Bacteria Criteria for Drinking Water and Fishing Designated Uses

Technical Support Document for the Proposed Criteria to Protect Secondary Recreators

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1.0 INTRODUCTION

In 2012, the United States Environmental Protection Agency (EPA) published "Recreational Water Quality Criteria," which prompted Georgia Environmental Protection Division (EPD) to update the bacteria rule for recreational waters as part of the 2013 Triennial Review. The recommended recreational bacterial indicators, E. coli and enterococci, were proven to have a stronger correlation with gastrointestinal, respiratory, and skin illnesses in primary contact recreators. The updated rule changed the bacterial indicator in freshwater recreational waters to E. coli and in saltwater recreational waters to enterococci.

Recreation, as a designated use, is described in Georgia Rule 391-3-6-.03(6)(b) as being suitable for "activities such as water skiing, boating, and swimming, or for any other use requiring water of a lower quality, such as recreational fishing." All waters with a recreation designated use are suitable for primary contact recreation. The designated uses drinking water and fishing include secondary contact recreation uses. Section 3, "Definitions", of the same rule identifies activities such as wading, occasional swimming, and incidental contact with the water as secondary contact recreation.

The designated use of recreation, which is for primary recreational uses, has been updated to the best available bacterial indicators for human health. Because waters with designated uses of drinking water and fishing are also designated for secondary contact recreation activities, EPD decided to update the bacteria criteria for these designated uses as part of the 2016 Triennial Review to adopt the best available bacterial indicator to protect human health across all uses. EPD has proposed the best bacterial indicators to protect the health of individuals who choose to recreate in and on Georgia's waters. This decision to change bacterial indicators is intended to provide better protection of secondary contact recreation and these criteria will undergo review when epidemiologically based values are derived. In a separate, but related rule change, EPD has changed the units for bacteria from MPN or CFU to counts in order to avoid favoring one EPA approved testing method over another.

2.0 A HISTORY OF EPA GUIDANCE DOCUMENTS AND GEORGIA ACTIONS

EPA publishes guidance documents based on the latest available scientific research. The intent of these documents is to provide recommendations to state and tribal regulatory agencies based on the latest data and technologies. EPA does not require other regulatory agencies adopt these recommendations into their rules, but encourages analysis of the information provided. The analysis of EPA's recommendations allows states and tribes to adopt rules that are a better fit for the geographic region, or existing rules or processes.

2.1 Pre-EPD/EPA

The Georgia Water Quality Control Act prompted the creation of the Georgia State Water Quality Control Board in 1964. During the life span of the Board, state water quality standards were established and approved by the U.S. Department of the Interior. Table 2-1 shows an overview of the approved 1967 bacteria criteria.

Table 2-1. Approved Bacteria Criteria in Georgia 1967 (#/100 mL)

Designated Use	Indicator	Mean	Not to Exceed*
Drinking Water Supplies (raw water criteria only)	Fecal coliform	5000	20000
Recreation	Fecal coliform	1000	4000
Fishing, Propagation of Fish, Shellfish, Game, and Other Aquatic Life (shellfish harvesting criteria excluded)	Fecal coliform	5000	20000
Agricultural	Fecal coliform	10000	40000
Navigation	Fecal coliform	10000	40000
*Not to exceed in more than 5% of the samples taken in any 90-day period.			

In 1968, the Board began a collaborative study with the Federal Water Pollution Control Administration (FWPCA) to determine optimal use-based bacteria criteria. The results of this study prompted Georgia to propose bacteria criteria for recreational waters in 1970. During this time period, many organizational changes took place. EPA was formed in 1970 and in 1972 the Georgia Department of Natural Resources and GA EPD were formed.

