Regulatory Analysis Form

(Completed by Promulgating Agency)

(All Comments submitted on this regulation will appear on IRRC's website)

INDEPENDENT REGULATORY REVIEW COMMISSION

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Independent Regulatory Review Commission

IRRC Number: 3383

(1) Agency:

Department of Environmental Protection

(2) Agency Number: 7

Identification Number: 577

(3) PA Code Cite:

25 Pa. Code, Chapter 93

(4) Short Title:

Water Quality Standards – Triennial Review

(5) Agency Contacts (List Telephone Number and Email Address):

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(6) Type of Rulemaking (check applicable box):

- ☒ Proposed Regulation
- ☐ Final Regulation
- ☐ Final Omitted Regulation
- ☐ Emergency Certification Regulation;
- ☐ Certification by the Governor
- ☐ Certification by the Attorney General

(7) Briefly explain the regulation in clear and nontechnical language. (100 words or less)

Section 303(c)(1) of the federal Clean Water Act (CWA) and the federal regulations at 40 CFR § 131.20 require states to periodically, but at least once every three years, review and revise as necessary their water quality standards. This requirement is commonly referred to as the state's triennial review of water quality standards. This proposed regulation – the Commonwealth's tenth triennial review of water quality standards – fulfills the Commonwealth's obligation to periodically review and revise its water quality standards and updates the water quality standards such that the surface waters of this Commonwealth are afforded the appropriate level of protection.

(8) State the statutory authority for the regulation. Include specific statutory citation.

This proposed regulation is being made under the authority of sections 5(b)(1) and 402 of The Clean Streams Law (35 P.S. §§ 691.5(b)(1) and 691.402), which authorize the Environmental Quality Board (Board) to develop and adopt rules and regulations to implement The Clean Streams Law (35 P.S. §§ 691.1—691.1001) and section 1920-A of The Administrative Code of 1929, (71 P.S. § 510-20), which grants to the Board the power and duty to formulate, adopt and promulgate rules and regulations for the proper performance of the work of the Department of Environmental Protection (Department).

(9) Is the regulation mandated by any federal or state law or court order, or federal regulation? Are there any relevant state or federal court decisions? If yes, cite the specific law, case or regulation as well as, any deadlines for action.

Under sections 4, 5 and 402 of The Clean Streams Law (CSL), the Department has the duty to formulate regulations that prevent and eliminate water pollution. "Pollution" is defined by the CSL as "contamination of any waters of the Commonwealth such as ... to render such waters harmful, detrimental or injurious to public health..., or to domestic, municipal, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life...." (35 P.S. §§ 691.4, 691.5, and 691.402). Section 1920-A of The Administrative Code of 1929 authorizes the Board to formulate, adopt and promulgate such rules and regulations as may be determined by the Board for proper performance of the work of the Department (71 P.S. § 510-20(b)). Where a pollutant found in discharges to surface waters is toxic to human health or aquatic life, the Commonwealth's regulations require development of appropriate water quality criteria to control pollution.

In addition, it is the duty of the Department, pursuant to section 5 of the CSL, to consider water quality management, pollution control in the watershed as a whole, as well as the present and possible future uses of waters in adopting regulations.

Section 303(c) of the federal CWA and 40 CFR Part 131 require states to develop water quality standards that consist of designated uses, water quality criteria to protect those uses, and antidegradation requirements. Such standards must "protect the public health or welfare and enhance the quality of water" (33 U.S.C.A. § 1313(c)). Section 303(c)(2)(B) directs states to adopt numeric criteria for toxic pollutants if they are present in a discharge that could reasonably be expected to interfere with designated uses, and as necessary to support those uses. In addition, such standards must take into consideration water uses including public water supplies, propagation of fish and wildlife, recreational purposes, agricultural purposes, and industrial purposes. Section 101(a)(3) of the CWA declares the national policy that the discharge of toxic pollutants in toxic amounts be prohibited (33 U.S.C.A. § 1251(a)(3)).

(10) State why the regulation is needed. Explain the compelling public interest that justifies the regulation. Describe who will benefit from the regulation. Quantify the benefits as completely as possible and approximate the number of people who will benefit.

The purpose of developing water quality standards is to protect this Commonwealth's surface waters. Through the Department's administration of the Commonwealth's water quality standards program, the Commonwealth's surface waters are protected for a variety of uses including: aquatic life; drinking water supplies for humans, livestock, and wildlife; irrigation for crops, turf, and other horticultural activities; industrial water supplies; fish consumption; recreation; and special protection. All residents and visitors to this Commonwealth benefit from the protection of water quality in the Commonwealth's surface waters at levels appropriate for the protected uses of those surface waters.

Periodic updates to the Commonwealth's water quality standards are required by the CWA and ensure that the standards are based on current science, recommendations, and methodologies, which includes U.S. Environmental Protection Agency (EPA) mandates, recommendations, and guidance. The federal mandate for states to develop water quality criteria is found at section 303(c) of the CWA. This proposed regulation is necessary to improve total pollution control in this Commonwealth. Water quality standards are instream water quality goals that are implemented by imposing specific regulatory requirements on individual sources of pollution and are used to determine appropriate treatment requirements, best management practices (BMPs), and effluent limitations.

This Commonwealth's residents and visitors and its natural resources benefit from providing the appropriate level of protection to preserve the integrity of existing and designated uses of surface waters in this Commonwealth. Protecting water quality provides economic value to present and future generations in the form of a cleaner water supply for human consumption, wildlife, irrigation, and industrial use. For example, when water used for drinking water supplies is protected, the consumers benefit from lower drinking water treatment costs and reduced medical costs associated with drinking water-related illnesses. Water quality standards also ensure that clean surface water is available for irrigation of crops and livestock and for use in industrial processes. Additionally, appropriate water quality standards protect aquatic life and provide for recreational opportunities such as fishing (including fish consumption), water contact sports, and boating.

(11) Are there any provisions that are more stringent than federal standards? If yes, identify the specific provisions and the compelling Pennsylvania interest that demands stronger regulations.

No. The proposed regulations are not more stringent than federal standards.

(12) How does this regulation compare with those of the other states? How will this affect Pennsylvania's ability to compete with other states?

Since other states are also required to maintain and periodically review and update water quality standards, based on the federal mandate at section 303(c) of the federal CWA and 40 CFR Part 131, the proposed rulemaking will not put Pennsylvania at a competitive disadvantage to other states. If other states or tribes have not yet evaluated or adopted EPA's water quality criteria recommendations under CWA § 304(a), they will be required to consider EPA's recommendations during their next triennial review of water quality standards.

(13) Will the regulation affect any other regulations of the promulgating agency or other state agencies? If yes, explain and provide specific citations.

No other state regulations are affected by this proposed regulation.

(14) Describe the communications with and solicitation of input from the public, any advisory council/group, small businesses and groups representing small businesses in the development and drafting of the regulation. List the specific persons and/or groups who were involved. ("Small business" is defined in Section 3 of the Regulatory Review Act, Act 76 of 2012.)

The Department presented the draft scope for this tenth triennial review of water quality standards to the Water Resources Advisory Committee (WRAC) on May 19, 2022. On November 17, 2022, the Department met with WRAC to discuss the draft proposed amendments to Chapter 93, and WRAC voted to support the Department's presentation of this proposed rulemaking to the Board. In addition, the Department provided to the Agricultural Advisory Board, on December 8, 2022, a regulatory review that included this triennial review of water quality standards.

(15) Identify the types and number of persons, businesses, small businesses (as defined in Section 3 of the Regulatory Review Act, Act 76 of 2012) and organizations which will be affected by the regulation. How are they affected?

Existing, new, or expanded activities or projects which result in discharges to waters of the Commonwealth and require a Department permit or approval are required to implement treatment or BMPs to meet the water quality standards established by this proposed regulation. Such treatment and practices may result in higher design, engineering, construction, monitoring, and treatment costs. However, it is not possible to identify the total number of persons, businesses, and organizations that will be affected by the proposed regulation for new or expanded discharge activities, or the potential costs associated with new or expanded activities. It is not possible to predict the future business decisions of existing or potentially new entities that choose to conduct associated activities that will be affected by these proposed regulations. Therefore, it is not possible or practicable to quantify the technology needs and BMP costs that may be associated with these future activities. The proposed regulations do, however, establish a clear and appropriate set of goals, objectives, and targets to which these persons, businesses, and organizations can plan and design towards.

There are approximately 10,300 facilities across the Commonwealth that hold permits issued pursuant to 25 Pa. Code Chapter 92a (relating to National Pollutant Discharge Elimination System (NPDES) permitting, monitoring and compliance). The Department identified 274 active NPDES permits with effluent limitations for one or more of the toxic substances included in this proposed rulemaking. These 274 active NPDES permits include permits for treated sewage, industrial waste, groundwater remediation, and stormwater associated with industrial activities.

A review of the federal Small Business Size Regulations under 13 CFR Part 121 provides a standard for determining what constitutes a small business. From the 274 permitted facilities identified above, the Department randomly selected and analyzed a subset of 81 permits and determined that 13 permitted entities, or approximately 16%, were likely to be classified as a small business based on available information. Using this subset analysis, the Department estimates that approximately 44 out of those 274 permitted entities are classified as small businesses.

There are also thousands of active earth disturbance activities that occur across the state and require general or individual NPDES permits for discharges of stormwater associated with construction activities issued under 25 Pa. Code Chapter 102 (relating to erosion and sediment control). Any person proposing a new earth disturbance activity requiring a permit under Chapter 102 must comply with this proposed regulation, as applicable.

(16) List the persons, groups or entities, including small businesses, that will be required to comply with the regulation. Approximate the number that will be required to comply.

All persons, groups, or entities with proposed or existing point source discharges that flow into surface waters of the Commonwealth must comply with the proposed regulation. There are approximately 274 NPDES discharge permits that currently contain effluent limitations for one or more of the 17 pollutants included in the proposed regulation. A subsampling of the 274 NPDES permits indicates that a majority of the permits are likely not associated with small businesses as defined in in Section 3 of the Commonwealth's Regulatory Review Act, 71 P.S. §§ 745.1—745.14.

Also, see the response to question #15.

(17) Identify the financial, economic and social impact of the regulation on individuals, small businesses, businesses and labor communities and other public and private organizations. Evaluate the benefits expected as a result of the regulation.

Overall, the Commonwealth's residents and visitors and its natural resources benefit from providing the appropriate level of protection to preserve the integrity of existing and designated uses of surface waters in this Commonwealth. Protecting water quality provides economic value to present and future generations in the form of a clean water supply for human consumption, wildlife, irrigation, and industrial use. It also protects aquatic life and provides for recreational opportunities such as fishing (including fish consumption), water contact sports, and boating.

All of this Commonwealth's residents and visitors, both present and future, will benefit from having clean water that is protected and maintained at appropriate levels of water quality. Any reduction in the total toxic load in this Commonwealth's surface waters is likely to have a positive effect on the human health of its residents. This will translate into a yet unknown economic benefit through avoided cleanup or remediation costs that would have been incurred later in time, as well as avoided costs for the treatment and caring for persons with diseases and disabilities that can be reasonably attributed to environmental contaminants in surface waters.

Reduced toxics in Pennsylvania's waterways positively impacts the recreational fishing and tourism industries by increasing the availability and use of swimming and fishing locations throughout this Commonwealth. Additionally, cleaner rivers and fish may lead to increased birding and wildlife viewing opportunities, as the benefits of cleaner water and less contaminated fish cascade up the food chain, resulting in substantial economic benefits. Persons who recreate on this Commonwealth's surface waters and who fish, both for sport and consumption, in those waters will benefit from better water quality protection.

A reduction in toxics found in Pennsylvania's waterways may also lead to increased property values for properties located near rivers or lakes. A 1979 study by Epp and Al-Ani used real estate prices to determine value of improvements in water quality in small rivers and streams in Pennsylvania. Water quality, whether measured in pH or by the owner's perception, has a significant effect on the price of adjacent property. Epp and Al-Ani's analysis showed a positive correlation between water quality and housing values. They concluded that buyers are aware of the environmental setting of a home and that differences in the quality of nearby waters affect the price paid for a residential property.

A 2006 study from the Great Lakes region (Braden et al. 2006) estimated that property values were significantly depressed in two regions associated with toxic contaminants (polycyclic aromatic hydrocarbons, polychlorinated biphenyls and heavy metals). The study showed that a portion of the Buffalo River region (approximately 6 miles long) had depressed property values of between $83 million and $118 million for single-family homes, and between $57 million and $80 million for multi-family homes, as a result of toxic sediments. The same study estimated that a portion of the Sheboygan River (approximately 14 miles long) had depressed property values of between $80 million and $120 million as the result of toxics. While this study related to the economic effect of contaminated sediment in other waters in the Great Lakes region, the idea that toxic pollution depresses property values is easily transferable to Pennsylvania. A reduction in toxic pollution in Pennsylvania's surface waters has a substantial economic benefit to property values in close proximity to waterways.

Southwick Associates has prepared several reports for the Theodore Roosevelt Conservation Partnership that analyze the economic contribution of outdoor recreation in Pennsylvania. A 2018 report (Southwick

Associates 2018) found that, during 2016, there were more than 390,000 jobs supported by outdoor recreation activities in Pennsylvania, and that, for comparison, this was more than the number of jobs in Pennsylvania that supported the production of durable goods during the same year. This report also found that, in 2016, outdoor recreation had an economic contribution in Pennsylvania of almost $17 billion in salaries and wages paid to employees and generated over $300 million in federal, state, and local tax revenue. An updated report (Southwick Associates 2020) revealed that economic contributions from outdoor recreation increased from nearly $17 billion in salaries and wages paid to employees in 2016 to nearly $20 billion in 2020. The 2020 report also continued to highlight the fact that more Pennsylvania jobs are supported by outdoor recreation than by the production of durable goods. The 2020 report found that, in 2020, outdoor recreation activities supported more than 430,000 jobs and contributed more than $32 billion to Pennsylvania's state gross domestic product and generated over $6.5 billion in tax revenue at the federal, state, and locals levels, which is a significant increase from the 2016 tax revenue total of over $300 million.

There are also economic benefits to be gained by having clearly defined remediation standards for surface waters. Under Pennsylvania's Land Recycling and Environmental Remediation Standards Act (35 P.S. §§ 6026.101—6026.908), liability relief is available, by operation of law, if a person demonstrates compliance with the environmental remediation standards established by the law. Surface water quality criteria are used to develop remediation standards under the law. Persons performing remediation depend upon these criteria to obtain a liability relief benefit under the law. An article in the *Duquesne Law Review* (Creenan and Lewis 1996) discusses the importance of liability limitation as "vital to the participation in the remediation process". The article recognizes that "liability protection provides the missing ingredient—financial incentive—for undertaking the cleanup of an industrial site." Industrial land redevelopers will benefit from these proposed regulations by having financial certainty when choosing a surface water cleanup standard and by being eligible for liability relief under state law.

Also, see the responses to questions #10 and #15.

(18) Explain how the benefits of the regulation outweigh any cost and adverse effects.

Section 4 of the CSL (Declaration of Policy) (35 P.S. § 691.4(1)) clearly states "clean, unpolluted streams are absolutely essential if Pennsylvania is to attract new manufacturing industries and to develop Pennsylvania's full share of the tourist industry." Section 4 also clearly indicates the benefits of and the essential nature of maintaining clean, unpolluted waters if Pennsylvania is "to have adequate out of door recreational facilities in the decades ahead" and that is the objective of the CSL to "not only prevent further pollution of the waters of the Commonwealth, but also to reclaim and restore to a clean, unpolluted condition every stream in Pennsylvania that is presently polluted." The prevention and elimination of water pollution is recognized as being directly related to the economic future of the Commonwealth.

Health and welfare benefits to all residents and visitors of this Commonwealth accrue from protecting the surface waters of this Commonwealth at the appropriate level. The benefits from substantial revenue and jobs associated with clean drinking water, recreational fisheries, and other industries that rely on clean water outweigh the cost and adverse effects associated with selective effluent treatment technology and BMPs for those who discharge pollutants to this Commonwealth's surface waters.

Protection of water quality before pollution occurs reduces the need for costly remedial measures that are often difficult to retrofit. In addition, maintenance of water quality eliminates the need for spending taxpayer dollars to meet additional regulatory obligations such as federally mandated total maximum daily loads (TMDLs). If a waterbody becomes impaired and is not meeting its protected water uses, the Commonwealth will be obligated to develop TMDLs and impose more stringent water quality standards.

By maintaining the appropriate water quality to protect the uses of Pennsylvania's surface waters, expensive remediation costs can be avoided.

(19) Provide a specific estimate of the costs and/or savings to the regulated community associated with compliance, including any legal, accounting or consulting procedures which may be required. Explain how the dollar estimates were derived.

NPDES permits and other approvals are required for discharges to surface waters of this Commonwealth. Discharge effluent limitations associated with these permits and other approvals are established to meet water quality standards, including the water quality criteria identified in this proposed regulation. Specific estimates of costs and savings cannot be determined because each discharge activity must be reviewed based on site-specific considerations. These site-specific considerations include, but are not limited to the size, flow, and the chemical, biological, and physical properties of both the receiving water and the discharge effluent. These site-specific considerations result in site-specific effluent limitations and treatment requirements. Generally speaking, anticipated economic impacts would primarily involve the potential for increased monitoring and sampling costs and higher treatment costs for existing, new, or expanded discharges to streams to meet any new or updated water quality standards.

The Department reviewed sampling cost information for each toxic substance in this proposed regulation that was available in the National Environmental Monitoring Index (NEMI). NEMI is a freely available compendium of information on a variety of environmental analytical test methods that was developed by the National Water Quality Monitoring Council in collaboration with partners in the federal, state, and private sectors. A review of the EPA-approved analytical test methods for each toxic substance revealed that the average cost per sample for many of these substances ranges between $201 and $400. A few of the analytical test methods, such as Method 4500-B B for boron, have an estimated cost per sample of less than $50 while other analytical methods, such as Method 1624 for methyl ethyl ketone, have an estimated cost per sample of over $400. Costs estimates were available in NEMI for each of the toxic substances in this proposed regulation with the exception of tributyltin. Note that no additional costs should be incurred by the 274 NPDES permit holders that currently have effluent limitations for one or more of these substances as a result of this proposed regulation since these entities are already required to monitor for these substances. Additional costs may be incurred for new or renewed permits if new water-quality-based effluent limitations are required to achieve any new or updated water quality criteria for the toxic substances in this proposed regulation.

(20) Provide a specific estimate of the costs and/or savings to the local governments associated with compliance, including any legal, accounting or consulting procedures which may be required. Explain how the dollar estimates were derived.

No costs will be imposed immediately upon local governments by this proposed regulation. This regulation is based on, and will be implemented through, existing Department programs, procedures, and policies. Certain municipalities or municipally-owned entities that discharge pollutants to surface waters may be affected by this proposed regulation for any existing or new discharge activity as described in the response to question #15, including publicly owned treatment works with an NPDES permit to discharge treated sewage. The costs associated with permits and performance or design requirements will be site-specific and will be based on effluent limitations or BMPs and the appropriate protections for a particular waterbody.

Local governments may gain or increase income from this proposed regulation due to potential increases in tourism and recreational revenue. For those local governments that receive income from the tourism industry, the proposed updates to water quality standards may help maintain local revenue and employment.

In addition, local land values may increase in the future as homes that are near areas of clean water and protected resources become more desirable places to live. Local governments that use surface waters as a public water supply may also gain an economic benefit by reduced source water treatment requirements. See the response to question #17 for additional details.

(21) Provide a specific estimate of the costs and/or savings to the state government associated with the implementation of the regulation, including any legal, accounting, or consulting procedures which may be required. Explain how the dollar estimates were derived.

No costs will be imposed immediately upon state government entities by this proposed regulation. This regulation is based on and will be implemented through existing Department programs, procedures and policies. Certain state agencies or state-owned entities that discharge pollutants to surface waters may be affected by this proposed regulation for any existing or new discharge activity as described in the response to question #15, including facilities with an NPDES permit to discharge treated sewage. The costs associated with permits and performance or design requirements will be site-specific and will be based on effluent limitations or best management practices and the appropriate protections for a particular waterbody.

State government entities may gain or increase income from this proposed rulemaking due to potential increases in tourism and recreational revenue. For those state government entities that receive income from the tourism industry, the proposed updates to water quality standards may help maintain state revenue and employment. In addition, land values within the Commonwealth may increase in the future as homes that are near areas of clean water and protected resources become more desirable places to live. State government entities that use surface waters as a public water supply may also gain an economic benefit by reduced source water treatment requirements. See the response to question #17 for additional details.

(22) For each of the groups and entities identified in items (19)-(21) above, submit a statement of legal, accounting or consulting procedures and additional reporting, recordkeeping or other paperwork, including copies of forms or reports, which will be required for implementation of the regulation and an explanation of measures which have been taken to minimize these requirements.

Each activity that will result in a discharge of pollutants to waters of this Commonwealth requires a review that is based on site-specific considerations, including the specific levels of pollutants expected or known to be in the discharge to waters of this Commonwealth, as well as the physical and chemical properties of the receiving water. Existing Department procedures will be used to implement this regulation.

Persons with existing or proposing new or expanded activities or projects which result in discharges to surface waters of the Commonwealth will be required to provide treatment and implement other appropriate protections to meet the water quality standards established by this proposed regulation. These requirements are generally implemented upon the issuance of new NPDES permits or the renewal or amendment of existing NPDES permits.

(22a) Are forms required for implementation of the regulation?

No additional forms are required as a result of this proposed regulation.

(22b) If forms are required for implementation of the regulation, attach copies of the forms here. If your agency uses electronic forms, provide links to each form or a detailed description of the information required to be reported. Failure to attach forms, provide links, or provide a detailed description of the information to be reported will constitute a faulty delivery of the regulation.

No additional forms are required as a result of this proposed regulation.

(23) In the table below, provide an estimate of the fiscal savings and costs associated with implementation and compliance for the regulated community, local government, and state government for the current year and five subsequent years.

	Current FY 2022-23	FY +1 2023-24	FY +2 2024-25	FY +3 2025-26	FY +4 2026-27	FY +5 2027-28
SAVINGS:	$	$	$	$	$	$
Regulated Community	Not Measurable	Not Measurable	Not Measurable	Not Measurable	Not Measurable	Not Measurable
Local Government	"	"	"	"	"	"
State Government	"	"	"	"	"	"
Total Savings	"	"	"	"	"	"
COSTS:						
Regulated Community	Not Measurable	Not Measurable	Not Measurable	Not Measurable	Not Measurable	Not Measurable
Local Government	"	"	"	"	"	"
State Government	"	"	"	"	"	"
Total Costs	"	"	"	"	"	"
REVENUE LOSSES:						
Regulated Community	Not Measurable	Not Measurable	Not Measurable	Not Measurable	Not Measurable	Not Measurable
Local Government	"	"	"	"	"	"
State Government	"	"	"	"	"	"
Total Revenue Losses	"	"	"	"	"	"

(23a) Provide the past three-year expenditure history for programs affected by the regulation.

Program	FY -3 (2019-20)	FY -2 (2020-21)	FY -1 (2021-22)	Current FY (2022-23)
160-10381 Enviro Protection Operations	$84,023,000	$94,202,000	$98,036,000	$102,719,000
161-10382 Enviro Program Management	$27,920,000	$32,041,000	$34,160,000	$35,739,000

(24) For any regulation that may have an adverse impact on small businesses (as defined in Section 3 of the Regulatory Review Act, Act 76 of 2012), provide an economic impact statement that includes the following:

(a) An identification and estimate of the number of small businesses subject to the regulation.

Persons with proposed or existing discharges into surface waters of the Commonwealth must comply with the proposed regulation. The Department analyzed a subset of permits and estimated that approximately 44 permitted facilities out of the 274 permitted facilities potentially affected by this proposed regulation are classified as small businesses. Also, see the response to question #15.

(b) The projected reporting, recordkeeping, and other administrative costs required for compliance with the proposed regulation, including the type of professional skills necessary for preparation of the report or record.

Each activity that will result in a discharge of pollutants to waters of this Commonwealth requires a review that is based on site-specific considerations. NPDES permits and other approvals will be required for discharges to surface waters, using the water quality criteria and standards identified in the regulations. Existing Department procedures will be used to implement this proposed regulation.

(c) A statement of probable effect on impacted small businesses.

Each activity that will result in a discharge of pollutants to waters of this Commonwealth requires a review that is based on site-specific considerations. NPDES permits and other approvals will be required for discharges to surface waters, using the water quality criteria and standards identified in the regulations. Existing Department procedures will be used to implement this proposed regulation.

(d) A description of any less intrusive or less costly alternative methods of achieving the purpose of the proposed regulation.

There were no non-regulatory alternatives or less intrusive methods available to consider in order to achieve the purpose of this proposed regulation.

In addition to the flexibility afforded by the regulatory mechanisms in the NPDES permitting program, the water quality standards regulations include a provision that allows for the development of site-specific water quality criteria, in lieu of the statewide criteria, under certain circumstances. A discharger has the opportunity to weigh the costs of developing a site-specific standard against the usage of an existing statewide standard.

(25) List any special provisions which have been developed to meet the particular needs of affected groups or persons including, but not limited to, minorities, the elderly, small businesses, and farmers.

While no special provisions are included in this proposed regulation, it is important to note that this regulation will afford the water quality protection necessary to ensure clean water for residents of and visitors to this Commonwealth.

(26) Include a description of any alternative regulatory provisions which have been considered and rejected and a statement that the least burdensome acceptable alternative has been selected.

No alternative regulatory schemes are available to achieve the correct level of protection for the surface waters of this Commonwealth.

(27) In conducting a regulatory flexibility analysis, explain whether regulatory methods were considered that will minimize any adverse impact on small businesses (as defined in Section 3 of the Regulatory Review Act, Act 76 of 2012), including:

(a) The establishment of less stringent compliance or reporting requirements for small businesses.

This proposed regulation does not establish or revise compliance or reporting requirements for small businesses. There were no less stringent compliance or reporting requirements to consider in this case. Any water quality criteria that are less stringent than those recommended by the Department, and accepted by the Board in the proposed rulemaking, would not be protective enough for the waters of the Commonwealth and would negate the benefits listed in the response to question #17. The proposed regulation reflects the results of a rigorous scientific evaluation of regulatory criteria.

(b) The establishment of less stringent schedules or deadlines for compliance or reporting requirements for small businesses.

This proposed regulation does not establish or revise schedules or deadlines for compliance or reporting requirements for small businesses Schedules of compliance and reporting requirements to meet the standards of this proposed regulation may be considered when permit or approval actions are taken, in accordance with 25 Pa. Code Chapter 92a. They are not considered as part of this scientific evaluation of the correct water quality criteria needed to protect surface waters.

(c) The consolidation or simplification of compliance or reporting requirements for small businesses.

Schedules of compliance and reporting requirements to meet the standards of this proposed regulation may be considered when permit or approval actions are taken. They are not part of this scientific evaluation and establishment of the correct water quality criteria needed to protect surface waters.

(d) The establishment of performing standards for small businesses to replace design or operational standards required in the regulation.

The proposed regulations represent performance standards. They identify the instream goals for water quality protection and do not identify the design or operational standards that must be used to meet the goals.

(e) The exemption of small businesses from all or any part of the requirements contained in the regulation.

There were no such exemptions of small businesses to consider in this case.

(28) If data is the basis for this regulation, please provide a description of the data, explain in detail how the data was obtained, and how it meets the acceptability standard for empirical, replicable and testable data that is supported by documentation, statistics, reports, studies or research. Please submit data or supporting materials with the regulatory package. If the material exceeds 50 pages, please provide it in a searchable electronic format or provide a list of citations and internet links that, where possible, can be accessed in a searchable format in lieu of the actual material. If other data was considered but not used, please explain why that data was determined not to be acceptable.

References cited in this Regulatory Analysis Form:

- Braden, J. B, L. O. Taylor, D. Won, N. Mays, A. Cangelosi, and A. A. Patunru. 2006. Economic benefits of sediment remediation. Project GL-96553601. Great Lakes National Program Office, U.S. Environmental Protection Agency, Chicago, Illinois. (www.nemw.org/Econ)

- Creenan, James W. and John Q. Lewis. 1996. Pennsylvania's Land Recycling Program: Solving the Brownfields Problem with Remediation Standards and Limited Liability. *Duquesne Law Review* 34(3): 661-701. (https://dsc.duq.edu/dlr/vol34/iss3/8/)

- Epp, D. J. and K. S. Al-Ani. 1979. The effect of water quality on rural nonfarm residential property values. *American Journal of Agricultural Economics* 61(3): 529-534. (www.jstor.org/stable/1239441)

- Southwick Associates. 2018. "The Power of outdoor recreation spending in Pennsylvania: How hunting, fishing, and outdoor activities help support a healthy state economy". Theodore Roosevelt Conservation Partnership, Washington D.C. (www.trcp.org/wp-content/uploads/2018/12/TRCP-and-Southwick-PA-Economic-Analysis-12-6-18.pdf)

- Southwick Associates. 2020. "Estimating the economic contributions of outdoor recreation in Pennsylvania: An analysis of 2020 state-level economic contributions made by hunting, fishing, and other outdoor recreation activities". Theodore Roosevelt Conservation Partnership, Washington D.C. (www.trcp.org/wp-content/uploads/2022/04/TRCP-PA-Economic-Report-2020-FINAL.pdf)

Please see the attached rationale documents for additional literature, references and citations used to inform the criteria recommendations contained in this proposed rulemaking.

