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Massachusetts Secondary Contact Recreational Bacteria Ambient Surface Water Quality Criteria Support Document

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Watershed Planning Program

The mission of the Watershed Planning Program (WPP) in the Massachusetts Department of Environmental Protection is to protect, enhance, and restore the quality and value of the waters of the Commonwealth. Guided by the federal Clean Water Act, WPP implements this mission statewide through five Sections that each have a different technical focus: (1) Surface Water Quality Standards; (2) Surface Water Quality Monitoring; (3) Data Management and Water Quality Assessment; (4) Total Maximum Daily Load; and (5) Nonpoint Source Management. Together with other MassDEP programs and state environmental agencies, WPP shares in the duty and responsibility to secure the environmental, recreational, and public health benefits of clean water for all people of the Commonwealth.

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Disclaimer

References to trade names, commercial products, manufacturers, or distributors in this report constituted neither endorsement nor recommendation by MassDEP.

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List of Acronyms

AUs	Assessment Units
BAV	Beach Action Value
CFU	Colony-Forming Unit
CMR	Code of Massachusetts Regulations
CWA	Clean Water Act
USEPA	United States Environmental Protection Agency
E. coli	*Escherichia coli*
GM	Geometric Mean
MA SWQS	Massachusetts Surface Water Quality Standards
MassDEP	Massachusetts Department of Environmental Protection
MDPH	Massachusetts Department of Public Health
mL	Milliliters
NPDES	National Pollutant Discharge Elimination System
PCR	Primary Contact Recreation
RWQC	Recreational Water Quality Criteria
SCR	Secondary Contact Recreation
STV	Statistical Threshold Value
TMDL	Total Maximum Daily Load
UCL	Upper Confidence Limit
WPP	Watershed Planning Program

1. Introduction

The Clean Water Act (CWA, 33 U.S. Code § 1251 *et seq*.) requires the United States Environmental Protection Agency (USEPA) to periodically update ambient water quality criteria to reflect the latest science. In 2012, USEPA revised recommended recreational water quality criteria (RWQC) for primary contact recreation (PCR). These criteria incorporate new scientific understanding that retains *Escherichia coli* (*E. coli*) and enterococci as the primary indicator organisms for pathogens and includes both geometric means (GMs) and statistical threshold values (STVs). The 2012 revisions introduced additional flexibility for states by offering two illness rates and criteria elements such as the Beach Action Value (BAV) that is used as a single-sample maximum (USEPA, 2012). Most recently, in 2023 and 2024, USEPA introduced a revised approach to the development of secondary contact recreation (SCR) criteria, which is addressed in this document.

The Massachusetts Department of Environmental Protection (MassDEP), through its Watershed Planning Program (WPP), amended the Massachusetts Surface Water Quality Standards (MA SWQS; 314 CMR 4.00) in August 2026. The amendments included revised, evidence-based SCR bacteria criteria that incorporate guidance from USEPA, scientific research, and local data to protect public health during SCR. The amended MA SWQS is enforceable by the Commonwealth, but federal Water Quality Standards regulations promulgated at 40 Code of Federal Regulations Part 131, 40 CFR 131, pursuant to the federal CWA, 33 USC 1251 et seq., require that revisions to state water quality standards be approved by USEPA for the revisions to be federally enforceable for CWA purposes. This document accompanies the regulatory package submitted to EPA for approval and contains supporting information on the rationale, process, and data associated with the criteria derivation.

2. Background

2.1. Bacteria and Human Health

The presence of certain indicator bacteria such as *E. coli* and enterococcus in surface water suggests possible fecal contamination, which may also indicate the presence of other harmful pathogens that can cause illness when contaminated water is ingested. Pathogenic bacteria infect the body, multiply, and produce toxins that lead to gastrointestinal or respiratory diseases (USEPA, 2024a). Pathogens typically enter water systems through human activities (e.g., wastewater discharges, agricultural runoff, stormwater). Although generally short-lived (days to weeks), pathogens may persist longer in sediments and biofilms; in addition, these organisms do not bioaccumulate in aquatic food webs (USEPA, 2012; USEPA, 2024a).

The probability of illness following recreational exposure depends on both pathogen concentration and the extent of exposure. Activities involving greater water contact (e.g., swimming) carry higher illness risk than those involving minimal contact, such as boating or fishing (Russo et al. 2020; Wade et al. 2003, 2006, 2008, 2010).