2.2 1972 - 1985

In 1972, EPA published a multi-topic recommendation document entitled "Water Quality Criteria". The section outlining criteria for "General Recreation, Bathing, and Swimming" recommended no specific criteria for "presence or concentration of microorganisms in bathing water because of the paucity of valid epidemiological data." However, this document described how a marked increase of Salmonella organisms could be isolated in a sample of water when

the fecal coliform concentration equals 200/100 mL or greater. This and additional research translated into the 1976 “Red Book” recommended values for fecal coliform in bathing waters:

> Based on a minimum of five samples taken over at 30-day period, the fecal coliform bacterial level should not exceed a log mean of 200 per 100 mL, nor should more than 10 percent of the total samples taken during any 30-day period exceed 400 per 100 mL.

The proposed use based bacteria criteria based on the work done by FWPCA is shown in Table 2-2. This proposal also included sanitary surveys as part of the updated bacteria criteria. The proposed criteria stated if water quality and sanitary studies show natural fecal coliform levels exceed 200/100 mL (geometric mean) occasionally in high quality recreational water, then the allowable geometric mean fecal coliform level shall not exceed 300/100 mL in lakes and reservoirs and 500/100 mL in free flowing fresh water streams.

Table 2-2. Proposed Bacteria Criteria in Georgia 1972 (#/100 mL)

Designated Use	Indicator	30-day Geometric Mean	Not to Exceed
Drinking Water Supplies (raw water criteria only)	Fecal coliform	1000	4000
Recreation	Fecal coliform	Coastal – 100 Other – 200*	N/A
Fishing, Propagation of Fish, Shellfish, Game, and Other Aquatic Life (shellfish harvesting criteria excluded)	Fecal coliform	1000	4000
Agricultural	Fecal coliform	5000	N/A
Navigation	Fecal coliform	5000	N/A
*Should water quality and sanitary studies show natural fecal coliform levels exceed 200/100 mL (geometric mean) occasionally in high quality recreational water, then the allowable geometric mean fecal coliform level shall not exceed 300/100 mL in lakes and reservoirs and 500/100 mL in free flowing fresh water streams.			

By 1974, EPD had adopted these criteria, which allowed for greater protection of other, non-recreational, designated uses. It also introduced additional recreational criteria for lakes and streams with naturally high fecal coliform not impacted by human sources. The new use based criteria resulted in increased stringency, as all permit holders had to consider fecal contamination and recreational waters had to consider natural sources of bacteria which are prevalent in all environments. Subsequent years saw the addition of other designated uses, including urban stream. The urban stream bacteria criterion was established as a geometric mean of 2000/100 mL with a maximum of 5000/100 mL.

2.3 1986 – 1992

In 1986, EPA published "Ambient Water Quality Criteria for Bacteria," which updated the previous bacteria criteria recommendation. The intent of the recommendation was not to increase stringency of the bacteriological criteria, but simply to update the indicator organism. The fecal coliform indicator used at the maximum geometric mean of 200/100 mL, was found to cause an estimated 8 illness per 1,000 swimmers in freshwater and 19 illness per 1,000 swimmers in marine waters. However, fecal coliform was found to be a poor indicator because it included several non-fecal sources of bacteria. The latest scientific data showed E. coli and enterococci were superior indicators of human illness. Recommended freshwater criteria as a 30-day geometric mean were 126/100mL E. coli and 33/100 mL enterococci and the recommended marine water criteria as a 30-day geometric mean was 35/100 mL enterococci. The recommended criteria also included use intensity recommendations.

In 1989, to meet the goal of the Clean Water Act, Georgia's fishing designated use name was shortened, but defined to encompass the propagation of fish, shellfish, game and other aquatic life as well as to explicitly include secondary recreation activities. The drinking water designation added language stating waters classifies as drinking water supplies also support fishing use. Georgia EPD also adopted seasonal fecal coliform criteria for the drinking water and fishing designated uses to further protect secondary recreational uses. The updated rules reduced the criteria for fecal coliform during the recreation season, May through October, from a 30-day geometric mean of 1,000 per 100 mL down to a 30-day geometric mean of 200 per 100 mL. During November through April, the criteria remained at 1,000 per 100 mL, measured as a 30 day geometric mean, with a "not to exceed" maximum of 4,000 per 100 mL for any sample. In addition, the natural source criteria were expanded beyond recreational uses to drinking water and fishing uses. The indicator organism remained fecal coliform because, at the time, there was no approved E. coli test method for wastewater treatment plants.