The Department assessed EPA's criteria recommendations under CWA § 304(a), the risk assessment information available in EPA's Integrated Risk Information System (IRIS) database, other peer-reviewed technical documentation and scientific literature and found it was scientifically sound.

(29) Include a schedule for review of the regulation including:

A. The length of the public comment period:	45 days
B. The date or dates on which any public meetings or hearings will be held:	November 14, 2023
C. The expected date of delivery of the final-form regulation:	Quarter 4, 2024

D. The expected effective date of the final-form regulation:	Upon publication in the *Pennsylvania Bulletin* as final-form rulemaking for CSL permit and approval actions, or as approved by EPA for purposes of CWA permits.
E. The expected date by which compliance with the final-form regulation will be required:	Upon issuance or renewal of NPDES permits or other approvals of the Department subsequent to publication of the final-form rulemaking in the *Pennsylvania Bulletin*. Compliance dates will be determined on a case-by-case basis in accordance with 25 Pa. Code Chapter 92a.
F. The expected date by which required permits, licenses or other approvals must be obtained:	When permits or approvals are issued or renewed subsequent to publication of the final-form rulemaking in the *Pennsylvania Bulletin*.

(30) Describe the plan developed for evaluating the continuing effectiveness of the regulations after its implementation.

The Board is not proposing to establish a sunset date for this proposed regulation because it is needed for the Department to meet its statutory obligations. The Department will continue to closely monitor this proposed regulation for its effectiveness and recommend updates to the Board as necessary.

Also, since the CWA requires review and revision of water quality standards as necessary, but at least once every three years, a schedule for review is inherently established.

COMMONWEALTH OF PENNSYLVANIA
PA DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

RATIONALE FOR THE DEVELOPMENT OF AMBIENT WATER QUALITY CRITERIA FOR PROTECTION OF HUMAN HEALTH

Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene

February 2022

Executive Summary

Section 303 of the federal Clean Water Act (CWA) requires states to periodically, but at least once every three years, review and revise as necessary their water quality standards. The CWA directs states to adopt criteria for toxic pollutants "the presence of which in the affected waters could reasonably be expected to interfere with a state's designated uses." 33 U.S.C. § 303(c)(2)(B).

In 2015, the U.S. Environmental Protection Agency (USEPA) published updated human health criteria exposure inputs, which included increased values for body weight (from 70 kg to 80 kg), drinking water intake (from 2 liters to 2.4 liters), and fish intake (from 17.5 g/day to 22.0 g/day). The Pennsylvania Department of Environmental Protection (Department) adopted these updated criteria exposure inputs in its 9th triennial review of water quality standards (WQS). These updates have prompted the Department to evaluate its agency-derived human health toxics criteria contained in 25 Pa. Code Chapter 93 (relating to water quality standards). The Department reviewed all 18 agency-derived human health toxics criteria and is recommending updated human health criteria for the following 11 toxics substances: acetone, barium, boron, formaldehyde, methyl ethyl ketone, metolachlor, resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and xylene. The Department is also recommending updated human health criteria for chloroform and chlorophenoxy herbicide (commonly known as 2,4-D) based on the current USEPA Section 304(a) water quality criteria recommendations for these substances.

The federal water quality standards regulation at 40 CFR 131.11(b)(1) requires states to adopt numeric water quality criteria that are based on section 304(a) criteria recommendations developed by the United States Environmental Protection Agency (USEPA), section 304(a) criteria recommendations modified to reflect site-specific conditions, or other scientifically-defensible methods.

Updated Exposure Inputs

The Department incorporated the USEPA's 2015 recommendations for body weight, drinking water intake, and fish consumption into the Commonwealth's water quality standards during its 9th triennial review. In 2015, USEPA also updated the methodology used to determine the bioaccumulation in fish, in addition to other toxicity factors (reference dose and cancer slope factors). Below is a summary of the USEPA recommendations.

Body Weight

The default body weight has been increased to 80 kilograms (176 pounds). This is the mean body weight for adults ages 21 and older. The new weight is based on data from the Centers for Disease Control and Prevention's National Health and Nutrition Examination Survey (NHANES), from 1999 to 2006. The previous default body weight was 70 kilograms (154 pounds) and was based on NHANES data from 1988 to 1994.

Drinking Water

The default drinking water intake assumption is increased to 2.4 liters per day (81.2 fl. oz./day). This is based on NHANES data collected from 2003 to 2006 for the 90th percentile of water consumption in adults ages 21 and older. The water intake rate is based on consumer-only estimates of direct and indirect water ingestion. The previous recommended default drinking water intake rate was 2 liters per day. The data used was from adults surveyed in the United States Department of Agriculture, 1994-1996 Continuing Survey of Food Intake by Individuals (CSFII) and the National Cancer Institute study of the 1977-1978 Nationwide Food Consumption Survey.

Fish Consumption

The recommended default fish consumption rate has been increased to 22 grams per day (0.78 oz./day). This rate represents the consumption of freshwater and shellfish from inland and near shore waters for adults 21 years of age and older, based on NHANES data from 2003 to 2010. The previous fish consumption rate was 17.5 grams per day based on the consumption rate of freshwater and estuarine fish for the adult population from 1994-1996 CSFII data.

Bioaccumulation Factors

The criteria have been updated using bioaccumulation factors (BAFs) as recommended in the USEPA human health criteria methodology (USEPA 2000). BAFs will account for the uptake and retention of a chemical by an aquatic organism from all surrounding

media (e.g., water, food, sediment). Criteria were previously calculated with bioconcentration factors (BCFs) that only accounted for direct water contact. In order to account for the variation in bioaccumulation due to the aquatic trophic position of an organism, USEPA is recommending that BAFs be determined and applied to three trophic levels of fish. USEPA used field-measured BAF's and laboratory-measured bioconcentration factors, along with octanol-water partition coefficients available from peer-reviewed databases to develop the national BAFs. USEPA verified the calculated BAFs using a peer-reviewed model called Estimation Program Interface Suite (EPI Suite).

Health Risk Factors
USEPA has updated the health risk factors using the most current toxicity information. The toxicity values for both non-carcinogenic and carcinogenic effects were used. USEPA's *Integrated Risk Information System* (IRIS) is the primary source for reference dose (RfD) and cancer slope values. For some pollutants, USEPA has used other sources provided by USEPA's Office of Water, Office of Pesticide Programs, and international and state agencies.

Relative Source Contribution
USEPA has updated the Relative Source Contribution (RSC) to reflect chemical-specific exposure. The RSC, which is only applied to threshold non-carcinogens, will range from 20 to 80 percent as recommended in USEPA's human health methodology (USEPA 2000). Unless adequate exposure pathway data is available, USEPA uses an RSC of 20 percent, which assumes that the major portion of total exposure comes from other sources. The RSC protects against particular pollutant exposures from other foods, marine fish consumption, dermal exposure, and respiratory exposures. The use of the RSC is to ensure that an individual's total exposure from all sources of a pollutant does not exceed the criteria.

Criteria Development

Criteria for the protection of Human Health from Toxic Substances
The Department develops human health-based criteria in accordance with its Water Quality Toxics Management Strategy – Statement of Policy. Human health criteria development considers various exposure pathways including exposures from drinking water and fish consumption and may include exposures from inhalation or dermal absorption.

Evaluation of Available Recommendations and Scientific Data
The Department has reviewed and considered the available scientific data and recommendations in accordance with 25 Pa. Code Chapter 16 (relating to water quality toxics management strategy – statement of policy) and Chapter 93. Human health criteria are based on one of two approaches – either threshold level or non-threshold level toxic effects (carcinogens). When no criteria have been developed by USEPA for a

substance identified or expected in a discharge, the Department will develop criteria following USEPA's standard toxicological procedures outlined in the *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (USEPA 2000) as amended and updated (25 Pa. Code §16.32(c)(2)). As further stated in §16.32(d), the sources the Department uses to obtain relevant risk assessment values for protection for threshold level toxic effects to human health as are follows:

(1) Verified references doses, listed in the EPA agency-wide supported data system known as IRIS and other EPA approved data sources referred through IRIS
(2) Maximum Contaminant Level Goals (MCLGs)
(3) The EPA's CWA § 304(a) health criteria listed under the National Toxics Rule in 40 CFR 131.36 (57 FR 80848, December 22, 1992) (relating to toxics criteria for those States not complying with CWA section 303(c)(2)(B)), as amended and updated and other final criteria published by the EPA and the Great Lakes Initiative Clearinghouse.
(4) Teratology and other data that have been peer-reviewed may provide information for criteria development.

In accordance with this policy, the Department has evaluated its human health toxics criteria for acetone, acrylamide, benzyl chloride, barium, 2-butoxyethanol, boron, chloroform, cyclohexylamine, formaldehyde, methyl ethyl ketone, metolachlor, resorcinol, strontium, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2,4-D and xylene.

Development of Human Health Criteria
In accordance with the USEPA *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (USEPA 2000) and using the updated exposure input values for body weight, drinking water intake, and fish consumption, the Department derived human health criteria for the toxic substances described above using the following calculation:

$$AWQC = RfD \times RSC \times (BW \div [DWI + (FI \times BAF)])$$

Where:

AWQC = ambient water quality criteria
RfD = published reference dose for each substance
RSC = Relative Source Contribution, default (0.2)
BW = Body Weight, default (80 kg)
DWI = Drinking Water Intake, default (2.4 L)
FI = Fish consumption rate for aquatic trophic levels 2, 3 and 4, default (0.022 kg/day)
BAF = Bioaccumulation factor for aquatic trophic levels 2, 3, and 4, default (1, if substance does not bioaccumulate)

Comparisons of DEP Current and Updated Agency-Derived Human Health Criteria

Of the 18 toxic substances evaluated, 13 substances warrant a change in current water quality criteria listed in 25 Pa. Code Chapter 93, Table 5. The origins and applications of the current water quality criterion as well as the criteria recommendations for each of these 13 toxic substances is described in the tables and summaries below.

Table 1. More Stringent Criteria

	Pollutant	CAS No.	DEP Current (ug/L)	DEP Recommended (ug/L)
1	Barium	07440393	2400	1000
2	Boron	07440428	3100	1000
3	Methyl ethyl ketone	00078933	21000	4000
4	1,2,3-trichloropropane	00096184	210	30
5	1,2,4-trimethylbenzene	00095636	72	10
6	1,3,5-trimethylbenzene	00108678	72	10
7	2,4-D	00094757	1400	1300
8	Xylene	01330207	70000	1000

Of the 18 toxic substances evaluated by the Department, eight substances will have a more stringent criterion than previously listed in 25 Pa. Code Chapter 93, Table 5.

1) Barium

The current barium criterion is 2,400 ug/L and was adopted/updated in the Department's 5th triennial review of WQS (2000).

There are currently 51 Bureau of Clean Water (BCW) National Pollutant Discharge Elimination System (NPDES) permits with effluent limitations for barium. Of these 51 permits, 39 facilities have reported results through the Department's Electronic Discharge Monitoring Report (eDMR) system. Most of the permits contain only monitor and report requirements and have had no violations since 2018.

Staff analyzed Department-collected surface water sample data for barium. Data was retrieved from the Water Quality Portal, which is sponsored by the United States Geological Survey (USGS), USEPA and the National Water Quality Monitoring Council (NWQMC). A total of 19,794 samples were collected between 1998-2020. Sample results ranged from below a lower reporting limit of 2 ug/L to 2,410 ug/L.

Staff recalculated the criterion using the USEPA IRIS RfD of 0.2 mg/kg/day (2005), an RSC of 0.2, a BAF of 1, and the new exposure inputs. The new value is 1,321 ug/L before rounding. After accounting for significant figures, the criterion value is rounded to 1,000 ug/L.

2) Boron

The current boron criterion is 3,100 ug/L and was adopted/updated in the Department's 5th triennial review of WQS (2000).

There are currently 43 BCW NPDES permits with effluent limitations for boron. Of these 43 permits, 30 facilities have reported results through the Department's eDMR system. Most of the permits contain only monitor and report requirements and have had no violations since 2018. One permit with numeric limits (PA0046680) has had violations.

Staff analyzed Department-collected surface water sample data for boron. Data was retrieved from the Water Quality Portal, which is sponsored by the USGS, USEPA and NWQMC. A total of 15,949 samples were collected between 2010-2020. Sample results ranged from below a lower reporting limit of 13.2 ug/L to 1,345 ug/L.

This criterion was based on a 1989 RfD (0.09 mg/kg/day) and old methodologies that did not include fish intake, a BAF or an RSC. Staff recalculated the criterion using the current USEPA IRIS RfD of 0.2 mg/kg/day (2004), an RSC of 0.2, a BAF of 1, and the new exposure inputs. The new value is 1321 ug/L before rounding. After accounting for significant figures, the criterion value is rounded to 1,000 ug/L.

3) Methyl ethyl ketone

The current methyl ethyl ketone criterion is 21,000 ug/L and was adopted/updated in the Department's 5th triennial review of WQS (2000).

Currently, there is one BCW NPDES permit with an effluent limitation for this pollutant. There is no eDMR system data on this permit.

Staff analyzed Department-collected surface water sample data for methyl ethyl ketone. Data was retrieved from the Water Quality Portal, which is sponsored by the USGS, USEPA and NWQMC. A total of 61 samples were collected between 1999-2009. Sample results ranged from 2.1 ug/L to 5 ug/L.

Staff recalculated the criterion using the USEPA IRIS RfD of 0.6 mg/kg/day (2003), an RSC of 0.2, a BAF of 1, and the new exposure inputs. The new value is 3,964 ug/L before rounding. After accounting for significant figures, the criterion value is rounded to 4,000 ug/L.

4) 1,2,3-trichloropropane

The current 1,2,3-trichloropropane criterion is 210 ug/L and was adopted/updated in the Department's 5th triennial review of WQS (2000).

There are currently two BCW NPDES permits with effluent limitations for this pollutant. Both permits contain numeric limits and have had no violations since 2018.

Staff analyzed Department-collected surface water sample data for 1,2,3-trichloropropane. Data was retrieved from the Water Quality Portal, which is sponsored by the USGS, USEPA and NWQMC. A total of 72 samples were collected between 1999-2015. Sample results ranged from below a lower reporting limit of 0.25 ug/L to 2 ug/L.

Staff recalculated the criterion using the USEPA IRIS RfD of 0.004 (2009), an RSC of 0.2, a BAF of 1, and the new exposure inputs. The new value is 26 ug/L before rounding. After accounting for significant figures, the criterion value is rounded to 30 ug/L.

5) 1,2,4-trimethylbenzene

The current 1,2,4-trimethylbenzene criterion is 72 ug/L and was adopted/updated in the Department's 8th triennial review of WQS (2013).

There are currently two BCW NPDES permits with effluent limitations for this pollutant. Both permits contain monitor and report requirements.

Staff analyzed Department-collected surface water sample data for 1,2,4-trimethylbenzene. Data was retrieved from the Water Quality Portal, which is sponsored by the USGS, USEPA and NWQMC. A total of 72 samples were collected between 1999-2015. Sample results ranged from below a lower reporting limit of 0.21 ug/L to 2 ug/L.

Staff recalculated the criterion using the USEPA IRIS RfD of 0.01 (2016), an RSC of 0.2, a BAF of 439 (BCF from USEPA 1994), and the new exposure inputs. The new value is 13.2 ug/L before rounding. After accounting for significant figures, the criterion value is rounded to 10 ug/L.

6) 1,3,5-trimethylbenzene

The current 1,3,5-trimethylbenzene criterion is 72 ug/L and was adopted/updated in the Department's 8th triennial review of WQS (2013).

There are currently two BCW NPDES permits with effluent limitations for this pollutant. Both permits contain monitor and report requirements.

Staff analyzed Department-collected surface water sample data for 1,3,5-trimethylbenzene. Data was retrieved from the Water Quality Portal, which is sponsored by the USGS, USEPA and NWQMC. A total of 72 samples were collected between 1999-2015. Sample results ranged from below a lower reporting limit of 0.25 ug/L to 2 ug/L.

Staff recalculated the criterion using the USEPA IRIS RfD of 0.01 (2016), an RSC of 0.2, a BAF of 439 (BCF from USEPA 1994), and the new exposure inputs. The new value is 13.2 ug/L before rounding. After accounting for significant figures, the criterion value is rounded to 10 ug/L.

7) Chlorophenoxy herbicide (2,4-D)

The current 2,4-D criterion is 1400 ug/L and was adopted in the Department's 9th triennial review of WQS. USEPA disapproved this criterion due to the rounding of the value. The calculated criterion before rounding was 1371 ug/L. USEPA chose to round the criterion to 1300 ug/L rather than 1400 ug/L. The current criterion is less stringent than USEPA's 304(a) recommendation. Therefore, the criterion value of 1300 ug/L is being recommended to be consistent with USEPA.

The Department has not collected surface water quality data for this parameter, and there no NPDES permits with limits for 2,4-D.

8) Xylene

The current xylene criterion is 70,000 ug/L and was adopted/updated in the Department's 5th triennial review of WQS (2000).

There are currently 55 BCW NPDES permits with effluent limitations for xylene. Of these 55 permits, 16 facilities have reported results through the Department's eDMR system. All of the permits except one contain monitor and report requirements and have had no violations since 2018. The one permit with numeric limits has reported some minor exceedances.

Data was retrieved from the Water Quality Portal, which is sponsored by the USGS, USEPA and NWQMC. While the Department has not collected surface water quality data for this parameter, samples have been collected by USGS and the Delaware River Basin Commission (DRBC). A total of 335 samples were collected between 1988-2021. Sample results ranged from 0.1 ug/L to 5.2 ug/L, but most results were less than the method detection limit. Method detection limits ranged from 0.06 ug/L to 3 ug/L.

Staff recalculated the criterion using the USEPA IRIS RfD of 0.2 (2003), an RSC of 0.2, a BAF of 1, and the new exposure inputs. The new value is 1,321 ug/L before rounding. After accounting for significant figures, the criterion value is rounded to 1,000 ug/L.

Table 2. Less Stringent Criteria

	Pollutant	CAS No.	DEP Current (ug/L)	DEP Recommended (ug/L)
1	Acetone	00067641	3500	6000
2	Formaldehyde	00050000	700	1000
3	Metolachlor	51218452	69	700
4	Resorcinol	01084603	2700	3000
5	Chloroform	00067663	5.7	60

The Department has recalculated the toxicity of the following five toxic substances which will result in a less stringent criterion than currently listed in 25 Pa. Code Chapter 93, Table 5.

9) Acetone

The current acetone criterion is 3,500 ug/L and was adopted/updated in the Department's 5th triennial review of WQS (2000).

There are currently 17 BCW NPDES permits with effluent limitations for acetone. Of these 17 permits, nine facilities have reported results through the Department's eDMR system. Most of the permits contain numeric limits and have had no violations since 2018.

Staff analyzed Department-collected available surface water sample data for acetone. Data was retrieved from the Water Quality Portal, which is sponsored by the USGS, USEPA and NWQMC. A total of 71 samples were collected between 1999-2010. The majority of samples were collected from Delaware River basin tributaries. Sample results ranged from 1.2 ug/L to 65.8 ug/L.

Staff recalculated the criterion using the current USEPA IRIS RfD of 0.9 mg/kg/day (2003), an RSC of 0.2, a BAF of 1, and the new exposure inputs. The new criterion value is 5,945 ug/L before rounding. After accounting for significant figures, the criterion value is rounded to 6,000 ug/L.

10) Formaldehyde

The current formaldehyde criterion is 700 ug/L and was adopted/updated in the Department's 5th triennial review of WQS (2000).

Currently, there are 10 BCW NPDES permits with an effluent limitation for this pollutant. Most, if not all, of the permits are for fish hatcheries. Of these ten permits, nine facilities have reported results through the Department's eDMR system. Most of the permits contain numeric limits and have had no violations since 2018.

The Department has not collected surface water quality data for this parameter.

Staff recalculated the criterion using the USEPA IRIS RfD of 0.2 mg/kg/day (1990), an RSC of 0.2, a BAF of 1, and the new exposure inputs. The new value is 1,321 ug/L before rounding. After accounting for significant figures, the criterion value is rounded to 1,000 ug/L.

11) Metolachlor

The current metolachlor criterion is 69 ug/L and was adopted/updated in the Department's 7th triennial review of WQS (2008).

Currently, there are no BCW NPDES permits with an effluent limitation for this pollutant.

The Department has not collected surface water quality data for this parameter.

The RfD used in the criterion calculation did not come from USEPA's IRIS. It was based on newer information contained in a USEPA Registration Eligibility Decision (RED) document for metolachlor (USEPA 1995). According to the RED document, a cancer potency factor was recommended in 1991 but later retracted in 1994. The Department included a safety factor of 10 due to the lack of a cancer potency factor in development of the 69 ug/L criterion. The RfD of 0.10 mg/kg/day was based on a No Observed Effect Level (NOEL) of 9.7 mg/kg/day and an uncertainty factor of 100. The NOEL was from a one-year feeding study in dogs.

Staff recalculated the criterion using the RED RfD of 0.10 mg/kg/day, an RSC of 0.2, a BAF of 1, and the new exposure inputs. The Department removed its cancer safety factor of 10 based on the information contained in USEPA's RED for metolachlor. In 1994, the Health Effects Division Peer Review Committee recommended a margin of exposures (MOE) approach for metolachlor since there was no supportable mutagenicity concern and in light of new information on the relative metabolism of metolachlor. The MOE was calculated from a NOEL of 15 mg/kg/day. Since the RfD is based on a NOEL of 9.7 mg/kg/day, cancer concerns are adequately addressed. The new criterion value is 700 ug/L after rounding.

12) Resorcinol

The current resorcinol criterion is 2,700 ug/L and was adopted/updated in the Department's 8th triennial review of WQS (2013).

Currently, there is one BCW permit with an effluent limitation for this pollutant. The permit contains only monitor and report requirements.

DEP has not collected surface water quality data for this parameter.

Staff recalculated the criterion using the previous RfD of 0.4 mg/kg/day, RSC of 0.2, BAF of 3.162 (based on a BCF from INDSPEC Chemical Corp), and the new exposure inputs. The RfD used in the criterion calculation did not come from USEPA's IRIS. It was based on toxicity information from the *Concise International Chemical Assessment Document 71* for resorcinol, which was published by the International Program on Chemical Safety (IPCS). The Rfd was based on a no-observed-adverse-effect-level (NOAEL) from a 1992 National Toxicology Program (NTP) study on rats that was adjusted to convert the 5 day/week exposure regime of the study (50 mg/kg/day for 5 days/week) into a daily exposure value (36 mg/kg/day 7 days/week). The new value is 2,595 ug/L before rounding. After accounting for significant figures, the new value is 3,000 ug/L.

13) Chloroform

The current chloroform criterion of 5.7 ug/L was evaluated by the Department during its 9th triennial review of WQS. During that rulemaking, an error was identified in the proposed criterion value, which was not consistent with USEPA's 304(a) criterion recommendation. The Department removed the criterion recommendation from the 9th triennial review pending additional review and consideration. Following additional review, the Department has determined that USEPA's 304(a) criterion recommendation for chloroform is appropriate for this Commonwealth. A criterion value of 60 ug/L is being recommended to be consistent with USEPA.

Table 3. Criteria that will not change

	Pollutant	CAS No.	DEP Current (ug/L)	DEP Recommended (ug/L)
1	Acrylamide	00079061	0.07	0.07
2	2-Butoxy ethanol	00111762	700	700
3	cyclohexylamine	000108918	1000	1000
4	strontium	07440246	4000	4000
5	Benzyl Chloride	000100447	0.2	0.2

There are five toxic substances that had no change in criterion value based upon review of the current RfD recommendations for each substance, recalculation using the updated exposure inputs, and observance of significant figures. Therefore, these five substances do not require any change to the current criteria.

Conclusion

The Department recommends the Board adopt the updated criteria for the 13 toxic substances as described in this rationale document.

Literature Cited

IPCS. 2006. Concise International Chemical Assessment Document 71 - Resorcinol. WHO Press. Geneva, Switzerland. (https://apps.who.int/iris/bitstream/handle/10665/43450/9241530715_eng.pdf?sequence=1)

USEPA. 1994. Chemical summary for 1,2,4-trimethylbenzene. EPA 749-F-94-022a. U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, D.C.

USEPA. 1995. Registration eligibility decision document for metolachlor. EPA 738-R-95-006. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C.

USEPA. 2000. Methodology for deriving ambient water quality criteria for the protection of human health. EPA-882-B-00-004. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, DC.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

RATIONALE FOR THE DEVELOPMENT OF AMBIENT WATER QUALITY CRITERIA HUMAN HEALTH PROTECTION

1,4-Dioxane

April 2022

Executive Summary

States have an obligation under Section 303(c)(1) of the federal Clean Water Act (CWA) to periodically, but at least once every three years, review and revise as necessary their water quality standards. The federal water quality standards regulation at 40 CFR 131.11(b)(1) requires states to adopt numeric water quality criteria that are based on section 304(a) criteria recommendations developed by the United States Environmental Protection Agency (USEPA), section 304(a) criteria recommendations modified to reflect site-specific conditions, or other scientifically-defensible methods. Additionally, the CWA directs states to adopt criteria for toxic pollutants "the presence of which in the affected waters could reasonably be expected to interfere with a state's designated uses." 33 U.S.C. § 303(c)(2)(B).

In December 2020, USEPA completed and published an updated evaluation of 1,4-dioxane under the Toxic Substances Control Act (TSCA) (USEPA 2020). This recent evaluation by USEPA continues to identify 1,4-dioxane as a likely human carcinogen. Following an evaluation of the available scientific data and information on permitted discharges in this Commonwealth, the Pennsylvania Department of Environmental Protection (Department) has developed an ambient water quality criterion recommendation of 0.3 µg/L to protect human health from the toxic effects of 1,4-dioxane.

History of Regulation

As part of its 8th triennial review of water quality standards, the Department evaluated 1,4-dioxane and developed a human health water quality criterion recommendation of 0.35 ug/L. This value was calculated using information available in USEPA's Integrated Risk Information System (IRIS), the Department's policies and regulations for the development of human health-based criteria, and USEPA's *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (EPA 2000). The recommendation was approved by the Environmental Quality Board (Board) as a

proposed rulemaking at its April 17, 2012 meeting and published in the *Pennsylvania Bulletin* on July 7, 2012 (42 Pa.B. 4367). Based on comments received during the public comment period, the Department withdrew its proposed statewide criterion for 1,4-dioxane at the final phase of rulemaking, pending further evaluation, including additional data collection.

Since 2013, the Department has collected additional information regarding various sources and discharges of 1,4-dioxane to surface waters of this Commonwealth. While neither the oral slope factor for 1,4-dioxane in IRIS nor the equation used to calculate water quality criteria to protect human health has changed since 2013, USEPA did publish updated exposure inputs in 2015 which are used in the calculation of human health criteria, including the inputs for human body mass, daily water intake and daily fish intake. The Department adopted these 2015 USEPA updates as part of its 9th triennial review, which was approved by USEPA in 2020. As such, the Department has reevaluated and recalculated a 1,4-dioxane water quality criterion for the protection of human health using USEPA's new exposure inputs for body mass, water intake and fish intake.

Background

1,4-dioxane (CASRN: 123-91-1) is a synthetic, semi-volatile organic compound that is also known as dioxane, p-dioxane, diethylene oxide, diethylene ether, dioxyethylene ether, and 1,4-diethylene dioxide and glycol (USEPA 2013, ITRC 2020). It is a clear, colorless liquid at ambient temperatures with a faint sweet odor similar to that of diethyl ether which mixes easily with water, most organic solvents, aromatic hydrocarbons and oils. 1,4-dioxane has been used as a laboratory reagent; as a chemical intermediate; in plastic, rubber, insecticides, and herbicides; as part of a polymerization catalyst; and as an extraction medium of animal and vegetable oils. However, it is primarily used as a solvent, or solvent stabilizer (ITRC 2020, ATSDR 2012). As a solvent, 1,4-dioxane has various uses in the medical, pharmaceutical, printing inks and paints, automotive, adhesives, and biotechnical industries (ITRC 2020). Historically, it was used as a stabilizer for the solvent 1,1,1-trichloroethane. It can also show up as a contaminant in ethoxylated surfactants. These substances are commonly used in consumer cosmetics, detergents, and shampoos (ATSDR 2012).

Production of 1,4-dioxane was at its highest during the period spanning the 1950s through the mid-1980s (ITRC 2020). Production significantly declined following the 1990 amendments to the Clean Air Act and the Montreal Protocol, which mandated a gradual phase-out of 1,1,1-trichloroethane production in the United States (USEPA 2013).

1,4-dioxane can be released into the environment during its production, the processing of other chemicals, its use, and with its unintentional formation during the manufacture of other substances (ATSDR 2012). Facilities that conduct disposal through incineration can release 1,4-dioxane via emissions. Wastewater treatment plant effluent, landfill leachate and improper waste disposal methods are the most significant contributors of 1,4-dioxane found in surface waters. Groundwater contamination primarily has been

associated with 1,1,1-trichloroethane releases, effluent water reuse (e.g., spray irrigation), and sewer line exfiltration issues (ITRC 2020).