2.2. Primary v. Secondary Contact Recreation

USEPA distinguishes PCR and SCR based on the likelihood and intensity of water exposure. PCR involves activities with frequent or prolonged bodily immersion and a higher risk of incidental water ingestion, such as swimming and water play. In contrast, SCR includes activities with limited or occasional contact with water, such as wading, boating, or fishing, where immersion and ingestion are less frequent. USEPA recommends different water quality criteria for PCR and SCR to reflect their respective levels of exposure and associated illness risk.

The MA SWQS define PCR as "any recreation or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water", including, but not limited to, "wading, swimming, diving, surfing, and water skiing". SCR is defined as "any recreation or other water use in which contact with the water is either incidental or accidental", including, but not limited to, "fishing, including human consumption of fish, boating and limited contact incident to shoreline activities. Where designated, [SCR] also includes shellfishing, including human consumption of shellfish" (MassDEP, 2021).

MassDEP excluded human consumption of fish and shellfish from consideration during the development of revised SCR criteria as these are not water contact recreational exposures.

2.3. MassDEP Secondary Contact Bacteria Criteria

Massachusetts first adopted bacteria criteria into the MA SWQS in 1967 to protect the human health shellfish consumption use and PCR such as swimming. Early standards used fecal coliform as the indicator organism for pathogens but were later revised to reflect federal guidance: *E. coli* and enterococci for freshwater and only enterococci for marine waters (USEPA, 1986).

In 1997, MassDEP adopted fecal coliform criteria to protect human health during SCR activities, consisting of a geometric mean (GM) of 1,000 organisms/100 mL, and a statistical threshold value (STV) where no more than 10% of samples may exceed 2,000 organisms/100 ml.

In 2006, MassDEP established SCR criteria for *E. coli* and enterococci using the multiplier approach from USEPA (i.e., establishing GMs at five times the PCR value and STVs at twice the SCR GM) (FWPCA, 1968). However, this was a National Technical Advisory Committee approach developed in 1968 that was not informed by empirical data or epidemiological research, and USEPA now views it as not scientifically defensible (USEPA, 2024a). USEPA

did not approve or disapprove MassDEP's 2006 MA SWQS amendments pertaining to SCR criteria. USEPA continued to defer action on these criteria revisions during subsequent MA SWQS review cycles in 2013 and 2021. Under the Alaska Rule[1], USEPA currently considers the criteria adopted in the 1997 MA SWQS amendments to be in effect for CWA purposes. USEPA now recommends a risk-based, exposure-specific framework for developing SCR criteria.

3. Implementation of USEPA's 2022–2024 Secondary Contact Recreation Criteria Methodology

3.1. EPA Guidance

To develop revised SCR criteria, MassDEP applied published recommendations from USEPA included in two key documents: *An Approach for Applying EPA's 2012 Recreational Water Quality Criteria Recommendation to Non-primary Contact Exposure Scenarios – White Paper* (USEPA, 2022) and *Adopting Water Quality Criteria for Secondary Contact Recreation: A User Guide* (USEPA, 2024a).

MassDEP used USEPA's 2022 non-primary contact exposure approach that quantifies the ratio of incidental water ingestion associated with PCR compared to SCR using a linear equation. The equation for calculating a recommended SCR criterion value is:

$$C_{secondary} = C_{primary} \times \frac{I_{primary}}{I_{secondary}}$$

where:

$C_{primary}$ = a USEPA 304(a) RWQC recommended value for PCR

$C_{secondary}$ = analogous criterion value for SCR with a comparable risk of illness to that of $C_{primary}$

$I_{primary}$ = ambient water incidentally ingested during PCR, as described in USEPA's 2012 RWQC

$I_{secondary}$ = ambient water incidentally ingested during SCR

The revised approach requires the use of a well-matched pair of ingestion rate values for both PCR and SCR to minimize bias and maintain internal consistency. MassDEP used ingestion rate data from the study by Dorevitch et al. (2011), which identified a lognormal distribution in the ingestion data and, as a result, recommended the use of median values instead of arithmetic means to better reflect central tendencies and reduce statistical bias. Estimated ingestion rates for various recreational activities, as reported in the Dorevitch et al. (2011) study, are provided in Table 1 below.

[1] On March 30, 2000, EPA revised its regulation that specifies when new and revised State water quality standards become effective for Clean Water Act (CWA) purposes (40 CFR 131.21, 65 FR 24641, April 27, 2000). Under this regulation (also known as the Alaska rule), new and revised standards submitted to EPA after May 30, 2000, must be approved before being used for CWA purposes. The final rule also provides that standards already in effect and submitted to EPA on or before May 30, 2000, may be used for CWA purposes, whether approved by EPA or not.

