen Saturation)	Duration	Exceedance Frequency
Spawning and Larval Development *(March 1 – June 30)*	66%	Daily Average	10% *(12 Days Cumulative)*
Juvenile Development	66%	Daily Average	10% *(12 Days Cumulative)*

(July 1 – October 31)	74%	Daily Average	50% *(61 Days Cumulative)*
Overwintering *(November 1 – February 28/29)*	66%	Daily Average	10% *(12 Days Cumulative)*

(d) *Applicability*. (1) The aquatic life designated use in paragraph (b) of this section applies concurrently with other applicable designated uses in New Jersey and Pennsylvania for river miles 108.4 to 70.0 of the Delaware River.

(2) The dissolved oxygen aquatic life water quality criteria in paragraph (c) of this section are the applicable dissolved oxygen criteria in Delaware, New Jersey, and Pennsylvania for river miles 108.4 to 70.0 of the Delaware River and apply concurrently with applicable water quality criteria for other parameters.

(3) The designated use and criteria established are subject to Delaware's, New Jersey's, and Pennsylvania's general rules of applicability in the same way and to the same extent as are other federally promulgated and state-adopted water quality standards in those states.