Since 1,4-dioxane is a semi-volatile compound, it will exist as a vapor when it enters the air and is expected to volatilize at a moderate rate from water and soil surfaces.

In air, 1,4-dioxane is degraded through photooxidation with an estimated half-life ranging from approximately 6 hours to 3 days.

Based on its estimated K_{oc} value,1,4-dioxane is expected to be highly mobile in soil, which indicates there is a high likelihood of this pollutant reaching and contaminating groundwater aquifers.

The estimated half-life of 1,4-dioxane from a river model is seven days and from a lake model is 56 days. Given that volatilization is hindered in cases of groundwater contamination, 1,4-dioxane is likely to be persistent (USEPA 2013, ATSDR 2012). In water, 1,4-dioxane has been found to be resistant to biodegradation, hydrolysis and direct photolysis. It may undergo indirect photolysis, but degradation through this process is very slow. The half-life for this reaction is approximately 336 days at pH 7 (ATSDR 2012). One author (Roy et al. 1994) did observe biodegradation of 1,4-dioxane by an acclimated microbial culture. However, this observation occurred under very specific and enhanced conditions, and biodegradation was generally not observed under ambient conditions (ATSDR 2012).

In 2017, USEPA collected data on 1,4-dioxane in water as part of its third Unregulated Contaminants Monitoring Rule (UCMR). USEPA uses the UCMR program to collect data for contaminants suspected to be present in drinking water, but that do not have health-based standards set under the federal Safe Drinking Water Act (SDWA). Every five years USEPA develops a new list of UCMR contaminants, largely based on the Contaminant Candidate List (CCL). Sampling indicated that approximately 10% of surface water sources had detections of 1,4-dioxane, and approximately 3% of the sample results were above the reference concentration of 0.35 ug/L (USEPA 2017a).

Discharges and Sources of 1,4-Dioxane in Pennsylvania

When the Department withdrew its recommendation for 1,4-dioxane in 2013, the Board requested the Department collect additional wastewater effluent data and report back to the Board. As a result, the Department determined that it should implement increased monitoring in National Pollutant Discharge Elimination System (NPDES) permits for several pollutants, including 1,4-dioxane, upon issuance or reissuance of an individual NPDES permit. Where the concentration of 1,4-dioxane in a discharge exceeded 10 µg/L and the discharge flow exceeded 0.1 million gallons per day (MGD), Part A of the permit included monitor and report for 1,4-dioxane. Discharges of 0.1 MGD or less were required to monitor and report for 1,4-dioxane if the concentration of 1,4-dioxane in the discharge exceeded 100 µg/L. Following these guidelines, the Department issued 22 NPDES permits containing monitor and report requirements for 1,4-dioxane, and there is currently one active NPDES permit containing numeric permit effluent limitations

based on a site-specific criterion for 1,4-dioxane. The 23 permitted facilities are located in five out of six Department regions and include permitted discharges of treated effluent from landfills, wastewater treatment plants, power generating stations and other industrial facilities. The Department also reviewed water quality sample data available for 1,4-dioxane in the Water Quality Portal. The Water Quality Portal is a cooperative service provided by the United States Geological Survey (USGS), USEPA, and the National Water Quality Monitoring Council (NWQMC). A search of the database generated approximately 100 sample results for 1,4-dioxane in Pennsylvania surface waters. Most of the relevant data were collected by the Delaware River Basin Commission (DRBC) in 2021. The samples were primarily collected within the Lehigh River basin, and the results ranged from 0.016 ug/L (i.e., the method detection limit) to 470 ug/L.

The Department's data collection and water quality data review efforts indicate that 1,4-dioxane is found in select surface waters as well as wastewater discharges across the Commonwealth. Thus, statewide ambient water quality criteria for 1,4-dioxane are appropriate to protect human health and the protected water uses listed in §93.3.

Human Health and 1,4-Dioxane

1,4-dioxane is known to enter the human body through inhalation, dermal absorption, intravenous injection, and ingestion. As a semi-volatile compound, 1,4-dioxane can be quickly taken into the human body via the lungs. This exposure route is primarily of concern to those who work with 1,4-dioxane in a laboratory or industrial setting. Adsorption through the skin is another route of concern, both for workers who handle 1,4-dioxane directly in a professional capacity and by consumers through the use of deodorants, shampoos or cosmetics which may have been contaminated. Some studies indicate that much of the 1,4-dioxane will evaporate before absorption through the skin can take place; however, USEPA noted there are significant data gaps for the potential carcinogenic effects of 1,4-dioxane from dermal exposure in humans and animals (USEPA 2020, ATSDR 2012). Ingestion, or oral exposure, to 1,4-dioxane can occur by eating food products contaminated with pesticides containing 1,4-dioxane, drinking contaminated water or through unintentional ingestion of consumer products (e.g., cosmetics, mouthwash and other personal care products). Upon exposure, 1,4-dioxane is bioavailable and will be absorbed, particularly when exposure occurs via the oral and inhalation pathways.

Most of the available scientific data that has been published on the toxic effects of 1,4-dioxane has been obtained through animal toxicity studies. Although the available data on toxic effects in humans is limited, acute and chronic exposures to 1,4-dioxane via the oral exposure pathway are known to negatively affect the liver and kidneys in both laboratory animals and humans. Furthermore, it has been documented that acute exposures to high concentrations of 1,4-dioxane may result in death, and chronic exposures may also cause cancer.

Factors influencing 1,4-Dioxane levels in the body

Certain subpopulations and individuals with pre-existing conditions may be biologically more susceptible to exposure than others. For example, variations in CYP enzyme expression can affect the body's ability to metabolize 1,4-dioxane, and it is known that there are large variations in CYP expression and functionality in humans, especially for the CYP2E1 enzyme (USEPA 2020). Diseases of the liver, kidney, upper respiratory system and other organs may also impair 1,4-dioxane metabolism and make individuals susceptible to toxic effects. For example, fatty liver disease has been associated with reduced CYP function, and there is some evidence of the potential for developmental toxicity as a result of gestational exposures to 1,4-dioxane (USEPA 2020). As a subpopulation, children may experience increased exposure to 1,4-dioxane when compared to that of an adult. Children generally drink more fluids, eat more food, and breathe more air per kilogram of body weight. They have a larger skin surface in proportion to their body volume and their diet often differs from that of adults. In addition, children crawl on the floor, put things in their mouths, intentionally or unintentionally eat inappropriate things (including consumer products such as baby shampoo, etc.) and spend more time outdoors. Children also are closer to the ground, and they do not have the judgment of adults to avoid hazards (ATSDR 2012).

Regarding the potential for 1,4-dioxane to bioaccumulate in organisms or biomagnify through food webs, USEPA has determined that 1,4-dioxane has a low bioconcentration and bioaccumulation potential due its hydrophilic properties and short half-life in animals following uptake. Using The EPI Suite™ BCFBAF model, USEPA estimated a bioaccumulation factor of 0.9 for 1,4-dioxane (USEPA 2020).

Guidelines for 1,4-Dioxane

Health-based Guidelines

USEPA's IRIS database provides human health assessment information on chemical substances following a comprehensive review of toxicity data as outlined in the IRIS assessment development process. An oral reference dose (RfD) is based on the assumption that thresholds exist for certain toxic effects such as cellular necrosis. It is expressed in units of mg/kg-day. In general, the RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The oral RfD for 1,4-dioxane was last revised in 2010. The current oral RfD for 1,4-dioxane is 0.03 mg/kg-day based on liver and kidney toxicity.

USEPA completed its initial cancer risk assessment in 1980s and classified 1,4-dioxane as a probable human carcinogen. When threshold level toxic effects were evaluated in 2010, USEPA updated its classification for 1,4-dioxane, identifying it as "likely to be carcinogenic to humans." An oral cancer slope factor of 0.1 mg/L was published in 1988 and this recommended value did not change following USEPA's updated review of 1,4-dioxane in 2013. USEPA's characterization of 1,4-dioxane is based on inadequate evidence of carcinogenicity in humans, but sufficient evidence in animals (USEPA

2013). USEPA cited evidence of hepatic tumors in three strains of rats, two strains of mouse, and in guinea pigs. In addition, mesotheliomas of the peritoneum, mammary, and nasal tumors were observed in rats following 2 years of oral exposure to this chemical. The oral slope factor of 0.1 mg/kg-day is based on the incidence of liver cancer in female mice exposed to 1,4-dioxane in drinking water for 2 years (USEPA 2013).

USEPA's Drinking Water Health Advisory Program, sponsored by the Health and Ecological Criteria Division of the Office of Science and Technology (OST), Office of Water (OW), provides information on the health and organoleptic (e.g., taste, odor, color) effects of contaminants in drinking water. A health advisory level (HAL) is not an enforceable standard, but rather provides technical guidance to assist Federal, State and local officials when emergency spills or contamination situations occur. HALs are generally determined for one-day, ten-day and lifetime exposure if adequate data are available that identify a sensitive noncarcinogenic end point of toxicity. The current HAL for 1,4-dioxane was published in 2012 (USEPA 2012) and is based on the current oral RfD and cancer slope factor published in IRIS. The one-day and ten-day HALs for a 10-kg child are 4 mg/L and 0.4 mg/L, respectively. The lifetime HAL for adults and children is 0.2 mg/L and was calculated using the oral reference dose for noncancer effects published in IRIS, which was last revised in 2010. USEPA also included a cancer risk level drinking water concentration of 0.035 mg/L at the 10^{-4} cancer risk level, which corresponds to an excess estimated lifetime cancer risk of 1 in 10,000 persons.

The World Health Organization (WHO) assessed 1,4-dioxane in 2004 and subsequently published a guideline value for drinking water of 0.05 mg/L in the third edition of its *Guidelines for Drinking-water Quality* (WHO 2008). This guideline was retained in WHO's 4th edition of the guidelines.

Scientific Literature and Data Related to the Human Health Effects of 1,4-Dioxane

USEPA published its *Final Risk Evaluation for 1,4-Dioxane* in December 2020 (USEPA 2020). Given the recentness of this comprehensive evaluation, little information on this subject can be found in recent academic reviews that has not already been covered in the 2020 USEPA report.

Evaluation of Available Recommendations and Scientific Data

The Department has reviewed and considered the available scientific data and recommendations in accordance with 25 Pa. Code Chapter 16. Water Quality Toxics Management Strategy – Statement of Policy and 25 Pa. Code Chapter 93. Human health criteria are based on one of two approaches – either threshold level or non-threshold level toxic effects (carcinogens). Department guidelines for the development of threshold level toxic effect human health-based criteria are found specifically at 25 Pa. Code §16.33 (relating to non-threshold effects (cancer)). In establishing water quality criteria for carcinogens, the Department makes a determination as to whether a substance is a carcinogen based upon USEPA's identification of the substance. For toxic substances for which oral slope factors (i.e., cancer slope factors) have been developed by USEPA and published in IRIS, the Department will use one of the

following approaches in establishing water quality criteria for this Commonwealth. The Department will use USEPA-developed 304(a) water quality criteria recommendations as amended and updated in USEPA's *National Recommended Water Quality Criteria – Human Health Criteria Table* if they are available. If 304(a) criteria recommendations are not available, the Department will develop water quality criteria based upon USEPA's oral slope factors using USEPA's *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (USEPA 2000). For carcinogens or suspected carcinogens for which oral slope factors have not been developed by USEPA, the Department will use threshold level effects toxicity data, if available, and apply an additional safety factor of 10 to develop a protective human health water quality criterion.

In accordance with this policy, the Department has reviewed the available scientific data and recommendations. Since USEPA does not currently have a 304(a) water quality criterion recommendation for 1,4-dioxane, the Department has determined that USEPA's oral slope factor as published in IRIS represents the best available data to calculate an ambient water quality criterion for 1,4-dioxane that is protective of human health.

Development of 1,4-Dioxane Water Quality Criteria

Criteria for the Protection of Human Health from Toxic Substance

As described above, the Department develops human health-based criteria in accordance with its Water Quality Toxics Management Strategy – Statement of Policy. Human health criteria development considers various exposure pathways including exposures from drinking water and fish consumption and may include exposures from inhalation or dermal absorption. The inclusion of multiple exposure pathways and the toxicity risk of the substance make development of human-health-based criteria different than the development of other types of water quality criteria, such as Potable Water Supply use criteria.

Development of a Human Health Criterion based on IRIS

USEPA identified 1,4-dioxane as a likely human carcinogen and developed the current oral slope factor in 1988. USEPA also published an RfD for 1,4-dioxane based on threshold level toxic effects to the liver and kidneys. Since USEPA has information available in IRIS for both threshold level and non-threshold toxic effects, the Department must evaluate both recommendations and develop an ambient water quality criterion that will provide the highest level of protection. The Department determined that use of the oral slope factor results in the most protective value when calculating an ambient water quality criterion for 1,4-dioxane. Thus, the Department used USEPA's oral slope factor to calculate an ambient water quality criterion for 1,4-dioxane in accordance with its Water Quality Toxics Management Strategy – Statement of Policy. The Department uses a 1×10^{-6} cancer risk level as specified in § 93.8a(d) (relating to water quality criteria for toxic substances). Expressing this another way, the probability of an

individual getting cancer from ambient water exposure to a carcinogen is increased by a factor of one in one million.

Calculation of the Risk-Specific Dose (RSD)

RSD = (Target Incremental Cancer Risk)/m

Where:

RSD = Risk-specific dose (mg/kg-day)
Target = 1×10^{-6} (in accordance with Department policy)
Incremental
Cancer Risk
m = cancer potency factor or oral slope factor $(mg/kg\text{-}day)^{-1}$

Calculation of Risk-Specific Dose for 1,4-Dioxane

$RSD_{1,4\text{-dioxane}} = (1 \times 10^{-6})/0.1$ mg/kg-day
= 0.00001 mg/kg-day

In accordance with the USEPA *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (USEPA 2000) using the Department's updated exposure input values (body weight, drinking water intake, and fish consumption) and Chapter 93 guidelines, the Department derived the following human health criterion for 1,4-dioxane. Based upon USEPA's review, 1,4-dioxane is not expected to bioaccumulate in freshwater fish or mussels. USEPA modelling has suggested that a bioaccumulation factor of 0.9 for 1,4-dioxane is appropriate. Thus, a bioaccumulation factor of 1 has been used in this calculation. The following equation is used for the calculation of ambient water quality criteria for carcinogens where an RSD is obtained from a linear approach:

Calculation of an Ambient Water Quality Criterion for 1,4-dioxane

$AWQC_{1,4\text{-dioxane}} = RSD \times (BW \div [DWI + (FI \times BAF)])$

Where:

RSD = 0.00001 mg/kg-day
Body Weight (BW) = 80 kg
Drinking Water Intake (DWI) = 2.4 L
Fish Intake (FI) = 0.022 kg/day
Bioaccumulation factor (BAF) = 1

$AWQC_{1,4\text{-dioxane}} = 0.00001 \times (80 \div [2.4 + (0.022\ kg/day \times 1)])$
$AWQC_{1,4\text{-dioxane}}$ **= 0.0003 mg/L (0.3 µg /L)**

Conclusion

In accordance with the Commonwealth's regulations and polices, the Department has calculated an ambient water quality criterion for 1,4-dioxane of 0.3 µg/L to protect human health from non-threshold level toxic effects (i.e., cancer). This water quality criterion shall be achieved in all surface waters at least 99% of the time as specified in 25 Pa. Code §96.3(c). Water quality based effluent limits (WQBELs) for 1,4-dioxane will be developed using the design flow conditions for non-threshold (cancer) human health criteria contained in 25 Pa. Code §96.4, Table 1.

Literature Cited

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological profile for dioxane. Division of Toxicology and Environmental Medicine/Applied Toxicology Branch. Atlanta, Georgia.

National Water Quality Monitoring Council. 2022. Water Quality Portal. Accessed 3 May 2022 at https://www.waterqualitydata.us

USEPA. 2000. Methodology for deriving ambient water quality criteria for the protection of human health. EPA 882-B-00-004. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, DC.

USEPA. 2012. 2012 edition of the drinking water standards and health advisories. EPA-822-S-12-001. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

USEPA. 2013. Integrated risk information system (IRIS) chemical assessment summary for 1,4 - Dioxane (CASRN 123-91-1). U.S. EPA Office of Research and Development, National Center for Environmental Assessment, Integrated Risk Information System Program. Washington, D.C. Accessed February 2021.

USEPA. 2017a. The third unregulated contaminant monitoring rule (UCMR3): data summary, January 2017. EPA-815-S-17-001. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

USEPA. 2017b. Technical fact sheet – 1,4-dioxane. EPA-505-F-17-011. U.S. Environmental Protection Agency, Office of Land and Emergency Management. Washington, D.C.

USEPA. 2020. Final risk evaluation for 1,4-Dioxane. EPA-740-R1-8007. U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention. Washington, D.C.

World Health Organization (WHO). 2008. Guidelines for drinking-water quality: third edition incorporating the first and second addenda, volume 1. Geneva, Switzerland. WHO Press.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

RATIONALE FOR THE DEVELOPMENT OF AMBIENT WATER QUALITY CRITERIA FOR PROTECTION OF AQUATIC LIFE USE

Cadmium

May 2022

Executive Summary

Section 303 of the federal Clean Water Act (CWA) requires states to periodically, but at least once every three years, review and revise as necessary their water quality standards. The federal water quality standards regulation at 40 CFR 131.11(b)(1) requires states to adopt numeric water quality criteria that are based on section 304(a) criteria recommendations developed by the United States Environmental Protection Agency (USEPA), section 304(a) criteria recommendations modified to reflect site-specific conditions, or other scientifically-defensible methods. Additionally, the CWA directs states to adopt criteria for toxic pollutants "the presence of which in the affected waters could reasonably be expected to interfere with a state's designated uses." 33 U.S.C. § 303(c)(2)(B).

USEPA published nationally recommended ambient water quality criteria for cadmium to protect aquatic life in March 2016 (USEPA 2016). USEPA's 2016 recommendation for cadmium replaces its recommended water quality criteria published in 2001. Pennsylvania's water quality standards currently include water quality criteria for protection of aquatic life that are based on USEPA's 2001 recommendations. The 2016 USEPA recommendation for cadmium was developed through its authority under section 304(a) of the CWA. Under the CWA, states and authorized tribes must adopt water quality criteria into their water quality standards to protect designated uses.

The Pennsylvania Department of Environmental Protection (Department) has reviewed USEPA's 2016 cadmium aquatic life criteria recommendations and has determined that they will provide an appropriate level of aquatic life protection to surface waters of this Commonwealth. Therefore, the Department is recommending the Environmental Quality Board (Board) adopt an equation-based criterion maximum concentration (CMC) of {1.136672 – [(ln[H]) x (0.041838)]} x Exp(0.9789 x ln[H] - 3.866) to protect freshwater aquatic life criteria from acute exposures to cadmium and an equation-based criterion continuous concentration (CCC) of {1.101672 – [(ln[H]) x (0.041838)]} x Exp(0.7977 x ln[H] - 3.909) to protect freshwater aquatic life from chronic exposures to cadmium.

History of Regulation

In 1980, the Department established a toxics management strategy following USEPA's publication of water quality criteria for the protection of human health and aquatic life for 104 of 126 priority pollutants. The Department's toxics management strategy contained ambient water quality criteria for cadmium based on USEPA's 1980 freshwater aquatic life criteria recommendations, which were updated in 1984. While USEPA's equation-based criteria recommendations did not change between 1980 and 1984, the expression of cadmium changed from total recoverable to acid-soluble.

In 1989, the Department published its toxics management strategy as a statement of policy in the *Pennsylvania Bulletin* on March 11, 1989 (19 Pa.B. 1059). This publication established 25 Pa. Code Chapter 16 (relating to water quality toxics management strategy – statement of policy). The Department's strategy contained ambient water quality criteria for cadmium based on USEPA's 1984 freshwater aquatic life criteria recommendations. As part of its 6th triennial review of water quality standards in 2005, the Department evaluated USEPA's 2001 cadmium water quality criteria recommendations for the protection of freshwater aquatic life and determined they were appropriate for the protection of Pennsylvania's surface waters. At that time, water quality criteria for toxic substances were still located in Chapter 16 (Appendix A - Table 1). The Department published final amendments to Chapter 16, which included updated aquatic life water quality criteria for cadmium based on USEPA's 2001 recommendations, in the *Pennsylvania Bulletin* on February 12, 2005 (35 Pa. B. 1223). In 2008, the Department moved the statewide water quality criteria from Appendix A-Table 1 to the newly-created Table 5 in 25 Pa. Code Chapter 93 (relating to water quality standards).

Background

Cadmium is a relatively rare, naturally occurring metal found in mineral deposits that is widely distributed at low concentrations in the environment. Cadmium has two oxidation states. The metallic state is insoluble and rarely present in water. The divalent state typically occurs as one of several salts that freely dissolve in water. Divalent cadmium is the form most likely to be found in well-oxygenated freshwaters with low levels of organic carbon (USEPA 2016).

Pennsylvania is rich in mineral resources such as coal. The concentration of cadmium in coal is dependent upon the type of coal. Bituminous coal has a higher average concentration of cadmium than anthracite coal (USEPA 2016). Cadmium is primarily used in manufacturing batteries, pigments, plastic stabilizers, metal coatings, alloys and electronics, but it is also found as an impurity in zinc, lead and copper ore mine wastes; fossil fuels; iron and steel; cement; and fertilizers. In addition, it is often present as a natural or introduced constituent in inorganic phosphate fertilizers. Currently, over 80%

of the cadmium consumed globally is used for nickel-cadmium batteries and the demand for cadmium has increased to support this market (USEPA 2016).

Cadmium enters the environment through both anthropogenic and natural pathways. The anthropogenic sources and pathways include mining, agriculture, urban activities, industrial waste, manufacturing, coal ash, use of fossil fuels, incineration, and municipal effluent. The natural sources and pathways include weathering and erosion of rocks and soils and natural combustion from volcanoes and forest fires. Anthropogenic sources account for more than 90% of the total cadmium present in surface waters (USEPA 2016).

Cadmium readily and strongly adsorbs to clays, muds, some hydrous oxides, humic materials and organic matter. This property greatly reduces cadmium bioavailability and results in its removal from the water column. It is estimated that up to 93% of cadmium entering surface waters will be removed from the water column through adsorption to sediments. Thus, the concentration of cadmium in unpolluted freshwaters is usually very low and often non-detectable. However, it should be noted that the solubility of cadmium compounds in water depends upon both the specific compound and on abiotic factors including pH, alkalinity, hardness and organic matter. USEPA's 2016 criteria recommendations for cadmium are hardness-based equations. Hardness is a measure of the dissolved minerals (mainly calcium and magnesium) in surface water. Increased hardness has been shown to ameliorate the toxic effects of cadmium in freshwater animals (USEPA 2016).

The Department reviewed water quality sample data for cadmium in the national Water Quality Portal. The Water Quality Portal is a cooperative service provided by the United States Geological Survey (USGS), USEPA and the National Water Quality Monitoring Council (NWQMC). A search of the database generated approximately 23,800 sample results for cadmium in Pennsylvania surface waters that were collected between 1967 and 2021 by USGS, the National Park Service and the Department. Approximately 5,700 of the 23,800 samples were collected during the past ten years (2012-2022). Most samples were analyzed for dissolved cadmium, but a small number of samples were analyzed for total recoverable. Over 99% of the samples had non-detectable levels of cadmium. Of the 0.7% of samples that had detectable amounts, the results ranged from 0.006 ug/L to 1.9 ug/L.

A search of National Pollutant Discharge Elimination System (NPDES) permits issued under the Department's Clean Water Program generated 169 permits with discharge effluent limitations or monitor and report requirements for cadmium. Cadmium effluent limitations in these NPDES permits may be affected by the Department's updated water quality criteria for cadmium upon renewal of the permit.

Cadmium and Aquatic Life Toxicity

Cadmium is a non-essential metal that has no biological function in animals, and it is acutely toxic to aquatic animals. Cadmium is a known teratogen, carcinogen and a probable mutagen. It is known to induce various short- and long-term adverse physiological effects in fish including effects on growth, reproduction, immune and endocrine function, development and behavior. Other toxic effects include histopathological effects of the gill, liver, and kidney in fish, renal tubular damage, alterations of free radical production and the antioxidant defense system, immunosuppression, and structural effects on invertebrate gills (USEPA 2016).

The free ionic form of cadmium is the suspected cause of acute and chronic toxicity in aquatic organisms. Exposure to free cadmium ions disrupts calcium homeostasis and causes oxidative damage. In freshwater fish, cadmium competes with calcium at high affinity binding sites in the gill membrane and blocks the uptake of calcium ions which results in acute hypocalcemia. Cadmium also disrupts sodium balance and enzymatic function within the cell (USEPA 2016).

As previous discussed in the background section, the toxicity of cadmium is dependent upon other water quality parameters such as hardness, pH, salinity, alkalinity, some metals and organic carbon.

Acute toxicity tests generally determine the amount of a substance it takes to kill 50% of the test organisms, but tests may also include determination of the amount of substance it takes to negatively affect or inhibit an organism. These values are often referred to as a lethal concentration (LC50), an effective concentration (EC50), or an inhibitory concentration (IC50). Depending upon the organism, acute toxicity tests are most often conducted over a 48- or 96-hour period. During USEPA's review of cadmium, acceptable toxicity test data were available for 101 freshwater species representing 75 genera, which represents a significant increase in data available since 2001. USEPA's 2016 freshwater acute criterion recommendation incorporates data for 36 new species and 20 new genera. The four most sensitive genus mean acute values (GMAVs) included the following: (1) trout (*Salvelinus confluentus* and *Salvelinus fontinalis*); (2) sculpin (*Cottus bairdii* and *Cottus confusus*); (3) Brown Trout (*Salmo trutta*); and (4) Striped Bass (*Morone saxatilis*).

Chronic toxicity tests measure longer-term effects associated with exposures to lower concentrations of a pollutant over an extended period of time. Chronic toxicity tests measure lethal and sublethal effects, which include growth, development, behavior, and reproduction. The typical endpoint for chronic exposure is the EC20, which is the concentration that it takes to affect 20% of the test organisms, but endpoints may include a no-observed-effect-concentration (NOEC) or a lowest-observed-effect-concentration (LOEC). Cadmium has been shown to negatively affect the survival, growth and/or reproduction of 20 genera of aquatic animals, including 11 species of invertebrates and 16 species of fish. The four most sensitive genus mean chronic

values (GMCVs) included the following: (1) amphipod (*Hyalella azteca*), (2) cladocerans (*Ceriodaphnia dubia* and *Ceriodaphnia reticulata*), (3) Mottled Sculpin (*Cottus bairdii),* and (4) midge (*Chironomus dilutus*).

Data on bioaccumulation of cadmium in freshwater aquatic organisms was available from approximately 30 different peer-reviewed publications for 29 species including aquatic plants, invertebrates, frogs and fish. The available data indicate that bioaccumulation of cadmium is low-to-moderate in freshwater organisms with values ranging from 3 to 65,600.

Guidelines for Cadmium

Current USEPA 304(a) Water Quality Criteria Recommendations for Cadmium

The current federal recommendations are designed to protect aquatic life from the acute and chronic effects of cadmium (USEPA 2016). The following equations give the magnitude for the CMC, or acute criterion, and the CCC, or chronic criterion, where H represents hardness.

$$CMC = \{1.136672 - [(\ln[H]) \times (0.041838)]\} \times \text{Exp}(0.9789 \times \ln[H] - 3.866)$$

$$CCC = \{1.101672 - [(\ln[H]) \times (0.041838)]\} \times \text{Exp}(0.7977 \times \ln[H] - 3.909)$$

The average duration periods for the CMC[1] and the CCC are one-hour and four-days, respectively. USEPA typically recommends average durations of one hour for the CMC and four days for the CCC for aquatic life criteria based on standard laboratory toxicity tests. These recommendations can be found in USEPA's Water Quality Standards Handbook (USEPA 2017). The current 304(a) cadmium criteria recommendations also state that the criterion magnitudes for cadmium are not to be exceeded at a frequency of more than once every three years on average.

Complete details regarding the specific derivation for both the acute and chronic components of the cadmium aquatic life criteria are described in USEPA's 2016 recommendation for cadmium (USEPA 2016).

The criteria recommendations were derived using the peer-reviewed procedures defined in USEPA's *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (the 1985 guidelines, Stephan et al. 1985). Therefore, comprehension of these guidelines will be necessary to understand the process used by USEPA to derive this aquatic life criterion recommendation. When these guidelines are followed, ambient water quality criteria are designed to be protective of the aquatic organisms and aquatic life uses specified by states in their water quality standards regulations.

[1] The duration of the 2016 criteria was changed from 1-day to 1-hour to reflect the 1985 guidelines-based recommended acute duration.

The 1985 guidelines require that a minimum of eight phylogenetically different families are represented in the toxicity data set that is used to derive criteria values for aquatic life and describe which eight phylogenetically different families are required to be in the dataset. The CMC was developed by first assembling available acute test data and it was determined that the minimum data requirements prescribed in the 1985 guidelines were met.