Table 1. Dorevitch et al. (2011) Estimated Water Ingestion During Water Recreation Activities (mL/hr).

	Surface Water Study				Swimming Pool Study			
Activity	**N**	**Median**	**Mean**	**UCL**	**N**	**Median**	**Mean**	**UCL**
Limited Contact Scenarios								
Boating	316	2.1	3.7	11.2	0	-	-	-
Canoeing	766				76			
No capsize		2.2	3.8	11.4		2.1	3.6	11.0
With capsize		3.6	6.0	19.9		3.9	6.6	22.4
All activities		2.3	3.9	11.8		2.6	4.4	14.1
Fishing	600	2.0	3.6	10.8	121	2.0	3.5	10.6
Kayaking	801				104			
No capsize		2.2	3.8	11.4		2.1	3.6	10.9
With capsize		2.9	5.0	16.5		4.8	7.9	26.8
All activities		2.3	3.8	11.6		3.1	5.2	17.0
Rowing	222				0			
No capsize		2.3	3.9	11.8		-	-	-
With capsize		2.0	3.5	10.6		-	-	-
All activities		2.3	3.9	11.8		-	-	-
Wading/splashing	0	-	-	-	112	2.2	3.7	11.2
Walking	0	-	-	-	23	2.0	3.5	10.6
Full Contact Scenarios								
Immersion	0	-	-	-	112	3.2	5.1	15.3
Swimming	0	-	-	-	114	6.0	10.0	34.8
Total	2,705				662			

N = Number of participants
UCL = Upper confidence limit
- = No data

Source: Dorevitch et al. (2011)

3.2. SCR Criteria Development and Rationale

To develop revised SCR criteria, MassDEP first identified the SCR activity associated with the highest potential for incidental water ingestion among those specified in the MA SWQS SCR definition (*see* Section 2.2 above). MassDEP did not include human consumption of fish and shellfish in the evaluation, as these are not water contact recreational exposures.

Estimated ingestion rates for boating and wading activities were evaluated as equivalent to MA-defined boating, fishing, and shellfishing SCR activities. Canoeing and kayaking activities exhibited the highest ingestion rates among SCR-designated uses in the Dorevitch et al. (2011) study.

Following a review of other state methodologies and consultation with USEPA, MassDEP determined that the "Kayaking – All Activities" category from the Dorevitch et al. (2011) study should be used as the representative SCR exposure scenario. This category includes

both capsizing and non-capsizing events, providing a composite ingestion rate that reflects realistic exposure with a higher ingestion rate than the "Wading and Splashing" scenario.

3.3. Revised SCR Criteria Calculations

MassDEP calculated revised GM and STV SCR criteria using 1) USEPA's linear equation; 2) current PCR criteria (GM and STV) in the MA SWQS; 3) the median ingestion rate for swimming (PCR) of 6.0 mL/hour provided in Table 1; and 4) the median ingestion rate for "Kayaking – All Activities" of 3.1 mL/hour, also from Table 1 (swimming pool data set).

3.3.1. Geometric Means (GMs)

E. coli: $126 \frac{cfu}{100mL} \times \frac{6.0 \frac{mL}{hour}}{3.1 \frac{mL}{hour}} = 244 \frac{cfu}{100mL}$

enterococci: $35 \frac{cfu}{100mL} \times \frac{6.0 \frac{mL}{hour}}{3.1 \frac{mL}{hour}} = 68 \frac{cfu}{100mL}$

3.3.2. Statistical Threshold Values (STVs)

E. coli: $410 \frac{cfu}{100mL} \times \frac{6.0 \frac{mL}{hour}}{3.1 \frac{mL}{hour}} = 794 \frac{cfu}{100mL}$

enterococci: $130 \frac{cfu}{100mL} \times \frac{6.0 \frac{mL}{hour}}{3.1 \frac{mL}{hour}} = 252 \frac{cfu}{100mL}$

3.4. Revised SCR Criteria

MassDEP's revised and previous SCR criteria are presented in Table 2. The revised criteria state that *E. coli* concentrations shall not exceed 244 colony-forming units (cfu) per 100 mL (/100mL), calculated as the GM of all samples collected within any 90-day or smaller interval, and no more than 10% of all such samples shall exceed 794 cfu/100 mL (the STV). Enterococci concentrations shall not exceed 68 cfu/100 mL, calculated as the GM of all samples collected within any 90-day or smaller interval, and no more than 10% of all such samples shall exceed 252 cfu/100 mL. In addition, the reduced 30-day interval requirements also apply to SCR criteria evaluations for public beach areas and POTW- and CSO-impacted segments.