As part of the 1992 Triennial Review, the water use classifications of agriculture, industrial, navigation, and urban stream were removed. Table 2-3 outlines the bacteria criteria in place from the approval of the 1992 Triennial Review until the approval of the 2013 Triennial Review.

Table 2-3. Georgia's Bacteria Criteria After 1992 Triennial Review - 2013 (#/100 mL)

Designated Use	Indicator	Non-Recreation Season (Geometric Mean*)	Non-Recreation Season (Not to Exceed – Single Sample)	Recreation Season (Geometric Mean*)	Recreation Season (Not to Exceed – Single Sample)
Drinking Water Supplies	Fecal coliform	1000	4000	200**	N/A
Recreation	Fecal coliform	Coastal – 100 Other – 200**		Coastal – 100 Other – 200**	
Fishing	Fecal coliform	1000	4000	200**	N/A

*Geometric Mean is calculated from at least 4 samples collected at a given site over a 30-day period at intervals not less than 24 hours.

**Should water quality sanitary studies show fecal coliform levels from non-human sources exceed 200/100 mL (geometric mean) occasionally, then the allowable geometric mean fecal coliform level shall not exceed 300/100 mL in lakes and reservoirs and 500/100 mL in free flowing fresh water streams.

2.3 Recreational Water Quality - 2012

In 2012, EPA published Recreational Water Quality that proposed bacteria criteria for all waters designated for primary contact recreation. The document did not examine potential criteria for secondary recreation or other designated uses. However, EPA mentioned that different criteria are no longer recommended for different use intensities, but does not elaborate why. The document cites the National Epidemiological and Environmental Assessment of Recreational Water (NEEAR) study, as well as other information from the Centers for Disease Control (CDC) and the European Union (EU). In the NEEAR study, illness rates for secondary recreators were combined with that of primary recreators. The recommendations used a different definition of "illness" (NEEAR Gastrointestinal Illness or NGI) which excluded fevers, thus capturing a larger number of ill persons. .

As part of the 2013 Triennial Review, GA EPD adopted the recommended bacteria criteria recommended for recreational waters. Other portions of the rules were changed so that there were no outstanding references to fecal coliform. Fecal coliform was replaced by "bacteria" so that all relevant bacteria criteria would continue to apply. The new criteria for recreational coastal waters was changed from a 30-day geometric mean of 100 per 100 mL of fecal coliform to a 30-day geometric mean of 35 colony forming units (CFU) per 100 mL of enterococci. The new criteria for freshwater recreational waters changed from a 30-day geometric mean of 200 per 100 mL of fecal coliform to a 30-day geometric mean of 126 CFU/100 mL of E. coli. Statistical threshold values (STV) criteria were adopted, stating that there should not be a greater than 10% excursion frequency of 130 counts/100 mL for enterococci in salt water and 410 counts/100 mL for E. coli in freshwater during the same 30-day interval. These criteria only apply to primary recreational waters. The criteria were not changed for those waters having a secondary contact recreational use (fishing and drinking water).