During USEPA's review of cadmium, acceptable toxicity test data were available for 101 freshwater species representing 75 genera (see Table A-1 in the Appendix). Although the freshwater acute dataset met the minimum data requirements in the guidelines, USEPA derived the CMC to be protective of the commercially and recreationally important Rainbow Trout (*Oncorhynchus mykiss*) as is consistent with procedures described in the 1985 guidelines. By accounting for the commercial and recreational importance of the Rainbow Trout, the CMC value is lower. This lower value is protective of the other salmonid species for which toxicity data are available, including some Federally-listed threatened and endangered species. Rainbow Trout are present in Pennsylvania surface waters.

The acceptable data for the chronic calculation included 27 species representing 20 genera, compared to 21 species and 16 genera in the 2001 criteria (see Table A2 in the Appendix).

USEPA also updated the acute and chronic hardness slopes with data for several new species. The 2016 updated acute cadmium hardness slope incorporates data for 13 species, where eight species were used in the 2001 criteria. The 2016 updated chronic slope incorporates data for four species, where two species were used in the 2001. The new chronic slope uses EC20 estimates for three of the four species, instead of only Maximum Acceptable Toxicant Concentrations (MATCs), as used for the 2001 chronic slope. USEPA explains the MATCs were used only for *Daphnia magna* in the 2016 slope in order to retain the invertebrate species.

Table 1 comes from USEPA's *2016 Ambient Aquatic Life Water Quality Criteria for Cadmium* (USEPA 2016). It provides a comparison between the freshwater CMC and CCC values calculated based on USEPA's 2016 recommendations (USEPA 2016) and the 2001 recommendations (USEPA 2001). The columns labeled "2016 criteria" contain the magnitude values that were calculated based on the equations given above for varying hardness concentrations. The columns labeled "2001 criteria" contain the magnitude values that were calculated based on the equations in USEPA's 2001 recommendations (USEPA 2001). The magnitude values for 2016 supersede the 2001 values.

Table 1. Freshwater CMC and CCC at Various Water Hardness.

Hardness (mg/L as CaCO3)	CMC (µg/L Cd dissolved)		CCC (µg/L Cd dissolved)	
	2001 Criteria (superseded)	2016 Criteria	2001 Criteria (superseded)	2016 Criteria
25	0.52	0.49	0.09	0.25
50	1.0	0.94	0.15	0.43
75	1.5	1.4	0.20	0.58
100	2.0	1.8	0.25	0.72
150	3.0	2.6	0.33	1.0
200	3.9	3.4	0.40	1.2
250	4.9	4.2	0.46	1.4
300	5.9	5.0	0.53	1.6
350	6.8	5.8	0.59	1.8
400	7.7	6.5	0.64	2.0

Calculated CMC values at all hardness concentrations based on the 2016 recommendation are all slightly lower or more stringent than the CMC values based on the previous recommendation published in 2001. Alternately, the calculated CCC values are all slightly less stringent as the calculated magnitudes have all increased. These minor differences can be attributed mainly to the inclusion of new toxicity studies in the derivation of the most recent national recommendation (Table 1).

USEPA 304(a) national criteria recommendations developed using the 1985 guidelines are based on the premise that toxicological data for the species used to derive the national criteria recommendations are representative of the sensitivities of appropriate untested species (USEPA 2013). Based on this premise, the national criteria recommendations are designed to protect the various freshwater and saltwater aquatic communities found across the United States.

Development of Cadmium Water Quality Criteria

The Department evaluated USEPA's 304(a) recommendations for acute and chronic freshwater cadmium criteria to determine if the recommendations are appropriate for this Commonwealth. The Department's evaluation included consideration of the toxicological studies and the aquatic organisms used in these studies along with the methodology used to derive the national recommendation (i.e. the guidelines). These 304(a) criteria recommendations are consistent with the Department's regulations and policies for developing aquatic life criteria found at §§ 93.8a, 93.8c, 16.21 – 16.24.

The following equations give the magnitude for the CMC, or acute criterion, and the CCC, or chronic criterion, where H represents hardness.

$$CMC = \{1.136672 - [(\ln[H]) \times (0.041838)]\} \times Exp(0.9789 \times \ln[H] - 3.866)$$

$$CCC = \{1.101672 - [(\ln[H]) \times (0.041838)]\} \times Exp(0.7977 \times \ln[H] - 3.909)$$

Table 2 provides a comparison between the freshwater CMC and CCC values calculated based on the Department's current 2022 recommendations and its previous recommendations which were published as final-form rulemaking in 2005.

Table 2. Freshwater CMC and CCC at Various Water Hardness.

Hardness (mg/L as CaCO3)	CMC (µg/L Cd dissolved)		CCC (µg/L Cd dissolved)	
	2005 Criteria (superseded)	2022 Criteria	2005 Criteria (superseded)	2022 Criteria
25	0.52	0.49	0.09	0.25
50	1.0	0.94	0.15	0.43
75	1.5	1.4	0.20	0.58
100	2.0	1.8	0.25	0.72
150	3.0	2.6	0.33	1.0
200	3.9	3.4	0.40	1.2
250	4.9	4.2	0.46	1.4
300	5.9	5.0	0.53	1.6
350	6.8	5.8	0.59	1.8
400	7.7	6.5	0.64	2.0

Conclusion

The Department recommends the Board adopt USEPA's 304(a) ambient water quality criteria recommendations for cadmium as described in this rationale document. Statewide application of these nationally-recommended water quality criteria will provide an appropriate level of protection for freshwater aquatic organisms from the toxic effects of cadmium.

Literature Cited

National Water Quality Monitoring Council. 2022. Water quality portal. Accessed 11 May 2022 at https://www.waterqualitydata.us.

Stephan, C. E., D. I. Mount, D. J. Hansen, J. H. Gentile, G. A. Chapman and W. A. Brungs. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. National Technical Information Service No. PB85-227049. Springfield, VA.

USEPA. 2001. 2001 Update of ambient water quality criteria for cadmium. EPA-822-R-01-001. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

USEPA. 2013. Technical support document for conducting and reviewing freshwater mussel occurrence surveys for the development of site-specific water quality criteria for ammonia. EPA-800-R-13-003. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

USEPA. 2016. Aquatic life ambient water quality criteria cadmium. EPA-820-R-16-002. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

USEPA. 2017. Water quality standards handbook; chapter 3: water quality criteria. EPA-823-B-17-001. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

Appendix A

Table A-1. This table was taken from USEPA 2016 and shows the freshwater GMAVs comparing species lists used in the 2001 and 2016 national recommendations for aquatic life for cadmium. All data are adjusted to a hardness of 100 mg/L as CaCO3. The values in bold are either new or revised for the 2016 recommendation.

2016 GMAV[a] (µg/L)	2001 GMAV (µg/L)	Species	2001 SMAV (µg/L)	2016 SMAV (µg/L)	Comment
49,052	195,967	Midge, *Chironomus plumosus*	-	**15,798**	New species added to GMAV calculation
-	-	Midge, *Chironomus riparius*	195,967	**>152,301**	Revised the effect concentration from Williams et al. 1985
30,781	8,573	Common carp, *Cyprinus carpio*	8,573	**30,781**	New data for existing species
26,837	21,569	Nile tilapia, *Oreochromis niloticus*	-	**66,720**	New species added to GMAV calculation
-	-	Mozambique tilapia, *Oreochromis mossambica*	21,569	**10,795**	New data for existing species
26,607	28,454	Planarian, *Dendrocoelum lacteum*	28,454	**26,607**	Acute value edited from re-review of Ham et al. 1995
22,138	-	Mayfly, *Rhithrogena hageni*	-	**22,138**	New genus
>20,132	-	Little green stonefly, *Sweltsa sp.*	-	**>20,132**	New genus
12,100	13,146	Mosquitofish, *Gambusia affinis*	13,146	12,100	-
11,627	4,754	Oligochaete, *Branchiura sowerbyi*	4,754	**11,627**	New data for existing species
11,171	12,479	Oligochaete, *Rhyacodrilus montana*	12,479	11,171	-
11,045	11,002	Threespine stickleback, *Gasterosteus aculeatus*	11,002	11,045	-
9,917	10,225	Channel catfish, *Ictalurus punctatus*	10,225	9,917	-
9,752	10,894	Oligochaete, *Stylodrilus heringianus*	10,894	9,752	-
7,798	-	Mayfly, *Hexagenia rigida*	-	**7,798**	New genus
7,752	8,551	Green sunfish, *Lepomis cyanellus*	5,997	6,276	-
-	-	Bluegill, *Lepomis macrochirus*	12,194	9,574	-

2016 GMAV[a] (µg/L)	2001 GMAV (µg/L)	Species	2001 SMAV (µg/L)	2016 SMAV (µg/L)	Comment
7,716	7,762	Red shiner, *Cyprinella lutrensis*	7,762	7,716	-
7,037	7,861	Oligochaete, *Spirosperma ferox*	6,933	6,206	-
-	-	Oligochaete, *Spirosperma nikolskyi*	8,913	7,979	-
6,808	-	Yellow perch, *Perca flavescens*	-	**6,808**	New genus
6,738	7,527	Earthworm, *Varichaetadrilus pacificus*	7,527	6,738	(formerly, *Varichaeta pacifica*)
5,947	6,344	White sucker, *Catostomus commersonii*	6,344	5,947	-
5,674	6,338	Oligochaete, *Quistadrilus multisetosus*	6,338	5,674	-
5,583	5,759	Flagfish, *Jordanella floridae*	5,759	5,583	-
4,929	4,981	Guppy, *Poecilia reticulata*	4,981	4,929	-
4,467	4,607	Mayfly, *Empherella subvaria*	4,607	4,467	-
4,193	2,753	Tubificid worm, *Tubifex tubifex*	2,753	**4,193**	New data for existing species
3,350	3,439	Amphipod, *Crangonyx pseudogracilis*	3,439	3,350	-
3,121	-	Copepod, *Diaptomus forbesi*	-	**3,121**	New genus
2,967	-	Zebrafish, *Danio rerio*	-	**2,967**	New genus
2,231	3,093	African clawed frog, *Xenopus laevis*	3,093	**2,231**	New data for existing species
1,983	3,536	Crayfish, *Procambarus acutus*	-	**812.8**	New species added to GMAV calculation
-	-	Crayfish, *Procambarus alleni*	-	**6,592**	New species added to GMAV calculation
-	-	Red swamp crayfish, *Procambarus clarkii*	3,536	**1,455**	New data for existing species
1,656	1,707	Goldfish, *Carassius auratus*	1,707	1,656	-
>1,637	-	Caddisfly, *Arctopsyche sp.*	-	**>1,637**	New genus

2016 GMAV[a] (µg/L)	2001 GMAV (µg/L)	Species	2001 SMAV (µg/L)	2016 SMAV (µg/L)	Comment
1,593	1,568	Oligochaete, *Limnodrilus hoffmeisteri*	1,568	1,593	-
1,582	59.08	Fathead minnow, *Pimephales promelas*	59.08	**1,582**	Same studies but only used F,M tests to calculate GMAV
1,023	1,055	Northwestern salamander, *Ambystoma gracile*	1,055	1,023	-
983.8	955.0	Isopod, *Caecidotea bicrenata*	955.0	983.8	(formerly, *Asellus bicrenata*)
>808.4	-	Snail, *Gyraulus sp.*	-	**>808.4**	New genus
651.3	-	Lake whitefish, *Coregonus clupeaformis*	-	**651.3**	New genus
539.7	525.3	Bryozoa, *Plumatella emarginata*	525.3	539.7	-
501.7	500.1	Cladoceran, *Alona affinis*	500.1	501.7	-
453.0	451.6	Cyclopoid copepod, *Cyclops varicans*	451.6	453.0	-
427.9	-	Pond snail, *Lymnaea stagnalis*	-	**427.9**	New genus
410.4	-	Planarian, *Dugesia dorotocephala*	-	**410.4**	New genus
392.5	389.5	Leech, *Glossiphonia complanata*	389.5	392.5	-
350.4	-	Mayfly, *Baetis tricaudatus*	-	**350.4**	New genus
346.6	337.4	Bryozoa, *Pectinatella magnifica*	337.4	346.6	-
275.0	264.2	Worm, *Lumbriculus variegatus*	264.2	275.0	-
208.0	202.6	Snail, *Physa acuta*	-	**2,152[b]**	New species for existing genus, but ten- fold difference in SMAVs for the genus, only most sensitive SMAV used in GMAV calculation
-	-	Pouch snail, *Physa gyrina*	202.6	208.0	-
204.1	210.3	Snail, *Aplexa hypnorum*	210.3	204.1	-
154.3	159.2	Amphipod, *Gammarus pseudolimnaeus*	159.2	154.3	-
145.5	-	Worm, *Nais elinguis*	-	**145.5**	New genus

2016 GMAV[a] (µg/L)	2001 GMAV (µg/L)	Species	2001 SMAV (µg/L)	2016 SMAV (µg/L)	Comment
120.1	-	Hydra, *Hydra circumcincta*	-	**184.8**	New genus (formerly, *Hydra attenuata*)
-	-	Hydra *Hydra oligactis*	-	**154.8**	New genus
-	-	Green hydra, *Hydra viridissima*	-	**38.85**	New genus
-	-	Hydra, *Hydra vulgaris*	-	**187.1**	New genus
103.1	-	Cladoceran, *Diaphanosoma brachyurum*	-	**103.1**	New genus
99.54	97.98	Isopod, *Lirceus alabamae*	97.98	99.54	-
94.67	>23,632	Crayfish, *Orconectes immunis*	>23,281	>22,579[b]	Ten-fold difference in SMAVs for the genus, only most sensitive SMAV used in GMAV calculation
-	-	Crayfish, *Orconectes juvenilis*	-	**134.0**	New species added to GMAV calculation
-	-	Crayfish, *Orconectes placidus*	-	**66.89**	New species added to GMAV calculation
-	-	Crayfish, *Orconectes virilis*	23,988	22,800[b]	Ten-fold difference in SMAVs for the genus, only most sensitive SMAV used in GMAV calculation
86.51	87.16	Cladoceran, *Moina macrocopa*	87.16	86.51	-
80.38	78.32	Bonytail, *Gila elegans*	78.32	80.38	-
76.02	74.08	Razorback sucker, *Xyrauchen texanus*	74.08	76.02	-
74.28	72.29	Bryozoa, *Lophopodella carteri*	72.29	74.28	-
73.67	72.61	Cladoceran, *Ceriodaphnia dubia*	63.46	**64.03**	New data for existing species
-	-	Cladoceran, *Ceriodaphnia reticulata*	83.08	84.76	-
71.76	86.82	Mussel, *Utterbackia imbecillis*	86.82	**71.76**	New data for existing species
70.76	71.16	Southern rainbow mussel, *Villosa vibex*	71.16	70.76	-
68.51	-	Mussel, *Lasmigona subviridis*	-	**68.51**	New genus
67.90	68.38	Mussel, *Actinonaias pectorosa*	68.38	67.90	-

2016 GMAV[a] (µg/L)	2001 GMAV (µg/L)	Species	2001 SMAV (µg/L)	2016 SMAV (µg/L)	Comment
61.42	50.44	Cladoceran, *Daphnia ambigua*	-	**24.81**	New species added to GMAV calculation
-	-	Cladoceran, *Daphnia magna*	27.14	**40.62**	New data for existing species and Attar and Maly (1982) was not used to calculate SMAV, see Unused data (Appendix J)
-	-	Cladoceran, *Daphnia pulex*	93.77	**109.2**	New data for existing species
-	-	Cladoceran, *Daphnia similis*	-	**129.3**	New species added to GMAV calculation
57.71	61.10	Cladoceran, *Simocephalus serrulatus*	61.10	57.71	-
51.34	68.29	Neosho mucket, *Lampsilis rafinesqueana*	-	**44.67**	New species added to GMAV calculation
-	-	Fatmucket, *Lampsilis siliquoidea*	-	**35.73**	New species added to GMAV calculation
-	-	Southern fatmucket, *Lampsilis straminea claibornensis*	96.44	93.17	-
-	-	Yellow sandshell, *Lampsilis teres*	48.35	46.71	-
46.79	452.6	Colorado pikeminnow, *Ptychocheilus lucius*	45.59	46.79	Ten-fold difference in SMAVs for the genus, only most sensitive SMAV used in GMAV calculation
-		Northern pike minnow, *Ptychocheilus oregonensis*	4,493	4,265[b]	-
<33.78	*Acipens e r*	White sturgeon, *Acipenser transmontanus*	-	**<33.78**	New genus
23.00	-	Amphipod, *Hyalella azteca*	-	**23.00**	New genus
>15.72	-	Mountain whitefish, *Prosopium williamsoni*	-	**>15.72**	New genus
6.141	7.760	Cutthroat trout, *Oncorhynchus clarkii*	-	**5.401**	New species added to GMAV calculation
-	-	Coho salmon, *Oncorhynchus kisutch*	12.58	11.88	-
-	-	Rainbow trout, *Oncorhynchus mykiss*	4.265	**3.727**	New data for existing species
-	-	Chinook salmon, *Oncorhynchus tshawytscha*	8.708	**5.949**	No new data, but only the most sensitive life stage used for SMAV calculation
5.931	5.916	Striped bass, *Morone saxatilis*	5.916	5.931	-

2016 GMAV[a] (µg/L)	2001 GMAV (µg/L)	Species	2001 SMAV (µg/L)	2016 SMAV (µg/L)	Comment
5.642	3.263	Brown trout, *Salmo trutta*	3.263	**5.642**	New data for existing species
4.411	-	Mottled sculpin, *Cottus bairdii*	-	**4.418**	New genus
-	-	Shorthead sculpin, *Cottus confusus*	-	**4.404**	New genus
4.190	<3.971	Bull trout, *Salvelinus confluentus*	4.353	4.190	Ten-fold difference in SMAVs for the genus, only most sensitive SMAV used in GMAV calculation
-	-	Brook trout, *Salvelinus fontinalis*	<3.623	**3,055[b]**	Carroll et al. 1979 was not used to calculate SMAV, see Unused data (Appendix J)

[a] Ranked from most resistant to most sensitive based on Genus Mean Acute Value.

[b] There is a 10x difference in SMAVs for the genus, only most sensitive SMAV is used in the GMAV calculation.

[The following species were not included in the Ranked GMAV Table because hardness test conditions were not reported and therefore toxicity values could not be normalized: Leech, *Nephelopsis obscura*; Crayfish, *Orconectes limosus*; Prawn, *Macrobrachium rosenbergii*; Mayfly, *Drunella grandis grandis*; Stonefly, *Pteronarcella badia*; Midge, *Culicoides furens*; Grass carp, *Ctenopharyngodon idellus*.]

Table A-2. This table was taken from USEPA 2016 and shows the freshwater GMCVs comparing species lists used in the 2001 and 2016 national recommendations for aquatic life for cadmium. All data are adjusted to a hardness of 100 mg/L as CaCO3. The values in bold are either new or revised for the 2016 recommendation.

2016 GMCV[a] (µg/L)	2001 GMCV (µg/L)	Species	2001 SMCV (µg/L)	2016 SMCV (µg/L)	Comment
>38.66	>39.48	Blue tilapia, *Oreochromis aureus*	>39.48	>38.66[c]	(formerly, *Oreochromis aurea*)
36.70	34.66	Oligochaete, *Aeolosoma headleyi*	34.66	**36.70**	Different values used from Niederlehner et al. 1984 that was a more appropriate duration
16.43	29.05	Bluegill, Lepomis *macrochirus*	29.05	16.43	-
15.16	-	Oligochaete, *Lumbriculus variegatus*	-	**15.16**	New genus
14.22	13.58	Smallmouth bass, *Micropterus dolomieu*	13.58	14.22[c]	-
14.17	13.52	Northern pike, *Esox lucius*	13.52	14.17[c]	-
14.16	27.37	Fathead minnow, *Pimephales promelas*	27.37	14.16	-
13.66	13.04	White sucker, *Catostomus commersonii*	13.04	13.66[c]	-
11.29	-	Fatmucket, *Lampsilis siliquoidea*	-	**11.29**	New genus
9.887	-	Pond snail, *Lymnaea stagnalis*	-	**9.887**	New genus
8.723	8.886	Flagfish, *Jordanella floridae*	8.886	8.723	-
3.516	8.055	Snail, *Aplexa hypnorum*	8.055	3.516	-
3.360	10.52	Atlantic salmon, *Salmo salar*	13.24	2.389	-
-	-	Brown trout, *Salmo trutta*	8.360	**4.725**	New data for existing species, and more sensitive exposure scenario used
3.251	4.082	Rio Grande cutthroat trout, *Oncorhynchus clarkii virginalis*	-	**3.543**	New species added to GMCV calculation
-	-	Coho salmon, *Oncorhynchus kisutch*	7.127	**NA[b]**	See footnote

2016 GMCV[a] (µg/L)	2001 GMCV (µg/L)	Species	2001 SMCV (µg/L)	2016 SMCV (µg/L)	Comment
-	-	Rainbow trout, *Oncorhynchus mykiss*	2.186	**2.192**	New data for existing species
-	-	Chinook salmon, *Oncorhynchus tshawytscha*	4.366	4.426	-
2.356	7.726	Brook trout, *Salvelinus fontinalis*	4.416	2.356	-
-	-	Lake trout, *Salvelinus namaycush*	13.51	**NA[b]**	See footnote
2.024	<0.6340	Cladoceran, *Daphnia magna*	<0.6340	**0.9150**	New data for existing species
-	-	Cladoceran, *Daphnia pulex*	10.30[b]	**4.478**	New data for existing species
2.000	4.686	Midge, *Chironomus dilutus*	4.686	2.000	(formerly, *Chironomus tentans*)
1.470	-	Mottled sculpin, *Cottus bairdii*	-	**1.470**	New genus
1.293	45.40	Cladoceran, Ceriodaphnia dubia	45.40	**1.293**	New data for existing species
-	-	Cladoceran, Ceriodaphnia reticulata	-	**NA[b]**	See footnote
0.7453	0.4590	Amphipod, Hyalella azteca	0.4590	0.7453	-

[a] Ranked from most resistant to most sensitive based on Genus Mean Chronic Value.
[b] Not included in the GMCV calculation because normalized EC_{20} data are available for the genus.
[c] Calculated from the MATC and not EC_{20} but retained to avoid losing a GMCV.
[d] Not used in GMCV calculation because species values are too divergent to use the geometric mean for the genus value, therefore, the most sensitive value used.
[The following species were not included in the Ranked GMCV Table because hardness test conditions were not reported and therefore toxicity values could not be normalized: Mudsnail, *Potamopyrgus antipodarum*.]

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

RATIONALE FOR THE DEVELOPMENT OF AMBIENT WATER QUALITY CRITERIA FOR PROTECTION OF AQUATIC LIFE USE

Carbaryl

May 2022

Executive Summary

Section 303 of the federal Clean Water Act (CWA) requires states to periodically, but at least once every three years, review and revise as necessary their water quality standards. The federal water quality standards regulation at 40 CFR 131.11(b)(1) requires states to adopt numeric water quality criteria that are based on section 304(a) criteria recommendations developed by the United States Environmental Protection Agency (USEPA), section 304(a) criteria recommendations modified to reflect site-specific conditions, or other scientifically-defensible methods. Additionally, the CWA directs states to adopt criteria for toxic pollutants "the presence of which in the affected waters could reasonably be expected to interfere with a state's designated uses." 33 U.S.C. § 303(c)(2)(B).

USEPA published nationally recommended ambient water quality criteria for carbaryl to protect aquatic life in April 2012 (USEPA 2012). This USEPA recommendation was developed through its authority under section 304(a) of the CWA. Under the CWA, states and authorized tribes must adopt water quality criteria into their water quality standards to protect designated uses.

The Pennsylvania Department of Environmental Protection (Department) has reviewed USEPA's 2012 carbaryl aquatic life criteria recommendations and has determined that they will provide an appropriate level of aquatic life protection to surface waters of this Commonwealth. Therefore, the Department is recommending the Environmental Quality Board (Board) adopt a criteria maximum concentration (CMC) of 2.1 ug/L to protect aquatic life from acute exposures to carbaryl and a criterion continuous concentration (CCC) of 2.1 ug/L to protect aquatic life from chronic exposures to carbaryl.

Background

Carbaryl (1-naphthol-N-methylcarbamate; $C_{12}H_{22}NO_2$, CAS #63-25-2), also commonly known as Sevin®, is a broad-spectrum insecticide that is classified with other N-methyl

carbamate pesticides. In addition to being a board-spectrum insecticide, carbaryl is also registered for use as a mosquito adulticide, a molluscicide, in pet care products and to thin fruit in orchards to enhance fruit size and repeat bloom (USEPA 2012). It is available for use in the following formulations: baits; dusts; wettable powders; molasses, oil, and water suspensions; pellets; and granules.

Nationally, carbaryl ranked third among the most commonly used conventional pesticides in homes and gardens in 2009. Carbaryl usage was reported to range between 4 and 6 million pounds of active ingredient used annually in 2009. In 2012, carbaryl ranked fifth among the most commonly used conventional pesticides in homes and gardens. Carbaryl usage was reported to range between 2 and 4 million pounds (USEPA 2017b). Since carbaryl is moderately mobile in soils, it enters aquatic environments primarily through stormwater runoff from areas where it has been applied, including agricultural and urbanized areas.

Once in the aquatic environment, carbaryl typically degrades into other substances via hydrolysis or photolysis with the primary degradant being 1-naphthol. Hydrolysis is pH dependent and will occur more rapidly at higher pH. Photolysis occurs in waters that can be penetrated by sunlight and is generally limited to the upper water column of an aquatic system. Degradation of carbaryl and 1-naphthol by photolysis is rapid with half-lives of 1.8 days and less than an hour, respectively. It is important to note that 1-naphthol can result from a variety of natural and anthropogenic processes, so its presence does not indicate usage of carbaryl (USEPA 2012).

The Department reviewed water quality sample data for carbaryl in the national Water Quality Portal. The Water Quality Portal is a cooperative service provided by the United States Geological Survey (USGS), USEPA, and the National Water Quality Monitoring Council (NWQMC). A search of the database generated approximately 2100 sample results for carbaryl in Pennsylvania surface waters that were collected between 1973 and 2022 by USGS. Approximately 600 of the 2100 samples were collected during the past ten years (2012-2022). Most samples were analyzed for dissolved carbaryl, but a small number of samples were analyzed for total recoverable. Approximately 75% of the samples had non-detectable levels of carbaryl. Of the 25% of samples that had detectable amounts, the results ranged from 0.003 ug/L to 0.14 ug/L. If historical sample results are considered, there were three results above the proposed acute and chronic criteria recommendations. The highest values were 335 and 260 µg/L and both of these samples were collected in 1973. The third result was 2.41 ug/L, which only slightly higher than the proposed criteria of 2.1 ug/L. This sample was collected from the Little Neshaminy Creek at Valley Road in 2000.

Based on this analysis of available water quality data, the current levels of carbaryl found in Pennsylvania's surface waters are low when compared to USEPA's ambient water quality criteria recommendations for the protection of aquatic life. It is important to recognize there is potential for concentrations of carbaryl to become elevated if its use becomes more widespread and common. This potential increase in concentration could

be further exacerbated if some exotic pests become ubiquitous, as in the case of the spotted lanternfly (*Lycorma delicatula*). Carbaryl is an effective suppression agent against the spotted lanternfly, so as local populations of invasive spotted lanternfly surge, there would be an expected rise in the amount of carbaryl released into the environment (Penn State Extension 2021). A search of National Pollutant Discharge Elimination System (NPDES) permits issued under the Department's Clean Water Program generated zero permits with discharge effluent limitations or monitor and report requirements for carbaryl.

Aquatic Life Toxicity and Carbaryl

Carbamate insecticides inhibit acetylcholinesterase in animals, which leads to a buildup of the neurotransmitter acetylcholine within the nervous system. This accumulation of acetylcholine triggers the nerve pulses to continue firing throughout the nervous system leading to uncontrolled movement, paralysis, convulsions, tetany and possibly death. Without proper neurological function, respiratory, circulatory, and other bodily functions fail. Most acetylcholinesterase inhibition effects are reversible upon removal of the exposure (USEPA, 2012).

Increases in water temperature, pH and hardness can increase carbaryl toxicity in the aquatic environment. However, there is generally a lack of sufficient trend data to warrant the need to adjust the carbaryl water quality criteria for these parameters.

It is also important to consider whether the degradants of carbaryl, such as 1-naphthol, are inimical to aquatic life. The primary effect of 1-naphthol exposure is thought to be narcosis which is a reversible anesthetic effect. It is caused by chemicals partitioning into cell membranes and nervous tissue which results in disruption of cell functions including those in the central nervous system. Toxicity test results indicate that 1-naphthol is toxic to aquatic life with the most sensitive endpoint being larval growth and development of fathead minnows when chronic exposure exceeds 100 µg/L (USEPA 2012). With that in mind, the highest estimated sample result for 1-naphthol found in the Water Quality Portal for Pennsylvania surface waters was more than 2,000 times lower than the levels that seem to have any effect on aquatic life. The observed low levels of 1-napthol are likely because of its rapid degradation. USEPA indicated that the available aquatic life toxicity data for 1-naphthol is inconclusive and recommended additional studies involving fish and invertebrates to address uncertainties surrounding toxicity and effects from 1-naphthol (USEPA 2012).