Table 2. Massachusetts Secondary Contact Recreational Bacterial Criteria (cfu/100mL)

Bacterial Indicator	Geometric Mean (GM)*	Previous GM (2006-2026)	Statistical Threshold Value (STV)*	Previous STV (2006-2026)
E. coli (Inland)	**≤244**	≤630	**≤794**	≤1260
Enterococci (Inland and Coastal and Marine)	**≤68**	≤175**	**≤252**	≤350**

*The geometric mean for at least one indicator shall not be exceeded in any 90-day or smaller interval. No more than 10% of all samples collected within that interval shall exceed the statistical threshold value for that indicator. The reduced interval requirements also apply (30-days for public beach areas and POTW- and CSO-impacted segments).
**The previous criterion applied only to coastal and marine waters.

4. Implementation

4.1. Initial Steps

MassDEP conducted the following steps for criteria adoption. Revised SCR bacteria criteria were listed at 314 CMR 4.05(5)(f). The previous SCR bacteria criteria were listed within the Class C and Class SC surface water designation sections of the MA SWQS (314 CMR 4.05(3)(c)4 and (4)(c)4, respectively), but Class C and Class SC designations have been removed from the MA SWQS. MassDEP coordinated with external partners such as the MA Department of Public Health and USEPA to review the proposed criteria, assess potential impacts, and consider implementation needs.

4.2. Data Management and Water Quality Assessment

An analysis of bacterial data across Massachusetts indicates that in many cases the SCR use is not supported (i.e., it is impaired) due to elevated bacteria levels. The *Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle* identifies 180 assessment units (AUs) as "Not Supporting" the SCR use due to elevated *E. coli*; 55 are "Not Supporting" due to elevated enterococci (MassDEP, 2023).

The revised SCR criteria are lower (more stringent), which could lead to more waterbodies being classified as impaired, and result in expanded management and monitoring responsibilities. However, during colder months, primary recreation bacteria criteria are typically met, supporting the assumption that secondary contact criteria will also be met.

4.3. National Pollutant Discharge Elimination System (NPDES)

MassDEP analyzed bacteria surface water discharge permittee information from the MA NPDES dataset. As of July 2026, there were 142 NPDES permittees monitoring discharges for *E. coli* and/or enterococci (102 and 40 permittees, respectively). This includes 78 major dischargers (52 *E. coli*; 26 enterococci) and 64 minor dischargers (50 *E. coli*; 14 enterococci). A total of 130 dischargers have numeric bacteria effluent limitations, while

12 facilities are only required to monitor. These monitoring requirements vary, however, with 84 facilities subject to seasonal monitoring and 58 to year-round monitoring.

MassDEP's NPDES Program has implemented bacteria requirements incorporating PCR criteria into effluent permits but not SCR criteria. Revised SCR criteria are anticipated to be applied seasonally to those treatment plants that are authorized for seasonal disinfection (i.e., PCR criteria-based limits would apply during the warmer months when disinfection occurs, and SCR criteria-based limits would apply in colder months when disinfection does not occur, subject to permit conditions). Additional data and details on NPDES bacteria dischargers are provided in Table 3.

Table 3. Bacteria Permit Details for Massachusetts NPDES Facilities

Permit Characteristic	***E. Coli* Dischargers**	**Enterococci Dischargers**	**Total Dischargers**
Number of dischargers	102	40	142
Major dischargers	52	26	78
Minor dischargers	50	14	64
Specific discharge limit	97	33	130
No discharge limit	5	7	12
Seasonal monitoring required	78	6	84
Year-round monitoring required	24	34	58
Discharge limit value range (CFU/100mL)	88 avg/260 max - 126 avg/410 max	35 avg/104 max - 153 avg/497 max	--

4.3.1. Seasonal Disinfection Extensions and Associated Costs

Wastewater treatment plants that conduct seasonal disinfection may have increased sampling requirements and operational costs due to the implementation of revised SCR criteria. Extending disinfection seasons or increasing sampling frequency to meet the revised criteria may require operational adjustments, more staffing, or infrastructure improvements; however, MassDEP has observed diminished bacteria levels in the colder winter months such that levels meet even the more stringent primary contact criteria. Confirmatory sampling prior to extending disinfection may help dischargers that seasonally disinfect avoid unnecessary disinfection extensions.

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