2.4 Implementation Guidance for Ambient Water Quality Criteria for Bacteria - 2002

In 2002, EPA began to explore how to implement bacteria criteria appropriate for protecting human health for both primary and secondary recreators. E. coli and enterococci were chosen as the preferred bacterial indicators. The draft document recognized there was not enough information to determine a risk based bacteriological recommendation for secondary recreation, but having criteria in place that utilizes superior indicator organisms is preferable. The document suggested adopting bacteria criteria for secondary recreation that is five times the geometric mean of the primary recreation bacteria. This stems from work done by Colorado (see section 4.3), where five times the geometric mean of the E. coli criteria with an illness rate of 8/1000 recreators was first used. The illness rate was based on the definition of highly credible gastrointestinal illness or HCGI, which includes fever along with gastrointestinal symptoms. The secondary recreation bacteria criteria illness rate effectively became 40/1000 recreators when the five times multiplier was adopted into the rules of several other states and recommended by Health Canada (see section 4.9). Georgia EPD believes that this illness rate, as calculated from the five times multiplier, for secondary contact recreation waters during the non-recreation season, yields acceptable criteria for the protection of human health from incidental water contact while incorporating superior bacterial indicator organisms across all uses.

3.0 PROPOSED BACTERIA CRITERIA

The proposed bacteria criteria for drinking water and fishing include short statements that the existing fecal coliform criteria shall apply until EPA approves the proposed E. coli and/or enterococci criteria. The proposed drinking water criteria are as follows:

> For the months of May through October, when water contact recreation activities are expected to occur, culturable E. coli not to exceed a geometric mean of 126 counts per 100 mL. The geometric mean duration shall not be greater than 30 days. There shall be no greater than a ten percent excursion frequency of an E. coli statistical threshold value (STV) of 410 counts per 100 mL in the same 30-day interval. Should water quality and sanitary studies show E. coli levels from non-human sources exceed 126 counts per 100 mL (geometric mean) occasionally, then the allowable geometric mean E. coli shall not exceed 189 counts per 100 mL in lakes and reservoirs and 315 counts per 100 mL in free flowing freshwater streams. For the months of November through April, culturable E. coli not to exceed a geometric mean of 630 counts per 100 mL. The geometric mean duration shall not be greater than 30 days. There shall be no greater than a ten percent excursion frequency of an E. coli statistical threshold value (STV) of 2050 counts per 100 mL in the same 30-day interval.

The proposed bacteria criteria for fishing waters are as follows:

> Estuarine waters: For the months of May through October, when water contact recreation activities are expected to occur, culturable enterococci not to exceed a geometric mean of 35 counts per 100 mL. The geometric mean duration shall not be greater than 30 days. There shall be no greater than a ten percent excursion frequency of an enterococci statistical threshold value (STV) of 130 counts per 100 mL the same 30-day interval. Should water quality and sanitary studies show enterococci levels from non-human sources exceed 35 counts per 100 mL (geometric mean) occasionally, then the allowable geometric mean enterococci shall not exceed 53 counts per 100 mL in lakes and reservoirs and 88 counts per 100 mL in free flowing freshwater streams. For the months of November through April, culturable enterococci not to exceed a geometric mean of 175 counts per 100 mL. The geometric mean duration shall not be greater than 30 days. There shall be no greater than a ten percent excursion frequency of an enterococci statistical threshold value (STV) of 650 counts per 100 mL the same 30-day interval.
>
> All other fishing waters: For the months of May through October, when water contact recreation activities are expected to occur, culturable E. coli not to exceed a geometric mean of 126 counts per 100 mL. The geometric mean duration shall not be greater than 30 days. There shall be no greater than a ten percent excursion frequency of an E. coli statistical threshold value (STV) of 410 counts per 100 mL in the same 30-day interval. Should water quality and sanitary studies show E. coli levels from non-human sources exceed 126 counts per 100 mL (geometric mean) occasionally, then the allowable geometric mean E. coli shall not exceed 189 counts per 100 mL in lakes and reservoirs and 315 counts per 100 mL in free flowing freshwater streams. For the months of November through April, culturable E. coli not to exceed a geometric mean of 630 counts per 100 mL. The geometric mean duration shall not be greater than 30 days.

There shall be no greater than a ten percent excursion frequency of an E. coli statistical threshold value (STV) of 2050 counts per 100 mL in the same 30-day interval.

The information in Table 3-1 displays the proposed criteria; however, the table is not being adopted into the rules.