Acute toxicity tests generally determine the amount of a substance it takes to kill 50% of the test organisms, but tests may also include determination of the amount of substance it takes to negatively affect or inhibit an organism. These values are often referred to as a lethal concentration (LC50), an effective concentration (EC50), or an inhibitory concentration (IC50). Depending upon the organism, acute toxicity tests are most often conducted over a 48- or 96-hour period. During USEPA's review of carbaryl, toxicity test data was available for 47 freshwater genera (60 species). The first, second, third, fourth,

and seventh most sensitive tested species were stoneflies with SMAVs ranging from 3.175 ug/L to 9.163 ug/L. The species included *Isogenus sp., Skwala sp., Pteronarcys californica, Claassenia sabulosa*, and *Pteronarcella badia.* Cladocerans (*Daphnia carinata* and *Ceriodaphnia dubia*) were the next most sensitive taxon followed by amphipods (*Gammarus pseudolimnaeus, Gammarus lacustris,* and *Hyalella azteca*). The ten most sensitive freshwater genera are in the classes Insecta and Crustacea, which is expected given that carbaryl is an insecticide (USEPA 2012).

Chronic toxicity tests measure longer-term effects associated with exposures to lower concentrations of a pollutant over an extended period of time. Chronic toxicity tests measure lethal and sublethal effects, which include growth, development, behavior and reproduction. The typical endpoint for chronic exposure is the EC20, which is the concentration that it takes to affect 20% of the test organisms, but endpoints may include a no-observed-effect-concentration (NOEC) or a lowest-observed-effect-concentration (LOEC). Carbaryl has been shown to negatively affect survival, growth and reproduction in Fathead Minnows (*Pimephales promelas).* Negative effects on reproduction were observed in a waterflea (*Daphnia magna)*, and negative effects on growth were observed in Colorado Pikeminnow (*Ptychochelius lucius*) and Bonytail Chub (*Gila elegans*).

No acceptable data on bioaccumulation of carbaryl in freshwater are available, but due to its low octanol/water partition coefficient, carbaryl is not expected to bioconcentrate to a significant extent (USEPA 2012).

Guidelines for Carbaryl

Current USEPA 304(a) Water Quality Criteria Recommendations for Carbaryl

The current federal recommendations are designed to protect aquatic life in freshwater from the acute and chronic effects of carbaryl (USEPA 2012). Table 1 below provides the final calculated values for the magnitude of both the CMC, or acute criterion and the CCC, or chronic criterion. Duration and frequency are also given in Table 1. USEPA typically recommends average durations of one hour for the CMC and four days for the CCC for aquatic life criteria based on standard laboratory toxicity tests. These recommendations can be found in USEPA's Water Quality Standards Handbook (USEPA 2017a).

Table 1. Summary of Freshwater Aquatic Life Criteria for Carbaryl.

	Magnitude	**Duration**	**Frequency**
Acute	2.1 µg/L	One-hour average	Once every 3 years on average
Chronic	2.1 µg/L	Four-day average	Once every 3 years on average

Complete details regarding the specific derivation for both the acute and chronic components of the carbaryl aquatic life criteria are described in USEPA's *2012 Ambient Aquatic Life Water Quality Criteria for Carbaryl* (USEPA 2012).

The criteria recommendations were derived using the peer-reviewed procedures defined in EPA's *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (the 1985 guidelines, Stephan et al. 1985). Therefore, comprehension of these guidelines will be necessary to understand the process used by the USEPA to derive this aquatic life criterion recommendation. Ambient water quality criteria derived using these guidelines will protect the aquatic organisms and aquatic life uses specified by states in their water quality standards regulations.

The 1985 guidelines require that a minimum of eight phylogenetically different families are represented in the toxicity data set that is used to derive criteria values for aquatic life and describe which eight phylogenetically different families are required to be in the dataset. The CMC was developed by first assembling available acute test data and it was determined that the minimum data requirements prescribed in the 1985 guidelines were met.

There were 47 genera (60 species) included in the dataset for the derivation of the nationally recommended acute freshwater criteria (see Appendix – Table A-1). The Species Mean Acute Values (SMAVs) were calculated by taking the geometric mean of the acute data for each species in the data set. Genus Mean Acute Values (GMAVs) are either (1) the calculated geometric mean for all of the SMAVs included in that genera; or (2) if there is only one SMAV in that genera, then the GMAV was set equal to the SMAV. The Final Acute Value (FAV) was derived through regression analysis on the four most sensitive GMAVs. The CMC was calculated by dividing the FAV by 2. The four most sensitive genera were within a factor of 1.8 of one another. The freshwater FAV (the 5th percentile of the species sensitivity distribution) for carbaryl is 4.219 ug/L. The CMC is derived by dividing the FAV by 2 and results in a recommendation of 2.1 ug/L.

Depending on the data that are available concerning chronic toxicity to aquatic animals, the final chronic value might be calculated in the same manner as the FAV or by dividing the final acute value by the final acute-chronic ratio (FACR). In some cases, it may not be possible to calculate a final chronic value. When sufficient chronic toxicity data is not available, acute-to-chronic ratios can be calculated using a minimum of three different aquatic life families provided that at least one species is a fish, one species is an invertebrate and one species is an acutely sensitive freshwater species. If this data is not available, a final chronic value cannot be calculated. There were 5 genera (5 species) in the chronic freshwater dataset for carbaryl (see Appendix; Table A-2). The minimum data requirements for eight phylogenetically different families as specified in the 1985 guidelines were not met, so the CCC calculation relied on the acute to chronic ratios (ACRs). There were 4 valid ACRs that were considered in this approach. The

difference between the lowest and highest ACR is a factor of 22, and the ACR increases as the SMAV increases. As such, the 1985 guidelines state that the final acute to chronic ratio (FACR) should be calculated from the geometric mean of the ACRs for species whose SMAVs are close to the FAV. Following this recommendation, the FACR would be the geometric mean of 1.094 (*C. dubia*) and 1.581 (*D. magna*), which is 1.315. The guidelines stipulate that if the most appropriate species mean ACRs are less than 2.0 then the FACR should be equal to 2.0. The CCC was given by dividing the FAV by the FACR of 2.0 and results in a recommendation of 2.1 ug/L.

USEPA 304(a) national criteria recommendations developed using the 1985 guidelines are based on the premise that toxicological data for the species used to derive the national criteria recommendations are representative of the sensitivities of other untested species (USEPA 2013). Based on this premise, the national criteria recommendations are designed to protect the various freshwater and saltwater aquatic communities found across the United States.

Development of Carbaryl Water Quality Criteria

The Department has evaluated USEPA's 304(a) acute and chronic freshwater criteria recommendations for carbaryl to determine if the recommendations are appropriate for this Commonwealth. The Department's evaluation included consideration of the toxicological studies and the aquatic organisms used in these studies along with the methodology used to derive the national recommendation (i.e., the 1985 guidelines). These 304(a) criteria recommendations are consistent with the Department's regulations and policies for developing aquatic life criteria found at §§ 93.8a, 93.8c, and 16.21—16.24.

Calculation of Ambient Water Quality Criteria for Carbaryl

Final Acute Value (FAV) = 4.219 µg/L

Criterion Maximum Concentration (CMC) = FAV ÷ 2

= (4.219 µg/L) ÷ 2

= 2.1095 µg/L

= 2.1 µg/L

Final Acute-Chronic Ratio (FACR) = 2.0

Final Chronic Value = FAV ÷ FACR

= (4.219 µg/L) ÷ 2.0

= 2.1095 µg/L

= 2.1 µg/L

Conclusion

The Department recommends the Board adopt USEPA's 304(a) ambient water quality criteria recommendations for carbaryl as described in this rationale document. Statewide application of these nationally-recommended water quality criteria will provide an appropriate level of protection for freshwater aquatic organisms from the toxic effects of carbaryl.

Literature Cited

National Water Quality Monitoring Council. 2022. Water quality portal. Accessed 10 May 2022 at https://www.waterqualitydata.us.

Penn State Extension. 2021. Spotted lanternfly management guide. (Available online at: https://extension.psu.edu/spotted-lanternfly-management-guide.)

Stephan, C. E., D. I. Mount, D. J. Hansen, J. H. Gentile, G. A. Chapman and W. A. Brungs. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. National Technical Information Service No. PB85-227049. Springfield, VA.

USEPA. 2012. Aquatic life ambient water quality criteria for carbaryl – 2012. EPA-820-R-12-007. National Technical Information Service, Springfield, VA.

USEPA. 2013. Technical support document for conducting and reviewing freshwater mussel occurrence surveys for the development of site-specific water quality criteria for ammonia. EPA-800-R-13-003. U.S. Environmental Protection Agency, Office of Water. Washington, D.C

USEPA. 2017a. Water quality standards handbook; chapter 3: water quality criteria. EPA-823-B-17-001. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

USEPA. 2017b. Pesticides industry sales and usage: 2008 - 2012 market estimates. Office of Pesticide Programs, Washington, D.C. 2017.

APPENDIX

Table A-1. This table was taken from USEPA 2012 and shows the freshwater GMAVs used in the derivation of the current national aquatic life recommendation for carbaryl. They are ranked from most resistant to most sensitive based on Genus Mean Acute Value.

Rank	Genus Mean Acute Value (µg/L)	Species	Species Mean Acute Value (µg/L)
47	27,609	Walking catfish, *Clarias batrachus*	27,609
46	>27,000	Snail, *Aplexa hypnorum*	>27,000
45	24,632	Mussel, *Anodonta imbecillis*	24,632
44	20,000	Black bullhead, *Ameiurus melas*	20,000
43	16,700	Goldfish, *Carassius auratus*	16,700
42	16,296	Green frog, *Rana clamitans*	16,296
41	12,400	Channel catfish, *Ictalurus punctatus*	12,400
40	12,310	Boreal toad, *Bufo boreas*	12,310
39	9,039	Green sunfish, *Lepomis cyanellus*	9,460
	-	Redear sunfish *L. microlophus*	11,200
	-	Bluegill, *L. macrochirus*	6,970
38	8,656	European chub, *Leuciscus cephalus*	8,656
37	8,200	Oligochaete worm, *Lumbriculus variegatus*	8,200
36	8,012	Fathead minnow, *Pimephales promelas*	8,012
35	6,400	Largemouth bass, *Micropterus salmoides*	6,400
34	4,350	Razorback sucker, *Xyrauchen texanus*	4,350
33	4,153	Common carp, *Cyprinus carpio*	4,153
32	>3,000	Gila topminnow, *Poeciliopsis occidentalis*	>3,000

Rank	Genus Mean Acute Value (µg/L)	Species	Species Mean Acute Value (µg/L)
31	2,930	Nile tilapia, *Oreochromis niloticus*	2,930
30	2,655	Bonytail chub, *Gila elegans*	2,655
29	2,600	Black crappie, *Pomoxis nigromaculatus*	2,600
28	2,515	Guppy, *Poecilia reticulate*	2,515
27	2,480	Yellow perch, *Perca flavescens*	2,480
26	2,470	Gray tree frog, *Hyla versicolor*	2,470
25	2,462	Crayfish, *Orconectes immunis*	2,870
	-	Crayfish, *O. virilis*	2,112
24	2,079	Greenthroat darter, *Etheostoma lepidum*	2,140
	-	Fountain darter, *E. fonticola*	2,020
23	2,005	Colorado pikeminnow (formerly squawfish), *Ptychochelius lucius*	2,005
22	1,810	Apache trout, *Oncorhynchus apache*	1,540
	-	Coho salmon, *O. kisutch*	1,654
	-	Chinook salmon, *O. tshawytscha*	2,690
	-	Cutthroat trout, *O. clarkii*	3,300
	-	Rainbow trout, *O. mykiss*	860
21	1,810	Shortnosed sturgeon, *Acipenser brevirostrum*	1,810
20	1,730	African clawed frog, *Xenopus laevis*	1,730
19	1,322	Striped bass, *Morone saxatilis*	1,322
18	1,269	Brook trout, *Salvelinus fontinalis*	1,629
	-	Lake trout, *S. namaycush*	988.1
17	1,000	Crayfish, *Procambarus clarkia*	1,000

Rank	Genus Mean Acute Value (µg/L)	Species	Species Mean Acute Value (µg/L)
16	889.0	Atlantic salmon, *Salmo salar*	1,129
	-	Brown trout, *S. trutta*	700
15	839.6	Crayfish, *Cambarus bartoni*	839.6
14	280	Aquatic sowbug, *Asellus brevicaudus*	280
13	250	Amphipod, *Pontoporeia hoyi*	250
12	230	Mysid, *Mysis relicta*	230
11	200	Backswimmer, *Notonecta undulate*	200
10	15.2	Amphipod, *Hyalella azteca*	15.2
9	13.78	Amphipod, *Gammarus lacustris*	18.76
	-	Amphipod, *G. pseudolimnaeus*	10.12
8	11.90	Cladoceran, *Daphnia carinata*	35
	-	Cladoceran, *D. magna*	7.521
	-	Cladoceran, *D. pulex*	6.4
7	9.163	Stonefly, *Pteronarcella badia*	9.163
6	8.781	Cladoceran, *Simocephalus serrulatus*	8.781
5	5.958	Cladoceran, *Ceriodaphnia dubia*	5.958
4	5.6	Stonefly, *Claassenia sabulosa*	5.6
3	4.8	Stonefly, *Pteronarcys californica*	4.8
2	3.6	Stonefly, *Skwala sp.*	3.6
1	3.175	Stonefly, *Isogenus sp.*	3.175

Table A-2. This table was taken from USEPA 2012 and shows the freshwater GMCVs used in the derivation of the current national aquatic life recommendation for carbaryl. They are ranked from most resistant to most sensitive based on Genus Mean Chronic Value.

Rank	Genus Mean Chronic Value (µg/L)	Species	Species Mean Chronic Value (µg/L)
5	897.8	Bonytail chub, *Gila elegans*	897.8
4	636.8	Fathead minnow, *Pimephales promelas*	636.8
3	620.8	Colorado pikeminnow (formerly squawfish), *Ptychochelius Lucius*	620.8
2	10.6	Cladoceran, *Ceriodaphnia dubia*	10.6
1	3.770	Cladoceran, *Daphnia magna*	3.770

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

RATIONALE FOR THE DEVELOPMENT OF AMBIENT WATER QUALITY CRITERIA FOR PROTECTION OF AQUATIC LIFE USE

Tributyltin

May 2022

Executive Summary

Section 303 of the federal Clean Water Act (CWA) requires states to periodically, but at least once every three years, review and revise as necessary their water quality standards. The federal water quality standards regulation at 40 CFR 131.11(b)(1) requires states to adopt numeric water quality criteria that are based on section 304(a) criteria recommendations developed by the United States Environmental Protection Agency (USEPA), section 304(a) criteria recommendations modified to reflect site-specific conditions, or other scientifically-defensible methods. Additionally, the CWA directs states to adopt criteria for toxic pollutants "the presence of which in the affected waters could reasonably be expected to interfere with a state's designated uses." 33 U.S.C. § 303(c)(2)(B).

USEPA published nationally recommended ambient water quality criteria for tributyltin (TBT) to protect aquatic life in December 2003 (USEPA 2003). This USEPA recommendation was developed through its authority under section 304(a) of the CWA. Under the CWA, states and authorized tribes must adopt water quality criteria into their water quality standards to protect designated uses.

The Pennsylvania Department of Environmental Protection (Department) has reviewed USEPA's 2003 TBT aquatic life criteria recommendations and has determined that they will provide an appropriate level of aquatic life protection to surface waters of this Commonwealth. Therefore, the Department is recommending the Environmental Quality Board (Board) adopt a criteria maximum concentration (CMC) of 0.46 ug/L to protect aquatic life from acute exposures to TBT and a criterion continuous concentration (CCC) of 0.072 ug/L to protect aquatic life from chronic exposures to TBT.

Background

TBT falls within a large class of chemicals described as organotins, which consist of one to four organic substituents plus a tin atom. TBT is formed when three butyl groups are attached to the tin molecule, and the formula is $(C_4H_9)_3Sn^+$. TBT derivatives include

dibutyltins and monobutyltins and tins with some methyltins detected when sulfate reducing conditions are present (USEPA 2003).

Organotins, such as TBT, are used extensively in the manufacturing of plastic products and less extensively as biocides and as preservatives for wood, textiles, paper, leather, and electrical equipment. They are used as an anti-yellowing agent in clear plastics and as a catalyst in poly vinyl chloride products. Organotins are used in anti-fouling paints applied to the wet bottom of ship hulls to deter the growth of barnacles and other fouling organisms. The most common organometallics used in these paints are TBT oxide and TBT methacrylate. The largest direct release of TBT into aquatic environments is most likely the result of these anti-fouling paints being used on ships, boats, nets, crab pots, docks and water cooling towers (USEPA 2003).

Currently, there is no available data to characterize TBT in discharges or surface waters of this Commonwealth. The Department reviewed water quality sample data for TBT in the national Water Quality Portal. The Water Quality Portal is a cooperative service provided by the United States Geological Survey (USGS), USEPA, and the National Water Quality Monitoring Council (NWQMC). A search of the database generated zero sample results for TBT in Pennsylvania surface water. A search of National Pollutant Discharge Elimination System (NPDES) permits issued under the Department's Clean Water Program generated zero permits with discharge effluent limitations or monitor and report requirements for TBT. Additional searches of permits and conversations with other Department programs identified no additional permits or discharges of TBT within this Commonwealth, including sites identified under the Hazardous Sites Cleanup Program.

Aquatic Life Toxicity and TBT

The toxicity of organotins is dependent upon the number of organic components that are bonded to the tin atom and the number of carbon atoms in each of the organic components. Toxicity to aquatic organisms generally increases as the number of organic components increases from one to three and decreases with the incorporation of a fourth, making triorganotins more toxic than other forms. Within the triorganotins, toxicity increases as the number of carbon atoms in the organic moiety increases from one to four, then decreases. Thus, the organotin most toxic to aquatic life is TBT (USEPA 2003).

Many acute and chronic toxic effects of TBT have been demonstrated both in the laboratory and the environment. TBT disrupts the normal flow of ions across cell membranes as it promotes chloride exchange across membranes.

Acute toxicity tests generally determine the amount of a substance it takes to kill 50% of the test organisms, but tests may also include determination of the amount of substance it takes to negatively affect or inhibit an organism. These values are often referred to as a lethal concentration (LC50), an effective concentration (EC50), or an inhibitory concentration (IC50). Depending upon the organism, acute toxicity tests are most often

conducted over a 48- or 96-hour period. During USEPA's review of TBT, toxicity test data were available for nine freshwater genera including hydras (*Gammarus pseudolimnaeus*), freshwater mussels *(Elliptio complanatus*), annelids (*Lumbriculus variegatus*), mosquito *(Culex* sp.), cladocerans *(Daphnia magna*), and several fish species including Fathead Minnow (*Pimephales promelas*), Rainbow Trout *(Oncorhynchus mykiss*), Juvenile Catfish *(Ictalurus punctatus*), and Bluegill (*Lepomis macrochirus*). Despite the molluscicidal properties of TBT, the freshwater hydras exhibited the most sensitivity to acute exposures. This discovery is likely at least partly explained by the fact that freshwater mussels can temporarily close themselves off from the environment to avoid exposures to surface waters when water quality is poor (USEPA 2003).

Chronic toxicity tests measure longer-term effects associated with exposures to lower concentrations of a pollutant over an extended period of time. Chronic toxicity tests measure lethal and sublethal effects, which include growth, development, behavior, and reproduction. The typical endpoint for chronic exposure is the EC20, which is the concentration that it takes to affect 20% of the test organisms, but endpoints may include a no-observed-effect-concentration (NOEC) or a lowest-observed-effect-concentration (LOEC). TBT has been shown to negatively affect survival, growth and reproduction in *D. magna* and *P. promelas*. It is also an endocrine disrupting chemical and can cause masculinization of certain female gastropods including one known freshwater species. This process, known as imposex, superimposes male sexual characteristics on female gastropods. Imposex has been associated with reduced reproductive potential and altered density and population structure. Plant species sensitivity was highly variable, but several green alga species appeared to be as sensitive as many of the animal species tested (USEPA 2003).

Bioaccumulation has been measured in at least one species of freshwater mussel, zebra mussel (*Dresissena polymorpha),* and four species of freshwater fish. Bioaccumulation factors (BAF), or bioconcentration factors (BCF), were calculated for Rainbow Trout (*Oncorhynchus mykiss*), Common Carp (*Cyprinus carpi*), guppy (*Poecilia reticulatus*), and goldfish (*Carassius auratus*). The BAF/BCFs ranged from 240 L/kg to 17,483 L/kg indicating the TBT's bioaccumulation potential is low to medium (USEPA 2003).

Guidelines for TBT

Current USEPA 304(a) Water Quality Criteria Recommendations for TBT

The current federal recommendations are designed to protect aquatic life in freshwater from the acute and chronic effects of TBT. Table 1 below provides the final calculated values for the magnitude of both the CMC, or acute criterion and the CCC, or chronic criterion. Duration and frequency are also given in Table 1. USEPA typically recommends average durations of one hour for the CMC and four days for the CCC for aquatic life criteria based on standard laboratory toxicity tests. These recommendations can be found in USEPA's *Water Quality Standards Handbook* (USEPA 2017).

Table 1. Summary of Freshwater Aquatic Life Criteria for TBT.

	Magnitude	Duration	Frequency
Acute	0.46 µg/L	One-hour average	Once every 3 years on average
Chronic	0.072 µg/L	Four-day average	Once every 3 years on average

Complete details regarding the specific derivation for both the acute and chronic components of the TBT aquatic life criteria are described in USEPA's *2003 Ambient Aquatic Life Water Quality Criteria for Tributyltin (TBT)* (USEPA 2003).

The criteria recommendations were derived using the peer-reviewed procedures defined in USEPA's *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (the 1985 guidelines, Stephan et al. 1985). Therefore, comprehension of these guidelines will be necessary to understand the process used by USEPA to derive this aquatic life criterion recommendation. Ambient water quality criteria derived using these guidelines will protect the aquatic organisms and aquatic life uses specified by states in their water quality standards regulations.

The 1985 guidelines require that a minimum of eight phylogenetically different families are represented in the toxicity data set that is used to derive criteria values for aquatic life and describe which eight phylogenetically different families are required to be in the dataset. The minimum data requirements were met for TBT such that a final acute criterion value could be calculated. Freshwater genus mean acute values (GMAVs) were available for 13 species representing 12 genera (see Appendix – Table A-1). As described in the previous section, the least sensitive organism to acute exposure was a freshwater clam, *E. complanatus,* which was more than 20,000 times less sensitive than the most sensitive organism. The final acute value (FAV) for freshwater aquatic organisms was calculated based on all twelve available GMAVs and is 0.9177 ug/L (*E. complanatus* is included in the FAV calculation for freshwater organisms). The CMC is derived by dividing the FAV by 2 and results in a recommendation of 0.4589 ug/L.

Depending on the data that are available concerning chronic toxicity to aquatic animals, the final chronic value might be calculated in the same manner as the FAV or by dividing the final acute value by the final acute-chronic ratio (FACR). In some cases, it may not be possible to calculate a final chronic value. For TBT, species mean chronic values (SMCV) were not available for eight families. When sufficient chronic toxicity data is not available, acute-to-chronic ratios can be calculated using a minimum of three different aquatic life families provided that at least one species is a fish, one species is an invertebrate and one species is an acutely sensitive freshwater species. If this data is not available, a final chronic value cannot be calculated. For TBT, chronic toxicity data was not available for eight families. However, sufficient data was available to

calculate an FACR (see Appendix – Table A-2). The FACR was calculated to be 12.69 and is equal to the geometric mean of the acute to chronic ratios for *Daphnia magna* (36.60), *Pimephales promelas* (10.01), *Acanthomysis sculpta* (4.664), and *Eurytemora affinis* (15.17). The CCC was derived by dividing the FAV by the FACR and results in a recommendation of 0.072 ug/L.

USEPA 304(a) national criteria recommendations developed using the 1985 guidelines are based on the premise that toxicological data for the species used to derive the national criteria recommendations are representative of the sensitivities of other untested species (USEPA 2013). Based on this premise, 304(a) criteria recommendations are designed to protect the various freshwater and saltwater aquatic communities found across the United States.

Development of TBT Water Quality Criteria

The Department has evaluated USEPA's 304(a) acute and chronic freshwater criteria recommendations for TBT to determine if the recommendations are appropriate for this Commonwealth. The Department's evaluation included consideration of the available toxicological data and the aquatic organisms used in these studies, the methodology used to derive the national recommendation (i.e., the 1985 guidelines), and the Department's policies and regulations found in 25 Pa. Code Chapters 93 and 16. The USEPA 304(a) criteria recommendations for TBT are consistent with the Department's regulations and policies for developing aquatic life criteria found at §§ 93.8a (relating to toxic substances), 93.8c (relating to human health and aquatic life criteria for toxic substances), and 16.21 – 16.24 (relating to guidelines for development of aquatic life criteria).

Calculation of Ambient Water Quality Criteria for TBT

Final Acute Value (FAV) = 0.9177 µg/L

Criterion Maximum Concentration (CMC) = FAV ÷ 2

= (0.9177 µg/L) ÷ 2

= 0.4589 µg/L

= 0.46 ug/L

Final Acute-Chronic Ratio (FACR) = 12.69

Final Chronic Value = FAV ÷ FACR

= (0.9177 µg/L) ÷ 12.69

= 0.0723 µg/L

= 0.072 ug/L

Conclusion

The Department recommends the Board adopt USEPA's 304(a) ambient water quality criteria recommendations for TBT as described in this rationale document. Statewide application of these nationally-recommended water quality criteria will provide an appropriate level of protection for freshwater aquatic organisms from the toxic effects of TBT.

Literature Cited

National Water Quality Monitoring Council. 2022. Water quality portal. Accessed 9 May 2022 at https://www.waterqualitydata.us.

Stephan, C. E., D. I. Mount, D. J. Hansen, J. H. Gentile, G. A. Chapman and W. A. Brungs. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. National Technical Information Service No. PB85-227049. Springfield, VA.

USEPA. 2003. Ambient aquatic life water quality criteria for tributyltin (TBT) - final. EPA-822-R-03-031. National Technical Information Service, Springfield, VA.

USEPA. 2013. Technical support document for conducting and reviewing freshwater mussel occurrence surveys for the development of site-specific water quality criteria for ammonia. EPA-800-R-13-003. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

USEPA. 2017. Water quality standards handbook; chapter 3: water quality criteria. EPA-823-B-17-001. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

Appendix A

Table A-1. This table was taken from USEPA 2003 and shows the ranked GMAVs that were used in the derivation of the nationally recommended freshwater aquatic life criteria for TBT.

Rank	Genus Mean Acute Value (µg/L)	Species	Species Mean Acute Value (µg/L)
12	24,600	Freshwater clam, *Elliptio camplanatus*	24,600
11	12.73	Lake trout, *Salvelinus naymaycush*	12.73
10	10.2	Mosquito, *Culex* sp.	10.2
9	8.3	Bluegill, *Lepomis macrochirus*	8.3
8	5.5	Channel catfish, *Ictalurus punctatus*	5.5
7	5.4	Annelid, *Lumbriculus variegatus*	5.4
6	4.571	Rainbow trout, *Oncorhynchus mykiss*	4.571
5	4.3	Cladoceran, *Daphnia magna*	4.3
4	3.7	Amphipod, *Gammarus pseudolimnaeus*	3.7
3	2.6	Fathead minnow, *Pimephales promelas*	2.6
2	1.80	Hydra, *Chlorohydra viridissmia*	1.80
1	1.170	Hydra, *Hydra littoralis*	1.201
		Hydra, *Hydra oligactis*	1.14

Table A-2. This table is taken from USEPA 2003 and it shows the acute to chronic ratios obtained in the derivation of the nationally recommended freshwater criteria for TBT.

Acute-Chronic Ratios

Species	Hardness (mg/L as $CaCO_3$)	Acute Value (µg/L)	Chronic Value (µg/L)	Ratio	Reference
Cladoceran, *Daphnia magna*	51.5	4.3	0.1414	30.41	Brooke et al. 1986
Cladoceran, *Daphnia magna*	160-174	11.2	0.2542	44.06	ABC Laboratories, Inc. 1990d
Fathead minnow, *Pimephales promelas*	51.5	2.6	0.2598	10.01	Brooke et al. 1986
Copepod, *Eurytemora affinis*	-	2.2	<0.088	>25.00	Hall et al. 1987;1988 a
Copepod, *Eurytemora affinis*	-	2.2	0.145	15.17	Hall et al. 1987;1988 a
Mysid, *Acanthomysis sculpta*	-	0.61[a]	0.1308	4.664	Davidson et al. 1986a,1986b
Snail, *Nucella lapillus*	34-35[b]	72.7	0.0143	5,084	Harding et al. 1996

[a] Reported by Valkirs et al. (1985).
[b] Salinity (g/kg).

CDL-1

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DEPARTMENT OF ENVIRONMENTAL PROTECTION
ENVIRONMENTAL QUALITY BOARD
(AGENCY)

DOCUMENT/FISCAL NOTE NO. 7-577

DATE OF ADOPTION July 11, 2023

BY Richard Negrin

TITLE RICHARD NEGRIN
CHAIRPERSON

EXECUTIVE OFFICER CHAIRPERSON OR SECRETARY

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BY

July 24, 2023
DATE OF APPROVAL

(Deputy General Counsel)
(Chief Counsel - Independent Agency)
(Strike inapplicable title)

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NOTICE OF PROPOSED RULEMAKING

DEPARTMENT OF ENVIRONMENTAL PROTECTION
ENVIRONMENTAL QUALITY BOARD

Triennial Review of Water Quality Standards

25 Pa. Code Chapter 93

PROPOSED RULEMAKING
ENVIRONMENTAL QUALITY BOARD
[25 PA. CODE CH. 93]

Triennial Review of Water Quality Standards

The Environmental Quality Board (Board) proposes to amend Chapter 93 (relating to water quality standards) to read as set forth in Annex A.

This proposed rulemaking was adopted by the Board at its meeting of July 11, 2023.

A. *Effective Date*

This proposed rulemaking will be effective upon final-form publication in the *Pennsylvania Bulletin*. Once approved by the United States Environmental Protection Agency (EPA), water quality standards are used to implement the Federal Clean Water Act (CWA) (33 U.S.C. §§ 1251—1388).

B. *Contact Persons*

For further information, contact Michael (Josh) Lookenbill, Bureau of Clean Water, 11th Floor, Rachel Carson State Office Building, P.O. Box 8774, 400 Market Street, Harrisburg, PA 17105-8774, (717) 787-9637; or Michelle Moses, Assistant Counsel, Bureau of Regulatory Counsel, 9th Floor, Rachel Carson State Office Building, P.O. Box 8464, Harrisburg, PA 17105-8464, (717) 787-7060. Persons with a disability may use the Pennsylvania Hamilton Relay Service at (800) 654-5984 (TDD users) or (800) 654-5988 (voice users). This proposed rulemaking is available on the Department of Environmental Protection (Department) web site at www.dep.pa.gov (select "Public Participation," then "Environmental Quality Board" and then navigate to the Board meeting of July 11, 2023).

C. *Statutory and Regulatory Authority*

This proposed rulemaking is authorized under sections 5(b)(1) and 402 of The Clean Streams Law (CSL) (35 P.S. §§ 691.5(b)(1) and 691.402), which authorize the Board to develop and adopt rules and regulations to implement the CSL (35 P.S. §§ 691.1—691.1001), and section 1920-A of The Administrative Code of 1929 (71 P.S. § 510-20), which grants to the Board the power and duty to formulate, adopt and promulgate rules and regulations for the proper performance of the work of the Department. In addition, sections 101(a)(2) and 303 of the CWA (33 U.S.C. §§ 1251(a)(2) and 1313) set forth requirements for water quality standards, which states must meet to implement the CWA in this Commonwealth.

D. *Background and Purpose*

Water quality standards are instream water quality goals that are implemented by imposing specific regulatory requirements and permit conditions (such as treatment requirements, effluent limits and best management practices (BMP)) on individual sources of pollution. They include

protected water uses, the specific numeric and narrative criteria necessary to achieve and maintain those water uses, and antidegradation requirements. Section 303(c)(1) of the CWA and the Federal regulations at 40 CFR 131.20 (relating to state review and revision of water quality standards) require states to periodically, but at least once every three years, review and revise as necessary their water quality standards. Under this Federal regulation, a state must provide an explanation to the EPA if the state does not adopt criteria that the EPA has published.

The surface waters of this Commonwealth are protected for a variety of water uses including: aquatic life; drinking water supplies for humans, livestock and wildlife; irrigation for crops, turf and other horticultural activities; industrial water supplies; fish consumption; recreation; and special protection. Water quality criteria are those elements of water quality standards representing the quality of water that support protected water uses and can be expressed as constituent concentrations or narrative statements. Water quality criteria represent the conditions sufficient for maintenance or attainment of the chemical, physical and biological integrity of water bodies and water uses. Since states must adopt scientifically defensible criteria that protect water uses, criteria recommendations are made independent of other considerations.

Water quality standards are an important element of the Commonwealth's water quality management program and have existed in this Commonwealth for over 75 years. The program began with the establishment of the Sanitary Water Board (SWB) in 1923. The SWB was abolished on January 19, 1971, and the responsibilities for developing and maintaining the water quality criteria and standards were transferred to the Department of Environmental Resources (DER). New or revised specific water quality criteria and standards were developed by DER for all surface waters in this Commonwealth, and formally adopted into Chapter 93 on September 10, 1971.

DER completed its first triennial review of the Commonwealth's water quality standards in 1979. Since the CWA requires that states periodically review and revise their water quality standards, DER completed additional revisions in 1985, 1989 and 1994. The Conservation and Natural Resources Act (71 P.S. §§ 1340.101—1340.1103), enacted in 1995, replaced DER with the Department of Conservation and Natural Resources and the Department of Environmental Protection (Department). The Department subsequently completed additional revisions to the Commonwealth's water quality standards in 2000, 2004, 2009, 2013 and 2020. This proposed rulemaking fulfills the Commonwealth's obligation to periodically review and revise its water quality standards and updates the water quality standards to ensure the surface waters of this Commonwealth are afforded the appropriate level of protection.

The EPA provided recommendations to the Department for this triennial review of water quality standards in a letter dated March 11, 2022. These recommendations included the following: consideration of all new or updated EPA criteria recommendations, developed by the EPA under section 304(a) of the CWA (33 U.S.C. § 1314), that have been published since May 30, 2000 and not yet adopted by the Commonwealth; clarification of the duration and frequency components of the Commonwealth's aquatic life criteria; consideration of the EPA's 2012 methodology for the development of secondary contact recreational water quality criteria; and the addition of a cross reference to the Department's compliance schedule provision in Chapter

92a (relating to National pollutant discharge elimination system permitting, monitoring and compliance).

On November 17, 2022, the Department met with the Water Resources Advisory Committee (WRAC) to discuss the proposed amendments to Chapter 93. WRAC voted to support presentation of this proposed rulemaking to the Board. In addition, on December 8, 2022, the Department provided to the Agricultural Advisory Board a regulatory review that included this triennial review of water quality standards.

E. *Summary of Regulatory Requirements*

The following is a detailed description of proposed amendments to Chapter 93.

§ 93.1. Definitions

The Board proposes to delete a reference to Appendix A, Table 1A from the definition of "toxic substance" in § 93.1 (relating to definitions). This table was removed from Chapter 16 (relating to water quality toxics management strategy—Statement of Policy) in the previous triennial review of water quality standards and the revised policy was published in the *Pennsylvania Bulletin* at 50 Pa.B. 3426 (July 11, 2020).

§ 93.7. Specific water quality criteria—Table 3

The Board proposes to add language to § 93.7(a) (relating to specific water quality criteria) that clarifies the duration period for the aquatic life use criteria found in Table 3. Unless otherwise specified in § 93.7, the duration period of the aquatic life criteria with minimum or maximum values, and of the pH criterion, is a one-hour average as defined in § 93.1. Aquatic life criteria consist of a magnitude, duration and frequency. In general, the EPA recommends a duration period of one-hour for acute criteria in accordance with the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (Stephan et al. 1985) and the EPA's *Technical Support Document for Water Quality-based Toxics Control* (EPA 1991).

§ 93.8c. Human health and aquatic life criteria for toxic substances

The Board proposes to add a new subsection (c) that clarifies the duration periods for the aquatic life criteria in Table 5. Unless otherwise specified in § 93.8c (relating to human health and aquatic life criteria for toxic substances), the aquatic life criteria duration periods for criteria maximum concentration (CMC) values and criteria continuous concentrations (CCC) values are a one-hour average and a four-day average, respectively, as defined in § 93.1. These criteria duration periods are part of the CWA section 304(a) criteria recommendations that were previously adopted by the Department and are otherwise consistent with the EPA's criteria duration recommendations as published in the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (Stephan et al. 1985) and the EPA's *Technical Support Document for Water Quality-based Toxics Control* (EPA 1991).

The Board proposes additions and amendments to the human health and aquatic life criteria in Table 5—Water Quality Criteria for Toxic Substances. These additions and amendments are proposed to reflect the latest scientific information and are consistent with the Department's Water Quality Toxics Management Strategy—Statement of Policy, § 16.22 (relating to criteria development) and § 16.32 (relating to threshold level toxic effects). Additionally, the proposed criteria are consistent with existing EPA policies outlined in the *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (EPA 2000) and the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (Stephan et al. 1985). The Board is proposing updated or new aquatic life and human health criteria for cadmium, carbaryl, tributyltin, acetone, barium, boron, chloroform, formaldehyde, methyl ethyl ketone, metolachlor, resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 1,4-dioxane, chlorophenoxy herbicide (known as 2,4-D), and xylene.

The Board also proposes to update the acronyms and footnotes to Table 5. These updates include the following: the replacement of the existing H and CRL column with a new "Notes" column; the replacement of the word "footnotes" with "notes" in "Acronyms and Footnotes to Table 5"; the replacement of the existing footnote symbols with numerals; the replacement of the existing H and CRL acronyms with numerals; and the addition of a numeral to clarify that several aquatic life criteria have duration periods that are instantaneous and 24-hour.

Summary of Table 5 proposed criteria

Cadmium is a relatively rare, naturally occurring metal found in mineral deposits that is widely distributed at low concentrations in the environment. Cadmium enters the environment through both anthropogenic and natural pathways including mining, agriculture, urban activities, industrial waste, manufacturing, coal ash, use of fossil fuels, incineration, municipal effluent, weathering and erosion of rocks and soils, and natural combustion from volcanoes and forest fires. The concentration of cadmium in unpolluted freshwaters is usually very low and often nondetectable, but solubility is dependent upon factors such as pH, hardness, alkalinity and organic matter. Increased hardness has been shown to ameliorate the toxic effects of cadmium in freshwater animals. Cadmium is a non-essential metal that has no biological function in animals, and it is acutely toxic to aquatic animals. Cadmium is a known teratogen, carcinogen and a probable mutagen. The EPA published updated section 304(a) aquatic life criteria recommendations for cadmium in 2016. The Department completed a comprehensive review of the EPA's 2016 recommendations as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Aquatic Life Use – Cadmium* (DEP 2022c) and determined they are appropriate for this Commonwealth. The Board's proposed acute and chronic cadmium criteria for the protection of aquatic life are equation-based and will be dependent upon instream hardness. These criteria are consistent with the EPA's current section 304(a) criteria recommendations.

Carbaryl is a broad-spectrum insecticide, commonly known as Sevin®. In addition to being a broad-spectrum insecticide, carbaryl is also registered for use as a mosquito adulticide, a molluscicide, in pet care products and to thin fruit in orchards to enhance fruit size and repeat bloom. Since carbaryl is moderately mobile in soils, it enters aquatic environments primarily

through stormwater runoff from areas where it has been applied, including agricultural and urbanized areas. Carbamate insecticides inhibit acetylcholinesterase in animals, which can lead to uncontrolled movement, paralysis, convulsions, tetany and possibly death. The EPA published section 304(a) aquatic life criteria recommendations for carbaryl in 2012. The Department completed a comprehensive review of the EPA's 2012 recommendations as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Aquatic Life Use – Carbaryl* (DEP 2022d) and determined they are appropriate for this Commonwealth. The Board's proposed criteria for the protection of aquatic life from carbaryl toxicity are 2.1 µg/L for acute toxicity and 2.1 µg/L for chronic toxicity. These criteria are consistent with the EPA's current section 304(a) criteria recommendations.

Tributyltin, also known as TBT, falls within a large class of chemicals described as organotins. Organotins, such as TBT, are used extensively in the manufacturing of plastic products and less extensively as biocides and as preservatives for wood, textiles, paper, leather and electrical equipment. The largest direct release of TBT into aquatic environments is most likely the result of anti-fouling paints being used on ships, boats, nets, crab pots, docks and water cooling towers. TBT is the most toxic organotin to aquatic life. TBT disrupts the normal flow of ions across cell membranes leading to cell death. It is also an endocrine-disrupting chemical that causes masculinization of certain female gastropods (for example, snails). The EPA published section 304(a) aquatic life criteria recommendations for TBT in 2004. The Department completed a comprehensive review of the EPA's 2004 recommendations as detailed in the Department's criteria rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Aquatic Life Use – Tributyltin* (DEP 2022e) and determined they are appropriate for this Commonwealth. The Board's proposed criteria for the protection of aquatic life from TBT toxicity is 0.46 µg/L for acute toxicity and 0.072 µg/L for chronic toxicity. These criteria are consistent with the EPA's current section 304(a) criteria recommendations.

Acetone is an organic solvent that has industrial, laboratory, medical and domestic applications. Human exposure to acetone may occur through inhalation, dermal absorption or ingestion of food and water. Acetone is generally produced by the human body in small quantities. However, individuals who choose a ketogenic diet or take ketone supplements may be at increased risk of exposure. Among the general public, cigarette smokers and individuals who frequently use acetone-based nail polish removers are also at increased risk. In addition, professional painters, salon workers, factory workers and commercial and household cleaning professionals are more likely to be exposed to acetone at higher concentrations. The Department is making updates to the existing acetone water quality criterion, which was previously approved by the EPA in 2000, based on new toxicity information and exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for acetone utilizing current toxicity information published in the EPA's Integrated Risk Information System (IRIS) database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a). Based on its low

potential for bioaccumulation, the human health criterion for acetone has been calculated with a total bioaccumulation factor of 1. The Board's proposed criterion is 6,000 µg/L.

Barium is a naturally occurring metal found in underground mineral deposits that has many important industrial uses and some medical uses. Human exposure to barium may occur through inhalation or ingestion of food and water. High amounts of barium can be found in some foods including Brazil nuts, seaweed, fish and certain plants. Individuals working in industries that make or use barium compounds have the greatest known risk of exposure to high concentrations. The Department is making updates to the existing barium water quality criterion, which was previously approved by the EPA in 2000, based on new toxicity information and exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for barium utilizing current toxicity information published in the EPA's IRIS database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a). Based on its low potential for bioaccumulation, the human health criterion for barium has been calculated with a total bioaccumulation factor of 1. The Board's proposed criterion is 1,000 µg/L.

Boron is a naturally occurring element found in the earth's crust. When boron combines with oxygen, it forms compounds called borates including boric acid, boron oxide and sodium tetraborates (that is, borax). Borates are used in the manufacture of industrial and consumer products including fire retardants, pesticides, glass, ceramics, soaps, bleaches and detergents. Human exposure to boron may occur through inhalation, dermal contact or ingestion of food and water. High amounts of boron can be found in some foods including nuts, dried fruits, avocado and peanuts. Individuals working in industries that make or use borate compounds have the greatest known risk of exposure to high concentrations. The Department is making updates to the existing boron water quality criterion, which was previously approved by the EPA in 2000, based on new toxicity information and exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for boron utilizing current toxicity information published in the EPA's IRIS database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a). Based on its low potential for bioaccumulation, the human health criterion for boron has been calculated with a total bioaccumulation factor of 1. The Board's proposed criterion is 1,000 µg/L.

Chloroform is a colorless, volatile liquid. Chloroform produced in the United States today is primarily used to make other chemicals, such as refrigerants. However, it can also form as a byproduct of adding chlorine to water, which is a common practice in the treatment of drinking water and wastewater. Human exposure to chloroform may occur through inhalation, dermal contact or ingestion of food and water. Individuals living near or working in industries that make

or use chloroform, living near municipal and industrial wastewater treatment plants and incinerators or paper and pulp plants, and receiving water from contaminated water sources have the greatest known risk of exposure to high concentrations. The EPA published an updated section 304(a) human health criterion recommendation for chloroform in 2015. The Department completed a comprehensive review of the EPA's 2015 recommendation as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a) and determined it is appropriate for this Commonwealth. The Board's proposed criterion is 60 µg/L, which is consistent with the EPA's current section 304(a) criterion recommendation.

Formaldehyde is a colorless, flammable gas at room temperature. Formaldehyde can be found in many household items including antiseptics, medicines, cosmetics, dish-washing detergents, fabric softeners, carpet cleaners, glues and adhesives, lacquers, plastics, paper and some types of wood products. It is also used in the production of sugar, fertilizers, paper, well-drilling fluids, latex, leather (tanning process), photographic film, embalming fluid, plywood and urea-formaldehyde resins. Human exposure to formaldehyde occurs primarily through inhalation but may also occur through ingestion of food and water. Individuals living near or working in industries that make or use formaldehyde have the greatest known risk of exposure to high concentrations. The Department is making updates to the existing formaldehyde water quality criterion, which was previously approved by the EPA in 2000, based on new exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for formaldehyde utilizing current toxicity information published in the EPA's IRIS database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a). Based on its low potential for bioaccumulation, the human health criterion for formaldehyde has been calculated with a total bioaccumulation factor of 1. The Board's proposed criterion is 1,000 µg/L.

Methyl ethyl ketone, also known as 2-butanone, is an organic, colorless liquid. Methyl ethyl ketone is used in the production of synthetic leathers, transparent paper and aluminum foil. It is also used as a solvent for paints, lacquers, rubber cement, printing inks, paint removers, vinyl films, resins, rosins, polystyrene, chlorinated rubber, polyurethane, acrylic coatings and cleaning solutions. Human exposure to methyl ethyl ketone may occur through inhalation, dermal contact or ingestion of food and water. Individuals working in industries that use methyl ethyl ketone have the greatest known risk of exposure to high concentrations. The Department is making updates to the existing methyl ethyl ketone water quality criterion, which was previously approved by the EPA in 2000, based on new toxicity information and exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for methyl ethyl ketone utilizing current toxicity information published in the EPA's IRIS database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development*

of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene (DEP 2022a). Based on its low potential for bioaccumulation, the human health criterion for methyl ethyl ketone has been calculated with a total bioaccumulation factor of 1. The Board's proposed criterion is 4,000 µg/L.

Metolachlor is an organic compound that is widely used as an agricultural and commercial herbicide. Human exposure to metolachlor may occur through inhalation, dermal contact or ingestion of food and water. Individuals living within or very near to areas of heavy agricultural use or who are involved in the production, formulation, handling or application of metolachlor have the greatest known risk of exposure to high concentrations. The Department is making updates to the existing metolachlor water quality criterion, which was previously approved by the EPA in 2008, based on new toxicity information and exposure inputs developed by the EPA. In 2004, the EPA announced that chemicals used as pesticides would not be reassessed by the IRIS program. The Department has recalculated the Commonwealth's human health criterion for metolachlor utilizing current toxicity information published in the EPA's *Reregistration Eligibility Decision (RED) Metolachlor* (RED document, EPA 1995) and updated human health exposure inputs for body weight, drinking water intake and fish intake. Based on its low potential for bioaccumulation, the human health criterion for metolachlor has been calculated with a total bioaccumulation factor of 1. According to the RED document, a cancer potency factor was recommended in 1991 but later retracted in 1994. In 1994, the Health Effects Division Peer Review Committee recommended a margin of exposures (MOE) approach for metolachlor since there was no supportable mutagenicity concern and in light of new information on the relative metabolism of metolachlor. The MOE was calculated from a no-observed-adverse-effect-level (NOAEL) of 15 mg/kg/day. Since the reference dose is based on a NOAEL of 9.7 mg/kg/day, cancer concerns are adequately addressed. The Department had previously applied an additional safety factor of 10 to the reference dose since the EPA had not published a cancer potency factor, but this cancer safety factor has been removed based on the 1995 RED document information. The Board's proposed criterion is 700 µg/L.

Resorcinol is a white crystalline compound. It is largely used by the rubber industry in the manufacture of tires and other fiber-reinforced rubber mechanical goods, such as conveyor and driver belts. Resorcinol is also used in manufacture of dyes, pharmaceuticals, flame retardants, agricultural chemicals, fungicidal creams and lotions, explosive primers, antioxidants and specialty chemicals. Human exposure to resorcinol may occur through inhalation, dermal contact or ingestion of food and water. Individuals working in industries that manufacture or use resorcinol have the greatest known risk of exposure to high concentrations. The Department is making updates to the existing resorcinol water quality criterion, which was previously approved by the EPA in 2013, based on new exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for resorcinol utilizing the previously used toxicity information and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-*

Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene (DEP 2022a). Based on its low potential for bioaccumulation, the human health criterion for resorcinol has been calculated with a total bioaccumulation factor of 1. The Board's proposed criterion is 3,000 µg/L.

1,2,3-trichloropropane is a colorless, non-naturally occurring liquid. It is commonly used as a chemical intermediate in the production of other chemicals. 1,2,3-trichloropropane was also used as a solvent and extraction agent in the past. Human exposure to 1,2,3-trichloropropane may occur through inhalation, dermal contact or ingestion of food and water. Individuals living near or working in industries that manufacture 1,2,3-trichloropropane have the greatest known risk of exposure to high concentrations. The Department is making updates to the existing 1,2,3-trichloropropane water quality criterion, which was previously approved by the EPA in 2000, based on new exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for 1,2,3-trichloropropane utilizing current toxicity information published in the EPA's IRIS database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a). Based on its low potential for bioaccumulation, the human health criterion for 1,2,3-trichloropropane has been calculated with a total bioaccumulation factor of 1. The Board's proposed criterion is 30 µg/L.

1,2,4-trimethylbenzene is a colorless liquid. It is used as a solvent in the manufacture of dyes, perfumes, and resins; in the manufacture of pharmaceuticals; as an industrial solvent and paint thinner; and as a fuel additive. Human exposure to 1,2,4-trimethylbenzene may occur through inhalation, dermal contact or ingestion of food and water. Individuals living near or working in industries that manufacture or use 1,2,4-trimethylbenzene have the greatest known risk of exposure to high concentrations. The Department is making updates to the existing 1,2,4-trimethylbenzene water quality criterion, which was previously approved by the EPA in 2013, based on new exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for 1,2,4-trimethylbenzene utilizing current toxicity information published in the EPA's IRIS database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a). The total bioaccumulation used in the calculation of the 1,2,4-trimethylbenzene criterion is 439. This value was provided by the EPA as a bioconcentration factor (EPA 1994). The Board's proposed criterion is 10 µg/L.

1,3,5-trimethylbenzene is a colorless liquid. It is used as a solvent in the manufacture of dyes, perfumes, and resins; and as an industrial solvent and paint thinner. Human exposure to 1,3,5-trimethylbenzene may occur through inhalation, dermal contact or ingestion of food and water. Individuals living near or working in industries that manufacture or use 1,3,5-trimethylbenzene have the greatest known risk of exposure to high concentrations. The Department is making

updates to the existing 1,3,5-trimethylbenzene water quality criterion, which was previously approved by the EPA in 2013, based on new exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for 1,3,5-trimethylbenzene utilizing current toxicity information published in the EPA's IRIS database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a). The total bioaccumulation used in the calculation of the 1,3,5-trimethylbenzene criterion is 439. This value was provided by the EPA as a bioconcentration factor (EPA 1994). The Board's proposed criterion is 10 µg/L.

1,4-dioxane is a synthetic, clear, colorless liquid at room temperature. It is primarily used as a solvent, but it was historically used as a stabilizer for the solvent 1,1,1-trichloroethane and can show up as a contaminant in ethoxylated surfactants. These substances are commonly used in consumer cosmetics, detergents and shampoos. Human exposure to 1,4-dioxane may occur through inhalation, dermal contact and ingestion of food and water. Individuals who work in industries that manufacture or use 1,4-dioxane have the greatest known risk of exposure to high concentrations. The Department has calculated the Commonwealth's human health criterion for 1,4-dioxane utilizing current toxicity information published in the EPA's IRIS database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – 1,4-Dioxane* (DEP 2022b). Based on its low potential for bioaccumulation, the human health criterion for 1,4-dioxane has been calculated with a total bioaccumulation factor of 1. The Board's proposed criterion is 0.3 µg/L.

Chlorophenoxy herbicide (2,4-D) is an herbicide used to control broad-leaved weeds in cereals, grain crops, roadsides and farm buildings. 2,4-D is currently registered as a pesticide by the EPA and is one of the most widely used agricultural herbicides in the United States. Human exposure to 2,4-D may occur through inhalation, dermal contact and ingestion of food and water. Individuals living within or very near to areas of heavy agricultural use or who are involved in the production, formulation, handling or application of 2,4-D have the greatest known risk of exposure to high concentrations. The EPA published an updated section 304(a) human health criterion recommendation for 2,4-D in 2015. The Department completed a comprehensive review of the EPA's 2015 recommendation as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a) and determined it is appropriate for this Commonwealth. The Board's proposed criterion is 1,300 µg/L, which is consistent with the EPA's current section 304(a) criterion recommendation.

Xylene is primarily a synthetic, colorless, flammable liquid produced from petroleum. It is commonly produced in the United States and is used as an industrial solvent, a paint thinner, a

cleaning agent, in the manufacture of plastics, and as a material in chemical, plastics, and synthetic fiber industries. Human exposure to xylene may occur through inhalation, dermal contact or ingestion of food and water. Individuals living near or working in industries that manufacture xylene have the greatest known risk of exposure to high concentrations. The Department is making updates to the existing xylene water quality criterion, which was previously approved by the EPA in 2000, based on new exposure inputs developed by the EPA. The Department has recalculated the Commonwealth's human health criterion for xylene utilizing current toxicity information published in the EPA's IRIS database and updated human health exposure inputs for body weight, drinking water intake and fish intake as detailed in the Department's criterion rationale document titled *Rationale for the Development of Ambient Water Quality Criteria for Protection of Human Health – Acetone, Barium, Boron, Chloroform, Formaldehyde, Methyl ethyl ketone, Metolachlor, Resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-Trimethylbenzene, Chlorophenoxy herbicide (2,4-D), and Xylene* (DEP 2022a). Based on its low potential for bioaccumulation, the human health criterion for xylene has been calculated with a total bioaccumulation factor of 1. The Board's proposed criterion is 1,000 µg/L.

§ 93.8e. Special criteria for the Great Lakes System

The Board proposes to add a new subsection (c) that clarifies the duration periods for the aquatic life criteria in Table 6—Great Lakes Aquatic Life and Human Health Criteria. Unless otherwise specified in § 93.8e (relating to special criteria for the great lakes system), the aquatic life criteria duration periods for criteria maximum concentration (CMC) values and criteria continuous concentrations (CCC) values are a one-hour average and a four-day average, respectively, as defined in § 93.1.

The Board also proposes to update the acronyms and footnotes to Table 6. These updates include: the replacement of the existing H and CRL column with a new "Notes" column; the replacement of the word "footnotes" with "notes" in "Acronyms and Footnotes to Table 6"; the replacement of the existing footnote symbols with numerals; and the replacement of the existing H and CRL acronyms with numerals.

§ 93.9. Designated water uses and water quality criteria.

The Board proposes to add language to subsection (a) that clarifies the duration period for certain criteria listed as "exceptions to specific criteria" in the following drainage lists: § 93.9e (relating to Drainage List E), § 93.9o (relating to Drainage List O), and § 93.9x (relating to Drainage List X). A duration period of a one-hour average, defined in § 93.1, applies to those criteria. The EPA recommends a duration period of one-hour for acute criteria in accordance with the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (Stephan et al. 1985) and its *Technical Support Document for Water Quality-based Toxics Control* (EPA 1991).

Exceptions for fishable/swimmable waters

The triennial review of water quality standards requires that states reexamine water body segments, where the fishable or swimmable designated uses specified in section 101(a)(2) of the CWA, have been removed, to determine if those uses are now attainable. There are two waterbodies in this Commonwealth where the fishable or swimmable uses have been removed including the Harbor Basin and entrance channel to Outer Erie Harbor/Presque Isle Bay (§ 93.9x), and several zones in the Delaware Estuary (§§ 93.9e and 93.9g (relating to Drainage List G)).

The Water Contact Sports (WC) designation was deleted from the Harbor Basin and entrance channel demarcated by United States Coast Guard buoys and channel markers on Outer Erie Harbor/Presque Isle Bay. This decision to remove the WC protected use was supported by a Use Attainability Analysis (UAA) study conducted in 1985 by DER. Because the same conditions exist today, as described in the UAA, no change is proposed to the designated use for Outer Erie Harbor/Presque Isle Bay.

In April 1989, DER cooperated with the Delaware River Basin Commission (DRBC), the Federal government and other DRBC signatory states on a comprehensive UAA study in the lower Delaware River and Delaware Estuary. This study resulted in recommendations regarding the DRBC's primary contact recreation designated use (synonymous with this Commonwealth's WC protected use), which the DRBC included in its regulations for water use classifications and water quality criteria for portions of the tidal Delaware River in May 1991. The DRBC standards are referenced in §§ 93.9e and 93.9g.

In addition, limited aquatic life uses for Zones 3 and 4, and upper Zone 5 of the Delaware Estuary basin were also incorporated into §§ 93.9e and 93.9g, which also date back to the original Article 301—Water Quality Criteria that were added to the SWB's rules and regulations in 1967. These are described in §§ 93.9e and 93.9g as Warm Water Fishes (WWF) (Maintenance Only) and Migratory Fishes (MF) (Passage Only) for tidal portions of the basin, from river mile 108.4 to the Pennsylvania-Delaware State Border. The current designated uses within these zones refer to the DRBC's water quality standards regulations which were developed to protect only maintenance of resident fish and other aquatic life and passage of anadromous fish.