Table 3-1. Proposed Bacteria Criteria

Designated Use	Season	Indicator	Geometric Mean	STV	Non-Human
Drinking Water	Recreation (May – October)	E. coli	126 counts per 100 mL	410 counts per 100 mL	189 counts per 100 mL (lakes and reservoirs)
					315 counts per 100 mL (free flowing freshwater streams)
	Non-recreation (November – April)	E. coli	630 counts per 100 mL	2050 counts per 100 mL	
Fishing (Estuarine)	Recreation (May – October)	Enterococci	35 counts per 100 mL	130 counts per 100 mL	53 counts per 100 mL (lakes and reservoirs)
					88 counts per 100 mL (free flowing freshwater streams)
	Non-recreation (November – April)	Enterococci	175 counts per 100 mL	650 counts per 100 mL	
Fishing	Recreation (May – October)	E. coli	126 counts per 100 mL	410 counts per 100 mL	189 counts per 100 mL (lakes and reservoirs)
					315 counts per 100 mL (free flowing freshwater streams)
	Non-recreation (November – April)	E. coli	630 counts per 100 mL	2050 counts per 100 mL	

4.0 BACTERIA CRITERIA IN OTHER STATES AND CANADA

In light of the criteria changes Georgia is proposing for its drinking water and fishing uses, bacteria criteria in other states and Canada were examined. A variety of indicators were found to be implemented at the time of criteria review, as well as variations in seasonal criteria and "not to exceed" criteria. Louisiana (Region 6), West Virginia (Region 3), Alaska (Region 10), and North Carolina (Region 4), still use fecal coliform as the indicator organism for recreational, drinking water, and fishing uses. These states have not updated their bacteria criteria to the latest scientific recommendation for protection of human health in primary recreational waters. Kentucky (Region 4) uses fecal coliform as the bacterial indicator for secondary recreational waters and during non-recreational season for primary waters.

Below are states that have adopted the EPA recommended bacteria criteria for primary contact recreational waters. These states are currently using EPA approved bacteria criteria for drinking water, fishing, and secondary contact recreational waters similar to what Georgia is proposing. Canada is included because Health Canada published guidelines for bacteria criteria comparable to Georgia's proposal.

4.1 Alabama (Region 4)

Table 4-1 provides Alabama's bacteria criteria for non-recreational waters. Alabama's designated uses of drinking water, or "public water supply", and fishing, or "fish and wildlife," reflect seasonality. As in Georgia, Alabama's recreational season is May through October and primary contact bacteria criteria apply during that time period; outside of the recreational season, higher criteria may apply. Alabama adds "when the geometric mean bacterial organism density exceeds these levels, the bacterial water quality shall be considered acceptable only if a second detailed sanitary survey and evaluation discloses no significant public health risk in the use of the waters." The 30-day geometric mean bacterial criteria are slightly more protective than the bacteria criteria Georgia is proposing for its non-recreational waters.

Table 4-1. Alabama's Bacteria Criteria for Non-Recreational Waters (colonies/100 mL)

Designated Use	Indicator	Recreation Season (Geometric Mean*)	Non-Recreation Season (Geometric Mean*)	Recreation Season (Not to Exceed – Single Sample)	Non-Recreation Season (Not to Exceed – Single Sample)
Public Water Supply	E. coli	126	548	298	2507
	Enterococci	35	N/A	158	275
Fish and Wildlife	E. coli	126	548	298	2507
	Enterococci	35	N/A	158	275
* Geometric Mean is calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours.					

4.2 Tennessee (Region 4)

The use designations of "Domestic Water Supply" and "Fish and Aquatic Life" in Tennessee are similar to drinking water and fishing uses in Georgia. As there is not a defined recreational season, the criteria apply year round. Table 4-2 shows Tennessee's criteria are similar to those proposed by Georgia in that the non-recreational uses have criteria equal to five times the geometric mean of the primary recreational bacteria criteria.