Recent data and observations suggest recovery is occurring in propagation for some species in portions of these zones. Therefore, the DRBC initiated an evaluation of available data for resident and anadromous fishes collected since 2000 to quantify spawning and early life stages, and the extent of successful reproduction for estuarine species.

Although this review continues, the DRBC found that for all nine fish species evaluated (Atlantic Sturgeon, American Shad, Striped Bass, White Perch, Bay Anchovy, Atlantic Silverside, Alewife, Blueback Herring, and Atlantic Menhaden) successful reproduction was clearly demonstrated in one or more of these estuary zones. In addition, moderate to strong reproduction was demonstrated for multiple species in each zone, indicating substantial recovery in the propagation use for Zones 3 and 4, and upper Zone 5 (DRBC 2015).

The Department continues to work in cooperation with the DRBC, the Federal government and other DRBC signatory states to determine the appropriate designated use or uses that should apply in the lower Delaware River and Delaware Estuary. The parties continue to implement DRBC Resolution 2017-4 (as modified) describing the Commission's next steps for protecting and improving the recovery taking place in the lower Delaware River and Delaware Estuary. The parties remain committed to enhancing the surface water quality of the lower Delaware River and Delaware Estuary.

While the Department continues to work in cooperation with the DRBC, the Federal government and other DRBC signatory states to determine the appropriate designated use or uses, the Department will protect existing uses in accordance with § 93.4c(a) (relating to implementation of antidegradation requirements).

F. *Benefits, Costs and Compliance*

Benefits

Overall, this Commonwealth's residents and visitors and its natural resources benefit from providing the appropriate level of protection to preserve the integrity of existing and designated uses of surface waters in this Commonwealth. Protecting water quality provides economic value to present and future generations in the form of a clean water supply for human consumption, wildlife, irrigation and industrial use. It also protects aquatic life and provides for recreational opportunities such as fishing (including fish consumption), water contact sports and boating.

All of this Commonwealth's residents and visitors, both present and future, will benefit from having clean water that is protected and maintained at appropriate levels of water quality. Any reduction in the total toxic load in this Commonwealth's surface waters is likely to have a positive effect on the human health of its residents. This will translate into a yet unknown economic benefit through avoided cleanup or remediation costs that would have been incurred later in time, as well as avoided costs for the treatment and caring for persons with diseases and disabilities that can be reasonably attributed to environmental contaminants in surface waters.

Reduced toxics in the Commonwealth's surface waters positively impacts the recreational fishing and tourism industries by increasing the availability and use of swimming and fishing locations throughout this Commonwealth. Additionally, cleaner rivers and fish may lead to increased birding and wildlife viewing opportunities, as the benefits of cleaner water and less contaminated fish cascade up the food chain, resulting in substantial economic benefits. Persons who recreate on this Commonwealth's surface waters and who fish, both for sport and consumption, in those waters will benefit from better water quality protection.

A reduction in toxics found in the waterways of this Commonwealth may also lead to increased property values for properties located near rivers or lakes. Epp and Al-Ani (1979)), used real estate prices to determine the value of improvements in water quality in small rivers and streams in this Commonwealth. Water quality, whether measured in pH or by the owner's perception, has a significant effect on the price of adjacent property. The analysis by Epp and Al-Ani (1979) showed a positive correlation between water quality and housing values. They

concluded that buyers are aware of the environmental setting of a home and that differences in the quality of nearby waters affect the price paid for a residential property.

A 2006 study from the Great Lakes region (Braden et al. 2006) estimated that property values were significantly depressed in two regions associated with toxic contaminants (polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and heavy metals). The study showed that a portion of the Buffalo River region (approximately 6 miles long) had depressed property values of between $83 million and $118 million for single-family homes, and between $57 million and $80 million for multifamily homes, as a result of toxic sediments. Braden et al. (2006) estimated that a portion of the Sheboygan River (approximately 14 miles long) had depressed property values of between $80 million and $120 million as the result of toxics. While this study related to the economic effect of contaminated sediment in other waters in the Great Lakes region, the idea that toxic pollution depresses property values applies in this Commonwealth. A reduction in toxic pollution in this Commonwealth's surface waters has a substantial economic benefit to property values in close proximity to waterways.

Southwick Associates has prepared several reports for the Theodore Roosevelt Conservation Partnership that analyze the economic contribution of outdoor recreation in this Commonwealth. A 2018 report (Southwick Associates 2018) found that during 2016 there were more than 390,000 jobs supported by outdoor recreation activities in this Commonwealth, and that, for comparison, this was more than the number of jobs in this Commonwealth that supported the production of durable goods during the same year. This report also found that, in 2016, outdoor recreation had an economic contribution in this Commonwealth of almost $17 billion in salaries and wages paid to employees and generated over $300 million in Federal, State and local tax revenue. An updated report (Southwick Associates 2020) revealed that economic contributions from outdoor recreation increased from nearly $17 billion in salaries and wages paid to employees in 2016 to nearly $20 billion in 2020. The 2020 report also continued to highlight the fact that "more Pennsylvania jobs are supported by outdoor recreation than by the production of durable goods." The 2020 report found that, in 2020, outdoor recreation activities supported more than 430,000 jobs and contributed more than $32 billion to the Commonwealth's state gross domestic product and generated over $6.5 billion in tax revenue at the Federal, State and local levels, which is a significant increase from the 2016 tax revenue total of over $300 million.

There are also economic benefits to be gained by having clearly defined remediation standards for surface waters. Under the Commonwealth's Land Recycling and Environmental Remediation Standards Act (35 P.S. §§ 6026.101—6026.908), liability relief is available, by operation of law, if a person demonstrates compliance with the environmental remediation standards established by the law. Surface water quality criteria are used to develop remediation standards under the law. Persons performing remediation depend upon these criteria to obtain a liability relief benefit under the law. Industrial land redevelopers will benefit from these regulations by having financial certainty when choosing a surface water cleanup standard and by being eligible for liability relief under state law.

It is important to realize these benefits and to ensure opportunities and activities continue in a manner that is environmentally, socially and economically sound. Protection and maintenance of

water quality at appropriate levels as supported by the latest science ensures that the surface waters of this Commonwealth can support all current and potential future uses.

Compliance costs

This proposed rulemaking is necessary to improve total pollution control in this Commonwealth and may impose additional compliance costs on the regulated community. The expenditures necessary to meet new compliance requirements may exceed that which is required under existing regulations.

The proposed amendments will be implemented through the Department's permit and approval actions as new and renewed permits are issued. Persons with existing permitted discharges or proposing to add new discharge points to a stream could be adversely affected upon permit issuance or permit renewal if they need to provide new or higher levels of treatment to meet any new or updated water quality standard established by this proposed rulemaking. For example, increased costs may take the form of higher engineering, construction or operating cost for point source discharges. Treatment costs and BMPs are site-specific and depend upon the size of the discharge in relation to the size of the stream and many other factors. It is therefore not possible to precisely predict the actual change in costs. Economic impacts would primarily involve the potential for increased monitoring and sampling costs and higher treatment costs for new or expanded discharges to streams to meet any new or updated water quality standards. The initial costs resulting from the installation of technologically advanced wastewater treatment processes and BMPs may be offset by potential savings from and increased value of improved water quality through more cost-effective and efficient treatment over time.

There are approximately 10,300 facilities across the Commonwealth that hold permits issued under 25 Pa. Code Chapter 92a (relating to National Pollutant Discharge Elimination System (NPDES) permitting, monitoring and compliance). The Department identified 274 active NPDES permits with effluent limitations for one or more of the toxic substances included in this proposed rulemaking. These 274 active NPDES permits include permits for treated sewage, industrial waste, groundwater remediation, and stormwater associated with industrial activities.

The Department reviewed sampling cost information for each toxic substance that was available in the National Environmental Monitoring Index (NEMI). NEMI is a freely available compendium of information on a variety of environmental analytical test methods that was developed by the National Water Quality Monitoring Council in collaboration with partners in the Federal, state and private sectors. A review of the EPA-approved analytical test methods for each toxic substance revealed that the average cost per sample for many of these substances ranges between $201 and $400. A few of the analytical test methods, such as Method 4500-B B for boron, have an estimated cost per sample of less than $50 while other analytical methods, such as Method 1624 for methyl ethyl ketone, have an estimated cost per sample of over $400. Costs estimates were available in NEMI for each of the toxic substances in this proposed rulemaking except for tributyltin. Note that no additional costs will be incurred by the 274 NPDES permit holders that currently have effluent limitations for one or more of these substances as a result of this proposed rulemaking since these entities are already required to monitor for these substances. Additional costs may be incurred for new or renewed permits if

new water-quality-based effluent limitations are required to achieve any new or updated water quality criteria for the toxic substances in this proposed rulemaking.

Compliance assistance plan

This proposed rulemaking has been developed as part of an established program that has been implemented by the Department since the early 1980s. This proposed rulemaking is consistent with and based on existing Department regulations. The proposed amendments extend appropriate protections to all surface waters in this Commonwealth and are consistent with antidegradation requirements established by the CWA and the CSL. All surface waters in this Commonwealth are afforded a minimum level of protection through compliance with the Commonwealth's water quality standards, which prevent pollution and protect existing water uses.

The proposed amendments will be implemented through the Department's permit and approval actions. For example, the NPDES permitting program bases effluent limitations on the protected water uses of the stream, and the water quality criteria developed to maintain those uses. These effluent limits are established to ensure water quality is protected and maintained.

Paperwork requirements

This proposed rulemaking should not generate new paperwork requirements on the Commonwealth, local governments, political subdivisions or the private sector. This proposed rulemaking will be implemented using existing permitting and other paperwork.

References cited in this preamble

Braden, J. B, L. O. Taylor, D. Won, N. Mays, A. Cangelosi, and A. A. Patunru. 2006. Economic benefits of sediment remediation. Project GL-96553601. Great Lakes National Program Office, U.S. Environmental Protection Agency, Chicago, Illinois. (www.nemw.org/Econ)

DEP. 2022a. Rationale for the development of ambient water quality criteria for protection of human health – acetone, barium, boron, chloroform, formaldehyde, methyl ethyl ketone, metolachlor, resorcinol, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2,4-D, and xylene. Pennsylvania Department of Environmental Protection, Harrisburg, Pennsylvania.

DEP. 2022b. Rationale for the development of ambient water quality criteria for protection of human health – 1,4-dioxane. Pennsylvania Department of Environmental Protection, Harrisburg, Pennsylvania.

DEP. 2022c. Rationale for the development of ambient water quality criteria for protection of aquatic life use – cadmium. Pennsylvania Department of Environmental Protection, Harrisburg, Pennsylvania.

DEP. 2022d. Rationale for the development of ambient water quality criteria for protection of aquatic life use – carbaryl. Pennsylvania Department of Environmental Protection, Harrisburg, Pennsylvania.

DEP. 2022e. Rationale for the development of ambient water quality criteria for protection of aquatic life use – tributyltin. Pennsylvania Department of Environmental Protection, Harrisburg, Pennsylvania.

DRBC. 2015. Existing use evaluation for zones 3, 4, &5 of the Delaware Estuary based on spawning and rearing of resident and anadromous fishes. Delaware River Basin Commission, West Trenton, New Jersey.

EPA. 1991. Technical support document for water quality-based toxics control. EPA/505/2-90-001. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

EPA. 1994. Chemical summary for 1,2,4-trimethylbenzene. EPA 749-F-94-022a. U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, D.C.

EPA. 1995. Registration eligibility decision document for metolachlor. EPA 738-R-95-006. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C.

EPA. 2000. Methodology for deriving ambient water quality criteria for the protection of human health. EPA 882-B-00-004. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, DC.

Epp, D. J. and K. S. Al-Ani. 1979. The effect of water quality on rural nonfarm residential property values. American Journal of Agricultural Economics. 61(3): 529-534. (www.jstor.org/stable/1239441)

Southwick Associates. 2018. The power of outdoor recreation spending in Pennsylvania: How hunting, fishing, and outdoor activities help support a healthy state economy. Theodore Roosevelt Conservation Partnership, Washington D.C. (www.trcp.org/wp-content/uploads/2018/12/TRCP-and-Southwick-PA-Economic-Analysis-12-6-18.pdf)

Southwick Associates. 2020. Estimating the economic contributions of outdoor recreation in Pennsylvania: An analysis of 2020 state-level economic contributions made by hunting, fishing, and other outdoor recreation activities. Theodore Roosevelt Conservation Partnership, Washington D.C. (www.trcp.org/wp-content/uploads/2022/04/TRCP-PA-Economic-Report-2020-FINAL.pdf)

Stephan, C. E., D. I. Mount, D. J. Hansen, J. H. Gentile, G. A. Chapman and W. A. Brungs. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. National Technical Information Service No. PB85-227049. Springfield, VA.

G. *Pollution Prevention*

The Federal Pollution Prevention Act of 1990 (42 U.S.C. §§ 13101—13109) established a National policy that promotes pollution prevention as the preferred means for achieving state environmental protection goals. The Department encourages pollution prevention, which is the reduction or elimination of pollution at its source, through the substitution of environmentally-friendly materials, more efficient use of raw materials and the incorporation of energy efficiency strategies. Pollution prevention practices can provide greater environmental protection with greater efficiency because they can result in significant cost savings to facilities that permanently achieve or move beyond compliance.

Water quality standards are a major pollution prevention tool because they protect water quality and designated and existing uses. The proposed amendments will be implemented through the Department's permit and approval actions. For example, the NPDES program will establish effluent limitations in permits based on the more stringent of technology-based or water quality-based effluent limits. Water quality-based effluent limits are determined by the protected water uses of the receiving stream and the water quality criteria necessary to achieve those designated and existing uses.

H. *Sunset Review*

These regulations will be reviewed in accordance with the sunset review schedule published by the Department to determine whether the regulations effectively fulfill the goals for which they were intended.

I. *Regulatory Review*

Under section 5(a) of the Regulatory Review Act (71 P.S. § 745.5(a)), on September 6, 2023, the Department submitted a copy of this proposed rulemaking and a copy of the Regulatory Analysis Form to the Independent Regulatory Review Commission (IRRC) and to the Chairpersons of the House and Senate Environmental Resources and Energy Committees. A copy of this material is available to the public upon request.

Under section 5(g) of the Regulatory Review Act, IRRC may convey comments, recommendations or objections to the proposed rulemaking within 30 days of the close of the public comment period. The comments, recommendations or objections must specify the regulatory review criteria in section 5.2 of the Regulatory Review Act (71 P.S. § 745.5b) which have not been met. The Regulatory Review Act specifies detailed procedures for review prior to final publication of the rulemaking by the Department, the General Assembly and the Governor.

J. *Public Comments*

Interested persons are invited to submit to the Board written comments, suggestions, support or objections regarding this proposed rulemaking. Comments, suggestions, support or objections must be received by the Board by November 21, 2023.

Comments may be submitted to the Board online, by e-mail, by mail or express mail as follows. Comments submitted by facsimile will not be accepted.

Comments may be submitted to the Board by accessing eComment at http://www.ahs.dep.pa.gov/eComment.

Comments may be submitted to the Board by e-mail at RegComments@pa.gov. A subject heading of this proposed rulemaking and a return name and address must be included in each transmission.

If an acknowledgment of comments submitted online or by e-mail is not received by the sender within 2 working days, the comments should be retransmitted to the Board to ensure receipt.

Written comments should be mailed to the Environmental Quality Board, P.O. Box 8477, Harrisburg, PA 17105-8477. Express mail should be sent to the Environmental Quality Board, Rachel Carson State Office Building, 16th Floor, 400 Market Street, Harrisburg, PA 17101-2301.

K. *Public Hearings*

The Board will hold one virtual public hearing for the purpose of accepting comments on this proposed rulemaking. The hearing will be held on November 14, 2023, at 1 p.m.

Persons wishing to present testimony at a hearing are requested to contact Casey Damicantonio for the Department and the Board, (717) 783-8727 or RA-EPEQB@pa.gov, at least 1 week in advance of the hearing to reserve a time to present testimony. Language interpretation services are available upon request. Persons in need of language interpretation services must contact Casey Damicantonio by 5 p.m. on November 6, 2023.

Oral testimony is limited to 5 minutes for each witness. Organizations are limited to designating one witness to present testimony on their behalf at one hearing.

Witnesses may provide testimony by means of telephone or Internet connection. Video demonstrations and screen sharing by witnesses will not be permitted.

Witnesses are requested to submit a written copy of their verbal testimony by e-mail to RegComments@pa.gov after providing testimony at the hearing.

Information on how to access the virtual public hearing will be available on the Board's webpage found through the Public Participation tab on the Department's web site at www.dep.pa.gov (select "Public Participation," then "Environmental Quality Board"). Prior to a hearing, individuals are encouraged to visit the Board's webpage for the most current information for accessing the hearing.

Members of the public wishing to observe a virtual public hearing without providing testimony are also directed to access the Board's webpage.

Persons in need of accommodations as provided for in the Americans with Disabilities Act of 1990 should contact the Board at (717) 783-8727 or through the Pennsylvania Hamilton Relay Service at (800) 654-5984 (TDD) or (800) 654-5988 (voice users) to discuss how the Board may accommodate their needs.

RICHARD NEGRIN,
Chairperson

(*Editor's Note*: See 53 Pa.B. XXXX (October 7, 2023) for a proposed statement of policy relating to this proposed rulemaking.)

ANNEX A

TITLE 25. ENVIRONMENTAL PROTECTION
PART I. DEPARTMENT OF ENVIRONMENTAL PROTECTION
Subpart C. PROTECTION OF NATURAL RESOURCES
ARTICLE II. WATER RESOURCES

CHAPTER 93. WATER QUALITY STANDARDS

* * * * *

§ 93.1 Definitions.

* * * * *

Toxic substance—A chemical or compound in sufficient quantity or concentration which is, or may become, harmful to human, animal or plant life. The term includes, but is not limited to, priority pollutants and those substances, which are identified in Tables 5 and 6. **[Additional toxic substances are also described in Chapter 16 Appendix A, Table 1A (relating to site-specific water quality criteria for toxic substances).]**

* * * * *

§ 93.7. Specific water quality criteria.

(a) Table 3 displays specific water quality criteria and associated critical uses. The criteria associated with the Statewide water uses listed in § 93.4, Table 2 apply to all surface waters, unless a specific exception is indicated in §§ 93.9a— 93.9z. These exceptions will be indicated on a stream-by-stream or segment-by-segment basis by the words ''Add'' or ''Delete'' followed by the appropriate symbols described elsewhere in this chapter. Other specific water quality criteria apply to surface waters as specified in §§ 93.9a—93.9z. All applicable criteria shall be applied in accordance with this chapter, Chapter 96 (relating to water quality standards implementation) and other applicable State and Federal laws and regulations. **Unless otherwise specified in Table 3, the duration of aquatic life criteria with "minimum" or "maximum" values is a one-hour average. The duration of the pH criterion in Table 3 is a one-hour average.**

* * * * *

§ 93.8c. Human health and aquatic life criteria for toxic substances.

* * * * *

(c) Unless otherwise specified in this section, the aquatic life criteria in Table 5 have the following duration periods:

(1) One-hour average for criteria maximum concentrations.

(2) Four-day average for criteria continuous concentrations.

TABLE 5

WATER QUALITY CRITERIA FOR TOXIC SUBSTANCES

PP NO	*Chemical Name*	*CAS Number*	*Fish and Aquatic Life Criteria*		*Human Health Criteria*	***Notes***
			Criteria Continuous	*Criteria Maximum*		
			|Concentrations (ug/L)| Concentration (ug/L)	*Concentration* ***|(ug/L)| (ug/L)***	***|(ug/L)| (ug/L)***	
1M	ANTIMONY	7440360	220	1100	5.6 [†]	**[H] 2,5**
2M	ARSENIC	7440382	150 (As3+)	340 (As3+)	10	**[H] 2**
3M	BERYLLIUM	7440417	N/A	N/A	N/A	-
4M	CADMIUM	7440439	**[*]**{1.101672-(ln[H]x0.041838)}x	**[*]**{1.136672-(ln[H]x0.041838)} x	N/A	**[-] 3**
			|Exp(0.7409xln|H|-4.719)| Exp(0.7977 x ln(|H|) - 3.909)	**|Exp(1.0166xln|H|-3.924)| Exp(0.9789 x ln(|H|) – 3.866)**		
			(ex: @H=100, CCC=**[0.25]0.72**)	(ex: @H=100, CMC=**[2.0]1.8**)		
			(ex: @ H=50, CCC= 0.43)	**(ex: @ H=50, CMC= 0.94)**		
			(ex: @ H=25, CCC= 0.25)	**(ex: @ H=25, CMC= 0.49)**		
5M	CHROMIUM III	16065831	**[*]**0.860xExp(0.819xln[H]+0.6848)	**[*]**0.316xExp(0.819xln[H]+3.7256)	N/A	**[-] 3**
			(ex: @H=100, CCC=74)	(ex: @H=100, CMC=570)		
5M	CHROMIUM VI	18540299	**[*]**11	**[*]**16	N/A	**[-] 3**
6M	COPPER	7440508	**[*]**0.960xExp(0.8545xln[H]-1.702)	**[*]**0.960xExp(0.9422xln[H]-1.700)	N/A	**[-] 3**
			(ex: @H=100, CCC=9.0)	(ex: @H=100, CMC=13)		
7M	LEAD	7439921	**[*]**{1.46203-(ln[H] x0.145712)} x	**[*]**{1.46203-(ln[H]x0.145712)} x	N/A	**[-] 3**
			Exp(1.273xln[H]-4.705)	Exp(1.273xln[H]-1.460)		
			(ex: @H=100, CCC=2.5)	(ex: @H=100, CMC=65)		
8M	MERCURY	7439976	**[*]**0.77 (Hg2+)	**[*]**1.4 (Hg2+)	0.05	**[H] 2,3**

9M	NICKEL	7440020	|*|0.997xExp(0.846xln[H]+0.0584)	|*|0.998xExp(0.846xln[H]+2.255)	610 |†|	**|H| 2,3,5**
			(ex: @H=100, CCC=52)	(ex: @H=100, CMC=470)		
10M	SELENIUM	7782492	|*|4.6	N/A	N/A	**|-| 3**
11M	SILVER	7440224	N/A	|*|0.850xExp(1.72xln[H]-6.590)	N/A	**|-| 3**
				(ex: @H=100, CMC=3.2)		
12M	THALLIUM	7440280	13	65	0.24 |†|	**|H| 2,5**
13M	ZINC	7440666	|*|0.986xExp(0.8473xln[H]+0.884)	|*|0.978xExp(0.8473xln[H]+0.884)	N/A	**|-| 3**
			(ex: @H=100, CCC=120)	(ex: @H=100, CMC=120)		
14M	CYANIDE, FREE	57125	5.2	22	4	**|H| 2**
1A	2-CHLOROPHENOL	95578	110	560	30	**|H| 2**
2A	2,4-DICHLOROPHENOL	120832	340	1700	10	**|H| 2**
3A	2,4-DIMETHYLPHENOL	105679	130	660	100	**|H| 2**
4A	4,6-DINITRO-o-CRESOL (2 METHYL-4,6-DINITROPHENOL)	534521	16	80	2	**|H| 2**
5A	2,4-DINITROPHENOL	51285	130	660	10	**|H| 2**
E	DINITROPHENOLS	25550587	N/A	N/A	10	**|H| 2**
6A	2-NITROPHENOL	88755	1600	8000	N/A	-
7A	4-NITROPHENOL	100027	470	2300	N/A	-
8A	P-CHLORO-m-CRESOL (3 METHYL-4-CHLOROPHENOL)	59507	30	160	500	**|H| 2**
9A	PENTACHLOROPHENOL	87865	Exp(1.005x[pH]-5.134)	Exp(1.005x[pH]-4.869)	0.03	**|CRL| 1**
			@pH= 6.5 7.8 9.0	@pH= 6.5 7.8 9.0		
			Crit= 4.1 15 50	Crit= 5.3 19 65		
10A	PHENOL	108952	N/A	N/A	4000	**|H| 2**
E	2,4,5-TRICHLOROPHENOL	95954	N/A	N/A	300	**|H| 2**
11A	2,4,6-TRICHLOROPHENOL	88062	91	460	1.5	**|CRL| 1**
1V	ACROLEIN	107028	3.0	3.0	3	**|H| 2**

2V	ACRYLONITRILE	107131	130	650	0.06	[CRL] 1,4
3V	BENZENE	71432	130	640	0.58	[CRL] 1
5V	BROMOFORM	75252	370	1800	7	[CRL] 1
6V	CARBON TETRACHLORIDE	56235	560	2800	0.4	[CRL] 1
7V	CHLOROBENZENE	108907	240	1200	100	[H] 2
8V	CHLORODIBROMO-METHANE	124481	N/A	N/A	0.8	[CRL] 1
9V	CHLOROETHANE	75003	N/A	N/A	N/A	-
10V	2-CHLOROETHYL VINYL ETHER	110758	3500	18000	N/A	-
11V	CHLOROFORM	67663	390	1900	[5.7] 60	[H] 2
12V	DICHLOROBROMO-METHANE	75274	N/A	N/A	0.95	[CRL] 1
14V	1,1-DICHLOROETHANE	75343	N/A	N/A	N/A	-
15V	1,2-DICHLOROETHANE	107062	3100	15000	9.9	[CRL] 1
16V	1,1-DICHLOROETHYLENE	75354	1500	7500	33	[H] 2
17V	1,2-DICHLOROPROPANE	78875	2200	11000	0.9	[CRL] 1
18V	1,3-DICHLOROPROPENE	542756	61	310	0.27	[CRL] 1
19V	ETHYLBENZENE	100414	580	2900	68	[H] 2
20V	METHYL BROMIDE	74839	110	550	100	[H] 2
21V	METHYL CHLORIDE	74873	5500	28000	N/A	-
22V	METHYLENE CHLORIDE	75092	2400	12000	20	[CRL] 1
23V	1,1,2,2-TETRACHLOROETHANE	79345	210	1000	0.2	[CRL] 1
24V	TETRACHLORO-ETHYLENE	127184	140	700	10	[CRL] 1
25V	TOLUENE	108883	330	1700	57	[H] 2
26V	trans-1,2-DICHLOROETHYLENE	156605	1400	6800	100	[H] 2

D	1,2 cis-DICHLORO-ETHYLENE	156592	N/A	N/A	12	[H] 2
27V	1,1,1-TRICHLOROETHANE	71556	610	3000	10000	[H] 2
28V	1,1,2-TRICHLOROETHANE	79005	680	3400	0.55	[CRL] 1
29V	TRICHLOROETHYLENE	79016	450	2300	0.6	[CRL] 1
31V	VINYL CHLORIDE	75014	N/A	N/A	0.02	[CRL] 1
1B	ACENAPHTHENE	83329	17	83	70	[H] 2
2B	ACENAPHTHYLENE	208968	N/A	N/A	N/A	-
3B	ANTHRACENE	120127	N/A	N/A	300	[H] 2
4B	BENZIDINE	92875	59	300	0.0001	[CRL] 1
5B	BENZO(a)-ANTHRACENE	56553	0.1	0.5	0.001	[CRL] 1
6B	BENZO(a)PYRENE	50328	N/A	N/A	0.0001	[CRL] 1
7B	3,4-BENZO-FLUOR-ANTHENE (BENZO(b)FLUORANTHENE)	205992	N/A	N/A	0.001	[CRL] 1
8B	BENZO(ghi)-PERYLENE	191242	N/A	N/A	N/A	-
9B	BENZO(k)-FLUORANTHENE	207089	N/A	N/A	0.01	[CRL] 1
E	BIS(CHLOROMETHYL)-ETHER	542881	N/A	N/A	0.0002	[CRL] 1
10B	BIS(2-CHLOROETHOXY)-METHANE	111911	N/A	N/A	N/A	-
11B	BIS(2-CHLOROETHYL)-ETHER	111444	6000	30000	0.03	[CRL] 1
12B	BIS(2-CHLORO-1-METHYLETHYL) ETHER	108601	N/A	N/A	200	[H] 2
13B	BIS(2-ETHYLHEXYL)-PHTHALATE	117817	910	4500	0.32	[CRL] 1
14B	4-BROMOPHENYL PHENYL ETHER	101553	54	270	N/A	-