Table 4-2. Tennessee's Bacteria Criteria for Non-Recreational Waters (CFU/100 mL)

Designated Use	Indicator	Geometric Mean*	Not to Exceed**
Domestic Water Supply	E. coli	630	N/A
Fish and Aquatic Life	E. coli	630	2880

*Geometric Mean is calculated from a minimum of 5 samples, taken at least 12 hours apart, collected over a 30 day period. For the purpose of determining the geometric mean, individual samples having an E. coli group concentration of less than 1 per 100 ml shall be considered as having a concentration of 1 per 100 ml.
**Not to Exceed criteria shall not exceed # per 100 mL in 20% or more of all samples taken during a 30 day period.

4.3 Colorado (Region 8)

In Colorado, criteria apply year round for all designated uses. Use designations are divided into four classes of Recreational use, three classes of Aquatic Life use, Agriculture, and Domestic Water Supply. Colorado states that for all use protected waters, "if E. coli samples from within the segment are infeasible due to its location, and a sanitary survey demonstrates that there are no human sources present that are likely to impact quality in the segment in question, E. coli data will not be required." There are no "not to exceed" criteria for E. coli in Colorado as compliance is based off of the geometric mean. Table 4-3 provides Colorado's bacteria criteria for non-recreational waters. The criteria for "Class N" and "Domestic Water Supply" are set at five times the criteria for "Class E" (Existing Primary Contact) and "Class U" (Undetermined Use), which are 126 E. coli per 100 mL. Georgia does not wish to subdivide use classes into what is "potential" and what is "undetermined," but, like Colorado, recognizes that limited contact recreational activities should have less stringent criteria.

Table 4-3. Colorado's Bacteria Criteria for Non-Primary Contact Recreational Waters (#/100 mL)

Designated Use	Indicator	Geometric Mean*
CLASS P (Potential Primary Contact Use)	E. coli	205
CLASS N (Not Primary Contact Use)	E. coli	630
Domestic Water Supply	E. coli	630

4.4 Texas (Region 6)

The use designations in Texas fall under three major categories: “Recreation Use”, “Aquatic Life Use”, or “Domestic Water Supply”. Every body of water in Texas is assigned one “Recreation Use” classification. “Recreation Uses” include the following subcategories: “Primary contact recreation 1”, “Primary contact recreation 2”, “Secondary contact recreation 1”, “Secondary contact recreation 2”, and “Noncontact recreation”. There are not seasonal divisions for Texas’s use criteria. “Secondary contact 1” is differentiated from “Secondary contact 2” by frequency of the limited contact activity. “Noncontact recreation” specifies activities that occur near the shoreline, but have little to no water contact, for example, hiking or biking. Texas bacteria criteria does not use a “not to exceed” value. Table 4-4 shows Texas’s criteria are similar to those proposed by Georgia, in that the values for “Secondary contact 1” are five times the values for “Primary contact recreation 1”, with the exception of criteria for high saline inland waters. Georgia does not wish to subdivide contact levels of recreational activities beyond primary or secondary.

Table 4-4. Texas’s Bacteria Criteria (#/100 mL)

Designated Use	Indicator	Geometric Mean*
Secondary contact recreation 1	E. coli	630
	Enterococci (Tidal Streams and Rivers)	175
	Enterococci (High saline inland waters)	165
Secondary contact recreation 2	E. coli	1030
	Enterococci (High saline inland waters)	270
Noncontact recreation	E. coli	2060
	Enterococci (Tidal Streams and Rivers)	350
	Enterococci** (High saline inland waters)	540
*Geometric Mean is calculated from a minimum of 4 samples per 30 day period		

4.5 Montana (Region 8)

Table 4-5 is a summary of Montana’s bacteria criteria for recreational waters. Montana’s recreational season is April through October. Use classifications “B-1”, “B-2”, “B-3”, “C-1”, “C-2”, “C-3”, “I” all list primary recreational activities (like bathing and swimming) as part of the use and have non-recreational season criteria that are five times the recreational season criteria. Uses “D-1”, “D-2”, “E-1”, “E-2”, “E-3”, “E-4”, “E-5”, “F-1”, and “G-1” all list secondary recreation as part of the use and have a year round value that is five times the primary contact recreational season criteria. Montana’s primary recreational bacteria criteria are similar to what Georgia is proposing for its secondary recreational bacteria criteria. Georgia’s proposed criteria are more protective than Montana’s secondary recreational bacteria criteria.

Table 4-5. Montana's Bacteria Criteria for Recreational Waters (CFU/100 mL)

Designated Use	Indicator	Recreation Season (Geometric Mean*)	Non-Recreation Season (Geometric Mean*)	Recreation Season (Not to Exceed**)	Non-Recreation Season (Not to Exceed**)
B-1, B-2, B-3, C-1, C-2, C-3, & I	E. coli	126	630	252	1260
D-1, D-2, E-1, E-2, E-3, E-4, E-5, F-1, & G-1	E. coli	630	630	1260	1260
*Geometric Mean is calculated from a minimum of 5 samples collected during separate 24-hour periods during any consecutive 30-day period analyzed by the most probable number or equivalent membrane filter methods. **10% of samples occurring during any 30- day period may not exceed the given number.					

4.6 South Dakota (Region 8)

In South Dakota, every stream with a specific designated use has a "limited contact recreation" use, which may or may not occur with an "immersion recreation waters" use. Each lake is assigned the beneficial uses of "immersion recreation waters" and "limited contact recreation," unless otherwise specified. South Dakota's recreational season is May 1 through September 30 and is the only time the bacteria criteria for "immersion recreation waters" apply. A shown in Table 4-6, the criterion for "limited contact recreation" is five times the criterion for "immersion recreation waters", which is 126 E. coli /100 mL. These criteria are less protective during the recreational season than the bacteria criteria Georgia is proposing for its drinking water and fishing waters.

Table 4-6. South Dakota's Bacteria Criteria for Waters Other than Primary Recreation (#/100 mL)

Designated Use	Indicator	Recreation Season (Geometric Mean*)	Non-Recreation Season (Geometric Mean*)	Recreation Season (Not to Exceed – Single Sample)	Non-Recreation Season (Not to Exceed – Single Sample)
Immersion recreation waters	E. coli	$\leq$126	N/A	$\leq$235	N/A
Domestic water supply	Total coliform	$\leq$ 5,000	$\leq$ 5,000	**	**
Limited contact recreation	E. coli	$\leq$ 630	$\leq$ 630	$\leq$ 1178	$\leq$ 1178
*Geometric Mean is based on a minimum of 5 samples obtained during separate 24- hour periods for any 30-day period. **May not exceed in more than 20% of the samples examined in the same 30-day period.					

4.7 Iowa (Region 7)

Iowa's "Class A" waters protect primary contact, secondary contact, and children's recreational uses, while "Class B" waters protect wildlife, fish, aquatic, and semiaquatic life. As shown in Table 4-7, some categories within these classes apply during the recreational season, which is March 15th through November 15th, while some apply year round. Classes "A1" and "A3" are for primary recreation and children's recreational use, respectively. Use class "A2" is for secondary recreation and "B(CW)" is for cold water aquatic life. They have bacterial criteria that are five times the primary criteria, similar to Georgia's proposed criteria. Georgia's proposed bacteria criteria for secondary recreation is more protective than Iowa's criteria during the recreational season.