15B	BUTYLBENZYL PHTHA-LATE	85687	35	140	0.1	[H] 2
16B	2-CHLORONAPHTHALENE	91587	N/A	N/A	800	[H] 2
17B	4-CHLOROPHENYL PHENYL ETHER	7005723	N/A	N/A	N/A	-
18B	CHRYSENE	218019	N/A	N/A	0.12	[CRL] 1
19B	DIBENZO(a,h)ANTHRACENE	53703	N/A	N/A	0.0001	[CRL] 1
20B	1,2-DICHLOROBENZENE	95501	160	820	1000	[H] 2
21B	1,3-DICHLOROBENZENE	541731	69	350	7	[H] 2
22B	1,4-DICHLOROBENZENE	106467	150	730	300	[H] 2
23B	3,3-DICHLOROBENZIDINE	91941	N/A	N/A	0.05	[CRL] 1
24B	DIETHYL PHTHALATE	84662	800	4000	600	[H] 2
25B	DIMETHYL PHTHALATE	131113	500	2500	2000	[H] 2
26B	DI-N-BUTYL PHTHALATE	84742	21	110	20	[H] 2
27B	2,4-DINITROTOLUENE	121142	320	1600	0.05 for dinitro-toluene	[CRL] 1
28B	2,6-DINITROTOLUENE	606202	200	990	See 27B	[CRL] 1
29B	DI-N-OCTYL PHTHALATE	117840	N/A	N/A	N/A	-
30B	1,2-DIPHENYLHYDRAZINE	122667	3	15	0.03	[CRL] 1
31B	FLUORANTHENE	206440	40	200	20	[H] 2
32B	FLUORENE	86737	N/A	N/A	50	[H] 2
33B	HEXACHLOROBENZENE	118741	N/A	N/A	0.00008	[CRL] 1
34B	HEXACHLOROBUTADIENE	87683	2	10	0.01	[CRL] 1
35B	HEXACHLOROCYCLO-PENTADIENE	77474	1	5	4	[H] 2
36B	HEXACHLOROETHANE	67721	12	60	0.1	[CRL] 1
37B	INDENO(1,2,3-cd)PYRENE	193395	N/A	N/A	0.001	[CRL] 1
38B	ISOPHORONE	78591	2100	10000	34	[H] 2

39B	NAPHTHALENE	91203	43	140	N/A	-
40B	NITROBENZENE	98953	810	4000	10	[H] 2
41B	N-NITROSODIMETHYL-AMINE	62759	3400	17000	0.0007 [†]	[CRL] 1,5
42B	N-NITROSODI-N-PROPYLAMINE	621647	N/A	N/A	0.005 [†]	[CRL] 1,5
43B	N-NITROSODIPHENYL-AMINE	86306	59	300	3.3 [†]	[CRL] 1,5
E	PENTACHLOROBENZENE	608935	N/A	N/A	0.1	[H] 2
44B	PHENANTHRENE	85018	1	5	N/A	-
45B	PYRENE	129000	N/A	N/A	20	[H] 2
E	1,2,4,5-TETRACHLOROBENZENE	95943	N/A	N/A	0.03	[H] 2
46B	1,2,4-TRICHLOROBENZENE	120821	26	130	0.07	[H] 2
1P	ALDRIN	309002	0.1	3	0.0000008	[CRL] 1
2P	alpha-HEXACHLORO-CYCLOHEXANE (HCH)	319846	N/A	N/A	0.0004	[CRL] 1
3P	beta-HEXACHLORO-CYCLOHEXANE (HCH)	319857	N/A	N/A	0.008	[CRL] 1
4P	gamma-HEXACHLOROCYCLO-HEXANE (HCH) (LINDANE)	58899	N/A	0.95	4.2	[H] 2
5P	delta-BHC	319868	N/A	N/A	N/A	-
E	**CARBARYL**	**63252**	**2.1**	**2.1**	**N/A**	**-**
6P	CHLORDANE	57749	0.0043	2.4	0.0003	[CRL] 1,4
E	CHLOROPHENOXY HERBICIDE (2,4-D)	94757	N/A	N/A	[1400] 1300	[H] 2
E	CHLOROPHENOXY HERBICIDE (2,4,5-TP)	93721	N/A	N/A	100	[H] 2

7P	4,4-DDT	50293	0.001	1.1	0.00003	[CRL] 1,4
8P	4,4-DDE	72559	0.001	1.1	0.00002	[CRL] 1
9P	4,4-DDD	72548	0.001	1.1	0.0001	[CRL] 1
10P	DIELDRIN	60571	0.056	0.24	0.000001	[CRL] 1
11P	alpha-ENDOSULFAN	959988	0.056	0.22	20	[H] 2,4
12P	beta-ENDOSULFAN	33213659	0.056	0.22	20	[H] 2,4
13P	ENDOSULFAN SULFATE	1031078	N/A	N/A	20	[H] 2
14P	ENDRIN	72208	0.036	0.086	0.03	[H] 2
15P	ENDRIN ALDEHYDE	7421934	N/A	N/A	1	[H] 2
16P	HEPTACHLOR	76448	0.0038	0.52	0.000006	[CRL] 1
17P	HEPTACHLOR EPOXIDE	1024573	0.0038	0.5	0.00003	[CRL] 1
E	HEXACHLOROCYCLO-HEXANE (HCH)-TECHNICAL	608731	N/A	N/A	0.007	[CRL] 1
E	METHOXYCHLOR	72435	N/A	N/A	0.02	[H] 2
18P	PCB		0.014	N/A	0.000064 for PCBs [†]	[CRL] 1,4,5
25P	TOXAPHENE	8001352	0.0002	0.73	0.0007	[CRL] 1
PP	2,3,7,8-TCDD	1746016	N/A	N/A	5.0 E-9 [†]	[CRL] 1,5
E	**TRIBUTYLTIN**		**0.072**	**0.46**	**N/A**	-
D	ACETONE	67641	86000	450000	[3500] 6000	[H] 2
D	ACRYLAMIDE	79061	N/A	N/A	0.07	[CRL] 1
D	ALUMINUM	7429905	N/A	750	N/A	-
D	BARIUM	7440393	4100	21000	[2400] 1000	[H] 2
D	BENZENE METADISULFONIC ACID	98486	1600000	2600000	N/A	-
D	BENZENE MONOSULFONIC ACID	98113	1200000	2000000	N/A	-

D	BENZYL CHLORIDE	100447	N/A	N/A	0.2	**|CRL| 1**
D	BORON	7440428	1600	8100	**|3100| 1000**	**|H| 2**
D	2-BUTOXY ETHANOL	111762	N/A	N/A	700	**|H| 2**
D	COBALT	7440484	19	95	N/A	-
D	p-CRESOL	106445	160	800	N/A	-
D	CYCLOHEXYLAMINE	108918	N/A	N/A	1000	**|H| 2**
E	DIAZINON	333415	0.17	0.17	N/A	-
D	**1,4-DIOXANE**	**123911**	**N/A**	**N/A**	**0.3**	**1**
D	FORMALDEHYDE	50000	440	2200	**|700| 1000**	**|H| 2**
D	2-HEXANONE	591786	4300	21000	N/A	-
D	LITHIUM	7439932	N/A	N/A	N/A	-
D	METHYL ETHYL KETONE	78933	32000	230000	**|21000| 4000**	**|H| 2**
D	METHYL ISOBUTYL KETONE	108101	5000	26000	N/A	-
D	METOLACHLOR	51218452	N/A	N/A	**|69| 700**	**|H| 2**
D	NONYLPHENOL	84852153	6.6	28	N/A	-
D	P-PHENOL SULFONIC ACID	98679	1400000	3500000	N/A	-
D	1-PROPANOL	71238	46000	230000	N/A	-
D	2-PROPANOL	67630	89000	440000	N/A	-
D	RESORCINOL	1084603	7200	28000	**|2700| 3000**	**|H| 2**
D	STRONTIUM	7440246	N/A	N/A	4000	**|H| 2**
D	1,2,3-TRICHLOROPROPANE	96184	N/A	N/A	**|210| 30**	**|H| 2**
D	1,2,4-TRIMETHYLBENZENE	95636	N/A	N/A	**|72| 10**	**|H| 2**
D	1,3,5-TRIMETHYLBENZENE	108678	N/A	N/A	**|72| 10**	**|H| 2**
D	VANADIUM	7440622	100	510	N/A	-

D	XYLENE	1330207	210	1100	[70000] 1000	[H] 2

Acronyms and [Footnotes]Notes to Table 5

[1]Indicates a human health criterion based on a cancer potency factor and cancer risk level at 1 × 10^{-6} (CRL); where no cancer potency factor exists the human health criterion is based on threshold toxicity data plus additional safety factors.

[2]Indicates a human health criterion based on threshold effect (H).

[*] [3]Indicates dissolved **[metal]** **aquatic life** criterion; others are total recoverable **[metals]**. Each listed dissolved criterion in Table 5 is equal to the corresponding total recoverable criterion before rounding (from the EPA National Ambient Water Quality Criteria Documents) multiplied by the conversion factor (from the Conversion Factors Table); a criterion that is expressed as a hardness (H)-based equation is shown in Table 5 as the conversion factor (listed) multiplied by the hardness criterion equation; an example criterion at hardness=100mg/L is included.

[4]Indicates duration for aquatic life criteria; CMC = instantaneous; CCC = 24 hour average.

[†] [5]Indicates **human health** criterion is based on the exposure inputs of 2 liters per day of drinking water and consumption of 17.5 grams of fish per day, for protection of a 70 Kg person.

CAS—Chemical Abstract Service number

[CRL—Cancer risk level at 1 × 10-6]

D—DEP developed criteria

E—EPA developed criteria

[H—Threshold effect human health criterion; incorporates additional uncertainty factor for some Group C carcinogens.]

[ln [H]] ln[H]—Natural Logarithm of the Hardness of stream as mg/l CaCO3

[ug/L] ug/L—Micrograms per liter

N/A—Criterion not developed

PP NO—Priority Pollutant Number

* * * * *

§ 93.8e. Special criteria for the Great Lakes System.

* * * * *

(c) Unless a different duration is indicated by the Notes in Table 6, the aquatic life criteria in Table 6 have the following duration periods:

(1) One-hour average for criteria maximum concentrations.

(2) Four-day average for criteria continuous concentrations.

TABLE 6

GREAT LAKES AQUATIC LIFE AND HUMAN HEALTH CRITERIA

			Fish and Aquatic Life Criteria		Human	
PP NO	*Chemical Name*	*CAS Number*	*Criteria Continuous Concentration|s| |(ug/L)| (ug/L)*	*Criteria Maximum Concentration |(ug/L)| (ug/L)*	*Health Criteria /(ug/L)/ (ug/L)*	*Notes*
2M	Arsenic	7440382	[*]148 (As3+)	[*]340 (As3+)	N/A	[-] 3
4M	Cadmium	7440439	[*]{1.101672-(ln[H]x0.041838)}x Exp(0.7852xln[H]-2.715)	[*]{1.136672-(ln[H]x0.041838)}x Exp(1.128xln[H]-3.6867)	N/A	[-] 3
			(ex: @H=100, CCC=2.24)	(ex: @H=100, CMC=4.26)		
5M	Chromium, III	16065831	[*]0.860xExp(0.819xln[H]+0.6848)	[*]0.316xExp(0.819xln[H]+3.7256)	N/A	[-] 3
			(ex: @H=100, CCC=74)	(ex: @H=100, CMC=570)		
5M	Chromium, VI	18540299	[*]10.56	[*]15.73	N/A	[-] 3
6M	Copper	7440508	[*]0.960xExp(0.8545xln[H]-1.702)	[*](0.960xExp(0.9422xln[H]-1.700)	N/A	3
			(ex: @H=100, CCC=8.96)	(ex: @H=100, CMC=13.44)		
8M	Mercury	7439976	[*]0.77	[*]1.44	0.0031	[H] 2,3
9M	Nickel	7440020	[*]0.997xExp(0.846xln[H]+0.0584	[*][0.998xExp(0.846xln[H]+2.255)	N/A	[H] 2,3
			(ex: @H=100, CCC=52.01)	(ex: @H=100, CMC=468.24)		
10M	Selenium	7782492	[*]4.61	N/A	N/A	[-] 3

13 M	Zinc	7440666	[*]0.986xExp(0.8473xln[H]+0.884)	[*]0.978xExp(0.8473xln[H]+0.884)	N/A	3
			(ex: @H=100, CCC=118.14)	(ex: @H=100, CMC=117.18)		
14 M	Cyanide, Free	57125	5.2	22	600	[H] 2
3A	2,4-Dimethyl-phenol	105679	N/A	N/A	450	[H] 2
5A	2,4-Dinitro-phenol	51285	N/A	N/A	55	[H] 2
9A	Pentachlorophenol	87865	Exp(1.005[pH]-5.134)	Exp (1.005[pH]-4.869)	N/A	-
			@pH= 6.5 7.8 9.0	@pH = 6.5 7.8 9.0		
			Crit = 4.05 14.95 49.95	Crit = 5.28 19.49 65.10		
3V	Benzene	71432	N/A	N/A	1.2	[CRL] 1
7V	Chloro-benzene	108907	N/A	N/A	470	[H] 2
22 V	Methylene Chloride	75092	N/A	N/A	4.7	[CRL] 1
25 V	Toluene	108883	N/A	N/A	5600	[H] 2
29 V	Trichloro-ethylene	79016	N/A	N/A	2.9	[CRL] 1
33 B	Hexachloro-benzene	118741	N/A	N/A	0.000045	[CRL] 1
36 B	Hexachloro-ethane	67721	N/A	N/A	0.53	[CRL] 1
4P	gamma-BHC (Lindane)	58899	N/A	0.95	0.47	[H] 2
6P	Chlordane	57749	N/A	N/A	0.000025	[CRL] 1
7P	4,4-DDT	50293	N/A	N/A	0.000015	[CRL] 1
10P	Dieldrin	60571	0.056	0.24	0.0000006 5	[CRL] 1
14P	Endrin	72208	0.036	0.086	N/A	-
18P	PCBs		N/A	N/A	0.0000003 9	[CRL] 1
25P	Toxaphene	8001352	N/A	N/A	0.0000068	[CRL] 1
PP	2,3,7,8-TCDD	1746016	N/A	N/A	8.6 E-10	[CRL] 1
—	Parathion	56382	0.013	0.065	N/A	-

Acronyms and [Footnotes]Notes to Table 6

[1]Indicates a human health criterion based on a cancer potency factor and cancer risk level at 1×10^{-6} (CRL); where no cancer potency factor exists the human health criterion is based on threshold toxicity data plus additional safety factors.

[2]Indicates a human health criterion based on threshold effect (H).

[*] [3]Indicates dissolved **[metal]** **aquatic life** criterion; others are total recoverable **[metals]**. Each listed dissolved criterion in Table 6 is equal to the corresponding total recoverable criterion before rounding (from the EPA National Ambient Water Quality Criteria Documents) multiplied by the conversion factor (from the Conversion Factors Table); a criterion that is expressed as a hardness (H)-based equation is shown in Table 6 as the conversion factor (listed) multiplied by the hardness criterion equation; an example criterion at hardness=100mg/L is included.

CAS—Chemical Abstract Service number

[CRL—Cancer risk level at 1×10^{-6}

H—Threshold effect human health criterion; incorporates additional uncertainty factor for some Group C carcinogens.]

[ln [H]] ln[H]—Natural Logarithm of the Hardness of stream as mg/l $CaCO_3$

[ug/L] µg/L—Micrograms per liter

N/A—Criterion not developed

PP NO—Priority Pollutant Number

* * * * *

§ 93.9. Designated water uses and water quality criteria.

(a) The tables in § § 93.9a—93.9z display designated water uses and water quality criteria in addition to the water uses and criteria specified in Tables 2 and 3. Designated uses shall be protected in accordance with Chapters 95 and 96 (relating to wastewater treatment requirements; and water quality standards implementation) and any other applicable State and Federal laws and regulations. The tables also indicate specific exceptions to Tables 2 and 3 on a stream-by-stream or segment-by-segment basis by the words "add" or "delete" followed by the appropriate symbols described elsewhere in this chapter. **A one-hour average duration period applies to: the Tur_1 and Tur_2 criteria in Drainage List E; the dissolved oxygen (DO) criterion in Drainage List O (Yellow Breeches); and the pH criterion in Drainage List X.** The county column in

§ § 93.9a—93.9z indicates the county in which the mouth of the stream or the downstream limit of the zone described for that entry is located. Abbreviations used in the Stream and the ''Zone'' columns are as follows:

* * * * *

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

September 6, 2023

David Sumner
Executive Director
Independent Regulatory Review Commission
333 Market Street, 14th Floor
Harrisburg, PA 17120

Re: Proposed Rulemaking: Triennial Review of Water Quality Standards (#7-577)

Dear Mr. Sumner:

Pursuant to Section 5(a) of the Regulatory Review Act, please find enclosed a copy of the Triennial Review of Water Quality Standards proposed rulemaking for review by the Independent Regulatory Review Commission (Commission). This proposal is scheduled for publication in the *Pennsylvania Bulletin* on October 7, 2023, opening a 45-day public comment period that will close on November 21, 2023. A virtual public hearing is scheduled for November 14, 2023. The Environmental Quality Board adopted this proposal on July 11, 2023.

Federal regulations require the Commonwealth to review and revise its water quality standards at least once every three years. As a result of this review, this rulemaking proposes to update the Department of Environmental Protection's water quality criteria regulations in 25 Pa. Code Chapter 93 to add or revise several human health and aquatic life criteria and provide other minor clarifications to the regulatory language.

As set forth in the Regulatory Review Act, the Department will consider any comments and recommendations made by the Commission, as well as the House and Senate Environmental Resources and Energy Committees and the public, prior to final adoption of the enclosed rulemaking.

Please contact me by e-mail at laurgriffi@pa.gov or by telephone at 717.772.3277 if you have any questions or need additional information.

Sincerely,

Laura E. Griffin

Laura Griffin
Regulatory Coordinator

Enclosures

TRANSMITTAL SHEET FOR REGULATIONS SUBJECT TO THE REGULATORY REVIEW ACT

I.D. NUMBER: 7-577

SUBJECT: Triennial Review of Water Quality Standards

AGENCY: DEPARTMENT OF ENVIRONMENTAL PROTECTION
ENVIRONMENTAL QUALITY BOARD

RECEIVED
SEP 06 2023
Independent Regulatory Review Commission

TYPE OF REGULATION

X Proposed Regulation

Final Regulation

Final Regulation with Notice of Proposed Rulemaking Omitted

120-day Emergency Certification of the Attorney General

120-day Emergency Certification of the Governor

Delivery of Tolled Regulation
a. With Revisions b. Without Revisions

FILING OF REGULATION

DATE	SIGNATURE	DESIGNATION
		HOUSE COMMITTEE ON ENVIRONMENTAL RESOURCES & ENERGY
09/06/2023	Evan Franzese-Peterson *(via electronic delivery)*	MAJORITY CHAIR Representative Greg Vitali
09/06/2023	Michele Musgrave *(via electronic delivery)*	MINORITY CHAIR Representative Martin Causer
		SENATE COMMITTEE ON ENVIRONMENTAL RESOURCES & ENERGY
09/06/2023	Matt Osenbach *(via electronic delivery)*	MAJORITY CHAIR Senator Gene Yaw
09/06/2023	Emily Eyster *(via electronic delivery)*	MINORITY CHAIR Senator Carolyn Comitta
		INDEPENDENT REGULATORY REVIEW COMMISSION
09/06/2023	_____	EXECUTIVE DIRECTOR David Sumner
_____	_____	~~*ATTORNEY GENERAL* (for Final Omitted only)~~
09/06/2023	Ernest Engvall *(via electronic delivery)*	*LEGISLATIVE REFERENCE BUREAU* (for Proposed only)

Shani Shenk

From: Michele Musgrave <Mmusgrav@pahousegop.com>
Sent: Wednesday, September 6, 2023 9:23 AM
To: Griffin, Laura; Franzese, Evan B.
Cc: Thrush, Ezra; Reiley, Robert A.; Nezat, Taylor; Shupe, Hayley
Subject: RE: [EXTERNAL]: Delivery of Proposed Rulemaking - Triennial Review of Water Quality Standards (7-577)

Received, thanks!

Michele Musgrave
Administrative Assistant II
Representative Martin Causer
67th Legislative District
Room 47 East Wing
PO Box 202067
Harrisburg, PA 17120-2067
717-787-5075

From: Griffin, Laura <laurgriffi@pa.gov>
Sent: Wednesday, September 6, 2023 9:01 AM
To: Michele Musgrave <Mmusgrav@pahousegop.com>; Franzese, Evan B. <EFranzese@pahouse.net>
Cc: Thrush, Ezra <ezthrush@pa.gov>; Reiley, Robert A. <rreiley@pa.gov>; Nezat, Taylor <tnezat@pa.gov>; Shupe, Hayley <HShupe@pahouse.net>
Subject: [EXTERNAL]: Delivery of Proposed Rulemaking - Triennial Review of Water Quality Standards (7-577)
Importance: High

Good morning,

Pursuant to Section 5(a) of the Regulatory Review Act, please find attached the Triennial Review of Water Quality Standards Proposed Rulemaking (#7-577) for review by the House Environmental Resources and Energy Committee. The rulemaking documents are attached in a compressed folder and the cover letters for Representatives Vitali and Causer are attached separately.

A copy of the transmittal sheet is attached for your records – all ERE Committee chairs are receiving the rulemaking electronically.

Please confirm receipt of this rulemaking by replying to all recipients.

Thank you,
Laura

Laura Griffin | Regulatory Coordinator

Department of Environmental Protection | Policy Office
Rachel Carson State Office Building
400 Market Street | Harrisburg, PA 17101
Phone: 717.772.3277 | Fax: 717.783.8926
(she/her/hers) | laurgriffi@pa.gov
www.dep.pa.gov

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RECEIVED

SEP 06 2023

Independent Regulatory
Review Commission

Shani Shenk

From: Eyster, Emily <Emily.Eyster@pasenate.com>
Sent: Wednesday, September 6, 2023 9:27 AM
To: Griffin, Laura; Osenbach, Matt
Cc: Thrush, Ezra; Reiley, Robert A.; Nezat, Taylor; Troutman, Nick
Subject: Re: Delivery of Proposed Rulemaking - Triennial Review of Water Quality Standards (7-577)

Received. Thank you Laura!

Emily Eyster
Legislative Director, Office of Senator Carolyn T. Comitta
Executive Director, Senate Environmental Resources and Energy Committee
Cell: (717) 756-4702
Phone: (717) 787-5709
www.pasenatorcomitta.com

From: Griffin, Laura <laurgriffi@pa.gov>
Sent: Wednesday, September 6, 2023 9:01:32 AM
To: mosenbach@pasen.gov <mosenbach@pasen.gov>; Eyster, Emily <Emily.Eyster@pasenate.com>
Cc: Thrush, Ezra <ezthrush@pa.gov>; Reiley, Robert A. <rreiley@pa.gov>; Nezat, Taylor <tnezat@pa.gov>; Troutman, Nick <ntroutman@pasen.gov>
Subject: Delivery of Proposed Rulemaking - Triennial Review of Water Quality Standards (7-577)

Good morning,

Pursuant to Section 5(a) of the Regulatory Review Act, please find attached the Triennial Review of Water Quality Standards Proposed Rulemaking (#7-577) for review by the Senate Environmental Resources and

Energy Committee. The rulemaking documents are attached in a compressed folder and the cover letters for Senators Yaw and Comitta are attached separately.

A copy of the transmittal sheet is attached for your records – all ERE Committee chairs are receiving the rulemaking electronically.

Please confirm receipt of this rulemaking by replying to all recipients.

Thank you,
Laura

Laura Griffin | Regulatory Coordinator
Department of Environmental Protection | Policy Office
Rachel Carson State Office Building
400 Market Street | Harrisburg, PA 17101
Phone: 717.772.3277 | Fax: 717.783.8926
(she/her/hers) | laurgriffi@pa.gov
www.dep.pa.gov

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Shani Shenk

From: Bulletin <bulletin@palrb.us>
Sent: Wednesday, September 6, 2023 9:45 AM
To: Griffin, Laura; Code&Bulletin
Cc: Leah Brown; A.J. Mendelsohn; Adeline E. Gaydosh; Thrush, Ezra
Subject: [External] RE: Delivery of Proposed Rulemaking - Triennial Review of Water Quality Standards (#7-577)

Thank you, Laura.

We have received Proposed Rulemaking #7-577 and will publish it in the October 7, 2023, issue of the *Pennsylvania Bulletin.*

Take care,

Ernest L. Engvall | Legal Assistant
eengvall@palrb.us | 717.783.1530
Legislative Reference Bureau
Code and Bulletin Office

From: Griffin, Laura <laurgriffi@pa.gov>
Sent: Wednesday, September 6, 2023 9:29 AM
To: Code&Bulletin <codeandbulletin@palrb.us>; Bulletin <bulletin@palrb.us>
Cc: Leah Brown <lbrown@palrb.us>; A.J. Mendelsohn <amendelsohn@palrb.us>; Adeline E. Gaydosh <agaydosh@palrb.us>; Thrush, Ezra <ezthrush@pa.gov>
Subject: Delivery of Proposed Rulemaking - Triennial Review of Water Quality Standards (#7-577)
Importance: High

Good morning,

Please see the attached documents, including Word versions of the Preamble and Annex A, for Proposed Rulemaking – Triennial Review of Water Quality Standards (#7-577), for publication on **October 7, 2023.**

A cover letter and the transmittal sheet confirming receipt of the rulemaking by the House and Senate ERE Committees is attached (all chairs are accepting electronic delivery).

Please confirm that you received the rulemaking documents for publication.

Thank you!
Laura

Laura Griffin | Regulatory Coordinator
Department of Environmental Protection | Policy Office

Rachel Carson State Office Building
400 Market Street | Harrisburg, PA 17101
Phone: 717.772.3277 | Fax: 717.783.8926
(she/her/hers) | laurgriffi@pa.gov
www.dep.pa.gov

Connect with DEP on: Twitter | Facebook | LinkedIn | YouTube | Instagram

Shani Shenk

From: Franzese, Evan B. <EFranzese@pahouse.net>
Sent: Wednesday, September 6, 2023 9:20 AM
To: Griffin, Laura; Michele Musgrave
Cc: Thrush, Ezra; Reiley, Robert A.; Nezat, Taylor; Shupe, Hayley
Subject: RE: Delivery of Proposed Rulemaking - Triennial Review of Water Quality Standards (7-577)

Receipt confirmed. Thank you!

Evan Franzese-Peterson
Executive Director | House Environmental Resources & Energy Committee (D)
Representative Greg Vitali
Pennsylvania House of Representatives
P: 717-787-7647
F: 717-780-4780

From: Griffin, Laura <laurgriffi@pa.gov>
Sent: Wednesday, September 6, 2023 9:01 AM
To: Michele Musgrave <Mmusgrav@pahousegop.com>; Franzese, Evan B. <EFranzese@pahouse.net>
Cc: Thrush, Ezra <ezthrush@pa.gov>; Reiley, Robert A. <rreiley@pa.gov>; Nezat, Taylor <tnezat@pa.gov>; Shupe, Hayley <HShupe@pahouse.net>
Subject: Delivery of Proposed Rulemaking - Triennial Review of Water Quality Standards (7-577)
Importance: High

Good morning,

Pursuant to Section 5(a) of the Regulatory Review Act, please find attached the Triennial Review of Water Quality Standards Proposed Rulemaking (#7-577) for review by the House Environmental Resources and Energy Committee. The rulemaking documents are attached in a compressed folder and the cover letters for Representatives Vitali and Causer are attached separately.

A copy of the transmittal sheet is attached for your records – all ERE Committee chairs are receiving the rulemaking electronically.

Please confirm receipt of this rulemaking by replying to all recipients.

Thank you,
Laura

Laura Griffin | Regulatory Coordinator
Department of Environmental Protection | Policy Office
Rachel Carson State Office Building
400 Market Street | Harrisburg, PA 17101
Phone: 717.772.3277 | Fax: 717.783.8926
(she/her/hers) | laurgriffi@pa.gov
www.dep.pa.gov

Shani Shenk

From: Osenbach, Matt <mosenbach@pasen.gov>
Sent: Wednesday, September 6, 2023 9:10 AM
To: Griffin, Laura
Cc: Eyster, Emily; Thrush, Ezra; Reiley, Robert A.; Nezat, Taylor; Troutman, Nick
Subject: Re: Delivery of Proposed Rulemaking - Triennial Review of Water Quality Standards (7-577)

Message received.

Thanks Laura!

Matt Osenbach

Director, Environmental Resources & Energy Committee

Office of State Senator Gene Yaw (R-23)

362 Main Capitol Building, Senate Box 203023

Harrisburg, PA 17120

T: (717) 787-3280

F: (717) 772-0575

www.SenatorGeneYaw.com

On Sep 6, 2023, at 9:04 AM, Griffin, Laura <laurgriffi@pa.gov> wrote:

Good morning,

Pursuant to Section 5(a) of the Regulatory Review Act, please find attached the Triennial Review of Water Quality Standards Proposed Rulemaking (#7-577) for review by the Senate Environmental Resources and Energy Committee. The rulemaking documents are attached in a compressed folder and the cover letters for Senators Yaw and Comitta are attached separately.

A copy of the transmittal sheet is attached for your records – all ERE Committee chairs are receiving the rulemaking electronically.

Please confirm receipt of this rulemaking by replying to all recipients.

Thank you,
Laura

Laura Griffin | Regulatory Coordinator
Department of Environmental Protection | Policy Office
Rachel Carson State Office Building
400 Market Street | Harrisburg, PA 17101
Phone: 717.772.3277 | Fax: 717.783.8926
(she/her/hers) | laurgriffi@pa.gov
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<7-577_TR10_Proposed.zip>
<Comitta_7-577_TR10_Proposed.pdf>
<Yaw_7-577_TR10_Proposed.pdf>
<7-577_TR10_Proposed_Transmittal Sheet.doc>