Table 4-7. Iowa's Bacteria Criteria (organisms/100 mL)

Designated Use	Indicator	Recreation Season (Geometric Mean*)	Non-Recreation Season (Geometric Mean*)	Non-Recreation Season (Not to Exceed – Single Sample Max)	Recreation Season (Not to Exceed – Single Sample Max)
A1	E. coli	126	N/A	N/A	235
A2	E. coli	630	N/A	N/A	2880
A2 + B(CW)	E. coli	630	630	2880	2880
A3	E. coli	126	N/A	N/A	235

4.8 Arkansas (Region 6)

All waters in Arkansas are assigned bacteria criteria based on designated use and seasonality as shown in Table 4-8. The primary recreational season is May 1 through September 30. The secondary contact recreational season is October 1 through April 30. For E. coli, the geometric mean criterion during the secondary contact recreational season is five times the primary contact recreational season. "ERW" use is for Extraordinary Recourse Waters, "ESW" use is for Ecologically Sensitive Waterway, and "NSW" use is for Natural and Scenic Waterways. Other designated uses include "Fisheries", "Domestic Water Supply", "Industrial Water Supply", and "Agricultural Water Supply". Georgia's proposed criteria are more protective than Arkansas'.

Table 4-8. Arkansas's Bacteria Criteria (colonies/100 mL)

Designated Use	Indicator	Primary Recreation Season (Geometric Mean*)	Secondary Recreation Season (Geometric Mean*)	Primary Recreation Season (Not to Exceed**)	Secondary Recreation Season (Not to Exceed**)
ERW, ESW, NSW, Reservoirs, Lakes	E. coli	126	630	298	1490

Designated Use	Indicator	Primary Recreation Season (Geometric Mean*)	Secondary Recreation Season (Geometric Mean*)	Primary Recreation Season (Not to Exceed**)	Secondary Recreation Season (Not to Exceed**)
ERW, ESW, NSW, Reservoirs, Lakes	Fecal coliform	200	1000	400	2000
All other waters	E. coli	N/A	N/A	410	2050
All other waters	Fecal coliform	200	1000	400	2000
*Geometric Mean is calculated from a minimum of 5 samples spaced evenly over a 30 day period. ** Individual samples shall not be exceeded in more than 25% of samples in no less than 8 samples.					

4.9 Canada

The environmental and workplace health division of Health Canada evaluates "health effects of environmental and workplace factors including air, noise, soil, and water pollution" and will occasionally publish guidelines for provinces to adopt into their individual objectives. The recommended criteria in Canada for primary contact recreation is a geometric mean of 200 E. coli/100 mL in fresh water and a geometric mean of 35 enterococci/100 mL in saltwater. The latest publication for bacteria in recreational waters includes use of the five times multiplier for secondary recreational bacteria criteria. There are no single sample maximum criteria recommendations for secondary contact waters. Like Georgia, Canada recognizes that insufficient data exist to epidemiologically derive criteria for secondary recreational contact and that once such criteria exist, the rules will be reviewed.

Table 4-9. Health Canada's Bacteria Criteria Guidelines for Secondary Contact Waters (#/100 mL)

Designated Use	Indicator	Geometric Mean*
Primary Contact	E. coli	200
	Enterococci	35
Secondary Contact	E. coli	1000
	Enterococci	175
*Geometric Mean is calculated from a minimum of 5 samples		

5.0 RESEARCH LITERATURE

A few researchers have attempted to determine illness rates for various secondary recreational activities and exact dosage for certain bacteria groups, but no solid and repeatable conclusions have come to light thus far. In fact, in EPA's 5-Year Review of the 2012 Recreational Water Quality Criteria, no new data from epidemiological studies have pinpointed statistically viable illness rates for secondary contact recreators related to water quality.

Via personal communication with CDC Healthy Water, it was determined that CDC's Waterborne Disease and Outbreak Surveillance System (WBDOSS) does not collect data to the level of specificity needed to calculate possible secondary recreational bacteria criteria. Similarly, the Water Industry Team of the EU replied over personal communication that "Recreational water uses involving minimal water contact, such as boating or fishing do not fall within the scope of the Bathing Water Directive. As there is currently no EU legislation setting the water quality standards for incidental contact recreation; we do not possess the data you requested."

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Bacteria Standards for Designated Uses of Drinking Water and Fishing Review and Assessment

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